555-102-201

Issue 1, April 1986

AT&T System 85

Release 2, Versions 1, 2, and 3

System Description

Reference Manual

Printed in U.S.A.

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1. OVERVIEW

This document provides general technical information on Release 2, Versions 1, 2, and 3 (R2V1, R2V2, and R2V3) of the AT&T System 85 (System 85). It is intended for use by AT&T Information Systems (AT&T-IS) sales and technical personnel. A detailed index is included at the back of this book to make it easier to use as a reference manual. For a complete listing of System 85 documents, refer to **AT&T System 85—Documentation Guide** (555-102-010).

ORGANIZATION

The rest of this document is divided into the following sections:

- FUNCTIONAL DESCRIPTION
- SYSTEM HARDWARE
- PERIPHERAL EQUIPMENT
- FEATURES AND SERVICES
- SOFTWARE DESCRIPTION
- SYSTEM ADMINISTRATION
- RELIABILITY
- MAINTENANCE PLAN
- SYSTEM ENGINEERING
- SYSTEM POWER
- UPGRADES (TO R2V3)
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INTRODUCTION

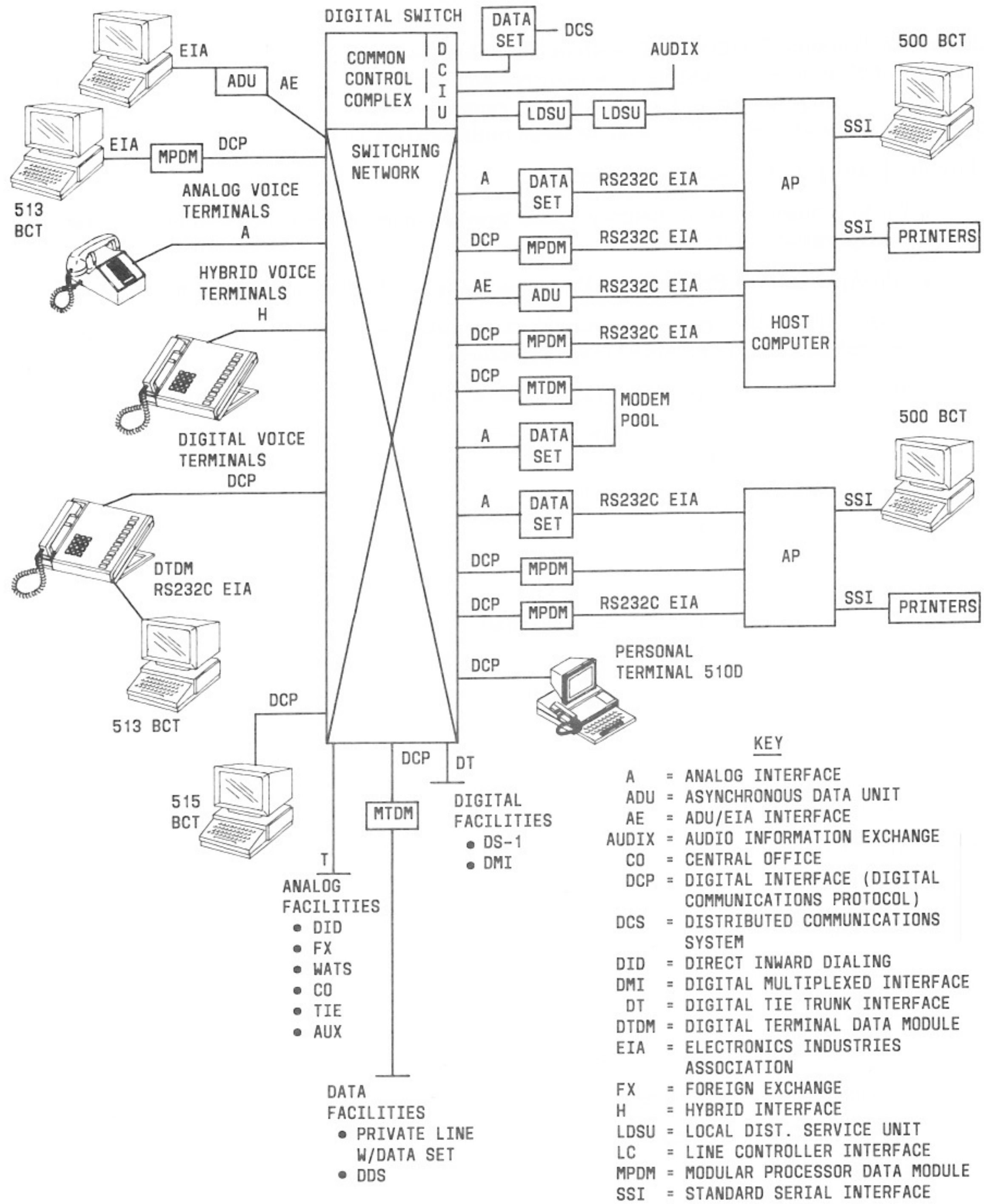
System 85 is an advanced digital switching system which integrates voice and data communications. It not only provides all the features and functions of a state-of-the-art PBX (such as stored program control, self-diagnostic routines, optional duplication of critical subsystems, and system expandability), but goes a step further by allowing digital data to be switched without being converted to analog signals. System 85 incorporates a design which uses Pulse Code Modulation (PCM) for voice and the Digital Communications Protocol (DCP) for integrated voice-data switching. Advanced information management capabilities can be used to set up high-speed connections between mainframe computers, data entry terminals, word processors, and personal computers. The RS-232C, RS-449, and V.35 interfaces are among the industry-wide standards accommodated by System 85.

A variety of attractive voice terminals are available with System 85. Functionally, the models range from basic desk telephones to multi-appearance voice terminals to integrated voice-data work stations. Most voice terminals accept optional adjuncts which expand their capabilities.

A variety of data modules provide interfaces for terminals or processing equipment using standard data rates. With these modules, data can be switched between on-premises data equipment or to outgoing analog or digital data facilities.

Applications Processors (APs), including the new 3B5 AP, enhance the communications capabilities of System 85 by providing comprehensive voice, data, and network management services and a broad range of integrated messaging and office management applications.

To get a general idea of the kinds of equipment System 85 interconnects, see Figure 1-1. A detailed index (including references to these and other equipment) is provided at the end of this document.



KEY

A = ANALOG INTERFACE
ADU = ASYNCHRONOUS DATA UNIT
AE = ADU/EIA INTERFACE
AUDIX = AUDIO INFORMATION EXCHANGE
CO = CENTRAL OFFICE
DCP = DIGITAL INTERFACE (DIGITAL COMMUNICATIONS PROTOCOL)
DCS = DISTRIBUTED COMMUNICATIONS SYSTEM
DID = DIRECT INWARD DIALING
DMI = DIGITAL MULTIPLEXED INTERFACE
DT = DIGITAL TIE TRUNK INTERFACE
DTDM = DIGITAL TERMINAL DATA MODULE
EIA = ELECTRONICS INDUSTRIES ASSOCIATION
FX = FOREIGN EXCHANGE
H = HYBRID INTERFACE
LDSU = LOCAL DIST. SERVICE UNIT
LC = LINE CONTROLLER INTERFACE
MPDM = MODULAR PROCESSOR DATA MODULE
SSI = STANDARD SERIAL INTERFACE
T = TRUNK INTERFACE
MTDM = MODULAR TRUNK DATA MODULE

Figure 1-1. Typical System 85 Components

INTRODUCING RELEASE 2, VERSION 3

Release 2, Version 3 (R2V3) of System 85 enhances the capabilities offered in previous versions of System 85 by adding new features and expanding the scope, capacity, and utility of many existing features. Larger system capacities and configurations of R2V3 make System 85 more attractive than ever to large multilocation customers.

Here are highlights for R2V3 hardware:

- Up to 8 megawords of memory which provide increased call processing capacities and configuration limits
- 3B5 Applications Processor (AP) compatibility and AP16 enhancements
- Remotely located groups of voice/data terminal port circuits linked to the System 85 central location by Remote Group Interfaces (RGIs)
- Multiple Line Storage Units (LSUs) for call detail recording applications
- Expanded Digital Service (DS-1) interface capabilities for loop-start central office, foreign exchange (FX), Wide Area Telecommunications Service (WATS), and Digital Multiplexed Interface (DMI) applications
- Information Systems Network (ISN) interface to provide access to a distributed processing system with an open architecture and high-speed transport capability
- Data interfaces that enable IBM 3270-type display terminals to communicate with a host through System 85 and allow substitution of less expensive American Standard Code for Information Interchange (ASCII) terminals
- New terminals with enhanced voice and data capabilities.

Highlights for R2V3 software include:

- System Capacity of 32,703 Line Records
- Automatic Call Distribution
- Busy Out of 2-Way Trunks
- Call Management System
- Centralized System Management
- Dedicated Switch Connections
- Display Message Scrolling
- Enhanced Symmetrical Routing
- Expanded (5-Digit) Dialing Plan
- Extension Number Portability
- Hot Line Service
- Interexchange Carrier Access
- Reduced Port Contention (Administration/Maintenance)
- Significant enhancements in existing voice, data, and network features, including integrated messaging services through the Unified Messaging concept.

Here is a look at some of the terminal equipment being introduced to System 85 in the R2V3 time frame:

AT&T Personal Terminal 510D

- New voice terminal with integrated data and display capabilities
- Has a touch-sensitive screen for user input
- Uses an SN270B digital port interface
- Has a range of 5000 feet over 24 AWG wire
- Is 120 V ac powered.

7404D

- New low-cost voice/data terminal
- Has a built-in asynchronous modem and comes with an RS-232C cable
- Uses an SN270B digital port interface
- Has a range of 5000 feet over 24 AWG wire
- Is 120 V ac powered.

Protocol Converters

- Data modules (with coaxial-to-DCP connections) allowing IBM 3270-type terminal connection to host through System 85
- Other protocol converters allowing use of less expensive ASCII-type terminals in place of dedicated 3270-type terminals
- Use less expensive standard twisted-pair building wiring instead of coaxial cable.

DCP Interfaces for PC 6300 and UNIX PC 7300*

DCP interface boards allow direct connection of PC 6300 and UNIX PC 7300 to System 85 through an SN270B digital port interface.

A Closer Look at R2V3 Capabilities

Abbreviated Dialing

For R2V3, enhancements allow a greater number of list entries. The system list, group list, and personal list maximums have been increased. Lists can now be programmed by any extension number that "homes" to the controlling terminal. The Manual Digit Entry function allows digits to be entered manually along with the automatically dialed digits.

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* Trademark of AT&T.

Automatic Call Distribution and Call Management System on the AP16

The Automatic Call Distribution (ACD) feature replaces the Direct Department Calling (DDC), Uniform Call Distribution (UCD), and Enhanced Uniform Call Distribution (EUCD) call distribution features. One of the most significant improvements with ACD is the addition of the Most Idle Agent call distribution algorithm; an algorithm which gives an incoming call to the agent who has been idle the longest. The Service Observing feature allows an observer to monitor performance of agents.

A dedicated AP16 can be used to provide Call Management System (CMS) capability. Switch software sends information relating to trunk calls, station calls, queuing, agent actions, etc., over a DCIU link to the AP. At the AP, CMS generates detailed reports based on these data; these reports are used by the customer to manage group sizing.

The ACD feature supports 1024 agents; CMS supports 144 agents.

AAR Conditional Routing

The System 85 switch can limit the number of satellite links in any end-to-end private network routing pattern. This feature lets tandem switches know how many satellite links have already been used by an incoming call and tells a tandem switch to choose an exclusively terrestrial facility for the outgoing call if the satellite link limit has been reached.

This type of generalized route selection permits customers to specify routing patterns that are based on additional call attributes other than just the destination address. In this application, routing is a function of the destination address and the number of satellite trunks already inserted in the connection, so that customers can specify strictly terrestrial routes for calls that have used the system limit of satellite links.

In addition to controlling the number of satellite links in any tandem route, this feature can be used to control the use of many different types of routing facilities in any network.

AAR/ARS Pattern Queuing

For R2V3, interaction between the Outgoing Trunk Queuing feature and the AAR/ARS features has changed. In previous versions, if all appropriate trunk groups in a pattern had been searched for an idle trunk and none were found, a call was allowed to queue only on the first choice trunk group of the pattern. With R2V3, a call can queue on any trunk group in a pattern, except for trunk groups to which the caller is denied access.

Centralized System Management on 3B5 AP

The 3B5 AP is a 32-bit minicomputer system which can serve as an adjunct processor to System 85. Applications which relate to System 85 are:

- Message Center
- Directory
- Centralized System Management (CSM).

Message Center and Directory are the same features previously offered on AP16, except that the 3B5 AP allows the support of greater capacities than the AP16.

The CSM feature is a software package which allows customers to administer and control customer-premises-based business communications systems. This feature runs on a dedicated 3B5 AP. It is particularly useful to large, multilocation, Electronic Tandem Network/Distributed Communication System customers. It offers the following applications:

- Cost Management
- Terminal Change Management
- Facility Mangement
- Traffic Management
- Adjunct Processor Management.

Digital Service-1 (DS-1)

DS-1 Trunk Interface

The ANN11 has been improved to provide both ground-start and loop-start PBX, CO, FX, WATS trunks, and DID trunks. This version is designated as the ANN11C.

DS-1 Carriers

Different trunk types can occupy different channels on the same DS-1 transmission facility so long as the channel-to-trunk type assignments are made in 4-channel blocks to correspond with a logical trunk board.

D4-Type Channel Bank

The DS-1 interface has also been enhanced to provide 24 analog voiceband Off-Premises Station service with a D4-type channel bank or equivalent at the distant end. The DS-1 line interface supports loop-start signaling and call sequencing.

R2V3 software supports various combinations of DS-1 interfaces, remote group interfaces, and Multi-Function Analog Terminal (MFAT) line ports located in the same DS-1 Carrier. Synchronization is essential for the proper operation of DS-1 applications.

Expanded AAR Route Preference Lists

Before R2V3, AAR routing tables allowed 255 routing patterns with each pattern containing four possible preferences arranged in order of preference for routing the call. With R2V3, the number of AAR routing patterns is increased to 640, and these patterns are expanded to permit up to 16 preferences per routing pattern.

Expanded ARS 6-Digit Translation Capability

6-Digit Translation Table Numbering Plan Area Code

With R2V3, the number of 6-digit translation tables is increased from 60 to 160. This supports a 6-digit translation for every possible Numbering Area Code. Also, the number of routing patterns that may be used per NPA in the 6-digit translation tables is increased from four to ten.

Expanded Numbering Plan

A private network can now serve up to 100,000 extension numbers through the use of the 5-Digit Dialing—Full capability. Calls may be made to other users in the same switch or different switch in a private network using five digits, without dialing an access code or pausing for dial tone between digits. Through the Extension Number Portability feature, users within the uniform numbering plan can retain their 4- or 5-digit extension number when moving to another switch within the complex which also has extension number portability. Users can also keep the same DID number even if the new switch is served by a different central office.

Interexchange Carrier (IXC) Access

R2V3 provides connection to any Interexchange Carrier complying with the FCC rules. This is done in a manner totally transparent to the user: AAR/ARS trunk group outpulsing instructions accept a user-dialed 7- to 10-digit address and construct outpulsing appropriate for any IXC access method.

Information Systems Network (ISN) Interface

The R2V3 switch provides Electronic Industries Association (EIA) RS-232C trunk connectivity with a colocated ISN high-speed packet switch. As with the ISN connectivity arrangement introduced with R2V2, the following parameters apply:

ISN Concentrator

- The ISN concentrator may be shelf-mounted or housed in a System 85 Auxiliary Cabinet with an 8.64-Mbps fiber interface to the ISN node; 120 V ac is required for the concentrator.
- The interconnecting trunks are 1-way and do not support autobauding.
- Trunk data baud rates must be set at either 300, 1200, 2400, 4800, 9600, or 19.2k bps for full-duplex 10-bit start/stop asynchronous data communications.

Modem Pool

- The Modem Pooling feature provides connectivity between ISN endpoints and remote endpoints accessed via System 85 CO trunks, WATS trunks, FX trunks, DID trunks, APLT trunks, tie trunks, and ETN trunks.
- End-to-end digital connectivity with ISN endpoints is provided for endpoints which are served either directly by the local System 85 switch or by a remote System 85/75 with DS-1 trunks to the local System 85.

BCTs

In R2V3, calls from 515 BCTs through System 85 to ISN endpoints use a new call setup procedure: the calling data terminal user enters a break, waits for a dial prompt, enters the address of the EIA trunk group, waits for a second dial prompt, and then enters the destination address. For the 500 BCT, call progress messages between the two dial prompts are suppressed.

ISN Calls

Calls for ISN to System 85 can be originated using either this same 2-stage dialing procedure, or a 1-stage procedure. With 1-stage dialing, the calling user enters the address of the EIA trunk group immediately followed by the destination address, all on one input text line.

Remote Group

R2V3 allows System 85 port circuit packs to be located in a remote location up to 100 miles from the switch. The remote group is connected to the System 85 central location through a DS-1 link. If this link is copper wire/cable and is connected to the public network, a Channel Service Unit (CSU) is required at the central and remote ends to serve as Network Channel Terminating Equipment (NCTE).

A DS-1 carrier can serve up to four remotely located port groups using ANN15B interfaces. Each remote group is interfaced to the CSU via a Remote Carrier Controller circuit pack (ANN16B) and supports any three of the following port interface circuit packs: SN238 (EIA), SN270B (digital), SN228B (analog), and ANN17B (MFAT hybrid). The maximum number of terminal ports supported is: 23 analog, 23 hybrid (7300S series), 12 digital (7400D series), 11 Digital Terminal Data Modules (DTDMs), 12 EIA, or 12 Modular Processor Data Modules

(MPDMs). A CSU must be provided as the NCTE for each ANN16B. Channel Division Multiplexers and Channel Expansion Multiplexers may be added to the DS-1 link as required.

The Remote Group Housing can accommodate up to two ANN16B circuit packs and a maximum of six port interface circuit packs (analog, MFAT hybrid, digital, or EIA). This housing has a built-in power supply and plugs into a 10-amp 120-V ac wall socket; no extra grounding is required. The housing can be wall-mounted, surface-mounted, or installed in the Auxiliary Cabinet.

Station Message Detail Recording (SMDR)

The expanded call record now includes 3-digit trunk IDs, 15-digit account codes, and a 5-digit dialing plan. Optional forced entry of account codes, variable call completion threshold delay, and flexible record start time have been added. Up to eight Line Storage Units can now be used, providing additional storage for larger customers.

System Management—AP16 Improvements

Smaller customers are typically supported by the AP16 Terminal Change Management (TCM)/Facilities Management (FM)/Call Detail Recording and Reporting (CDRR), which is enhanced for most R2V3 applications. Response time through input for system management functions has been improved by increased use of the System Management Application Transaction Protocol. These improvements are important for many functions including initialization and ongoing administration. In previous versions, System 85 could only support one maintenance or administration process at a time, preventing RMATS-II access to the system for maintenance while the system administrator was making administrative changes. R2V3 supports two simultaneous administration/maintenance processes, which allows one administration plus one maintenance task to be performed at the same time.

CALL-HANDLING CAPABILITIES

System 85 can be arranged as a stand-alone system or for access to private networks. It may serve as a tandem node in an Electronic Tandem Network (ETN) or a Distributed Communication System (DCS), or as a tandem or end in a Tandem Tie Trunk Network (TTTN). The system can also serve in a main/satellite/tributary configuration. In this configuration, it can function independently or serve as an ETN access arrangement.

System 85 can provide the following:

- Up to 32,703 line records for digital, hybrid, and analog terminals and equipment, or up to 100,000 extension numbers (total) in a DCS configuration
- Data switching capacity of up to 16,000 digital data endpoints* and up to 495 pooled modems with optional single-button access to the pooled facilities

* Digital data endpoints include Modular Processor Data Modules, Modular Trunk Data Modules, Digital Terminal Data Modules, 515 Business Communications Terminals, AT&T Personal Terminal 510Ds, the Applications Processor interface, and the internal data channels.

- Up to 6000 physical trunks including central office (CO) trunks, Direct Inward Dialing (DID) trunks, tie trunks, foreign exchange (FX) trunks, Wide Area Telecommunications Service (WATS) trunks, and other common carrier trunks.

It should be noted, however, that the limits listed for each of these items may not be achievable in any one system. Allowable limits are determined according to expected call usage. For example, if light calling is expected, the limits may be allowed. On the other hand, if heavy calling and data switching are expected, the limit listed for each item could not be provided. A single-module system has a capacity of approximately 5000 busy hour calls (BHCs). This is equivalent to 1200 lines of heavy voice traffic. A multimodule system has a capacity of approximately 20,000 BHC (5000 lines of heavy voice traffic). A DCS network configuration has a capacity of up to 150,000 BHC.

For detailed information on other System 85 parameters, refer to Section 10, SYSTEM ENGINEERING.

FCC RULES AND REGULATIONS

FCC Registration Numbers

The AT&T System 85 is registered for compliance with FCC Part 68 Rules for Registration. The system has also been tested and complies with Part 15, Subpart J of the FCC rules relating to electro-magnetic interference (EMI). System 85 is a fully protected customer switching system registered under the multifunction (MF) category. The system registration number is AS593M-11185-MF-E with a Ringer Equivalence Number (REN) of 3.0A (highest REN of registered interfaces).

Additionally, a new Emergency Transfer Panel (573-5) which incorporates an automatic ground-start function is registered for use with the system. This unit is intended to replace the 609A panel. The new unit is registered separately and carries Registration Number CPC746-63375-TP-N with a REN of 0.4B and interface jack RJ21X (USOC).

Digital Tie Trunk Registration Compliance

The System 85 DS-1 Digital Tie Trunk Interface must comply with FCC interim procedures, tariffs, and rules for connection to High-Capacity Terrestrial Digital Service (provided by operating telephone companies) in Docket 81-216 (FCC 83-268). The DS-1 interface connects to the telephone operating company interface through grandfathered Network Channel Terminating Equipment (NCTE) that assures compliance with part of the Interim Plan. Additionally, the tariff requires that compliance with the signal power and billing protection rules, as applied to the analog content of encoded information, must be assured.

System 85, when connected to the High-Capacity Terrestrial Digital Service in an arrangement as specified below, complies with the requirements of the "FCC Interim Plans for Connection of Customer Provided CSUs (Channel Service Units) and NCTE to Digital Services," as required by Docket 81-216 (FCC 83-268). Specifically, this arrangement complies with local tariffs and interim tariff #270 requirements that allow connection of DS-1 terminal equipment to the network when that equipment is connected by means of a grandfathered NCTE. The arrangement used for providing this interface is a 551-type NCTE. The NCTE connects, on the terminal side, to the System 85 DS-1 interface.

The system, including the DS-1 interface, complies with the tariff requirements for Signal Power Limits (Part 68, Section 308) and Billing Protection Limits (Part 68, Section 314).

The FCC also requires that any equipment connected under the interim plan must be modified, if required, in response to final rules in FCC Docket 81-216. When the new rules are issued, it may be necessary to modify or change equipment that is installed during the interim plan.

Connection Information

The public switched telephone network connection information for System 85 interfaces is as follows:

CIRCUIT PACK	TYPE SERVICE	INTERFACE JACK (USOC)	TYPE START	RINGER EQUIV.
SN230B	2-Wire CO, FX, WATS	RJ21X RJ2GX	Ground	1.0A
SN232B	DID	RJ21X RJ2GX	-	0.0B
TN492C w/212AR Data Set	2-Wire CO	RJ21X	Loop	0.0A 2.0A

The private-line services connection information (interfaces with service code 9.0F) is as follows:

CIRCUIT PACK	TYPE SERVICE	INTERFACE JACK (USOC)	FACILITY INTERFACE CODE	SIGNAL ARRANGEMENT
SN233C	TIE	RJ2GX	TL31M	-
SN244B	AIOD	RJ21X RJ2GX	AX15X	-
SN228B	OPS	RJ2GX RJ21X RJ11C	OL13C	Type C, 20 Hz
SN229B	OPS OPS	RJ26X RJ21X RJ11C	OL13C	Type C, 20 Hz
SN243B	OPS	RJ2GX RJ21X RJ11C	OL13C	Type C, 20 Hz

UNDERWRITERS LABORATORIES (UL) LISTING AND RECOGNITION

AT&T Information Systems Laboratories (AT&T-ISL) has pursued UL listing for all versions of System 85 and related equipment. Standards UL478, 114 are being used for testing System 85, the AP16, data modules, data terminals, and printers. Listing of voice terminals and their adjuncts is not required at this time.

Listing for Release 1 has been achieved. Listing for Release 2 is targeted during the first quarter of 1986. If interim information is required to satisfy local codes, the National Customer Support Center (NCSC) or Engineering, Product Planning, and Support contact list should be consulted.

2. FUNCTIONAL DESCRIPTION

GENERAL

This section describes how a System 85 digital switch works and introduces these applications:

- Private network configurations
  - Electronic Tandem Network
  - Main/Satellite/Tributary
  - Distributed Communication System
  - Automatic Transmission Measurement System (ATMS) feature
- Data communications
- Digital Service-1 (DS-1)
- Synchronization
- Information Systems Network (ISN).

HOW SYSTEM 85 WORKS

System 85 uses a digital switch to route voice or data calls from one point to another. Figure 2-1 shows a bare bones diagram of the switch. Here is how it works:

- The common control orchestrates the operation of the switch by controlling the call processing modules and the time-multiplexed switch.
- Each call processing module supervises the ports under its control by reporting all changes in port status to the common control. (All lines and trunks use port circuits to interface with the switch.) Call processing modules also set up intramodule port connections when told to do so by the common control.
- When System 85 is configured as a single-module system, the time-multiplexed switch is not provided. Intermodule calls are unnecessary.
- When setting up an intermodule call, the common control tells the two modules containing the ports to be connected to connect those ports to the time-multiplexed switch.
- The common control instructs the time-multiplexed switch to complete the connection.

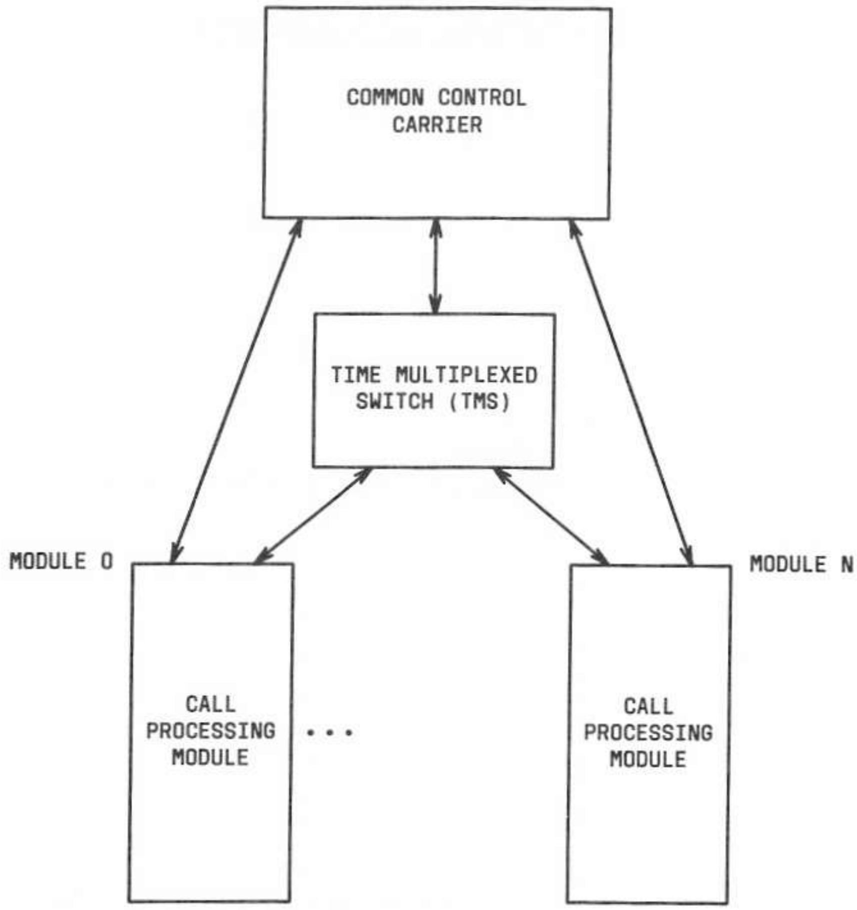

Figure 2-1. Multimodule Switch

Common Control

The common control (see Figure 2-2) provides the highest level of control in the digital switching complex. It contains the 501CC processor, the "main" memory, an optional cache memory, the diagnostic processor, the Data Communications Interface Unit (DCIU), and a variety of other interface circuits.

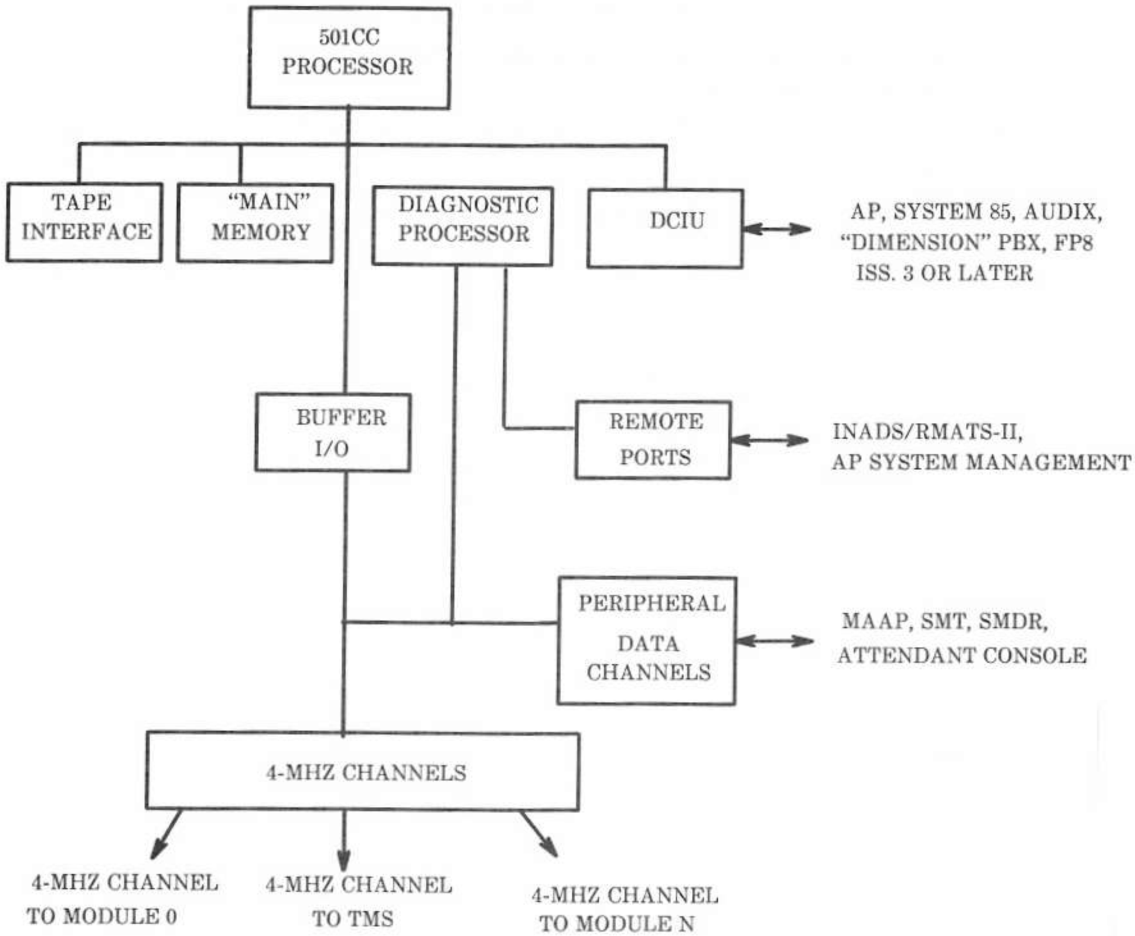

Figure 2-2. Common Control Carrier

501CC Processor

The 501CC processor performs high-level call processing by executing programs stored in main memory. It monitors and controls port-to-port connections, provides status indication to users, and performs the operations necessary to implement system features.

The 501CC processor is contained in four circuit packs:

1. The 501CC Bus Interface connects the 501CC to the system bus and to the cache memory bus. It is also used to buffer data and addressing information.
2. The 501CC Sequencer contains the microstore that runs the 501CC. It also includes logic that sequences the microstore.
3. The 501CC Instruction Decoder contains special logic which preprocesses instructions bound for the ALU.
4. The 501CC Arithmetic Logic Unit (ALU) operates on 16 bits of data simultaneously and has a 24-bit address bus.

Main Memory

The 501CC processor uses the main memory which contains the generic software program, system translation parameters, call processing status, and administrative and maintenance procedures. The main memory consists of multiple 1-megaword Random Access Memory (RAM) circuit packs. Each word in memory contains 16 data bits plus 6 bits of Error Correction Code (ECC) for a total of 22 bits. With ECC, 1-bit errors are automatically corrected and multiple bit errors are detected.

Cache Memory

The 501CC processor has access to an optional 16-k word high-speed cache memory. The cache memory stores a copy of recently accessed instruction or data words. And it has an access time which is three times faster than that of the main memory. This reduces the wait time when the 501CC processor needs to fetch something from memory. Current studies show that nine out of ten times the 501CC processor will find the instruction or data word it is seeking in the cache memory. This increases the system's busy hour call throughput capacity.

The cache memory communicates with the 501CC processor over a dedicated bus.

Diagnostic Processor

The diagnostic processor detects common control failures and isolates faults to the circuit pack level in the Common Control Carrier. Demand diagnostics (microdiagnostics) performed by the diagnostic processor can be invoked locally via the alarm panel or remotely from a remote maintenance facility.

A dedicated maintenance bus, controlled by the diagnostic processor, connects to each circuit pack in the common control.

Data Communications Interface Unit (DCIU)

The DCIU is the interface between System 85's 501CC processor and:

- Applications Processors (APs)
- Audio Information Exchange (AUDIX) system
- Other Release 2 System 85 switches
- System 75 switches
- FP8 Issue 3 Enhanced DIMENSION* PBXs.

When a System 85 is part of a Distributed Communication Service (DCS) network, the DCIU provides the interface between the System 85 and the other switches or PBXs.

Details on how the DCIU works appear later in this section.

Tape Interface

The tape interface connects the 501CC processor to a High Capacity Mini-Recorder (HCMR). The HCMR is equipped with a tape cartridge which maintains a permanent record of main memory contents for initialization and backup.

Remote Port Interface

The Remote Port Interface provides two ports for external communications. Port 0 is used to communicate with the RMATS-II center. It has an internal automatic calling unit for automatic alarm reporting which eliminates the need for an external autodialer. Port 1 is used for customer administration. Both ports provide an RS-232C compatible interface for external data set connections. The Remote Port Interface also accepts contact closure alarm inputs from external equipment such as auxiliary cabinets and APs.

Peripheral Interface

The Peripheral Interface provides dual-speed data channels which connect to local administrative and maintenance panels, attendant consoles, SMDR data collection devices, etc.

4-MHz Channels

The common control uses 4-MHz channels to communicate with call processing modules and the time-multiplexed switch. Each channel connects the common control's 16-bit parallel I/O bus to a 4-MHz serial data channel.

Common Control Buses

The three main buses in the common control (see Figure 2-3) are:

- The system bus
- The DCIU bus
- The buffered bus.

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* Registered trademark of AT&T.

System Bus

The system bus provides a path for following common control circuits to communicate with each other:

- 501CC processor
- Main memory
- DCIU
- Tape interface
- I/O Buffer
- Other circuits—These circuits (shown in Figure 2-3) are described in Section 3, SYSTEM HARDWARE under CIRCUIT PACKS.

The 501CC, DCIU, Tape Interface, Duplication Channel, and Software Control Analysis Monitor and Processor Event Recorder (Scamper—Maintenance Tool) use the system bus to perform data transfers by Direct Memory Access (DMA). DMA allows faster and more efficient data transfers.

DCIU Bus

The DCIU bus connects the four DCIU circuit packs to each other. This approach reduces traffic on the system bus and decreases the throughput time for the DCIU.

Buffered Bus

This bus connects the peripheral data channels, 4-MHz channels, and the diagnostic processor (along with the remote interface) to an Input/Output (I/O) buffer. The I/O buffer is connected to the system bus. This allows the common control to send and receive information without having to wait for time on the system bus.

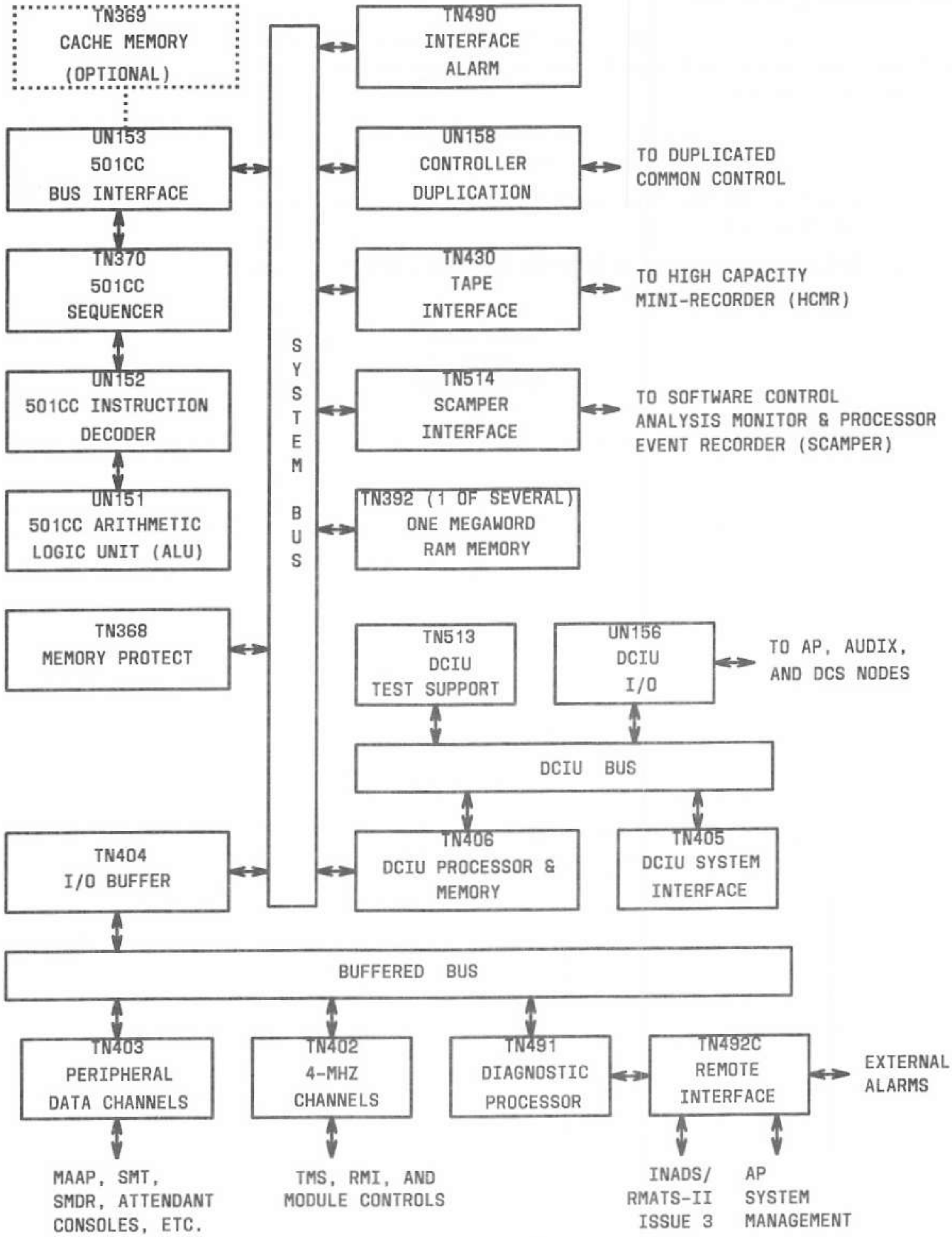


Figure 2-3. Common Control Buses

Call Processing Modules

A System 85 switch can have from 1 to 31 call processing modules. Each one consists of a module control carrier and up to 12 port or DS-1 carriers (see Figure 2-4). The circuits in a module control carrier:

1. Connect the module's ports to each other, or to the time-multiplexed switch, when told to do so by the common control.
2. Supervise the module's ports by reporting line and trunk status changes to the common control.
3. Relay certain commands from the common control to the ports.

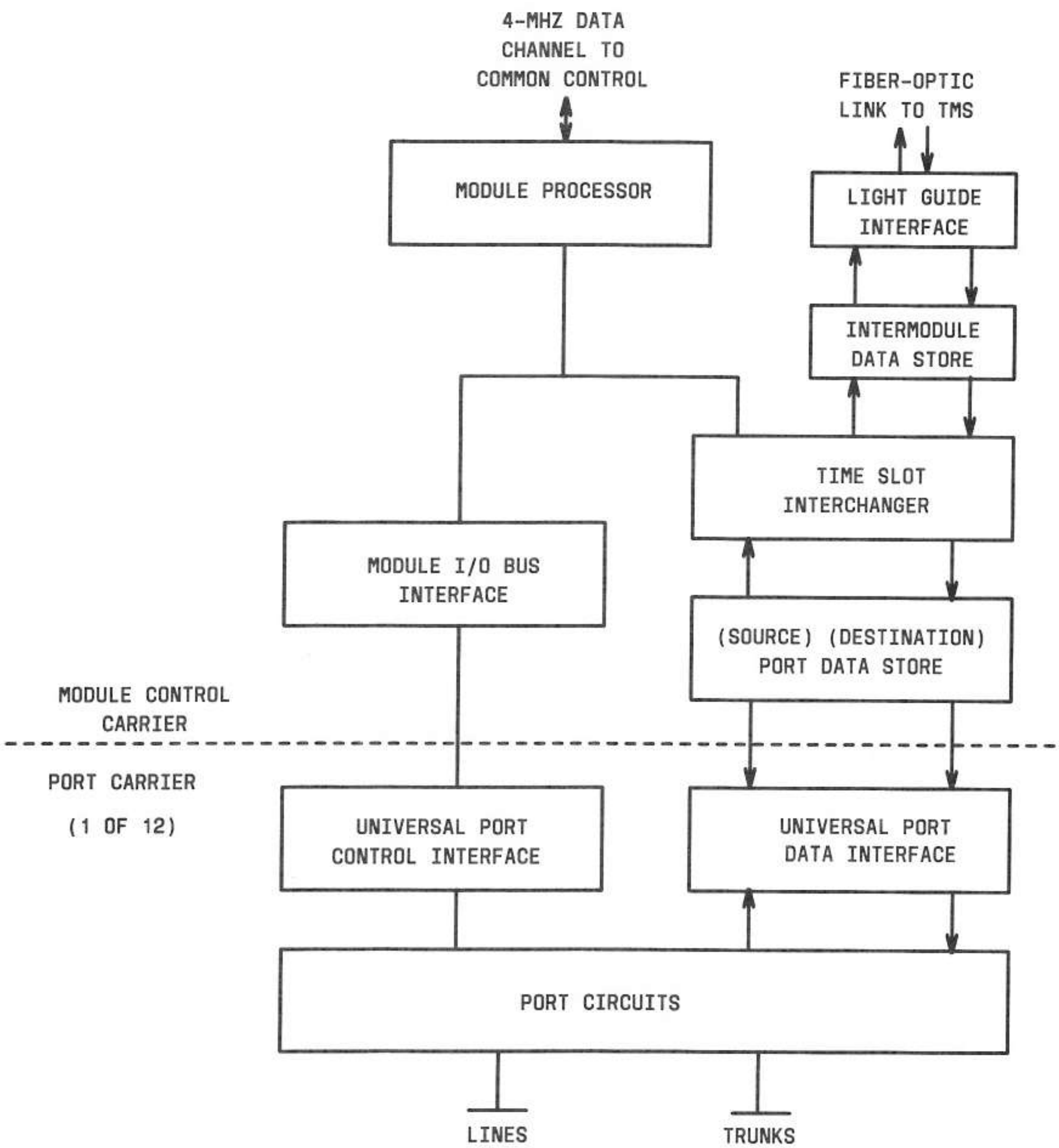


Figure 2-4. Call Processing Module

Digitizing Voice Calls

This is a brief description of how an analog voice signal is digitized and how a digitized signal is changed back to an analog signal. Knowledge of how this is done is essential to understanding digital switching.

Figure 2-5 shows a portion of an analog voice signal. Such a signal can be approximated by taking samples of its voltage levels during regular time intervals called time slots. If 8000 or more of these samples are taken per second, the resulting signal can be run through a smoothing filter, yielding a good approximation of the original signal that sounds as though sampling never took place.

Since an analog signal can be closely approximated by sampling, a digital version of the signal becomes possible. This is done by converting the voltage level of each sample into a number which is proportional to the voltage. The Pulse Code Modulation (PCM) technique of analog to digital conversion assigns an analog sample to one of 256 voltage levels which makes it possible to represent the sample as an 8-bit binary number. This process allows a voice call to be treated as a series of 8-bit numbers.

Converting a digitized call to an analog signal is done by applying 8-bit sample numbers to a circuit which creates voltage levels proportional to the values of the 8-bit numbers. These voltages are run through a smoothing filter to create an approximation of the original analog signal.

For System 85, digitizing calls takes place at the voice terminal for digital sets or at the port circuit for analog sets. Data calls which come to System 85 through devices such as data modules do not undergo this process since they are already in digital form. However, data modules, or similar circuits, are needed to put the data in a format which the system can understand.

Digital Switching

The backbone of every call processing module is the Time Slot Interchanger (TSI). It is a processor which operates under the control of the Module Processor. And its job is to connect module ports to each other or to the Time-Multiplexed Switch. Here is how the TSI connects two module's ports (Ports A and B) to each other:

1. Ports A and B each have two dedicated spots in memory devices called data stores. These spots handle 8-bit PCM samples. Port A and Port B each have a spot reserved for send PCM data and receive PCM data.
2. The TSI interchanges this data by:
   a. Moving Port A's send PCM data to Port B's receive PCM data location
   b. Moving Port B's send PCM data to Port A's receive PCM data location.
3. Other circuits transmit the receive data back to Ports A and B and place the next PCM samples in the send locations.
4. The net effect of this operation is an exchange of samples. By repeating this process for each PCM sample, the TSI creates a 2-way connection between Ports A and B.

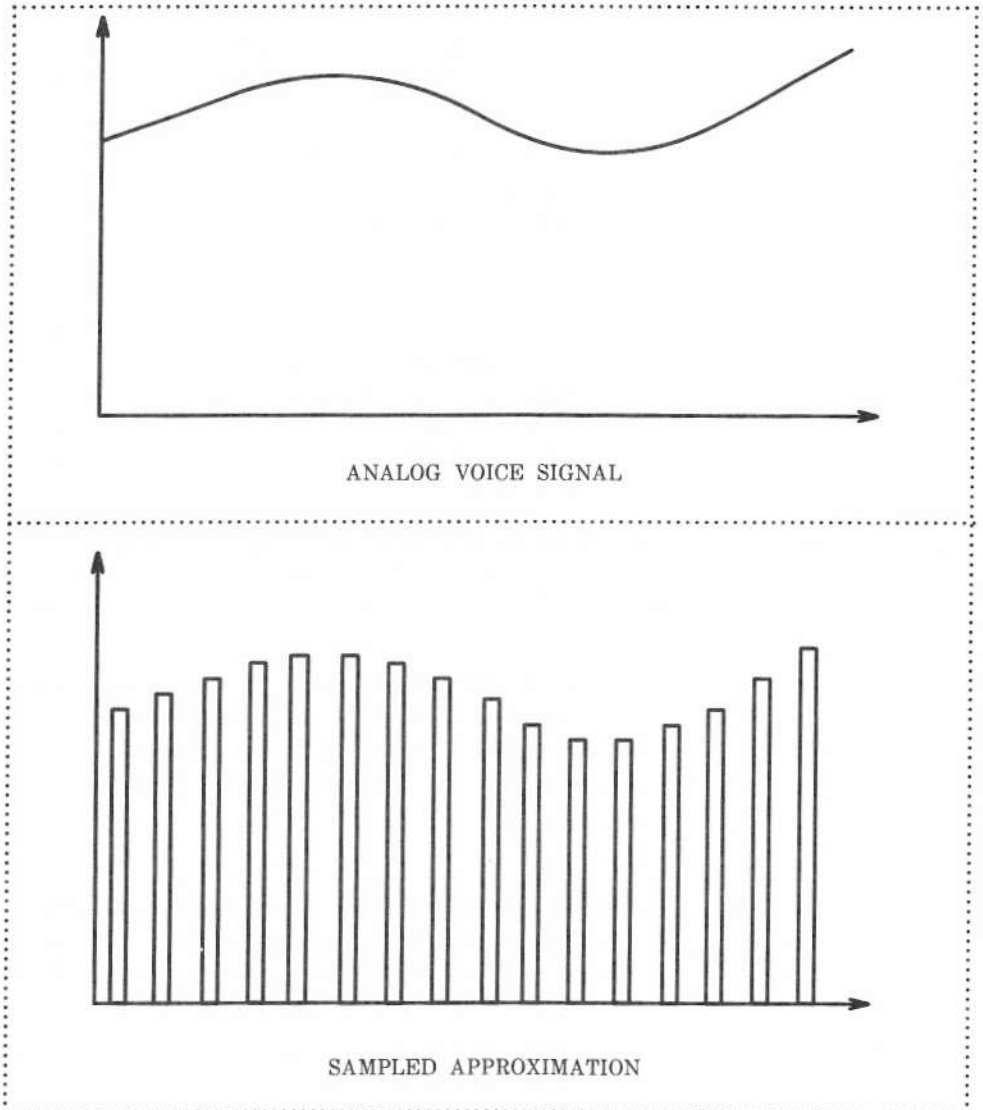


Figure 2-5. Sampling

The rest of this part describes these functional areas of a call processing module:

1. Module Control Carrier
   - Module Control Channel
   - Module Processor
   - Module I/O Bus Interface
   - Time Slot Interchanger
   - Port Data Stores
   - Intermodule Data Store
   - Light Guide Interface
2. Port Carrier
   - Port Circuits
   - Universal Port Control Interface
   - Universal Port Data Interface
3. DS-1 Carrier.

Module Control Carrier

The circuits in this carrier are shared by all port carriers and DS-1 carriers within the same call processing module.

Module Control Channel

This circuit (TN401) interfaces the 4-MHz serial I/O link from the common control to the module control.

Module Control Processor

The module control processor (TN380C) performs these tasks for the Common Control:

- Digit collection
- Scanning ports for off-hook conditions and button depressions
- Controlling port circuits
- Controlling the TSI
- Gathering traffic data
- Helping with administration and maintenance.

Module I/O Bus Interface

The Module I/O Bus Interface circuits (TN400Bs) provide bidirectional connectivity between the Module Control Processor and the Port Carriers.

Time Slot Interchanger (TSI)

These circuits—the TSI P-Store (TN445) and the TSI Arithmetic Logic Unit (ALU) (TN446)—perform digital switching for the module. In addition to the 2-port intramodule connection described above, the TSI can create a 3-way conference connection; performing any necessary loss calculations with its ALU. The TSI can also connect ports to a fiber-optic link connected to the Time-Multiplexed Switch in order to establish intermodule connections.

Port Data Stores

Port Data Stores (TN440Bs) contain memory which provides storage locations for data and samples of PCM voice to be acted on and switched by the Time Slot Interchanger. A dedicated source and destination location is provided for each port.

Intermodule Data Stores

The Intermodule Data Store (TN441) is similar to a Port Data Store. But instead of storing send and receive data for ports, it stores send and receive data for the Time-Multiplexed Switch.

Light Guide Interface

The Light Guide Interface (TN481) formats data or samples of PCM voice for transmission between the module and Time-Multiplexed Switch and provides a termination for the Time-Multiplexed Switch-to-Module fiber-optic link.

Module Control Carrier Bus Structure

Figure 2-6 depicts the bus structure of the module control carrier.

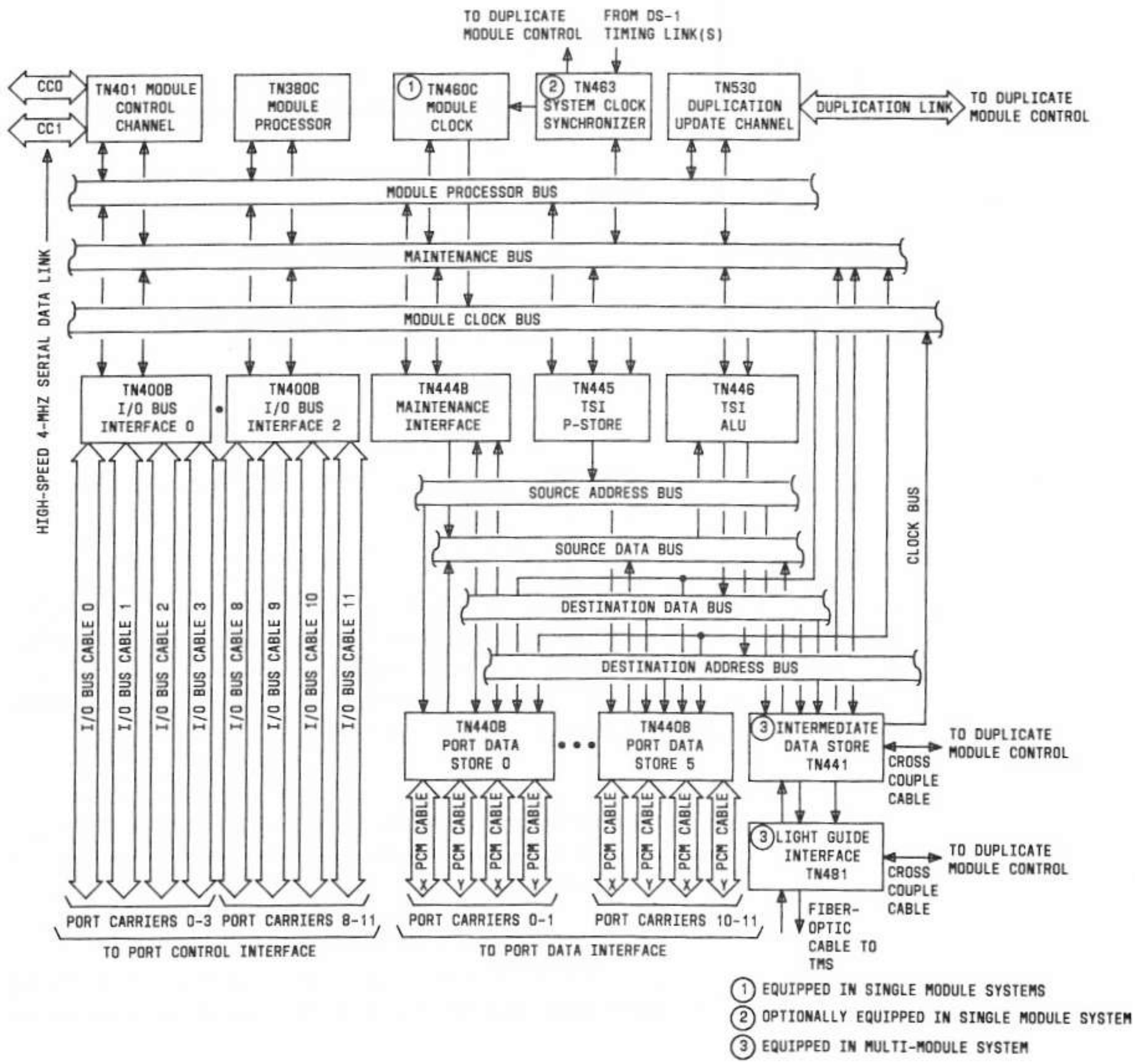


Figure 2-6. Module Control Carrier Bus Structure

Port Carriers

A Port Carrier houses port circuits. These circuits interface the call processing module to lines and analog trunks. Other port circuits provide touch-tone, call progress tones, etc. The Port Carrier also includes two types of circuits which interface port circuits to the module control.

Up to 12 Port Carriers can be included in a call processing module. Or they can be used in combination with DS-1 Port Carriers—a special type of Port Carrier designed to handle digital trunk and digital Off-Premises Station (OPS) line circuits.

Port Circuits

Most port circuit packs have an SN prefix, such as the SN270 circuit pack. General information about these circuits can be found in Section 3, SYSTEM HARDWARE under CIRCUIT PACKS.

Universal Port Control Interface

The Universal Port Control Interface (TN452B/C) serves as a buffer and multiplexer for control and status information between the port circuits and the I/O Bus Interface in the Module Control.

Universal Port Data Interface

The Universal Port Data Interface (TN454B) serves as a buffer and multiplexer of PCM voice and data between the port circuits and the Port Data Store in the Module Control.

Port Carrier Bus Structure

Figure 2-7 depicts the bus structure of the port carrier.

DS-1 Carrier

The DS-1 Carrier is similar to the Port Carrier since it has a Universal Port Control Interface and a Universal Port Data Interface. But unlike the Port Carrier, it accommodates DS-1 Digital Trunk Interface circuits.

With Release 2, Version 1 software, the DS-1 Carrier will not accept SN-coded packs. But with Release 2, Versions 2 and 3 software, SN-coded packs can be accepted. The DS-1 Carrier does not replace the Port Carrier for housing SN-coded packs because inefficiency in cabling to termination fields results. The DS-1 carrier is used primarily to house ANN-coded packs. Spare slots are used to house SN-coded packs so cabinet and carrier resources can be optimized.

DS-1 Carrier Bus Structure

Figure 2-8 depicts the bus structure of the DS-1 carrier.

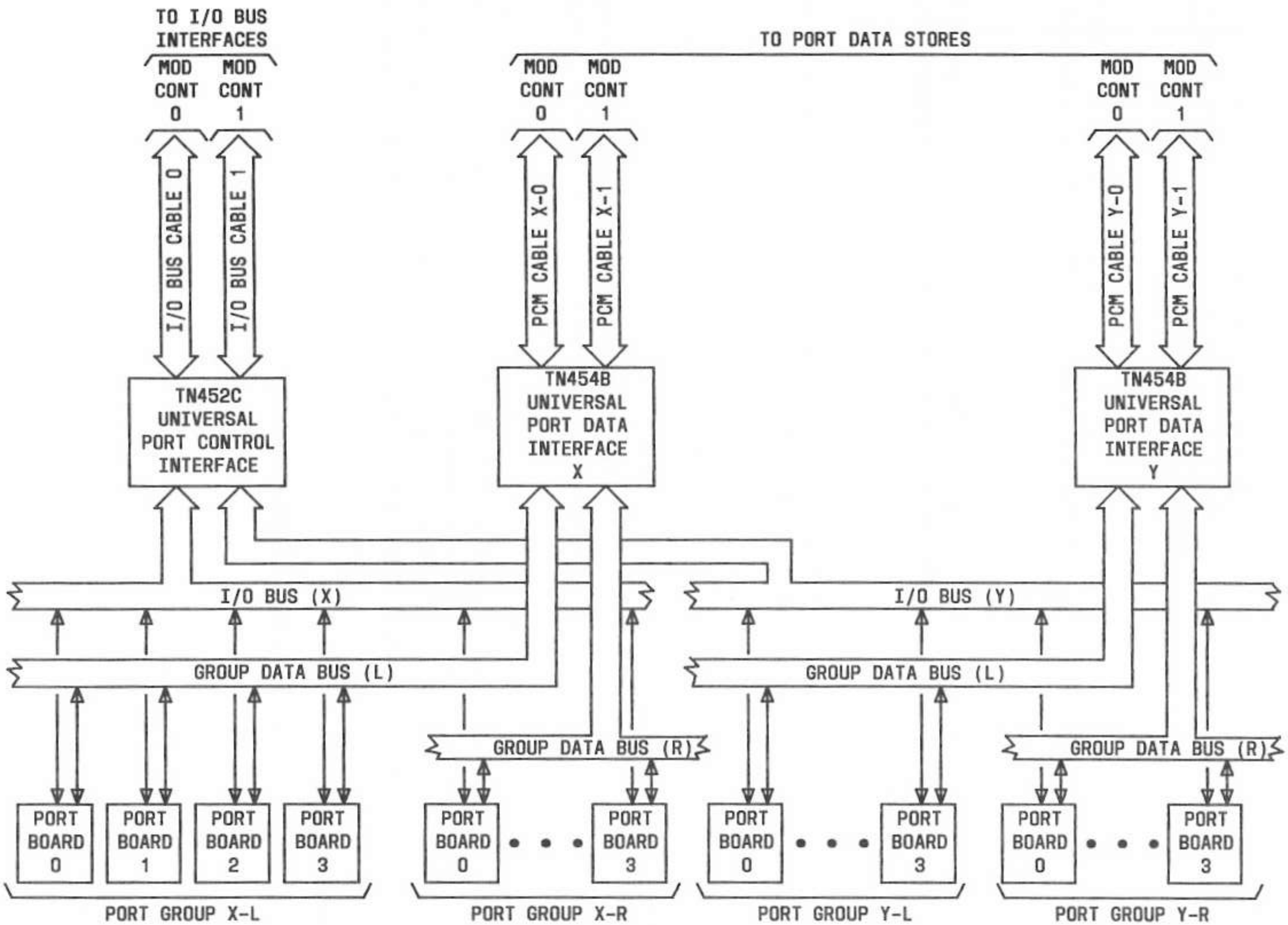
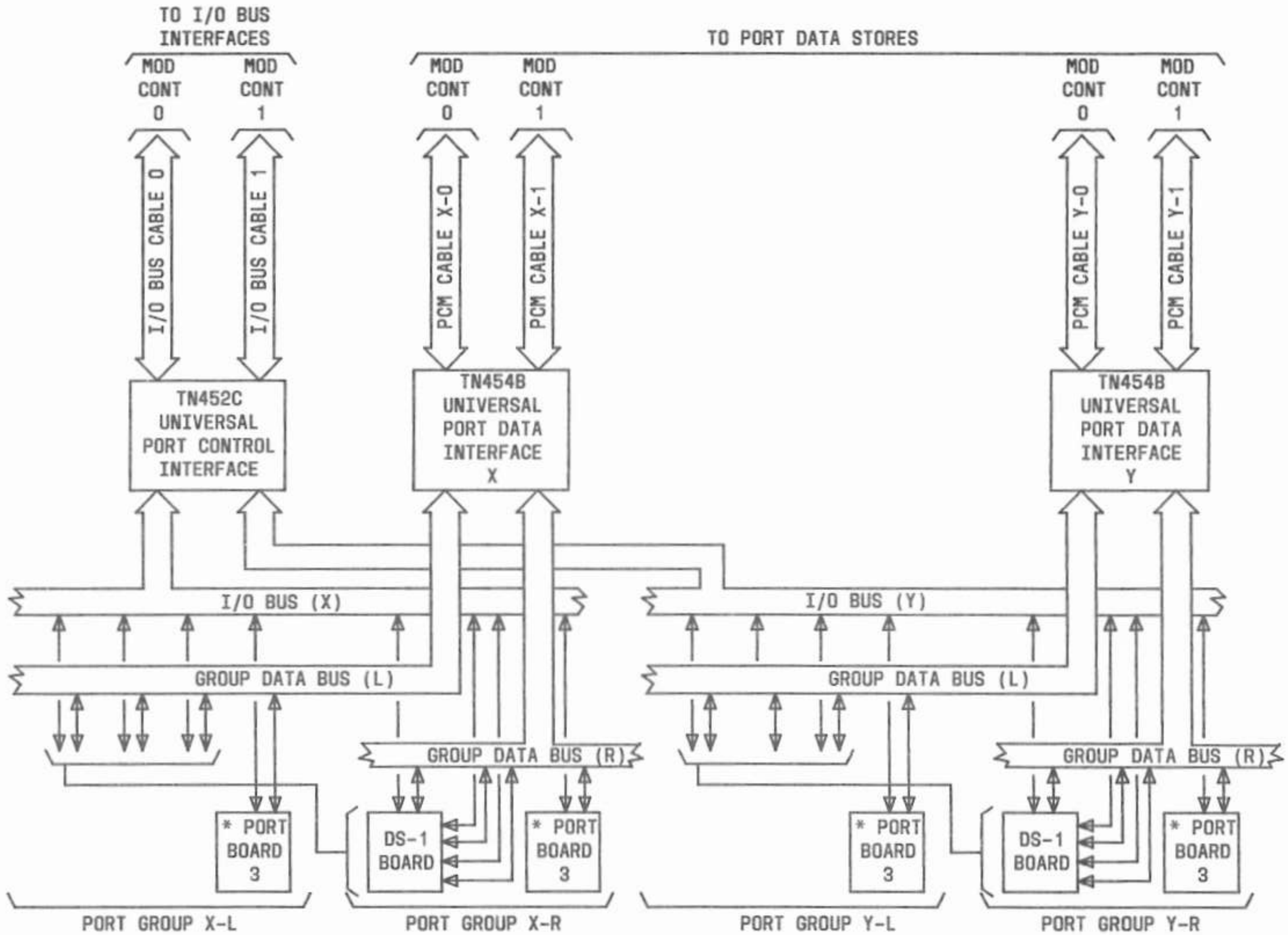


Figure 2-7. Port Carrier Bus Structure



* ASSIGNABLE WITH R2V2/V3 SOFTWARE ONLY

Figure 2-8. DS-1 Carrier Bus Structure

Port Groupings and Designations

A port on the System 85 switch network provides connectivity to lines, trunks, and the various service circuits, such as Call Progress Tones (Dial Tone, Busy Tone, Ring Back Tone) and Touch-Tone Senders, for establishing calls and implementing related features. Each network module can accommodate a maximum of 1536 ports equally distributed among 12 Port or DS-1 Carriers.

Each Port or DS-1 Carrier is assigned a physical and electrical position in its call processing module. The electrical carrier designation is assigned sequentially from 0 to 11 to correspond with the maximum of 12 Port or DS-1 Carriers which can be accommodated in a call processing module (Electrical Carrier Position 0 cannot be assigned as a DS-1 Carrier). The physical designation corresponds to the actual physical position within the switch network such as Module 00, Cabinet 01, Carrier position 02.

The Port Carrier accommodates 16 Port Circuit Packs which are grouped into physical and electrical designations. When viewed from the front of the carrier, the left half is designated as X and the right half is designated as Y. Each half carrier (X and Y) is subdivided into a left and right. This means the carrier is segmented into quarters physically designated X Half-Left (X-L), X Half-Right (X-R), Y Half-Left (Y-L), and Y Half-Right (Y-R).

X-L	X-R	Y-L	Y-R

Electrically, these quarter carrier groupings have designations based on the electrical carrier assignment within the module and the physical location in the carrier. Electrical Carrier Assignment 0, 2, 4, 6, 8, or 10 contain Port Groups 0, 1, 2, and 3 which correspond to X-L, X-R, Y-L, and Y-R. Electrical Carrier Assignment 1, 3, 5, 7, 9, or 11 contain Port Groups 4, 5, 6, and 7 which correspond to X-L, X-R, Y-L, and Y-R. Port Circuit packs within each electrical port group designation are assigned as 0, 1, 2, and 3 from left to right. The electrical carrier and port group designations correlate to a fixed source/destination address in the Port Data Store for each of the possible 1536 ports (see Figure 2-9).

Each Port or DS-1 Carrier provides an interface arrangement for a maximum of 128 ports. In the Port Carrier, the 128 ports are equally distributed among the circuit pack positions in each of the four electrical port groups (16 port pack positions) providing 8 ports per port pack slot.

Whether all eight ports can be used depends on the number of port interfaces provided by the circuit pack placed in the slot. Since an Analog Trunk pack such as the SN230 provides only four trunks per pack, the other four of the eight possible ports available in the slot position are unused. An Analog Line pack such as the SN229 provides eight analog lines per pack and uses all eight ports available. The SN270 Digital Line Interface pack provides four DCP lines per pack and use four to eight ports, depending on how many lines are used for integrated voice/data. (Each Digital Voice Terminal equipped with a Digital Terminal Data Module uses two ports per line.)

Each DS-1 carrier also provides an interface arrangement for 128 ports. However, when DS-1 trunk circuit packs are placed in the carrier, six circuit pack slots worth of ports (48 ports) will be allocated to one DS-1 circuit pack in each half-carrier.

The DS-1 pack provides an interface for up to 24 trunks multiplexed onto a single DS-1 interface. The DS-1 pack may use 24 of the 48 ports allocated to its position. Since six circuit pack slots worth of ports are allocated to each DS-1 pack in a half-carrier, two circuit pack slots in each half-carrier are physically available. These slots are available for assignment with R2V2 or later software.

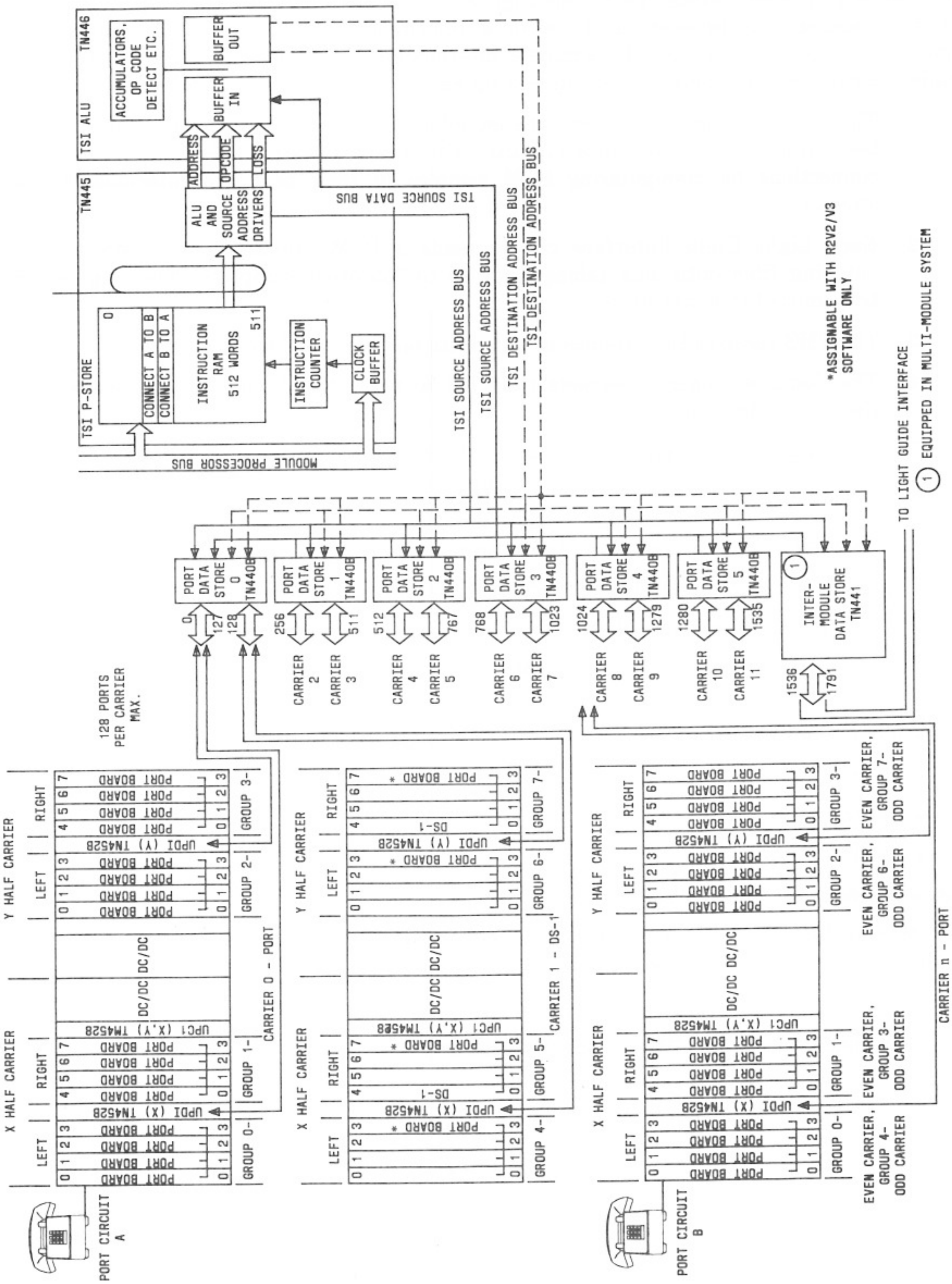


Figure 2-9. Module Port Groupings

Time-Multiplexed Switch (TMS)

The Time-Multiplexed Switch (TMS) (see Figure 2-10) is a digital switch that provides voice and data connections between modules in a multimodule System 85. This means the Common Control uses the TMS to complete intermodule connections. Sparing some of the details, here is how the Common Control sets up an intermodule voice connection:

1. The Common Control instructs the modules involved to set up 2-way connections to their Light Guide Interface circuits. (Recall that the modules will make these connections by manipulating PCM samples in their port and intermodule data stores.)
2. Each Light Guide Interface circuit sends a PCM sample to the TMS over an outgoing fiber-optic link (along with up to 255 other samples). The samples are transmitted in serial form.
3. The TMS receives the samples in two of its module interface circuits.
4. The Common Control instructs the TMS to make two 1-way connections between the module interface circuits.
5. The samples are passed through the TMS switch fabric to the module interface circuits and then on to the modules involved in the connections.
6. Each Light Guide Interface circuit takes the sample from the incoming fiber-optic link and writes the sample to the Intermodule Data Store.
7. The modules complete the connection by switching the samples to the port.

Intermodule data calls are handled the same way.

The rest of this part explains how the TMS does its job. The following major functional areas are described:

- Module interfaces
- Switch
- Control structure
- Clock.

Module Interfaces

Each Module Interface circuit (TN482) terminates a duplex fiber-optic link connected to a module. A Module Interface circuit:

- Forwards data or PCM samples received from a module to the switch.
- Transmits data or PCM samples from the switch to a module.

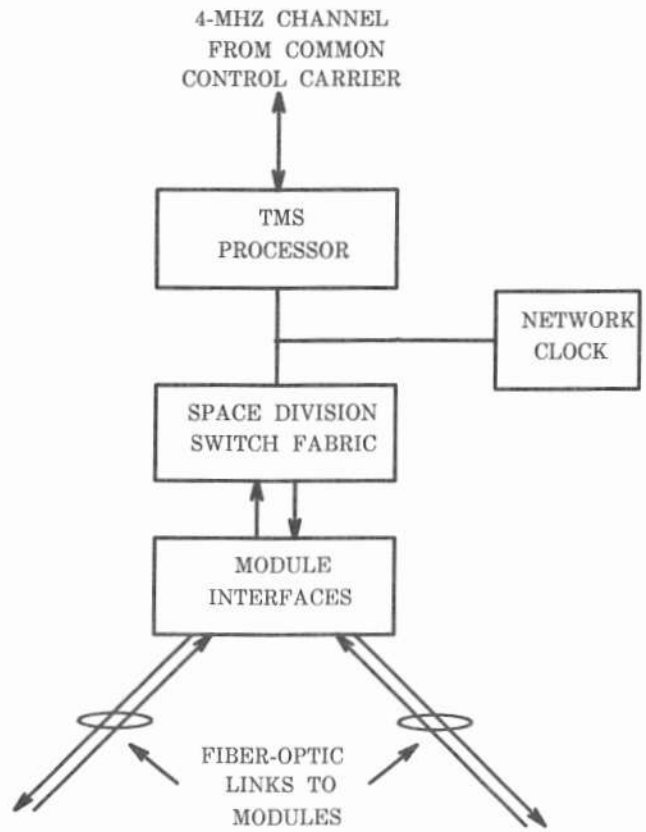


Figure 2-10. Time-Multiplexed Switch

Switch

The TMS uses a switching method that is different from the one used by call processing modules. The TMS makes connections in a different way than the modules. It uses a switching scheme called time-multiplexed space switching. Space switching means the TMS has switch fabric where actual physical connections are made (see Figure 2-11). If space switching was all that went on, these connections would last for the duration of the call. But this would be a waste since the switch would spend most of its time waiting for modules to send their next samples. This is where time multiplexing comes to the rescue. It lets the switch reconfigure to handle other connections. Time multiplexing allows 256 connection patterns to be applied to the switch on a time-shared basis.

Each module sends a stream of bits to the TMS; the stream is partitioned into groups of 256 time slots. A time slot can contain a PCM sample, data, or be unused. The TMS switch fabric uses time multiplexing to provide 256 connection patterns; one for each time slot. When the common control decides to set up an intermodule call, it tells both module controls to use the same time slot for sending samples from those ports to the TMS.

Example: The common control assigns an intermodule call between Port A in Module 0 and Port B in Module 1 to time slot 10. Module 0 sends all samples from Port A and Module 1 sends all samples from Port B to the TMS during time slot 10. The common control tells the TMS to make two 1-way connections through the TMS switch fabric during time slot 10: one from Module 0 to Module 1, and the other from Module 1 to Module 0. These connections last long enough for one sample to be passed through each of them. After passing through the switch fabric, the samples are sent to the module interface units for transmission back to the modules.

The switch consists of three types of circuits:

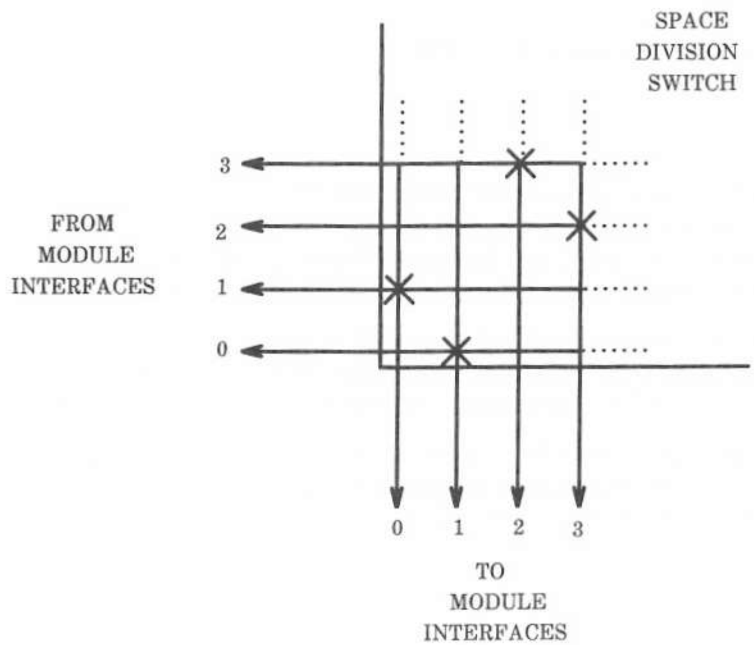
1. Fan Out (TN473)
2. Fan In (UN150)
3. Switch Fabric Multiplexers (TN470s).

Control Structure

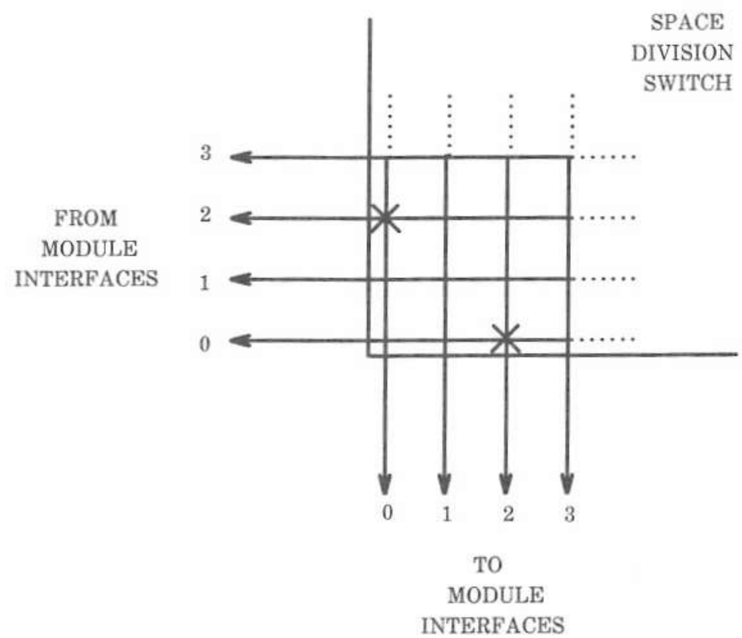
The TMS has a processor (TN381) that carries out commands from the Common Control and tells the switch which connections to establish. It also participates in maintenance and diagnostic routines.

System Clock Synchronizer

The System Clock Synchronizer (TN463) is located in the TMS for multimodule systems. (For a single-module system, it is located in the module control.) When synchronization to a high-speed digital facility is required, this circuit can slave to external clock sources. More information is provided in this section under Synchronization.



SPACE DIVISION SWITCH CONFIGURATION DURING TIME SLOT N:
TWO 2-WAY CALLS ESTABLISHED BETWEEN MODULES 0 AND 1 AND MODULES 2 AND 3



SPACE DIVISION SWITCH CONFIGURATION DURING TIMESLOT N + 1:
ONE 2-WAY CALL ESTABLISHED BETWEEN MODULES 0 AND 2

Figure 2-11. Space Division Switch Functional Illustration

TMS Carrier Bus Structure

Figure 2-12 depicts the bus structure of the TMS carrier.

Remote Modules

The Remote Module feature overcomes the 200 feet distance limitation of the 4-MHz coaxial cable that provides the serial control channel between the common control and each module control. One to 30 remote modules can be located up to 13,000 feet (3,962 meters) from the common control. This is made possible by using fiber-optic cable instead of coaxial cable.

Remote modules increase the geographical area that a single switch can serve. Previously, a campus or industrial park with buildings more than 200 feet apart usually required more than one switch. Remote modules can reduce or eliminate the need for additional switches.

The standard fiber-optic subsystem for System 85 is designed with 62.5 micron core fiber. It uses fiber ribbon cable for interbuilding and intrabuilding distribution. Each cable can contain up to 12 ribbon fibers of 12 fibers each (see Figure 2-13). Each end of this cable is terminated at a Lightguide Cable Interconnection Terminal (LCIT) (see Figure 2-14). The LCIT fans out into 12 individual fibers with bi-conic connectors. These connectors accept 401 series build-outs (attenuators) which balance the optical power level to eliminate overdriving and underdriving the receivers. The LCIT and attenuators are the demarcation point for switching equipment and facilities distribution.

The fiber-optic subsystem for System 85 can also be designed with 50 micron core fiber but it must be a higher grade fiber to overcome increased optical loss. All sections of a fiber link must be the same size. In other words, 62.5 micron and 50 micron fiber cannot be mixed in the same link.

Connectivity

Connection from the LCIT(s) to the switching equipment is via a single jacketed fiber pair (duplex) cable. One fiber is the transmit link; the other is the receive link. Each cable terminates on the appropriate carrier backplane with a paddleboard transmitter or receiver:

- Z982C—Transmitter (TMS), terminates on TN480 and TN481
- Z982J—Transmitter (RMI), terminates on TN456
- Z982D—Receiver (TMS and RMI), terminates on TN480, TN481, and TN456.

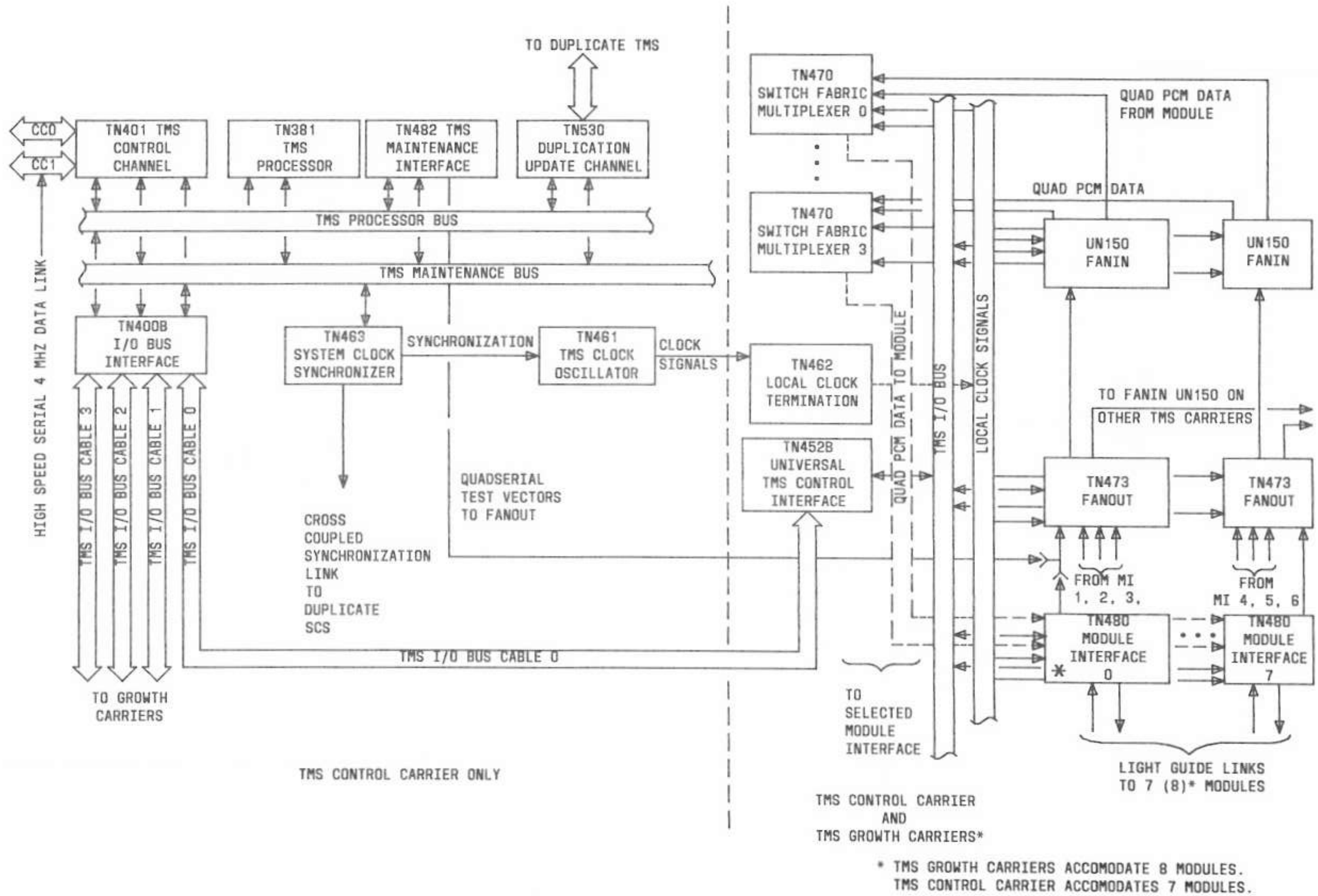


Figure 2-12. TMS Carrier Bus Structure

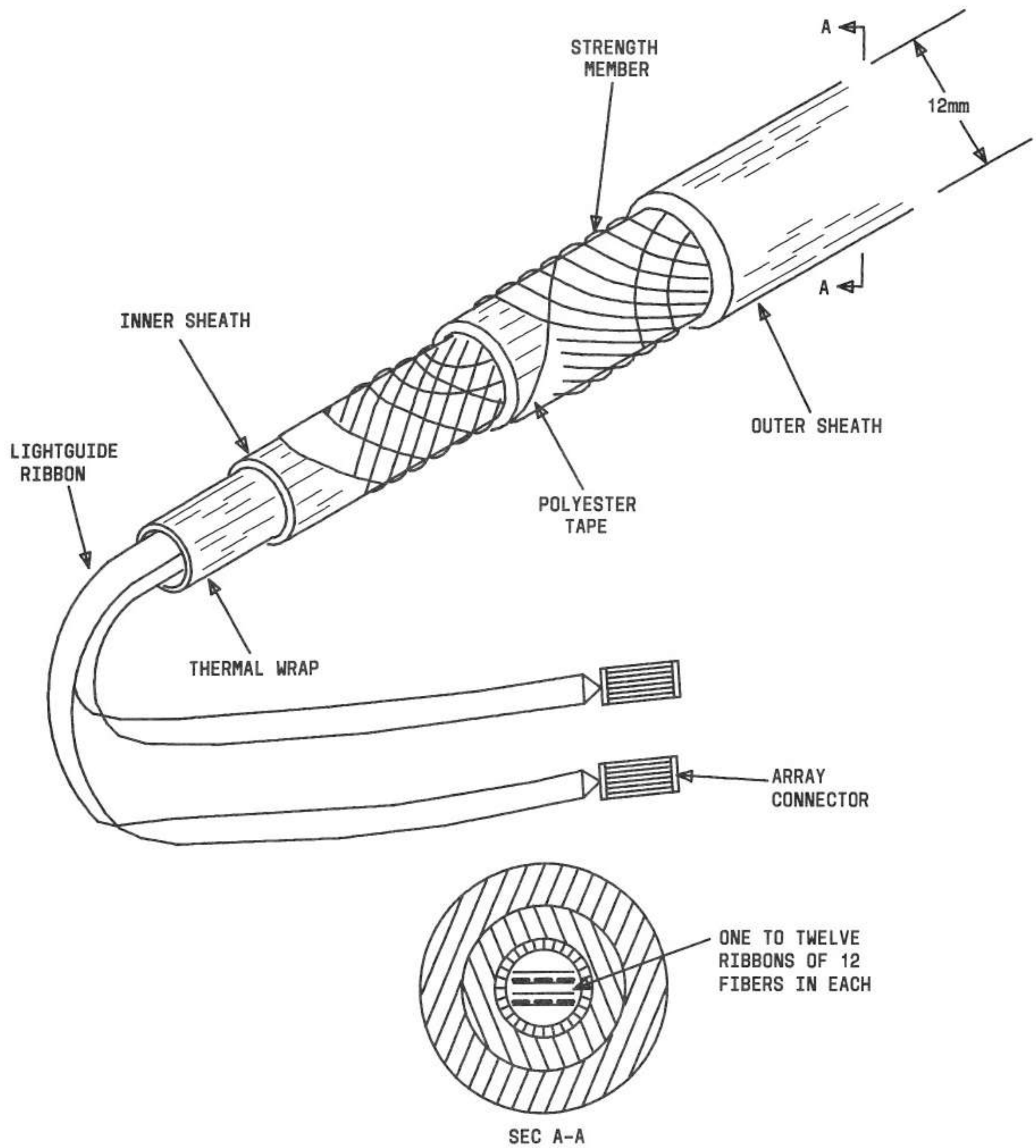


Figure 2-13. Lightguide Cable

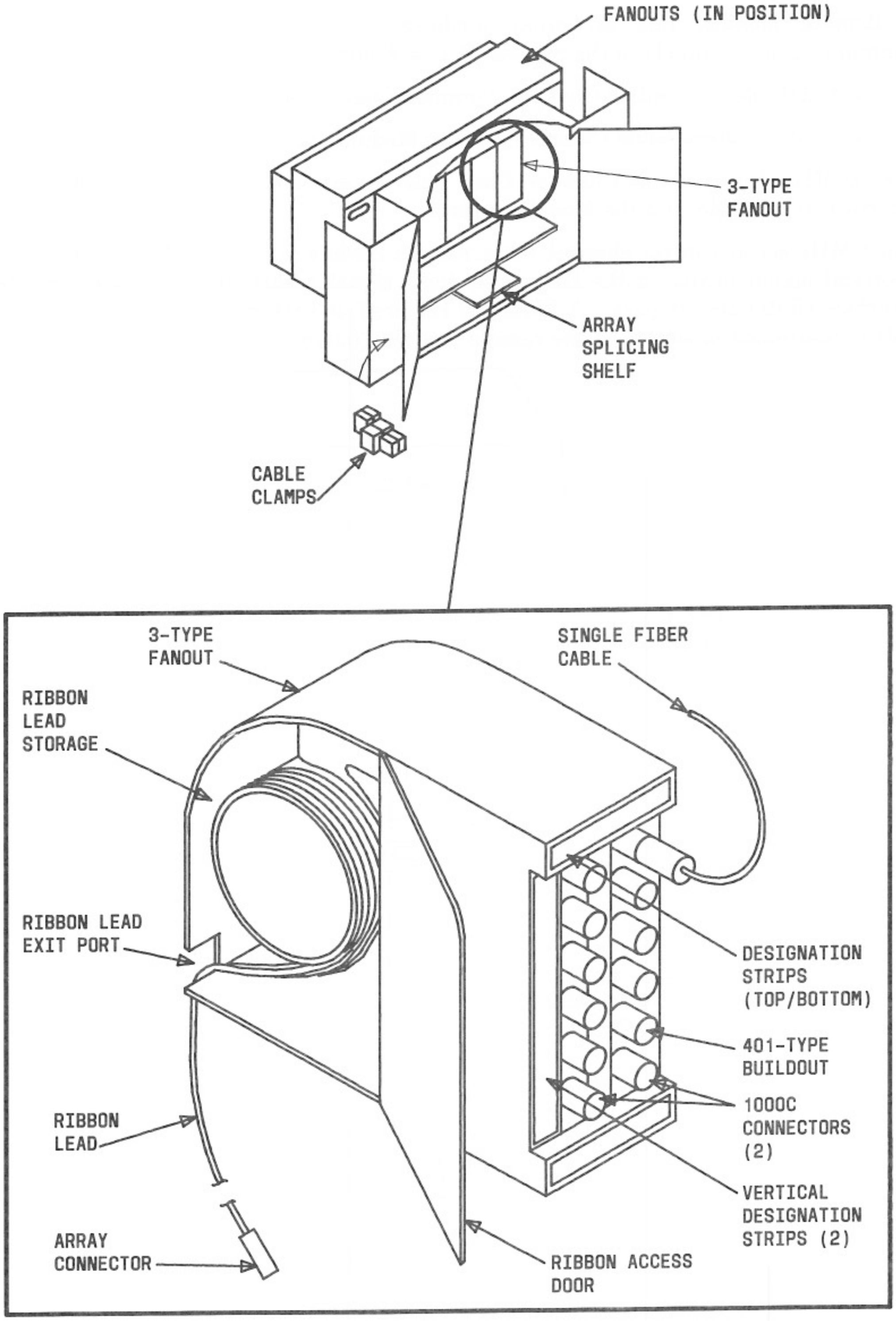


Figure 2-14. Lightguide Cable Interconnection Terminal (LCIT)

A Remote Module, like all other modules in a multimodule switch, requires two communications channels to the System 85 (see Figure 2-15):

- 4-MHz Serial Control Channel, Common Control to Module Control
- 32-MHz Intermodule Channel, TMS to Module Control.

The 32-MHz Intermodule Channel fiber pair is extended via the existing Light Guide Interface at the TMS and the Module Control.

The 4-MHz serial control channel for a remote module is converted from the coaxial cable electrical signal media to the fiber-optic light signal media by the TN456 Remote Module Interface (RMI) circuit pack. A TN456 is required at each end of the fiber-optic link. The RMI is positioned in slot 25 of the remote Module Control Carrier.

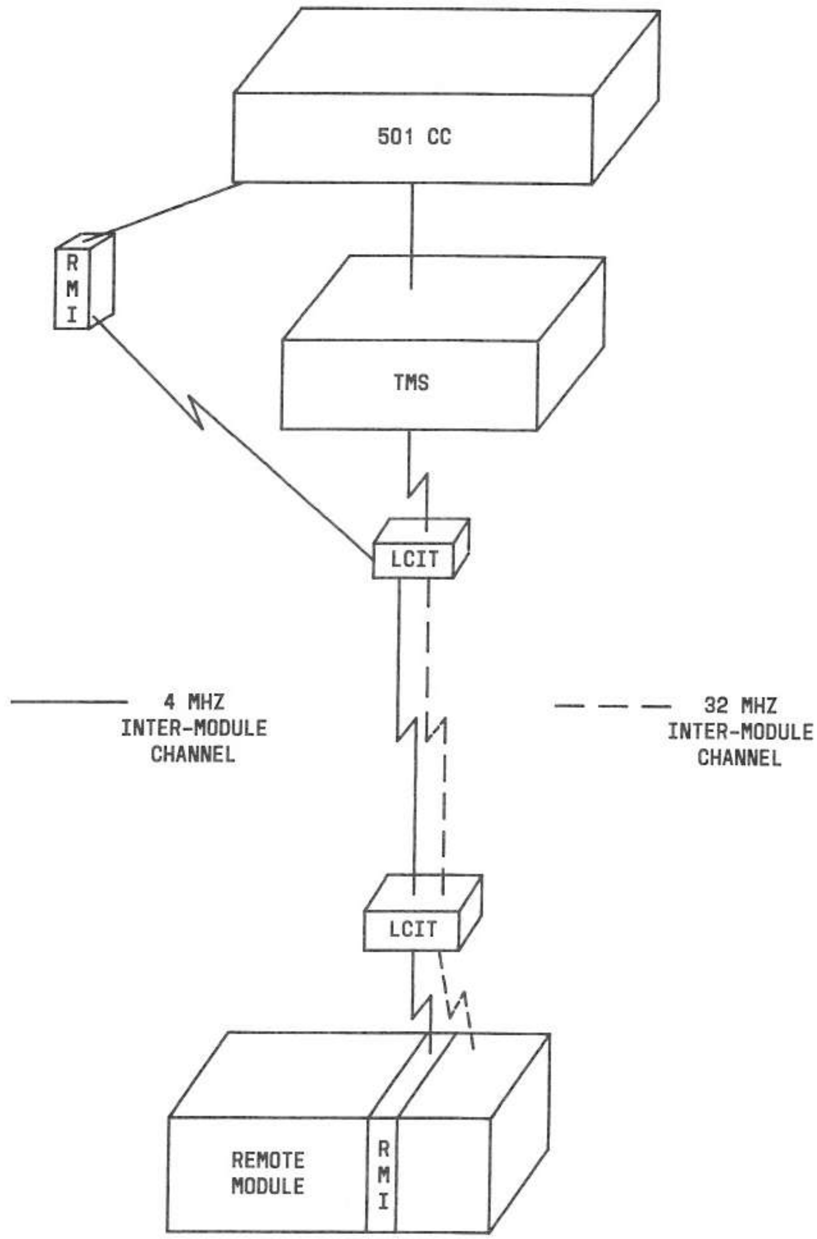


Figure 2-15. Remote Module—Fiber and LCIT

In System 85 Remote Module—Phase 1, the RMI is positioned in slot 25 of a central locale Module Control Carrier. One central locale Module Control Carrier equipped with an RMI is required for each remote module (see Figure 2-16).

In System 85 Remote Module—Phase 2, the central locale RMIs are positioned in a Remote Module Carrier (see Figure 2-17). The Remote Module Carrier can be equipped with up to 16 RMIs and is mounted in a TMS cabinet. The Remote Module Carrier eliminates the one-to-one relationship of central to remote modules that existed with Phase 1. A System 85 with unduplicated module control(s) can be equipped with a maximum of two Remote Module Carriers and 30 RMI circuit packs. All System 85s require a minimum of one central locale module. A System 85 can be provided with both Phase 1 and Phase 2 equipment arrangements.

If a System 85 has fully duplicated control functions (Common Control, Module Control, TMS), the RMIs are also duplicated. In a duplicated Phase 1 arrangement, an RMI is required in each central and remote Module Control Carrier (four per remote module). In a duplicated Phase 2 arrangement, two RMIs are required per remote module in the Remote Module Carrier and two RMIs (one per Module Control Carrier) at the remote module. A total of four fiber pairs are required per remote module, if duplicated. When separate paths are selected for the duplicated fiber, the difference between the two lengths cannot exceed 2400 feet (732 meters). A System 85 with duplicated module control(s) can be equipped with a maximum of 4 RMI carriers and 60 RMI circuit packs.

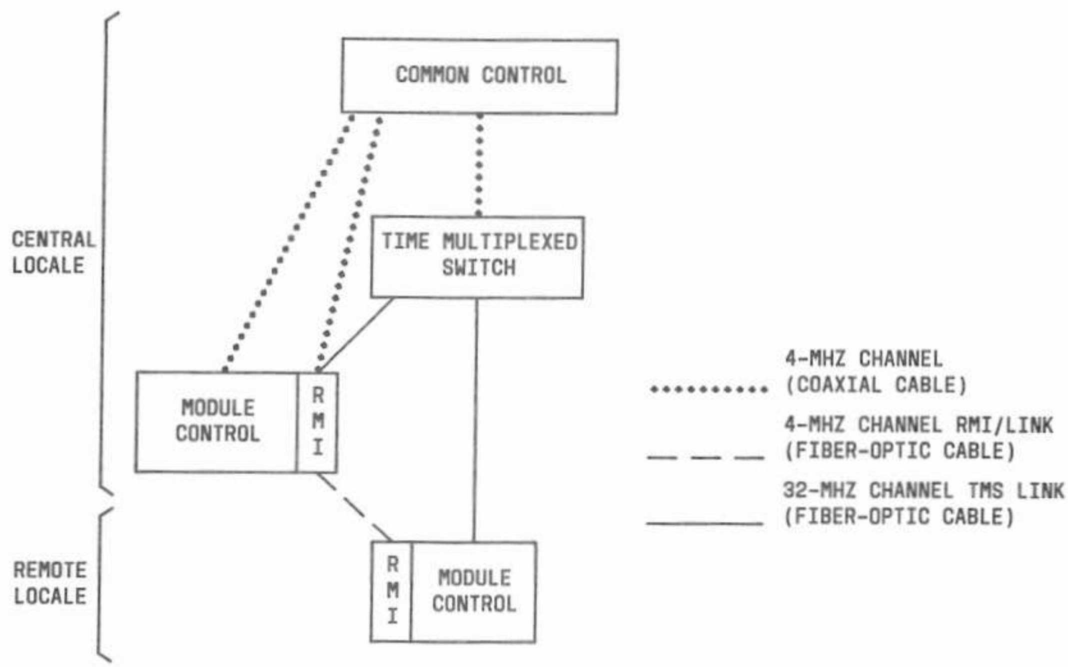


Figure 2-16. Remote Module With RMI in Central Module Control Carrier

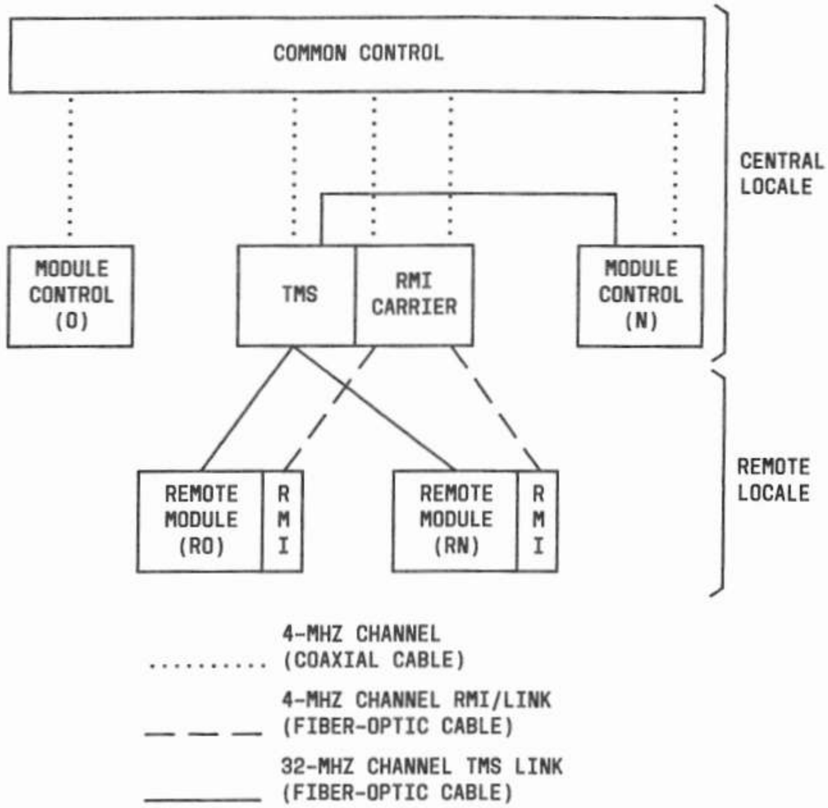


Figure 2-17. Remote Module With RMI in RMI Carrier

MAAP Operation

The RMI fiber link also interfaces an I/O data channel for full remote Maintenance and Administration Panel (MAAP) operation. In addition, alarming is also provided through the fiber.

Emergency Transfer

Emergency transfer operation is provided remotely in the same manner as locally, regardless of local emergency transfer.

Emergency transfer is available at the remote end through the RMI. This is accomplished via a small circuit pack that mounts on the MAAP bracket within the remoted Module Control Cabinet.

An emergency transfer can be initiated from the central end of the link under any one of four conditions:

1. The emergency transfer switch is manually activated at the alarm panel.
2. The hardware invokes emergency transfer because there is a processor failure.
3. Software invokes emergency transfer because there is a failure of 75 percent or more of the modules.
4. There is a loss of power, causing the emergency transfer control relay on the alarm system to be de-energized.

At the remote end of the link, an emergency transfer is invoked under any one of three additional conditions:

1. The remote module fails, preventing it from responding to messages from the Common Control.
2. The fiber link fails, breaking communications between the Common Control and the remote Module Control.
3. The power fails at the remote end.

Emergency transfer requires that trunks (outgoing or 2-way) be terminated on the remote module.

Equipment Room

The equipment room considerations for remote module equipment are the same as the local equipment room. This includes environmental, floor loading, and ac/dc power (including distribution and ac protection). Network interface is also required for central office facilities.

Traffic

A multimodule system with all modules colocated with the common equipment has the port circuits equally distributed (balanced) among all modules. This way all modules carry approximately the same traffic load. Remote module arrangements require an unbalanced configuration to accommodate port connections within the remote module. This unbalanced configuration requires specific traffic guidelines that are administered only by the National Customer Support Center (NCSC).

Remote Groups

The use of DS-1 facilities is expanded in R2V3 to include optional remoted lines (analog, hybrid, and digital) and non-CO remoted trunks (digital and EIA). This capability allows small groups of voice terminals and their port interface circuits (equivalent to one or more port carriers, but less than one module) to be located up to 100 miles away from the central switch.

Twenty-three PCM time slots and one signaling time slot are multiplexed onto the DS-1 channel by a pair of remote group interfaces. One type, the Remote Carrier Local (RCL) interface, is located at the central switch and appears as three port circuit boards to call processing software. The other interface, the Remote Carrier Controller (RCC), is located at the remote site and appears as a Port Data Interface/Port Control Interface to the remoted port circuits. Each remote port group is limited to the 24 time slots available on the DS-1 link. Figure 2-18 illustrates the basic Remote Group connection.

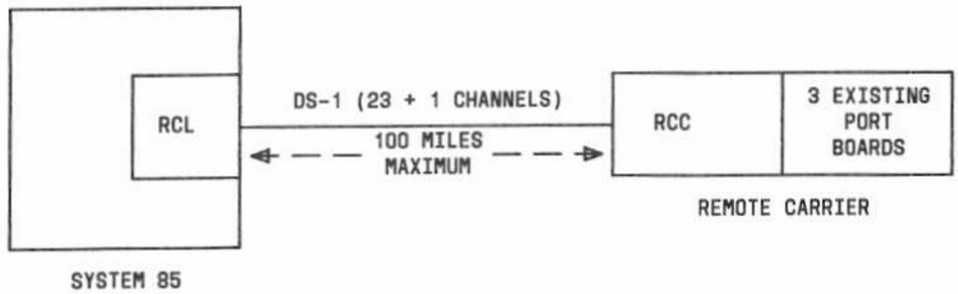


Figure 2-18. Remote Group

Applications Processors (APs)

APs provide many of the advanced capabilities of System 85. These functions may be implemented with a single processor or with multiple processors. Either AP16s or 3B5 APs can be configured to support System 85. Either processor can be tightly coupled with System 85 to provide integrated functions.

The following AP applications require a link to the System 85 DCIU:

- Message Center
- Call Detail Recording and Reporting.

The following AP applications do not necessarily require a DCIU link:

- Directory
- Electronic Document Communications
- Terminal Emulation
- Automated Building Management
- Terminal Change Management
- Facilities Management.

Data Communications Interface Unit (DCIU)

The DCIU is a microprocessor-controlled communications interface mounted in the Common Control carrier. The 501CC uses a program called the DCIU Interface Program (DIP) to communicate with the DCIU. Communication between the DCIU and the 501CC processor is via direct memory access to the 501CC system bus; this allows the DCIU to scan buffers in 501CC memory for outgoing messages and to write incoming messages directly into buffers in 501CC memory.

The DCIU has eight full-duplex synchronous data links which can be connected to any of the following remote machines:

- Applications Processors (APs)
- Audio Information Exchange (AUDIX) system
- Other System 85 switches
- System 75 switches
- FP8 Issue 3 Enhanced DIMENSION PBXs.

BX.25 Protocol

Messages passing between the DCIU and remote machines and between the DCIU and DIP conform to the BX.25 protocol. The following brief discussion of BX.25 is intended to introduce relevant terminology used in describing the DCIU.

BX.25 is a layered protocol, which means for example that the details of error correction and flow control are handled by lower level entities in a way which is transparent to higher level entities. Here are the levels:

Application Layer
Session Layer
Packet Layer
Link Layer
Physical Layer

Physical Layer

This layer, also called Level 1, is a hardware specification (voltage levels, signal lines, etc.) which is compatible with RS-232C and RS-449.

Link Layer

This layer, also known as Level 2, is primarily responsible for detecting bit errors by means of a cyclic redundancy check and correcting those errors by retransmission; this procedure is compatible with High-Level Data Link Control (HDLC) procedure and is performed by DCIU firmware and by an HDLC chip on each of the DCIU's eight links.

Packet Layer

This layer, also known as Level 3, multiplexes different logical streams of data through the Level 2 entity and regulates the flow of data on each of these logical streams so as to prevent the overrunning of receiver buffers. Level 3 responsibilities are performed by firmware in the DCIU.

Session Layer

This layer binds two applications into a session and shields the applications from the details of controlling the Level 3 interface. Session Layer services are provided by DIP on the 501CC.

Application Layer

This layer is named but not regulated in BX.25.

Communication Pathways and Endpoints

BX.25 terms describing communication pathways and their endpoints are *link, logical channel, port, virtual circuit, permanent virtual circuit,* virtual call.

Link

Link is a Level 2 term describing a segment of a communication path, e.g., between two DCIU's or between a DCIU and an AP Line Controller, on which there is established a Level 2 protocol. Link includes whatever entities are performing Level 2 services at each end of the segment. Note that since link is a Level 2 term, it does not imply what kind of hardware is used at Level 1.

Logical Channel

Logical channel is a Level 3 term describing one of many logically independent streams of data which are multiplexed on a single link. The definition of a logical channel begins and ends with the Level 3 entities at each end of a given link. This means logical channel numbers are defined on a given segment of a communication path and that a single logical stream of data may be assigned different logical channel numbers on different segments of a communication path.

Virtual Circuit

Virtual circuit is a Level 3 term referring to the entire communication path between two Level 3 entities. Since the communication path may consist of several links, with a different logical channel number used on each link, the logical channel numbers at opposite ends of a virtual circuit can differ.

Permanent Virtual Circuit

A permanent virtual circuit is a virtual circuit that is permanently established, as opposed to a *Virtual Call* which is a virtual circuit that is dynamically established as the need arises and then released when no longer needed.

Port

Port is a Session Layer term describing a gateway between Session Layer and a single application. To the application, a port looks like an I/O device. Once a session has been established, it is safe to think of ports as the endpoints of a virtual circuit between two applications. Although the port numbers at opposite ends are generally not equal, the Session Layer entity at each end knows the port numbers at both ends.

Message, Packet, and Frame

The units of information in BX.25 are the *message*, the *packet*, and the *frame*. Starting with the data that an application (e.g., on the 501CC) wishes to send to its remote peer (on the AP), the Session Layer entity (DIP) serving the local application prefaces the application data with a Session Layer Data Header (SLDH), thereby forming a message. The SLDH describes the length of the application message and defines a message sequence number used by the remote Session Layer entity to insure that messages are received in the same order they were sent.

```
          ------------------------
message:  |  SLDH   |  appl msg  |
          ------------------------
```

Level 3 (in the DCIU) then prefaces the Session Layer message with another header to form a packet. If the message exceeds the maximum packet size, Level 3 will break the message into multiple packets in a way which allows later reconstruction of the original message.

The Level 3 header defines packet sequence numbers used for flow control and delivery confirmation; it also identifies the logical channel to which this packet belongs so that different logical channels can be multiplexed onto the same Level 2 link.

```
          ------------------------------
packet:   |  L3  |  SLDH  |  appl msg  |
          ------------------------------
```

Level 2 (also in the DCIU) envelopes the packet with a Level 2 header and a Level 2 trailer to form a frame. The header and trailer have unique bit patterns to delimit the frame. The trailer also carries the cyclic redundancy check, while the header defines frame sequence numbers which govern retransmission in the event that a bit error is detected by the remote receiver.

```
        ---------------------------------------------
frame:  |  L2  |  L3  |  SLDH  |  appl msg  |  L2  |
        ---------------------------------------------
```

In addition to the above packet and frame formats used for packaging application data, BX.25 provides for control packets and control frames which generally have a more abbreviated format and do not contain application data or SLDHs.

Conceptual Model of the DCIU

The following simplified conceptual model of the DCIU is essential to understanding Alternate Routing and the administration of the DCIU. Instead of thinking of the DCIU as a region of the 501CC where eight data links can be attached, it is more appropriate to regard the DCIU as a separate box connected to the 501CC by a ninth data link (see Figure 2-19.) The principal difference between this link and the other eight is at Level 1, the Physical Layer. In place of serial transmission by an RS-449 connection, the ninth data link uses direct memory access to the 501CC. Inside the DCIU box, however, the ninth data link presents the same Level 2 and Level 3 appearance as the other eight links.

Thus the DCIU can be pictured as a box with nine lines radiating from it and nine bubbles attached to the inside walls, as illustrated below. The bubbles represent the Level 3 entities serving each of the nine links numbered 1 through 9. The access point to the channels provided by each of these entities can be represented as numbered stubs protruding from the bubbles. Here we use the term access point to refer to the Level 3 packet receive queue and transmit queue associated with a given logical channel. No two stubs on the same bubble may have the same logical channel number, but stubs on different bubbles may; in other words, a stub is uniquely specified by its link number and logical channel number.

Within this conceptual model, the message handling responsibility of the DCIU is to pick up an incoming packet from the receive queue on one stub and place it in the transmit queue of the appropriate outgoing stub. The details of actually transmitting and receiving packets are handled inside each bubble by a Level 3 entity. What does concern us now is how the DCIU selects the appropriate outgoing stub, i.e., the appropriate link and logical channel numbers.

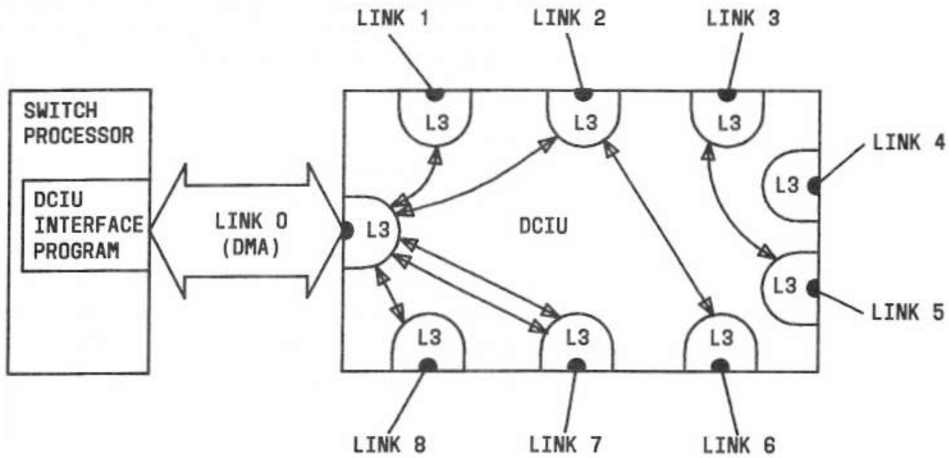


Figure 2-19. Conceptual Model of the Release 2 DCIU

How does the DCIU know which stubs to connect? In the Release 1 DCIU, the answer to this question was contained in a table called group channel map which was located in an alterable translation memory. This table grouped stubs into pairs and each pair was referred to as a network channel. For the conceptual model, a network channel would be represented as a solid line drawn between two stubs. By use of a simple indexing scheme, the DCIU could quickly look up the appropriate outgoing stub given the index of the incoming stub. Please note that the term tandem network channel refers to the special case in which neither stub is on the DMA link leading to the switch (Link 0).

In the Release 2 DCIU, the use of the group channel map table and the notion of a network channel have been modified to allow for Alternate Routing. There are now two kinds of network channels: a fixed network channel, which is the same as a Release 1 network channel, and an Alternate Routing network channel, which is described below.

Alternate Routing

Alternate routing is assigned on a per-network channel basis and provides a way for DCIU messages to bypass a failed data link. Presently, the only application using alternate routing is Distributed Communication Service (DCS).

How does alternate routing work? The switch software adds an Alternate Routing Field to the DCS message as it is passed to the DCIU. This field contains the destination switch number and port index as well as postage information. The destination switch number is used by the DCIU to select a route table. The destination port index is used by the destination DCIU to deliver the message to the appropriate switch port link logical channel. The postage is decremented by one at each DCIU and is used to limit the number of hops.

Two algorithms are used to select one of the three routes in the route table. The first algorithm selects the first path in the route table. The second algorithm selects the first path in the table whose link does not have a hard failure.

If alternate routing is used, the originating and terminating switches must both be System 85 R2s and any intermediate switch through which the call tandems must also be an R2.

SYSTEM 85 APPLICATIONS

Private Network Configurations

A private network is a web of trunk and switching facilities dedicated to the use of a business or organization. It may have as few as two switches or hundreds of switches located throughout the country. An Electronic Tandem Network (ETN) is similar to the public network, in that a call may pass through one or more intermediate switches before reaching its destination. These intermediate switches that accept and pass on call traffic from other locations are called tandem switches. By concentrating and distributing call traffic, tandem switches offer a cost-effective alternative to the large number of direct trunk groups that would otherwise be necessary to interconnect the switches (nodes) of a private network.

The following configurations make it possible for organizations of all sizes to realize the benefits of a private network:

- Electronic Tandem Network—Serves the needs of a medium-to-large organization with many locations nationwide or worldwide.
- Main/Satellite/Tributary—Serves the needs of the customer with a few locations in a small geographic area. Or, as part of an Electronic Tandem Network, a larger business can interconnect several geographically dispersed Main/Satellite/Tributary complexes.
- Distributed Communication System—Serves the needs of a single-location or multilocation customer requiring several switches that operate as a single system.

For a detailed discussion of these three configurations, refer to **AT&T-IS Network and Data Services—Reference Manual** (555-025-201).

A feature that is very useful for private networks is the Automatic Transmission Measurement System (ATMS). It is discussed after the private network configurations.

Electronic Tandem Network (ETN)

An ETN is a network of privately owned trunk and switching facilities. It consists of tandem switches, the intertandem tie trunks which interconnect them, and the access or bypass access tie trunks from a tandem switch to a main switch. Figure 2-20 depicts a typical ETN configuration, with network switches providing sophisticated voice terminal and data features as well as tandem switching of network calls.

One of the most fundamental attributes of an ETN is a uniform numbering plan. It assigns a unique number to every voice or data terminal in an ETN. Here is how it is set up:

- Each switch in an ETN has a location code. This code is similar to the 3-digit central office code of a public network telephone number.
- Within each switch, a unique extension number identifies every terminal.

Because call routing is under the control of a stored software program, a telephone number only has to be dialed once, even though the call may pass through more than one switch. Software routines known as subnet trunking can even modify a telephone number. For instance, if all private network routes to a particular location are busy, the switch changes the dialed private network number to a public network number and routes the call accordingly. Network switches use touch-tone senderized operation, a process that reduces call setup and completion time.

Network switches automatically route private network and public network calls over the most economical trunk facility available. If the first-choice route is busy, the switch makes as many as three attempts to complete a private network call (nine attempts for public network calls) via alternate routes. The first-choice route is normally more direct than alternate routes. In fact, an alternate route may involve three or more switches and two or more tie trunks in tandem. Alternate routing can reduce network trunk requirements by making more efficient use of trunk facilities. This capability also reduces service interruptions since a call has more than one possible path to its destination. If for any reason a trunk must be taken out of service, calls can use another route until the trunk is restored to normal operation.

Data calls are more susceptible to signal degradation than are voice calls, and transmission quality depends, in part, on the number of trunks and switches in a connection. Consequently, data calls use separate trunk groups and routing patterns (the first-choice route and any alternate routes) that are designed to minimize tandem connections.

In addition to automatic routing features, an ETN offers a means of defining network calling privileges. Individual terminals or groups of terminals can be denied access to a specific outgoing trunk facility like WATS, or all trunk facilities. Furthermore, network support features combine hardware and software components that collect and process traffic data, administer network features and parameters, and automatically test trunk facilities and report the results.

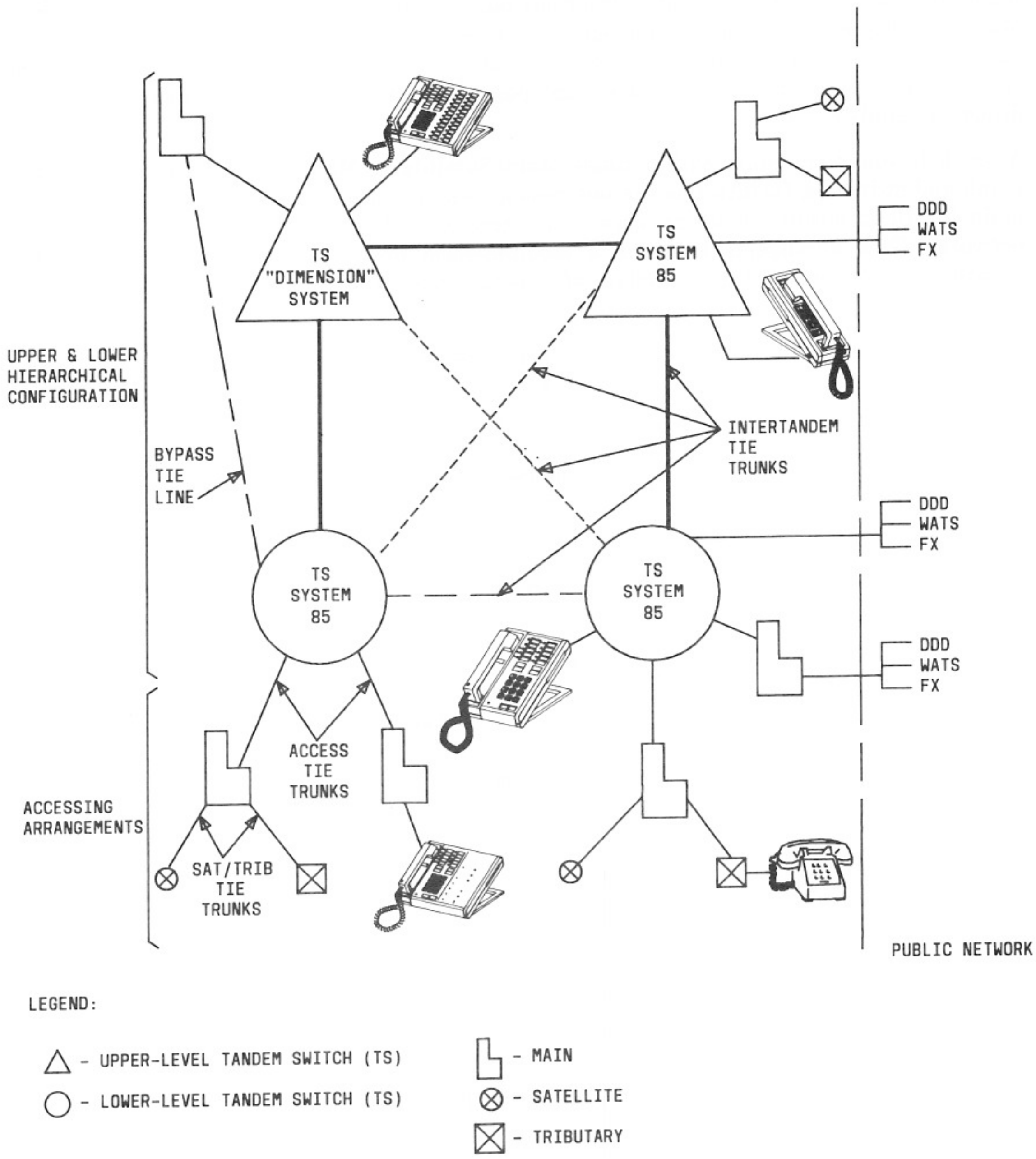


Figure 2-20. Typical ETN Configuration

Main/Satellite/Tributary

Figure 2-21 depicts a Main/Satellite/Tributary configuration. It can function independently or serve as an ETN access arrangement (see Figure 2-20). For a Main/Satellite configuration, attendant positions and public network trunk facilities are concentrated at the main, and calls to or from satellite locations pass through the main. To a caller outside the Main/Satellite complex, the system appears to be a single switch with one listed directory number. A tributary location is similar to a satellite location with the following exceptions: (1) a tributary has one or more attendant positions, and (2) a tributary has its own listed directory number.

A small business can start with a single Main/Satellite or Main/Tributary complex and add trunk and switching facilities as the business grows. In this situation, tie trunks connect the main locations within an urban area and intercity traffic is routed by way of the public network. This arrangement favors a medium-sized organization or one that has small isolated locations where the intercity traffic is too small to justify the cost of tie trunks.

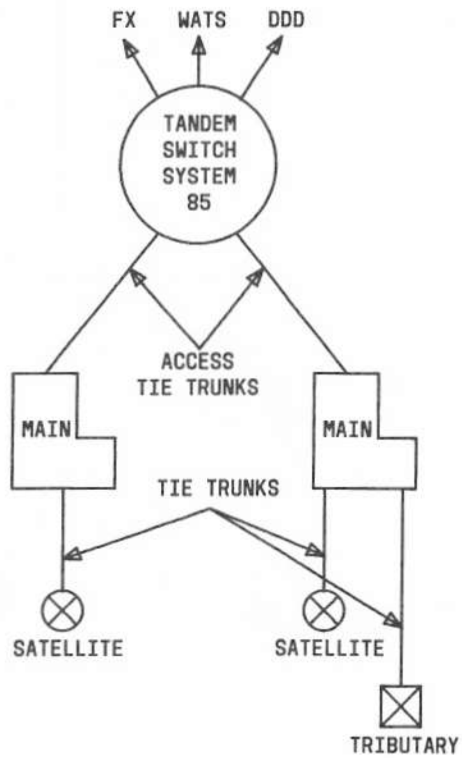


Figure 2-21. Main/Satellite/Tributary Configuration

Distributed Communication System

The Distributed Communication System (DCS) is a feature that permits a multi-PBX network (cluster) to approximate the functionality of one PBX by making certain attendant and station features transparent. Feature transparency means that a feature works the same within a node (switch within a cluster) as it does between nodes. Transparency is made possible by message communication between the switch processors involved.

Direct processor-to-processor communication is accomplished over a High-Level Data Link Control (HDLC) link terminated in a Data Communications Interface Unit (DCIU) at each processor. This communication is accomplished using the BX.25 layered data communications protocol. (For more information about the DCIU, BX.25, or the terminology used to describe DCS [e.g., virtual circuit], see the write-up on the DCIU in this section.)

A DCS cluster can consist of up to 20 nodes. Combinations of DIMENSION PBX FP8 Issue 3 and System 85 Release 2 and System 75 can be mixed in a cluster but will restrict the number of nodes that can be supported. System 75 can only be used as an endpoint in a DCS cluster. Certain feature transparencies are unique to a particular type switch; therefore, the detailed feature description should be consulted for each switch.

Operation

Direct processor-to-processor communication provides for the transfer of data necessary for features to appear transparent to the user.

For feature transparency to work, the nodes in question must have the necessary hardware, software, and be connected by a permanent virtual circuit within a DCIU link. There must be a voice path (direct or tandem) via either a Main Satellite or intermachine trunk, tie trunk group. This voice path must be accessed by Station Number Steering or the routing capabilities provided by Automatic Alternate Routing (AAR). If attendant transparencies are required, a direct trunk group must connect the attended switch and the other switches in the cluster.

The permanent virtual circuits connecting the processors in a cluster may pass through the DCIUs of up to two intermediated processors. This pass through or "hop" is controlled by the packet layer of BX.25 communications protocol.

A hop is accomplished by using a network channel to connect a logical channel from one HDLC link to a logical channel of another link. Thus a permanent virtual circuit (time multiplexed data stream) is constructed using up to three logical channels (2 hops). Refer to Figure 2-22 for an example of a 3-node cluster with one hop between nodes 2 and 3 illustrated.

If the voice connection between nodes tandems, the signaling path tandems as well (the intermediate switch processor receives the DCIU message and formulates a new one for transmission to the destination switch). This is not a hop. The originating and terminating switches require a direct communication path (permanent virtual circuit with up to two hops) for transparency of certain features such as call forwarding and automatic callback calling.

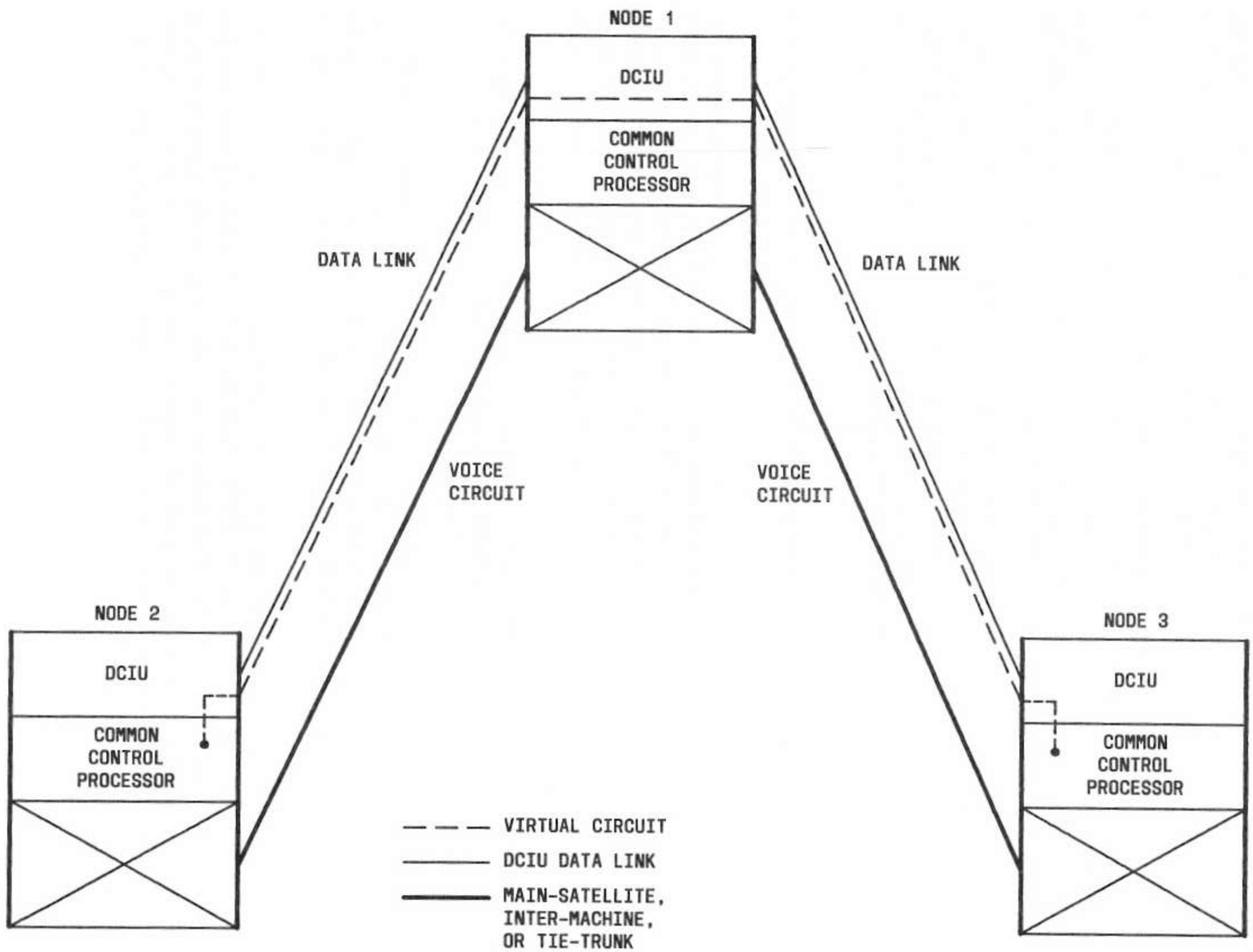


Figure 2-22. Three Node DCS Cluster With One Hop

Alternate Routing

R2V2 of System 85 introduced alternate routing to DCS. DCS messages can now be sent over an alternate route if a failure exists on the route of first choice. Two alternate routes can be specified in addition to the route of first choice. For more information, see the write-up on the DCIU in this section.

Capacities

The eight links supported by the System 85 DCIU permit a DCS cluster with up to 20 nodes.

Any link that carries a 2-hop permanent virtual circuit must be limited to a maximum of nine messages per second and operate at 9.6 kbps or higher (nine messages per second corresponds to about 10,000 busy hour calls).

Reliability considerations may necessitate a limit to the number of 2-hop permanent virtual circuits in a cluster as well as economic considerations caused by the message-link transmission speed limits.

All nodes in a DCS cluster must be within the continental United States and since message delay is a limiting factor, communications paths involving unusual delay, such as Satellite Circuits, must be avoided.

Automated Transmission Measurement System (ATMS)

Automated Transmission Measurement System (ATMS) is an integrated hardware- and software-based facility monitoring system. It automatically measures the transmission characteristics of private "analog and voice-grade" DS-1 and public network trunk facilities. The ATMS feature is available with Release 2 of System 85 or the DIMENSION PBX FP8, Issue 3 software. This capability is especially important for ETN and DCS customers, who can use ATMS to conduct scheduled and demand maintenance tests on their trunking facilities. These tests help assess the health of the network, which leads to better network management. ATMS can be accessed by the user with any of these facilities:

- Centralized System Management (CSM)
- Facilities Management (FM)
- Initialization and Administration System (INADS)
- Remote Maintenance, Administration, and Traffic System II (RMATS-II)
- Maintenance and Administration Panel (MAAP).

ATMS automatically measures three kinds of transmission impairment: loss, voice, and echo. It does this by setting up a connection between an originating test line (OTL) on the near-end switch and a terminating test line (TTL) on the far-end switch through the trunk to be tested (see Figure 2-23). Transmission tests are then made automatically.

ATMS compares the results of these tests with thresholds that have been previously set in order to identify trunks which are out of tolerance or unusable. If trouble is found, ATMS takes certain recovery actions including alarming and removing the unusable trunk from service.

The following list shows all possible transmission measurements. The measurements an OTL makes may only include a part of this list since some TTLs cannot perform all of the tests.

- Two-way loss at 404, 1004, and 2804 hertz
- Two-way loss at 1004 hertz
- Two-way C-message weighted noise
- Two-way C-notched noise
- Two-way singing return loss—low frequency
- Two-way singing return loss—high frequency
- Two-way echo return loss.

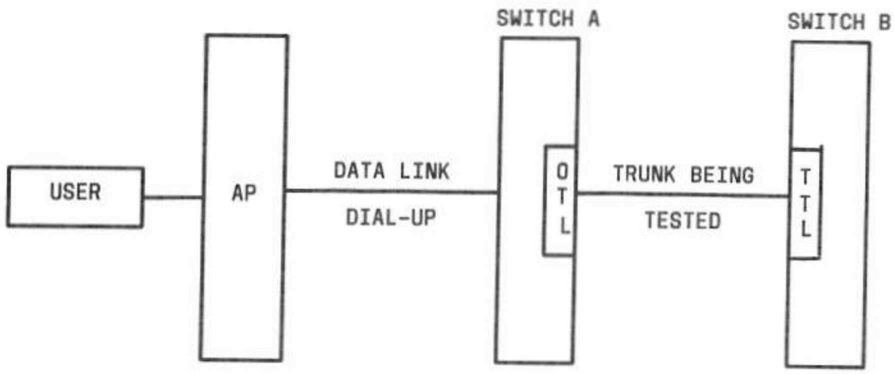


Figure 2-23. Automatic Transmission Measurement System

Configuration

The OTL can be configured from either a DIMENSION FP8, Issue 3 or a System 85, Release 2.

Only System 85 and DIMENSION FP8 can be equipped with OTLs. Other type switches, however, can be provided with TTLs. This allows measurements to be made on tie trunks that connect to other type switches.

ATMS establishes a connection from the OTL, across the tested trunk, to a TTL circuit on the far-end switch. The OTL allows up to 18 transmission parameter measurements depending on the type of TTL used (see Table 2-A).

The OTL for System 85 is the SN261B; for DIMENSION FP8 it is the LC12. The TTL for System 85 is the SN260 or SN261B; for DIMENSION FP8 it is the LC145 or ZLC12.

TABLE 2-A. ATMS TTL Test Measurement Capability

TEST	TERMINATING TEST LINE				
	105 With Return Loss SN261 ZLC12	56A/105 Without Return Loss	LC145 SN260	100	102
1004-Hz Loss FE* to NE†	X	X	X	X	X
1004-Hz Loss NE to FE	X	X			
404-Hz Loss FE to NE	X	X	X		
404-Hz Loss NE to FE	X	X			
2804-Hz Loss FE to NE	X	X	X		
2804-Hz Loss NE to FE	X	X			
C-message Noise NE	X	X	X	X	
C-message Noise FE	X	X			
C-notched Noise NE	X	X			
C-notched Noise FE	X	X			
Return Loss ‡ NE	X	X	X	X	
Return Loss ‡ FE	X				

* FE = Far End

† NE = Near End

‡ Return loss includes Singing Return Loss High Frequency, Singing Return Loss Low Frequency, and Echo Return Loss.

Test Description

ATMS automatically establishes the connection by having switch call processing dial the administered access numbers of a TTL. A supervision test or a transmission test is then made. In a supervision test, the OTL attempts to detect the presence of initial tone from the TTL.

In transmission testing, measurements are made and compared to two levels of administered thresholds. The first level is referred to as the marginal level and identifies trunks that are out of tolerance. The second level is referred to as the unacceptable level and identifies trunks that are unusable and should be removed from service.

Test Modes

Two test modes are available: scheduled and demand.

Scheduled testing allows the user to:

- Set up as many as 16 independent test schedules that specify start time, duration (in hours), days of the week the test will run, and the number of weeks between tests
- Define thresholds for test measurements
- Display trunks that failed the tests along with the reason for each failure.

The switch automatically establishes test connections according to the test schedule. Trunks whose measurements fail the administered thresholds have their identities and measurements stored in the switch. Also stored are the identities of any trunks that could not be tested and the reason the test could not be made. As a part of scheduled testing, certain recovery and alarming actions are taken for failed trunks.

Demand testing allows the user to immediately test a trunk, all trunks in a trunk group, or all trunks in the system. Three tests are contained in the demand testing capability:

Test 1—Allows the displaying of the scheduled test results (no transmission measurements). Information displayed includes the identity of the failing trunk and a fault code indicating the reason.

Test 2—Provides a transmission test on a single trunk or all trunks in a trunk group. All possible tests (determined by the capability of the TTL) will be executed and the measurement results can be displayed. Other capabilities of this test include a "camp-on" feature on in-use trunks which allows them to be tested when call processing releases the trunks. Maintenance busied trunks may be tested (they are automatically returned to the maintenance busy state after the test) and a trunk can be maintenance busied or released from maintenance busy.

Test 3—Provides the supervision test which attempts to detect only an initial tone (Test Progress Tone or 104-Hz Tone) from the TTL. Test 3 operations (circuit selection, busy out, camp-on) are identical to those of test 2.

Exception Recording

During scheduled testing, exception recording occurs when ATMS encounters trunk failures or trunk tests that cannot be made. The recording consists of both the traditional error logging in the Maintenance Information Data Structure (MIDS) and the Periodic Maintenance Information Data Structure (PMIDS), plus logging in several exception tables. Table 2-B summarizes the exception recording.

Note that the exception tables described in Table 2-B are not available through MAAP procedures. The exception tables are available to System Management as required. They can also be cleared in the switch at the request of System Management.

TABLE 2-B. ATMS Exception Recording Table

	CONTENTS	FUNCTION	ACCESS
Error Log (MIDS) DIMENSION PBX	— Trunk ID — Fault codes — Failure rate, duration, and time since last failure — Alarm level	Traditional error logging used by system technician	CSM FM INADS MAAP
Error Log (PMIDS) System 85	— Trunk ID — Fault code — Time stamps for: first and last failure, alarm activated and resolved — Number of failures — Alarm level	Traditional error logging used by system technician	CSM FM INADS MAAP
Transmission Exception Table	— Trunk ID — Schedule number — Measurement results — Month, day, hour, and minute of table entry	Identifies failed trunks and their measurements	CSM FM
Miscellaneous Exception Table	— Trunk ID — Schedule number — Fault code — Month, day, hour, and minute of table entry	Provides summary of trunks that could not be tested and why	CSM FM
Trunk Group Exception Table	— Trunk group — Schedule number — Month and day of table entry — Number of trunks passed, failed, not tested with suspected trouble	Provides summary of overall health of a system's trunks	CSM FM

Alarming and Recovery

When failures are detected by scheduled testing, an alarm (warning or minor) and recovery actions are taken by ATMS.

The alarming strategy differs slightly for DIMENSION FP8 and System 85. For System 85, the following conditions will cause an immediate warning alarm (no alarm origination to INADS):

- The inability to set up a connection (including trunk in-use)
- Failure to obtain a TTL
- Administered marginal thresholds not met.

For both DIMENSION FP8 and System 85, the strategies for raising minor alarms are the same. If the trunk fails the unacceptable level of thresholds twice, a minor alarm will be raised. Note that a minor alarm will result in alarm origination to INADS/RMATS-II.

ATMS can remove an unusable trunk from service by placing it in the maintenance busy state. This happens the second time the trunk being tested exceeds the unacceptable threshold level. ATMS lets the user specify the percentage of trunks in a particular trunk group that can be maintenance busied by ATMS. One of five percentage levels may be administered: 0, 25, 50, 75, or 100. Note that after the error log is full (55/60 entries) a unique minor alarm is generated and originated to INADS/RMATS-II.

Every 4 hours, the recovery feature of AMTS automatically retests every trunk that has an error or an alarm logged against it. If the trunk passes this test, the switch removes the trunk from the error log and returns the trunk to service. One of the main reasons for automatic retesting is to automatically return to service any trunks which subsequently pass the unacceptable threshold level test.

Table 2-C indicates when minor errors and minor alarms result and the actions that are taken by automatic retesting.

TABLE 2-C. ATMS Scheduled Retest Decision Table

	RESULTS OF THE SCHEDULED RETEST		
Current Error/Alarm Level	Passes both levels	Passes unacceptable but not marginal	Passes neither level
Minor Error	Release busy and resolve*	Release busy and immediate warning alarm†	Immediate minor alarm
Minor Alarm	Release busy and resolve*	Release busy and immediate warning alarm†	No change

* An alarmed entry is resolved by turning off the fault indicator. However, the fault indicator is not turned off if another alarmed entry is affecting that same fault indicator. For DIMENSION PBX the entry is cleared.

† DIMENSION PBX does not support the warning level, so just a logged error applies for these situations in that system.

Data Communications

System 85 is a digital switching system capable of voice and data communications using analog and digital data endpoints. A data network can be set up using System 85 as a central switching point to interconnect other switching systems, host computers, and users both on- and off-premises.

The System 85 switch connects to almost any type of data equipment provided with an Electronic Industries Association (EIA) RS-232C interface. Supported types of equipment include:

- Data terminals
- Printers
- Graphic and facsimile equipment
- Computers.

Data modules or EIA port circuit packs provide the digital interface between the System 85 switch and data terminals, hosts, and off-premises facilities. Because the switch itself is digital, this interface does not require analog conversion unless the facilities themselves are analog. Since data modules use plug-in connectors and flexible extension numbering is available for data terminals, system support personnel can rearrange the system to meet dynamic organizational needs.

The connectivity between System 85 and the data endpoints is provided by several Data Management interface features. Data Communications Access provides the connection between on-premises data endpoints when both connect to the switch via analog facilities. Host Computer Access provides the connection between on-premises data endpoints when both data endpoints connect to the switch using digital facilities. Modem Pooling provides analog-to-digital and digital-to-analog conversion resources for off-premises connections. The resources are pooled for switched access operation. Remote data equipment can be provided switched access from local data terminals through Off-Premises Data-Only Extensions. Analog or digital private-line facilities, dedicated to data, can be used. When multiplexing is advantageous, the DS-1 Interface provides a means to replace analog tie trunks, digital CO trunks, and OPS lines with DS-1 facilities. This arrangement can be expanded to increase the capacity or add dedicated data channels by using Channel Expansion and Channel Division Multiplexing. For R2V3, the Digital Multiplexed Interface introduces a cost-effective means of system-to-host communications.

Data management user features provide an efficient and reliable means of establishing data connections from the data terminals. Data Call Setup, along with several Voice Communications features, provides the user with access to the data network. And Data Protection adds reliability to the system by preventing other System 85 features from interrupting the data transmissions.

Terminal Emulation can be provided on the AP to integrate the System 85 data network with an IBM host computer. Emulation programs make the AP and the AP data terminals appear as an IBM 3270 display system or IBM 2780/3780 data communications terminals.

For a detailed discussion of data communications, refer to **AT&T System 85 (R2V3)—Feature Descriptions—Reference Manual** (555-102-301).

Digital Service-1 (DS-1) Interface

The System 85 DS-1 interface provides a high-performance digital communications interface to System 85 which is T-carrier compatible.

- The T1 carrier is the standard method for interconnecting digital telecommunication systems within North America. It is a 4-wire twisted pair digital trunking facility which operates at 1.544 Mbps and has provisions for synchronization, control, and maintenance.

What does DS-1 mean? It is a Digital Service (DS) number which corresponds to a digital transmission rate. Here are some examples of DS numbers: DS-0 = 64 kbps, DS-1 = 1.544 Mbps, DS-2 = 6.312 Mbps, and so on. The System 85 DS-1 interface combines 24 DS-0 signals (twenty-four 64-kbps channels) and 8000 framing bits into one data stream operating at the DS-1 rate (1.544 Mbps).

The DS-1 interface can be used in conjunction with other System 85s for transparent transmission of Digital Communications Protocol (DCP) formatted data. A completely digital link (with no protocol conversion) may be established from a DCP endpoint on one System 85 to another System 85 DCP endpoint.

A channel may be used for digitized voice, data, or signaling transmission. Each DS-0 channel (separate channel within the data stream) can be treated as a trunk circuit. The channels can be administered as trunks; this means that they can be assigned to trunk groups and features and can also be restricted just like analog trunks.

The ANN-11C provides the System 85 DS-1 interface. This circuit pack can emulate the following types of analog trunks:

- CO (ground-start and loop-start)
- DID (battery-reversal)
- FX (ground-start and loop-start)
- OPS
- Remote Access (ground-start)
- Tie
- WATS (ground-start and loop-start).

DS-1 digital trunks can provide a cost-effective alternative to analog trunks when considering the number of facilities required for data calls and the maximum data rates supported.

The ANN-11D also supports DS-1 based switch-to-host computer connections (Digital Multiplexed Interface with Bit Oriented Signaling [DMI-BOS]).

Framing, Line Coding, and Signaling

Specifications for the framing, line coding, and signaling employed on a DS-1 interface is necessary to insure compatible communication between digital terminal products such as digital switches, Channel Banks, and host computers. The types of framing, line coding, and signaling employed are independent of each other and don't depend on the transport facility (with the possible exception of line coding). Even though framing, line coding, and signaling are independent of each other, they must be compatible between the terminal equipment endpoints; for example, if one type of signaling is used at one end, the same type of signaling has to be used at the other end.

Framing

Two types of framing formats can be used with the System 85 DS-1 interface:

- D4 format
- Fe format (Fe is an abbreviation for extended framing).

Both formats use a basic frame which consists of 24 eight-bit time slots followed by one framing bit which adds up to 193 bits per frame. Since there are 24 eight-bit time slots, both formats provide 24 channels. A channel passes 8 bits of information during its time slot in each frame; for example, it takes two frames for a channel to pass 16 bits of information. The D4 and Fe formats organize frames into larger structures called super-frames. Within each super-frame, the formats dictate which frames are used to pass signaling information and define how the framing bit is to be interpreted.

D4 Framing Format

With D4 framing, the framing bit is divided into two fields: terminal framing pattern and signaling framing pattern. The terminal frame pattern is an alternating one-zero pattern and is used to determine the boundaries between frames. The signaling frame pattern is used to determine which frames contain signaling data. It repeats every 12 frames providing a 12-frame super-frame. During the 6th and 12th frames of a D4 super-frame, the least significant bit of each of the 24 channel's time slots may be used to pass signaling information for each channel. This method of signaling is known as "robbed-bit" signaling. (Another method, called 24th channel signaling, uses the 24th channel to pass signaling for the other 23 channels. This method leaves the least significant bits in the 6th and 12th frames unaffected.)

FRAME NUMBER	F BITS		BIT USE IN EACH CHANNEL TIME SLOT		SIGNALING BIT USE OPTION		
	Fs (NOTE 1)	Ft (NOTE 2)	TRAFFIC	SIGNALING	T (NOTE 3)	2 (NOTE 4)	4 (NOTE 5)
1	-	1	Bits 1-8				
2	0	-	Bits 1-8				
3	-	0	Bits 1-8				
4	0	-	Bits 1-8				
5	-	1	Bits 1-8				
6	1	-	Bits 1-7	Bit 8	-	A	A
7	-	0	Bits 1-8				
8	1	-	Bits 1-8				
9	-	1	Bits 1-8				
10	1	-	Bits 1-8				
11	-	0	Bits 1-8				
12	0	-	Bits 1-7	Bit 8	-	A	B

Note 1: Fs—Signaling Framing (sequence ...001110...).

Note 2: Ft—Terminal Framing (sequence ...101010...).

Note 3: Option T—Transparent (robbed-bit signaling disabled, bit 8 used for traffic).

Note 4: Option 2—2-state signaling (channel A).

Note 5: Option 4—4-state signaling (channels A & B).

Fe Framing Format

The Fe framing format extends the DS-1 super-frame from 12 to 24 frames and redefines the framing bit into three fields. The terminal and signaling framing fields that are used in D4 framing are combined into one framing field. A second field provides a 4-kbps data link for terminal-to-terminal use (this is not used by the ANN-11). A third field provides a 6-bit Cyclic Redundancy Check code (CRC-6) which performs error detection over the entire super-frame. The least significant bit of each of the 24 channels in the 6th, 12th, 18th, and 24th frame can be used for "robbed-bit" signaling.

FRAME	F BITS			BIT USE IN EACH CHANNEL TIME SLOT		SIGNALING BIT USE OPTIONS			
NUMBER	Fe (NOTE 1)	DL (NOTE 2)	BC (NOTE 3)	TRAFFIC	SIGNALING	T (NOTE 4)	2 (NOTE 5)	4 (NOTE 6)	16 (NOTE 7)
1		-	m	-	Bits 1-8				
2		-	-	C1	Bits 1-8				
3		-	m	-	Bits 1-8				
4		0	-	-	Bits 1-8				
5		-	m	-	Bits 1-8				
6		-	-	C2	Bits 1-7	Bit 8	-	A	A
7		-	m	-	Bits 1-8				
8		0	-	-	Bits 1-8				
9		-	m	-	Bits 1-8				
10		-	-	C3	Bits 1-8				
11		-	m	-	Bits 1-8				
12		1	-	-	Bits 1-7	Bit 8	-	A	A
13		-	m	-	Bits 1-8				
14		-	-	C4	Bits 1-8				
15		-	m	-	Bits 1-8				
16		0	-	-	Bits 1-8				
17		-	m	-	Bits 1-8				
18		-	-	C5	Bits 1-7	Bit 8	-	A	A
19		-	m	-	Bits 1-8				
20		1	-	-	Bits 1-8				
21		-	m	-	Bits 1-8				
22		-	-	C6	Bits 1-8				
23		-	m	-	Bits 1-8				
24		1	-	-	Bits 1-7	Bit 8	-	A	A

Note 1: Fe—Extended Framing (sequence ...001000...).

Note 2: DL—4-kbps Data Link (Message Bits m).

Note 3: BC—Block-Check field (Check bits C1-C6).

Note 4: Option T—Transparent (Bit 8 used for traffic).

Note 5: Option 2—2-state Signaling (Channel A).

Note 6: Option 4—4-state Signaling (Channels A & B).

Note 7: Option 16—16-state Signaling (Channels A, B, C, & D).

Signaling Format

Two signaling formats are available:

- Robbed-Bit
- 24th channel.

Robbed-Bit Signaling Format

With D4 framing, the least significant bit of each channel time slot in the 6th and 12th frame is used for signaling. Either 2-state signaling (signaling bit A in 6th and 12th frame) or 4-state signaling (signaling bit A in the 6th frame and signaling bit B in the 12th frame) is possible.

With Fe framing, the least significant bit of each channel time slot in the 6th, 12th, 18th, and 24th frames are used for signaling. This allows for 2-, 4-, or 16-state signaling.

24th Channel Signaling

With 24th channel signaling, the 24th channel of each frame is used as a common signaling channel for the other 23 channels. Only 23 channels may be used for PCM voice or data transmission, but 64-kbps digital data rates are possible.

For Fe framing, 5 bits (A, B, C, D, and E) in the 24th channel can be assigned to signaling. Since Fe framing has 24 frames per super-frame, per-channel signaling for each of the 23 transmission channels is accommodated by a 24-frame long channel signaling sequence.

Example: Using the table that follows this example, it can be seen that channel number 5 uses the 24th channel during frame number 5 of an Fe super-frame to transmit its A, B, C, D, and E signaling bits. Channel number 5 also uses the 24th channel during frame number 17 to transmit its A signaling bit. This means that the value of signaling bit A gets transmitted twice during an Fe super-frame.

Fe FRAMING WITH 24th CHANNEL SIGNALING									
FRAME NO.	CHANNEL TIME SLOT USE IN EACH FRAME								
	CHS. 1-23 BITS 1-8	24th CHANNEL BITS (NOTE)							
		1	2	3	4	5	6	7	8
1	Traffic	A-13	A-1	B-1	C-1	D-1	0	1	E-1
2	Traffic	A-14	A-2	B-2	C-2	D-2	0	1	E-2
3	Traffic	A-15	A-3	B-3	C-3	D-3	0	1	E-3
4	Traffic	A-16	A-4	B-4	C-4	D-4	0	1	E-4
5	Traffic	A-17	A-5	B-5	C-5	D-5	0	1	E-5
6	Traffic	A-18	A-6	B-6	C-6	D-6	0	1	E-6
7	Traffic	A-19	A-7	B-7	C-7	D-7	0	1	E-7
8	Traffic	A-20	A-8	B-8	C-8	D-8	0	1	E-8
9	Traffic	A-21	A-9	B-9	C-9	D-9	0	1	E-9
10	Traffic	A-22	A-10	B-10	C-10	D-10	0	1	E-10
11	Traffic	A-23	A-11	B-11	C-11	D-11	0	1	E-11
12	Traffic	1	A-12	B-12	C-12	D-12	0	1	E-12
13	Traffic	A-1	A-13	B-13	C-13	D-13	0	1	E-13
14	Traffic	A-2	A-14	B-14	C-14	D-14	0	1	E-14
15	Traffic	A-3	A-15	B-15	C-15	D-15	0	1	E-15
16	Traffic	A-4	A-16	B-16	C-16	D-16	0	1	E-16
17	Traffic	A-5	A-17	B-17	C-17	D-17	0	1	E-17
18	Traffic	A-6	A-18	B-18	C-18	D-18	0	1	E-18
19	Traffic	A-7	A-19	B-19	C-19	D-19	0	1	E-19
20	Traffic	A-8	A-20	B-20	C-20	D-20	0	1	E-20
21	Traffic	A-9	A-21	B-21	C-21	D-21	0	1	E-21
22	Traffic	A-10	A-22	B-22	C-22	D-22	0	1	E-22
23	Traffic	A-11	A-23	B-23	C-23	D-23	0	1	E-23
24	Traffic	A-12	1	1	1	1	0	1	1

Note: A-nn—Per channel signaling bit for channel nn (1.5-msec update). B-nn through E-nn—Additional per-channel signaling bits for channel nn (3.0-msec update).

Since D4 framing has 12 frames per super-frame and the 24th channel signaling sequence is 24 frames long, it would not normally be conducive to 24th channel signaling. But, the ANN-11 uses a unique signaling arrangement which provides 24th channel signaling. (See the table following this paragraph.) Bits 1 and 2 in the 24th channel provide 2-state signaling for each of the other 23 transmission channels. Bit 8 in the 24th channel alternates between 0 and 1 with each super-frame to allow emulation of the 24-frame 24th channel signaling sequence. This arrangement provides twenty-three 64-kbps transmission channels with D4 framing and can only be used between System 85s.

D4 FRAMING WITH 24th CHANNEL SIGNALING (SPANNING 2 SUPERFRAMES)										
FRAME NO.	CHANNEL TIME SLOT USE IN EACH FRAME									
	CHS. 1-23 BITS 1-8	24th CHANNEL BITS (NOTE)								
		1	2	3	4	5	6	7	8
1	Traffic	A-13	A-1	X	X	X	0	1	0
2	Traffic	A-14	A-2	X	X	X	0	1	0
3	Traffic	A-15	A-3	X	X	X	0	1	0
4	Traffic	A-16	A-4	X	X	X	0	1	0
5	Traffic	A-17	A-5	X	X	X	0	1	0
6	Traffic	A-18	A-6	X	X	X	0	1	0
7	Traffic	A-19	A-7	X	X	X	0	1	0
8	Traffic	A-20	A-8	X	X	X	0	1	0
9	Traffic	A-21	A-9	X	X	X	0	1	0
10	Traffic	A-22	A-10	X	X	X	0	1	0
11	Traffic	A-23	A-11	X	X	X	0	1	0
12	Traffic	1	A-12	X	X	X	0	1	0
13	Traffic	A-1	A-13	X	X	X	0	1	1
14	Traffic	A-2	A-14	X	X	X	0	1	1
15	Traffic	A-3	A-15	X	X	X	0	1	1
16	Traffic	A-4	A-16	X	X	X	0	1	1
17	Traffic	A-5	A-17	X	X	X	0	1	1
18	Traffic	A-6	A-18	X	X	X	0	1	1
19	Traffic	A-7	A-19	X	X	X	0	1	1
20	Traffic	A-8	A-20	X	X	X	0	1	1
21	Traffic	A-9	A-21	X	X	X	0	1	1
22	Traffic	A-10	A-22	X	X	X	0	1	1
23	Traffic	A-11	A-23	X	X	X	0	1	1
24	Traffic	A-12	1	X	X	X	0	1	1

Note: A-nn—Per-channel signaling bit for channel nn (1.5-msec update). X—Don't care.

Line Coding

In order to insure adequate timing recovery in regenerative digital facilities, a "ones density" criteria must be met. The terminal equipment must not transmit more than 15 "zeroes" in a row and in each and every time window, of 8 X (n + 1) bits (where n can = 1 through 23), there should be at least n "ones" present. System 85 meets this requirement by using either Bipolar with 8 Zero Substitution (B8ZS) or Zero Code Suppression (ZCS) line coding.

Bipolar With 8 Zero Substitution (B8ZS)

B8ZS replaces any eight consecutive zeroes to be transmitted on the DS-1 bit stream with the B8ZS code. If the pulse preceding the inserted code is transmitted as positive pulse (+), the inserted code is 000+-0-+. If the pulse preceding the inserted code is negative (-), the inserted code is 000-+0+-. Bipolar violations always occur in the fourth and seventh bit positions. The incoming DS-1 bit stream is continually monitored to detect B8Zs code words and, when detected, replaces it with eight "zeroes" (AT&T Compatibility Bulletin No. 144 "Clear Channel Capability"). With this coding arrangement, clear 64-kbps channels can be supported and still meet the ones density requirement for regenerative digital facilities. However, the digital facilities must be checked to insure that bipolar violations can be passed. Line repeaters will not typically pass bipolar violations, in which case B8ZS cannot be used.

Zero Code Suppression (ZCS)

ZCS is the most predominant line coding used. If any 8-bit time slot contains all "zeroes", bit 2 is changed from a "zero" to a "one" (AT&T Compatibility Bulletin No. 119). This is not significant in PCM voice transmission, but would obviously cause errors in digital data. Therefore, only digital data formats which do not allow time slots containing eight "zeroes" may be used. Digital Communications Protocol (DCP) formatted data meets this criteria for data rates from 300 bps to 19.2 kbps, 56 kbps, and restricted 64 kbps. The restricted 64 kbps is used for switched 515 BCT transmission to a remote AP16 with SDCP interface. The High Level Data Link Control (HDLC) format is inverted for this application to meet the ZCS criteria for full 64 kbps data rates.

System 85 DS-1 Signaling

The DS-1 interface can be administered in either of two modes of signaling, 24th channel signaling or robbed-bit signaling.

In the robbed-bit signaling mode, all 24 channels are used as trunks with certain bits on the channels used for signaling. Each of the 24 trunk channels can be used for voice connections, analog voiceband data connections, or ACCUNET* Switched 56-kbps Service. The maximum analog voiceband data rate supported is 9.6 kbps. Voiceband data also requires data sets or modem pool resources.

In the 24th channel signaling mode, 23 channels are used as trunks and the 24th channel is used for signaling. Since the 23 channels have no bits robbed for signaling, the integrity of their 64-kbps data streams are preserved. This allows 64-kbps transmission of digital data.

Trunk Assignments

A trunk channel which supports voice, DCP formatted digital data calls, and analog voiceband data calls is referred to as Alternate Voice Data (AVD); AVD trunks may also be referred to as data-grade trunks. A trunk channel which supports voice calls and analog voiceband data calls only is referred to as voice grade. A DS-1 interface using 24th channel signaling can have both AVD and voice-grade trunks assigned to the 23 possible trunk channels. A DS-1 interface using robbed-bit signaling can have only voice grade trunks or ACCUNET Switched 56-kbps Service assigned to the 24 trunk channels. DS-1 AVD and voice-grade trunks may be assigned in any manner that analog tie trunks, CO trunks, FX trunks, OPS, and WATS trunks may be assigned. For example, trunks on the same DS-1 pack may be assigned to separate trunk groups, assuming the physical terminations permit this, or a number of the trunks may be assigned to a dummy trunk group. All of the route selection functionality of Automatic Alternate Routing (AAR) and Automatic Route Selection (ARS) is available with DS-1 AVD and voice-grade trunks.

Care must be taken not to mix voice-grade and AVD trunk groups in the same routing patterns. For a data call, the decision to use a modem pool is based on the type of trunk requested, not the type of trunk provided by the system. Using an access code for an AVD trunk to make a digital data call from a DCP connected terminal instructs the System 85 not to provide a modem pool resource. If a voice-grade trunk is provided because of mixed trunk to trunk group or routing pattern assignments, the data call cannot be established as no modem pool resource will be allocated.

* Registered service mark of AT&T.

Physical Connectivity

Overview

The System 85 DS-1 interface conforms to DSX-1 standards (AT&T PUB 62411). The DS-1 carrier houses up to two ANN-11 circuit packs. A standard 50-pin connector, manufactured by Amphenol Products, accessible at the back of the switch cabinet housing the carrier is used for each DS-1 interface to mate with a special connecting cable. The connecting cable is 606-type (ABAM) which provides 6 pairs (send pair, receive pair, and four unused pairs*) of 22 AWG wire which are shielded and jacketed. Connecting cables are used to interface to Channel Service Units (Figure 2-24), Transmission Terminal Products (CDM and CEM), and colocated System 85s equipped with DS-1.

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* One of these unused pairs may be used to provide a contact closure loopback signal from the DS-1 pack to the equipment it connects to. The signal indicates that the equipment should loopback the send to receive pair from the DS-1 pack for demand tests initiated via a maintenance procedure.

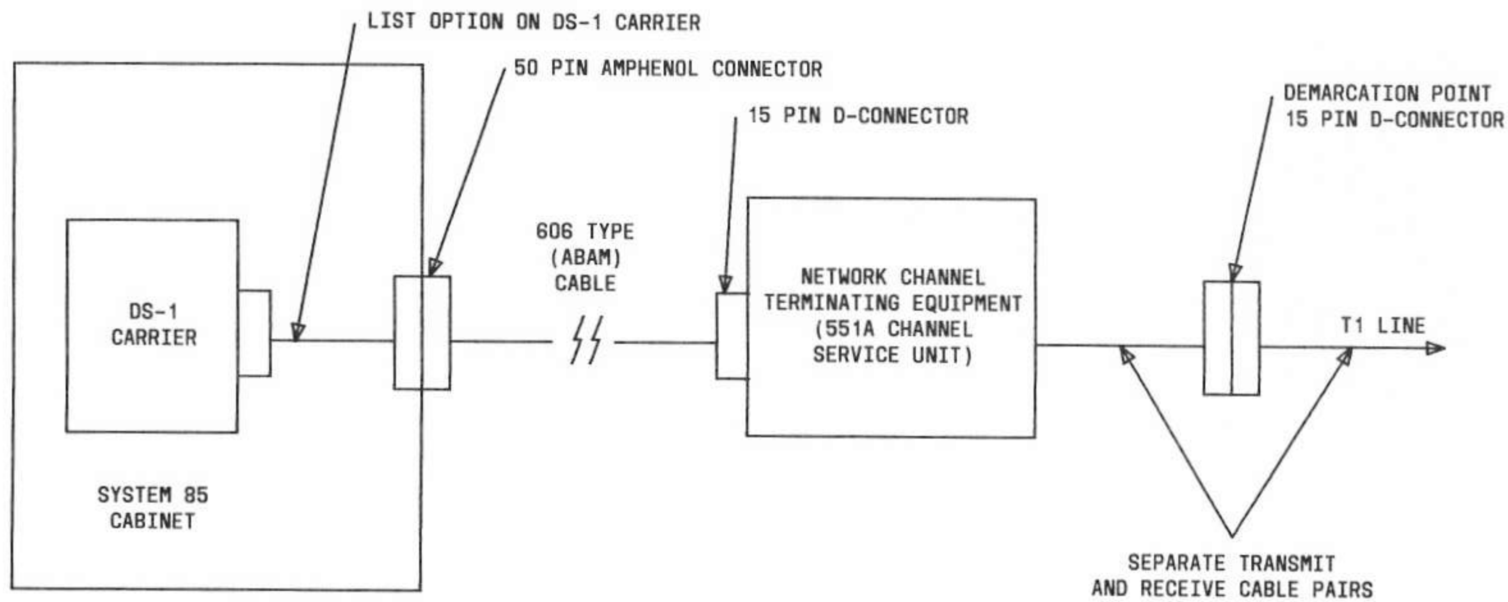


Figure 2-24. DS-1 Physical Connectivity

Equalizer Settings and Distance Limitations

The DS-1 circuit pack (ANN-11) has option switches to select one of five transmit equalizer settings. The equalizer setting required is based on the distance along the 606-type cable connection from the System 85 DS-1 connector to a specified point. The equalizers provide preconditioning of the transmit signal so that the DS-1 pulse shape falls within defined boundaries at a common specified point.

A DIP switch on the ANN-11 provides equalizer settings for distances up to 655 feet (200 meters):

S2	S1	S0	DISTANCE TO SPECIFIED POINT
L	L	H	0 to 133 ft. (0 to 41 m)
L	H	L	133 to 266 ft. (41 to 81 m)
L	H	H	266 to 399 ft. (81 to 122 m)
H	L	L	399 to 532 ft. (122 to 162 m)
H	L	H	532 to 655 ft. (162 to 200 m)

The Transmission Terminal Products also have equalizer settings for distance to a common specified point. For direct cabling between units (System 85 DS-1 to CDM, System 85 DS-1 to colocated System 85 DS-1, etc.), the specified point may be anywhere on the span between the units (midpoint is recommended) as long as distance limitations are not exceeded. If a cross-connect field is interposed on the span between units, the cross-connect field should be used as the common specified point for equalizer settings.

```
                            Specified Point for
                             Equalizer Setting

Unit:                                 |                    Unit:
System 85--------X--------            |--------Y--------CDM, CEM, or
DS-1                                  |                    System 85 DS-1
```

Cable Distance X is used for equalizer setting of Unit 1.
Cable Distance Y is used for equalizer setting of Unit 2.

When using direct cable to connect a System 85 DS-1 interface to a Channel Service Unit (CSU) without equalizer settings, the cabling distance to the CSU should be used for the ANN-11 equalizer setting. With an interposed cross-connect field, the cabling distance from the ANN-11 to the cross-connect field may be used for the equalizer setting if the cable length from the cross-connect field to the CSU is less than 50 feet.

```
                                    Specified Point for
                                     Equalizer Setting

                                             |
System 85------------X------------           |----Y----Channel
                                             |         Service
                                             |         Unit
```

Cable distance X is used for System 85 DS-1 equalizer setting.
Cable distance Y must be less than 50 feet.

DS-1 Interface Signal Lead Assignment

The following table lists the signal lead assignments for the cable interface associated with the DS-1 circuit pack. The DS-1 pack may be placed in slot 05 or 18 of the DS-1 Carrier. This connector is designated D04 for slot 05 and D12 for slot 18.

USE		D04 OR D12 CONNECTOR PIN NUMBER	LEAD DESIGNATION
Receive	Ring-Line In	26	LIN
Pair	Tip-Line In	1	LIP
	-	27	LI75
	-	2	-
		28	LON75
	-	3	LOP75
	-	29	LON120
Transmit	Tip-Line Out	4	LOP120
Pair	-	30	-
	Ring-Line Out	5	LON
Loopback	Loopback Signal	31	LBACK2
Signal Pair	Loopback Signal	6	LBACK1

Facility Interface

System 85 DS-1 interfaces used for interbuilding or interlocation connectivity must terminate to engineered facilities providing suitable signal levels and protection.

System 85 DS-1 used with T-Carrier type offerings from Local Area Transport Access (LATA) providers must terminate to Network Customer Terminal Equipment (NCTE) such as the 551A Channel Service Unit (CSU). The NCTE is not provided as part of the T-Carrier facility and must be provided by AT&T-IS, the customer, or another vendor.

The Federal Communications Commission (FCC) is currently reviewing registration and tariffing of high-speed digital transport services such as T-Carrier. Several NCTE units currently have grandfathered status.

The NCTE used to terminate System 85 DS-1 which interfaces to facilities providers must meet DSX-1 signal level requirements. The following must also be taken into consideration:

- Loop current—the facilities provider may use a 40-milliamp or 140-milliamp circuit to power critical circuitry including regenerators, keep alive alarms, and line loopback which must be supported by the NCTE.
- Loopback signaling—the facilities provider may request loopback capabilities in the NCTE to the facility initiated by separate pair or inband signaling.
- Signal level—Line build-out requirements are specified by the facilities provider.
- Impedance Matching—the cable section connecting the Network interface to the NCTE may be either of two types specified by the facilities provider. Type 1 is .083uF per mile capacitance, nonloaded, staggered twist, paired exchange-type cables. The characteristic impedance of this type cable at 772 kHz is nominally 100 ohms, ranging from roughly 90 to 110 ohms. Type 2 is .064uF per mile capacitance, nonloaded, staggered twist, paired exchange type cables. The characteristic impedance of this type cable at 772 kHz is nominally 120 ohms, ranging from roughly 115 to 125 ohms.

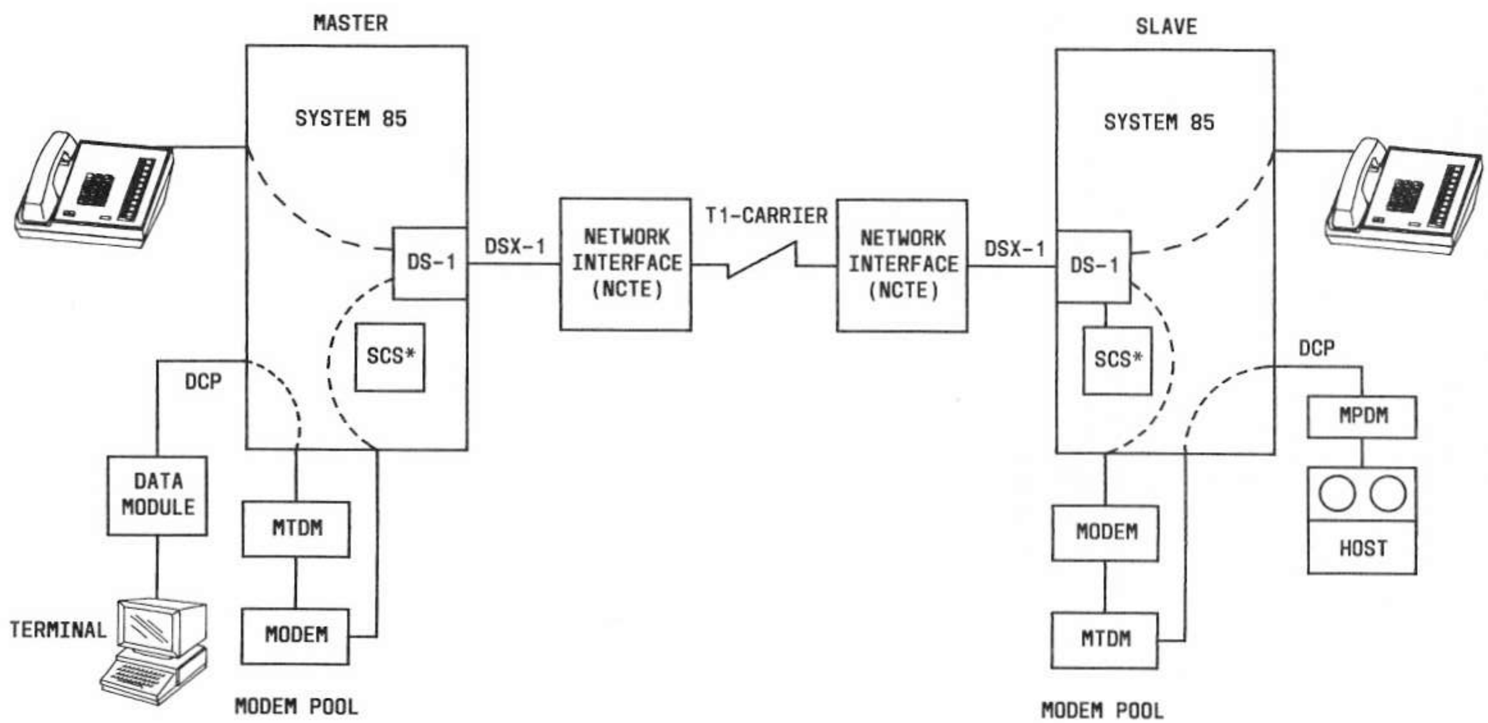
Colocated System 85 Interface

System 85 DS-1 may be used to provide digital tie-trunks between System 85s located in the same building. Intervening equipment such as repeaters or channel service units are not required. Direct connectivity can be provided up to a maximum of 1310 feet.

Digital Switch Connectivity

DS-1 may be used to interconnect System 85s with either 24th channel or robbed-bit signaling to provide voice-grade and/or AVD trunks (Figures 2-25 and 2-26).

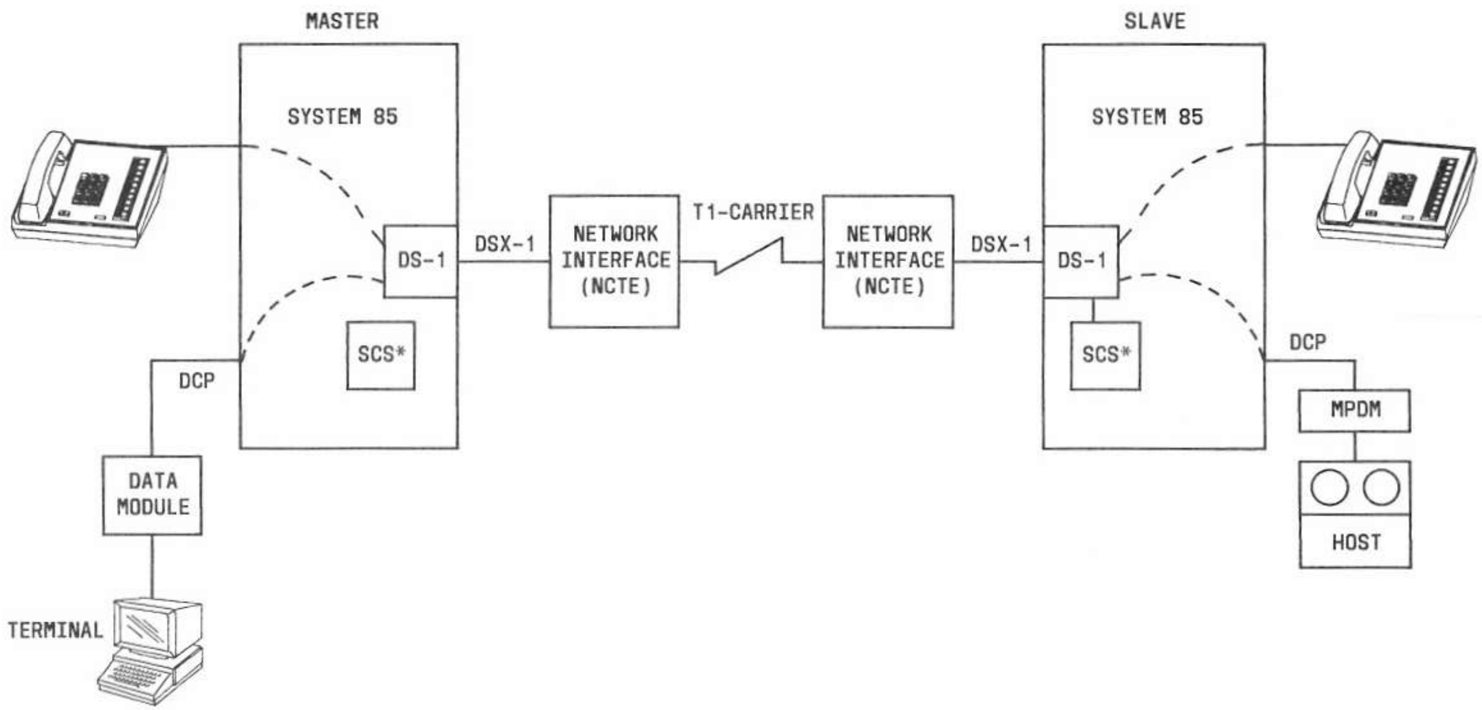
DS-1 may also be used to connect to other vendor digital switches with certain restrictions. When connecting to other vendor DS-1 or T-Carrier compatible interfaces, robbed-bit signaling and voice-grade trunks must be used on System 85. AVD and 24th channel signaling trunks cannot be used with other vendor switch interfaces. The other vendor interface must be D4 framing and signaling compatible. The other vendor digital switch must also be able to supply timing to the System 85 (if it is a master) or be able to derive timing from the System 85 (if it is a slave). This may or may not be possible, depending on the other vendor switch clock accuracy (Figure 2-27).



*CLOCK SYNCHRONIZATION IS REQUIRED

NCTE – NETWORK CHANNEL TERMINATING EQUIPMENT
E.G. CHANNEL SERVICE UNIT

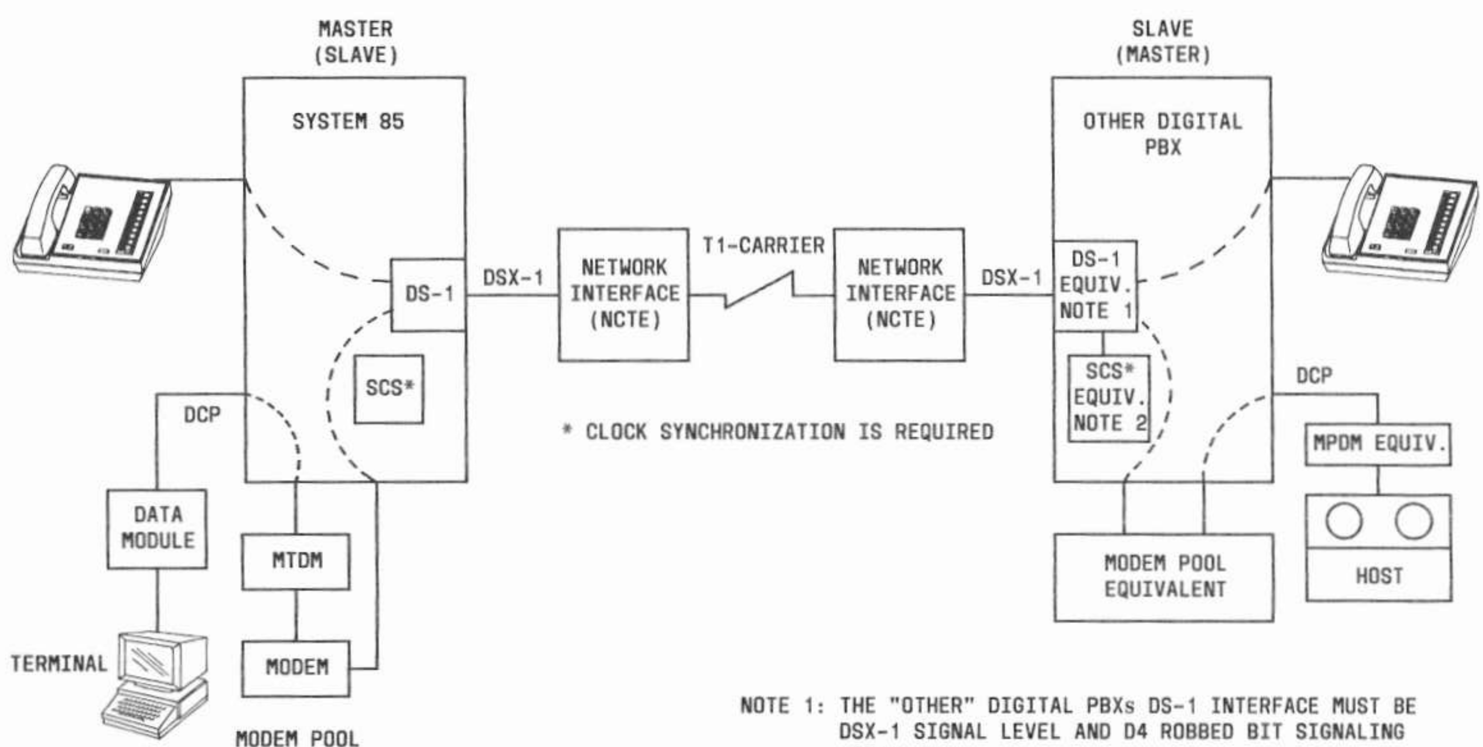
Figure 2-25. Voice Grade DS-1



*CLOCK SYNCHRONIZATION IS REQUIRED

NCTE – NETWORK CHANNEL TERMINATING EQUIPMENT
E.G. CHANNEL SERVICE UNIT

Figure 2-26. AVD DS-1



NCTE – NETWORK CHANNEL TERMINATING EQUIPMENT
E.G. CHANNEL SERVICE UNIT

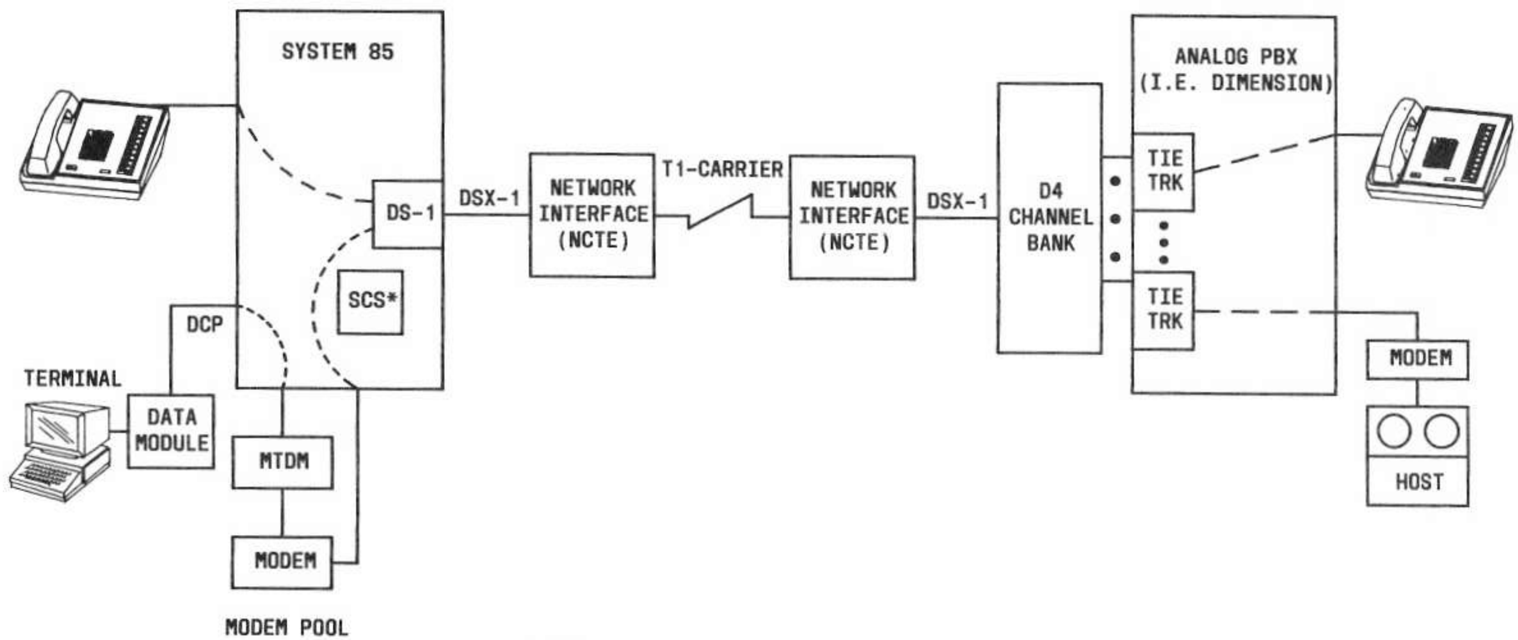
NOTE 1: THE "OTHER" DIGITAL PBXs DS-1 INTERFACE MUST BE DSX-1 SIGNAL LEVEL AND D4 ROBBED BIT SIGNALING COMPATIBLE.

NOTE 2: THE "OTHER" PBX MUST BE ABLE TO SUPPLY TIMING FROM THE SYSTEM 85 (IF IT IS MASTER) OR BE ABLE TO DERIVE TIMING FROM THE SYSTEM 85 (IF IT IS SLAVE). THIS MAY OR MAY NOT BE POSSIBLE DEPENDING ON THE OTHER PBXs CLOCK ACCURACY. SEE AT&T COMPATIBILITY BULLETIN #147 AND AT&Ts EIA SPEC FOR PBXs #PN1429 (DRAFT) SECTION ON SYNCHRONIZATION FOR REQUIREMENTS ON THE "OTHER" PBX.

Figure 2-27. DS-1 to Other Vendor Digital Switch

Analog Switch Connectivity

DS-1 may be used in conjunction with analog to digital conversion transmission products for connectivity to other switches providing analog trunk interfaces. In this arrangement, robbed-bit signaling and voice-grade trunks must be used to interface to a terminal product such as the D4 Channel Bank which is DSX-1 signal level and D4 robbed-bit signaling compatible (see Figure 2-28).



*CLOCK SYNCHRONIZATION IS RECOMMENDED

NCTE – NETWORK CHANNEL TERMINATING EQUIPMENT
E.G. CHANNEL SERVICE UNIT

Figure 2-28. DS-1 to Analog Switch

Multiplexer Connectivity

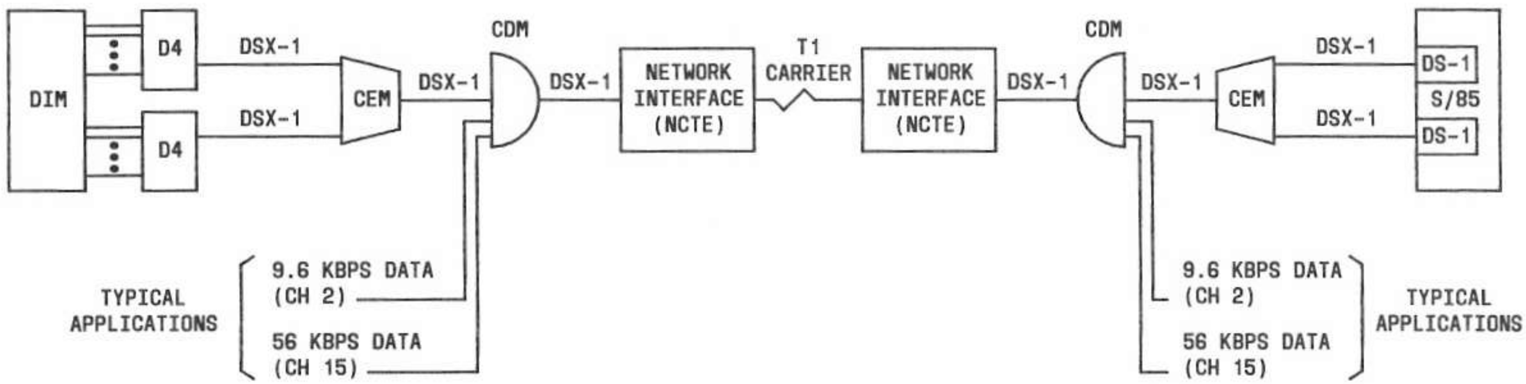
The Channel Expansion Multiplexer (CEM) and Channel Division Multiplexer (CDM) in combination with the System 85 DS-1 trunk interface provide extremely flexible arrangements to optimize voice and both switched and point-to-point data networks.

The CEM employs a new signal processing technique which results in a significantly more efficient digital representation of Pulse Code Modulated voice or voiceband data transmission. It provides a 2 to 1 compression of voiceband channels which allows up to 48 channels of voiceband transmission at 32 kbps per channel to pass over a single DS-1 interface. Two DS-1 interfaces with 24 channels each can pass through the CEM and exit with a single DS-1 interface. Voice quality on a compressed channel at 32 kbps is still subjectively equivalent to that at 64 kbps, and voiceband data transmission up to 4.8 kbps can be supported. The CEM can selectively compress channels so that full 64-kbps uncompressed channels from either of the two DS-1 inputs can be mixed with compressed voiceband channels on the DS-1 output. Each uncompressed channel, however, takes up 2 of the 48 possible 32-kbps channels on the output.

The CDM provides a means to individually input digital transmission channels onto a DS-1 interface. A 24th Channel Signaling DS-1 interface from System 85 may only require 15 of the 23 possible trunk channels. The DS-1 interface from System 85 may be passed to a CDM where the eight unused channels may be allocated to equipment requiring nonswitched point-to-point connectivity.

Care must be exercised when using CDMs and CEMs in conjunction with System 85 DS-1. With 24th Channel Signaling, the 24th channel used for signaling and any AVD trunk channels used for DCP formatted digital data transmission (no data sets or modem pool employed) require full 64-kbps channels and may not be compressed in the CEM. Only voice-grade trunks should be compressed in the CEM. Trunk assignments on System 85 DS-1 channels must be coordinated with CEM channel compressions and CDM channel assignments so as to insure duplicated channel assignments or unwanted compression is avoided (see Figure 2-29).

D4 – D4 CHANNEL BANK
CDM – CHANNEL DIVISION MULTIPLEXER
CEM – CHANNEL EXPANSION MULTIPLEXER



NCTE – NETWORK CHANNEL TERMINATING EQUIPMENT
E.G. CHANNEL SERVICE UNIT

DIM – DIMENSION PBX

S/85 – SYSTEM 85

Figure 2-29. DS-1 and Transmission Terminal Products

Digital Multiplexed Interface (DMI)

DMI provides multichannel digital connectivity between AT&T Information Systems products and host computers; it is available for use by other vendors via license agreements. DMI is based on 1.544-Mbps T-carrier and provides 23 data channels of 64 kbps capacity with a 64-kbps channel reserved for signaling.

When compared to other System 85 DS-1 offerings, DMI is very similar to the 23-Alternate Voice/Data channel tie trunk offering. Both use DS-1 to carry 23 channels plus one signaling channel. The difference is that the DMI is always terminated on a computer which means all 23 channels carry data; the DMI specification has no provision for voice.

Another way of looking at DMI functionality is to say that it is the equivalent of 23 MPDMs. This can be said since DMI uses the same data channel protocol as DCP; DCP is the protocol used by the MPDM. In a typical application involving a System 85 and a 3B5, a single DMI link could directly replace up to 23 General Purpose Port (GPP) to MPDM links between the System 85 and the 3B5. If a DMI link to another host is also established, 64-kbps data channels between hosts can be established by using the switch to connect DMI channels (see Figure 2-30).

Like a GPP-to-MPDM link, a DMI data channel can be accessed through the switch by either analog or digital data endpoints. If analog endpoints are used, the Modem Pooling feature is required.

System 85 implements DMI with the ANN-11C circuit pack. It supports the same line coding and framing mode options as DS-1. B8ZS line coding should be used whenever possible. DMI requires 24th channel signaling to provide 23 DCP formatted data channels. DMI channels are administered on the switch as one of two types of trunks:

- DMI with wink-in/auto-out (dial-repeating)
- DMI with wink-in/wink-out.

DMI obtains synchronization from the switch while the host operates in loop-timing mode with the switch. DMI facilities may not be used to supply synchronization to the switch.

This version of the DMI uses Bit-Oriented Signaling as described in the main body of the DMI technical specification. Message-Oriented Signaling is not available at this time.

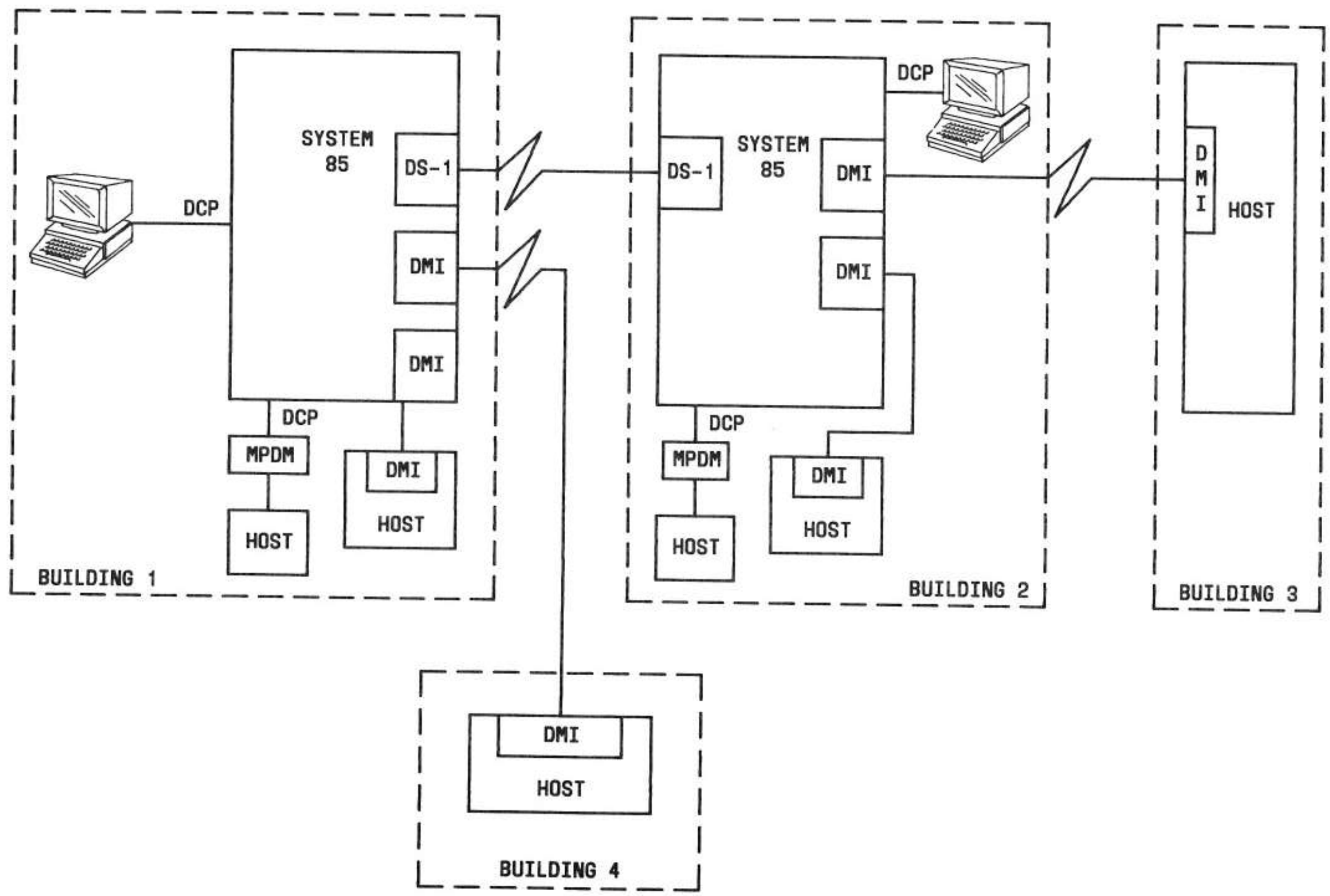


Figure 2-30. Typical DMI Application

Synchronization

An accurate network clock is crucial for error-free operation of a digital switch. The digital switch uses the network clock to provide error-free timing signals for the many concurrent and sequential operations required to switch digital voice and data.

The network clock must be able to synchronize to an external timing source when interfacing to high-speed digital facilities such as DS-1. And it must be able to provide satisfactory stand-alone accuracy if an external synchronization source is lost or the network clock is to be the synchronization source for other digital systems.

When two pieces of digital equipment using high-speed digital interfaces communicate, they must be able to synchronize so that no bits will be lost. Without synchronization, the clock frequencies of two systems may be slightly different and sets of bits referred to as frames may occasionally be repeated or deleted. When a frame is deleted or repeated, it is called a slip. Slips degrade voice quality and cause errors in data or signaling information. Here are two examples which show how slips happen:

Example: If System A's clock frequency causes 10,000 bits to be sent to System B in 1 second and System B's clock frequency allows only 9,999 bits to be received in 1 second, a slip, or frame deletion, in System B will occur. Since System 85 packages bits in buffered frames and only complete frames are accepted, a frame will be lost.

Example: If System A sent 10,000 bits and System B tried to receive 10,001 bits, a frame would be repeated in System B.

> ***Note:*** The bit rates for these examples are much lower than those actually used. These examples are purely illustrative and not intended to imply actual bit rates or error probabilities.

A repeated or deleted frame has little effect on the quality of a voice call. Repeating or deleting whole frames is better than sending a partial frame since doing so produces annoying clicks. Where slips really cause trouble is with digital data or signaling information since the loss or repetition of a frame will corrupt the intelligence of the information. This is why synchronization is essential.

Synchronization for System 85 is handled by the TN-463 System Clock Synchronizer. This circuit is required whenever DS-1 is used with System 85. The TN-463 resides in the TMS carrier for multimodule switches or in the Module Control carrier for single-module switches.

For more information about synchronization, refer to **AT&T-IS Network and Data Services—Reference Manual** (555-025-201).

Information System Network (ISN)

AT&T Information Systems Network (ISN) provides high-speed data communications links between devices in a multistation data processing environment. System 85 can be linked to an ISN system on the same premise to provide integrated access to the data communications devices on both systems.

The main component of ISN is the Packet Controller which, among other things, establishes connections between devices served by ISN. Devices connect to the Packet Controller through interface modules such as the Fiber Interface Module or the EIA Asynchronous Interface Module (AIM). Interface modules can be located in the Packet Controller or housed in an ISN Concentrator. A fiber-optic cable connects Concentrators to the Packet Controller carrying multiplexed data to and from the devices connected to Concentrators. Each Concentrator uses statistical multiplexing to concentrate up to 40 channels into an 8.64-Mbps data stream.

ISN Connectivity

The basic link between System 85 and ISN is an EIA connection between an SN-238 quad EIA port in System 85 and a Z3A Asynchronous Data Unit (ADU) connected to an Asynchronous Interface Module (AIM) in the ISN. The EIA connection establishes a 1-way trunk, which must be set for 300; 1,200; 2,400; 4,800; 9,600; or 19,200 bps; autobauding is not provided. The AIM can be located in either a Concentrator which connects to the Packet Controller by optical fiber or in the ISN Packet Controller.

If the Packet Controller is located in another room or another building, a Concentrator is placed in a System 85 Auxiliary cabinet and a fiber-optic cable is run to the ISN Packet Controller in the other location. If the ISN Packet Controller is located in the same room with the System 85 equipment, the two systems are directly linked by EIA connections.

Once the System 85—ISN link is established:

- The System 85 modem pooling feature provides connectivity between ISN endpoints and remote endpoints accessed through System 85 CO trunks, WATS trunks, FX trunks, DID trunks, APLT trunks, tie trunks, and ETN trunks.

- End-to-end digital connectivity with ISN endpoints is provided for endpoints which are served either directly by the local System 85 switch or by a remote System 85/75 with DS-1 trunks to the local System 85.

3. SYSTEM HARDWARE

OVERVIEW

This section describes the System 85 switch hardware within the following major areas of coverage:

- Basic Switch Cabinets
- System Cabinet Configurations
- Cabinet Equipment
- Carriers
- Circuit Packs
- System Interconnections
- Switch Equipment Code Summary.

BASIC SWITCH CABINETS

The following basic hardware units can be used to configure a System 85 digital switch:

- Unduplicated Common Control Cabinet (J58886J)
- Duplicated Common Control Cabinet (J58886K)
- Time-Multiplexed Switch (TMS)/Remote Module Interface (RMI) Cabinet (J58886F)
- Module Control Cabinet (J58886B)
- Port Cabinet (J58886C)
- Remote Group Housing (J58889AN).

Unduplicated Common Control Cabinet (J58886J)

An Unduplicated Common Control Cabinet (see Figure 3-1) provides a standard reliability common control for the digital switch. This cabinet contains the following equipment:

- An unduplicated alarm panel
- A total of up to three port and/or DS-1/MFAT carriers
- One common control carrier
- A dc fan assembly with frequency generator
- A high capacity mini-recorder
- One dc/dc converter unit
- A bus bar.

In standard ac-powered systems, this cabinet is equipped with a battery reserve unit (dedicated to the common control carrier for nominal holdover) and a dc filter for -48 V power from an adjacent Module Control Cabinet.

In cost-reduced ac-powered systems, this cabinet is equipped with an ac distribution unit, bulk Off-Line-Switcher (OLS) power supply, and OLS battery reserve unit mounted at the bottom. The dc/dc converter unit and mini-recorder are moved up and mounted under the fan assembly.

In systems powered from a standby power plant, this cabinet is equipped with a standby power dc filter for two -48 V power sources.

If all carrier positions are equipped in the cabinet, an ED-1E430-70,G2 thermal sensor assembly is equipped as part of the alarm panel; otherwise, an ED-1E430-70,G1 thermal sensor assembly is placed above the topmost carrier. One Unduplicated Common Control Cabinet is required in an unduplicated common control system.

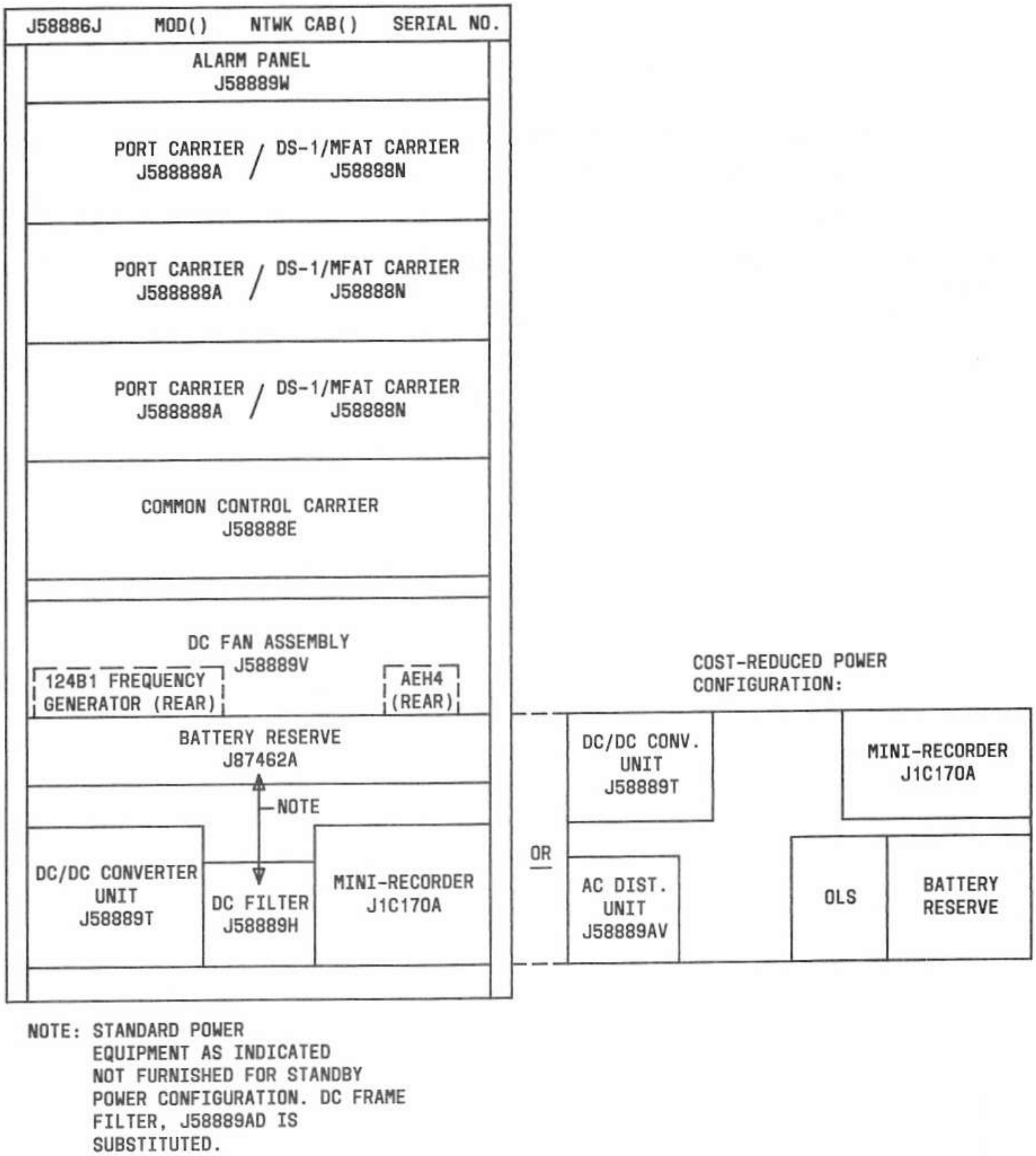


Figure 3-1. Unduplicated Common Control Cabinet (J58886J)

Duplicated Common Control Cabinet (J58886K)

A Duplicated Common Control Cabinet (see Figure 3-2) provides a high reliability common control for the digital switch. This cabinet contains the following equipment:

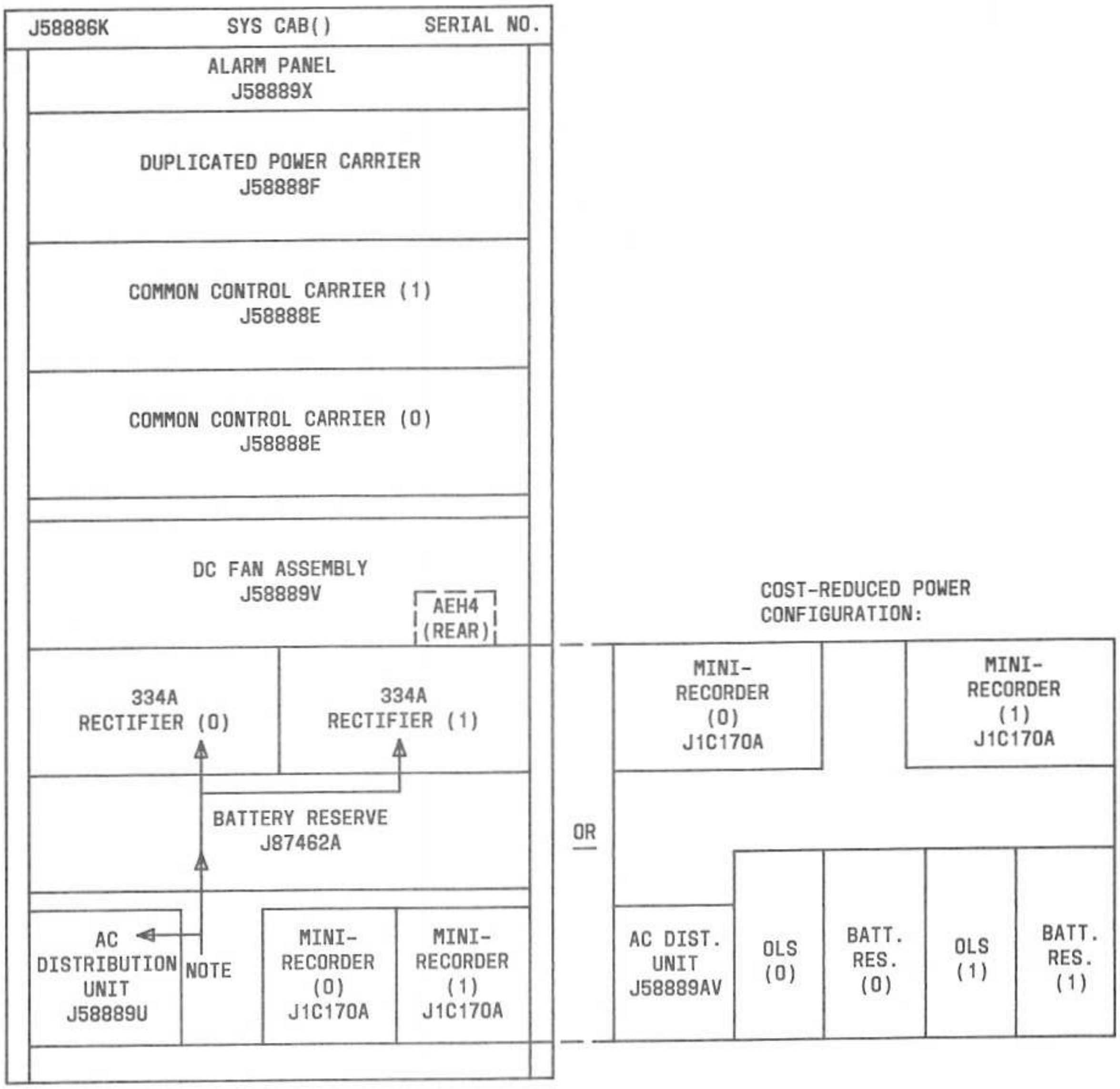
- A duplicated alarm panel and thermal sensor assembly
- Two common control carriers
- One power carrier
- A dc fan assembly and alarm board
- Two high capacity mini-recorders
- A bus bar.

In standard ac-powered systems, this cabinet is equipped with an ac distribution unit, two 334A rectifiers, and a battery reserve unit (dedicated to the common control carriers for nominal holdover).

In cost-reduced ac-powered systems, this cabinet is equipped with an ac distribution unit, two bulk Off-Line-Switcher (OLS) power supplies, and two OLS battery reserve units mounted at the bottom. The two mini-recorders are moved up and mounted under the fan assembly.

In systems powered from a standby power plant, this cabinet is equipped with a standby power dc filter for two -48 V power sources.

One Duplicated Common Control Cabinet is required in either a duplicated common control system or fully duplicated common control system.



NOTE: STANDARD POWER EQUIPMENT AS INDICATED NOT FURNISHED FOR STANDBY POWER CONFIGURATION. DC FRAME FILTER, J58889AD IS SUBSTITUTED.

Figure 3-2. Duplicated Common Control Cabinet (J58886K)

Time-Multiplexed Switch (TMS)/Remote Module Interface (RMI) Cabinet (J58886F)

The TMS/RMI Cabinet (see Figure 3-3) is used only in multimodule systems. It contains the following equipment:

- A thermal sensor assembly
- A total of up to four TMS basic, TMS growth, and/or RMI carriers
- A dc fan assembly and alarm board
- A bus bar.

In standard ac-powered systems, this cabinet is equipped with an ac distribution unit and 334A rectifier(s). One 334A rectifier is equipped for each two cabinet carriers. If duplicated TMS carriers or an RMI carrier containing duplicated interfaces to the same remote module are housed in the cabinet, two 334A rectifiers are equipped as standard. An optional battery reserve unit can be accommodated for the 334A rectifier(s).

In cost-reduced ac-powered systems, this cabinet is equipped with an ac distribution unit, bulk Off-Line-Switcher (OLS) power supply, and OLS battery reserve unit mounted at the bottom. If duplicated TMS or RMI carriers are housed, a second bulk OLS power supply and battery reserve are equipped as standard equipment.

In systems powered by a standby power plant, this cabinet is equipped with a standby power dc filter for two -48 V power sources.

In the unduplicated TMS configuration, there is one basic TMS carrier. It accommodates the circuitry and connectivity for up to seven modules. There also may be up to three growth TMS carriers, each accommodating the connectivity for 8 additional modules (up to a total of 31). This configuration includes up to two no-carrier adapters (ED-1E444) in the middle carrier positions if unoccupied, or up to three RMI carriers. Each RMI carrier accommodates the interfaces for 8 remote modules with duplicated TMS and module controls or 16 remote modules with unduplicated TMS and module controls.

In a duplicated TMS configuration, there may be two basic carriers, a no-carrier adapter, and one RMI carrier. If there are no remote modules, this arrangement can be expanded to two basic and two growth TMS carriers. In the maximum duplicated TMS configuration, two cabinets are provided—each containing one basic carrier and two or three growth carriers. Both cabinets must be located adjacent to each other, and both must contain the same number of growth carriers. Growth carriers must be installed in the same cabinet with their associated basic carrier.

If required, a third TMS/RMI Cabinet may be provided for RMI carriers exclusively. In a system equipped with remote modules, a TMS/RMI cabinet may contain up to four RMI carriers, as required. A maximum of two RMI carriers are provided for a system with unduplicated common controls. A maximum of four RMI carriers are provided for a system with duplicated TMS and module controls.

The number of TMS/RMI Cabinets required in a multimodule system is dependent on the number of (basic and growth) TMS and RMI carriers to be equipped in the switch. The maximum number of TMS/RMI Cabinets is 2 per system with duplicated TMS, 31 modules, and no remote modules; or 3 per system with duplicated TMS, 31 modules (with one to 30 remote modules), and RMI carriers.

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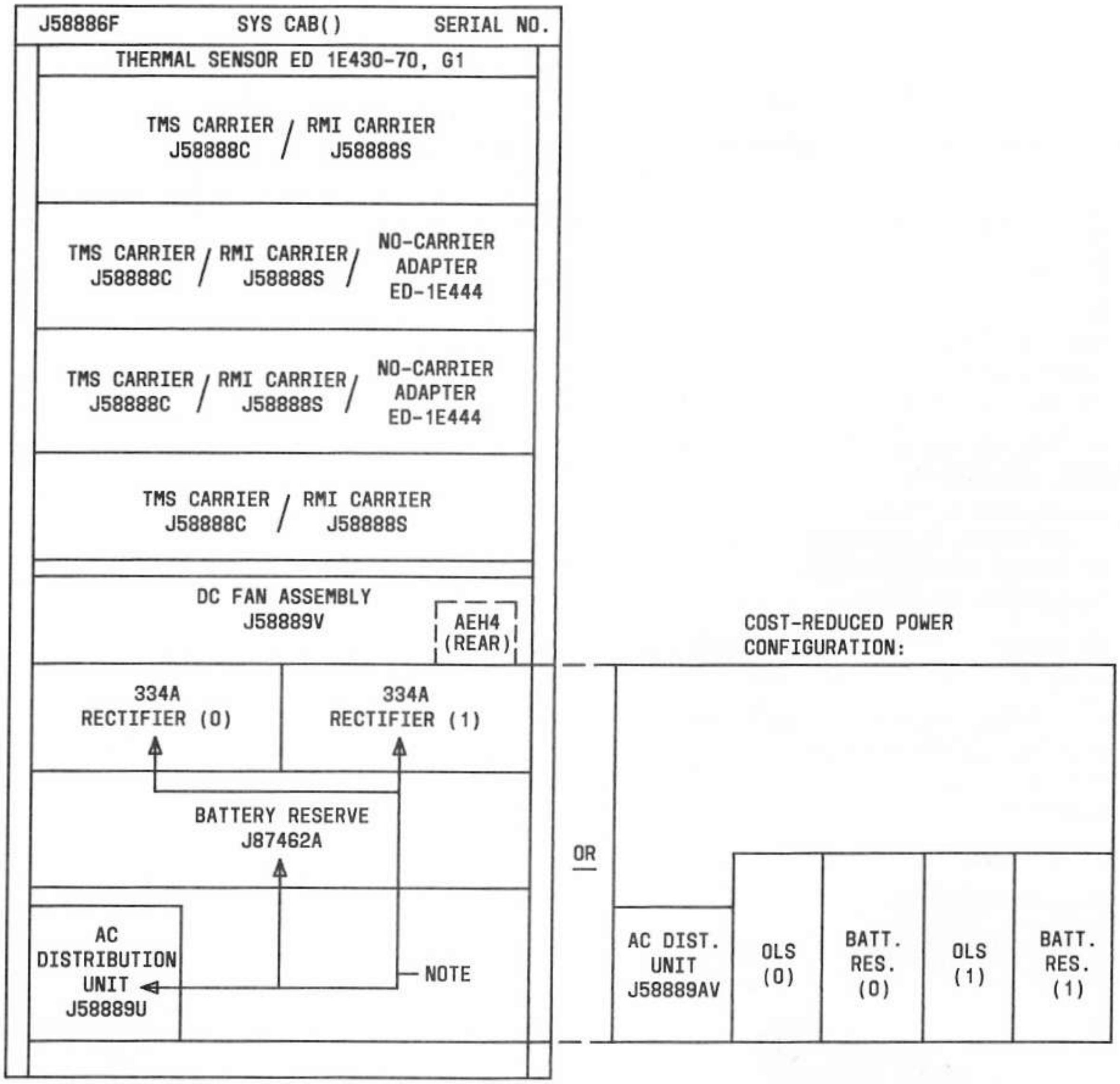


Figure 3-3. Time Multiplexed Switch/Remote Module Interface Cabinet (J58886F)

Module Control Cabinet (J58886B)

The Module Control Cabinet (see Figure 3-4) houses module control and port circuits. It contains the following equipment:

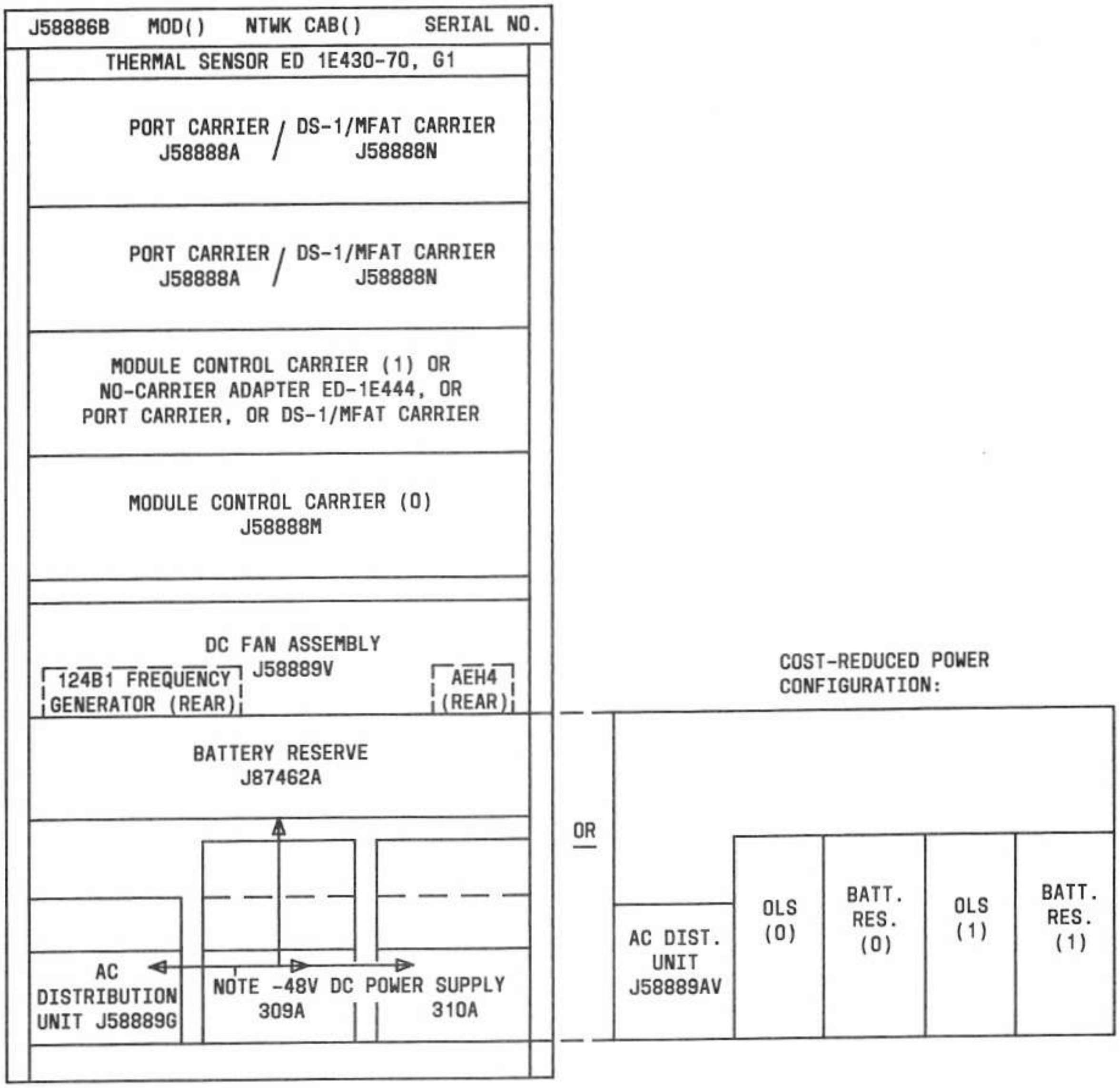
- A thermal sensor assembly
- One module control carrier and one no-carrier adapter for an unduplicated module control or two module control carriers for a duplicated module control
- A total of up to three port and/or DS-1/MFAT carriers. (Note: The DS-1 carrier cannot be installed in the bottom carrier position.)
- A dc fan assembly with frequency generator
- A bus bar.

In standard ac-powered systems, this cabinet is equipped with an ac distribution unit and 309A/310A -48 V rectifier. An optional battery reserve unit can be accommodated. In this configuration, the cabinet can supply -48 V power to an adjacent Unduplicated Common Control Cabinet or to a Port Cabinet without a -48 V rectifier.

In cost-reduced ac-powered systems, this cabinet is equipped with an ac distribution unit, bulk Off-Line-Switcher (OLS) power supply, and optional OLS battery reserve unit(s) mounted at the bottom. If duplicated module control carriers are housed, a second bulk OLS power supply is equipped as standard equipment. If an unduplicated module control carrier and more than two MFAT/DS-1 carriers are housed, a second bulk OLS power supply is equipped as standard equipment.

In systems powered from a standby power plant, this cabinet is equipped with a standby power dc filter for a -48 V power source.

One Module Control Cabinet is required per module. This cabinet, with the Remote Module Interface (RMI) circuitry and interconnections, may also serve as a module control in a remote module system configuration (refer to SYSTEM CABINET CONFIGURATIONS in this section).



NOTE: STANDARD POWER
EQUIPMENT AS INDICATED
NOT FURNISHED FOR STANDBY
POWER CONFIGURATION. DC FRAME
FILTER, J58889AD IS
SUBSTITUTED.

Figure 3-4. Module Control Cabinet (J58886B)

Port Cabinet (J58886C)

The Port Cabinet (see Figure 3-5) houses carriers which contain port circuits. It contains the following equipment:

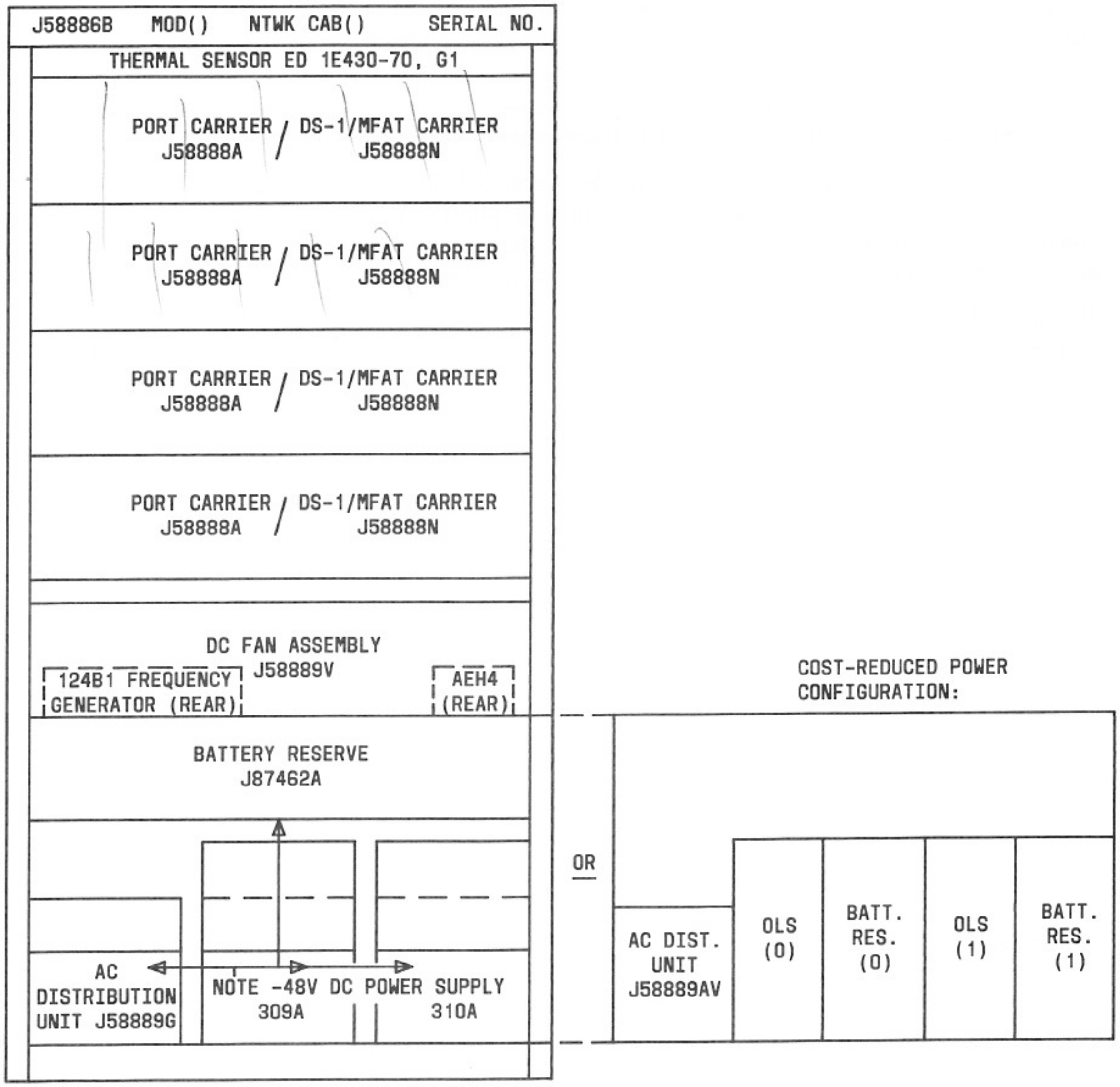
- A thermal sensor assembly
- A total of up to four port and/or DS-1/MFAT carriers
- A dc fan assembly with frequency generator
- A bus bar.

In standard ac-powered systems, this cabinet is equipped for one of two power arrangements. When equipped with an ac distribution unit and 309A/310A -48 V rectifier, this cabinet can supply -48 V power to an adjacent Port Cabinet without a -48 V rectifier. An optional battery reserve unit can be accommodated. When equipped with a dc filter only, this cabinet receives -48 V power from an adjacent Module Control Cabinet or Port Cabinet equipped with a -48 V rectifier.

In cost-reduced ac-powered systems, this cabinet is equipped with an ac distribution unit, bulk Off-Line-Switcher (OLS) power supply, and OLS battery reserve unit mounted at the bottom. If three or more carriers with double-density hybrid port circuit packs (ANN17B) are housed or if cabinet power requirements exceed 30 amperes, a second bulk OLS power supply and battery reserve are equipped as standard equipment.

In systems powered from a standby power plant, this cabinet is equipped with a standby power dc filter for a -48 V power source.

The number of Port Cabinets required is dependent on the number of port and DS-1/MFAT carriers to be equipped in the modules. This cabinet, with the proper interconnections, may also be used to house port interface circuits in a remote module system configuration (refer to SYSTEM CABINET CONFIGURATIONS in this section).



NOTE: STANDARD POWER EQUIPMENT AS INDICATED NOT FURNISHED FOR STANDBY POWER CONFIGURATION. DC FRAME FILTER, J58889AD IS SUBSTITUTED.

Figure 3-5. Port Cabinet (J58886C)

Remote Group Housing (J58889AN)

The Remote Group Housing (see Figure 3-6), though not a full-size Port Cabinet, is a basic switch hardware unit that houses port interface circuits in a remote group system configuration (refer to SYSTEM CABINET CONFIGURATIONS in this section). Similarly to a cabinet, this unit also provides fan cooling, power rectification, and thermal detection (with over-temperature shutdown capability) to support the equipment within. An inverter circuit provides ringing current for the port interfaces. This housing (installed at the remote location) may be mounted in an Auxiliary Cabinet, wall-mounted, or set on a table or shelf. Both nominal holdover and long-term battery reserve capabilities are optional.

When mounted in an Auxiliary Cabinet, the Remote Group Housing is powered through the cabinet -48 V rectifier or by an external battery plant. The dc-dc converter in the housing converts this input voltage to the low-level dc voltages required by the port interface circuits. For cabinet mounting, a circuit ground is required in addition to lightning ground.

When wall- or shelf-mounted, the Remote Group Housing is powered from an ac feeder protected by a dedicated customer-provided fuse or circuit breaker. No disconnect switch, ac protector cabinet, or ac load center is required.

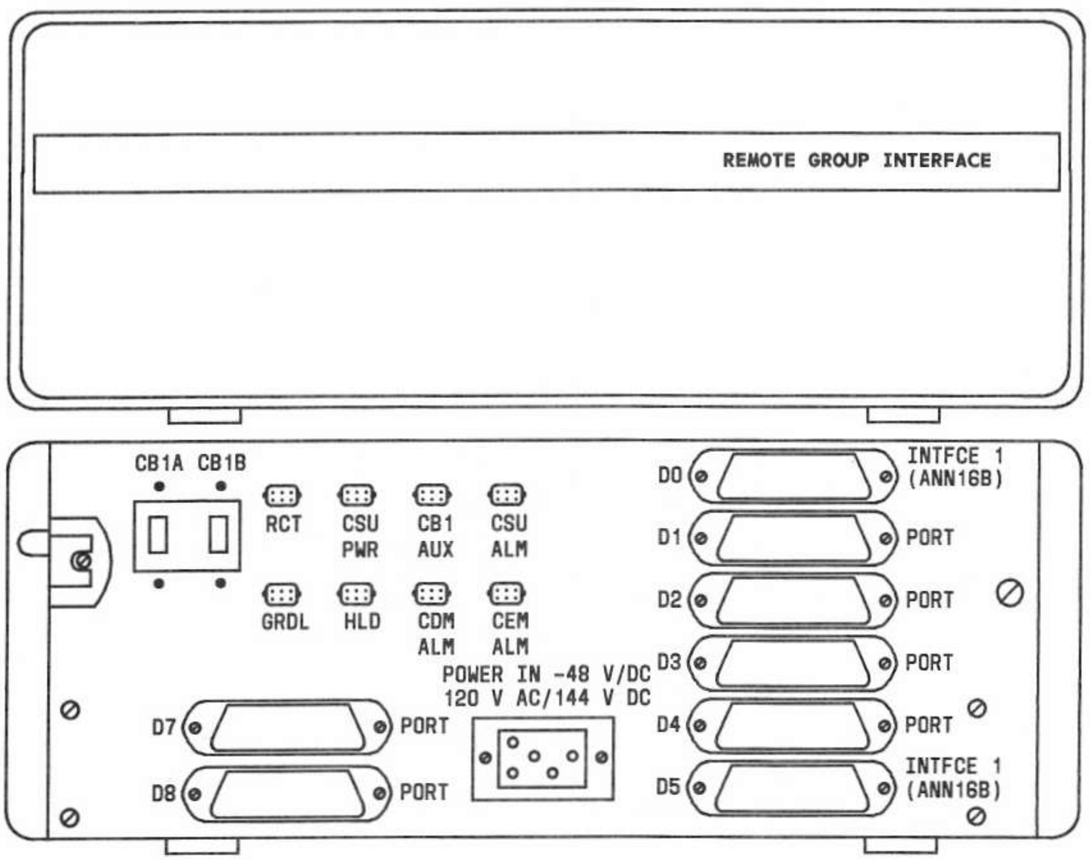


Figure 3-6. Remote Group Housing (J58889AN)

SYSTEM CABINET CONFIGURATIONS

Overview

System 85 switching and interface equipment is housed in the basic switch cabinets installed in an equipment room. Switch cabinets that can contain any port interface circuits (line, trunk, or peripheral) are referred to as Network Cabinets. Switch cabinets that contain control or switching circuitry exclusively are referred to as System Cabinets. (An exception to this rule is the unduplicated Common Control cabinet, which is always considered a Network Cabinet, with or without port or DS-1/MFAT carriers.)

Switch cabinets are configured in functional groups known as modules. A module consists of up to four Network Cabinets: a module control cabinet and up to three port cabinets. A Network Cabinet associated with a particular module houses port or DS-1/MFAT carriers for that module only. A single Network Cabinet cannot house port or DS-1/MFAT carriers associated with different modules.

A system in the basic configuration consists of a single module with one common control cabinet. A standard multimodule configuration consists of up to 15 modules, along with two System Cabinets (one duplicated common control and one TMS/RMI). An expanded multimodule configuration consists of 16 to 31 modules, along with up to four System Cabinets (one duplicated common control and up to three TMS/RMI).

The internal administrative assignments for cabinet identification within the switching system designate each cabinet with a 2-digit module identifier and cabinet identifier. Module designations range from 00 to 30 (31 modules), plus 99 for System Cabinets. The cabinet identifiers range from 0 to 3 (four cabinets per module) for module numbers 00 through 30 and module number 99. The physical carrier position designation within any cabinet is 0, 1, 2, and 3 from bottom to top.

In standard systems configured for ac power input, only certain cabinets need be equipped with rectifiers. This is dictated by physical cabinet pairing for power arrangements. In a single-module system or the first module of a multimodule system with unduplicated controls, the module control cabinet must be adjacent to the common control cabinet. Both cabinets derive power from the 309A/310A -48 V rectifier located in the module control cabinet. The TMS and duplicated common control cabinets are always equipped with 334A -48 V rectifiers for internal use only. Additional Network Cabinets are paired (one sharing rectifier power with another cabinet not housing a rectifier). A port cabinet not equipped with a -48 V rectifier must derive power from an adjacent module control cabinet or from another port cabinet with a 309A/310A rectifier. Any pair of cabinets sharing power must be associated with the same module.

In cost-reduced ac-powered systems and in systems configured for dc power input from a standby power plant, -48 V dc is fed to each cabinet individually. These arrangements are not subject to cabinet pairing restrictions for power arrangements. In these cases, the module control in a single-module system or the first module in a multimodule system should still be placed adjacent to the common control, which may still be associated with the module (housing port circuits).

System 85 can be provided in four different configurations related to system reliability. The difference between these configurations is the amount of duplication of major subsystems. These options include:

- Standard reliability—no duplication of major subsystems
- High reliability—duplicated common controls

- Critical reliability—duplicated common controls, duplicated TMS, and duplicated module control(s)
- Critical reliability with battery reserve—same as critical reliability with the addition of the long-term battery reserve option.

Two additional system configuration options—remote modules and remote groups—provide greater flexibility to basic switch interface capabilities. These options allow groups of voice and data terminals at remote locations to interface directly to the main system switch, thus making them functionally equivalent to on-premises terminals. The remote module option provides this capability at the network module level, while the remote group option provides this capability at the carrier or subcarrier level through dedicated port interfaces.

Standard Reliability Configuration

Figure 3-7 illustrates the module/cabinet/carrier layout for a standard reliability system configured with standard ac power input and optional battery reserve units for nominal holdover. The module control cabinet(s) comes equipped with one module control carrier (carrier position 0) and can accommodate up to three port and/or DS-1/MFAT carriers. However, if upgrading to duplicated controls is a serious future consideration, a carrier space (carrier position 1) can be left vacant to accommodate the subsequent addition of a second module control carrier. In this case, a total of only two port and DS-1/MFAT carriers can be accommodated in the module control cabinet(s).

The module control cabinet in a single-module system or the first module in a multimodule system must be adjacent to the common control cabinet. The common control cabinet contains port or DS-1/MFAT carriers for the first module and must derive power from this adjacent cabinet. Additional port cabinets with and without rectifiers are provided for each module as required. If RMI carriers are not required in a multimodule system, a single TMS cabinet can accommodate the TMS basic and growth carriers for a full 31-module system.

In this configuration, the TMS cabinet is a System Cabinet, while the common control cabinet, module control cabinets, and port cabinets are all Network Cabinets.

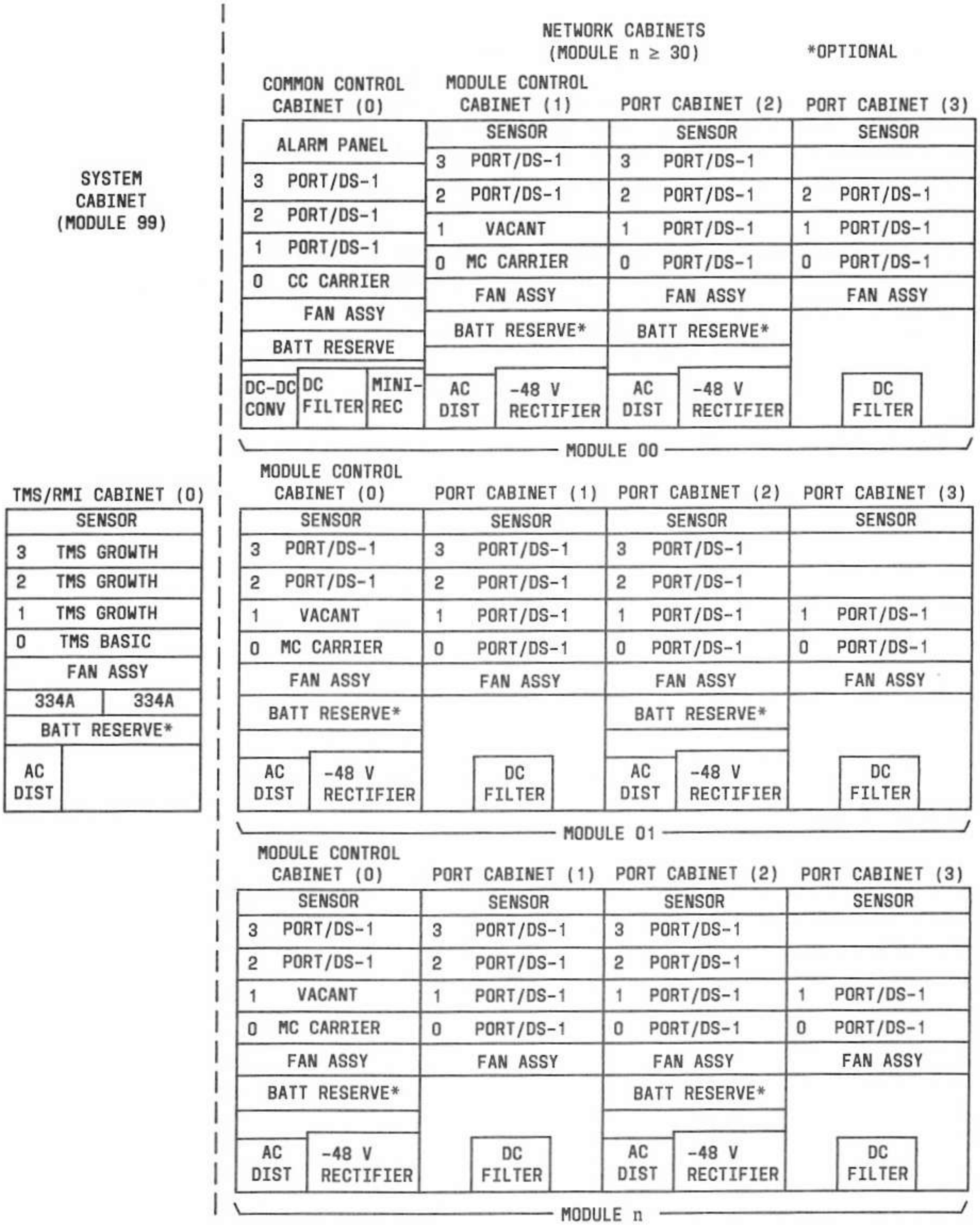


Figure 3-7. Module/Cabinet/Carrier Layout for Standard Reliability Configuration

High Reliability Configuration

Figure 3-8 illustrates the module/cabinet/carrier layout for a high reliability system configured with standard ac power input and optional battery reserve units for nominal holdover. The module control cabinet(s) comes equipped with one module control carrier (carrier position 0) and can accommodate up to three port and/or DS-1/MFAT carriers. However, if upgrading to duplicated controls is a serious future consideration, a carrier space (carrier position 1) can be left vacant to accommodate the subsequent addition of a second module control carrier. In this case, a total of only two port and DS-1/MFAT carriers can be accommodated in the module control cabinet(s).

The duplicated common control cabinet does not house port or DS-1/MFAT carriers and contains two 334A -48 V rectifiers for internal power. Additional port cabinets with and without rectifiers are provided for each module as required. If RMI carriers are not required in a multimodule system, a single TMS cabinet can accommodate TMS basic and growth carriers for a full 31-module system.

In this configuration, the duplicated common control cabinet and TMS cabinet are System Cabinets, while the module control and port cabinets are all Network Cabinets.

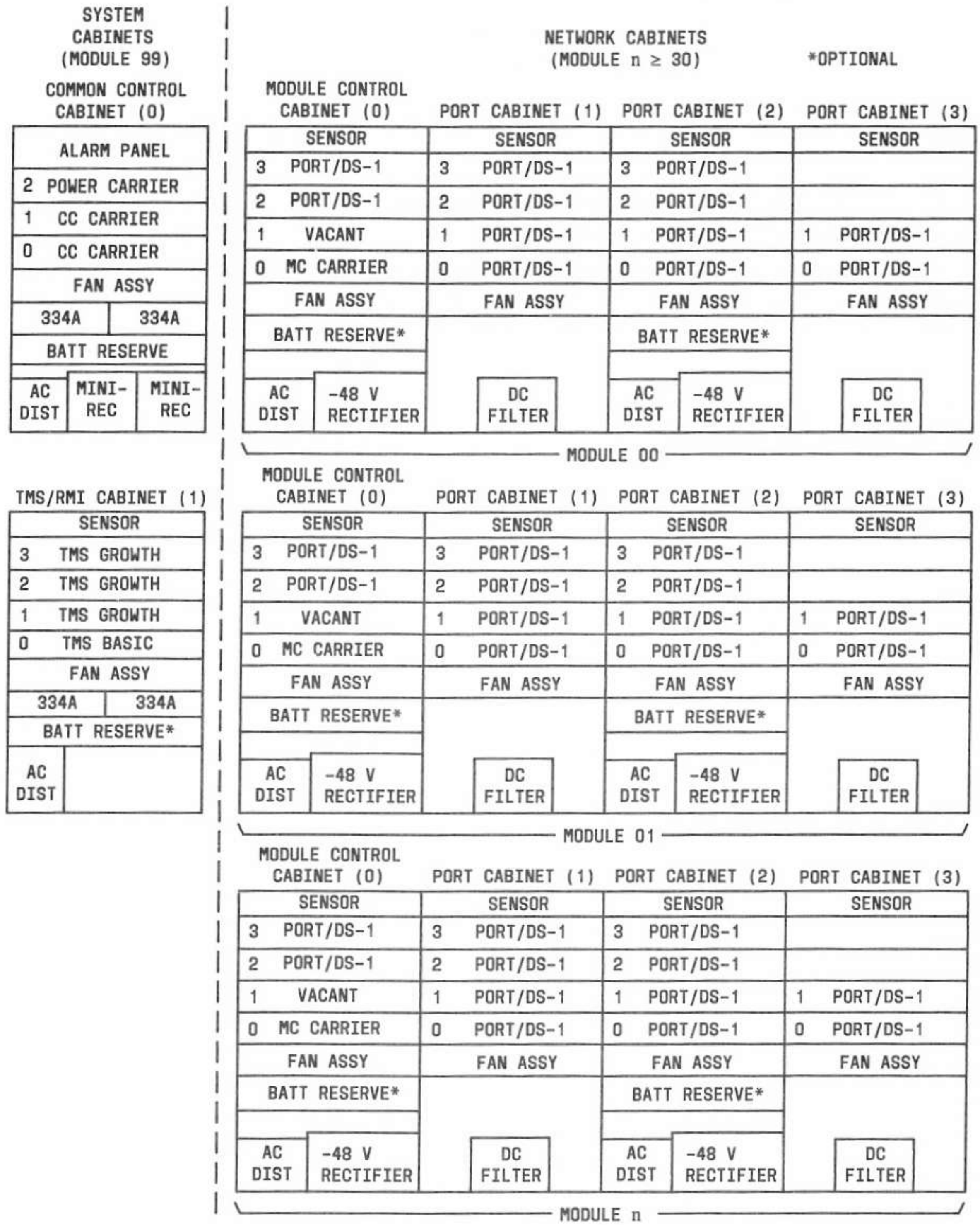


Figure 3-8. Module/Cabinet/Carrier Layout for High Reliability Configuration

Critical Reliability Configuration

Figure 3-9 illustrates the module/cabinet/carrier layout for a critical reliability system configured with standard ac power input and optional battery reserve units for nominal holdover.

The module control cabinets come equipped with two module control carriers (carrier positions 0 and 1) and can accommodate a total of two port and/or DS-1/MFAT carriers. The duplicated common control cabinet does not house port or DS-1/MFAT carriers and contains 334A -48 V rectifiers for internal power. Additional port cabinets with and without rectifiers are provided for each module as required.

If RMI carriers are not required, a single TMS cabinet can accommodate the duplicated TMS basic and growth carriers for up to 15 modules. If more than 15 modules are required, two TMS cabinets are provided—each housing one TMS basic carrier and up to three TMS growth carriers for a fully duplicated system (see Figure 3-9).

In this configuration, the duplicated common control cabinet and TMS cabinet(s) are System Cabinets, while the module control and port cabinets are all Network Cabinets.

For more detailed information on System 85 reliability, refer to Section 8, RELIABILITY.

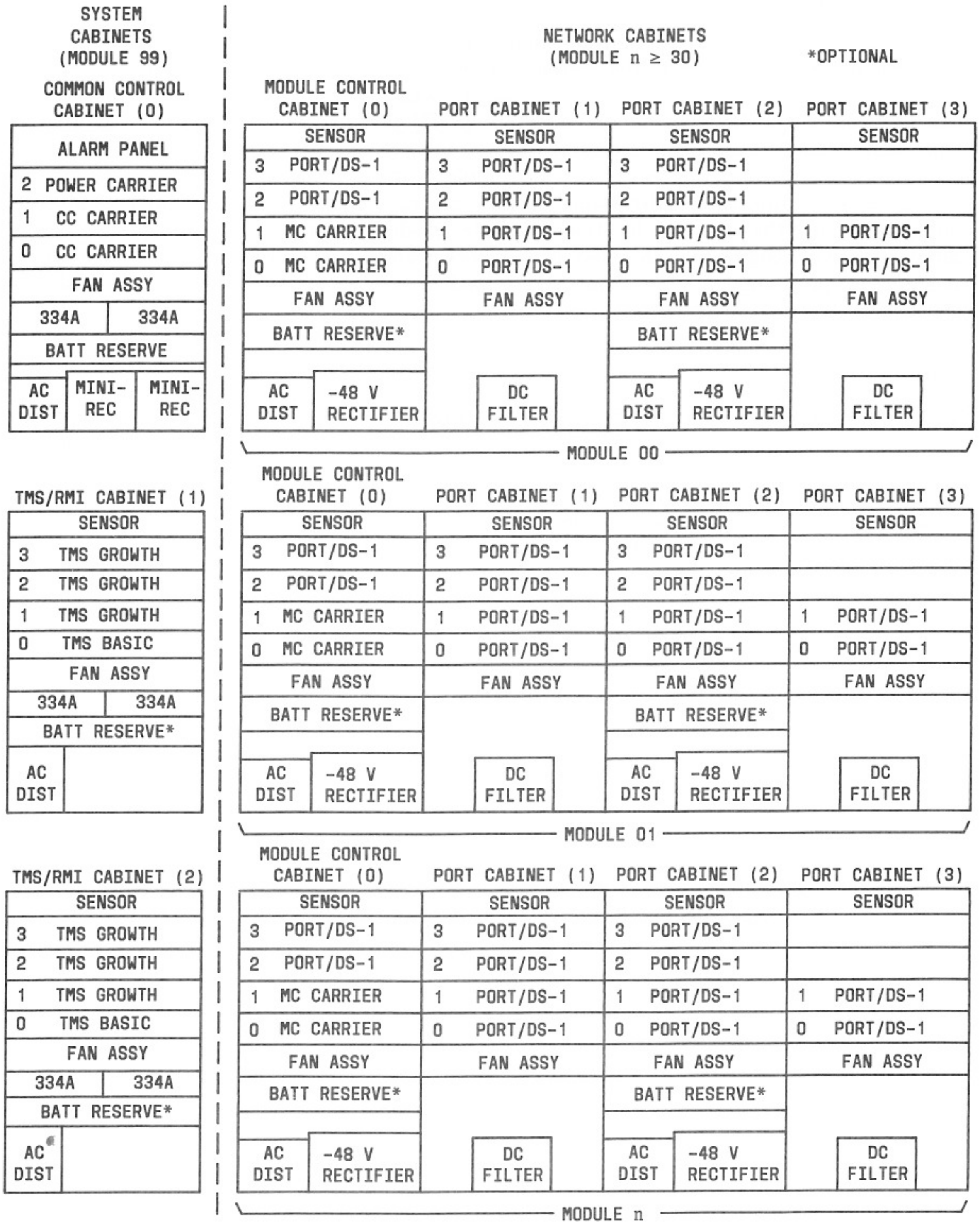


Figure 3-9. Module/Cabinet/Carrier Layout for Critical Reliability Configuration

Remote Module Configuration

The optional remote module configuration provides for one or more modules at remote locations directly connected to the system switch. Cabinets in this configuration are similar in layout and hardware to cabinets in a network module at the central switch location, with the addition of the Remote Module Interface (RMI) circuitry and interconnect equipment. The same basic reliability requirements for subsystems in the main switch cabinets (described in the preceding coverage) also apply to the remotely located cabinets in this configuration. Duplicated subsystems at the central switch location require duplicated subsystems at the remote location. Remote module cabinets have similar internal administrative assignments to those of Network Cabinets at the central switch location. System call processing functions for remote modules are performed in a manner similar to those of central switch modules.

System 85 remote modules are provided in one of two configuration options: Phase 1 and Phase 2.

In a Phase 1 remote module configuration (see Figure 3-10), an RMI circuit pack (TN456) is installed in a module control cabinet at the central location. A matching RMI circuit pack is installed in the module control cabinet at the remote location. The RMIs are directly connected by the lightguide cable interconnect terminals (LCITs) and fiber-optic link. With this configuration, the number of remote modules cannot exceed the number of modules at the central switch location. A Phase 1 system provides the ability to place up to 15 module control cabinets at one or more remote locations.

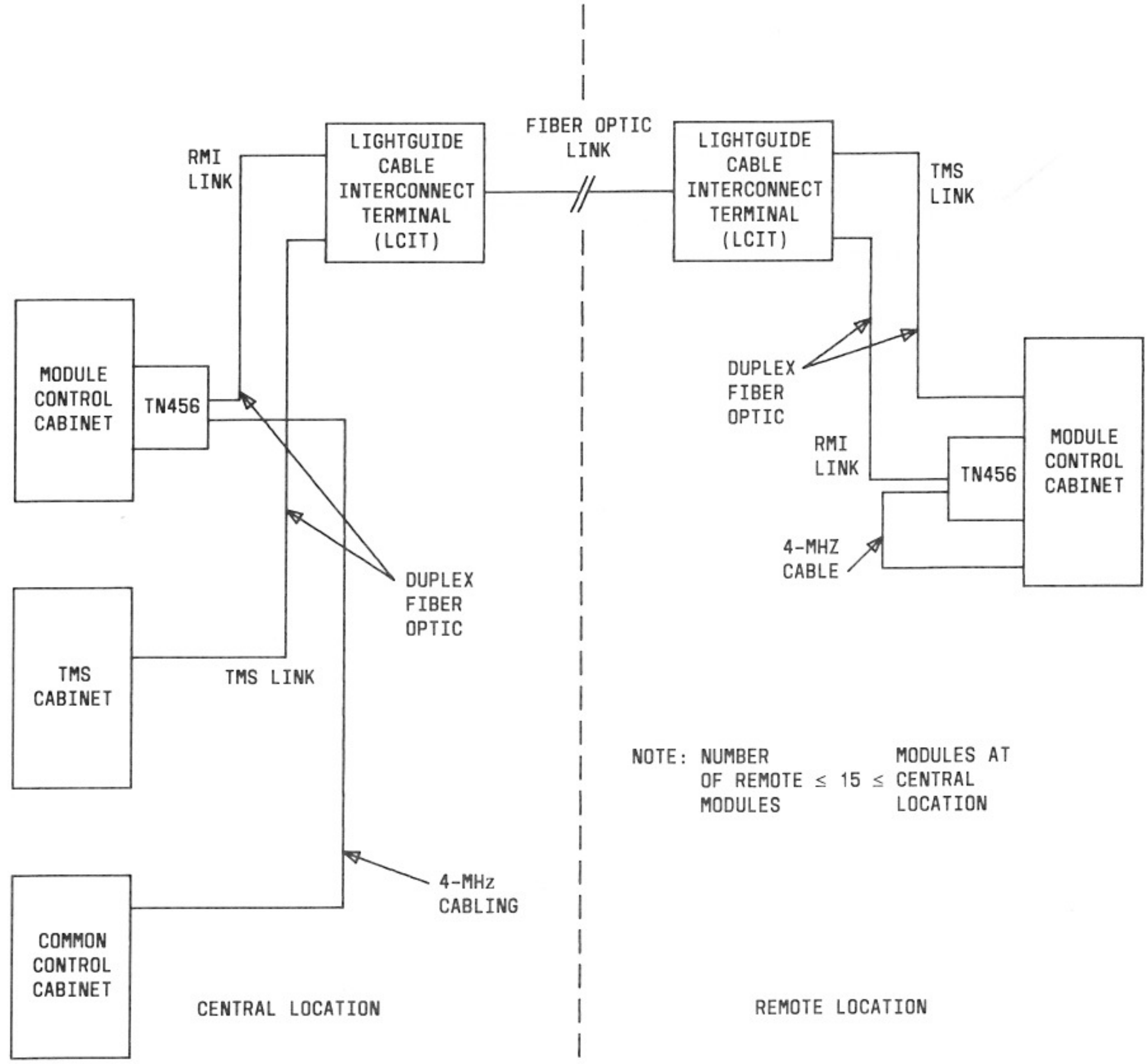


Figure 3-10. Remote Module System Configuration (Phase 1)

In a Phase 2 remote module configuration (see Figure 3-11), at least one RMI carrier is required ~~at the central switch location~~. This carrier accommodates up to 16 RMI circuit packs, thereby allowing for up to 16 unduplicated or 8 duplicated remote modules per RMI carrier. The RMI carrier(s) is housed in one or more TMS/RMI cabinets at the central location. One RMI circuit pack is installed in each module control cabinet at the remote location, thus matching each RMI circuit pack at the central location. A Phase 2 system provides up to 30 remote modules with only one central module control. A TMS/RMI cabinet housing only RMI carriers (with no TMS carriers) may be provided at the central location, if required. The Phase 2 configuration is available only with R2V2 and R2V3 systems.

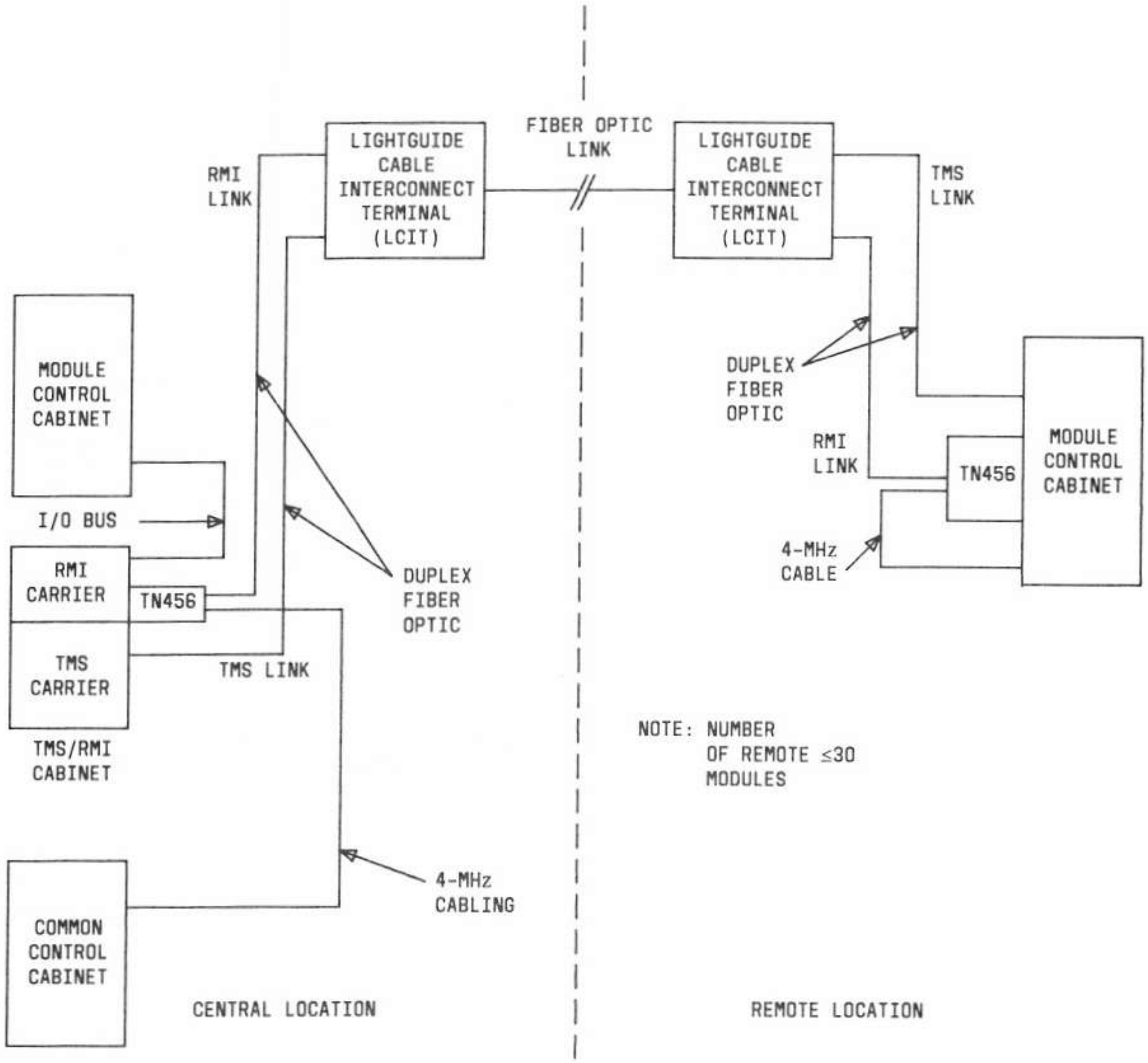


Figure 3-11. Remote Module System Configuration (Phase 2)

Remote Group Configuration

The optional remote group configuration (see Figure 3-12) provides for small groups of voice and/or data terminals at a remote location, connected directly to the system switch through DS-1 facilities. Because this configuration involves only small numbers of DS-1 port interface circuits, there are no switch cabinet considerations involved at the network module level. Remote groups are equivalent functionally to the other groups of analog, hybrid, and digital port interfaces installed within the port cabinets at the central system location. System call processing functions for remote groups are performed in a manner similar to those of ports at the central location.

Each remotely located port group is connected to a DS-1 carrier (installed in a port cabinet at the central location) through a pair of dedicated remote group interface (RGI) circuit packs. An interface circuit pack (ANN15B) in the central location DS-1 carrier is connected over the DS-1 link with an interface circuit pack (ANN16B) in the remote group housing (refer to CARRIERS in this section). Two ANN15B/ANN16B RGI pairs are accommodated per remote group housing. Each RGI circuit pack pair accommodates up to three port interface circuit packs.

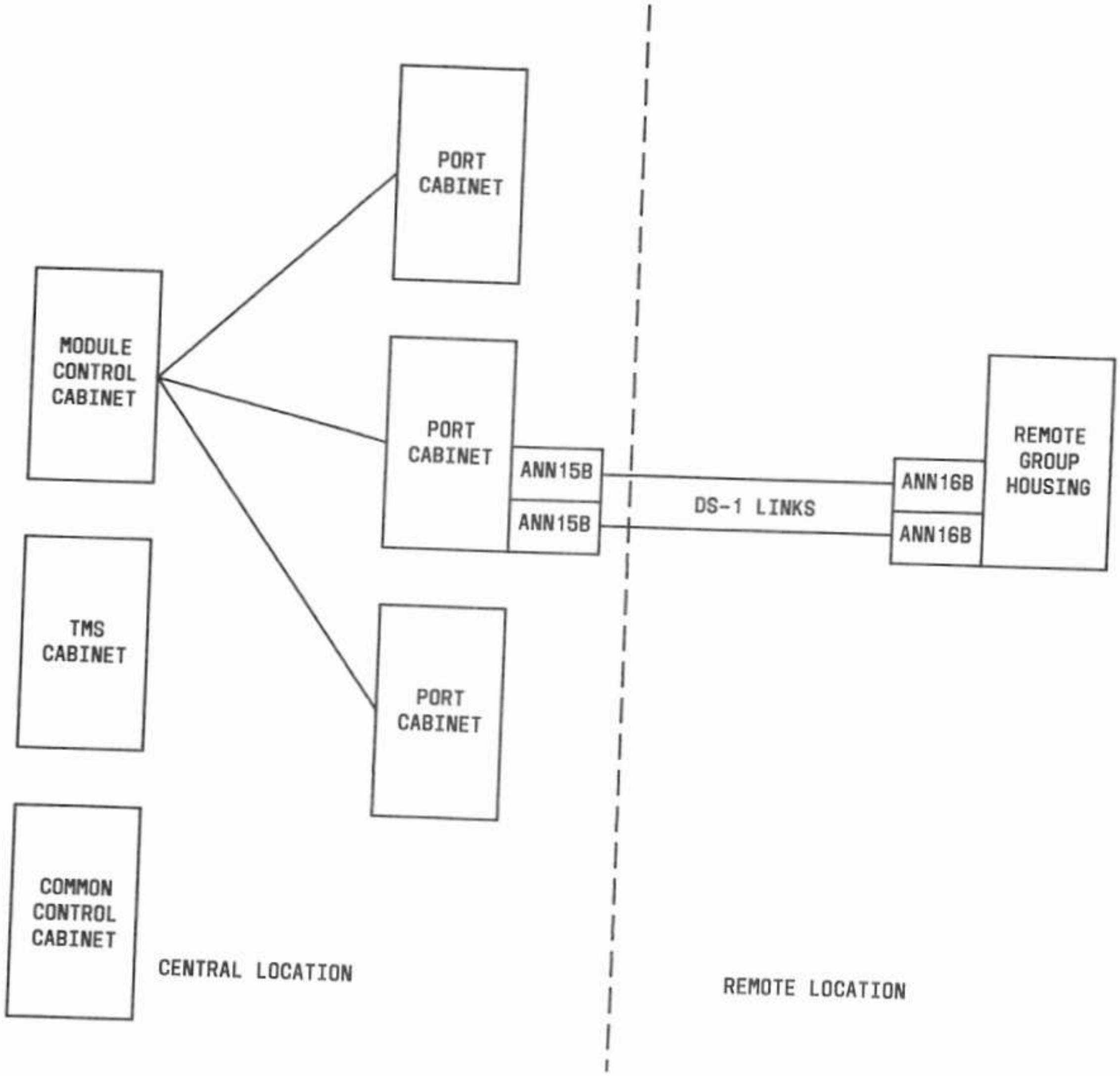


Figure 3-12. Remote Group System Configuration

CABINET EQUIPMENT

This part describes the system hardware that is housed in and associated with the basic switch cabinets. This equipment supports the essential switch circuitry in the carriers.

Alarm Panel

The alarm panel houses indicator lamps and switches used by service personnel to diagnose system faults and to monitor/control switch status. The panel provides visual indications of the state of health of the system by showing which alarms are active and which functional areas of the system are causing active alarms. Equipment failure indicators are grouped functionally by their potential importance to system operation and call processing integrity.

The alarm panel has controls for processor operation, diagnostic testing, and emergency transfer. It also provides connection for the Maintenance and Administration Panel (MAAP) and indicates (through labeled indicators) which MAAP maintenance procedure (PROC) can be invoked for diagnostic information. The panel may also be provided with an integral thermal sensor assembly (ED-1E430-70,G2) if the top carrier position of the cabinet is equipped.

Two types of alarm panels are available: the J58889W panel for the Unduplicated Common Control Cabinet (see Figure 3-13) and the J58889X panel for the Duplicated Common Control Cabinet (see Figure 3-14).

High Capacity Mini-Recorder (HCMR)

The high capacity mini-recorder (J1C170A) drives a tape cartridge which contains a copy of the programs, parameters, and translations used by the system common control. The tape cartridge contains five tracks on 150 feet (46 m) of tape. The HCMR reloads the system memory whenever power to the system is interrupted or whenever memory is lost for other reasons. In addition, the HCMR is used to load certain areas of the memory for maintenance and administration use. One HCMR is used in an Unduplicated Common Control Cabinet, while two HCMRs are used in a Duplicated Common Control Cabinet.

The HCMR contains the following replaceable circuit packs:

- SN441—Controller
- SN442—Data Electronics
- SN443—Transport Preamp
- SN445—Servo Circuit
- SN446—DC Power.

The stored program memory (J58889TM) provides the generic program magnetization and cartridge tape (KS-22754, L2).

Thermal Sensor Assembly

If all carrier positions are equipped in a cabinet, an ED-1E430-70,G2 thermal sensor assembly is equipped as part of the alarm panel; otherwise, an ED-1E430-70,G1 thermal sensor assembly is placed above the topmost carrier. The thermal sensors monitor cabinet temperatures and regulate the speed of the cabinet fans accordingly.

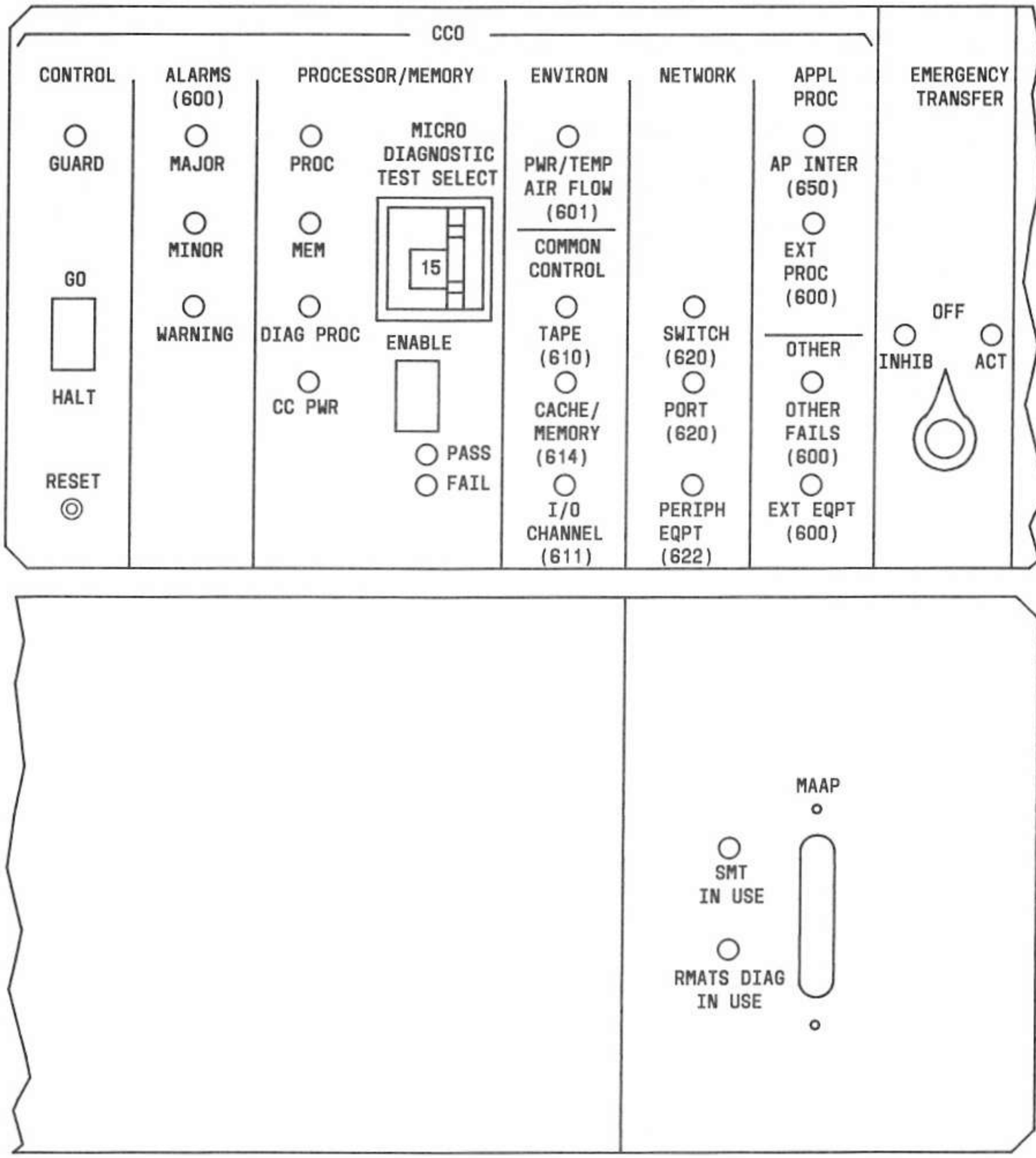


Figure 3-13. Unduplicated Common Control Alarm Panel (J58889W)

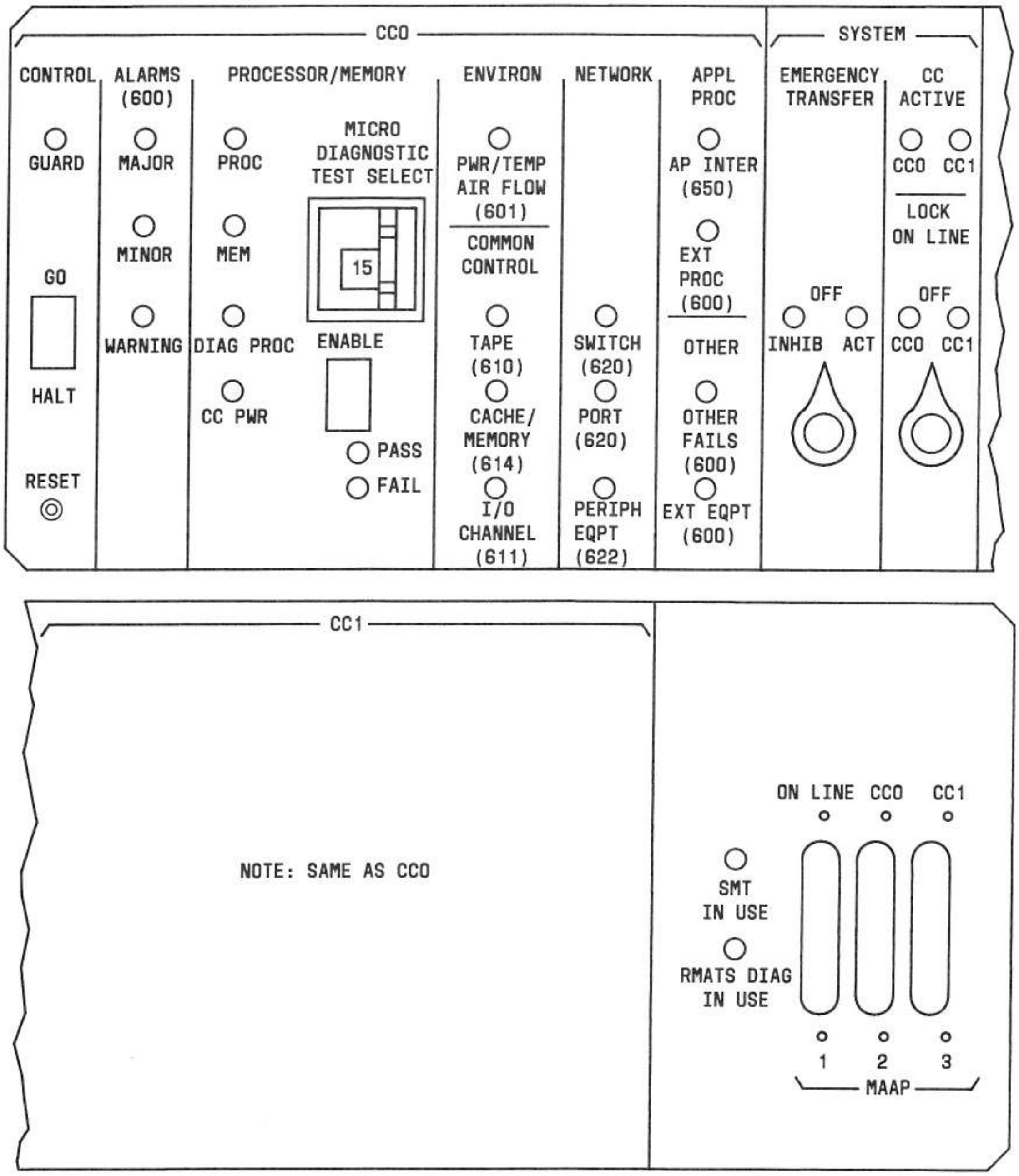


Figure 3-14. Duplicated Common Control Alarm Panel (J58889X)

Fan Assembly

The fan assembly (J58889V) in each switch cabinet provides three forced-draft fans to maintain interior temperature within the acceptable operating limit. The fans are mounted vertically side by side and are designed to run continuously with dc power. The fans operate on low speed for noise reduction until the ambient temperature reaches 95°F (35°C). At higher temperatures, the fans switch to high-speed operation. A removable air filter in the assembly traps airborne matter and must be changed periodically.

The fan assembly also accommodates a frequency generator (124B1), fusing and power sources for attendant consoles, ground blocks for internal system ground connections, and a circuit board (AEH4) for cabinet fuse and power alarm interconnections and airflow monitoring circuits. The airflow monitor circuit compares the temperature differential between the air intake at the fan assembly and the air exit at the top of the cabinet. If the differential reaches 16.5°C, a fan failure is indicated and a fan alarm for the cabinet is activated. The assembly also contains a low-voltage monitor which activates an alarm when the cabinet dc voltage drops below -42 V.

AC Distribution Units

Each cabinet ac distribution unit provides ac power, filtering, and frame grounding for the -48 V rectifier(s) and utility receptacle(s), as required. The distribution unit receives power from a commercial ac power source. This ac power is then passed through an electromagnetic interference (EMI) filter for distribution. The EMI filter also prevents EMI from being generated back into the power source by the system. Utility receptacles are mounted on the ac distribution unit housing. A circuit breaker is provided for each utility receptacle.

The ac distribution units and their main applications are as follows:

- J58889U—used in the Duplicated Common Control and TMS Cabinets, for systems with the standard dc power configuration. This unit provides an electrically filtered source of ac power for one or two 334A rectifiers. The unit has two power cords with plugs which mate to 3-wire Twist-Lock receptacles (providing 120 V ac, 60 Hz). Two standard outlets supply power for the 334A rectifiers, and one utility outlet is provided with access from the front of the cabinet.
- J58889G—used in the Module Control and Port Cabinets, for systems with the standard dc power configuration. This unit provides an electrically filtered source of ac power for the 309A/310A rectifier. The unit has a power cord with plug which mates to a 4-wire Twist-Lock receptacle (providing single-phase 120/240 V ac or 3-phase 120/208 V ac, 60 Hz). Power for the 309A/310A rectifier is supplied through hard-wired terminal lug connections. One utility outlet is provided with access from the front of the cabinet.
- J58889AV—replaces the J58889U and J58889G units, for systems with the new cost-reduced dc power configuration. This unit is used in each switch cabinet and provides an electrically filtered source of ac power for one or two Off-Line-Switcher (OLS) power supplies. The version of this unit used in a cabinet with one OLS power supply is equipped with one power cord and one 3-wire receptacle for the OLS. The version of this unit used in a cabinet with two OLS power supplies is equipped with two power cords and two 3-wire receptacles for the OLS.

Rectifiers

Three types of rectifiers may be used in system switch cabinets. Each type of rectifier converts ac power to -48 V and serves as the primary dc power source for the cabinet it is housed in.

309A/310A Rectifier

The 309A/310A rectifier, consisting of two combined units, is the primary dc power source in systems with the standard dc power configuration. It is mounted at the bottom of alternate network cabinets. This rectifier includes a magnetics package (309A) and an electronics package (310A). The magnetic package contains a transformer which steps down the input voltage and supplies low-voltage ac power to the electronics package. The electronics package contains the ac-to-dc rectifier, cooling fans, filter circuit, and control unit (AEN1) which regulates the output.

One rectifier has an output capacity of 60 amperes and can provide -48 V dc power for one cabinet or a pair of cabinets. The nonrectifier-equipped cabinet (in a pair of cabinets sharing power) houses a dc filter. Input power from the ac distribution unit may be either 208 or 240 V 60 Hz. Adjustable taps at the primary winding of the 309A transformer provide for either input voltage. An access cover on the front of the 309A is used for verifying or changing the option setting.

An ac sense voltage interfaces with the battery reserve unit to detect an ac power failure at the rectifier input. The rectifier provides three alarm indications to the AEH4 alarm distribution unit: fan alarm (failure of fan in 310A), fuse alarm (circuit breaker tripped in 310A), and rectifier alarm (loss of -48 V output).

334A Rectifier

The 334A rectifier provides -48 V dc power to the Duplicated Common Control Cabinet and the TMS/RMI Cabinet in systems with the standard dc power configuration. Two 334A rectifiers are mounted under the fan assembly of each of these cabinets. This unit rectifies 120 V 60 Hz from the ac distribution unit to -48 V dc power. A control unit (AEN1) regulates the output. Each rectifier has an output capacity of 20 amperes and provides primary power for half of the cabinet. An ac sense voltage interfaces with the battery reserve unit to detect an ac power failure at the rectifier input.

The rectifier provides three alarm indications to the AEH4 alarm distribution unit: fan alarm, fuse alarm, and rectifier alarm.

Bulk Off-Line-Switcher (OLS) Power Supply

Each bulk OLS power supply (ITT PEC 3965-1) provides -48 V dc power for a switch cabinet in systems with the new cost-reduced dc power configuration. Two bulk OLS power supplies are mounted in Common Control, TMS, and Module Control Cabinets if they are duplicated. A second bulk OLS is optional in the Module Control and Port Cabinets if required by port power demands.

These new bulk OLS units provide lower cost, increased reliability, greater ac input flexibility for universal applications, and reduced space requirements. They are designed to replace 309A/310A and 334A rectifiers in the System 85 switch cabinets.

One bulk OLS has an output capacity of 30 amperes and can provide -48 V dc power. Input power from the ac distribution unit ranges from 170 to 275 V ac single phase, at 47 to 63 Hz.

DC/DC Converters

The dc/dc converters are units in circuit pack form that provide low-level dc voltages for the switch. Source voltage for the converters is provided by the -48 V rectifier output.

The dc/dc converters include the following:

- 494GA converters—provide -5 V and +5 V dc (50 watts) for the TMS carriers, duplicated module control carriers, DS-1/MFAT carriers, and port carriers. This unit provides 50 watts on one output or 40 watts on one output and 10 watts on the other output.
- 495FA converters—provide +5 V dc (250 watts) for the common control carrier(s) (via the power carrier or dc/dc converter unit), TMS carriers, RMI carriers, and module control carriers.

Bus Bar

The bus bar (ED-1E435) is a laminated assembly that provides dc power distribution and ground to the carriers and fans in each cabinet. The bus bar is mounted vertically on the right side within the cabinet frame. Terminals are designated to identify the individual layers of conductors.

DC Filters

Two types of dc filters are used in system cabinets.

The J58889H dc filter provides input filtering for the various equipment in cabinets which receive -48 V power from an adjacent cabinet. Three 4-AWG wires (-48 V unfiltered, -48 V filtered [talk battery], and circuit ground [-48 V return]) are used to connect the dc bus bars and circuit ground blocks for two cabinets sharing -48 V power. The dc filter in a cabinet without a rectifier connects to the bus bar and circuit ground in parallel with the filtered and unfiltered power leads, to provide additional filtering for both power sources.

The J58889AD filter provides input filtering for the Auxiliary Cabinet and for cabinets which receive -48 V direct input in an extended power reserve configuration. The unit receives dc power from the battery plant and distributes it to the equipment through the bus bar. Certain filters are configured for two separate inputs and outputs when dual power sources are required (such as in the Common Control and TMS Cabinets).

Frequency Generators

Two types of frequency generators are used to provide ringing voltage to peripheral equipment.

The 124B1 frequency generator provides low-frequency voltage for nonelectronic ringing voice terminals and other peripheral equipment, such as recorded telephone dictation. Its output is superimposed on the -48 V rectifier output. Normal input voltage for the frequency generator ranges from -45.5 V dc to -52.5 V dc. The output characteristics are as follows:

- Sinusoidal voltage of 75 V to 100 V, RMS
- Load of 0 to 18 high-impedance ringers with series capacitors
- Frequency of 21 Hz, ±1 Hz.

The 124B1 receives fused -48 V power from the network cabinet fan assembly and is mounted on the rear of the assembly (except in the Auxiliary Cabinet where it is contained in the J58889N unit). Ringing voltage is distributed to the port and DS-1 carriers through daisy chain cables. A maximum of four ports per quarter carrier (port group) can receive ringing current simultaneously and is referred to as "ring group blocking." If the frequency generator malfunctions, a signal is provided to the AEH4 alarm distribution unit, which activates an alarm for the cabinet.

The other type of frequency generator is contained in the CAL1 circuit board. This is a special-application unit mounted within each remote group housing in a Remote Group system configuration. The CAL1 board provides 20-Hz ringing voltage for the remoted port groups. The CAL1 also provides low-voltage detection, alarm conversion, and other miscellaneous features. Ringing voltage is provided by two dc/dc converter circuits which generate +90 V and -190 V from a nominal -48 V supply. Up to four -48 V fuse alarms and five contact closure alarms can be paralleled. Resistors are provided for 2-speed fan operation and over-temperature shutdown.

Nominal Holdover Equipment

The nominal holdover capability maintains dc voltage for an ac-powered System 85 should a short-term loss of commercial ac power occur.

This capability is standard for the Common Control Cabinet and provides a minimum of 10 minutes of holdover for common control carrier(s) and related equipment. The actual amount of holdover is dependent on the number of circuit packs. The holdover prevents tape reloads due to loss of main memory contents during a short-term ac power interruption. All associated common control equipment, including the HCMRs and alarm panel, is also held over during this period.

The nominal holdover equipment is optional for the TMS, Module Control, and Port Cabinets equipped with rectifiers. Depending on circuit pack configurations and traffic generated during this period, holdover power sustains operation of these cabinets for approximately 3 to 5 minutes. The holdover furnishes power for the switch network and all peripherals deriving power from switch interfaces.

Two types of battery reserve hardware for nominal holdover are used in the switch cabinets. The holdover capability for systems with the standard dc power configuration is provided through the J87462A battery reserve unit and its associated hardware. This battery reserve unit is mounted under the cabinet fan assembly or 334A rectifiers, as required. Each battery reserve unit has a basic housing and assembly (33A apparatus unit) and accepts the following modular units as required.

DESCRIPTION	EQUIPMENT DESIGNATION
Contactors and Circuit Breakers	398A Power Unit
Charger and Alarms for One Input Channel	AMC1 Circuit Pack
AC Sense and Logic for One Output Channel	AMD1 Circuit Pack
Ni-Cad Battery Assembly With Power-Lock Connectors	Gates Battery #0800-0256 (403736291)

Battery reserve hardware is equipped in switch cabinets as follows:

CABINET	398A	AMC1	AMD1	BATTERY
Unduplicated Common Control	1	1	1	1
Duplicated Common Control	2	2	2	2
TMS	2	2	2	See Note 1
Module Control	2	2	1	See Note 2
Port (W/Power)	2	2	1	See Note 2

Note 1: One battery assembly is equipped for each 334A rectifier equipped in the TMS Cabinet (maximum of 2).

Note 2: One battery assembly is always equipped. A second battery assembly is required if the cabinet powers an adjacent cabinet not equipped for power.

The rechargeable battery pack contains 24 sealed lead acid cells. These cells provide a normal -48 V output. To prevent damage to the cells, the unit is disconnected when the output voltage drops to about -42 V. When commercial ac power is restored, the batteries begin recharging immediately. The batteries require a maximum of 16 hours to reach a fully charged state after they have been fully discharged. (The specified holdover durations are for worst-case conditions and assume that associated batteries are fully charged.)

The holdover capability for systems with the new cost-reduced dc power configuration is provided through the OLS battery reserve unit (ITT PEC 3965-2). Installed and paired with a bulk OLS power supply, this battery reserve unit is mounted at the bottom of the switch cabinet. In cabinets equipped with two bulk OLS power supplies, two battery reserve units may also be equipped.

All holdover power configurations provide for single outputs of 30 or 60 amperes or for dual outputs of 30 amperes each, as required per cabinet. Each battery reserve unit is rated at 5 ampere-hours and supplies up to 30 amperes at a nominal -48 V dc. The input power to the unit is derived (through the bus bar) from the rectifier in the same or adjacent cabinet. Each unit requires approximately 0.6 amperes at -48 V per input channel.

AC sense leads monitor the status of rectifiers feeding the cabinets. If commercial ac power is lost, the battery reserve unit supplies -48 V dc power to the cabinet equipment through the bus bar. The reserve unit provides a nominal holdover alarm input to the AEH4 alarm distribution unit mounted behind the fan assembly. The alarm is activated if there is a malfunction in the battery reserve unit or if the unit is supplying holdover power to the cabinet.

Extended Power Reserve Equipment

The (optional) extended power reserve capability maintains dc voltage for System 85 should a long-term loss of power occur. In the event of an interruption of commercial ac power, the extended power reserve sustains operation of the system cabinets for up to 8 hours through a separate battery plant. The battery plant provides -48 V dc power directly to the cabinets through feeders. To prevent damage to the batteries, they are disconnected when their output voltage drops to about -42 V. When commercial ac power is restored, the battery plant is automatically reconnected to ac power for recharging.

Extended power reserve configurations vary according to individual system requirements. For systems with up to eight modules, each cabinet is powered by its own 30-ampere feeder protected by a circuit breaker in the battery plant. Cabinets with dual dc power arrangements (such as the Duplicated Common Control and TMS Cabinets) are equipped with two -48 V feeders per cabinet. In larger systems, feeders from the battery plant feed a Power Distributing Frame (PDF) located so that it can supply a group of cabinets.

In cabinets equipped for extended power reserve, the usual cabinet power configuration (rectifiers, battery reserve unit, and ac distribution unit) is not needed. Instead, a modified filter arrangement is required at the bottom of the cabinet. The J58889AD dc filter and terminal strip (accessible from the back of the cabinet) provides a termination point for the -48 V dc cabinet feeder(s).

The AP(s) and Auxiliary Cabinet(s) retain an ac power input configuration (in addition to the -48 V dc input) for ac-powered auxiliary equipment. The source may be standby ac power from an inverter or may be a feeder from the main ac service supplying the battery plant. If the ac-powered equipment is not powered from the inverter, these units will not be operational during an ac power outage.

For detailed information on extended power reserve battery plant requirements, refer to Section 11, SYSTEM POWER.

TABLE 3-A. Common Control Carrier Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
Memory Protect	TN368	1 Required per control carrier
Cache Memory	TN369	1 Optionally required per control carrier based on processor occupancy
Sequencer	TN370	1 Required per control carrier
1M RAM Memory	TN392C	Number required based on generic software requirements. Maximum per control carrier: 8 for R2V3, 4 for R2V2, 2 for R2V1.
4-MHz Channels	TN402	Per control carrier: 1 Required for 1 to 7 modules 2 Required for 8 to 15 modules 3 Required for 16 to 23 modules 4 Required for 23 to 31 modules
Dual-Speed Channels	TN403	1 Required per control carrier. First TN403 provides 3 dedicated channels (MAAP/SMT, NCOSS, and SMDR/CSMDR) and 13 undedicated channels. Each additional TN403 provides 16 undedicated channels. 4 Maximum per control carrier
I/O Buffer	TN404	1 Required per control carrier
DCIU Interface	TN405	1 Required per control carrier when DCIU connectivity is required (adjunct APs or DCS)
DCIU Memory	TN406	1 Required per control carrier when DCIU connectivity is required
Tape Interface	TN430	1 Required per control carrier
Alarm Interface	TN490	1 Required per control carrier
Diagnostic Processor	TN491	1 Required per control carrier
Remote Interface	TN492C	1 Required per control carrier
DCIU Test Support	TN513	Not required for system operation. Equipped in control carrier during high-level maintenance testing
SCAMPER Interface	TN514	Not required for system operation. Equipped in control carrier during high-level maintenance testing
ALU	UN151	1 Required per control carrier
Instruction Decoder	UN152	1 Required per control carrier
Bus Interface	UN153	1 Required per control carrier
DCIU I/O	UN156	1 Required per control carrier when DCIU connectivity is required
Duplication Control	UN158	1 Required per control carrier when duplicated common controls provided

Power Carrier (J58888F)

The power carrier (see Figure 3-16) provides dc power in the Duplicated Common Control Cabinet. It contains dc/dc converters that provide logic-level dc voltages required by the two common control carriers. This unit occupies one of the carrier positions in the cabinet and receives -48 V dc through the bus bar. The carrier is functionally segmented into two halves which provide fully isolated logic level voltages to each of the common control carriers.

Each dc/dc converter circuit pack is functionally partitioned in the carrier to simplify maintenance and replacement. For additional information, refer to Table 3-B and DC/DC Converters in this section.

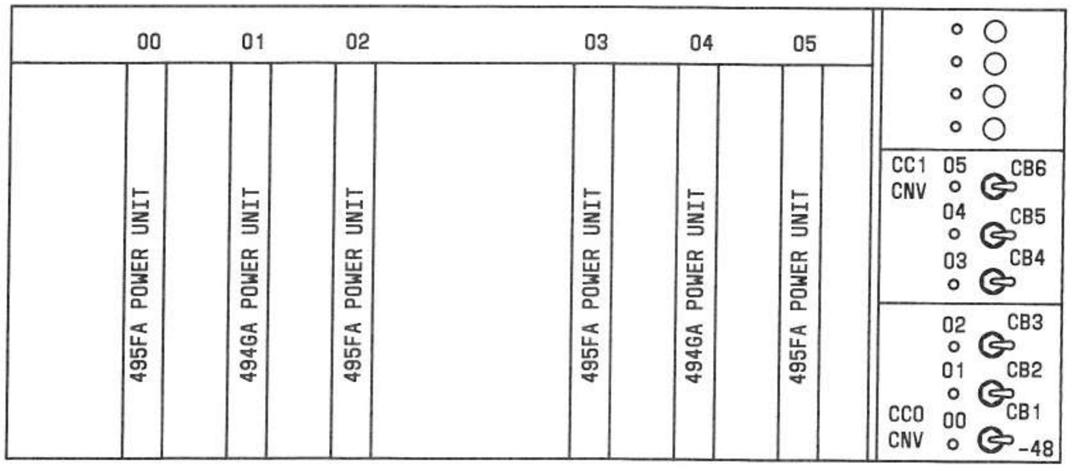


Figure 3-16. Power Carrier (J58888F)

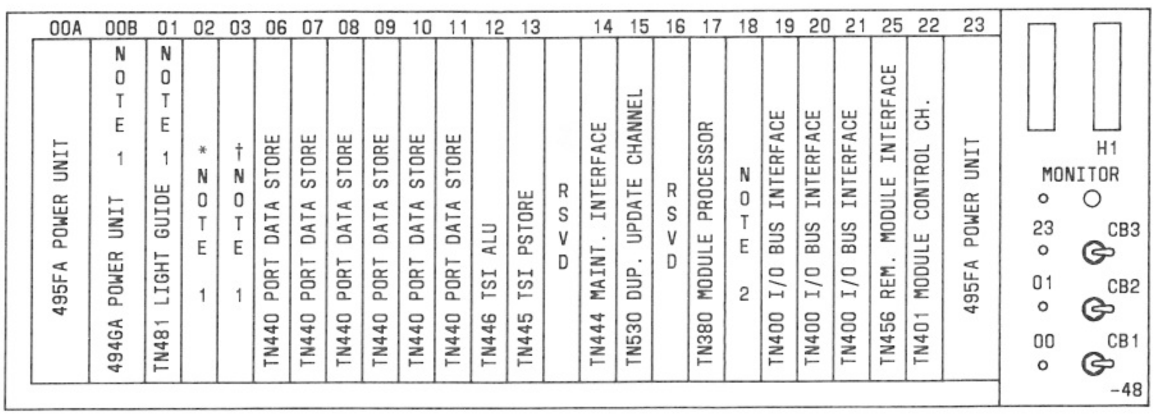
TABLE 3-B. Power Carrier Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
DC/DC Converter	494GA	2 Required per carrier
DC/DC Converter	495FA	4 Required per carrier

Module Control Carrier (J58888M)

The module control carrier (see Figure 3-20) provides module call processing and the associated circuits that detect and process requests for service. It controls the module switching network and serves as an intelligent interface between the common control and the port circuits. This carrier contains the hardware and software that allows the common control to interrogate and scan the ports, send instructions to them, and create transmission path connections.

The module control carrier is designed to accommodate TN-coded circuit packs and dc/dc converters, all using FASTECH 963C 200-pin connectors. For information on circuit packs in the module control carrier, refer to Table 3-F and CIRCUIT PACKS in this section.



* TN481 OR TN463
† TN441 OR TN460

NOTES:

1. FOR A SINGLE MODULE UNSYNCHRONIZED SWITCH, SLOTS 00B, 01, AND 02 ARE EMPTY AND TN460 (MODULE CLOCK) IS USED IN SLOT 03. FOR A SINGLE MODULE SYNCHRONIZED SWITCH, SLOTS 00B AND 01 ARE EMPTY, TN463 (SYSTEM CLOCK SYNCHRONIZER) IS USED IN SLOT 02, AND TN460 IS USED IN SLOT 03. FOR AN UNDUPLICATED MULTIMODULE SWITCH, SLOTS 00B AND 01 ARE EMPTY, TN481 (LIGHT GUIDE INTERFACE) IS USED IN SLOT 02, AND TN441 (TMS INTERMODULE DATA STORE) IS USED IN SLOT 03. FOR A DUPLICATED MULTIMODULE SWITCH, 494GA POWER UNIT IS USED IN SLOT 00B, TN481 IS USED IN SLOT 01, SLOT 02 IS EMPTY, AND TN441 IS USED IN SLOT 03.
2. TN512 (TEST SUPPORT) IS INSTALLED IN SLOT 18 IF SHIPPED WITH THE SWITCH.

Figure 3-20. Module Control Carrier (J58888M)

TABLE 3-F. Module Control Carrier Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
Module Processor	TN380	1 Required per control carrier
I/O Bus Interface	TN400B	1 Required per control carrier to interface to a total of 4 port, DS-1, or RMI carriers. 3 Maximum per control carrier
Module Control Channel	TN401	1 Required per control carrier
Port Data Store	TN440B	1 Required per control carrier to interface to a total of 2 port or DS-1 carriers. 6 Maximum per control carrier
Intermodule Data Store	TN441	1 Required per control carrier only in multimodule system
Maintenance Interface	TN444B	1 Required per control carrier
TSI P-Store	TN445	1 Required per control carrier
TSI ALU	TN446	1 Required per control carrier
Remote Module Interface	TN456	1 Required per remote module in Phase 1 equipment configuration
Module Clock Oscillator	TN460C	1 Required per control carrier only in single-module system
System Clock Synchronizer	TN463	1 Required per control carrier in single-module system with DS-1 trunks
Light Guide Interface	TN481	1 Required per control carrier only in multimodule system
Test Support	TN512B	Not required for system operation. Equipped during high-level maintenance testing
Duplication/Update Channel	TN530	1 Required per control carrier only when duplicated controls are provided
DC/DC Converter	494GA	1 Required per control carrier only in multimodule systems with duplicated module controls
DC/DC Converter	495FA	2 Required per control carrier

Port Carrier (J58888A)

The standard port carrier (see Figure 3-21) connects the system to external equipment (analog/digital, voice/data, and lines/trunks). This carrier provides dedicated port circuits determined by the peripheral terminal equipment or trunking facilities connected. It also provides an interface to the module control for port control and status information, and for pulse code modulated voice or data connections.

The port carrier uses FASTECH technology and is designed to accommodate SN-coded circuit packs using 100-pin 963G connectors and TN-coded circuit packs using 200-pin 963C connectors. Any port circuit pack that needs access to eight or fewer time slots on the group bus may be installed into any universal port position in the carrier. However, there are pairing rules for assigning these packs due to cabling assignments to termination fields and number of circuits per pack. Eight 25-pair connectors, manufactured by Amphenol Products, are provided for input/output cabling to termination fields with each connector accommodating the interfaces for two adjacent port circuit packs.

For information on circuit packs in the port carrier, refer to Table 3-G and CIRCUIT PACKS. For information on port circuit pack pairing rules, refer to Port Circuit Pack Assignments, under CIRCUIT PACKS in this section.

mod 0

Dup Com Control 1

Module Control 1 B   Cabinet 0

Aux. Cabinet J58886N 2

Port Cabinet J58886C 2

Time Multiplex Switch 1 J58886F

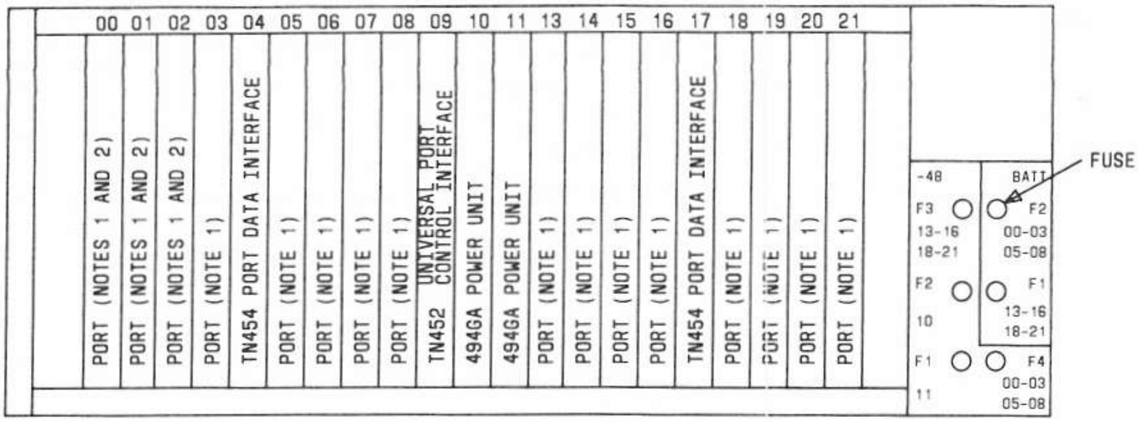
mod 7 Cab 0

Port 2

mod Control 2

mod 1 01 Cabinet

2 DS1/MFAT + 2 Port

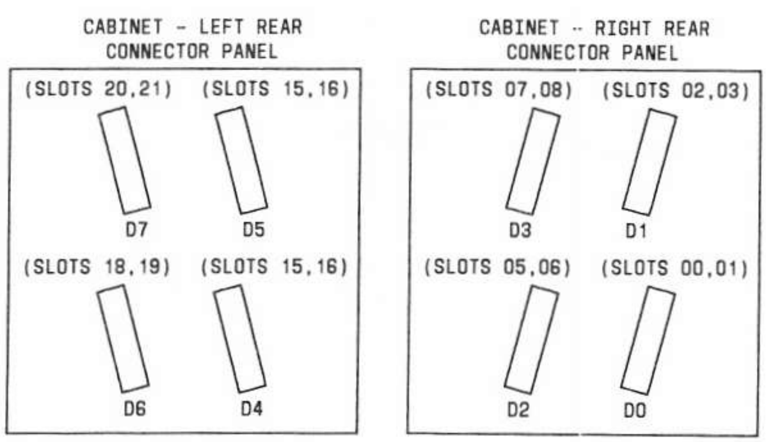


NOTES:

1. CARRIER POSITIONS 00-03, 05-08, 13-16, 18-21 ARE UNIVERSAL PORT POSITIONS WHICH CAN ACCEPT THE FOLLOWING SN-CODED CIRCUIT PACKS:

CKT PACK CODE	CIRCUIT PACK NAME	CKT PACK CODE	CIRCUIT PACK NAME
SN224	MFET LINE PORT	SN250	CALL PROGRESS TONE
SN228	OFF PREMISES LINE	SN251	TOUCH-TONE RECEIVER
SN229	ON PREMISES LINE	SN252	TOUCH-TONE SENDER
SN230	CO TRUNK	SN253	AUXILIARY TONES
SN231	AUXILIARY TRUNK	SN254	ATTENDANT CONFERENCE
SN232	DID TRUNK	SN255	TONE DETECTOR 2
SN233	TIE TRUNK/ATTENDANT INTERFACE	SN261	ANALOG/DIGITAL FACILITY TEST
SN238	EIA INTERFACE	SN270	GENERAL PURPOSE PORT
SN241	CONTACT INTERFACE		
SN243	DATA PORT		

2. CARRIER POSITIONS 00 THROUGH 02 CAN ACCEPT SN244 AUTOMATIC NUMBER IDENTIFICATION (ANI) CIRCUIT PACK



454B

Figure 3-21. Port Carrier (J58888A)

TABLE 3-G. Port Carrier Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
MFET Line Port	SN224B	4 Lines per pack
OPS Line Circuit	SN228B	8 Lines per pack
ONS Line Circuit	SN229B	8 Lines per pack; Used only for loop lengths less than 3500 feet
CO Trunk	SN230B	4 Trunks per pack
Auxiliary Trunk	SN231	4 Trunks per pack
DID Trunk	SN232B	4 Trunks per pack
Tie Trunk/Atnd Intfc.	SN233C	4 Trunks per pack
EIA Port	SN238	4 Lines per pack
Contact Interface	SN241	8 Make contacts per pack
Data Port	SN243B	4 Lines per pack
ANI Data Transmitter	SN244B	2 Channel outputs per pack
Call Progress Tones	SN250	8 Progress tones generated; 1 Required per module
Touch-Tone Receiver	SN251	4 Circuits per pack; Number required per system is based on traffic engineering
Touch-Tone Sender	SN252	4 Circuits per pack; Number required per system is based on traffic engineering
Auxiliary Tones	SN253C	1 Required per module; 2 Required per module for reliability with certain optional features (i.e., AUTOVON or terminal-dialed calls using modem pool or DS-1 trunks)
Attendant Conference Circuit	SN254	1 Required for each 6 port attendant conference circuits; 13 Maximum per system
Tone Detector 2	SN255	Number based on traffic engineering
A/D Facility Test	SN261B	1 Required per system; More may be required based on amount of ATMS testing scheduled
General Purpose Port	SN270B	4 Lines per pack supporting the Digital Communications Protocol (DCP)
Universal Port Control Interface	TN452C	1 Required per port carrier
Universal Port Data Interface	TN454B	2 Required per port carrier (1 required for each carrier half)
DC/DC Converter	494GA	2 Required per port carrier (1 required for each carrier half)

T1 + Carrier

DS-1/MFAT Carrier (J58888N)

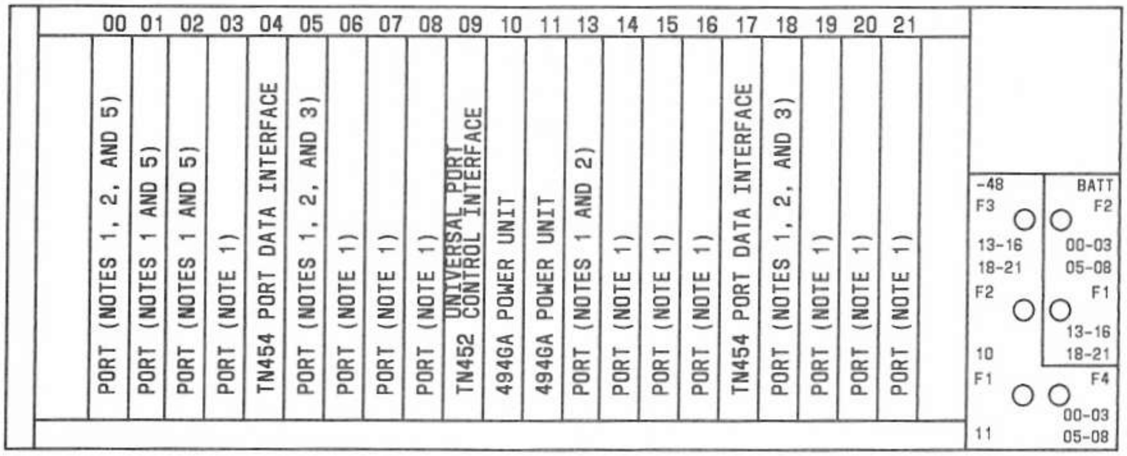
This carrier (see Figure 3-22) is a modified port carrier. It provides high-density dedicated interface circuits for DS-1 trunks and/or 7300S series voice terminals. It uses FASTECH carrier technology to accommodate SN- or ANN-coded circuit packs using 100-pin 963G connectors or 150-pin 963 connectors and TN-coded circuit packs using 200-pin 963C connectors.

For information on circuit packs in the DS-1/MFAT carrier, refer to Table 3-H and CIRCUIT PACKS in this section.

DS-1 CSU

TABLE 3-H. DS-1/MFAT Carrier Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
DS-1 Trunk Interface	ANN11C	24 Multiplexed voice-grade tie trunks (Robbed Bit Signaling); or 23 multiplexed alternate voice/data and/or voice grade tie trunks (24th Channel Signaling)
Remote Carrier Local	ANN15B	Equivalent to 3 line port packs or 24 line ports; Up to 4 maximum per carrier installed when remote groups are provided
MFAT Line Port	ANN17B	8 Lines per pack
SN-Coded Port Circuit Packs	SNxxx	All SN-coded circuit packs can be installed with R2V2/R2V3 software
Universal Port Control Interface	TN452C	1 Required per carrier
Universal Port Data Interface	TN454B	2 Required per carrier (1 required for each carrier half)
DC/DC Converter	494GA	2 Required per carrier (1 required for each carrier half)



NOTES:

1. CARRIER POSITIONS 00-03, 05-08, 13-16, 18-21 ARE UNIVERSAL PORT POSITIONS WHICH CAN ACCEPT ALL SN-CODED CIRCUIT PACKS AND ANN17 MFAT LINE PORT.
2. CARRIER POSITIONS 00, 05, 13, AND 18 CAN ACCEPT CIRCUIT PACK ANN15 REMOTE CARRIER LOCAL (RCL). IF ANN15 IS USED IN SLOT 00, 05, 13, OR 18, THE NEXT 2 ADJACENT SLOTS TO THE RIGHT MUST BE LEFT VACANT.
3. CARRIER POSITIONS 05 AND 18 CAN ACCEPT CIRCUIT PACK ANN11 DS-1 TRUNK INTERFACE. IF ANN11 IS USED IN SLOT 05, SLOTS 00, 01, 02, 06, AND 07 CANNOT BE USED. HOWEVER, SLOTS 03 AND 08 CAN BE USED FOR ANN17 OR ANY PORT CIRCUIT WHEN SLOT 05 IS USED FOR ANN11. IF ANN11 IS USED IN SLOT 18, SLOTS 13, 14, 15, 19, AND 20 CANNOT BE USED. HOWEVER, SLOTS 16 AND 21 CAN BE USED FOR ANN17 OR ANY PORT CIRCUIT WHEN SLOT 18 IS USED FOR ANN11.
4. THE DS-1/MFAT CARRIER IS NOT INTENDED TO REPLACE THE PORT CARRIER. USE OF SN PORT CIRCUIT PACKS IN THE DS-1/MFAT CARRIER CAUSES INEFFICIENT USE OF THE WALL FIELD.
5. CARRIER POSITIONS 00 THROUGH 02 CAN ACCEPT SN244 AUTOMATIC NUMBER IDENTIFICATION (ANI) CIRCUIT PACK.

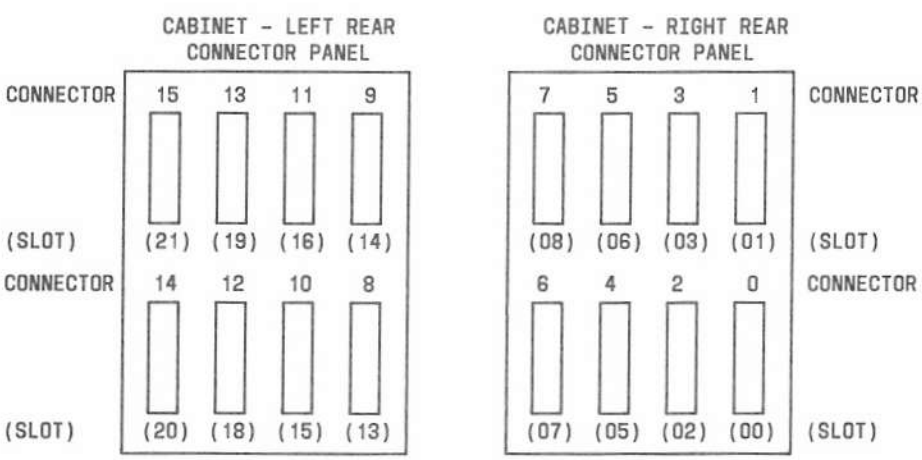


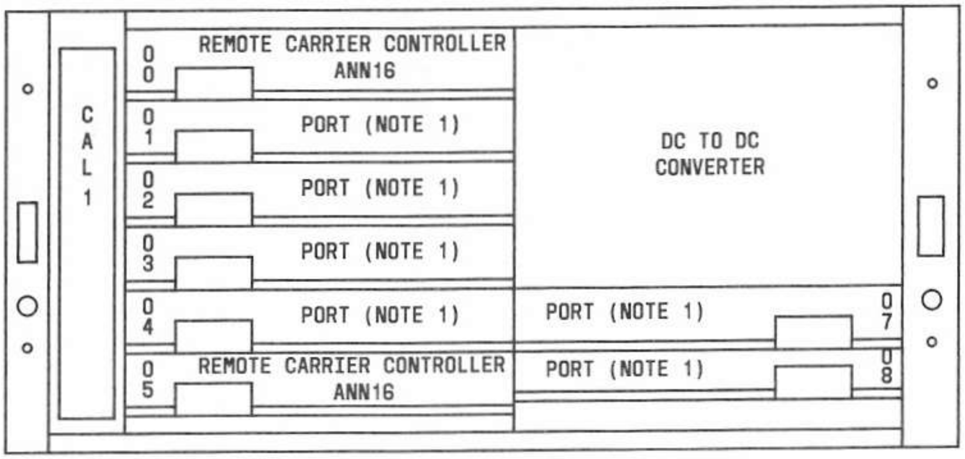
Figure 3-22. DS-1/MFAT Carrier (J58888N)

Remote Group Housing (J58889AN)

The remote group housing (see Figure 3-23) provides the remoted port interface circuitry in a remote group system configuration (refer to SYSTEM CABINET CONFIGURATIONS in this section). Though not a standard carrier housed in a network cabinet, this self-contained unit houses up to two remotely located port groups. Each port group consists of one controller circuit pack (ANN16B) and up to three port interface circuit packs (analog, hybrid, digital, or EIA). For information on circuit packs in the remote group housing, refer to Table 3-I and CIRCUIT PACKS in this section.

TABLE 3-I. Remote Group Housing Circuit Packs

CIRCUIT PACK	CODE	COMMENTS
Remote Carr. Control	ANN16B	Terminates up to 3 line port packs (24 time slots); 2 Maximum per remote group housing
MFAT Line Port	ANN17B	8 Lines per pack
OPS Line Circuit	SN228B	8 Lines per pack
EIA Port	SN238	4 Lines per pack
General Purpose Port	SN270B	4 Lines per pack supporting the Digital Communications Protocol (DCP)
Frequency Generator/Alarm	CAL1	1 Required per remote group housing



NOTES:

1. CARRIER POSITIONS 01-04, 07, AND 08 ARE UNIVERSAL PORT POSITIONS WHICH CAN ACCEPT THE FOLLOWING CIRCUITS PACKS:

CKT PACK CODE	CIRCUIT PACK NAME
ANN17	MULTIFUNCTIONAL ANALOG TERMINAL (MFAT)
SN228	OFF PREMISES LINE
SN238	EIA INTERFACE
SN270	GENERAL PURPOSE PORT
SN271	OFF PREMISES GENERAL PURPOSE PORT

2. CAL1 CIRCUIT PACK - FREQUENCY GENERATOR/ALARM IS INSTALLED IN SLOT 09.

Figure 3-23. Remote Group Housing (J58889AN)

CIRCUIT PACKS

System 85 circuit packs contain the circuitry required for operation of the system. These circuits include common control circuits, network control circuits, port interface circuits, and special applications circuits. Circuit packs are installed in slots within carriers. Each carrier is located in one of four designated carrier slots within each switch cabinet.

Most circuit packs make use of a packaging system technology in which female connectors mate with male pins in the carrier backplane. Many circuit packs contain red, yellow, and green light-emitting diode (LED) indicators on the faceplate as aids in determining their operational status. In addition, a circuit pack may provide test points to allow interrogation of internal circuit states for fault diagnosis.

Most circuit packs use identification (ID) chips and signature analysis chips (SACs) for testing purposes. The ID chips, assigned on a per-board basis, interface to the Input/Output (I/O) bus. The ID chips provide readable information about circuit pack type and vintage. They contain drivers and status sensors for the green and red maintenance LEDs. The ID chips also contain a test register which can be written and then read to validate the address/data paths through the I/O buffers. The SAC function detects timing-related errors by initializing a unique data stream, known as a signature, during a self-test mode. After the register is cleared, the returned signature is compared to a "known good" signature. The two signatures are identical when the SAC is functioning properly.

Some circuit packs contain option switches that are set according to the interface type, range requirement, data rate, or other factors that impact the specific circuit pack application. These option switches are set or verified during initial installation and testing. For detailed information on specific circuit pack option switch settings, refer to **AT&T System 85—Installation—Service Manual** (555-102-104).

Each circuit pack is equipped with an identification faceplate containing a color-coded label. The system circuit packs are grouped by color according to function to simplify maintenance and repair. A circuit pack may be replaced only with a similar circuit pack having either the same or subsequent suffix as that printed on the carrier designation strip. (For example, an SN230 cannot be used if the designation strip specifies SN230B. Therefore, SN230B, C, or later alpha-suffixed SN230 packs are suitable replacements.) Suffix codes indicate successive improvements or modifications. Circuit pack availability and applications [according to System 85 Release (R) and Version (V)] are listed on the next two pages.

CIRCUIT TYPE	R2V1	R2V2	R2V3
COMMON CONTROL	TN368	TN368	TN368
	TN369	TN369	TN369
	TN370	TN370	TN370
	TN392C	TN392C	TN392C
	TN402	TN402	TN402
	TN403	TN403	TN403
	TN404	TN404	TN404
	TN405	TN405	TN405
	TN406	TN406	TN406
	TN490	TN490	TN490
	TN491	TN491	TN491
	TN492B	TN492C	TN492C
	TN513	TN513	TN513
	UN151	UN151	UN151
	UN152	UN152	UN152
	UN153	UN153	UN153
	UN156	UN156	UN156
	UN158	UN158	UN158
MODULE CONTROL	TN380B	TN380B	TN380C
	TN400B	TN400B	TN400B
	TN401	TN401	TN401
	TN440B	TN440B	TN440B
	TN441	TN441	TN441
	TN444B	TN444B	TN444B
	TN445	TN445	TN445
	TN446	TN446	TN446
	TN456	TN456	TN456
	TN460C	TN460C	TN460C
		TN463	TN463
	TN481	TN481	TN481
	TN512B	TN512B	TN512B
	TN530	TN530	TN530

CIRCUIT TYPE	R2V1	R2V2	R2V3
PORT INTERFACE	SN224B	SN224B	SN224B
	SN221B		
	SN228	SN228	SN228B
	SN222B		
	SN229	SN229	SN229B
	SN230	SN230	SN230B
	SN231	SN231	SN231
	SN232B	SN232B	SN232B
	SN233B	SN233B	SN233C
		SN238	SN238
	SN241	SN241	SN241
	SN243B	SN243B	SN243B
	SN244	SN244B	SN244B
	SN250	SN250	SN250
	SN251	SN251	SN251
	SN252	SN252	SN252
	SN253C	SN253C	SN253C
	SN254	SN254	SN254
	SN255	SN255	SN255
	SN260		
	SN261	SN261B	SN261B
	SN270	SN270B	SN270B
	TN452B	TN452B	TN452C
	TN454B	TN454B	TN454B
		ANN11B	ANN11C
			ANN15B
			ANN16B
		ANN17B	ANN17B
TMS	TN381	TN381	TN381
	TN400B	TN400B	TN400B
	TN401	TN401	TN401
	TN452B	TN452B	TN452C
	TN461	TN461	TN461
	TN462	TN462	TN462
		TN463	TN463
	TN470	TN470	TN470
	TN473	TN473	TN473
	TN480	TN480	TN480
	TN482	TN482	TN482
	TN512B	TN512B	TN512B
	TN530	TN530	TN530
	UN150	UN150	UN150

SN-Coded Circuit Packs

The SN-coded circuit packs are the port interfaces of the system. These circuit packs are designed with FASTECH packaging system technology that utilizes a 100-pin connector. Each circuit pack measures approximately 13.875 inches (352 mm) in length by 7.670 inches (195 mm) in height. The faceplate of each circuit pack provides 19 positions for LED and test point placement.

The SN-coded circuit packs are usually located in the port carrier only. They may be located in spare slots within a DS-1/MFAT carrier in R2V2/R2V3 system configurations, but this causes inefficient use of the wall field.

SN224B MFET Line Port

This circuit pack interfaces the digital switch to hybrid sets such as 7200H series voice terminals, Multibutton Electronic Telephones (METs), and Electronic Custom Telephone Service (ECTS) sets.

The SN224B has its own microprocessor which provides an interface between the module processor and the voice terminal control data links. Control information to and from a terminal is transmitted in digital form. Voice information is transmitted in analog form. The SN224B provides four port circuits, each serving a single voice terminal. Each circuit has three pairs: one pair for voice, one pair for feature button control information, and one pair for feature lamp control information. The SN224B provides phantom power to the terminals over the two data pairs.

A single shorting plug option adapts all four ports for hybrid or ECTS data pulse timing. The 7200H series voice terminals will work with ECTS data pulse timing but are limited to a range of 1000 feet (305 m). The MET/ECTS terminals will not work with hybrid terminal pulse timing.

The SN224B is required whenever 7200H series voice terminals or MET/ECTS sets are used in the system.

SN228B OPS Line Circuit

This circuit pack interfaces the digital switch to analog voice terminals that are off-premises to the main location of the system, or on-premises with a large loop insertion loss. It also provides lightning protection.

The SN228B provides off-premises extension capability with call monitoring and transmission level detect compensation. It incorporates one option switch per port for impedance compensation. This switch offers either a 600-ohm or RC impedance equivalent balance network to optimize transmission quality. The SN228B provides selection of either a 0-dB or 3-dB loss per circuit for short or long loop applications.

Each circuit receives loop signaling from the voice terminal to detect switchhook status and rotary dial pulses. Analog signals from the voice terminal are received over the tip and ring pair, encoded as serial pulse code modulation (PCM) data and transmitted to the network. The PCM signals from the network are decoded and transmitted as analog signals over the tip and ring pair to the attached terminal. This circuit pack also provides 20-Hz ringing current.

The Message Waiting feature is supported when interfaced to a 7100A series voice terminal. The port circuit signals the voice terminal to light the Message Waiting indicator by providing a ground on the ring lead. The ground signal is a 0.1-second pulse occurring every 1.3 seconds in phase with the beginning of a ringing cycle. (The ring relay is used to implement the ground signal which occurs between ringing generation in the cycle.) The indicator draws 10 milliamps from the line circuit battery feed, which is enough to power it without indicating an off-hook state.

The SN228B incorporates line current drivers and can be used for bridged 2500 voice terminals or 1A2 key applications. Four ringers can be supported. (Only two 2500 terminals should be bridged to insure adequate transmission levels with multiple terminals off-hook.) The 7100A series voice terminals cannot be used in physically bridged applications due to loop current considerations and the Message Waiting feature current drain requirement.

The SN228B provides eight separate line circuits and is usually used when the loop length is greater than 3500 feet (1067 m). The SN228B does permit a shorter range when required. This circuit pack is the only analog port interface supported in the remote group housing due to its horizontal mounting. (Since it has no mercury relays, the SN228B is not mounting sensitive.)

SN229B ONS Line Circuit

This circuit pack interfaces the digital switch to analog voice terminals within the system, or to off-premises voice terminals that have a low loop insertion loss. Each port circuit incorporates a 600-ohm balance network. The SN229B provides a fixed 3-dB loss per circuit to compensate for short loop loss and to insure adequate voice levels.

The SN229B operates much like the SN228B, receiving loop signaling from the voice terminals to detect switchook status and rotary dial pulses. Analog signals from the voice terminal are received over the tip and ring pair, encoded as serial PCM data, and transmitted to the network. The PCM signals from the network are decoded and transmitted as analog signals over the tip and ring pair to the attached terminal. This circuit pack also provides 20-Hz ringing current.

The Message Waiting feature is supported when interfaced to a 7100A series voice terminal. The port circuit signals the voice terminal to light the Message Waiting indicator by providing a ground on the ring lead. The ground signal is a 0.1-second pulse occurring every 1.3 seconds in phase with the beginning of a ringing cycle. (The ring relay is used to implement the ground signal which occurs between ringing generation in the cycle.) The indicator draws 10 milliamps from the line circuit battery feed, which is enough to power it without indicating an off-hook state.

The SN229B does not incorporate line current drivers and should not be used for bridged terminal or 1A2 key applications.

The SN229B provides eight separate line circuits and is usually used when the loop length is less than or equal to 3500 feet (1067 m).

SN230B CO Trunk (Ground Start)

This circuit pack provides 2-wire central office (CO), Foreign Exchange (FX), and Wide Area Telecommunications Service (WATS) ground-start trunk interfaces to a local CO. The SN230B interfaces the digital switch to a CO through a 2-wire tip and ring connection. The four circuits employ ground-start signaling and can be used in 1-way incoming, 1-way outgoing, or 2-way transmission. Each circuit pack provides four separate trunk circuits.

An option switch is provided for each trunk circuit. These switches select the balancing network corresponding to the tip and ring loop equivalence to which the trunk circuit is connected. Each switch offers either a 600-ohm or an RC impedance equivalent balance network.

SN231 Auxiliary Trunk

This circuit pack provides a trunk-type interface between the digital switch and auxiliary equipment. Examples of auxiliary equipment are as follows:

- Loudspeaker paging
- Music-on-hold

- Recorded announcement
- Recorded telephone dictation.

The SN231 provides four 2-wire trunk circuits. Option switches allow each circuit to serve as a 1-way incoming, 1-way outgoing, or 2-way transmission path, depending on the registration requirements and auxiliary equipment to which the circuit is connected. Ground signaling between the auxiliary equipment and each trunk circuit occurs through a separate pair designated AL and S. The AL lead is used to receive signaling from the auxiliary equipment through a ground applied to AL. The S lead is used to receive signaling from the auxiliary equipment through a ground applied to S. The SN231 also supports sending dial pulses over the tip and ring leads.

The SN231 provides an option switch for each circuit with four sections (toggle switches) per option switch. One section (D) is not used. The remaining sections (A, B, and C) provide for various signaling arrangements. The B and C sections allow the trunk to serve in the following ways:

- 1-way incoming with B open and C closed
- 1-way outgoing with B closed and C open
- 2-way transmission with B and C closed.

The A section is closed when the auxiliary equipment requires only one path for ground signaling using the S lead for 1-way signaling, either incoming or outgoing.

SN232B DID Trunk

This circuit pack provides an interface between the local CO and the digital switch. It permits incoming calls to terminate on a specific port within the system without requiring attendant assistance.

Each of the four trunk circuits has a 2-wire audio connection with provision for detecting a low-resistance loop closure (high-low signaling) by the CO as an off-hook or ready-to-transmit dial pulses indication. In response, the Direct Inward Dialing (DID) trunk returns a reversal of battery as an indication of ready-to-receive dial pulsing or immediately receives the dial pulsing, depending upon the exchange requirements.

The SN232B provides four separate trunk circuits. Each trunk circuit has an option switch to select a 600-ohm or RC impedance equivalent balance network corresponding to the tip and ring loop impedance to which the trunk port is connected.

SN233B/C Tie Trunk/Attendant Interface

This circuit pack is normally used to provide Common Control Switching Arrangement (CCSA) access and tie trunk service. It may also be used for certain DID applications, as a release link trunk (RLT) for the Centralized Attendant Service (CAS) feature, and as an audio interface for the attendant console.

The SN233B provides four separate trunk circuits. Each trunk provides a 4-wire audio connection (transmit and receive pairs) and two signaling leads (with option switches) for Types 1 or 5, E&M signaling. (E&M Type 1 interfaces cannot be set "back-to-back" directly unless an external signal conversion device is used.)

The SN233C compatible E&M (cE&M) circuit pack offers direct E&M Type 1 and 5 connectivities. Ownership of external facilities and regulatory/protective issues determines use.

Access to both transmit and receive audio pairs and to the E&M signaling leads for each trunk are provided by jacks at the circuit pack faceplate. Plug insertion into the transmit and receive jacks accesses the local end and opens the pair toward the distant end. Option switches are provided for each signaling lead and for each trunk individually to determine the type of access from the E&M signaling jacks. The option can be set to allow access to the distant end when the plug is inserted or to bridge the signaling lead when the jack is inserted.

When the SN233B is connected to an attendant console, only one signaling lead is used. Additional option switches are provided for simplex signaling, lightning-protected E&M (to provide off-premises connections without external interface equipment), and for A-law or mu-law companding.

SN238 EIA Port

This circuit pack provides a cost-effective interface between the digital switch and general trade devices that employ Electronic Industries Association (EIA) RS-232C signaling protocol. From a call processing aspect, it appears as a digital port interface connected to a data module. Used in conjunction with a Z3A asynchronous data unit (ADU) at the device end, the SN238 completes the RS-232C connection.

The SN238 supports American Standard Code for Information Interchange (ASCII) dialing and full-duplex asynchronous communications. It features option switch settings for port data rates, autoband and parity, and keyboard dialing. Each 2-pair (send and receive) data link supports standard data rates from 300 to 19,200 bps, with built-in limited distance modems (LDMs) to overcome the distance limitations of RS-232C protocol. Links up to several miles in length can be supported depending on the data rate used.

The required standard RS-232C signals supported by the SN238 are:

- Signal Ground
- Transmitted Data
- Data Terminal Ready
- Received Line Signal Detector, Data Set Ready, and Clear to Send (all provided as one signal).

The SN238 provides four port interface circuits for RS-232C devices. Each circuit incorporates the complementary ADU functionality and protocol conversion to the digital communications protocol (DCP).

The SN238 has the following switches for various option settings:

- S1A (O/EPR)—In the on position selects Odd Parity and in the off position selects Even Parity.
- S1B (PRTY)—In the on position enables Parity and in the off position disables Parity.
- S1C (19.2 k)—In the on position selects 19.2 kbps as the data rate for all four ports.
- S1D (9600)—In the on position selects 9600 bps as the data rate for all four ports.
- S1E (4800)—In the on position selects 4800 bps as the data rate for all four ports.
- S1F (2400)—In the on position selects 2400 bps as the data rate for all four ports.
- S1G (1200)—In the on position selects 1200 bps as the data rate for all four ports.
- S1H (300)—In the on position selects 300 bps as the data rate for all four ports.
- S2A (AUTO 0)—In the on position enables and in the off position disables the Auto-band and Auto-parity function for port 0.
- S2B (AUTO 1)—In the on position enables and in the off position disables the Auto-band and Auto-parity function for port 1.

- S2C (AUTO 2)—In the on position enables and in the off position disables the Auto-band and Auto-parity function for port 2.
- S2D (AUTO 3)—In the on position enables and in the off position disables the Auto-band and Auto-parity function for port 3.
- S2E (KYBD 0)—In the on position enables and in the off position disables the Keyboard Dialing function for port 0.
- S2B (KYBD 1)—In the on position enables and in the off position disables the Keyboard Dialing function for port 1.
- S2C (KYBD 2)—In the on position enables and in the off position disables the Keyboard Dialing function for port 2.
- S2D (KYBD 3)—In the on position enables and in the off position disables the Keyboard Dialing function for port 3.

SN241 Contact Interface

This circuit pack is used as an interface to provide signaling to external equipment. It is typically used to operate indicators (LEDs or beehive lamps) through the closure of contacts on the circuit pack. The SN241 provides eight "make" contacts that are operated (closed) on command from the common control. These contacts are connected to the peripheral equipment through tip and ring pairs that are electrically isolated from the circuit pack.

At least one SN241 is required when the EUCD and CAS features are provided.

SN243B Data Port

This circuit pack provides a 2-wire tip and ring connection to data equipment for 2-way voiceband data transmission and also provides the off-premise extension functionality for the Off-Premises Terminal feature using trunk-type translations.

The SN243B contains four separate trunk-type data ports. Each port provides a tip and ring connection. The data port is a line termination but is viewed as a trunk port by the call processing software. For outgoing calls, the alerting functions are provided by this circuit pack. The associated data equipment requires a line-circuit-type of termination. Each port circuit has an option switch that selects a 600-ohm or RC impedance equivalent balance network.

SN244B ANI Data Transmitter

This circuit pack transmits the extension and trunk numbers of calls that are to be identified for billing purposes to a local CO or CCSA office.

The SN244B has two basic functions. One function is dc simplex signaling, in which handshaking is performed with the CO to properly set up the switch and CO for transmission of information. The other function is to convert and transmit the information stored in the ANI Data Register circuit.

Battery and ground signaling are used to perform handshaking between the switch and the CO. These signals are used to indicate an idle state, a busy signal, a transmit signal, and switch or CO disconnect signals.

The SN244B provides two channels, with only one channel active at any one time. The signaling and information transfer occurs over a tip and ring connection to the CO.

SN250 Call Progress Tones

This circuit pack generates eight call progress tones used by the system. These tones are used in their normal state by the system and by the time slot interchanger (TSI) to produce tones that have nonperiodic interrupts.

The SN250 generates tones directly in digital form through a digital signal processor (DSP) circuit. The tones are sent to the port data store through the TSI. The DSP generates the eight tones continuously and outputs each tone in the assigned time slot at a separate port. The tones and port assignments are as follows:

- 440-Hz tone at port 0
- Dial tone at port 1
- Interrupted dial tone at port 2
- Ringing tone at port 3
- Call Waiting ringback tone at port 4
- Intercept tone at port 5
- Busy tone at port 6
- Reorder tone at port 7.

The SN250 also performs reflection testing of the port circuits and call progress tones testing. One SN250 is required per module.

SN251 Touch-Tone Receiver

This circuit pack provides the dual-tone multifrequency (DTMF) receiving capability for the system. It provides four separate touch-tone receiver circuits.

The SN251 provides two main functions. First, the receiving circuit must accept digitally coded DTMF PCM signals, recognize what signals are present, and convert the PCM signals into a 4-bit word. This information is then sent out on the I/O bus to the port control interface and the module processor. Secondly, the circuit pack serves as an interface supplying both single-ported or dual-ported call connections.

SN252 Touch-Tone Sender

This circuit pack provides DTMF signaling and dial tone detect capability for the system. It provides four separate circuits.

The SN252 contains a DTMF tone sender. It also has a dial tone detector, thus allowing the system to perform DTMF signaling and dial tone detection on its trunks. The touch-tone senders can send up to 25 digits, as well as 15 test tones that are used for touch-tone sender and receiver maintenance testing. The tones are generated and detected digitally by using a programmable DSP.

SN253C Auxiliary Tones

This circuit pack generates tones used by the system. The following three tones are generated in analog format:

- Dial tone
- Audible ring
- Chime tone (Chime Paging).

The following seven tones are generated in digital format:

- CAS feature (3 identification tones)
- Chime tone
- Data answer tone
- Precedence tone (AUTOVON)
- Priority audible ringback (AUTOVON).

Option switches S1 and S2 are used to select the internal chime tone or the optional relay contact closure to control an external signaling device. The option switches also select the period of the contact closure when an external signaling device is used.

SN254 Attendant Conference Circuit

This circuit pack allows conference bridging for up to six parties and the attendant. The conferencing of the time slots is linear. All of the parties must be at the same transmission level coming into the conference circuit to assure that all speakers are heard at the same level. Any combination of six trunks and internal lines may be conferenced (except CO trunks, two maximum). The SN254 provides six conference circuits. There can be up to 13 SN254s per system.

SN255 Tone Detector 2

This circuit pack detects all tones and tone pairs on the subscriber loop necessary to provide terminal-dialed data calls through modem-pool-accessed or digital tie trunk facilities. Digital filters using DSP technology detect these tones. The SN255 detects dial tone, busy tone, recorder tone, data answer tone, and other tones which may be encountered during call progress for feedback to the originating terminal. The tone information is encoded in PCM format and is sent to the SN255 through the A-bus. The output of the four tone detection circuits are available through the I/O bus.

SN261 (A)/D Facility Test Circuit

The SN261 provides digital facility testing only. The SN261B provides simultaneous analog and digital facility testing in addition to other R2V2/R2V3 testing capabilities. Digital facility testing in this context refers to data module connections through the SN270B digital port circuits with trunk-type translations.

The SN261 contains circuitry which permits automatic testing of the system data facility and data equipment, including data modules and modem pool facilities. The modem pool facility is a combination of Modular Trunk Data Modules (MTDMs) and analog data sets used to convert data from digital to analog format and vice versa.

Digital facility tests are performed through switched connections to the SN261. When the connection is established, the SN261 transmits a pseudo-random periodic data pattern. This pattern is returned to the SN261 through loopback control points in the facility under test or through another switched network connection from a second data module. The returned data is checked for errors and the results are reported to the system in terms of both errors per bits transmitted and errors per block transmitted. Other failures such as inability to reach the data transmission mode because of "handshaking" failures are also reported. A typical test requires 2 to 3 minutes. Modem pool facilities are at times tested in pairs to obtain end-to-end testing requiring digital-to-analog-to-digital conversion. The SN261 is also capable of providing a loopback connection to any data module on a dial-up basis through a switched connection.

Demand tests are provided for all data modules and are invoked by maintenance procedures (PROCs). Periodic tests are provided for modem pool facilities and all data modules are translated as trunks (e.g., Host Computer Access); each is checked once per day. Demand and periodic tests take approximately 3 minutes per connection for a data module and 12 minutes for a modem pool facility pair.

The SN261B incorporates all the digital facility test capabilities provided by the SN261 plus the Originating Test Line (OTL) and Terminating Test Line functions for the Automated Transmission Measurement System (ATMS) feature. Available with R2V2 and R2V3 systems, the ATMS feature provides a comprehensive customer-controlled testing capability for analog trunk transmission.

The SN261 complements the SN260 in an R2V1 system, while the SN261B only is required in an R2V2 or R2V3 system. Multiple SN261Bs may be required depending on the amount of ATMS testing scheduled for a given period.

SN270B General Purpose Port (GPP)

This circuit pack provides an interface between the switching network and the DCP. The DCP uses two twisted pairs (send and receive) operating at a rate of 160 kbps full duplex. This protocol consists of a 20-bit frame with two 8-bit information fields (I-channel), a 1-bit signaling field (channel), and a 3-bit framing pattern.

The SN270B transfers PCM voice or data between the DCP I-channels and corresponding switch network time slots. Signaling between the attached terminal and common control or other DCP-interfaced terminal is supported by the signaling channel. When combined voice and data are required, both DCP I-channels and corresponding switch network time slots are used. For voice only or data only, one DCP I-channel and corresponding time slot is used.

Each SN270B provides four DCP line ports for connection to 7400D series voice terminals (with or without DTDMs), all data modules, AT&T Personal Terminals (510D), and 515 BCTs. When combined voice and data are required on the DCP, two ports are used. For voice service only, one port is used. Phantom power is provided over the two data pairs for 7400D series voice terminals and the voice terminal module of the Personal Terminals (PTs)/Business Communications Terminals (BCTs) only. Data modules (including the DTDM) and the remaining PT/BCT functionality are not powered from the SN270B.

TN-Coded Circuit Packs

The TN-coded circuit packs are the network control circuits of the system. They are designed with FASTECH packaging system technology that utilizes a 200-pin connector. Each circuit pack measures approximately 13.375 inches (340 mm) in length by 7.670 inches (196 mm) in height. The faceplate of each circuit pack provides 19 positions for LED and test point placement.

TN368 Memory Protect

This circuit pack prevents write operations into certain areas of memory and also prevents program fetches from nonprogram areas of the memory. In addition, it performs sanity timing, bus resolution, and miscellaneous control functions.

The TN368 is located in the common control carrier.

TN369 Cache Memory

This circuit pack contains frequently accessed instructions and data. The high-speed memory dynamically monitors and replaces its contents based upon 501CC program execution and activity of other bus masters. It provides processor throughput enhancement by reducing the effective memory address time.

The TN369 provides memory enhancement in systems that have nine or more modules. It is located in the common control carrier.

TN370 Sequencer

This circuit pack contains the microstore and logic for sequencing the microstore, latching the microinstruction, and generating the clocking for the 501CC processor. The TN370 is one of the four circuit packs in which the bit-slice-designed processor is partitioned. The functions of the other three circuit packs are controlled by microinstructions supplied by this circuit pack.

The TN370 is located in the common control carrier.

TN380C Module Processor (MP)

This circuit pack is the central control unit for all network module operations. It controls communications between the common control and the digital network. The TN380C performs the following tasks for the system:

- Network control
- Port scanning
- Digit collecting and sending
- Port alerting and demand distribute.

All communication between the common control and the network is controlled by the MP. The MP interface to the common control is through the module control channel and a 4-MHz serial subchannel. The MP interfaces the network port circuits through the I/O bus interface for control and through the time slot interchanger (TSI) for servicing connection paths (voice and data).

The MP incorporates a 16-bit microprocessor and contains 32/64 kbytes of programmable read-only memory (PROM) for firmware storage and 32 kbytes of static RAM. The PROM firmware consists of those routines which perform line and trunk scanning and validation, digit collecting and sending, and line alerting. The RAM functions as a storage area for processing or validating state changes.

The TN380C is located in the module control carrier. Within duplicated modules, the TN380s must have matching suffixes (both B or both C). However, TN380s in one module may have a different suffix from TN380s in another module within the same switch.

TN381 TMS Processor

This circuit pack is similar to the TN380C MP but contains a different ROM program. It provides the control interface between the TMS and the common control.

The TN381 is located in the basic TMS carrier only. In systems with a duplicated TMS, one TN381 is required in each basic TMS carrier.

TN392C 1M RAM Memory

This circuit pack provides 1 megaword of memory for the 501CC processor. Each word consists of 16 data bits and 6 bits of error correction code. The TN392C is a self-contained main memory circuit pack that appears as a slave device on the main system bus. It uses dynamic RAM and contains all of the required control and error-protection circuitry.

The TN392C is located in the common control carrier.

TN400B I/O Bus Interface

This circuit pack buffers and decodes communications between the MP and port circuits, between the MP and Remote Module Interface (RMI) circuit packs, and between the TMS processor and the TMS switch fabric.

The TN400B provides an interface between the MP or the TMS processor bus and I/O bus cables which terminate to port control interfaces. Each TN400B can support up to four I/O bus cables. Each interface to a cable is a bidirectional, 8-bit parallel, multiplexed data and address bus for control, status, and maintenance information.

One TN400B is required for every three port carriers. It is located in the module control and basic TMS carriers.

TN401 Module Control Channel (MCC)

This circuit pack is the interface between the common control and the digital network. It buffers and reformats data communications with the 501CC for the MP and the TMS processor.

The MCC primarily serves a serial-to-parallel and parallel-to-serial conversion function. It provides a first-in, first-out (FIFO) buffer that stores 16-bit message envelopes (in serial form) that are sent by the common control. It converts this 4-MHz serial data from the common control coaxial cable link to 16-bit parallel information that is compatible with the MP bus.

The TN401 is located in the module control and basic TMS carriers.

TN402 4-MHz Channels

This circuit pack provides a 4-Mbps I/O mechanism for communication between common control and distributed controllers in the network modules and TMS. It buffers and reformats data communications with the TMS processor and MPs for the 501CC. The common control uses these channels to distribute network control orders and to scan network status.

The TN402 provides sixteen 4-MHz interfaces which are assigned in pairs to the TMS and modules. Two channels are dedicated to the TMS carrier. All other channels are assigned in translations to module control carriers.

The TN402 is located in the common control carrier.

TN403 Dual-Speed Channel

This circuit pack provides the interface between the 501CC processor and peripherals connected to the network. Two of the sixteen channels available per circuit pack are speed-selectable (through option switches) for connecting either a low-speed (185-kbps) or high-speed (833-kbps) peripheral. The remaining 14 channels are used for interfacing low-speed channels only.

The TN403 is used primarily as an interface for attendant consoles. Dedicated channels may be assigned for the MAAP, Network Control Operations Support System (NCOSS), SMT, and SMDR. The TN403 is located in the common control carrier.

TN404 I/O Buffer

This circuit pack buffers 16 data leads, 2 data parity bits, 24 address leads, 2 byte/word write leads, and some control leads. It also provides bus termination for the system bus and the buffered bus.

The TN404 is located in the common control carrier.

TN405 DCIU Interface

This circuit pack provides the arbitration control for the DCIU local bus, as well as 128 kbytes of dynamic RAM for data storage. The TN405 also provides the circuitry for RAM timing and control; addressing and buffering; and parity generation, checking, and wait state generation.

The TN405 operates with the TN406 and UN156 as a unit to provide the DCIU capability. The TN405 is located in the common control carrier.

TN406 DCIU Memory

This circuit pack contains a 16-bit microprocessor and 32 k words of firmware used for DCIU program execution. It provides the control and status registers used for passing information such as supervisory commands and health status between the DCIU and 501CC processor. It also provides a control port through which the 501CC can reset or interrupt the DCIU.

The TN406 operates with the TN405 and UN156 as a unit to provide the DCIU capability. The TN406 is located in the common control carrier.

TN430 Tape Interface

This circuit pack connects the high capacity mini-recorder (HCMR) to the 501CC processor, memory, and peripherals through the system bus. The TN430 performs the bulk of system bus operations as a bus master, executing direct memory access (DMA) transfers of data blocks to and from memory. The tape interface acts as a bus slave for control and status information registers.

The TN430 contains an 8086 processor, ID chip, EPROMs, RAMs, and a status register which contains state-of-health information about the HCMR subsystem. The firmware provides the maintenance capabilities for the subsystem.

The TN430 is located in the common control carrier.

TN440B Port Data Store (PDS)

This circuit pack buffers, stores, and reformats Pulse Code Modulation (PCM) voice and data transmission with the port circuits for the TSI. It provides an interface between the serial data in the ports and parallel data in the TSI. The PDS also provides RAM storage for the TSI data. The PDS contains the port multiplexing and demultiplexing logic and the TSI input and output storage for 256 time slots.

The PDS receives serial data from the port data interface and converts it to 16-bit parallel data that is stored in the TSI RAM. The PDS also receives parallel data from the TSI, converts it to the 32-bit serial group format, and transmits it to the ports through PCM cables. The PCM cables terminate to port data interfaces in the port carriers. Each TN440B interfaces to 4 cables, each of which terminates to 1 port data interface and supports 64 ports (1 port group or half-carrier).

The TN440B is located in the module control carrier.

TN441 Intermodule Data Store (IDS)

This circuit pack buffers, stores, and reformats PCM voice and data transmission between the TSI and the TMS through the light guide interface (LGI). The IDS provides RAM storage for PCM voice or data which may be be accessed directly by the TSI source and destination address and data buses. The IDS performs conversion between parallel and serial data formats to interface the RAM storage locations to the LGI. It provides the functions for intermodule calls that the TN440B PDS does for intramodule calls. The IDS also contains the module clock and the circuitry for switching between duplicated TMS controls.

The TN441 is located in the module control carrier.

TN444B Maintenance Interface

This circuit pack interfaces the MP to all the circuit packs in the module control carrier for most maintenance purposes. The TN444B provides the following functions:

- Interfaces the MP bus to the maintenance bus
- Provides the test vector generator
- Provides the destination register
- Provides a source of IDLE code to the TSI source bus
- Generates a 10-MHz clock for the I/O bus control and the maintenance bus control
- Provides termination for the network clock signals and the TSI bus
- Checks parity on the MP address bus

- Provides data parity generation and checking for MP read and write operations
- Provides two power sense circuits for the dc/dc converters.

The TN444B is located in the module control carrier.

TN445 TSI Program Store (P-Store)

This circuit pack stores switching instructions from the common control through the MP for TSI arithmetic logic unit to execute. The TN445 also performs the following functions:

- Provides error detection and control for the TSI
- Provides parity checking on instructions fetched
- Drives the source address bus and TSI arithmetic logic unit
- Provides hardware and software initialization and circuit pack identification through software
- Provides a sense circuit for the associated power regulator.

The TN445 is located in the module control carrier.

TN446 TSI Arithmetic Logic Unit (ALU)

This circuit pack provides execution logic for the switching instructions stored in the TSI P-Store. The TSI ALU digitally inserts loss in port-to-port connections, as required. The TSI ALU receives the source PCM voice or data from the PDS source memory location, inserts the appropriate loss, and delivers it to the appropriate destination memory location in the PDS. Under instruction from the P-Store, the TSI ALU also performs digital addition and subtraction for 3-party conference calls.

The TN446 is located in the module control carrier.

TN452C Universal Port Control Interface (UPCI)

This circuit pack buffers and decodes communications between the ports and MP, between the MP and RMI circuits, and between the switch fabric and the TMS processor. It buffers the I/O bus signals onto the port carrier backplane. The UPCI receives address and signal information from the I/O bus interface through the I/O bus cable. Each TN452C can interface with up to two bus cables. In a duplicated system, one cable comes from each control carrier. The UPCI determines which cable is active.

Two TN452Cs are required for operation of both halves of a port carrier or DS-1/MFAT carrier. The TN452C is located in the TMS, RMI, port, and DS-1/MFAT carriers.

TN454B Universal Port Data Interface (UPDI)

This circuit pack is the voice/data interface between the PDS and the port circuits. It buffers two groups (64 time slots) of PCM voice or data transmission to and from the PDS. The UPDI provides an interface between a port group data bus and one or two PCM cables which terminate to a PDS. The second cable is used to terminate to the duplicated module control, if equipped.

Two TN454Bs are required for operation of both halves of a port carrier or DS-1/MFAT carrier. The TN454B is located in the port and DS-1/MFAT carriers.

TN456 Remote Module Interface (RMI)

This circuit pack provides an interface to the fiber-optic link used for the 4-MHz channel between the common control (central locale) and the module control of a remote module (remote locale). An option switch selects operation by locale (central or remote).

Two TN456s are required for each remote module: one in the host module control or RMI carrier at the central locale and one in the module control carrier of the remote module.

TN460C Module Clock Oscillator

This circuit pack is the timing source for all clock signals used in a single-module system. The clock signals control sequence timing on all circuit packs that comprise the time-division switch portion of the module. The TN460C slaves its clock to a system clock synchronizer, if equipped.

The TN460C is located in the module control carrier.

TN461 TMS Clock Oscillator

This circuit pack is the timing source for all clock signals used in a multimodule system and serves as an interface between the system clock synchronization and the circuits which generate secondary clock signals. The TN461 slaves its clock to a system clock synchronizer, if equipped.

The TN461 is located in the basic TMS carrier.

TN462 Local Clock Termination (LCT)

This circuit pack receives clock oscillator signals, generates secondary signals, and distributes them for the TMS carrier.

The TN462 is located in the basic TMS carrier.

TN463 System Clock Synchronizer (SCS)

This circuit pack provides a free-running clock or externally slaved reference source for the TN460C/TN461 clocks. It also provides synchronization of clock signals with an external clock when synchronization with high-speed digital facilities is required.

The TN463 conforms to Stratum 3 and 4 clock requirements. In the free-running mode, it provides a clock reference with 32 parts per million accuracy. When cabled to one or two DS-1 interfaces, it will slave to an external clock reference of Stratum 3 or 4, or better. One of the external references is the primary or preferred reference, and the other is the secondary or back-up external reference.

The TN463 is located in the module control carrier in single-module systems. It is located in the basic TMS carrier in multimodule systems.

TN470 TMS Multiplexer

This circuit pack provides the "half connections" which allow voice and data communications between modules. The TMS Multiplexer provides a time-division multiplexer function for the TMS space-division switch. It receives source PCM voice or data transmission from the module interfaces through the fan-in and fan-out circuits. The PCM information is multiplexed to two module interfaces for transmission to the appropriate destination module.

Each TN470 provides two 32:1 multiplexers. The TN470 is located in the TMS carrier.

TN473 Fan-Out

This circuit pack provides a portion of the distribution function for the TMS space-division switch. In conjunction with the fan-in circuit pack, it provides digital space-division cross-point connectivity from any module to any module. The fan-out receives source PCM voice or data transmission from four module interfaces and distributes it to the fan-in circuits of the half-carrier.

The TN473 is located in the TMS carrier.

TN480 Module Interface

This circuit pack provides termination in the TMS for the fiber-optic link to each module control in a multimodule system. It frames and formats PCM signals for transmission from the multiplexer to the light guide interface (LGI) through the fiber-optic link. The TN480 recovers signals received from the LGI and delivers it to its associated fan-in circuit for switching through the TMS. It also transmits the system clock signal, as well as framing and TMS on-line status (with duplicated TMS and module control) information, to the module control.

One TN480 serving a module allows blocking access to the network; two TN480s allow nonblocking access. The TN480 is located in the TMS carrier.

TN481 Light Guide Interface (LGI)

This circuit pack provides a termination in the module control for the fiber-optic link to the TMS in multimodule systems. It frames and formats PCM signals from the intermodule data store (IDS) to the module interface in the TMS. The LGI recovers PCM signals from the module interface and delivers it to the IDS for switching through the TSI. The LGI also recovers frame information and a clock reference required by the IDS (derived from the data rate on the fiber-optic link).

The TN481 is actually an extension of the TMS located in the module control. When duplicated TMS and module controls are provided, the LGI associated with the on-line TMS remains active regardless of whether its module control carrier is on- or off-line. Cross-coupling of the duplicated LGIs insures access to the on-line module control.

The TN481 is located in the module control carrier.

TN482 TMS Maintenance Interface

This circuit pack contains the TMS maintenance bus interface, test-vector buffer memory, and destination register. The TMS maintenance interface links the TMS processor to all the circuits in the TMS for test purposes. In addition, it performs the following functions:

- Links the TMS processor bus to the maintenance bus
- Generates test vectors
- Generates a 10-MHz clock for I/O and TMS maintenance bus control
- Terminates the TMS clock bus
- Checks TMS processor address-data parity.

The TN482 is located in the basic TMS carrier.

TN490 Alarm Interface

This circuit pack serves as an interface between the 501CC processor and the alarm panel. It also allows service personnel to exercise manual control over the common control.

The TN490 is a multifunctional circuit pack that generates initialization signals, monitors system sanity, supplies state-of-health information, maintains on-line information, provides for emergency transfer, monitors -48 voltage for the common control, interfaces with the remote interface for automatic alarm reporting, controls the LED display on the alarm panel, and maintains the cabinet alarm information.

The TN490 is located in the common control carrier.

TN491 Diagnostic Processor

This circuit pack provides for fault isolation to a single common control circuit pack and reports system failures. It can interrogate the ID chips of each of these circuit packs to identify type, vintage, and issue. The diagnostic processor also provides an intelligent interface to RMATS-II, FM, and TCM through the remote interface. This allows automatic alarm origination and reporting to a remote location and remote initialization of microdiagnostic tests performed on the common control and related equipment.

The TN491 contains an 8-bit microprocessor to perform tests which isolate failures at the circuit pack level. It contains the diagnostic processor control (with program and data memory), maintenance bus control, and buffered bus interface.

The TN491 is located in the common control carrier.

TN492C Remote Interface

This circuit pack provides the interface for the diagnostic processor to external equipment alarms and provides two interface ports for external access and communications with the common control. The first port is dedicated for RMATS-II access and incorporates an automatic calling unit for automatic call origination and reporting (eliminating the need for external autodialers). The second port is used for customer access to system management through the TCM/FM facilities. Each port has an EIA RS-232C interface, which terminates to a 25-pin connector at the back of the common control. The first port also has a tip and ring interface for the RMATS-II central office line. A 212AR data set is normally used to connect to the remote interface port at 1200 bps data rates.

The TN492C has 10 leads which serve as a common bus for 10 different alarm types, plus 32 leads for identifying the equipment reporting the alarm. Only certain leads are used on specific pieces of equipment. A unit number is assigned to each equipment cabinet that uniquely initiates alarms. A contact closure between a unit lead and an alarm-type lead is detected and registered through the TN492C. An automatic alarm origination then occurs, reporting a major or minor alarm as appropriate.

The TN492C is located in the common control carrier.

TN512B Test Support

This circuit pack provides memory expansion for the MP and TMS so that code testing may be performed. The TN512B provides 32 kbytes of static RAM for temporarily downloading the MP code and for scratchpad work lists. It also provides 16 kbytes of EPROM to support the Basic-16 software development system. A serial link interface is provided for downloading programs and communicating with a console.

The TN512B is field-installed in the module control carrier or TMS carrier only during troubleshooting.

TN513 DCIU Test Support

This circuit pack performs the same functions for the DCIU processor as the TN512B does for the MP. It provides 16 k words of RAM and 8 k words of EPROM. The TN513 monitors addresses and data bus transmission, and provides breakpoint matching functions.

The TN513 is field-installed in the common control carrier only during troubleshooting.

TN514 Scamper Interface

This circuit pack provides an interface through which the Scamper (Software Control Analysis Monitor and Event Recorder) may be used for high-level troubleshooting of the common control. It is used to monitor and control the various address and data buses.

The TN514 is field-installed in the common control carrier only during troubleshooting.

TN530 Duplication/Update Channel (DUP)

A pair of these circuit packs is used to directly link the two module control carriers of a duplicated module control system. Two TN530s link the on-line and off-line sides of a duplicated module control. Both circuit packs provide a bidirectional, high-speed data link between the module controls. Through this link all data, address, and control information from the on-line carrier can flow to the off-line carrier so that "soft switches" can be performed with no loss of data or degradation of service. The TN530s monitor the state of health of both module processors and select the healthier processor to be on-line. These circuit packs simultaneously keep the memory of the off-line processor up to date.

Two TN530s (of matching vintages) are required only when a system has duplicated module controls. The TN530 is located in the module control carrier.

UN-Coded Circuit Packs

UN150 Fan-In

This circuit pack provides a portion of the distribution function for the TMS space-division switch. In conjunction with the fan-out, it provides digital space-division cross-point connectivity from any module to any module. One fan-in and one fan-out circuit pack is located in each half of each TMS carrier. The UN150 receives PCM voice or data signals from the fan-out circuits of the same half-carriers. The fan-in then distributes it to the appropriate module interface.

The UN150 is located in the TMS carrier.

UN151 Arithmetic Logic Unit (ALU)

This circuit pack contains the units that process and temporarily store data normally obtained from main memory or I/O locations. The memory of the UN151 also houses high-usage data/address tables. This is one of the four circuit packs into which the bit-slice-designed 501CC processor is partitioned.

The UN151 is located in the common control carrier.

UN152 Instruction Decoder

This circuit pack contains special logic to accelerate the decoding of instruction fields and/or operator descriptors for the ALU and decoding of addresses for the 501CC sequencer. Interrupt control, sanity timing, and the signature-analysis circuit also reside in the UN152. This is one of the four circuit packs into which the bit-slice-designed 501CC processor is partitioned.

The UN152 is located in the common control carrier.

UN153 Bus Interface

This circuit pack contains the 501CC processor interface to the cache bus and to the system bus. The UN153 also holds the registers used to latch memory and I/O addresses and data. Commands obtained through these interfaces are decoded and used in sequencing the microstore, which in turn instructs the remainder of the processor. This is one of the four circuit packs into which the bit-slice-designed 501CC processor is partitioned.

The UN153 is located in the common control carrier.

UN156 DCIU I/O

This circuit pack provides the interface between the DCIU and an external processor. The UN156 provides eight full-duplex, synchronous data links for communicating to an adjunct processor or other switch processor at a DCS node. It contains all support circuitry necessary for port operation such as decoding, timing, DMA, High-Level Data Link Control (HDLC), and arbitration logic for each data link. Each of the eight interfaces is EIA RS-449/423 and terminates to a 37-pin connector on the back of the common control.

The UN156 is located in the common control carrier.

UN158 Duplication Control

A pair of these circuit packs is used to directly link the two common control carriers of a duplicated common control system. Two UN158s link the on-line and off-line sides of a duplicated common control. Both circuit packs provide a bidirectional, high-speed data link between the common controls. Through this link all data, address, and control information from the on-line carrier can flow to the off-line carrier so that "soft switches" can be performed with no loss of data or degradation of service. The UN158s monitor the state of health of both 501CC processors and select the healthier processor to be on-line. These circuit packs simultaneously keep the memory of the off-line processor up to date.

Two UN158s are required only when a system has duplicated common controls. The UN158 is located in the common control carrier.

ANN-Coded Circuit Packs

The ANN-coded circuit packs are special-application port interfaces. All of these circuit packs installed in R2V3 systems must have "B" (or later) suffixes.

ANN11B/C DS-1 Trunk Interface

This circuit pack provides direct high-speed digital connectivity between System 85 and external facilities. Voice and data transmission with this interface provides an alternative to current analog tie trunks; high-speed data transmission capabilities are made possible.

The ANN11B/C provides a digital tie trunk interface which conforms to DSX-1 standards and is T-carrier compatible. The interface is 2-pair (send and receive) full-duplex operating at 1.544 Mbps in each direction. Twenty-four 64-kbps channels plus framing are supported on each pair. The ANN11B/C can be optioned through administrative procedures (PROCs) to provide D4 or extended (Fe) framing, Bipolar with 8 Zero Substitution (B8ZS) or Zero Code Suppression (ZCS), and Robbed-Bit Signaling or 24th-channel signaling.

The ANN11B/C performs direct conversion between the A&B bit signaling on the DS-1 facility and the E&M signaling used with the switch. The circuits appear as tie trunks to the system switch call processing, but provide two types of interfaces to the outside.

One option uses Robbed-Bit signaling and appears functionally as normal analog tie trunks. Each of the 24 channels in this option can be assigned as voice-grade trunks. The other option performs all signaling on the 24th channel, leaving no bit robbing on the other channels. These 23 channels can be assigned as either voice-grade trunks or Alternate Voice/Data (AVD) trunks. AVD trunks support voice and restricted full 64-kbps data. This option can only be used for tie trunks between two System 85s. The Robbed-Bit option must be used for all other applications and may be used for tie trunks between System 85s.

The physical interface to the ANN11B/C is provided by a 50-pin connector, manufactured by Amphenol Products, on the back of its cabinet and is part of the carrier assembly it is mounted in. The cable mating to this connector must be 606-type shielded cable. The shield is always grounded at the connector end.

The ANN11B/C also provides a signaling pair over the connector interface which can be used to activate a remote loopback for demand maintenance testing. The circuit pack provides an isolated contact closure on the pair to signal the external unit to loop back the receive-to-send pair for the testing period.

Two outputs are also provided to interface to the system clock synchronizer(s) (SCS). If the DS-1 link terminated to the ANN11B/C is to serve as an external clock reference, the ANN11B/C is cabled to one or both SCSs (depending on network control duplication). The ANN11B/C derives a timing reference from the incoming DS-1 bit stream (used by the SCS to slave the network clock to it).

For R2V3, the ANN11C features the following enhancements:

- Provides both ground-start and loop-start CO, FX, WATS (In/Out), and (reverse battery) DID trunks in addition to tie trunks.
- Provides 24 analog voiceband OPS service with a D4 channel bank or equivalent.

The ANN11B/C provides 24 channels which logically are equivalent to 6 SN233B tie trunk circuit packs. The corresponding slots in the carrier are reserved and cannot be used for other port circuits. The ANN11B/C is located in the DS-1/MFAT carrier.

ANN15B Remote Carrier Local (RCL)

This circuit pack is the first of a pair of circuit packs that provides an interface for the Remote Group capability (R2V3). It is located at the central switch and serves as the local interface to remoted ports which can be hybrid, analog, digital, or EIA interfaces.

The ANN15B is equivalent to any combination of 3 line port circuit packs, or 24 line ports. The corresponding slots in the local carrier are reserved and cannot be used for other port circuits. The ANN15B is required whenever remote carriers are used in the system.

ANN16B Remote Carrier Controller (RCC)

This circuit pack is the second of a pair of circuit packs that provide an interface for the Remote Group capability (R2V3). It is located at the remote carrier and serves as the link to the switch for the remoted hybrid, analog, digital, or EIA ports.

The ANN16B terminates 3 line port circuit packs (24 time slots), appearing as a Port Data Interface (PDI) and Port Control Interface (PCI) to the remoted ports. The ANN16B is required whenever remote carriers are used in the system.

ANN17B MFAT Line Port

This circuit pack provides a double-density interface between the digital switch and 7300S series voice terminals. The design and operation of the ANN17B is similar to that of the SN224B line port. It provides eight port circuits, each serving a single voice terminal.

The ANN17B is required whenever 7300S series voice terminals are used in the system. It is located in the DS-1/MFAT carrier.

Port Circuit Pack Assignments

Circuit packs are assigned to and installed in designated carrier slots within the system cabinets. For detailed information on circuit pack/slot assignments for each type of carrier, refer to CARRIERS in this section.

A major consideration with system port interface configurations involves cabling restrictions. These restrictions dictate certain circuit pack pairings. Each 25-pair cable connecting the port or DS-1 carrier to the termination field accommodates the interfaces from two circuit packs. Traffic and reliability considerations require placement of certain packs so they will be distributed throughout the system. Administration considerations direct the quantity and placement of like units in a carrier.

An example of cabling restrictions dictating circuit pack pairing is the analog line circuit pack, which provides eight ports per pack. Pair assignments on the pack and carrier wiring from the pair of slots to the 25-pair interface dictate that an analog line pack may be paired with a similar pack or another pack not requiring access to the termination field (e.g., touch-tone sender pack). Additionally, an adapter or "Y" cable is required at the termination field end if connectorized hardware is used. The Y cable is designed to maintain 3-pair uniformity per port on the termination block for analog line packs.

An example of reliability considerations dictating circuit pack pairing is the call progress tones (CPT) pack (SN250). This pack does not require access at the termination field and may be physically paired with another CPT pack. However, if a port carrier dc/dc converter or control/data interface pack fails which serves the same portion of the carrier with the CPT circuit pack pair, all service to the module would be lost. Therefore, these packs should be placed in separate carriers and preferably in separate cabinets served by different power sources.

SN-Coded Circuit Pack Pairing

The SN-coded circuit packs are divided into basic groups and subgroups for pairing purposes. The packs in each subgroup should be distributed throughout separate carriers and preferably in cabinets served by different power sources for reliability considerations.

Group A consists of the following subgroups:

- A1 SN250 Call Progress Tones
- A2 SN251 Touch-Tone Receiver
- A3 SN252 Touch-Tone Sender
- A4 SN253C Auxiliary Tones
- A5 SN254 Attendant Conference Circuit
- A6 SN255 Tone Detector 2
- A7 SN261B Analog/Digital Facility Test.

The circuit packs in Group A are predominately those which are essential to call processing or feature operation and for which access is not required at the termination field. Two exceptions are subgroups A4 and A7. The former must be cabled to the termination field, while the latter provides capabilities not essential to call processing or feature operation.

The circuit packs in Group B provide eight interfaces per pack for which access is required either at the line field or the trunk/auxiliary field. Group B consists of the following subgroups:

- B1 SN228B Analog Line
  SN229B Analog Line
  SN241 Contact Interface
- B2 SN228B Analog Line
  SN229B Analog Line.

The circuit packs listed in subgroup B1 are used for applications which require access at the line field (e.g., internal building applications). The circuit packs listed in subgroup B2 are used for applications which currently require access at the trunk/auxiliary field (e.g., out-of-building or off-premises).

The circuit packs in Group C provide four interfaces per pack for which access is required at either the line field or the trunk/auxiliary field. Group C consists of the following subgroups:

- C1 SN224B MFET Line Port
  SN238 EIA Port
  SN243B Data Port
  SN270B Digital Port

- C2 SN224B—out-of-building application on nonexposed cable
  SN238—out-of-building application on nonexposed cable or to concentrate interface for access in equipment room, such as to the ISN network
  SN243B—out-of-building, off-premise, or modem pool application
  SN270B—out-of-building application on nonexposed cable or modem pool application.

The circuit packs listed in subgroup C1 are used for applications which require access at the line field. The packs listed in subgroup C2 are used in applications which currently require access at the trunk/auxiliary field.

The circuit packs in Group D provide four interfaces per pack for which access is required at the trunk/auxiliary field. These circuit packs should be distributed among separate carriers and preferably cabinets served by different power sources. Allocation of trunk packs among modules in a multimodule system is also essential for proper traffic balancing (per locale for remote modules). Group D consists of the following subgroups:

- D1 SN230B CO Trunk
  SN231 Auxiliary Trunk
  SN232B DID Trunk
  SN233B Tie Trunk.

DS-1 Interface/Module Processor Compatibility

In various System 85 applications, software compatibility between different suffix-coded versions of the DS-1 trunk interface circuit packs (ANN11) and the Module Processor circuit packs (TN380) must be considered. The following compatibility matrix applies in this instance:

SOFTWARE	TN380 SUFFIX	ANN11 SUFFIX
R2V1	B C	B,C (Note 1) B,C (Note 2)
R2V2	B C	B,C (Note 1) B,C (Note 2)
FEMA	C	C (Note 3)
AUTOPLEX	C	C (Note 3)
R2V3	C	C (Note 3)

Note 1: When ANN11C and TN380B are used with this software, only the Tie Trunk and DMI DS-1 features are available.

Note 2: When ANN11C and TN380C are used with this software, only the Tie Trunk and DMI DS-1 features are available unless the "Series 900" DS-1 software patch is present. This patch adds ground-start FX, WATS, Remote Access, DID, and CO trunks to the DS-1 features available.

Note 3: This combination supports all ANN11C features.

SYSTEM INTERCONNECTIONS

Cross-Connect Unit

Overview

The main cross-connect unit (Figure 3-24) is the interface between the system ports and the building cable. (The building cable includes all on-premises wiring on the customer side of the main distribution frame.) The cross-connect unit serves two basic functions:

- Provides termination for building wiring, port circuits, input/output wiring, and auxiliary equipment wiring.
- Directs circuits to destinations within the customer's building wiring network.

This cross-connect facility consists of two building cable termination fields located on each side of a line port field. The cross-connect field hardware is color-coded in accordance with telephone industry standards:

- Green—to outside trunk facilities (customer side)
- Purple—to and from system equipment (line and trunk)
- Yellow—to and from special equipment (auxiliary)
- White—to building wiring (satellite fields)
- Gray—to tie cable terminations between satellite and riser apparatus closets
- Blue—to terminal cable terminator.

Installation of cross-connect facilities in a raised-floor environment is accomplished using the standard procedure, if the raised area of the floor is not used. If the space under the floor is used for the distribution of input/output (I/O) and house cables, the design of cross-connect facilities requires additional installation guidelines and may require new hardware.

The cross-connect unit consists of vertical trough(s), patch cords, miscellaneous hardware, and the termination fields.

A vertical trough uses backboards made of a metal frame with special split-closed distributing rings. These backboards are mounted directly to the wall (between the terminal fields) and are offered in three sizes. The 188C1 is used with 900-pair TBs, and the 188D1 is used with 300-pair TBs. Both are equipped with bottom cable ducts. The 188E1 is similar to the 188D1 except the 188E1 does not have the cable duct.

Patch cords (as required) are available in various lengths and use 1- or 3-pair 28-gauge stranded wire. The quantity and lengths are specified per installation requirements. Miscellaneous hardware includes boxes for patch cord storage, caps for unused terminals and special circuits, test cords, and color-coded designation strips.

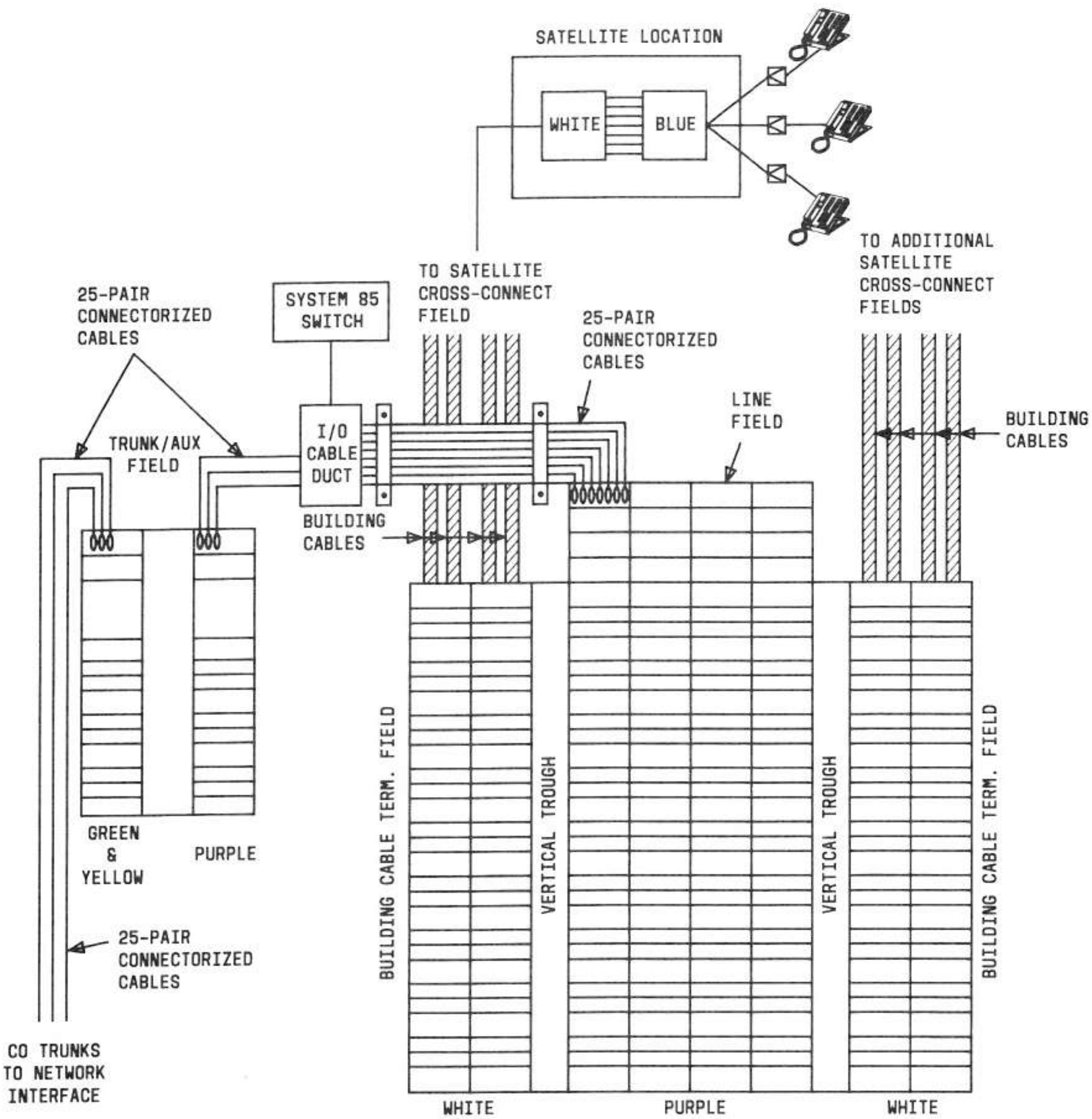


Figure 3-24. Typical Main Cross-Connect Unit

Termination Fields

Termination fields provide access points to cross-connect trunk facilities and to external terminal equipment interfaces. These fields may be located on more than one wall or frame and may vary in configuration. Three types of termination fields are used with System 85:

- Trunk/auxiliary field—terminates the system analog trunk interfaces, off-premises line interfaces, and miscellaneous connections (such as external alarm inputs, attendant console, and SMDR data channels). This type of field also terminates interfaces such as modem pool interfaces, or interfaces which must be grouped together from multiple modules to connect colocated equipment in the same equipment room (such as the ISN concentrator).
- Line field—terminates the system voice terminal and data equipment interfaces which are cross-connected to the building wiring distribution. The building wiring distribution terminates to the white portion of the line field and provides access to various terminal equipment located throughout the building.
- DS-1 field—provides cross-connect points for DS-1 cables. These cables may run direct from the switch cabinet to their termination point (other colocated switch, multiplexers, channel service units, etc.). However, specific translation assignments to DS-1 interface locations may not be known at the time the hardware is ordered and processed. Direct cabling, especially with double connectorized cables, will complicate accurate determination of cable lengths and inhibit flexibility in connectivity. This field should be logically segmented on or totally separated from the trunk/auxiliary fields. This will minimize the possibility of cross-connecting non-DS-1 to DS-1 cables.

The number and configuration of termination fields is dependent on the number and types of interfaces to be accommodated. A system will typically have one of each field type per module. Multiple modules may terminate to a single trunk/auxiliary field and a single line field, but one module cannot terminate to multiple trunk/auxiliary fields or multiple line fields.

A termination field identifier and reference point is assigned to each termination field to determine cabinet-to-field I/O cable lengths. Trunk/auxiliary field reference points are designated T/A00, T/A01, etc. Line field reference points are designated LN00, LN01, etc., and normally correspond to the module number (00, 01, etc.) of the I/O cables that are terminated to it. A separate DS-1 field requires its own unique reference point in the equipment room.

110-Type Hardware

Two versions of 110-type termination field hardware are available for use with System 85. The 110P-type hardware provides female 50-pin connectorized interfaces, manufactured by Amphenol Products, for the I/O cable terminations. The 110A-type hardware can be equipped with or without this connectorized interface. This type hardware may be used in conjunction with the 110P-type. Such a combination would typically include 110A-type at the main cross-connect field and 110P-type at the satellite closets.

The 110P-type termination field has a terminal block layout and designation strips which correspond to the System 85 3-pair uniform wiring circuit assignments. The I/O cables required to connect cabinets to the termination field are provided with the system. These are currently 25-pair shielded cables with a male 50-pair connector, manufactured by Amphenol Products, on each end. An auxiliary/trunk or line field may consist of one to four columns of 110P-type hardware for I/O cable terminations and a corresponding number of columns for trunk facility or internal building wiring terminations. An appropriate amount of space is allocated between certain columns to minimize cross-connect wiring congestion. Each 110P-type hardware column can terminate up to thirty-six 50-pin connectorized cables, manufactured by Amphenol Products, (900 pairs).

The 110A-type hardware requires less space than the 110P-type and can be configured to allow greater flexibility in cross-connects between specific switch interfaces and building wiring pairs. The 110A-type hardware can be used with any size system and is recommended for systems which cut with (or will grow to) five or more modules. Use of this hardware on larger systems will minimize switch-interface-to-building wiring mismatch and cross-connect congestion that may be prevalent with 110P-type modular line fields and patch cords. The cables which terminate to the 110A-type hardware can use a connectorized interface or arrangement for field termination. The feasibility of using this hardware is dependent on the size of the system and cable congestion anticipated. Cross-connects are implemented with punch-down wire. Special considerations must be given to I/O cable lengths (from the switch cabinets to the termination fields) and to the type of interface required.

Cables

The various types of system cables (ED-1E434) include the following:

- 902A polyvinyl chloride (PVC) flat ribbon cables
- 25-pair standard and shielded connectorized cables
- 4-MHz channel coaxial cables
- Discrete wires of various gauges for alarm, voltage, and ground leads
- Connectorized cables for slow-speed I/O data channel peripherals
- 110-type connectorized patch cords
- Fiber-optic cables.

902A Cables

The 902A PVC flat ribbon cables are 31-conductor cables terminated on each end with 943AR paddleboard connectors. The 943AR paddleboard connectors are provided with an arrow that indicates the top of the assembly and a clamp that firmly holds the cable to the connector. These cables are provided in varying lengths, with intercabinet cable length dependent upon the floor plan cabinet layout.

The 902A cables are used to connect the common control carriers in duplicated common controls, to connect the module control carriers in duplicated module controls, to connect the module control carriers to the port carriers, and to connect the common control carrier(s) to the first port carrier.

Six of the 902A cables that connect the module control carrier(s) to the port carriers include two input/output bus (IOB) cables and four pulse code modulation (PCM) cables. The IOB cables interface the module processor to the port circuit packs via the IOB interface and port control interface. The PCM cables interface the port circuits to the port data interface circuit packs.

25-Pair Cables

The 25-pair connectorized building cables are 24-gauge 50-conductor cables with each conductor individually covered with a PVC insulator jacket. The vinyl jacket conforms to the even-count color code scheme. The individual conductors are combined and covered in an outer jacket of light olive gray vinyl. These cables are terminated on each end with a 25-pair connector.

The 25-pair connectorized cables are used to connect from the network interface module to the trunk/auxiliary cross-connect field, from the trunk/auxiliary cross-connect field to the main cross-connect field, and from the main cross-connect field to the system equipment cabinets.

The 25-pair shielded connectorized cables are similar to the standard connectorized cable except that the outer vinyl jacket is covered with a tinned copper wire braided shield. These cables are used between the system and the main cross-connect field.

4-MHz Channel Cables

The 4-MHz channel coaxial cables are dual-conductor cable with a braided outer conductor and a central solid wire conductor. The outer conductor surrounds dielectric material and is covered with a PVC jacket. The central conductor is terminated at the common control end with 953 k paddleboard connectors and at the module control end with 982AA paddleboard connectors. The outer conductor is not terminated on the common control end. These cables interface the 4-MHz data subchannel in the common control carrier to the module control carrier.

Discrete Wires

Discrete wires of various gauges that are used in the system are usually insulated, stranded wire. Wires are terminated on each end with spade lugs or connectors or a combination of spade lugs and connectors. The connector types used are paddleboard and Burndy connectors. The discrete wires are used to connect the frequency generator to the port carriers and to connect voltage and ground from the bus bar to the carriers and other cabinets. Discrete wires are also used for connection of the thermal sensor and for alarm field terminal strip connections to the alarm panel.

Peripheral Cables

The connectorized cables (mounting cord) for the slow-speed data channel peripherals are usually 12-pair or 25-pair standard building cable terminated with appropriate connectors for connection to the peripheral. These cables connect the Maintenance and Administration Panel (MAAP), System Management Terminal (SMT), and attendant console to the common control cabinet.

Patch Cords

The 110-type connectorized patch cords are stranded 24-gauge wire with polyvinyl chloride insulation. The connectors are designed to mate with standard 110-type connecting blocks and are configured for either 1-pair (110P2A) or 3-pair (110P6A) termination. Patch cords are designed for cross-connect field connections with building wiring. Quantities and lengths vary and are system dependent.

Fiber-Optic Cables

The system fiber-optic cables are designed with 62.5-micron core fiber. Fiber ribbon cable is used for inter- and intra-building distribution. Each cable can contain up to 12 ribbon fibers of 12 fibers each. The fiber-optic cables use transmitter and receiver interfaces to interface to the system carriers. Each of these cables is duplex, containing a send fiber and a receive fiber in the same jacket. Each send and receive fiber link requires a transmitter at one end and a receiver at the other end. Signals are converted from Transistor-Transistor-Logic (TTL) driven data to unipolar light pulses and are then carried over the fiber-optic cable. After the pulses are carried over the cable, they are then converted from light pulses back to TTL driven data.

The fiber-optic cables are used to connect the TMS and the module controls and to connect the TMS and remote module interfaces.

Fiber-Optic Link Subsystem

Fiber-optic links are used between the TMS and module controls, as well as between the TMS and Remote Module Interfaces (RMIs) through Lightguide Cable Interconnection Terminals (LCITs). The LCIT fans out into 12 individual fibers with biconic connectors. These connectors accept 401-series attenuators which balance the optical power level to eliminate overdriving or underdriving the receivers. The LCIT and attenuators are the demarcation point for switching equipment and facilities distribution.

The fiber-optic links use transmitter and receiver paddleboards to interface to the system carriers. A transmitter paddleboard uses a light-emitting diode (LED) to convert serial TTL-driven data to light pulses. A receiver paddleboard uses a photo diode to convert light pulses back to TTL-driven data.

Each paddleboard provides a mating connector for the fiber cable interface and a small connector for mounting on and connecting to the carrier backplane pins at the appropriate circuit pack slot. Paddleboards are relatively small and only a few inches square. Transmitter paddleboards used for remote modules have switch settings for full/half power and normal/test mode. Receiver paddleboards for remote modules have green and red LEDs to provide an indication of whether the link is being underdriven or overdriven. Paddleboards for co-located TMS and modules do not require or have option switches or LEDs.

The following transmitter and receiver paddleboards are used with the System 85 fiber-optic links:

TYPE	INTERFACES	CODE
Co-located TMS and Module Controls:		
Transmitter	TN480, TN481	Z982A
Receiver	TN480, TN481	Z982B
Remote Modules:		
Transmitter (TMS)	TN480, TN481	Z982C
Transmitter (RMI)	TN456	Z982J
Receiver (TMS/RMI)	TN480, TN481, TN456	Z982D

Duct Work

Cable ducts (ED-1E465) are mounted on the top of each cabinet and are interconnected to provide a continuous pathway for system cables. These ducts provide support and protection for the system cable. If the system layout consists of two or more rows of cabinets, cross-aisle cable duct assemblies are installed. In many configurations, an overhead (suspended) cable support rack is installed to facilitate cabinet interconnections. Cables and wiring for the system are routed between the cabinets and to the main cross-connect field through three types of cable ducts: shielded, unshielded, and power ducts (see Figure 3-25).

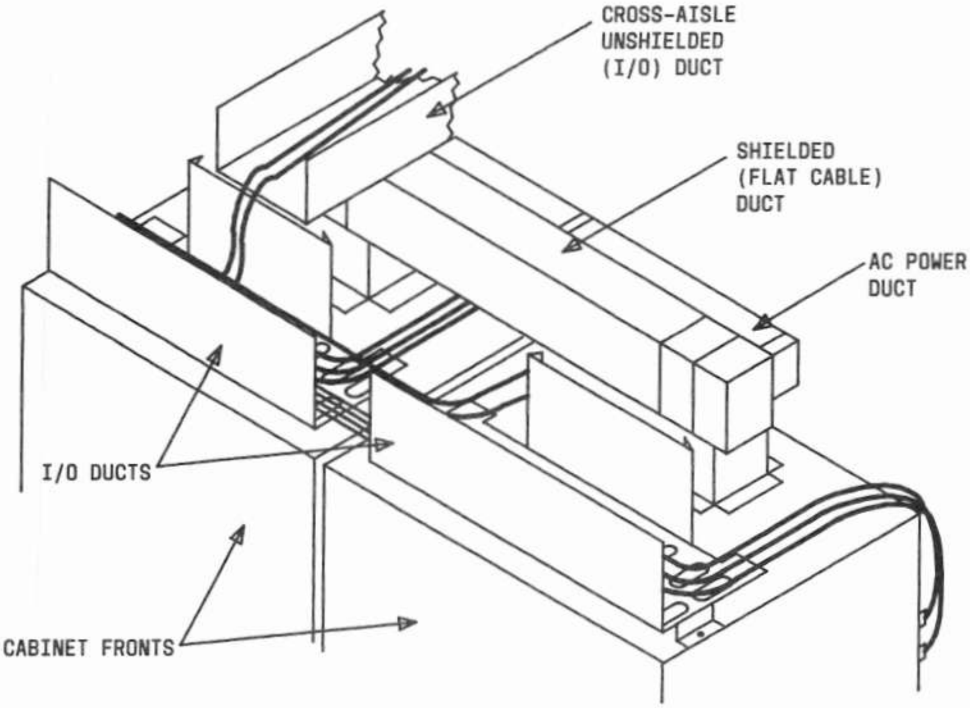


Figure 3-25. Cable Routing Through Duct Work

Shielded (Flat Cable) Duct

The shielded duct provides a pathway which is physically enclosed for inter-cabinet cabling. This duct is predominantly used to route flat ribbon cables and other inter-cabinet cables which require external shielding for electro-magnetic compliance. This duct is also used to route inter-cabinet cabling such as the fiber-optic cables between the TMS and module control. The shielded duct is often referred to as the flat cable duct.

This duct runs along the top rear of the System 85 cabinets and has vertical extensions (referred to as risers or chimneys) which allow internal access to the cabinet through the top. Shielded duct segments are also available to provide cross-aisle connectivity between rows of cabinets.

Unshielded (I/O) Duct

The unshielded duct provides an open trough for external cabinet-to-cabinet and cabinet-to-termination-field cabling. This duct is predominantly used to route 25-pair shielded I/O cables between the cabinets and the termination fields. It is also used for routing fiber-optic cables between cabinets and the LCIT for remote modules. (An access hole in the duct chimney allows the fiber-optic cable to exit through the top of the cabinet and enter the unshielded duct.) The unshielded duct runs along the top front of the cabinets, behind a front facia which is also mounted at the top front of the cabinets for aesthetics. Unshielded duct segments are also available to provide cross-aisle connectivity between rows of cabinets, and also to provide a cable route from the side or rear of a cabinet to a wall with nominal 43-inch spacing. The unshielded duct is more commonly referred to as the I/O duct.

Power Duct

The power duct provides an ac wire pathway and required ac receptacles for cabinet ac power and/or utility outlets. The power duct runs along the top rear of the cabinets and is physically mounted to the shielded (flat cable) duct.

SWITCH EQUIPMENT CODE SUMMARY

The following equipment codes designate major hardware units associated with the basic System 85 switch:

CODE	DESCRIPTION
ED-1E430-70	Thermal Sensor Assembly
ED-1E434-11	System Cables
ED-1E435-70	Bus Bar
ED-1E436-10	Intra-Cabinet Cables
ED-1E437-10	Inter-Cabinet Cables
ED-1E444-70	No-Carrier Adapter
ED-1E453-70	Document File Assembly
ED-1E465-70	Duct Work
J1C170A	High Capacity Mini-Recorder
J58886B	Module Control Cabinet
J58886C	Port Cabinet
J58886F	TMS/RMI Cabinet
J58886J	Unduplicated Common Control Cabinet
J58886K	Duplicated Common Control Cabinet
J58888A	Port Carrier
J58888C	TMS Carrier
J58888E	Common Control Carrier
J58888F	Duplicated Common Control Power Carrier
J58888M	Module Control Carrier
J58888N	DS-1/MFAT Carrier
J58888S	RMI Carrier
J58889AD	DC (Frame) Filter Unit
J58889AN	Remote Group Housing
J58889AV	AC Distribution Unit (With OLS Hardware)
J58889G	AC Distribution Unit
J58889H	DC Filter Unit
J58889T	Unduplicated Common Control DC/DC Converter Unit
J58889TM	Program Tape
J58889U	AC Distribution Unit
J58889V	DC Fan Assembly
J58889W	Unduplicated Common Control Alarm Panel
J58889X	Duplicated Common Control Alarm Panel
J87462A	Battery Reserve Unit

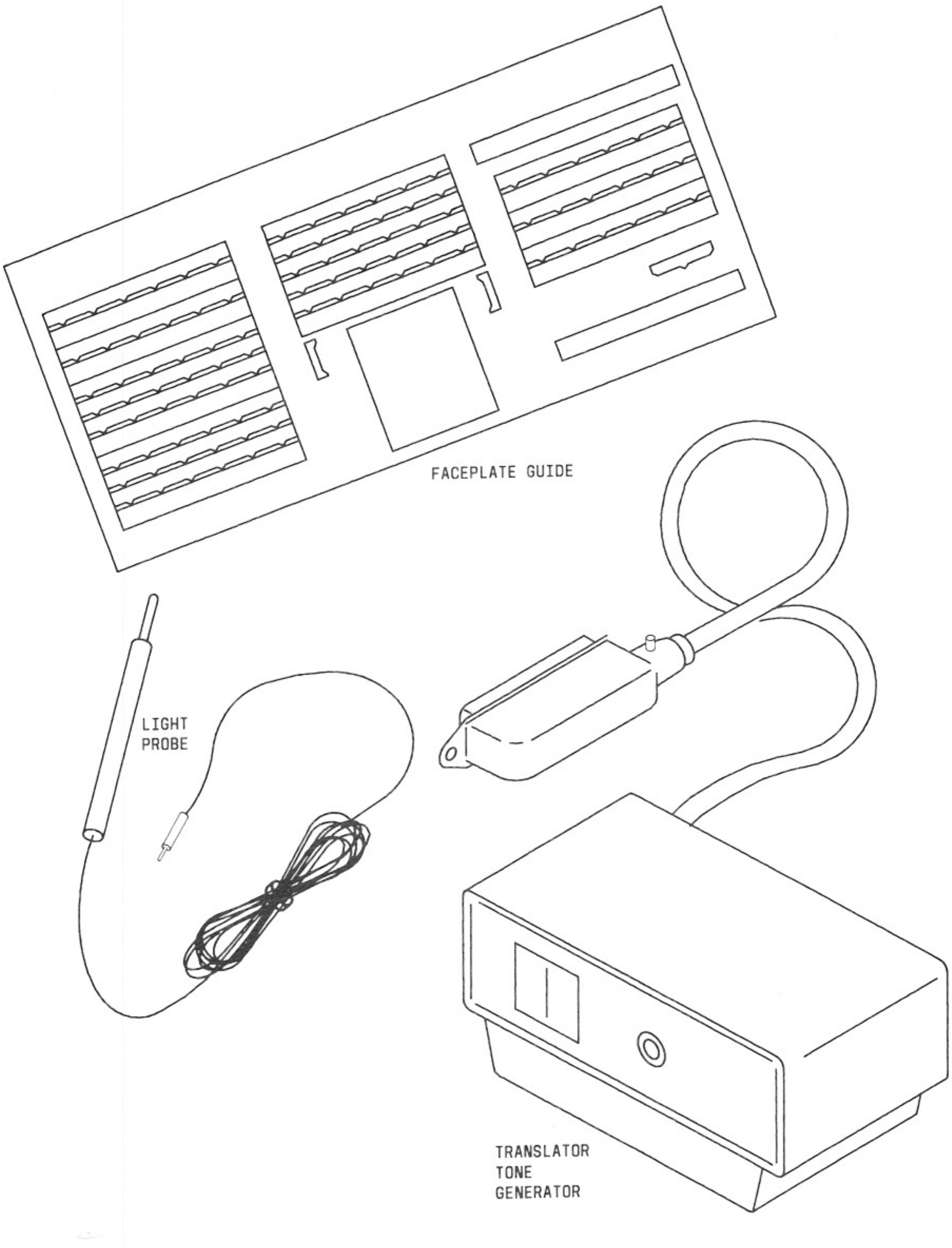


Figure 4-2. Visually Impaired Attendant Service Equipment

Attendant Console Repeaters

Attendant console repeaters (J58889Y) are electronic circuit amplifiers and/or isolators that provide range extension and/or surge protection from high voltages such as lightning. When the console is located in a separate building from the system control complex, but near enough that range extension is not needed, the repeaters are equipped to provide surge protection only.

The following equipment is used in conjunction with the basic unit (see Figure 4-3) to provide the specific configuration of surge protection and/or range extension required:

- AE48—single direction repeater, required for range extension. Also, provides data channel lightning protection for off-premise console with range extension.
- AE49B—clock and regulator, required for range extension.
- WJ3—single direction data link buffer, used for both the system-end and console-end repeaters. These are required for lightning protection without range extension.
- WJ6—alarm repeater, required for the system-end repeater.
- WJ7—alarm repeater, required for the console-end repeater.
- 284B1—power unit, required with or without range extension.
- 28D2—power unit, required for range extension.

Figure 4-4 illustrates connectivity for an off-premises attendant console with range extension and intermediate repeaters. A repeater located at the console end of the channel is usually wall mounted. A repeater located at the system end of the channel is mounted in the Auxiliary Cabinet.

Each attendant console repeater providing range extension requires 120-V 60-Hz commercial power. Attendant console repeaters not providing range extension require 120-V 60-Hz commercial power only at the repeater near the console.

Connections

Power for the attendant console is -48 V dc and is derived from connectors on Module Control Cabinets and Port Cabinets equipped with rectifiers. If range extension is required with repeaters, power for the console is derived locally at the console-end repeater. During a commercial ac power outage, a console without range extension will operate for the length of time specified for nominal holdover or extended power reserve (if equipped). Consoles using out-of-building protection or range extension will not be operable during this time unless the repeater equipment is also powered through holdover or essential ac power sources.

Three signal leads from the common control carrier are multiplied to each console. These leads are alarm (ALM*), acknowledge (ACK*), and alarm power (-48ACAL). They control visual indications of system alarm status on the attendant consoles. The alarm lamp on the console is lighted whenever there is an active major or minor alarm. The ACK lamp is lighted whenever the active alarm has been successfully reported to the remote maintenance center through the remote interface in the common control.

For each attendant console, four data channel leads connect to a low-speed peripheral interface (TN403) in the System 85 common control. Six voice and control leads connect to an attendant console audio interface (SN233B/C) port circuit.

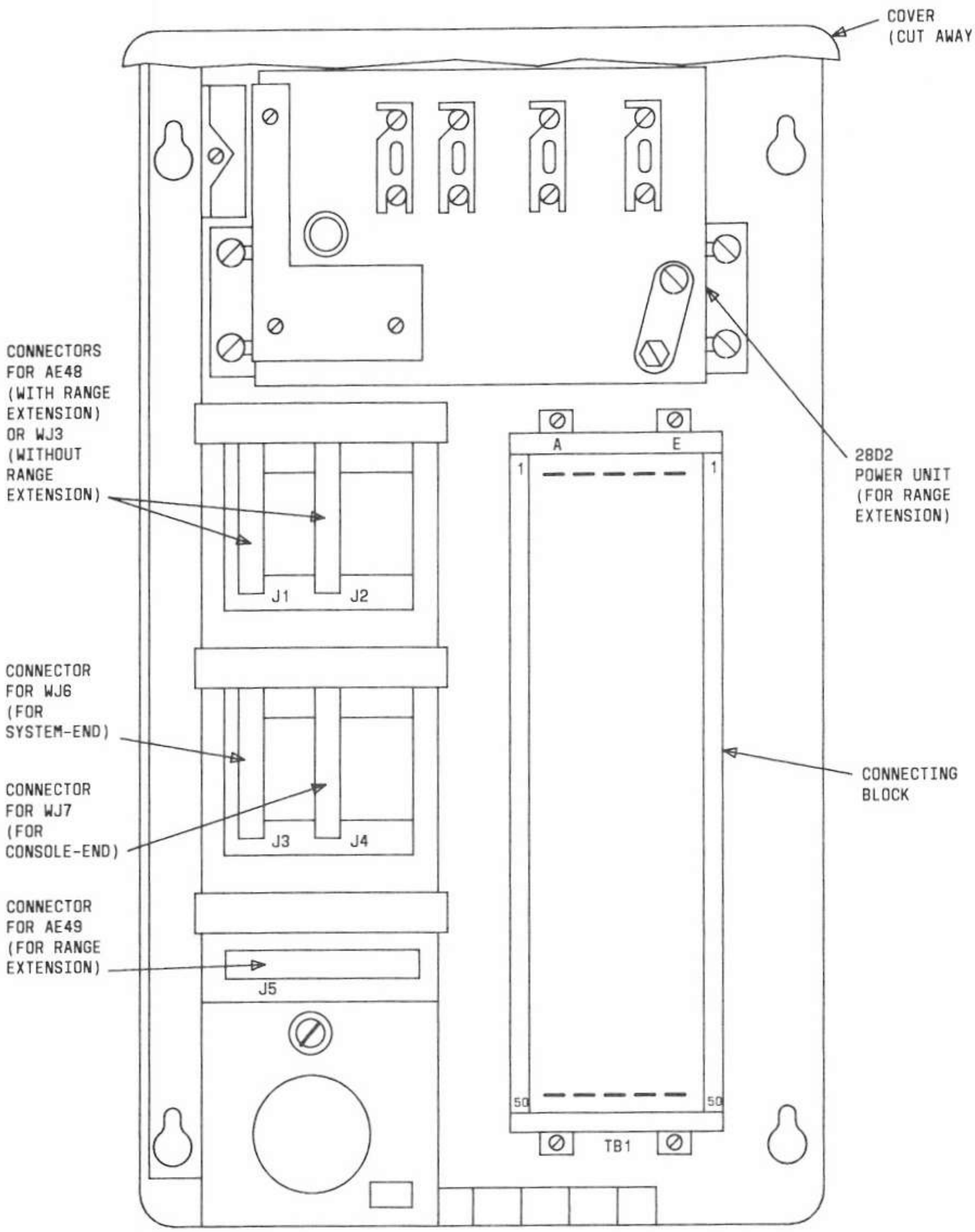
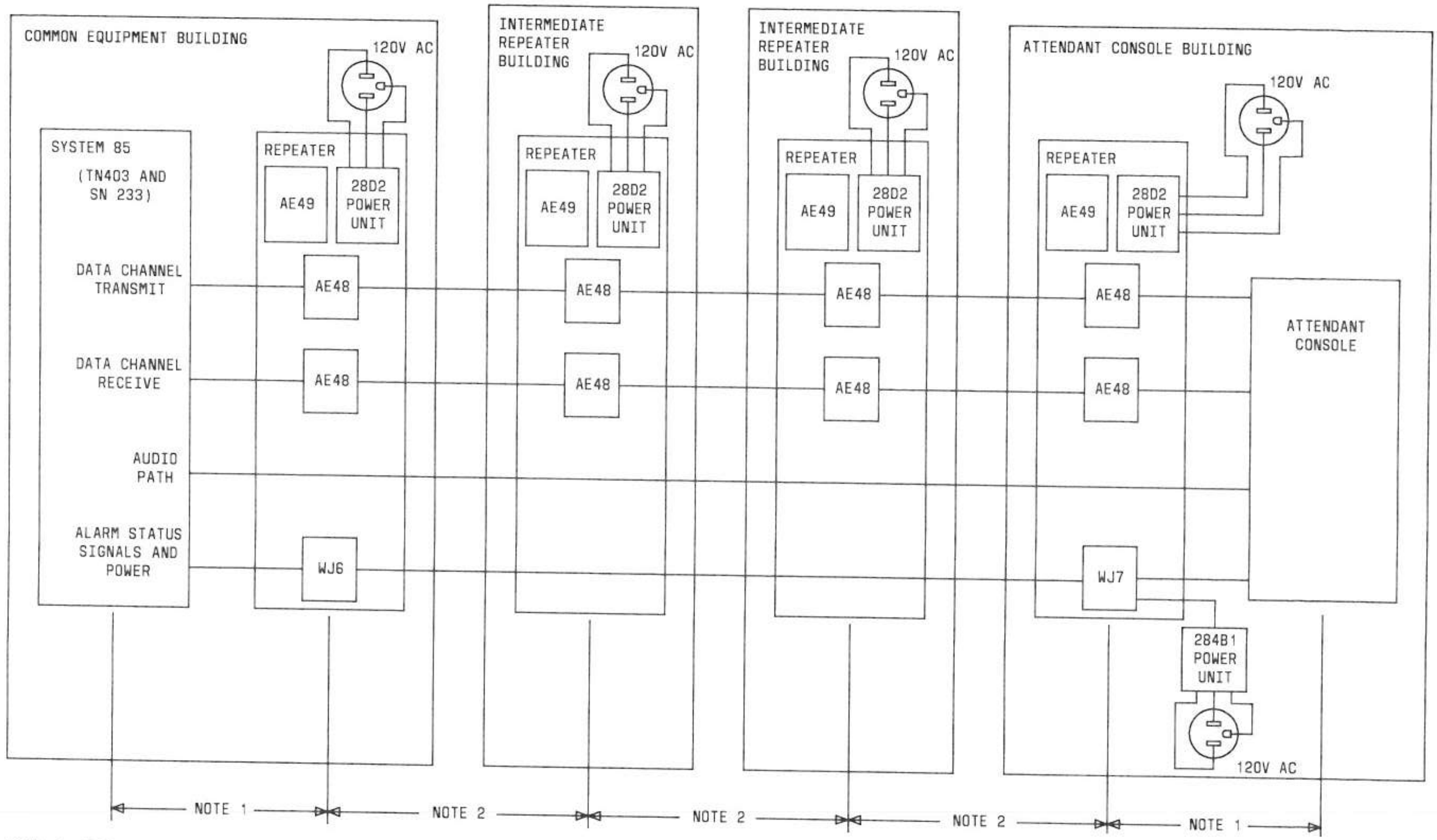


Figure 4-3. Attendant Console Repeater (J58889Y)



NOTE 1: 1000 FEET MAX. FOR 24 AWG.
NOTE 2: 3000 FEET MAX. FOR 24 AWG.

Figure 4-4. Off-Premises Attendant Console Connectivity

The attendant console is equipped with a 12-pair mounting cord that is connected to a 12- or 25-pair system distribution cable. The mounting cord is equipped with a 50-pin KS-16689, L1 connector, while a mating connector terminates the distribution cable.

The first console cable is run to a jumpered module control cabinet connector. These jumpered connectors allow the console to be disconnected and a "test" console connected at the module control cabinet. All other console cables extend from the auxiliary cross-connect field to the console location.

Location

When repeaters without range extension are used, the distance between the attendant console and the system must not exceed 1000 feet (305 m). When repeaters with range extension are used, the maximum distance is 11,000 feet (3,353 m).

For more detailed information on the attendant console, refer to **AT&T System 85 (R2V3)—Console Operation—User's Guide** (555-102-730).

VOICE TERMINALS AND ADJUNCTS

Overview

Voice terminals have a variety of controlling and monitoring capabilities. In addition to providing basic telephone service (placing and answering calls), voice terminals also access System 85 features. They offer a wide spectrum of price/performance tradeoffs to tailor the system to a customer's needs.

Two analog and seven multi-appearance models, along with feature-intensive optional adjuncts, are designed specifically for use with System 85 (see Figure 4-5). All System 85 voice terminals can be desk or wall mounted, and most offer (mutually exclusive) speakerphone and headset adapter options. They are available in black, brown, white, and burgundy.

In addition to the System 85 models, three 2500-type models and five Multibutton Electronic Telephone (MET) models can be supported by the system. (The METs are supported only on an "in-place" basis and are not generally available. They must be administered as 7200H series hybrid voice terminals with similar button assignment restrictions.)

The voice terminals, adjuncts, and system switch interfaces conform to a modular uniform wiring arrangement. This arrangement provides for a maximum of three pairs of wiring from the switch interface cross-connect point (satellite closet or equipment room) to a 4-pair modular jack. The fourth pair provides an option for remote power for certain voice terminal adjuncts. (Note: None of the voice terminals specifically designed for System 85 are registered under FCC Part 68 Rules for the emergency transfer capability. This precludes their use for direct connection to the public switched network or for emergency transfer applications. The 2500-type sets must be used in these cases.)

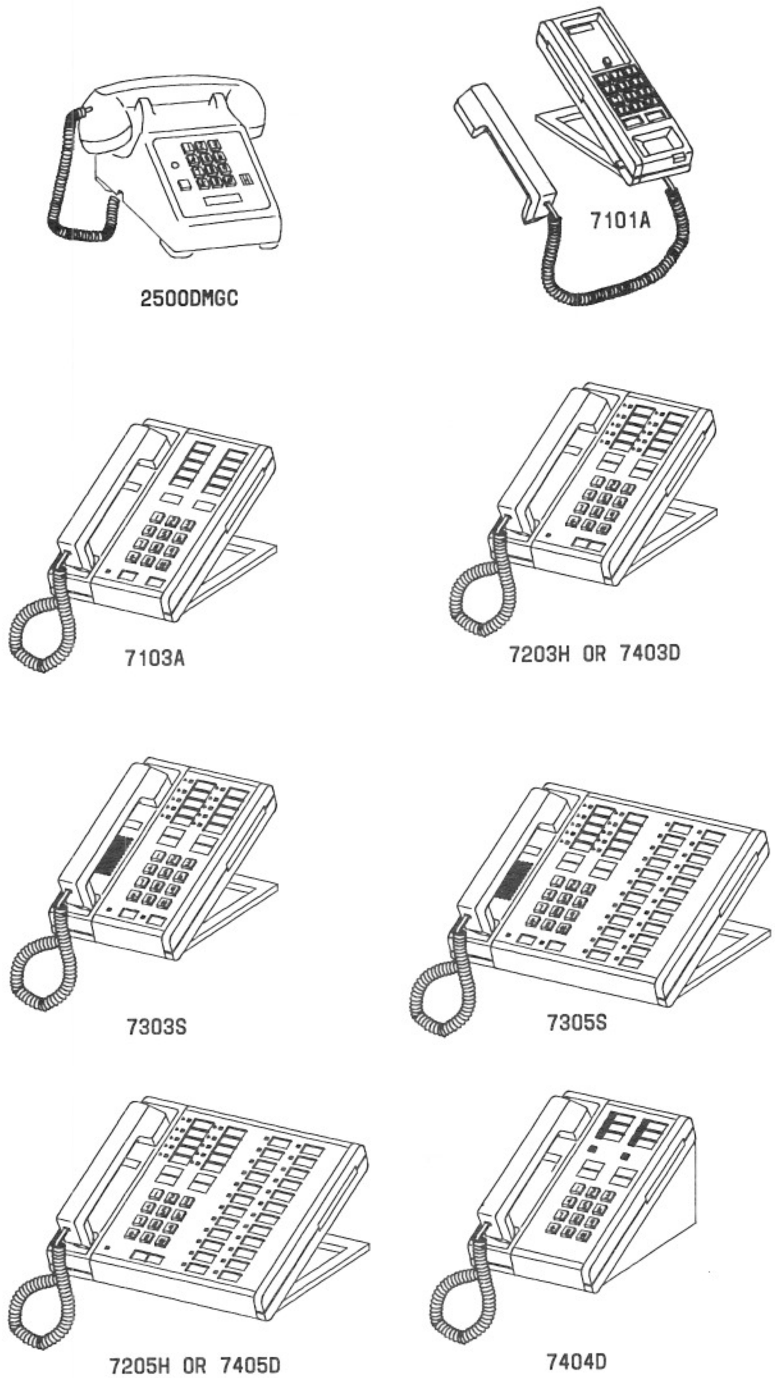


Figure 4-5. System 85 Voice Terminals

Analog Voice Terminals

The analog voice terminals are single-line sets that handle analog voice signals over a tip and ring pair of wires (see Figure 4-6). They have only one call appearing at any one time at the voice terminal. Power for these terminals is provided from the switch interface over the single voice pair. The analog voice terminals interface to SN228B/SN229B analog line port circuit packs.

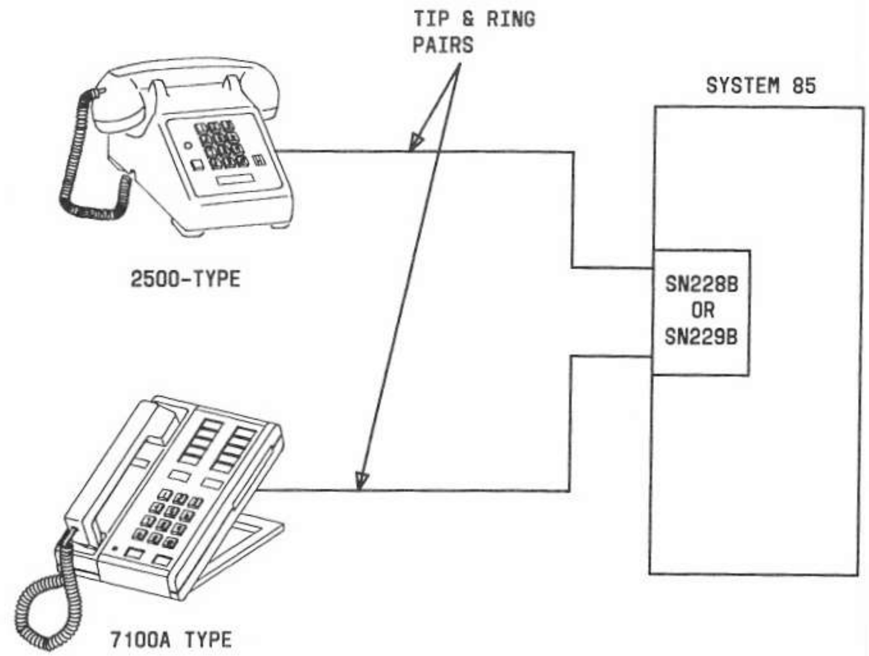


Figure 4-6. Analog Voice Terminal Connectivity

2500-Type Voice Terminals

These single-line models are conventional touch-tone telephones equipped with handset, touch-tone telephone dial, and ringer volume control. These voice terminals, though not specifically designed for use with System 85, may be interfaced to SN228B/SN229B analog line port circuit packs. Physical bridging is possible when interfaced with the SN228B pack. Although four ringers can be supported with bridging, only two 2500-type voice terminals should be physically bridged to insure proper transmission levels when multiple terminals are off-hook.

The basic 2500 voice terminal is a desk-top telephone. The 2554 model is a wall-mounted touch-tone telephone. It has the same features as the basic 2500 version. The 2500DMGC voice terminal (see Figure 4-7) is a recently enhanced version of the basic 2500 voice terminal. In addition to the features of the 2500/2554 models, the 2500DMGC comes equipped with a Message Waiting indicator and RECALL button for timed switchhook flash.

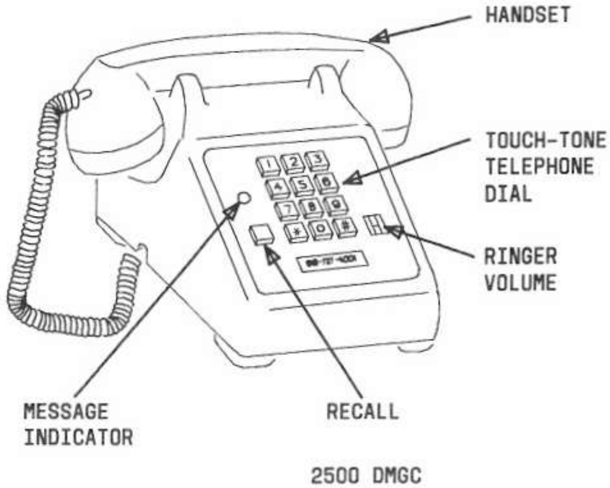


Figure 4-7. 2500DMGC (Analog) Voice Terminal

7100A Series Voice Terminals

These single-line analog voice terminals require one pair of wiring for operation and are compatible with standard 2500-type signaling and voice levels. These voice terminals also interface with SN228B/SN229B analog line port circuit packs. Due to the Message Waiting feature and loop current circuitry, the 7100A series terminals cannot be physically bridged to the same analog line port (in the manner of the 2500-type voice terminals).

The following summarizes capabilities provided by the 7101A:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- RECALL and DISCONNECT Buttons.

The 7103A-01A voice terminal (R2V1 systems only) provides all the capabilities of the 7101A plus additional fixed feature buttons and optional speakerphone or headset adapter. The fixed feature buttons allow single-button operation for a predefined set of system features. Within any one System 85, all voice terminals of this type have identical customer-designated feature buttons located in the same positions on all the terminals.

The following summarizes capabilities provided by the 7103-01A:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- RECALL and DISCONNECT Buttons
- Eight Fixed Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter.

The 7103A-01C is a redesigned programmable version of the 7103A-type voice terminal. It features personalized ringing for selecting one of four different ringing tones. It also has ten individually assigned feature buttons (instead of the eight systemwide feature buttons of the 7103A-01A) and two additional fixed function buttons (LAST NUMBER/WAIT and PROGRAM). The individually programmable buttons allow each user to choose the most desirable features or enter often dialed numbers. The PROGRAM button activates/deactivates the programming mode. The WAIT button is used when storing a number that requires a second dial tone. Programming is accomplished by switching the voice terminal into the program mode and entering up to 13 characters (including WAIT) per feature button. If there is a power failure or the terminal is unplugged, the customer-programmed memory is maintained by an internal backup battery.

The following summarizes capabilities provided by the 7103A-01C:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Four Fixed Function Buttons
- Ten Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter.

Hybrid Voice Terminals

The hybrid voice terminals are multi-appearance sets that employ digital signaling and analog voice over three wire pairs (see Figure 4-8). They can have one, two, or more calls appearing simultaneously at the voice terminal. Power for these terminals and their optional add-on modules is phantomed from the switch interface over the two digital pairs used for control and signaling. The 7200H series terminals and METS interface to SN224B hybrid line port circuit packs. The 7300S series terminals interface to ANN17B double-density hybrid line port circuit packs.

7200H Series Voice Terminals

Two 7200H series voice terminals are available. These are multi-appearance models based on MET technology and requiring 3-pair wiring for operation. One wire pair is used for analog voice and two pairs are used for digital control and signaling. These voice terminals interface to SN224B hybrid line port circuit packs.

The following summarizes capabilities provided by the 7203H:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons
- Ten Appearance/Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter.

The 7205H incorporates all the capabilities provided by the 7203H plus 24 additional feature-only buttons. It may also accommodate an add-on call coverage module which provides 20 additional appearance/feature buttons and a function key module which provides 24 additional feature-only buttons. The call coverage module attaches to the top of the voice terminal, and the function key module attaches to the right side. These optional modules use the same phantom power from the switch (through the digital pairs) that also powers the 7205H. This impacts the distance allowed from the switch.

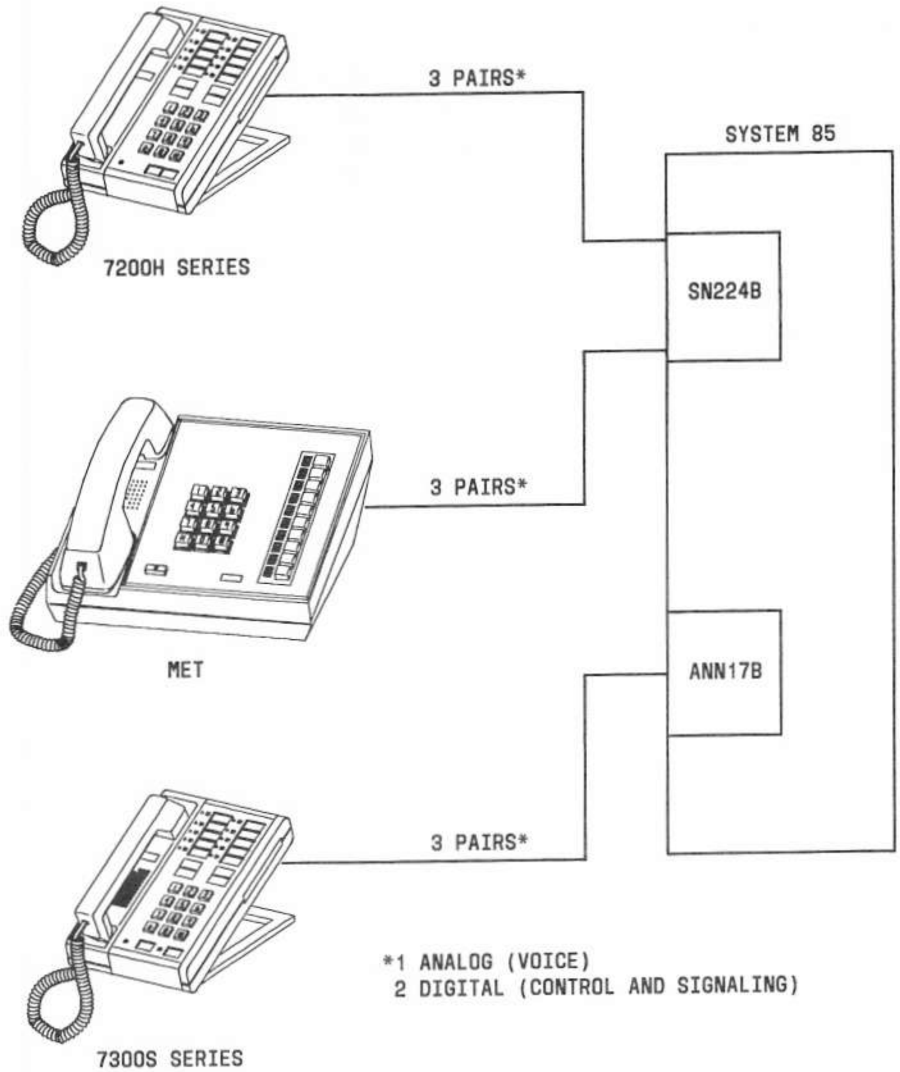


Figure 4-8. Hybrid Voice Terminal Connectivity

The following summarizes capabilities provided by the 7205H:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons
- Thirty-Four Appearance/Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter, C201A Call Coverage Module, and F201A Function Key Module.

7300S Series Voice Terminals

Two 7300S series voice terminals are available. These multi-appearance models have characteristics similar to those of the 7200H series (including MET technology and 3-pair wiring). They are designed for use with two optional add-on adjuncts and incorporate a built-in speaker with related controls. These voice terminals interface to ANN17B double-density line port circuit packs.

The following summarizes capabilities provided by the 7303S:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons
- Ten Appearance/Feature Buttons
- Built-In Speaker
- Combined Tone Ringer/Speaker Volume Control
- Speaker Control Button and Indicator
- Optional—S102A Speakerphone or 502A Headset Adapter.

The 7305S voice terminal (like the 7205H) provides an additional 24 feature-only buttons. The following summarizes capabilities provided by the 7305S:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons
- Thirty-Four Appearance/Feature Buttons
- Built-In Speaker
- Combined Tone Ringer/Speaker Volume Control
- Speaker Control Button and Indicator
- Optional—S102A Speakerphone or 502A Headset Adapter.

Multibutton Electronic Telephones (METs)

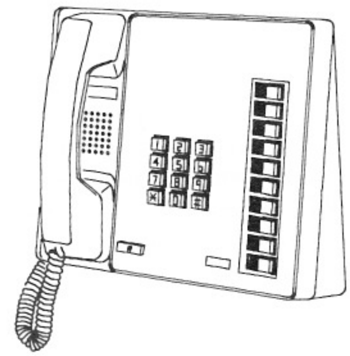
The METs used with System 85 (see Figure 4-9) are supported only on an "in-place" basis and are not generally available. They must be administered as 7200H series voice terminals with similar button assignments. The METs interface to SN224B hybrid line port circuit packs.

The following summarizes capabilities provided by the METs:

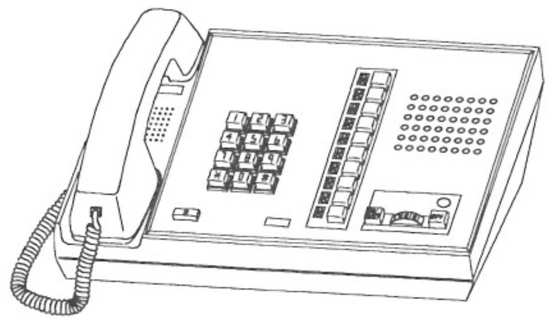
- Volume Control (Tone Ringer)
- Six Fixed Function Buttons
- Five, Fifteen, or Twenty-Five Appearance/Feature Buttons.

The desk METs include 10-, 20-, and 30-button versions. One MET is a wall-mounted version of the 10-button desk model. Another version has all the features of the 10-button desk MET in addition to a built-in speakerphone, indicator, and controls.

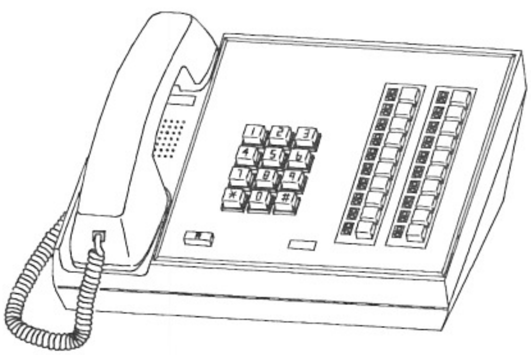
10-BUTTON MET (DESK)



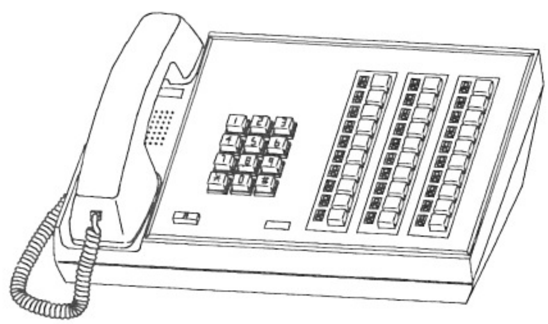
10-BUTTON MET (WALL)



10-BUTTON MET WITH SPEAKERPHONE



20-BUTTON MET (DESK)



30-BUTTON MET (DESK)

Figure 4-9. Multibutton Electronic Telephones (METs)

Digital Voice Terminals

The digital voice terminals are multi-appearance sets that employ both digital signaling and voice over a 4-wire digital communications protocol (DCP) channel (see Figure 4-10). Each data pair supports one signaling channel and two information channels for simultaneous Pulse Code Modulation (PCM) voice and data. Similar to the hybrid voice terminals, they can also have one, two, or more calls appearing simultaneously at the terminal. Power for digital voice terminals is phantomed from the switch interface over the two data pairs. Their optional add-on modules and adjuncts are powered locally by an adjunct power supply, or from a power source in a satellite closet through a fourth pair of voice terminal wiring. The 7400D series voice terminals interface to SN270B digital port circuit packs. The AT&T Personal Terminal 510D and 515 BCT (discussed later in this section) employ similar voice terminal connectivity.

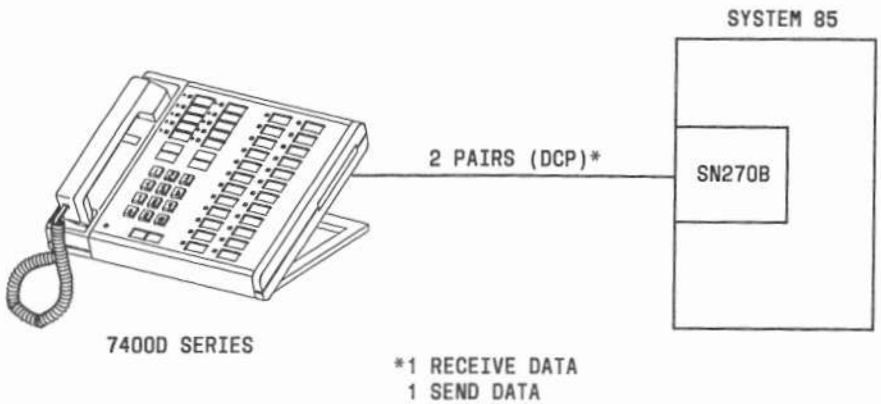


Figure 4-10. Digital Voice Terminal Connectivity

7400D Series Voice Terminals

Three 7400D series voice terminals are available. These terminals convert analog voice to digital PCM for transmission through the DCP and vice versa. They allow integration of voice and data simultaneously over the 2-pair DCP interface. All of the optional modules and adjuncts for 7400D series terminals are powered locally by an adjunct power supply or from a power source in a satellite closet through a fourth pair of terminal wiring. These voice terminals interface to SN270B digital port circuit packs.

The 7403D voice terminal is externally and functionally equivalent to the 7203H hybrid terminal. In addition, the 7403D may also accommodate a Digital Terminal Data Module (DTDM), which attaches to the right side and allows connection of an EIA RS-232C data terminal. With this arrangement, two individual ports are effectively utilized in the switching network, but are multiplexed over a single port interface and DCP line. The following summarizes capabilities provided by the 7403D:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons

- Ten Appearance/Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter, and 701A DTDM.

The 7405D incorporates all the capabilities provided by the 7403D plus 24 additional feature-only buttons. The 7405D may also accommodate an add-on call coverage module which provides 20 additional appearance/feature buttons, or a 40-character digital display module for call-related information and message retrievals. (The call coverage module and digital display module are mutually exclusive.) Other optional adjuncts for the 7405D include a function key module which provides 24 additional feature-only buttons, or a Digital Terminal Data Module (DTDM). The call coverage module or digital display module attaches to the top of the voice terminal. The function key module or DTDM attaches to the right side.

The following summarizes capabilities provided by the 7405D:

- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Lamp Test Switch
- Six Fixed Function Buttons
- Thirty-four Appearance/Feature Buttons
- Optional—S101A Speakerphone or 500A Headset Adapter, C401A Call Coverage Module or D401A Digital Display Module, and F401A Function Key Module or 701A DTDM.

The new 7404D voice/data terminal (see Figure 4-11) provides the basic functions of a 7403D voice terminal with an integrated data module at a reduced price. The 7404D does not support a speakerphone or headset, but it comes equipped with the following voice terminal features:

- MESSAGE Indicator
- DATA CALL IN PROGRESS Indicator
- Volume Control (Tone Ringer)
- Self-Test Switch
- Four Fixed Function Buttons
- Six Appearance/Feature Buttons.

In addition, the 7404D provides the following data module features:

- Asynchronous full-duplex operation
- American Standard Code for Information Interchange (ASCII) dialing for call origination
- DCP cartridge-based architecture
- RS-232C interface
- 10-bit start-stop codes
- Automatic answer for incoming calls on I2 channel
- Data rates of 300; 1,200; 2,400; 4,800; 9,600; and 19,200 bits per second (bps)
- Local echoing of user data and customer programming options
- Menu-based options via an attached data terminal.

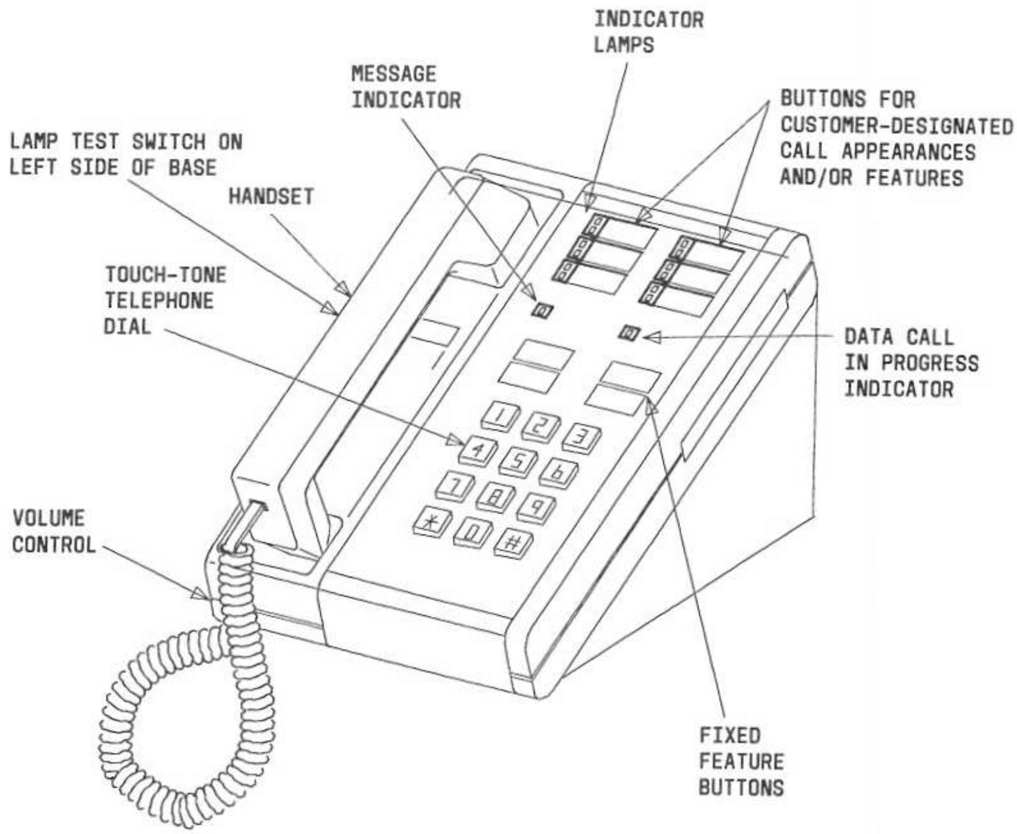


Figure 4-11. 7404D (Digital) Voice/Data Terminal

Voice Terminal Adjuncts

Speakerphones

Four types of speakerphones are used as adjuncts to voice terminals. Two are specifically designed for System 85, while the others are supported on an "in-place" basis along with their voice terminals.

S101A Speakerphone

Figure 4-12 depicts the S101A speakerphone. This unit features an ON/OFF button for the speakerphone, an ON/OFF button for the microphone, indicator lamps, and a volume control. It measures 4.75 inches (121 mm) wide, 6 inches (152 mm) deep, and 2.5 inches (64 mm) high. The S101A is designed specifically for use with the 7103A, 7200H series, and 7400D series voice terminals. This speakerphone is mutually exclusive with the headset adapter option and is powered locally by an adjunct power supply or from a power source in a satellite closet through a fourth pair of voice terminal wiring.

S102A Speakerphone

Figure 4-12 depicts the S102A speakerphone. This unit features an ON/OFF button for the speakerphone, an ON/OFF button for the microphone, indicator lamps, and a volume control. It measures 4.75 inches (121 mm) wide, 6 inches (152 mm) deep, and 2.5 inches (64 mm) high. The S102A is designed specifically for use with the 7300S series voice terminals. This speakerphone is mutually exclusive with the headset adapter option and is powered locally by an adjunct power supply or from a power source in a satellite closet through a fourth pair of voice terminal wiring.

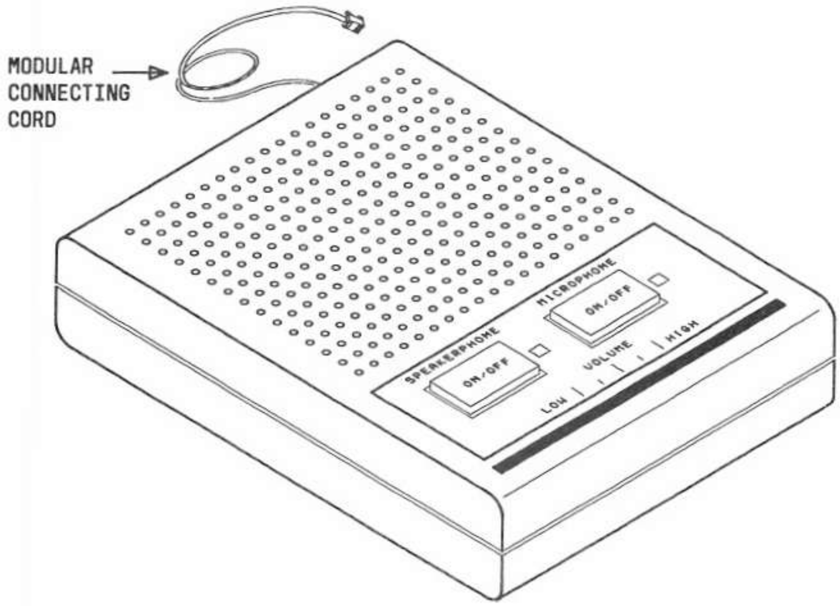


Figure 4-12. Speakerphone (S101A/S102A)

107-Type Loudspeaker

The 107-type loudspeaker amplifies only the received voice signal and has a rotary volume control and on/off switch. This loudspeaker measures 5.75 inches (146 mm) wide, 4 inches (102 mm) high, and 3.75 inches (95 mm) deep. It is used only with 2500-type voice terminals on an "in-place" basis.

4A Speakerphone

The 4A speakerphone system uses a speakerphone and a separate transmitter that contains an indicator lamp and operating controls. The controls include an ON OR QUIET button, an OFF button, and a volume control. The 4A speakerphone system is used only with basic 2500-type terminals and METs on an "in-place" basis.

Headset Adapters

Headset adapters (500A/502A) provide an interface for connecting a headset to the associated voice terminal. Each adapter has an ON/QUIET button, an OFF button, a green indicator lamp, headset jacks, and two modular jacks (4-wire and 8-wire keyed). The 500A adapter is designed specifically for use with the 7103A, 7200H series, and 7400D series voice terminals. The 502A adapter is designed specifically for use with the 7300S series voice terminals. The 500A/502A headset adapters are mutually exclusive with the speakerphone option and are powered locally by an adjunct power supply or from a power source in a satellite closet through a fourth pair of voice terminal wiring.

Call Coverage Modules

When added to a 7205H hybrid voice terminal, the optional hybrid call coverage module (C201A) provides 20 additional appearance/feature buttons. The additional appearance buttons allow one voice terminal to provide coverage for a group of extension numbers. This module attaches to the top of the voice terminal. The hybrid module uses the same phantom power from the switch (through the digital pairs) that also powers the 7205H. This impacts the distance allowed from the switch.

The corresponding digital version of the call coverage module (C401A) is attached to the 7405D digital voice terminal. This module is powered locally by an adjunct power supply, or from a power source in a satellite closet through a fourth pair of terminal wiring. The digital call coverage module is mutually exclusive with the digital display module.

Function Key Modules

When attached to a 7205H hybrid voice terminal, the optional hybrid function key module (F201A) provides 24 additional feature-only buttons for expanded feature capabilities. This module attaches to the right side of the voice terminal. The hybrid module uses the same phantom power from the switch (through the digital pairs) that also powers the 7205H. This impacts the distance allowed from the switch.

The corresponding digital version of the function key module (F401A) is attached to the 7405D digital voice terminal. This module is powered locally by an adjunct power supply, or from a power source in a satellite closet through a fourth pair of terminal wiring.

Digital Terminal Data Module (DTDM)

The 7403D and 7405D digital voice terminals may accommodate a DTDM (DSU 701A), which attaches to the right side of the voice terminal and allows connection of an EIA RS-232C data terminal. With this arrangement, two individual ports are effectively utilized in the switching network, but are multiplexed over a single port interface and DCP line. The DTDM is mutually exclusive with the function key module. For more detailed information, refer to DTDM (under DATA EQUIPMENT AND INTERFACE DEVICES in this section).

Digital Display Module

When attached to a 7405D digital voice terminal, the optional digital display module (D401A) provides a 40-character digital display for call-related information and message retrievals. The digital display module attaches to the top of the voice terminal. This module is powered locally by an adjunct power supply, or from a power source in a satellite closet through a fourth pair of terminal wiring. The digital display module is mutually exclusive with the digital call coverage module.

Automatic Dialer

The automatic dialer (2870A1) is an optional add-on adjunct for a MET (provided on an "in-place" basis only). The dialer provides the capability to record and automatically dial 31 telephone numbers of up to 15 digits each. It also provides last number dialed (manually) memory and the capability to pause for subsequent dial tones during automatic dialing (WAIT input).

The automatic dialer is equipped with a touch-tone telephone dial, 32 programmable buttons, RECORD indicator, and 4 fixed function buttons.

Voice Terminal Adjunct Power

Optional adjuncts enhance existing System 85 voice terminal features or add capabilities to them. However, power for the following adjuncts is not derived from the switch interface:

- Speakerphone (S101A/S102A)
- Headset adapter (500A/502A)
- Digital call coverage module (C401A)
- Digital function key module (F401A)

- Digital terminal data module (DSU 701A)
- Digital display module (D401A).

Power for these adjuncts (see Figure 4-13) must be provided locally at the voice terminal or from a satellite closet through the terminal wiring. Three types of power supplies are currently recommended:

- 2012D power supply—may be used locally to power either a headset adapter or speakerphone and may be located in a satellite closet (within distance limitations).
- KS-22911, L1 power supply—may be used locally or in a satellite closet to power a headset adapter or speakerphone plus one additional adjunct.
- 329A power supply—may be used locally or in a satellite closet and is capable of supplying power to any number of adjuncts that may be added to a digital voice terminal.

One of these power supplies must be used for each voice terminal equipped with one or more adjuncts. Voice terminal adjuncts and modules are not operational during interruptions of commercial ac power unless their power supplies are also powered through Standby Power or other essential ac power service.

The 329A-type power supplies clustered in a satellite closet are normally mounted on ac power strips. Power to these strips is provided from a dedicated 120-V ac, 60-Hz, 20-ampere circuit breaker and feeder either directly or through a 543A telephone power unit. The 543A unit provides an inductive filter to limit inrush current on the feeder. It comes equipped with an ac power cord which plugs into the dedicated feeder and provides four receptacles for ac power strips.

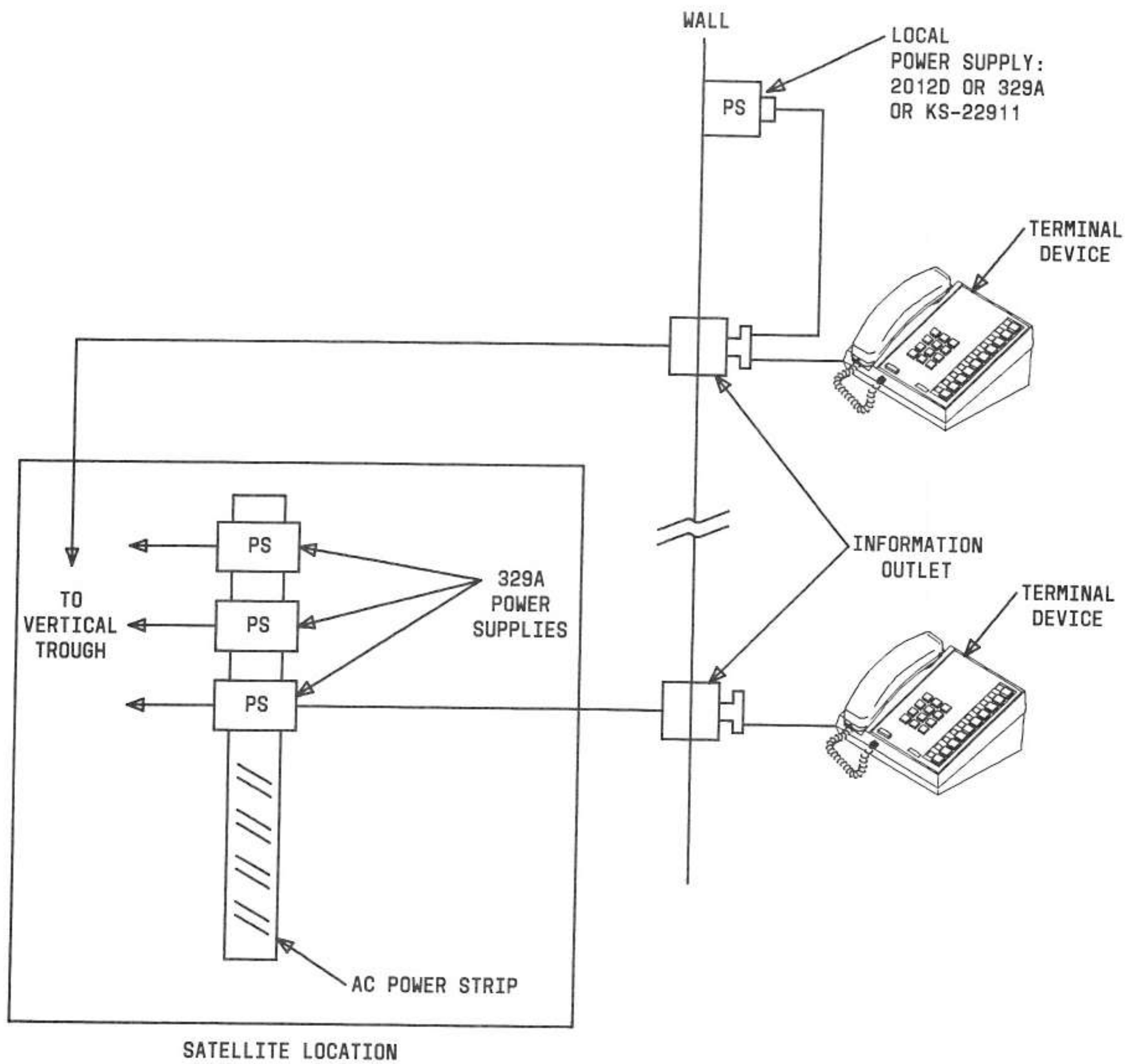


Figure 4-13. Local and Satellite Adjunct Power Sources

DATA EQUIPMENT AND INTERFACE DEVICES

Data Modules

Data modules provide protocol conversion for data terminal equipment (DTE) or data communications equipment (DCE) that is digitally connected (no analog conversion) to the System 85 switching network (see Figure 4-14). They provide selected Electronics Industries Association (EIA) data interfaces to customer data equipment and a Digital Communications Protocol (DCP) interface to the switch network. Certain data modules, in conjunction with analog data communications equipment, allow switched access between analog and digitally connected data equipment or facilities. Data modules support a wide range of data rates, interfaces, and data communications feature options. Automatic and demand self-tests and loop back tests through the System 85 switch are supported.

Data modules interface to the DCP line ports of SN270B circuit packs, with 2-pair wiring to the switch DCP interface for operation. One pair of the DCP line is for send data and one pair is for receive data. Each data pair supports a signaling channel and two information channels. Only one information channel of a DCP line can be used for data communications when connected to a modular-type data module (MPDM or MTDM).

Processor Data Module (PDM)

The PDM (DSU 700A) provides a DCE-type of EIA RS-232C interface to data terminal equipment. The PDM supports full- and half-duplex, synchronous and asynchronous data communications. Standard asynchronous data rates supported are: 300; 1,200; 2,400; 4,800; 9,600; and 19,200 bits per second (bps). Standard synchronous data rates supported are: 300; 1,200; 2,400; 4,800; 9,600; and 19,200 bps. Nonstandard asynchronous data rates up to 1,800 bps are supported by 19,200 bps blind sampling.

The 700A, if so equipped, may also support a nonstandard and full-duplex synchronous 64 kbps data rate if the EIA data cable is less than 17 feet in length. The 64 kbps rate can be used to access an AP16 equipped with the Switched Digital Communications Protocol (SDCP) subsystem (see Figure 4-15). This arrangement allows high-speed switched access to the AP16 from a 515 Business Communications Terminal.

One SN270B digital line port is required per PDM (see Figure 4-15). System 85 translations allow the PDM to be assigned for either line or trunk-type access features.

The stand-alone PDM measures 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (5.5 kg). It requires an area less then 1 square foot and can be located on a desk or table top. The PDM may also be placed in a multiple mounting (discussed later).

Modular Processor Data Module (MPDM)

The MPDM (DSU 700D) provides a DCE-type interface to data terminal equipment. It provides all the functionality of the PDM (700A), in addition to modular plug-in interface boards and enhanced data interface capabilities. The MPDM (see Figure 4-16) is externally similar to the PDM, but contains these unique internal functional elements:

- Main module—comes in one version that is common to all modular-type data modules and provides the basic digital interface and protocol conversion functions.
- Interface module—comes in three versions providing a choice of V.35, RS-232C, or RS-449 interfaces.
- 801C-Type Automatic Calling Unit (ACU) module—comes in one optional version. It provides the capability to emulate an ACU and supports the RS-366 interface.

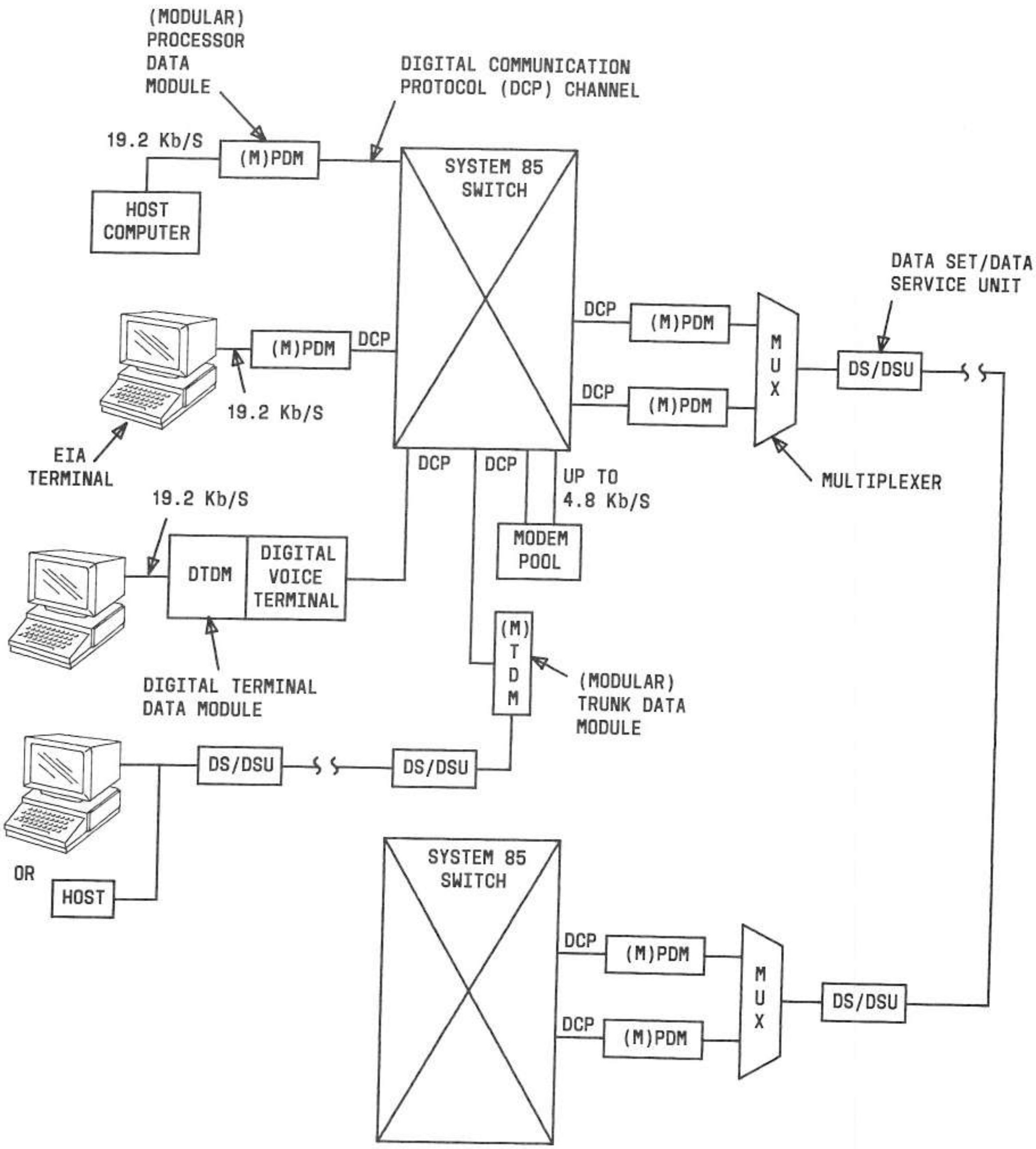
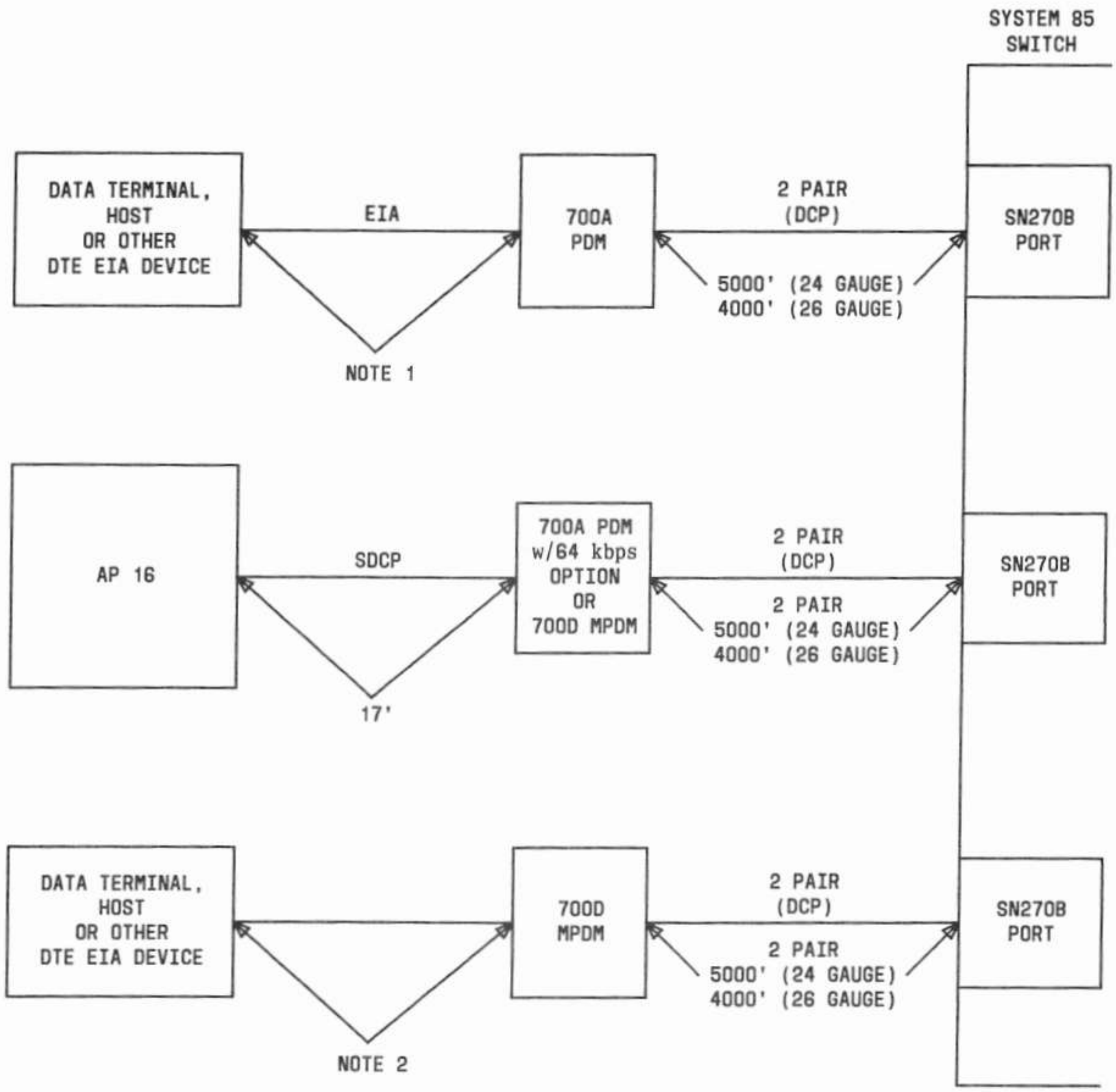


Figure 4-14. Typical System 85 Data Module Usage



NOTES:
1. RANGE AS SPECIFIED IN RS-232C (APPROX. 50')
2. RANGE AS SPECIFIED IN RS-232C, RS-449, OR V.35

Figure 4-15. PDM/MPDM Connectivity

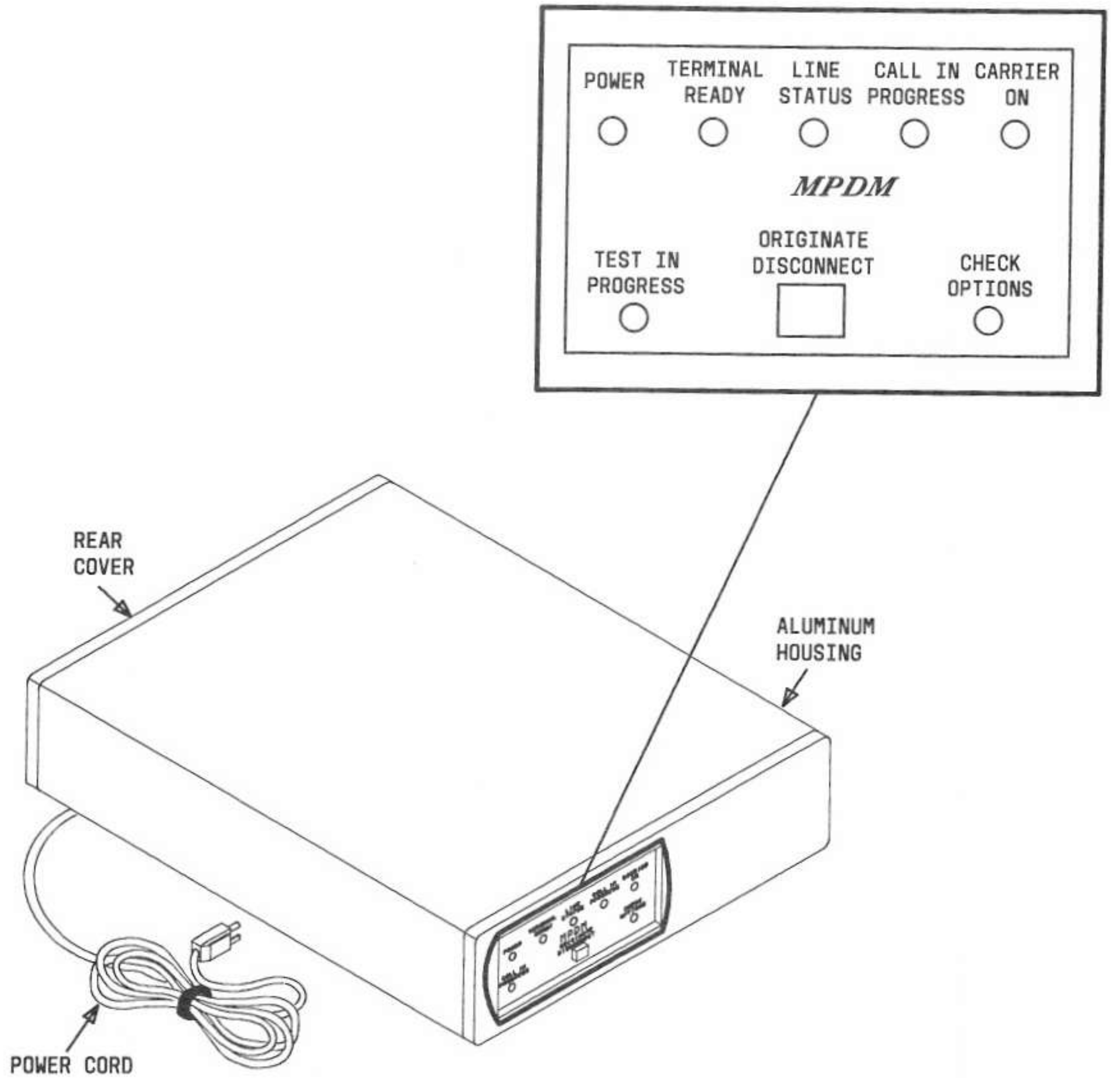


Figure 4-16. Modular Processor Data Module (DSU 700D) in Stand-Alone Housing

One SN270B digital line port is required per MPDM (see Figure 4-15). The system can switch the MPDM to communicate with another data module. Access to data sources outside the system operating environment is through the (Modular) Trunk Data Module and associated private-line data set or multiplexer, as well as through Direct Distance Dialing (DDD) and modem pools. System translations allow the MPDM to be assigned for either line or trunk type access features.

The stand-alone MPDM measures 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (5.5 kg). It requires an area less then 1 square foot and can be located on a desk or table top. The MPDM may also be placed in a multiple mounting (discussed later).

Trunk Data Module (TDM)

The TDM (DSU 700B) provides a DTE-type of EIA RS-232C interface to data service units for access to Digital Dataphone Service, private-line (nonpublic switched network) data sets, common data rate multiplexers, etc. The TDM supports full- and half-duplex standard asynchronous data rates from 300 to 19,200 bps; standard synchronous data rates from 300 to 19,200 bps; and nonstandard asynchronous data rates up to 1,800 bps with 19,200 bps blind sampling.

The 700C (TDM/2) has all the functionality of the 700B, in addition to public switched network data access. The 700C may be used in conjunction with public switched network data sets to provide modem pooling resources for System 85 (see Figure 4-17). In this application, a single conversion resource consists of a TDM and an analog data modem connected at the RS-232C interface. This conversion resource performs the analog-to-digital and digital-to-analog conversions that allow the analog and DCP data endpoints to communicate.

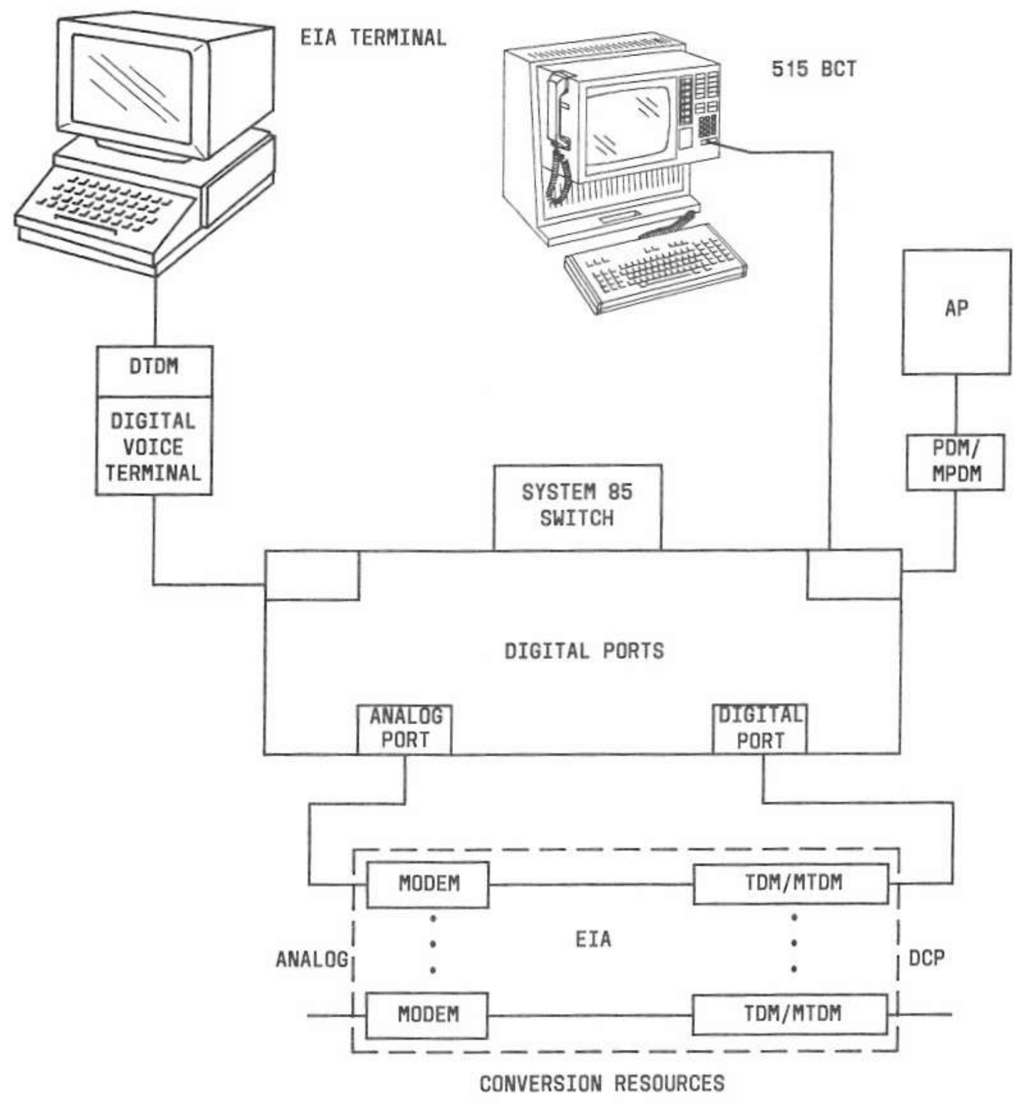


Figure 4-17. Modem Pooling

One SN270B digital line port is required per TDM (see Figure 4-18). System 85 translations allow the TDM to be assigned for either line or trunk-type access features.

The stand-alone TDM measures 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (5.5 kg). It requires an area less than 1 square foot and can be located on a desk or table top. The TDM may also be placed in a multiple mounting (discussed later).

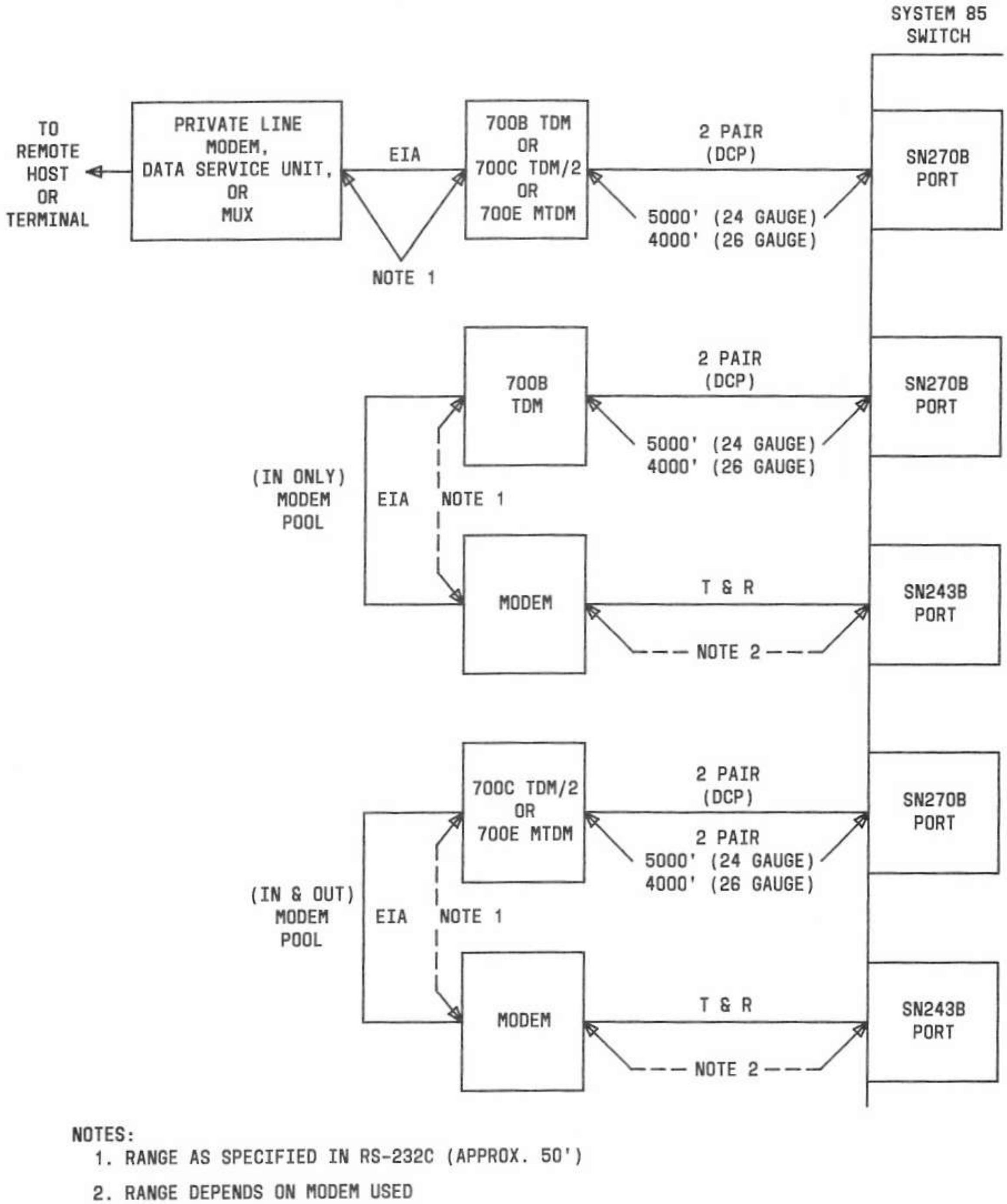


Figure 4-18. TDM/MTDM Connectivity

Modular Trunk Data Module (MTDM)

The MTDM (DSU 700E) provides a DTE-type interface to data terminal equipment. It provides all the functionality of the TDM/2 (700C), in addition to modular plug-in interface boards and enhanced data interface capabilities. The MTDM (see Figure 4-19) is externally similar to the TDM but contains these unique internal functional elements:

- Main module—comes in one version that is common to all modular-type data modules and provides the basic digital interface and protocol conversion functions.
- Interface module—provides an RS-232C interface.

One SN270B digital line port is required per MTDM (see Figure 4-18). System 85 translations allow the MTDM to be assigned for either line or trunk-type access features.

The stand-alone MTDM measures 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (5.5 kg). It requires an area less than 1 square foot and can be located on a desk or table top. The MTDM may also be placed in a multiple mounting (discussed later).

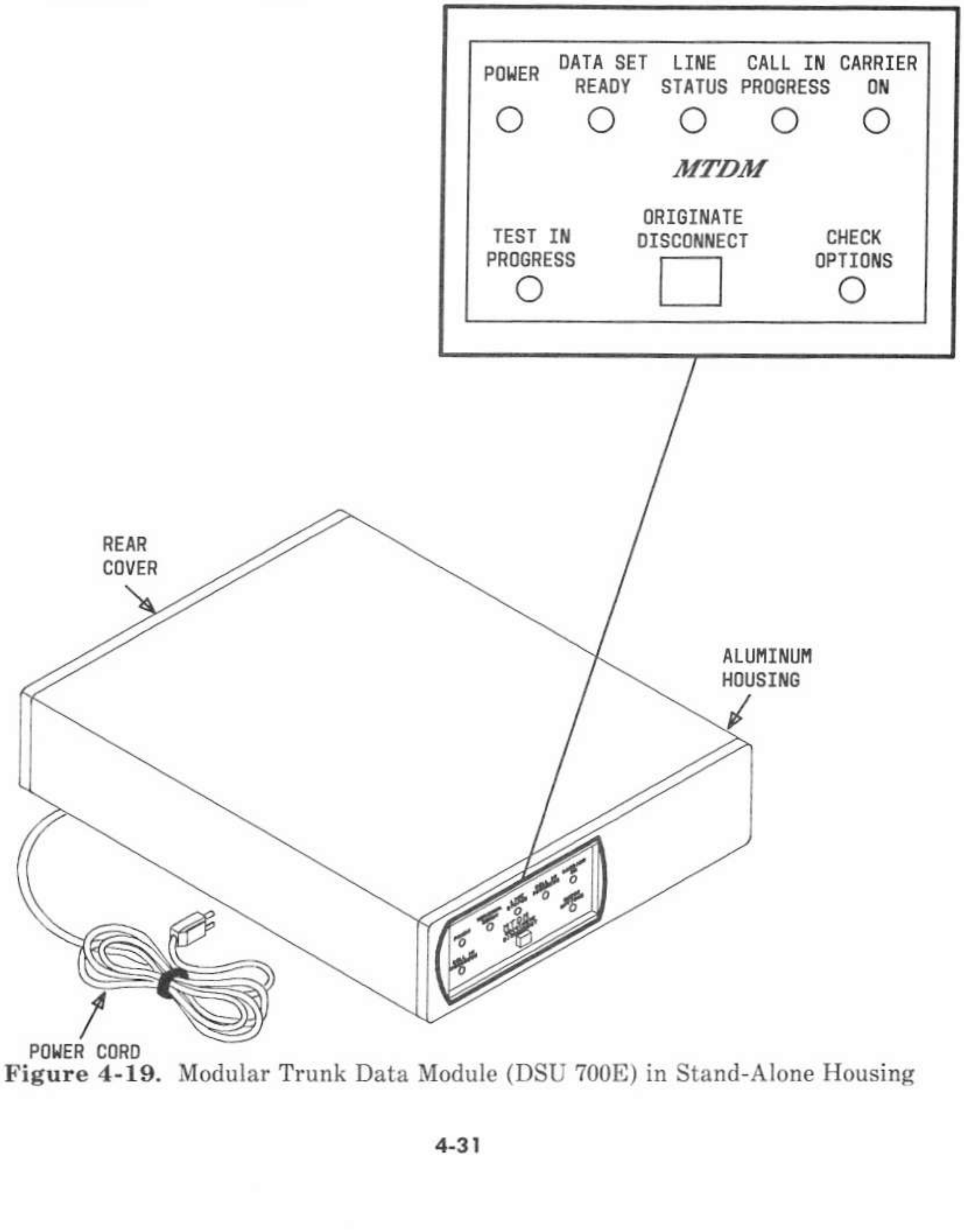


Figure 4-19. Modular Trunk Data Module (DSU 700E) in Stand-Alone Housing

Digital Terminal Data Module (DTDM)

The DTDM (DSU 701A) provides a DCE-type interface to data terminal equipment. It supports full- and half-duplex standard asynchronous data rates from 300 to 19,200 bps; standard synchronous data rates from 300 to 19,200 bps; and nonstandard asynchronous data rates up to 1,800 bps with 19,200 bps blind sampling.

The DTDM (see Figure 4-20) operates as an adjunct to a 7400D series digital voice terminal and is attached to the right side of the terminal. One SN270B digital line port is required per DTDM. The 701A uses the second information channel of the voice terminal DCP line for data communications. This arrangement allows integrated simultaneous voice and data communications (see Figure 4-14).

The DTDM measures 5 inches (127 mm) wide, 8.4 inches (213 mm) deep, and 1.75 inches (44 mm) high and weighs approximately 1.75 pounds (3.86 kg).

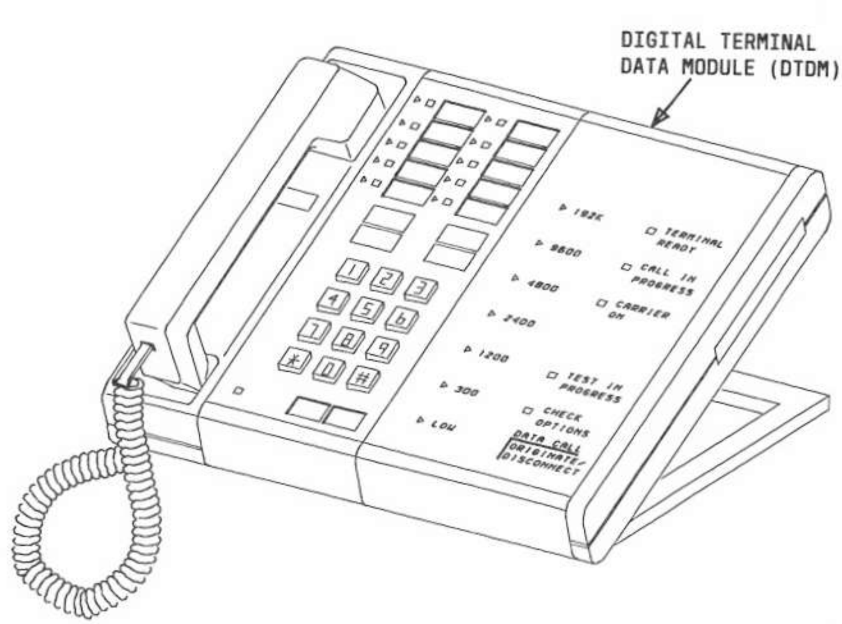


Figure 4-20. Digital Terminal Data Module (DSU 701A) Typical Application

Summary of Data Rates and Interfaces Supported

The following summary lists the data rates and interfaces supported by the aforementioned System 85 data modules:

DATA MODULE	STANDARD SYNC/ASYNC, FULL/HALF DUPLEX 300-19.2 K	NON-STD. ASYNC, FULL/HALF DUPLEX TO 1800	SYNC, HALF DUPLEX 56 K	SYNC, FULL DUPLEX 64 K	EIA RS-232C	EIA RS-449/422	CCITT V.35
700A PDM	X	X	Note	Note	X		
700D MPDM	X	X	X	X	X	X	X
700B TDM	X	X			X		
700C TDM/2	X	X			X		
700E MTDM	X	X	X	X	X		
701A DTDM	X	X			X		

Note: Requires 700A PDM with 56 kbps and 64 kbps option.

Data Module Power and Mountings

Data modules do not receive power from the System 85 interface. They are not operational during interruptions of commercial ac power, unless the data modules are powered through holdover or essential ac power.

The DTDM is physically attached as an optional adjunct to a 7400D series voice terminal. It requires -48 V dc power provided either locally or from a satellite closet through a fourth pair of station wiring. This configuration is more fully described in VOICE TERMINALS AND ADJUNCTS (in this section) under Voice Terminal Adjunct Power.

The PDM/MPDMs and TDM/MTDMs may be contained individually within stand-alone housings, or up to eight data modules may be mounted in a multiple housing rack within an auxiliary cabinet or data cabinet.

The stand-alone housing consists of a brushed aluminum top and black plastic base. The aluminum extrusion has rails which allow the data module to slide into the housing. Power for the stand-alone housing is provided through a power cord included with the unit. The power cord requires a standard 117-V ac 3-wire grounded outlet.

The 71A1 multiple mounting rack is of steel construction and provides slots for eight data modules in any combination. The faceplate is reversed to display panel callouts for vertical mounting (see Figure 4-21). This mounting comes equipped with a single power cord and can supply power to all eight data modules. The power cord requires 117 V ac from a 3-wire grounded outlet in the cabinet or from a standard ac outlet. The multiple-mounting rack measures 19 inches (483 mm) wide, 8.7 inches (221 mm) high, and 14.9 inches (378 mm) deep and weighs 22 pounds (48 kg) unloaded and 40 pounds (88 kg) loaded with eight modules.

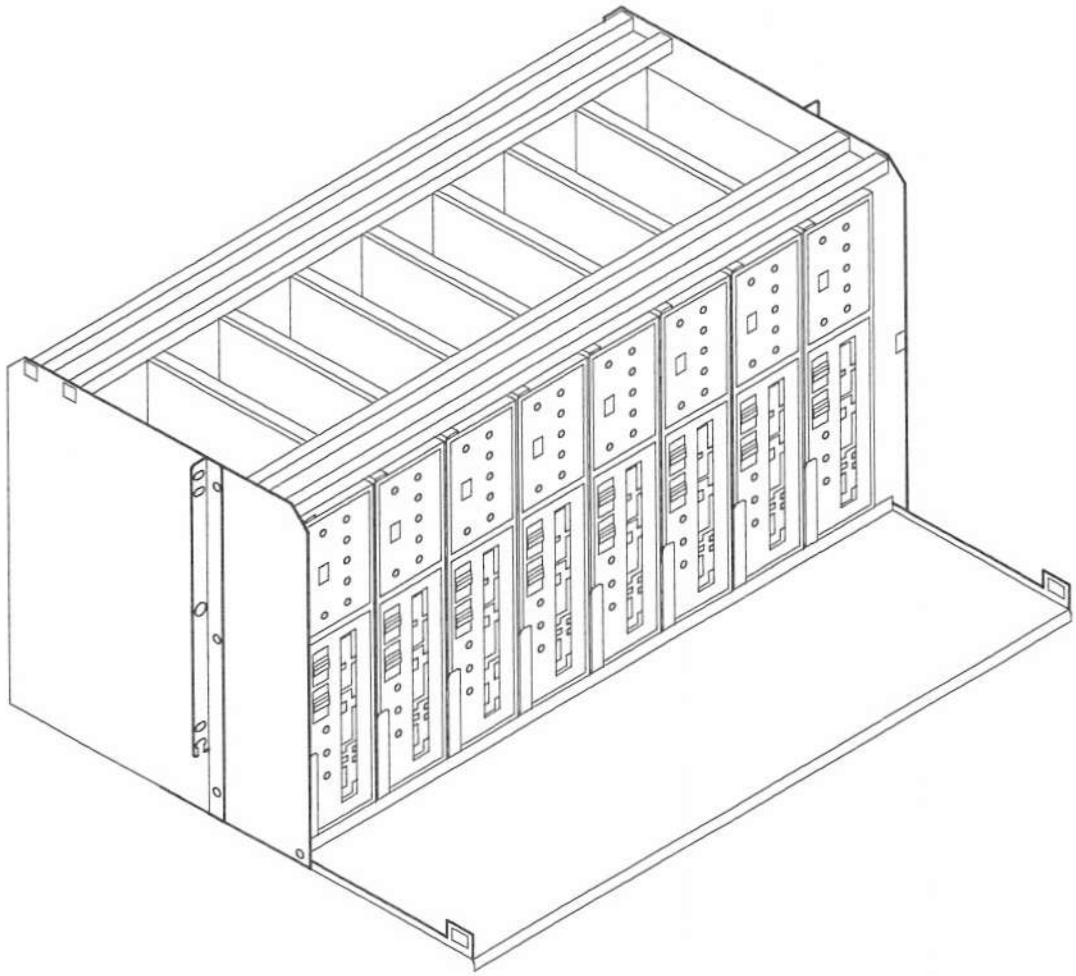


Figure 4-21. Data Modules in Multiple Mounting Rack (71A1)

The following matrix indicates which mounting may be used for each type of data module:

DATA MODULE	STAND-ALONE 70A1 HOUSING	STAND-ALONE 70A2 HOUSING	MULTIPLE 71A1 MOUNTING
700A PDM	X	Note	X
700D MPDM		X	X
700B TDM	X	Note	X
700C TDM/2	X	Note	X
700E MTDM		X	X

Note: Physically mounts in 70A2, but leaves open area at back of housing and is not recommended.

Modems (Data Sets)

Modems (derived from the term MOdulation/DEModulation) are devices that provide conversion from digital signals to analog signals and vice versa. Also referred to as data sets, these devices are always used in pairs. Typically, a modem is used to convert the digital signals from a data terminal, printer, or computer to multifrequency voiceband signals that are suitable for transmission over the analog telephone network.

There are two basic applications for modems: private line and switched access. Different modems are required for each application. Modems that are used for switched access are accompanied by either a voice terminal or automatic call unit (such as the 801-type ACU). Therefore, switched access modems can both originate and answer data calls. These modems can be used along with TDM/MTDMs to provide conversion resources for the Modem Pooling feature (see Figure 4-17). These modems provide an RS-232C interface to the data equipment and a tip and ring interface to transmission facilities. The following is a list of switched access modems suitable for this application:

MODEM	DUPLEX	SYNCHRONIZATION	DATA RATE (BPS)	MODE
103JR	Full	Asynchronous	low (up to 300)	originate/answer
212AR	Full	Asynchronous	300 or 1200	originate/answer (autobaud)
		Synchronous	1200	originate/answer
201CR	Half	Synchronous	2400	originate/answer
208BR	Half	Synchronous	4800	originate/answer
2224A	Full	Asynchronous	300,1200,2400	originate/answer
		Synchronous	1200 or 2400	originate/answer

Asynchronous Data Unit (ADU)

The ADU (Z3A) is a small DCE-type limited-distance modem. It is a low-cost device used to extend the communication distance between two RS-232C devices. It also provides ground isolation, immunity to noise, and exhibits low error rates.

The ADU (see Figure 4-22) is enclosed in a small housing with a 25-pin plug and 8-pin modular jacks. It measures approximately 2 inches (51 mm) wide, 4.5 inches (114 mm) long, and 1 inch (25.4 mm) high. The housing weighs approximately 1 ounce. One jack is designed for an optional originate/disconnect switch (551A). The switch provides a "break" signal for as long as it is activated.

In their primary application, ADUs paired with switch EIA port circuits (SN238) allow switched access between System 85 and EIA terminals, printers, and host computer ports (see Figure 4-23). In this case, DTE devices can access the switch without using a separate data module or modem. The Z3A is installed at the device end of the EIA connection. ADUs also can be hardwired in pairs with other ADUs to interface data terminals directly to a host computer. This application is typical when access to the host is not made through the system.

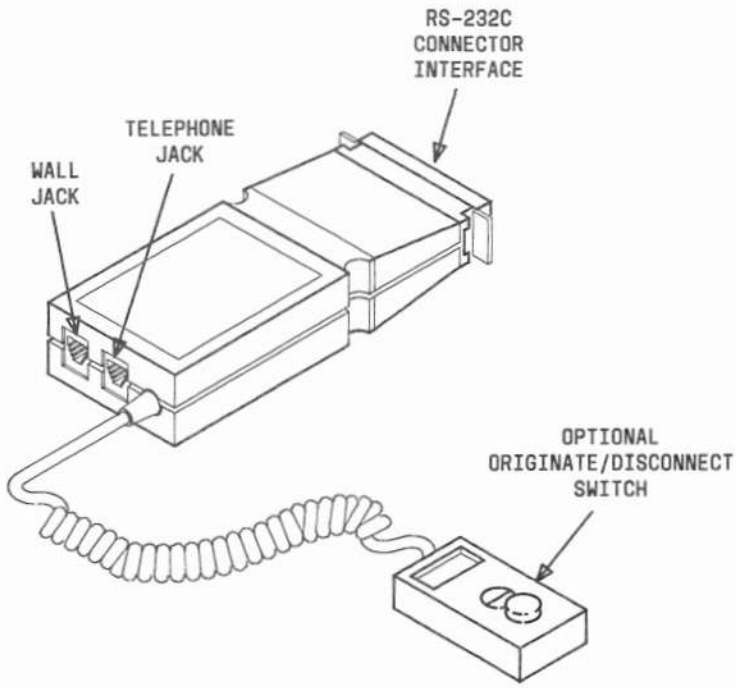


Figure 4-22. Asynchronous Data Unit (Z3A)

The following versions of ADUs are available, each with unique connector arrangements:

ADU	RS-232C INTERFACE	TWO-PAIR DATA INTERFACE
Z3A1	Male 25-pin "D" connector on 3-foot cord	8-Conductor modular jack
Z3A2	Male 25-pin "D" connector	8-Conductor modular jack
Z3A3*	3-Pair 110-type patch cord plug on 7-foot cord	3-Pair 110-type patch cord plug on 7-foot cord
Z3A4	Female 25-pin "D" connector on 3-foot cord	8-Conductor modular jack

* Intended for use with Information Systems Network (ISN).

The ADU requires two twisted pairs of standard voice-grade nonloaded intrabuilding wiring to the switch interface for operation. One pair is used to receive data and control signals. The digital signals on the data pairs are designed to comply with proposed Local Area Data Channel (LADC) II rules and allow the data pairs to be located in the same cable with other voice and DCP lines. This overcomes the standard EIA distance limitations and eliminates the need for separate wiring to handle the high signal levels of typical EIA interfaces. The ADUs also provide dc ground isolation between endpoints with opto-couplers. This transmission method has high noise immunity, ensuring low error rates. The ADU transmits asynchronous, full-duplex data and control signals at standard data rates including 300; 1,200; 2,400; 4,800; 9,600; and 19,200 bps. No internal option switches are necessary to change data rates.

The ADU is designed to be powered from the Terminal Ready and Send Data signals at the terminal. If this host power is not sufficient, the ADU can be optionally powered from a small plug-mounted transformer (2012D or equivalent) connected to pins 7 and 8 of the modular jack.

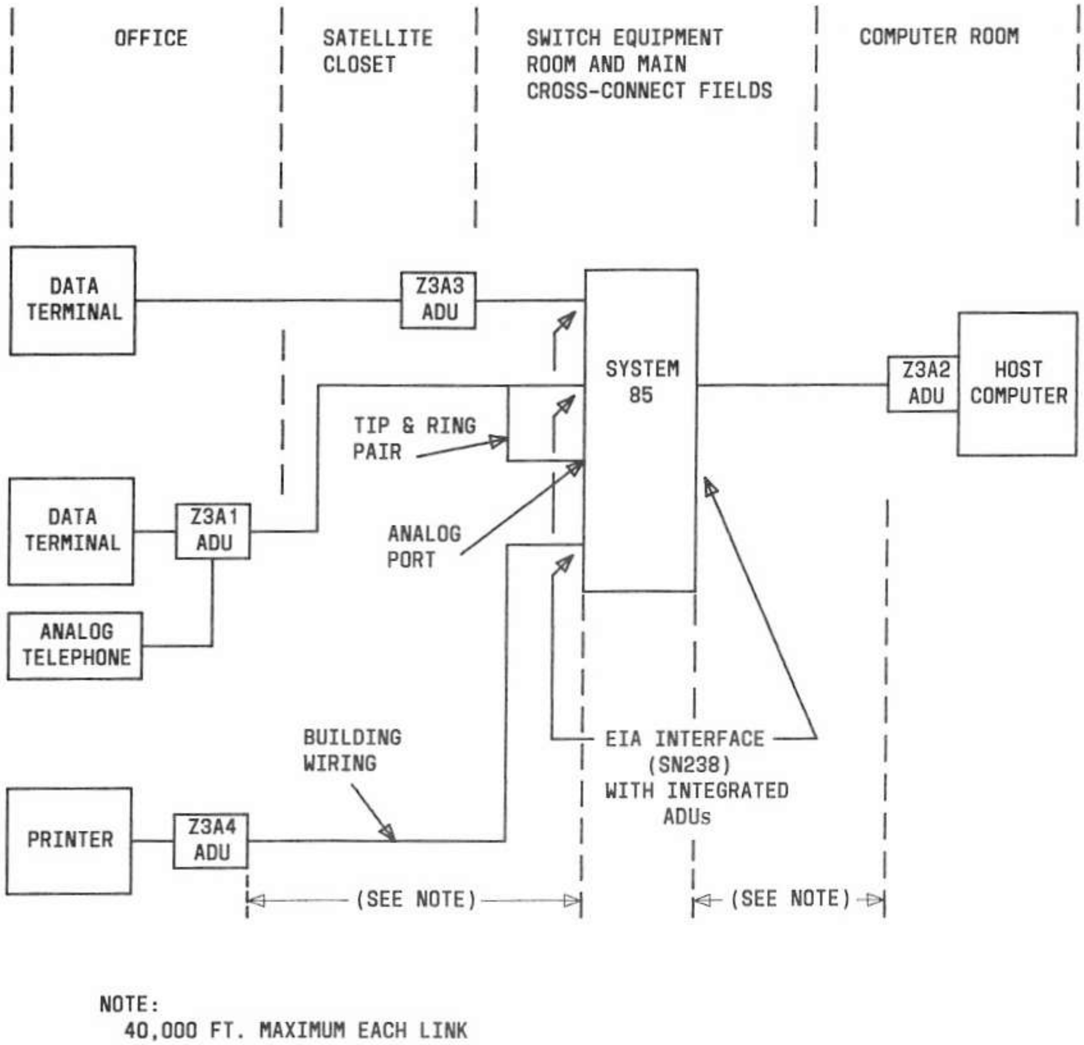


Figure 4-23. ADU Typical Applications

No self-tests or loopback tests to the SN238 are provided by the ADU. Operation of the ADU may be tested by placing a loopback plug in place of the modular plug for the 2-pair data interface. In this configuration, characters transmitted by the terminal equipment are looped back, verifying operation of the ADU.

For more detailed information on the Z3A ADU, refer to **Asynchronous Data Unit—User Manual** (555-401-701).

Multiple Asynchronous Data Unit (MADU)

The MADU provides an RS-232C compatible, full-duplex, asynchronous data interface providing host computer access for a variety of DTE devices. The MADU converts information sent to it from a host computer in RS-232C protocol to low-voltage signals. These signals may be transmitted over standard building wiring or to the switch over much greater distances than regular EIA signals may travel. The host computer is set up to appear as a DCE device to the MADU. The MADU sends the converted information out through its building wiring interface.

The MADU has the circuit functionality of the ADU in addition to the following:

- The circuit packs (BPP2) are self-powered and do not require power from the host computer.
- Status LEDs are provided for each port to indicate the host's Data Terminal Ready (DTR) state, port in-use status, and busy-out state.
- Both a manual busy-out switch and a host-driven busy-out lead are provided to facilitate MADU maintenance and testing.

The MADU interface includes the following hardware:

- BPP2 circuit packs each providing eight full-duplex ports
- 7001A faceplate and 504A1 circuit module for the BPP2s
- 72A carrier used to house up to eight BPP2s or a single-unit housing for individual circuit packs
- M48C octopus cable for multiple port terminations
- Power strip assembly with outlets, filter, and circuit breaker
- Transformer and modular cords used for carrier power arrangement.

The MADU may be used in various connection arrangements (see Figure 4-24). Like the ADU, it can be hardwired with ADUs to interface data terminals directly to a host computer, or it can be connected to System 85 through an EIA port circuit pack (SN238). The former application is typical when access to the host is not made through the system. Standard building wiring is sufficient when connecting the MADU through the system. Modular connectors provide hookups to the building wiring, host computer, and power cord.

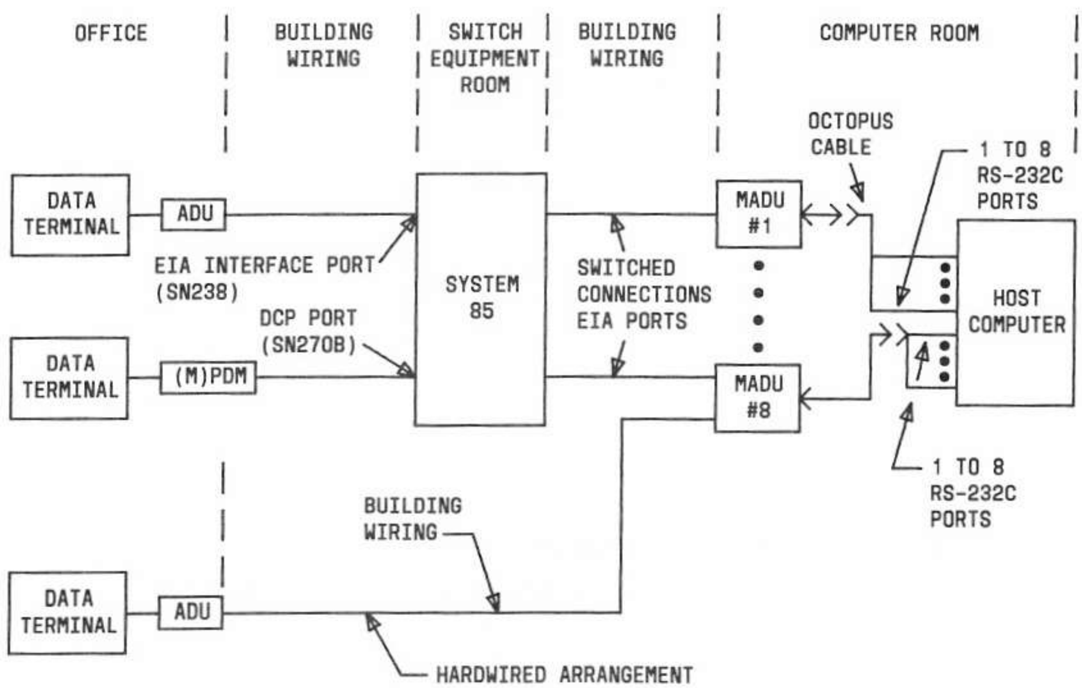


Figure 4-24. Multiple Asynchronous Data Unit (MADU) Typical Applications

In a stand-alone configuration, a single MADU is placed horizontally, measuring 1.65 inches (42 mm) high and 7.67 inches (195 mm) wide. This configuration is cost-effective if only one or two MADUs are required. The single-unit housings are stackable.

In a fully-equipped MADU carrier configuration, 64 ports are available per carrier. This reduces considerably the amount of space and number of cabinets required to connect asynchronous devices to a host computer with PDM/MPDMs or other devices.

For more detailed information on the MADU, refer to **Multiple Asynchronous Data Unit—User Manual** (555-401-702).

Protocol Converters

Switched access to a protocol converter allows cost-effective connectivity to external systems and other internal host systems. Several types of protocol converters are available with System 85 to provide this compatibility.

The 3270 series data modules are protocol converters that allow IBM 3270-type data terminals to communicate with a host computer through the system switch using standard twisted-pair building wiring instead of coaxial cable. A 3270 data module at one end of the switch converts messages and data from coaxial cable protocol to the DCP protocol supported by the system. In addition to eliminating the need for coaxial wiring, this arrangement allows more terminals to access the system resources through available ports or cluster controllers rather than by direct connection to specific controllers (see Figure 4-25).

Another series of protocol converters allows lower equipment costs through the use of less expensive ASCII terminals (in place of dedicated 3270-type terminals) and standard building wiring. Four types are currently available: the 4271, 4276, 5274, and 5276 protocol converters.

3270T Data Module

The 3270T (Terminal) data module is a protocol converter attached to a Category A 3270-type terminal, such as an IBM 3278 Information Display System. The 3270T is then connected to the building wiring by a standard 4-pair modular cord. The 3270T data module appears as a cluster controller to the terminal. The terminal sends messages for the controller in coaxial cable Category A protocol, which the data module converts to DCP protocol. Data and messages are then sent through the system switch to the 3270C at the cluster controller side of the switch. The 3270C decodes the DCP information back to coaxial cable protocol and sends it to the controller. The protocol conversion sequence is reversed for controller messages to the terminal. This method of communicating with a host computer is transparent to the computer.

The 3270T data module (see Figure 4-26) is a self-contained unit installed near the 3270-type terminal. It measures 9.14 inches (232 mm) in length, 5.64 inches (143 mm) in width, and 1.33 inches (34 mm) in height. The 3270T weighs approximately 1.25 pounds and requires an external ac-to-dc power supply which converts commercial ac power to 5 V dc. Each 3270T data module provides a coaxial interface for connecting a short coaxial cable to the display terminal and an 8-pin modular jack for connecting to a digital endpoint (wall jack). In addition, the 3270T has a rear-mounted telephone jack which can support a 2500-type or 7100A series voice terminal.

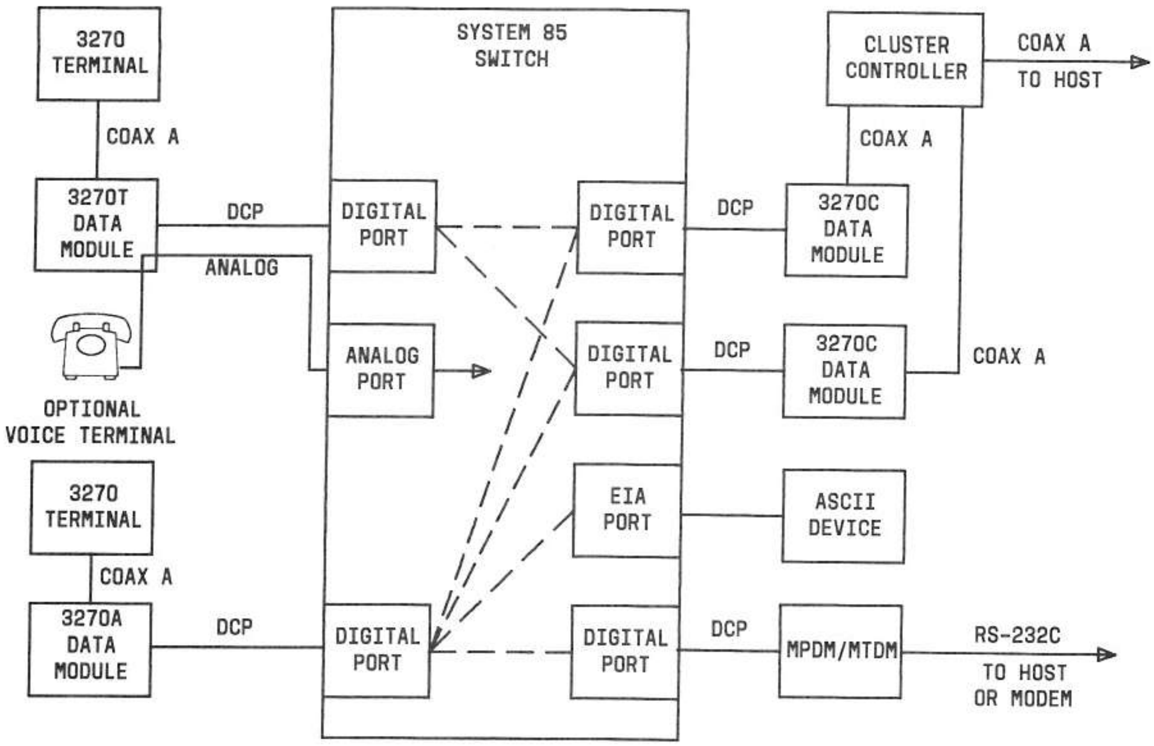


Figure 4-25. 3270 Data Modules (Protocol Converters) Typical Applications

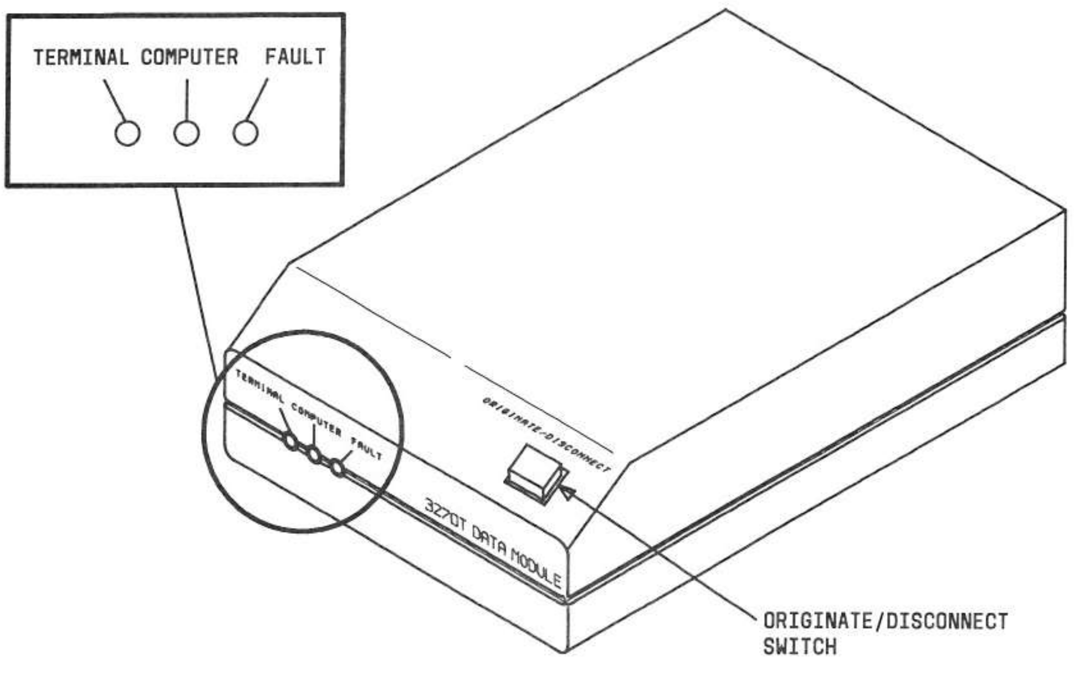


Figure 4-26. 3270A/T Data Module

3270A Data Module

The 3270A (Asynchronous) data module performs all the functions of the 3270T data module for attaching 3270-type terminals to a cluster controller. In addition, the 3270A data module allows a 3270-type terminal to emulate an asynchronous ASCII terminal (such as Model VT100, manufactured by Digital Equipment Corporation, or AT&T 4410) to an ASCII endpoint. This "ASCII emulation mode" provides access to time-sharing services and computers not normally accessed by a 3270-type terminal in a conventional setup. In this mode, the 3270A data module does not require a 3270C data module at the other end of the system. Instead, the 3270A uses a digital port (SN270B) circuit to access ASCII devices through an (M)PDM or to access a modem through an (M)TDM. Direct connection through the switch to the ASCII device is possible (without a data module) using an EIA port (SN238) circuit.

The 3270A and 3270T data modules (see Figure 4-26) use the same physical housing. They are self-contained units installed near the 3270-type terminal. The 3270A data module measures 9.14 inches (232 mm) in length, 5.64 inches (143 mm) in width, and 1.33 inches (34 mm) in height. It weighs approximately 1.25 pounds. The 3270A requires an external ac-to-dc power supply which converts commercial ac power to 5 V dc. Each 3270A data module provides a coaxial interface for connecting a short coaxial cable to the display terminal and an 8-pin modular jack for connecting to a digital endpoint (wall jack). In addition, the 3270A has a rear-mounted telephone jack which can support a 2500-type or 7100A series voice terminal.

3270C Data Module

The 3270C (Controller) data module connects an IBM 3274 or 3276 cluster controller to System 85. The 3270C appears as a 3270-type terminal to the controller. The controller sends messages in coaxial Category A protocol to the 3270C data module, which converts them to DCP protocol and transmits them through the switch. The 3270A or 3270T at the other end translates the messages back to coaxial cable protocol for the attached terminal. Messages sent from the terminal through the switch are translated by the 3270C from DCP protocol back into coaxial cable protocol for the cluster controller.

The 3270C data module (see Figure 4-27) measures 16.5 inches (419 mm) in length, 19 inches (483 mm) in width, and 5.79 inches (147 mm) in height. It weighs approximately 31 pounds. An ac-to-dc power supply is mounted inside the 3270C housing and converts commercial power to 5 V dc.

For more detailed information on 3270 data modules, refer to **3270 Data Module—User Manual** (555-030-701).

4271 Protocol Converter

The 4271 protocol converter enables asynchronous ASCII terminals to communicate with a host computer (through the switch) using a bisynchronous 3270 protocol. The 4271 emulates a 3270-type cluster controller and, for this application, is a drop-in replacement for a 3271 controller. The 4271 converter provides either three or seven RS-232C ASCII ports for connecting display terminals and one BSC port for private-line connection to the front-end processor. Supported BSC data rates include 1200, 2400, 4800, and 9600 bps. Supported asynchronous data rates include 300, 1200, 2400, 4800, and 9600 bps.

4276 Protocol Converter

The 4276 protocol converter enables asynchronous ASCII terminals to communicate with computers or front-end processors (3270 applications) that support the Synchronous Network Architecture (SNA)/Synchronous Data Link Control (SDLC) line protocol. The 4276 emulates a 3276-2 cluster controller and, for this application, is a drop-in replacement for a 3274 or 3276 controller. The 4276 converter provides either three or seven RS-232C ASCII ports for connecting display terminals and one SNA/SDLC communications port. Supported Binary Synchronous Communications (BSC) data rates include 1200, 2400, 4800, and 9600 bps. Supported asynchronous data rates include 300, 1200, 2400, 4800, and 9600 bps.

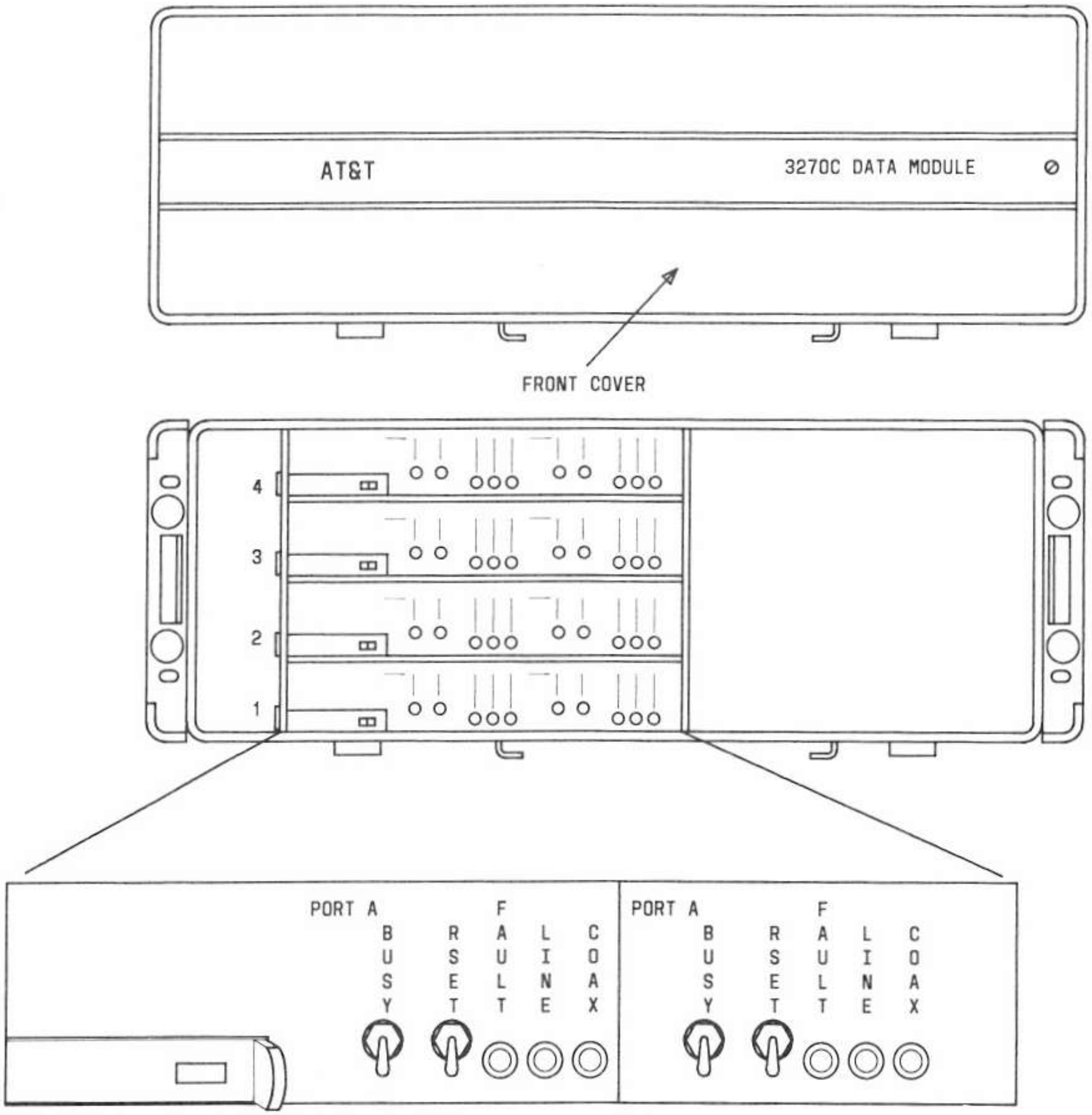


Figure 4-27. 3270C Data Module

5274 Protocol Converter

The 5274 protocol converter enables BSC 3270 compatible display terminals to communicate with computers or front-end processors (3270 applications) that support the SNA/SDLC line protocol. The 5274 emulates a 3270-type cluster controller and, for this application, is a drop-in replacement for a 3274 controller. The 5274 converter provides three BSC ports for connecting from one to three cluster controllers, including AP16s that provide 3270 emulation. Each protocol converter will support up to a maximum of 32 BSC display terminals from the 3 cluster controllers. Supported SNA/SDLC include 1200, 2400, 4800, and 9600 bps. Supported BSC data rates include 1200, 2400, 4800, and 9600 bps.

5276 Protocol Converter

The 5276 protocol converter permits one BSC 3780 or 2780 compatible display terminal to communicate with a computer or front-end processor that supports the SNA/SDLC line protocol. The 5276 emulates a cluster controller and is a drop-in replacement for a 3276-2 controller.

For more detailed information on protocol converters and their applications, refer to **AT&T-IS Network and Data Services—Reference Manual** (555-025-201).

Channel Division Multiplexer (CDM)

A CDM provides an economical means to directly access the same DS-1 digital transmission facility that also provides interswitch connectivity. This multiplexer connects directly to the integrated DS-1 interface in a System 85. The CDM allows preselected voice, data, or video to be added to or removed from the DS-1 facility while passing the remaining channels through on a digital basis. The CDM provides point-to-point or multipoint nonswitched private-line data connections over the same digital facility.

The CDM is available in single-shelf or double-shelf configurations. The single-shelf unit has a basic shelf with circuitry for line interface circuits, alarms, power converter, and up to eight channel service units (CSUs). The double-shelf unit has the same basic shelf plus a second shelf with space for 16 additional CSUs, for a total of up to 24 CSUs. The single-shelf unit cannot be upgraded to a double-shelf unit. Standard equipment for both configurations includes:

- Line interface circuits
- Strobe generator assembly
- -48 V dc power converter
- Alarm assembly
- Equalizer assemblies
- Channel select matrix
- Jack panel unit.

Channel Expansion Multiplexer (CEM)

A CEM compresses 64-kbps voice and voiceband data signals into 32-kbps channels. This multiplexer connects directly to the integrated DS-1 interface in a System 85. The CEM can compress two DS-1 signals, each with up to twenty-four 64-kbps channels, into one DS-1 signal containing a maximum of forty-eight 32-kbps channels. A multiplexer is required at each end of the DS-1 link to recover compressed signals for point-to-point DS-1 applications.

The CEM consists of a single-shelf unit housing all the equipment needed to double the capacity of a DS-1 facility. The basic circuitry for the shelf has all the common equipment for line interfaces, alarms, and CSUs. Optional equipment for the CEM includes:

- 16- and 32-millisecond echo cancellation cards
- Signal plug-in card
- -48 V power supply.

Data Channel Repeater

The data channel repeater (J58879K) is an electronic circuit amplifier and isolator that provides range extension and/or surge protection for the system low-speed data channels. It is connected in series with the data channel to repeat data pulses and to provide insulation between input and output pairs. The data channel repeater detects and reconstructs incoming modified biphase (bipolar) data pulses to eliminate any pulse attenuation or distortion as well as to increase data channel range.

The two basic arrangements are single channel and dual channel, each of which can be with or without range extension. The maximum distance between a repeater and the system or peripheral device is 1000 feet (305 m). The maximum distance between two repeaters is 3000 feet (914 m). Up to four repeaters may be used to extend the maximum distance to 11,000 feet (3,353 m).

Information Systems Network (ISN) Interface

The ISN interface provides enhanced EIA RS-232C trunk connectivity to the ISN with a co-located high-speed packet switch. This interface is provided through EIA ports (SN238), asynchronous data units (ADUs), and an ISN concentrator.

The ISN concentrator multiplexes 40 EIA ports over a fiber interface to the ISN node. The concentrator carrier houses five interface circuit packs which accommodate eight ports each. Eight ADUs are required per ISN concentrator circuit pack, or one ADU per EIA port.

Local Distribution Service Unit (LDSU)

The LDSU (48250) interfaces the System 85 switch DCIU with an external processor, such as an AP, AUDIX, or another DCIU. The LDSU also provides required ground isolation between the Common Control Cabinet (containing the DCIU) and the external processor. Two LDSUs per external processor are required to provide this interface.

Each LDSU contains:

- A transmitter with filtering and modulation—allows data transmission at speeds from 2.4 kilobits per second (kbps) up to 19.2 kbps
- A receiver with equalization, demodulation, clock recovery, and signal presence detection—accepts incoming data from a 150-ohm line
- A regulated dc power supply for the required dc voltage
- An EIA RS-232C interface.

Note: A single Isolating Data Interface may be substituted for two LDSUs between each external processor.

Isolating Data Interface (IDI)

The IDI (105A) is a miniature connection unit for point-to-point, full-duplex operation. Powered entirely from the EIA interface through control signals, the IDI plugs directly between the System 85 switch DCIU and the connecting external processor (AP, AUDIX, or another DCIU). One IDI connected to an external processor provides an economical substitute for two synchronous Local Distribution Service Units (LDSUs). Like a pair of LDSUs, the IDI provides ground isolation between the two endpoints. It needs no adjustments or option settings, since it operates automatically at the DCIU data rate and uses timing from the DCIU as the controlling time source.

BUSINESS COMMUNICATIONS TERMINALS (BCTs)

500 BCT

The 500 BCT (see Figure 4-28) is an input/output terminal providing data entry and data retrieval capabilities. The 500 BCT is connected directly to the AP through a Standard Serial Interface (SSI). The applications software is downloadable from the AP.

The 500 BCT includes the following:

- Video display
- Keyboard
- Processor
- Memory.

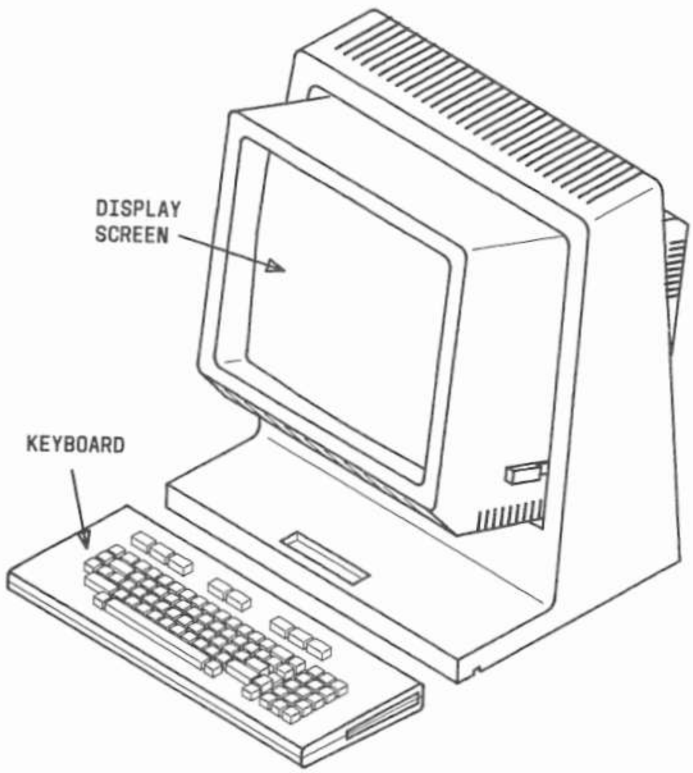


Figure 4-28. 500/513 Business Communications Terminal (BCT)

Video Display

The video display is a cathode-ray tube (CRT) capable of displaying characters at normal, half, or full intensity and capable of producing blinking or underlined characters. The screen measures 13 inches (330 mm) diagonally and displays 25 lines, each containing up to 80 characters with a 7 by 9 dot matrix.

Keyboard

The detached keyboard is connected to the video display by a 6-foot (1.8-m) cord. The 500 BCT keyboard (see Figure 4-29) houses 96 keys organized into seven functional groups:

- Function Group 1—Twelve editing keys with English abbreviations standard to text-editing functions.
- Function Group 2—Eight customer-designated function keys; the labels for these keys appear on the 25th line of the video display and can vary according to the tasks being performed.
- Function Group 3—Numeric and programmed function keys; the programmed function keys operate in conjunction with the CONTROL key and are labeled on a designator strip above the group.
- Function Group 4—QWERTY keys conforming to standard typewriter convention (uppercase and lowercase)
- Function Group 5—Space bar, CONTROL, NUMERIC, CONFIRM, and CANCEL keys
- Function Group 6—Cursor control keys
- Function Group 7—General system function keys: HELP, PRINT, HOME, PAGE, and BEGIN/END.

Other keyboard features include sculptured nonglare keys, 4-key rollover, matrix key coding, auto-repeat, an output sounder for audible keystroke feedback, and a "ping" to alert the operator when important events have occurred.

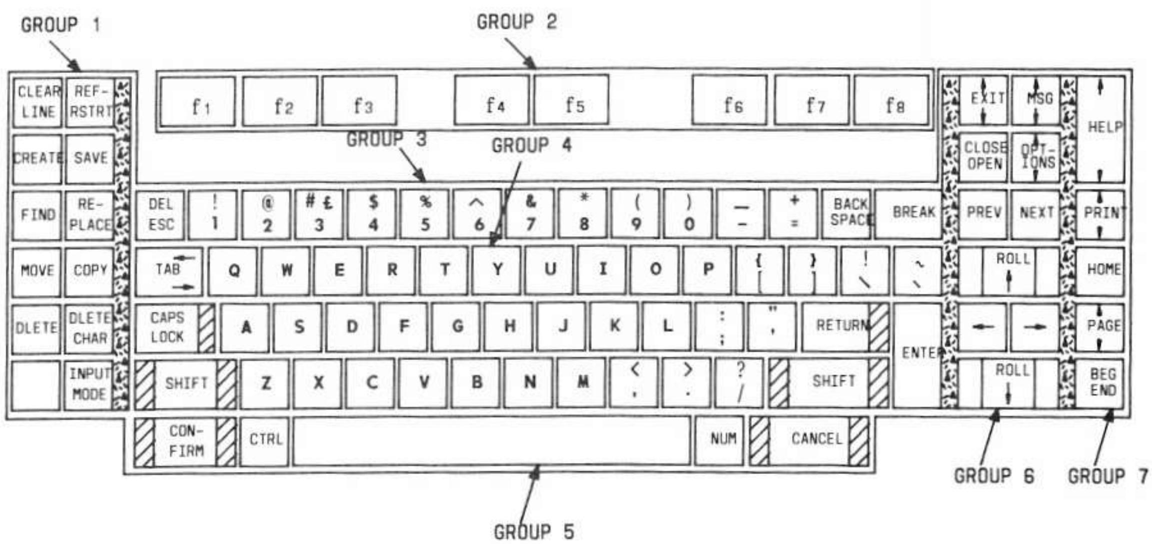


Figure 4-29. 500 BCT Keyboard (Without Numeric Keypad)

Processor

The Z80 processor controls the input and output for the 500 BCT and is housed in the base of the video display unit.

Memory

The memory is part of the processor and stores:

- Display font
- Applications programs
- Diagnostic programs for power-up self-diagnostics
- Bootstrap (initializing) programs.

Memory for the 500 BCT includes 64 kbytes of random access memory (RAM) and 32 kbytes of read-only memory (ROM).

Power and Location

The 500 BCT requires 117-V 60-Hz commercial power from a 3-wire grounded outlet.

The maximum cable distance between the 500 BCT and the AP is 5000 feet (1524 m). Approximately 4 square feet of table or desk space is required.

AT&T Personal Terminal 510D

The Personal Terminal 510D (see Figure 4-30) is a new voice/display terminal providing the combined capabilities of a 7405D voice terminal, digital display module, data module, and 513 BCT. The 510D has a DCP interface and display capabilities for dedicated S-channel messages. It offers a small footprint, stylish design, and easy use.

The 510D offers the following standard features:

- A Z80 processor.
- A 9-inch (229-mm) diagonal monitor with nonglare display. The display is organized in 40-, 80-, or 132-character by 27-line formats and supports five video attributes on an individual character basis. Lines 26 and 27 are reserved for screen-labeled action blocks. A window at the top is dedicated to telephony instructions and messages, leaving the remainder of the display for use by data applications (I2 channel) or local applications.
- A touchscreen that overlays the monitor to provide easy access to terminal functions without a keyboard.
- Screen-based keyboard with a QWERTY layout.
- Privacy mode that blanks off all but selected parts of the display.
- Time manager.
- Screen-based calculator.
- Personal directory.
- Self-diagnostics.
- Time-of-day and elapsed-time display.
- Automatic "sleep mode" display dimming after 15 minutes of inactivity.
- Eight action blocks that provide access to the terminal capabilities and that are programmable for host interaction.

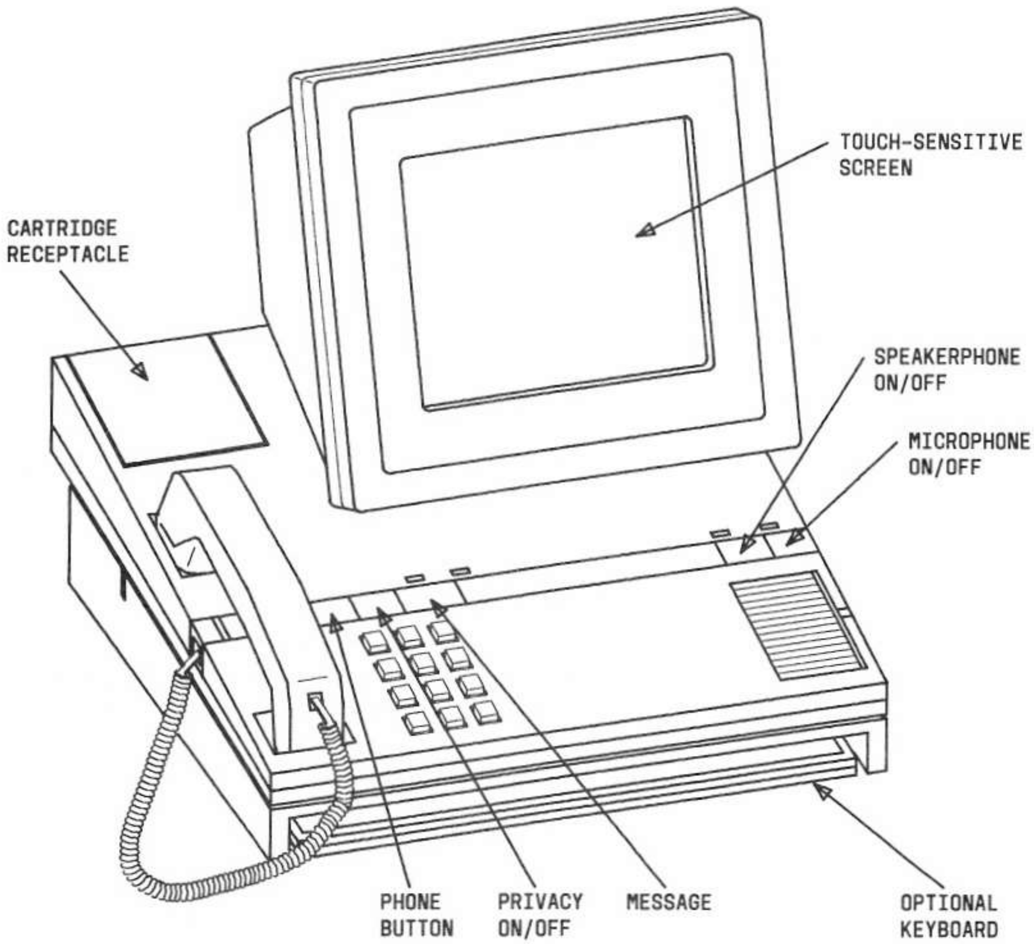


Figure 4-30. AT&T Personal Terminal 510D

The 510D provides the following voice/display features:

- Message Waiting indicator
- Built-in speaker and microphone with control buttons and indicators
- Volume controls for tone ringer and speaker
- Four appearances on the screen
- Nine programmable feature buttons on the touchscreen
- Automatic display of calling and called party identification
- Screen-accessed telephone directory that allows 1-touch voice and data call setup from a directory of approximately 100 entries
- A hard button to display the "PHONE" screen.

The 510D provides the following data features:

- Full- or half-duplex, flow-controlled, parity-protected, asynchronous data at speeds up to 19,200 bps
- VT100 and 513 BCT terminal emulation

- ANSI X3.64 compatible
- Character or block transmission
- Two pages of data memory
- Six character sets of which two may be selected at a time
- Smooth vertical scrolling and horizontal scrolling
- Multiple windows
- Protected fields for forms support.

Options for the 510D include:

- Feature expansion with pluggable cartridges containing modules for demonstration, training, directory extension, and terminal security
- An optional 72-key keyboard with features that are a subset of those transmitted by the 103-key and 89-key keyboards used with the 513/515 BCTs (discussed later).

513 BCT

The 513 BCT (see Figure 4-28) is an input/output terminal providing data entry and data retrieval capabilities. The 513 BCT is connected by an EIA interface to a digital voice terminal/DTDM combination, then to the system through the DCP. The 513 BCT also may be connected to the DCP through a modem or PDM/MPDM.

The 513 BCT includes the following:

- Video display
- Keyboard
- Processor
- Memory.

Video Display

The video display is a cathode-ray tube (CRT) capable of displaying characters at normal, half, or full intensity and capable of producing blinking or underlined characters. The screen measures 12 inches (305 mm) diagonally and the screen displays 27 lines, each containing up to 80 characters with a 7 by 9 dot matrix.

Keyboard

The detached keyboard is connected to the video display by a 6-foot (1.8-m) cord. A 103-key product family keyboard is standard, and an optional 89-key keyboard is available. Both keyboards provide linear feedback upon key depression.

Processor

The processor controls the input and output for the 513 BCT and is housed in the base of the video display unit.

Memory

The memory is part of the processor and stores:

- Display font
- Applications programs

- Diagnostic programs for power-up self-diagnostics
- Bootstrap (initializing) programs.

Memory for the 513 BCT includes 64 kbytes of RAM and 32 kbytes of ROM.

Power and Location

The 513 BCT requires 117-V 60-Hz commercial power from a 3-wire grounded outlet.

The maximum cable distance between the 513 BCT and a PDM/MPDM is 50 feet (15 m) and less than 5000 feet (1524 m) from the PDM/MPDM to the AP. Approximately 4 square feet of table or desk space is required.

515 BCT

The 515 BCT (see Figure 4-31) is a voice/display terminal providing the combined capabilities of a 7403D voice terminal, digital display module, data module, and 513 BCT. The 515 BCT is an intelligent terminal that is downloadable from the AP. It has a DCP voice/data interface and display capabilities for dedicated S-channel messages, and may be configured with an auxiliary parallel or serial printer. Data communications are supported optionally over an EIA RS-232C interface. The 515 BCT includes the following:

- Video display
- Keyboard
- Processor
- Memory
- Voice terminal components.

Video Display

The video display is a 12-inch (305 mm) diagonal CRT capable of displaying characters at normal, half, or full intensity and capable of producing blinking or underlined characters. The screen displays 27 lines. Each line contains up to 80 characters with a 7 by 9 dot matrix. One line at the top of the screen is devoted to displaying S-channel telephony messages. Two lines at the bottom are devoted to screen-labeled keys.

Keyboard

The detached keyboard is connected to the video display by a 6-foot (1.8-m) cord. Two types of keyboards are available. The large keyboard houses 103 keys; the small keyboard has an 89-key proper subset.

Processor

The processor is housed in the base of the video display unit. It controls the input and output and requests a download of application software from the AP.

Memory

The memory is part of the processor and stores:

- Display font
- Applications programs
- Diagnostic programs for power-up self-diagnostics
- Bootstrap (initializing) programs.

Memory for the 515 BCT includes 64 kbytes of RAM and 32 kbytes of ROM. The processor has access to 32 kbytes of the RAM and all of the ROM. However, the entire 64 kbytes of RAM can be downloaded and the ROM switched out of the circuit, so that different software can be downloaded to give the terminal a different functionality.

Voice Terminal Components

The 515 BCT contains several components similar to that of a digital voice terminal and digital display module. These components, located on the video display base, include:

- Handset
- Touch-Tone Telephone Dial
- MESSAGE Indicator
- Volume Control (Tone Ringer)
- Appearance/Feature Buttons
- Display Function Buttons.

Voice terminal features function with the DCP interface only.

Power and Location

The 515 BCT requires 117-V 60-Hz commercial power from a 3-wire grounded outlet. Power for the voice terminal functionality is phantomed from the switch DCP interface over the two data pairs.

The maximum cable distance between the 515 BCT and the system is 3400 feet (1036 m). Approximately 4 square feet of table or desk space is required.

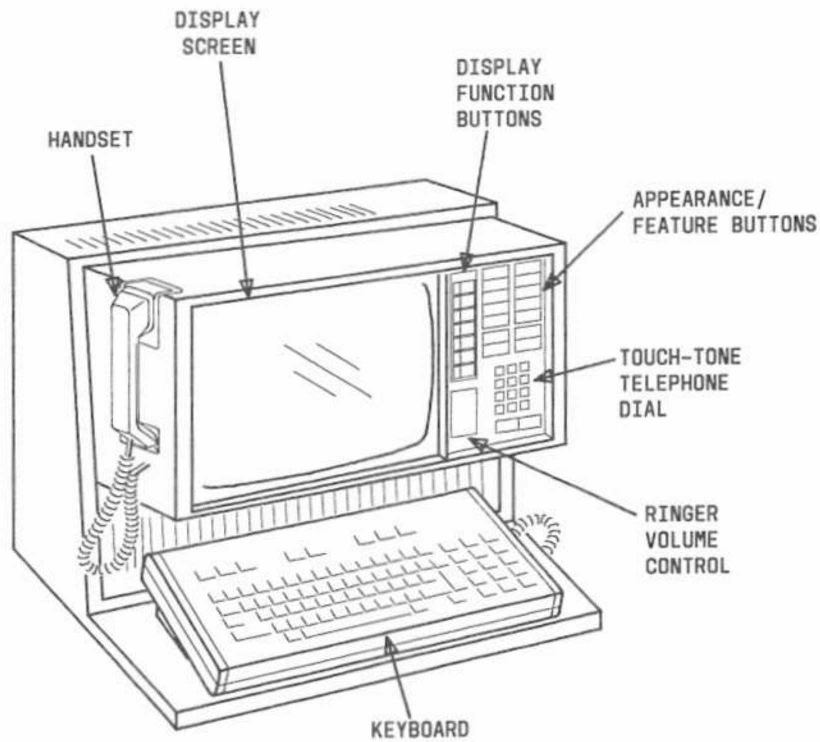


Figure 4-31. 515 Business Communications Terminal

PRINTERS

The printers used with System 85 (see Figure 4-32) are peripheral output devices that produce hard copy (printed pages) from data files as requested by a data terminal user. Four printers are available for use with the system:

- 443 Printer
- 445 Printer
- 450 Printer
- 460 Printer.

The System 85 printers:

- Are used in conjunction with an AP
- Can produce an original and five copies (two copies on the 443 printer)
- Accommodate up to 132 columns and print from a standard 94-character set (uppercase and lowercase)
- Use American Standard Code for Information Interchange (ASCII)
- Have a tractor-feed drive (optional on 450 printer)
- Require a Standard Serial Interface (SSI) data channel
- Require 120-V 60-Hz power from a 3-wire grounded outlet.

443 Printer

The 443 printer:

- Is a low-speed, inexpensive draft-quality matrix printer
- Prints 47.5 characters per second (cps) with a throughput 30 cps
- Accommodates paper widths of 3 to 15 inches (76 to 381 mm)
- Is designed for table or desk use.

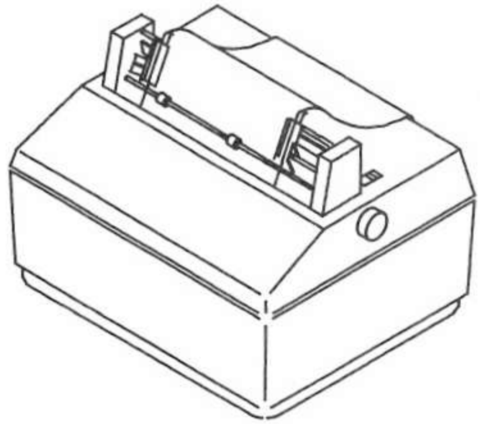
The 443 printer prints at 10 characters per inch (25.4 mm) with a 9-wire matrix print head. Friction feed and full forms control is provided. The ON/OFF switch is located on the top right of the printer.

The 443 printer can be located up to 5000 feet (1524 m) from the AP Cabinet and requires approximately 4 square feet of desk or table space.

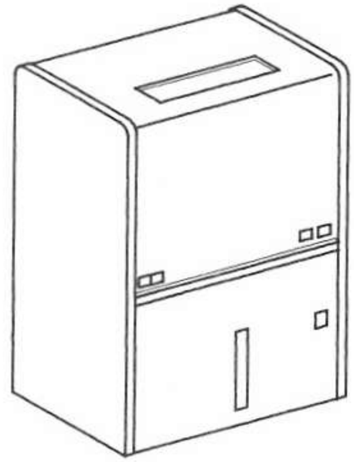
445 Printer

The 445 printer:

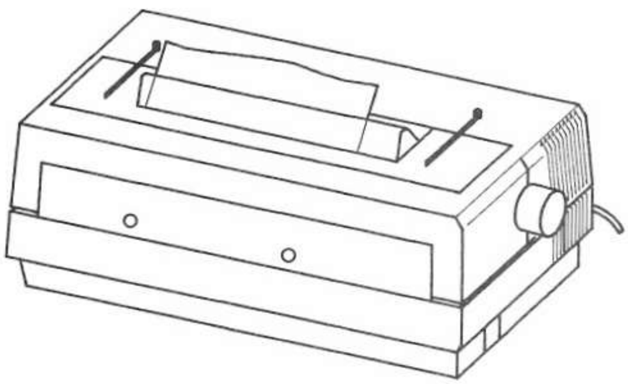
- Is a high-speed, draft-quality line printer
- Prints up to 220 lines per minute (300 lines per minute with the 64-character monocase character set)
- Accommodates paper widths of 4-1/8 to 15 inches (105 to 381 mm).



443 PRINTER



445 PRINTER



450 PRINTER

460 PRINTER

Figure 4-32. System 85 Printers

The 445 printer prints at 10 characters per inch with hammers striking the character pallets in a moving belt. Form length and width are operator-adjustable and full forms control is provided. The 445 printer is housed in an upright cabinet designed to reduce printer noise. Paper-handling facilities in the cabinet include:

- The paper supply and the paper supply shelf
- The paper accumulator and the paper accumulator shelf
- A window at the top of the cabinet for viewing the printout, and another window near the bottom front of the cabinet for viewing the printout accumulation.

A FORM ADVANCE switch and a red PAPER switch are located on the right front of the cabinet. These switches control the paper, and the PAPER switch lights whenever the paper jams or the printer is out of paper. The ON/OFF switch is located on the left front of the cabinet.

The 445 printer can be located up to 2000 feet (610 m) from the AP Cabinet and requires approximately 4 square feet of floor space.

450 Printer

The 450 printer is a medium-speed, document-quality character printer. It prints up to 55 characters per second with bidirectional printing. It can print a 132-column line with spacing of 10 characters per inch; it can also print a 158-column line with spacing of 12 characters per inch. Other 450 printer features include:

- Tab, margin, and form control
- Friction-feed and optional adjustable tractor-feed
- Accommodates paper widths of 3 to 15 inches (76 to 381 mm)
- Variable form length of 4 to 14 inches (102 to 356 mm).

The ON/OFF switch is located on the back of the printer.

The 450 printer can be located up to 5000 feet (1524 m) from the AP Cabinet and requires approximately 4 square feet of desk or table space.

460 Printer

The 460 printer:

- Is a medium-speed, draft-quality matrix printer
- Prints at 200 cps (340 cps burst)
- Accommodates paper widths of 3 to 16 inches (76 to 406 mm)
- Is designed for table or desk use.

The 460 printer uses a 7-wire print head and provides full forms control. It also offers three choices of character density:

- Normal—10 characters per inch, with 132 characters per line
- Condensed—16 characters per inch, with 218 characters per line
- Expanded—5 characters per inch, with 66 characters per line.

The control panel, located on the right side of the printer, contains four control buttons:

- ON LINE (on/off) switch
- TOP OF FORM—advances paper to the top of the form when pressed momentarily
- PAPER STEP—advances the paper one line for each press of the button
- ALARM CLEAR—lights when a fault is detected; when pressed, clears the printer logic.

The auxiliary control panel, on the right side of the printer, has the following controls:

- Lines Per Inch (LPI) Switch—selects six or eight lines per inch (25.4 mm)
- Form Length Switch—selects 11 commonly used form lengths
- Two-Digit Status Display—indicates which function was being performed when a problem occurred
- Pitch Switch—allows the selection of 10 or 16.7 characters per inch
- Test Switch—exercises the printer for testing (without external data input).

The 460 printer can be located up to 5000 feet (1524 m) from the AP Cabinet and requires approximately 4 square feet of desk or table space.

MISCELLANEOUS PERIPHERALS

System Management Terminal (SMT)

The SMT (J58889K) is a keyboard/display terminal used by the system administrator to perform local switch administration functions, such as the following:

- Change line extension numbers and features assigned to voice terminals
- Add and remove restrictions assigned to line extension numbers
- Change authorization codes
- Search translations (in memory) for particular line extension numbers (to identify the services provided).

The SMT (see Figure 4-33), measuring approximately 16 inches (406 mm) in length and 8.25 inches (210 mm) in width, is designed for desk-top use. The display panel and keyboard are specifically angled and designed to provide the user easy viewing and operation. The SMT contains:

- A 12-button keypad
- 24 Control buttons
- 4 Digital displays
- 8 Status lamps
- Flipcharts.

Whenever power is applied to the SMT, one of the status lamps indicates the SMT's current operational status, such as the following:

- Maintenance and Administration Panel (MAAP); Remote Maintenance, Administration, and Traffic System II (RMATS-II); or Terminal Change Management (TCM) is in use.
- Wait.
- Disconnect.
- Line or trunk being administered is busied out.

The SMT shares the same data channel to the system as the MAAP, RMATS-II, and TCM. The channel is used on a first-come, first-served basis. Operation of the SMT requires 120-V 60-Hz commercial power from a 3-wire grounded outlet. The SMT can be located up to 1000 feet (305 m) from the Common Control Cabinet.

The R1 SMT is fully compatible for R2 use, but in R1 required an external interface unit (ED-1E440) not needed for R2. Installation for the R2 application requires removal of the interface unit and replacement with a bypass cable.

For more detailed information on the SMT, refer to **AT&T System 85 (R2V3)—SMT Administration Management—User's Guide** (555-102-501).

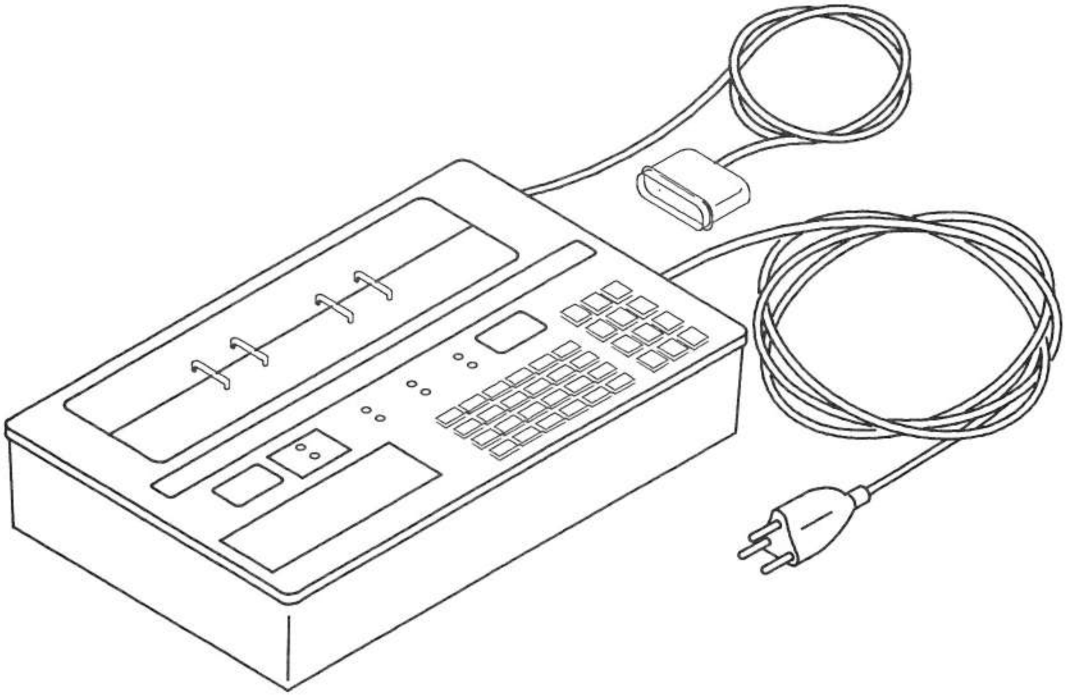


Figure 4-33. System Management Terminal (J58889K)

Maintenance and Administration Panel (MAAP)

The MAAP (J58889J) is a keyboard/display terminal used by service personnel to perform administration and maintenance procedures locally at the switch. These procedures allow service personnel to modify call processing translation tables and to perform the maintenance functions of system interrogation, testing, and fault isolation.

The MAAP (see Figure 4-34) contains a 12-button keypad and four rows of control buttons. It provides a 25-digit operational display, a 3-digit procedure number display, a 2-digit field identification display, and a 2-digit error code display. It also has eight LED lamps that indicate alarm and operational status.

The MAAP plugs into a MAAP connector on the Common Control Cabinet alarm panel (see Figures 3-13 and 3-14) or into an extended MAAP connector in Module Control Cabinets and remote modules. There is one connector for each common control processor and one connector for whichever processor is currently on-line in a duplicated common control system. The MAAP shares the same data channel to the system as the SMT, RMATS-II, and TCM. The channel is used on a first-come, first-served basis.

Flipcharts are attached to the MAAP and serve as a quick reference for each of the numbered administration and maintenance procedures (PROCs). Each flipchart explains the boundaries, limits, and definitions of the fields presented on the operational display for a given PROC.

For more detailed information on using the MAAP for administration procedures, refer to **AT&T System 85 (R2V3)—Feature Translations—Service Manual** (555-102-107). For more detailed information on using the MAAP for maintenance procedures, refer to **AT&T System 85 (R2V3)—Maintenance—Service Manual** (555-102-108).

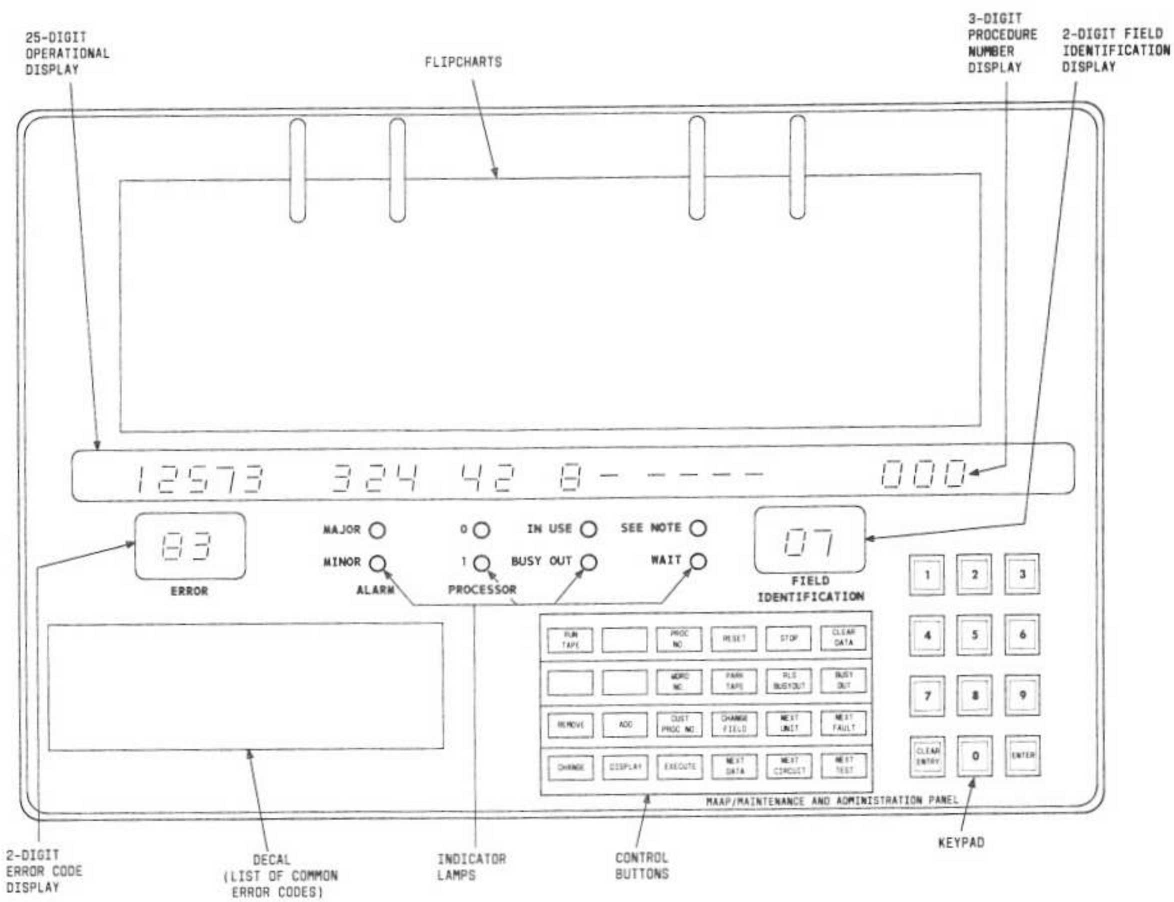


Figure 4-34. Maintenance and Administration Panel (J58889J)

Force Administration Data System (FADS) Terminal

The FADS terminal (see Figure 4-35) is used to display call traffic data for the Centralized Attendant Service (CAS) and/or Uniform Call Distribution (UCD) features. The FADS display terminal includes:

- A 12-button keypad to enter the requested data
- Two display fields to show the data requested
- Faceplate designating type of data displayed.

The FADS arrangement may be used to display CAS force administration data for integrated attendant concentration applications. Force administration data is made available at a main location by both visual and printed displays. One dedicated low-speed data channel and one 102F1-A terminal per system is used in this case. For UCD group studies (R2V1 systems only), one 102G1-A terminal per group (maximum of 12) may be used.

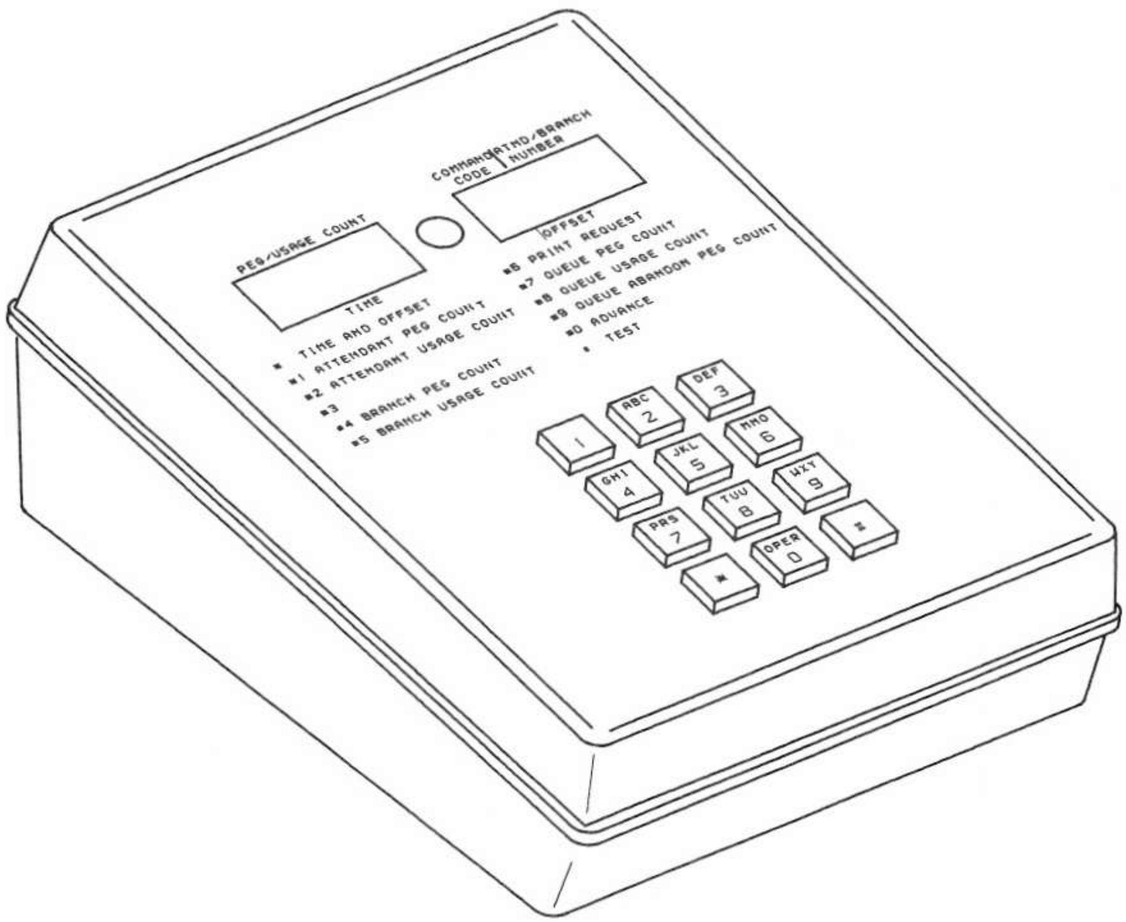


Figure 4-35. Force Administration Data System Terminal (102F1-A)

Position Status Indicators

The Position Status Indicator unit (106B1-A) provides a display (see Figure 4-36) of operational status for call distribution (ACD/EUCD/UCD) answering positions. The 100 indicators display the status of each of up to 20 positions, as follows:

- STAFFED—position available to receive ACD/EUCD/UCD calls
- ACD CALL—position active on an ACD/EUCD/UCD call
- AFTER WORK—position in after-work mode
- AUX WORK—position in auxiliary-work mode
- NON ACD—position active on a non-ACD/EUCD/UCD call.

When all the status lamps for a position are dark, this indicates that the position is not staffed. A TEST button is used to test for burned-out lamps.

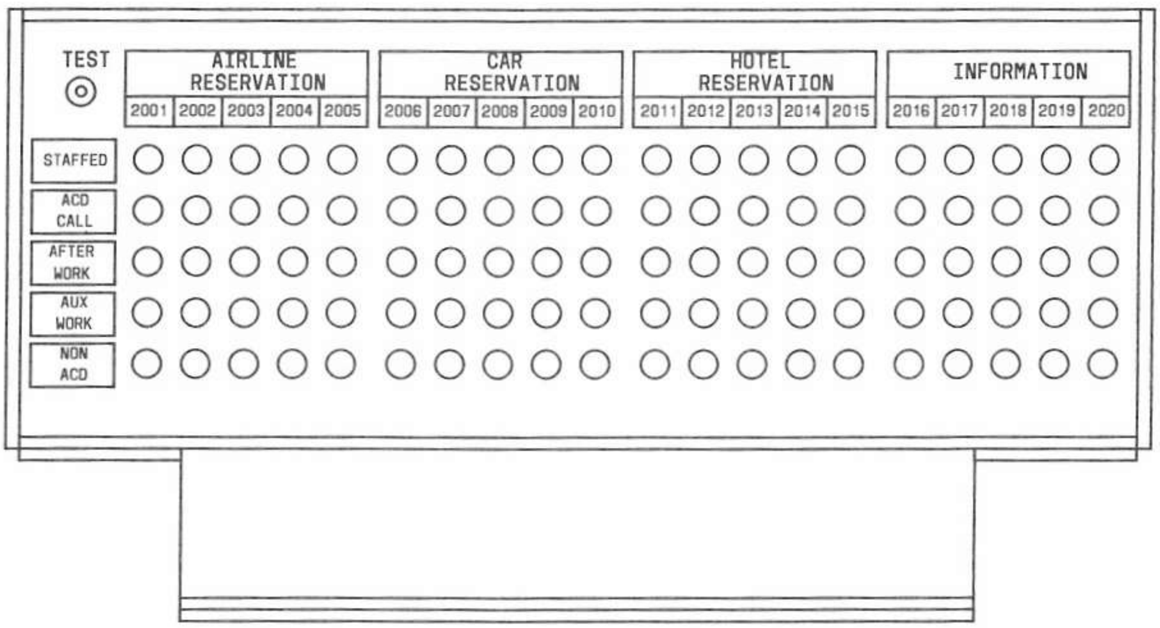


Figure 4-36. Position Status Indicator Unit (106B1-A)

System Status Indicators

The System Status Indicator unit (30A8) contains lamps that indicate the status of the following:

- ACD/EUCD/UCD calls
- Centralized Attendant Service (CAS) calls.

These indicators function as monitoring devices and provide the following information:

- Busy/Idle status of trunks
- Status of queues
- Warnings when the number of queued calls has exceeded the threshold number
- Warnings when system major or minor alarms indicate a need for maintenance.

Each System Status Indicator unit (see Figure 4-37) contains eight lamps and their associated circuitry. The units measure 6.50 inches (165 mm) wide, 3.125 inches (79 mm) high, and 5.25 inches (133 mm) deep. They are available in either black or ivory and are suitable for desk or wall mounting.

System Status Indicators used for ACD/EUCD/UCD calls may require up to 2 units (16 indicators). These indicators monitor the queue warning status of trunk groups for ACD/EUCD/UCD. Fifteen indicator lamps monitor the queue warning level and the remaining one indicates a system reload.

System Status Indicators for CAS calls may be used at both System 85 branch and main locations.

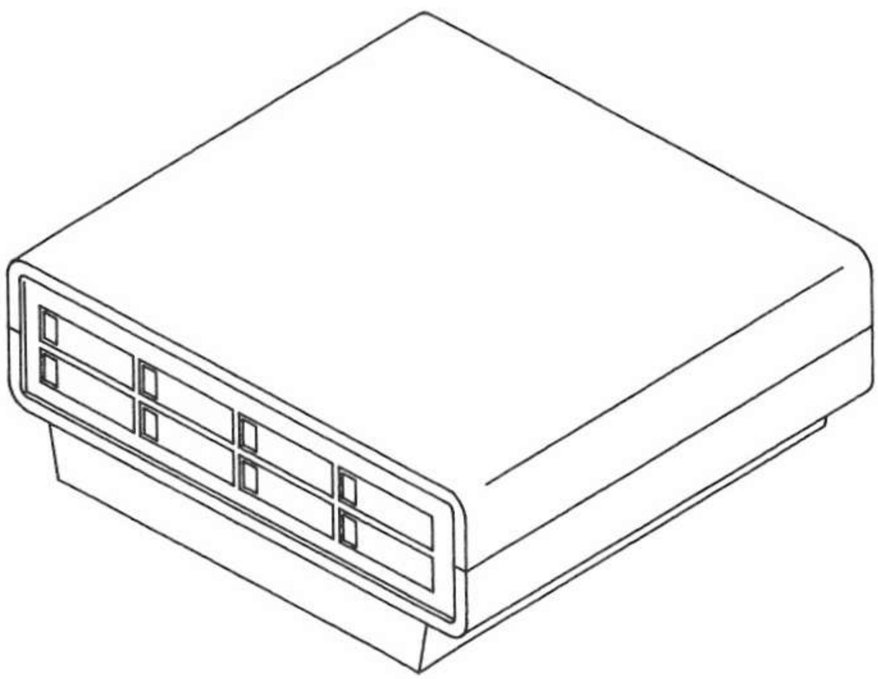


Figure 4-37. System Status Indicator Unit (30A8)

Main Locations

A maximum of 15 System Status Indicator units (with 8 indicators per unit) can be used at any System 85 main location. When the maximum number of units is in use, the indicators are assigned as follows:

- 110 indicators to monitor 110 Release Link Trunks (RLTs)
- 4 indicators to monitor the following system status information:

  Overload—the queue threshold number is exceeded

  Major—the system has a major alarm

  Minor—the system has a minor alarm

  Control—the system is in the backup mode.

If the maximum number of 110 RLTs and the overload, major, minor, and control functions are to be monitored, 15 System Status Indicator units are required as follows:

- 14 units to monitor the 110 RLTs (leaving 2 indicators unused)
- 1 unit to monitor 2 or all of these indicators: overload, major alarm, minor alarm, and control.

Branch Locations

A maximum of three System Status Indicator units can be used at any System 85 branch location. When the maximum number of units is in use, the indicators are assigned as follows:

- 2 units (16 indicators) to monitor 16 RLTs
- 1 unit (8 indicators)—4 indicators are used to indicate overload, major alarm, minor alarm, and control.

AUXILIARY EQUIPMENT

Auxiliary Cabinet

The Auxiliary Cabinet (J58886N) houses auxiliary equipment usually associated with optional features that are not integral to the digital switch. This cabinet includes the framework and equipment required to provide a maximum of 64 inches (1626 mm) of vertical mounting space for 23-inch (584-mm) wide auxiliary equipment units. It allows for carrier, rack, or panel mounting of up to 26.9 cubic feet of installed hardware. (Required hardware installations reduce the actual amount of available space.) The Auxiliary Cabinet is recommended when the system configuration requires more than only RMATS-II and TCM/FM access data equipment or when equipment requires power and/or rack mounting.

The Auxiliary Cabinet (see Figure 4-38) can be equipped with the following hardware to support auxiliary equipment housed within:

- A fuse panel (J58889AB)—distributes -48 V to fused cabinet circuits requiring that voltage.
- A thermal sensor assembly (ED-1E430-70)—monitors cabinet temperature.
- Multiple-mounting racks (40A4 and 71A)—provide vertical mounting for up to eight data sets (modems), automatic calling units (ACUs), or data modules.
- Interconnect panels—provide access to auxiliary equipment to/from the termination fields.
- Molded structural foam panels (4- and 11-inch)—used to mount auxiliary equipment (so that it need not be mounted on equipment room walls).
- A frequency generator and interrupter (J58889N)—provides low-frequency ringing current for associated equipment.
- 2012D power transformer—converts commercial ac power to low-level ac voltage for associated equipment.
- An ac fan assembly (J58889AL)—maintains interior cabinet temperature.
- An ac distribution unit (J58889AK)—provides an electrically filtered source of ac power to a power strip. Thirteen outlets are provided with access from the front of the cabinet.
- A -48 V rectifier (ITT Model 3947)—provides main dc power. It may be shelf-mounted or mounted at the base of the cabinet. Input power from the ac distribution unit (power strip) may be 120 V 60 Hz or 200 to 250 V 50 Hz. Adjustable taps on the primary winding of the transformer provide for either input or output voltage. Output capacity is 20 amperes.
- An auxiliary alarm distribution unit (J58889AE)—detects and reports equipment malfunctions.

In Auxiliary Cabinets powered from a standby power plant, the rectifier is not equipped and a dc filter (J58889AD) replaces the ac distribution unit. The number of Auxiliary Cabinets and the equipment they contain depends upon the number of features and services in the system that require auxiliary equipment.

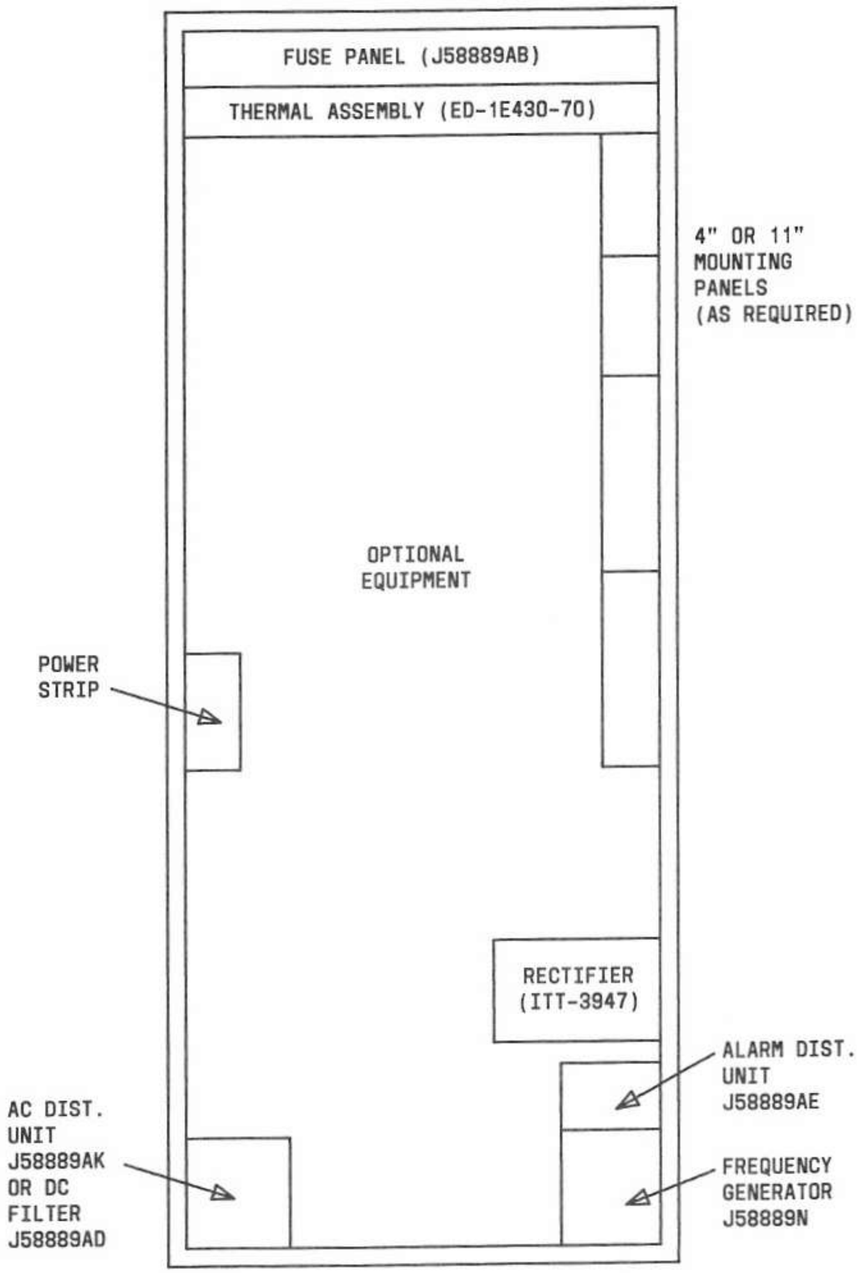


Figure 4-38. Auxiliary Cabinet (J58886N)

Auxiliary Cabinet alarms are consolidated for the various equipment and conditions within the cabinet. The alarm distribution unit registers these conditions and provides a compatible interface for the external equipment alarm input (provided by the remote interface circuit pack in the common control carrier). This allows automatic registering and reporting of auxiliary equipment alarms by the switch alarm panel. The possible Auxiliary Cabinet alarm types are as follows:

- Temperature
- Rectifier
- Circuit breaker/fuse
- Frequency generator
- Fans.

A 212AR data set and loop-start trunk are required to provide RMATS-II access to the switch. A data set may also be needed for AP access to a switch remote port. These data sets may be installed in a multiple-mounting rack in the Auxiliary Cabinet, if the cabinet is located within 50 feet (15 m) of the common control.

Interconnect panels for 3-pair connections (ED-1E443) may provide 32 or 64 terminations. The panels provide 110-type termination blocks which are prewired to 50-pin connectors, manufactured by Amphenol Products, mounted on the back of the Auxiliary Cabinet. Twenty-five pair I/O cables complete the connection between the interconnect panel and the selected termination field. With this arrangement, 3-pair modularity and pair sequencing on the 110 blocks is preserved. The interconnect panels are used for line and auxiliary trunk port access such as to data sets, data modules, or recorded announcement channels.They may also be used for any miscellaneous connections within the Auxiliary Cabinet.

Special cable assemblies for certain data sets and data modules are provided which allow EIA connector access at the back of the cabinet for direct cable runs to data terminal or data communications equipment.

Automatic Trunk Level Interface Unit

This unit (J53050P) provides automatic trunk level access to customer-provided equipment used for functions such as radio paging or recorded telephone dictation.

Channel Division Multiplexer (CDM) Equipment

A CDM provides an economical means to directly access the same DS-1 digital transmission facility that also provides interswitch connectivity. This multiplexer connects directly to the integrated DS-1 interface in a System 85. The CDM allows preselected voice, data, or video to be added to or removed from the DS-1 facility while passing the remaining channels through on a digital basis. The CDM provides point-to-point or multipoint nonswitched private-line data connections over the same digital facility.

The CDM is available in single-shelf or double-shelf configurations. The single-shelf unit has a basic shelf with circuitry for line interface circuits, alarms, power converter, and up to eight channel service units (CSUs). The double-shelf unit has the same basic shelf plus a second shelf with space for 16 additional CSUs, for a total of up to 24 CSUs. The single-shelf unit cannot be upgraded to a double-shelf unit. Standard equipment for both configurations includes:

- Line interface circuits
- Strobe generator assembly

- -48 V dc power converter
- Alarm assembly
- Equalizer assemblies
- Channel select matrix
- Jack panel unit.

Channel Expansion Multiplexer (CEM) Equipment

A CEM compresses 64-kbps voice and voiceband data signals into 32-kbps channels. This multiplexer connects directly to the integrated DS-1 interface in a System 85. The CEM can compress two DS-1 signals, each with up to twenty-four 64-kbps channels, into one DS-1 signal containing a maximum of forty-eight 32-kbps channels. A multiplexer is required at each end of the DS-1 link to recover compressed signals for point-to-point DS-1 applications.

The CEM consists of a single-shelf unit housing all the equipment needed to double the capacity of a DS-1 facility. The basic circuitry for the shelf has all the common equipment for line interfaces, alarms, and CSUs. Optional equipment for the CEM includes:

- 16- and 32-millisecond echo cancellation cards
- Signal plug-in card
- -48 V power supply.

89A Control Unit

The 89A control unit provides feature controls and protective isolation between the system and customer-provided paging equipment. The control unit performs the following functions:

- Provides circuitry for seizing the paging system or code calling system.
- Provides capability to "busy out." Also provides an option where a page-in-progress has priority over a busy-out signal.
- Permits application of music, tones, or a mix. Also removes music when paging is selected.
- Suppresses objectionable disconnect clicks on conclusion of a voice page.
- Presents a balanced input to the paging trunk circuit and a balanced output to a paging system power amplifier.
- Equalizes loud and soft voice signals.

The 89A control unit is powered by a 2012D power transformer.

Customer Premises Facility Terminal (CPFT) Equipment

The CPFT equipment (J99380) provides transmission and signaling range extension for the system line and trunk circuits. This equipment consists of metallic facility terminal (MFT) circuit packs and terminal balancing networks housed in connectorized shelves. The CPFT equipment terminates either 2- or 4-wire metallic facilities and is contained in a separate auxiliary cabinet.

The CPFT equipment includes the following basic components:

- Single- or double-module shelf—The single-module shelf is used when transmission only is required. The double-module shelf (see Figure 4-39) is used when both transmission and signaling treatments are required.
- Terminal balancing network—These shelves are used for 837-type networks. The network selected for a particular circuit is determined by the cable makeup of the circuit and the impedance of the system.
- Double-depth shelf frame and plug-in circuit packs.
- Power distribution/feature panel and voice frequency circuits—These are used for supplementary power distribution.
- Circuit pack shelf for small CPFT installations—This arrangement is for one to eight MFT circuits, with power unit included.
- Test extender—This may be required to allow access to the adjustments and test points when aligning the MFT circuit packs during CPFT installation.

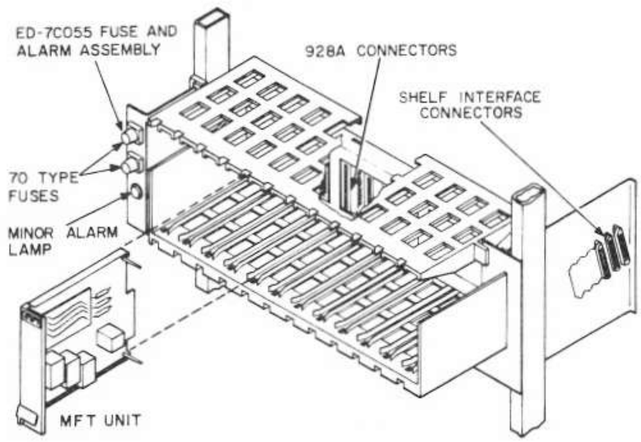


Figure 4-39. Customer Premises Facility Terminal Shelf (J99380)

Data Channel Repeater

The data channel repeater (J58879K) is an electronic circuit amplifier and isolator that provides range extension and/or surge protection for the system low-speed data channels. It is connected in series with the data channel to repeat data pulses and to provide insulation between input and output pairs. The data channel repeater detects and reconstructs incoming modified biphase (bipolar) data pulses to eliminate any pulse attenuation or distortion as well as to increase data channel range.

The two basic arrangements are single channel and dual channel, each of which can be with or without range extension. The maximum distance between a repeater and the system or peripheral device is 1000 feet (305 m). The maximum distance between two repeaters is 3000 feet (914 m). Up to four repeaters may be used to extend the maximum distance to 11,000 feet (3,353 m).

Information Systems Network (ISN) Interface

The ISN interface provides enhanced EIA RS-232C trunk connectivity to the ISN with a co-located high-speed packet switch. This interface is provided through EIA ports, asynchronous data units (ADUs), and an ISN concentrator.

The ISN concentrator multiplexes 40 EIA ports (SN238) over a fiber interface to the ISN node. The concentrator carrier houses five interface circuit packs which accommodate eight ports each. Eight ADUs are required per ISN concentrator circuit pack, or one ADU per EIA port. The carrier may be shelf mounted or housed in the System 85 Auxiliary Cabinet with an 8.64 Mbps fiber interface to the ISN node; 120 V ac is required for the concentrator. Trunk data baud rates must be set at either 300, 1200, 2400, 4800, 9600, or 19.2k bps for full duplex 10-bit start/stop asynchronous data, communications.

The Modem Pooling feature provides connectivity between ISN endpoints and remote endpoints accessed via System 85 CO trunks, WATS trunks, FX trunks, DID trunks, APLT trunks, tie trunks, and ETN trunks. End-to-end digital connectivity with ISN endpoints is provided for endpoints which are served either directly by the local System 85 switch or by a remote System 85/75 with DS-1 trunks to the local System 85.

Local Distribution Service Unit (LDSU)

The LDSU (48250) interfaces the System 85 switch Data Communications Interface Unit (DCIU) with an external processor, such as an AP, AUDIX, or another DCIU. The LDSU also provides required ground isolation between the Common Control Cabinet (containing the DCIU) and the external processor. Two LDSUs per external processor are required to provide this interface.

Each LDSU contains:

- A transmitter with filtering and modulation—allows data transmission at speeds from 2.4 kilobits per second (kbps) up to 19.2 kbps
- A receiver with equalization, demodulation, clock recovery, and signal presence detection—accepts incoming data from a 150-ohm line
- A regulated dc power supply for the required dc voltage
- An EIA RS-232C interface.

Note: A single 105A Isolating Data Interface (IDI) may be substituted for two LDSUs between each external processor.

Radio Paging Interface Trunk Unit

This unit (J58824CD) is required to provide the Radio Paging Access feature. The unit has two incoming ports and two answer ports. The four ports are connected to two central office trunk circuits. In addition to the interface unit, the following equipment is required:

- Touch-tone calling receiver (G1)
- Link and electronic dial unit (J58847Y)
- 36A voice coupler and 2012D power transformer.

The radio paging interface trunk unit is available in the following configurations to meet specified requirements:

- For radio paging without answerback
- For radio paging with answerback
- To repeat dialed digits on a 2-out-of-7 lead basis
- For one applique unit when touch-tone signals are converted to dial pulses
- For one applique unit when touch-tone signals are converted to dc signals on a 2-out-of-7 lead basis.

Recorded Announcement Set

The recorded announcement set provides the capability to intercept incoming calls and route them to a recorded message which indicates to the caller the reason for interception. One set must be used for each UCD/DDC delay announcement message or for Intercept Treatment announcements.

Three types of recorded announcement sets are available: the KS-16765 set, the 13A set, and the Model 213300 set, manufactured by Cook Electrics. The KS-16765 set preserves samples of speech for playback in analog form (stored on magnetic tape). It includes an amplifier, mounting bracket and connecting cord, and 36A voice coupler with its 2012D power transformer. The 13A set preserves samples of speech for playback in digital form (stored in a magnetic bubble memory). It is equipped for eight channels and provides variable message lengths of 3 to 24 seconds, adjusted in 3-second increments. The 13A set also provides an 8:1 space savings and low maintenance. The Model 213300 set also features voice storage and reproduction in digital form. It provides one channel of voice with message lengths of up to 16 seconds. This set features remote recording capability through a line access number.

Connections between the system and a recorded announcement set are made through the cross-connect field and voice coupler.

Recorded Telephone Dictation (RTD) Equipment

The RTD trunk (J58827E) allows access to and control of dictating equipment by voice terminal users within the system. The record and playback functions of the dictating equipment are dial-controlled. The start and stop functions may be dial- or voice-controlled. The RTD equipment includes the following:

- Dial dictation machines (not in Auxiliary Cabinet)
- RTD trunk equipment
- Frequency generator and interrupter unit
- Touch-tone interface and receiver
- Voice terminal for RTD attendant
- Voice coupler and transformer (discussed later).

Transfer Panel

Two types of transfer panels are available for installation in the Auxiliary Cabinet.

The Model 573-5 panel, manufactured by Porta Systems Corporation, is usually used for the emergency transfer capability. This provides a direct connection to central office (CO) trunks for preselected 2500-type voice terminals during a major system equipment failure or power failure at the system location. When the failure occurs, CO trunks are automatically connected through relays in the emergency transfer panel to the voice terminals, bypassing the system switch. Operation of the 573-5 panel does not require ground-start buttons on the voice terminals. This panel provides transfer for five trunks.

The 609A panel is usually used for the night transfer or alternate console position capabilities, if used for emergency transfer for voice terminals. A ground-start key is required at each preselected voice terminal to signal the CO when the voice terminal user wants to place a call. The 609A panel provides transfer for ten trunks.

Voice Coupler

The 36A voice coupler is used to couple the transmission of music, voice, or other signals to the system. The coupler also provides protection of the tip and ring circuit by limiting signal power from the music source, dictation machine, or paging equipment. For Radio Paging Access, the voice coupler is required when 2-way transmission or 1-way receiving is provided. For Music-On-Hold Access, the coupler provides isolation to the music source, which should be on at all times. For Intercept Treatment—Recorded Announcement, the coupler provides an interface between the system and the announcement set. For Recorded Telephone Dictation Access, the coupler connects the system and the dial dictation machine.

The 36A voice coupler is powered by the 2012D power transformer (set at -15 dBm).

Voice Switched Gain Amplifier

This amplifier (VFR-5050) automatically inserts extra transmission gain when total end-to-end losses are large enough to degrade transmission quality in a central office trunk connection. Switched bidirectionally under voice control, this equipment improves the transmission level of the connection. Up to 13 amplifiers (in circuit pack form) are housed in the 500-13 carrier.

APPLICATIONS PROCESSOR (AP) EQUIPMENT

Overview

The AP Cabinet houses a minicomputer system connected to various data entry and retrieval devices. It controls many functions and features not directly associated with call processing. Internally, the AP consists of the main central processing unit (CPU) and the peripheral subsystems. The CPU provides computing power and runs the operating system, offering a software execution environment to all applications programs. The peripherals are operated through microprocessor-based controllers, executing their own programs independent of the main CPU.

An AP may be connected to the System 85 switch through the Data Communications Interface Unit (DCIU) or through a digital port (SN270B). The AP is housed in a single cabinet containing several standard and optional subsystems. Terminals, printers, and data sets (modems) are connected externally.

An AP may support any of the following System 85 features:

- Call Detail Recording and Reporting
- Directory
- Electronic Document Communications
- Facilities Management
- Leave Word Calling (AP-based)
- Message Center
- Terminal Change Management
- Terminal Emulation.

The AP is provided in one of two major configurations: the AP16 and the 3B5 AP. Depending on the optional hardware subsystems provided, different variations of both types of AP Cabinets are possible.

AP16

The AP16 (J59222A) is controlled by a 16-bit main processor using an AP version of the UNIX operating system. The main processor communicates with internal and external equipment through 8-bit microprocessor-based subsystems. The AP16 Cabinet (see Figure 4-40) houses the following equipment:

- System control and maintenance panel—permits access to the control, monitoring, and maintenance functions for the AP. It is located on the front of the AP Cabinet. The system control panel has the key-lock-protected ON-OFF-RESET switch; power status, test status, and alarm status indicators; and the panel test pushbutton. The maintenance panel is located next to the system control panel. It has a 24-character alphanumeric display, several pushbuttons and switches for testing, and the panel enable key-lock switch.
- 212-AR data set and alarm origination equipment—provides an interface for connection to Remote Maintenance, Administration, and Traffic System II (RMATS-II) and alarm alerting to remote facilities.

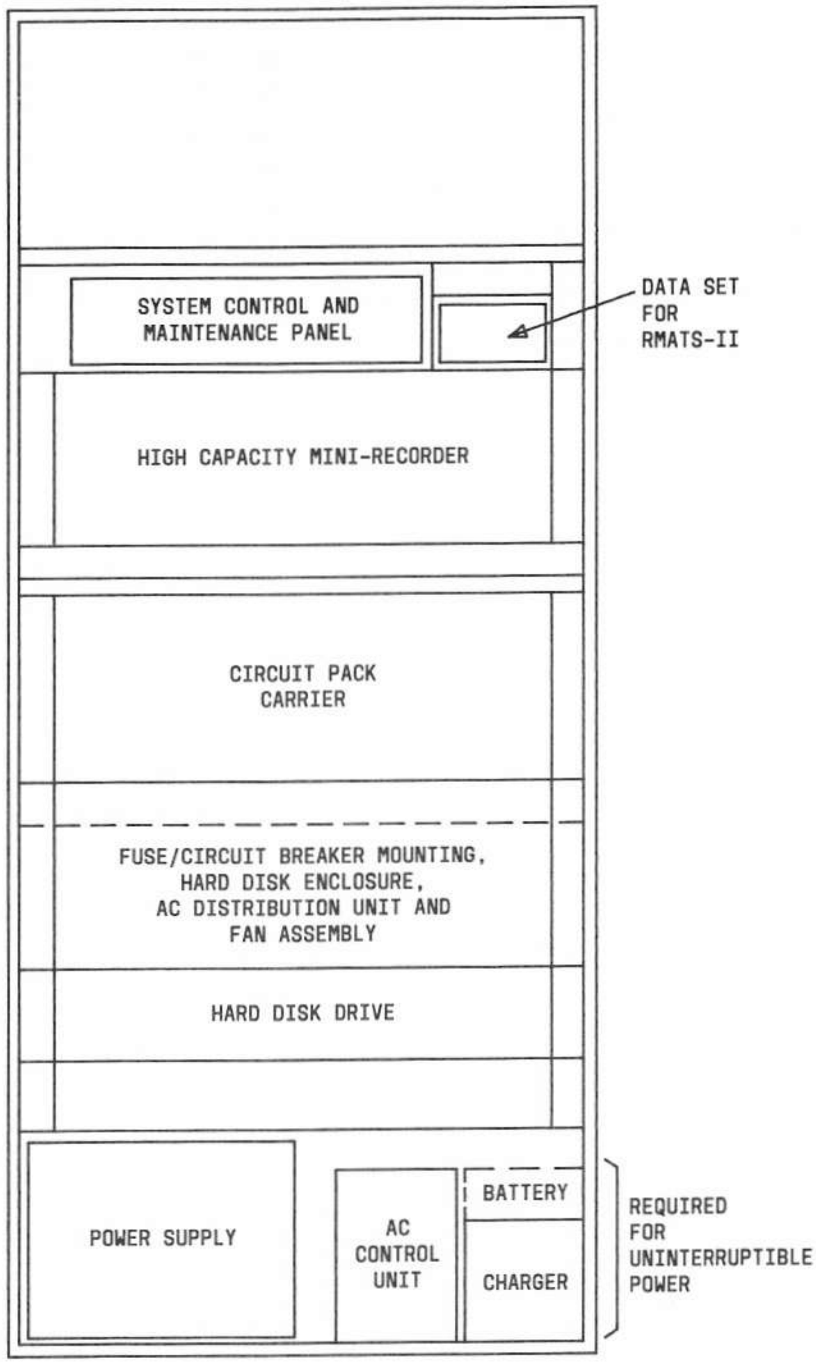


Figure 4-40. Applications Processor 16 (AP16) Cabinet (J59222A)

- Dual-Drive High Capacity Mini-Recorders (J1C170C)—drive tape for read and write operations. It is connected to the hard disk controller peripheral processor. An additional optional single-drive mini-recorder may be used, depending on features employed and customer requirements. The tape contains a backup copy of the applications programs and customer data stored on the hard disk. One tape cartridge stores approximately 23 megabytes of unformatted data.

- Processor carrier—contains operation and control circuitry for the main processor, memory, interfaces, and controller. The 16-bit processor comes with up to 3 megabytes of memory. Optional peripheral interfaces (discussed later) are provided for Standard Serial Interface (SSI) protocol, Electronics Industries Association (EIA) RS-232C protocol, and Switched Digital Communications Protocol (Switched DCP) terminal connections.

- Fuse/circuit breaker mounting—provides mountings for circuit overload and short-circuit protection.

- Hard disk drive—stores, in a nonvolatile mass storage, the operating system programs, applications programs, and UNIX file systems. It performs all device control functions and presents a high-level interface to the main operating system. This subsystem includes a Winchester-type Century Data Systems "Marksman" model disk drive, the hard disk interface, and the hard disk controller. Disk options include capacities of 40 or 160 megabytes.

- 9-Track tape subsystem—provides an optional drive used for archival storage of user data. This subsystem includes a Model 9800 Kennedy tape drive, a separate Model 9217 formatter electronics unit, a controller circuit pack, and an interface circuit pack. The tape drive stores 23 megabytes of data on a 1200-foot reel of standard 12-inch magnetic tape. The controller connects to the main system bus through its shared memory.

- AC control unit—controls and distributes ac power to the data set, mini-recorder(s), 9-track tape drive, hard disk drive, and dc power supply. The ac control unit houses the main circuit breaker, transformer, and relays.

- Uninterruptible dc power supply (J87458A)—provides dc power for the processor carrier and ac power for the hard disk drive and reserve charger. In the event of commercial ac power failure, the power supply bridges the reserve battery to its output for continuous normal operation. If the power failure lasts for more than 1 minute, a controlled shutdown of the AP is begun. The AP will write data from buffers in memory to disk, close files, and turn off power to the disk with no loss of data. When power is restored, the AP will automatically resume full operation.

- Reserve battery (KS-21906) and 327A charger unit—provide backup power for use during brief commercial power failures. The reserve battery supplies dc power for up to 4 minutes during "graceful shutdowns." The charger unit charges the reserve battery with power received from the power supply.

- Fan assembly (J58889V)—provides three forced-draft fans to maintain interior cabinet temperature within the acceptable operating limit. The fans are mounted vertically side by side and are designed to run continuously with dc power.

- Automatic alarm origination subsystem—provides alarm alerting to a remote location. It can be incorporated with the System 85 Alarm Origination feature or optionally provided with an autodialer, manufactured by Silent Knight Security Systems, internal to the AP16 and sharing the CO connection used to access the maintenance port.

For more detailed information on the AP16, refer to **Applications Processor 16—Reference Manual** (585-201-201 or 999-700-407).

3B5 AP

The 3B5 AP is controlled by a 32-bit main processor. This higher-capacity version of the AP has many of the capabilities of the AP16 (discussed previously) in addition to the following:

- Expandable to 8 megabytes of main memory with cache memory
- Digital Communications Protocol (DCP) controller/interface
- Local Area Network (LAN) using back-end packet switch and fiber-optic links for interconnection with other 3B5 APs (16-Mbps data rate)
- Customer programming in Office Program Language (OPL)
- Growth cabinet option.

The basic 3B5 AP Cabinet (see Figure 4-41) houses the following equipment:

- Basic control unit—contains major AP components such as the central control; the main store, integrated disk file, and storage module drive controllers; and power controls/converters. In addition, this unit houses the alarm interfaces, memory, AP peripheral interfaces (discussed later), and other input/output (I/O) circuitry.
- Growth control unit—provides additional slots for I/O and memory circuitry.
- AC control panel—controls and distributes ac power to various cabinet hardware. A growth ac panel is provided with the growth control unit.
- 9-Track tape subsystem—provides storage of user data. This subsystem includes an intelligent tape controller and a Model 92181 Control Data Corporation tape unit. The tape unit stores 1600 characters per inch in an ANSI-compatible, phase-encoded format.
- Fan assembly—provides forced-draft fans to maintain interior cabinet temperature within the acceptable operating limit. The fans are designed to run with dc power.
- Disk drive—stores the operating system programs, applications programs, and file systems. Up to two 160-megabyte disks with power supply may be accommodated.
- Autodialer—provides alarm alerting to a remote location.

For more detailed information on the 3B5 AP, refer to **3B5 AP—System Description—Reference Manual** (585-210-201).

AP Peripheral Interfaces

Four types of terminal controller/interface subsystems provide ports for hardwired or switched connections to an AP.

SSI Subsystem

The SSI terminal subsystem links 500 BCTs or SSI printers through direct connection at 56 kbps. Each SSI terminal interface provides user/operator access to the AP through up to sixteen 500 BCT terminals and two SSI printers (additional printers may be connected in place of terminals). They may be located up to 5000 feet (1524 m) from the AP and are cabled to the I/O connector field in the back of the AP directly or through building wiring. Dial-up access into the SSI is not provided. Programs are downloaded into the terminal's memory by the AP when each terminal is turned on.

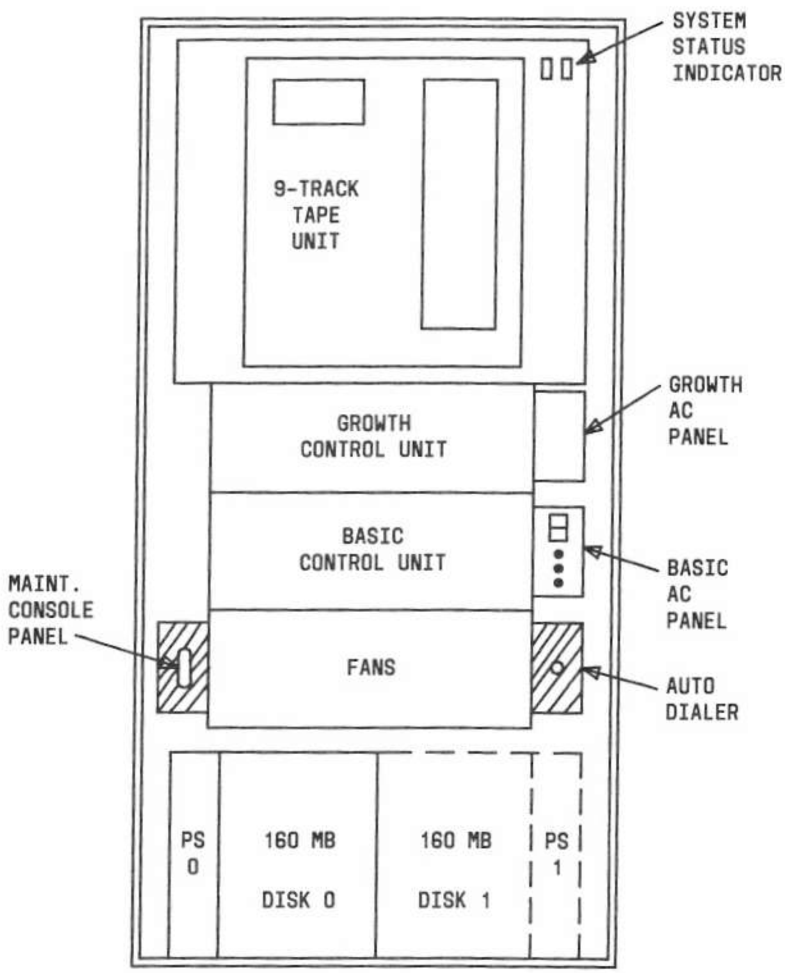


Figure 4-41. 3B5 Applications Processor (3B5 AP)

EIA Subsystem

The EIA terminal subsystem provides ports for switched or nonswitched RS-232C compatible terminals and/or printers at up to 1200 bps asynchronous. Each EIA terminal interface provides up to 12 interface ports for RS-232C compatible asynchronous communication, plus up to 2 interface channels for operation of RS-366 compatible Automatic Calling Units (ACUs). Optional data sets and ACUs are located externally. The RS-232C compatible terminals (including the 513 BCT), printers, or other devices are connected locally through null modems, data sets, or the System 85 equipped with data modules for local or remote switched access.

SDCP Subsystem

The Switched DCP (SDCP) terminal subsystem provides ports for switched access from 515 BCTs through the System 85 and Modular Processor Data Modules (MPDMs) at 64 kbps. This subsystem supports the same interface to the 515 BCT that is supported by the SSI subsystem to the 500 BCT. All AP features are accessible with this subsystem. Each SDCP terminal interface supports up to 12 simultaneously connected 515 BCTs. Each port must have an MPDM to connect to a switch using DCP protocol. The 515 BCTs are supported with high-speed interfaces into the AP. They must be switched through digital switches and use only digital facilities if used from remote locations to access the AP.

Line Controller Subsystem

The line controller subsystem provides the AP with two medium-speed communications ports, linking it to a remote mainframe computer, a data network, another AP, or a System 85 common control Data Communications Interface Unit (DCIU). Each line controller interface provides one RS-232C compatible port and one RS-449 compatible port, switch programmable for different modes and speeds of operation. When connected to a co-located DCIU, two Local Distribution Service Units (LDSUs) or a single Isolating Data Interface (IDI) are used to provide ground isolation between the AP Cabinet and the DCIU. For additional information on LDSUs, refer to AUXILIARY EQUIPMENT in this section.

AUDIO INFORMATION EXCHANGE (AUDIX) EQUIPMENT

The AUDIX equipment provides capabilities to perform the following functions of voice mail:

- Prepare voice messages
- Edit voice messages
- Send voice messages
- Receive and store voice messages from others.

The AUDIX system is configured in an arrangement which includes the following major hardware components:

- Control Cabinet
- Disk Cabinet.

In addition, a local administration terminal (513 BCT, 515 BCT, 5420, or similar terminal) is used to perform maintenance and administration tasks. Optional printers can be slaved to data terminals or can be connected to the AP for report outputs.

Control Cabinet

The Control Cabinet (J58886L) contains the following subsystems which control all AUDIX operations and process voice signals during storage and retrieval:

- Feature processor—handles most AUDIX control functions and controls all user interactions.
- Voice session processor—acts as the interface between voice terminal users on the System 85 switch and the AUDIX system.
- Data base processor—controls the operation of the disks through one or two disk controllers.
- Voice processors—sample digital voice signals, encode the silent parts, and compress the remaining signals.

The Control Cabinet also contains the AUDIX data interface to the switch DCIU I/O circuit pack (UN156). It also contains up to 32 voice ports with access to analog voice ports in the switch (SN228B/SN229B circuit packs). The AUDIX ports are represented by these switch analog ports, and call handling is performed through the System 85 call distribution capabilities.

The Control Cabinet (see Figure 4-42) contains the following AUDIX equipment:

- A power carrier (J58888L)—provides low-level dc power for the cabinet.
- A port carrier (J58888J)—provides the data and voice interfaces to the switch.
- A control carrier (J58888H)—contains operation and control circuitry.
- A data base processor carrier (J58888K)—controls the operation of the disks through one or two disk controllers.

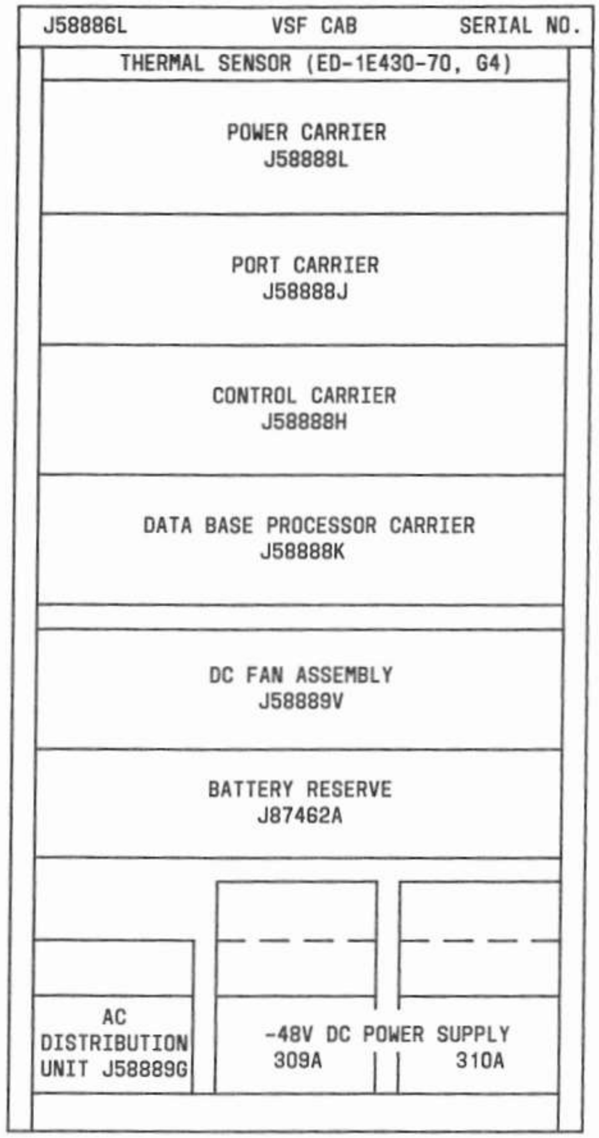


Figure 4-42. AUDIX Control Cabinet (J58886L)

The SMDR equipment (J58886H) receives, processes, and stores information pertaining to calls to and from voice terminals and attendant consoles. The customer has access to detailed call records to facilitate cost allocation, traffic analysis, and policing (detecting unauthorized calls).

The SMDR interface to the switch is through a dedicated data channel on the peripheral interface circuit pack (TN403) in the switch common control. Two SMDR interfaces can be supported.

The 9-track SMDR Cabinet (see Figure 4-44) contains the following:

- A Kennedy 9800 tape drive (KS-22077)—drives a 9-track magnetic tape.
- A 9-track magnetic tape (J59209TB)—stores information for approximately 330,000 calls (a readable form of the tape can be provided through machine processing).
- A fan assembly (ED-1E354-70)—provides cooling for the 9-track tape drive.
- A clock/calendar display unit (J59209AB)—provides a convenient means for setting the time and date to be recorded onto the tape.
- A call information display—shows detailed call information for one call at a time.
- A control panel (J59209AC)—provides a user interface to the 9-track tape operation for functions such as changing the tape, dumping memory, and clearing the display.
- An SMDR carrier (J59209AA)—contains the circuit packs that control SMDR operations (includes a 207B power supply).
- Fan assembly (J58889B)—provides forced-draft fans to maintain interior cabinet temperature within the acceptable operating limit.
- A Kennedy 9217 tape formatter (KS-22078)—records data on a standard 9-track magnetic tape.
- An ac distribution unit (J58889M)—provides ac power, filtering, and cabinet frame grounding.

The SMDR Cabinet must be located in the same building as the system switch cabinets. This helps to protect SMDR equipment from external voltage surges such as lightning and high-voltage lines outside the building. The SMDR Cabinet can be located up to 200 feet (61 m) from the Common Control Cabinet.

The direct output version of SMDR can be provided in a small stand-alone cabinet (J59209A-2) housing the SMDR carrier and clock/calendar display. Equipment typically used with the direct output SMDR includes an RS-232C-compatible printer, paper tape punch, or other customer-provided terminal equipment. This terminal equipment must be located in the same building within 100 feet (31 m) from the SMDR unit.

The 94A LSU is used to support the Centralized Message Detail Recording (CMDR) feature. The LSU stores Message Detail Records (MDRs) for Electronic Tandem Network (ETN) customers or multilocation customers served by other systems. These systems poll the LSU periodically to check for MDRs. SMDR records of 59-byte lengths are sent to the LSU. System 85 allows up to eight 94A LSUs to be connected for storage of MDRs on trunk traffic. The output of the LSUs can be connected to either a 93B Centralized Message Detail Recorder (CMDR) or any direct output device.

For more detailed information on SMDR equipment, refer to **SMDR—System Description—Reference Manual** (555-006-201).

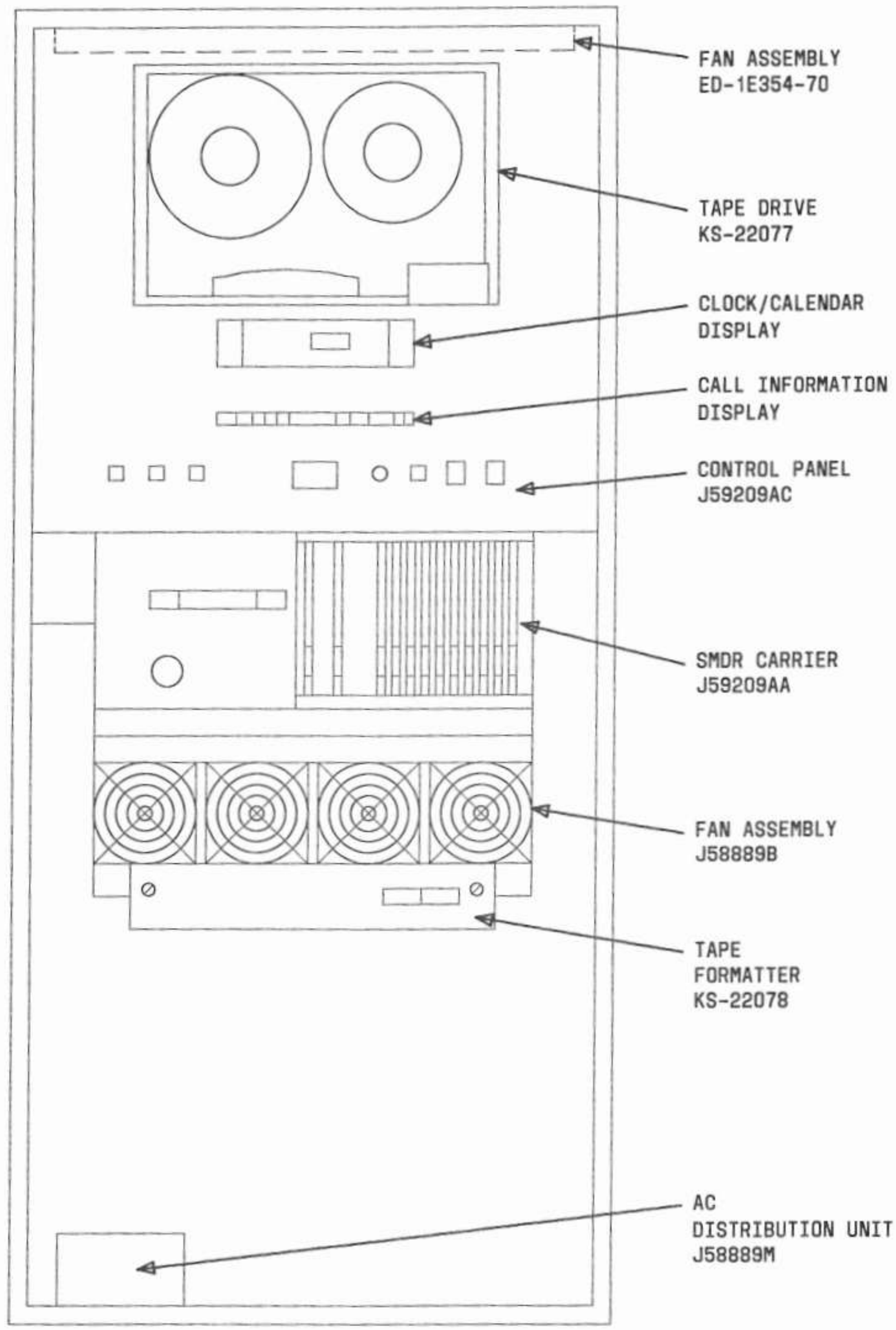


Figure 4-44. Station Message Detail Recording Cabinet (J58886H)

5. FEATURES AND SERVICES

OVERVIEW

This section contains general information on features and services available with System 85. It is divided into the following areas of coverage:

- Feature Availability—Table 5-A lists each system feature and indicates the Release 2 version(s) where it is available.
- New Features and Enhancements—highlights features that are new for Release 2, Version 3 (R2V3) of System 85, as well as R2V3 enhancements to features available in earlier versions.
- Feature Descriptions—lists the System 85 features in alphabetical order. A concise definition or description follows each feature entry.
- Feature-Related Hardware—includes a feature/hardware cross-reference (Table 5-B) that lists the hardware-dependent features in alphabetical order. Each listing specifies the additional hardware required for implementation of the feature.

Most of the basic System 85 features have their software residing in the switch. For more detailed information on these features, refer to **AT&T System 85 (R2V3)—Feature Descriptions—Reference Manual** (555-102-301). This document covers the following topics pertaining to each basic switch feature:

- Detailed descriptions (including feature history and development)
- User operations
- Considerations
- Interactions with other features
- Restrictions on feature use
- Hardware requirements
- Feature administration.

Other System 85 features and services have their software residing in major subsystems other than the switch (such as the AP16, 3B5 AP, SMDR, and AUDIX adjuncts). For more detailed information on these features and their applications, refer to the appropriate documents listed in the **AT&T System 85—Documentation Guide** (555-102-010).

TABLE 5-A. System 85 Feature Availability

FEATURE	RELEASE 2 VERSION		
	R2V1	R2V2	R2V3
Abbreviated Dialing	X	X	X
Advanced Private Line Termination (APLT)	X	X	X
Attendant Auto-Manual Splitting	X	X	X
Attendant Call Waiting (ACW)	X	X	X
Attendant Control of Trunk Group Access (ACTGA)	X	X	X
Attendant Direct Extension Selection (DXS) With Busy Lamp Field (BLF)	X	X	X
Attendant Direct Trunk Group Selection	X	X	X
Attendant Display	X	X	X
Attendant Interposition Calling and Transfer	X	X	X
Attendant Recall	X	X	X
Attendant Release Loop (ARL) Operation	X	X	X
Audio Information Exchange (AUDIX)		X	X
Authorization Codes	X	X	X
Automatic Alternate Routing (AAR)	X	X	X
AAR/ARS Pattern Queuing			X
Automatic Call Distribution (ACD)			X
Automatic Callback	X	X	X
Automatic Circuit Assurance (ACA)	X	X	X
Automatic Identification of Outward Dialing (AIOD)	X	X	X
Automatic Route Selection (ARS)	X	X	X
Automatic Transmission Measurement System (ATMS)		X	X
Automatic Voice Network (AUTOVON)	X	X	X
Bridged Call	X	X	X
Busy Out of Two-Way Trunks			X
Busy Verification of Lines	X	X	X
Call Coverage	X	X	X
Call Detail Recording and Reporting (CDRR)	X	X	X
Call Forwarding—Busy and Don't Answer	X	X	X
Call Forwarding—Follow Me	X	X	X
Call Hold			X
Call Management System (CMS)			X
Call Park	X	X	X
Call Pickup	X	X	X
Call Waiting	X	X	X
Centralized Attendant Service (CAS)	X	X	X

TABLE 5-A. System 85 Feature Availability (Contd)

FEATURE	RELEASE 2 VERSION		
	R2V1	R2V2	R2V3
Centralized Station Message Detail Recording (CSMDR)	X	X	X
Centralized System Management (CSM)			X
Code Calling Access	X	X	X
Conference—Attendant Six Party	X	X	X
Conference—Three Party	X	X	X
Data Call Setup	X	X	X
Data Communications Access (DCA)	X	X	X
3270 Data Modules			X
Data Protection	X	X	X
Dedicated Switch Connection			X
Dial Access to Attendant	X	X	X
Digital Multiplexed Interface (DMI)			X
Digital Service (DS-1) Trunk Interface		X	X
Direct Department Calling (DDC)	X		
Direct Inward Dialing (DID)	X	X	X
Direct Outward Dialing (DOD)	X	X	X
Directory	X	X	X
Display Message Scrolling (DMS)			X
Display—Voice Terminal	X	X	X
Distributed Communication System (DCS)		X	X
Electronic Document Communications (EDC)	X	X	X
Enhanced Symmetrical Routing			X
Enhanced Uniform Call Distribution (EUCD)		X	
Expanded Numbering Plan			X
Extension Number Portability			X
Facilities Management (FM)	X	X	X
Facilities Restriction Level (FRL)	X	X	X
Five Digit Dialing—Partial	X	X	X
Five Digit Dialing—Full			X
Force Administration Data System (FADS)	X	X	X
Foreign Exchange (FX) Access	X	X	X
Hold	X	X	X
Host Computer Access	X	X	X
Hot Line Service			X
Hunting	X	X	X
Information Systems Network (ISN) Interface		X	X
Intercept Treatment	X	X	X
Intercom—Automatic	X	X	X

TABLE 5-A. System 85 Feature Availability (Contd)

FEATURE	RELEASE 2 VERSION		
	R2V1	R2V2	R2V3
Intercom—Dial	X	X	X
Intercom—Manual	X	X	X
Interexchange Carrier (IXC) Access			X
Last Extension Dialed	X	X	X
Leave Word Calling (LWC)	X	X	X
Line Lockout	X	X	X
Line/Feature Status Indication	X	X	X
Loudspeaker Paging Access	X	X	X
Main/Satellite/Tributary	X	X	X
Maintenance and Administration Panel (MAAP)	X	X	X
Manual Signaling	X	X	X
Message Center	X	X	X
Message Waiting—Manual	X	X	X
Modem Pooling	X	X	X
Multi-Appearance Preselection and Preference	X	X	X
Multidigit Steering	X	X	X
Multiple Listed Directory Numbers (LDNs)	X	X	X
Music-On-Hold Access	X	X	X
Off-Premises Data-Only Terminals	X	X	X
Off-Premises Terminals	X	X	X
Override	X	X	X
Personal Central Office (CO) Line	X	X	X
Power Failure Transfer	X	X	X
Priority Calling	X	X	X
Privacy—Attendant Lockout	X	X	X
Privacy—Manual Exclusion	X	X	X
Queuing	X	X	X
Radio Paging Access	X	X	X
Recall Signaling	X	X	X
Recorded Telephone Dictation (RTD) Access	X	X	X
Remote Access	X	X	X
Remote Groups			X
Remote Maintenance, Administration, and Traffic System II (RMATS-II) Access	X	X	X
Remote Modules	X	X	X
Restriction—Attendant Control of Voice Terminals	X	X	X
Restriction—Code Restriction	X	X	X
Restriction—Miscellaneous Trunk Restrictions	X	X	X

TABLE 5-A. System 85 Feature Availability (Contd)

FEATURE	RELEASE 2 VERSION		
	R2V1	R2V2	R2V3
Restriction—Toll Restriction	X	X	X
Restriction—Voice Terminal Restrictions	X	X	X
Ringing (Alerting)—Abbreviated and Delayed Ringing	X	X	X
Ringing (Alerting)—Distinctive Ringing	X	X	X
Ringing (Alerting)—Ringing Cutoff	X	X	X
Ringing (Alerting)—Ringing Transfer	X	X	X
Route Advance	X	X	X
Serial Calls	X	X	X
Service Observing			X
Station Message Detail Recording (SMDR)	X	X	X
Straightforward Outward Completion	X	X	X
System Management Terminal (SMT)	X	X	X
Terminal Busy Indications	X	X	X
Terminal Change Management (TCM)	X	X	X
Terminal Emulation	X	X	X
Through Dialing	X	X	X
Timed Recall on Outgoing Calls	X	X	X
Timed Reminder	X	X	X
Touch-Tone Calling Senderized Operation	X	X	X
Touch-Tone Dialing	X	X	X
Transfer	X	X	X
Traveling Class Mark	X	X	X
Trunk Group Busy/Warning Indicators to Attendant	X	X	X
Trunk Verification—Attendant	X	X	X
Trunk Verification—Voice Terminal	X	X	X
Trunk-to-Trunk Connections	X	X	X
Unattended Console Service—Alternate Console Position	X	X	X
Unattended Console Service—Call Answer From Any Voice Terminal	X	X	X
Unattended Console Service—Preselected Call Routing	X	X	X
Unified Messaging (UM)		X	X
Uniform Call Distribution (UCD)	X		
Uniform Numbering	X	X	X
Visually Impaired Attendant Service (VIAS)	X	X	X
Wide Area Telecommunications Service (WATS) Access	X	X	X

NEW FEATURES AND ENHANCEMENTS

This part highlights new features that are introduced in Release 2, Version 3 (R2V3) of System 85. In addition to these, enhancements to features that existed in earlier versions are specified. The following new features and enhancements are now available for R2V3:

- Abbreviated Dialing Enhancements—Allow a greater number of list entries. The system list can now contain up to 9999 items. There can now be up to 9999 group lists. These lists and personal lists now can have up to 95 items. Lists can now be programmed by any extension number that "homes" to the controlling terminal. A new special function, Manual Digit Entry, has also been added. This encode, along with a single digit, allows digits to be entered manually along with the automatically dialed digits. The encode can be entered anywhere in the list item.
- Applications Processor 16 (AP16) Enhancements—Provide enhanced Terminal Change Management (TCM), Facilities Management (FM), and Call Detail Recording and Reporting (CDRR) capabilities for customers with less than 5000 lines. Response time/throughput for system management is improved by increased use of the System Management Application Transaction Protocol (SMATP). These improvements are important for many functions, including initialization and ongoing administration.
- Authorization Codes Enhancement—Increased to provide up to 90,000 possible codes.
- Automatic Alternate Routing (AAR)/Automatic Route Selection (ARS)/Queuing Enhancements—Improve the interaction between the Outgoing Trunk Queuing and AAR/ARS features. ARS now provides preference-depth queuing which allows a call to be served by any number of trunk groups in the pattern, instead of just the first choice trunk group. The number of 6-digit translators for foreign-NPA routing has increased to 160. Also, the number of routing patterns per translator has increased to ten. Conditional routing has been added to ARS. AAR now provides 640 patterns with 10 preferences per pattern possible, and Generalized Route Selection.
- Automatic Call Distribution (ACD)—Replaces and enhances the functionality previously provided by the UCD/DDC/EUCD features. An incoming ACD call can be distributed to the "most idle agent" using an agent queue. The maximum number of agents within the switch has been increased to 1024. Also, Service Observing allows an observer to monitor an agent's performance.
- Bridged Call Enhancement—Allows one single-line voice terminal to share an appearance with as many as 15 multi-appearance voice terminals.
- Busy Out of Two-Way Trunks—Allows 2-way tie trunks (excluding 2-way CO, FX, and WATS trunks) to be busied out in addition to the similar capability previously offered for 1-way trunks.
- Call Management System (CMS)—Allows ACD call processing activity to be recorded with a dedicated AP16 for real-time and later report processing output. The switch software sends information relating to trunk calls, extension calls, queuing, agent actions, etc., over a DCIU link to the AP. The CMS generates detailed reports based on this data to facilitate customer management of group sizing.
- Call Park, Code Calling, and Loudspeaker Paging Access Enhancement—Allows access to music-on-hold.

- Centralized Station Message Detail Recording (CSMDR) and SMDR Enhancements—Expanded call record now includes 3-digit trunk IDs, 15-digit account codes, and a 5-digit dialing plan. Optional forced entry of account codes and flexible record start time have been added. The number of Local Storage Units that can be attached to a single switch has increased to eight. Call completion threshold delay is now variable per trunk group, ranging from 2 to 98 seconds.

- Centralized System Management (CSM)—Provides a versatile system management vehicle for large customers with more than 5000 lines. Employing the 3B5 AP, it handles all FM and TCM functions, Traffic Management and Automatic Transmission Measuring, Cost Management, and AP Management. This feature also may support AUDIX, System 75, and Information Systems Network. The CSM contains switch image data bases with switch translation information, user records, and an equipment inventory. It also provides centralized multiswitch polling storage (via SMDR) and processing of message detail recording.

- 3270 Data Modules—Introduces a family of coaxial-to-DCP (Digital Communications Protocol) converters that allow IBM 3270-type display terminals to communicate with a host computer through System 85. The converters terminate the coaxial cable protocol and convert the information into a form and protocol compatible with DCP.

- Dedicated Switch Connection—Supports continuous connection of associated terminals through the switch. This provides a set of full-duplex dedicated connections through analog line/trunk ports and Digital Service (DS-1) interfaces.

- Digital Multiplexed Interface—Provides a cost-effective multiplexing scheme for switch-to-remote-host communications, using simple A/B bit tie-trunk-like signaling and sending 23-channel data over DS-1 facilities.

- Digital Service (DS-1) Interface Enhancements—Provide both ground-start and loop-start CO, FX, WATS (In/Out), and (reverse battery) DID trunks in addition to tie trunks. Different trunk types can occupy different channels on the same DS-1 transmission facility so long as the channel-to-trunk-type assignments are made in pairs. The DS-1 interface is also enhanced to provide 24 analog voiceband OPS service with a D4 channel bank or equivalent at the distant end. Provision of this type service implies that the interface be able to support loop-start signaling and call sequencing.

- Display Message Scrolling (DMS)—Provides for retrieval of Message Center Service (MCS) messages longer than 40 characters using the 40-character display module. The user can scroll through discrete message segments to view the entire message.

- Display—Voice Terminal Enhancement—Increased to provide up to 32,767 entries in the Name/Number data base.

- Enhanced Symmetrical Routing—Allows up to nine different tie trunk groups to be preferenced in any given AAR pattern when calling other nodes in the private network.

- Expanded Numbering Plan—Allows a private network to serve up to 100,000 extension numbers through the use of a 5-Digit Dialing—Full capability. Calls may be made to other users in the same switch or different switch in a private network using five digits, without dialing an access code or pausing for dial tone between digits. In addition, the Extension Number Portability feature allows users to retain their 4- or 5-digit extension number when transferring to another switch within this Uniform Numbering plan.

- Hold Enhancement—Provides Hold dial access code availability for single-appearance voice terminal users. This access to "Call Hold" allows more flexible handling of calls by providing an enduring ability to return held calls.
- Hot Line Service—Provides for automatic dialing to a preassigned number in the private or public network when the user of a Hotline voice terminal goes off-hook. Hotline terminals receive incoming calls normally (unless restricted by another feature) and are administered on a per-analog-line basis. This feature is introduced as part of Federal Emergency Management Agency (FEMA) enhancements and is implemented through the Abbreviated Dialing feature.
- Information Systems Network (ISN) Interface—Provides enhanced connectivity to the ISN, a distributed processing system with an open architecture and high-speed transport capability. The ISN interface may share a common administration terminal with the switch.
- Interexchange Carrier (IXC) Access—Provides voice terminal users the capability to specify the IXC vendor to be used for a call to a given dialing destination. Up to 24 digits may be outpulsed.
- Reduced Port Contention—Supports two simultaneous administration/maintenance processes, which now allows one administration plus one maintenance task to be performed at the same time. Previous versions of the system have supported only one maintenance or administration process at a time.
- Remote Group Capability—Makes provision for remoting System 85 port circuit packs up to approximately 100 miles from the main switch. This permits small clusters of off-premises analog, hybrid, EIA, and digital terminals with total feature transparency.
- Trunk Verification—Voice Terminal Enhancement—Provides the ability to busy out 2-way tie trunks.
- Unified Messaging (UM)—Introduces a fully integrated, cost-effective family of distinct messaging services. Unified Messaging provides the conceptual basis for combining the AUDIX, Call Coverage, Leave Word Calling, Message Center, and Electronic Document Communications services. The first phase of UM in R2V3 focuses on Integrated Alerting and Notification. This capability allows integration of alerting functions regardless of the originating service and notification of additional messages waiting from other services.

FEATURE DESCRIPTIONS

Abbreviated Dialing

Allows a voice terminal user to access numbers with fewer button presses than by using a touch-tone dial. Single-line voice terminal users dial an access code and index number. Multi-appearance voice terminal users press a single button. This feature is enhanced in R2V3 to allow a greater number of list entries. System list, personal list, and group list maximums are all increased from previous limits.

Advanced Private Line Termination (APLT)

Provides access to and termination from the following private line networks: Common Control Switching Arrangement (CCSA) and Enhanced Private Switched Communications Service (EPSCS). This feature allows network inward dialing and direct outward dialing to distant network locations.

Attendant Auto-Manual Splitting

Allows the attendant to privately identify the calling party to the voice terminal user.

Attendant Call Waiting

Allows a call to wait when the attendant extends a call to a busy single-line voice terminal. This reduces the attendant workload by reducing the number of recall attempts to a busy extension.

Attendant Control of Trunk Group Access (ACTGA)

Prevents voice terminal users from directly accessing selected trunk groups. If a user dials a trunk group under attendant control, the call is routed to the attendant (who decides whether to allow the call). This feature ensures efficient use of trunk groups by limiting access during high-demand periods.

Attendant Direct Extension Selection (DXS) With Busy Lamp Field (BLF)

Allows the attendant to place or extend calls to any of up to 600 (or 1800) extension numbers by pressing two buttons instead of dialing a number. The BLF indicates the busy/idle status of each extension.

Attendant Direct Trunk Group Selection

Allows the attendant to access an idle outgoing trunk by pressing the button assigned to the desired trunk group.

Attendant Display

Provides the attendant with information needed for rapid call completion. The alphanumeric display shows the identity, nature, status, and class of service of the calling line or trunk. Capabilities include Calling Number Display, Class-of-Service Display, Incoming Call Identification (ICI), and Trunk Identification.

Attendant Interposition Calling and Transfer

Allows an attendant in a multiposition system to call another attendant by dialing an access code and the called attendant's number. This feature is useful for consultation on call processing and for special handling requiring call transfers.

Attendant Recall

Allows a voice terminal user on a 2-party or conference call to recall the attendant for assistance.

Attendant Release Loop (ARL) Operation

Allows the attendant to hold an incoming trunk call off the console if completion of the call has to be delayed. This frees the release loop to handle other incoming calls.

Audio Information Exchange (AUDIX)

Provides the ability to perform voice mail functions from a subscriber's voice terminal. With AUDIX a subscriber can prepare, edit, and send voice messages to other users. A subscriber can also receive and store incoming voice messages from others. Call processing provides the means for establishing voice connections and for passing feature-related control information to the AUDIX adjunct.

Authorization Codes

In R2V3, authorization codes are increased to provide 90,000 possible codes. These may be any 4- to 7-digit number selected by the customer. The elimination of seed and check digits permits this flexible code assignment. Authorization codes may be used to override the Facilities Restriction Level (FRL) of a caller's line or incoming trunk to permit access to otherwise restricted facilities.

Automatic Alternate Routing (AAR)

Provides alternate routing for calls within the private network (tie trunk calls). This feature establishes routing patterns which are ordered lists of the routes (trunk groups) that the system can use to complete a call. Each routing pattern has a first-choice (most direct route) trunk group and up to three alternate trunk groups arranged in order of preference.

AAR Conditional Routing

Provides control over the number of satellite links in any tandem connection and controls the use of many different types of facilities in a routing pattern.

The maximum number of satellite hops allowed in an end-to-end private network routing pattern may be limited through a network utility known as Generalized Route Selection (GRS). A satellite hop is the use of a satellite link as a trunk in a routing pattern. This feature provides the ability to limit the number of these links in order to avoid unacceptable degradations and delays sometimes associated with satellite connections. In this application, routing is a function of the destination address and the number of satellite trunks already inserted in the connection path.

Automatic Alternate Routing (AAR)/Automatic Route Selection (ARS) Pattern Queuing

Enhances the interaction between Outgoing Trunk Queuing and the AAR/ARS features. In previous releases, queuing is allowed only on the first-choice trunk group in each pattern, after all appropriate trunk groups in a pattern have been searched unsuccessfully for an idle trunk. With this R2V3 enhancement, a call is queued on all trunk groups in the pattern (except restricted trunk groups) rather than just the first.

Automatic Call Distribution (ACD)

Permits incoming Direct Inward Dialing (DID), Central Office (CO), Foreign Exchange (FX), Tie Trunk, and Wide Area Telecommunications Service (WATS) calls as well as local extension and attendant calls to be terminated to the most idle of a prearranged group (split) of answering positions. These positions appear as normal extensions to the switch and can function in the usual manner to originate and receive calls directly. For Version 3, this feature replaces and enhances the functionality previously provided by the Version 2 EUCD feature.

Automatic Callback

Allows a user to call a busy extension, go on-hook, and then be automatically connected when the called extension becomes idle. When both extensions are idle, the calling terminal receives distinctive ringing. Upon answer, the called extension is alerted. This feature provides the convenience of having the system monitor the busy/idle status of both extensions, rather than the user redialing. It is generally used when the Call Coverage feature is not utilized.

Automatic Circuit Assurance (ACA)

Provides early detection of possible trunk malfunctions. Switch software measures and records the holding time (duration) for each call on specified trunk groups. Comparing actual holding times to preassigned limits, the switch detects and counts the number of unusually long or short calls that are characteristic of faulty trunk circuits. Verification of such trouble can then be performed by an attendant or voice terminal user. When problems are detected on a trunk, a designated attendant is automatically alerted. The attendant may then check the trunk condition using the Trunk Verification—Attendant feature.

Automatic Identification of Outward Dialing (AIOD)

Provides automatic identification of extension numbers on outward calls in conjunction with Automatic Message Accounting (AMA) facilities at the local central office. This feature permits individual extension billing on toll calls and the equivalent on private network calls.

Automatic Route Selection (ARS)

Provides alternate routing for calls through the public network. This feature establishes routing patterns with a first-choice trunk group and up to ten alternate trunk groups arranged in order of preference. Usually, the first-choice group is the least expensive trunk facility for a given time-of-day and day-of-week, while each alternate route is increasingly more expensive.

Automatic Transmission Measurement System (ATMS)

Allows the customer to make meaningful transmission tests of on-network and off-network facilities by measuring loss, noise, and echo impairments. This feature is implemented through switch hardware and associated software in both the switch and the AP.

Automatic Voice Network (AUTOVON)

Provides preemption capabilities for calls related to national defense. AUTOVON is part of the Defense Communications System. The AUTOVON interface allows attendants and users to access the military network with an access code. Users can receive assistance on outgoing calls by dialing an attendant assistance code.

Bridged Call

Allows multi-appearance voice terminal users sharing an extension number to bridge onto an existing call on that number. The 2-party call becomes a 3-party call. For R2V3, this feature is enhanced to allow a single-line voice terminal to share an appearance with up to 15 multi-appearance voice terminals.

Busy Out of Two-Way Trunks

For R2V3, this feature allows 2-way tie trunks (excluding 2-way CO, FX, and WATS trunks) to be busied out in addition to the similar capability previously offered for 1-way trunks. It may be the customer's responsibility to coordinate the busy-out action at both ends of the circuit and to initiate actions to clear any resulting alarms.

Busy Verification of Lines

Allows the attendant to verify that an apparently busy extension is actually busy. This is done through the use of the VERFY button on the attendant console.

Call Coverage

Allows a user's incoming calls to be automatically redirected to alternate answering points. Up to three answering points may be specified in a prearranged coverage path. A coverage path is specified per principal (user with Call Coverage active). For Versions 2 and 3, two coverage paths can be assigned per principal. This feature may take effect for all incoming calls, or when the user is busy on a call, or when the user does not answer the call.

The Call Coverage feature frees users from the problems of missed incoming calls. They have the assurance that calls will always be answered and messages taken. Call Coverage is preprogrammed so there are no feature codes to remember.

Call Detail Recording and Reporting (CDRR)

Provides call detail recording and administration capabilities on the AP for calls processed through the switch. The customer has access to detailed call records to facilitate call costing, cost allocation, traffic analysis, and policing (detecting unauthorized calls).

Call Forwarding—Busy and Don't Answer

Forwards calls to a selected extension or attendant. Whenever the called user is busy or does not answer, the call is automatically forwarded to a destination assigned by the user. This feature provides a simple form of coverage for calls that might otherwise go unanswered.

Call Forwarding—Follow Me

Forwards calls to a selected extension or attendant. Whenever the called user activates this feature, all calls are automatically forwarded to a destination assigned by the user.

Call Hold

Allows a single-line voice terminal user to temporarily disconnect from a call (using a Hold feature access code), perform other call functions, and then return to the original call.

Call Management System (CMS)

Allows ACD/EUCD call processing activity to be recorded with a dedicated AP16 for real-time and later report processing output. The switch software sends information relating to trunk calls, extension calls, queuing, agent actions, etc., over a DCIU link to the AP. The AP-CMS generates detailed reports based on this data to facilitate customer management of group sizing.

Call Park

Allows a user to put a call on hold and then transfer the call to an answer-back channel. Any other voice terminal within the system can then pick up the call. This procedure is useful when needed information is in another area or the call could be handled more efficiently in another area. For R2V3, this feature has access to music-on-hold.

Call Pickup

Allows a user to answer any call to another extension within the user's specified group. This provides a simple means for answering calls to unattended voice terminals.

Call Waiting

Provides notification to a voice terminal user when a call is waiting. After hearing the special tone, the called user can then answer by using either the answer-hold code or by going on-hook. This feature essentially doubles the user's call-handling ability.

Centralized Attendant Service (CAS)

Allows users served by separate systems (at two or more locations) to concentrate the attendant positions at one location. At unattended branch locations, calls requiring attendant assistance route over release link trunks to the centralized (main) attendant location.

Centralized Station Message Detail Recording (CSMDR)

Provides a record of incoming and outgoing calls through the switch. This feature is normally used in a network environment for centralized call information collection. The customer has access to detailed call records to facilitate cost allocation, traffic analysis, and policing (detecting unauthorized calls). Call records may be produced through a 9-track tape or the direct output option. The recorded information includes date (month and day), time of call completion, call duration, condition code (call type), dialed access code or trunk group access code, dialed number, and calling extension number (or dial access code of incoming trunk group). When applicable, the CSMDR feature also records the account number dialed, time in queue, Facilities Restriction Level (FRL), Automatic Route Selection (ARS) plan, incoming and outgoing circuit ID, and Interexchange Carrier (IXC) code.

The R2V3 version of CSMDR introduces several enhancements to the existing feature. An optional capability allows for provision of user-dialed account codes of up to 15 digits. An administrable option for forced entry of account codes is provided for both the 5- and 15-digit capabilities. Call completion thresholds are changed from a fixed delay to a customer-administrable per-trunk-group variable ranging from 2 to 98 seconds. Up to eight CSMDR Local Storage Units per switch can be supported for increased capacity and added reliability.

Centralized System Management (CSM)

For R2V3, provides a versatile system management vehicle for large customers with more than 5000 lines. Employing the 3B5 AP, it handles all FM and TCM functions, Traffic Management and Automatic Transmission Measuring, Cost Management, and AP Management. This feature also may support AUDIX, System 75, and Information Systems Network. The CSM contains switch image data bases with switch translation information, user records, and an equipment inventory. It also provides centralized multiswitch polling storage (via SMDR) and processing of message detail recording.

Code Calling Access

Allows attendants, voice terminal users, and tie trunk users to page with coded signals. These signals consist of chimes, bells, or gongs distributed by a loudspeaker system. The called party answers the page by dialing an answer-back code from any voice terminal within the system. This feature is especially useful for alerting users who are normally away from their desk (such as maintenance or security personnel). For R2V3, this feature has access to music-on-hold.

Conference—Attendant Six Party

Allows the attendant to set up a conference for up to six conferees, plus the attendant. Conferees from inside and outside the system can be added for consultation.

Conference—Three Party

Allows voice terminal users to set up 3-party conferences without attendant assistance.

Data Call Setup

Provides several ways to establish completely digital data calls between local (within the system) data terminals. When used with the Modem Pooling or DS-1 Interface features, the user can make either analog or digital switched connections between local data terminals and external data endpoints. This feature does not require the dedication of a voice terminal to a data call.

Data Communications Access (DCA)

Provides connectivity for data terminals that use conventional analog interface modems. This feature permits gradual or phased conversion to digital service for existing analog equipment facilities. A data call is set up as a voice call; then control is transferred to the associated modem. The voice terminal is usually dedicated to the data call (unavailable for voice service) while the call is in progress.

3270 Data Modules

Introduces a family of coaxial-to-DCP converters that allow IBM 3270-type display terminals to communicate with a host computer through System 85. The converters terminate the coaxial cable protocol and convert the information into a form and protocol compatible with DCP. One converter connects a terminal to DCP while a similar converter connects the cluster controller to DCP. The converters use DCP mode

3. A unique message set conveys the terminal input and output to and from the cluster controller. These modules support terminal dialing. Each one appears to System 85 software similar to a modular processor data module (MPDM).

Data Protection

Provides protection for data calls from system-generated tones or intrusion attempts. This feature offers both temporary and permanent protection options for either digital or analog data calls.

Dedicated Switch Connection

Supports continuous connection of terminals through the switch. This feature provides a set of full-duplex dedicated connections through analog line ports, analog trunk ports, and DS-1 interfaces. After any service disruption, the system will automatically reestablish these customer-specified connections.

Dial Access to Attendant

Allows a voice terminal user to access an attendant by dialing a code, usually zero (0). The attendant can then extend the call to trunks, other voice terminals, or other attendants. This feature permits a user to contact the attendant for assistance or to extend access to normally restricted facilities.

Digital Multiplexed Interface (DMI)

Provides a cost effective means of switch-to-host communications with simple A/B bit tie-trunk-like signaling. Twenty-three clear 64-kbps channels transfer data from an equivalent number of Digital Communications Protocol (DCP) or Electronic Industries Association (EIA) terminals to the host. The multiplexed channels can be sent over Digital Service (DS-1) carrier facilities, allowing the host to be located remotely from the switch. The DMI effectively removes any distance limitation for interconnecting System 85s and host processors, with high-speed data communications links, in an interpremises configuration.

Digital Service (DS-1) Trunk Interface

Provides a high-speed, high-volume digital trunking facility that operates at 1.544 Mbps. By multiplexing 24 digital channels onto a single T1 carrier, DS-1 offers an economical alternative to the standard 4-wire analog tie trunk. The DS-1 trunk interface is compatible with all switch and network configurations of System 85 and gives complete access to voice-only or Alternate Voice/Data (AVD) communications paths. The DS-1 capability also eliminates the need for modem pools.

This feature is enhanced in R2V3 to provide both ground-start and loop-start CO, FX, WATS (In/Out), and (reverse battery) DID trunks in addition to tie trunks. Different trunk types can occupy different channels on the same DS-1 transmission facility so long as the channel-to-trunk-type assignments are made in pairs. The DS-1 interface is also enhanced to provide 24 analog voiceband OPS service with a D4 channel bank or equivalent at the distant end. Provision of this type service implies that the interface be able to support loop-start signaling and call sequencing.

Direct Department Calling (DDC)

Provides a distribution service for departments with a high volume of incoming calls. Each department terminates one or more non-DID listed directory number (LDN) type trunk groups to a designated voice terminal in a linear hunting group. (This feature is available for Version 1 only.)

Direct Inward Dialing (DID)

Allows calls from the public network to connect to the dialed extension number without attendant assistance. The DID feature can also allow access to Data Communications Access ports, local attendants, Centralized Attendant Service (CAS) attendants, and remote voice terminals without attendant assistance. (Extension numbers are also assigned to attendants.)

Direct Outward Dialing (DOD)

Allows a voice terminal user to access the public network without attendant assistance.

Directory

An AP-based service which provides access to an internal company personnel directory for a designated agent. The agent can perform directory lookup with a Business Communications Terminal (BCT) and may obtain hard copy printouts of the directory information.

Display Message Scrolling (DMS)

Provides for retrieval of Message Center Service (MCS) messages longer than 40 characters using the 40-character display module. The user can scroll through discrete message segments to view the entire message.

Display—Voice Terminal

Provides updated call and message information on a 40-character alphanumeric display. Display modes are selected by the user of a digital voice terminal equipped with the display. This feature is enhanced in R2V3 to allow a greater number of name/number data base entries.

Distributed Communication System (DCS)

Provides the ability to connect two or more switching systems to operate as one large switching system. Centralization is accomplished by control signals transmitted over Data Communications Interface Unit (DCIU) links and voice/data signals transmitted over tie trunks. The DCS multimachine network can serve customers who require more capacity than a single system can provide and/or customers who require multilocation systems to function as a single system.

The DCS configuration allows a defined set of transparent attendant and voice terminal features. A feature is transparent if it works the same whether terminals involved in a call are assigned to the same node (switch) or different nodes. The following attendant features are transparent for DCS: Attendant Call Waiting, Attendant Control of Trunk Group Access, Automatic Circuit Assurance, Busy Verification of Lines, Calling Number Display, Class-of-Service Display, Direct Trunk Group Selection, Incoming Call Identification, Trunk Group Busy/Warning Indicators, and Trunk Verification by Customer. The following voice terminal features are transparent for DCS: Abbreviated Dialing, Ringing (Alerting)—Distinctive Ringing, Automatic Callback, Call Coverage, Call Forwarding—All Calls, Call Waiting, Leave Word Calling (on AP), and Three Party Conference and Transfer.

Electronic Document Communications (EDC)

An AP-based service which encompasses the entire text information, generation, and movement technologies available with the system. The EDC feature combines the capabilities of text mail, electronic filing, text processing, data entry, and forms creation in one package.

Enhanced Symmetrical Routing

Allows up to nine different tie trunk groups to be preferenced in any given AAR pattern when calling other nodes in the network.

Enhanced Uniform Call Distribution (EUCD)

Provides increased call-handling efficiency for departments that receive a high volume of similar incoming calls. Selected voice terminal users (agents) can be organized into a group to allow for balanced call distribution among the agents. Offered in Version 2 only, this feature replaced and enhanced the functionality previously provided by the Version 1 Uniform Call Distribution (UCD)/Direct Department Calling (DDC) features.

Expanded Numbering Plan

Allows a private network to serve up to 100,000 extension numbers through the use of a 5-digit dialing plan. The actual number of lines served depends upon the calling rate required by the customer and is limited by other internal software factors.

Extension Number Portability

Retains a user's extension number when moving to another R2V3 switch within a network. If a user is served by any tie trunk network with a uniform numbering plan, the user can retain his/her existing 4- or 5-digit extension number when moving to another switch within the complex which also offers this feature. The user may also retain his/her AUTOVON, DID, and Electronic Tandem Network (ETN) numbers when moving to a different node within the multiswitch environment.

Facilities Management (FM)

Provides an AP-based system management tool for managing system status, performance information, and network administration capabilities. These capabilities are accessed with a BCT. The following network features can be administered and changed through FM: Automatic Circuit Assurance, Facilities Restriction Levels, Authorization Codes, Call Queuing, Synchronization, and Trunk Group Maintenance Busy. When a system is set up and functioning, a customer can produce meaningful traffic reports that are designed to reveal system usage patterns and performance data.

Facilities Restriction Level (FRL) and Authorization Codes

The FRL feature defines network calling privileges. Authorization codes protect a private network against unauthorized calls. Each call-originating facility and each authorization code has an FRL. Each trunk group in an AAR or ARS pattern also has an FRL. When a user places a call, the routing pattern is selected based on the dialed digits. The switch then compares the FRL of the originating facility (default FRL) to the FRLs of the trunk groups in the pattern and chooses accordingly. The authorization code is optional and is dialed by a caller. The switch replaces the default FRL with an FRL associated with the authorization code. Using the new FRL, the caller can make a second attempt to place a call. The system can be arranged so that only callers having a high enough FRL can make calls through the public network.

Five Digit Dialing—Full

Provides a means for voice terminal users to call other users in the same switch or a different switch in a private network using five digits, without dialing an access code or pausing for dial tone between digits.

Force Administration Data System (FADS)

Collects and stores traffic-related information for CAS and/or UCD groups. Access to this data is obtained through one or more FADS display terminals. Optionally, a printer may be provided with each terminal to obtain printouts of the traffic data. (The UCD FADS is available for Version 1 only.)

Foreign Exchange (FX) Access

Provides connectivity to central office (CO) trunks from areas outside of the local service area where the switch is located. This feature provides the same functionality to the FX CO service area as is provided by local CO trunks in the local dialing area.

Hold

Allows a multi-appearance voice terminal user to temporarily disconnect from a call (using a feature button), perform other call functions, and then return to the original call. For R2V3, the Hold dial access code is made available for single-appearance voice terminal users (see Call Hold).

Host Computer Access

Provides for switched connections between local host computers and other data endpoints. Both digital and analog connections are supported. This feature also provides the ability to place host computer-originated digital data calls without an automatic calling unit.

Hot Line Service

Provides for automatic dialing to a preassigned number in the private or public network when the user of a Hotline voice terminal goes off-hook. Hotline terminals receive incoming calls normally (unless restricted by another feature) and are administered on a per-analog-line basis. This feature is introduced in R2V3 as part of Federal Emergency Management Agency (FEMA) enhancements and is implemented through the Abbreviated Dialing feature.

Hunting

Provides call routing to another voice terminal in a preset group when the called terminal is busy. The group member's status (busy or idle) is checked in a predetermined order. If an extension is busy, the call routes to (hunts to) the next available group member. The search for an idle member can be circular or linear.

Information Systems Network (ISN) Interface

Provides enhanced connectivity [through an EIA trunk and Asynchronous Data Unit (ADU)] to a distributed processing system with an open architecture and high-speed transport capability. ISN combines diverse processing equipment into a fully integrated network using packet switching, centralized system management, state-of-the-art optical fiber distribution, and an innovative network topology. ISN provides automated system management and simple operator-initiated administrative and maintenance procedures. It also has capacity for addition/enhancement of equipment without service disruptions or network congestion. The ISN interface may share a common administration terminal with the switch.

Intercept Treatment

Provides intercept tone, attendant assistance, recorded announcement, or recorded announcement with time-out to attendant when a call cannot complete or when use of a feature is denied.

Intercom—Automatic

Provides a dedicated talking path between two multi-appearance voice terminals. The called terminal is notified with distinctive ringing when the other terminal goes off-hook and activates the feature.

Intercom—Dial

Allows multi-appearance voice terminal users to gain rapid access to other users in the same intercom group. The calling user dials a 1- or 2-digit code to reach the desired party who receives distinctive ringing.

Intercom—Manual

Allows a multi-appearance voice terminal user to access other terminals assigned to the same intercom group. At any one time, up to three users in the group can connect. This feature cannot be used without Manual Signaling.

Interexchange Carrier (IXC) Access

Provides, in a manner totally transparent to the user, connection to any IXC complying with the FCC Rules. To accomplish this, AAR/ARS trunk group outpulsing instructions accept a user-dialed 7- to 10-digit address and construct outpulsing appropriate for any of the standard IXC access methods. Up to 24 digits may be outpulsed, and SMDR records an IXC identifier.

Last Extension Dialed

Automatically redials the last extension number dialed whenever multi-appearance voice terminal users press a designated button. This feature is useful for redials to a busy extension.

Leave Word Calling (LWC)

Allows internal callers to leave messages for other internal users without the assistance of a secretary or Message Center agent. This feature stores a standard message on the AP, Audio Information Exchange (AUDIX) adjunct, or the switch.

The LWC feature is designed to encourage the use of automatic rather than manual message storage and retrieval. For example, a caller can activate the feature on a redirected call rather than leaving a message with an agent. A single touch on a voice terminal does the following:

- Stores a "please call" message and the caller's name and extension number.
- Automatically lights the message waiting light on the voice terminal.

When messages are retrieved, the system identifies the caller and time of each message. The user can then activate "return call" to automatically return the call.

If the call is handled by a coverage point, the coverage person can leave the message for the caller by activating the "Coverage Callback" function.

Line Lockout

Provides an intercept tone when a user picks up the handset and does not dial within 10 seconds. The extension is taken out of service until the handset is placed on-hook. This feature frees switching facilities for other calls.

Line/Feature Status Indication

Provides a visual indication of call status and feature activation status for multi-appearance voice terminals. This feature prevents call interruptions and serves as a reminder of the features that are active. Appearance buttons and feature buttons are associated with green status lamps. Appearance buttons are also associated with red I-use (in-use) status lamps.

Loudspeaker Paging Access

Provides attendants and voice terminal users access to voice paging equipment. This feature permits contacting a given party without a messenger or repeated dialing and is useful in emergency situations. The Loudspeaker Paging Access feature is enhanced in R2V3 to provide a music option. This allows a user to be optionally connected to music (instead of audible ringback) while in the "parked" condition. When a loudspeaker paging circuit is accessed, an answerback channel may be requested and the call is held (parked) until the paged party responds.

Main/Satellite/Tributary

Provides a private network configuration, with one main switch and several associated switches, that serves the needs of a customer with a few locations in a small geographic area. Attendant positions and public network trunk facilities are usually concentrated at the main switch. As part of an Electronic Tandem Network (ETN), a larger customer can interconnect several geographically dispersed Main/Satellite/Tributary complexes. To a caller outside the complex, the system appears to be a single switch with one Listed Directory Number (LDN). A tributary location is similar to a satellite location, except that it has one or more attendant positions and has its own LDN.

Maintenance and Administration Panel (MAAP)

Provides the basic interface between the Systems Technician and System 85. It provides access to maintenance and administration procedures (PROCs). These procedures allow the technician to modify call processing translation tables and to perform the maintenance functions of system interrogation, testing, fault isolation, and repair. Some MAAP PROCs are off-line, and a request to access them causes the software to read from the tape cartridge into a designated memory block. Most MAAP operations do not interfere with system services.

The MAAP provides buttons for entering data and commands and provides display devices to indicate data and status information. The extended MAAP capability allows physical connection of a MAAP to a module control, in addition to the standard common control connection. This additional MAAP interface is incorporated in the last module control in the extended MAAP chain. For more detailed information on the MAAP, refer to Section 4, PERIPHERAL EQUIPMENT.

Manual Signaling

Allows a multi-appearance terminal user to signal a preselected terminal by pressing a button. This feature is used in conjunction with the Manual Intercom feature to provide signaling.

Message Center

An AP-based service which provides coverage of calls which otherwise would not be answered. Calls are routed via a redirection feature (Call Coverage) to the assigned group for answering calls with the intended principal's name, current status, messages for incoming callers, and for message recording.

Message Waiting—Manual

Enables multi-appearance voice terminal users to light the status lamp associated with the manual message waiting button at another preassigned terminal. This feature normally indicates a need to contact the activating party or a desire not to be disturbed, depending on its application.

Modem Pooling

Provides for switched connections between the system's data modules and computer ports and external analog networks. This feature bridges the gap between digital-interfaced on-premises equipment and analog carriers in public or private networks. On-premises terminals and hosts can call, and be called from, off-premises operations such as remote host computers or data entry points.

Modem pools use paired groups of port circuits (one digital and one analog). Each Modem Pool group can support up to 99 conversion resources. Route Advance can access up to five groups, for a maximum of 495 conversion resources, before a call is denied or enters a queue. The conversion resource consists of a trunk data module or modular trunk data module (MTDM) coupled with a modem (data set). Modem Pooling automatically supports incoming calls placed directly to a digital data endpoint. The system can recognize the need for a conversion resource on these calls. Modem Pooling also supports a call placed to a voice terminal when an assigned data button is used to transfer the call to the desired data endpoint. The Modem Pooling feature is designed specifically to support incoming or outgoing (interswitch) calls.

Multi-Appearance Preselection and Preference

Provides multi-appearance voice terminal users with the following options for placing or answering calls on selected appearances: Preselection, Ringing (Alerting) Appearance Preference, Idle Appearance Preference, Prime Appearance Preference, No Appearance Preference, and Last Appearance Preference.

Multidigit Steering

Allows a user to dial what appears to be an extension number, which the switch translates into a trunk group or feature access code. The access code is then used to route the call to the desired location.

Multiple Listed Directory Numbers (LDNs)

Provide multiple, publicly published numbers for access to a single system. These numbers may terminate at consoles or individual groups within a company. For calls handled by the attendant, each LDN can have a unique display on the console.

Music-On-Hold Access

Provides customer-provided music to a held party to indicate that the connection is still in effect.

Off-Premises Data-Only Terminals

Provides a means of establishing direct data communications with remote work stations. These remote facilities use private-line data channels that do not compete for limited external connections to the system.

Off-Premises Terminals

Provides a means of establishing direct voice communications with remote terminals. These remote voice terminals use dedicated line interface circuits that do not compete for limited external (trunk interface) connections to the system.

Override

Permits authorized multi-appearance voice terminal users to interrupt other users busy on a 2-party connection. A warning tone intrudes on the busy connection before the interruption.

Personal Central Office (CO) Line

Guarantees privacy and direct access to dedicated CO trunks by establishing a direct connection to the public network using CO, Foreign Exchange (FX), or Wide Area Telecommunications Service (WATS) trunks.

Power Failure Transfer

Provides service between designated central office (CO) trunks and designated voice terminals on the switch if a power failure occurs, if reserve power is not provided, or if the battery reserve is depleted. This feature is also provided when certain major alarm conditions occur.

Priority Calling

Provides priority ringing to an idle single-line voice terminal or to an idle appearance of a multi-appearance terminal.

Privacy—Attendant Lockout

Prevents the attendant from reentering a 2-party connection held on the console, unless recalled by a user.

Privacy—Manual Exclusion

Prevents other users with the same extension number from bridging onto a terminal in use. This feature is useful at voice terminals where the user has occasional need for assured privacy but a general need for other terminals to pick up calls.

Queuing

Improves caller efficiency by reducing or eliminating repeated dialing attempts when all available trunks for a particular call are busy. A queue is a space in memory where information about waiting call attempts is stored. This feature is useful during periods of high call volume. The switch processes calls in queue on a first-in, first-out basis. Three types of queuing are available, with optional type combinations and time-in-queue limits: off-hook priority, off-hook nonpriority, and ringback queuing.

Radio Paging Access

Enables attendants and voice terminal users to page a person who is carrying a radio receiver. The paged party can answer the call by using a voice terminal and accessing an answer-back channel. This feature is provided for persons who do not normally remain at one location or whose services cannot remain out of reach for even short periods of time.

Recall Signaling

Allows a single-line voice terminal user who is busy on a 2-party call to place the second party on hold and obtain recall dial tone. The user can then call another party or activate another feature.

Recorded Telephone Dictation (RTD) Access

Permits users to access customer-provided dictation equipment. The start and stop functions can be voice- or dial-controlled.

Remote Access

Permits a caller from the public network to enter the private network and access the features and services it provides. To ensure private network security, the switch can be set up to require a barrier code (one code for all users) or an authorization code (individual codes) before processing a call. A remote access user normally requires a touch-tone dialing instrument, but a time-out option enables callers to use a rotary-dial instrument to reach the attendant.

Remote Groups

Makes provision for remotely locating System 85 port circuit packs up to approximately 100 miles from the main switch. This permits small clusters of distant voice/data terminals with total feature transparency. A remote group, utilizing standard DS-1 facilities accessed through a Remote Group Interface (RGI), will support off-premises analog, hybrid, EIA, and digital ports. Each remote group supports any combination of three interface circuit packs. Local trunk interfaces to the remote group are not supported.

Remote Maintenance, Administration, and Traffic System II (RMATS-II) Access

Provides a service (operated by AT&T-IS) using a computer and the UNIX operating system to perform maintenance, administration, and traffic studies from a central location. It also provides some pre-cutover changes at the time of installation. The RMATS-II receives alarm notification from the system through an automatic calling unit. The RMATS-II then accesses System 85 by direct distance dialing.

Remote Modules

Provide an efficient alternative configuration for a campus-type environment, where customer buildings are clustered and the users require similar system capabilities. Remote modules offer feature transparency with less space and cost than separate systems. The number of remote modules is determined by the number and type of interfaces at the main system site.

Restriction—Attendant Control of Voice Terminals

Allows an attendant to activate or cancel restrictions for specific extension numbers. This feature assigns any one of the following types of restriction to one extension number or to a group: Outward and Terminal-to-Terminal, Outward and Termination, Outward, Terminal-to-Terminal, Termination, and Total Restriction.

Restriction—Code Restriction

Allows users to place calls from authorized extension numbers to specified geographical areas. Three restriction levels are available to define the type of calls allowed from a voice terminal. Five unique lists can be established, each defining a different set of three geographical areas.

Restriction—Miscellaneous Trunk Restrictions

Restricts preselected voice terminals from the use of certain trunk groups.

Restriction—Toll Restriction

Restricts preselected voice terminals from placing toll calls except with attendant assistance.

Restriction—Voice Terminal Restrictions

Provides the following fixed restrictions for voice terminals to inhibit the call receiving and/or originating abilities of the users: Inward, Manual Terminating Line, Origination, Outward, Terminal-to-Terminal Only Calling, and Termination Restriction.

Ringing (Alerting)—Abbreviated and Delayed Ringing

Provides multi-appearance voice terminal users with manual transfer or delayed automatic transfer of alerting (for all bridged appearances of an extension number on different terminals). This feature cannot be used when Call Coverage is defined.

Ringing (Alerting)—Distinctive Ringing

Helps users distinguish between various types of incoming calls by providing three distinctive ringing burst patterns.

Ringing (Alerting)—Ringing Cutoff

Silences the ringing at a particular terminal, but does not affect the functions of the status lamp for the called appearance.

Ringing (Alerting)—Ringing Transfer

Allows multi-appearance voice terminal users to transfer all alerting for a given extension number to another terminal that is assigned the same number or that has a bridged appearance of the same number.

Route Advance

Provides for outgoing calls to be automatically routed over alternate trunk groups when the trunk group of first choice is busy.

Serial Calls

Allows the attendant to connect a caller from the public network to two or more voice terminals in succession.

Service Observing

Allows the ACD split supervisors to monitor the performance of assigned ACD agent positions in an extended, convenient, and transparent manner.

Station Message Detail Recording (SMDR)

Provides a record of incoming and outgoing calls through the switch. The customer has access to detailed call records to facilitate cost allocation, traffic analysis, and policing (detecting unauthorized calls). Call records may be produced through a 9-track tape or the direct output option. The recorded information includes: date (month and day), time of call completion, call duration, condition code (call type), dialed access code or trunk group access code, dialed number, and calling extension number (or dial access code of incoming trunk group). When applicable, the SMDR feature also records the account number dialed, time in queue, Facilities Restriction Level (FRL), and Automatic Route Selection (ARS) plan.

The R2V3 version of SMDR introduces several enhancements to the existing feature. An optional capability allows for provision of user-dialed account codes of up to 15 digits. An administrable option for forced entry of account codes is provided for both the 5- and 15-digit capabilities. Call completion thresholds are changed from a fixed delay to a customer-administrable per-trunk-group variable ranging from 2 to 98 seconds. Up to eight SMDR Local Storage Units can be supported for increased capacity and added reliability. The maximum number of SMDR records is increased to 6000.

Straightforward Outward Completion

Allows an attendant to complete an outgoing trunk call for a user. By completing such calls, the attendant can screen calls and control their destinations.

System Management Terminal (SMT)

Provides an interface terminal for customer management of system translations and network administration. The SMT uses a series of procedures (PROCs) to accomplish designated functions. The SMT gives a customer the ability to administer software translations of System 85 in the following categories: voice terminal rearrangement and button assignments, line assignments, class of service, feature administration, and systemwide options.

The SMT provides buttons for entering data and commands and provides display devices to indicate data and status information. A PROC flipchart for each procedure is attached to the SMT and serves as a quick reference. For more detailed information on the SMT, refer to Section 4, PERIPHERAL EQUIPMENT.

Terminal Busy Indications

Provides a visual indication of the busy or idle status of one multi-appearance voice terminal to another. A secondary answering position uses this information when servicing calls for a busy primary position.

Terminal Change Management (TCM)

Provides an AP-based tool for administration of System 85 terminals. User interface to TCM is through a BCT. Following are the major capabilities of TCM:

- Terminal rearrangement and change—allows for the addition, move, and deletion of voice terminals on any accessible switch.
- Voice terminal feature administration—permits the assignment of capabilities on a per-terminal basis.
- Data module administration—permits assignment of a data module as a voice terminal or as a supplement to a voice terminal.
- Call restriction administration—determines the restrictions that apply to a specific voice terminal. With special access codes, users can reassign restrictions on a per-call basis.
- Miscellaneous system operations—include limited maintenance of switch software and the capability to run backup tapes of current switch configurations.
- Report generation—provides on-line and printed reports of terminal and switch configurations and group assignments.

Terminal Emulation

Provides an efficient and economical means of accessing diverse computer systems from the same terminal. It is an AP-based communications processing feature, providing both data communications and system interface services. Three types of Terminal Emulation are available:

- 3270 Bisync Emulation
- TTY 33/35 KSR Emulation
- 2780/3780 Emulation.

Emulation is provided by software routines that reside in the AP. The AP communicates directly with the host (unswitched mode) over analog or digital links using modems or digital service units. Switched links through System 85 are used for some, but not all, emulations.

Through Dialing

Allows an attendant to select the outgoing trunk group a call will use. The calling party then dials the digits required to complete the call. The attendant retains control of trunk use while reducing attendant call processing time.

Timed Recall on Outgoing Calls

Automatically transfers outgoing calls to the attendant after a predetermined time interval. The system sends a warning tone to the calling party before transfer occurs.

Timed Reminder

Automatically alerts the attendant after 30 seconds for calls placed in queue or on hold. The attendant can reenter the call and decide whether to terminate the call or permit waiting to continue.

Touch-Tone Calling Senderized Operation

Reduces the time necessary to set up calls to distant locations equipped to receive touch-tone calling signals. If a distant location is not equipped for them, the system generates and sends dial pulses.

Touch-Tone Dialing

Provides quick and easy dialing from a touch-tone dialing pad. Touch-tone dialing pads are standard on voice terminals and attendant consoles. When pressing the buttons, a distinctive tone is generated for each button.

Transfer

Allows users to transfer calls to other terminals or trunks without attendant assistance.

Traveling Class Mark

Used by network switches to determine call routing. When an AAR or ARS call is routed through a tie trunk to a distant private network switch, the final digit sent is the Traveling Class Mark. This digit is based on the FRL assigned to the originating facility and is only sent from one tandem switch to another.

Trunk Group Busy/Warning Indicators to Attendant

Provides the attendant with a visual warning when the number of available trunks in a group reaches a preset level. A visual indication is also provided when all trunks in a group are busy.

Trunk Verification—Attendant

Allows the attendant to test the condition of a trunk. This feature can test outgoing trunks when they are busy or idle; incoming trunks can be tested only when busy.

Trunk Verification—Voice Terminal

Allows a designated voice terminal user to test the operation of individual trunks. The user can then identify and remove defective trunks from service. Remote testing from outside the system is now also possible.

Trunk-to-Trunk Connections

Allows the attendant to connect an incoming or outgoing trunk call to an outgoing trunk.

Unattended Console Service—Alternate Console Position

Directs all calls for one attendant console to an alternate console. The regular attendant operates a transfer switch so that calls will be redirected to an alternate console position. This feature is useful at night, when only one console is in service (for example, a console at a security desk).

Unattended Console Service—Call Answer From Any Voice Terminal

Allows a voice terminal user to answer calls made to an attendant not on duty. The incoming call activates a gong, bell, or chime to alert the answering user.

Unattended Console Service—Preselected Call Routing

Redirects calls for the attendant to designated extension numbers whenever the console is unattended. The attendant can designate and cancel the assignments, as desired, without disturbing calls in progress.

Unified Messaging (UM)

Introduces a fully integrated, cost-effective family of distinct messaging services. Unified Messaging provides the conceptual basis for combining the AUDIX, Call Coverage, Leave Word Calling, Message Center, and Electronic Document Communications services. The first phase of this capability focuses on Integrated Alerting and Notification, which allows integration of alerting functions regardless of the originating service and notification of additional messages waiting from other services.

Uniform Call Distribution (UCD)

Terminates incoming LDN-type trunk calls, without attendant assistance, directly to the next idle of a prearranged group of voice terminals. (This feature is available for Version 1 only.)

Uniform Numbering

Provides a consistent numbering plan throughout a private network. The caller dials the AAR access code plus a 4- to 7-digit number that uniquely identifies each terminal on the network. Network size determines how many digits a caller has to dial to place a call. Each number has a location code and an extension number. To reach a terminal assigned to the same switch, only the extension number must be dialed. Direct Distance Dialing (DDD) calls are routed through the ARS feature.

Visually Impaired Attendant Service (VIAS)

Provides additional devices (light-sensitive pen, tone generator, and grooved faceplate) to enable visually impaired attendants to operate the attendant console.

Wide Area Telecommunications Service (WATS) Access

Provides users with direct access into the WATS network. Outgoing call service to a predetermined area or areas is provided on a reduced cost basis compared to corresponding toll service. Calls using this feature can be originated by System 85 users or Remote Access users provided restrictions are not applied, or connection may be established using attendant assistance.

FEATURE-RELATED HARDWARE

The following Feature/Hardware Cross-Reference (Table 5-B) lists the hardware-dependent features in alphabetical order. Each listing specifies the additional hardware required for implementation of the feature. Equipment that is assumed to be provided with the system is not specified as hardware requirements. For voice features that can be used at any voice terminals, no hardware requirements are listed. Features that are used only at multi-appearance voice terminals and voice/data terminals (7200H/7300S/7400D series, 515 BCT, and 510D) are so noted. Circuit packs are listed where deemed appropriate.

TABLE 5-B. Feature/Hardware Cross-Reference

FEATURE	HARDWARE REQUIREMENTS
Abbreviated Dialing	List access, none; single-button activation with multi-appearance terminal
Alternate Console Position	6017B key (or equivalent) and transfer panel; console repeaters may be required per position for lightning protection and/or range extension
Attendant DXS/BLF	ZAGJ-09AF-03
Audio Information Exchange	J58886L control cabinet, J58886M disk cabinet
Automatic Call Distribution (R2V3)	SN241 contact interface and 30A8 status indicator (optional), SN231 auxiliary trunk and recorded announcement unit (optional delay announcement)
Automatic Ident. of Outward Dialing	SN244B AIOD circuit pack
Automatic Route Selection	SN252 touch-tone senders
Automatic Trans. Measurement System	SN261B A/D facility test circuit
Automatic Voice Network	Attendant console, SN253C auxiliary tones circuit packs duplicated per module
Bridged Call	Multi-appearance voice terminal
Call Answer From Any Voice Terminal	L1A ringer (signaling device) and analog line port
Call Coverage	Multi-appearance or display voice terminal, depending on use
Call Detail Recording and Reporting	Applications processor, SSI terminal equipment
Call Management System	AP16, SSI terminal equipment
Call Park	SN231 auxiliary trunk and loudspeaker paging equipment
Centralized Attendant Service	SN233B tie trunks and release link trunks, FADS (optional), 30A8 status indicator and SN241 contact interface (optional), backup voice terminals (optional)
Centralized System Management	Applications processor, 94A local storage unit, 93B poller

TABLE 5-B. Feature/Hardware Cross-Reference (Contd)

FEATURE	HARDWARE REQUIREMENTS
Code Calling Access	SN231 auxiliary trunk port; KS-16626,L5 relay for gong or bell, or 89A control unit and 2012D for chime
Conference—Attendant Six Party	SN254 attendant conference circuit
3270 Data Modules	Related interconnect hardware
Digital Multiplexed Interface	ANN11C DS-1 trunk interface
Digital Service-1 Trunk Interface	ANN11C circuit pack
Direct Department Calling (R2V1)	SN241 contact interface and 30A8 status indicator (optional), FADS (optional), SN231 auxiliary trunk and recorded announcement unit (optional delay announcement)
Direct Inward Dialing	SN232B DID trunk
Direct Outward Dialing	SN230B CO trunk
Directory	Applications processor and SSI terminal equipment, or 510D
Display Message Scrolling	Message Center equipment; display voice terminal, 515 BCT, or 510D
Display—Voice Terminal	401A display module with 7405D voice terminal, or 515 BCT, or 510D
Distributed Communication System	DCIU links, SN233B tie trunks, other switches
Electronic Document Communications	Applications processor, SSI terminal equipment
Enhanced Uniform Call Distribution (R2V2)	Same as UCD
Facilities Management	Applications processor, SSI terminal equipment
Force Administration Data System (for CAS only)	102F1-A display unit, 211A power unit, KS-19252,L7 adapter, 9042-2 ADDMASTER* printer, peripheral interface channel
Host Computer Access	MPDM, MTDM, or ADU
Information Systems Interface	SN238 EIA trunk and Z3A ADU
Intercept Treatment	SN231 auxiliary trunk and recorded announcement channel
Intercom	Multi-appearance voice terminal
Leave Word Calling	AP16 (where applicable), for retrieval: printer, Message Center agent, or display voice terminal

* Registered trademark of Addmaster Corporation.

TABLE 5-B. Feature/Hardware Cross-Reference (Contd)

FEATURE	HARDWARE REQUIREMENTS
Line/Feature Status Indication	Multi-appearance voice terminal
Loudspeaker Paging Access	SN231 auxiliary trunk, 89A control unit, 2012D power transformer, associated amplifier and speakers
Maintenance and Administration Panel	J58889K, TN403 dedicated data channel
Main/Satellite/Tributary	SN233B tie trunks
Message Center	Applications processor, SSI terminal equipment
Message Waiting	Voice terminal with MW indicator
Modem Pooling	MTDM, analog data set, and SN255 tone detector
Multiple LDNs	Additional trunks may be required due to smaller trunk group sizes
Music-On-Hold Access	SN231 CO trunk, multi-appearance voice terminal
Off-Premises Data-Only Terminals	SN243 data port
Off-Premises Terminals	SN228B/SN229B analog line
Override	Multi-appearance voice terminal
Personal CO Line	SN230 CO trunk, multi-appearance voice terminal
Private Network Access	SN233B tie trunk
Queuing	On-hook, none; Off-hook (per module)—SN233B auxiliary trunk, 36A voice coupler and customer music source (optional)
Radio Paging Access	SN230 CO trunks, SN251 touch-tone receiver, J58824CD radio paging interface, 36A voice coupler, 2012D power transformer
Recorded Telephone Dictation Access	SN231 auxiliary trunk, SN251 touch-tone receiver, J58827E RTD unit, 36A voice coupler, 2012D power transformer, auxiliary frequency generator and interrupter
Remote Access	SN230 CO trunk, VFR-5050 voice switch gain amplifier (optional)
Remote Group	DS-1 link, J58889AN remote group housing, ANN15B/ANN16B remote carrier interfaces

TABLE 5-B. Feature/Hardware Cross-Reference (Contd)

FEATURE	HARDWARE REQUIREMENTS
Remote Module	TN456 RMI circuit packs duplicated per module; module(s) with associated hardware as required
RMATS-II Access	TN403 dedicated data channel
Station Message Detail Recording	J58886H, TN403 dedicated data channel, 94A local storage unit
System Management Terminal	J58889K
Terminal Busy Indications	Multi-appearance voice terminal
Terminal Change Management	Applications processor, SSI terminal equipment
Touch-Tone Dialing	SN251 touch-tone receiver
Touch-Tone Senderized Operation	SN252 touch-tone sender
Transfer	Multi-appearance voice terminal
Trunk Group Busy/Warning Indicators	Attendant console
Uniform Call Distribution (R2V1)	SN241 contact interface and 30A8 status indicator (optional), FADS (optional), SN231 auxiliary trunk and recorded announcement unit (optional delay announcement)
Visually Impaired Attendant Service	990A light sensor, 2A translator, faceplate guide

6. SOFTWARE DESCRIPTION

ARCHITECTURE

Overview

System 85 software consists of several hundred programs, routines, and data bases. Some of these programs schedule and supervise the execution of other programs. These supervisory programs are known as the operating system. Other routines manage the major functions of the switch; that is:

- Interface with and monitor stimuli that are external to the switch
- Provide port-to-port switched connections.

The external stimuli include line/trunk seizures and releases, user button pushes from voice terminals, etc. These stimuli are processed promptly (in real time) so that the system presents the user a timely response.

Still other software performs routine, periodic, and time-available error-detection type tests on the switch network. Diagnostic tests are performed on demand.

The software architecture includes the following:

- Operating system
- Software/hardware translation data bases
- Call processing routines
- On-line and off-line maintenance routines
- Administration routines
- Features
- Traffic-monitoring routines.

Operating System

The operating system resides in main memory and is executed by the common control processor. Its features and capabilities are optimized for the System 85 call processing environment. The operating system consists of a real-time executive-type scheduler that:

- Monitors the processor's real-time clock, which generates fractional-second time intervals
- Dispenses control to the call processing, maintenance, and base-level task schedulers.

Figure 6-1 is a functional diagram of the System 85 operating system.

Software routines are executed according to their importance or priority. There are three basic levels of priority. Generally, call processing tasks have the highest priority. General-purpose maintenance routines are the second level. Those routines controlled by the base-level scheduler have the lowest priority.

The call processing scheduler, a table-driven task matrix, schedules the high-priority tasks. These tasks are divided so that some are scheduled for execution in one fraction of a second and other tasks in subsequent fractions or time intervals. When all scheduled call processing tasks have been completed within a time interval, scheduled maintenance and base-level maintenance tasks are sequentially executed. If the processing environment is such that scheduled maintenance tasks are not executed within their assigned interval, those remaining tasks are executed in the next or subsequent intervals. All call processing tasks are executed at least once every 200 milliseconds.

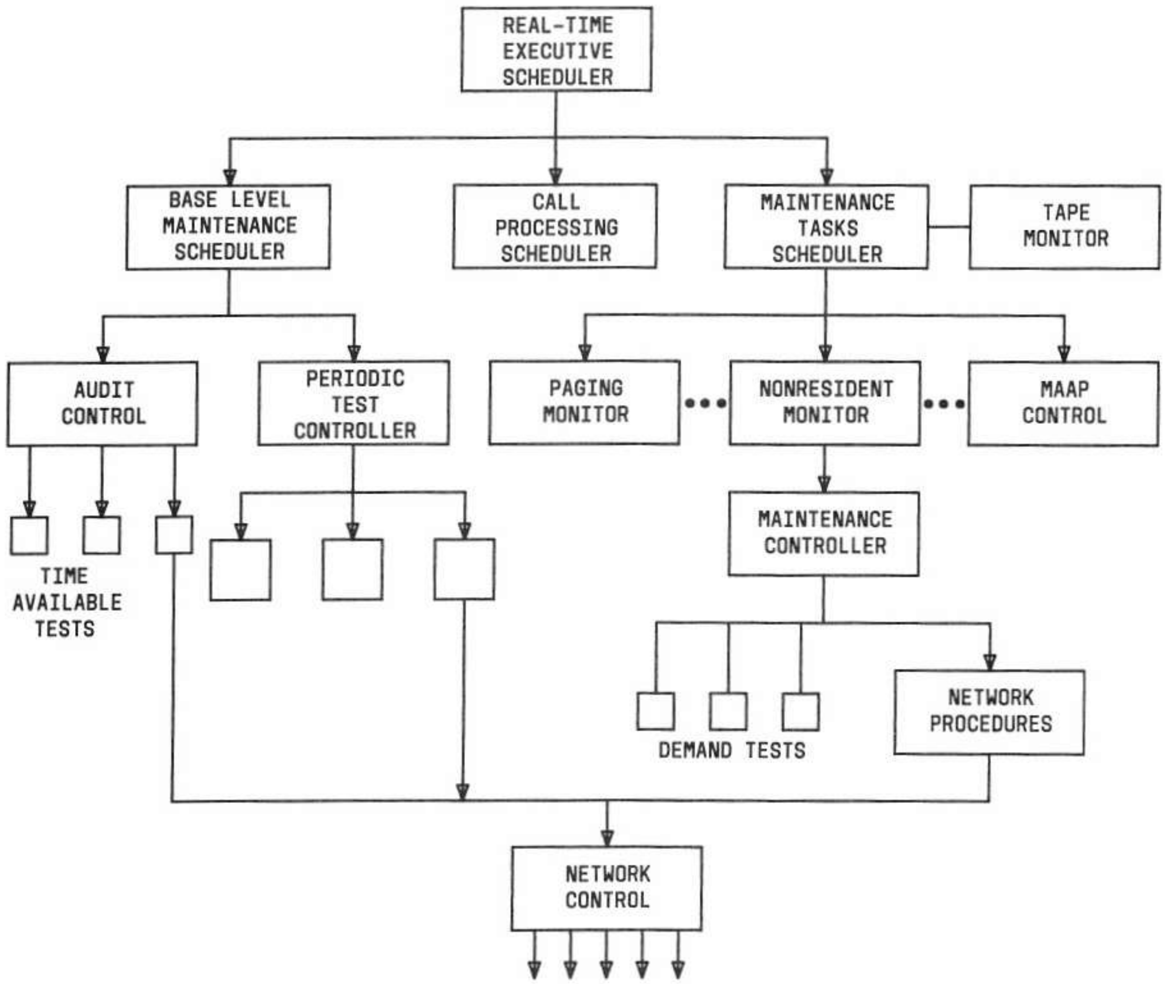


Figure 6-1. System 85 Operating System Functional Diagram

Translations

The switch allows several different module, cabinet, and carrier configurations. Port carrier slots can be used with tone circuits, analog lines and trunks, digital lines and trunks, etc. The hardware translations are data bases which contain internal equipment addresses (module, cabinet, carrier, slot, and circuit identification).

Software translations define feature assignments. Generally, this includes whether a user or extension can access a feature, the assigned permissions, restrictions, etc. Both hardware and software translations are stored in the system. There are certain fixed translations that are common to all systems. These are precoded and cannot be changed. All other translations can be changed from a MAAP terminal through use of the administration procedures (PROCs), and most can also be changed from an SMT or by use of the TCM capability.

Call Processing Routines

Call processing involves establishing and removing communications connections between ports. Call processing functions are distributed between the module processors and the common control. Those call processing functions which perform port scanning are stored in read-only memories that are a part of the module processors. Ports are scanned and their status is recorded in the module processor's status memory. Call processing functions are initiated when new (that is, changed) port status information is received from the module processor. Therefore, the common control call processing routines read the status of each module processor (in real time) and provide the requested services. Typically, these will include:

- Completing calls—that is, connecting a calling (originating) port to the called ports
- Providing the features and services that are enabled for the requesting port.

On-Line and Off-Line Maintenance Routines

On-line maintenance tests are operational tests and serve the purpose of performing error detection, error recording, and error recovery if possible. Off-line maintenance tests are demand tests and reside on the tape cartridge. They are loaded into main memory upon command and executed on demand.

The on-line maintenance tests are scheduled by the operating system. They execute on a routine, periodic, or time-available basis. Network control (see Figure 6-1) contains the routines which perform network circuit testing. Stimuli for these tests are provided in the form of translations data. Test status information (incomplete, pass, fail) is written into the status area of main memory. Test failure data is written into a periodic or time-available failure log. Test failure data consists of the circuit number, fault code, alarm level, etc. The failure log can be examined by diagnostic tests for determining the identity of the failing circuit and, if required, the second and third most likely choices.

Off-line maintenance test procedures (PROCs) are identified by 3-digit numbers. The MAAP control software (part of the operating system, see Figure 6-1) monitors the MAAP terminal, processes user commands, and loads a designated PROC into an area of main memory known as the paging buffer. These tests are diagnostic in nature. They are used to isolate and identify a fault to a replaceable item such as a circuit pack.

Administration Routines

Administration is the means whereby the switching equipment (hardware) and services can be customized, within certain limits, to meet user needs. Administration capabilities are provided through readily accessible software routines (PROCs). The switching equipment can be administered by entering configuration/assignment changes into the translation data bases. Additionally, there are administration procedures which permit changes to existing feature or service capabilities and add/remove access to other features/services on a per-port basis.

Features

System 85 features are provided largely by software routines and some require special hardware. Section 5, FEATURES AND SERVICES, provides a brief description of each feature.

Traffic Monitoring

The function of the traffic software is to monitor use of the system features, switching network, and various processors. Many of the traffic routines are an embedded part of the call processing and feature software. There are separate routines for monitoring the various hardware subsystems. Traffic data is obtained by activating the desired traffic PROC. When activated, it generates traffic data continuously.

The basic type of traffic data collected by the procedures is accumulated as peg counts. There are additional routines which are scheduled to run periodically. These routines analyze the call progress status words for each port and yield port usage rate statistics for each module, cabinet, and carrier. These collecting routines are typically executed at second, minute, or hourly intervals, depending on their significance.

The types of traffic data collected by the periodic tests include peak and time-coincident usage measurements. Data from these periodic measurements may be reported in raw form or processed to provide peak, null, and average occupancies.

The module processor traffic data provides information that is useful for engineering port activity queues, port assignments, and for balancing the load across the module processors for optimum performance. The types of data collected from each module processor include:

- Processor occupancy and distribution of execution time
- Blocking counts for all queues
- Queue-length instantaneous values.

Detail traffic studies may be performed on specific hardware subsystems. These measurements may be accessed from either the MAAP, RMATS-II, or customer facilities such as SMDR. The system contains traffic measurements polling and interface hardware. This software responds to polling requests from either a DCIU port or remote data port. However, only one polling facility may be active at any one time.

MEMORY ALLOCATION

The system software, like the hardware, is identified by release number and by version, such as R2V3. Each version pertains to a particular memory configuration that is usually limited by the maximum size that the translations data bases can accommodate. Main memory contains program instructions, patch area, translations data bases, plus free space. Once main memory is loaded with instructions, certain addresses are protected from corruption by making them write-protected.

REAL-TIME CONSTRAINTS

Real-time constraints are a function of the speed of the common control processor, its main memory, and the traffic load. The switch is designed so that many time-consuming and repetitious call processing functions are performed by module processors, thus relieving the common control. The 501CC common control processor (used in all R2 systems) is optionally equipped with a cache memory, which further enhances its performance.

Traffic load, defined as the sum of static and dynamic loads, is a function of the number of features that are executed, the frequency with which they are executed, the customer configuration, and the instantaneous (peak) call processing load. The configuration contribution to load is known as the static load, and the call processing contribution is known as the dynamic load.

The real-time constraint or maximum system capacity is defined as a load of 75 percent. This limit reserves approximately 25 percent of the processor capacity for performing routine, periodic, and time-available maintenance and overload handling tasks. The load is determined on a per-system basis by completing traffic engineering worksheets.

For additional information concerning traffic engineering, refer to **AT&T System 85 (R2V3)—Traffic Data Analysis Guide—Administration Manual** (555-102-502).

TAPE CARTRIDGES

Overview

The high capacity mini-recorder (HCMR) is the device which loads software into main memory. The software is contained on a tape cartridge cassette. The cassette medium provides a flexible and convenient way to transport software from the factory to the field. Therefore, software updates/revisions can be easily incorporated into existing systems.

The HCMR has extensive error detection and correction capabilities which remove the need to have multiple copies of data on the tape. The drive can read or write in either the forward or reverse tape directions.

The HCMR performs four basic system functions. They are:

- Load tape—loads the common control main memory with programs, translations data, and patches following an initialization or power recovery.
- Load off-line—load, from tape, an off-line procedure (PROC) into the paging buffer of main memory.
- Run tape—updates the tape's translation data to match the memory's contents.
- Patch—write program modification data on identified patch blocks which will then overwrite program data in memory during a load tape operation.

Organization

Data is recorded on the tape cartridge in 1024 word blocks using a 5-track format. It is recorded in streaming mode (continuous recording). Data is organized in a logical ordered format that assures the quickest reload of the system in case of a power failure.

The tape cartridge(s) contains header information which identifies the tape and specifies any particular requirements for using the tape. The tape translations directory gives a listing of the translation table names and memory addresses for all translation data on the tape. The text blocks contain the actual data to be loaded into memory. This data includes resident programs, translations, off-line programs (PROCs), and patches.

Configurations

The tape cartridges are available in various configurations, depending upon the intended use. These include:

- Blank tape—reserved for making backup copies.
- Generic tape—contains program instructions for the particular system release and version without any of the assignable translations (sometimes called CAPDEF tape).
- Customized Hardware and Pseudo Software (CHAPS) tape—consists of the generic software plus a subset of translations reflecting the complete system hardware configuration. This tape is preliminary (not customer-specific) and is used for operational field testing of hardware.
- Fully customized program tape—consists of the generic software plus all of the equipment and customer-specific translations.

The tape cartridges are always shipped from the manufacturer with the latest available version of software. When a system is upgraded using a generic tape, a run tape operation must be executed in order to write the translation data onto the new tape.

DCIU SOFTWARE

The DCIU is a special applications I/O processor. It has its own memory and executes software that resides in the memory. The main component of the DCIU software is the network interface program (NIP). This program provides packet-type communication facilities for the eight physical ports. Each port contains eight logical channels which implement the BX.25 packet communications protocol. The DCIU software is a part of the generic program, contained on the tape cartridge, and is loaded into the DCIU memory during initialization.

APPLICATIONS PROCESSOR (AP) SOFTWARE

The AP software is written in a high-level programming language ("C" language) and may vary from one AP installation to another. Architecture of the AP software is characterized by several layers of programs executed at various times by the AP processing unit and peripheral controllers. For a detailed discussion of the AP software, refer to **Applications Processor 16—Reference Manual** (555-201-201).

7. SYSTEM ADMINISTRATION

OVERVIEW

The software which controls System 85 operation uses a variety of tables located in system memory to keep track of:

- Port circuits
- Trunk circuits
- Extension numbers
- Feature assignments
- Network configuration
- System configuration
- Systemwide options.

Collectively, these tables are called translations. Thus by tabulating this data, information (such as the number of modules the system has, the equipment location of a data module, or the features a voice terminal may access) can easily be changed.

System 85 comes with a tape which includes generic software and translations. When the system is installed, the tape is used to load the main memory. The information used to create these translations comes from the order form received by the factory. A printed record of these translations is provided by the Customer System Document (shipped with each System 85).

Administration is the process of changing translations. System 85 uses a series of programs called procedures to change translations. A person wanting to administer the system (change translations) can access the procedure programs through one of the System Management features. System Management features provide an interface between the user and the procedure programs. The System Management features include:

- Centralized System Management (CSM)—A versatile system management feature for large customers with more than 5000 lines. This feature is new for R2V3, and it resides on the 3B5 AP. It handles all FM and TCM functions, Traffic Management and Automatic Transmission Measuring, Cost Management, and AP Management. It can also support AUDIX, System 75, and Information Systems Network.
- Facilities Management (FM)—A feature on the AP, available to the system administrator via a BCT. This feature is used for network administration.
- Terminal Change Management (TCM)—A feature on the AP, available to the system administrator via a BCT. This feature is used for feature assignment and terminal rearrangement.
- System Management Terminal (SMT)—A terminal available to the system administrator to perform any type of translation changes described under FM and TCM.
- Maintenance and Administration Panel (MAAP)—A panel (terminal) available to service personnel to change any type of translation. It can also be used to run several maintenance routines.

- Remote Maintenance, Administration, and Traffic System II (RMATS-II)—A service available from an AT&T service center. This service has the same administrative capabilities as the MAAP. It can also be used to run maintenance routines.

Figure 7-1 depicts the relative administration capabilities among the System Management features. The MAAP or RMATS-II can access any procedure. The CSM feature or the SMT can access a subset of the procedures available through the MAAP. Together, the TCM and FM features (through the AP) can access the same procedures as the SMT. The MAAP and RMATS-II are intended for service personnel; the CSM, FM, TCM, and SMT are intended for the system administrator.

The CSM feature offers functions that are beyond the scope of the procedures available through the MAAP or RMATS-II. These include Automatic Transmission Measurement, Cost Management, and AP Management. Another major difference between CSM and the other System Management features is that CSM maintains switch image data bases with switch translation information, user records, and an equipment inventory. It can maintain data bases for several switches. Administration changes can be made to the data bases during the day, but the actual update to the translations can be scheduled at night when traffic is lower.

Another difference among System Management features is the level of intelligence provided by the user interface. The RMATS-II, CSM, FM, and TCM features reside on computers and have programs which access the procedures in the System 85 switch. These programs simplify administration by providing forms for video display terminals. These forms can display existing translations and allow the user to make changes to them.

While the MAAP and the SMT access the same procedures as the AP, they do so at a more primitive level. The user interface for the MAAP and the SMT consists of a 25-digit light-emitting diode (LED) display, a number of command keys, a numeric keypad, and flipcharts. (Flipcharts are a series of cards attached above the 25-digit display that define the meaning of the numbers appearing on the display.) One or more flipchart cards exist for each procedure.

The RMATS-II, CSM, FM, and TCM features access System 85 through a dial-up connection to the common control remote interface (TN492). These features can be used to administer more than one System 85. The MAAP and the SMT cannot administer more than one System 85 since they physically connect to the peripheral data channels (TN403).

Reduced port contention in R2V3 supports two simultaneous administration/maintenance processes. This allows an administration task to be performed by the system administrator (through the SMT or AP) while a maintenance task is also being performed (through the MAAP or RMATS-II).

8. RELIABILITY

GENERAL

To ensure reliability, System 85 uses high-quality components and thoroughly debugged software. Hardware circuit and firmware designs are thoroughly reviewed and tested before prototype circuits are provided for software designers. Software designs are reviewed during design and coding. Then, each design goes through validation tests—unit testing, integration testing, function testing, and system testing. System testing also serves as a validation test for hardware and firmware designs.

Before standard production is started, several controlled introduction systems are put into service. AT&T closely follows the operation of these systems and quickly finds and fixes any remaining faults before the systems are installed.

Each System 85 switch must pass three levels of testing during manufacture, shipping, and installation. First, it undergoes a series of factory tests of component parts, circuit packs, major subsystems, and the entire assembled system. Second, it may undergo a series of quality assurance tests, in which systems ready for shipment are randomly selected for extensive retesting. Third, it undergoes a series of installation tests, in which AT&T personnel unpack and inspect for possible shipping damage and retest the system after final assembly and installation.

Reliability refers to the failure rate of a system. Maintainability refers to the ease of troubleshooting and servicing with minimum downtime or degradation of service. Availability refers to the probability that a system is operational at any given time and depends on its reliability and maintainability. System 85 availability may be enhanced by optionally provided subsystems. These ensure that the switch can continue to perform without interruption even if some hardware component fails.

ENHANCED AVAILABILITY CONFIGURATIONS

System 85 is offered in four basic configurations. The configurations differ principally in the enhanced availability provided by duplication of major system components and related hardware. These options include:

- Standard availability—no duplication of major components
- High availability—duplicated common control
- Critical availability—duplicated common control, duplicated time-multiplexed switch (TMS), and duplicated module control(s)
- Critical availability with battery reserve—same as critical availability with the addition of the long-term (8-hour) battery backup option.

In a standard availability system, if a fault occurs in the common control, the system usually continues to operate because of the fault-tolerant design of the common control. However, there are common control faults that may render the entire system inoperable. Also, TMS and network module faults can significantly affect service. If service becomes severely degraded, the system is placed in emergency transfer until it can be diagnosed and repaired by systems technicians. If the technicians are on-site, normal repair time is 30 minutes. If a systems technician must be dispatched from a service center, the system could be out of service for several hours.

The enhanced-availability configurations provide the following benefits:

- There is a significant increase in system availability if the common control, TMS, and network modules are all duplicated.
- If a fault occurs in a part of the system that is duplicated, the system software causes the standby unit to be automatically activated. Most of the time service is restored in only a few seconds, causing little or no degradation of service. Uninterrupted service can be maintained while faults are repaired and tested in the off-line portion of duplicated subsystems. The probability of the duplicated subsystem failing while the defective portion is being repaired is extremely small.
- For some serious common control faults, it takes only a minute or two for software to reestablish the records for calls that were in progress when the fault occurred. Calls in progress are not affected during this process; only new call attempts are affected.
- Uninterrupted service is possible during system updates of hardware or software. When a system is updated, modifications can be made in the off-line portion of duplicated subsystems.
- Reliable service (neglecting occasional short recovery times) is virtually guaranteed as long as human error and long-term power outages do not occur. In the unlikely event that independent major controls malfunction at the same time, system level software can test all of the hardware and then reconfigure the system and restore service.

System availability can be significantly affected by commercial power outages. For the System 85 switch, standard and optional features minimize the effect of these outages. As a standard feature, power for the common control is held over with batteries for a minimum of 10 minutes. During commercial power outages of less than 10 minutes, service is restored automatically within about 20 seconds after power is restored, as there is no need to reload the programs or translations from the memory tape. Optionally, a 3- to 5-minute nominal holdover can be provided for the rest of the switch for continuous service during outages of less than 3 minutes. During an extended power failure, customer-designated lines are automatically transferred to central office trunks. Long-term extended power reserve (engineered to customer needs, typically up to 8 hours) is also available as an option.

For the AP, battery holdover for at least 10 minutes can optionally be provided. This allows time for the system to be shut down gracefully with no loss of customer data.

SYSTEM AVAILABILITY

System 85 is designed to provide continuous service with a small predicted outage time per year. System availability is directly related to "downtime". Downtime is expressed as the predicted average time that a single user is out of service in minutes per year. Downtime for a single user includes that which affects all users (for example, common control faults), that which affects the group of which a user is a part (for example, network module faults), and that which affects only the single user (for example, a port circuit fault).

A given system may have more or less downtime than predicted. Predictions are based on an average for a large number of systems. The device failure rates used are based on experience using similar devices in similar systems. The system is assumed to be operating at a room temperature of approximately 80 degrees Fahrenheit. Only hardware failures caused by faults in the common equipment, switching network, and port circuitry are considered. Voice terminal faults, commercial power failures, human errors, and software faults are not included. Also, these predictions are based on system operation after the 1-year warranty period.

A fault is now considered to cause downtime if it prevents a user from placing or receiving a call for more than 15 seconds. (In the past, central offices have considered 30 seconds as an outage.) Predicted single user downtime in a year is a function of the mean number of faults occurring per year that affect a single user and the mean time to repair (MTTR). The MTTR includes diagnostic, repair, and travel time for a systems technician to get to the equipment site. The mean travel time depends on how far the systems technician is from the site (equals zero if the technician is on-site). The predicted MTTR for System 85, not including travel time, is 20 minutes. (For previous systems, 30 minutes has been considered as the MTTR.)

For detailed information on predicted availability (in relation to the four system configuration options), refer to **System 85 Reliability and Maintenance** (999-700-401IS, Issue 1).

When a faulty unit is not duplicated, downtime depends on how often a fault occurs and the repair time. When a faulty unit is duplicated (for example, common control or TMS), downtime is primarily a function of how often a fault occurs and the automatic recovery time, which ranges from seconds to minutes, depending on the fault and the subsystem. For some common control faults (for example, processor faults), a "hard switch" occurs and the connection status is copied from the switching network so that existing calls are not affected. This takes from less than 30 seconds to several minutes, depending on the system size. For most faults, the switch to the duplicated subsystem takes several seconds with very little impact on service.

The duplicated common control in the high availability case and the duplicated TMS and network module in the critical availability case significantly reduces the predicted user downtime. Adding the long-term battery backup option provides additional duplication for the network module and port cabinet rectifiers to further reduce predicted downtime. For this case, the primary contributor to downtime is the port circuitry that is not duplicated. The single user downtime due to common control, TMS, and network module faults is less than 2 minutes per year. The total downtime for a single user is predicted to be less than 8 minutes per year, even with an MTTR of 2 hours. This corresponds to an availability greater than 99.998 percent.

The increased system price (not including terminal equipment) to go from a standard availability to a critical availability system is about 10 percent for a system larger than 3000 lines. If the cost of terminal equipment is considered, the percent of price increase to obtain critical availability is even less, because terminal equipment often represents up to half the cost of the total system price.

The AP is not duplicated, so any serious fault results in system downtime. The downtime is a function of how often the system fails and the repair time. For an MTTR of 1 hour, the predicted system downtime for 1 year is 2 hours. This corresponds to an availability greater than 99.97 percent.

- Loopback test circuits—Provide controlled loopbacks in the data circuits to loop back test data for verification of proper circuit operation and to isolate faults.
- Circuit pack ID chips—Allow maintenance technicians to interrogate the type, vintage, and issue of circuit packs.
- Circuit pack LEDs—Indicate circuit packs under test, failed circuit packs, and circuits in use.
- Alarm Panel—Provides visual alarm indicators (LEDs) that indicate the status of the processor memory, common control, network, switch environment, applications processor, and other subsystems. Located in the common control cabinet, it indicates the status of the system at a glance.
- Analog/digital facility test circuit—Provides test source and/or destination for transmission tests of analog facilities and bit-error-rate measurements of digital facilities and circuits.
- Terminal testing—Provides self-test and loop-around test capabilities. Data module self-tests are run periodically whenever a module is idle.
- Attendant console—Has an alarm indicator which is lighted when an alarm is generated and an acknowledge indicator which is steadily lighted when the alarm is successfully reported via the Alarm Origination feature. This indicator flashes if the alarm cannot be reported.

MAINTENANCE TESTS

Using maintenance hardware, there are a number of maintenance tests that System 85 performs automatically on itself and/or that are easily performed by system technicians to further reduce maintenance costs and downtime:

- X-ray testing—At the factory and again during installation, exercises the switch thoroughly and locates any faults before cutover to the customer. X-ray testing features an accelerated testing rate to quickly and thoroughly test system hardware without the need for customer translation data. These tests must be performed locally and require that the system be out of service. The tests can be controlled from RMATS-II after the X-ray tape is loaded into the system. The factory and pre-cutover tests make use of the internal maintenance control structure.
- Reinitialization—Automatically verifies system integrity each time the switch is turned on or restarted, and confirms that the major parts of the switch are operating properly.
- Periodic and time-available background tests—Automatically detect less critical faults before they are noticed by the system user. These background tests are used to identify failed circuits, remove them from service, and alert maintenance personnel to the problem. For duplicated subsystems, background tests are run on the off-line subsystem but at a lower rate than for the on-line subsystem.
- Terminal tests—Enable the user or system technician to diagnose and repair terminal problems quickly, resulting in short downtime and low maintenance costs. Multi-appearance voice terminals have self-test capability that the user can activate to test the terminal and diagnose terminal problems. Dial-up self-tests let the user verify button, lamp, and ringing operation. All digital communications protocol (DCP) terminals also have built-in self-test capability activated by operating a test button with test results on the terminal.

An error and alarm log provides a log for errors detected by operational error processing and background tests. Logged are: the circuit reporting the error, the fault code indicating type of error (when provided), time of first and last error, time of alarm (if any), and a count of the total number of times the error occurred. The error log is automatically analyzed every minute, and circuits with error counts over threshold are alarmed. When an alarmed error is cleared, the entry is marked resolved, providing a history of resolved alarmed entries.

MAINTENANCE PROCEDURES

The maintenance procedures shown in Figure 9-1 include both the automatic system checks and audits that occur continuously and the manual diagnostic and repair procedures used by system technicians to identify and resolve problems.

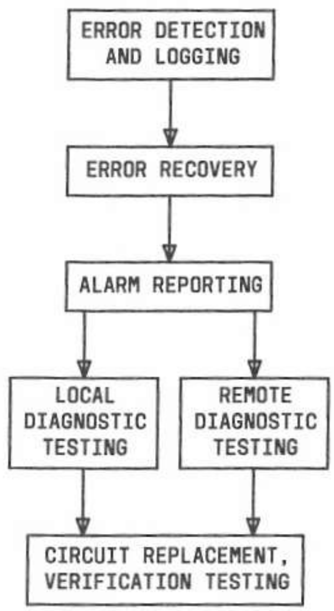


Figure 9-1. System 85 Maintenance Procedures

Error Detection and Logging

The first step in resolving a problem is to accurately detect the error. The following types of errors are automatically and continuously checked by operational error processing or audited by the switch:

- Power and environmental faults
- Parity error on memory read, data transfer, or time-division network paths
- Digital communications protocol (DCP) link protocol errors
- Light guide link errors
- Call processing errors.

In addition, the following types of background tests are automatically performed to detect other errors:

- Periodic and time-available tests—Critical circuits are tested as often as every second. Less critical circuits are tested at a lower rate or on a time-available basis (that is, when a processor is not busy with call processing or other maintenance tasks).
- Audits—Status data (for example, representing the state of a trunk circuit) are audited on a time-available basis to detect discrepancies caused by noise hits or software errors. Discrepancies found by audits are logged, but not alarmed.
- Refreshes—Some status data (for example, lamp status in terminals) are refreshed periodically to correct any errors that may arise due to noise or power interruptions.

All errors detected through background tests or operational error processing are logged. In some cases, additional testing is automatically done to determine the severity of the error. When the error count is over a certain set threshold, an alarm is automatically generated. The switch alarm log includes unit type, unit location, alarm status, number of errors, and time of first error, alarming, and alarm resolution.

Error Recovery

Once a fault is identified, the switch may take one or more of the following steps to minimize the impact of the fault:

- Reconfigure duplicated circuits—Keep the best subsystem on-line. If several subsystems are duplicated (for example, common control, TMS, and network modules), the optimum configuration is selected to remain on-line.
- Busy-out circuits—Make circuits with faults unavailable for service (for example, a faulty trunk circuit).
- Reinitialize—Perform at several levels when the detected error indicates that software or data are inconsistent or that a processor is malfunctioning.

Alarm Reporting

When a fault is detected and verified, System 85 automatically generates one of the following three alarms:

- Major alarm—A serious service fault is detected. System local and remote alarms are activated.
- Minor alarm—Service is degraded, but only a few users are affected. System local and remote alarms are activated.
- Warning alarm—There is a fault, but service is probably not noticeably degraded. The system local alarm is activated.

The alarm level is established by the detection test that reports the error. System 85 automatically reports all major and minor alarms to a remote AT&T maintenance center (RMATS-II) and to the attendant console and the alarm panel. Warning alarms are only reported to the alarm panel. An indicator on the attendant console is lighted when the alarm has been successfully reported to RMATS-II.

Local and Remote Diagnostic Testing

The MAAP (for the switch) and the alarm panel of the Applications Processor are the principal local communications links between System 85 and the system technician. Higher level testing can be performed through the SCAMPER interface and the DCIU test circuit packs (if provided), which may be plugged into slots in the common control carrier. Remote maintenance is performed by means of a dial-up connection to RMATS-II. Local (MAAP) maintenance and remote (RMATS-II) maintenance can perform the following maintenance functions:

- Examine error and alarm logs to find the most serious faults
- Run error-detection tests of circuits to verify if the system is still defective
- Run diagnostic tests
- Resolve alarms in the alarm log and retire alarm indications
- Switch between duplicated subsystems to place standby subsystems in service
- Make circuits available or unavailable for service
- Monitor system status
- Reinitialize all or part of the system.

Reduced port contention in R2V3 allows a maintenance task to be performed (through RMATS-II or MAAP) simultaneously with a local administration change by the system administrator. For more detailed information on MAAP maintenance procedures, refer to **AT&T System 85 (R2V3)—Maintenance—Service Manual** (555-102-108).

Circuit Pack Replacement and Verification Testing

On the System 85 switch, if a diagnostic test finds a problem, the red LED (if provided) is lighted on the first-choice circuit pack to be replaced. The circuit pack can then be replaced by the maintenance technician without interrupting service, except in the area directly affected by its replacement.

In most cases, verification tests are automatically run on the circuit pack as soon as it is plugged in. If the fault is not corrected, the maintenance interface can be used to indicate a second-choice replacement by lighting the red LED (if provided) on the second-choice circuit pack (if any). If replacing a second circuit pack does not correct the fault, the process can be repeated for a third-choice replacement (if any).

When the verification test indicates that the fault is corrected, the alarm log entry is automatically resolved and the circuit is returned to service.

On the applications processor, if a diagnostic test finds a problem, the first-choice circuit pack to replace is indicated on the maintenance terminal display. Power must be turned off to replace the circuit pack. After circuit pack replacement, the power is turned on and initialization tests verify proper circuit operation. If initialization tests pass, the alarm is cleared.

10. SYSTEM ENGINEERING

This section highlights the engineering considerations for a System 85, Release 2 configuration. Detailed traffic and hardware configuration information is contained in **Applications Engineering Manual** (555-101-600). The Applications Engineering Manual is a 2-volume document divided into three major sections. These sections are: Configuration Guide, Configuration References, and Appendices. The Configuration Guide provides step-by-step instructions and worksheets used to engineer and configure a System 85, Release 2. The Configuration References contain an in-depth analysis of unusual configuration situations. Examples of Configuration References are: Processor Occupancy Evaluation, Time-Multiplexed Switch (TMS) Evaluation, Nonblocking Configuration Guidelines, etc. Appendices provide additional, more technical information on various engineering topics such as: theory of essentially Nonblocking (P.000001) configuration, PUR, CUR, Erlang and CCS explanations, TMS Mismatch Blocking, etc. Appendices are also provided on auxiliary cabinet hardware configurations and developing equipment room specifications.

SWITCH ENGINEERING—TRAFFIC

Traffic Engineering is required for System 85 traffic sensitive equipment components and software records. Examples are: number of modules, touch-tone register packs, touch-tone sender packs, data tone detector packs, cache memory, dial pulse register records, intercom trunk records, TMS capacity check and processor occupancy check.

Overproviding traffic sensitive equipment may appear to be a safe means of satisfying a customer's service objectives. But, it ignores the customer's concern about cost and may result in a loss of sale. On the other hand, cutting cost at the expense of grade of service can generate a poor product. This would damage AT&T's credibility and could jeopardize future business with the customer and others who hear about it. To avoid these pitfalls, traffic and equipment engineering methods have been developed to provide least-cost system configurations which meet stated service objectives. These methods are contained in **Applications Engineering Manual—AT&T System 85, Release 2**. The following information highlights the traffic considerations.

Port Usage Rate (PUR) and Erlang

Due to the new and different types of functions being provided by System 85, a new characterization of customer-switched traffic through the network module fabric has been developed. It is called Port Usage Rate (PUR). PUR differs from the traditional traffic measure of hundred call seconds (CCS) in two respects.

1. It is based on the average number of busy ports (a port is any item, line, trunk, computer, etc., requiring interconnection to the switching network) instead of the "connections" in progress. This approach is better for characterizing customer traffic when there is a large amount of conference traffic or when there is a variety of types of traffic between many different types of ports; both of these conditions exist within System 85.
2. PUR is expressed in units of Erlangs. The Erlang has replaced CCS/Hour as the traffic measurement unit of choice and the Erlang is internationally accepted.

Port Usage Rate (PUR)

The PUR expressed in units of Erlangs is the basic measure of traffic intensity in the System 85 switching network. The traditional CCS measure of traffic intensity is not used; instead, the capacity of the network is given in terms of PUR. The PUR can be interpreted as the average number of simultaneously busy ports.

Erlang Unit

The Erlang is the international unit of traffic load equal to the average number of simultaneous calls offered to or carried by a group of servers. Erlangs need not be referenced to time interval; however, the typical time unit is the busy hours, in which case 1 Erlang = 36 CCS per hour.

Characterizing Customer Traffic

Characterizing individual groups of customer lines using the PUR method is advantageous in systems such as System 85 where there are a variety of traffic "types" offered to the switch. When looking at a particular group of ports with common characteristics, it is easier to define their relative impact on the network by simply stating their occupancy during the busy hour. Once the occupancy of a particular group of ports is known, multiplying this occupancy by the number of ports in the group gives the PUR for the group. Adding the PURs of all the groups gives the overall PUR. In any specific case, occupancies for each different type of port must be determined. Data terminals will frequently have much higher occupancies than voice lines. Trunk port occupancies vary depending on group size and grade of service. Computer ports are typically very heavily loaded.

Switching Network

A physical capacity of 1536 ports exists in each module of the 31 possible modules in System 85. However, only 254 simultaneous connections can be established in each module. Because of this, traffic engineering procedures are required to:

- Determine the busy-hour traffic load generated by port traffic sources
- Evaluate the switch traffic capacity against the load.

These procedures determine whether the objective grade of service can be maintained.

Every port is assigned a dedicated time slot. These time slots guarantee access to the Time Slot Interchanger (TSI). Each port in a 2-port connection requires a TSI program store word; this means a 2-port connection uses a total of two TSI program store words (also called a "program word pair"). A maximum of 256 TSI program word pairs are available for port-to-port connections. Even though the network can terminate up to 1536 ports per module, only 256 2-port connections per module can be set up at any one given time. Although every port is guaranteed a time slot into the TSI, not all ports can simultaneously be involved in a connection through the TSI.

Conference Traffic

Unlike switching networks using pulse amplitude modulation (PAM), System 85 uses a pulse code modulation (PCM) network. From a traffic engineering standpoint, the electronic differences between the two are unimportant. But, the difference in how each handles conference connections is significant. In a single-module PAM network, a 3-party conference connection can be handled with a single time slot. The same connection in a PCM network requires three TSI program word pairs (the equivalent of three time slots in a system using PAM).

Conference calling reduces the traffic capacity of the TSI. For example, if four 3-party conference connections were simultaneously in progress; 12 TSI program word pairs would be required, 1 for each party. When this is contrasted with the 6 TSI program word pairs required to connect 12 parties with six 2-party connections, it can be seen that conferencing has a significant impact on the traffic handling capacity of a network module.

Three-party conference calls are not the only connections that involve 3-port connections. For example, from the time a station goes off-hook until the first digit is dialed, a 3-port connection (using three TSI program store words) exists between a station line, a tone source, and a touch-tone receiver. (Once the first digit is dialed the tone source drops out, leaving a 2-port connection.) These types of connections are referred to as system-generated conference calls.

Another example of system-generated conference traffic involves the use of a touch-tone sender. The outgoing call requires a 2-port connection between the originating port and a touch-tone dialing register, the outgoing trunk and a sender. These two connections are equivalent from the standpoint of TSI usage to four 2-port connections.

Time-Multiplexed Switch (TMS) and Mismatch

Unlike other traffic sensitive components which block calls when all servers into the group are in use (referred to as concentration blocking), the TMS is limited by a form of blocking called "mismatch blocking." To make an intermodule connection, the TMS must link a time slot of one module to a like-numbered time slot of the other module. Even though each module has 256 time slots into the TMS, a call cannot be completed between any two modules unless the same time slot number is available in both modules. If the TMS is unable to find like-numbered time slots, mismatch blocking occurs making it impossible to set up a call between two modules; this can occur even when there are idle time slots on the channels that connect the modules to the TMS.

Processor Occupancy and Cache Memory

There are two major processors in System 85: the main processor (501CC) and the Module Processor. Each module contains a module processor with a capacity of 7000 busy hour calls. The main processor (501CC) can handle over 20,00 busy hour calls. If the estimated busy hour calls exceeds 20,000, a detailed processor occupancy evaluation is needed to determine how many more calls can be processed before the processor reaches maximum busy hour occupancy.

For heavy traffic applications, a device called cache memory is installed. This device, which is provided by adding a TN369 circuit pack to the Common Control, reduces processor occupancy. Cache is a high-speed memory used to decrease the access time to program instructions. The cache memory has an access time of about one-third that of the main memory. The cache memory maintains "copies" of frequently accessed storage elements; when a storage element is repetitively requested, the cache memory can quickly return its "copy" of that element, saving the slower main memory access.

Remote Modules and Unbalanced Systems

System 85 remote modules can be placed up to 13,000 feet from the main processor. Applications using remote modules create unbalanced traffic and hardware between the modules. This requires special engineering methodologies.

Service Objectives (Grade of Service)

The System 85 has an overall service objective of P.002 (2/1000) blocking probability for the Standard configuration and P.000001 (1/1,000,000) blocking probability for the essentially nonblocking configuration. These probabilities apply to the switching fabric and do not include blocking caused by lack of port circuits such as central office trunks, tie trunks, service circuits, etc.

On an intermodule call, blocking can occur from three sources: the originating module TSI, the TMS, and the terminating module TSI. The capacity of each module TSI is based on a blocking probability of P.001. The capacity of the TMS is based on a blocking probability of less than P.0001. When all the probabilities are added together, the result is:

$$P.001 + P.0001 + P.001 = P.0021.$$

Rounding off will yield the objective service level of P.002. The essentially nonblocking configuration (P.000001) is obtained by artificially increasing the traffic load by 25 percent and providing modules based on this inflated value. When the switch encounters the real traffic load (25 percent less than the engineered load), enough equipment is in place to carry the traffic with a one in one million probability of blocking.

A nonblocking switching network is basically a hardware configuration but is addressed here for completeness. The total number of ports having access to the switch network is determined. This includes service-type ports such as call progress tones and touch-tone senders and receivers.

The number of modules required is calculated by insuring that every port can be involved in a connection simultaneously through the TSI in a single-module system and through the TSI and TMS in a multimodule system. The methodology essentially limits the number of ports equipped per module. For a single-module system, on the order of 500 ports may be equipped. For a multimodule system, a maximum of only 128 ports per module may be equipped to insure TMS mismatch blocking cannot occur. These numbers must also be derated to take into account percentages of 3-port conference traffic which requires additional TSI and TMS resources.

Here is a comparison of the number of modules required based on traffic for an average system with 80 percent voice traffic and 20 percent data traffic engineered and configured for the three different grades of service:

3,200 lines @ 4 CCS/line voice
1.5 CCS/line Incoming
1.5 CCS/line Outgoing
1 CCS/line Intercom
128 computer ports @ 25 CCS/port. (50% specific and 50% nonspecific)
437 Trunks @ 22 CCS/trunk

Grade of Service	Number of Modules Required
Standard (P.002)	4
Essentially Nonblocking (P.000001)	5
Totally Nonblocking	30

This example is for illustrative purposes only. The number of modules required for a specific application and grade of service must be determined individually using the appropriate engineering and configuration methodologies.

Capacities

The TSI capacity per module is set at 430 PUR. This value is established based on 256 TSI maximum connections, 2 ports per connection, 512 maximum ports connected, up to 5 percent conference traffic, and some limited source gain based on 100 ports per module. These variables are applied to an Erlang B finite source blocked calls cleared model resulting in 430 PUR capacity per module at P.001 grade of service.

The TMS capacity is based on 256 maximum connections from a given module to the TMS, a Poison arrival rate, and simulation techniques to determine mismatch blocking. This results in a range from 140 PUR to 195 PUR per module, depending on the number of modules in the system.

SWITCH ENGINEERING—HARDWARE/SOFTWARE CONFIGURATION

This section uses the term "hardware" to refer to items such as circuit packs, carriers, and cabinets that are physically arranged to construct a System 85 switch and/or auxiliary cabinet.

The **Application Engineering Manual—System 85** (555-101-600) provides the algorithms, worksheets, and instructions necessary to determine the orderable hardware and software items for the switch and auxiliary cabinet. The algorithms take into account variables for the required terminal and trunk interfaces, traffic, features, distance constraints, carrier and cabinet capacity, etc. Special sections are provided to configure unbalanced or Remote Module systems which require specific hardware allocation per module or groups of modules (requires completion of unbalanced/remote module traffic engineering as a prerequisite). The result of completing the configuration is a specific quantity and type of Price Element Codes (PECs).

PECs are the means by which the required hardware and software is specified for manufacturing and by which the customer is billed. Attributes associated with PECs are a means to provide variations of the basic item ordered. The attributes specified in the Applications Engineering Manual configuration are those which are pertinent to insure the system can provide the functionality required. Attributes for items such as cabinet earthquake protections mounting bolts or style of door are not configuration dependent and must be specified as needed.

Certain PECs specified in the configuration are referred to as Pseudo-PECs which have X600 as the first four characters. These are used to identify hardware quantities used for translation assignment data checks, to specify quantities of certain traffic sensitive software variables such as intercom records and originating registers, and to provide configuration information for the manufacturer.

A review of the switch generic program memory configuration limitations should be performed prior to and is required upon completion of the configuration process to insure that no limitations have been exceeded.

Hardware

The hardware PECs are unique groupings of apparatus such as J- and ED-coded hardware that comprise a logical building block (e.g., cabinet, carrier, and circuit packs) for the switch and auxiliary cabinet. These were established with the intent of minimizing the number of unique PECs required while maintaining sufficient granularity to minimize the amount of hardware provided for a specific customer's application. An order of magnitude of 1000 unique hardware items has been reduced to an order of magnitude of 100 hardware PECs. These PECs may be used to specify the hardware order for a 500-line single-module system or a 7000-line 18-module system with any variations of terminal, trunk, or feature requirements.

Software

Software PECs are used to specify feature groups within the generic program which are individually billable, such as Electronic Tandem Networking and Distributed Communication System. This provides a means to incrementally offer desired features and functionality.

Switch Memory Configuration Limits

The limits described in the following tables are system maximums. Certain limits may not be achievable simultaneously.

The following tables list the maximum parameters for hardware and software items for Release 2, Version 1; Version 2; and Version 3:

- TABLE 10-A. System Parameters
- TABLE 10-B. Line Parameters
- TABLE 10-C. Terminal Feature Parameters
- TABLE 10-D. Trunk Parameters
- TABLE 10-E. Network Parameters.

TABLE 10-A. System Parameters

TYPE	ITEM	R2V1	R2V2	R2V3
Hardware	APs Assigned to DCIU	7	7	7
	Active BCT Users	16	16	16
	Active EIA Users	24	24	24
	Printers	30	30	30
	Attendant Consoles	28	40	40
	Calling Number Display Units	20	20	20
	DCIU Links	8	8	8
	DCIU Logical Applications Channels	64	64	64
	DCIU Network Channels	128	128	128
	DCS Links Assigned to DCIU	8	8	8
	FADS—CAS Display Units	1	1	1
	FADS—UCD Display Units	12	-	-
	Loudspeaker Paging Zones	18	18	18
	Low-Speed Data Channels	64	64	64
	Network Cabinets per Module	4	4	4
	Network Modules	18	31	31
	Remote Carriers	-	-	511
	Remote Modules	-	30	30
	Port Carriers per Module	12	12	12
	Port Circuit Packs per Carrier	16	16	16
	Non-EUCD Recorded Announcements	1	16	16
	EUCD Recorded Announcements	-	30	30
	System Status Indicator Lamps	128	168	168
Software	Attendant ORs	28	40	40
	Attendant Switched Loops	168	240	240
	Attendant Conference Bridges	13	13	13
	Dial Access Codes	175	500	500
	Dial Pulse and Touch-Tone ORs	246	246	246
	Logins per AP	200	200	200
	Memory Space	2.10M	4.19M	8.39M
	Patch Area	55K	437K	420K
	Resident Programs	563K	604K	800K
	Status Data	568K	1127K	2300K
	Translation Data	911K	1873K	4700K
	SMDR Records	2000	5012	6000
	Total ORs	300	300	300
	AUDIX Subscribers	-	2000	4000
	Distribution Lists per Subscriber	-	99	999
	Hours of Stored Messages	-	200	200
	Members per Distribution List	-	250	250
	Simultaneous Connections	-	32	32

TABLE 10-B. Line Parameters

TYPE	ITEM	R2V1	R2V2	R2V3
Hardware	Analog Terminals (2500, 2554, 7101A, 7103A)	7,000	8,000	32,000
	Multi-Appearance Terminals (7203H, 7205H, 7303S*, 7305S*, 7403D, 7404D, 7405D)	5,000	5,000	10,000
	Line Side Data Modules	5,000	8,040	16,000
	Display Modules (Including 513/515 BCT)	900	2,000	5,000
Software	Line Records	15,000	19,145	32,703

* The 7303S and 7305S terminals are not provided in R2V1.

TABLE 10-C. Terminal Feature Parameters

TYPE	ITEM	R2V1	R2V2	R2V3
Hardware	Abbreviated Dialing Buttons	24,064	65,536	65,536
	Auto Message Waiting Lamps	7,500	10,500	32,000
	Auto Message Waiting Lamps per Line	1	1	1
Software	Abbreviated Dialing Characters per Button	20	20	20
	Abbreviated Dialing Characters per Call	36	36	36
	Abbreviated Dialing Group Lists	500	1,000	9,999
	Abbreviated Dialing Nonsystem Lists	2,047	5,120	13,107
	Abbreviated Dialing System List Records	99	99	9,999
	Auto/Manual Intercom Records	300	300	300
	Button Table Words	64,000	220,002	408,750
	Call Pickup Groups	1,000	1,000	1,000
	Characters per Name	30	30	30
	Coverage Groups	3,000	4,096	4,096
	Display Names	5,000	8,500	32,767
	Line Appearance Occurrences	16	16	16
	Line Appearances per Terminal	12	12	12
	Line Classes of Service	63	63	63
	LWC Messages Without AP	3,000	6,000	6,000
	Manual Signaling Pairs	140	140	140

TABLE 10-D. Trunk Parameters

TYPE	ITEM	R2V1	R2V2	R2V3
Hardware	AIOD Circuit Packs	2	2	2
	DS-1 Trunk Circuit Packs	256	256	512
	Contact Interface Circuit Packs	34	34	34
	Personal CO Lines	150	150	150
	Physical Trunks	2250	5000	6000
	Release Link Trunks, Inward	110	110	110
	Release Link Trunks, Outward	16	16	16
	Remote Access Trunks	45	45	45
Software	AIOD Queues	6	6	6
	Assignable Trunk Records	2705	7525	8525
	Code Restriction Levels	4	4	4
	Flexible Night Trunk Groups	255	255	255
	Flexible Night Trunks per Trunk Group	99	99	99
	Host Access Trunk Groups	175	238	238
	Modem Pool Trunk Groups	175	238	238
	RLT Groups at the Main	40	40	40
	Route Advance—No. of Trunk Groups	5	5	5
	Trunks per Trunk Group	99	255	255
	Trunk Records (Total)	3250	7970	8970
	ACD/EUCD Splits or UCD Groups	28	30	30
	ACD/EUCD/UCD Agents per Group	40	512	512

TABLE 10-E. Network Parameters

TYPE	ITEM	R2V1	R2V2	R2V3
Hardware	DCS Nodes	12	20	20
Software	AAR Routes	255	255	640
	AAR Trunk Groups per Route List	4	4	16
	ARS Foreign NPAs	64	64	160
	ARS Routes	64	64	64
	ARS (Home) NPAs—Free NNX List	64	64	160
	ARS Trunk Groups per Route	16	16	16
	Authorization Codes	9000	9000	90,000
	AUTOVON Precedence Levels	6	6	6
	AUTOVON Routing Patterns (Nodes)	12	12	12
	Facilities Restriction Levels	8	8	8

Circuit Pack Assignments in Port Carriers

The port carrier is designed to accept all SN-coded port circuit packs. There are several similar, but different, circuit packs used in the System 85 network. Certain types of packs can be paired with other types; others can only be paired with one of the same type. Additionally, certain circuit packs may be cabled to either Line Fields or Trunk/Auxiliary Fields depending on the type of application.

Circuit Pack Pairing

Cabling restrictions dictate certain circuit pack pairing. Each 25-pair cable connecting the port carrier to the termination field accommodates the interfaces from two circuit packs. Traffic and reliability considerations require placement of certain circuit packs so they will be distributed throughout the system. Administration considerations direct the quantity and placement of like units in a carrier.

An example of cabling restrictions dictating circuit pack pairing is the analog line pack. The analog line pack provides eight ports per pack. Pair assignments on the pack and carrier wiring from the pair of circuit pack slots to the 25-pair cable interface dictate that an analog line pack may be paired with another analog line pack or a circuit pack which does not require access at the termination field (e.g., Touch-Tone Sender). Additionally, an adapter or "Y" cable (ED1E434-11, G71) is required at the termination field end if connectorized hardware is used for the termination field. The "Y" cable is designed to maintain 3-pair uniformity per port on the termination block for analog line packs.

An example of reliability considerations dictating circuit pack pairing is the Call Progress Tones pack. This pack does not require access at the termination field and may be physically paired with another Call Progress Tones pack. However, if a port carrier dc to dc power pack or control or data interface pack failed which served the portion of the carrier in which the pair was placed, all service to the module would be lost. Therefore, these packs should not be paired and should be placed in separate carriers and preferably in separate cabinets served by different power sources.

Circuit Pack Groupings and Pairing Rules

The SN-coded circuit packs can be segmented into basic groups and subgroupings for pairing purposes. Figure 10-1 provides a table with recommended pairing rules for the following groups and subgroups.

LEGEND:
P = Preferred
A = Allowed
(–) = Not Recommended

		SN250 A1	SN251 A2	SN252 A3	SN253C A4	SN254 A5	SN255 A6	SN260 SN261 A7	SN221B SN222B SN228 SN229 SN241 B1	SN221B SN228 SN229 B2	SN224B SN238 SN243B SN270 C1	SN224B SN238 SN243B SN270 C2	SN230 SN231 SN232 SN233 SN244 D1
SN250	A1	–	P	P	P	P	P	P	A	A	A	A	A
SN251	A2	P	–	P	P	P	P	P	A	A	A	A	A
SN252	A3	P	P	–	P	P	P	P	A	A	A	A	A
SN253C	A4	P	P	P	–	P	P	P	A	A	A	A	A
SN254	A5	P	P	P	P	–	P	P	A	A	A	A	A
SN255	A6	P	P	P	P	P	–	P	A	A	A	A	A
SN260, SN261	A7	P	P	P	P	P	P	A	A	A	A	A	A
SN221B, SN222B, SN228, SN229, SN241 (Cabled to Line Field)	B1	A	A	A	A	A	A	A	P	–	–	–	–
SN221B, SN228, SN229 (Cabled to Aux/Trunk Field)	B2	A	A	A	A	A	A	A	–	P	–	–	–
SN224B, SN238, SN243B, SN270 (Cabled to Line Field)	C1	A	A	A	A	A	A	A	–	–	P	–	–
SN224B, SN238, SN243B, SN270 (Cabled to Aux/Trunk Field)	C2	A	A	A	A	A	A	A	–	–	–	P	–
SN230, SN231, SN232, SN233, SN244 (Cabled to Aux/Trunk Field)	D1	A	A	A	A	A	A	A	–	–	–	–	P

Figure 10-1. Circuit Pack Pairing

GROUP A

A1	SN250 Call Progress Tones
A2	SN251 Touch-Tone Receiver
A3	SN252 Touch-Tone Sender
A4	SN253C Auxiliary Tones
A5	SN254 Attendant Conference
A6	SN255 Data Tone Detector
A7	SN260 Analog Facility Test SN261 Analog/Digital Facility Test

The circuit packs in Group A are predominately those which are essential to call processing or feature operation and for which access is not required at the termination field. Two exceptions are Subgroups A4 (SN232C) and A7 (SN260 and SN261). The SN253C provides the interface for chime tone, dial tone, and ringback tone for certain auxiliary equipment and must be cabled to the termination field. The SN260 and SN261 provide certain trunk and modem pool testing capabilities that are not essential to call processing or feature operation.

The circuit packs in each subgroup should be distributed in separate carriers and preferably in cabinets served by different power sources for reliability considerations.

GROUP B

B1	SN221B Analog Port SN222B Analog Port SN228 Analog Port SN229 Analog Port SN241 Contact Interface
B2	SN221B Analog Port SN228 Analog Port SN229 Analog Port

The circuit packs in Group B provide eight interfaces per pack for which access is required at either the Line Field or Trunk/Auxiliary Field. The circuit packs listed in Subgroup B1 are used for applications which require access at the Line Field (e.g., internal building application). The circuit packs listed in Subgroup B2 are used for applications which currently require access at the Trunk/Auxiliary Field (i.e., out of building or off-premises applications).

GROUP C

C1 SN224B Hybrid Port
SN238 ADU/EIA Port
SN243B Data Port (Analog)
SN270 Digital Port

C2 SN224B Hybrid Port
SN238 ADU/EIA Port
SN243B Data Port (Analog)
SN270 Digital Port

The circuit packs in Group C provide four interfaces per pack for which access is required at either the Line Field or Trunk/Auxiliary Field. The circuit packs listed in Subgroup C1 are used for applications which require access at the Line Field (e.g., internal building application which uses building wiring access). The circuit packs listed in Subgroup C2 are used for applications which currently require access at the Trunk/Auxiliary Field:

SN224B Out-of-building application on "nonexposed cable"

SN238 Out-of-building application on "nonexposed cable" or to physically concentrate interfaces for access in equipment room such as to the Information Systems Network

SN243B Out-of-building, off-premise, or modem pool application

SN270 Out-of-building application on "nonexposed" cable or modem pool application

GROUP D

D1 SN230 CO Trunk
SN231 Auxiliary Trunk
SN232 DID Trunk
SN233 Tie Trunk

The circuit packs in Group D provide four interfaces per pack for which access is required at the Trunk/Auxiliary Field. These circuit packs should be distributed among separate carriers and preferably cabinets served by different power sources for reliability considerations. Allocation of trunk packs among modules in a multimodule system is also essential for proper traffic balancing (per locale for Remote Modules).

AUXILIARY CABINET AND EQUIPMENT CONFIGURATION

The System 85 Auxiliary Cabinet is used for housing auxiliary hardware on shelves and racks. Molded structural foam panels are available for mounting auxiliary equipment inside the cabinet instead of on a wall. The Auxiliary Cabinet may or may not be required depending on the system configuration. If only remote access equipment (such as the 212AR data set) is required, consideration should be given to wall mounting the data equipment. But an Auxiliary Cabinet is recommended if additional auxiliary equipment is necessary, especially if the equipment requires power or rack mounting.

Basic Auxiliary Cabinet and Equipment

The J58886N1 L-1 Auxiliary Cabinet includes a J58889AE1 L-1 alarm distribution panel and can be equipped to accept ac input power or -48 V dc input power:

- The ac input power option consists of a J58886N1 L-29 ac power outlet strip and a J58889AK1 L-2 ac power distribution unit. A -48 V dc power supply can be ordered if internal -48 V dc is required.
- The -48 V dc input power option consists of a J58889AB1 L-1 fuse panel and a J58889AD1 L-1 wiring and equipment package which includes a dc filter unit.

Here is a list of optional equipment:

- Fan assembly for forced air cooling
- Small interconnect panel (thirty-two 3-pair terminations)
- Large interconnect panel (sixty-four 3-pair terminations)
- 11-inch vertical height structural foam mounting panel
- 4-inch vertical height structural foam mounting panel
- Frequency (ringing) generator and interrupter
- Miscellaneous mounting packages which include adapter brackets for 19-inch or 23-inch wide rack equipment, shelves for local area data sets, cable assemblies for data sets, and data modules. Mounting packages are also available for Remote Group Interface, Channel Division Multiplexer (CDM), Channel Expansion Multiplexer (CEM), and Channel Service Unit (CSU).

Auxiliary Cabinet Alarms

The alarm distribution unit in each Auxiliary Cabinet consolidates alarms for the various equipment and conditions within the cabinet. It also provides a compatible interface for the external equipment alarm input provided by the TN492C in the 501 common control. This allows automatic registering and reporting of Auxiliary Cabinet alarms by System 85. The possible Auxiliary Cabinet alarm types are:

- Temperature
- Rectifier
- Circuit breaker/fuse
- Frequency Generator
- Fans.

Interconnect Panels and Cable Assemblies

The large and small interconnect panels provide a means for connecting auxiliary equipment mounted in the auxiliary cabinet to the cross-connect fields. The interconnect panels provide 110-type termination blocks which are pre-wired to 50-pin connectors, manufactured by Amphenol Products, mounted on the back of the Auxiliary Cabinet. Twenty-five pair I/O cables complete the connection between the interconnect panel and selected cross-connect field. With this arrangement, 3-pair modularity and pair sequencing on the 110-type blocks is preserved. The interconnect panels are used for line and auxiliary trunk port access to data sets, data modules, recorded announcement channels, etc. They may also be used for any miscellaneous-type connections to equipment in the Auxiliary Cabinet such as radio paging interface or cabinet alarm connections.

Special cable assemblies for certain data sets and data modules are provided in the Auxiliary Cabinet. These assemblies provide EIA connector access at the back of the cabinet for direct cable runs to data terminal or data communications equipment.

Auxiliary Equipment Mounting

Two sizes of structural foam panels are available for wall-mount type auxiliary equipment: 4 inches high and 11 inches high. Various configurations are available for mounting equipment on the panels in prescribed locations with pre-drilled mounting holes. All other equipment is either rack or shelf mounted in the Auxiliary Cabinet.

Data Sets

A 212AR data set and loop-start trunk are required to provide RMATS-II access to the System 85 switch. A 212AR data set may also be required for CSM or TCM/FM access to switch remote port. These data sets may be placed in the equipment room up to 50 feet from the common control cabinet. The data sets may be wall mounted, placed on a suitable surface, or placed in a multiple mount in the Auxiliary Cabinet.

A data link is required between the DCIU and the AP. If the AP is located in the same building or room as the System 85 switch, local area data sets (LADS) or an isolating data interface (IDI) are required for ground isolation of the EIA interface.

Auxiliary Equipment Accommodated

The following is a list of auxiliary equipment for which mounting and cabling arrangements are available if placed in the Auxiliary Cabinet:

AUXILIARY EQUIPMENT	PEC
Local Area Data Set—(Model 8250, manufactured by Codex Corporation)	2123-250
40A4 Multiple Mounting—Mounts 8 units of 212AR Data Set (2126-212), Automatic Calling Unit (2180-ACU), 57B1, 202SR Data Set (2122-202), and 103JR Data Set (2122-103)	21401
71A Multiple Mounting—Mounts 8 units of PDM, MPDM, TDM, TDM/2, and MTDM	21711
609A Transfer Panel—Used for night transfer or alternate console position (use 65252 for emergency transfer)	64102

	PEC
89A Control Unit and 2012D power supply—Used for loudspeaker paging	64152
13A Recorded Announcement Carrier—Includes basic equipment and mounts 8 units of 24-second announcement channel circuit packs (64967)	64966
500-13 LORAIN* Multiple Mounting—Mounts 13 units of LORAIN Model VFR-5050 Voice Switch Gain Circuit Pack (65231) and ASTRO-ENDYNE† Model 11625-1 E&M Type I Trunk Signaling Converter Circuit Pack (65255)	65230
36A Voice Coupler and 2012D Power Supply	65235
J588824CD-1 Radio Paging Interface	65237
J588827E-1 Recorded Telephone Dictation Trunk Interface Unit	65241
J53050F-2 Automatic Trunk Interconnect Unit	65246
Emergency Transfer Panel	65262
Single 16-second recorded announcement channel unit (COOK‡ Model 213300-23016113 and 213288 ac power converter)	65270
ADU Multiple Mounting—mounts 40 Z3A3 ADUs	65393
ISN Concentrator Carrier—mounts 5 interface packs (65394)	69010

General Configuration Guidelines

There are several things to consider when configuring Auxiliary Cabinets. The maximum amount of vertical mounting space in any one cabinet is 64 inches. However, the usable vertical space is 51 inches in front and 34 inches in the rear. This allows for subsequent addition of a -48 V dc power supply. Certain pieces of hardware required to support the auxiliary equipment mounted in the cabinet are installed in fixed places and should be checked first when arranging equipment. Optional support equipment refers to items such as interconnect panels, -48 V rectifier, and fans.

Fixed Placement

When the ac input power option is ordered, the ac distribution unit and the alarm distribution unit are mounted in the base of the cabinet; this uses up the first 7 inches of vertical mounting space. If a -48 V rectifier is called for, it is mounted in the base of the cabinet.

* Trademark of Lorain Electronics Corporation.

† Trademark of Astro-Endyne Corporation.

‡ Trademark of Cook Electrics.

When either -48 V dc input or the -48 V rectifier is ordered, a fuse panel is included. This panel mounts in the top 2 inches in the front of the cabinet (vertical height of 62 to 64 inches).

The fan assembly is mounted in the cabinet door and intrudes 3 inches into the cabinet. The fans are ac powered. The thermal sensor is mounted in vertical height 61 to 62 inches below the fuse panel.

Front and Rear Mounting

Provisions have been made for front and rear mounting of auxiliary equipment. However, front and rear mounting is restricted to foam panels mounted front and rear in the same vertical height locations and to the thermal sensor and fuse panel. Shelf and rack-mounted equipment in the front of the cabinet will protrude past the center line of the cabinet and preclude mounting equipment in the rear at the same vertical height. It is advisable to place foam panels above the 29-inch vertical height to take advantage of front and rear mounting.

Equipment Placement in Cabinets

Auxiliary equipment to be installed should be identified and placed into the following four primary categories:

1. Equipment requiring forced air cooling
2. Equipment requiring -48 V dc
3. Equipment requiring 115 V ac receptacles
4. Other equipment.

These groupings determine the order in which the equipment is placed into the Auxiliary Cabinets. All equipment requiring forced air cooling should be considered first to see if it can be housed in the same cabinet. The second grouping to be considered is equipment requiring -48 V dc. The third grouping to be considered is equipment requiring 115 V ac receptacles. Hardware outside the three previous groupings is grouped last.

The vertical mounting space, number of 3-pair cross-connects, and ac receptacles required for each piece of hardware should be determined at the same time as the equipment category.

When an Auxiliary Cabinet is ordered with the ac input power option, ten standard ac receptacles are included.

A simple sketch should be made, showing front and rear views of the cabinet configuration, as a final check against all parameters. It should be compared with the list of hardware to ensure that all parameters have been met. This will also provide the System Technician with the required layout of the equipment in the Auxiliary Cabinet(s).

DISTANCE SPECIFICATIONS

This section specifies the nominal operating distance for:

- Attendant Consoles
- Analog Voice Terminals
- Multifunction Voice Terminals
- Voice/Data Business Communications Terminals
- Data-Only Business Communications Terminals
- Data Modules
- Switch Modules
- Miscellaneous.

The term "nominal maximum" distance (or range) is the maximum distance at which the minimum acceptable voltage for correct operation is assured; this value assumes a temperature of 122°F (50°C).

Attendant Console

The nominal maximum distances between attendant consoles and the System 85 switch are listed below and shown in Figure 10-2. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

CONNECTING ARRANGEMENT	NOMINAL MAXIMUM RANGE IN FEET (METERS)
Without Console Repeaters:	
12-Pair Cable	700 (213)
25-Pair Cable	1,000 (305)
With Console Repeaters:	
1 Console Repeater	2,000 (610)
2 Console Repeaters	5,000 (1,524)
3 Console Repeaters	8,000 (2,438)
4 Console Repeaters	11,000 (3,353)

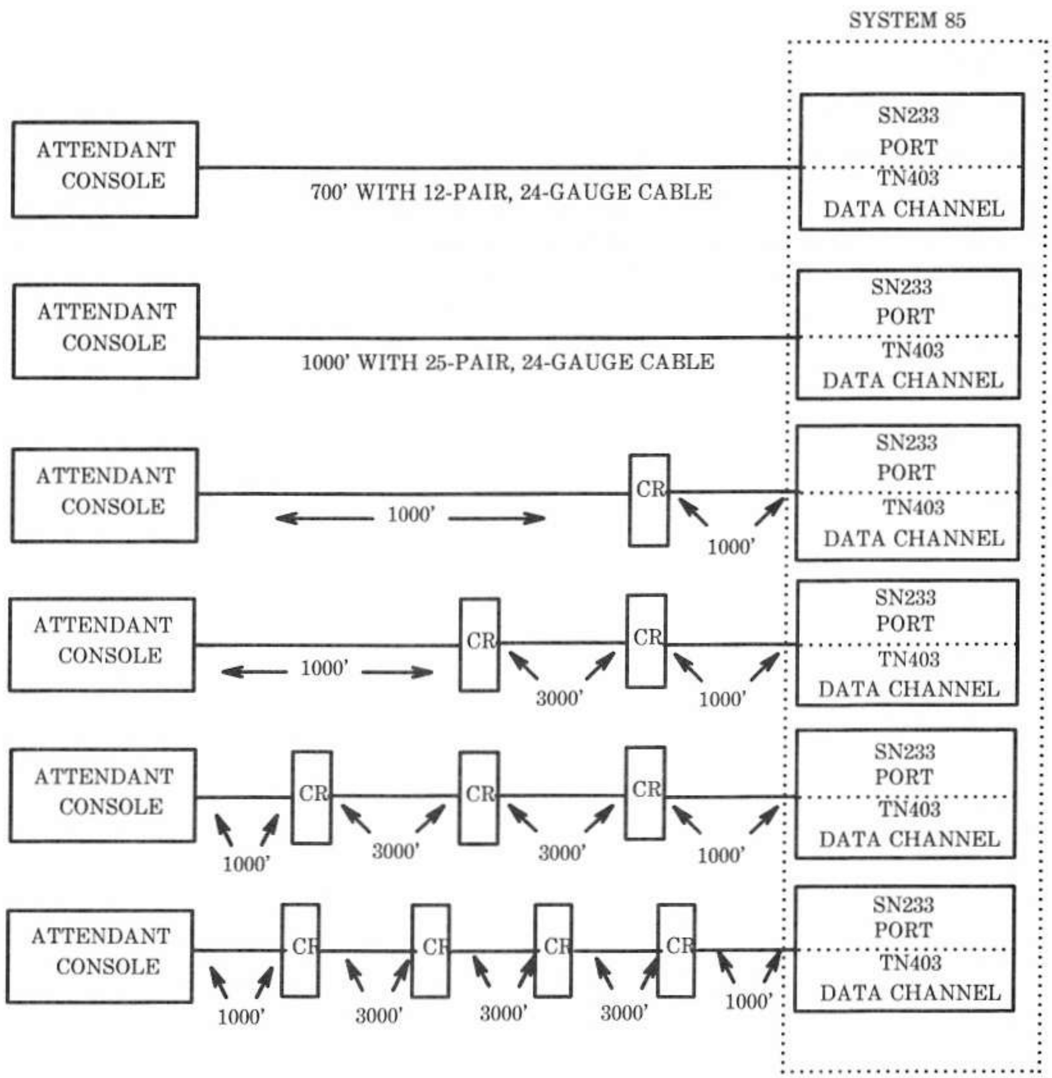


Figure 10-2. Distance Limitations for Attendant Consoles

Analog Voice Terminals

Distance limitations for the following models are given:

- Models 2500, 2500 DMGC, and 2554
- Models 7101A and 7103A.

Models 2500, 2500 DMGC, and 2554

The nominal maximum distances between Model 2500, 2500 DMGC, or 2554 voice terminals and the System 85 switch are listed below and shown in Figure 10-3. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

TERMINAL TYPE	PORT BOARD	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
2500 or 2554	SN229 SN228	3,500 (1,067) 20,000 (6,096)	3,500 (1,067) 12,000 (3,658)	- (1)
2500 DMGC	SN229 SN228	3,500 (1,067) 15,000 (4,572)	3,500 (1,067) 9,000 (2,743)	- (1)

Note 1: The SN228 port board has an option switch to permit a shorter range—less than 3000 feet (914 m)—where required.

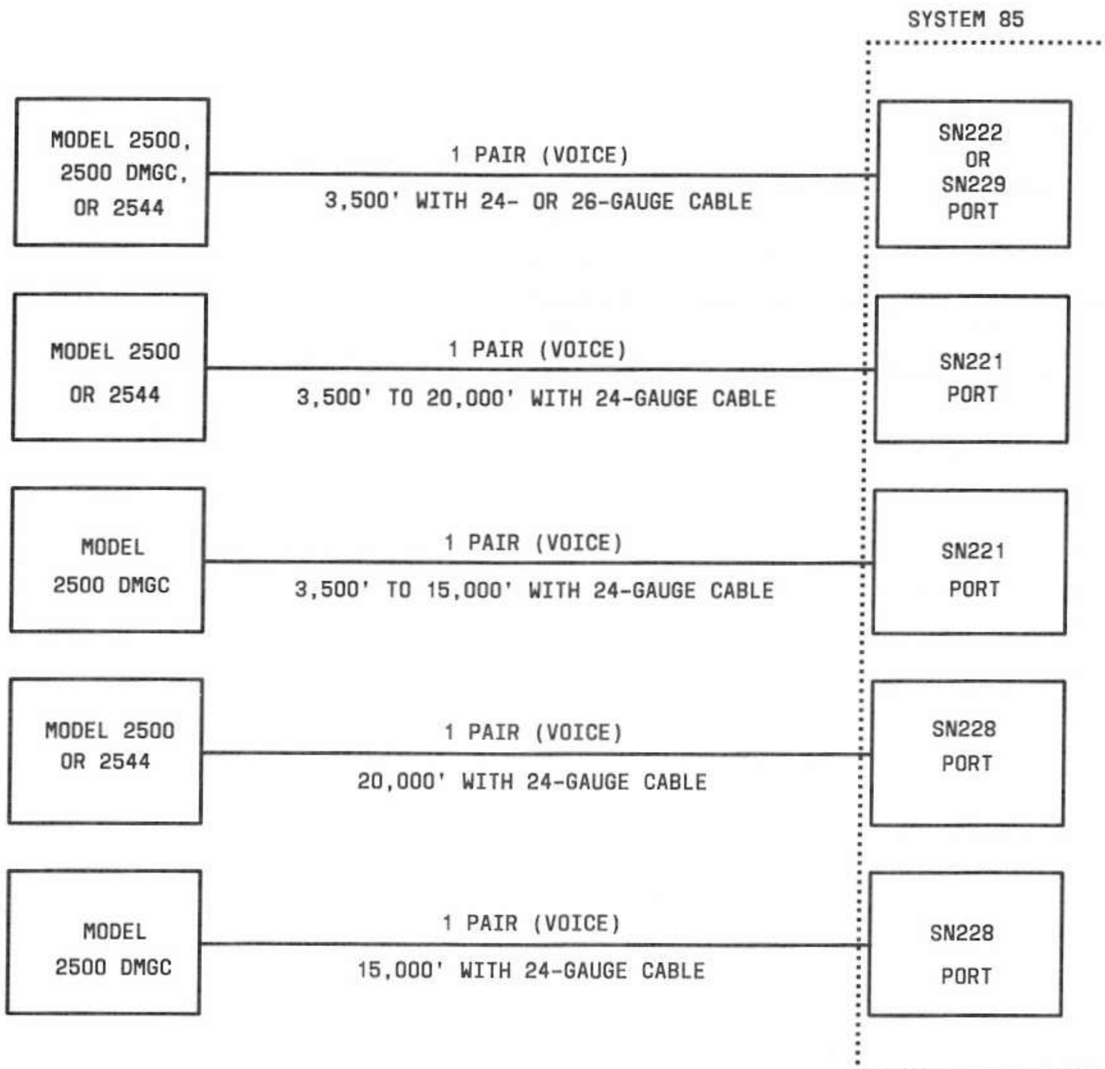


Figure 10-3. Distance Limitations for Voice Terminal Models 2500, 2500 DMGC, and 2554

Models 7101A and 7103A

The nominal maximum distances between Model 7101A or 7103A voice terminals and the System 85 switch are listed below and shown in Figure 10-4.

TERMINAL TYPE	PORT BOARD	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
7101A	SN229	3,500 (1,067)	3,500 (1,067)	-
	SN228	15,000 (4,572)	9,000 (2,743)	(1)
7103A	SN229	3,500 (1,067)	3,500 (1,067)	(2)
	SN228	15,000 (4,572)	9,000 (2,743)	(1, 2)

Note 1: The SN228 port board has an option switch to permit a shorter range—less than 3000 feet (914 m)—where required.

Note 2: Additional power is required when Speakerphone or Headset modules are used with the 7103A. It can be provided locally using a 2012D transformer or remotely from the satellite closet. The nominal maximum distance from the modular terminal wall jack to the satellite closet is 150 feet (46 m) for 24-AWG wire; this maximum is lower when 26-AWG wire is used.

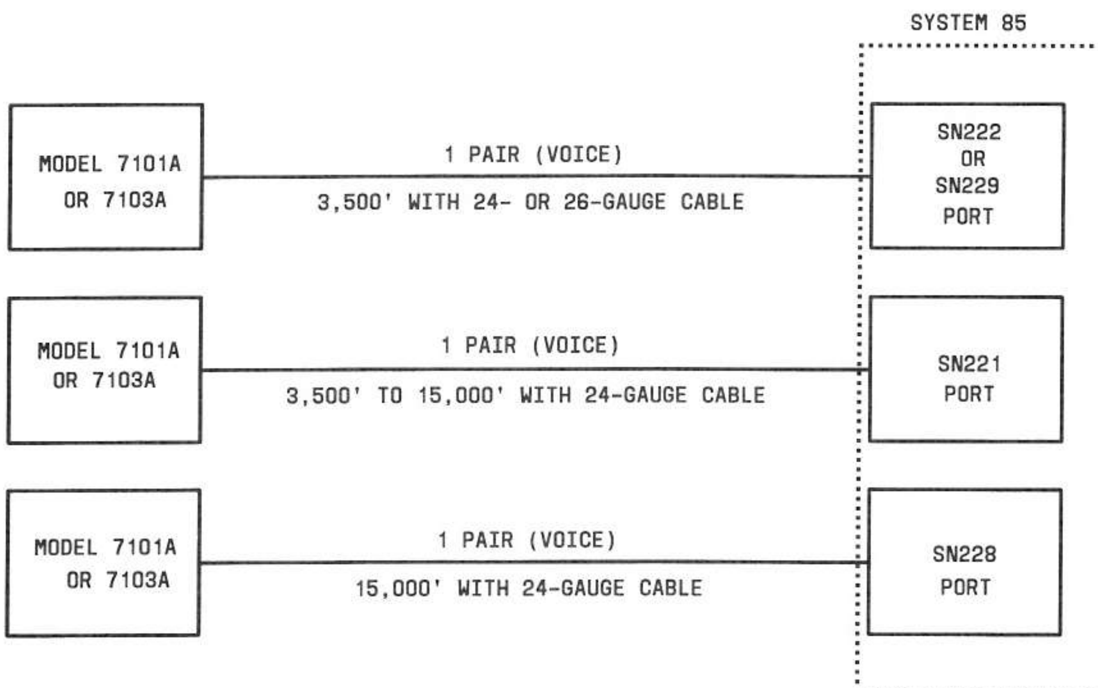


Figure 10-4. Distance Limitations for Voice Terminal Models 7101A and 7103A

Multi-Appearance Voice Terminals

Distance limitations for the following models are given:

- Models 7203H and 7205H
- Models 7303S and 7305S
- Models 7403D, 7404D, and 7405D.

Models 7203H and 7205H

The nominal maximum distances between Model 7203H or 7205H voice terminals and the System 85 switch are listed below and shown in Figure 10-5. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

TERMINAL TYPE	FEATURE OR COVERAGE ADJUNCTS	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
7203H	-	3000 (914)	2300 (701)	(1)
7205H	0	3000 (914)	2300 (701)	(1)
	1	1750 (533)	1100 (335)	(1)
	2	1000 (305)	750 (229)	(1)

Note 1: Additional power is required when Speakerphone or Headset modules are used. It can be provided locally using a 2012D transformer or remotely from the satellite closet. The nominal maximum distance from the modular terminal wall jack to the satellite closet is 150 feet (46 m) for 24-AWG wire; this maximum is lower when 26-AWG wire is used.

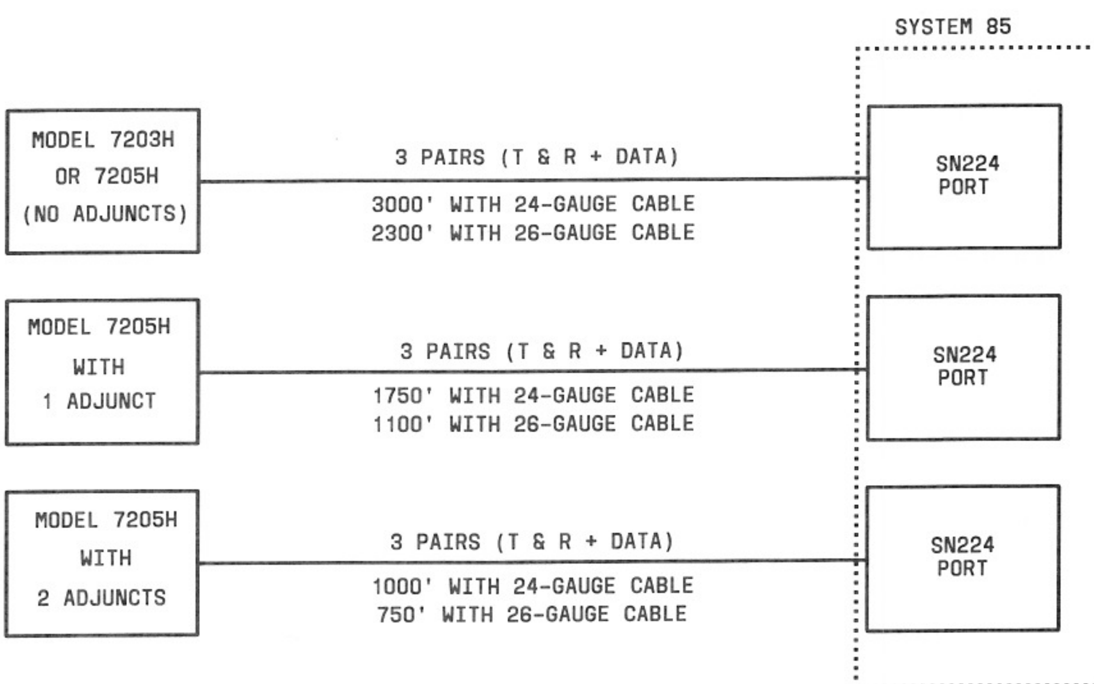


Figure 10-5. Distance Limitations for Voice Terminal Models 7203H and 7205H

Models 7303S and 7305S

The nominal maximum distances between Model 7303S or 7305S voice terminals and the System 85 switch are listed below and shown in Figure 10-6. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

TERMINAL TYPE	FEATURE OR COVERAGE ADJUNCTS	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
7303S	0	1700 (519)	1000 (305)	(1)
	1	1000 (305)	650 (198)	(1)
7305S	0	1000 (305)	650 (198)	(1)
	1	700 (213)	450 (137)	(1)

Note 1: Range may be extended to 2000 feet (610 m) for 24- or 26-AWG wire by adding local -48 V dc power in the satellite closet. Power supplies such as the 346A or 329A may be connected to the fourth pair from the terminals to obtain the increased range.

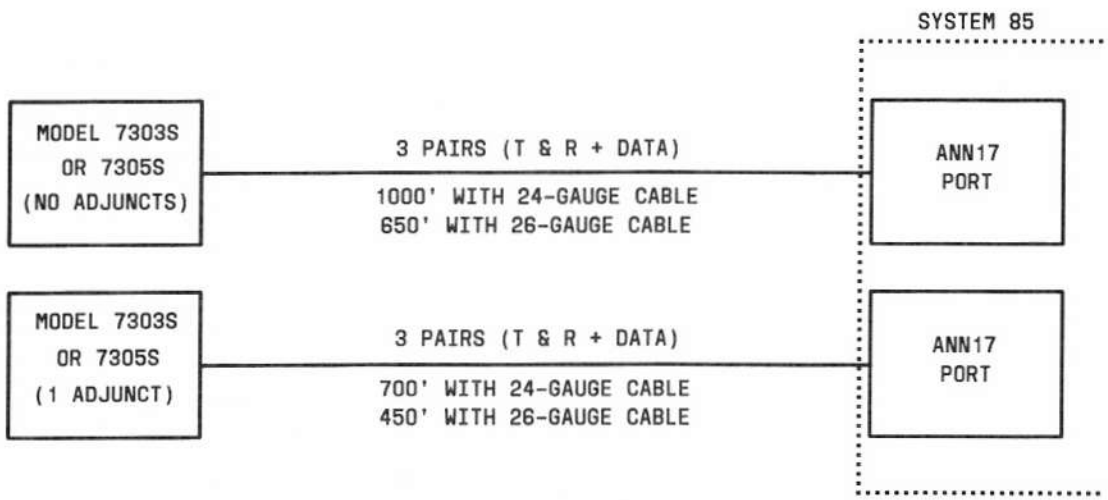


Figure 10-6. Distance Limitations for Voice Terminal Models 7303S and 7305S

Models 7403D, 7404D, and 7405D

The nominal maximum distances between Model 7403D, 7404D, or 7405D voice terminals (740_D) and the System 85 switch are listed below and shown in Figure 10-7. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

TERMINAL TYPE	FEATURE OR COVERAGE ADJUNCTS	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
7403D	-	3400 (1036)	2200 (671)	(1, 2)
7404D	-	3400 (1036)	2200 (671)	(1)
7405D	0, 1, or 2	3400 (1036)	2200 (671)	(1, 2)

Note 1: Additional power is required when any of the following adjuncts are used with 740_D series voice terminals: Coverage Module, Digital Terminal Data Module (DTDM), Display Module, Function Key Module, Headset module, or Speakerphone module. Additional power can be provided locally using a 2012D transformer or remotely from the satellite closet. The nominal maximum distance from the modular terminal wall jack to the satellite closet is 150 feet (46 m) for 24-AWG wire; this maximum is lower when 26-AWG wire is used.

Note 2: The distances given are nominal maximums. Distances of up to 5000 feet for 24-AWG wire and up to 4000 feet for 26-AWG wire are typical.

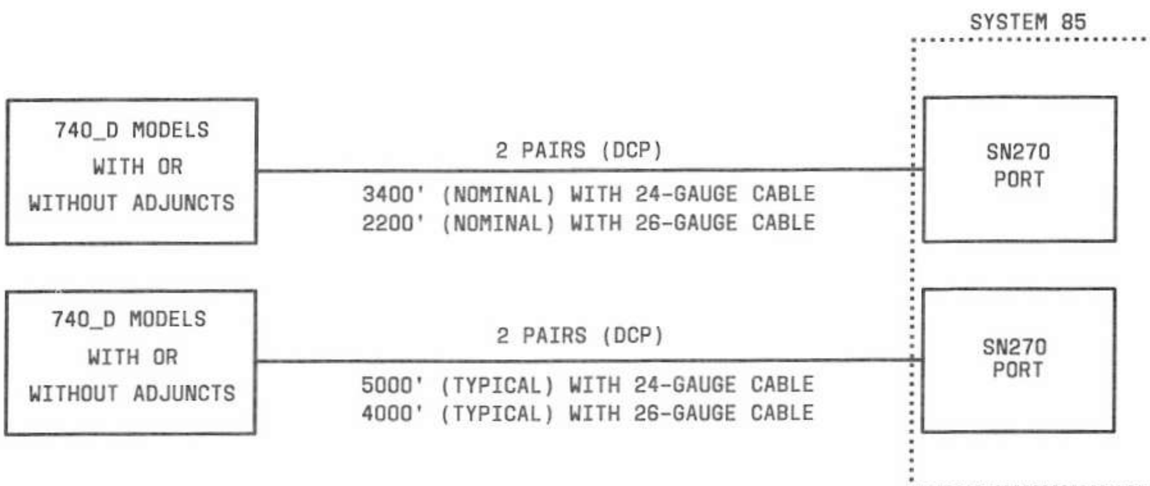


Figure 10-7. Distance Limitations for Voice Terminal Models 7403D, 7404D, and 7405D

Data Terminals

Distance limitations for the following data terminals are given:

- 515 BCT and Personal Terminal 510D
- 513 BCT (or any other EIA RS-232C data terminal).

Models 515 BCT and 510D

These models are voice/data terminals which means that in addition to being data terminals, they also have the voice terminal capabilities found in the 740_D series voice terminals. The nominal maximum distances between the 515 BCT or the 510D and the System 85 switch are listed below and shown in Figure 10-8. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX. If optional printers are used, see distance limitations for electrical interfaces in this section.

TERMINAL TYPE	NOMINAL MAXIMUM RANGE IN FEET (METERS)		SEE NOTE
	24 AWG	26 AWG	
515 BCT	3400 (1036)	2200 (671)	(1, 2, 3)
510D	3400 (1036)	2200 (671)	(1, 2, 3)

Note 1: These terminals plug into 117-V 60-Hz 3-wire grounded outlets.

Note 2: The distances given are nominal maximums. Distances of up to 5000 feet for 24-AWG wire and up to 4000 feet for 26-AWG wire are typical.

Note 3: Both models have a parallel printer, manufactured by Centronics Data Computer Corporation, interface with a distance limit of 10 feet. The 515 BCT also has an EIA RS-232C serial printer interface (nominal distance limit is 50 feet).

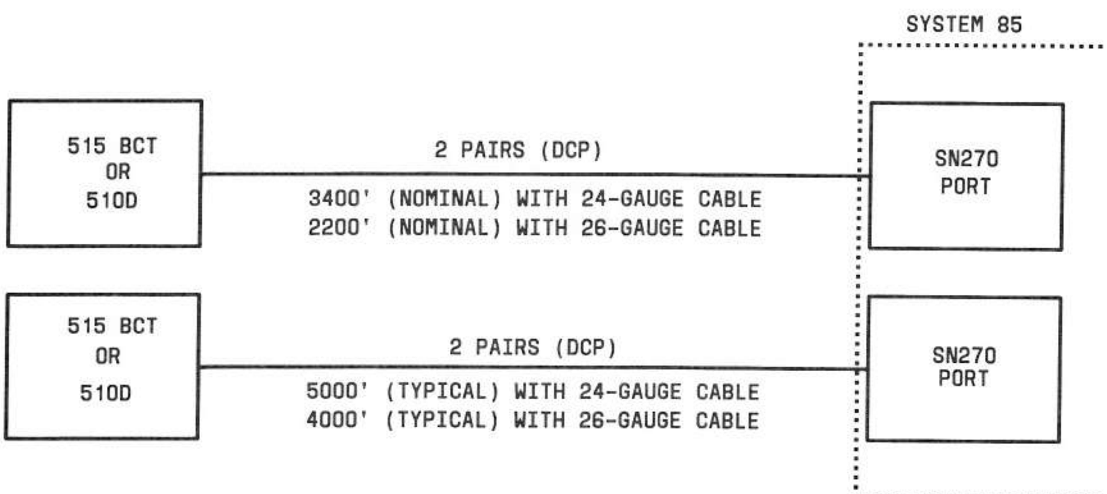


Figure 10-8. Distance Limitations for the 515 BCT and the 510D

Model 513 BCT (or Other EIA RS-232C Terminal)

The Model 513 BCT is a digital data terminal that provides an external EIA RS-232C interface. It must go through one of the following types of devices to connect to the switch:

- Asynchronous Data Unit
- Data Module
- Analog Modem.

Figure 10-9 shows these connections. The 513 BCT uses its external EIA RS-232C interface to connect to these devices. The nominal distance limit for the EIA RS-232C interface is 50 feet (15.2 meters). The 513 BCT also has an EIA RS-232C serial printer interface.

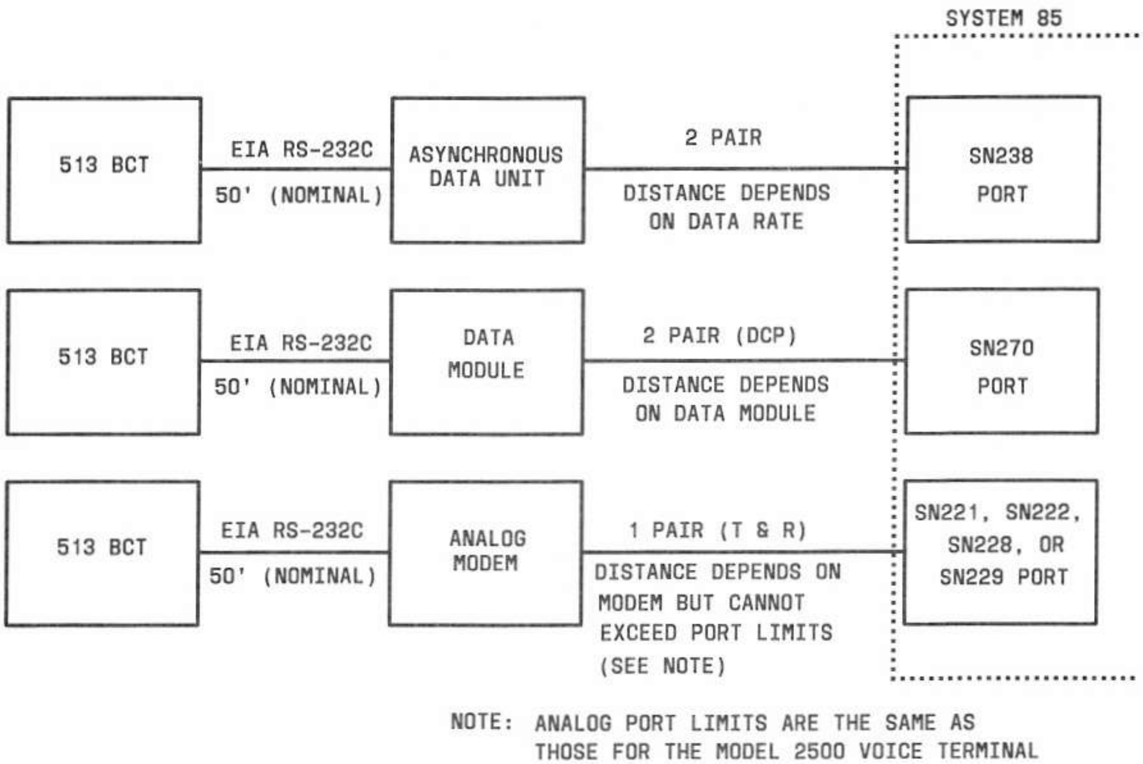


Figure 10-9. Distance Limitations for Data Terminal Model 513 BCT

Data Modules

Data modules have two distance limitations:

1. Distance to the System 85 switch
2. Distance to the Data Terminal Equipment (DTE) or Data Communications Equipment (DCE).

The nominal maximum distances between data modules and the System 85 switch are listed below and shown in Figure 10-10. Also included are the circuit pack codes associated with the connections; for more detailed information about a specific circuit pack, look up the code in the INDEX.

DATA MODULE	INTERFACE DCE/DTE	NOMINAL MAX. DISTANCE FROM SWITCH IN FEET (METERS)		SEE NOTE
		24 AWG	26 AWG	
DTDM	RS-232C	3400 (1036)	2200 (671)	(1, 2)
MPDM	RS-232C, RS-449, RS-422, OR V.35	5000 (1524)	4000 (1219)	(2, 3, 4)
MTDM	RS-232C	5000 (1524)	4000 (1219)	(2)

Note 1: The DTDM is only used as an adjunct to a Model 740_D voice terminal; the distance from the switch is limited by the power available to control lamps in the basic voice terminal.

Note 2: For operation up to 19.2 kbps with EIA RS-232C, the range between the connected device (DTE or DCE) and the data module is limited by the RS-232C interface specification which is nominally 50 feet (15.2 meters) with 24-AWG wire.

Note 3: For operation at 64 kbps with the RS-232C interface, the cable loading must not exceed 875 picofarads (pf) between the connected device (AP16 with SDCP interface) and the data module. This equates to 17 feet of cable at 50 pf per foot.

Note 4: For operation with RS-449/RS-442 or V.35 interface, the range between the DTE and the data module is limited by the interface specifications for RS-449/RS-422 or V.35.

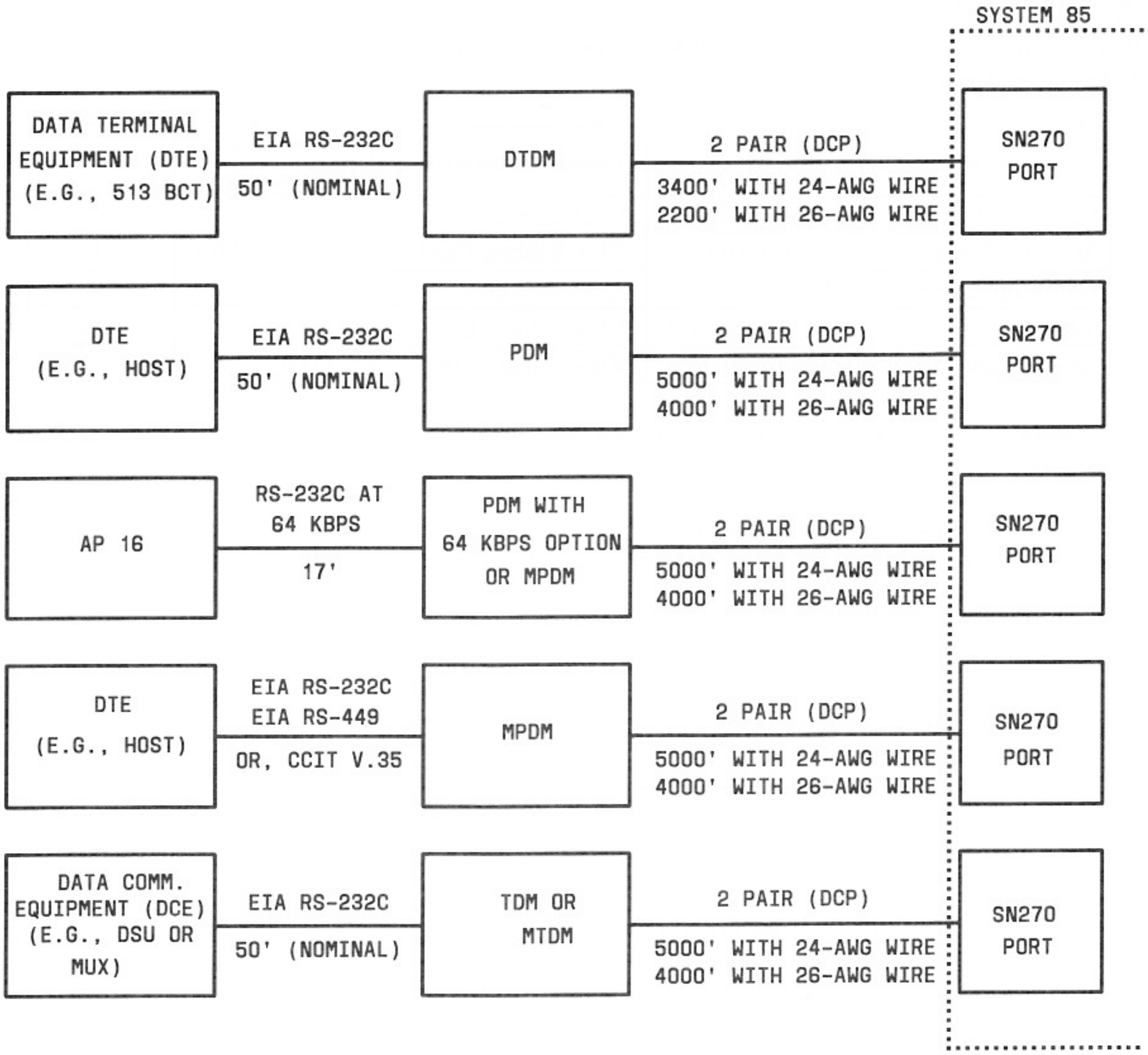


Figure 10-10. Distance Limitations for Data Modules

Switch Modules

The nominal maximum distances between major components of the switch complex are listed below and shown in Figure 10-11.

FROM	TO	TRANSMISSION MEDIUM	RANGE IN FEET (METERS)	SEE NOTE
Common Control	Module Control	Coaxial Cable	200 (61)	-
Module Control	Port Carrier	Flat Ribbon Cable	35 (10)	(1)
Common Control	TMS	Coaxial Cable	200 (61)	-
TMS	Module Control	Fiber-Optic Link	9,800 (2,987)	(2)
System Switch	Remote Module	Fiber-Optic Link	13,000 (3,962)	(3)

Note 1: Two flat ribbon connections are made: one is the PCM Bus, and the other is the I/O Bus. The PCM Bus also has a minimum of 15 feet (4.5 meters).

Note 2: When the TMS and Module Control(s) are duplicated, the difference between the lengths of the duplicated links must be less than 2400 feet (731 meters).

Note 3: The fiber-optic links from Remote Modules terminate at Remote Module Interface (RMI) circuits in the TMS and in some cases in a local Module Control. The fiber-optic links that carry control information are extended to the Common Control with coaxial cable (200 feet limit).

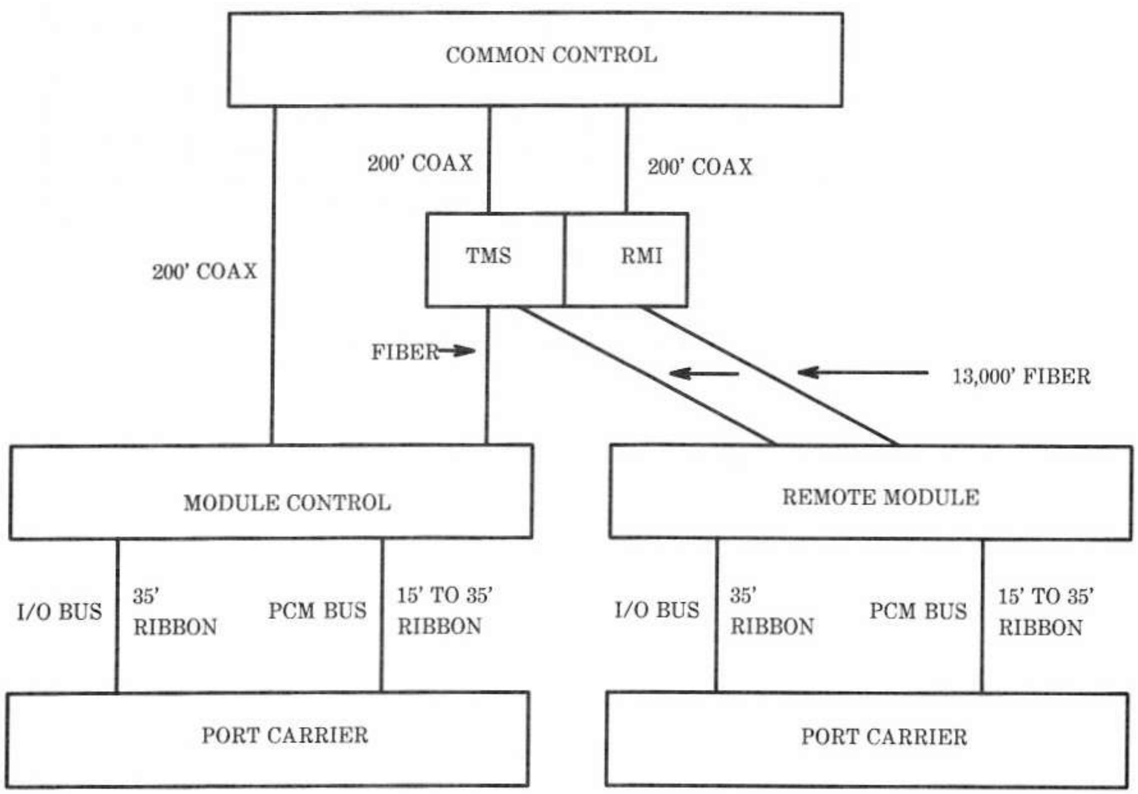


Figure 10-11. Distance Limitations for Switch Modules

Miscellaneous

The nominal maximum distance between various peripherals and the Common Control are listed below and shown in Figure 10-12.

PERIPHERAL	VIA	RANGE IN FEET (METERS)	SEE NOTE
MAAP		8 (2.4)	(1)
SMT	Alarm Panel Connector	1000 (305)	-
SMDR or LSU	Peripheral Interface	200 (61)	-
RMATS-II or TCM/FM Modem	Remote Port		(2)
Auxiliary Equipment	Auxiliary Trunk		(3)
573-5 or 609A Emergency Transfer Panel	System Power Source	200 (61)	-

Note 1: The MAAP may be connected via the Alarm Panel in the Common Control Cabinet or the extended MAAP connector located in each Module Control Cabinet (including Remote Modules).

Note 2: The range between the Remote Port and the modem is limited by the RS-232C interface (for 24 AWG, nominally 50 feet or 15.2 meters); the distance between the modem and the Central Office depends on the modem used.

Note 3: The range between an Auxiliary Trunk and the connected auxiliary equipment cannot have a resistance greater than 400 Ω; for 24 AWG, this is a maximum of 6000 feet (1828 meters).

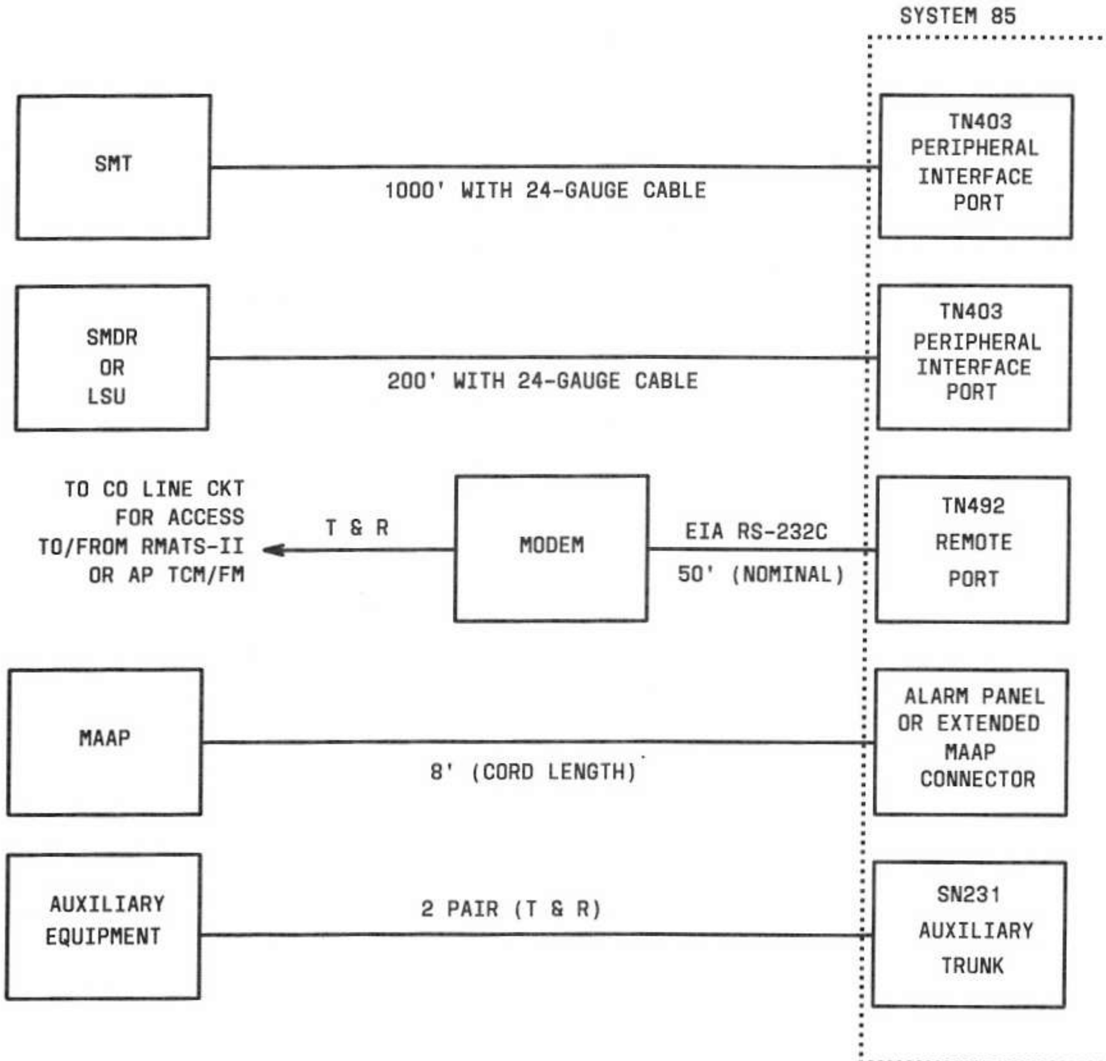


Figure 10-12. Distance Limitations for Miscellaneous Peripherals

TONES

The various call progress and ringing tones that are generated by the system are shown in Figure 10-13.

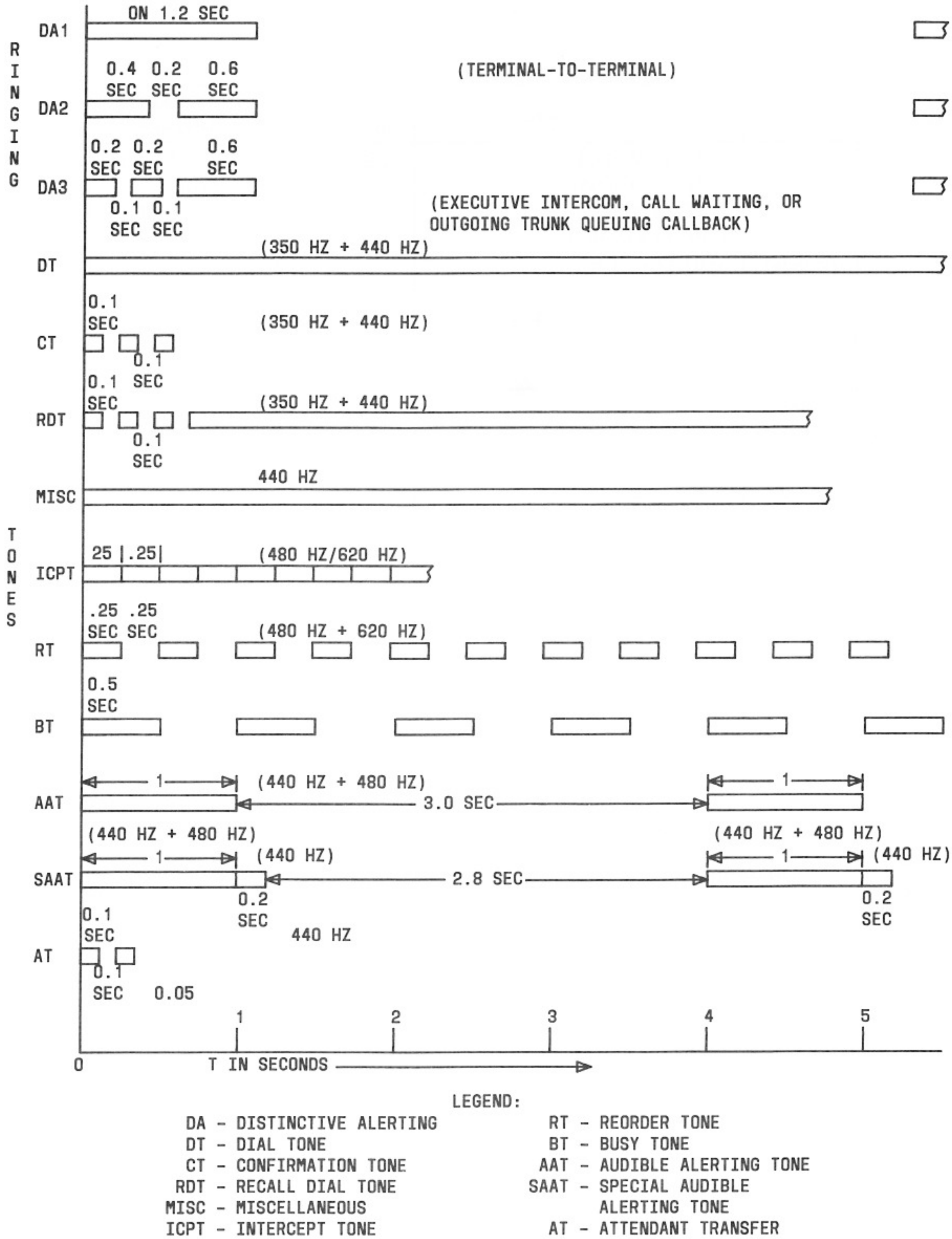


Figure 10-13. Call Progress and Ringing Tones

PROTOCOLS

The various protocols used in the system are listed below with system application and maximum limitations.

PROTOCOL	APPLICATIONS	MAXIMUM DATA RATE	MAXIMUM DISTANCE
DCP	GPP to MTDM, GPP to DTDM, GPP to MPDM, GPP to 515 BCT	160 kbps*	5000 ft (1524 m) for data 3400 ft (1036 m) for voice
RS-232C	MPDM to AP, MPDM to 513 BCT, MPDM to Host Computer, AP to Data Set, MPDM to Printer	19.2 kbps	50 ft (15.2 m)
RS-449	LDSU to AP, AP to AP	19.2 kbps 9.6 kbps 4.8 kbps 2.4 kbps	200 ft (61 m) 400 ft (122 m) 800 ft (244 m) 1600 ft (488 m)
SSI	500 BCT to AP, 400 Series Printers to AP	56 kbps	5000 ft (1524 m)
BISYNC	AP Line Controller to Host Computer for Terminal Emulation (9.6 kbps)	2.4 kbps 4.8 kbps 9.6 kbps	
X.25	DCIU to AP Communications Links Between Multiple APs and With Net 1000	19.2 kbps	
SDCPI	MPDM to AP	64 kbps	17 ft (5.9 m)
RS-366	Host Computer to ACU, AP to ACU		

The DCP sends digitized voice and digital data in frames. Each frame consists of four fields or channels. The first field is a unique 3-bit framing pattern (24 kbps) that defines the frame boundary. The second field is a 1-bit control or signaling channel (8 kbps) between the digital switch and digital data endpoint. The third and fourth fields are two independent information (I) channels (64 kbps each).

TRUNK SPECIFICATIONS

The specifications for the various trunk-type circuit packs are as follows:

TRUNK TYPE	CIRCUIT PACK	SPECIFICATIONS
Central Office	SN230B	Capacity: 4 Circuits Transmission: 1-Way In, 1-Way Out, or 2-Way 2-Wire 600 Ohms or, RC Balance Network Signaling: Ground Start
Auxiliary Trunk	SN231	Capacity: 4 Circuits Transmission: 1-Way In, 1-Way Out, or 2-Way 2-Wire Signaling: Ground Through Separate Tip and Ring or 2-Way 1-Wire
Direct Inward Dialing	SN232B	Capacity: 4 Circuits Transmission: 1-Way Incoming 600 Ω or Compromise Balance for Unknown Tip and Ring Impedance Signaling: High-Low (Detects Low Resistance Loop Closure, Responds With Battery Reversal)
Tie Trunk or Attendant Interface	SN233B	Capacity: 4 Circuits Transmission: 4-Wire Tip and Ring Signaling: E & M
Data Port Trunk	SN243B	Capacity: 4 Circuits Transmission: 2-Way Voiceband Data Over 2-Wire Tip and Ring Signaling: Loop
DS-1 Trunk	ANN11C	Capacity: 24 Trunks for Voice-Grade Service or 23 Trunks for Alternate Voice/Data Service Plus 1 Trunk Used to Supervise Mode: Multiplexes 24 or 23 Trunks Onto 1 Channel and Demultiplexes 1 Channel into 24 or 23 Trunks Speed: Trunks at 64 kbps 1 Channel at 1.544 Mbps Signaling: DS-1 Over 4-Wire

ANALOG TRANSMISSION CHARACTERISTICS

Frequency Response:

FREQUENCY	LOSS
60 Hz	>20 dB
200 Hz	<5 dB
300-3000 Hz	<1 dB
3200 Hz	<1.5 dB
3400 Hz	<3 dB

Insertion Loss:

CONNECTION TYPE	LOSS
On-Premises Station to On-Premises Station	6 dB
On-Premises Station to Off-Premises Station	3 dB
Off-Premises Station to Off-Premises Station	0 dB
Station-to-Trunk	0 dB
Trunk-to-Trunk	0 dB

Noise: <20 dBrnC0

Overload Level: +3 dBm0

Crosstalk: >75 dB

Intermodule Distortion:

FOUR TONE METHOD	
R2	>45 dB
R3	>53 dB

Quantization Distortion:

SIGNAL LEVEL	DISTORTION LEVEL
+2 to -30 dBm0	35 dB
-40 dBm0	29 dB
-45 dBm0	25 dB

Encoding Characteristic: μ255

Sampling Rate: 8 kHz

Terminating Impedance: 600 Ω

Trunk Balance Impedance: 600 Ω or Complex Z (selectable)

POWER CONSUMPTION, CIRCUIT BREAKER REQUIREMENTS, FLOOR LOADING, AND HEAT DISSIPATION

AC-Powered Systems

The following table provides statistics on the dc watt power consumption, circuit breaker requirements, weight and maximum dissipation for the various System 85 and related equipment based on Price Element Code (PEC). The dc watt and BTU/Hour values provided for TMS, Module Control, Port and Common Control cabinets include required cabinet and carrier values only. Values for Port, DS-1, TMS Growth, and Remote Module Interface carriers are provided separately. These values apply to ac-powered systems.

PEC	CABINET/ CARRIER TYPE	DC WATTS PER UNIT	SINGLE-POLE BREAKERS PER UNIT	DOUBLE-POLE BREAKERS PER UNIT	WEIGHT (LBS.) PER UNIT	MAX. BTU/HR. PER UNIT
6552-CSU	Unduplicated Common Ctrl Cabinet	680			750	2110
6552-CSD	Duplicated Common Ctrl Cabinet	1200	2		750	5050
6552-MCU	Unduplicated Module Ctrl Cabinet	370		1	750	3525
6552-MCD	Duplicated Module Ctrl Cabinet	670		1	750	4500
65310	Port Cabinet With Power	130		1	750	780
65311	Port Cabinet Without Power	130			750	215
65340	Port Carrier	240				340
65341	DS-1 Carrier	240				340
6552-TMU	Unduplicated TMS Cabinet	290	2		750	1900
6552-TMD	Duplicated TMS Cabinet	380	2		750	3590
65302	TMS Growth Carrier	200				580

PEC	CABINET/ CARRIER TYPE	DC WATTS PER UNIT	SINGLE-POLE BREAKERS PER UNIT	DOUBLE-POLE BREAKERS PER UNIT	WEIGHT (LBS.) PER UNIT	MAX. BTU/HR. PER UNIT
65389	Remote Mod. Interface Carrier	400				1160
65445	Aux. Cabinet	600	1		500	1360
*	AP16 Cabinet	1000	1		600	2560
65210	SMDR Cabinet (9-Track)	400	1		600	1000

* Check "AT&T-IS Price Element Manual" for PEC.

−48 V DC Standby Powered Systems

The following table provides information on the dc watt power consumption, circuit breaker requirements, weight, and maximum heat dissipation for the various System 85 and related equipment based on Price Element Codes (PECs). The DC Watt and BTU/Hour values provided for TMS, Module Control, Port and Common Control Cabinets include required cabinet and carrier values only. Values for Port, DS-1, TMS Growth, and Remote Module Interface carriers are provided separately. These values apply to -48 V dc standby powered systems.

PEC	CABINET/ CARRIER TYPE	DC WATTS PER UNIT	SINGLE-POLE BREAKERS PER UNIT	DOUBLE-POLE BREAKERS PER UNIT	WEIGHT (LBS.) PER UNIT	MAX. BTU/HR. PER UNIT
6552-CLU	Unduplicated Common Ctrl Cabinet	680	2		750	2110
6552-CLD	Duplicated Common Ctrl Cabinet	1200	2		750	4200
6552-MLU	Unduplicated Module Ctrl Cabinet	370	1		750	1300
6552-MLD	Duplicated Module Ctrl Cabinet	670	1		750	2340
65312	Port Cabinet	130	1		750	215
65340	Port Carrier	240				340

PEC	CABINET/ CARRIER TYPE	DC WATTS PER UNIT	SINGLE-POLE BREAKERS PER UNIT	DOUBLE-POLE BREAKERS PER UNIT	WEIGHT (LBS.) PER UNIT	MAX. BTU/HR. PER UNIT
65341	DS-1 Carrier	240				340
6552-TLU	Unduplicated TMS Cabinet	290	2		750	1015
6552-TLD	Duplicated TMS Cabinet	380	2		750	1330
65302	TMS Growth Carrier	200				580
65389	Remote Mod. Interface Carrier	400				1160
65445	Aux. Cabinet (-48 V dc input)	300	1		500	1000
65445	Aux. Cabinet (AC input)	600	1		500	1360
*	AP16 Cabinet (AC input)	1000	1		600	2560
65210	SMDR Cabinet (9-Track) (AC input)	400	1		600	1000

* Check "AT&T-IS Price Element Manual" for PEC.

EQUIPMENT ROOM ENVIRONMENTAL CONSIDERATIONS

Temperature and Humidity

The equipment room environment has a substantial effect on the overall operational availability of any system. System 85 has been designed to operate in a broad range of environmental conditions. But, to minimize downtime the equipment room environment should be kept within the recommended operating range shown below. Not doing so increases the likelihood of equipment failure and causes additional maintenance servicing beyond that anticipated for AT&T maintenance contracts.

Recommended Continuous Operating Range

Temperature: 65°F to 85°F Ambient Room Temperature
Humidity: 20% to 60% Relative Humidity

Short-Term Maximum Operational Limits:

40°F with 15% to 95% relative humidity
120°F with 15% to 34% relative humidity

Recommended continuous operating ambient temperature and relative humidity must be maintained 24 hours a day, 7 days a week. Ambient temperature is determined at a distance of 5 feet (1.5 m) above the floor after the equipment is in operation. Normally an air-conditioning system will be required to keep the equipment room environment within the recommended operating limits throughout the year. The air-conditioning system must be able to remove the maximum amount of heat dissipated by the system.

Mechanical Requirements

Here are some other requirements for the equipment room:

- Width of doorways and stairways must be sufficient to permit the movement of assembled equipment frames or cabinets. Minimum width is 3 feet (0.9 m).
- Floors must be level within 1/8 of an inch (3 mm) over 8 linear feet (2.7 m) and be free of excessive vibration.
- Cover the equipment room floor with tile, linoleum, or sealer (paint) to provide a durable, dust-free surface. Carpet may be used but should be antistatic or treated with antistatic chemicals.
- Walls and ceiling are to be sealed, dust-free, and of a suitable light color to aid illumination. Turpentine must not be used for thinning paint or for any other purpose in equipment areas.
- Illuminate the equipment and attendant areas uniformly. Lighting fixtures must be above the maximum height of equipment and associated cabling. And, provide 30 foot-candles 3 feet (0.9 m) above the floor for the equipment area. The light switch which controls lighting for the equipment area must be readily accessible.
- Fire protection sprinkler heads, if installed in the equipment area, shall be arranged to operate at 212°F or higher temperature.

- Water and drain pipes within the equipment area must be fitted with drip pans.
- When a standby power plant with wet storage batteries is installed, the environmental requirements may become more stringent. Additional ventilation may also be required in accordance with national, state, and local codes.
- Equipment area floor strength must be sufficient to carry the equipment loads as indicated.

Miscellaneous Requirements

The following are miscellaneous requirements for System 85:

- The equipment area must be free of excessive electromagnetic radiation emanating from such sources as radar transmitters, radio communications equipment, X-ray devices, nonsynchronous motors, etc. The System 85 radio frequency immunity is:

FREQUENCY RANGE	MAXIMUM INTENSITY
100 kHz to 40 MHz	7 Volts per Meter
40 MHz to 200 MHz	5 Volts per Meter

- Copying machines must not be in the switching equipment area. The area allocated to system equipment is dedicated for this purpose only. It is not to be used for storage of materials or for work operations that could damage or interfere with the operation of digital electronic equipment.
- Secured storage for equipment shall be provided before and during installation.
- During installation, the following shall be performed:
    a. Air conditioning/heating for equipment room.
    b. Access into work area (equipment and storage)
    c. Toilet facilities for installation personnel.
- It is the customer's responsibility to provide and maintain portable fire extinguishers per National Fire Protection Association (N.F.P.A), Volume No. 10.

INSTALLING SYSTEM 85 AT CONSTRUCTION SITES

When customer premise communication systems, such as System 85, are installed on construction sites or when construction activities take place near customer-owned or leased switching equipment, there is considerable risk of contaminating the equipment. This can cause damage to the equipment, resulting in service cut delays and additional cost to the contractors and the customer. Table 10-F specifies some of the more common contamination hazards found on construction sites.

Ideally, customer premise switching equipment should not be installed until all construction activities are completed. In cases where this is unsatisfactory to the customer, equipment installation may begin when:

1. The equipment room itself is complete with a properly filtered, dry air supply.
2. Construction activities in the immediate surroundings (the areas adjacent to equipment room entrances) are complete. In the event that changes in or near the equipment room must be made, it is essential that the equipment already in place be adequately protected.

If the equipment room might be subject to contamination, the following steps should be taken to protect the equipment.

1. *Plastic enclosure*: A temporary enclosure surrounding the equipment should be built. Any sawing or other particle-producing activity related to this should be done outside the equipment room. Further, if it is at all possible for water to enter the equipment room through the roof or ceiling, a waterproof covering over the top should be provided. Water can, and frequently does, travel horizontally on the underside of a ceiling to fall on equipment not directly under the point of entry. The covering must be placed with proper regard for how the water is to run off.

   When airborne contamination is possible, such as in the presence of welding smoke (or any other activity that produces a visible haze in the air), the enclosure must be completely sealed (with waterproof tape if necessary). This arrangement will prevent airborne particles from entering the enclosure.

   If the equipment will be operating, then the enclosure should be pressurized with filtered dry air. The air supply should meet the requirements for equipment cooling detailed in this manual. It is highly recommended that if water contamination is possible, the equipment should be turned off to prevent the possibility of electrolytic corrosion.

2. *Clean up*: The equipment room and the exterior of the temporary enclosure should be thoroughly cleaned before it is removed. A vacuum cleaner and brushes should be used. The vacuum cleaner should be of a type that removes particles from its airstream by both impaction and filtration. This is to prevent contamination from reentering the air. If any contaminants have entered the equipment, especially water, consult the service organization.

TABLE 10-F. Contamination Hazards

<table>
<tr><th>CONTAMINANTS</th><th>ACTIVITY</th><th>DANGER TO EQUIPMENT</th></tr>
<tr><td>Concrete dust</td><td>Concrete grinding</td><td rowspan="5">Dust and fibers can penetrate connectors causing:
• Accelerated wear due to its abrasive nature
• Open circuits (sometimes intermittent) due to nonconducting properties.</td></tr>
<tr><td>Plaster dust</td><td>Dry wall and ceiling tile installation</td></tr>
<tr><td>Fiberglass</td><td>Insulation for walls and ducts</td></tr>
<tr><td>Organic and mineral fibers</td><td>Insulation, carpet installation, and ceiling tile installation</td></tr>
<tr><td>Rock wool</td><td>Insulation</td></tr>
<tr><td>Metal particles</td><td>Duct work, welding, torch cutting, and metal work such as filing, drilling, and grinding</td><td>Particles are abrasive and conducting, and can bridge conductors to cause shorts. Iron and steel particles are attracted to magnetic fields and high-voltage areas. Welding is especially hazardous because welding smoke condenses into large numbers of small metal spheres which can form long filaments when magnetized.</td></tr>
<tr><td rowspan="2">Water</td><td>Leaks through roof and broken pipes</td><td>Water entering equipment usually contains sufficient ionic compounds to cause damage by electrolytic corrosion. Turning off power will halt the process until cleanup can be done. Building wiring can also be affected by electrolytic corrosion.</td></tr>
<tr><td>Flooding of surrounding area</td><td>Dust in equipment, in the presence of high humidity caused by local flooding, can attract water in the air and combine with it to form electrolytic solutions.</td></tr>
<tr><td rowspan="4">Chemicals and petroleum products</td><td>De-icing and concrete curing</td><td>De-icing and concrete curing compounds can act with water to form electrolytic solutions. See comments about water.</td></tr>
<tr><td>Concrete finishing</td><td>Concrete finishing is typically done with acids that can corrode equipment and building wiring.</td></tr>
<tr><td>Combustion</td><td>Combustion products can be corrosive to equipment and connectors.</td></tr>
<tr><td>Fuel storage</td><td>Fuel near equipment can leave deposits on connectors and relays. These deposits will in time oxidize, forming a nonconductive coating causing intermittent problems. Also, fuel deposits attract dust.</td></tr>
<tr><td>Oil base paints</td><td>Painting</td><td>Vapors may cause damage to plastic and wiring systems.</td></tr>
</table>

EQUIPMENT DESIGNATIONS, TERMINATION FIELDS, AND REFERENCE POINTS

Cabinet Designation and Numbering

The System 85 cabinets fall into three categories: (a) system cabinets, (b) network cabinets, and (c) special function cabinets.

System Cabinets

System cabinets are defined as TMS and duplicated common control cabinets. These cabinets are assigned to module 99 and are designated as TM9901, TM9902, and CC9900.

Network Cabinets

Network cabinets are cabinets which may be equipped with port carriers, i.e., nonduplicated common control, module control, and port cabinets. The general format for designating a system or a network cabinet is:

2-letter cabinet code
2-digit module number
2-digit cabinet number.

For example, PP0102 refers to a port cabinet with power (PP), in the second module (01), and is the third cabinet (02) in the second module. (The code 00 refers to the first module or cabinet.)

Special Function Cabinets

Special function cabinets are Auxiliary, Applications Processor, and SMDR cabinets which are identified by their cabinet code and a 2-digit number beginning with 00 and incremented sequentially by one. For example: AUX00 refers to the first Auxiliary cabinet.

Figure 10-14 provides details on all cabinet designations and numbering.

Termination Fields and Reference Point Designations

Release 2 of System 85 may require multiple termination field reference points. This is necessary in order to calculate accurate cabinet to termination field cable lengths. The termination fields may be located on more than one wall or frame and may vary in configuration.

Termination fields provide access points to cross-connect trunk facilities and external terminal equipment to System 85 interfaces. For detailed information on termination fields, refer to Section 3, SYSTEM HARDWARE, under SYSTEM INTERCONNECTIONS.

SYSTEM CABINET NUMBERING		
	DUPLICATED COMMON CONTROL	DUPLICATED COMMON CONTROL
	TM9901 TM9902	CC9900 TM9901 TM9902

NETWORK CABINET NUMBERING		
	DUPLICATED COMMON CONTROL	DUPLICATED COMMON CONTROL
FIRST MODULE:	CC0000 MC0001 PP0002 PT0003	MC0000 PT0001 PP0002 PT0003
SECOND MODULE:	MC0100 PT0101 PP0102 PT0103	MC0100 PT0101 PP0102 PT0103
MODULE nn:	MCnn00 PTnn01 PPnn02 PTnn03	MCnn00 PTnn01 PPnn02 PTnn03

SPECIAL FUNCTION CABINET NUMBERING	
AUXILIARY CABINETS:	AUX00, AUX01, etc.
APPLICATION PROCESSOR/ ADJUNCT (w/DCIU connection):	APA00, APA01, etc.
APPLICATION PROCESSOR/ TERMINAL (w/o DCIU connection):	APT00, APT01, etc.
9-TRACK SMDR:	SMT00

* If system is configured for –48V standby power,
all port cabinets are designated "PT".

LEGEND:
CC = Common Control Cabinet
MC = Module Control Cabinet
PP* = Port Cabinet with Power
PT* = Port Cabinet without Power
TM = TMS Cabinet
nn = Module 02 thru 30

Figure 10-14. Cabinet Numbering

DUCT WORK AND CABLE RUNS

Duct Work

Cables are run through two type of ducts: unshielded and shielded. In addition, cables may be run on ladder rack if the standard system unshielded duct work does not provide the required routing for a particular application.

Shielded (Flat Cable) Duct

The shielded duct provides a pathway which is physically enclosed for intercabinet cabling. This duct is predominantly used to route flat ribbon cables and other intercabinet cables which require external shielding for electromagnetic compliance. This duct is also used to route cables requiring intercabinet cabling such as the fiber-optic cables between the TMS and module control. The shielded duct is often referred to as the flat cable duct.

The shielded duct runs along the top rear of the System 85 cabinets and has vertical extension referred to as risers or chimneys which allow internal access to the cabinet through the top. Shielded duct segments are also available to provide cross-aisle connectivity between rows of cabinets.

Unshielded (I/O) Ducts

The unshielded duct provides an open trough for external cabinet-to-cabinet and cabinet-to-termination field cabling. This duct is predominantly used to route 25-pair shielded I/O cable between the cabinets and the termination fields. It is also used for routing fiber-optic cables between cabinets and the Lightguide Communications Interface Terminal (LCIT) for remote modules (an access hole in the shielded duct chimney allows the fiber-optic cable to exit through the top of the cabinet and enter the unshielded duct). The unshielded duct runs along the top front of the cabinets behind a front facia which also is mounted at the top front of the cabinets for aesthetics. Unshielded duct segments are also available to provide cross-aisle connectivity between rows of cabinets and also to provide a cable route from the side or rear of a cabinet to a wall with nominal 43-inch (1.1-m) spacing. The unshielded duct is more commonly referred to as the I/O duct.

Power Duct

The power duct provides an ac wire raceway and required ac receptacles for cabinet ac power and/or utility outlets. The power duct runs along the top rear of the cabinets and is physically mounted to the shielded duct.

Duct Work Price Element Code (PEC) Descriptions

Duct work must be specified for the System 85 to provide the power ducts, I/O (unshielded) ducts, and flat cable (shielded) ducts required for the system interconnections and power connections. The particular equipment room layout and types of cabinets will dictate the quantity and type of duct work required. The following describes the PECs available for the various packages of duct work.

- PEC 65379 orders the duct work per cabinet and includes the power duct, I/O duct, flat cable duct (shielded), and facia required per cabinet. The appropriate attribute specifies the required power duct for the type of cabinet it is to be mounted on.
- PEC 65380 orders the appropriate duct work required per lineup. It includes all end caps and facia required.
- PEC 65381 orders the duct work to extend the AT&T System 85 I/O cable duct to the wall. This duct is 12 inches (305 mm) wide by 10 inches (254 mm) high. It will provide for a nominal 43-inch (1.1-m) distance from the cabinet to the wall. The appropriate attribute specifies whether the duct will extend from the rear of the cabinet to the wall.

- PEC 65382 orders an adapter to allow a 12-inch (305-mm) wide ladder rack to interface to the I/O cable duct. The appropriate attribute specifies whether the interface to the ladder rack is to the left, right, or rear of the cabinet lineup. This interface allows one end of the ladder rack to be physically mounted to the I/O duct on the cabinet.
- PEC 65383 orders the cross-aisle flat cable (shielded) duct. One is required for each flat cable cross-aisle segment.
- PEC 65384 orders the cross-aisle I/O duct. One is required for each I/O cable cross-aisle segment.

Cable Runs

The term "cable run" is intended to mean a particular run of cable, a group of cables, or certain classification of cables run through cable duct or on the ladder rack.

The following are the various types of cable runs:

- Flat ribbon and coaxial cable runs are those runs that are restricted in an electrical sense and must be routed between cabinets through the enclosed or shielded duct and kept separate from I/O cables.
- Flat ribbon cables connect the port carrier and module control carriers and must be routed between module control and port cabinets through the enclosed or shielded duct and kept separate from I/O cables.
- Coaxial cables connect the common control to the module control, TMS, and RMI carriers. These cables are run between the respective cabinets through the enclosed or shielded duct.
- Fiber-optic cables run between the module control cabinets and colocated TMS cabinet. This type of cable run is routed through the shielded ducts.
- For remote module systems, fiber-optic cables run between the TMS cabinet(s) and LCIT and between the module control cabinets and LCIT (if it contains RMI packs) at the central locale via the I/O duct. Also, at remote locales, fiber-optic cables run between the module control cabinet(s) and LCIT via the I/O duct.
- The 25-pair line, trunk, and miscellaneous I/O cable runs are those cables (usually 25-pair) which run in the unshielded I/O duct between cabinets or to the termination field on the I/O duct between cabinets or to the termination field on the I/O duct and/or ladder rack.
- The minimum length of I/O cable is presently defined to be 50 feet (15 m) for Release 2. Since these cables are run in open or unshielded ducts, shielded cables are used to minimize electromagnetic radiation. The minimum length of 50 feet is currently required to comply with FCC Part 15 rules for electromagnetic radiation. This minimum length of shielded I/O cable is anticipated to be reduced t approximately 5 feet (1.5 m) at a later date. The 5-foot minimum requires the use of ferrite cores on internal cabinet cables which connect to cables which leave the cabinet via the rear-mounted connectors and are run in the unshielded I/O duct. Unless the system is equipped with the following versions of equipment (or later versions), the 50-foot minimum shielded I/O cable length applies.

Figure 10-15 specifies required intercabinet and cabinet-to-termination field and LCIT cabling. Currently, the manufacturer is accepting equipment room floor plans for multimodule systems to determine required cable lengths. The floor plan must be designated with all required reference points, cable routing, and cable running distance information. Cabling distances for single-module system are specified via "Y600" type PECs and must be provided with all other hardware and software PECs ordered.

Inter-Cabinet Cabling Via Shielded Duct (Y600-FCC)			
From Reference Point	To Reference Point	Remarks	Cable Type
Common Control Cabinet	Module Control Cabinets	All - Max. 190 ft.	Coax
		1st Module Only – Max 25 ft (Note 1)	Flat
	TMS Cabinets	All - Max. 190 ft.	Coax
Module Control Cabinet	TMS Cabinets	All	Fiber
	TMS/RMI Cabinets	Max. 25 ft. (Note 2)	Flat
	Port Cabinets	Of respective module Only – max. 25 ft.	Flat and Wire

Cabinet to Cabinet Cabling Via I/O Duct (Y600-ICC)			
From Reference Point	To Reference Point	Remarks	Cable Type
Common Control Cabinet	SMDR Cab. or LSU	Max. 200 ft.	2 Pr. Shielded
	Aux Cabinet	DCIU To Lads for AP/A – Max 50 ft.	Data Cable
Module Control Cabinet	Module Control Cabinet	From Module 0 to Module 1, Module 1 to Module 2, etc. Only – for MAAP Daisy Chain	25 Pr. Shielded

Cabinet to Termination Field Cabling Via I/O Duct (Y600-ICW)			
From Reference Point	To Reference Point	Remarks	Cable Type
Common Control Cabinet	Trunk/Aux Field		25 Pr. Shielded
	Line Field (Note 1)	Of 1st Module Only (Note 1)	25 Pr. Shielded
Module Control Cabinet	Trunk/Aux Field		25 Pr. Shielded
	Line Field	Of Respective Module	25 Pr. Shielded
Port Cabinet	Trunk/Aux Field		25 Pr. Shielded
	Line Field	Of Respective Module	25 Pr. Shielded
Aux. Cabinet	Trunk/Aux Field		25 Pr. Shielded

Cabinet to LCIT Cabling Via I/O Duct – Remote Modules (Y600-ICW)			
From Reference Point	To Reference Point	Remarks	Cable Type
TMS Cabinet	LCIT		Fiber
TMS/RMI Cabinet	LCIT		Fiber
Module Control Cabinet	LCIT	Module Control W/RMI Packs Only at Central Locale; All at Remote Locale	Fiber

Notes: 1 – Applies to systems with unduplicated common control only.
2 – Applies to central locale with RMI Carriers; I/O Bus cables are required between RMI carriers and an associated module control.

Figure 10-15. Cabling Specifications

Equipment Room Layout

This part provides information on physical equipment and cabling requirements for equipment room layouts. Refer to **AT&T System 85—Equipment Room Floor Plans and Specifications Planning Manual** (555-102-603) for a more thorough discussion on layout and planning parameters.

Cabinet Dimensions and Required Ceiling Heights

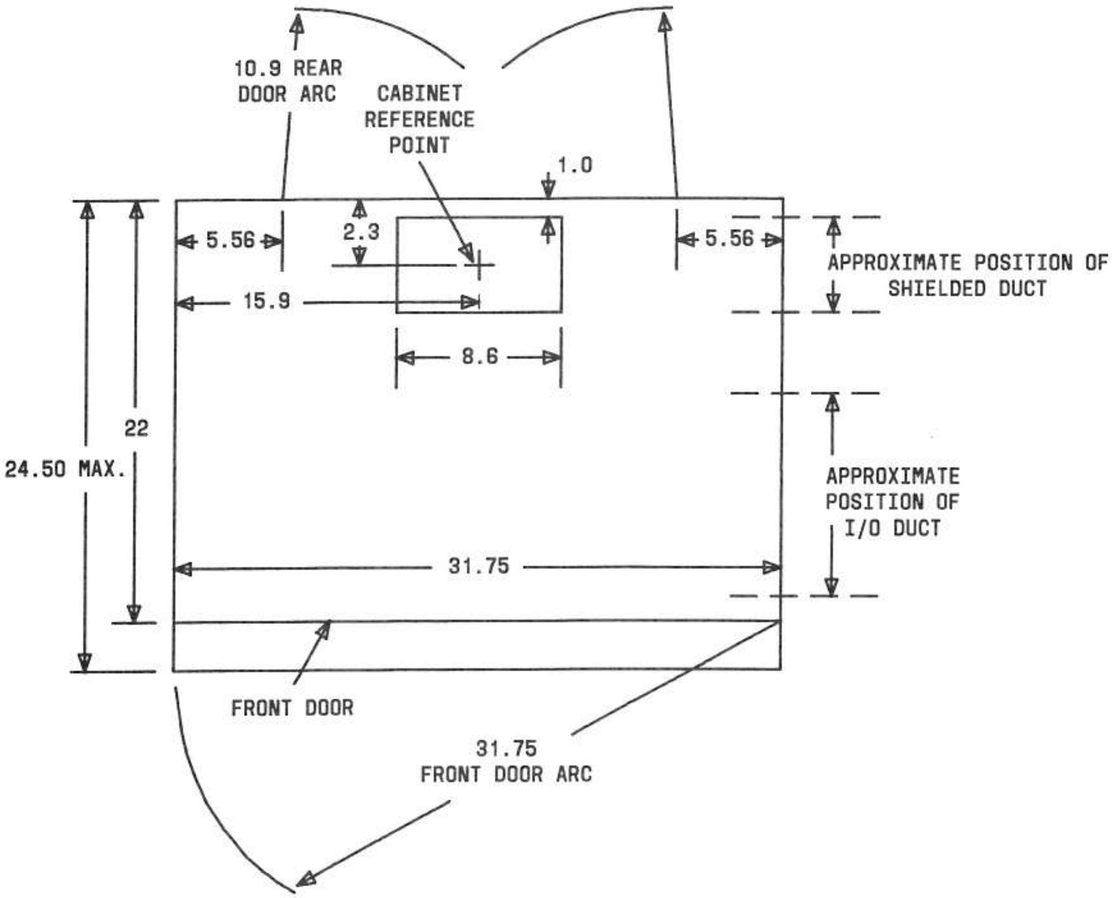
An equipment cabinet is nominally 32.75 inches (832 mm) wide, 24.5 inches (622 mm) deep (rear plane to face of front door), and 70 inches (1778 mm) high (without duct work and with leveling feet extended). Figure 10-16 shows the top view of cabinet outline dimensions including door arcs and cabling reference point.

The preferred equipment room ceiling height is 9 feet (2.7 m). Systems configured in a single row using standard I/O duct work to a wall require a ceiling height of 8.5 feet (2.6 m) [provides 11 inches (280 mm) clearance from top of duct to ceiling]. A minimum ceiling height of 8 feet (2.4 m) may be used but will allow only 5 inches (127 mm) of clearance between the top of the I/O duct segment to the wall and the ceiling. With an 8.5-foot (2.6-m) ceiling height or less, ladder rack is recommended in lieu of an I/O duct to the wall. The bottom of the ladder rack must be 82 inches (2.1 m) from the floor to allow adequate head clearance.

Systems configured in multiple rows using cross-aisle I/O ducts and I/O duct segments to a wall also require a ceiling height of 8.5 feet (2.6 m) to provide an 11-inch (280-mm) clearance from the top of the I/O duct to the ceiling. With ceiling heights less than 8.5 feet, ladder rack should be used in lieu of I/O ducts to walls and/or cross-aisle I/O duct. The bottom of the ladder rack must be 82 inches (2.1 m) from the floor to allow adequate head clearance.

Ceiling height requirements for termination field configurations which are wall- or frame-mounted and associated cable runs must also be considered.

Figure 10-17 illustrates cabinet and duct work heights.



NOTE: ALL DIMENSIONS IN INCHES

Figure 10-16. Top View of Cabinet Dimensions

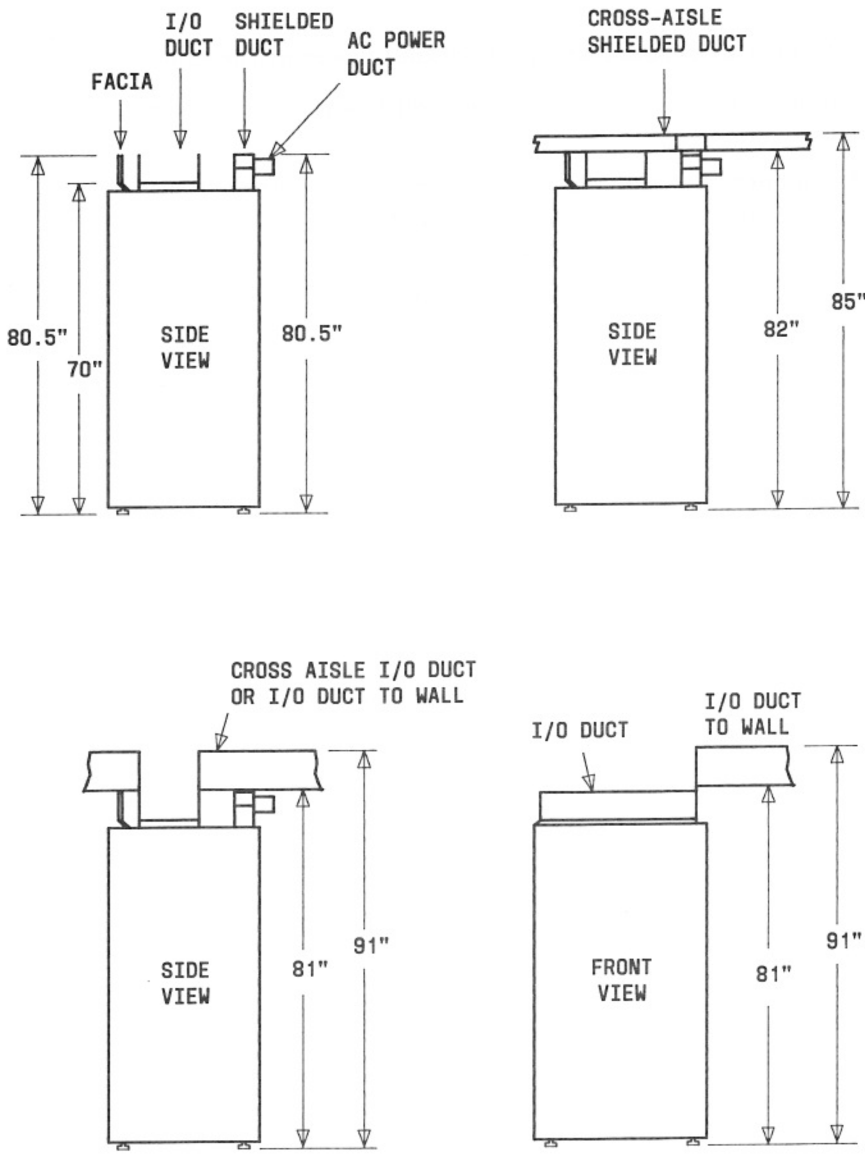


Figure 10-17. Cabinet and Duct Work Heights

Equipment Layout Constraints

Cabinet Pairing and Distance Limits:

- In an ac-powered system, cabinet pairs that share the same rectifier must be located side by side. Cabinet pairs that share power are:
    1. Unduplicated common control and module control of the first module
    2. Module control and port without power of the same module
    3. Port with power and port without power of the same module.
- Port cabinets must be within 25 cable feet (7.6 m) of their module control cabinet via the shielded duct.
- A TMS cabinet with a Remote Module Interface Carrier must be within 25 cable feet of an associated Module Control Cabinet via the shielded duct (for I/O Bus connection from Module Control Carrier).
- Duplicated TMS cabinets must be adjacent to each other.
- All module control and TMS cabinets must be within 190 cable feet (58 m) of the common control cabinet via the shielded duct (except for Remote Modules).
- An auxiliary cabinet containing Local Area Data Sets (LADS) for DCIU to AP connectivity must be within 40 feet (12 m) of the common control cabinet (and also within 40 feet of the AP) via the I/O duct.

Cabinet Lineup Constraints:

- Duct work requires that no holes be left in an equipment row; i.e., duct work cannot span an empty space with cabinets on each side.
- Cabinet orientation must be consistent; i.e., the fronts of all cabinets will face toward the same wall in single and multiple row configurations.
- A distance of 38 inches (965 mm) is required between rows, as measured from the front door of one row to the back of the next row.
- A distance of 43 inches (1.1 m) is required from the cabinet row (rear or side) to the wall if I/O duct work to the wall is used. If required, a ladder rack can be provided in various lengths (where duct work is not used because the cabinets are further that 43 inches from the wall).

    Note: The height of the bottom of the I/O duct segment to the wall is 82 inches (2.1 m) from the floor and will not clear the top of wall mounted 900-pair 100P-type columns.

- A space of 3/8 inch (10 mm) should be maintained between cabinets within a cabinet lineup.
- Cross-aisle ducts should run in a straight line in order to minimize cable congestion and length.
- Shielded (flat) cross-aisle ducts should be mounted across module control cabinets, thereby minimizing cable congestion.
- The I/O cross-aisle ducts should run near the center of the cabinet row in order to reduce cable congestion.
- Cross-aisle I/O and shielded ducts cannot both be placed on the same cabinet.

Figures 10-18 and 10-19 illustrate the required lineup constraints for single-module and multimodule systems, respectively.

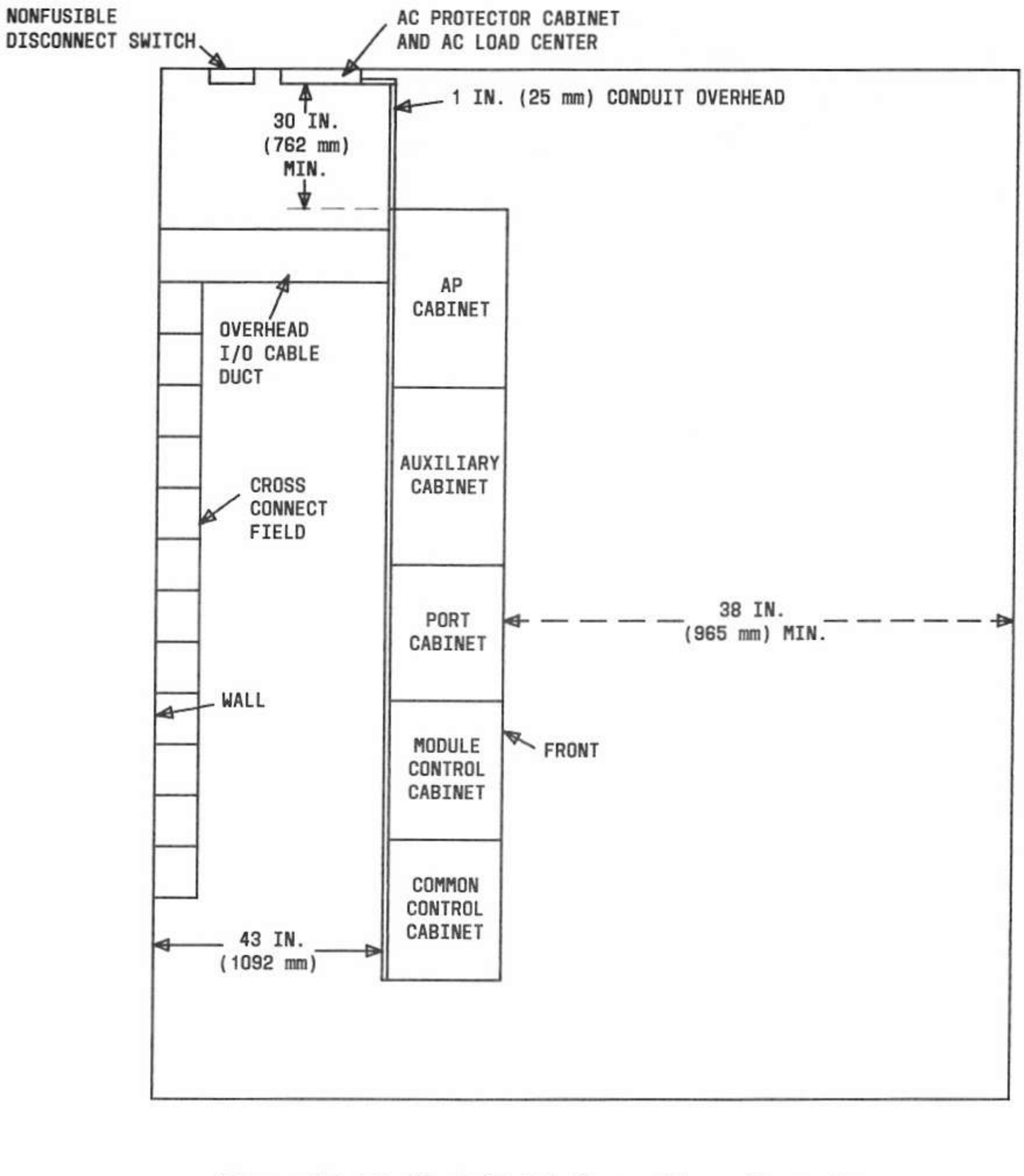


Figure 10-18. Single-Module System Lineup Constraints

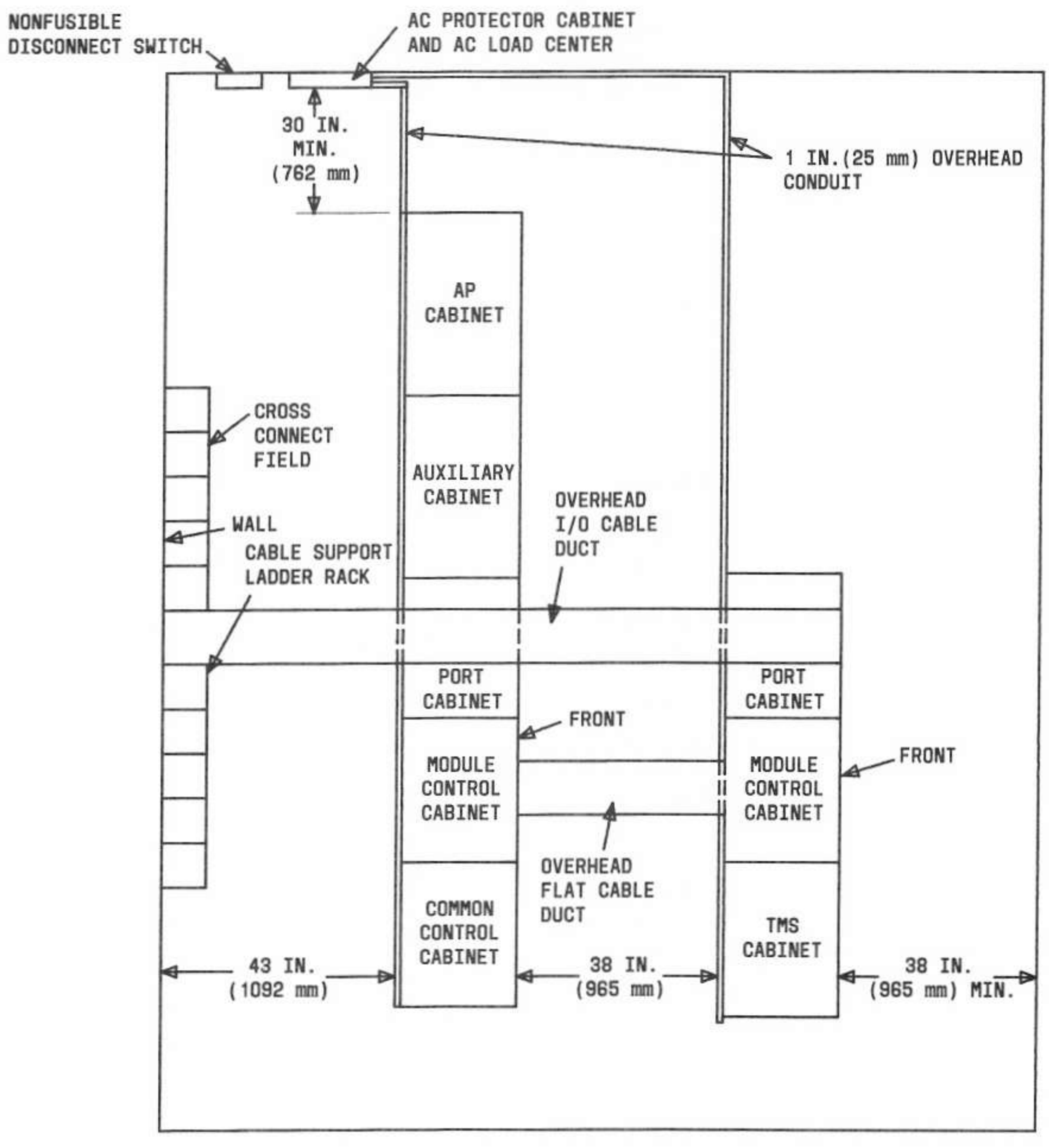


Figure 10-19. Multimodule System Lineup Constraints

11. SYSTEM POWER

The equipment contained in System 85 switch cabinets runs off of -48 V dc power. On a systemwide basis, power is supplied to switch cabinets in one of two ways (but not both):

1. AC power is brought into the cabinet where it is converted to -48 V dc. AC power is either 3-phase 208 V ac or single-phase 240 V ac.
2. -48 V dc is brought into the cabinet from an outside dc power source. This method is called -48 V dc Standby Power (sometimes referred to as -48 V dc input power).

The rest of this section explains the power and grounding requirements for both of these powering methods. AC input power and grounding is discussed first.

AC POWER AND GROUNDING

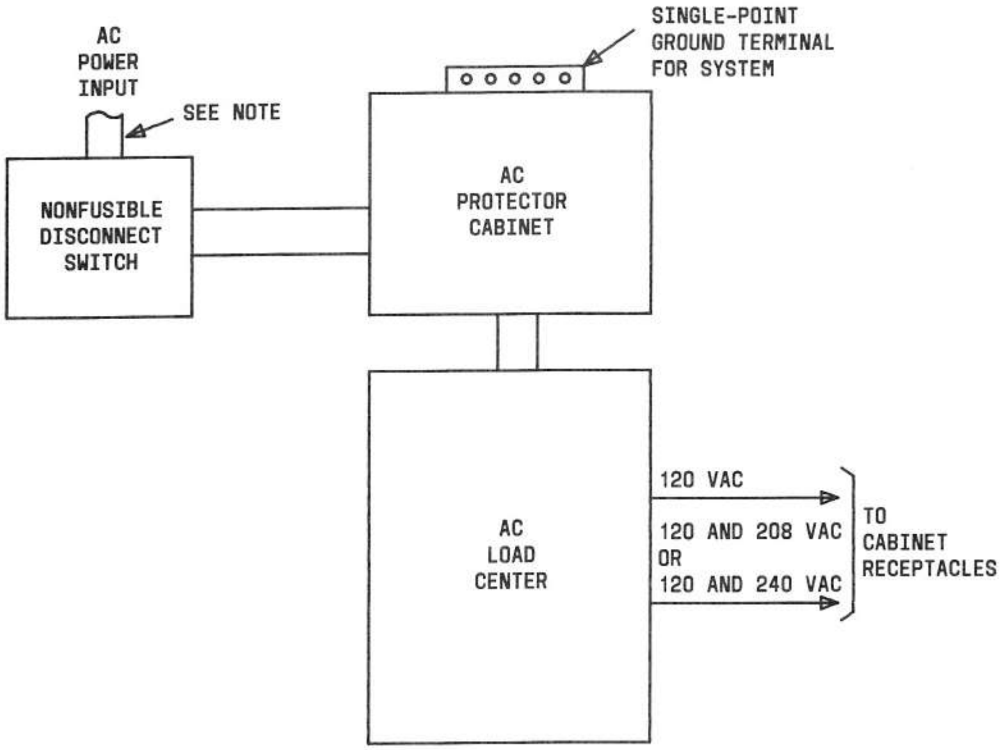
The system ac power distribution shown in Figure 11-1 consists of:

- A main disconnect or safety switch
- An ac protector cabinet
- An ac load distribution center.

The customer or agent must make arrangements with an electrical contractor for the purchase and installation of this equipment and its associated wiring, with the exception of the ac protector cabinet. The ac protector cabinet will be supplied by AT&T as part of the system order; however, this cabinet must be installed by the electrical contractor along with the main disconnect switch and ac load center by the negotiated equipment-room-ready date.

After the System 85 equipment has been physically installed, the customer or agent must also arrange for the electrical contractor to wire and install the individual feeder circuits from the ac load center to the system cabinet and equipment receptacles.

Standby power to a Release 2, System 85 may be arranged with essential service (engine/alternator) or with chargers, battery plants, and inverters which supply standby ac power. In these arrangements, the ac power and grounding requirements as listed in this section apply to the System 85.



NOTE: AC INPUT MUST BE 3-PH 120 AND 208V, 4-WIRE GROUNDED WYE OR SINGLE-PHASE 120 AND 240V, 3-WIRE 60 HZ FROM A DEDICATED MAIN BRANCH FEEDER.

Figure 11-1. AC Power Distribution

AC Power Requirements

Dedicated Main Branch Feeder Configuration

The customer or agent must provide a dedicated main branch feeder protected and supplied according to local codes. A dedicated main branch feeder is defined as one which has a single load (i.e., System 85) connected to a power source. No other equipment shall be connected to this branch. This provides isolation from electrically noisy or heavy variable loads (motors, elevators, etc.) which could have an adverse impact on System 85 operation.

One of two types of ac power configurations must be used as the dedicated main branch feeder for System 85:

Type 1

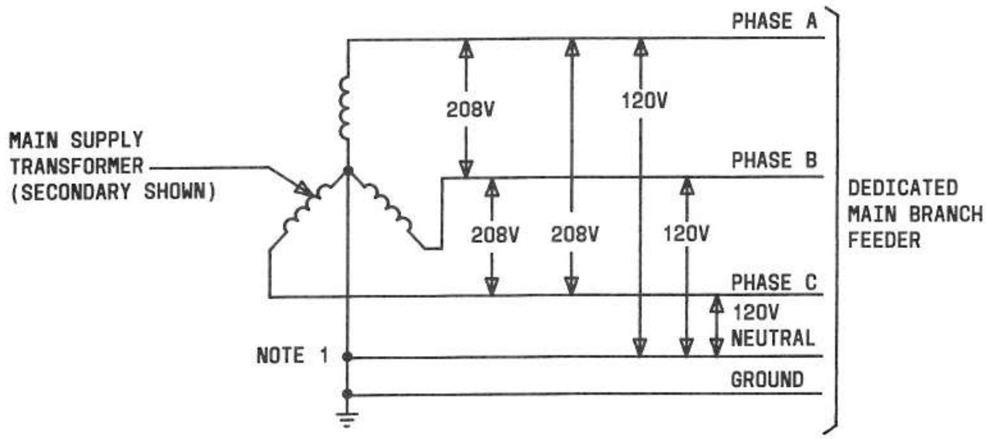
3-phase grounded wye
4 wire (plus safety ground)
120/208 V ac RMS, ± 10% @ 60 Hz (± 3 Hz)
or -15% @ 60 Hz (± 0.3 Hz)

This configuration (see Figure 11-2 top) is provided by a 3-phase transformer with a wye secondary. The 120 V ac is measured between the wye center tap (neutral) and each of the three "hot" legs (Phase A, Phase B, and Phase C). The 208 V ac is measured between any two of the three "hot" legs.

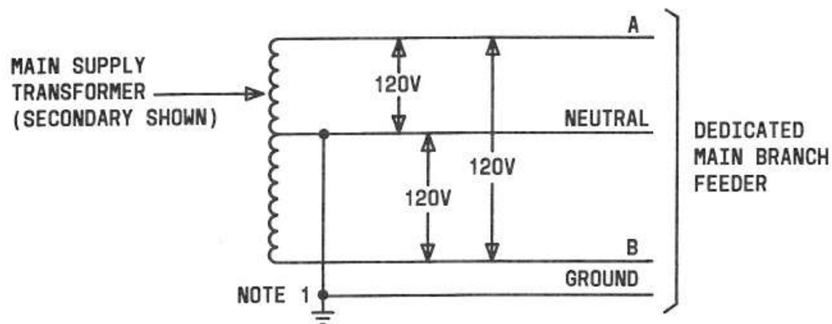
Type 2

Single-phase
3 wire (plus safety ground)
120/240 V ac RMS, ± 10% @ 60 Hz (± 3 Hz)
or -15% @ 60 Hz (± 0.3 Hz)

This configuration (see Figure 11-2 bottom) is provided by a center tapped transformer secondary. The 120 V ac is measured between the center tap (neutral) and either of the two outer "hot" legs (A and B). The 240 V ac is measured between the two outer "hot" legs.



TYPE 1:
3-PHASE, 4-WIRE (PLUS GROUND), GROUNDED WYE, 120/208 VAC RMS, 60 HZ



TYPE 2:
SINGLE PHASE, 3-WIRE (PLUS GROUND), 120/240 VAC RMS, 60 HZ

Note:
1. Grounding to be provided according to local codes.

Figure 11-2. AC Power Configurations

Dedicated Main Branch Feeder Sizing

The main branch feeder current capacity required for the system is determined by totaling the -48 V dc power wattage that is calculated for the system considering growth and converting it to ac power using a 0.8 factor for system rectifier efficiency. The ac current per phase is obtained by dividing the total system ac by a factor for the type power configuration used.

Type 1

3-phase, 4-wire, grounded wye, 120/208 V ac RMS, 60 Hz configuration:

Total System AC Power = (Total System -48 V DC Power)/0.8

I (AC Amperes) = (Total System AC Power)/359.84

I = The AC Current per Phase (A, B, and C) in Amperes

Type 2

Single-phase, 3-wire, 120/208 V ac RMS, 60 Hz configuration:

Total System AC Power = (Total System -48 V dc Power)/0.8

I (AC Amperes) = (Total System AC Power)/240.00

I = The AC Current per Leg (A and B) in Amperes

Nonfusible Main Disconnect or Safety Switch

This unit is to be supplied and installed according to local codes and practices by the customer or agent as part of the AC power service to the system. The nonfusible disconnect switch provides the means to remove all power from the system. For safety reasons, it is physically located in the equipment room to allow easy access and viewing by personnel in the room.

A unit rated at 200 or 400 amperes per phase or one rated to match the main feeder current capacity is recommended. The size should be determined according to local codes and practices.

Typical 3-pole nonfusible disconnect switches rated at 200 and 400 amperes per phase are listed below:

TYPE	RATING (PER PHASE)	POWER ARRANGEMENT
JU-324 ITE Gould	200 AMPs	3-Phase, 60 Hz, 120/208 V ac
JU-325 ITE Gould	400 AMPs	3-Phase, 60 Hz, 120/208 V ac
GU-324 Westinghouse	200 AMPs	3-Phase, 60 Hz, 120/208 V ac
GU-325 Westinghouse	400 AMPs	3-Phase, 60 Hz, 120/208 V ac
TGN-3324 General Electric	200 AMPs	3-Phase, 60 Hz, 120/208 V ac
TGN-3325 General Electric	400 AMPs	3-Phase, 60 Hz, 120/208 V ac
DU-324 Square D	200 AMPs	3-Phase, 60 Hz, 120/208 V ac
DU-325 Square D	400 AMPs	3-Phase, 60 Hz, 120/208 V ac

These units or their functional equivalent at the current rating required may be used.

Figure 11-3 shows the main disconnect switch connection to the ac protector cabinet for a 3-phase power configuration, and Figure 11-4 shows a single-phase power configuration.

If 2-pole disconnect switches are not available for single-phase, 60-Hz, 120/240-V ac power arrangements, the above listed 3-pole disconnect switches can be used if power is applied to Phase A and Phase B. Phase C will not have a connection.

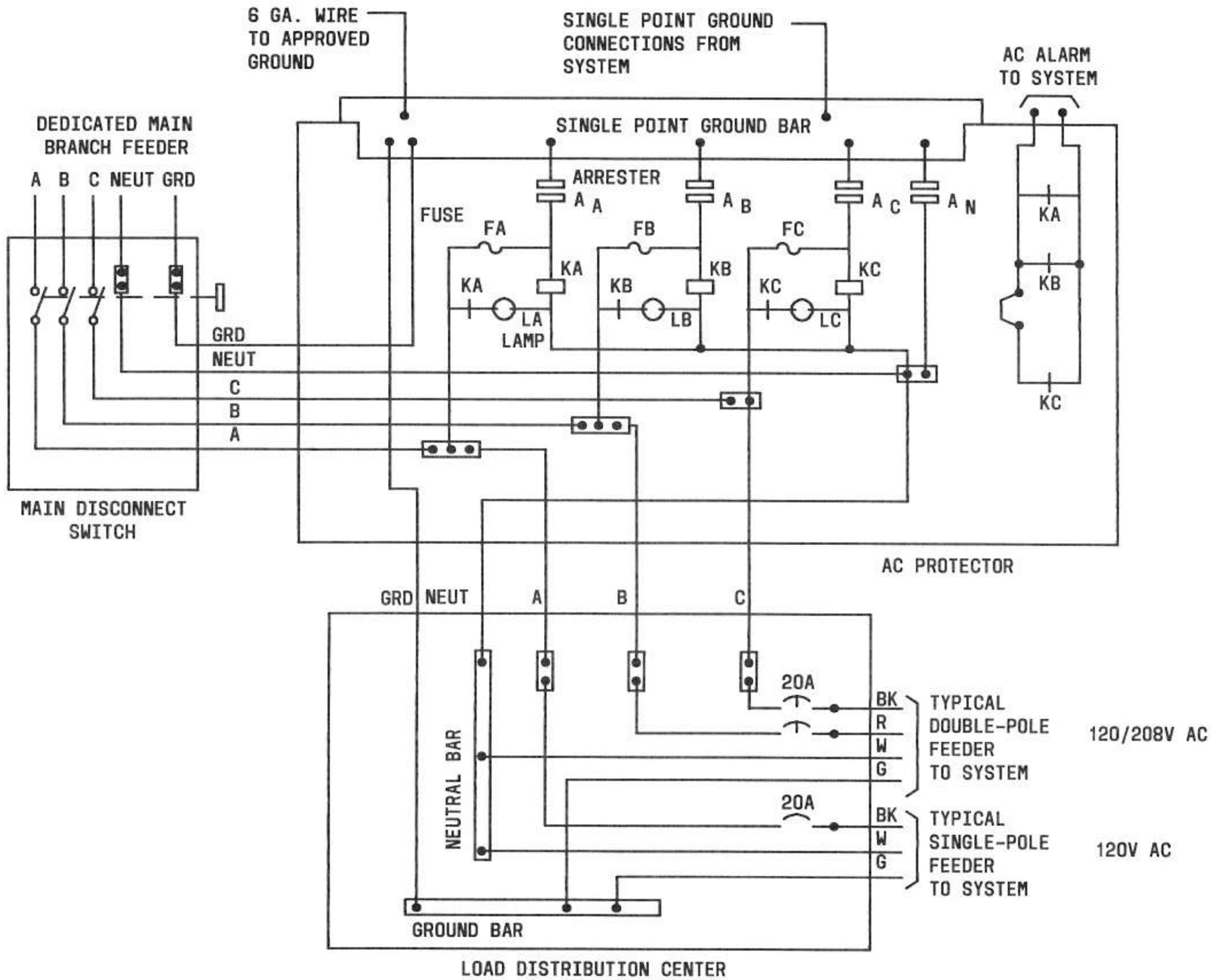


Figure 11-3. 3-Phase 120/208-V AC Power Distribution

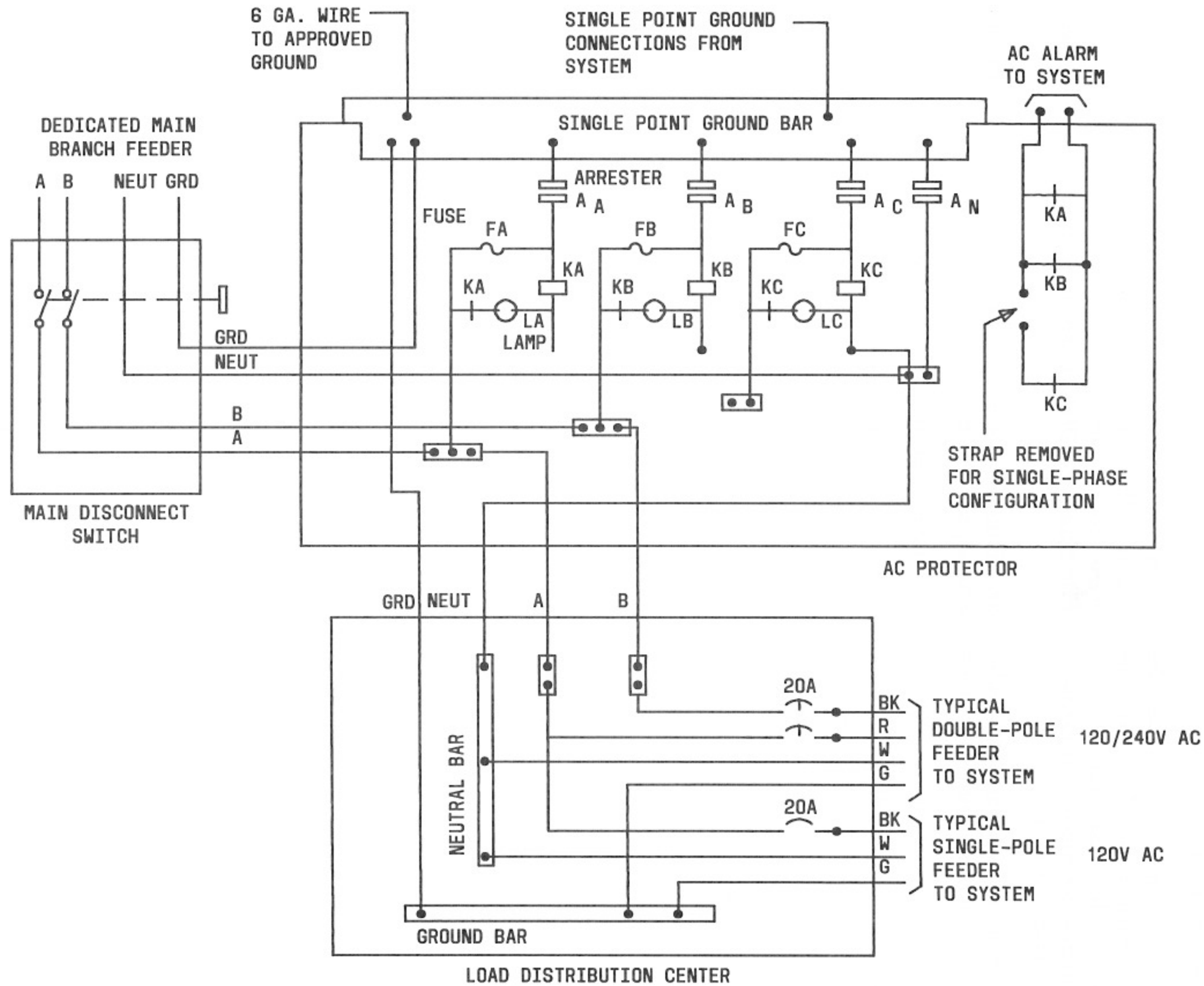


Figure 11-4. Single-Phase 120/240-V AC Power Distribution

AC Protector Cabinet

The ac protector cabinet is supplied by AT&T as part of the system order. This cabinet is to be installed according to local codes and practices by the customer or agent as part of the ac power service to the system.

The ac protector cabinet is manufactured by Joslyn Manufacturing and Supply Company to AT&T specifications. The unit is designed for either 3-phase, 120/208-V ac, 4-wire grounded wye or single-phase, 120/240-V ac, 3-wire, 60-Hz power arrangements. It is rated at 200 amperes per phase and carries UL File Number E7944(s) and part number 1455-75. See Figures 11-3 and 11-4.

The physical dimensions of the cabinet are 20 inches (508 mm) wide, 24 inches (610 mm) high [27 inches (686 mm) high with mounting bars], and 7.5 inches (191 mm) deep.

The ac protector cabinet provides the following equipment and functions:

- Lightning arresters which protect the system from transients and surges caused by lightning, induction, static, etc.
- Fuses, relays, and lamps to provide a visual indication and an alarm signal input to the system that a lightning arrester has failed or that ac power has been lost.
- A single-point ground terminal which serves as the single-point ground for the coupled bonding conductor from outside plant facilities, cabinet power distribution module ground, cabinet power distribution lightning ground, and approved ground reference.

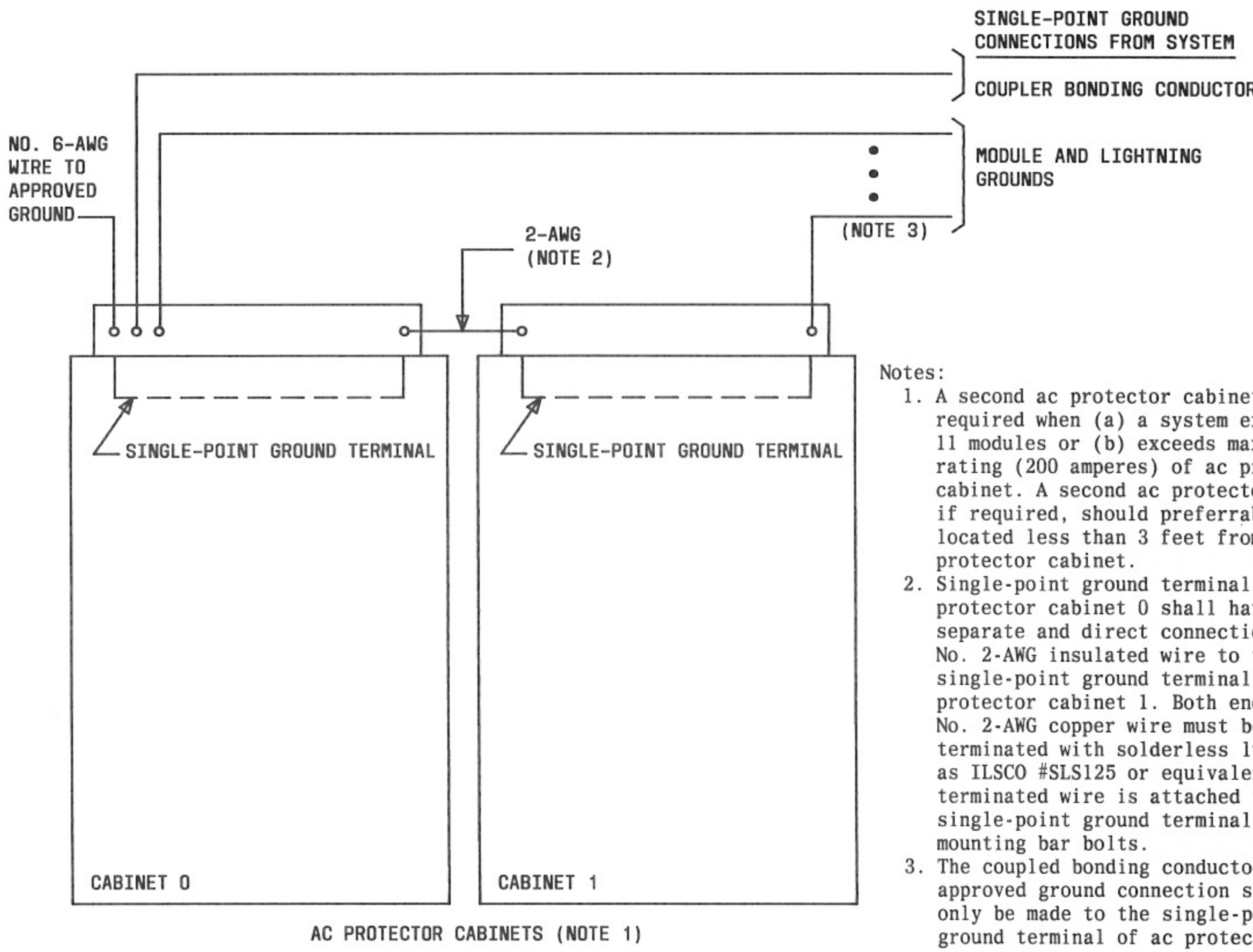
When lightning induced or other power surges occur, the surge passes through a fuse to the lightning arrester which shorts the potential to ground. After the surge passes, the arrester returns to a normal high impedance state. However, if the arrester is overstressed, it may remain short-circuited causing the related fuse to blow to avoid grounding the phase lead so the system will continue to receive power. When the arrester fuse blows, an associated relay operates to provide a visual indication that the arrester has failed and to also send an alarm signal to the system alarm reporting mechanism indicating this condition so that action may be initiated to replace the blown fuse and failed lightning arrester.

Replacement lightning arrestors are: Part #1250-32, manufactured by Joslyn Manufacturing and Supply Company. Replacement fuses are: Bussman FNM 15; 15 A 125 V.

If the system requires more than 200 amperes per phase, a second ac protector cabinet and corresponding ac load center will be required (see Figure 11-5). The system equipment will be distributed between the two ac load centers according to the dedicated main branch feeder arrangement.

If a second ac protector cabinet is required on new installations, it is recommended that a single nonfusible disconnect switch rated at 400 amperes be used and both ac protector cabinets be fed from the single nonfusible disconnect switch. If it is not possible to use a single dedicated main branch feeder, then two dedicated main branch feeders and nonfusible disconnect switches may be used.

If a second ac protector cabinet is required and added to an existing system, a second nonfusible disconnect switch rated at 200 amperes per phase must be installed to provide disconnect capability to the second ac protector cabinet. It is preferable that both nonfusible disconnect switches be powered from the same dedicated main branch feeder. If this is not possible, two separate dedicated main branch feeders may be used.



Notes:

1. A second ac protector cabinet is required when (a) a system exceeds 11 modules or (b) exceeds maximum rating (200 amperes) of ac protector cabinet. A second ac protector cabinet, if required, should preferrably be located less than 3 feet from the first protector cabinet.
2. Single-point ground terminal of ac protector cabinet 0 shall have a separate and direct connection with a No. 2-AWG insulated wire to the single-point ground terminal of ac protector cabinet 1. Both ends of the No. 2-AWG copper wire must be terminated with solderless lugs such as ILSCO #SLS125 or equivalent. The terminated wire is attached to the single-point ground terminal mounting bar bolts.
3. The coupled bonding conductor and approved ground connection shall only be made to the single-point ground terminal of ac protector cabinet 0.

Figure 11-5. Additional AC Protector Cabinet

AC Load Distribution Center

This unit is to be supplied and installed according to local codes and practices by the customer or agent as part of the ac power service to the system. The ac load distribution center receives its main input power from the ac protector cabinet (see Figures 11-3 and 11-4). It houses single-pole and double-pole circuit breakers which provide individual feeder circuits used to power the various system cabinets and equipment.

The ac load distribution center is chosen taking into consideration the size and configuration of the dedicated main branch feeder, the system power requirements, the number of single-pole and double-pole circuit breakers required, future growth requirements, and local codes.

Article 384-15 of the National Electrical Code limits the maximum number of overcurrent devices (spaces) in ac load centers to 42 (other than those provided for the mains). Since a single-pole circuit breaker generally requires one space and a double-pole circuit breaker requires two spaces, the maximum number of single- or double-pole circuit breakers a maximum size ac load center can contain is 42 or 20, respectively. Any combination of the two, as long as the total number of spaces is not exceeded, can be used. It is important to know the maximum number of single- and double-pole circuit breakers the system requires, plus anticipated growth, before the ac load center(s) is selected.

Typical ac load distribution centers for 3-phase, 4-wire, 60-Hz, 120/208-V ac-powered systems are listed below:

TYPE	RATING	BREAKER CAPACITY
ITE Gould GQ424B	200 AMP	24 Single-Pole or 12 Double-Pole
General Electric TL30420	200 AMP	30 Single-Pole or 14 Double-Pole
ITE Gould GQ442B	200 AMP	42 Single-Pole or 20 Double-Pole
General Electric TL42420	200 AMP	42 Single-Pole or 20 Double-Pole

The ac load distribution center chosen should meet the specific requirements of the installation.

The ac load distribution center shall be equipped with the quantities of single-pole and double-pole circuit breakers as required.

Single-pole thermal magnetic breakers must be rated 20 amperes and be capable of handling 130 amperes of inrush current for 1/2 cycle (ITE Gould QP1-Q120H typical or equivalent).

Double-pole thermal magnetic breakers must be rated 20 amperes and be capable of handling 200 amperes of inrush current for 1/2 cycle (ITE Gould QP2-Q220H typical or equivalent).

Feeder Circuits to System Equipment

After the system cabinets have been installed, the customer or agent will provide feeder circuits from the single-pole and double-pole circuit breakers in the ac load distribution center to each of the system receptacles. System 85 equipment cabinets will be supplied with ac power ducts attached to the top rear of the cabinets which form an ac wireway (raceway) on each lineup. These power ducts will be equipped with the required receptacles to which the feeder circuits will be terminated. The customer or agent will be required to provide conduit and all required wiring between the ac load distribution center and the ac power duct wireway and receptacles on each cabinet lineup in a manner complying to local codes and practices. See Figures 11-6 and 11-7.

The type of receptacles provided at specific locations in the power ducts depends on type and placement of system cabinets in the lineup.

Figure 11-8 provides information on the required feeder circuit and corresponding power receptacle supplied for each type of system cabinet. System utility receptacles are also provided in the cabinet power ducts and should be powered by a single utility feeder and associated breaker. The equipment room floor plan layout will show the types and positions of each of the system cabinets along with a unique system cabinet identifier. This identifier (e.g., MC0200, PP0102, or AUX01) will also be found on the front door of most cabinets and should be used as the designation on the associated circuit breaker label in the ac load distribution center.

The floor plan also designates the type and placement of any additional miscellaneous feeders and receptacles required for the system to be provided by the customer or agent. These receptacles will not be provided with the system and are designated as customer provided.

> ***Note:*** If local practices dictate that the receptacles supplied with the power duct attached to the cabinets cannot be used, individual ceiling drop receptacles or floor receptacles can be provided for the system cabinets by the customer or agent according to local codes.

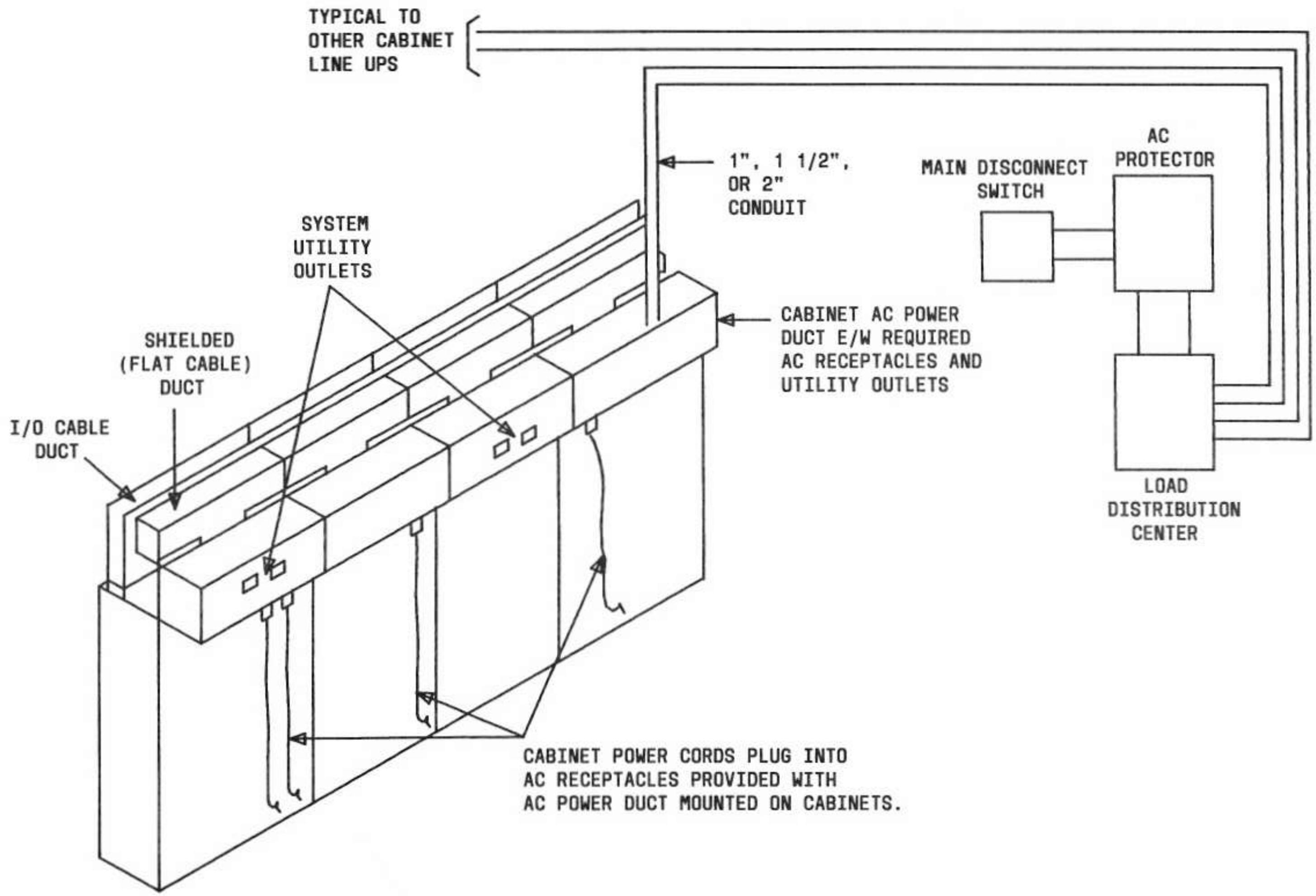


Figure 11-6. System Cabinet AC Power Connectivity

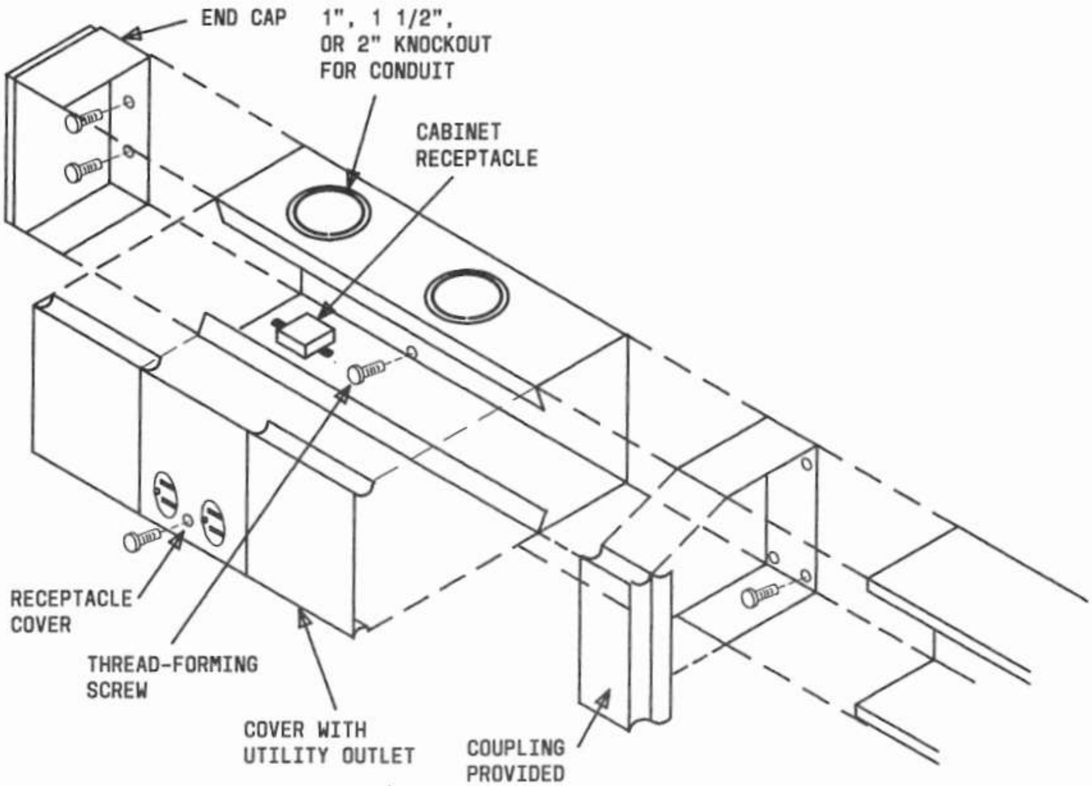


Figure 11-7. Detail of Cabinet AC Power Duct

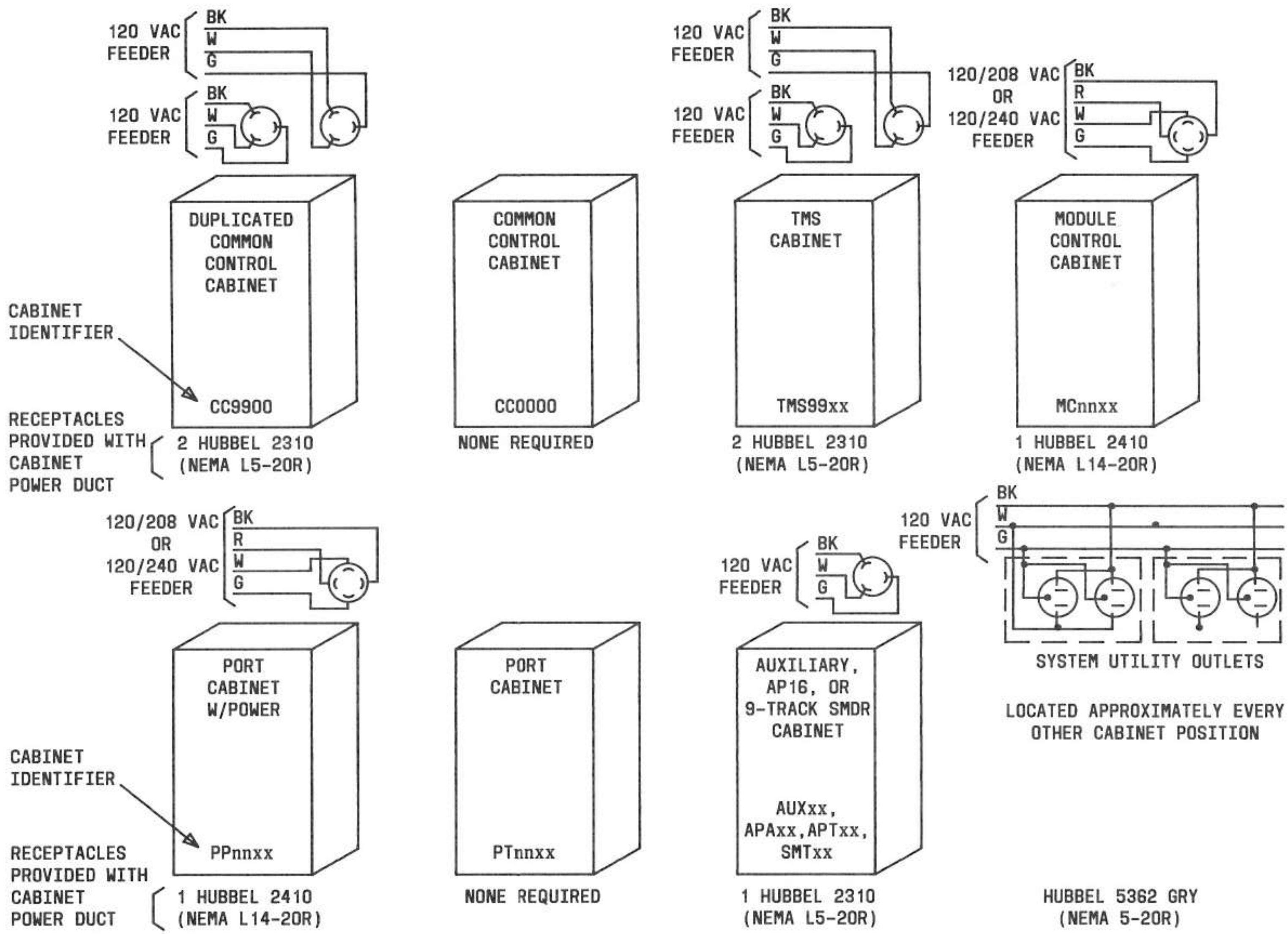


Figure 11-8. System Equipment Feeders and Receptacles With AC Power

System Cabinet and Equipment Feeder Balance

The single-pole and double-pole feeder circuits to system equipment should be balanced as evenly as possible among the three phases of a 3-phase 120/208-V ac configuration or between the two "hot" legs of a single-phase 120/240-V ac configuration.

The system has an option for duplicating certain key components such as the common control processor and the Time-Multiplexed Switch (TMS). When these are duplicated, they are powered by separate power supplies. Two receptacles will therefore be provided for the separate power supplies for a duplicated common control cabinet and for the TMS cabinet. The two feeders to each of these cabinets should be placed on separate phases or "hot" legs for added reliability.

Internal Power Distribution With AC Power Source

Rectifiers are used to supply -48 V dc to cabinets. System 85 switch cabinets use -48 V dc to power cooling fans, alarm panels, mini-recorders, attendant consoles, etc., and to power dc to dc converters which provide low-voltage power to circuit packs. Filtered -48 V dc is also used to provide talk battery for certain types of circuit pack port interfaces. A laminated bus bar within each cabinet is used to distribute -48 V power to carriers and other cabinet equipment.

Power Distribution With AC Power Source

In ac-powered systems, certain cabinet pairs can share an ac distribution unit and a -48 V dc rectifier if they are physically adjacent to each other and are associated with the same module. The pairs are:

- Module Control Cabinet and Unduplicated Common Control Cabinet
- Module Control Cabinet and Port Cabinet (without power)
- Port Cabinet (with power) and Port Cabinet (without power).

The cabinet without the rectifier is equipped with a dc filter for its internal power. Number 4 AWG wire is used to interconnect -48 V, filtered -48 V (talk battery), and circuit ground between the cabinet pairs. These power connections are run between cabinets in a small power duct located near the bottom rear of the cabinets.

The duplicated common control cabinet and TMS cabinet use rectifiers for internal use only and cannot share power with an adjacent cabinet. Since the duplicated common control cabinet must provide fully independent power for each common control carrier and related equipment, it is always equipped with two rectifiers which are fed by separate ac sources. When the TMS cabinet is equipped with one or two unduplicated carriers, it is supplied with one rectifier fed by an ac power source; when equipped with three or four unduplicated carriers, it is supplied with two rectifiers fed by separate ac power sources. The TMS cabinet is also supplied with two rectifiers, fed by separate ac power sources, when it is equipped with any number of duplicated carriers; this provides independent power sources for the on-line and off-line carriers.

Figure 11-9 illustrates the basic cabinet power arrangement for ac-powered systems and Figures 11-10, 11-11, and 11-12 provide detailed arrangements for each cabinet. These illustrations depict nominal reserve (holdover) and grounding which are the next two topics discussed.

Nominal Holdover

The J87462A Nominal Holdover unit provides battery reserve for all Release 2 System 85 common control cabinets. This unit is optionally available for TMS, Module Control, and Port cabinets.

Nominal Holdover for Common Control

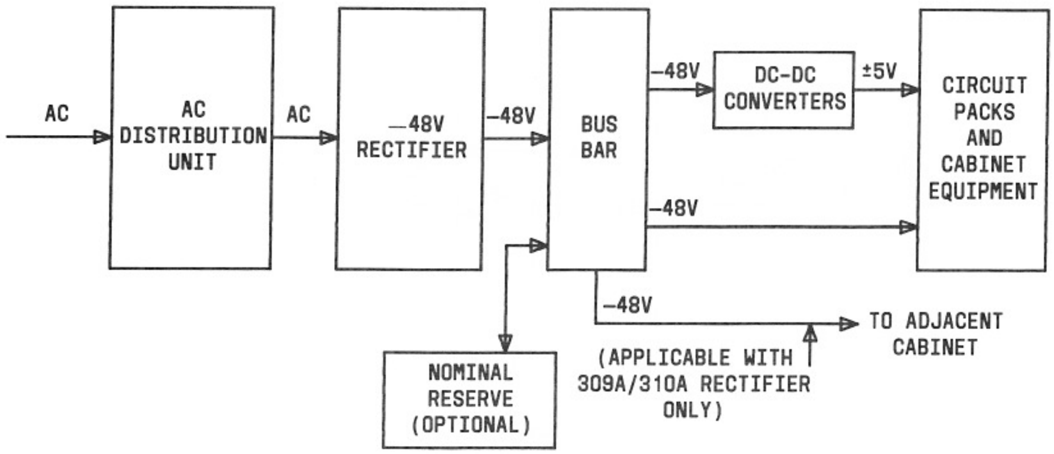
For unduplicated and duplicated ac-powered Common Control cabinets, the J87462A Nominal Holdover unit:

- Is always included.
- Will provide at least 10 minutes holdover power to the common control. Holdover power beyond 10 minutes depends on the number of circuit packs equipped in the common control carrier.
- Prevents the loss of main memory contents during the holdover period. This eliminates the need for tape reloads if ac power is restored within the holdover period.
- Allows common control equipment such as mini-recorders and the alarm panel to operate during the holdover period.
- Requires up to 16 hours to fully recharge after a complete discharge.

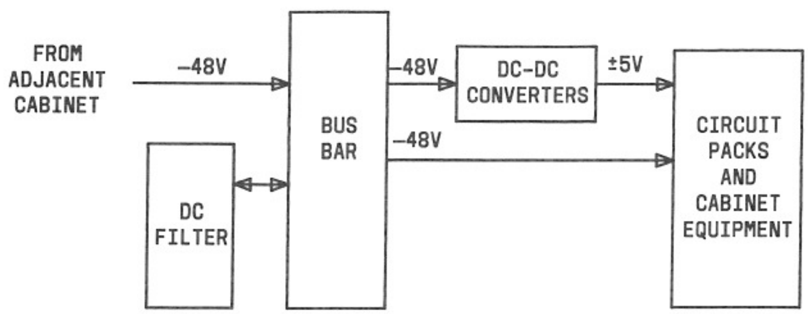
Nominal Holdover for Other Switch Cabinets

For AC powered TMS, Module Control, and Port cabinets equipped with rectifiers, the J87462A Nominal Holdover unit:

- Is optionally available.
- Provides power for the switch network and all switch-powered peripherals.
- Provides 3 to 5 minutes of holdover power depending on the type and quantity of circuit packs in the cabinets and the amount of traffic present during the holdover period.
- Requires up to 16 hours to fully recharge after a complete discharge.



CABINET WITH RECTIFIER



CABINET WITHOUT RECTIFIER

Figure 11-9. Typical Cabinet Power Arrangements for AC-Powered System

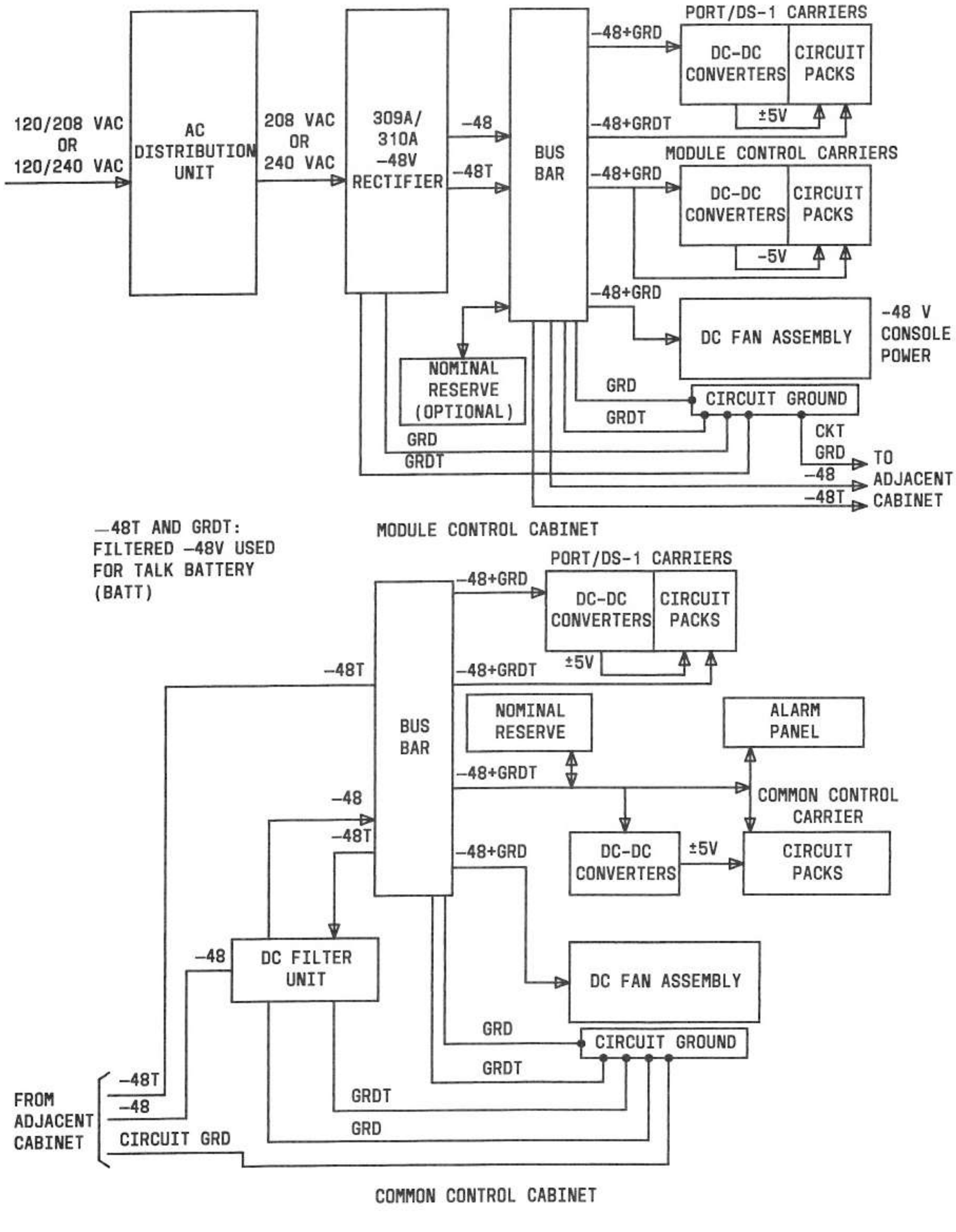


Figure 11-10. Module Control and Common Control Power (AC-Powered System)

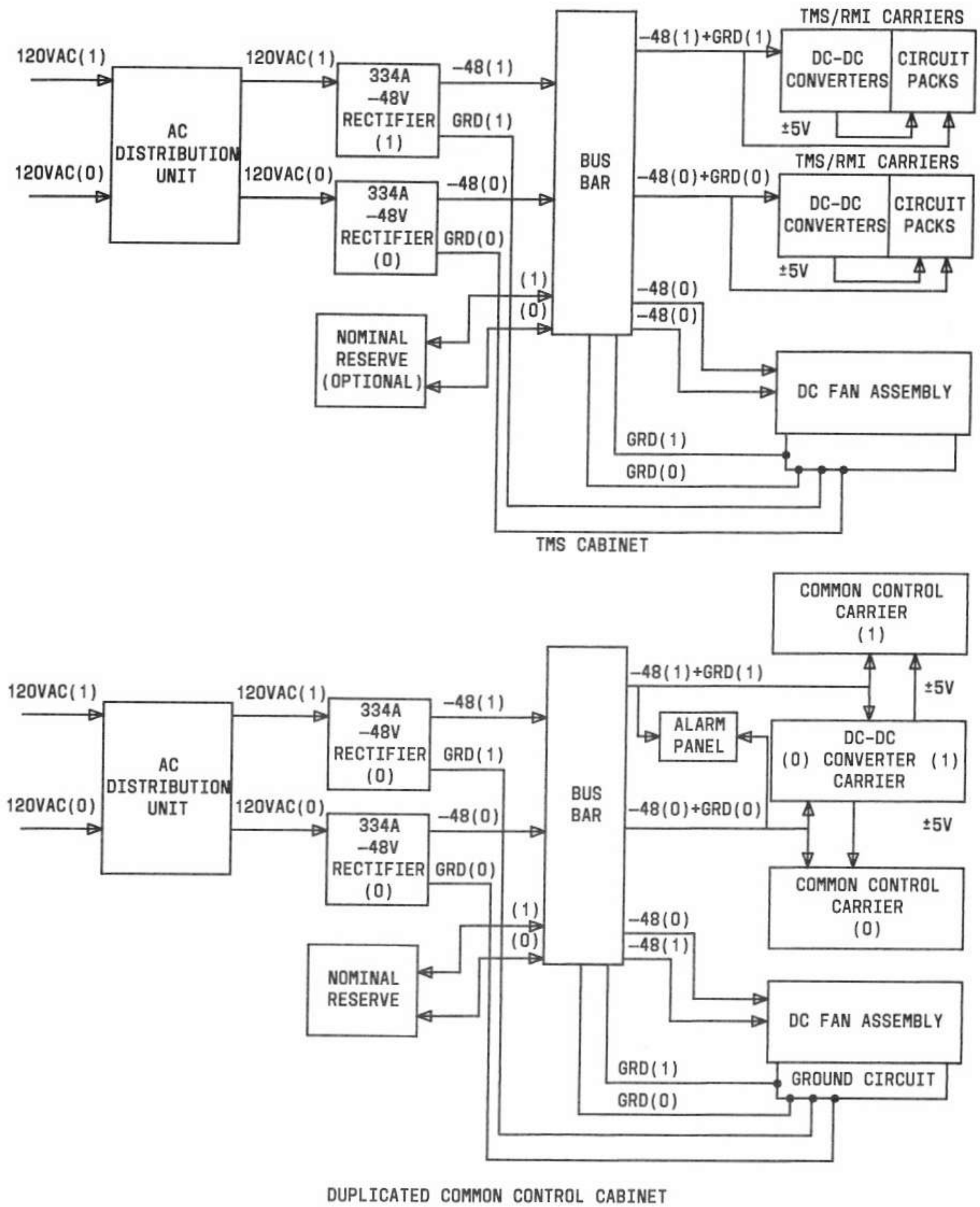


Figure 11-11. TMS and Duplicated Common Control Cabinet Power (AC-Powered System)

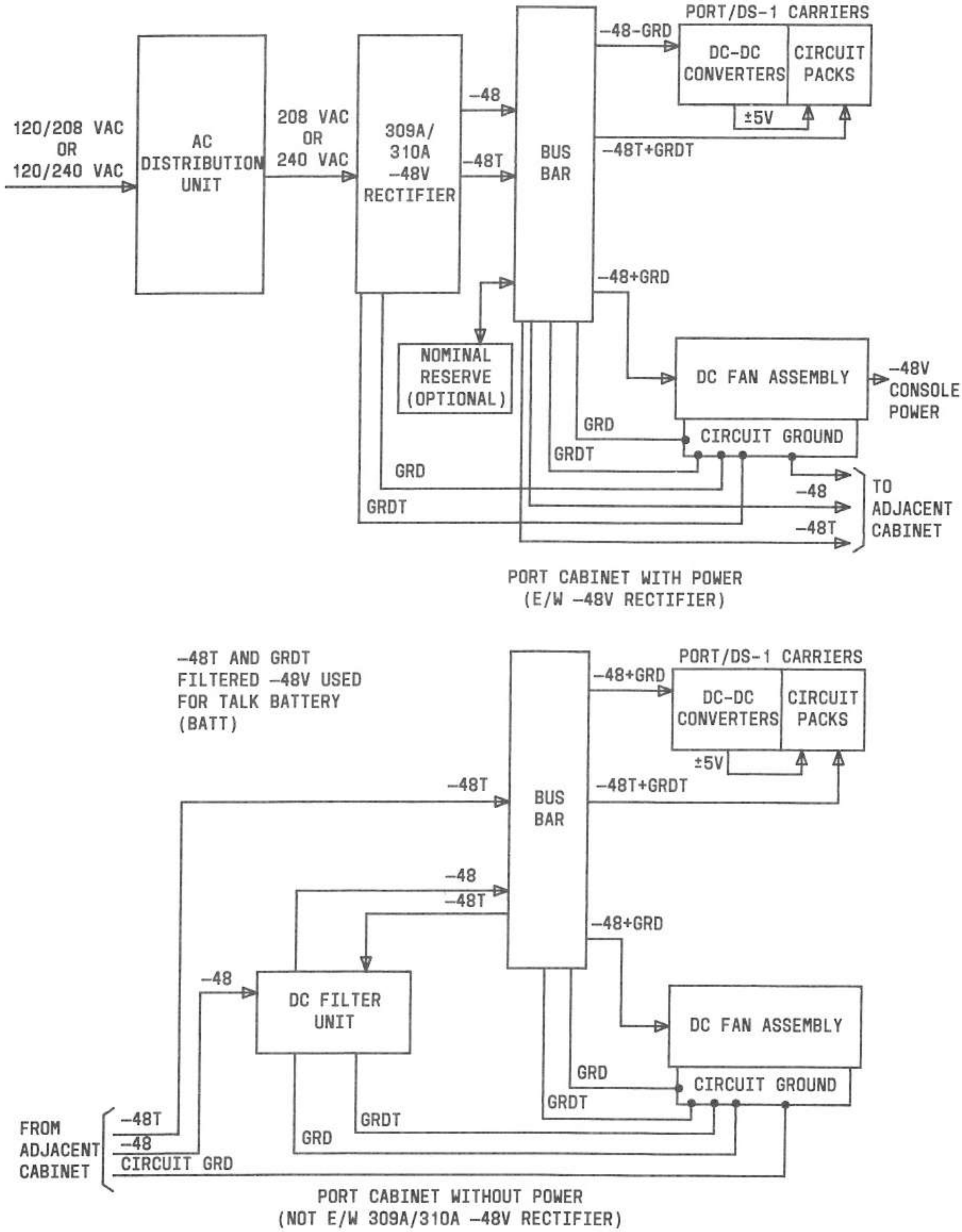


Figure 11-12. Port Cabinet Power (AC-Powered System)

System Grounding With AC Power

Figure 11-13 illustrates the System 85 grounding scheme. All connections to the single-point ground terminal on the ac protector cabinet from the system equipment will be installed by the System 85 installation personnel. A 6-AWG wire ground connection from this single-point ground terminal to a customer-provided "Approved Ground" will be installed by the System 85 installation personnel, the customer, or agent as required.

The grounding scheme provides:

- Protection from danger of electric shock
- Protection of equipment from damage in the event of a power fault to ground
- Low impedance path for static and surges
- A common circuit ground reference to alleviate different ground potentials which could adversely impact system operation.

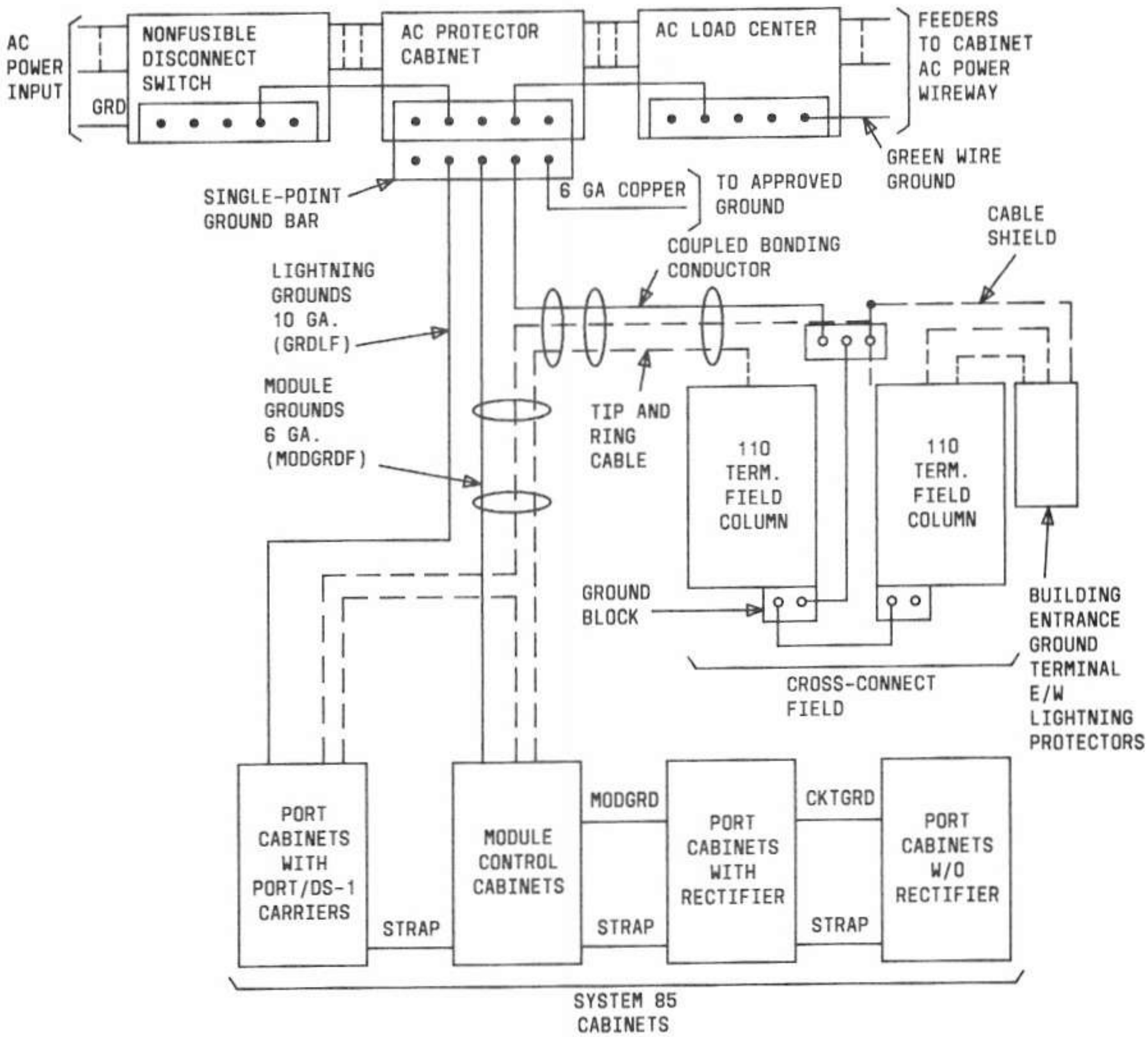


Figure 11-13. Grounding Arrangement for AC-Powered System

An "approved ground" is an acceptable grounding medium as specified in Section 250-81 of the National Electric Code (NEC). An approved ground may consist of any of the following:

- Grounded Building Steel—The metal frame of the building where effectively grounded, such as with bonded joints.
- Acceptable Water Pipe—A metal pipe, not less than 1/2 inch (13 mm) in diameter, electrically connected to a metal underground water pipe that is in direct contact with the earth for 10 feet (3 m) or more. This must be electrically continuous (or made electrically continuous by bonding around insulated joints, plastic pipe, or plastic water meters) to a point where the protector ground is connected.
- Concrete-Encased Ground—An electrode encased by at least 2 inches (51 mm) of concrete and located within and near the bottom of a concrete foundation or footing in direct contact with earth. This must consist of at least 20 feet (6.1 m) of one or more steel reinforcing bars or rods of not less than 1/2 inch (13 mm) diameter, or at least 2 feet (610 mm) of bare solid copper wire not smaller than No. 4 AWG.
- Ground Ring—A ground ring that encircles a building or structure in direct contact with the earth at a depth of at least 2-1/2 feet (762 mm) below the earth's surface. This must consist of at least 20 feet (6.1 m) of bare copper conductor not smaller than No. 2 AWG.

An approved floor ground in a high-rise building suitable for connections to the ground terminal in the riser closet and to a system single-point ground may be any of the following:

- Grounded building steel
- Acceptable water pipe
- Power feed metallic conduit supplying panel boards on the floor
- The grounding conductor for the secondary side of the power transformer feeding the floor
- A grounding point specifically provided in the building for this purpose.

System Ground Leads

The following leads are used to effectively ground System 85. These leads are required in conjunction with the approved and single-point grounds discussed above and will be installed by System 85 installation personnel (except for green wire grounds in ac feeders).

Coupled Bonding Conductor

The coupled bonding conductor provides a connection between the system single-point ground and the protector ground terminal for cable facilities at the building entrance. It is run adjacent to protected pairs in an associated cable. The mutual coupling between the bonding conductor and the pairs reduces the difference in electrical potential in terminating equipment which may result from lightning surges. This conductor can consist of the following:

- When pairs are run in shielded cable, the cable shield shall be used as the coupled bonding conductor. Shield continuity must be verified using a T-124, manufactured by Wilcor Grounding Systems, or equivalent.
- With inside wiring cable, the coupled bonding conductor shall consist of a number 10 AWG wire that is tie-wrapped to the cable. If this is impractical, six dedicated, good spare pairs within the cable may be used as the coupled bonding conductor. The six spare pairs must be twisted and soldered to prevent their use for other purposes.

A suitable connecting point (coupled bonding conductor terminal block) should be provided for the connection to the system single-point ground.

Equipment Grounding Conductor (Green Wire)

The AC power equipment must be grounded by an equipment grounding conductor (green wire) in compliance with NEC, Article 250-32 (1981 Edition). This ground serves as the green wire ground for the System 85 in accordance with NEC, Articles 250-42 and 250-45 and is distributed to cabinets equipped with rectifiers via the ac feeder circuits.

Lightning Ground (GRDLF)

Each cabinet containing a port or DS-1 carrier requires a lightning ground connection to route lightning surges away from circuit components. A lightning ground (GRDL) is chain-wired to each cabinet within a module. The lightning ground is wired from one of the cabinets to the system single-point ground terminal via GRDLF. Each module must have a separate lightning ground connection (GRDLF) to the system single-point ground.

Module Ground (MODGRDF)

Each cabinet equipped with a rectifier requires a circuit ground connection to the system single-point ground to ensure proper system operation. A circuit ground (MODGRD) is chain-wired to each rectifier-equipped cabinet within each module and to any adjacent system cabinets such as the duplicated common control or TMS. The circuit ground is wired from one of the cabinets to the system single-point ground terminal via MODGRDT. Each module must have a separate circuit ground connection (MODGRDF) to the system single-point ground.

Internal Grounding Arrangement With AC Power Source

Internal grounding arrangements provide equipment protection from lightning surges, insure proper system operation, and insure safety.

There are four basic types of intracabinet and intercabinet grounds used in ac-powered systems. They are:

- Module Ground (Circuit Ground)
- Lightning Ground
- Green Wire Ground
- Cabinet Bonding Ground.

These grounds are kept totally isolated from each other in the system cabinets and are individually routed to the System Single-Point Ground at the AC Protector Cabinet where they are interconnected. In addition to these, a digital ground (GRDD) which is tied to circuit ground is distributed to port or DS-1 carriers within a cabinet to insure a low impedance path for digital signals.

Module Ground

Each switch cabinet is equipped with a circuit ground block located on the dc fan assembly. The circuit ground block is connected to the power distribution grounds of the cabinet bus bar. A number 6 AWG wire is used to interconnect the circuit ground block of each Port Cabinet equipped with a rectifier to the circuit ground block of its associated Module Control Cabinet. The circuit ground block of duplicated common control and TMS cabinets are connected via a number 6 AWG wire to the circuit ground block of the closest module control cabinet. A number 6 AWG wire is run from the circuit ground block of each module control cabinet to the system single-point ground via an Electro-Magnetic Compliance (EMC) filter located in the cabinet.

Each of these module ground connections to the system single-point ground is designated MODGRDF (see Figure 11-14).

Digital Ground

Digital ground connections (GRDD) represent four or more equally spaced number 14 AWG wire straps used to electrically interconnect adjoining or sequential carriers within a cabinet to insure a low impedance path for digital signals. The digital grounds are connected to the circuit ground block on the dc fan assembly (see Figure 11-14).

Lightning Ground

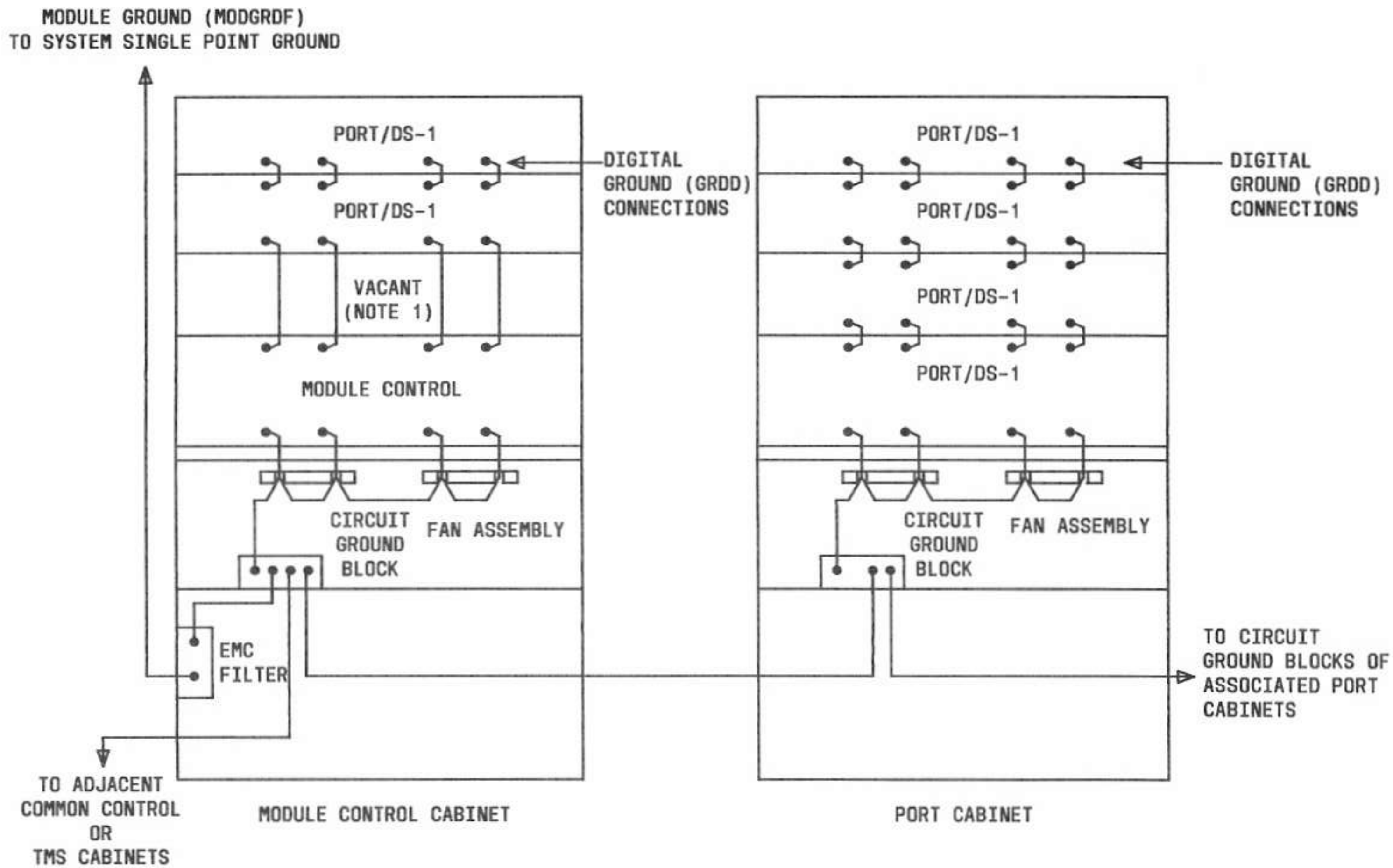
Each cabinet equipped with port or DS-1 carriers has number 10 AWG wire straps chained to each port or DS-1 carrier from a terminal strip located in the cabinet. These connections are used to route lightning surges away from circuit components. A number 10 AWG wire is chain-wired from the lightning ground terminal strip of one cabinet in a module to each other cabinet associated with the module in that row. This cabinet will have a number 10 AWG wire run from its lightning ground terminal strip to the System Single-Point Ground via an Electro-Magnetic Compliance (EMC) filter located in the cabinet. The cabinet equipped with this EMC filter will either be an unduplicated common control cabinet or Port Cabinet. If one or more port cabinets are located cross-aisle from their associated module control cabinet, one of the port cabinets must also be equipped with an EMC filter and have a lightning ground connection to the system single-point ground. The lightning ground terminal strip of the cabinet with the EMC filter and lightning ground connection is chain-wired to any other port cabinets in the row associated with its module. Each of the lightning ground connections from the modules to the system single-point ground is designated GRDLF (see Figure 11-15).

Green Wire Ground

Each cabinet equipped with a rectifier will have a green wire ground from the ac feeder(s) which is electrically connected to the cabinet frame. The green wire ground of the ac feeder(s) is connected to the system single-point ground by the ac distribution arrangement.

Cabinet Bonding Ground

A braided strap approximately 5 inches long is used to bond adjacent cabinet frames together within a lineup (excluding Auxiliary, AP16, 3B5 AP, and 9-track SMDR cabinets). The bonding strap is fastened to the lower rear cover mounting screws. This bonding is used to reduce Electro-Magnetic Interference (EMI) radiation and susceptibility. The Auxiliary, AP16, 3B5 AP, and 9-track SMDR cabinets use the green wire ground of their ac feeders exclusively for their grounding arrangement and no other grounds or bonds are connected to them. Their ac feeders originate from the ac distribution source for the switch cabinets.



NOTE:
1. DIGITAL GROUND CONNECTIONS SPAN VACANT CARRIER POSITIONS EQUIPPED WITH NO-CARRIER ADAPTER

Figure 11-14. Typical Arrangement for Module Ground and Digital Ground in AC-Powered System

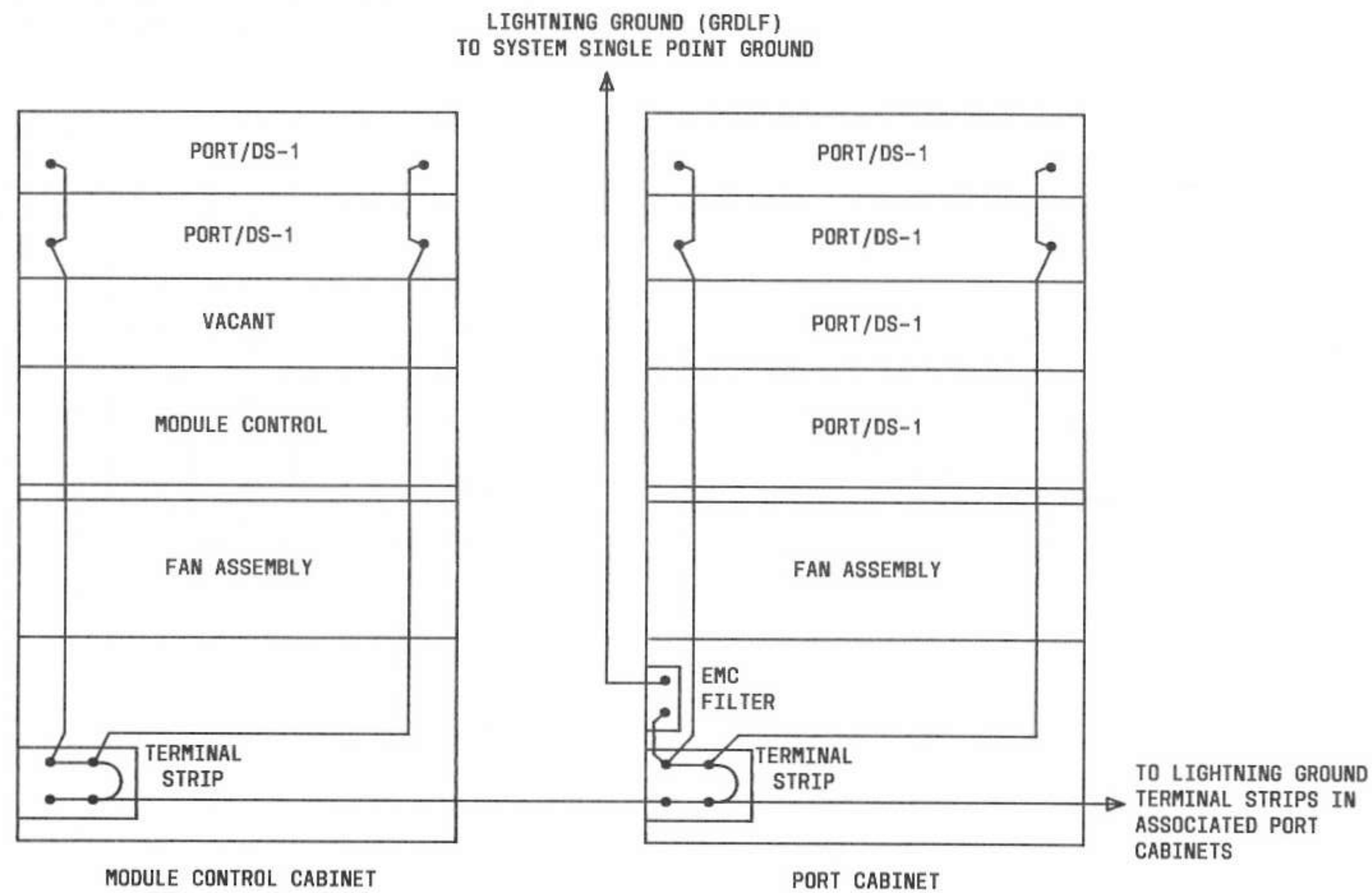


Figure 11-15. Typical Arrangement for Lightning Ground in AC-Powered System

—48 V DC STANDBY POWER AND GROUNDING

With -48 V dc Standby Power, the System 85 switch cabinets and auxiliary cabinets containing -48 V dc-powered equipment are configured for -48 V dc direct input. The cabinet rectifier is replaced with a dc filter and terminal strip (accessible from the back of the cabinet) and provides a termination point for the -48 V dc cabinet feeder(s).

The auxiliary cabinets retain an ac power input configuration in addition to the -48 V dc input configuration for ac-powered auxiliary equipment. Other system equipment such as the Applications Processor may also require ac power. The ac power supplied to these cabinets may be standby ac power from an Inverter or may be a feeder from the main ac service supplying the standby power plant. If the ac-powered equipment is not powered from the inverter, the units will not be operational during an ac power outage. Figure 11-16 illustrates a typical -48 V dc Standby Power arrangement.

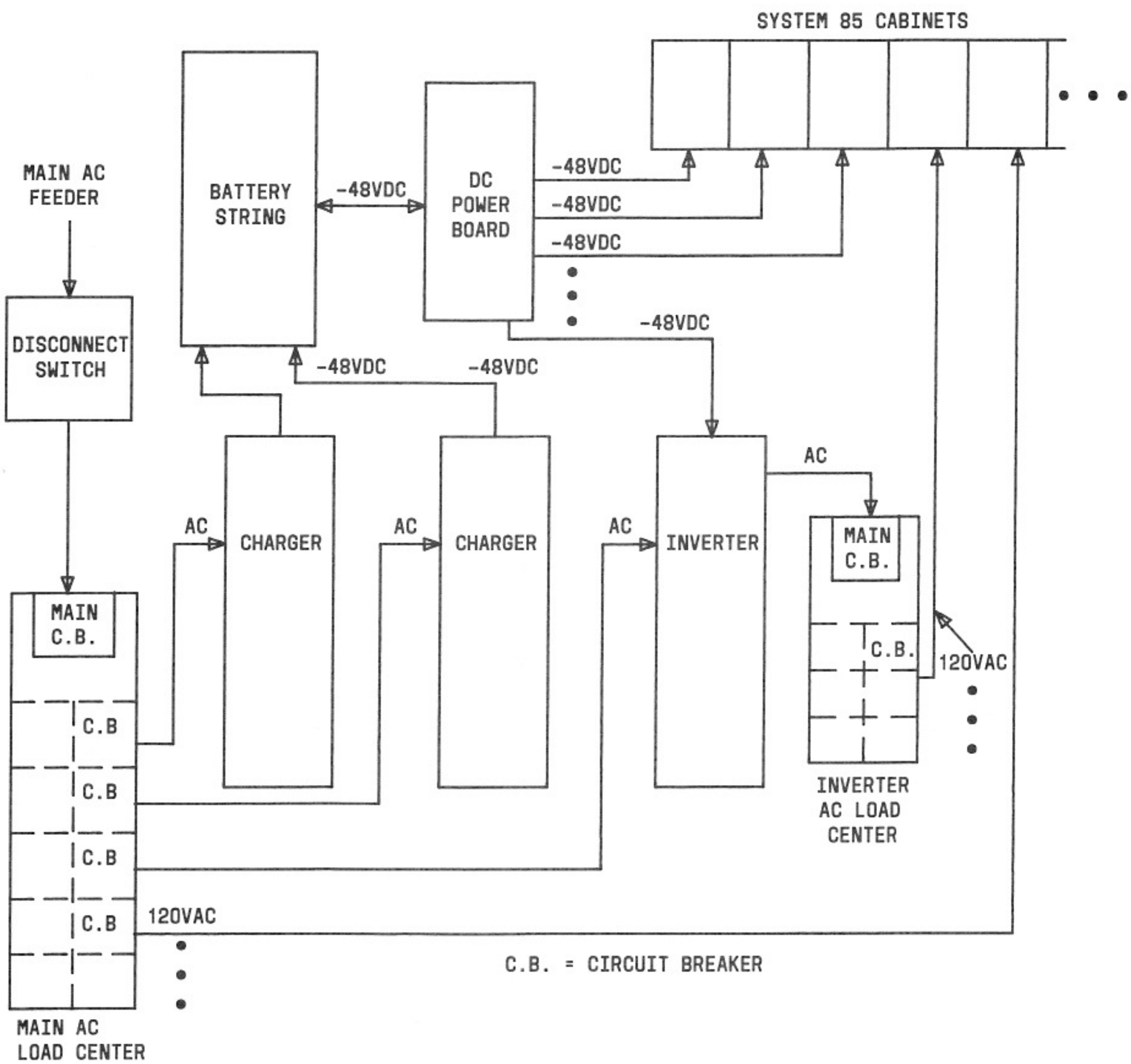


Figure 11-16. Typical -48 V DC Standby Power Arrangement

−48 V DC Standby Power Plant Configuration

The Standby Power Plant consists of:

- Chargers—ac to dc conversion
- Battery Strings—storage of dc power
- DC Power Board—circuit breakers for dc feeders and ground discharge bar for ground returns
- Inverters—dc to ac conversion.

The chargers are used for converting ac to dc power. The chargers are sized to supply power to system equipment via dc feeders with additional capacity to charge a fully drained battery string (usually in a 24-hour period). Reliability and redundancy considerations may also impact the number and capacity of the chargers chosen. For example, if 200 amperes must be supplied, three 100 amperes may be provided instead of a single 200 ampere charger. If one of the 100 ampere chargers should fail, the two remaining charges will still be capable of satisfying the system power requirements without drawing on the battery strings.

The battery strings store dc power and are sized to supply power to system equipment via dc feeders and inverters for a specified period of time. During an ac power outage, the chargers are inoperable and the battery strings supply the system power. The battery strings are usually sized to supply power for a 1/2-, 1-, 2-, 4-, 6-, or 8-hour period, but may be engineered for any specific period within technical limitations.

The DC Power Board is used for power distribution. The board is sized to handle the total amount of dc power required for system equipment and inverters. The sizing should also consider the quantity and rating of circuit breakers required for dc feeders.

Inverters have an ac and dc input and an ac output. If the ac input fails, it draws -48 V dc power and converts it to ac power. Inverters are sized to supply the type and quantity of ac feeders required by the system. The inverters will supply an ac load distribution center equipped with the appropriate circuit breakers for the system ac feeders. The number and capacity of inverters may also be determined considering reliability and redundancy.

Main AC Feeder Size and Power Arrangement

The main ac feeder size and power arrangement is determined by the specific requirements of the standby power plant configured. Any ac feeders to System 85 equipment that will not be provided from inverters should be considered when the main ac feeder is being sized. A System 85 AC Protector Cabinet is not required with -48 V dc Standby Power.

−48 V DC Feeder Arrangement

After the System 85 cabinets have been installed, feeder circuits must be run from the single-pole circuit breakers and ground discharge bar in the dc power board to the appropriate cabinets (see Figure 11-17).

The circuit breaker for each System 85 cabinet feeder should be a 30-amperes high inrush current unit with an auxiliary alarm contact (make contact when tripped), such as AM1-B39-A-30-251 manufactured by Heinmann Electric Company.

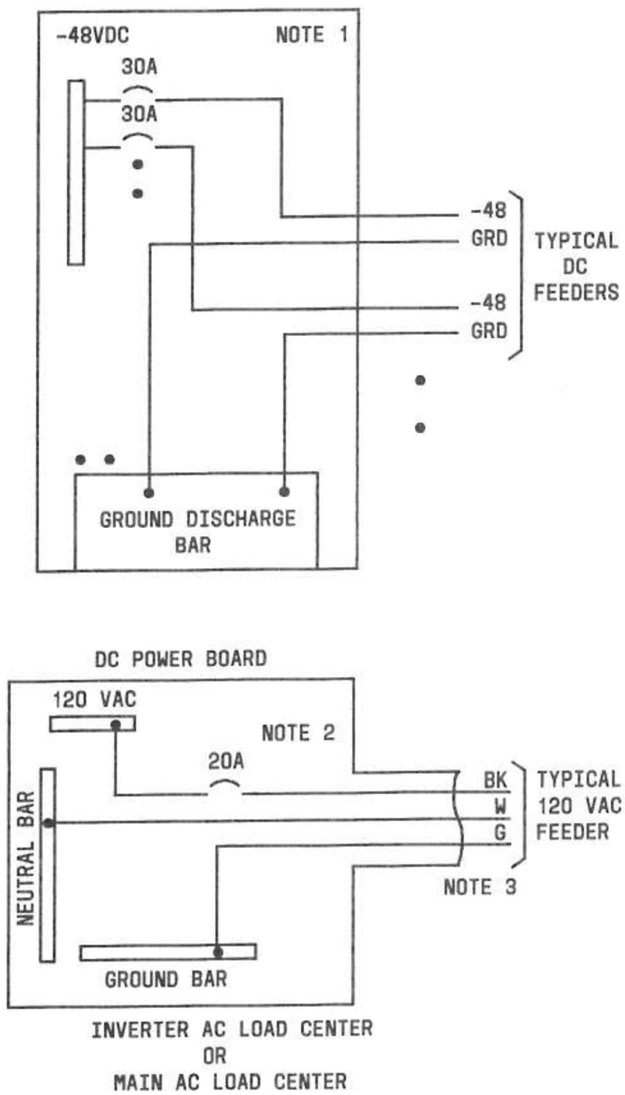
> ***Note:*** Equipment arrangements are currently being evaluated to handle inrush currents. Use of this breaker or its equivalent may require multiple attempts to reset it.

This circuit breaker or its equivalent is recommended. Power to the feeder should be nominal -48 V dc and may range from -42.5 V dc to -52 V dc.

A terminal strip (accessible from the back of the System 85 cabinet) is used to terminate the -48 V dc and ground leads of the feeder circuit. The terminal strip accepts up to No. 2 AWG wire.

The feeder must be engineered for less than 1 percent voltage drop at 30 amperes. This can be provided with No. 2 AWG wire up to a maximum of 50 feet from the circuit breaker to the cabinet terminal strip.

The most economical arrangement for physically running the feeders is to route them via a ladder rack from the dc power board to the cabinet lineups, through the I/O cable duct, along the tops of the cabinets, and down to the terminal strip located at the back of the cabinets. However, local codes and practices may dictate alternative arrangements for feeder distribution and/or demarcation points for the feeder.



Notes:

1. DC Breakers should be 30 Amperes high inrush equipped with auxiliary alarm contact (make contact when tripped): Heinemann AMI-B39-A-30-251 or equivalent:
2. AC Breakers should be thermal magnetic rated 20 Amperes capable of 130 Amperes inrush current for 1/2 cycle: ITE Gould QPI-Q120 H or equivalent.
3. AC Feeder should be:
   120 Vac RMS
   ±10% @ 60Hz (±3Hz)
   -15% @ 60Hz (±3Hz)

Figure 11-17. Standby Power Feeder Arrangements

AC Feeder Arrangement—Standby Power

AC feeders to auxiliary cabinets, Applications Processors, utility receptacles, and any wall-mounted system equipment will be provided from the single-pole circuit breakers in the main ac load center or the inverter AC load center when standby ac power is required (see Figure 11-18). The utility feeders and remote access data set should be powered from the inverter ac load center. Failure to do so will impair any required maintenance activity during an ac power outage.

System 85 cabinets are supplied with ac power ducts attached to the top rear of the cabinets. They form an ac wireway (raceway) on each lineup. These power ducts will be equipped with the required receptacles for auxiliary and AP cabinets to which their feeder circuits will be terminated (see Figure 11-7). System 85 switch cabinets are supplied with direct dc feeders and do not require ac feeders or receptacles in the power duct. Power ducts for the System 85 switch cabinets are supplied to provide continuity of the ac wireway for AP and Auxiliary cabinets in the same lineup. They also provide utility receptacles at approximately every other cabinet position. The utility receptacles should be powered from a single ac feeder and associated circuit breaker.

Conduit and wiring must be run from the main ac load center and/or inverter ac load center to the ac power duct and receptacles on each cabinet lineup in a manner complying with local codes and practices. Additional miscellaneous feeders, conduit, and receptacles must also be provided for any system equipment not contained in system cabinets (see Figure 11-17).

> ***Note:*** If local practices dictate that the receptacles supplied with the power duct attached to the cabinets cannot be used, individual ceiling drop or floor receptacles may be used.

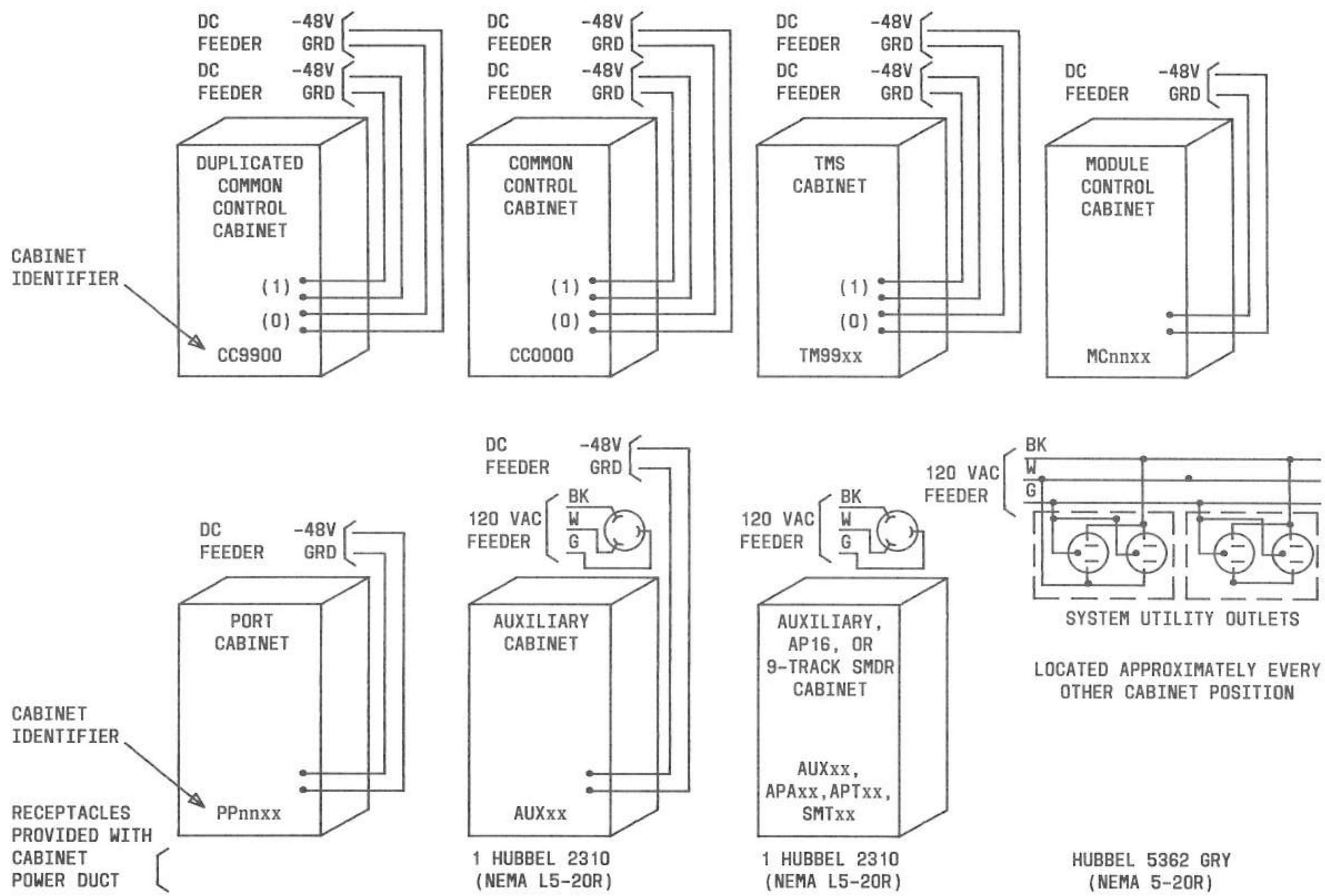


Figure 11-18. System Equipment Feeders with –48 V DC Standby Power

Internal Power Distribution With −48 V DC Standby Power

System 85 switch cabinets use -48 V dc to power cooling fans, alarm panels, mini-recorders, attendant consoles, etc., and to power dc to dc converters which provide low-voltage power to circuit packs. Filtered -48 V dc is also used to provide talk battery for certain types of circuit pack port interfaces. A laminated bus bar within each cabinet is used to distribute -48 V power to carriers and other cabinet equipment.

Power Distribution With −48 V DC Power Source

In -48 V dc powered systems, each switch cabinet receives power individually and is equipped with a DC Frame Filter and terminal strip to terminate the -48 V dc feeder(s). Cabinets are not paired to share power. The -48 V dc feeders are fed from a Standby Power Plant which provides holdover power. Battery reserve units are not equipped in any of the switch cabinets.

The unduplicated common control cabinet receives two feeders, one for the common control carrier and related equipment and one for port or DS-1 carriers located in the cabinet. The duplicated common control cabinet receives two feeders to provide fully independent power for each common control carrier and related equipment. The TMS cabinet receives two feeders of which only one is required if only one or two unduplicated carriers are equipped.

Figure 11-19 illustrates the basic cabinet power arrangement for -48 V powered systems and Figures 11-20, 11-21, and 11-22 provide detailed arrangements for each cabinet.

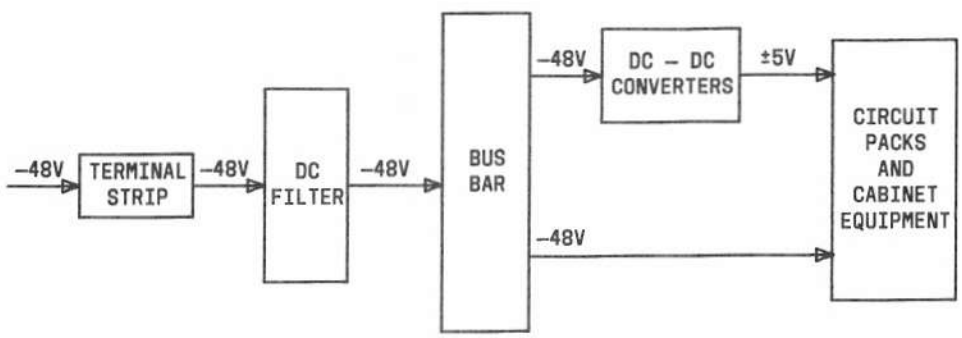


Figure 11-19. Typical Cabinet Power Arrangements for -48 V DC Powered System

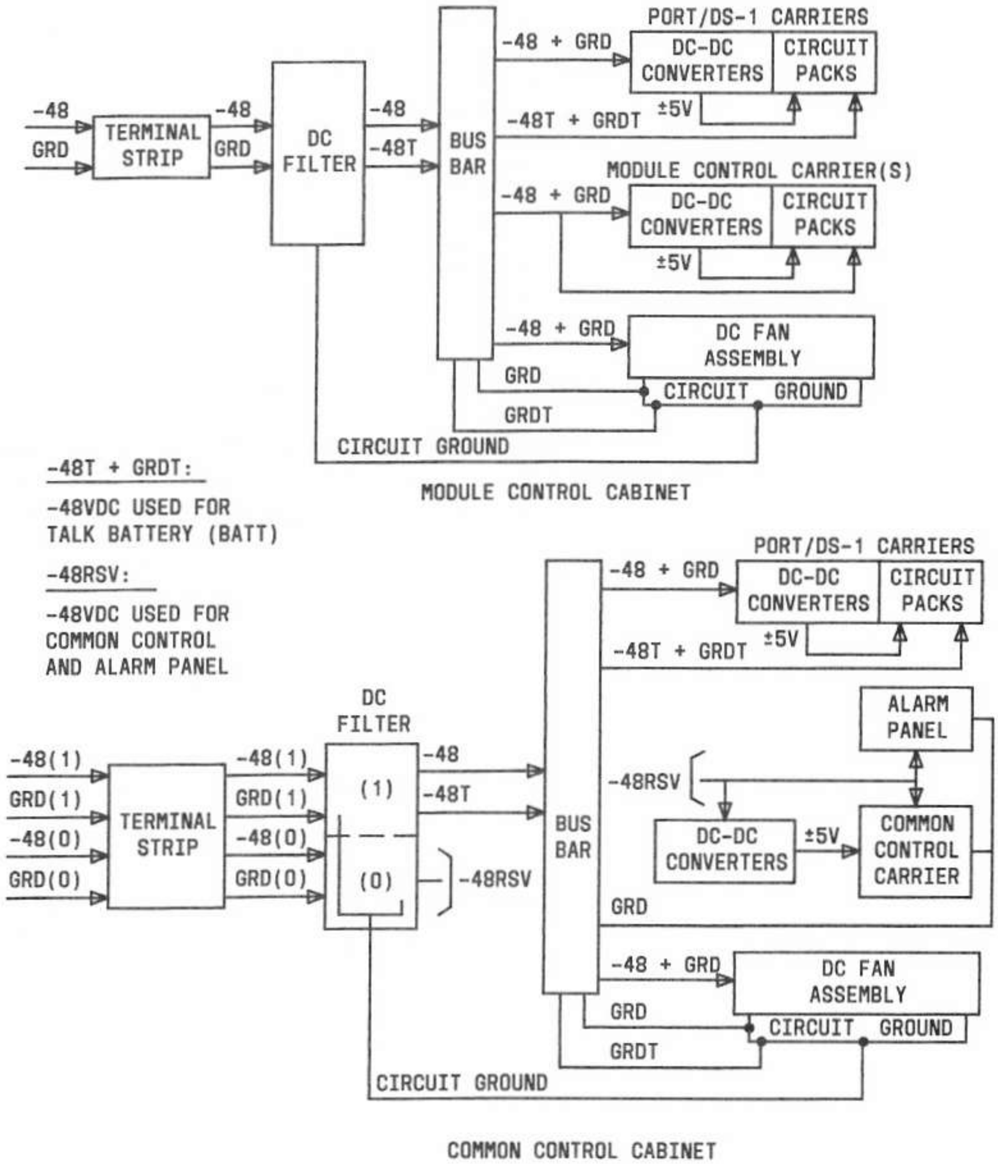


Figure 11-20. Module Control and Common Control Power (-48 V DC Powered System)

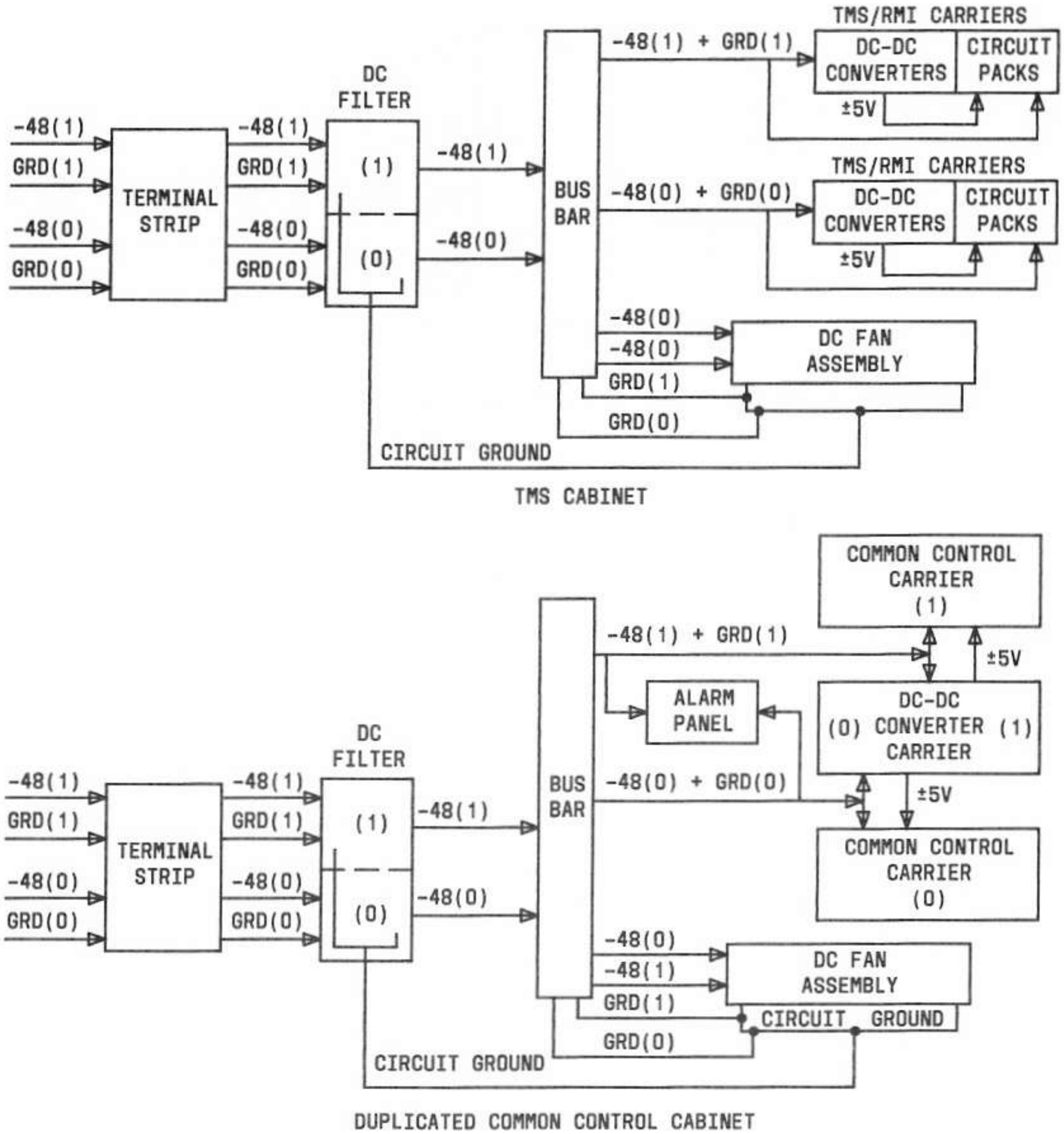


Figure 11-21. TMS and Duplicated Common Control Cabinet Power (-48 V DC Powered System)

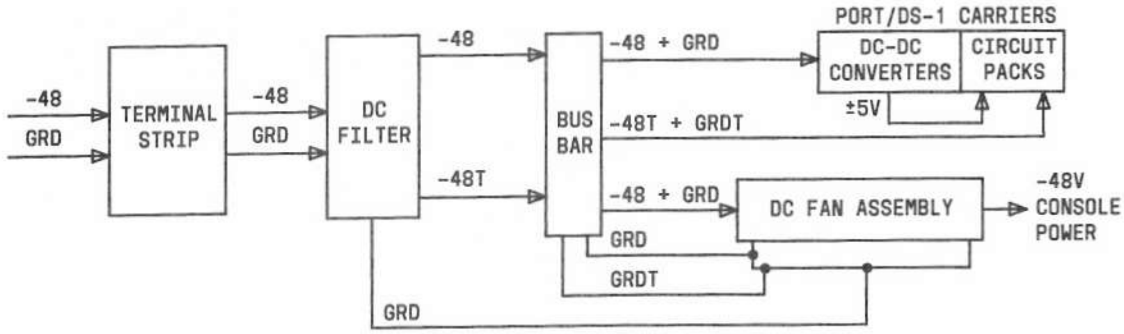


Figure 11-22. Port Cabinet Power (-48 V DC Powered System)

System Grounding With −48 V DC Standby Power

Figure 11-23 illustrates the System 85 grounding scheme for -48 V dc standby powered systems. The ground discharge bar in the dc power board serves as the System 85 single-point ground. A No. 6 AWG wire ground connection must be provided from the ground discharge bar to an approved ground.

The grounding scheme provides:

- Protection from danger of electrical shock
- Protection of equipment from damage in the event of a power fault to ground
- A low impedance path for static and surges
- A common circuit ground reference to alleviate different ground potentials which could adversely impact system operation.

An "approved ground" is an acceptable grounding medium as specified in Section 250-81 of the National Electric Code (NEC). An approved ground may consist of any of the following:

- Grounded Building Steel—The metal frame of the building where effectively grounded, such as with bonded joints.
- Acceptable Water Pipe—A metal pipe, not less than 1/2 inch (13 mm) in diameter, electrically connected to a metal underground water pipe that is in direct contact with the earth for 10 feet (3 m) or more. This must be electrically continuous (or made electrically continuous by bonding around insulated joints, plastic pipe, or plastic water meters) to a point where the protector ground is connected.
- Concrete-Encased Ground—An electrode encased by at least 2 inches (51 mm) of concrete and located within and near the bottom of a concrete foundation or footing in direct contact with earth. This must consist of at least 20 feet (6.1 m) of one or more steel reinforcing bars or rods of not less than 1/2 inch (13 mm) diameter, or at least 2 feet (610 mm) of bare solid copper wire not smaller than No. 4 AWG.
- Ground Ring—A ground ring that encircles a building or structure in direct contact with the earth at a depth of at least 2-1/2 feet (762 mm) below the earth's surface. This must consist of at least 20 feet (6.1 m) of bare copper conductor not smaller than No. 2 AWG.

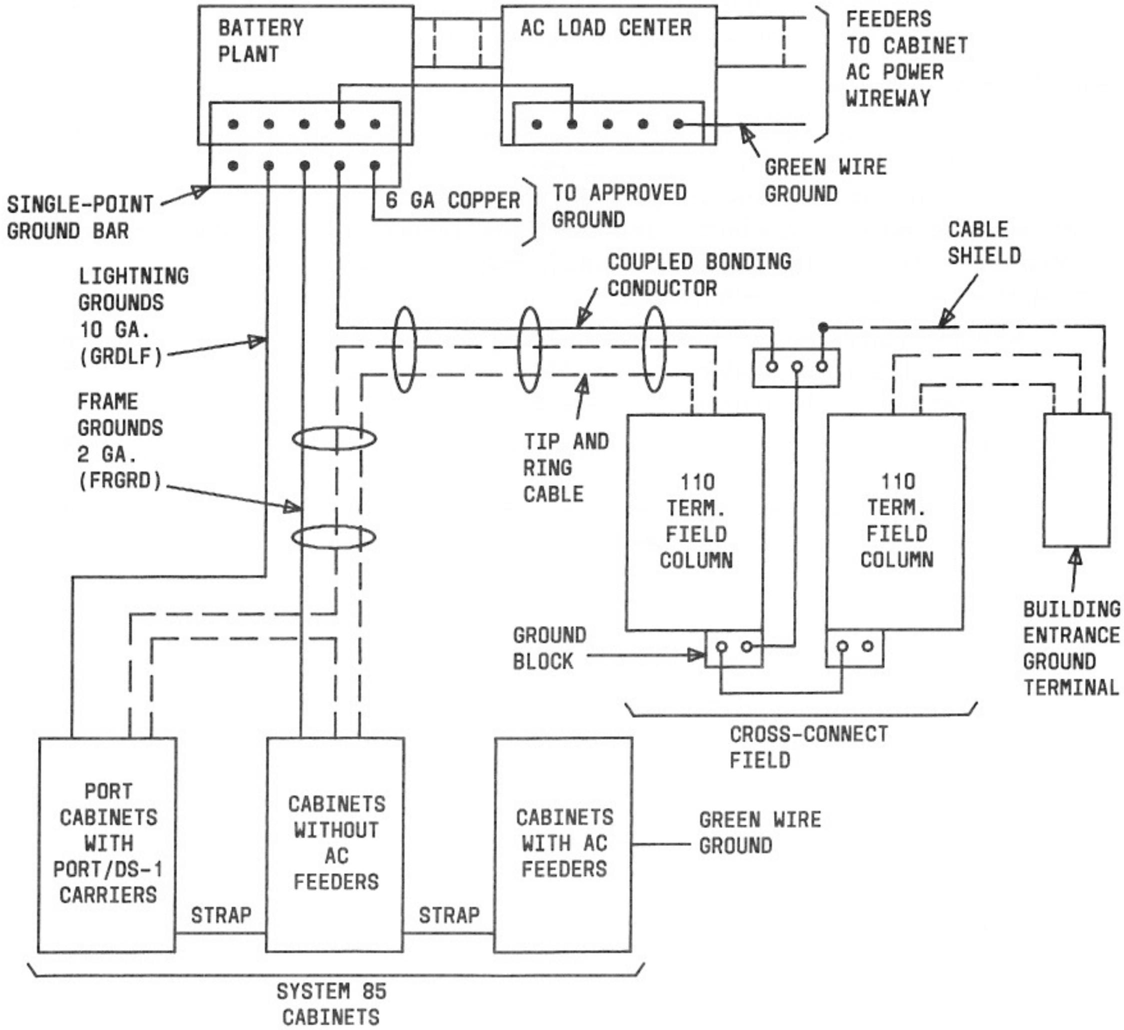


Figure 11-23. Grounding Arrangement for -48 V DC Powered System

An approved floor ground in a high-rise building suitable for connections to the ground terminal in the riser closet and to a system single-point ground may be any of the following:

- Grounded building steel
- Acceptable water pipe
- Power-feed metallic conduit supplying panel boards on the floor
- The grounding conductor for the secondary side of the power transformer feeding the floor
- A grounding point specifically provided in the building for this purpose.

System Ground Leads

The following leads are used to effectively ground System 85. These leads are required in conjunction with the approved and single-point grounds discussed above and will be installed by System 85 installation personnel (with the exception of green wire grounds in ac feeders).

Coupled Bonding Conductor

The coupled bonding conductor provides a connection between the system single-point ground and the protector ground terminal for cable facilities at the building entrance. It is run adjacent to protected pairs in an associated cable. The mutual coupling between the bonding conductor and the pairs reduces the difference in electrical potential in terminating equipment which may result from lightning surges. This conductor can consist of the following:

- When pairs are run in shielded cable, the cable shield shall be used as the coupled bonding conductor. Shield continuity must be verified using a T-124, manufactured by Wilcor Grounding Systems, or equivalent.
- With inside wiring cable, the coupled bonding conductor shall consist of a No. 10 AWG wire that is tie-wrapped to the cable. If this is impractical, six dedicated, good spare pairs within the cable may be used as the coupled bonding conductor. The six spare pairs must be twisted and soldered to prevent their use for other purposes.

A suitable connecting point (coupled bonding conductor terminal block) should be provided for the connection to the system single-point ground.

Equipment Grounding Conductor (Green Wire)

The ac power equipment must be grounded by an equipment grounding conductor (green wire) in compliance with NEC, Article 250-32 (1981 Edition). This ground serves as the green wire ground for the System 85 in accordance with NEC, Articles 250-42 and 250-45 and is distributed to cabinets equipped with rectifiers via the ac feeder circuits.

Lightning Ground (GRDLF)

Each cabinet containing a port or DS-1 carrier requires a lightning ground connection to route lightning surges away from circuit components. A lightning ground (GRDL) is chain-wired to each cabinet within a module. Then the lightning ground is wired from one of the cabinets to the system single-point ground terminal via GRDLF. Each module must have a separate lightning ground connection (GRDLF) to the system single-point ground.

Frame Ground (FRGRD)

Each cabinet which does not use an ac feeder requires a cabinet frame ground connection for safety precautions from shock hazards. A frame ground wire is tied to each non-ac powered cabinet in a lineup and to a No. 2 AWG wire which is terminated to the single-point ground terminal. Each cabinet lineup requires a separate frame ground connection to the system single-point ground.

Grounding Arrangement With −48 V DC Power Source

There are three basic types of intracabinet and intercabinet grounds used in -48 V dc powered systems. They are:

- Equalizing Ground (Circuit Ground)
- Lightning Ground
- Frame Ground.

These grounds are kept totally isolated from each other in the system cabinets and are individually routed to the ground discharge bar on the Standby Power Plant DC Power Board which serves as the system single-point ground. In addition to these, a digital ground which is tied to circuit ground is distributed to port or DS-1 carriers within a cabinet to insure a low impedance path for digital signals.

Equalizing Ground

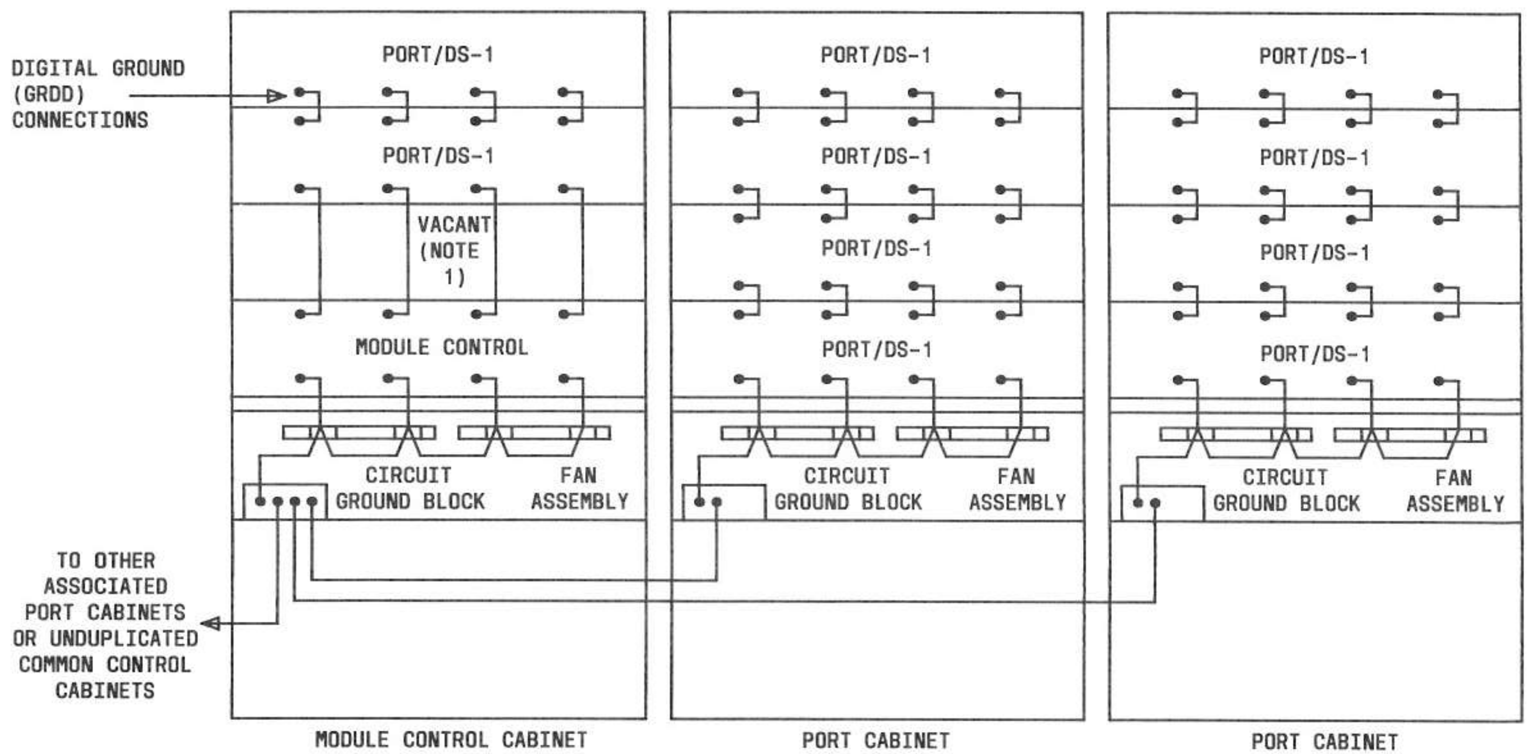
Each switch cabinet is equipped with a circuit ground block located on the dc fan assembly. The circuit ground block is connected to the power distribution grounds of the cabinet bus bar and to the ground(s) of -48 V dc feeders powering the cabinet. The ground leads of the -48 V dc feeders originate from the ground discharge bar (system single-point ground) in the dc power board of the standby power plant. A No. 4 AWG wire is run from the circuit ground block in the module control cabinet to the circuit ground block in each cabinet containing port or DS-1 carriers associated with that module. This is used to equalize the circuit ground potentials of cabinets within a module. The equalizing ground is not required for TMS or duplicated common control cabinets (see Figure 11-24).

Digital Ground

Digital ground connections (GRDD) represent four equally spaced No. 14 AWG wire straps used to electrically interconnect adjoining or sequential carriers with a cabinet to insure a low impedance path for digital signals. The digital grounds are connected to the circuit ground block on the dc fan assembly (see Figure 11-24).

Lightning Ground

Each cabinet equipped with port or DS-1 carriers has No. 10 AWG wire straps chained to each port or DS-1 carrier from a terminal strip located in the cabinet. These connections are used to route lightning surges away from circuit components. A No. 10 AWG wire is chain-wired from the lightning ground terminal strip of one cabinet in a module to each other cabinet associated with the module in that row. This cabinet will have a No. 10 AWG wire run from its lightning ground terminal strip back to the System Single-Point Ground via an Electro-Magnetic Compliance (EMC) filter located in the cabinet. The cabinet equipped with this EMC filter will either be an unduplicated common control cabinet or Port Cabinet. If one or more port cabinets are located cross-aisle from their associated module control cabinet, one of the port cabinets must also be equipped with an EMC filter and have a lightning ground connection to the system single-point ground. The lightning ground terminal strip of the cabinet with the EMC filter and lightning ground connection is chain-wired to any other port cabinets in the row associated with its module. Each of the lightning ground connections from the modules to the system single-point ground is designated GRDLF.



NOTE 1: DIGITAL GROUND CONNECTIONS SPAN VACANT CARRIER POSITIONS EQUIPPED WITH NO CARRIER ADAPTER

Figure 11-24. Typical Arrangement for Module Ground and Digital Ground in –48 V DC Powered System

12. UPGRADES (TO R2V3)

A System 85 upgrade is the process of transforming the hardware and software of a previously installed system to that of a later version. This is performed when increased call processing demands, need for greater feature capabilities, and other changes in customer requirements justify such an action. Upgrades from System 85 Release 1 (R1); Release 2, Version 1 (R2V1); or Release 2, Version 2 (R2V2) to Release 2, Version 3 (R2V3) are supported with minimal hardware/software changes.

FLOOR PLAN

The floor plan ensures that all system components will be located according to agreements made with the customer. It is used as a site inspection guide to ensure that customer-provided electrical and mechanical facilities are correct, agreeing with plant requirements and electrical codes, before installation.

Appropriate floor plan modifications are performed according to the type and extent of system upgrade. The floor plan is revised when additional cabinets are required for the upgrade. These cabinets are installed at the most convenient positions within the cabinet lineup (including required power, cabling, and ductwork modifications), in accordance with the proper configuration guidelines. If an additional common control cabinet is required, it must be located within 200 cable feet of the module control cabinet(s).

SOFTWARE TRANSLATIONS

Translation recovery is the process of removing translation data from an existing tape cartridge for transfer onto a new tape cartridge containing a new program generic and/or configuration. To prepare a new tape for the upgraded system, the translation data must be stripped from the previous system tape through the recovery process. The stripped data is modified to reflect hardware rearrangements required for the upgraded configuration. Additionally, new translation data or added hardware items must be added to the translation database. This database, composed of three items (recovery from previous system, modifications or rearrangements, and new additions), is used to generate the upgraded system tape.

Appropriate translation recovery procedures are performed according to the type and extent of system upgrade. A copy of the current software tape is sent to AT&T, where the translations are extracted and loaded onto a tape with R2V3 software programs.

In most instances, additional memory is required to upgrade to the R2V3 system. An R2V3 system will require 4 to 8 megawords of memory per common control, depending on the configuration of terminals, trunks, and features specified.

R1 TO R2V3 UPGRADES

Ordering and implementing procedures for an upgrade from R1 to R2V3 are essentially unchanged from the R1-to-R2 procedures previously described under UPGRADE PLANS in **Reference Manual—AT&T System 85 (R2V1/V2)—System Description** (999-700-006IS, Issue 1). However, additional memory is required to upgrade to the R2V3 system. The following guidelines apply in this case:

- If upgrading from an unduplicated R1 to an unduplicated R2V3 system, eight 1-megaword memory circuit packs (TN392C) must be ordered (maximum configuration).
- If upgrading from an unduplicated R1 to a duplicated R2V3 system, sixteen 1-megaword memory circuit packs must be ordered (maximum configuration).
- If upgrading from a duplicated R1 to a duplicated R2V3 system, sixteen 1-megaword memory circuit packs must be ordered (maximum configuration).

For more detailed information on R1-to-R2 upgrades, refer to **Service Manual—AT&T System 85—In-Service System Upgrades** (555-101-111IS).

R2V1 to R2V3 UPGRADES

To upgrade from R2V1 to R2V3 (maximum configuration), the following guidelines apply:

- If the R2V1 common control is unduplicated, six 1-megaword memory circuit packs must be ordered.
- If the R2V1 common control is duplicated, twelve 1-megaword memory circuit packs must be ordered.

R2V2 TO R2V3 UPGRADES

To upgrade from R2V2 to R2V3 (maximum configuration), the following guidelines apply:

- If the R2V2 common control is unduplicated, four 1-megaword memory circuit packs must be ordered.
- If the R2V2 common control is duplicated, eight 1-megaword memory circuit packs must be ordered.

13. PRICE ELEMENT CODE (PEC) DESCRIPTIONS

This section lists price element codes in two formats. The first format groups PECs, along with a brief equipment description, into hardware and software groups. The second format lists price element codes in numerical order, along with its official title and a basic description for each. The "AT&T-IS Price Element Manual" should be consulted for more detailed descriptions of each PEC.

PECs BY EQUIPMENT TYPE

Software

PEC	DESCRIPTION
1252-AVN	R2 AUTOVON
1252-DCS	R2 Distributed Comm. System
1252-ETN	R2V1 & R2V2 Elec. Tandem Ntwk.
1252-ET3	R2V3 Electronic Tandem Network
1252-MP1	R2V1 & R2V2 Multipremises
1252-MP3	R2V3 Multipremises
1252-RS2	R2V2 System Software
1252-RS3	R2V3 System Software
1252-US2	R2V2 Upgrade Software
1252-US3	R2V3 Upgrade Software
65326	Switch Software Tape
65364	Upgrade Tape R1 to R2
65365	Additional Software CSDs
65366	Customized Tape and CSDs for major additions
65369	Phase 2 Software Tape for R2V2 & R2V3
65440	DCS Software Activation

Cabinets

PEC	DESCRIPTION
6552-CC2	Unduplicated Common Control Cabinet with OLS Power supply
6552-CLD	Duplicated Common Control Cabinet with -48 V dc input
6552-CLU	Unduplicated Common Control Cabinet with -48 V dc input
6552-CSD	Duplicated Common Control Cabinet
6552-CSU	Unduplicated Common Control Cabinet
6552-MCD	Module Control Cabinet with Duplicated Module Controls
6552-MCU	Module Control Cabinet with Unduplicated Module Controls
6552-MLD	Module Control Cabinet with Duplicated Module Controls & -48 V dc Input
6552-MLU	Module Control Cabinet with Unduplicated Module Controls & -48 V dc Input
6552-RLC	Remote Module Cabinet with -48 V dc Input
6552-RMC	Remote Module Cabinet
6552-TLD	TMS Cabinet with Duplicated TMS controls & -48 V dc Input
6552-TLU	TMS Cabinet with Unduplicated TMS controls & -48 V dc Input
6552-TMD	TMS Cabinet with Duplicated TMS controls
6552-TMU	TMS Cabinet with Unduplicated TMS controls
65209	RS232 Direct Output SMDR Cabinet
65210	9-Track SMDR Cabinet
65310	Port Cabinet with power (rectifier)
65311	Port Cabinet without power (no rectifier)
65312	Port Cabinet with -48 V dc Input
65445	Auxiliary Cabinet
65462	Module Control Cabinet with Duplicated Module Controls and OLS Power Supply
65463	Module Control Cabinet with Unduplicated Module Controls and OLS Power Supply
65470	Port Cabinet with power (OLS power supply)

Carriers

PEC	DESCRIPTION
65302	TMS Growth Carrier
65340	Port Carrier
65341	DS-1 Carrier
65363	Additional Module Control Carrier
65389	Remote Module Interface Carrier

Line Port Circuit Packs

PEC	DESCRIPTION
65103	Hybrid Line—SN224B
65104	Digital Line—SN270B
65343	7303/7305 Line—ANN17B
65346	Analog Line—SN228B
65347	Analog Line—SN229B
65392	ADU/EIA—SN238

Trunk Port Circuit Packs

PEC	DESCRIPTION
65110	CO Trunk Interface—SN230B
65111	DID Trunk Interface—SN232B
65113	Auxiliary Trunk Interface—SN231
65420	DS-1 Digital Trunk—ANN11C
65425	Tie/Console/RLT (E&M)—SN233C

Feature-Related Circuit Packs

PEC	DESCRIPTION
65123	Touch-Tone Receiver—SN251
65124	Touch-Tone Sender—SN252
65202	Contact Interface—SN241
65204	Computer Port Interface—SN243B
65205	Attendant Conference—SN254
65344	AIOD Transmitter—SN244B
65345	Auxiliary Tones—SN253C
65348	Data Tone Detector—SN255
65390	ATMS Interface—SN261B

Common Control Circuit Packs and Equipment

PEC	DESCRIPTION
65320	Cache Memory—TN369
65322	1-Megaword Memory—TN392C
65323	4-MHz Channels—TN402
65324	Peripheral Interface—TN403
65325	DCIU—TN405, TN406, & UN156

TMS Circuit Packs and Equipment

PEC	DESCRIPTION
65301	Additional TMS Rectifier—334A
65303	External Clock Synch—TN463
65305	TMS Multiplexer—TN470
65306	TMS Module Interface—TN480
65307	Duplication/Update Channel—TN530

Module Control Circuit Packs and Equipment

PEC	DESCRIPTION
65120	Port Data Store—TN440B
65121	I/O Bus Interface—TN400B
65333	External Clock Synch.—TN463
65334	Module Control to TMS—TN441 & TN481
65335	Module Control Power Pack—494GA
65336	Module Clock—TN460C
65450	Module Processor Upgrade Kit

Remote Module Circuit Packs and Equipment

PEC	DESCRIPTION
65386	Remote Module Interface—Remote
65388	Remote Module Interface—Dup. Remote
65395	Rem. Mod. Int.—for MC0 at Central
65396	Rem. Mod. Int.—for MC1 at Central

Remote Group Equipment

PEC	DESCRIPTION
65410	Remote Group Housing
65411	Remote Group Interface—Remote
65412	Remote Group Interface—Central

Nominal Holdover Equipment (J87462A)

PEC	DESCRIPTION
65349	Nominal Battery Reserve—TMS Cabinet
65350	Nominal Battery Reserve—Mod. Cont. Cab.
65351	Nominal Battery Reserve—Port Cabinet
65353	Battery Packs
65472	Critical Battery Backup (Not part of J87462)

Attendant Console Equipment

PEC	DESCRIPTION
65358	Basic Console
65359	Console with 1800 DXS/BLF
65430	Console Repeater for Off-Prem. Protection
65431	Console Repeater w/Range Ext.—5000 Ft.
65432	Console Repeater w/Range Ext.—8000 Ft.
65433	Console Repeater w/Range Ext.—11000 Ft.

Auxiliary Equipment

PEC	DESCRIPTION
64102	609A Transfer Panel
65224	Additional AC Power
65230	Voice Switch Gain and E&M Carrier
65231	Voice Switch Gain Ckt. Pack—VFR-5050
65234	Auxiliary Mounting Panel
65235	36A Coupler with Power
65237	Radio Paging Interface
65241	Recorded Telephone Dictation
65246	General Purpose Trunk Interconnect
65252	Emergency Transfer Panel
65254	Cable from DCIU to LADS
65255	E&M Converter Circuit Pack
65257	Additional Data Set Cables
65270	Recorded Announcement Unit
65373	Small Interconnect Panel
65374	Large Interconnect Panel
65375	Aux. Misc. Mountings
65394	ISN Concentrator Interface

Duct Work

PEC	DESCRIPTION
65379	Duct Per Cabinet
65380	Duct Per Lineup
65381	Duct I/O to Wall
65382	Duct I/O Interface to Ladder Rack
65383	Duct X-Aisle Flat
65384	Duct X-Aisle I/O

Miscellaneous

PEC	DESCRIPTION
65243	ETN Per Trunk Circuit Pack Administation
65244	ETN Remote Access
65253	AC Protector Cabinet
65258	Additional I/O Cable—SN Pack in DS-1 Carrier
65259	Cable—DCIU to (M)PDM
65261	Additional DS-1 Sync. Cable
65264	Additional Extender Cable for Adding RMI pack.
65265	Cable, 4-MHz—Common Control to Module Control
65360	Proc. Upgrade—U/U R1 to R2
65361	Proc. Upgrade—U/D R1 to R2
65362	Proc. Upgrade—D/D R1 to R2
65464	Upgrade Tape—R2V2
65465	Upgrade Tape—R2V3
65473	Additional OLS Power Supply

NUMERICAL LISTING OF PECs

PEC	TITLE AND DESCRIPTION
1252-AVN	AUTOVON: Charge for AUTOVON system software.
1252-DCS	DIST COMMUN SYS-R2: Charge for DCS software.
1252-ETN	ELEC TANDM NTWK-R2: Charge for ETN software—R2V1 and R2V2.
1252-ET3	ELEC TANDM NTWK-R2V3: Charge for ETN software—R2V3.
1252-MP1	MULTIPREMISES-R2: Charge for multipremises (main/satellite) software—R2V1 and R2V2.
1252-MP3	MULTIPREMISES-R2V3: Charge for multipremises (main/satellite) software —R2V3.
1252-RS2	SYSTEM SOFTWARE-R2V2: Charge for basic/required system software—R2V2.
1252-RS3	SYSTEM SOFTWARE-R2V3: Charge for basic/required system software—R2V3.
1252-US2	UPGRADE SFWR TO R2V2: Charge for R2V2 upgrade software.
1252-US3	UPGRADE SFWR TO R2V3: Charge for R2V3 upgrade software.
6552-CC2	SYS 85 COM CTL W/SMT Provides J58886J R2 common control cabinet, wiring, cables, alarm panel, common control carrier, basic circuit packs, etc.; arranged for ac input power. This PEC includes an OLS power supply.
6552-CLD	SYS 85 DUP W/SMT-LT: Provides J58886K R2 duplicated common control carrier, wiring, cables, basic circuit packs, etc.; arranged for ac input power.
6552-CLU	SYS 85 COMM W/SMT-LT: Provides J58886J R2 common control cabinet, common control carrier, basic circuit packs, wiring, cables, alarm panel, etc.; arranged for -48 V dc input power.

6552-CSD SYS 85 DUP CTL W/SMT:
Provides J58886K R2 duplicated common control cabinet, wiring, cables, alarm panels, two common control carriers, basic circuit packs, etc.: arranged for ac input power.

6552-CSU SYS 85 W/SMT:
Provides J58886J R2 common control cabinet, wiring, cables, alarm panel, common control carrier, basic circuit packs, etc.; arranged for ac input power.

6552-MCD MOD CTL DUPLICATED:
Provides J58886B R2 module control cabinet, two module control carriers, wiring, cables, basic circuit packs, etc.; arranged for ac input power.

6552-MCU MODULE CTL CABINET:
Provides J58886B R2 module control cabinet, module control carrier, basic circuit packs, wiring, cables, etc.; arranged for ac input power.

6552-MLD MOD CTL DUP-LT:
Provides J58886B R2 module control cabinet, two module control carriers, basic circuit packs, wiring, cables, etc.; arranged for -48 V dc input power.

6552-MLU MODULE CTL-LT:
Provides J58886B R2 module control cabinet, module control carrier, basic circuit packs, wiring, cables, etc.; arranged for -48 V dc input power.

6552-RLC REM MOD CABINET-LT:
Provides J58886B R2 module control cabinet, module control carrier, basic circuit packs, remote module interface circuit, LCIT and associated interconnections, wiring, cables, etc.; arranged for -48 V dc input power.

6552-RMC REM MOD CABINET:
Provides J58886B R2 module control cabinet, module control carrier, basic circuit packs, remote module interface circuit, LCIT and associated interconnections, wiring, cables, etc.; arranged for ac input power.

6552-TLD TMS CTL DUP-LT:
Provides J58886F R2 duplicated TMS cabinet, two TMS control carriers, basic circuit packs, wiring, cables, etc.; arranged for -48 V dc input power.

PEC	TITLE AND DESCRIPTION
6552-TLU	TMS CONTROL-LT: Provides J58886F R2 TMS cabinet, TMS control carrier, basic circuit packs, wiring, cables, etc.; arranged for -48 V dc input power.
6552-TMD	TMS DUP CTL CABINET: Provides J58886F R2 duplicated TMS cabinet, two TMS control carriers, basic circuit packs, wiring, cables, etc.; arranged for ac input power.
6552-TMU	TMS CONTROL CABINET: Provides J58886F R2 TMS cabinet, TMS control carrier, basic circuit packs, wiring, cables, etc.; arranged for ac input power.
65103	HYBRID INTERFACE: SN224B provides four hybrid voice ports for hybrid voice terminals such as the 7200H Series.
65104	DIGITAL INTERFACE: SN270B provides four digital voice/data ports for digital voice terminals, data modules, and integrated voice/data terminals.
65110	CO TRUNK INTERFACE: SN230B provides four trunk ports for CO, FX, and WATS.
65111	DID TRUNK INTERFACE: SN232B provides four trunk ports for DID.
65113	AUX TRUNK INTERFACE: SN231 provides four trunk ports for auxiliary equipment.
65120	PORT DATA STORE: TN440B provides PDS for module control to each two port carriers.
65121	ADDL MODULE CTL ITFC: TN400B provides I/O buffer interface for module control to each four port carriers.
65123	TT RECEIVER PACK: SN251 provides four touch-tone receiver circuits.
65124	TT SENDER PACK: SN252 provides four touch-tone sender circuits.
65202	CAS/UCD INDICATOR IF: SN241 provides eight contact interface circuits for UCD/EUCD/ACD and CAS.

65204 COMPUTER PORT INTERFACE:
SN243B provides four trunk-type external computer ports.

65205 ATTD CONF 6-PORT:
SN254 provides 6-port attendant conference circuit.

65209 SMDR W/RS232 OUTPUT:
J59209A RS-232C SMDR direct output cabinet, SMDR direct output carrier and circuit packs, and all other required equipment.

65210 SMDR W/9-TRACK OUTPUT:
J58886H 9-track SMDR Cabinet, SMDR carrier and circuit packs, and all other required equipment.

65224 ADDL AC DISTRIBUTION:
Provides six additional ac outlets for auxiliary cabinet.

65230 V.S.G. CARRIER:
Lorain Mfg. 460054L (comcode 402984231) provides housing for 13 V.S.G. packs or E&M converters.

65231 V.S.G. PACK:
Lorain CP VFR-5050 (comcode 402986079) provides voice switched gain circuit.

65234 AUX MOUNTING PANEL:
Provides 4-inch or 11-inch foam mounting panels for auxiliary cabinet.

65235 36A COUPLER W/POWER:
36A Voice Coupler and 2012D provides interface from common equipment to unregistered customer-provided auxiliary equipment.

65237 RADIO PG INT-TT:
J58824CD provides radio paging interface. Touch-tone without conversion.

65241 RECORD TEL DICTATION:
J58827E provides recorded telephone dictation interface.

65243 ETN PER TRK CKT PACK:
No material. Provides billing for ETN.

65244 ETN-REMOTE ACCESS:
Teltone M106 remote access unit provides ETN access for remote testing.

65246 GEN PURPOSE TRK I/C:
J53050F provides trunk interface to customer-provided equipment.

65253 AC PROTECTOR CABINET:
JOSLYN 1455-75 protector cabinet provides ac protection for System 85.

65254 CABLE LADS TO S85/AP:
ED1E434-11 provides cable to connect local area data set to DCIU.

65255 E&M CONVERTERS:
Astro Endyne E&MC 11625-1-1 provides four E&M circuits for connection between colocated PBX systems.

65257 ADDL DATA SET CABLES:
ED1E434-11 provides data cables to connect a second 212AR data set for customer Remote Interface access.

65258 ADDL I/O CABLE:
ED1E434-11 provides I/O cables to connect an SN-coded circuit pack in a DS-1 carrier.

65259 CABLE DCIU TO PDM:
ED1E434-11 provides cables to connect the DCIU to an (M)PDM for AUDIX.

65261 ADDL DS1 SYNC CABLE:
ED1E434-11 provides additional DS-1 cable.

65264 ADDL EXTENDER CABLE:
ED1E434-11 provides cables for adding remote module interface.

65265 CC/MC CABLE
ED1E434-11 Group 84 provides 4-MHz cable for connecting the Common Control to the Module Control.

65270 RECORD ANN-BASIC UN:
Cook Electric Announcement Unit (213300-2301611) and ac converter (213288) provides single-channel announcement.

65301 TMS RECTIFIER-ADD:
Provides additional 334A rectifier for TMS cabinet.

65302 TMS GROWTH CARRIER:
J58886C provides TMS growth carrier, basic circuit packs, wiring, cabling, etc.

65303 TMS EXT CLOCK SYNCH:
TN463 synchronizes the system clock with digital facilities.

65305 TMS MULTIPLEXER:
TN470 provides portion of TMS fabric.

65306 TMS MODULE INTERFACE:
TN480 interfaces the TMS to module controls.

65307 TMS DUPLICATION BDS:
Two TN530s provide link between duplicated TMS control carriers.

65310 PORT CABINET W/PWR:
J58886C port cabinet and basic equipment; arranged for ac input power.

65311 PORT CABINET W/O PWR:
J58886C port cabinet and basic equipment; arranged for dc input power from adjacent cabinet.

65312 PORT CABINET-LT:
J58886C port cabinet and basic equipment; arranged for -48 V dc input power.

65320 MEMORY-CACHE:
TN369 provides additional high speed 16 k memory to increase processor throughput.

65322 MEMORY-1 MW COM CTL:
TN392C provides 1 megaword of memory.

65323 COM CTL/MOD CTL INT:
TN402 provides 4-MHz channel interface between the common control and module control.

65324 PERIPHERAL INTERFACE:
TN403 provides 16 additional data channels (16-31) for interfacing between the common control and peripherals.

65325 DATA COM INT UNIT:
TN405, TN406, and UN156 DCIU circuit packs.

65326 SWITCH SOFTWARE TAPE:
J58889TM provides four cartridge tapes with stored program memory magnetization, customized translations, and CSDs.

65333 MOD CLOCK-EXT SYNCH:
TN463 provides synchronization for single-module system clock with digital facilities.

65334 MOD CTL TO TMS:
TN441 and TN481 interface the module control to TMS.

65335 MOD CTL POWER PACK:
494GA power pack for module control in multimodule system with duplicated module controls.

65336 MOD CLOCK-SINGLE MOD:
TN460C provides system clock for single-module system.

65340 PORT CARRIER:
J58888A port carrier, basic circuit packs, wiring, cabling, etc.

65341 DS1 CARRIER:
J58888N DS-1 carrier, basic circuit packs, wiring, cabling, etc.

65343 7303/7305 INTERFACE:
ANN17B provides eight multifunction analog terminal ports for the 7300S Series voice terminals.

65344 AIOD DATA TRANSMITTER:
SN244B provides two channels to CO/CCSA for automatic billing.

65345 CAS/CODE TONE SOURCE: (Auxiliary Tone Source)
SN253C provides tones for CAS and code calling, AUTOVON, certain terminal dialed data calls, etc.

65346 OFF-PREM ANALOG INT:
SN228B provides eight analog line ports for off/on premises up to 20,000 feet (6096 m).

65347 ANALOG INTERFACE:
SN229B provides eight analog line ports for on-premises up to 3500 feet (1067 m).

65348 DATA TONE DETECTOR:
SN255 provides tone detection for certain terminal dialed data calls.

65349 NOMINAL BAT RES-TMS:
J87462 provides nominal battery reserve housing and basic equipment for TMS cabinet.

65350 NOMINAL BAT RES-MOD:
J87462 provides nominal battery reserve housing and basic equipment for module control cabinet.

65351 NOMINAL BAT RES-PORT:
J87462 provides nominal battery reserve housing and basic equipment for port cabinet.

65353 BATTERY-NOMINAL:
J87462 provides nominal battery reserve battery pack.

65358 CONSOLE W/O DXS:
ZAAG-09AF-03 attendant console without direct extension select/busy lamp buttons.

65359 CONSOLE W/1800 DXS:
ZAGJ-09AF-03 attendant console with 18 groups of 100 direct extension select/busy lamp buttons.

65360 PROC UPGRADE-U/U:
Provides replacement equipment required for existing module and aux cabinets when upgrading an unduplicated R1 common control to an unduplicated R2 common control.

65361 PROC UPGRADE-U/D:
Provides replacement equipment required for existing module and aux cabinets when upgrading an unduplicated R1 common control to a duplicated R2 common control.

65362 PROC UPGRAGE-D/D:
Provides replacement equipment required for existing module and aux cabinets when upgrading a duplicated R1 common control to a duplicated R2 common control.

65363 ADDL MOD CTL CARRIER:
J58888M provides additional module control carrier and basic packs required when changing from unduplicated to duplicated module control.

65364 UPGRADE TAPE:
Provides cartridge tapes with stored program memory magnetization, customized translations and CSDs for system upgrades, i.e., R1 to R2, etc.

65365 ADDL SFTWR CSD'S:
Provides three paper copies of the Customer System Document.

65366 SFWR TAPE-MAJOR ADDN:
Provides translated tapes and Customer System Documents on major additions.

65369 SFWR TAPE-PHASE 2:
Provides translated Phase 2 tapes and CSDs for new R2V2s and R2V3s. Phase 2 tapes are primarily intended to contain station review information such as button assignments or class of service assignments.

65373 SM INTERCON PANEL:
Provides 32 three-pair terminations. Used for connecting auxiliary equipment to the rear of the J58886G auxiliary cabinet.

65374 LG INTERCON PANEL:
Provides 64 three-pair terminations. Used for connecting auxiliary equipment to the rear of the J58886G auxiliary cabinet.

65375 AUX MISC MOUNTINGS:
Miscellaneous mountings for J58886G auxiliary cabinet.

65379 DUCT PER CABINET:
ED1E464-70 and ED1E465-70 provide facia and duct work for the top of each cabinet.

65380 DUCT PER LINEUP:
ED1E464-70 and ED1E465-70 provide facia and duct work for each lineup of cabinets.

PEC	TITLE AND DESCRIPTION
65381	DUCT I/O TO WALL: ED1E465-70 provides duct work from I/O to wall.
65382	DUCT I/O INT LADDER: ED1E465-70 provides duct work which interfaces to ladder rack.
65383	DUCT X-AISLE FLAT: ED1E465-70 provides cross-aisle flat cable duct work segment.
65384	DUCT X-AISLE I/O: ED1E465-70 provides cross-aisle I/O duct work segment.
65386	REM MOD INT-REMOTE: Interface at the remote equipment location for one remote module for a system with unduplicated module control. Includes one RMI circuit pack (TN456), ED1E434 fiber-optic cabling to the wall field, and MC intracabinet cabling.
65388	REM MOD INT-REMOTE-DUP: Interface at the remote equipment location for one remote module for a system with duplicated module control. Includes two RMI circuit packs (TN456), ED1E434 fiber-optic cabling to the wall field, and MC intracabinet at cabling.
65389	REMOTE MOD CARRIER: J58888S provides RMI carrier, basic circuit packs, cabling, etc.
65390	ATMS INTERFACE: SN261B provides originating and terminating transmission testing of trunking facilities.
65392	EIA INTERFACE: SN238 provides interface for four asynchronous data units.
65394	ISN CONC INTERFACE: Provides mounting brackets for one ISN concentrator, cabling and hardware for connecting the concentrator to the maximum number of asynchronous data units.
65395	REM MOD INT-CENT MCO: Interface at the central equipment location for one module control 0 (MC0). Includes one RMI circuit pack (TN456) and ED1E434 fiber-optic cabling to the LCIT.

65396 REM MOD INT-CENT MCI:
Interface at the central equipment location for one module control 1 (MC1). Includes one RMI circuit pack (TN456) and ED1E434 fiber-optic cabling to the LCIT.

65410 REMOTE GRP HOUSING:
Provides power and mounting equipment for a remote group.

65411 REMOTE GRP INT-REMOTE:
ANN16B and various ED1E434-11 cables provide the remote group interface at the remote location.

65412 REMOTE GRP INT-CENTRAL:
ANN15B and various ED1E434-11 cables provide the remote group interface at the central location.

65420 DS1 TRK INTERFACE:
ANN11C and various ED1E434-11 cables provide the DS-1 trunk interface.

65425 TIE/CONSOLE/RLT (E&M)
SN233C provides four tie/console/release link trunk trunk ports.

65426 MF SENDER ITFC
Provides ...

65427 MF RECEIVER ITFC
Provides ...

65430 CSL OFF PREMISES PORT:
Is equipped with two console repeaters without range extension. Limit 1000 feet (305 m). (J58889Y)

65431 CSL RPTR W/RE (5K FT):
Is equipped with two console repeaters with range extension. (J58889Y)

65432 CSL RPTR W/RE (8K FT):
Is equipped with three console repeaters with range extension. (J58889Y)

65433 CLS RPTR W/RE (11K FT):
Is equipped with four console repeaters. (J58889Y)

65440 DCS SFTWR ACTIVATION:
Charge for activating DCS software in a System 85 switch.

65441 FANS (65445):
J58889AL provides fan for auxiliary cabinet; PEC also includes thermal sensor.

65442 FREQ GEN (65445):
J58889N provides frequency generator for auxiliary cabinet.

65443 -48V PWR (65445):
J58886N provides -48 V power for auxiliary cabinet.

65445 AUXILIARY CABINET:
Provides J58886N auxiliary cabinet.

65450 MOD PROC UPGRADE KIT
Provides equipment to upgrade the TN380B module processor to a TN380C module processor. This kit is required when upgrading an R2V1 switch to either an R2V2 or R2V3 switch.

65462 MOD CTL CAB-DUP
Provides J58886B R2 module control cabinet, two module control carriers, wiring, cables, basic circuit packs, etc.; arranged for ac input power. This PEC includes an OLS power supply.

65463 MOD CTL CAB-UNDUP
Provides J58886B R2 module control cabinet, module control carrier, basic circuit packs, wiring, cables, etc.; arranged for ac input power. This PEC includes an OLS power supply.

65464 UPGRADE TAPE-R2V2:
Upgrade tapes and CSDs for upgrading system to R2V2.

65465 UPGRADE TAPE-R2V3:
Upgrade tapes and CSDs for upgrading system to R2V3.

65470 PORT CAB W/PWR
J58886C port cabinet and basic equipment; arranged for ac input power. This PEC includes an OLS power supply.

65472 CRITICAL BATT BACKUP
Provides battery charger and battery.

65473 ADDITIONAL OLS POWER
Provides an additional OLS power supply.

14. REFERENCES

The following documents are associated with System 85 and, when available, may be used for additional information:

AT&T-IS Network and Data Services—Reference Manual	555-025-201
AT&T System 85 (R2V3)—Console Operation—User's Guide	555-102-730
AT&T System 85—Documentation Guide	555-102-010
AT&T System 85 (R2V3)—Feature Descriptions—Reference Manual	555-102-301
AT&T System 85 (R2V3)—Feature Translations—Service Manual	555-102-107
AT&T System 85—Installation—Service Manual	555-102-104
AT&T—Large Business Systems Catalog	555-000-010
AT&T System 85 (R2V3)—Maintenance—Service Manual	555-102-108
AT&T System 85 (R2V3)—SMT Administration Management—User's Guide	555-102-501
AT&T System 85 (R2V3)—Traffic Data Analysis Guide	555-102-502
AUDIX—Introduction to AUDIX—Service Manual	585-300-020
CSM—Facilities Management—User's Guide	585-220-702
CSM—Terminal Change Management—User's Guide	585-220-701
SMDR—System Description—Reference Manual	555-006-201

The following schematic drawings (SDs) and associated circuit descriptions (CDs) are associated with System 85 and, when available, may be used for additional information:

SMDR Ckt.	SD-1E 449-01
System Power Distribution Ckt.	SD-1E 551-01
Cabinet Power Distribution Ckt.	SD-1E 552-01
MAAP Ckt. and SMT Ckt.	SD-1E 554-01
Common Control, DCIU, and Power Units Ckt.	SD-1E 555-01
Port Interface Ckt.	SD-1E 557-01
Time Multiplexed Switch Ckt.	SD-1E 558-01

Attendant Console Ckt.	SD-1E 559-01
Auxiliary Equipment Application Ckt.	SD-1E 562-01
Common Control Carrier	SD-1E 565-01
Attendant Console Repeater Ckt.	SD-1E 566-01
Common Control Power Ckts.	SD-1E 567-01
Alarm Panel Ckt.	SD-1E 568-01
Module Control Ckt.	SD-1E 570-01
System Interconnection and Information Ckt.	SD-1E 580-01
AP Application Ckt.	SD-1E 581-01
DS-1/MFAT Port Carrier	SD-1E 582-01
AUDIX Control Ckt.	SD-1E 587-01
Remote Group Housing	SD-1E 600-01

15. GLOSSARY

This section provides explanations for acronyms and definitions of terms used in this document.

AAR
    Automatic Alternate Routing

ACA
    Automatic Circuit Assurance

ACTGA
    Attendant Control of Trunk Group Access

ACU
    Automatic Calling Unit

ADU
    Asynchronous Data Unit

AIOD
    Automatic Identification of Outward Dialing

ALU
    Arithmetic Logic Unit

AMA
    Automatic Message Accounting

AP
    Applications Processor

ARL
    Attendant Release Loop

ARS
    Automatic Route Selection

ASCII
    American Standard Code for Information Interchange

ATMS
    Automatic Transmission Measurement System

AUDIX
    Audio Information Exchange

AUTOVON
    Automatic Voice Network

AVD
    Alternate Voice/Data

Alerting
    Audible and/or visual (lamp) signals indicating arrival of a terminating call.

Analog
    Of or relating to data in the form of directly measurable quantities.

Analog Voice Terminals
    Voice terminals served by a single-line tip and ring circuit (2500 series and 7100A series).

Answer-Back

An assigned number used to respond to a page from a code calling or loudspeaker paging system, or to reestablish a parked call.

Answer-Hold

A feature access code that, when dialed, places the current call on hold and establishes a connection with the attempted call.

Appearance Button

A button on a voice terminal accessing an appearance of an extension number; indicator lamps next to the button light when a terminal user makes outgoing calls, receives incoming calls, or holds calls. Any 2-lamp button on a multi-appearance voice terminal can be assigned as an appearance button.

Applications Programs

The software that provides features and functions for the applications processor.

Architecture

The formation or construction of hardware and/or software.

Asynchronous Data Transmission

A scheme for sending and receiving data when there is no restriction on when data elements may occur.

Auxiliary Trunk

A trunk circuit used to connect auxiliary equipment to a switching system, for example, Radio Paging.

B8ZS

Bipolar with 8 Zero Substitution

BCT

Business Communications Terminal

BHC

Busy Hour Calls

BLF

Busy Lamp Field

Backup Terminal

A voice terminal used with the Centralized Attendant Service feature to answer calls at a branch location when the attendant at the main location is not available.

Baud Rate

A unit of transmission speed equal to the number of code elements per second.

Bit (Binary Digit)

One unit of information in binary notation (having two possible states or values: zero or one).

Bit-Swapping

The process of using the parity bit to replace a defective bit in a memory word.

Bit-Synchronous

A bit is returned to the original transmitting source for each transmitted bit.

Bootstrap Memory

An area of memory, undisturbed by removal of operating power, used to initialize a processor for operation.

Bootstrap Program

A program contained in bootstrap memory which copies the UNIX operating system from hard disk to main memory.

Buffer

A circuit or component which isolates one electrical circuit from another. In software, an area of memory used for temporary storage.

Bus

One or more conductors used as a path over which information is transmitted.

Byte

A single unit of binary digits, usually consisting of 8 bits processed together.

CAS

Centralized Attendant Service

CCS (Hundred Call Seconds)

A traffic-measuring unit that expresses the load of one or more traffic-handling devices. A device used for 1 hour without interruption generates 36 CCS which equals 1 erlang (see Erlang).

CDRR

Call Detail Recording and Reporting

CHAPS

Customized Hardware and Pseudo Software

CPFT

Customer Premise Facility Terminal

CRT

Cathode Ray Tube

CSU

Channel Service Unit. This term is synonymous with NCTE (Network Channel Termination Equipment).

C Language

A general-purpose computer programming language.

Central Office (CO)

A place where public telephone switching equipment is housed.

Central Office (CO) Trunk

A telecommunications channel on the public network between the CO and System 85.

Channel

A communications path over which voice or data signals are carried.

Clock Bus

A conductor or group of conductors carrying clock signals.

Common Control Switching Arrangement (CCSA)

A private telecommunications network using dedicated trunks and a shared switching center for interconnecting company locations.

Cycle Stealing

A memory cycle stolen from the normal Central Processing Unit (CPU) operation for a direct memory access operation.

DCE

Data Communications Equipment

DCIU
Data Communications Interface Unit

DCP
Digital Communications Protocol

DCS
Distributed Communication System

DDC
Direct Department Calling

DDD
Direct Distance Dialing

DID
Direct Inward Dialing

DM
Data Management

DMA
Direct Memory Access

DMI
Digital Multiplexed Interface

DOD
Direct Outward Dialing

DS-1
Digital Service-1

DSP
Digital Signal Processor

DTDM
Digital Terminal Data Module

DTE
Data Terminal Equipment

DTMF
Dual-Tone Multifrequency

DTR
Data Terminal Ready

DUP
Duplication/Update

Data Buffer
An electronic storage area, for blocks of data, between two processing devices or programs.

Data Communications Equipment (DCE)
Any equipment that connects to a data terminal device using an EIA RS-232C interface. These may include communication devices, modems, common carrier lines, and facilities that interconnect data terminal equipment.

Data Communications Interface Unit (DCIU)
An interface between the System 85 main processor (501CC) and APs, AUDIX equipment, or (in a DCS configuration) other switches. The DCIU consists of four circuit packs in the common control carrier.

Data Service Unit

A device designed to transmit digital data on transmission facilities.

Data Terminal Equipment (DTE)

A terminal that serves as a data source or a data link allowing the data communication control function to be performed in accordance with a link protocol.

Demultiplexer

A device or circuit used to separate two or more signals transmitted over a single channel that were previously combined by a compatible multiplexer.

Digital Trunk

A circuit in a telecommunications channel designed to handle data.

Direct Distance Dialing (DDD)

Long distance calls completed without operator assistance.

Direct Extension Selection (DXS)

An option on an attendant console which allows an attendant direct access to an idle voice terminal (inside the system) by pressing a hundreds button and a tens and units button.

Disk Drive

A mechanism used to store data on and retrieve data from one or more magnetic platters (disks).

Duplex Data Link

Electronic equipment that permits automatic transmission of digital information between two points simultaneously in both directions.

Duplicated Common Control

Two processors assuring continuous operation of the System 85 switch. While one processor is on-line, the other is used as a backup. The backup processor goes on-line periodically or when a trouble condition occurs.

Dynamic Memory

A type of semiconductor memory in which the presence or absence of an electrical charge represents the two states of a storage element.

ECC

Error Correction Code

ECTS

Electronic Custom Telephone Service

EDC

Electronic Document Communications

EIA

Electronics Industries Association

EMI

Electro-Magnetic Interference

ETN

Electronic Tandem Network

EUCD

Enhanced Uniform Call Distribution

Emulation Code

The software that permits programs written for one computer to be run on another computer.

Enhanced Private Switched Communications Service (EPSCS)

A private network that provides advanced voice and data telecommunications services to companies with a large number of locations.

Erlang

A traffic-measuring unit that expresses the load of one or more traffic-handling devices [36 CCS equals 1 erlang—see CCS (Hundred Call Seconds)].

FADS

Force Administration Data System

FIFO

First-In First-Out

FM

Facilities Management

FRL

Facilities Restriction Level

Foreign Exchange (FX)

A central office other than the one located in the calling customer area.

General Purpose Port (GPP)

A port used for either a digital telephone or a data module.

HCMR

High Capacity Mini-Recorder

HDLC

High-Level Data Link Control

Handshaking Logic

Logic circuits used to establish a data connection between two devices.

Hard Disk

A rigid magnetic platter used to store data.

Hundred Call Seconds (CCS)

A traffic-measuring unit that expresses the load of one or more traffic-handling devices. A device used for 1 hour without interruption generates 36 CCS which equals 1 erlang (see Erlang).

Hybrid

Of or relating to processing of both analog and digital data.

ICI

Incoming Call Identification

ID

Identification

IDI

Isolating Data Interface

IDS

Intermodule Data Store

IOB

Input/Output Bus

ISN

Information Systems Network

I/O Command

Signals to and from input and output (I/O) equipment resulting from I/O instructions.

I-Use Lamp

An indicator lamp on a multi-appearance voice terminal that indicates whether or not a particular appearance is in use.

Image

A means of accessing an appearance. It is a button on a multi-appearance voice terminal, a port for an Analog/Digital Facility Test Circuit (ADFTC) board, and an "implicit button" for a single-line voice terminal or data module.

Intelligent Terminal

A data terminal containing a microprocessor to reduce the data transmitted and to expand the data received.

Interface

A common boundary between two systems or pieces of equipment.

LAN

Local Area Network

LCT

Local Clock Termination

LDN

Listed Directory Number

LDSU

Local Distribution Service Unit

LED

Light-Emitting Diode

LGI

Light Guide Interface

LPI

Lines Per Inch

LSI

Large Scale Integration

LWC

Leave Word Calling

Line

Single-line—the family of voice terminals that can be connected to only one call at a time

Multi-appearance—the family of voice terminals on which several calls (usually a maximum of three) can be handled at the same time on the same extension number.

Line Port

The hardware providing the access point to the system switching network for each circuit associated with an extension.

Link

A transmitter-receiver channel or system that connects two locations.

MAAP

Maintenance and Administration Panel

MADU

Multiple Asynchronous Data Unit

MCC

Module Control Channel

MET

Multibutton Electronic Telephone

MF

Multi-Function

MFAT

Multi-Function Analog Terminal

MFT

Metallic Facility Terminal

MP

Module Processor

MPDM

Modular Processor Data Module

MTDM

Modular Trunk Data Module

MTTR

Mean Time to Repair

Main Location

A centralized area where attendants answer calls routed from branch locations.

Modem

A device that modulates and demodulates signals transmitted over a communications path. Also known as a data set.

mu-255

A type of code by which analog signals are encoded to digital signals.

Multiplexer

A device for simultaneous transmission of two or more signals over a common transmission medium.

NCSC

National Customer Support Center

NCTE

Network Channel Termination Equipment. This term is synonymous with CSU (Channel Service Unit).

NEC

National Electrical Code

NFPA

National Fire Protection Association

NIP

Network Interface Program

NM

Network Management

Network

An interconnected system of transmission lines that provides connections between voice terminals.

Node

A single switch in a DCS network configuration.

OLS

Off-Line-Switcher

OM

Office Management

OTL

Originating Test Line

Off-Loading

The delegation of processing functions by the central processor to peripheral processors.

Off-Premises

A term used to describe System 85 voice or data terminals that are not located within the same building or site as the system digital switch, or having loop lengths greater than 3500 feet (1067 m).

Operation Code

The part of a computer instruction word which specifies the operation to be performed.

PCM

Pulse Code Modulation

PDF

Power Distributing Frame

PDS

Port Data Store

PUR

Port Usage Rate

PROC

Procedure

PROM

Programmable Read-Only Memory

PT

Personal Terminal

PVC

Polyvinyl Chloride

Packet Switching

Time division multiplexing of data information packets over a high-speed digital link.

Parameter

Any set of physical properties whose values determine the characteristics or behavior of something.

Parity

A method of checking the accuracy of binary numbers.

Port

A point of access to the system or to a computer that uses trunks or lines for transmitting or receiving voice or data.

Private Network

A network used exclusively for handling the telecommunications needs of a particular customer.

Protocol

A set of conventions or rules governing the format and timing of message exchanges to control data movement and correction of errors.

Public Network

A network which can be openly accessed for local or long distance calling.

Queue

An ordered sequence of calls waiting to be processed.

Queuing

The process of placing calls in an ordered sequence waiting for an idle trunk.

RCC

Remote Carrier Controller

RCL

Remote Carrier Local

REN

Ringer Equivalence Number

RGI

Remote Group Interface

RLT

Release Link Trunk

RMI

Remote Module Interface

RSC

Regional Support Center

RTD

Recorded Telephone Dictation

Radio Paging Trunk

A telecommunications channel used to access paging transmitter equipment.

Random Access Memory (RAM)

A storage arrangement where information can be written into and retrieved from memory with a speed that is independent of the location of the information in storage.

Read-Only Memory (ROM)

A storage arrangement only for information retrieval applications.

Read Operation

The process of retrieving information from memory.

Refresh

The periodic renewing or restoring of data or data-carrying electrical charge in a semiconductor memory.

Register

A short-term storage circuit usually having a capacity of one computer word.

Remote Access Trunk

A telecommunications channel used by an authorized user to gain access to System 85.

Ringing

Audible signals indicating arrival of a terminating call.

SCS

System Clock Synchronizer

SDCP

Switched Digital Communications Protocol

SM

System Management

SMDR

Station Message Detail Recording

SMT

System Management Terminal

SSI

Standard Serial Interface

S-Channel

A channel used for communicating control signals between System 85 and a data module.

Sampling Switch

A time division switch that samples a common bus at a rate of approximately 8000 times per second.

Scanner

A circuit or device that samples each of a group of circuits to determine busy or idle status.

Serial Data

An operation where data is transmitted or processed 1 bit after the other.

Soft Switch

A planned transfer of system control from one processor to another that does not affect service.

Software

A set of computer programs designed to accomplish one or more tasks.

Standard Serial Interface (SSI)

A communications protocol that interfaces the AP to 400-series printers and the 500 BCT.

Status Information

Information defining the current state of call processing within a switching system.

Status Lamp

An indicator lamp showing the status of a call appearance by the state of the lamp (lighted, flashing, fluttering, or dark).

Stored Program Control

Software programs controlling system operation.

Stored Programs

A set of instructions in computer memory specifying the operations to be performed and the location of the data on which these operations are to be performed.

Switch

The software-controlled communications processor complex that interprets dialing pulses/tones/keyboard characters and makes the proper interconnections both within the system and external to the system. The switch itself consists of a digital computer, software, storage device (memory), and carriers with special hardware to perform the actual connections.

Switched Digital Communications Protocol Interface (SDCPI)

An interface that connects a data module with a port in the AP. Its primary function is to provide System 85 with a link for downloading AP files into the 515 BCT.

Switched Loop Operation

An automatic system in which an incoming call is switched to an idle loop on an available attendant console.

Synchronous Data Transmission

A scheme for sending and receiving data, where data elements may occur only at regular specified times. Sending and receiving devices must operate in step with each other.

System Administrator

An executive responsible for specifying features and/or services available to system users.

System Reload

A process that allows stored data to be written from a tape into the system memory.

System Status Indicator

A lamp on a panel that indicates the busy/idle condition of Release Link Trunks.

TCM

Terminal Change Management

TMS

Time Multiplexed Switch

TSI

Time Slot Interchanger

TTL

Transistor-Transistor Logic

Tandem Tie Trunk Network (TTTN)

A private network in which several customer switching systems are interconnected.

Tie Trunk

A telecommunications channel between two switching systems.

Tone Ringer

A device with a speaker used in electronic voice terminals to alert the user.

Tractor Feed

A mechanism used to advance paper for a printer.

Translations

Specific information assigned to a terminal or to the system and customized for the user.

Trunk

A communications channel between two switching systems.

Trunk Port

The hardware providing the access point to the system switching network for each circuit associated with a trunk.

Turnkey

A button on a backup voice terminal (used with the Centralized Attendant Service feature at a branch location); when turned clockwise or counterclockwise, switches between on-hook and off-hook status; when pressed, flashes the switchhook.

UCD

Uniform Call Distribution

UL

Underwriters Laboratories

UM

Unified Messaging

UNIX Operating System

A time-sharing software operating system for data processing equipment.

UPCI

Universal Port Control Interface

UPDI

Universal Port Data Interface

USOC

Universal Service Ordering Code

VIAS

Visually Impaired Attendant Service

VM

Voice Management

Voice Service

The switching and transmission of voice frequencies.

Voice Terminal

A single-appearance or multiappearance telephone.

Wide Area Telecommunications Service (WATS) Trunk

A telecommunications channel used for special direct distance dialing rates.

Write Operation

The process of putting information into memory.

X.25 Packet Software

Programs designed to implement X.25 protocol.

ZCS

Zero Code Suppression

16. INDEX