CHANNEL UNIT DESCRIPTION
D3 CHANNEL BANK
DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This section describes the channel units for the D3 channel bank which are listed along with abbrevations in Table A. Included are descriptions of common channel unit circuits and options, the application of the various units, and the functions of the selectable options and controls. This practice supplements the instructions in Section 365-800-001 (TOP) on how to make the settings given on the circuit layout. Sections 855-351-107, 855-351-108, and 855-351-109 contain the engineering for determining prescription settings.

1.02 This section is being reissued to include the J987186A and J987186B security channel units and to delete a PLR channel unit reference compatibility with a PLR channel unit in Table B. Revision arrows are used to emphasize the more significant changes.

1.03 The basic function of a channel unit (Fig. 1) is to provide the interface between the central office trunk circuits (or other connecting circuits) and the common equipment in the D3 channel bank. The channel transmit circuitry extracts samples of the outgoing voice and signaling under control of the bank timing. The channel receive circuitry demultiplexes the message and signaling pulses from the common equipment, converts message pulses to VF information which is applied to the trunk or subscriber loop, and produces signaling conditions from the signaling pulses. Notable variations in channel unit design occur in the direct interface units for ESS, dataport units, and program units. The direct interface units include trunk circuit equipment instead of serving as an interface. Dataport units apply

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data directly to the common equipment; no signal sampling is done. There are separate transmit and receive program units; whereas the other units contain both circuits.

1.04 There is a wide variety of channel units to meet the transmission and signaling requirements of the connecting circuits. All channel units are the same size (6 inches high, 1-3/4 inches wide, 10 inches deep) and will fit in any channel slot, but the selection of the unit depends on the type of service; such as message, special service or data, and the signaling requirements such as loop or E&M. For overall circuit operation, the channel units at the ends of the carrier must be compatible. In many cases there will be complementary units such as originating and terminating versions of a particular type unit, but some units will function with different units as shown in Table B. If compatibility is a problem in systems with a D1D, D2, or D4 channel bank at one end, there will be options on the units to adapt the operation or there will be restrictions on the use of the units or certain equipment lists. See Section 365-010-105 for information on channel unit compatibility.

1.05 Options and adjustable controls are located inside the channel units and on the faceplate of special service units and are identified by the associated designations. The options are either screw-switch type or the newer socket-and-plug types and the attenuators are slide-switch, socket-and-plug, miniswitch, or potentiometer types. Nameplates on the units have a surface suitable for marking with pencil or pen to keep a working record of the settings. To enable adjustments while making any tests at the channel unit, it can be mounted in the ED-3C424 extender.

1.06 When any drop transmission tests are to be made on trunks using dial pulse, revertive pulse, or foreign exchange channel units, the circuit must be put in the proper supervisory state to close the transmission path through the channel units. For dial pulse and revertive pulse units, the trunk must be seized and held by attaching a holding coil at the originating end. Foreign exchange circuits must be seized at the office end (FXO end) to provide tip ground signaling to the FXS channel unit and a loop closure must be applied at the FXS end to send loop closure signaling to the FXO unit. Switch S3 on the front of the FXS/GT operates the tip ground relay (closing the transmission path) for testing toward the drop from the unit.

2. COMMON CHANNEL UNIT CIRCUITS

A. Connecting Circuit Interface

2.01 Channel units have transformers for matching the 2- or 4-wire connecting circuits to the 4-wire, 600-ohm unbalanced input to the common equipment. Attenuators control the signal level toward line and toward drop. The 2-wire units (Fig. 2) have a built-in terminating set consisting of a hybrid transformer to produce separate transmit and receive paths on the 4-wire side and network build-out capacitors for balance. Most of the 2-wire units are for 900-ohm connecting circuits, but there is a 2W E&M extended range unit for 600 ohms. The 4-wire units (Fig. 3) have a transformer in the transmit and receive paths for matching the 600- or 135-ohm (dataport channel units) connecting circuits to the common equipment. Multiple impedance taps are provided as part of the equalization controls on 4-wire special service units which have equalization.

B. Channel Jack Access

2.02 To allow adjustments and measurements, all channel units contain adjustable attenuators and jacks. The XMT and RCV jacks are at −7.5 dB and +2.5 dB transmission level points (TLPs), respectively, and provide access to either the line or drop sides. Certain special service units also contain calibrated potentiometers which are used in frequency compensating (equalization) networks, balance networks, and as attenuators (see Fig. 4). Pin jacks on the faceplates allow bridged connection to channel unit leads. Commonly provided are the T and R and N1 and N2 jacks on 2-wire units and the T, R, T1, and R1 on 4-wire units. The T and R jacks are for the tip and ring leads (T1 and R1 for 4-wire receive) and the N1 and N2 are across the compromise balance network. These network jacks allow connection of a precision capacitor in the event that the channel unit hybrid is used to establish the NBO capacitance value for the office. Signaling lead jacks are covered under respective channel unit description.

2.03 Access to the drop side of the XMT or RCV jack is on the ring and sleeve contacts, and access to the line side is on the tip and sleeve contacts. When testing with the D3 channel access unit, the direction is selected by the TEST switch on this unit. An additional contact is on the RCV jack which is wired into a circuit that couples the input of the receive gate driver to a trunk processing unit (TPU)

lead through a diode. When the TPU is operated and the RCV jack is vacant, the input of the receive gate driver is grounded to prevent noise and test signals from reaching the trunk circuit. When a plug is inserted in the RCV jack while the TPU is operated, the receive gate is reenabled for testing.

C. Channel Gates and Filters

2.04 The channel gates and filters are part of the voice path in all channel units except dataports. There is no PAM signal produced in the dataports; digital data is connected directly to the PCM transmit bus and digital data is extracted from the PCM receive bus. The transmit and receive active filters, consisting of operational amplifier circuits, are low-pass filters with a 3.4-kHz cutoff frequency and are associated with the transmit and receive gates, respectively. Under the control of the timing circuits in the D3 common equipment, the transmit gate extracts PAM samples from the VF signal, and the receive gate allows PAM pulses received from the D3 common equipment to enter the receiving section of the channel unit. The channel unit logic circuitry processes the timing pulses from the D3 common equipment and applies trigger pulses to the appropriate gate driver which operates a gate. The gate and filter circuitry is identical for both 2-wire and 4-wire units.

D. Signaling Circuitry

2.05 All message channel units and most of the special service units with the exception of program units, dataport units, and transmission only units have signaling circuitry. The flow of signaling information between D3 channel units is used to originate, maintain, and terminate a call over the channel. In originating or terminating a call, the receive signaling circuits in the channel units respond to a change at the far end of the channel by producing the appropriate signaling condition toward the office. The signaling information is represented by the presence or absence of the PCM signaling bits for the channel. All the channel units with signaling have primary signaling circuits to provide 2-state signaling. Two-state signaling is for sending on-/off-hook conditions and uses information conveyed by one of the signaling bits. The same information is sent with a second bit for use at the distant terminal, but the primary circuit at the receive end ignores the second bit. Three-state signaling is accomplished by transmitting two signaling bits. This requires that the appropriate channel units with additional secondary signaling circuits be used.

2.06 Although slightly different transmitting signaling circuits are used in the various channel units because of the circuit requirements, the principle of operation is the same. For ease of presentation, Fig. 5 is a simplified transmitting signaling circuit. The supervision and signaling detectors, which are designed to monitor the particular signaling conditions, differ in detail between the transmitting signaling circuits in various units. In Fig. 5, the timing pulses from the D3 channel counter are applied to the logic circuitry, which samples the output of the supervision and signaling detector. The output of the transmitting signaling circuit is the presence or absence of pulses during the periods that the timing pulses arrive from the channel counter. In the D3 common equipment, this output is converted to the presence or absence of 1-digit PCM bits which are inserted every sixth frame in the outgoing 8-digit PCM code groups for 24 channels.

2.07 The channel units also have signaling receivers which respond to signaling trigger pulses from the D3 common signaling equipment by activating relays to provide signaling functions. A simplified block diagram of the signaling receiver is shown in Fig. 6. The timing pulses from the D3 digit generator are applied to part of the channel unit logic circuitry to demultiplex the signaling trigger pulses for the channel. Thus, only the signaling trigger pulses for the channel are applied to the amplifier which operates the relay.

E. Trunk Processing Unit (TPU)

2.08 The trunk processing unit (TPU) in the channel bank sends control signals to channel units and to the switching machine during a carrier failure to effect trunk processing; ie, disconnecting customers, stopping toll charges, and making circuits busy. When a failure occurs, battery is removed from all −48 SP leads forcing the signaling receivers to signal an on-hook (disconnect), and, if option BB is selected in the channel units, battery is applied after a 10-second delay forcing an off-hook condition for the duration of the failure. Futhermore, make-busy leads from the TPU are connected to the switching equipment via the distributing frame (Fig. 7).

2.09 The TPU also contains E-lead grounding options which are used for channels with E&M

(in 2-way or outgoing trunks), DX, or TDM units when switch make-busy leads are not connected. All TPU equipment lists have the EG option for each channel and the J98718AD-3 TPU also has an EL option (type II E&M) for each channel.

3. CHANNEL UNIT FEATURES AND APPLICATIONS

A. Message Channel Units

E&M Units

3.01 All E&M units have a transmitting signaling circuit which recognizes battery or ground conditions on the M lead and transmits information to the D3 common signaling equipment. The units have a signaling receiver to produce a ground or open on the E lead corresponding to the condition of the M lead at the far end. Pin jacks allow bridged connection to the E&M signaling leads.

3.02 The original 2-wire, 900-ohm E&M unit and the 4-wire unit were designed for use in message trunks with 2- or 4-wire connecting circuits, as well as for miscellaneous applications in foreign exchange circuits and for voiceband data (4-wire unit).

3.03 The E&M extended range units also provide E&M signaling but have more adjustable attenuation and splitting jacks for 2-way access to the E&M leads. There is a 4-wire, 600-ohm unit and 600- and 900-ohm versions of the 2-wire extended range unit. The 4-wire unit is well suited for back-to-back connection of equipment and for direct connection to a 4-wire switch since the additional loss eliminates the need for external pads. The 2-wire units are intended for direct connection to 2-wire, 600- or 900-ohm switches without the need for external pads. The additional loss adjustment range in the 2-wire units permits application in both low and high-loss intertoll trunks.

Revertive Pulse

3.04 Revertive pulse originating (RPO) channel units are required to recognize loop closure signals in the transmitting direction and receive signaling which results from the application of revertive pulses and battery at the far end. Only one transmitting signaling circuit is necessary to recognize the loop closure signals. Two signaling receivers are necessary to produce the signaling levels for the office switching system in response to signaling from the far end.

3.05 In the revertive pulse terminating (RPT) unit, the roles of the signaling circuits at the originating end are reversed; ie, the terminating unit has two transmitting signaling circuits for recognizing revertive pulses and battery polarity signal and a signaling receiver which opens or closes the loop.

Dial Pulse

3.06 Dial pulse originating (DPO) channel units have a transmitting signaling circuit which recognizes loop closure signals. A signaling receiver responds to signaling which results from the application of normal or reverse battery conditions at the far end by providing the corresponding conditions at the originating end. In addition, the sleeve dial pulse orginate (SDPO) channel unit contains a sleeve ground control circuit that applies ground to the sleeve lead in a step-by-step office when the trunk is seized. This eliminates the outgoing repeater in many step-by-step applications.

3.07 Dial pulse terminating (DPT) channel units have a transmitting signaling circuit which recognizes battery polarity signals and a signaling receiver which opens or closes the loop corresponding to the loop condition at the far end.

3.08 The 2-wire multifrequency originate unit (MFO) is used at the originating end of the trunk with loop signaling and multifrequency pulsing. Added resistance to spurious loop transients makes the MFO unit superior to the DPO for multifrequency use but makes it unusable for dial pulsing.

No. 2 ESS Direct Interface

3.09 The 2-wire ESS originating unit for No. 2 ESS (ES2O) provides for direct control of the channel unit by the No. 2 ESS and combines features of the No. 2 ESS outgoing trunk circuit and the DPO channel unit. These features permit the elimination of trunk circuit and trunk frames as well as simplification of maintenance in No. 2 ESS offices. The ES2O also offers a reverse make-busy feature, permitting distant terminal alarms to be received immediately and the channel unit to be made busy by the No. 2 ESS processor. Detailed information on the direct interface between T Carrier equipment and the No. 2 ESS may be found in Section 232-190-027.

3.10 Control of the channel unit is exercised over three control leads (A, B, C) by the ESS trunk

peripheral decoder circuit. These leads can assume two states (0 or 1); therefore, the three operated together can provide eight states. The supervision control circuit accepts inputs from the peripheral decoder circuits, the loop closure detector, and the signaling receiver. It also provides supervisory outputs toward the far end and reports customer line status and far-end line status to the ESS scan points.

3.11 The 2-wire terminating unit for No. 2 ESS (ES2T) provides the same functions as the ES2O unit, except the ES2T unit combines the functions of the incoming trunk circuits and the functions of the DPT channel unit. Control of the channel unit is the same as the ES2O unit.

Loop Simplex Originate Unit

3.12 The 4-wire loop simplex originate (4 LSXO) unit recognizes open/closed loop signaling and receives normal/reverse battery signaling from the far end like the DPO unit, but it is a 4-wire unit with the signaling leads derived from the simplex of the 4-wire paths. The 4 LSXO unit is designed to reduce wiring and eliminate loop/E&M conversions that would otherwise be necessary in a traffic service position system (TSPS) trunk to a No. 4 ESS. In this application, the D3 channel bank connects directly to the digroup terminal, producing a lower cost alternative to the voice interface frame for connecting 24 voice circuits.

B. Special Service Channel Units

Foreign Exchange (FX)

3.13 FX channel units are used to provide FX lines and trunks, off-premise stations (and extensions), long distance trunks, and WATS lines (and trunks). Units with loop-start and ground-start circuit capabilities send ringing and tip-ground signaling from the office to the subscriber and send loop closure and ring ground signaling from the subscriber to the office. The office end channel units (2-wire and 4-wire FXO) have two transmitting signaling circuits which recognize tip ground and ringing. Two signaling receivers produce loop closure and ring ground corresponding to the conditions at the far end. The functions of the signaling circuits are reversed in the station end (FXS) channel units; ie, the subscriber unit has two transmitting signaling circuits which recognize loop-closure signaling levels and ring ground. Two signaling receivers produce tip ground and 20-Hz ringing at the station end.

3.14 Station and office-end versions of FX units with only loop-start capability are also available (FXS-LS and FXO-LS). Since the units do not contain tip-ground and ring-ground circuits, the units are simpler and cost less than other FX units. The simplification improves operation with some PBXs where stray trip ground signals are a problem. The FXS-LS has a loop-closure detector and ringing detector, and the FXO-LS has a ringing detector and loop-closure detector. Only 2-state signaling is needed for these on-off conditions at each end, but both the primary and secondary signaling circuits are used to achieve compatibility with other FX units. For this reason TDM channel units must be used to extend the channel instead of a E&M-PLR combination at the intermediate office.

3.15 The 4-wire FXO and FXS units are equipped with a multiple tap transformer (150, 600, or 1200 ohms) and 15-dB and 2-dB attenuators in both the transmit and receive paths. Two of these attenuators are the XMT and RCV potentiometers mounted on the front of the channel unit. Equalization controls are also mounted on the front of the channel unit and are used to correct frequency response degradation introduced by the loaded subscriber loop. The signaling circuits in the 4-wire FX units are the same as those used in the 2-wire units. Pin jack access to the T, R, T1, and R1 leads is provided on the front of the channel unit for monitoring signaling and transmission. Figure 8 shows typical FX channel unit applications.

3.16 The 2-wire FXS and FXO units (without gain transfer) are designed for FX trunks. These units also can be used with short VF extensions, but the 2 FXS/GT has gain and equalization required to support longer loops. The 2 FXS/GT will, in many cases, eliminate the need for 2-2 repeater or 4-wire circuits on long loops. The units without gain transfer have a compromise balance network for the hybrid with either a 600- or 900-ohm option in the 2 FXO, while the 2 FXS/GT unit has a built-in precision balance network. Both the equalization and balance networks in the 2 FXS/GT consist of active circuitry.

Duplex (DX)

3.17 These channel units, either 2-wire or 4-wire, are used at the ends of a channel to provide 2-way calling between PBX locations over the T1 Carrier (see Fig. 9). Both 2-wire and 4-wire units have a

variable resistor (RLP on front of unit) and A and B options inside the unit used to balance the signaling circuitry to the metallic loop.

3.18 The 2-wire version has a 900-ohm hybrid winding for connection to the customer loop and provides no gain or equalization since it is designed for short metallic loops. Adjustable (in 0.1-dB increments) 1.5-dB and 3-dB attenuators are provided in both the transmit and receive paths. Pin jack access to the T&R pair and the N1 and N2 hybrid balance leads is provided on the front of the channel unit.

3.19 The 4-wire DX has transformer taps at 150, 600, and 1200 ohms which are used in equalizing loaded (H88) or nonloaded cable. Adjustable controls in the transmit path are provided on the front of the channel unit for equalization of loaded cable. Pin jack access to the T, R, T1, and R1 transmission leads is provided on the front of the unit for monitoring signaling and transmission.

Private Line Automatic Ringdown (PLAR)

3.20 The private line automatic ringdown (PLAR) provides a nonswitched intercom-like service where two station sets or PBX switchboards are tied together using the T1 Carrier (see Fig. 10). When a station goes off-hook, the loop closure it creates causes the PLAR unit to send a signaling bit which is converted by the receiving PLAR unit into 20-Hz ringing (2 seconds on, 4 seconds off) and a ringback signal to the calling station. The audible ringing level is factory set for −27.5 dBm at the XMT jack. If the called station answers, the ringing is inhibited and a talking path is established so that each channel unit provides talking battery to its respective station.

3.21 The 4-wire PLAR employs switch selectable 150-, 600-, and 1200-ohm transformer taps for VF interface to loaded (H88) or unloaded cable. The 1.5-dB and 15-dB attenuators in the transmit and receive paths provide 16.5 dB of attenuation in 0.1-dB steps. Equalization controls for the transmit path are provided on the front of the channel unit to accommodate H88 loaded cable. The T, R, T1, and R1 pin jacks on the front of the unit provide access to the respective leads for monitoring signaling and transmission.

3.22 The 2-wire PLAR has 900-ohm VF impedance. Two attenuators (1.5 and 15 dB) providing 16.5 dB (in 0.1-dB steps) are contained in both the transmit and receive path. Pin jacks on the front of the channel unit provide monitoring and testing access to the T&R pair and N1 and N2 leads of the hybrid balance network.

Tandem (TDM)

3.23 This 4-wire unit is used with another tandem unit in a separate channel bank or F-signaling bay to interconnect two channels when the 2-link trunk uses 3-state signaling. Figure 11A illustrates this 6-wire connection. Only digital carrier channels are shown connected back to back in this figure, but an analog carrier channel equipped with an F-signaling tandem unit can also be connected to the D3 TDM unit. Although the TDM unit is primarily used when the circuit to be extended uses 3-state signaling (such as FX), it is also compatible with 2-state signaling. Open/ground (E lead) signaling is used for both signaling channels. E and EX leads are used for primary signaling between channel units (one lead for each direction of transmission). Secondary signaling required for 3-state signaling is transferred between channel units by the E1 and EX1 leads which are simplexed on the T-R and T1-R1 pairs (E1 and EX1 leads are not directly connected between channel units). E, EX, E1 and EX1 pin jacks on the front of the unit provide bridged access to the respective signaling leads. A 1.5-dB pad, variable in 0.1-dB increments, and a 3.25-dB fixed pad are provided in the transmit path; a fixed 3.9-dB attenuator is provided in the receive path.

Pulse Link Repeater (PLR)

3.24 This 4-wire channel unit can be used to extend a channel of another digital terminal or an analog terminal in the office over a T1 carrier link when 2-state signaling is used on the 2-link trunk. The basic function of the PLR channel unit is to reverse the signals on the E&M so that it can interface directly with an E&M channel unit in another carrier without the need for a signaling converter. The voice-frequency connections to the 4-wire E&M channel unit are made at the +7, −16 level points. Figure 11B shows the 6-wire connection required. A 1.5-dB attenuator (adjustable in 0.1-dB increments) is provided in the receive path; the 1.5-dB and 15 dB attenuators in the transmit path provide 16.5 dB (adjustable or 0.1-dB increments). Early PLR units could only accommodate a transmit path input of +7 to +5.5 dB TLP (to allow for intraoffice wiring loss),

but the attenuation range was extended to allow connecting an analog carrier trunk to a 4ESS switch using a D3 channel bank and digroup terminal. Jacks on the faceplate are designated to match the connecting E&M unit so that the E lead is an open/closed input and the M lead is a battery/ground output. EQP and FAC jacks are provided on the front of List 2 units for access in either direction on these leads. If inband signaling is used instead of E&M signaling, the PLR channel unit merely provides the attenuation needed for the back-to-back connection.

Transmission Only (TO)

3.25 The transmission only (TO) units (2-wire or 4-wire) provide transmission without signaling capability (other than inband signaling). The units may be used for voiceband data circuits and circuits employing inband signaling. A 1.5-dB and 15-dB attenuator is provided in both the transmit and receive paths of the 2-wire and 4-wire versions. This 16.5-dB cumulative attenuation is adjustable in 0.1-dB increments, thus making external pads unnecessary.

3.26 The 2-wire, 900-ohm unit is designed primarily to connect to short metallic loops having little loss and requiring no equalization. Pin jacks to the T&R leads and N1 and N2 leads of the hybrid balance circuit are provided on the front of the channel unit.

3.27 The 4-wire, 600-ohm unit is used on voiceband data circuits and circuits with inband signaling when no loop equalization is required. It can also be used at an intermediate office to interface with another TO unit at 0 TLP (in tandem fashion as shown in Fig.11C)or another carrier system at +7, −16 dB TLP. Pin jacks to the T, R, T1, and R1 leads are provided on the front of the channel unit.

Equalized Transmission Only (ETO)

3.28 The equalized tranmission only (ETO) units provide 4-wire VF transmission without signaling capability (other than inband signaling). ETO units are used primarily on voiceband data circuits and circuits employing inband signaling where there is a metallic extension from the carrier to the subscriber. To accomplish this objective, the unit provides equalization in the transmit path and 1.5-dB and 15-dB attenuators (adjustable in 0.1-dB steps) in both the transmit and receive paths. Switch selectable 150-, 600-, and 1200-ohm transformer taps are used in equalizing loaded (H88) or nonloaded cable. Equalization controls for H88 loaded cable and jacks to the T, R, and T1, R1 leads are provided on the face of the channel unit.

Ringdown (RD)

3.29 The ringdown (RD) channel units (2-wire and 4-wire) are designed to operate with ringdown service, which is a nonswitched private line service connecting two or more stations. In this intercom-like arrangement, a ringdown station wishing to call a party station operates a pushbutton to signal the called station(s). The pushbutton generates 20-Hz bursts which are converted by the signaling circuitry of the RD unit and are transmitted to all stations. At the receiving end, the RD unit (if properly conditioned by internal switch settings) converts the signaling pulses back to 20-Hz ringing (to ring the station) or to dc pulses (for VF multipoint bridge application). The setting of switches mounted on the RD unit circuit board provides the following ringing modes:

(a) Code Select Ringing With Group Code—All RD units tied to the link count the number of times the calling station pushbutton is operated. The station(s) whose switch selectable code (15 codes available) corresponds to the transmitted code will receive a single 2-second, 20-Hz ringing burst. More than one station may be set to the same code and every station can be set to more than one code.

(b) No Code Mode—All stations are rung by a 2-second, 20-Hz ringing burst when the calling station pushbutton is released. Therefore, operation of a pushbutton results in a 2-second ringing.

(c) External Mode (Morse Code-Type Signaling)—All stations ring and follow the pulse interval of the calling station pushbutton operation. Each station operator must audibly recognize the code of his station.

(d) External Mode With 2-Second Limit (Morse Code-Type Signaling)—Same as (c) above except that ringing bursts are limited to 2 seconds to prevent annoyance.

Figure 12 illustrates a typical multipoint connection using the 2-wire and 4-wire RD channel units.

3.30 The 2- and 4-wire RD units are equipped with 15-dB and 1.5-dB attenuators in both the

transmit and receive paths. The cumulative 16.5-dB attenuation is adjustable in 0.1-dB increments to accommodate variations in transmission levels. Two of those attenuators are the XMT and RCV potentiometers mounted on the front of the channel unit. Along with tip-ring and comp network (2-wire unit) pin jacks, both units have S1, S2, and the 4-wire unit has SX1 and SX2 pin jacks. The S1 and S2 (ground) jacks allow monitoring −48 volt pulses when the S1 lead is used for signaling around a station bridge connecting as many as nine stations. SX1 and SX2 jacks on the 4-wire unit allow measuring the 20-Hz ringing voltage on the simplex.

3.31 The 4-wire RD unit has switch selectable 150-, 600-, and 1200-ohm transformer taps (at both the transmit and receive VF interface) for equalizing loaded (H88) and nonloaded cable. Controls mounted on the front of the channel unit provide equalization in the transmit path for H88 loaded cable. The 4-wire RD unit accepts input levels of −16 to 0 dB TLP to the transmit path (−16 is permitted when no equalization is involved, ie, bridge interface). The receive path delivers an output range of −9 to +6 dB TLP.

C. Program Channel Units (PGCUs)

3.32 The D3 program channel units have been developed to provide temporary or permanent service for series 6004, 6005 and series 6006, 6007 programming. Such service includes remote-main or secondary studio links and remote pickup and network access links. PGCUs may also be used to equip main studio-transmitter links for AM broadcasting only since FM and TV links require 15-kHz bandwidth. The channel units provide 1-way service without signaling or control circuits. Furthermore, no cable equalization circuitry is contained in the channel units. If program equalization is required for the metallic extension, it must be provided by external equipment. The two PGCU versions (5 kHz and 8 kHz) are further described in Section 365-150-106.

D. Dataport Channel Units

3.33 The dataport channel units connect data customer loops or office data signals to the T Carrier and to the Digital Data System (DDS) in the primary application by providing a direct data interface at the carrier channel. Dataports match the connecting circuits and apply and extract data on the carrier channel under control of DDS timing. Different office channel unit dataports (OCU DP) are available for customer data rates of 2.4, 4.8, 9.6, and 56 kb/s. The DS/ DP is used for office DS/ signals and can also be used for 56 kb/s customer data. The TST jack on the units is a card-type jack with contacts for test access either toward the carrier or the drop. The dataports are only end-to-end compatible with other dataports (D3 or D4); consult Section 365-150-107 for other considerations and option information.

E. ▶Security Channel Units

3.34 The security channel units (station-end and office-end) are designed to facilitate transmission of alarm service (burglar, fire, sprinkler systems) signals through a digital T-Carrier channel via D3 channel banks in place of metallic pairs. Figure 13 shows how the application of the security channel units will allow a single channel of T Carrier to replace a 19-gauge metallic pair between central offices.

3.35 The security unit station end (SEC STA) unit provides an interface to a McCulloh transmitter at the station end of a loop that is used to transmit alarm signals for commercial alarm companies. The security units pass loop closures and loop grounds from the alarm receiver to the alarm transmitter. The station end unit has two transmitting signaling circuits which recognize loop closures and loop grounds. Two signaling receivers produce double battery and loopback tests at the station end.

3.36 The security circuit office end (SEC OFF) unit provides an interface to a McCulloh receiver at the office end of a loop that is used to transmit alarm signals for commercial alarm companies. The security units pass loop closures and loop grounds from the alarm transmitter to the alarm receiver and loopback test and double battery conditions from the alarm receiver to the alarm transmitter. The station end unit has two transmitting signaling circuits which recognize double battery and loopback tests. Two signaling receivers produce loop closures and loop grounds.◀

4. OPTIONS—DESCRIPTION AND APPLICATION

4.01 The options will be either the screw-switch type or the newer socket-and-plug type. Screw-switch options are selected by turning the screw down to contact terminals on the circuit board. Selection on socket-and-plug option blocks is done by positioning the shorting plug on the socket. A KS-

21838 extractor or long-nose pliers is used to snap the plug out of and into the socket. When each socket position on an option block is a designated option, the plug is placed alongside the required option (Fig. 14). On an option block for a single option, the plug is placed so that the white is showing when the option is required. When it is not required, the plug is stored in the white socket position so that the black is showing.

4.02 Table C lists the channel units (except program units and dataport units which are covered in other documents) and options on them along with the option functions. Options common to many of the units are described further in the following paragraphs. Option settings are obtained from circuit layout cards prepared by engineering or from other office records.

Trunk Processing Option BB

4.03 The trunk processing option BB in DPO, FXS, 4-wire PLR, and DX units is used to make the trunk appear busy during a carrier failure via the signaling leads. It is used when the switching machine make-busy leads are not available at the channel bank because equipment is located in different buildings. When operated, the TPU removes the −48 volt signaling battery from the −48 SP lead which releases relays, making the trunk appear idle. However, the BB option screw closes the BB lead which, along with the BG lead, supplies battery and ground from the TPU after a time delay of 2 seconds. Thus, the relays operate sending an off-hook signal to the trunk circuit. When the carrier system has been restored, the TPU removes battery and ground from the BB and BG leads and reapplies battery to the −48 SP lead. This action returns control of relays to the signaling receiver. The BB option requires a trunk circuit capable of busying itself out upon receiving an off-hook backward supervision signal.

E Lead Signaling Option E

4.04 The E lead signaling option E in 2- and 4-wire E&M units makes ground available for open/ground signaling on the channel unit E lead (see Fig. 15). This option must be used for two of the three E&M trunk circuit arrangements, these being types I and III. The option is not selected for type II which is used with electronic switching systems. Instead, a looped arrangement exists between the channel unit and trunk circuit in which the channel unit supplies battery to the trunk circuit (on SB/MB lead) and the trunk circuit supplies ground to the channel unit (on SG/EB lead).

Trunk Circuit Capacitance Options X and Y

4.05 Figure 16 is a schematic diagram of the hybrid circuit of a 2W E&M channel unit. Resistor R1 and capacitor C10 form the compromise network of the 2W E&M channel unit. For applications not using the A and B leads, option X must be closed to provide continuity through the 1 μF capacitor C1. On trunks where the X option has been selected or the trunk circuit provides a 1 μF capacitor, capacitor C2 balances the 1 μF capacitance. When the channel unit is connected to a trunk circuit which has a capacitance of a 4 μF, option Y should be selected to connect C3 in parallel with C2. This connection properly balances the 4 μF trunk capacitance.

Compromise Net Option 600 and 900

4.06 Depending on circuit requirements, 2-wire FXS and PLAR channel units are required to balance either a 600- or 900-ohm impedance. In addition, connection to an external precision network may be required. To achieve this flexibility, two options are provided on the channel units. The 600 or 900 option is turned down to provide 600- or 900-ohm channel unit impedance, respectively. If an external precision network is to be used, neither option should be selected. Figure 17 shows the precision network connected into the FXS channel unit hybrid circuit. Under no circumstances should the 600 and 900 options be selected together. The 600, 900, or precision network selection should be made to give optimum transhybrid loss.

Ringing Extension Option RX

4.07 The ringing extension option RX is provided on the 4-wire FXS unit (J98718SB) to provide higher ringing current on subscriber loops with a dc resistance greater than 600 ohms. When selected (screw down), option RX shorts out a resistor in the path connecting 20-Hz ringing to the T1, R1 channel unit leads.

Loop Extension Options LX1 and LX2

4.08 Exercising both the LX1 and LX2 options in the FXO unit reduces the loop resistance in the unit while maintaining the balance in order to

supply current to long loops. Figure 18 shows a simplified diagram of the options. The LX1 (2- and 4-wire FXO) option shorts out a channel unit resistor to increase loop current, and the LX2 (2-wire FXO) option shorts out a channel unit resistor to maintain hybrid balance. The loop extension option should be selected when the dc resistance of the loop is greater than 850 ohms.

4.09 The DX units have a 5000-ohm RLP potentiometer and capacitor options A and B to balance the DX signaling circuit to the loop. The potentiometer is set to equal the resistance of the 2-wire loop or to one-half the resistance of one pair in a 4-wire circuit. Although options A and B each add 1 μF to the fixed 4 μF capacitance, it is recommended that both be inserted to make a total of 6 μF which provides optimum balance for any loop. The NOR/REV switch in the DX units allows reversing the connections at the channel unit to match the polarity of the DX set at the PBX.

Pulse Link Repeater Options Y and Z

4.10 The pulse link repeater options Y and Z provide the flexibility of connecting to an E&M channel unit which is arranged for type I, II, or III signaling. Both options are selected to make battery and ground available in the PLR unit (see Fig. 19) for signaling on the connecting M lead. For type II, both options are up and ground is supplied to the E&M unit on the EB lead and battery is supplied to the PLR unit on the MB lead.

Tandem Unit Options

4.11 The tandem unit options are signaling options that determine the correlation between signaling conditions and their logic representation and select either 2- or 3-state signaling. Table D gives the setting for different tandem configurations. Options S, T, Y, and Z are set so that the on- or off-hook signal will be transmitted on the tandem link with the proper logic signal (zero or one) to operate the distant channel unit. With option S down, an open on the EX lead is represented by the absence of signaling pulses on the T1 line; whereas, with option T, the same condition is represented by the presence of signaling pulses. Similarly, option Y or Z controls whether a zero or a one is applied to the primary signaling receiver in response to the incoming signaling. The other options are V, W, R, and E. Options V and W insert the secondary signaling circuit for 3-state signaling and should be selected when an FX unit is used as the far-end unit. Option R is selected when 2-state signaling is used and is open for 3-state signaling since, when selected, it causes primary signaling to be transmitted on both paths. Option E is selected to obtain nonlooped signaling and is open for looped signaling in which the connecting circuit supplies the ground controlled by the channel unit relay.

Ringdown Unit Options

4.12 Options C and E are found only on the 2-wire unit. Option C is selected for normal channel unit operation and is open to prevent its station from receiving or sending signaling. Option E is closed or opened to maximize return loss. Closing the E option adds a resistor and capacitor to the channel unit balance network.

4.13 Options A, B, S, and W and rocker switches S3, S4, and S5 are common to both 2- and 4-wire units. Options A and B are selected to provide 20-Hz ringing for station-end use and are open to provide the dc signaling required for multiport bridge applications. Option S is used only for bridge applications; it is selected for nonlooped signaling and is open for looped signaling. Option W is selected to limit the ringing of its station to 2 seconds per interval and must be prescription set for the ringing mode desired. Switch S3 or S4 selects the desired station by setting the corresponding switch to off (away from station number); switch S3 is for stations 1 through 8 and S4 for stations 9 through 15. Thus, station 5 would be number 5 switch on S3 and station 10 would be number 2 switch on S4. Switch S5 and option screw W are used to select the required ringing mode per Table E.

Network Buildout, Customer Line Buildout, and Precision Balance

4.14 Network build-out capacitance (NBOC) options on 2-wire units are associated with the compromise network for the hybrid. These options allow setting the NBOC to the prescribed value for the office to achieve the through and terminal balance requirements. When the channel unit has a CN or COMP NET option, it must be selected to connect the compromise network; otherwise, the leads are made available for connecting to a precision network which must be provided externally. Each NBOC option is associated with a capacitor whose value is represented by a numeral located near the option (2, 4,

8, 16, 32, and 64). For example, if option 4 is selected, a .004 μF capacitor is inserted in parallel with the compromise network. If additional options are selected, capacitors with values corresponding to the numerals selected are also inserted in the circuit in parallel.

4.15 If the office balance is to be optimized, tests can be done from the D3 channel bank using the D3 channel access unit. The return loss test set is connected to the EXT jacks on the CAU, and the XMT and RCV jacks on the CAU are connected to the channel XMT and RCV jacks, respectively. On the CAU, the REJ FLT is set OUT, SEND LEVEL to 0, and the TEST switch will be set to CHAN DROP to test back through the intertoll trunk connection.

4.16 On the 2W FXS/GT hinged daughter board are miniswitches for a built-in electronic precision balance network (PBN) and a miniswitch for the customer line build-out capacitors (LBOC). The PBN is inserted by positioning the plug on option block J10 (on main board) so that the white is showing; a 2.15 μF, 900-ohm compromise network is connected when the black is showing. Switches R1, R2, and Z are used for nonloaded cables; switches R and Z, for loaded. The L position on the R/R1 switch is for MAT ® trunk cable. These are set to provide the required combination of numbers by moving slide switches to expose the numbers (Fig. 20). The LBOC options are also used for loaded cable and are set to provide the required combination by pressing switches toward the letters.

▶Security Channel Unit Options

4.17 The security channel units (station-end and office-end) provides the MASTER/SLAVE (M/S) and DIVERSITY (DIV) options. The M/S switch conditions the channel unit for either master (main carrier unit) or slave (alternate carrier unit). The DIV switch is set when an alternate and main carrier link is in the system. In this configuration, both the alternate and main channel units are set for this option.

4.18 The office-end channel unit provides two additional options, the 3/30 and build-out resistance (BOR) options. The 3/30 switch sends a signal to the alarm company 3 or 30 seconds after a carrier failure. The BOR switches are used to adjust the resistance at the T and R leads to 4.7K, 2.7K, or 700 ohms.◀

5. CHANNEL UNIT ATTENUATORS

5.01 Adjustable attenuators in the channel units introduce the amount of loss required to achieve the circuit levels. The transmit path attenuators are adjusted to obtain the −7.5 TLP at the XMT jack so that the +2.5 TLP will be obtained at the RCV jack of the far-end channel unit. The receive path attenuators are adjusted to obtain the TLP at the drop side T1 and R1 leads (T and R for 2-wire units). Table F lists the insertion gain or loss, the attenuation range, and the drop side input and output for the message and special service channel units. Although a wider range of drop side levels is realizable with the attenuators in some of the special service units, only the recommended operating levels are given. The insertion gains and levels include the circuitry between the drop side leads and the channel test jacks with attenuators and equalizers at zero.

A. Attenuator Types

5.02 Four types of attenuators are found on D3 channel units: slide switch, socket-and-plug, miniswitch, and potentiometers (Fig. 21). Each type serves the same function of selecting the amount of attenuation and has a designation indicative of its application or circuit location; eg, DBO (drop buildout), XMT, and RCV.

(a) Slide Switch Type: The amount of loss introduced in the circuit is selected by setting the slide switches. With the black squares on each attenuator section showing, no loss is introduced; but as switches are moved to the loss side, the amount of loss equal to the sum of the loss value is inserted. The switches on the DBO attenuator simultaneously control the insertion of loss in both the transmit and receive paths; whereas two switches on the T&R attenuator are for the transmit path and the other two for the receive path. Only one of the two switches for receive is operative on the older 50B code of attenuator. The DBO attenuator is used to produce the same amount of loss (1.5 dB) for all office drop circuits even though office wiring and equipment losses differ. The T&R attenuator controls the overall trunk losses.

(b) Socket-Plug Options: The amount of loss introduced by these is selected by positioning the shorting plugs on the socket mounting. A KS-21838 extractor or long-nose pliers are used to snap the plugs out of and into the socket mounting.

When all the plugs are on the zero side, the attenuator loss is zero. As plugs are moved to the numbered side, loss is introduced. The plugs are positioned so that the sum of the loss values selected equals the required loss. For example, the configuration in Fig. 21 with three plugs alongside the loss values on the numbered side produces 3.7 dB of loss.

(c) Miniswitch Type: The loss is selected by setting the combination of the eight miniswitches to equal the required loss. This type attenuator is used on the 2 FXS/GT unit. IN and OUT designations indicate which way to set the switches. When a switch is moved to IN, the loss equal to the assigned number is inserted. When all the switches are moved to OUT, there is zero attenuation. Care must be taken to ensure that each switch is moved to the limit of its travel.

(d) Potentiometer: The loss in dB is controlled by setting the screwdriver-slotted dial. Potentiometers are only used as loss controls on RD units and on the 2W PLAR unit.

B. No. 4 ESS Considerations

5.03 Toll-connecting trunks going to a No. 4 ESS digital toll office (TP3 office) are designed to have 3 dB of loss inserted by the receive section of the T&R attenuator at the D3 end. All of the applicable D3 channel units except the original list dial pulse units have the 3-dB loss capability. If the D3 channel bank is used at the No. 4 ESS office as an economical alternative for connecting an analog trunk to the digroup terminal, the level at the channel XMT jack must be set below the −7.5 dB TLP to achieve the correct trunk loss. The extended range 4-wire E&M channel unit has the additional loss for the back-to-back connection of channels.

6. EQUALIZATION CONTROLS

A. 4-Wire Channel Units

6.01 High- and low-frequency networks consisting of capacitor options and an inductor for the high-frequency network are included in the transmitting path of the 4-wire FXO, FXS, DX, ETO, RD, and PLAR units. These networks are used to obtain a nearly flat response with loaded cable. One or both networks may be required by the composition and length of loop. When required, the low-frequency network is inserted by opening the LF screw and is adjusted with capacitor option screws (C.25, C.5, C1, and C2) and calibrated potentiometer RLF. This network provides from 0 to 9 dB of loss at 200 Hz with respect to 1-kHz loss. The high-frequency network is inserted by closing the HF screw and is adjusted by calibrated potentiometer RHF. This network provides a 2-dB change from 1 kHz to 3 kHz. Sections 855-351-107, 855-351-108, and 855-351-109 provide prescription settings for these controls based on the gauge and length of the cable to the subscriber.

6.02 The 4-wire units with equalization (Fig. 22) have two identical 4-position switches (150-ohms, 600-ohms, 1200-ohms, and open) to select impedance taps on input transformers. Both switches are set to the same position which is determined by the type of equipment on the drop side and the length of the loop. Nonloaded cable is equalized by selecting the 150-ohms tap or 600-ohms tap depending on the cable makeup and terminating equipment. Sections 855-351-107, 855-351-108, and 855-351-109 provide guidelines for making this selection. Loaded cable is equalized by selecting the 1200-ohms tap along with equalization networks per paragraph 6.01.

B. 2-Wire FXS Unit With Gain Transfer

6.03 The gain transfer feature of the 2-wire foreign exchange subscriber end channel unit with gain transfer (2FXS/GT) provides the capability for a D3 channel to operate at a net gain to overcome partly the loss of the 2-wire cable. Standard practice calls for a carrier channel in special services to operate at a net loss from 2-wire port to 2-wire port of 1 dB at 1 kHz. When the 1-kHz loss of a 2-wire metallic extension from a carrier channel is 2 to 3 dB, a repeater such as an metallic facility terminal (MFT) E6 is usually added to meet end-to-end loss objectives for special service lines and trunks. Naturally, an external repeater would not be needed if the carrier channel could operate at a net gain instead of loss. So, the 2FXS/GT channel unit is designed to be operated with up to 6 dB of gain transfer by prescription setting the necessary controls on the channel unit.

6.04 Both the transmit and receive circuits are controlled by the slope equalization (SL) control located on the main circuit by a single SL control located on the main circuit board. The SL control has four slide-action switches labeled 1, 2, 4, and 8. Settings are made by moving the switches to expose the combination of numbers equal to the required equal-

ization. For example, the switches would be positioned with numbers 1 and 4 showing and the others covered to obtain an SL setting of 5. When all the number are covered by the switches, no shaped gain is introduced. Sections 855-351-107, 855-351-108, and 855-351-109 contain prescription equalizer settings.

TABLE A

D3 CHANNEL UNITS

SD/CD	J98718	CHANNEL UNIT
3C122-( ) incl.	BA	2-Wire Dial Pulse Originating (DPO)
3C122-04 (Opt Z)		
3C122-04 (Opt Y)	BY	2-Wire Multifrequency Originate (MFO)
3C123	BB	2-Wire Dial Pulse Terminating (DPT)
3C124	BC	4-Wire E&M
3C125	BD	2-Wire Foreign Exchange Station End (FXS)
3C126	BE	2-Wire Foreign Exchange Office End (FXO)
3C127	BJ	2-Wire E&M
3C128	BF	2-Wire Revertive Pulse Originating (RPO)
3C129	BG	2-Wire Revertive Pulse Terminating (RPT)
3C130	BH	Sleeve Dial Pulse Originating (SDPO)
3C131	BK	2-Wire Foreign Exchange Station End Loop-Start (FXS LS)
3C132	BL	2-Wire Foreign Exchange Office End Loop-Start (FXO LS)
3C136 (Opt Y)	BS	2-Wire No. 2 ESS Direct Interface Terminating (2ES2T)
3C136 (Opt Z)	BP	2-Wire No. 2 ESS Direct Interface Originating (2ES2O)
3C137	BW	4-Wire 600-Ohm E&M Extended Range (4W E&M ER)
3C138	BU	2-Wire 900-Ohm E&M Extended Range (2W E&M ER9)
3C139	BT	2-Wire 600-Ohm E&M Extended Range (2W E&M ER6)
3C217	SB	4-Wire Foreign Exchange Subscriber End (4W FXS)
3C218	SC	4-Wire Foreign Exchange Office End (4W FXO)
3C219	SD	2-Wire Duplex (2W DX)
3C220	SE	4-Wire Duplex (4W DX)
3C221	SF	4-Wire Tandem (4W TDM)
3C223	SH	4-Wire Transmission Only (4W TO)
3C224	SJ	2-Wire Transmission Only (2W TO)
3C225	SK	4-Wire Pulse Link Repeater (4W PLR)
3C226	SL	2-Wire Ringdown (2W RD)
3C227	SM	4-Wire Ringdown (4W RD)
3C228	SN	2-Wire Private Line Automatic Ringdown (2W PLAR)
3C229	SP	4-Wire Private Line Automatic Ringdown (4W PLAR)
3C230	SQ	4-Wire Equalized Transmisson Only (4W ETO)

TABLE A (Contd)

D3 CHANNEL UNITS

SD/CD	J98718	CHANNEL UNIT
3C269	CA	2-Wire 5 kHz Program Transmitter (PGCU-5T)
3C270	CB	2-Wire 5 kHz Program Receiver (PGCU-5R)
3C271	CC	2-Wire 8 kHz Program Transmitter (PGCU-8T)
3C272	CD	2-Wire 8 kHz Program Receiver (PGCU-8R)
3C409	BZ	4-Wire Loop Simplex Originate (4 LSXO)
7C090	SR	2-Wire Foreign Exchange Station End With Gain Transfer (2 FXS/GT)
3C411	BM	4-Wire 64 kb/s Level Zero Dataport (DSØ DP)
3C412	BN, L1 L4, L7	4-Wire 2.4 kb/s Office Channel Unit Dataport (OCU DP)
	L2, L5 L8	4-Wire 4.8 kb/s Office Channel Unit Dataport (OCU DP)
	L3, L6 L9	4-Wire 9.6 kb/s Office Channel Unit Dataport (OCU DP)
3C419	DA	4-Wire 56 kb/s Digital Signal Zero Dataport (DSØ DP)
3C446	DB	4-Wire 56 kb/s Office Channel Unit Dataport (OCU DP)
3C466	GA	Security Circuit Station End (SEC STA)
3C467	GB	Security Circuit Office End (SEC OFF)

TABLE B

D3 COMPATIBLE UNITS

CHANNEL UNIT	COMPATIBLE CHANNEL UNITS
DPO	DPT, E&M, PLR, TDM, DX
SDPO	DPT, E&M, PLR, TDM
MFO	DPT, E&M, PLR, TDM
DPT	DPO, SDPO, MFO, E&M, PLR, RDM, DX
E&M	DPO, SDPO, MFO, E&M, DX, TDM, PLR, RD, PLAR
FXS	FXO, TDM, FXO-LS
FXO	FSX, TDM, FSX-LS
RPO	RPT
RPT	RPO
DX	E&M, DX, TDM, PLR, DPO, DPT
TDM	DPO, SDPO, MFO, E&M, FSX, FXO, DX, TDM, PLR, RD, PLAR, DPT, FXS-LS, FXO-LS, 4 LSXO, ES2T, SEC STA, SEC OFF
FXS-LS	FXO, TDM, FXO-LS
FXO-LS	FXS, TDM, FXS-LS, FXS/GT
TO	TO, ETO
PLR	DPO, SDPO, MFO, E&M, DX, TDM, RD, PLAR
RD	E&M, TDM, PLR, RD
PLAR	E&M, TDM, PLR, PLAR
ETO	TO, ETO
4 LSXO	DPT, E&M, PLR, TDM
ES2O	DPO, E&M, PLR, TDM
ES2T	DPO, SDPO, MFO, E&M, PLR, TDM
FXS/GT	FXO, TDM, FXO-LS
SEC STA	SEC OFF, TDM
SEC OFF	SEC STA, TDM

◗ TABLE C ◖

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718BA Dial Pulse Originating (DPO)	3C122-	BB	Provides off-hook signal toward switch during a carrier failure.
		CN	Close for compromise network; open for external precision network.
J98718BY Multifrequency Originate (MFO)	3C122-04	BB	Same as above.
J98718BB Dial Pulse Terminating (DPT)	3C123-	S	Close when bylink incoming trunk circuits are involved.
		COMP NET	Close for compromise network; open if external precision network used.
J98718BC 4-Wire E&M	3C124-	E	Makes local ground available for types I and III E-lead signaling. Option out for type II.
J98718BD Foreign Exchange Subscriber End (FXS)	3C125-	BB	Provides tip ground (busy) during carrier failure.
		600 or 900	Select one with compromise network: 600 for PBX or ACD applications; 900 for switching office and long loops.
		X Strap	Prevents prematurely tripping the ringing with certain PBX trunks, but ringing cannot be tripped with loops over 1000 ohms.
		V Strap	Removes 1000-ohm restriction.
		CN	Connect CN for compromise network; disconnect if external precision network is provided.
		PN	Connect PN for external precision network.
		V or W Strap	V if far bank is D1D or D3; W if far bank is D2.

TABLE C (Contd)

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718BE Foreign Exchange Office End (FXO)	3C126-	LX-1 and LX-2	Both used to increase loop current when loop resistance exceeds 600 ohms.
		V or W Strap	V if far bank is D1D or D3; W if far bank is D2.
J98718BJ 2-Wire E&M	3C127-	E	Makes local ground available for types I and III E-lead signaling. Option out for type II.
		CN	Close for compromising network; open if external precision network is connected.
		PN	Close for external precision balance network.
		X	Connects 2.15μF across A and B lead (when no capacitance is included in trunk circuit).
		Y	Used when trunk circuit has 4μF capacitance.
		Z	Used when trunk circuit has 1μF.
J98718BF Revertive Pulse Originating (RPO)	3C128-	None	
J98718BG Revertive Pulse Terminating (RPT)	3C129-	XB	Used for proper operation when unit is connected to XBAR incoming registers with U-type GR relays; not for panel offices.
J98718BH Sleeve Dial Pulse Originating (SDPO)	3C130-	W Strap	Required in a 35E97 dial office; supplies — 48 volts to sleeve lead when channel is idle.
		COMP NET	Close for compromise network; open if external precision network is connected.

TABLE C (Contd)

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718BK Foreign Exchange Subscriber End Loop Start (FXS LS)	3C131-	CN	Close for compromise network; open if external precision network is connected.
		600 or 900	Select one with compromise network; 600 for PBX or ACD applications; 900 for switching office and long connecting loops.
		PN	Close for external precision network.
J98718BL Foreign Exchange Office End Loop-Start (FXO LS)	3C132-	LX1 and LX2	Both used to increase loop current when loop resistance exceeds 600 ohms.
J98718SR Foreign Exchange Subscriber End With Gain Transfer (2 FXS/GT)	7C090-	LBOC	Connects customer line build-out capacitors (LBOC)
		BB(J8)	Busy indication toward customer during carrier failure.
		J10	Connects internal active precision balance network (PBN) when white is showing or compromise network when black is showing.
		PBN Switches	See text. (Paragraph 4.16)
		T(J7)	Disconnect option (white showing) for rapid release of tip ground for DIMENSION® PBX-CO trunk circuit.
		W or V (J6 and J9)	Connect W for D2 bank; V for D3 or D1D at other end.
J98718BP No. 2 ESS Originating (ES20) or J98718BS Terminating (ES2T) Unit	3C136-	Mini-Switch Select 2, 4 8, 16, 32, 64	Network build-out capacitance of 0.002μF, 0.004μF, 0.008μF, 0.016μF, 0.032μF, 0.064μF.

◆TABLE C (Contd)◆

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718BW 4-Wire E&M Extended Range (4 E&M ER)	3C137-	E	Makes local ground available for types I and III E-lead signaling; option out for type II.
		Z	Inserts 3.2 dB loss in transmit path when D3 channel provides direct interface between an analog carrier bank and DT/No. 4 ESS.
J98718BU 2-Wire, 900-ohm E&M Extended Range (2 E&M9)	3C138-	CN or PBN	Selects compromise network (CN) or connection to precision balance network (PBN).
		E	Makes local ground available for types I and III E-lead signaling; option open for type II.
		X	Connects 2.15μF across A and B leads (when no capacitance is included in trunk circuit).
		Y	Used when trunk has 4μF or more capacitance.
		Z	Used when trunk has 1μF.
J98718BT 2-Wire, 600-ohm E&M Extended Range (2 E&M6)	3C139-	CN or PB	
		E	
		X	
		Y	Same as above.
		Z	
		6.4/0	Inserts additional loss in receive path, either 6.4 dB or no additional loss.
J98718SB 4-Wire Foreign Exchange Subscriber End (4FXS)	3C217-	BB	Grounds tip lead (busy indication) during a carrier failure.
		RX	Increases ringing current on loops with over 600 ohms.

TABLE C (Contd)

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718SC 4-Wire Foreign Exchange Office End (4FXO)	3C218-	LX-1	Closed when loop resistance is over 850 ohms.
J98718SD 2-Wire 900-ohm Duplex (DX)	3C219-	BB	Provides busy indication during carrier failure
		COMP NET	Close for compromise network; open for external precision network.
		A and B	Select both (1μF ea) to add 2μF capacitance for total of 6μF which is recommended for all loops.
J98718SE 4-Wire 600-ohm DX	3C220-	BB	Same as above.
		A and B	
J98718SF 4-Wire 600-ohm Tandem (TDM)	3C221-	E, R, W and V, S, or T; and Y or Z	Signaling options (described in Part 4 of text).
J98718SH 4-Wire, 600-ohm Transmission Only (4 TO)	3C223-	None	
J98718SJ 2-Wire, 900-ohm (TO)	3C224-	COMP NET	Connect for compromise network; disconnect if external precision network is provided.
J98718SK Pulse Link Repeater (PLR)	3C225-	BB	Provides busy indication toward switch during carrier failure.
		Y and Z	Option Y provides local ground in channel unit and Z provides battery. Both options are closed for type I E&M; neither for type II; and Y is closed and Z open for type III.

TABLE C (Contd)

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718SL 2-Wire 900-ohm Ringdown (RD)	3C226-	A and B	Both closed to connect 20-Hz ringing inside unit.
		C	Connects capacitor across ringing leads.
		E	Connects compromise network across hybrid.
		S	Provides local ground in channel unit; closed for types I and III E-lead signaling.
		Switches S3, S4 and S5, and Option W	Ringing mode selection (described in Part 4 of text).
J98718SM 4-Wire 600-ohm Ringdown (RD)	3C227-	A and B	Both closed to connect 20-Hz ringing inside unit.
		S	Provide local ground in channel unit; closed for types I and III E-lead signaling.
		Switches S3, S4 and S5, and Option W	Ringing mode selection (described in Part 4 of text).
J98718SN 2-Wire, Private Line Automatic Ringdown (2 PLAR)	3C228-	600 or 900	Select one for compromise network: 600 for PBX or ACD applications; 900 for switching office and long connecting loops. Both open if external precision network is connected.
J98718SP 4-Wire, Private Line Automatic Ringdown (4 PLAR)	3C229-	None	
J98718SQ 4-Wire Equalized Transmission Only, (ETO)	3C230-	None	

TABLE C (Contd)

D3 CHANNEL UNIT OPTIONS

CHANNEL UNIT	SD/CD	OPTION	APPLICATION
J98718BZ 4-Wire Loop Simplex Originate (4 LSXO)	3C409-	BB	Select for busy indication during carrier failure.
		MF or DP	Selected to correspond to type signaling; MF for multifrequency or DP for dial pulsing.
		SX or LP	Select SX to connect simplex to signaling circuitry; LP connects signaling circuitry to pins 3 and 6 at channel slot.
J98718GA Security Circuit Station End (SEC STA)	3C466-	M or S	Select Master (M) when channel unit is used in the main carrier link. Select Slave (S) when channel unit is used in the alternate carrier link.
		DIV	The Diversity (DIV) option is set in the black showing position when a main carrier link only is in the system. When an alternate and main carrier link is in the system the DIV for both alternate and main channel units are set in the white showing position.
J98718GB Security Circuit Office End (SEC OFF)	3C467-	M or S	Select Master (M) when channel unit is used in the main carrier link. Select Slave (S) when channel unit is used in the alternate carrier link.
		DIV	The Diversity (DIV) option is set in the black showing position when a main carrier link only is in the system. When an alternate and main carrier link is in the system the DIV for both alternate and main channel units are set in the white showing position.
		3 or 30	Set to position 3 to send an open to the alarm company 3 seconds after a carrier failure. Set to position 30 to send an open to the alarm company 30 seconds after a carrier failure.
		BOR (2 jumper plug switches)	Set to High (H) Medium (M) or Low (L) position to build out the channel unit resistance to 4.7K, 2.7K or 700 ohms. Both switches should be set together.

TABLE D

TANDEM UNIT OPTIONS

	TYPE OF CONNECTION		SCREW SWITCH DESIGNATION (NOTE)							
			Z	Y	E	W	V	T	S	R
Foreign Exchange	Nonlooped Signaling Leads	Tandem Unit Toward CO End of Ckt	0	1	1	1	1	0	1	0
		Tandem Unit Toward Subscriber End of Ckt	1	0	1	1	1	1	0	0
	Looped Signaling Leads	Tandem Unit Toward CO End of Ckt	0	1	0	1	1	0	1	0
		Tandem Unit Toward Subscriber End of Ckt	1	0	0	1	1	1	0	0
All 2-State Signaling (except FXSLS)	Nonlooped Signaling Leads		1	0	1	0	0	0	1	1
	Looped Signaling Leads		1	0	0	0	0	0	1	1

Note: 0 = open, 1 = closed.

TABLE E

RINGDOWN UNIT OPTIONS

RINGDOWN UNIT RINGING MODES	SWITCHES (NOTE)						
	S5-1	S5-2	S5-3	S5-4	W	S3 1-8	S4 1-7
Code Select	1	1	0	X	1	*	*
No Code	0	1	0	X	1	S3, 1 = 0 All Others = 1	1
Repeat Input Timing (No Limit)	X	0	1	0	1	1	1
Repeat Input Timing (2 Seconds)	X	0	1	1	0	1	1

Note: 0 = open, 1 = closed, X = don't care.

* Switches S3, 1-8 select stations 1-8 while switches S4, 1-7 select stations 9-15. A station is selected by setting the switch corresponding to the desired station number to the "off" position.

TABLE F

CHANNEL UNIT INSERTION LOSSES, INPUT/OUTPUT LEVELS, AND ATTENUATOR RANGES

CHANNEL UNIT	TRANSMIT PATH				RECEIVE PATH			
	G_T INSERTION GAIN (+) OR LOSS (–) dB	TRMT ATTENUATOR RANGE (dB)	INPUT (T&R) LEVEL (dB)		G_R INSERTION GAIN (+) OR LOSS (–) dB	RCV ATTENUATOR RANGE (dB)	OUTPUT LEVEL	
			MIN	MAX			MIN	MAX
MESSAGE								
DPO, DPT, SDPO, or 2 E&M	– 4.0	*0–4.5 †0–6.3	*– 3.5 †– 3.5	*+ 1.0 †+ 2.8	– 4.0	*0–4.5 †0–6.3	*– 6.0 †– 7.8	*– 1.5 †– 1.5
MFO	– 4.0	0–6.3	– 3.5	+ 2.8	– 4.0	0–6.3	– 7.8	– 1.5
2 E&M-ER6 or 2 E&M-ER9	– 1.2	0–6.3	– 6.3	0	– 1.0 ‡– 7.4	0–6.3	– 4.8 ‡–11.2	+ 1.5 ‡– 4.9
ES2O or ES2T	– 6.8	0–0.7	– 0.7	0	– 4.8	0–0.7	– 6.0	– 2.3
4 E&M	+10.0	0–1.5	–17.5	–16.0	+ 6.0	0–1.5	+ 7.0	+ 8.5
4 E&M-ER	+11.0 §+ 7.8	0–25.5	–18.5 §–15.3	+ 7 §+10.2	+ 6.0	0–25.5	–17.0	+ 8.5
4 LSXO	+10.0	0–25.5	–17.5	+ 8.0	+ 6.0	0–25.5	–17.0	+ 8.0
SPECIAL SERVICE								
FXS, FXO	– 4.0	*0– 4.5 †0– 6.3	*– 3.5 †– 3.5	*+ 1.0 †+ 2.8	– 4.0	*0– 4.5 †0– 6.3	*– 6.0 †– 7.8	*– 1.5 †– 1.5
FXS LS, FXO LS	– 4.0	0– 6.3	– 3.5	+ 2.8	– 4.0	0– 6.3	– 7.8	– 1.5
2 FXS/GT	+ 1.5	0–16.5	– 9.0	0	+ 3.5	0–16.5	– 8.0	+ 6.0
2 DX	– 3.9	0– 4.5	– 3.6	+ 0.9	– 3.9	0– 4.5	– 5.9	– 1.4
2 TO	+ 5.0	0–16.5	– 9.0	+ 4.0	– 4.0	0–16.5	– 9.0	– 1.5
2 RD	+ 4.5	0–16.5	– 9.0	+ 4.0	– 0.5	0–16.5	– 9.0	+ 2.0
2 PLAR	+ 4.5	0–16.5	– 9.0	+ 4.0	– 0.5	0–16.5	– 9.0	+ 2.0
4 FXS	+ 5.5	0–17	– 9.0	0	+ 3.5	0–17	– 9.0	+ 6.0
4 FXO	+ 5.5	0–17	– 9.0	0	+ 3.5	0–17	– 9.0	+ 6.0
4 PLR	– 7.6	0–16.5	0	+ 7.0	–17.0	0–1.5	–16.0	–14.5
4 TDM	– 3.9	0– 1.5	– 3.6	– 2.1	– 4.6	NONE	– 2.1	– 2.1
4 TO	– 2.0	0–16.5	– 5.5	+ 7.0	– 2.5	0–16.5	–16.0	0
4 ETO	+ 4.0	0–16.5	– 9.0	+ 5.0	+ 3.5	0–16.5	– 9.0	+ 6.0
4 RD	+ 8.5	0–16.5	–16.0	0	+ 3.5	0–16.5	– 9.0	+ 6.0
4 PLAR	+ 8.5	0–16.5	– 9.0	0	+ 3.5	0–16.5	– 9.0	+ 6.0
4 DX	+ 8.5	0–16.5	– 9.0	0	+ 3.5	0–16.5	– 9.0	+ 6.0

* Slide switch attenuator.
† Socket-and-plug attenuator.
‡ Option 6.4 installed.
§ Option Z installed.

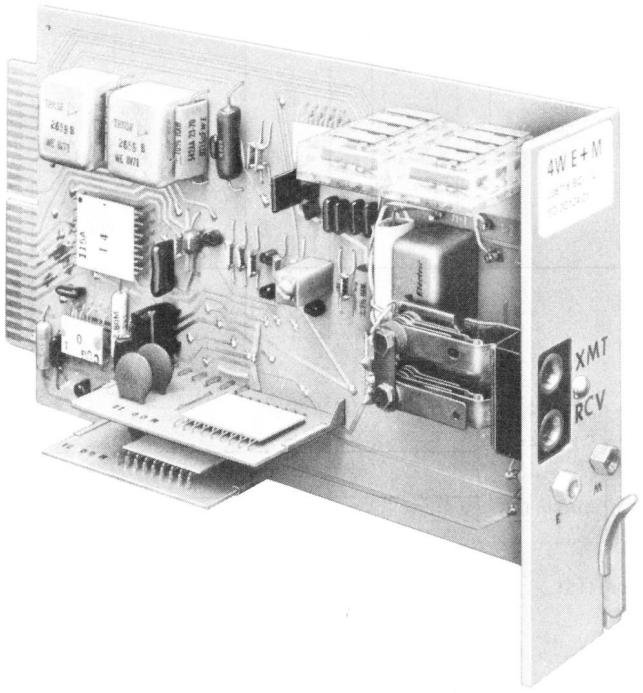


Fig. 1—Typical D3 Message Channel Unit

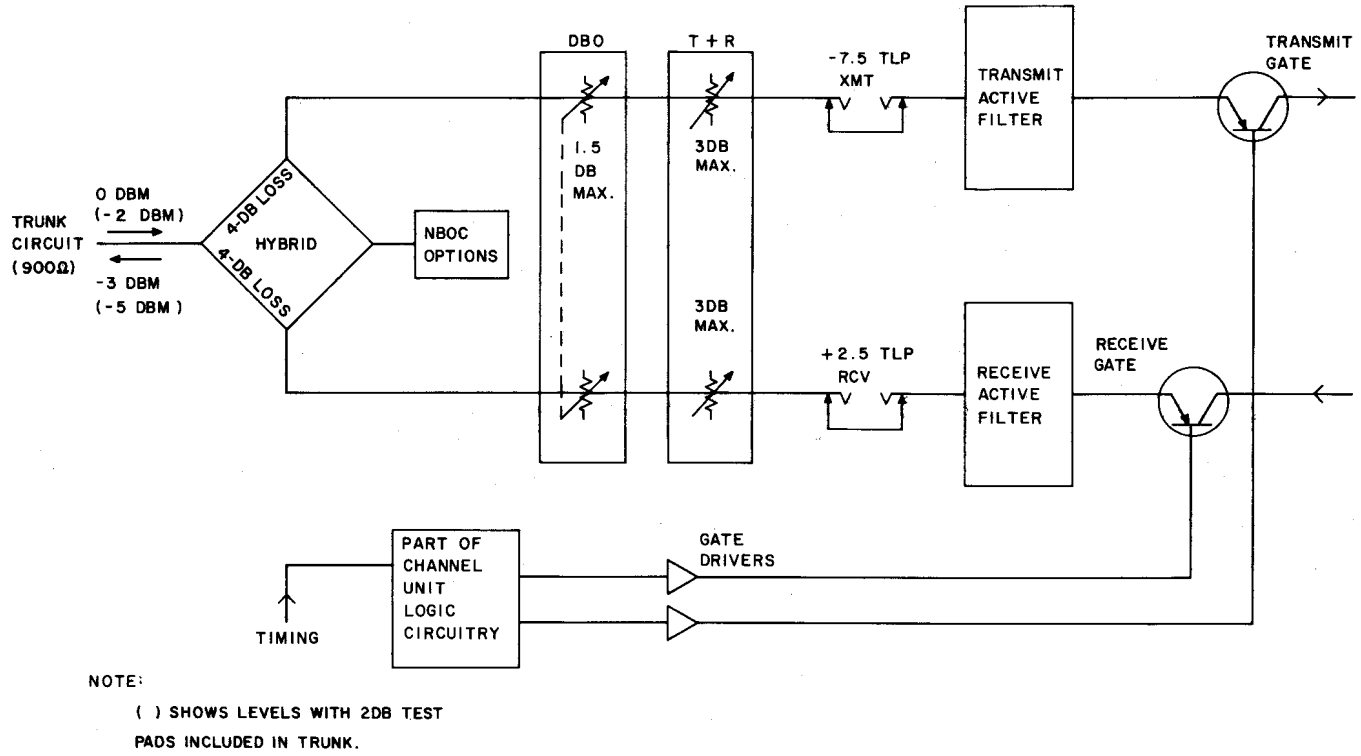


Fig. 2—Transmission Paths in a Typical 2-Wire Channel Unit

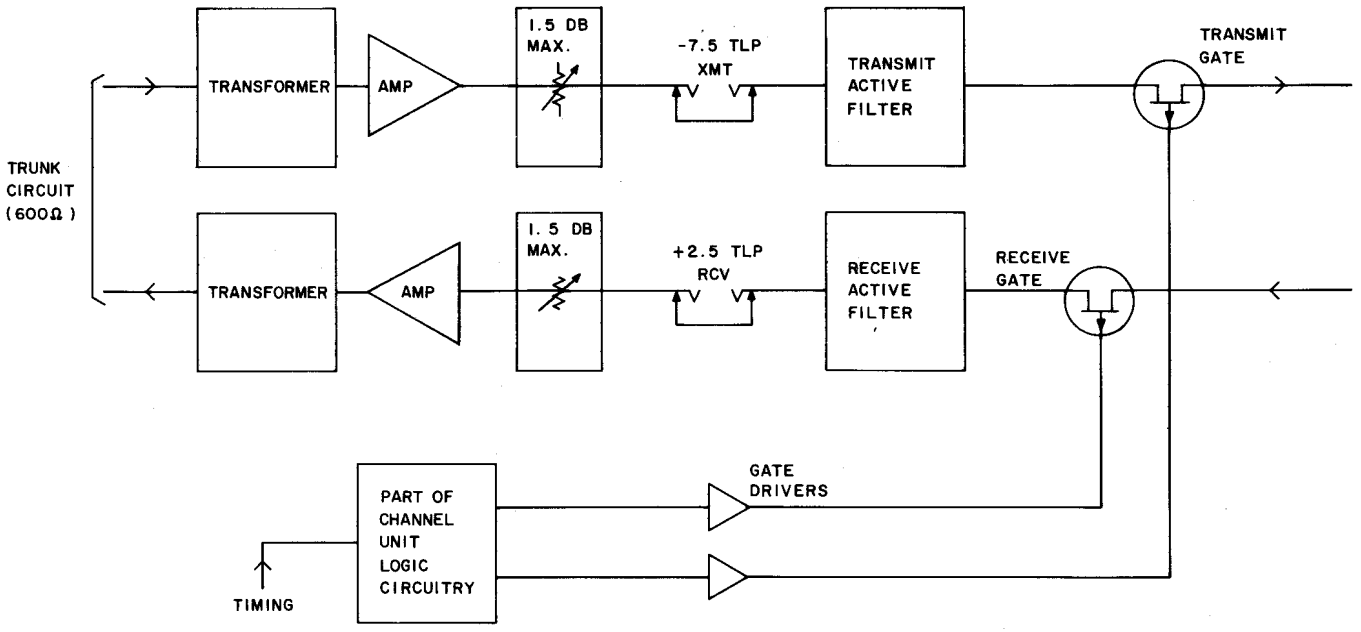


Fig. 3—Transmission Paths in a Typical 4-Wire Channel Unit

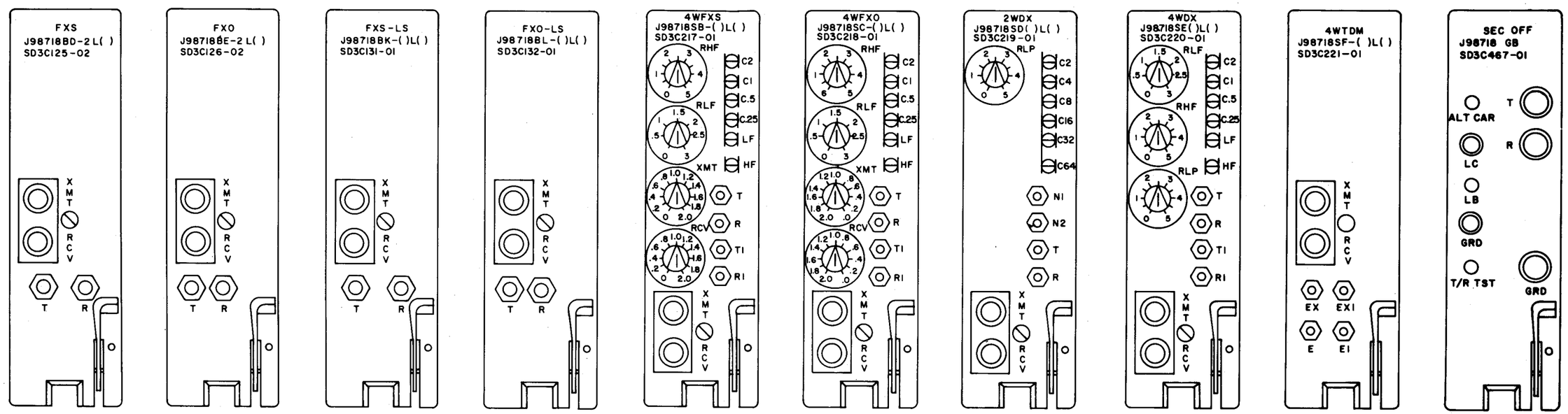


Fig. 4—Special Service Channel Units

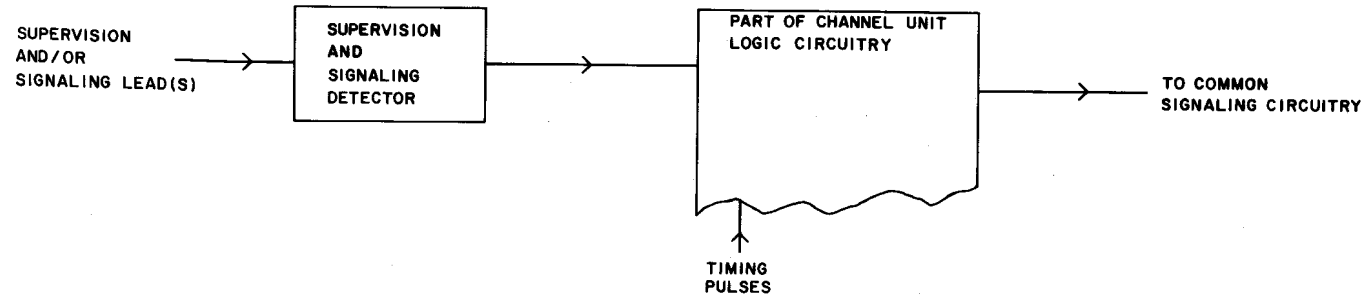


Fig. 5—Simplified Transmitting Signaling Circuitry

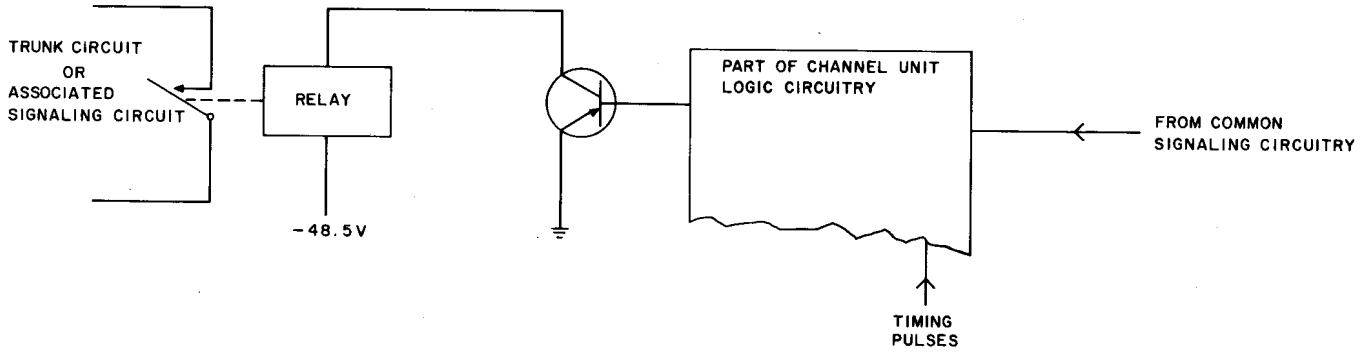


Fig. 6—Simplified Signaling Receiver

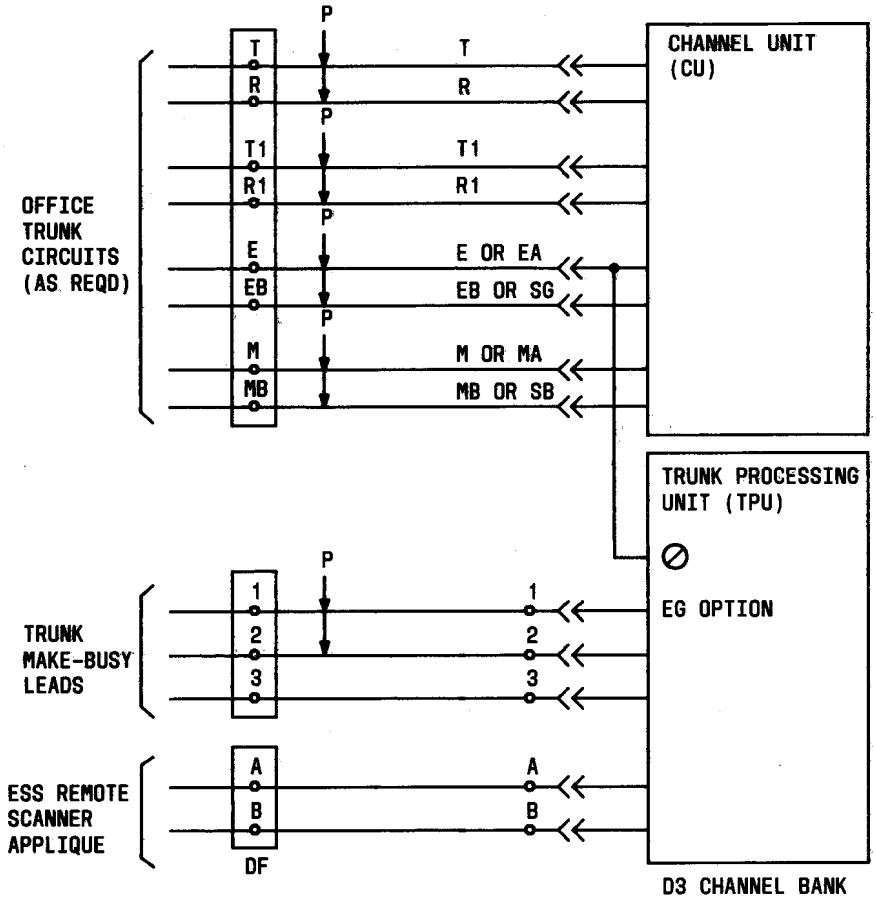
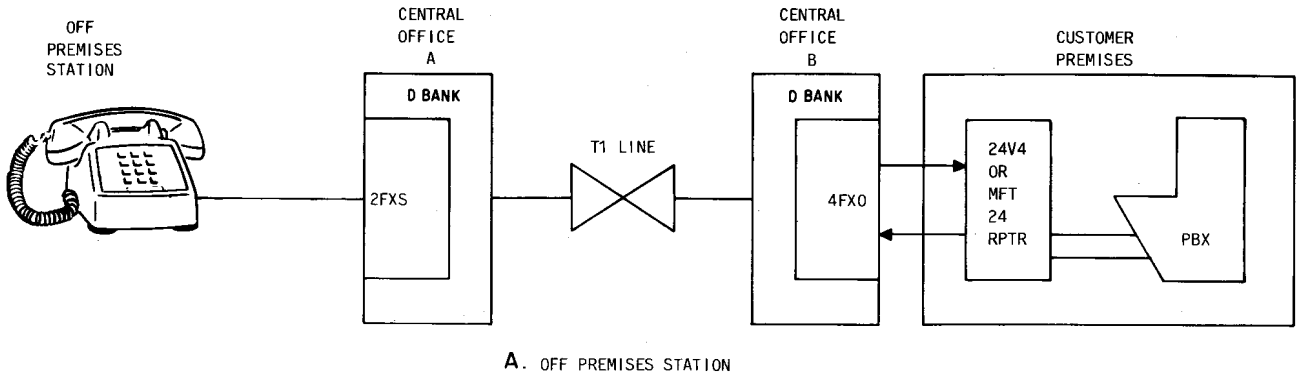
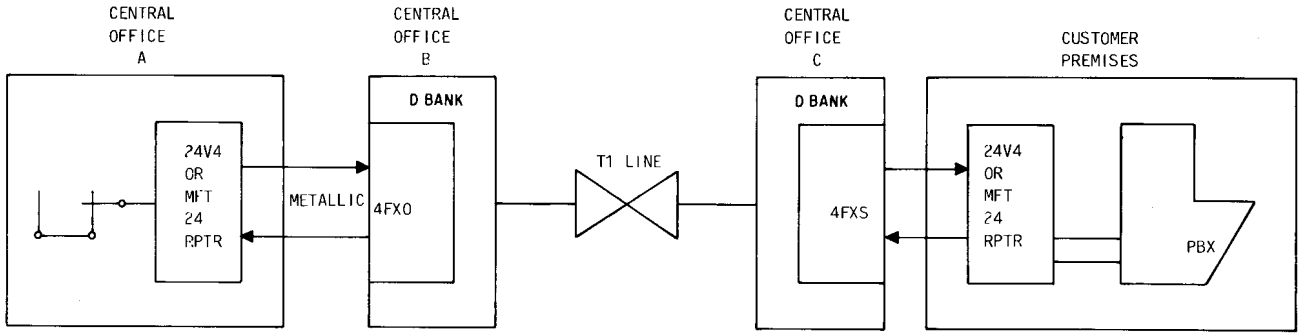


Fig. 7—Universal Wiring to Distributing Frame



A. OFF PREMISES STATION



B. FX TRUNK

Fig. 8—Typical FXO and FXS Applications

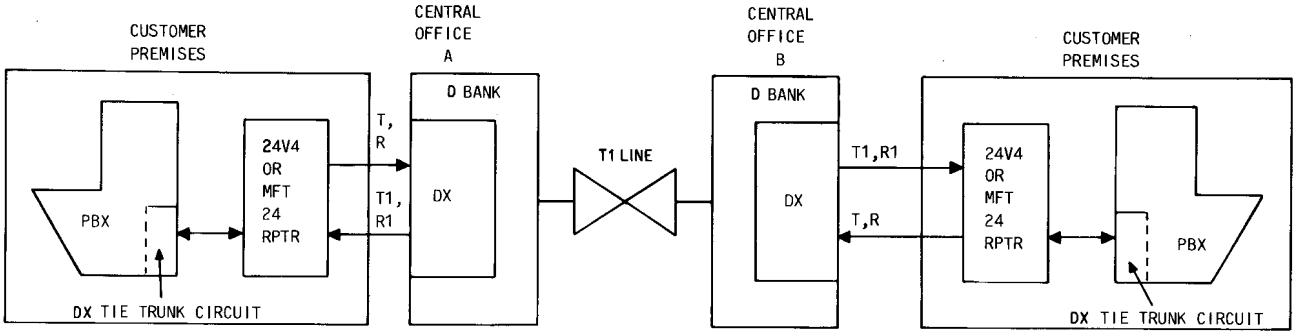
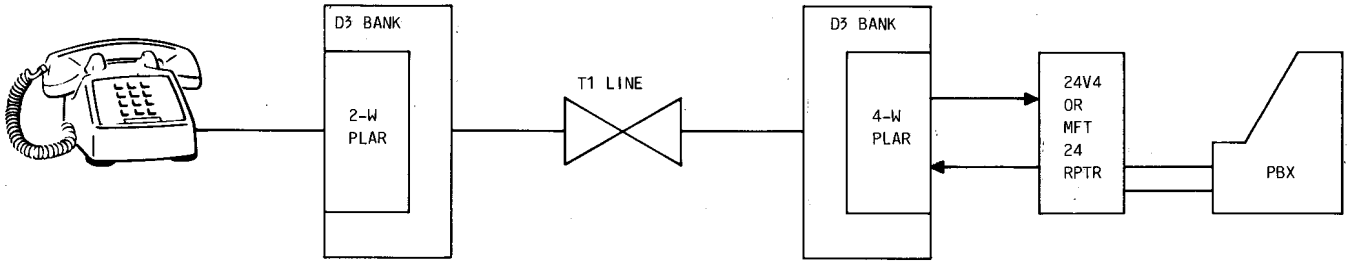


Fig. 9—Typical DX Application



NOTE:
LOOP CLOSURE AT ONE END PRODUCES RINGING AT THE OTHER END.

Fig. 10—Typical PLAR Application

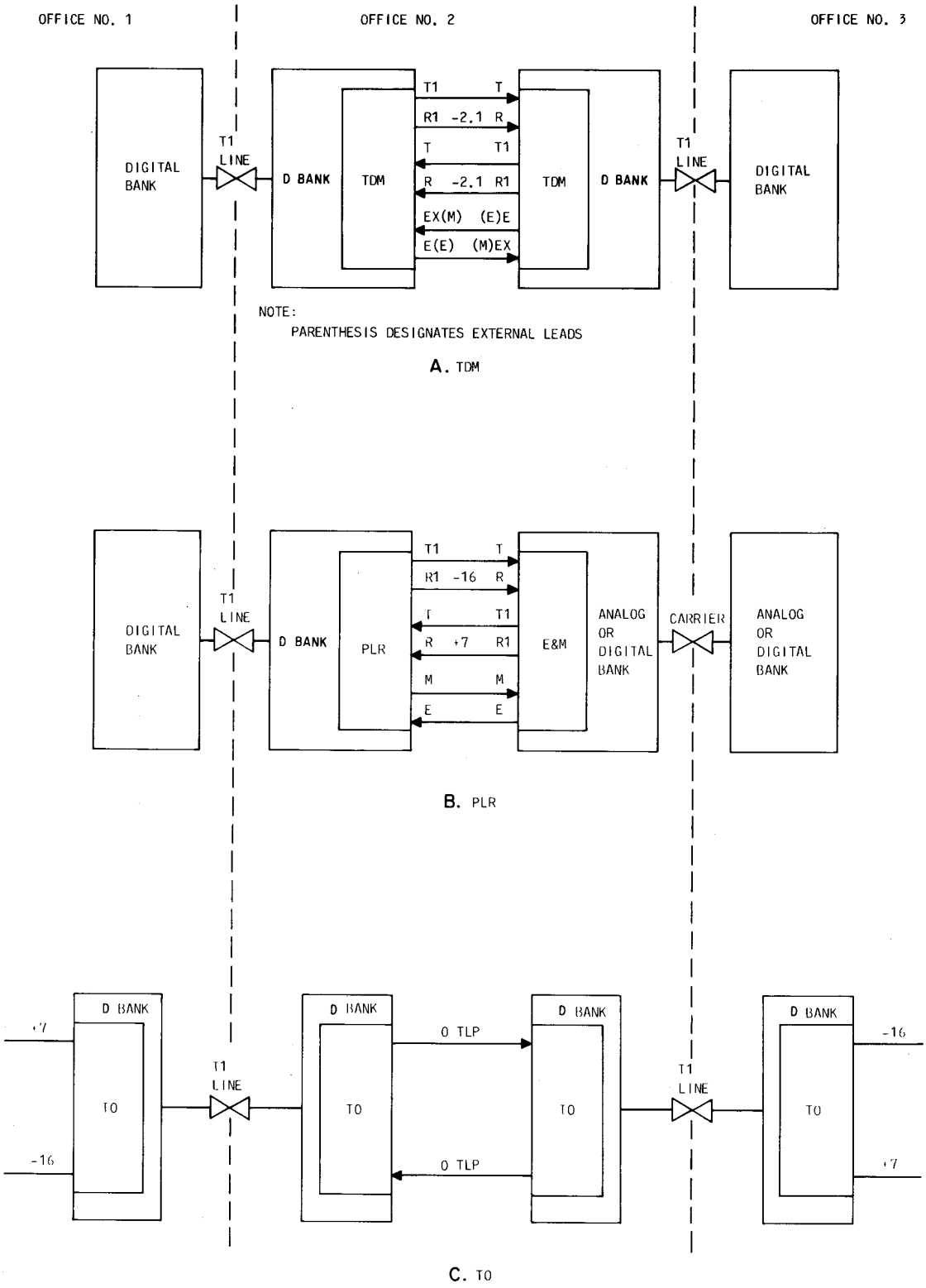


Fig. 11—Tandem Connections Using TDM, PLR, and 4-Wire TO Units

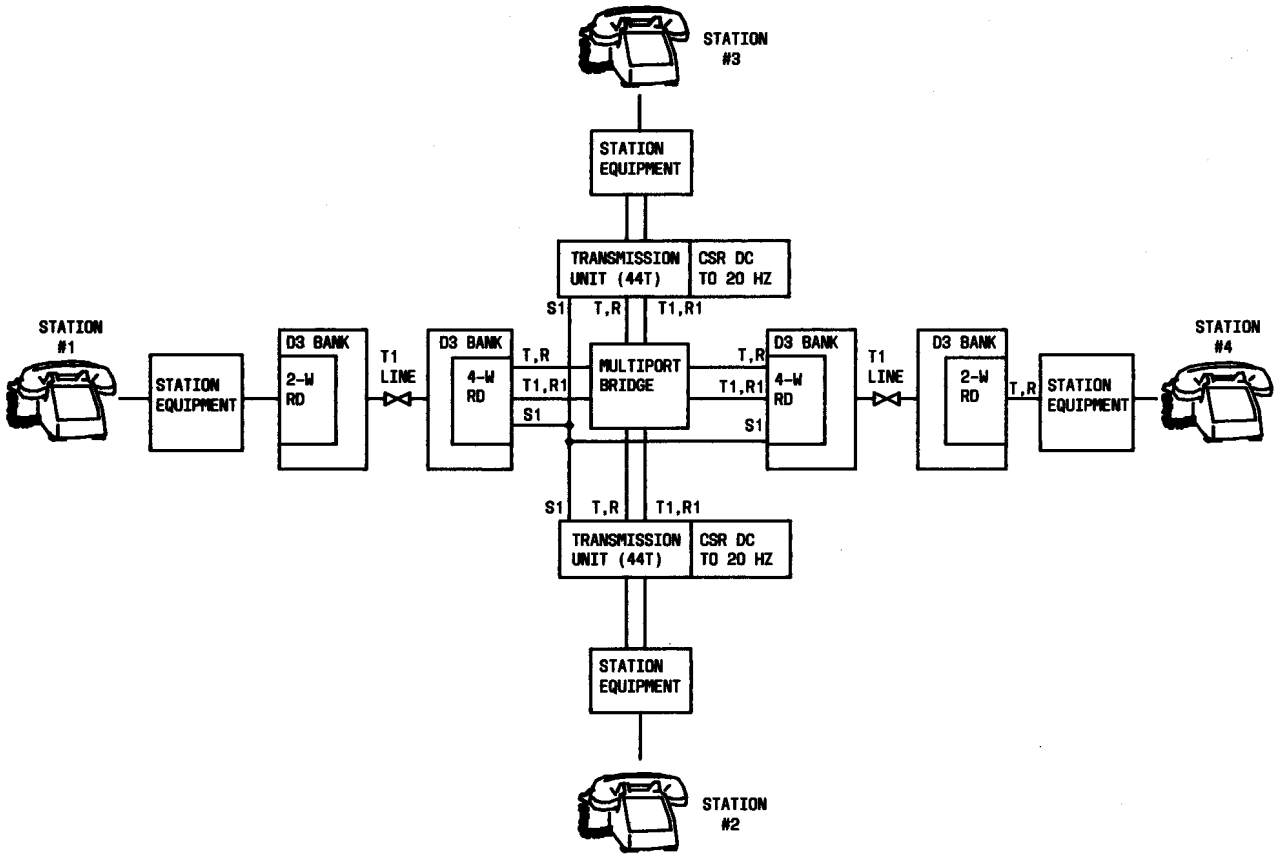


Fig. 12—Typical Multipoint RD Application

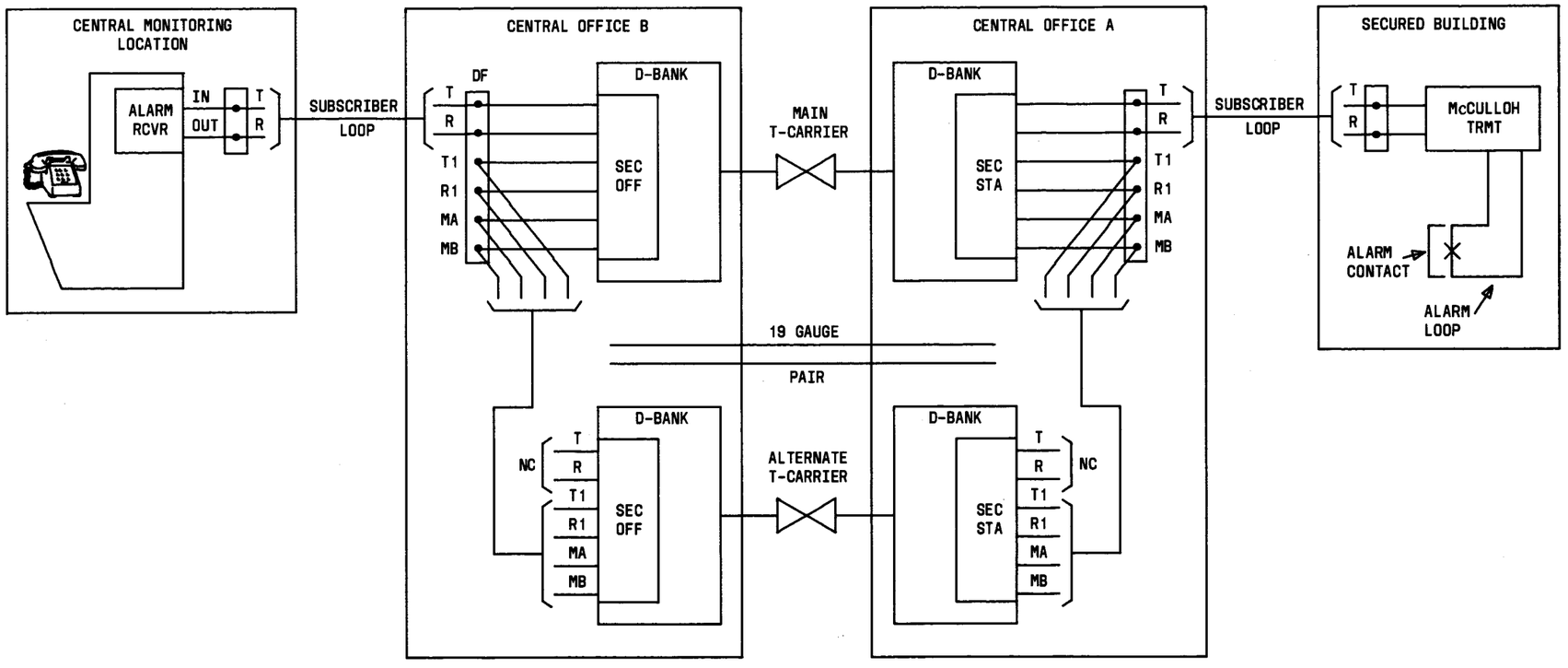


Fig. 13—Typical Application for Security Channel Units

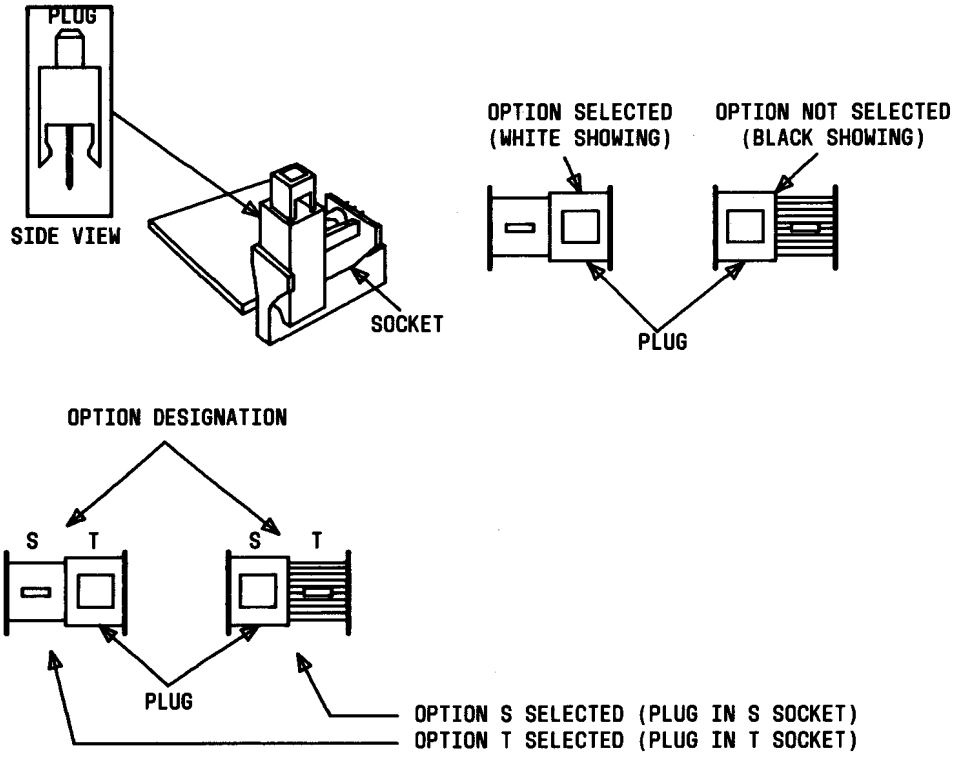


Fig. 14 —Socket-and-Plug Type Option Selector

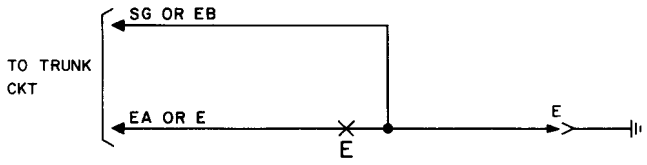


Fig. 15 —Option E for E&M Units

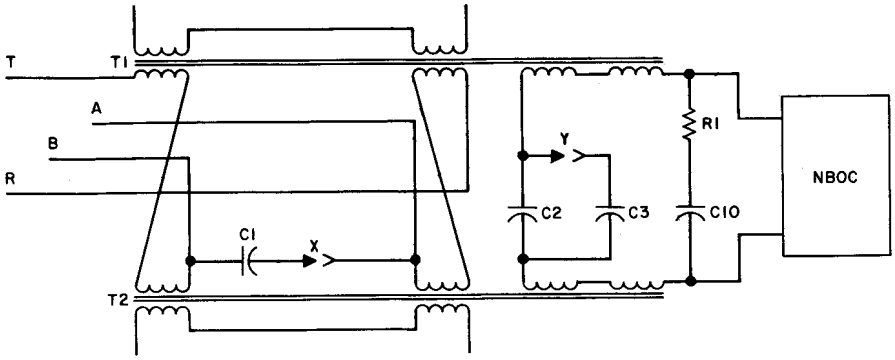


Fig. 16—Options X and Y for 2-Wire E&M Unit

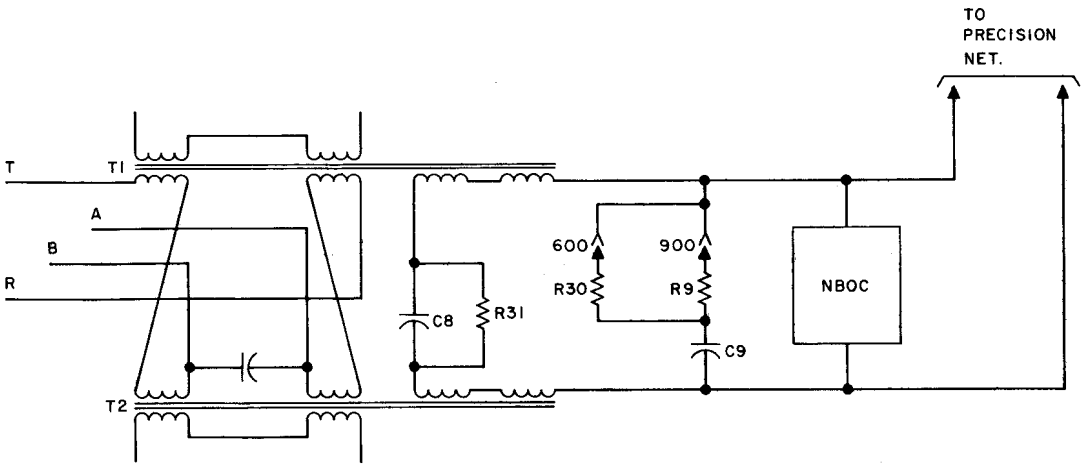


Fig. 17—Options 600 and 900 for 2-Wire FXS and PLAR Units

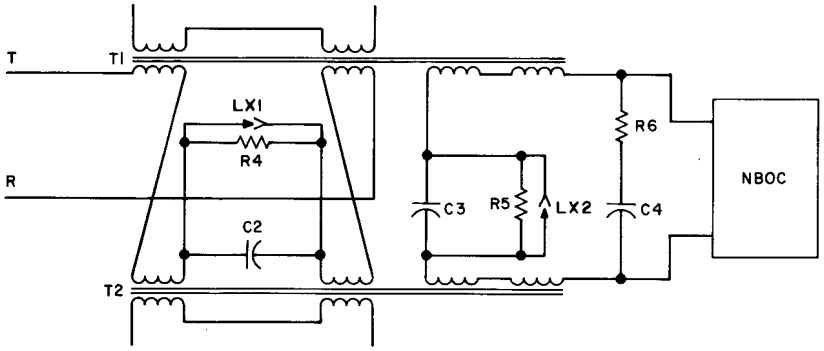


Fig. 18—Options LX1 and LX2 for 2-wire FXO Unit

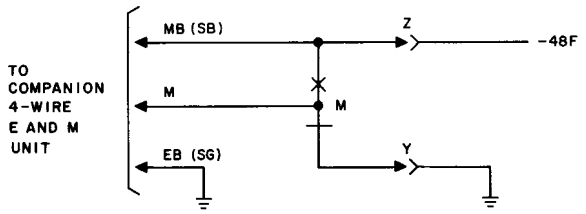


Fig. 19—Options X and Y for 2-Wire E&M Unit

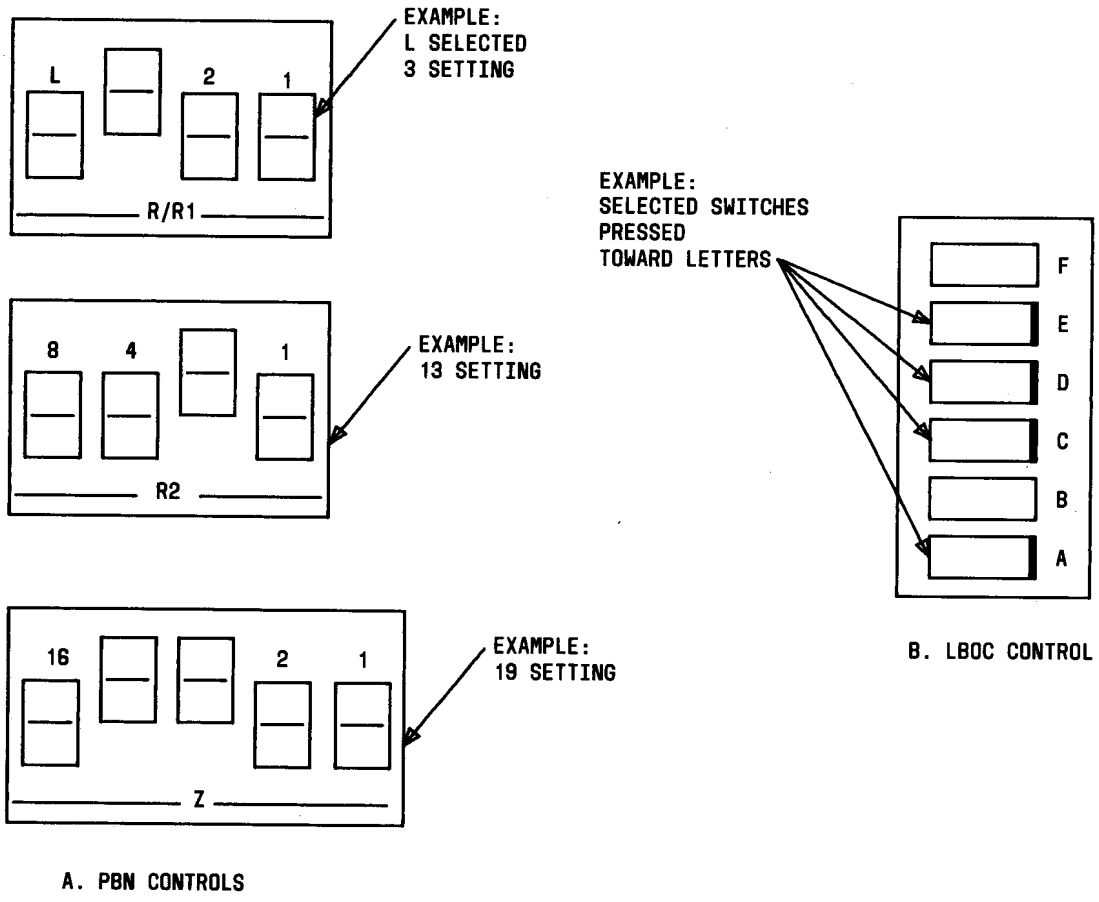
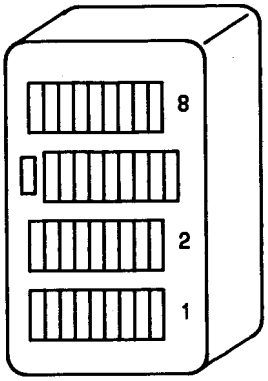


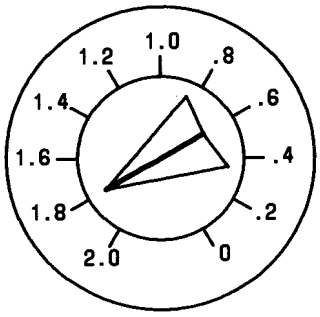
Fig. 20—PBN and LBOC Controls on 2 FXS/GT Unit

SLIDE TYPE



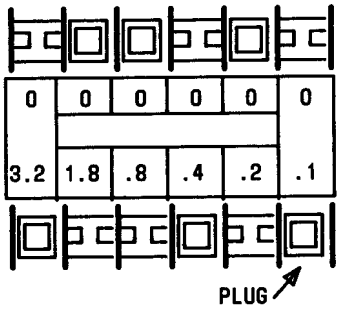
SLIDE SWITCHES ARE SET SO THAT SUM OF EXPOSED DIGITS EQUALS REQUIRED DB ATTENUATION VALUE (11-DB SETTING IS SHOWN)

POTENTIOMETER



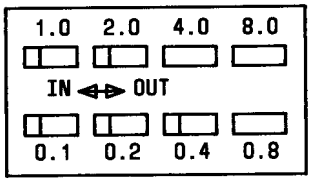
SCREWDRIVER IS USED TO ROTATE POINTER TO REQUIRED DB ATTENUATION VALUE (1.8-DB SETTING IS SHOWN)

SOCKET-PLUG



THERE MUST BE ONE PLUG FOR EACH SECTION. PLUGS ON NUMBERED SIDE SELECT AMOUNT OF LOSS AND PLUGS ON ZERO SIDE BALANCE OPERATION (3.7-DB SETTING SHOWN)

MINISWITCH TYPE



SWITCHES ARE SET IN TO EQUAL TOTAL REQUIRED VALUE (3.7-DB SETTING SHOWN)

Fig. 21—Attenuator Types

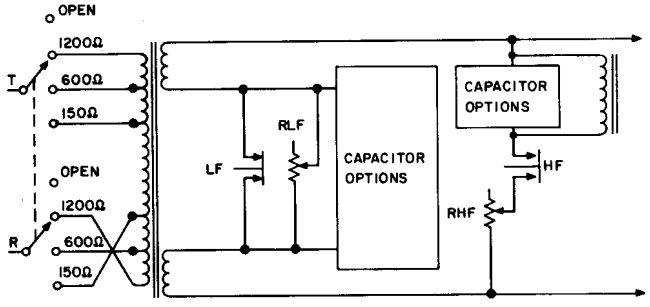


Fig. 22—4-Wire Equalization Networks