AT&T

555-105-201
Issue 1
June 1992

DEFINITY ®

Communications System

Generic 2

System Description

Notice

While reasonable efforts were made to ensure that the information in this document was complete and accurate at the time of printing, AT&T can assume no responsibility for any errors. Changes and corrections to the information contained in this document may be incorporated into future reissues.

Your Responsibility for Your System's Security

You are responsible for the security of your system. AT&T does not warrant that this product is immune from or will prevent unauthorized use of common-carrier telecommunication services or facilities accessed through or connected to it. AT&T will not be responsible for any charges that result from such unauthorized use. Product administration to prevent unauthorized use is your responsibility and your system administrator should read all documents provided with this product to fully understand the features available that may reduce your risk of incurring charges.

Federal Communications Commission Statement

Class A Statement. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Operation of this equipment in a residential area is likely to cause interference, in which case the user at his/her own expense will be required to take whatever measures may be required to correct the interference.

Network Registration Number. This equipment is registered with the FCC under FCC network registration number AS593M-11185-MFE.

Answer-Supervision Signaling. Allowing this equipment to be operated in such a manner as to not provide proper answer-supervision signaling is in violation of Part 68 rules. This equipment returns answer-supervision signals to the public switched network when:

- Answered by the called station
- Answered by the attendant
- Routed to a recorded announcement that can be administered by the CPE user.

This equipment returns answer-supervision on all DID calls forwarded back to the public switched telephone network. Permissible exceptions are:

- A call is unanswered
- A busy tone is received
- A reorder tone is received

Trademarks

DEFINITY is a registered trademark of AT&T. In this document, DEFINITY Communications System Generic 2 is often abbreviated to DEFINITY Generic 2 or Generic 2

Ordering Information

The ordering number for this document is 555-105-201 To order this document, call the AT&T Customer Information Center at 1-800-432-6600 (in Canada, 1-800-255-1242). For more information about AT&T documents, refer to the *Business Communications Systems Publications Catalog* (555-000-010).

Comments

To comment on this document, return the comment card at the front of the document.

Acknowledgment

This document was prepared by the AT&T Technical Publications Department, Denver CO.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Overview

This document contains general technical information about DEFINITY* Communications System, Generic 2.1 and Generic 2.2, plus Release 2 of AT&T's System 85. It is intended for use by AT&T sales and technical personnel. A detailed index and a glossary which includes abbreviations and acronyms are provided at the end of this book.

Within this manual, *Generic 2* refers to AT&T DEFINITY Communications System, Generic 2.1 and Generic 2.2, while *System 85* refers to AT&T System 85, Release 2.

Organization

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

- **Functional Description**
- **System Hardware**
- **Peripheral Equipment**
- **Features and Services**
- **Software Description**
- **System Administration**
- **Reliability and Maintenance**
- **System Engineering**
- **System Power**
- **Upgrades and Additions**
- **References**
- **Glossary**
- **Index**

* DEFINITY is a Trademark of AT&T

Introduction

Generic 2 is a digital switching system which integrates voice and data communications. Generic 2 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, modular design, and a Busy Hour Capacity of up to 54,500 calls.

Generic 2 uses μ -1aw PCM for voice switching and ISDN—BRI or DCP (an AT&T proprietary protocol) for integrated voice-data switching. Since switching is entirely digital, high-speed data connections can be made between mainframe computers, data entry terminals, and personal computers. ISDN (Integrated Services Digital Network), DSl (Digital Service 1), RS232C, RS-449, and V.35 interfaces are among the industry-wide standards accommodated by Generic 2.

A variety of "data modules" provide interfaces to the digital switch 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.

Several attractive voice terminals (phones) are available for Generic 2. Models range from basic desk telephones to multiappearance voice terminals. Most of these voice terminals accept optional adjuncts which expand their capabilities.

Software residing on adjunct processors enhance the communications capabilities of Generic 2 by providing comprehensive voice, data, and network management services. Generic 2 offers its own messaging services and can work in conjunction with messaging server or other adjuncts suchh as the AUDIX™ voice messaging system.

To get a general idea of the types of equipment Generic 2 interconnects, look at Figure 1-1. A detailed index (including references to these and other equipment) is provided at the end of this document.

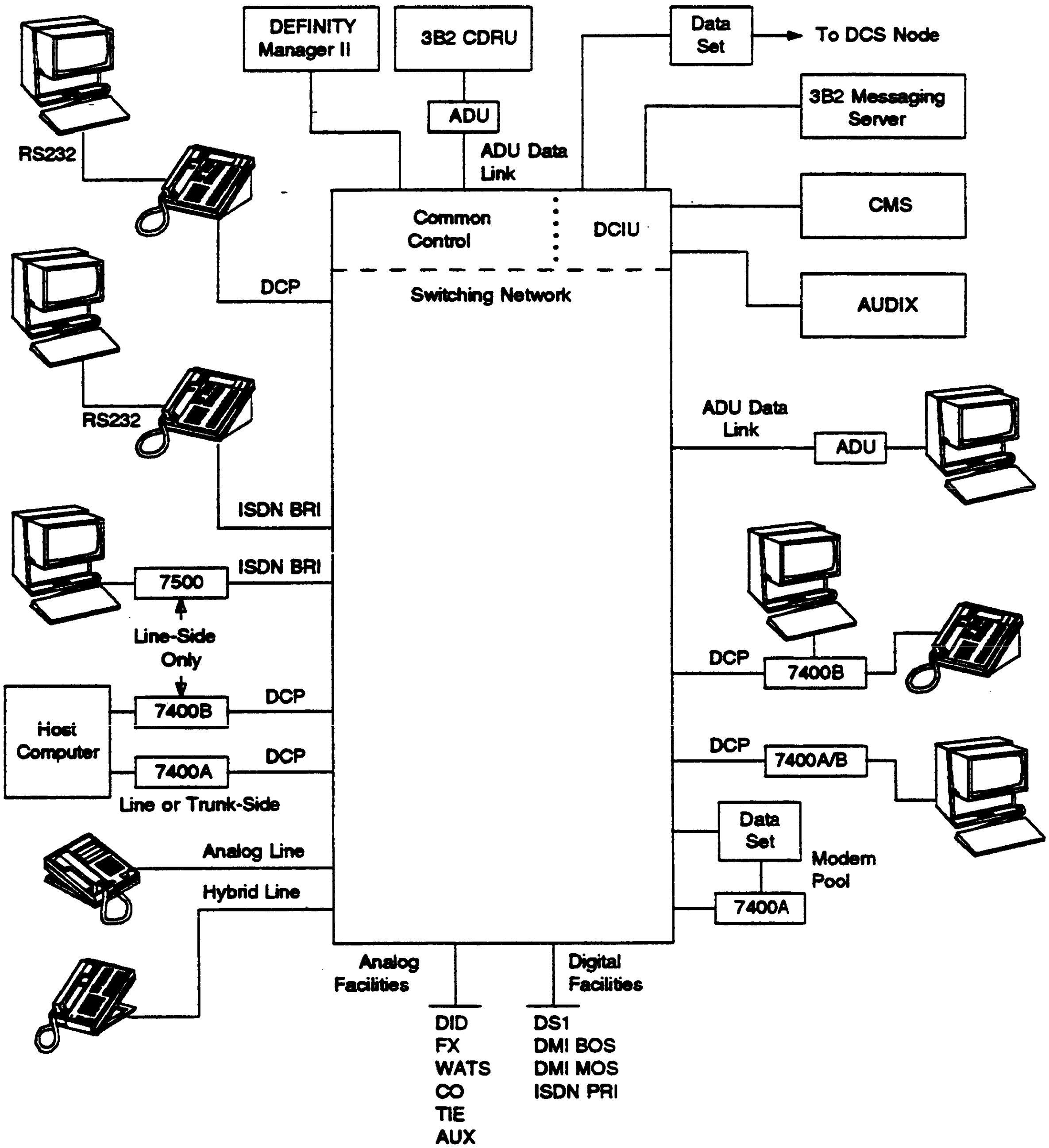


Figure 1-1. Typical Generic 2 Components

Introducing DEFINITY Generic 2

Generic 2 uses universal modules which house universal port hardware, such as that employed in DEFINITY Generic 1 and System 75. The universal module is a 5-carrier single cabinet replacement for a traditional System 85, Release 2 multicabinet call processing module. Traditional modules usually require more than one cabinet to house the module control complex and the module's port circuits.

The Generic 1/System 75 port technology used in universal module port hardware allows a greater circuit density than does traditional System 85 port technology. In most cases, universal port hardware circuits offer twice as many ports per circuit pack as do their traditional module counterparts. Furthemore, the universal module's port carriers have 20 line and trunk port-pack slots per carrier rather than the 16 line and trunk port-pack slots per carrier found in traditional port carriers. The result is a single-cabinet module that requires less floor space in the equipment room.

The Generic 2 system is a merging of System 75 and System 85 technology offering a viable migration plan from System 75 to the larger line sizes that were previously available only with System 85. Specifically, a System 75 can now be upgraded to a Generic 2 universal module. Since there are some limitations on which System 75s can be upgraded, please refer to *DEFINlTY Communications System Generic 2 and System 85 Upgrades* (555-104-111) for details.

Although traditional (System 85 type) modules are available with Generic 2, the reduced floor space required by the universal module, plus the universal module's support of the new ISDN—BRI (Integrated Services Digital Network Basic Rate Interface), make it the module of choice. ISDN—BRI capability is not available on traditional modules.

A new line of fiber optic transmitters and receivers, based on AT&T's ODL*-50 lightwave data link family, extends the maximum range for remote modules to 25,000 feet (7.6 km). This is almost twice the System 85 limit of 13,000 feet (4 km).

A combined Common Control/TMS (Time Multiplexed Switch) cabinet replaces the J58886J and J58886K unduplicated and duplicated common control cabinets. The J58886F TMS cabinet will still be available for larger systems (the CC/TMS cabinet has only two carrier positions available for the TMS).

Differences also exist between the System 85 common control and the Generic 2 common control. A DTS (Disk/Tape System) is used instead of a HCMR (High-Capacity Minirecorder). The 140 Mbyte hard disk drive included in the DTS dramatically improves system reload time. Another major change is the introduction of DEFINITY* Manager II which is used instead of the MAAP/SMT (Maintenance and Administration Panel/System Management Terminal) maintenance and administration devices. DEFINITY Manager II is a PC based administration and maintenance tool offering a better user interface than those available with System 85.

* Registered trademarks of AT&T.

Another common control improvement available with Generic 2 is a new cache memory circuit (TN379) for the 501CC processor.

Several new terminal models are being introduced with Generic 2. Perhaps the most important of these are the ISDN—BRI terminal products. These include three voice terminal models, an asynchronous data module that is an option for voice terminals, and a stand-alone data module.

Voice terminal administration has been enhanced allowing new terminal-type encodes to be defined. This flexible administration strategy eliminates the need to “alias” new voice terminal models as existing model types when new models are introduced in the future.

DEFINITY Generic 2.2, Feature Changes

New Features for Generic 2.2

The following features are new with Generic 2.2:

- Call Work Codes — allows customer-defined codes to be entered from an agent's DCP (Digital Communications Protocol) phone and sent to a CMS (Call Management System) adjunct, assuming the agent is measured by and logged into CMS. The switch forwards the codes to the CMS adjunct Work codes defined by customers might include call activity codes or codes for gathering call-related data such as credit card numbers or social security numbers.
- Expert Agent Selection — enhances Call Vectoring and ACD (Automatic Call Distribution) capabilities by distributing selected ACD calls to subsets of ACD agents who are members of larger splits. These agent subsets are based on the agents' call-handling skills, which could be based on agent training, type of product or service, foreign-language skills, or other expertise.
- World Class Routing — provides flexible call routing for most customer network calls through a single feature. WCR combines the routing capabilities of the previous network routing features AAR (Automatic Alternate Routing) and ARS (Automatic Route Selection) plus relaxes most of the constraints on these earlier features.

Enhanced Features

The following features are enhanced for Generic 2.2:

- ACD (Automatic Call Distribution)

  — 2048 agents per system

  The maximum number of ACD agents per system has been increased from 1024 to 2048.

  — Split-size restrictions removed

  Split-size restrictions have been removed. previously, the size of an ACD split had to be specified in multiples of 16; now, an ACD split may contain any number of agents from 0 to 1024 (1023 if the split is measured by CMS).

  — Splits administered as "measured by CMS"

  CMS can measure up to 1023 extension numbers. Previously, individual extension numbers or a range of extension numbers had to be assigned as "measured by CMS;" now, all extension numbers in an individual ACD split can be assigned at once as "measured by CMS" or "not measured by CMS."

  — 106B display unit lamp assignments based on extension number

  In some ACD applications, lamps on 106B display units are used to monitor agent calling activity. Previously, 106B lamp assignments were based on agent split- and member-numbers; now, lamp assignments are based on extension numbers. This enhancement allows agents to be reassigned to other splits without having to change their106B lamp assignments.

— CMS-status indication for stroke-count buttons

When the stroke count function is assigned to a button with a status lamp and that button is pressed, the status lamp will either be steadily lit for 2 seconds if a message can be sent to CMS or it will flash for 2 seconds if a message can't be sent to CMs.

- Call Vectoring

  — 511 vectors per system

  The maximum number of vectors per system has increased from 128 to 511.

  — "go to vector" command

  This new command lets vector processing branch to a different vector.

  — 255 recorded announcement trunks

  The maximum number of recorded announcement trunks has increased from 84 to 255.

  — 475 abbreviated dialing group-list items

  The maximum number of abbreviated dialing group-lists that can be used by the "route-to" command has increased from 1 group-list to 5 group-lists. Consequently, the maximum number of group-list items has increased from 95 to 475 since each group-list may contain up to 95 items.

- IXC (Interexchange Carrier) Access

  In previous versions, IXC Access was controlled completely by switch administration. There was no way a caller could specify a particular IXC. Beginning with Generic 2.2, an administerable option isavailable through the WCR feature that allows the caller to enter an IXC code as part of the dialed number.

Feature Name Changes

- AUDIX™ Voice Messaging System

  This feature has been available as the AUDIX (Audio Information Exchange) feature since System 85, Release 2, Version 2. In 1991 the acronym"AUDIX" became trade marked.

- CallVisor™ ASAI Gateway Interface

  This feature was introduced in Generic 2.1 (Issue 3.0) as ITGI (Integrated Telemarketing Gateway Interface). For Generic 2.2, the feature name changes to CallVisor ASAI Gateway Interface.

Feature Independent Enhancements

Some enhancements available with DEFINITY Generic 2.2, are not related to a particular feature. These include:

- **Increased number of ORs (Originating Registers)**

  Previously, the total number of ORs was 300; now, the total number is 512.

- **Increased capacity of ORs**

  Previously, the maximum number of digits an OR could hold was 36; now, the maximum is 68.

Call-Handling Capabilities

Generic 2 can be arranged as a stand-alone system or for access to private networks. It may serve as a tandem node in an ETN (Electronic Tandem Network) or a DCS (Distributed Communication System), or as a tandem or end in a Tandem Tie Trunk Network. 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.

Generic 2 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*
- Up to 6000 physical trunks including CO (Central Office) trunks, DID (Direct Inward Dialing) trunks, tie trunks, FX (foreign exchange) trunks, WATS (Wide Area Telecommunications Service) trunks, and other common carrier trunks.

Please note that these limits cannot always be achieved simultaneously. 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.

The BHC (Busy Hour Capacity) that can be achieved with GeneriC 2 depends on the system's specific hardware configuration, the percentage of intercom calls, incoming and outgoing traffic, the type and mix of voice terminals and the amount of feature usage. For example, a hypothetical system using no features and having 100 percent analog sets could achieve a BHC as high as 63,000 calls. On the other hand, the same system configured with 100 percent digital sets might have a BHC of approximately 53,000 calls. A system with 60 percent analog sets and 40 percent digital that use features such as ARS and SMDR might have a BHC as high as 48,000 calls.

For detailed information on other Generic 2 parameters, refer to Chapter 9, "System Engineering".

* Digital data endpoints include DCP and ISDN—BRI data modules and data stands, as well as the PCs equipped with the PC interface feature.

FCC Rules and Regulations

DEFINITY Communications System Generic 2 and System 85 are 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 EMI (electromagnetic interference). Generic 2 is a fully protected customer switching system registered under the multifunction (MF) category. The system registration number is AS593M-11185-MF-E with a REN (Ringer Equivalence Number) of 3.0A (highest REN of registered interfaces).

Connection Information

The public switched telephone network connection information for Generic 2 interfaces is as follows:

Circuit Pack	Type Service	Interface Jack (USOC)	Type Start	Ringer Equiv.
SN230B TN747B	**2-Wire CO, FX, WATS**	**RJ21X RJ2GX**	**Ground**	**1.0A**
SN232B TN753	**DID**	**RJ21X RJ2GX**	–	**0.0B**
TN492C w/212AR Data set	**2-Wire CO**	**RJ21X**	**Loop**	**0.0A 2.0A**
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	Facility Interface Jack (USOC)	Interface Code	Signal Arrangement
SN233C TN753	**Tie Tie**	**RJ2GX RJ2GX**	**TL31M TL3IM**	— —
SN244	**AIOD**	**RJ21X RJ2GX**	**AX15X**	—
SN228B TN742	**OPS**	**RJ2GX RJ21X RJ11C**	**OL13C**	**Type C, 20 Hz**
SN229	**OPS**	**RJ26X RJ21X RJ11C**	**OL13C**	**Type C, 20 Hz**
SN243B	**OPS**	**RJ2GX RJ21X RJ11C**	**OL13C**	**Type C, 20 Hz**

UL Listing and Recognition

AT&T has pursued UL (Underwriters Laboratories) Listing for all versions of Generic 2 and related equipment. System 85 Release 1, System 85 Release 2, and Generic 2 are Listed under UL file number E116320. The J58886N auxiliary cabinet is not Listed; however, it is Recognized by UL.

Functional Description

This Chapter describes how DEFINITY Generic 2 and System 85 digital switches work and discusses these applications:

- **Private Network Configurations**
  - **— Electronic Tandem Network**
  - **— Main/Satellite/Tributary**
  - **— Distributed Communication System**
- **Data communications**
- **Digital Trunking**
- **Sychronization**
- **ISN (Information Systems Network).**

How DEFINITY Generic 2 and System 85 Work

The DEFINITY Generic 2 and System 85 use a digital switch to route voice or data calls from one point to another (see Figure 2-1). The switch works as follows:

- The common control supervises the operation of the call processing modules and the TMS (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.)
- The common control sets up intramodule calls by telling the module to connect the ports at each end of the call.
- The common control sets up an intermodule call by telling the two modules to connect the ports at each end of the call to the TMS. The common control then instructs the TMS to complete the connection.
- When configured as a single-module switch, there are no intermodule calls; therefore, the TMS is not provided.

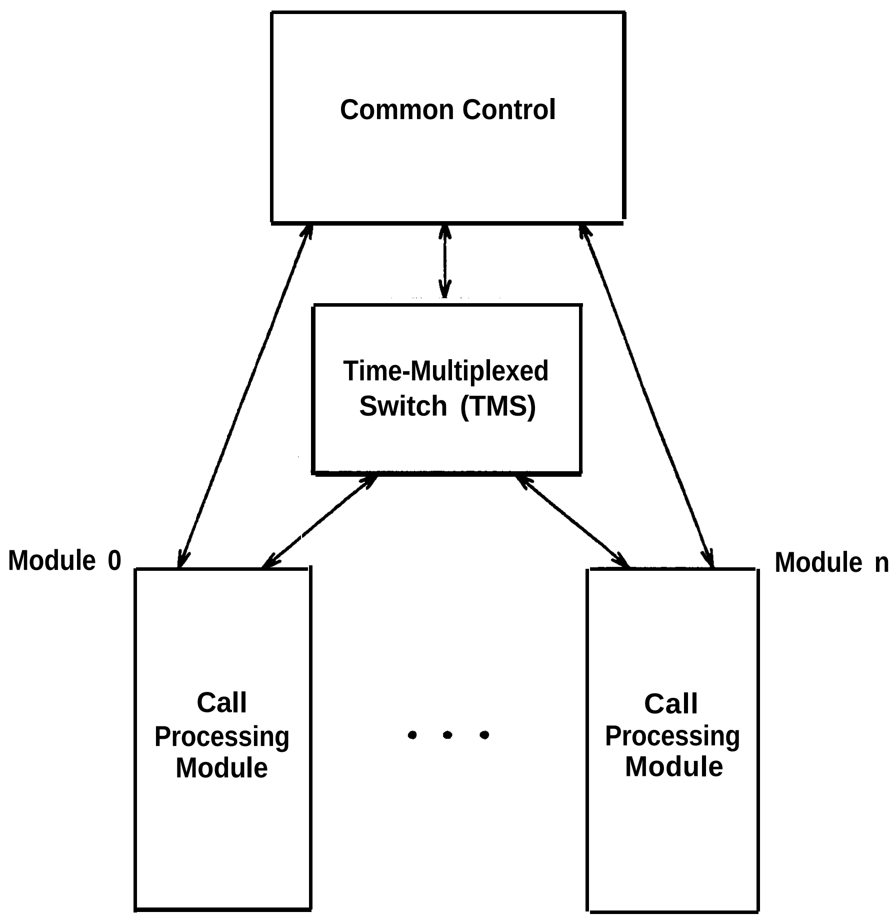


Figure 2-1. Multimodule Switch

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, an optional DCIU (Data Communications Interface Unit), and a variety of other interface circuits.

501CC Processor

The 501CC processor performs high-level call processing by executing programs stored in main memory. The 501CC monitors and controls port-to-port connections 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 (Arithmetic Logic Unit).
4. The 501CC 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. Main memory consists of TN392 1-Megword or TN394 4-Megaword RAM (Random Access Memory) circuit packs. Here are the memory requirements for System 85 R2V2, R2V3, and R2V4; plus DEFINITY Generic 2:

Release	Memory Required	Circuit Packs
DEFINITY Generic 2	16 Megawords	4 TN394s
R2V4	12 Megawords	3 TN394s
R2V3	8 Megawords	8 TN392s or 2 TN394s
R2V2	4 Megawords	4 TN392s or 1 TN394

Each word in memory contains 16 data bits plus 6 bits of ECC (Error Correction Code) for a total of 22 bits. With ECC, l-bit errors are automatically connected and multiple bit errors are detected.

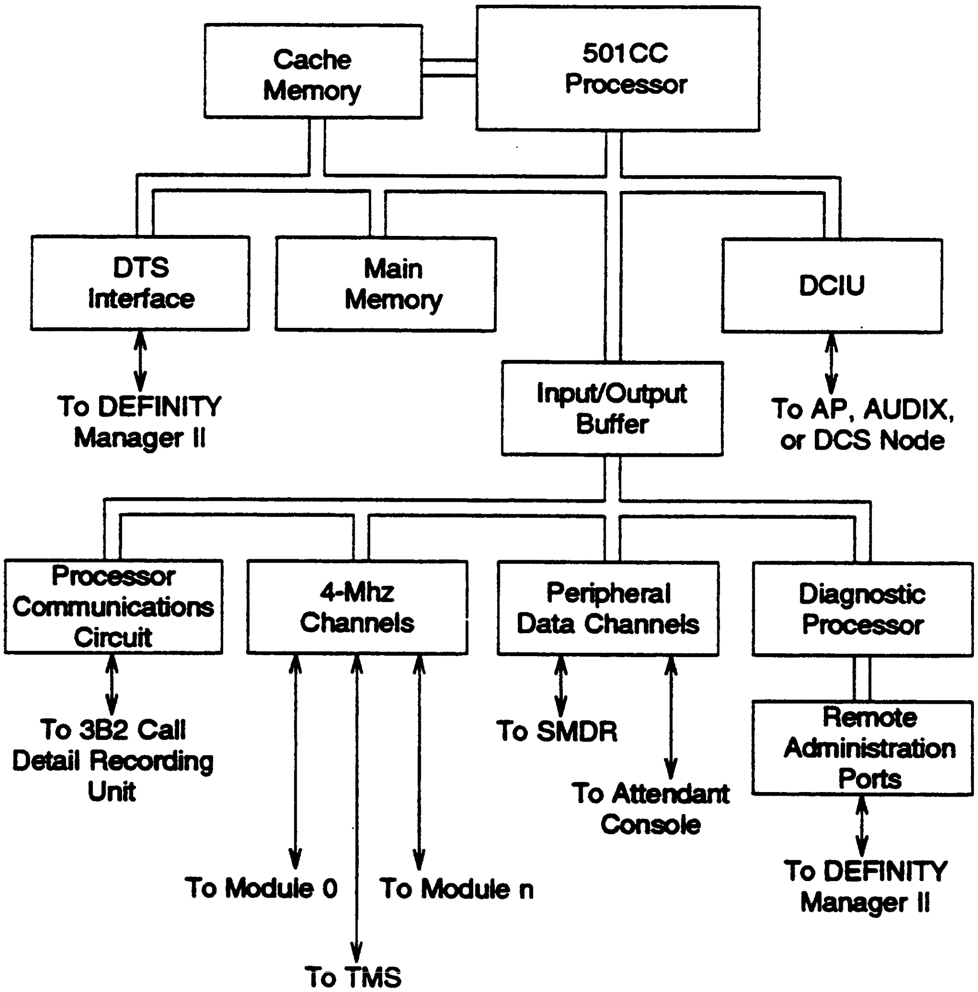


Figure 2-2. Common Control

Cache Memory

The 501CC processor connects to an optional high-speed cache memory over a dedicated bus. The cache memory stores a copy of recently accessed instruction or data words. And it has an access time which is at least three times faster than that of the main memory. This reduces the wait time when the 501CC processor needs to fetch something from memory. 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 (nine out-of ten hit rate). This increases the system's busy hour call throughout capacity.

DEFINITY Generic 2 and System 85 use different cache memory circuit packs. The TN379 cache (used with DEFINITY Generic 2) outperforms the TN369 cache (usd with System 85), even though the TN379 cache is six times the size of the TN369 cache. The increased size of the TN379 cache yields a higher "hit rate" than the TN369.

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 from a remote maintenance facility.

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

DCIU (Data Communications Interface Unit)

The DCIU is the interface between the 501CC processor and:

- APs (Applications Processors)
- AUDIX (Audio Information Exchange) system
- Other DEFINITY Generic 2 or Release 2 System 85 switches
- DEFINITY Generic 1 or System 75 switches
- FP8 Issue 3 Enhanced DIMENSION* PBXs.

Whe a DEFINITY Generic 2 or System 85 is part of a DCS (Distributed Communication Service) network, the DCIU provides the interface between the DEFINITY System 85 and the other switches or PBXs.

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

SCSI Host Adapter or Tape Interface

For DEFINITY Generic 2, the SCSI host adapter gives the DTS (Disk Tape Subsystem) access to the 501CC system bus. The SCSI host adapter also provides two administration and maintenance ports. More information about the DTS appears in Chapter 3.

For System 85, the tape interface connects the 501CC processor to an HCMR (High Capacity Mini-Recorder). The HCMR is equipped with a tape cartridge which maintains a permanent record of main memory contents for initialization and backup.

Remote Interface

The remote interface provides two ports for external communications. Port 0 is used to communicate with the remote maintenance center. This port 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 (System 85), attendant consoles, call detail recording data collection devices, etc.

* Registered trademark of AT&T.

PCC (Processor Communications Circuit)

The TN474B PCC provides an independent, asynchronous, I/O port for communications between the common control's buffered bus and RS-232 peripherals connected to Z3A Asynchronous Data Units. Although two PCC circuits are provided with the TN474B, at this time standard applications allow only one PCC circuit per system. Presently, the main use for the PCC is to forward call detail records to CDRUs (Call Detail Recording Units) such as the 3B2 CDRU.

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

There is also a maintenance bus (not shown in Figure 2-3).

System Bus

The system bus provides a path for the floowing 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 Chapter 3, 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 DMA (Direct Memory Access). DMA allows faster and more efficient data transfer.

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, PCC, 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.

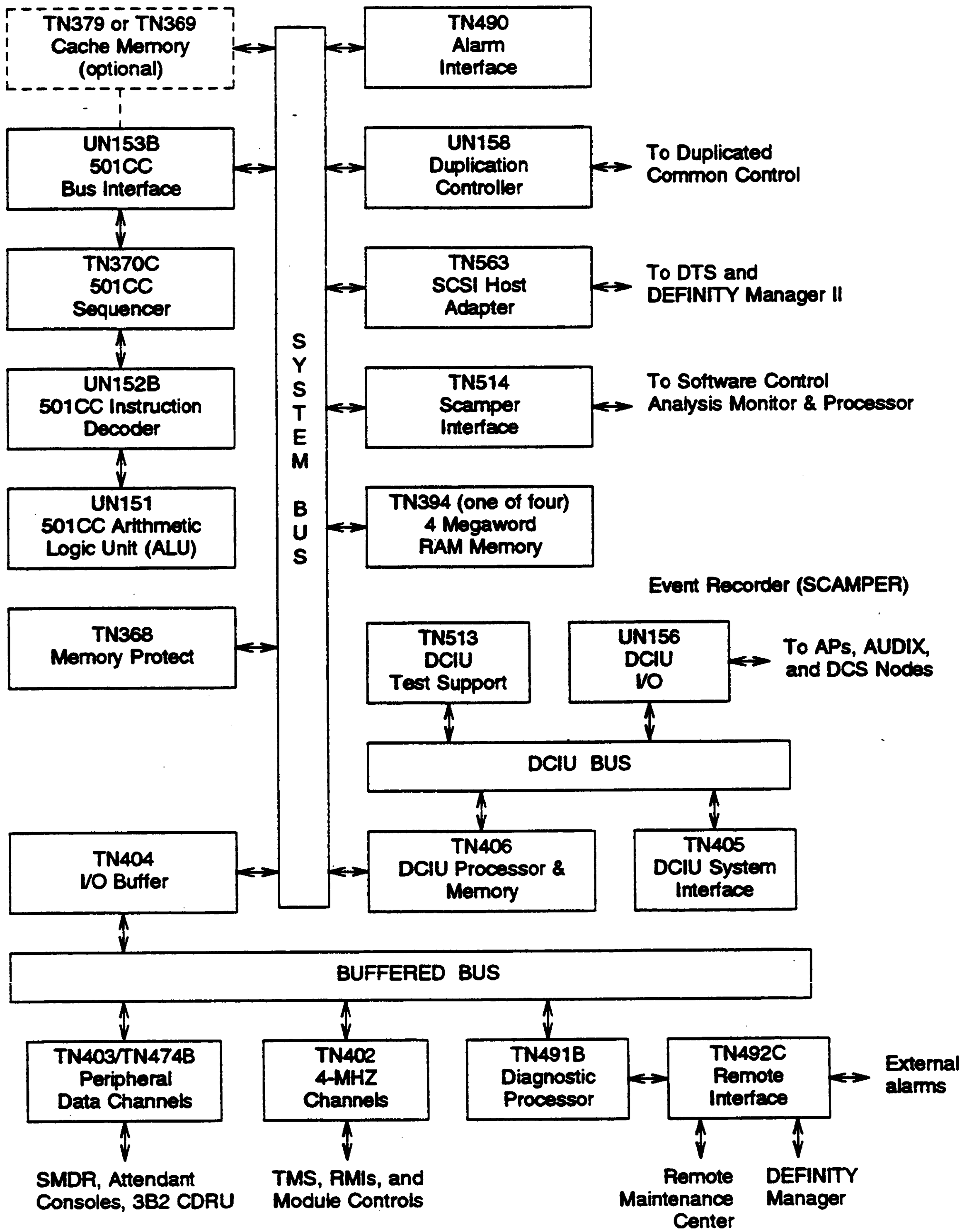


Figure 2-3. Common Control Buses

TMS (Time-Multiplexed Switch)

The TMS (see Figure 2-4) is a digital switch that provides voice and data connections between modules in a multimodule configuration. 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. (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 l-way connections between the module interface circuits.
5. The samples are passed through the TMS switch fabric to the module interface circuits and then 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 their respective ports.

Intermodule data connections are handled the same way.

The rest of this section explains how the TMS operates. The following major functional areas are described:

- Module interfaces
- Switch
- Control structure
- System Clock Synchronizer
- TMS Bus Structure

Module Interfaces

Each module interface circuit (TN480) 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.

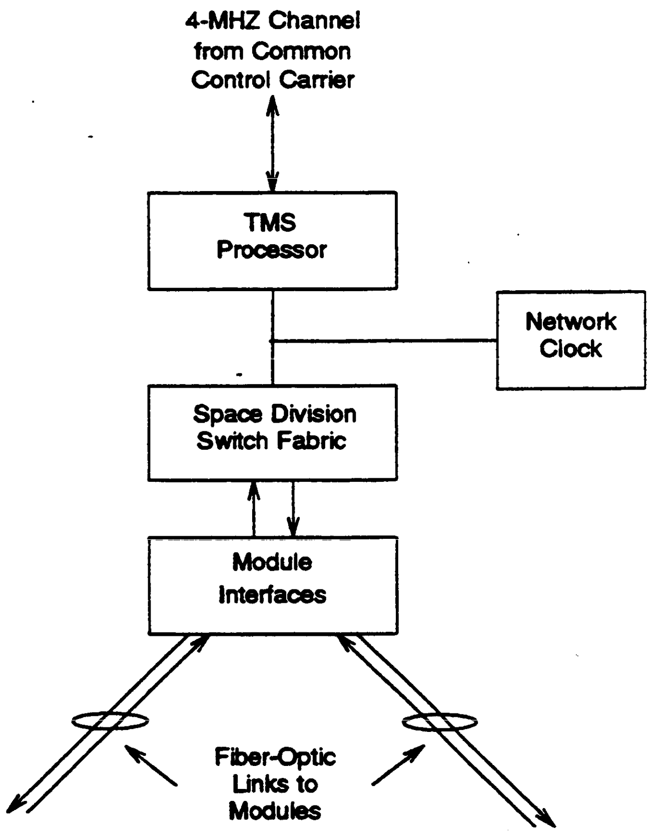


Figure 2-4. Time-Multiplexed Switch

Switch

The TMS uses a switching method that is different from the one used by call processing modules. The method is called *time-multiplexed space switching.* Space switching means the TMS has switch fabric where actual physical connections are made (see Figure 2-5). Moreover, spare switching is combined with time multiplexing (a time sharing strategy) such that the TMS switching fabric is reconfigured into 256 separate connection patterns.

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 or data or can 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 add two l-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 just 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 TMS switch consists of three types of circuits:

1. Fan Out (TN473)
2. Fan In (UN150)
3. Switch Fabric Multi-plexers (TN470s).

Control Structure

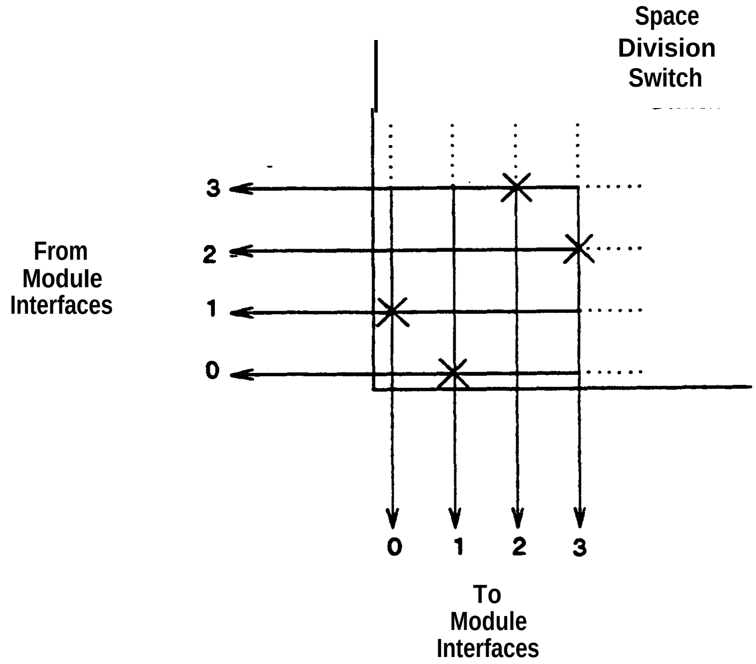
The TMS has a processor (TN381) that carries out commands from the common control and tells the switch which connections to establish. It also participates in maintenance and diagnostic routines.

System Clock Synchronizer

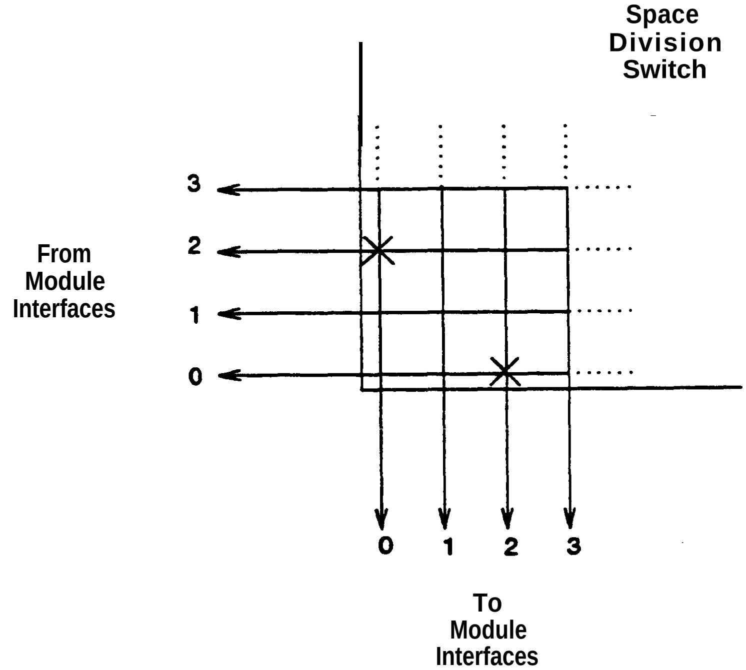
The system clock synchronizer (TN463) is located in the TMS for multimodule systems. (For a single-module system, it is located in the module control.) When synchronization to a high-speed digital facility is required, this circuit can slave to external clock sources.

The synchronization clock is an alternative to the TN463 clock. This is an external stratum 3 clock that interfaces to the switch through a TN2131 external clock interface board.

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 time slot N + 1:
One 2-way call established between modules 0 and 2

Figure 2-5. Space Division Switch Functional Illustration

Traditional Module Architecture

Traditional module architecture is depicted in Figure 2-6.

The TN401 is the interface between 4 MHz serial I/O link from the common control and the module processor bus.

The TN380D module control processor performs the following tasks:

- Controls the TSI (Time Slot Interchanger)
- Controls port circuits
- Scans ports for off-hook conditions and button depressions
- Collects dialed digits
- Gathers traffic data
- Assists with maintenance

The module I/O bus interface circuits (TN400Bs) allow the module processor to send control signals to, and receive status information from, the port carriers. Each TN400B serves four port carriers.

Two circuits make up the TSI: the TSI P-Store (TN445) and the TSI ALU (Arithmetic Logic Unit) (TN446). The TSI performs digital switching for the module. In addition to the 2-port intramodule connection, the TSI can create a 3-way conference connection performing any necessary loss calculations with its ALU. The TSI also sets up part of the connection used for intermodule calls by connecting ports to the fiber-optic link which terminates at the TMS.

Port data stores (TN440Bs) hold PCM voice and data samples to be switched by the TSI. Port data stores also store PCM voice and data samples received from the TSI. A port data store buffers PCM voice and data samples received from the TSI bus. These received samples are sent over a PCM cable to a port data interface circuit in a port carrier. The port data interface circuit sends the samples to the desired port circuits. In the other direction, PCM voice and data samples are sent from the port circuits to a port data interface circuit in the port carrier. These samples are then sent over a PCM cable to a port data store circuit in the module control complex. The port data store buffers these samples and finally puts them onto the TSI bus. Each TN440B serves two port carriers.

The Intermodule Data Store (TN441) is similar to a port data store. But, instead of storing transmit and receive samples for ports, the TN441 stores transmit and receive samples for the fiber-optic link to the TMS.

The light-guide interface (TN481) multiplexes PCM voice and data samples for transmission to the TMS. The TN481 also demultiplexes samples received from the TMS and sends them to the intermodule data store.

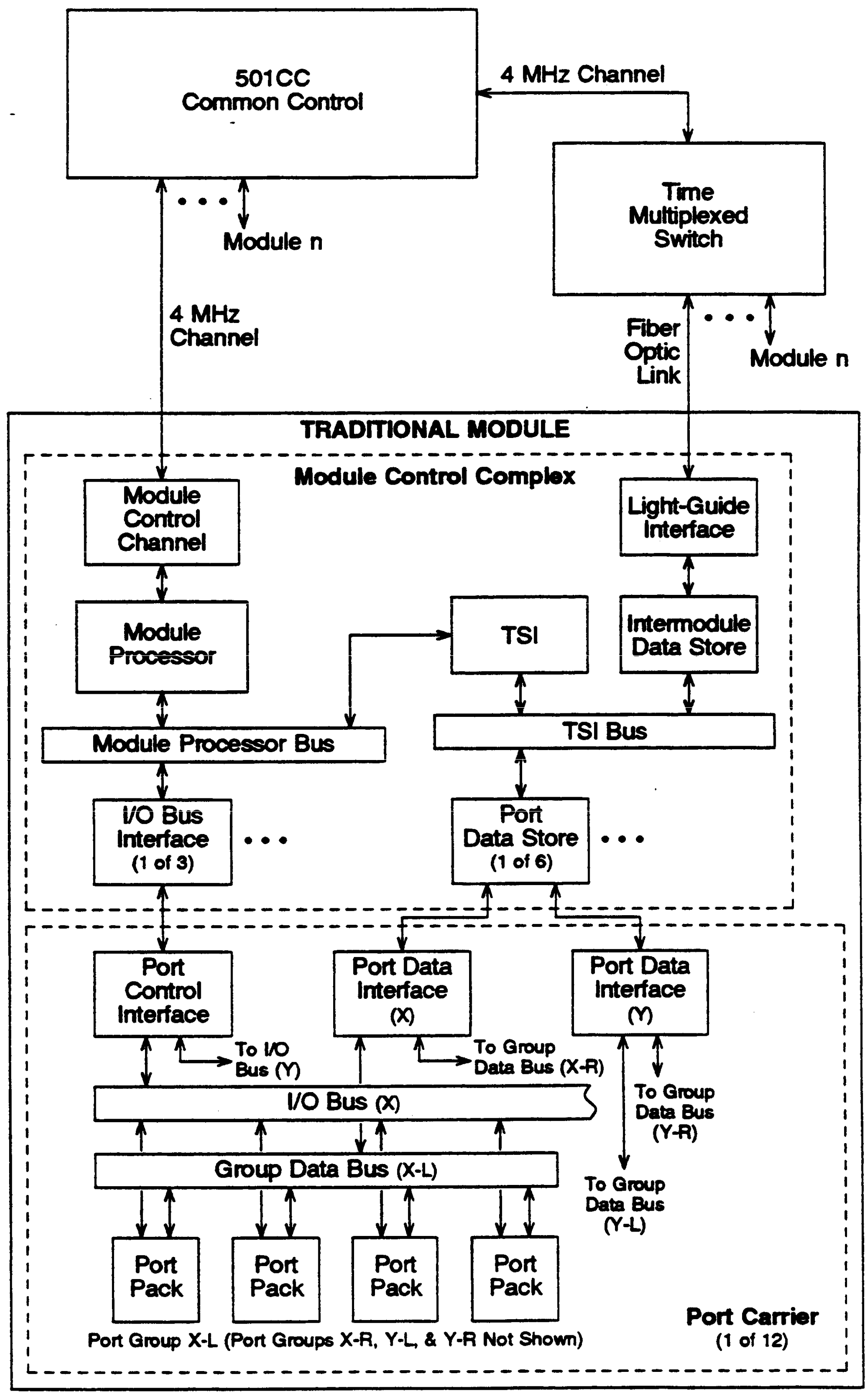


Figure 2-6. Traditional Module Block Diagram

Universal Module Architecture

DEFINITY Generic 2 universal module architecture is a combination of System 85 and System 75 architectures. This hybrid design uses a modified System 85 module control complex to operate System 75 based port circuit packs (see Figure 2-7).

Module Control Complex

The most important modification to the module control complex is the addition of the universal bus interface circuit. It allows the module control complex to operate System 75 universal port hardware. This circuit also eliminates the need for port data stores and I/O bus interface circuits.

Several changes and additions have been made to the module processor's firmware. As a result, on-board memory sizes (EPROM and RAM) have been increased. The increase in module processor memory size required the duplication channel to be modified. The module control channel was also modified to include three alarm control leads associated with cabinet powering.

Universal Bus Interface Circuit

The UN154C Universal Bus Interface circuit performs several functions:

- Allows the module control processor to communicate with the System 75 based universal port hardware by providing the "archangel" function. In other words, the universal bus interface circuit looks like a System 75 network control circuit to the port network.
- Sends dialed digits from ports to the module processor.
- Passes port status changes to the module processor.
- Transmits call set-up instructions to the port network.
- Passes PCM voice and digital data samples between the port network and TSI Bus for intermodule calls. Although the module processor no longer uses the TSI for intramodule calls, the TSI is used for intermodule calls. To the TSI, the universal bus interface circuit looks like a pair of intermodule data stores.
- Provides ISDN control connectivity for D-channel messages passing between the LAN bus and the module processor.
- Provides clock signals to the port network.

Details of how the universal bus interface circuit interacts with the port network are described in the "Port Network" section.

Module Processor

The universal module uses the TN580 module processor. Three major differences exist between TN580 and TN380D firmware: (1) TN580 firmware communicates with the universal bus interface circuit. This firmware replaces code in the TN380D that was used to control the I/O bus circuits and the port data stores. (2) Several information elements have been altered in the 501CC message queues. (3) TN580 firmware establishes and maintains level 2 D-channel signaling links for BRI and PRI connections. The module processor can handle up to 1500 point-to-point logical links.

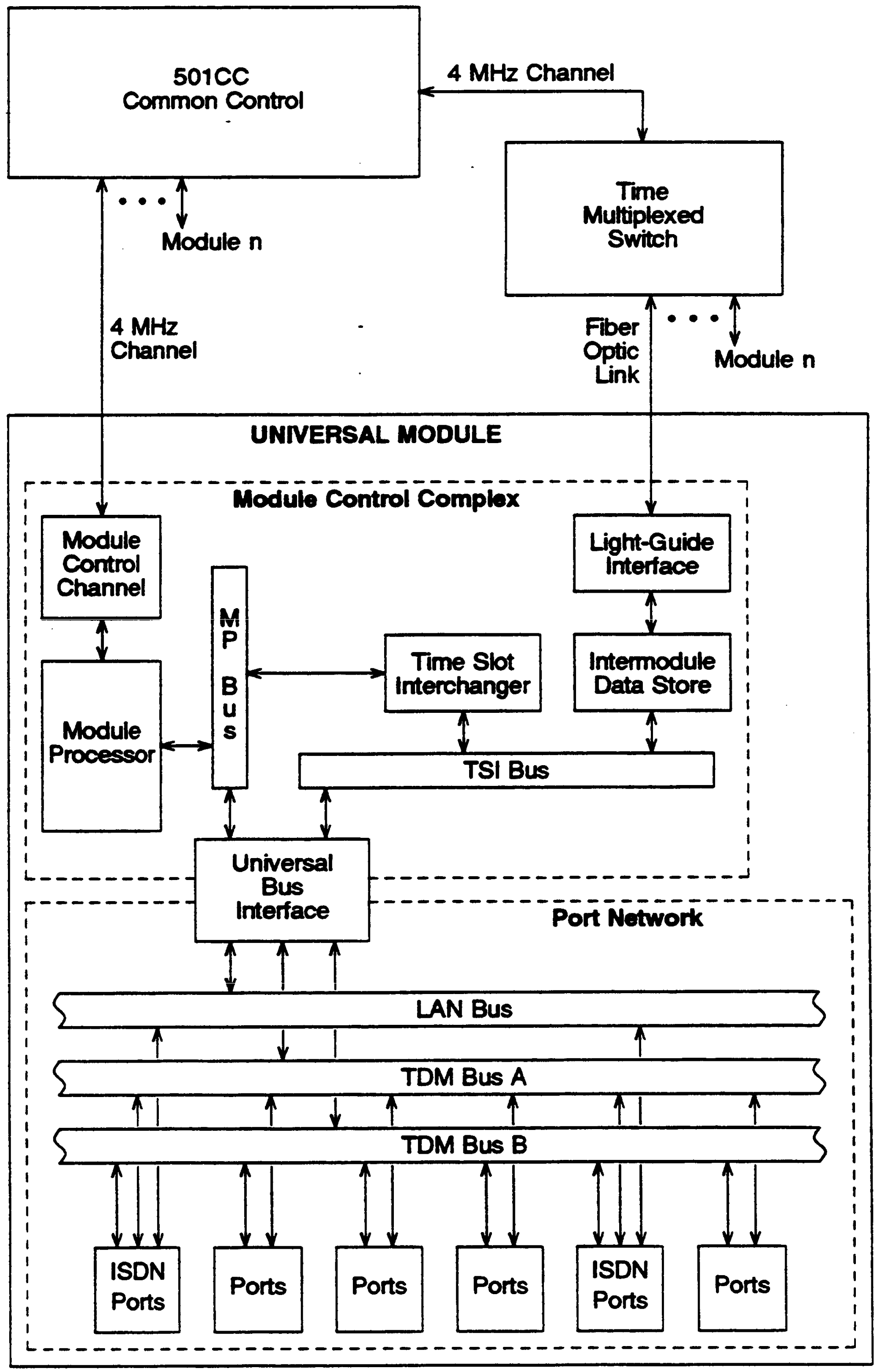


Figure 2-7. Universal Module Block Diagram

Duplication Channel

The address decoding space in the duplication channel has been expanded to handle the RAM size increase m the module processor.

Module Control Channel

The TN588 universal module control channel is a modified version of the TN401 traditional module control channel. The TN588 was modified to handle environmental alarms to and from the universal module. In addition to this, the module control channel provides three control leads in universal modules — no control leads are provided in traditional modules.

The common control reads the following environmental and power alarm categories from a status register located on the module control channel circuit:

- High battery charge rate
- Battery reserve on line
- Airflow restriction
- Over temperature
- Power unit shutdown
- Battery reserve unit fault
- Battery depleted.

The module control channel provides the following control leads in universal modules:

- Port carrier power shutdown
- Cabinet battery shutdown
- Battery Overcharge LED

Port Network

Two parallel TDM buses form the backbone of the port network (see Figure 2-7). AU PCM voice samples, data samples, and control messages travel over the TDM buses*. This is quite different from the approach used in a traditional module port network. There, PCM voice samples and data samples travel over group data buses while control messages travel over separate I/O buses (see Figure 2-6). Also, the universal module uses fewer common interface circuits; that is, there are no I/O bus interface, port control interface, or

* ISDN D-Channel packets are an exception since they are routed over the LAN bus and not the TDM bus.

port data interface circuit packs. There are two reasons for this:

1. Samples and control messages can travel over a single bus instead of separate buses. (Functionally, the two TDM buses can be viewed as a single bus carrying 512 time slots.).
2. Universal-module port circuit packs are microprocessor controlled and are more intelligent than their traditional-module counterparts. This eliminates the need for address decoding and signal routing circuitry to be provided by I/O bus interface circuit packs and port control interface circuit packs.

TDM Buses

AT&T digital PBXs handle 8000 8-bit samples a second from any of the ports they serve. To do this, the port network in the universal module uses two TDM buses. Each TDM bus carries 256 time slots (channels) for a combined capacity of 512 time slots. Since each TDM bus handles 8-bits parallel, one sample can be transmitted (in parallel) over each TDM bus during every clock cycle The 2.048 MHz clock rate used on each bus is divided into 8000 frames/second with each frame containing 256 samples.

$$1\ \frac{cycle}{sample} \times 256\ \frac{samples}{frame} \times 8000\ \frac{frames}{second} = 2{,}048{,}000\ \frac{cycles}{second} = 2.048\ \text{MHz}$$

This means that there are 512 time slots carried over the TDM buses, with each time slot having a throughput of 64 Kbps.

The reasons for having two 256 time-slot TDM buses rather than one 512 time-slot TDM bus are as follows:

- Having two buses instead of one lowers the speed of the bus easing the timing requirements on VLSI interface devices.
- Having two buses improves system reliability. If one bus fails, the port network can continue operating at reduced capacity on the other bus.

TDM buses are printed paths on the carrier backplanes. All port and module control carriers within a cabinet are daisy-chained together with cables so that both buses run continuously through the cabinet. Resistive bus terminator circuits are used on each end of the TDM buses.

Thirty-two TDM bus time slots are reserved for tone distribution and for the control channel. Eight time slots continuously carry the eight single frequency components of the Dual-Tone Multifrequency (DTMF) signaling tones. Other tones such as dial tone, ringback tone, busy tone, and intercept tone are provided in other dedicated time slots. A total of 473 time slots are available for switching.

Control Channel

The universal module interface circuit and the port board microprocessors (these microprocessors are called "angels" in System 75) use the TDM bus to pass control information. The first five time slots on each bus are used as a control channel between the universal bus interface circuit and the port circuits. The control channel can be active on only one TDM bus. By default, the control channel is active on TDM bus A; however, it can be moved to TDM bus B if TDM bus A fails.

The control channel operates in a polled mode, with the universal module interface circuit as master and the port bead microprocessors as slaves. The first time slot of each frame (TS0) contains control addresses; the next four time slots (TS1 to TS4) contain control data. The universal module interface circuit grants bus usage to a particular port board microprocessor or group of port bead microprocessors by transmitting a specific address in TS0. The direction of transmission during the control data time slots (TS1 to TS4) depends on the message type.

On each port board a custom VLSI device called the SAKI (Sanity and Control Interface, see Figure 2-8) handles address recognition, control data buffering, and synchronization between the port board microprocessor and the control channel. Each port carrier slot contains seven address pins that are hard-wired to define a unique address. During initialization, the port board microprocessor reads this address, then the microprocessor writes the address to the address-detection portion of the SAKI.

The universal bus interface circuit can address port board microprocessors individually or as a group. If the universal bus interface circuit wants to address a particular port board, it sets the most significant bit in TS0 to 0. The remaining seven bits contain that particular port board's address. If the universal bus interface circuit wants to address a group of eight port board microprocessors, it sets the most significant bit in TS0 to 1. The next four bits are used to address the group, and the remaining three bits indicate the type of scan or command which will follow.

Group Addressing

The group address mode is used in two ways:

- Collecting status information (short-scanning)
- Sending certain commands to a group of port board microprocessors simultaneously (group commands).

In a short scan, each port board microprocessor in the addressed group responds with a single bit of information in TS2. The bit-position used by a particular port bead microprocessor is determined by the lower three bits of the port board address. (In other words, the port board microprocessor whose lower three address bits are 001 responds on TDM bus bit 1 during TS2.) By using short scans, the universal bus interface circuit can gather status information much faster than if each port board were polled directly.

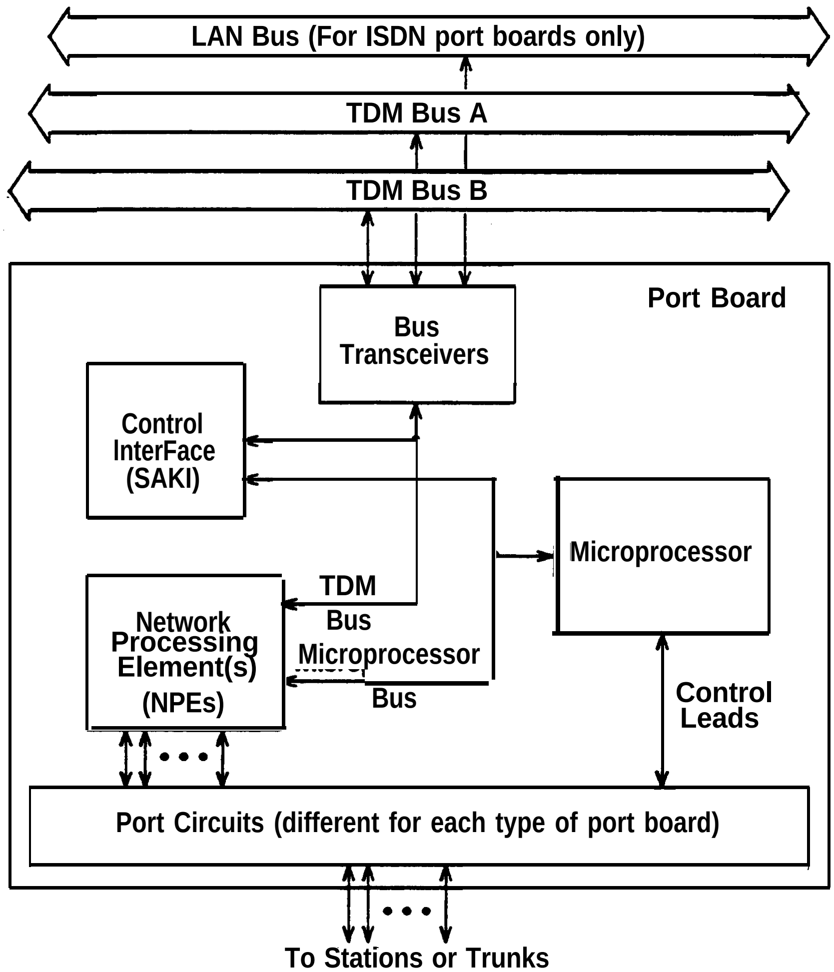


Figure 2-8. Port Board Architecture

The universal bus interface circuit obtains two types of status information from short scans:

- Activity scans determine which port board microprocessors have messages waiting for uplink transmission. Those that do will be individually polled to collect the messages.
- Sanity scans collect state-of-health information from the port board microprocessors.

Intelligent Port Boards

A common equipment switching circuit, such as the TSI, isn't used for intramodule calls since the port board circuitryy can recognize all samples on the TDM bus which are directed to its ports. The port boards are also able to multiplex all samples from their ports onto the specified time slots on the TDM bus.

Intelligent port boards contain NPE (Network Processing Element) channels for passing samples between the TDM bus and the on-board port interface circuits. These NPE channels are also used to insert whatever gain (or loss) is needed on intramodules calls.

(The TSI ALU performs gain adjustments for universal module intermodule calls and for all traditional module calls.)

NPEs and Conference Connections

A conference connection is made by assigning each port in the connection one talking time slot and letting each port in the connection listen to all of the talking time slots assigned to the other ports in the connection.

Figure 2-9 depicts NPE channel operation. The associated conference buffer is a network of memory arrays which buffers PCM samples from the TDM bus and receives control information from the port board microprocessor. The microprocessor tells the associated conference buffer which time slots to listen to and which time slot to use for talking. The microprocessor also tells the NPE how much loss needs to be applied to each PCM sample received from a "listen" time slot.

The expand circuit converts each "listen" PCM sample from µ- law PCM to linear PCM. The linear PCM sample is then multiplied by the specified gain factor. The gain-adjusted samples from each "listen" time slot in a TDM-bus frame are added by the accumulator, then passed to the compress circuit which converts this sum to a µ-law PCM sample. The resulting sample (conference sum) is passed to the port circuit.

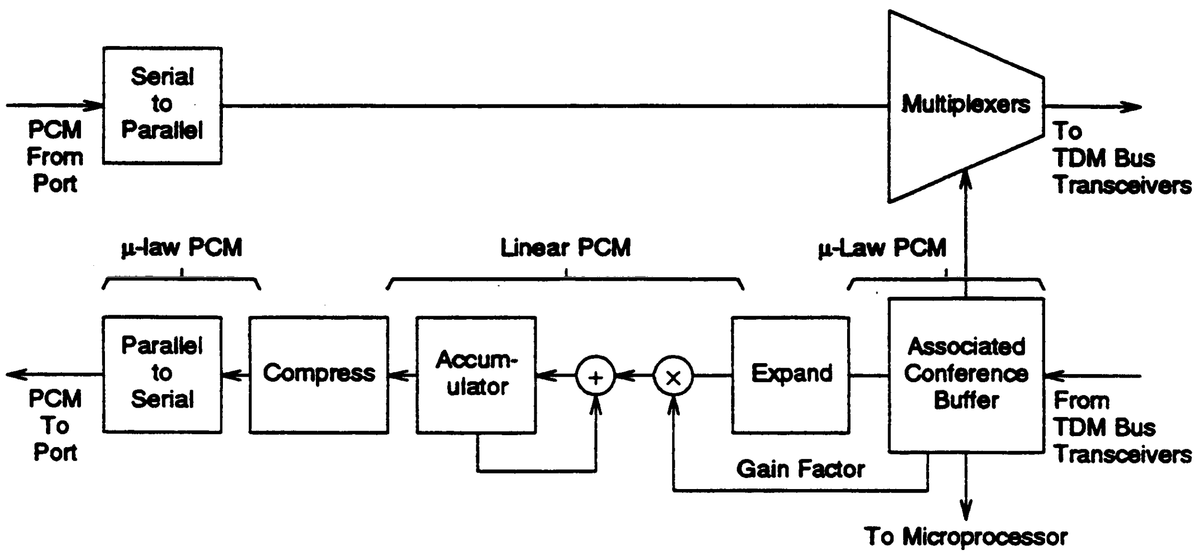


Figure 2-9. Network Processing Element Channel

LAN Bus

The universal bus interface circuit passes ISDN D-Channel packets back and forth between the module processor and the LAN bus in the port network. All ISDN PRI and ISDN BRI port circuit packs are connected to the LAN bus.

The LAN bus is a 20-bit bus which operates at 2.048 MHz. Each 20-bit quantity (slice) contains two bytes of data. Each byte has two extra bits associated with it: a qualifier (Q) bit and a parity (P) bit. The Q bit is used on the last slice of a packet to indicate whether both bytes in the slice are valid packet bytes. The Q bit allows for transmission of odd byte packets. The P bit is calculated to create odd parity over the 10-bit field.

Call Setup

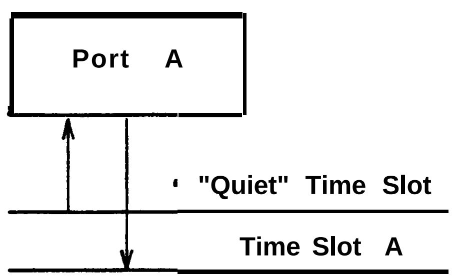
Intramodule Call

lntramodule calls in the universal module are made by using the port network TDM bus and the NPE's on the port boards. All connections of this type are completely contained within the port network and do not use the TSI in the module control carrier.

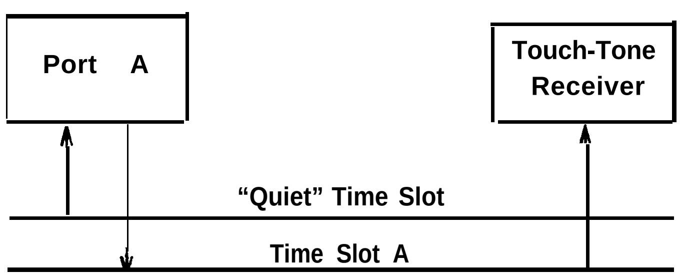
Time slots are managed by keeping track of who the talkers are on the call. A listener doesn't use any time slots on an intramodule call, but simply listens to all of the talk time slots. Also, some time slots are used in more than one connection (music, tones, recorded announcements, etc.).

The following are the steps DEFINITY Generic 2 goes through to set up an intramodule call between "Port A" and "Port B":

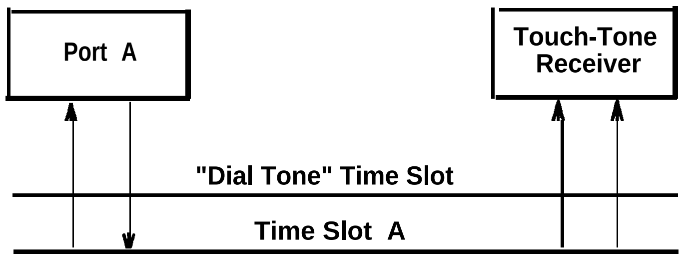
1. The port board microprocessor detects the handset going off-hook on port A's telephone.
   a. The microprocessor sends an off-hook uplink message through the universal bus interface circuit to the module processor.
   b. The module processor forwards the off-hook message to the 501CC.
2. The 501CC interprets the message as a call origination and takes the following steps:
   a. The 501CC sends a downlink message to the port bead, via the module processor and the universal bus interface circuit, telling Port A to talk on time slot A and to listen to the "Quiet" time slot. The "Quiet" time slot is listened to since no other circuits have been added at this point.



   b. The 501CC sends another downlink message which adds a touch-tone Receiver to the connection. At this point the touch-tone Receiver is listening to time slot A.



c. The 501CC adds the dial-tone time slot to the connection by telling Port A and the touch-tone receiver to listen to the dial-tone time slot.



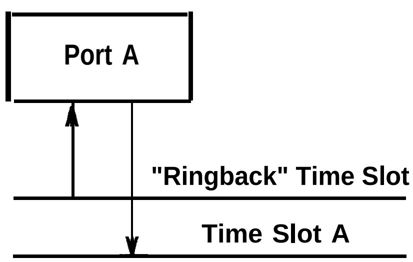
3. After the touch-tone receiver receives the first digit, dial tone is removed from the connection.

4. The touch-tone receiver forwards all received digits to the 501CC (via the universal bus interface circuit and the module processor).

5. Once the 501CC receives all of digits necessary to identify the destination (Port B), it sends the following messages to the port network:

   a. Remove the touch-tone Receiver from the connection.

   b. Instruct port A to listen to “Ringback” time slot.



   c. Ring Port B's ringer.

6. Port B's port board microprocessor detects off-hook on port B's telephone. The microprocessor sends an off-hook uplink message to the 501CC.

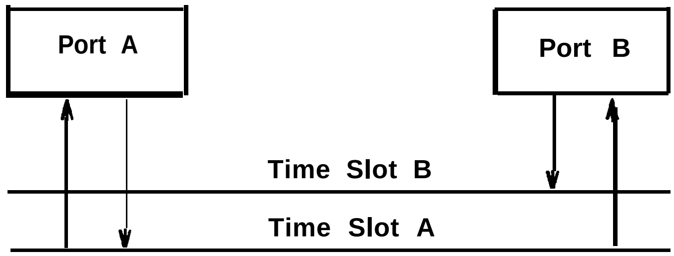
7. The 501CC sends the following messages to the port network:

   a. Port A quits listening to Ringback and starts listening to quiet.

   b. Port B listens to time slot A (Port B’s NPE channel is told to insert Loss L into the connection).

   c. Port B talks on time slot B.

   d. Port A quits listening to “Quiet” and begins listening to time slot B (Port A’s NPE channel is told to insert Loss L into the connection).



Inter-Module Call Setup

The call processing sequence the 501CC uses to set up an intermodule connection is similar to the sequence it uses for an intramodule call; i.e., off-hook causes 501CC to send connection information to the originating module's port network and so on. For intermodule calls, however, the 501CC must use the following additional switching elements: the originating module's TSI, the TMS, the terminating module's TSI, and the terminating module's port network (see Figure 2-10).

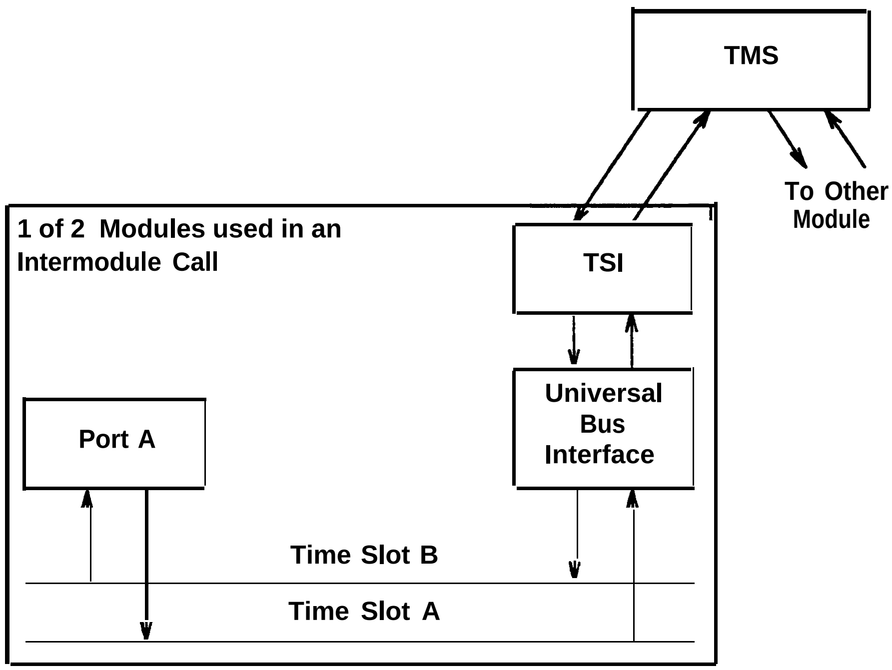


Figure 2-10. Intermodule Connection

Remote Modules

The remote module feature overcomes the 200 feet distance limitation of the 4-MHz coaxial cable that provides the serial control channel betwen the common control and each module control. Fiber-optic cable allows System 85 remote modules to be located up to 13,000 feet (4.0 km) from the central location. For the DEFINITY Generic 2 switch, this distance has been increased to 25,000 feet (7.6 km).

Without remote modules, a campus or industrial park with buildings more than 200 feet apart would require more than one switch. By using remote modules, the need for additional switches is reduced and usually eliminated. At least one module must be equipped at the central location.

A remote module, like any other module in a multimodule switch, requires two communications channels to the system 85 (see Figure 2-11):

- 4-MHz common control channel
- 32-MHz TMS channel

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

The 4-MHz common 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 RMI (Remote Module Interface) circuit pack. A TN456 is required at each end of the fiber-optic link.

For System 85, RMI circuit packs at the central location are placed either in slot 25 of central location module control carriers or in a special RMI carrier housed in a TMS cabinet. At remote locations RMI circuit packs are housed in slot 25 of the module control carrier.

For DEFINITY Generic 2, RMI circuit packs at the central location are placed in slots 15 through 21 of a universal module's module control carrier or in slot 25 of a traditional module's module control carrier. At remote locations RMI circuit packs are housed in slot 15 for universal modules and slot 25 for traditional modules.

Because each central location universal module is able to support up to seven remote modules, the RMI carrier is not offered with DEFINITY Generic 2. However, the RMI carrier may still be used when System 85s with RMI carriers are upgraded to DEFINITY Generic 2.

Two pairs of fiber-optic cable serve each remote module: one for the 4 MHz common control channel and another for the 32 MHz TMS channel. When module controls are duplicated, four pairs of fiber-optic cable are required. If separate paths are selected for the duplicated fiber, the difference between the two lengths cannot exceed 2400 feet (732 meters).

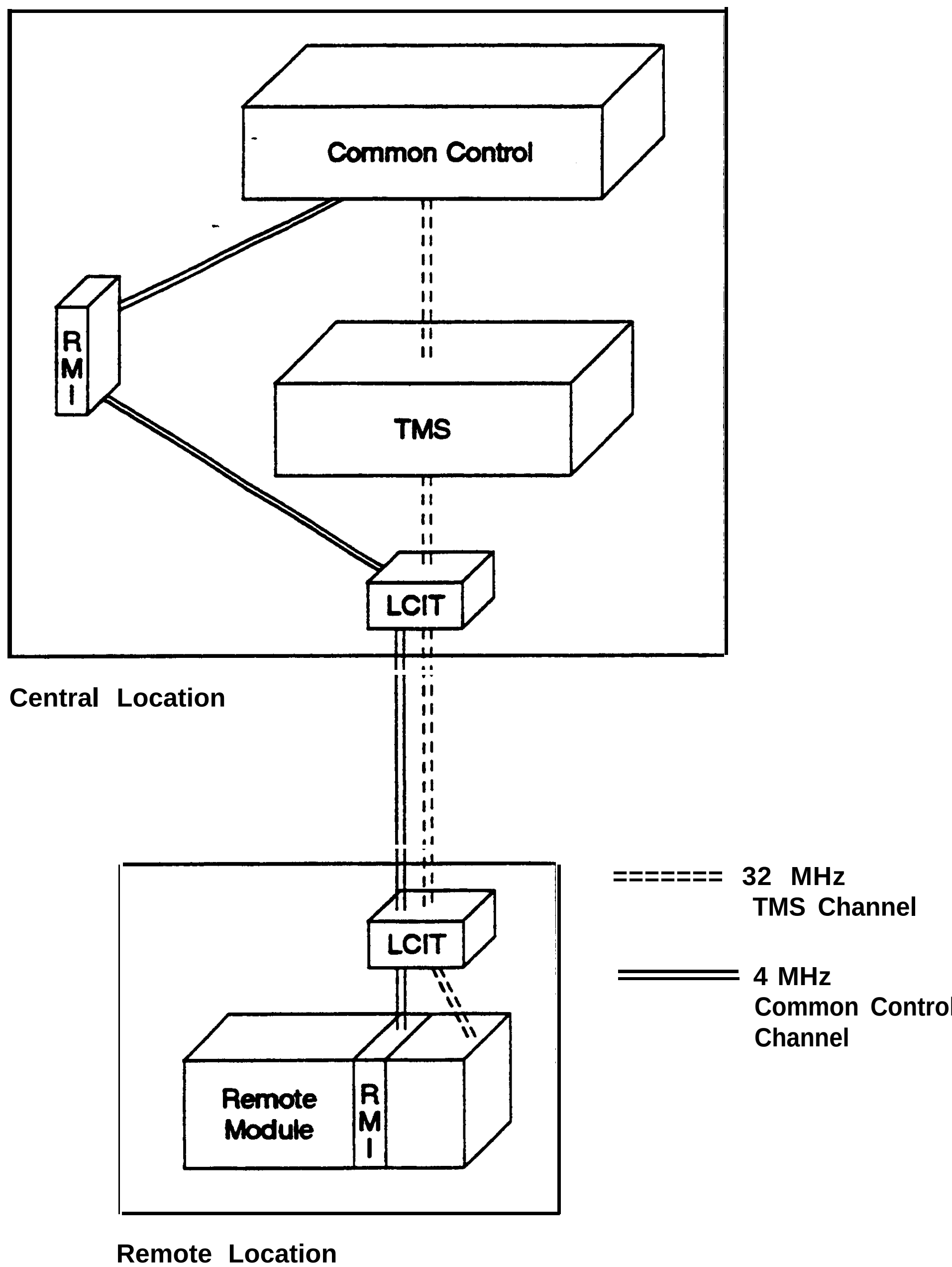


Figure 2-11. Remote Module Connections

Remote Module Considerations

Equipment Room

The equipment room for a remote module must meet the same requirements as the central location 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 located in the central location 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.

Attendant Console at Remote Module Site

Up to five attendant consoles may be connected to a remote traditional module; three is the maximum for a remote universal module. The 107A ORPI (Optically Remoted Peripheral Interface) provides the required attendant console control and alarm connections to the common control complex. The trunk/attendant interface circuit packs in the module's port carriers provide the voice connections. The ORPI is discussed in greater detail in the Attendant Console section of chapter 4.

Power Failure Transfer

Any remote module can be equipped to provide the power failure transfer feature for a remote location. All that is required at the remote location is a model 808A emergency transfer panel, one to five CO trunks terminated on the remote module, and an FCC registered telephone (such as AT&T model 8110) for each of these CO trunks. The central location needs no additional equipment.

A power failure transfer can be initiated by either the common control (central location) or by the remote module control (remote location).

The common control initiates a power failure transfer at a remote module by sending a message through the RMI link to the remote module. The message is detected by a small circuit pack mounted in the remote module control cabinet The common control initiates a power failure transfer when any of the following conditions take place:

- The power failure transfer switch on the common control's alarm panel is manually activated.
- The common control hardware senses a processor failure.
- The 501CC software detects failures in 75 percent or more of the modules.
- There is a loss of power, causing the power failure transfer control relay on the common control alarm system to be de-energized.

The remote module initiates a power failure transfer when any of the following conditions take place:

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 module.

More information about the Power Failure Transfer feature appears in *DEFINITY Communications System Generic 2 and System 85 Feature Descriptions* (555-105-301). More information about the model 808A emergency transfer panel appears in Chapter 4 of this manual under Emergency Transfer Panel.

System 85 MAAP Operation

The RMI fiberlink has an I/O data channel which can be used for System 85 remote MAAP (Maintenance and Administration Panel) operation. In addition, alarming is also provided through the fiber.

Remote Groups

The use of DS1 facilities was expanded in System 85 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. Remote group capability is available with System 85 and with DEFINITY Generic 2 switches equipped with a traditional module. Remote groups are not supported on DEFINITY Generic 2 universal modules.

Twenty-three PCM time slots and one signaling time slot are multiplexed onto the DS1 channel by a pair of remote group interfaces. One interface, the RCL (Remote Carrier Local), is located at the central switch and appears as three port circuit boards to call processing software. The other interface, the RCC (Remote Carrier Controller), 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 DS1 link. Figure 2-12 illustrates the basic remote group connection.

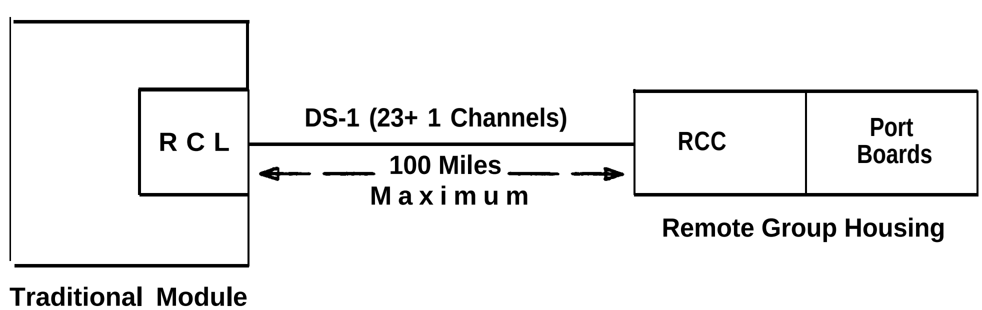


Figure 2-12. Remote Group

Duplication

Overview

Although DEFINITY Generic 2 and System 85 are highly reliable switches, there are occasions when even greater reliability is required. The high-reliability and critical-reliability configurations address this need. Specifically, the high-reliability configuration contains a duplicated (redundant) common control, and the critical-reliability configuration contains a duplicated common control, duplicated module control, a duplicated TMS, and duplicated TMS growth. DC-to-DC converters and AC power units are also duplicated.

If a fault or a failure occurs in an active control unit, a special circuit switches the duplicated unit into service (on-line). Whether system users notice any interruption of service depends on the fault, failure, or condition that caused the special circuit to switch. Usually, such switches go undetected by users.

Duplication strategy for DEFINITY Generic 2 and System 85 ensures that the control unit in the best condition is the one that is on-line. If neither control unit experiences faults or failures, periodic graceful (soft) switches take place to verify correct operation of the duplication control circuitry.

Generally, that is how duplication works. For those who need a deeper understanding of the duplication architecture, this section continues with a look at cabinet interconnections for high and critical-reliability configurations. Then, a detailed discussion of duplication for the common control is given. Next, details about duplication for the TMS and the module control are presented. Finally, a table showing lab measurements for various duplication tasks, including hard and soft switches, is presented.

Cabinet Interconnections

Figure 2-13 shows cabinet interconnections for the high-reliability and critical-reliability configurations. To simplify the drawing, the system depicted is a 2-module version. Systems with more than two modules use the same rules for connections, namely:

- High-Reliability Configuration—each module and each TMS is connected to both common controls.
- Critical-Reliability Configuration—both module controls in each module and both TMSs are connected to both common controls. In addition, both module controls in each module are connected to both TMSs.

For more information about cabinet interconnections see *DEFINITY Communications System Generic 2 and System 85 Installation* (555-104-104) or *System Interconnect and Information* (SD-1E580-01).

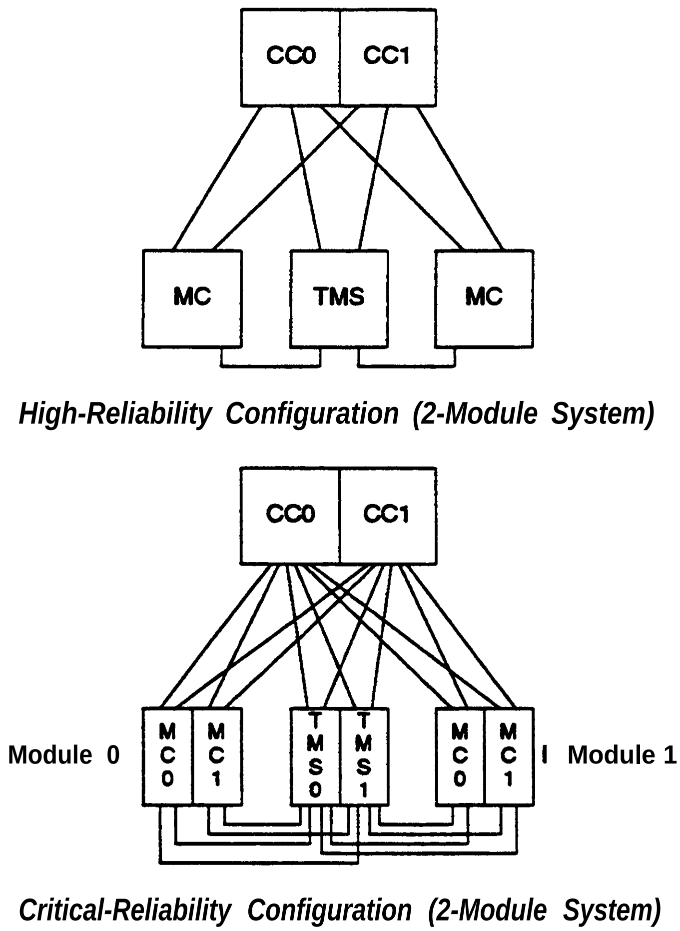


Figure 2-13. Intercabinet Connections for Systems With Duplication

Duplicated Common Control

The UN158 Duplication Controller is the common control circuit pack that decides which common control is on-line. It also makes sure that the off-line common control's memory is current. Each common control has an LED on the alarm panel which indicates whether it is on-line.

How does the UN158 decide which common control to place on-line? For each common control, the UN158 monitors four categories of status information to formulate a state of health value. The lower the number, the healthier the common control. The UN158 compares these numbers and initiates a switch if the off-line common control is healthier than the on-line common control. Table 2-A lists the status categories and gives their values. These values are used to calculate the common control state of health.

Procedure 613 can be used to determine whether HARDWARE, SOFTB, or SOFTA are in effect for the on-line and off-line processors. This Procedure can also be used to initiate a soft switch.

TABLE 2-A. Common Control State of Health Determination

Category	Value	Description
HARDWARE	8	This value is assigned if there is a power failure, a major hardware failure in the common control, the common control HALT Switch is operated, or the common control select switch (CC0/OFF/CC1) is operated. The HALT switch and the select switch are on the alarm panel.
SOFTB *	4	This value is assigned if the common control processor (501CC) detects hardware or software faults. Examples are I/O or DCIU failures, frequent processor initialization or both common controls on-line.
SOFTA *	2	This value is assigned if there are minor 501CC irregularities such as the processor being initialized. Other events which cause this value to be assigned are switches requested from maintenance Procedure 613 or switches which are periodically initiated by the 501CC.
ONLINE	1	This value is assigned if the common control is off-line

* The term "SOFT" in SOFTA AND SOFTB means that these values can be set by software. Switches caused by the value of SOFTA or SOFTB are not necessarily soft switches.

Table 2-A's description of SOFTA mentions periodic switches. The 501CC processor in on-line common control initiates a periodic switch after 62 hours by activating SOFTA. If the off-line common control is in better health than the on-line common control, a switch takes place. The cycle is repeated 62 hours later providing no switches have occurred during the interim.

Periodic switches and switches initiated through Procedure 613 are soft switches. That is, no interruption in service is detected by system users.

Switches are not always soft; sometimes they are hard. For hard switches, some interruption to service is noticed, usually lasting for only a few minutes. Calls which are being set up when a hard switch occurs are lost, but established calls stay up. Even though established calls stay up, they can't alter the call with features such as transfer, conference or hold. Once the newly on-line common control is in service for a few minutes, normal service resumes.

Duplicated common controls allow either of the common controls to be placed out of service for repairs or updates without affecting service. However, some repairs or updates will disrupt service if they involve changes to the TMS or the module controls unless these processors are also duplicated.

Duplicated Module Controls and TMSs

Like the duplicated common control, duplicated module controls and duplicated TMSs use state of health comparisons to determine which control unit is on-line Table 2-B lists the status categories and values used to calculate the state of health for modules and TMSs.

The periodic soft switch rate for module controls and the TMS is 32 hours. Periodic soft switches for modules are staggered on a system-wide basis so that no more than one module is switched per hour.

Procedure 621 can be used to detemine whether CC, SHUTDOWN, SOFTB, or SOFTA are in effect for the on-line and off-line module (or TMS) processors in a particular module or TMS. Procedure 621 subdivides SOFTA into three categories to indicate the severityof the problem:

- Level 1—failures that affect more than 50 percent of the ports in the module.
- Level 2—failures that affect 10 to 50 percent of the ports in the module.
- Level 3—failures that affect less than 10 percent of the ports in the module.

TABLE 2-B. Module Control and TMS State of Health Determination

Category	Value	Description
CC	8	This value is always in effect unless the 501CC instructs the off-line processor to replace it with zero. This gives the 501CC final say over which module (or TMS) processor is on-line A hard switch results when this method is used.
SHUTDOWN	4	This value is in effect whenever the module (or TMS) processor is experiencing sanity problems. Sanity problems cause the processor to go into the shutdown mode. If a switch happens because of SHUTDOWN, it will be a hard switch.
SOFTB	2	This value is in effect whenever the module (or TMS) processor detects serious hadware problems within itself or the interfaces to its peripheral hardware. If a switch happens because of SOFTB, it will be a hard switch.
SOFTA	1	This value is in effect whenever the module (or TMS) processor is required to perform a soft switch. Once the switch happens, this value is reset to zero.

Duplication Performance Data

Table 2-C lists various duplication operations and gives times measured in the laboratory for DEFINITY Generic 2 and System 85 software versions on a lightly equipped, idle, 5-module configuration. In the table, the term “demand” refers to a user-initiated processor switch, and the term “recovery" refers to a system-initiated processor switch; also, the following abbreviations are used:

- CC (Common Control)
- MC (Module Control)
- TMS (Time Multiplexed Switch)

TABLE 2-C. Duplication Performance Data for DEFINITY Generic 2 and System 85 (Note)

Operation	R2V2	R2V3	R2V4	Gen. 2
Duplicated CC soft switch (demand)	25min.	4.0 min.	3.2 min.	0.4 min.
Duplicated CC soft switch (recovery)	6 sec.	10 sec.	8 sec.	25 sec.
Duplicated CC hard switch (either)	20 sec.	25 sec.	35 sec.	30 sec.
Duplicated MC soft switch (demand)	2 sec.	2 sec.	2 sec.	2 sec.
Duplicated MC soft switch (recovery)	1 sec.	1 sec.	1 sec.	1 sec.
Duplicated MC hard switch (either)	3 sec.	3 sec.	3 sec.	3 sec.
Duplicated TMS soft switch (demand)	4 sec.	4 sec.	4 sec.	4 sec.
Duplicated TMS soft switch (recovery)	8 sec.	8 sec.	8 sec.	8 sec.
Duplicated TMS hard switch (either)	4 sec.	4 sec.	4 sec.	4 sec.

NOTE: Do not assume these measurements will hold true for other configurations. The measurements were made in the laboratory on a lightly equipped, 5-module configuration operating in an idle state. Actual times vary according to equipment configuration.

Trunks

This section discusses trunk types and trunk signaling.

Trunk-Types

A trunk type is a 2- or 3-digit number which can be assigned to one or more groups of trunks providing a specific type of service. Trunk types specify the direction in which a group of trunks operates: 1-way incoming, 1-way outgoing, or 2-way. For System 85 Release 2, Versions 1, 2, and 3, a trunk type number also identifies the signaling type. Trunk type 20, for example, is assigned to trunk groups which use 2-way signaling and connect to a local exchange company (central office) which performs the party-line test. Beginning with System 85 Release 2, Version 4 and continuing with DEFINITY Generic 2, trunk type and signaling are separate. Before discussing signaling, more needs to be said about the types of services trunk groups are assigned to provide. They are:

APLT

Advanced Private Line Termination is the term used for a trunk group which connects the DEFINITY Generic 2 or System 85 to a CCSA (Common Control Switching Arrangement) or EPSCS (Enhanced Private Switched Communications Service) switching machine, or connects a main PBX to a tandem PBX. APLT trunk circuits are provided by the SN233C in traditional modules and the TN760C in universal modules; digital trunk circuits may also be used.

CAS

Centralized Attendant Service is implemented by using RLT (Release Link Trunk) groups which connect “branch” location PBXs to the “main” location where the attendant force is located. RLT trunk circuits are provided by the SN233C in traditional modules and the TN760C in universal modules; digital trunk circuits may also be used.

CO

Central Office trunk groups are used to connect the PBX to the local exchange company serving the PBX for incoming or outgoing calls. CO trunk circuits are provided by the SN230B in traditional modules and the TN747B in universal modules; digital trunk circuits may also be used.

DCP

Digital Communications Protocol trunk groups are used to connect data modules to DEFINITY Generic 2 and System 85. DCP trunk circuits are provided by the SN270B in traditional modules and TN754B in universal modules.

DID

Direct Inward Dialing trunk groups are used to connect the PBX to the local exchange company for completing calls that are dialed into the PBX, directly to voice terminals without attendant assistance. DID trunk circuits are provided by the SN232B in traditional modules and the TN753 in universal modules.

DMI—BOS

Digital Multiplexed Interface with Bit Oriented Signaling trunks are used for 24-channel digital connections between host computers and DEFINITY Generic 2 or System 85 at the 1.544-Mbps rate. These trunks are also compatible with the AT&T Communications toll network. DMI—BOS trunk circuits are provided by the ANN11E in traditional modules and the TN767 in universal modules.

EIA

Electronic Industries Association (RS-232C) compatible trunks are used to connect RS-232C devices to DEFINITY Generic 2 and System 85. EIA compatible trunk circuits are provided by the SN238 in traditional modules and the TN726 in universal modules.

ETN

Electronic Tandem Network trunk groups are used to connect tandem PBXs within a network of PBXs. ETN trunk circuits are provided by the SN233C in traditional modules and the TN760C in universal modules; digital trunk circuits may also be used.

FX

Foreign Exchange trunk groups are used to connect the PBX to a foreign central office (any central office other than the one serving the PBX). FX trunk circuits are provided by the SN230B in traditional modules and the TN747B in universal modules; digital trunk circuits may also be used.

ISDN

Integrated Services Digital Network trunks are used to connect DEFINITY Generic 2 or System 85 to other ISDN endpoints at the 1.544 Mbps rate. This capability is sometimes referred to as DMI—MOS (Message Oriented Signaling). ISDN trunk circuits are provided by the ANN35 in traditional modules and by the TN767 plus the TN555 in universal modules.

M/S

Main/Satellite trunk groups are used to connect two PBXs together in a main/satellite complex. M/S trunk circuits are provided by the SN233C in traditional modules and the TN760C in universal modules; digital trunk circuits may also be used.

RA (VSG)

Remote Access trunk groups are used to connect the PBX to the local central office for the purpose of completing remote access calls. Remote access trunk groups can be arranged with or without Voice Switched Gain. For special applications, remote access trunk groups can be used for outgoing calls as well as incoming calls. RA trunk circuits are provided by the SN230B in traditional modules and the TN747B in universal modules.

TIE

Tie trunk groups are used to connect two PBXs together in order to complete inter-PBX calls. TIE trunk circuits are provided by the SN233C in traditional modules and the TN760C in universal modules; digital trunk circuits may also be used.

WATS

Wide Area Telecommunication Service trunk groups are used to connect the PBX to a WATS serving office for outward WATS dialing or 800 service. WATS trunk circuits are provided by the SN230B in traditional modules and the TN747B in universal modules; digital trunk circuits may also be used.

Signaling Types

Most trunk types require some sort of signaling protocol to be followed. Here are the three most common signaling protocols used with DEFINITY Generic 2 and system 85:

- Wink-Start Signaling: A wink-start signal is a momentary off-hook signal (on-hook to off-hook to on-hook) which lasts 140 to 290 ms (milliseconds). The receiving switch sends the wink-start signal approximately 100 ms after the initial trunk seizure by the originating switch. The wink-start signal lets the originating switch know that the receiving switch is ready to accept digits.
- Immediate-Start Signaling: When the receiving switch gets a call on a trunk group which uses immediate-start signaling, it expects to receive digits from the originating switch without having to send a start-dial signal (like a wink-start or a delay-dial). The originating switch starts outpulsing digits approximately 70 ms after seizing the trunk on the receiving switch.
- Delay-Dial Signaling: A delay-dial signal is an off-hook signal followed by an on-hook signal. The receiving switch sends the delay-dial signal approximately 100 ms after the originating switch seizes the trunk. The off-hook signal can last anywhere from 200 ms to several seconds. The off-hook signal lets the originating switch know that a trunk has been seized, and the on-hook signal lets the originating switch know that the receiving switch is ready to accept digits.

For more information about trunk signaling see *Application Notes — Trunk Signaling and Transmission* (555-025-205).

Trunk Interfaces

The trunk interfaces are:

- **Ground-Start**
- **Loop-Start/Reverse Battery**
- **E&M**
- **DMI—BOS**
- **DMI—MOS**
- **Auxiliary and Service Circuits**

Ground-Start Interface

The principal of operation of the ground-start interface is to connect one side of the line to ground. This helps minimize glare. (Glare is the simultaneous seizure of a 2-way trunk circuit by both the originating and terminating end of the circuit.) The ground-start trunk interface is provided by the SN230B CO trunk circuit pack for traditional modules and by the TN747B for universal modules.

Condition	Signaling Operation
Incoming Call Notification	For DEFINITY Generic 2 and System 85, incoming seizure is detected with tip ground plus ringing current. For DIMENSION PBX only, tip ground is required to cause incoming seizure. Response is to operate circuit in “cut-through” mode, which means that ground is removed from ring and applicable circuit relays or gate arrays are operated to allow current to flow from tip through circuit and out on ring.
Outgoing Call Notification	For DEFINITY Generic 2, System 85, and DIMENSION PBX, outgoing call notification is caused by ground applied to ring. Response is tip ground from central office.
Answer to Incoming Call	The PBX will close the loop to answer an incoming call. From a central office perspective, the PBX is just a station connected via the tip and ring.
Disconnect Notification to Central Office	The loop is opened by operating applicable relays or gate arrays to cause current flow to stop.
Disconnect Notification from Central Office	The tip ground is removed when the central office is disconnecting.

Loop/Reverse Battery Interface

Loop start operation uses loop open as on-hook and loop closure as off-hook. Reverse battery operation reverses the battery and ground leads; the first reversal after idle signals off-hook and the second reversal signals on-hook. The loop/reverse battery trunk interface is provided by the SN232B DID trunk for traditional modules and by the TN753 for universal modules.

Condition	Signaling Operation
Incoming Call Notification	**For DEFINITY Generic 2 and System 85, incoming seizure is detected by the presence of loop current. This current is caused by the CO operating applicable circuitry that allows current to flow from the PBX over the tip to the remote switch. (PUB 611000 indicates that an M contact or switch is operated in the CO circuit to allow the current path to be established.)** **Response from the PBX in the case of immediate start operation is to attach a receiver within 60 ms from detection of incoming seizure and be ready to receive digits. For wink-start operation, the response is to reverse battery for 140 to 290 ms. At the end of the 140-290 ms time interval, reverse battery again and be ready to receive digits.**
Outgoing Call Notification	**The Loop/Reverse Battery interface operation is only incoming from the perspective of the PBX. No outgoing call notification is possible.**
Answer to Incoming Call	**The PBX will reverse the loop current to indicate an off-hook.**
Disconnect Notification to Central Office	**A battery reversal will indicate to the remote switch that thePBX is disconnecting.**
Disconnect Notification from Central Office	**The M contact or relay is operated to open the path that was allowing current flow.**

E&M Interface

The E&M interface provides two separate signaling leads. With E&M interfaces, connections can be made to central offices and other PBXs. The following is an example of E&M signaling between a PBX and a CO as seen from the PBX end of the connection E&M Type Ia).

Condition	Signaling Operation
Incoming Call Notification	Incoming call notification is detected by a ground on the E lead. Response to the ground can be: • Immediate-Start— connect receiver and be ready to receive digits within 60 ms. • Delay-Dial– put battery on the M lead to indicate acknowledgement of the incoming seizure. Remove M lead battery when the switch is ready to receive digits. • Wink-Start— put battery on the M lead for 140 to 190 ms and at the end of wink be ready to receive digits.
Outgoing Call Notification	Outgoing call notification places battery on the M lead. Depending on the signaling used, the outgoing Seizure will expect: • Immediate-Start— wait 60 ms and begin sending digits. • Delay-Dial— wait 140 ms for E lead response. If response is seen, wait up to five seconds for removal of E lead ground and send digits. • Wink-Start— wait for E lead response. If response is 140 to 290 ms, send digits. If no response, a signaling failure has occurred.
Answer to Incoming Call	Answer notification is indicated by putting battery on the M lead.
Answer from Distant Switch	Answer notification from the distant switch is the result ofscanning ground on the E lead.
Disconnect Notification to Distant Switch	Disconnect notification is the result of removing battery from the M lead.
Disconnect Notification from Distant Switch	Disconnect from the distant switch is the result ofscanning ground removed from the E lead.

The E&M interface is provided by the SN232C Tie Trunk circuit pack for traditional modules and by the TN753 for universal modules. These packs provide Type Ia, Type Ib, and Type V E&M signaling. This manual describes the E&M packs in Chapter 3. Coverage includes equivalent circuits for the E&M types offered and application notes for E&M pack options.

DMI—BOS (Digital Multiplex Interface-Bit Oriented Signaling)

DMI—BOS is implemented using the DS1 interface. The DS1 interface circuit (ANN11E or TN767) multiplexes 24 logical trunks into one 4-wire interface running at a 1.544-Mbps rate. The operation of signaling over a DMI—BOS interface is the same protocol as E&M. Two protocols are used to signal seizure, answer, etc.:

- E&M immediate-start operation both incoming and outgoing
- E&M immediate-start outgoing and wink-start incoming.

The description of incoming call notification, outgoing call notification, answer, and disconnect are the same as described under E&M.

Condition	Signaling Operation
Incoming Call Notification	Incoming call notification is detected by a ground on the E lead. Response to the ground can be: • Immediate-Start— connect receiver and be ready to receive digits within 60 ms. • Wink-Start— put battery on the M lead for 140 to 190 ms and at the end of wink be ready to receive digits.
Outgoing Call Notification	Outgoing call notification places battery on the M lead. The outgoing seizure will expect immediate-start: wait 60 ms and begin sending digits.
Answer to Incoming Call	Answer notification is indicated by putting battery on the M lead.
Answer from Distant Switch	Answer notification from the distant switch is the result of scanning ground on the E lead.
Disconnect Notification to Distant Switch	Disconnect notification is the result of removing battery from the M lead.
Disconnect Notification from Distant Switch	Disconnect from the distant switch is the result ofscanning ground removed from the E lead.

ISDN Signaling

ISDN is implemented using the DS1 interface (ANN35 or TN767 plus TN555) running at a 1.544-Mbps rate. One channel is designated as the signaling channel (D-channel) and the remaining 23 channels are predesignated as bearer channels (B-channels). Rather than using the "A" bit to indicate various states of a 64-Kbps channel, messages are sent over the D-channel to accomplish call setup and disconnect.

This type of message oriented signaling differs from the stimulus oriented.

Condition	Signaling Operation
Incoming Call Notification	A setup message (SETUP) is received from the originating system.
Outgoing Call Notification	A setup message (SETUP) is sent to the terminating system.
Answer to Incoming Call	A call proceeding message (CALL PROC) is sent to the originating system followed by a connect message (CONN) to indicate that the call has been answered.
Disconnect Notification to Distant System	A disconnect message (DIS) is sent to the system. The distant system will respond with a release message (REL) followed by a release complete message (REL COM) when the channel that was used is available for another call.
Disconnect Notification from Distant System	A disconnect message (DIS) is received from the distant system. A release message (REL) is sent to the distant system followed by a release complete (REL COM) from the distant system when the channel has been set idle and is ready for use by another call.

Separation of Trunk and Signaling Type

For DEFINITY Generic 2 and System 85 R2V4, up to 32 types of signaling combinations are defined (see Table 2-D for System 85 R2V4 and Table 2-DA for Generic 2). For most trunk types, more than one type of signaling can be assigned in translations. Default signaling types will be translations unless administered otherwise. The default values will approximate those associated with System 85 R2V3 trunk types. For each trunk type, Table 2-E (System 85 R2V4) and Table 2-EA (Generic 2) shows the default signaling type, other signaling types that can be assigned, and the trunk interface associated with each type of signaling.

TABLE 2-D. Signaling Definitions for System 85 R2V4

Trunk No.	Signaling Type
0	No Signaling Required*
1	Ground-Start
2	Ground-Start with Party Test
3	Loop/Reverse Battery, Wink-Start
4	E&M Immediate-Start In and Out
5	E&M Wink-Start In and Immediate-Start Out
6	ANI
7	Auxiliary Equipment
8	E&M Delay-Dial In and Immediate-Start Out
9	E&M Delay-Dial In and Wink/Delay-Dial Out With Dial Tone
10	E&M Wink-Start In and Wink/Delay-Dial Out With Dial Tone
11	E&M Wink-Start In and Wink/Delay-Dial Out (known as the Universal Sequence)
12	E&M Immediate-Start In and Wink/Delay-Dial Out
13	E&M Release Link Trunk Out
14	E&M Release Link Trunk In
15	E&M Main Satellite, Immediate-Start
16	E&M Main Satellite, Wink-Start
17	E&M Main Satellite, Delay-Dial
18	‘S’ Channel Signaling, Host Access-GPP ‘S’ Channel Signaling, Host Access—EIA
19	Loop-Start
20	ISDN or DMI/MOS
21	E&M Wink-Start In and Out
22	E&M Delay-Dial In and Out
23	E&M Delay-Dial In, Wink-Start/Delay-Dial Out
24	E&M Delay-Dial In, Wink-Start/Delay-Dial Out with Fail On Time-Out
25	E&M Immediate-Start In, Wink-Start/Delay-Dial Out with Fail On Time-Out
26	E&M Wink-Start In, Wink-Start/Delay-Dial Out with Fail On Time-Out
27	Analog Line Loop

* No signaling required for Music Interface, Dial Tone Detector.

TABLE 2-E. Trunk Type Versus Signaling Type for System 85 R2V4 (Note)

Trunk Type & Description	Trunk Interface					
	SN233 (E&M)	SN230 (GS)	SN232 (RB)	ANN11 (LS)	ANN35 (ISDN)	Other
All 2-way APLT Trunks:						
12 APLT	**(9)**					
13 APLT	**(10)**					
14 APLT	**(8)**					
15 APLT	**(5)**					
Regular CO Trunks:						
16 1-way in Attendant Completing	**4, 21***	**(1)**		**19**	**20**	
17 1-way Outgoing DOD	**4, 21**	**(1)**		**19**	**20**	
18 1-way Outgoing DOD w/Party Test		**(2)**				
19 2-way Incoming Attendant Completing/DOD	**4, 21***	**(1)**		**19**	**20**	
20 2-way with Party Test Attendant Completing In DOD Out		**(2)**				
Foreign Exchange Trunks:						
21 1-way In Attendant Completing	**4, 21***	**(1)**		**19**	**20**	
22 1-way Outgoing DOD	**4, 21**	**(1)**		**19**	**20**	
23 1-way Outgoing DOD w/Party Test						
24 2-way Incoming Attendant Completing/DOD	**4, 21***	**(1)**		**19**	**20**	
25 2-way with Party Test Attendant Completing In DOD Out		**(1)**				
WATS Trunks:						
26 1-way in Attendant Completing	**4, 21***	**(1)**		**19**	**20**	
27 1-way Outgoing DOD or toll terminal access for TSPS	**4, 21**	**(1)**		**19**	**20**	
28 1-way Outgoing DOD w/Party Test		**(2)**				
DID Trunks:						
30 Immediate-Start DID	**4**		**(3)†**		**20**	
31 Wink-Start DID	**11**		**(3)**		**20**	
E&M Trunks:						
32 1-way in Dial Repeating	**(4)**					
33 1-way out Automatic	**(4)**					
34 1-way Dial Repeating Out	**(4)**	**1**				
35 1-way In Automatic	**(4)**	**1**				

NOTE: ( ) Number inside parenthesis is the default signaling type.

*** Direct connections to class 4 offices (4 ESS™ switches), using multifrequency signaling, require wink-start for incoming trunk seizures. The 4 ESS switch sends at least one address digit; these address digits are ignored by DEFINITY Generic 2 and system 85.**

† Call processing eliminates the wink to distant end.

TABLE 2-E. Trunk Type Versus Signaling Type for System 85 R2V4 (Note) (Contd)

Trunk Type & Description	Trunk Interface					
	SN233 (E&M)	SN230 (GS)	SN232 (RB)	ANN11 (LS)	ANN35 (ISDN)	Other
E&M Trunks (Contd):						
36 2-way Dial Repeating Both Ways	(4)					
37 2-way Dial Repeat In/Auto Out	(4)					
38 2-way Auto In/Dial Repeat Out	(4)	1				
39 2-way Auto Both Ways	(4)	1				
40 l-way in Dial Rep., Delay Dial	(27)					
41 2-way Dial Repeating	(26),11 21,22				20	
42 l-way in Dial-Repeating	(26),11 21,22				20	
43 l-way out Dial-Repeating	(26),11 21,22				20	
44 2-way Dial Repeating	(27)					
45 2-way Dial Repeating	(27)					
46 2-way Dial Repeating	(24),12 21,22,25				20	
47 2-way Dial Repeating	(24),21 22,23				20	
Special Trunks:						
50 Remote Access 2-way	4,21	(1)			20	
51 Telephone dictation Interface						(7) SN231
52 Recorded Annc.. Interface						(7) SN231
53 Code Call Interface						(7) SN231
54 Loudspeaker Paging Interface						(7) SN231
55 Touch-Tone Sender						0 – SN252
57 CAS Release Link Trunk Outgoing From Branch, 1-way out	(13)					
58 ANI Interface						(6) SN244
62 Music-On-Hold Interface						0–SN231
65 Contact Interface						0–SN241

NOTE: ( ) Number inside parenthesis is the default signaling type.

TABLE 2-E: Trunk Type Versus Signaling Type for System 85 R2V4 (Note) (Contd)

Trunk Type & Description	Trunk Interface					
	SN233 (E&M)	SN230 (GS)	SN232 (RB)	ANN11 (LS)	ANN35 (ISDN)	Other
Special Trunks (Contd):						
66 CAS Release Link Trunk Incoming At Main 1-way in	(14)					
67 Audio Interface						0
68 UCD Delay Recorded Annc.						0
Special E&M Trunks:						
70 l-way in Immediate-Start	(15)					
71 l-way out Immediate-Start	(15)					
72 2-way Immediate-Start	(15)					
73 l-way In Wink-Start	(16)					
74 l-way Out Wink-Start	(16)					
75 2-way Wink-Start	(16)					
76 l-way Delay-Dial in	(17)					
77 l-way Delay-Dial out	(17)					
78 2-way Delay-Dial	(17)					
Data Trunks:						
100 Tone Detector						0 - SN255
101 Analog Data Modem Pool	(4)					
102 Digital Data Modem Pool						(18)SN270
103 Host Access PDM						(18)SN270
104 Host Access TDM						(18)SN270
105 AP 32 DCPI						(18)SN270
106 EIA Port						(18)SN238
107 ISN/EIA Port						(18)SN238
108 DMI Host Terminating Dial Repeating In Automatic Out	(5)				20	
109 DMI Dial Repeating In/Out	(11)				20	
ISDN Trunks:						
120 ISDN Dynamic*					(20)	

NOTE: ( ) Number inside parenthesis is the default signaling type.

* For more information about the "ISDN Dynamic" trunk type, see *DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRl Reference* (555-025-101).

TABLE 2-F. Signaling Definitions for Generic 2

Trunk No.	Signaling Type
0	No Signaling Required*
1	Ground-Start
2	Ground-Start with Party Test
3	Loop/Reverse Battery, Wink-Start
4	E&M Immediate-Start In and Out
5	E&M Wink-Start In and Immediate-Start Out
6	ANI
7	Auxiliary Equipment
8	E&M Delay-Dial In and Immediate-Start Out
9	E&M Delay-Dial In and Wink/Delay-Dial Out With Dial Tone
10	E&M Wink-Start In and Wink/Delay-Dial Out With Dial Tone
11	E&M Wink-Start In and Wink/Delay-Dial Out (known as the Universal Sequence)
12	E&M Immediate-Start In and Wink/Delay-Dial Out
13	E&M Release Link Trunk Out
14	E&M Release Link Trunk In
15	E&M Main Satellite, Immediate-Start
16	E&M Main Satellite, Wink-Start
17	E&M Main Satellite, Delay-Dial
18	‘S’ Channel Signaling, Host Access-GPP 'S' Channel Signaling, Host Access—EIA
19	Loop-Start
20	ISDN or DMI/MOS
21	E&M Wink-Start In and Out
22	E&M Delay-Dial In and Out
23	E&M Delay-Dial In, Wink-Start/Delay-Dial Out
24	E&M Delay-Dial In, Wink-Start/Delay-Dial Out with Fail On Time-Out
25	E&M Immediate-Start In, Wink-Start/Delay-Dial Out with FaiI On Time-Out
26	E&M Wink-Start In, Wink-Start/Delay-Dial Out with Fail On Time-Out
27	Analog Line Loop
28	E&M Automatic In, Immediate-Start Out
29	E&M Automatic In, Wink-Start Out
30	Loop/Reverse Battery, Immediate-Start
31	E&M Immediate-Start In, Automatic Out
32	E&M Automatic In, Automatic Out

* No signaling required for Music Interface, Dial Tone Detector.

TABLE 2-G. Trunk Type Versus SignalingType for Generic 2 (Note)

Trunk Type & Description	Trunk Interface					
	TN760 SN233 (E&M)	TN747 SN230 (GS)	TN753 SN232 (RB)	TN767 ANN11 (LS)	TN555+ TN767 ANN35 (ISDN)	Other
All 2-way APLT Trunks:						
12 APLT	(9)					
13 APLT	(10)					
14 APLT	(8)					
15 APLT	(5)					
Regular CO Trunks:						
16 l-way in Attendant Completing	28,29*	(1)		19	20	
17 l-way Outgoing DOD	28,29	(1)		19	20	
18 l-way Outgoing DOD w/Party Test		(2)				
19 2-way Incoming Attendant completing/DOD	28,29*	(1)		19	20	
20 2-way with Party Test Attendant Completing In/ DOD Out		(2)				
Foreign Exchange Trunks:						
21 l-way In Attendant Completing	28,29*	(1)		19	20	
22 l-way Outgoing DOD	28,29	(1)		19		
23 l-way Outgoing DOD w/Party Test		(2)				
24 2-way Incoming Attendant Completing/DOD	28,29*	(1)		19		
25 2-way with Party Test Attendant Completing In/ DOD Out		(2)				
WATS Trunks:						
26 l-way in Attendant Completing	28,29*	(1)		19	20	
27 l-way Outgoing DOD or toll terminal access for TSPS	28,29	(1)		19	20	
28 l-way Outgoing DOD w/Party Test		(2)				
DID Trunks:						
30 Immediate-Start DID	4		(30)†		20	
31 Wink-Start DID	11		(3)		20	
E&M Trunks:						
32 l-way in Dial Repeating	(4)					
33 l-way out Automatic	(31)					27
34 l-way Dial Repeating Out	(4)	1				
35 l-way In Automatic	(28)	1				

NOTE: ( ) Number inside parenthesis is the default signaling type.

*** Direct connections to class 4 offices (4 ESS switches), using multifrequency signaling, require wink-start for incoming trunk seizures. The 4 ESS switch sends at least one address digit; these address digits are ignored by DEFINITY Generic 2 and System 85.**

† Call processing eliminates the wink to distant end.

TABLE 2-G. Trunk Type Versus Signaling Type for Generic 2 (Note) (Contd)

Trunk Type & Description	Trunk Interface					
	TN760 SN233 (E&M)	TN747 SN230 (GS)	TN753 SN232 (RB)	TN767 ANN11 (LS)	TN555+ TN767 ANN35 (ISDN)	Other
E&M Trunks (Contd):						
36 2-way Dial Repeating Both Ways	(4)					
37 2-way Dial Repeat In/Auto Out	(31)					27
38 2-way Auto In/Dial Repeat Out	(4)					
39 2-way Auto Both Ways	(32)	1				
40 1-way in Dial Rep., Delay Dial	(8)					
41 2-way Dial Repeating	(26),11 21,22				20	
42 1-way in Dial Repeating	(26),11 21,22				20	
43 1-way out Dial Repeating	(26),11 21,22				20	
44 2-way Dial Repeating	(8)					
45 2-way Dial Repeating in, Automatic Out	(8)					
46 2-way Dial Repeating DD/WS out	(24),12 21,22,25				20	
47 2-way Dial Repeating	(24),21 22,23				20	
Special Trunks:						
50 Remote Access 2-way	4,21	(1)			20	
51 Telephone dictation Interface						(7) SN231
52 Recorded Annc. Interface						(7) SN231
53 Code Call Interface						(7) SN231
54 Loudspeaker Paging Interface						(7) SN231
55 Touch-Tone Sender						0 - SN252
57 CAS Release Link Trunk Outgoing From Branch, l-way out	(13)					
58 ANI Interface						(6) SN244
62 Music-On-Hold Interface						0 - SN231
65 Contact Interface						0 - SN241

NOTE: ( ) Number inside parenthesis is the default signaling type.

TABLE 2-G. Trunk Type Versus Signaling Type for Generic 2 (Note) (Contd)

Trunk Type & Description	Trunk Interface					
	TN760 SN233 (E&M)	TN747 SN230 (GS)	TN753 SN232 (RB)	TN767 ANN11 (LS)	TN555+ TN767 ANN35 (ISDN)	Other
Special Trunks (Contd):						
66 CAS Release Link Trunk Incoming At Main, l-way In	(14)					
67 Audio Interface						0
Special E&M Trunks:						
70 l-way in Immediate-Start	(15)					
71 l-way out Immediate-Start	(15)					
72 2-way Immediate-Start	(15)					
73 1-way In Wink-Start	(16)					
74 1-way Out Wink-Start	(16)					
75 2-way Wink-Start	(16)					
76 1-way Delay-Dial in	(17)					
77 1-way Delay-Dial out	(17)					
78 2-way Delay-Dial	(17)					
Data Trunks:						
100 Tone Detector						0 - SN255
101 Analog Data Modem Pool						(27)
102 Digital Data Modem Pool						(18)SN270
103 Host Access PDM						(18)SN270
104 Host Access TDM						(18)SN270
105 AP 32 DCPI						(18)SN270
106 EIA Port						(18)SN238
107 ISN/EIA Port						(18)SN238
108 DMI Host Terminating Dial Repeating In Automatic Out	(5)				20	
109 DMI Dial Repeating In/Out	(11)				20	
ISDN Trunks:						
120 ISDN Dynamic*					(20)	

NOTE: ( ) Number inside parenthesis is the default signaling type.

* For more information about the "ISDN Dynamic" trunk type see *DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN-PRl Reference* (555-025-101, Issue 3).

DCIU (Data Communications Interface Unit)

The DCIU is a microprocessor-controlled communications interface mounted in the Common Control carrier. The 501CC uses a program called the DIP (DCIU Intertface Program) 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:

- APs (Applications Processors)
- AUDIX (Audio Information Exchange) system
- Other DEFINITY Generic 2 or System 85 switches
- DEFINITY Generic 1 or 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 that the details of error correction and flow control are handled by lower level layers in a way which is transparent to higher level layers. Here are the levels:

Level 5	Application Layer
Level 4	Session Layer
Level 3	Packet Layer
Level 2	Link Layer
Level 1	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 connecting those errors by retransmission; this procedure is compatible with the HDLC (High-Level Data Link Control) procedure and is performed by DCIU firmware and by an HDLC chip on each of the DCIUs eight links.

Packet Layer

This layer, also known as Level 3, multiplexes different logical streams of data through Level 2 and regulates the flow of data on each of these logical streams to prevent overrunning the 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,* and *permanent virtual circuit.*

Link

Link is a Level 2 term describing a segment of a communication path (e.g., between two DCIU's or between DCIU and an AP Line Controller) on which there is an established Level 2 protocol. Link includes whatever entities are performing Level 2 services at each end of the segment. Note that since link is a Leve1 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.

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.

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

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 SLDH (Session Layer Data Header), 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 ensure that messages are received in the order they were sent.

message:

SLDH	application message

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 wiIl 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	application message

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	application message	L2

In addition to the 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

Understanding the following simplified conceptual model of the DCIU is essential if Alternate Routing and the administration of the DCIU is to be understood. 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 connectd to the 501CC by a ninth data link (see Figure 2-14). 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 conncetion, 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 apearance 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 in Figure 2-14. The bubbles represent the Level 3 entities serving each of the nine links numbered 0 through 8. 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 receive-queue and transmit-queue that is 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.

How does the DCIU know which stubs (i.e., link and logical channel numbers) 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 DEFINITY Generic 2 and System 85 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.

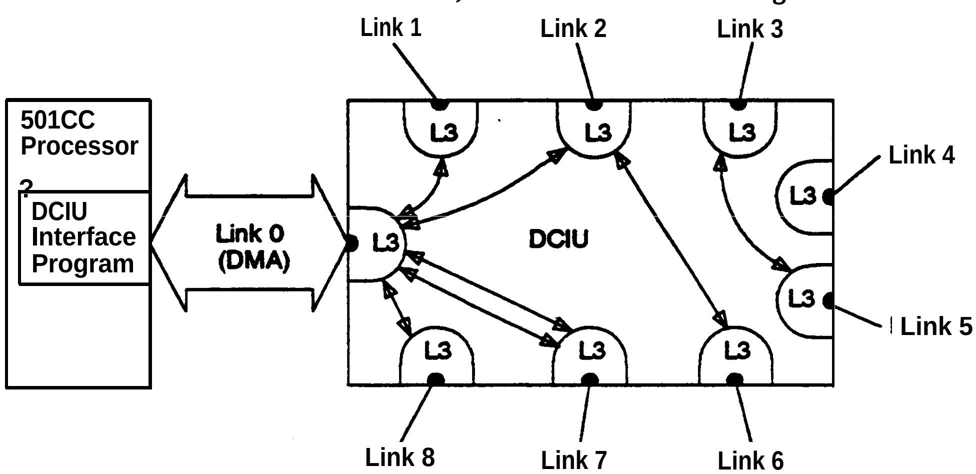


Figure 2-14. Conceptual Model of the DCIU

DCIU 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 DCS (Distributed Communication Service).

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 (tandem connections).

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 be a combination of DEFINITY Generic 2 and System 85 R2s switches; any intermediate switch through which the call tandems must also be a DEFINITY Generic 2 or a System 85 R2.

DEFINITY Generic 2 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 from two to hundreds of switches located throughout the country. An ETN (Electronic Tandem Network) 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 *Network and Data Services Reference* (555-025-201, Issue 3).

ETN (Electronic Tandem Network)

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 2-15 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 slenderized operation, a process that reduces call setup and completion time.

Network switches automatically mute 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.

For incoming calls in ETN arrangements, an ETN tandem serves as the gateway switch for its own terminals plus those terminals on subtending switches. Meanwhile, for outgoing calls, an ETN tandem serves as the gateway to the public network and to other ETN tandems for its own terminals plus those terminals on subtending switches. This practice of funneling access to the public and private network through an ETN tandem produces significant economies because the combined trunking requirement is *much less* than the sum of the parts. In a carefully planned ETN arrangement, many trunk facilities are saved because the needs of the individual switches are averaged and shared.

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 (CMDR), administer network features and parameters (DEFINITY Manager), and automatically test trunk facilities and report the results (ATMS).

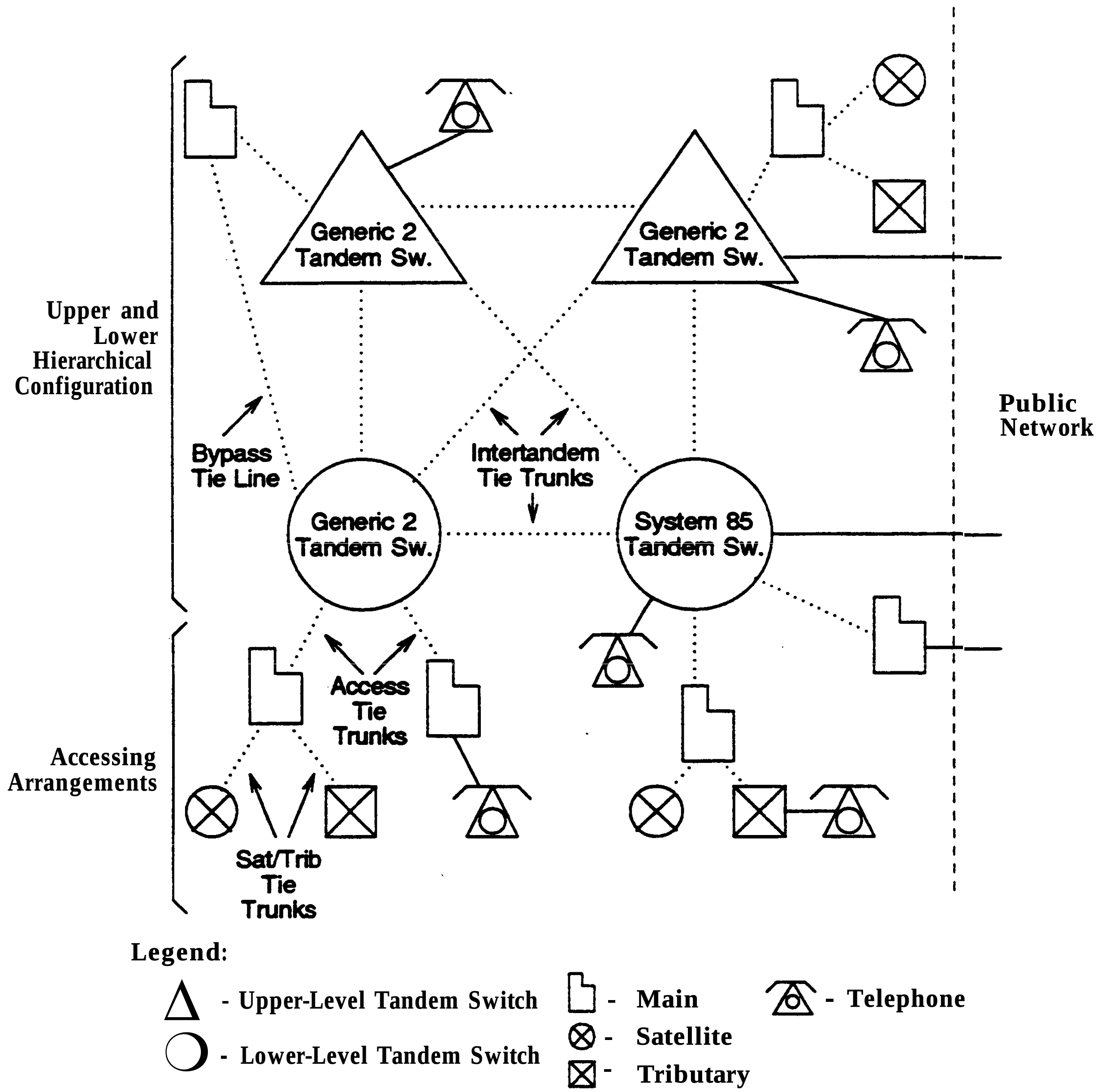


Figure 2-15. Typical ETN Configuration

Main/Satellite/Tributary

Figure 2-16 depicts a Main/Satellite/Tributary configuration. It can function independently or serve as an ETN access arrangement (see Figure 2-15). 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 interconnecting tie trunks.

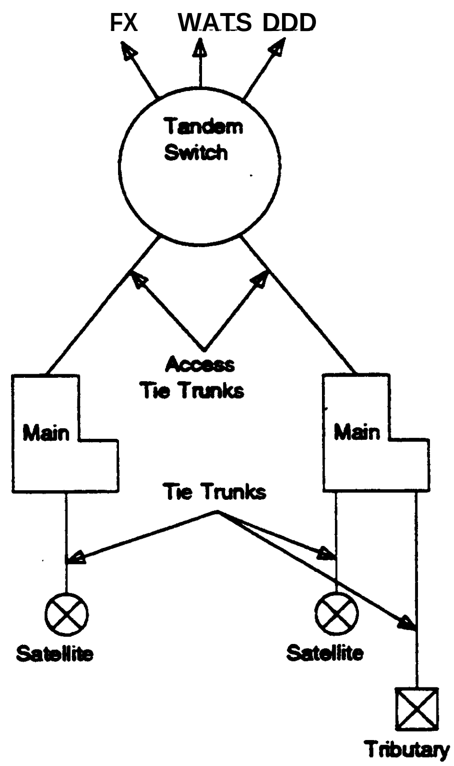


Figure 2-16. Main/Satellite/Tributary Configuration

Distributed Communication System

The DCS (Distributed Communication System) feature permits a multi-PBX network (cluster) to approximate the functionality of one PBX by making a large number of 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 an HDLC (High-Level Data Link Control) link terminated in a DCIU (Data Communications Interface Unit) at each processor. This communication uses 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 DCIU in this chapter.)

For Generic 2 and System 85 R2V4, a DCS cluster can consist of up to 63 nodes. System 85 R2V3 and R2V2 support 20 nodes, and R2V1 supports 12 nodes. Combinations of DIMENSION PBX FP8, Issue 3; System 85, Release 2; System 75; DEFINITY Generic 1; and DEFINITY Generic 2 can be in a cluster but will restrict the number of nodes that can be supported. System 75 and DEFINITY Generic 1 can only be used as endpoints 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 transfers the data necessary for features to appear transparent to the user.

For feature transparency to work, the nodes in question must have the necessary hardware and software, and must be connected by a permanent virtual circuit within a DCIU link. There must also be a voice path (direct or tandem) via either a Main Satellite or tie trunk group. This voice path must be accessed by Station Number Steering or the routing capabilities provided by WCR (World Class Routing) in Generic 2.2 or AAR (Automatic Alternate Routing) in earlier switches. 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 intermediate processors. This pass through or “hop” is controlled by the packet layer of BX.25 communications protocol.

A hop uses 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 (two hops). See Figure 2-17 for an example of a 3-node cluster with one hop between nodes 2 and 3.

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.

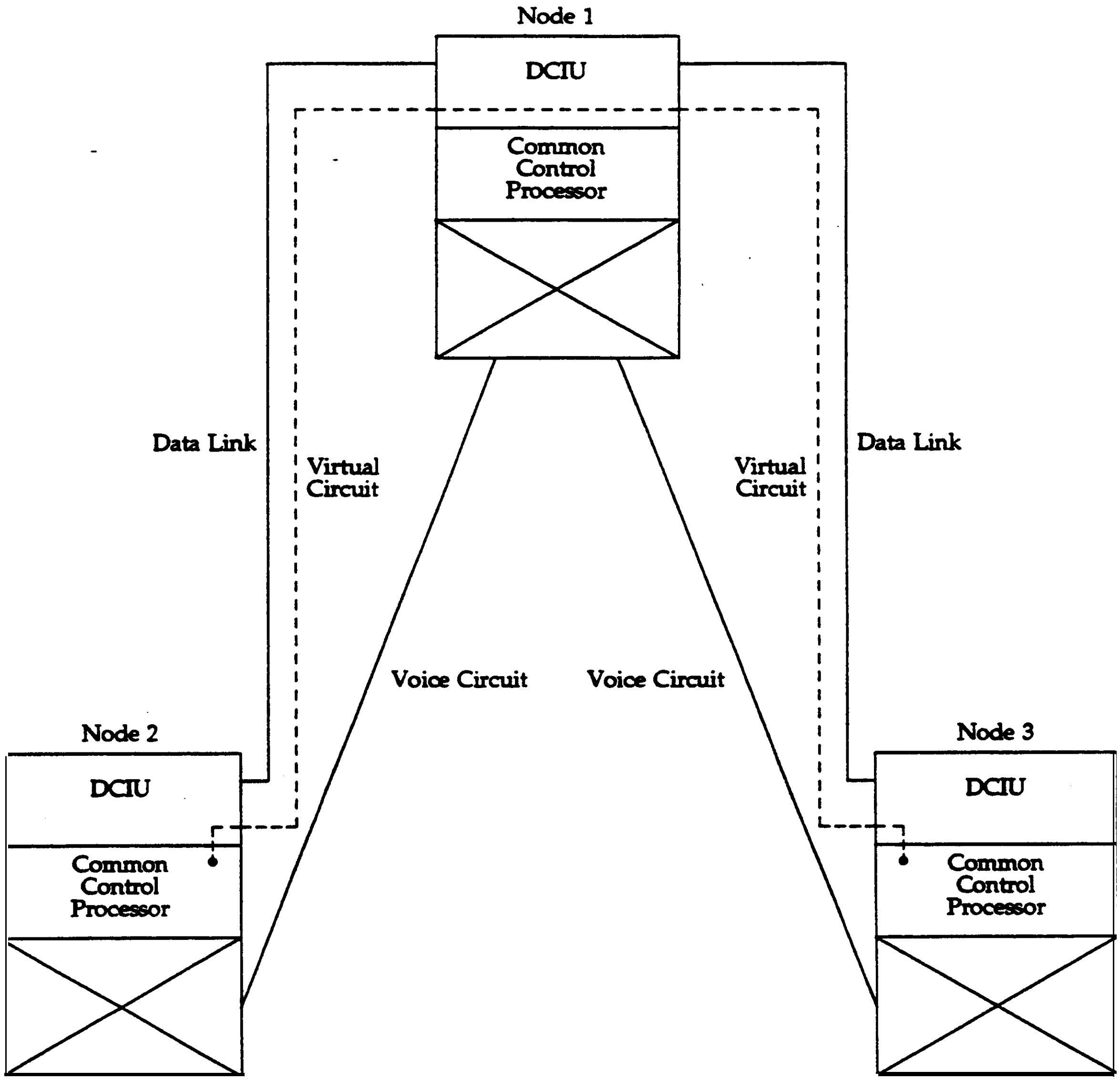


Figure 2-17. 3-Node DCS Cluster With One Hop

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 DCIU in this chapter.

Capacities

The eight links supported by the System 85 and Generic 2 DCIUs permit a DCS cluster with up to 63 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.

Data Communications

DEFINITY Generic 2 and System 85 can serve as a central switching point in a data network, interconnecting on- and off-premises data end-points. The DEFINITY Generic 2 and System 85 switch can connect to almost any type of data equipment which has an EIA (Electronic Industries Association) RS-232C interface, such as:

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

Data modules or EIA port circuit packs provide the digital interface between the switch and data terminals, hosts, and off-premises facilities. Since the switch itself is digital, this interface does not require analog conversion unless the facilities themselves are analog. Because data modules use the same type of modular plugs and the same type of wiring as voice terminals, system support personnel can easily rearrange data modules.

The switch's data capabilities are provided through the data management features:

- Data Call Setup—provides access to DEFINITY Generic 2 and System 85 data services from most types of data endpoints. These endpoints may be located on-premises or off-premises and may use either analog or digital interfaces. The data rates supported are Low (300 bps or less), 300 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, or 19.2 Kbps. Keyboard dialing, which includes call progress prompts, is available with this feature.
- Data Communications Access—provides connectivity for data terminals that use conventional analog interface modems.
- Data Protection—protects data calls from system-generated tones or intrusion attempts which could ordinarily barge in on a call.
- Host Computer Access—provides switched connections between local host computers and other data endpoints. Both digital and analog connections are supported. This feature also allows host-originated data calls.
- Modem Pooling—provides for switched connections between the system's data modules or computer ports and external analog networks. This feature is useful since most public and private networks are analog facilities. In addition, this feature allows the number of modems required to be reduced since they are dynamically allocated to trunks rather than dedicated.

Both the DS1 trunk interface and the ISDN primary rate port circuit packs enhance DEFINITY Generic 2 and System 85 data communications capabilities by making digital trunking available. With either of these interfaces, data trunks are available which can transmit data at speeds up to 64 Kbps.

ISDN and Other Types of Digital Trunking

This section describes digital trunking. But first, terms and concepts associated with digital trunking (such as T1 Carrierer, DS1, AVD, B8ZS, and ESF framing) are presented. To fully appreciate the differences among the DEFINITY Generic *2* and System 85 digital trunking offerings, knowledge of Tl digital transmission is essential. For convenience, some of the basics of T1 are given. Then the various digital trunking options are presented.

T1 Carrier and DS1

What does DS1 mean and how does it relate to T1 Carrier?

- DS1 is a Digital Service (DS) number which corresponds to a digital transmission rate. Here are some examples of DS numbers: DS0 = 64 Kbps, DS1 = 1.544 Mbps, DS2 = 6.312 Mbps, and so on. The DS1 rate accommodates 24 channels operating at the DS0 rate (64 Kbps). Here's how it's done (also, see Figure 2-18):

  Frames are sent 8000 times per second. Within each frame, an 8-bit sample from each channel (digital data or PCM) plus one framing bit are sent. Mathematically, it looks like this:

  {(8 bits/ch. x 24 chs.) + 1 bit} /frame x 8000 frames/sec =
  (192 bits + 1 bit) /frame x 8000 frames/sec =
  193 bits/frame x 8000 frames/sec = 1.544 Mbps

  Since each channel sends 8 bits per frame and frames are sent 8000 times per second, a channel transmits 64 Kbps, the DS0 rate. For this document, the term "DS1" means 24-channel digital transmission at 1.544 Mbps.

- 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 the DS1 rate (1.544 Mbps) and has provisions for synchronization, control, and maintenance. The terms DS1 and T1 are often used interchangeably.

Signaling, Framing, and Line Coding

Signaling, framing, and line coding ensure compatible communication between digital terminal products such as digital switches, channel banks, and host computers. The following paragraphs explain the types of signaling, framing, and line coding DEFINITY Generic 2 and System 85 use and what their functions are in digital trunking.

Signaling

Some form of signaling protocol is essential for any type of trunk, whether it is analog or digital. Signaling protocol is an established sequence of events recognized and adhered to at each end of a connection. This sequence is used to set up and tear down connections. Common methods of signaling are:

- E&M
- Delay dial
- Wink start

- **Immediate start.**

DEFINITY Generic 2 and System 85 use two methods for passing signaling information over digital trunks:

- **Robbed-bit signaling—Every six frames the least significant bit of each channel's time slot is used for signaling. With this method, either 2-state signaling (signaling bit A in the 6th and 12th frames) or 4-state signaling (signaling bit A in the 6th frame and signaling bit B in the 12th frame) is possible. The 16-state signaling is also possible when the ESF (Extended Super-Frame) framing format is used.**
- **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 since no bits are robbed from any of the channels, 64-Kbps digital data rates become possible. This type of signaling is sometimes called "common channel" signaling or AVD (Alternate Voice Data) capability. The 24th channel signaling is discussed in greater detail after Framing and Line Coding.**

Framing

For DS1, a frame contains an 8-bit sample from each of the 24 channels plus a bit used to mark the beginning of the frame. In all, there are 193 bits in a DS1 frame. Since 8000 frames are sent per second, the framing bit is able to carry up to 8 Kbps of information. Framing formats specify how the "framing" information channel is used. The formats used with DEFINITY Generic 2 and System 85 D4 and ESF)organize frames into larger structures called super-frames. When robbed-bit signaling is used, the framing formats dictate which frames within each super-frame pass signaling information. And, the framing format specifies how the signaling information is to be interpreted.

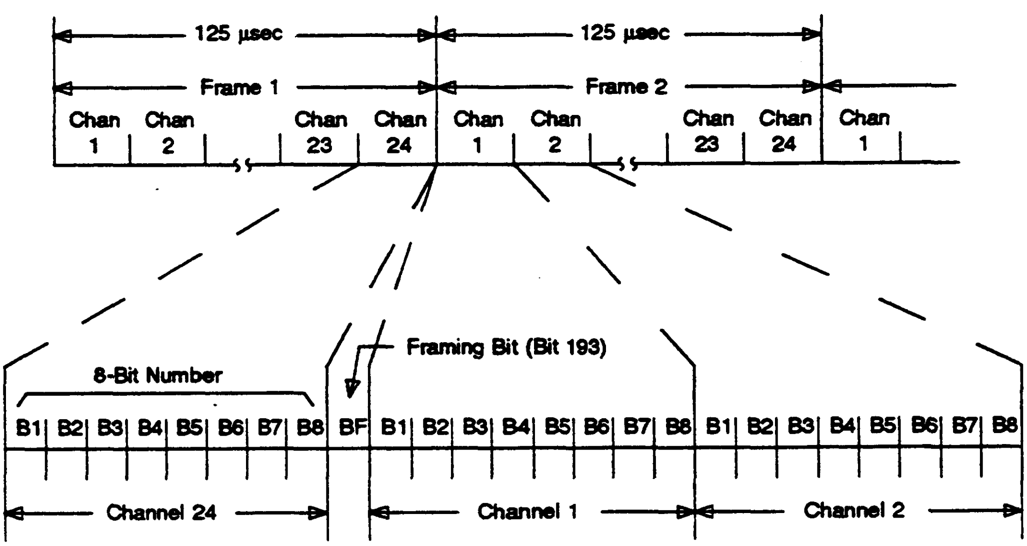


Figure 2-18. T1 Carrier Format

D4 Framing Format

With D4 framing, the framing bit is divided into two fields: terminal framing pattern (Ft) and signaling framing pattern (Fs) (see the following table). The terminal frame pattern is an alternating one-zero pattern which marks the boundaries between frames, and the signaling frame pattern determines which frames contain signaling data for robbed-bit signaling. Option T disables robbed-bit signaling; this allows each channel's 8-bit samples to be passed unaltered during the 6th and 12th frames (the frames used for robbed-bit signaling). Table 2-H shows bit assignments for the D4 framing format.

TABLE 2-H. D4 Framing Format

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

NOTES:

1. Fs—Signaling Framing (sequence ..001110...)
2. Ft—Terminal Framing (sequence ..101010...)
3. Option T—Transparent (robbed-bit signaling disabled, bit 8 used for traffic)
4. Option 2—2-state signaling (channel A)
5. Option 4—4-state signaling (channels A & B)

ESF (Extended Super-Frame) Framing Format

The ESF framing format extends the DS1 super-frame from 12 to 24 frames and redefines the framing bit into three fields instead of two.

- The terminal and signaling framing fields used in D4 framing are combined into one framing field.
- This field provides a 4-Kbps data link for terminal-to-terminal use (this is not used by the TN767 or the ANN11).
- This 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 the 24 channels in the 6th, 12th, 18th, and 24th frame can be used for robbed-bit signaling. Table 2-I shows the ESF framing format.

Line Coding

DS1 specifications have a "ones density" criteria which must be met:

The terminal equipment must not transmit more than 15 "zeroes" in a row.

For every 8 x (n + 1) bits that are sent, there must be at least n "ones" present.

DEFINITY Generic 2 and System 85 meets this requirement with line coding: either B8ZS (Bipolar with 8 Zero Substitution) or ZCS (Zero Code Suppression).

B8ZS (Bipolar With 8 Zero Substitution)

B8Z replaces any eight consecutive zeroes to be transmitted on the DS1 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 are always inserted in the fourth and seventh bit positions. The incoming DS1 bit stream is continually monitored to detect B8ZS code words, and when detected, replaces it with eight "zeroes" (see *AT&T Compatibility Bulletin No. 144 Clear Channel Capability).* With this coding arrangement, clear 64-Kbps channels can be supported while still meeting the ones density requirement. However, digital facilities must be checked to make sure that bipolar violations can be passed. Often, line repeaters and NCTEs will not pass bipolar violations. If this is the case, use ZCS (Zero Code Suppression) instead.

ZCS (Zero Code Suppression)

ZCS is the most common DS1 line coding scheme in use. If any 8-bit time slot contains all "zeroes", bit 2 is changed from a "zero" to a "one" (see AT&T Compatibility Bulletin No. 119). Although this is not significant in PCM voice transmission, it would obviously cause errors in digital data. Therefore, only digital data formats which do not allow time slots containing eight "zeroes" may be used. DCP (Digital Communications Protocol) formatted data meets this criteria for data rates from 300 bps to 19.2 Kbps, 56 Kbps, and restricted 64 Kbps. The HDLC (High-Level Data Link Control) format is inverted for this application to meet the ZCS criteria for full 64 Kbps data rates.

TABLE 2-I. ESF Framing Format

Frame Number	F Bits			Bit Use in Each Channel Time Slot		Signaling Bit Use Options			
	ESF (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**	**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**	**B**
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**	**C**
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**	**D**

NOTES:

1. **ESF—Extended Super-Frame Framing (sequence ...001011...)**
2. **DL—4 Kbps Data Link (message bits m) (not supported)**
3. **BC—Block-Check field (Check bits C1-C6)**
4. **Option T—Transparent (Bit 8 used for traffic)**
5. **Option 2—2-state Signaling (Channel A)**
6. **Option 4—4-state Signaling (Channels A & B)**
7. **Option 16—16-state Signaling (Channels A, B, C, and D)**

More About 24th Channel Signaling

As mentioned before, 24th channel signaling is provided by using the 24th channel of each frame as a common signaling channel for the other 23 channels. Since robbed-bit signaling isn't used, 64 Kbps digital data rates are possible.

For ESF framing, five of the eight bits in the 24th channel can be assigned to signaling. Site ESF framing has 24 frames per super-frame, per-channel signaling for each of the 23 channels bearing traffic is carried by a 24-frame channel signaling sequence.

Example: By using Table 2-J, it can be seen that channel number 5 uses the 24th channel during frame number 5 of an ESF 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 ESF super-frame.

TABLE 2-J. ESF Framing With 24th Channel Signaling

Frame No.	Channel Time Slot Use In Each Frame								
	Chs. 1-23	24th Channel Bits (Note)							
	Bits 1-8	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 TN767 (ANN11) uses a unique signaling arrangement which provides 24th channel signaling. (See Table 2-K.) Bits 1 and 2 in the 24th channel provide A signaling bits 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 or DEFINITY Generic 2s.

TABLE 2-K. D4 Framing With 24th Channel Signaling (Spanning 2 Super-Frames)

Frame No.	Channel Time Slot Use In Each Frame								
	Chs. 1-23	24th Channel Bits (Note)							
	Bits 1-8	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.

The 2-, 4-, and 16-state BOS (bit oriented signaling) schemes just described are not the only ones that can be used for 24th channel signaling. Twenty-fourth channel MOS (message oriented signaling), as used with ISDN, is also available. Bit oriented signaling allows only a limited amount of call-related information to be exchanged. But, with message oriented signaling actual messages such as CONNect and CONNect ACKnowledge are used to pass call setup requests and call status information.

DEFINITY Generic 2 and System 85 Digital Trunk Offerings

The following table is a quick summary of DEFINITY Generic 2 and System 85 digital trunk offerings:

Digital Service	Ckt. Pack	Signaling	Application
Robbed-Bit	TN767 (ANN11)	In-Band	Tie, FX, CO, DID, DOD, and MEGACOM* WATS service access trunks
ACCUNET* Switched 56 Service	TN767 (ANN11)	In-Band	Interface to AT&T Communications ACCUNET Switched 56 service
AVD	TN767 (ANN11)	24th Ch.	Tie trunk
DMI—BOS	TN767 (ANN11)	BOS	Host-to-PBX and PBX-to-Host connections; can also be used with AT&T Communications 4 ESS toll switch and with the DACS Digital Access and Cross-Connect System)
ISDN—PRI	TN767+TN555 (ANN35)	MOS	Connectivity to 4 Ess and 5 Ess® CO switches. Services available: CO, DID, DOD, WATS, FX, and tie
DMI—MOS	TN767+TN555 (ANN35)	MOS	PBX-to-Host, Host-to-PBX, and PBX-to-PBX

ISDN—PRI

DEFINITY Generic 2 and System 85 ISDN is a subset of the ISDN defined by the CCITT (International Telegraph and Telephone Consultative Committee). Specifically, DEFINITY Generic 2 and System 85 provides a 1.544-Mbps ISDN—PRI (Primary Rate Interface) which includes 23 bearer (B) channels used for voice or data calls and one data (D) channel used for 24th channel message oriented signaling.

The ANN35, or the TN767 plus the TN555, provide MOS (Message Oriented Signaling) for DEFINITY Generic 2 and System 85 so that it can comply with CCITT standards for ISDN—PRI. MOS is different than the BOS (Bit Oriented Signaling) used with the TN767 (ANN11). BOS allows only a small amount of call-related information to be exchanged, such as on-hook or off-hook status. But, MOS uses several message types to transmit information elements containing all-related data. For example, the SETUP message is a request for connection to the far end switch. It carriers information about the channel's capabilities, the channel ID, the destination address, and the origination name. SETUP and the rest of the ISDN message types form the ISDN message set. DEFINITY Generic 2 and

* Registered Service Marks of AT&T.

System 85 does not provide the entire CCITT ISDN message set found in Recommendation Q.931. But should it become necessary, port circuit architecture allows messages to be added by replacing universal module processor or TN555 (ANN35) circuit firmware.

The TN767 plus TN555 (ANN35) also provides a DMI—MOS (Digital Multiplexed Interface—Message Oriented Signaling) interface which differs from the ISDN interface in connectivity:

- DMI—MOS provides connectivity between hostcomputers and PBXs or PBXs and PBXs.
- ISDN usually connects to central offices or toll offices.

The ISDN and DMI—MOS message sets are compatible with those used by the 4 ESS switch, the 5ESS switch, System 75, and DMI—MOS licensees. This permits end-to-end digital service among these systems.

The preceding description gives a general idea of what the ISDN—PRI interface is. Here are the rest of the ISDN—PRI capabilities that complete the DEFINITY Generic 2 and system 85 offereing:

- 64-Kbps clear and restricted channel connections. All 23 bearer channels in a T1 ISDN link are administered as clear or are administered as restricted. (A restricted channel is one that is subject to the T1 ones density requirement; a clear channel is not.)
- Non-Facility Associated Signaling (NFAS). This feature allows a single D-channel to carry signaling for up to 20 ISDN—PRI circuit packs. The circuit packs that do not have a D-channel use the 24th channel as a B-channel. However as a precaution, a backup D-channel is usually specified on a different ISDN—PRI circuit pack in the group. This feature is only available with DEFINITY Generic 2 software, it will not work on System 85.
- Channel negotiation on incoming and outgoing calls. Channel negotiation occurs when one end of a T1 link talks to the other, and they agree to use a channel for a call that is different from the one originally requested.
- Recognition of BCC05 (Bearer Capability Class Of Service) that indicates the channel capabilities required.
- Support for equal common carrier access across ISDN facilities by identifying the desired common carrier in the SETUP message
- Name of service providing incoming calls (such as Direct Inward Dialing or 800 Service) for incoming call identification on a call-by-all basis.
- Delivery of ten digits that identify the originating station to the network or to the destination PBX.
- Acceptance of station identification or automatic number identification from the network or originating PBX for display on a voice terminal.
- Transport and display of calling party name across a private ISDN network.
- Tandeming user-to-user information with call setup messages. User information received from an ISDN endpoint in call setup messages is included with the call

setup messages sent out on the outgoing ISDN link. This allows special call-related information to be passed from the calling party to the called party.

- Certain limited interworking services such as interfacing an existing analog facility to an ISDN facility in a tandem PBX environment. Interworking is the linking of dissimilar networks to complete a call.

More information about the ISDN interface appears in *DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRI Reference* (555-025-101, Issue 3).

Non-Facility Associated Signaling (NFAS)

Non-Facility Associated Signaling is an enhancement to ISDN—PRI. By using the excess bandwidth on a single D-channel, NFAS provides call control and signaling for a D-channel group which may contain up to 479 B-channels. Up to 255 D-channel groups may be assigned. D-channel backup is recommended.

D-channel backup uses a redundant D-channel to improve the reliability of NFAS D-channel groups. Should the primary D-channel fail, the redundant D-channel would take over. The redundant D-channel is assigned to the 24th channel on an ISDN—PRI facility other than the facility carrying the primary D-channel, preferably on a facility located in a different module.

The TN767 is used in conjunction with the TN555 to provide an ISDN—PRI interface in universal modules, and the ANN35 provides an ISDN—PRI in traditional modules. NFAS D-channels can be assigned to either, or both, module types. For traditional modules, attitional B-channels (beyond the 23 on the facility carrying the D-channel) are obtained from other ANN35 packs. For universal modules, additional Bchannels are obtained from other TN767 packs; if the TN767 is carrying only B-channels (i.e., not carrying a D-channel) the TN555 is not required. However, the ANN11 traditional module DS1 interface cannot be used to supply additional B-channels. Finally, D-channel groups may contain a mixture of universal and traditional module B-channels.

DMI—BOS

System 85 DMI—BOS became compatible with AT&T Communications 4 ESS toll equipment and DACS (Digital Access and Cross-Connect System) with R2V4. This 64 Kbps of data per channel capability conforms to the DMI—BOS standard and is an addition to the DMI—BOS quality introduced in R2V3. DMI—BOS can pass channels 1 to 23 as:

- 64-Kbps clear if ESF framing and B8ZS line coding are used
- 64-Kbps restricted if D4 or ESF framing and ZCS line coding are used.

Regardless of the line coding scheme used, the A and B signaling bits for channels 1 to 23 are passed in the 24th channel according to the BOS signaling format.

Two different alarms were introduced with R2V4: the RMA (Remote Multiframe Alarm) and the LMA (Loss of Multiframe Alignment) condition. The LMA condition occurs when the near end cannot detect a specific bit pattern in the 24th channel of the incoming DS1 signal; this condition indicates a loss of signaling integrity. Once an LMA condition has been detected, an RMA is sent to the far end to signify that the near end has lost multiframe alignment. Together, LMA and RMA assure signaling integrity for the DMI—BOS format and eliminate the need for DS1 super-frame checks.

Other Digital Trunking Applications

Other digital trunking applications, such as robbed-bit DS1 connections, are described in *AT&T DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRI Reference* (555-025-101, Issue 3).

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 DS1. 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, called 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 Bin 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 the switch 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 DEFINITY Generic 2 and System 85 is handled by the TN463 System Clock Synchronizer. A synchronization circuit pack is required whenever DS1 or ISDN—PRI is used with System 85. The TN463 resides in the TMS carrier for multimodule switches or in the Module Control carrier for single module switches.

The Synchronization Clock is an alternative to the TN463 clock. This is an external stratum 3 clock that interfaces to the switch through a TN2131 external clock interface board.

For more information about synchronization, refer to *AT&T DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRl Reference* (555-025-101, Issue 3).

ISN (Information System Network)

AT&T ISN (Information Systems Network) provides high-speed data communications links between devices in a muitistation data processing environment. The switch 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 AIM (Asynchronous Interface Module). 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.

The basic link between the switch and ISN is an EIA connection between an SN238 (or TN726) EIA port in the switch and a Z3A ADU (Asynchronous Data Unit) connected to an AIM (Asynchronous Interface Module) in the ISN. The EIA connection establishes a l-way trunk, which must be set for 300; 1,200; 2,400; 4,800; 9,600; or 19,200 bps automatic baud rate selection 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 an 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 switch, the two systems are directly linked by EIA connections.

Once the switch—ISN link is established:

- The modem pooling feature provides connectivity between lSN endpoints and remote endpoints accessed through switch 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 switch or by a remote switch with DS1 trunks to the local switch.

System Hardware

This chapter describes:

- **Cabinets and cabinet hardware**
- **Carriers**
- **Circuit packs**
- **System interconnections**

Basic Switch Cabinets

Several combinations of cabinets are used to make up a Generic 2 switch or a System 85 switch. Table 3-A shows which cabinets are available with which switching system.

TABLE 3-A. Cabinet Availability

Cabinet	DEFINITY Generic 2	System 85
CC/TMS	**Available**	**Not available**
Unduplicated common control	**Upgrades Only**	**Available**
Duplicated common control	**Upgrades Only**	**Available**
TMS/RMI	**Large multimodule conifigurations**	**Available**
Universal module	**Available**	**Not available**
SCC module	**Available**	**Not available**
Module control	**Used in traditional modules**	**Available**
Port	**Used in traditional modules**	**Available**
Remote group housing	**Requires a traditional module**	**Available**

On a system-wide basis, power is supplied to switch cabinets in one of two ways (but not both):

- AC power is brought into the cabinet. With all cabinets, except for the Generic 2 universal module cabinet, AC power is converted to -48 V DC in the base of the cabinet and distributed to DC-to-DC converter circuit packs and other equipment in the cabinet. The universal module cabinet distributes AC power to the carriers where power packs perform the AC-to-DC conversion.

  With the Generic 2 CC/TMS cabinet, System 85 R2V4, and some System 85 R2V3 systems, AC-to-DC conversion is done using bulk OLS (Off-Line Switcher) power supplies. Prior to this, AC-to-DC conversion was done using rectifiers. (Cabinet drawings in this manual only show the OLS configuration.)

- -48 V DC is brought into the cabinet from an external DC power source. This method is called the extended power reserve option.

DEFINITY Generic 2 Cabinets

This section covers cabinets that are only available with Generic 2 (see Table 3-A). Cabinets that are available with both Generic 2 and System 85 are covered in the System 85 Cabinets section.

CC/TMS Cabinet (J58886S)

The CC/TMS (Common Control/Time Multiplexed Switch) cabinet (Figure 3-1) replaces the System 85 duplicated or unduplicated common control cabinets in Generic 2 equipment line-ups. Moreover, in most multimodule systems this cabinet also houses the TMS. Table 3-B lists new system configurations which are shipped with a separate TMS cabinet (J58886F).

TABLE 3-B. TMS Cabinet Requirements for DEFINITY Generic 2

	Unduplicated CC	Duplicated CC
Unduplicated TMS	**TMS/RMI cabinet required for 16 or more modules**	**TMS/RMI cabinet required for 16 or more modules**
Duplicated TMS	**Not Applicable**	**TMS/RMI cabinet required for 8 or more modules**

When the TMS cabinet is provided in new systems, all TMS basic and TMS growth carriers are housed in the TMS cabinet; CC/TMS cabinet positions reserved for the TMS are vacant.

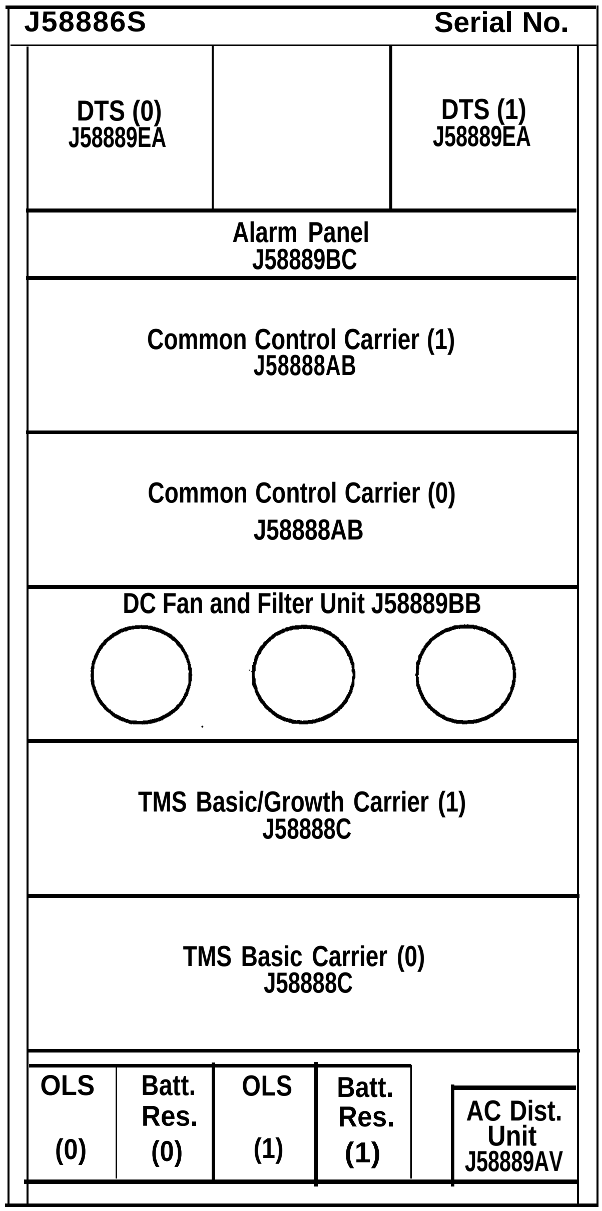
The CC/TMS cabinet is 32 inches (813 mm) wide, 28 inches (711 mm) deep, and 70 inches (1778 mm) high (without duct work and with leveling feet extended). When fully equipped, a CC/TMS cabinet requires 1500 watts of power at -48 V DC and weighs 765 lbs. (347 kg).

The CC/TMS cabinet layout, from top to bottom, is as follows:

- **DTS (J58889EA) — one DTS is required; a second DTS is required for dupliated common control configurations.**
- **Alarm Panel (J58889BC)**
- **Common Control Carrier (J58888AB) — one common control carrier is required; a second common control carrier is required for duplicated common control configurations**
- **DC Fan and Filter Unit (J58889BB)**
- **Alarm Distribution unit (AEH105)**
- **TMS carrier (J58888C) — if the TMS is duplicated, both TMS carrier positions are configured as “basic;” if not, the TMS carrier position directly below the fan assembly can be configured as “growth” and the other TMS carrier position is configured as “basic.” (The TMS basic carrier supports up to seven modules and each TMS growth carrier supports up to eight additional modules.)**
- **Standard AC Power Equipmmt — Includes AC distribution unit J58889AV, bulk OLS power supply, and battery reserve unit. If the common control is duplicated,**

a second OLS power supply, with battery reserve unit, is provided.

- DC Power Equipment (not shown in Figure 3-1) — If selected, DC Distribution unit J58889AD replaces all of the standard AC power equipment in the last list item.



Note: Standard power equipment is shown here. For the standby power option, DC distribution unit J58889AD replaces OLS units, battery reserve units, and ac distribution unit.

Figure 3-1. CC/TMS Cabinet (J58886S-3)

Alarm Panel (J58889BC)

The CC/TMS cabinet is equipped with the J58889BC alarm panel. For unduplicated common control configurations half of the alarm panel is disabled. Descriptive information on the J58889BC alarm panel appears under the System 85 Cabinet Equipment section further on in this chapter.

Disk/Tape System (J58889EA)

The DTS (Disk/Tape System) has replaced the HCMR (High Capacity Mini-Recorder) mass storage device used in System 85. Like the HCMR, the DTS loads the 501CC memory, performs translation updates, and administers program patches. The improved performance afforded by the DTS reduces the amount of time needed for a 501CC memory reload by a factor of five. Part of the DTS is a tape drive which is used for disk back-up and disk initialization.

The DTS consists of a 140 Mbyte disk drive, a 125 Mbyte streaming tape drive, a TN563 host adaptor interface circuit, and an SCSI (Small Computer System Interface) bus cable. SCSI is an ANSI (American National Standards Institute) bus specification. Both the disk drive and the tape drive are SCSI compatible, and the TN563 host adaptor interface gives the 501CC processor access to the SCSI bus.

The disk drive and tape drive are contained in an 8-inch by 8-inch by 17-inch housing which is located at the top of the CC/TMS cabinet. The DTS also fits in the space used by the HCMR in upgraded System 85 common control cabinets. In systems with duplicated common controls, two DTSs are provided. The DTS housing includes:

- A DC/DC converter which converts -48 V to +5 and +12 volts for powering the disk and tape drives
- A temperature alarm thermostat which is connected to a sensing circuit on the TN563
- A fan unit
- An air filter

The TN563 also provides two ADU-type serial asynchronous ports for use by the Manager II. (More information on the TN563 can be found further on in this chapter.) One of these ADU interfaces is a modular jack located on the front of the DTS housing, the other is a 50-pin connector located on the back of the DTS housing.

The TN563 is housed in slot 20 of the common control carrier and is connected to the DTS housing with the SCSI bus cable.

DC Fan and Filter Unit (J58889BB)

The J58889BB-2 fan assembly consists of six fans with built-in speed control for cooling in the upward and downward directions. This fan assembly cannot be used to replace the J58889BB-1 fan assembly (used in CC/TMS and universal module cabinets manufactured before second quarter 1992). The older fan assembly (J58889BB-1) requires an AHD1 fan speed control/thermal alarm circuit.

AEH105 Alarm Distribution Circuit

The AEH105 collects and distributes power and environmental alarms for the common control and TMS carriers.

Power Equipment

As was mentioned previously, standard AC power equipment consists of the AC distribution unit J58889AV, a bulk OLS power supply, and a battery reserve unit. If the common control is duplicated, a second OLS power supply with battery reserve unit is provided. These units are the same models used in System 85, R2V4.

The DC distribution unit, J58889AD, replaces the standard AC power equipment when required. The J58889AD is the same model used in System 85, R2V4 DC powered systems.

Battery Reserve

Depending on the cabinet configuration, eight to fourteen minutes of backup power is available from the batteries in the CC/TMS cabinet. A fully charged battery string will provide power to a fully configured CC/TMS cabinet for at least eight minutes. A CC/TMS cabinet configured with only an unduplicated common carrier will have fourteen minutes of backup power. Most other configurations will provide at least ten minutes of backup power. Batteries can require up to 16 hours to fully recharge.

Different Production Models of the CC/TMS Cabinet

Another version of the CC/TMS cabinet (J58886S-3) has replaced the original CC/TMS cabinet (J58886S-2). The J58886S-2 was manufactured between October 1989 and May 1990. All CC/TMS cabinets shipped after May 1990 are the newer J58886S-3 model.

Functionally, the two models are identical. The newer cabinet differs from the older cabinet in the following ways:

- A redesigned alarm panel (J58889BC) replaces the old alarm panel (J58889X). The two alarm panels are functionally the same; differences are cosmetic. If necessary, the newer alarm panel can also be installed in the older J58886S-2 CC/TMS cabinet.
- A redesigned common control carrier (J58888AB) replaces the old common control carrier (J58888AA). The new common control carrier houses the DC/DC converter packs (410AA and 495JC) replacing those formerly housed in the power carrier adjacent to the DTS assembly. The newer common control carrier can be installed in the older J58886S-2 CC/TMS cabinet, but it is recommended that the J58888AA be used in the J58886S-2 Cabinet.
- The power carrier has been eliminated from the newer J58886S-3 CC/TMS cabinet. The DC/DC converters that were housed in the power carrier are replaced by those in the new J58888AB common control carrier.

Universal Module Cabinet (J58890K)

This 5-carrier cabinet (Figure 3-2) contains all the hardware and equipment required for a module. It weighs about 800 pounds when fully equipped and is 70 inches high by 32 inches wide by 28 inches deep (including the integral rear doors). All cabling from the rear of this cabinet is contained within the cabinet housing. Although the universal module cabinet is 4 inches deeper than a traditional System 85 cabinet, the increased depth does not affect floor plans or existing cabinet line-up space requirements (i.e., front-to-front distance). This is because traditional module cabinet dimensions do not account for cables protruding from the rear of the cabinet.

The following electrical equipment is provided:

- Module Control Carrier (J58890AK-1)
  - — Current Limiter Board (CFY1)
  - — 9823A and 9823B Lightwave Transceivers
- Common Port Carrier (J58890BB)

  TDM/LAN Bus Cables and TDM/LAN Bus Termination Boards
- Power Distribution Unit and Power Supplies
  - — SOPS (single Output Power Supplies)
  - — DOPS (Dual Output Power Supplies)
  - — Frequency Generator (124B2)
- Fan Assemb]y Unit (ED-67077-G4)
- Thermal Sensor Assembly (P/O LCJ258890A, G3).

Other standard and optional equipment is also provided:

- Front door and rear covers
- Front covers for power distribution unit, fan assembly, and equipped carrier positions
- Blank front covers for unequipped carrier positions
- Overhead shielded cable duct (central site modules only)
- Overhead power duct (optional)
- I/O cable duct (optional)
- Facia (optional)
- Earthquake bracing (optional).

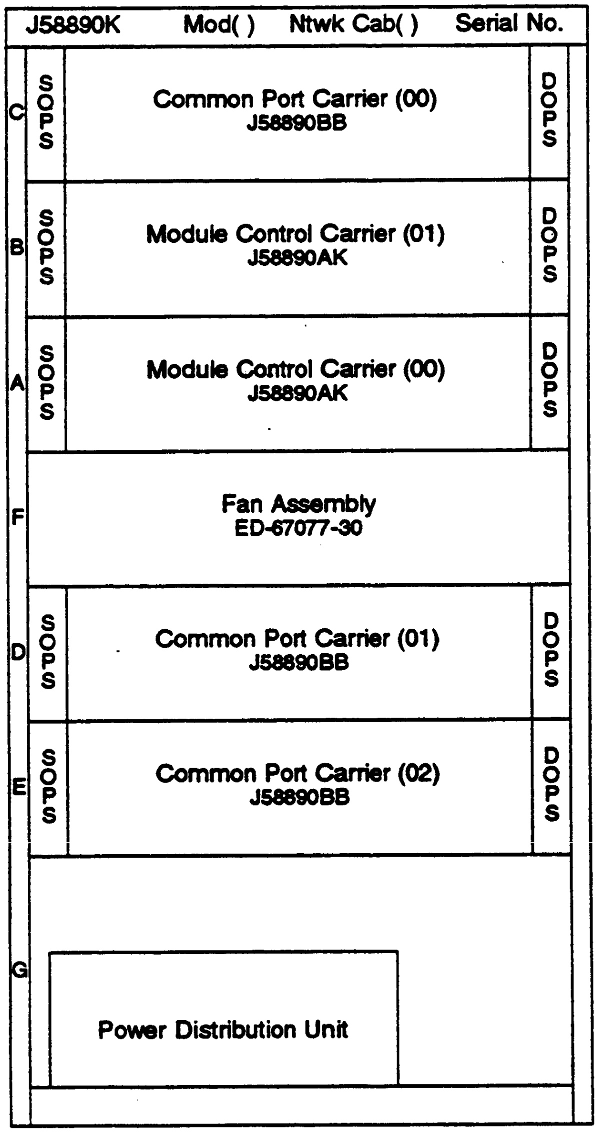


Figure 3-2. Universal Module Cabinet

Universal modules can be located side by side with Common Control, TMS, and traditional module cabinets allowing them to become an integral part of the switch line-up. Furthermore, the universal cabinet accommodates System 85 type overhead power and cable ducts, as well as decorative facia. Universal module cabinets located in a central equipment room are equipped with overhead shielded cable duct. This duct houses the unshielded 4 MHz coaxial cables which connect each module to the common control.

Duct work is not required for universal modules installed in remote equipment rooms.

Cabinet Configuration

Table 3-C and Table 3-D show cabinet equipment positions for universal module hardware.

TABLE 3-C. Universal Module Cabinet Positions for Unduplicated and Duplicated Configurations

Equipment Position	Unduplicated Module Control	Duplicated Module Control
A	**Universal Module Control Carrier (0) (J58890AK-1)**	**Universal Module Control Carrier (0) (J58890AK-1)**
B	**Blank Front Cover (844173492)**	**Universal Module Control Carrier (1) (J58890AK-1)**
C	**Common Port Carrier (0) (J58890BB)**	**Common Port Carrier (0) (J58890BB)**
D	**Common Port Carrier (1) (J58890BB)** OR **Blank Front Cover (844173492)**	**Common Port Carrier (1) (J58890BB)** OR **Blank Front Cover (844173492)**
E	**Common Port Carrier (2) (J58890BB)** OR **Blank Front Cover (844173492)**	**Common Port Carrier (2) (J58890BB)** OR **Blank Front Cover (844173492)**
F	**Fan Assembly Unit (ED-67077)**	**Fan Assembly Unit (ED-67077)**
G	**AC Power Distribution Unit, 397 Batt. Charger* (J58890CE)** OR **DC Power Distribution Unit (J58890CF)**	**AC Power Distribution Unit, 397 Batt. Charger* (J58890CE)** OR **DC Power Distribution Unit (J58890CF)**

*** The 397 battery charger and the KS-21906, L9 battery pack are optional for systems that derive power from a UPS (Uninterruptible Power Supply).**

TABLE 3-D. Cabinet Positions of Universal Module Hardware

Hardware/Equipment	Location	Comments
Power Distribution Front Cover (846194504)	G	One required per cabinet.
Intracabinet Wiring Harness LCJ58890A, G3)	internal	One required per cabinet.
Current Limiter Pack (CFY1)	backplane, position A (module control 0)	One required per cabinet.
TDM/LAN Bus Terminator Pack (ZAHF4)	both ends of bus	Two required per cabinet.
TDM/LAN Bus Extension Cable (Short) (WP-91112, L1 or WP-91716, L1)	between pos. A & B between pos. B & C between pos. D & E	Two required if pos. B is equipped. One required if pos. E is equipped.
TDM/LAN Bus Extension Cable (Long) (WP-91112, L2 or WP-91716, L2)	between pos. A & C between pos. A & D	One required if pos. B is unequipped. One required if pos. D is equipped.
Front Door (ED67080-70, G4 or ED1E536-70, G1)	front of cabinet	One required per cabinet.
Rear Door (846147767, 846147775)	rear of cabinet	One set required per cabinet.
Access Hole Cover	top of cabinet	One required per cabinet. (Applies only to remote module or modules without overhead shielded duct.)
Shielded Cable Duct	top of cabinet	Required for central site cabinets. (See Notes 1 &2)
Power Duct	top of cabinet	Optional. (See Note 2)
I/O Cable Duct	top of cabinet	Optional. (See Note 2)
Facia	top of cabinet	Optional. (See Note 2)
Earthquake Bracing	bottom of cabinet	Optional. (See Note 2)

Note 1: Unless otherwise specified, central modules require the overhead shielded duct to route the 4 MHz coaxial cable to the common control.

Note 2: Field installed.

Cabinet Equipment

Descriptions of universal module cabinet equipment follow. Carrier descriptions appear later in this chapter.

TDM/LAN Bus

The TDM/LAN bus runs continuously through all the carriers within the universal module cabinet. This is accomplished with bus extension cables which connect the TDM/LAN bus from one carrier to another. Bus terminator packs are used at each end of the bus.

Current Limiter Paddleboard (CFY1)

The CFY1 current limiter provides -48 volt power for the fans, frequency generator, and three System 85 type attendant consoles. It also delivers -48 volt and +5 volt leads to power failure detection circuitry. In remote universal modules, this paddleboard controls emergency transfer. One current limiter paddleboard is required per universal module. This paddleboard is mounted on the backplane of the module control carrier in position A. The current limiter paddleboard is never equipped in position B. (See Figure 3-2 for carrier positions.)

Lightwave Transceivers

One 9823A lightwave transceiver or one 9823B lightwave transceiver is required for each TN481 and TN456 equipped in the carrier. The lightwave transceivers mount on the I/O connector plate located on the rear of the universal module control carrier.

The 9823A lightwave transceiver is required for fiber optic links up to 4900 ft. (1.5 km) long and the 9823B lightwave transceiver is required for fiber optic links between 4900 ft. (1.5 km) and 25,000 ft. (7.6 km). The 9823A and 9823B transceivers cannot be mounted in traditional modules or in the TMS; four new paddleboard models are provided for that purpose.

Power Distribution

The universal module cabinet can be provisioned to operate in an AC or a DC powered system. When the system is powered by AC, an AC power distribution unit and AC carrier-mounted OLS power units are equipped. When the system is DC powered, a DC power distribution unit and DC carrier-mounted power supplies are equipped.

- AC Powered Cabinet (Figure 3-3):
  - One 631DA1 power supply per carrier (slot 00)
  - One 631DB1 power supply per carrier (slot 22)
- -48 VDC Powered Cabinet (Figure 3-4):
  - One 644A1 power supply per carrier (slot 00)
  - One 645B1 power supply per carrier (slot 22)

The power distribution unit equipped in the cabinet determines the power cord and the power service required by the cabinet For AC equipped cabinets, one of four J58890CE AC distribution units is equipped:

J58890CE, L1 This distribution unit is used when it is desirable to power remote J58890K-1, List 1 universal modules (i.e., those manufactured before second quarter 1992) with 120-volt AC, 50A service. When this distribution unit is selected, a main disconnect switch and duct work are not required.

J58890CE, L2 This distribution unit is used in J58890K-1, List 1 universal module cabinets (i.e., those manufactured before second quarter 1992). It requires single phase 208-volt AC, 30A service.

J58890CE, L3 This distribution unit is used when it is desirable to power remote J58890K-1, List 14 or List 15 universal modules (i.e., those manufactured after second quarter 1992) with 120-volt AC, 50A service. When this distribution unit is selected, a main disconnect switch and duct work are not required.

J58890CE, L4 This distribution unit is used in J58890K-1, List 14 or List 15 universal module cabinets (i.e., those manufactured after second quarter 1992). It requires either two-phase 208-volt AC, 30A service with neutral plus ground or single-phase 240-volt AC, 30A service with a center tapped neutral plus ground.

For DC equipped cabinets, the J58890CF DC distribution unit is equipped. It requires -48-volt DC, 80A service.

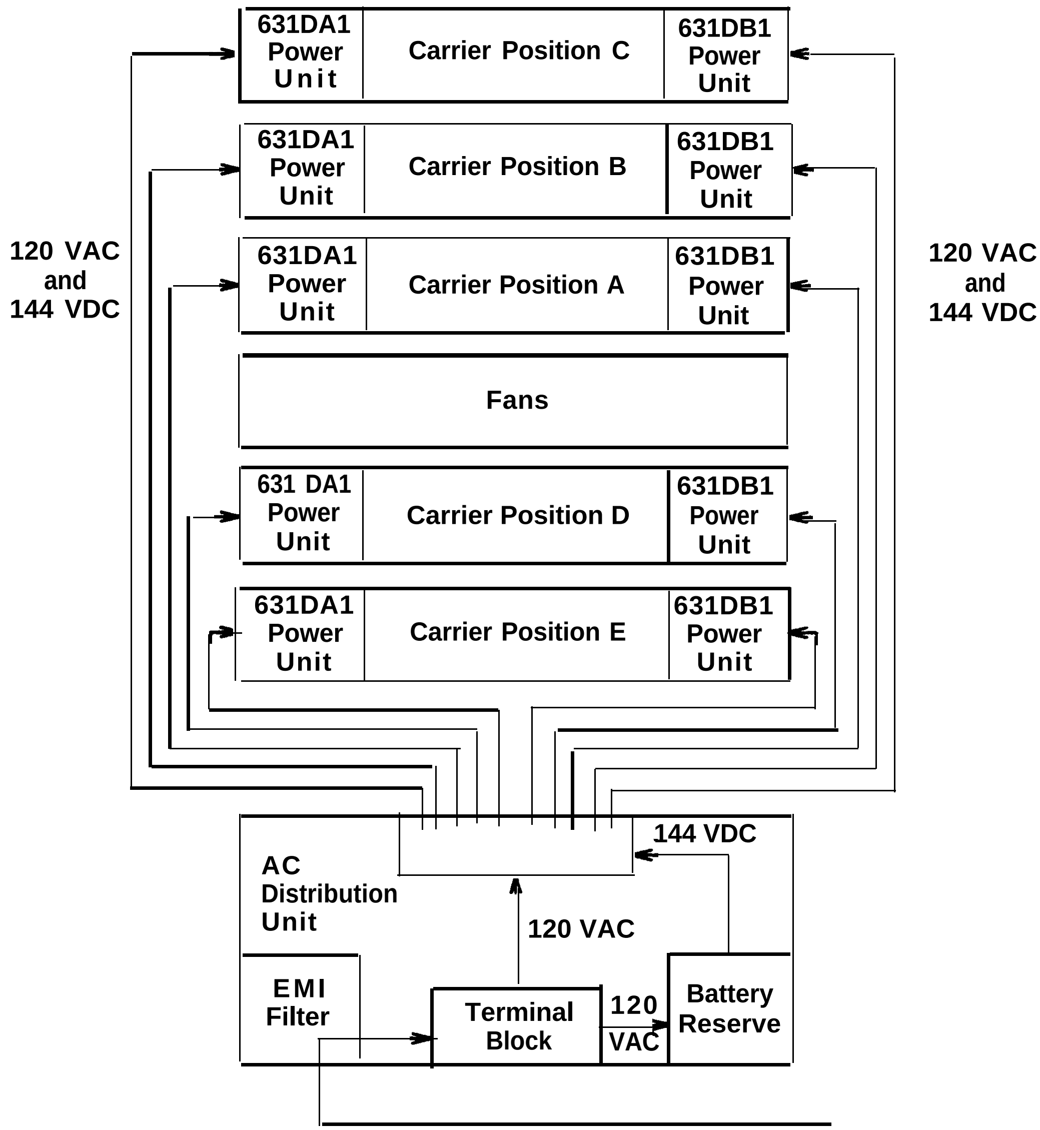


Figure 3-3. AC Power Distribution Diagram

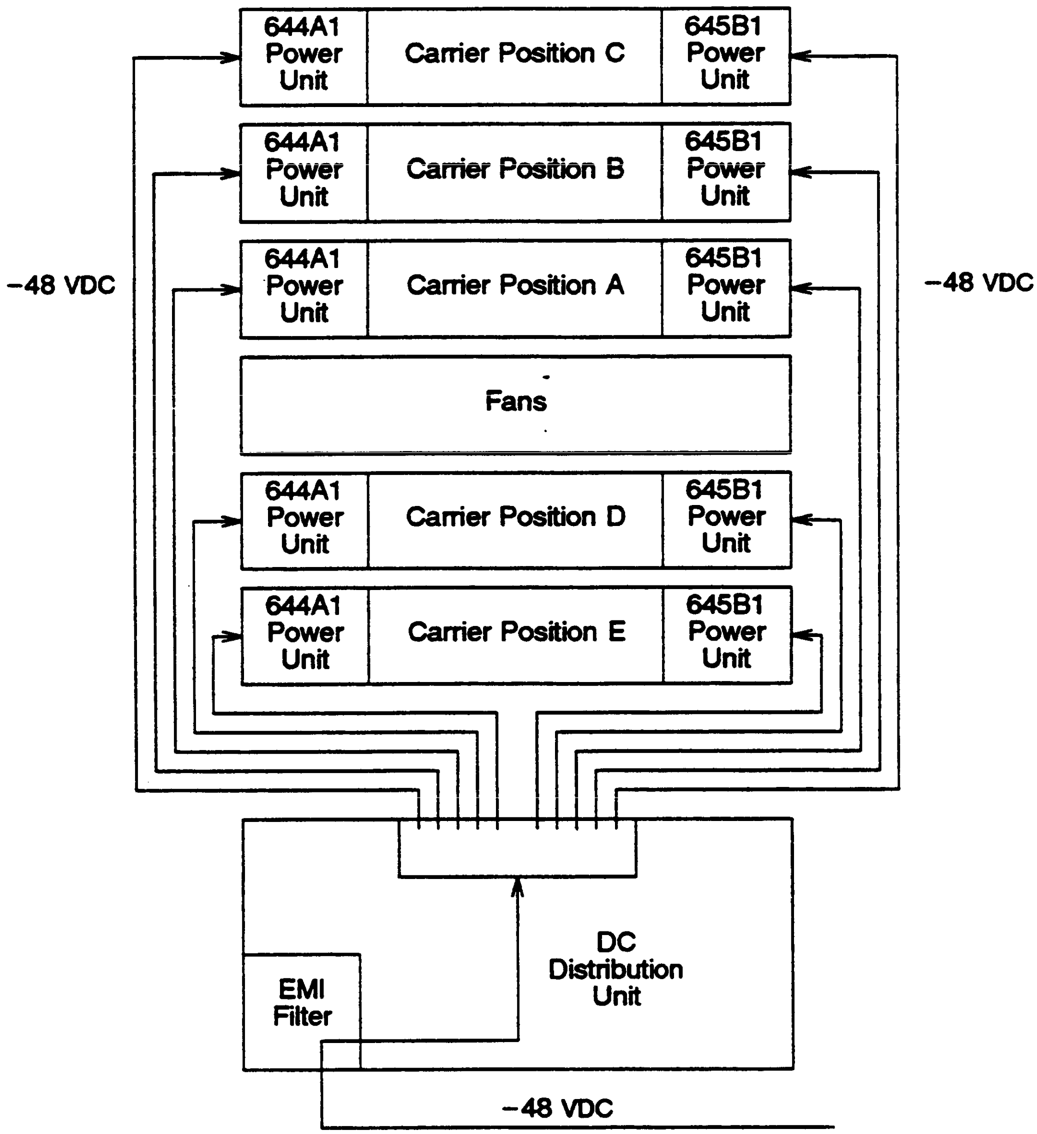


Figure 3-4. DC Power Distribution Diagram

Battery Reserve

A fully charged battery string will provide power to a fully configured universal module cabinet for at least two minutes. Batteries can require up to 16 hours to fully recharge.

SCC Module

The SCC module is universal module hardware housed in Single-Carrier Cabinets (see Figure 3-5). Two, three, or four single-carrier cabinets (SCCs) are stacked on top of each other to form a module. The bottom cabinet contains one or two module control complexes; the upper three cabinets each contain 18-slot port carriers. (Circuit pack layout for the single-carrier cabinets are discussed under Carriers later on in this chapter.) The single-carrier cabinet is also used with DEFINITY Communications System, Generic 1 and System 75.

Single-carrier cabinet dimensions are 20 inches (508 mm) high by 27 inches (686 mm) wide by 22 inches (559 mm) deep. A single-carrier cabinet housing a duplicated module control weighs approximately 130 pounds (59 kg) and a single-carrier cabinet housing a fully equipped port carrier weights approximately 125 pounds (57 kg).

Four -48V DC fans are located in the top rear of each single-carrier cabinet. Air is forced through a filter, over the circuit packs, and out through vent holes at the lower front and rear of the cabinet. The air filter is easy to replace from the front of the cabinet.

NOTE: The SCC module may only be used as a remote module.

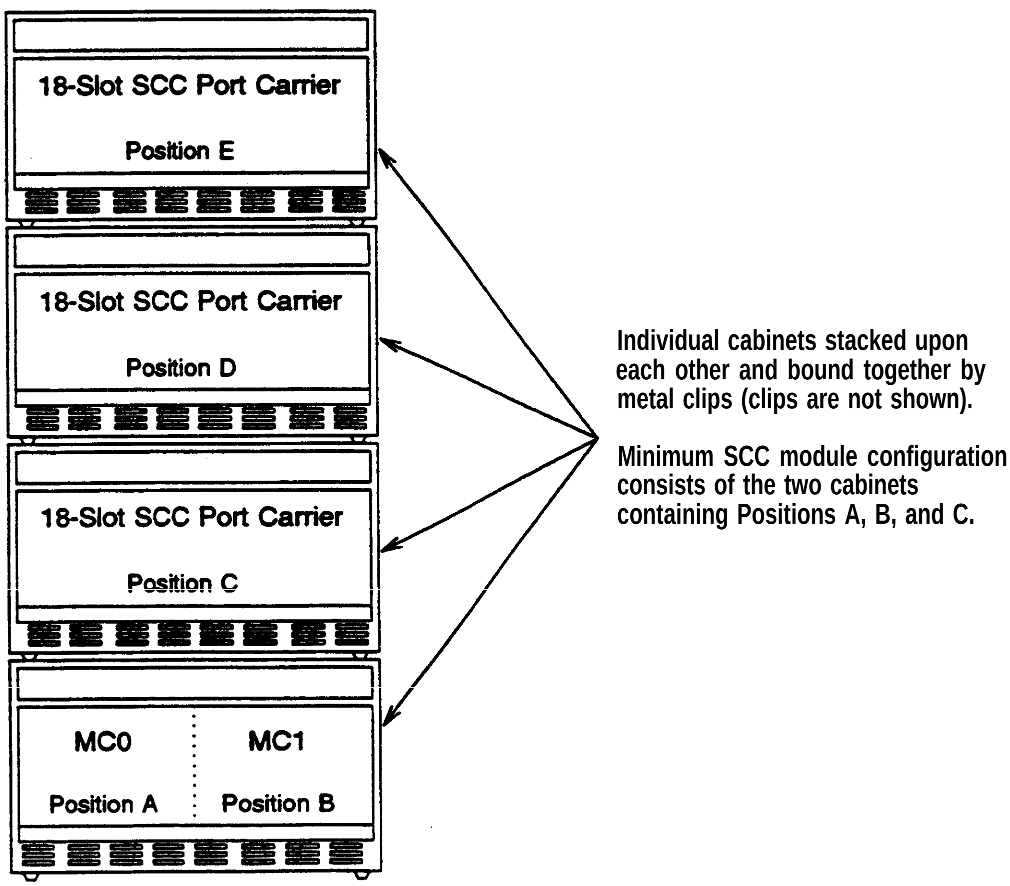


Figure 3-5. SCC Module

System 85 Cabinets

This section covers cabinets that are available with System 85, and in some cases with Generic 2. Since these cabinets use a lot of the same hardware, detailed descriptions of cabinet hardware appear in the next section.

Unduplicated Common Control Cabinet (J58886J)

An unduplicated common control cabinet (see Figure 3-6) provides standard reliability common control for System 85. It contains:

- An unduplicated alarm panel
- Up to three port or DS1 carriers
- A common control carrier
- A DC fan assembly
- A frequency generator (if port carriers are equipped)
- An HCMR (High Capacity Mini-Recorder)
- An OLS power supply
- A DC/DC converter unit
- A bus bar

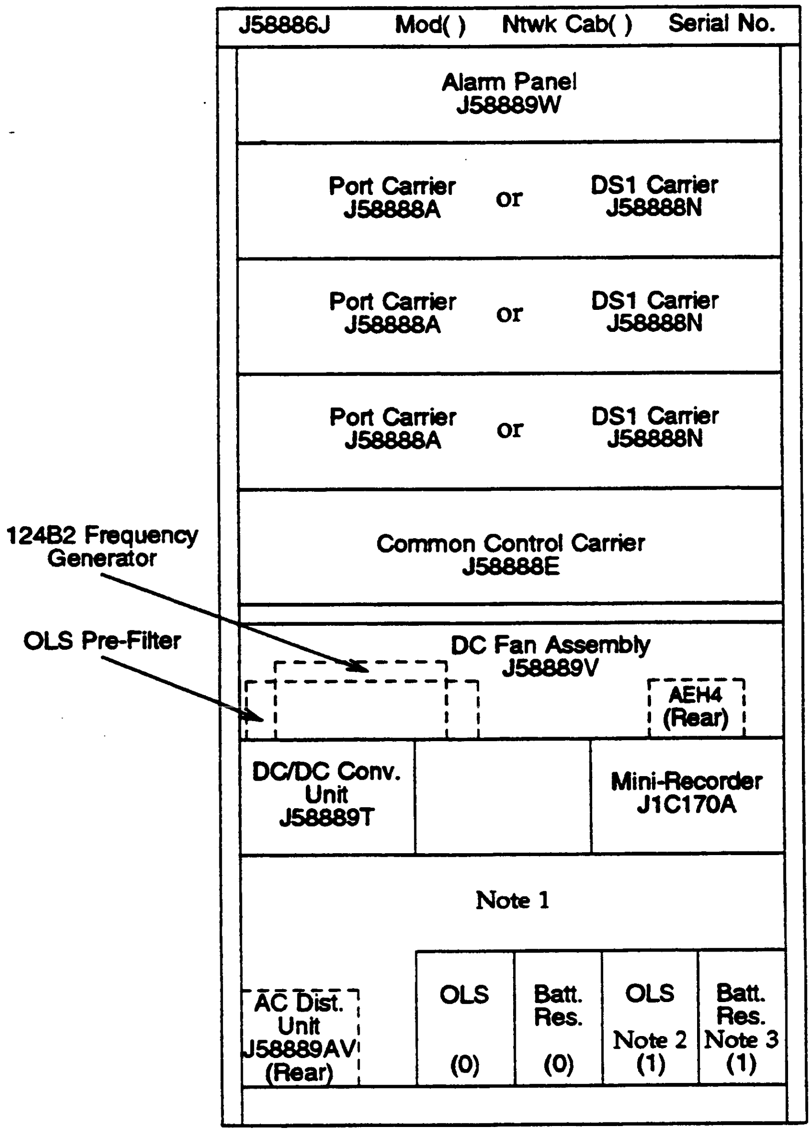
The lower portion of this cabinet contains an AC distribution unit, an OLS power supply, and an OLS battery reserve unit. The DC/DC converter unit and HCMR are mounted under the fan assembly.

In systems with the extended reserve power option, DC frame filter J58889AD replaces the OLS power supplies, OLS battery reserve units, AC distribution unit, and the DC/DC converter.

One of two thermal sensors is provided:

- The ED-1E430-70, G2 is used if all carrier positions are occupied. It is included as part of the alarm panel assembly.
- The ED-1E430-70, G1 is used if a vacant carrier position exists. It is placed above the topmost carrier.

The unduplicated common control cabinet is not used in Generic 2 except for systems that have been upgraded from System 85. When this is the case, the HCMR is replaced with a DTS, memory size is increased, and some circuit packs are updated with newer versions.



Notes:

1. Standard power equipment is shown here. For the standby power option, DC frame filter J58889AD replaces OLS units, battery reserve units, ac distribution unit, and DC/DC converter unit.
2. This OLS unit is required when more than 40 ANN17s circuit packs are used.
3. This battery reserve unit is only used when a second OLS is required.

Figure 3-6. Unduplicated Common Control Cabinet (J58886J)

Duplicated Common Control Cabinet (J58886K)

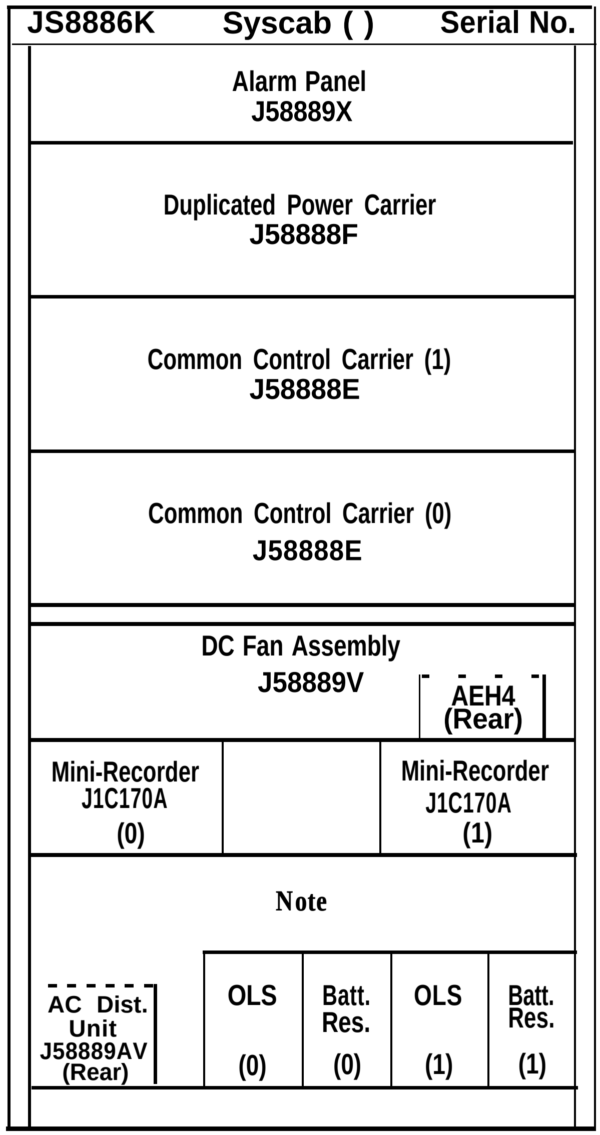
A Duplicated Common Control Cabinet (see Figure 3-7) provides high reliability common control for System 85. It contains:

- A duplicated alarm panel and thermal sensor assembly
- Two common control carriers
- One power carrier containing DC/DC converter units
- A DC fan assembly and alarm board
- Two HCMRs (high capacity mini-recorders)
- A bus bar

The lower portion of this cabinet contains an AC distribution unit, two OLS power supplies, and two OLS battery reserve units. Two HCMRs are mounted under the fan assembly.

In systems with the extended reserve power option, DC frame filter J58889AD replaces the OLS power supplies, OLS battery reserve units, AC distribution unit, and the DC/DC converter.

The duplicated common control cabinet is not used in Generic 2 except for systems that have been upgraded from System 85. When this is the case, the HCMRs are replaced with DTSs, memory size is increased, and some circuit packs are updated with newer versions.



Note: Standard power equipment is shown here. For the standby power option, DC frame filter J58889AD replaces OLS units, battery reserve units, and AC distribution unit.

Figure 3-7. Duplicated Common Control Cabinet (J58886K)

TMS/RMI Cabinet (J58886F)

The TMS/RMI Cabinet (see Figure 3-8) is used for all System 85 multimodule systems and for larger Generic 2 multimodule systems. It contains:

- A thermal sensor assembly
- Up to four carriers. They are a combination of TMS basic, TMS growth, and RMI carriers. A TMS basic carrier serves up to seven modules; systems having more than seven modules require from one to three TMS growth carriers. Each TMS growth carrier serves an additional eight modules.
- A DC fan assembly and alarm board
- A bus bar

The lower portion of this cabinet contains an AC distribution unit, an OLS power supply, and an optional OLS battery reserve unit. If duplicated TMS or RMI carriers are housed, a second OLS power supply and a second optional OLS battery reserve unit are included.

In systems with the extended reserve power option, DC frame filter J58889AD replaces the OLS power supplies, OLS battery reserve units, and the AC distribution unit.

Table 3-E shows cabinet requirements for housing the TMS complex. Keep in mind that for Generic 2, the CC/TMS cabinet can house the TMS for smaller multimodule systems.

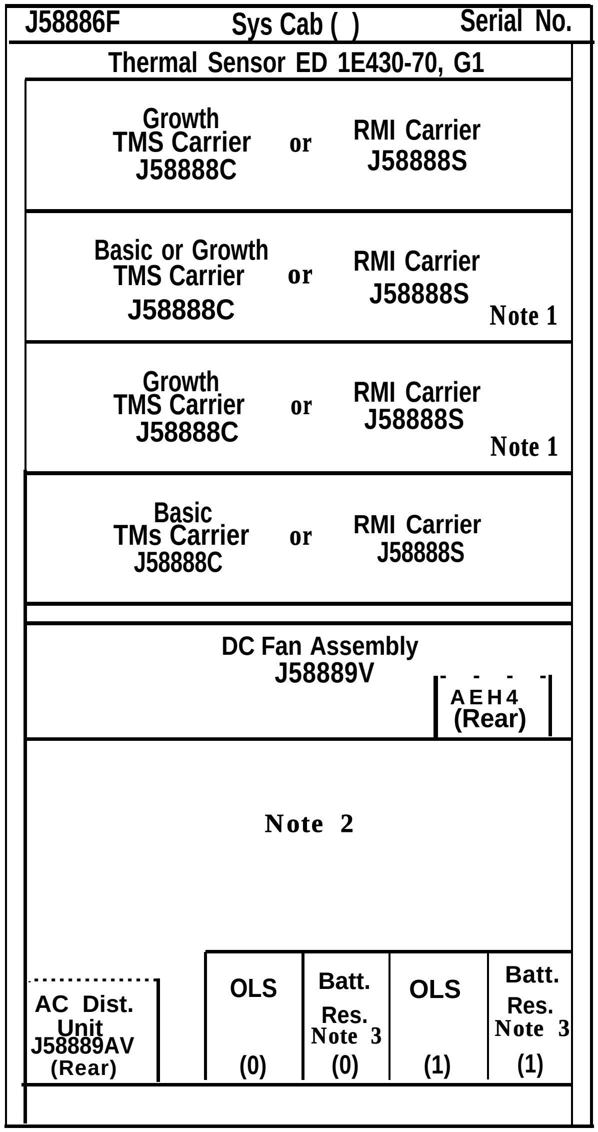
TABLE 3-E. TMS Cabinet Requirements

TMS Configuration	DEFINITY Generic 2	System 85
Unduplicated	One TMS cabinet required for 16 or more modules.	One TMS cabinet required for two or more modules.
Duplicated	One TMS cabinet required for 8 through 15 modules, two TMS cabinets required for 16 through 31 modules.	One TMS cabinet required for 2 through 15 modules, two TMS cabinets required for 16 through 31 modules.

Each vacant carrier position requires the no-carrier adapter (ED-1E444).

For System 85, RMI carriers can be installed in vacant carrier positions instead of the no-carrier adapter. Each RMI carrier serves up to 16 remote modules. If there isn't enough space to house all of the RMI carriers, an extra TMS/RMI cabinet is equipped.

RMI carriers are not offered with Generic 2 switches since-there is almost always enough RMI circuit pack capacity available in universal module control carriers.



Notes:

1. The ED-1E444 no-carrier adapter maybe used instead.
2. Standard power equipment is shown here. For the standby power option, DC frame filter J58889AD replaces OLS units, battery reserve units, and AC distribution unit.
3. Battery reserve units for OLS (0) and OLS (1) are optional. If battery reserve is needed, it must be provided for both OLS units.

Figure 3-8. Time Multiplexed Switch/Remote Module Interface Cabinet (J58886F)

Module Control Cabinet (J58886B)

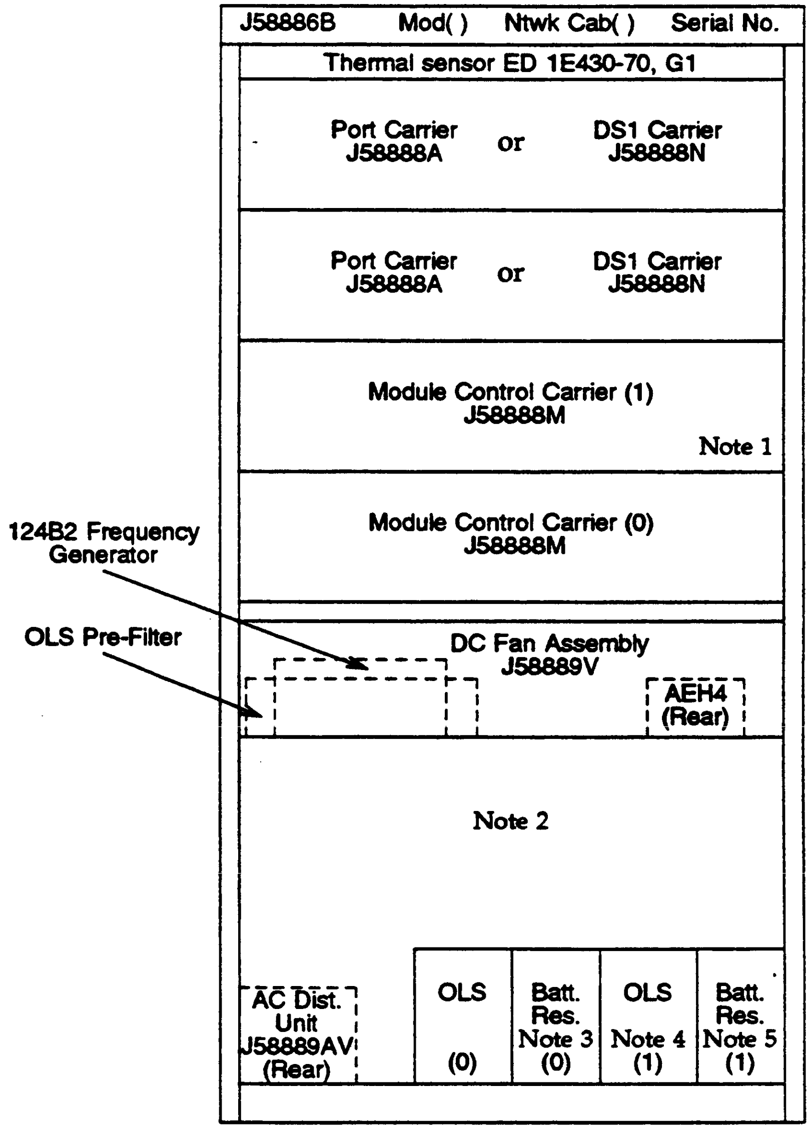
The Module Control Cabinet (see Figure 3-9) houses traditional module control and traditional port circuits. It contains the following equipment:

- 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 DS1 carriers
- A DC fan assembly with frequency generator
- A bus bar

The lower portion of this cabinet contains an AC distribution unit, OLS power supply, and an optional OLS battery reserve unit. A second OLS power supply is provided for the duplicated module control configuration. The second OLS is also provided for the unduplicated module control configuration when more than 40 ANN17Bs are housed.

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

One module control cabinet is required per traditional module. This cabinet, with the RMI (Remote Module Interface) circuitry and interconnections, may also serve as a module control in a remote module location.



Notes:

1. For unduplicated systems, an ED-1E444 no-carrier adapter, a port carrier, or a DS1 carrier is used here.
2. Standard power equipment is shown here. For the standby power option, DC frame filter J58889AD replaces OLS units, battery reserve units, and AC distribution unit.
3. This battery reserve unit is optional.
4. This OLS unit is required for duplicated module control configurations or for when more than 40 ANN17s circuit packs are used in and unduplicated module control configuration.
5. This battery reserve unit is only used when a second OLS is required. Even then, it's provided only if OLS (0) is equipped with a battery reserve unit.

Figure 3-9. Module Control Cabinet (J58886B)

Port Cabinet (J58886C)

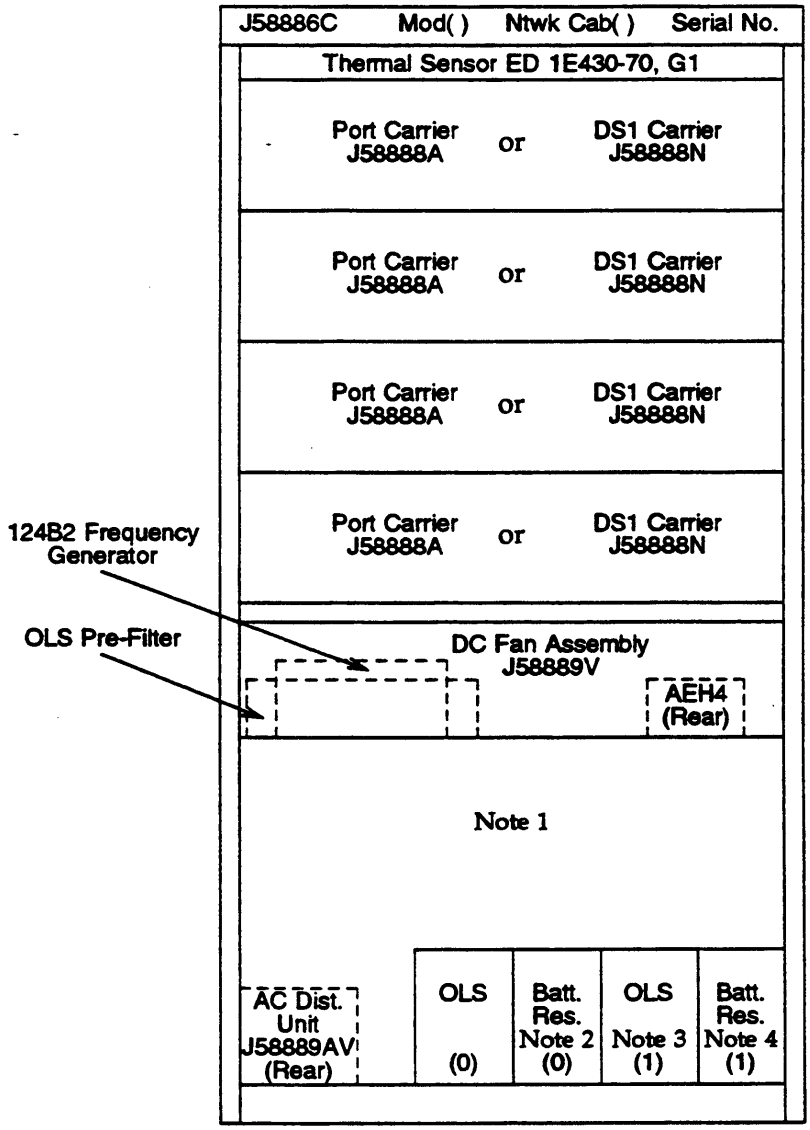
The Port Cabinet (see Figure 3-10) houses carriers containing traditional port circuits. It contains the following equipment:

- A thermal sensor assembly
- A total of up to four port and/or DS1 carriers
- A DC fan assembly with frequency generator
- A bus bar.

The lower portion of this cabinet contains an AC distribution, OLS power supply, and OLS battery reserve unit. If more than 40 ANN17Bs are housed, a second OLS power supply and battery reserve are provided.

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

The number of Port Cabinets required is dependent on the number of port and DS1 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 location.



Notes:

1. Standard power equipment is shown here. For the standby power option, DC frame filter J58889AD replaces OLS units, battery reserve units, AC distribution unit, and DC/DC converter unit.
2. This battery reserve unit is optional.
3. This OLS unit is required when more than 40 ANN17s circuit packs are used.
4. This battery reserve unit is only used when a second OLS is required. Even then, it's an option; it's not required.

Figure 3-10. Port Cabinet (J58886C)

Remote Group Housing (J58889AN)

The remote group housing (see Figure 3-11) is a hardware unit used at remote locations and contains line or data circuits, a cooling fan, a rectifier, an inverter (supplies ringing current), and a thermal sensor. The remote group housing can be wall-mounted or set on a table or shelf. The remote group housing must be supported by a traditional module.

In most cases, power for the housing comes from an AC feeder which is protected by a dedicated customer-provided fuse or circuit breaker. Disconnect switches and AC load centers are not required for the housing. Critical battery backup and extended power reserve are optional. DC power is provided by a -48 V rectifier unless the extended power reserve option is used. For extended power reserve, a DC/DC converter replaces the rectifier and provides low-level DC voltage to the port interface circuits.

More information about the Remote Groups and the Remote Group Housing appears further on in this chapter under System Switch Configurations and Carriers.

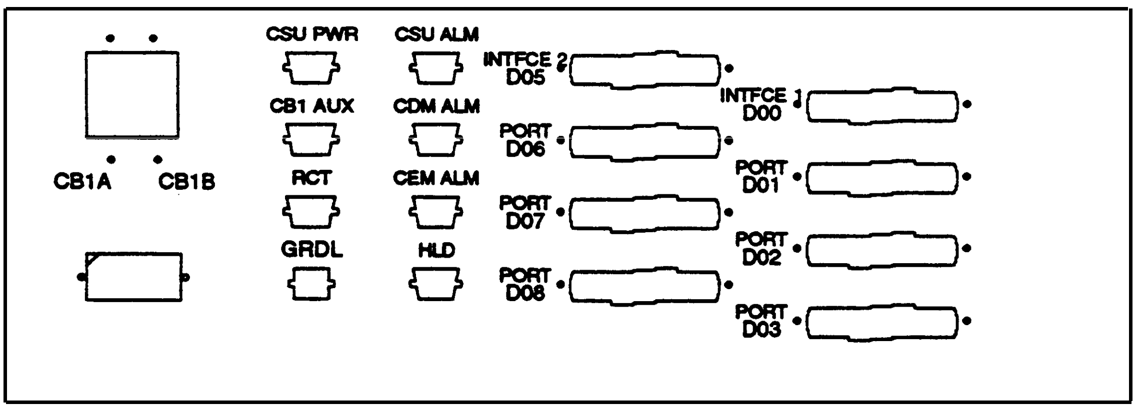


Figure 3-11. Remote Group Housing (J58889AN)

System 85 Cabinet Equipment

Unless otherwise stated, the equipment described in this section applies only to traditional System 85 equipment.

Alarm-Panel

This unit is housed in System 85 common control cabinets and in Generic 2 CC/TMS cabinets. The alarm panel uses LEDs to provide a visual indication of the state of health of the system. The LEDs show which alarms are active and which functional areas of the system are causing active alarms. Equipment failure indicators are grouped according to function and are arranged within each group by their potential importance to system operation and call processing integrity.

The alarm panel also has controls for processor operation, diagnostic testing, and emergency transfer. It provides connection for the MAAP (Maintenance and Administration Panel) and indicates (through labeled indicators) which MAAP maintenance PROC (procedure) should be used to obtain additional diagnostic information. The panel is also provided with an integral thermal sensor assembly (ED-lE430-70, G2) if the top carrier position of the cabinet is used.

Three types of alarm panels are available: the J58889X panel for the duplicated common control cabinet (see Figure 3-12), the J58889W panel for the unduplicated common control cabinet (see Figure 3-13), and the J58889BC for the CC/TMS cabinet. Functionally, the J58889BC panel is identical to the J58889X panel.

HCMR (High Capacity Mini-Recorder)

The HCMR (JlC170A) is a tape recorder. It drives a tape cartridge which contains a copy of the programs, parameters, and translations used by the system common control. The HCMR reloads the 501CC's memory whenever power to the memory is interrupted or whenever memory is lost for other reasons. In addition, the HCMR is used to load certain areas of memory for maintenance and administration use. One HCMR is used in an unduplicated common control cabinet; two HCMRs are used in a duplicated common control cabinet.

The HCMR contains these 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).

> **NOTE:** For Generic 2, DTSs (Disk Tape Systems) are used instead of HCMRs. This is also true for System 85s that have been upgraded to Generic 2; in those cases the HCMRs are removed and replaced by DTSs.

Thermal Sensor Assembly

The thermal sensors monitor System 85 cabinet termperatures and supply temperature readings to the AEH4 alarm distribution circuit (the AEH4 regulates the speed of the cabinet fans). The ED-1E430-70, G1 thermal sensor assembly is placed above the topmost carrier in each cabinet, except for common control cabinets that have the alarm panel in the topmost carrier position. When this is the case, an ED-1E430-70, G2 thermal sensor assembly is included as part of the alarm panel.

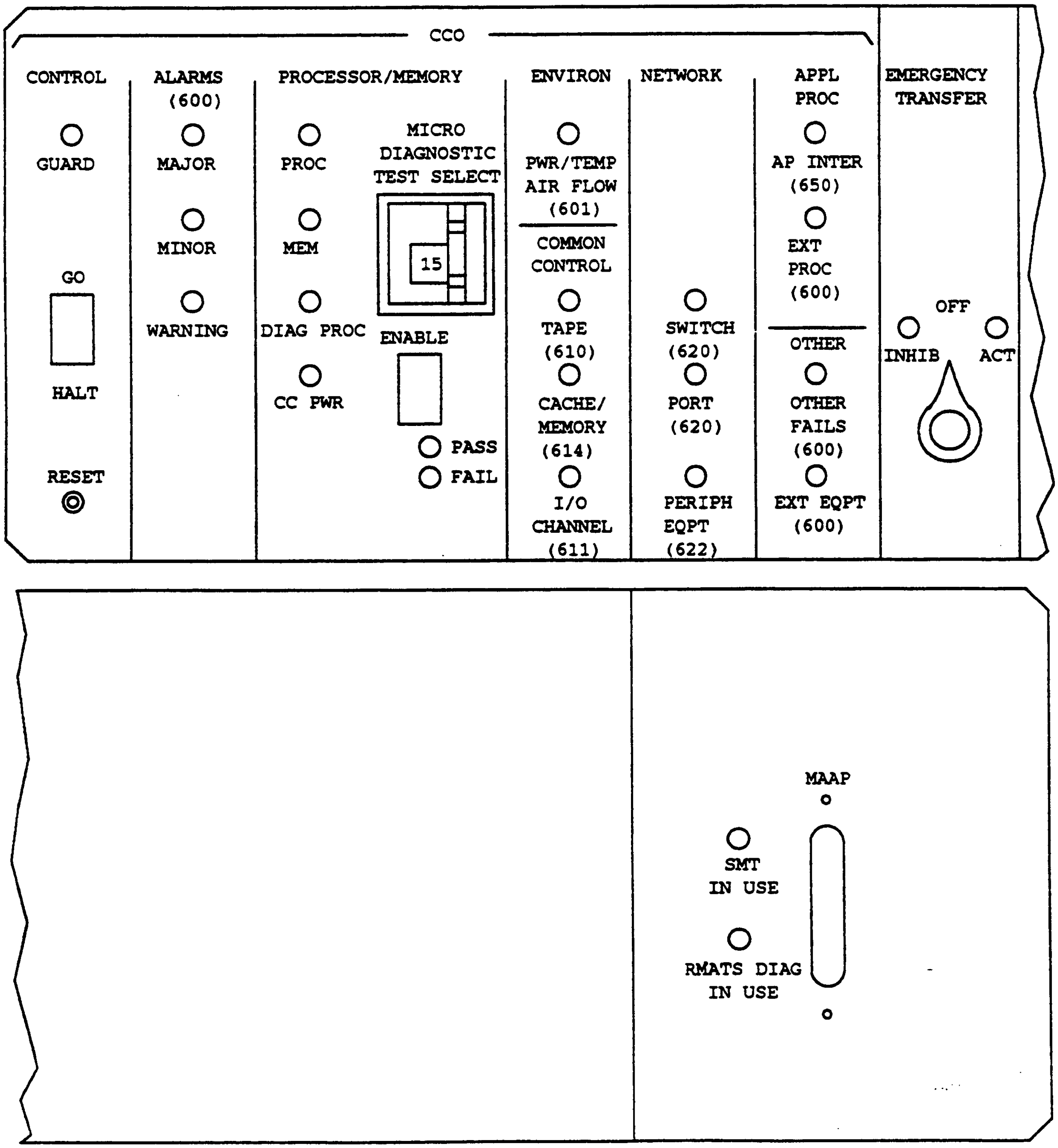


Figure 3-12. Unduplicated Common Control Alarm Panel (J58889W)

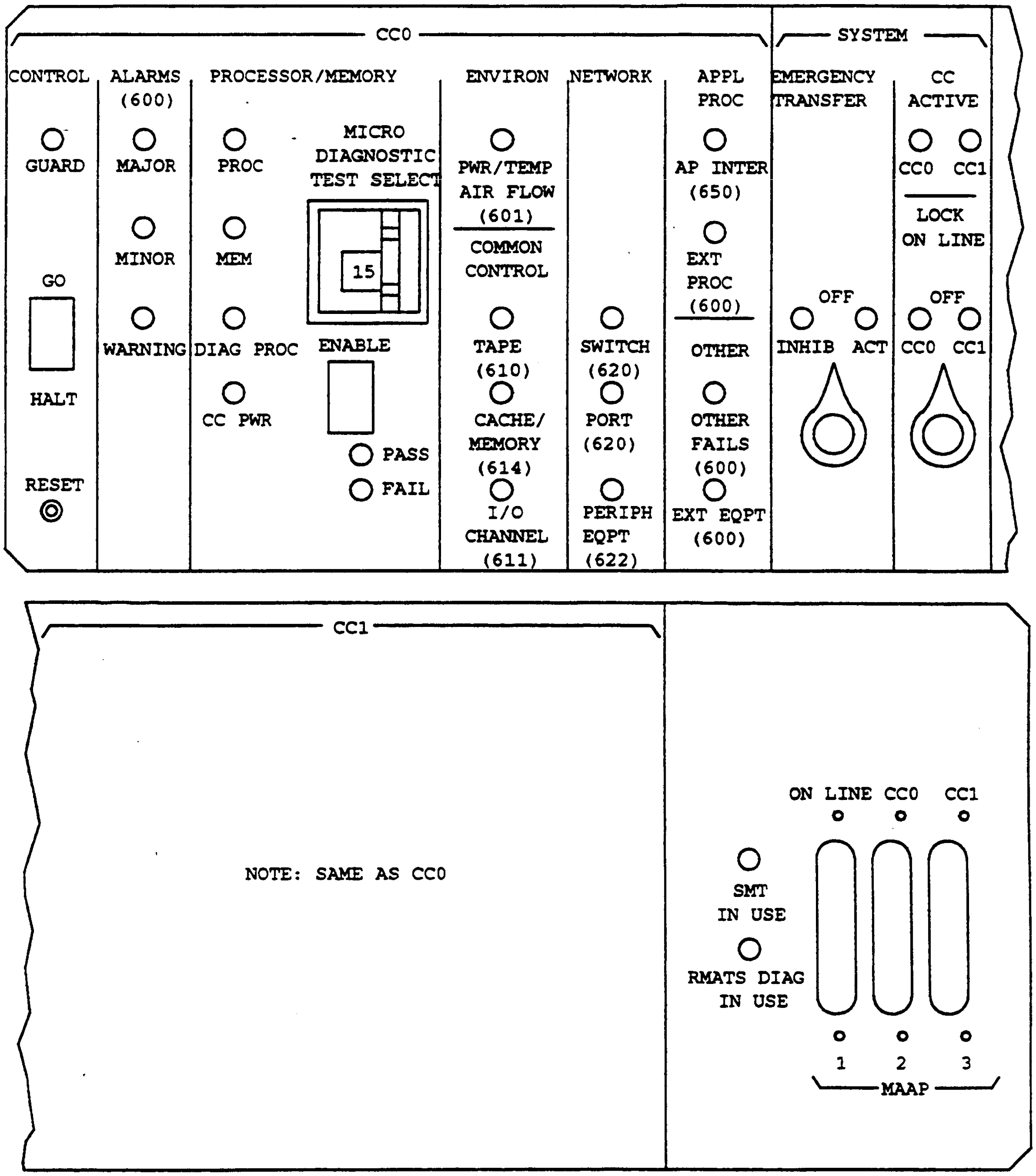


Figure 3-13. Duplicated Common Control Alarm Panel (J58889X)

Fan Assembly

Each System 85 cabinet has a J58889V fan assembly (see Figure 3-14) which contains:

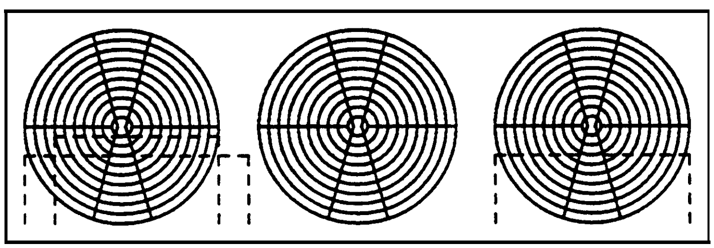
- 3 fans and a removable air filter
- 124B2 Frequency Generator
- AEH4 Alarm Distribution Unit
- Fusing and power sources for attendant consoles
- Ground blocks for internal system ground connections.

Fans

The three DC-powered fans run continuously to keep the ambient cabinet temperature within recommend limits. They operate at one of two speeds:

- *Low*— Fans run at this speed when the ambient temperature is below 95°F (35°C). At low speed, the fans consume less power and are quieter than at high speed.
- *High*— Fans run at this speed when the ambient temperature exceeds 95°F (35°C). Fan speed is controlled by the AEH4 Alarm Distribution Circuit.

Power for the three fans is protected by a 2 amp fuse located in the fan assembly. The removable air filter must be changed periodically.



Dashed boxes above show the positions the 124B2 Frequency Generator and the OLS Pre-Filter occupy behind the fans. (The taller box is the 124B2.)

Dashed box above shows the position the AEH4 Alarm Distribution Unit occupies behind the fans.

Figure 3-14. J58889V Fan Assembly (Front View)

124B2 Frequency Generator

The 124B2 frequency generator provides 21 Hz ringing voltage for analog ringing voice terminals and other peripheral equipment. This unit is supplied with System 85 cabinets housing port carriers and as an option for auxiliary cabinets. Frequency generator 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:

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

The 124B2 receives fused -48 V power from the network cabinet fan assembly and is mounted behind the fans. Ringing voltage is distributed to the port and DS1 carriers through daisy chain cables. A maximum of four ports per quarter carrier (port group) can receive ringing current simultaneously; when this number is exceeded, it is referred to as “ring group blocking.”

Input power for the frequency generator passes through a pre-filter and a 2 amp fuse in the fan assembly. A 1 amp fuse is in-line with output lead RNGSRC; this fuse is located inside the frequency generator housing. If the frequency generator malfunctions, a signal is provided to the AEH4 alarm distribution unit, which activates an alarm for the cabinet.

AEH4 Alarm Distribution Unit

In addition to controlling fan speed and monitoring the frequency generator, the AEH4 alarm distribution unit circuit board provides:

- Fan fuse alarm interconnections
- A low-voltage alarm interconnection
- Airflow monitoring circuits

An alarm is sent by the AEH4 whenever a fan fuse blows. If the cabinet housing the fan assembly is a duplicated common control, duplicated TMS, duplicated traditional module control, or an unduplicated TMS with two OLS power supplies, a second fan fuse is provided. This fuse is also alarmed. When the AEH4’s low voltage monitor detects cabinet DC voltage below -42 V, the low-power alarm is activated. 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 61°F (16.5°C), a fan failure is indicated, and a fan alarm for the cabinet is activated.

Attendant Console Power and Fuses

The fan assemblies in traditional module cabinets can power up to four attendant consoles each. Each of the four console power sources is protected by a 1-1/3 amp fuse.

Ground Block

This copper block is used as the cabinet circuit single point ground. It is electrically isolated from the rest of the fan assembly.

AC Distribution Units

AC distribution units provide AC power, filtering, and frame grounding for power supplies. They receive power from the AC load center. The AC distribution units for system 85 are:

- J58889AV —Used for System 85s with the OLS power configuration. It is used in each switch cabinet and provides an electrically filtered source of AC power for one or two OLS (Off-Line Switcher) power supplies. For cabinets with one OLS power supply, this unit has one power cord and one 3-wire receptacle for the OLS; for cabinets with two OLS power supplies, this unit is equipped with two power cords and two 3-wire receptacles.
- J58889U —Used in the duplicated common control and TMS cabinets for System 85s with the non-OLS AC 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 A circuit breaker is provided for the utility outlet. This unit also includes an EMI (electromagnetic interference) filter. The EMI filter prevents EMI from being introduced to the system through input power and prevents the system from sending EMI back to the power source.

- J58889G —Used in the module control and port cabinets for System 85s with the non-OLS AC 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. This unit includes one utility outlet; it is protected by a circuit breaker.

AC-Powered Supplies

Equipment housed in System 85 cabinets runs off of -48 V DC. In AC powered systems, DC voltage is delivered by one of two types of units:

- OLS power unit —At least one OLS power unit per cabinet for OLS powered systems.
- Rectifiers (non-OLS) —Usually one or more per cabinet; cabinets not equipped with rectifiers rely on a recrtifier in an adjacent cabinet to furnish DC voltage. System 85 R2V4 system cabinets do not use rectifiers.

Bulk OLS (Off-Line Switcher) Power Supply

Each OLS power supply (ITT code 3965-1) provides -48 V DC. Two OLS power supplies are mounted in common control cabinets, TMS cabinets, and module control cabinets containing a duplicated module control. A second OLS power supply may be provided for module control cabinets with unduplicated module controls and for port cabinets if required by port power demands.

One OLS power supply 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. In case of an AC power failure, the OLS power supply sends an alarm to the AEH4 alarm distribution unit. Battery backup is provided for an OLS power supply when an OLS battery Charger unit (Part No. PEC 3965-2) is included in the Configuration.

OLS power supplies replace the 309A/310A and 334A rectifiers; these rectifiers were standard in earlier versions of System 85.

Rectifiers

309A/310A Rectifier

The 309A/310A rectifier (used in older Release 2, System 85s) consists of two combined units and is the primary DC power source in systems with the non-OLS AC power configuration. It is mounted at the bottom of alternate network cabinets. This rectifier is made up of a 309A transformer and a 310A electronics package The transformer 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 309A/310A 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 taps.

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 System 85s with the non-OLS AC 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.

DC/DC Converters

DC/DC converters are System 85 circuit packs that provide low-voltage DC power for the switch. The converters draw -48 V DC from the cabinets they are housed in. System 85's DC/DC converters are:

- 494GA which provides -5 V and +5 V DC (50 watts)
- 495FA which provides +5 V DC (250 watts)

Here is where DC/DC converters are used:

Carrier	Conv.	No.	Converter Location
Unduplicated Common Control Carrier	494GA	1	DC/DC converter unit—slot 01
	495FA	2	DC/DC converter unit—slots 00 and 02
Duplicated Common Control Carrier	494GA	2	Duplicated Power Carrier—slots 01 and 04
	495FA	4	Duplicated Power Carrier—slots 00, 02, 03, and 05
TMS Carrier	494GA	2	TMS Carrier—slots 00 and 01
	495FA	1	TMS Carrier—slot 28
RMI Carrier	495FA	2	RMI Carrier—slots 10 and 11
Module Control Carrier	494GA	1	Module Control Carrier—slot 00B*
	495FA	2	Module Control Carrier—slots 00A and 23
Port Carrier	494GA	2	Port Carrier—slots 10 and 11
DS1 Carrier	494GA	2	DS1 Carrier—slots 10 and 11

* The 494GA is provided with the module control carrier only for multimodule system configurations which have duplicated module controls.

DC Filters

Whenever a cabinet receives -48 V DC from an external source, a DC filter is provided; this happens with the extended power reserve option or when power is supplied from an adjacent cabinet as is the case in non-OLS AC powered systems. The DC filter shunts to ground electrical noise riding on the -48 V power feed. Eliminating this noise reduces the chance of error being introduced to the switch's digital circuits. The following DC filters are used:

- For systems using the -48 V extended reserve option, the J58889AD frame filter is provided in each system cabinet This filter is also used with the auxiliary cabinet. The unit receives DC power from the battery plant and distributes it to the equipment through the bus bar. Four versions of the J58889AD frame filter are provided:

  1. Type C—Used for auxiliary cabinets
  2. Type D—Used for duplicated common control cabinets and TMS/RMI cabinets
  3. Type E—Used for port cabinets and module control cabinets
  4. Type F—Used for cabinets unduplicated common control cabinets.

- The J58889H DC filter provides input filtering for older Release 2, System 85 cabinets that 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. This provides additional filtering for both power sources.

Equipment for Critical Battery Backup

Critical battery (nominal holdover) backup maintains DC voltage for AC powered System 85 cabinets when short-term loss of commercial AC power occurs.

This capability is standard for the common control cabinet. With fully charged batteries, a minimum of 10 minutes of backup power is available to common control carriers and related equipment such as HCMRs and the alarm panel. Critical battery backup for the common control helps prevent time consuming tape reloads due to loss of main memory contents.

Critical battery backup equipment is optional for the TMS cabinet, module control cabinet, and port cabinet. With fully charged batteries and depending on circuit pack configurations and traffic existing during an outage, backup power sustains operation of these cabinets for approximately two to five minutes. During an outage, batteries furnish power for all the cabinet's carriers and the peripherals powered from the cabinet's ports.

The OLS Battery Charger unit (Part No. PEC 3965-2) provides critical battery backup. Installed and paired with an OLS power supply, this battery charger unit is mounted at the bottom of the switch cabinet.

Critical battery backup for systems with the non-OLS AC 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
Contractors 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
Lead-Acid Battery Assembly With Power-Lock Connectors	Gates Battery #0800-0256 (403736291)

Battery reserve hardware is equipped in non-OLS AC powered switch cabinets as follows:

Cabinet	398A	AMC1	AMD1	Battery
Unduplicated Common Control	1	1	1	1
Duplicated Common Control	2	2	2	2
T M S	2	2	2	*
Module Control	2	2	1	†
Port (W/Power)	2	2	1	†

* One battery assembly is equipped for each 334A rectifier equipped in the TMS cabinet (maximum of two).

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

OLS and non-OLS powered systems use the same rechargeable battery pack. The battery pack contains 24 sealed lead aad cells and provides -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 and require up to 16 hours to recharge from-42 V.

All critical battery backup 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 cabinet power supply. Each unit requires approximately 0.6 amperes at -48 V per input channel.

In each cabinet, AC sense leads monitor the status of AC power supply. If they detect a commercial AC power loss, critical battery backup units supply -48 V DC power to the cabinet equipment through the bus bar. The critical battery backup unit provides an alarm input to the AEH4 alarm distribution unit. This input goes active when the unit begins supplying power to the cabinet or when the unit malfunctions.

More information about critical battery backup appears in Chapter 10. Information about battery reserve for the CC/TMS cabinet and the universal module cabinet appear under their cabinet descriptions (near the beginning of this chapter).

Equipment for Standby Power

The extended power reserve option maintains DC voltage for System 85 during a long-term commercial AC power failure. The extended power reserve option uses a large array of batteries to power the system if commercial AC power is interrupted. Standby power can be engineered to meet customer needs; eight hours is typical.

Here is a list of extended power reserve equipment:

- Battery Strings—Provide storage of DC power
- Rectifiers—Charge the battery strings a supply -48 V to operate the system
- DC Power Board—Houses circuit breakers for DC feeders going to the cabinets. The ground discharge bar for ground returns is also mounted on this board.
- DC Filters—Replace OLS and AC distribution equipment in the cabinets.
- Inverters—Provide standby AC power for auxiliary equipment. Inverters are powered by the standby power equipment.

In systems equipped with the extended power reserve option, cabinet power always comes from DC feeders which originate at the battery strings. The DC power board provides circuit breaker protection for each DC feeder and ground return for these feeders. During normal operation, battery chargers keep a full charge on the battery strings and an AC feeder powers auxiliary equipment. When AC power failure occurs, the chargers drop out and the system relies on power stored in the battery strings. The batteries also power an optional inverter so that standby AC power can be provided to auxiliary equipment. If battery output voltage drops to -42 V the batteries are disconnected so they won't be damaged. When AC power is restored, the charger units begin recharging the battery strings. A battery string that has been drained to -42 V will usually take 24 hours to fully recharge.

For more information on extended power reserve battery plant requirements refer to Chapter 10, "System Power".

System Switch Configurations

Overview

A switch configuration is a combination of Generic 2 or System 85 equipment that functions as a system. The term "configuration" is used because of the large number of customer's needs. Systems are available in three size categories and can be equipped to satisfy various reliability requirements. Modules and carriers at remote locations can be included in a switch configuration.

Sizes

The configuration sizes are:

- Basic–a single module
- Multimodule—2 to 15 modules
- Expanded multimodule—16 to 31 modules

Reliability

Varying degrees of reliability are available depending on how the system is equipped. Here are the terms used to describe the different configurations:

- Standard reliability—no duplication of major subsystems (see Figures 3-15, 3-16, and 3-17).
- High reliability—duplicated common controls (see Figures 3-18, 3-19, and 3-20).
- Critical reliability—duplicated common controls, duplicated TMS, and duplicated module controls (see Figures 3-21, 3-22, 3-23, and 3-24).
- Critical reliability with extended power reserve—same as critical reliability with the addition of the extended power reserve option.

Standard Reliability Configuration

DEFINITY Generic 2

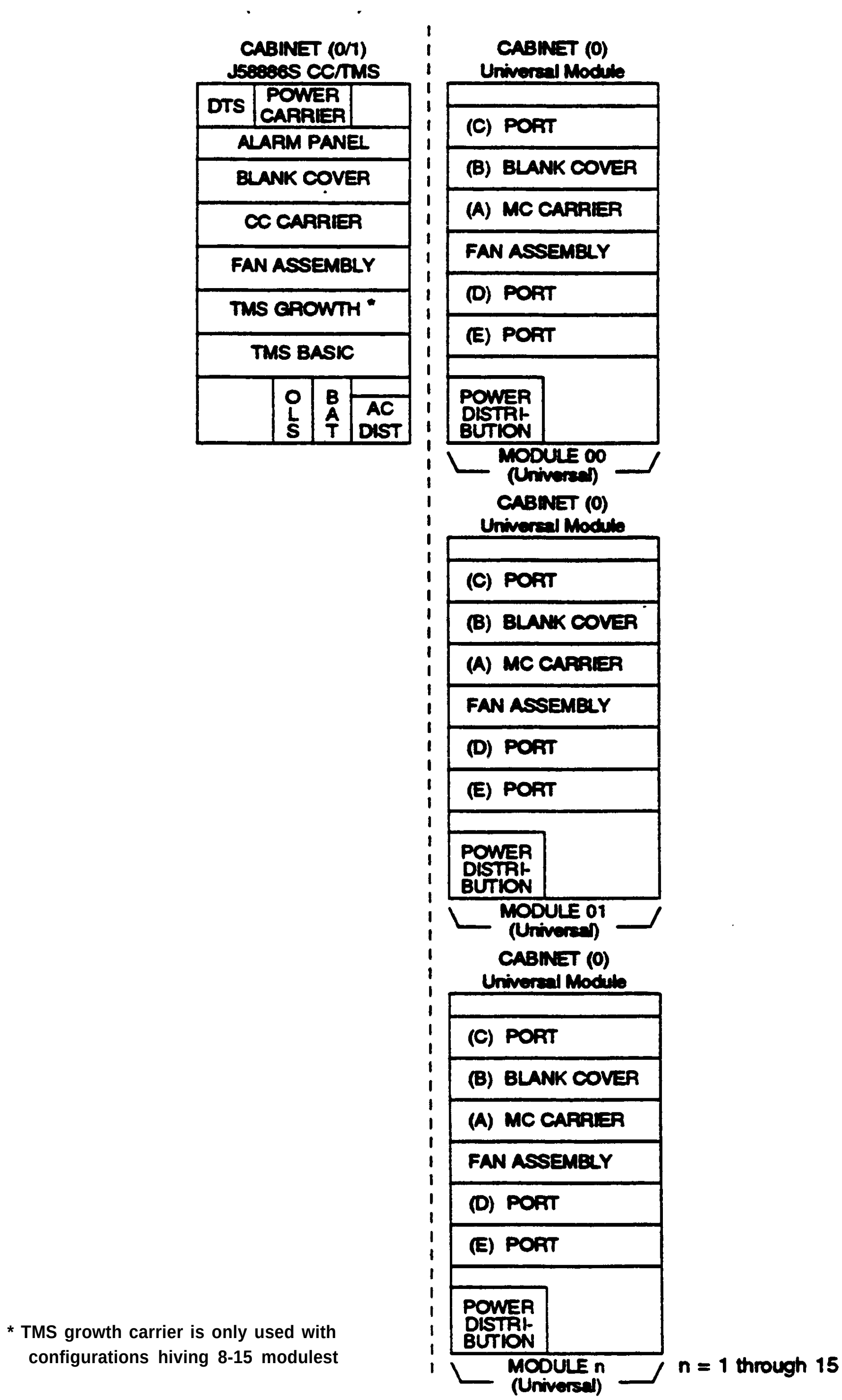
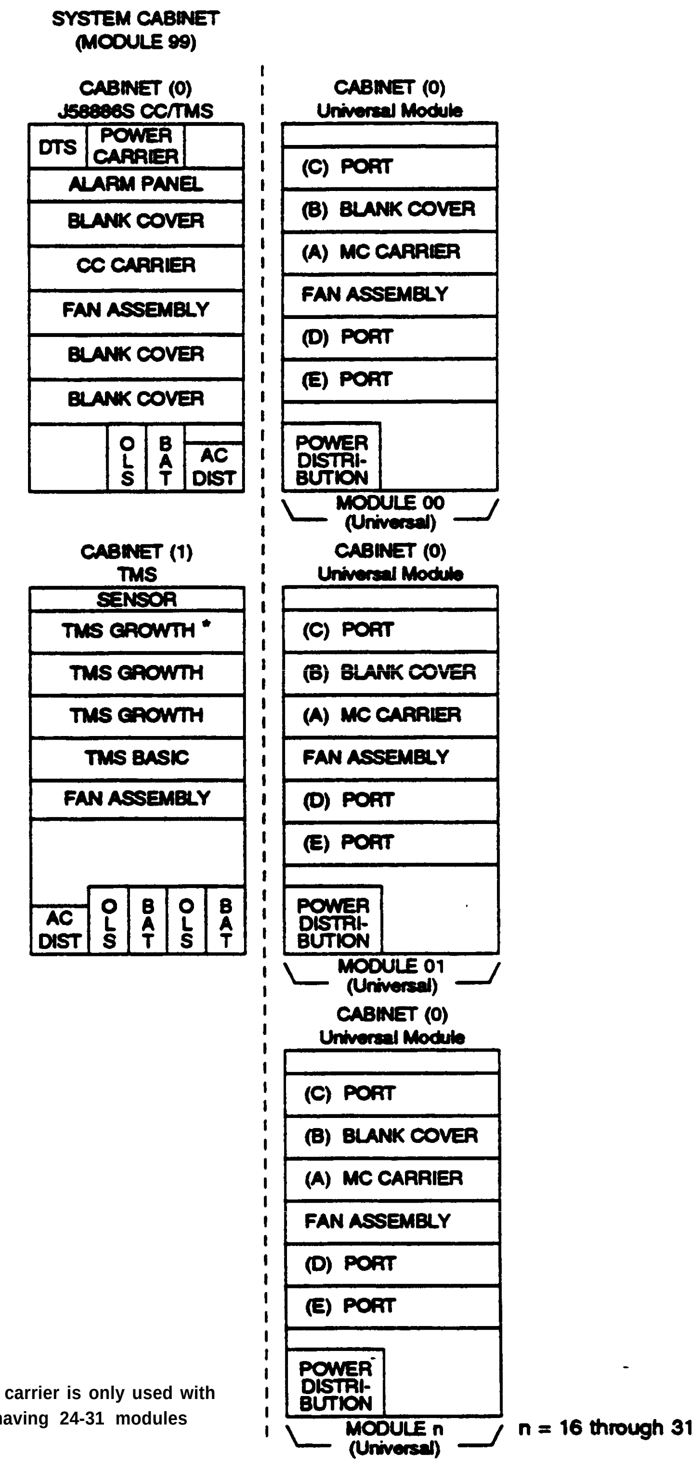


Figure 3-15. Sample Configuration for Standard Reliability, 1 through 15 Modules



* This TMS growth carrier is only used with configurations having 24-31 modules

Figure 3-16. Sample Configuration for Standard Reliability, 16 through 31 Modules

System 85

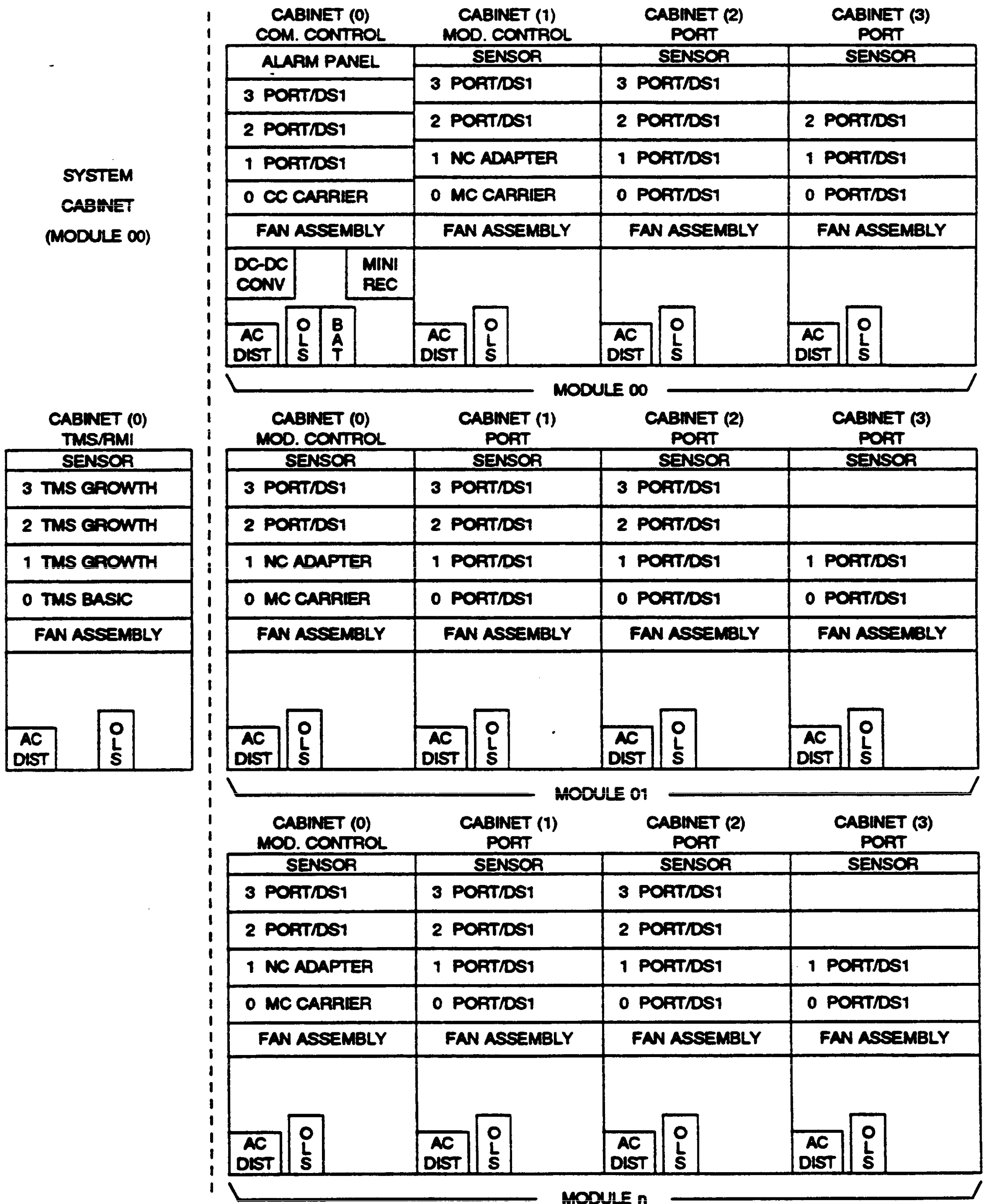


Figure 3-17. Typical Module/Cabinet/Carrier Layout for Standard Reliability Configuration

High Reliability Configuration

DEFINITY Generic 2

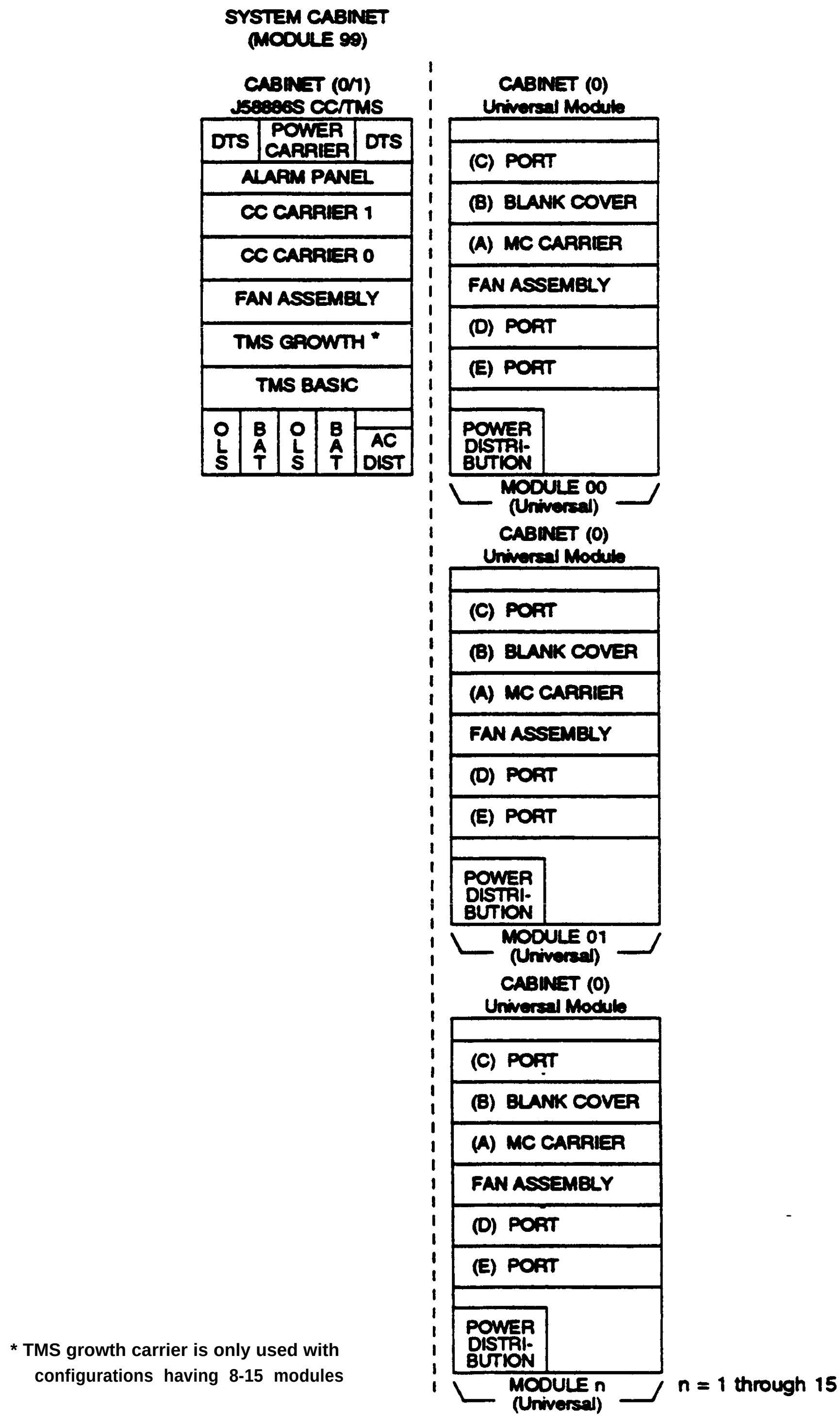


Figure 3-18. Sample Configuration for High Reliability, 1 through 15 Modules

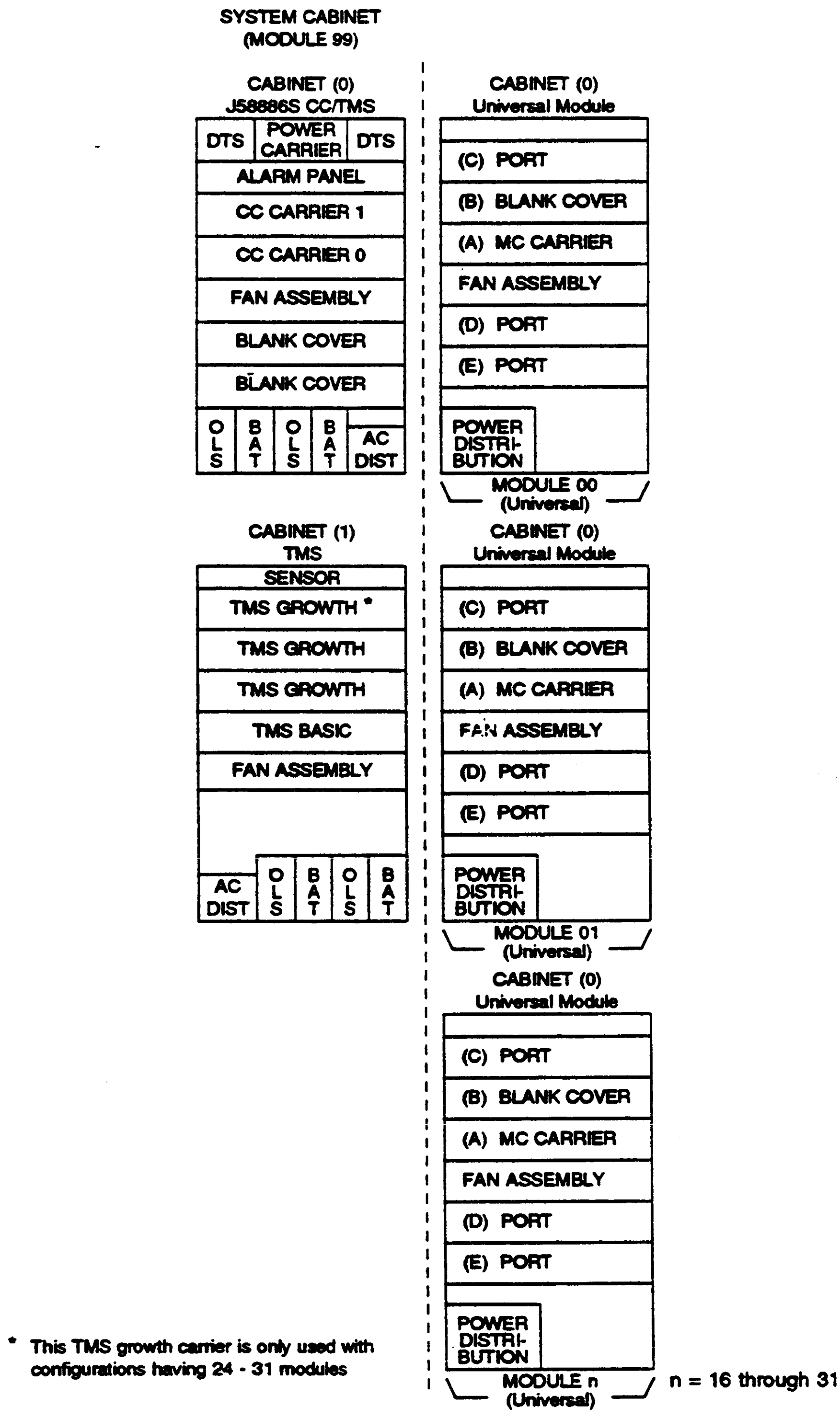


Figure 3-19. Sample Configuration for High Reliability, 16 through 31 Modules

System 85

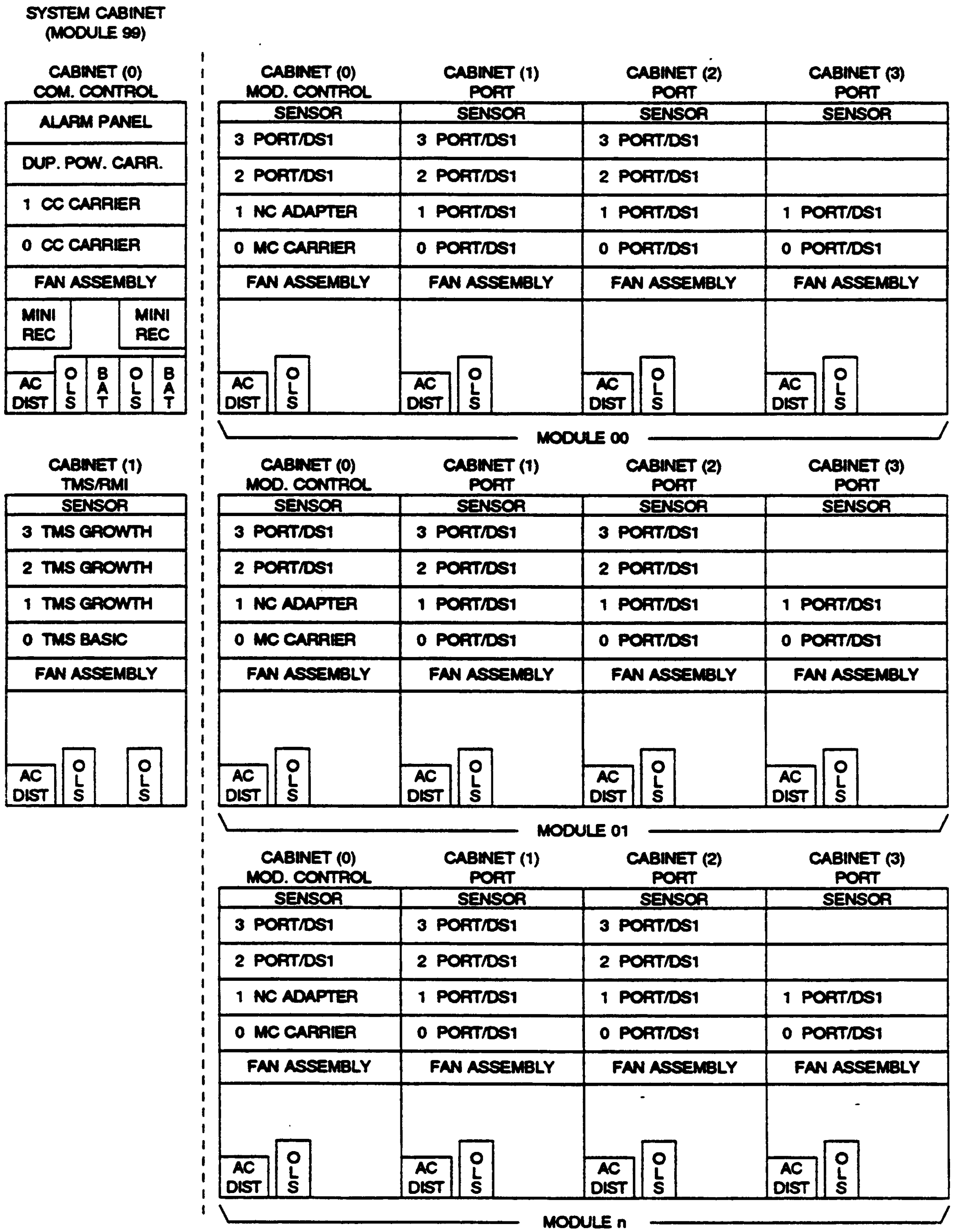


Figure 3-20. Typical Module/Cabinet/Carrier Layout for High Reliability Configuration

Critical Reliability Configuration

DEFINITY Generic 2

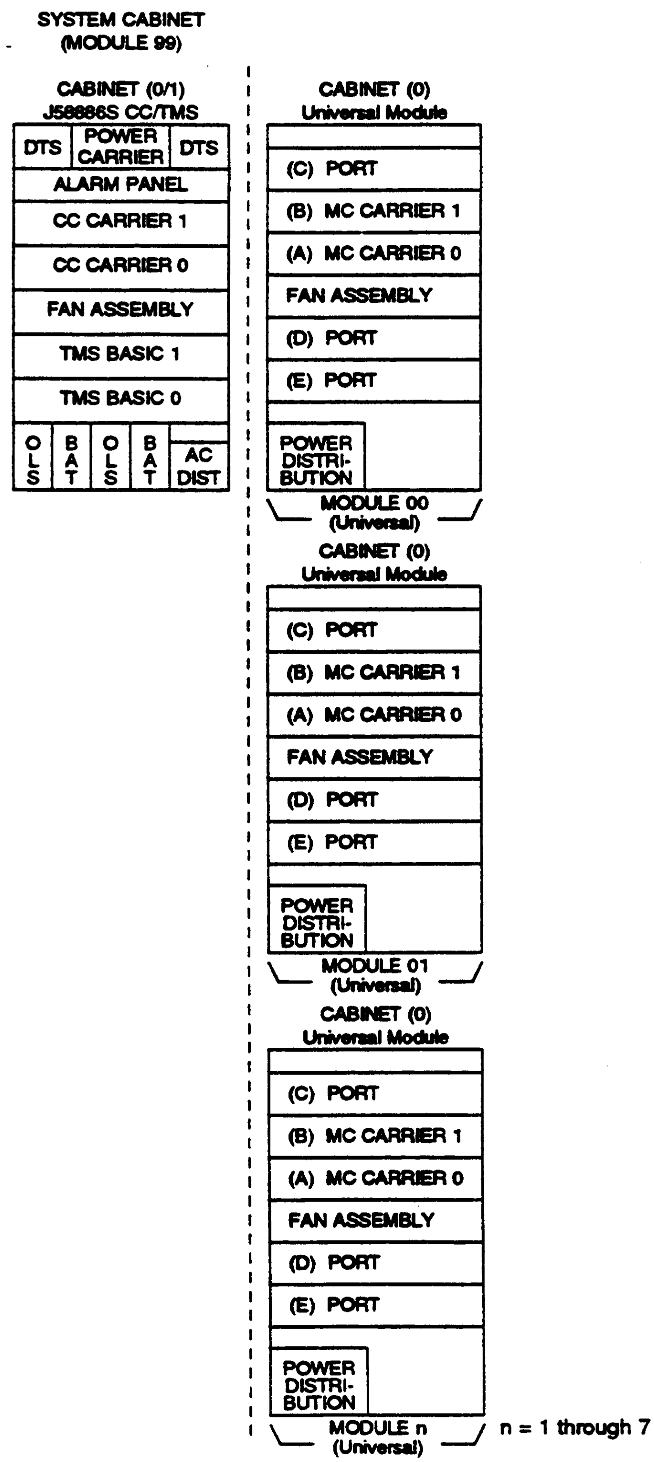


Figure 3-21. Sample Configuration for Critical Reliability, 1 through 7 Modules

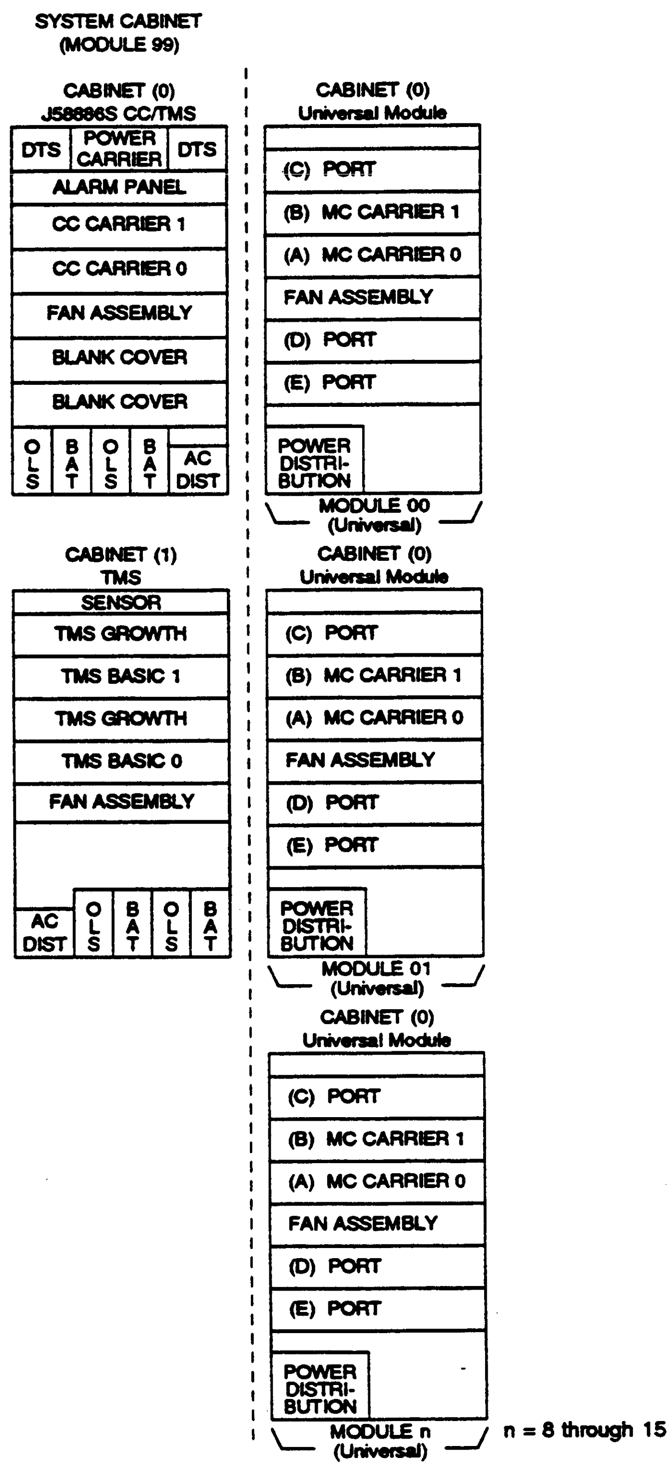


Figure 3-22. Sample Configuration for Critical Reliability, 8 through 15 Modules

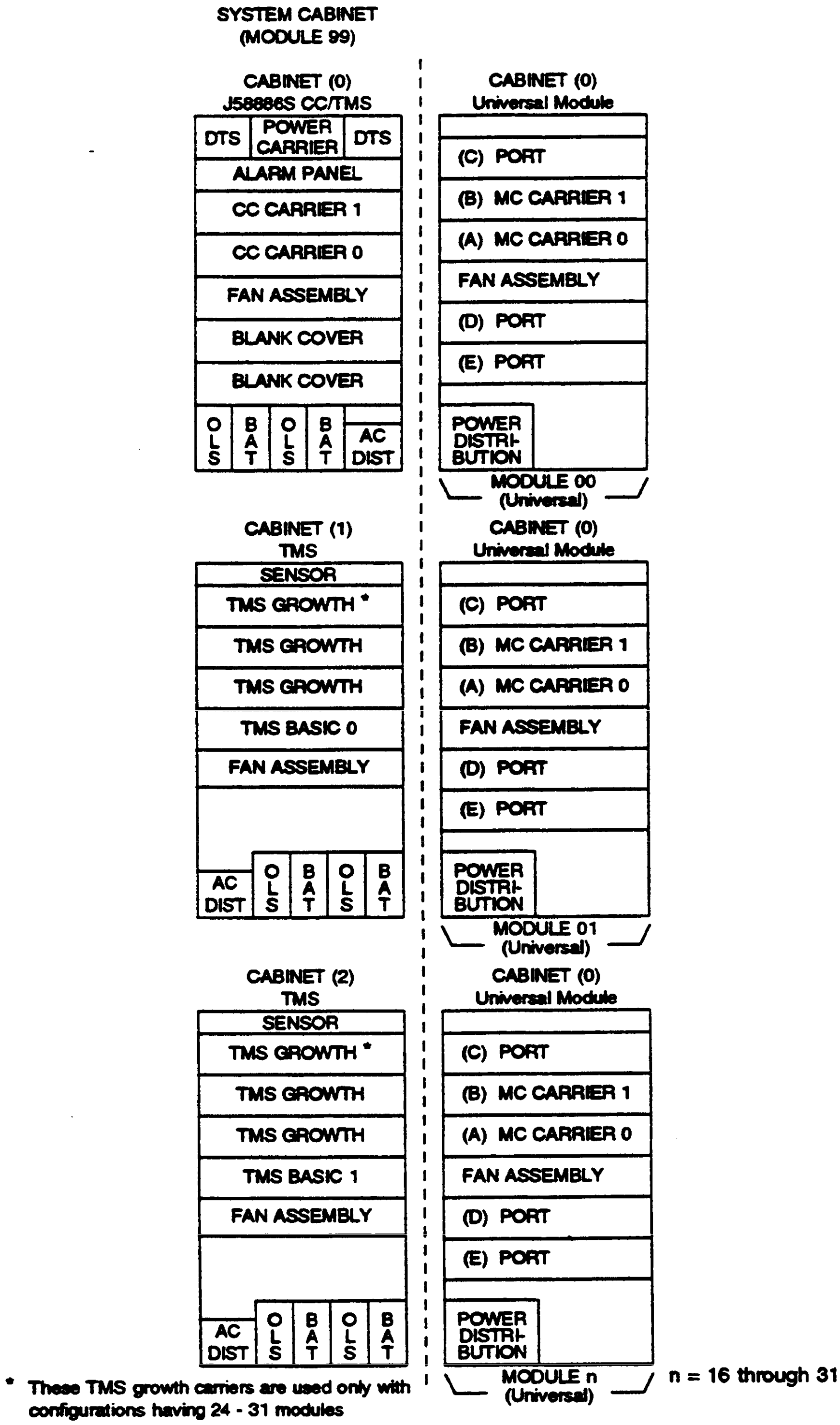


Figure 3-23. Sample Configuration for Critical Reliability, 16 through 31 Modules

System 85

Figure 3-24. Typical Module/Cabinet/Carrier Layout for Critical Reliability Configuration

Configurations That Serve Remote Locations

Two additional configuration options—remote modules and remote groups—are practical ways of providing telecommunication service to remote locations. Both configurations multiplex lines and signaling over fiber-optic cable or DS1 metallic links, yielding a significant savings in cabling. Voice and data terminals at remote locations interface directly to the main system switch which makes 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 level.

Remote Module Configuration

This configuration allows one or more modules at remote locations to be directly connected to the system switch with fiber-optic cable. Cabinets at the remote location are configured like cabinets in a network module at the central switch location, with the addition of RMI (Remote Module Interface) packs (TN456) and some interconnect equipment. The TN456 at the central locale "feeds" the TN456 at the remote locale all 4-MHz channel and TMS-link data. Duplicated TMSs at the central switch location require duplicated module controls at the remote location.

Connectivity

Unduplicated remote modules require two fiber pairs (four fiber strands): one carrying 4 MHz channel data from the common control and the other carrying PCM data to and from the TMS. For duplicated remote modules, four fiber pairs (eight fiber strands) are required.

RMIs Housed in a Central Locale Universal Module

The module control carrier in a universal module can accommodate up to seven RMI circuit packs (TN456s). Figure 3-25 shows a universal module supporting one remote module; up to six additional remote modules could be connected to that central site universal module. The remote modules can be universal or traditional. The supporting central location module could also be a traditional module, but a central-location traditional module will only support one remote module since it only accommodates one TN456 RMI circuit pack.

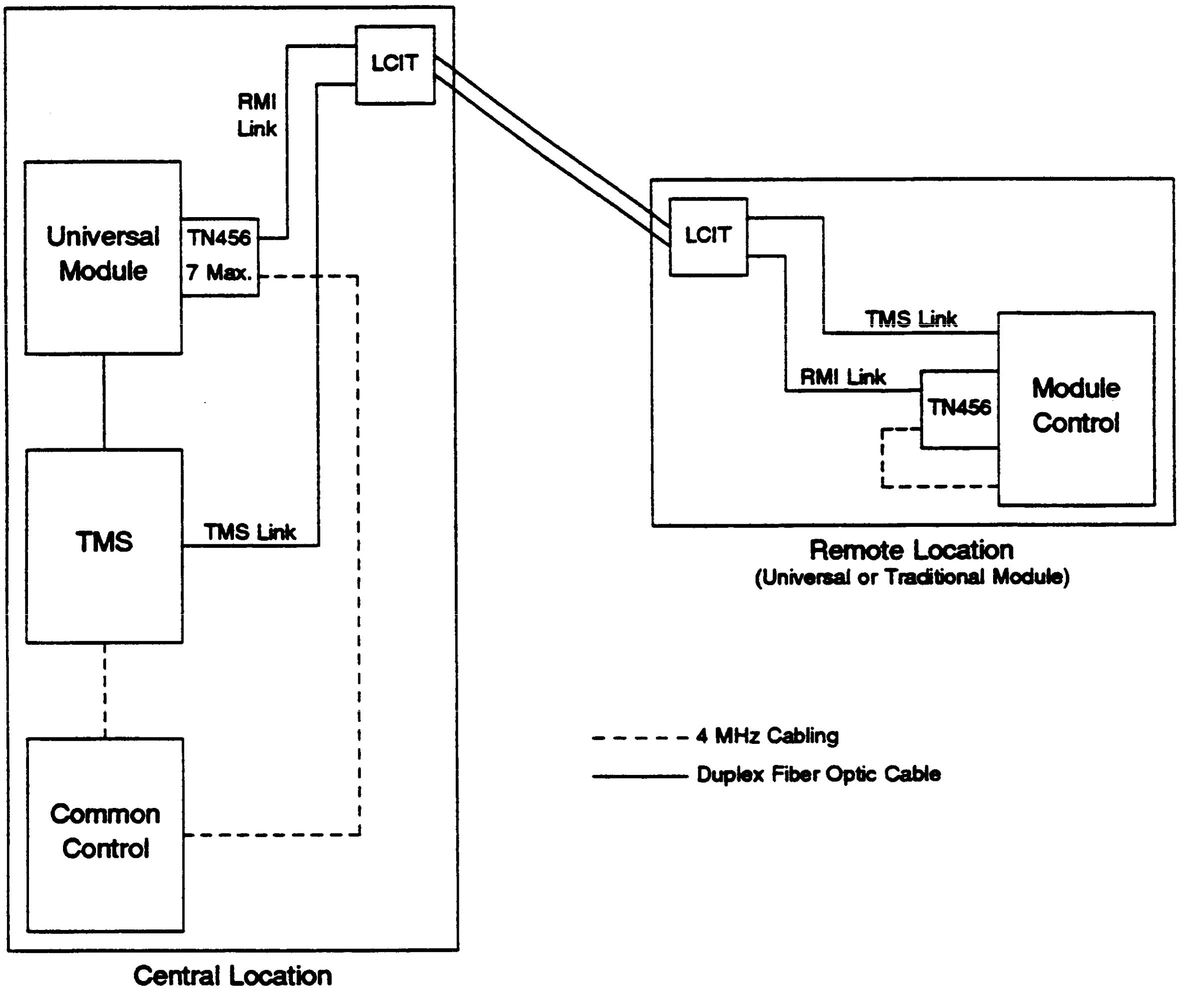


Figure 3-25. Remote Module System Configuration — Universal Module

RMIs Housed in a Central Locale Traditional Module

An RMI circuit pack (TN456) is installed in a tradtional module control cabinet at the central location (see Figure 3-26). A matching RMI circuit pack is installed in the traditional or universal module control cabinet at the remote location. The RMIs are connected with a fiber-optic link. With this configuration, the number of remote modules cannot exceed the number of modules at the central switch location (15 maximum). Generally, this configuration won't be used if universal modules are present at the central location. For Generic 2, this configuration is most likely to be found in System 85s that have been upgraded.

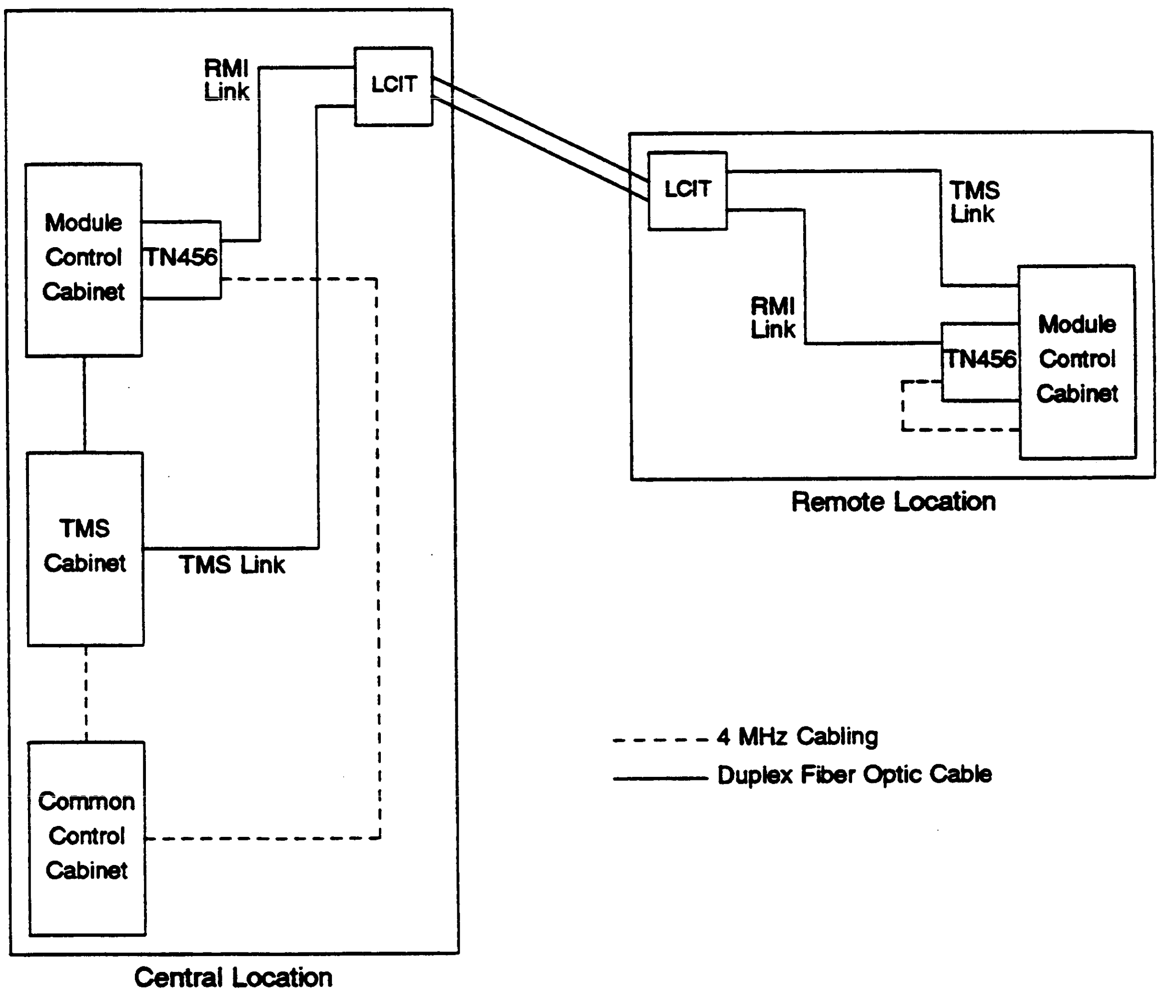
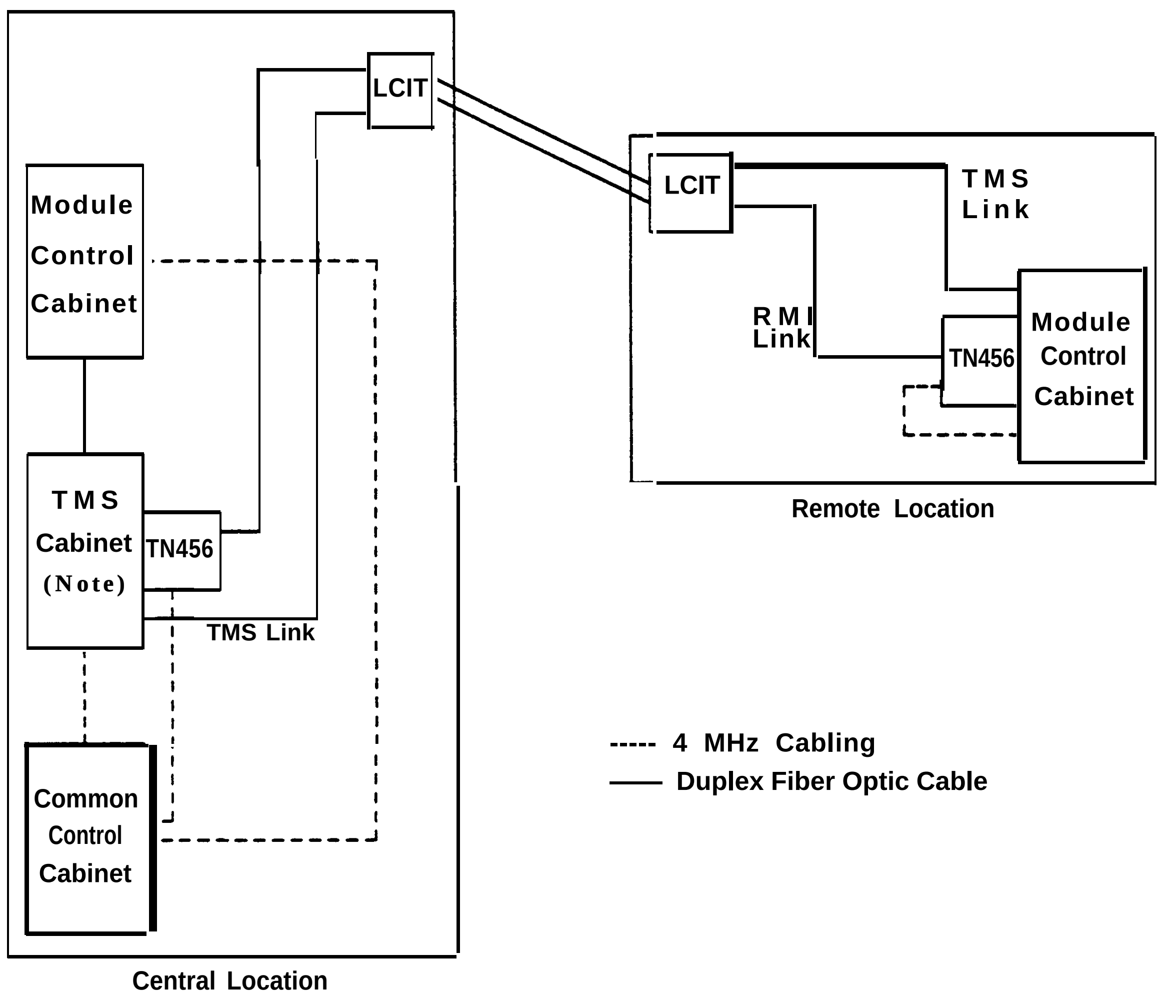


Figure 3-26. Remote Module System Configuration — Traditional Module

RMIs housed in an RMI Carrier At the Central Locale

One or more RMI carriers are located in a TMS/RMI cabinet at the central location (see Figure 3-27). These carriers hold up to 16 RMI circuit packs which allow them to serve up to 16 unduplicated or eight duplicated remote each. One RMI circuit pack is installed in each module control cabinet at the remote location; each of the remote RMI circuit packs have matching RMI circuit packs at the central location. Up to 30 modules can be remoted using this method with only one module required at the central location. A TMS/RMI cabinet housing only RMI carriers (with no TMS carriers) may be provided at the central location, if required. RMI carriers are available for System 85 R2V2, R2V3, and R2V4. For Generic 2, RMI carriers are only found in switches that have been upgraded from System 85.



Note: TMS Cabinet must be equipped with at least one RMI Carrier.

Figure 3-27. Remote Module System Configuration — RMI Carrier

Remote Group Configuration

The remote group configuration (see Figure 3-28) serves one or two groups of voice terminals and data terminals at a remote location. A DS1 carrier in a traditional module is required. DS1 facilities connect the remote group to the central switch location. (DEFINITY Generic 2 requires a traditional module if remote groups are to be supported.) Since this configuration involves only two DS1 port interface circuits per remote group, there are no cabinet considerations involved at the network module level.

Each remote group is connected to a DS1 carrier (installed in a network cabinet at the central location) through a pair of Dedicated RGI (Remote Group Interface) circuit packs. An ANN15B Remote Group Interface—Central circuit pack terminates the DS1 link at the central location and an ANN16B Remote Group Interface—Remote terminates the DS1 link at the remote location. Each DS1 link can provide service for up to three line or data interface circuit packs. The remote group housing can handle two DS1 links. For more information, see Carriers in this chapter.

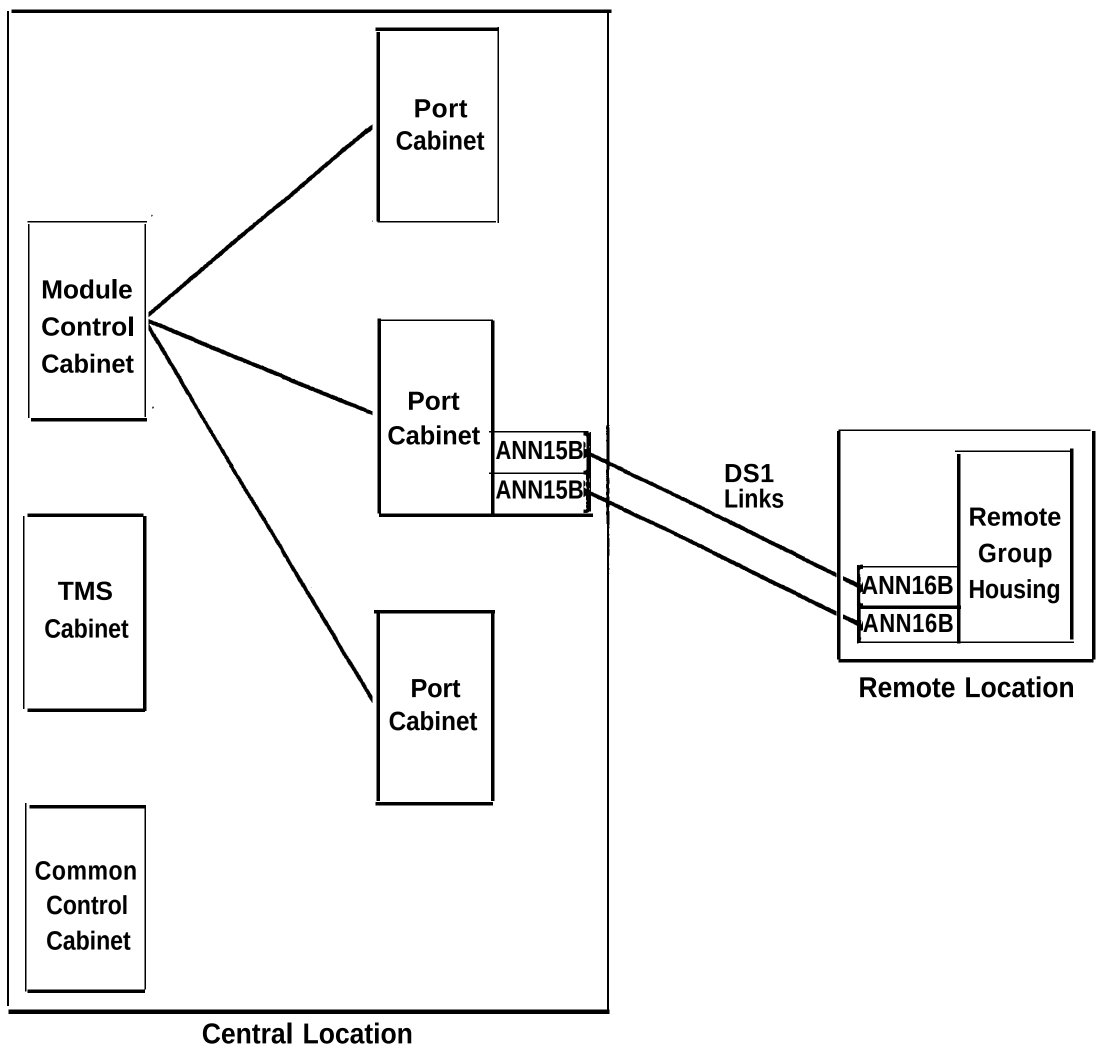


Figure 3-28. Remote Group System Configuration

Carriers

Carriers are designed to hold circuit packs. This arrangement allows most of the system's circuitry to be replaced without the use of tools. The circuit packs are usually designed to accomplish one or more functions. This modular approach simplifies maintenance by making it easier to diagnose an isolate system problems. Each carrier is designed to accommodate specific types of circuit packs.

All loose wiring and cabling from the backplane to the circuit breakers and connectors are furnished with the carrier unit. Circuit breaker panels are located at the right front of the carrier. Connectors are located on the backplane or on the cabinet skin.

Table 3-F lists the carriers that are used in System 85 and Generic 2.

TABLE 3-F. DEFINITY Generic 2 and System 85 Carrier Use

Carrier	DEFINITY Generic 2	System 85
Common control carrier (J58888AB)	CC/TMS cabinet	Not used
Common control carrier (J58888E)	Upgrades	Duplicated or unduplicated common control cabinet
Power carrier (J58888F)	Upgrades	Duplicated common control cabinet
DC/DC converter unit (J58889T)	Upgrades	Unduplicated common control cabinet
TMS carrier (J58888C)	CC/TMS or TMS/RMI cabinett	TMS/RMI cabinet
RMI carrier (J58888S)	Upgrades	TMS/RMI cabinet
SCC module control (J58890P)	Single-carrier cabinet	Not used
Module control carrier (J58890AK)	Universal module cabinet	Not used
Module control carrier (J58888M)	Module control cabinet (Traditional)	Module control cabinet
SCC port carrier (J58890H)	Single-carrier cabinet	Not used
Common port carrier (J58890BB)	Universal module	Not used
Port carrier (J58888A)	Module control cabinet (Traditional)	Module control cabinet
DS1 Carrier (J58888N)	Module control cabinet (Traditional)	Module control cabinet
Remote Group Housing (J58889AN)	Traditional module with DS1 carrier required	DS1 carrier required

Common Control Carriers

Generic 2 and System 85 have different coded common control carriers: J58888AB for Generic 2 and J58888E for System 85. The J58888AB is modified carrier created for the Generic 2 CC/TMS cabinet. However, the J58888E can accommodate all circuit packs needed to upgrade a System 85 common control to a Generic 2 common control.

The common control carriers (see Table 3-G and Figure 3-29) house the TN- and UN-coded circuit packs that make up the 501CC processor complex and related I/O circuitry.

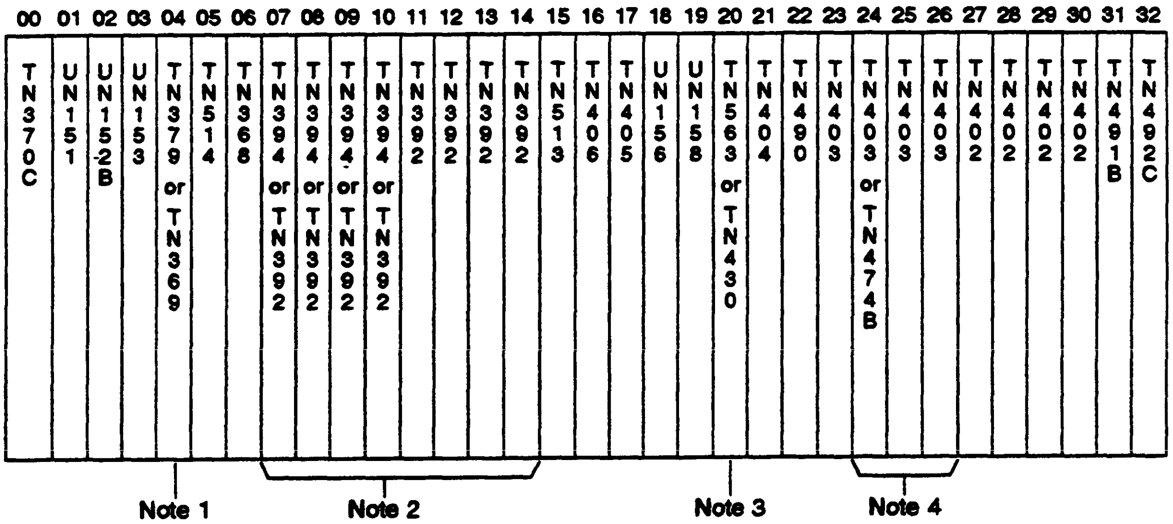
For information on circuit packs in the common control carriers, refer to Table 3-G or to the specific circuit pack code under the Circuit Packs section in this chapter.

TABLE 3-G. Common Control Carrier Circuit Packs

Code	Circuit Pack	Comments
TN368	Memory Protect	One required per common control carrier.
TN369	Cache Memory	One optional per System 85 common control carrier based on processor occupancy. The TN369 can be retained when upgrading to Generic 2.
TN370C	Sequencer	One required per common control carrier.
TN379	Cache Memory	One optional per Generic 2 common control carrier, based on processor occupancy. This pack is not used with System 85.
TN392	1M RAM Memory	Number required based on generic software requirements. Maximum per control carrier: eight for System 85 R2V3, four for R2V2, two for R2V1.
TN394	4M RAM Memory	Four required per Generic 2 common control and three required per System 85 R2V4 common control.
TN402	4-MHz Channels	For each common control, one required for 1 to 7 modules, two required for 8 to 15 modules, three required for 16 to 23 modules, four required for 23 to 31 modules.
TN403	Dual-Speed Channels	First TN403 provides three dedicated channels (MAAP/SMT, NCOSS, and SMDR/CSMDR) and 13 undedicated channels; each additional TN403 provides 16 undedicated channels. Four maximum per control carrier.
TN404	I/O Buffer	One required per control carrier.
TN405	DCIU Interface	One required per control carrier when DCIU connectivity is required.
TN406	DCIU Memory	One required per control carrier when DCIU connectivity is required.

TABLE 3-G. Common Control Carrier Circuit Packs (Contd.)

Code	Circuit Pack	Comments
TN430B	Tape Interface	One required per common control whenever the common control cabinet contains an HCMR. This pack is not used with Generic 2 or with common control cabinets containing a DTS.
TN474B	Processor Communication Circuit	One required per control carrier when 3B2 CDRU connectivity is required (use in slot 24,25, or 26).
TN490	Alarm Interface	One required per control carrier.
TN491B	Diagnostic Processor	One required per control carrier.
TN492C	Remote Interface	One required per control carrier.
TN513	DCIU Test Support	Equipped in carrier only during high-level maintenance testing.
TN514	SCAMPER Interface	Equipped in carrier only during high-level maintenance testing.
TN563	SCSI Host Adapter	One required per common control carrier for Generic 2 or for common control cabinet using a DTS instead of an HCMR.
UN151	ALU	One required per control carrier.
UN152B	Instruction Decoder	One required per control carrier.
UN153B	Bus Interface	One required per control carrier.
UN156	DCIU I/O	One required per control carrier when DCIU connectivity is required.
UN158	Duplication Control	One required per control carrier when duplicated common controls are provided.
410AA	DC/DC Converter	One required for each J58888AB common control.
495JC	DC/DC Converter	One required for each J58888AB common control.



Notes:

1. These packs are optional. The TN379 is used for Generic 2.
2. Four TN394s are required for Generic 2 and three TN394s are required for System 85, R2V4. TN392s are used for System 85 R2V1, R2V2, and R2V3.
3. Generic 2 uses the TN563 SCSI host adapter circuit pack. System 85 uses the TN430 tape interface.
4. Slots 24 through 26 accommodate a combination of TN474Bs or TN403s. At this time, only one TN474B port can be used in standard applications.
5. The 410AA and 495JC DC/DC converters are not shown. The 410AA is located at the end of the carrier next to slot 00 and the 495JC is located at the other end of the carrier next to slot 32.

Figure 3-29. Common Control Carrier (J58888AB)

Power Carrier (J58888F)

The power carrier provides DC power in the System 85 duplicated common control cabinet (J58888F). It contains DC/DC converters that provide logic-level DC voltages required by common control carrier. The J58888F occupies one of the carrier positions in the System 85 duplicated common control cabinet. This carrier is functionally segmented into two halves and provides fully isolated logic-level voltages to the common control carriers (see Figure 3-30).

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

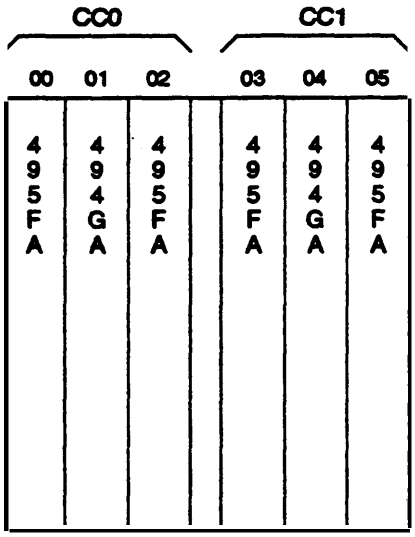


Figure 3-30. Power Carrier Slot Layout

TABLE 3-H. Power Carrier Circuit Packs

Code	Circuit Pack	Comments
494GA	**+5V/-5V DC/DC converter**	**Used with J58888F (System 85) power carrier. One required for each common control carrier.**
495FA	**+5V DC/DC converter**	**Used with J58888F (System 85) power carrier. Two required for each common control carrier.**

DC/DC Converter Unit (J58889T)

The DC/DC converter unit (see Figure 3-31) provides DC power in the System 85 unduplicated common control cabinet. (The DC/DC converter unit is never used with the Generic 2 CC/TMS cabinet.) This unit contains DC/DC converters that provide logic-level DC voltages required by the common control carrier. It is mounted in a shelf assembly next to the HCMR.

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

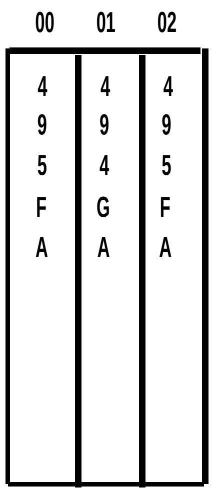


Figure 3-31. DC/DC Converter Unit (J58889T)

TABLE 3-I. DC/DC Converter Unit Circuit Packs

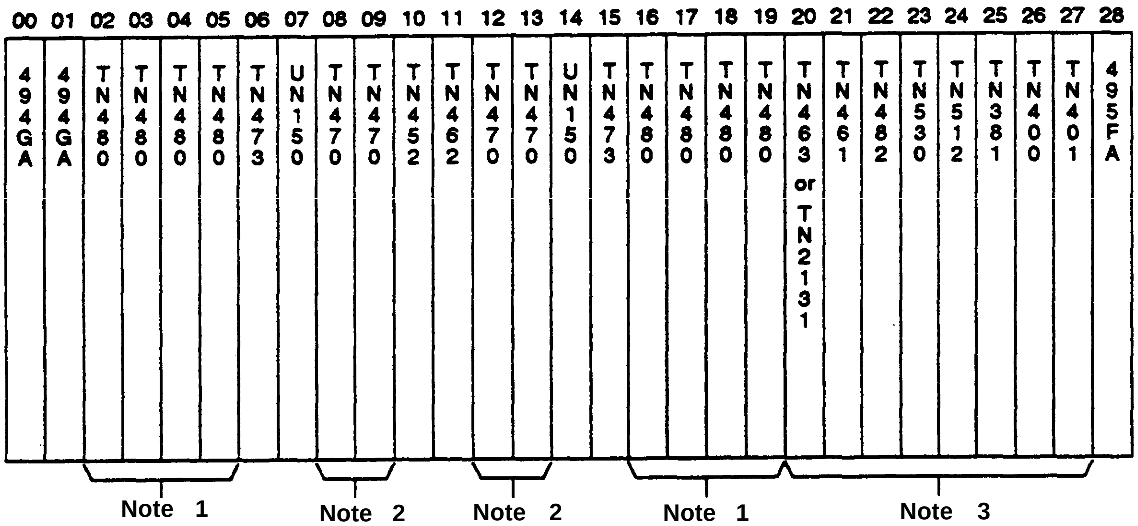
Code	Circuit Pack	Comments
494GA	**+5V/-5V DC/DC converter**	**One required.**
495FA	**+5V DC/DC converter**	**Two required.**

TMS Carrier (J58888C)

The TMS carrier (see Figure 3-32) houses a time-multiplexed switch which interconnects modules in a multimodule system. A TMS carrier can be equipped as either basic or growth:

- A basic TMS carrier contains interface circuitry for up to seven modules and
- A TMS growth carrier contains interface circuitry for up to eight additional modules.

For information on circuit packs in the TMS carrier, refer to Table 3-J and the Circuit Packs section in this chapter.



Notes:

1. One TN480 is required per module. The TN480 cannot be equipped in slot 19 of the basic TMS carrier.
2. One TN470 is required in the basic TMS carrier for the first module; after that, each TN470 added will accommodate an additional two modules.
3. Circuit packs in slots 20 through 27 are provided only in the basic TMS carrier.

Figure 3-32. TMS Carrier (J58888C)

TABLE 3-J. TMS Carrier Circuit Packs

Code	Circuit Pack	Comments
TN2131	External Clock Interface	One TN2131 (or TN463) required per basic carrier in multimodule system with DS1 or ISDN trunks. This is used instead of the TN463 when using an external Synchronization Clock.
TN381	TMS Processor	One required per basic carrier.
TN400B	I/O Bus Interface	One required per basic carrier.
TN401	Mod. Control Channel	One required per basic carrier.
TN452C	Universal Port Control Interface	One required per basic or growth carrier.
TN461	TMS Clock Oscillator	One required per basic carrier.
TN462	TMS Local Clock Termination	One required per basic or growth carrier.
TN463	System Clock Synchronizer	One TN463 (or TN2131) required per basic carrier in multimodule system with DS1 or ISDN trunks.
TN470	TMS Multiplexer	Basic carrier: One required for first module and one required for each two additional modules up to seven modules. Four maximum per basic carrier. Growth carrier: One required for each two additional modules up to eight modules. Four maximum per growth carrier.
TN473	Fan-Out	Two required per basic or growth carrier.
TN480	Module Interface	Basic carrier: One required per module up to seven modules. Seven maximum per basic carrier. Growth carrier: One required per module up to eight modules. Eight maximum per growth carrier.
TN482	TMS Maintenance Interface	One required per basic carrier.
TN512B	Test Support	Not required for system operation. Equipped in carrier only during high-level maintenance testing.
TN530	Duplication/Update Channel	One required per basic carrier only when duplicated module controls are provided.
UN150	Fan-In	Two required per basic or growth carrier.
494GA	DC/DC Converter	Two required per basic or growth carrier.
495FA	DC/DC Converter	One required per basic or growth carrier.

RMI Carrier (J58888S)

The RMI carrier (see Figure 3-33) is a piece of System 85 hardware that provides space for Up to 16 TN456 RMI (Remote Module Interface) packs. RMI carriers are not used in new Generic 2 switch configurations but may be used if they are already equipped in a System 85 that is being upgraded to Generic 2. Each RMI carrier contains interface circuitry for up to eight remote modules with duplicated controls or up to 16 remote modules with unduplicated controls. A maximum of two RMI carriers are possible for a system with unduplicated module controls or four RMI carriers for a system with duplicated module controls.

For information on circuit packs in the RMI carrier, refer to Table 3-K and the Circuit Packs section in this chapter.

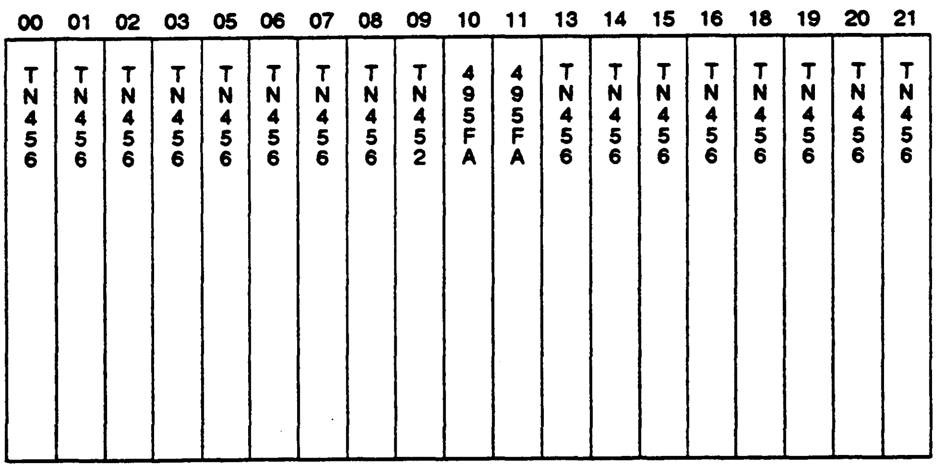


Figure 3-33. RMI Carrier (J58888S)

TABLE 3-K. RMI Carrier Circuit Packs

Code	Circuit Pack	Comments
TN456	**Remote Module Interface**	**One per remote module (two if duplicated TMS and module controls provided).**
495FA	**DC/DC Converter**	**Two required per carrier (one for each carrier half).**
TN452C	**Universal Port Control Interface**	**One required per carrier.**

Module Control Carriers (J58890AK, J58890P, and J58888M)

Generic 2 and System 85 have different coded module control carriers: J58890P for Generic 2 SCC modules (see Figure 3-34), J58890AK (see Figure 3-35) for Generic 2 universal modules, and J58888M (see Figure 3-36) for System 85 modules or Generic 2 traditional modules. The module control carriers provide 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. These carriers contain hardware that allows the common control to interrogate and scan the ports, send instructions to them, and create transmission path connections.

When duplicated module controls are required in an SCC module, the J58890P can house two complete module control complexes within the same carrier (see Figure 3-34).

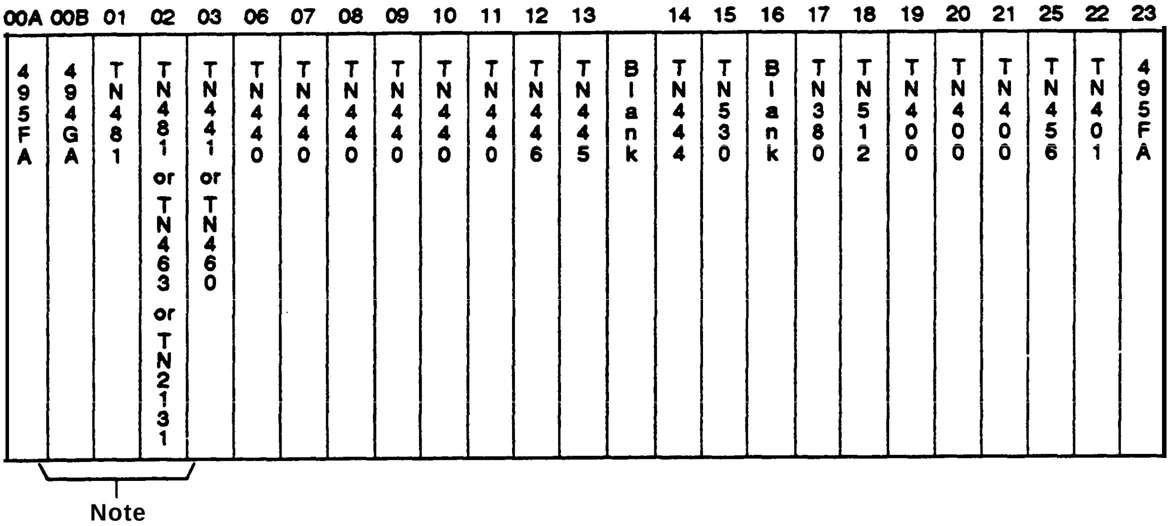
For information on circuit packs in the module control carrier, refer to Table 3-L and the Circuit Packs section in this chapter.

	POWER	01A	02A	03A	04A	05A	06A	07A	08A	09A	10A	11A	01B	02B	03B	04B	05B	06B	07B	08B	09B	10B	11B	POWER
Blank Adapter	ACX535 or 647A	TN588	TN512B	TN541	TN590	TN444B	UN154C	TN445	TN446	TN441	TN481	TN456	TN588	TN512B	TN541	TN590	TN444B	UN154C	TN445	TN446	TN441	TN481	TN456	ACX535 or 647A

Figure 3-34. SCC Module Control— Single-Carrier Cabinet (J58890P)

Slot:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
+5V Power	TN588	TN512B	Blank	TN541	TN580 or TN590	TN444B	UN154C	Blank	Reserved	Reserved	TN445	TN446	TN460C or TN441	TN463 or TN481 or TN2131	TN456	TN456	TN456	TN456	TN456	TN456	TN456	-5V/-48V Power

Figure 3-35. Universal Module Control Carrier (J58890AK)



Note: **For a single module unsynchronized switch, slots OOB, 01, and 02 are empty and TN460 (Module Clock Oscillator) is used in slot 03. For a single module synchronized switch, slots OOB and 01 are empty, TN463 (System Clock Synchronizer) or TN2131 (External Clock Interface) is used in slot 02 and TN460 (Module Clock Oscillator) 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.**

Figure 3-36. Traditional Module Control Carrier (J58888M)

TABLE 3-L. Module Control Carrier Circuit Packs

Code	Circuit Pack	Comments
TN2131	External Clock Interface	One required per module control carrier in single-module system with DS1 or ISDN trunks. This is used instead of the TN463 when using an external Synchronization Clock.
TN380D	Module Processor	One required per traditional module control carrier.
TN400B	I/O Bus Interface	One required per traditional module control carrier to interface to a total of four port, DS1, or RMI carriers. Three maximum per control carrier.
TN401	Module Control Channel	One required per traditional module control carrier.
TN440B	Port Data Store	One required per traditional module control carrier to interface to a total of two port or DS1 carriers. Six maximum per control carrier.
TN441	Intermodule Data Store	One required per module control carrier (multimodule systems only).
TN444B	Maintenance Interface	One required per module control carrier.

TABLE 3-L. Module Control Carrier Circuit Packs (Contd.)

Code	Circuit Pack	Comments
TN445	TSI P-Store	One required per module control carrier.
TN446	TSI ALU	One required per module control carrier.
TN456	Remote Module Interface	One required in each remote module. Each remote module must have a supporting TN456 at the central location. Universal modules at the central location can house up to seven TN456s. SCC modules and traditional modules can house only one TN456.
TN460C	Module Clock Oscillator	One required per module control carrier, only in single-module systems.
TN463	System Clock Synchronizer	One required per module control carrier in single-module system with DS1 or ISDN trunks.
TN481	Light Guide Interface	One required per module control carrier (multimodule systems only).
TN512B	Test Support	Not required for system operation. Equipped only during high-level maintenance testing.
TN530	Duplication/Update Channel	One required per traditional module control carrier (duplicated module controls only).
TN541	Duplication/Update Channel	One required per universal module control carrier (duplicated module controls only).
TN580	Module Processor	One TN580 (or TN590) required per universal module control carrier running under G2.1 issue 1.0 or 2.0 software. The TN580 is *not* recommended for G2.1 issue 3.0.
TN590	Downloadable Module Processor	One required per SCC module control carrier. One required per universal module control carrier running under G2.1 issue 3.0 software.
TN588	Module Control Channel	One required per universal module control carrier.
UN154C	Universal Bus Interface	One required per universal module control carrier.

TABLE 3-L. Module Control Carrier Circuit Packs (Contd.)

Code	Circuit Pack	Comments
494GA	DC/DC Converter	One required per traditional module control carrier only in multimodule systems with duplicated module controls.
495FA	DC/DC Converter	Two required per traditional module control carrier.
631DA1 or 644A1	+5V Single Output Power Supply	One 631DA1 is always required per universal module control in AC-powered systems. For DC-powered systems, the 644A1 is used instead.
631DB1 or 645B1	+5/-48V Dual Output Power Supply	One 631DB1 is always required per universal module control in AC-powered systems. For DC-powered systems, the 645B1 is used instead.
ACX535 or 647A	+5/-48V Power Supply	One ACX535 is always required per SCC module control in AC-powered systems. For DC-powered systems, the 647A is used instead.

Port Carriers

The common port carrier (J58890BB) is used in Generic 2 universal modules. The single-carrier port cabinet (J58890H) is used in SCC modules. The standard port carrier (J58888A) and the DS1 carrier (J58888N) can be used in traditional modules.

Common Port Carrier (J58890BB)

Common port carriers contain the universal module's port network complex which consists of System 75 based port and tone circuit packs. The main hardware features are:

- An I/O connector plate on the rear of the cabinet. This plate provides twenty 25-pair connectors used to interface the circuit pack slots with the cross-connect field.
- Two dedicated slots for power units, one dedicated slot for service packs, and 20 universal slots for port packs (see Figure 3-37). Each of the 20 universal port slots has a connector appearance on the I/O connector plate.
- A carrier label mounted on the front cover.

The common port carrier is used in universal modules only; it will not work in traditional modules. The universal module houses one, two, or three port carriers. As can be seen in Figure 3-2 in the Universal Cabinet section, port carrier (00) is installed in position C, port carrier (01) is in position D, and port carrier (02) is in position E. At least one port carrier is always equipped. For critical reliability configurations, at least two port carriers must be equipped in each module. This allows tone generator circuit packs to be installed in two different port carriers.

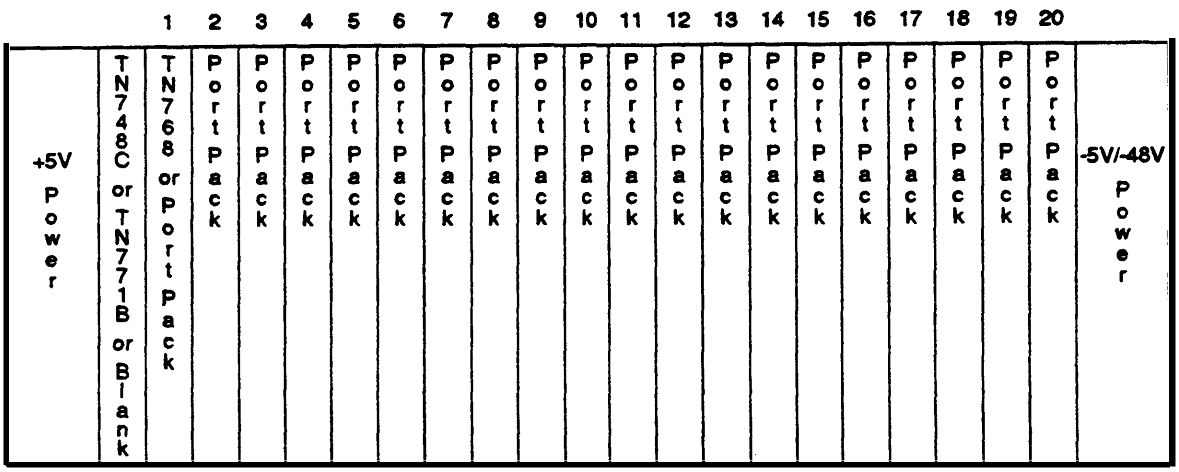


Figure 3-37. Common Port Carrier

Table 3-M lists common port carrier circuit packs. Detailed circuit pack descriptions appear later in this chapter.

TABLE 3-M. Common Port Carrier Circuit Packs

Code	Circuit Pack	Comments
TN555	DS1 Packet Adjunct	Adds a D-channel to a DS1 link. Used with TN767 to provide ISDN—PRI.
TN556	ISDN—BRI Line	Twelve ISDN—BRI ports per pack.
TN726	Data Line (EIA)	Eight lines per pack.
TN735	MET Line	Four lines per pack. Used for 106B display unit.
TN742	Analog Line (OPS, ONS, OPX, Test)	Eight lines or eight analog modems per pack.
TN746B	Analog Line (OPS, ONS, OPX)	Sixteen lines per pack.
TN747B	CO Trunk	Eight trunks per pack.
TN748C	Tone Detector	Number of packs required per system is based on traffic engineering. Minimum of one pack per module.
TN753	DID Trunk	Eight trunks per pack.
TN754B	Digital Line	Eight lines per pack to support terminals which use the Digital communications Protocol (DCP).
TN760C	Tie Trunk	Four trunks per pack.
TN762B	Hybrid Line (7300 Series Only)	Eight lines per pack.
TN763C	Auxiliary Trunk	Four trunks per pack.
TN767	DS1 Interface	Twenty-four channels per pack. When used in trunk mode, this pack requires an adjacent carrier slot.
TN768	Tone Clock	One pack required per module. Maximum of one TN768 per port carrier.
TN771B	Maintenance Test Circuit Pack	One required per system. More may be required based on amount of ATMS testing scheduled.
631DA1	AC Single Output Power Supply (+5V)	One required per port carrier in modules equipped with an AC distribution unit.
631DB1	AC Dual Output Power Supply (-5V/ -48V)	One required per port carrier in modules equipped with an AC distribution unit.
644A1	DC Single Output Power Supply (+5V)	One required per port carrier in modules equipped with an DC distribution unit.
645B1	DC Dual Output Power Supply (-5V/ -48V)	One required per port carrier in modules equipped with an DC distribution unit.

Single-Carrier Port Cabinet (J58890H)

The single-carrier port cabinet has 18 port slots which accommodate any of the common port carrier TN-prefixed circuit packs mentioned in Table 3-M. However, the single-carrier port cabinet uses different power supplies to provide all of the DC voltages needed by the carrier. Power supply WP91153 is equipped in AC powered systems (shown in Figure 3-38), and power supply 676B is equipped in DC powered systems (not shown in Figure 3-38).

Port circuit packs may be placed in any of the 18 port slots in the cabinet except for the TN555 ISDN—PRI packet adjunct which, when used, must always be placed adjacent to the TN767 DS1 interface pack in the next higher numbered slot. Convention dictates that the TN768 tone clock pack or the TN748C tone detector pack be placed in slot 1. If the SCC module only has one single-cabinet port carrier, then the TN768 is placed in slot 1 and the TN748C is placed in slot 2.

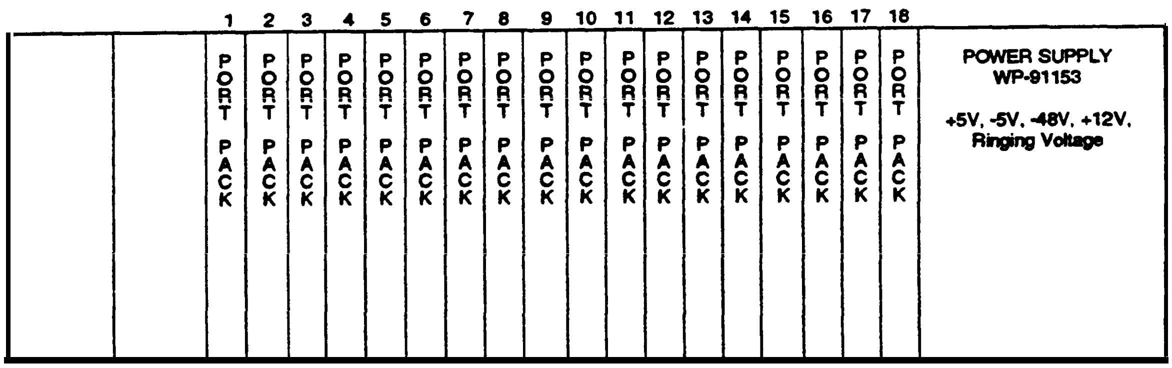


Figure 3-38. Single-Carrier Port Cabinet (J58890H)

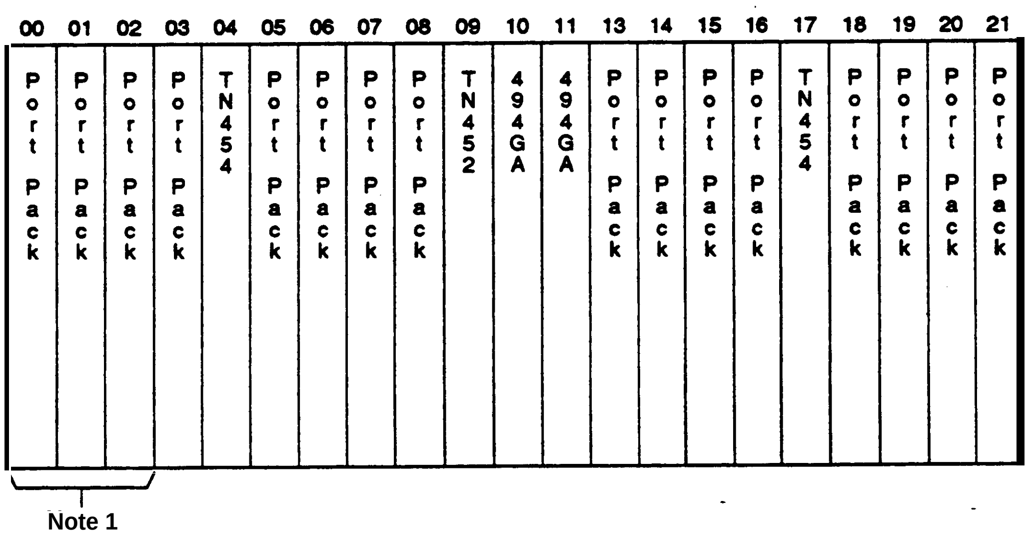
Standard Port Carrier (J58888A)

The traditional module standard port carrier (see Figure 3-39) 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 accommodates SN-coded circuit packs using l00-pin 963G connectors and TN-coded circuit packs using 200-pin 963C connectors. The port carrier will also accept ANN17B circuits. When the ANN17B is installed in the port carrier, line circuits are available for 7300 series voice terminals. Any port circuit pack that needs access to eight or fewer time slots on the group bus may be installed into any port pack 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 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-N and the Circuit Packs section in this chapter. For information on port circuit pack pairing rules, refer to the Port Circuit Pack Assignments in this chapter.

> NOTE: In systems using the -48 V DC standby power option, SN232B DID trunks must *not* be housed in the port or DS1 carrier occupying the carrier position directly above the module control carrier (J58888M).



Notes: Slots 00, 01, and 02 are the only slots that will accept the SN244 automatic number identification circuit pack; these slots, like all the others marked “PORT PACK”, will accept any other port packs with an SN prefix as well as the ANN17. When the ANN17 is used in this carrier, only four of its eight ports may be assigned. However, when the ANN17 is used in the DS1 carrier, all eight of its ports may be assigned.

Figure 3-39. Port Carrier (J58888A)

TABLE 3-N. Port Carrier Circuit Packs

Code	Circuit Pack	Comments
ANN17B	7303/7305 Interface Circuit	Four Lines per pack when used in port carrier.
SN224B	MFET Line Port	Four Lines per pack.
SN228B	OPS Line Circuit	Eight Lines per pack. Used for long loop lengths and bridging.
SN229	ONS Line Circuit	Eight Lines per pack. Used only for loop lengths less than 3500 feet.
SN230B	CO Trunk	Four Trunks per pack.
SN231	Auxiliary Trunk	Four Trunks per pack.
SN232B	DID Trunk	Four Trunks per pack.
SN233C	Tie Trunk/Atnd Intfc..	Four Trunks per pack.
SN238	EIA Port	Four lines per pack.
SN241	Contact Interface	Eight make contacts per pack.
SN243B	Data Port	Four lines per pack.
SN244	ANI Data Transmitter	Two channel outputs per pack.
SN250	Call Progress Tones	Eight progress tones generated. Two required per module.
SN251	Touch-Tone Receiver	Four circuits per pack. Number required per system is based on traffic engineering.
SN252	Touch-Tone Sender	Four circuits per pack. Number required per system is based on traffic engineering.
SN253C	Auxiliary Tones	One required per module. Two required per module for reliability with certain optional features (e.g., AUTOVON or terminal-dialed calls using modem pool or DS1 trunks).
SN254	Attendant Conference Circuit	One required for each six port attendant conference circuit. Thirteen maximum per system.
SN255	Tone Detector 2	Number based on traffic engineering. Used for keyboard dialing, etc.
SN261C	A/D Facility Test	One required per system. More may be required based on amount of ATMS testing scheduled.
SN270B	General Purpose Port	Four lines per pack to support the DCP. Each line can support one voice channel and one data channel.
TN452C	Universal Port Control Interface	One required per port carrier.
TN454B	Universal Port Data Interface	Two required per port carrier (one per half carrier).
494GA	DC/DC Converter	Two required per port carrier (one per half carrier).

DS1 Carrier (J58888N)

This traditional module carrier is a modified port carrier; however, the slot layout remains the same (see Figure 3-39). The DSI carrier provides high-density dedicated interface circuits for DS1 trunks and/or 7300S series voice terminals. The DS1 carrier accommodates SN- or ANN-coded circuit packs using 100-pin 963G connectors or 150-pin 963M connectors and TN-coded circuit packs using 200-pin 963C connectors. Fifteen 25-pair connectors are provided for input/output cabling to termination fields with each connector providing the interface for an ANN17B or an SN-coded circuit pack.

One of two modes of operation are used by DS1-based circuits:

- *Line Plus Trunk* mode, which allows lines (serving analog Off-Premises Stations) and trunks on the same DS1 facility. However, this mode is almost always used for trunks only. Six slots are required; one for the pack and five left blank. ANN1lE trunks and all ANN35s are administered in this mode.
- *Line Only* mode, which allows up to 24 lines serving analog Off-Premises Stations (OPSs) to use T1 facilities; the analog voice terminals are usually served by a terminal transmission product such as a D4 Channel Bank, on the far end. Three slots are required; one for the pack and two blank. The ANN11E can be administered this way. Also, the ANN15B and ANN16B are administered as line onIy.

Circuit pack slot placement in for DS1-based circuits depends on whether it is being used as line-plus-trunk or as line-only (see Figure 3-40).

For information on circuit packs in the DS1 carrier, refer to Table 3-O and the Circuit Packs section in this chapter.

NOTE: In systems using the -48 V DC standby power option, SN232B DID trunks must not be housed in the port or DS1 carrier occupying the carrier position directly above the module control carrier (J58888M).

TABLE 3-O. DS1 Carrier Circuit Packs

Code	Circuit Pack	Comments
ANN11E	DS1 Trunk Interface	One per half carrier when used in the line + trunk mode; two per half carrier when used in the line only mode.
ANN15B	Remote Carrier Local	Equivalent to three line port packs or 24 line ports. Up to two per half carrier installed when remote groups are provided.
ANN17B	7303/7305 Interface Circuit	Eight lines per pack. Up to 16 packs per carrier. If more than 40 ANN17Bs are used in a cabinet equipped with a single OLS power supply, an extra OLS power supply must added.

TABLE 3-O. DS1 Carrier Circuit Packs (Contd.)

Code	Circuit Pack	Comments
ANN35	ISDN Primary Rate Port	Same carrier configuration as ANN11E Line + Trunk mode.
SNxxx	SN-Coded Port Circuit Packs	All SN-coded circuit packs can be installed with R2V2/R2V3/R2V4/G2 software.
TN452C	Universal Port Control Interface	One required per carrier.
TN454B	Universal Port Data Interface	Two required per carrier (one per carrier half).
494GA	DC/DC Converter	Two required per carrier (one per carrier half).

00	01	02	03	04	05	06	07	08	09	10	11	13	14	15	16	17	18	19	20	21
Leave Vacant	Leave Vacant	Leave Vacant	Port Pack	TN454	DS1 Pack	Leave Vacant	Leave Vacant	Port Pack	TN452	494GA	494GA	Leave Vacant	Leave Vacant	Leave Vacant	Port Pack	TN454	DS1 Pack	Leave Vacant	Leave Vacant	Port Pack

Line Plus Trunk Mode

00	01	02	03	04	05	06	07	08	09	10	11	13	14	15	16	17	18	19	20	21
DS1 Pack	Leave Vacant	Leave Vacant	Port Pack	TN454	DS1 Pack	Leave Vacant	Leave Vacant	Port Pack	TN452	494GA	494GA	DS1 Pack	Leave Vacant	Leave Vacant	Port Pack	TN454	DS1 Pack	Leave Vacant	Leave Vacant	Port Pack

Line Only Mode

Figure 3-40. Slot Requirements For DS1-Based Circuit Packs

Remote Group Housing (J58889AN)

The remote group housing (see Figure 3-41) provides the remoted line and data interface circuitry in a remote group system configuration. The remote group housing requires a traditional module equipped with a DS1 carrier. This self-contained unit houses up to two remotely located port groups. Each port group consists of:

- A Remote Group Interface—Remote circuit pack (ANN16B)
- Up to three line or data interface circuit packs (analog, hybrid, digital, or EIA)
- A CAL1B Frequency Generator / Alarm Board which is shared with the other port group in the remote group housing.

The CAL1B Frequency Generator/Alarm Board is a special-application unit mounted inside a remote group housing. It provides 20-Hz ringing voltage for the remoted port groups. Ringing voltage is obtained from two DC/DC converter circuits which generate +90 V and -190 V from a -48 V supply.

The CAL1B also provides low-voltage detection, alarm conversion, and other miscellaneous features. Up to four -48 V fuse alarms and five contact closure alarms can be paralleled. Resistors are provided to facilitate 2-speed fan operation and over-temperature shutdown.

For information on the other circuit packs in the remote group housing, refer to Table 3-P and the Circuit Packs section in this chapter.

TABLE 3-P. Remote Group Housing Circuit Packs

Code	Circuit Pack	Comments
ANN16B	Remote Carrier Control	Terminates up to three line port packs while using 24 time slots; 23 for voice or data and one for signaling. Two maximum per remote group housing.
ANN17B	7303/7305 Interface Circuit	Eight lines per pack.
SN228B	OPS Line Circuit	Eight lines per pack.
SN238	EIA Port	Four lines per pack.
SN270B	General Purpose Port	Four lines per pack to support the DCP.
CAL1B	Frequency Generator / Alarm	One required per remote group housing.

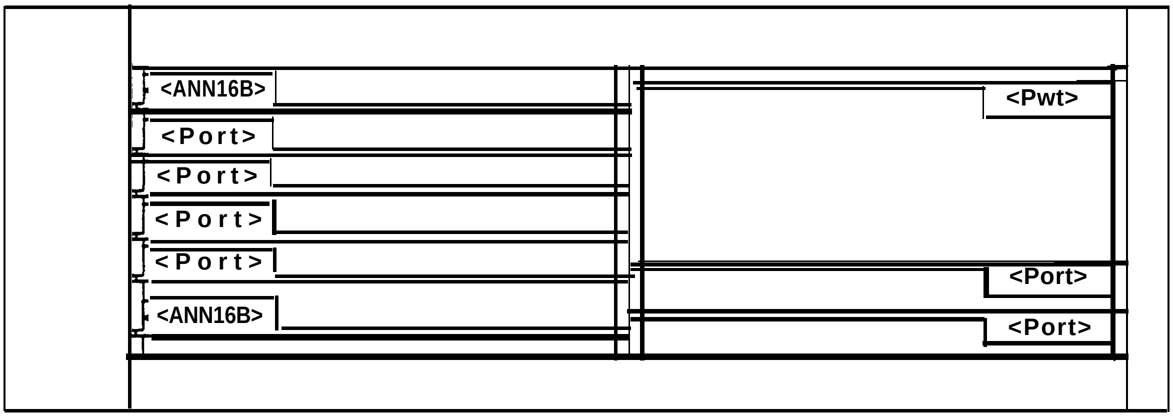


Figure 3-41. Remote Group Housing (J58889AN)

Circuit Packs

Generic 2 and System 85 circuit packs contain the system's electronics. They are installed in slots within carriers. Female connectors at the end of the packs fit over male pins in the carrier backplane. Many circuit packs have red, yellow, and green LEDs (lamps) on the faceplate which indicate the pack's operational status. If fault diagnosis becomes necessary, circuit packs have test points which allow internal circuit states to be examined.

Most circuit packs use ID (identification) chips and SACS (signature analysis chips) for testing purposes. The ID chips, assigned on a per-board basis, interface to the I/O (Input/Output) bus. ID chips provide information about circuit pack type and vintage. They contain drivers and status sensors for the green and red maintenance LEDs. 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 signature known to be good. The two signatures are identical when the SAC is functioning properly.

Many circuit packs contain option switches. Some of the things the option switches select are interface type, range, data rate, or other factors relevant to 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 *DEFINITY Communications System Generic 2 and System 85 Installation* (555-104-104).

Each circuit pack is equipped with an identification faceplate containing a color-coded label. 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 TN380B cannot be used if the designation strip specifies TN380C Therefore, TN380C or the later alpha-suffixed TN380D packs are suitable replacements. Suffix codes indicate successive improvements or modifications. Circuit pack availability is listed in Table 3-Q by System 85 Release/Version and for Generic 2.

> NOTE: To determine whether a specific circuit pack suffix will work with specific System 85 R2 version or Generic 2, the current "Minimum Vintage List" should be consulted.

TABLE 3-Q. Circuit Pack Availability

Circuit Type	R2V1	R2V2	R2V3	R2V4	Generic 2
Common Control Carrier	TN368	TN368	TN368	TN368	TN368
	TN369	TN369	TN369	TN369	
	TN370	TN370	TN370	TN370B	TN370C
	TN392	TN392	TN392		
					TN379
			TN394	TN394	TN394
	TN402	TN402	TN402	TN402	TN402
		TN403		TN403	TN403
		TN404		TN404	TN404
		TN405		TN405	TN405
		TN406		TN406	TN406
		TN430		TN430B	
				TN474B	TN474B
	TN490	TN490	TN490	TN490	TN490
	TN491	TN491	TN491	TN491B	TN491B
	TN492C	TN492C	TN492C	TN492C	TN492C
	TN513	TN513	TN513	TN513	TN513
					TN563
	UN151	UN151	UN151	UN151	UN151
	UN152	UN152	UN152	UN152B	UN152B
	UN153	UN153	UN153	UN153B	UN153B
	UN156	UN156	UN156	UN156	UN156
	UN158	UN158	UN158	UN158	UN158
Universal Module Control Carrier					TN2131
					TN441
					TN444B
					TN445
					TN446
					TN456
					TN460C
					TN463
					TN481
					TN541
					TN580
					TN588
					TN590
					UN154C

TABLE 3-Q. Circuit Pack Availability (Contd.)

Circuit Type	R2V1	R2V2	R2V3	R2V4	Generic 2
Traditional Module Control Carrier	TN380B TN400B TN401 TN440B TN441 TN444B TN445 TN446 TN456 TN460C TN481 TN530	TN380B TN400B TN401 TN440B TN441 TN444B TN445 TN446 TN456 TN460C TN463 TN481 TN530	TN2131 TN380C TN400B TN401 TN440B TN441 TN444B TN445 TN446 TN456 TN460C TN463 TN481 TN530	TN2131 TN380D TN400B TN401 TN440B TN441 TN444B TN445 TN446 TN456 TN460C TN463 TN481 TN530	TN2131 TN380D TN400B TN401 TN440B TN441 TN444B TN445 TN446 TN456 TN460C TN463 TN481 TN530
Universal Common Port Carrier					TN555 TN556 TN726 TN735 TN742 TN746B TN747B TN748C TN753 TN754B TN760C TN762B TN763C TN767 TN768 TN771B

TABLE 3-Q. Circuit Pack Availability (Contd.)

Circuit Type	R2V1	R2V2	R2V3	R2V4	Generic 2
	SN224B	SN224B	SN224B	SN224B	
	SN221B	*	*	*	*
	SN228	SN228	SN228	SN228B	SN228B
	SN222B	*	*	*	*
	SN229	SN229	SN229	SN229	SN229
	SN230	SN230	SN230B	SN230B	SN230B
	SN231	SN231	SN231	SN231	SN231
	SN232B	SN232B	SN232B	SN232B	SN232B
	SN233B	SN233B	SN233C	SN233C	SN233C
		SN238	SN238	SN238	SN238
	SN241	SN241	SN241	SN241	SN241
	SN243B	SN243B	SN243B	SN243B	SN243B
	SN244	SN244	SN244	SN244	SN244
Traditional	SN250	SN250	SN250	SN250	SN250
Module Port or	SN251	SN251	SN251	SN251	SN251
DS1 Carrier	SN252	SN252	SN252	SN252	SN252
	SN253C	SN253C	SN253C	SN253C	SN253C
	SN254	SN254	SN254	SN254	SN254
	SN255	SN255	SN255	SN255	SN255
	SN260				
	SN261	SN261B	SN261B	SN261C	SN261C
	SN270	SN270B	SN270B	SN270B	SN270B
	TN452B	TN452B	TN452C	TN452C	TN452C
	TN454B	TN454B	TN454B	TN454B	TN454B
	ANN11B	ANN11B	ANN11C	ANN11E	ANN11E
			ANN15B	ANN15B	ANN15B
			ANN16B	ANN16B	ANN16B
		ANN17B	ANN17B	ANN17B	ANN17B
				ANN35	ANN35
			TN2131	TN2131	TN2131
	TN381	TN381	TN381	TN381	TN381
	TN400B	TN400B	TN400B	TN400B	TN400B
	TN401	TN401	TN401	TN401	TN401
	TN452B	TN452B	TN452C	TN452C	TN452C
	TN461	TN461	TN461	TN461	TN461
TMS Carrier	TN462	TN462	TN462	TN462	TN462
		TN463	TN463	TN463	TN463
	TN470	TN470	TN470	TN470	TN470
	TN473	TN473	TN473	TN473	TN473
	TN480	TN480	TN480	TN480	TN480
	TN482	TN482	TN482	TN482	TN482
	TN530	TN530	TN530	TN530	TN530
	UN150	UN150	UN150	UN150	UN150

* The SN221B and SN222B will work on all versions of System 85 Release 2 and on Generic 2 traditional modules.

Traditional-to-Universal Port Circuit Cross-Reference

Traditional Module			Universal Module		
Code	Ports	Description	Code	Ports	Description
SN224B	4	MFET line port	TN735	4	MET line/106B display [Note 1]
SN228B	8	OPS line circuit	TN742	8	Analog line
SN229	8	ONS line circuit	TN746B	16	Analog line (ONS/OPS)
SN230B	4	CO trunk	TN747B	8	CO trunk
SN231	4	Auxiliary trunk	TN763C	4	Auxiliary trunk
SN232B	4	DID trunk	TN753	8	DID Trunk
SN233C	4	Tie trunk/ Attendant interface	TN760C	4	Tie trunk/ Attendant interface
SN238	4	EIA port	TN726	8	Data line
SN241	8	Contact interface	NA	NA	No equivalent
SN243B	4	Computer data port	TN742	8	Analog line
SN244	2	ANI data transmitter	NA	NA	No equivalent
SN250	NA	Call-progress tones	TN768	NA	Tone/Clock
SN251	4	Touch tone receiver	TN748C	4 (of 8)	Tone detector
SN252	4	Touch tone sender	TN748C	2 (of 8)	Tone detector
SN253C	1	Auxiliary tones	TN768	NA	Tone/Clock
SN254	1	Attendant 6-way Conf.	NA	NA	No equivalent
SN255	4	Tone detector 2	TN748C	2 (of 8)	Tone detector
SN260		Facility test circuit	NA	NA	No equivalent
SN261C	1	ADFTC	TN771B	3	MTCP
SN270B	4	General purpose port	TN754B	8	Digital line
	NA	No equivalent	TN556	12	ISDN—BRI
ANN11E	24	DS1 interface	TN767	24	DS1 Interface
ANN15B	NA	RGI — central	NA	NA	No equivalent
ANN16B	NA	RGI — remote	NA	NA	No equivalent
ANN17B	8	7303/7305 interface	TN762B	8	Hybrid line
ANN35	24	ISDN—PRI [Note 2]	TN767 + TN555	24	DS1 interface [Note 3] DS1 packet adjunct

Note 1: **The TN735 supports only the 106B display unit. MET sets, such as those used for Electronic Custom Telephone Service with DIMENSION PBX, and 7200 Series voice terminals (e.g., Models 7203H and 7205H) are not supported.**

Note 2: **Only 23 of the 24 channels are B-channels unless Nonfacility Associated Signaling is used. In that case, all 24 channels may be assigned as B-channels.**

Note 3: **ISDN—PRI requires both the TN767 DS1 and the TN555 DS1 circuit packs (except in an NFAS arrangement).**

SN-Coded Circuit Packs

The SN-coded circuit packs are all System 85 and Generic 2 traditional module port circuits. These circuit packs will *not* work in Generic 2 universal modules. They use 100-pin connector FASTECH packaging technology to plug into the port carrier backplane. Each circuit pack measures 13.9 inches (352 mm) in length by 7.7 inches (195 mm) in height. The faceplate of each circuit pack has 19 positions for LEDs or test points when used.

The SN-coded circuit packs are usually located in the port carrier. However, if unassigned slots are available in the DS1 carrier, they maybe used by SN-coded packs.

> **NOTE:** For the DS1 carrier, vacant slots are not necessarily unassigned slots. Often, vacant slots will be assigned to an ANN-coded circuit pack located in the same half-carrier. If vacant slots are assigned, they cannot be used for SN-coded circuit packs.

SN224B MFET Line Port

This circuit pack indicates the traditional module to hybrid sets such as 7200H series voice terminals. [While the 7200H series sets were being designed they were known internally as MFET's (Multifunction Electronic Telephones.)] A shorting plug can be used to adapt this circuit pack for use with METs (Multibutton Electronic Telephones) such as those supplied with DIMENSION PBX ECTS (Electronic Custom Telephone Service). The SN224B is required whenever 7200H series voice terminals or MET/ECTS sets are used in the system.

The SN224B provides four port circuits, each serving a single voice terminal. Each circuit is an interface to a 3-pair line: a pair for voice, a pair for feature button control, and a pair for feature lamp control. Phantom power is supplied to the terminals: -48 V over the button pair and ground over the lamp pair. The voice pair is analog which means that PCM-to-analog conversion (and analog-to-PCM) takes place within the SN224B. The button and lamp pairs for all four circuits are digitally controlled with data pulses generated by the SN224B's microprocessor. The microprocessor gets its instructions from the module processor.

A single shorting plug selects hybrid or ECTS data pulse timing for all four ports. The 7200H series voice terminals will work with ECTS data pulse timing but the range is reduced to 1000 feet (305 m); this is only one-third of the normal distance (3000 feet). However, the MET ECTS terminals will not work with hybrid terminal pulse timing.

> **WARNING:** *The SN224B does not offer lightning protection for off-premises hybrid terminals. Therefore, approved off-premises electrical protection for these circuit packs and associated hybrid terminals is mandatory. (See* **Protection for Exposed Ports and Terminals** in Chapter 9.)

SN228B OPS Line Circuit

This circuit pack provides eight 2-wire tip and ring lines for analog telephones located away from the central switch location (off-premises). The SN228B is also suited for on-premises applications requiring long loop lengths and for use in remote group housings. Each of the eight circuits can operate message waiting lamps such as those used with 7100 series voice terminals. Since this circuit pack can be used to serve off-premises telephones, lightning protection is built into the circuitry. However, primary protection should be provided by adding carbon blocks or gas tubes to both ends of an exposed line.

The SN228B provides eight separate line circuits and is usually used when the loop length is greater than 3500 feet (1067 m). The SN228B permits a shorter range when required. This circuit pack is the only analog port interface supported in the remote group housing due to the housing's horizontal mounting scheme. Unlike the SN229 and the SN228 (through version 5), the SN228B does not have mercury orientation-sensitive relays. The absence of these relays allows the SN228B (and SN228s version 6 or later) to be mounted horizontally in a remote group housing. The SN228B also supports Forward Disconnect allowing conference bridges to be taken down.

Two options optimize SN228B performance for different loop lengths. One option allows a 600 Ω or a RC balanced network to be selected. The other allows 0-dB loss (high gain) or 3-dB loss (low gain) to be selected. For loops 3500 feet or longer use the RC option with high gain and for loops less than 3500 use the 600 Ω option with low gain.

Each circuit receives loop signaling from the voice terminal 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 switch. The PCM signals from the switch are decoded and transmitted as anolog signals over the tip and ring pair to the attached voice terminal. This circuit pack also provides 20-Hz ringing current.

The SN228B supports the message waiting feature. The port circuit causes the voice terminal to light the Message Waiting indicator by signaling with a ground on the ring lead (LED indicators only). 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.

This circuit pack can be used for bridged Model 2500-type telephones or for 1A2 Key Systems applications. Up to five ringers can be supported but no more than two telephones should be off-hook at the same time to ensure adequate transmission levels. 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.

SN229 ONS Line Circuit

This circuit pack provides eight 2-wire tip and ring lines for on-premises analog telephones. Each of the eight circuits can operate message waiting lamp such as those used with 7100 series voice terminals. The maximum loop length is 3500 feet (1067 m); 3-dB loss is provided for each circuit to compensate for the short loop length. Each circuit uses a 600 Ω balanced network.

The SN229 operates like the SN228B; 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 PCM data, and transmitted to the switch. The PCM signals from the switch are decoded and transmitted as analog signals over the tip and ring pair to the attached voice terminal. This circuit pack also provides 20-Hz ringing current.

The SN229 supports the Message Waiting feature. The port circuit causes the voice terminal to light the Message Waiting indicator by signaling with “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.

Although in most cases this circuit pack will support bridged Model 2500-type telephones in ONS applications, marginal performance sometimes results due to low loop current. Therefore, the SN228 should be used instead since it supplies more loop current. The SN229 can be used for 1A2 Key Systems applications.

SN230B CO Trunk (Ground Start)

This circuit pack provides 2-wire CO (Central Office), FX (Foreign Exchange), and WATS (Wide Area Telecommunications Service) 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 andcan 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. Each switch offers either a 600 Ω or an RC impedance equivalent balance network.

SN231 Auxiliary Trunk

This circuit pack is a trunk interface between the switch and auxiliary devices such as:

- Loudspeaker paging equipment
- Malicious Call Trace tape recorder
- Music-on-hold equipment
- Recorded announcement equipment
- Recorded telephone dictation tape recorder.

The SN231 provides four 2-wire (tip and ring) trunk circuits. The output impedance for each circuit is 600 Ω and the voice output level ranges from -15 to -25 dBm0. Transmission options for each circuit are:

- 1-way incoming
- 1-way outgoing
- 2-way

Each circuit has two signaling leads: AL and S. They are used for signaling between the trunk circuit and auxiliary equipment. The SN231 also allows dial pulses to be sent over the tip and ring leads.

Options are selected on a per circuit basis.

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 requring 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 DID (Direct Inward Dialing) 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 Ω or RC impedance equivalent balance network corresponding to the tip and ring loop impedance to which the trunk port is connected.

SN233C Tie Trunk/Attendant Interface

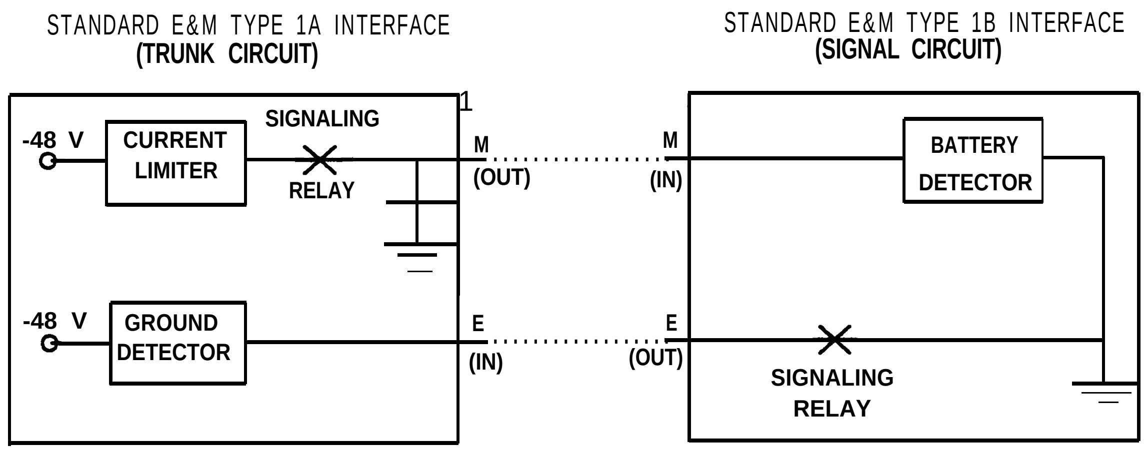
The SN233C provides four E&M tie trunk circuits. Each of the four trunk circuit consists of a transmit pair (T&R), a receive pair (T1&R1), and a signaling pair (E&M). In addition to E&M tie trunks, these circuits can also be used for:

- CCSA (Common Control Switching Arrangement) access. This service is considered to be part of the APLT (Advanced Private Line Termination) feature.
- DID (Direct Inward Dialing) service; immediate start E&M signaling or wink start E&M signaling
- RLTs (Release Link Trunks) with the CAS (Centralized Attendant Service) feature
- An audio interface to the attendant console. For this application, the E lead is used to detect whether the handset is plugged into the console and the M lead is unused. When the SN233 is used for attendant console applications, only two of the four circuits may be used: 0 and 1; circuits 2 and 3 must not be used for any reason. Other applications must not share the same SN233 with attendant consoles. Circuit 0 should always be assigned before circuit 1.

E&M Interfaces

Option switches allow the SN233C to provide Type 1, Type 1 compatible, or Type 5 E&M signaling. The next few paragraphs describe various Type 1 and Type 5 E&M signaling schemes.

What is Type 1 E&M signaling? It consists of two circuits: a trunk circuit (Type 1A) and a signaling circuit (Type 1B). These are shown in Figure 3-42.



E&M TYPE 1A	IN (E LEAD)	OUT (M LEAD)
ON HOOK	OPEN	GROUND
OFF HOOK	GROUND	BATTERY

E&M TYPE 1B	IN (M LEAD)	OUT (E LEAD)
ON HOOK	GROUND	OPEN
OFF HOOK	BATTERY	GROUND

Figure 3-42. Standard Type 1 E&M Signaling Circuits

Until the introduction of the SN233C, the only System 85 E&M circuits were Type 1A (SN233B). A Type 1A circuit cannot be connected directly to another Type 1A circuit; a converter unit must be used. This scenario is shown in Figure 3-43.

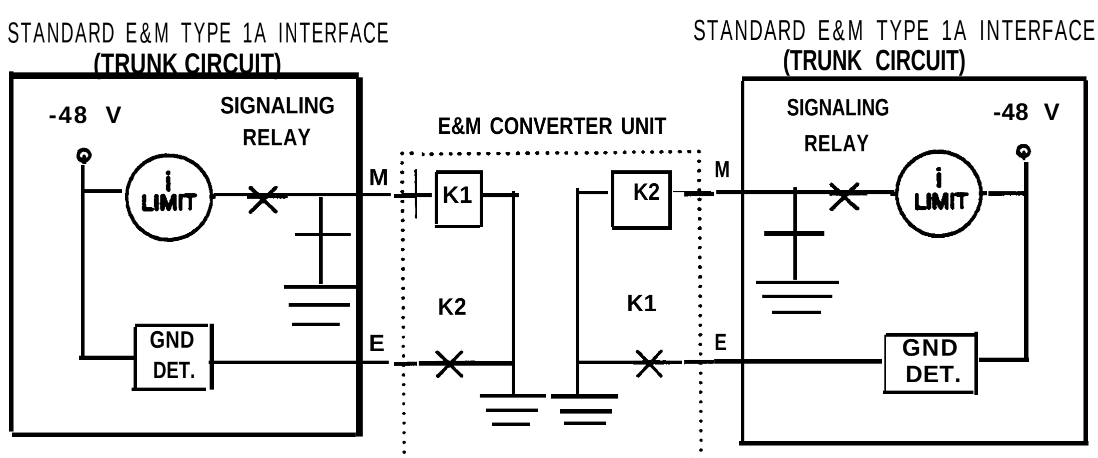


Figure 3-43. Type 1 E&M Signaling Using Trunk Circuits and a Converter Unit

The SN233C eliminates the converter unit requirement since it can operate as a Type 1A E&M circuit or as a Type 1B E&M compatible circuit. Even though the SN233C does not strictly conform to the standard Type 1B E&M circuit shown in Figure 3-42, it will operate in a mode which is compatible. Figure 3-44 shows the SN233C operating in this fashion. The main difference between this and the standard Type 1B circuit is the reversal of the E and M lead designations.

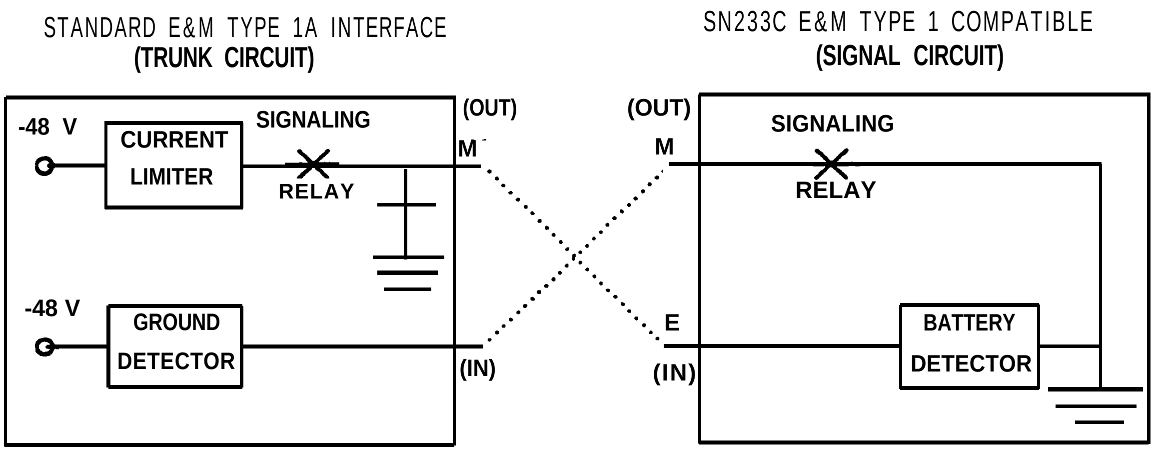


Figure 3-44. SN233C Serving As an Equivalent to a Type 1B E&M Signal Circuit

The Type 1A and Type 1B business can get rather confusing. This can be avoided by using the SN233C to provide Type 5 E&M signaling. As can be seen in Figure 3-45, both ends of the link are the same.

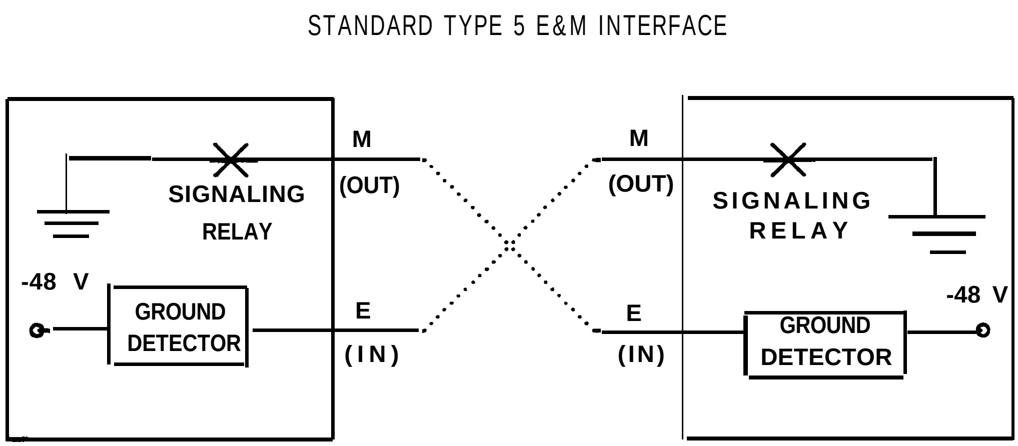


Figure 3-45. Type 5 E&M Signaling

Lightning Protection and Other Options

E&M signaling was never intended as an interbuilding signaling scheme. Consequently, the E and M leads are susceptible to lightning damage. The SN233C has options that provide protection but the signaling is no longer "true" E&M. One option, called simplex, multiplexes the E&M signaling onto the transmit (T&R) and receive (T1&R1) pairs. The E and M leads are still active, but not used. The other option, called protection, places a resistance in series with the M lead. Neither of these methods is true E&M, but they will work with most PBXs. Table 3-R summarizes the signaling options and shows which are compatible with which.

TABLE 3-R. Signaling Compatibility (Note)

Type of E&M Signaling		Standard			Protected			Simplex		
		1A	1B	5	1A	1B	5	1A	1B	5
Standard	**1A**		+			+				
	1B	+			+					
	5			+			+			
Protected	**1A**		+			*				
	1B	+			*					
	5			+						
Simplex	**1A**								*	
	1B							*		
	5									*

Note: "+" means intrabuilding only; "*" means inter- or intrabuilding connectivity.

The SN233C also allows either μ-law or a-law PCM encoding to be selected.

Monitoring and Testing

Even though each trunk circuit appears on the cross-connect field, the transmit, receive, and signaling pairs for each circuit are available for monitoring or testing through jacks located on the circuit pack faceplate. Inserting a plug half-way into the transmit or receive channel jack allows monitoring of the signals. And, full insertion of the jack opens the channel toward the distant end while providing access to the local end. Inserting a plug into the signaling lead jack allows monitoring of the E and M leads. Use of this jack does not open the E and M leads.

Specifications

Type 1A E&M Signaling:

Type 1A	E Lead	M Lead
On-Hook	Open (resistance to ground> 20K Ω)	Ground (less than 1 V drop under 50 mA load)
Off-Hook	Ground (resistance to grounds ≤ 150 Ω)	Battery (-48 V nominal with less than 5 V drop under 85 mA load)

Type 1B equivalent E&M signaling:

Type 1B	E Lead	M Lead
On-Hook	Ground (less than 1 V drop under 50 mA load)	Open
Off-Hook	Battery (-48V source through > 1K Ω)	Ground

Type 5 E&M Signaling:

Type 5	E Lead	M Lead
On-Hook	Open (resistance to ground > 20K Ω)	Open
Off-Hook	Ground (resistance to grounds ≤ 150 Ω)	Ground

The E lead on the SN233 uses hysteresis to improve resistance to noise, and filtering to improve resistance to 60 Hz interference. The maximum M lead resistance is 50 Ω.

Transmit and Receive Pairs:

- 600 Ω AC termination on both pairs
- Full code PCM signal into the codec on any port produces a +2.875 dBm signal into a 600 Ω termination on the transmit (T and R) pair.
- A +3.125 dBm signal with a source impedance of 600 Ω driven into the receive pair (T1 and R1) produces a full code PCM signal out of the codec on any port.

SN238 EIA Port

This circuit pack, when used in conjunction with Z3A ADUs (Asynchronous Data Units), provides four EIA RS-232C compatible ports. The Z3A ADUs are used at the DTE (Data Terminal Equipment) end of the connection. As can be seen in the following table, ADUs allow the nominal maximum range of RS-232C connections to be dramatically increased for all six data rates supported by the SN238. (Without the ADU/SN238 combination, the nominal maximum range for an RS-232C connection is 50 feet.)

Data Rate	Nominal Maximum Range In Feet (Meters)	
	24 AWG	26 AWG
19.2 Kbps	2,000 (610)	2,000 (610)
9600 bps	5,000 (1,524)	4,500 (1,370)
4800 bps	7,000 (2,134)	6,000 (1,824)
2400 bps	12,000 (3,657)	10,000 (3,048)
1200 bps	20,000 (6,096)	16,000 (4,876)
300 bps	40,000 (12,192)	30,000 (9,144)

Since the SN238 also provides ASCII keyboard dialing, it is an economic alternative to data modules such as the DTDM. The EIA ports do not use an associated voice terminal and only require twisted pair wiring. Full duplex asynchronous data rates up to 19.2

Kbps are provided. The SN238 converts signals from the ADU into DCP which is a protocol understood by the switch, and it performs the opposite task of converting DCP into ADU signal levels.

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

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

Options for the SN238 are:

- Six speed settings to select from: 300, 1200, 2400, 4800, 9600, and 19,200 bps. These six switches select one speed for all four ports. For example, if the 9600 switch is in the ON position, all four ports will operate at 9600 bps.
- Two parity switches, ENB PR and O/E PR, select the choice of parity for ports using keyboard dialing. Parity selected by the setting is used only for call progress messages (such as the DIAL: prompt) and for test messages. Like the speed setting, the parity setting is common for all four ports. Here are the settings:

Parity	ENB PR	O/E PR
Even Parity	ON	OFF
Odd Parity	ON	ON
Zero Parity	ON	OFF
One Parity	OFF	ON

- ASCII keyboard dialing (KYBD) can be turned ON of OFF for each of the four ports. Typically, terminals have this option turned ON and printers have it turned OFF.
- An autobaud setting (AUTO) is provided for each of the four ports. When enabled, speed and parity settings at the SN238 port are ignored. Instead, they are selected from the user's terminal. Both keyboard dialing and autobaud must be enabled for autobaud to work.

SN241 Contact Interface

This circuit pack is a signaling interface 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. Each contact is rated at 25VA, 1.0 Amp, maximum.

The SN241 has no equivalent circuit pack in the universal module. A custom work order is required to obtain the special hardware needed to provide SN241 functionality from a universal module.

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-premises 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 Ω or RC impedance equivalent balance network.

SN244 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 SN244 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 SN244 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 TSI (Time Slot Interchanger) to produce tones that have nonperiodic interrupts.

The SN250 generates tones directly in digital form through a DSP Digital Signal Processor) 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, circuit assignments, and cadence areas follows:

- 440-HZ tone; circuit 0; steady
- Dial tone; circuit 1; steady
- Interrupted dial tone; circuit 2; .1-sec on, .1-sec off
- Ringing tone; circuit 3; 1-sec on, 3-sec off
- Call Waiting ringback tone; circuit 4; .9-sec 440/480 Hz on, .2-sec 440 Hz on, 2.9-sec off
- Intercept tone; circuit 5; .5-sec 440 Hz, .5-sec 620 Hz alternating
- Busy tone; circuit 6; .5-sec on, .5-sec off
- Reorder tone; circuit 7; .25-sec on, .25-sec off.

The SN250 also supports reflection testing of the port circuits and call progress tones testing. Two SN250s are required per traditional module and are housed in port or DS1 carriers.

SN251 Touch-Tone Receiver

This circuit pack provides the DTMF (Dual-Tone Multifrequency) receiving capability for the system. It has four separate touch-tone receiver circuits.

The SN251 performs 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 (MP). Second, 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 has four separate circuits.

The SN252 contains DTMF tone sender. It also has a dial tone detector, thus allowing the system to perfom 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, shown with the circuit and cadence, are generated in digital format:

- CAS immediate ringback; circuit 0; steady
- CAS zip tone; circuit 1; steady
- CAS remote hold; circuit 2; .05-sec on, .05-sec off
- Chime tone; circuit 3; .525-sec on, .525-sec off
- Data answer tone; circuit 4; steady
- Precedence tone (AUTOVON); circuit 5; steady
- Priority audible ringback (AUTOVON); circuit 6; 1.6-sec on, .3-sec off.

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.

One SN253 is provided per module as needed.

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 one six-party conference circuit. There can be up to 13 SN254s per system.

SN255B Tone Detector 2

This circuit pack detects all tones and tone pairs on the subscriber loop necessary for terminal-dialed data calls through modem-pool-accessed or digital tie trunk facilities. Digital filters, using DSP technology, detect these tones. The SN255B 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 SN255B through the A-bus. The output of the four tone detection circuits are available through the I/O bus.

The SN255B should be used for applications requiring modems that use 2100 Hz answer tone since the SN255 (without suffix) cannot detect 2100 Hz tone. 2100 Hz tone is used in AT&T modem types 2296, 2248, and 2224 and most other vendor's modems that are CCTTT V.32 compatible.

SN261 B/C Analog/Digital Facility Test Circuit

The SN261B/C provides simultaneous analog and digital facility testing in addition to other testing capabilities. (Digital facility testing in this context refers to data module connections through the SN270B/TN754B digital port circuits with trunk-type translations.)

The SN261 containscircuitry 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 MTDMs (Modular Trunk Data Modules) 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 with 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 originally provided by the SN261 plus the OTL (Originating Test Line) and Terminating Test Line functions for the ATMS (Automated Transmission Measurement System) feature. The ATMS feature provides a comprehensive customer-controlled testing capability for private-network, “voice and voice-grade data” DS1, and public-network trunk transmission. The SN261C (System 85 R2V4 systems only) provides all the analog and digital test capabilities of the SN261B, in addition to new firmware to accommodate loop-around testing without handshaking.

The original SN261 digital-test-only circuit pack complements the SN260 analog-test pack in an R2V1 system, while only the SN261B is required in an R2V2 or R2V3 system. Only the SN261C is required in an R2V4 system. Multiple SN261B/Cs may be required depending on the amount of ATMS testing scheduled for a given period.

SN270B GPP (General Purpose Port)

This circuit pack provides an interface between the switching network and the DCP (Digital Communications Protocol). 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 (S-channel), and a 3-bit framing pattern.

The SN270B transfers PCM voice or data between the CDP 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 S-channel. When combined voice and data are required, both DCP I-channels and corresponding switch network time slots are used. For voice or data only, one I-channel and time slot are used.

> NOTE: The SN270B does not incorporate lightning protection for off-premises digital terminals. Therefore, approved off-premises electrical protection for these circuit packs and associated digital terminals is mandatory.)

Each SN270B provides four DCP line ports for connection to 7400 series voice terminals (with or without data capability), all DCP data modules, and CallMaster™ data communications terminal. Phantom power is provided over the two data pairs for 7400 voice terminals and the voice terminal module of the Personal Termimals (PTs) and BCTs (Business Communications Terminals) only. Data modules (including the DTDM) and the remaining PT/BCT functionality are not powered from the SN270B.

TN-Coded Circuit Packs

TN2131 External Clock Interface

This circuit pack is used instead of the TN463 SCS (System Clock Synchronizer) when the external Synchronization Clock is used for the clock timing source. The TN2131 accepts two composite clock inputs from the external clock, converts the signals to an 8-KHz TTL signal, and then sends the TTL signal to either the module control clock or the TMS clock, depending on the configuration.

The TN2131 is located in the basic TMS carrier, slot 20, for multimodule systems. For single-module systems, the TN2131 is located in the universal module control carrier, slot 14, or the traditional module control carrier, slot 2.

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, slot 6.

TN369 Cache Memory

This System 85 circuit pack contains frequently accessed instructions and data. (See TN379 for Generic 2.) The high-speed memory dynamically monitors and replaces its contents based upon 501CC program execution and activity of other bus masters. It enhances processor throughput by reducing the effective memory access time.

The TN369 is located in the common control carrier, slot 4.

TN370C 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 TN370C 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 TN370C is located in the common control carrier, slot 0.

TN379 Cache Memory

This Generic 2 circuit pack replaces the optional TN369 Cache Memory pack used in System 85. The most significant feature of the TN379 is that it improves performance beyond its predecessor, the TN369 Cache Memory pack.

Cache memory's function is to reduce the average amount of time it takes to fetch data from main memory. The resulting savings in time allows the 501CC to spend less time waiting for memory fetch operations. Thus, the 501CC executes tasks in less time, allowing it to handle a greater task processing load.

The TN379 cache memory has six times the memory capacity of the TN369 (96K 27-bit words versus 16K 27-bit words). No performance penalties were paid to get the increase in size. In fact, several time-based parameters have improved.

The TN379 is located in the common control carrier, slot 4.

TN380D Module Processor (MP)

The TN380 circuit-pack is the control unit for all operations in a System 85 or Generic 2 traditional module. The MP performs the following tasks for the system:

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

All communication between the common control and the traditional module port circuits 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 traditional module port circuits through the I/O bus interface for control and through the TSI (Time Slot Interchanger) for servicing connection paths (voice and data).

The MP uses a 16-bit microprocessor and contains 32/64 kilobytes of PROM (Programmable Read-Only Memory) for firmware storage and 32 kilobytes of static RAM (Random Access Memory). 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 TN380D has firmware modified to accommodate ISDN requirements. Within duplicated traditional modules, both TN380s must have matching suffixes. However, TN380s in one module may have a different suffix from TN380s in another module within the same switch.

The TN380D is located in the traditional module control carrier, slot 17.

TN381 TMS Processor

This circuit pack is similar to the TN380 MP but contains different firmware It provides the control interface between the TMS and the common control.

The TN381 is located in the basic TMS carrier only, slot 25.

TN392 1 M RAM Memory

This circuit pack provides 1 megaword of memory for the 501CC processor (System 85 R2V1, R2V2, and R2V3 systems only). Each word consists of 16 data bits and 6 bits of error correction code. The TN392 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-correction circuitry.

TN392s are located in the common control carrier, slots 7 through 14.

TN394 4M RAM Memory

The TN394 memory circuit pack uses an array of 88 one megabit dynamic RAM chips to provide four megawords of memory. Four of these packs supply the memory required by the 501CC processor to run Generic 2 software. Three TN394s supply the 12 megawords of memory to run System 85, R2V4 software; TN392 memory packs are not used with System 85, R2V4 and Generic 2. Like the TN392C, the TN394 performs error checking and error correction on data being read from the memory array.

The TN394 can be used to replace TN392s in System 85, R2V2 (tape issue 1.4 or later) and System 85, R2V3 (tape issue 1.2 or later) versions of System 85; no special administration is required. For System 85, R2V2, one TN394 replaces all four TN392s providing the 4 megawords of RAM required to run System 85, R2V2 software. For System 85, R2V3, two TN394s can replace all eight TN392s providing the eight megawords of RAM needed to run System 85, R2V3 software.

TN394s are located in the common control carrier, slots 7 through 10.

TN400B I/O Bus Interface

This circuit pack buffers and decodes communications between the MP and port circuits. between the MP and RMI (Remote Module Interface) circuit packs, and between the TMS processor and the TM switch fabric. One TN400B is required for every four port carriers.

The TN400B provides an interface between the MP or the TMS processor bus and I/O bus cables which terminate on 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.

TN400Bs are located in the traditional module control carrier, slots 19 through 21, and in the basic TMS carrier, slot 26.

TN401 MCC (Module Control Channel)

This circuit pack is the interface between the common control and the digital network. (The Generic 2 universal module doesn't use the TN401; it uses the TN588 instead.) 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 FIFO (First-In, First-Out) 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 traditional module control carrier, slot 22, and in the basic TMS carrier, slot 27.

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 processor. 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 basic carrier. All other channels are assigned in translations to module control carriers. For each common control, one TN402 is required for 1 to 7 modules, two are required for 8 to 15 modules, three are required for 16 to 23 modules, and four are required for 24 to 31 modules.

The TN402 is located in the common control carrier, slots 27 through 30.

TN403 Dual-Speed Channel

This circuit pack provides the interface between the 501CC processor and peripherals connected to the network. Two of the 16 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, NCOSS (Network Control Operations Support System), SMT, and SMDR.

TN403s are located in the common control carrier, slot 23.

TN404 I/O Buffer

This circuit pack buffers 16 data leads, two 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, slot 21.

TN405 DCIU Interface

This circuit pack provides the arbitration control for the DCIU local bus, as well as 128 kilobytes 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, slot 17.

TN406 DCIU Memory

This circuit pack contains a 16-bit microprocessor and 32 kilowords 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, slot 16.

TN430B Tape Interface

This circuit pack connects the System 85 HCMR (High Capacity Mini-Recorder) to the 501CC processor, memory, and peripherals through the system bus. The TN430 performs the bulk of System 85 system bus operations as a bus master, executing DMA (Direct Memory Access) 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 capabilites for the subsytem. For System 85, R2V4 systems, the TN430B has firmware modified to provide a new timing feature (required for the 12-megaword memory configuration).

The TN430B is located in the System 85 common control carrier, slot 20.

TN440B PDS (Port Data Store)

This traditional module circuit pack buffers, stores, and reformats PCM (Pulse Code Modulation) voice and data transmission between the port circuits and 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 four cables, each of which terminates on one port data interface and supports 64 ports (one port group or half-carrier).

TN440Bs are located in the traditional module control carrier, slots 6 through 11.

TN441 IDS (Intermodule Data Store)

This circuit pack buffers, stores, and reformats PCM voice and data transmission between the TSI and the TMS through the LGI (Light Guide Interface). The IDS provides RAM storage for PCM voice or data which may 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 same 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 traditional module control carrier, slot 3, and in the universal module control carrier, slot 13.

TN444B Maintenance Interface

This circuit pack interfaces the MP to all 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 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 traditional module control carrier, slot 13, and in the universal module control carrier, slot 6.

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 power regulator

The TN445 is located in the traditional module control carrier, slot 13, and in the universal module control carrier, slot 11.

TN446 TSI ALU (Arithmetic Logic Unit)

This circuit pack provides execution logic for the switchinginstructions stored in the TSI P-store. The TSI ALU digitally inserts loss in port-to-port connections, as required. The TSl 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 TSl ALU also performs digital gain adjustments for 3-party conference calls.

The TN446 is located in the traditional module control carrier, slot 12, and in the universal module control carrier, slot 12.

TN452C UPCI (Universal Port Control Interface)

This System 85 and Generic 2 traditional module 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.

The TN452C is used in the TMS carrier, slot 10; TMS growth carrier, slot 10; RMI carrier, slot 9; traditional module port carrier, slot 9; and DS1 carrier, slot 9.

TN454B UPDI (Universal Port Data Interface)

This traditional module 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 or 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 each traditional module port or DS1 carrier. TN454Bs are placed in slots 4 and 17 for either carrier type.

TN456 RMI (Remote Module Interface)

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).

One TN456 is required in each remote module, and each remote module must have a supporting TN4556 at the central location in either a module control carrier or an RMI carrier. Each universal module control carrier at the central location can house up to seven TN456s in slots 15 through 21, and at the remote location the TN456 is located in slot 15. Each traditional module control carrier can house one TN456 in slot 25 at central and remote locations. The RMI carrier can house up to 16 TN456s at the central location, slots 0 through 3, 5 through 8, 13 through 16, and 18 through 21.

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 for single module configurations; slot 3 for a traditional module or slot 13 for a universal module.

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 or external clock interface, if equipped.

The TN461 is associated in the basic TMS carrier, slot 21.

TN462 LCT (Local Clock Termination)

This circuit pack receives clock oscillator signals, generates secondary signals, and distributes them for TMS basic and TMS growth carriers.

The TN462 is located in basic and growth TMS carriers, slot 11.

TN463 SCS (System Clock Synchronizer)

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 4 Type II clock requirements. In the free-running mode, it provides a clock reference with ± 32 parts per million accuracy. When cabled to one or two DS1 interfaces, it will slave to an external clock reference of Stratum 4, or better. One of the external references is the primary or preferred reference, and the other is the secondary or backup external reference.

The TN463 is located in the module control carrier in single module systems; slot 2 for a traditional module or slot 14 for a universal module. For multimodule systems, the TN463 is located in the basic TMS carrier, slot 20.

If the Synchronization Clock (stratum 3) is used, the TN463 is replaced with the TN2131.

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-dvision 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.

In the basic TMS carrier, one TN470 is required for the first module and one TN470 is required for each two additional modules; the basic TMS can house up to four TN470s supporting up to seven modules. For the growth TMS carrier, each TN470 supports two modules; a maximum of four TN470s may be housed in a growth carrier supporting up to eight modules. Up to three growth carriers can be equipped (six if duplication is desired).

TN470s are located in basic and growth TMS carriers, slots 8, 9, 12, and 13.

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 crosspoint connectivity from 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.

TN473s are located in basic and growth TMS carriers, slots 6 and 15.

TN474B PCC (Processor Communication Circuit)

The TN474B allows the 501CC processor to be connected to EIA RS-232C peripheral equipment. It is designed for high-throughput, and it works with variable call detail record formats. The initial application of the PCC connects the 501CC processor to an AT&T 3B2 or 6386 CDRU (Call Detail Recording Utility); the CDRU is used for Call Detail Recording and Automatic Number Verification.

The TN474B provides an independent, asynchronous I/O port for communications between the 501CC and a peripheral device. The port is fully programmable and is intended to interface with a variety of RS-232C equipment. (At this time, however, supplying data to call detail recording devices, such as the 3B2 CDRU, is the TN474B's only application.) An 80186 microprocessor controls the channel to provide a "smart" interface between the 501CC and the peripheral device. The TN474B electrical interface is the same as the one used for the SN238 EIA interface circuit. And like the SN238, it requires a Z3A ADU (Asynchronous Data Unit) to be used at the RS-232C device end.

Call detail recording applications make use of the TN474B's 8K memory buffer to store up to 256 18-word call records. This buffering capability eases synchronization problems between the 501CC and adjunct processors such as the 3B2.

The TN474B is located in the common control carrier, slots 24, 25, or 26. For standard applications, only one TN474B pack is allowed per common control, and only one port may be used for call detail recording applications.

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 LGI (Light Guide Interface) through the fiber-optic link. The TN480 recovers signals received from the LGI and delivers the signals to their 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.

TN480s are located in the basic and growth TMS carrier; slots 1 through 5 and 16 through 18. The growth TMS can also house a TN480 in slot 19.

TN481 LGI (Light Guide Interface)

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 IDS

(Intermodule Data Store) to the module interface in the TMS. The LGI recovers PCM signals from the module interface and delivers the signals 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 ensures access to the on-line module control.

The TN481 is located in the module control carrier in multimodule systems; slot 2 for unduplicated traditional modules, slot 1 for duplicated traditional modules, or slot 14 for a universal module.

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, slot 22.

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, connects to 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, slot 22.

TN491 B 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 interface to CSM (Centralized System Management) and Manager II through the remote interface (TN492C). 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 that 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. For R2V4 systems, the TN491B has firmware modified to provide traffic information for remote port access.

The TN491B is located in the common control carrier, slot 31.

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. Both ports have 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 a central office line.

When a 3B2 or a 3B5 is connected to a TN492C port, two Z3A ADUs (Asynchronous Data Units) are used to provide electrical isolation. One ADU must be placed at the TN492C end, the other at the 3B2/3B5 port. Two pairs of standard voice grade wiring connect the ADUs. This span can be up to 20,000 feet when 24 AWG wire is used or up to 16,000 feet when 26 AWG wire is used (assuming a data rate of 1200 bps).

The TN492C has ten leads which serve as a common bus for ten 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. The loop can have a resistance of up to 200 Ω which is approximately 3895 ft (1187 m) for 24 AWG wire or 2450 ft (746 m) for 26 AWG wire. A major or minor alarm origination then occurs.

The TN492C is located in the common control carrier, slot 32.

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 kilobytes of static RAM for temporarily downloading the MP code and for scratch-pad work lists. It also provides 16 kilobytes 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 installed in the module control carrier (traditional, slot 18; universal, slot 2) or basic TMS carrier (slot 24) 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 16K words of RAM and 8K words of EPROM. The TN513 monitors addresses and data bus transmission, and provides breakpoint matching functions.

The TN513 is installed for troubleshooting in common control carrier slot 15.

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 address and data buses.

The TN514 is installed in the common control carrier (slot 5) only during troubleshooting.

TN530 DUP (Duplication/Update Channel)

A pair of TN530s is used to directly link duplicated traditional module controls or duplicated TMSs. The two circuit packs provide a bidirectional, high-speed data link between the on-line and off-line processors. Through this link all data, address, and control information from the on-line processor flows to the off-line processor ensuring that the memory of the off-line processor is kept current. This allows "soft switches" to be performed with no loss of data or degradation of service. The TN530s monitor the state of health of both processors and select the healthier processor to be on-line.

Two TN530s (of matching vintages) are required for each duplicated module control or duplicated TMS. Please note that even when the TMS is duplicated, TMS growth carriers never require the TN530. This is because TMS growth carriers do not have TMS processors; they are controlled by the TMS processors contained in the TMS basic carriers.

The TN530 is located in traditional module control carriers (slot 15) and basic TMS carriers (slot 23).

TN541 Duplication/Update Channel

This Generic 2 circuit pack provides TN530 functionality for the universal module with expanded double write address space. A pair of TN541s is used to directly link duplicated module controls. The two circuit packs provide a bidirectional, high-speed data link between the on-line and off-line processors. All data, address, and control information from the on-line processor is sent through this link to the off-line processor ensuring that the memory of the off-line processor is kept current. This allows "soft switches" to be performed with no loss of data or degradation of service. The TN541s monitor the state of health of both processors and select the healthier processor to be on-line.

Two TN541s are required for duplicated universal module control. TN541s are located in the universal module control carrier of duplicated universal modules (slot 4).

TN555 DS1 Packet Adjunct

This common port carrier circuit pack is used in conjunction with the TN767 DS1 interface pack to provide ISDN-PRI trunk circuits. When paired with the TN767, the TN555 provides twenty-three 64 Kbps B-channels for voice or data and one 64 Kbps D-channel for signaling. Under certain conditions the 24th channel may also be used as a B-channel [non facility associated signaling (NFAS)]. For more information about NFAS see Chapter 2 or the ISDN—PRI feature in *DEFINITY Communications System Generic 2 and AT&T System 85 Feature Descriptions* (555-104-301). A special "Y" cable (ED-1E434-11, Group 506) is required to connect the TN767 and the TN555 to each other and to the cross-connect.

Synchronization is derived from the TN463 in single module systems and from the UN154C in multimodule systems.

The TN555 is located in the common port carrier. When looking at a common port carrier from the front, the TN555 is always placed in the adjacent slot to the right of the TN767.

TN556 ISDN—BRI

This common port carrier circuit pack provides 12 ports for ISDN—BRI line applications. Each port supports two 64 Kbps channels for voice or data and one 16 Kbps channel for signaling and data. The maximum number of BRI devices per port is limited to one. The TN556 may be installed in any unused common port slot. One 25-pair cable connects the ports to the cross-connect field.

TN563 SCSI Host Adapter

This Generic 2 circuit pack replaces the System 85 TN430B in the common control. The TN563 is the interface between the DTS and the 501CC.

The TN563 provides two serial ADU-type ports for Manager II. One of these ports is a modular jack on the front of the DTS. The other port is accessed through a 50-pin connector on the back of the DTS housing. In duplicated systems, the “50-pin” port is always connected to the on-line common control; the “modular jack” port connects to the common control served by the DTS. If desired, the "modular jack" port can also be picked up off the 50-pin connector, thereby disabling the modular jack.

The TN563 ADU ports can operate at 300 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, or 19.2 Kbps. Distance limits for these data rates are specified earlier in this chapter under the SN238 circuit pack description. The default rate is 1200 bps, but by hitting the “break” key, a user can step through the other rates.

Connections to these ports must be ADU compatible on the distant end of the links. For example, a DEFINITY Manager II wired directly to the DTS must have an ADU at the Manager II end of the link.

The TN563 is installed in slot 20 of the Generic 2 common control carrier.

TN580 Universal Module Processor

This universal module circuit pack provides TN380D functionality with expanded RAM/EPROM size and upgraded firmware. The TN580 firmware frees the 501CC from having to know much about the architectural differences between the universal module and the traditional module. The TN580 should only be used with G2.1 issue 1.0 or issue 2.0 software. The TN590 is required for G2.1 issue 3.0 software.

The TN580 is located in the universal module control carrier, slot 5.

TN588 Module Control Channel

This Generic 2 universal module circuit pack provides TN401 functionality with an increased number of alarm and control leads. The TN588 is the circuit pack at the universal module end of a 4-MHz channel from the common control. (The TN402 is used at the common control end of the link.) The TN588 places commands from the common control onto the module processor bus. The TN588 provides responses to the 501CC commands through one channel.

The TN588 is located in universal module control carriers, slot 1.

TN590 Downloadable Module Processor

This universal module circuit pack provides TN580 functionality with expanded memory size and upgraded firmware. The TN590 is downward compatible with the TN580. The TN590 is required with for G2.1 issue 3.0 software. The TN590 differs from the TN580 in that the TN590's firmware can be downloaded from the common control. This means that when a firmware change is required for the module processor, the change is contained on a new system tape and is installed automatically from the common control rather than manually with an EPROM replacement. The TN590 download capability is possible because it uses "flash" PROM nonvolatile memory technology. (Flash PROMs can be reprogrammed — up to 10,000 times — by simply applying a low DC voltage to the appropriate device input pin.)

The TN590 is located in slot 5 of the universal module control carrier or in slot 04A of the SCC module control carrier (plus slot 04B, if the SCC is duplicated).

TN726 Data Line

This common port carrier circuit pack provides eight ports for asynchronous equipment with RS-232 serial interfaces. For each circuit, an on-board ADU supports a serial communications link—over two pairs of standard voice-grade wire—to an ADU connected to customer-provided equipment.

The TN726 may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN735 MET Line

This common port carrier circuit pack provides four ports for the Multibutton Electronic Telephone (MET) sets and the l06B display unit. This pack will *not* support 7200H series voice terminals. The TN735 may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN742 Analog Line

This common port carrier circuit pack provides eight ports. The TN742 supports on-premises or off-premises wiring with either touch-tone or rotary dialing and with or without the LED message waiting indicators. When translated as off-premises (OPS), the TN742 inserts 0 dB loss (high gain) and uses RC balanced network impedance. When translated as on-premises (ONS), the TN742 inserts -3 dB loss (low gain) and uses 600 Ω impedance. The OPS option (0 dB loss and RC balanced network) is recommended for loop lengths greater than 3500 feet. For loop lengths less than 3500 feet, use th ONS option (-3 dB loss and 600 Ω).

The TN746B analog line pack should be considered as a replacement for the TN742; especially since the TN746B provides twice as many analog circuits per pack (16 instead of 8). These circuits are functionally identical to those of the TN742. The TN746B's predecessor, the TN746 (without a suffix), is an on-premises analog port pack and is not a suitable replacement for the TN742 when off-premises or long loop length applications must be supported.

> **DANGER:** *Any metallic loop extending out of the building must use AT&T certified electrical protection. This is true regardless of whether the circuit pack is translated as ONS or OPS; jf the loop goes outside, protection must be provided. Failure to provide electrical protection could result in injury to users or damage to equipment. For more information about electrical protection, see DEFINITY Communications System, Generic 2 and System 85 Wiring (555-104-630).*

The TN742 will accommodate station adjuncts such as speakerphones or headsets. Each port supports up to three ringer loads. Up to four ports can ring simultaneously.

The TN742 also supports modems.

The TN742 may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN746B Analog Line

This common port carrier circuit pack provides 16 ports. The TN746B supports on-premises or off-premises wiring with either touch-tone or rotary diaIing and with or without the LED message waiting indicators. When translated as off-premises (OPS), the TN746B inserts 0 dB loss (high gain) and uses RC balanced network impedance. When translated as on-premises (ONS), the TN746B inserts -3 dB loss (low gain) and uses 600 W impedance. The OPS option (0 dB loss and RC balanced network) is recommended for loop lengths greater than 3500 feet. For loop lengths less than 3500 feet, use the ONS option (-3 dB loss and 600 Ω).

> **DANGER:** *Any metallic loop extending out of the building must use AT&T certified electrical protection. This is true regardless of whether the circuit pack is translated as ONS or OPS; if the loop goes outside, protection must be provided. Failure to provide electrical protection could result in injury to users or damage to equipment. For more information about electrical protection, see DEFINITY Communications System, Generic 2 and System 85 Wiring (555-104-630).*

The TN746B accommodates station adjuncts such as speakerphones or headsets. The TN746B also supports modems. Each port supports up to three ringer loads. Up to six ports can ring simultaneously.

A few important differences exist between the TN746 and the TN746B:

- The TN746 can only be used for ONS applications with loop lengths under 3100 feet. However, TN746B can be used for either ONS or OPS applications, and has a distance limit of 20,000 feet (24 AWG cable, no message waiting lamp).
- The TN746 will not support model 7101 or 7103 analog voice terminals — the TN746B will.
- The TN746 will not support auxiliary equipment such as line status indicators, fax machines, answering machines, modems, or amplifier handsets — the TN746B will.
- The TN746 can have up to four ports ringing simultaneously — the TN746B can have up to six ports ringing simultaneously.

The TN746B may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN747B CO Trunk

This common port carrier circuit pack provides eight ports for ground-start CO (Central Office), FX (Foreign Exchange, or WATS (Wide Area Telecommunications Service) trunks. This circuit pack also supports the Abandoned Call Search feature for ACD applications. Do not use the TN747B in cases where the serving central office performs a party test on the central office loops provided as CO trunks.

Generic 2 does not support loop-start operation for the TN747B; assignment is blocked in administration. Loop-start signaling is not allowed because it provides no disconnect supervision.

The TN747B may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN748C Tone Detector

There are eight ports on this board. Two are used for digital loop around testing, four are used for touch-tone digit detection (circuit 0 through 3), and two are used for general purpose tone detection (ports 4 and 8). The four touch tone detector circuits perform the same function as the SN251 touch tone receiver pack used in traditional modules. The two general purpose tone detection circuits are used in either of the following ways:

- Dial tone detection — this is the same function that was performed by one of the four circuits on the SN252 touch tone sender pack in traditional modules. When this operations is desired, the port is translated as a touch tone sender circuit (trunk type 55).
- Call progress tone detection for keyboard dialed calls — this is the same function that was performed by the SN255 tone detector 2 pack in traditional modules. When this operation is desired, the port is translated as a tone detector circuit (trunk type 100).

At least one, and generally two, TN748Cs are required per universal module; more may be required depending on traffic and other engineering considerations. The TN748C is installed in the common port carrier's service slot. If there are more TN748Cs than there are service slots, universal port slots may be used. This pack does not require I/O cabling to the cross-connect field.

TN753 DID Trunk

This common port carrier circuit pack provides eight ports for immediate-start or wink-start DID (Direct Inward Dialing) trunks. The TN753 may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN754B Digital Line

This common port carrier circuit pack provides eight ports for connection to digital voice terminals which use DCP (Digital Communications Protocol), such as the 7400 series voice terminals. The ports can also be used by DCP data modules such as the PDM or 7400B.

DCP uses two twisted pairs (send and receive) operating at a rate of 160 Kbps fulI duplex. This protocol consists of a 20-bit frame with two 8-bit information fields (I-channel), a 1-bit signaling field (S-channel), and a 3-bit framing pattern.

The TN754B transfers PCM voice or data between the DCP I-channels and corresponding switch network time slots. Signaling between the attached terminal and common control is handled over the signaling channel. When combined voice and data are required, both DCP I-channels and corresponding switch network time slots are used. For voice or data only, one DCP I-channel and one time slot are used.

The TN754B may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN760C Tie Trunk

This common port carrier circuit pack provides four ports for Type 1, Type 1 Compatible, or Type 5 E&M signaling tie trunks. E&M converters are not required with this pack. Type 5 Simplex has the added advantage of eliminating one pair of wires per circuit. In addition to providing tie trunks, the TN760C provides link trunks which are required for CAS (Centralized Attendant Service). The TN760C also provides the attendant console interface for the universal module.

When the TN760C is used for attendant console applications, only two of the four circuits may be usd: 0 and 1; circuits 2 and 3 must not be used for any reason. Other applications must not share the same TN760 with attendant consoles. Circuit 0 should always be assigned before circuit 1.

Trunks can be administered as automatic, immediate-start, wink-start, or delay-dial. Table 3-S shows which combinations are compatible. Of the 14 compatible formats shown in Table 3-S, a subset of four formats meets all likely domestic installation situations. Table 3-T lists the likely-to-be-encountered installation situations in the domestic marketplace.

TABLE 3-S. Compatible E&M Signaling Types

Type of E&M Signaling		Standard			Protected			Simplex		
		1A	1B	5	1A	1B	5	1A	1B	5
Standard	1A		+			+				
	1B	+			+					
	5			+			+			
Protected	1A		+			*				
	1B	+			*					
	5			+						
Simplex	1A								*	
	1B							*		
	5									*

+ means intrabuilding connectivity only
* means inter- or intrabuilding connectivity

The TN760C may be installed in any unused universal port slot. One25-pair cable connects the ports to the cross-connect field.

TABLE 3-T. E&M Signaling Format Combinations

Trunking Situation			Recommended E&M Signaling Format	
From	To	Circumstance	Near End	Far End
Generic 2*	Generic 2	Collocated	Type 5 (Simplex)	Type 5 (Simplex)
Generic 2	Generic 2	Off-premises	Type 5 (Simplex)	Type 5 (Simplex)
Generic 2	Generic 1†	Collocated	Type 5 (Simplex)	Type 5 (Simplex)
Generic 2	Generic 1	Off-premises	Type 5 (Simplex)	Type 5 (Simplex)
Generic 2	DIMENSION PBX	Collocated	Type 1 Compatible (Unprotected)	Type 1 Standard (Unprotected)
Generic 2	DIMENSION PBX	Off-premises	Type 1 Compatible (Protected)	Type 1 Standard (Protected)
Generic 2	Other	Collocated	Type 1 Compatible (Unprotected)	Type 1 Standard (Unprotected)
Generic 2	Other	Off-Premises	Type 1 Compatible (Protected)	Type 1 Standard plus Protection Unit
Generic 2	Network Interface	Collocated	Type 1 Standard (Unprotected)	Don't Care

* Or System 85
† Or System 75

TN762B Hybrid Line

This common port carrier circuit provides eight ports for 7300 series voice terminals. (7200H series voice terminals are not supported by this, or any other, universal module port pack.) It may be installed in any unused universal port slot. A 25-pair cable connects the ports to the cross-connect field.

TN763C Auxiliary Trunk

This common port carrier circuit pack provides four ports for on-premises trunk applications such as Music-on-Hold, Loudspeaker Paging, and Recorded Telephone Dictation Access.

Four trunk types can be assigned through administration:

- Loudspeaker Paging
- Telephone Dictation
- Music on Hold
- Recorded Announcement.

Table 3-U lists how the TN763C circuit pack leads must be set to interface with the above features.

TABLE 3-U. TN763C Circuit Pack Leads

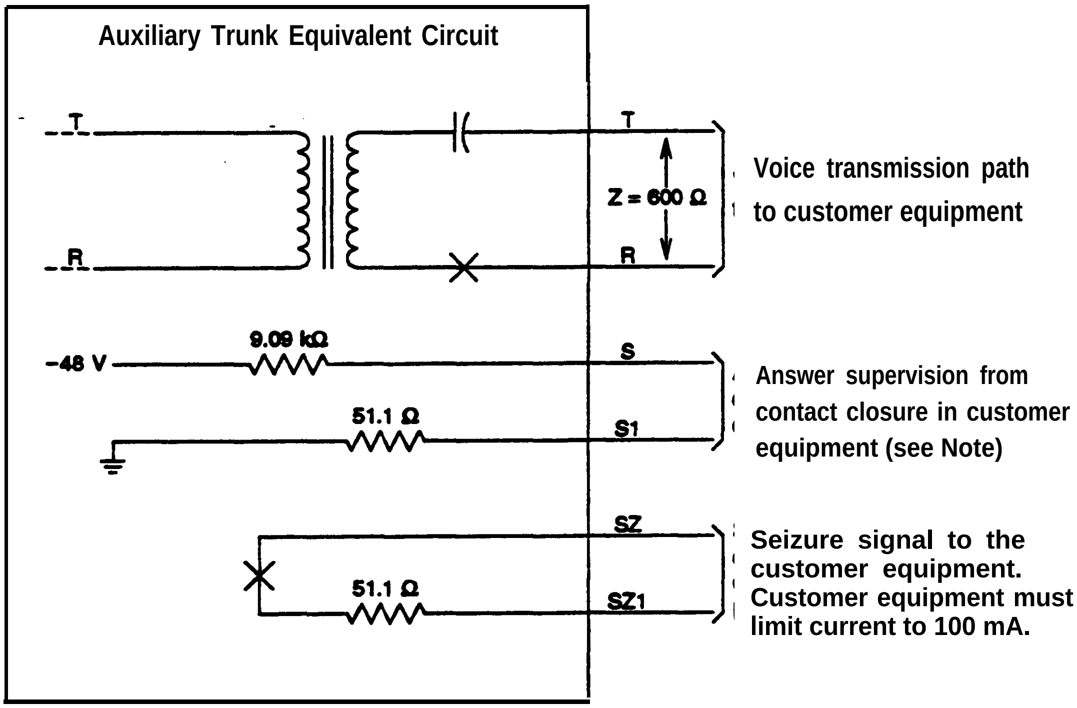
Application	TN763C Circuit Leads		
	T&R	S&S1	SZ&SZ1
Loudspeaker Paging	x	x	x
Telephone Dictation	x	x	
Music-on-Hold	x		
Recorded Announcement	x	x	x

Figure 3-46 shows an equivalent circuit for one of four identical port circuits on the TN763C.

The T & R (Tip & Ring) pair is the voice transmission path of the TN763C. The T & R leads also carry touch-tone signals to the auxiliary equipment. This transformer coupled pair has an impedance of 660 Ω and a gain of 0 dB in both directions.

The S & S1 pair carries answer supervision and busy-out information from the auxiliary equipment to the TN763C. A contact closure in the auxiliary equipment forces-the pair to a potential near ground. When the TN763C senses this near ground potential, it informs call processing. The auxiliary equipment must have a resistance of 3000 Ω or less connected to this pair.

The SZ & SZ1 pair is used by the TN763C to seize auxiliary equipment. With some types of auxiliary equipment (such as Ioudspeaker paging), a seizure acknowledge response is returned over the S & S1 leads. The auxiliary equipment must limit the current through these leads to 100 mA or less.



NOTE: The customer equipment provides a "contact closure" between leads S and S1. The maximum external resistance connected to these leads is 3000Ω.

Figure 3-46. TN763C Auxiliary Trunk Equivalent Circuit

When the TN763C is initialized (or reinitialized), all ports are set to inactive.

This common port carrier circuit pack provides four ports for on-premises trunk applications such as Music-on-Hold, Loudspeaker Paging, Code Calling, and Recorded Telephone Dictation Access. The TN763C may be installed in any unused universal port slot. One 25-pair cable connects the ports to the cross-connect field.

TN767 DS1 Interface

This common port carrier circuit pack provides 24 channels for DS1 line or trunk applications. Each channel supports a 64 Kbps transmission channel for voice or data Trunk applications include CO ground start or loop start, E&M tie trunk ISDN, PRI, RLT, MEGACOM 800 service access, and WATS.

For ISDN—PRI trunk applications, the TN767 is paired with a TN555 to provide twenty-three 64 Kbps B-channels for voice or data. The pack also provides one 64 Kbps D-channel for signaling. Under certain conditions the 24th channel may also be used as a B-channel [non facility associated signaling (NFAS)].

When the TN767 is used in the line only mode it can be installed in any universal port slot in the common port carrier. If possible, it is recommended that the adjacent slot to the left remain empty for future growth. (Left and right assume a front view.) When the TN767 is used in the line + trunk mode, however, the adjacent slot to right must be left blank. Finally, when the TN767 is used in conjunction with the TN555 to provide

ISDN—PRI, no empty slots are required, but the TN555 is installed in the adjacent slot to the right of the TN767. A special "Y" cable (ED-1E434-11, Group 506) is required to connect the TN767 and the TN555 to each other and to the cross-connect. When looking at a common port carrier from the front, the TN555 is always placed in the adjacent slot to the right of the TN767. Because of this, the TN767 should never be placed in slot 20.

Equalizer settings for the TN767 are set through Procedure 260 Word 1 Field 18. A discussion on which distance setting to use appears under the ANN11 circuit pack description.

TN768 Tone/Clock Generator

This common port carrier circuit pack uses a digital signal processor, in conjunction with the on-bard microprocessor, to generate all tones necessary for call progress, signaling, and maintenance.

One TN768 is required for a universal module. Two TN768s may be provided in a universal module if duplicated tones are desired. The TN768 is installed in universal module position C, carrier slot 1; if a second TN768 is required it is installed in position D, carrier slot 1. This pack does not require I/O cabling to the cross-connect field.

TN771 B MTCP (Maintenance Test Circuit Pack)

The TN771B provides facilities testing on the following systems:

- ATMS (Automatic Transmission Measurement System)
- ISDN facilities (B channels)
- Modem pool and digital facilities (digital facility testing in this context refers to data module connections through the SN270B/TN754B digital port circuits with trunk-type translations).

The TN771B contains circuitry which permits automatic testing of the system data facility and data equipment, including data modules, modem pool facilities, and ISDN B channels. The modem pool facility is a combination of MTDMs (Modular Trunk Data Modules) 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 TN771B. When the connection is estaablished, the TN771B transmits a pseudo-random periodic data pattern. This pattern is returned to the TN771B 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 TN771B 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 with 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.

Multiple TN771Bs may be required depending on the amount of ATMS testing scheduled for a given period.

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 crosspoint connectivity from any module to any module. One fan-in and one fan-out circuit pack are allocated 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 basic and growth TMS carriers, slots 07 and 14.

UN151 ALU (Arithmetic Logic Unit)

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, slot 1.

UN152B 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. For R2V4 systems, the UN152B has firmware modified to accommodate new data transfer instructions in the TN370B processor sequencer.

The UN152B is located in the common control carrier, slot 2.

UN153B Bus Interface

This circuit pack contains the 501CC processor interface to the cache bus and to the system bus. The UN153B 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 UN153B is located in the common control carrier, slot 3.

UN154C — Universal Bus Interface

This universal module circuit pack controls the port network according to instructions it receives from the universal module processor. In addition, the UBI (Universal Bus Interface) sends status and maintenance messages from the port network to the universal module processor. The UBI also maps 502 circuit data time slots between the port network TDM bus and the module control's TSI bus for intermodule connections.

The UBI contains four blocks of circuitry that are virutally independent of each other.

- Control Complex: Sends and receives port network control messages to and from the TDM module processor bus.
- Circuit Complex: Maps TSI bus time slot data in the module control complex to and from the TDM bus in the port network for intermodule calls.
- Packet Complex: Allows the UMP to transmit and receive ISDN packets to and from the LAN bus.
- Clock Complex: Synchronizes all UBI and port network clock signals to the module clock. In multimodule systems, the UN154C receives synchronization from the TMS.

The UN154C is located in the universal module control carrier, slot 7.

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 DMS, HDLC (High-Level Data Link Control), 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 UN 156 is located in the common control carrier, slot 18.

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 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 healthth 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.

UN158S are required only when a system has duplicated common controls. The UN158 is located in the common control carrier, slot 19.

ANN-Coded Circuit Packs

The ANN-coded circuit packs are T1-compatible interfaces. The exception is the ANN17B which is a port circuit pack for 7300 series voice terminals.

ANN11E DS1 Trunk Interface

This circuit pack is a digital trunk interface. Each of the 24 channels on the ANN11E can be administered to carry voice or data. While voice channels offer an economical alternative to analog trunks, data channels offer transmission rates that were previously unavailable for dial-up connections. AT&T and some other common carriers can terminate DS1 trunks and provide switched connections for data channels operating at, or near, 64 Kbps. (Some offer 56 Kbps switched connections.)

How does it work? A set of proprietary chips provide a digital interface which is T-carrier compatible and generates output that meets the pulse shape requirements defined in the DSX-1 specifications. The interface connects to a send-pair and a receive-pair operating in full-duplex at 1.544 Mbps. This speed allows twenty-four 64-Kbps channels plus framing information to be handled over the DSl span.

Switch administration software (PROC 260) can assign various framing, signaling, and line coding options to the ANN11 (framing, signaling, and line coding are explained in Chapter 2 under Digital Trunking). They are:

- D4 framing
- ESF (Extended Super Framing)
- Robbed-Bit Signaling
- 24th channel signaling
- Bipolar with 8 Zero Substitution (B8ZS) line coding
- ZCS (Zero Code Suppression) line coding.

The ANN11 offers two modes of operation:

- *Line Plus Trunk* mode, which allows lines (serving analog Off-Premises Stations) and trunks on the same DS1 facility. Table 3-V is a channel number-to-equipment locations cross-reference for ANN11s used in the Line Plus Trunk mode.
- *Line Only* mode, which allows up to 24 lines serving analog OPSs (Off-Premises Stations) to use T1 facilities: the analog voice terminals are usually served by a terminal transmission product, such as a D4 Channel Bank, on the far end. When the Line Only mode is used, the carrier slot housing the ANN11 must have an option strap connecting backplane pins 208 and 224. For J58889N, List 2, Mod C or later, the carrier is manufactured with the strap installed in slots 0 and 13. However, the strap must be field installed for slots 5 and 13. Table 3-W is a channel number-to-equipment locations cross-reference for ANN11s used in the Line Only mode.

The ANN11E offers a metallic interface which connects to a send pair and a receive pair. It is accessed through a 50-pin connector on the back of cabinet housing the ANN11; the 50-pin connector is part of the carrier assembly. A signaling pair, which can be used to activate a remote loopback demand test, also appears at the connector.

TABLE 3-V. Channel Number-to-Equipment Location Cross-Reference (Line Plus Trunk Mode)

DS1 Channel Number	ANN11 in Slot 5 (Slot, Circuit)	ANN11 in Slot 18 (Slot, Circuit)
1	5,0	18,0
2	6,0	19,0
3	7,0	20,0
4	5,1	18,1
5	6,1	19,1
6	7,1	20,1
7	5,2	18,2
8	6,2	19,2
9	7,2	20,2
10	5,3	18,3
11	6,3	19,3
12	7,3	20,3
13	0,0	13,0
14	1,0	14,0
15	2,0	15,0
16	0,1	13,1
17	1,1	14,1
18	2,1	15,1
19	0,2	13,2
20	1,2	14,2
21	2,2	15,2
22	0,3	13,3
23	1,3	14,3
24	2,3	15,3

Synchronization sources for the ANN11 are specified by using PROC 260. Two outputs are also provided to interface to the SCS (System Clock Synchronizers). If the DS1 link terminating on the ANN11 serves as an external clock reference, the ANN11 is cabled to one or both SCSs (depending on network control duplication). The ANN11 derives a timing reference from the incoming DS1 bit stream (used by the SCS to slave the network clock to it).

The ANN11C and ANN11E feature:

- CO, FX, WATS, 800-service, tie, and DID trunks
- OPS (Off-Premises Station) analog voice terminal service with a D4 channel bank or equivalent providing the DS1 interface at the remote function.

New firmware and a new framer IC introduced with the ANN11E adds DMI-BOS (Digital Multiplexed Interface—Bit-Oriented Signaling) capability to the ANN11. This allows data transmission through toll network equipment such as DACS (Digital Access and Cross-Connect systems and the 4 ESS™ switch (4ell Generic).

Different combinations of ANN11Bs, -Cs, or -Es and TN380Bs, -Cs, or -Ds (the TN380 is the module processor) are required to provide DS1 features for the R2 software releases. Table 3-X lists the hardware and software combinations required for the various port types. (The ANN11B and TN380B are no longer being manufactured.) Although some prototypes of a -D version of the ANN11 DS1 circuit pack were built for controlled introduction of System 85 R2V4, the ANN11D will never be manufactured for general availability.

TABLE 3-W. Channel Number-to-Equipment Location Cross-Reference (Line Only Mode)

DS1 Channel Number	ANN11 in Slot 0 (Slot, Circuit)	ANN11 in Slot 5 (Slot, Circuit)	ANN11 in Slot 13 (Slot, Circuit)	ANN11 in Slot 18 (Slot, Circuit)
1	0,0	5,0	13,0	18,0
2	1,0	6,0	14,0	19,0
3	2,0	7,0	15,0	20,0
4	0,1	5,1	13,1	18,1
5	1,1	6,1	14,1	19,1
6	2,1	7,1	15,1	20,1
7	0,2	5,2	13,2	18,2
8	1,2	6,2	14,2	19,2
9	2,2	7,2	15,2	20,2
10	0,3	5,3	13,3	18,3
11	1,3	6,3	14,3	19,3
12	2,3	7,3	15,3	20,3
13	0,4	5,4	13,4	18,4
14	1,4	6,4	14,4	19,4
15	2,4	7,4	15,4	20,4
16	0,5	5,5	13,5	18,5
17	1,5	6,5	14,5	19,5
18	2,5	7,5	15,5	20,5
19	0,6	5,6	13,6	18,6
20	1,6	6,6	14,6	19,6
21	2,6	7,6	15,6	20,6
22	0,7	5,7	13,7	18,7
23	1,7	6,7	14,7	19,7
24	2,7	7,7	15,7	20,7

TABLE 3-X. Port Type, Circuit Pack Suffix, and Software Compatibility for DS1

Port Type	R2V1	R2V2	R2V3	R2V4/G2	TN380	ANN11
Tie Trunk (E&M)	x	x	x	x	B, C, D	B, C, E
Ground Start CO, FX, WATS, RA, & Rev. Batt. DID	*	x	x	x	C, D	C, E
Loop Start CO, FX, WATS, & RA			x	x	C D	C, E
OPS Line			x	x	C, D	C, E
DMI/BOS			x	x	C, D	E

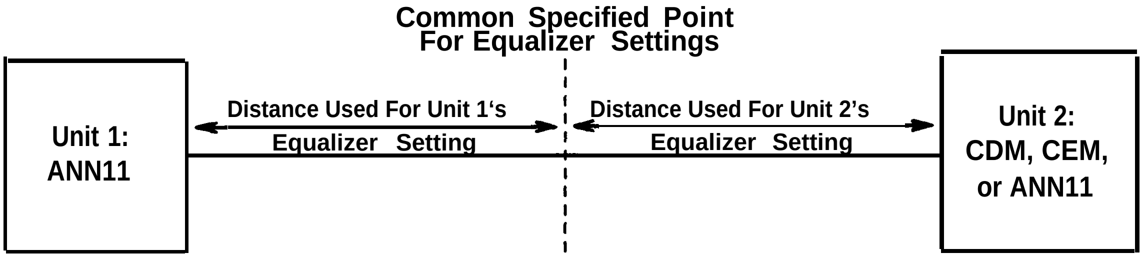
* R2V1 can be retrofitted to provide ground start DS1 channels only if configured with software version 1.5 or later.

Equalizer Settings and Distance Limitations

The ANN11, ANN15, ANN16, and ANN35 all have option switches to select one of five transmit equalizer settings. The TN767 (universal module DS1 interface pack) equalizer settings are specified through Procedure 260, Word 1, Field 18. Equalizers provide preconditioning of the transmit signal so that the DS1 pulse shape falls within DSX-1 specifications at a common specified point. The equalizer setting depends on the distance from the System 85 DS1 connector to a common specified point. (Examples of common specified points are given further on in this write-up.) A DIP switch on the ANN11, ANN15, ANN16, or ANN35 provides equalizer settings for distances up to 655 feet (these same distance ranges are specified for the TN767 through Procedure 260 Word 1 Field 18):

S2	S1	S0	Distance To Specified Point	
			24AWG	26AWG
L	L	H	0 to 133 ft. (0 to 41 m)	0 to 90 ft. (0 to 27 m)
L	H	L	133 to 266 ft. (41 to 81 m)	90 to 180 ft. (27 to 55 m)
L	H	H	266 to 399 ft. (81 to 122 m)	180 to 270 ft. (55 to 82 m)
H	L	L	399 to 532 ft. (122 to 162 m)	270 to 360 ft. (82 to 110 m)
H	L	H	532 to 655 ft. (162 to 200 m)	360 to 450 ft. (110 to 137 m)

The transmission terminal products also have quaker settings for distance to a common specified point. For direct cabling between units (System 85 or Generic 2 DS1 to CDM, System 85 or Generic 2 DS1 to colocated System 85 or Generic 2 DS1, 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.



When using direct cable to connect a System 85 DS1 interface to a CSU (Channel Service Unit) having no equalizer settings, the cabling distance to the CSU should be used for the ANN- circuit pack equalizer setting. With an interposed cross-connect field, the cabling distance from the ANN- circuit pack 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.

For a more thorough discussion on Generic 2 and System 85's DS1 features, refer to *DEFINITY Communications System Generic 2 and System 85 Feature Descriptions* (555-104-301). For an in depth discussion on DS1 and DMI-BOS, see *AT&T DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRI Reference* (555-025-101, Issue 3).

The ANN11E is housed in DS1 carriers (traditional modules only).

ANN15B Remote Group Interface—Central

This circuit pack is the first of a pair of circuit packs that provides a DS1 interface for the remote group capability (System 85 R2V3/V4 and Generic 2 traditional modules). It is housed in the DS1 carrier at the central switch and serves as the interface to remoted ports which may be hybrid, analog, digital, or EIA interfaces.

The ANN15B is equivalent to any combination of three line port circuit packs or 24 line ports. Like other DS1-type circuit packs housed in the DS1 carrier, this pack requires certain slots to be left vacant ("line-only" mode). Equalizer settings for the ANN15B are discussed under the ANN11 circuit pack description. The ANN15B is required whenever remote groups are used in the system.

The ANN15B is housed in DS1 carriers (traditional modules only).

ANN16B Remote Group Interface—Remote

This circuit pack is the second of a pair of circuit packs that provide an interface for the remote group capability (R2V3/V4 and Generic 2 traditional modules). It is located in the remote group housing and serves as the link to the switch for the remoted hybrid, analog, digital, or EIA ports.

The ANN16B terminates three line port circuit packs (24 time slots), which appear as a PDI (Port Data Interface) and PCI (Port Control Interface) to the remoted ports. Equalizer settings for the ANN16B are discussed under the ANN11 circuit pack description. The ANN16B is required whenever remote groups are used in the system.

ANN17B 7303/7305 Interface Circuit

The ANN17B 7303/7305 Interface Circuit pack provides an 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.

In traditional modues, the 7300S series voice terminals require ANN17 ports. The ANN17B can be located in the DS1 carrier, the standard port carrier, or the remote group housing. When the ANN17B is installed in the standard port carrier, only four ports can be used. When the ANN17B is installed in a remote group housing, an EMI filter must be used on the associated 50-pin connector on the back of the housing.

> NOTE: The ANN17B does not provide lightning protection for off-premises terminals. Primary electrical protection for these circuit packs and associated 7300S series terminals is not available.

The ANN17B is housed in DS1 or port carriers (traditional modules).

ANN35 ISDN PRP (Primary Rate Port)

This circuit pack provides a DMI (Digital Multiplexed Interface) and ISDN (Integrated Services Digital Network) interface to T1 (1.544 Mbps) from System 85 to digital networks which conform to the ISDN standard of CCITT.

The ANN35 provides System 85 connectivity for twenty-three 64-Kbps data channels, and one 64-Kbps message-based signaling channel. The ANN35 is required whenever connectivity to an ISDN network configuration is provided. The ANN35 will also work in NFAS (Non Facility Associated Signaling) arrangements. Equalizer settings for the ANN35 are discussed under the ANN11 circuit pack description.

The ANN35 is housed in DS1 carriers (traditional modules).

Circuit Pack Assignments in Traditional Module Port Carriers

The traditional module port carrier is designed to accept all SN-coded port circuit packs. There are several similar, but different, circuit packs used in traditional modules. 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. Even though this pack does not require access at the termination field and may be physically paired with another Call Progress Tones pack, it is a good idea to place them apart. Preferably, they should be located in separate cabinets. If this is not possible, they should at least be located in different carriers. This way, if a fault occurs in another piece of carrier equipment (such as a DC-to-DC converter pack, a PCI [Port Control Interface] pack, or a PDI [Port Data Interface] pack which places the carrier out of service, the Call Progress Tones pack in the other cabinet (or carrier) will be able to supply call progress tones for the module.

Circuit Pack Groupings and Pairing Rules

Most pairing grouping and pairing rules apply only to traditional module circuit packs. For the universal module, rules exist for the TN767; for details see the TN767 circuit pack description in Chapter 3.

For traditional modules, the SN-coded circuit packs can be segmented into basic groups and subgroupings for pairing purposes. Table 3-Y provides a table with recommended pairing rules for the following groups and subgroups.

TABLE 3-Y. Circuit Pack Pairing

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	4
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, SN23, SN232, SN233, SN244 (Cabled to Aux/Trunk Field)	D1	A	A	A	A	A	A	A	–	–	–	–	P

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
SN261C 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 (SN253C) 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
SN228B Analog Port
SN229 Analog Port
SN241 Contact Interface

B2 SN221B Analog Port
SN228B 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)
SN270B Digital port

C2 SN224B Hybrid Port
SN238 ADU/EIA Port
SN243B Data Port (Analog)
SN270B 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-premises, or modem pool application

SN270B Out-of-building application on “nonexposed” cable or modem pool application

Group D

D1 SN230B CO Trunk
SN231 Auxiliary Trunk
SN232B DID Trunk
SN233C 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).

System Interconnections

Cross-Connect Unit

Overview

The main cross-connect unit, also known as the main distribution frame, (Figure 3-47) 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 backboareds 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 standard 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.

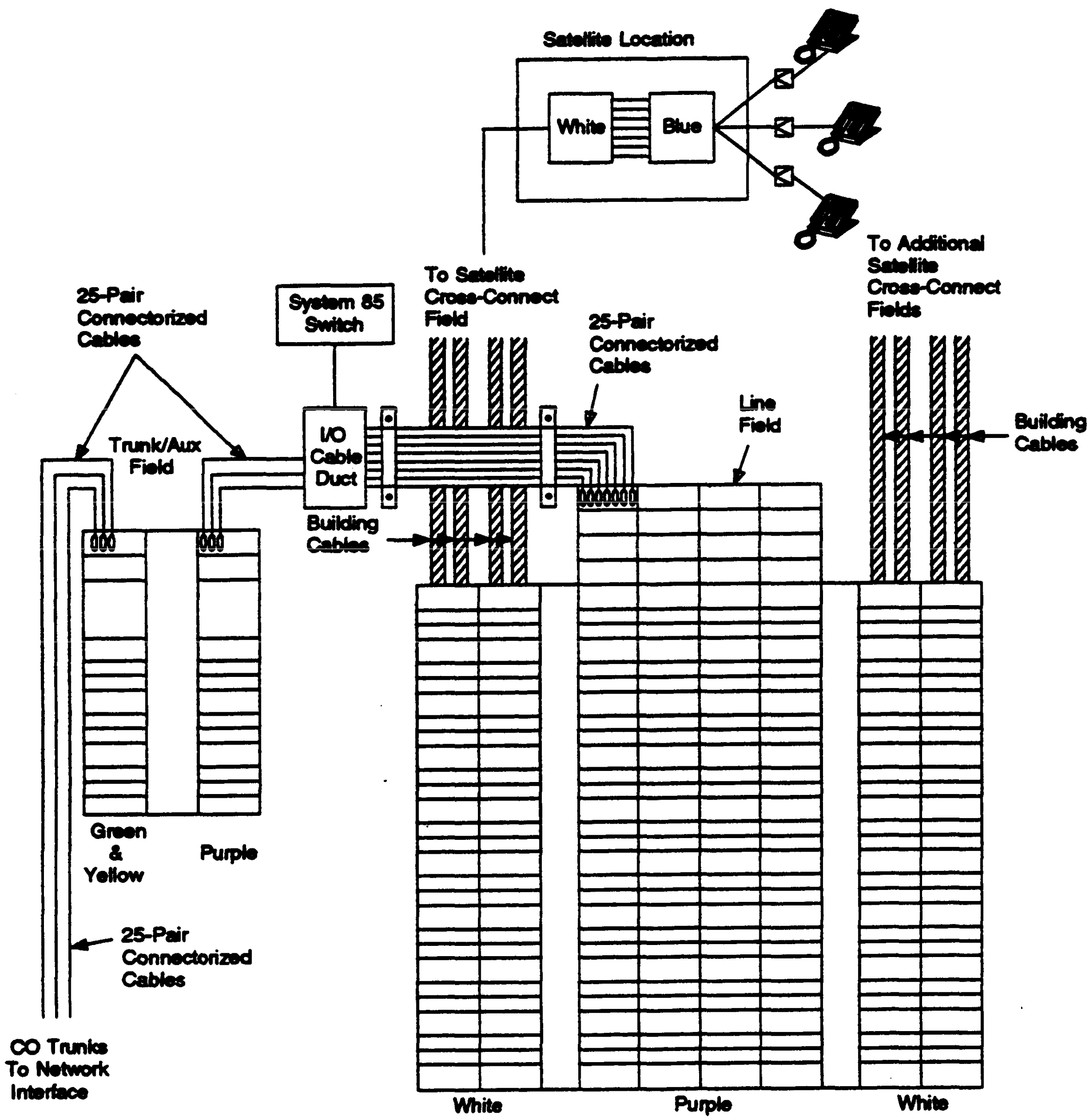


Figure 3-47. Typical Main Cross-Connect Unit

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 colored portion of the line field and provides access to various terminal equipment located throughout the building.
- DS1 field—provides cross-connect points for DS1 cables. These cables may run direct from the switch cabinet to their termination point (other colocated switch, multiplexer, channel service units, etc.). However, specific translation assignments to DS1 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-DS1 to DS1 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 DS1 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 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 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 (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 mismatch between the switch interface and the building wiring. This hardware will also minimize 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 depends on the size of the system and anticipated cable congestion. 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-lE434) include the following:

- 902A PVC (polyvinyl chloride) 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.

In traditional modules, six of the 902A cables that connect the module control carrier(s) to the port carriers include two IOB (input/output bus) cables and four PCM (pulse code modulation) 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 foil and drain wire outer conductor and a central solid wire conductor. The outer conductor surrounds dielectric material and is covered with a teflon jacket. The conductors are terminated at the common control end with a 953K paddleboard connector and at the module control end with four 982AA paddleboard connectors. These cables interface the 4-MHz control channel in the common control carrier to the module control carrier. An ED-1E434 Group 501 cable is used for 4-MHz connections to the universal modules.

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 MAAP (Maintenance and

Administration Panel), SMT (System Management Terminal), 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 crowding 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 Subsystem

For each module in a multimodule system, a pair of fiber-optic cables connects the TMS to the module control carrier. A fiber-optic receiver and fiber-optic transmitter pair are equipped at each end of every TMS-to-module control link. A pair of fiber-optic cables also connects RMI circuits in remote modules to RMI circuits at the central locale. Fiber-optic receiver and fiber-optic transmitter pairs are also used on both ends of these links.

Fiber-Optic Cable Interconnection

Longer intra-building links and inter-building links, such as those used to support remote modules, require a more durable cable. A typical cable used in Generic 2 and System 85 (see Table 3-Z) consists of 12 ribbons containing 12 fibers each (144 fibers total). But, this cable cannot directly terminate on the fiber-optic transmitters and receivers. A device called a modular fanout is required. A modular fanout provides 12 connectors for a 12-fiber ribbon. Two-fiber cable from the TMS, or RMI circuit pack, plugs into these connectors.

When several modular fanouts are required, they may be housed in a small cabinet assembly called a Lightguide Cable Interconnection Terminal (LCIT). The LCIT can accommodate up to six modular fanouts.

Generic 2 switches, and those System 85 switches manufactured during 1991 or later, require ST connectors on the modular fanout. System 85s manufactured prior to 1991 require biconic connectors on the modular fanout.

Fiber-Optic Transmitters, Receivers, and Transceivers

Fiber-optic transmitters, receivers, and transceivers are mounted on small circuit boards called paddleboards which are only a few inches square. Each paddleboard has a connector for dual fiber cable and a 982-type connector which attaches to carrier backplane pins at the appropriate circuit pack slot. The transceiver (used for Generic 2 universal modules) has two dual fiber connectors and a 50-pin connector.

TABLE 3-Z. AT&T Fiber Optic Cable Technical Specifications

Parameter	62.5 Micron Core	50 Micron Core
Cladding Diameter	125.0 microns	125.0 microns
Core Diameter	62.5 microns	50 microns
Core Eccentricity	7.5% maximum (1.5% typical)	8.5% maximum (1.5% typical)
Core Ovality	20% maximum (4% typical)	20% maximum (4% typical)
Refractive Index Delta	2.0%	1.3%
Numerical Aperture	0.29 (theoretical)	0.23
Attenuation Range	0.85 to 2.7dB/km @ 1300 nm 4.0 dB/km @ 850 nm	0.75 to 1.2 dB/km @ 1300 nm 3.2 to 4.0 dB/km @ 850 nm
Bandwidth Range	300 to 700 MHz-km @ 1300 nm 160 to 300 MHz-km @ 850 nm	500 to 1100 MHz-km @ 1300 nm 500 to 700 MHz-km @ 850 nm
Typical Field Splice Loss	0.10 dB (array) 0.20 dB (mechanical)	0.15 dB (array) 0.20 dB (mechanical)
Coating Diameter	245 microns	245 microns

Up until January, 1991, Generic 2 and System 85 used different fiber-optic transmitter and receiver technology. Previously, System 85 transmitters and receivers used ODL 40 fiber optic devices. Generic 2, and now System 85, use ODL 50 fiber optic devices. (ODL fiber-optic devices convert electrical signals to light pulses and light pulses to electrical signals.)

The ODL 50 fiber-optic device family offers both short and long wavelength devices. The long wavelength devices allow greater fiber-optic cable distances. Generic 2, and now System 85, offer transmitters, receivers, and transceivers in shbrt wavelength and long wavelength versions.

Table 3-AA, 3-AB, and 3-AC show the fiber-optic transmitter and receiver requirements for System 85 and Generic 2.

The 107A ORPI continues to use ODL 40 devices which means it still uses biconic connectors. Because of this, the 107A needs a special cable assembly (ED-1E434-11, Group 509) whenever it is used. The Group 509 cable has a biconic connector plus an attenuator on the 107A end and an ST connector on the modular fanout end. The 107A ORPI also has a distance limit of 13,000 ft. (4.0 km) for 62.5 micron and 50 micron fiber. More information about the 107A ORPI appears in Chapter 4.

TABLE 3-AA. Generic 2 Fiber-Optic Transmitters, Receivers, and Transceivers

Application		Model	Distance Limits 62.5 Micron	Distance Limits 50 Micron
Generic 2 traditional module — as a central locale module, a nearby remote module, or containing an RMI serving a nearby remote module	Transmitter	982NL	4900 ft. (1.5 km)	2000 ft. (0.6 km)
	Receiver	982NK	4900 ft. (1.5 km)	2000 ft. (0.6 km)
Generic 2 traditional module — as a distant remote module or containing an RMI serving a distant remote module	Transmitter	982NN	25,000 ft. (7.6 km)	12,140 ft. (3.7 km)
	Receiver	982NM	25,000 ft. (7.6 km)	12,140 ft. (3.7 km)
Generic 2 TMS — connection to a central locale module or a nearby remote module	Transmitter	982NL	4900 ft. (15 km)	2000 ft. (0.6 km)
	Receiver	982NK	4900 ft. (1.5 km)	2000 ft. (0.6 km)
Generic 2 TMS — connection to a distant remote module	Transmitter	982NN	25,000 ft. (7.6 km)	12,140 ft. (3.7 km)
	Receiver	982NM	25,000 ft. (7.6 km)	12, 140 ft. (3.7 km)
Generic 2 universal module — as a central locale module, a nearby remote module, or containing an RMI serving a nearby module	Transceiver	9823A	4900 ft. (1.5 km)	2000 ft. (0.6 km)
Generic 2 universal module — as a distant remote module or containing an RMI serving a distant remote module	Transceiver	9823B	25,000 ft. (7.6 km)	12,140 ft. (3.7 km)

TABLE 3-AB. System 85 (1991 or Later) Fiber-Optic Transmitters, and Receivers

Application		Model	Distance Limits	
			62.5 Micron	50 Micron
System 85 module (1991+) — as a central locale module, a nearby remote module, or containing an RMI serving a nearby remote module	Transmitter	982NL	4900 ft. (1.5 km)	2000 ft. (0.6 km)
	Receiver	982NK	4900 ft. (1.5 km)	2000 ft. (0.6 km)
System 85 module (1991+) — as a distant remote module or containing an RMI serving a distant remote module	Transmitter	982NN	13,000 ft. (4.0 km)	12,140 ft. (3.7 km)
	Receiver	982NM	13,000 ft. (4.0 km)	12,140 ft. (3.7 km)
Generic 2 TMS (1991+) — connection to a central locale module or a nearby remote module	Transmitter	982NL	4900 ft. (1.5 km)	2000 ft. (0.6 km)
	Receiver	982NK	4900 ft. (1.5 km)	2000 ft. (0.6 km)
Generic 2 TMS (1991+) — connection to a distant remote module	Transmitter	982NN	13,000 ft. (4.0 km)	12,140 ft. (3.7 km)
	Receiver	982NM	13,000 ft. (4.0 km)	12,140 ft. (3.7 km)
Remote Attendant Console	ORPI	107A	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)

TABLE 3-AC. System 85 (Through 1990) Fiber-Optic Transmitters, and Receivers

Application		Model	Distance Limits	
			62.5 Micron	50 Micron
System 85 module (pre-1991) — at central locale connecting to the TMS	Transmitter	Z982A	200 ft. (60 m)	200 ft. (60 m)
	Receiver	Z982B	200 ft. (60 m)	200 ft. (60 m)
System 85 module (pre-1991) — at remote location connecting to the TMS	Transmitter	Z982C	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
	Receiver	Z982D	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
System 85 module (pre-1991) — at remote location connecting to an RMI at the central locale	Transmitter	Z982J	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
	Receiver	Z982D	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
System 85 RMI (pre-1991) — in a central locale module, or an RMI carrier, connecting to an RMI in the remote module	Transmitter	Z982J	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
	Receiver	Z982D	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
System 85 TMS (pre-1991) — connecting to a central locale module	Transmitter	Z982A	200 ft. (60 m)	200 ft. (60 m)
	Receiver	Z982B	200 ft. (60 m)	200 ft. (60 m)
System 85 TMS — connecting to a remote module	Transmitter	Z982C	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
	Receiver	Z982D	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)
Remote Attendant Console	ORPI	107A	13,000 ft. (4.0 km)	13,000 ft. (4.0 km)

Duct Work

Cable ducts 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 3-48).

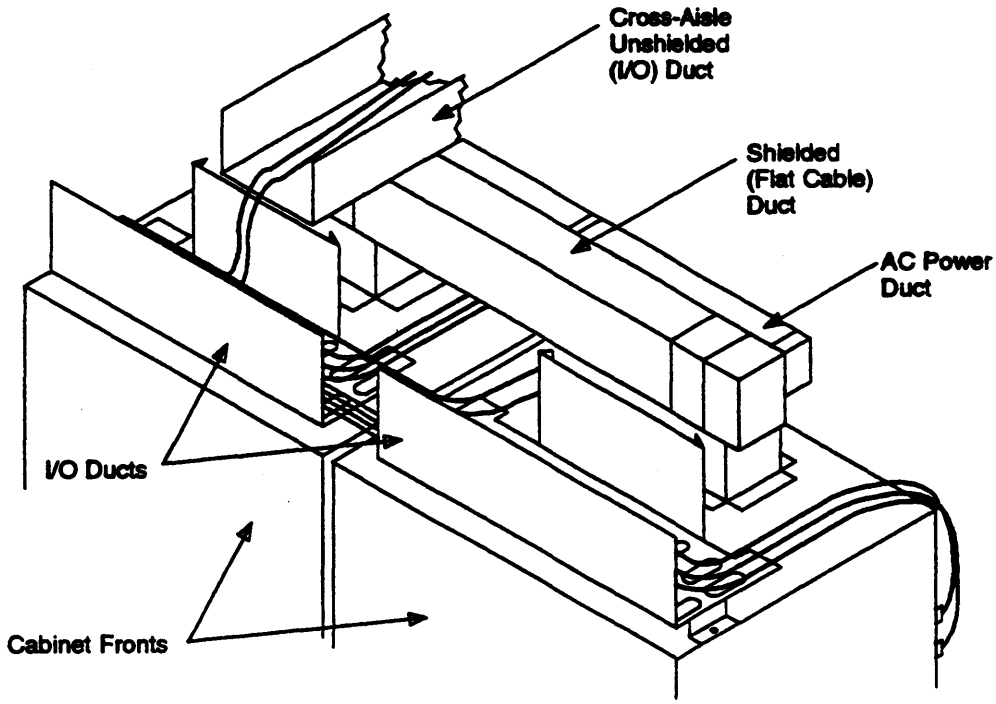


Figure 3-48. Cable Routing Through Duct Work

Shielded (Flat Cable) Duct

The shielded duct provides a pathway which is physically enclosed for intercabinet cabling. This duct is mainly used to route flat ribbon cables and other intercabinet cables which require external shielding for electromagnetic compliance. This duct is also used to route 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.

This duct runs along the top rear of the 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 modular fanouts 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.

Peripheral Equipment

The AT&T DEFINITY Communications System Generic 2 and AT&T System 85 switching complexes were described in the last chapter. This chapter describes equipment that connects to the switch. The following peripherals are described:

- Attendant Console
- Voice terminals (telephones) and their adjuncts
- Data equipment and interface devices
- Miscellaneous peripherals
- Auxiliary equipment
- AP (Applications Processor) equipment
- AUDIX (Audio Information Exchange) equipment
- Call detail recording equipment

Throughout this chapter, as well as elsewhere in this document, the abbreviations GA, LA, and DA may appear, they are defined as follows:

- GA (General Availability) — Products in this classification are readily available for ordering and carry a standard price and delivery interval (transmit to ship).
- LA (Limited Availability) — Products in this classification are not readily available for ordering. Products classified as LA are generally near the beginning or the end of their life cycle.
- DA (Discontinued Availability) — Products in this classification are no longer available for ordering. Maintenance stock is available for the installed base of a product for at least five years after that product has been classified as DA..

Attendant Console

The attendant console (see Figure 4-1) is a sophisticated special-purpose telephone used by an operator (attendant) to handle incoming and outgoing calls and to control incoming and outgoing trunk groups. In addition, the attendant can use the console for basic telephone service such as placing or receiving personal calls.

The attendant console is contained in a black and silver housing. Lights on the console are LEDs mounted under windows in the housing's faceplate. The faceplate also has spaces so it can fit over the touch-tone keypad and the control keys.

Two models are available:

- (ZAGJ-09AF-03)—Console with DXS/BLF (Direct Extension Selection/Busy Lamp Field)
- (ZAAG-09AF-03)—Console without DXS/BLF.

Both models have the following:

- Six loop buttons—each loop can handle a call
- A touch-tone keypad
- An 8-digit alphanumeric display—shows incoming call identification and class of service information
- Attendant control buttons—used for incoming and outgoing calls
- Trunk group select buttons
- A handset/headset—an N1B3 handset (similar to a voice terminal handset) with a 342A adapter or a headset (60A or KS-20778 type).

The DXS/BLF model includes a DXS/BLF module. By using DXS and hundreds-group-select buttons, the attendant can directly access up to 1800 extensions. The attendant can also use hundreds-group-select buttons to examine the BLF lamps associated with each of these extensions. When an extension is busy, its BLF lamp on the console is lighted.

Information about console operation can be found in *DEFINITY Communications System Generic 2 and System 85 Attendant Console User's Guide* (555-14-730).

Circuit Packs and Equipment

The console's electronics are contained on these circuit packs:

- The AEE3 data control and speech circuit provides logic for timing and control of all console functions, data transmitter circuits, and attendant voice circuits. This includes scanning for all buttons and keys..
- The AES1 dial circuit contains the circuitry that generates touch-tone signals for outgoing trunk calls and digital dial signals for internal calls.
- The AE1A backplane board provides console circuit pack connectors and internal wiring connections.

- The MN19 lamp control and carrier has 51 buttons with matrix input logic and LEDs.
- The MP2 alphanumeric control has a read/write memory, character generator, column decoder, row and column drivers, and display protection for the alphanumeric display.
- The MR2B and MR3B ADXS carrier provides 18 group select buttons and lamps with associated address decoders for selection of 1800 extensions. It mounts the 10 BLF indicators or 100 ADXS/BLF buttons and lamps contained on the KS-21672 assemblies. This carrier also provides circuitry for memory address decoders and lamp drivers.
- The MW4 power supply converts and regulates -48 V DC to +5 V, -12 V, -15 V, and +15 V for console circuits.
- The ZTB1 alphanumeric display is an 8-character alphanumeric display.
- The KS-21672 assemblies provide the buttons and lamps used with the DXS/BLF feature.

4-Character and 8-Character Alphanumeric Display Consoles

For Generic 2 and System 85 Release 2, consoles with 8-character alphanumeric displays are standard. But, consoles sold with System 85 Release 1 systems have 4-character alphanumeric displays. For System 85 R1 to R2 upgrades, these 4-character consoles (models AAG-08AF-03 and AGJ-08AF-03) can still be used unless the upgrade adds the 5-digit numbering plan feature or the AUTOVON feature. Both of these features require a console with an 8-character alphanumeric display.

Visually Impaired Attendant Service

Visually impaired people can operate an attendant console by using the Visually Impaired Attendant Service. In addition to the standard console, this service requires the following equipment (see Figure 4-2):

- A light-sensitive probe (990A) to detect and identify lighted LEDs on the console. When the probe detects a lighted LED, the 2A translator tone generator sends a tone to the headset. To order the 990A, use comcode 103056222.
- A grooved console faceplate track (6C) to guide the probe. To order the 6C, use comcode 103971859.
- A translator tone generator (2A) to supply coded ringing. The transistor reads ICI (Incoming Call Identification) signals received at the console and generates one of six coded ringing patterns to let the attendant know what type of call is being received. (ICI information still appears on the alphanumeric display.) The 2A translator tone generator also transmits a tone to the headset when the light probe detects a lighted LED. To order the 2A, use comcode 102965415.

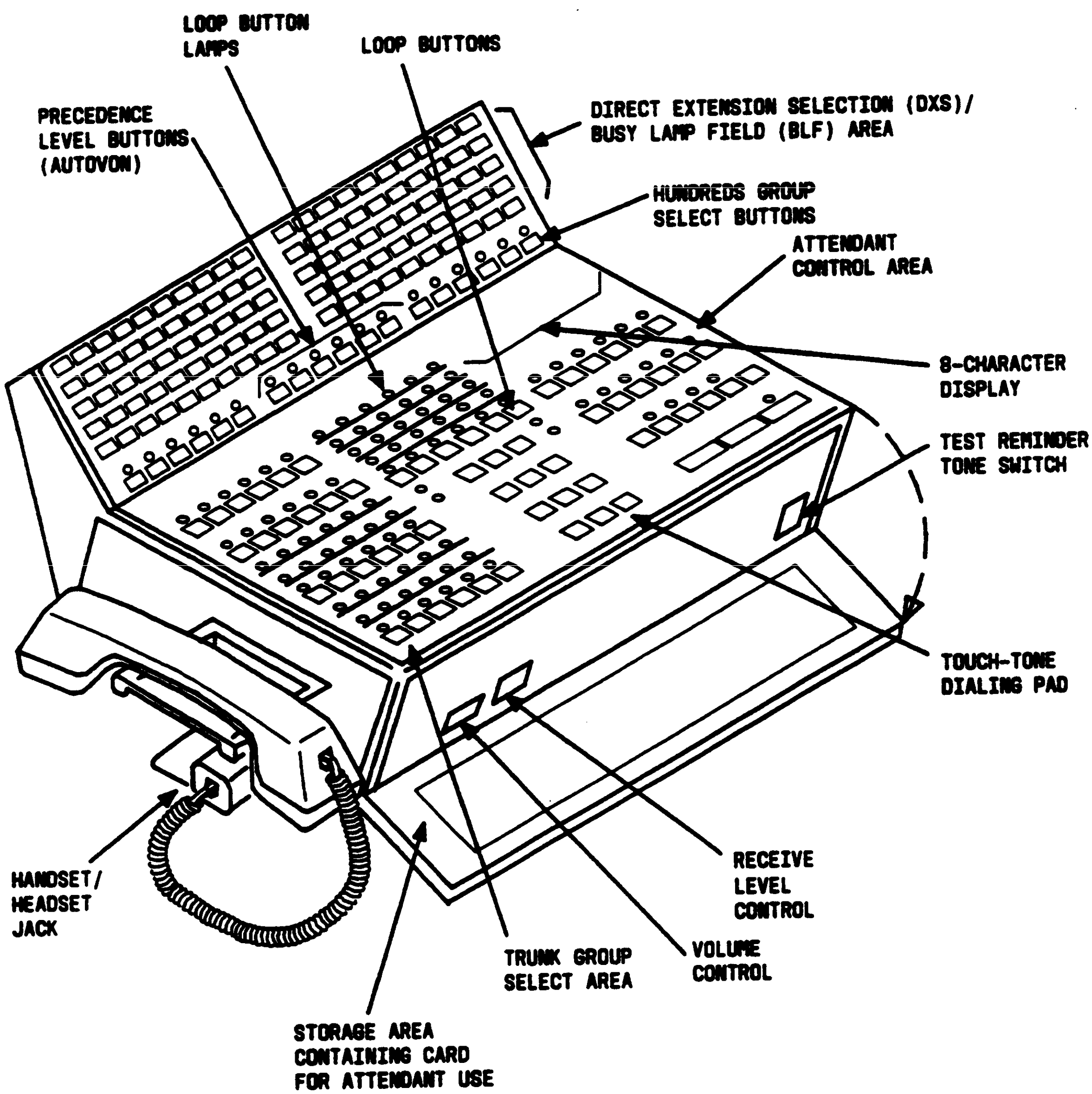


Figure 4-1. Attendant Console

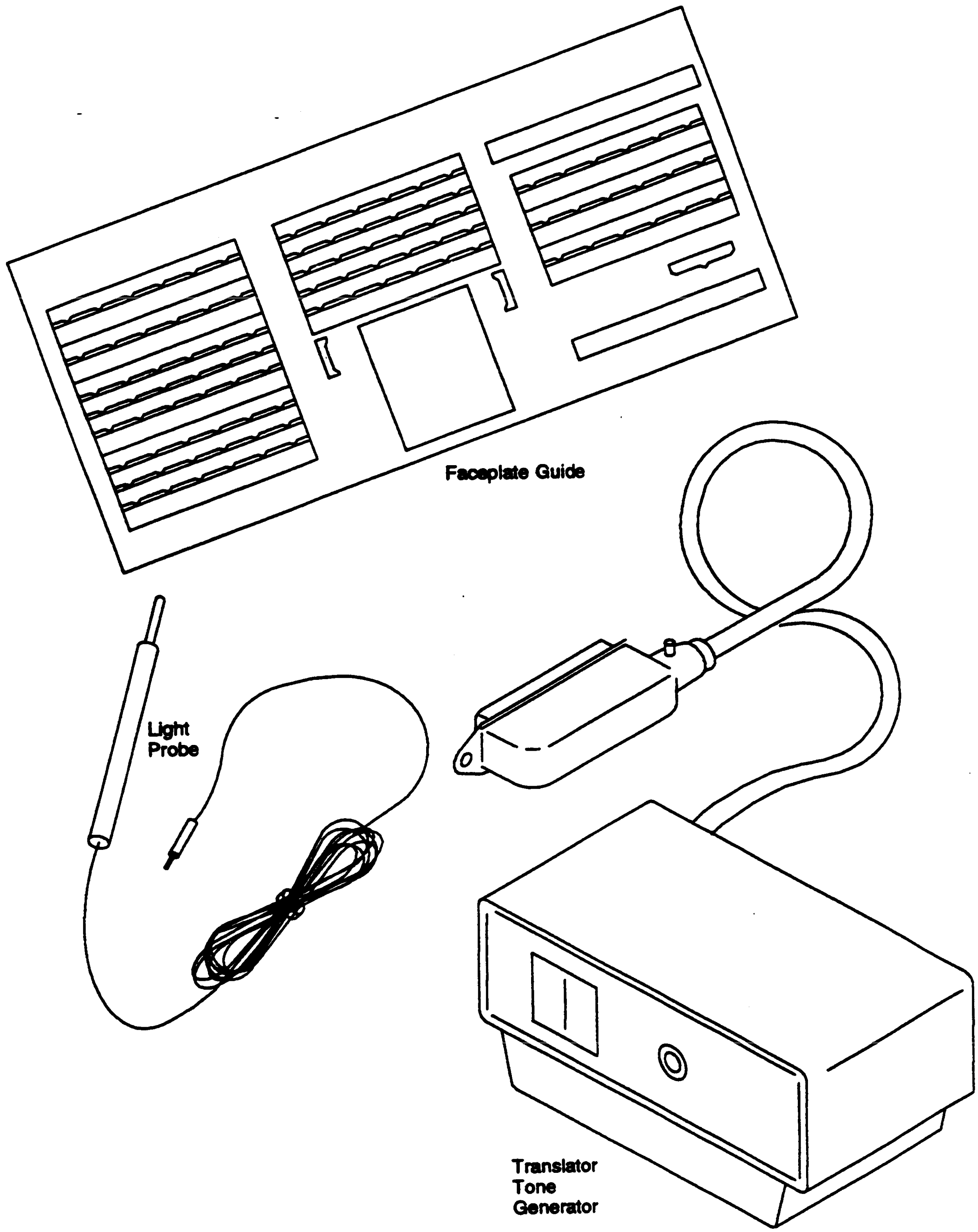


Figure 4-2. Visually Impaired Attendant Service Equipment

Attendant Console Repeaters

Figure 4-3 shows an Attendant Console Repeater (J58889Y). This unit does two things:

- Provides transformer coupled isolation for surge protection on exposed console loops
- Amplifies (regenerates) console control and alarm signals.

Repeaters are always required for exposed console loops. Range extension (amplifier) circuits are available for console loops greater than 1000 feet. These circuits extend the loop range to 3000 feet. And by cascading repeaters, loops up to 11,000 feet can be obtained.

> WARNING: *Like any exposed (outdoor) cable run, an exposed console loop requires standard protection, such as carbon blocks, at building entrances and exits— the surge protection circuits in the repeaters provide additional protection. (See Chapter 9 for more about standard protection.)*

The equipment contained in a console repeater depends on the application (see Figure 4-4). Here are the various devices used to equip repeaters:

- AE48—single direction repeater used for range extension on data channels. Transformer coupling provides surge protection.
- AE49B—clock and regulator, required for range extension.
- WJ3—single direction data channel buffer. This circuit replaces the AE48 for exposed loops without range extension. For these applications, the system-end and the console-end repeaters each require WJ3s. Its transformer coupling provides surge protection for the data channel.
- WJ6—alarm repeater, used in the system-end repeater.
- WJ7—alarm repeater, used in the console-end repeater.
- 284B1—power unit, used for the console-end repeater. This unit requires 120V AC power and is located outside the repeater housing.
- 28D2—power unit, used with range extension. This unit requires 120V AC power.

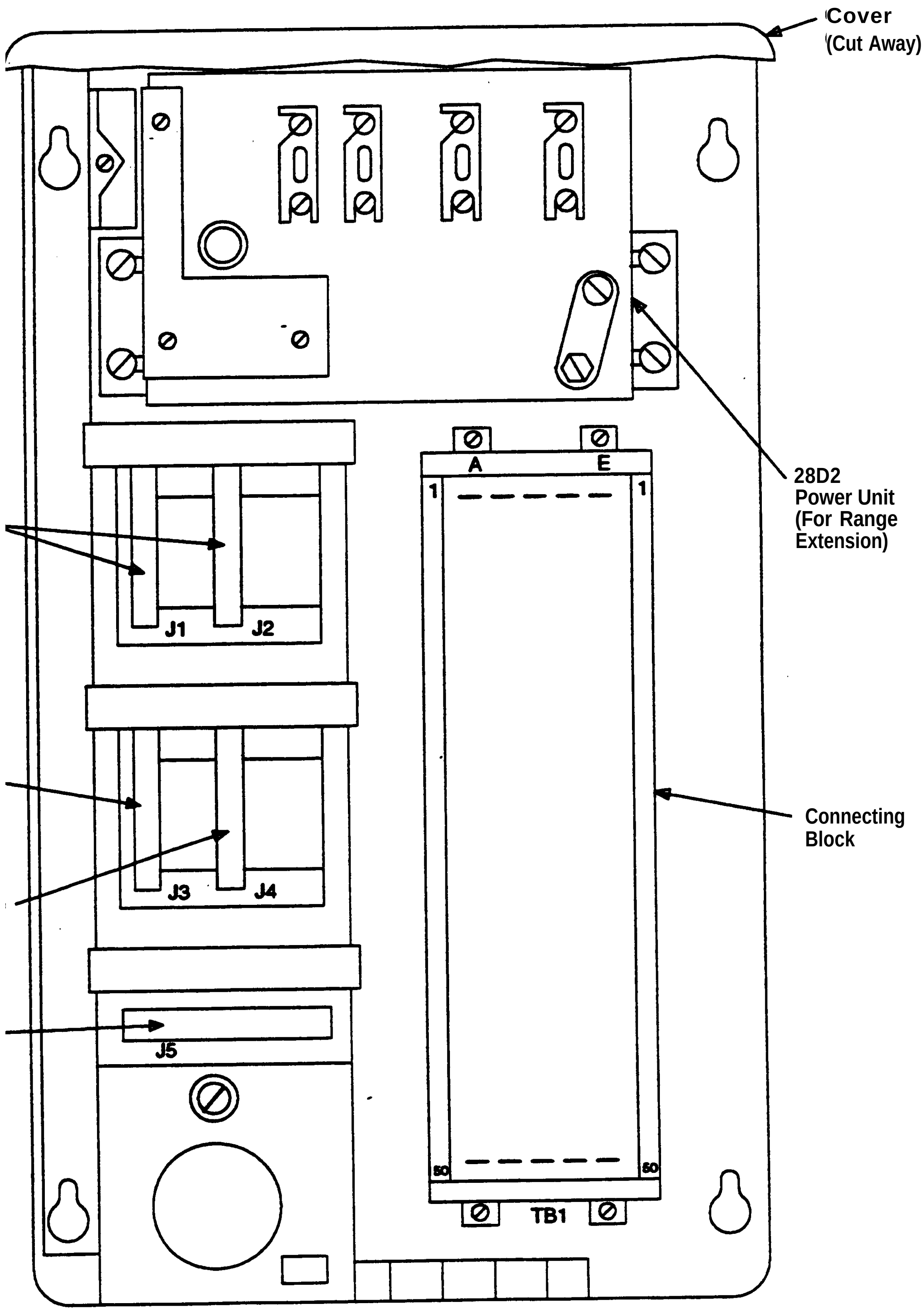


Figure 4-3. Attendant Console (J58889Y)

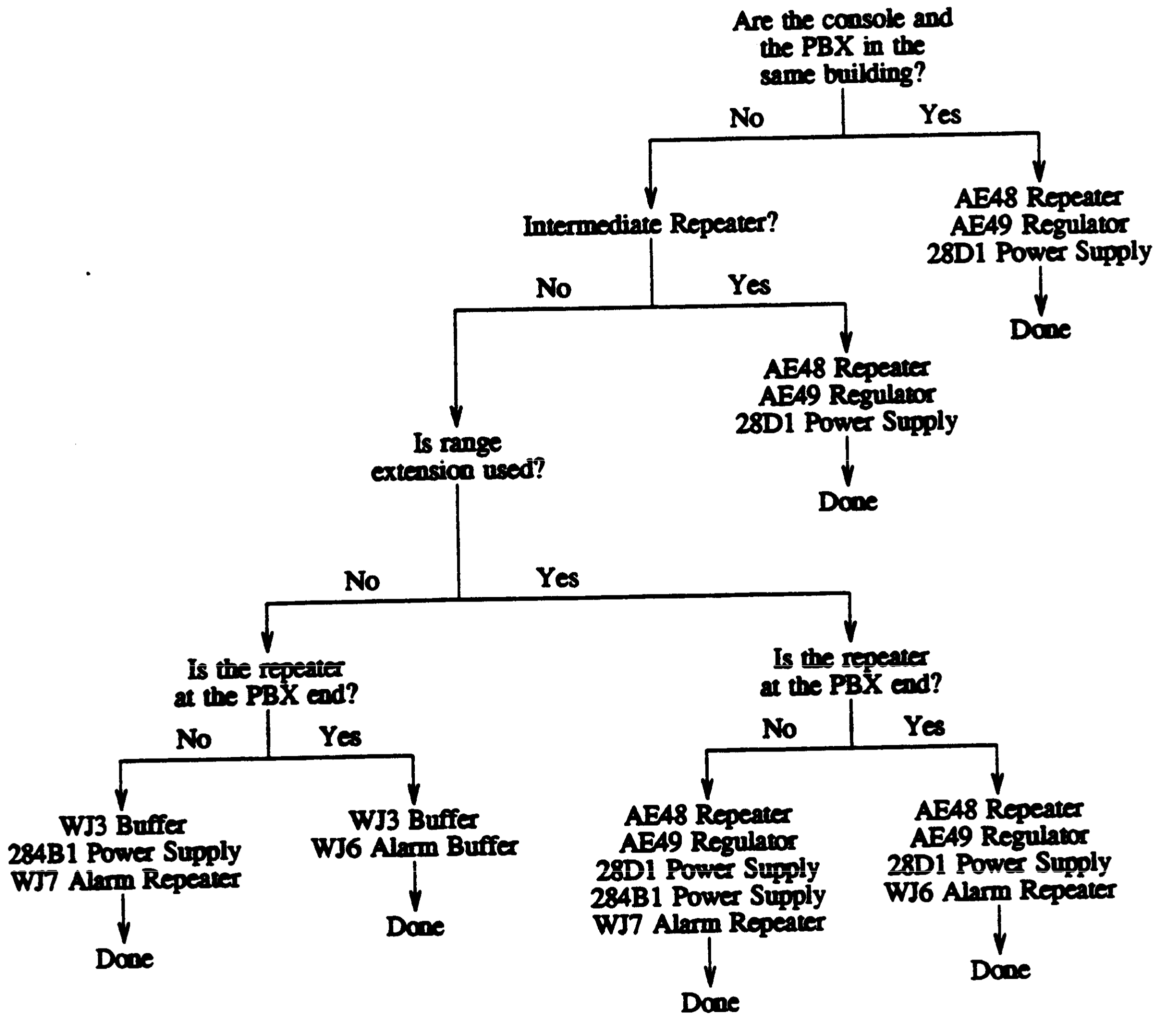
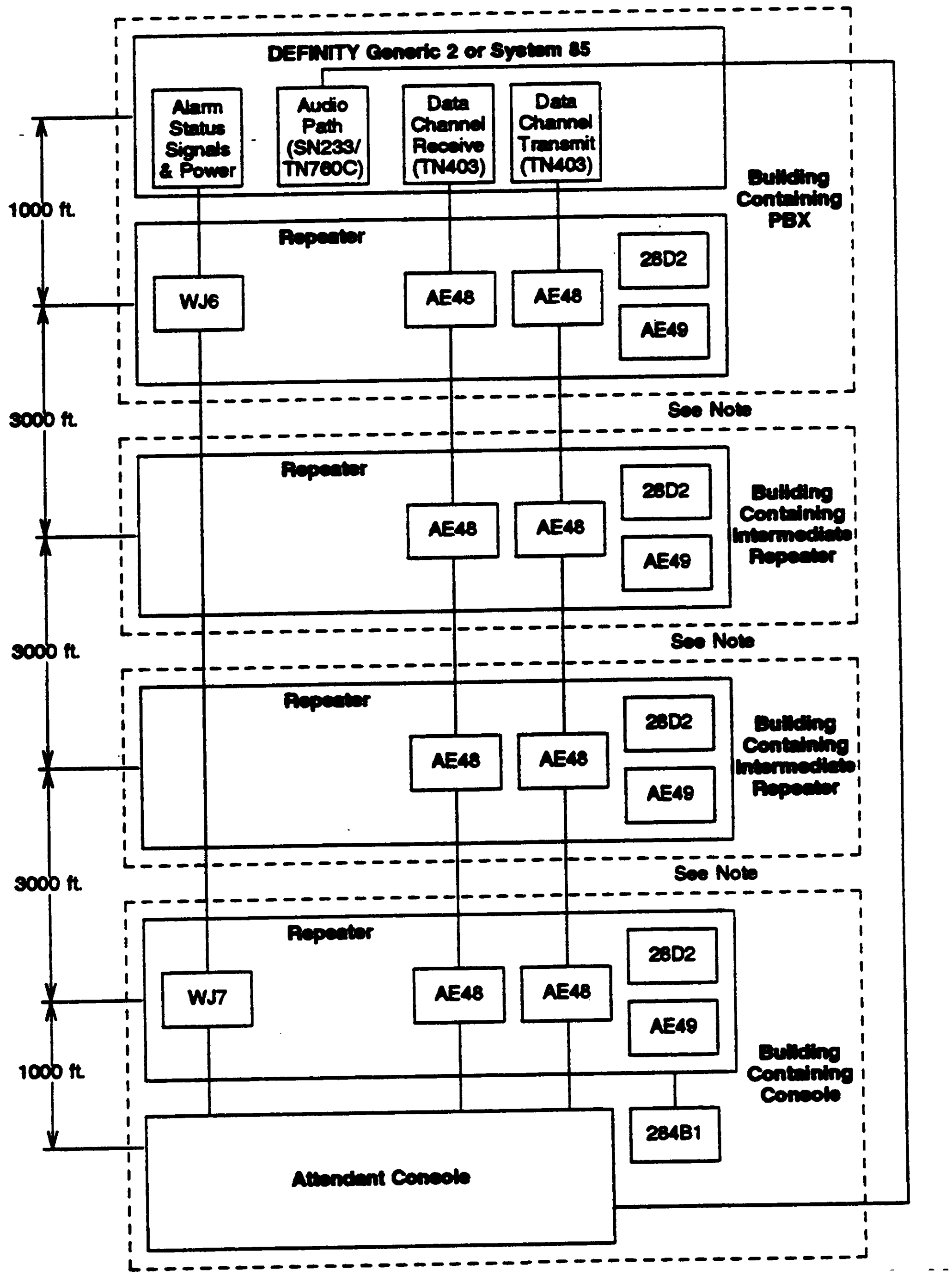


Figure 4-4. Configuration Rules for the Console Repeater

Figure 4-5 shows connections for an off-premises attendant console with range extension and intermediate repeaters. The repeater located at the console-end is usually wall mounted. The repeater located at the switch-end is mounted in the auxiliary cabinet.

All repeaters with range extension require commercial power (120-V, 60-Hz). For repeaters without range extension, only the repeater at the console-end requires commercial power.



Note: **Standard protection must be used at building entrances and exits for all exposed cable runs.**

Figure 4-5. Off-Premises Attendant Console Using Cascaded Repeaters

Connections and Location

For each attendant console, four data channel leads connect to a TN403 dual-speed channel in the common control. The audio path to the console is provided through either a TN760C or SN233C Tie Trunk/Attendant Interface port circuit. No more than two attendant consoles may be assigned to each TN760C or SN233C circuit pack.

Power for attendant consoles 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 multiplexed to each console. These leads are alarm (ALM*), acknowledge (ACK*), and alarm power (-48ACAL). They control system alarm status lamps 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.

The attendant console has a 12 pair mounting cord that connects to a 12- or 25-pair system distribution cable. The mounting cord uses a 50-pin KS-16689, L1 connector, and the distribution cable uses a mating connector.

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.

The 107A ORPI (Optically Remoted Peripheral Interface) allows up to five attendant consoles to operate at a traditional remote module location; three consoles if it is a universal remote module. The ORPI must be wall mounted—mercury orientation sensitive relays disable the unit if it’s oriented differently.

Figure 4-6 shows connections for the ORPI. The ORPI gets power (-48V) from a network cabinet and connects to one or more TN403 Low-Speed Peripheral Interface circuits at the 501CC common control. The attendant console data and alarm information from these links are sent out over fiber-optic cable to the LCIT (Lightguide Cable Interconnection Terminal). From here, it is sent along with other remote module signals to an LCIT at the remote module location. An ORPI at the remote module location connects to the remote LCIT and distributes the attendant console data and alarm information to the attendant consoles at the remote module location. Data and alarm information for up to five consoles can be sent over a single pair of fibers.

Trunks appearing on the remote location attendant consoles are TN760Cs or SN233Cs located in a port carrier in the remote module control cabinet. The remote module cabinet also supplies power (-48V) to the 107A ORPI and to the attendant consoles.

For more information on the attendant console, see *DEFINITY Communications System Generic 2 and System 85 Attendant Console User's Guide* (555-104-730).

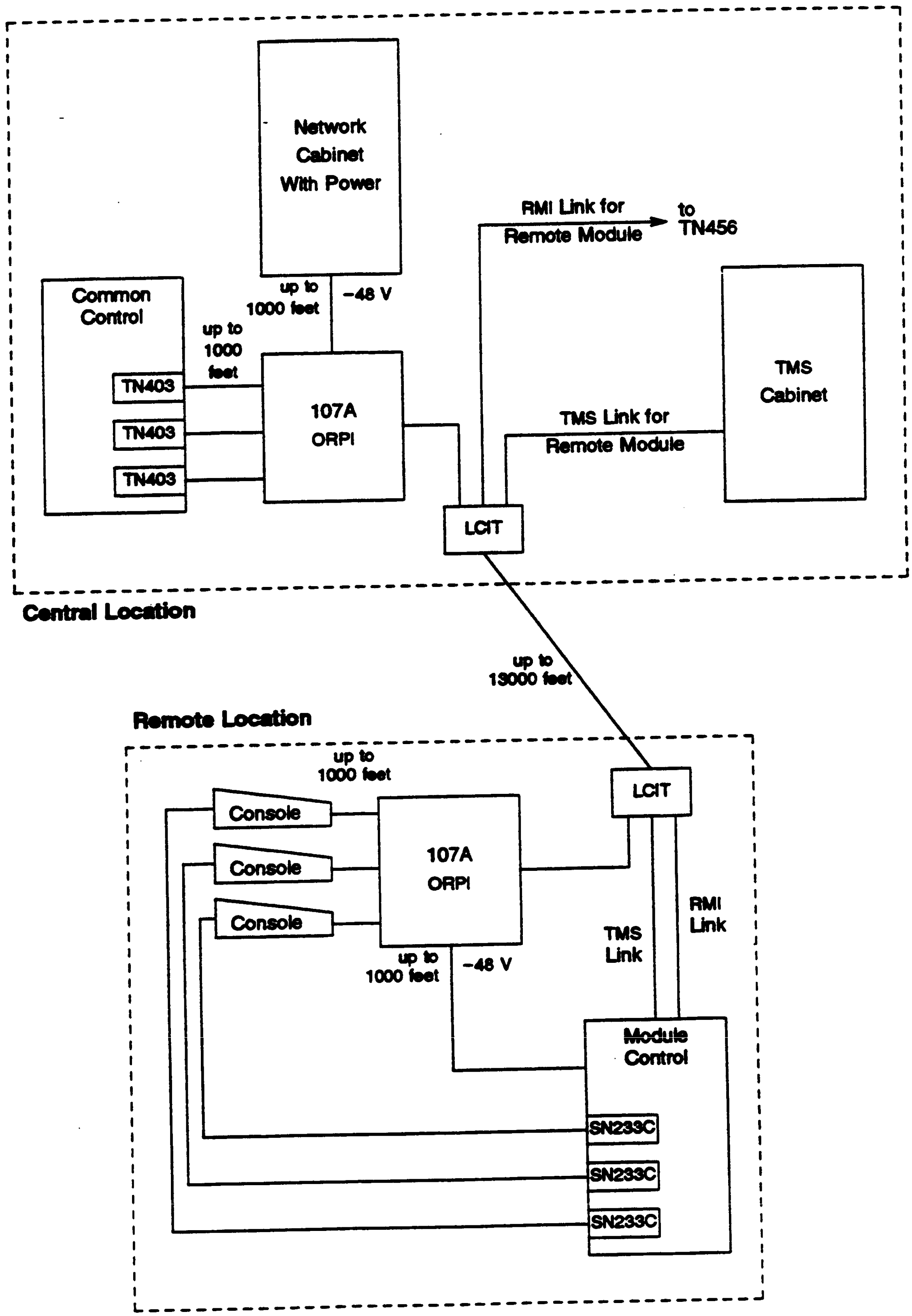


Figure 4-6. Remote Attendant Console Connectivity

Voice Terminals and Their Adjuncts

A variety of voice terminals (telephone sets) are available with Generic 2 and System 85 ranging from basic analog-type sets to multiappearance digital sets equipped with adjuncts. This section briefly describes the various voice terminal interfaces offered; information on specific models can be found in *DEFINITY Communications System and Systems 75 and 85 Terminals and Adjuncts Reference* (555-015-201).

Generic 2 and System 85 also accommodate some phone models that were sold with DIMENSION PBX, such as the model 2500 desk set and the MET (Multibutton Electronic Telephone) sets.

The voice terminals, adjuncts, and system switch interfaces conform to a modular uniform wiring arrangement. This arrangement provides for a maximum of three wire pairs from the switch interface cross-connect point (satellite closet or equipment room) to a 4-pair modular jack. The fourth wire pair provides an option for remote power for certain voice terminals.

> NOTE: At the time this document went to press, the following AT&T voice terminal models were both compatible with the DEFINITY product line and registered under FCC Part 68 rules for emergency transfer (power failure transfer) applications: model 8110, model 8102, model 7102, and 2500-type sets. Other models such as the 7400 series sets or the model 7103 analog set are not acceptable for emergency transfer use.

Electrical protection for off-premises voice terminals and their port interface circuits is accomplished by several protection methods. Primary protection consisting of carbon blocks or gas tubes is sufficient for analog voice terminals and ports. Multiappearance (hybrid or digital) voice terminals and their port interface circuit packs do not incorporate complete lightning protection. Therefore, approved protection of these "exposed" port interfaces and associated terminals is mandatory.

> NOTE: Primary electrical protection for off-premises 7300 series hybrid voice terminals and associated ANN17B port interface circuit packs is not available.

For detailed information on protection for exposed terminals and port interfaces, refer to Chapter 9, “System Engineering".

Analog Voice Terminals

Analog voice terminals require one of the following port circuit packs: an SN221B, SN222, SN228B, or SN229 for traditional modules and TN742 or TN746B for universal modules.

Hybrid Voice Terminals

System 85 offered a few series of hybrid voice terminals that used analog voice plus digital button/lamp control. Although these sets can no longer be ordered, they are supported on an in-place basis. Hybrid series include:

- 7200 Series — required SN224B MFET line port pack (not supported on universal modules)
- 7300 Series — required ANN17B line port pack (not supported on universal modules)
- MET Sets — required an SN224B (not supported on universal modules).

DCP Digital Voice Terminals

The 7400 series and the CallMaster data communications terminal are DCP digital voice terminals. Analog-to-digital and digital-to-analog conversion takes place in the set. Digitized voice samples are passed to and from the switch's SN270B or TN754B DCP digital port packs over two pair of wires. Transmission over the two pair takes place according to the DCP. This protocol allows data to be transmitted simultaneously over the same two pair used by the voice. A DCP digital voice terminal can be equipped with a data module allowing data from a nearby data terminal to be integrated with voice from the digital set.

Bridged taps are *never* allowed on 7400 series sets.

ISDN—BRI Digital Voice Terminals

Generic 2 introduces ISDN—BRI capability to the AT&T PBX family. The ISDN—BRI voice terminals initially offered with Generic 2 can be equipped with an ADM-T (Asynchronous Data Module) to provide integrated voice—data. If the ADM-T is not equipped, a (VOM-T) Voice Only Module takes its place.

The TN556 ISDN—BRI pack provides 12 ISDN—BRI ports. This circuit pack is housed in the common port carrier (in the universal module); the TN556 willnot work in traditional modules. Distance limits for ISDN—BRI sets must conform to CCITT standards; ISDN—BRI set power supplies also impose a distance limit. See Chapter 9, "System Engineering", for more information about distance limits.

All ISDN—BRI sets require power from adjunct power supplies. Because of this, adjunct power for add-ons (such as an S201 speakerphone or a 500A headset adapter) is not required. During power outages ISDN—BRI sets will continue to operate, but with reduced capabilities; this mode is called "phantom power operation."

Generic 2's ISDN—BRI offering uses the S/T interface specified in the CCITT ISDN—BRI Specification. The S/T interface requires a terminating resistor to be placed at or near the station end of a loop.

Voice Terminal Adjuncts

Speakerphones

S101A and SIO2A Speakerphones

Figure 4-7 depicts the S101A or the S102A speakerphone. These units feature an ON/OFF button for the speakerphone, an ON/OFF button for the microphone, indicator lamps, and a volume control. They are 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 7103 (DA), 7200 series (DA), 7400 series voice terminals (except for 7401 and 7404 DA), and 7500 series. The S102A is designed for use with the 7300 series voice terminal. These speakerphones cannot be used with the headset adapter option and are powered by adjunct power supplies.

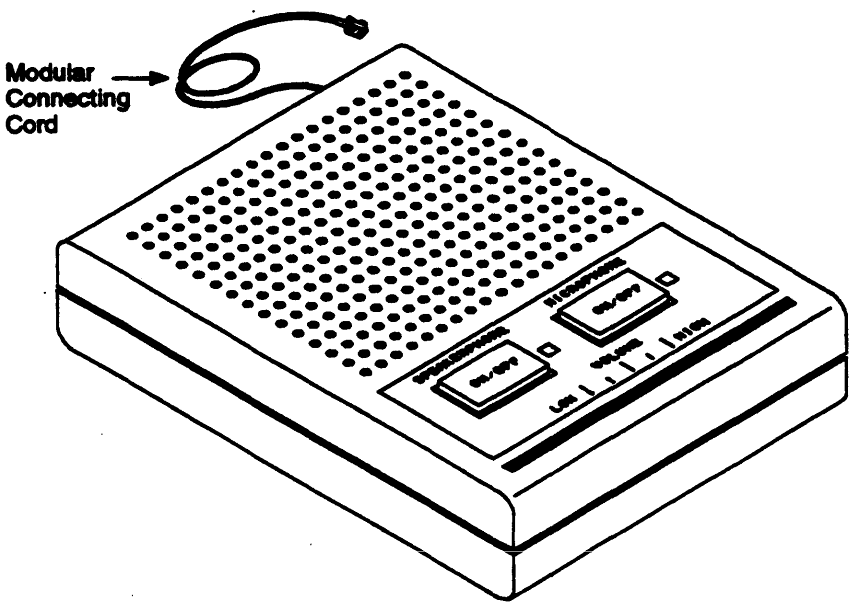


Figure 4-7. **Speakerphone (S101A/S102A)**

S201A and S202A Speakerphones

These units feature a SPEAKERPHONE button for activating and deactivating the speakerphone, a MUTE button to disable the microphone, a volume control plus a visual volume indicator. What differentiates these speakerphones from older models, such as the S101A or S102A, is improved performance. A microprocessor-controlled acoustical test is run every time the unit is plugged in, or on demand by pressing the RESET button. The results of the acoustical test are used to compensate for background noise such as fans, air conditioners, and motors.

These speakerphones are 4.75 inches (121 mm) wide, 6 inches (152 mm) deep, and 2.25 inches (58 mm) high. The S201A is designed for use with the 7103 (DA), 7200 series

(DA), 7400 series voice terminals (except for 7401 DA), and 7500 series. The S202A is designed for use with the 7300 series voice terminal. These speakerphones cannot be used with the headset adapter option and are powered by adjunct power supplies.

107-Type Loudspeaker

The 107-type loudspeaker amplifies only the received voice signal and has a rotary volume control and ON/OFF switch. This unit is 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/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.

500A and 502A 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, and OFF button, a greeen indicator lamp, headset jacks, and two modular jacks (4-wire and 8-wire keyed). The 500A adapter is designed specifically for use with the 7103 (DA), 7200 series (DA), and 7400 series voice terminals (except for 7401 and 7404 DA). It cannot be used with the speakerphone option. Power for the 500A comes from an adjunct power supply or from a power source in a satellite closet through a fourth pair of voice terminal wiring.

The 502A adapter is designed specifically for use with the 7300 series voice terminals. It uses the same phantom power from the switch (through the digital pairs) that also powers the voice terminal. This reduces the distance allowed from the switch.

Call Coverage Modules

When added to a 7205 (DA) hybrid voice terminal, the optional hybrid call coverage module, C201A (DA), 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 7205. This reduces the distance allowed from the switch.

The corresponding digital versions of the call coverage module, C401A (DA) and C401B, are attached to the 7405 (DA) or 7434 digital voice terminals. (The C401B has replaced the C401A.) 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 cannot be used with the digital display module.

Digital Display Module

When attached to a 7405 (DA) or a 7434 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. The digital display module cannot be used with the digital call coverage module.

Function Key Modules (DA)

When attached to a 7205 (DA) 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 7205 (DA). This affects the distance allowed from the switch.

The corresponding digital version of the function key module, F401A (DA), is attached to the 7405 (DA) 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.

DTDM (Digital Terminal Data Module) (DA)

The 7403 (DA) and 7405 (DA) digital voice terminals accommodate an optional DTDM (DSU 701A) (DA), 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 used in the switching network, but are multiplexed over a DCP line to a single port interface. The DTDM cannot be used with the function key module. For more detailed information, refer to DTDM (under Data Equipment and Interface Devices in this chapter).

ADM (Asynchronous Data Module)

The ADM is used in conjunction with a model 7505, 7506, or 7507 ISDN—BRI voice terminal to provide integrated voice/data. With the ADM, an attached data terminal or personal computer can send and receive data through the switch. This unit mounts in the base of the voice terminal and is used instead of the Voice Only Module—T (VOM—T). The VOM—T cannot be upgraded to an Asynchronous Data Module.

An RS-232D connector and an 8-pin jack are on the back of the ADM.

ADS (Asynchronous Data Stand) (DA)

Both the 7406 and 7407 digital voice terminals accommodate an optional ADS (Z703A) (DA), which attaches underneath the desk-mounted versions only. Wtih this adjunct, basic data communications is made possible through an EIA RS-232C interface. The ADS features default speed select, parity option switches, and a self-test switch. If the Z703A is unavailable, the 7400B data module is an effective substitute.

7400B Data Module

The 7400B data module adds integrated voice—data capability to any DCP voice terminal (7400 series and CallMaster voice terminal). This Hayes-compatible data module converts EIA RS-232 asynchronous data into DCP.

Voice Terminal Adjunct Power

Several voice terminal configurations require adjunct power to supplement the power delivered from the port circuit serving the voice terminal. The 7500 series ISDN—BRI voice terminals always-require adjunct power. Voice terminals having one or more of the following adjuncts also require adjunct power:

- Speakerphone (S101A)
- Speakerphone (S201A)
- Headset adapter (500A)
- Digital call coverage module (C401A) (DA)
- Digital call coverage module (C401B)
- Digital function key module (F401A) (DA)
- Digital terminal data module (DSU 701A)
- Asynchronous data stand (Z703A) (DA)
- Digital display module (D401A).

Power for these adjuncts (see Figure 4-8) must be provided locally at the voice terminal or from a satellite closet through the terminal wiring. The following power supplies are currently recommended:

- 2012D power supply—may be used locally or in a satellite closet to power a single headset adapter or speakerphone.
- 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. This unit has a power output of 10 watts.
- KS-21239, L4/L5 power supply—may be used locally or in a satellite closet to power a single speakerphone-dialer.
- 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 DCP voice terminal. This unit has a power output of 25 watts.
- 346A modular bulk power supply (see Figure 4-9)—may be used in a satellite closet only and is capable of supplying power to any number of adjuncts that may be added to a DCP or ISDN—BRI voice terminal. This unit provides switch-selectable options for four outputs at 10 watts or two outputs at 20 watts.
- 353A power supply—may be used locally to power ISDN—BRI sets. This 15-watt single output supply has three 8-pin modular jacks, two of which are used with Generic 2 ISDN—BRI sets (PHONE and LINE). The ISDN-BRI set must be located within 75 feet of this unit. Do not use this supply to power 7500 data modules or DCP sets.
- 945-1 bulk power supply—provides thirteen 40-volt outputs at 18 watts each. One or more BRI sets can be powered from each 945-1 output. Do not use the 945-1 to power DCP voice terminals (7400 series).

CAUTION: *The 945-1 does not provide electrical isolation among its output ports. A short on one port will short out the whole power supply.*

The 7500 series voice terminals require either the 346A power unit or the 945-1 power unit. Information on adjunct power distance limits for the 7500 series voice terminals appears in Chapter 9, "Engineering."

For other adjunct power applications, the power supply must be located within 250 feet of the voice terminal, except for the 2012D which must be located within 150 feet (45 m) of the voice terminal. 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 and 346A 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.

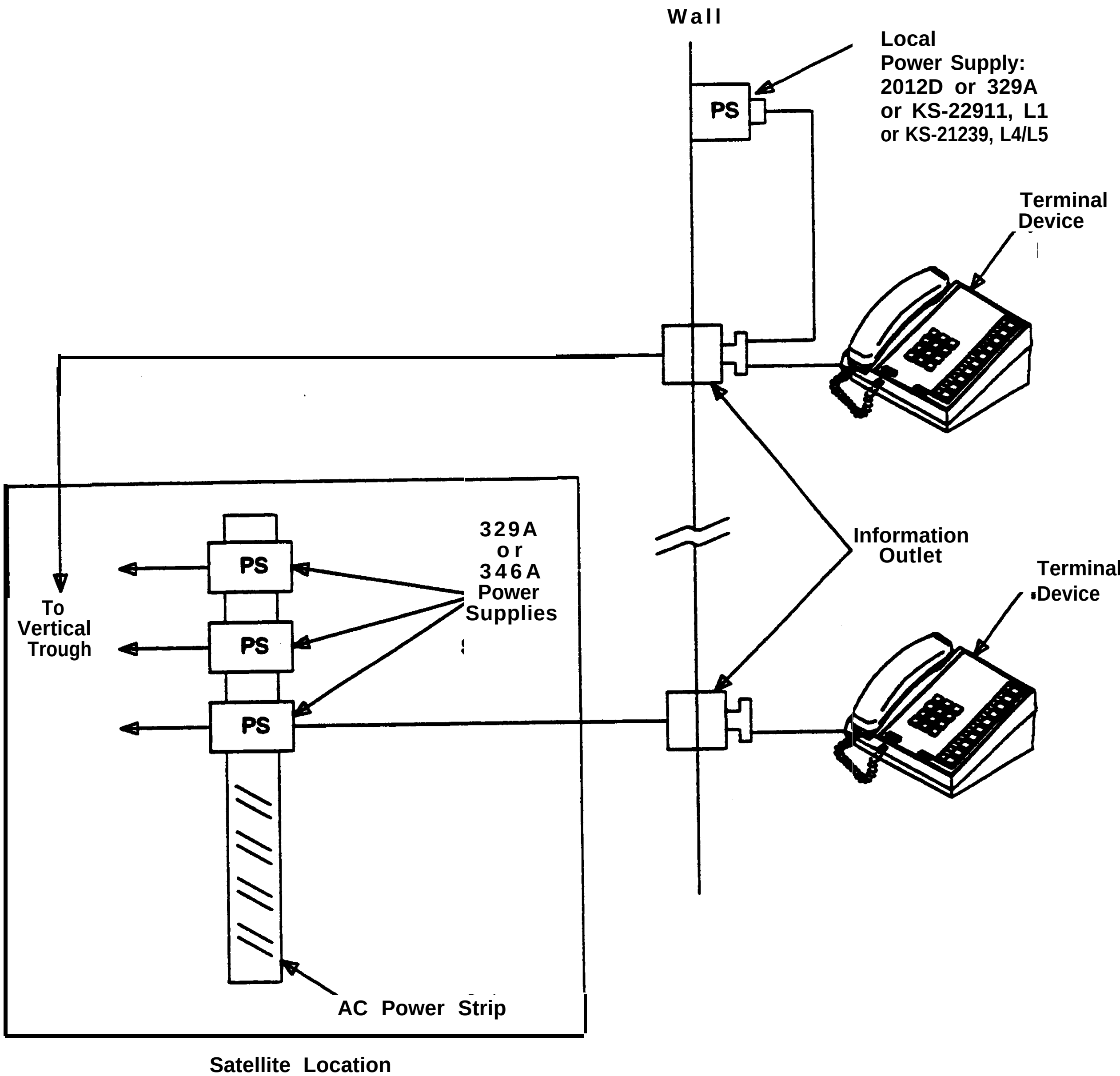


Figure 4-8. Local and Satellilte Power Sources for Voice Terminal Adjuncts

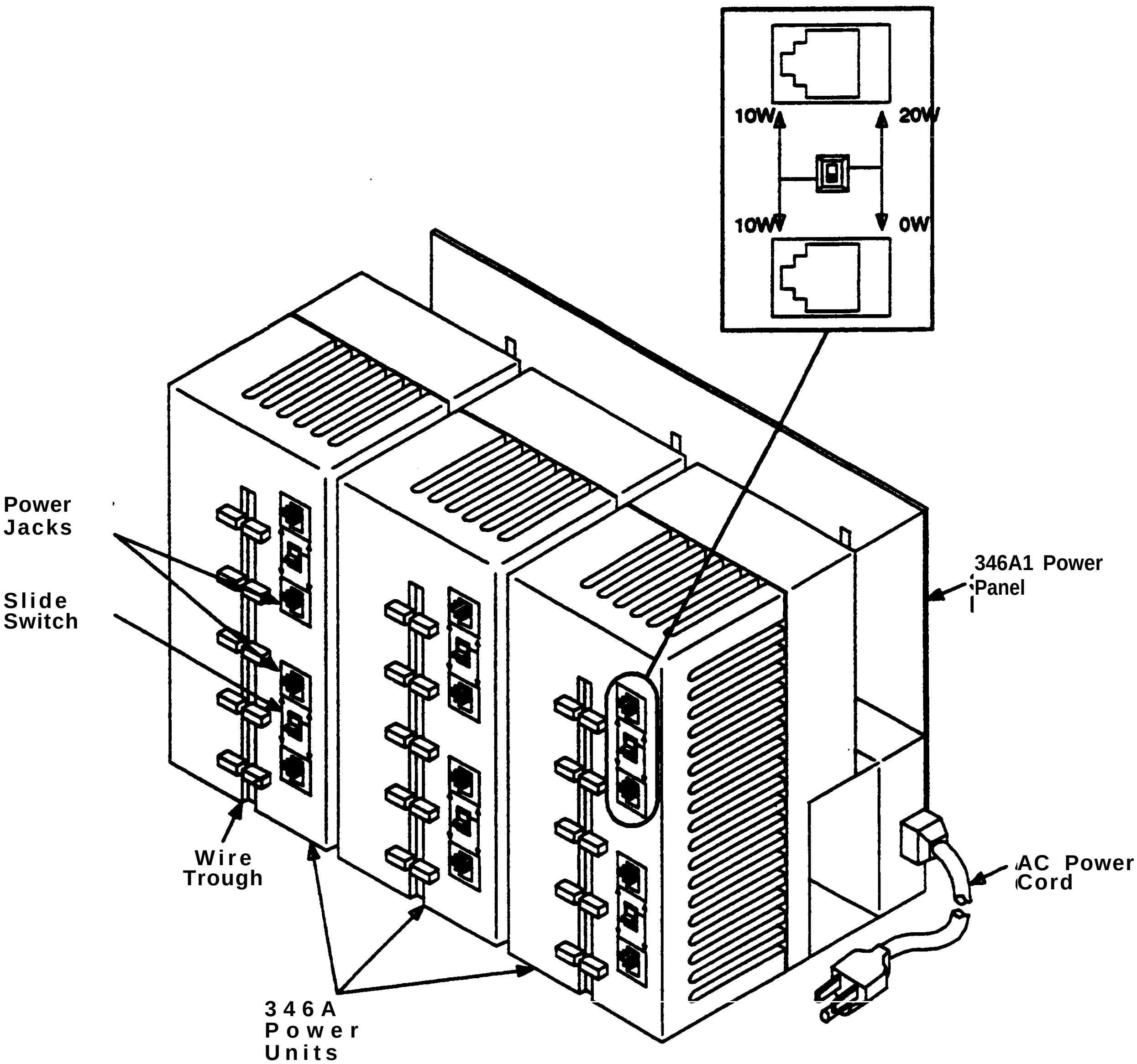


Figure 4-9. 346A Bulk Modular Power Supplies Mounted In a 346A1 Power Panel

AT&T 6500 ISDN Advantage

The AT&T 6500 ISDN Advantage integrates telemarketing programs running on a host computer with the voice capabilities of the switch. ACD agents access this information through AT&T 6538 or 6539 workstations. The host computer is connected to the switch through a 6544 controller which is served by an ISDN—PRI trunk from the switch (see Figure 4-10). Data communications between the host and specific workstations are combined with voice for those workstations and sent over DCP links. For voice, the ACD agent actually uses a DCP phone set connected to the workstation; call status and basic features such as Hold, Conference, Transfer, and Drop are accessible from the workstation. At this time, the only DCP sets approved for use with the workstation are models 7401, 7406, and CallMaster digital voice terminal. Dimensions for the 6538, 6539, and 6544 appear in Table 4-A.

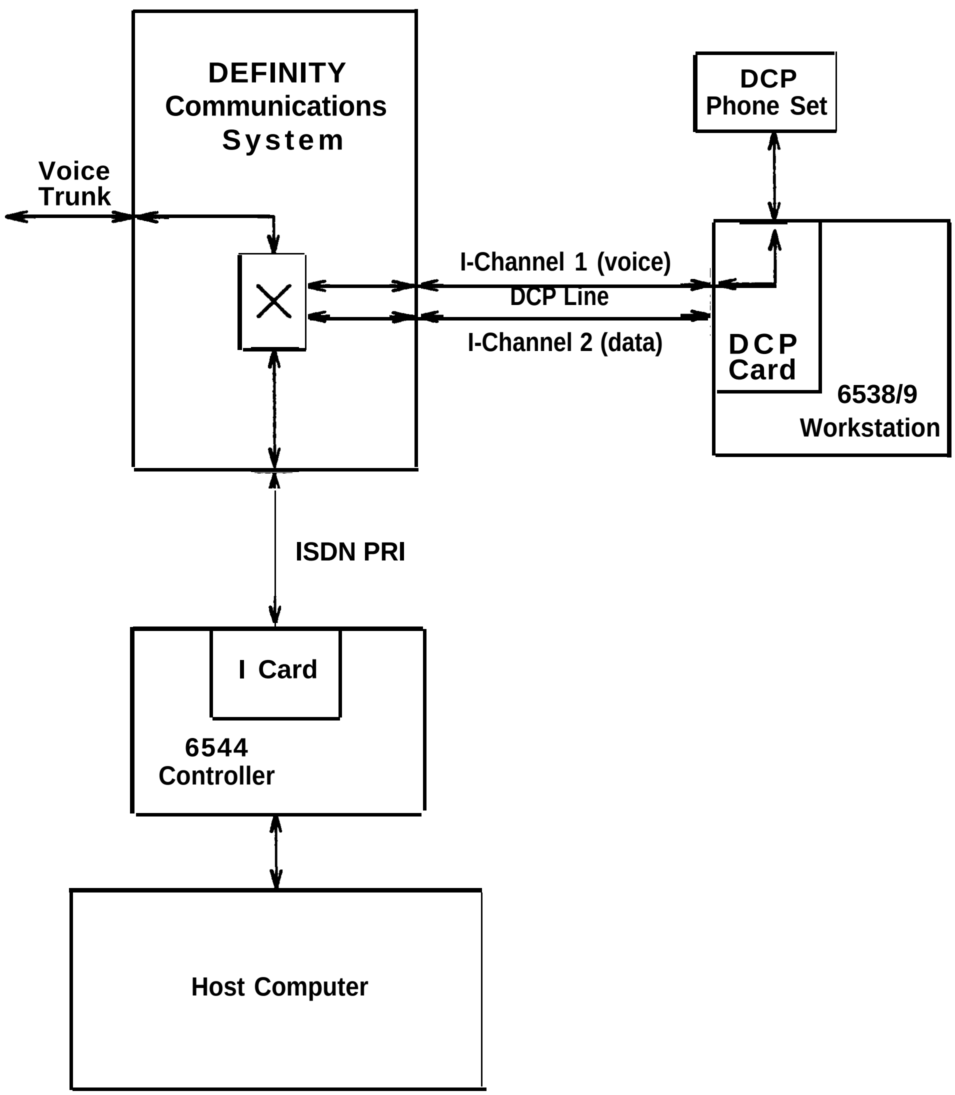


Figure 4-10. AT&T 6500 ISDN Advantage

TABLE 4-A. AT&T 6500 ISDN Advantage — Dimensions

Device	Width		Height		Depth		Weight	
	in.	mm.	in.	mm.	in.	mm.	lbs.	kg.
6538	14.5	369	16.5	420	13.0	331	29	14
6539	14.0	356	16.5	420	15.0	381	32	15
6544	22.5	572	30.5	775	20.0	508	125	57

Data Equipment and Interface Devices

Data Modules

Data modules provide protocol conversion for DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) that is digitally connected (no analog conversion) to the switching network. They provide selected EIA (Electronic industries Association) data interfaces to customer data equipment and either a DCP interface or an ISDN—BRI 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 loopback tests through the switch are supported.

DCP data modules use 2-pairwiringto connect to DCP line ports on SN270B or TN754B circuit packs. Each 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).

Generic 2 also offers ISDN—BRI data modules either in the form of a data stand used with the 7500 series voice terminals or as a stand-alone data module. The stand-alone data module, model 7500, can support two 64-Kbps data channels.

7400A Data Module

The 7400A is a Hayes-compatible and keyboard dialing-capable data module used for several applications on Generic 2 or System 85 (see Figure 4-11).

The 7400A data module, connected to Hayes-compatible modems, forms a modem pool arrangement that provides network access to asynchronous host computers via a full-duplex, asynchronous communications path.

On the desktop, the 7400A provides Hayes-compatible, RS-232 connectivity to data terminals for asynchronous communications. The 7400A is also compatible with many industry standard communications packages that use the Hayes command set.

On the trunk side of the switch, the 7400A is an alternative to the MPDM when asynchronous communications are required.

The 7400A features two port connections, one DCP line to the switch, and one RS-232 connection (for connection to an analog data set for modem pooling, a data terminal for desktop applications, and a host computer on the trunk side). In addition, the 7400A is fully backward compatible to D-lead modem pooling arrangements. Speeds from 300 to 19,200 bps are supported. Options are easily changed from the front panel.

The 7400A is 1.75 inches (45 mm) high by 8.75 inches (223 mm) deep, by 7 inches (178 mm) wide. A separate power supply is required when the 7400A is ordered as stand-alone. A mounting rack, which supports eight data modules, can be ordered. This mounting rack includes a power supply which provides power for the housed data modules.

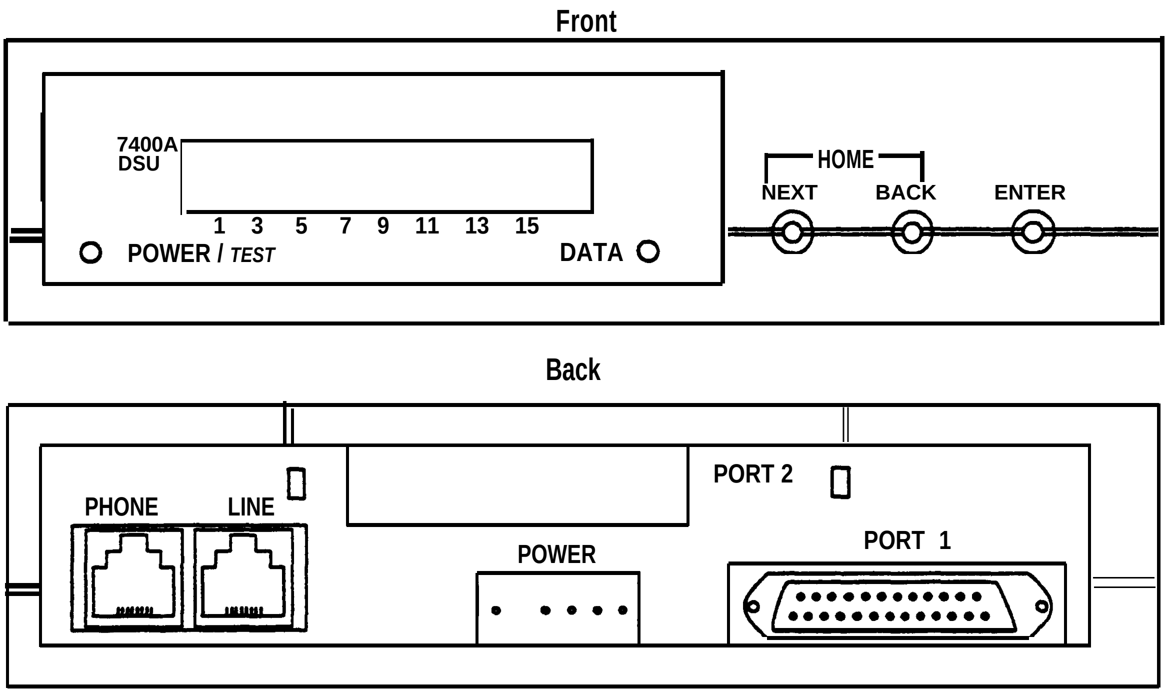


Figure 4-11. 7400A Data Module

7400B Data Module

The 7400B is a data module offering Hayes-compatible, full-duplex, asynchronous communications for DCP voice terminals installed in a Generic 2 or System 85 (see Figure 4-12). The 7400B can be used on the desktop inconjunction with a DCP voice terminal, or on the line side of the switch to provide connectivity to asynchronous host computers. Selectable asynchronous speeds range from 300 bps to 19,200 bps.

On the desktop, the 7400B provides Hayes-compatible, RS-232 connectivity to line side data terminals for asynchronous communications. The 7400B is also compatible with many industry standard communications packages that use the Hayes command set.

The 7400B at the desktop also links to any AT&T DCP 7400 series voice terminal or to the CallMaster data communications terminal providing simultaneous voice—data over a single DCP link. With the 7400B, any 7400 series set can now provide Hayes-compatible data communications through the use of one data module.

The 7400B is available in stand-alone configuration only. A separate power supply is required for each 7400B, even where power is already being provided to an associated DCP voice terminal.

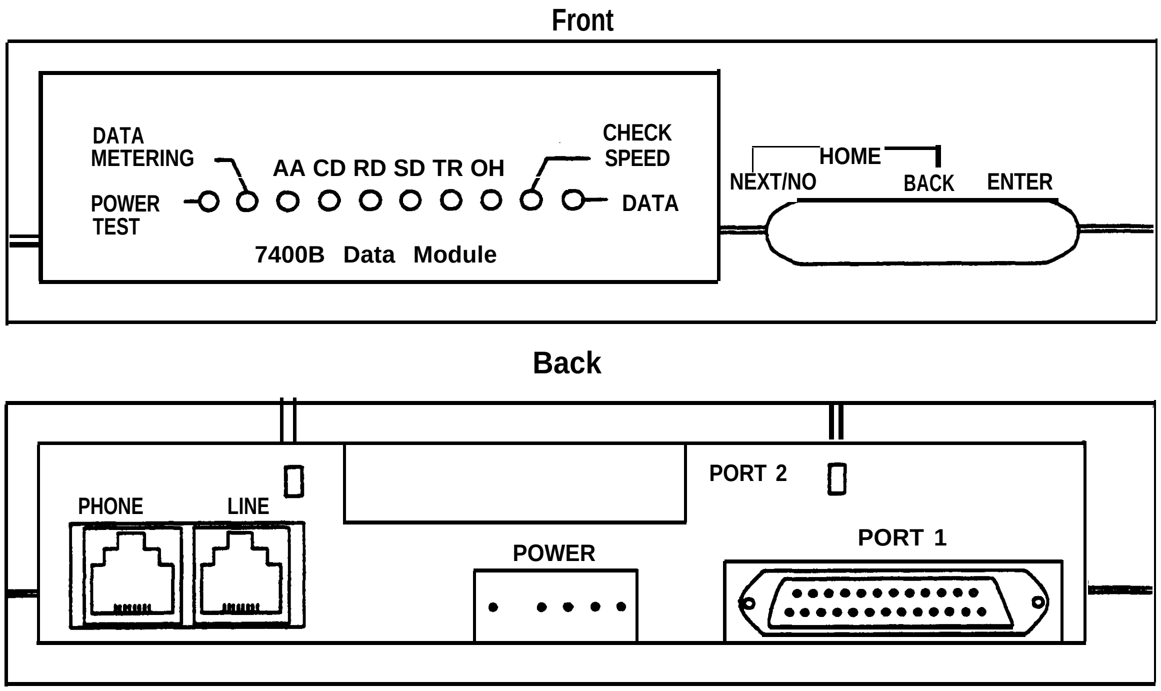


Figure 4-12. 7400B Data Module

7500 Data Module

The ISDN 7500 data module is a stand alone ISDN—BRI data module (see Figure 4-13) which provides BRI connectivity to a data terminal without an associated voice terminal.

The following modes of operation are available.

- Asynchronous Mode: The ISDN—BRI provides an asynchronous data interface in either a DTE or a DCE mode for line side applications (not including host computer access or modem pooling). In asynchronous mode, the 7500 data module uses 10-bit start/stop transmission, including a parity bit. It supports data rates of 300, 1200, 2400, 4800, 9600, and 19,200 bps.
- Synchronous Mode: To support synchronous data, the 7500 data module offers an optional low-speed or an optional high-speed enhancement board. With the low-speed board, the 7500 data module supports the same data rates supported in the asynchronous mode. With the high-speed board, the 7500 data module supports the CCITT V.35 interface at speeds of 48 Kbps, 56 Kbps, and 64 Kbps.
- ACU (Automatic Calling Unit) Operation: With an optional board, the 7500 data module can provide an EIA-RS366 interface for ACU operation.
- Packet Switched Operation: The 7500 data module can be configured to support a packet switched mode of operation. However, this option is not supported on the DEFINITY Generic 2 switch.
- ACCUNET Switched 56 digital service: The 7500 data module supports ACCUNET switched 56 digital service.

The 7500 data module and its operation are described in more detail in *Integrated Services Digital Network (ISDN) 7500 Data Module User's Manual* (555-021-703, Issue 3).

NOTE: Some operations described in terminal equipment user's manuals are not available on the DEFINITY Generic 2 switch.

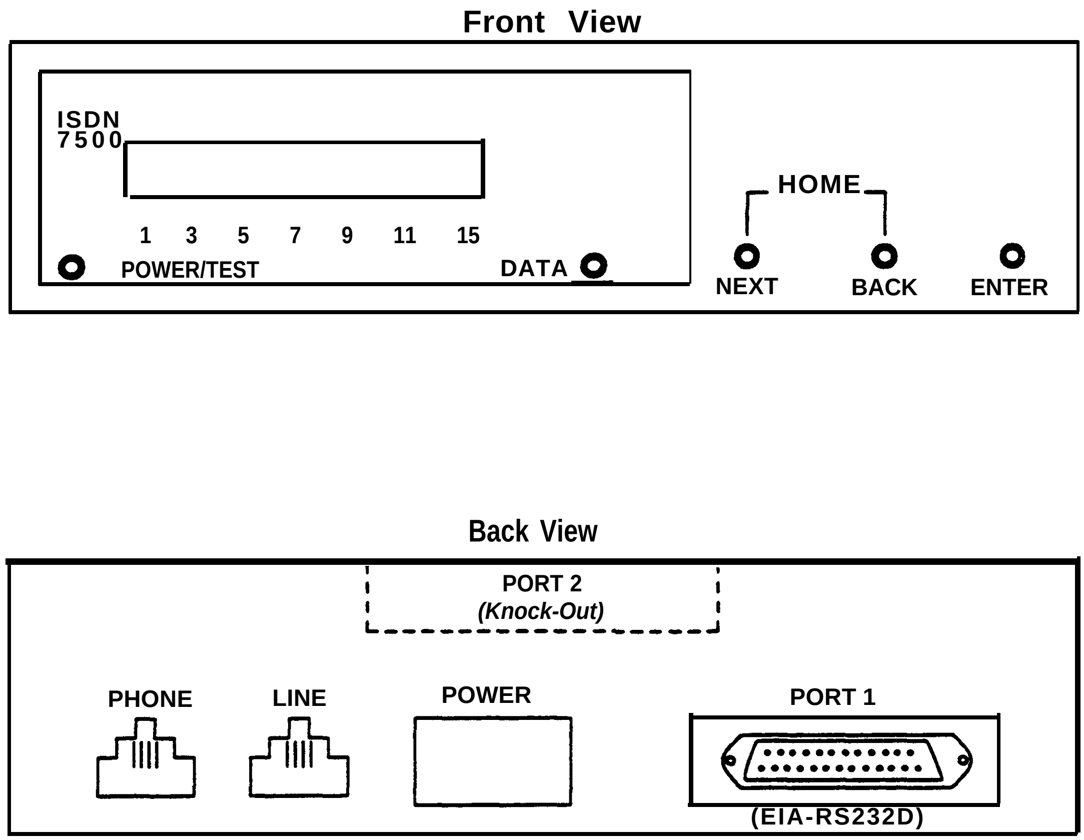


Figure 4-13. ISDN—BRI 7500 Data Module

PDM (Processor Data Module) (DA)

The PDM (DSU 700A) (DA) provides a DCE-type of EIA RS-232C-to-DCP interface to data terminal equipment. The PDM supports full- and half-duplex, synchronous and asynchronous data communicaitons. Standard asynchronous data rates supported are 300; 1,200; 2,400; 4,800; 9,600; and 19,200 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.

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 AP 16 (MD) equipped with the SDCP (Switched Digital Communications Protocol) subsystem. This arrangement allows high-speed switched access to the AP 16 from a 515 BCT (DA).

One TN754B or SN270B digital line port is required per PDM. Switch transitions allow the PDM to be assigned for either line or trunk-type access features.

The stand-alone PDM is 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (1.1 kg). The PDM may be placed in a multiple mounting (discussed later).

MPDM (Modular Processor Data Module)

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 4-14) is similar to the PDM, but contains the following modules:

- 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 ACU (Automatic Calling Unit) module—comes in one optional version. It provides the capability to emulate an ACU and supports the RS-366 iterface.

One TN754B or SN270B digital line port is required per MPDM. 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 DDD (Direct Distance Dialing) and modem pools. System translations allow the MPDM to be assigned for either line or trunk type access features.

A modified version of the MPDM provides ACCUNET switched 56 digital service access for Generic *2* and System 85. This service provides switched digital connections over the public network via 4 ESS™ toll offices. The modified MPDM is called the M1*PDM (but is sometimes referred to as the MPDM M1*1). The M1*PDM is similar to the standard unit, but has an additional option switch to operate in one of the two modes: ACCUNET switched 56 digital service access ON or ACCUNET switched 56 digital service access OFF. In the OFF mode, the M1*PDM acts as a normal MPDM for use with a Generic 2 or System 85 data terminal. In the ON mode, data endpoints operating at 56 Kbps (DCP mode 1) can interface to the Generic *2* or System 85 for access to ACCUNET switched 56 digital service. A kit is available for converting an MPDM to an M1*PDM.

The stand-alone MPDM is 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (1.1 kg). The MPDM may be placed in a multiple mounting (discussed later).

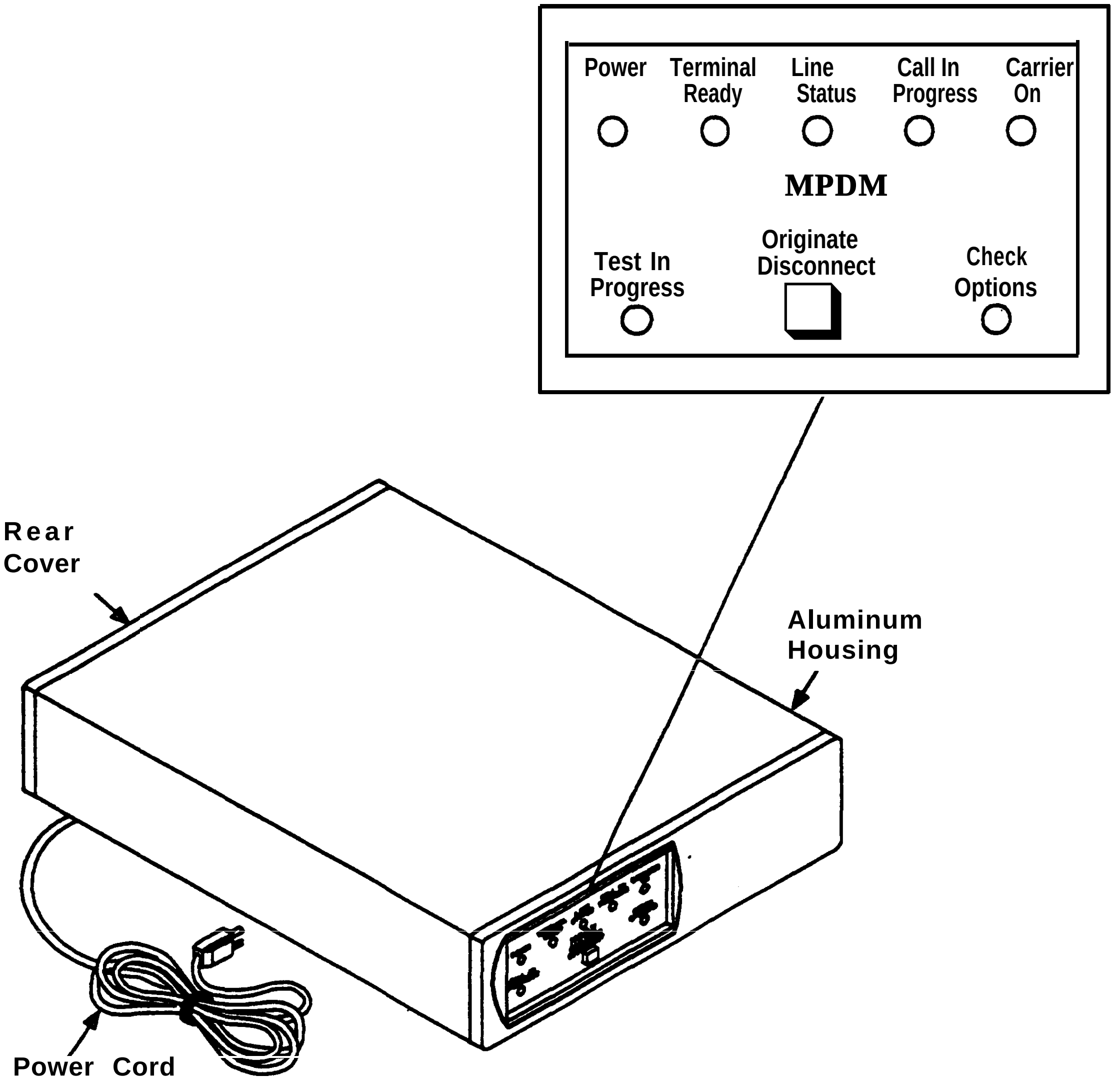


Figure 4-14. Modular Processor Data Module (DSU 700D) in Stand-Alone Housing

TDM (Trunk Data Module) (DA)

The TDM (DSU 700B) (DA) provides a DTE-type of EIA RS-232C-to-DCP interface to data service units for access to Digital Dataphone Service, private (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 syncronous data rates from 300 to 19,200 bps; and nonstandard asynchronous data rates up to 1,800 bps.

The 700C (TDM/2) (DA) has all the functionality of the 700B, plus public switched network data access. The 700C maybe used in conjunction with public switched network data sets to provide modem pooling resources for System 85 or Generic 2 (see Figure 4-15). In this application, a single conversion resource consists of a TDM and an analog data modem connectd 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.

One TN754B or SN270B digital line port is required per TDM. System 85 or Generic 2 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 (1.1 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).

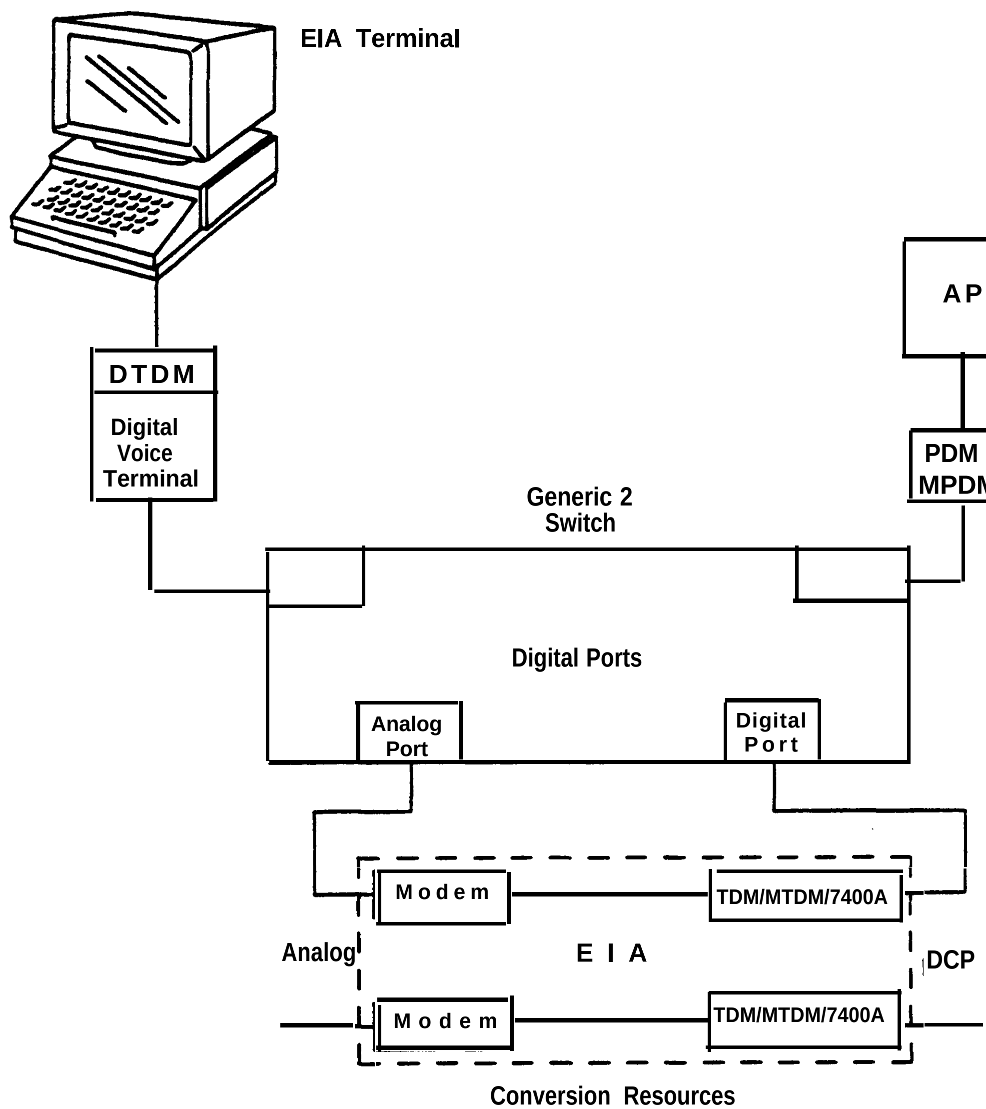


Figure 4-15. Modem Pooling

MTDM (Modular Trunk Data Module)

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 4-16) is externally similar to the TDM but contains the following modules:

- 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 TN754B or SN270B digital line port is required per MTDM Generic 2 or System 85 translations allow the MTDM to be assigned for either line or trunk-type access features.

The stand-alone MTDM is 12 inches (305 mm) long, 8.69 inches (221 mm) wide, and 2.75 inches (70 mm) high and weighs approximately 2.5 pounds (1.1 kg). The MTDM may be placed in a multiple mounting (discussed later).

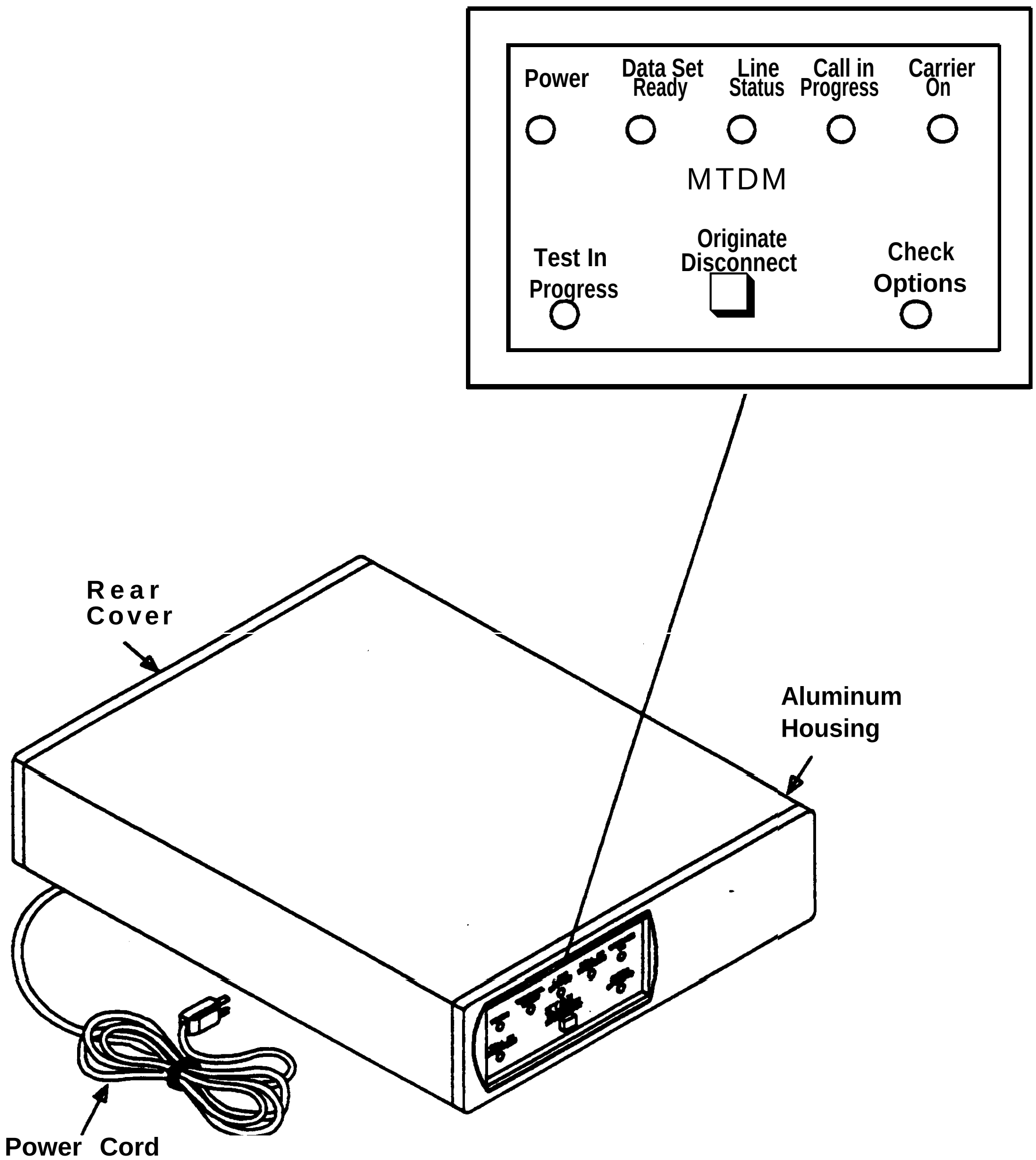


Figure 4-16. Modular Trunk Data Module (DSU 700E) in Stand-Alone Housing

DTDM (Digital Terminal Data Module) (DA)

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.

The DTDM (see Figure 4-17) operates as an adjunct to a 7403 (DA) or 7405 (DA) series digital voice terminal and is attached to the right side of the terminal. One TN754B or SN270B digital line port is required per DTDM/voice terminal combination. 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.

The DTDM is 5 inches (127 mm) wide, 8.4 inches (213 mm) deep, and 1.75 inches (44 mm) high and weighs approximately 1.75 pounds (0.79 kg).

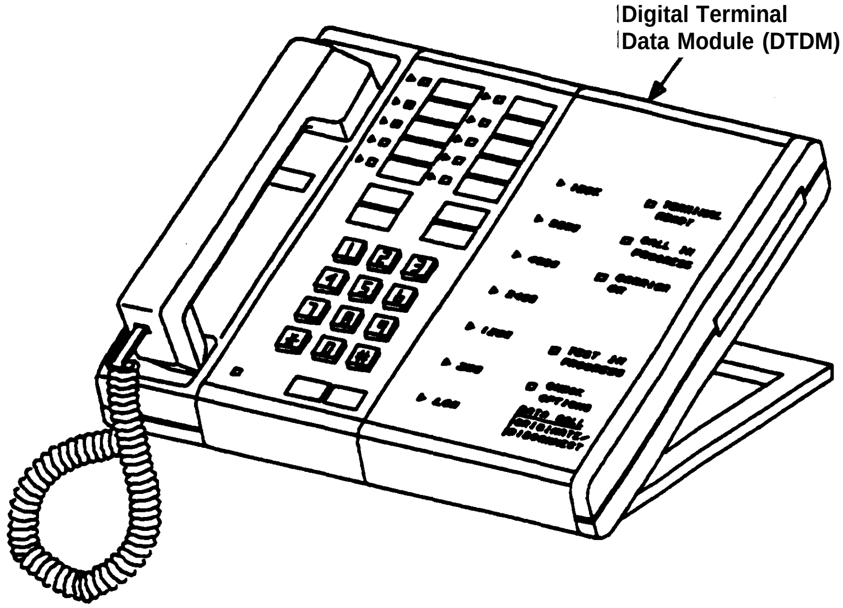


Figure 4-17. Digital Terminal Data Module (DSU 701A) Typical Application

ADM (Asynchronous Data Module)

The ADM is used in conjunction with a model 7505, 7506, or 7507 ISDN—BRI voice terminal to provide integrated voice/data. With the ADM, an attached data terminal or personal computer can send and receive data through the switch. This unit mounts in the base of the voice terminal and is used instead of the Voice Only Module—T (VOM—T). The VOM—T cannot be upgraded to Asynchronous Data Module.

The following data features are provided:

- Asynchronous full-duplex operation
- Data rates up to 19.2 Kbps

- DATA/SEND/OFF button with two indicator lamps
- Data call setup from an ASCII keyboard through an EIA RS-232D interface
- Ability to change options without dropping the data call
- Automatic or manual answering of incoming data calls
- Remote and local loopback test
- Local mode operation for option setting and call control via terminal keyboard

An RS-232D connector and an 8-pin modular jack are on the back of the ADM.

ADS (Asynchronous Data Stand) (DA)

Both the 7406 and 7407 digital voice terminals accommodate an optional ADS (Z703A) (DA), which attaches underneath the desk-mounted versions only. Wtih this adjunct, integrated voice—data communications are made possible through an EIA RS-232C interface. The ADS features default speed select, parity option switches, and a self-test switch. If the Z703A is unavailable, the 7400B data module can provide integrated voice—data for the 7406 or the 7407.

Summary of Data Rates and Interfaces Supported

7400A DCP Data Module	Asynchronous, full duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. This model is Hayes-compatible and comes with a DCE-type RS-232D interface.
7400B DCP Data Module	Asynchronous, full duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. This model is Hayes-compatible and comes with a DCE-type RS-232D interface. GA is scheduled for 10/31/89.
7500 BRI Data Module	Asynchronous, full duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Synchronous data is optionally supported with a low-speed card which provides speeds up to 19.2 Kbps or with a high-speed card which provides 56 Kbps or 64 Kbps. This model is Hayes-compatible and comes with a DCE-type RS-232D interface.
ADM ISDN—BRI Data Stand	Asynchronous, full duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. This model comes with a DTE-type RS-232D interface.
ADS (Z703A) (DA) DCP Data Stand	Asynchronous, full, duplex, at 300 bps, 1200 bps, 2400 bps, 2800, bps, 9600 bps, or 19.2 Kbps. This model comes with a DTE-type RS-232C interface.
DTDM (DSU 701A) (DA) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. This model comes with a DTE-type RS-232C interface.

MPDM (DSU 700D) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. Additional synchronous speeds of 56 Kbps (half duplex) and 64 Kbps (full duplex) are supported. This model will work with ACCUNET switched 56 digital service access. The MPDM can be equipped with a DCE-type RS-232C interface, RS-449C/RS-422C interface, RS-366C, or CCITT V.35 interface.
MTDM (DSU 700E) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. Additional synchronous speeds of 56 Kbps (half duplex) and 64 Kbps (full duplex) are supported. The MTDM can be equipped with a DTE-type RS-232C interface.
PDM (DSU 700A) (DA) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. Synchronous speeds of 56 Kbps (half duplex) and 64 Kbps (full duplex) are available if the high-speed option is configured. This model comes with a DCE-type RS-232C interface.
TDM (DSU 700B) (DA) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. This model comes with a DTE-type RS-232C itnerface.
TDM/2 (DSU 700C) (DA) DCP Data Module	Synchronous or asynchronous, full- or half-duplex, at 300 bps, 1200 bps, 2400 bps, 2800 bps, 9600 bps, or 19.2 Kbps. Asynchronous full- or half-duplex at nonstandard speeds up to 1800 bps. This model comes with a DTE-type RS-232C interface.

Data Module Power and Mountings

Data modules do not receive power from the switch port circuit. They will not operate 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 7403 (DA) or 7405 (DA) 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 under Voice Terminal Adjunct Power earlier in this chapter.

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 call-outs for vertical mounting (see Figure 4-18). 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 is 19 inches (483 mm) wide, 8.7 inches (221 mm) high, and 14.9 inches (378 mm) deep and weighs 22 pounds (10.0 kg) unloaded and 40 pounds (18.1 kg) loaded with eight modules.

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	*	X
700D MPDM		X	X
700B TDM	X	*	X
700C TDM/2	X	*	X
700E MTDM		X	X

* Physically mounts in 70A2, but leaves open area at back of housing and is not recommended.

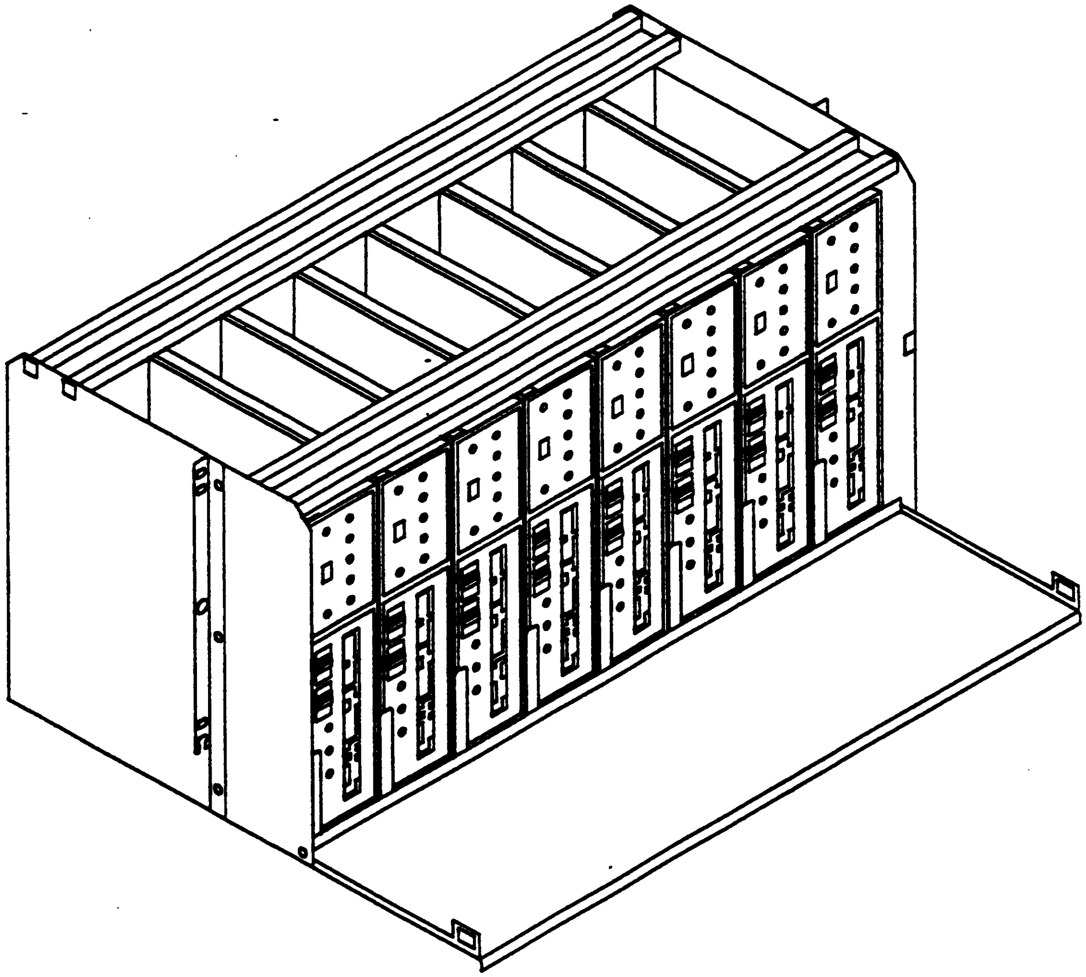


Figure 4-18. Data Modules in Multiple Mounting Rack (71A1)

Modems (Data Sets)

Modems are devices that provide conversion from digital signals to analog signals and vice versa. Also referred to as data sets, these devices are 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. Modems provide an RS-232C interface to the data equipment and a tip and ring interface to transmission facilities. These modems can be used along with TDM/MTDMs to provide conversion resources for the Modem Pooling feature. The following is a list of switched access modems:

Modem	Duplex	Synchronization	Data Rate (bps)	Mode
103JR	Full	Asynchronous	low (up to 300)	originate/answer
212AR	Full	Asynchronous Synchronous	300 or 1200 1200	originate/answer (autobaud) originate/answer
201CR	Half	Synchronous	2400	originate/answer
208BR	Half	Synchronous	4800	originate/answer
2224A	Full	Asynchronous Synchronous	300, 1200, 2400 1200 or 2400	originate/answer originate/answer
2296A	Full	Asynchronous Synchronous	4800 or 9600 4800 or 9600	originate/answer originate/answer

ADU (Asynchronous Data Unit)

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 and immunity to noise, and exhibits low error rates.

The ADU (see Figure 4-19) is enclosed in a small housing with a 25-pin plug and 8-pin modular jacks. It is 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 Generic 2 or System 85 EIA port interface circuits (TN726 or SN238) allow switched access between Generic 2 or System 85 and EIA terminals, printers, and host computer ports. 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 hard-wired 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. The maximum distance between the TN726 or SN238 at the switch end and the ADU at the device end depends on the data rate used:

Data Rate (bps)	Nominal Maximum Range In Feet (Meters)	
	24 AWG	26 AWG
19,200	**2,000 (610)**	**2,000 (610)**
9,600	**5,000 (1,524)**	**4,500 (1,370)**
4,800	**7,000 (2,134)**	**6,000 (1,824)**
2,400	**12,000 (3,657)**	**10,000 (3,048)**
1,200	**20,000 (6,096)**	**16,000 (4,876)**
300	**40,000 (12,192)**	**30,000 (9,144)**

The following versions of ADUs are available, each with unique connector arrangements:

ADU	RS-232C Interface	Two-Pair Data Interface
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**

*** Intended for use with ISN (Information Systems Network).**

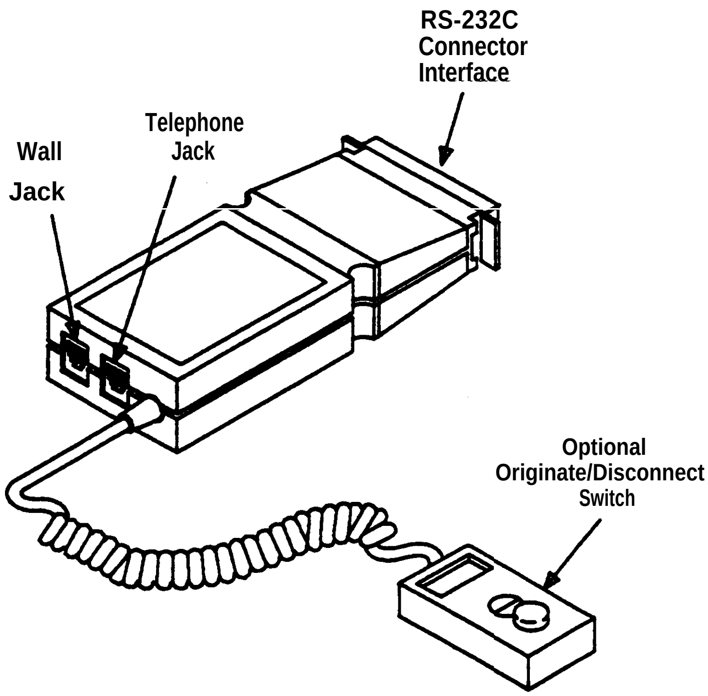


Figure 4-19. Asynchronous Data Unit (Z3A)

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 LADC (Local Area Data Channel) II rules and they allow the data pairs to be located in the same cable with other voice and DCP lines. By using LADC, RS-232 distance limitations are overcome, and the need for separate wiring to handle the high signal levels of typical EIA interfaces is eliminated. 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.

No self-tests or loopback tests to the TN726 or 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).

MADU (Multiple Asynchronous Data Unit)

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 m 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 or a DTE device to the MADU. The MADU sends the converted information 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 DTR (Datat Terminal Ready) 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 individualized circuit packs (106A)
- M48C or M48G octopus cables 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 4-20). Like the ADU, it can be hard-wired with ADUs to interface data terminals directly to a host computer, or it can be connected to Generic 2 or System 85 through an EIA port circuit pack (TN726 or 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.

In a stand-alone configuration, a single MADU is placed horizontally; its dimensions are 1.65 inches (42 mm) high and 7.67 inches (195 mm) wide. This configuration is cost-effective if ony 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).

Miscellaneous Peripherals

DEFINITY Manager II

The DEFINITY Generic 2 and System 85 switches use a series of programs called Procedures to change translations. With System 85, devices such as the MAAP (Maintenance and Administration Panel) and the SMT (System Management Terminal) were used to access the Procedure programs. With generic 2, these devices are replaced with the DEFINITY Manager II, a PC (Personal Computer) based administration and maintenance tool. Manager II has three modes of operation: basic, enhanced, and task. (Information about these modes appears in Chapter 7.) One Manager II is required per system.

DEFINITY Manager II requires a PC running version 3.2, or later, of the MS—DOS operating system. The PC also needs 640K RAM, one floppy disk drive, a hard disk drive, one RS232-C serial port, and one 25 by 80 character display (color is desireble). If a color monitor is selected, it must be CGA (Color Graphics Adapter) compatible. A hard disk with at least 10 Megabytes of available space is desirable. Compatible AT&T PC models include the 6286 WGS, 6300 WGS, 6312 WGS, and the 6386 WGS. PCs configured with two floppy disk drives will also work but are not recommended.

Another Generic 2 enhancement is the Disk/Tape System (DTS) which replaces the HCMR (High Capacity Mini Recorder). In addition to storing a copy of all system translations, the DTS also stores a copy of the SSB (Switch Support Base) which the DEFINITY Manager II uses for the enhanced mode. The SSB can be downloaded to the Manager II if necessary.

The DTS uses the TN563 to connect to the 501C system bus. The TN563 also provides two ADU (Asynchronous Data Unit) compatible ports, both of which can be used by Manager II. For duplicated common controls, the first ports from each TN563 are wired together so that the Manager II will automatically be connected to the on-line common control. Even though the TN563 asynchronous ports operate at speeds of up to 19.2 Kbps, the 501CC does not process administrative and maintenance programs much faster than it did in System 85, R2V4. The 19.2 Kbps link is mainly useful for downloading the SSB file from the DTS.

DEFINITY Manager II can also connect to the switch through the TN492C remote port. The TN492C is the circuit pack that has been traditionally used for dial-up administration and maintenance access to System 85. Data rate for the TN492C is limited to 1200 bps. Also, the DTS cannot download the SSB to the DEFINITY Manager II over a TN492C remote port connection. When this type of connection is used, the SSB must already be loaded on the PC in order to use enhanced mode or task mode; in this situation, the SSB is usually loaded (initially) from a floppy disk containing a copy of the SSB. More information about connecting Manager II appears in Chapter 7.

SMT (System Management Terminal)

The SMT (J58889K) is a System 85 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 is approximately 16 inches (406 mm) long and 8.25 inches (210 mm) wide and 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 key pad
- 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:

- MAAP (Maintenance and Administration Panel), RMATS-II (Remote Maintenance, Administration, and Traffic System II), or TCM (Terminal Change Management) 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 System 85 R1 SMT is fully compatible for System 85 R2 use, but in System 85 R1 required an external interface unit (ED-1E440) which is not needed for System 85 R2. Installation for the System 85 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—SMT Administration Management—User's Guide* (555-103-501).

---

* In Generic 2, DEFINITY Manager II replaces both the SMT and the MAAP.

MAAP (Maintenance and Administration Panel)

The MAAP (J58889J) is a System 85 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 contains a 12-button key pad 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 LEDs that indicate alarm and operational status.

The MAAP plugs into a MAAP connector on the common control cabinet alarm panel 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.

Flipcharts are attached to the MAAP and serve as a quick reference for each of the numbered administration and maintenance PROCs (procedures). 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—Feature Translations—Service Manual* (555-104-107). For more detailed information on using the MAAP for maintenance procedures, refer to *AT&T System 85—Maintenance—Service Manual* (555-103-108).

FADS (Force Administration Data System) Terminal

The FADS terminal is used to display call traffic data for the CAS (Centralized Attendant Service) and/or UCD (Uniform Call Distribution) features. The FADS display terminal includes:

- A 12-button key pad 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. Force administration data for call distribution splits in System 85 R2V2 and later is available through the CMS (Call Management System) feature.

Position Status Indicators

The Position Status Indicator unit (106B1-A) provides a display (see Figure 4-20) of operational status for call distribution (ACD/EUCD/UCD) answering positions. An agent's status can not be displayed by more than one 106B1-A. 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.

The 106B is 12.3 inches (313 mm) wide by 3.5 (89 mm) inches deep by 6 (153 mm) inches high, including the base. The display portion of the 106B1-A is tilted back approximately 10 degrees for easier viewing.

Each 106B1-A requires 2 ports on a TN735 or an SN224 port pack. The 106B1-A must be within 700 feet (210 meters) of the switch for 24 AWG wire or within 1100 feet (335 meters) of the switch for 22 AWG wire.

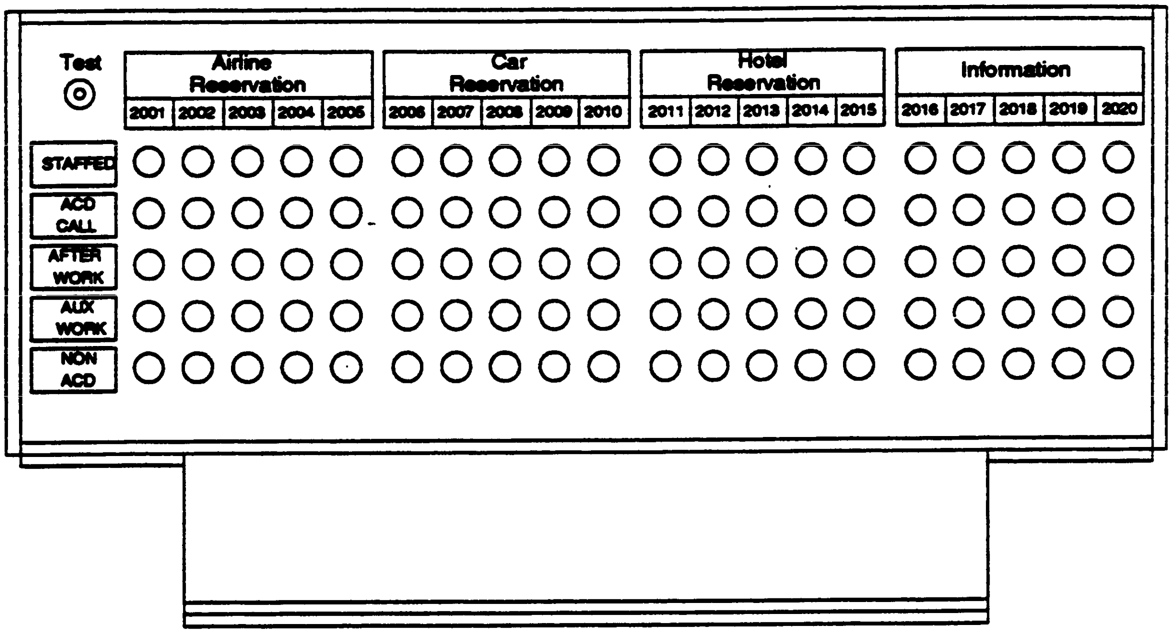


Figure 4-20. Position Status Indicator Unit ((106B1-A)

(SSI) System Status Indicator

The SSI unit (30A8) contains lamps that indicate the status of the following:

- ACD/EUCD/UCD calls
- CAS(Centralized Attendant Service) calls.

These indicators function as monitoring devices and provide the following information:

- Busy/Idle status of trunks or splits
- 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 SSI unit (see Figure 4-21) contains eight lamps and their associated circuitry. The unit is 650 inches (165 mm) wide, 3.125 inches (79 mm) high, and 5.25 inches (133 mm) deep. It is available in either black or ivory and can be desk or wall mounting.

With traditional modules, the 8-port SN241 contact interface circuit pack is used. For universal modules, a custom work order is required to support the 30A8.

ACD

The SSIs used for ACD/EUCD/UCD calls may require up to eight units (64 indicators). These indicators monitor the queue warning status of splits for ACD/EUCD/UCD. Sixty indicator lamps monitor the queue warning level and the remaining one indicates a system reload.

CAS

SSIs for CAS calls may be used at both branch and main locations.

Main Locations

A maximum of 15 SSI units (with eight indicators per unit) can be used at any Generic 2 or System 85 main location. When the maximum number of units is in use, the indicators are assigned as follows:

- 110 indicators to monitor 110 RLTs (Release Link Trunks)
- Four indicators to monitor the following system status information:

  Control — Indicates that the system is in Regular (CAS active) mode or either Backup Voice Terminal mode or CAAVT mode.

  Overload — Indicates that the queue threshold has been reached or exceeded

If the maximum number of 110 RLTs and the overload and control functions are to be monitored, 15 SSI units are required as follows:

- 14 units to monitor the 110 RLTs (leaving two indicators unused)
- One unit to monitor two or all of these indicators: overload and control.

Branch Locations

A maximum of three SSI units can be used at any Generic 2 or System 85 branch location. When the maximum number of units is in use, the indicators are assigned as follows:

- Two units (16 indicators) to monitor 16 RLTs
- One unit (8 indicators)—four indicators are used to indicate overload and control.

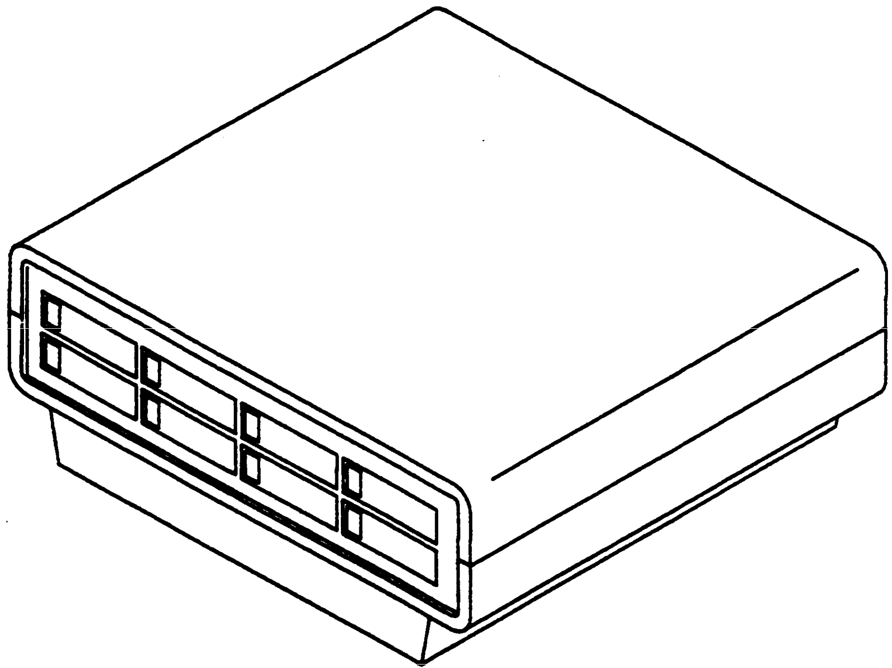


Figure 4-21. System Status Indicator Unit (30A8)

Auxiliary Equipment

36A Voice Coupler

The 36A voice coupler connects Generic 2 or System 85 to music, voice, or other signals generated by customer equipment that is not registered with the FCC. The 36A refines these signals by:

- Suppressing out-of-band signals (low-pass filtering)
- Limiting the power of the remaining signal
- Passing the signal through a hybrid circuit to minimize longitudinal imbalance.

The 36A also provides hazardous voltage protection.

The following features use the 36A voice coupler:

- Automatic Call Distribution: the 36A provides an interface between the system and 13A-type announcement channels.
- Intercept Treatment—Recorded Announcement: the 36A provides an interface between the system and 13A-type announcement channels.
- Music-On-Hold Access: the 36A provides isolation between the switch and the music source.
- Queuing: the 36A provides isolation between the switch and the optional music source.
- Radio Paging Access: the 36A connects the J58824CD trunk interface unit to the radio paging transmitter.
- Recorded Telephone Dictation Access : the 36A connects the J58827E-1 recorded telephone dictation trunk unit to the dictation recording unit.

The 36A voice coupler is a wall-mounted unit that is 4.7 inches (11.9 cm) by 7.0 inches (17.8 cm) by 2.0 inches (5.1 cm). It has seven connection screw terminals and one screw switch. Table 4-B lists connections for the 36A.

TABLE 4-B. 36A Voice Coupler Connections

Connectors	Comments
T & R	Tip and Ring which are used to terminate a tip and ring pair from the Generic 2 or System 85; usually from a TN763C or an SN231 auxiliary trunk.
CT, CR, & GRD	Customer Tip, Customer Ring and Ground which are used to terminate a tip and ring pair and a ground wire from the customer equipment.
AC & ACG	AC and AC Ground which are used to receive AC power from a 2012D transformer.

The screw switch is shipped from the factory in the closed (down) position. In this position, the signal output level on T and R is limited to -9 dBm. In the open (up) position, signal output level on T and R is limited to -15 dBm.

For more information on the 36A, see *36A Voice Coupler—Identification, Installation, Connection, and Maintenance* (463-332-140).

89A Control Unit

The 89A control unit is an interface device which allows Generic 2 or System 85 to seize a customer-provided loudspeaker paging or code calling access amplifier. When the 89A is in its idle state (not seized by the switch and not in the "busy-out" mode), it can connect a customer-provided music source to the amplifier. Customer-provided tones can be sent through the amplifier when the 89A is idle or when the 89A is seized by the switch. Two leads going into the 89A allow it to be placed in the "busy-out" mode. In this mode, the switch is unable to seize the 89A. The switch detects busy-out mode through the busy-out indication leads from the 89A.

The 89A control unit balances and equalizes audio input received from switch before sealing it on to the customer-provided amplifier. The control unit also has on-board volume controls for customer-provided music and tone sources. Another feature of the 89A is an optional click suppression mode which minimizes objectionable disconnect clicks at the end of voice pages. Click suppression is provided by placing switch S2 on the 89A in the open (out) position.

The 89A control unit is 11 inches by 9 inches by 2.5 inches.

The following features use the 89A control unit:

- Code Calling Access: the 89A provides an interface between the switch's auxiliary tones circuit (TN768 or SN253C) and the customer-provided amplifier.
- Loudspeaker Paging Access: the 89A provides an interface between the switch's auxiliary trunk (TN763B or SN231) and the customer-provided amplifier.

NOTE: These two features can use the same customer-provided amplifier if the 89As are connected in a lock-out arrangement. Lock-out prevents the two features from seizing the amplifier simultaneously. See *DEFINITY Communications System Generic 2 and System 85 Installation* (555-104-104) for more information.

Table 4-C lists 89A control unit connections.

More information about the 89A control unit can be found in *89A Control Unit—Identification, Installation, Connection, Operation, and Maintenance* (463-332-130).

TABLE 4-C. 89A Control Unit Connections

Connectors	Comments
AC1 & AC2	AC input. These leads accept input from a 2012D transformer. One 2012D can power up to three 89As.
BSY1 & BSY2	Busy indication output. These leads go active when busy-out is in effect.
CBS1 & CBS2	Seizure indication. These output leads are connected to customer provided equipment to indicate whether the switch has seized the 89A.
CMS1 & CMS2	Music input. These input leads are connected to a customer-provided music source. They present an input impedance of 45k Ω and accept AC signals from 0.1 volts to 60 volts.
COS1 & COS2	Busy-Out input. These leads connect to a relay which prevents the 89A from sending an output signal to the customer-provided amplifier. (Approximately 20 Ω of protection resistance is in series with the relay contacts.) When the relay is tripped, a busy indication signal is sent out over BSY1 & BSY2. If switch S3 is in the closed (in) position, these leads cannot stop output from reaching the amplifier until the PBX releases the 89A. If S3 is open (out), these leads stop output immediately.
CT & CR	Audio output to customer-provided amplifier. These leads have an output impedance of 600 Ω.
CTS1 & CTS2	Tone input. These input leads are connected to a customer-provided tone source. They present an input impedance of 45K Ω and accept AC signals from 0.1 volts to 60 volts.
PG1 & PG2	PBX seize input. The PBX uses these leads to deliver a seize signal to a relay in the 89A. (Approximately 20 Ω of protection resistance is in series with the relay contacts.) A DC signal ranging from 6 to 60 volts (+ or -) is required to seize the 89A.
T & R	Audio input. These leads accept audio input (a tip and ring pair) from the PBX. They present an input impedance of 600 Ω. Optionally, switch S1 on the 89A can be put in the open (out) position to provide an input impedance of 15K Ω. This high impedance setting allows a number of 89As to be connected in parallel.

278A Adapter

The Malicious Call Trace feature uses this unit to interface an auxiliary trunk circuit to a customer-provided tape recorder. Since the 278A only accepts -24 V DC, a D181321 kit of parts (converts -48 V to -24 V) must be ordered as well.

The 278A is also used with the Loudspeaker Paging Access feature to interface to a customer-provided amplifier. The D181321 kit (comcode 105031181) is also required. This arrangement can be used instead of the 89A control unit.

The 278A is installed in the auxiliary cabinet and requires a 5.4-inch by 5.0-inch mounting space on a foam panel. The D181321 kit contains a 42A connector block which requires a 2.0-inch by 2.0-inch mounting space adjacent to the 278A.

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.

Auxiliary Cabinet

The auxiliary cabinet houses miscellaneous equipment required by the switch to implement various features. Details about the auxiliary cabinet appear in *Chapter 9 — System Engineering.*

CPFT (Customer Premises Facility Terminal) Equipment

The CPFT equipment (J99380) provides transmission and signaling range extension for the system line and trunk circuits. This equipment consists of MFT (Metallic Facility Terminal) 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 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.

Customer Service Unit (CSU)

The CSU, or NCTE (Network Channel Terminating Equipment), is a piece of customer premises equipment that is always required when connecting to network-provided metallic transmission facilities. The CSUs is also required for some customer premises applications. For example, if the on-site distance between the two endpoints is such that office repeaters or line repeaters are required, then CSUs or their equivalent must be used.

NOTE: The CSUs are generally not required when nonmetallic facilities such as fiber and microwave are used.

Features provided by most CSUs include:

- 4-Wire bipolar signaling that conforms to the DSX-1 interface specification
- DS1 signal input monitoring and, when necessary, adding pulses (1s) to ensure the 1s-density requirements are met
- Bipolar violation removal (which implies incompatibility with B8ZS line coding) although this feature may be optional on some CSUs
- Termination of the DS1 rate facility and regeneration of received data using an office repeater
- Supplemental DC power to the DS1 rate facility to power line repeaters if necessary
- A fault-locating jack to aid in testing repeaters on the DS1 rate facility
- Jacks for manually looping the CSU and aiding in maintenance testing
- A DC-activated remote (i.e., toward the far-end) loopback relay.

Other optional features include in-band loopback control and the ability to pass bipolar violations.

The most frequently used CSUs are the 551V and the 551V ST (manufactured by Verilink Corporation). The 551V has a maximum transmit distance (toward the System 75/G1/85/G2 switch) of 85 feet. Therefore, when this type CSU (the 551V) is used, the DS1 rate interface should be optioned/administered accordingly. The 551V ST has a maximum transmit distance (toward the System 75/G1/85/G2 switch) of 655 feet. Exact distance settings are usually determined at installation time and by configuring the CSU's user selectable option switches. Switch option selection must be coordinated with the particular switch DSl rate interface. Other vendor-provided CSUs may have distance limitations different from those for the 561V and 551V ST.

For most types of CSUs, the critical circuitry (e.g., network protection and 1s-density enforcement) is normally line-powered from the CO using a 60-mA current loop. If power from the CO is not available, then power must be provided locally. The type of power required (120 V AC or -48 V DC) generally depends upon installation/engineering specifications and on the CSU being used; refer to the Installation and/or User's manual for the particular CSU. The CSUs noncritical circuits (e.g., error monitoring, alarming, etc.,) are always powered locally.

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 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).

Emergency Transfer Panel

The model 808A emergency transfer panel provides five bypass circuits to support the power failure transfer feature. During normal switch operation, -48V DC power from the alarm panel keeps the 808A's power failure detection relays open. During a power failure or major system failure the 808A operates as follows:

- Upon failure, the power failure detection relays close enabling the bypass circuits.
- Each bypass circuit directly connects a designated model 8110, 8102, 7102, or 2500-type analog voice terminal to a central office (CO) trunk. The switch is completely bypassed.
- When a voice terminal connected to the 808A goes off-hook during bypass, circuitry inside the panel places signaling on the CO trunk causing the CO to return dial tone. Each 808A bypass circuit can be optioned for either loop-start or ground-start signaling.

Should power be restored to the relays while a call connected through the 808A is in progress, the 808A maintains the connection until the user goes on-hook. This is an improvement over the model 574-5 emergency transfer panel which simply drops all calls in progress when power is restored. Unlike the older 609A transfer panel, the 808A panel doesn't require the voice terminal user to operate a signaling key. Each 808A can handle up to five CO trunks.

The model 574-5 panel, manufactured by Porta Systems Corporation, supported the power failure transfer feature before the AT&T model 808A became available. Operation for the 574-5 is essentially the same as 808A operation except that the 574-5 immediately drops all calls in progress when power is restored.

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.

IDI (Isolating Data Interface)

The IDI (105A) is a small connection unit for point-to-point, synchronous, full-duplex operation between the DCIU and an external processor. The DCIU and the external processor can be up to 400 feet apart. One IDI connected to an external processor provides an economical substitute for two synchronous LADSs (Local Area Data Sets). Like a pair of LADSs, 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 (300 through 19,200 bps) and uses timing from the DCIU as the controlling time source. The IDI is powered entirely from the EIA interface through control signals.

ISN (Information Systems Network) Interface

The ISN interface provides enhanced EIA RS-232C trunk connectivity to the ISN with a colocated high-speed packet switch. This interface is provided through ETA ports, ADUs (Asynchronous Data Units), and an ISN concentrator.

The ISN concentrator multiplexes 40 EIA ports (TN726 or 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 Generic 2 or 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 19,200 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 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 switch or by a remote switch with DS1 trunks to the local switch.

LADS (Local Area Data Set) (DA)

The LADS (DA) interfaces the System 85 switch DCIU (Data Communications Interface Unit) with an external processor, such as an AP, AUDIX, or another DCIU. The LADS also provides required ground isolation between the common control cabinet (containing the DCIU) and the external processor. Two LADSs per external processor are required to provide this interface. (Please note that a single 105A IDI may be substituted for two LADSs.) Each LADS contains:

- A transmitter with filtering and modulation—allows data transmission at speeds from 2.4 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.

Radio Paging Interface Equipment

Radio paging interface equipment connects the switch to customer-provided radio paging equipment. The J58824CD L7, L12, L16, and L17 Interface Trunk Circuit is always required. Additional equipment is required if the radio paging transmitter provides individual paging. With individual paging, a J59204CA touch-tone receiver and a J58824CD L15 touch-tone to DC signal converter must be provided. These units take touch-tone signals, entered by the paging user, and convert them to DC signals; the radio paging transmitter uses these DC signals to alert (beep) a specific paging receiver. Table 4-D lists the interface equipment.

TABLE 4-D. Radio Paging Interface Equipment

Equipment Code	Description
J58824CD, L7 & L16	These two list items are part of PEC 65237. List 7 is a basic radio paging interface trunk unit used to connect a radio paging unit to two TN747B or SN230 ground start trunk circuits in the switch. In addition to providing two tip and ring paging ports, the interface unit connects tones to the paging user from an TN768 or SN253C auxiliary tones circuit. The List 7 interface unit also controls any other equipment that is provided. List 7 is 8 by 23 inches and mounts on a standard 3-inch relay rack. List 16 adapts List 7 for use with Generic 2 or System 85. List 16 is 2 by 23 inches and mounts on a standard 23-inch relay rack.
J58824CD, L12 & L17	These two list items are part of PEC 65237. List 12 provides two answer-back channels. These channels are connected over tip and ring pairs to two TN747B or SN230 ground start trunk circuits in the switch. List 17 adapts List 12 for use with Generic 2 or System 85.
J58824CD, L15	List 15 adds individual paging capability by converting touch-tone signals from the paging user to DC signals (2-out-of-7 arrangement) which are sent to the radio pager. A J59204CA, L1 G1-type touch-tone receiver must also be ordered whenever this List 15 unit is provided. These units are required only for radio paging transmitters which support individual paging. List 15 is 6 by 23 inches and mounts on a standard relay rack.
J59204CA, L1	G1-type touch-tone receiver. Required only when J58824CD, L15 is provided.
36A Voice Coupler	Provides a conditioned tip and ring interface to the radio paging unit. This unit ensures compliance with FCC Part 68 rules. The 36A requires a 2012D power transformer.
TN747B or SN230	Ground start trunk. Four trunk circuits are required to supply two paging channels and two answer-back channels.
TN768 or SN253C	Auxiliary tones circuit.

Table 4-E describes the connections from the J58824CD, L7 radio paging interface trunk unit to the switch and to the radio pager.

TABLE 4-E. J58824CD, L7 Radio Paging Interface Trunk Connections

Connectors	Comments
ER1 & ER2	Equipment ready (from the radio pager).
RLS & RLS1	Release (to radio pager).
AK1 & AK2	Acknowledgement. Closed by the radio pager when the last digit necessary has been received.
RLS2 & RLS	Release (to radio Pager).
AT1 & AT2	Time out (from radio pager).
S1 & S2	Seizure (from switch paging trunks).
IS1 & IS2	In service. Closed whenever the radio pager is working.
PS1 & PS2	Pulsing (not used).
T&R	Tip and ring. From switch paging and answer-back trunks.

For more information on radio paging interface equipment, see *Interface Trunk Circuit—J58824CD Interface Trunk Unit* (463-332-120, Issue 4).

Recorded Announcement Sets

Recorded announcement sets deliver pre-recorded announcements to callers. A caller may be diverted to a recorded announcement during a call handled by any one of these features: Automatic Call Distribution, Call Vectoring, Enhanced Uniform Call Distribution, or Intercept Treatment. The two types of recorded announcement sets are available for use with Generic 2 or System 85:

- KS-65270 single channel digital announcer and KS-65272 4-channel digital announcers
- 13A digital announcement system.

KS-65270 and KS-65272 Digital Announcers

The KS-65270, L12 Single Channel Digital Announcer with battery backup and remote recording capability stores one digitally encoded message up to 32 seconds long. A 64-second memory expansion kit is also available (PEC 65275); up to two of these kits may be installed.

The KS-65270 requires:

- An TN763C or SN231 auxiliary trunk circuit
- A TN742, TN746, SN228B, or SN229 line circuit (for remote recording capability).

A KS-65272, 4-Channel Digital announcer is also available. It has the same capabilities as the KS-65270; in fact, a PEC 65276 3-channel adder kit can be used to upgrade the KS-65270 to a 4-channel unit. The basic 4-channel unit comes with 64 seconds of recorded memory which provides 16 seconds per channel. A PEC 65275 64-second memory expansion kit can be installed in the 4-channel unit; the kit provides an additional 16 seconds per channel. Should more memory be required, a PEC 65274 extended memory addition kit provides extra memory chip sockets plus 64 seconds of additional memory; there are enough empty sockets to accommodate an additional five PEC 65275 64-second memory expansion kits for a total of 512 seconds of memory (128 seconds per channel).

The KS-65272 requires:

- Four TN763C or SN231 auxiliary trunk circuits (one circuit pack)
- A TN742, TN746, SN228B, or SN229 line circuit (for remote recording capability).

13A Announcement System

The 13A stores digitally encoded announcements in magnetic bubble memory for subsequent retrieval. A single 13A set can be equipped to handle up to eight separate announcement channels, each of which can handle messages from 3 to 24 seconds long. The 13A requires no battery back-up provisions since its magnetic bubble memory is nonvolatile. Whenever possible, a KS-65272 or the KS-65270 digital announcer should be used in place of the 13A.

Recorded Telephone Dictation Interface Equipment

The interface equipment required for recorded telephone dictation depends on the capabilities of the dictation recording unit and whether dictation is being originated from a telephone that uses rotary dialing. If the dictation recording unit can interpret touch-tone commands, then the only equipment required is an TN763C or SN231 auxiliary trunk at the switch and a 36A voice coupler; the 36A is not required if the recording unit is FCC registered. If the dictation recording unit cannot interpret touch-tone commands, then a TN763C or SN231 auxiliary trunk and a J58827E-1, L1 recorded telephone dictation trunk unit are required. The recorded telephone dictation trunk unit must also be equipped with a J59204CA touch-tone calling receiver and a J58827E-1, L2 touch-tone translation unit if dictation is to be given from a touch-tone telephone. This conversion equipment is required because the J58827E-1, L1 recorded telephone dictation trunk unit only recognizes dial pulse signals. But, if dictation is to be given from rotary phones only, the touch-tone equipment is not needed. Table 4-A lists equipment codes for J58827E-1 and other equipment which may be required.

Table 4-B describes the connections from the J58827E-1, L1 recorded telephone dictation trunk unit to the switch and to the dictation recording unit.

For more information on recorded telephone dictation interface equipment, see *Recorded Telephone Dictation Trunk Circuit—PBX and Key Telephone Applications* (463-332-110, Issue 4).

TABLE 4-F. Recorded Telephone Dictation Interface Equipment

Equipment Code	Description
J58827E-1, L1 & L7	These two list items are part of PEC 65241. List 1 is a basic recorded telephone dictation trunk unit used to connect a telephone dictation recorder to an TN763C or SN231 auxiliary trunk in the switch. This unit converts dialed digits (dial pulses) from the voice terminal (or touch-tone translation unit) into control signals which are sent to the dictation recorder. This unit is 4 inches by 23 inches and can be mounted on a 23-inch relay rack. List 7 provides wiring and equipment for List 1.
J58827E-1, L2 & L8	List 2 is a touch-tone translation unit used to convert touch-tone signals from the touch-tone receiver to dial pulse signals which are used by the recorded telephone dictation trunk unit. This unit is 2 inches by 23 inches and can be mounted on a 23-inch relay rack. List 8 provides a cable assembly required for List 2.
J58889N	Frequency generator and frequency interrupter
J59204CA, L1	G1-Type touch-tone calling receiver equipped with circuit packs HJ16, HJ17, and AE46. This receiver collects touch-tone digits from voice terminals and forwards them to the touch-tone translation unit. The touch-tone receiver can terminate two dictation trunks. One HJ16, one HJ17, and one AE46 is required for each dictation trunk. (A J99289C touch-tone calling receiver can be used in place of the J59204CA.)
36A Voice Coupler	Required if the dictation recording unit is not FCC registered. The 36A requires a 2012D power transformer.
TN763C or SN231	auxiliary trunk
TN768 or SN253C	auxiliary tones circuit

TABLE 4-G. J58827E-1, L1 Connections

Connectors	Description
T00 & T10	To TN768 or SN253C auxiliary tone circuit
B&G	Ready-for-use (from recorder)
CT & CR	Maintenance test line
C1, C2, C3, & C4	Correction (to recorder)
E1, E2, E3, & E4	End of message (to recorder)
PB & G2	Playback key (to recorder)
PB1, PB2, PB3, & PB4	Playback (to recorder)
PB5 & C	End-of-playback from machine
S1 & S2	Start-Stop (to recorder)
T, R, & S	Voice circuit and signaling lead to TN763C or SN231
T1 & R1	Attendant telephone
TT & TR	Two-Way voice circuit (to recorder)

Synchronization Clock

The Synchronization Clock provides a Stratum 3 clock interface for use with the DS-1 and ACCUNET digital services of the System 85 and Generic 2 switch. The Stratum 3 specification is a more accurate clock than what is provided on the current SCS (System Clock Synchronizer) service.

The Synchronization Clock includes the following equipment:

- The Stratum 3 clock unit
- A duplicated -48 volt DC power source
- One or two TN2131 interface circuit packs (depending on system configuration)
- Miscellaneous cabling.

The Stratum 3 clock unit and the power source are installed in a standalone cabinet (a modified AUDIX small cabinet).

The TN2131 clock interface circuit packs are used instead of the standard TN463 SCS circuit packs. You must have one TN2131 circuit pack per module control carrier in a single module system or one TN2131 circuit pack per TMS basic carrier in a multimodule system. If the module control carrier or the TMS basic carrier are duplicated, two TN2131 circuit packs are required.

Common cabling is used from the clock unit housed AUDIX small cabinet to the cabinet housing the module control carrier or the TMS basic carrier. Special cabling is used from the skin of the cabinet to the TN2131 clock interface circuit pack(s).

The Synchronization Clock is available as a duplicated system only. This includes two clocks and two output boards with ten circuits on each board. An unduplicated system is not available at this time.

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 used for remote access. 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.

3B Call Management System

The 3B Call Management System (3B CMS) is a software product used by customers who receive a large volume of telephone calls through the Automatic Call Distribution (ACD) feature. The 3B CMS software runs on a 3B2 and receives ACD information from the switch through a DCIU link.

The 3B CMS compiles this information, formats it into call-related categories, and stores it in a database that can be viewed on-line by the customer. The customer can monitor the real-time ACD activities to determine if the ACD should be reconfigured to provide the most efficient service possible for the calling public.

A 3B CMS environment consists of the following major components:

- 3B CMS software
- AT&T 3B2 computer and peripheral equipment
- Switch with the ACD feature—3B CMS also works with DEFINITY Generic 1 and System 75.
- Data link—The 3B2 Computer communicates with the DEFINITY Communications System Generic 2 or the System 85 through the DCIU.

AP (Applications Processor) Equipment

Features that require an AP are no longer sold. Most of the functions provided by those features are now available as part of separate product offerings, each of which require their own adjunct processor. For example, the capabilities provided by the Call Detail Recording and Reporting feature—this feature ran on the AP16—have been replaced by the 6386 CDRU which is a call detail recording product that runs on a 6386 processor.

3B2 Computer

Features that require an AP are no longer sold. Most of the functions provided by those 3B2 computer can be ordered.

3B2 computers use a 32-bit WE* 32000 series microprocessor to run the UNIX* System V operating system. The 3B2 line provides user level object code compatibility among other 3B2 models, the 3B5, the 3B15, and the 3B4000. Any of the 3B2 models maybe equipped with 3BNET, a high-speed local area network that is compatible with the ETHERNET † local area network.

All 3B2 models, except for the 3B2/300, accept (Small Computer System Interface) compatible peripherals and come with a single-ended SCSI host adapter card.

* Registered trademarks of AT&T

† Registered trademark of Xerox Corporation

The 3B2 computer line offers a wide range of computing capabilities.

3B5 AP (DA)

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. This product is no longer available. Several 3B2 or 6386 models make suitable replacements.

For more detailed information on the 3B5 AP, refer to *3B5 AP—System Description — Reference Manual* (585-210-201).

AP16 (DA)

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 several microprocessor-based subsystems. This product is no longer available. Several 3B2 models make suitable replacements.

For more detailed information on the AP16, refer to *Applications Processor 16—Reference Manual* (585-201-201 or 999-700-407).

AUDIX Voice Messaging System

AUDIX is a voice mail and voice messaging system. Two models are available:

- One-Cabinet AUDIX
- Two-Cabinet AUDIX.

The AUDIX-Large (AUDIX-L) has been discontinued, although upgrades to newer AUDIX software releases are available.

The following is a high-level summary of AUDIX equipment. For a more complete description of AUDIX and its features, see *AUDIX Reference* (585-300-201).

One-Cabinet AUDIX

The one-cabinet AUDIX model, formerly called the AUDIX-S, is housed in a single, half-height cabinet A single carrier houses the circuit packs. Connectors on the back of the cabinet provide connections for voice ports, alarms, the data link (if used), the administration terminal (or PC), the maintenance link, and AUDIX Networking (if used). Additional connections allow service personnel to monitor various boards. .

Two types of disk drives are used:

- *Hard Disk Drive (HDD):* One (minimum) to three disk drives provide permanent storage for system and customer information. Either 170-Mbyte disks, 380-Mbyte disks, 760-Mbyte disks, or a combination maybe installed.
- *Removable Cartridge Drive (RCD):* One 20-Mbyte cartridge-type drive with removable media is used for routine backups of system data and for updating system software.

Capacity. The number of subscribers this model handles depends on the disks and ports available, and on subscriber-usage patterns. A fully configured one-cabinet AUDIX could support:

- About 2000 light-usage subscribers, 1000 medium-usage subscribers, or 750 heavy-usage subscribers, depending on the disks installed
- Up to 16 simultaneous calls (on a 16-port system)
- From 50 hours of subscriber voice storage with three 170-Mbyte disks installed to 230 hours of subscriber voice storage with three 760-Mbyte disks installed.

The one-cabinet AUDIX runs R1V2 or later AUDIX software. The one-cabinet model is also used as a base cabinet in the two-cabinet configuration.

Two-Cabinet AUDIX

The one-cabinet AUDIX model may have a second cabinet installed on top of it as part of the same system. This second (upper) cabinet is called the AUDIX*expansion* cabinet. An AUDIX base cabinet with an expansion cabinet isthe two-cabinet AUDIX configuration.

The AUDIX expansion cabinet provides another carrier and it allows an additional three hard disk drives to be installed. This added capacity is evident in the following list which tells what a fully configured two-cabinet AUDIX could support:

- About 4000 light-usage subscribers, 2000 medium-usage subscribers, or 1000 heavy-usage subscribers, depending on the disks installed
- Up to 32 simultaneous calls (on a 32-port system)
- From 104 hours of subscriber voice storage with six 760-Mbyte disks installed to 470 hours of subscriber voice storage with six 760-Mbyte disks installed.

AUDIX-L (DA)

AUDIX-L hardware is arranged in two AT&T System 85-type equipment cabinets. The AUDIX-L hardware model has been discontinued (the two-cabinet AUDIX is now ordered instead). However, an existing AUDIX-L may be upgraded to run the latest software release.

Switch Hardware Connections

AUDIX connects to Generic 2 or System 85 through the following interfaces:

- *Administration Link:* Various configurations may be used to connect the administration terminal, PC, or WGS to AUDIX depending on the customer's needs.
- *Alarms Link:* Major and minor alarm connections run from AUDIX to existing alarm facilities on the switch. The alarms alert service personnel who normally monitor the system for possible problems with AUDIX.
- *Data Link:* A fully integrated AUDIX system includes a data link, which is used to exchange nonvoice information between the switch and AUDIX such as LWC messages, extension identification, automatic message-waiting lamp status, and call

connect/disconnect information. Generic 2 and System 85 use a DCIU link.

- *Maintenance Link:* Service personnel can access AUDIX remotely through a modem (usually a 2212 or equivalent). Usually the modem is connected to AUDIX and an analog port on the switch which has an extension number accessible by a CO line leading to the remote site. The AUDIX maintenance is also used for local service as needed.
- *Networking:* For AUDIX Networking only, an additional 25-pair cable must be added to connect the AUDIX Networking board with a digital port board on Generic 2 or System 85 switch.
- *Voice Links:* AUDIX may have 2 to 32 voice ports connected to an equivalent number of analog voice ports on the switch. Each group of eight ports on the AUDIX requires one 25-pair cable connection to the switch or cross-connect field. The switch ports are set up in one or more call-distribution or hunt groups which route calls to idle ports on AUDIX as calls are received. Generic 2 or System 85 analog ports which may be used are the SN228B, SN229, and TN742.

CDR (Call Detail Recording) Equipment

CDR equipment collects and stores data about calls such as dialed number and call duration information. This data can be used to bill voice terminal users for their calls. Historically, AT&T has designed several products and services for storing and processing call detail records. The latest such offerings are the 3B2 CDRU (Call Detail Recording Utility), the 6386 CDRU, the CDRU/S, and the 3B2 CDRP (Call Detail Recording Poller). Other CDR equipment includes the 94A LSU (Local Storage Unit), the 93B CMDR (Centralized Message Detail Recording) Poller, the 9-track SMDR (Station Message Detail Recorder) cabinet, and the direct output SMDR cabinet.

For more information about the call detail recording equipment, see *Call Detail Acquisition and Processing Reference* (555-006-202).

Monitor I

Monitor I tracks the performance of switch resources such as trunk groups and attendant consoles and insures a desired level of service through standardized reports. Standard reports provide the user with frequently needed measurements to manage switch resources; all other traffic data available from the PBX may be polled and stored in the Monitor I database for custom reporting.

The software runs on the 3B2/600 and on the 6386 in stand alone or coresident with other applications. Monitor I can track traffic data from the following switches: DEFINITY Generic 2, System 85 R2V2 through R2V4, and DIMENSION FP8 Issues 1.16 and 3.8. DEFINITY Generic 1 and System 75 R1V1-V3 trunk measurements are also supported.

Features and Services

Overview

This chapter contains general information on features and services available with DEFINITY Communications System, Generic 2 and 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.**
- **Feature Descriptions—lists the 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 features have their software residing in the switch. For more detailed information on these features, refer to *DEFINITY Communications System Generic 2 and AT&T System 85 Feature Descriptions* (555-105-301) which 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 features and services have their software residing in major subsystems other than the switch (such as the 3B2 AP 16, 3B5 AP, SMDR, and AUDIX adjuncts). For more detailed information on these features and their applications, refer to the appropriate documents listed in *AT&T—Large Business Systems Catalog* (555-000-010).

TABLE 5-A. Feature Availability

Feature	System 85				DEFINITY	
	R2V1	R2V2	R2V3	R2V4	G2.1	G2.2
800 Service Access	x	x	x	x	x	x
Abbreviated Dialing	x	x	x	x	x	x
ACCUNET Switched 56 Digital Service			x	x	x	x
APLT (Advanced Private Line Termination)	x	x	x	x	x	x
Attendant Auto-Manual Splitting	x	x	x	x	x	x
Attendant Call Waiting	x	x	x	x	x	x
Attendant Control of Trunk Group Access	x	x	x	x	x	x
Attendant DXS/BLF	x	x	x	x	x	x
Attendant Direct Trunk Group Selection	x	x	x	x	x	x
Attendant Display	x	x	x	x	x	x
Attendant Interposition Calling and Transfer	x	x	x	x	x	x
Attendant Recall	x	x	x	x	x	x
Attendant Release Loop Operation	x	x	x	x	x	x
AUDIX Voice Messaging System		x	x	x	x	x
Authorization Codes	x	x	x	x	x	x
AAR (Automatic Alternate Routing)	x	x	x	x	x	
AAR/ARS Pattern Queuing			x	x	x	
ACD (Automatic Call Distribution)			x	x	x	x
Automatic Callback	x	x	x	x	x	x
ACA (Automatic Circuit Assurance)	x	x	x	x	x	x
Automatic Identification of Outward Dialing	x	x	x	x	Tmod	Tmod
ARS (Automatic Route Selection)	x	x	x	x	x	
Automatic Transmission Measurement System		x	x	x	x	x
AUTOVON (Automatic Voice Network)	x	x	x	x	x	x
Bearer Capability				x	x	x
Bridged Call	x	x	x	x	x	x
Busy Verification of Lines	x	x	x	x	x	x
Call Coverage	x	x	x	x	x	x
CDRR (Call Detail Recording and Reporting)	x	x	x	x		
Call Forwarding—Busy and Don't Answer	x	x	x	x	x	x
Call Forwarding—Don't Answer	x	x	x	x	x	x
Call Forwarding—Follow Me	x	x	x	x	x	x
Call Hold		2.0	x	x	x	x
CMS (Call Management System)			1.1	x	x	x
Call Park	x	x	x	x	x	x

TABLE 5-A. Feature Availability (Contd)

Feature	System 85				DEFINITY	
	R2V1	R2V2	R2V3	R2V4	G2.1	G2.2
Call Pickup	x	x	x	x	x	x
Call Vectoring				x	x	x
CallVisor ASAI Gateway Interface					3.0	x
Call Waiting	x	x	x	x	x	x
Call Work Codes						x
CAS (Centralized Attendant Service)	x	x	x	x	x	x
Centralized SMDR	x	x	x	x	x	x
CSM (Centralized System Management)			x	x	x	x
Code Calling Access	x	x	x	x	x	x
Conference—Attendant Six Party	x	x	x	x	Tmod	Tmod
Conference—Attendant Five Party					x	x
Conference—Three Party	x	x	x	x	x	x
Data Call Setup	x	x	x	x	x	x
Data Communications Access	x	x	x	x	x	x
Data Protection	x	x	x	x	x	x
Dedicated Switch Connection (voice only)			x	x	x	x
Dedicated Switch Connection (voice or data)				1.1	x	x
Dial Access to Attendant	x	x	x	x	x	x
Digital Facilities Errored Seconds Processing				1.1	x	x
DNIS (Dialed No. Ident. Service)				x	x	x
DMI (Digital Multiplexed Interface)			x	x	x	x
DS1 Trunk Interface	x	x	x	x	x	x
DDC (Direct Department Calling)	x	x				
DID (Direct Inward Dialing)	x	x	x	x	x	x
DOD (Direct Outward Dialing)	x	x	x	x	x	x
Directory	x	x	x	x	x	x
DMS (Display Message Scrolling)			x	x	x	x
Display—Voice Terminal	x	x	x	x	x	x
DCS (Distributed Communication System)		x	x	x	x	x
EDC (Electronic Document Communications)	x	x	x	x		
Enhanced Symmetrical Routing			x	x	x	x
EUCD (Enhanced Uniform Call Distribution)		x	x			
Expert Agent Selection						x
Extension Number Portability—4-Digit				2.0	x	x
Extension Number Portability—5-Digit			x	x	x	x

TABLE 5-A. Feature Availability (Contd)

Feature	System 85				DEFINITY	
	R2V1	R2V2	R2V3	R2V4	G2.1	G2.2
FM (Facilities Management)	x	x	x	x		
FRL (Facilities Restriction Level)	x	x	x	x	x	x
Five Digit Dialing—Partial		x	x	x	x	x
Five Digit Dialing—Full			x	x	x	x
FADS (Force Administration Data System)	x	x				
FADS/CAS	x	x	x	x	x	x
Foreign Exchange (FX) Access	x	x	x	x	x	x
Hold	x	x	x	x	x	x
Host Computer Access	x	x	x	x	x	x
Hot Line Service			x	x	x	x
Hunting	x	x	x	x	x	x
ISN (Information Systems Network) Interface		x	x	x	x	x
ISDN—BRI					x	x
ISDN—PRI				x	x	x
Intercept Treatment	x	x	x	x	x	x
Intercom—Automatic	x	x	x	x	x	x
Intercom—Dial	x	x	x	x	x	x
Intercom—Manual	x	x	x	x	x	x
IXC (Interexchange Carrier) Access			x	x	x	x
Last Extension Dialed	x	x	x	x		
Last Number Dialed			1.2	x	x	x
LWC (Leave Word Calling)	x	x	x	x	x	x
Line Lockout	x	x	x	x	x	x
Line/Feature Status Indication	x	x	x	x	x	x
Look-Ahead Interflow				1.3	x	x
Loudspeaker Paging Access	x	x	x	x	x	x
Main/Satellite/Tributary	x	x	x	x	x	x
MCT (Malicious Call Trace)				x	x	x
Manual Signaling	x	x	x	x	x	x
MEGACOM WATS Service Access	x	x	x	x	x	x
MEGACOM WATS 800 Service	x	x	x	x	x	x
Message Center	x	x	x	x		
Message Server		x	x	x	x	x
Message Waiting—Manual	x	x	x	x	x	x

TABLE 5-A. Feature Availability (Contd)

Feature	System 85				DEFINITY	
	R2V1	R2V2	R2V3	R2V4	G2.1	G2.2
Modem Pooling	x	x	x	x	x	x
Multiappearance Preselection and Preference	x	x	x	x	x	x
Multidigit Steering	x	x	x	x	x	x
Multiple LDNs (Listed Directory Numbers)	x	x	x	x	x	x
Music-On-Hold Access	x	x	x	x	x	x
(NFAS) Non-Facility Associated Signaling					x	x
Off-Premises Data-Onlv Terminals	x	x	x	x	x	x
Off-Premises Terminals	x	x	x	x	x	x
Optically Remoted Peripheral Interface (107 A ORPI)		1.4	1.2	x	x	x
Override	x	x	x	x	x	x
Personal Central Office (CO) Line	x	x	x	x	x	x
PC Interface	x	x	x	x	x	x
PC Interface (ISDN)					x	x
Power Failure Transfer	x	x	x	x	x	x
Priority Calling	x	x	x	x	x	x
Privacy—Attendant Lockout	x	x	x	x	x	x
Privacy—Manual Exclusion	x	x	x	x	x	x
Queuing	x	x	x	x	x	x
Radio Paging Access	x	x	x	x	x	x
Recall Signaling	x	x	x	x	x	x
Recorded Telephone Dictation Access	x	x	x	x	x	x
Remote Access	x	x	x	x	x	x
Remote Groups			x	x	x	x
Remote Modules	x	x	x	x	x	x
Remote Module Console (107A ORPI)		1.4	1.2	x	x	x
Restriction—Atnd Control Voice of Terminals	x	x	x	x	x	x
Restriction—Code Restriction	x	x	x	x	x	x
Restriction—Misc. Trunk Restrictions	x	x	x	x	x	x
Restriction—Toll Restriction	x	x	x	x	x	x
Restriction—Voice TerminaI Restrictions	x	x	x	x	x	x
Ringing—Abbreviated and Delayed	x	x	x	x	x	x
Ringing Cutoff	x	x	x	x	x	x
Ringing—Distinctive	x	x	x	x	x	x

TABLE 5-A. Feature Availability (Contd)

Feature	System 85				DEFINITY	
	R2V1	R2V2	R2V3	R2V4	G2.1	G2.2
Ringing Transfer	x	x	x	x	x	x
Route Advance	x	x	x	x	x	x
Serial Calls	x	x	x	x	x	x
Service Observing			x	x	x	x
SMDR (Station Message Detail Recording)	x	x	x	x	x	x
Staightforward Outward Completion	x	x	x	x	x	x
Tenant Service				x	x	x
Terminal Busy Indications	x	x	x	x	x	x
TCM (Terminal Change Management)	x	x	x	x		
Terminal Emulation	x	x	x	x		
Through Dialing	x	x	x	x	x	x
Timed Recall on Outgoing Calls	x	x	x	x	x	x
Timed Reminder	x	x	x	x	x	x
Touch-Tone Calling Senderized Operation	x	x	x	x	x	x
Touch-Tone Dialing	x	x	x	x	x	x
Transfer	x	x	x	x	x	x
Traveling Class Mark	x	x	x	x	x	x
Trunk Group Busy/Warning Indicators to Attendant	x	x	x	x	x	x
Trunk Verification—Attendant	x	x	x	x	x	x
Trunk Verification—Voice Terminal	x	x	x	x	x	x
Trunk-to-Trunk Connections	x	x	x	x	x	x
Unattended Console Service—Alternate Console Position	x	x	x	x	x	x
Unattended Console Service—Call Answer From Any Voice Terminal	x	x	x	x	x	x
Unattended Console Service—Preselected Call Routing	x	x	x	x	x	x
UM (Unified Messaging)		x	x	x	x	x
UCD (Uniform Call Distribution)	x	x				
Uniform Numbering	x	x	x	x	x	x
Variable Format Call Detail Recording				x	x	x
VIAS (Visually Impaired Attendant Service)	x	x	x	x	x	x
WATS (Wide Area Telecommunications Service) Access	x	x	x	x	x	x
World Class Routing						x

Brief Feature Definitions

The following are brief definitions of the Generic 2 and System 85 features; for more detailed information, refer to *DEFINITY Communications System Generic 2 and AT&T System 85 Feature Descriptions* (555-105-301).

800 Service Access

Provides service for incomign 800-type calls on a reduced-cost basis. Formerly called INWATS, this feature is similar to (but separate from) the WATS Access feature for outgoing calls. Incoming 800 Service calls can be directed to an attendant, be directed to a call distribution split, go directly to a specific extension, or be provided use of the Remote Access feature.

Abbreviated Dialing

Allows voice terminal users to dial frequently called or emergency numbers with significantly fewer button presses than if the number were dialed in the usual way (i.e., one digit at a time).

ACCUNET Switched 56 Digital Service

Provides a DS1 interface between the switch and the AT&T Communications ACCUNET switched 56 digital service.

APLT (Advanced Private Line Termination)

Provides access to and termination from the following private line networks: CCSA (Common Control Switching Arrangement) and EPSCS (Enhanced Private Switched Communications Service). This feature allows network inward dialing and direct outward dialing to distant network locations.

Attendant Auto-Manual Splitting

Allows an attendant to privately identify the calling party to the called voice terminal user. The caller is automatically "split away" from the attendant and the called party when the attendant presses either the START or a DXS (direct extension selection) button.

Attendant Call Waiting

Allows a call to wait when the attendant extends a call to a busy single-line voice terminal.

ACTGA (Attendant Control of Trunk Group Access)

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 DXS (Direct Extension Selection) With BLF (Busy Lamp Field)

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, ICI (Incoming Call Identification), 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 call 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.

ARL (Attendant Release Loop) 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.

AUDIX Voice Messaging System

Provides AUDIX subscribers with the ability to send and receive voice messages. AUDIX subscribers can also receive messages from callers using either the call answering capabilities of the AUDIX feature or the Leave Word Calling feature.

Authorization Codes

Allows a voice terminal user to raise the FRL (Facilities Restriction Level) associated with a voice terminal to gain access to otherwise restricted facilities.

AAR (Automatic Alternate Routing)

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.

For Generic 2.2, functions provided by this feature and the ARS feature have been replaced by the World Class Routing feature.

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.

For Generic 2.2, functions provided by this feature and the ARS feature have been replaced by the World Class Routing feature.

AAR/ARS Pattern Queuing

Enhances the interaction between Outgoing Trunk Queuing and the AAR/ARS features. In System 85 R2V1 and R2V2 systems, 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 System 85 R2V3 enhancement, a call is queued on all trunk groups in the pattern (except restricted trunk groups) rather than just the first.

For Generic 2.2, functions provided by this feature have been replaced by the World Class Routing feature.

ACD (Automatic Call Distribution)

Permits incoming DID (Direct Inward Dialing), CO (Central Office), FX (Foreign Exchange), Tie Trunk, and WATS (Wide Area Telecommunications Service) 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 System 85 R2V3, this feature replaces and enhances the functionality perviously provided by the System 85 R2V2 EUCD feature. For Generic 2 and System 85 R2V4, the ACD feature works in conjunction with the Call Vectoring feature, and the maximum number of splits is increased.

Automatic Callback

Allows a voice terminaI user to call a busy extension number, go on-hook and then be automatically connected when the called extension becomes idle.

ACA (Automatic Circuit Assurance)

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.

AIOD (Automatic Identification of Outward Dialing)

Provides automatic identification of extension numbers on outward calls in conjunction with AMA (Automatic Message Accounting) facilities at the local central office. This feature permits individual extension billing on toll calls and the equivalent on private network calls. This feature requires a traditional module.

ARS (Automatic Route Selection)

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. ARS can also be used to route international (dial 01) calls.

For Generic 2.2, functions provided by this feature and the AAR feature have been replaced by the World Class Routing feature.

ATMS (Automatic Transmission Measurement System)

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. For System 85 R2V4, this feature also provides for loop-around testing (without handshaking) for the ISDN primary rate interface.

AUTOVON (Automatic Voice Network)

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.

Bearer Capability

Matches the calling requirements of a specific call with the best available resources to support that call. This feature is particularly useful with data calls. For System 85, R2V4, bearer capability is used only as a route selection criteria for the AAR and ARS features.

Bridged Call

Allows multiappearance 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 System 85 R2V3/V4, this feature is enhanced to allow a single-line voice terminal to share an appearance with up to 15 multiappearance voice terminals.

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 prearranaged coverage path. A coverage path is specified per principal (user with Call Coverage active). For all versions (except System 85 R2V1), two coverage paths can be assigned per principal. This feature may take effect for all incoming calls, when the user is busy on a call, or when the user does not answer the call. For System 85 R2V4, this feature introduces two types of SAC (Send All Calls) buttons and ring-ping reminder ringing for immediately redirected calls.

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.

CDRR (Call Detail Recording and Reporting)

Provides call detail recording and administration capabilities on the AP 16 for calls processed through the switch. The customer has access to detailed call records to facilitate billing, cost allocation, traffic analysis, and policing (detecting unauthorized calls). This feature is not available after System 85 R2V3; the CDRU (Call Detail Recording Utility) is used instead.

Call Detail Recording Utility

Provides call detail recording and report capabilities on a 3B2 minicomputer for calls processed through the switch.

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.

CMS (Call Management System)

Allows ACD/EUCD call processing activity to be recorded on a dedicated processor, such as a 3B2 minicomputer, for report generation. Switch software sends information relating to trunk calls, extension calls, queuing, agent actions, etc., over a DCIU link to the dedicated processor. CMS software 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 Generic 2 and System 85 R2V3/V4, this feature can use 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 Vectoring

Provides enhanced and highly flexible processing of incoming calls for the switch. Vectors are the basis of the Call Vectoring feature. These vectors are programmed using methods that resemble a “high-level” programming language. Using a "vector" (a discrete set of predefined call-processing steps), the customer can design appropriate and desirable ways of treating specific incoming calls.

CallVisor ASAI Gateway Interface

Provides an interface between a DEFINITY Generic 2 and an (Adjunct/Switch Application Interface) ASAI Gateway.

Call Waiting

Notifies a busy single-appearance voice terminal user that a call is waiting by sounding a special tone. After hearing the special tone, the called user can answer by using either the answer-hold code or by going on-hook.

Call Work Codes

Allows customer-defined codes to be entered from an agent's DCP phone and sent to a CMS adjunct, assuming the agent is measured by and logged into CMS. The switch forwards the codes to the CMS adjunct. Work codes defined by customers might include call activity codes or codes for gathering call-related data such as credit card numbers or social security numbers.

CAS (Centralized Attendant Service)

Allows users served by separate systems (at two or more locations) to concentrate attendants at one location. At unattended branch locations, calls requiring attendant assistance route over release link trunks to the centralized (main) attendant location.

CSMDR (Centrallized Station Message Detail Recording)

Provides a means of collecting and reporting statistics on call activity for selected trunk groups. Each switch has one or more 94A LSUs (Local Storage Units) which are polled by a 93B Centralized message Detail Recording Unit.

Centralized System Management

Allows PBX and adjunct administration to be done from a central location. CSM is software that resides on a minicomputer running the UNIX operating system. For each switch, a database that is an image of that switch's translations is stored on CSM. An administrator makes changes to the database; then at a scheduled later time, CSM calls up the switch and updates the switch's translations with the new changes. An administrator can also use CSM to directly access administration screens on System 75, AUDIX, and ISN.

Code Calling Access

Allows attendants, voice terminal users, and tie trunk users to page using audible coded signals. These signals consist of chimes, bells, or gongs carried over a loudspeaker system. The called party answers the page by dialing an answer-back code from any voice terminal within the system. Beginning with System 85 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. This feature requires a traditional module.

Conference—Attendant Five Party

Allows the attendant to set up a conference for up to five 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 access to the switch's data services from most types of data endpoints. Data endpoints may be located on-premises or off-premises and may use either analog or digital interfaces. Standard data rates supported are: Low (300 bps and below), 300 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, and 19.2 Kbps.

DCA (Data Communications Access)

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.

Data Protection

Provides protection for data calls from system-generated tones or intrusion attempts. This feature offers both temporary and permanent protection options for digital and analog data calls.

Dedicated Switch Connection

Acts like a hard-wired link between two ports on the switch. In effect, this feature provides a full time open line between the assigned end points.

DEFINITY Manager II

Provides a means for administering Generic 2 switches. DEFINITY Manager II is included with every purchase of a Generic 2 switch. For more information about Manager II, see Chapter 7, "Administration."

Dial Access to Attendant

Allows a voice terminal user to access an attendant by dialing a code, usually zero (0), or by dialing an LDN (listed directory number). In a system with multiple attendants, a specific attendant can be accessed when an individual access code is assigned.

DNIS (Dialed Number Identification Service)

Allows an ACD agent to see the number a caller dialed in order to reach the agent's set (the agent's set must have display capability).

DMI (Digital Multiplexed Interface)

Provides 23-channel, 64-Kbps digital connectivity between the switch and a host computer. Signaling for all 23 channels is done on a separate channel. DMI is available with BOS (Bit Oriented Signaling) or MOS (Message Oriented Signaling). MOS is designed to work with the ISDN—PRI (Integrated Services Digital Network/Primary Rate Interface) feature.

Digital Service (DS1) Trunk Interface

Multiplexes up to 24 voice or data channels onto a single carrier. This feature provides the switch with digital connections to DEFINITY Generic 2 switches, DEFINITY Generic 1 switches, System 85 switches, System 75 switches, DIMENSION PBXs, or COs (Central Offices).

DDC (Direct Department Calling)

Provides a distribution service for departments with a high volume of incoming calls. Each department terminates one or more non-DID LDN (Listed Directory Number) type trunk groups to a designated voice terminal in a linear hunting group. (This feature is available for System 85 R2V1 only.)

DID (Direct Inward Dialing)

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, CAS (Centralized Attendant Service) attendants, and remote voice terminals without attendant assistance. (Extension numbers are also assigned to attendants.)

DOD (Direct Outward Dialing)

Allows a voice terminal user to access the public network without attendant assistance.

Directory

Provides access to an internal company personnel directory on an AP 16 for a designated agent. The agent can perform directory lookup with a BCT (Business Communications Terminal) and may obtain hard copy printouts of the directory information.

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 was enhanced in System 85 R2V3 to allow a greater number of name/number database entries.

DCS (Distributed Communication System)

Meets the needs of customers with telecommunication requirements that exceed the capacity of a single switch. It allows the customer to operate and control multiple switches as if they were a single switch.

Electronic Document Communications

Combines the capabilities of text mail, electronic filing, text processing, data entry, and forms creation in one package. This is an AP16-based service.

EUCD (Enhanced Uniform Call Distribution)

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 System 85 R2V2 only, this feature replaced and enhanced the functionality previously provided by the System 85 R2Vl UCD/DDC Uniform Call Distribution/Direct Department Calling features.

Expert Agent Selection

Enhances Call Vectoring and ACD (Automatic Call Distribution) capabilities by distributing selected ACD calls to subsets of ACD agents who are members of larger splits. These agent subsets are based on the agents' call-handling skills, which could be based on agent training, type of product or service, foreign-language skills, or other expertise.

Extension Number Portability

Allows a user in a private network to move from one node to another (i.e., switch-to-switch) without changing extension numbers. Portability is available with four- and five-digit extension numbers.

Facilities Management (FM)

Provides an AP16-based system management tool for managing system status, performance information, and network administration capabilities. These capabilities are accesed 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.

FRL (Facilities Restriction Level)

Provides a means of access control and protects against unauthorized use of private network facilities. Each originating facility (voice and data terminals, incoming tie trunk, remote access trunks, and attendant positions) is assigned an FRL. Each trunk group in an AAR (Automatic Alternate Routing) or ARS (Automatic Route Selection) pattern is also assigned an FRL.

FADS (Force Administration Data System)

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 povided with each terminal to obtain printouts of the traffic data. (The UCD FADS is available for System 85 R2V1 only.)

Foreign Exchange Access

Provides connectivity to central office (CO) trunks from areas outside of the local service area where the switch is located.

Hold

Allows a voice terminal user to temporarily disconnect from incoming, outgoing, or intraoffice calls.

Host Computer Access

Provides 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

Provides automatic dialing of a predesignated number by going off-hook.

Hunting

Routes calls directed to a busy terminal to other terminals in a predetermined group (hunt group).

Information Systems Network Interface

Provides an interface to the ISN which is a packet switched LAN (Local Area Network) that connects digital processors and devices in an asynchronous distributed processing system.

ISDN (Integrated Services Digital Network) Basic Rate Interface

Provides ISDN connectivity and services at the terminal level. This feature conforms to the ISDN—BRI (Basic Rate Interface) standard of the CCITT. The ISDN—BRI format allows simultaneous voice and data over the same wires. BRI (Basic Rate Interface) provides

ISDN (Integrated Services Digital Network) Primary Rate Interface

Provides enhanced connectivity to digital networks which conform to the ISDN standard of CCITT. Beginning with System 85 R2V4, the ISDN interface supports the 1.544-Mbps primary rate to provide the switch with an internationally recognized standard interface for integrated voice/data and for enhanced data services. This ISDN—PRI (Primary Rate Interface is an expansion of DMI—MOS, with messages added to interact with the public network. The ISDN—PRI is used to establish, maintain, and clear connections between switches, between the switch and a digital switching office, and between the switch and a digital toll office.

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 multiappearance voice terminals. The called terminal is notified with distinctive ringing when the other terminal goes off-hook and activates the feature.

Intercom—Dial

Allows multiappearance 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 multiappearance 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.

IXC (Interexchange Carrier) Access

Provides connection to any IXC complying with the FCC Rules. AAR/ARS trunk group outpulsing instructions accept a user-dialed 7- to l0-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

Redials the last extension number dialed.

Last Number Dialed

Redials the last number dialed.

LWC (Leave Word Calling)

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, AUDIX (Audio Information Exchange) adjunct, or the switch.

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 th euser presses the disconnect button or places the handset on-hook. This feature frees switching facilities for other calls.

Line/Feature Status Indication

Provides a visual indication of a call's status or a feature's status (activated or deactivated) for each button on a multiappearance voice terminal. LEDs adjacent to the buttons provide visual indication.

Look-Ahead Interflow

The Look-Ahead Interflow feature provides conditional routing of calls (typically ACD calls) from one switch to another switch using the capabilities of the Call Vectoring and ISDN features.

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 was enhanced with System 85 R2V3 to provide a music-on-hold option.

Main/Satellite/Tributary

Provides an independent private network configuration that can also function as an Electronic Tandem Network access arrangement. 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.

MCT (Malicious Call Trace)

Allows the customer to obtain information that may identify the calling party of a malicous call.

Manual Signaling

Allows a multiappearance 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 Server

Provides coverage of calls which otherwise would not be anwwered. Calls are routed via a redirection feature (Call Coverage) to the assigned group for answering calls. Message server agents can answer with the intended principal's name, give the principal's current status, relay messages from the principal to incoming callers, and record messages from incoming callers to the principal.

Message Waiting—Manual

Enables multiappearance voice terminal users to light the status lamp associated with the manual message waiting button at another preassigned terminal.

Modem Pooling

Provides for switched connections bewtween 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.

Multiappearance Preselection and Preference

Provides multiappearance 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.

Multiple Listed Directory Numbers

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 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 multiappearance 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, FX (Foreign Exchange), or WATS (Wide Area Telecommunications Service) trunks.

PC Interface

Provides a set of PC-to-PBX interface products for DEFINITY Communications Systems, System 85, and System 75. These products offer the users of AT&T PCs (personal computers) and IBM* compatible PCs the voice and data capabilities of a fully integrated voice/data workstation.

Power Failure Transfer

Provides service between designated central office (CO) trunks and designated voice terminals on the switch if a power failure occurs and 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 multiappearance 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 on to 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

* Registered trademark of the IBM Corporation.

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.

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 Access

Permits users to access customer-provided dictation equipment. The start and stop function 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. Normal remote access operation requires touch-tone dialing, but a time-out option enables callers to use a rotary-dial instrument to reach the attendant.

Remote Groups

Allows groups of traditional module port circuits to be located up to 100 miles from the switch. Voice and data terminals connected to these circuits operate as if they were installed at the central location. Local trunk interfaces to the remote group are not supported.

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.

Remote Module Console

Provides up to five attendant consoles connected to a remote module. This feature requires the 107A ORPI (Optically Remoted Peripheral Interface).

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 restriction of calls by selected extension numbers to areas defined by specific area codes and/or office codes. The feature designates the 3-digit area codes, 3-digit office codes, and 6-digit combinations of area codes and office codes that a restricted voice terminal user is allowed to access. The switch returns intercept tone whenever the caller dials a code that is not allowed.

Restriction—Miscellaneous Trunk Restrictions

Restricts preselected voice terminals from 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—Abbreviated and Delayed

Provides voice terminal users with manual transfer or delayed automatic transfer of ringing. The ringing can be directed to any subset of the voice terminals sharing an appearance with the primary terminal.

Ringing Cutoff

Silences the ringing at a particular terminal but does not affect status lamps.

Ringing—Distinctive

Helps users distinguish between various types of incoming calls by providing three distinctive ringing burst patterns.

Ringing Transfer

Allows a multiappearance voice terminal user to transfer all ringing for a given extension number to other voice terminal(s). When Ringing Transfer is active for an extension, a call terminating to an appearance of that extension rings a predefined subset of the other terminals sharing the same appearance.

Route Advance

Provides for outgoing calls to be automatically muted 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.

Station Message Detail Recording

Provides a means of collecting and reporting detailed call information on selected trunk groups.

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.

Tenant Services

Allows a large switch to appear to users of the switch as many small, independent switches. This capability allows a single large switch to be shared among a wide assortment of user groups (referred to as "tenants").

Terminal Busy Indications

Provides a visual indication of the busy or idle status of one multiappearance voice terminal to another. A secondary answering position uses this information when servicing calls for a busy primary position.

TCM (Terminal Change Management)

Provides an AP16-based tool for administration of System 85 terminals.

Terminal Emulation

Provides an efficient and economical means of accessing diverse computer systems from the same terminal. It is an AP16-based communications processing feature, providing both data communications and system interface services. Three types of Terminal Emulation are available: 3270 Bisync, TTY 33/35 KSR, and 2780/3780.

Through Dialing

Allows an attendant to select the outgoing trunk group a call willl use. Then, the calling party 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

Automaticallly 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.

Transfer

Allows user to transfer calls to other terminals or trunks without attendant assistance.

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. Beginning with System 85 R2V3, 2-way trunks can also be busied-out.

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.

Variable Format Call Detail Recording

Allows the system to format call detail records to be compatible with one of several call detail reporting devices such as the 9-track SMDR or the 3B2 CDRU.

VIAS (Visually Impaired Attendant Service)

Provides additional devices (light-sensitive pen, tone generator, and grooved faceplate) to enable visually impaired attendants to operate the attendant console.

WATS (Wide Area Telecommunications Service) 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.

World Class Routing

Provides flexible call routing for most customer network calls through a single feature. WCR combines the routing capabilities of the previous network routing features AAR (Automatic Alternate Routing) and ARS (Automatic Route Selection) plus relaxes most of the constraints set on these earlier features. This feature is new with Generic 2.2.

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. The "Hardware Requirements" column does not list equipment that is automatically provided with the system. Traditional module hardware is listed inside of parentheses.

TABLE 5-B. Feature/Hardware Cross-Reference

Feature	Hardware Requirements
ACCUNET Interface	TN767 (ANN11C, D, or E); 7500B or M1 * PDM data module
APLT	TN760C (SN233) tie trunk/attendant interface
Attendant DXS/BLF	ZAGJ-09AF-03 console
AUDIX	AUDIX adjunct and TN742 (SN228B or SN229) analog line circuits; DCIU and IDl
Automatic Alternate Routing	TN748C tone detector (SN252 touch-tone senders and SN251 touch-tone receivers) See Note
Automatic Call Distribution	Optional 30A8 system status indicator supported by special interface hardware for universal modules or SN241 contact interface for traditional modules; optional KS-65270 or KS-65272, L12 digial announcer supported by a TN763C (SN231) auxiliary trunk (s) and an analog line circuit; optional 13A recorded annoncement unit with associated hardware; optional 106B display unit supported by a TN735 (SN224B)
AIOD	(SN244 ANI data transmitter) Not supported on universal modules
Automatic Route Selection	TN748C tone detector (SN252 touch-tone senders and SN251 touch-tone receivers) See Note
ATMS	(SN261B or C analog/digital facility test circuit) Not supported on universal modules
Automatic Voice Network (AUTOVON)	Attendant console, SN253C auxiliary tones circuit packs duplicated per module
Call Management System	Dedicated 3B5, 3B2-310, 3B2-400, 3B2-500, or 3B2-600 processor; 4425 or 610 BCT terminals; DCIU and IDI
Call Park	TN763C (SN231) auxiliary trunk and loudspeaker paging equipment
Note: Overall tone plant requirements are engineered at the system level.	

TABLE 5-B. Feature/Hardware Cross-Reference (Contd)

Feature	Hardware Requirements
Centralized Attendant Service	TN760C (SN233C) tie trunk/attendant interface, optional FADS, optional 30A8 status indicator requiring SN241 contact interface for traditional modules or special equipment for universal modules, optional backup voice terminals
Centralized System Management	3B5 or 3B2
Centralized SMDR	3B2 CDRU, 6386 CDRU, or 94A LSU; 3B2 CDRP or 93B poller; TN474B PCC and ADU required with 3B2- or 6386-CDRU; TN403 dual-speed channel required with 94A LSU
Code Calling Access	TN768 tone/clock (SN253 auxiliary tones) See Note; KS-16626, L5 relay for gong or bell; or 89A control unit and 2012D for chime
Conference—Attendant Six Party	(SN254 attendant conference circuit) Not supported on universal modules, use the Conference—Attendant Five Party feature instead.
Data Call Setup	TN748C (SN255) tone detector See Note
Data Communications Access	TN742 analog line (SN243B Data Port), 212A Data Set or similar modem
Digital Multiplexed Interface — Bit Oriented Signaling	TN767 (ANN11D or E) DS1 trunk interface
Digital Multiplexed Interface — Message Oriented Signaling	TN767 + TN555 (ANN35 ISDN primary rate port), Generic 2 or System 85 R2V4 common control and module control
DS1 Trunk Interface	TN767 (ANN11C, D, or E) circuit pack
Direct Inward Dialing	TN753 (SN232B) DID trunk
Direct Outward Dialing	TN747B (SN230B) CO trunk
Distributed Communication System	DCIU links; tie trunks: TN760C (SN233C), TN767 (ANN11), or TN767+TN555 (ANN35)
ETN	Tie trunks: TN760C (SN233C), TN767 (ANN11), or TN767+TN555 (ANN35)
FADS (for CAS only)	102F1-A display unit; 211A power unit, KS-19252, L7 adapter, 9042-2 ADDMASTER printer, TN403 peripheral interface channel
Note: Overall tone plant requirements are engineered at the system level.	

TABLE 5-B. Feature/Hardware Cross-Reference (Contd)

Feature	Hardware Requirements
Host Computer Access	7400A, MPDM, MTDM, or ADU
ISN Interface	TN726 data line (SN238 EIA port) and an ADU
ISDN—BRI	TN556 (Not supported on traditional modules)
ISDN—PRI	TN767 + TN555 (ANN35 ISDN primary rate port), Generic 2 or System 85 R2V4 common control and module control
Intercept Treatment	TN763C (SN231) auxiliary trunks; digital announcer: KS 65270 or KS-65272 digital announcer supported by an analog lines or 13A announcement system with associated hardware.
Leave Word Calling	Optional 3B Message Server; for retrieval printer, message server agent, AUDIX, or display voice terminal
Loudspeaker Paging Access	TN763C (SN231) auxiliary trunk, 89A control unit with 2012D power transformer or 278A with D181321 kit of parts, associated amplifier and speakers
Malicious Call Trace	TN763C (SN231) auxiliary trunk, -48V relay, 278A paging adapter circuit, D181321 kit of parts, customer voice recorder with remote on-off capability
Modem Pooling	7400A or MTDM/2, TN742 analog line (SN243B Data Port), 2224A or 2296A modem.
Music-On-Hold Access	TN763C (SN231) auxiliary trunk, 36A Voice coupler, 2012D power transfomer, customer provided music source
Off-Premises Data-Only Terminals	Analog or digital private line
Off-Premises Terminals	TN742/TN746 (SN228B/SN229) analog line
Personal CO Line	TN747B (SN230) CO trunk, multiappearance voice terminal
PC Interface	See Feature Descriptions Manual
Power Failure Transfer	Model 808A emergency transfer panel, (SN230) CO trunk, Model 8110, 8102, 7102, or 2500 voice terminal
Queuing	On-hook, none; off-hook (per module)—(SN231) TN763C auxiliary trunk, 36A voice coupler, 2012D power transformer, and optional customer music source
Note: Overall tone plant requirements are engineered at the system level.	

TABLE 5-B. Feature/Hardware Cross-Reference (Cont)

Feature	Hardware Requirements
Radio Paging Access	TN747B (SN230) CO trunks, J58824CD radio paging interface, J59204CA, L1 G1-type touch-tone receiver, 36A voice coupler, 2012D power transformer, TN768 tone/clock (SN253) auxiliary tone plant See Note, customer radio transmitting and receiving equipment
Recorded Telephone Dictation Access	TN763C (SN231) auxiliary trunk, TN768 tone/clock (SN253 auxiliary tone plant) See Note, frequency generator and interrupter units J58889N, L1 & L2, recorded telephone dictation unit with touch-tone dialing translation unit J58827E L1 & L2, touch-tone calling receivers J99289C or J59204CA, L1
Remote Access	TN747B (SN230) CO trunk, VFR-5050 voice switch gain amplifier if required
Remote Group	(J58889AN remote group housing, DS1 span supported by ANN15B/ANN16B remote group interfaces) Not supported on universal modules
Remote Module	TN456 RMI circuit packs—2 for every remote module
Remote Module Console	Two 107A ORPIs, TN760C (SN233) tie trunk
Touch-Tone Dialing	TN748C (SN251 touch-tone receiver and SN252 touch-tone sender) See Note
Touch-Tone Senderized Operation	TN748C (SN252 touch-tone sender) See Note
Trunk Group Busy/Warning Indicators	Attendant console
Unattended Console Service —Alternate Console Position	6017B-type key alternate console (or equivalent) and 609A transfer panel, console repeaters may be required by position for lightning protection and/or range extension
Unattended Console Service —CAAVT	Customer provided signaling device operted by a 2-Hz signal and analog line port
Variable Format CDR	TN474B PCC, 3B2- or 6386-CDRU, ADU
Visually Impaired Attendant Service	990A light sensor, 2A translator, faceplate guide

Note: Overall tone plant requirements are engineered at the system level.

Software Description

Architecture

DEFINITY Generic 2 and 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:

- Monitoring stimuli that are external to the switch
- Providing 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.

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 Generic 2 and System 85 call processing environment. The operating system consists of a real-time scheduler that does the following:

- 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 Generic *2* and 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.

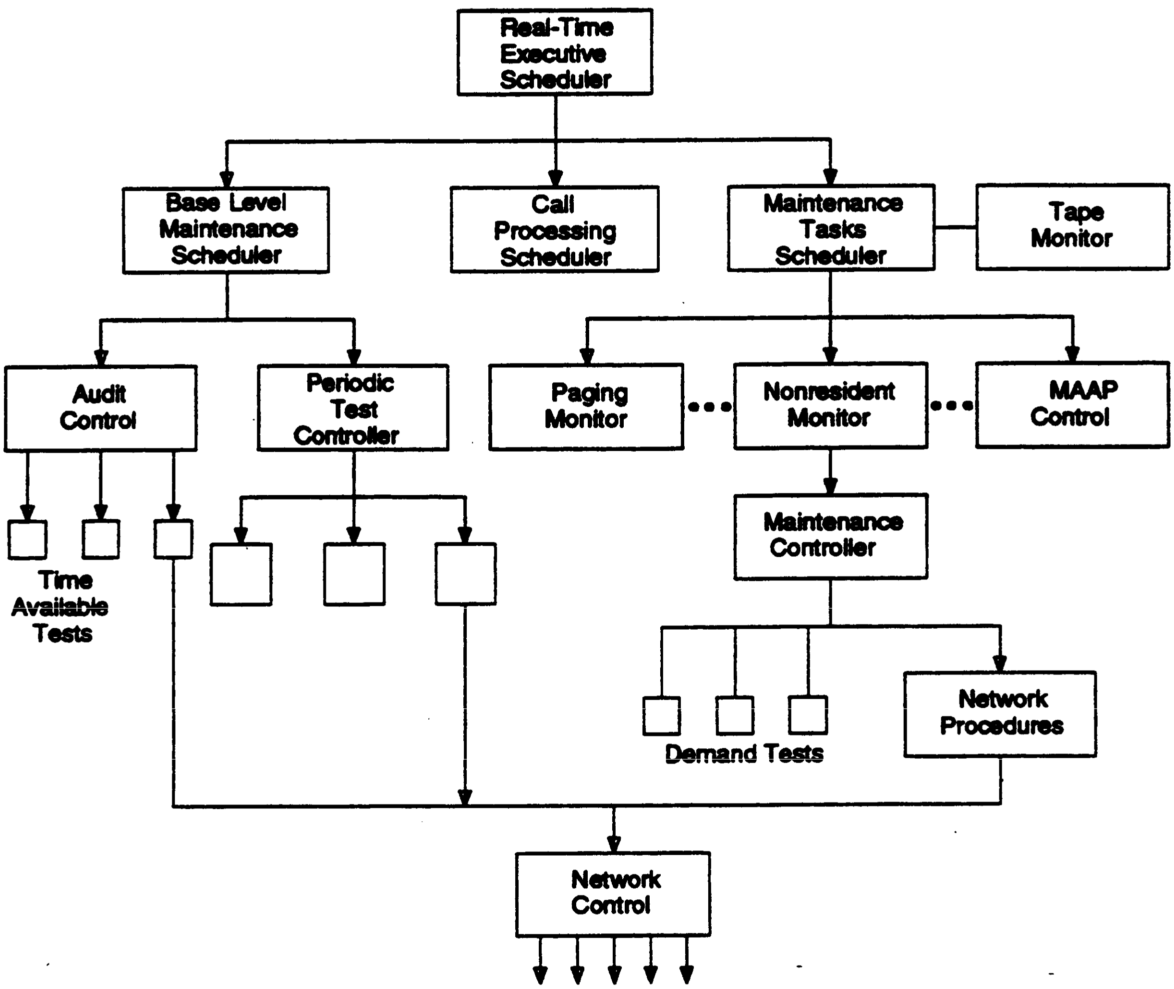


Figure 6-1. Generic 2 and System 85 Operating System Functional Diagram

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 DEFINITY Manager II or a MAAP terminal through use of the administration procedures. On System 85, most of these can also be changed from a System 85 SMT or by use of the TCM or CSM features.

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

Periodic, Time-Available, and Demand 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.

Periodic and time-available maintenance tests are scheduled by the operating system. 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.

Demand maintenance test procedures are identified by 3-digit numbers. The DEFINITY Manager II or MAAP control software (part of the operating system, see Figure 6-1) monitors the Manager II or MAAP terminal, processes user commands, and loads a designated procedure 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 allows switching equipment (hardware) and services to be customized, within certain limits, to meet user needs. Administration capabilities are provided through easy to access software routines (procedures). 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

DEFINITY Generic 2 and System 85 features are provided largely by software routines; although some features require special hardware. Chapter 5, Features and Services, provides a brief description of each feature.

Traffic Monitoring

Traffic software monitors the use of system features, the switching network and various processors. Many 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 procedure. When activated, it collects traffic data continuously.

Most traffic data is collected as peg counts. There are additional routines which are scheduled to run periodically. These routines analyze the status of 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.

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.

Module processor traffic data provides information that is useful for engineering port activity queues, port assignments, and for balancing the traffic load across the module processors for optimum performance. The types of data collected from each module processor include the following:

- 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 the Monitor I, Manager II, MAAP, a remote maintenance center, or CSM. 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

System software is identified by system name, release number, and version, such as System 85 R2V4. 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 can be 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 releiving the common control. The 501CC common control processor (used in all Generic 2 and System 85 R2 systems) can be optionally equipped with a cache memory, to improve performance.

Traffic load, defined as the sum of static and dynamic loads, is a function of the customer configuration, the instantaneous call processing load, the number of features that are executed, and the frequency with which the features are executed. The configuration contribution to load is known as the static load, and the call processing contribution is known as the dynamic load.

For additional information concerning traffic engineering, refer to *AT&T System 85—Traffic Data Analysis Guide—Administration Manual* (555-102-502).

Tape Cartridges

The System 85 HCMR (High Capacity Mini-Recorder) 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 main functions:

- Load tape—loads the common control main memory with programs, translations data, and patches following an initialization or power recovery.
- Load off-line—loads from tape, an off-line PROC into the paging buffer of main memory.
- Run tape—updates the tape's translation data to match the memory's contents.
- Patch—writes program modification data on identified patch blocks which will then overwrite program data in memory during a load tape operation.

Disk Tape Subsystem

In Generic 2, the HCMR is replaced with the DTS (Disk Tape Subsystem) which uses cassette tapes to load and back up a disk drive. The disk drive is then used to back up 501CC memory.

Organization

For System 85, data is recorded on the tape cartridge in 1024 word blocks using a 5-track format. It is recorded in streaming mode (continuous reading). Data is organized in a logical ordered format that assures the quickest reload of the system in case of a power failure.

A tape cartridge 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 (procedures), and patches.

Configurations

Tape cartridges are available in various configurations, depending upon the intended use. These include:

- Blank tape—used to make backup copies.
- Generic tape—contains program instructions for the particular system release and version without any of the assignable translations (sometimes called CAPDEF tape).
- CHAPS (Customized Hardware and Pseudo Software) 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.

Tape cartridges are always shipped 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.

DTS and HCMR Performance Data

The automatic tape refresh interval for Generic *2* and System 85 is every 29 hours (23 hours for System 85 R2V1 and R2V2). This interval is marked from the last automatic or manual tape refresh that was done. Table 6-A lists various tape operations and gives times measured in the laboratory for different System 85 software versions on a lightly equipped, idle, 5-module switch. Do not assume these measurements will hold true for other configurations. Actual times vary according to equipment configuration and switch traffic.

TABLE 6-A. Performance Data for the DTS and the HCMR

Operation	R2V2	R2V3	R2V4	Generic 2
Load Tape & initialization *	**4.0 minutes**	**7.3 minutes**	**10.3 minutes**	**7.5 minutes**
Run-Tape, unduplicated system †	**63 minutes**	**11.5 minutes**	**18.0 minutes**	**17.0 minutes**
Run-Tape, duplicated system †	**19.0 minutes**	**37.0 minutes**	**43.1 minutes**	**42.5 minutes**

Notes: * **For Generic 2, all subsequent loads with the same tape will cause a load from disk which takes 5 minutes less than listed.**

† **Subsequent run-tape operations on duplex CC configurations require less time; the time is comparable to a simplex run-tape since only the online CC will perform subsequent run-tapes. For Generic 2, additional run-tapes of tape(s) already run takes 5 or 10 minutes less for the simplex or duplex than listed.**

DCIU Software

The DCIU is an optional special applications I/O processor. It executes software that resides in its memory. The main component of the DCIU software is the NIP (Network Interface Program). This program provides packet-type communication logic for the eight physical ports. Each port contains eight logical channels which implement the BX.25 packet communications protocol. DCIU software is part of the generic program contained on the tape cartridge, and is loaded into the DCIU memory during initialization.

Notes:

System Administration

DEFINITY Generic 2 and System 85 call processing software uses a variety of tables located in system memory to keep track of the following:

- Port circuit addresses
- Trunk circuit addresses
- Extension numbers
- Feature assignments
- Voice terminal button assignments
- Network configuration
- System configuration
- Systemwide options.

Collectively, these tables are called *translations.* Generic 2 and System 85 are shipped with tapes that include 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 which is shipped with each System 85.

Since translations are stored in memory, 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. The process of changing translations is called administration. Generic 2 and System 85 use a series of programs called procedures to change translations. A person wanting to administer the system (change translations) can access the procedure program by using one of the following system management adjuncts:

- DEFINITY Manager II—A PC (Personal Computer) based administration and maintenance tool required for Generic 2. Manager II has three modes of operation: basic (similar to VMAAP), enhanced, and task. Manager II replaces the MAAP and the SMT used in System 85. Other DEFINITY Manager products are also being developed to take the place of CSM. More information about Manager II appears later in this chapter.

- CSM (Centralized System Management)—A forms-based CRT-screen user interface (System 85 only). CSM maintains data bases which contain copies of translations for one or more System 85 switches allowing an administrator to change translations off-line from the switch. CSM is then programmed to contact the System 85 at a later time; when contact is made, CSM tells the switch to execute the procedures needed to make the corresponding changes in the switch's translations.

---

* With Generic 2, the tape is used to load the disk, then the disk is used to load main memory.

- MAAP (Maintenance and Administration Panel)—A numeric key pad, a 25-digit display, and a set of flipcharts are used to access procedures (System 85 only). (Flipcharts are cards attached to the MAAP which allow the user to interpret the data appearing on the 25-digit display.)
- VMAAP (Visual Maintenance and Administration Panel)—A CRT screen interface that emulates the 25-digit display of the MAAP. In order to interpret the numbers appearing on the screen, a user must have a copy of the flipcharts for the software version being run on the switch. Terminals access this software through an RS-232 link which connects to the System 85 remote port interface circuit.
- SMT (System Management Terminal)—A unit almost identical to the MAAP which offers access to a subset of the procedures available through the MAAP (System 85 only).
- FM (Facilities Management)—An AP 16 feature used for network administration. This feature was discontinued, along with the AP 16, after System 85 R2V3.
- TCM (Terminal Change Management)—An AP 16 feature used for feature assignment and terminal rearrangement. This feature was discontinued, along with the AP 16, after System 85 R2V3.
- RMATS-II (Remote Maintenance, Administration, and Traffic System 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.

All of these system management vehicles work with older versions of System 85 (see Table 7-A). But, the AP 16 system management features and RMATS-II, which were available as system management vehicles for older versions, are not supported beyond System 85 R2V3.

Manager II, CSM, VMAAP, AP 16 TCM and FM, and RMATS-II all use the TN492 remote port interface circuit to access the switch. Manager II can also be connected to the TN563. Before System 85 R2V3, only one of these tools could use the remote port at any given time. For System 85 R2V3 and beyond, two simultaneous connections are allowed as long as one is being used to access maintenance procedures, and the other is being used to access administrative procedures. Two simultaneous administrative sessions or two simultaneous maintenance sessions are not allowed. For Generic 2, the same limitations apply but display-only can be used on the remaining two ports.

TABLE 7-A. Remote Administration for Generic 2 and System 85

Vehicle	Processor	Comments
CSM	3B2	Supports System 85 R2V4 and earlier versions
	3B5	Supports System 85 R2V3 and earlier versions but does not support System 85 R2V4
	3B15	Supports System 85 R2V4 and earlier versions
	VAX	Although CSM upgrades to System 85 R2V4 are available, new System 85 R2V4 VAX CSMs are not
VMAAP	PC7300	Requires flipcharts that correspond to the tape running on the switch
TCM & FM	AP 16	Supports System 85 R2V3 and earlier versions but does not support System 85 R2V4 or Generic 2
RMATS-II	VAX	Supports System 85 R2V3 and earlier versions but does not support System 85 R2V4 or Generic 2
Manager II	PC based	Basic mode works like VMAAP and will support any System 85 or Generic 2. Enhanced and task modes requires an SSB (Switch Support Base) which corresponds to the software load running on the switch. SSBs only exist for Generic 2 switches.
Other DEFINITY Manager Products		These products will replace CSM, but as of this writing, they are still under development.

Connecting System Management Adjuncts

A system management adjunct can connect to the switch using one of two RS232C-compatible RMATS ports provided by the TN492C circuit pack; additionally, for Generic 2, one of two ADU (Asynchronous Data Unit) compatible PPG (Programmable Processor Gateway) ports on the TN563 circuit pack can be used. System 85 allows two system management adjunct connections; Generic 2 allows four. The following list explains the recommended connections:

- RMATS 0: Dedicated Analog CO Trunk Access (Generic 2 and System 85).

  With this arrangement, a CO trunk from the local exchange company terminates on a 1200 bps modem which is directly connected to the RMATS 0 port on the TN492C remote interface circuit pack (located in the common control carrier). This arrangement allows personnel at a remote maintenance center to access the on-line common control by dialing the number that the local exchange company has assigned to the CO trunk. For duplicated systems, the modem is connected to the RMATS 0 port in each common control.

- RMATS 1: Analog Dial Access Through the Switch (Generic 2 and System 85).

  With this arrangement, an analog line circuit in one of the switch's modules serves a 1200 bps modem which is directly connected to the RMATS 1 port on the TN492C. This arrangement allows intercom call access to the TN492C. For duplicated systems, the modem is connected to the RMATS 1 port in each common control.

- PPG 0: Analog Dial Access Through the Switch (Generic 2 only).

  With this arrangement, an analog line circuit in one of the switch's modules serves a 1200 bps modem which is directly connected to an ADU; the ADU connects to the PPG 0 port on the TN563 SCSI host adapter circuit pack (located in the common control carrier). This arrangement allows intercom call access to the TN492C. For duplicated systems, the ADU is connected to PPG 0 in each common control.

- PPG 1: Direct Access (Generic 2 only).

  With this arrangement, an ADU serving the system management adjunct connects directly to the PPG 1 port on the TN563. For duplicated systems, the ADU is connected to PPG 1 in each common control.

Detailed equipment lists and connectivity diagrams for these four options are found in *DEFINITY Communications System Generic 2 and System 85 Installation* (555-104-104) and *DEFINITY Communications System Generic 2 and System 85 Upgrades* (555-104-111).

More About Manager II

DEFINITY Manager II has three modes of operation: basic, enhanced, and task.

Basic Mode

In this mode the Manager II emulates a MAAP by displaying field numbers and their values on the screen (see Figure 7-1). Paper copies of the Procedures (called Flipcharts) are needed to interpret the display. This mode of operation gets all of its procedure display information from the switch. Manager II can also be used from an off-site location via a dial-up connection to a TN492C remote interface port or the TN563 SCSI adapter.

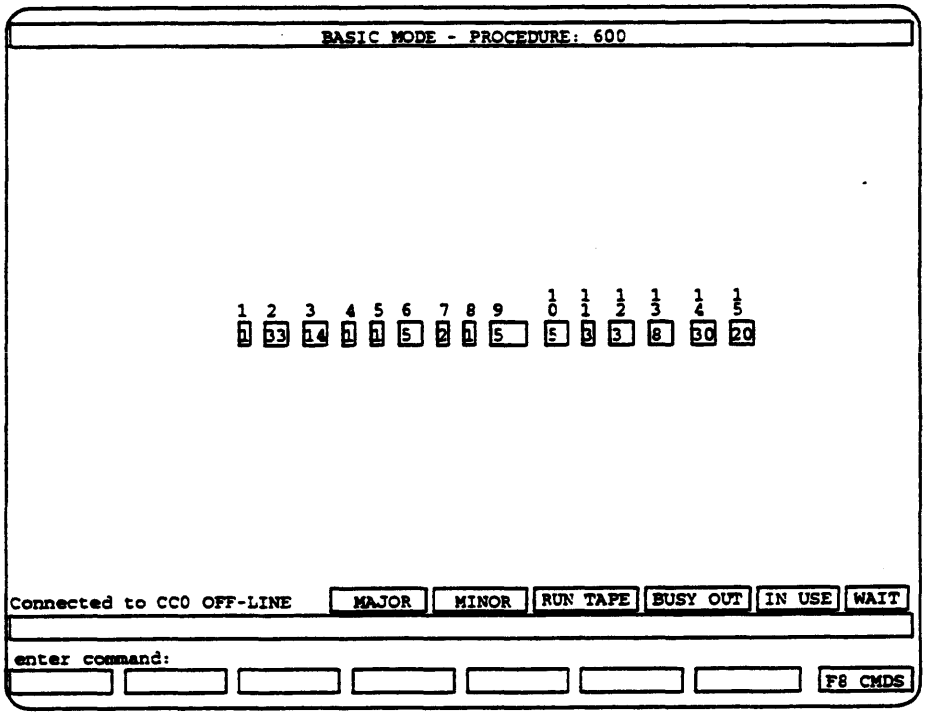


Figure 7-1. Sample of Basic Mode Screen

Enhanced Mode

In this mode the Manager II serves as an intellligent MAAP emulator by using a version-dependent data base called the SSB (Switch Support Base). The SSB supplies an electronic version of a flipchart whenever a Procedure is accessed (see Figure 7-2). (The SSB is not used with basic mode.) Field numbers and names are displayed. Moreover, encode definitions, notes, on-line help, and error information are available to the user. In most cases, this supplementary information goes beyond what has traditionally been offered on flipcharts in System 85. In this mode, Manager II can also be used from an off-site location via a dial-up connection to a TN492C remote interface port or the TN563 SCSI adapter. The SSB cannot be downloaded to Manager II over a TN492C connection.

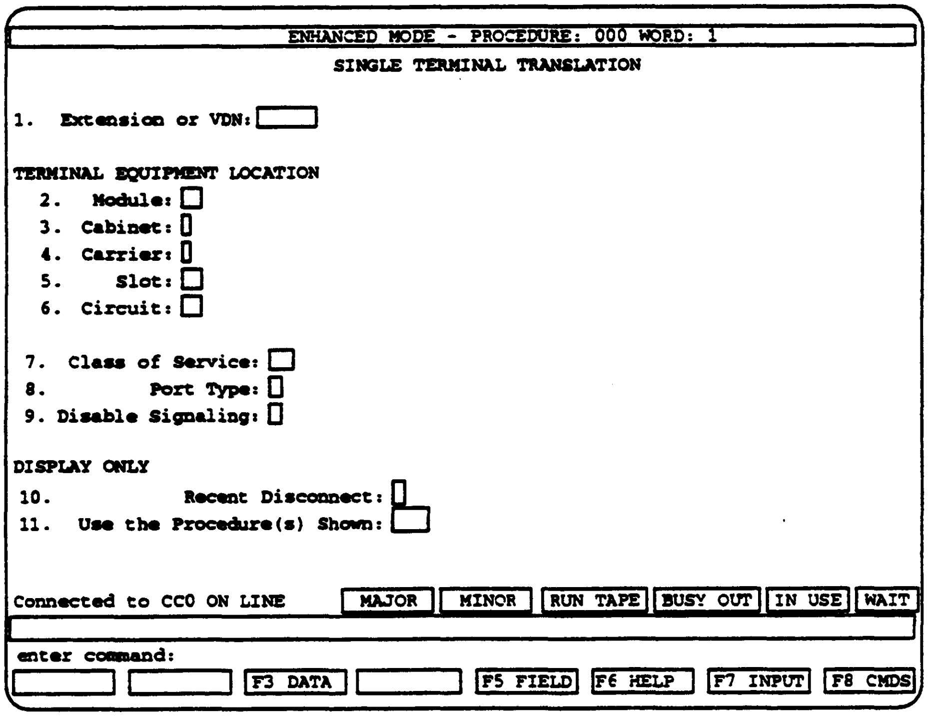


Figure 7-2. Sample of Enhanced Mode Screen

Task Mode

In this mode Manager II presents task oriented screens to the user (see Figure 7-3). The task mode provides station administration for all predefined terminal types. In the task mode, Manager II can also be used from an off-site location via a dial-up connection to a TN492C remote interface port or the TN563 SCSI adapter.

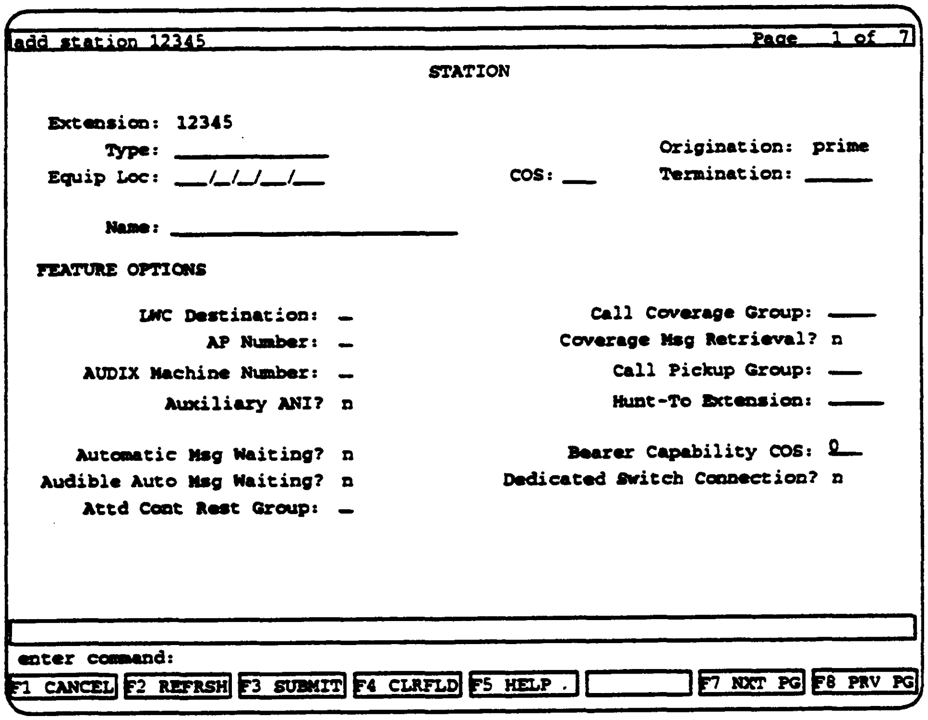


Figure 7-3. Sample of Task Mode Screen

General Terminal Administration

Beginning with Generic 2, general terminaladministration simplifies the administration of multiappearance voice terminals and data modules by making it easier to specify how a voice terminal is equipped and by allowing new terminal types to be defined. Procedure 50 has been added to make this possible. Also, procedures 51 and 58 have been modified to take advantage of procedure 50. For detailed information on using these procedures, please refer to *DEFINITY Communications System Generic 2 Administration Procedures* (555-104-506.)

Terminal Types

As in System 85, voice terminals and data modules have "type" encodes for each different model. For example, a model 7405 voice terminal will always have a "type" encode of 45. Encodes 1 through 99 are reserved for AT&T terminal types (see Table 7-B).

TABLE 7-B. Terminal Type Encodes for DEFINITY Generic 2

Encode	Terminal Type	Encode	Terminal Type
1	PDM (Processor Data Module)	43	7403
2	TDM (Trunk Data Module)	44	7404
3	Dual Port Data	45	7405
5	ADFTC (A/D Fac. Test Circuit)	46	7406 (without display)
7	EIA Port	47	7407
10	Straight Line Set	55	7505 ISDN BRI Set
15	10-Button MET Set	56	7506 ISDN BRI Set
16	20-Button MET Set	57	7507 ISDN BRI Set
17	30-Button MET Set	62	CallMaster Voice Terminal
23	7203	64	7406 (with display)
25	7205	70	7434
33	7303	91	510BCT
35	7305	95	515BCT
41	7401	99	DCP PC Interface
42	7410		

Encodes 100 through 200 are available for defining "new" terminal types. Terminals must be electrically similar to, and operate like, existing terminal types. General Terminal Administration is primarily intended to be an inventory tool for keeping track of what equipment is being used. This is accomplished by eliminating the need to assign a new type of terminal with an old terminal type. In practice, these definitions will probably be limited to other vendor's ISDN BRI terminals or to future AT&T voice terminal models. Here are the attributes that are specified to create a new terminal type:

- Circuit Pack Type
  - — SN270/TN754B DCP port

- — TN556 BRI port
- — SN228/SN229 or TN742B/TN746 analog port
- — ANN17/TN762B hybrid port (7300 series)
- — SN261 facilites test circuit
- — SN238/TN726 ADU compatible data line port
- — TN735 MET line port

- Data Type:
  - — No data
  - — Optional data
  - — Integrated data
  - — Data only.
- Display Type
- Number of Buttons on Voice Terminal: 0 through 62

Terminal Options

In addition to terminal type, a separate "option" encode has been introduced for specifying how a terminal is configured. For example, if the 7405 is equipped with a display and a DTDM it will have an “option” encode of 10. A complete list of option encodes appears in Table 7-C.

TABLE 7-C. Option Encodes for DEFINITY Generic 2

Encode	Terminal Type
0	Data only
1	Voice only
2	Basic terminal and function key module
3	Basic terminal and coverage module
4	Basic terminal, function key module and coverage module
5	Basic terminal and display module
6	Basic terminal and data
7	Basic terminal, function key module and display module
8	Basic terminal, function key and data
9	Basic terminal, coverage module and data
10	Basic terminal, display module and data
11	Basic terminal, function key module, coverage module, and data
12	Basic terminal, function key module, display module, and data

Notes:

Reliability and Maintenance

Reliability

To ensure reliability, Generic 2 and System 85 use high-quality components and 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 generally available.

Each Generic 2 and System 85 switch must pass three levels of testing during manufacture, shipping and installation. First, they undergo a series of factory tests covering component parts, circuit packs, major subsystems, and and the entire assembled system. Second, they may undergo a series of quality assurance tests in which systems ready for shipment are randomly selected for extensive retesting. Third, they undergo 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. Generic 2 and System 85 availability may be enhanced by equipping redundant subsystems. This duplication strategy ensures that the switch can continue to perform without interruption even if some hardware component fails.

Enhanced Availability Configurations

Generic 2 and System 85 are offered in four basic configurations. The configurations differ principally in the enhanced availability provided byduplication of major system components and related hardware. These options include:

- **Standardd availability—no duplication of major components**
- **High availability—duplicated common control**
- **Critical availability—duplicated common control, duplicated TMS (Time Multiplexed Switch), and duplicated module control(s)**
- **Critical availability with battery reserve—same as critical availability with the addition of the long-term (8-hours typically) 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.

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 serious common control faults, it takes only a few minutes for software to reestablish the records for calls that were in progress when the fault occurred. Established calls 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 guaranateed 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 Generic 2 or 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 2- to 5-minute nominal holdover can be provided for the rest of the switch for continuous service during outages of less than 2 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.

System Availability

Generic 2 and System 85 are 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 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 MTTR (Mean Time To Repair). The MTTR includes diagnostic, repair, and travel time for a systems technician to get to the equipment site.

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 (the commm control for example), downtime is primarily a function of how often a fault occurs and the automatic reecovery 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 modules in the critical availability case significantly reduce the predicted user downtime. Adding the long-term battery backup option further reduces predicted downtime. In this case, the primary contributor to downtime is the port circuitry since it 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.

Maintenance

The Generic 2 and System 85 maintenance plans reduce the cost of maintenance and reduce system downtime by providing fast and accurate fault detection and diagnosis. Operational error processing automatically analyzes errors reported from normal call processing, runs tests to verify each error, and determines the severity of the problem. For severe errors, recovery action is initiated within seconds, switching to standby circuits (if provided), making the faulty circuit unavailable for service, and generating an alarm. Less serious errors may be logged and their frequency of occurrence monitored without generating an alarm.

For the critical subsystems (common control, time multiplexed switch and network modules), Generic 2 and System 85 automatically detect 90 to 99 percent of faults (depending on the circuit) and isolate the faults to a first-choice circuit pack about 90 percent of the time. For the port interface circuits, about 75 percent of faults are automatically detected and isolated to a first-choice circuit pack. Switch maintenance diagnostics can now cover approximately 70 percent of the switch hardware (weighed average of the line, trunk, and common hardware circuitry).

Ninety-five percent of all faults are resolved by maintenance technicians. The other 5 percent of faults are addressed by specialists with direct access to diagnostic equipment and design and manufacturing experts at AT&T.

Maintenance Hardware

The following additional hardware is provided to improve the speed and accuracy of fault detection, diagnosis, and repair:

- Diagnostic processor—Provides for initialization testing of the main processor and provides the interface for alarm reporting and remote system maintenance. The remote interface connects alarm leads from the auxiliary equipment and the applications processors (APs) to the diagnostic processor. With this configuration, the system can report problems existing within one of 32 units. Within an auxiliary cabinet, six potential problem areas are identifiable. For both AP and external equipment, two conditions (major and minor alarms) are identifiable.
- Data integrity check circuits—Regularly checks the stored program memory and continuously checks the digital network path to ensure data integrity.
- Signature accumulator chips—Provide a way to test digital network and data paths for error-free transmission. These circuits are placed at strategic points in the switching network, providing fault isolation with faster and more thorough testing of switch components. Test data sent over a path is accumulated to form signatures at different points along the path. The signatures (made up of digital samples of data, address, and control information) are compared to expected values for fault detection and isolation.
- 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. (Universal module port packs use firmware to

- 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 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—Lights an alarm indicator when an alarm is generated and an acknowledge indicator 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 Generic 2 and System 85 perform automatically on themselves 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 a remote maintenance center 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-availabIe background tests—Automaticaliy detect 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. Multiappearance 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 option. All DCP and ISDN-BRI voice

terminals also have built-in self-test capability activated by operting a test button with test results on the terminal.

- Hyperactive endpoint—Detects and busies out trunks and stations that are hyperactive.

An error and alarm log provides a record of errors detected by operational error processing and background tests. The following errors and alarms are logged: 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 Procedure

The maintenance procedures shown in Figure 8-1 include both the automatic system checks and audits that occur continuously and the manual diagnostic and repair procedures used by system teachnicians to identify and resolve problems.

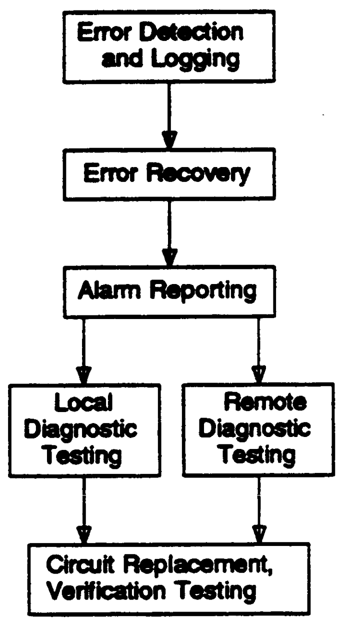


Figure 8-1. Generic 2 and System 85 Maintenance Procedures

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

- DCP and ISDN 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, Generic 2 and System 85 automatically generate 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. One or more endpoints may be lost.

The alarm level is established by the detection test that reports the error. Generic 2 and System 85 automatically report major and minor alarms to a remote AT&T maintenance center 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 lit when the alarm has been successfully reported to the maintenance center.

Local and Remote Diagnostic Testing

The Manager II or MAAP and the alarm panel are the principal local communications links between Generic 2 or 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 from a remote maintenance center. Local maintenance and remote 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 Generic 2 and System 85 R2V3/V4 allows a maintenance task to be performed simultaneously with a local administration change by the system administrator. For more detailed information on Manager II or MAAP maintenance procedures, refer to either *DEFINITY Communications System, Generic 2 Maintenance Procedures* (555-104-117) or *AT&T System 85—Maintenance—Service Manual* (555-103-108).

Circuit Pack Replacement and Verification Testing

On the Generic 2 or System 85 switch, if a diagnostic test finds a problem the red LED (if provided) is lit 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.

System Engineering

This chapter highlights engineering considerations for DEFINITY Communications System, Generic 2 and System 85, Release 2 configurations.

Switch Engineering—Traffic

Traffic Engineering is required for Generic 2 and System 85 traffic sensitive equipment components and software records. Examples include 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.

Providing more traffic-sensitive equipment than necessary may appear to be a safe means of satisfying a customer's service objectives. However, 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 could result in a configuration which fails to meet the customer's needs.

PUR (Port Usage Rate) and Erlang

Due to the new and different types of functions being provided by Generic 2 and System 85, a new characterization of customer-switched traffic through the network module fabric has been developed. It is called PUR (Port Usage Rate). PUR differs from the traditional traffic measure of CCS (hundred call seconds) in two respects.

1. PUR is usually 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 Generic 2 and 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.

PUR (Port Usage Rate)

The PUR expressed in units of Erlangs is the basic measure of traffic intensity in the Generic 2 or 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 and is 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-hour, 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 Generic 2 or 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

Traditional Modules

A physical capacity of 1536 ports exists in each traditional module. However, only 255 simultaneous connections can be established in each module. Because of this, traffic engineering procedures are required to do the following:

- 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 TSI (Time Slot Interchanger). 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 255 TSI program word pairs are available for port-to-port connections. Even though the network can terminate up to 1536 ports per module, only 255 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.

Universal Modules

Generic 2 universal modules have similar limitations. The physical capacity is 768 analog ports. The TDM bus can support 236 simultaneous port-to-port connections. Like the traditional module, the universal module is engineered to support a certain grade of service based on expected traffic.

Conference Traffic

A 3-party conference connection in a traditional module requires three TSI program word pairs. Conference calling reduces the traffic capacity of the tradition module's TSI. For example, if four 3-party conference connections were simultaneously in progress, 12 TSI program word pairs would be required—one 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 traditional 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 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.

Conference, or 3-party, connections on a universal module has no additional impact on traffic since conferencing is handled by the port boards' NPEs (Network Processing Elements).

TMS (Time-Multiplexed Switch) 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

For heavy traffic applications, a device called cache memory is installed. This device, which is provided by adding a TN379 (Generic 2) or a TN369 (System 85) 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 which is much faster than 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 and Generic 2 remote modules can be placed up to 25,000 away. Applications using remote modules create unbalanced traffic and hardware between the modules. This requires special engineering methodologies.

Service Objectives (Grade of Service)

DEFINITY Generic 2 and System 85 switches have 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 tabulated, including 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 ensure 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.

The following 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 traditional module is set at 430 PUR, and per universal module is 395 PUR. These values are established based on 256 TSI maximum connections, two 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 Poisson arrival rate, and simulation techniques to determine mismatch blocking. Table 9-A shows the TMS load per module.

TABLE 9-A. TMS Load per Module

Number of Modules	TMS Load per Module (PUR)
3	140
4	190
5	175
6	190
7	185
8	190

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 Generic 2 or System 85 switching system.

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. Attributes for items such as cabinet earthquake protections, mounting bolts, or style of door are independent of the configuration 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 ensure 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 wre 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. Over a thousand unique hardware items have been reduced to less than 150 hardware PECs. These PECs may be used to specify the hardware order whether the switch is a 500-line single-module system or a 7000-line 18-module system.

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 providing a means to offer desired features at various levels of sophistication.

Switch Memory Configuration Limits

The following tables provide a quick reference to the limits of Generic 2 and System 85, Release 2, configurations by version. These limits are based on allocated or available memory table space. Each application has a maximum limit, and the system has a limit that further constrains the sum of all applications.

Line Limits (Note)						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
Analog Station Sets (2500, 7100 Series)	**7,000**	**8,000**	**32,000**	**32,000**	**32,000**	**32,000**
Multiappearance Station Sets (7200H Series, 7300H Series, 7400D Series, 7500D Series)	**5,000**	**5,000**	**10,000**	**10,000**	**10,000**	**10,000**
Voice Data Stations (7400D Series with data module or cartridge and 7500D Series with ADM-T)	**2,500**	**4,020**	**8,000**	**8,000**	**8,000**	**8,000**
Display Stations (7400D or 7500 Series with display, 515 BCT, and 510D)	**900**	**2,000**	**5,000**	**10,000**	**10,000**	**10,000**
Line Side Data Modules (DTDM, PDM, TDM, MDM, 7400A, EIA Ports, etc.) Plus Total Multiappearance Sets	**5,000**	**8,040**	**16,000**	**16,000**	**16,000**	**16,000**
Line Records	**15,000**	**19,145**	**32,703**	**32,703**	**32,703**	**32,703**
Dedicated Switch Connections (voice and data)	**—**	**—**	**1023**	**1023**	**1023**	**1023**

NOTE: The Line Records limit is the upper limit of combinations of other line applications. The sum of other limits exceeds this figure, but the total administered in an installation cannot.

Limits for multiappearance sets, voice/data sets, display sets, and line-side data modules cannot be realized simultaneously. Moreover, these imits should be reduced if heavy feature usage or a heavy traffic load is anticipated.

Station Feature Limits						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
Abbreviated Dialing:						
-Characters Per Button	20	20	20	20	20	20
-Characters Per Call	36	36	36	36	36	60
-Maximum in System List	99	99	9999	9999	9999	9999
-Maximum in a Nonsystem List	30	30	95	95	95	95
-Number of Nonsystem Lists	2047	5118	13,107	52,223	52,224	52,224
-Number of Group Lists	500	1000	9999	9999	9999	9999
-Maximum in All Lists	24,000	65,535	65,535	262,143	262,144	262,144
Mnemonic (Keyboard) Dialing:						
-List Entries	—	—	300	1000	1000	1000
-Mnemonic Characters	—	—	10	10	10	10
-Characters in Number	—	—	20	20	20	20
Default (Terminal) Dialing:						
-Characters in Number	—	—	20	20	20	20
Button Table Words *	64,000	220,000	400,000	400,000	476,670	
Call Pickup Groups	999	999	999	999	999	999
Coverage Groups	3000	4096	4096	4096	4096	4096
Effective Coverage Groups (Dual Paths Counted as 1)	3000	3047	3047	3047	3047	3047
Display—Voice Terminal:						
-Display Names	5000	8500	32,767	32,767	32,767	32,767
-Average Characters Per Name	22	22	22	22	22	22
-Maximum Characters Per Name	30	30	30	30	30	30
-Maximum Characters Per Msg (buffer)	40	40	40	40	40	40
Intercom Records:						
-Auto/Manual	300	300	300	300	300	300
-Dial	280	280	280	280	280	280
Last Number Dialed:	3000	6000	6000	6000	6000	6000
-Maximum Digits	—	—	—	20	20	20
Line Appearances and Images:						
-Appearances Per Extension	12	12	12	12	12	12
-Images Per Line Appearance	16	16	16	16	16	16
-Images Per Extension	192	192	192	192	192	192
-Images Per Terminal	30	30	30	30	52	52
Leave Word Calling Messages on the Switch	3000	6000	6000	6000	6000	6000
Extension Classes of Service	63	63	63	63	63	63
Message Waiting Lamps (Auto)	7500	10,500	32,000	32,000	32,000	32,000
Message Waiting Lamps (Auto) Per Extension	3	3	3	3	3	3

* Set the next table for Button Table Word requirements.

Button Table Word Requirements	
Application	V1 to V4 Requirement
2500, 7101A, 7102A, 7103A, and Encore Station Sets	None
Straight Line Sets	l Word Each Unit
7203H, 7303S, 7401D, 7403D, and 7410D Station Sets, and 10-Button MET Sets	12 Words Each Unit
7205H, 7305S, 7405D, 7434D, PC/PBX Station Sets, and 20- and 30-Button MET Sets	36 Words Each Unit
7404D Station Sets	8 Words Each Unit
7406D and 7406D With Display Station Sets	32 Words Each Unit
CALLMASTER Station Set	36 Words Each Unit
510D Terminal	36 Words Each Unit
515 BCT	12 Words Each Unit
C201A, C401A, and C401B Call Coverage Modules	20 Words Each Unit
Display Modules	8 Words Each Unit
Data Modules (PDM, TDM, DTDM, MDM, EIA Port)	2 Words Each Unit
Dual Port Data Modules and ADFTC	4 Words Each Unit
One Button Transfer	1 Word Each Unit
F201A and F401A Function Key Modules	24 Words Each Unit
Manual Message Waiting Button	1 Word Each Unit
Stations Signaled by Station Busy	2 Words Each Unit
Stations Signaled by Manual Signaling	1 Word Each Unit

(Continued)

Button Table Word Requirements *(Continued)*	
Application	G2 Requirement
2500, 7101A, 7102A, 713A, and Encore Station Sets	None
Straight Line Sets	1 Word Each Unit
7401D Station Sets	11 Words Each Unit
7203H, 7303S, 7403D, and 7410D Station Sets	12 Words Each Unit
7205H, 7305S, 7405D, 7434D, PC/PBX Station Sets	36 Words Each Unit
7404D Station Sets	8 Words Each Unit
7406D and 7406D With Display Station Sets	30 Words Each Unit
CALLMASTER Station Set	30 Words Each Unit
7505D and 7506D Station Sets (with or without data)	19 Words Each Unit
7507D Station Set (with or without data)	42 Words Each Unit
10-Button MET Set	7 Words Each Unit
20-Button MET Set	17 Words Each Unit
30-Button MET Set	27 Words Each Unit
510D TerminaI	21 Words Each Unit
515 BCT	12 Words Each Unit
C201A, C401A, and C401B Call Coverage Modules	20 Words Each Unit
Display Modules	7 Words Each Unit
Data Modules (PDM, TDM, DTDM, MDM, EIA Port)	2 Words Each Unit
Universal Data Modules (UDM)	4 Words Each Unit
Dual Port Data Modules and ADFTC	4 Words Each Unit
One Button Transfer	1 Word Each Unit
F201A and F401A Function Key Modules	24 Words Each Unit
Manual Message Waiting Button	1 Word Each Unit
Stations Signaled by Station Busy	2 Words Each Unit
Stations Signaled by Manual Signaling	1 Word Each Unit

System Parameters Limits						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
ACD (EUCD):						
-Agents	—	512	1024	1024	1024	2048
-Agents Measured (by CMS)	—	—	1023	1023	1023	1023
-Service Observers (Active)	—	—	64	64	64	64
-Splits	—	30	30	60	60	60
-Recorded Announcements	—	30	30	84	84	255
Answer-Back Channels:						
-Call Park and Loudspeaker Paging *	9	9	9	9	9	9
-Code Calling Access	6	6	6	6	6	6
Attendant Features:						
-Conference Bridges	13	13	13	13	13	13
-Console Positions	28	40	40	40	40	40
-Switched Loops Per Console	6	6	6	6	6	6
-Switched Loops	168	240	240	240	240	240
-Remote Console Positions (ORPI)	—	40	40	40	40	40
-Consoles (100s Groups)	100	100	100	100	100	100
-Originating Registers (ORs)	28	40	40	40	40	40
-Voice Terminal Restriction Groups	63	63	63	63	63	63
Call Forwarding—Follow Me:						
-Off-Net Forwarding Relationships	3200	3200	3200	3200	3276	3276
Call Vectoring:						
-Number of Vectors	—	—	—	128	128	511
-Steps per Vector	—	—	—	15	15	15
-Recorded Announcements	—	—	—	84	84	255
Calling Number Display Units	20	20	20	20	6	6
DCIUs:						
-DCIU Links	8	8	8	8	8	8
-APs per DCIU	7	7	7	7	7	7
-AUDIX Adjuncts per DCIU	—	4	4	8	8	8
-DCS Links per DCIU	8	8	8	8	8	8
-Logical Channels per Link	64	64	64	64	64	64
Maximum Digits in Dial Access Code	3	3	3	4	4	4
Dial Access Codes (Feature and Trunk)	175	500	1104	1104	1104	1102
Dial Pulse and Touch-Tone ORs	246	246	246	246	246	458
Total ORs	300	300	300	300	300	512

* The Call Park and Loudspeaker Paging Access features share the same nine answer-back channels.

(Continued)

System Parameters Limits *(Continued)*

Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
DS1:						
-DS1 Circuit Packs Per Switch	255	255	511	511	511	511
-Circuit Packs Per Universal Carrier						
Line Side	—	—	—	—	20	20
Trunk Side	—	—	—	—	10	10
-Line Side DS1 Circuit Packs per DS1 Carrier		4	4	4	4	4
-Trunk Side DS1 Circuit Packs per DS1 Carrier	2	2	2	2	2	2
-73-Series Port Circuits Per DS1 Port Carrier	—	16	16	16	16	16
FADS:						
-CAS Display Units	1	1	1	1	1	1
-UCD Display Units	12	—	—	—	—	—
Listed Directory Numbers (DID)	4	4	9	999	999	999
Loudspeaker Paging Zones	18	18	18	18	18	18
Network Modules	18	31	31	31	31	31
Remote Modules	—	15	30	30	30	30
Network Cabinets Per Module						
Traditional Module	4	4	4	4	4	4
Universal Module	—	—	—	—	1	1
Port Carriers Per Module						
Traditional Module	12	12	12	12	12	12
Universal Module	—	—	—	—	3	3
PCC (Processor Communications Circuit) Circuit Packs	—	—	—	3 *	3 *	3 *
Port Circuit Packs:						
-Per Traditional Port Carrier	16	16	16	16	16	16
-Per Universal Port Carrier	—	—	—	—	21 †	21 †
Recorded Announcements (Non ACD/EUCD)	2	15	15	15	15	15
System Status Indicator Lamps	128	168	168	168	168	168
Tenant Services:						
-Extension Partitions	—	—	—	1000	1000	1000
-Extension Partition Groups	—	—	—	500	500	500
-Attendant Partitions	—	—	—	41	41	41
CDR:						
-Number of Data Item Encodes	—	—	—	76	76	76
-Maximum Record Length	18	18	18	24	24	24
-Maximum LSUs	2	2	8	8	8	8
Malicuous Call Trace:						
-Maximum Simultaneous Traces	—	—	—	15	15	15

* Only one PCC port can be used and this port can only be used as a CDR port.

† This includes the service slot which can only accommodate a TN748C Tone Detector.

Trunk Limits (per Switch)						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
ANI Boards	2	2	2	2	2	2
Contact Interface Boards	34	34	34	34	34	34
Preselected Call Routing Groups	255	255	255	982	982	982
Preselected Call Routing Trunks Per Trunk Group	99	99	99	99	99	99
Personal Central Office Lines (Trunks)	150	150	150	150	150	150
AIOD Queues	6	6	6	6	6	6
Trunks, Physical (Including Host Access and Modem Pooling)	2250	5000	6000	6000	6000	6000
Trunk Records, Assignable (Outgoing Trunk Queues, Physical Trunks, and Trunk Intercom Records)	2705	7525	10,500	10,500	10,500	10,500
Trunk Records (Total)	3250	7970	11,046	11,046	11,046	11,046
Trunk Groups:						
-Modem Pooling Trunk Groups	175	238	238	982	982	982
-Host Computer Access Trunk Groups	175	238	238	982	982	982
-Total (Including Host Access and Modem Pooling)	255	255	255	999 *	999 *	999 *
-Trunk Group Dial Access Codes	255	255	255	999	999	999
-Trunks Per Trunk Group (Modem Pooling)	99	99	99	99	99	99
-Trunks Per Trunk Group (Host Computer Access)	99	99	99	99	99	99
-Trunks Per Trunk Group (Others **)	99	255	255	255	255	255
RLTs (Release Link Trunks):						
-Inward †	110	110	110	110	110	110
-Outward	16	16	16	16	16	16
-Groups at Main (CAS Branch)	40	40	40	40	40	40
Remote Access Trunks	45	45	45	6000	6000	6000
Restriction Levels (Code Restriction)	4	4	4	4	4	4
Route Advance, Trunk Groups Per Pattern	5	5	5	5	5	5

* The first 17 trunk groups are dedicated to internal service facilities. The number of trunk groups available for customer use is 982.

** Trunk groups 16 and 17 can have a maximum of 458 trunks in Generic 2.2.

† The limit of 110 for RLTs is imposed by the number of System Status Indicator (SSI) that can be used. If RLTs are not monitored by SSIs, the limit is the same as for other types of trunks.

Network Parameter Limits						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
AAR ***(System 85 and Generic 2.1):***						
-Patterns	**255**	**255**	**640**	**640**	**640**	**—**
-Trunk Groups Per Pattern	**4**	**4**	**16**	**16**	**16**	**—**
-Conditional Routing Call Categories	**—**	**—**	**3**	**3**	**3**	**—**
-Maxirnum Valid RNXs	**780**	**780**	**780**	**780**	**780**	**—**
-Maximum Number of Routes	**10,240**	**10,240**	**10,240**	**10,240**	**10,240**	**—**
ARS ***(System 85 and Generic 2.1):***						
-Patterns Per Plan	**64**	**64**	**64**	**64**	**64**	**—**
-Plans— Time Dependent	**3**	**3**	**3**	**3**	**3**	**—**
-Trunk Groups Per Pattern	**16**	**16**	**16**	**16**	**16**	**—**
-Call Categories for Tenant Services	**—**	**—**	**—**	**64**	**64**	**—**
-Foreign NPAs (6-Digit Translation)	**64**	**64**	**160**	**160**	**160**	**—**
-Patterns Per 6-Digit Translation	**4**	**4**	**10**	**10**	**10**	**—**
-Maximum Number of Routes	**1024**	**1024**	**1024**	**1024**	**1024**	**—**
Unauth. Call Control/10- to 7-Digit Conversion:						
-3-Digit NPAs	**None**	**None**	**None**	**None**	**None**	**—**
-6-Digit NPA-NXX Combinations	**500**	**500**	**500**	**500**	**500**	**—**
-7-Digit NPA-NXX-X Combinations	**2048**	**2048**	**2048**	**2048**	**2048**	**—**
-8-Digit NPA-NXX-XX Combinations	**2048**	**2048**	**2048**	**2048**	**2048**	**—**
-9-Digit NPA-NXX-XXX Combinations	**2048**	**2048**	**2048**	**2048**	**2048**	**—**
-10-Digit NPA-NXX-XXXX Combinations	**2048**	**2048**	**2048**	**2048**	**2048**	**—**
Generic 2.2 M to N Conversions:	**—**	**—**	**—**	**—**	**—**	**4095**
Authorization Codes	**9000**	**9000**	**90,000**	**90,000**	**90,000**	**90,000**
Facilities Restriction Levels	**8**	**8**	**8**	**8**	**8**	**8**
DCS:						
-Maximum Nodes	**12**	**20**	**20**	**63**	**63**	**63**
-Maximum ES Nodes	**—**	**—**	**—**	**63**	**63**	**63**
-Maximum Nodes with Attendants Centralized at One Node	**12**	**20**	**20**	**40**	**40**	**40**
-Maximum Nodes per AUTOVON Interface	**12**	**20**	**20**	**40**	**40**	**40**
Maximum Extension Numbers Per Network (5 Digit Dialing)	**—**	**—**	**—**	**100,000**	**100,000**	**100,000**
Maximum NPA-NXX Designators	**99**	**99**	**99**	**99**	**99**	

(Continued)

Network Parameter Limits *(Continued)*						
Application	System 85, Release 2				DEFINITY	
	V1	V2	V3	V4	G2.1	G2.2
ISDN:						
-Codesets	—	—	—	8	8	8
-Codepoints Per Codeset	—	—	—	1024	1024	1024
-Codepoints Per Codeset	—	—	—	—	256	256
-Mappings Per Codeset	—	—	—	—	16	16
-Maximum ISDN Call Records	—	—	—	6000	15,000	15,000
-Maximum Calls on D-channel	—	—	—	23	500	500
-Maximum D-channels						
BRI:	—	—	—	—	10,000	10,000
PRI:	—	—	—	512	512	512
-Maximum NFAS D-channel Groups	—	—	—	—	255	255
-Maximum Number for Interface ID	—	—	—	—	32	32
-Bearer Capability Classes of Service	—	—	—	—	256	256
WCR:						
-Maximum Networks	—	—	—	—	—	8 *
-Access Code Length	—	—	—	—	—	4
-Maximum Digit String Length	—	—	—	—	—	31
-Call Categories	—	—	—	—	—	256
-Time-of-Day Plans	—	—	—	—	—	8
-Plan Changes Per Day	—	—	—	—	—	6
-Patterns	—	—	—	—	—	1023
-Preferences Per Pattern	—	—	—	—	—	16
-Toll-free Tables	—	—	—	—	—	63
-Toll-free Table Maximum String Length	—	—	—	—	—	7
-Maximum Digits Deleted	—	—	—	—	—	31
-Maximum Digits Inserted	—	—	—	—	—	31

* Network numbers range from 0 through 7. Network 0 is reserved for the internal (local) dialing plan.

Auxiliary Cabinet and Equipment Configuration

The Generic 2 and 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

During May 1990 the J58886N-1 auxiliary cabinet was replaced with the J58886N-2 auxiliary cabinet. The J58886N-1 cabinet can no longer be ordered. The new auxiliary equipment uses the universal cabinet frame which is 70 inches (1778 mm) high by 32 (813 mm) inches wide by 28 inches (712 mm) deep (including the integral rear doors), which is 4 inches (102 mm) deeper than the traditional System 85 cabinet. This increased depth is used to internally house all cables connected to the cabinet. Floor plan space requirements allowed at least 4 inches for cables protruding from the rear of the older auxiliary cabinet. Because of this allowance, the increased depth of the new auxiliary cabinet does not affect existing cabinet line-up space requirements.

The following changes to auxiliary cabinet equipment were introduced with the J58886N-2:

- The AC power distribution unit (J58889AK-1) is no longer used
- The ITT 3947 rectifier has been replaced with the AC/DC Electronics Model JF751B power supply (PEC 65443)
- The optional front door mounted AC fan unit (J58889AL-1) has been replaced with a rear cabinet mounted AC fan unit (PEC 65441). The new optional fan unit is equipped with a removable, washable metal mesh filter.
- The AC power strip used with the J5886N-1 cabinet has been replaced with a Brooks Electronic Model L100074 AC power strip (PEC 65445).

The following equipment may still be used with an auxiliary cabinet:

- 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, CDM (Channel Division Multiplexer), CEM (Channel Expansion Multiplexer), and CSU (Channel Service Unit).

- 2012D power transformers—convert commercial AC power to low-level AC voltage for auxiliary equipment such as the 36A voice coupler or the 89A control unit.
- A fuse panel (J58889AB)—distributes -48 V to fused circuits requiring that voltage.
- A thermal sensor assembly (ED-1E430-70)—monitors cabinet temperature.
- An auxiliary alarm distribution unit (J58889AE)—detects and reports equipment malfunctions to the common control.

The alarm distribution unit consolidates alarms by equipment within the cabinet. When an alarm is raised, the alarm distribution unit notifies the common control's diagnostic processor causing the "EXT EQPT" LED on the Generic 2 or System 85 alarm panel to light. Possible causes of the auxiliary cabinet alarm are:

- Temperature
- Rectifier
- Circuit breaker/fuse
- Frequency generator
- Fans.

Remote system management adjuncts require a 212AR data set connected to the TN492C to gain access to Generic 2 or System 85. The data set may be installed 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 to equipment such as 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.

Auxiliary Cabinet Alarms

The alarm distribution unit in each auxiliary cabinet consolidates alarms from equipment and for various conditions within the cabinet. It also provides an interface to the external equipment alarm input on the TN492C in the 501 common control. This allows Generic 2 or System 85 to automatically record and report auxiliary cabinet alarms. 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 prewired to 50-pin connectors 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 misecllaneous-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 predrilled 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 remote access to the System 85 switch. A212AR 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, LADS (local area data sets) or an Isolating Data Interface (106A IDI) are required for ground isolation of the EIA interface. The LADS (DA) is typically mounted in the auxiliary cabinet; the IDI does not require mounting and is less costly.

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-l03)	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
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 (609A for night console position)	65262
COOK‡ Electric Recorded Announcement Channel Units	65272 65270
ADU Multiple Mounting—mounts 40 Z3A ADUs	65393
ISN Concentrator Carrier—mounts 5 interface packs (65394)	69010

* Trademark of Lorain Electronics Corporation.

† Trademark of Astro-Endyne Corporation.

‡ Trademark of Cook Electric.

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, fans, etc.

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.

When the -48 V DC input option is ordered, the DC filter and the alarm distribution unit are mounted in the base of the cabinet; this uses up the first 8 inches of vertical mounting space.

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).

Electrical Protection

Electrical surges from the following sources can cause electrical or fire damage to personnel, the switch, terminals, building wiring, equipment, or the building itself:

- Lightning — can cause a high-voltage surge by striking on or near distribution wiring.
- Power Lines — can fall across the distribution cables causing a high-voltage surge. Moreover, power lines strung parallel and close to telephone lines for long distances can induce electrical power on to the telephone lines.
- Differences in Ground Potential — can cause unwanted current to flow. These differences can arise from lightning hits or a power fault.

Because of this, electrical protection is required for cabling exposed to lightning. A cable is considered exposed if any of the following conditions exist:

- It is aerial.
- It is above ground in an area where thunder is heard more than five times a year.
- The surrounding terrain has a history of lightning damage.
- It is buried without a grounded metallic shield or the grounding is poor.
- It is buried in a span longer than 140 feet in soil with a resistivity greater than 100 Ω per meter.
- It is outside the "protection" of buildings or other conducting surfaces.

Protecting Terminal Equipment

Protectors are required on exposed distribution cables at both the near and far ends. The three types of protectors used are:

- Primary — grounds the circuit when high voltage is present
- Enhanced primary — also grounds the circuit when high voltage is present, but has a lower voltage threshold than “primary” devices.
- Secondary — protects against currents and, in some cases, residual voltages that get past primary protectors.

In some cases, adding protectors to a line circuit can reduce the maximum allowed distance of the loop. For more information about protectors, when to use them, and their effects on distance limits, see *DEFINITY Communications System Generic 2 and System 85 Wiring* (555-104-630).

Distance Specifications

This section specifies the nominal operating distance for:

- Attendant Consoles
- Voice Terminals
- Voice/Data Business Communications Terminals
- Data-Only Business Communications Terminals
- Data Modules
- Switch Modules
- Miscellaneous

Attendant Console

The maximum distances between attendant consoles and the Generic 2 or System 85 switch are listed in the following table and shown in Figure 9-1. 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.

Distance limits for consoles at remote module locations are given in Chapter 4, "Peripheral Equipment." At the remote module location, repeaters can extend the distance of the console to the 107A ORPI to up to 11,000 feet.

Connecting Arrangement	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)

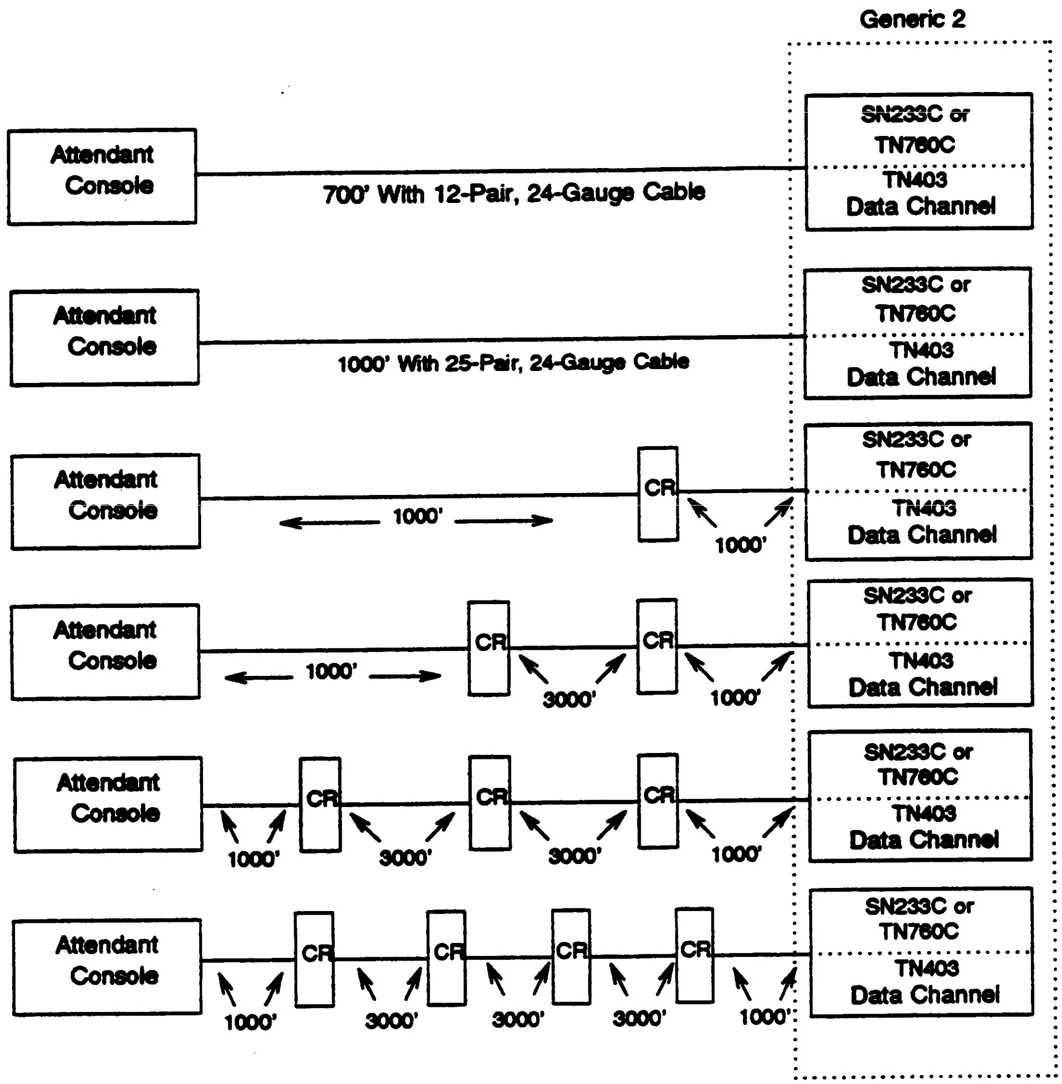


Figure 9-1. Distance Limits for Attendant Consoles

Voice Terminals

Table 9-B shows distance limits for voice terminals offered with Generic 2 and System 85. ISDN—BRI voice terminals have distance limits which cannot be expressed in the table. These limits are discussed later in this section. Some of the models listed in the table are no longer available (see Chapter 4Peripheral Equipment for details).

Adjunct power (also covered in Chapter 4) is required in the following situations:

- Whenever a model is equipped with speakerphones or headsets
- Whenever increased range is required for a 7300S Series voice terminal
- Whenever a DCP voice terminal is equipped with a DTDM, a data stand, or other adjunct
- For all ISDN--BRl voice terminals.

Distance limits also apply to adjunct power supplies (see Chapter 4). Generally, the limits are less than 250 feet. Power supply distance limits for ISDN-BRI voice terminals depend on the voice terminal configuration; these limits are discussed later in this section.

TABLE 9-B. Voice Terminal Distance Limits

Equipment	24-AWG		26-AWG	
	Feet	Meters	Feet	Meters
Analog Sets:				
SN228B				
Sets w/o lights (2500, 2554)	20000	6095	12000	3658
Sets with lights (2500 DMGC, 2500 YMGK, 2554, 7101A, 7102A, 7103A)	15000	4572	9000	2743
SN229				
All analog models	3500	1067	3500	1067
TN742				
Sets w/o lights (2500, 2554)	20000	6095	13000	3962
Sets with lights (2500 DMGC, 2500 YMGK, 2554, 7101A, 7102A 7103A)	15200	4633	10000	3050
TN746B				
Sets w/o lights (2500, 2554)	20000	4572	12000	3658
Sets with lights (2500 DMGC, 2500 YMGK, 2554, 7101A, 7102A, 7103A)	15200	4633	9000	2743
Hybrid Voice Terminals:				
SN224				
7203H or 7205H w/o adjuncts	3000	914	2300	701
7205H with 1 adjunct	1750	533	1100	335
7205H with 2 adjuncts	1000	305	750	229
ANN17B				
7303S w/o adjuncts	1700	519	1000	305
7303S with 1 adjunct	1000	305	650	198
7305S w/o adjuncts	1000	305	650	198
7305S with 1 adjunct	700	213	450	137
7303S or 7305S (with power)	2000	610	2000	610
TN762B				
7303S or 7305S (w/o power)	1000	305	750	229
7303S or 7305S (with power)	2000	610	2000	610
DCP Voice Terminals — 7400 Series:				
SN270B or TN754B				
All models (w/o power)	3400	1036	2200	671
All models (with power)	5000	1524	4000	1219
ISDN—BRI Voice Terminals — 7500 Series:				
TN556				
All models	See text.			

ISDN—BRI Voice Terminals

Two considerations limit the maximum distance for ISDN—BRI voice terminals: loop signal loss and power.

Signal Loss Considerations

According to the CCITT ISDN—BRI standard, the distance from the TN556 ISDN—BRI port circuit pack to the terminal should be engineered such that the total loss is 6 dB or less for a 96 KHz test signal. Transmission test equipment such as the Hewlett Packard 4935A Transmission Impairment Measuring Set (TIMS), or the equivalent, should be used to make this measurement.

Loss for ISDN—BRI loops can be estimated. The losses of individual cable lengths should be calculated and summed. The total loss should be within the 6 dB limit. When the loss is within the 6 dB limit, S/T ISDN—BRI interfaces and analog loops are fully supported and signals may be shared within the same binder group. No bridged taps are allowed on the loops.

The unit loss depends on the type of cable. Table 9-C gives the worst case unit loss and maximum distance for some typical premises cables. Typical pairs may show lower measured losses. The unit loss values in 9-C are based on the following conditions and assumptions.

- No load coils or bridged taps are in the loop.
- The loss values take into account cable variations, maximum temperature conditions (100°F for buried cables and 140°F for aerial cables), and the effect of impedance mismatch loss at splices. Link engineering using these unit loss values will result in a loss within the 6-dB limit when measured with the HP4935A Transmission Impairment Measuring Set or equivalent. In the design phase, if the calculated loss exceeds the 6-dB limit by a small amount, it is possible to reduce the loss by rearranging the loop plant or by using better cable.
- The losses for short lengths of interface cable, F cross-connecting wire, and D8W mounting cord can be neglected.
- When the T-terminals are being served by a cable exposed to lightning, like in a campus environment, carbon block protectors must be provided (minimum requirement) to protect the terminal equipment. These protectors (without heat coils) do not add significant loss to the link. On the switch side, solid-state gas tube, or carbon block protectors are required. If the cable is exposed to commercial AC power, protectors with heat coils are required on both the switch side and terminal side. Allow 0.3 dB loss for each protector with a heat coil; loss for protectors without heat coils can be ignored.

Power Considerations

All ISDN—BRI voice terminals require supplemental power, although these sets do operate at reduced capability by using power supplied from TN556 ISDN—BRI interface port board. For supplemental power, AT&T recommends using 346A, 353A, or 945-1 adjunct power supplies. The 353A can be used for voice terminals, but not for the 7500B data module. The 346A and 945-1 supplies are typically installed in satellite closets.

TABLE 9-C. 96 KHz Loss by Cable Type

Cable Type	AWG	dB/Kft at 96 KHz	6 dB Distance (in ft.) to wall jack
AFA-, ALA-	22	1.8	3300
ARM-	24	2.7	2200
AFM-, ALM	24	2.5	2400
BKM-	24	2.9	2100
DIW, Plenum & Non-Plenum	24	3.2	1900
ALT-	26	3.4	1800
BKT-	26	3.8	1600

The 346A modular bulk power supply provides four -46-volt outputs at 10 watts or two outputs at 20 watts. The 353A power supply provides a 15-watt single output and has three 8-pin modular jacks, two of which are used with Generic 2 ISDN—BRI sets (PHONE and LINE). The ISDN-BRI set must be located within 75 feet of this unit. The 945-1 bulk power supply provides thirteen -40-volt outputs at 18 watts each. More than one BRI set can be powered from each 945-1 output. Do not use the 353A or the 945-1 to power DCP voice terminals (7400 series).

Table 9-D shows distance limits for the 346A and 945-1 supplies. The configurations referred to in the table are:

- Phantom — Voice terminal capabilities limited.
- Idle — No calls active; one red LED lighted.
- Max. — Maximum power consumed. One active voice call, one active data call on sets equipped with ADM-T, and ringer alerting continuously at maximum volume.
- Max. + Adj. — Maximum power consumed plus one 1.5-watt adjunct such as an S101A or a 500A headset.

Table 9-D makes the following assumptions:

- Point-to-point wiring configuration.
- Minimum input voltage required by set is 32 V.
- Minimum full-load output voltages for the power supplies are 44 V for the 346A and 38 V for the945-1.
- Distance between the power supply and the cross-connect (main or satellite closet) is less than 10 feet. The distance between the wall-jack and the set total less than 33 feet.
- Resistance:

  — 24 AWG = 0.0262 Ω/foot

  — 26 AWG = 0.0418 Ω/foot

— 28 AWG = 0.0663 Ω/foot.

Consideration: Whenever possible, wall jacks serving ISDN—BRI sets should be located within the worst case BRI set-to-power supply distance limit for the power supply serving the set. For the 945-1, this is 390 feet for 24 AWG or 240 feet for 26 AWG, and for the 346A this is 860 feet for 24 AWG or 540 feet for 26 AWG. Wall jacks within the worst case distance limits can accommodate any ISDN—BRI set configuration. When wall jacks are located further away, there is the danger that someone will do a station move where the current BRI set is replaced with one that requires the power supply to be closer.

TABLE 9-D. ISDN—BRI Set Adjunct Power Supplies

Set	Config.	Power Used By Set (Watts)	Adjunct Power Supply — Distance and Total Power							
			945-1 (38 V Min. Output)				346A (44 V Min. Output)			
			24 AWG		26 AWG		24 AWG		26 AWG	
			Feet	Watts	Feet	Watts	Feet	Watts	Feet	Watts
7505 VOM-T or 7506 VOM-T	Phantom	0.9	*	2.4	*	2.4	*	1.3	*	1.3
	Idle	1.2								
	Max.	2.6	1333	3.6	835	3.6	*	4.1	*	4.1
	Max.+Adj.	3.6	941	4.8	590	4.8	1959	5.4	1228	5.4
7505 ADM-T or 7506 ADM-T	Phantom	2.0	1196	3.9	750	3.9	*	3.0	*	3.0
	Idle	2.4								
	Max.	4.3	776	5.6	486	5.6	1628	6.4	1020	6.4
	Max.+ Adj.	5.3	615	6.8	385	6.8	1306	7.8	819	7.8
7507 VOM-T	Phantom	1.0	*	2.4	*	2.4	*	1.3	*	1.3
	Idle	1.3								
	Max.	5.3	615	6.8	385	6.8	1306	7.8	819	7.8
	Max.+Adj.	6.3	505	8.0	317	8.0	1087	9.2	681	9.2
7507 ADM-T	Phantom	2.3	1196	3.9	750	3.9	*	3.0	*	3.0
	Idle	2.5								
	Max.	6.8	463	8.6	290	8.6	1001	9.9	628	9.9
	Max.+Adj.	7.8	393	9.8	247	9.8	863	11.2	541	11.2

*** Distance limited by BRI specification's 6-dB maximum loop loss rather than by power supply.**

Data Terminals and Data Modules

Table 9-E lists distance limits for most data terminal and data module applications. Distance limits for the 7500B data module are the same as for 7500 Series ISDN—BRI voice terminals (discussed earlier in this chapter).

For data module applications, there are distance limits associated with the interface used to connect the data module to the terminal equipment. For example, a 615 BCT using a 7400B data module to connect to the switch must be located witin 50 feet of the 7400B since an RS-232 interface is used to connect them (RS-232 specifies a maximum distance of 50 feet).

TABLE 9-E. Data Terminal and DCP Data Module Distance Limits

Equipment	24-AWG		26-AWG	
	Feet	Meters	Feet	Meters
Data Terminals				
SN270B or TN754B				
515 BCT, PT 510D, asynchronous terminal using DCP data module	5000	1524	4000	1219
SN238 or TN726				
Asynchronous terminal using an ADU				
19.2 Kbps	2000	610	2000	610
9600 bps	5000	1524	4500	1370
4800 bps	7000	2134	6000	1824
2400 bps	12,000	3657	10,000	3048
1200 bps	20,000	6096	16,000	4876
300 bps	40,000	12,192	30,000	9144
Data Modules				
SN270B or TN754B				
All DCP models	5000	1524	4000	1219

Switch Modules

The nominal maximum distances between major components of the switch complex are listed in the following table and shown in Figure 9-2.

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**	**200 (61)**	
System Switch	**Remote Module**	**Fiber-Optic Link**	**25,000 (7600)**	**(2), (3), & (4)**

NOTES:

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).**
2. **When the TMS and Remote Module Control(s) are duplicated, the difference between the lengths of the duplicated links must be less than 2400 feet (731 meters).**
3. **The fiber-optic links that carry control information from remote modules terminate at RMI (Remote Module Interface) circuits in a central locale module control carrier and in some cases in an RMI carrier housed in a TMS cabinet. The fiber-optic links that carry control information are extended to the common control with coaxial cable (200-foot limit).**
4. **The 25,000-foot limit is the absolute maximum for Generic 2 and is almost double the limit for System 85. For more information about fiber-optic distance limits, see Fiber-Optic Subsystem near the end of Chapter 3.**

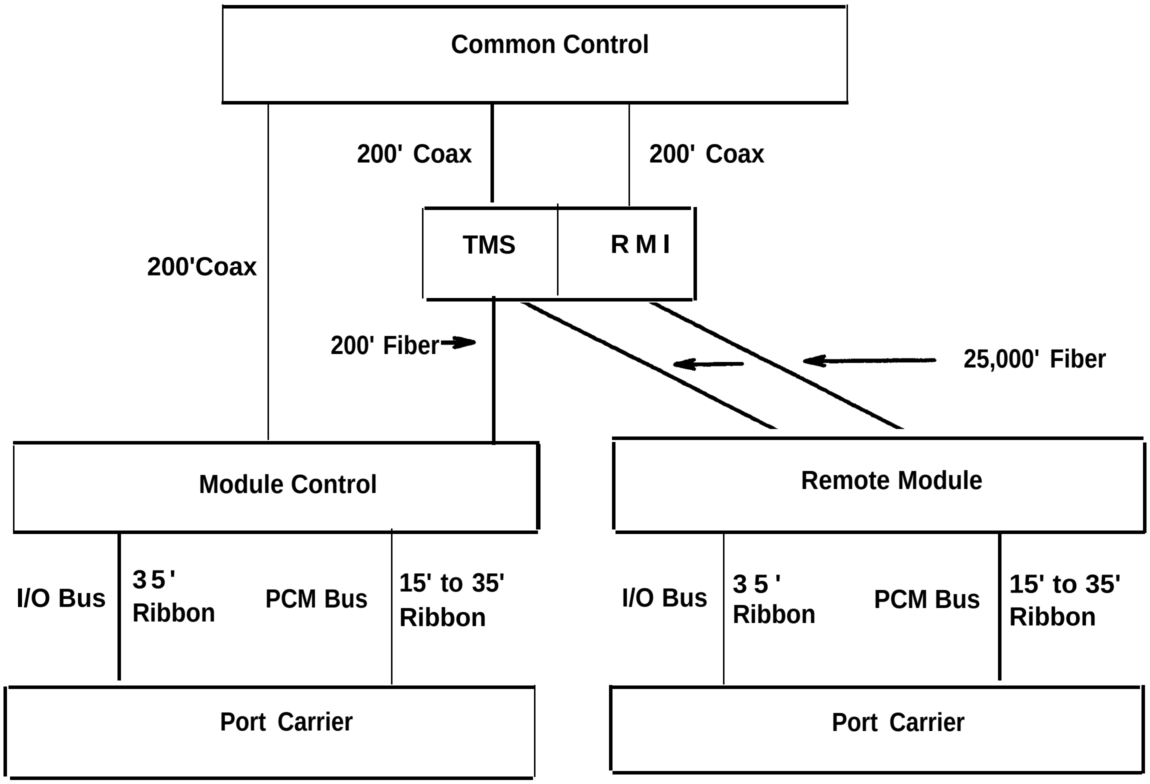


Figure 9-2. Distance Limits for Switch Modules

Miscellaneous

The nominal maximum distance between various peripherals and the Common Control are listed in the following table and shown in Figure 9-3.

Peripheral	Via	Range In Feet (Meters)	See Note
MAAP		8 (24)	(1)
SMT	Alarm Panel Connector	1000 (305)	—
SMDR	Peripheral Interface	200 (61)	—
CDRU	TN474B PCC	2,000 (610)	(2)
Manager II or CSM Modem	Remote Port		(3)
Auxiliary Equipment	Auxiliary Trunk		(4)
808A, 574-5, or 609A Emergency Transfer Panel	System Power Source	200 (61)	—

NOTES:

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).**
2. **This range is for a 19.2 Kbps link. Greater distances are provided at lower speeds. See the table provided under SN238 in Chapter 3 for details. (A TN474B port has the same electrical characteristics as an SN238 port.)**
3. **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.**
4. **The range betweeen an Auxiliary Trunk and the connected auxiliary equipment cannot have a resistance greater than 400Ω; for 24 AWG. This is a maximum of 6000 feet (1828 meters).**

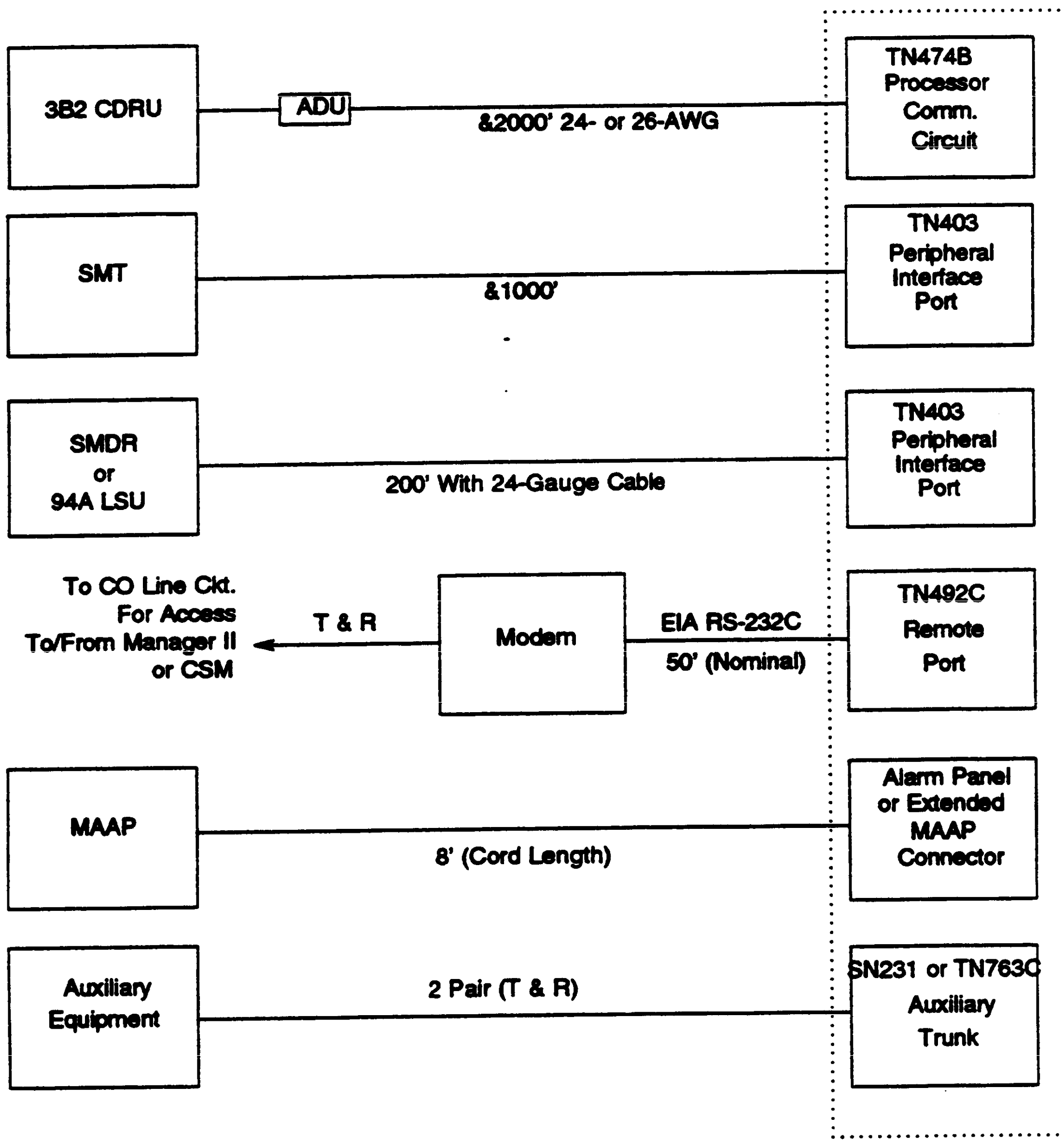


Figure 9-3. Distance Limits for Miscellaneous Peripherals

Tones

TABLE 9-F. Ringing Patterns (Distinctive Alerting)

Ringing Pattern		Interruption Pattern (Seconds)
Ringing Pattern 1	Traditional Mod.	on 1.1, off 4.1 *(pattern repeats)*
	Universal Mod.	on 0.9, off 4.3 *(pattern repeats)*
Ringing Pattern 2	Traditional Mod.	on 0.2, off 0.4, on 0.5, off 4.1 *(pattern repeats)*
	Universal Mod.	on 0.4, off 0.2, on 0.3, off 4.3 *(pattern repeats)*
Ringing Pattern 3	Traditional Mod.	on 0.2, off 0.1, on 0.2, off 0.1, on 0.5, off 4.1 *(pattern repeats)*
	Universal Mod.	on 0.2, off 0.1, on 0.2, off 0.1, on 0.3, off 4. 3 *(pattern repeats)*

TABLE 9-G. Call Progress Tones

Tone	Interruption Pattern (Seconds)	Frequency (Hz)
Dial Tone	on	350 + 440
Confirmation Tone	on 0.1, off 0.1, on 0.1, off 0.1, on 0.1, off	350 + 440
Recall Dial Tone	on 0.1, off 0.1, on 0.1, off 0.1, on 0.1, off 0.1, on	350 + 440
Miscellaneous Tone	on	440
Intercept Tone	on 0.25 (480), on 0.25 (620) *(pattern repeats)*	480, 620
Reorder Tone	on 0.25, off 0.25 *(pattern repeats)*	480 + 620
Busy Tone	on 0.5, off 0.5 *(pattern repeats)*	480 + 620
Audible Ringing Tone	on 1.0, off 3.0 *(pattern repeats)*	440 + 480
Special Audible Ringing Tone	on 1.0 (440 + 480), on 0.2 (440), off 2.8 *(pattern repeats)*	440 + 480,
Attendant Transfer	on 0.1, off 0.1, on 0.1, off	440

Protocols

The various protocols used in the system are listed in the following table with system application and maximum limitations.

Protocol	Applications	Maximum Data Rate	Maximum Distance
BISYNC	AP Line Controller to Host Computer for Terminal Emulation (9.6 kbps)	2.4 kbps 4.8 kbps 9.6 kbps	
DCP	GPP to (M)TDM, GPP to DTDM, GPP to (M)PDM, GPP to 515 BCT	64 Kbps/Channel	5000 ft (1524 m) or data 400 ft (1036 m) or voice
ISDN—BRI	TN556 to ISDN—BRI voice terminal or ISDN—BRI data module.	64 Kbps/Channel	6 dB loss @ 96 KHz
RS-232C	(M)PDM to AP, (M)PDM to 513 BCT, (M)PDM to Host Computer, AP to Data Set, (M)PDM to Printer	19.2 kbps	50 ft (15.2 m)
RS-366	Host Computer to ACU, AP to ACU		
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 (122m) 800 ft (244 m) 1600 ft (488 m)
SDCPI	(M)PDM to AP	64 kbps	17 ft (5.9 m)
SSI	500 BCT to AP, 400 Series Printers to AP	56 kbps	5000 ft (1524 m)
V.35	ACCUNET Switched 56 Digital Service	56 kbps	
X.25	DCIU to AP Communications Links Between Multiple APs and With Net 1000	19.2 kbps	

Trunk Specifications

The specifications for the various trunk-type circuit packs are as follows:

Trunk Type	Circuit Pack	Specifications
Central Office	**SN230B or TN747B**	**Capacity: SN230B 4 ckts., TN747B 8 ckts. Transmission: 1-way in, 1-way out, or 2-way 2-wire 600 or RC balance network Signaling: ground start**
Direct Inward Dialing	**SN232B or TN753**	**Capacity: SN232B 4 ckts., TN753 8 ckts. 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	**SN233C or TN760C**	**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**
DS1 Trunk	**ANN11E or TN767**	**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: 24 channels at 64 kbps for a total of 1.544 Mbps Signaling: DS1 over 4-wire**

Transmission Characteristics

Analog Characteristics

Frequency Response:

Frequency	Loss
60 Hz	>20 dB
200 HZ	<5 dB
300-300 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 dBmC0
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)

Port-to-Port Loss Values

To detemine what the correct loss should be between any two terminated ports of a digital switch, use Table 9-H. To determine the correct end-to-end loss for a tandem connection (through an analog or digital switch), add up the losses in each leg.

TABLE 9-H. Port-to-Port Loss Values

Transmit Direction		Receive Direction (Values in dB Loss)										
		ONS-Line	OPS-Line	Ana Tie Trk	Comb or Dig Tie Trk	Analog CO Trunk BAL	Analog CO Trunk N BAL	EIA Dig CO Trk	ISL Dig Tie Trk	ATO Trk	DTO Trk	ISL DCO
On-Premises (ONS-Line)		6	3	3	3	0	0	3	3	6	3	3
Off-Premises (OPS-Line)		3	0	2	0	0	0	0	2	3	0	0
Analog Tie Trunk		3	2	0	- 3	0	2	2	0	0	- 3	2
Combination or Digital Tie Trunk		9	6	3	0	3	6	6	6	3	0	3
Analog CO Trunk	BAL	0	0	0	- 3	0	0	0	0	2	0	0
	N BAL	0	0	2	0	0	0	2	2	2	0	2
EIA Digital CO Trunk		3	0	2	0	0	2	0	0	3	0	0
ISL Digital Tie Trunk		3	2	0	0	0	2	0	0	3	0	0
(ATO) Analog Toll Office Trunk		6	3	0	- 3	2	2	3	3	0	- 3	3
(DTO) Digital Toll Office Trunk		9	6	3	0	6	6	6	6	3	0	6
ISL Digital CO Trunk		3	0	2	- 3	0	2	0	0	3	0	0

The switch implements the digital loss plan specified by Electronic Industries Association EIA-464-1. There are two versions of the digital loss plan:

- **EIA—an early version which is also referred to as *digital fixed loss*. This version requires a 6-dB connection loss from one end switch port to the other end switch port.**
- **ISL—a newer version which requires a 3-dB connection loss from one end switch port to the other end switch port.**

For more information about the digital loss plan, refer to *DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN PRI Reference* (555-025-101 Issue 3).

Preinstallation Considerations

DEFINITY Generic 2 and System 85 communications systems are installed in equipment rooms which conform to specific environmental requirements. Satisfying these requirements ensures optimum performance and maximum reliability from system components.

AT&T publishes a document called *DEFINITY Communications System Generic 2 and System 85 Equipment Room Floor Plans and Specifications* (555-104-603) which describes equipment room planning and preparation. A working knowledge of the contents of that document is essential for planning a successful Generic 2 or System 85 installation.

Electromagnetic Susceptibility

Tables 9-I, 9-J, and 9-K list electric field and magnetic field thresholds which if exceeded could result in degraded service that a user might detect. The data in these tables may also be useful in diagnosing performance anomalies at existing installations where high electromagnetic field strengths exist.

The tables contain conservative approximations of the electromagnetic environment limits for DEFINITY systems and are not intended to be a rigid screening criteria for installation sites. In many cases, a DEFINITY system may operate without impairment in electromagnetic fields more intense than those indicated. The tables serve mainly as a caution boundary. However, a new installation in an environment which exceeds these limits is not advisable without consulting Bell Labs on mitigation techniques that may be required.

TABLE 9-I. Electric Field and Plane Wave — System 85 and Generic 2

Cabinet Doors Open		Cabinet Doors Closed	
Frequency	Level	Frequency	Level
0.1 MHz to 1.0 MHz	7 V/m	0.1 MHz to 20 MHz	7 V/m
1 MHz to 20 MHz	5 V/m	20 MHz to 100 MHz	5 V/m
20 MHz to 150 MHz	3 V/m	100 MHz to 1000 MHz	10 V/m
150 MHz to 1000 MHz	10 V/m		

NOTE: In the above table, the thresholds are the field strength at which degradation of the analog voice channel becomes perceptible to the user. The system will function at field strengths greater than those indicated.

TABLE 9-J. Electric Field and Plane Wave — System 75 and Generic 1

Analog Port Circuits		Digital Port Circuits	
Frequency	Level	Frequency	Level
0.5 MHz to 2 MHz	5 V/m	0.5 MHz to 10 MHz	10 V/m
2 MHz to 200 MHz	1 V/m	10 MHz to 88 MHz	3 V/m
		88 MHz to 200 MHz	1 V/m

NOTE: The impairment threshold for analog ports is the level at which degradation of the voice channel becomes apparent. The threshold for digital ports is the level at which bit errors begin to occur at high rates. This is an abrupt margin for digital ports while analog ports degrade gradually as the field strength increases.

TABLE 9-K. Magnetic Field — System 75, System 85, DEFINITY Generic 1 and Generic 2

Frequency	Level
25 HZ	500 milligauss
60 HZ	200 milligauss
120 Hz	100 milligauss
180 Hz	70 milligauss

The following observations give a general idea of the effect a magnetic field has on various electronic instruments:

- AT&T 513 terminal has objectionable display jitter on the CRT at 1000 milligauss. The screen sweep of this unit is not synchronized to the power frequency.
- A Tektronix Oscilloscope had no problems at 400 milligauss.
- A Sony color TV had slight skew of the picture at 400 milligauss, but the degradation was barely perceptible.
- A PC 6300 WGS computer had no functional impairment at 400 milligauss although it's CRT display exhibited a slight lateral skew.
- A 7405 digital telephone had a slight audible hum at 400 milligauss but no other functional impairment.
- A System 75 XE showed no symptoms during start-up and various maintenance and-diagnostic routines while subjected to 400 milligauss, 60 Hz.

DEFINITY Communications System equipment can be installed in an almost unlimited variety of hardware configurations. Since electromagnetic effects are strongly dependent on the physical arrangement of the components of a system, the above immunity limits may not precisely apply to every installation. Please note that the above limits apply only to switch hardware cabinets and not to telephone sets or terminals. Telephones and terminals should be considered separately.

Notes:

System Power

This section describes power and grounding requirements for AC- and DC-powered systems. On a system-wide basis, System 85 and DEFINITY Generic 2 cabinets receive power in one of the two ways:

- AC power is brought into the cabinet and converted to -48 volts DC. AC power is either single phase 120-volt AC, 208-volt AC, or 240-volt AC.
- DC power (-48 volts) is brought into the cabinet from an external DC power source. This method is called -48 volts DC standby power (sometimes referred to as -48 volts DC input power).

Another power option is to use a UPS (Uninterruptible Power Supply) arrangement where AC power is supplied through them. Should commercial power fail, the UPS will continue to supply AC power. The length of time that a UPS will be able to maintain power chiefly depends on how the particular UPS was provisioned (i.e., the UPS model chosen and the battery options selected). AT&T offers a variety of UPS models.

If the UPS arrangement is opted for, universal module cabinets can be ordered without nominal holdover equipment (i.e., 397 battery charger and KS-21906, L9 battery pack).

AC Power and Grounding

Dedicated Main Branch Feeder

The customer or agent must provide a dedicated main branch feeder that complies with local electrical codes. A dedicated main branch feeder is a feeder that has a single load (for example, System 85) connected to a power source. A dedicated power source isolates the system from electrically noisy or heavy variable loads (motors, elevators, etc.) that could have an adverse effect on system operation. One of the following AC power configurations must be used as the dedicated main branch feeder for System 85 and DEFINITY Generic 2.

Type 1 AC Power Configuration

3-phase, 4-wire, grounded wye plus ground 120/208 volts AC RMS, ± 10% @ 60 Hz (± 3 Hz) or -15% @ 60 Hz (± 0.3 Hz).

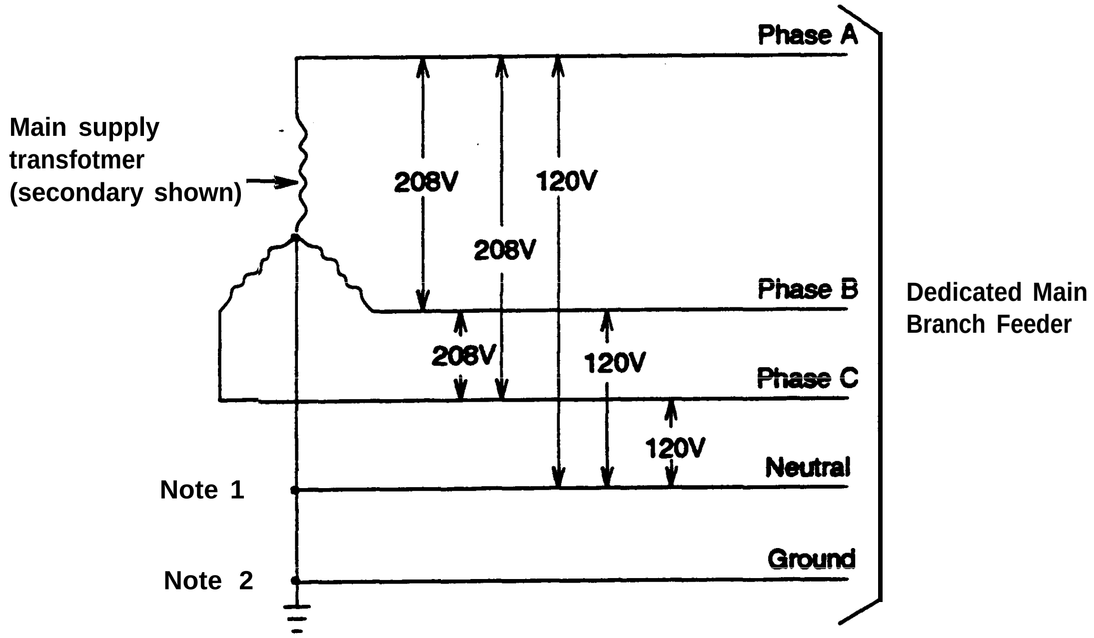
This configuration (see Figure 10-1, top) is provided by a 3-phase transformer with a wye secondary. The 120 volts AC is measured between the wye center tap (neutral) and each of the three "hot" legs (Phase A, Phase B, and Phase C). The 208 volts AC is measured between any two of the three "hot" legs.

Type 2 AC Power Configuration

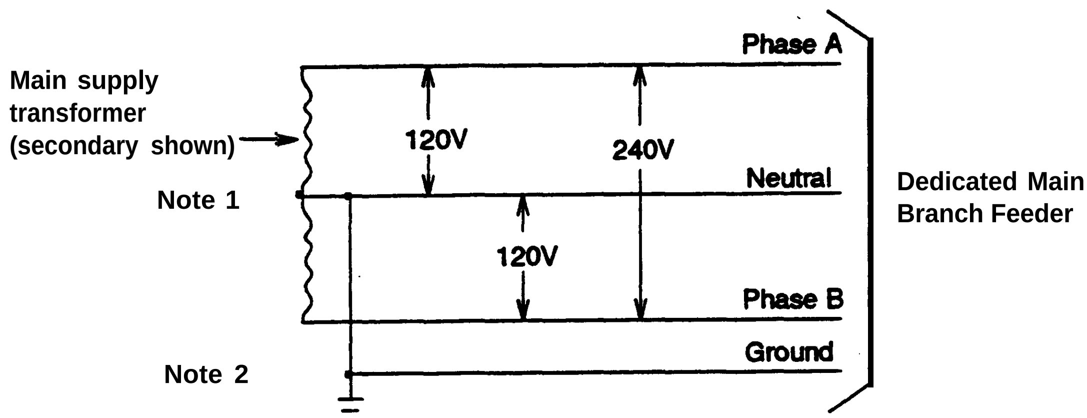
Single-phase, 3-wire, center-tapped grounded neutral, plus ground 120/240 volts AC RMS, ± 10% @ 60 Hz (± 3 Hz) or -15% @ 60 Hz (± 0.3 Hz).

This configuration (see Figure 10-1, bottom) is provided by a transformer with a center tapped secondary. The 120 volts AC is measured between the center tap (neutral) and either of the two outer "hot" legs (A and B). The 240 volts AC is measured between the two outer "hot" legs.

NOTE: Universal module control cabinets manufactured before second quarter 1992 are equipped with J58890CE, L2 AC distribution units. These units require 208-volt AC power; consequently, for sites using the Type 2 power configuration (120/240 volts AC), step-down transformers are required to derive 208 volts AC. Cabinets manufactured after second quarter 1992 are equipped with J58890CE, L4 AC distribution units which directly accept the Type 2 arrangement, eliminating the need for step-down transformers.



Type 1: **3-phase, 4-wire, grounded wye plus ground, 120/208 Volts AC RMS, 60 Hz.**



Type 2: **Single-phase, 3-wire plus ground, 120/240 Volts AC RMS, 60 Hz.**

Notes:

1. **The neutral lead should not be grounded at the system single-point ground bar or at the AC load center.**
2. **Grounding to be provided according to local codes and practices.**

Figure 10-1. AC Power Configurations

Determining the Size of the Dedicated Main Branch Feeder

Use the following steps to determine the size of the dedicated main branch feeder:

1. For each cabinet, calculate the total power consumed (in DC watts). Remember to allow for expected growth.
2. Separate the cabinet DC watt figures into three groups:

   Group A: Cabinets with 309A/310A or 334A rectifiers

   Group B: Bulk OLS (Off-Line Switcher) power supplies

   Group C: Universal module cabinets.
3. Calculate the total power consumed for each of the three groups.
4. Adjust the totals for groups A and B by dividing the total for each by 0.8. (This step accounts for power supply efficiency.)
5. If the main branch feeder is a Type 1 AC power configuration (i.e., 3-phase, 4-wire, grounded wye, 120/208 volts AC RMS, 60 Hz), do the following:
   a. Determine the AC current per phase consumed by Group A cabinets by dividing Group A's DC Watt total by 360.

      amps/phase = (Group A total DC Watts)/360.

   b. Determine the AC current per phase consumed by Groups B and C by adding Group B's DC Watt total to Group C's DC Watt total and then dividing the sum by 234.

      amps/phase = (Group B total DC Watts + Group C total DC Watts)/234.

   c. Calculate the total AC current (amps) per phase by adding the result of Step 5a to the result of Step 5b. This number determines the size of dedicated main branch feeder for Type 1 AC power configurations.
6. If the main branch feeder is a Type 2 AC power configuration (i.e., Single-phase, 3-wire, 120/240 volts AC RMS, 60 Hz), do the following:
   a. Determine the AC current per phase consumed by Group A cabinets by dividing Group A's DC Watt total by 240.

      amps/phase = (Group A total DC Watts)/240.

   b. Determine the AC current per phase consumed by Groups B and C by adding Group B's DC Watt total to Group C's DC Watt total and then dividing the sum by l56.

      amps/phase = (Group B total DC Watts + Group C total DC Watts)/156.

   c. Calculate the total AC current (amps) by adding the result of Step 6a and to the result of Step 6b. This number determines the size of the dedicated main branch feeder for Type 2 AC power configurations.

System AC Power Distribution

The system AC power distribution shown in Figure 10-2 includes:

- A nonfusible disconnect switch
- An AC load distribution center
- Feeder circuits to switch cabinets, special function cabinets, and other equipment.

The customer or agent must provide and arrange for an electrical contractor to install the system AC power distribution equipment and any associated wiring and conduit according to local electrical codes and practices. Furthermore, the electrical contractor must also mount all system single-point ground bars to the side of the AC load distribution center. These ground bars are included as part of the system order; one bar for every 13 cabinets shipped.

TheAC protector cabinet is no longer provided with AC power distribution equipment orders. Customers who wish to include an AC protector cabinet must furnish it and install it according to local codes.

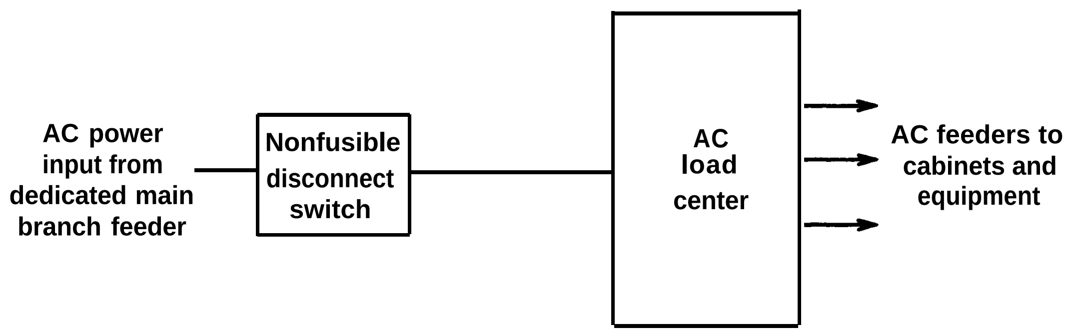


Figure 10-2. System AC Power Distribution

Nonfusible Disconnect (Safety Switch)

The customer or agent must provide the nonfusible disconnect switch and install it according to local electrical codes and practices. The nonfusible disconnects switch, which removes all power from the system, should be located so that service personnel can easily view and access it. The nonfusible disconnect switch should be sized to match the current capacity of the main branch feeder. Figure 10-3 shows a disconnect switch.

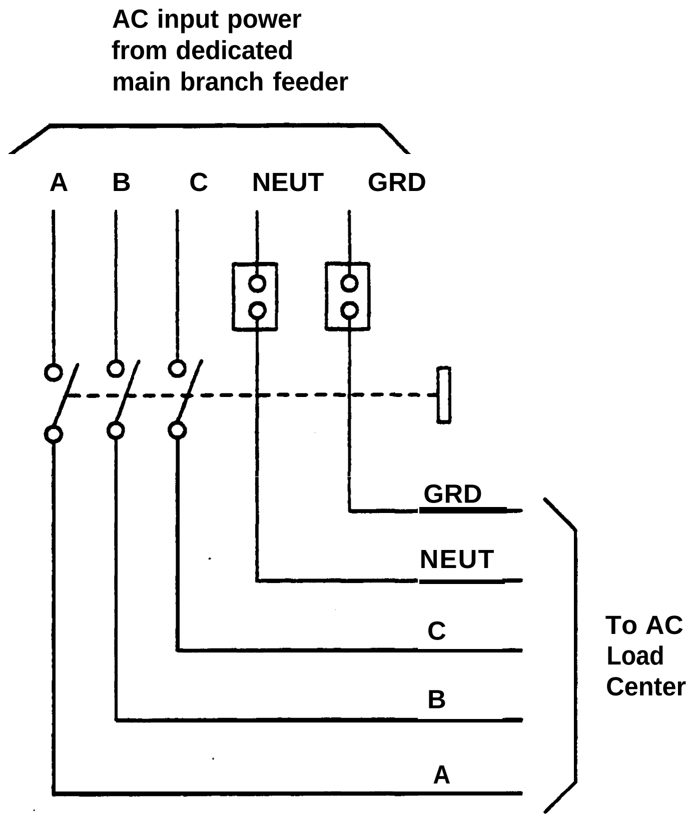


Figure 10-3. Nonfusible Disconnect Switch

Typical 3-pole nonfusible disconnect switches rated at 200 and 400 amperes per phase are listed in the following table.

Type (Note)	Rating (Per Phase)	Power Arrangement
JU-324 Siemens-ITE	200 amps	3-Phase, 60 Hz, 120/208 volts AC
JU-32 Siemens-lTE	400 amps	3-Phase, 60 Hz, 120/208 volts AC
GUN-324 Westinghouse	200 amps	3-Phase, 60 Hz, 120/208 volts AC
GUN-325 Westinghouse	400 amps	3-Phase, 60 Hz, 120/208 volts AC
TGN-3324 General Electric	200 amps	3-Phase, 60 Hz, 120/208 volts AC
TGN-3325 General Electric	400 amps	3-Phase, 60 Hz, 120/208 volts AC
DU-324 Square D	200 amps	3-Phase, 60 Hz, 120/208 volts AC
DU-325 Square D	400 amps	3-Phase, 60 Hz, 120/208 volts AC
Note: These units or their functional equivalent at the required current rating may be used.		

If 2-pole disconnect switches are not available for the single-phase, 60-Hz, 120/240 volts AC power configuration, the 3-pole disconnect switches listed above can be used if power is only applied to Phase A and Phase B. Phase C will not have a connection.

AC Protector Cabinet

Prior to September 16, 1991, an AC protector cabinet was supplied by AT&T as part of the system order. (The AC protector cabinet was placed between the nonfusible disconnect switch and the AC load center.) The AC protector cabinet served two purposes: 1) it provided lightning arresters, and 2) it provided a system single-point ground terminal. All systems shipped since September 16, 1991 have been equipped with a system single-point ground bar instead of an AC protector cabinet—the lightning arrester function is no longer provided. Customers who wish to include lightning arresters in the AC power configuration must provide and install their own according to local codes.

This version of the *Generic 2 and System 85 System Description* no longer depicts or references the AC protector cabinet in any of the AC power distribution and grounding illustrations nor is the AC protector cabinet referred to elsewhere in the text.

AC Load Distribution Center

The customer or agent must provide an AC load distribution center and have a licensed electrician install it according to local electrical codes and practices. In addition, the electrician must also install the system single-point ground bar on the side of the load distribution center.

The AC load distribution center receives AC power from the main disconnect switch. Inside the load distribution center, breaker-protected feeder circuits are formed from the AC phases, the neutral bar, and the ground bar for distribution to switch cabinets, special function cabinets, and other equipment (see Figures 10-4 and 10-5).

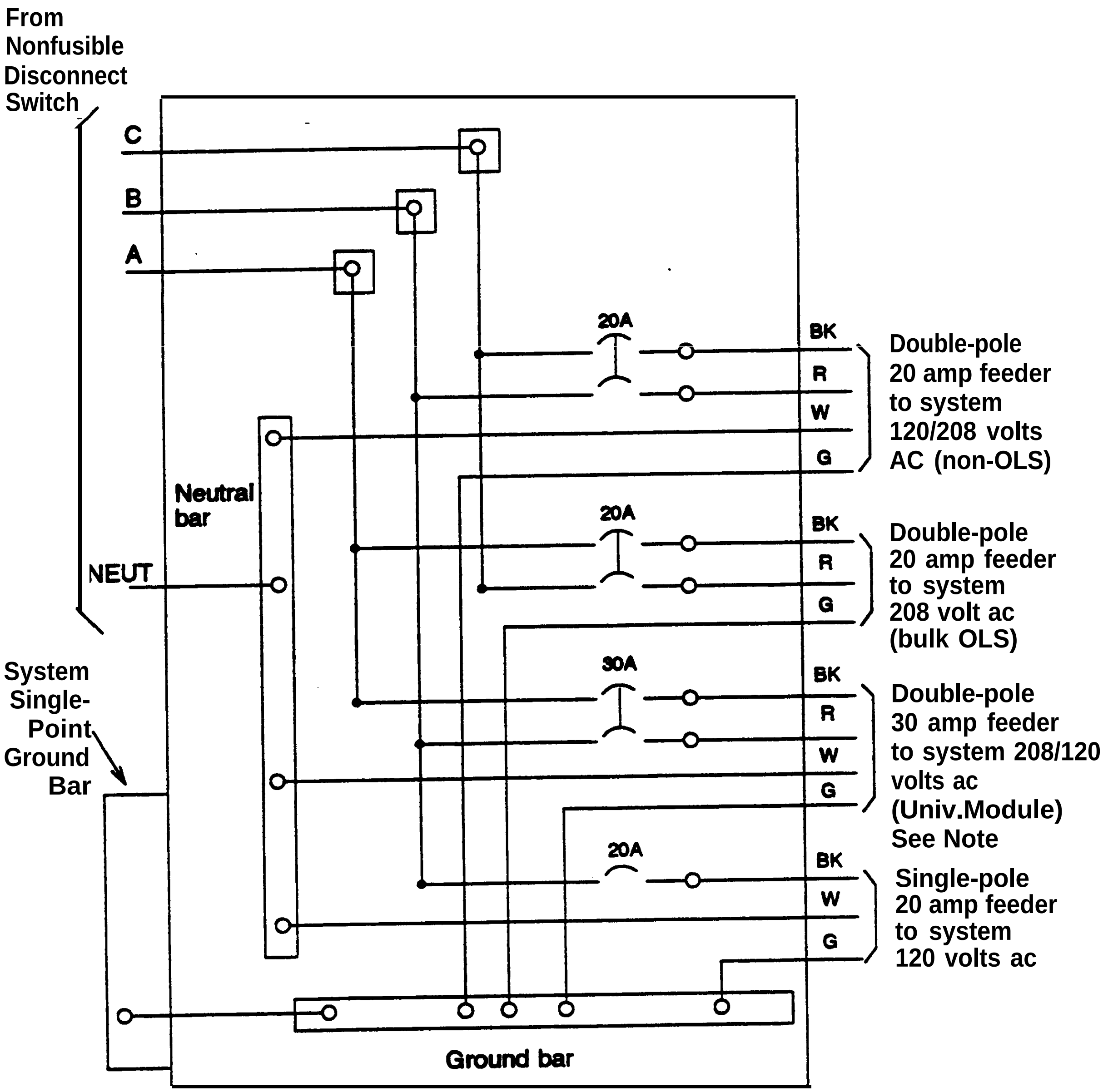
The AC load distribution center should be chosen according to:

- The size and configuration of the dedicated main branch feeder
- System power requirements
- Circuit breaker requirements
- Future growth requirements
- Local electrical codes.

Article 384-15 of the National Electrical Code, 1987 edition, limits the maximum number of overcurrent devices (spaces) in an AC load center 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 is selected.

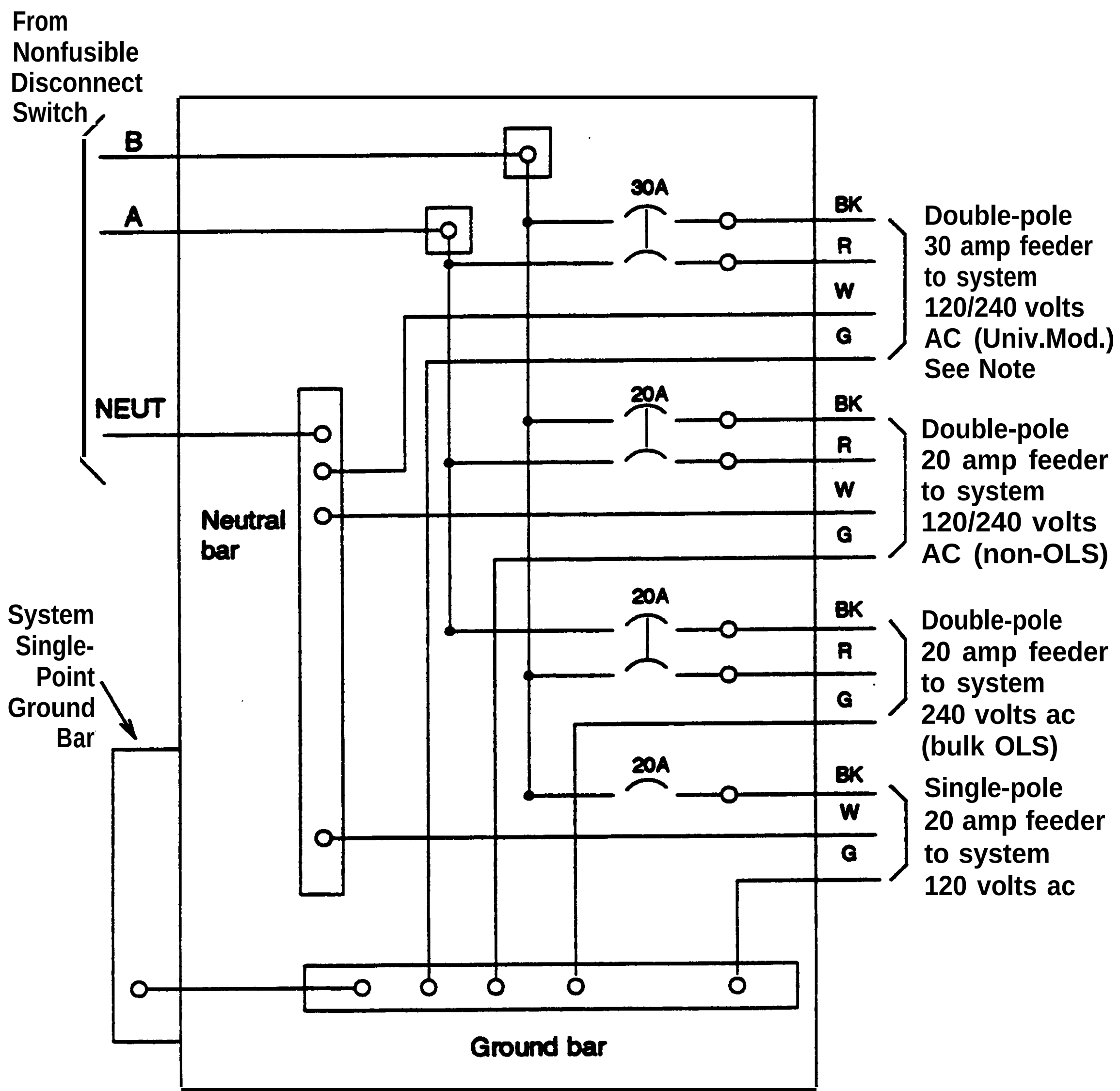
Typical AC load distribution centers for 3-phase, 4-wire, 60-Hz, 120/208 volts AC-powered systems are listed in the following table:

Type	Rating	Breaker Capacity
Siemens-ITE G2442ML3200CU	200 AMP	24 Single-Pole or 12 Double-Pole
General Electric TL30420	200 AMP	30 Single-Pole or 14 Double-Pole
Siemens-ITE G4242ML3200CU	200 AMP	42 Single-Pole or 20 Double-Pole
General Electric TL42420	200 AMP	42 Single-Pole or 20 Double-Pole
Note: The AC load distribution center must meet the specific requirements of the installation.		



Note: This arrangement applies only to universal module cabinets containing the J58890CE, List 4 AC distribution unit (i.e., those cabinets shipped after second quarter 1992). Older universal module cabinets contain the J58890CE, List 2 AC distribution unit and don't use neutral (the "W" wire).

Figure 10-4. Load Distribution Center for 120/208 Volt Configuration



Note: This arrangement applies only to universal module cabinets containing the J58890CE, List 4 AC distribution unit (i.e., those cabinets shipped after second quarter 1992). Older universal module cabinets contain the J58890CE, List 2 AC distribution unit which doesn't use neutral and requires a 240-to-208 volt AC stepdown transformer.

Figure 10-5. Load Distribution Center for 120/240 Volt Configuration

Circuit Breakers

The AC load distribution center must be equipped with the required quantities of UL (Underwriters Laboratories) listed and CSA (Canadian Standards Association) certified circuit breakers. The recommended AC circuit breakers are as follows:

- Single-pole thermal magnetic circuit breaker rated at 20 amperes and capable of handling 130 amperes of inrush current for 1/2 cycle (Siemens-ITE Q120H or equivalent). One circuit breaker is required for each 120-volt AC feeder.
- Double-pole thermal magnetic circuit breaker rated at 20 amperes and capable of handling 200 amperes of inrush current for 1/2 cycle (Siemens-ITE Q220H or equivalent). One circuit breaker is required for each 208- or 240 volt AC feeder that supplies a switch cabinet other than the universal module control cabinet.
- Double-pole thermal magnetic circuit breaker rated at 30 amperes and capable of handling 200 amperes of inrush current for 1/2 cycle (Siemens-lTE Q230H or equivalent). One circuit breaker is required for each 208- or 240-volt AC feeder that supplies a universal module control cabinet.

Feeder Circuits to Cabinets and Equipment

After the system equipment has been installed, the customer or agent must provide and install conduit and feeder circuits from the AC load distribution center to each of the system receptacles in a manner complying with local electrical codes and practices.

Switch cabinets and some special function cabinets are equipped with AC power ducts (attached to the top rear of each cabinet) that serve as an AC wireway for the cabinet lineup. The power ducts are equipped with cabinet and/or utility receptacles to which the feeder circuits are connected (see Figures 10-6 and 10-7). The number and types of receptacles depend on the type and placement of cabinets in the lineup. Figure 10-8 shows feeder circuits and power receptacles for AC-powered switch and special function cabinets.

The cabinet designation and numbering scheme used on the equipment room floor plan drawing (for example, MC0200, PP0102, and AUX01) should be used to label the associated circuit breaker in the AC load distribution center.

The floor plan drawing also shows the type and placement of any additional miscellaneous feeders and receptacles the system requires. These receptacles are not supplied with the system and must be provided and installed by the customer or the agent.

> NOTE: If local pracitces dictate that the power duct receptacles supplied with the system equipment cannot be used, the customer or the agent must provide receptacles that comply with local electrical codes.

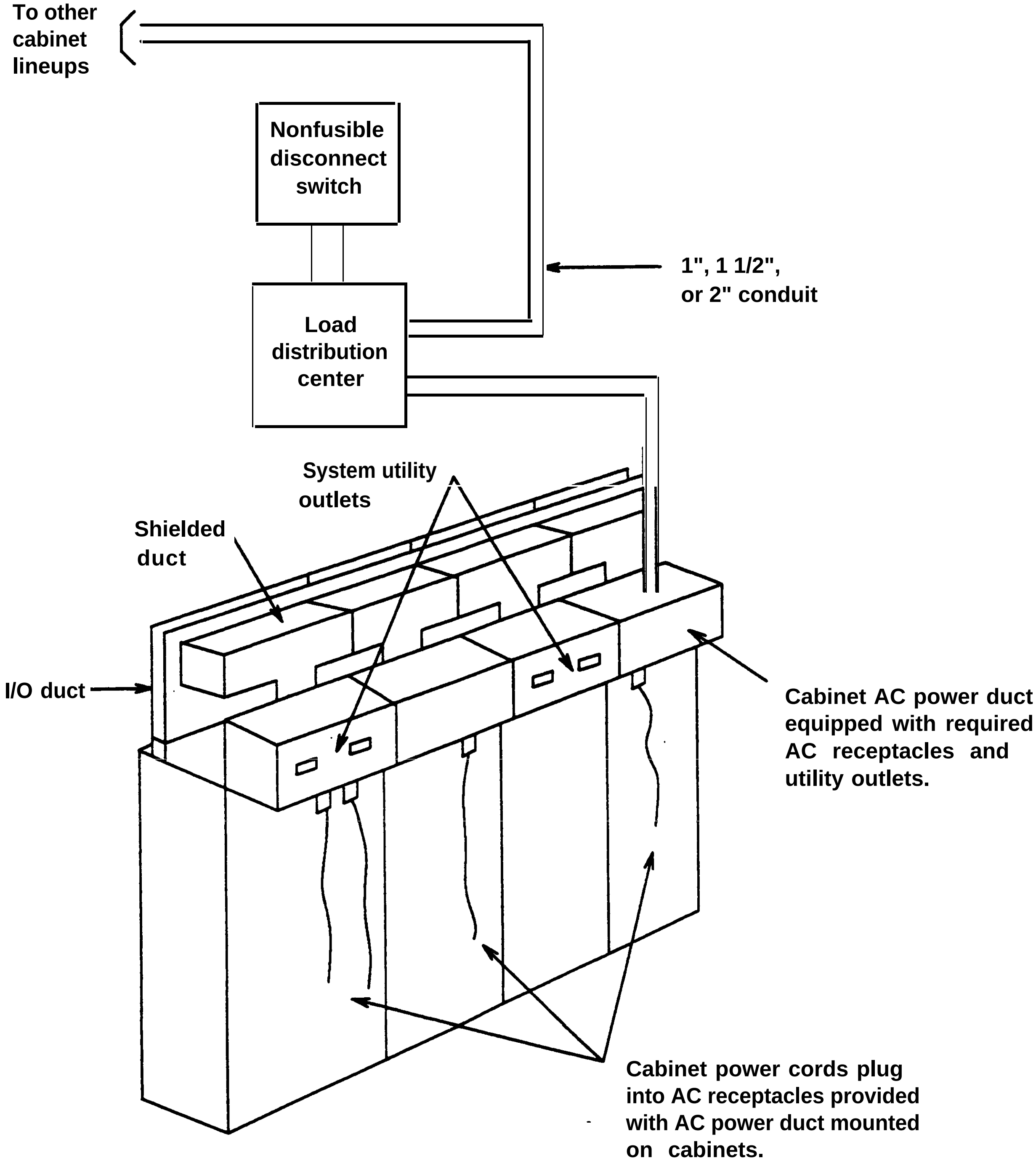


Figure 10-6. Cabinet AC Power Connectivity

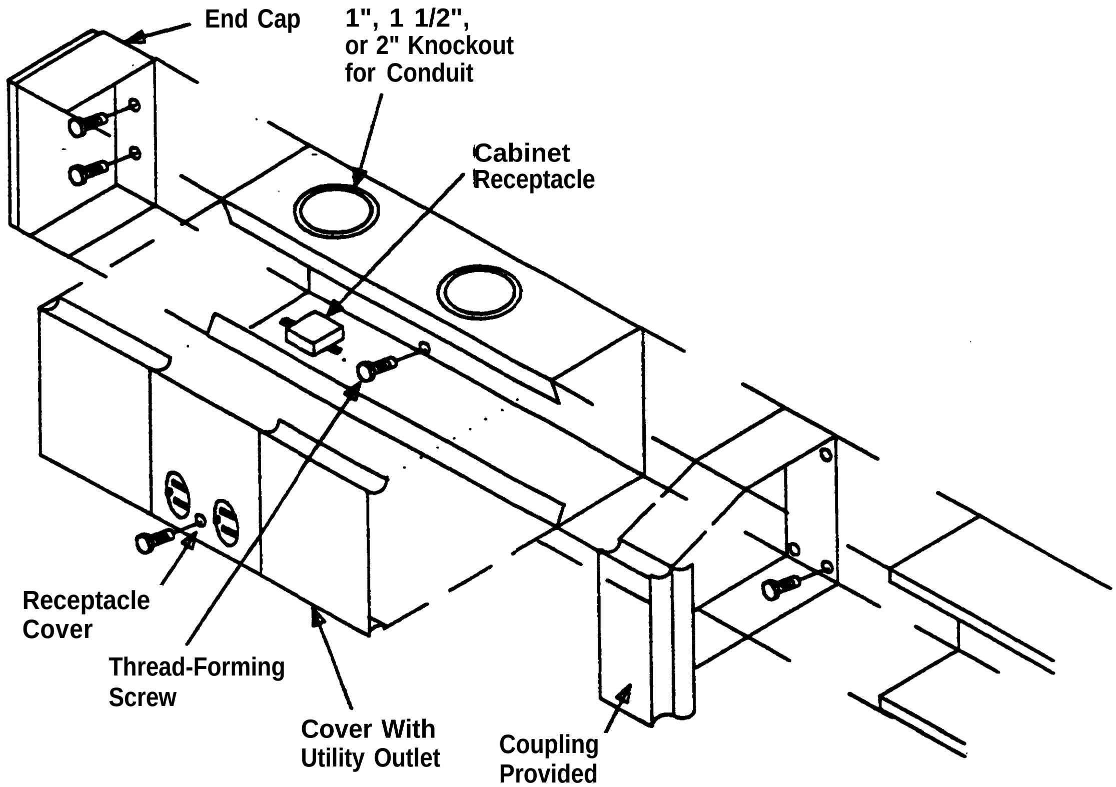


Figure 10-7. Detail of Cabinet AC Power Duct

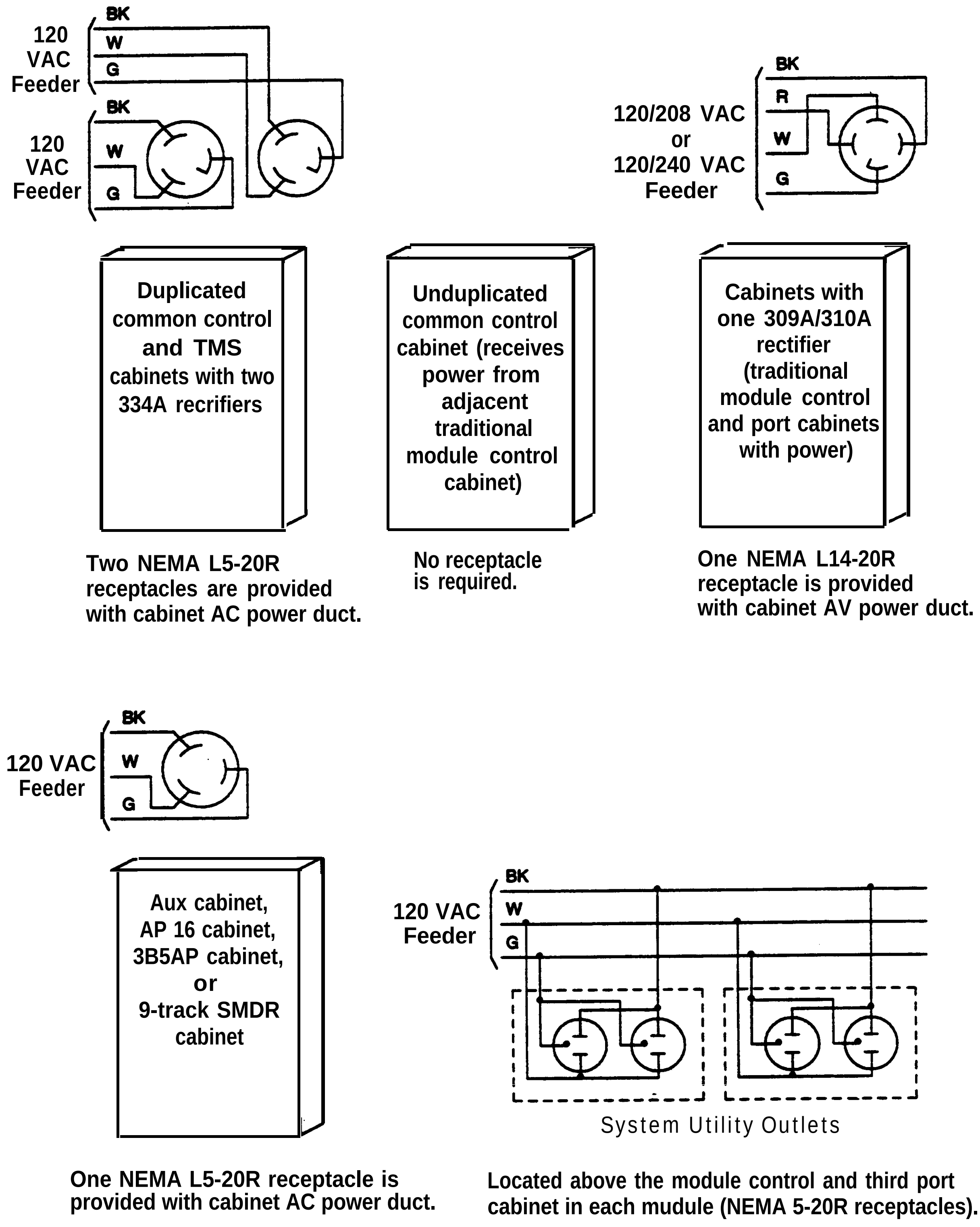


Figure 10-8. System Equipment Feeders and Receptacles (AC Power)

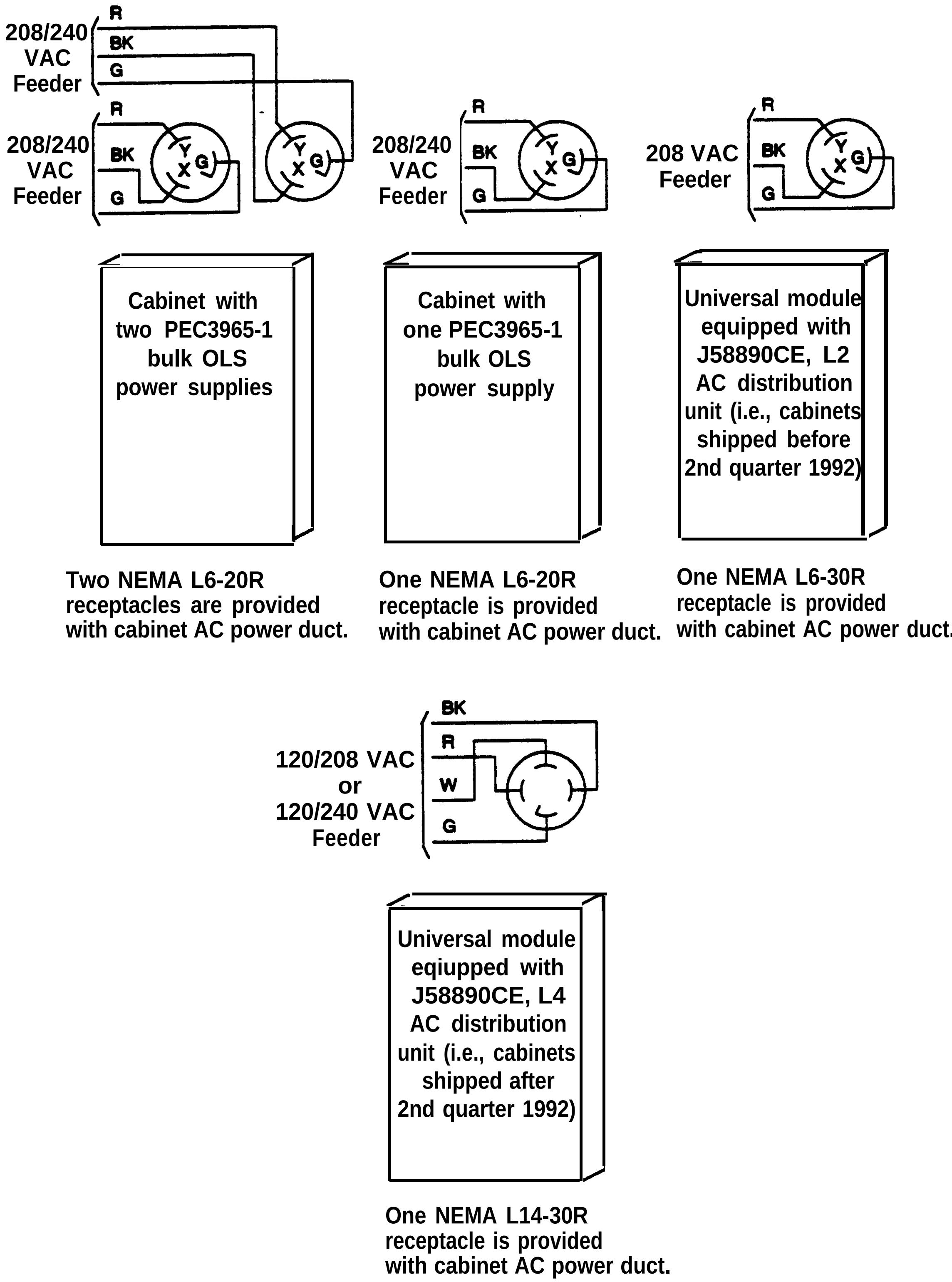


Figure 10-8. System Equipment Feeders and Receptacles (AC Power) (Contd)

Cabinet Power Distribution With AC Power

Internally, switch cabinets use -48 volts DC to power cooling fans, alarm panels, minirecorders, and DC-to-DC converters which provide low-voltage power to most circuit packs. In traditional modules, filtered -48 volts DC is also used to provide talk battery for certain types of port interface circuit packs and a laminated bus bar (or power distribution unit) distributes -48 volts power to carriers and other cabinet equipment.

There are three configurations for internal power distribution in switch cabinet's:

- Non-OLS — Only certain cabinets contain rectifiers. Cabinets without rectifiers receive power from an adjacent cabinet. All switch traditional cabinets manufactured before July, 1986 use this configuration.
- Bulk OLS — Each traditional cabinet contains one or two bulk OLS power supplies (PEC3965-1). All switch cabinets manufactured after November, 1986 (except the universal module control cabinet) use this configuration.
- Distributed OLS — The cabinet contains an AC distribution unit that distributes both AC and DC power to the carrier-based OLS power supplies used in universal module control cabinets. These carrier-based OLS power supplies normally run off of 120-volt AC supplied by the AC distribution unit but can run for a limited time off of 144-volt DC supplied by nominal holdover batteries housed in the base of the cabinet. For universal cabinets that derive power from a UPS (Uninterruptible Power Supply) arrangement, the battery pack (KS21906, L9) and the battery charger (397) are optional.

System 85s manufactured from July through November of 1986 use a combination of OLS and non-OLS power supplies. During that period, the following traditional cabinets were equipped with non-OLS power supplies:

- Duplicated Common Control
- Duplicated TMS
- Unduplicated TMS.

Non-OLS Power Configuration

For non-OLS AC-powered systems, certain tradition cabinet pairs can share an AC distribution unit and a -48 volts DC rectifier. The cabinets must be physically adjacent to each other and in the same call processing module. The traditional cabinet pairs are:

- Traditional module control cabinets and unduplicated common control cabinet
- Traditional module control cabinet and port cabinet without power
- Port cabinet with power and port cabinet without power.

The cabinet without a rectifier is equipped with a DC filter. 4-gauge wires connect the -48 volts, filtered -48 volts (talk battery), and circuit ground between the cabinet pairs. The wires are routed through a small power duct located near the bottom rear of the cabinets.

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 and nominal holdover.

When the TMS cabinet is equipped with one or two unduplicated carriers, it has one rectifier; when equipped with three or four unduplicated carriers, it has two rectifiers fed by separate AC power sources. The TMS cabinet also has two rectifiers, fed by separate AC power sources, when it is equipped with any number of duplicated carriers. This configuration provides independent power sources for the on-line and off-line carriers. Two rectifiers are also required in the TMS cabinet whenever an RMI (Remote Module Interface) carrier is equipped.

Bulk OLS Power Configuration

The traditional unduplicated common control, traditional module control, and traditional port cabinets require only one bulk OLS power supply if they have 40 or fewer MFAT (ANN17B) circuit packs. Otherwise, cabinets require two bulk OLS power supplies. See Figure 10-9.

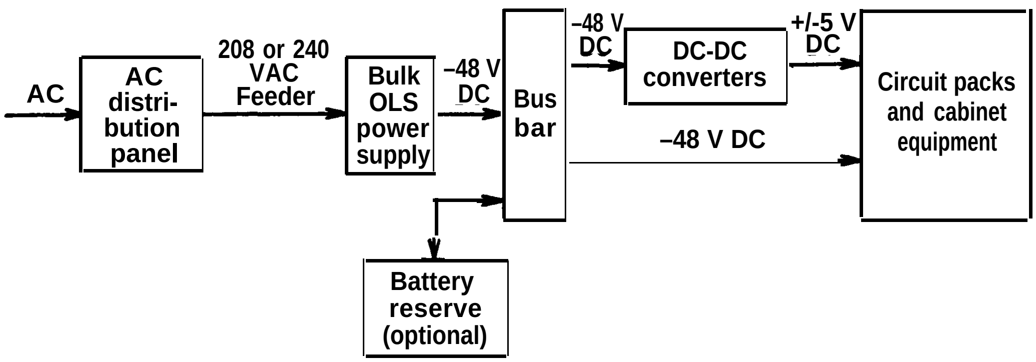


Figure 10-9. Typical Cabinet Power Arrangement for Bulk OLS AC-Powered System

Distributed OLS Power Configuration

The universal module control cabinet has an AC distribution unit that distributes power to the carrier-based OLS power supplies which provide low-voltage power to circuit packs and -48 volts DC power to other cabinet equipment. In addition the AC distribution unit provides:

- Cabinet input power connection
- Input power filtering
- Overcurrent circuit protection
- Nominal 144-VDC holdover power and distribution (optional if power is derived from a UPS)
- Ringing voltage distribution (frequency generator).

Battery Reserve (Nominal Holdover)

The battery reserve unit maintains DC voltage for AC-powered cabinets during short-term commercial AC power outages. AC-powered, Release 2 System 85 common control, CC/TMS, and universal module control* cabinets are equipped with battery reserve units. Battery reserve units are optionally available for the TMS cabinet, traditional module control, and traditional port cabinets.

The non-OLS and bulk OLS battery reserve units use batteries available through comcode 403736291. This battery pack contains 24 sealed lead acid cells and provides -48 volts output. To prevent damage to the cells, the battery pack is disconnected if the output voltage drops to -42 volts.

The distributed OLS configuration (found in universal module cabinets) uses three battery packs available through comcode 403302912. Each battery pack contains 24 sealed lead acid cells and each battery pack provides -48 volts output. Together, the three battery packs supply 144 volts DC. Battery packs are optional for universal modules powered by UPSs. The distributed OLS power configuration requires three matched battery packs.

> NOTE: Do not use the battery available through comcode 403736291 in the universal module control cabinet.

The length of the holdover period depends on the type and quantity of circuit packs in a cabinet and, for network cabinets, the amount of traffic present during the holdover period. Backup power times for cabinets in the system are as follows:

- Common control cabinet (duplicated or unduplicated) — 7 to 10 minutes
- CC/TMS cabinet — *8* to 14 minutes
- TMS cabinet — 2 to 5 minutes
- Traditional module cabinet — 2 to 5 minutes
- Port cabinet — 2 to 5 minutes
- Universal module cabinet — 2 minutes.

When commercial power is restored, the batteries begin recharging and require up to 16 hours to recharge. Non-OLS power configurations use the AMC1 battery charger, bulk OLS power configurations use the OLS Battery Charger Unit (PEC 3965-2), and the distributed OLS power configuration uses the 397-type battery charger unit.

* The battery reserve unit is optional for universal modules powered in a UPS arrangement.

System Grounding With AC Power

Figure 10-10 illustrates the system grounding scheme. The installation crew installs all the ground connections from the system equipment to the system single-point ground bar on the AC load distribution center. The connection from the single-point ground bar to the closest customer-provided approved ground is installed by the installation crew, the customer, or agent as required by local practices. For more detailed grounding information, refer to *DEFINITY Communications System Generic 2 and System 85 Electrical Protection, Grounding, and Exposure Checklist* (555-104-120) or *DEFINITY Communications System Generic 2 and System 85 Installation manual* (555-104-104).

The grounding scheme provides:

- Protection from electric shock
- Equipment protection from damage due to power fault to ground
- A low impedance path for static and power surges
- A common circuit ground reference

An approved ground is an acceptable grounding medium as specified in Article 250-81 of the National Electric Code, 1987 edition. An approved ground may consist of any of the following:

- Grounded Building Steel—The structural steel beams that make up the frame of the building. Building steel may be used for grounding only if the steel frame is buried in the earth.
- Acceptable Water Pipe—A metal pipe, not less than 3/4 inch (1.9 cm) in diameter, electrically connected to a metal underground water pipe that is in direct contact with the earth for 10 feet (3m) 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 (5 cm) 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 m) of one or more steel reinforcing bars or rods of not less than 1/2 inch (1.3 cm) diameter, or at least 20 feet (6m) of bare solid copper wire not smaller than number 4 AWG (American Wire Gauge).
- Ground Ring—A ground ring that encircles a building or structure in direct contact with the earth at a depth of at least 2 and l/2 feet (0.8 m) below the earth's surface. This must consist of at least 20 feet (6 m) of bare copper conductor not smaller than number 2 AWG.

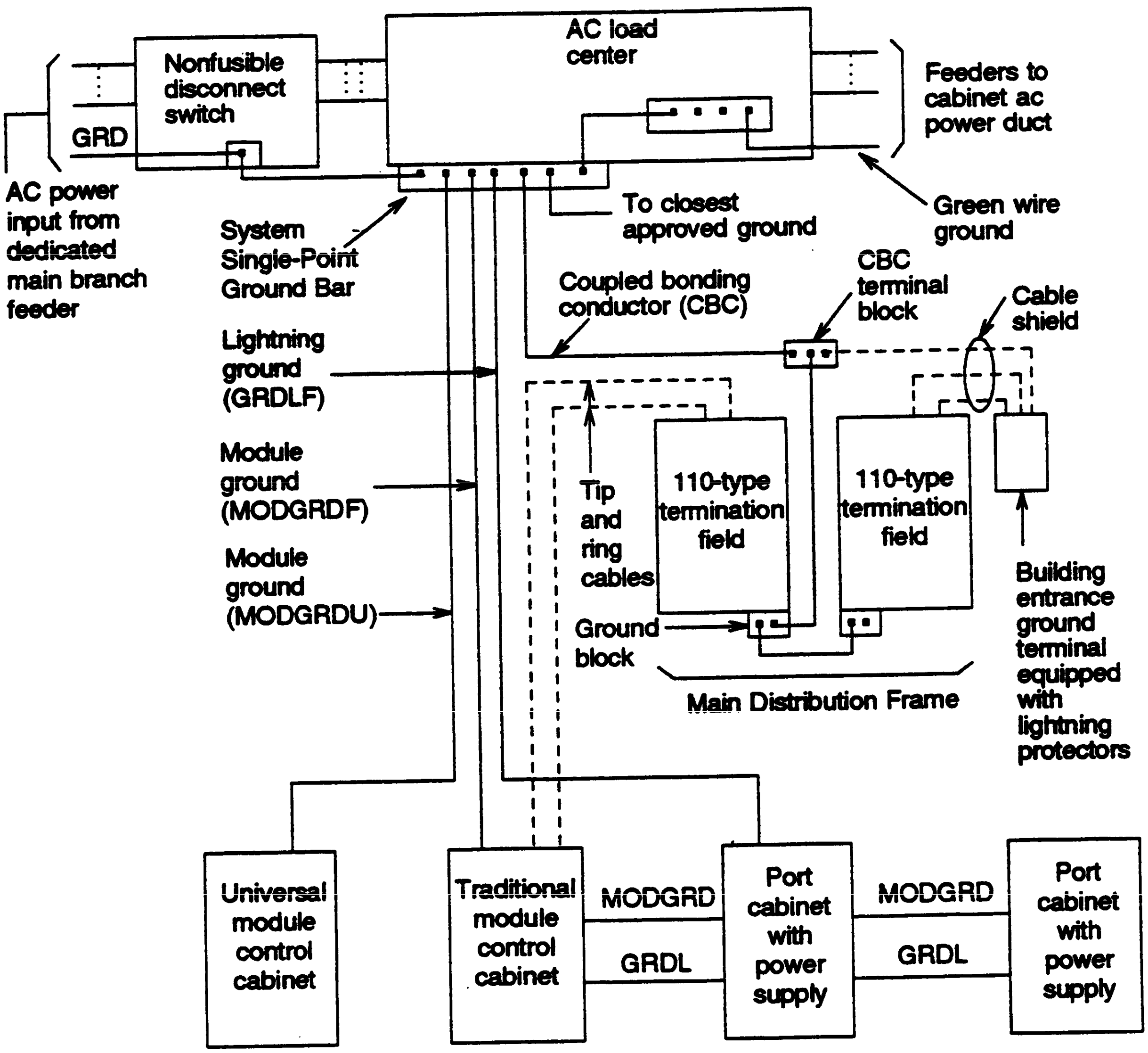


Figure 10-10. Grounding Arrangement for AC-Powered System

In a high-rise building, an approved floor ground, which is 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 from the secondary side of the power transformer that supplies the floor
- A grounding point specifically provided for this purpose.

System Ground Leads

The following leads are used to ground System 85 and DEFINITY Generic 2. These leads are required in addition to the approved and single-point grounds described above and are installed by the installation crew (except green wire grounds in the AC feeders).

Coupled Bonding Conductor

The coupled bonding conductor provides a connection between the system single-point ground and the protector ground terminal for tip and ring 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. The continuity of the cable shield can be tested using a T-124, manufactured by Wilcom Grounding Systems, or equivalent.
- With inside wiring cable, the coupled bonding conductor shall consist of a 10-gauge wire that is tie-wrapped to-the cable. If this is impractical, use six good spare pairs within the cable as the coupled bonding conductor. Twist and solder the six spare pairs 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 Ground)

To comply with Articles 250-32, 250-42, and 250-45 of the NEC (National Electrical Code), 1987 edition, the AC power equipment must be grounded by an equipment grounding conductor (green wire ground). The green wire ground is routed to switch cabinets, special function cabinets, and other equipment by way of the AC feeder circuits.

Lightning Ground (GRDLF)

Each traditional cabinet* containing a port or DS1 carrier requires a lightning ground connection to the system single-point ground. A lightning ground wire is chain-wired to each cabinet in a traditional module and from one of the cabinets (the cabinet closest to the system single-point ground equipped with an EMC filter) to the ground. Each traditional module must have a separate lightning ground connection (GRDLF) to the system single-point ground.

Module Ground (MODGRDF)

Each traditional cabinet equipped with a power supply requires a circuit ground connection to the system single-point ground. A ground wire is connected to each power supply-equipped cabinet in each traditional module and to any adjacent system cabinets

* A traditional cabinet is any cabinet which uses rectifiers or bulk OLS power supplies.

(duplicated common control or TMS). A ground wire (MODGRDF) is also connected from one of the cabinets in the module (the cabinet closest to the system single-point ground equipped with an EMC filter) to the system single-point ground. The GRDLF and MODGRDF wires must be at least 6 inches (15.2 cm) apart.

Module Ground (MODGRDU)

MODGRDU wires (6 AWG) run from the system single-point ground to each cabinet lineup containing one or more universal modules. Since MODGRDU should be as short as possible, the universal module cabinet in each lineup that is closest to the AC load distribution center is connected to the system single-point ground.

Traditional Cabinet Grounding With AC Power

Cabinet grounding protects the equipment and service personnel from lightning-induced and other power surges. Because the grounding arrangement for the universal module control cabinet is somewhat different from other switch cabinets, it is described separately.

There are three types of intracabinet and intercabinet grounds used in AC-powered systems:

- Module Ground
- Lightning Ground
- Green Wire Ground.

Module ground and lightning ground are isolated from each other in traditional cabinets and are individually routed to the system single-point ground bar on the AC load distribution center where they are interconnected. In addition to these grounds, a digital ground (GRDD), which is tied to circuit ground, interconnects the carriers within a cabinet to ensure a low impedance path for digital signals.

Module Ground

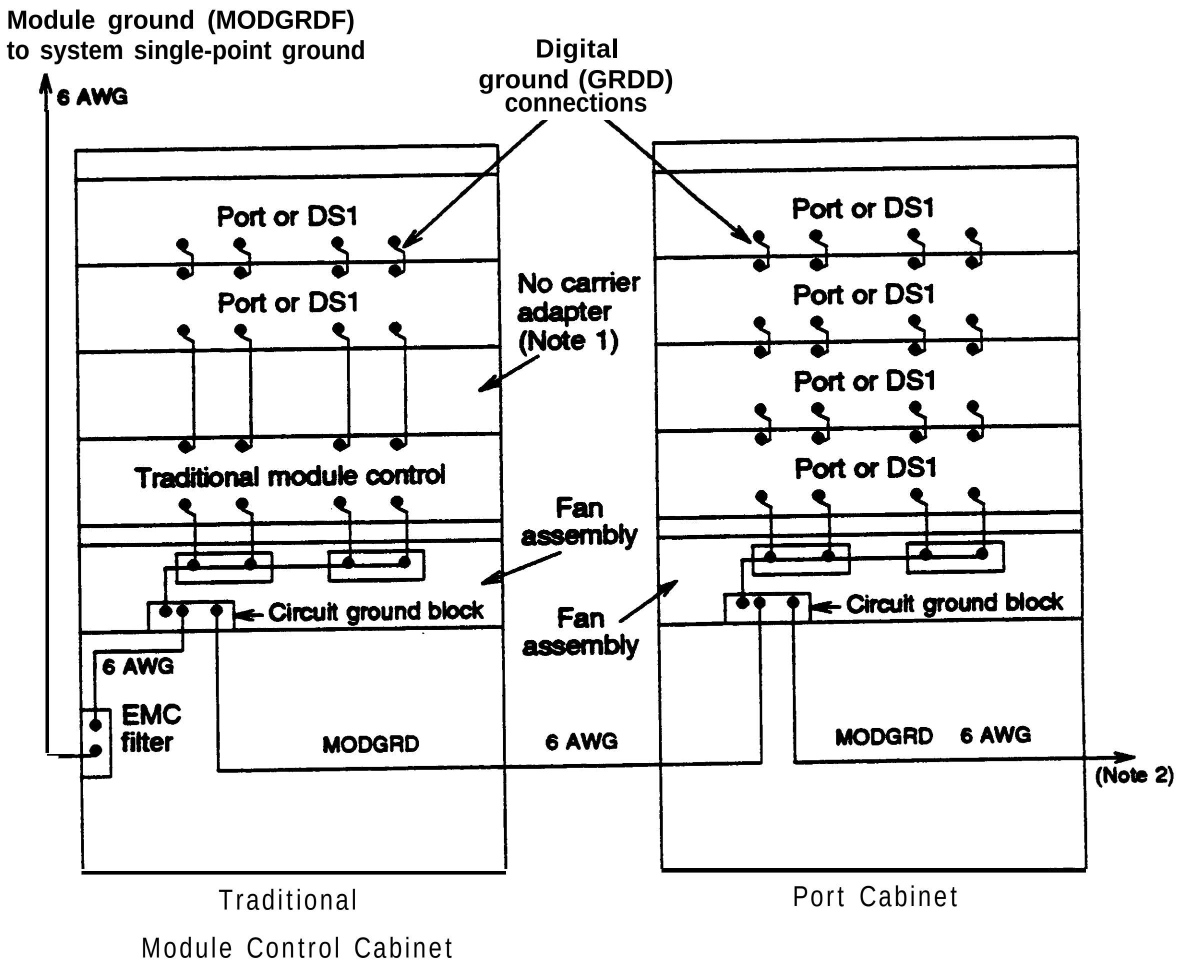
Each traditional cabinet is equipped with a circuit ground block located on the DC fan assembly. The circuit ground block is connected to the power distribution grounds at the cabinet bus bar. The circuit ground blocks of all power supply-equipped cabinets in a module are interconnected with a 6-gauge wire that is designated MODGRD.

A 6-gauge wire also connects from the circuit ground block of each traditional module control cabinet to the cabinet's EMC (Electro-Magnetic Compliance) filter and from the EMC filter in the cabinet closest to the system single-point ground terminal (see Figure 10-11). The ground wire from the EMC filter to the system single-point ground is designated MODGRDF. Module ground and lightning ground connect to separate EMC filters.

A 6-gauge wire also connects the circuit ground blocks of each system cabinet (duplicated common control and TMS) in a lineup and connects from one of the cabinets to the circuit ground block in a traditional module control cabinet.

Digital Ground

Four or more equally spaced 14-gauge wire straps electrically interconnect adjoining or sequential carriers within a cabinet. These wire straps, which connect to the circuit ground block on the DC fan assembly, provide a low impedance path for digital signals (see Figure 10-11).



Notes:

1. When digital ground connections span vacant carrier positions equipped with no carrier adapters, the wire gauge changes from 14 to 10.
2. Connects to the circuit ground block in an adjacent port cabinet that belongs to the same module.

Figure 10-11. Module Ground and Digital Ground in an AC-Powered System

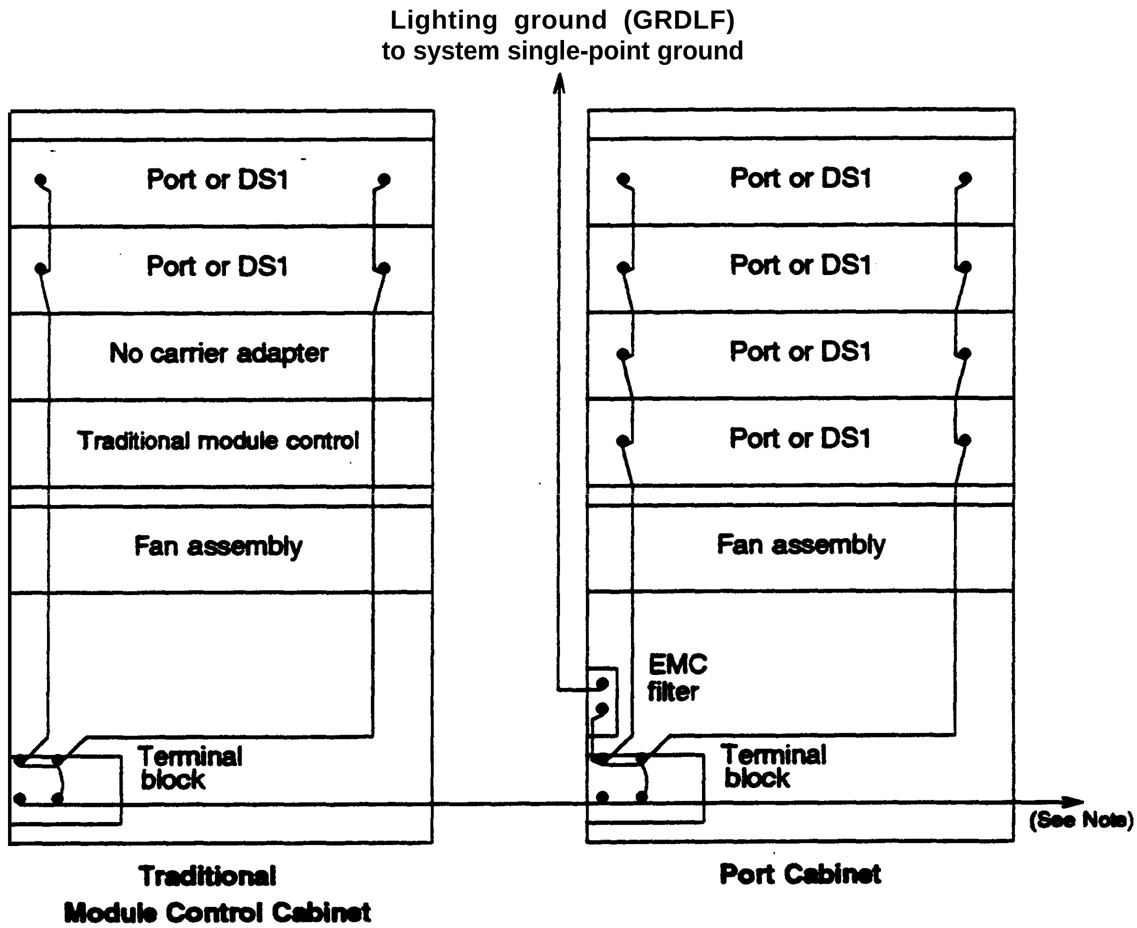
Lightning Ground

Each cabinet equipped with port or DS1 carriers has 10-gauge wire straps connecting each port or DS1 carrier to the lightning ground terminal block (see Figure 10-12). These wire straps route lightning-induced power surges away from circuit components. The lightning ground terminal blocks of all the cabinets that belong to the same module and are in the same cabinet lineup are chain-wired together. Then a ground wire (GRDLF) is connected from the cabinet in the module closest to the system single-point ground by way of the cabinet's EMC (Electro-Magnetic Compliance) filter to the single point ground. Unduplicated common control and port cabinets can be equipped with an EMC filter.

If one or more port cabinets are located cross-aisle from their associated traditional module control cabinet, one of the port cabinets must also be equipped with an EMC filter and have a lightning ground connection (GRDLF) to the system single-point ground. The cabinet with the EMC filter is chain-wired to any other port cabinets in the row that are associated with the same module. If a traditional module control cabinet does not have associated port cabinets in the same cabinet lineup, the traditional module control cabinet must be equipped with an EMC filter and have a lightning ground connection to the system single-point ground. Lightning ground and module ground connect to separate EMC filters.

Green Wire Ground

Each cabinet equipped with a power supply has a green wire ground (from the AC feeder) connected to the cabinet's frame.



Note: Connects to lightning ground terminal blocks in other port cabinets which belong to the same module and are located in the same cabinet lineup.

Figure 10-12. Lightning Ground in an AC-Powered System

Universal Module Control Cabinet Grounding With AC Power

Figure 10-13 shows the grounding arrangement for an AC-powered universal module control cabinet. The most significant differences in the grounding arrangements between the universal module control cabinet and traditional switch cabinets are:

- The universal module control cabinet does not require a lightning ground, cabinet bonding ground, or an EMC filter.
- The circuit and green wire grounds are isolated from each other in traditional switch cabinets, but they are tied together at the mod ground block in the universal module control cabinet.

AC-powered system cabinets and the universal module control cabinet are equipped with a MODGRD block that is located in the bottom rear of the cabinet. The MODGRD blocks of all system and universal module control cabinets in a lineup are interconnected with 6-gauge ground wire (MODGRD). MODGRD wires should be as short as possible.

For Generic 2, the cabinet in a lineup closest to the system single-point ground has a 6-gauge ground wire called MODGRDU which runs from the MODRGD block to the system single-point ground. MODGRDU should be as short as possible.

If a universal module control cabinet is added to a lineup that has a traditional module, no ground connection (circuit ground, lightning ground, or cabinet bonding ground) should be made between the universal module and the traditional module.

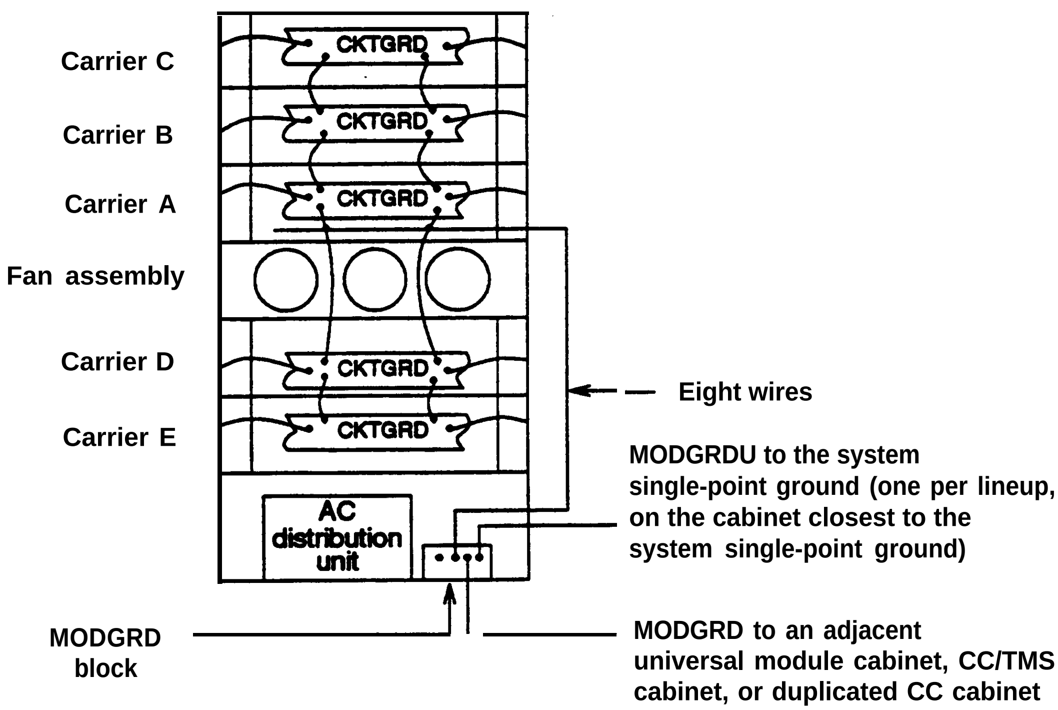


Figure 10-13. Universal Module Control Cabinet Grounding in an AC-Powered System

–48 Volt DC Standby Power and Grounding

The term "standby power" is used to describe equipment that provides continuous power service during commercial AC power failures. This section describes the standby power equipment offered by AT&T. There are three categories of standby power equipment that can be used with system 85 and DEFINITY Generic 2:

DC Power Cabinets and Maintenance-Free Battery Cabinets
This is the standard configuration for powering switch cabinets and auxiliary cabinets containing -48 volt DC-powered equipment.

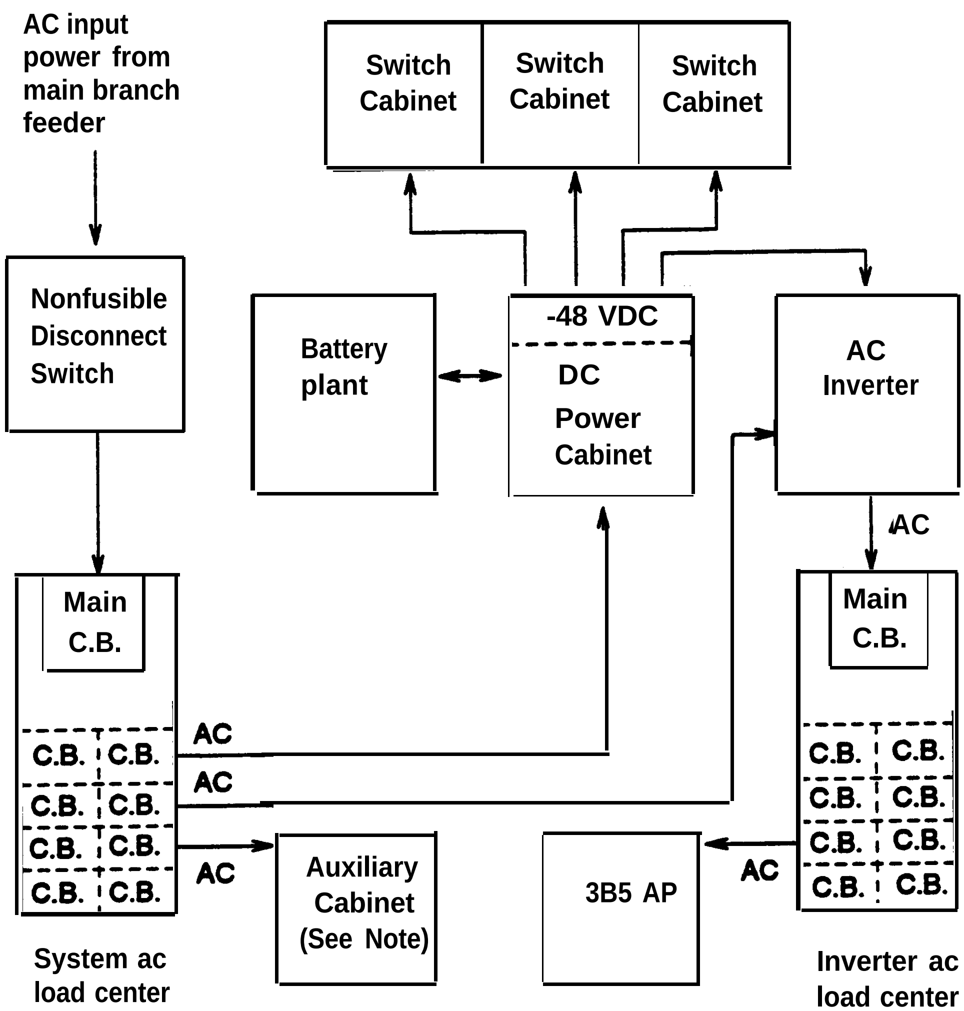
AC Inverters and Maintenance-Free Battery Cabinets
This configuration is used to power auxiliary cabinets containing AC-powered equipment and other peripheral equipment and adjunct processors that require an AC input.

Self-Contained Uninterruptible Power System (UPS)
This configuration is used to power auxiliary and peripheral equipment and adjunct processors that require an AC input.

Depending on the required amount of power and holdover time, equipment that requires an AC input can receive power from either a DC power cabinet with AC inverter and maintenance-free batteries or a self-contained UPS. Another way to power system equipment that requires an AC input is from the main AC service that supplies power to the standby power equipment.

NOTE: Any system equipment powered from the main AC service will not operate during a commercial AC power outage.

Figure 10-14 shows a typical -48 volts DC standby power configuration which consists of one or more DC power cabinets, AC inverters, and maintenance-free battery cabinets. AT&T designs the configuration to satisfy the customer's standby power requirements.



C.B. = Circuit breaker

Note: Equipment powered from the main AC service will not operate during a commercial AC power outage.

Figure 10-14. Typical -48 Volts DC Standby Power Configuration

DC Power Cabinet

The DC power cabinet is 32 inches (81 cm) wide, 24 inches (61 cm) deep, and 68 inches (173 cm) high. Table 10-A lists specifications for the various sizes of DC power cabinets.

TABLE 10-A. Specifications for DC Power Cabinets

PEC	Size (amps)	Number of Cabinets	Number of DC Circuit Breakers	Number/Size of Rectifiers	Weight (Lbs.)	Floor Loading (Lbs./Sq. Ft.)	Maximum BTU/Hour
2400-010	50	1	4	2/50 amp	600	84	1200
2400-011	100	1	8	3/50 amp	780	110	2500
2400-012	200	2	16	3/100 amp	590	83	2200
					900	127	4200
2400-013	400	3	20	5/100 amp	590	83	2200
					900	127	4200
					900	127	4200
2400-014	800	2	35	5/200 amp*	400	56	4100 per rectifier
					325	46	
2400-015	1200	2	50	7/200 amp*	400	56	4100 per rectifier
					325	46	

* Floor-standing rectifiers (not mounted in DC power cabinet)

All DC power cabinets contain a bus bar, low voltage disconnect, meters, rectifier failure and low output alarms, cabling, and a control unit. The 50 through 400 amp DC power cabinets also house the rectifiers. The 800 and 1200 amp DC power cabinets have floor-standing rectifiers (not housed in the cabinet). Each floor-standing rectifier is 13 inches (33 cm) wide, 16 inches (41 cm) deep, and 72 inches (183 cm) high and requires approximately 1.4 square feet of floor space.

The rectifiers convert 208 or 240 volts AC input power into regulated, filtered, low-noise, -48 volt DC output power. The output is connected in parallel with the maintenance-free batteries, keeping the batteries charged while the rectifiers provide system power. If commercial AC power fails, the batteries power the system equipment for the period of time specified by the customer. To prevent damage to the batteries, output power is shut off if battery voltage drops below 43 volts at the battery plant.

The control unit monitors commercial input power and output current and voltage, and generates alarm signals if it detects abnormal conditions.

Maintenance-Free Battery Cabinet

Maintenance-free batteries have been available since January, 1988. These batteries use oxygen-recombination technology, which eliminates the need to add water. Furthermore, because the batteries require no extra ventilation, the battery cabinets can be placed in the same equipment room or even the same lineup with switch cabinets. The battery cabinets are rated for use in Seismic Zones 0 through 4 and, if required by local building codes, they can be anchored to the equipment room floor. Table 10-B lists specifications for the various maintenance-free battery configurations.

TABLE 10-B. Specifications for Maintenance-Free Battery Cabinets

PEC	Capacity In amps/Hour (8 Hour Rate)	Number of Cabinets	Cabinet Dimensions W x D x H (inches)	Weight Per Cabinet (Lbs.)	Floor Loading Per Cabinet (Lbs./Sq. Ft.)
24001	100	1	48 21 16	400	57
24002	200	1	48 21 31	815	116
24003	300	1	48 21 31	1300	186
24004	400	1	48 21 46	1580	226
24005	600	1	48 21 61	2600	371
24006	900	2	48 21 46	1950	279
24007	1200	2	48 21 61	2600	371
24008	1800	3	48 21 61	2600	371

AC Inverter

An AC inverter has an AC and a DC input and an AC output. As long as commercial AC line voltage and frequency are within the acceptable operating range, power flows through the regulator/filter to the load. During commercial AC power disruptions (such as blackouts, brown-outs, interruptions, or transients) the inverter receives -48 volts DC from the DC power cabinet. The inverter supplies the inverter AC load center.

Self-Contained Uninterruptible Power System

The self-contained Uninterruptible Power System (UPS) is functionally equivalent to a DC power cabinet, AC inverter, and maintenance-free batteries. It has an AC and a DC input and an AC output. A microprocessor control circuit monitors the commercial AC power, load current, and battery voltage levels.

Main AC Feeder Size and Power Arrangement

The size and power arrangement of the main AC feeder is determined by the power requirements of the standby power equipment and any AC-powered system equipment that does not receive power from an inverter.

-48 Volt DC Feeders

After the system equipment has been installed, DC feeder cables must be routed from the DC power cabinet (s) to the switch cabinets, special function cabinets, and other equipment that requires -48 volt DC input power. Figure 10-15 shows typical AC and DC feeders.

The nominal DC input power for switch cabinets (at the cabinet input) is -48 volts DC, but may range from -42.5 volts DC to -52.5 volts DC. The DC feeder cables must be sized such that the voltage drop does not exceed 0.5 volts one way, or 1.0 volts round trip. The wire gauge of the DC feeders must be no smaller than 6 AWG and no larger than 1/0 AWG. The DC feeders must be UL listed and CSA certified. The recommended DC feeder cables are as follows

- Royal Electric X4905 or equivalent. Only the universal module control cabinet uses this DC feeder. The wire gauge is 1 AWG for distances up to 50 feet. The resistance of the cable must be equal to or less than 0.1290 ohms per thousand feet.
- Royal Electric X4902 or equivalent. All switch cabinets other than the universal module control cabinet use this DC feeder. The wire gauge is *2* AWG for distances up to 50 feet. The resistance of the cable must be equal to or less than 0.1630 ohms per thousand feet.

Typically, DC feeders are routed from the DC power cabinet to a cabinet lineup over a ladder rack, then through the overhead I/O cable duct to the appropriate cabinets. The feeders are terminated on a terminal block that is accessible from the back of the cabinet. Local codes and practices may require a different arrangement for feeder distribution and/or demarcation points for the feeders.

The unduplicated common control cabinet receives two feeders: one for the common control carrier and related equipment, and one for port or DS1 carriers housed in the cabinet. The CC/TMS cabinet or the duplicated common control cabinet receive two feeders, which provide independent power for each common control carrier and related equipment. If the CC/TMS cabinet houses a duplicated TMS, each TMS is powered from a different feeder (along with one of the common control carriers). The TMS cabinet receives two feeders; only one is required if one or two unduplicated carriers are equipped.

Circuit Breakers

If a DC power cabinet is being used instead of an AT&T UPS cabinet, it must be equipped with the required number of UL listed and CSA certified circuit breakers. The recommended DC circuit breakers are as follows:

- Single-pole magnetic circuit breaker rated at 30 amperes. One circuit breaker is required for each DC feeder that supplies a switch cabinet other than the universal module control cabinet.
- Single-pole magnetic circuit breaker rated at 75 amperes. One circuit breaker is required for each DC feeder that supplies a universal module control cabinet.

Unduplicated common control, traditional module control, and port cabinets with 40 or more MFAT (ANN17B) circuit packs require 50 ampere DC circuit breakers.

AC Feeders With -48 Volts DC Standby Power

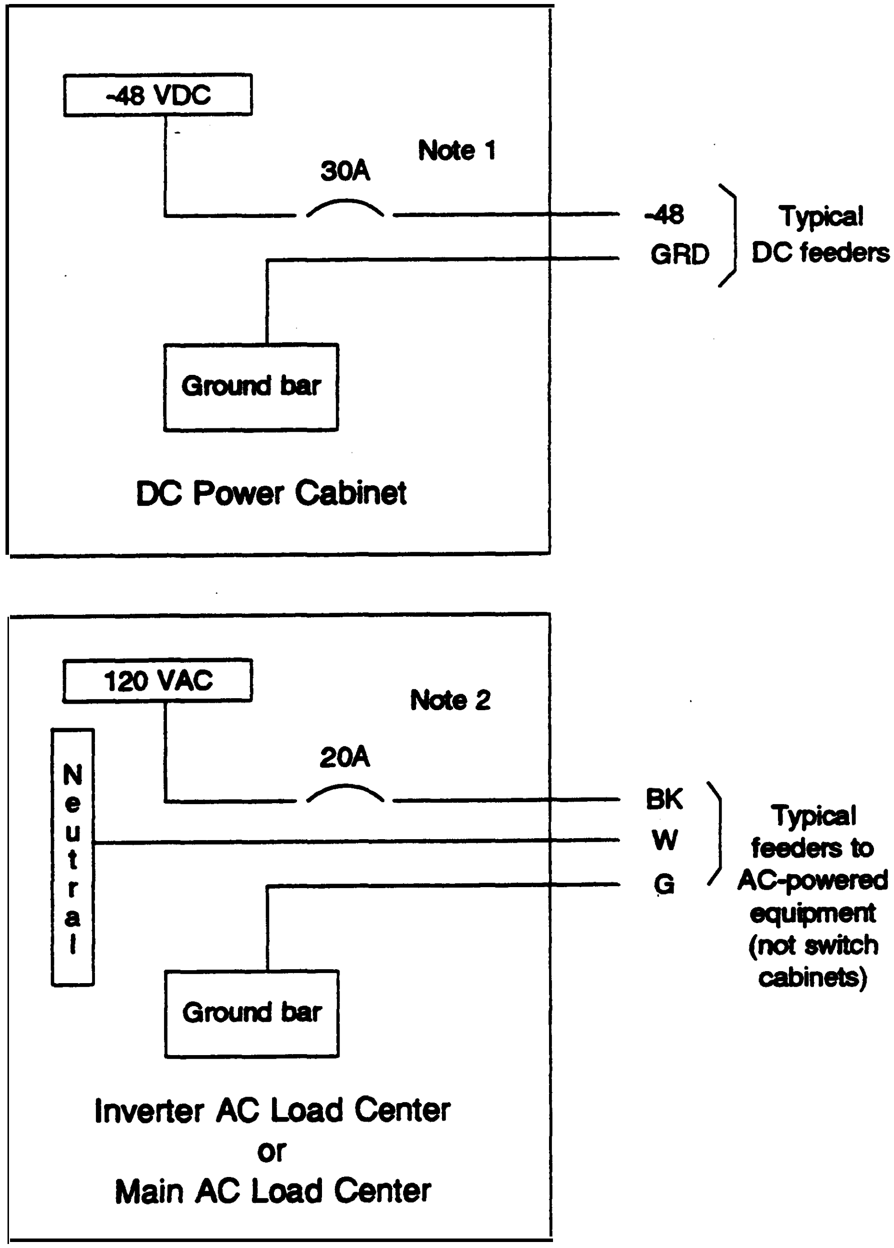
System equipment that requires an AC input can receive power from either the main AC load center or the inverter AC load center. Any equipment that must operate during a commercial AC power outage should be powered from the inverter AC load center.

NOTE: The maintenance and administration data set (connected to the TN492) should be powered from the inverter AC load center. Failure to do so will impair required maintenance activities during a commercial AC power outage.

AC feeders are routed through the overhead AC power duct and terminated at cabinet and utility AC receptacles. Switch cabinets, which receive power from DC feeders, do not have AC receptacles in the power duct or require AC feeders. The power duct for switch cabinets does, however, provide utility AC receptacles at approximately every other cabinet position. Utility AC receptacles should be powered from a single AC feeder (16 receptacles maximum).

AC conduit and feeders must be routed in a manner complying with local codes and practices. Additional miscellaneous feeders, conduit, and receptacles must also be provided for any system equipment not housed in a cabinet (see Figure 10-16).

NOTE: If local practices dictate that the power duct receptacles supplied with AC-powered system equipment cannot be used, the customer or agent must provide receptacles that comply with local electrical codes.



Notes:

1. DC breakers should be 30 amperes high inrush. Unduplicated common control, traditional module control, and port cabinet with 40 or more MFAT (ANN17B) circuit packs require 50 ampere DC breakers. The universal module control cabinet requires an 75 ampere DC breaker.
2. AC breakers should be 20 amperes capable of handling 130 amperes inrush current for 1/2 cycle.

Figure 10-15. Typical Feeder Arrangement For -48 Volt DC Standby Power

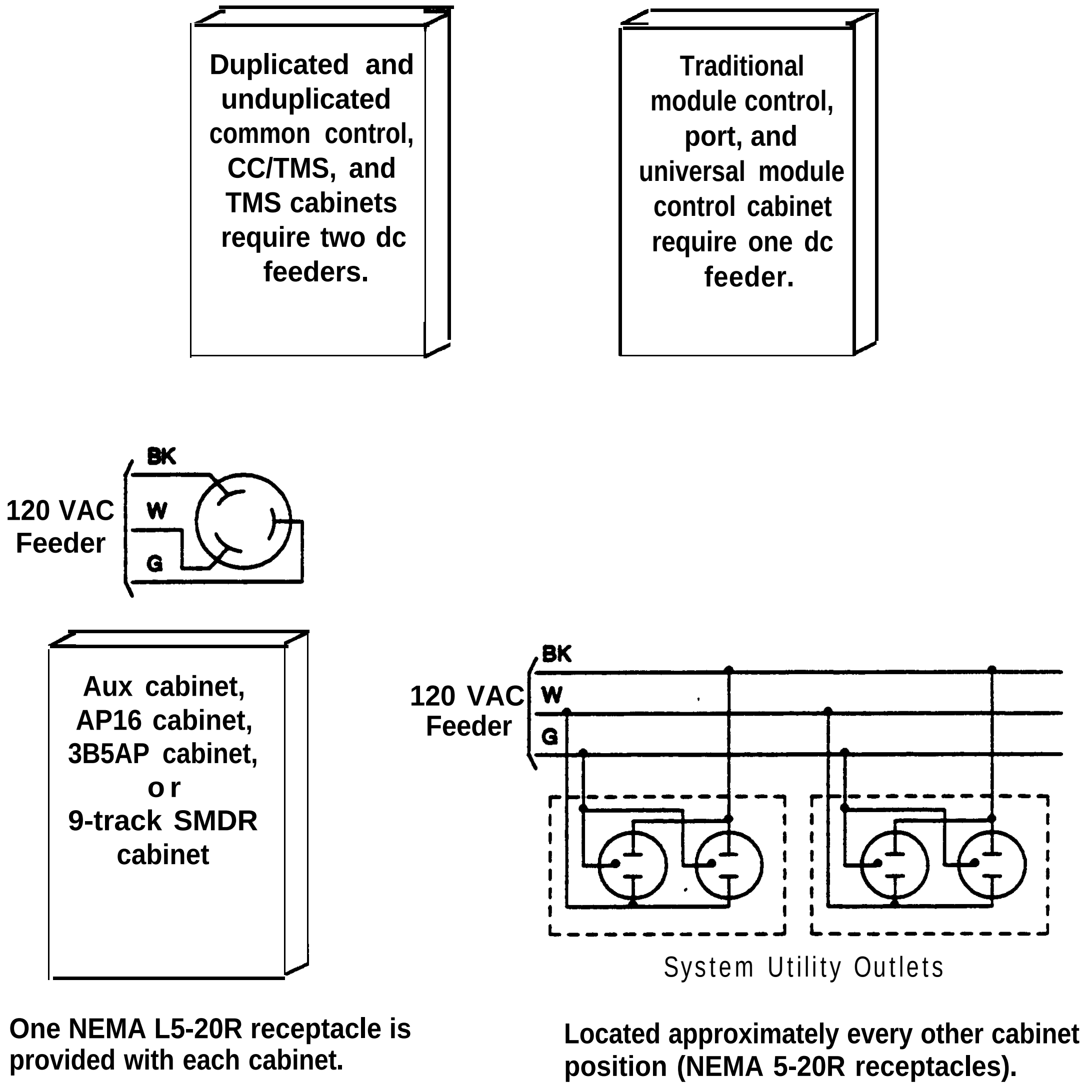


Figure 10-16. System Equipment Feeders with -48 Volt DC Standby Power

Cabinet Power Distribution With -48 Volt DC Standby Power

When switch cabinets are powered by -48 volt DC standby power, the AC power supply, battery reserve unit, and AC distribution unit are replaced by a DC filter and a termination block for the -48 volt DC feeders. Cabinets are not paired to share power each cabinet receives power individually. The -48 volt DC feeders originate from the standby power plant.

Power Distribution for Traditional Cabinets

Traditional switch cabinets use -48 volts DC to power cooling fans, alarm panels, and DC-to-DC converters which provide low-voltage power to circuit packs. Filtered -48 volts DC is also used to provide talk battery for certain types of circuit pack port interfaces. Switch cabinets have a laminated bus bar (or DC distribution unit) that distributes -48 volt power to carriers and other cabinet equipment.

Figure 10-17 shows the power distribution for -48 volt DC powered switch cabinets (other than the universal module control cabinet).

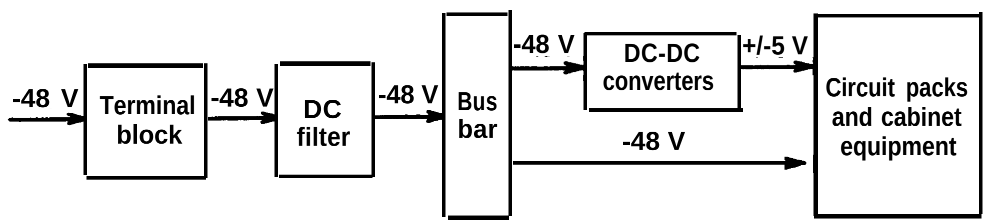


Figure 10-17. Power Distribution for -48 Volt DC-Powered Switch Cabinets

Power Distribution for the Universal Module Control Cabinet

The universal module control cabinet has a DC distribution unit that distributes power to fans and carrier-based DC-to-DC converters. In addition to distributing DC power, the DC distribution unit provides:

- Overcurrent circuit protection
- Ringing voltage distribution (frequency generator)
- Input power filtering
- A block for terminating DC feeders
- An equalizing ground terminal.

System Grounding With -48 Volt DC Standby Power

Figure 10-18 illustrates the grounding scheme for -48 volt DC standby powered systems. The ground discharge bar in the DC power cabinet serves as the single-point ground for the standby power equipment, the switch cabinets, and special function cabinets. The single-point ground must be bonded to the green wire ground on the system AC load center. The installation crew, the customer, or agent, as required by local practices, installs a wire from the ground discharge bar in the DC power cabinet to the closest approved ground. The wire must be at least 6 AWG and no smaller than the largest conductor in the system. For more detailed grounding information, refer to*DEFINITY Communications System Generic 2 and System 85 Electrical Protection, Grounding, and Exposure Checklist* (555-104-120) or *DEFINITY Communications System Generic 2 and System 85 Installation Manual* (555-104-104).

The grounding scheme provides:

- **Protection from danger of electrical shock**
- **Equipment protection from damage due to a power fault to ground**
- **A low impedance path for static and power surges**
- **A common circuit ground reference.**

An approved ground is an acceptable grounding medium as specified in Article 250-81 of the National Electric Code, 1987 edition. An approved ground may consist of any of the following:

- **Grounded Building Steel— The structural steel beams that make up the frame of the building. Building steel may be used for grounding only if the steel frame is buried in the earth.**
- **Acceptable Water Pipe—A metal pipe, not less than 3/4 inch (1.9 cm) 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 (5 cm) 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 m) of one or more steel reinforcing bars or rods of not less than 1/2 inch (1.3 cm) diameter, or at least 20 feet (6 m) of bare solid copper wire not smaller than number 4 AWG (American Wire Gauge).**
- **Ground Ring—A ground ring that encircles a building or structure in direct contact with the earth at a depth of at least 2 and 1/2 feet (0.8 m) below the earth's surface. This must consist of at least 20 feet (6 m) of bare copper conductor not smaller than number 2 AWG.**

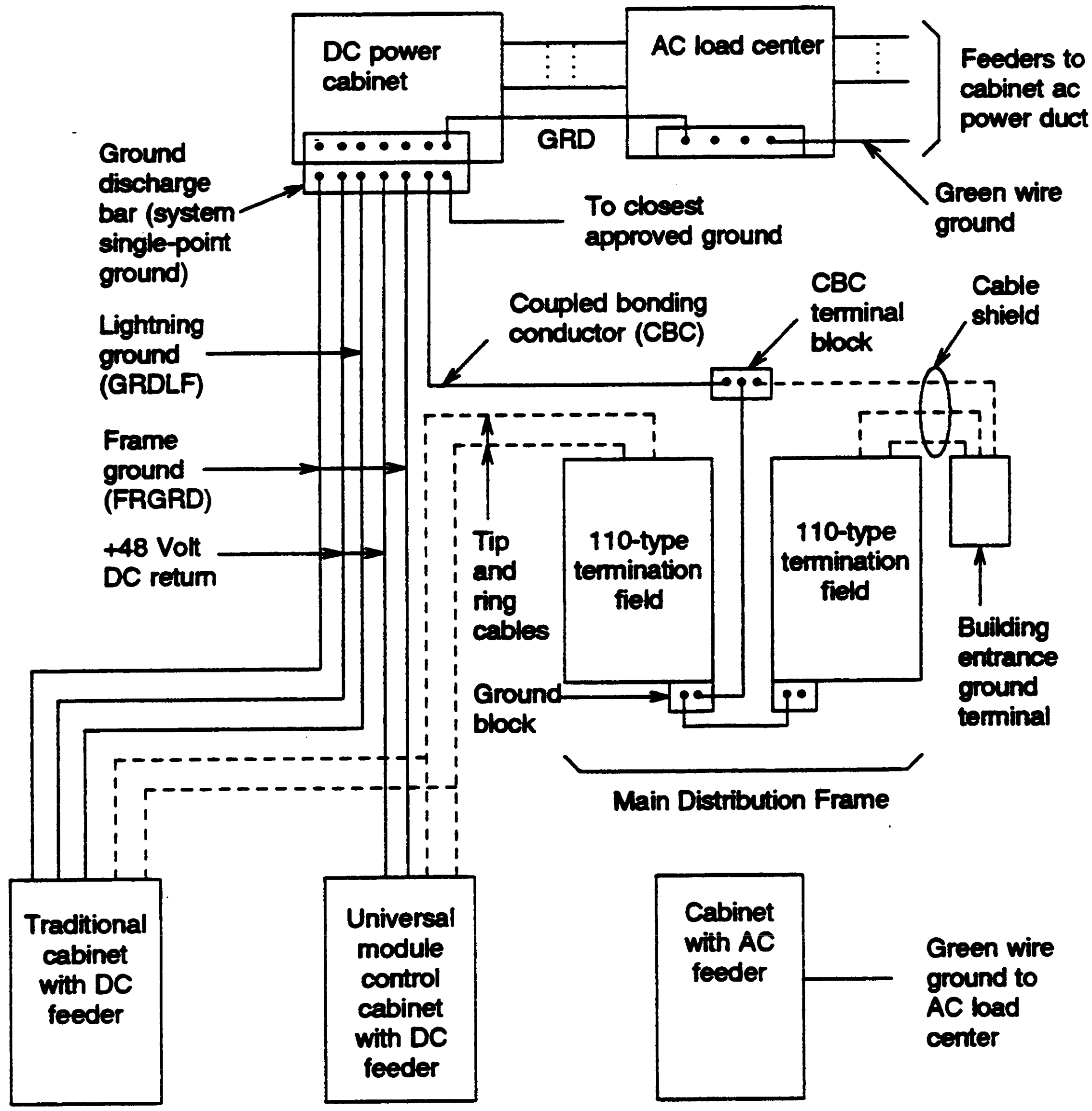


Figure 10-18. Grounding Arrangement for -48 Volt DC-Powered System

In a high-rise building, an approved floor ground, which is 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 from the secondary side of the power transformer that supplies the floor

- A grounding point specifically provided for this purpose.

System Ground Leads

The following leads are used to ground System 85 and DEFINITY Generic 2. These leads are required in addition to the approved and single-point grounds described above and are installed by the installation crew (except green wire grounds in the 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. The continuity of the cable shield can be tested using a T-124, manufactured by Wilcom Grounding Systems, or equivalent.
- With inside wiring cable, the coupled bonding conductor shall consist of a 10-gauge wire that is tie-wrapped to the cable. If this is impractical, use six good spare pairs within the cable as the coupled bonding conductor. Twist and solder the six spare pairs 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 Ground)

To comply with Articles 250-32, 250-42, and 250-45 of the NEC (National Electrical Code), 1987 edition, the AC power equipment must be grounded by an equipment grounding conductor (green wire ground). The green wire ground is routed to AC-powered cabinets and equipment by way of the AC feeder circuits.

Lightning Ground (GRDLF)

Each cabinet containing a port or DS1 carrier (except the universal module control cabinet) requires a lightning ground connection to the system single-point ground. A lightning ground wire is chain-wired to each cabinet in a module and from the closest cabinet, with an EMC filter, to the system single-point ground terminal. Each module must have a separate lightning ground connection (GRDLF) to the system single-point ground.

Frame Ground (FRGRD)

Each cabinet that does not have an AC feeder requires a cabinet frame ground. The frame ground wire interconnects all DC-powered cabinets in a lineup and connects to the single-point ground terminal. Each cabinet lineup requires a separate frame ground connection (FRGRD) to the system single-point ground.

Traditional Cabinet Grounding With -48 Volt DC Power

There are three types of intracabinet and intercabinet grounds used in -48 volt DC-powered systems:

- Equalizing (Circuit) Ground
- Digital Ground
- Lightning Ground.

These grounds are isolated from each other in traditional switch cabinets and, except for equalizing ground, are individually routed to the ground discharge bar on the DC power cabinet, which serves as the system single-point ground. Because the grounding arrangement for the universal module control cabinet is somewhat different from traditional switch cabinets, it is described separately at the end of this section.

Equalizing (Circuit) Ground

Each traditional 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 at the cabinet bus bar and to the return (positive) lead of -48 volt DC feeders powering the cabinet. The leads of the -48 volt DC feeders originate from the ground discharge bar (system single-point ground) in the DC power cabinet. The DC feeder return leads must be isolated from frame grounds and other AC grounds except where they are tied togeher at the ground discharge bar. This isolation includes any AC-powered peripheral equipment that interfaces with the universal module cabinet. A 4-gauge wire connects the circuit ground blocks of each traditional cabinet that contains a port or a DS1 carrier and is in the same module and lineup. Equalization ground only connects traditional DC-powered cabinets together; do not connect an equalizing ground wire from a traditional switch cabinet to the ground discharge bar in the DC power cabinet. Furthermore, equalizing ground is not required for CC /TMS, TMS, or duplicated common control cabinets (see Figure 10-19).

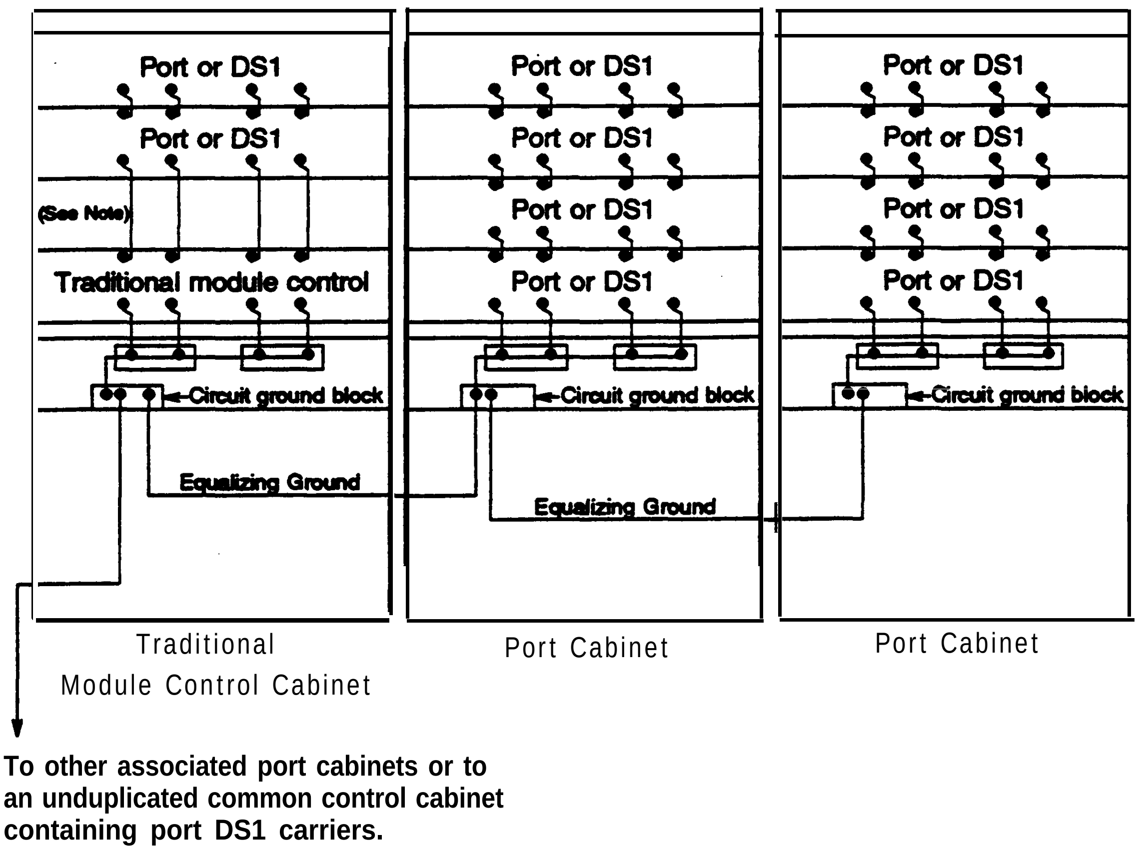
Digital Ground

Four or more equally spaced 14-gauge wire straps electrically interconnect adjoining or sequential carriers within a cabinet. These digital ground connections (GRDD) provide a low impedance path for digital signals. Number 10 AWG wire straps are used instead of 14-gauge straps to span a vacant carrier position. Digital grounds are connected to the circuit ground block in the DC fan assembly (see Figure 10-19).

Lightning Ground

Each cabinet equipped with port or DS1 carriers has 10-gauge wire straps connecting each port or DS1 carrier to the lightning ground terminal block (see Figure 10-20). These wire straps route lightning-induced power surges away from circuit components. The lightning ground terminal blocks of all the cabinets that belong to the same module and are in the same cabinet lineup are chain-wired together. Then a ground wire (GRDLF) is connected from the cabinet in the module closest to the system single-point ground by way of the cabinet's EMC (Electro-Magnetic Compliance) filter. Unduplicated common control and port cabinets can be equipped with an EMC filter.

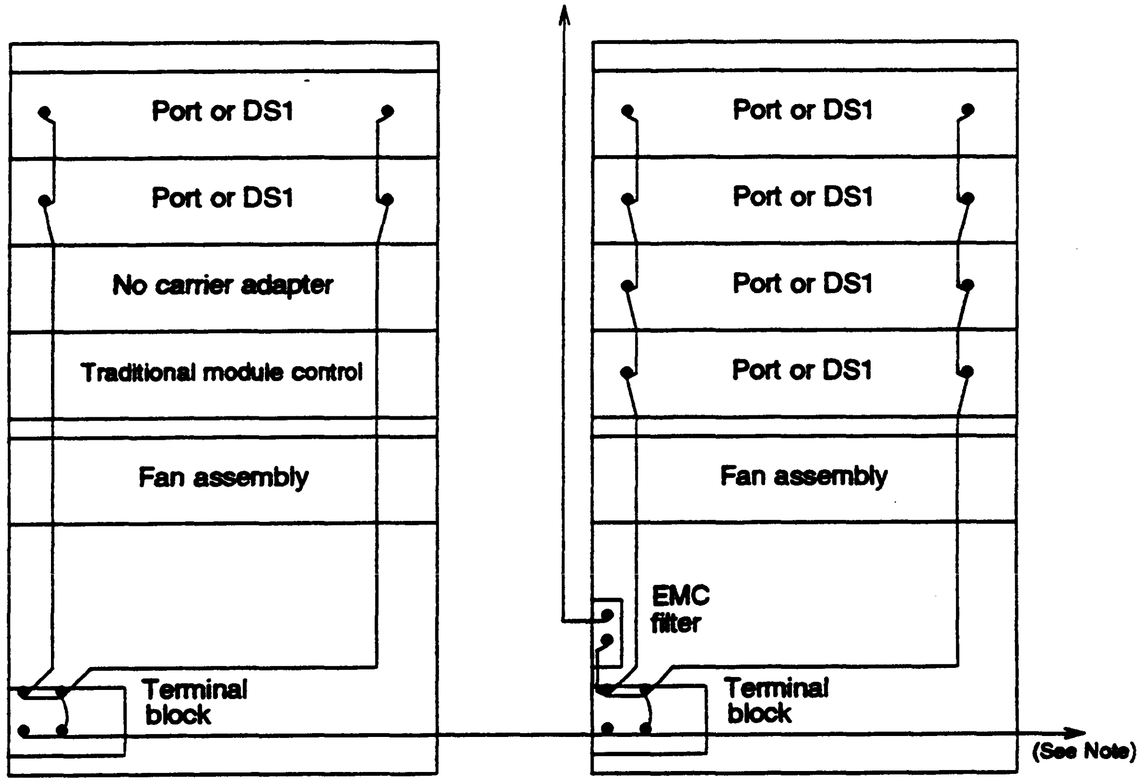
If one or more port cabinets are located cross-aisle from their associated traditional module control cabinet, one of the port cabinets must also be equipped with an EMC filter and have a lightning ground connection (GRDLF) to the system single-point ground. The cabinet with the EMC filter is chain-wired to any other port cabinets in the lineup that are associated with the same module. If a traditional module control cabinet does not have associated port cabinets in the same cabinet lineup, the traditional module control cabinet must be equipped with an EMC filter and have a lightning ground connection to the system single-point ground.



Note: When digital ground connections span vacant carrier positions equipped with no-carrier adapters, the wire gauge changes from 14 to 10.

Figure 10-19. Equalizing Ground and Digital Ground in a -48 Volt DC-Powered System

Lightning ground (GRDLF)
to system single-point ground



Traditional
Module Control Cabinet

Port Cabinet

Note: **Connects to lightning ground terminal blocks in other port cabinets that belong to the same module and are located in the same cabinet lineup.**

Figure 10-20. Lightning Ground in a -48 Volt DC-Powered System

Universal Module Control Cabinet Grounding With -48 Volt DC Power

Figure 10-21 shows the grounding arrangement for a DC-powered universal module control cabinet. The most significant difference in the grounding arrangements between the universal module control cabinet and switch cabinet is that the universal module control cabinet does not have a lightning ground. Unlike the AC-powered universal module cabinet, circuit ground is isolated from the cabinet frame in the DC-powered universal module control cabinet. If a cabinet lineup has more than one universal module control cabinet, an equalizing ground wire should not be connected between the equalizing ground blocks of universal module cabinets. Moreover, an equalizing ground wire should not be connected between a universal module cabinet and a traditional cabinet.

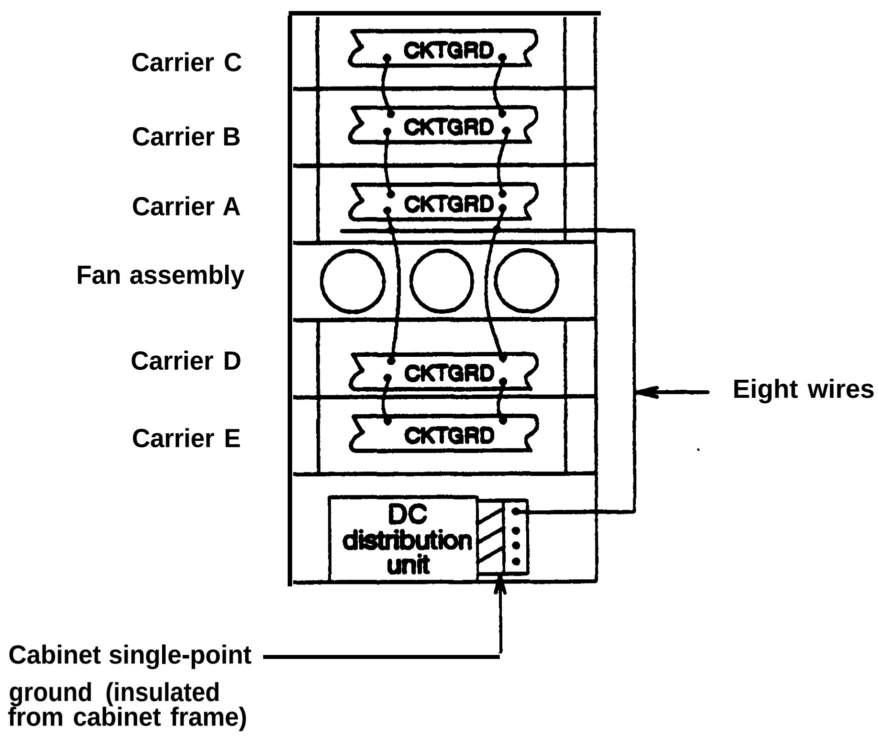


Figure 10-21. Universal Module Control Cabinet Grounding in a DC-Powered System

Upgrades and Additions

An upgrade is the process of transforming the hardware and software of a previously installed system to that of a later version. Upgrades are performed when the need for greater feature capabilities and other changes in customer requirements justify such an action. Additions involve the installation of more switch hardware (such as extra modules, cabinets, growth carriers, port interfaces, etc.) to a previously installed system. Additions are performed when increased call processing demands create a need for greater system capacity.

Upgrades

Upgrades to various AT&T System 85 versions and to the DEFINITY Communications System bring the system directly to the targeted version or system. For example, you may upgrade from any preceding version of AT&T System 85 directly to R2V4 or from any preceding version of AT&T System 85 or System 75 directly to the DEFINITY Communications System. However, all upgrades must be planned and implemented carefully.

This chapter only provides a high-level overview of upgrades. Detailed information about upgrades and upgrade policy appear in *DEFINITY Communications System Generic 2 and System 85 Upgrades* (555-104-111).

Hardware and Software Features

The hardware and software features for each AT&T System 85 version generally build on the preceding version. For example, Uniform Call Distribution (UCD) in V1 became Enhanced Uniform Call Distribution (EUCD) in V2. EUCD in V2 became Automatic Call Distribution (ACD) in V3, then became ACD with vectoring in V4.

The following is a summary of the new hardware and software features provided in each AT&T System 85 R2 version. For additional information on each AT&T System 85 R2 version and DEFINITY Communications System Generic 2, refer to other chapters in this manual and to *DEFINITY Communications System Generic 2 and System 85 Feature Description* (555-105-301).

R2V1

The hardware and software changes between R1 and R2V1 include the following:

- The 501 Common Control (CC) processor replaced the 301CC processor.
- The Time-Multiplexed Switch (TMS), which allows multimodule configurations of AT&T System 85, was introduced.
- Circuitry was added to support up to nine remote modules.
- Support was added for Distributed Communications Service (DCS).

R2V2

The hardware and software changes between R2V1 and R2V2 include:

- Support was added for the Audio Information Exchange (AUDIX) adjunct.
- An interface to the Information Systems Network (ISN) was included.
- Capacity was increased for up to 31 total modules, 30 of which can be remote.
- Automatic Trunk Measurement System (ATMS) was added to improve customer testing capabilities.
- Digital Service 1 (DS1) digital trunking capabilities were improved for digital central office (CO) and tie trunk touch-tone signal only.

R2V3

The hardware and software changes between R2V2 and R2V3 include:

- Support for remote groups was added.
- Call distribution features were consolidated and enhanced to provide the ACD feature.
- Support was added for the 3B5 Applications Processor (AP), which further provided:
  - — Call Management System (CMS) for managing ACD groups
  - — Centralized System Management (CSM) for system administration.
- Digital Multiplexed Interface (DMI) with bit-oriented signaling was added.
- 5-Digit Dialing for Unrestricted, and Hotline service was included.

R2SE

R2SE is described follows:

- It is a single-module system with duplicate common control.
- AT&T System 85 R2V3 hardware and software is used.
- Electronic tandem networking (ETN) and Distributed Communications Systems (DCS) software were eliminated from the main software program to reduce cost.

The upgrade procedures for R2SE to R2V3 do not require hardware changes.

R2V4

The hardware and software changes between R2V3 and R2V4 include the following:

- Support was added for Integrated Service Digital Network—Primary Rate Interface (ISDN—PRI) introducing the concept of bearer capability to the AT&T System 85.

- 501CC processor performance was improved.
- A 4-megaword memory circuit pack (TN394) was added increasing memory to 12 megawords.
- A 2-port processor communications circuit (TN474B) was added.
- Firmware changes to several AT&T System 85 circuit packs were required to support ISDN.
- Call Vectoring, Malicious Call Trace, Tenant Services, and Variable Format Call Detail Recording (CDR) were added.

DEFINITY Communications System, Generic 2

The hardware and software changes introduced with the DEFINITY Communications System Generic 2 include the following:

- Each DEFINITY Communications System Generic 2 uses four TN394 circuit packs increasing memory to 16 megawords.
- The Disk/Tape Subsystem (DTS) replaces the High-Capacity Mini-Recorder (HCMR). Improvements introduced with DTS include decreased data retrieval times and increased mass storage capabilities. With a 140 Mbyte disk drive and a 125 Mbyte streaming tape drive the DTS offers substantial performance enhancements.
- An associated Small Computer System Interface (SCSI) circuit pack (TN563) replaces the TN430 circuit pack in the CC carrier and provides an ANSI-based bus specification for the DTS connection.
- A new sequencer circuit pack, TN370C, replaced the “B” version in use for R2V4.
- TN379 Cache Memory circuit pack option may be selected instead of the TN369 circuit pack in use prior to the DEFINITY Communications System. The TN379 increases processor occupancy load handling capabilities. The TN369 remains upward compatible with DEFINITY Generic 2 systems.
- DEFINITY Manager II replaces the Maintenance and Administration Panel (MAAP) for switch administration and maintenance. Manager II is a PC-based administration and maintenance tool offering version-independent MAAP panel emulation, version-dependent Electronic Flip Charts (EFCS), system information data base access, and screen-driven system administration. Manager II also replace the SMT (System Management Terminal).
- A dual serial interface called the Programmable Processor Gateway (PPG) provides connectivity options for the DEFINITY Manager II system administration tool.
- DEFINITY Communications System fully supports ISDN—BRI (Basic Rate Interface). With the Basic Rate Interface enhancement to ISDN, two 64 Kbps bearer channels and one 16 Kbps data channel support two independent communication channels and one control/signaling channel respectively. This arrangement allows simultaneous voice and data terminal communication from a combined voice/data

station or from a single voice/single data station.

- Although actually a part of the installation process, it should be noted that DEFINITY Communications System Generic 2 supports the use of the universal module cabinet as well as the traditional cabinet which is commonly used for field retrofit of System 85.
- DEFINITY Communications System Generic 2 supports much of the existing common port hardware for upgrades from AT&T System 75.

Additions

Additions involve the installation of switch hardware (such as extra modules, cabinets, growth carriers, or port interfaces) that provides increased capacity to a previously installed system.

If additional cabinets are required, the system floor plan must be revised. 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, and agree with plant requirements and electrical codes, before installation.

Appropriate floor plan modifications are performed according to the type and extent of system additions. The additional 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).

> NOTE: Universal module cabinets shipped after March 1992 contain a modified AC distribution unit and require a slightly different input power arrangement from the one used for older universal module cabinets. See Chapter 10 for details.

If the additions require only the installation of growth carriers or more port interface circuits, there is no impact on the system floor plan. However, removal of no-carrier adapters and changes in equipment location assignments may be necessary.

References

The following documents are associated with System 85 and , when available, may be used for additional information:

3270 Data Module—User Manual	555-030-701
36A Voice Coupler—Identification, Installation, Connection, and Maintenance	463-332-140
89A Control Unit—Identification, Installation, Connection, Operation, and Maintenance	463-332-130
AT&T Compatibility Bulletin, Clear Channel Capability	No. 144
AT&T DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN—PRI Reference	555-025-101, Issue 3
AT&T System 85—Feature Translations—Service Manual	555-104-107
AT&T System 85—Maintenance—Service Manual	555-103-108
AT&T System 85—SMT Administration Management—User's Guide	555-103-501
AT&T System 85—Traffic Data Analysis Guide—Administration Manual	555-102-502
AT&T-IS Network and Data Services—Reference Manual	555-025-201
AUDIX Reference	585-300-201
Application Notes — Trunk Signaling and Transmission	555-025-205
Applications Processor 16—Reference Manual	585-201-201
Call Detail Acquisition and Processing Reference	555-006-202
DEFINITY Communications System Generic 2 Administration Procedures	555-105-506
DEFINITY Communications System, Generic 2 Maintenance Procedures	555-104-117
DEFINITY Communications System Generic 2 and AT&T System 85 Feature Descriptions	555-105-301
DEFINITY Communications System Generic 2 and System 85 Attendant Console User's Guide	555-104-730
DEFINITY Communications System Generic 2 and System 85 Electrical Protection, Grounding, and Exposure Checklist	555-104-120
DEFINITY Communications System Generic 2 and System 85 Equipment	555-104-603

Room Floor Plans and Specifications	
DEFINITY Communications System Generic 2 and System 85 Installation	555-104-104
DEFINITY Communications System Generic 2 and System 85 Upgrades	555-104-111
DEFINITY Communications System Generic 2 and System 85 Wiring	555-104-630
DEFINITY Communications System and System 75 and System 85 DS1/DMI/ISDN PRI Reference	555-025-101, Issue 3
DEFINITY Communications System and Systems 75 and 85 Terminals and Adjuncts Reference	555-015-201
Integrated Services Digital Network (ISDN) 7500B Data Module User's Manual	555-021-703, Issue 3
Interface Trunk Circuit—J58824CD Interface Trunk Unit	463-332-120, Issue 4
Multiple Asynchronous Data Unit—User Manual	555-401-702
Network and Data Services Reference	555-025-201, Issue 3
Recorded Telephone Dictation Trunk Circuit—PBX and Key Telephone Applications	463-332-110, Issue 4
System Interconnect and Information	SD-1E580-01

Glossary

This chapter begins with a list of the abbreviations used in this document. Following the list is a glossary of terms.

Abbreviations

AAR
: Automatic Alternate Routing

ACA
: Automatic Circuit Assurance

ACD
: Automatic Call Distribution

ACTGA
: Attendant Control of Trunk Group Access

ACU
: Automatic Calling Unit

ADM
: Asynchronous Data Module

ADS
: Asynchronous Data Stand

ADU
: Asynchronous Data Unit

ADFTC
: Analog Digital Facilities Test Circuit

AIM
: Asynchronous Interface Module

AIOD
: Automatic Identification of Outward Dialing

ALU
: Arithmetic Logic Unit

AMA
: Automatic Message Accounting

ANI
: Automatic Number Identification

AP
: Applications Processor

APLT
: Advanced Private Line Termination

ARL
: Attendant Release Loop

ARS
: Automatic Route Selection

ASCII
: American Standard Code for Information Interchange

ATMS
: Automatic Transmission Measurement System

AUTOVON
: Automatic Voice Network

AVD
: Alternate Voice/Data

B8ZS
: Bipolar with 8 Zero Substitution

BCT
: Business Communications Terminal

BHC
: Busy Hour Calls

BLF
: Busy Lamp Field

BOS
: Bit Oriented Signaling

BRI
: Basic Rate Interface

BSC
Binary Synchronous Communications

CAAVT
Call Answer Any Voice Terminal

CAS
Centralized Attendant Service

CCITT
International Telegraph and Telephone Consultative Committee

CCS
Hundred Call Seconds

CCSA
Common Control Switching Arrangement

CDM
Channel Division Multiplexer

CDR
Call Detail Recording

CDRP
Call Detail Recording Poller

CDRR
Call Detail Recording and Reporting

CDT
Compact Digital Telephone

CDRU
Call Detail Recording Utility

CEM
Channel Expansion Multiplexer

CHAPS
Customized Hardware and Pseudo Software

CMDR
Centralized Message Detail Recording

CMS
Communications Management System

CO
Central Office

CPFT
Customer Premise Facility Terminal

CRT
Cathode Ray Tube

CSD
Customer System Document

CSM
Centralized System Management

CSMDR
Centralized Station Message Detail Recording

CSU
Channel Service Unit

DA
Discontinued Availability

DACS
Digital Access and Cross-Connect System

DCE
Data Communications Equipment

DCP
Digital Communications Protocol

DCIU
Data Communications Interface Unit

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

DNIS
Dialed Number Identification Service

DOD
Direct Outward Dialing

DOPS
Dual Output Power Supply

DS1
Digital Service-1

DSP
Digital Signal Processor

DTDM
Digital Terminal Data Module

DTE
Data Terminal Equipment

DTMF
Dual-Tone Multifrequency

DTR
Data Terminal Ready

DTS
Disk Tape System

DUP
Duplication/Update

DXS
Direct Extension Selection

ECC
Error Correction Code

ECTS
Electronic Custom Telephone Service

EDC
Electronic Document Communications

EFC
Electronic Flipchart

EIA
Electronic Industries Association

EMI
Electro-Magnetic Interference

EMC
Electro-Magnetic Compliance

ESF
Extended Super Framing

ETN
Electronic Tandem Network

EUCD
Enhanced Uniform Call Distribution

FADS
Force Administration Data System

FCC
Federal Communications Commission

FIFO
First-In First-Out

FM
Facilities Management

FRL
Facilities Restriction Level

FX
Foreign Exchange

GA
General Availability

GPP
General Purpose Port

GRS
Generalized Route Selection

HCMR
High Capacity Minirecorder

HDLC
High-Level Data Link Control

HSAM
Host Security Access Manager

ICI
Incoming Call Identification

ID
Identification

IDI
Isolating Data Interface

IDS
Intermodule Data Store

IOB
Input/Output Bus

ISDN
Integrated Services Digital Network

ISDN—BRI
Integrated Services Digital Network—Basic Rate Interface

ISDN—PRI
Integrated Services Digital Network—Primary Rate Interface

ISN
Information Systems Network

IXC
Interexchange Carrier

LA
Limited Availability

LAN
Local Area Network

LCD
Liquid Crystal Display

LCT
Local Clock Termination

LCIT
Lightguide Cable Interconnection Terminal

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

LSU
Local Storage Unit

LWC
Leave Word Calling

MAAP
Maintenance and Administration Panel

MADU
Multiple Asynchronous Data Unit

MC
Module Control

MCC
Module Control Channel

MET
Multibutton Electronic Telephone

MF
Multifunction

MFAT
Multifunction Analog Terminal

MFET
Multifunction Electronic Telephone

MFT
Metallic Facility Terminal

MOS
Message Oriented Signaling

MP
Module Processor

MPDM
Modular Processor Data Module

MTDM
Modular Trunk Data Module

MTTR
Mean Time to Repair

NCOSS
Network Control Operational Support System

NCTE
Network Channel Termination Equipment.

NEC
National Electrical Code

NFAS
Non Facility Associated Signaling

NIP
Network Interface Program

NPE
Network Processing Element

OLS
Off-Line-Switcher

OM
Office Management

ORPI
Optically Remoted Peripheral Interface

OTL
Originating Test Line

PBX
Private Branch Exchange

PC
Personal Computer

PCC
Processor Communication Circuit

PCM
Pulse Code Modulation

PDF
Power Distributing Frame

PDI
Port Data Interface

PDS
Port Data Store

PPG
Programmable Processor Gateway

PRI
Primary Rate Interface

PROC
Procedure

PROM
Programmable Read-Only Memory

PRP
Primary Rate Port

PT
Personal Terminal

PUC
Public Utilities Commission

PUR
Port Usage Rate

PVC
Polyvinyl Chloride

RA
Remote Access

RAM
Random Access Memory

RCC
Remote Carrier Controller

RCL
Remote Carrier Local

REN
Ringer Equivalence Number

RGI
Remote Group Interface

RLT
Release Link Trunk

RMATS
Remote Maintenance and Traffic System

RMI
Remote Module Interface

RMS
Root Mean Square

ROM
Read-Only Memory

RTD
Recorded Telephone Dictation

SAC
Send All Calls *or* Signature Analysis Chip

SAKI
Sanity and Control Interface

SCAMPER
Software Control Analysis Monitor and Event Recorder

SCS
System Clock Synchronizer

SCSI
Small Computer System Interface

SDCP
Switched Digital Communications Protocol

SDN
Software Defined Network

SM
System Management

SMDR
Station Message Detail Recording

SMT
System Management Terminal

SOPS
Single Output Power Supply

SSB
Switch Support Base

SSI
Standard Serial Interface

Terminal Change Management

TDM
Time Division Multiplexing (or Multiplexed)

TMS
Time Multiplexed Switch

TSI
Time Slot Interchanger

TTL
Transistor-Transistor Logic

UBI
Universal Bus Interface

UCD
Uniform Call Distribution

UL
Underwriters Laboratories

UM
Unified Messaging

UMP
Universal Module Processor

UPCI
Universal Port Control Interface

UPDI
Universal Port Data Interface

UPS
Uninterruptible Power Supply

USOC
Universal Service Ordering Code

VIAS
Visually Impaired Attendant Service

VLSI
Very-Large Scale Integration

VM
Voice Management

VMAAP
Visual Maintenance and Administration Panel

VOM-T
Voice Only Module

WATS
Wide Area Telecommunications Service

ZCS
Zero Code Suppression

Definitions

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).

Angel

A microprocessor for universal module (or DEFINITY Generic 1) port circuit packs.

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.

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.

Bridged Appearance

An appearance on a voice terminal matching an appearance on another voice terminal. For every appearance on a "home" terminal, there can be a bridged appearance on as many as 15 other voice terminals. (The concept of is similar to the concept of "images.")

Bridging

Connecting one circuit in parallel with another without interrupting the continuity of the first.

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.

CCSA (Common Control Switching Arrangement)

A private telecommunications network using dedicated trunks and a shared switching center for interconnecting company locations.

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.

CSU

Channel Service Unit. This term is synonymous with NCTE (Network Channel Termination Equipment).

Cycle Stealing

A memory cycle stolen from the normal CPU (Central Processing Unit) operation for a direct memory access operation.

DA (Discontinued Availability)

A classification used to assign ordering status to a product or PEC (Price Element Code). Products classified as DA are no longer available for ordering. Maintenance stock is available for the installed base of a product for at least five years after that product has been classified as DA. Related terms are GA (General Availability) and LA (Limited Availability).

Data Buffer

An electronic storage area, for blocks of data, between two processing devices or programs.

Data Service Unit

A device designed to transmit digital data on transmission facilities.

DCE (Data Communications Equipment)

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..

DCIU (Data Communications Interface Unit)

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.

DCP (Digital Communications Protocol)

An AT&T proprietary data format used to allow voice, data, and signaling information to be passed between terminals and ports.

DDD (Direct Distance Dialing)

Long distance calls completed without operator assistance.

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.

Disk Drive

A mechanism used to store data on and retrieve data from one or more magnetic platters (disks).

DTE (Data Terminal Equipment)

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.

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.

DXS (Direct Extension Selection)

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.

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.

Emulation Code

The software that permits programs written for one computer to be run on another computer.

EPSCS (Enhanced Private Switched Communications Service)

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)].

FX (Foreign Exchange)

A central office other than the one located in the calling customer area.

GA (General Availability)

A classification used to assign ordering status to a product or PEC (Price Element Code). Products in this classification are readily available for ordering and carry a standard price and delivery interval (transmit to ship). Related terms are DA (Discontinued Availability) and LA (Limited Availability).

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.

I/O Command

Signals to and from input and output (I/O) equipment resulting from I/O instructions.

Image

A means of accessing an appearance. It is a button on a multi-appearance voice terminal, a port for an ADFTC (Analog/Digital Facility Test Circuit) board, and an "implicit button" for a single-line voice terminal or data module.

In-Use Lamp

An indicator lamp on a multi-appearance voice terminal that indicates whether a particular appearance is in use.

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.

LA (Limited Availability)

A classification used to assign ordering status to a product or PEC (Price Element Code). Products in this classification are not readily available for ordering. Products classified as

LA are generally near the beginning or the end of their life cycle. Related terms are GA (General Availability) and DA (Discontinued Availability).

Line

Single-line—the family of voice terminals that can be connected to only one call at a time.

Multiappearance—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.

Main Location

A centralized area where attendants answer calls routed from branch locations.

Modem

A device that modulates and demodulates signals transmittal 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.

Network

An interconnected system of transmission lines that provides connections between voice terminals.

NPE (Network Processing Element)

A piece of circuitry common to universal module (or DEFINITY Generic 1) port circuit packs that performs conferencing and gain adjustments.

Node

A single switch in a DCS network configuration.

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.

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.

Radio Paging Trunk

A telecommunications channel used to access paging transmitter equipment.

RAM (Random Access Memory)

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 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.

ROM (Read-Only Memory)

A storage arrangement only for information retrieval applications.

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.

SAKI (Sanity and Control Interface)

A piece of circuitry common to universal module (or DEFINITY Generic 1) port circuit packs that provides address recognition and the interface between the TDM-bus control channel and the port board microprocessor (angel).

Scanner

A circuit or device that samples each of a group of circuits to determine busy or idle status.

SDCPI (Switched Digital Communications Protocol Interface)

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.

Serial Data

An operation where data is transmitted or processed 1 bit at a time.

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.

SSI (Standard Serial Interface)

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 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.

Tandem Tie Trunk Network

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.

UNIX Operating System

A time-sharing software operating system for data processing equipment.

Voice Service

The switching and transmission of voice frequencies.

Voice Terminal

A single-appearance or multiappearance telephone.

WATS (Wide Area Telecommunications Service) 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.

INDEX

D

Q

R

S

T