

SWITCHING SYSTEMS MANAGEMENT
NO. 4A/4M CROSSBAR—ELECTRONIC TRANSLATOR SYSTEM
COMMON CHANNEL INTEROFFICE SIGNALING
SYSTEM DESCRIPTION

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1. GENERAL

1.01 This section describes the common channel interoffice signaling (CCIS) feature as it applies to the 4A Toll Switching System. DFMP, Division H, Section 18a, offers the network administrator an overview of the CCIS system configuration and highlights the inherent advantages of the CCIS over conventional signaling.

1.02 Whenever this section is reissued, the reason will be listed in this paragraph.

1.03 CCIS is a system for exchanging information between processor-equipped switching systems

which are interconnected by a network of data links. All signaling information, including the supervisory and address signals necessary to control call setup and takedown, as well as network management signals, are exchanged by these systems over the signaling links instead of being sent over the voice path as done using inband signaling techniques.

1.04 The broad service and technical advantages of CCIS over inband signaling are as follows:

(a) **Signaling Speed:** CCIS signals at much higher speeds; calls can be set up and taken down faster. This has the effect of reducing post dialing delays to the calling customer. In addition, the holding time of trunks and switching equipment is reduced, leading to more efficient use.

(b) **Information Capacity:** CCIS design provides more information capacity than conventional systems. Routing and control information is included in the basic address message and subsequent control and supervisory information may be transmitted in additional messages. More efficient operation of the telephone network can be achieved by the transfer of network management messages over CCIS links.

(c) **Two-Way Signaling:** CCIS uses a separate 2-way data link, and signals may be transmitted in both directions simultaneously. Signaling may also take place during the period of conversation on the trunk.

(d) **Separate Channel:** Interaction between voice and signaling, such as "talk off" (disconnect of the trunk by voice), are eliminated. The possibility of fraud by simulation of inband signals is reduced and would be eliminated on an all CCIS network. Also eliminated would be mass seizures resulting from the loss of inband tone signals (SF) due to carrier failure.

(e) **International Traffic:** It is expected that (1) international telephone traffic will make extensive use of the International Telegraph and Telephone Consultative Committee (CCITT) #6 signaling in the future and (2) nominal format changes and few adaptations will be required to efficiently integrate CCITT #6 and CCIS.

(f) **Flexibility:** Within the CCIS message signal structure there is considerable latitude and flexibility for the possible use of signaling information for services not yet defined.

1.05 The advantages of CCIS in signaling speed, signal capacity, and flexibility permit the introduction of many new signaling/switching features. These new features (generally unavailable with conventional signaling systems) will be beneficial both to customers and operating companies.

1.06 Although limited to the intertoll network, the initial application of CCIS will have a variety of new and attractive features. Most of these features stem directly from CCIS's capability of transmitting additional information between machines rapidly and reliably. The following paragraphs contain those features planned for the initial installations of CCIS in the toll network, along with a brief description of each.

1.07 **Additional Routing Information**—This added routing information, a part of the Initial Address Message (IAM) which contains the trunk identity and all the address digits, includes the following:

(a) **Nature-of-Trunk Indicator**—Used to indicate whether a satellite trunk is in the connection and as such can be used by switching systems, via routing constraints, to preclude two satellite trunks on a given connection.

(b) **Out-of-Chain Routing Indicator**—Used to indicate whether a given call has been routed in chain or out of chain.

(c) **Link-Out-of-Chain Indicator**—Used to distinguish between out-of-chain status on a directly connected incoming trunk or on some previous trunk. The combination of these two indicators [(b) and (c)] can be used to show whether a given call has departed from normal hierarchical routing patterns and, on that basis, control subsequent routing to eliminate circular and shuttle routing (frequently called ring-around-the-rosy).

(d) **CCIS History Indicator**—Used to indicate whether a given call has been served by CCIS on all previous links of a built-up connection. Initially, it will be used on domestic toll links in conjunction with the international inbound

routing category (discussed under Routing Category) to differentiate between those calls requiring audible signals (for no circuit or reorder) to indicate ineffective attempts (not CCIS all the way) and those calls on which electrical (data) signals can be used (CCIS all the way). The use of electrical signals permits the release of the connection and the application of the audible signals at, in the case described, the originating outgoing international exchange.

(e) **Calling Party Category**—Used to indicate either the call source (eg, unknown source, ordinary operator, or ordinary calling customer) or call type (such as test call). Call source information will be useful in applications which require discrimination between operator- and customer-originated calls for screening or other purposes.

(f) **Routing Category**—Used to indicate type of call, such as ordinary intertoll, international outbound, international inbound, or international transient. The latter routing category, international transient, will be especially useful in that it will provide the necessary discriminating information to permit handling international transient traffic over domestic trunk groups between international switching centers.

1.08 **Ineffective Attempt Signals**—Several electrical signals transmitted in the backward direction (such as trunk congestion, switching congestion, address incomplete, vacant number, and call failure) are used in place of audible tones or announcements. By use of these signals, a switching system close to the call source can release the connection ahead and provide an appropriate audible signal or recorded announcement to the calling customer. This feature eliminates wasted trunk holding time for ineffective attempts. Electrical signals should also simplify the process of identifying ineffective attempts for subsequent analysis.

1.09 **Trunk Blocking-Unblocking Signals**—By means of these signals, CCIS trunks can be blocked by Maintenance personnel to remove them from outgoing service at the distant end. The ability to make a distant trunk "busy" facilitates the testing of that trunk and reduces the need for coordination between testboards. The blocking signal can be initiated on a trunk that is in use. In this case, the trunk will be blocked when the call terminates. Blocking of a trunk is automatic

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on failure of the continuity check (1.11). An unblocking signal is provided to restore the trunk to service. Maintenance personnel at each end of the trunk are notified when a trunk is taken out of service.

1.10 *Elimination of Trunk Guard*

Timing—Another signal transmitted in the backward direction, release guard, eliminates trunk guard timing at the outgoing end of a trunk. The receipt of the release guard signal, which is sent in response to the disconnect signal subsequent to making the trunk idle, is an indication that the trunk is available for a new call.

1.11 *Continuity Check*

—CCIS-equipped offices perform a continuity check of the selected trunk during call setup. If the terminating office is a 4-wire switching system, the originating processor attaches a 2010-Hz transceiver to the selected trunk concurrent with sending the IAM. Upon receipt of the IAM, the distant office connects the receive side of the trunk to the transmit side through a zero-loss loop. If the terminating office is a 2-wire No. 1 ESS, the originating office transmits 1780 Hz. Upon receipt of the IAM, the terminating office attaches a transponder to the incoming trunk and returns 2010 Hz upon recognition of the 1780-Hz tone. In either case, the originating office checks the level of the returning tone to verify that transmission loss is within acceptable limits. The sensitivity of this check is superior to the implied check obtained with conventional inband signaling systems and will thus provide an improved grade of service. If the check fails, a second trunk is selected, the failed trunk is automatically blocked, and a special test call is initiated to repeat the test. If the second test passes, the trunk is automatically unblocked. A second failure will initiate a teletypewritten Maintenance request.

1.12 *Repeat Attempt Capability*

—With CCIS, provisions are made to rapidly initiate a repeat attempt at the outgoing end, when required, such as on detection of a continuity check failure. If glare is detected, the noncontrol end backs off, processes the incoming call on that trunk, and repeats the outgoing attempt on another trunk.

2. SYSTEM DESCRIPTION

A. Signaling Link

2.01 With CCIS, both the SF unit and the MF equipment are replaced by a signaling link

between the processors. The signaling link is designed to carry signaling for many trunks, as opposed to SF signaling which requires an SF unit on every trunk. (See block diagrams for systems using inband signaling [Fig. 1] and CCIS signaling [Fig. 2].) As shown in Fig. 2, the signaling link consists of two signaling terminals, two modems, and a voice frequency link (VFL). The signaling terminals serve to store both the outgoing signal messages awaiting transmission and the incoming signal messages until ready to be processed. The signaling terminals also perform error control and retransmission of messages found to be in error. The modem provides a digital/analog interface between the terminal and the VFL. The terminal access circuit (TAC) provides access for the processor to the various signaling links through an interface with the terminals.

2.02 With CCIS, no signals are passed over the message trunks. Hence, trunk failures can no longer be detected by the loss of supervision as is done with SF/MF signaling. Instead, a number of tone transceivers are provided which are connected to CCIS trunks during call setup to check the voice path continuity.

2.03 With CCIS, the signaling for many trunks is sent over the same signaling links. Therefore, all portions of the signaling network are sufficiently redundant and diversified to insure signaling availability.

2.04 To insure continuity of service, provision is made for automatic transfer from a faulty signaling link to an alternate link in the event of a failure condition. The signaling terminal monitors the data carrier and the signal unit error rate continuously; either a total failure (exceeding 350 milliseconds) or excessive signal unit errors will initiate the transmission of messages over the alternate signaling link. The error correction method chosen (retransmission) makes it possible to effect this transfer without the loss of signaling information. Signaling traffic is restored to the regular route automatically after the trouble clears.

B. Signaling Network

2.05 The simplest and most direct form of CCIS is the direct signaling link between the processors of all CCIS-equipped switching offices having interconnecting trunks. This is referred to as associated signaling. Although a direct signaling link is shown in Fig. 2, in most instances the

signaling information will be routed through one or two signal transfer points (STPs) to concentrate the signaling for a large number of trunk groups into a few signaling paths. This is known as nonassociated signaling. The STPs serve as signal message switching centers, sorting and redirecting the signal messages from an incoming to an outgoing signal link. No link switching is involved—only the transfer of the signal message.

2.06 Studies have shown that it is not economical to provide CCIS for all candidate trunk groups on an associated basis because of resulting light loading of signaling links. Fully associated (F) links may prove economical between switching offices with a sufficiently large number of interconnecting trunks.

2.07 The basic CCIS signaling network is shown in its nonduplicated form in Fig. 3. As indicated in 2.09, the actual CCIS network is fully duplicated. For simplicity reasons only two CCIS switching offices (SOs) are shown in each of two regions. Each SO within a region concentrates its signaling traffic for CCIS trunks on a few well loaded access (A) links to an STP. Between the regions a number of bridge (B) links interconnect the STPs. This network can be generalized to represent many SOs and signaling regions by imagining (a) an A link between each STP and each SO in a region and (b) a B link from each STP to the STPs in all other signaling regions.

2.08 From Fig. 3, for example, signaling from SO1 to SO2 (for trunk group TG1) would be sent to access link A1 to STP1 where it would be forwarded, after translation, on link A2 to SO2. Interregional signaling would involve two STPs. Thus signaling from SO1 to SO3 (for trunk group TG2) would be sent on access link A1 to STP1, then forwarded on bridge link B1 to STP2, and finally sent over access link A3 to SO3.

2.09 In some cases a CCIS switching office in one region may have sufficient trunks to CCIS offices in other regions to justify a direct signaling link to the STP of another region. Such a signaling link is known as an extension (E) link. It is introduced to save processing capacity at a bypassed STP and construction costs associated with facilities and terminal hardware. This is shown as signaling link E1 in Fig. 3.

2.10 In the example used in Fig. 3, no backup or alternate routes are shown for protection against the failure of signaling links or STPs. For example, if signaling link A1 should fail, switching office SO1 will be isolated from the system. Thus large areas of the network could be left without signaling should an STP or signaling link fail. For this reason all STPs and signaling paths are fully duplicated.

C. Data Message Format

2.11 In the CCIS system, the basic data word is the signal unit. A signal unit is 28 bits long, with the last eight bits used for error checking. Therefore, each signal unit contains a 20-bit field used for signaling information. When no data-filled signal units are being transmitted, a synchronization signal unit (SYU) is transmitted to maintain synchronization.

2.12 CCIS messages are one or more signal units in length, depending on the quantity of information to be sent. Single unit messages, referred to as lone signal units (LSUs), are generally used for specific information (ie, answer), whereas, multiunit messages (MUM) are generally used for passing address information (ie, digits).

2.13 The heading and signal information fields of the LSU contain information on the action the LSU is requesting. A trunk label is used to identify the trunk being served. The trunk label is subdivided into two fields, a band number (one or more of which is associated with a trunk group and which is used in determining the routing of the message in the signaling network), and a trunk number which identifies a specific trunk. The initial signal unit (ISU) of the miscellaneous multiunit message has a unique heading code which identifies it as an initial signal unit and an ISU-type code which identifies the message as a miscellaneous multiunit message. The length indicator gives a count of how many subsequent signal units (SSUs) may be expected. A unique heading code is used to identify a subsequent signal unit. The first subsequent signal unit of a miscellaneous multiunit message has a message category to identify the type of miscellaneous multiunit message. The miscellaneous multiunit message may be used for telephone signals, network management messages, and a special (header) message for routing signals via C links between intraregional signal transfer points.

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D. Routing Procedures

2.14 As mentioned previously, all telephone signaling messages contain a trunk label identifying the specific trunk by a combination band and trunk number. Labels are assigned at the switching offices in such a way that all trunks with the same band number are part of the same trunk group. In this way, routing at the STPs is done using only the band number.

2.15 Signal routing at the STPs is done in the following way. All incoming and outgoing links at the STPs are assigned a link number. Furthermore, each STP has stored in memory a Band Translation table for each A link and B, link pair. Given the number of the link on which a message was received and the band number contained in the message label, the associated table gives the number of the desired outgoing link and an outgoing band number. The action taken by the STPs is as follows. When a message is received, the STP determines the incoming band and link number. Using the appropriate band translation table, the STP determines the outgoing band and link number. The STP then replaces the received band number in the message label with a new band number and transmits this modified message on the indicated outgoing link.

2.16 Note from the previous discussion that only the processors at the two ends of a link need agree on which band number is assigned to a given trunk. This is important concerning the required length of the band labels since, in general, the links on which a message enters and leaves an STP carries signaling for different sets of trunks.

E. Routing During Link Failures—Signaling Network Controls

2.17 The signaling network is designed to immediately reroute signaling around most link failures. Whenever an A link fails, all outgoing signaling at the affected SO is rerouted on the mate A link. Similarly, traffic for a failed B link is routed on the mate B link. Traffic at an STP for a failed A link or outgoing interregional signaling at an STP with both B and D links failed is routed to the mate STP over the C link.

2.18 In this last case, note that less overall delay is incurred if the signaling traffic is sent directly to the mate STP. Moreover, if the C

links themselves are also in failure, no outgoing path for the received signaling exists. For this reason, a group of signals known as signaling network management signals have been developed. These signals communicate information among STPs and CCIS switching offices allowing the network to reconfigure itself to bypass failures whenever possible. The status of the various links and paths in the network is determined by, and stored at, the STPs and transmitted to appropriate switching offices and other STPs. Examples of such signals are Transfer Prohibited (TFP) and Transfer Restricted (TFR) messages. Transfer prohibited messages are sent by an STP to appropriate STPs and SOs whenever it determines that it has no outgoing path available for signaling trunks with a given band number. Similarly, receiving a transfer restricted message from an STP indicates that all signaling which that STP receives with the indicated band number will be routed over C links.

2.19 The correctness and consistency of these control signals are verified periodically by an audit procedure which causes the retransmission of the correct signals. The audit is also automatically initiated at any time there is evidence of an incorrect network control state or upon recovery of a failed signaling link.

F. Signaling Network Overload Controls

2.20 In addition to the signaling network controls, signaling network overload controls exist to help prevent overtaxing the real-time capacity of STP processors or the overflowing of the available message buffering for signaling links. These control signals cause the rerouting of signaling traffic or the reduction of new telephone traffic, if necessary, depending on the location of the overload and the condition of the other elements of the network.

G. Provisions for CCIS Switching Office Failure and Recovery

2.21 When a CCIS switching office experiences a serious processor failure, the CCIS terminals at that office signal the STPs in the signaling network to cut off all CCIS traffic to that office. The STPs then notify all offices with CCIS trunks to the failed office of the failure. This allows appropriate rerouting or cancellation of telephone traffic. During the process of recovery, certain trunks may have to be initialized (all trunks in the case of manual intervention in connection with

Phase 4 recovery action of an ESS office). For non-CCIS trunks, this is achieved by the return of the on-hook condition on the trunks, which ultimately forces the trunks to be idle at both ends. For CCIS trunks, special signals and signaling procedures are used to achieve this end. CCIS telephone traffic to the recovered office may continue to be withheld, if desired, while these housekeeping actions take place.

2.22 The network reaction to an STP processor failure, initiated by the link terminals at the failed STP, is to route signals in the same manner as if all links to the failed STP were simultaneously failed.

3. EQUIPMENT DESCRIPTION

A. General

3.01 The application of CCIS in 4A Electronic Translator System (ETC) switching offices requires major new hardware additions to the ETS electronic frame complex including the terminal group frame, the distributor and scanner (DAS) frame and the insulated gate field effect transistor (IGFET) store frame. In the 4A electromechanical area the continuity check transceivers and the CCIS intraoffice trunk test circuit are also required. New CCIS trunks and outpulsing equipment may be provided for all or part of the CCIS trunk equipment, or conventional trunks and senders may be modified for either MF or CCIS. Trunk modification is recommended whenever a significant number of MF trunks become permanently surplus since the cost of modification is substantially less than new trunks and outpulsing equipment. Offices with substantial growth remaining may satisfy their CCIS trunk requirements with a mixture of new and modified trunks. See Fig. 4 for a block diagram indicating the new and modified equipment required.

3.02 All CCIS candidate offices must be equipped with the peripheral bus computer (PBC) and arranged for sender retrieval and marker speedup operations. (It is expected that all offices will have implemented these features prior to CCIS.) The PBC is a CCIS prerequisite since CCIS traffic and maintenance measurements and ineffective attempt analysis for 4A/ETS toll switching offices are available only through the PBC. (See DFMP, Division H, Section 13b(3).)

3.03 Modifications will also be required in all outgoing link frames, markers, senders, decoder connectors, decoder channels, marker connectors, incoming sender register test frame (ISRT), the decoder marker test and trouble recorder frame, and the automatically directed outgoing intertoll test (ADOIT) frame or outgoing trunk test system (OTTS). Trunk transmission maintenance requires the addition of integrated manual test frame (IMTF) test positions or the modification of existing IMTFs for CCIS testing.

3.04 Existing 2-way, incoming and outgoing MF intertoll trunk relay equipments may be modified to function in either the MF or CCIS mode under the control of a trunk mounted selector switch. Several of newer plug-in conventional trunks will be convertible by cabling the associated trunk frame appearances to the DAS frame and either replacing the conventional plug-in trunk with a new CCIS unit or reconfiguring the unit for CCIS operation by means of option plugs on the printed wiring board. Incoming and 2-way trunks which are converting to CCIS operation must be served by senders that are modified to serve as outpulsers.

3.05 The CCIS hardware is grouped into three categories. The first (items A, B, C, D) consists of equipment added to the ETS complex. The second (items E, F) includes equipment added to the electromechanical portion of the system. The third (items G, H, I, J), which is optional and provided only when new CCIS trunks are required, is also an adjunct to the electromechanical equipment.

B. CCIS Terminal Group Frame

3.06 The CCIS terminal group (Fig. 5) is a 4-bay complex consisting of the signaling terminal units and data modems for up to 16 signaling links, as well as the duplicated TAC. A fully equipped CCIS terminal group consists of one 2-bay CCIS terminal basic frame and two single-bay CCIS terminal supplementary frames. The CCIS terminal basic frame contains the duplicated TACs, six signaling terminal units and associated data modems, and the power control circuits. Each of the supplementary frames contains five signaling terminal units (with modems) and power control circuits.

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3.07 The TAC controls all communications between the stored program control (SPC) and associated terminals. It contains the circuitry to interface 16 terminals with the SPC via the peripheral unit buses (PUB) 0 and 1 and the scanner answer buses (SCAB) 0 and 1. The TAC must function as follows:

- (a) Receive instruction and data from the SPC.
- (b) Check, decode, and analyze the information.
- (c) Select the sequence to be used.
- (d) Communicate the information to the proper terminal.
- (e) Check the terminal information.
- (f) Transmit the requested terminal data to the SPC.

3.08 The terminal (Fig. 6) is a small, high-speed, stored program processor specifically designed for the CCIS system. The terminal performs the following functions:

- (a) Attains and maintains synchronization with the terminal at the other end of the voice-frequency link.
- (b) Receives the serial data from the modem and converts that data to parallel data.
- (c) Groups the bits of the data stream into signal units of 28 bits.
- (d) Examines the eight code bits included in the signal unit to determine whether the signal unit was received in error.
- (e) Generates and transmits acknowledgment control units which indicate to the far-end terminal to the signal units that were received in error.
- (f) Processes any required retransmission of signal units.
- (g) Separates incoming data according to priority and indicates reception to the SPC.
- (h) Collects multiunit messages.

- (i) Filters from the received data to be presented to the SPC erroneous signal units and certain signal units that contain data that are of no interest to the SPC.
- (j) Files data received from the SPC in the appropriate priority buffer.
- (k) Transmits faulty-link information for the far-end terminal to regain synchronization after synchronization has been lost.
- (l) Transmits data according to priority rules and transmits filter signal units when no data are available.
- (m) Converts parallel data from the SPC to serial data.
- (n) Generates eight code bits over the 20 data bits to form the signal units.
- (o) Presents binary data to the modem.

3.09 The modem is a 201D data set and is physically located within the terminal unit (Fig. 6). The main function of the modem is to change digital data received from the terminal to analog data for transmission over the voice frequency link, and the reverse in the opposite direction. For additional information, reference Bell System Practices Section 312-811-100.

C. Voice Frequency Link Access Circuit

3.10 The voice frequency link (VFL) access circuit consists of two circuit packs per interconnecting A link. The VFL access circuit (Fig. 7) performs the following instructions:

- (a) Provides access to a 4-wire VFL for both manual and automatic testing. Access for all testing is under SPC control. Automatic testing is performed on all idle VFLs using actual data transmission.
- (b) Provides line build-out functions to compensate for variable lengths of office wiring and options for use in SOs and STP facilities.

D. Distributor and Scanner

3.11 Each 2-bay DAS (Fig. 8) contains 8 matrix units, a duplex controller, a communications

bus, a power converter unit, a fuse panel, and a power control unit. The DAS provides autonomous scanning of various 4A circuits (trunks, common control, etc) and reports scan point changes to the SPC processor. Scan points can be arranged to be nonreporting; ie, the processor must read the point to determine its state. Distribute points may be operated individually or in groups of up to 8 points.

3.12 DAS points are the principal circuits of these interfaces. Control signals from the SPC to the CCIS hardware are issued via the distribute points. Monitoring of functions requiring information transfer from the CCIS equipment to the SPC is done by the scan circuits. A detailed description of the DAS is contained in Bell System Practices Section 212-804-101.

3.13 The primary functions performed by the DAS are as follows:

- (a) Provides the SPC with scan access to read the status of trunk scan points and other scan points throughout a CCIS office.
- (b) Provides the SPC with control of distribute points in trunk circuits and in other circuits throughout a CCIS office.
- (c) Autonomously provides the SPC with change reports when reporting scan points change states. As a result, the SPC takes no data inputs from DAS frames unless activity has occurred.
- (d) Provides fault detection and diagnostic access to ensure that the DAS is functioning properly.

E. Insulated Gate Field Effect Transistor Store Frame

3.14 The IGFET store frame (Fig. 9) provides the additional program and data memory required for the CCIS feature. This single-bay unit contains a controller, a power control panel, a fuse panel, a bus unit, and up to six memory modules. A single-bay, fully equipped IGFET store frame is capable of storing 196,608 47-bit words. IGFET store frames are installed in pairs for reliability.

F. Transceiver and Connector

3.15 The transceiver and connector circuit frame (Fig. 10), a single bay unit, contains five connector units and ten transceiver housings or units. A transceiver unit contains two transceivers, each consisting of six circuit packs. Since transceivers are always furnished in groups of four, a frame can accommodate a maximum of five transceiver groups. A connector unit consists of relays on mounting plates for three connector circuits. Each transceiver and connector frame has the capacity to accommodate 255 terminations. These can be senders, sender/outputpulsers, outputpulsers, automatically directed outgoing intertoll trunk test frame (ADOIT), or outgoing trunk test (OTTs) terminations. The primary function of the transceiver and connector frame is to make a per-call check of the trunk transmission facilities.

G. Auxiliary Decoder Connector Frame

3.16 The auxiliary decoder connector frame (Fig. 11) contains 2 fuse panels and 20 multicontact relay units on the first frame and 24 multicontact relay units on subsequent frames. The primary function of this unit is to pass five additional address digits to the decoder channel permitting the processor (via the DAS) to read the complete address from the senders or load the complete address into the outputpulsers.

H. CCIS Printed Wiring Board Plug-in Trunk Frame

3.17 The CCIS printed wiring board (PWB) plug-in trunk frame (Fig. 12) accommodates 10 shelf housings. Each shelf housing may accommodate up to 12 CCIS plug-in trunk units, for a maximum of 120 trunks per frame.

3.18 Every third CCIS trunk frame contains a test panel housing for connecting three manual test lines to the CCIS intraoffice trunk (CIOT) test frame or integrated manual test frame. The test panel housing provides a convenient station for manual testing of any of the 120 plug-in trunks in the same frame or any of the 120 trunks in each of the two immediately adjacent frames.

3.19 The CCIS PWB trunk unit is basically a 2-way unit. It may be used for one-way incoming service by omitting the outgoing link cross-connection at the trunk connector and making appropriate changes in the software trunk data

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tables. The unit may also be ordered minus certain incoming apparatus to provide one-way outgoing-service. A CCIS trunk unit utilizes distribute points, located in the DAS, for processor control of the following:

- Incoming seizure
- Incoming ring (CCIS-EM [electromechanical] connections only)
- Incoming disconnect
- Outgoing supervision (EM-CCIS connection only).

A CCIS trunk also utilizes distribute points to report the following, via DAS, to the processor:

- Incoming supervision (CCIS-EM connections only)
- Incoming equipment release
- Outgoing seizure
- Outgoing disconnect
- Outgoing ring (EM-CCIS connections only).

I. Outputer Link Controller Circuit

3.20 The outputer link controller frame (Fig. 13) accommodates four outputer link controllers, a fuse panel, and a guard unit panel. Each of the four outputer link controller units consists of an outputer link controller unit, a control unit, and a preference unit.

3.21 The main function of the outputer link controller unit is to select an idle outputer and establish the outputer link connection between the outputer and the CCIS trunk requesting the connection. Each outputer link controller may select any of the 48 outputers of a group. However, each of the 4 controllers is permanently wired to prefer a different subgroup of 12 outputers.

J. Outputer Link Frame

3.22 The outputer link frame (Fig. 14), a 2-bay complex, contains 24 small 12-level 6-point crossbar switches. Twelve of these are primary switches and twelve are secondary switches. Both the primary and secondary switches are arranged

in three groups each containing four crossbar switches. Incoming CCIS trunks appear on the horizontals of the primary switches, and outputers appear on the horizontals of the secondary switches. Each of the three primary switch groups terminate 120 CCIS trunks for a total of 360 CCIS trunks per outputer link frame. Each switch group has access to all outputers within the group. A maximum of 11 outputer link frames (3960 trunks) may be associated with 48 outputers. The outputer link frame connects an incoming call arriving on a CCIS trunk to an outputer.

K. Outputer Frame

3.23 The outputer frame (Fig. 15) contains a fuse panel, a terminal strip panel, a miscellaneous panel, and three outputers. Each outputer contains a trunk control timing and test unit, a decoder marker and outputting control unit, and a seizure registration and code conversion unit. An outputer works with the outputer link and outputer link controller and serves only CCIS incoming trunks. An outputer is connected on every CCIS incoming call as follows:

- (a) To enable the marker to establish the cross-office connection.
- (b) To provide transceiver access to perform a continuity check of the CCIS trunk transmission facility.
- (c) To output the address digits to the next office if a conventional outgoing trunk is selected.

4. TRAFFIC CONSIDERATIONS

Signal Link Capacity and Loading

4.01 The full load capacity of a signaling link is approximately 3,000 trunks, utilizing a data link speed of 2400 bits per second and assuming a busy hour call attempt rate of 10 per CCIS trunk (5 each way on a 2-way trunk). To insure adequate protection against failure, the signaling links are provided in pairs with the load divided between the paired links. A toll office having 3000 CCIS trunks connects to the signaling network via a single pair of A-links, one to each STP in its region. An additional A-link pair would be provided for each 3,000 CCIS trunks. Each A-link pair functions as an autonomous unit, having no operational

interaction such as failure backup with subsequently added A-link pairs.

4.02 The interregional quad of links form a functional unit serving approximately 6,000 trunks between two signaling regions. Additional quads would be added for each increment of 6,000 CCIS interregional trunks.

5. NO. 4A/ETS SIGNAL TRANSFER POINT

5.01 For 4A/ETS toll switching offices which are not candidates for conversion to CCIS switching office operation, the STP feature has been developed. The STP feature is intended to utilize the spare processing capacity of the ETS and is envisioned as a temporary solution which will allow early introduction of a signaling network. The STP feature is designed to have minimum interface, both software and hardware, with the host switching machine. Therefore, no connections are between the 4A crossbar frames and the STP equipment. The major interconnections are located in the ETS peripheral unit area. Because of this limited interface, there are no prerequisites for STP installation other than a PBC-equipped ETS with the most current generic.

5.02 There are no system modifications, additional features, or data recompilation required for installation of the 4A/STP feature. Power plant enhancement may be required, and test appearances at existing trunk test frames for CCIS voice frequency links must be provided. A basic STP functional system diagram is shown in Fig. 16 without the duplication of buses and controllers. New equipment required for the 4A/STP is shown in Fig. 17. New ETS and PBC generic programs are required to include the STP features.

5.03 The installation of an STP pair is required in each signaling region prior to introduction of CCIS on any switching machine in that region. The STP program by design will make use of spare processor capacity of existing 4A/ETS systems and will allow early introduction of a nonassociated switching network. As mentioned above, the 4A STP is designed to have no interface with its associated switching machine. The 4A/ETS which shares its processor with the STP function cannot use CCIS signaling for its trunks because of processor real time limits and generic design.

6. DIVISION OF REVENUE

6.01 A new separations procedure is used to determine relative usage among operating companies using the STP. Separations data are required for each STP location for Division of Revenue (DR) purposes as an input to the Centralized Message Data System (CMDS).

6.02 Trunk group information can be obtained from CCIS records to identify those groups associated with a pair of STPs, or if between regions, two pairs of STPs. A table of STPs and related trunk groups can be developed from the combined CMDS and CCIS data sources. Messages routed over these groups are counted for each STP location. If the state codes of the originating and terminating points of the message differ, the code is counted as interstate. If the state codes are the same, the code is counted as intrastate.

7. ADMINISTRATION OF THE CCIS NETWORK

7.01 As the CCIS network grows, planning for this growth becomes increasingly important. So, too, the day-to-day administration of the network becomes a larger and more complex job as the network grows in size and complexity.

7.02 For trunk forecasting requirements to be properly analyzed, procedures must be implemented to give adequate administrative controls. A centralized approach provides these controls in an economical and efficient manner. This approach calls for the establishment of a CCIS Network Administration Center, operated by AT&T Long Lines, to perform these functions. Two functional activities must be performed by the CNAC: planning analysis and current administration.

A. Planning Analysis

7.03 This activity will analyze the CCIS requirements as indicated by the Bell System and independent telephone companies trunk forecasts. It will show where additional data link facilities and STPs are required and when they are needed to meet the forecasted requirements of the message network. The results of this analysis will then be forwarded to the appropriate carrier and equipment engineers for action.

7.04 The value of a CNAC is enhanced by the fact that multiple engineering entities cannot

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identify the total load impact on equipment or carrier facilities of the interregional quad. By having the CNAC analyze all the forecasts and comparing them with the existing CCIS network, a more thorough analysis can be made. Also, the CNAC will be in a better position to know the current and planned condition of the CCIS network. It should know of any impact the network might suffer due to the addition of new toll switching systems, as well as any rehoming or conversion activity. It should also be able to insure that good diversity is maintained. Under the supervision of a centralized group, proper administration can be given to the planning analysis portion of CCIS.

B. Current Administration

7.05 This functional job is concerned with the day-to-day activities of CCIS administration.

This function has been called ***current administration*** because it deals with the day-to-day job. It will react to the current Long Lines and associated company requirements. The primary responsibilities of this job will be assigning labels, bands, and signal paths, as well as maintaining their respective files.

7.06 This CNAC function will enable a close evaluation of how the links, quads, and equipment are being loaded. Proper administration is vital to the successful and economical growth of the CCIS network. The group will work with the Long Lines Circuit Layout people in coordinating the CCIS assignment job with the makeup of associated circuit orders. Label and band numbers pertaining to associated company requirements will be given directly to the concerned groups by the CNAC.

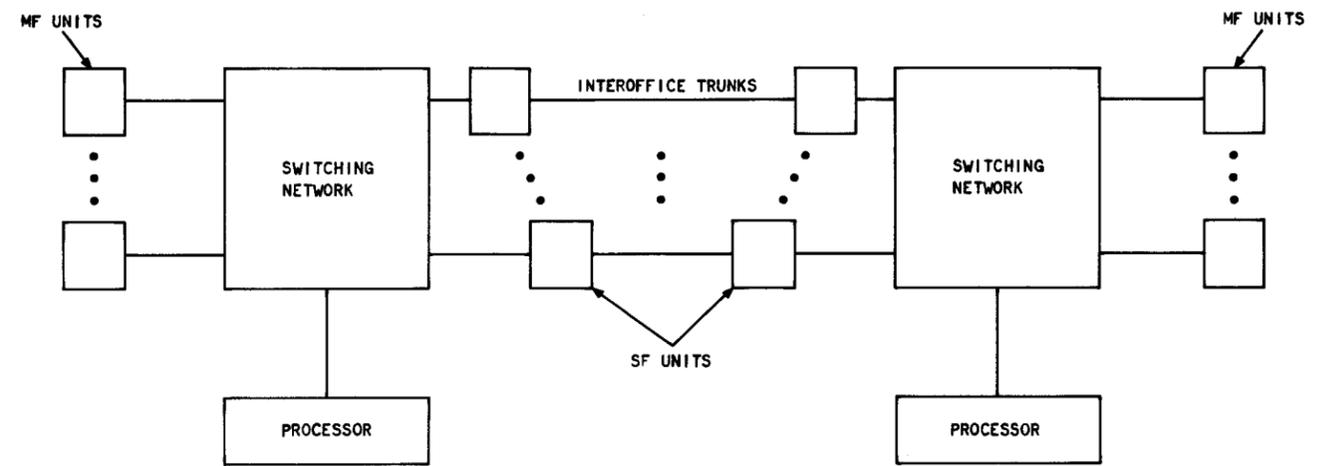


Fig. 1—Block Diagram of Inband Signaling

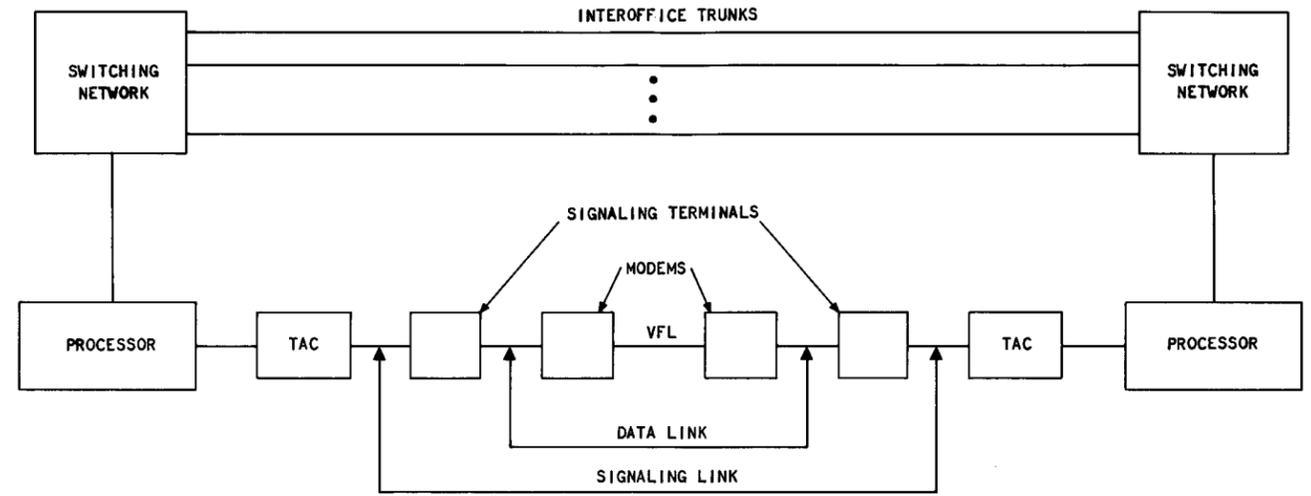


Fig. 2—Block Diagram of CCIS Signaling

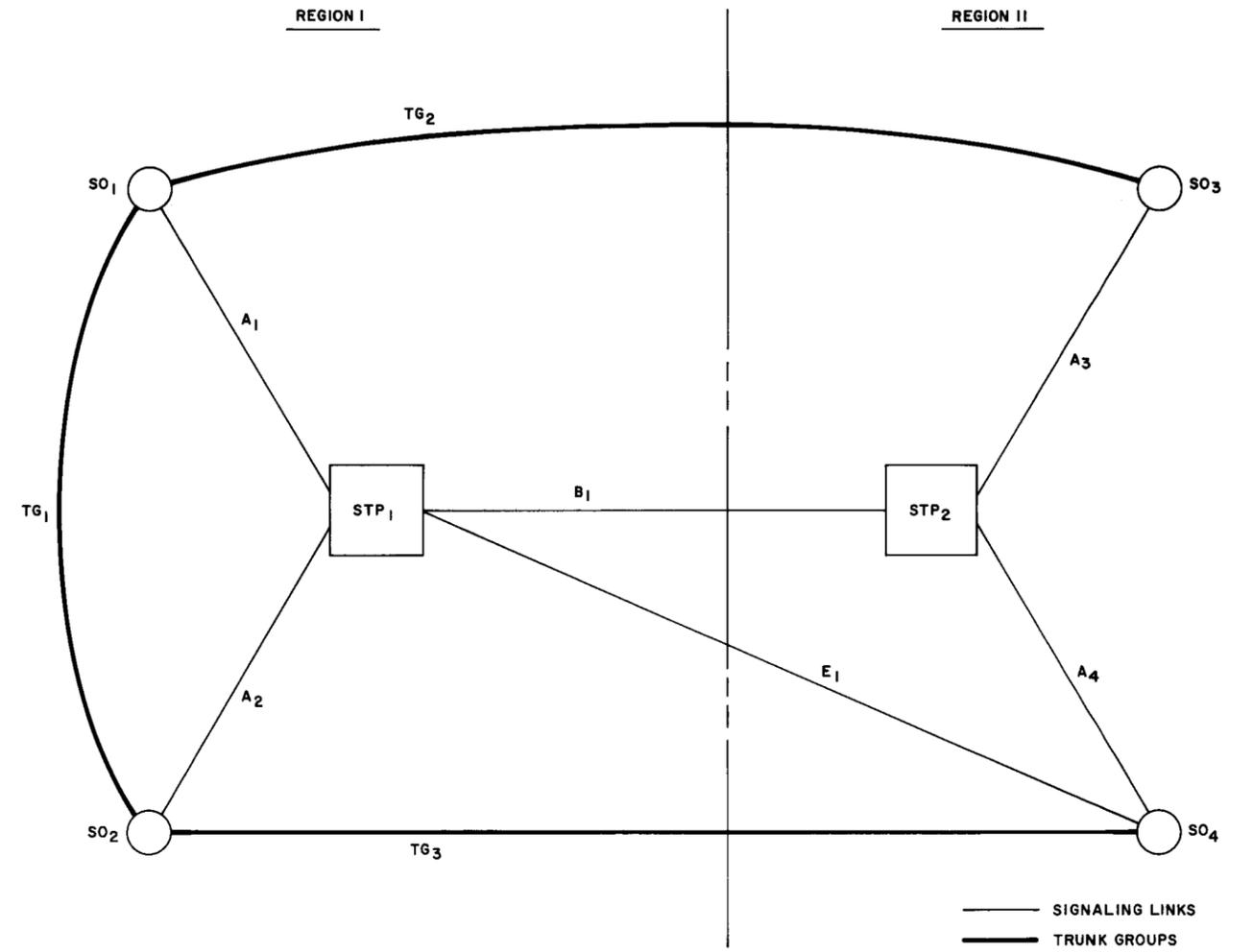


Fig. 3—Block Diagram of Basic CCIS Signaling Network

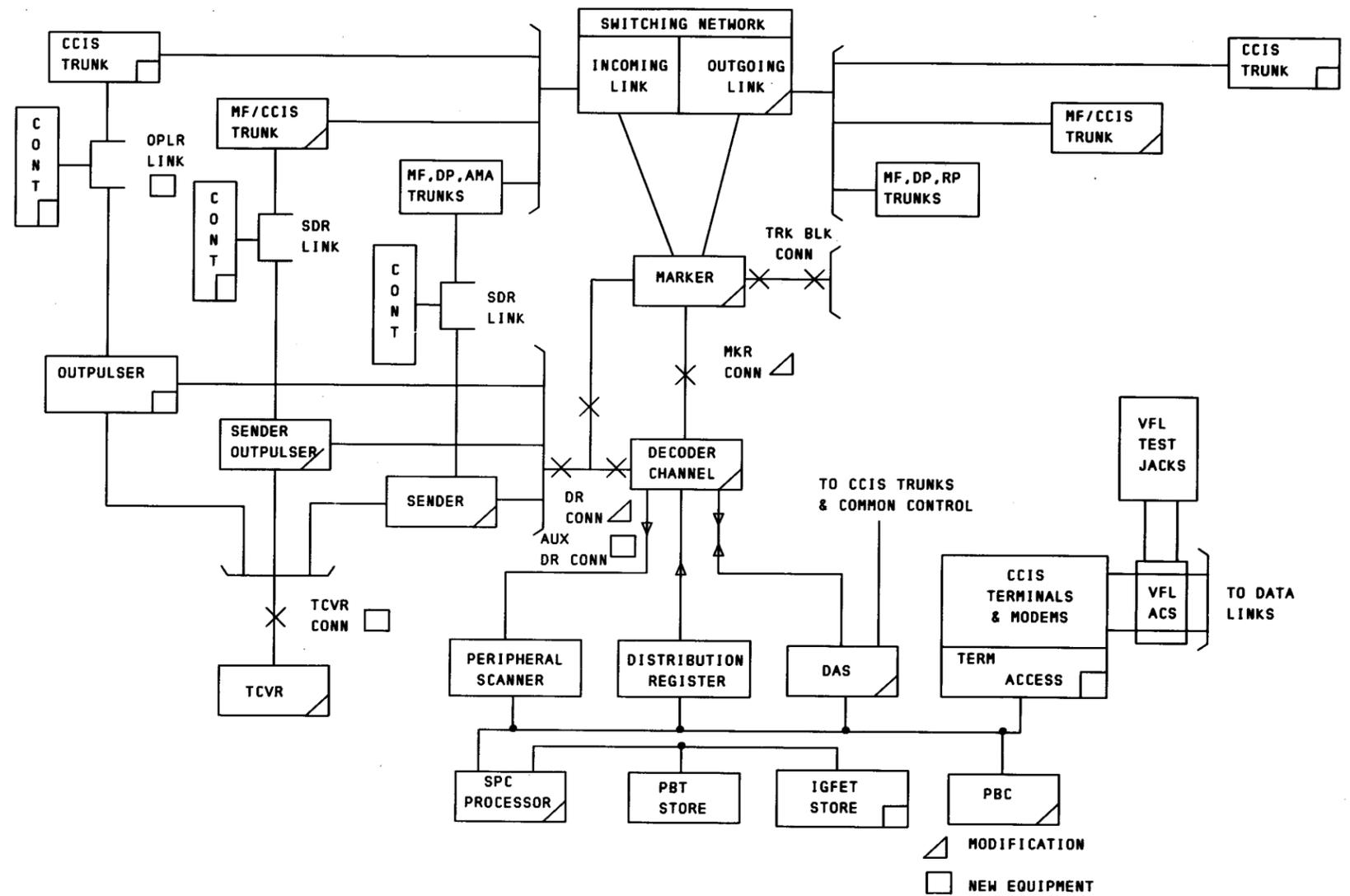


Fig. 4—Block Diagram of New and Modified CCIS Equipment

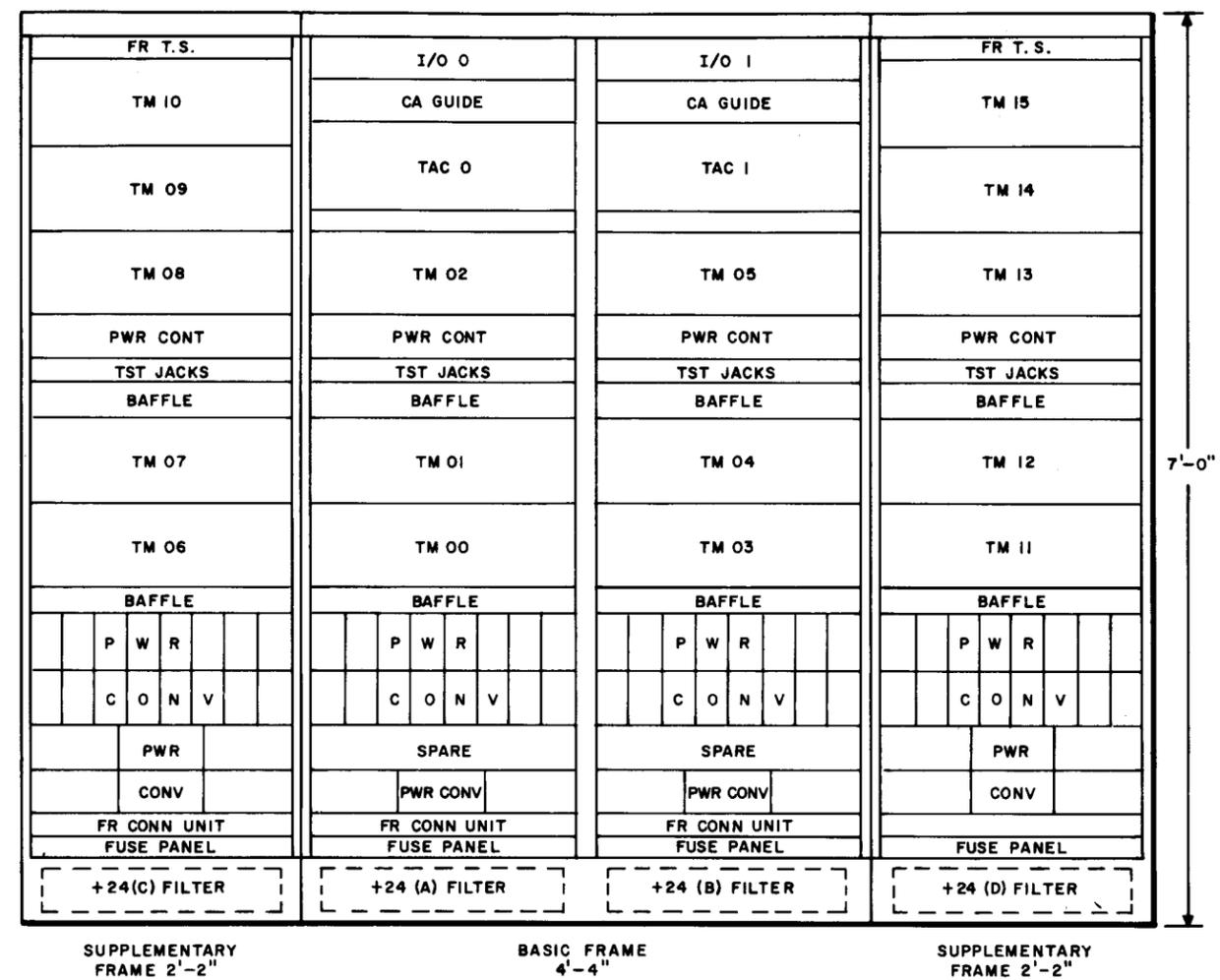


Fig. 5—No. 4A/ETS CCIS Terminal Group Frame

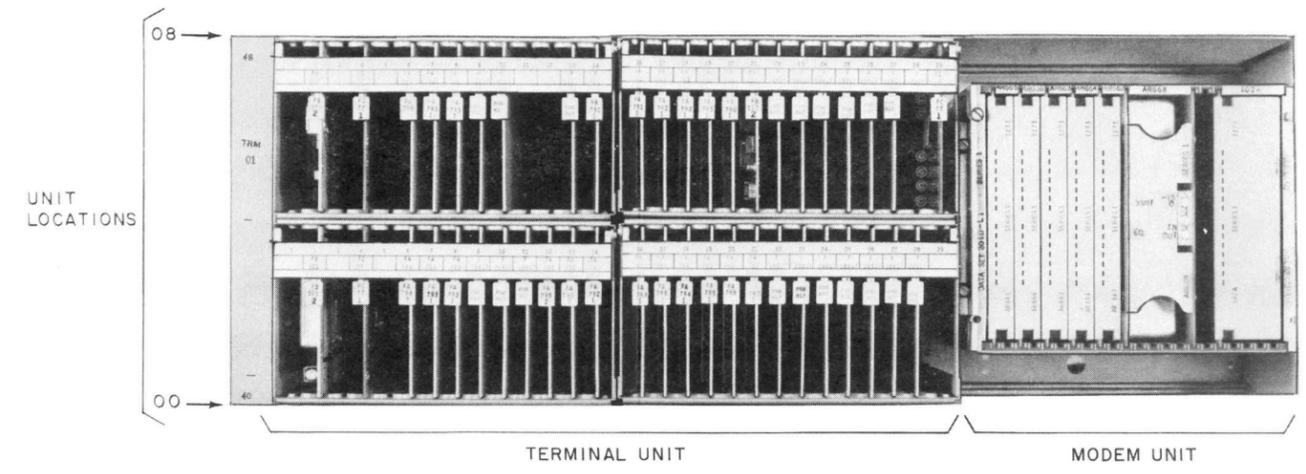


Fig. 6—Terminal Unit J99360A

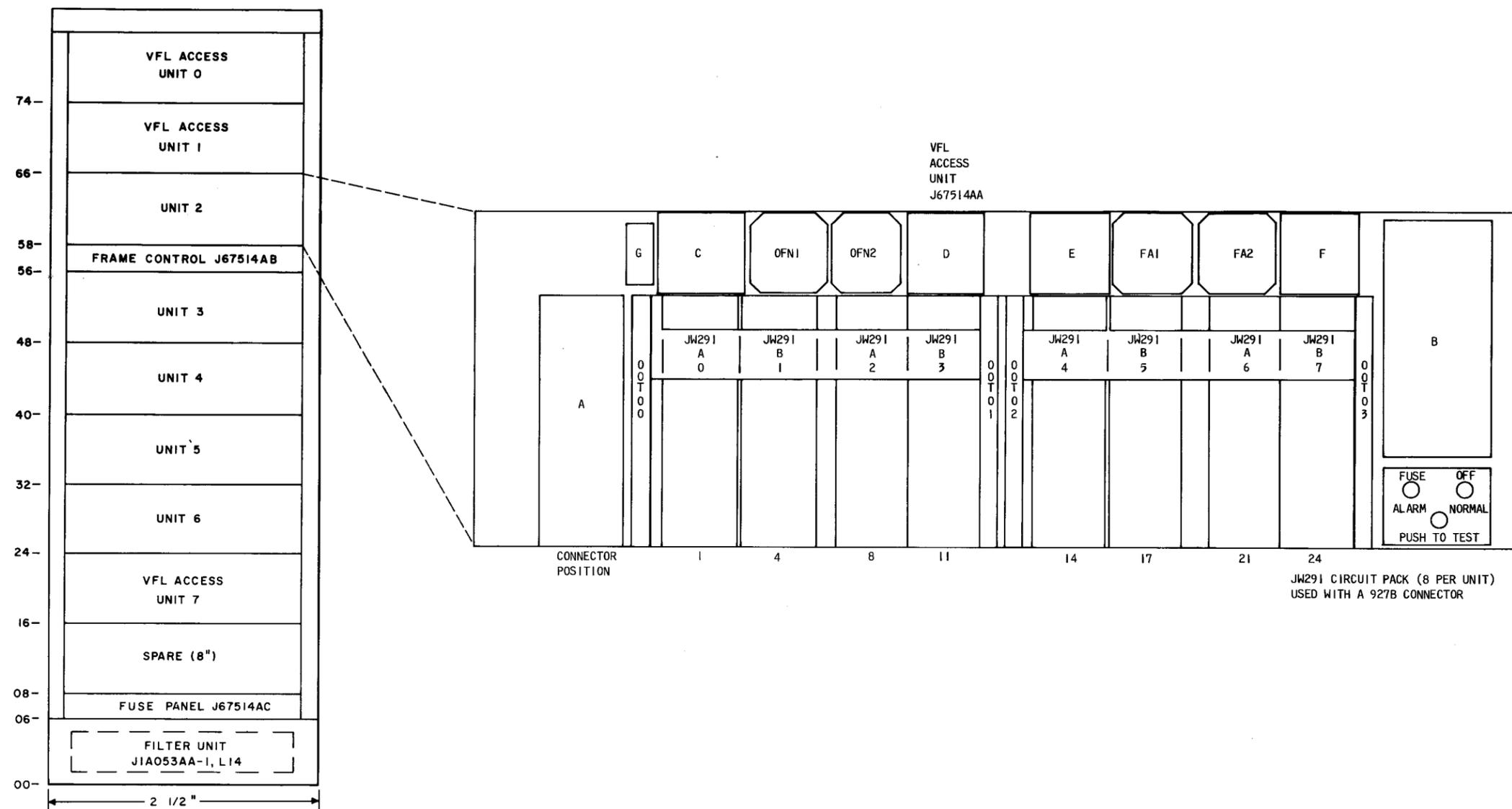


Fig. 7—Voice Frequency Link Access Frame

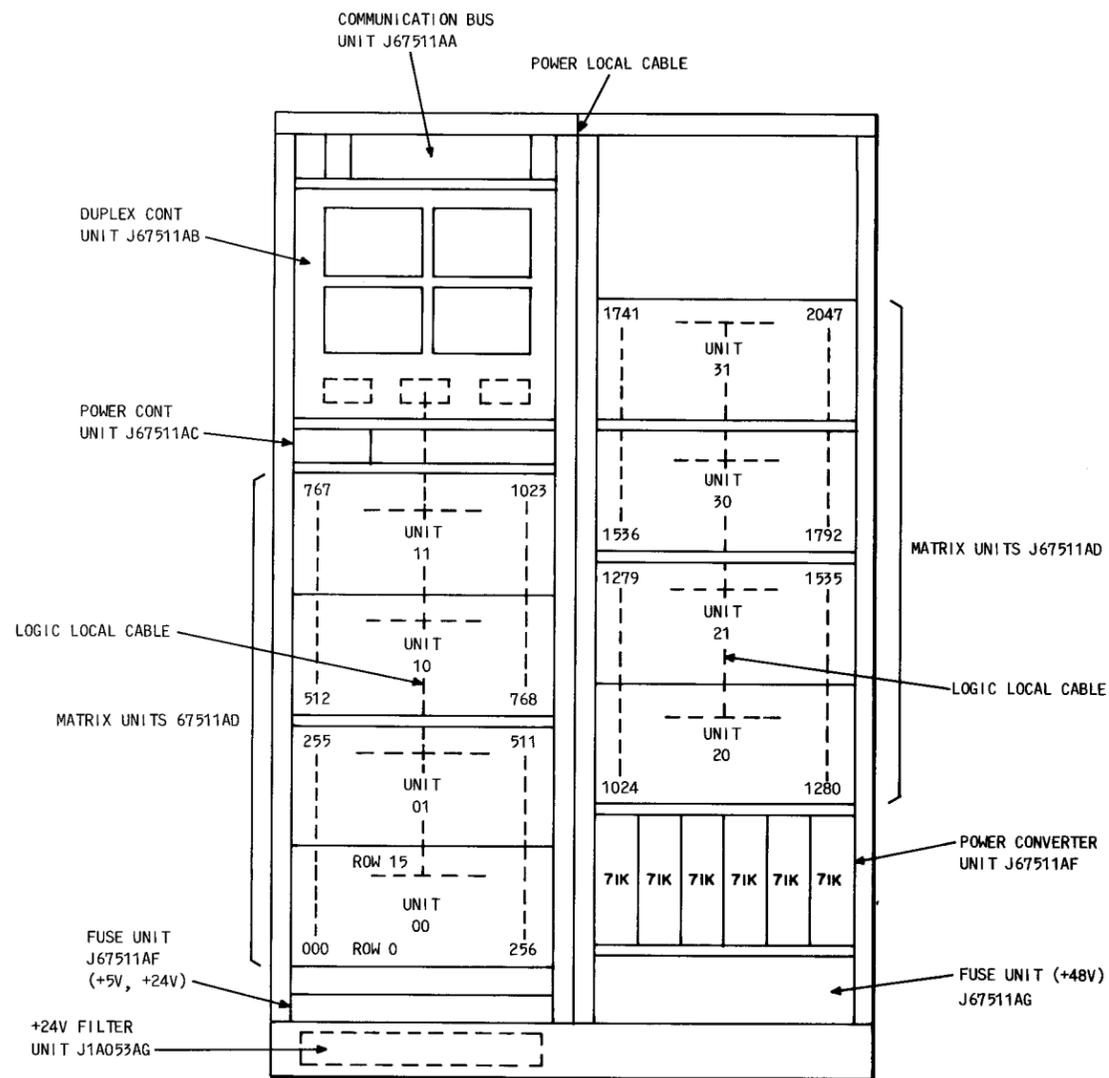


Fig. 8—Distribute and Scanner Frame

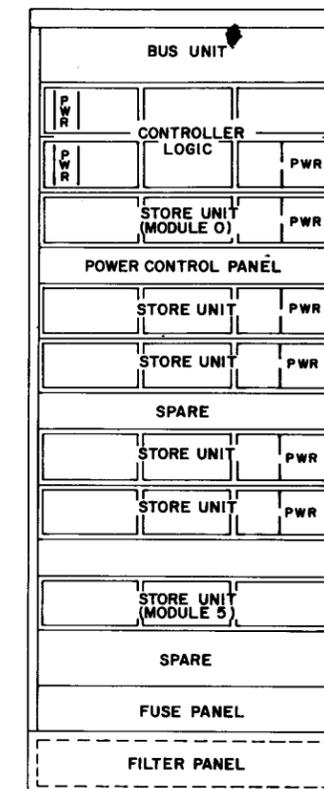


Fig. 9—Insulated Gate Field Effect Transistor Store Frame

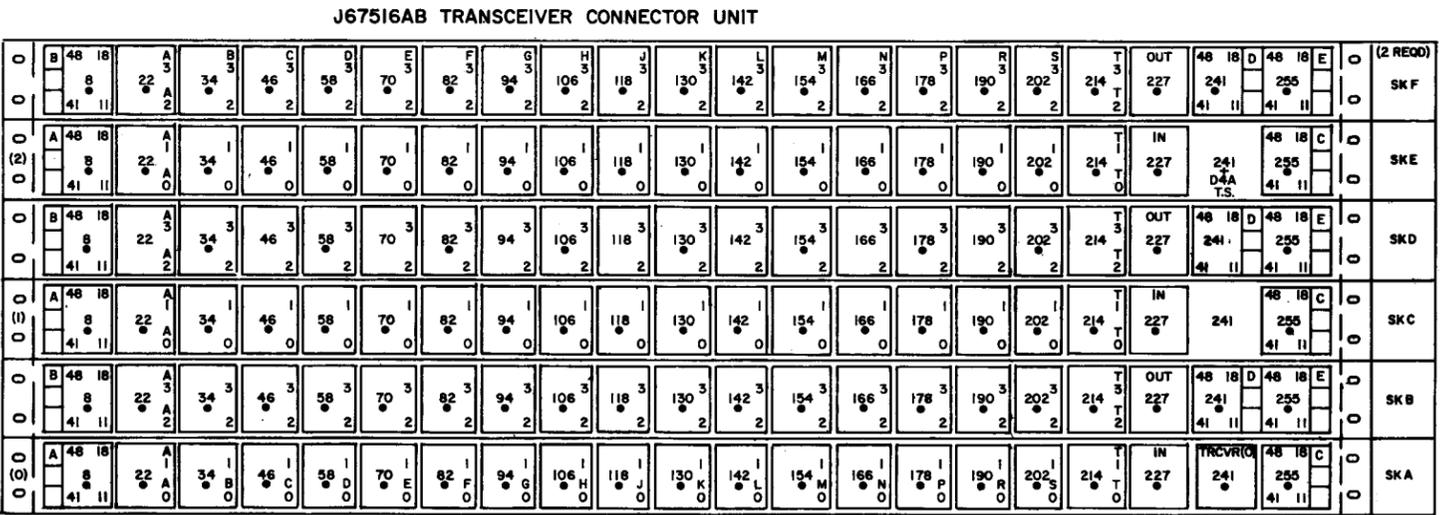
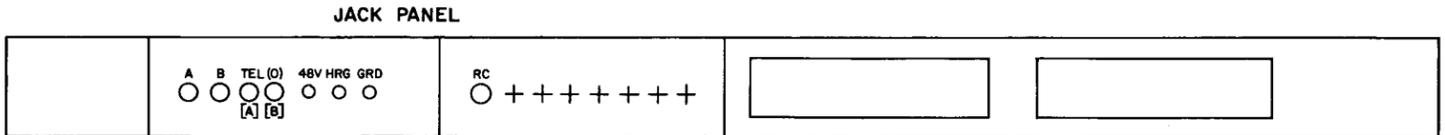
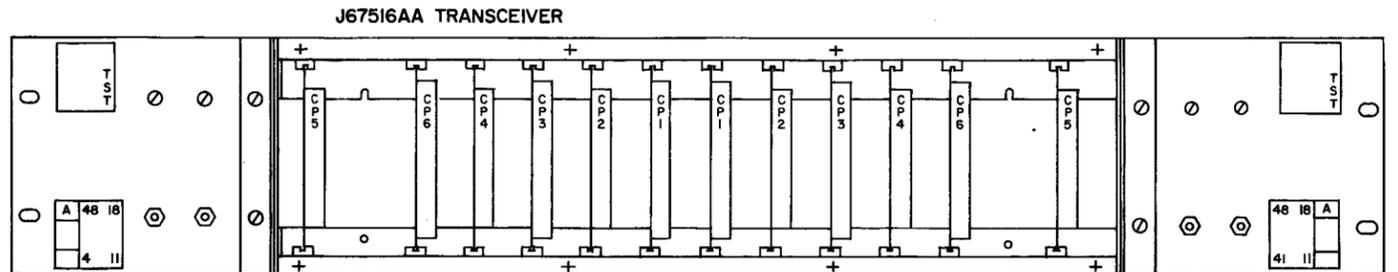
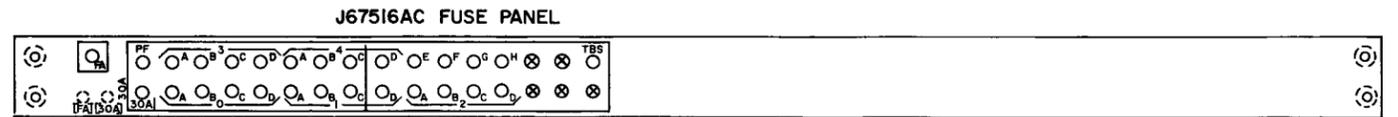
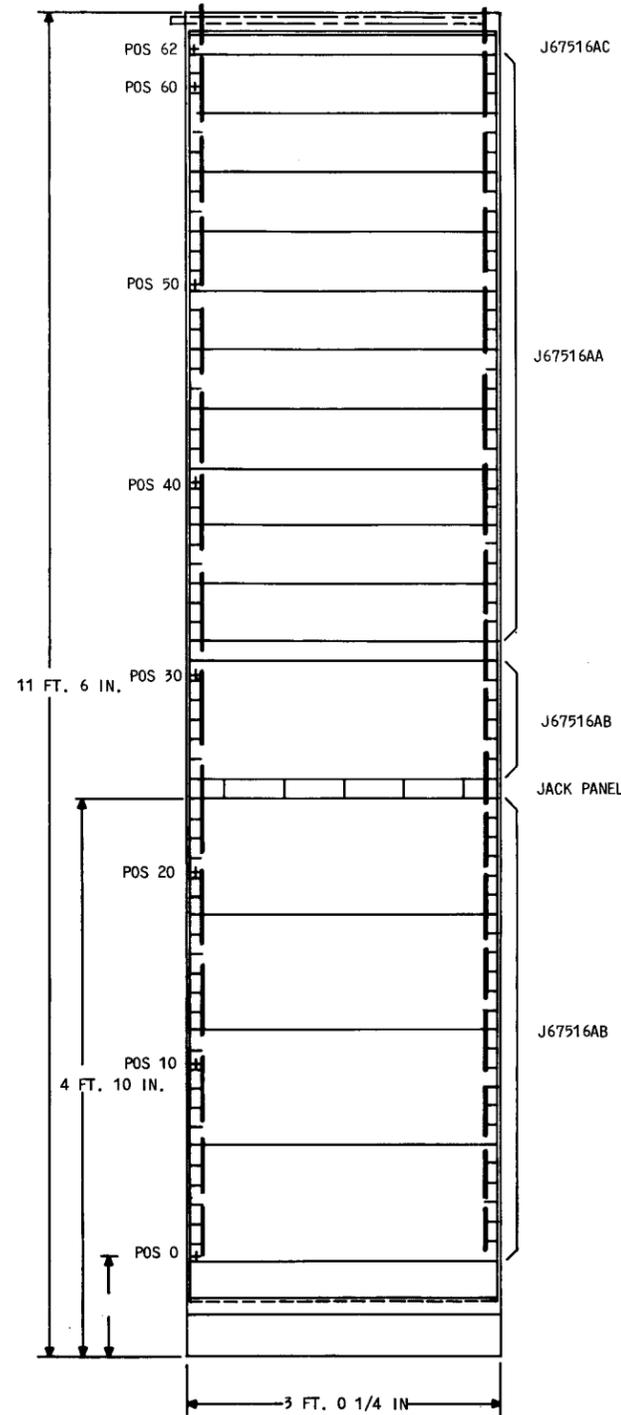


Fig. 10—Transceiver and Connector Circuit Frame

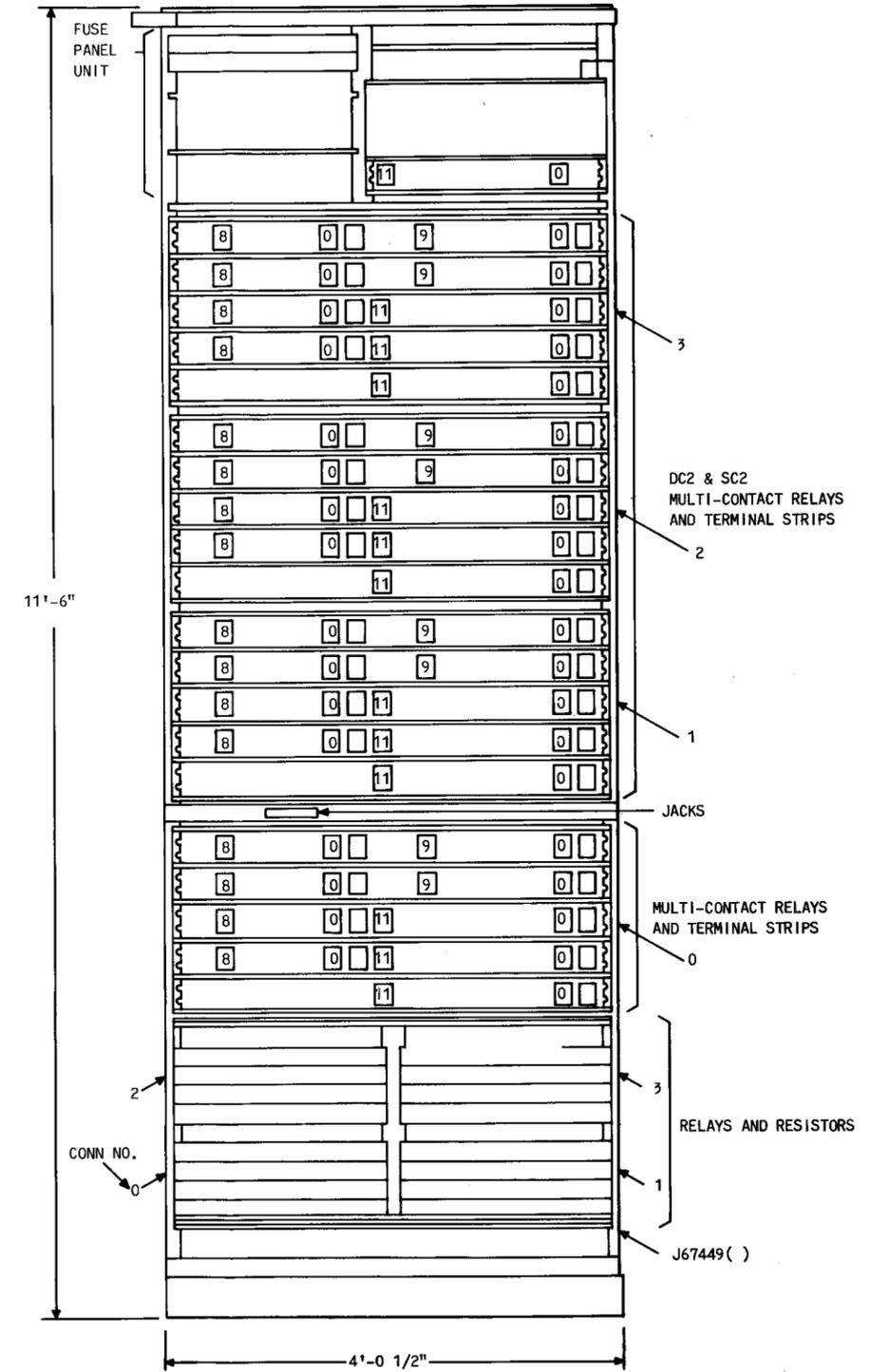


Fig. 11—Auxiliary Decoder Connector

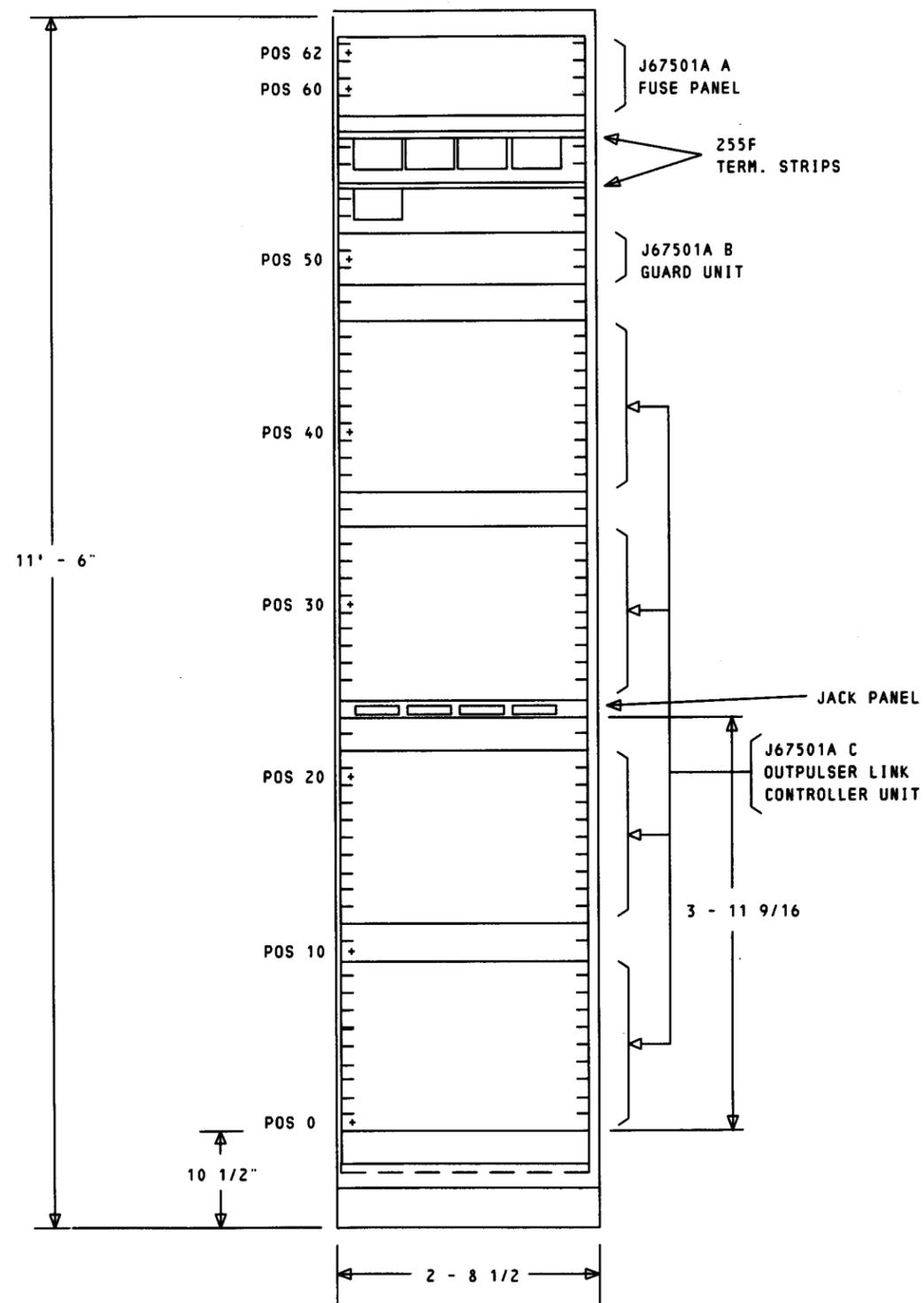


Fig. 12—CCIS Printed Wiring Board Plug-In Trunk Frame

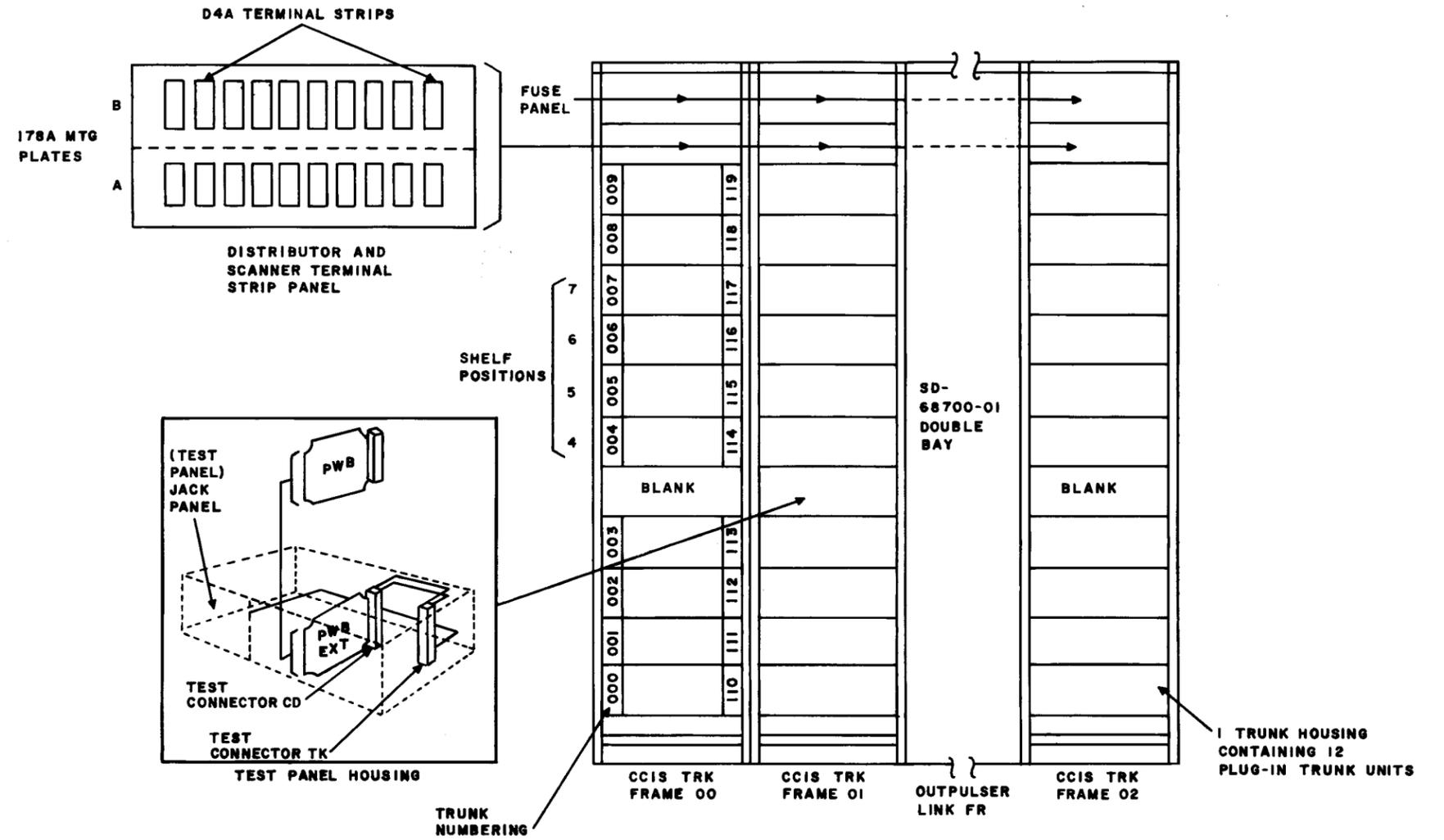


Fig. 13—Outpulser Link Controller and Connector Frame

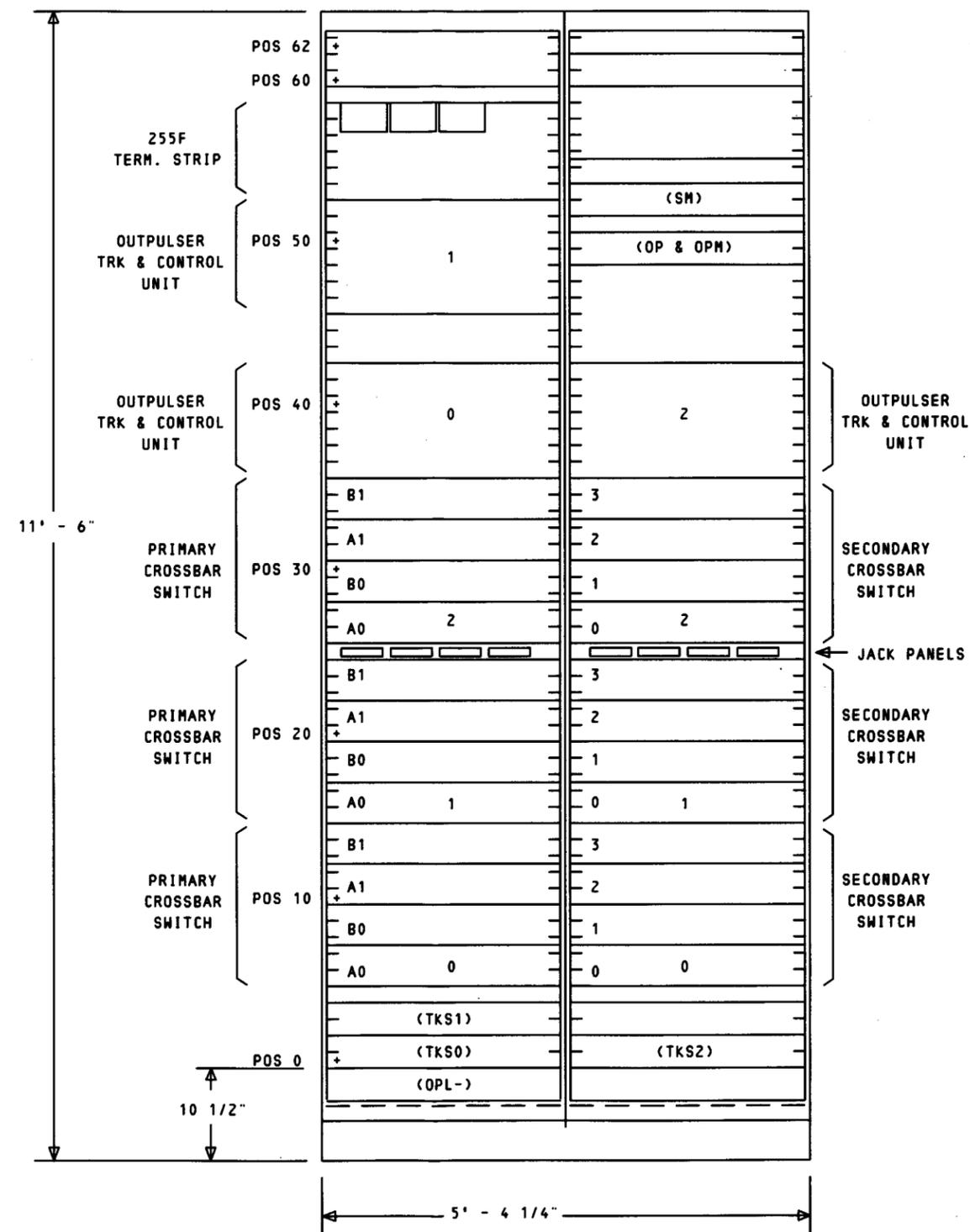


Fig. 14—Outpulser Link Frame

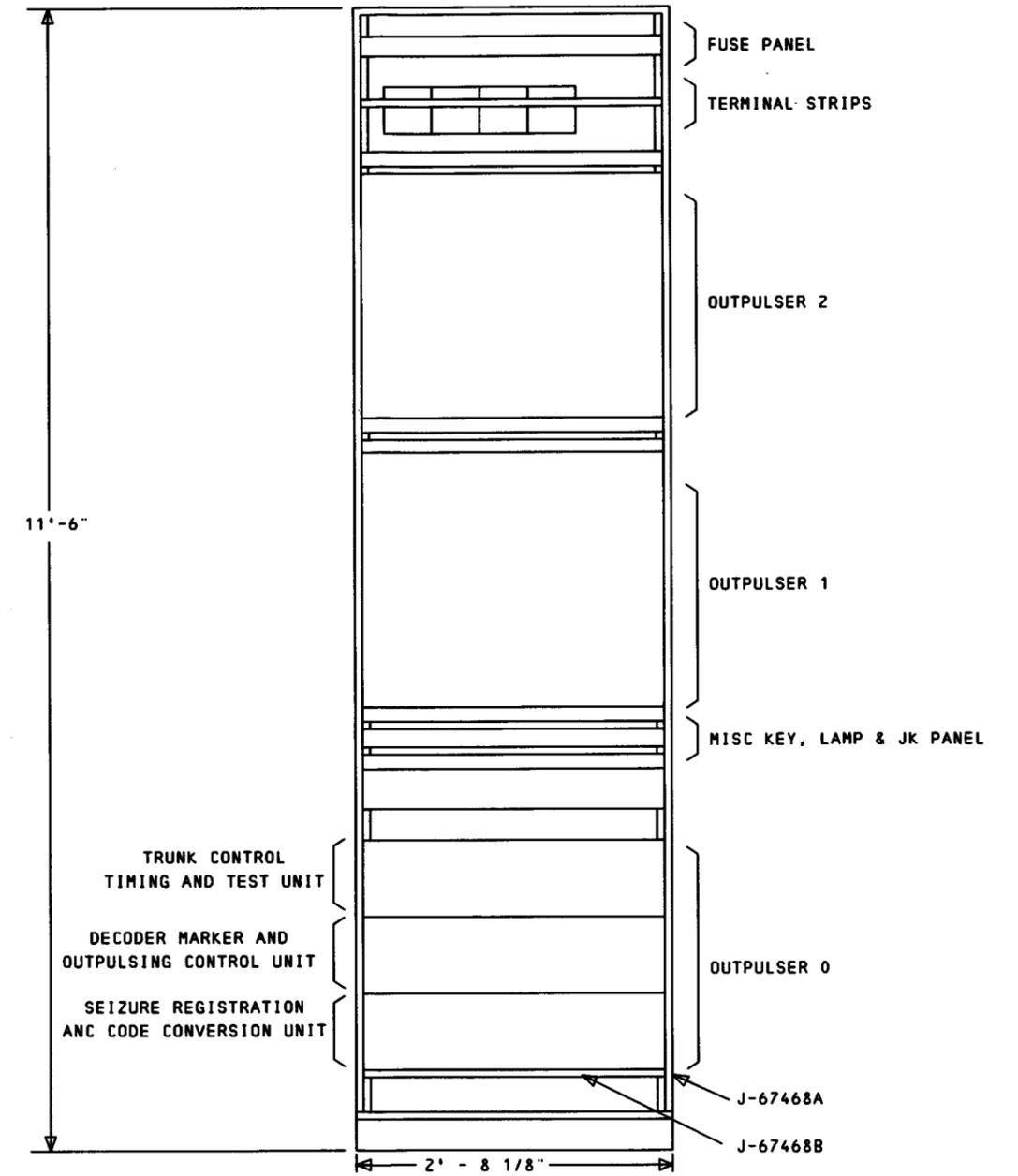


Fig. 15—Outpuler Frame

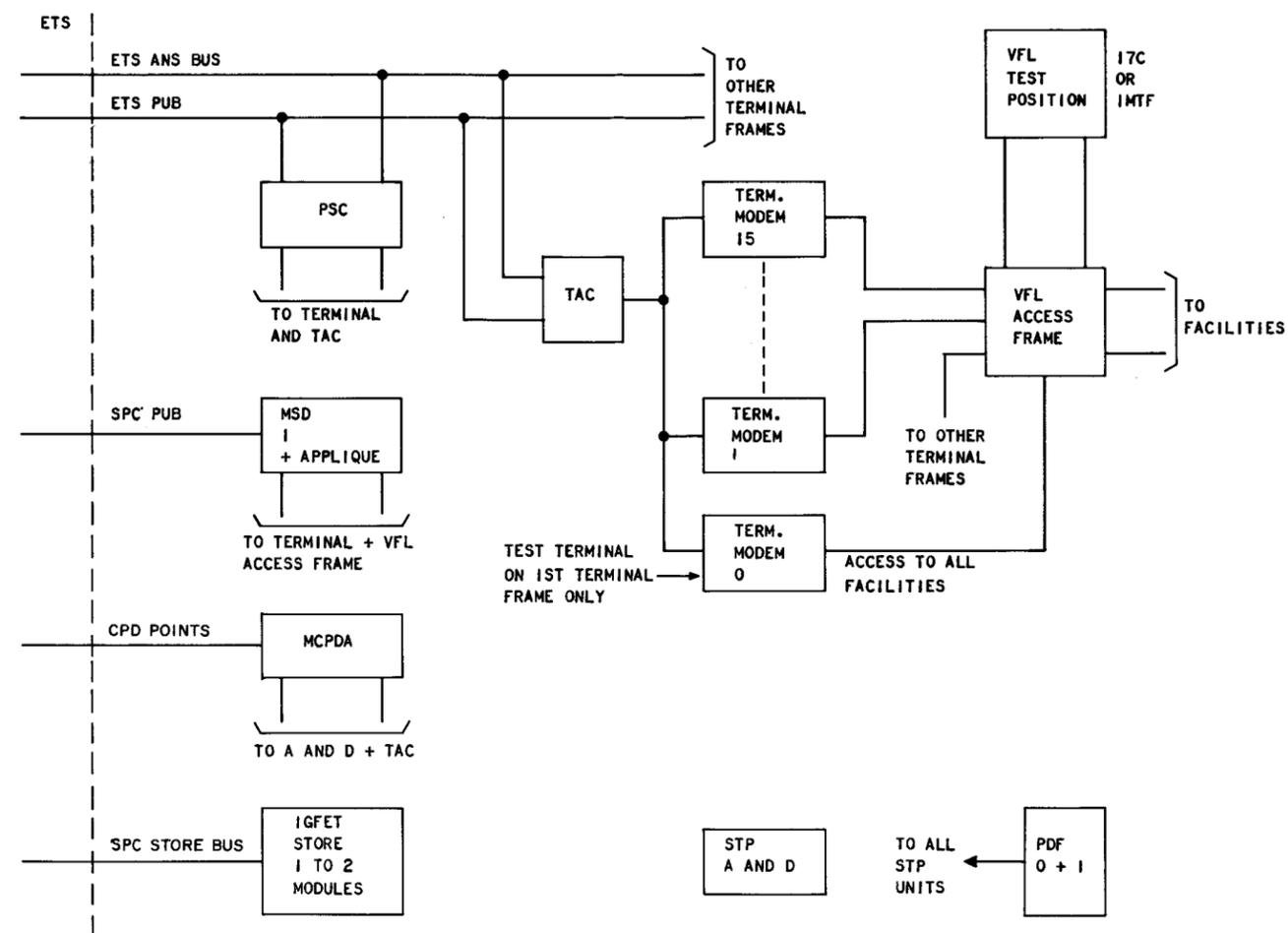


Fig. 16—Functional Diagram of 4A/ETS Signal Transfer Point

STP Equipment Requirements

Frame	Capacity	Quantity
Peripheral Scanner (SD 68601)	1280 Points	1 per Office.
Master Signal Dist. (SD 1C104)	256 Points	1 per Office
Signal Dist. Applique ¹ (SD 1C111)	256 Points	1 per Office
STP Alarm & Display ²	—	1 per Office
VFL Access Frame	64 VFL Access Circuits/Frame	1 per 32 Terminals (max of 4 frames)
VFL Access Circuit	—	2 per Terminal
IGFET Store	192K Words (6-32K Modules)	2 frames E/W 1 module each for first 60 Terms. 1 additional module per frame for next 60 terms.
Misc CPDA Unit ³ (SD 68608)	32 Points (4 MCPD Circuits)	1 per office
<u>Terminal Frame</u>		
1) Basic Frame	2 Terminal Access Circuits + up to 6 Terminal-Modem Units	
2) Supplementary Frame	Up to 5 Terminal-Modem Units per Frame (max of 2 suppl frame per basic frame)	See Fig. 13
Power Dist Frame	—	2 per Office
1) Mounted on MSD Frame 2) Mounted on ETS A+D Frame 3) Mounted on ETS A+D Frame		

Fig. 17—Signal Transfer Point—Equipment Requirements