

555-520-105 Issue 2, October 1987

AT&T SYSTEM 25 MAINTENANCE MANUAL



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Maintenance Manual Prepared by System 25 Document Development Group and the AT&T Documentation Management Organization

DANGER

Do not open the fan assembly or remove rear cabinet cover before unplugging the cabinet from the electrical outlet. Wait at least five minutes after unplugging the power cord before removing the rear cover or power supply. The AT&T System 25 cabinets are not user serviceable. Some voltages inside the cabinets are hazardous. This equipment is to be serviced only by qualified technicians.

CUSTOMER WARNING

The Installation and Test Manual and the Maintenance Manual are designed for use **by qualified service technicians only.** Technician qualification includes completion of an AT&T hands-on instructor-led course covering installation and maintenance for this product. The use of these documents by anyone else might void the warranty. **Hazardous electrical voltages are present inside this product.**

FCC NOTIFICATION AND REPAIR INFORMATION AT&T SYSTEM 25

This telephone equipment is registered with the Federal Communications Commission (FCC) in accordance with Part 68 of its Rules. In compliance with the Rules, be advised of the following:

MEANS OF CONNECTION

Connection of this telephone equipment to the nationwide telecommunications network shall be through a standard network interface USOC RJ21X jack. Connection to private line network channels requires USOC RJ2GX jack for tie lines or USOC RJ21X jack for off-premises station lines. These can be ordered from your telephone company.

NOTIFICATION TO THE TELEPHONE COMPANY

If the system is to be connected to off-premises stations (OPSs), you must notify the telephone company of the OPS class of service, OL13C, and the service order code, 9.0F.

Upon the request of the telephone company, inform them of the following:

- The Public Switched Network "lines" and the Private "lines" to which you will connect the telephone equipment.
- The telephone equipment's "registration number" and "ringer equivalence number" (REN) from the label on the equipment.
- For private line connections, provide the facility interface code, TL31M for tie lines. You must also specify the service order code, 9.0F.

- The quantities and USOC numbers of the jacks required.
- For each jack, provide the sequence in which lines are to be connected; the type lines and the facility interface code and the ringer equivalence number by position, when applicable.

This telephone equipment should not be used on coin telephone lines. Connection to party line service is subject to state tariffs.

REPAIR INSTRUCTIONS

If you experience trouble with this telephone equipment, contact the AT&T Business Customer Service Center on 1-800-242-2121. The telephone company may ask that you disconnect this equipment from the network until the problem has been corrected or until you are sure that this equipment is not malfunctioning.

RIGHTS OF THE TELEPHONE COMPANY

If your telephone equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service. The voice terminals described in this manual are compatible with inductively coupled hearing aids as prescribed by the FCC.

HEARING AID COMPATIBILITY

The voice terminals described in this manual are compatible with inductively coupled hearing aids as prescribed by the FCC.

FCC REGISTRATION INFORMATION			
Registration Number	AS593M-71565-MF-E		
Ringer Equivalence	0.5A		
Network Interface	RJ21X or RJ2GX		

PRIVATE LINE SER	VICE
Service Order Code	9.0F
Facility Interface Code	
•Tie Lines	TL31M
•Off-Premises Stations	OL13C

FCC WARNING STATEMENT

Federal Communications Commission (FCC) Rules require that you be notified of the following:

- 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 or her own expense will be required to take whatever measures may be required to correct the interference.

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INTRODUCTION

This manual provides the information necessary for monitoring, testing, and maintaining AT&T System 25 (Release 1 Version 1 and Release 1 Version 2). The modular self-testing capabilities of the system allow most maintenance to be reduced to simple procedures.

This issue replaces all previous issues of this manual. This manual is reissued to include changes in System 25 maintenance strategy that enhance product safety and to make minor corrections in the previous issue.

This manual replaces the *AT&T* System 25 Maintenance Manual (555-500-105). This manual includes information on Version 1 (V1) and Version 2 (V2). V2 is primarily a software upgrade that provides the following:

- Enhanced Data Services
- STARLAN NETWORK Access
- Switched Loop Attendant Console
- Virtual Facilities
- Miscellaneous Changes/Enhancements.

Required hardware for V2 includes a ZTN128 Processor circuit pack and a ZTN127 Memory circuit pack. A ZTN84 STARLAN Interface circuit pack and a switched loop attendant console are optional.

The maintenance procedures include:

- · Observation of alarm conditions;
- · Analysis of error messages and test results;
- Performance of restoration procedures;
- Replacement of system components; and
- Performance of tests.

This manual is intended for use by a maintenance technician dispatched to a System 25 site in response to an alarm or a user trouble report. The technician must have completed the Tier 1 training course (T-335).

INTRODUCTION

Each installed System 25 has a customer-designated System Administrator. The Administration and Implementation Manuals for your system describe the administrator's functions. The maintenance technician should work closely with the System Administrator.

Organization

This manual is divided into 13 sections. The remaining sections are as follows:

- Section 2. General Maintenance Information—Provides an overview of alarms, maintenance concepts, equipment, and basic procedures.
- Section 3. System Hardware—Describes the principal components of the system, and provides detailed information on the switching network and all circuit packs (CPs) supported by the system.
- Section 4. System Software—Describes the system software resources including switched services software, administration software, and maintenance software.
- Section 5. Maintenance Strategy—Provides an overview of the maintenance process.
- Section 6. Error Log—Presents the format for error records and examples of error messages with explanations.
- Section 7. Operating the Digital Tape Unit—Provides operating instructions for the digital tape recorder to save and restore translations.
- Section 8. Clearing System-Detected Troubles—Provides general trouble-clearing techniques and procedures for clearing specific system troubles.
- Section 9. Clearing User-Reported Troubles—Describes user complaints and provides procedures for clearing them.
- Section 10. Reference Documentation—Provides a list of other System 25 documentation that may be valuable to the maintenance technician.
- Section 11. Abbreviations and Acronyms—Provides a list of abbreviations and acronyms used in System 25 documentation.
- Section 12. Glossary—Provides a definition of terms and acronyms used in System 25 documentation.

 Section 13. Index—Provides an alphabetical listing of principal subjects covered in this manual.

Equipment Needed

The following tools and equipment should be taken by the maintenance technician on any System 25 service call:

- EIA breakout box
- Digital voltmeter (KS-20599 or equivalent)
- Modular cord breakout box
- 110-type punchdown tool (AT 8762D or equivalent)
- Dracon TS21 or equivalent touch-tone test set
- Assorted flat-head screwdrivers
- Assorted Phillips-head screwdrivers
- · Long-nosed pliers
- Regular pliers
- · Wrist grounding strap
- Model DC4 Digital Tape Unit, with 355A adapter and a D8W cord (Comcode 404079429)
- Administration terminal (TI 703KSR or equivalent), with 355A adapter (Comcode 404079436).

An oscilloscope is not needed for the Tier 1 maintenance procedures provided in this manual.

Assumption

The information provided in this manual assumes that the system was initially installed and tested in accordance with the *Installation and Test Manual* (555-520-100).

INTRODUCTION

Precautions

Electromagnetic fields radiating from the system cabinets may generate noise in other communications equipment. The technician must be sure that all cabinet panels and covers are securely in place after performing maintenance.

WARNING: Electrostatic discharge can destroy or severely damage integrated circuits or CPs.

The maintenance technician **MUST ALWAYS WEAR A WRIST GROUNDING STRAP** when handling CPs. The cord must be attached to the grounding block at the back of the cabinet. Damage to integrated circuits via electrostatic discharge may not be immediately apparent.

DANGER: Do not clip the wrist grounding strap to any cabinet location other than the grounding block. Do not clip the wrist grounding cord to a CP.

The primary maintenance objective is to detect, report, and clear troubles as quickly as possible with minimum disruption to normal service. Periodic system self-tests, automatic software diagnostic programs, and fault detection hardware are several of the maintenance tools used to achieve this objective. The system design allows most troubles to be isolated to a replaceable unit.

The System 25 hardware is maintained as a group of independent units (that is, maintenance objects). Each object is normally a separately replaceable unit. Examples include circuit packs (CPs), power supplies, fan assemblies, the Digital Tape Unit, AC Power Distribution Unit, voice terminals, lines, and trunks.

There are two general categories of troubles in system maintenance:

- System-Detected Errors
- User-Reported Troubles.

For system-detected errors, a light-emitting diode (LED) on the Attendant Console is automatically lighted if the error qualifies as an "alarm." This is a serious error. Most alarms are also indicated by LEDs on system CPs.

User-reported troubles usually result from service problems at individual voice and data terminals and are often related to alarmed conditions.

Error records and alarms are retired either automatically or manually. After a trouble or error has been cleared, the system retests the previously faulty area within a variable time interval. When the error is no longer detected, the error message, and alarm if applicable, is retired. Maintenance personnel may choose to retire error records and alarms manually after a problem has been fixed by entering commands at the System Administration Terminal (SAT). Using the SAT, error records can be accessed, listed, and removed. Certain errors may not be removed. On the other hand, some alarms *must* be cleared manually. After the error messages have been removed from the error tables, the Attendant Alarm LED (and red CP LEDs) will go dark—*unless the trouble recurs.*

System Errors and Alarms

When a system maintenance object begins to fail periodic testing, the system automatically generates an error record. Depending on severity, the record is stored in one of three tables in the error log.

The three tables are:

- Permanent System Alarms: These are failures that cause degradation of service and require immediate attention. These alarms will light the Alarm LED on the Attendant Console and are stored in the Error Log Permanent System Alarm table. This type of alarm also lights a red LED on an associated CP. The LED, when lighted, is a visual signal that service is required.
- **Transient System Errors:** These are potential failures that may cause degradation of service, although they do not light the Alarm LED on the Attendant Console. Transient System Errors are errors that have not yet been verified by system self-tests, and/or have not reached the level of a Permanent System Alarm.

If a Transient System Error is verified or reaches a certain threshold level of severity, it is reclassified as a Permanent System Alarm, and the Alarm LED on the Attendant Console lights. Transient system errors are stored in the Transient System Error table. The system stores up to 40 Permanent System Alarms and Transient System Errors in their respective tables in the error log.

• **Most Recent System Errors:** These are the ten most recent errors recorded by the system, regardless of their severity. They do not light the Alarm LED on the Attendant Console, unless they escalate to a Permanent System Alarm.

Error Log

The three error tables can be displayed on the System Administration Terminal (SAT). The error tables are very useful in diagnosing and analyzing problems, particularly when the problem has not caused an alarm or when alarms cannot be retired by replacement of maintenance objects.

The error tables are organized by time of occurrence. Unresolved errors are listed, as well as past alarms providing a profile of past and current state of the system. Example error records are provided in the Error Log description.

Emergency Transfer

System 25 has emergency transfer capability in case of total system outage. Emergency transfer connects preassigned single-line voice terminals directly to trunks that are connected directly to the CO, bypassing the System 25. Emergency transfer is invoked by loss of ac power or by any failure of the system that prevents it from processing calls.

Alarm and Status Indicators

Maintenance-related LED indicators are provided on the following equipment:

- Attendant Console: A green Alarm LED is provided to indicate the presence of a Permanent System Alarm. The LED flashes with each new alarm. The attendant can press the associated button to cause the LED to light steadily.
- *Circuit Packs (CPs):* LEDs are provided on the front edge of the CPs. The LEDs are visible when the front cover of the cabinet is removed. When lighted, these LEDs indicate the status of the CP as follows:
 - Port CPs:
 - Red—"On" several seconds during power up and test, "Off" with test pass, and "On" if fault in CP or associated trunk is detected.
 - Green—"On" indicates call resource available (port capable of processing calls).
 - Yellow—"On" indicates a call in progress, "Off" when not in use.
 - No LEDs Lighted-CP is not translated.
 - Memory CP—Red status LED—"On" several seconds during power up and test, "Off" with test pass. After test pass, "On" if fault in CP is detected.
 - Service Circuit CP—Same as port CPs except yellow LED flashes (that is, flashes when busy). Steady "Off" indicates a CP problem. Steady "On" indicates a tone receiver is being used.

• Call Processor CP—This CP has only a green LED that flashes, except during test. "Off" or "On" steady indicates a problem.

Refer to "Clearing System-Detected Troubles—Interpreting Circuit Pack LEDs" in Section 8 for additional information.

• *Power Supply:* The cabinet power supply has a green LED that, when lighted, indicates normal power operation.

Switches and Test Points

The power switch on the back of the cabinet controls cabinet ac power and should be left in the "On" position (1="On"), except when otherwise indicated. The system has no other field accessible switches, fuses, or circuit breakers. The power supply contains its own fuses, but these are not field replaceable.

Newer models have voltage test points located on the upper right corner at the front of the cabinet.

Older models have test points on the backplane behind the rear cover. These test points are factory use only! Under no circumstances should the rear cover be removed to provide access to the test points unless the power cord has first been unplugged.

System Administration Terminal

The SAT used to administer the system may also be used to read and clear the error log tables. The error log is read by logging on the SAT, selecting the main menu item "SEARCH," and then selecting the table to be read (that is, Permanent System Alarms, Transient System Errors, or Most Recent System Errors). To log on the SAT and access an error table, refer to the procedures provided in Section 6 "Error Log."

Maintenance Tests

There are two classes of automatic maintenance tests: periodic and demand.

Periodic tests are run automatically at fixed intervals on a specific schedule and do not affect service.

Demand tests are run by the system when it detects a need for them. Demand tests include the tests that are required only when trouble occurs. Some of the demand tests may be disruptive to system operation. Maintenance personnel cannot initiate any of these automatic tests.

Overview

Figure 3-1 is a block diagram of the major components of System 25. The major hardware components of the system are:

- Digital Switch
- Station Interconnect Panel (SIP)
- Trunk Access Equipment (TAE)—includes 700A [110-type or 66-type (157BF)] Connector Blocks and Network Access Facilities
- Terminal Equipment
- Wiring
- Emergency Transfer Unit (ETU) *
- Digital Tape Unit *
- Common Control and Switching Network
- System Administration Terminal (SAT) *
- SMDR/Call Accounting System Output Device. *

* Optional Equipment

Refer to the *Reference Manual* (555-520-200) for a complete description of the system hardware. Refer to the *Installation and Test Manual* (555-520-100) for system grounding details.



Figure 3-1. System 25 Block Diagram

Digital Switch

System 25 consists of up to 3 separate cabinets, each equipped with 12 universal slots for circuit packs (CPs). Each cabinet has its own power supply and fan assembly for cooling. No auxiliary equipment or customer-provided equipment is located in the cabinets.

The Common Control circuitry (Call Processor, Memory, and Service Circuit) is located in Cabinet 1. Other CPs can be located in any slot in any cabinet, but certain rules are suggested (see Reference Manual). All CPs are replaceable from the front of the cabinet upon removal of the front cover.

An address plug inserted into the header on the cabinet's backplane (lower center portion) designates the cabinet number. When plugged into slot #5, the cabinet is translated as Cabinet #1, slot #6 = Cabinet 2, and slot #7 = Cabinet #3.

Station Interconnect Panel

The Station Interconnect Panel (SIP) (Figure 3-2) provides connectivity between the digital switch and station equipment via the building wiring. Peripheral equipment is also generally connected to the system through the SIP.

The SIP consists of a group of 617A panels and associated adapters. The adapters support building wiring circuits that are either cutdown or modular. *Octopus* cables connect the system cabinets to the SIP. Adapters that can be mounted on the SIP are as follows:

- Z210A—Six 4-pair modular jacks to six 4-pair modular jacks
- 858A—Six 4-pair modular jacks to six 110-type cutdown blocks.



Figure 3-2. Typical Station Interconnect Panel (SIP) Connections

Trunk Access Equipment

The Trunk Access Equipment (TAE) (Figure 3-3) connects common carrier facilities to trunk CPs. The TAE consists of 700A Network Interface Blocks and Network Interface cables. The 700A [110-type or 66-type (157BF)] Connector Blocks are connected to RJ21X or RJ2GX network interfaces by 25-pair single-ended cables. Incoming central office trunks are sorted on the 700A blocks into sets of up to eight trunks of the same type. These blocks are then connected to the cabinets with *splitter* cables.



LEGEND:

- A SINGLE-ENDED 25-PAIR CONNECTOR CABLE (A25D)*
- B 3 TO 1 SPLITTER CONNECTORIZED CABLE (OR6016) PEC 2720-06X C 2 TO 1 SPLITTER CONNECTORIZED CABLE (OR6015) PEC 2720-05X
- OPS OFF-PREMISES STATION
- SIP STATION INTERCONNECT PANEL*
 - D OCTOPUS CABLE (WP90780) PEC 2720-05P
 - E INSIDE WIRE*
 - * FURNI SHED BY INSTALLER

Figure 3-3. Trunk Access Equipment Connections

Terminal Equipment

System 25 terminal equipment includes various voice terminals, Asynchronous Data Units (ADUs), data terminals, attendant consoles, and auxiliary equipment. System 25 supports three types of voice terminals: 7300H series, Single-Line [Tip & Ring (touch-tone or rotary*)], and MET (Multibutton Electronic Telephone). Each type of voice terminal must be connected to a compatible port CP.

ADUs provide the interface between the system and data equipment connected to the Data Line Circuit (TN726) ports. Single-line and 7300 series multiline voice terminals can also be connected to ADUs along with data equipment. Separate wire pairs in the ADU provide voice terminal connectivity back to the digital switch via the SIP. At the SIP, an adapter is used to separate the voice and data leads for connection to their respective system ports.

Wiring

The wiring plan is consistent with the Small Business Distribution System. The system uses 4-pair cables (24 AWG or 26 AWG) and cords as well as modular connectors and adapters. Various building wiring arrangements are supported, including new wiring, reuse, and modular.

Emergency Transfer Unit

The Emergency Transfer Unit (ETU) supports five power failure transfer stations and a Direct Inward Dialing (DID) make busy function. A System 25 installation can have up to four ETUs. The ETU is activated if ac power fails or if the system stops functioning.

If rotary-type voice terminals are used, System 25 features or services accessed by the # or * button are not available to the user.

Digital Tape Unit

The Model DC4 Digital Tape Unit (DTU) is required on all maintenance calls. It is used to save translations if the system fails. Translations should be saved on both the original and the backup tape cassette on a maintenance call (see Section 7 "Operating the Digital Tape Unit").

Common Control and Switching Network

Figure 3-4 shows the System 25 digital switch.

The basic switch hardware consists of the following:

Common Control

- Memory Bus
- Call Processor CP
- Memory CP

•Switching Network

- TDM (Time Division Multiplex) Bus
- Port Circuits
- System Resources



Figure 3-4. System 25 Digital Switch

Common Control

The Common Control circuitry consists of the Call Processor [ZTN82 (V1) or ZTN128 (V2)] and Memory [ZTN81 (V1) or ZTN127 (V2)] circuit packs and associated memory bus.

Memory Bus

The memory bus is a 60-wire (including grounds), 39-bit (16-data, 23-address), 6-MHz frontplane flat ribbon cable.

Call Processor Circuit Pack [ZTN82 (V1) or ZTN128 (V2)]

The Call Processor runs the system feature software. It is powered from the backplane by +5 and -5 volts. It also draws -48 volts from the backplane to drive the Emergency Transfer Unit. Each system must include one Call Processor CP. The Call Processor circuitry, as shown in Figure 3-5, includes:

- Microprocessor
- Memory management
- •On-board memory
- •EIA channels
- •Network controller
- Clock
- •Frontplane interface
- •Reset circuitry
- •Bus error circuitry
- Interrupt circuitry
- •Emergency Transfer Unit Control.



Figure 3-5. Call Processor [ZTN82 (V1) or ZTN128 (V2)] Circuitry

Microprocessor: A 68010 16-bit microprocessor that executes call processing and data processing features. This includes all maintenance, administration, testing, and reporting software.

Memory Management: Memory management separates the on-board Random Access Memory (RAM) into 1024 memory pages of 256 bytes each. Each page is read and write protected, generates bus errors when violated, and each is recappable allowing data areas to remain contiguous.

On-Board Memory: On-board memory includes 64 K bytes of Read Only Memory (ROM) containing the power-up tests and the switch operating system. In addition, there are 80 K bytes of protected RAM containing writable data storage for call processing. The RAM is backed up by an on-board trickle-charge battery that maintains memory contents for up to 2 months. Of the 80 K RAM, 24 K is dedicated to translation data. The remainder is dedicated to call status data and the operating system message queues.

EIA Channels: Four asynchronous RS-232C EIA ports (1-4) are included to permit communication with an administration terminal, a maintenance terminal, a Station Message Detail Recording (SMDR) device, and a Digital Tape Unit.

Network Controller: The network controller transmits control channel messages between the Call Processor and the port circuits over the TDM bus. The controller also monitors system clocks.

The controller includes an 8-bit microprocessor that acts as a throttle, passing messages between the Call Processor and the port board microprocessors.

All uplink messages from the port circuits are checked for consistency and passed to the common control. The controller is the distribution control point for all downlink control messages. It continuously scans, over the TDM bus, the port circuit microprocessors for sanity and activity. External RAM associated with this microprocessor stores control channel information and port related information.

The controller consists of bus buffers and a System And Control Interface (SAKI). The bus buffers provide the interface between the TDM bus and the on-board data buses to the SAKI. The SAKI receives and transmits control messages on the first five time slots on the TDM bus. The microprocessor communicates with the SAKI and external RAM over the address and data bus.

3-12

Clock: A clock provides time of day information in seconds, minutes, and hours and the date to the 68010 microprocessor. The clock automatically adjusts for leap years. An on-board battery backs up the clock so that accurate time is maintained even when the system power is off.

Frontplane Interface: Dedicated buffers provide an interface to the frontplane, which is the communication path to the Memory circuit pack.

Reset Circuitry: The processor is automatically reset when power is turned on, when the +5 volt power supply drops below 4.5 volts (after it returns to +5 volts), or when the network controller detects the processor insane. The processor can also reset the network controller when it detects the network controller insane.

Bus Error Circuitry: Bus errors suspend the processor from executing code. Bus errors are generated when memory management detects illegal reads or writes to RAM, when the processor attempts to access circuit packs or chips not physically present, or when the network controller detects the processor insane.

Interrupt Circuitry: Interrupts are prioritized into seven levels, of which the highest (level 7) is non-maskable. The interrupts are:

Interrupt	Level
AC Fail	7
Work cycle	6
Off board	5
Two EIA ports	4
Other two EIA ports	3
Off board	2
Off board	1

Emergency Transfer Unit (ETU) Control: Removes -48 V dc power from the system's ETUs when the system loses power or a major system malfunction occurs.

Memory Circuit Pack [ZTN81 (V1) or ZTN127 (V2)]

The Memory circuit pack provides for the storage of software associated with system operation. This software includes call and administration processing and other related programs. The circuit pack is powered from the backplane by +5 volts. Each system must include one Memory circuit pack. The Memory circuit pack circuitry (Figure 3-6) includes:

- •Address and data buffers
- •ROM array
- •ROM select
- •Timing and control logic
- •Built-in TDM bus termination resistors.

Address and Data Buffers: The address and data buffers interface the Memory circuit pack to the address and data lines on the frontplane.

ROM Array: The memory array consists of 16 ROM devices of 32 K, 8-bit bytes each, for a total capacity of 512 K ROM. The ROMs are organized into pairs allowing the Call Processor to access 16-bit words.

ROM Select: The memory selects the proper pair of ROMs according to address information.

Timing and Control Logic: This circuit controls the access speed of the ROM (no wait states) by returning a Data Transfer Acknowledge signal at the proper time.

Termination Resistors: These resistors are required for proper operation of the TDM bus. The ZTN81 (V1) or ZTN127 (V2) provides the proper termination for one end of the bus, and a plug-in TDM bus termination circuit card (plugs into cabinet backplane) is used to terminate the other end. For this reason, the ZTN81 (V1) or ZTN127 (V2) CP must always be located in slot #1 of Cabinet 1.

3-14


Figure 3-6. Memory [ZTN81 (V1) or ZTN127 (V2)] Circuitry

Switching Network

System 25 uses distributed processing techniques to provide switched voice and data services. The switch operates at 64 Kbps. The switching network consists of the following:

- •Time Division Multiplex (TDM) bus
- •Port Circuits
- •System Resources.

The TDM bus connects the intelligent ports to the Common Control circuit packs and other ports through the network control circuit. The system resource circuits provide tone sources, receivers, detectors, and pooled modems. The intelligent ports connect external communications facilities to the TDM bus.

TDM Bus

The TDM bus consists of two groups of eight signal leads and five control leads, each with matching grounds. The port circuit packs place digitized voice [pulse code modulated (PCM)] signals on the bus.

The bus operates at 2.048 MHz. The system framing pulse is 8 kHz. This provides 256 time slots (0-255) on the bus. The time slots are 488 ns wide. Time slots are generated as shown in Figure 3-7. The first five time slots are used for communications between the Common Control, the intelligent port, and resource circuit packs. Two time slots are required for each 2-party conversation. Each party transmits (talks) on one time slot and receives (listens) on another. Only five parties are allowed in a conference. During a conference connection, each member of the conference transmits on an individual time slot while receiving on as many as four other time slots. The actual switch capacity is 115 simultaneous 2-party conversations.

Table 3-A shows the allocation of the 256 time slots. Five are used for system control, 15 for tones, 235 for call processing, and 1 is not used.



Figure 3-7. TDM Bus Time Slot Generation (Not a Timing Diagram)

TIME SLOT NO.	FUNCTION		
00 thru 04	Control (5)		
	-Tones-(15)		
05 06 07 08 09 10 11 12 13 14 15 16 17 18 19	Dial Tone Busy Tone Reorder Tone Ringback Tone Data-Null Voice-Null Music 697 Hz* 770 Hz* 852 Hz* 941 Hz* 1209 Hz* 1336 Hz* 1447 Hz* 1637 Hz*		
20 thru 254	Call Processing (235)		
255	Not Used (1)		

Table 3-A. TDM Bus Time Slots

* These tones are used to generate touch-tone signals.

Physical Characteristics: The TDM bus is an 8-bit bus. The bus snakes continuously between cabinets in a multicabinet system as shown in Figure 3-8. The total length is about 9 feet for a 3-cabinet system. The bus is driven from any of the circuit packs in the cabinets. Similarly, a signal on the bus can be received by any circuit pack.

Within a cabinet, the bus is printed on one side of the circuit pack carrier backplane, and the other side is solid ground. Ribbon cables are used to cable the TDM bus between cabinets in a multicabinet system.

Electrical Characteristics: The TDM bus is an unbalanced, low-characteristic impedance transmission line. Paths printed over a ground plane on the carriers and the flat ribbon cables between carriers maintain this impedance level over the full length of the bus.

One end of the bus is terminated to ground with a bus termination circuit card and the other end is terminated by a network on the ZTN81 (V1) or ZTN127 (V2) Memory CP. Each circuit pack connects to the bus through a custom bus driver device. The bus driver is a switchable constant current source so that even in the "high" output state there is no bus loading to cause reflections. The current output of the drivers is adjusted so that logic "high" is 1.5 volts compared to a "low" of 0 volts.



Figure 3-8. TDM Bus Diagram—3-Cabinet System

Port Circuits

The following port circuit packs provide the link between trunks and external equipment and the TDM bus:

- •Ground Start Trunk (ZTN76)
- •Loop Start Trunk (ZTN77)
- Tip Ring Line (ZTN78).
- •ATL Line (ZTN79)
- •Data Line (TN726)
- •MET Line (TN735)
- •Analog Line (TN742)
- •DID Trunk (TN753)
- •Tie Trunk (TN760B)
- •Auxiliary Trunk (TN763)
- •STARLAN Interface (ZTN84) (V2)

Figure 3-9 shows the equipment types that can be connected to the digital switch by the Call Processor and port circuit packs. Figure 3-9 shows only overall concepts. Some arrangements require auxiliary power and/or adapters. See the *Installation and Test Manual* (555-520-100) or *Reference Manual* (555-520-200) for complete details.



Figure 3-9. Equipment Connected to System 25 By Call Processor and Port Circuit Packs (Sheet 1 of 3)

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Figure 3-9. Equipment Connected to System 25 By the Call Processor and Port Circuit Packs (Sheet 2 of 3)



- SAT SYSTEM ADMI NI STRATI ON TERMI NAL
- SMDR STATION MESSAGE DETAIL RECORDING
- WATS WIDE AREA TELECOMMUNICATIONS SERVICE

Equipment Connected to System 25 By the Call Processor Figure 3-9. and Port Circuit Packs (Sheet 3 of 3)

Eight port circuits are provided on most port circuit packs. The MET Line, Tie Trunk, and Auxiliary Trunk CPs each contain four port circuits. The port circuits provide an interface between terminals/trunks and the TDM bus. The STARLAN Interface CP (V2) is unique. It provides one interface (port) to a Network Extension Unit (NEU) and four connections to the TDM bus.

The number of port circuit packs required varies per customer requirements and equipment configuration.

Each of the System 25 port circuit packs contain a number of common elements (see Figure 3-10), such as:

- •Bus buffers
- •Sanity And Control Interface (SAKI)
- •On-board microprocessor with external Random Access Memory (RAM)
- •One or more Network Processing Elements (NPEs)
- •Circuit Pack Address Leads.



Figure 3-10. Port Circuit Pack Common Circuitry

Bus Buffers: The bus buffers are the digital interface between the backplane TDM bus wires (system bus) and the on-board circuitry (data bus). They also receive and distribute clock and frame signals.

SAKI (Sanity and Control Interface): The SAKI is the control interface between the Common Control that sends information via the network control circuit down the TDM buses and the on-board circuitry controlled by the on-board microprocessor. The SAKI receives control information (down-link messages) on the first five time slots and, as requested by the on-board microprocessor, transmits control information (up-link messages) on these same time slots.

The SAKI also performs the following functions:

- Identifies the circuit pack to the Common Control (location and vintage)
- Controls status indicator light-emitting diodes (LEDs)—red (failure), green (translated), and yellow (circuit busy)
- Initiates power-on startup procedures
- Checks the on-board microprocessor for sanity and causes reinitialization if problems occur
- Takes NPEs out of service under control of the on-board microprocessor
- Resets the protocol handler on the ATL Line circuit pack
- Generates the STARLAN NETWORK address on the STARLAN Interface circuit pack
- Resets the OATMEAL devices on the STARLAN Interface circuit pack
- Takes the whole circuit pack out of service on command from the Common Control or when it determines that on-board interference is present in the control time slots.

On-Board Microprocessor With External RAM: The on-board processor performs all low level functions such as scanning for changes and relay operations. In general, it carries out commands received from the Common Control and reports status changes to it. The on-board processor also provides a Tier 3 maintenance interface to an RS-232C asynchronous terminal on the STARLAN Interface circuit pack. The external RAM stores control channel information and port-related information.

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NPEs (Network Processing Element): Each port circuit pack contains one or two NPEs. The Analog Line, ATL Line, Tip Ring Line, Data Line, Ground Start, Loop Start, and DID Trunk circuit packs contain two NPEs. The MET Line, Auxiliary Trunk, and Tie Trunk circuit packs contain one NPE.

The NPEs perform switching network functions for the port circuits. Under control of the on-board microprocessor, an NPE can connect a port circuit to any one of the TDM bus time slots. More specifically, it allows a port circuit to talk on one time slot and listen to the same time slot (NPE sidetone) and on up to four other time slots at the same time. In 2-wire circuits that provide their own sidetone, the NPE sidetone is not used.

Circuit Pack Address Leads: Seven leads (BA0-BA6) are tied to corresponding logic levels to uniquely identify each CP slot in the system, including multiple cabinet systems. The logic values on leads BA4 and BA5 are used to identify the cabinet (Cabinet 1, 2, or 3) and are tied by the cabinet address plugs to either +5 V dc or ground, as appropriate. Lead BA6 is tied to ground.

Ground Start Trunk (ZTN76)

The Ground Start Trunk circuit pack interfaces eight central office trunks and the TDM bus. Figure 3-11 shows the following Ground Start Trunk unique circuitry:

- •Ground detector circuit
- •Port Input/Output (I/O) circuit
- Eight port circuits.

Ground Detector Circuit: The ground detector circuit determines if ground has been applied to the tip lead for incoming seizure. It also senses tip ground on outgoing seizure indicating dial tone is present. One ground sensor is used for each port circuit. Input for the ground sensor comes from the port circuit as an analog current to the -48 V dc supply. The ground sensor's output is a port control point to the port I/O circuit.

Port I/O Circuit: This circuit consists of bus expanders for communication between the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The eight port circuits are identical. Each port circuit consists of a coder/decoder (codec), hybrid circuit, line transformer, relay driver, and surge protection circuit.

The codec is a 4-wire circuit that converts the NPEs digital output to an analog signal. Likewise, it converts the analog signal from a central office trunk to a Pulse Code Modulation (PCM) data signal to the NPE. The hybrid circuit converts the codec 4-wire analog signal to a 2-wire analog signal that is connected to the central office trunk by the line transformer.

The relay driver buffers and inverts the relay drive signals from the port I/O circuit so that a logic high input operates the appropriate relay. The relay control circuitry provides the proper signaling for ground start trunks. The trunks support touch-tone dialing. The surge protection circuit provides overvoltage lightning surge protection for the circuit pack.

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Figure 3-11. Unique Ground Start Trunk (ZTN76) Circuitry

Loop Start Trunk (ZTN77)

The Loop Start Trunk circuit pack interfaces eight central office loop start trunks and the TDM bus. Figure 3-12 shows the following Loop Start Trunk unique circuitry:

- Port Input/Output (I/O) circuit
- Eight port circuits.

Port I/O Circuit: This circuit consists of bus expanders for communication between the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The eight port circuits are identical. Each port circuit consists of a codec, hybrid circuit, line transformer, relay driver, and surge protection circuit.

The codec is a 4-wire circuit that converts the NPEs output to an analog signal. Likewise, it converts the analog signal from a central office trunk to a PCM data signal to the NPE. The hybrid circuit converts the codec 4-wire analog signal to a 2-wire analog signal that is connected to the central office trunk by the line transformer.

The relay driver buffers and inverts the relay drive signals from the port I/O circuit so that a logic high input operates the appropriate relay. The relay control circuitry provides the proper signaling for loop start trunks. The trunks support touch-tone dialing and dial pulse signaling. The surge protection circuit provides overvoltage lightning surge protection for the circuit pack.



Figure 3-12. Unique Loop Start Trunk (ZTN77) Circuitry

Tip Ring Line (ZTN78)

The Tip Ring Line circuit pack interfaces eight analog tip and ring voice terminal lines (single-line voice terminals) and the TDM bus. Figure 3-13 shows the following Tip and Ring Line unique circuitry:

- •Ringing application circuit
- •Port Input/Output (I/O) circuit
- -48 V to -24 V Power Conditioner

• Eight port circuits.

Ringing Application Circuit: This circuit receives ringing voltage from the power supply. It monitors ringing voltage and current and generates signals to the on-board microprocessor indicating zero ringing voltage and current. It also detects when a terminal user has lifted the receiver during ringing, preventing the application of ringing to the terminal's handset receiver.

Port I/O Circuit: This circuit includes bus expanders connecting the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

-48 V To -24 V Power Conditioner: This circuit converts -48 V power from the power supply into a conditioned source of -24 V power for the electronic battery feed circuits.

Port Circuits: Each port circuit is identical. A port circuit consists of a coder/decoder (codec), hybrid circuit, battery feed circuit, and ring relay.

The codec is a 4-wire circuit that converts the NPE's output to an analog signal. Likewise, it converts the analog signal from a central office trunk to a PCM data signal to the NPE. The hybrid circuit converts the codec 4-wire analog signal to a 2-wire analog signal that is connected to the central office trunk by the line transformer.

The battery feed circuit provides talking battery to the voice terminal. It also detects when a receiver is lifted, and provides the message waiting signal by periodically reducing the feed voltage to zero.

The ring relay provides the interface between the ringing application circuit and the port circuit. It causes ringing to turn on and off.



Figure 3-13. Unique Tip Ring Line (ZTN78) Circuitry

ATL Line (ZTN79)

The ATL Line circuit pack interfaces eight hybrid voice terminal (7300H series) lines and the TDM bus. It terminates three pairs of wires from each terminal: analog voice pair, digital control pair, and power pair. Figure 3-14 shows the following ATL Line unique circuitry:

Protocol handler

• Eight port circuits.

Protocol Handler: The 8-bit on-board microprocessor translates the control information in CCMS message format to the control information message format used by the 7300H series voice terminals. The protocol handler sends the messages to the terminals using transceivers located in the port circuits.

Port Circuits: Each port circuit is identical. A port circuit consists of an analog port, one-half of a transceiver, and an electronic power feed device.

The analog port circuit consists of a codec, a hybrid circuit, an isolation transformer, and associated power filtering circuitry. The codec and hybrid circuits perform the same function as the codec and hybrid circuits in the Analog Line circuit pack (TN742). The output of the hybrid circuit is connected to the primary of the isolation transformer. The secondary of the transformer is connected to the analog voice pair.

The transceiver interfaces the voice terminal pair to the protocol handler. The electronic power feed device provides -48 V dc on the power pair to the voice terminal. The device is polled by the on-board microprocessor, periodically and on demand, to test for an overcurrent or no-current condition.

Each Electronic Power Feed (EPF) circuit supports two ports. If one of the associated lines become overloaded, the associated pair of lines will also be out of service. One EPF supports Ports 0 and 1, one supports Ports 2 and 3, one supports Ports 4 and 5, and one supports Ports 6 and 7. The on/off state of the device is controlled by the on-board microprocessor.



Figure 3-14. Unique ATL Line (ZTN79) Circuitry

Data Line (TN726)

The Data Line circuit pack interfaces eight Asynchronous Data Units (ADUs) data devices and the TDM bus. The ADUs are typically, in turn, connected to RS-232C-type devices. Figure 3-15 shows the Data Line unique circuitry that includes:

- A bit clock
- •Bus isolation
- Eight port circuits.

Bit Clock: The bit clock circuitry is used to provide the OATMEALs (Octal Asynchronous Terminal Mode Two EIA Asynchronous LSIs) with a clock frequency that is a multiple of each baud rate. In addition, the clock rate is divided down to 160 kHz. The 160 kHz is then compared to the system's 160 kHz data clock and is phase-locked to the system clock. The phase-locked circuit is required for low-speed operation.

Bus Isolation: This portion of the circuit pack is used to isolate the microprocessor bus. Isolation is required because the realized bus load exceeds the maximum limit specified for this device, due to the large number of devices controlled by the NPE. The OATMEALs are isolated from the common bus structure.

Port Circuits: Each of the eight identical port circuits allows the connection of interface equipment having an RS-232C compatible serial interface to the switch. The circuit provides an asynchronous full-duplex subset of standard data speeds from 300 to 19,200 bps. Each port includes an Asynchronous Data Unit (ADU) to extend the serial communications link length and provide safe isolation. The ADU terminates to another ADU at the Customer-Provided Equipment (CPE). The distance between the digital switch and CPE is inversely proportional to the speed at which the link is run. See *Reference Manual* (555-520-200) for details.

Throughout the circuit, various gates are used to provide a means of isolating devices for automated circuit pack testing. Typically, these devices are crystal oscillators or memory components attached to the microprocessor bus.



Figure 3-15. Unique Data Line (TN726) Circuitry

MET Line (7N735)

The MET Line circuit pack interfaces four Multibutton Electronic Telephone (MET) lines and the TDM bus. The MET Line unique circuitry consists of four port circuits as shown in Figure 3-16.

Port Circuits: The four port circuits are identical. Each port circuit consists of an analog port, a digital port, and an electronic power feed device.

The analog port circuit consists of a codec, a hybrid circuit, an electronic battery feed, and a power filter. The codec, hybrid circuit, and power filter perform the same function as in the Analog Line circuit pack (TN742). The electronic battery feed provides talking battery to the MET set. The electronic battery feed produces a controlled dc battery feed current for short and long loops and detects when a MET set user lifts a receiver.

The digital port circuit provides a full-duplex channel over two 2-wire pairs. All outgoing lamp (LT, LR) and incoming button depression (BT, BR) information is carried on these channels. Ringing and switchhook information is also sent over these channels.

The electronic power feed device provides phantomed -48 V dc power for the MET terminals over the data channels. The electronic power feed device is a "smart" circuit breaker. When it senses an overcurrent condition, it indicates the condition on an output lead and goes into thermal shutdown if not turned off by the on-board microprocessor. When the overcurrent condition disappears, the circuit breaker can be turned on by the on-board microprocessor.



Figure 3-16. Unique MET Line (TN735) Circuitry

Analog Line (TN742)

The Analog Line circuit pack interfaces eight analog voice terminal lines and the TDM bus. Figure 3-17 shows the following Analog Line unique circuitry:

- •Ringing application circuit
- •Port Input/Output (I/O) circuit
- . Eight port circuits.

Ringing Application Circuit: This circuit receives ringing voltage from the power supply. It monitors ringing voltage and current, generates signals to the on-board microprocessor indicating zero ringing voltage and current, and detects a terminal user lifting the receiver during ringing. This prevents the application of ringing to the port circuit when a terminal user lifts the receiver during the ringing phase. Maintenance circuitry is also included. The maintenance circuitry detects when a terminal is connected to the port circuitry and checks for faults in the ringing application circuitry.

Port I/O Circuit: This circuit consists of bus expanders connecting the onboard microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The eight port circuits are identical. Each port circuit consists of a coder/decoder (codec), hybrid circuit, electronic battery feed circuit, ring relay, and overvoltage surge protection circuit.

The codec is a 4-wire circuit that converts the analog signal from a voice terminal to a PCM data signal. It converts an incoming PCM data signal from the NPEs to an analog signal. The hybrid circuit converts the 4-wire analog signal from the codec to a 2-wire analog signal that is connected to the analog line. Filtered power is provided for the codec and hybrid circuits.

The electronic battery feed circuit provides talking battery to the voice terminal. It also produces a controlled dc battery feed for short and long loops, detects when a receiver is lifted, and provides the message waiting signal by periodically turning off the feed voltage.

The ring relay provides the interface between the ringing application circuit and the port circuit. It causes ringing turn on and turn off.

The overvoltage surge protection circuit provides lightning surge and power line cross protection for the circuit pack.

Note: The TN742 may be used instead of the ZTN78 Tip Ring circuit pack. The TN742 supports up to five bridged single-line voice terminals; however, only two may be off-hook at one time. The ZTN78 circuit pack does not support bridged terminals. In addition, the TN742 supports out-of-building, extended, and off-premises stations; the ZTN78 does not.



Figure 3-17. Unique Analog Line (TN742) Circuitry

DID Trunk (TN753)

The DID Trunk circuit pack interfaces eight central office trunks arranged for Direct Inward Dialing (DID) and the TDM bus. Figure 3-18 shows the following DID Trunk unique circuitry:

• Port Input/Output (I/O) circuit

• Eight port circuits.

Port I/O Circuit: This circuit consists of bus expanders for communication between the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The eight port circuits are identical. Each port circuit consists of a codec, balance network, trunk interface unit, and loop termination circuit.

The codec is a 4-wire circuit that converts the NPE output to an analog signal. Likewise, it converts the analog signal from the central office (CO) to a PCM signal to the NPE.

The trunk interface unit contains a hybrid circuit, a 2-wire interface circuit, and control circuitry. The hybrid circuit converts the 4-wire analog signal from the codec to a 2-wire analog signal that is connected to the analog line by the 2-wire interface circuit. The control circuitry controls loop current, internal signal gain, terminating resistance, battery feed shutdown, and battery reversal. The circuit pack accepts both dial pulse and touch-tone signaling.

The loop termination circuit provides a fixed impedance to the DID trunk.



Figure 3-18. Unique DID Trunk (TN753) Circuitry

Tie Trunk (TN760B)

The Tie Trunk circuit pack interfaces four 6-wire tie trunks and the TDM bus. Two tip and ring pairs form a 4-wire analog transmission line. An E and M pair is used for signaling. The T and R pair transmits analog signals from the circuit pack. The T1 and R1 pair receives analog signals from the tie trunk. The E and M pair are dc signaling leads used for call setup handshaking. The E lead receives signals from the tie trunk and the M lead provides signals from the circuit pack. The TN760B's four port circuits support Type I, Type I Compatible, or Type V signaling. Incoming and outgoing trunks may be either automatic, immediate start, wink start, or delay dial. Figure 3-19 shows the following Tie Trunk unique circuitry:

- •Ground detector circuit
- Port Input/Output (I/O) circuit
- •Four port circuits.

Ground Detector Circuit: This circuit determines if a ground has been applied to the E lead. Ground detector inputs come from the port circuits as an analog current to the -48 V dc supply. Its output is a port control point to the port I/O circuit.

Port I/O Circuit: This circuit consists of bus expanders for communication between the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The port circuits are identical, except for port 3 where part of the E-lead maintenance circuit is located. Each port circuit consists of a codec with associated input and output line transformers, analog operational amplifiers, a power filter, loop-around transistors, port control comparators, a relay driver, an electronic power feed device, an E-lead test maintenance circuit, and surge protection circuits.

The codec converts the incoming 4-wire analog signal from the tie trunk to a PCM data dignal. The codec converts the incoming PCM data signal from the NPE to an analog signal. Outgoing and incoming line transformers provide dc isolation to the tip and ring leads. Analog operational amplifiers provide amplification and buffering for the codec and network and loop-around gain compensation. Filtered power is provided to the codec and amplifiers.

The loop-around transistors are under control of the port control comparators and provide a loop-around path for the signal for testing purposes. The relay driver buffers and inverts the relay drive signals from the port I/O circuit so that a logic high input operates the appropriate relay. The relays and electronic power feed device control the M-lead circuitry to provide the proper signaling handshake for call progress tones and dial pulse dialing.

The electronic feed device provides a -48 V dc current to the M-lead circuits. It also tests the M-lead circuits for opens or shorts and prevents uncontrolled operation during powerup. The E-lead test circuit provides a ground to the ground detector circuit for testing purposes. The surge protection circuitry provides lightning surge and power cross protection for the circuit pack.





Various signaling formats (consists of a mode and a type) are available with the TN760B. The mode designates the electrical interface and the type designates the logical signaling used. For each port circuit, the mode is selected by option switch settings on the CP. Table 3-B lists the preferred signaling formats for likely-to-be encountered installation situations and option switch settings. The option switches are shown in Figure 3-20.

Syste Install Situa	m 25 ation tion	25 ion Preferred on Signaling Format		Set E&M/ SMPLX	Set Prot/ Unprot	Administer
Circumstance	То	System 25	Far-End	Switch	Switch	the Port
Co-Located	S25/S75	Simplex Type 5	Simplex Type 5	SMPLX	Either	Type 5
Inter-Bldg.	S25/S75	Simplex Type 5	Simplex Type 5	SMPLX	Either	Type 5
Co-Located	S85	Simplex Type 5	Simplex Type 5	SMPLX	Either	Type 5
Inter-Bldg.	S85	Simplex Type 5	Simplex Type 5	SMPLX	Either	Туре 5
Co-Located	DIMENSION PBX	E&M Type 1 Compatible	E&M Type 1 Standard	E&M	Unprot	Type 1 Compatible
Inter-Bldg.	DIMENSION PBX	Prot. Type 1 Compatible	Prot. Type 1 Standard	E&M	Prot	Type 1 Compatible
Co-Located	Other	E&M Type 1 Compatible	E&M Type 1 Standard	E&M	Unprot	Type 1 Compatible
Inter-Bldg.	Other	Prot. Type 1 Compatible	Prot. Type 1 Std. Plus Protection Unit	E&M	Prot	Type 1 Compatible
Co-Located	Net Int.	E&M Type 1 Standard	Don't Care	E&M	Unprot	Туре 1

Table 3-B. TN760B Option Switch Settings and Administration



Figure 3-20. Tie Trunk (TN760B) Circuit Pack Option Switches

Table 3-C summarizes the conditions present as the transmit and receive control signals for each signaling type.

Table 3-C. Signaling Type Summary

SIGNALING	TRANSMIT		RECEIVE				
TYPE	On-Hook	Off-Hook	On-Hook	Off-Hook			
I Std.	grd	bat	open/bat (*)	grd			
I Compat.	open/bat (*)	grd	grd	open/bat (*)			
V	open	grd	open	grd			

* An open circuit is preferred over voltage.

Auxiliary Trunk (TN763)

The Auxiliary Trunk circuit pack interfaces four ports provided for customerprovided equipment (CPE) and the TDM bus. It is connected to the CPE by up to three pairs of wires. The transmission pair (T and R) carries voice signals and touch-tone control signals. T and R also provides a loop start seizure indication to the CPE. The seizure pair (SZ and SZ1) provides seizure indication to the CPE. The signal pair (S and S1) provides answer supervision and/or make-busy information from the CPE. Depending on the application, the transmission pair only or all three pairs are connected to the CPE.

Figure 3-21 shows the following Auxiliary Trunk unique circuitry:

- •Ground detector circuit
- Port Input/Output (I/O) circuit
- •Four port circuits.

Ground Detector Circuit: This circuit determines if an answer-supervision or make-busy signal from the CPE is present. The ground detector's inputs come from the port circuits as an analog current to the -48 volt dc supply. Its output is a port control point to the port I/O circuit.

Port I/O Circuit: This circuit consists of bus expanders for communication between the on-board microprocessor and the port circuits. It receives commands from the on-board microprocessor and distributes them to the individual port circuits. It also accesses the port circuit scan points and passes the information to the on-board microprocessor.

Port Circuits: The four port circuits are identical. Each port circuit consists of a codec, hybrid circuit, line transformer, relay driver, battery polarity sensor, and surge protection circuit.

The codec is a 4-wire circuit that converts the analog signal from the CPE to a PCM data signal. It converts an incoming PCM data signal from the NPE to an analog signal. The hybrid circuit converts the 4-wire analog signal from the codec to a 2-wire analog signal that is connected to the CPE by a line transformer.

The relay driver buffers and inverts the relay drive signals from the port I/O circuit so that a logic high input operates the appropriate relay. The relay control circuitry provides the proper interfaces for CPE.

The surge protection circuit provides lightning surge protection for the circuit pack. Longitudinal surges are isolated from the hybrid and codec by the line transformer.



Figure 3-21. Unique Auxiliary Trunk (TN763) Circuitry
System Resources

The System Resource circuit packs are as follows:

- Service Circuit (ZTN85)
- •Tone Detector (TN748)
- •Pooled Modem (TN758).

Service Circuit (ZTN85)

The Service Circuit circuit pack provides the system's clock signals. It also generates and receives tones. The Service Circuit circuit pack (Figure 3-22) consists of the following:

- •Bus buffers
- •Sanity And Control Interface (SAKI)
- •On-board microprocessor with external RAM
- Clock circuit
- •Tone Generator
- •Time slot table and counter
- •Tone detector ports
- •Port I/O and Sanity Check circuit.

The ZTN85 provides four touch-tone receivers, generates all tones for the system, and supplies the system clocks. The ZTN85 can support up to 75 Dual Tone Multifrequency (DTMF) dialers. Each System 25 must contain one Service Circuit circuit pack. Power for the circuit pack (+5 V dc) is provided on the backplane.

Bus Buffers: There are four bus buffers on the circuit pack. The clock driver and receive buffers interface three system clock signals (2.048 MHz, 8 kHz, and 160 kHz) to the TDM bus. Two buffers interface the system tones (see Table 3-A) between the TDM bus and the Service Circuit circuit pack. Music is not provided by the Service Circuit but may be provided by a port interface on a Tip Ring Line circuit pack (ZTN78).

SAKI: This circuit functions the same as in the SAKI in the common circuitry for the intelligent port circuits.

SYSTEM HARDWARE

On-Board Microprocessor With External RAM: This circuit functions the same as the microprocessor in the common circuitry for the intelligent port circuits. In addition, it tells the dual-port RAM in the time slot table circuit the appropriate time slots in which to place a tone. The external RAM also has work space for complex tones (that is, those tones that vary with time).

Clock Circuit: The clock circuit consists of a 20.48-MHz oscillator, various dividers, and shift registers. The clock circuit runs independently from the rest of the Service Circuit circuitry. The clock circuits start running when the circuit pack is first powered up and is not controlled by the on-board microprocessor.

The output of the 20.48-MHz oscillator is fed to the clock divider. The divider divides by 10, 2560, and 128. These circuits produce the 2.048-MHz, 8-kHz, and 160-kHz clock signals, respectively. The clock generator feeds these signals to the clock driver/receiver bus buffer and the tone clock. The tone clock uses these signals to synchronize the counters in the tone generator and time slot table circuits with the TDM bus.

Tone Generator: The tone generator consists of a digital signal processor (DSP), a counter, and a dual-port tone RAM. The DSP operates at 10 MHz and produces 24 different tones. The dual-port tone RAM stores these tones in 24 different addresses. The counter under control of the tone clock causes the DSP to transmit one sample of each tone every 8 kHz. The counter is synchronized to the TDM bus and is offset to provide delay needed for access time.

Time Slot Table and Counter: The time slot table consists of a dual-port time slot table RAM and a counter. The dual-port RAM (DPRAM) contains 256 different addresses. These addresses correspond to the time slots on the TDM bus. The counter sequences through the time slot table addresses in the dual-port RAM and causes the proper tone(s) to be output by the dual-port tone RAM on TDM bus time slots.

Tone Detector Ports: The Service Circuit circuit pack provides four Dual-Tone Multifrequency (DTMF) detector port circuit interfaces via the TDM bus. Each port circuit is connected to an NPE serial input and output. Ports 0, 1, 2, and 3 are DTMF tone detectors with NPE loop-around paths.

The four port circuits contain a DSP, NPE to DSP interface circuitry, a DSP restart circuit, and an interrupt generator. One DSP implements two tone receivers.

The TDM bus signals are connected to the DSP in serial form from the NPEs by the DSP interface circuits. The DSP controls the output clocking of the NPE. The system framing signal is synchronized and connects to the DSP.

Port I/O and Sanity Check Circuit: This circuit interfaces the on-board microprocessor to the port circuits and checks the sanity status of the port circuits' DSPs.



Figure 3-22. Service Circuit (ZTN85)

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Tone Detector (TN748)

The Tone Detector circuit pack provides four touch-tone receivers and two general purpose tone receivers that detect appropriate system and network tones on the TDM bus.

The Tone Detector circuit pack consists of the same common circuitry as the intelligent port circuits and the following unique circuits (see Figure 3-23):

- Port I/O circuit
- •Port and DSP Sanity check circuit
- •Four touch-tone port circuits
- •Two general purpose tone detector port circuits
- •Two NPE loop-around test port circuits.

Up to a maximum of two Tone Detector circuit packs may be provided in the system.

Port I/O and Sanity Check Circuit: This circuit interfaces the on-board microprocessor to the port circuits and checks the sanity status of the port circuits Digital Signal Processors (DSPs).

Port Circuits: There are eight port circuits. Six port circuits are connected to NPEs. Port circuits 0, 1, 4, and 5 are DTMF tone detector ports. Each of the six port circuits has an associated DSP, NPE to DSP interface circuitry, a DSP restart circuit, and an interrupt filter. Port circuits 2 and 6 are general purpose tone and detector ports. Port circuits 3 and 7 provide digital loop-back testing of each NPE on the circuit pack.

The NPE serializes TDM bus signals that are connected to the DSP in serial form from the NPEs by the DSP interface circuit. Serial clock and data signals connect directly from the NPE to the DSP. The system framing signal is synchronized and connects to the DSP.

The DSP restart circuit controls the DSPs. When the on-board microprocessor is not functioning properly, the DSP restart circuit takes all of the DSPs out of service. It restarts each individual DSP under control of the port I/O and sanity check circuit.

The touch-tone DSPs, under control of the on-board microprocessor, write data synchronously to the NPEs. The interrupt filter detects valid touch-tone signals and allows end-to-end transmission while blocking end-to-end touch-tone signaling.

SYSTEM HARDWARE



Figure 3-23. Tone Detector (TN748) Circuit

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Pooled Modem (TN758)

The Pooled Modem circuit pack supports 0-300 and 1200 bits per second (bps) data speeds and provides the following:

- Circuitry to provide a signal compatible with the modulation formats of the 212-series modems
- Modem emulation (see below)

Capability	Data Module Mode		
0-300 Asynchronous	Low		
1200 Asynchronous	1200 Asynchronous		

• Modem control functions corresponding to 212-series modem operations.

A maximum of two Pooled Modem circuit packs are allowed in a single cabinet (six in a 3-cabinet system).

The Pooled Modem circuit pack (Figure 3-24) consists of common circuitry and two conversion resources. The conversion resource (port) allows communications between two dissimilar endpoints. For example, the Pooled Modem circuit pack enables a digital data endpoint linked to an ADU connected to a port on the Data Line circuit pack (TN726) to communicate with either a local analog data endpoint, such as a personal computer with a modem, or a remote host using a central office (CO) trunk connection. Each port has two connections to the TDM bus. One connection is made to the digital data endpoint using an ADU data module. The other connection is made to an analog endpoint.

SYSTEM HARDWARE



Figure 3-24. Pooled Modem (TN758) Circuit

SYSTEM HARDWARE

Common Circuitry: The Pooled Modem common circuitry, which includes all circuitry shown on Figure 3-24 except the Conversion Resource circuitry, provides the same general function as the intelligent port common circuitry.

Conversion Resources: The two conversion resources (port circuits) are identical and each contains the following:

- Microprocessor
- •Transmit and Receive I-channel Controller (TRIC)
- •Universal Synchronous/Asynchronous Receiver and Transmitter (USART)
- Data USART Clock (DUCK)
- Digital Signal Processor (DSP).

The microprocessor controls an on-board data module and modem. This microprocessor communicates with the port circuit microprocessor over a serial control channel. This channel allows the on-board microprocessor to send messages to the port circuit microprocessor specifying call startup information, option settings, information requests, various test modes, and call termination information. It also allows the port circuit status information.

The DUCK and TRIC interface I-channel information between the port circuit and the remote data module. The microprocessor controls the operation of the DUCK and the TRIC by programming their internal registers. The DUCK and TRIC together recreate the clock and serial data stream from the remote data module, and process an on-board clock and serial data stream for delivery to the remote data module. Control information, handshaking, and RS-232C control leads are passed between the port circuit microprocessor and the remote data module by the TRIC. The USART interfaces the DUCK's serial data stream to the conversion microprocessor. The USART can be programmed by the microprocessor to operate synchronously or asynchronously. The USART also performs the following tasks for the port circuit microprocessor:

- Appends start and stop bits to parallel data received from the microprocessor in the asynchronous mode
- Converts serial data received from the DUCK to parallel data
- Buffers data in both directions
- Detects and generates break characters.

The DSP provides modem emulation. It interfaces the port circuit signal and the remote modem. The microprocessor directs the DSP to execute one of many programs. The DSP produces data, carrier detection, and timing information for the port circuit microprocessor.

General

The System software consists of switched services, administrative, and maintenance software. This software runs on top of the real-time operating system software.

Switched Services Software

The switched services software provides voice and data call processing. This software resides in the Call Processor and Memory circuit packs (collectively referred to as the Common Control circuitry) and in the 8-bit onboard microprocessors located in the port and service circuits.

The switched services software uses the operating system to provide a process based, message passing, execution environment. The operating system scheduler provides scheduling for the software according to process priority.

Administrative Software

The administrative software provides the control for system rearrangement and change using the System Administration Terminal (SAT). This software resides in the Memory circuit pack and performs the following functions:

- Organizes the translation data for administrable entities in the system in a form that can be viewed and changed at the SAT.
- Tests entered data for consistency with data previously entered in order to avoid such errors as the assignment of the same extension number to two voice terminals. An erroneous or inconsistent data entry is disallowed and an error message is provided.
- Causes the translation data to be downloaded, on command, to an optional Digital Tape Unit (DTU).

Maintenance Software

The maintenance software provides automatic periodic testing of maintenance objects within the system as well as consistency tests among the call status tables within the system. In addition, demand testing is initiated when the system detects a condition requiring a need for testing. Software tables are provided for storing error records. The records can be accessed by maintenance personnel via the SAT. A Permanent System Alarm (a serious error) causes an alarm indicator on the attendant console to light and an error record to be stored in the error table.

Memory Allocation

The system software, like the hardware, is identified by release and version number. Each version identifies a particular memory configuration for the release number. Main memory is located in the Common Control circuitry. The operating system and error log software resides on the Call Processor circuit pack, and the remaining administration and call processing software is on the Memory circuit pack.

Real-Time Constraints

Real-time constraints are a function of the speed of the Common Control circuitry and the traffic load. The switch is designed so that many time-consuming and repetitious functions are performed by processors in the port and service circuit packs, thus relieving the common control circuits.

Traffic load, defined as the sum of static and dynamic loads, is a function of the number of features that are executed, the frequency with which they are executed, the system configuration, and the instantaneous (peak) call processing load. The configuration contribution to load is known as dynamic load. The static load consists of maintenance and audit routines.

Software Partitioning

System 25 software is comprised of various modules, each supporting a particular process. Typical modules (referred to as tasks) include the following:

- Administration
- •Station Call Processing
- •SMDR Call Record Processing
- •Trunk Call Processing
- •Dial Plan Manager
- •Event Timer
- •Save/Restore (Administration function)
- •Maintenance and Audit Functions.

As shown on Figure 4-1, software tasks associated with the Memory circuit pack are Administration and Feature Code Modules. The Feature Code Modules includes Station Call Processing. Each task controls the storage and movement of data and messages between associated elements within the system.

Memory Circuit Pack

Administration: Provides for administration of station and system features. This software also supports maintenance procedures related to checking errors and diagnosing trouble.

Feature Code Modules: Includes the software that sends and receives data to/from the Operating System as well as controls all voice and data features supported by the system. Station Call Processing includes the processing of messages and data associated with voice terminal on-hook/off-hook indications, associated port identifications, and button and light-emitting diode (LED) operations. The Station Message Detail Recording (SMDR) software generates SMDR records associated with a particular call. The records are then sent to the System RAM for storage and then to the SMDR output channel.

Call Processor Circuit Pack

System RAM: Provides for the storage of the following:

- · Variables for the various software tasks
- System translations
- · Error Records
- · Feature Code Data
- Stack.

Error Logger: Prioritizes and stores system errors. The errors stored in the three error records (located in System RAM) are:

- Permanent System Alarms
- Transient System Errors
- Most Recent System Errors.

The Error Logger lights the Alarm LED (located on the Attendant Console) when a serious error is detected.

Operating System (OS): Controls all message and data flow to/from the Memory circuit pack and the Arch Angel Driver Interface to the microprocessors on the port circuit packs, and to RS-232C driver interfaces. Messages destined for a particular task are queued until the associated task can receive them. When a task has completed a particular process, the next message is obtained from the task's message queue. The OS provides an interval timer that is used to time tasks. Processes that exceed the set interval (approximately 60 seconds) are terminated by the OS.

Arch Angel Driver Interface: Provides an interface between the OS and Network Control (NC).

RS-232C Driver Interface: Handles the flow of information between the Call Processor circuit pack and the system's peripheral equipment (that is, System Administration Terminal, Digital Tape Unit, SMDR Output Device).

TDM Bus

Provides an electronic link among the system port circuits (including System Resources) and between the Call Processor circuit pack and port circuits.

Port Circuit Packs

Each port circuit pack has on-board software that provides for the sending/receiving of Network Control messages and data. Circuit pack status messages are also sent to the Network Control software.



Figure 4-1. System Software Partitioning

Step-By-Step Call Description

The following is a description of a call originated between two multiline voice terminals.

- 1. A microprocessor on a station port circuit pack (port controller) continually monitors associated port circuits for switchhook status/change and button presses.
- 2. When a user goes off-hook, the port controller detects the change.
- The port controller sends an off-hook up-link message along with port identification to the Call Processor Network Controller (CPNC) via the TDM bus.
- 4. The CPNC accepts the message and forwards it to the Operating System (OS) via the Arch Angel Driver Interface.
- 5. The OS checks a message directory to determine which task (that is, software module) is to receive the message. A function of the OS, referred to as the "transformer," determines it has a message for the Station Call Processing task and queues the message in Random Access Memory (RAM).
- 6. The Station Call Processing task retrieves its message and interprets it as a call origination. The task determines whether there is an idle call appearance button (System Access button) on the called voice terminal. If so, two available time slots are reserved for the connection.
- The task sends downlink messages to the port circuit via the OS. The messages instruct the port circuit to listen for dial tone on a specified time slot and to light the call appearance status LED on the terminal.
- 8. When the user dials the first digit, the port circuit determines the digit dialed. It then listens to appropriate time slots on the TDM bus for the two tones used to generate an equivalent Dual-Tone Multifrequency (DTMF) signal. It then removes dial tone and feeds the DTMF signal back to the user until the user releases the button.
- 9. The port circuit sends an up-link message with each digit dialed to the OS which routes them to the Dial Plan Manager (DPM).
- 10. The DPM collects the dialed digits and determines that the call is a station-to-station call.

- 11. When the DPM collects enough digits to identify an extension number, it stops collecting digits.
 - *Note:* If the extension number dialed is invalid, the DPM sends a down-link message to the port circuit instructing it to listen to time slot 07 (Reorder Tone) that is then heard by the user. Go to Step 18.
- 12. A down-link message is sent to the originating port instructing it to listen to time slot 06 (busy) or 08 (ringing), as appropriate. Go to Step 18 for Busy Tone or an unanswered call.
- 13. Station Call Processing sends a down-link message to the station port circuit pack associated with the called extension to turn on the terminal's ringer and to flash the call appearance LED.
- 14. When the called party lifts the receiver, the associated port circuit pack controller sends an off-hook message to the OS as before.
- 15. The Station Call Processing task, when it receives the message, interprets the off-hook message as an answer.
- 16. The task sends a down-link message to the called port circuit to turn off the ringer and to change the flashing LED to steadily lighted.
- 17. Down-link messages are sent to the port circuits assigning talk and listen time slots for the connection.
- 18. When either of the parties hangs up, the associated port circuit controller sends an up-link message to the Station Call Processing task.
- 19. Station Call Processing interprets the on-hook message as the end of the call.
- 20. The task then sends a down-link message to the port circuit pack controllers to disconnect the time slot connections and turn off the LEDs associated with the calls.

MAINTENANCE STRATEGY

Fault isolation is the cornerstone of the System 25 maintenance strategy. Maintenance activity isolates faults to one (or more) repairable or replaceable maintenance units. Equipment should be tested in the following order:

- 1. Terminal equipment
- 2. Station wiring
- 3. Port circuit packs (CPs)
- 4. Common control circuitry
- 5. Power supply and cabinet
- 6. Backplane.

The first fault isolation step attempts to reproduce the fault, whether it is system-detected or user-reported. If a fault can be reprodeuced, it can be diagnosed more easily and its correction confirmed.

Figure 5-1 presents a practical approach in responding to system troubles. If the maintenance technician is sent to a System 25 site in response to a trouble report, the maintenance activity will probably consist of isolating and replacing one or more faulty units of equipment. Multiple faults recorded in the error log and user-reported troubles may require more investigation and analysis.



Figure 5-1. Response to System 25 Trouble Report

General Procedures

Sometimes, faults recorded in the error log and user-reported troubles will exist at the same time. The logged faults should always be cleared first, if possible. This procedure often clears the user-reported troubles without any additional maintenance.

Clearing the most serious logged fault may clear some or all of the other faults. Descriptions of the errors in the error log indicate their relative urgency.

Error log records should be manually recorded before clearing a recorded error or alarm. If a faulty CP is located in the process of clearing a problem, it must be replaced with a known good CP. The associated error record should be included with the CP when it is returned for repair. If the System Administration Terminal (SAT) has an associated printer, the error records can be printed instead of being manually recorded.

Traditional trouble-shooting methods still have a valid place in maintaining a system as advanced as System 25. Indeed, they are sometimes sufficient to locate and clear faults. These methods include voice terminal substitution, visual inspections, continuity checks, and clarification of operating procedures with users.

Total System Failures

As the flow chart in Figure 5-1 shows, a failure of the common control circuitry (that is, Call Processor, Memory, and Service Circuit) must be repaired immediately. This may clear other problems in the system as well.

Port Problems

Port CP failures can usually be cleared by replacing the CP displaying the lighted red light-emitting diode (LED) (if reseating was unsuccessful). When replacing suspected defective CPs, it is desirable to wait until the amber LED (indicating CP is in use) turns off before removing the pack. (See "Interpreting Circuit Pack LEDs" in Section 8, for additional information on CP LEDs.)

MAINTENANCE STRATEGY

Common Control Problems

Common Control circuitry is difficult to troubleshoot and replace. The system must be powered down before any of these CPs are replaced. Before powering down, translations should be saved to tape (see Section 7 "Operating the Digital Tape Unit"). Other repair procedures may also require the system to be powered down. After removing a suspected faulty CP, do the following

- Visually inspect the CP. If a problem is identified, attach a note to the CP identifying the problem.
- Attach any error reports that may apply.
- Visually inspect cabinet backplane.

After the suspected faulty pack has been replaced, the system can be powered up. Replacing the Call Processor CP causes all historical alarm data to be lost. The system will then have to be restored from the tape backup unit with the latest copy of the system's translations. If no tape exists, the system has to be reinitialized.

Also increasing the common control trouble-clearing difficulty is the high degree of interaction between the CPs. Multiple errors and off-board errors are more likely to occur in common control problems than in port problems. Use of the error log is imperative in clearing common control problems.

Station, Wiring, and Trunk Problems

If the system indicates that a fault is with station, or if a user complaint indicates a station problem, the trouble must be isolated to the station itself or to the wiring between the cabinet or station interconnect panel and the station.

A visual inspection of station wiring, particularly the mounting cord, is suggested in cases of station trouble reports. A dead station can result from the mounting cord being pulled loose. Station trouble can also occur when wiring is crushed or severed by furniture or traffic. Stations can be swapped with known good stations of the same type to help isolate the trouble.

Trunk problems reported by alarms or by users can be evaluated with tests from stations or by interpreting the error log. If trunk troubles appear to be outside the System 25, the responsible common carrier should be asked to make repairs.

MAINTENANCE STRATEGY

Automatic Maintenance Tests

Because System 25 maintenance tests are performed automatically, there is no provision for users or technicians to initiate maintenance tests. The error log is read by entering commands from the SAT. Additional information that may be of help in clearing complex or subtle troubles is also available via the SAT (for example, the record of port locations).

Refer to *Administration Manual* (555-520-500) for your system for information on using "Search" procedures from the SAT as an aid in troubleshooting.

Maintenance Failure

If a System 25 equipment problem cannot be corrected using the procedures in this manual, the technician should follow established maintenance escalation procedures.

The error log is accessible via the System Administration Terminal (SAT) using the following procedures. The Error Log is comprised of the following three error tables:

- · Permanent System Alarms
- Transient System Errors
- Most Recent System Errors.

Each error record is reported as one line on the SAT (80 characters or fewer). Permanent System Alarms and Transient System Errors tables use the same format. These error records provide the location of the error [by port and circuit pack (CP) type], the date and time of the first occurrence and last occurrence of the error, the number of times the error has occurred, and a description of the error.

A typical error record from the Permanent System Alarms and Transient System Errors table is as follows:

PERMANENT SYSTEM ALARMS

PORT NUMBER	BOARD CODE	FIRST OCCURRED	LAST OCCURRED	COUNT	NAME
10201	ZTN82	23/12:30	30/01:56	6	System Restart

Interpret this record as follows:

- "Port Number" 10201 is the 5-digit port identification number specifying the location of the error. The first digit indicates the cabinet (1-3), the next two digits indicate the slot within the cabinet (01-12), and the last two digits indicate the port number on the CP in the slot (01-16).
- "Board Code" ZTN82 is the CP on which the error occurred (or that is associated with the error if this is an off-board error).
- "First Occurred" 23/12:30 is the date and time of the first occurrence of this error. The date is assumed to be the current year and month. A 24-hour clock is used.

- "Last Occurred" 30/01:56 is the date and time of the last occurrence of this error. The date is assumed to be the current year and month. A 24-hour clock is used.
- "Count" 6 is the number of times this particular error has occurred.
- "Name" System Restart is a description of the nature of the error. Descriptions are self-explanatory.

Error records in the Most Recent System Errors table have a slightly different format. A typical error record from the Most Recent System Errors table is as follows:

MOST RECENT SYSTEM ERRORS

PORT	BOARD	DATE	TIME	NAME
NUMBER	CODE	OCCURRED	OCCURRED	
10201	ZTN82	03/12/85	12:01:56	ArchAngel Insane Restart

Interpret this record as follows:

- "Port Number" 10201 is the 5-digit port identification number.
- "Board Code" ZTN82 is the CP on which the error occurred (or that is associated with the error if this is an off-board error).
- "Date Occurred" 03/12/85 is the date this error occurred. A conventional calendar designation is used.
- "Time Occurred" 12:01:56 is the time this error occurred. A 24-hour clock is used.

A combined total of 40^{*} (V1) or 50^{*} (V2) error records for Permanent System Alarms and Transient System Errors is stored by the system. Ten error records are stored in the Most Recent System Errors table. Errors are displayed in chronological order.

Two or more instances of the same error result in only two entries in the log (that is, the first and last occurrence).

The error log is under the control of internal background maintenance software that automatically escalates an error to a more serious category or retires it. The system tests itself after a repair has been made. If the error condition is corrected, the error may be removed from the error log.

Although some errors are automatically retired from the error log, they can also be manually retired by entering commands at the SAT. Alarms, conditions that light the alarm light-emitting diode (LED) on the attendant console, can also be manually retired in the same way.

Accessing the Error Log From the SAT

Follow these steps to read any of the tables in the error log from the SAT:

- Confirm that the SAT is properly connected to the Call Processor CP administration port.
- 2. If the SAT has a selectable baud rate, set it to 1200 baud.
- 3. Be sure transmission parity is set to none, with the parity bit set to space (0).

Note: For the AT&T Model 703 SAT, four pencil switches under the paper compartment cover are set as follows: switches 1 and 3 to "Off;" switches 2 and 4 to "On."

- 4. Turn on the terminal and press the carriage return character once or twice. On most terminals, this key is <RETURN> or <ENTER>.
- 5. After communication with the system is established, a prompt is displayed:

Enter Password ->

- Obtain the password from the system administrator. Enter the password and press <RETURN>. The main menu is displayed with the prompt: Make one selection from menu ->.
- 7. Enter 8 (for the SEARCH selection) and press <RETURN>.

8. The SAT displays:

When search is defined type c to search >Action=

- 9. Enter 1 and <RETURN>.
- 10. The SAT displays:

SEARCHES: ACTION=1 DATA=

- 11. Enter D. The system completes the word Data followed by the = sign.
- 12. After Data= enter one of the following numbers, depending on which error table you wish to see:
 - •30 to see Permanent System Alarms
 - •31 to see Transient System Errors
 - •32 to see Most Recent System Errors.

If you select 30, for example, the system responds with: SEARCHES: Action=1 Data=30.

Now, enter the letter c to begin the search of this table. The c must be entered repeatedly to access each line.

To remove a record from the Permanent System Alarms or Transient System Errors table, enter the letter r.

If you enter a letter incorrectly, press the backspace key. Each time you press this key, one character is erased.

When you finish viewing one of the error log tables and want to view another error log table, enter D. The system completes the word Data followed by the = sign. Now enter the appropriate number for the table you want to view. (See preceding Steps 11 and 12.)

If you want to return to the main menu at any point, type M and <RETURN>. To sign off, simply turn off the terminal.

Error Log Dictionary

The following provides a listing of error messages displayed on the SAT and an associated description of each.

AC Power Failure: An indication that ac power has been lost (for example, plug removed from a wall receptacle, building power down, etc.)

Alarm Log Overflow: The error logs are full and no more errors can be written to them. This error is kept, however, to alert you of the fact.

Arch Angel Insane Restart: Clocks may be missing from the TDM bus. Make sure TDM bus terminators are plugged in. Insure that the Service Circuit CP is plugged in and that the cables connecting the cabinets are okay. Check Call Processor CP.

Arch Angel Interrupt Restart: System restarted due to Call Processor problem. Check Call Processor CP if the error occurs frequently. Problem could be software related.

Bad Data: (Other than CPU or Memory) Data portion on a down-link message invalid. System may recover from this error.

Bad Major Heading: (Other than CPU or Memory) Header portion of a down-link message is invalid. System may recover from this error.

Bad Oat Device: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Bad Port: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Bad Port Number: Port number on a down-link message is invalid. System may recover from this error.

Bad Port Translations: Service Circuit or Tone Detector. Receiver requested to listen to time slots that do not have tones on them. System may recover from this error.

Bad Ringing Supply: Problems detected with ringing portion of power supply.

Bad Sub Qualifier: (Other than CPU or Memory) Invalid message type on a down-link message. System may recover from this.

Belated External Release: See "No External Release On PBX Disconnect."

Board Initialization Audit Error: (Other than CPU or Memory) System may recover from this.

Buffer Deallocation Failure: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, the CP should be checked.

Bus Error Test Failed: Bus error circuitry failure. Replace CPU.

Cold Start: System was restarted for some reason (CP unplugged, power problem, or some other error). Translations may be corrupted if the Call Processor or Memory CP is removed while in use or if power supply shuts down for any reason other than ac power failure (+5 V shorted, overheat).

The system initializes itself to the default state. A translation restoration is required to reinstate customer specific data.

CPU ROM Checksum Error: CPU has failed the ROM test. Check Call Processor CP.

DC Fail Check: Indicates the absence of +5 V dc on a cabinet. Each cabinet has its own power supply; therefore, this may not cause a Warm Start.

DC Fail Transient Record: This message is provided when dc power fails. It provides a record of the length of the outage.

DC Power Failed: Indicates the absence of +5 V dc on a cabinet. Each cabinet has its own power supply; therefore, this may not cause a Warm Start.

DC Power Restored: Indicates that +5 V dc has been restored. The "DC Fail Check" log is removed. This message keeps a record of dc "hits." It is possible to produce this error when a CP is inserted into a slot with power "On."

Down-Link Buffer Overflow: Software problem. Down-link buffer receiving messages too fast.

DPR/Arch Angel Interface Test Failed—CPU: CPU has failed the DPR/Arch Angel Interface test. Check the CPU.

DSP Insane: Service Circuit or Tone Detector CP problem. Check and replace CP as required. Error okay if on an audit pass a log of DSP sane message occurs.

DSP Sane: See "DSP Insane."

Dual Port RAM Read-Back Failure: Service Circuit dual port RAM problem. Check CP and replace if required.

DUART Test Failed: Peripheral port on Call Processor CP has failed. Check Call Processor CP.

DXS Console Reset: The DXS console has been reset. This will normally happen when the console is plugged in, but it could also point to a potential short circuit in the console.

Electronic Power Feed Off, Overcurrent: Probable short in cable interface to Hybrid Line (ZTN79) port interface. Error removed if audit passed and short removed.

Electronic Power Feed Overload: See "Electronic Power Feed Off, Overcurrent."

Electronic Power Feed Test No Load: External open circuit on a tie trunk.

Electronic Power Feed Test Overload: The "M" lead on a tie trunk has an external short circuit.

Empty CSMA Queue: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Error Log Table Full: Remove entries from the Transient Error Log to free-up space.

External RAM Failure: Port CP or Call Processor error while running background non-destructive external RAM tests. Check appropriate CP.

External Stack Full: (STARLAN interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Frame Length Error: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Generator DSP Insane: Service Circuit problem. Check CP and replace if required. Error okay if on an audit pass a log of Generator DSP Sane message occurs.

Generator DSP Sane: See "Generator DSP Insane."

Ground But No Ringing: Incoming calls are okay, but a problem could exist with the CO ringing generator or with the CP's ring detector. Check CP.

Illegal Instruction: This error is logged when an illegal instruction is encountered by the CPU. The problem could be with the ROM on the CPU or the Memory CP.

Illegal Interrupt: The Call Processor or Memory CP has a problem. The CPs may still pass the powerup test for their ROMs. Replace Call Processor or Memory CP.

Illegal LAN Interrupt: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable. If this error occurs too frequently, a permanent alarm will be generated and the CP should be checked.

Illegal Port Command: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Illegal Port Interrupt: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable. If this error occurs too frequently, a permanent alarm will be generated and the CP should be checked.

Internal RAM Failure: Port CP or Call Processor error while running background non-destructive internal RAM tests. Check port or Call Processor CP.

Internal Sanity Timeout: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Invalid Board Message: The port CP sent an up-link message that is not in the expected message set. Replace the CP.

Invalid Bridge Mode: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Invalid LAN Command: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Invalid Message Length: The port CP sent an up-link message that is not in the expected message set. Replace the CP.

Invalid Port Board: (Other than CPU or Memory) Port CP not supported by system plugged into slot.

Invalid Port Message: The port CP sent an up-link message that is not in the expected message set. Replace the CP.

LAN Protocol Error: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable. This error may be caused by a defective endpoint on the STARLAN NETWORK.

Limited Default Cold Start: This is a cold start after which only a limited amount of default translations have been made.

Memory Management Corruption: Software audit determined and corrected memory management. If problem persists, replace Call Processor CP.

Memory Management Error: May be bus error. A Warm start is logged after this error. Check CPU.

Memory ROM Checksum Error: Memory has failed the ROM test. Check Memory CP.

Message Corruption: (Other than CPU or Memory) Down-link message checksum error. If consistent error for particular port CP—check TDM bus drivers on the CP. If error is associated with many CPs—drivers on CPU may be bad. Also check TDM bus terminators.

Message From Non-Translated Port: The port CP sent an up-link message. Translate the CP and its port or remove the CP.

No Channel Buffer: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

No External Release On PBX Disconnect: CO did not release within 4 minutes on DID trunk after System 25 disconnected. Message sent every 4 minutes until release. Message cleared from log if release occurs belatedly.

No Free Buffer: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. This error may be caused by a defective endpoint on the STARLAN NETWORK. If the reset fails, then the CP should be checked.

No Loop Current On Incoming Call: Check port circuit. Also may be CO problem. Swap CP with another similar CP. If problem stays at original slot, likely CO or trunk problem.

No Loop Current On Outgoing Call: Test trunk circuit; swap CP with similar CP. If problem moves, replace CP; otherwise, check with CO.

No Tip Ground Detected Outgoing: No CO ground detected in response to an outgoing seizure. After this message is logged, an internal audit busies out the offending port. Check system translations to insure that the port should be active. Inform CO if trunk is good.

On-Hook Before Ready To Receive Digits: For a tie trunk with delay dial or wink start—after the handshake is complete, there is a 50 ms guard time that must pass before receiving digits. If the far end goes on-hook before guard time elapses, this message is logged.

On-Hook Before Wink: For a tie trunk with delay dial or wink start—if the far end goes on-hook (possibly indicating the beginning of a rotary dial digit) before the wink handshake is completed, the error is logged. A disconnect sequence is started and the call may be dropped.

On-hook During Wink: This error indicates that digits are being sent by the far end before the switch is ready to receive them. The two switches are probably not set up so that they are compatible to each other.

Physical and Logical Type Mismatch: (Other than CPU or Memory) Port CP plugged into wrong slot; change translations for slot.

Port Board In Unadministered Slot: (Other than CPU or Memory) Port CP inserted into a slot that is not translated, or inserted into wrong slot.

Port Board Missing But Administered: (Other than CPU or Memory) Translated port CP that CPU cannot access. Check CP slot; reseat CP; change CP; or remove CP from translations.

Port Board Out Of Service: (Other than CPU or Memory) Message occurs when a CP is removed from a cabinet. Error removed when the CP passes powerup. Check port CP.

Port Board ROM Checksum Failure: The port CP has found that the checksum on its firmware is bad. Try reseating the CP. If this error happens again, then replace the CP.

Port Buffer Full: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Port Fault: For an Auxiliary trunk, this message is logged when a ground is expected from external equipment and is not detected.

Port Queue Full: (STARLAN Interface CP) This error resets the CP. If the reset is successful, then the error is transient and recoverable. If the reset fails, then the CP should be checked.

Port Translation Audit Error: (Other than CPU or Memory) Check port CP including CP translations.

Program Logic Inconsistent: (Other than CPU or Memory) Check port CP.

Protected Memory Access Error: Attempt to access memory without permission. May be Memory or CPU problem. Restart may solve problem.

Queue Overflow: Message queue for task supervisor full; some messages may have been lost.

RAM Test Failed: CPU has failed the RAM test. Check CPU.

Real Time Clock Test Failed: Replace CPU.

Received Incorrect Number Of DID Digits: This error indicates that the CO is set up to send a different number of DID digits than the switch has been administered to receive.

ROM Checksum Failure: ROM checksum test has failed. Replace the CPU.

Ringing Without Ground: Tip and ring on Ground Start port circuit may be reversed or may be CP problem. Also, CO may not be able to send ground.

Service Circuit In Mismatched Slot: Service Circuit in slot translated for other type CP; two Service Circuits mounted in cabinet. Only one Service Circuit (ZTN85) allowed per system. Additional tone detection available using Tone Detector CP (TN748).

Service Circuit Test Failed: Service Circuit problem. Check CP and replace if required. Also check TDM bus terminators.

Signaling Lead Fault: See "Port Fault."

Slot Configuration Error: (STARLAN Interface CP) This error means that another ZTN84 port CP is on the STARLAN NETWORK and has the same physical address. This condition can be resolved by moving the ZTN84 port CP to another slot in the carrier.

Software Error: Illegal address or bus error. Check CPU and Memory CPs.

Software Program Logic Inconsistent: Feature code has detected invalid states. System may recover from this.

State Inconsistency: (Other than CPU or Memory) Attempt to set port CP to invalid state. System may recover from this.

Switch-Hook Error: Station still on-hook although a ring trip was detected. Could be a problem with ringing portion of cabinet power supply. Check CP and ringing supply.

System Lock-Up: This error is logged by the task supervisor if, during scheduling of tasks, no messages have been read for at least 60 seconds. This would result in a restart of the system.

System Restart: System locked up in a software task. Possible software error if system not warm or cold started on purpose. The "Port Number" entry in the log is the task at fault.

Translation Memory Test Failed: Memory translation checksum test failed. Reload translations from tape; check CPU; check if Cold Start error has occurred as a result of power failure problems.

Trunk Call Dropped: A call that had been up on a trunk for more than 9 hours has been detected by an audit and dropped. The port associated with the error identifies the trunk in question.

Trunk Call Too Long: An audit found a call that had been up on a trunk for more than 5 hours and logged this error to alert the user of it. This error is removed when a "Trunk Call Dropped" error is logged.

Unable To Send Downlink Message: Downlink message queue is full. This means that messages to CPs may be lost. If this error happens at different times, replace the Call Processor CP.

Unexpected Command: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

Unexpected Interrupt: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable. If this error occurs too frequently, a permanent alarm will be generated and the CP should be checked.

Unrecognized Command: (STARLAN Interface CP) This error is an isolated transient condition that is normally recoverable.

User Forced Cold Start: System was cold started via the SAT

User Forced Warm Start: System was warm started via the SAT.

Warm Start: System was restarted for some reason (CP unplugged, power problem, or some other error). Translations okay. Power supply may be running out of regulation, or may be Call Processor problem.

Wink Too Short For Valid Signal: For a delay dial or wink start outgoing trunk, if the wink from the far end is less than the minimum 100 ms, this error is generated and the tie trunk remains waiting for a valid signal.

Work Cycle Interrupt Test Failed: Work cycle interrupt problem. System most likely is stopped. Try to Warm Start the system via the SAT. May also correct by replacing Call Processor CP.

OPERATING THE DIGITAL TAPE UNIT

The Model DC4 Digital Tape Unit (DTU) or equivalent is extremely important in system maintenance. The DTU is used to store system translations, in the unlikely event that translations are lost in a system failure.

This section covers the following:

- · Setting up the DTU
- Saving Translations
- Verifying Translations
- Restoring Translations.

Setting up the DTU

The DTU must be properly connected to the system before it can be used. Refer to the *Installation and Test Manual* (555-520-100) for connection information. The unit must be connected to ac power and turned on to operate, although most of the control is exercised from the SAT.

The DTU must also be connected to the Call Processor. Normally, this connection is made via Channel 3 in the octopus cable originating from the Call Processor circuit pack. This connection should be verified, however, as the channel can be reassigned from the SAT.

A high quality audio cassette tape should be used. Acceptable tapes are the Maxell UD XL-II C60 or C90, the TDK SA C60 or C90, etc.

Before operating the DTU, always follow these steps:

- Press the STOP/EJECT button on the unit. (The plastic cover pops up.)
- 2. Insert the cassette so the exposed portion of the tape faces the unit's buttons. Press the cassette downward until it snaps into place.
- 3. Close the cover.
- 4. Press the REWIND button and wait for the unit to fully rewind the tape. This step is necessary before proceeding to ensure that the tape is played from the beginning.
Note: The system automatically compensates for the clear "leader" material at the beginning and end of the tape.

Saving Translations

Follow these steps to save translations on tape:

- 1. Complete the steps in the preceding "Setting up the DTU" section.
- 2. Press both the RECORD and PLAY buttons simultaneously. (The unit should not yet begin to run.)
- 3. Log on to the SAT, if not yet logged on.
- 4. The system displays the main menu prompt:

Make one selection from menu ->.

Enter 9 for the SAVE/RESTORE selection.

5. The system responds with:

>Action=, Enter 1.

The system responds with:

Save/Restore: Action=1 Data=.

- 6. Enter D. The system completes the word Data followed by the = sign.
- 7. Enter 1. The system responds with:

Save/Restore: Action=1 Data=1

W24: YOU ARE ABOUT TO START A TAPE SAVE

Keyboard input is blocked while doing tape operation

c to continue, any other key for abort

The tape unit is automatically started by the system. Saving translations on tape takes about 5 minutes.

When the save is complete, the unit stops automatically.

If the save is successful, the SAT displays:

SAVE COMPLETED SUCCESSFULLY.

- 8. Press the STOP/EJECT button on the unit.
- 9. Press the REWIND button and rewind the tape fully.
- 10. Verify the translations saved on the tape, following the steps in the next section.

Verifying Translations

Always verify the translations saved to tape because of the possibility of faults with cassettes or equipment. Successful completion of the Verify function assures that saved translations match exactly the translations in the system.

CAUTION: Performing the Verify function takes about 5 minutes.

To verify translations saved to tape, follow these steps:

- 1. Complete the steps in the preceding "Setting up the DTU" section unless Verify is being performed immediately after the Save function.
- 2. Press the PLAY button on the tape unit. (The unit should not yet begin to run.)
- 3. Log on to the SAT, if not already logged on.
- 4. The system displays the main menu prompt:

Make one selection from menu ->.

Enter 9 for the SAVE/RESTORE selection.

5. The system responds with:

>Action=, Enter 2.

The system responds with:

Save/Restore: Action=2 Data=.

 Enter D. The system completes the word Data followed by the = sign. 7. Enter 1. The system responds with the complete line:

Save/Restore: Action=2 Data=1

W25: YOU ARE ABOUT TO START A TAPE VERIFY

c for continue, any other key for abort

The tape unit is automatically started by the system. Verifying translations takes about 5 minutes.

When verification is complete, the unit stops automatically.

If verification is successful, the SAT displays:

"(feature code issue, date, time, size)"

followed by:

VERIFY COMPLETED SUCCESSFULLY.

- 8. Press the REWIND button to rewind the tape fully.
- 9. Label the tape with the date and time. Be sure the tape is stored in a safe place for future access.
- 10. Repeat both the Save and Verify procedures for a backup tape. Label and date both tapes accurately and be sure they are stored in a secure place for future access.

Restoring Translations

CAUTION: Restoring translations from tape removes the system from operation for about 5 minutes.

When it is necessary to restore system translations from tape, follow these steps:

- 1. Complete the steps in the "Setting up the DTU" section, using the cassette on which translations were saved.
- 2. Press the PLAY button on the tape unit. (The unit will not run at this time.)

- 3. Log on to the SAT, if not already logged on.
- 4. The system displays the main menu prompt:

Make one selection from menu ->.

Enter 9 for the SAVE/RESTORE selection.

5. The system responds with:

Action=, Enter 3.

6. The system responds with:

Save/Restore: Action=3 Data=.

- Enter D. The system completes the word Data followed by the = sign.
- 8. Enter 1. The system responds with:

Save/Restore: Action=3 Data=1

W26: YOU ARE ABOUT TO START A TAPE RESTORE

c for continue, any other key for abort

The tape unit is automatically started by the system. Restoring translations takes about 5 minutes.

When restoration is complete, the unit stops automatically.

If restoration is successful, the SAT displays:

(feature code issue, date, time, size)

followed by:

RESTORE COMPLETED SUCCESSFULLY

Initiated warm start

9. If above message is not displayed on the SAT, restoration was probably not successful. Force a warm start of the system and check the restart message (see "Restarting the System" in Section 8). If the system has done a cold restart (which you can tell by reading the restart message), the restoration was not successful.

OPERATING THE DIGITAL TAPE UNIT

- 10. In the event of an unsuccessful restoration, repeat the restoration process. Otherwise, escalate the problem to a higher support level.
- 11. Press the REWIND button to rewind the tape fully.
- 12. Be sure the tape and the backup tape are labeled and dated accurately and stored in a secure place for future access.

Most troubles are detected and reported via the Alarm light-emitting diode (LED) located on the Attendant Console, the error log, and, in some cases, the LEDs on the circuit packs (CPs). The following covers general troubleclearing techniques and recommends procedures for identifying and clearing a variety of specific system troubles:

General Trouble-Clearing Techniques

- •Consulting Error Log
- •Reseating and Replacing Circuit Packs
- •Removing and Restoring Power
- •Restarting the System
- •Interpreting Circuit Pack LEDs.

Consulting Error Log

Consulting the error log should be the first step in diagnosing system-related troubles (refer to Section 6 "Error Log" for instructions on accessing error log records).

Reseating and Replacing Circuit Packs

Except for the Memory, Call Processor, and Service CPs, power can be left on while a CP is reseated or replaced. When possible, CPs should not be removed when the yellow LED is "On."

CAUTION: Removing a CP that is in use may cause users to be disconnected.

Note: When you remove a CP from an unused slot (slot was being used for storage), a "Port Board Out of Service" error message is generated by the missing CP and the attendant Alarm LED flashes. You must remove the error message from the Error Log.

To remove a CP:

- 1. Remove cabinet front cover.
- 2. Make sure your hands are clean and dry. Put on a wrist grounding strap and attach it to the metal grounding block on the back of the cabinet to discharge static electricity.

WARNING: Static electricity can damage a CP.

- 3. With your thumb, pull up on the latch of the removal lever.
- 4. When the latch is up, pull the removal lever down until it stops, at an angle of about 30° to the floor.
- 5. Pull the CP out a few inches, tugging hard, then slide the CP the rest of the way out of the carrier. Use both hands when removing a circuit pack.

DANGER: Do not touch the backplane when performing any maintenance procedure. The backplane contains hazardous voltages.

- 6. Inspect the cabinet backplane and also inspect the connectors at the back of the CP. It may be possible to clean dirty connectors per prescribed procedures and return the CP to service. If any connectors are damaged or corroded, however, replace the CP.
- 7. Rest the CP on a firm non-conducting surface and press in all socketed devices on the CP to be sure they are firmly connected. Insure that all straps (if there are any) are firmly seated.

- 8. To reseat a CP, slide it back firmly in its slot. When it is almost back in place, you'll feel resistance and the removal lever will start to return to its vertical position, flush with the edge of the circuit pack.
- 9. Push the lever all the way to vertical, until it catches on the latch.
- 10. The red LED on the CP lights for up to 4 seconds during self-testing and then goes dark when the self-test is okay. If the CP has already been translated, the green LED lights.
- Recheck CP LEDs. Red LEDs should be dark. The Call Processor green LED should flash. Green LEDs on all translated port and trunk CPs should be lighted; yellow LEDs may be lighted or dark. The Service Circuit yellow LED should be lighted or flashing.

Removing and Restoring Power

The following procedures require the system to be unplugged from the ac power source:

- . Reseating or replacing Service Circuit, Call Processor, or Memory CPs
- Replacing frontplane ribbon connector between the Call Processor and Memory CPs
- Replacing power supply
- Replacing fan assembly.

DANGER: The System 25 cabinet contents are not user serviceable. Some voltages inside the cabinets are hazardous. This equipment is to be serviced only by qualified technicians.

Before removing power from one or more cabinets, save translations on the tape backup unit, following the steps in Section 7 "Operating the Digital Tape Unit. "

To remove power from a cabinet, set the power switch on the rear panel of the cabinet to the OFF (0) position and unplug the cabinet's power cord. Once the repair or replacement has been completed, restore power by plugging the cabinet back in and setting the power switch back to the ON (1) position. Note that whenever power is removed from the first cabinet (contains the common control circuits), the Emergency Transfer Unit is automatically activated.

Restarting the System

The system automatically warm starts after power is restored. (The system's maintenance software may restart the system under certain self-detected error conditions.) There are two types of restart: cold and warm.

A Cold Start (which takes about 4 to 5 minutes) causes the system to check all slots for valid CP types and assign default translations to all ports, except auxiliary trunk ports.

A Warm Start (which takes about 3 minutes) causes the system to check all slots for valid CP types but *does not assign* default translations. Current translations are retained, though all call status information is cleared. This means that all calls in progress are dropped.

During a Cold or Warm Start, the SAT lists the version of the firmware loaded in the Call Processor and Memory CPs and lists all CPs in the system, by cabinet, and indicates any invalid types/versions detected. When the Cold or Warm Start is complete, every CP (except the Memory and Auxiliary Trunk) should show a green LED; in addition, the yellow LED on the Service Circuit should be flashing or steady. No red LEDs should be on.

The system can also be restarted by entering commands at the SAT. Follow these steps to manually restart the system from the SAT:

- 1. Confirm that the SAT is properly connected to the processor CP administration port.
- 2. If the SAT has a selectable baud rate, set it to 1200 baud.
- 3. Be sure transmission parity is set to none, with the parity bit set to space (0).
- 4. Turn on the terminal and press the carriage return character once or twice. On most terminals, this key is <RETURN> or <ENTER>.

After communication with the system is established, a prompt is displayed:

Enter Password ->.

 Obtain the password from the system administrator. Enter the password and press <RETURN>. The main menu is displayed along with the prompt:

Make one selection from menu ->.

- 6. Enter 9 (for the SAVE/RESTORE selection) and press <RETURN>.
- 7. The system responds with:

Action=, Enter 10 for a warm restart.

The system responds with:

Save/Restore: Action=10 Data=.

- Enter D. The system completes the word Data followed by the = sign.
- 9. Enter 1. The system responds with:

Save/Restore: Action=10 Data=1

You are about to initiate a warm start

c to continue, any other key to abort.

10. Press the character c to initiate the warm restart.

To perform a cold restart, follow the preceding steps for Restarting the System, except enter 20 after Action=. Enter 1 or 2 after Data=. Data=1 will initiate a "full default" cold start; Data=2 (V2 only) initiates a limited cold start. See the *Administration Manual for R1V2* (555-520-500) for a listing of default translations provided in Version 2 systems. The system responds with:

Save/Restore: Action=20 Data=1 (or Data=2)

You are about to initiate a cold start

c to continue, any other key to abort.

Press the character c to initiate the cold restart.

If you make any typing errors while entering information, press the backspace key. Each time you press this key, one character is erased.

Messages displayed on the SAT indicate which restart is being performed. Cold and warm restarts both display the same type of information. This is a listing of the version of the firmware loaded in the Call Processor and Memory CPs, followed by a configuration listing of all CPs recognized by the system. Note that the Memory and Call Processor CPs are not listed in the configuration listing. They should be located in slots 1 and 2, respectively, of Cabinet 1.

Table 8-A provides a listing of SAT messages that may be displayed during a cold or warm restart. The displayed message is a result of CP occupancy, type, and port translations.

CIRCUIT PACK (CP) IN SLOT	PORT TRANSLATED	DISPLAYED MESSAGE
No	Yes	Missing
Yes	No	CP Type Listed *
Yes	Yes	CP Type Listed
Yes	Yes (doesn't match physical CP)	Mismatch
Yes (Unsupported CP Type)	Yes or No	Illegal

Table 8-A. Displayed SAT Messages During Cold or Warm Restart

* Mark indicating that the CP is unused.

The SAT message for a cold restart appears after the system has performed all self-tests and reading of its configuration. The time required for a cold start is a function of the number of CPs in the system but is generally several minutes. A typical Version 1 cold restart SAT message is as follows:

Note: A Version 1 message lists five "MEM ROM" pairs while a Version 2 message lists eight "MEM ROM" pairs.

RESTART			
CPU ROM pair	1: version 1.24 *		
MEM ROM pair	1: version 1.46.1 *		
MEM ROM pair	2: version 1.46.1 *		
MEM ROM pair	3: version 1.46.1 *		
MEM ROM pair	4: version 1.46.1 *		
MEM ROM pair	5: version 1.46.1 *		
COLD START			
SLOT	CABINET 1	CABINET 2	CABINET 3
1		TN735	
2		TN742	
3	ZTN85	TN753	
4	ZTN79	TN760B	
5	ZTN79	TN760B	
6	ZTN79	TN760B	
7	ZTN78		
8	ZTN78		
9	ZTN78		
10	TN747		
11	TN747		
12	TN748		

* This is important information that should be noted in trouble reports.

Enter <RETURN>. The system responds with the administration prompt:

SYSTEM 25 ADMINISTRATION (CPU and Memory release information) Enter password -->

The SAT message for a warm restart appears more quickly. The warm restart message is identical to the cold restart message except that "WARM START" appears between the firmware version listing and the configuration listing.

Interpreting Circuit Pack LEDs

During the various states of operation (start-up testing, normal operation, and failure), CP LEDs appear as follows:

Memory [ZTN81 (V1) or ZTN127 (V2)]: The red LED on this CP lights when power is applied and is extinguished upon successful completion of the ROM checksum test initiated by the Call Processor CP. Failure is indicated by a steady "On" red LED.

Call Processor [Z7N82 (V1) or ZTN128 (V2)]: The green LED on this CP lights when power is applied and flashes during normal operation. When the system resets itself, the green LED turns on and then off for a few seconds each while the Call Processor performs its self-tests. Once testing is complete, the green LED flashes and the Call Processor resets all port CPs. Failure is indicated when the green LED remains steadily "On" or "Off."

Service Circuit (ZTN85): The red LED on this circuit pack lights during selftesting and goes off upon successful test completion. The yellow LED flashes during normal operation, indicating that the clock generator is active and remains "On" when any tone receiver on the CP is in use. "Off" indicates CP not translated or a problem. The green LED is "On" once translations have been loaded and remains "On" during normal operation.

Port CPs: The red LED on port CP lights during power-up testing and goes off upon successful test completion. The green LED lights once translations have been loaded and remains "On" during normal operation. The red LED remains "On" for any port CP that fails the start-up test or fails while in use. The yellow LED is "On" when any port on the CP is in use.

Once the system has done either a cold or warm restart, the SAT prompts the user with the "->" after a <RETURN> is entered, and normal procedures can then be followed to read the error log, perform administrative tasks, or sign off.

Clearing Specific System Troubles

- · Complete System Failure
- Common Control Trouble
- Circuit Pack Trouble
- Frontplane Ribbon Connector Trouble
- Power Supply Trouble
- Fan Assembly Trouble
- Overheating Trouble
- Backplane and Cabinet Trouble
- Emergency Transfer Unit Trouble.

Complete System Failure

A complete system failure is caused by a catastrophic failure in the Common Control circuitry, the power supply, the backplane, or the cabinet. Refer to procedures in the relevant section below in the event of such a failure. Complete system failures are rare; most failures are of a non-critical component, such as a port on a CP.

Common Control Trouble

Failure of any of the Common Control CPs (that is, Call Processor, Memory, or Service Circuit) is critical and requires replacement of the faulty pack(s). Failure of these CPs can affect the entire system and may cause activation of the Emergency Transfer Unit (ETU).

Failure of either the Call Processor or Memory circuit pack generates the following type of error message:

FAIL: <CARD>: <TEST>: <DETAIL>:

The bracketed fields contain the following information:

•<CARD> is either CPU (Call Processor) or MEM (memory)

•<TEST> is one of the following:

RAM TEST ROM TEST AA INTERFACE DUART TEST REAL-TIME-CLOCK TEST BUS ERROR WORK CYCLE DPR TEST MMU TEST

 <DETAIL> specifies the specific location of the failure, such as the address of a failed integrated circuit.

A representative common control failure message would be:

FAIL: CPU: RAM TEST: IC26:

This message identifies the failure as a Random Access Memory (RAM) test failure in integrated circuit 26 occurring on the Call Processor CP.

After partial failure, the system continues operation and the green LED on the Call Processor CP flashes normally.

After total failure, the system ceases operation and the Call Processor green LED may not flash or the red LED on the Memory CP may remain steadily lighted.

Failure can also be verified by checking the LEDs on each CP. If the Call Processor fails, its green LED is steady on or off. If the Memory fails, its red LED is steady on. (Note that the failure indications resemble the LED indications during the start-up process.)

If either a partial or total common control failure is detected, remove and then restore system power. This forces the system to perform a warm restart.

If the failure exists after system restart, remove power again and seat the suspected faulty CP (being sure to press in all socketed devices to ensure firm connections). Restore system power. If a common control failure continues to exist, one of the CPs must be replaced. Determine which CP to replace by checking the messages on the SAT and in the error log and the LEDs on the CPs.

Common control error messages sometimes appear on the SAT automatically during power-up testing. If the common control is experiencing serious failure, error messages may appear only on the SAT and not even be sent to the error log.

Any Memory CP problem could be caused by (1) a fault in the frontplane connector to the Call Processor CP or (2) a problem on the Call Processor CP itself. It does not necessarily indicate a fault in the Memory CP.

Follow the preceding instructions for Common Control CP replacement, being sure to first save translations on tape before removing power. Replacing either the Call Processor or Memory CP also requires the frontplane connector to be disconnected and then reconnected.

It is also mandatory to force a Cold Start after replacement of a defective Call Processor CP. This is done using the SAT after a restart. The Cold Start initializes the new Call Processor with the system's CP configuration as well as clears all status and error logs. (Old information may have been stored on the replacement CP.)

Circuit Pack Trouble

Most CP troubles result in user complaints, discussed in Section 9 "Clearing User-Reported Troubles." Diagnosis is aided by messages in the error log and LEDs on the CPs.

Once a faulty CP is identified, it can be replaced using the procedures in "Reseating and Replacing Circuit Packs." Refer to the information in "Interpreting Circuit Pack LEDs" to understand the meaning of the CP LEDs.

If the error log notes an error related to the touch-tone receivers, the receivers are performing below system requirements.

Touch-tone receiver problems are due to a faulty Service Circuit (ZTN85) or Tone Detector (TN748). Replace the faulty CP.

Frontplane Ribbon Connector Trouble

The frontplane ribbon connector is a flat cable connecting the Call Processor and Memory CPs at their front edges.

To reattach or replace this cable, follow these steps:

- 1. Remove power from the system.
- 2. Pull the exposed tab on the cable from one of the CPs. This exposes a second tab at the other end of the cable.
- 3. Pull the second tab to remove the cable entirely.
- 4. Replace the cable in the reverse manner. (The cable is keyed for correct placement.)

Power Supply Trouble

The system, due to a major malfunction, may activate the 10B Emergency Transfer Unit. With this condition, the system may be nonfunctional, even though the green LEDs on CPs in the other cabinets remain lighted. Failure of the power supply in a cabinet containing only port cards (Cabinet 2 or 3) may shut down all devices connected to that cabinet but will not shut down the entire system.

Table 8-B lists the voltages used by the CPs and symptoms that occur when voltages are missing. This information is useful in diagnosing power supply or power distribution problems.

Newer models have voltage test points located on the upper right corner at the front of the cabinet.

Older models have test points on the backplane behind the rear cover. These test points are factory use only! Under no circumstances should the rear cover be removed to provide access to the test points unless the power cord has first been unplugged.

Voltage/	+5 volts		-5 volts		-48 Volts	
Circuit Pack	*	No	*	No	*	No
Call Proc.(ZTN82, ZTN128)	Х	System Failure	Х	EIA Failure	Х	ETU Activated
Memory(ZTN81, ZTN127)	Х	System Failure	1	-	•	-
STARLAN(ZTN84)	Х	CP Failure	Х	CP Failure	-	-
Service Ckt.(ZTN85)	Х	System Failure	-	-	-	-
Hybrid Line(ZTN79)	Х	CP Failure	Х	No Voice	Х	Station OS
Tip/Ring(ZTN78)	Х	CP Failure	Х	No Voice	Х	Station OS
Analog Line(TN742)	Х	CP Failure	Х	No Voice	Х	Station OS
MET Line(TN735)	Х	CP Failure	Х	No Voice	Х	Station OS
Loop Start(ZTN77)	Х	CP Failure	Х	No Voice	Х	Trunks OS
GD. Start(ZTN76)	Х	CP Failure	Х	No Voice	Х	Trunks OS
DID Trk.(TN753)	Х	CP Failure	Х	No Voice	Х	Trunks OS
Tie Trk.(TN760B)	Х	CP Failure	Х	No Voice	Х	Trunks OS
Aux. Trk.(TN763)	Х	CP Failure	Х	No Voice	Х	Aux. Eq. OS
Data Line(TN726)	Х	CP Failure	-	-	-	-
Tone Det.(TN748)	Х	Tone Failure	-	-	-	-

Table 8-B. Circuit Pack	Voltages—Symptoms	(Note)	
-------------------------	-------------------	--------	--

Legend:

CP—Circuit Pack ETU—Emergency Transfer Unit OS—Out-of-Service

* X indicates that the voltage is used by the associated CP.

Note: Ringing Voltage (not shown on the table) is used by the Tip Ring and Analog Line CPs. Associated stations will not ring if there is a Ringing Voltage problem.

Each power supply has one green LED on its front that can be seen through the fan assembly. The LED is visible through the ventilation slots on the front cover, but the cover must be removed for diagnostic and service purposes. This LED is always lighted when the system is receiving 5.1 volts power. The LED is dark when there is a failure in the +5 volt power supply or power connections, or when there is a short on the backplane.

If the green LED on the power supply is not lighted, first check to be sure the cabinet is receiving ac power. Be sure that the fans are running, the connection to building ac power has been made correctly, and the power rocker switch is "On" (1). See DANGER below. Then check the internal power connections (see Figure 8-1).

DANGER: Do not remove rear cover to check connections before unplugging the power cord. Simply turning off the power switch is not enough.



Figure 8-1. AC Power Schematic

Power Supply Protection

Power supply outputs are protected from damage when they are subjected to either momentary or sustained short circuits. "Shutdown" current protection is provided at 125 percent (plus or minus 5 percent) of full load for each dc output. Current foldback is provided for the 90 V ac output.

Output power is removed when the output voltage exceeds an internally set trip point. The trip point is set at the factory at +6.25 or -0.75 V for the +5.1 V output for all rated line and load conditions.

Output power is removed when the power supply overheats for any reason (for example, fan failure, operation outside ambient temperature limits). The power supply will recover from a shutdown automatically once the cause of the shutdown is corrected. Recovery requires about 5 minutes with ac power removed. The green LED visible through the fan slots on the front of the cabinet will turn on when the power supply recovers.

Although the power circuits are designed to withstand lightning surges on the ac line with proper grounding, it is advisable to provide supplemental protection with external protectors in high lightning activity areas.

Power Supply Replacement

To replace the power supply, follow these steps:

DANGER: Hazardous voltages are present on some backplane pins. Unplug power cord and wait at least 5 minutes before removing rear cover or power supply.

- 1. Remove the four No. 6-32 screws at the corners of the fan assembly.
- 2. Unplug the fan assembly from system power by removing the two modular plugs on the left side of the assembly.
- 3. Set the fan assembly aside in a safe place.
- Unplug the 3-prong ac power connector that supplies building power to the power supply. This is located at the bottom of the power supply at the front.
- 5. Reach into the cabinet, between the power supply and the port carrier. At the rear of this narrow space is the multipin dc power connector that connects the power supply to the backplane. Remove this connector by squeezing the tabs on the top and bottom of the plug and pulling the plug up and away from its receptacle. The

receptacle is mounted in the cabinet at a 45° angle relative to the cabinet floor.

- 6. Remove the four No. 10-24 screws on the left side of the cabinet (viewed from the front). These screws secure the power supply in position.
- Pull up on the top lip of the power supply and carefully slide it out of the cabinet. The power supply rests on the cabinet floor. There are no additional anchors or guides. The power supply weighs about 4 pounds.

To reinstall a new power supply, follow the preceding steps in reverse order.

Fan Assembly Trouble

The fans should always be operating when the system is receiving ac power and the cabinet switch(es) is turned on. If the fans are not operating, be sure the system is receiving ac power.

If the system is receiving power and the fans are still not operating, the ac power connection to the fan assembly is faulty or the fans themselves are faulty (for example, due to burned out motors).

To check the ac power connection to the fan assembly, first unplug the power cord, and then remove the four No. 6-32 screws at the corners of the assembly. Carefully lift the fan assembly away from the cabinet. Check the two modular plugs attached on the left side of the assembly. If the plugs are securely attached, the fan assembly itself is faulty and must be replaced.

To replace the fan assembly, remove the modular plugs at the left side of the assembly. Reconnect these plugs to a known good fan assembly, and reinstall the new fan assembly by setting it in place in front of the power supply and replacing the four No. 6-32 screws at the corners of the assembly. (Without fans, the power supply will overheat and the system will automatically shut down.)

DANGER: Whenever the power supply shuts itself down (due to overheating, shorting, etc.), unplug the power cord and wait at least 5 minutes before restoring power.

Overheating Trouble

A clogged or dirty (or missing) air filter can cause the cabinet to overheat. The cabinet air filter rests on the floor of the cabinet, under the CP carrier. The air filter should be inspected on any service call and replaced as needed.

To replace the air filter, pinch it in the center and pull straight out.

Backplane and Cabinet Trouble

The backplane provides power, TDM bus connections, and telephone and trunk interconnections. Each carrier has 12 universal slot positions. Any port card can be installed in any slot. Connection to the corresponding telephones or trunks is made through the backplane to the appropriate cross-connect field.

DANGER: Hazardous voltages are present on some backplane pins. Unplug power cord and wait at least 5 minutes before removing rear cover.

Figure 8-2 provides a rear view of the cabinet backplane (rear cover must be removed). Figures 8-3 and 8-4 show TDM signal designations and power designations on the cabinet backplane.

Typical backplane pin designations are noted on Figure 8-2 for pins 355, 254, and 056 located on slots 4, 3, and 1, respectively. Address plug locations for Cabinets 1, 2, and 3 are also noted. The address plug position assigned slot 8 is reserved for future use. Seven leads (BA0-BA6, see Figure 8-3) are tied to corresponding logic levels to uniquely identify each CP slot in the system, including multiple cabinet systems. The logic values on leads BA4 and BA5 are used to identify the cabinet (Cabinet 1, 2, or 3) and are tied via the cabinet address plugs to either +5 V dc or ground, as appropriate. Lead BA6 is tied to ground.

An address plug inserted on a cabinet's backplane (pins 19 and 20) at slot #5 designates the cabinet as Cabinet 1, slot #6 = Cabinet 2, and slot #7 = Cabinet #3.



Figure 8-2. System Cabinet Backplane (Sheet 1 of 2)



Figure 8-2. System Cabinet Backplane (Sheet 2 of 2)

1	SVEDUCAO	• -	254		102	TA. 0	Ì
	SYSBUSAU SYSBUSAU	-	354	BACKPLANE	103	TB. O	
	SYSBUSAI	<u> </u>	353	158901A	104	TC. O	
	SYSBUSA2	<u>×</u>	352	00070111	105	TA. 1	
	SYSBUSA3	-	351		106	TB. 1	
	SYSBUSA4	-	350		107	TC. 1	
	<u>SYSBUSA5</u>	<u> </u>	349		108	TA. 2	
	SYSBUSA6	<u>y</u>	348		109	TB. 2	
	SYSBUSA/	<u> </u>	347		110	TC. 2	
	SYSBUSBU	<u> </u>	346		111	TA. 3	
	SAZRAZEL	<u> </u>	345		112	TB. 3	
	SYSBUSB2	<u> </u>	344		113	TC. 3	
	SYSBUSB3	<u> </u>	343		302	TA. 4	
TO	SYSBUSB4	<u> </u>	342		303	TB. 4	
10	SYSBUSB5	<u> </u>	341		304	TC. 4	
SLOIS	SYSBUSB6	<u> </u>	340		305	TA. 5	
1-12	SAZROZRI	<u> </u>	339		306	TB. 5	
	SYSCLK	ع	337		307	TC. 5	
	SYSUCLK	<u> </u>	330		308	TA. 6	
	CLKSEL	<u> </u>	020		309	TB. 6	
	SYSSYNC	<u> </u>	030		310	TC. 6	
	SYSER	<u> </u>	030		311	TA. 7	
	SPARE-BUS	<u> </u>	034		310	TB. 7	I
	BA6 (GRD)	2	220		312	TC. 7	TO
	BA5	1	120		002	RAOS	SLOTS
	BA4	1	020		002	RB. O	1-12
	BA3		019		004	RC 0	1
	BA2		119		005	RA. 1	
	BA1		219		006	RB 1	
l	BAO		319		007	RC. 1	
					008	RA. 2	
					009	RB. 2	
					010	RC. 2	
	LLGLIND.				011	RA. 3	
	= D033LD				012	RB. 3	
					013	RC. 3	
					202	RA, 4	
					202	RB. 4	
					200	RC. 4	
					205	RA. 5	
					205	RB. 5	
					207	RC. 5	
					208	RA. 6	
					200	RB. 6	
					207	RC. 6	
					210	RA. 7	
					211	RB 7	
					212	RC. 7	
							٦

Figure 8-3. TDM Signal Designations On Cabinet Backplane



Figure 8-4. Power Designations On Cabinet Backplane

Each of the 12 universal carrier slots has 48 pins on the backplane for connection to station and trunk ports. The 48 pins are divided into eight groups of 6 pins each, one group for each port circuit. Lead designations consist of the lead name suffixed by the group number (for example, TA.2, RA.2). Specific functions depend on the type of port card. Table 8-C provides the 25-pin connector to backplane pin designations.

Manifestations of typical backplane problems include power supply failure, sudden failure of one or more circuit packs, or nonspecific system troubles that cannot be isolated to a specific maintenance unit.

Backplane troubles are usually caused by bent or broken pins. A visual inspection of the backplane may be adequate to determine if pins are bent or broken. This may require removing one or more CPs.

Backplanes are not field repairable. A faulty backplane requires replacement of the entire cabinet (but not the CPs in the cabinet).

25-Pin	Conn.	Call	GS	LS	Tip Ring	ATL	MET	Backplane
Pin No.	Wire	Proc.	Trunk	Trunk	Line	Line ZTNZ9	Line	Pin No. (Slots 1-12)
	Color	DDA	Z11N/0 T4	Z111/1 T4	Z111/0	Z11073	T1	102
26 1	W-BL BI-W	RDA SGA	R1	R1	R1	R1	R1	002
27	W-0					CT1	BT1	103
2	0-W	DCDA				CR1	BR1	003
28	W-G	DTRA				P-1	LT1	104
3	G-W	TDA				P+1	LTR1	004
29	W-BR	RDB	T2	T2	T2	T2	T2	105
4	BR-W	SGB	R2	R2	R2	R2	RZ DT0	005
30	W-S	DODD				CI2 CP2	BR2	006
5	S-W	DCDB					1.T2	107
31	R-BL					P+2	I TR2	007
30		PDC	T3	T3	T3	T3	T3	108
32 7	O-R	SGC	R3	R3	R3	R3	R3	008
33	R-G	000	-			CT3	BT3	109
8	G-R	DCDC				CR3	BR3	009
34	R-BR	DTRC				P-3	LT3	110
9	BR-R	TDC				P+3	LTR3	010
35	R-S	RDD	T4	T4	T4	T4	T4	111
10	S-R	SGD	R4	R4	R4	R4	R4	011
36	BK-BL	DODD				CT4 CP4	B14 BD4	012
11	BL-BK	DCDD				D /		113
37	D-BK					P+4	LTR4	013
38	BK-G		T5	T5	T5	T5		302
13	G-BK		R5	R5	R5	R5		202
39	BK-BR					CT5		303
14	BR-BK					CR5		203
40	BK-S					P-5		304
15	S-BK			-		P+5		204
41	Y-BL		T6 B6	16 DC	16	Ib P6		305
16	BL-Y		RO	RO	RO	CTE		306
42	1-U					CR6		206
/3	V-G					P-6		307
18	G-Y					P+6		207
44	Y-BR		T7	T7	T7	T7		308
19	BR-Y		R7	R7	R7	R7		208
45	Y-S	ETU48				CT7		309
20	S-Y	ETUGD				CR7		209
46	V-BL	ETU48				P-7 P±7		310
47	BL-V	ETUGD	тя	тя	тя	T8		311
41 22	0-V		R8	R8	R8	R8		211
48	V-G	ETU48				CT8	1	312
23	G-V	ETUGD				CR8		212
49	V-BR	ETU48				P-8		313
24	BR-V	ETUGD				P+8		213
50	V-S		GND	GND	GND	GND	GND	300
25	S-V	I	GND	GND	GND	GND	GND	200

Table 8-C. 25-Pair Connector to Backplane Designations

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25-Pin Conn.		DID	Tie	Aux. Data		Analog	Backplane
Pin No.	Wire	Trunk	Trunk	Trunk	Line	Line	Pin No.
	Color	TN753	TN760B	TN763	TN726	TN/42	(510(3 1-12)
26	W-BL	T1	T1	T1			102
1	BL-W	<u>R1</u>	R1	<u>R1</u>		<u> </u>	102
27	W-0		T11	SZ1	TXT1		003
2	0-W		R11	SZ11	IXHI		104
28	W-G		E1	S1	PXTI		004
3	G-W		<u>M1</u>	S11	PXH1		105
29	W-BR	T2	T2	T2		12	005
4	BR-W	R2	R2	R2		H2	106
30	W-S		T12	SZ2	TX12		106
5	S-W		R12	SZ12	TXH2		107
31	R-BL		E2	S2	PXT2		107
6	BL-R		M2	S12	PXH2		100
32	R-0	Т3	Т3	Т3		13	108
7	O-R	R3	R3	R3		нз	100
33	R-G		T13	SZ3	TXT3		109
8	G-R	I	R13	SZ13	TXR3	L	110
34	R-BR	1	E3	S3	PXT3		010
9	BR-R		M3	<u>\$13</u>	PXR3		110
35	R-S	T4	T4	T4		T4	111
10	S-R	R4	R4	R4		H4	110
36	BK-BL		T14	SZ4	TXT4		012
11	BL-BK		R14	SZ14	TXH4		012
37	BK-O		E4	S4	PXT4		113
12	0-ВК		M4	S14	PXH4		013
38	BK-G	T5				T5	302
13	G-BK	R5	1			R5	202
39	BK-BR				TXT5		303
14	BR-BK				TXR5		203
40	BK-S				PXT5		304
15	S-BK	1			PXR5	+	204
41	Y-BL	T6				T6	305
16	BL-Y	R6				R6	205
42	Y-0		T		TXT6	1	306
17	0-Y				TXR6		200
43	Y-G				PXT6	1	307
18	G-Y				PXR6	+	20/
44	Y-BR	T7				17	308
19	BR-Y	R7	<u> </u>	+		1 M/	200
45	Y-S	1			TXT7		209
20	S-Y			+	1XH7	+	203
46	V-BL				PXT7		310
21	BL-V				PXR7	+ =	210
47	V-0	T8				18	311
22	0-V	R8				H8	211
48	V-G	1			TXT8		312
23	G-V		1		TXR8	+	212
49	V-BR				PXT8		313
24	BR-V				PXR8	+	213
50	V-S	GND	GND	GND	GND	GND	300
25	S-V	GND	GND	GND	GND	GND	200

Table 8-C. 25 Pair Connector to Backplane Designations (Contd)

Emergency Transfer Unit Trouble

If the Emergency Transfer Unit (ETU) will not enter the power failure mode, do the following steps:

- Unplug the cable bringing the control signal from port seven/eight on the Call Processor CP to the ETU. This cable terminates in a modular jack that is inserted in a modular plug labeled "CPU" on the left-hand side of the ETU.
- 2. If the ETU goes into the power failure mode, the Call Processor is probably faulty or there is a wiring problem. Plug the cable back in, then reset the Call Processor by removing and restoring power to the system. If the ETU still does not go into the power failure mode, the Call Processor CP must be replaced.
- 3. If the ETU does not go into the power failure mode after the control cable was unplugged in Step 1, the ETU is faulty and must be replaced.

If the ETU remains in the power failure mode continuously (preventing normal operation of the system), follow these steps:

- 1. At the ETU, unplug the cable bringing the control signal from the Call Processor.
- 2. Using a modular jack breakout box and voltmeter, check to see that 48 volts is present between pins 1 and 2 and pins 3 and 6 of the control cable from the Call Processor.
- 3. If the above voltages are present, the ETU is faulty and should be replaced.
- 4. If the above voltages are not present, either the Call Processor or the cable is faulty and should be replaced.

CLEARING USER-REPORTED TROUBLES

User-reported troubles are usually associated with voice or data terminal equipment or trunks. They can result from system-detected errors and are often solved by clearing system error conditions or alarms.

This section presents trouble-clearing techniques and procedures for userreported troubles.

Maintenance routines for data terminals and Asynchronous Data Units (ADUs) are not contained in this section (although some basic routines for clearing administration equipment troubles are included). Manuals covering data terminals and data modules are listed in Section 10 "Reference Documentation." Maintenance for auxiliary devices that are customer provided is the responsibility of the user.

Administration Equipment Troubles

Administration equipment that is connected to the system on a dedicated basis includes the System Administration Terminal (SAT), Station Message Detail Recording (SMDR), and Digital Tape Unit.

Symptoms:

Terminal dead or functioning intermittently. Messages contain "garbage" characters.

Procedures:

- 1. Check ac power connection.
- 2. Check cabling to cabinet.
- 3. Check administered settings for terminal from SAT (see *Administration Manual* for your system). Settings should be for 8-bit word length; no parity; space (0) for bit 8.
- Check pin 20 of EIA connector for DTR signal. Signal should be steady at greater than or equal to +3.0 volts with respect to pin 7 (ground).

Note: For problems with administration equipment that is not connected on a dedicated basis, refer to the *Terminal Operations Manual* (555-520-710).

Time-Keeping Troubles

Symptoms:

Clock doesn't reflect current time or date.

Procedures:

 Reset clock from SAT (see the Administration Manual for your system). Clock has tolerance of +/- 3 minutes per month. Variances outside this range indicate a faulty clock and require replacement of the Call Processor. Time must be reset for Daylight Savings Time.

Voice Terminal and Wiring Troubles

Symptoms:

Intermittent voice terminal troubles.

Procedures:

- 1. Swap a known good terminal with the questionable terminal to determine if problem is localized to a single terminal. If local power is provided, check power supply.
- 2. If troubles do not persist, problem is localized to single terminal. Replace faulty terminal.
- If good terminal does not work properly, fault is in wiring or circuit pack (CP).
- Check other terminals connected to same CP. If other terminals are working properly, fault is probably in wiring. Swap wiring between Station Interconnect Panel and terminal to verify wiring problem. Check and clear any wiring problems.
- 5. If other terminals connected to same CP are not working properly, fault is probably in CP.

- 6. Check CP translations from the SAT to be sure this CP has been properly translated.
- 7. Check LEDs on CP. Red light-emitting diode (LED) is lighted if there is a fault on the CP that affects all ports but may be lighted if one or a few ports are faulty.
- 8. Check error log for relevant messages.
- 9. Reseat the CP, whether or not the red LED is lit. (See "Reseating and Replacing Circuit Packs" in Section 8.) Replace faulty CP.

Voice Transmission Troubles

Symptoms:

Voice terminals not receiving tone transmission.

Procedures:

- 1. Check that green LED on power supply is lighted.
- 2. Check power supply for voltages.

Symptoms:

Many single-line sets or multibutton electronic telephone (MET) sets are not able to dial correctly even though they are able to receive calls.

Procedures: Using a single-line set, do the following to test touch-tone registers:

- At a single-line voice terminal, go off-hook, dial *3 and the 2-digit number (01 through 12) of the touch-tone receiver to be tested. Receivers 01 through 04 are on the ZTN85 CP. Receivers 05 through 12 are only present if your system has TN748 CP(s).
 - You will hear busy tone if the receiver is in use. You will hear reorder tone if you misdialed or addressed a receiver not in your system (for example, you dialed *305 and your system does not have a TN748 CP). Try again.
 - If you hear dial tone, proceed with this test.
- 2. Dial the digits 1 2 3 4 5 6 7 8 9 0 * #.

- You should hear a DTMF signal as each key is pressed.
- You will hear dial tone one to three seconds after entering the "#" if the test passes.
- 3. Repeat the test for each touch-tone receiver.
- 4. Replace the Service Circuit CP if this test fails.

7300H Series Terminal Troubles

Symptoms:

7300H Series terminal LEDs and/or tones not functioning properly.

Procedures:

- 1. Move the T/P lever on the left-hand side to the "T" (Test) position and hold it there.
- 2. Tone ringing should be heard.
- 3. All the red and green LEDs on the terminal should flash alternately while the lever is held in this position.
- 4. Release the lever, letting it return to its normal position.
- 5. Ringing tone should be silenced and LEDs extinguished.
- 6. If any part of the test fails, the terminal is faulty and should be replaced.

Symptoms:

Set keys don't click.

Procedures:

- 1. Check to be sure appropriate ZTN79 CP is translated.
- 2. Check for presence of -48 volts at power supply.

Trunk Troubles

Many trunk troubles originate in the central office (CO) facilities. The first step in identifying trunk troubles should be to check for presence of dial tone at the Trunk Access Equipment (TAE). If required, check the error log records, and make a trunk test call.

Note that it is sometimes difficult for the user to detect or identify trunk troubles. If an outgoing trunk is down, an error is recorded in the error log and the trunk is taken out of service (see Note below). If an incoming-only trunk is down, however, the only manifestation of trouble is customer complaints that incoming calls are not being answered.

Note: For Version 2 systems, the system will not busy out more than half of the trunks in any pool. Thus, a permanent alarm may be logged against a particular trunk, but the trunk may not be taken out of service because of this constraint.

Outging Trunk Problems

Symptoms:

Difficulty is seizing outgoing trunks.

Procedures:

- 1. Verify that dial tone is received from the CO at the TAE (see Note below). If no dial tone is present, notify the CO through the proper channels.
 - **Note:** For ground start trunks, you must apply ground to the Ring lead to get dial tone.
- 2. Go off-hook at a test station and get system dial tone.
- 3. Dial *2 (the test code for all non-DID facility trunks).
- 4. Dial the 4-digit trunk number of the trunk to be tested. (This is the same number used by the System Administrator to identify this trunk.)
- 5. Listen for dial tone from the accessed trunk. If dial tone is not present, isolate the fault to a trunk port CP or location in the trunk access equipment, etc., using a test set.

9-5
- 6. If dial tone is present, dial a working outside number. Verify that the call is complete.
- 7. If trunk is busy, fast busy tone is heard. If a non-port trunk was dialed, fast busy tone is heard.

Incoming Trunk Problems

Symptoms:

Incoming trunks (of any type) not working properly.

Procedures:

- 1. Place an incoming call through the troubled trunk.
- 2. Check the trunk translations via the SAT to be sure this trunk has been properly translated. (See the *Administration Manual* for your system.)

Error Log Interpretation: Loop Start Trunks

Procedures:

- 1. Check error log for messages pertaining to loop start trunks.
- If "no loop current on incoming call" is displayed, no loop current was detected on an incoming call. The CP detected ringing, but not loop current when it closed the loop. In this case, the CO facility is probably good, but either the current sensor on the CP is faulty or the CO battery circuit is faulty.
- 3. Switch trunk ports and see if the problem moves to the new loop start trunk.
- 4. If the problem does not move, the loop start CP is faulty and must be replaced.
- 5. If the problem moves, the fault is with the CO and should be notified through the proper channels.
- 6. If "no loop current on outgoing call" is displayed, either of the above conditions could be true. It is more likely, however, that the facility is down.
- 7. Place an outside call on the line using the trunk test call steps under "Outgoing Trunk Problems." If you get fast busy tone, switch trunk ports and try again.

- 8. If the problem does not move, the loop start CP is faulty and must be replaced.
- 9. If the problem moves, the fault is with the CO. Notify CO personnel through the proper channels.

Error Log Interpretation: Ground Start Trunks

Procedures:

- 1. Check error log for messages pertaining to ground start trunks.
- If "no loop current on incoming call" is displayed, no loop current was detected on an incoming call. The CP detected ringing, but not loop current when it closed the loop. In this case, the CO facility is probably good, but either the current sensor on the CP is faulty or the CO battery circuit is faulty.
- 3. Switch trunk ports and see if the problem moves to the new ground start trunk.
- 4. If the problem does not move, the ground start CP is faulty and must be replaced.
- 5. [f the problem moves, the fault is with the CO and should be notified through the proper channels.
- 6. If "fault on outgoing seizure" is displayed, either of the two conditions is true. The first condition is that the trunk CP did not detect loop current as in the case of the "no loop current on incoming call" message. The second condition is that the trunk CP did not detect Tip ground. This could be either a problem with the CO or the ground detector on the CP.
- 7. Place an outside call on the line using the trunk test call steps "Outgoing Trunk Problems." If you get fast busy tone, switch trunk circuits and try again.
- 8. If the problem does not move, the ground start CP is faulty and must be replaced.
- 9. If the problem moves, the fault is with the CO. Notify CO personnel through the proper channels.
- 10. If "Ringing no ground" is displayed, the T and R leads may be reversed in the trunk access wiring. The T lead should have ground and the R lead should have -48 volts. These can be verified by

reversing the ground and ring leads and checking with either a voltmeter or a test set (with a polarity switch). A voltmeter should indicate a presence of 48 volts. A test set should provide dial tone when temporarily grounding the Ring lead.

- 11. "Ringing no ground" may also mean that the ground detect circuit on the Ground Start CP is faulty. Check and replace this CP if necessary.
- 12. "Ringing no ground" may also mean the CO is unable to send ground. If this is the problem, notify the CO through the proper channels.

DID Trunks Troubles

Symptoms:

User complaints that direct inward dialing trunks are not operating properly (for example, callers hear trunks ring, but users hear no ringing at voice terminals).

Procedures:

- 1. Check the trunk translations via the SAT to be sure that trunks have been properly translated. (See the *Administration Manual* for your system.)
- 2. Check the error log for messages such as:
 - •Rotary dial before wink
 - •Rotary dial pulse too early
 - •Rotary dial pulse during wink
 - •CO failure to release after PBX disconnect
 - •CO belated release.

These messages indicate CO problems. The first three errors are very common when DID trunks are installed. The CO should be notified through the proper channels about any of these problems.

 CO failure to release after PBX disconnect can frequently be corrected by disconnecting and then reconnecting the DID trunk. If this procedure does not resolve the problem, notify the CO through the proper channels.

- 4. Check each suspect DID trunk port by dialing in with the touch-tone test set beginning at the network interface. (Be sure to use the appropriate dialing mode: dial pulse or rotary.)
- 5. If the test call is successful at the network interface, the fault is probably with the CO facility, and the CO should be notified through the proper channels.
- 6. if the test call is not successful at the network interface, repeat this test at the cabinet.
- 7. If the test fails at the cabinet, the DID circuit pack is faulty and must be replaced.
- 8. If the test call is successful at the cabinet but not at the network interface, the trunk access equipment wiring is faulty and must be repaired.
- 9. Check the error log for any messages indicating unused (inaccessible) DID trunks.

Special Port Circuit Options for Stations and Trunks

Tables 9-A and 9-B provide the special port circuit options that are administered in the system. System defaults and associated action codes applicable to the various port CPs are also shown. Procedures are available in the *Administration Manual* for your system for logging on the system and accessing the information shown in Table 9-A. The administrable items shown on Table 9-A should not be changed unless CO and maintenance personnel agree that an item needs changing.

CIRCUIT BOARD OPTIONS (See Applicable Actions—Table 9-B)			
ACTION	DESCRIPTION	DATA	DEFAULT
32	CO Disconnect time (in 20 msec increments)	(0-2540) Msecs	[500]
33	End-To-End Signaling Tone Timing (in 20 msec increments)	(0-2540) Msecs	[60]
34	End-To-End Signaling Pause Timing (in 20 msec increments)	(0-2540) Msecs	[60]
35	Hybrid Balance	1 - Resistor 0 - Resistor/Capacitor	[*]
36	Gain	1 - Gain = 3db 0 - Gain = 0db	[0]
37	E&M Signaling Type	2 - Type I Compatible 1 - Type V 2 - Type I	[2]
38	Answer Supervision Delay Timing	(0-5100) Msecs	[300]

Table 9-A. Station/Trunk/Special Port Circuit Board Options

* Default depends on CP type. Trunk ports are defaulted to 0 (RC termination) while station ports are defaulted to 1 (R termination).

ACTIONS FOR CIRCUIT BOARD OPTIONS (See Circuit Board Options—Table 9-A)								
CIRCUIT	BOARD	ACTIONS						
BOARD	TYPE	32	33	34	35	36	37	38
ZTN76	GS Board	•	•	٠	•			
ZTN77	LS Trunk	•	•	٠	•			
ZTN78	Tip/Ring Line		•	•				
TN742	Analog Line		•	•	•	•		
TN753	DID Trunk	•	•	•	•			
TN760B	Tie Trunk	•	•	•			•	٠
TN763	Aux. Trunk		•	•				

Table 9-B. Applicable Actions for Circuit Board Options

Data Line Troubles

Symptoms:

Data terminals connected via the data line card (TN726) dead or not functioning properly.

Procedures:

- Check that the RS-232C connector on the Asynchronous Data Unit (ADU) is properly connected to the RS-232C connector on the data terminal. *Always* tighten the screws or other fasteners on the connectors.
- 2. Check terminal ac power connection.
- 3. Check to be sure connection to ADU is 4-pair modular plug.
- 4. Check ADU ac power connection (see Steps 5, 6, and 7). Note that any ADU connected to a port on the Call Processor must have a local ac power source. Briefly disconnect the ADU's power cord.
- If ADU is not externally powered, check pin 20 (DTR signal on the RS-232C connector) for presence of at least +7 volts relative to pin 7 (ground).

- 6. If +7 volts are not present, the ADU is receiving insufficient power from the data terminal and must be locally powered.
- If ADU is powered from local transformer, check to be sure a 3-pair or 2-pair modular cord is connected between the transformer and the ADU.
- 8. Using a 4-pair modular jack breakout box, check to be sure that the ac voltage between pins 7 and 8 is approximately 14 volts under load or about 28 volts for an open circuit.
- 9. Even with alternate power, the data terminal needs to deliver at least 3 volts on pin 20 (DTR signal).
- 10. Check the data terminal settings that have been administered at the SAT to be sure the administered settings match those of the data terminal. Settings should be for 8 bits, no parity with 0 in the parity bit. Check baud rate settings. Even if terminal accommodates auto baud rate, administered settings must include baud rate.
- 11. If data port is administered for "long break" disconnects, check to be sure breaks from the terminal are at least 2 seconds. If they are not, or if the break length cannot be determined, insert a device with a disconnect button in the line and enter 2-second breaks.
- 12. Check wiring.
- 13. If none of the preceding procedures correct the terminal troubles, change the ADU.
- 14. if the problems persist, replace the Data Line CP.

Multiple or Undiagnosable Troubles

Symptoms:

Red LED is lighted on all port CPs. SAT displays this message: "FAIL: CPU: ARCH ANGEL INSANE: CHECK ZTN85: TERMINATOR?".

Procedures:

- 1. Check the TDM bus terminator card.
 - *Note:* The ZTN81 Memory CP provides built-in bus termination circuitry for one end of the bus, and the TDM bus termination card is used to terminate the other end.
- 2. Reseat the Call Processor, Memory, and Service CPs (see "Reseating and Replacing Circuit Packs" in Section 8). Check the frontplane connector cable between the Call Processor and Memory CPs.
- If troubles persist, replace units in this order: TDM bus terminator card; Service Circuit; frontplane connector; Memory CP; Call Processor CP. Recheck the system after each unit has been replaced to see if the trouble clears.

Symptoms:

Red LED is lighted on several port CPs.

Procedures:

- 1. Check power supply to be sure it is providing correct voltages (see "Power Supply Trouble" in Section 8).
- 2. Check the frontplane connector, the Memory and Call Processor CPs, and replace any faulty units.
- 3. Reseat any CPs on which the red LED is still lighted. Replace any CPs on which the red LED is still lighted.
- 4. If troubles persist, check the backplane for signs of shorts or other troubles. A port CP with trouble may be providing a logic "1" or "0" onto the backplane causing other port CPs to experience trouble also. In multiple cabinet systems, move suspect CPs to another cabinet to help identify CP or backplane trouble (see "Backplane and Cabinet Trouble" in Section 8).

Symptoms:

Undiagnosable or unfixable troubles.

Procedures:

- 1. Force a cold restart of the system from the SAT (see "Restarting the System" in Section 8).
- 2. Read in the latest tape containing system translations (see Section 7 "Operating the Digital Tape Unit").
- 3. Focus your attention on the Call Processor and Memory CPs. Check the LEDs on these CPs. Check the error log for relevant messages.
- 4. If troubles persist, follow established escalation procedures.

REFERENCE DOCUMENTATION

The following System 25 documents are available for reference. A brief description of each manual is provided. Manuals not specified for Release 1 Version 2 (R1V2) cover both R1V1 and R1V2.

Administration Manual	555-500-500
Administration Manual for R1V2	555-520-500
Advanced Administration Manual for R1V2	555-520-510
• An Introduction to AT&T System 25	555-520-021
Implementation Manual	555-500-650
 Implementation Manual for R1\/2 	555-520-650
 Installation and Test Manual 	555-520-100
 Maintenance Manual 	555-520-105
New Capabilities Manual for R1V2	555-520-205
Diaphing Manual	555-520-600
• Planning Manual	555-520-200
Terminal Operations Manual	555-520-710
Liser Guides	
- Data Features User Guide	555-520-704
— Direct Trunk Attendant Console User Guide	555-520-701
-Multiline Voice Terminal User Guide	555-520-703
— Single-Line Voice Terminal User Guide	555-520-702
- Switched Leen Attendent Canada Lleer Cuide	555-520-706
- Switched Loop Attendant Console User Guide	

Administration Manual or Administration Manual for R1V2

Provides the information necessary to initialize a system and to perform ongoing system administration. Explains the operation of the System Administration Terminal, the Digital Tape Unit, and the commands that allow the System Administrator to make changes and additions.

REFERENCE DOCUMENTATION

Advanced Administration Manual for R1V2

Provides information for administrative procedures not covered in the basic *Administration Manual.* Advanced administration allows the System Administrator to make changes in voice and data terminal assignments, call group coverage, action codes, and other system features such as Automatic Route Selection (ARS).

An Introduction to AT&T System 25

Provides an introduction to System 25 features and services. The emphasis is on how System 25 helps solve information management, productivity, and cost control problems.

Implementation Manual or Implementation Manual for R1V2

Describes how to plan the system's operating configuration. Explains how to determine customer needs and how to convert these needs into a system configuration plan. This plan is recorded on accompanying forms that are used in conjunction with the *Administration Manual* to initialize the system. The *Implementation Manual* and associated forms are packaged together in the Administration Records Binder.

Installation and Test Manual

Provides step-by-step procedures for installing System 25 and associated equipment. Includes procedures for testing equipment and trunks and for making additions and changes to the system.

Maintenance Manual

Provides a detailed description of system operation and procedures for isolating and clearing customer affecting faults.

New Capabilities Manual for R1V2

Describes the System 25 Release 1 Version 2 (R1V2) features that were not included in Release 1 Version 1 (R1V1). In addition, R1V1 features that have been enhanced for R1V2 and new R1V2 hardware are covered.

Planning Manual

The document is a presale workbook used by the Account Team and customer to define a set of orderable equipment that meets the customer's specific requirements. This workbook, when completed, may be used in conjunction with the Quick-Quote Price Estimator or the DOSS Configurator to obtain a price estimate or formal quote or to place an order.

REFERENCE DOCUMENTATION

Reference Manual

This document is the system's principal technical reference. It provides reference material for sales support, system configuration and operation, and for the system technician. It contains a comprehensive description of the system, emphasizing features, components and overall capabilities and capacities. This reference manual is divided into 10 sections:

- SECTION 1—OVERVIEW
- SECTION 2—FEATURES AND SERVICES
- SECTION 3—FUNCTIONAL DESCRIPTION
- SECTION 4—HARDWARE DESCRIPTION
- SECTION 5—TECHNICAL SPECIFICATIONS
- SECTION 6—ENVIRONMENTAL REQUIREMENTS
- SECTION 7—PARTS INFORMATION
- SECTION 8—REFERENCE DOCUMENTATION
- SECTION 9-GLOSSARY
- SECTION 10-INDEX.

Terminal Operations Manual

This manual is designed to help the System Administrator better understand System 25 voice terminal and data terminal operation. This manual contains all operating procedures provided in the various User Guides and provides additional explanatory material as well.

User Guides (700 Series)

These guides specify operating procedures for System 25 voice and data terminals users.

ABBREVIATIONS AND ACRONYMS

ADU	Asynchronous Data Unit
ARS	Automatic Route Selection
ASCII	American Standard Code for Information Interchange
BLF	Busy Lamp Field
BPS	Bits Per Second
CCS	Hundred Call Seconds
CCSA	Common Control Switching Arrangement
COS	Class of Service
DCE	Data Communications Equipment
DDC	Data Dial Code
DDD	Direct Distance Dialing
DID	Direct Inward Dialing
DGC	Direct Group Call
DTAC	Direct Trunk Attendant Console
DTE	Data Terminal Equipment
DTMF	Dual-Tone Multifrequency
DXS	Direct Extension Selector
EIA	Electronics Industries Association
ETU	Emergency Transfer Unit

ABBREVIATIONS AND ACRONYMS

FNPA	Foreign Numbering Plan Area
FRL	Facility Restriction Level
FX	Foreign Exchange
HNPA	Home Numbering Plan Area
LDN	Listed Directory Number
LED	Light-Emitting Diode
МЕТ	Multibutton Electronic Telephone
МОН	Music-on-Hold
NAU	Network Access Unit
NEU	Network Extension Unit
NPA	Number Plan Area
OPS	Off-Premises Station
PDC	Personal Dial Code
PDS	Premises Distribution System

ABBREVIATIONS AND ACRONYMS

RAM	Random Access Memory
RNX	Private Network Office Code
ROM	Read Only Memory
SAT	System Administration Terminal
SIP	Station Interconnect Panel
SLAC	Switched Loop Attendant Console
SMDR	Station Message Detail Recording
TAE	Trunk Access Equipment
TC	Technical Consultant
VT	Voice Terminal
WATS	Wide Area Telecommunications Service

The following is a list of definitions of terms used in System 25 documentation.

Administer

To access and change the parameters associated with the services or features of the system.

Analog Data Endpoint

Data endpoints connected to the system by (built-in or stand-alone) modems. They do not require the use of data modules (asynchronous data units) and are addressed like a voice terminal, by Personal Dial Code (PDC). These endpoints connect to tip ring circuit pack ports.

Analog Voice Terminals

See "Single-Line Voice Terminals."

Appearance

See "Call Appearance."

Asynchronous Data Transmission

A scheme for transmitting data where each character is preceded by a start bit and followed by a stop bit, thus permitting data elements to occur at irregular intervals. This type transmission is advantageous when transmission is not regular (characters typed at a keyboard).

Asynchronous Data Unit (ADU)

A Data Communications Equipment (DCE) device that allows direct connection between RS-232C equipment and the digital switch via ports on the TN726 Data Line circuit pack.

GLOSSARY _

Attendant

The operator of the attendant console.

Attendant Console

- **.** *Direct Trunk Console:* An electronic call-handling position with pushbutton control. Used by attendants to answer and place calls and to manage and monitor some system operations.
- **.** *Direct Extension Selector (DXS) Console:* Provides the attendant with a visual indication of the status of stations. Also allows the attendant to conveniently extend incoming calls to stations.

Auxiliary Equipment

.Dictation Equipment

.Delay Announcement Devices

.External Alerting Devices (external alerts)

.Music-on-Hold Equipment

.Paging Equipment.

Auxiliary Trunk

A trunk circuit used to connect auxiliary equipment to the switch. Only dictation and paging equipment may be connected via an auxiliary trunk.

Bit (Binary Digit)

One unit of information in binary notation (having two possible states or values, 0 or 1).

Bridge (Bridging)

The sharing of the same extension by two or more voice terminals.

Buffer

A circuit or component that isolates one electrical circuit from another. Typically, a buffer holds data from one circuit or process until another circuit or process is ready to accept the data.

Bus

A multiconductor electrical path used to transfer information over a common connection from any of several sources to any of several destinations.

Bus, Time Division Multiplex

See "Time Division Multiplex Bus."

Call Appearance

A button on a multiline voice terminal at which a call seems to appear. Calls may be received, originated, and held at an appearance. System Access, Personal Lines, Direct Extension Selection, and Pooled Facilities are examples of call appearances. Software makes it seem to the terminal user that a line actually is terminated at the button.

Call Appearance, Voice Terminal

A button labeled with an extension number or line number used to place outgoing calls, receive incoming calls, or hold calls. Two light-emitting diodes (LEDs) next to the button show the status of the call appearance or status of the call.

CCS (Hundred Call Seconds)

A traffic-measuring unit that expresses the load of one or more traffic-handling devices. A device used for 1 hour without interruption represents a load of 36 CCS which equals 1 Erlang (see "Erlang").

Central Office

The location housing telephone switching equipment that provides local telephone service and access to toll facilities for long-distance calling.

Central Office Codes

The first three digits of a 7-digit public network telephone number. These codes are numbered from 200 through 999 and are sometimes referred to as NNXs.

Central Office Trunk

A telecommunications channel that provides access from the system to the public network through the local central office (CO).

Channel

A communications path for transmitting voice and data.

Class of Service (COS)

Parameters used to define voice terminal, data, and trunk port capabilities and restrictions.

Common Control Switching Arrangement (CCSA)

A private telecommunications network using dedicated trunks and a shared switching center for interconnecting company locations.

Confirmation Tone

Three short bursts of tone followed by silence; indicates that the feature has been activated, deactivated, or canceled.

Console

See Attendant Console.

Coverage Call

A call that is redirected from the called station to an alternate answering position.

Coverage Path

The order in which calls are redirected to alternate answering positions.

Covering User

The person at an alternate answering position who answers a redirected call.

Data Channel

A communications path between two points used to transmit digital signals.

Data Communications Equipment (DCE)

Refers to a specific RS-232C interface connector configuration. DCE devices are designed to interface directly (pin-for-pin) to Data Terminal Equipment (DTE). The transmit and receive pins are reversed from that of a DTE interface. A modem is an example of a DCE device.

Data Dial Code (DDC)

The extension number of a digital data endpoint.

Data Endpoint

Two general groups: those having a DTE-type interface, which encompasses almost all of the data terminal devices, and those having a DCE interface, which are primarily modems. It should be noted that within each category control interfaces may vary. Refer to Analog Data Endpoint and Digital Data Endpoints for additional information.

Data Module

A DCE device providing a standard interface between data equipment and a TN726 Data Line CP port on the switch. Only ADU Models Z3A1, Z3A2, Z3A4, and Z3A5 are supported.

Data Terminal Equipment (DTE)

DTE refers to a specific RS-232C connector termination designed to connect directly to a DCE-type connection. Typically associated with video display terminals, printers, and computers which either originate or terminate a data transmission path.

Delay-Dial Tie Trunk

After a request for service (called a seizure) is detected on an incoming trunk, the system sends a momentary signal followed by a steady tone over the trunk. This informs the calling party that dialing can start. This type of trunk allows dialing directly into the system; that is, the digits are received as they are dialed.

Digital Data Endpoints

In System 25, digital data endpoints include any DTE or DCE with an RS-232C interface to the switch connected via Asynchronous Data Units.

Digital Tape Unit (DTU)

RS-232C peripheral DTE used to store and reload system translations.

Direct Extension Selector (DXS) Console

An option at the attendant console that allows an attendant direct access to voice terminals by pressing a Group Select button and a DXS button.

Direct Group Call (DGC)

An incoming call that arrives on a loop-start, ground-start, or tie trunk and is routed to a predetermined group of stations (for example, sales department, service department).

Direct Inward Dialing (DID)

A service whereby the called extension (station) number is transmitted to a PBX by the central office (CO) and incoming calls are routed directly to the called station, bypassing the attendant.

Dual-Tone Multifrequency (DTMF)

Industry terminology for touch-tone calling.

Emergency Transfer Unit (ETU)

Provides direct connection of designated Power Failure Transfer (PFT) registered voice terminals to the CO during a power failure or other service interruption.

Erlang

A traffic measuring unit that expresses the load of one or more traffic-generating devices [36 CCS equals 1 erlang—see "CCS (Hundred Call Seconds)"].

Extension Number

A 1- through 4-digit number assigned to each voice terminal and data endpoint in the system. Also see "Personal Dial Code."

External Call

A connection between a system user and a party on the public telephone network or on a tie trunk. Sometimes referred to as an outside call.

Facility (Physical)

A transmission channel to another switching system; to a Central Office, for example. By application, examples are:

•CO Trunks

.FX Trunks

.WATS Trunks

.OCC Trunks

.Tie Trunks.

By technical type these include loop start, ground start, DID, automatic ringdown, etc. These facilities may be accessed by their facility access codes (FACs).

Facility Restriction Level (FRL)

A restriction parameter associated with ARS. Determines whether a particular station can access a particular trunk.

Fast Busy Tone

See "ReorderTone."

Feature

A specifically defined function or service provided by the system.

Feature Button

A labeled button on a voice terminal or attendant console designating a specific feature.

Foreign Exchange (FX)

A central office other than the one providing local access to the public telephone network.

Foreign Exchange Trunk

A telecommunications channel that directly connects the system to a central office other than its local central office.

Foreign Numbering Plan Area (FNPA) Code

An area code other than the local area code. The FNPA code must be dialed to call outside the local numbering plan area.

Ground Start Trunk

On outgoing calls, System 25 transmits a request for service to the distant switching system by grounding the trunk ring lead. When the distant system is ready to receive the digits of the called number, that system grounds the trunk tip lead. When System 25 detects this ground, it removes the ground from the ring lead and the trunk is ready for service.

Home Numbering Plan Area (HNPA) Code

The local area code. Does not have to be dialed to call numbers within the local numbering plan area.

Immediate-Start Tie Trunk

After establishing a connection with the distant switching system for an outgoing call, the system waits a nominal 65 milliseconds before sending the digits of the called number. This allows time for the distant system to prepare to receive the digits. Similarly, on an incoming call, the system has 65 milliseconds to prepare to receive the digits.

Intercept Tone

On System 25, this tone is the same as Reorder Tone. Indicates a dialing error or denial of the service requested.

Interface

A common boundary between two systems or pieces of equipment.

Internal Call

A connection between two stations within the system. Sometimes called an inside or intercom call.

I-Use Lamp

A red lamp on a multiline voice terminal that lights to show which call appearance will be selected when the handset is lifted or which call appearance is active when a user is off-hook.

Loop Start Trunk

Simplest type of central office (CO) trunk. Calls are originated by providing a dc path between the tip and ring leads. The CO detects the *loop current* thus drawn and returns dial tone. Incoming calls are signaled by the CO placing an ac ringing voltage between the tip and ring leads. [The port circuit pack (CP) detects this signal.]

Modem

A device that modulates and demodulates signals transmitted over a communications path. Used to connect Data Terminal Equipment to the system's analog ports. The system (optionally) provides a 212A compatible conversion resource.

Modem Pooling

Provides shared-use conversion resources that eliminate the need for dedicated modems.

Multiline Voice Terminal

A terminal equipped with several call appearance buttons for the same extension number. Allows the user to handle more than one call at the same time.

Multiplexed

The simultaneous transmission of two or more signals over a common transmission medium.

Network

An arrangement of inter- and/or intra-location circuits designed to perform specific functions.

Network Interface

Provided by the telephone company in two forms:

(1) RJ21X for trunk facilities other than tie trunks.

(2) RJ2GX for tie trunk facilities.

Number Plan Area (NPA)

The area code.

Off-Premises Station (OPS)

An arrangement provided by the local telephone company which permits remote Terminal Equipment to operate as though it was directly connected to the system. This tariffed service can be provided only for FCC registered single-line voice terminals.

Out-Of-Building Station

Terminal Equipment directly connected to the system, but not located in the same building as the common equipment. Special arrangements are made to protect the system and its users from lightning, power line crosses, etc. Only single-line and 7300H series voice terminals may be so connected. (MET sets cannot be connected as Out-of-Building stations.)

Paging Trunk

A telecommunications channel used to access a paging system.

Peripheral Equipment

Equipment connected to one of the RS-232C channels on the Call Processor CP. Examples are the System Administration Terminal (SAT), SMDR Output device such as a Printer or a Call Accounting System, and Digital Tape Unit (DTU).

Personal Dial Code (PDC)

Voice terminal extension number.

Each system user is assigned a PDC and is allowed to "login" the PDC at any voice terminal in the system as they move about the premises. The PDC may be a 1-, 2-, 3-, or 4-digit number. There are two types of PDCs:

- •PDCs assigned to voice terminals—One is associated with each voice terminal in the system.
- •Floating—Assigned to visitors who will be moving about the premises. Floating PDCs may be associated with the attendant position or may be "logged in" by the user at any voice terminal. Calls to the floating PDC will ring at the terminal where "logged in."

Pickup Group

A group of individuals who can answer any incoming call within the group by dialing a code.

Port

An interface circuit between System 25 and associated trunks and terminals. Specifically:

.Terminal port (station port)

.Facility port (trunk port)

•Auxiliary equipment port.

Private Branch Exchange

A switching system that provides switched communications access among its terminals and facilities (for example, System 25).

Private Network

A network used exclusively for handling the telecommunications needs of a particular customer.

Private Network Office Code (RNX)

The first three digits of a 7-digit private network number. These codes are numbered 220 through 999, excluding any codes that have a 0 or 1 as the second digit.

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

The network that can be openly accessed by all customers for local or long-distance calling.

Queue

An ordered sequence of tasks to be processed.

Queuing

The process of holding calls in order of their arrival to await connection to an attendant, to a DGC group, or to an outgoing trunk. Calls are automatically connected in first-in, first-out sequence.

Random Access Memory (RAM)

A storage arrangement whereby information can be retrieved at a speed independent of the location of the stored information.

Read Only Memory (ROM)

A storage arrangement primarily for information retrieval applications.

Recall Dial Tone

Three short bursts of tone (confirmation tone) followed by steady dial tone; indicates the system has completed some action (such as holding a call) and is ready to accept dialing.

Redirection Criteria

The information administered for each voice terminal that determines when an incoming call is redirected to coverage.

Reorder Tone

A tone repeated 120 times a minute; indicates that at least one of the facilities, such as a trunk or a digit transmitter, required for the call is not available. Also called Fast Busy Tone.

Single-Line Voice Terminals

Single-line voice terminals served by a Tip Ring Line or Analog Line circuit pack (2500 series and 7101A voice terminals or industry standard Dual-Tone Multifrequency equivalent).

Software

A set of computer programs that accomplishes one or more tasks.

GLOSSARY _

Station

A place where terminal equipment is located or sometimes the terminal equipment itself. Each voice terminal (station) is assigned a station (extension) number. Users of the terminal are sometimes referred to as station users. Reference to the extension number is sometimes in the form PDC (Personal Dial Code) rather than station number. PDCs may be "logged in" at other stations. In most circumstances, PDCs and station numbers may be used interchangeably. Analogously, data stations are assigned DDCs (Data Dial Codes).

Station Interconnect Panel (SIP)

The station cross-connect field.

Station Message Detail Recording (SMDR)

Data output by System 25 that provides a record of each incoming and outgoing external call.

Status LED (lamp)

A green LED or lamp that shows the status of a call appearance or a feature button by the state of the lamp (lighted, flashing, fluttering, broken flutter, or dark).

Switch

The software-controlled communications processor complex that interprets dialing pulses/tones/keyboard characters and makes the proper interconnections both within the system and outside the system. The switch itself consists of a digital computer, software, storage device (memory), and associated circuit packs and special hardware necessary to perform the actual connections.

Switchhook

The button(s) on a voice terminal located under the receiver. A user typically goes "off-hook" to place or answer a call by picking up the receiver and goes "on-hook" (hangs up) to end a call.

System Administration Terminal (SAT)

RS-232C DTE peripheral equipment used to enter and change system translations.

System Administrator

A person responsible for specifying and administering features and services for the system.

System Restore

A process that allows stored data to be written from a tape into the system memory (normally after a cold start).

Terminal Equipment

Equipment used to change information (sound, keystrokes) into an electrical signal compatible with System 25's port circuits. (Voice and data terminals are the two primary types.)

Tie Trunk

A telecommunications channel that directly connects two private switching systems.

Time Division Multiplex Bus

A special bus that is time-shared by preallocating short time slots to each transmitter on a regular basis. In a PBX, all port circuits are connected to the time division multiplex bus permitting any port to send a signal to any other port.

Tone Ringer

A device with a speaker, used in electronic voice terminals to alert the user.

Translations

Specific information assigned to a terminal or to the system and customized for the user. Translations are entered and changed via the SAT.

Trunk

A telecommunications channel between two switching systems.

Trunk Access Equipment (TAE)

The cross-connect field for central office (CO)/network facilities.

Trunk Group

Telecommunications channels assigned as a group for certain functions.

Trunk Port

The hardware (circuit pack) providing an interface between the system and central office (CO)/network trunks.

Unit Load

A measurement used to evaluate a System 25 cabinet's power load capacity. Each System 25 cabinet can handle 80 unit loads of 48-volt power. One unit load equals 44mA.

Voice Terminal

A single-line or multiline voice instrument (that is, telephone). See "Terminal Equipment."

Wide Area Telecommunications Service (WATS)

A service that allows calls to a certain area or areas for a flat-rate charge based on expected usage.

Wink-Start Tie Trunk

After establishing a connection with a distant switching system for an outgoing call, the system waits for a momentary signal (wink) before sending the digits of the called number. Similarly, on an incoming call, the system sends the wink signal when ready to receive digits.

Write Operation

The process of putting information onto a storage medium such as magnetic tape.

800 Service

A service that allows incoming calls from a certain area or areas to an assigned number for a flat-rate charge based on usage.

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