ELECTRONIC TRANSLATION SYSTEM
GENERAL DESCRIPTIVE INFORMATION
NO. 5 CROSSBAR SYSTEM

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1. INTRODUCTION

GENERAL

1.01 This section describes in general terms, the Electronic Translation System (ETS) operation

in a No. 5 Crossbar Telephone Switching System. Section 958-110-100 describes the switching features of the system.

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

1.03 For additional BSPs on ETS, refer to ETS Alphabetical Index 218-799-000.

1.04 ETS uses a computer system, control, and interface equipment/facilities to provide a stored program control of the line, trunk, and routing translations as well as providing full local and centralized automatic message accounting (LAMA and CAMA) capabilities. Provisions are provided to accommodate all current standard No. 5 crossbar customer services.

1.05 Charge call data is assembled for remote recording on magnetic tape at a No. 1 AMA recording center (AMARC). The call recording information is assembled into a single line entry format and is recorded on magnetic tape at a density of 1600 bits per inch. The system obtains the call information by scanning the completing markers for "initial entry" information and by scanning the associated trunk for answer and disconnect information.

1.06 Figure 1 presents a basic block diagram of the ETS in a No. 5 crossbar switching environment. Call information is received from markers, trunks, and lines via scan leads, and routing information is returned to the markers via distribute leads. The scanning of trunks provides ETS with supervisory status of trunks for routing and billing. Line scanning is used on lines in multiline hunt groups, to provide busy/idle status for hunting and, on INWATS lines, for AMA purposes. Figure 2 presents the typical ETS floor plan for a 60 line link/30 trunk link size office.

CAPACITY

1.07 An ETS can accommodate 60/30 offices equipped with 6 dial tone markers, 12 completing markers, and a maximum of 4800 AMA trunks (including INWATS lines and CAMA trunks) that can be scanned.

1.08 Only one marker group is handled by ETS.

1.09 An ETS provides billing information for a maximum of 512 remote message register (hotel/motel) lines.

1.10 A maximum rate of 50,000 calls per hour may be recorded by ETS at a remote location via five one-half duplex data links between the 202T data sets and No. 1 AMARC.

1.11 The system can utilize a maximum of 62 office indices (compressed office codes) for billing.

1.12 Previously, a maximum of 100 classes of service with 20 rate treatments were provided. In ETS, 2000 total classes of service are available.

FEATURES

1.13 Some of the features of the ETS in No. 5 crossbar offices are as follows:

- Line class of service translation (in software) eliminates line link frame cross-connections for class of service

- Route translation (in software) provides the equivalent of 1000 route relays with route advance as well as the equivalent of 2000 screening relays

- Trunks per group per trunk link frame are limited only by the capacity of the trunk link frame

- Sender groups are assigned on a per-trunk basis

- Random hunt and trunk selection is a function of software

- Two trunk hunting sequences are provided—ordered (previously only for 2-way trunks) and random hunting.

- Terminating translation, hunting, and line route functions for line link pulsing are a part of software

- Three line hunting sequences are provided: hunt-to-end, circular hunt, and uniform call distribution

- Traffic measurements for system administration, plant maintenance, traffic engineering, billing, and division of revenue are provided

- Dynamic overload control (DOC) functions are performed in software and are compatible with existing equipment

- Central recording (via data links to No. 1 AMARC) for LAMA and CAMA

- Single entry format billing

- Precise timing (records answer and disconnect indications in less than one second after answer without special modifications)

- Compatible with AIOD (toll and message rate calls)

- Provides a means for multiple scoring of remote message registers for hotel/motel outgoing calls

- Existing equipment that may be removed for additional floor space recovery includes number group frames, AMA equipment (transverters, recorders, call identity indexers, translators), foreign area translators, and marker routing and screening relays

- Reduced wiring effort to complete service orders by eliminating wired cross-connections for number group, AMA translators, line class of service, marker route and screening, CAMA billing indexer, foreign area translators, and LIT skip resistors

- ANI services for TSP/TSPS, automatic number announcement system, or LIT directory number printout

- Centrex Phases I, II, and III may be accommodated.

FEATURES - GENERIC TWO

1.14 The following features are found in No. 5 ETS offices operating under *Generic 2 and subsequent generic issues.*

A. Aging Numbers On Intercept

1.15 Aging of numbers on intercept is the interval that numbers on blank or regular intercept remain on intercept before they are eligible for reassignment. The two essential items for aging are the aging class and the aging date (refer to Section 218-799-339).

B. Mass Line Class and Terminating Class Changes

1.16 This procedure provides a means whereby the line classes (LC) or the terminating classes (TC) may be rearranged in the LCTT or the TCTT data base tables respectively, and all references to the old class numbers in the different data base tables are changed to the new class numbers. The mass line class or terminating class changes may be required to bring all No. 5 ETS offices associated with ATA or a central maintenance center into agreement by having the same line class or terminating class in every office. Recent change type entries are used for making the mass changes.

C. Recent Change Procedure—Input/Output Terminals

1.17 Means have been provided in No. 5 ETS offices operating under generic 2 and subsequent generic issues to allow flexibility in the inputting and outputting of messages at input/output terminals (DATASPEED® 40s and teletypewriters). This flexibility has been accomplished by assigning message (data) classes to particular tasks or functions inputted or outputted at I/O terminals. Table A provides a list of the message classes available. Additional information can be found in Section 218-799-337.

D. Automatic Trouble Analysis—ATA

1.18 Service calls which encounter trouble in ETS offices will generate records at the trouble recorder, the ETS maintenance terminals, or both. ETS also provides additional information at the maintenance terminals such as results of audits and diagnostics. Information is also provided on craft requested traps, traces, and data base output. ATA generic 3 in conjunction with ETS generic 2, provides the capability of receiving all of this data over a single dedicated voice grade data link between each ETS office and the ATA computer. ATA will subject all trouble records and error messages to the two-level (binning and sorting) real time analysis that it currently performs for non-ETS offices. Exception reports based on system thresholds will result when consistent patterns of trouble are identified by ATA. These reports can be monitored at maintenance work stations in the

TABLE A

MESSAGE CLASSES	
MESSAGE CLASS (MSGCLS)	NAME
00	EOS ERRORS
01	ETS ERRORS - NONTEST
02	ETS ERRORS - TEST
04	DUMPS - NONTEST
05	DUMPS - TEST
09	CLID REPORTS - NONTEST
10	CLID REPORTS - TEST
15	TROUBLE RECORD CARDS TO ATA
16	ERROR MESSAGES (BINARY) TO ATA
20	SUMMARY (DAILY) REPORTS
21	UNAUTHORIZED TOUCH-TONE REPORTS
24	DATA BASE PRINTOUT - 3 LINES OR LESS
25	DATA BASE PRINTOUT - MORE THAN 3 LINES
26	OUTPUT FROM AUDIT COMMANDS
27	OUTPUT FROM RC COMMANDS
30	CHANGE MESSAGE CLASS COMMAND
35	MAINTENANCE COMMANDS AND OUTPUT
36	DIAGNOSTIC COMMANDS AND OUTPUT
37	AUDIT COMMANDS
38	REALLOCATION AND TAPE ADMINISTRATION COMMANDS AND OUTPUT
39	MAINTENANCE RC COMMANDS
40	LINE RC COMMANDS
41	DATA BASE AND OFFICE RECORD PRINTOUT COMMANDS
42	NETWORK MANAGEMENT COMMANDS AND OUTPUT
43	TRAFFIC AND PLANT COMMANDS AND OUTPUT
46	ATA COMMANDS AND OUTPUT
50	ATA STATUS AND HANDSHAKING
51	ATA DIAL-UP MESSAGE
55	MISCELLANEOUS
▶62◀	COMMUNICATIONS BETWEEN TERMINALS◀

Electromechanical Switching Control Center (EM-SCC) and used to control the maintenance activities in the served offices.

1.19 Error messages generated by ETS will be stored in the ATA computer in a chronological history file which may be examined by SCC personnel for possible trouble conditions. Features similar to those provided by the No. 2 SCCs (such as browsing, filtering, expansions, and conversions) for use in ESS SCCs will be provided in generic 3 to aid in the analysis of these history files. It is expected, however, that there will be infrequent need to perform this interactive kind of analysis since real time analysis should report all trouble conditions needing attention. The history file and associated features will be useful for reconstructing events prior to a serious system outage, for technical assistance when SCC and central office craft are cooperating on trouble shooting specific problems, and for analysis of audits, tapes, and traces.

1.20 It will be possible with ATA generic 3 to establish remote ETS maintenance teleprinters. This can be accomplished by one of two arrangements:

 1. At an ATA work station through ATA and the dedicated ETS to ATA data link.

 2. By establishing a dial up data link to a port on the ETS machine from any compatible teleprinter.

The No. 1 arrangement would normally be used at a SCC supported by ATA. The No. 2 arrangement could be used at a SCC if the ATA was not operational or from locations such as company technical assistance centers where access to ATA is limited or not required. To accomodate situations where either prolonged "on-line" operation with a specific ETS office or extensive examination of the history files is planned, a new work station and terminal type are added to SCCs serving ETS offices. The work station will be referred to as the analysis work station and the associated teleprinter as the analysis terminal. Using the analysis work station for these functions prevents the tying up of a corrective maintenance work station, which is normally responsible for several (4 to 6) offices, with the problems of a single office for a long period of time.

1.21 An existing No. 5 ETS office will require new hardware to accomodate the ETS generic

2 necessary to run with ATA. This new equipment includes additional memory (64K to 75K words), additional RSI input/output ports for ATA primary and secondary data links, and additional circuitry associated with the Program Controlled Data Acquisition Interface (PCDAI) and the master test frame.

1.22 The dedicated data links between ETS offices and either ATA or permanent remote maintenance terminal use 202T data sets set for 1200 baud, full-duplex 4-wire operations. Data sets for secondary (back-up) ATA lines will be 212As running full-duplex at 1200 baud. Data Links for non-dedicated remote maintenance terminals will also use full duplex 212As but may optionally run on either 300 or 1200 baud.

1.23 No changes are required in the ATA central computer configuration to support No. 5 ETS.

2. EQUIPMENT ELEMENTS

GENERAL

2.01 This part provides a brief description of the equipment elements that are unique to ETS. Some elements are new, such as the processor complex and the distributor and scanner frame. Other elements, such as the markers and the trunks, are modified to function with ETS.

PROCESSOR COMPLEX

2.02 Figure 3 represents an overall view of the processor complex. The complex is composed of: (1) 3A Central Control, (2) Main and Supplementary Stores, (3) System Status Panel and Controller, (4) ETS Status Panel, (5) Teletypewriter and Controller, (6) Tape Data Facility, and (7) Power and Data Interface.

2.03 The two 3A central controls, the two basic main stores, and their associated power supplies are located on the 3A auxiliary processor frame. For the sake of clarity and consistency, the only use of the term *3A auxiliary processor* will be with respect to the frame. When referring to that part of the processor complex used for call processing (the 3A central control and the main store), the term *processor* will be used.

A. 3A Central Control

Purpose

2.04 The 3A central control (3A CC) is an 18-bit (16 data bits and 2 parity bits) switching central control unit designed for electronic switching systems. The 3A CC is used in a duplex system configuration in the No. 5 Crossbar ETS. The duplex configuration involves the duplication of system components for continuous real-time operation with a high degree of system reliability. One 3A CC always has active control over the system, while the other 3A CC operates in a standby mode. A 3A CC, the associated memory, and the distributor and scanner (DAS) form the ETS entity in the No. 5 Crossbar System. The on-line 3A CC keeps both the on-line and standby memory up-to-date so that the standby 3A CC can assume control of the system as required.

Characteristics

2.05 The major characteristics provided by the 3A CC are as follows.

- *1A Technology:* This technology, which provides standardized logic gates implemented with silicon integrated circuits (SICs) mounted on ceramics which use an automated packaging and interconnections type, enables the 3A CC to be small in size, economical in price, and to function at a very fast speed.

- *Self-Checking Circuits:* The 3A CC uses self-checking circuits to give immediate detection of faults. These circuits eliminate the process of synchronous operation and match comparison between two control units while still providing rapid detection of failures.

- *Microprogram Control:* The internal sequencing of actions is controlled by a microprogram structure which results in a highly flexible means of implementing the instruction set and basic control functions. Each instruction is performed by a sequence of microinstructions within the microprogram control. The microcycle time (time to perform one microinstruction) is 150 nanoseconds.

- *Asynchronous Communication to Memory and the Periphery:* Additional flexibility is allowed by the asynchronous nature of both the 3A CC-to-memory and 3A CC-to-periphery communication. This means that after ordering the memory or periphery to accomplish a task, the 3A CC can proceed to other tasks without having to further control those units in their performance. At a later time, the 3A CC returns for the memory or peripheral response.

- *Flexible Input/Output (I/O) Communication:* A modular, loosely coupled, I/O structure provides the capability of handling a wide variety of I/O devices. This I/O facility is growable by increments of 20 subchannels up to a maximum of 360 high-speed (6.67 megabits per second) serial I/O subchannels.

- *Large Addressing Capability:* The 3A CC may directly access up to 768K words of storage (where K=1024) by using 20-bit addresses.

- *Sixteen General Registers:* General purpose registers in the 3A CC provide flexibility in data handling and processing.

- *Manual Control and Display Panel:* The 3A CC has a control panel by which maintenance personnel can gain access to the unit for testing or performing manual operations.

Broad Functional Overview

2.06 A block diagram (Fig. 4) shows the functional sections within the 3A CC. The functional sections are as follows.

- *Microprogram Control:* The microprogram control is the heart of the 3A CC operation. It directs and controls the operation of other functional sections within the 3A CC and is responsible for the overall performance for which the 3A CC is designed. The internal sequencing of actions is controlled by a microprogram structure which results in a highly flexible means of implementing the instruction set and basic control functions. Each instruction which is read from main store is performed by a sequence of

microinstructions within the microprogram control. The sequence of microinstructions performs various functions such as gating between registers, data manipulation, sending of control signals, etc, which are necessary to interpret and execute the instructions fetched from main store.

- **System Clock:** The system clock supplies the basic timing pulses necessary to control system actions.

- **General Registers:** The general registers provide a quick access storage medium for storing data being used in the current data processing operation.

- **Data Manipulation:** The data manipulation section performs all arithmetic and logic operations upon one or two operands.

- **Interrupt Facility:** The interrupt facility provides the means of interrupting the program flow so that a timed or more urgent task may be performed.

- **Main Memory Control:** The interface by which information is transmitted to or received from the main store.

- **I/O Channel and Controller:** The interface by which information is transmitted to or received from the other units of the ETS system.

- **Maintenance Channel and Controller:** The maintenance channel and controller provide the means by which information is transmitted between the duplicated 3A CCs for maintenance purposes.

- **Control Panel and Interface:** The control panel provides one of the means of communication between the 3A CC and the maintenance personnel.

- **Gating Bus and Bus Parity Checker:** The gating bus is the communications path within the 3A CC. The bus parity checker tests the parity of the information placed on the gating bus to ensure its accuracy.

- **Miscellaneous:** This section contains a group of special registers and cable receivers.

The cable receiver provides a means for receiving information from the system status panel. The special registers are buffers mainly for maintenance, control, status, and error information. They also provide a scratch area used by some programs and a hold-get register.

General Description of Operation

2.07 The 3A CC comprises a large number of registers and their associated circuitry. The 3A CC obtains the sequence of commands from the main store (MAS) and translates them into action. This action usually results in the movement of data between the registers in the 3A CC or between the registers in the 3A CC and the MAS. The translation is performed by a sequence of microinstruction steps. Each microinstruction step consists of reading a word out of the MAS. This word indicates the microinstruction to be performed on this microcycle, as well as the address of the next microinstruction to be performed. In this way, an instruction obtained from the MAS is used to point to the starting address in the microstore, of a sequence of microinstructions that causes the microprogram control to perform a required action.

2.08 At the completion of the sequence of microinstructions, the microprogram control interrogates the MAS to determine whether the next instruction has been fetched from the MAS. If not, the microprogram control goes into a loop in which it constantly checks to see if the MAS cycle is complete. When the MAS cycle is complete, the next instruction is loaded into the 3A CC and a new microinstruction sequence is initiated.

2.09 The 3A CC also has the ability to write into the MAS. Writing is normally performed in the temporary storage portion of the MAS. The other portions of the MAS are write-protected and a special sequence of operations is required to allow the 3A CC to write into protected areas of the MAS.

Interface With No. 5 Crossbar ETS

2.10 The 3A CC accesses and controls certain portions of the No. 5 Crossbar ETS through the 3A CC input/output (I/O) main channel and the distributor and scanner frame (DAS).

2.11 The I/O main channel is the means by which information is transmitted to or received from the other units of the processor. The I/O main channel provides serial AC data transfers at a bit rate of 6.67 mega bits per second, and has a 20-subchannel capacity. An I/O subchannel is provided to each main store controller (MASC), tape data controller (TDC), teletypewriter (TTY) controller, and certain system status and control panel functions.

2.12 The DAS performs interfacing between the 3A CC and the relatively low-speed peripheral equipment. The DAS is the buffer circuit through which inputs are received and from which outputs are transmitted to the peripheral equipment (excluding remote terminals and data sets). Serial data is converted into parallel data at the DAS for use by scanners and distributors.

Physical Description

2.13 The 3A CC is located in the upper midsection of each bay of the processor frame. The position on the frame provides the operator convenient access to the keys and switches on the 3A CC control panel which controls the 3A CC and the system. The 3A CC is 23-1/2 inches wide, 12 inches high, and approximately 14 inches deep. Basically, the 3A CC consists of the logic unit and the control panel.

2.14 All interconnections between the 3A CC and other units are accomplished by one of the following types of cabling. The first type of cable is a 30-gauge, 31-conductor flat ribbon cable; the second consists of coaxial cable. Both types of cable require a connector and paddleboard assembly at each end. Coaxial cable with a subminiature RF-type connector may also be used in the interconnection of certain units.

2.15 The *control logic unit* uses a 12-inch mounting plate as the necessary structure for mounting eight 80A apparatus housings. These housings hold the 3A CC logic unit circuit packs.

2.16 The *control panel* consists of a 12-inch by 23-1/2 inch plastic panel, silk-screened black with the appropriate nomenclature. The panel includes the following apparatus:

(a) Status indicator lamps and switches

(b) Light-emitting diodes (LEDs) which display the data or address of the memory or register

(c) Register select switches for loading or display purposes

(d) Switches for selecting a particular manual function.

The panel is mounted on an aluminum frame and has a printed wiring board which supports all the apparatus and circuitry necessary for the control panel to function. The entire assembly is hinged to the side brackets of the 3A CC logic unit to provide access to the circuit packs within the unit. Most of the interconnections between the panel and the rest of the 3A CC are accomplished by means of a connectorized flat tape cable assembly. Some interconnections are by the coaxial cable type.

B. Main Store

Purpose

2.17 The main store is the means of storage for the program instruction and data used by the 3A CC to direct and control system action. Each 3A CC, I/O control circuit, store bus, and associated main store(s) forms a control unit (Fig. 5) and is duplicated for system reliability. Each control unit is a switchable entity and contains at least a partially equipped main store as its memory.

2.18 The following definitions are useful in understanding terms used in this description of main store (MAS).

- *Main Store:* The main store is a data storage system consisting of a controller and up to eight memory modules.

- *Main Store Controller:* The main store controller is the circuit used for timing, control, addressing, and data buffering needed in the store operation.

- *Main Store Memory Module:* A main store memory module is a group of memory planes and associated access and detection circuits constituting 32K 18-bit words (where K=1024).

- *Memory Plane:* The memory plane is a group of memory cells and associated circuits mounted on a circuit pack.

- *Memory Cell:* Memory cells are integrated circuits actually used for data storage.

- *Random Access Memory (RAM):* RAM is an organization of memory cells allowing read or write operations on any memory word during any allowable memory cycle. The sequence of the word addresses in time can be completely random.

- *Double Store Read:* Double store read is the ability of the processor to initiate a new store read operation, at the same address in the standby store, if a parity error is detected when a word is read out of the active store. If the parity is good when read out of the standby store, the processor will use the data read out of the standby store and continue to process instructions from the active store without any immediate corrective action.

- *Complement Correction:* Complement correction allows the use of a location that has a single stuck bit in it that causes bad parity when read. The bits of the word are complemented and then written back at the failed location. The data is therefore stored in a correct but complemented form. When the data is read, two parity errors are detected and all bits out of the location are recomplemented to obtain the correct data. This is referred to as the *automatic correction mode.*

- *Write Protected Memory:* Write protected memory is a block of memory that cannot be rewritten as long as it is protected. Each block constitutes 4K of memory. The block is protected by setting its dedicated bit in a write-protect register. All the information in that block is protected until the write protect register is rewritten.

- *Volatile Memory:* A volatile memory is a memory that loses information when electrical power is removed.

- *Dynamic Memory:* A dynamic memory is a memory with a data level decay characteristic such that it must be periodically refreshed to retain information. This type of memory normally dissipates less power than other types of semiconductor memory.

- *Nondestructive Readout:* A nondestructive readout detection does not cause any alteration of memory information when accessed.

- *Access Time:* The access time is the time required between the initiation of a store command and the availability of output data.

- *Cycle Time:* Cycle time is the minimum time interval between successive store commands.

- *Asynchronous Store Operation:* Asynchronous store operation means that store timing is initiated by a processor command, but the response from the store does not occur in a predefined time period.

Broad Functional Overview

2.19 The main store is located below its dedicated 3ACC and may be either a 4K- or 16K-bit chip configuration. The main store contains a main store controller and a main store memory, ranging in size from 32K to 256K words of storage (where K=1024 words). The memory is growable in increments of 32K word modules, and is subdivided functionally into the program store and call store. The program store contains the generic program and translation data, and the call store is a temporary memory used by the 3A CC as a means of storage for transitory data.

2.20 In normal operation, the active 3A CC keeps the standby call store up-to-date. The active 3A CC not only writes into its own call store, but into the call store of the other 3A CC as well. This is done to keep the standby control unit ready to take control from the active control unit in case of a switch and to keep the standby main store available for a double store read operation.

2.21 The main store is a dynamic, volatile, semiconductory type of storage. If total power failure occurs, a "bootstrap" operation is performed which is the reloading or rewriting of the information into the memory from the backup tape system.

2.22 The 3A CC starts a store operation by sending the store a "GO" command. Once the store recognizes the "GO" command, the store initiates timing to execute the command. The maximum time in which the store has to return the information to the 3A CC is approximately 96 microseconds to prevent a time-out. The normal command execution time of the store is a maximum of two memory cycles, and this only occurs if the main store has started a refresh cycle of the dynamic memory prior to receiving a normal read or write order; otherwise, the store commands are executed in one memory cycle.

C. System Status Panel and Controller

General

2.23 The system status panel (SSP) and the system status panel controller (SSPC) provide the interface between maintenance personnel and the processor. The SSP and SSPC are not duplicated units within the processor complex since they perform no function in call processing. The SSP provides the means to monitor and control the status of the entire processor complex (with the exception of the PDI). The SSPC provides the interface between the 3A CC and the SSP.

Physical Description

2.24 The SSP and SSPC are housed in the upper midsection of the maintenance frame (Fig. 6). Only the SSP is viewed since it mounts in front of the SSPC. The SSP is hinged to the side bracket of the SSPC, and a magnetic latch on the panel keeps it securely closed. The circuit packs of the SSPC are easily accessed by opening the SSP.

2.25 All interconnections between the SSPC and other units are accomplished by (1) a 30-gauge, 31-conductor flat ribbon cable, (2) cables consisting of twisted pairs, and (3) coaxial cables.

System Status Panel

2.26 The majority of the processor complex visual alarm indicators are located on the SSP. Panel devices, supported by the printed wiring boards, include the following:

(a) Lamp and light emitting diode (LED) displays which show the status of the system, including certain alarm conditions, system control status, and certain peripheral equipment conditions

(b) LEDs for displaying memory or scanner readings in manual testing

(c) Key/lamps for controlling system control status

(d) Key/lamps for manually selecting and initiating system initializations.

2.27 The SSP is broken down into two major areas: The *System Status and Control* which reflects the general system condition and the *System Emergency Manual Control* which is used to initialize a system via manual intervention during an emergency situation.

System Status Panel Controller

2.28 Since the SSPC is the interface between the SSP and the rest of the processor complex, it enables communications between the 3A CC and local maintenance personnel via the SSP.

2.29 The SSPC to 3A CC I/O interface contains the necessary registers, transmit and receive transformers, parity checker and generator, etc, to allow communication between 3A CCs and the local SSP.

D. ETS Status Panel

2.30 The ETS Status Panel (ETSSP) includes the following equipment:

(a) Light emitting diode(s) (LEDS) displays which show the status of the DAS groups and peripheral equipment.

(b) Switches which provide control of peripheral equipment.

(c) LEDS to indicate alarm conditions.

2.31 Major alarm indications and control are provided on the ETSSP for the DAS group watch dog timer (WDT) and for the PBX AIOD buffer connector and control circuit (PBX-AIOD BCC).

2.32 Fuse alarm indications are provided for +5, ±15, +24, and −48 volt power supplies

located on the power and data interface (PDI) frame.

Physical Description

2.33 The ETSSP is located in the upper middle section of the right bay of the ETS PDI frame as shown in Fig. 7. The position of the ETSSP on the frame allows convenient visual and manual access to the panel.

E. Terminals and Teletypewriter Controllers

2.34 Maintenance and administrative access to the processors is provided via four types of terminals. These include two types of maintenance terminals (Type A and Type B), a recent change (RC) terminal, and a traffic (TF) measurements control terminal. Four teletypewriter (TTY) controllers (TTYC 0-3), mounted on the processor maintenance frame, constitute the interface circuits for these terminals (Fig. 6).

2.35 The maintenance "A" terminal receives all system-type messages while maintenance "B" terminal receives "per call" type error reports. The two maintenance terminals serve as back-ups for each other as well as for the RC and TF terminals.

2.36 The RC terminals can make line assignment changes and interrogate all translations. All other recent changes, such as routing, must be made from maintenance "A" or "B" terminal. The TF terminals can specify the traffic count outputs and can interrogate the machine translations but may not change them. The RC and TF terminals are optional.

2.37 Each processor has access to each TTYC. MTCE A terminal is on TTYC 0; MTCE B terminal is on TTYC 1; the RC terminals are on TTYC 2; and the TF terminals are associated with TTYC 3.

2.38 Each TTYC has four ports so that up to four terminals can be provided on each TTYC. These terminals may be local or remote. All terminals on a TTYC must operate at the same data rate which is selectable at either 110 or 300 baud. TTYs (35-type) and DS40s can be intermixed on a controller but then must operate at 110 baud. When a controller serves only DS40s, the data rate can be set to 300 baud.

2.39 The recommended local MTCE A terminal is DS40 KD-ROP (keyboard display-read only printer). A DS40 KD-ROP terminal is required for MTCE B. This terminal is also used for data base generation.

2.40 In offices operating under *generic 2 and subsequent generic issues,* terminals assigned to RSIs can be operated at higher speeds than the 300 baud rate currently available on TTYCs. A DS40 with a tractor-feed printer can be run as high as 2400 baud on an RSI. If data sets are used with the terminal, there may be a speed restriction imposed by the data set. The 212A data sets are restricted to 300 or 1200 baud. The 202T data sets operate up to 1200 baud without conditioned lines and up to 1800 baud with conditioned lines. If the terminal is connected to the RSI via a null modem, 2400 baud is possible. Most applications are expected to be 300 or 1200 baud.

F. Tape Data Facility

General

2.41 The tape data controller (TDC) and the tape cartridge (TC) provide a memory backup facility for the ETS. If the volatile semiconductor main store (MAS) becomes mutilated, it is automatically reloaded from information stored on the tape cartridge.

2.42 The TDC provides the read/write circuitry, control circuitry, and drive mechanism for the tape cartridge. The tape cartridge is a magnetic tape storage device for the duplicate MAS information and the information required to reload the MAS.

2.43 If the MAS information is destroyed, the processor microprogram control circuitry is alerted by hardware error detection circuits and/or a free-running software resetable timer having reached a time-out count. The microprogram control sends orders to the TDC that starts the reloading of the affected MAS from information stored on the magnetic tape.

2.44 There are two TDCs located with the 3A processor. The TDCs are designated 0 and 1, and are assigned to the 3A CCs designated 0 and 1, respectively. The control interface between the 3A CC and the TDC allows either 3A CC to interface with either TDC, or with both TDCs (Fig. 8). However, the bootstrap loader of TDC0

only works with processor 0 and the bootstrap loader of TDC1 only works with TDC1.

Physical

2.45 Each TDC is installed on an 8 by 12 by 23 inch mounting plate. These plates are located on the maintenance frame (Fig. 6).

2.46 The TDC consists of a tape data controller circuit, tape data controller power supply, and a cartridge tape transport. A tape cartridge is used with the TDC as the data storage device.

2.47 The tape cartridge consists of a case 4 by 6 by .66 inches and houses 300 feet of 1/4-inch wide 4-track magnetic tape, drive system, and sensing and protection devices. Hole patterns placed at appropriate locations on the tape allow for beginning, ending, early warning, and load point sensing. A mirror mounted in the case directs light through the hole patterns to sensors in the cartridge tape transport. It is possible to write-protect tracks 2, 3, and 4 by rotating the file protect plug to the SAFE position. Track 1 is always write-protected.

G. Power and Data Interface Circuit

2.48 One power and data interface (PDI) circuit, SD-28114-01, is required for each No. 5 ETS installation. The PDI circuit is mounted on a 2-bay frame 7 feet high, 52 inches wide (Fig. 9), and is located in the line-up for the processor complex. The PDI contains the following equipment.

- −48 volt and ±24 volt power converters for the 3A processor complex and PDI relays.

- +5.3, +15, and −15 volt power converters for PDI-contained data sets, serial-parallel interface, and regular serial (RS) type interfaces.

- Data Base generator interface.

- Status and alarm controls.

- Means are provided on the PDI to remove No. 5 crossbar control circuits associated with each DAS group from service, either by failure of the watch-dog timer or under individual key control. Make-busy and alarm release of the PBX-AIOD buffer control

and connector circuits is also controlled from the PDI.

2.49 It is necessary to convert serial data received from the 3A CC into parallel data prior to sending data via data sets to AMARC. The conversion is accomplished in the PDI, using an input/output sub-channel interface, comprised of a serial-parallel interface (SPI), in conjunction with an RS-232C interface (RSI). The SPI handles the serial-parallel conversion and the RSI provides the necessary interface into the 202S, 202T, or 212A data sets (Fig. 10). One SPI may receive data from either processor 0 or 1 and serves 4 RSIs. There may be a maximum of 6 SPIs.

MARKER DISTRIBUTOR CONTROL CIRCUIT

2.50 One marker distributor control (MDC) circuit, SD-28115-01, is required for each completing marker as an interface between distribute points and the completing marker. Distribute points provide information on a 2/5 or 2/6 basis to the MDC which checks, then converts the information into 1/x for operating relays in the completing marker. Sequential events are also received from the distribute points and controlled in the MDC.

2.51 The MDC requires 18 inches of relay rack space and may be mounted on miscellaneous relay rack frames. Lead lengths must be kept within those specified for ETS.

DISTRIBUTOR AND SCANNER EQUIPMENT

2.52 The interface between the No. 5 crossbar switching equipment and the processor complex is the distributor and scanner (DAS) equipment (Fig. 1). Scan points are the data inputs to the 3A CC and convert noisy battery-ground signals of the electro-mechanical circuits to the low-level, noise-free signals required by the processor. Scan point inputs consist of single high impedance leads which are bridged onto the existing electro-mechanical circuits (Fig. 11).

2.53 Distribute points (Fig. 12) are the output control devices for the 3A CC which convert the low-level processor signals to the −48 volt signals required by the electro-mechanical circuits. Each distribute point contains a latching device which drives a circuit-pack-mounted, mercury-contact relay. The contact of this relay is the distribute output.

In most cases, distribute points are used to operate relays in the electro-mechanical environment.

2.54 Scan points are grouped into scan matrices of 256 points (16x16), while distribute points are grouped into distribute matrices of 64 points (4x16). Two matrices, plus their respective access circuit packs are mounted on the same plate to form one unit—scan-scan matrices or scan-distribute matrices. A maximum of ten units form one DAS group.

2.55 An access circuit is associated with each matrix. The scan access circuit provides the address fan-out and control signals to read the state of 16 scan inputs onto the data lines of the interconnecting bus. The distribute access circuits generate the clock signals that load the 16 data bits into a row of distribute points.

2.56 One DAS group provides the necessary DAS equipment for one dial tone marker and one completing marker, plus portions of the units required for lines, trunks, and miscellaneous functions. One DAS frame is required for each two completing markers. A maximum of 12 DAS groups on six DAS frames may be provided (Fig. 13). The DAS frame is 11'6" high, 2'9" wide—the size of a standard No. 5 crossbar frame. Also associated with each DAS group is a group scan-distribute controller, with associated power, and fusing.

2.57 The scan-distribute controller interfaces the processor and the scan-distribute units by converting the 3A CC serial address and data into parallel addresses and data for use by the scan or distribute access circuits. A block diagram of the typical passage of address and data between scan and distribute points and the 3A CC is provided in Fig. 14.

2.58 The scanners and distributors used in the ETS are as follows:

- **Dial Tone Marker Scanner (MKS-).** One scanner is provided for each dial tone marker. The calling line location (LLF, VG, HG, VF), marker progress, and control information is passed from the marker to the MKS-. This scanner is a part of MKS-B and is shared with a completing marker.

- **Dial Tone Marker Distributor (MKD-).** One distributor is provided for each dial tone marker. Type-of-line mark (MAN, CN, etc) relays are operated in the marker via the operation of associated distribute points. This distributor is shared with a completing marker.

- **Completing Marker Scanner (MKS).** Two scanners are required for each completing marker (MKS—A, MKS—B). MKS—B is shared with dial tone markers in DAS groups 0 - 5. When handling originating calls, the marker operates scan points associated with the calling line location, called number, translation marks received from the originating register, marker progress, and on centrex transfer calls, the class of service. When handling incoming calls, the incoming trunk class, trunk number, translation marks from the incoming register, and the called number scan points are operated.

- **Completing Marker Distributor (MKD-).** Four distributors, (MKD—A, B, C, D) are required to operate relays in one completing marker. MKD—D is shared with dial tone markers in DAS groups 0 - 5. When handling originating calls, relays in the marker are operated by distribute points associated with the selected trunk location and outsender group. When handling terminating calls, relays in the marker are operated by distribute points associated with the called line location, ringing combination, and called number.

- **Line Scanner (LIS-).** Line scanners are used to determine the condition (busy/idle) of a subscriber within a hunt group by observing the sleeve lead for each line. When a line is busy, ground on the sleeve lead operates an associated scan point. Each line scanner may accommodate 256 lines, and there may be a maximum of 32 line scanners provided.

- **Trunk Scanners (TKS-).** Scan points in the trunk scanner are used to observe the trunk supervision (CS, S1) and busy/idle condition (FT). A trunk may have one to three scan points assigned, depending upon the type of trunk. The trunk scanner is divided into three parts and the scan points

associated with a trunk must have the same bit number and be located five rows apart in the scanner. Referring to Fig. 15, recordable trunk "A" has its S1 scan point at bit position 05, row 00; its CS scan point at bit position 05, row 05; and its FT scan point at bit position 05 row 10. Assignments of IN-WATS or CAMA trunks as well as trunks that handle non-recordable calls, are also shown in Fig. 15.

- *AIOD/CAMA Scanner (ACS-).* The AIOD scanner receives the information on AIOD calls from the PBX AIOD buffer connector and control circuit (PABCC). Scan points associated with progress and trunk conditions as well as the trunk number, and the thousands, hundreds, tens, and units digits of the directory number, are operated. This scanner is shared for the CAMA feature. The CAMA scanner receives information from the programmed controlled transverter (PCTV) for CAMA on incoming CAMA calls. Scan points corresponding to the calling line and trunk identification are operated.

- *AIOD/CAMA Distributor (ACD-).* Distribute points in the AIOD distributor are used to pass to the PABCC, the AIOD trunk number making the call for translation into a directory number. This distributor is shared for the CAMA feature. The CAMA distributor receives information from the 3A CC. Distribute points are operated which provide control signals to the PCTV and CAMA sender.

- *ANI Scanner (ANS-).* The ANI scanner (which is part of system ANI scanner matrix [SAS]) receives information from the PCTV for automatic number identification on calls to TSP/TSPS. Scan points corresponding to the calling line location are operated. This scanner is shared with the system control scanner and contains the scan points associated with system control, network measurements control, and test functions.

- *ANI Distributor (AND-).* The ANI distributor which is part of system ANI distributor [SAD]) receives information from the 3A CC. Distribute points are operated, which in turn, operate relays in the PCTV corresponding to the calling billing number. This distributor is shared with the system

control distributor and contains the distribute points associated with system control functions.

- *Hotel/Motel Scanner (HMS-).* The hotel/motel (H/M) scanner is used to verify the operation of distribute points on H/M-type calls.

- *Hotel/Motel Distributor (HMD-).* Distribute points dedicated to hotel/motel lines are operated by the 3A CC, to operate or score remote message registers (RMR) at the hotel/motel premises.

- *Sytem Control Scanner (SCS-).* The SCS (which is part of the SAS matrix) contains the verifying scan points associated with system control, traffic distributor control, and test functions.

- *System Control Distributor (SCD).* This distributor (which is part of the SAD matrix) contains the distribute paints associated with system control functions.

- *Test Scanner (TTS-).* The test scanner contains the verifying scan points for the interface circuit for program controlled data acquisition (ICPDA), the line insulation test (LIT) circuit and the ETS originating test line.

- *Test Distributor (TTD-).* The test distributor contains the distribute points associated with the PCDAI, the LIT circuit, trunk test supervisory indication, and the ETS originating test line.

- *Measurements Registration Distributor (MRD-).* The measurements registration distributor contains the distribute points associated with controlling traffic counts for the system.

- *Route Transfer Control Scanner.* The RTC scanner contains scan points associated with RTC. These scanners are a part of SAS 0 and 1.

LOGICAL FUNCTIONS VERSUS PHYSICAL MATRICES IN SCAN AND DISTRIBUTE UNITS

2.59 In ETS, many of the logical functions, such as marker scanning, use several scan matrices. By the same token, one scan or distribute matrix

may be associated with several logical functions, such as completing marker scan matrix "B" is associated with completing marker scanning, dial tone marker scanning, and unit make-busy scanning. Figure 16 illustrates the relationship between logical functions and their associated physical matrices.

2.60 Because of this many-to-one and one-to-many phenomenon, it is necessary that both matrices and logical functions be acted upon for make-busy conditions. This interaction is handled by the processor and associated hardware, but must also be kept in mind when removing matrices from service. For ETS to process any given function, both the logical function and all required matrices (scan and distribute) must be in service.

DATA SETS

2.61 The interface between the No. 5 ETS and the AMA recording center (AMARC) is via data sets (Fig. 17). The communication with AMARC is via 1200 baud, one-half duplex data links using 202T data sets. Provisions are made for as many as five primary data links. One dial back-up link using a 202S data set is provided for use in event of failure of a primary data link. Dial back-up connections are originated at AMARC, therefore No.5 ETS is required to provide automatic answering capabilities. When automatic trouble analysis (ATA) is added to No. 5 ETS with *generic two and subsequent generic issues,* the 212A data set will be used for dial back with a 1200 baud rate and full duplex operation.

2.62 The 202S, 202T, and 212A data sets are mounted in the power and data interface (PDI) frame.

TRUNKS AND JUNCTORS

2.63 All trunks in the office must be modified to pass either busy/idle conditions and/or supervisory signals to the processor. Since trunk selection is made by the processor, the busy/idle condition of the trunk must always be known. This is accomplished by connecting a scan point to the FT lead in the trunk (this does not include incoming trunks). Scan points may also be attached to the S1 and CS (or equivalent) relays in the trunk to determine answer and disconnect supervision.

2.64 All trunks do not require three scan points. Trunks that handle non-recordable calls

require only an FT scan point. IN-WATS or CAMA trunks (incoming) require S1 and CS scan points. CAMA junctors or trunks that handle recordable calls require S1, CS, and FT scan points.

PBX-AIOD BUFFER, CONNECTOR AND CONTROL CIRCUIT

2.65 The PBX-AIOD buffer, connector and control circuit (PABCC), SD-28086-01, provides the interface and control between the DAS-3A CC and AIOD translator. When the office is arranged for AIOD, two PABCCs are required.

2.66 The processor operates distribute points corresponding to the line number assigned to a particular PBX line. The operated distribute points operate corresponding relays in the PABCC, which in turn passes the line number to the AIOD translator. When the station identification frame passes the PBX station number to the AIOD translator, corresponding relays are operated in the PABCC which in turn operate scan points in the DAS.

2.67 Overall timing is provided in the PABCC in event troubles are encountered during the electro-mechanical translation. Error reports are printed at the TTY, listing the trouble conditions.

DIAL TONE MARKERS

2.68 Dial tone markers, SD-26001-01, are modified to pass the line location (LLF, VG, HG, VF) of the calling line to the dial tone marker scanners. The class of service is no longer read from cross-connections on the line link frame, nor passed to the originating register. The processor determines the class of service for the given line location and, after determining the type of line (Table B) from the class of service, passes the type of line to the marker via distribute points, which in turn passes the calling line location and the type of line to the originating register.

COMPLETING MARKERS

2.69 Completing markers (SD-25550-01, SD-26002-01) are no longer required to perform the following functions:

- Route translation

- Screening (route and class of service)

TABLE B

Location 'LC_X1DTM' in the LCTT table indicates one of seventeen translation marks to be distributed to the dial tone marker.

LC_X1DTM	TRANSLATION MARK	MEANING
0	Not Used	
1	AO	All Others
2	CN	Coin
3	MAN	Manual Lines
4	2P	Two Party
5	MCN	Manual Coin Lines
6	PKI	Same as PBX7 or WBT. PBX(7 Digits for Intra-PBX)
7	AC8	Access 8
8	NCSL	No Console
9	PBX	PBX Lines With Direct Switching
10	PBX5	PBX(5 Digits for Intra-PBX)
11	PLNC	Private Line Network-No Console
12	PLN	Private Line Network (4 Digits for Intra-PBX)
13	PLN5	Private Line Network (5 Digits for Intra-PBX)
14	PLN7	Private Line Network (7 Digits for Intra-PBX)
15	AOMR	All Others With Message Registers
16	2PMR	Two-Party With Message Registers
17	MPL	Manual Private Line (Cut-Through Immediately on Digit 8)
18-31	Unassigned	

Location 'LC_X2DTM' in the LCTT table indicates none or one of three translation marks to be distributed to the dial tone marker.

LC_X2DTM	TRANSLATION MARK	MEANING
0	None	
1	TAO	Treatment All Others
2	MPBX	Manual PBX
3	RV	Toll Diversion Reversal

- AMA functions

- Trunk selection (but will set the linkages to the selected trunk)

- Trunk routing

- Terminating translations and routing

- Route advance

- Traffic sampling.

2.70   The completing marker passes to the 3A CC, via scan points, the line location of the calling line, along with translation and progress marks. The processor then determines the route and the trunk to be used and passes this information, via distribute points, to the marker distributor control, then to the completing marker. The marker then makes the necessary channel selections and sets the linkage to the trunk, as well as establishing sender connections. The marker then goes through its normal release sequence. The type of line translation for the completing marker can be found in Table C.

PROGRAM CONTROLLED TRANSVERTER CIRCUITS

2.71   The program controlled transverter (PCTV) circuit, SD-28085-01, functions as an interface between the outgoing senders and the DAS - 3A CC on ANI-type calls. When the office is arranged for ANI operation, two PCTVs are required. When the office is arranged for CAMA operation, two additional PCTVs are required.

2.72   ANI.   The calling line location is passed from the outgoing sender by operating corresponding relays in the PCTV. The operated relays, in turn, operate scan points in the DAS. From the operated scan points, the processor translates the calling line location into a billing number. The billing number is then passed, via operated distribute points in the DAS, to operate corresponding relays in the PCTV. The PCTV in turn operates relays in the outgoing sender that correspond to the billing number.

2.73   CAMA.   The calling line location, called number, and trunk number are passed from the CAMA sender to the PCTV. The PCTV causes corresponding scan points to be operated in the DAS for the 3A CC. The 3A CC then controls

the release of the PCTV by signaling (via operated distribute points in the DAS) the sender to bid for a completing marker.

2.74   Overall timing and second trial features are provided. When troubles are encountered, error reports are printed at the TTY listing the trouble conditions.

REMOTE MESSAGE REGISTER CIRCUIT

2.75   The remote message register (RMR) circuit, SD-25770-01, provides an interface between the sleeve lead of a hotel/motel line and the DAS - 3A CC. Under control of the processor, a distribute point operates and releases a relay in this circuit which, in turn, supplies battery on the M- or S- lead to score a remote message register at a hotel/motel. The processor has the capability of 99 scores for a single call.

2.76   Each circuit is equipped to handle 16 registers. There may be a maximum of 32 circuits with the capability of handling 512 remote message registers. These circuits may be mounted on a miscellaneous relay rack frame.

PROGRAM CONTROLLED DATA ACQUISITION INTERFACE (PCDAI)

2.77   The PCDAI circuit, SD-27165-01, is used to interface the master test frame (MTF) trouble recorder with the 3A CC. The PCDAI contains a scan controller and a scan matrix. Leads from the scan points in the matrix are connected to the leads between the trouble recorder and the marker at the master test frame connector (Fig. 18).

2.78   The purpose of this configuration is to allow the 3A CC to verify all distribute points in the ETS that are used for call processing. The verification may be done automatically or on command from the maintenance terminal for all distribute points, or for a particular distribute point.

2.79   A diagnostic program causes the processor to operate a series of distribute points in the marker distributor, which, in turn operates corresponding relays in the marker distributor control circuit. After converting from 2/x to 1/x, corresponding relays are operated in the marker. The condition of the marker relays is seen on the trouble recorder leads by operated/released scan

TABLE C

Location 'LC_X1CM' in the LCTT table indicates one of seven translation marks to be distributed to the completing marker.		
LC_X1CM	**TRANSLATION MARK**	**MEANING**
0	Not Used	
1	AO	All Others
2	CN	Coin
3	DLT	Dial Transfer Four Digit
4	5DLT	Dial Transfer Five Digit
5	7DLT	Dial Transfer Seven Digit
6	MLT	Manual Transfer
7	CGS	Customer Group Service

Location 'LC_X2CM' in the LCTT table indicates a particular translation mark to be distributed to the completing marker		
LC_X2CM	**TRANSLATIONMARK**	**MEANING**
0	None	
1	2WDC	Two Wire Network that Enables Echo Suppressors

Location 'LC_X3CM' in the LCTT table indicates one or none of three translation marks to be distributed to the completing marker.		
LC_X3CM	**TRANSLATION MARK**	**MEANING**
0	None	
1	MTR	Marker Trouble Release
2	HTR	Heavy Traffic
3	CNS	Coin Service

Location 'LC_X4CM' in the LCTT table indicates none or one of two translation marks to be distributed to the completing marker.		
LC_X4CM	**TRANSLATION MARK**	**MEANING**
0	None	
1	ADD	Add-on Customer
2	NAD	Nonadd-on Customer
3	Not Assigned	

points in the PCDAI. The 3A CC then reads the scan points and compares with the data originally set on the distribute points. In this manner, distribute points, leads, and portions of the MDC and completing marker may be checked.

2.80 THe PCDAI scanner controller is used to read, in sequence, the scan matrix - one row at a time - by the test distributor.

2.81 Network measurements taken by the No. 5 ETS are distributed to the data collection devices via the network measurement distribute matrix and the measurements registration circuit (MRC), SD-28116-01. The data collection devices include traffic registers, plant registers, and EADAS or vendor supplied devices. These are operated by output pulses from the MRC.

2.82 The network measurement distribute matrix contains 64 distribute points and performs two functions: (a) eight points are used to control the MRC connector relays; (b) 56 points are used to outpulse the data. The 56 output leads are multiplexed by 16 groups of connector relays to a total of 896 (16 × 56) measurement leads. The MRC can be equipped either with eight groups (448 leads) or the 16 groups (896 leads). Measurement counts are distributed to one group every 60 milliseconds. Each group is served once every 960 milliseconds.

2.83 Two words of memory are assigned to each measurement lead. One, called a scaling register word, is used to accumulate counts for the lead. The second, called a scaling factor word, indicates whether a specific lead is assigned and, if so, what the scaling should be. Scaling of one (no scaling), 10 (divided by 10), or 100 (divided by 100) can be provided.

2.84 Each lead is assigned a specific function in software. The first group of 56 leads is dedicated to plant register data. The remaining 15 groups are assigned to traffic register data on a per office basis as required.

2.83 In *generic 2,* PCDAI is also used for ATA.

3. SOFTWARE

GENERAL

3.01 This section covers *software,* which includes programs, tables, extended operating system, and buffers that either reside in processor memory or are called in from magnetic tape. These are used in the No. 5 ETS to accomplish tasks such as call processing, recent changes, diagnostics, audits, and administration. The software may be sub-divided into several categories - the extended operating system (EOS), the generic or application programs, data base, data base generation, and diagnostics.

EXTENDED OPERATING SYSTEM

3.02 The extended operating system (EOS) is an operating system created for the 3A processor to allow different applications to use the same physical machine design. This allows varied application programs to be written to work through one operating system.

3.03 The EOS, as in other operating systems, is responsible for the interaction of application programs or tasks and for performing the actions required for the completion of the tasks. A general overview of the functions of the EOS follows.

- *Clock Up-Date.* The EOS is responsible for the administration of a system clock. The time up-date function is performed each 10 milliseconds. The calendar up-date function is also performed under the EOS.

- *Scheduling of Tasks From Other Tasks.* One task may control the execution of other tasks. The EOS, through an event structure, is the means by which this is accomplished.

- *Furnishing Communications Between Tasks.* The EOS provides the capability of transferring information between application tasks. An example would be the transferring of required data from the Initial Entry program to the AIOD Handler program.

- *Peform Task Interface With Peripheral Devices.* A file system is used for the convenience of the application tasks input/output. To the tasks using EOS, all

devices appear the same, therefore the interface to all devices by application tasks is by a simple "read" or "write."

- **System Priority Queue.** An EOS queue is maintained on a priority basis to control the execution of the various tasks. Before a task may be executed, it must have reached a "ready" state. The task transitional states are:

(a) **Inactive**—Idle, no work.

(b) **Hold**—Upon activation, a task enters this state while attempting to reserve all resources it requires before execution begins.

(c) **Ready**—All conditions necessary for the execution of the task have been met—all data present and has been put on a priority queue for execution. When the task reaches the top of the queue, it is executed when the processor next becomes free.

(d) **Running**—The state of the task while being executed by the processor.

(e) **Suspended**—The state of the task which has been suspended by an accompanying task.

(f) **Wait**—The state of the task suspended while waiting the completion of some asynchronous event, such as the change of state of a particular scan point.

(g) **Interrupted**—When an interrupt occurs, the task in execution is suspended temporarily and placed in this state. Upon completion of the interrupt, the task is either returned to the running state or if the interrupt readied a higher priority task, is returned to the ready queue.

(h) **Completed**—Upon task completion, the EOS must delete various table entries and perform any necessary post-processing, such as statistics recording. During this period, the task is in this state.

APPLICATION PROGRAMS

3.04 The application programs are the software programs used in ETS to do the translations and control for call processing. The extended operating system (EOS) uses the application programs to perform the tasks required in each phase of the call processing.

3.05 The application programs are common to all ETS offices—only the parameters contained in the data base reflect the features and options peculiar to a given office.

3.06 The application programs or tasks may be grouped into several categories, as follows.

- **Common to System**—Tasks that may be used by other tasks are referred to as being common to the system, which includes scanning and distributing, clock control, error reporting, unit initialization, and alarm conditions.

- **Dial Tone Marker**—Tasks are provided for interpreting the dial tone marker scan points, performing a line translation, and the distribution of class of service translation marks to the dial tone marker.

- **Completing Marker**—Tasks are provided for interpreting marker scan points, performing a data check and conversion, doing a number analysis, network management, and distributing translation marks to the completing marker.

- **Route Translation**—Tasks are provided to select a particular route for completion of a call, and for providing various data to completing markers. (Route translation indicates if terminating translation is required on an incoming tandem or IAO call.)

- **Terminating Translation**—Tasks are used to translate a called directory number into a particular line location. This includes 2-line hunting, multi-line hunting groups, and line link pulsing.

- **Automatic Message Accounting (AMA)**—The tasks for AMA include trunk scanning for answer and disconnect supervision, billing treatment, formatting completed calls into a single line entry format, remote

message register (RMR) operation for hotel/motel, automatic number identification (ANI), automatic identification of outward dialed (AIOD) calls from a PBX, and centralized AMA (CAMA).

● *Testing*—Tasks are provided for testing ANI, CAMA, AIOD, and RMR. Additional tasks are used to provide a printout of the data contained in dial tone marker, completing marker, AIOD, and ANI software buffers on test calls. The contents of the trunk registers can also be printed out on test calls.

● *Diagnostics*—Tasks are provided for diagnosing the distributors and scanners for correct addressing, open leads, false responses, etc.

● *Data Base Generation*—Tasks are provided for manually generating part of the data base and office parameters for a particular office. Additional tasks provide the capability of automatically generating parts of the office data base. (These tasks are not part of the application or generic programs.)

● *Recent Changes*—Tasks are provided to change the office data base tables for subscriber lines, trunk reassignment, adding of new equipment, billing, routing, and network management.

● *Cartridge Tape Administration*—Tasks are provided for generating and up-dating the cartridge tapes used in system initialization. This also includes tape administration for data base generation, updating recent change information, and generating back-up cartridge tapes.

● *Audits*—Tasks are provided to verify manually or automatically, data base tables for write protection, out of range conditions, duplicate entries, etc.

● *Office Record Administration*—Tasks are provided for maintaining, administering, updating, and printing single table office record forms and multiple table office record forms.

Note: The following tasks are provided in No. 5 ETS offices operating under *generic 2 or subsequent generic issues.*

● *Dial-Up Capabilities*—Tasks are provided to permit secured dial-up capabilities for terminals in remote locations.

● *Automatic Trouble Analysis*—Tasks are provided to forward to automatic trouble analysis (ATA) centers trouble record information, EOS and ETS air reports, and upon request, data dumps and table printouts.

BUFFERS

General

3.07 **Buffer** is the term used to indicate a temporary, changeable, write-unprotected, storage area in software. Data may be stored in buffers on a per-call basis or stored for a given circumstance.

3.08 Buffers are used within the extended operating system, the application programs, and as a part of the data base. To provide a better understanding of call processing, only the buffers associated with the application programs and the data base are covered. Also not covered are small buffers contained within particular application programs for the purpose of scratch pad or data manipulation.

3.09 The use of a buffer may fall into one or more of the following:

● Temporary storage area

● Scratch pad for data manipulation

● Interface between application programs

● Interface between scan-distribute points and application programs

● Used on a per-call basis

● Not write-protected.

Application Program Buffers

3.10 There are six primary buffers associated with the application programs (this does not include small, internal program buffers used only while the program is being executed.) The buffers are: dial tone marker, completing marker, ANI, AIOD, formatted call record, and last look memory. Additional buffers include the auxiliary test buffer and the trunk dump message buffer. Buffers found under generic 2 are the dial-up buffer and the ATA buffers.

- **Dial Tone Marker Buffer** (one per marker) is used as a scratch pad area for determining the type of call translation marks on a per-call basis.

- **Completing Marker Buffer** (one per marker) is used as a storage area, scratch pad area, and is used by programs associated with billing, routing, and trunk selection. Each program uses data from the buffer to access data base tables for particular data, then stores the data from the data base tables into the buffer for use by other programs to complete the call processing sequence. The data remains in the buffer until the marker has been released from the call and is idle.

- **ANI Buffer** (one per PCTV) is the software interface between the sender-PCTV and the 3A CC.

- **AIOD Buffer** (one per PABCC) is the software interface between the PABCC and the 3A CC.

- **Formatted Call Record Buffer** is used to store the formatted call records prior to transmittal via data links to AMARC.

- **Last Look Memory Buffer** is used to store the last state of certain control scan points. A change of state indicates further action is required for a given task in call processing.

- **AUXTST—Auxiliary Test Buffer.** This buffer is used to collect information from the terminal that is pertinent for test calls to be made from the master test frame.

- **TRKTRAIL—Trunk Dump Message Buffer.** This buffer contains information relative to the dumping of trunk register.

Note: The following buffers are provided in No. 5 ETS offices operating under **generic 2 and subsequent generic issues.**

- **DUBUF—Dial-Up Buffer.** This buffer is used for both originating test line tests (line scan point test) and for establishing dial-up operations.

- **ATA Buffers—Automatic Trouble Analysis Buffers.** Three buffers are provided to store data prior to transmitting to ATA. These buffers are the trouble record buffer, the thresholded error message buffer, and the non-thresholded error message buffer.

Data Base Buffers

3.11 There are three buffers used for storage that are associated with the data base. The buffers are: distributor and scanner, trunk register, and remote message register.

- **Distributor and Scanner Buffer** is used to store the information received from scan points (or the state of the scan points—operated/released) and the state of distribute points (operated/released)....i.e. all data from the completing marker to the processor is via leads from the marker to scan points which are operated or released. The state of the scan points are stored in completing marker scan buffers. Data passed to the completing marker from the processor is from operated distribute points to the marker distributor control, then to the completing marker. An image of the states of the marker distribute points is maintained in the completing marker distribute buffer.

- **Trunk Register Buffer** is used to store data previously compiled in the trunk register for a specific call. The data is stored until a format program converts the data into a single entry call record (which is then stored in the formatted call record buffer.)

- **Remote Message Register Buffer** is used to keep track of the time, overtime,

and register scoring (or pulsing) for hotel/motel remote message registration.

DATA BASE

A. General

3.12 The office data base in No. 5 ETS is defined to be that portion of software data which varies with the installation in size, in control, and in address. The data base also contains the software tables used to maintain status of various functions, tables to be used in originating and terminating translations, tables for routing, and tables for billing. The data base is unique to each office and is generated at the time of installation of ETS by the installation division.

3.13 A table in software contains rows of binary (0 or 1) words, 16 characters in length and as many rows as needed to define the function of the table. The words may be on a 2-out-of-5 basis, 1-out-of-X basis, or a single bit to indicate an action or condition. Figure 19 contains an example of the format and the stored data found in the line translation expansion table (LINTEXP) for an automatic identified outward dialed (AIOD) line.

3.14 The translation for the LINTEXP entry found in Fig. 19 is as follows.

- **Row 00.** The compressed office code (COC) is 44, the AIOD translator number is 0, the trunk units digit is 5 (listed on a 2-out-of-5 basis), and the line type is AIOD (indicated by a 2 in the LX-TYPE entry).

- **Row 01.** The line is not on trap, complaint observed, service denied, nor entitled TOUCH-TONE® service. The line class number is 314.

- **Row 02.** The listed directory number is 7125 (listed in binary coded decimal—BCD).

- **Row 03.** The trunk number is 3945. This number is listed on a 2-out-of-5 basis with the units digit (5) being found in bit positions 3 through 7 in Row 00.

- **Row 04.** No entries.

3.15 The data base may be divided into the functions performed and their associated tables—system status and administration, originating translation, terminating translation, route translation, billing translation, trunk selection, hunting groups, line and trunk mapping, and miscellaneous.

3.16 The means by which the generic program interfaces with the variable data base is accomplished by use of a table directory (TABDIR).

- **TABDIR - Table Directory.** TABDIR has an entry for every possible table for a particular installation. It indicates whether a table is provided for that particular installation, the size of the table for that particular installation, and the address where the table is located in memory for that particular installation.

B. System Status and Administration Tables

3.17 All addresses in memory for the following tables are given as offsets from the start of the appropriate table as given in TABDIR.

- **OPT - Office Parameter Table.** OPT describes the No. 5 office being served by ETS. It contains hardware quantities (number of markers, trunks, etc) and other options needed by the ETS generic program for processing calls.

- **LSTAT - Logical Status Table.** LSTAT of ETS. These include logical entities, such as a completing marker, a trunk scanner, an ANI buffer, and a remote message register sub-group.

- **PSTAT - Physical Status Table.** PSTAT contains information relating to physical scan and distribute DAS units.

- **MATCH—Matching List.** This table is used to store telephone numbers or line locations that are to be matched during call processing for calling line identification, maintenance trace, and CAMA code check. This table also stores information relative to code blocking.

- **PAGMAP—Page Update Map.** This table is used to store office record page numbers that have been affected by recent change.

● *CALLBACK—Call Back.* This table is used to provide the characteristics associated with a dial-up connection for remote terminals. *This table is found in generic 2 and subsequent generic issues.*

● *MLA—Measurement Lead Assignment.* This table is used to specify leads in the message register connector (MRC) circuit on which peg and overflow counts are distributed.

● *MSF—Measurement Scale Factor.* This table provides the scale factoring which is to be applied for a given measurement.

C. Originating Translation Tables

3.18 The tables described in this part are used for determining line and trunk information for their respective equipment locations on the line link frame (LLF, VG, HG, VF). Figure 20 presents a functional view of originating translation.

● *VGDIR - Vertical Group Directory.* VGDIR, as shown in Fig. 20 is indexed or accessed via the LLF number and the VG number. The information within the table for a particular LLF and a particular VG is an address or offset into the line translation table (LINT).

● *LINT - Line Translation Table.* LINT is indexed from the VGDIR and by software computations using the HG and VF. At each particular HG and VF, the information relative to a particular LEN is to be found. Due to the many types of lines, it is necessary to use additional tables to store information relative to the LEN. The LINT entry for a basic LEN contains the following data.

(a) whether or nor the line is on line trap, complaint observed, or service denied, the billing number is the same as the directory number, may be tested using the LIT circuit, and if TOUCH-TONE.

(b) Compressed office code (a two-digit number corresponding to the office code).

(c) The thousands, hundreds, tens, and unit digits of the billing station number.

(d) The high three bits of an 11-bit class. (The other 8 bits of the line class are contained in the auxiliary line translation table (AUXLNT). The 11 bits translate to one of 2000 classes of service.)

When the line is assigned to 2-party, AIOD trunk, or hotel/motel (remote message register) subscribers, additional information is required. Only data indicating 2-party, AIOD, or hotel/motel line, plus an offset or pointer into the line translation expansion table (LNTEXP), is given in the LINT.

● *AUXLNT - Auxiliary Line Translation Table.* AUXLNT contains only the lower 8 bits of an 11-bit line class for a particular LEN and is used in conjunction with LINT.

● *LNTEXP - Line Translation Expansion Table.* LNTEXP contains the information ncessary for translation of 2-party, automatic identified outward dialed (AIOD), and hotel/motel (remote message register operation) lines. The format for each type differs since the information required for each type is not the same.

(a) Two-party format - individual information for tip party and ring party.

 1. Line trap, complaint observed, service denied, and billing number equal directory number.

 2. Compressed office code.

 3. Billing station number.

 4. Line class (11 bits).

(b) AIOD format

 1. Line trap, complaint observed, service denied, and billing number equal directory number.

 2. Charge status for message rate, TOLL, and ANI.

 3. AIOD translator number.

 4. Line class (11 bits) and compressed office code.

5. AIOD trunk number.

(c) Hotel/Motel (RMR) format.

1. Line trap, complaint observed, service denied, and billing number equal directory number.

2. Line class (11 bits).

3. Billing station number.

4. Offset or pointer into the RMR table. (The RMR table contains the distribute point assignment to score the remote message register via the line sleeve lead.)

(d) Combined AIOD-RMR format.

1. Contains the same information as AIOD (b) above, and RMR (c) above.

● *LCTT - Line Class Translation Table.* The LCTT contains a 3-word entry for each line class and contains the parameters required for billing and routing per line class. The table may contain 100 classes or 2000 classes, depending upon class requirements.

The types of line class translation available from the LCTT are as follows:

(a) Dial tone marker type of line translation (Table B)

(b) Completing marker type of line translation (Table C)

(c) Internal quantities for determining billing and routing (originating treatment, terminating treatment, billing class, and routing class).

D. Terminating Line Translation Tables

3.19 The tables described in this part are used to convert the directory number received on an incoming tandem, toll, or IAO type of call, into a terminating line location, or trunk number line link frame location. The number group, which was used in the No. 5 crossbar prior to ETS, performed the directory number to line location translation via hardware cross-connections. In ETS, the translation is a function of software programs and tables. Figure 21 presents a functional view of terminating translation.

● *NSST - Number Series Screening Table.* The NSST is divided into two parts, the NSST header and the NSST body. The *NSST header* contains the A, B, and C digits of the 6 terminating office codes that correspond to offices A and B physical, theoretical, and extra-theoretical. The *NSST body* is indexed by the thousands and hundreds digits of the station number. Each entry in this table is an index into a particular block of 100 numbers in the directory table (DIRT). This portion of the NSST table also indexes trunk numbers whose location is on the line link frame and must be accessed via trunk numbers. The NSST body may also point directly to an LLP hunting group where 100 numbers are assigned to a particular hunting group.

● *DIRT - Directory Table.* DIRT may have four different formats, depending upon the type of line to which a call is to be terminated—an individual line, a pointer for intercept treatment, a centrex customer group intercept treatment, or an offset or pointer into tables specified by the class (peg count, 2-line hunt group, sleeve lead or multi-line hunt group, or test access to individual line link pulsing line circuits).

● *ITGLST—Incoming Trunk Group List.* The ITGLST is used for translating the trunk class and the incoming trunk group numbers. Only the trunk class is translated for trunks without trunk numbers. For trunks with trunk numbers, both the trunk number and the incoming trunk group mark (obtained from DIRT or ITGLST) are translated.

● *TCTT - Terminating Class Translation Table* - This table provides restricted line information, free number indications, and, when centrex is provided, the customer group class of service.

E. Line Hunting Group Tables

3.20 There are two types of hunt groups found in No. 5 ETS. They are multiline hunt groups and two-line hunt groups.

Multiline Hunt Groups

3.21 The term *multiline hunt* defines a type of terminating service where a number of lines (or line circuits) to a particular subscriber location are grouped. This grouping allows terminating calls to the subscriber location to be completed when the called telephone number is found busy. Also, intercept lines to an operator or an announcement may be grouped into a hunting group. The procedure for finding an idle line to the location is termed hunting.

3.22 Three types of hunting are provided in No. 5 ETS—hunt to end, circular hunt, and uniform hunt.

- *Hunt to end* begins at the position in the hunt list assigned to the dialed number and may continue to the end of the hunt list.

- *Circular hunt* begins at the position in the hunt list assigned to the dialed number, continues to the bottom of the list, and if no idle lines are found, will begin at the top of the list.

- *Uniform hunt* begins at the first line after the most recently selected line and proceeds on a circular hunt. This type of hunt is most often used when line link pulse (LLP) line circuits are employed to complete calls in order to give equal usage to all line circuits in the hunt group.

3.23 Multiline hunt groups can be either LLP or non-LLP.

- *LLP multiline hunt group* implies that telephone numbers assigned to a subscriber location complete to the station over a group of common line circuits are being outpulsed to the location via an outgoing sender (Fig. 22a and 22b).

- *Non-LLP Multiline Hunt Group* may be divided into three types

  (a) telephone numbers assigned to the stations at the subscriber location have lines dedicated to each station number.

  (b) a listed directory telephone number that has a group of lines that terminate to a PBX switchboard or console and requires attendant completion to a given station.

  (c) intercept lines that complete to an operator or an announcement machine.

The conditions of all these lines are determined by the busy/idle condition of the line sleeve lead. For further information refer to Fig. 23a and 23b.

3.24 In No. 5 ETS, the multiline hunt function is performed entirely within software with the completing marker operating essentially the same as for non-hunt lines (Fig. 24). The data base tables for the line hunting groups are as follows.

- *LGLIST - Line Group List.* The LGLIST is comprised of one block of information common to a particular group. There are as many blocks as hunting groups. The block of information contains the following data for each hunting group.

  (a) Line group class and type of hunt
  (b) Offset or pointer to first block in Line Hunt Group Table (LHGT)
  (c) Offset to last block in LHGT
  (d) Usage peg count and overflow count
  (e) Offset to block in LHGT where next hunt of this type starts
  (f) Line number where next hunt starts
  (g) LLP sender information

- *LHGT - Line Hunt Group Table.* One LHGT is provided for each hunting group and provides the line location for each line in the group. The following information is contained in the table:

  (a) Busy/idle mark
  (b) Link or offset to next block (where more than 16 lines are in a multiline hunt group)
  (c) Offset into LGLIST for this hunt group
  (d) Audit information - memory of busy and idle lines
  (e) Line location for 16 lines in the

hunting group

(f) LLP outgoing sender group

● **LISMAP - Line Scan Map.** The LISMAP translates the line scan assignment (line scanner number, row, and bit position) into the appropriate entry in the line hunting group tables. This provides posting busy/idle changes of a particular line in a hunting group.

Two Line Hunt Groups

3.25 Any two single party numbers can be associated in a two-line hunt group (Fig. 25). When two numbers are grouped for this feature, the respective DIRT entries contain the identity of the number in the group (1 or 2) and an index to an entry in the two-line hunt group table (LGHT2). If the data in the LGHT2 entry indicates that hunting to the other number is permitted, a hunt indication in addition to the normal terminating data is passed to the completing marker. If the marker encounters line busy when attempting to set the network connection it will recycle and request a second LEN. LHGT2 is then accessed by the terminating translation program to obtain data on the other number. This data is passed to the marker. If the data is the LHGT2 entry indicates that hunting to the other number is not permitted, the marker causes a line busy signal to be returned.

● **LHGT2—Line Hunt Group Table 2-Party.** The following information is contained in the LHGT2:

(a) Originating Equipment (OE) numbers for both lines

(b) Trap and temporary service denial flags

(c) Terminating class indications

(d) Indices to the TCTT

F. Billing Translation Tables

3.26 The billing translation is used to furnish billing or charging information associated with a particular call. The information is used by the accounting center to charge the subscriber for the call, based upon the type of call (toll, message rate, WATS, directory assistance, etc), and the

message billing index (MBI). The MBI indicates to the accounting center the charging pattern for message rate calls, or the WATS band for WATS-type calls.

3.27 In the sequence of call processing, the billing translation is performed prior to route translation and trunk selection. In the process of billing translation, it may become apparent that special routing is required, therefore provisions are provided in the billing translation to screen the call and in some cases screen to a diverted route, such as in the case of toll diversion.

3.28 To determine the type of call and MBI, the called number and the calling subscriber's billing class are used. This information has been previously stored in the completing marker buffer from the line translation tables and the line class translation tables as part of the call processing.

3.29 Figures 26 and 27 present a general overview of 7-digit and 10-digit billing translations. The translation tables associated with each are explained below and in the sequence of use.

● **NBRXLT—Number Translation Table.** Four types of translators are provided in the NBRXLT table. They are as follows.

(a) **Entry Code Translator.** In the completing marker buffer (CMBUF), the originating class of call (OR or FAC) and the associated translator indications (LT, LT1, etc) from the originating register translations, are translated into a billing entry code (BEC) and stored in CMBUF. The BEC then becomes a pointer into the entry code translation section of the number translation tables (NBRXLT). The pointer from the entry code translator may be a pointer into the numbering plan area (NPA) translator or to the local office code translator (local completion).

(b) **NPA Translator.** This section of the NBRXLT is accessed by a 10-digit BEC indication from the entry code translator and the offset into the translator is the NPA code number of the called number from CMBUF. The entry in the translator for a particular NPA code may be a pointer to the local office code translator where the NPA had been dialed on a toll call

within the same area code; a pointer to a foreign office code translator when the office code translation is required for an office in an adjacent NPA; or a pointer to a billing class screening table when all calls to the NPA are toll calls.

(c) **Foreign Office Code Translator.** This section of the NBRXLT table is pointer from the NPA translator, and the offset into the foreign office code translator is the office code from CMBUF. The entry in the foreign office code translator is a pointer to a particular billing class screening table.

(d) **Local Office Code Translator.** This section of the NBRXLT table is accessed via pointers from either the NPA translator, or the entry code translator. The offset into the local office code translator is the office code from the CMBUF. The entry in the local office code translator is a pointer to a particular billing class screening table.

● **SCREEN-Billing Class Screening Table.** These tables are acessed via pointers from NPA translator, entry code translator, foreign office code translator, local office code translator, or another billing class screening table. The tables contain (1) the type of call and the MBI for a given class, or (2) a diverted route, or (3) a pointer into a supplemental billing class screening table when additional classes are required. The offset into the table is the corresponding calling billing class from CMBUF. The entry for a particular calling billing class from the screening table will be stored in CMBUF for later use and is the final step in the billing translation.

● **COCEXP—Compressed Office Code Expansion Table.** This table is required to expand the calling compressed office code that is stored with each line location as part of its billing number. The expansion is into a full NPA code plus the local office code.

● **MBIEXP—Message Billing Index Expansion Table.** The MBIEXP table contains information for each of 16 possible

MBIs. Each MBI entry gives the initial and overtime intervals, plus the number of scorings to be made on remote message registers for initial and overtime charges.

G. Route Translation Tables

3.30 Route translation is the process required to properly dispose of a call. The call may be incoming, outgoing, intraoffice, or in case of centrex, transfer. The routing of calls to intercept are also performed in the route translation. For outgoing calls, the route translation provides the trunk group number, sender information (delete and arbitrary digits, class, and group), route advance conditions, route transfers, WATS overflow control, and peg counts. This information is stored in the CMBUF for use in trunk selection, trunk register, traffic administration, etc. As in the billing translation, the information required to perform the route translation task is contained in the CMBUF along with pointers and offsets into the data base tables.

3.31 Figures 28 and 29 present a general overview of a 7-digit and 10-digit routing translation. The translation tables associated with each are explained below and in the sequence of their use.

● **NBRXLT—Number Translation Table.** Four types of translators are provided in the NBRXLT table. They are as follows.

(a) **Entry Code Translator.** In the completing marker buffer (CMBUF), the originating class of call (OR or FAC) and the associated translator indications (LT, LT1, etc) from the originating register translations, are translated into a billing entry code (BEC) and stored in CMBUF. The BEC then becomes a pointer into the entry code translation section of the number translations tables (NBRXLT). The pointer from the entry code translation may be a pointer into the NPA translator or to the local office code translator (local completion).

(b) **NPA Translator.** This section of the NBRXLT table is accessed by a pointer from the entry code translator, and the offset into the translator is the NPA code number from the CMBUF for the called number. The entries within the translator may be a pointer to the foreign

office code translator or to a screening table for grouping.

(c) **Foreign Office Code Translator.** This section of the NBRXLT table is accessed by a pointer from the NPA translator and the offset into the foreign office code translator is the called office code from the completing marker buffer. The entries within the foreign office code translator may be a pointer to a screening or grouping table or a pointer to a particular routing table.

(d) **Local Office Code Translator.** This section of the NBRXLT table is accessed via a pointer from the entry code translator. The offset into the local office code translator is the called office code from the completing marker buffer. The entries within the local office code translator may be pointers to a particular screening table or a pointer to a particular routing table.

● **Route Screening Table.** This table is used for screening via the calling subscriber's routing class as well as grouping of codes to a particular trunk group. This table performs the same function as code point grouping and screening in the completing marker prior to ETS. The table is accessed via pointers from the NPA translator, the local office code translator, or the foreign office code translator. The offset within the table is the calling subscriber's routing class. The entry within the table is a pointer to a particular routing table or another screening table.

● **Routing Tables.** These tables contain all the information required for a particlar route - trunk group number, route series pointer, terminating office or line group, route advance pointer, call type, sender information, trunk class, and AMA information, billable or non-billable, WATSAFR billing, etc. The tables are accessed by a pointer from the foreign office code translator or the screening and grouping tables. The information contained within the table entries is stored in the completing marker buffer to be used later by other programs, such as trunk selection, route advance, alternate routing, etc.

● **Routing Controls.** The following tables are used for route controls to modify or supplement the normal routing treatment for any given translation.

(a) **CONTAB—Control Table.** This table provides the control information required for trunk group control (TGC), route switch (RTSW), simulated facilities (SIMFAC), and traffic sample controls. The first 30 entries in the table are assigned to the route transfer control leads.

(b) **TGCP—Trunk Group Control Priority.** This table provides a maximum of 15 control priorities that may be associated with a given trunk group in the outgoing trunk group list (OTGLST) table.

H. Trunk Selection

3.32 The description of trunk selection is divided into four parts - General, Trunk Registers, Outgoing Trunk Group List, and Typical Trunk Selection.

General

3.33 The selection of trunk circuits, whether to intercept, tandem, announcement, or outgoing, is performed by the processor. The *route translation*, previously described, obtains the trunk group associated with the selected route and stores the information in the completing marker buffer. The processor takes the trunk group information and, using the outgoing trunk list (OTGLST), determines the next-to-be used idle trunk register (trunk registers are dedicated to trunks and are explained in more detail later). The processor examines the trunk register to determine the physical location of the trunk assigned to the trunk register and the sender group associated with the trunk. Corresponding distribute points are operated by the processor to pass the trunk location and sender group information to the completing marker (via the MDC) for completion of the call. The progress of the call is maintained in the trunk register via scan point(s) associated with the selected trunk. Also, information relative to the call for billing or testing purposes is maintained in the trunk register.

Trunk Registers

3.34 Trunk registers (nine words in the data base) are an integral part of the trunk selection process. A trunk register is assigned and dedicated to every scannable trunk in the office. The status of the trunk (busy/idle, answered, unanswered) is maintained in the trunk register as well as (1) a link to the next trunk in the trunk group, and (2) an idle link from the preceding idle trunk as well as to the next idle trunk.

3.35 When the trunk has been selected for the completion of a call, the progress of the call as well as all data pertinent to the call relative to billing, or trace outputs is stored in the trunk register until the trunk becomes idle. The information is then disposed of in one or more of the following ways:

(1) If the call was a billable call, the data is transferred to a buffer to await formatting and forwarding to AMARC.

(2) If a trap or trace bit is set, the data is transferred to a buffer to await printing at the TTY.

(3) If neither of the above apply, the data is disregarded and discarded when the trunk is reused.

Outgoing Trunk Group List (OTGLST)

3.36 An OTGLST entry is assigned one per trunk group and is divided into two sections. One section contains a pointer to the first trunk in the trunk group, a pointer to the last trunk in the trunk group, traffic usage and overflow identification, number of trunks in the trunk group, and the trunk billing class.

3.37 The second section contains pointers to the first and last idle trunks in the trunk group, usage peg counts, and overflow peg counts.

Typical Trunk Selection

3.38 Figure 30 presents the typical use of the OTGLST and the trunk registers in the trunk selection process. It also illustrates the busy/idle linkages and the linkage of the trunks within the trunk group.

3.39 All trunks within the trunk group are linked via pointers (PTR) or addresses within the trunk register. Referring to Fig. 30 (a), TRK REG 10 contains a pointer to TRK REG 14, which in turn contains a pointer to TRK REG 21, and so on, to the last trunk in the trunk group.

3.40 Idle trunks within the trunk group are also linked, the linking beginning with the longest idle and terminating with the last idle—in Fig. 30 (a), TRK REG 14 links to TRK REG 53, which in turn links to TRK REG 61.

3.41 After the processor has determined the routing, it stores all the routing information, which includes the trunk group, in the completing marker buffer. When the call processing schedule calls for trunk selection, the processor uses the trunk group information for the selected route (as stored in the completing marker buffer) as an index or pointer to a particular OTGLST. A pointer to the first idle trunk register in the OTGLST is used by the processor to access the trunk register. From the register, the processor uses the trunk link frame and sender group information, associated with the trunk to test for the trunk link frame being idle and to determine if any senders are idle in the selected sender group. If the trunk link frame is idle and a sender is available, the processor passes the appropriate information from the trunk register to the completing marker for the selection of the trunk. If the processor finds the trunk link frame busy or no idle senders in the group, it goes to the next longest idle trunk in the idle link and repeats the same process. Figure 30 (a) illustrates the selection of TRK REG 14 from the OTGLST.

3.42 The processor updates the idle list in the OTGLST and the idle linkage between the trunk registers following a trunk selection. Figure 30 (b) illustrates the up-dated OTGLST and the idle linkage.

3.43 When a trunk becomes idle following a call, the processor again updates the idle list in the OTGLST and the trunk register idle linkage. Figure 30 (c) illustrates the updated OTGLST and the trunk register idle linkage after TRK REG 21 becomes idle.

3.44 In case of a failure to match by the marker in channel selection and the marker cannot seize the selected trunk on the trunk link frame,

it causes a recycle to occur and the processor selects another trunk on a different idle trunk link frame.

3.45 When no senders are idle in the selected sender group or no trunks are available from the idle list, the marker route advances, causing the processor to seek a trunk in another trunk group for alternate routing.

I. Single Entry Call Record - AMARC

3.46 The means for providing charging information to the accounting center prior to LAMA-C, BDT, or No. 5 ETS, was via paper or magnetic tape. With the advent of the AMA recording center (AMARC), it became possible - with LAMA-C or No. 5 ETS - to forward charging information in a single entry format, via data links, to AMARC, where the entry was recorded on magnetic tape. A number of No. 5 crossbar offices equipped with LAMA-C, BDT, or No. 5 ETS may now send charging information to one central location for recording, thus eliminating tape transportation to the accounting center from individual offices.

3.47 The *single entry call record* is of the same format as used in the electronic switching systems. The entry is broken up into data groups, with each data group containing specific information relative to the call, such as called and calling number, answer and disconnect times, billing treatment, etc. Also, depending upon the type of call, all or a portion of the data groups are required.

> **Note:** In generic 2 and subsequent generic issues, on billable centrex calls, the customer group number is included in the call record.

> An example of single entry call record is given below.

V011000N112540347106430113826591 97273511614

(expanding into data groups for explanation)

V01 1000 N1125403 4710643 01138265 9197273511 614

TC   A2   A3   B2   C   D   J

where:

TC = (Type Code) = direct dialed, station paid

A2 = (Information digits) - call was service observed, charge

A3 = (Connect time) - 11:25:40.3

B2 = (Calling number) - 471-0643

C = (Midnights passed and disconnect time) - 0, 11:38:26.5

D = (Called Number) - 919-727-3511

J = (Calling NPA) - 614

3.48 After the processor has formatted the data into a single entry format (from information stored in the trunk register buffer), the entry is stored in the call record buffer. When AMARC requests the transmission of the call records, ETS transmits the records in blocks, where a block may be from 2 to 4 call records, depending upon the type of call recorded.

CARTRIDGE TAPE FILE STRUCTURE

3.49 A 4-track magnetic cartridge tape serves as the memory backup for the generic programs and the data base, as well as providing space for the non-memory-resident programs (DAS diagnostics, etc), and for deferred messages for recent changes.

3.50 Figure 31 is a general layout of the file structure. In order to maintain continuity in the filing system, the structure is made up of 512 words per block, and the number of blocks required is dependent upon the number of words used.

INITIALIZATION

3.51 System initialization applies to the procedure(s) (automatic, or manual) required to condition the 3A CC, the main store, and the peripheral equipment for handling call processing. The initialization may be the initial start-up of the processor complex following installation, which requires the loading of the generic and data base into main memory from cartridge tape. Initialization may also be corrective action or actions taken by the 3A CC to correct (or attempt to correct)

hardware or software detected faults. This type of initialization may be automatic or manual.

3.52 *Automatic Initialization* begins when a maintenance reset function (MRF) occurs. (A MRF is an indication that the 3A CC has detected a particular hardware or software fault.) Figure 32 presents a time chart for the four levels of automatic initialization that may occur, depending upon the time interval between successive MRFs. The levels of initialization follow.

- *LEVEL 1* - Elapsed time, 3 seconds. Calls being established are slightly delayed. The processor ceases communicating with the switching system until the following have been restored to their initial state.

    (a) EOS kernel
    (b) All transient memory except AMA buffers
    (c) All tasks
    (d) All devices

- *LEVEL 2* - Elapsed time, 3 seconds. Same action as LEVEL 1 except AMA buffers are initialized. Revenue is lost on established calls since all trunk registers are restored to their initial state.

- *LEVEL 3* - Elapsed time - 2 minutes. Same action as LEVEL 2 plus the generic and data base including recent changes loaded from the cartridge tape using checksum (a method for determining bit errors). Revenue is lost on established calls.

- *LEVEL 4* - Elapsed time - 3 minutes. Same action as LEVEL 2 plus the generic and data base including recent changes loaded using the complete cartridge tape. Revenue is lost on established calls.

3.53 *Manual Initialization* occurs because of a request from the system status panel. The functions performed in the manual initialization are dependent on the state of certain system status panel keys. The equivalent of LEVELS 1, 2, and 4 performed by the automatic initialization may be duplicated by various key operations on the system status panel.

3.54 A fifth initialization level, *LEVEL 5* - elapsed time - 2 1/2 minutes, is available

only in the manual mode. The data base, without recent changes, is reloaded using the complete cartridge tape. Revenue is lost on established calls.

3.55 All levels of initialization can be initiated from either the A or B maintenance terminals via commands.

RECENT CHANGE

3.56 The term *recent change* is used to indicate changes that are to be made in the ETS data base tables as a result of subscriber line changes, routing changes, billing changes, etc.

3.57 When a change is to be made in the data base tables, a specific entry is made at the terminal associated with either the system or the main distributing frame (in some cases, the service bureau). The processor uses a series of recent change programs, compilers, and formatters in software to change the information contained in the data base tables, update the main stores, and record the change on magnetic tape cartridges.

3.58 When a change is made in a data base table, both main stores are updated. Also, the change is recorded on the magnetic tape cartridge. Should it be necessary due to power failure or initialization, the original data base can be read from the tape into main store, then the recent changes read from the tape to update the data base in main store.

3.59 The recent changes may be classified as low level and high level commands. *Low level commands* are those changes that affect only one specific data base table, such as a line class translation table (LCTT). A change made to one of the line classes does not affect other tables in the data base. *High level commands* are those changes which affect more than one table in the data base. An example of the high level is the changing of a customer's directory number, but not his line location. The directory number assigned to that particular line location is changed in the line translation table (LINT), and, in the directory table (DIRT), the line location is entered at the new directory number location in the table and removed from the old directory number location.

3.60 Line traps, trunk traps, complaint observing, traffic sampling, and information studies are also established by the use of recent change entries.

VERIFICATION

3.61 Means are provided whereby the recent changes may be automatically verified when entered at the terminal. The verification may also be manually requested. The printout received at the terminal for a verification request contains all the information relative to the condition being verified. For instance, the request to verify a particular line location yields the directory number, billing number, trap condition, complaint observed, line class, and any special considerations to be given the particular line location. The verification becomes a very useful tool when analyzing customer complaints, audit failures, or inconsistencies.

REALLOCATION

3.62 When office growth exceeds the existing data base or new features are added, it is necessary to expand the size of the data base. This requires restructuring the addresses in main stores for the various tables. The reallocation, in most cases, is performed by the installation division at the time new equipment is added to the office.

3.63 In some instances, however, the reallocation may be performed by the local operating company personnel, which might be the case when additional number series is required, and sufficient memory is available, but no allocation had been made in the data base.

TABLE PRINT

3.64 Table print, as the name implies, provides a tool for accessing, interrogating, matching, counting, and printing information contained in the data base tables. The tables may be interrogated on a per-table basis or on a multi-table basis by commands entered at the terminals. Also, when a table is printed in its entirety, it may become part of the local office records.

DATA BASE GENERATION

3.65 As previously mentioned, the data base for No. 5 ETS is organized into a series of tables that reside in main memory. These tables contain all the office-dependent information necessary for call processing or traffic and administration functions. Since these tables are office dependent, it is necessary to generate the tables for each office at the time of an ETS installation. *The data base generation is performed by the installations division.*

3.66 Prior to the installation, data base and equipment specification forms are completed by engineer/traffic department for the operating company. These forms contain such information as office codes, number of markers, features' and options, line classes available, trunk types, number of trunks, etc. From these completed forms the installation division generates the office data base.

3.67 The data base is generated in two phases, manual and automatic, by using data base generation software programs and the extended operating system (EOS). The generation programs reside on a separate magnetic 4-track cartridge tape.

3.68 The first phase of data base generation requires inputting the office parameter data from the data specification forms via a teletypewriter (TTY) or a Dataspeed 40. These inputs build such tables as the office parameter, logical status, physical status, number series screening, billing and routing translations, etc. Also, all data base required to test the added and modified No. 5 circuits are included in the first part.

3.69 Following the installation of ETS equipment, the additional data is entered as in part one and the automatic interpretation is accomplished using an installation test equipment (ITE) unit. The 3A CC causes the ITE to seize a completing marker which interrogates the number group (via cross-connections) for the line location, terminating treatment, ringing combination, and certain line hunting information. The interrogation begins with office 0A, station number 0000. The line location is then used by the ITE, 3A CC, and completing marker to access the line link frame to determine the class of service for that particular number. When AMA translators are provided, the line location is passed to the AMA transverter-translator combination to (1) determine if the billing number is the same as the listed directory number, and (2) provide verification of the line translation table. Discrepancies are reported via the TTY for resolution. From the information derived in the preceding interrogations, the line translation table (LINT), line translation expansion table (LNTEXP), and the directory number translation table are generated. A somewhat similar process is followed for defining trunks that have line link frame locations.

3.70 After all directory numbers for the six local offices (if provided) have been interrogated in the number groups, an audit is performed to verify the constructed tables. Once again, any discrepancies are reported at the TTY for resolution.

3.71 The total data base is then written on the 4-track cartridge tape, along with the generic programs, for back-up for the main memory. The data base is maintained via recent change procedures.

DIAGNOSTICS

A. General

3.72 Means are provided in ETS to establish the location of faulty hardware components (circuit packs, leads, etc). This is accomplished by using a series of programs labeled *diagnostics.* The objective of the programs is usually accomplished by exercising the device in question as thoroughly as possible in a logical sequence tailored to that particular device. After isolating, repairing, or replacing the faulty hardware components, the diagnostic programs are used to verify the correction of the failure.

3.73 The diagnostics may be divided into two categories - those that are associated with the auxiliary 3A processor complex and those that are associated with the distributor and scanner (DAS).

B. Processor Complex Diagnostics

3.74 The diagnostics for the processor complex provide the capability of isolating and locating hardware faults in the 3A central control, main store, system status panel, maintenance channel, the serial I/O channels, the cartridge tape devise and associated control circuitry, I/O terminal interfaces, and to a certain extent, the data sets, along with their associated interfaces (RSI). The data sets have built-in diagnostics which, when connected to the data sets in the AMARC complex, provide a means for checking.

C. Distributor and Scanner Diagnostics

3.75 The DAS diagnostics are designed to test the control circuitry, address registers, scanner and distributor matrices, interconnecting buses, false sync response, and valid sync response. Tests are also provided to determine the ability

for information to be passed to the completing marker, via the marker distributor control circuit, from operated distribute points, using the interface circuit for program controlled data acquisition.

3.76 Directed scan and directed distribute programs allow individual diagnostic checks for the operation and/or release of particular scan points and/or distribute points.

AUDITS

3.77 The process used to perform certain checks to insure validity of data is called *audits.* The audits may be performed during the transfer of data, manipulation, outputting, storing, or the maintaining of data in software tables. Audits may be an integral part of an applications software program, in which case they are known as *error control audits.* Other software programs have the specific task of performing various checks primarily with the data base and are known as *stand-alone audits.*

3.78 *Error control audits* which are being performed as the programs are being processed may be checking the following conditions:

(a) the address range

((b) the range of an m-out-of-n code

(c) check for abnormally long or short release times

(d) check for abnormal use of equipment (such as busy/idle conditions for trunks).

3.79 *Stand-alone audits* may be used as follows:

(a) to check all tables in the data base

(b) check the range of tables

(c) check for duplicate entries in tables

(d) perform cross-audit checks between data bases either in memory or on cassette tape.

3.80 The *stand-alone audits* are initiated by the craft by entering a particular command at the system terminal. Also, the stand-alone audits may be automatically activated at a pre-set

time in software and the results printed at the system terminal.

3.81 Audits are designed as a mechanism to detect "problems" within software which are likely to cause deterioration of system operation even though call processing may not indicate that a problem exists. An example might be a duplicate entry in a line translation table where a problem might be encountered only when the duplicated subscriber initiated a call. Remedial action is required to correct audit-detected data base problems, and in most cases, is corrected via recent change procedures.

4. METHOD OF OPERATION

GENERAL

4.01 The method of operation of ETS calls covers primarily those operations unique to the No. 5 ETS equipment and describes only briefly marker, register, and sender functions, since these are covered in Section 958-110-100.

4.02 Additional information, relative to functions performed within the data base, are covered in Part 3—SOFTWARE, of this section.

OUTGOING CALL - AMA/NON-AMA

4.03 In the No. 5 ETS, the routing, screening, AMA, and trunk selection are performed by the processor, replacing those functions previously performed by the completing marker.

4.04 Figure 33, Typical Outgoing Call, provides an overview of call processing with ETS.

Dial Tone Marker Function

4.05 When a subscriber goes off hook, a dial tone marker is selected. The dial tone marker, through the line link connector, determines the calling line location (line link frame, vertical group, horizontal group, and vertical file). Prior to ETS, it would have determined the class of service assigned to a particular line location. After ETS, the class of service is stored in the processor main memory. After checking the received line location, the marker passes to the processor via scan points, the originating line location. The processor then determines the type of line (coin, manual, 2-party, etc) and passes the type-of-line mark, via distribute

points, to the dial tone marker. The marker in the meantime, has selected and attached an originating register via its connector, and passes to the register the originating line location. When the processor operates the type-of-line distribute points, the same information is passed to the register. When all checks are completed, linkage through the cross-bar switches is established between the originating line and the originating register. The dial tone marker is then released and dial tone sent to the originating line by the register. After dialing of the called number is completed, the originating register bids for a completing marker.

Completing Marker Function

4.06 The completing marker, after receiving the calling line location, the called number, and the type of line translation from the originating register, operates corresponding scan points in the completing marker scanners. The processor, using the information from the operated scan points, determines the class of service of the originating line, the billing class, billing treatment, the type of line, and the billing number associated with the calling line location. Using the called directory number, the processor selects a route and an idle outgoing trunk within the selected route. It also begins storing information in the trunk register that is dedicated to the outgoing trunk selected. The class and billing treatment translation yields a message billing index (MBI) and the type of billing to be used by the accounting center for the call.

4.07 After determining the route and the trunk, the processor passes this information to the completing marker, via operated distribute points in the completing marker distributors and the marker distributor control circuit (MDC). The MDC is used to convert 2/x information from the processor into 1/x as needed by the completing marker. The marker then establishes linkage between the outgoing trunk and the calling line location. The call is then completed in a normal manner at the distant office.

4.08 Should troubles be encountered when setting linkage between the calling line location and the outgoing trunk, the marker signals the processor to select another trunk in the same route, or an alternate route when all trunks in the same route are busy.

4.09 Scan points associated with the supervisory and busy relays in each trunk indicate to the processor the progress of the call—answered, unanswered, idle, etc. This information is stored in the associated trunk register.

AMA Functions

4.10 As indicated previously, the trunk register contains all the information relative to the call - calling billing number, called number, MBI, the progress of the call, and the answer time. When an AMA record is to be made for the call, the RCD (record) bit is set by the processor at the time the MBI for the call is determined.

4.11 When the calling end terminates the call by going on hook, the S1 scan point is released, indicating a change of call status. The processor then calls up a program for formatting the call into a single entry format, using all the information contained in the trunk register. The disconnect time is then computed.

4.12 The formatted record is then stored in a buffer, and when requested, is sent via 202-type data sets and data links to the AMA recording center (AMARC), where it is recorded on magnetic tape to be processed later at the accounting center.

NON-AMA Type of Call

4.13 When the RCD (record) bit is not set in the trunk register by the processor, the information is still retained in the trunk register as though the call were to be recorded. The purpose of this is to have all information available on the call, should a line trap bit or a trunk trap bit be set in the trunk register, requiring a printout at the system terminal, of the pertinent information relative to the particular call.

INCOMING CALLS

4.14 On incoming call, whether local, terminating, or tandem completion, the incoming trunk will bid for an incoming register. When the register is attached to the incoming trunk, an indication is given to the distant office to transmit the called number. The register then receives (via the trunk) and stores the called number, and after translation, bids for a completing marker, to which it passes the called number, trunk location and number,

trunk class, and translation marks derived from the called number (5-digit, 7-digit, local completion, tandem, toll, etc.) The marker causes scan points to be operated in the marker scanner corresponding to the information received from the incoming register. The register is then released from the trunk and the marker.

A. Local Completion

4.15 On calls to be completed locally (Fig. 34), the processor must pass to the marker the terminating line location and the ringing combination for the called subscriber.

4.16 To accomplish this, the processor uses the information from the operated marker scan points and performs a directory number to line location translation (terminating translation). The called number may be a single party, two party, part of a multi-line hunt group, or may require line link pulsing to complete to a PBX. The billing, routing, and terminating translations determine the type of line and passes the line location and ringing combination, via operated distribute points, to the marker distributor control circuit. The marker then sets up the necessary linkage (and if line link pulsing is required, selects a sender) to complete the call.

4.17 When the call is to terminate to a hunting group, the processor knows the idle lines within the group by the condition of the scan points associated with each scan line sleeve lead.

B. Tandem Completion

4.18 On tandem or through-switched calls, the processor must (1) pass to the marker the line location of the tandem appearance of the incoming trunk on the line link frame, and (2) select an outgoing route and trunk to complete the call through the office to the distant facilities (Fig. 35).

4.19 To accomplish the above, the processor uses the information from the operated marker scan points. From the called number and the translation mark (generated by the incoming register), the processor determines that the call is to be switched through to another office. It then selects a route and an outgoing trunk. Corresponding distribute points are operated to pass the selected trunk information, via the MDC, to the marker.

4.20 Using the trunk number (thousands, hundreds, tens, and units), the processor does a trunk-number-to-line-location translation along with billing and routing translations to determine the line link frame location for the tandem appearance of the incoming trunk. The processor then passes the line location, via operated distribute points, through the MDC to the completing marker.

4.21 The marker selects a sender, attaches it to the outgoing trunk, and sets up linkage betwen the line link appearance of the incoming trunk and the trunk appearance of the outgoing trunk. The call is then completed in a normal manner to the distant office.

AUTOMATIC NUMBER IDENTIFICATION (ANI)

4.22 The automatic number identification (ANI) provides a means whereby the calling directory number may be identified on calls to TSP/TSPS. An overview of the typical ANI operation is presented in Fig. 36.

4.23 When a call is placed that requires ANI, the ETS recognizes this and selects an ANI route. The marker attaches a multi-frequency sender to the selected trunk and passes to the sender the calling line location, the called number, and a mark indicating that an ANI operation is required.

4.24 The sender bids for a program controlled transverter (PCTV) through the transverter connector (TVC), then passes to the PCTV the calling line location. The PTV operates corresponding scan points in the ANI scanner. Using the line location indicated by the operated scan points, the processor uses the LINT table (or LNTEXP table) to determine the billing number assigned to the calling line location. The processor then causes corresponding distribute points to be operated in the ANI distributor. The operated distribute points then operate corresponding digit registers in the sender via the PCTV and the TVC. When the sender is satisfied with the digits received, it releases the TVC and PCTV, then, upon request, outpulses the calling number to the TSPS or distant office.

4.25 The ETS is also arranged to handle ANI-AIOD operations.

AUTOMATIC IDENTIFIED OUTWARD DIALING (AIOD)

4.26 The automatic identified outward dialing (AOID) feature provides a means for identifying the directory number for a particular PBX station placing a call via dedicated PBX trunks. An overview of the typical AIOD operation is presented in Fig. 37.

4.27 Calls initiated from a PBX come into the No. 5 office via dedicated trunks having appearances on the line link frame. Each trunk is assigned a dedicated number which is recognizable by both the central office and the station identification circuitry associated with the PBX. The completing marker passes the line location, called number, etc, via the completing marker scanner, to the 3A processor. The processor uses the line location to index into the line translation table (LINT) where an offset or pointer into the line translation expansion (LNTEXP) table indicates that an AIOD operation is required. The LNTEXP table contains the trunk number assigned to that particular line location. The processor operates distribute points in the AIOD distributor corresponding to the trunk number. Corresponding relays in the PBX-AIOD buffer, connector and control circuit (PABCC) are operated by the operated distribute points. The trunk number is then passed to the station identification frame (SIF) via a translator and connector circuit. The SIF, using the trunk number, identifies the station using the trunk by a four-digit directory number which it passes to the AIOD scanner via the translator and connector circuit and the PABCC to operate corresponding scan points. The calling directory number is then stored in the trunk register for billing when the call is completed. When AIOD is used with a 101 ESS PBX, the SIF may or may-not be used. The 101 ESS control unit in the central office establishes the connections at the PBX and therefore knows the station and trunk numbers used on the call.

4.28 When ANI-AIOD is required, the information returned from the SIF to the AIOD scanner is used to operate ANI distribute points going to the outgoing sender.

REMOTE MESSAGE REGISTER OPERATION (RMR)

4.29 The remote message register (RMR) feature provides a means whereby a hotel/motel may keep a record (via message registers) of charge calls made from lines within the hotel/motel complex.

Figure 38 presents an overview of the typical RMR operation.

4.30 When a call is placed from the hotel/motel, the marker passes the line location, called number, etc, via the completing marker scanner to the 3A processor. The processor uses the line location to index into the line translation table (LINT) where an offset or pointer into the line translation expansion (LNTEXP) table indicates that RMR operation is required. An offset is given into an RMR register (RMRREG) table where the distribute point associated with an RMR- relay assigned to that particular line location is given. The distribute point may be operated and released as required for the number of scorings required for the initial charge and/or overtime charges for the call.

4.31 Meanwhile, back at the processor, it has selected a trunk, passed this information to the marker which in turn has set up the required linkage between the calling line and the outgoing trunk. The called number is passed to the trunk register (TRKREG) assigned to the selected trunk. The billing number is also passed to the trunk register, having been obtained from the LNTEXP table.

4.32 When trunk supervision indicates an answer condition (CS scan point operated), the RMR- relay in the RMR circuit is operated by the associated distribute point. The operation of the RMR- relay causes the RMR- at the hotel/motel to be scored. Operation and release of the distribute point results in scoring of the RMR- at the hotel/motel. Initial multiple scorings and overtime scorings are provided in the ETS and are a function of the billing class assigned to the subscriber.

CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA)

4.33 The No. 5 ESS has the capability of performing the centralized automatic message accounting (CAMA) function. Figure 39 presents an overview of the CAMA arrangement in the No. 5 ETS offices.

4.34 A CAMA call enters the No. 5 ETS via a CAMA incoming trunk. An incoming register is attached to the trunk, receives the called number from the distant office, and determines the trunk number, trunk link frame number, and the trunk class number. The incoming register then requests

a completing marker to which it passes the above information.

4.35 *CAMA First Marker Usage.* The completing marker, through information received from the ETS, determines that the call is to have CAMA handling. A CAMA sender is selected which is attached to the CAMA incoming trunk. The CAMA sender requests the distant office, via the incoming trunk, to send the calling number.

4.36 After receiving the calling number, the CAMA sender requests a program controlled transverter (PCTV) to which it passes the trunk number, calling, and called numbers. The PCTV causes corresponding scan points to be operated in the CAMA scanner. The 3A processor reads the scan points, and, from the trunk number, determines the trunk register assigned to that particular trunk. An initial entry is then made into the trunk register. The sender then releases the PCTV and bids for a completing marker for the completion of the call.

4.37 *CAMA Second Marker Usage.* After the marker has been attached to the sender, it receives the incoming trunk number and the called number. The marker is used to complete the call either to a subscriber in the same CAMA marker group (local completion) or to tandem switch through to a distant office. The trunk used for completion will be selected by the ETS in the same manner described previously under *Trunk Selection.*

4.38 *CAMA Recording.* CAMA incoming trunks are equipped with supervisory scan points. When the trunk is seized, the S1 (or equivalent) relay is operated, which in turn operates the S1 scan point, and the progress is noted in the respective trunk register. When the call is answered, the CS (or equivalent) relay is operated, in turn operating the CS scan point, and the progress is noted in the trunk register. When the called subscriber disconnects, the CS scan point ultimately is released and is noted in the trunk register. The ETS then formats the call (when the S1 or calling party releases) in the normal manner, to forward to the AMA recording center.

4.39 The outgoing (tandem) trunk used in the completion of the call is also equipped with scan points, but these are ineffective when the outgoing trunk is used in a tandem mode.

5. OBSERVING FACILITIES

A. General

5.01 Two types of observing facilities, service and complaint, are provided in ETS. Service observing is used to ensure that customers are receiving the grade of service to which they are entitled and is made by an observer at a central observing bureau. Complaint observing is used to verify that calls are billed properly on customers lines for which complaints have been received. A detailed record is made for each observed charge call originated at the customers line. In addition to these two types of observing facilities, a third one is provided in ETS offices with CAMA. CAMA line observing performs essentially the same function as complaint observing in basic ETS.

B. Service Observing

5.02 Access to a customer line for service observing is obtained by plugging an observing line to a service observing jack at the service observing patching panel. A trunk connected directly to a central observing bureau is used for connecting to the customer line. Only originating calls may be observed. The observer monitors on an originated call by means of an amplifier, acting as a one-way repeater which prevents noise transfer from the observing trunk to the customer line.

5.03 When a call is originated by a customer on a line to be service observed, the marker recognizes it as a service observed call. During the scan cycle, the marker scanner (for the marker associated with the call) receives an OBS indication from the marker and forwards it to the processor. The processor recognizes the service observing indication and includes a service observed indication in the trunk register, and subsequently, in the formatted call record. Incompleted calls that would have been recorded had they completed, are recorded when service observed.

C. Complaint Observing

5.04 A customers line is put on complaint observing by a recent change procedure using a system terminal. This procedure causes the "complaint observed" bit associated with the customers calling number to be set (in the line translation table.)

5.05 When a charge call is originated by a customer on a line designated for complaint observing, the marker scanner obtains information from the marker and passes it to the processor. The processor translates the line equipment number into a calling number and determines that the associated "complaint observed" bit is set. On call disconnect, the call record is formatted for recording with a type of call indication for an observed call.

D. CAMA Line Observing

5.06 In No. 5 ETS with CAMA, CAMA line observing performs the same function as complaint observing in basic No. 5 ETS. When a calling telephone number is to be CAMA line observed, the calling telephone number is entered in the CAMA line observing number match (LONM) section of the MATCH table. On every CAMA call, the calling telephone number is compared with the numbers in the CAMA LONM section of the MATCH table. If a match is found, the complaint observed bit will be set in the trunk register. When the CAMA incoming trunk is being service observed and a complaint observed match is found, the service observed (OBS) bit will be set in the trunk register. (Service observing takes precedence over complaint observing.)

6. MAINTENANCE FEATURES

A. General

6.01 The maintenance facilities used in the basic No. 5 Crossbar System are retained after conversion to ETS with the exception of the following test facilities: line verification test circuit, SD-26181-01; traffic sample, monitor, and test circuit SD-27876-01; and the test equipment on the message register frame. Modifications are required at the master test frame (MTF) to connect scan/distribute points to certain keys, switches, and lamps. Additional keys are added to the master test control circuit to provide to ETS, indications for class of service, trunk selection, and test printouts.

6.02 A new test circuit - interface circuit for program controlled data acquisition (PCDA), SD-27165-01 - is added to allow the 3A processor to verify all distribute points in ETS that are used for call processing. This circuit is used to test the new marker distributor control circuit. Through this test circuit, limited tests may be initiated through the completing marker.

6.03 The MTF retains the capability of testing the basic No. 5 hardware, such as registers, senders, parts of the dial tone and completing marker functions, trunks, and connectors. ETS hardware and the interfaces between the ETS and the No. 5 are tested via software programs.

6.04 The software tests may be divided into several general categories - audits, diagnostics, verifications, and checks.

6.05 *Audits* are programs or sections of programs, that test for consistency or reasonableness of data stored in memory.

- *Error Control Audits* are tests which operate on data and test the results in normal call processing sequences.

- *Semi-In-Line Audits* are tests which operate on data during call processing but are only executed on a timed or demand basis.

- *Off-Line Audits* are tests done on a timed or demand basis only and are not testing call processing. An example is the verification of the contents of a particular table in memory.

6.06 *Diagnostics* is a dedicated program or series of programs used to localize a malfunction once the fault has been detected. A series of diagnostic programs are used to test the distributor and scanner circuits to isolate malfunctions.

6.07 *Verification* is used to test the validity of data base table information. All the data associated with a particular line location or a particular directory number may be verified by a manual input at the system terminal.

6.08 *Checks* are made on data to test the validity of the data. This may be in the form of checking for one-out-of-x, two-out-of-x, or the presence or absence of parity bits in a given software word.

B. Trouble Detecting and Analysis

6.09 When a malfunction (trouble or failure) is detected by either the markers or the ETS software, an indication that a malfunction exists must be given. Two means are employed - the *trouble record card* at the MTF and the *error reports* at the ETS system terminal along with the system status panels at the processor maintenance frame and the power and data interface (PDI) frame.

6.10 The *trouble record card* is perforated by the trouble recorder to indicate the marker progress and the data that was used to set up a particular call by the marker. Due to the continuous interaction between the markers and ETS during call processing, troubles may be detected by either the markers, the ETS, or by both. When the marker detects a trouble (such as failure of a one-up check), it causes a trouble record to be perforated. When ETS software detects a trouble during the interaction with the marker, a trouble record may be taken and an XTRK designation perforated to indicate the trouble was detected by ETS software. An error report may also be printed at the system terminal. The logic of trouble record cards (and the trouble reports) is dependent upon the type and severity of the trouble.

6.11 The *error report* is a message printed at the system terminal or TTY to indicate the type of trouble detected by the ETS software. The report contains the time, type of trouble, a trouble number, and an argument as to the hardware involved. The contents of the general registers may also be printed. A trouble locating manual (TLM) is used to interpret the trouble report and lists the possible malfunctioning equipment(s) and the corrective action required to resolve the trouble. The system status panel at the processor maintenance frame and the ETS status panel at the PDI also provide information in the form of lamp indications.

C. Special Maintenance Features

6.12 Many special maintenance features are possible with ETS. The features may be automatic or requested by maintenance personnel. Some of the special features which may be used as an aid in maintaining the system are listed as follows.

- *Calls up longer than twenty four hours* - Each day at a designated time, the processor causes a printout at the system terminal of the call record data for any call which has been in progress longer than twenty-four hours. The maintenance personnel may wish to verify that a call is actually in

progress, and those calls are not a switching equipment malfunction.

- **Sixteen consecutive answered calls to the same trunk with a connect time less than 18 seconds** - The processor causes a message to be printed at the terminal when a trunk is connected on sixteen consecutive answered calls, as an aid in locating switching equipment malfunctions.

- **Sixteen consecutive unanswered calls to the same trunk** - The processor causes a message to be printed at a terminal when a trunk is connected on sixteen consecutive unanswered calls, as an aid in locating switching equipment malfunctions.

- **Line Trap** - When the line trap bit is set (for a particular line) in the line translation tables, a message giving the details of the call is printed at the terminal for each call initiated by the line. This feature was designed as an aid in troubleshooting switching equipment and may be initiated or removed by a procedure performed at the system terminal.

- **Trunk Trap** - When the trunk trap bit is set (for a particular trunk) in the trunk register, a message is printed at the terminal giving the details of each call using the trunk. This feature was designed as an aid in troubleshooting switching equipment and may be initiated or removed by a procedure performed at the system terminal.

- **Maintenance Trace**—When the call trace bit is set for a particular line, a printout is received at the system terminal which contains all the data dumps (see data dumps which follows) for the equipment used in processing the call. A malfunction that may have occurred in the call-processing chain from a particular line may then be isolated by an analysis of the dumps. A trace can be performed on maintenance or test calls for (1) outgoing called digits (OCD), (2) originating line location (OE), and (3) terminating telephone number (TN).

- **Data Dumps** - This term is used to indicate a printout of all the information contained in a particular buffer in memory associated with a particular marker, as well as the condition of associated scan and distribute points. The following dumps may be requested on test calls by specific entries at the system terminal: dial tone marker, completing marker, trunk register, formatted call record, AIOD, and PCTV (ANI)

- **ETS Originating Test Line** - This test line is used in setting up test calls originated by a message entered at the system terminal.

- **Trunk Audit** - By using a trunk audit, the trunk registers (one per trunk) are examined to determine all trunks that have been continuously idle or busy (service or maintenance) for a specified length of time.

- **Directed Scan/Distribute** - Means are provided to operate or release a particular distribute or scan point, under certain conditions. This allows the maintenance personnel an additional tool when verifying scan/distribute points.

- **Calling Line Identification**—Means are provided in No. 5 ETS to put the following calling line identifications on trap. They are (1) outgoing called digits (OCD), (2) origination line location (OE), and (3), terminating telephone number (TN). These 3 identifications may be used in any combinations, however seperate intries must be made to initiate each type. For further information, refer to Section 218-799-302.

7. ETS ADMINISTRATION

GENERAL

7.01 The ETS requires some operating procedures which are new to the No. 5 Crossbar System. This part of the description briefly describes some of the procedures unique to ETS which are necessitated by use of the processor, and other procedures for gathering data (for engineering, maintenance etc), which are facilitated by use of the processor. Details of the procedures are found in other BSPs in the 218-799 division.

NETWORK MANAGEMENT

7.02   Comptroller Registrations.   Prior to
ETS, it was necessary to furnish readings
of certain peg count registers and forward these
readings, along with the perforated AMA paper
tape, to the AMA accounting center. After ETS,
the data required by the Comptroller Division is
compiled in software and forwarded at specific
intervals to AMARC for recording on magnetic
tape—later to be processed by the accounting
center.

7.03   Call Count Registrations.   Counts are
maintained for LAMA, CAMA, TOLL-NONTOLL,
ANI, AIOD, and INWATS for total recordable
attempts and total messages. Also counts of blocks
of data sent to AMARC, number of transmits,
number of retransmits, and total call record counts
are maintained.

7.04   Traffic and Plant Measurements.
Measurements are made by No. 5 ETS for
plant maintenance, system administration, traffic
engineering, billing, and division of revenue. They
include new measurements and a number of existing
measurements that have been transferred to No. 5
ETS. Existing measurements that were not
transferred have been eliminated.

7.05   Measurements taken by No. 5 ETS are
distributed to data collection devices such
as traffic and plant registers or software programs
such as EADAS, via the measurement registration
connector (MRC) circuit. Software program MRCON
(measurement registration control) controls the
MRC via the DAS unit. MARCON determines from
traffic data accumulated in memory if ground pulses
are to be distributed on count registration leads.
Scaling is provided to assure that the total counts
do not exceed the capacity of the data controlling
equipment.

7.06   There are seven data base tables that contain
the group and lead numbers for scoring peg
and overflow counts. They are as follows: CONTAB,
LGLIST, LHGT2, MLA, OTGLST, ROUTE, and
SCREEN. MLA is for scoring information not
directly associated with a particular table. The
remaining tables are used in call processing and
the information required for scoring is associated
with the individual tables.

7.07   For additional information on plant and traffic
measurements and registrations refer to
Sections 218-799-242, 218-799-319, and 218-799-338.

7.08   Code Blocking.   Means are provided in
No. 5 ETS to block a percentage of 7-digit
and 10-digit originating and/or outgoing calls. Calls
that are code blocked may be re-routed to special
network management announcements, busy tone,
or overflow tone, depending on the dictates of the
blocking condition. Information relative to code
blocking is stored in 4-word entries in the MATCH
table. For additional information refer to Section
218-799-302.

7.09   SIMFAC—Simulated Facilities.   In
No. 5 ETS, means are provided to limit
traffic between common control switching arrangement
(CCSA) tandem trunk groups and a colocated centrex
central office. SIMFAC is also used to simulate
small groups of WATS trunks to limit access to a
large group which may carry both WATS and
DDD traffic. The control may also be applied to
CCSA incoming trunks. Refer to Section 218-799-347
for additional information on SIMFAC.

7.10   RTSW—Route Switch.   RTSW provides
the capability of handling service while a
new trunk group is being built. In some instances,
RTSW has been used for operator night transfer
(by key operation at the MTF). For additional
information refer to Section 218-799-346.

7.11   TGC—Trunk Group Control.   TGC
provides the capability of limiting traffic to
overloaded switching machines or congested areas.
This function is based on the trunk over which
the call is to be routed (refer to Section 218-799-345).

7.12   Traffic Sample Control.   The traffic
sample control provides a means for requesting
an AMA record after a predetermined number of
calls (1-25) have been originated or terminated for
a given class of service or for a given trunk group.
The traffic sample control is used predominately
by CCSA customers, through its applications are
not limited to CCSA usage. Refer to Section
218-799-348 for additional information.

LOCAL OFFICE RECORDS

7.13   It is essential that all local office records
pertaining to software data be maintained
and kept current with the information contained in

the data base. New forms are required for recording software information and recent changes, consequently the recommended forms are covered in the Bell System Practices associated with ETS recent change procedures.

7.14 The office record printout is a printout of the data contained in a single table in the data base or a composite of data derived from multiple tables in the data base. When all printouts are compiled, an overview of the existing data base for a given ETS office is available and becomes a tool for those responsible for initiating changes affecting subscribers or the engineering for the central office. The office recorded printout or FORM is divided into two catagories. They are single table (ST) and multiple table (MT). A list of these forms can be found in Table D. (Refer to Section 218-799-340.)

BACK-UP CARTRIDGE TAPES

7.15 It is necessary to maintain one set of backup and one set of spare cartridge tapes as well as the service orders, etc, associated with the changes made to the data base. The generating, storing, and handling of back-up cartridge tapes is covered in Section 218-799-317.

TABLE D

OFFICE RECORD FORM	FORM NAME
MT01	Basic Telephone Number Record
MT02	Supplemental Telephone Number Record for Sleeve Lead Hunt Groups
MT03	Originating Equipment Record for 1- or 2-Party Lines
MT04	Outgoing Trunk Group Record for OG and 2-Way Trunks, Junctors, and IAO Trunks
MT05	Trunk Line Frame Record
MT06	Incoming Trunk Group Record
MT07	Measurement Registration Connector Record
MT08	Supplemental Measurement Registration Connector Record for Multiple Assignments
MT09	Line Scan Record
MT10	Supplemental Telephone Number Record for 2-Party, AIOD, and RMR Lines
MT11	MLA Table Measurement Record
ST01	Office Parameter Record (OPT)
ST02	Logical Status Record (LSTAT)
ST03	Physical Status Record (PSTAT)
ST04	Number Series Screening Header Record (NSSTHDR)

* The mnemonic in brackets following the form name is a particular data base table, covered by this office record.

TABLE D (CONT.)

OFFICE RECORD FORM	FORM NAME
ST05	Table Directory Record (TABDIR)
ST06	Supplemental Telephone Number Record (LHGT2)
ST07	Line Class Translation Record (LCTT)
ST08	Terminating Class Translation Record (TCTT)
ST09	Compressed Office Code Record (COCEXP)
ST10	MBI Expansion Record (MBIEXP)
ST11	Vertical Group Directory Record (VGDIR)
ST12	Line Hunt Group Record
ST13	Trunk Register/Trunk Scanner Record
ST14	Number Translation Record (NBRXLT)
ST15	Screening Translation Record (SCREEN)
ST16	Route Information Record (ROUTE)
ST17	(Reserved)
ST18	Number Series Screening Translation (NSST)

*   The mnemonic in brackets following the form name is a particular data base table, covered by this office record.
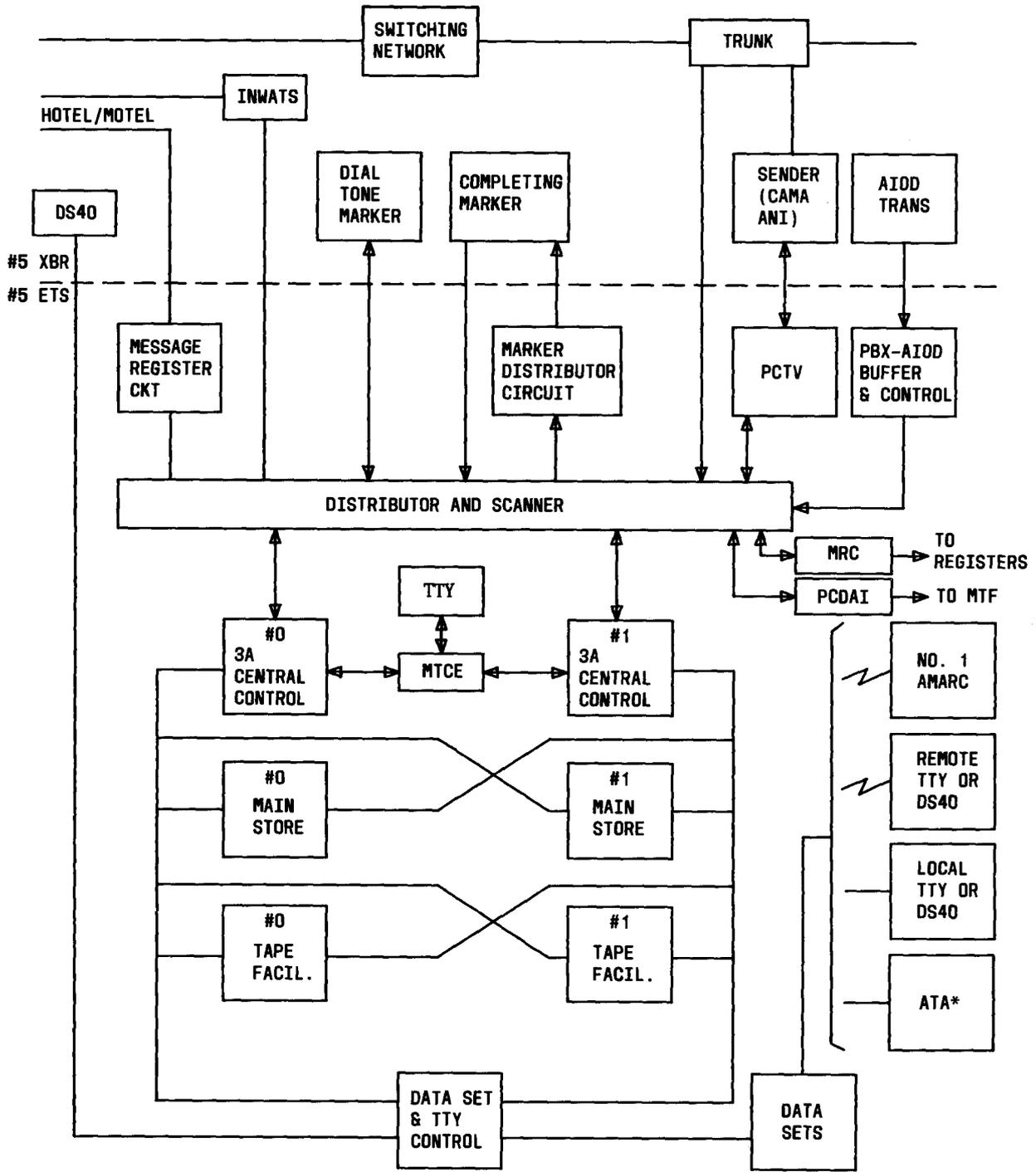
* TO BE FOUND IN GENERIC 2 AND SUBSEQUENT GENERIC ISSUES.

Fig. 1—No. 5 Crossbar ETS Block Diagram
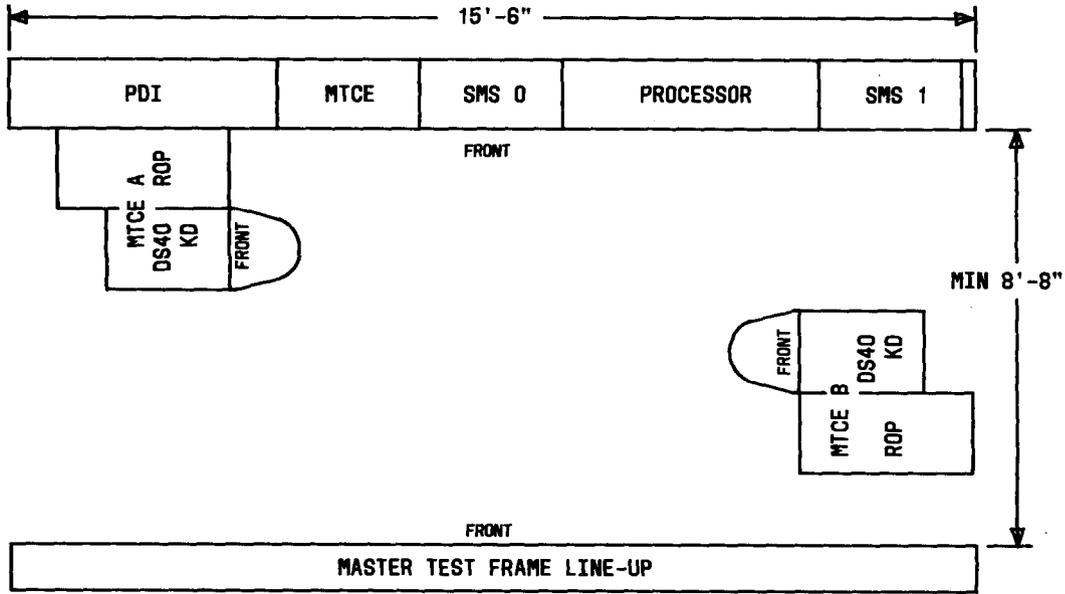
PDI   - POWER AND DATA INTERFACE
MTCE   - MAINTENANCE FRAME
SMS 0/1 - SUPPLEMENTARY MAIN STORE FRAME
MTCE A   - TERMINAL, DS40-KD, WITH ROP (READ ONLY PRINTER)
MTCE B   - TERMINAL, DS40-KD, WITH ROP (READ ONLY PRINTER)

Fig. 2—Typical ETS Floor Plan
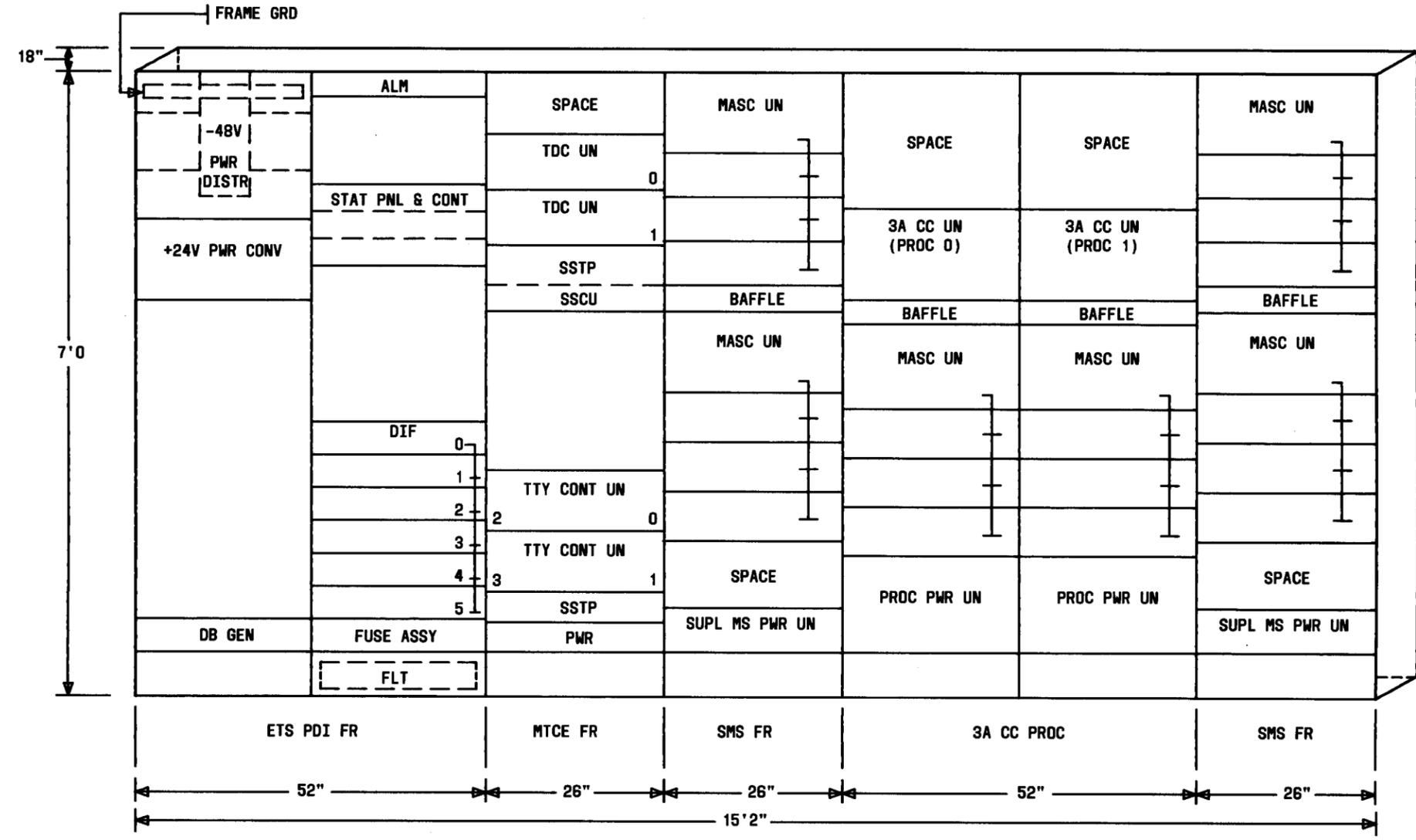
Fig. 3—Physical Layout for Processor Complex
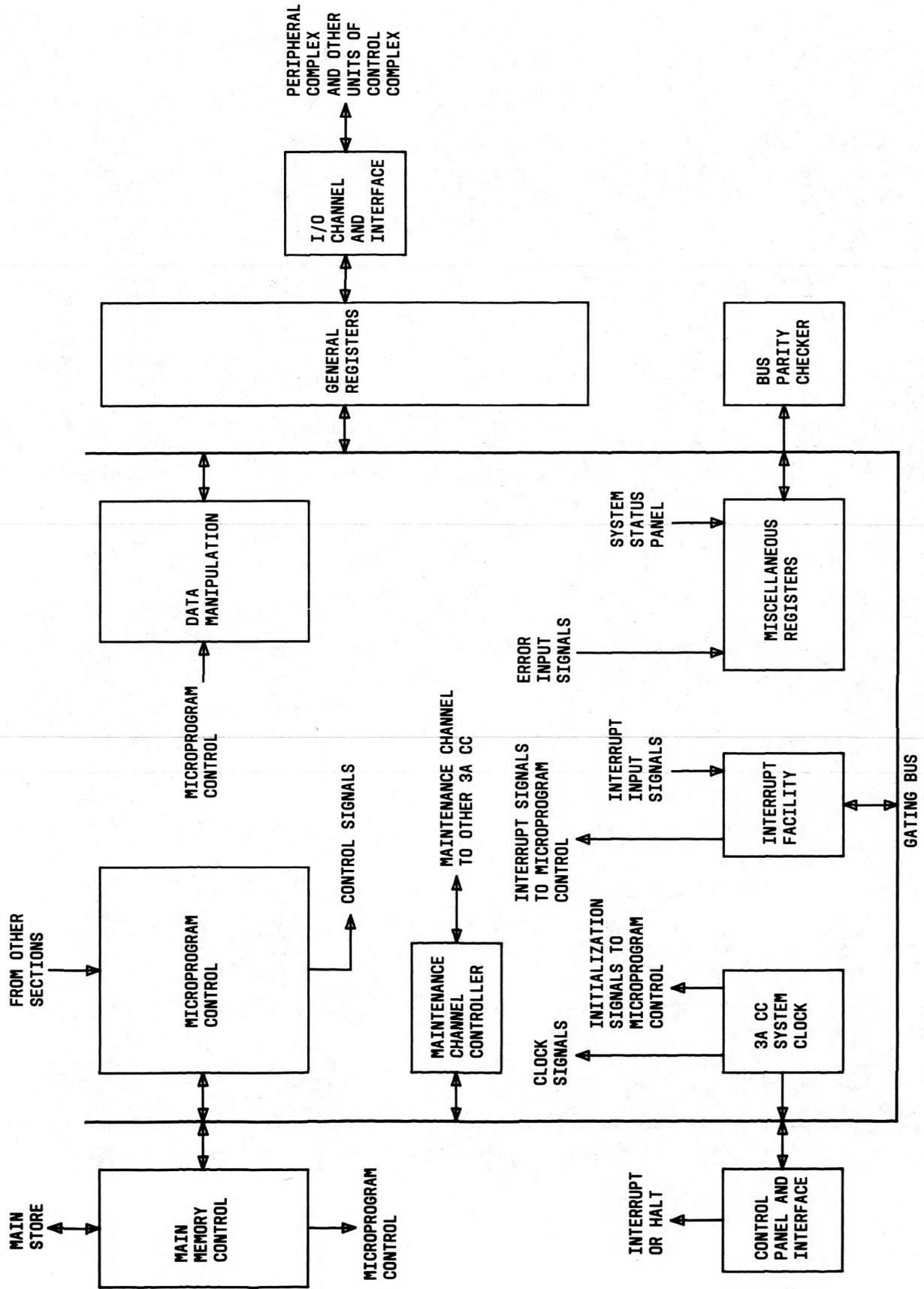
Fig. 4—Block Diagram of 3ACC

Fig. 5—Pictoral Diagram—Main Store

CARTRIDGE

TAPE DATA
CONTROLLER 0

TAPE DATA
CONTROLLER 1

SYSTEM
STATUS
PANEL

SSP CONTROLLER
MOUNTED ON REAR

THE AREA MAY BE USED FOR
A 35-TYPE TELETYPEWRITER
WHEN A DATA SPEED 40 (R)
CANNOT BE PROVIDED.

SPARE

TTY
CONTROLLER
UNIT 0

TTY
CONTROLLER
UNIT 1

SSP RLY UNIT

MC POWER

FILTER
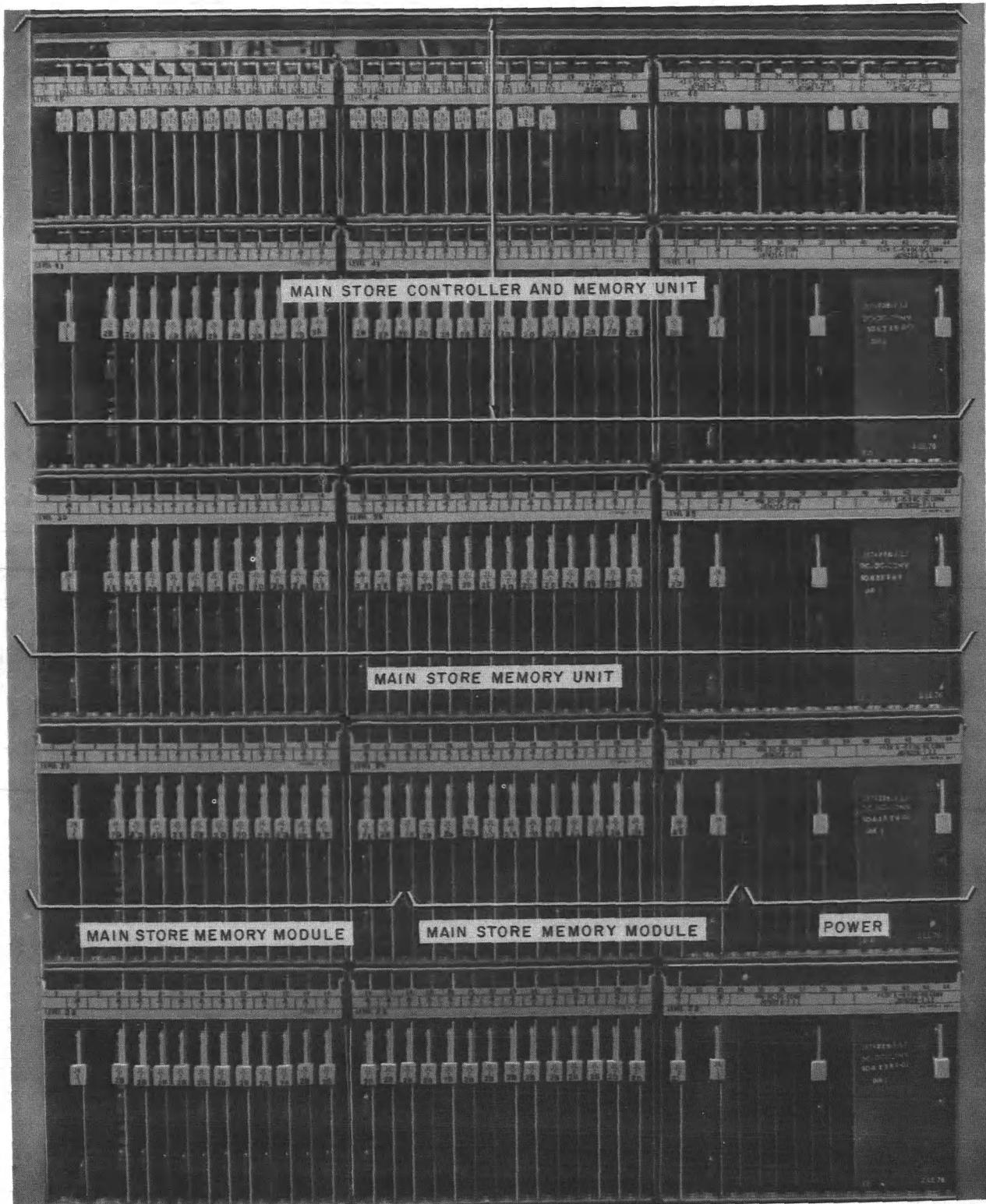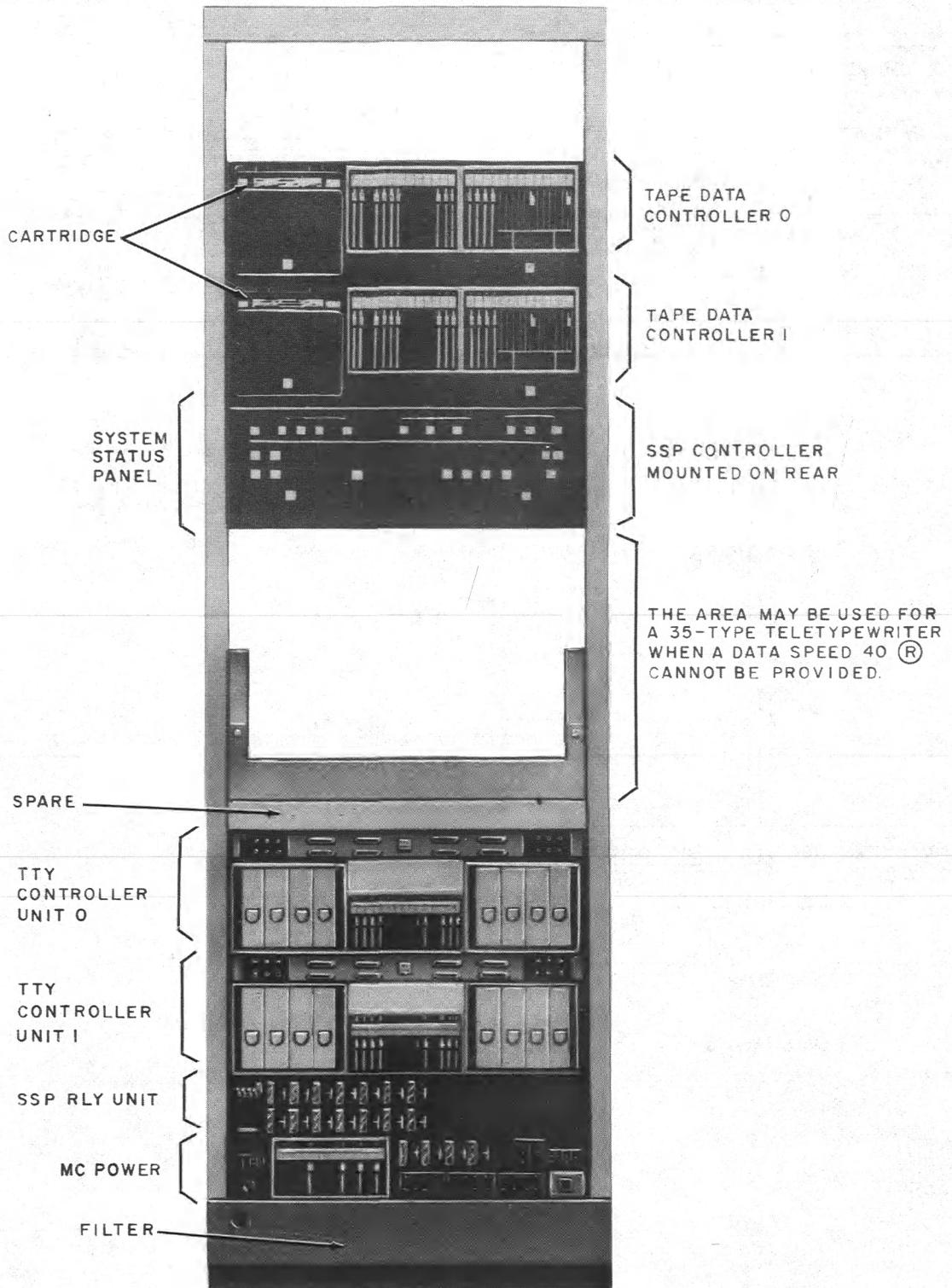
Fig. 6—Processor Complex Maintenance Frame With System Status Panel

ETS GROUND WINDOW	ALARM & MISC
−48V POWER DISTRIBUTION	
+24V POWER CONVERTER	MODE CONTROL UNIT
	ETS STATUS PANEL
	ACCESSORY PANEL
	DATA INTERFACE 0
	1
	2
	3
	4
	5
DATA BASE GENERATOR CONNECTORS	INSULATED GROUND
	FUSES
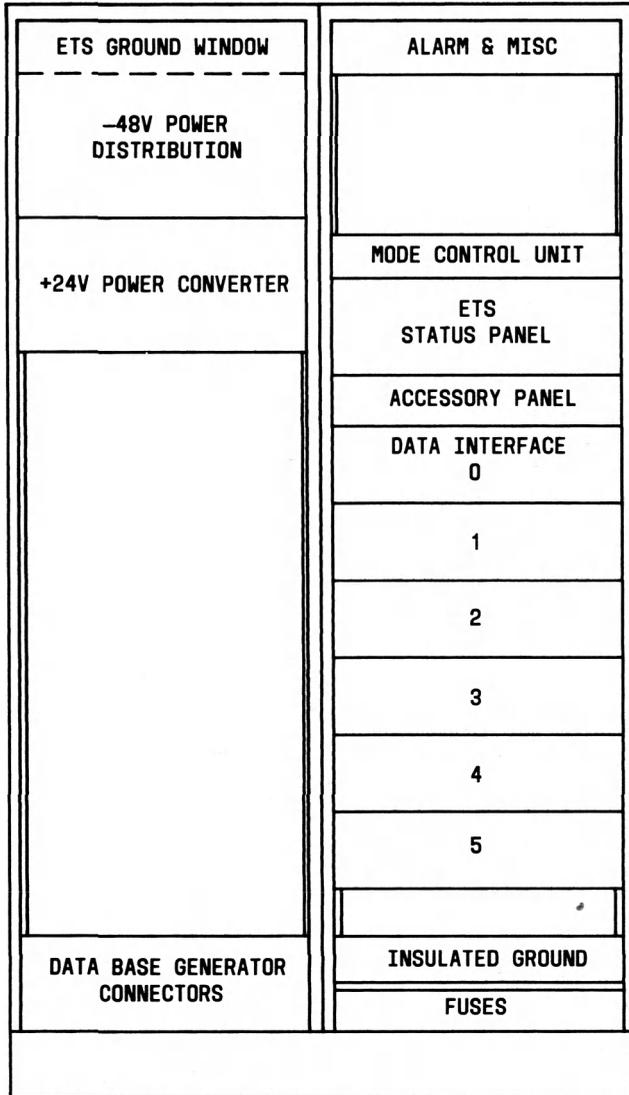
J29277B

Fig. 7—Power and Data Interface Frame—ETS Status Panel
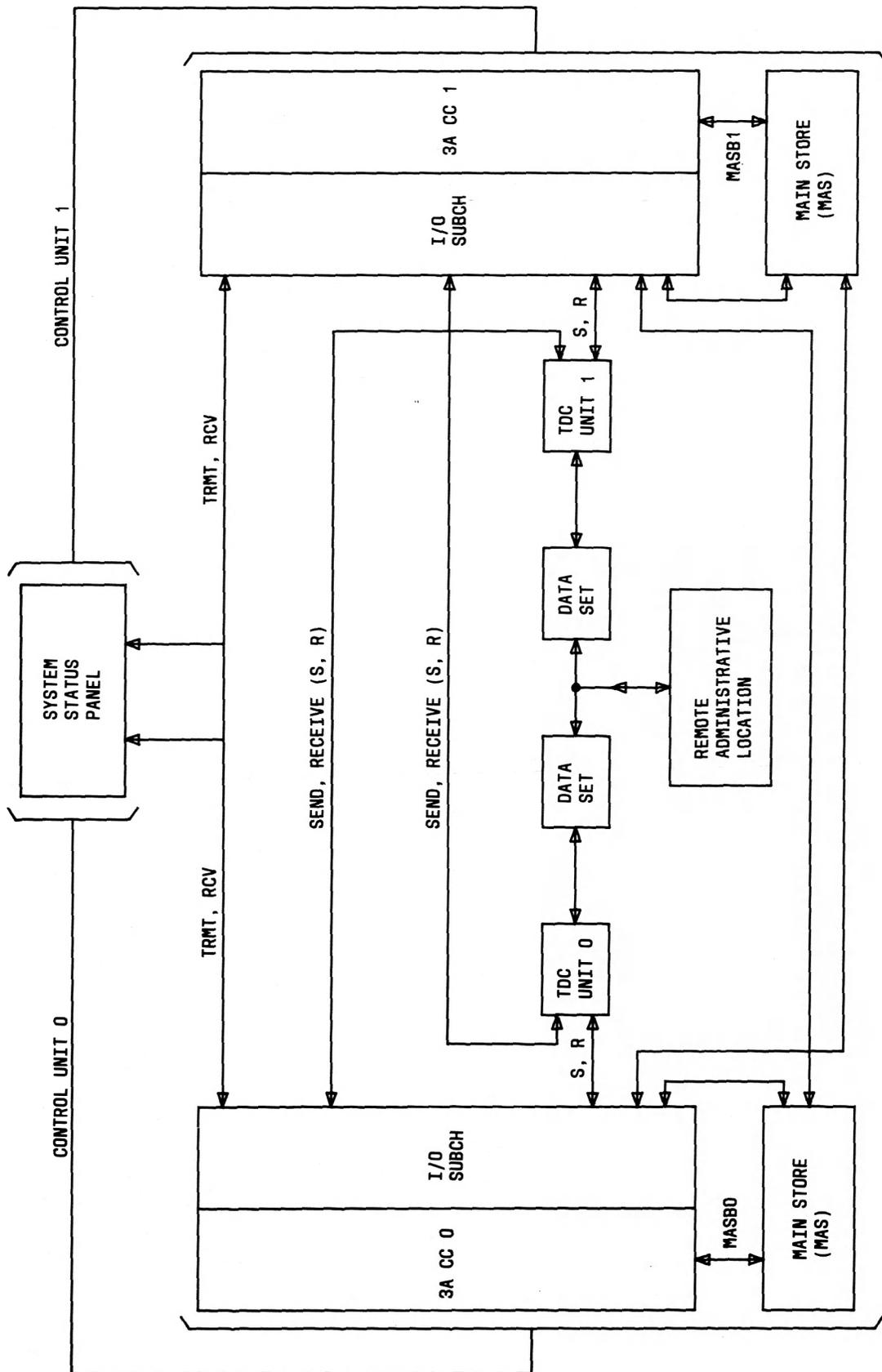
Fig. 8—Tape Data Controller Unit Interface Block Diagram

Fig. 9—Power and Data Interface Frame

POWER & DATA INTERFACE

I/O SUBCHANNEL INTERFACE

| SPI 0 | | RSI 00 | | DATA SET 0 |

3A CC "0"

3A CC "1"

| RSI 04 |

| SPI 5 | | RSI 50 | | DATA SET 5 |

| RSI 54 |

TO DATA LINK FACILITIES

Fig. 10—I/O Sub Channel Interface

MARKER OR TRUNK CIRCUIT

DAS SCANNER CIRCUIT

+5

SCAN POINT

−48V

−48V

NOT PROVIDED IN LINE SCANNERS
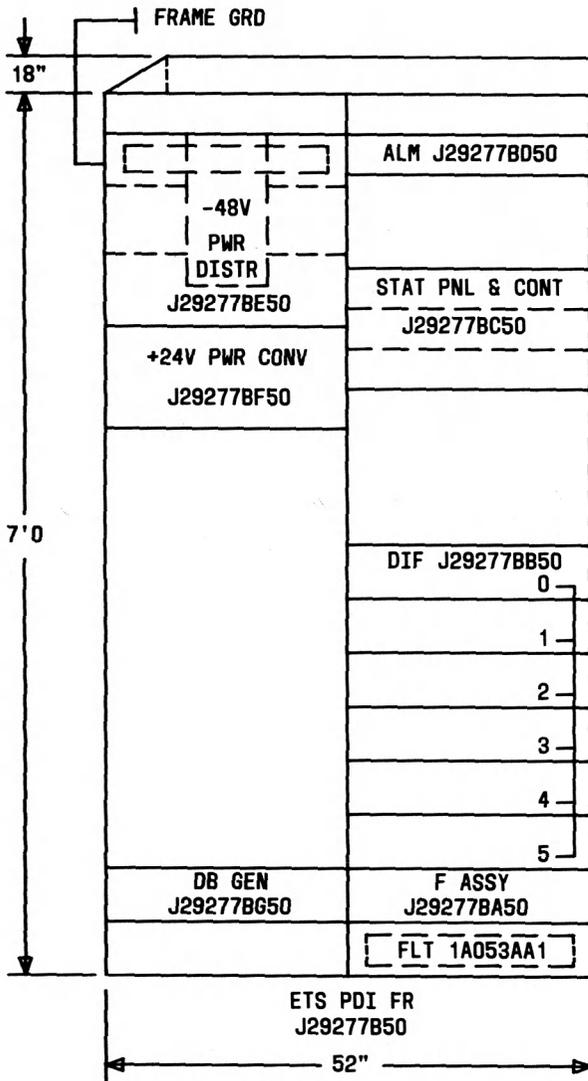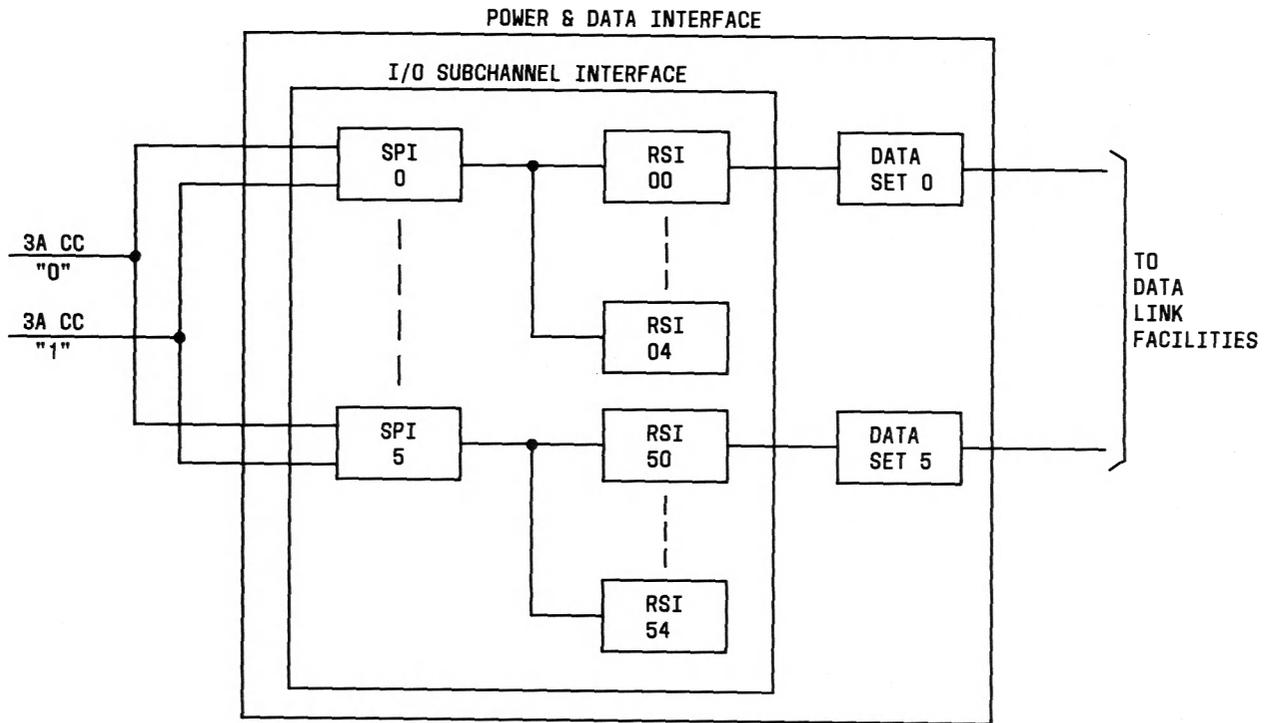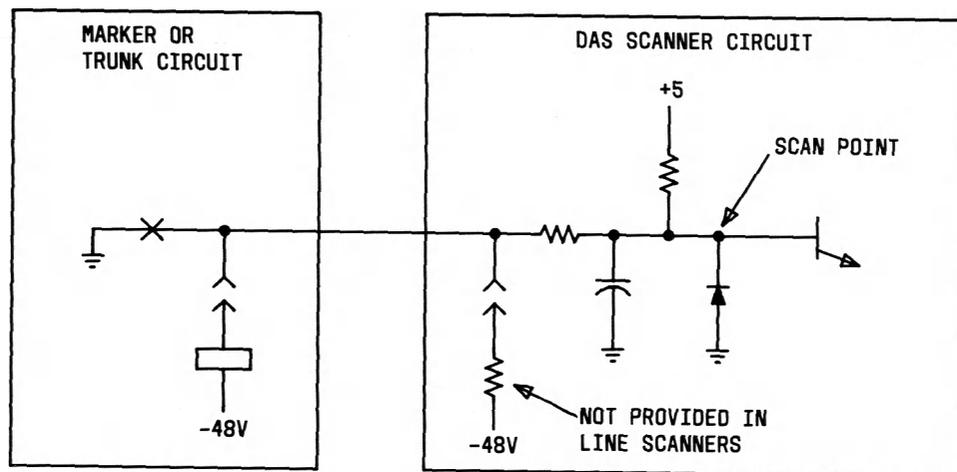
Fig. 11—Typical Scan Point Configuration
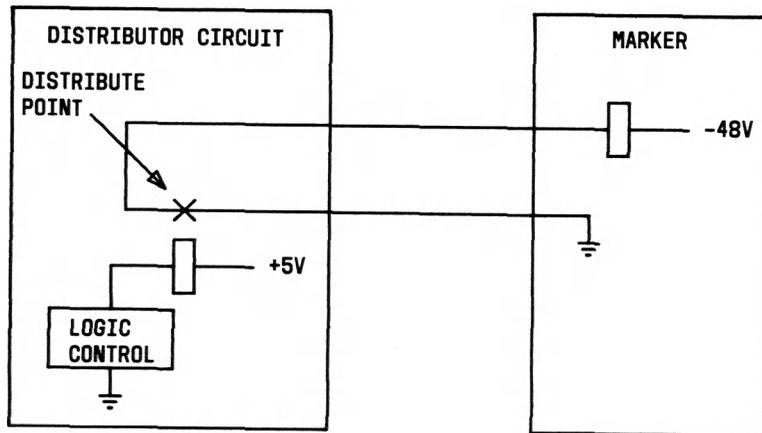
Fig. 12—Typical Distribute Point Configuration

	DAS FRAME 00		DAS FRAME 01		DAS FRAME 02		DAS FRAME 03		DAS FRAME 04		DAS FRAME 05	
11	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
10	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
9	TKS--/LIS--	HMD01	TKS--/LIS--	HMD03	TKS--/LIS--	HMD005	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TLS--/LIS--
8	HMS00	HMD00	HMS01	HMD02	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--
7	LIS00	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--
6	TKS--	MKD00A	TKS--	MKD02A	TKS--	MKD04A	TKS--	MKD06A	TKS--	MKD08A	TKS--	MKD10A
5	TKS00	MKD00B	TKS--	MKD02B	TKS--	MKD04B	TKS--	MKD06B	TKS--	MKD08B	TKS--	MKD10B
4	MKS00A	MKD00C	MKS02A	MKD02C	MKS04A	MKD04C	MKS06A	MKD06C	MKS08A	MKD08C	MKS10A	MKD10C
3	MKS00B	MKD00D	MKS02B	MKD02D	MKS04B	MKD04D	MKS06B	MKD06D	MKS08B	MKD08D	MKS10B	MKD10D
2	SAS00	SAD00	ACS00	ACD00	HMS02	HMD04	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
1	CONTROL UNIT DAS GROUP 0		CONTROL UNIT DAS GROUP 2		CONTROL UNIT DAS GROUP 4		CONTROL UNIT DAS GROUP 6		CONTROL UNIT DAS GROUP 8		CONTROL UNIT DAS GROUP 10	
11	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
10	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
9	TKS--/LIS--	MKD00	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	HMD07	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--
8	TTS00	TTD00	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--
7	LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--	TKS--/LIS--
6	TKS--	MKD01A	TKS--	MKD03A	TKS--	MKD05A	TKS--	MKD07A	TKS--	MKD09A	TKS--	MKD11A
5	TKS--	MKD01B	TKS--	MKD03B	TKS--	MKD05B	TKS--	MKD07B	TKS--	MKD09B	TKS--	MKD11B
4	MKS01A	MKD01C	MKS03A	MKD03C	MKS05A	MKD05C	MKS07A	MKD07C	MKS09A	MKD09C	MKS11A	MKD11C
3	MKS01B	MKD01D	MKS03B	MKD03D	MKS05B	MKD05D	MKS07B	MKD07D	MKS09B	MKD09D	MKS11B	MKD11D
2	SAS01	SAD01	ACS01	ACD01	HMS03	HMD06	DO NOT	EQUIP	DO NOT	EQUIP	DO NOT	EQUIP
1	CONTROL UNIT DAS GROUP 1		CONTROL UNIT DAS GROUP 3		CONTROL UNIT DAS GROUP 5		CONTROL UNIT DAS GROUP 7		CONTROL UNIT DAS GROUP 9		CONTROL UNIT DAS GROUP 11	
	DAS FRAME 00		DAS FRAME 01		DAS FRAME 02		DAS FRAME 03		DAS FRAME 04		DAS FRAME 05	

Fig. 13—Physical Layout for Distributor and Scanner Frame

27-LEAD
PARALLEL BUS

```
                                                    ┌──────────┐
  ──────▶┌─────────┐        ┌─────┐         ┌─────┐ │ 64 POINT │──────▶
  ──────▶│256 POINT│◀─────  │ SA* │◀──────▶ │ DA† │▶│DISTRIBUTE│
         │  SCAN   │        └─────┘         └─────┘ │  MATRIX  │──────▶
  ──────▶│ MATRIX  │──────▶                         └──────────┘
         └─────────┘
```

* SA – SCAN ACCESS
† DA – DISTRIBUTE ACCESS

SERIAL BUS

```
┌──────┐
│3A CC │
│  0   │
└──────┘              ┌─────────────┐
                      │SCAN-DISTRIBUTE│
┌──────┐              │  CONTROLLER  │
│3A CC │              └─────────────┘
│  1   │
└──────┘
```
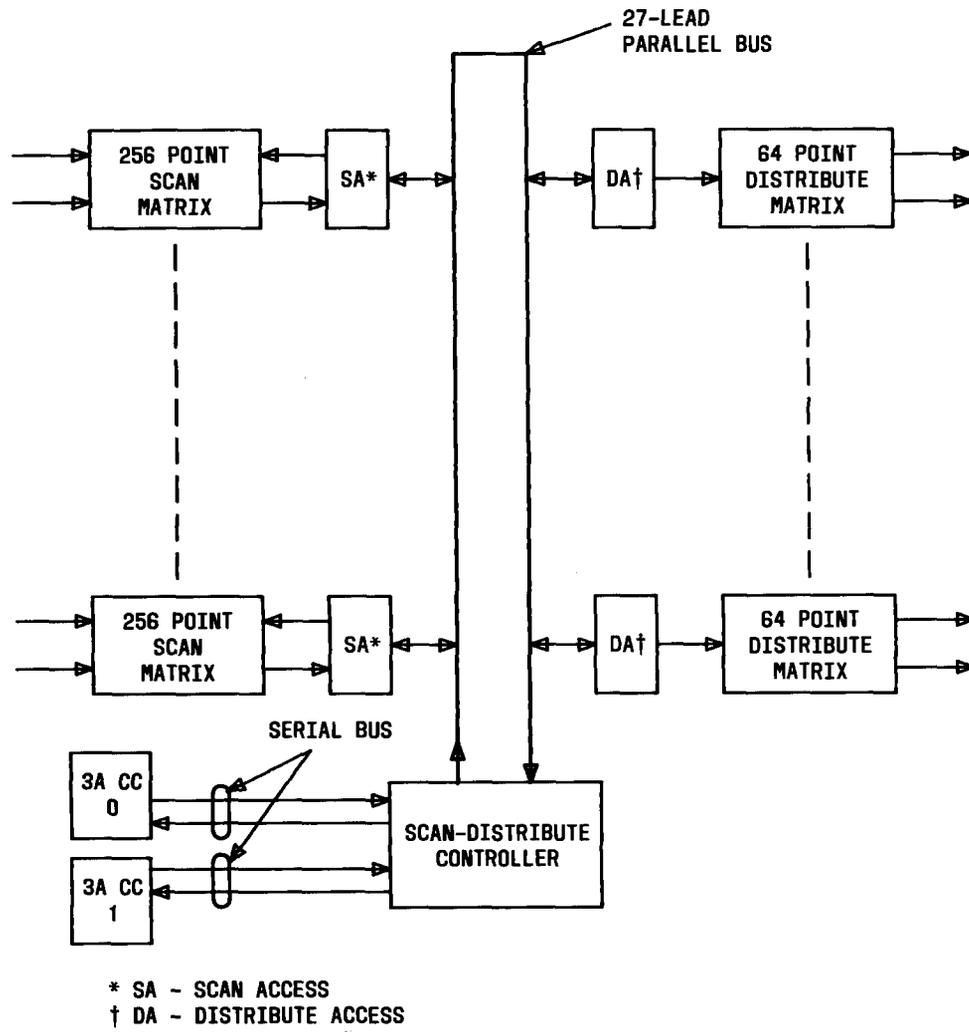
Fig. 14—Data/Address Between Matrices and 3ACC

Fig. 15—Trunk Scanner Matrix
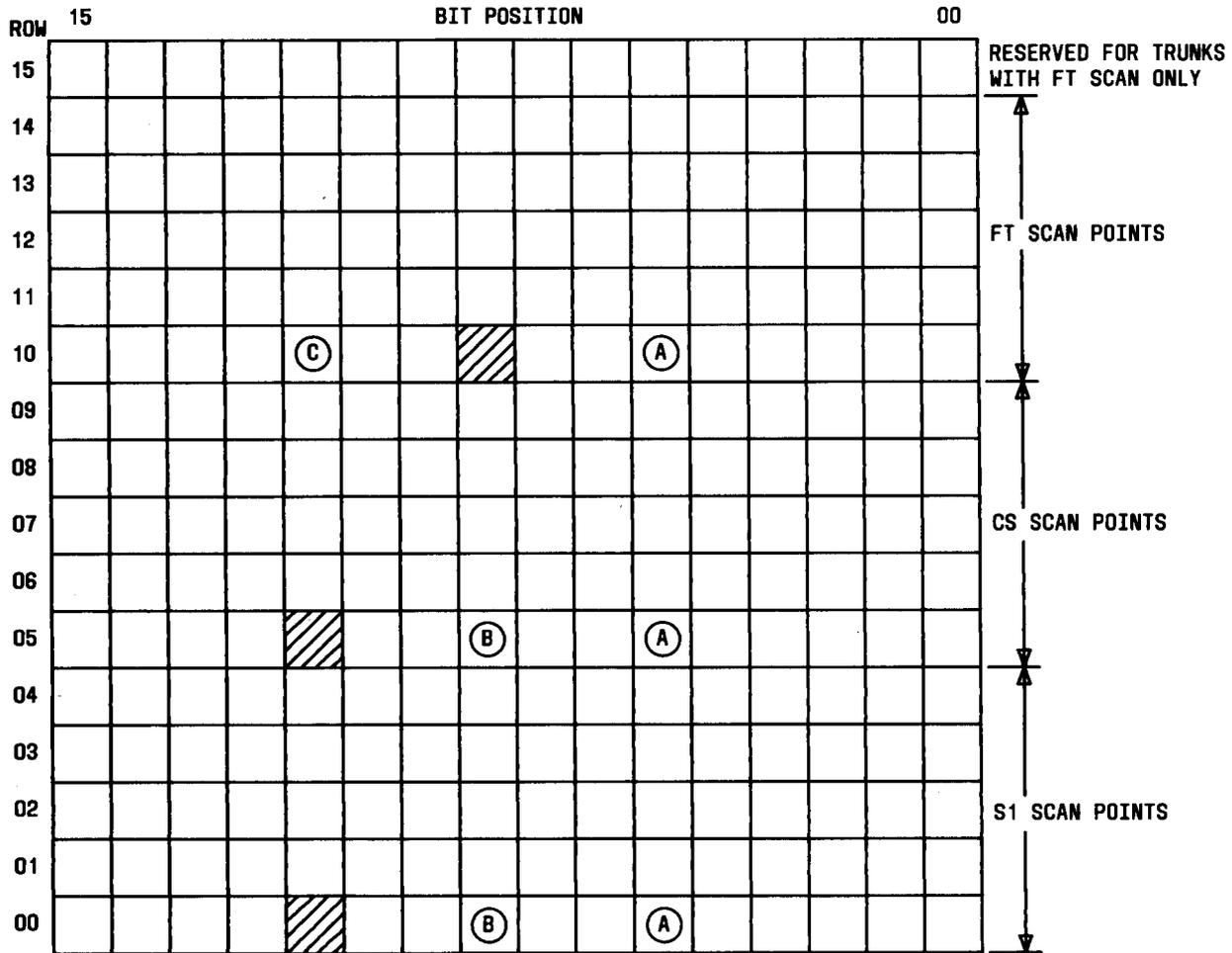
(A) – CAMA JUNCTORS OR TRUNKS THAT HANDLE RECORDABLE CALLS (BIT POSITION 05)

(B) – IN-WATS OR CAMA TRUNKS (BIT POSITION 08)

(C) – TRUNKS THAT HANDLE NON-RECORDABLE CALLS (BIT POSITION 11)

PHYSICAL MATRICES

LOGICAL FUNCTIONS	TKS--	LIS--	MKS--A	MKS--B	MKD--A	MKD--B	MKD--C	MKD--D	SAS-	SAD-	ACS-	ACD-	HMS-	HMD-	MRD	TTS--	TTD--
TRKS--	X																
LINES--		X															
CM--			X	X	X	X	X	X									
DTM--				X				X									
CAMA-											X	X					
ANI-									X	X							
LIT																X	X
RMR-													X	X			
MRC									X						X		
RTC-									X	X							
AIOD-											X	X					
MBP--			X				X										
MBS--				X		X											
TEST									X								
PCDA																X	X
TRKSUP																	X
OTL																X	X
*MTFTST										X							

LOGICAL FUNCTION ABBREVIATIONS

TRKS	-	TRUNKS
LINES	-	LINES
CM	-	COMPLETING MARKERS
DTM	-	DIAL TONE MARKERS
CAMA	-	CAMA PCTV
AIN	-	ANI PCTV
LIT	-	LINE INSULATION TEST CIRCUIT
RMR	-	REMOTE MESSAGE REGISTERS
MRC	-	MEASUREMENTS REGISTRATION CONN CKT
RTC	-	ROUTE TRANSFER CONTROL
AIOD	-	PBX-AIOD BUFFER AND CONTROL
MBP	-	MAKE-BUSY PRIMARY CONTROL
MBS	-	MAKE BUSY SECONDARY CONTROL
TEST	-	TEST CIRCUIT CONTROL (MTF, APTT, ETC)
PCDA	-	PROGRAM CONTROLLED DATA ACQUISITION
TRKSUP	-	TRUNK SUPERVISION MONITORING, MTF, APTT
OTL	-	ORIG TEST LINE CONTROL FOR ETS
MTFTST	-	MTF AUXILIARY TESTING

*PROVIDED IN GENERIC 2 AND SUBSEQUENT GENERIC ISSURES.

PHYSICAL MATRIX ABBREVIATIONS

TKS	-	TRUNK SCAN MATRIX
LIS	-	LINE SCAN MATRIX
MKS--A,B	-	MARKER SCAN MATRICES
MKD--A,B,C,D	-	MARKER DISTRIBUTE MATRICES
SAS	-	SYSTEM CONTROL AND ANI SCAN MATRIX
SAD	-	SYSTEM CONTROL AND ANI DISTRIBUTE MATRIX
ACS	-	AIOD AND CAMA SCAN MATRIX
ACD	-	AIOD AND CAMA DISTRIBUTE MATRIX
HMS-	-	HOTEL/MOTEL SCAN MATRIX
HMD	-	HOTEL/MOTEL DISTRIBUTE MATRIX
MRD	-	MEASUREMENTS REGISTRATION DISTRIBUTE MATRIX
TTS	-	TEST SCAN MATRIX
TTD	-	TEST DISTRIBUTE MATRIX

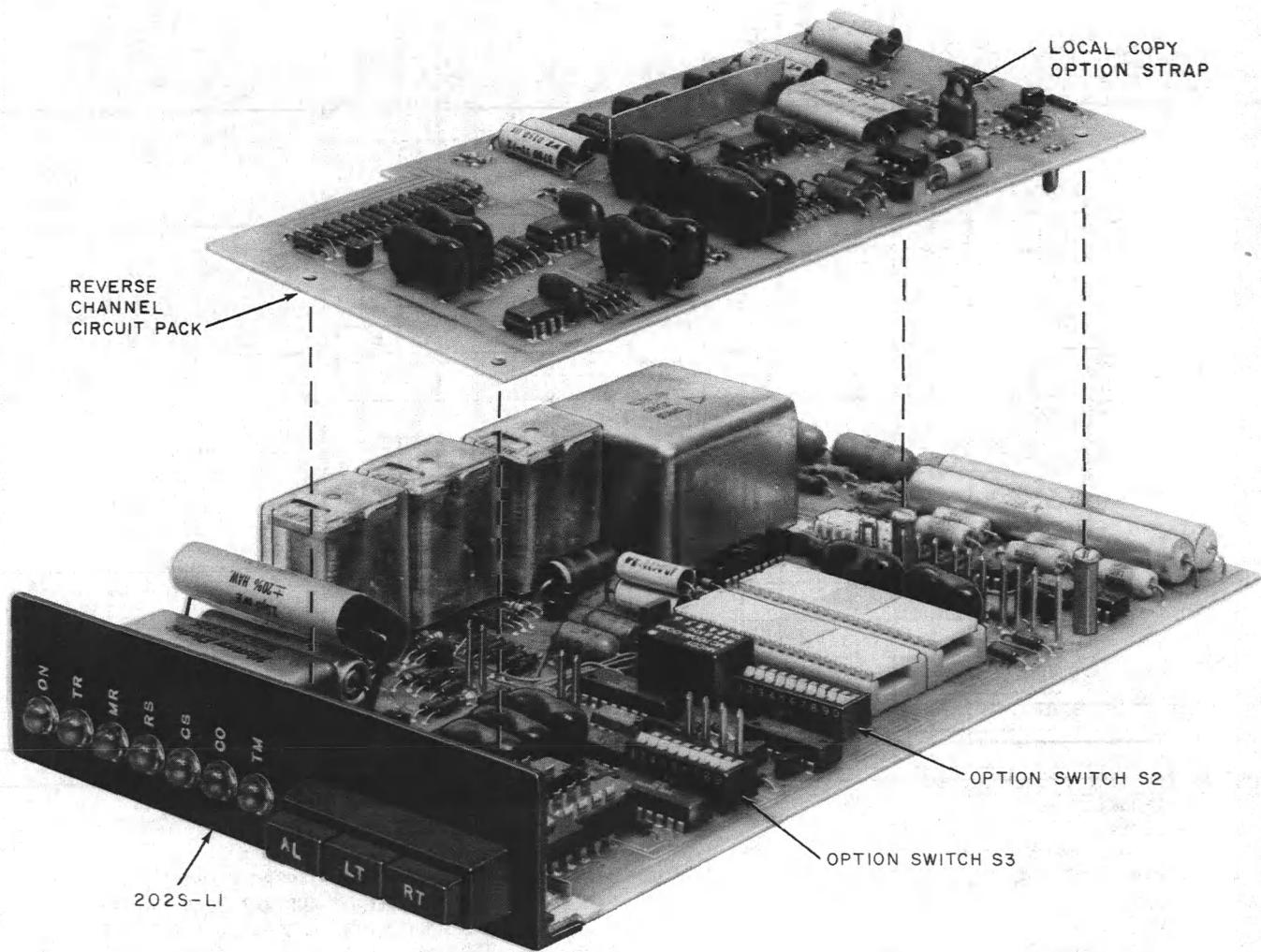**Fig. 16—Logical Functions Versus Physical Matrices for Scan/Distribute Units**

Fig. 17a—Data Set—202S
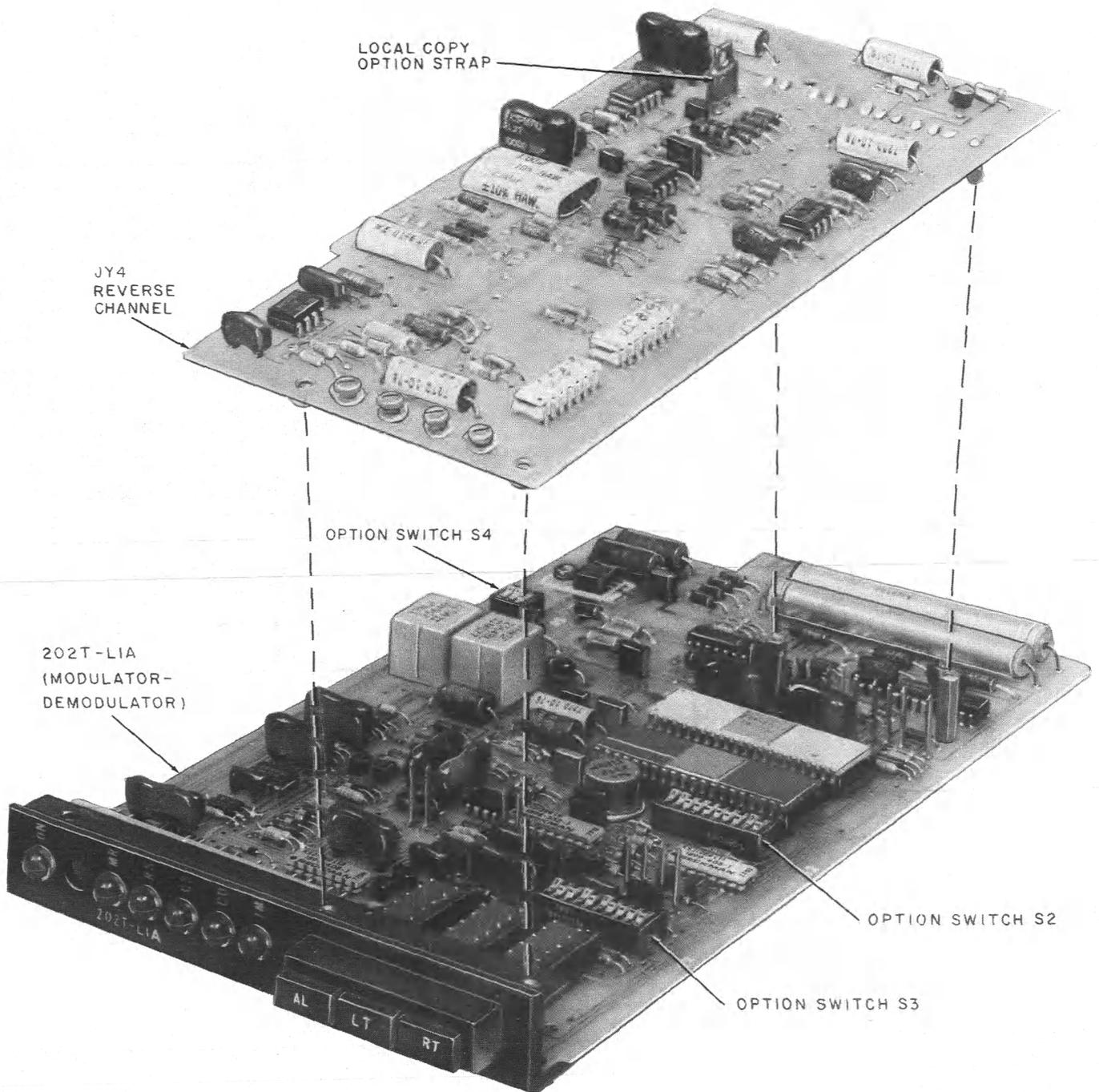
Fig. 17b—Data Set—202T
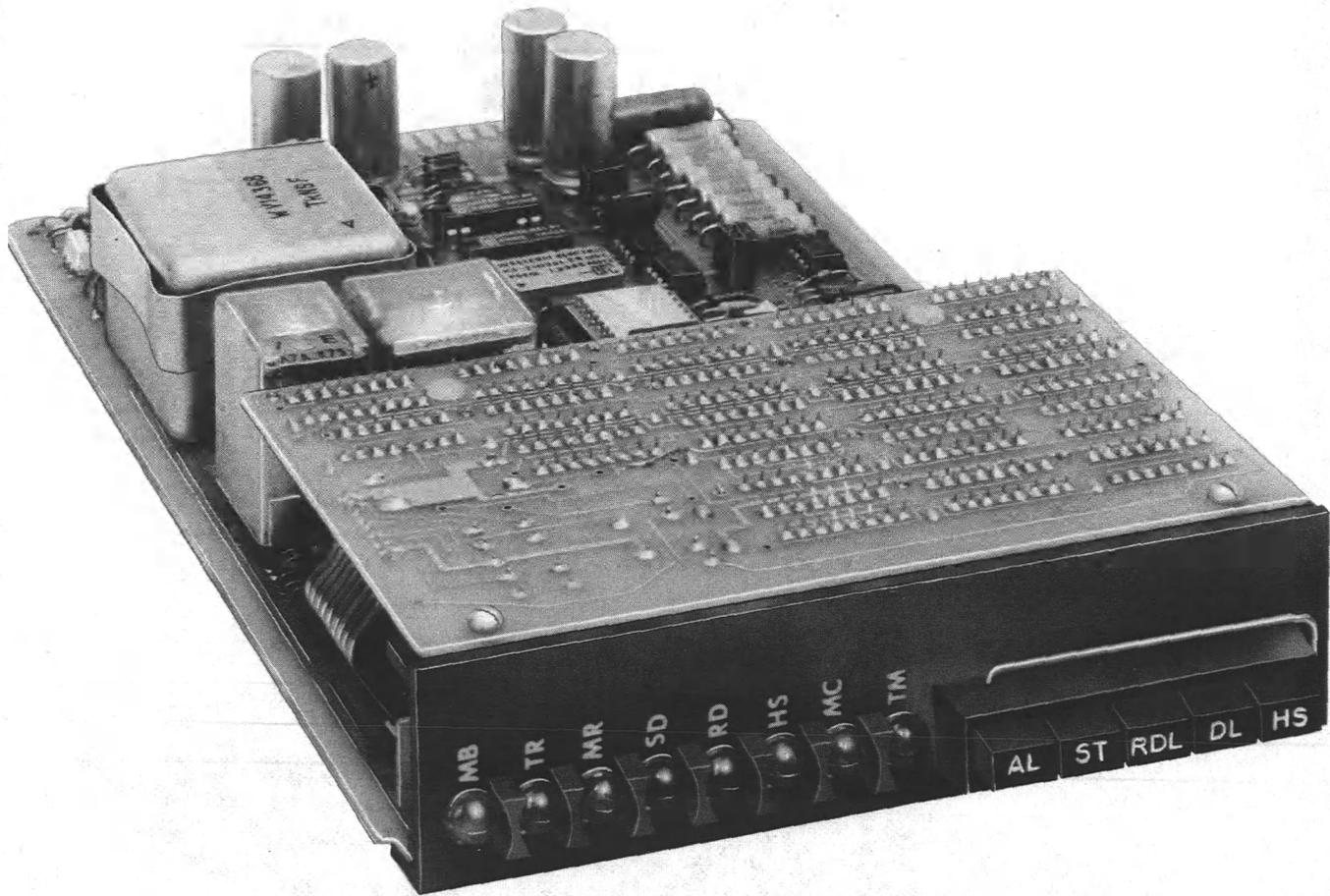
Fig. 17c—Data Set 212A-LIA
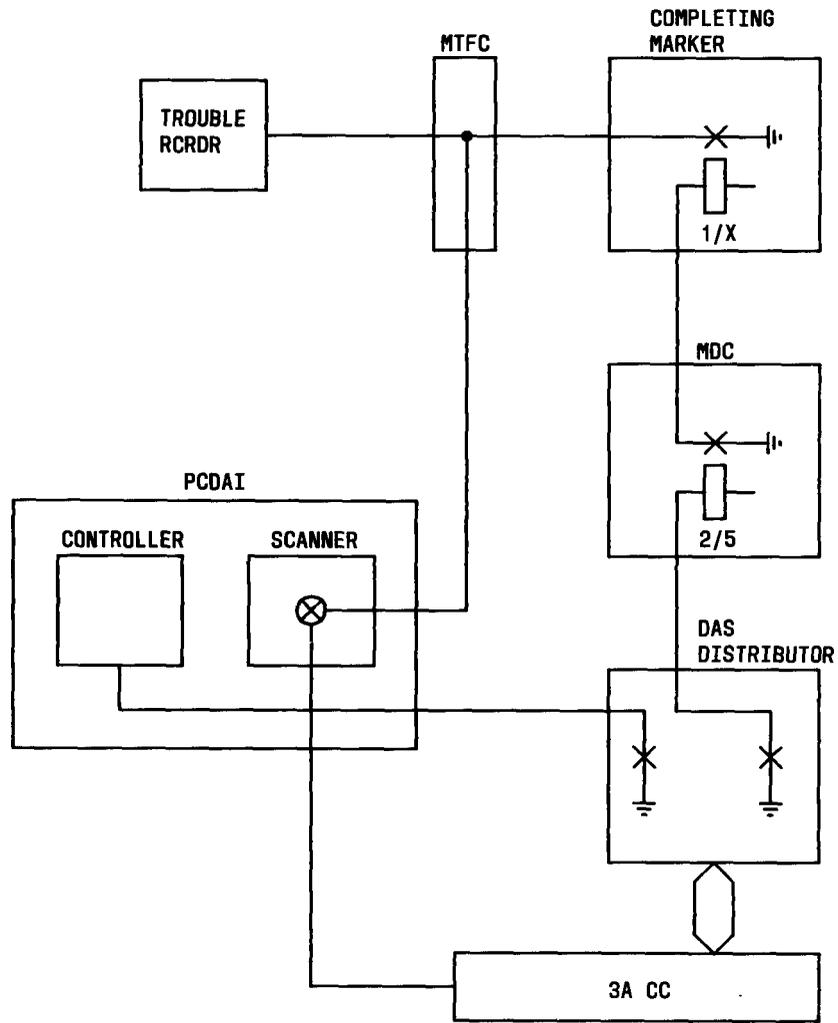
Fig. 18—Testing Using the PCDAI

ROW   FORMAT

ROW	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
00	LX-COC COMPRESSED OFFICE CODE							LX-XLT AIOD XLATOR NO			LX-TRKU TRK UNITS DIGIT (2/5)			LX-TYPE	
01	LX-LT TRAP	LX-CO CMP OBS		LX-SD SVC DNY		LX-MM SPL BTN	LX-TT T-TONE	LX-LC LINE CLASS								
02	LX-TH LDN THOUSANDS (BCD)						LX-H LDN HUNDREDS (BCD)			LX-T LDN TENS (BCD)			LX-U LDN UNITS (BCD)		
03	0	LX-TRKT TRK TENS DIGIT (2/5)					LX-TRKH TRK HUNDREDS DIGIT (2/5)					LX-TRKTH TRK THOUSANDS DIGIT (2/5)				
04	0																

BIT POSITION

ROW   STORED DATA

ROW	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
00	1	0	1	1	0	0	0	0	0	1	0	1	0	0	1	0
01	0	0	0	1	1	0	0	1	0	0	1	1	1	0	1	0
02	0	1	1	1	0	0	0	1	0	0	1	0	0	1	0	1
03	0	0	1	0	0	1	1	0	1	0	0	0	0	1	1	0
04																

BIT POSITION

Fig. 19—LINTEXP Entry for an AIOD Office
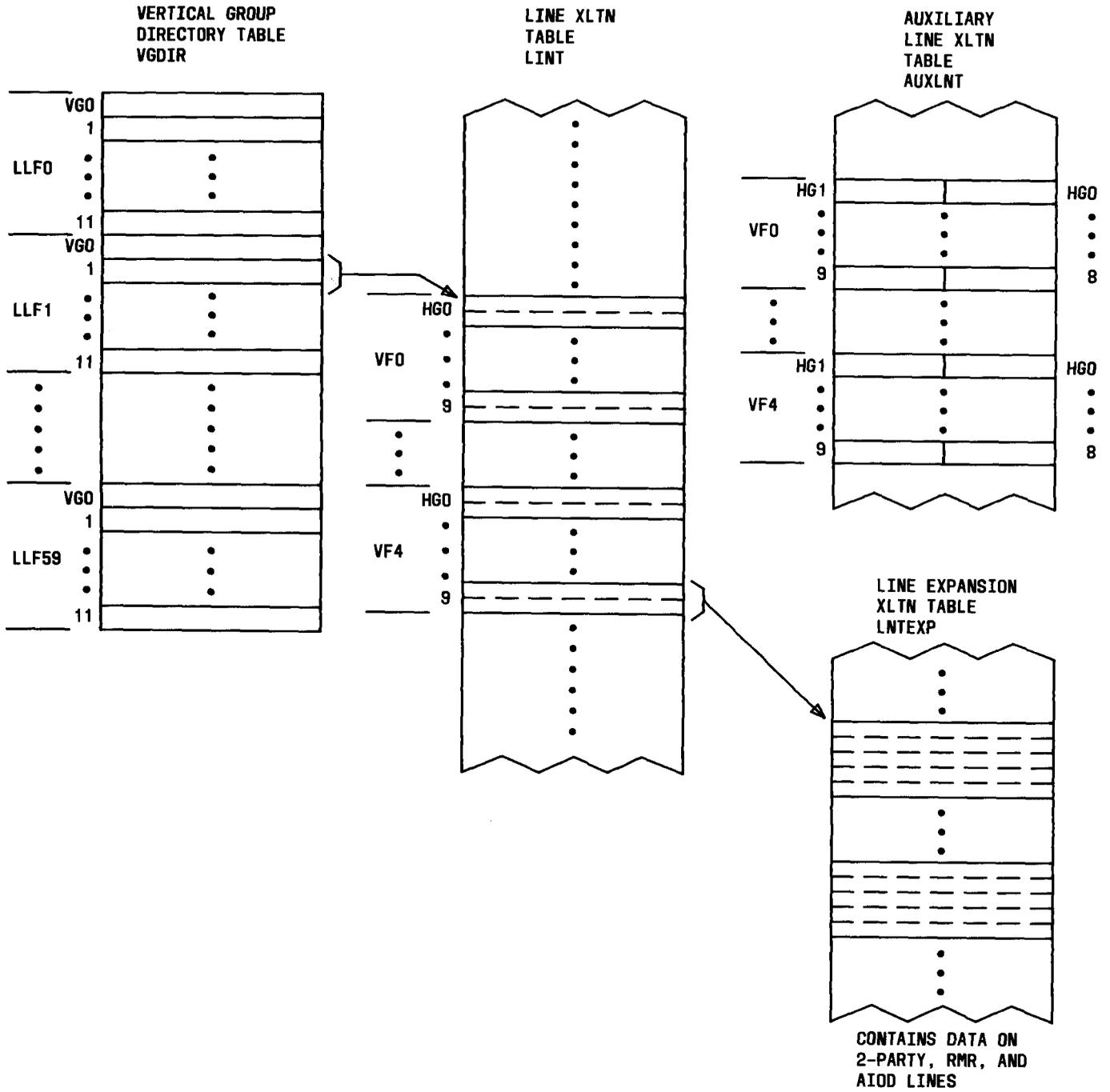
Fig. 20—Originating Line Translation
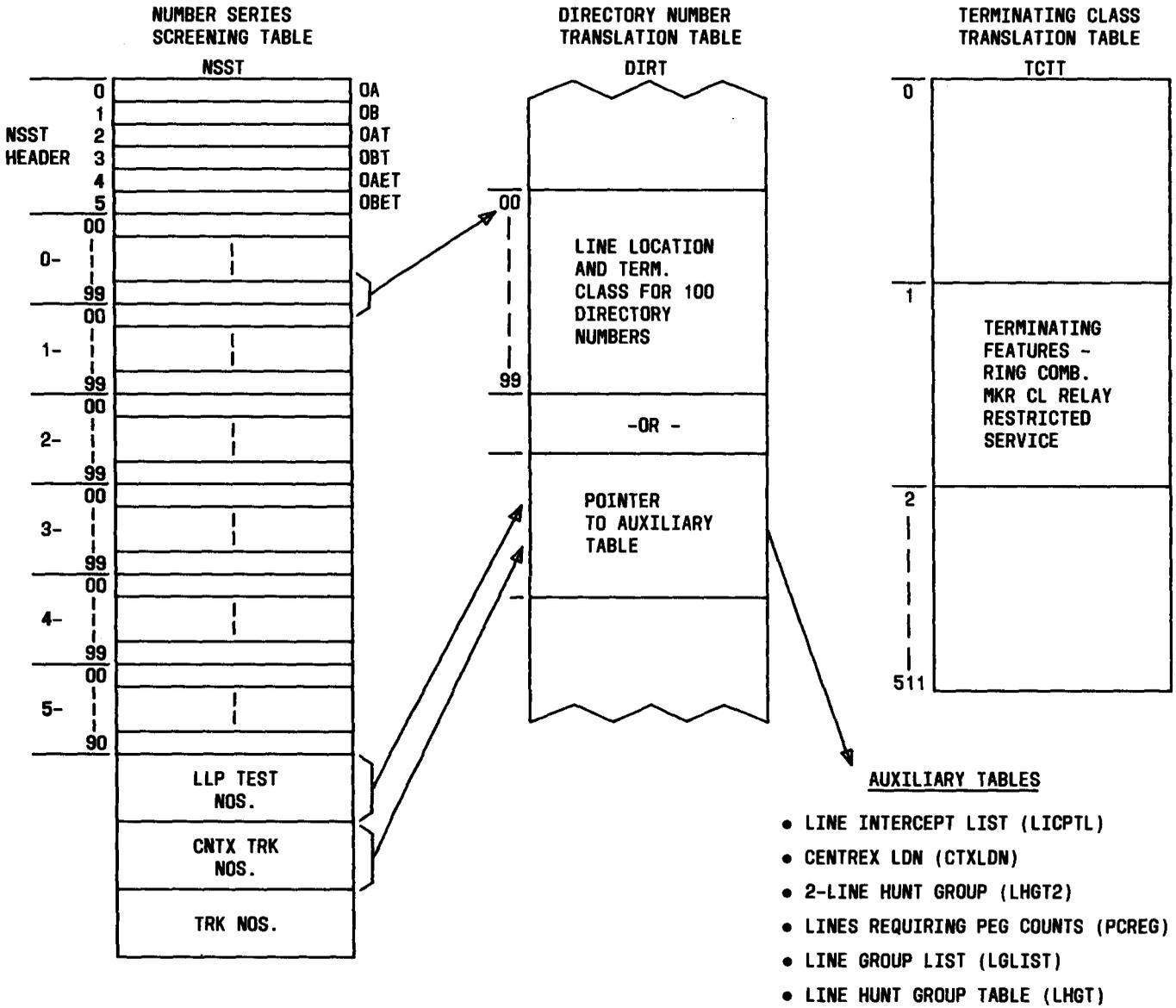
Fig. 21—Directory Number (Terminating Line) Translation

NSST

LGLIST

868-5000
TO
868-5199 — POINTER TO LGLIST HML3

DIRT

868-5200
TO
868-5299 — POINTER TO DIRT BLK 15

BLK 15

200 — POINTER TO LGLIST HML4

NSTYP1
0100 — POINTER TO DIRT BLK 25

201
TO
299 — POINTER TO LGLIST HML3

0200 — POINTER TO DIRT BLK 24

BLK 25

0165 — BLK 41--LINE 0

0199 — BLK 43--LINE 4

BLK 26

BLK 43--LINE 5

HML3
SBLK 0
EBLK 0
CNT 0
TC12

HML4
SBLK 0
EBLK 0
CNT 0
TC13

HML5
SBLK 41
EBLK 43
CNT 3
TC14

LINE LINK PULSING
TEST ACCESS

**ADDRESS FROM
LINE SCANNER**

LISMAP

ROW 00-15 — LIS 01

BIT 01 — BLK 41--LINE 0

BIT 15 — BLK 41--LINE 15

ROW 00-15 — LIS 02

BIT 01 — BLK 42--LINE 0

BIT 15 — BLK 42--LINE 15

BUSY/IDLE

SLEEVE LEAD
INDICATIONS

LHGT

BLK 41-HML5

LINE 0 — OE 090432

LINE 15 — OE 100844

BLK 42-HML5

LINE 0 — OE 180452

LINE 15 — OE 120381

BLK 43-HML5

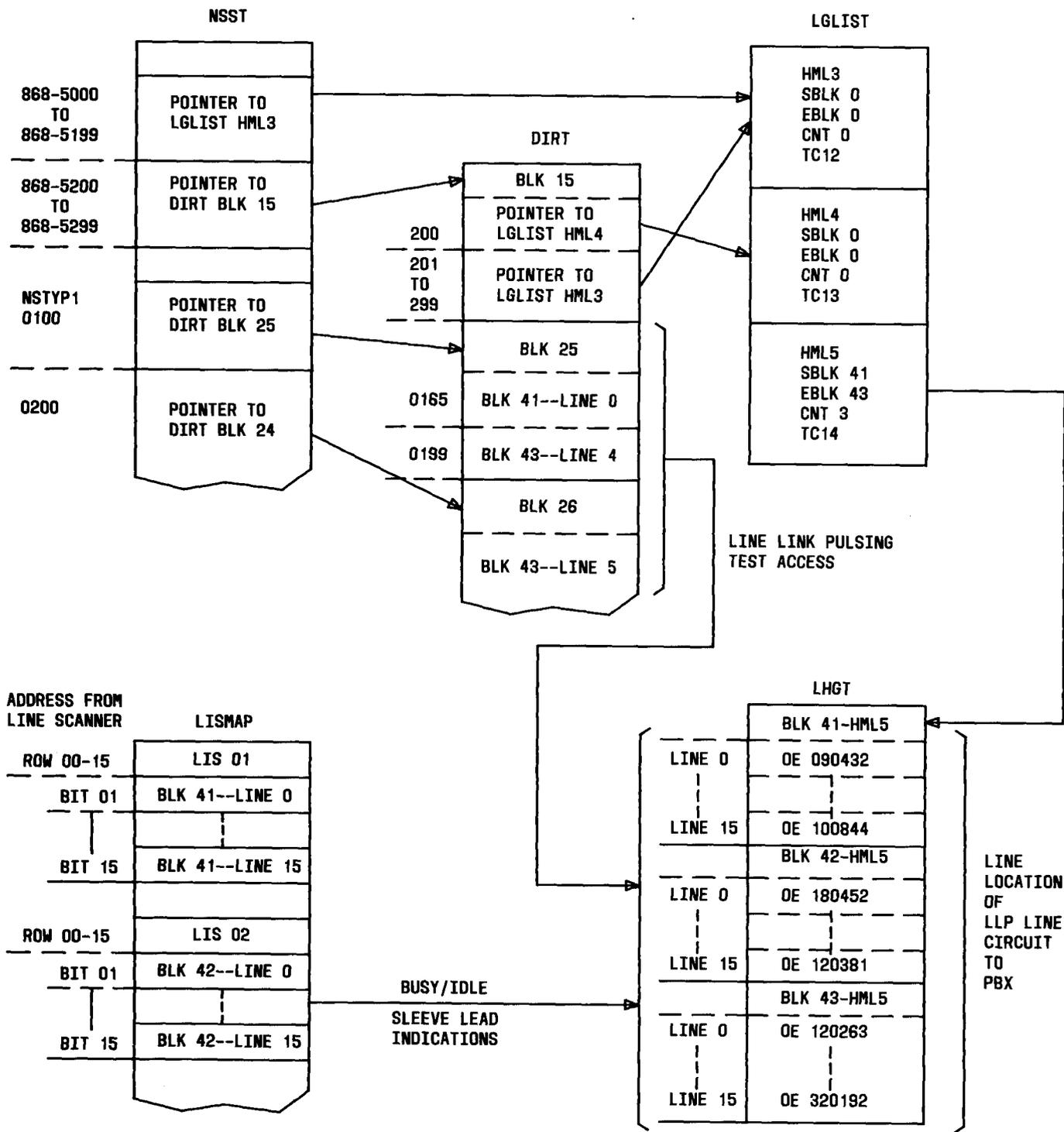LINE 0 — OE 120263

LINE 15 — OE 320192

LINE
LOCATION
OF
LLP LINE
CIRCUIT
TO
PBX

Fig. 22a—Data Base Overview for Multiline Hunt Groups With LLP Line Circuits

Fig. 22a—Data Base Overview for Multiline Hunt Groups With LLP Line Circuits (contd)

START

| ARE TERMINATING CLASSES IN TCTT? | N → | RC:TABLE:TCTT/ TYP NEW/ PART 35, 218-799-335 |

Y

| HAVE CODE POINT TRANSLATIONS BEEN ENTERED? | N → | RC:TABLE:NBRXLT/ TYP NEW/ PART 24, 218-799-335 |

Y

| HAVE PARAMETERS BEEN ENTERED IN SCRHDR? | N → | RC:TABLE:SCRHDR/ TYP NEW/ PART 33, 218-799-335 |

Y

| ARE ENTRIES IN SCREEN TABLES? | N → | RC:TABLE:SCREEN/ TYP NEW/ PART 32, 218-799-335 |

Y

| ARE ROUTE TRANSLATIONS ENTERED? | N → | RC:TABLE:ROUTE/ TYP NEW/ PART 31, 218-799-335 |

Y

BUILD LGLIST TABLE AND LHGTHDR →

ENTER HMLs THAT DO NOT HAVE LINES ASSIGNED (TC WILL BE FOR THE ENTRY CODE FOR SCREENING, ROUTING, ETC)
RC:TABLE:LGLIST/
TYP NEW/
PART 12
218-799-335

→ ENTER HMLs WITH LINES ASSIGNED
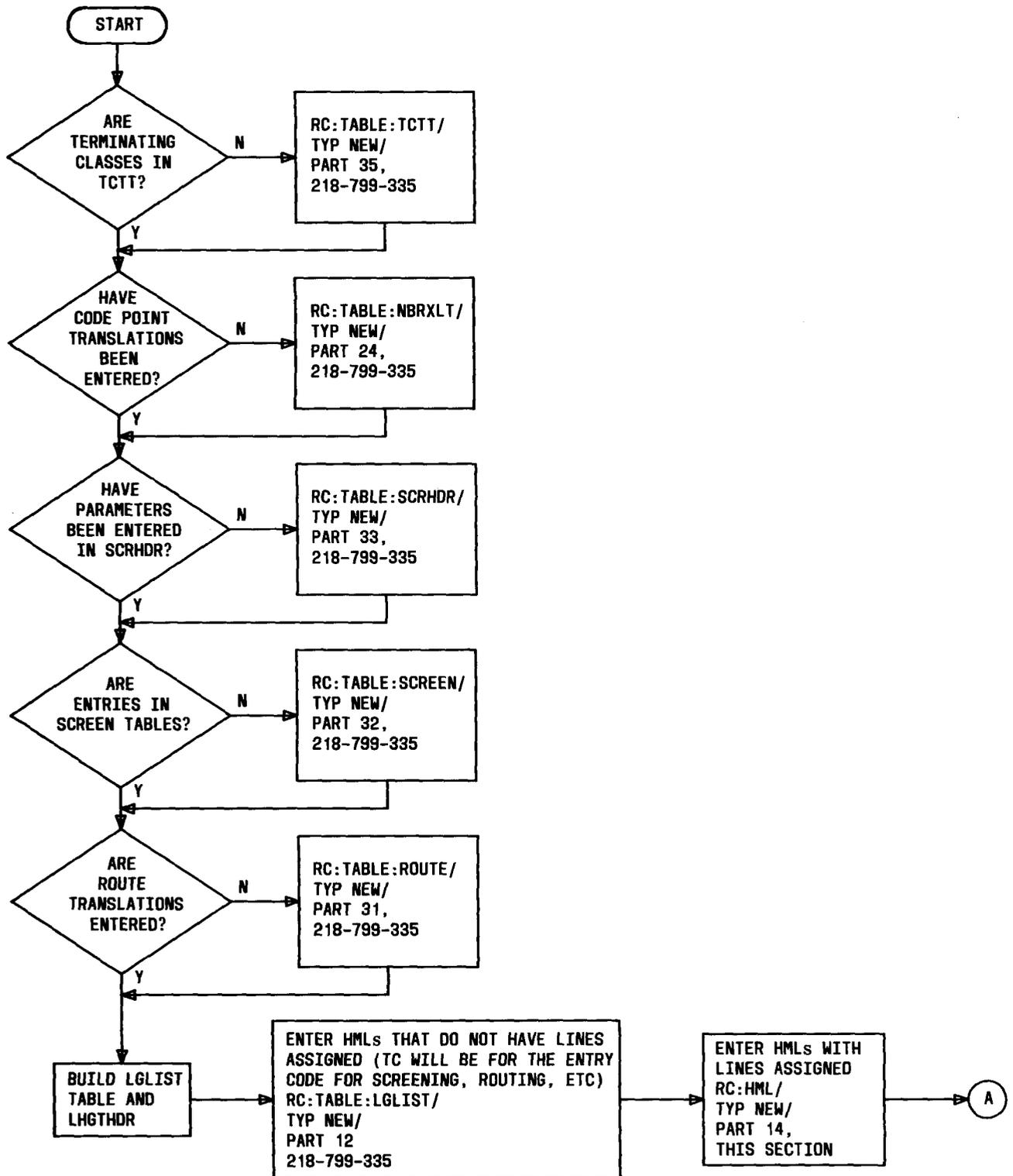RC:HML/
TYP NEW/
PART 14,
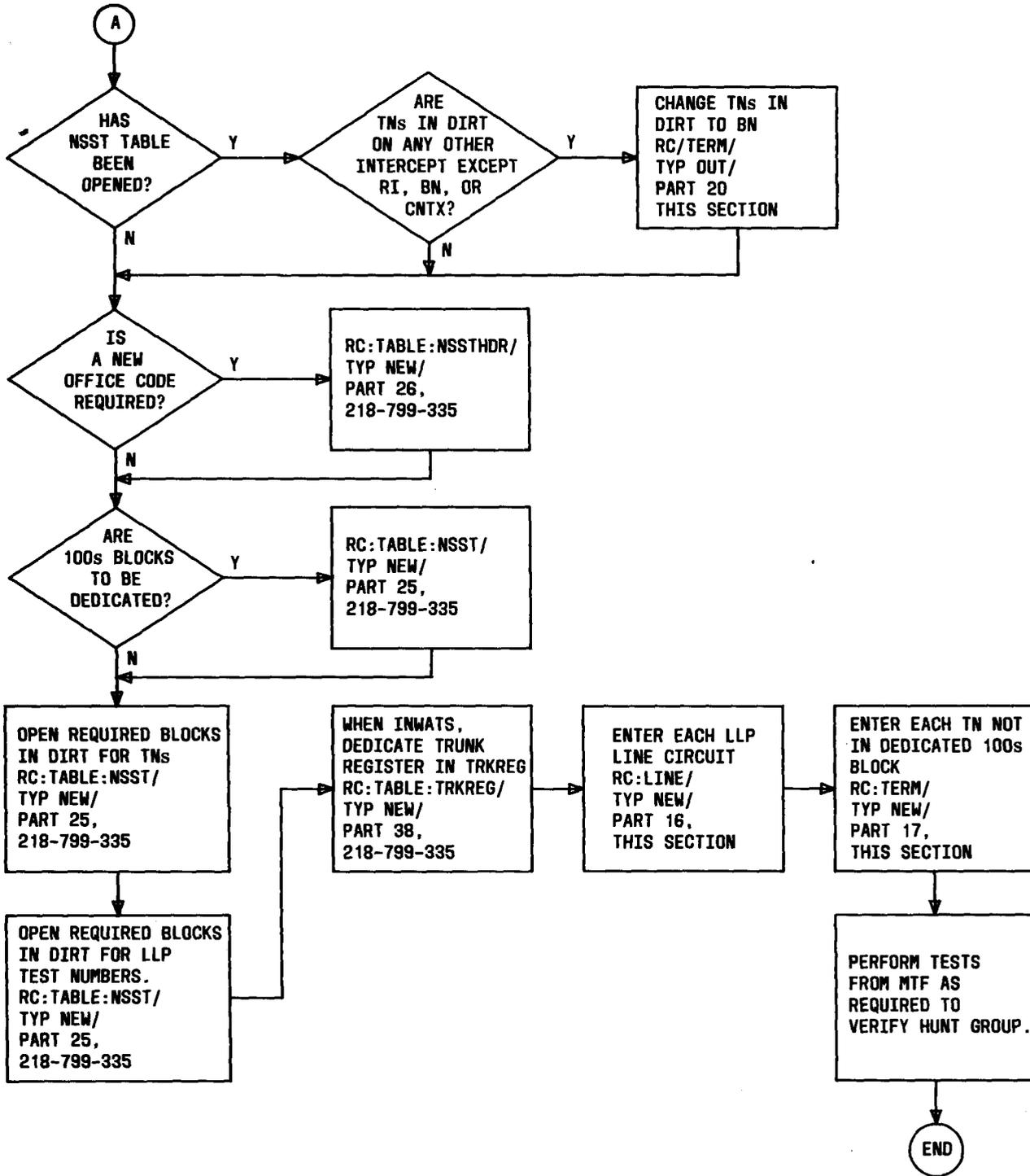THIS SECTION → (A)

Fig. 22b—Building LLP Hunt Group

Fig. 22b—Building LLP Hunt Group (contd)

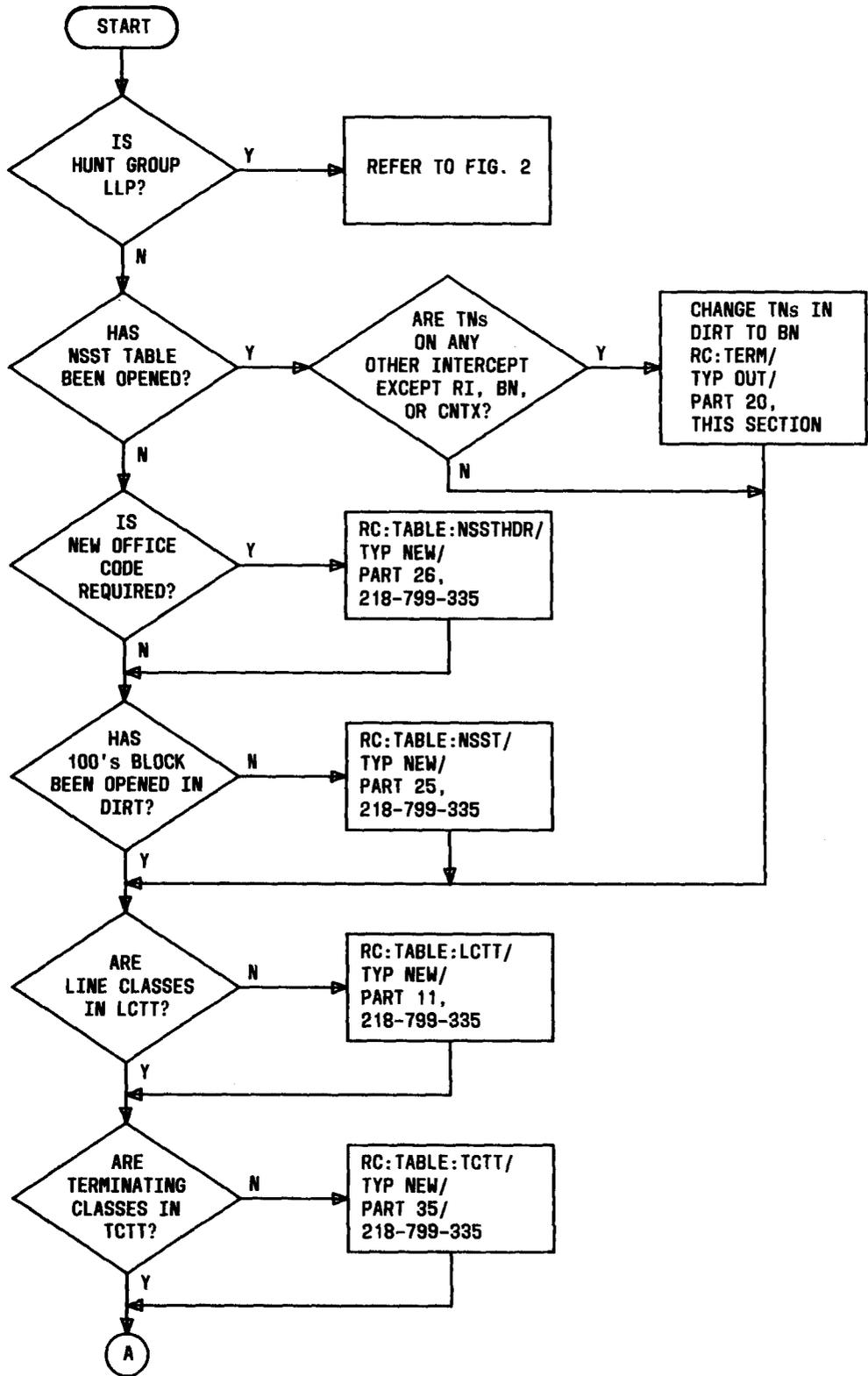Fig. 23a—Data Base Overview for Non-LLP Multiline Hunt Group
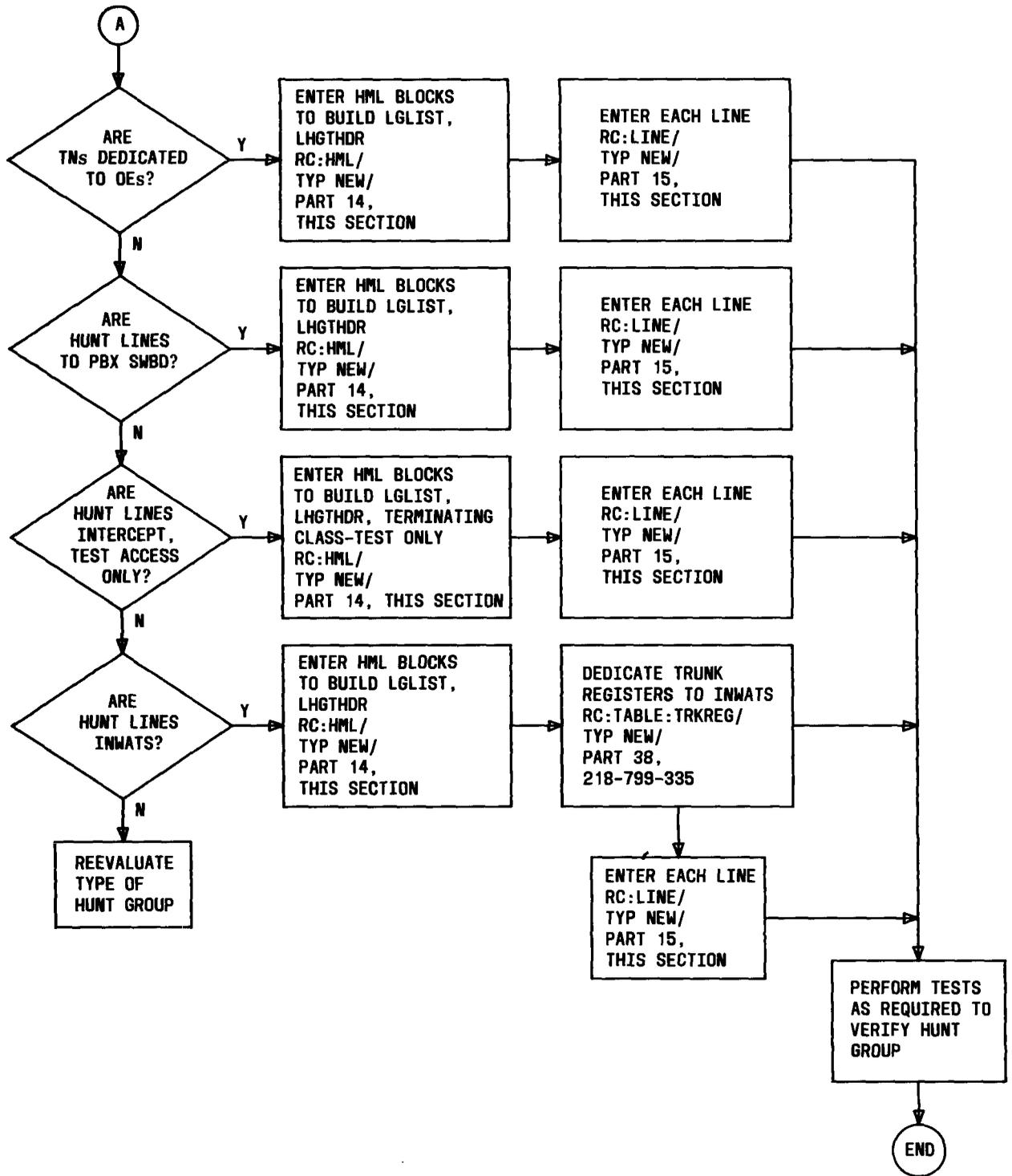
Fig. 23b—Building Non LLP Hunt Group

(A)

ARE
TNs DEDICATED
TO OEs? →Y→ ENTER HML BLOCKS
TO BUILD LGLIST,
LHGTHDR
RC:HML/
TYP NEW/
PART 14,
THIS SECTION → ENTER EACH LINE
RC:LINE/
TYP NEW/
PART 15,
THIS SECTION

↓N

ARE
HUNT LINES
TO PBX SWBD? →Y→ ENTER HML BLOCKS
TO BUILD LGLIST,
LHGTHDR
RC:HML/
TYP NEW/
PART 14,
THIS SECTION → ENTER EACH LINE
RC:LINE/
TYP NEW/
PART 15,
THIS SECTION

↓N

ARE
HUNT LINES
INTERCEPT,
TEST ACCESS
ONLY? →Y→ ENTER HML BLOCKS
TO BUILD LGLIST,
LHGTHDR, TERMINATING
CLASS-TEST ONLY
RC:HML/
TYP NEW/
PART 14, THIS SECTION → ENTER EACH LINE
RC:LINE/
TYP NEW/
PART 15,
THIS SECTION

↓N

ARE
HUNT LINES
INWATS? →Y→ ENTER HML BLOCKS
TO BUILD LGLIST,
LHGTHDR
RC:HML/
TYP NEW/
PART 14,
THIS SECTION → DEDICATE TRUNK
REGISTERS TO INWATS
RC:TABLE:TRKREG/
TYP NEW/
PART 38,
218-799-335

↓N

REEVALUATE
TYPE OF
HUNT GROUP

ENTER EACH LINE
RC:LINE/
TYP NEW/
PART 15,
THIS SECTION

PERFORM TESTS
AS REQUIRED TO
VERIFY HUNT
GROUP

(END)

Fig. 23b—Building Non LLP Hunt Group (contd)

Fig. 24—Multiline Hunt Group Line Selection

INPUT

INDEX:

100 X TERM. OFF INDEX
+10 X "TH" DIGIT
+"H" DIGIT

INDEX:

10 X "T" + "U" DIGITS

OUTPUT

LEN, etc.

RING, COMB, etc.

NSST TABLE — LINK — 100s BLOCK INDEX

DIRT TABLE — BLOCK / DATA & LINK

56,000 ENTRIES MAX.
IN BLOCKS OF 100

AUX. TABLE FOR 2-LINE HUNT

LHGT2 TABLE — DATA & LINK

TCTT TABLE — DATA

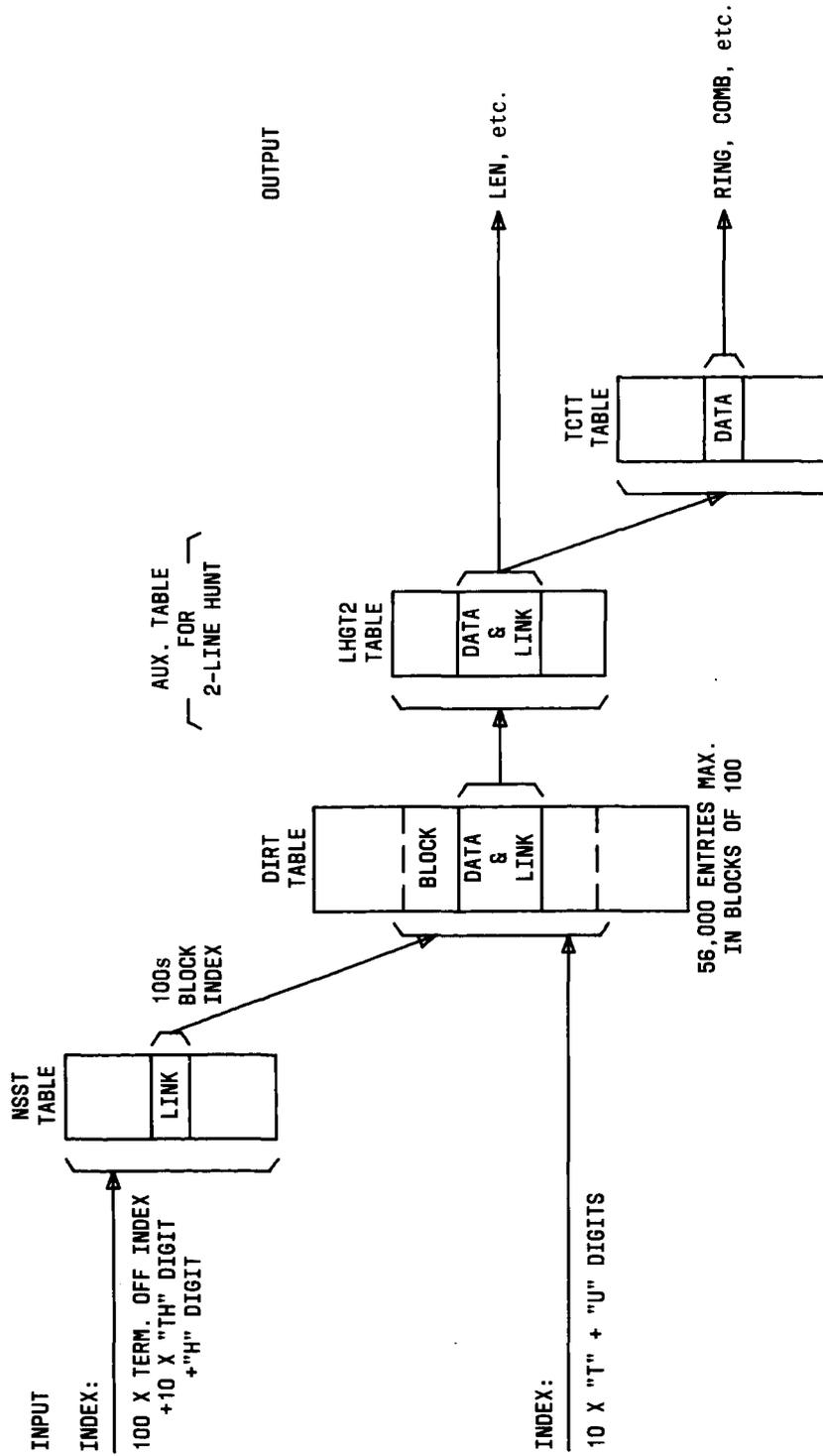**Fig. 25—Two-Line Hunt Group Selection**

Fig. 26—Typical 7-Digit Billing Translation

Fig. 27—Typical 10-Digit Billing Translaion

COMPLETING MARKER
BUFFER (CMBUF)

BILLING ENTRY CODE

POINTER TO NBRXLT

ORIGINATING XLTN

| OR | LT |

CALLED NUMBER

| NPA – 614 |
| OC – 471 |
| STA – 0643 |

CALLING LINE
ROUTING CLASS

A   E
| 2 | — — — — | 0 |

ROUTING & SDR INFO

TRK GRP NO
SDR INFO
RTE ADV., FTC

NUMBER TRANSLATION
TABLES (NBRXLT)

ENTRY CODE XLTN

POINTER TO LOC XLTN

999   LOCAL OFFICE XLTN

471   POINTER TO SCREEN
       OR GRP

000

GROUPING & SCREENING
TABLES

GROUPING

POINTER – ROUTING/
SCREENING

SCREENING

POINTER TO ROUTING
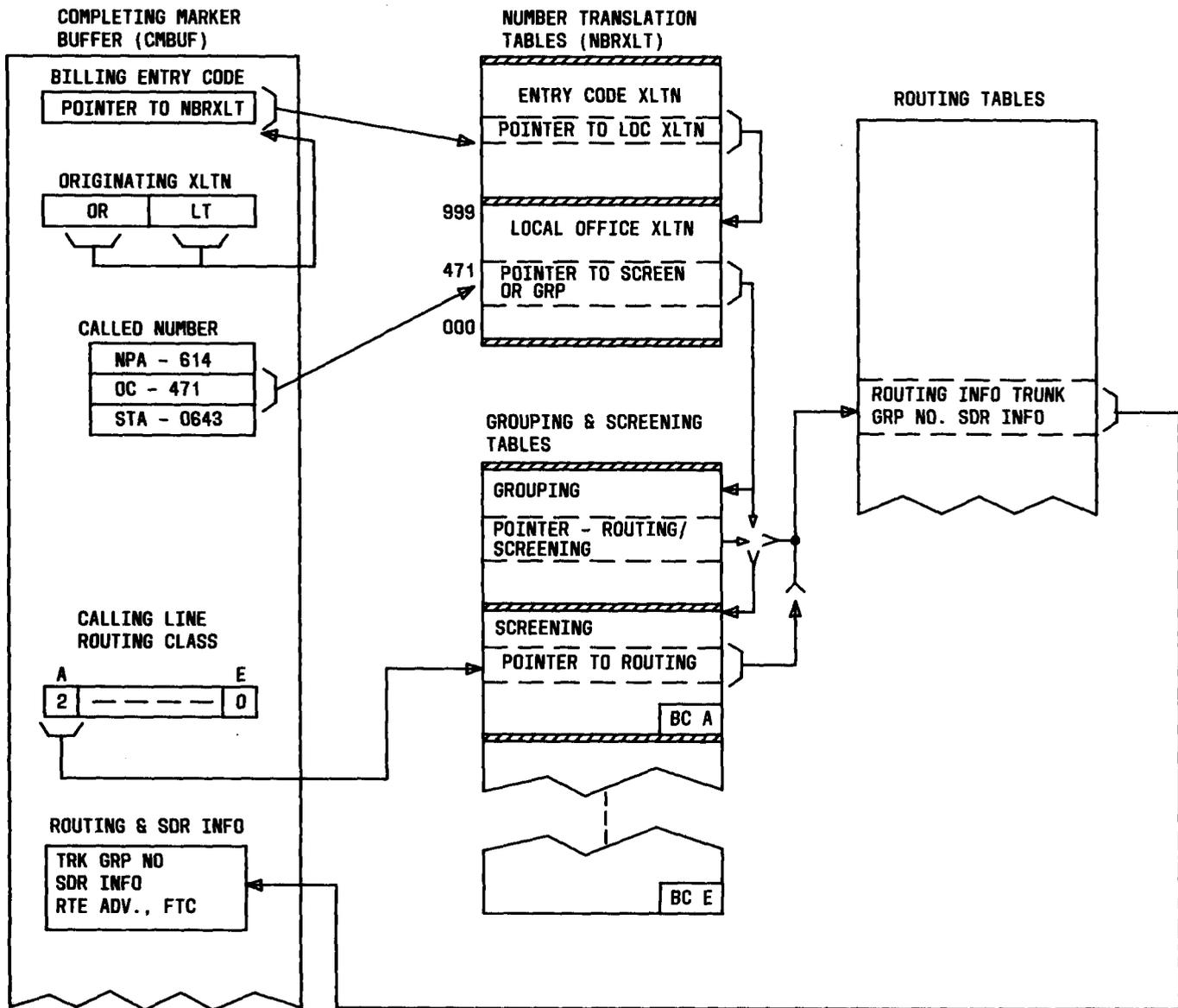
BC A

BC E

ROUTING TABLES

ROUTING INFO TRUNK
GRP NO. SDR INFO

Fig. 28—Typical Routing Translation—7-Digit Call

COMPLETING MARKER
BUFFER (CMBUF)

NUMBER TRANSLATION
TABLES (NBRXLT)

BILLING ENTRY CODE

POINTER TO NBRXLT

ENTRY CODE XLTN

POINTER TO NPA XLTN

ORIGINATING XLTN

| FAC | LT |

999   NPA XLTN

ROUTING TABLES

919   POINTER TO FOC/
      GROUPING

000

CALLED NUMBER

| NPA - 919 |
| OC - 727 |
| STA - 3511 |

999   FOREIGN OFFICE CODE
      XLTN

ROUTING INFO TRK
GRP NO. SDR INFO

727   POINTER TO GROUP/
      SCREEN

000

GROUPING & SCREENING
TABLES

CALLING LINE ROUTING
CLASS

A — — — — — E

| 5 | — — — — | 0 |

GROUPING

POINTER TO ROUTE/
SCREEN

SCREENING

5   POINTER TO ROUTING

ROUTING INFO

TRK GRP NO.
SDR INFO
RTE ADV., ETC

BC-A

0

BC-E

Fig. 29—Typical Routing Translation 10-Digit Call

OTGLST

00	PTR TO FIRST TRK REG
01	PTR TO LAST TRK REG
	IDLE LIST
00	PTR TO FIRST IDLE TRK REG
01	PTR TO LAST IDLE TRK REG

TRK REG

00	PRT TO NEXT TRK IN
	TRK GRP
02	PTR TO PRECEDING IDLE
	TRK REG
03	PTR TO NEXT IDLE TRK REG

ASSUME TRUNKS ASSOCIATED WITH TRK REG 10, 21 BUSY

OTGLST

00	TRK REG 10
01	TRK REG 61
	IDLE LIST
00	TRK REG 14
01	TRK REG 61

TRK REG 10

00	PTR TRK REG 14
02	-
03	-

TRK REG 14

00	PTR TRK REG 21
02	FIRST IDLE
03	PTR TRK REG 53

TRK REG 21

00	PTR TRK REG 53
02	-
03	-

TRK REG 53

00	PTR TRK REG 61
02	PTR TRK REG 14
03	PTR TRK REG 61

TRK REG 61

00	END OF LIST
02	PTR TRK REG 53
03	LAST IDLE

(a)

NEXT-TRUNK ASSOCIATED WITH TRK REG 14 BECOMES BUSY

OTGLST

00	TRK REG 10
01	TRK REG 61
	IDLE LIST
00	TRK REG 53
01	TRK REG 61

TRK REG 10

00	PTR TRK REG 14
02	-
03	-

TRK REG 14

00	PTR TRK REG 21
02	-
03	-

TRK REG 21

00	PTR TRK REG 53
02	-
03	-

TRK REG 53

00	PTR TRK REG 61
02	FIRST IDLE
03	PTR TRK REG 61

TRK REG 61

00	END OF LIST
02	PTR TRK REG 53
03	LAST IDLE

(b)

NEXT-TRUNK ASSOCIATED WITH TRK REG 21 BECOMES IDLE

OTGLST

00	TRK REG 10
01	TRK REG 61
	IDLE LIST
00	TRK REG 53
01	TRK REG 21

TRK REG 10

00	PTR TRK REG 14
02	-
03	-

TRK REG 14

00	PTR TRK REG 21
02	-
03	-

TRK REG 21

00	PTR TRK REG 53
02	PTR TRK REG 61
03	END OF LIST

TRK REG 53

00	PTR TRK REG 61
02	FIRST IDLE
03	PTR TRK REG 61

TRK REG 61

00	END OF LIST
02	PTR TRK REG 53
03	PTR TRK REG 21

(c)

Fig. 30—Typical Selection

TRACK								
3	DATA BASE							
2	BOOT		CHECK-SUMS	TAPE DIR.	NON-RESIDENT GENERIC		DEFERRED MESSAGE	DATA BASE
1	BOOT	SYSTEM CORE		RESIDENT GENERIC				
4					PATCH	BACK DATE	RECENT CHANGE	

Fig. 31—Cartridge Tape File Structure

LEVEL 1 INITIALIZATION
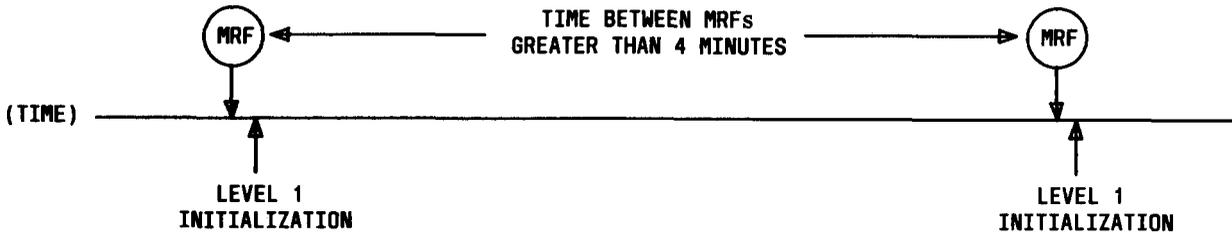
LEVEL 2 INITIALIZATION
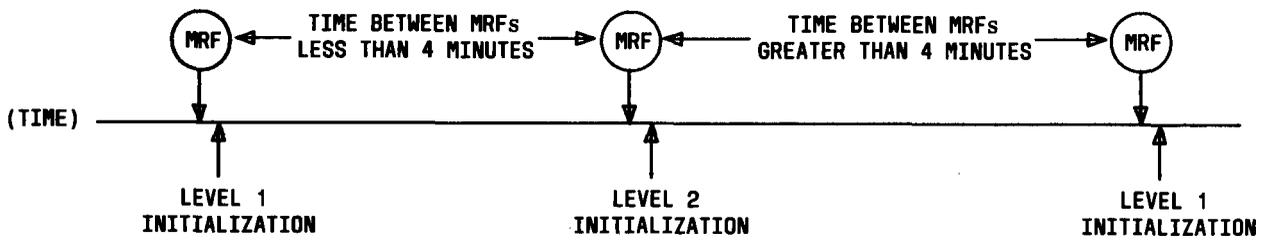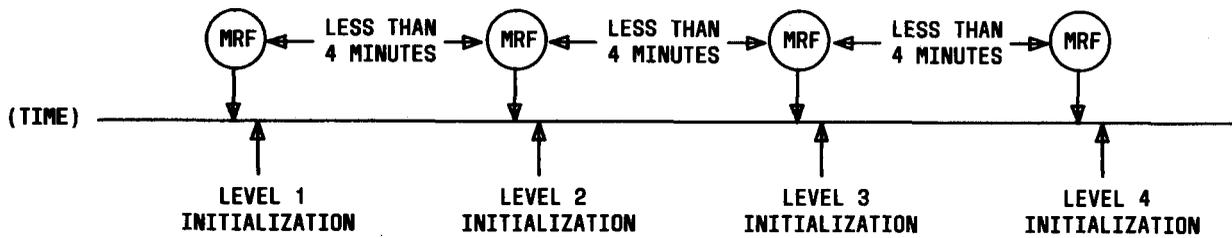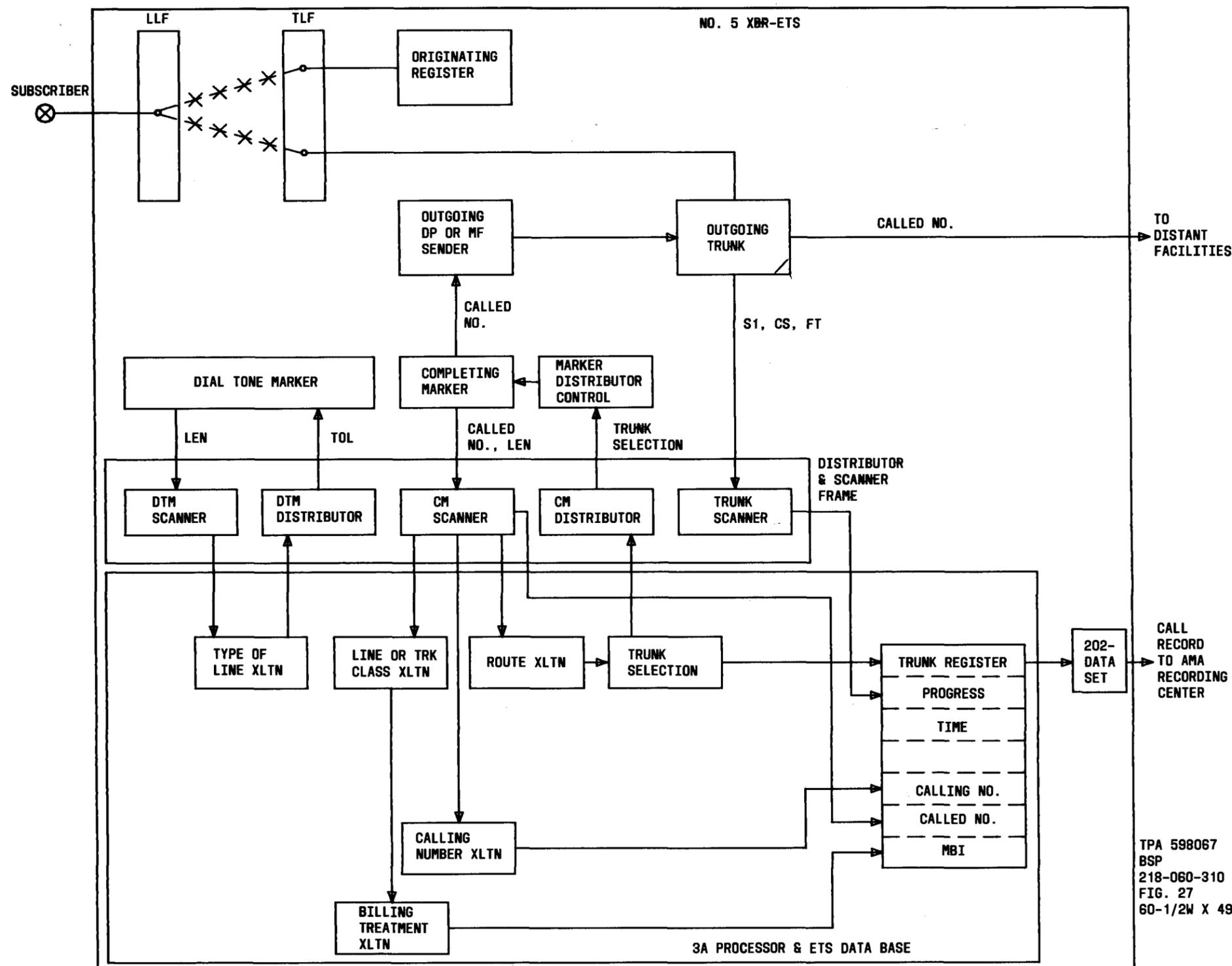

LEVEL 3 INITIALIZATION
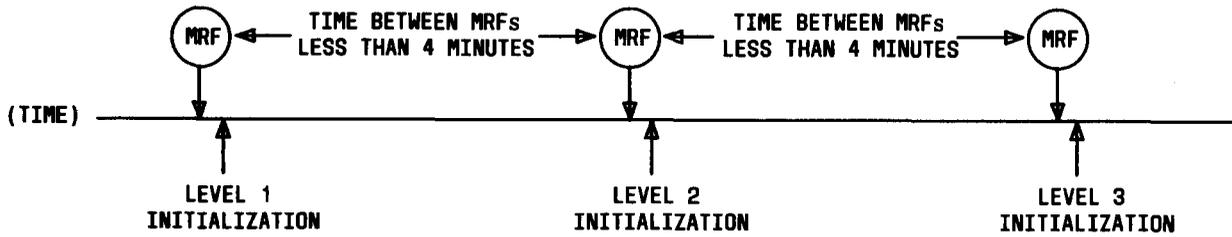
LEVEL 4 INITIALIZATION

Fig. 32—Time Chart for Four Levels of Automatic Initialization

Fig. 33—Typical Outgoing Call With AMA
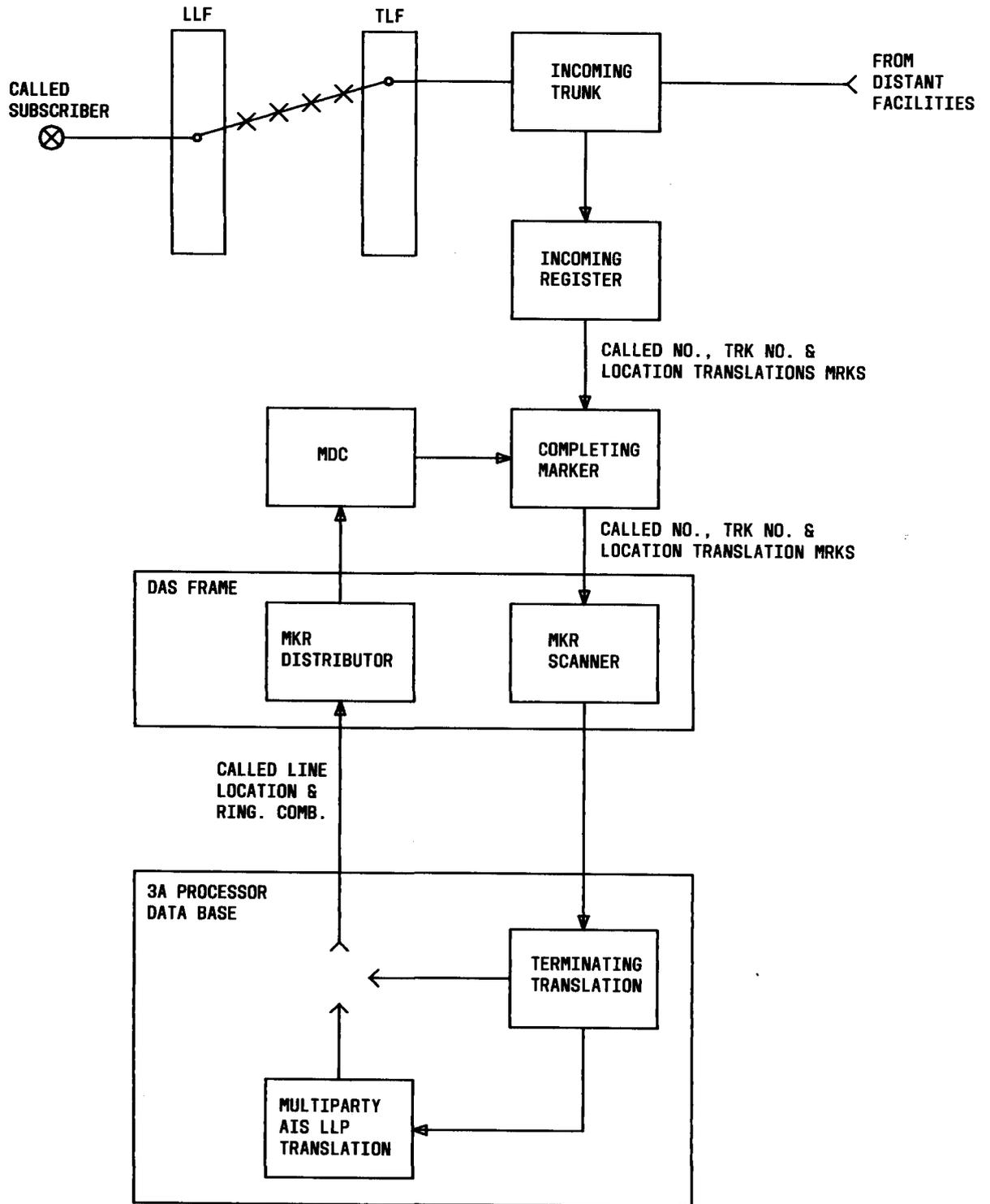
Fig. 34—Typical Incoming Call—Local Completion
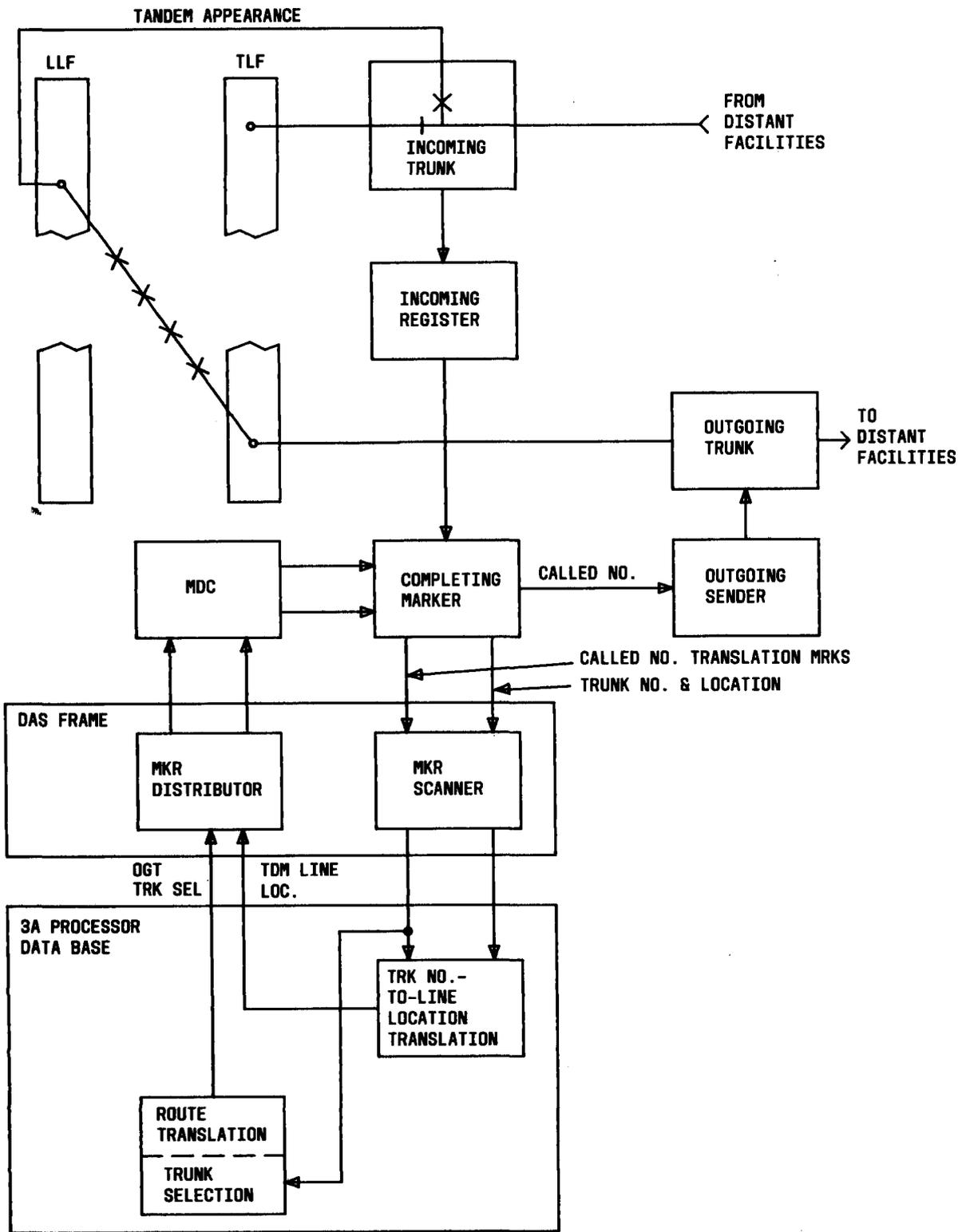
Fig. 35—Typical Incoming Call—Tandem Completion
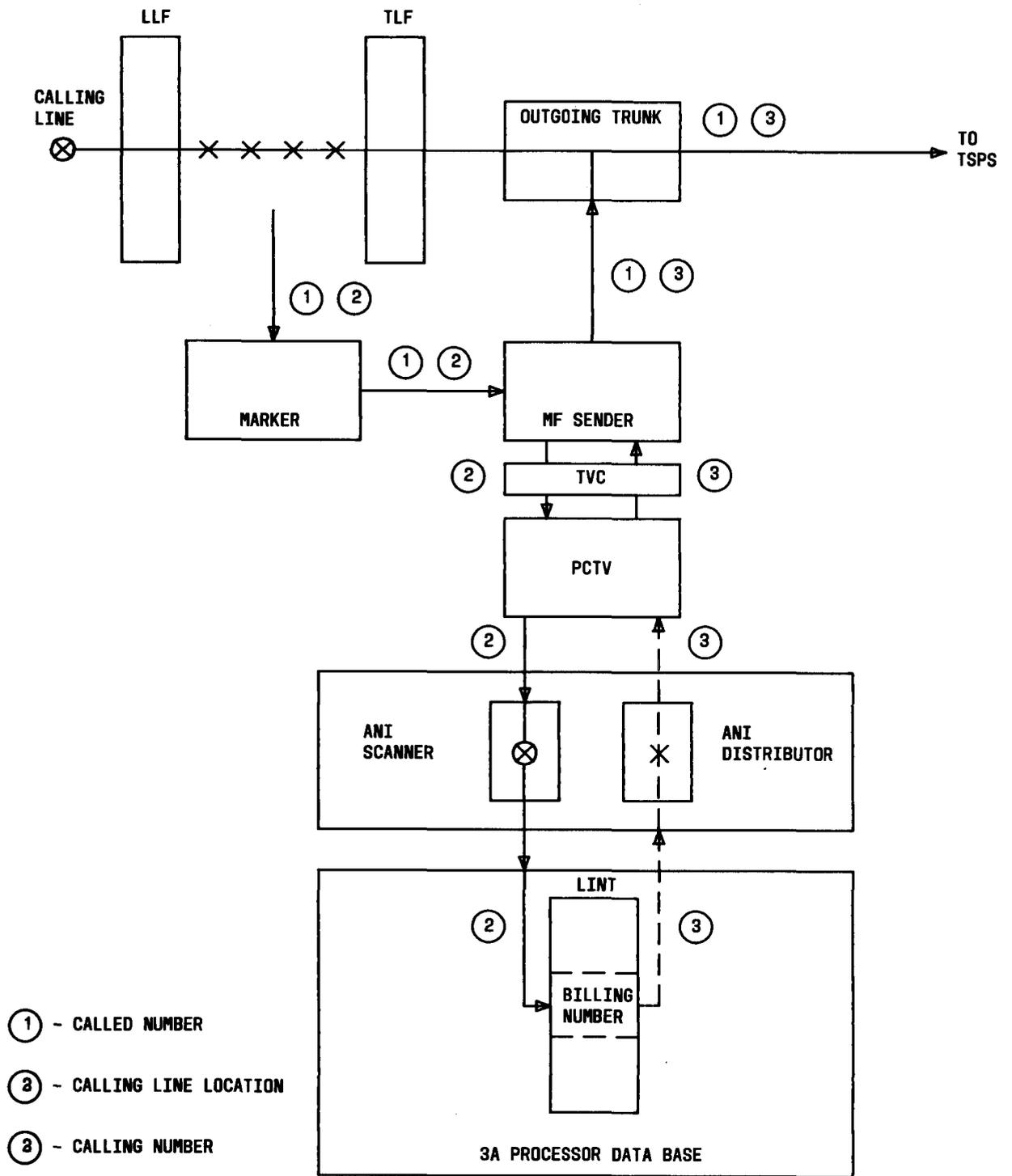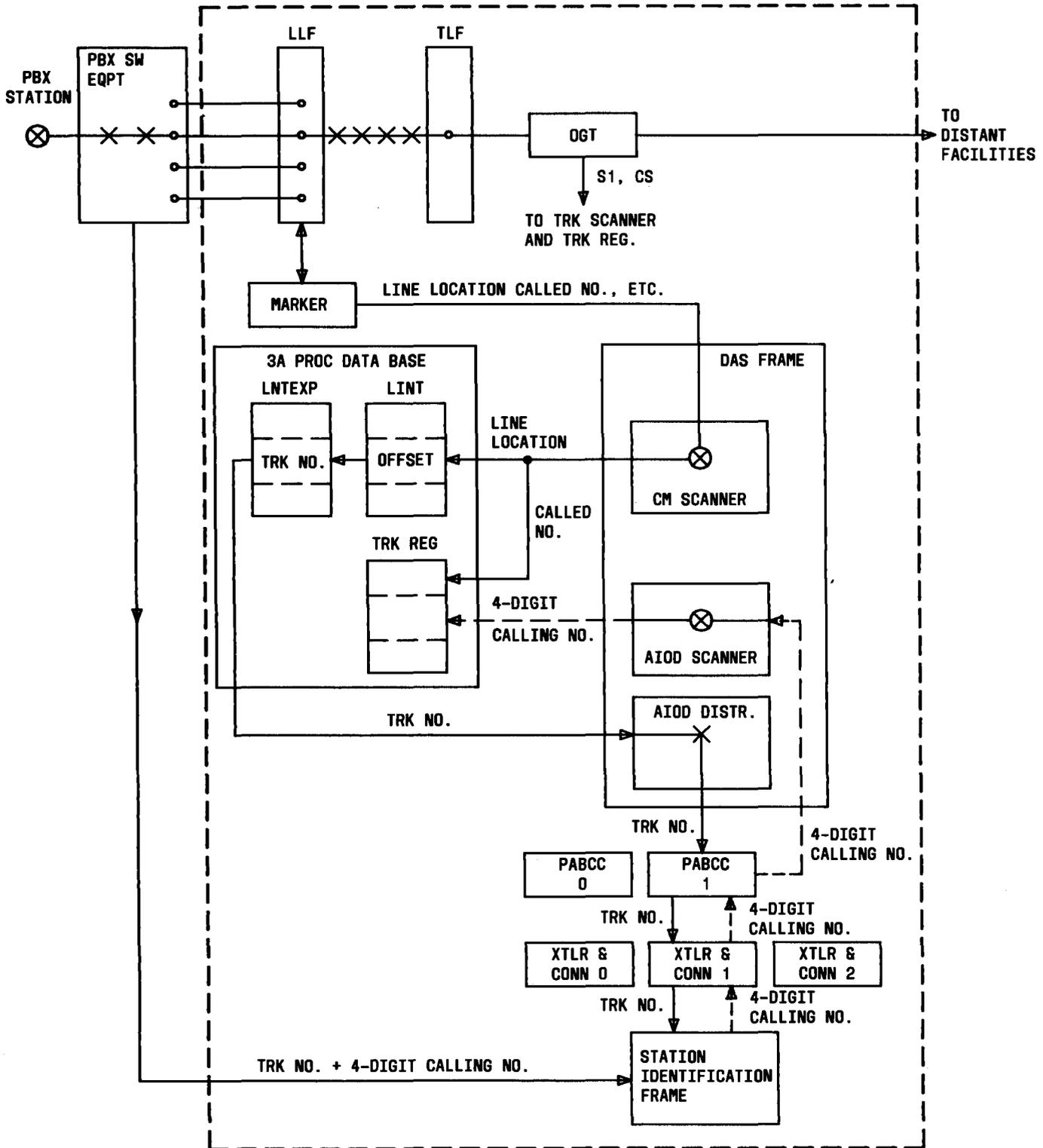
Fig. 36—Automatic Number Identification Call
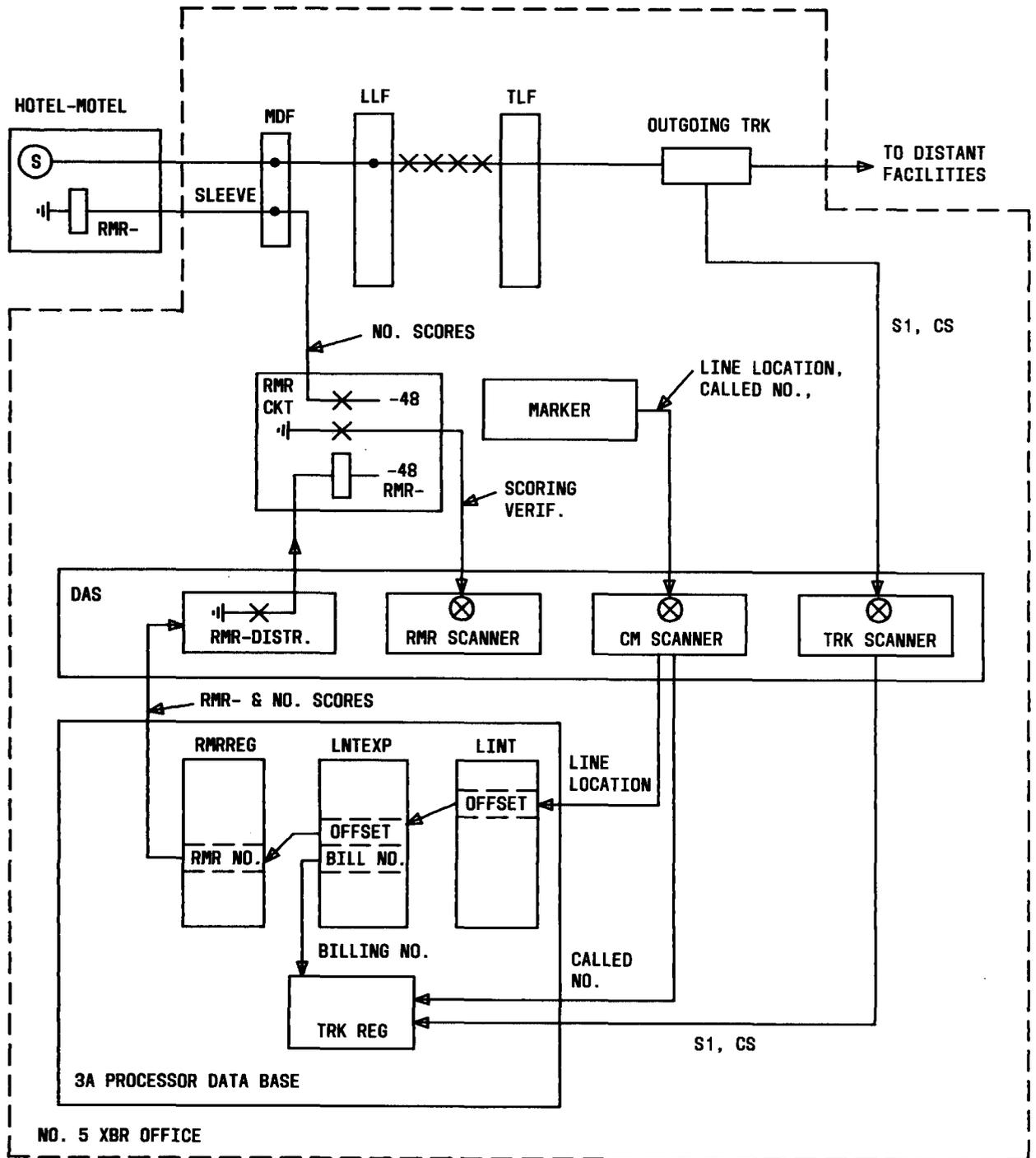
Fig. 37—Automatic Identified Outward Dialed Call
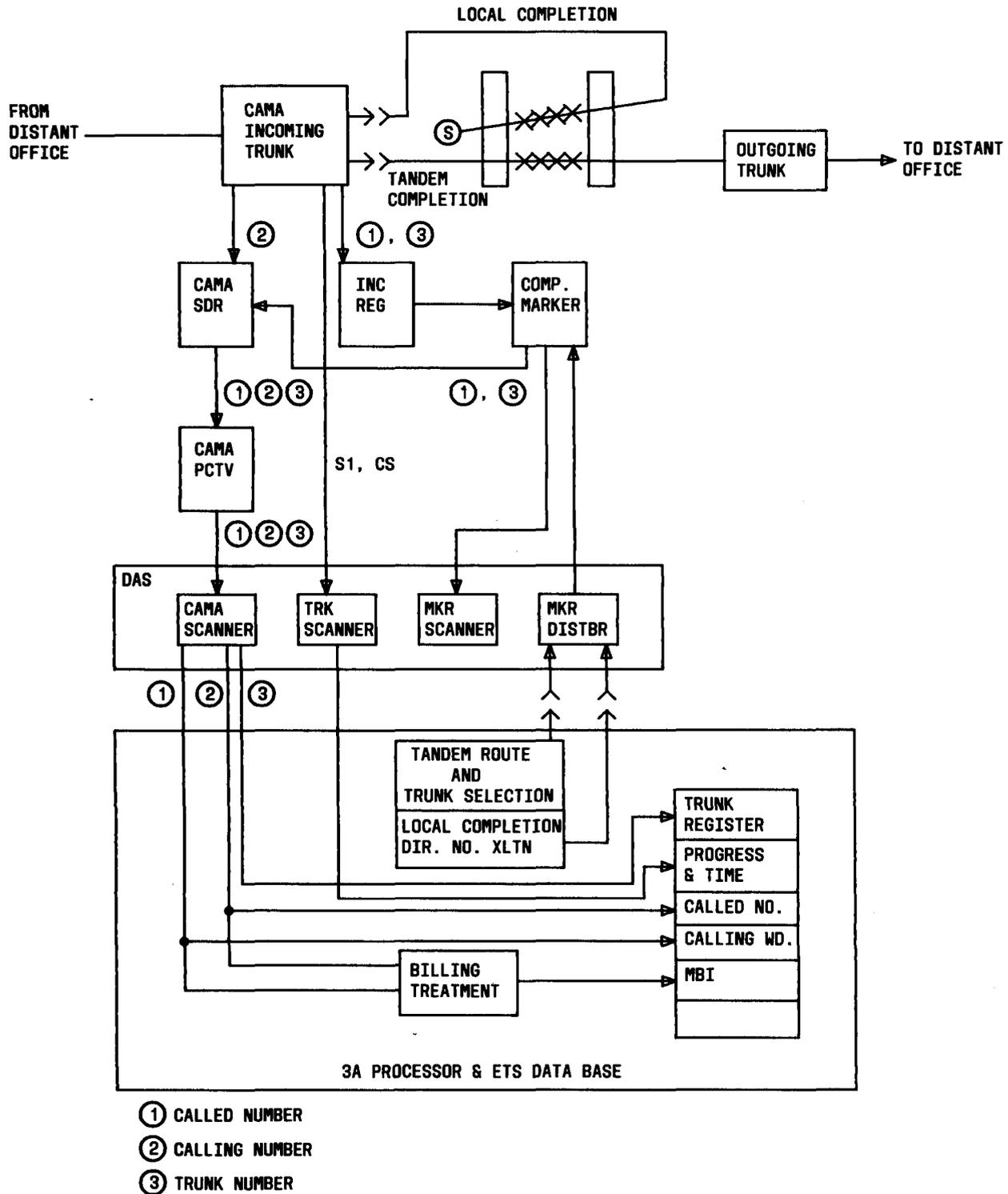
Fig. 38—Remote Messages Register Operation

Fig. 39—Centralized Automatic Message Accounting (CAMA) Call