SWITCHING SYSTEMS MANAGEMENT
NO. 3 ELECTRONIC SWITCHING SYSTEM
SYSTEM DESCRIPTION

CONTENTS

		PAGE
1.	GENERAL	2
	SYSTEM CHARACTERISTICS	2
	SYSTEM ORGANIZATION	3
2.	PHYSICAL DESCRIPTION	3
	CONTROL COMPLEX	3
	A. Processor Frame	3
	B. Maintenance Frame	4
	PERIPHERY	4
	A. Network Frame	4
	B. Control Frame	4
3.	FUNCTIONAL DESCRIPTION	4
	A. Control Complex	6
	B. Periphery	7
	C. Power	8
4.	STORED PROGRAM CONTROL	8
5.	STORED PROGRAM ORGANIZATION	9
	GENERAL	9
	BASE LEVEL LOOP AND INTERRUPT	9
6.	FUNCTIONAL PROGRAM DESCRIPTION	9
	OPERATIONAL	10
	A. Call Processing	10
	ADMINISTRATIVE	12
	A. Recent Change	12
	B. System Utilities	12
	C. Tape Loading	12
	D. Teletypewriter	13
	E. Data Link Software	13
	F. System Timing Functions	13
7.	ADMINISTRATION FACILITIES	13
8.	GROWTH	13
9.	COMPATIBILITY	14
10.	REFERENCES	14
11.	GLOSSARY	14
12.	ABBREVIATIONS	15

Figures

1.	System Control (SYC 0, SYC 1)	17
2.	Processor Frame	18
3.	Maintenance Frame	19
4.	Network Frame	20

CONTENTS PAGE

5. No. 3 ESS Topology 21
6. No. 3 ESS Block Diagram 22
7. No. 3 ESS TTY Plan 23
8. System Status Panel 25
9. Trunk and Line Test Panel 27
10. Base Level 28
11. Interrupt Level 28
12. No. 3 ESS Programs 29
13. Typical Intraoffice Call Connection . . 30
14. Typical Interoffice Call Connection . . 31
15. MF Incoming Call Connections 32
16. Dial Pulse Incoming Call Connections . 33

Tables

A. No. 3 ESS General Features . . . 34
B. No. 3 ESS Line Features 35
C. No. 3 ESS Trunk Features . . . 37
D. No. 3 ESS Routing Features . . . 37
E. No. 3 ESS Miscellaneous Features . 38
F. Universal Trunk Circuits 39
G. Growth Requirements 40
H. Compatibility Chart 42

1. GENERAL

1.01 This section describes the physical and functional characteristics of the No. 3 Electronic Switching System (ESS).

1.02 When this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which the figure is referenced.

SYSTEM CHARACTERISTICS

1.04 The No. 3 ESS is an electronic community dial office (CDO) that has been developed to offer modern telephone service to small communities. It is capable of serving from several hundred to approximately 4500 lines.

1.05 The No. 3 ESS uses stored program control to offer service and maintenance features that either are not available or are not economically feasible in electromechanical machines of similar size. The extensive use of new devices and technology has resulted in a system requiring much less building space than any machine of comparable switching capacity.

1.06 This system was designed primarily for the unattended CDO market and, as a result, offers the advantage of remote maintenance and administrative tasks. These include such items as:

(a) Accessing, testing, and exercising the system

(b) Removing equipment from service

(c) Making class of service and directory number assignment.

1.07 Other advantages of the No. 3 ESS include the short time interval between order due date and service date and simplified telephone company engineering and growth procedures.

1.08 Six switching frame designs are common to every office and are completely assembled, interconnected, and system tested at the factory with the actual program and office parameters. The line engineering effort for the No. 3 ESS has been minimized by reduction of the number of choices available and by modular design of all growth equipment. The use of a fixed floor plan eliminates the engineering of frame location, cable racks, and cabling. The modular design of the network frames provides network, associated control, trunks, and service equipment in one package with no options except for plug-in trunks and service circuits.

SYSTEM ORGANIZATION

1.09 Functionally, the No. 3 ESS consists of the following major equipment areas:

(a) Control complex

(b) Periphery

(c) Power equipment.

1.10 The ***control complex*** consists of the equipment necessary to access the system for administration, operation (call processing), and maintenance. It is the area where the craft/machine interface functions are accomplished.

1.11 The ***periphery*** consists of necessary equipment as selected by the control complex to switch calls through the office and to perform related functions. Upon command from the control complex, the periphery performs tasks such as scanning customer lines, selecting paths through the office, and changing state relays.

1.12 The ***power equipment*** consists of the rectifiers, converters, inverters, fuses, and controls necessary to supply all office power requirements. Ringing and tone requirements will also be identified in the power area.

1.13 The functional areas are interrelated to provide two systems, each capable of assuming total office operations instantaneously. The system control (SYC) 0 or 1 consists of a control unit (CU) and associated controllers located in the periphery (Fig. 1). The CU consists of the 3A central control (3ACC), main store memory (MAS), and the system status panel (SSP). The controllers located in the periphery include the frame input/output controller (FIOC), the scanner controller, the network controller, and the peripheral pulse distributor (PPD). Power requirements are fulfilled without regard to which SYC has control of the office.

1.14 Each SYC is switched as a unit since the supporting components assigned to each SYC cannot be interchanged. It should be noted, however, that the on-line SYC has the responsibility to update the standby SYC memory. There are two equipment units, duplicated, which support both SYCs but are not specifically assigned to either SYC:

(a) Teletypewriter controllers 0 and 1

(b) Tape data controllers (TDCs) 0 and 1.

1.15 Comprehensive feature lists (Tables A through E) include TOUCH-TONE® and automatic number identification (ANI) over a full range of line sizes. ANI will be provided to a distant centralized automatic message accounting (CAMA) office, and message rate service will feature storage of message units in memory. Tandem switching is provided under the following conditions:

(a) Connect-through from one class 5 office to another class 5 office

(b) No intertoll or CAMA features.

2. PHYSICAL DESCRIPTION

2.01 Six switching frame designs are common to every office and are completely assembled, interconnected, and system tested at the factory.

CONTROL COMPLEX

2.02 The control complex consists of units which direct and control the operation and functions of the system. It provides the storage and processing units as well as the interface between maintenance personnel and the system.

2.03 The control complex issues commands and other information needed by the peripheral equipment to establish the talking path between a calling party and a called party. The control complex not only issues the orders but also ensures that they are executed in a timely and accurate manner. If a trouble occurs, the control complex becomes aware of it via automatic trouble detection and initiates automatic recovery actions, either major or minor.

A. Processor Frame

2.04 The processor frame (Fig. 2) is a double-bay frame provided on a one-per-office basis. This frame contains the duplicated 3ACCs and MASs. It also contains the necessary power converters, filters, and fusing for this equipment.

B. Maintenance Frame

2.05 The maintenance frame (Fig. 3) is a single-bay frame provided on a one-per-office basis. This frame houses the one optional teletypewriter (TTY), system status panel (SSP), tape units, and associated controllers for each of these units. Each of the two teletypewriter controller units (0 and 1) provided on the maintenance frame has space to equip two independent teletypewriter controllers (TTYCs); however, in the No. 3 ESS, only one TTYC will be used in each teletypewriter controller unit. Each TTYC provides four ports. The maintenance frame also contains the necessary power converters, filters, and fusing for this equipment.

PERIPHERY

A. Network Frame

2.06 Each network frame (Fig. 4) provides the first- and second-stage remreed switches for 384 terminals, 32 junctor circuits, 24 universal trunks, 4 customer dial pulse receivers, 3 regular ringing circuits, and some associated control and power equipment. Since neither optional units nor wiring (except for ground start, loop start option) is required on the network frame, the only variation between frames is the quantity and type of circuit packs for trunk and service circuits. There are 512 ferrod sensors located on this frame for the line scanner. The first and second stages of the network are connectorized to facilitate repair and are organized to minimize interruption of service during repair. The trunk units are universally wired to accept the most commonly used trunk circuits. A total of 15 network frames may be provided.

2.07 The switching network is constructed of concentrator groups. Associated with each network frame is one concentrator group which accommodates 384 terminals. A full-size office consists of 15 concentrator groups capable of handling approximately 4500 customer lines.

2.08 The concentrator group is made up of two concentrators, and there are 192 terminals associated with each concentrator. Within each concentrator are first- and second-stage remreed switches. There are twenty-four 8-by-8 first-stage remreed switches and eight 8-by-8 second-stage switches per concentrator (Fig. 5). The first and second stages of switches are connected by "A-links" which represent access paths.

First-Stage Switching

2.09 The first stage of switching concentrates the 192 input terminations to 64 outputs in each concentrator. (The output of each concentrator is multipled to the other concentrator in the concentrator group to provide a 6-to-1 concentration ratio.) The 64 outputs are connected to the second stage so that each of the single 8-by-8 switches in the first stage has access to each of the second-stage 8-by-8 switches.

Second-Stage Switching

2.10 Eight 8-by-8 switches are used in each second-stage concentrator. This arrangement provides 64 inputs and 64 outputs for the second stage associated with a concentrator. The two second-stage outputs per concentrator group are connected together to maintain the fixed 6-to-1 concentration ratio per concentrator group.

Junctor Circuit

2.11 Thirty-two junctors are necessary for each concentrator group. The junctor is electrically located between the second and third stages of switching. The junctor provides seven states and is used in all connections between terminals. The states are as follows:

(a) Bypass state

(b) Open state

(c) Line-to-line state

(d) Line-to-trunk state

(e) Trunk-to-line state

(f) Audible ring state

(g) Overflow tone state.

Line Scanner Array

2.12 The line scanner array, which indicates status to the 3ACC, is wired to service, trunk, line, and junctor circuits and the switching network. The scanner array uses ferrod sensors to detect

the circuit states. The array consists of 16 columns and 32 rows, and 16 ferrod sensors are associated with each row. There are 512 ferrod sensors located on each network frame. The arrangement of the three types of ferrod sensors constitutes one scanner array.

Service, Auxiliary Line, Universal Trunk, and Test Circuits

Service Circuits

2.13 The following special-function service circuit types are required for the initial features provided by the No. 3 ESS:

(a) A customer dial pulse receiver receives dial pulses and serves as an interface to a TOUCH-TONE receiver when TOUCH-TONE service is provided.

(b) A TOUCH-TONE detector circuit and a customer dial pulse receiver are used together to detect TOUCH-TONE frequencies or dial pulses.

(c) A superimposed ringing circuit provides ringing to 4-party full-select, 8-party semiselect, and 8-party coded lines. It is also used for revertive ringing and operator ringback.

(d) A regular ringing circuit type is used to ring individual, coin, revertive, PBX, 2-party, and 4-party semiselect lines.

(e) A dial pulse transmitter sends dial pulses to a distant office.

(f) A coin control circuit is used to collect or return coins and to make initial and overtime deposit checks.

(g) Tone circuits provide an interface between the ringing/tone plant and the network for high tone, low tone, receiver off-hook tone, and custom calling service tones.

(h) A multifrequency (MF) receiver circuit detects MF signals.

(i) An MF transmitter circuit is used to transmit MF pulsing.

Line Circuits

2.14 There are six special-purpose auxiliary line circuit types which can be used in the No. 3 ESS.

(a) ***Emergency Manual Line Circuit:*** This circuit is used to provide manual service to certain customers when a service-affecting equipment failure exists.

(b) ***Public Emergency Line Circuit:*** This circuit is used to terminate up to ten different simultaneous calls to a public emergency line (e.g., fire department) and ring the station or stations on this line.

(c) ***Group Alerting Line Circuit:*** This circuit provides means, independent of the switching network, to alert a special group of customers (fire departments, etc.) over regular message telephone lines.

(d) ***Emergency Line Circuit:*** This circuit is used to allow operators to complete direct emergency calls (independent of the switching machine) to police, fire, or other emergency lines.

(e) ***Noise Immunity Line Circuit:*** The noise immunity line circuit is used when excessive environmental noise is present which exceeds the operating characteristics provided by the normal line sensor. This circuit can also provide for additional ground start lines when necessary.

(f) ***Distributor Applique Circuits:*** The auxiliary line sleeve circuit is used with common system circuits which require a sleeve lead. The hotel-motel line circuit permits message register operation for a hotel or motel.

Universal Trunk Circuits

2.15 Table F lists the universal trunk circuits offered by the No. 3 ESS and their applications according to pulsing, signaling, and class. Any of these may be plugged into any position of the universal trunk unit in the network, control, or miscellaneous frames.

Test Circuits

2.16 The following test circuits are provided to make periodic tests (under software control) on critical hardware circuits:

(a) Continuity and polarity test circuit

(b) Station ringer test line circuit

(c) Transmission test environment

(d) Transmission environment test circuit

(e) Dial pulse receiver test circuit

(f) TOUCH-TONE receiver test circuit

(g) Tone presence detector

(h) Loop environment test circuit

(i) Test vertical test circuit

(j) Line insulation test circuit.

B. Control Frame

2.17 The control frame is a double-bay frame. It houses the duplicated peripheral controllers with the associated +3 volt power converters and the basic third stage of the network. The network third stage is also connectorized to facilitate repair and expansion. The remaining space on the frame is used for master scanner ferrod sensors and trunk, service circuit, and miscellaneous circuit equipment which is provided according to individual office needs. The initial control frame (0) is equipped to accommodate the first seven network frames. A second control frame (1) is required to accommodate network frames 8 through 15. This frame houses the additional peripheral controllers, +3 volt power converters, and the switches required for expanding the third network stage.

Third-Stage Switching

2.18 The third stage of remreed switching consists of thirty-two 8-by-8 switches. One-half of the outputs (of a concentrator group) are distributed (one each) to the inputs of the 32 third-stage switches. The other half of the outputs are connected, via circuit junctors, to the output of the third-stage switch. This arrangement allows the third stage to accommodate, without link rearrangement, up to seven concentrator groups or 2688 terminals. "B-links" or access paths connect the second and third stages of switching. There are wire B-links and circuit B-links.

2.19 Wire B-links are the connections from the output of the second-stage switch to the input of the third-stage switch.

2.20 Circuit B-links provide a junctor circuit between the second and third stages of switching.

3. FUNCTIONAL DESCRIPTION

3.01 The relationships among the control complex subsystem, periphery, and power equipment provide the basis for the overall No. 3 ESS functional description. A block diagram for No. 3 ESS is provided in Fig. 6.

A. Control Complex

3.02 The control complex serves in an executive (or administrative control) capacity, directing all system functions to process and handle data for the No. 3 ESS.

3A Central Control

3.03 The 3ACC is a 16-bit (plus two parity bits) data processor.

3.04 In the No. 3 ESS, the 3ACC operates in a duplex mode; i.e., one 3ACC always has active control over the system while the other 3ACC operates in a standby mode. Each 3ACC and its associated memory form part of a single switchable entity (SYC). Therefore, each 3ACC is a separate and complete unit capable of controlling the periphery and system actions. The on-line 3ACC keeps both the on-line and standby main store memories up to date. The standby 3ACC can assume control of system tasks as required.

Main Store Memory

3.05 The MAS contains the call records, translation data, and system program. The MAS is electrically alterable, and memory contents can be changed by accessing it via the maintenance TTY. Recent change (RC) messages are used to alter the memory when there are subscriber changes,

trunk additions, additions of new routes, service observing, or change in office code treatment.

Tape Data Controller and Tape

3.06 Each 3ACC has its own preferred cartridge tape system and may access the other cartridge tape system under normal operating conditions. Each tape unit contains all the programs, parameters, and translation data which reside in the MAS. It also contains other programs vital to the No. 3 ESS which are infrequently used. These programs are referred to as nonresident (since they are stored external to the MAS) and include diagnostics, service programs, etc. The most important function of the tape unit is to serve as the backup unit for the MAS.

Teletypewriter and Teletype Controller

3.07 The TTY is the primary means of man-machine communication with the system. The TTY will print out test results, trouble records, and diagnostic results. The maintenance TTY can be used for requesting tests, diagnostics, removal of equipment from service, and directory number assignments.

3.08 Two TTYCs, 0 and 2, are accessible by the on-line 3ACC (Fig. 7). Each TTYC unit has space to equip two independent teletypewriter controllers. Each controller provides four ports. No. 3 ESS utilizes one teletypewriter controller in each TTYC unit. One TTYC is designated as the maintenance unit (0) and the other TTYC as the miscellaneous unit (1).

Maintenance TTYC

3.09 Each of four ports of the maintenance TTYC is dedicated to a particular user (Fig. 7). One port is used by a local maintenance TTY. The remaining three ports can be associated with up to three remote maintenance TTYs. The local and remote maintenance TTYs will receive the same messages from the system.

Miscellaneous TTYC

3.10 The miscellaneous TTYC also provides four ports (Fig. 7). These ports are recommended for administrative functions. The miscellaneous controller provides for direct distance dialing (DDD) data link access for one or more centralized TTYs and is used for service/circuit orders or traffic measurements. The miscellaneous units will be redirected for priority maintenance should the maintenance unit become inoperative.

System Status Panel

3.11 The system status panel (SSP) which is mounted on the maintenance frame provides indications of normal as well as emergency and alarm conditions (Fig. 8). The SSP provides designated keys to implement system emergency manual control as well as keys for test control, alarm control, and panel power.

3.12 Visual indications are provided on the SSP to relate instantaneous system status. The types of indications include SYC status, other equipment status, equipment troubles, and power failures.

B. Periphery

Frame Input/Output Controller

3.13 The 3ACC controls the entire periphery over 6.67-megabit serial input/output (I/O) channel. The frame input/output controller (FIOC) serves as an interface between the 3ACC and the peripheral controllers (network, scanner, and peripheral pulse distributor). It converts information between serial and parallel forms (depending on the direction of flow) and gates the data to and from the peripheral controllers. The FIOC, as well as the peripheral controllers, is duplicated for reliability. Each 3ACC has a dedicated FIOC which can communicate with its associated peripheral controllers.

Network Controller

3.14 A network order is sent to the network controllers from the 3ACC via the FIOCs. The network controller directs current pulses to selected network crosspoints to establish paths through the network. Verification of proper access pulsing is returned to the 3ACC via the FIOC and the I/O subchannel.

3.15 The network, network access, and network controller circuit interconnects lines, junctors, and service circuits as directed by the 3ACC. The network controller also operates and releases the line cutoff and test vertical switches associated with the network. When a network order has been

sent and the access enabled, the network controller and the network pulser validate the selected network path. If all tests pass, a start signal is sent to the network pulser which generates a pulse to be sent through the control terminals of the designated remreed switches.

Scanner Controller

3.16 The scanner permits the processor to monitor the status of the system. The scanner controller receives address information via the FIOC from the 3ACC for a designated scan row to be interrogated. The interrogation results are sent back to the 3ACC via the FIOC.

3.17 The scanners are used to detect the on-hook status and off-hook status of a customer line, to check the status of talking paths for flash and disconnect, to monitor certain test points in various frames, and to scan other miscellaneous points about which information is described.

3.18 There are two designated types of scanners which are labeled line scanners and master scanners. The line scanners are used for scanning the line attending elements and provide the supervision function in junctors, trunks, and service circuits. The master scanner monitors some service circuits, maintenance circuits, alarm circuits, and some trunks.

Peripheral Pulse Distributor and Peripheral Decoder

3.19 The peripheral decoder (PD) controls peripheral circuit relays (service, trunk, line, and test circuits) as determined by the 3ACC. The 3ACC sends information via the FIOC to the PPD. The PPD controller receives information from the FIOC and directs it to the transformer matrix of the PPD. The PPD can access many PDs and determines which one is to be accessed. The specified PD accepts the information from the PPD in its shift register. The information in the shift register determines which group of three flip-flops in the PD is to receive the information. The activated flip-flops then pass the information to amplifiers which drive up to three relays in the peripheral circuitry.

Trunk and Line Test Panel

3.20 The trunk and line test panel (TLTP) is located on the test frame which is also part of the periphery (Fig. 9). The TLTP has the capability to access all trunks, lines, service circuits, and most test circuits by use of panel-mounted controls in conjunction with off-line software.

3.21 Two access trunks are used by the TLTP. The trunks have appearances at the switching network. Trunks, lines, and test and service circuits may be taken out of service or put into service from the TLTP.

3.22 A voltmeter is mounted on the TLTP. Also, jacks are provided for connecting external test equipment to the access trunks. The TLTP is used in conjunction with other maintenance equipment to perform transmission and operational tests on trunks and lines and provides access to any line terminated in the No. 3 ESS.

C. Power

3.23 A 151A power plant is used to supply -48 volt power directly to the equipment frames. Power distribution feeders are run between the power frames and the fuse panels in the equipment frames. When other voltages are needed, converters on the equipment frames and miscellaneous power frame change the -48 volts to the voltage necessary in order to operate various components on the frame or, in the case of the miscellaneous power frame, to other frames.

4. STORED PROGRAM CONTROL

4.01 The No. 3 ESS performs the functions of a central office under the control of a stored program acting through data processing, input/output, and 2-wire switching equipment. Virtually all actions of the systems are determined by sequences of instructions coded and stored in memory. This data is grouped into functional categories called programs which contain all the data necessary to control the performance of a specific task. These programs consist of combinations of precisely defined instructions which are read from memory and transmitted one at a time to the central processor for execution via microprogrammed circuitry. The stored program makes use of stored data (office data) which contains information pertaining to customer lines, routing, charging, etc. To alter system operation, most changes can be made only to the stored program or office data rather than to hardware or wiring.

4.02 The microcode of the 3ACC processor is the stored sequence of control functions necessary for the operation of the system. It is comparable to the command functions in normal data processing machines. Because of its major importance, it is stored in read-only memory (ROM). Code changes involve replacing circuit packs with no alteration to back plane wiring.

4.03 Microcode executes its own set of instructions and, in addition, controls interrupt processing, the front panel functions of the 3ACC, and a certain amount of recovery code including bootstrap. It provides a memory checking sequence utilizing a cycle time of 150 ns.

5. STORED PROGRAM ORGANIZATION

GENERAL

5.01 The No. 3 ESS stored program is comprised of the common systems division and the applications division. The common systems division consists of programs used by any ESS equipped with a 3ACC. The applications division consists of programs written to perform tasks specifically for the No. 3 ESS.

5.02 Stored programs are either resident or nonresident.

- The resident programs are stored in the write protected portion of the main store memory of the 3ACC processor. These programs include all of the call processing programs and some of the administrative and maintenance programs (fault detection, recovery programs).

- The nonresident programs are stored on magnetic tape and are transferred to the main store as required. The remaining administrative (e.g., traffic data, most recent change programs) and maintenance programs which are not used for the normal operation of the system are brought in upon request from the tape as required. The tape includes a backup of all main store data which is necessary for recovery purposes and essential information used in conjunction with the trouble locating manual (TLM).

5.03 Subroutines are used extensively to provide for efficient use of main storage. The subroutine is a short program which performs a specific task as requested by another program. Control is passed by the requesting program/subroutine to the called program (subroutine) until completion, at which time control is returned and normal processing continues.

BASE LEVEL LOOP AND INTERRUPT

5.04 The base level loop is a set of major programs which are executed sequentially at approximately 100-ms intervals. It includes most call processing programs and those maintenance tasks which can be deferred or are of low priority and called at the end of the normal call processing loop. All base level tasks are scheduled by the base level monitor program which also determines the additional tasks to be performed after the normal call processing scan (Fig. 10).

5.05 There are two types of interrupt level programs which break into the base level loop. After the interrupt level has completed its allocated work, control is returned to the base level loop.

- The first interrupt occurs on a periodic timed basis every 10 ms. It is hardware-initiated and includes such call processing functions as immediate start trunk scanning, digit receiving, and outpulsing (Fig. 11).

- The second type of interrupt occurs upon demand when a fault or difficulty of high priority is discovered. It is initiated by mismatches between the on-line and off-line call stores, by some peripheral unit and I/O errors, or by manual request (e.g., TTY). When a demand interrupt occurs, the trouble recovery programs are immediately initiated. Following appropriate recovery actions, the problem is passed for further resolution to the lowest priority base level maintenance programs. After the interrupt level has completed its allocated functions, control is returned to the base level loop.

6. FUNCTIONAL PROGRAM DESCRIPTION

6.01 The No. 3 ESS programs are functionally identified by the following categories (Fig. 12):

- Operational

- Administrative
- Maintenance.

OPERATIONAL

6.02 The operational software includes the functions which control the processing of office traffic under normal operating conditions.

A. Call Processing

Memory Areas

6.03 The call processing software uses allocated blocks of storage to retain data associated with the junctors and lines during the call interval. Three of the storage blocks used in the description of basic call processing are as follows.

(a) ***Terminal Memory Record (TMR):*** The TMR is a fixed 3-word block of storage assigned to each junctor. For stable calls, the scan point numbers (SPNs) of the calling and called parties are stored. For calls in the process of connection or disconnection (transient stage), the assigned transient call record and SPN of the connected circuits are stored.

(b) ***Transient Call Record (TCR):*** The TCR is a 16-word block of storage assigned to calls in the transient state to store the state of the call, collect and send digits, record assigned service circuits, identify whether a task is at base level or interrupt level, and store progress marks which identify sections of code to perform certain functions.

(c) ***Input Hoppers:*** These are used to retain changes in the stages of line trunks, junctors, and service circuits until the data is used by the software.

Basic Call Processing

6.04 A generalized explanation of the functional sequences of the software involved in intraoffice, interoffice, and incoming calls is as follows. Outgoing calls are included in the description of interoffice calls. The first five functions performed for the intraoffice and interoffice calls are the same.

(a) ***Scanning:*** The call is initiated by the originating subscriber going off-hook and thereby activating a line dedicated equipment device called a line ferrod sensor. The input monitor invokes the line scanning program to order the interrogation of the ferrod sensors. Changes (which denote origination) are reported to the monitor via entries in the line origination hopper.

(b) ***Input Monitor:*** Once every base level loop, the input monitor searches the hopper for input. If any input is detected, the monitor selects a TCR to record the progress of the call and distributes the valid service requests accordingly.

(c) ***Dial Tone:*** The dial tone routine is invoked upon receiving a valid service request. A customer digit pulse receiver (CDPR) is selected and placed in the dial tone state as directed by the processor. A path through the network from the line to the CDPR via junctor A (Fig. 13) is selected and connected. Supervision is maintained in the CDPR at this time. An interrupt progress mark is entered in the TCR to indicate that digit-receiving functions are required during the next timed interrupt. Dial tone is removed as the first dialed digit is detected.

(d) ***Digit Collection:*** At timed interrupt, the dial pulses detected by the CDPR are counted, or tones are translated into digits and recorded in the specific TCR via the digit collection software. The signal digit, as supplied by the digit interpretation program, indicates the number of digits required for further translation. When all necessary digits are received, the collection program alerts base level via a progress mark in order that translation can proceed.

(e) ***Data Interpretation:*** As the digits are received, the data interpretation program calls various translation routines to determine the type of calls. Once established, the call is routed via a route index to the proper call handling routine, i.e., the terminating program for an intraoffice call or the outgoing call handling program for an interoffice call.

6.05 The functions which are necessary to complete both intraoffice and interoffice calls differentiate at this point in the sequence. Specific information

as to how they differ is given in (a) through (c) below.

(a) ***Intraoffice Call:*** Terminating translation is performed on the number dialed to determine the terminal equipment number (TEN) and terminating treatment (Fig. 13). Tests are performed to establish if the called line is idle and the type of ringing required.

(1) ***Ringing Connection:*** If the called line is busy, a tone circuit supplying line busy tone to the calling party via a selected junctor is placed in its line-to-line state. If the called line is determined to be idle (based upon line-busy status information in the MAS), a connection is established between the called line and a ringing circuit via junctor B, and the talking path is reserved. Audible ringing tone is applied to the calling line through the junctor TALK. Every 100 ms, the ringing circuit is scanned for off-hook or answer, and the junctor is scanned for on-hook or abandonment.

(2) ***Talking Connection:*** The ringing circuit is released, and the remaining part of the previously reserved talking path is established through the junctor TALK when the called line answers. The TCR is idled, and the TMR maintains a record of the call during the talking state. During talking, the junctor TALK is scanned every 100 ms for supervision. Verification for a true on-hook is made when a change in state is detected which starts talk-off timing (150 ms).

(3) ***Disconnect:*** Once an on-hook condition is determined, the disconnect program initiates a timed interval on the line, depending upon the party which goes on-hook first. Releasing the talking path, junctor, and TMR and returning supervision to the normal line scan (line ferrod) complete the call.

(b) ***Outgoing Interoffice Call:*** Translation information provides the number of digits expected and route index information, i.e., the outgoing trunk group number and digit prefixing and deletion actions (if required), type of transmitter, alternate route index, and any required special options. Figure 14 shows a typical interoffice call connection. The dial connection is similar to an intraoffice call. With this information, the calling line continues to be supervised from the CDPR.

(1) ***Ringing Connection:*** An idle outgoing trunk and transmitter are selected. A network path between the transmitter and trunk circuit is established, and a network path between the calling line and trunk circuit is reserved. The idle transmitter is connected through a junctor (B) to the outgoing trunk. Specific checks in continuity and polarity are made, and a seizure signal is sent to the distant office. Outpulsing under control of the distant office is begun with verification of correct polarity. Upon completion of outpulsing, the transmitter is released, and supervision toward the distant office is transferred from the transmitter to the trunk circuit. A connection is established using the reserved path between the calling line and trunk circuit. Ringing is applied in the distant office; audible ringing is returned to the local office. Every 100 ms, the trunk is scanned via the scanner associated with the trunk for answer (off-hook), and the calling line is scanned via the junctor TALK for possible abandonment (on-hook).

(2) ***Talking Connection:*** When the called line answers, the change in supervision from the distant office (via the trunk) is recognized.

(3) ***Disconnect:*** A similar disconnect and timing function as described for intraoffice calls is used for the calling party.

(c) ***Incoming Call:*** Incoming end office terminating calls are handled as follows:

(1) ***Scanning:*** Incoming calls are detected by the scanning of incoming trunks which can be divided into two categories: immediate start (bylink) and operator trunks (of which one-fourth are scanned at each timed interrupt) and all other trunks (scanned at base level under the control of the input monitor). All inputs including immediate start are reported to the input monitor via an entry in a hopper.

(2) ***Input Monitor:*** The input monitor distributes the necessary tasks to the appropriate processing routines.

(3) ***Initial Translation:*** Upon detecting a seizure of an incoming trunk, the input monitor invokes a program to retrieve the trunk SPN and to select a TCR. An initial translation provides trunk class information, whether or not a receiver is to be used, the type of supervisory signals required, how the call is to be handled, and the number of digits to be received which is stored in the TCR. The 3ACC proceeds by selecting an idle MF receiver (if MF tones are being sent) and establishing the network path between the trunk circuit and the receiver (Fig. 15). If dial pulses (DPs) are being sent, a receiver is not needed. The DPs are detected at the trunk circuit (Fig. 16).

(4) ***Digit Receiving:*** Digit collection for an incoming (wink) trunk is performed via the actual counting of dial pulses at the trunk ferrod sensor. No receiver or network path is seized. Incoming (delay or wink) trunks are connected to an MF receiver where the tones are received. The junctor is put in the bypass state, and supervision of the trunk is maintained via the MF receiver. A start dial signal is transmitted to the distant office which, in turn, transmits four or more digits of the called line directory number. The tones are then decoded, and the digits are collected in the TCR.

(5) ***Final Translation:*** Final translation is performed in two parts after all digits have been received and are recorded in the main store memory.

- The digits are interpreted until sufficient information is derived to identify the call as a terminating call.

- Translation is performed to determine the terminal equipment number and the terminating class of service of the called directory number.

The ringing and talking connections for MF calls follow the same sequence of events as in an intraoffice call. When DP calls are detected, no initial junctor is required to help provide the necessary states to establish a talking network path. The two junctors necessary provide ringing, audible, overflow, and trunk-to-line connections in the same manner as previously described for MF calls.

(b) ***Disconnect:*** If the distant end has disconnected first, the trunk is made available for reseizure, and a time-release period of 10 seconds is started. During this time, the called line is being scanned at the line sensor element every 100 ms (base level) for on-hook. Should the trunk be reseized during this time period, the connection to the previously called line would be released; and if after the timed-release period the called line remains off-hook, the off-hook line is treated as a new origination. If the called line disconnects first, the on-hook is transmitted to the distant office.

ADMINISTRATIVE

6.06 The administrative software handles the functions which are related to office operations such as an automatic means for changing office parameters and initiating service orders.

A. Recent Change

6.07 The nonresident programs handle any data changes within the system, such as the assignment of new telephone numbers via scan point number translation. They utilize office data administration data and input messages which define office data specified by the operating companies, thereby interfacing with call processing. They have the capabilities for verifying, packing, reallocating, updating, and retrieving data.

B. System Utilities

6.08 The system utilities programs are common systems which provide the craft with "software analysis tools" to find and/or correct problems in the hardware or software of the system. The functions of these programs, performed at base level or interrupt, are manually requested via the TTY. They provide certain functions which include the capabilities for monitoring, dumping, and loading specific locations of store. Also included are an overwrite and a tape utility which manipulates the tape unit.

C. Tape Loading

6.09 The programs which are not required for immediate control of system efforts are

stored on magnetic tape. These programs are segmented into a treelike structure made up of several levels.

6.10 Bootstrap provides an absolute reload of all memory only from the 3ACC preferred cartridge tape system. It is a sophisticated, selective, partial reload of only the memory which has been destroyed. It is a microprogram initiated loader with three major segments. The first brings in enough of the loader to continue with a more reliable error checking loader; a second, in turn, loads in a more sophisticated system loader and its associated programs. A third more sophisticated loader handles selective reloading of the 3ACC system by interaction with the 3ACC initialization programs.

D. Teletypewriter

6.11 Primary communication with the No. 3 ESS is conducted via the TTY. This communication consists of maintenance messages and commands, entering and updating of office translation data and diagnostic messages, and exercising administrative system control.

6.12 The software employed to serve the TTY devices may be either resident or nonresident, common systems or application. All TTY devices operate under the control of the TTY handler program which acts as a software driver between the TTY hardware controller and application message processing.

6.13 Embedded in the associated TTY programs are program-initiated fault handling routines which continually check the validity of the TTY input/output transmissions. When an indication of character mishandling or some other malfunction is detected, these routines will take corrective and system self-protection actions, including removing from service and isolating malfunctioning TTY controllers and ports.

E. Data Link Software

6.14 The data link software is used to transmit and/or receive memory information from a remote location via the administrative data link (ADL) circuit. The information passed between the ADL and the remote location can be used in a variety of ways. If the information is translation information, the regional center can use it to repack the translation to make better use of the available memory and/or to insert growth information. The information may also be used to generate new office records. The repacking of translation is called an office data assembler update.

F. System Timing Functions

6.15 The programs associated with system timing functions maintain the software clock by incrementing seconds and minutes when necessary and by updating unprotected words in main store. These words initiate time periodic functions based upon predetermined timing tables, i.e., an hour table which identifies the routine to be performed at a specific hour of the day.

7. ADMINISTRATIVE FACILITIES

7.01 The miscellaneous TTYC is associated with the administrative functions and can be used with a repair service bureau TTY. The administrative plan specifies a dial-up TTY channel for:

(1) Service assignments and changes

(2) Traffic measurements.

One TTY port is connected to the switching network via a data set to administer the dial-up situations.

7.02 Traffic data printouts are programmed to occur at regular intervals, reporting peg counts and usage records concerning the frequency of use and loading conditions of equipment. These printouts indicate necessary equipment adjustments to meet traffic conditions.

8. GROWTH

8.01 A substantial degree of flexibility is provided for growth considerations. The relationships between office terminal capacity and associated hardware and software additions are indicated in Table G.

8.02 The network frame is the main growth entity since it provides most of the equipment necessary for each increment of network growth. Each network frame provides for 384 terminals. The third-stage switch provided on the initial control frame (0) can accommodate up to seven network frames or 2688 terminals.

8.03 The addition of the eighth network frame requires an expansion of the third-stage switch. An additional control frame (1) must be provided and will house the third-stage extension switches. Also, additional extension switches must be added to the existing third-stage switch located in control frame 0. Table G indicates peripheral controller requirements which will be housed on control frame 1.

8.04 Initially, the third stage of switching is equipped to accommodate 2688 input terminals. When additional capacity is required, the third stage must be built out with extension switches. This third-stage network is expanded from an 8-by-8 configuration to a 16-by-16 configuration.

8.05 The only variation between network frames will be the quantity and type of circuit packs for trunks and service circuits. The trunk units are universally wired to accept the most commonly used trunk circuits. No junctor rearrangement is required since a fixed 6-to-1 concentration ratio is provided.

9. COMPATIBILITY

9.01 A summary of requirements for switching, test, and intercept systems to communicate with No. 3 ESS is provided in Table H. Detailed information on the circuits actually used to provide compatibility and the restrictions on the type of circuit used are provided in the No. 3 ESS AT&T Engineering Letter.

10. REFERENCES

10.01 For additional descriptive and maintenance information on the No. 3 ESS equipment, refer to the Bell System Practices Numerical Index, Section 233-000-000. Section 233-000-010 contains information on the documentation scheme adopted for No. 3 ESS.

11. GLOSSARY

11.01 A glossary of terms is provided to aid in the understanding of definitive words used in this section.

3ACC The combination of logic, microstore, and I/O channel which is primarily utilized to interpret and act upon information read from the MAS or from external stimuli through the interrupt mechanism.

Concentration Group A 384-terminal portion of the network which comprises the first two stages of switching, contains two concentrators, and is packaged on one network frame.

Control Complex That equipment located in the No. 3 ESS office required to provide control and maintenance of that office.

Control Unit (CU) The combination of 3ACC, main store, power, store buses, and the system status and control panel.

Direct Distance Dialing (DDD) Toll service which permits customers to dial their own long-distance calls.

Duplication Providing two of the same units in vital areas to maintain call handling capabilities if a problem occurs with one of the units.

Fault A condition which causes a device, a component, or an element to fail to perform in a required manner.

Ferrod Sensor A current sensing device used in scanners for supervisory and other purposes.

Ground Start Signaling method which uses a ground connected to the ring lead to saturate a line sensor when an off-hook condition exists.

Input Message Manual (IM) A listing of TTY input codes understood by the system and used to inform the system that it must perform a specific task.

Interoffice Call A call switched between different central offices to complete a talking path.

Intraoffice Call Communication link provided within a central office between subscribers assigned to same local central office.

Junctor A circuit associated with the switching network which provides a path for a call through the network.

Line Any connection to a network terminal which is not classified as a trunk or service circuit.

Usually a pair of wires which serves to connect a customer telephone to a terminal on the network.

Loop Start Signaling method which uses the metallic loop formed by the trunk conductors and terminating bridges.

Main Store Memory (MAS) That part of the No. 3 ESS which primarily stores program and translation information for the office as well as information collected, used, and deposited during each call.

Network The fabric consisting of network link and switches which serves to provide a 2-wire metallic talking path between any two network terminals. Remreed switches are used in No. 3 ESS.

Nonresident Programs Those programs housed outside the main store memory and called into use with the system manually. These programs are stored on the tape cartridge.

Off-Hook The condition that indicates the active state (closed loop) of a customer line, trunk, or service circuit.

On-Hook The condition which indicates the idle state (open loop) of a customer line, trunk, or service circuit.

Output Message Manual (OM) A listing of output codes automatically produced on a TTY. The OM describes the purpose and significance of the coding as presented on the TTY.

Protector Unit A protector guards against lightning and other foreign potentials and serves tip and ring conductor pairs.

Remanent Reed (Remreed) Type of material used in the construction of the switches associated with the network. Characteristics of the material are faster operating speeds, fewer moving parts, and decrease in size.

Service Circuit An auxiliary circuit connected through the switching network to lines or trunks as required. It performs a specialized function such as dial-pulse detection.

Service Order A change or a new addition to the central office affecting subscriber lines.

Single-Sided Network Lines, trunks, and service circuits are assigned to terminals at one side of the network.

System Control The combination of the control unit, FIOCs, network controllers, scanner controllers, and peripheral pulse distributors which together provide complete control of the periphery and whose status is switchable as a single unit. Except for the system status panel, the system control is duplicated for reliability purposes.

Terminal A point at which information can enter or leave a communication network.

Translation The conversion of information received in one form to another form; for example, in switching machines, the translation of digits received to those required to complete a call.

Trouble Locating Manual (TLM) Basically used to identify faulty circuit packs associated with particular failures. The TTY prints out a coded number which when referenced in the TLM indicates a list of possible faulty circuit packs.

Trunk A channel connecting switching centers or exchanges. An interface circuit for transmission and supervisory purposes.

12. ABBREVIATIONS

3ACC	3A Central Control
ADL	Administrative Link
ANI	Automatic Number Identification
CAMA	Centralized Automatic Message Accounting
CDO	Community Dial Office
CDPR	Customer Dial Pulse Receiver
CU	Control Unit
DDD	Direct Distance Dialing
DP	Dial Pulse
FIOC	Frame Input/Output Controller
I/O	Input/Output

JC	Junctor
JSW	Junctor Switch
LTD	Local Test Desk
MAS	Main Store Memory
MCC	Master Control Center
MF	Multifrequency
MTC	Maintenance
PD	Peripheral Decoder
PPD	Peripheral Pulse Distributor
RC	Recent Change
ROM	Read-Only Memory
SCCS	Switching Control Center System
SPN	Scan Point Number
SSP	System Status Panel
SYC	System Control
TCR	Transient Call Record
TDC	Tape Data Controller
TEN	Terminal Equipment Number
TLM	Trouble Locating Manual
TLTP	Trunk and Line Test Panel
TMR	Terminal Memory Record
TTYC	Teletypewriter Controller

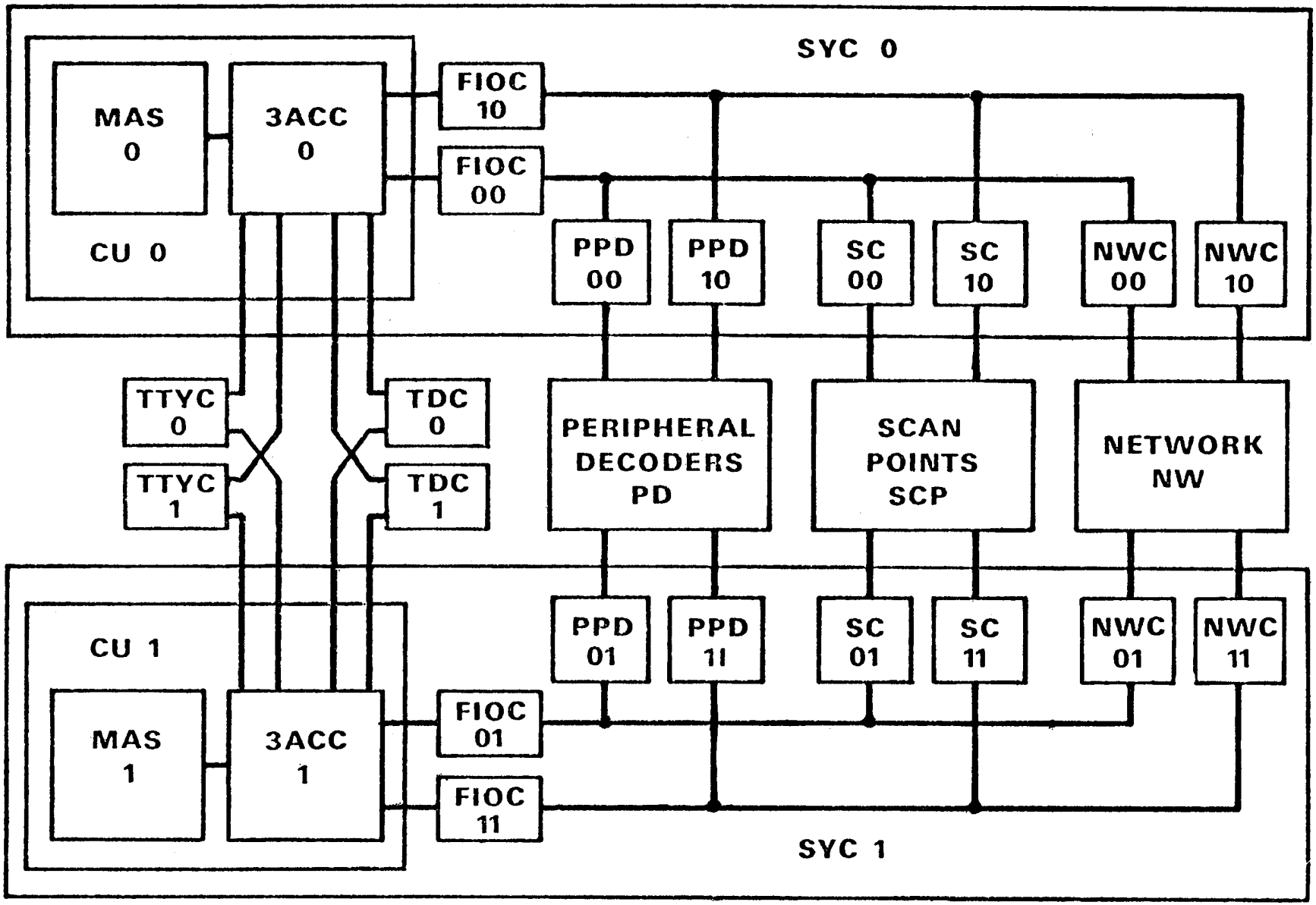


Fig. 1—System Control (SYC 0, SYC 1) (1.13)

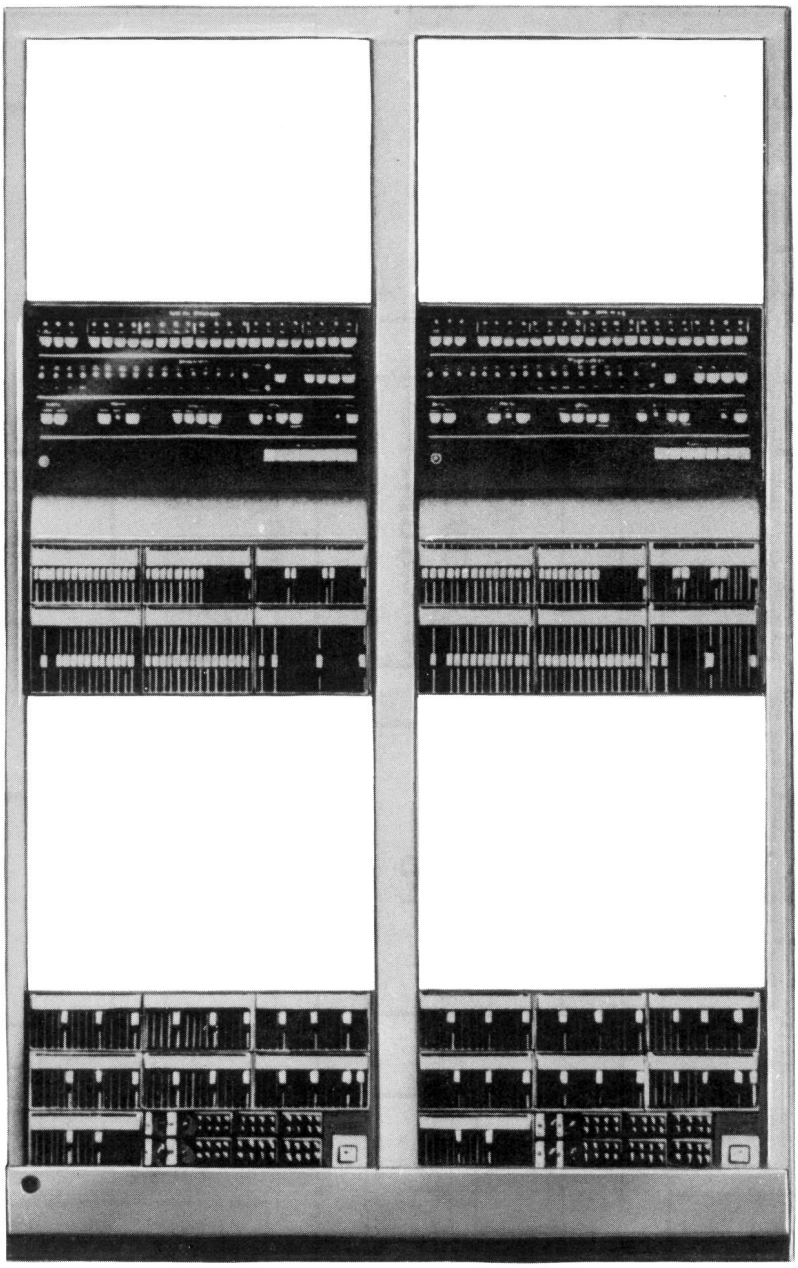


Fig. 2—Processor Frame (2.04)

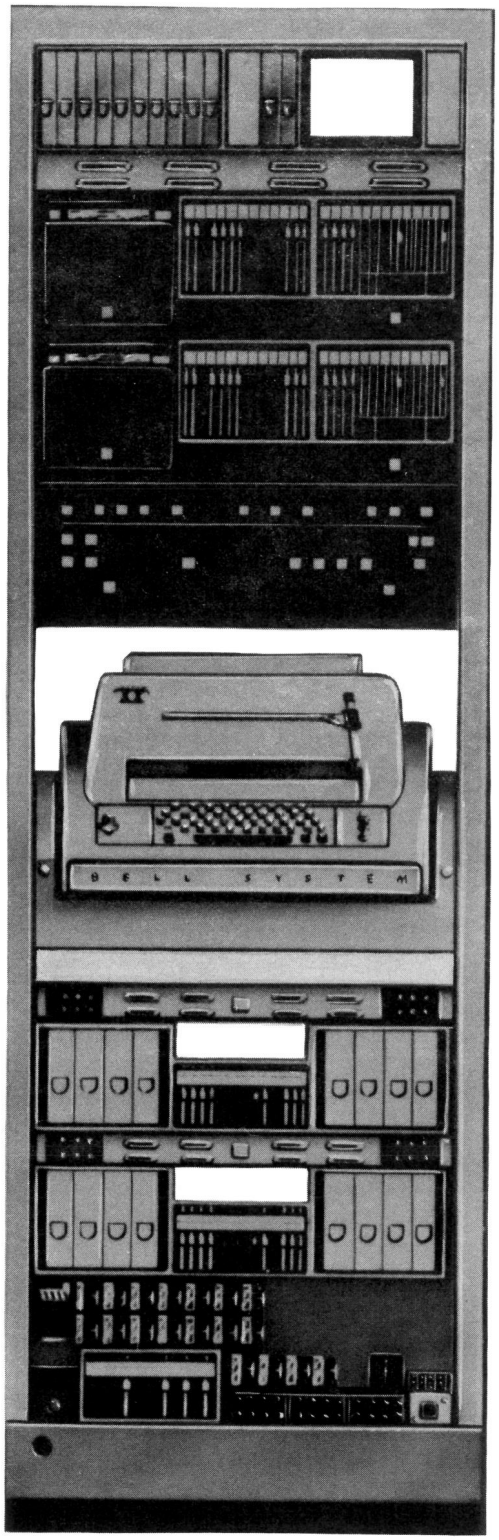


Fig. 3—Maintenance Frame (2.05)

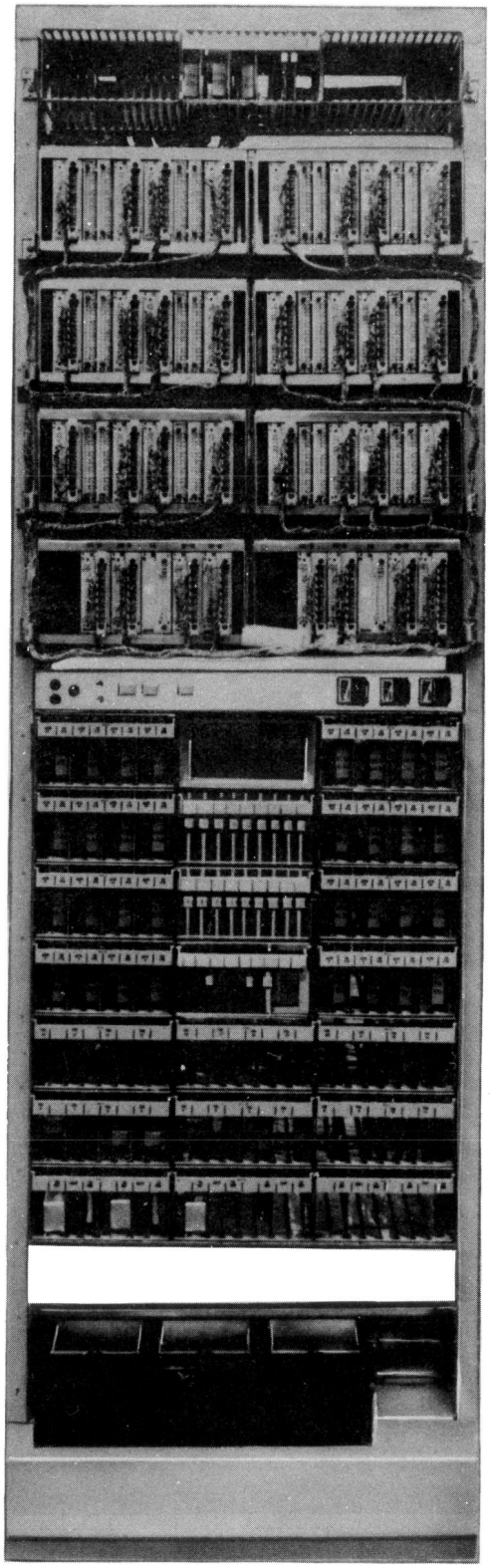


Fig. 4—Network Frame (2.06)

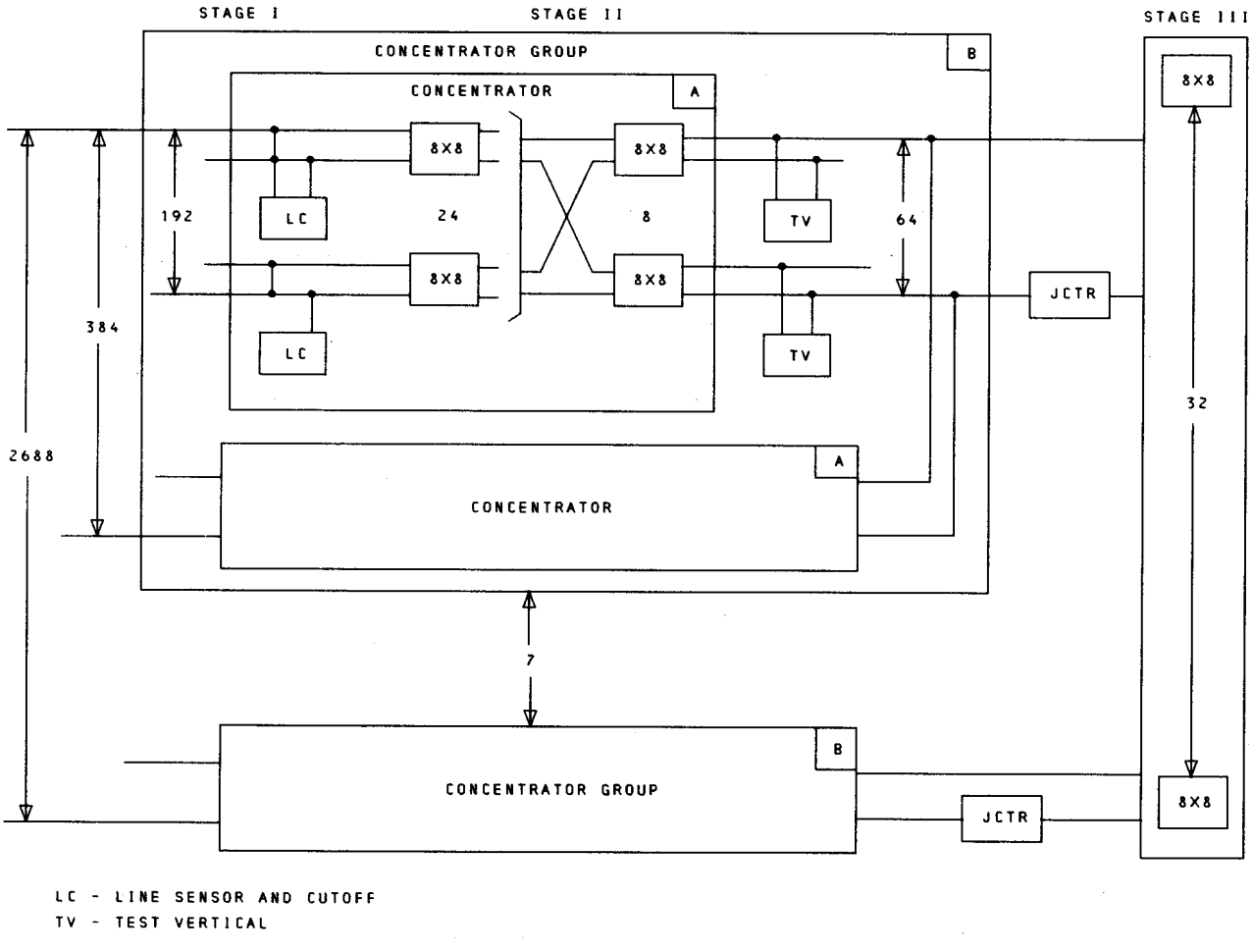


Fig. 5—No. 3 ESS Topology (2.08)

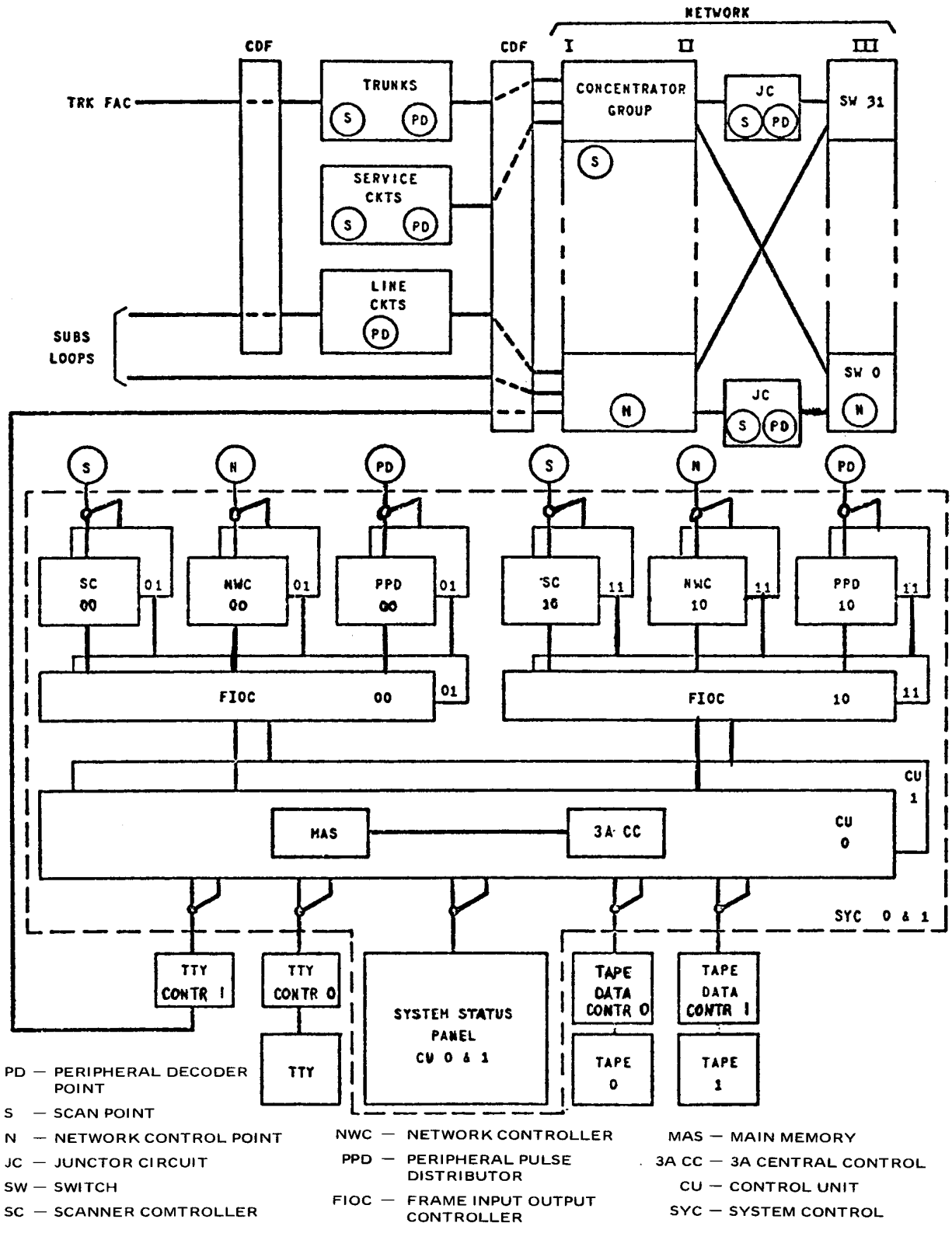


Fig. 6—No. 3 ESS Block Diagram (3.01)

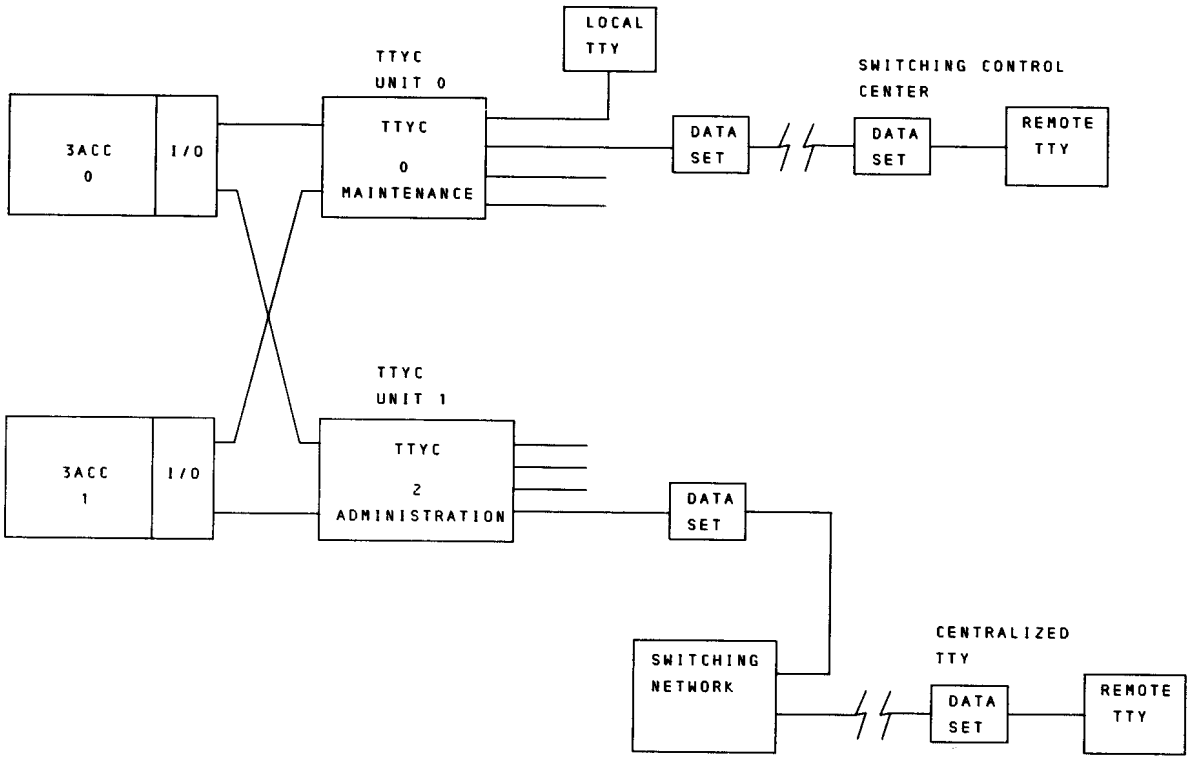


Fig. 7—No. 3 ESS TTY Plan (3.08, 3.09, 3.10)

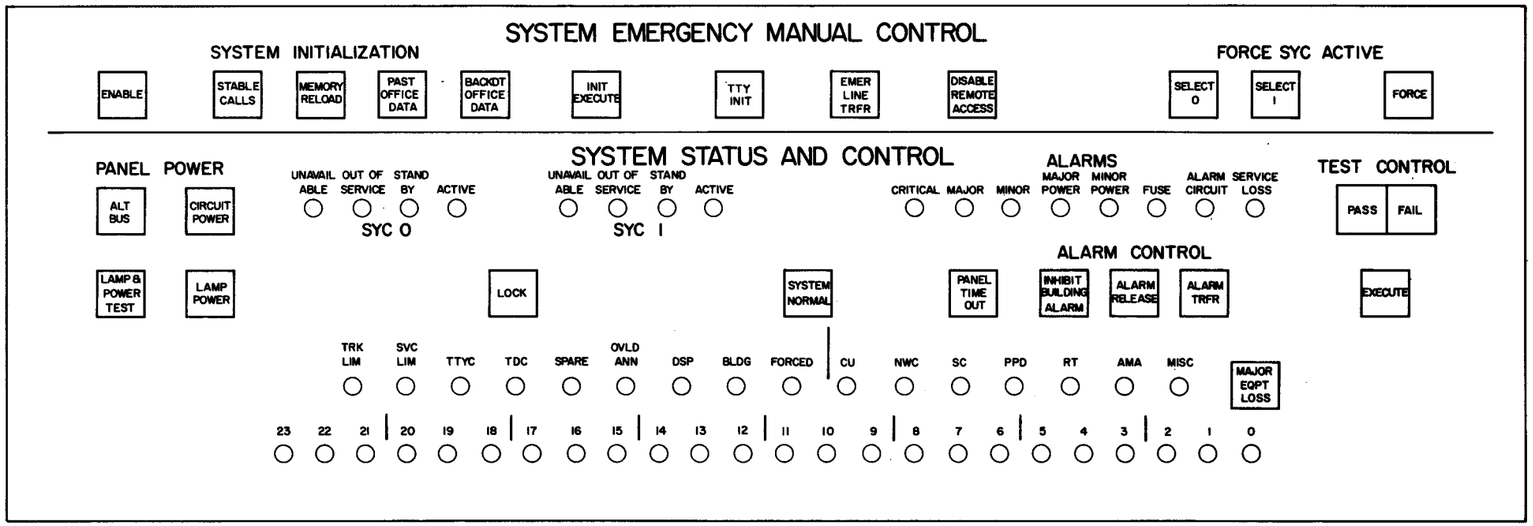


Fig. 8—System Status Panel (3.11)

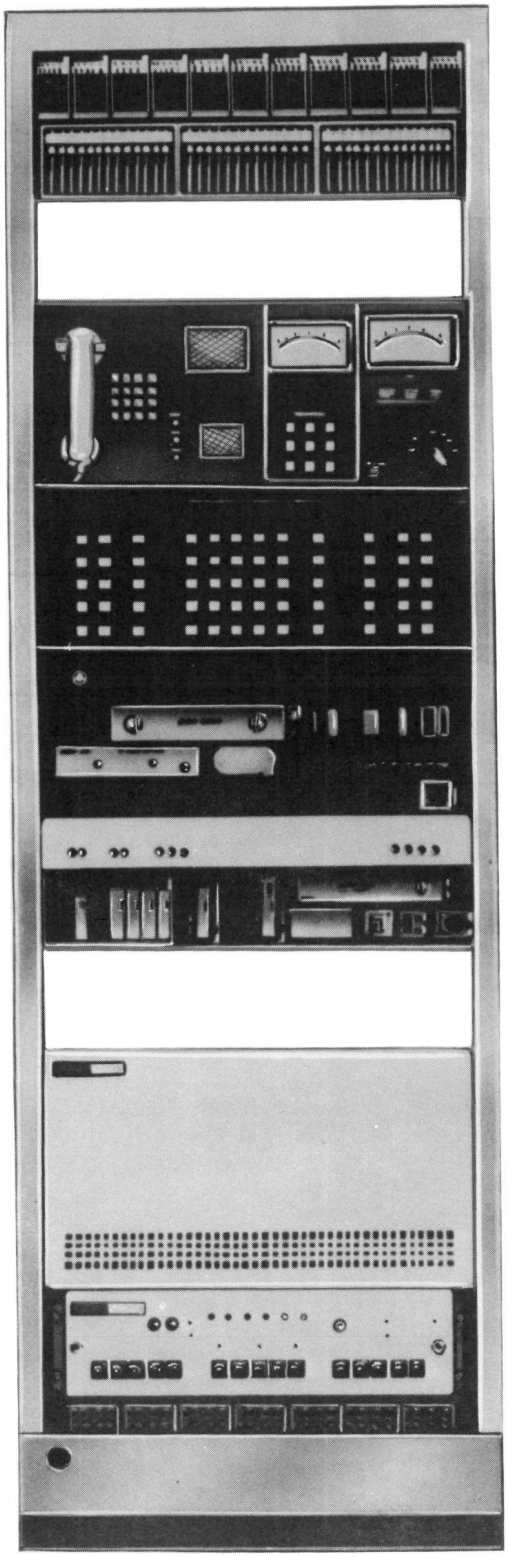


Fig. 9—Trunk and Line Test Panel (3.20)

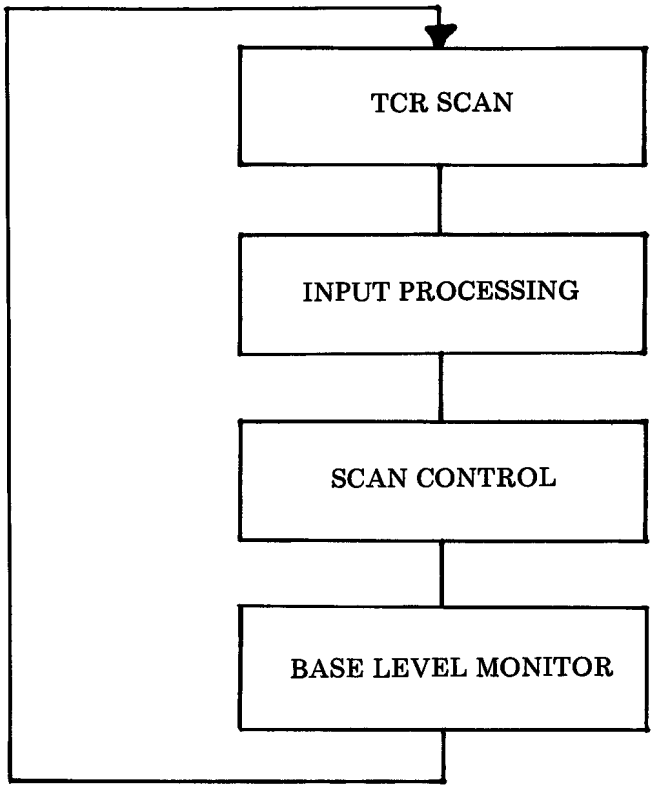


Fig. 10—Base Level (5.04)

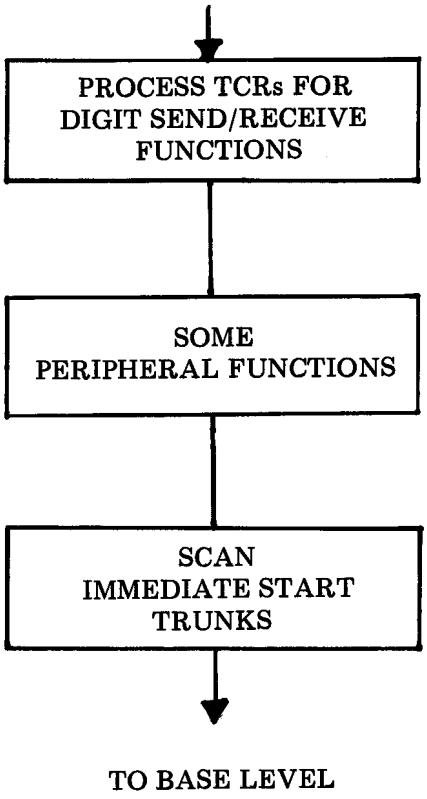
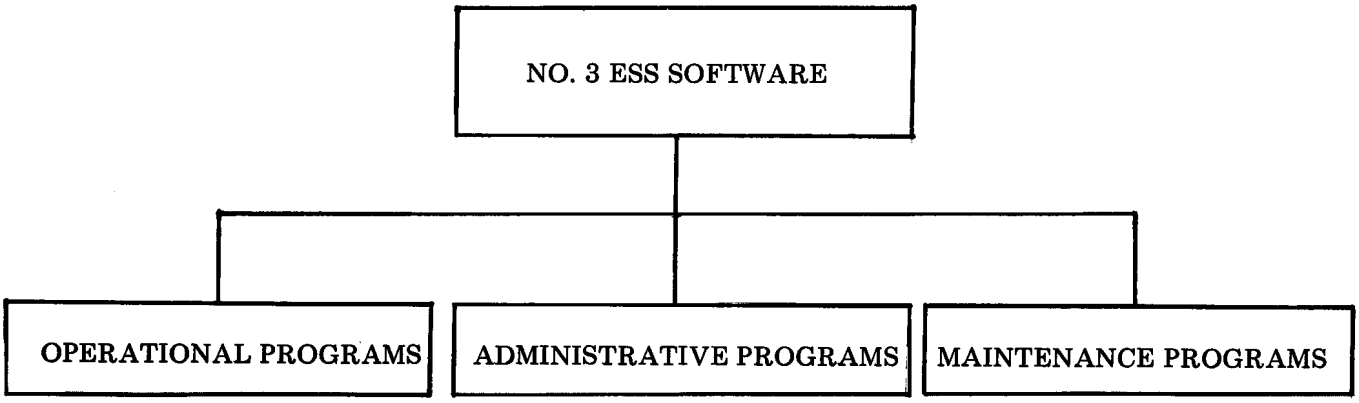


Fig. 11—Interrupt Level (5.05)



CALL PROCESSING

PERIPHERAL INPUT OUTPUT CONTROL

BASE LEVEL MONITOR

INTERRUPTS

RECENT CHANGE

SYSTEM UTILITIES

TAPE LOADING

TELETYPE

DATA LINK

SYSTEM STATUS MONITOR

SYSTEM TIMING

PROGRAMMED MAINTENANCE AIDS

ALARM AND STATUS REPORTING

ERROR ANALYSIS AND FAULT DETECTION

DIAGNOSTICS

FAULT RECOVERY, COLD START AND INITIALIZATION

Fig. 12—No. 3 ESS Programs (6.01)

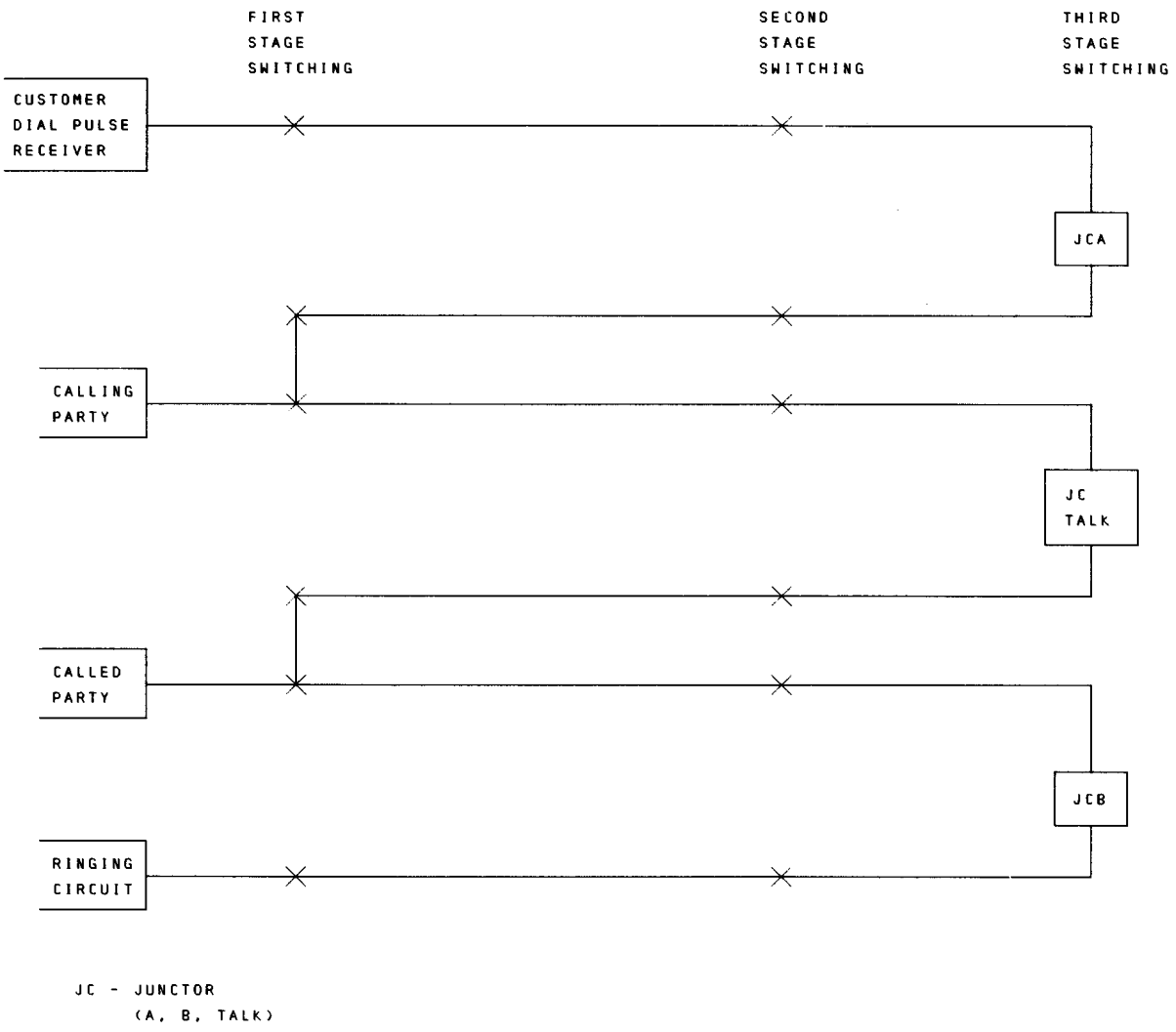


Fig. 13—Typical Intraoffice Call Connection (6.04, 6.05)

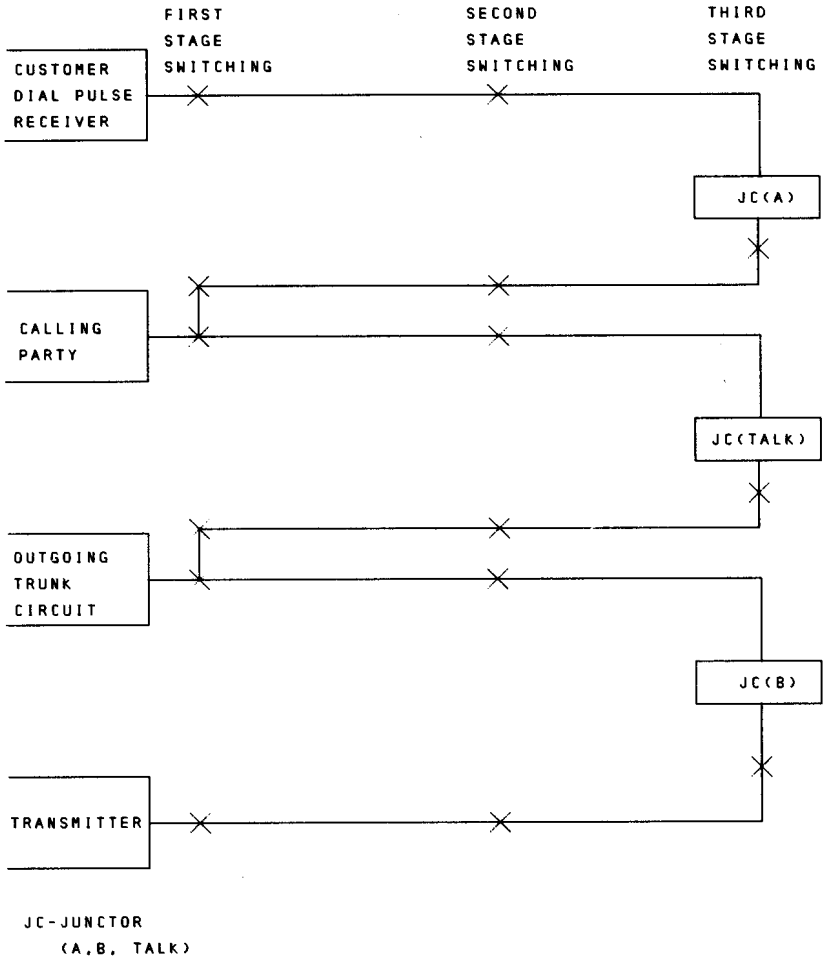


Fig. 14—Typical Interoffice Call Connection (6.05)

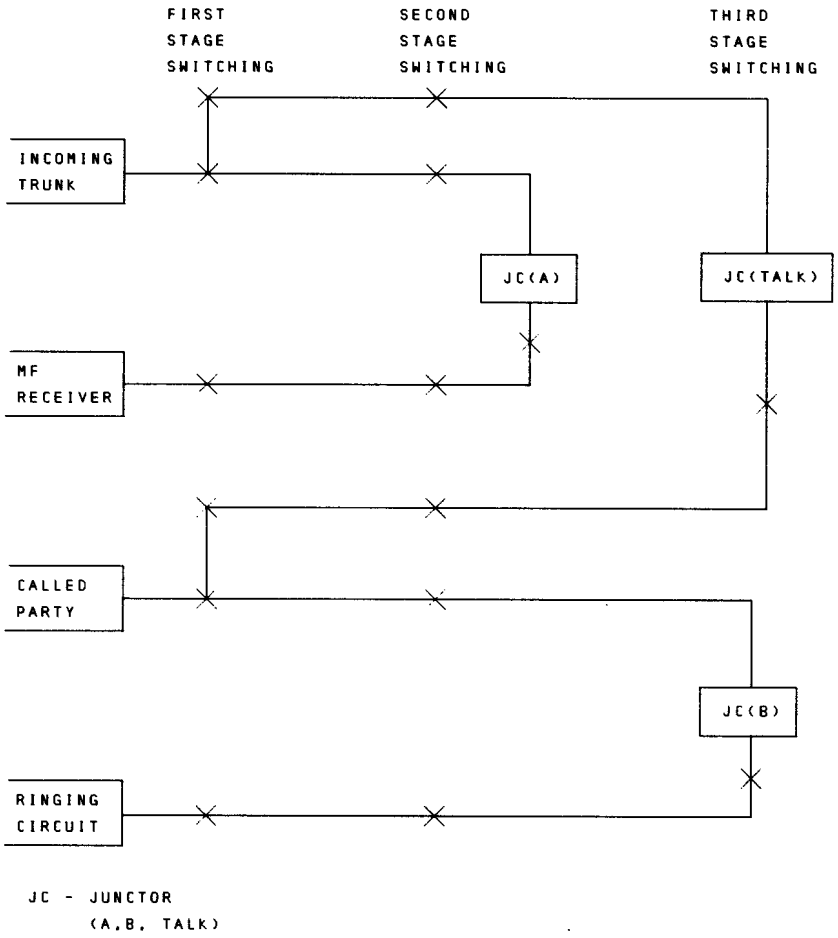


Fig. 15—MF Incoming Call Connections (6.05)

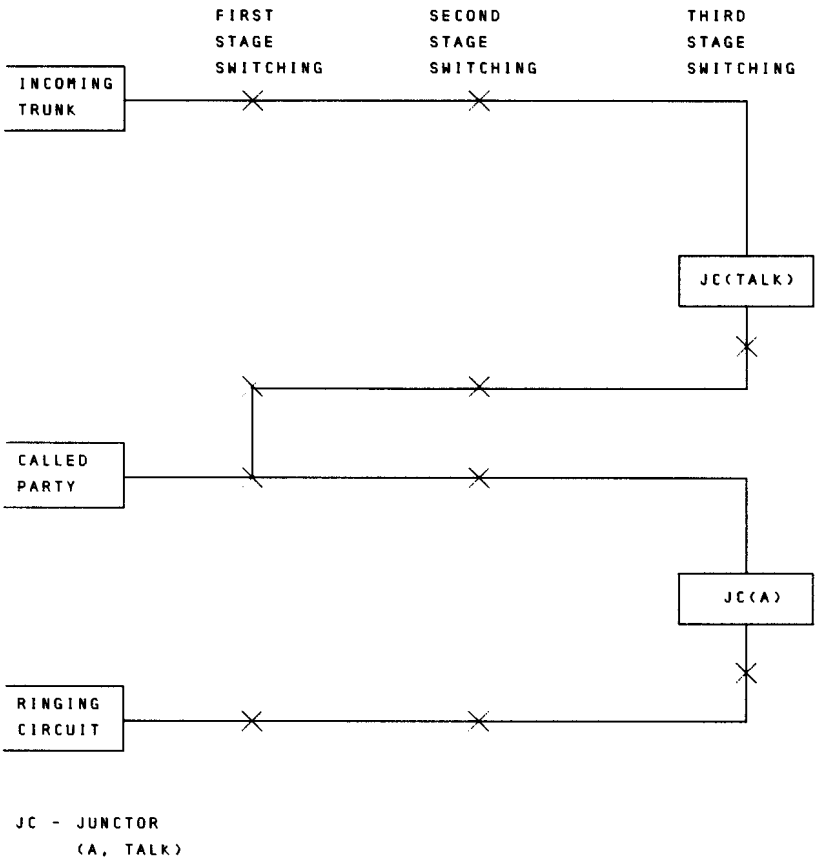


Fig. 16—Dial Pulse Incoming Call Connections (6.05)

TABLE A

NO. 3 ESS GENERAL FEATURES

TYPES OF LINES SERVED
Individual-Residence, Business, Manual, PBX, Coin
2-Party
4-Party
8-Party
TRUNK CAPABILITIES
Outgoing Local (Extended Area Service — EAS)
Incoming Local (EAS)
2-Way Local (EAS)
2-Way Operator Office
Outgoing Recording Completing
Incoming Toll Switch
Outgoing CAMA
Incoming Toll
Incoming From Local Test Desk Number 14
Outgoing Intercept
Outgoing Verification Request
Outgoing TSP and TSPS
Outgoing To Repair Service Board
Local Tandem

TABLE B

NO. 3 ESS LINE FEATURES

LINE FEATURE	SINGLE PARTY			MULTIPARTY		
	RES. BUS.	MAN.	PBX	COIN	2	4&8
Originating	X	X	X	X	X	X
Terminating	X	X	X	X	X	X
Flat Rate	X	X	X	—	X	X
Message Rate	X	X	X	—	X	X
Hotel — Motel (To TSP/TSPS)	—	—	X	—	—	—
Free Terminating	X	X	X	—	—	—
TOUCH-TONE®	X	—	X	X	X	X
Dial Pulse 10 PPS	X	—	X	X	X	X
Dial Pulse 20 PPS	—	—	X	—	—	—
ANI	X	—	X	X	X	—
ONI	X	X	X	X	X	X
Bill To Listed Number	—	—	X	—	—	—
QZ Billing	—	—	X	—	—	—
Remote Message Register	X	—	X	—	—	—
Reverting Calls	—	—	—	—	X	X
Plug-Up List	X	X	X	X	X	X
Emergency Manual Line	X	X	X	—	—	—
Emergency Line (Fire, Police)	X	—	X	—	—	—
Denied-Originating	X	X	X	X	X	—
Denied-Terminating	X	X	X	X	X	X
Loop Start	X	X	X	X	X	X
Ground Start	X	—	X	X	—	—
Immediate Ring	X	X	X	X	X	X
Coin First	—	—	—	X	—	—
Dial Tone First	—	—	—	X	—	—
Retain Coin On 0 Or X11	—	—	—	X	—	—
Return Coin On 0 Or X11	—	—	—	X	—	—
Local Overtime	—	—	—	X	—	—
Multiline Hunt	X	—	X	—	—	—
Series Completion	X	—	—	—	—	—
No Hunt	X	—	X	—	—	—

TABLE B (Cont)

LINE FEATURE	SINGLE PARTY			MULTIPARTY		
	RES. BUS.	MAN.	PBX	COIN	2	4&8
Make Busy	X	—	X	—	—	—
Dynamic Service Prot.	X	X	X	X	X	X
Toll Network Prot.	X	—	X	X	X	X
Group Alerting	X	—	—	—	—	—
Call Waiting	X	—	—	—	—	—
Speed Calling	X	—	X	—	—	—
3-Way Calling	X	—	—	—	—	—
Call Forwarding	X	—	X	—	—	—
Toll Diversion	—	—	X	—	—	—
Toll Restriction	X	—	X	X	—	—
Service Observing	X	X	X	X	X	X
Line Lockout	X	X	X	X	X	X
Call Tracing	X	X	X	X	X	—
Nonsynchronized Audible	X	X	X	X	X	X

TABLE C

NO. 3 ESS TRUNK FEATURES

TRUNK FEATURES	LOCAL			OPERATOR		OGT	LOCAL TEST		
	OGT	ICT	2-WAY	REC COMP.	TOLL SWITCH	CAMA OR TSP/TSPS	TOLL ICT	DESK OGT	#14 INC
E and M Lead	X	X	X	X	X	X	X	—	—
Rev. Batt.	X	X	—	X	X	X	—	X	X
Imm. Start	X	X	X	—	—	—	—	—	—
Wink Start	X	X	X	—	X	X	X	—	X
Delay Dial	—	—	—	—	X	X	X	—	X
Stop — Go	X	—	X	—	—	—	—	—	—
Dial Pulsing	X	X	X	—	X	—	X	—	X
MF Pulsing	X	X	X	—	X	X	X	—	—
Inband Coin and Rering	—	—	—	X	X	X	—	—	—
Class Of Service Tone	—	—	—	X	—	—	—	—	—
Automatic Ring	—	—	—	—	X	—	—	—	—
No Test Access	—	—	—	—	X	—	—	—	X
Local Tandem	X	—	X	—	—	—	—	—	—

TABLE D

NO. 3 ESS ROUTING FEATURES

ROUTING FEATURES	
Access Codes	0+, 1+
Service Codes	X11, 11X
Information Codes	411, 1+411, 555 1212, 1+555 1212 NPA+555 1212, 1+NPA+555 1212
0, 0+, 1+, To TSP/TSPS	
1, 3, 7, 10 Digit Dialing (Exclusive of Access Codes)	
Dialing Plan — NXX-NXX-XXXX (N=2-9, X=0-9)	
IDDD — Route to TSPS	
Up To 2 Alternate Routes (Including one For Recorder)	
Shared Office Code Via 1000's Digit Translation	
Up To 3 Foreign Area Translators (Optional)	
Extended Area Service (EAS)	
Emergency Service Bureau 911	

TABLE E

NO. 3 ESS MISCELLANEOUS FEATURES

MISCELLANEOUS LINE FEATURES
Partial Dial Treatment Permanent Signal Treatment 8-Party Semiselective Ringing and 4-Party Full Selective 8-Party Divided Code Ringing and 4-Party Semiselective Ringing
SLEEVE LEAD FUNCTION
32 Major Classes of Service 6 Incoming Office Codes 256 Possible Routes
MISCELLANEOUS TRUNK FEATURES
Delete Digits (Up to 7) Prefix Digits (Up to 3)
MISCELLANEOUS EQUIPMENT ARRANGEMENT FEATURES
7-Foot Frames — Single Sided Fire Detection Earthquake and Disaster Bracing (Optional) RF and External Power Protection (Optional) Van Mounting (Optional)
MISCELLANEOUS HARDWARE FEATURES
Low Profile Conventional Distributing Frame (24" deep) Protector Units Reuse of Existing Protector and MDF (Optional) Power Plant — Solid State 151A Type Ringing and Tone Supply Plant, 1/2 Amp

TABLE F

UNIVERSAL TRUNK CIRCUITS

TRUNK CIRCUIT TYPE	PULSING		USE	CLASS		
	DP	MF		NC	CN	COMB.
Outgoing Reverse Battery	√	√	EAS*	—	—	—
				—	—	—
				—	—	—
E and M Lead	—	√	CAMA	—	—	—
	—	√	AIS	—	—	—
	—	√	TSP	√	√	—
	—	√	TSPS	√	√	√
	—	—	Regular and Trouble Intercept	—	—	—
	√	√	One-Way Out EAS*	—	—	—
	—	—	One-Way Out SWBD	√	√	√
	√	√	One-Way In SWBD	√	√	√
	√	√	One-Way In EAS*	—	—	—
	√	√	One-Way In Toll Connect	—	—	—
	√	√	2-Way SWBD	√	√	√
	√	√	2-Way EAS*	—	—	—
Incoming Reverse Battery Wink Or Immediate	√	√	EAS*	—	—	—
	√	√	Outgoing SWBD	√	√	√
	√	√	Incoming SWBD	√	√	√
	√	√	2-Way SWBD	√	√	√
Incoming Reverse Battery (Delay Dial)	—	√	Toll Connect	—	—	—
High-Low Reverse Battery	—	√	CAMA	√	√	—
	—	√	TSP	√	√	—
	—	√	TSPS	√	√	√
Outgoing Tandem Reverse Battery	√	√	EAS*	—	—	—
				—	—	—
				—	—	—

TABLE F (Cont)

TRUNK CIRCUIT TYPE	PULSING		USE	CLASS		
	DP	MF		NC	CN	COMB.
E and M Lead Tandem	√	√	Regular and Trouble Intercept	—	—	—
	√	√	AIS	—	—	—
	√	√	One-Way Out EAS*	—	—	—
	√	√	2-Way EAS*	—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—
				—	—	—

* EAS includes crossbar tandem and all local offices except panel.

NC — Noncoin
CN — Coin
Comb. — Coin-noncoin

TABLE G

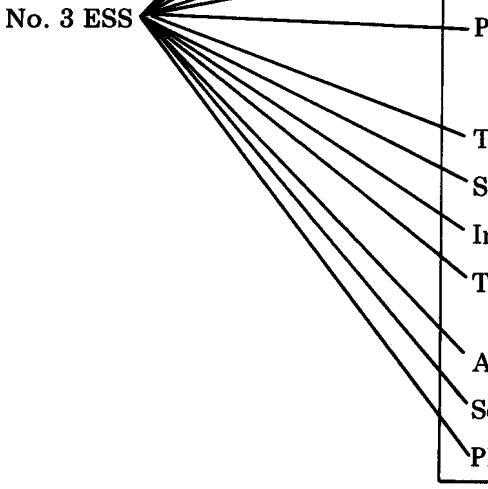
GROWTH REQUIREMENTS

APPARATUS AND FRAMES															
*TERMINALS	0-384	385-768	769-1152	1153-1536	1537-1920	1921-2304	2305-2688	2689-3072	3073-3456	3457-3840	3841-4224	4225-4608	4609-4992	4993-5376	5377-5760
Memory (MAS) Size Requirements (No. of Words)	64K	64K	64K	64K	** 96K	96K	96K	96K	96K	96K	96K	96K	96K	96K	96K
*Network Frame(s)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Control Frame 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Control Frame 1	0	0	0	0	0	0	0	***1	1	1	1	1	1	1	1
Miscellaneous Frames (Minimum)	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Maintenance Frame	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Test Frame	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Processor Frame	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Low-Profile Conventional Distributing Frame	1 (MOD)	1	1	1	1	2	2	2	2	2	3	3	3	3	3

* Based on Terminal Limited Network
** 96K Required at 1800 Terminals
*** Expansion of Third-Stage Switch

TABLE H

COMPATIBILITY CHART



COMPATIBLE SYSTEMS	REMARKS
No. 1 ESS	
No. 2 ESS	
No. 5 Crossbar	Immediate start possible but not recommended.
No. 4A and 4M Crossbar	Many 4A trunk circuits require 2-to-4 wire conversion.
Step By Step	No start pulsing signal.
Crossbar Tandem	Immediate start possible but not recommended.
Panel and No. 1 Crossbar	No. 3 will not receive or outpulse revertive or PCI pulse.
Traffic Service Position System	No. 1
Switchboards	3C and 3CL or equivalent.
Intercept Systems	6A and AIS
Test Desks	No. 14 and No. 16 local test desks
Announcement System and Desks	
Service Observing Set	No. 713
PBX	101 ESS