REMOTE ACCESS UNIT

SD-1E502-01

DESCRIPTION, INSTALLATION, AND MAINTENANCE INFORMATION

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1. GENERAL

1.01 This section provides description, installation, and maintenance information for the J59204DA remote access unit (RAU), SD-1E502-01. The RAU provides access to a PBX, centrex (CTX), or a key telephone system (KTS) station line from the direct distance dialing (DDD) network. The RAU permits a user to access a PBX, CTX, or KTS station line circuit from a remote location by dialing a 7-digit access code followed by a 4-digit authorization code. After the 4-digit authorization code has been accepted by the RAU, the calling party is given control of the associated PBX, CTX, or KTS station line circuit. In the case of a PBX or CTX application, the calling party has access to any of the PBX features available to an internal PBX station; ie, tie trunks, common control switching arrangement (CCSA), WATS, etc. In the case of a KTS application, the user can make use of a WATS line or any other specialized feature. The RAU has some restrictions. A TOUCH-TONE service telephone set is required at the remote location for dialing. The RAU is applicable to existing PBXs, CTXs, or KTSs including the DIMENSION® PBX. However, the DIMENSION PBX has this capability as an optional software-controlled feature; therefore, the unit is not required. If the calling party local CO is step-by-step and returns answer supervision, a polarity guard is required in the calling party's phone.

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

1.03 This issue of the section is based on SD-1E502-01, Iss 1. If this section is to be used with equipment or apparatus reflecting a later issue of the drawing, reference should be made to the SD and CD to determine the extent of the changes and the manner in which the section may be affected.

2. SYSTEM DESCRIPTION

PBX OR CTX APPLICATION

2.01 The RAU is used with 701, 740, 756A, 757, 770A, 800, 801, 805, and 812A PBXs and centrex systems to provide coded access into customer PBXs from any off-premises station. It is connected between a CO ground start line circuit and a PBX station line circuit (Fig. 1) or a CTX line circuit (Fig. 2). It functions as a barrier between the CO and PBX for the transmission and signaling functions required to interface with the CO and PBX. It provides the same features as a PBX or CTX off-premises station, and has the advantage of not being limited to a fixed location.

2.02 A call is made utilizing the RAU by the calling party dialing the 7-digit number associated with the CO line circuit connected to the unit. The CO applies ringing to the RAU; the RAU trips the CO ringing and returns a ready tone to the calling party. The ready tone (440 Hz) indicates that the RAU can accept the authorization code. After the 4-digit authorization code is dialed, the PBX line is seized and dial tone is returned to the calling party. The user can now dial the appropriate feature code to access a tie trunk, WATS line, etc, that is available to the RAU by the station line circuit's class of service.

2.03 The line circuits assigned to the RAU can have a class-of-service restriction depending on the customer's requirements and the switching system capabilities.

KTS APPLICATION

2.04 The RAU is connected between a CO ground start line circuit and, for example, a WATS line via a KTS line circuit (Fig. 3). The circuit operation is the same as described under PBX application, except if the WATS line is in use by a party within the KTS. With the WATS line in use, an incoming call is routed to an attendant. When the WATS line becomes available, the attendant can complete the RAU call. The KTS line circuits that are connected to the RAU provide lamp indications to the attendant and other KTS users.

REMOTE ACCESS CIRCUIT FEATURES

Authorization Code

2.05 The 4-digit authorization code allows the customer to prevent unauthorized use of the remote access services. The code is customer controlled and administered. The control panel (Fig. 4) contains the code switch, labeled ENCODER, and is accessible by the customer for control.

2.06 To set the authorization code, the sliding door on the front of the RAU is opened and the vertical 4 deck thumbwheel switches are set to any number desired. It may be changed as often as necessary or desired. The authorization code is required on calls through the RAU. Whenever the authorization code is changed, proper operation of the RAU can be verified by using any PBX extension to call out through the CO and back to the CO line associated with the RAU.

Intercept Tone and Time-Out

2.07 If an incorrect authorization code is dialed, an "intercept tone" will be sent to the calling station, and the calling station will have to hang up and dial the RAU again. (See 2.09.) The intercept tone is also sent to the calling station if no authorization code is dialed within 12 to 15 seconds. After the intercept tone is sent for 12 to 15 seconds, the RAU will automatically time out and disconnect the call if the calling station has not hung up. These features prevent anyone from busying out the RAU.

Night Transfer

2.08 For the PBX application, a night transfer feature is available which allows the RAU to share the CO line circuit with a one-way or 2-way PBX CO trunk circuit. If the line is shared, it can be arranged for normal PBX service use in the daytime and for RAU use at night. It should be the last choice in the CO hunting group. The night transfer feature can be controlled at the unit or remotely. The ON/OFF rocker switch on the control panel (Fig. 4) is used to control the feature at the unit. When the sharing is under

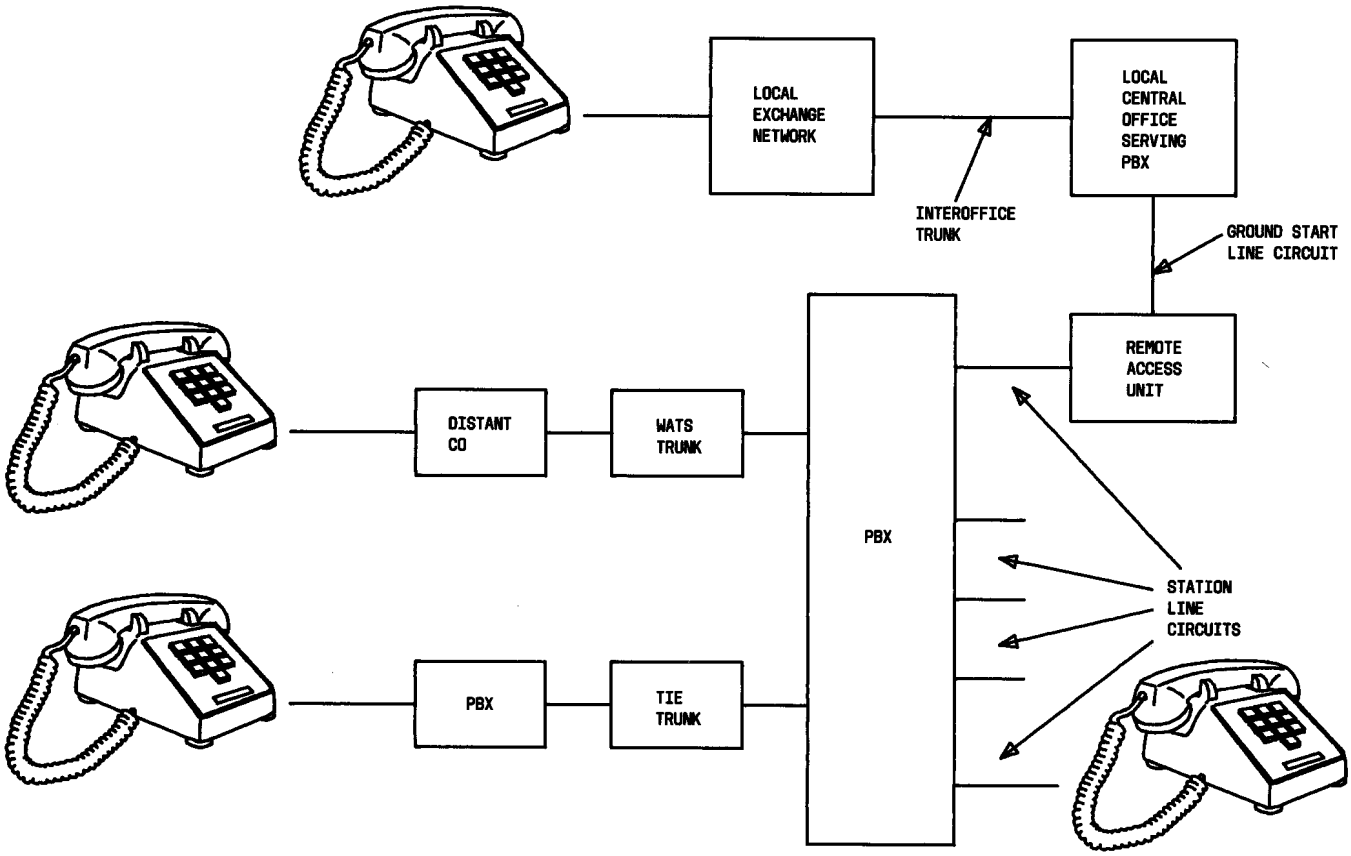


Fig. 1—Remote Access Unit—PBX Application

control of this ON/OFF switch, the CO line will be connected to the RAU when the switch is set to ON. The CO line will be connected directly to the PBX with the switch set to OFF, and the RAU cannot be used. The feature can optionally be controlled by the PBX attendant night transfer switch, and thereby eliminate the need of using the ON/OFF switch. Setting the ON/OFF switch from ON to OFF will not interrupt a call connected through the RAU. As soon as the call is completed, the CO line will be disconnected from the RAU. An option screw switch is available that overrides the rocker switch. The screw switch can be used to turn the RAU on all the time.

Remote Reoriginate

2.09 The remote reoriginate feature gives the calling party the ability to originate a second call through the PBX without going on-hook and redialing the 7-digit CO line number and 4-digit authorization code. If the calling party has incorrectly dialed, got a busy signal, or wishes to make additional calls, the user may terminate this call by depressing the * key on the TOUCH-TONE dialing pad. Upon completion of the disconnect, the RAU reseizes the PBX line circuit and PBX dial tone is returned. This feature is also applicable on CTX and KTS installations.

Remote Flash

2.10 The remote flash feature operates similarly to the remote reoriginate feature but uses the # key on the TOUCH-TONE dialing pad. The remote flash feature provides the customer with the capability of generating a switchhook flash to the PBX which conditions the station for a controlled conference, call transfer, etc, provided the PBX is equipped with these features. This feature is applicable to PBX and CTX installations only (not usable in CTX ESS offices that use the # key for custom calling services such as speed calling).

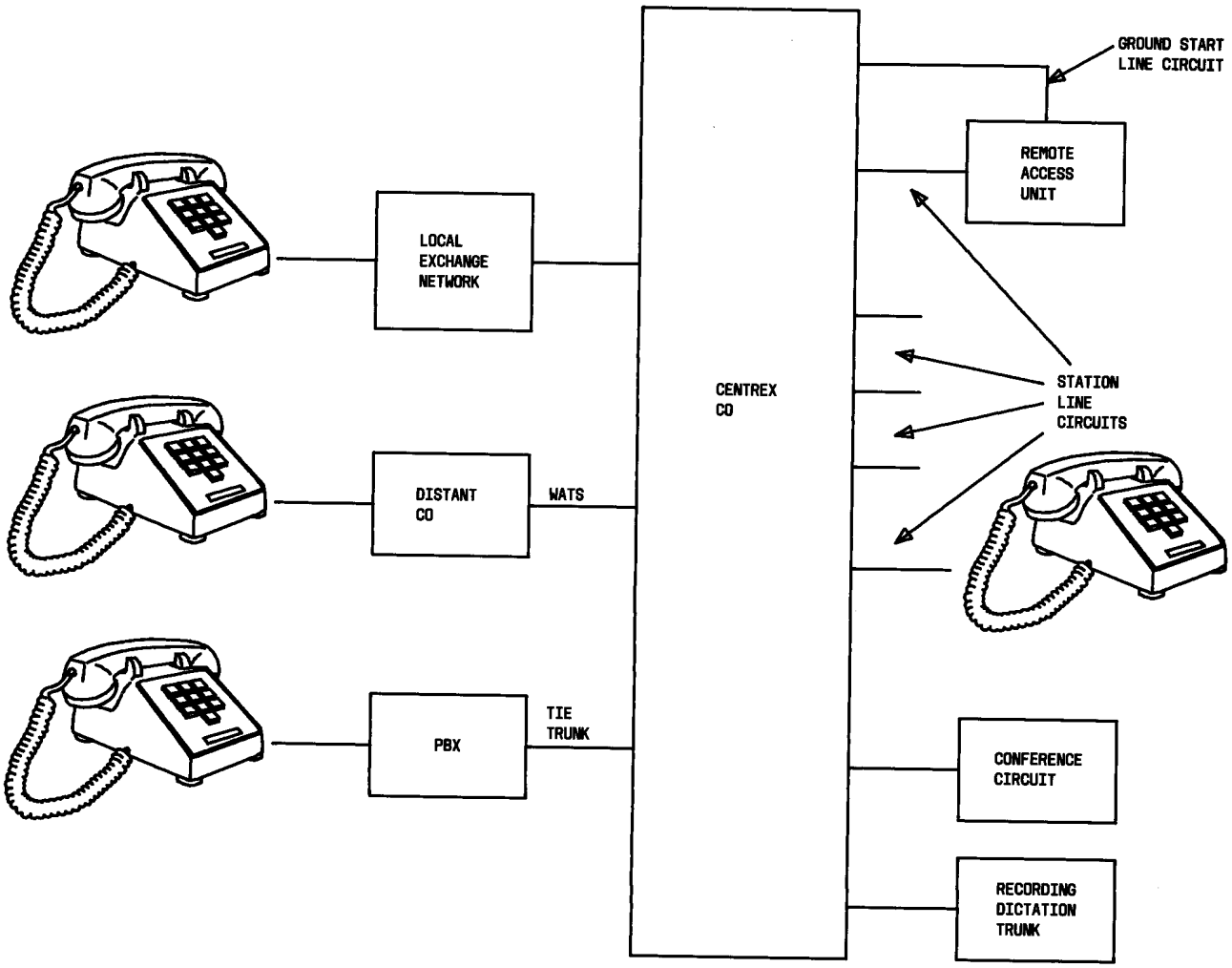


Fig. 2—Remote Access Unit—CTX-CO Application

Message Counter

2.11 The message counter is a 3-digit, manual-resettable register. The register is on the control panel (Fig. 4) and accumulates the number of calls that have been completed through the RAU. The register counts once each time the authorization code is dialed and accepted. The register may be reset to zero (000) by depressing the white plunger protruding from the panel on the message register.

Call Processing Indicators

2.12 Two light-emitting diodes (LED) on the control panel (Fig. 4) provide the status of a call being processed through the RAU. The LED with a red lens, labeled IN, lights steadily when the RAU has been seized (authorization code not dialed). The LED remains lighted while the RAU is processing a call. The LED with a green lens, labeled OUT, lights steadily when a valid authorization code has been recognized and a call is in progress. When the RAU is equipped with a TOUCH-TONE dialing to dial pulse conversion circuit pack (HJ29), the green LED flashes on and off following the dial pulsing.

2.13 Both LEDs remain steadily lighted while the calling and called parties are connected.

Gain Adjustment

2.14 A fixed gain amplifier is provided as part of the RAU and is adjustable in 0.5-dB steps to a maximum of 5.5 dB.

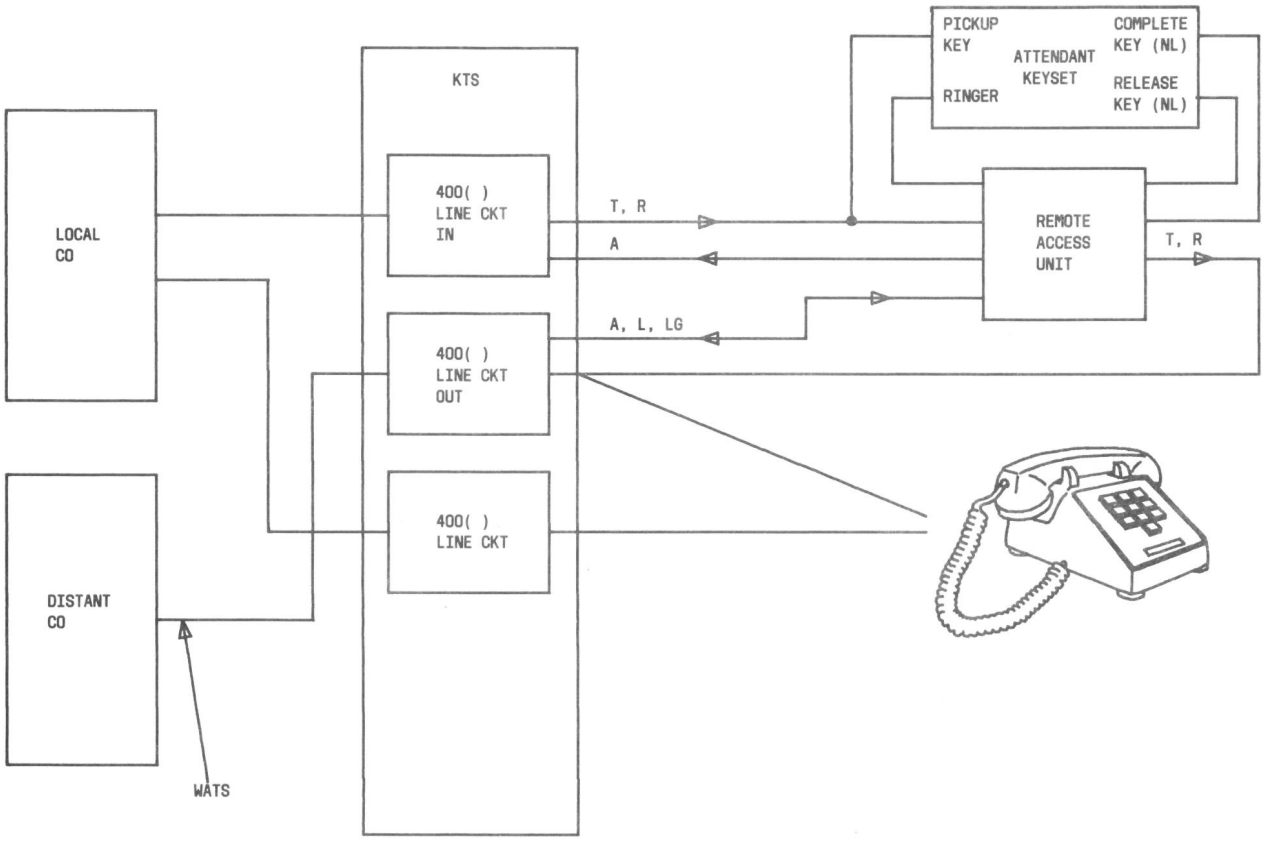


Fig. 3—Remote Access Unit—KTS Application

Fig. 4—Remote Access Unit—156A Cover Installed—Customer Access Panel in Open Position—Encoder, Counter, Switches, and Lamps

TOUCH-TONE Dialing to Dial Pulse Converter

2.15 The RAU can be equipped with an optional circuit pack (CP) to provide dial pulses to the PBX in the event the PBX is not equipped with TOUCH-TONE calling. This optional circuit pack also provides dial pulses to any remote terminating location which can be reached over this connection but cannot accept TOUCH-TONE calling signals.

3. EQUIPMENT DESCRIPTION

IDENTIFICATION

3.01 The RAU equipment consists of circuit packs containing functional circuitry mounted on HJ-type circuit packs. Its outside dimensions, when installed with the cover in place, are approximately 13 inches wide, 9 inches high, and 8 inches deep, and it weighs approximately 15

pounds (Fig. 5). The unit comes equipped with the following equipment:

- An 89C apparatus mounting (a carrier)
- Eight standard HJ-type circuit packs
- An optional ninth HJ-type circuit pack for TOUCH-TONE dialing to dial pulse conversion
- A 218A power unit with 9 feet of 3-conductor power cord for connecting the unit to the power source, and 30 feet of 5-conductor, 20-gauge cable for connecting the power unit to the RAU
- A 731B tool for extracting circuit packs
- A 156A cover assembly.

Fig. 5—Remote Access Unit—Cover Installed

3.02 Fig. 6 shows the RAU, the 218A power units, and the cable and terminal lugs for connecting the power unit to the RAU.

3.03 The J59204DA RAU is composed of the following.

(a) ***List 1***—Assembly, wiring, and equipment for one remote access circuit per SD-1E502-01, Fig. 1 and 2, including an externally mounted 218A power unit and equippd with the following circuit packs:

- HJ13—Control panel and power supply
- HJ14—Input amplifier and channel detectors
- HJ17—Filter
- HJ18—CO and PBX interface and night transfer
- HJ19—Amplifier and tone
- HJ20—Time-out and customer features
- HJ21—Decoder and comparator
- HJ22—Switch scanner and match storage.

(b) ***List 2***—Apparatus required in addition to the List 1 unit for TOUCH-TONE dialing to dial pulse conversion per SD-1E502-01, Fig. 2, consisting of the following circuit pack:

- HJ29—Memory and dial pulse generator.

89C APPARATUS MOUNTING

3.04 The 89C apparatus mounting consists of a wall mounting plate assembly, a carrier assembly, and two removable hinge pins. The eight (and optionally nine) circuit packs (HJ series) are housed in the carrier of the 89C apparatus mounting as shown in Fig. 7. The 89C carrier is fastened to the wall mounting plate by two removable hinge pins. The design intent is that after the mounting bracket has been installed, only one pin is removed at a time. For example, when the left-side pin is removed, the carrier will open and swing to the right; when the right-side pin is removed, the carrier will open and swing to the left. Local cabling is terminated on the side of the carrier. (See Fig. 7 and 8.)

CIRCUIT PACKS

3.05 The nine plug-in circuit packs are printed wiring assemblies and are designed to plug into 908E connectors mounted in the 89C carrier. Each circuit pack has a small rectangular slot in the faceplate. This slot accommodates the triangular-shaped 731B extraction tool used to

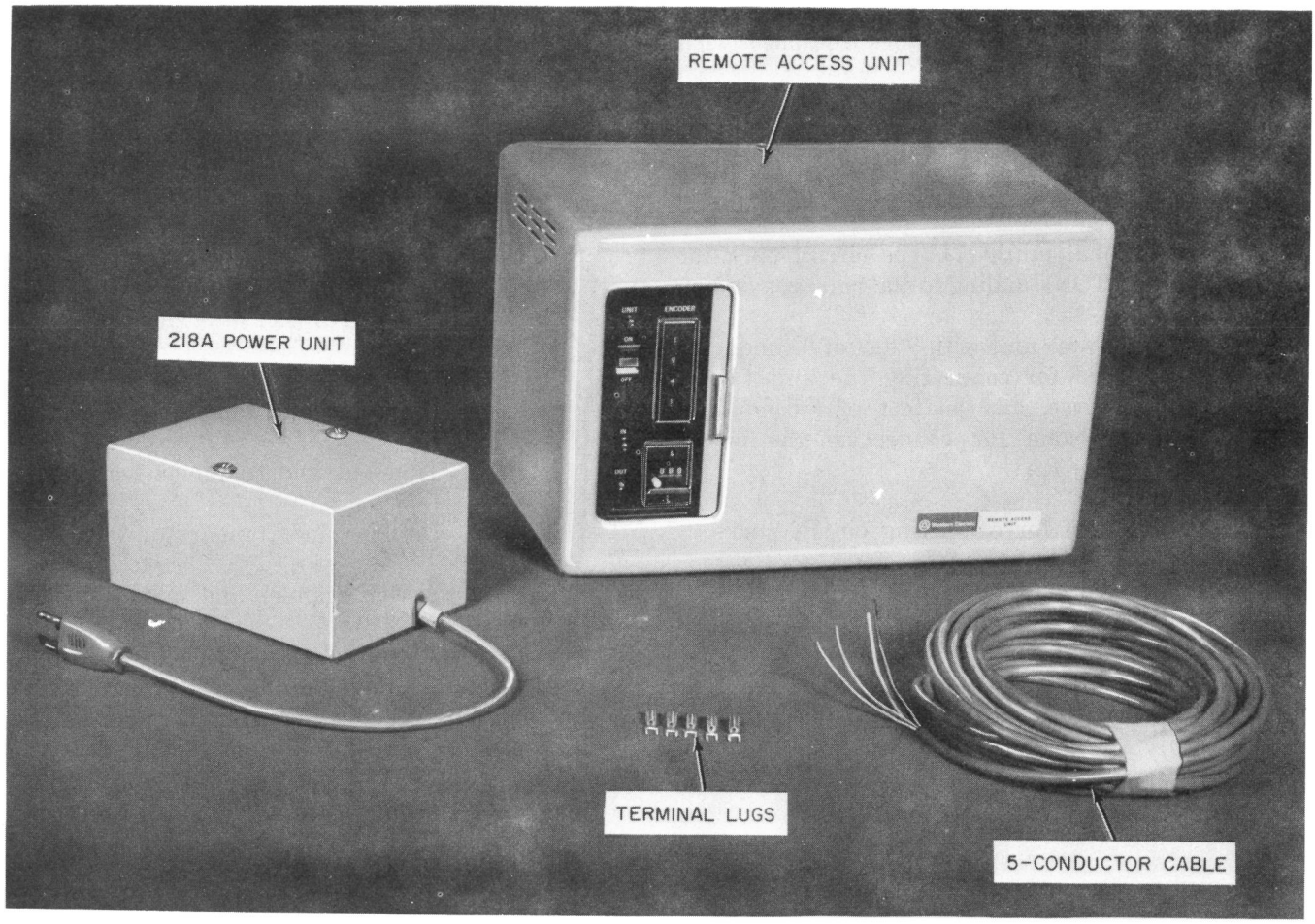


Fig. 6—Remote Access Unit—218A Power Unit—5-Conductor Cable and Terminal Lugs

withdraw the circuit packs from the carrier. A description of each circuit pack follows.

(a) ***Control Panel and Power Supply Circuit Pack (HJ13)***—The HJ13 CP is designed to be used as the control panel and power supply for the RAU. The CP is held in the carrier by a screw on the left side of the faceplate. Its function is to provide a positive-action feeling when the switches mounted in the faceplate are operated. A note is provided to remind maintenance personnel that ***the side screw holding the HJ13 CP in place must be loosened prior to disengaging the CP from the carrier.*** The switches and lamps that are a part of the HJ13 CP as shown in Fig. 9 provide the following functions.

- ***ENCODER***—The encoder consists of a thumbwheel-type switch in four segments. Each thumbwheel has ten positions (0 through 9). The switch is used to set the authorization code. Any combination of wheel settings may be used as the authorization code, eg, 1776, 1234, 0566, 1941, etc.

- ***COUNTER***—The counter is a 3-digit, manual-reset peg count register. The counter will score once each time the RAU is seized and the proper authorization code accepted (ringing tripped, 440-Hz ready tone returned to calling party, calling party dials proper authorization code, and PBX dial tone heard after the authorization code is accepted by the RAU). It is reset to zero at any time by fully depressing the white plunger on the message counter.

- ***R Lamp***—An LED with red lens, labeled IN, lights steadily when the RAU has been

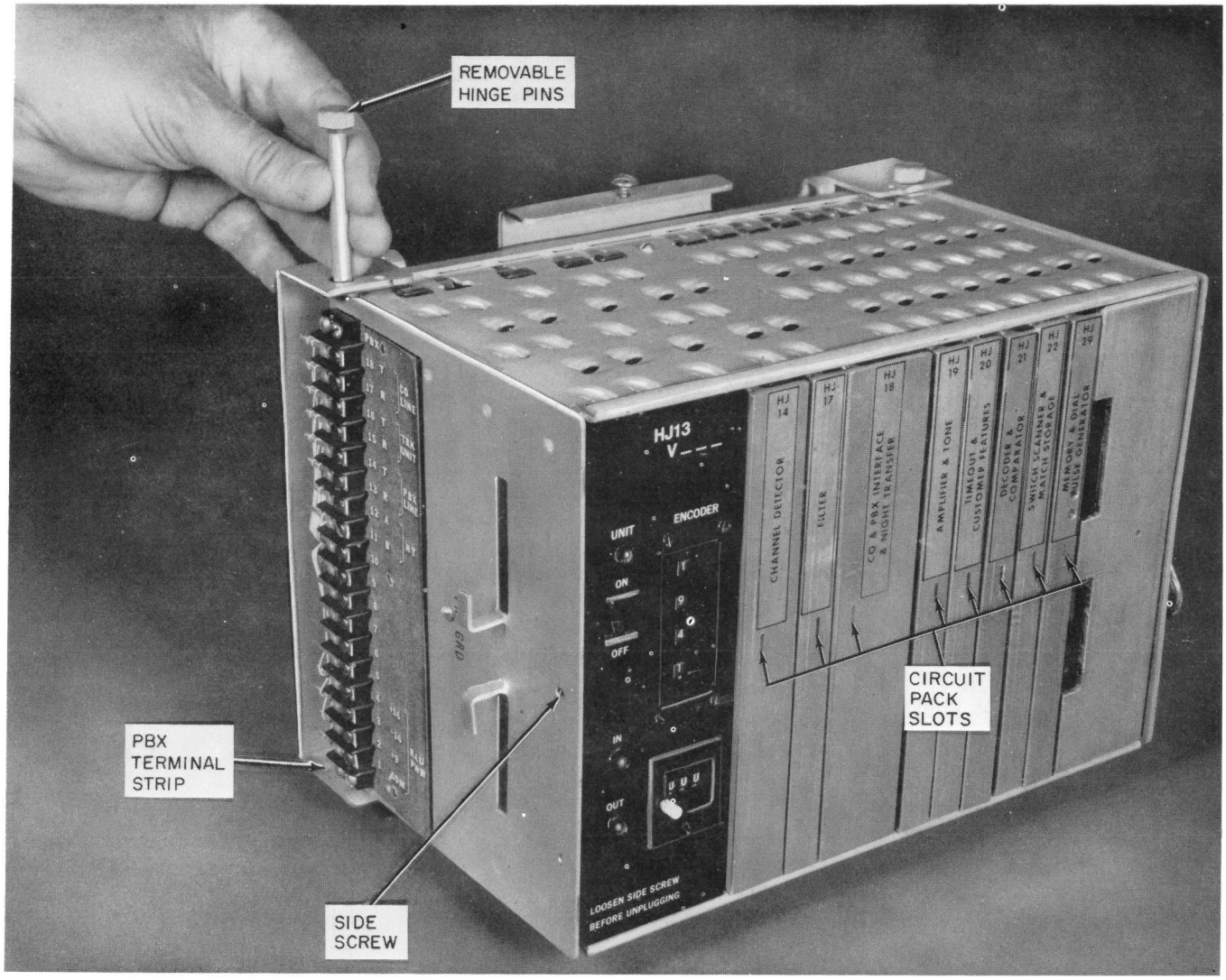


Fig. 7—Remote Access Unit—Cover Removed—Circuit Pack Arrangement—Removable Hinge Pins

seized. It continues to light steadily while the RAU is processing a call, and stays lighted while the RAU remains connected to the transmission path and provides supervision for the duration of the call.

- ***G Lamp***—An LED with green lens, labeled OUT, lights steadily when a valid authorization code is recognized. During the period that the calling and called parties are connected, both the R and G LEDs are steadily lighted.

- ***ON/OFF Switch***—In addition to the LEDs described, the control panel CP also has one red LED mounted at the top left side of the front panel. This LED lights steadily when the RAU is activated by the black rocker switch on the HJ13 CP front panel. The normal setting of the switch is ON. When set to ON, the RAU is available to process calls from a remote location when the proper codes are dialed. When set to OFF, the RAU is "removed from the tip and ring leads" and is not available to process calls. While in the OFF position, the CO trunk circuit normally assigned to the RAU is used as an incoming/outgoing CO-PBX trunk circuit. As determined by local requirements, this trunk circuit may be terminated at a PBX station or at the PBX

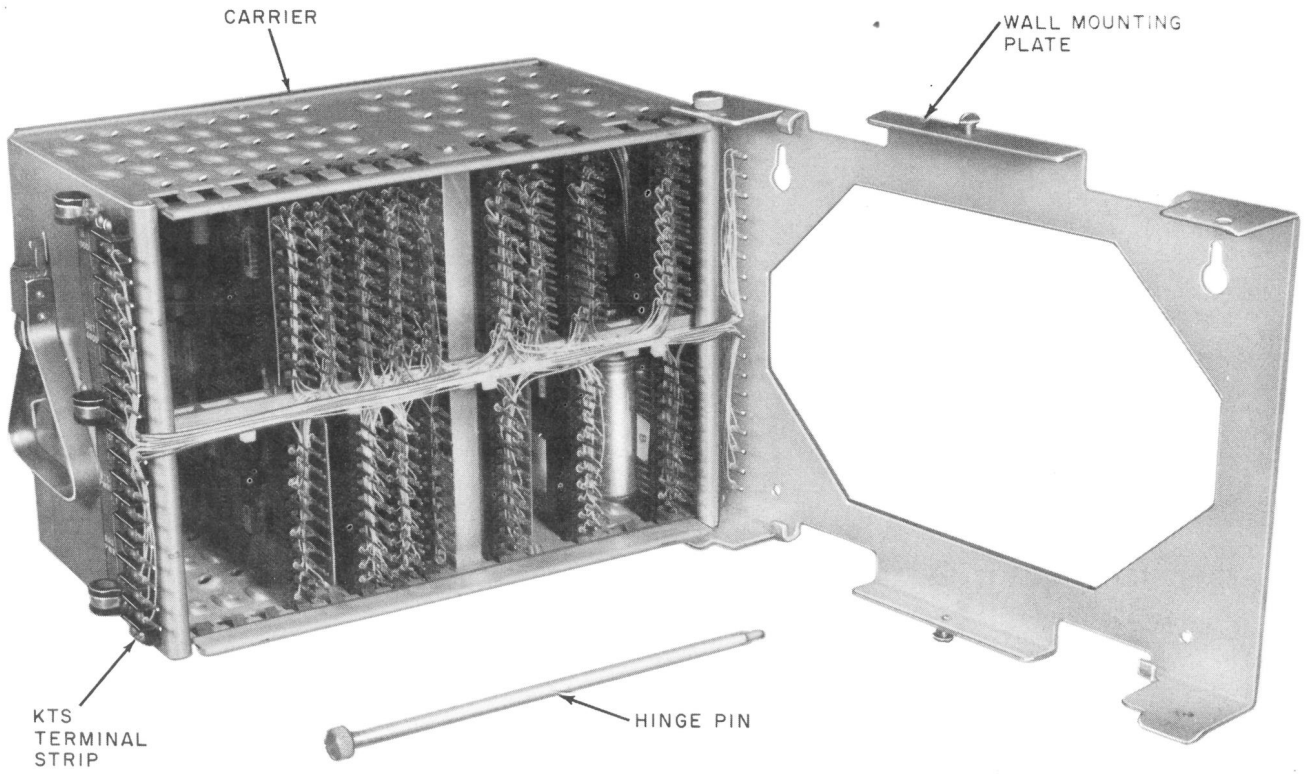


Fig. 8—Remote Access Unit—89C Apparatus Mounting—Hinge Pin Removed—Right Side View

attendant console. The ON/OFF switch is a night transfer switch and is not turning the power on or off. The ON/OFF rocker switch has a bypass in the form of a screw switch located on the HJ13 CP (Fig. 9). When the screw switch is closed, the HJ13 CP is turned on all the time. The screw switch overrides the rocker switch. When the screw switch is open, the rocker switch controls the RAU.

(b) ***Channel Detector (HJ14) and Filter (HJ17) Circuit Packs***—The channel detector (HJ14) and filter (HJ17) CPs are the TOUCH-TONE service receiver circuit packs. The HJ14 and HJ17 CPs detect and separate the low and high group frequencies of the digit dialed and convert them to a 2-out-of-7 logic signal. At the same time the 2-out-of-7 logic signal is generated, a steering signal is generated by the HJ14 and HJ17 CPs to activate the time-out feature and the registers for comparing digits dialed with the authorization code set by the customer.

(c) ***CO and PBX Interface and Night Transfer Circuit Pack (HJ18)***—The HJ18 CP detects ringing from the CO, provides a 0.5-second delay to allow the calling party to hear a burst of ringing, connects the CO tip and ring to the transmission circuitry of the RAU, and functions to trip the CO ringing. After ringing has been tripped, a signal is sent to activate the ready tone control circuitry of the HJ19 CP. The night transfer feature capability is detected by the HJ18 CP to activate or deactivate the RAU.

(d) ***Amplifier and Tone Circuit Pack (HJ19)***

- The amplifier and tone CP (HJ19) functions to provide a transmission path, amplification, and a means of coupling a tone to the transmission path. The HJ19 CP generates, adjusts the level, and applies the ready tone (440 Hz) to the transmission to alert the calling path that the RAU is ready to accept the authorization code. The HJ19 CP also provides the intercept tone (620 Hz on 0.2

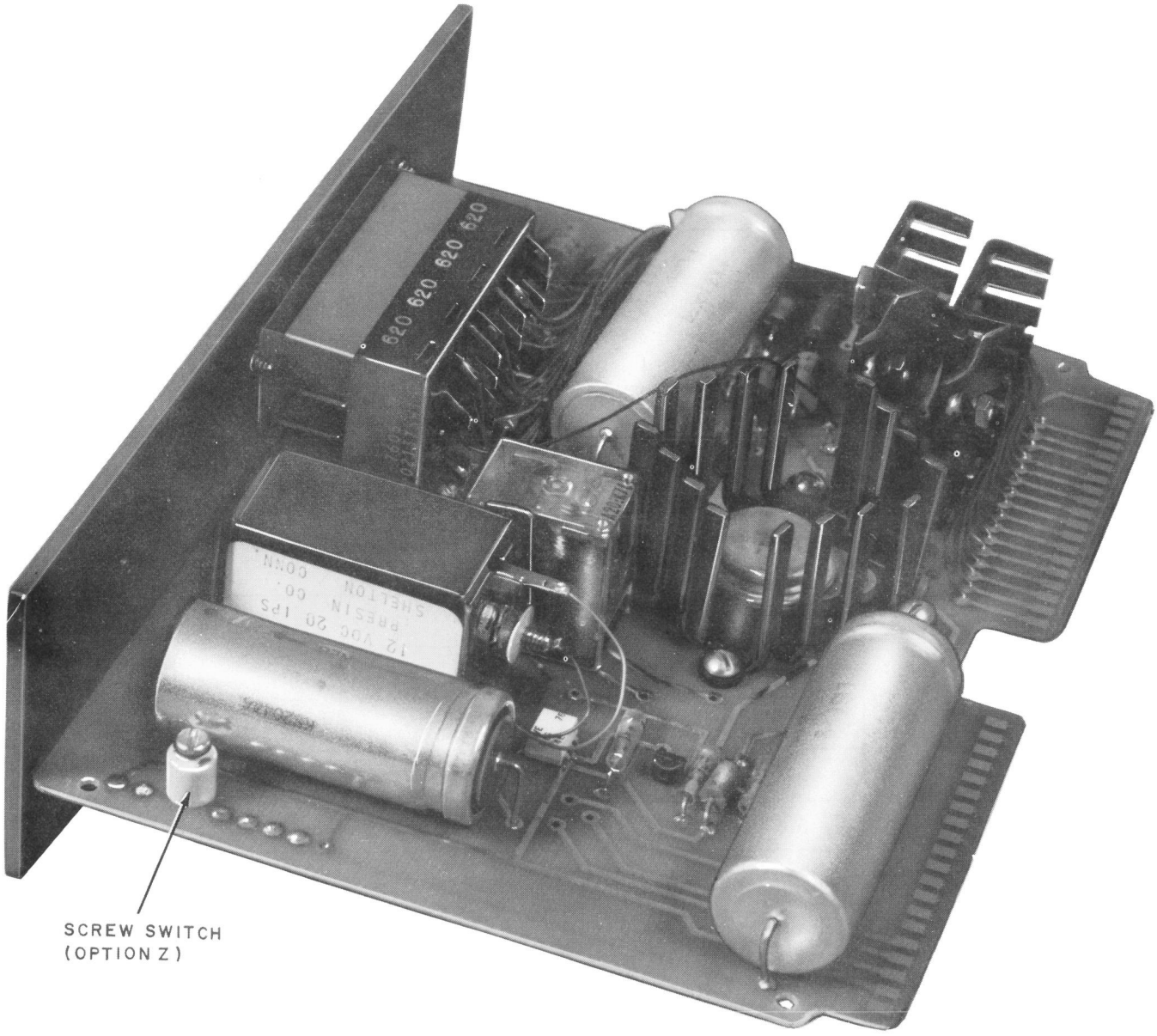


Fig. 9—HJ13 Control Panel and Power Supply Circuit Pack (Option Z)

second and 440 Hz on 0.2 second, etc) if an invalid code is dialed or time-out occurs.

- A gain adjustment is part of the HJ19 CP for adjusting the transmission gain to a maximum of 5.5 dB in 0.5-dB steps. The desired gain is obtained by selecting the open and closed positions of the contacts on the S1 switch per Table A. Fig. 10 shows the location of the gain adjustment switch (S1) on the HJ19 CP. When the rocker arm is in the L position, the switch is open and the gain is IN. With the rocker arm in the R position, the switch is closed and the gain is removed.

- Some recommended guidelines for determining the amount of gain for the two possible configurations are as follows:

RAU working into collocated PBX—The 3-dB design loss of the incoming line to the

TABLE A

GAIN ADJUSTMENTS--ROCKER ARM POSITIONS

DB	S1 ROCKER ARM NUMBER			
	4 0.5 DB	3 1.0 DB	2 2 DB	1 2 DB
0	C	C	C	C
0.5	O	C	C	C
1.0	C	O	C	C
1.5	O	O	C	C
2.0	C	C	O	C
2.5	O	C	O	C
3.0	C	O	O	C
3.5	O	O	O	C
4.0	C	C	O	O
4.5	O	C	O	O
5.0	C	O	O	O
5.5	O	O	O	O

Legend: O = Open; C = Closed.

RAU can be compensated by the gain adjustment.

RAU working into a remotely located switching system such as a centrex—The design loss of both the incoming and outgoing lines (3 dB each) can be compensated by the gain adjustment. For example, if the incoming line has a loss of 4 dB and the outgoing line is 4.5 dB (4 dB + 4.5 dB = 8.5 dB), the amplifier can be set for a gain of 2.5 dB (8.5 dB - 6 dB = 2.5 dB).

These guidelines are valid even if the involved facilities already have gain devices on them, provided no attempt is made to reduce the individual facility loss to less than 3 dB.

(e) ***Time-Out and Customer Features Circuit Pack (HJ20)***

- The HJ20 CP generates a time-out clock of approximately 12 seconds and sends a signal to the intercept tone circuit pack (HJ19). If the 12-second limit is exceeded from the time ready tone is applied and the time the 4-digit authorization code is dialed, the HJ19 CP applies intercept tone. If the calling party has not disconnected after 12 seconds of intercept tone, a signal is sent to disconnect the call.

- The HJ20 CP provides a means to detect the customer's desire to use the remote reoriginate and the remote flash features. The HJ20 CP recognizes the * key (remote

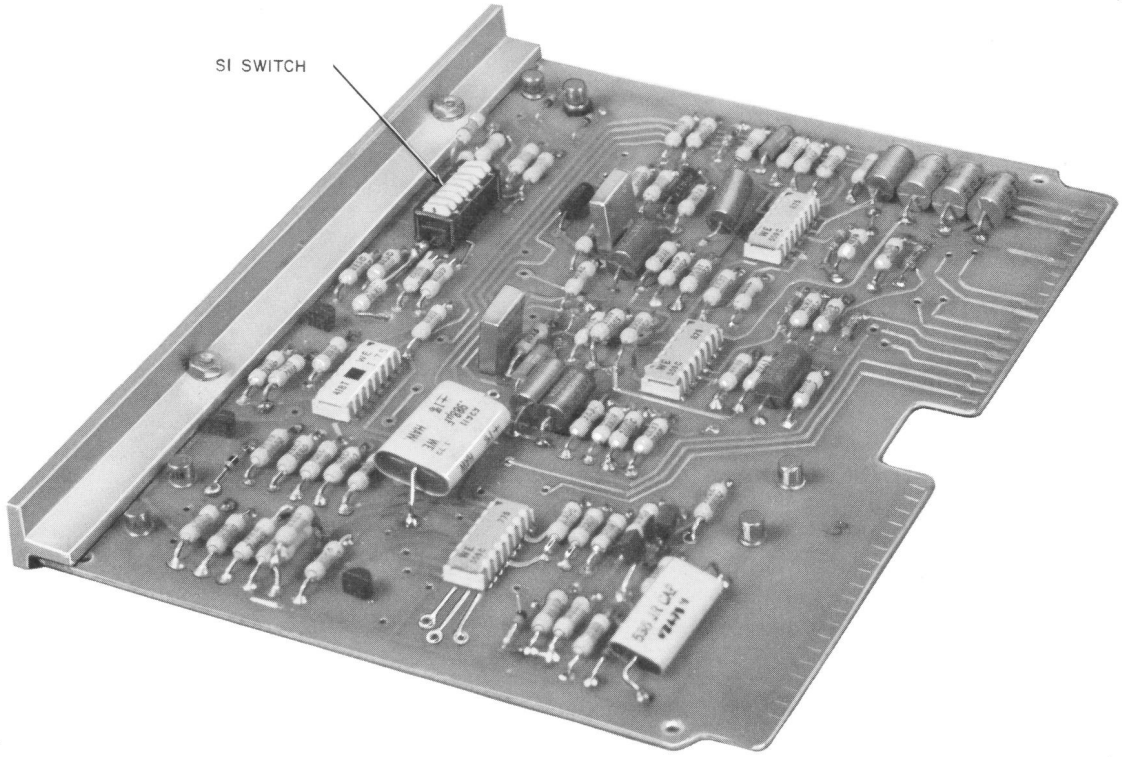


Fig. 10—HJ19 Amplifier and Tone Circuit Pack—Gain Adjustment Switch (S1)

reoriginate) or # key (remote flash) when dialed, and generates a timed signal to release the call and reapply PBX dial tone.

(f) ***Decoder and Comparator Circuit Pack (HJ21)***—The decoder and comparator CP (HJ21) is used to compare the digits dialed for the authorization code with the thumbwheel settings and, when a match occurs in the proper sequence, a signal for each digit is sent to the switch scanner and match storage CP (HJ22).

(g) ***Switch Scanner and Match Storage Circuit Pack (HJ22)***—This CP functions to provide a storage for the 4-digit authorization signals generated by the decoder and comparator CP (HJ21). When all four correct matches are received, the CP locks out any more digits and sends a signal to apply PBX dial tone to the calling party. If an incorrect digit is dialed, the CP functions to send a signal to the HJ19 CP which activates the intercept tone.

(h) ***Memory and Dial Pulse Generator Circuit Pack (HJ29)***—The HJ29 CP is an optional circuit pack for converting TOUCH-TONE dialing to dial pulses in the event the PBX or any remote terminating location cannot accept TOUCH-TONE calling signals.

218A POWER UNIT

3.06 The 218A power unit (Fig. 11 and 12) provides basic dc power to the RAU. The power unit occupies a mounting space of 5 inches wide, 8 inches high, and 5 inches deep. The power unit provides +16 volts, -16 volts, +9 volts, and ground to the RAU.

3.07 The power unit requires a 3-wire, 120-volt ac standard outlet. A 9-foot, 3-wire cord is provided as part of the unit. The power unit can be located a maximum of 30 feet from the RAU. A 30-foot, 5-conductor, 20-gauge sheathed cable is provided to connect the power unit to the RAU.

3.08 There is no power switch on the RAU or the 218A power supply. Plugging the 218A power unit into an active ac power outlet applies

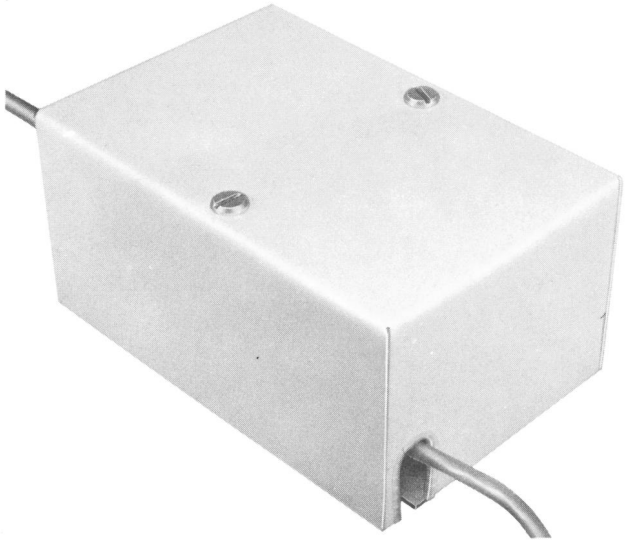


Fig. 11—218A Power Unit—Cover Installed

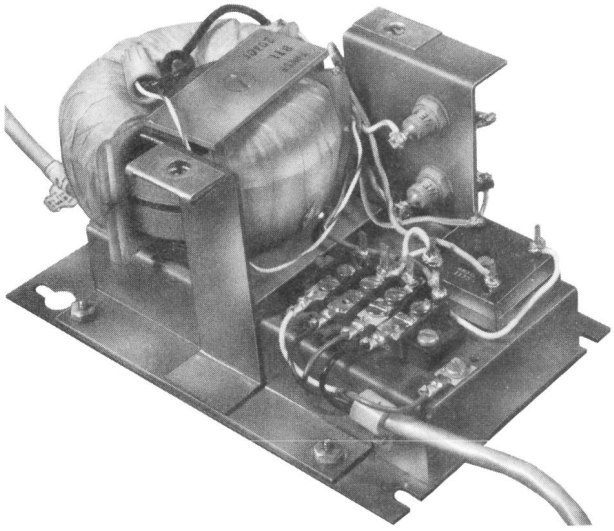


Fig. 12—218A Power Unit—Cover Removed—Terminal Strip on Left Side

power to the RAU when it is properly connnected to the 218A power unit.

731B EXTRACTION TOOL

3.09 The 731B extraction tool is used to remove the HJ-type CPs for inspection, maintenance, gain adjustments, etc. The 731B tool has a red anodized handle with a special end hook for CP extraction. The tool is stored inside the 156A cover on either side of the 89C carrier.

3.10 A left-side view of the carrier showing the 731B extraction tool is in Fig. 13, and the slot locations for inserting the tool in order to remove the CP are shown in Fig. 7.

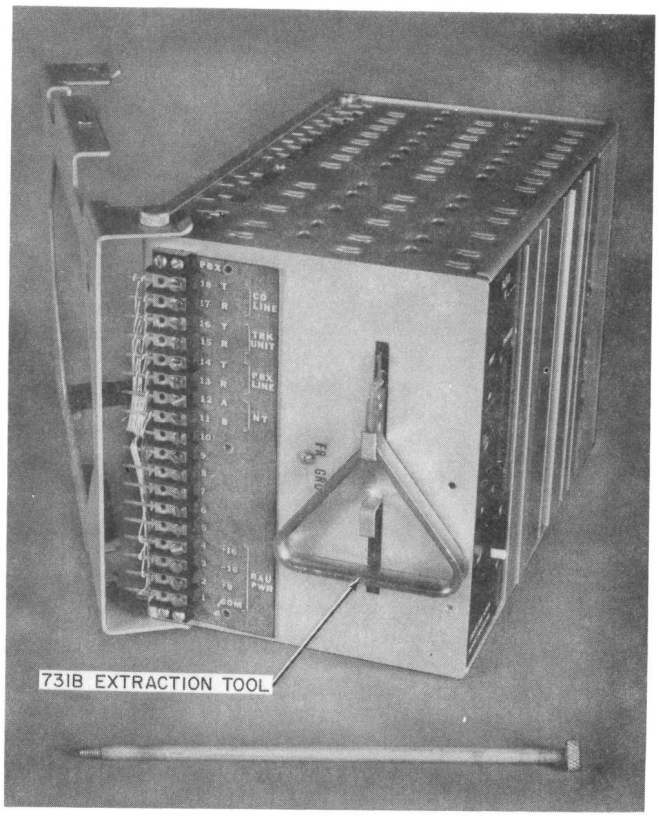


Fig. 13—Remote Access Unit Carrier—731B Extraction Tool

156A COVER

3.11 The 156A access cover provides a decorative and protective cover for the 89C apparatus mounting and circuit packs. The cover assembly completely encloses the circuit packs, carrier, and mounting plate when installed on the mounting surface. It protects the RAU from dust, dirt, and other contamination. The cover does not seal the RAU. It does have heat outlet vents in each end as well as a sliding door for control panel

access. Fig. 4 shows the 156A cover installed on the RAU with the customer access panel in the open position. Two large headed captive screws on the wall mounting plate that fit into slots in the plastic cover hold the cover to the mounting plate by pressure.

4. INSTALLATION AND CONNECTIONS

4.01 The RAU is installed on the customer premises and is designed to be wall-mounted. The 89C carrier is removed from the wall mounting plate while the mounting plate is being secured to the wall with four screws. A wall area with a 110-volt, 60-Hz, 3-wire standard outlet is required. Connections are made to the unit using terminal strips on the side of the carrier. When selecting a location(s) to mount the RAU(s) and to make the necessary connections, the following should be observed.

WARNING: The RAU must be installed and operated in a vertical position to prevent damage to the mercury relay on the HJ18 CP.

(a) Install the RAU and 218A power unit on a wall so that the cabling run is no longer than 30 feet when connected.

(b) Mount the carrier where the hinge pins can be installed or removed from the top of the carrier. Approximately 18 inches clearance above the carrier and mounting plate is needed.

(c) The carrier can swing to the left or right; therefore, install the carrier so that it can swing fully to the left or right without any obstruction. An approximate 12-inch clearance on each or either side of the carrier is needed.

(d) The entire carrier assembly is protected by the 156A cover. Connect the cabling to the carrier so that the cable cut-outs on the bottom of the cover will slide over the cable.

(e) Route the cabling alongside of the terminal strip.

4.02 The RAU circuitry is connected to a CO ground start circuit and a station line circuit. Connections to the unit can be terminated from the left or right side. (See 3.03.) Terminal strips are mounted on both sides. The left terminal strip is used for the PBX/CTX application connections, while the right terminal strip is used when connecting to the unit for a KTS application. Connection information for the PBX application is shown in Fig. 14 and 15, the CTX application is shown in Fig. 16, and the KTS application is shown in Fig. 17.

4.03 If an HJ29 CP (TOUCH-TONE dialing to dial pulse conversion) is to be installed in the RAU, remove the spacer plate shown in Fig. 18 by removing the screw on the right side. Invert and rotate the spacer plate and install in the RAU with the side screw per Fig. 19. Insert the HJ29 CP in the slot provided (Fig. 19).

4.04 A power check should be made on the RAU. Prior to applying power to the RAU, remove all CPs from the carrier with the 731B extraction tool. Check the power for correct voltage and polarity on the carrier terminal strip per Fig. 14 through 17. A safety ground test on each unit should also be performed.

4.05 A typical installation for the RAU is shown in Fig. 20.

4.06 Refer to Table B for the maximum conductor loop resistance when connecting to the CO and the attendant console (KTS application).

5. ENVIRONMENT AND POWER REQUIREMENTS

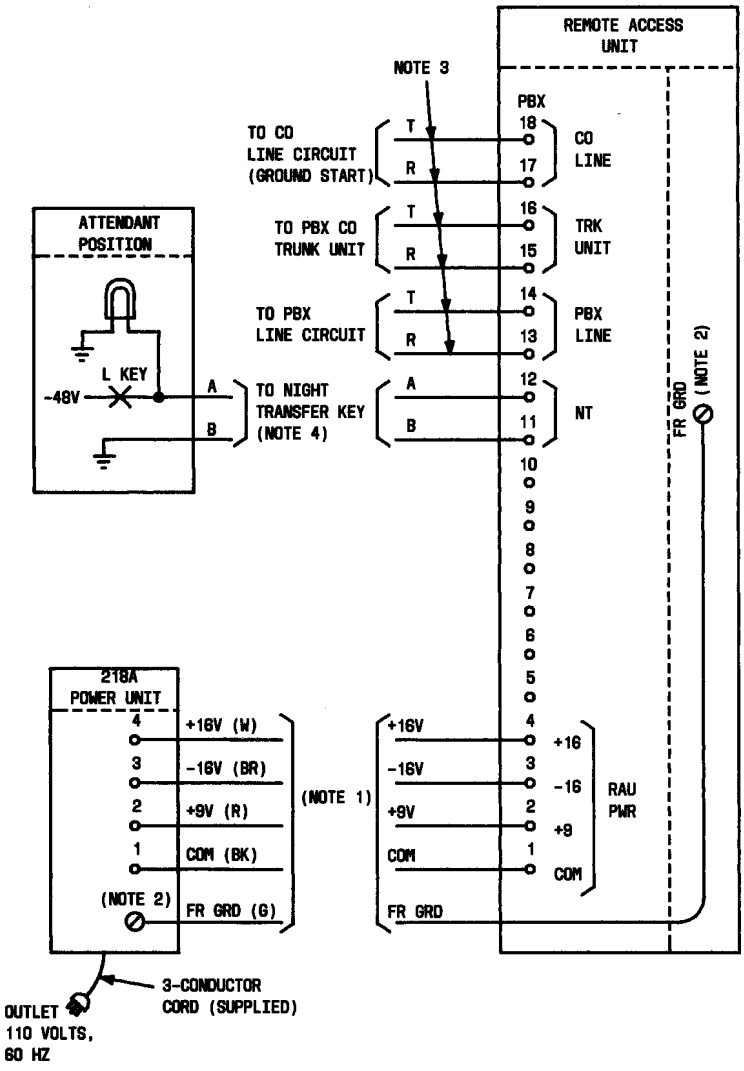
ENVIRONMENT

5.01 The RAU should be installed in an area where the customer has access to it. The recommended environmental operating ambient temperature range for the RAU is 40 to 100°F not to exceed 120°F maximum or 35°F minimum for any short term. The recommended relative humidity operating range is 15 to 55 percent. For any short term, the maximum relative humidity is not to exceed 80 percent and the minimum is 15 percent.

Note: "Short term" is a period of time not to exceed 3 days at a time and 15 days per year.

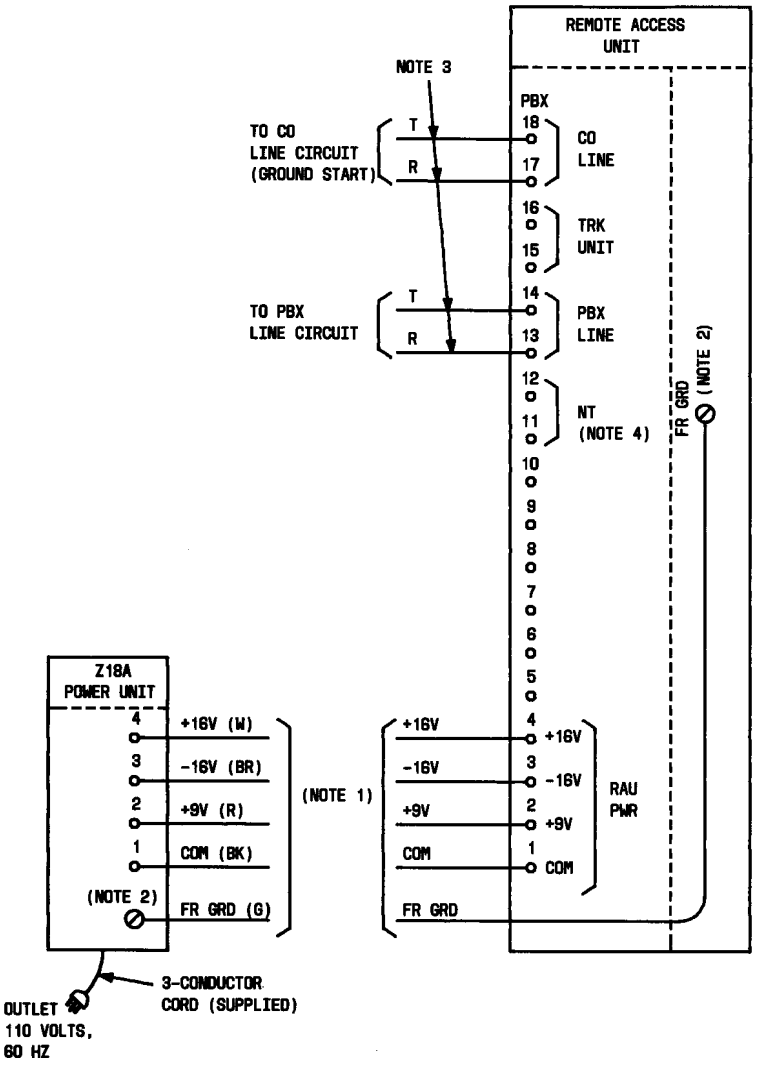
POWER

5.02 The RAU requires 110 volts ac, 60 Hz, using a standard 3-wire outlet. The maximum current drain, under normal operating conditions,



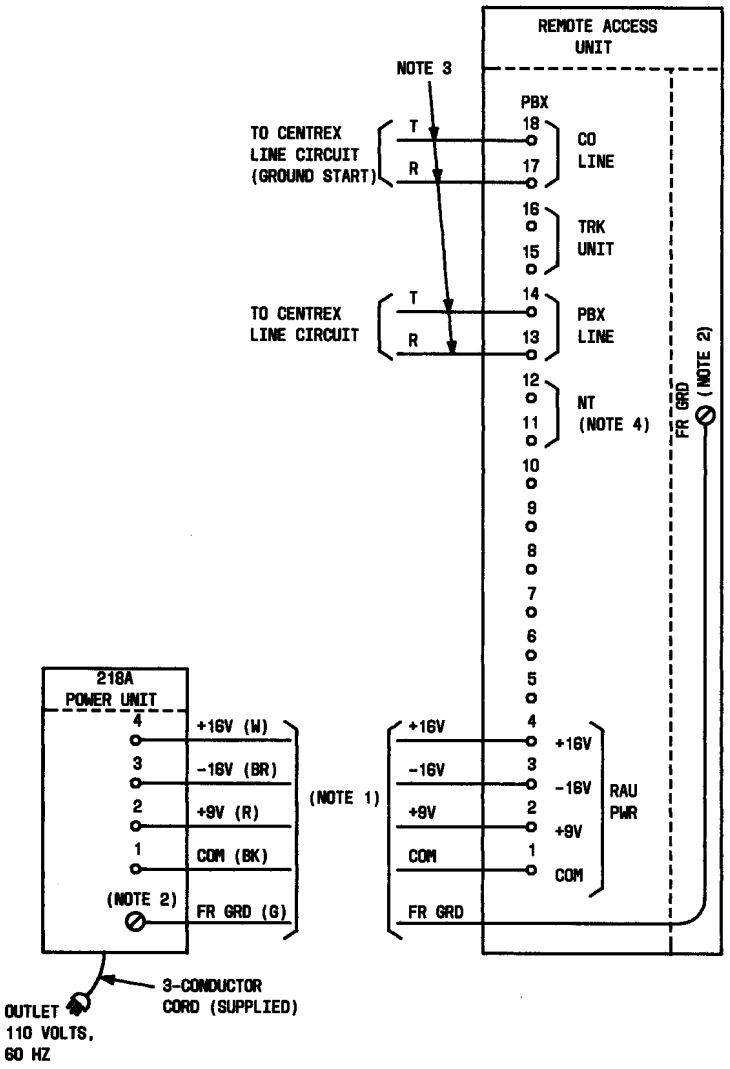
NOTES:
1. INSTALLER SHALL USE 5-CONDUCTOR, 20-GAUGE CABLE PROVIDED. THIS CABLE IS TO BE CUT TO LENGTH (MAX 30 FT - 9.14 M) AND TERMINATED WITH SPADE TIP TERMINALS.
2. SCREW CONNECTION ON SIDE OF RAU AND POWER UNIT IS PROVIDED FOR SAFETY GROUND.
3. EACH CIRCUIT TIP AND RING SHOULD BE A TWISTED PAIR.
4. THE NIGHT TRANSFER FEATURE CAN BE CONTROLLED FROM KEY AT AN ATTENDANT POSITION. IT CAN BE CONTROLLED WITH ON/OFF SWITCH ON CONTROL PANEL AND, WHEN USED, THE A AND B LEADS ARE NOT TO BE PROVIDED.

Fig. 14—Remote Access Unit—Connections—PBX Application With Night Transfer—Terminal Strip on Left Side



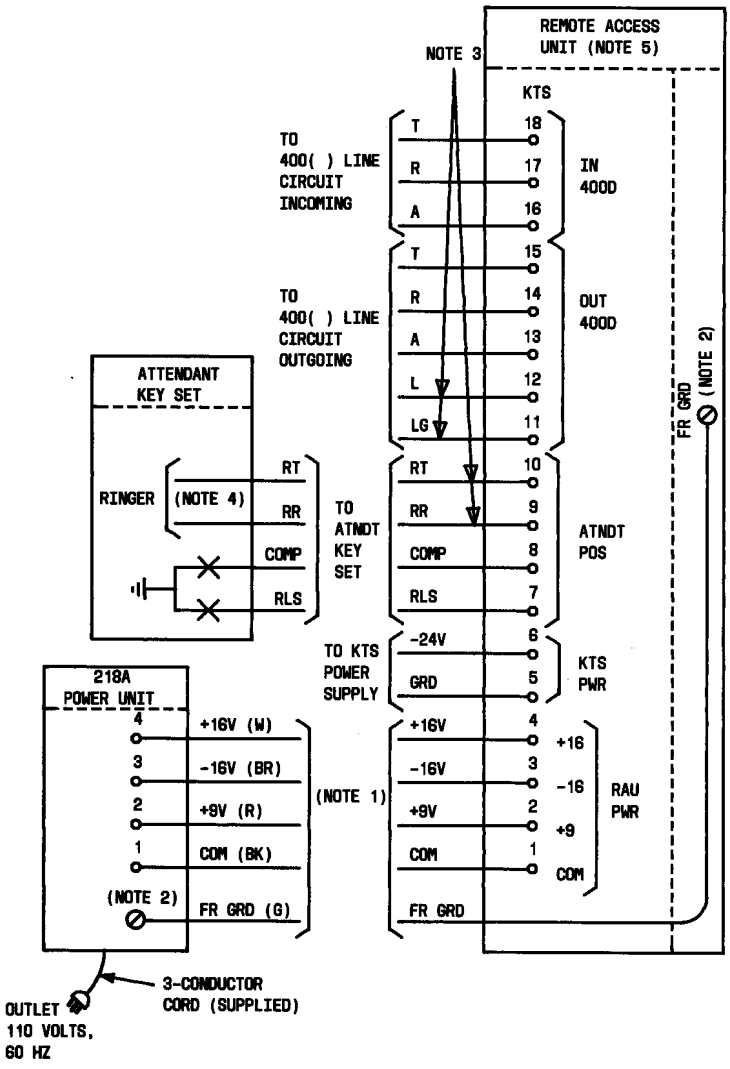
NOTES:
1. INSTALLER SHALL USE 5-CONDUCTOR, 20-GAUGE CABLE PROVIDED. THIS CABLE IS TO BE CUT TO LENGTH (MAX 30 FT - 9.14 M) AND TERMINATED WITH SPADE TIP TERMINALS.
2. SCREW CONNECTION ON SIDE OF RAU AND POWER UNIT IS PROVIDED FOR SAFETY GROUND.
3. EACH CIRCUIT TIP AND RING SHOULD BE A TWISTED PAIR.
4. WHEN A DEDICATED CO LINE CIRCUIT IS USED, TIGHTEN DOWN THE SCREW SWITCH (OPTION Z) ON CIRCUIT PACK HJ13. (SEE FIG. 9.)

Fig. 15—Remove Access Unit—Connections—PBX Application Without Night Transfer—Terminal Strip on Left Side



NOTES:
1. INSTALLER SHALL USE 5-CONDUCTOR, 20-GAUGE CABLE PROVIDED. THIS CABLE IS TO BE CUT TO LENGTH (MAX. 30 FT - 9.14 M) AND TERMINATED WITH SPADE TIP TERMINALS.
2. SCREW CONNECTION ON SIDE OF RAU AND POWER UNIT IS PROVIDED FOR SAFETY GROUND.
3. EACH CIRCUIT TIP AND RING SHOULD BE A TWISTED PAIR.
4. WHEN THE RAU IS USED IN A CENTREX APPLICATION, TIGHTEN DOWN THE SCREW SWITCH (OPTION Z) ON CIRCUIT PACK HJ13. (SEE FIG. 9).

Fig. 16—Remote Access Unit—Connections—Centrex Application—Terminal Strip on Left Side



NOTES:
1. INSTALLER SHALL USE 5-CONDUCTOR, 20-GAUGE CABLE PROVIDED. THIS CABLE IS TO BE CUT TO LENGTH (MAX. 30 FT - 9.14 M) AND TERMINATED WITH SPADE TIP TERMINALS.
2. SCREW CONNECTION ON SIDE OF RAU AND POWER UNIT IS PROVIDED FOR SAFETY GROUND.
3. THESE ARE TWISTED PAIR.
4. A BELL OR BUZZER IS REQUIRED AND CONNECTED TO THE RT AND RR LEADS.
5. TIGHTEN THE SCREW SWITCH (OPTION Z) ON CIRCUIT PACK HJ13 (SEE FIG. 9)

Fig. 17—Remove Access Unit—Connections—KTS Application—Terminal Strip on Right Side

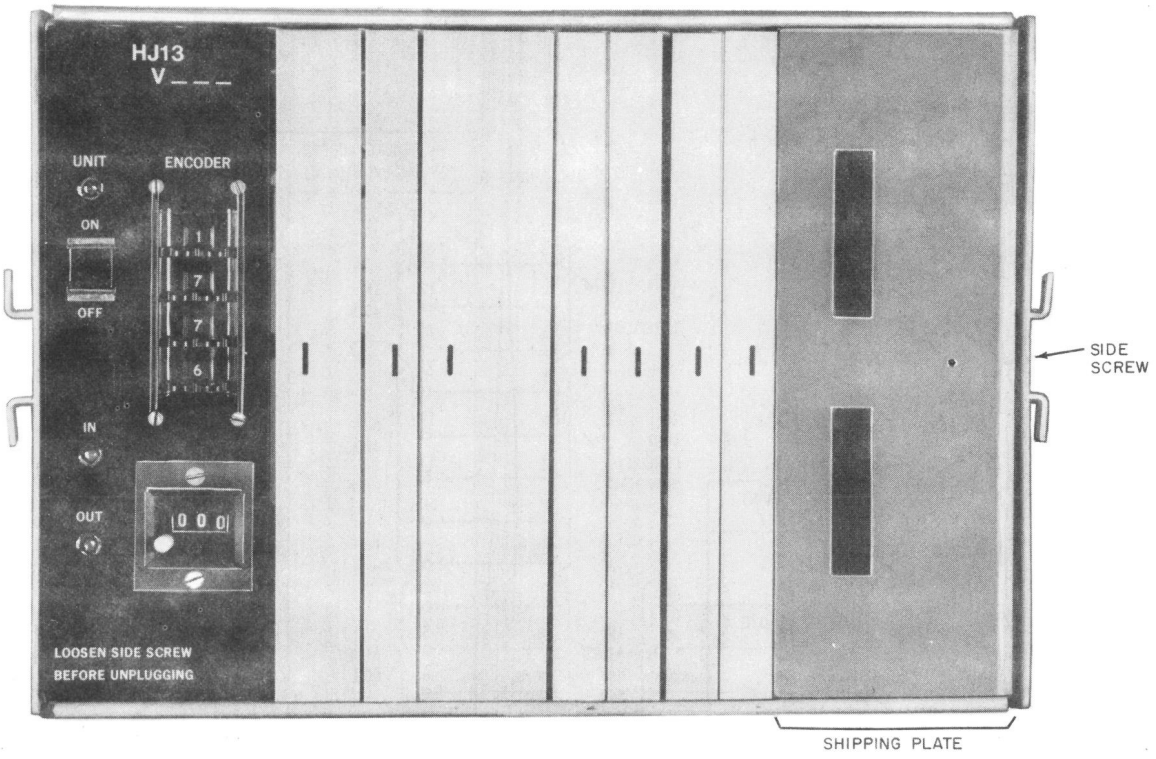


Fig. 18—Remote Access Unit Carrier—Shipping Plate Shown Without HJ29 Circuit Pack

is 0.5 ampere. The maximum ac input to the 218A power unit at 60 Hz is 129 volts and the minimum is 105 volts.

5.03 The power supply consists of a 218A power unit, a power check circuit, and a regulator. The power check circuit and regulator are part of the HJ13 CP. The output of the 218A power unit is connected to the HJ13 CP power check circuit. The power check circuitry performs a protective function. If the four input potentials (+16V, -16V, +9V, and ground) from the 218A power unit are incorrectly connected or not connected, these input potentials will not close through to the regulator. The regulator filters the +16, -16, and +9 volt inputs and produces +12, +6, +5, -12, and -6 volt outputs for the various circuit packs. The 218A power unit have a line fuse and a thermal fuse.

6. USER OPERATIONS

6.01 When the user desires to make a call using the remote access unit (RAU), the caller goes off-hook from a remote or off-premises TOUCH-TONE service telephone set and receives dial tone from the CO.

6.02 The user then dials the 7-digit CO circuit number connected to the RAU. The user will hear a short burst of ringing followed by a steady "ready tone" (440 Hz) indicating to the calling party that the RAU has been seized and is ready to accept the 4-digit authorization code.

6.03 The user must dial the 4-digit authorization code within 15 seconds after receiving ready tone. If the correct code is dialed, the RAU accepts the call, removes the 440-Hz ready tone, and returns PBX dial tone to the calling party. If the user has not dialed the authorization code within 15 seconds or has dialed an incorrect code, intercept tone is returned (620 Hz on 0.2 second and 440 Hz on 0.2 second, alternately). If the calling party does not hang up for 15 more seconds, the RAU will automatically time-out and disconnect the call. If the user receives intercept tone, the user must hang up and redial the 7-digit CO number and the 4-digit authorization code to retry the call.

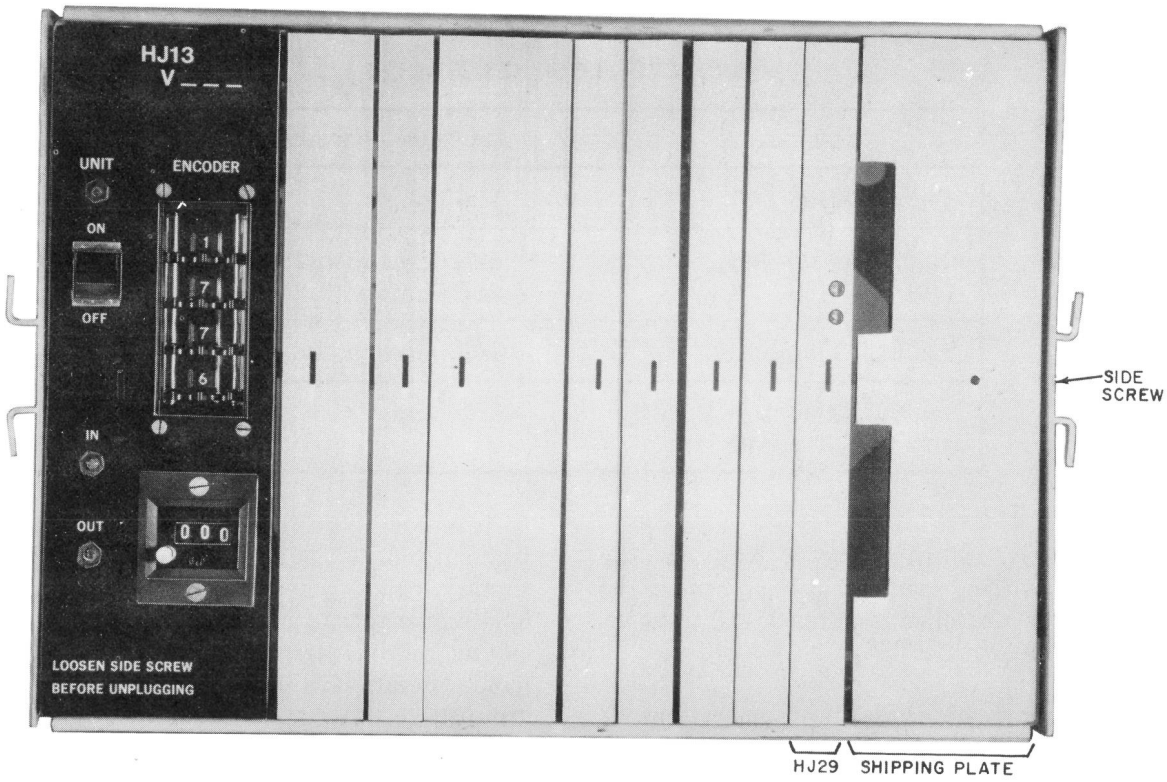


Fig. 19—Remote Access Unit Carrier—Shipping Plate Shown With HJ29 Circuit Pack Installed

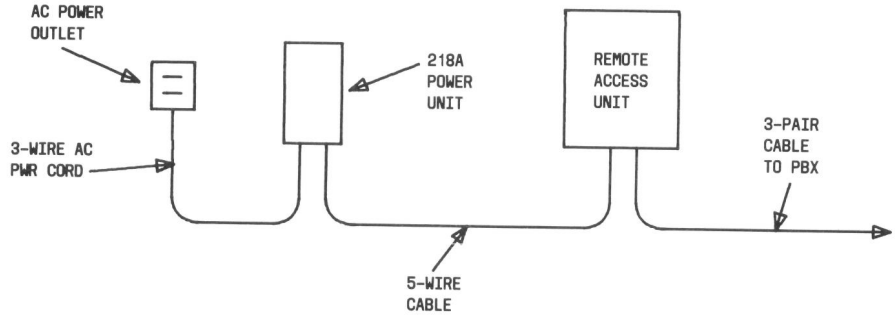


Fig. 20—Remote Access Unit—Typical Installation

6.04 After receiving PBX dial tone, the user can then dial the access code for any feature, tie trunk, WATS line, etc, for the class of service authorized to the station line connected to the RAU provided it is within the PBX, CTX and/or KTS capabilities.

6.05 If the calling party wants to originate a second call, the RAU is equipped with a remote reoriginate feature. This feature permits the calling party to obtain PBX dial tone by dialing the * key on the TOUCH-TONE dialing unit without having to hang up and reinitiate the call by dialing the CO number and authorization code. This feature is normally used when the called station is busy or does not answer, or when a wrong code or wrong number is dialed.

6.06 Provided the PBX or CTX is so equipped, a call transfer or switchhook flash condition

TABLE B

CONDUCTOR LOOP RESISTANCES

CONNECTION	MAXIMUM LOOP RESISTANCE
Central office	1200 ohms
Night transfer key	500 ohms with 48 volts 250 ohms with 24 volts
L and LG lamp leads	100 ohms
Attendant console COMP and RLS key leads	300 ohms

can be made by dialing the # key on the TOUCH-TONE dialing pad. This conditions the calling station for controlled conference, call transfer, etc (not available with KTS).

6.07 A flowchart of these user operations is shown in Fig. 21.

7. CIRCUIT DESCRIPTION

PBX OR CTX APPLICATION

7.01 After the calling party dials the RAU 7-digit CO number, the central office applies ringing voltage to the tip and ring leads of the RAU. Ringing voltage is detected by the CO interface circuit pack (HJ18) and trips the ringing signal from the CO in approximately 0.5 second.

7.02 The 0.5-second delay allows the calling party to hear a burst of ringback before ready tone is returned.

7.03 After ringing is tripped, loop current starts to flow over the tip and ring leads from the CO. The CO interface senses the current and holds the connection.

7.04 The tone control is enabled, activating the tone gate in the amplifier and tone control circuit pack (HJ19) and allowing the tone oscillator (440 Hz) to be coupled to the calling party. The calling party, on receipt of this ready tone, is notified that the authorization code is to be dialed.

7.05 When the calling party dials the authorization code, a TOUCH-TONE calling signal is transmitted by the set for each digit dialed. Each signal, which consists of a high-frequency and low-frequency tone, is separated by the TOUCH-TONE calling receiver circuit packs (HJ14 and HJ17) by band separation filters into low- and high-frequency groups.

7.06 The output of the filters is fed into channel detectors with each channel detector detecting a particular frequency.

7.07 Each time a digit is dialed, two output signals (one from the high group detectors and one from the low group detectors) are encoded (2-out-of-7 code) and sent to the 2-out-of-7 binary coded decimal (BCD) decoder of the decoder and comparator circuit pack (HJ21).

7.08 When the first digit of the authorization code is dialed, the TOUCH-TONE calling signal is detected by the TOUCH-TONE service receiver (HJ14 and HJ17 CPs) and stored in the comparator (HJ21 CP). At this time, the tone gate is disabled and ready tone is removed.

7.09 The next three digits of the authorization code are also stored in the comparator. The comparator matches the incoming TOUCH-TONE calling digits, one at a time, with the thumbwheel settings selected by the customer.

7.10 After the fourth digit is matched, the switch scanner and match storage CP (HJ22) causes the line start and indicator driver in the HJ20 CP to operate. This action closes the loop to the PBX via the CO and PBX interface circuit pack (HJ18).

7.11 After the loop to the PBX is closed, the PBX line circuit is seized and dial tone is returned to the calling party. The green progress indicator LED is lighted (HJ13 CP). This indicates that the PBX line circuit has been seized and that a call is in progress through the RAU.

7.12 When the calling party hears PBX dial tone, the party can dial a call or feature available to the PBX.

KTS APPLICATION

7.13 A KTS operates as described in 7.01 through 7.12 when the WATS line is idle. In addition, when ringing is tripped, the connection is held, and the keys (lamps) on the attendant console associated with the RAU and with the WATS line illuminate. These keys remain lighted for the duration of the call.

7.14 When the WATS line is busy and a user dials the RAU 7-digit CO number, the night transfer is activated and ringing from the CO rings the attendant console. The attendant depresses the pickup key corresponding to the incoming line. Ringing is tripped and the attendant handset is connected to the incoming call. The attendant can now converse with the calling party.

7.15 When the WATS line becomes idle, the attendant can connect the calling party to the WATS line by operating the COMP (complete) key. This causes the PBX interface to close the loop to the WATS line via the KTS outgoing line circuit. The calling party and the attendant will hear dial tone over the WATS line. The calling party or the attendant can dial the call.

7.16 If the attendant dials for the calling party and wishes to release the call, the attendant depresses the RLS (release) key.

8. TROUBLE LOCATING PROCEDURES

MAINTENANCE PHILOSOPHY

8.01 The maintenance repair philosophy is to isolate a failure to a faulty circuit pack (CP). The faulty CP is replaced and returned to the factory for repair or discard.

8.02 Fig. 22 through 27 are step-by-step procedures to be followed in isolating a failure to a specific CP for a particular trouble. The trouble locating procedures assume (1) that the RAU has been correctly installed, tested, and initially operating, and (2) that only one trouble exists for any one particular failure.

8.03 The trouble locating procedures (Fig. 22 through 27) consist of action and decision blocks in a numerical step-by-step order. Following the procedures should lead the maintenance person to a faulty circuit pack which can be replaced. When the word ***END*** appears after a step, the faulty CP normally should have been located. After replacing the CP, a verification test should be performed. If the test is unsuccessful, the trouble locating procedures should be repeated until the trouble is located.

8.04 The CP terminals referenced in the procedures in Fig. 22 through 27 are located on the 908E connectors of the carrier backplane as shown in Fig. 28. The A- terminals are on the top connectors of the CPs and the B- terminals are on the bottom connectors. The terminal numbers are stamped on the back of the connectors.

8.05 As a general rule, voltages should be checked prior to performing the trouble locating procedures. Voltages can be checked at the terminal strip on either side of the RAU per Fig. 14, 15, 16, or 17.

LOGIC PROBE

8.06 It is recommended that a logic probe be used during the trouble analysis to isolate the fault to a particular CP. Use of a logic probe minimizes the number of times a CP must be removed and reinserted. This prevents troubles created by connector wear and improper insertion of the CPs in their connectors.

8.07 A CP replacement sequence shown on each trouble locating procedure can be followed when a logic probe is not available.

8.08 An HP-10525T logic probe (Fig. 29) or equivalent is recommended. The logic probe is used to test for the appropriate ***high*** or ***low*** logic levels called out in the procedures.

8.09 An indicator lamp on the logic probe indicates the state of the logic level. This lamp has three states: off, dim, and bright. The lamp is

normally in the dim state and changes to one of the other two states by voltage levels at the probe tip.

8.10 When touched to a ***high*** level, a bright band of light appears around the entire probe tip; when touched to a ***low*** level, the light extinguishes. Open circuits or voltages in the bad level region cause lamp illuminations at half brilliance. The lamp flashes at a frequency of 10 Hz when the input frequency is 10 Hz or greater.

8.11 A +5 volt supply is required for logic probe operation. The +5 volts is obtained by attaching an adpater (BNC to alligator clips) to the probe and connecting it to the CP terminals on back of the RAU terminals per Table C. The red clip connects to + 5 volts, and the black clip to GRD A.

9. REFERENCE INFORMATION

9.01 The following sections and schematic drawings (SD) are listed by category to provide additional information on the subject contained in this section.

9.02 *Equipment Design Requirements*

SECTION	TITLE
809-121-150	Common Equipment—Equipment Design Requirements—PBX Systems

9.03 *Connecting Circuits*

SD	DESCRIPTION
1A106-01	No. 1 ESS—Line Switching Circuit
1E011-02	801A PBX Line Circuit
1E211-02	805A PBX Line Circuit
1E304-01	800A PBX Line Circuit
1E333-01	770A PBX Line Circuit
1E397-01	812A PBX Line Circuit
26030-01	No. 5 Crossbar System—Line, Link, and Marker Connector Control Circuit
32123-01	No. 1 Step-By-Step System—350A, 355A, and 360A—Subscriber Line Circuit
65741-01	756A PBX Line Circuit
66715-01	701A PBX Line Circuit
66733-01	757A PBX Line Circuit
69513-01	400D KTS Line Circuit

9.04 *Related Circuits*

SD	DESCRIPTION
1C586-01	TOUCH-TONE Calling Receiver Circuit—Type G1
1E504-01	Converter Circuit

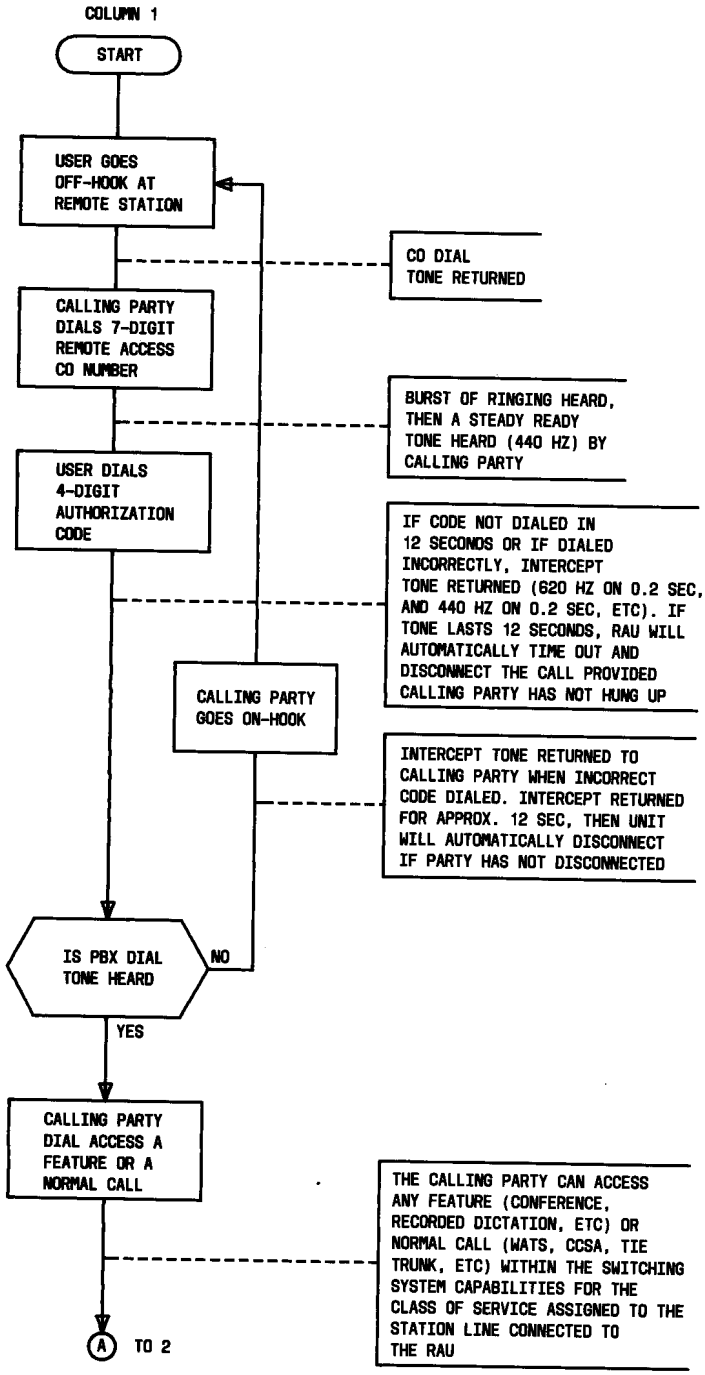


Fig. 21—User Operations Flowchart (Sheet 1 of 2)

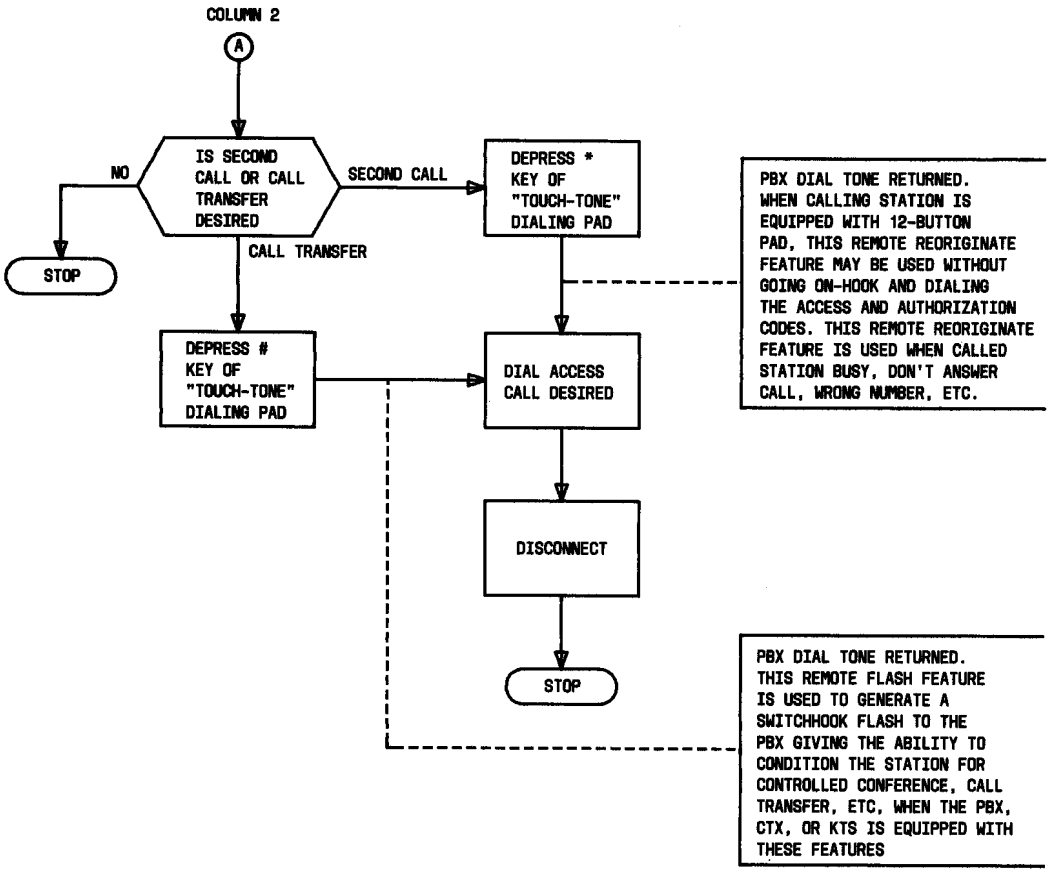
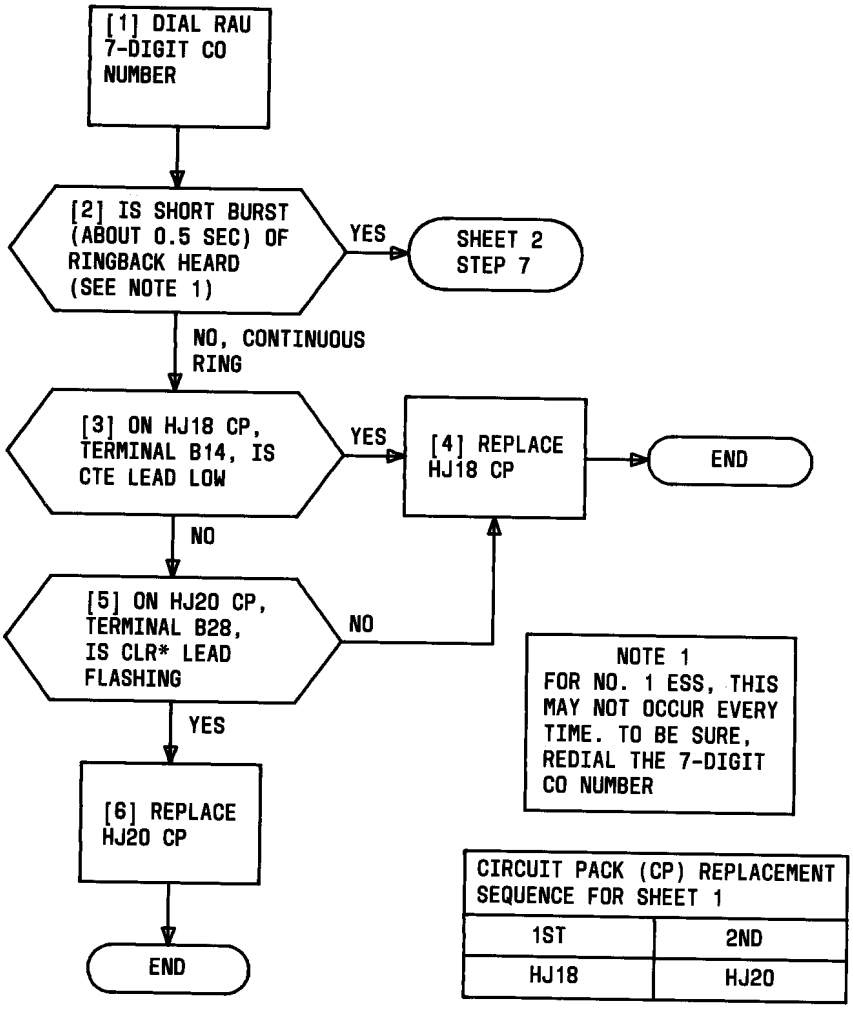


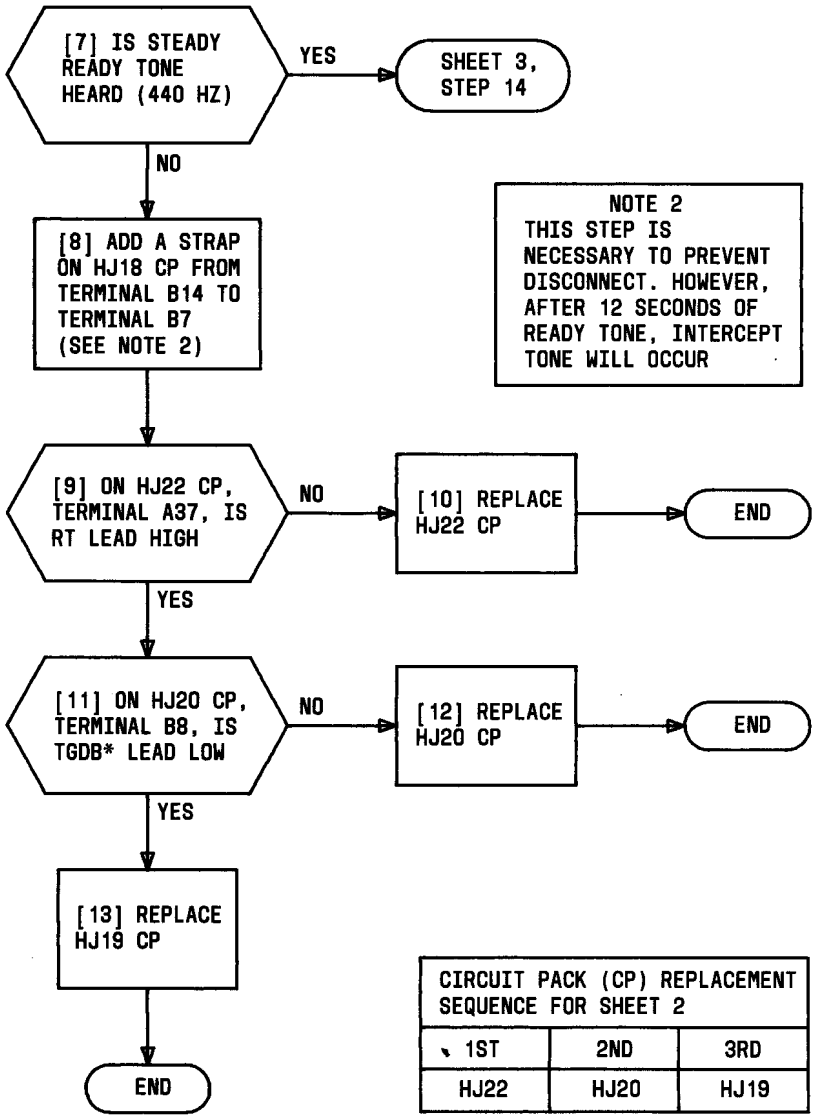
Fig. 21—User Operations Flowchart (Sheet 2 of 2)



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 1

1ST	2ND
HJ18	HJ20

Fig. 22—Clear Remote Access Trouble (Sheet 1 of 7)



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 2		
1ST	2ND	3RD
HJ22	HJ20	HJ19

Fig. 22—Clear Remote Access Trouble (Sheet 2 of 7)

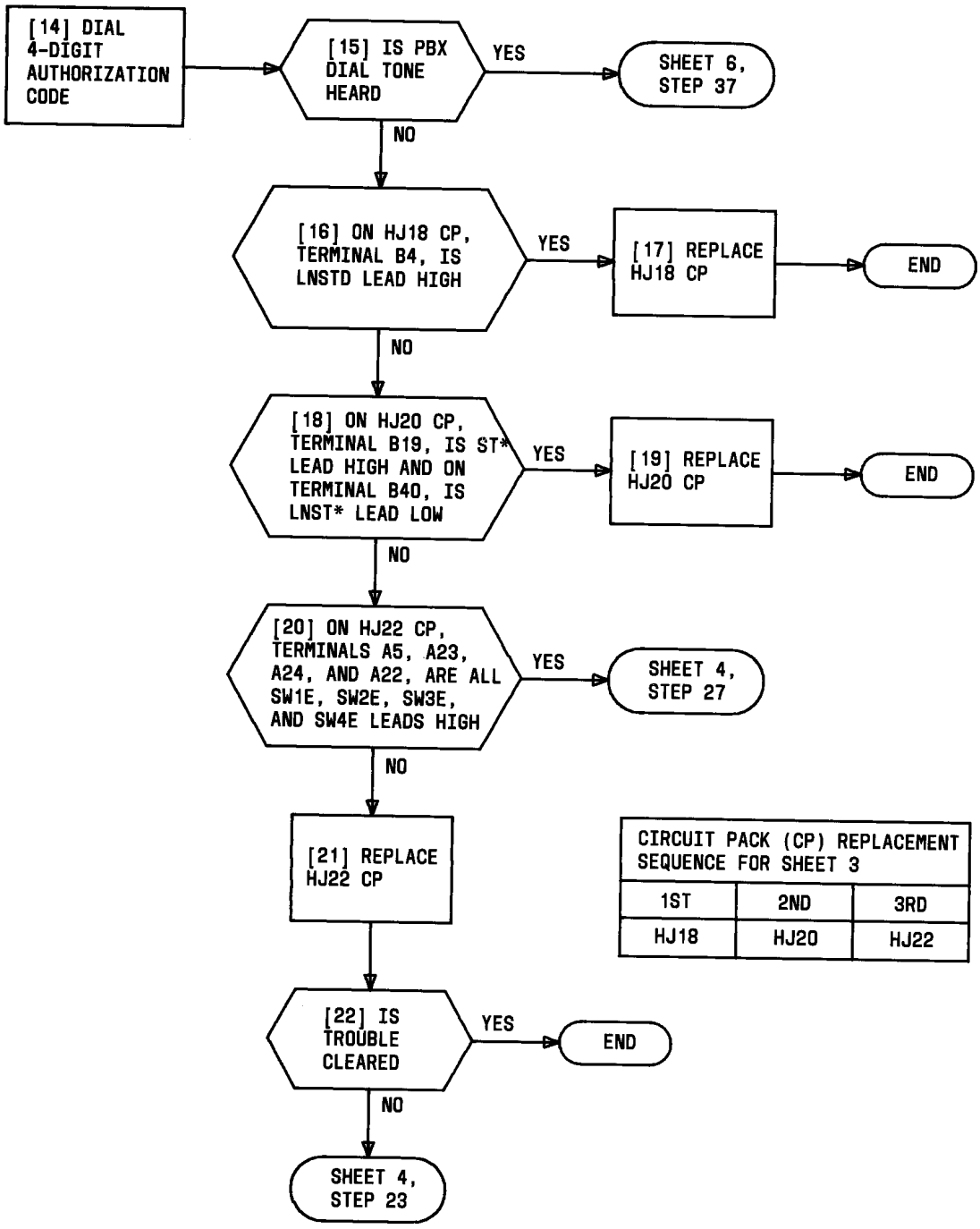
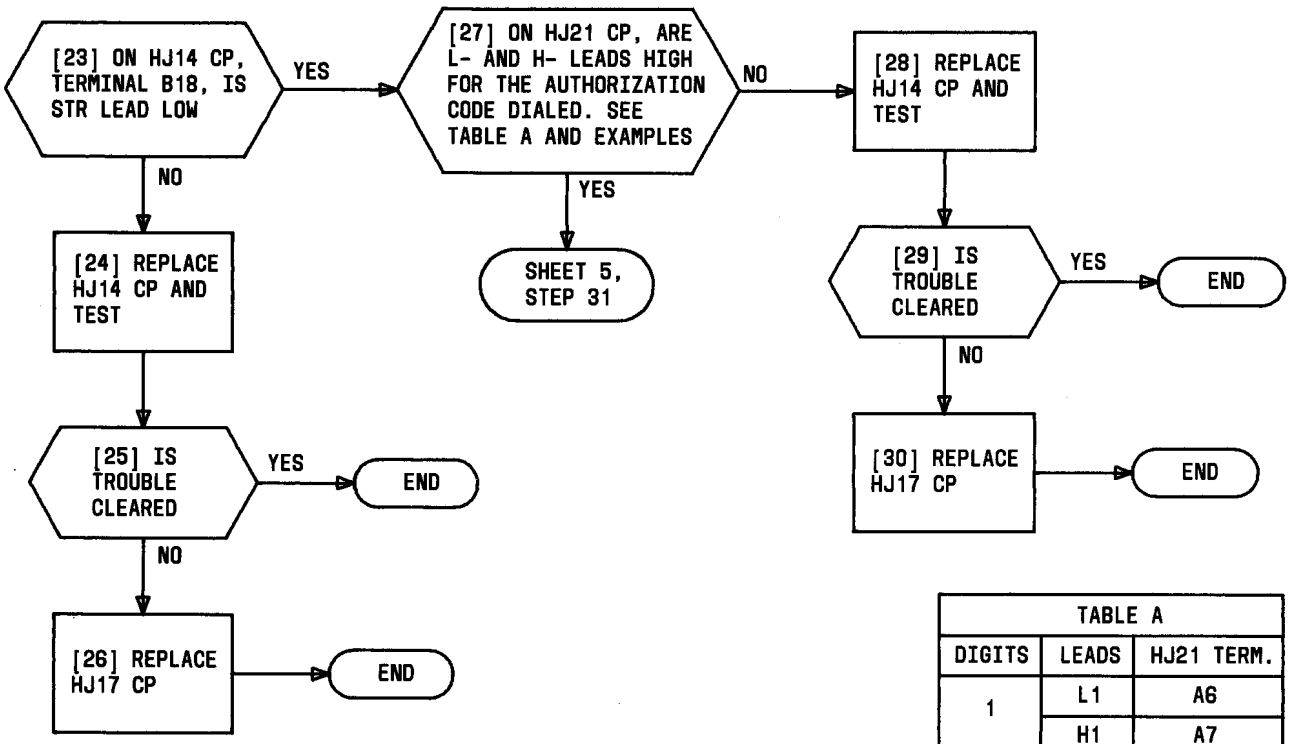


Fig. 22—Clear Remote Access Trouble (Sheet 3 of 7)



EXAMPLES			
AUTH CODE	DIGITS DIALED	LEADS HIGH	HJ21 TERM.
	EXAMPLE 1		
	1	L1 H1	A6 A7
	7	L3 H1	A1 —
	7	L3 H1	— —
	6	L2 H3	A10 A9
	EXAMPLE 2		
	5	L2 H2	A10 A8
	6	L2 H3	— A9
	9	L3 H3	A1 —
	4	L2 H1	— A7

CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 4	
1ST	2ND
HJ14	HJ17

TABLE A		
DIGITS	LEADS	HJ21 TERM.
1	L1	A6
	H1	A7
2	L1	A6
	H2	A8
3	L1	A6
	H3	A9
4	L2	A10
	H1	A7
5	L2	A10
	H2	A8
6	L2	A10
	H3	A9
7	L3	A1
	H1	A7
8	L3	A1
	H2	A8
9	L3	A1
	H3	A9
0	L4	A4
	H2	A8

Fig. 22—Clear Remote Access Trouble (Sheet 4 of 7)

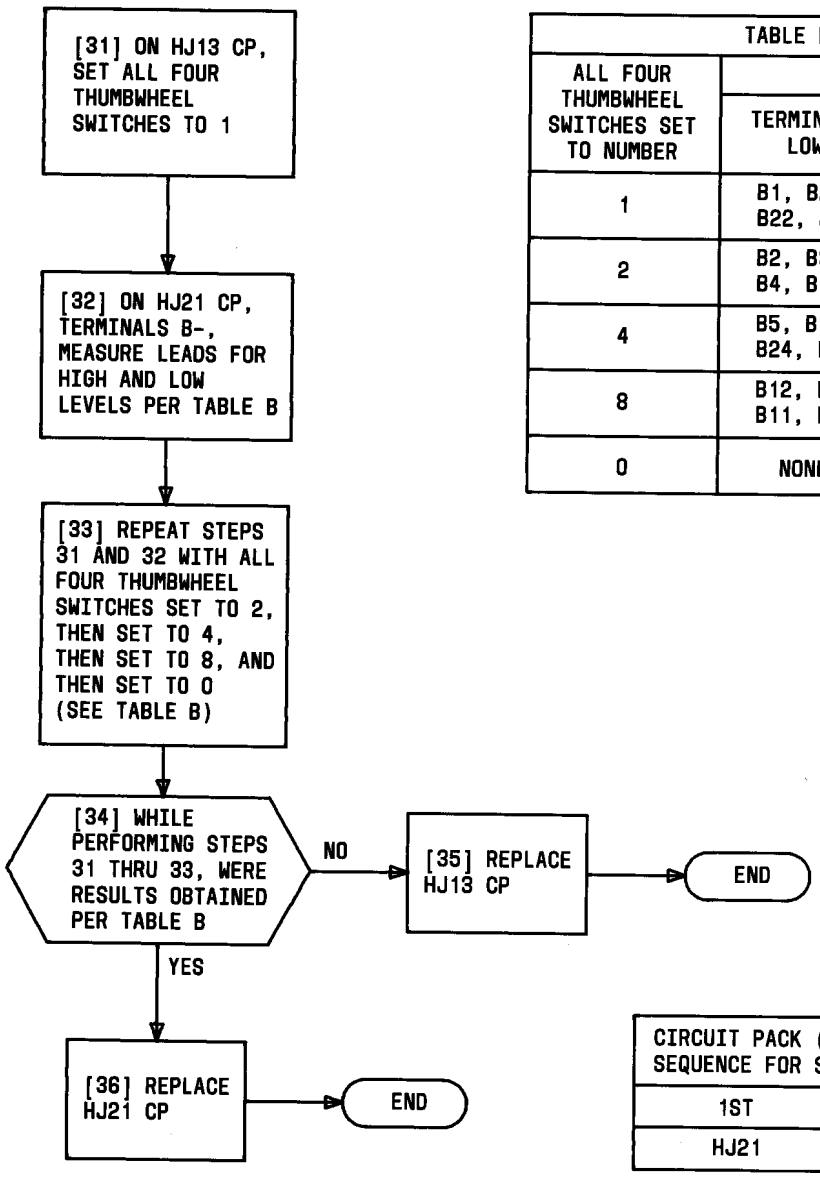
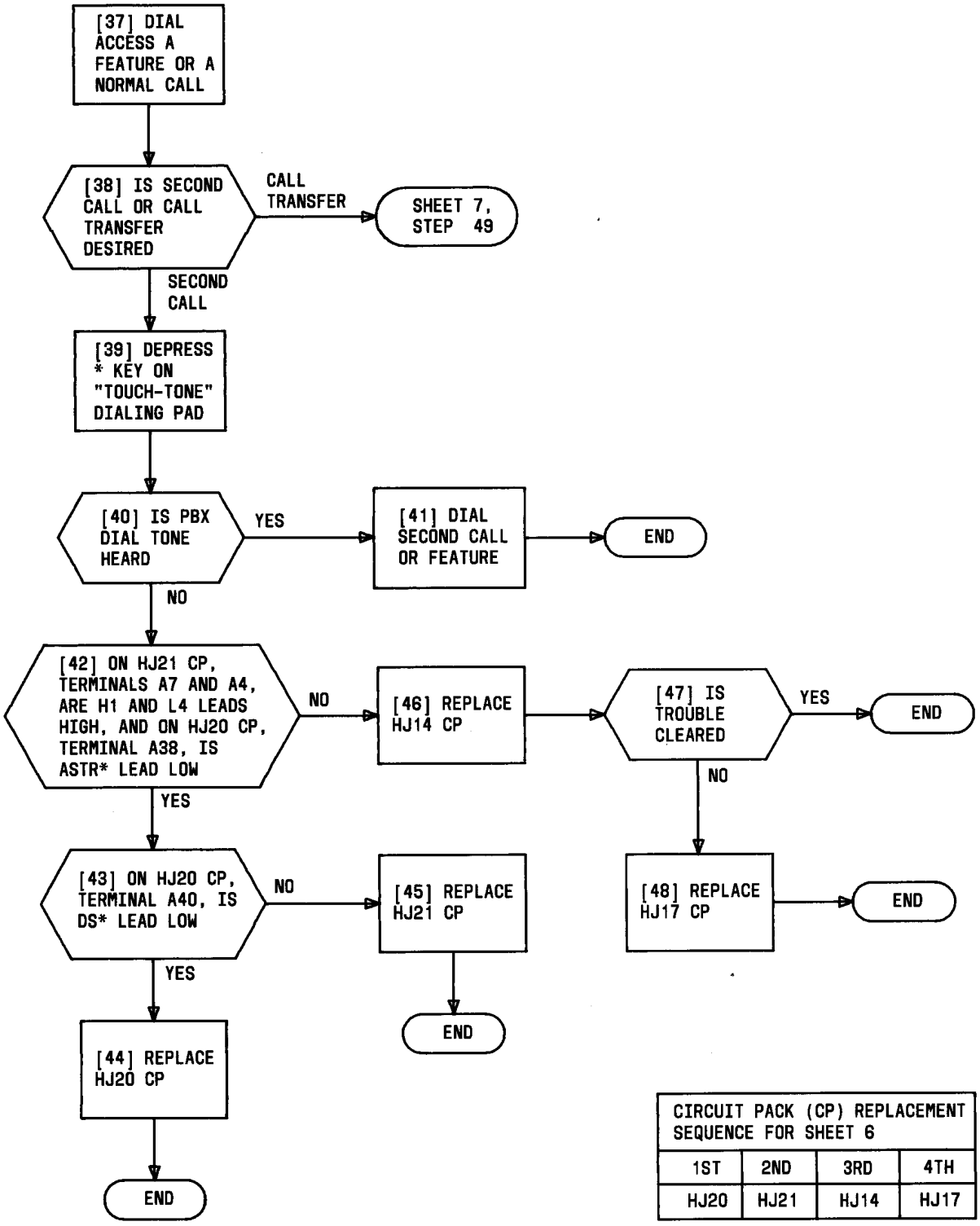


TABLE B		
ALL FOUR THUMBWHEEL SWITCHES SET TO NUMBER	HJ21 CP	
	TERMINALS LOW	TERMINALS HIGH
1	B1, B21 B22, B23	ALL OTHERS ON TERMINAL B
2	B2, B3 B4, B19	
4	B5, B10 B24, B25	
8	B12, B13 B11, B20	
0	NONE	ALL

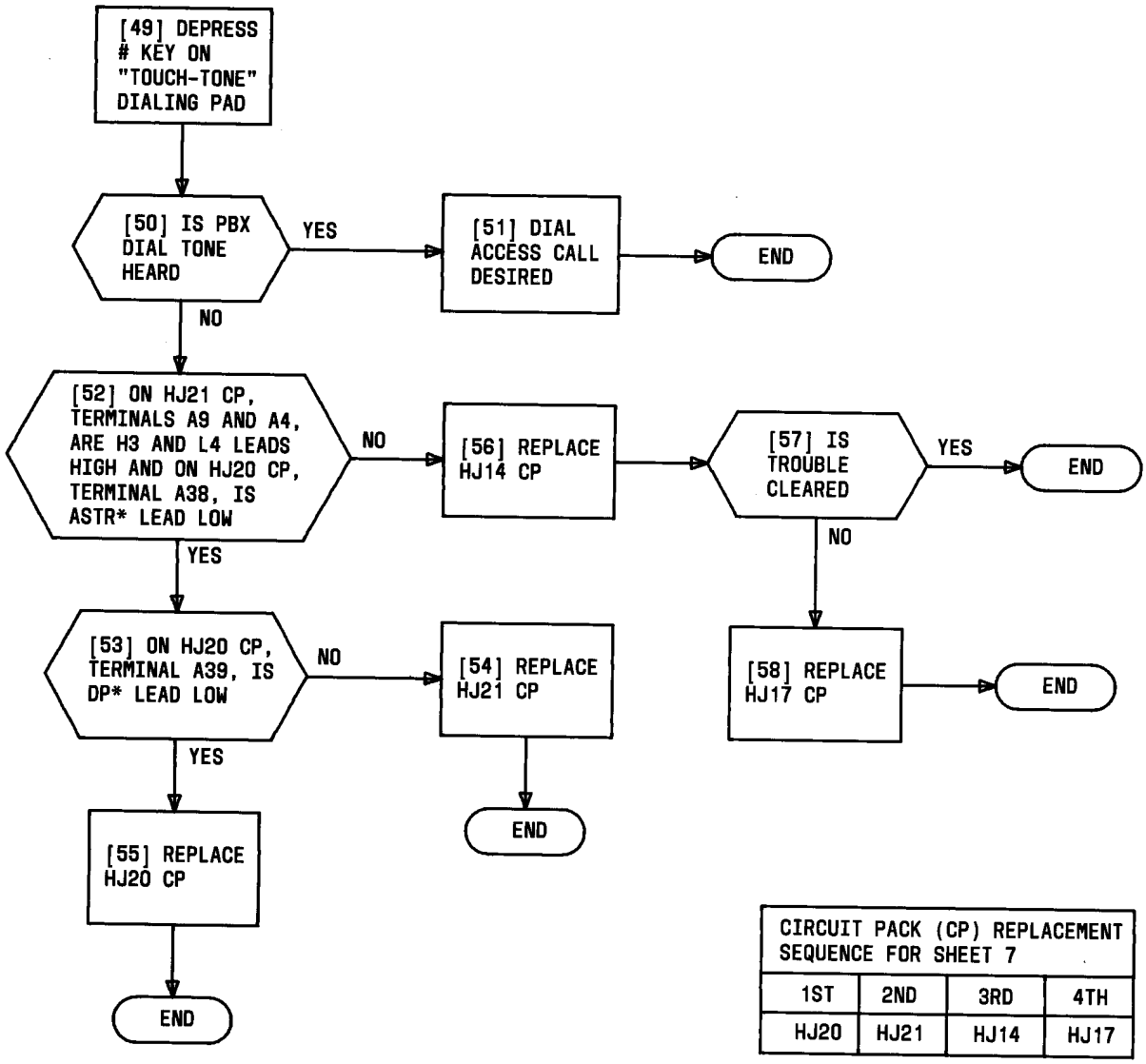
CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 5	
1ST	2ND
HJ21	HJ13

Fig. 22—Clear Remote Access Trouble (Sheet 5 of 7)



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 6			
1ST	2ND	3RD	4TH
HJ20	HJ21	HJ14	HJ17

Fig. 22—Clear Remote Access Trouble (Sheet 6 of 7)



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 7

1ST	2ND	3RD	4TH
HJ20	HJ21	HJ14	HJ17

Fig. 22—Clear Remote Access Trouble (Sheet 7 of 7)

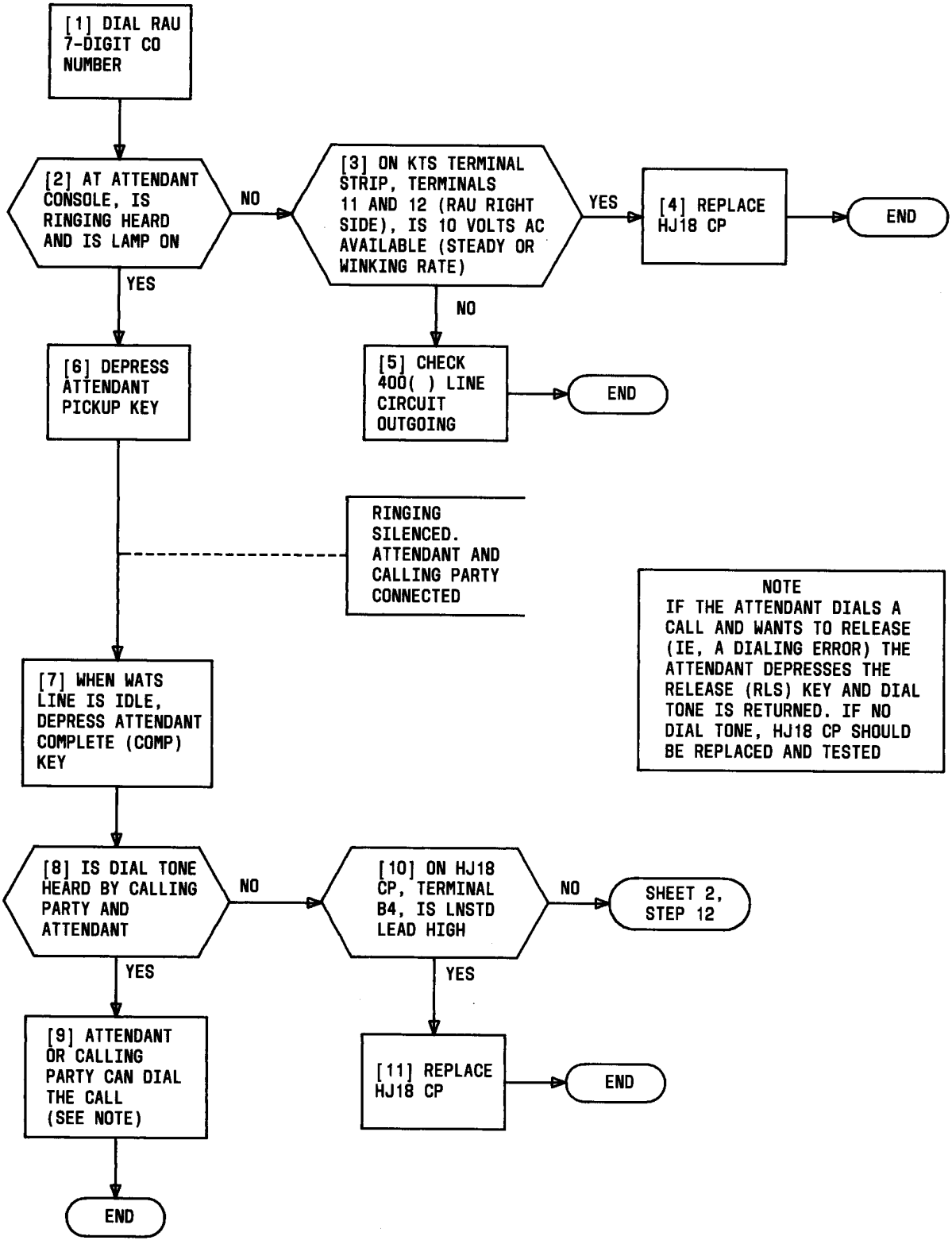
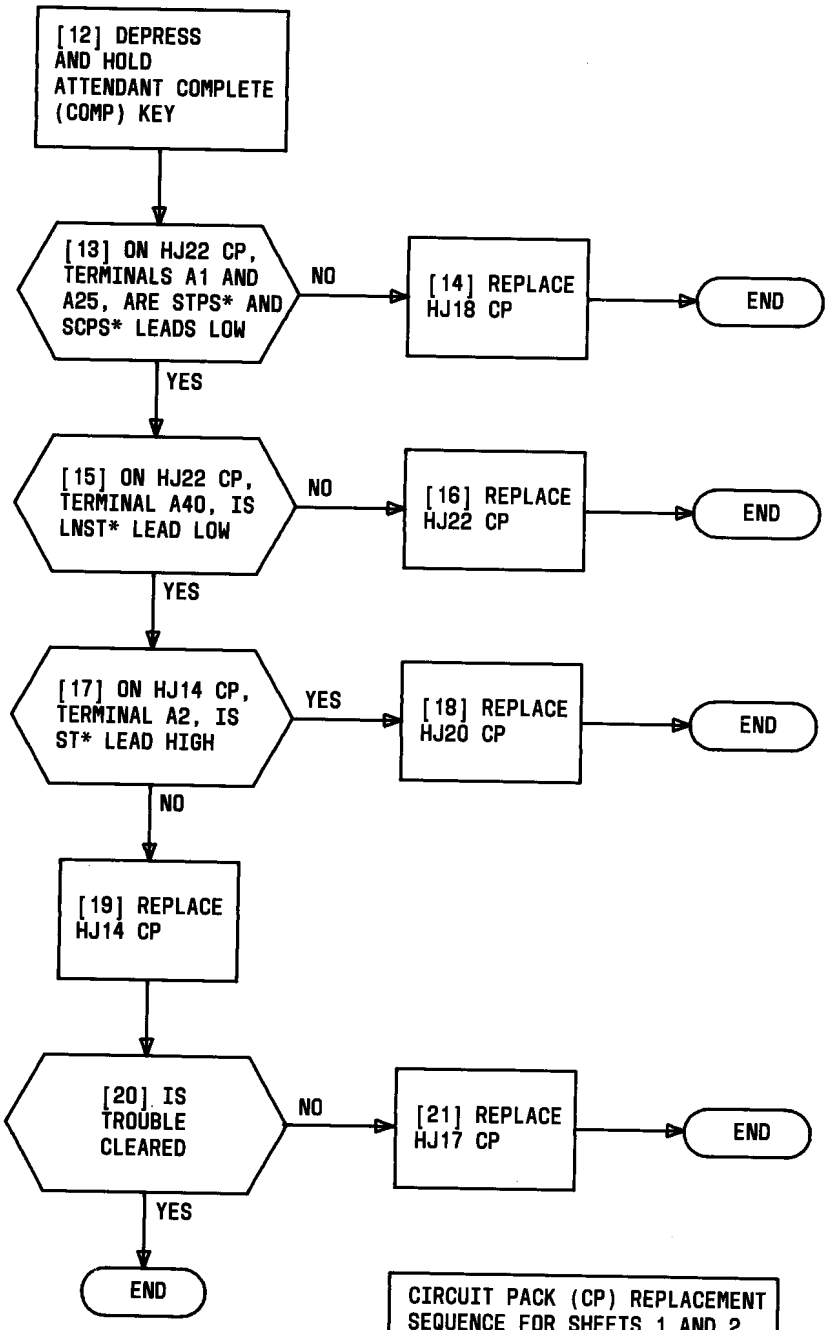


Fig. 23—Clear Incoming Calls to Busy WATS Line—KTS Application (Sheet 1 of 2)



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEETS 1 AND 2

1ST	2ND	3RD	4TH	5TH
HJ18	HJ22	HJ20	HJ14	HJ17

Fig. 23—Clear Incoming Calls to Busy WATS Line—KTS Application (Sheet 2 of 2)

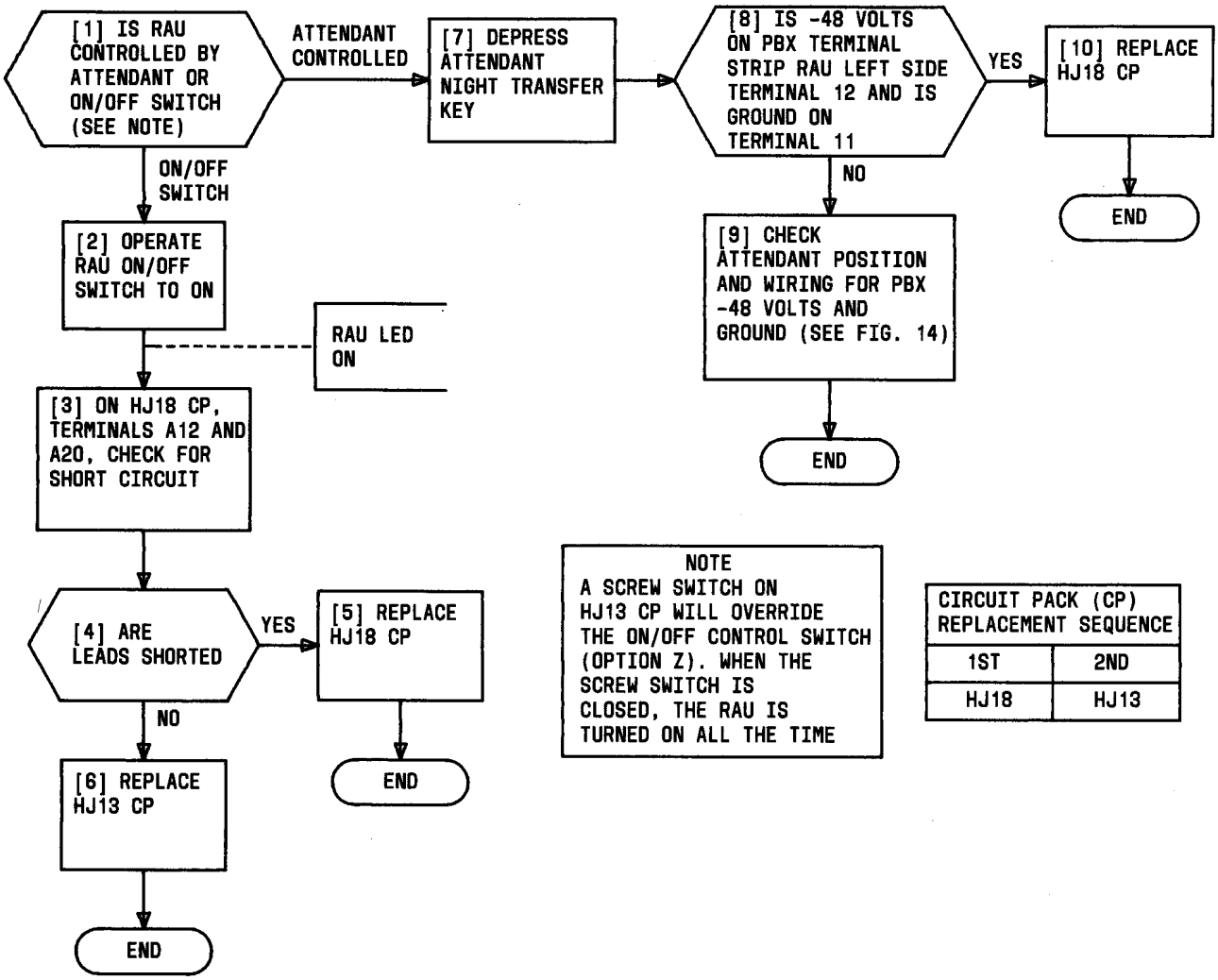
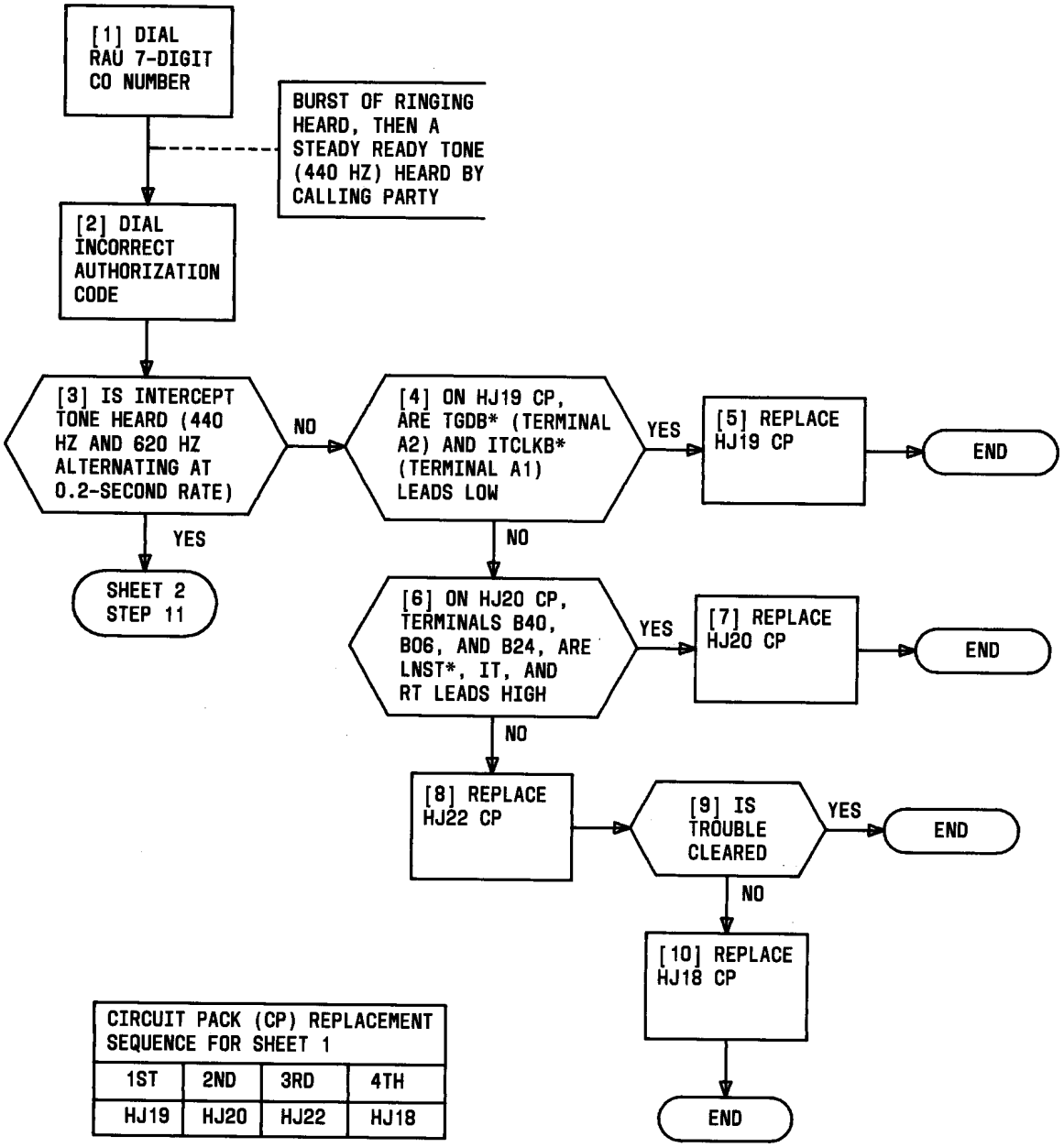


Fig. 24—Clear Remote Access Night Transfer Trouble—PBX Application



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE FOR SHEET 1			
1ST	2ND	3RD	4TH
HJ19	HJ20	HJ22	HJ18

Fig. 25—Clear Remote Access Intercept Tone and/or Time-Out Trouble (Sheet 1 of 2)

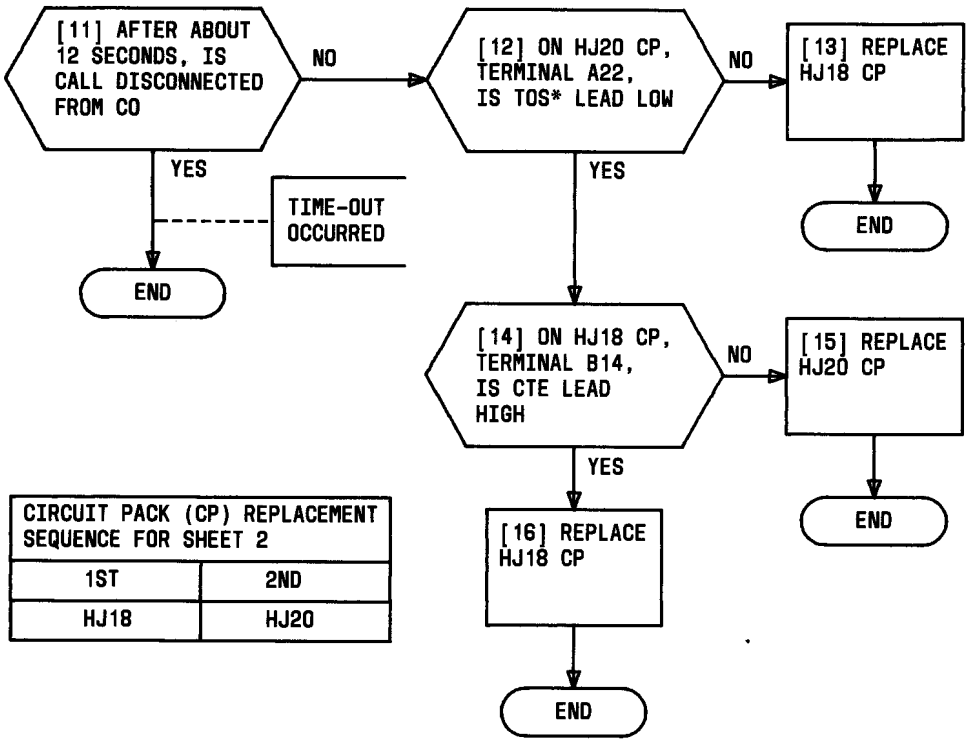


Fig. 25—Clear Remote Access Intercept Tone and/or Time-Out Trouble (Sheet 2 of 2)

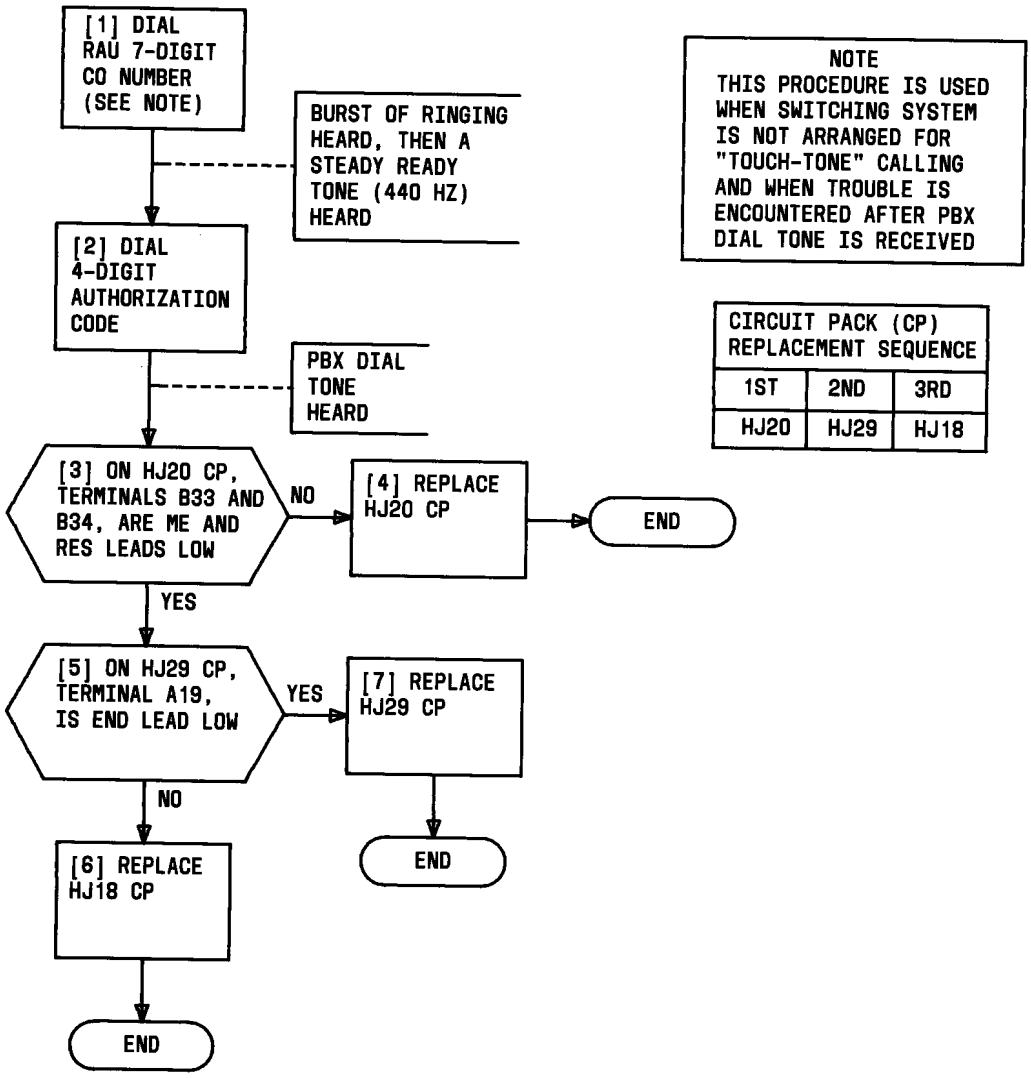
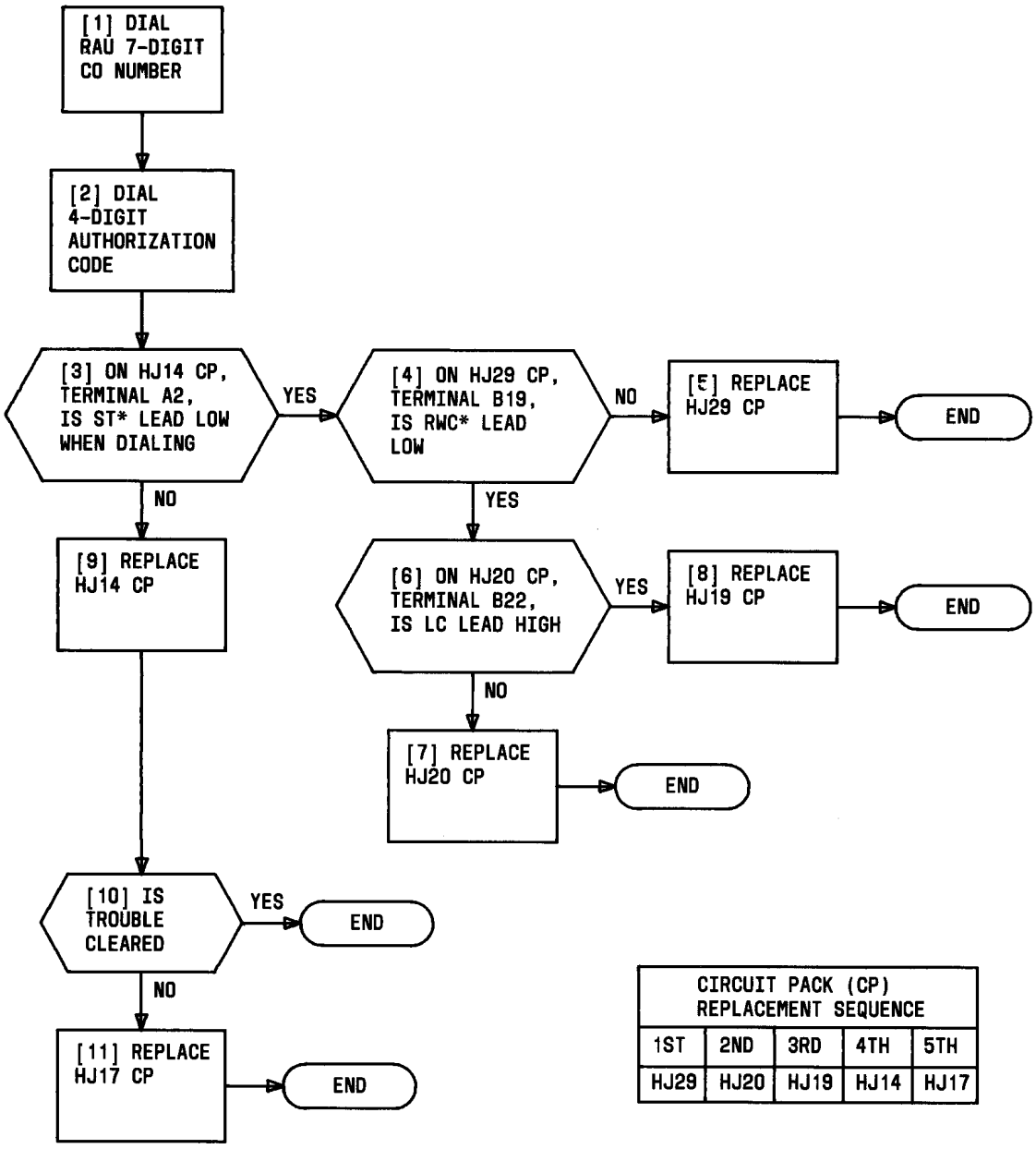


Fig. 26—Clear TOUCH-TONE Calling to Dial Pulse Conversion Trouble



CIRCUIT PACK (CP) REPLACEMENT SEQUENCE				
1ST	2ND	3RD	4TH	5TH
HJ29	HJ20	HJ19	HJ14	HJ17

Fig. 27—Clear Incorrect or Wrong Numbers at Far End (Early-Cut Trouble)

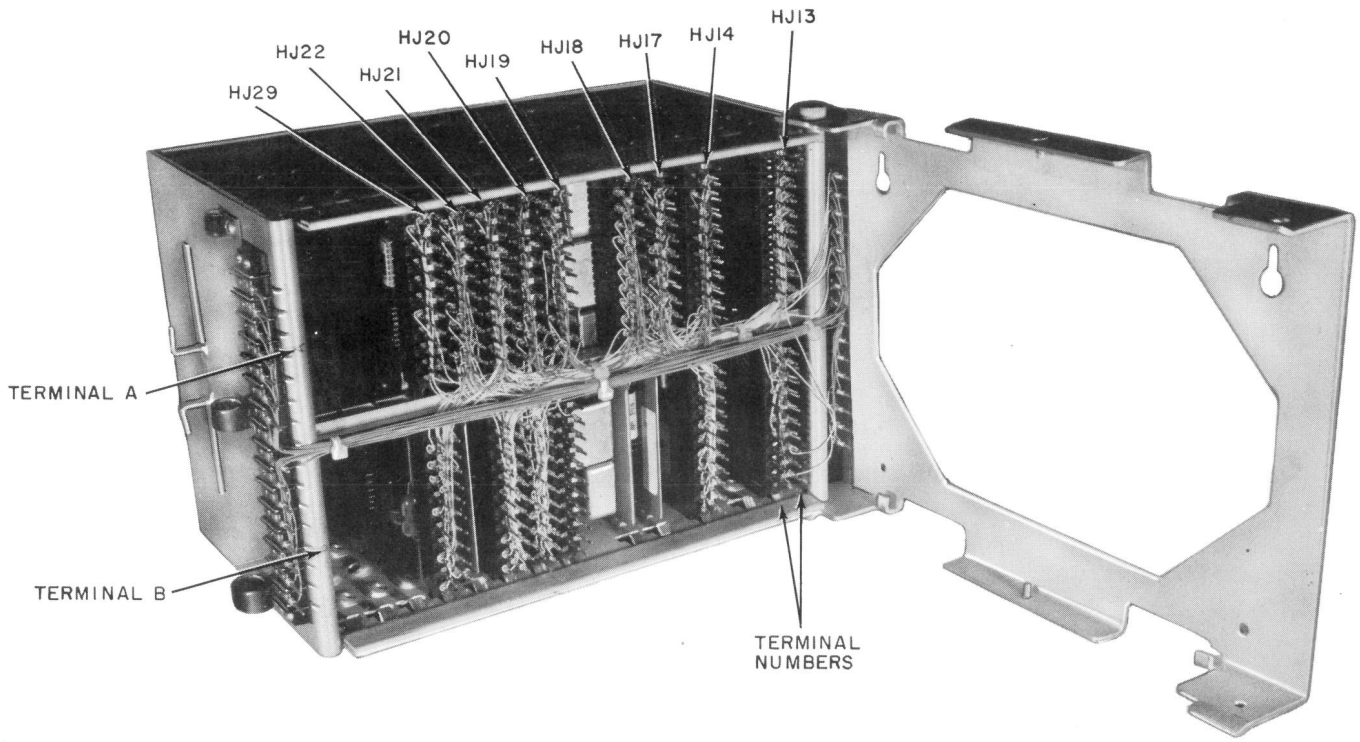


Fig. 28—Circuit Pack Terminal Locations on 908E Connectors

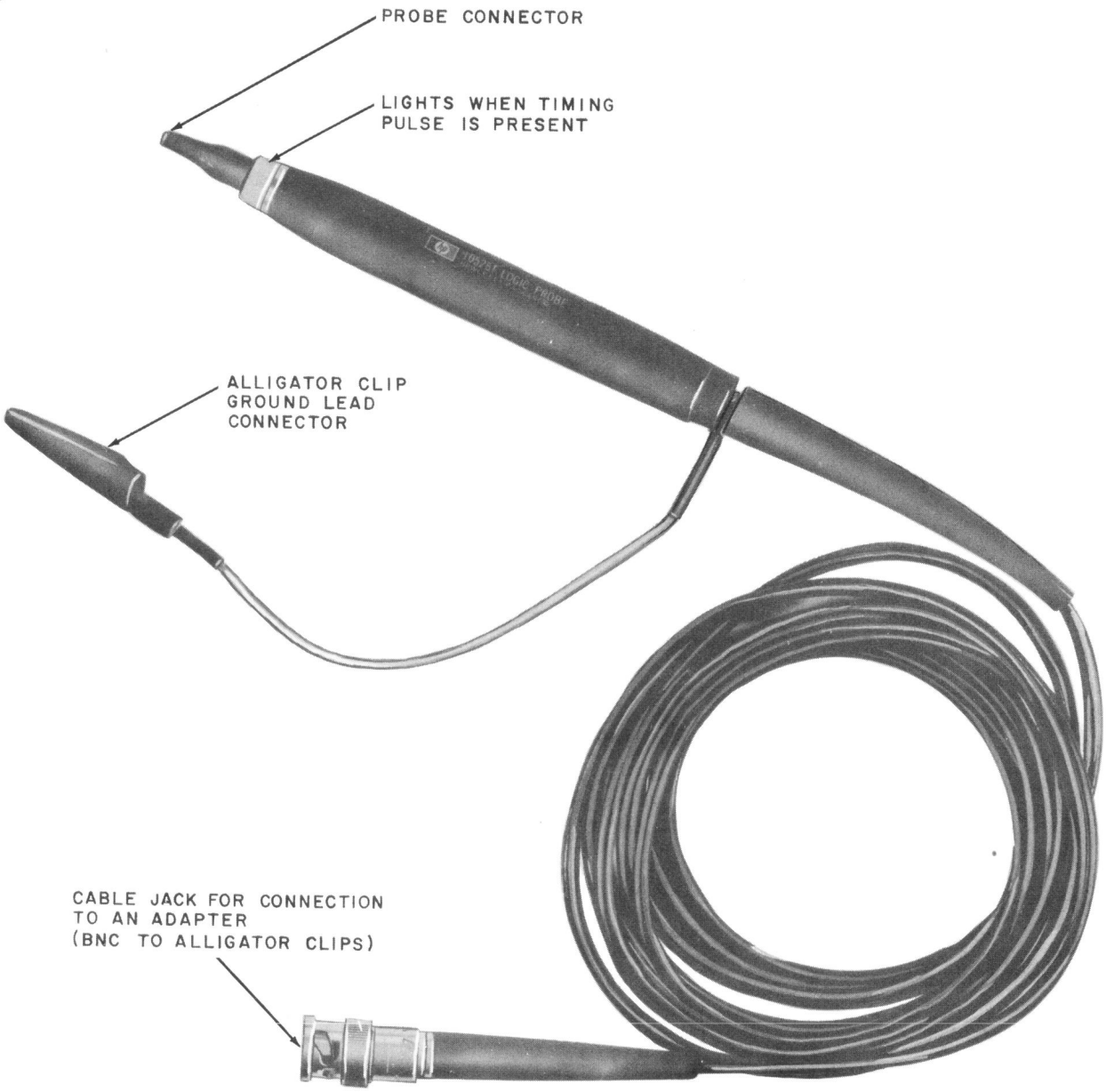


Fig. 29—Logic Probe

TABLE C

LOGIC PROBE—POWER CONNECTIONS

CONNECTION	CIRCUIT PACKS							
	HJ13	HJ14	HJ18	HJ19	HJ20	HJ21	HJ22	HJ29
+5 volts	B25	A12	B13	A20	A20	A20	A20	B30
GRD A	B22	A37	B7	A15	A15	A15	A15	B26