PRIVATE LINE SERVICE TERMINATIONS
STATION ENGINEERING INFORMATION
PBX TERMINATIONS (FOREIGN EXCHANGE AND WIDE AREA TELECOMMUNICATIONS SERVICE)

CONTENTS PAGE

1. GENERAL

1.01 This section describes the commonly used arrangements for PBX foreign exchange (FX) trunks and PBX Wide Area Telecommunications Service (WATS) trunks.

Comments concerning contents, usability and adequacy of this practice will be welcome. Mail comments directly to the Bell System Practices Organization.

Mail to:

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1.02 This section is reissued to provide current reference information.

1.03 This section will serve as an aid to those who are engaged in the provision of these services by providing:

- Uniform Service Order Code (USOC) tables.
- General explanation of FX and WATS Services.
- Illustrations of various arrangements for FX and WATS trunks using V4 repeaters, dial long line circuits, etc, for both 2-wire and 4-wire applications.
- Tables with pertinent information for each of the applicable central office (CO) trunks.

1.04 General notes for all figures appear on a foldout on the last page of this section.

1.05 General rules for setting screw-type switches on terminating sets are provided in Section 851-300-101.

1.06 For general information for the entire Private Line Service Terminations series, refer to Section 812-002-200.

1.07 Section 812-002-201, Uniform Service Order Code (USOC) Index of Definitions and Applications, complements this section with additional information and references. It provides coordination for the entire Private Line Service Terminations series, and will be maintained to reflect changes in the related sections.

2. PRIVATE LINE SERVICE TERMINATIONS SERIES

2.01 The following sections constitute the Private Line Service Terminations series. All of these are related sections.

SECTION	TITLE
812-002-200	General Information
812-002-201	Uniform Service Order Code (USOC) Index of Definitions and Applications
812-002-210	PBX Terminations (Tie Trunk and SS-3)
812-002-211	PBX Terminations (Foreign Exchange and Wide Area Telephone Service)
812-002-215	Telephoto Station Arrangements
812-002-221	Station Equipment (Voice)
812-002-230	Station Equipment (Data-Voiceband)
812-002-231	Station Equipment (Data-Wideband)
812-002-250	Alternate Arrangements
812-002-270	Engineering Sketches and Signaling Devices
812-002-290	V4 Repeater Mountings and Components.

3. USOC (FX AND WATS)

3.01 Table A provides descriptions of individual USOCs for FX trunks. Table B provides descriptions of combinations of USOCs which may appear on Universal System Service Orders (USSO).

3.02 Table B does not associate any USOC with any particular figure in this section since USOCs for FX trunks are not defined according to equipment arrangements.

3.03 The descriptive information in Tables A and B is written in simple language and not worded as it will appear on the USSO. Refer to Section 812-002-201 and the Intercity Services Manual (ISM) for proper wording and descriptions.

3.04 WATS trunk terminations are not covered by USOCs. Only WATS service areas (geographical locations) are covered by appropriate codes. The USSO covering WATS trunks will spell out the desired service.

4. DEFINITIONS (FX AND WATS)

4.01 The following are terms used to describe foreign exchange (FX) and Wide Area Telecommunications Service (WATS) and their operation.

TABLE A

USOC DESCRIPTIONS AS APPLIED
TO FOREIGN EXCHANGE TRUNKS

CODE	DESCRIPTION OF SERVICE (NOTE C)
WP9 (Note A)	2006 Service Terminal where the Distance of Interexchange Facilities (IXC) exceeds 25 airline miles (Foreign Exchange Service)
WPB (Note A)	2006 Service Terminal where the Distance of Interexchange Facilities (IXC) is 25 airline miles or less (Foreign Exchange Service)
1YX(—) (Note B)	Transfer arrangements

Notes:

A. Type 2006 Service Terminals provide for FX service (approximate band width of 300 to 3000 Hz). These channels are furnished to permit a customer to obtain PBX trunk connections in an exchange foreign to the exchange in which the customers PBX is located.

B. USOC 1YX will always be succeeded by an additional alpha and numeric or combination of these, eg, 1YXKA. Refer to Section 812-002-270 which includes transfer arrangements, their applications, and associated USOCs.

C. These descriptions are applicable to PBX arrangements only and not worded as they will appear on the (USSO). Refer to Section 812-002-201 and the Intercity Services Manual (ISM) for proper wording and descriptions.

- ***Foreign Exchange (FX) Service***—The provision of local telephone service in an area foreign to the exchange area in which the customer is located. The telephone equipment at the customers location may consist of one or a combination of the following:

  (a) Telephone set

  (b) CALL DIRECTOR® set

  (c) Key telephone equipment

  (d) Manual PBX

  (e) Dial PBX

  (f) Automatic Call Distributing System (ACD)

  (g) Secretarial Service Switchboard

  (h) Data set.

- ***Station End***—The end of the FX line which terminates at a customer location. This end of the line receives 20 Hz ringing as a signal for an incoming call. It transmits rotary dial pulses or TOUCH-TONE calling signals for an outgoing call, if dial outgoing service is provided.

- ***Switching End***—The end of the FX line located at a local CO, or in the case of an off-premises station, at the PBX. It receives

TABLE B

USOC COMBINATION DESCRIPTIONS AS APPLIED TO FOREIGN EXCHANGE TRUNKS

CODE	DESCRIPTION OF SERVICE (NOTE)
WP9SP	Foreign Exchange Service with interexchange facilities in excess of 25 airline miles terminating as a PBX or ACD Foreign Exchange Trunk
WPBSP	Foreign Exchange Service with interexchange facilities 25 airline miles or less, terminating as a PBX or ACD Foreign Exchange Trunk
WP9SP1YX (—)	Same as WP9SP except that a transfer arrangement is also provided
WPBSP1YX (—)	Same as WPBSP except that a transfer arrangement is also provided

Note: Refer to Table A for individual code descriptions and notes.

rotary dial pulses or TOUCH-TONE calling signals from the station end, and transmits the 20 Hz ringing signals toward the station.

- ***Off-hook and On-hook***—These designate the two signaling conditions of a trunk. If a trunk is not in use, it is signaling on-hook towards both ends. Seizure of the trunk at the switching end usually initiates an off-hook signal transmitted toward the station end. If a trunk is in the condition of awaiting an answer from the station end, the station end normally is signaling on-hook toward the switching end. Answering of the call normally results in the sending of an off-hook signal back toward the switching end. If the station is on-hook, the loop is open to dc. If the station is off-hook, there is a dc bridge (shunt) across the line.

- ***WATS Line***—Similar to an FX line. The WATS line will usually terminate in a local CO. If the local CO is not arranged for WATS service, the WATS line is extended to a distant CO which is arranged for the service.

- ***Outward WATS***—A customer line that is used exclusively for outgoing calls to the toll network.

- ***Inward WATS***—A customer line that is used exclusively for incoming calls from the toll network.

- ***PBX Foreign Exchange Trunk (FXT)***—Provides service between a PBX or ACD at a customer location, and a remote CO.

- ***PBX WATS Trunks***—Connects a PBX to a WATS CO.

- ***Manual PBX***—System located on the customer premises where all switching is done manually. All connections, whether between two stations, or between stations and trunks, are made by a PBX attendant at one or more cord switchboards or cordless consoles.

- ***Dial PBX***—System located on the customer premises where all station switching is accomplished by dial operation. Connections between two stations, or outgoing calls from

stations to trunks may be machine switched under control of the PBX station dial. Incoming calls from CO trunks are received by the PBX attendant who extends them to the desired station via a cord switchboard or cordless console.

- ***Automatic Call Distributor (ACD)***—A switching system designed to distribute a large volume of incoming calls to a group of attendants in the approximate order in which the calls were received. ACDs are commonly used by airlines, retail stores, and others for handling order and information-type calls.

- ***Forward Disconnect***—The release of a ground start CO trunk circuit at a dial PBX or ACD on an answered incoming call from the CO (regardless of any off-hook condition at the PBX or ACD). This release is initiated by the disconnect of the calling party and the resultant release of the central office switching equipment. When the CO switching equipment releases, the tip conductor is opened toward the PBX or ACD, reducing conductor loop current to zero. The absence of loop current and the removal of the tip ground initiates the release of the ground start trunk circuit at the dial PBX or ACD (independent of any off-hook condition). Ground start dial long line circuits and other range extension equipment should repeat this forward disconnect signal.

- ***Facility***—All of the telephone plant between the serving CO or PBX, and the station. It may be a pair of wires, or several carrier systems in tandem on radio or wire lines.

5. CIRCUIT OPERATION (FX AND WATS—GENERAL)

5.01 Different signaling requirements exist in the two different directions of transmission. 20 Hz signaling is used from the "switching end" toward the "station end." If ground start signaling applications are used, a signal is applied to indicate seizure in addition to the 20 Hz signal.

5.02 The off-hook and on-hook supervisory signals are sent from the "station end" toward the "switching end." They indicate seizure and disconnect, respectively.

5.03 Rotary dial pulses which control dial switching equipment are transmitted from the station as a succession of open and closure line signals. Some circuits use TOUCH-TONE signaling. With this system, combinations of signaling tones are used.

5.04 Facilities which exceed approximately 3000 ohms loop resistance usually require conversion of the metallic loop signals to other forms such as composite (CX), duplex (DX), simplex (SX), inband, or out-of-band signaling.

5.05 Even when these more complex signaling arrangements are used, a particular metallic loop signal applied at one end of the circuit will appear at the opposite end of the circuit. For example, an open on the 2-wire side at one end of the circuit produces an open at the other end. The application of 20 Hz ringing at one end of the circuit causes 20 Hz ringing to appear at the other end.

5.06 Small changes in the signal do occur in actual practice. These occur because of transit time through the facility, relay operating and releasing time, and other circuit response time.

5.07 In some cases, circuits are extended on a 4-wire basis to the customer premises to meet transmission design requirements.

6. LOOP-START AND GROUND-START SIGNALING

Loop Start

6.01 Loop-start signaling is the normal type of signaling between a CO and a noncoin-, nondial-PBX, subscriber station, or between a PBX and a PBX station. This is sometimes called plain ordinary telephone service (POTS).

6.02 When the handset is removed from its cradle or switchhook at the station end, a resistance of approximately 200 ohms is placed across the line toward the switching end as a request for service.

6.03 Loop-start signaling may be used when providing service to a manual PBX.

6.04 An incoming call to the station end is recognized by the receipt of the 20 Hz ringing signal only. The usual ringing signal consists of a 2-second ringing period followed by a 4-second

silent period. Therefore, a call can be initiated as long as 4 seconds before it is recognized at the receiving station end. The person at the receiving station may attempt to originate a call during this interval. This is not considered a problem since the person originating the call from the station end is usually the person to whom the call is directed.

Ground Start

6.05 Ground-start signaling is required when providing service to a dial PBX, or to an ACD from the CO. Typical dial PBXs include the 701, 740, 756, 757, 770A, 800A, 801A, and 805A. Typical ACDs include the 2A, 2B, and 3A.

6.06 A dial PBX is like a dial CO in that any one of the dial PBX stations can dial other telephones and also originate and receive calls over the same trunk between the serving CO and the dial PBX. Since this trunk can be seized at either end, it is apparent that special means must be taken to transmit seizure signals in each direction as quickly as possible.

6.07 Ground-start signaling eliminates the 4-second interval during which a seizure may be present at the switching end (without knowledge at the station end) as with loop-start signaling. (See 6.04.)

6.08 With ground-start, the subscriber line circuit at the CO is modified by removing the ground which is normally connected to the tip conductor of the line. This modification is shown on the subscriber line circuit schematic diagram (SD) for the particular switching system involved.

6.09 When the CO switching equipment seizes the line for a call toward the dial PBX, it immediately places ground on the tip and battery on the ring of the line. The trunk circuit at the PBX recognizes the presence of battery and ground on the loop as a seizure signal and immediately becomes unavailable to outgoing calls from the PBX. When the 20 Hz signal is received, a signal is given to the PBX attendant to indicate an incoming call.

6.10 An outgoing call from the PBX toward the CO causes a ground to be placed on the ring conductor toward the CO. The CO equipment recognizes this as a seizure signal and prepares to receive dialing. The CO equipment places a ground on the tip conductor toward the PBX and applies dial tone. The PBX trunk circuit recognizes the tip ground as a start-dial signal and closes the line through for dialing. The ground placed on the ring conductor earlier is removed. After dialing, the call is completed in the usual way.

6.11 The dial PBX recognizes the removal of battery and ground from the loop as a disconnect signal. The CO switching equipment recognizes the opening of the ring conductor as a disconnect signal.

7. METALLIC LOOP SIGNALING LIMITATIONS

7.01 The maximum distance over which metallic loop signaling is used may be limited by any one, or all of the following:

- Dial pulsing or TOUCH-TONE calling range
- Supervisory range
- Ringing range
- Ringing trip range
- Transmission considerations.

Dial Pulsing or TOUCH-TONE® Calling Range

7.02 Dial pulsing range is determined in part by the sensitivity and speed of the pulsing relay. It must maintain the percent break of the dial pulses within the limits that the equipment in the associated CO or dial PBX can accept.

7.03 Other factors which may reduce rotary dial pulsing range include pulse distortion, pulse mutilation, or false pulse generation. These can be caused by the interaction of components contained in voice repeaters, terminating sets, or trunk circuits in the signaling path.

7.04 TOUCH-TONE dialing range is limited by the following:

- Transmission capability of the TOUCH-TONE oscillator at the station with respect to its output for the available line current
- The transmission loss of the facility

- The sensitivity of the TOUCH-TONE receiver.

Supervisory Range

7.05 Supervisory range is the range over which a circuit can detect off-hook (seizure) and on-hook (disconnect) signals. Supervisory signals are not critical with respect to percent break. They are normally detected by the same relay as dial pulses. The supervisory range of a specific circuit usually exceeds its dial pulsing range.

7.06 Ground-start circuits must detect the presence of ground on one conductor. Earth potential differences between the station and the CO may be a limiting factor.

Ringing Range

7.07 Ringing range is determined by the RMS voltage of the ringing source. This may vary from 84 to 88 volts ac, depending on the type of ringing plant and the current required to operate a station ringer within certain loudness limits.

7.08 With a PBX trunk, the ringing range is determined by the current required to operate a ringup relay with a safety margin for circuit variations.

Ringing Trip Range

7.09 Most circuits are arranged to trip ringing during the ringing period and/or during the silent period of the ringing cycle.

7.10 Ringing trip range for the ringing period is determined by the following:

- Sensitivity of the tripping relay
- 20 Hz voltage
- Voltage of the superimposed dc component.

7.11 If the ringing source does not have superimposed dc, tripping can occur only during the silent period of the ringing cycle. With this arrangement, if the station end goes off-hook during the ringing interval, 20 Hz ringing will be heard for the remaining portion of the interval. Tripping during the silent interval is done by the CO or PBX relay used for dial pulsing and supervisory signals.

Transmission Considerations

7.12 Other considerations in determining maximum metallic loop signaling range include:

- Insulation resistance between conductors or between conductor and ground
- Supply voltage variation limits
- Effects of impedance compensator and/or voice repeater equipment
- Induced 60 Hz voltages
- Extension ringers
- Ringing bridges in PBX switchboard cord circuits
- Station set current requirements.

7.13 These factors are considered in the preparation of circuit range charts and similar data that specifies the maximum range over which circuits will function properly. They are also considered in determining the maximum number of links that may be connected in tandem.

7.14 All circuits with rotary dial pulsing are arranged to work at a nominal 10 pulse per second dial pulsing rate.

7.15 All 20 pulse per second dials must be replaced with 10 pulse per second dials when rotary dialing is used.

7.16 When circuits use E and M leads, the maximum resistance of each lead to the connecting circuit is limited to 25 ohms. When the connecting circuit is T1 carrier, a maximum lead resistance of 300 ohms is permitted. If the resistance of the leads exceeds these limitations, E and M lead extension circuits SD-95487-01 and/or SD-95488-01 or SD-1C363-01 and/or SD-1C364-01 are used.

8. EFFECT OF PBX TRUNK AND CORD CIRCUITS ON STATION LOOP CURRENT

8.01 Loop current affects transmission as well as signaling range in special service circuits due to the effect on telephone efficiency (Section AB-43.571).

8.02 Loop resistance and any equipment which affects loop current at the station end of the circuit should be considered in special service circuit design.

8.03 The effect of PBX trunk and cord circuits on station loop current should be considered with special service trunks terminating in PBXs.

8.04 Section 851-310-101 discusses various relays and bridges and their effect on loop current with PBX circuit arrangements.

8.05 Incoming calls to a PBX over non-DID (non-direct inward dialing) trunks require the PBX attendant to complete the call to the appropriate extension. With manual PBXs and some dial PBXs, the attendant may also be required to complete outward calls by dialing the called number. If either of these actions occurs through a cord switchboard, a bridging resistance (1200 to 1500 ohms) exists across the circuit after the call is established.

8.06 PBXs operating with consoles instead of cord boards do not have a bridging resistance connected after an incoming or an outgoing call is established. The exceptions are the 756A and 757A PBXs which have bridges on incoming calls only.

8.07 Since talking battery to the PBX extension is supplied from the CO on an outside call, the resistances of PBX supervisory relays and the cord circuit bridge must be considered when calculating the loop current supplied to the extension.

8.08 The various circuit arrangements can be classified broadly into three general categories. These are classed according to the manner in which incoming and outgoing calls are handled and are as follows:

(1) Applies to PBXs where all incoming and outgoing calls are placed through a cord board. Section 851-310-101 shows a simplified schematic of this arrangement and the formulas for calculating maximum trunk resistance or loop resistance for a desired loop current.

(2) Applies to PBXs where incoming calls are routed through the cord board and outgoing calls are handled by the PBX switching machine. Section 851-310-101 shows this arrangement and the formulas for calculating the trunk loop and station loop resistance.

(3) Applies to PBXs where incoming calls go through the console and PBX switching machine, and outgoing calls go through the PBX switching machine. This category includes all console PBXs. Cord circuits are not involved in these arrangements. Section 851-310-101 shows two arrangements for this category. One applies to the 800A and 701B PBX; the other applies to the 756A and 757A PBX.

9. NONSTANDARD CIRCUIT ARRANGEMENTS

9.01 Several nonstandard circuit arrangements have been used to provide FX service. These arrangements are not shown on standard drawings because of signaling difficulties. It is recommended that these nonstandard arrangements only be used as a last resort.

9.02 One nonstandard arrangement makes use of circuits ES-95668-01 or ES-65602-01, and ES-65625-01 or ES-65699-01 for ground start applications. These circuits are modifications of Dial Long Line circuits SD-96251-01 and SD-96252-01. They are rated "special" since they were designed for a specific installation and are unacceptable for general application.

9.03 One of the difficulties with these circuits is the lack of the forward disconnect feature (4.01). The absence of the forward disconnect feature prevents the PBX or ACD trunk circuit from releasing following an incoming call abandoned by the calling party. This abandoned condition may be the result of a legitimate answer and completion to a PBX station by the PBX attendant who is unaware that a disconnct has occurred, since no disconnect is received from the switching end. This may also result from a recorded announcement from the ACD.

9.04 Failure of the trunk circuit to release may result in the application of permanent signal tone. This condition continues until an "on-hook" signal is received from the station end. The permanent signal tone is a high level tone and may be induced into adjacent channels in the facility. These circuits require a facility arranged to accept the E and M leads.

SD-96251-01 (With X-Type or E3B Inband Signaling Unit)

9.05 Another nonstandard arrangement involves the use of Dial Long Line circuit SD-96251-01 together with an inband signaling unit (X-type, SD-56292-01 or E3B, SD-98124-02) at the switching end of the FX circuit.

9.06 SD-96251-01 will perform satisfactorily with some E and M lead signaling systems, but the combination of this circuit with an inband signaling unit is not satisfactory when dial outgoing service from the station end is required and rotary dial pulsing is used.

9.07 Difficulties are encountered in either the tone on or tone off mode of operation. The tone on mode of operation results in false rings to the station talk off troubles, and voice transmission impairment. The tone off mode of operation causes dialing difficulties resulting in reaching wrong numbers or uncompleted calls.

9.08 The E and M, trunk-type, and single frequency (SF) signaling units are capable of transmitting only two signals, on-hook or off-hook. One is represented by the transmission of tone, the other by no tone.

Tone On-Tone Off

9.09 In FX service it is necessary to transmit a ringing signal from the switching end toward the station end. If the removal of tone on SF-type signaling is used to represent the ringing signal, tone will be transmitted during both the idle and talking condition of the unit. This is referred to as tone on operation.

9.10 The following are disadvantages of tone on operation:

- Voice transmission is impaired. 2600 Hz is transmitted by the unit at the switching end during both the talking and idle state. The SF unit at the station end maintains a 2600 Hz band elimination filter in the transmission path during conversation because it is receiving tone.

- The talk off problem of the SF unit at the switching end is increased greatly. Maximum talk off protection is provided by the SF units when no SF tone is transmitted in either direction. Talk off shows itself as a false disconnect of the circuit, or clicks and thumps due to voice simulation of the 2600 Hz signaling tone.

- Ringing will be falsely received at the station. With tone on operation, the removal of tone causes ringing to be applied toward the station. Carrier failure or hits and fades in the carrier will remove the signaling tone simulating the legitimate tone off ringing signal.

9.11 To eliminate the disadvantages of tone on, the SF unit at the switching end is usually used in the tone off mode. In this arrangement the SF unit transmits 2600 Hz tone as a ringing signal, and does not transmit tone during idle or talking conditions. This eliminates the transmission impairment, talk off, and false ringing difficulty, but presents dialing problems.

9.12 When used in FX applications, the tone off mode will cause a delay in responding to signal tone such as rotary dial pulses due to the high-guard feature of the SF unit.

10. REFERENCE INFORMATION

10.01 The following Bell System Practices and schematic diagrams (SD) will serve as an aid to those who desire more detailed information on the general subjects covered in this section. Titles are condensed and rearranged for use as a ready reference.

SECTION	TITLE
179-701-101	DC Signaling Systems—Description
179-702-101	CX and SX Signaling Systems—Description
179-331-101	E1P Single Frequency Signaling Units—Description
179-332-101	E1R Single Frequency Signaling Unit—Description
311-200-180	Description of Circuit Arrangements for Providing Foreign Exchange and Other Special Access Services

SECTION	TITLE
311-350-100	Balance Test Considerations—PBX 4-Wire VNL Tie Trunks and Access Lines
311-350-500	Balance Test Procedure for PBX Switched 4-Wire Tie Trunks and Access Lines
500-114-100	Ringing Limitations
812-015-170	Ringing Ranges and Ringing Bridge Limitations
812-002-290	V4 Telephone Repeater
851-310-101	Effect of PBX Trunk and Cord Circuits Upon Station Loop Current
975-110-100	Local Subscriber Loop Signals and Signaling Systems
975-230-100	DX Signaling System
975-240-100	Type E Single Frequency Signaling System
981-235-100	2A Automatic Call Distributing System
981-235-101	2B Automatic Call Distributing System
981-236-100	3A Automatic Call Distributing System
981-531-100	557 PBX for Secretarial Answering Service—Description
981-610-100	701 and 711 PBX—General Description
981-660-100	756 PBX—General Description
981-662-100	757 PBX—General Description
981-680-100	770 PBX—General Description
981-705-100	800A PBX—General Description
981-706-100	801A PBX—General Description
981-709-100	805A PBX—General Description

SECTION	TITLE
Range Charts:	
SD-96323-01	Range Chart for Dial Long Line Circuits—1200-ohm Panel & Crossbar Central Offices
SD-96327-01	Range Chart for Dial Long Line Circuits—Dial PBXs
SD-96328-01	Range Chart for PBXs using Dial Long Line Circuits SD-96234-01, SD-96252-01, SD-96555-01, etc.

10.02 The following Bell System Practices pertain to PBX trunk and station ranges

851-300-100	Transmission Design Considerations and Objectives—Switched Special Services and PBX Services
AB43.277	Effective Transmission Losses of PBX Cord and Tie Trunk Circuits
534-362-151	No. 1 Crossbar Central Offices—Having 1300-Ohm Subscriber Conductor Loop—400-Ohm Talking Battery Feed Circuit—AC/DC or Superimposed Ringing—(84-88V AC Component— Office Voltage of 48V (Floating)
534-362-152	No. 1 Crossbar Central Offices—Having 1300-Ohm Subscriber Conductor Loop—520-Ohm Talking Battery Feed Circuit—AC/DC or Superimposed Ringing—(84-88V AC Component)— Office Voltage of 48V (Floating)
534-362-153	Panel Central Offices—Having 1300-Ohm Subscriber Conductor Loop—140-Ohm Talking Battery Feed Circuit—AC/DC Ringing (84-through 88-Volt AC Component)—48 Volt Minimum Office Voltage (Floating)
534-362-154	Panel Central Offices—Having 785-Ohm Subscriber Conductor Loop—50-Ohm Talking Battery Feed Circuit AC/DC or Superimposed Ringing—(84 to 88 Volts AC

SECTION	TITLE
	Component)—Minimum Office Voltage of 24.5 (Floating)
534-362-155	Panel Central Offices—Having 635-Ohm Subscriber Conductor Loop—50-Ohm Talking Battery Feed Circuit—AC/DC or Superimposed Ringing—(72, 80, or 84 Volts Minimum AC Component)—Minimum Office Voltage of 21V
534-363-156	No. 5 Crossbar Central Offices—Having 1360-Ohm Subscriber Conductor Loop-400-Ohm Talking Battery Feed Circuit—AC/DC Ringing (84-Through 88-Volt AC Component)—48V Minimum Office Voltage (Floating)
534-362-157	No. 5 Crossbar Central Offices—Having 1430-Ohm Subscriber Conductor Loop—400-Ohm Talking Battery Feed Circuit—AC/DC Ringing (84-88V AC Component)—Office Voltage of 48V (Floating)
534-362-158	Step-By-Step Line Finder Central Offices—Having 885-Ohm Subscriber Conductor Loop—400-Ohm Talking Battery Feed Circuit—AC/DC or Superimposed Ringing—(72, 80, or 84-Volt Minimum AC Component)—Office Voltage of 48V (Floating)
534-362-159	Step-by-Step Line Finder Central Office—Having 1300-Ohm Subscriber Conductor Loop—400-Ohm Talking Battery Feed Circuit—AC/DC or Superimposed Ringing—(72, 80, or 84-Volt Minimum AC Component)—48-Volt Minimum Office Voltage (Floating)
809-006-151	A Method For Establishing PBX Conductor Loop Signaling Ranges—Engineering Information—PBX Systems

10.03 The following Bell System Practices pertain to Call Distributing, Trunk, and PBX equipment.

CALL DISTRIBUTING EQUIPMENT

SECTION	TITLE
809-135-151	(J53127) 2A ACD
809-135-152	(J53131) 3A ACD
809-135-153	(J53134) 2B ACD

TRUNK EQUIPMENT

SECTION	TITLE
809-201-150	(J58817) Equip. Units Common to Various PBXs
809-201-151	(J53120) Trunk and Miscellaneous Units Manual PBX
809-201-152	(J58815) Trunk and Miscellaneous Relay Units for 606A, 606B AND 702A PBX
809-201-153	(J58824) Trunk and Miscellaneous Units Dial PBX.

500 SERIES PBXs

809-701-150	(J59019) 507 PBX Switchboard
809-716-152	(J59020) 552B PBX Switchboard
809-716-153	(J59026) 552B PBX Switchboard
809-716-154	(J53112) 552D PBX Switchboard
809-716-155	(J53123) 552D PBX Switchboard
809-716-156	(J53121) 552E PBX Switchboard
809-716-157	(J53124) 552E PBX Switchboard
809-718-150	(J59013) 555 PBX Switchboard
809-721-150	(J59027) 558A PBX Switchboard

600 SERIES PBX

SECTION	TITLE
809-752-150	(J53101) 605A PBX Switchboard

SECTION	TITLE
809-753-150	(J53106) 606A PBX Switchboard
809-753-151	(J53113) 606B PBX Switchboard
809-754-150	(J53118) 607A PBX Switchboard
809-754-151	(J53119) 607A PBX Switchboard
809-755-150	(J53125) 608A PBX Switchboard
809-755-154	(J53129) 608B PBX Switchboard
809-755-157	(J53132) 608D PBX Switchboard Units
809-755-158	(J53133) 608D PBX Switchboard General and Summarizing Specification

700 SERIES PBXs

SECTION	TITLE
809-803-150	(J58801) 701A AND 711A PBXs
809-803-151	(J58831) 701B AND 711B PBXs
809-803-152	(J58832) 701B AND 711B PBXs Summarizing Specification
809-803-153	(J58837) Equipment for Modernizing 701B PBX
809-815-150	(J58826) 740E PBX General Information
809-815-151	(J58823) 740E PBX
809-819-150	(J58819) 755A PBX
809-820-150	(J58829) 756A PBX
809-820-151	(J58830) 756A PBX Summarizing Specification
809-821-150	(J58838) 757A PBX
809-830-150	(J58876) 770A PBX

800 SERIES PBX

809-850-150	(J58849) 800A PBX
809-850-151	(J58860) 800A PBX Summarizing Specification
809-850-160	(J58872) 801A PBX
809-852-150	(J58873) 805A PBX

11. CIRCUIT ARRANGEMENTS

11.01 Table C provides an index to Fig. 1 through 14.

11.02 Fig. 1 through 14 are examples of circuit configurations required to effect Foreign Exchange and WATS services terminating in PBXs.

12. CENTRAL OFFICE TRUNKS AND ATTENDANT FACILITIES

12.01 Each central office trunk is designed to function with a specific PBX or several PBXs. The following Tables provide a list of some of the more commonly used central office trunks:

Table D—Central Office Trunks Associated With Dial PBXs

Table E—Central Office Trunks Associated with Cord Switchboards

Table F—Central Office Trunks Associated with Cordless Switchboards or Consoles

Table G—Central Office Trunks Associated With Automatic Call Distributors.

12.02 Table H provides a list of PBX systems and associated attendant facilities for both existing and planned PBXs.

TABLE C

FIGURE INDEX

FIG.	LOCATION	APPLICATION	NOTE
1	STATION END	4-Wire Loop or Ground Start	A
2		2-Wire Loop or Ground Start	A
3		4-Wire Loop Operation — DX Operation	B
4		2-Wire Loop Operation — DX Operation	B
5		4-Wire Ground Start Operation — Metallic Facilities	C
6		2-Wire Ground Start Operation — Metallic Facilities	C
7	SWITCHING END	4-Wire Loop or Ground Start Operation	A
8		2-Wire Loop or Ground Start Operation	A
9		4-Wire Loop Operation	C
10		2-Wire Loop Operation	C
11		4-Wire Loop Operation — DX Operation	B
12		2-Wire Loop Operation — DX Operation	B
13		4-Wire Ground Start Operation — Dial Long Trunk	C
14		2-Wire Ground Start Operation — Dial Long Trunk	C

Notes:

A. Loop or ground start operation is provided by selecting the proper type of CO trunk and providing proper wiring options for the station line circuits.

B. This arrangement may be used when the range of loop to loop dial long lines is exceeded.

C. This arrangement may be used when the range of the CO is exceeded.

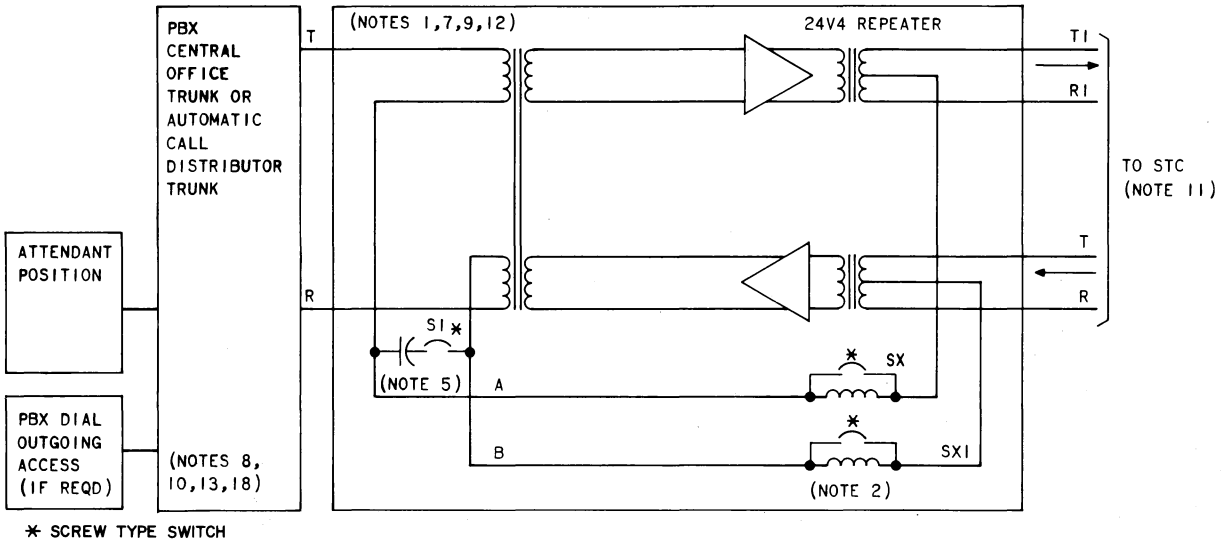

Fig. 1—PBX FX Trunk or WATS Trunk Termination (Station End)—4-Wire Local Channel (Associated With Fig. 7 or 9)

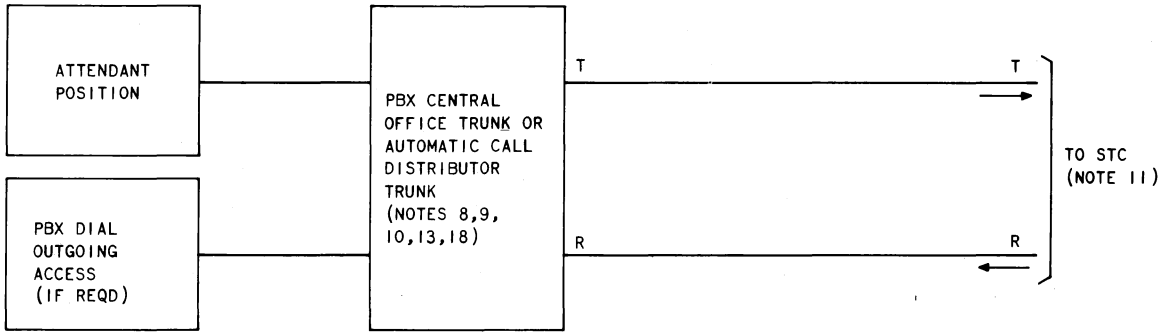

Fig. 2—PBX FX Trunk or WATS Trunk Termination (Station End)—2-Wire Local Channel (Associated With Fig. 8 or 10)

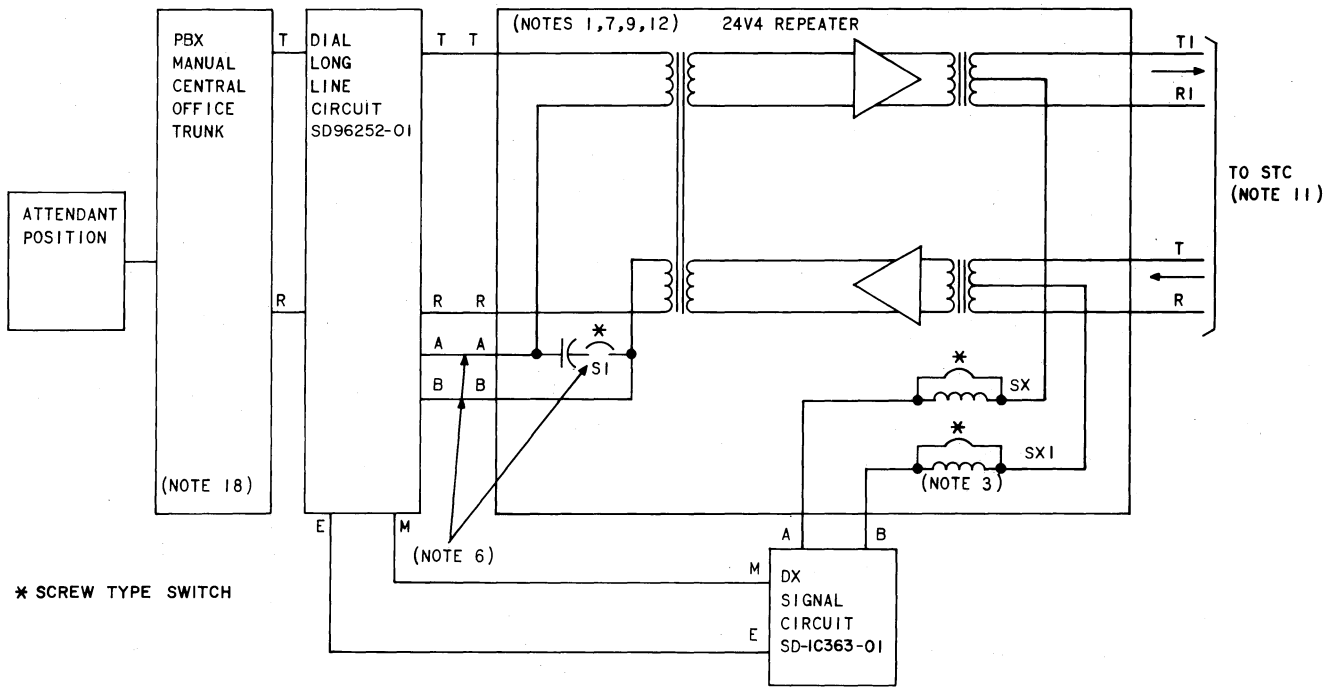

Fig. 3—PBX FX Trunk or WATS Trunk Termination (Station End) Using DX Signaling—4-Wire Local Channel (Associated With Fig. 11) (Note 19)

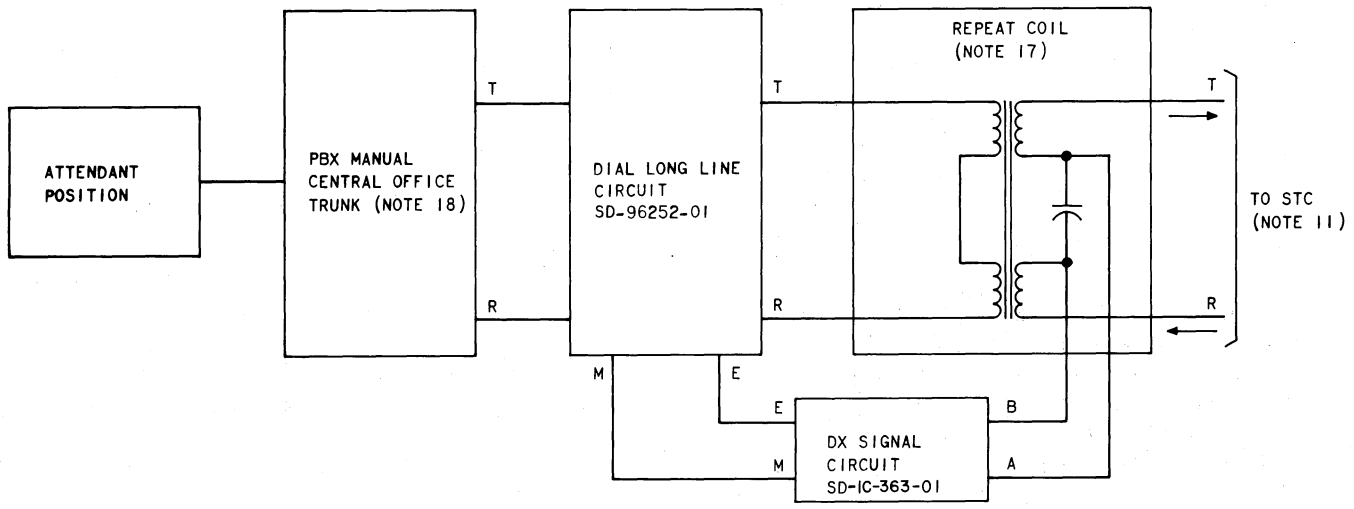

Fig. 4—PBX FX Trunk or WATS Trunk Termination (Station End) Using DX Signaling—2-Wire Local Channel (Associated With Fig. 12) (Note 19)

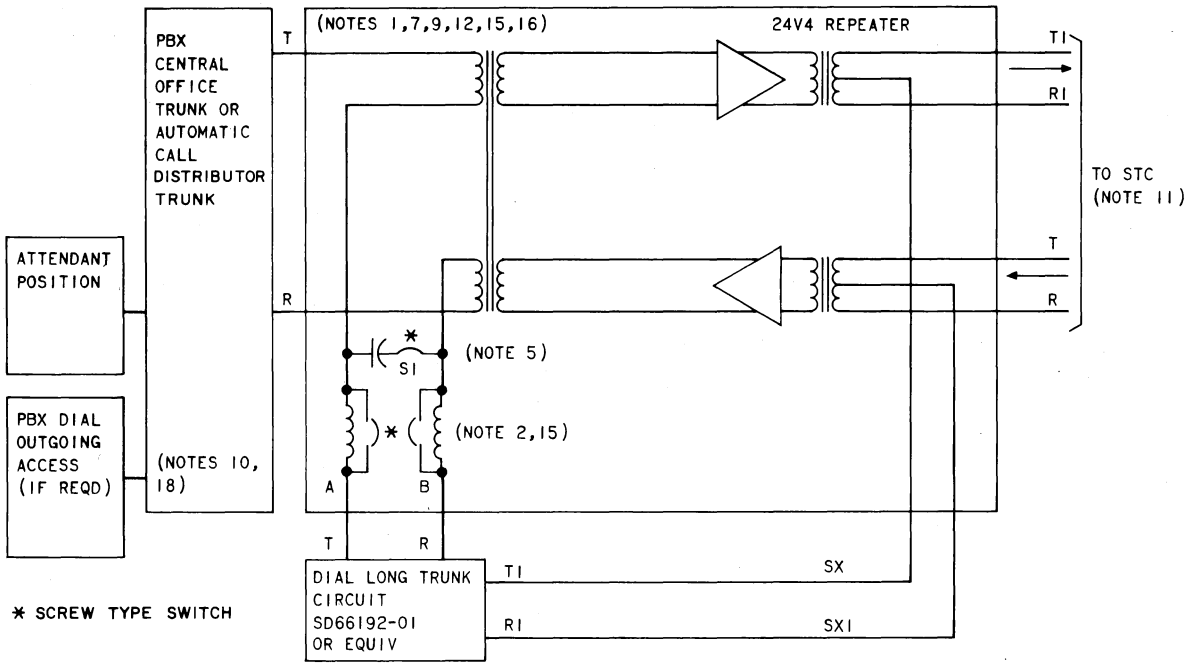

Fig. 5—PBX FX Trunk or WATS Trunk Termination (Station End) Arranged for Ground Start Long Trunk—4-Wire Local Channel—Metallic Facilities Only—(Associated With Fig. 1 or 13)

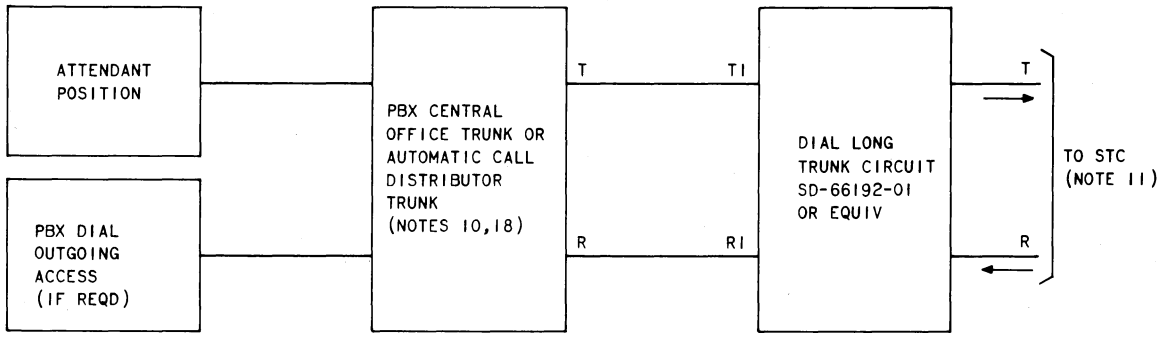

Fig. 6—PBX FX Trunk or WATS Trunk Termination (Station End)—Arranged for Ground Start Long Trunk—2-Wire Local Channel—Metallic Facilities Only—(Associated With Fig. 2 or 14)

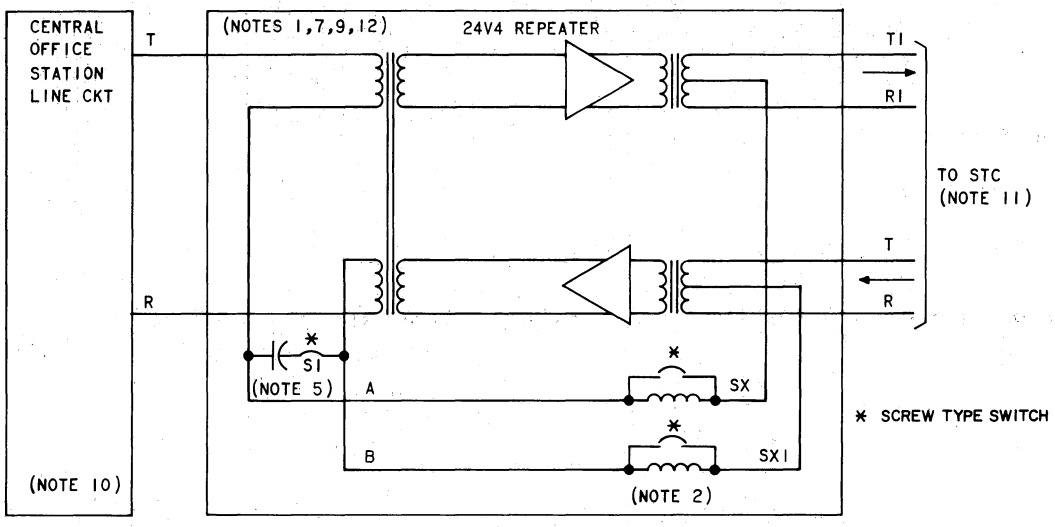

Fig. 7—PBX FX Trunk or WATS Trunk Termination (Switching End)—4-Wire Local Channel (Associated With Fig. 1)

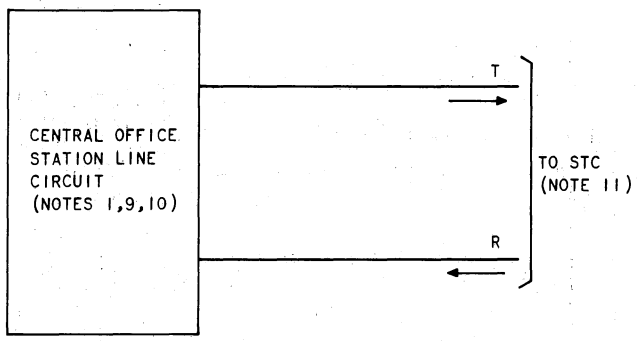

Fig. 8—PBX FX Trunk or WATS Trunk Termination (Switching End)—2-Wire Local Channel (Associated With Fig. 2)

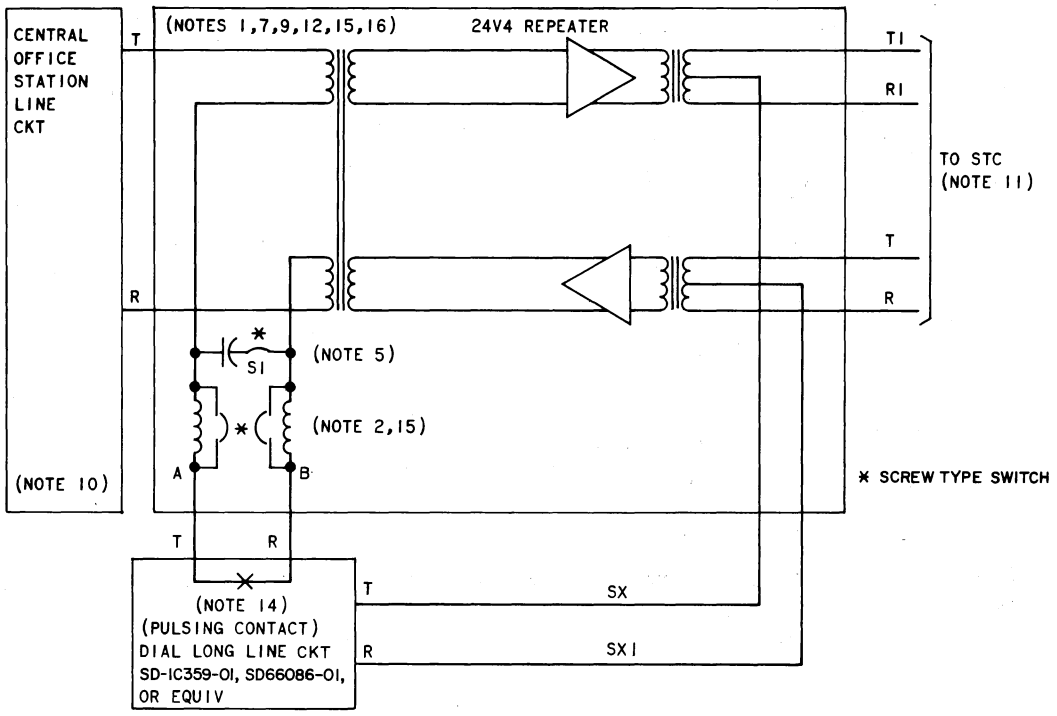

Fig. 9—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged For Loop to Loop Dial Long Line—4-Wire Local Channel (Associated With Fig. 1) (Note 20)

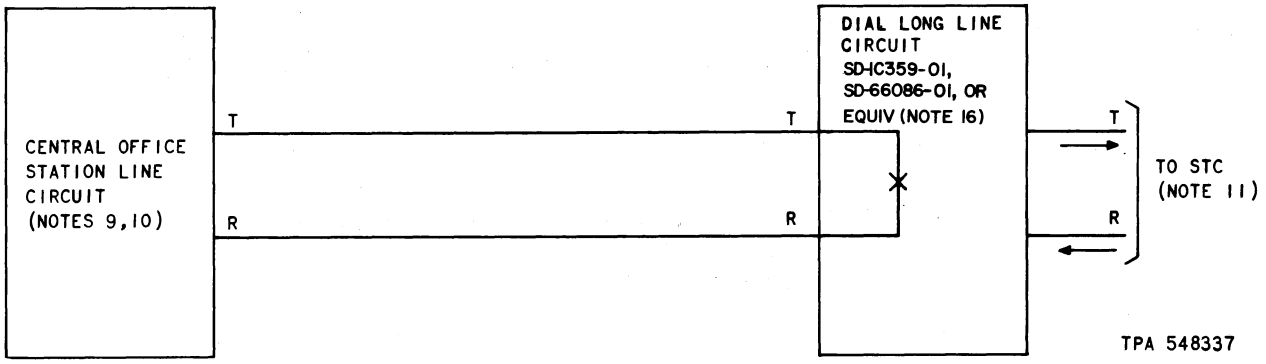

Fig. 10—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged For Loop to Loop Dial Long Line—2-Wire Local Channel (Associated With Fig. 2) (Note 20)

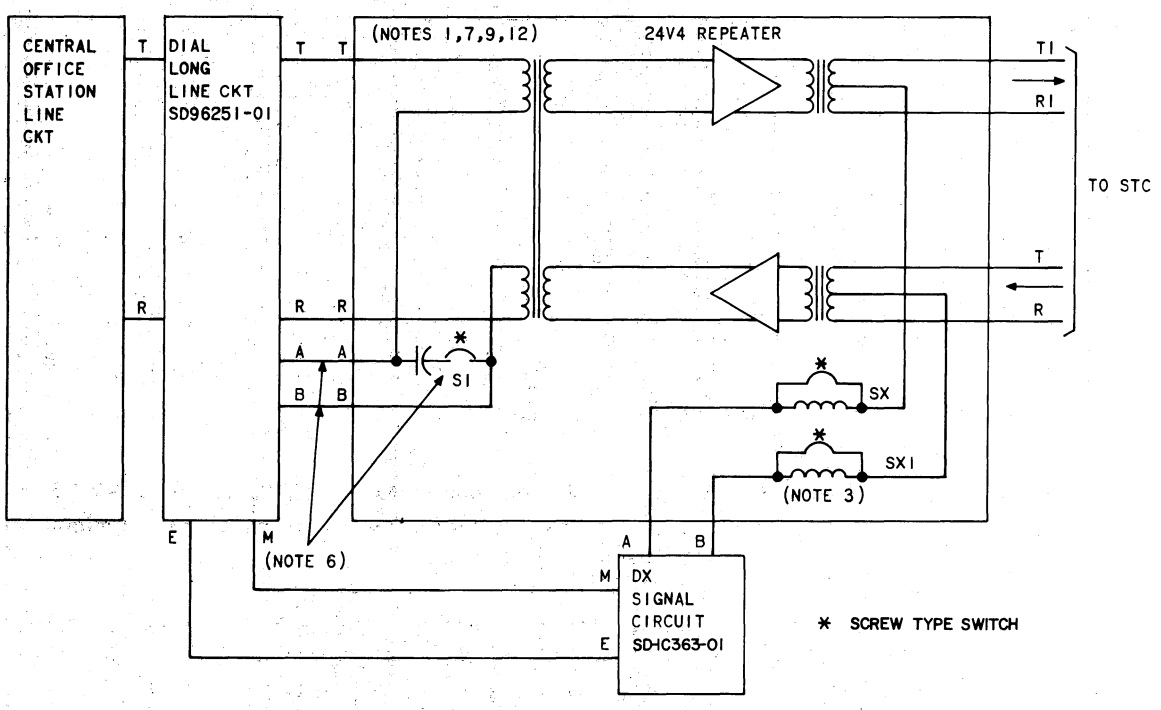

Fig. 11—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged For Loop Operation Using DX Signaling—4-Wire Local Channel (Associated With Fig. 3) (Note 21)

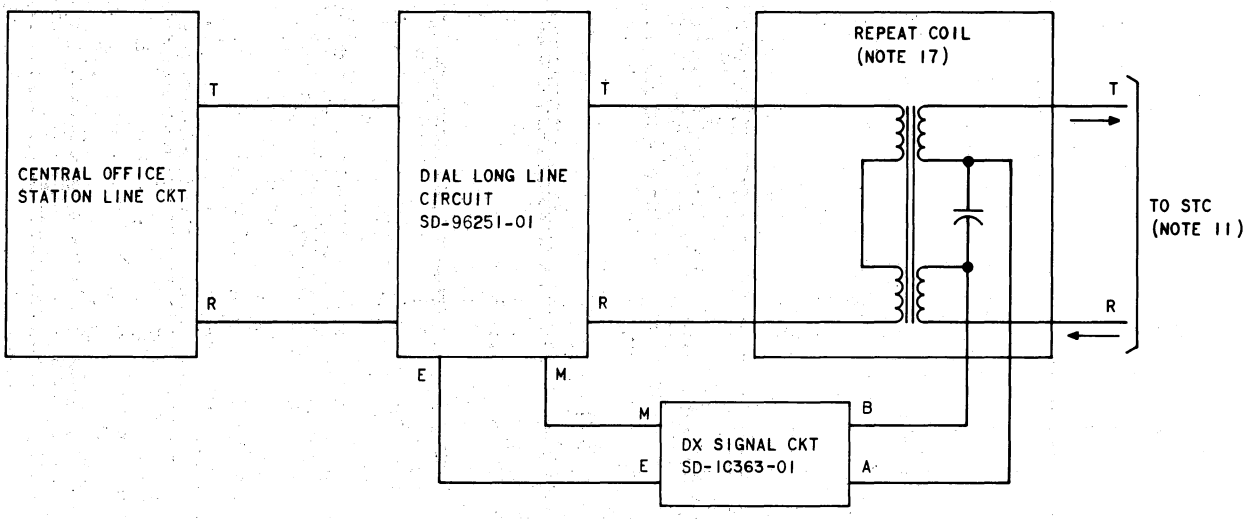

Fig. 12—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged For Loop Operation Using DX Signaling—2-Wire Local Channel (Associated With Fig. 4) (Note 21)

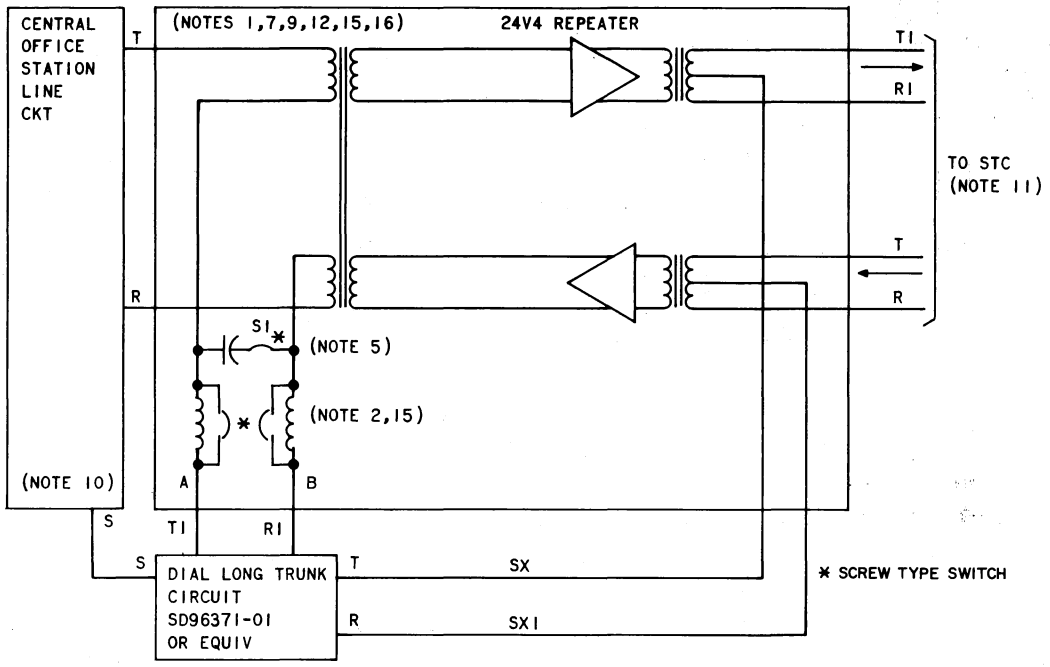

Fig. 13—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged for Ground Start Long Trunk—4-Wire Local Channel—Metallic Facilities Only—(Associated With Fig. 1 or 5)

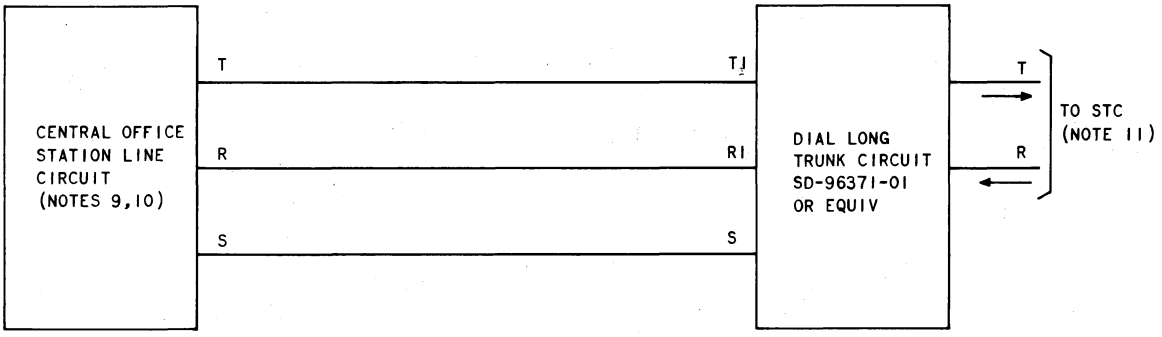

Fig. 14—PBX FX Trunk or WATS Trunk Termination (Switching End) Arranged For Ground Start Long Trunk—2-Wire Local Channel—Metallic Facilities Only—(Associated With Fig. 2 or 6)

TABLE D

CENTRAL OFFICE TRUNKS
ASSOCIATED WITH DIAL PBXs (NOTES A AND B)

PBX DIAL SWITCHING SYSTEM (NOTE C)	J SPECIFICATION	CIRCUIT	SECTION
701*	J58824A ‡	SD-65657-01	809-201-153
	J58824CC	SD-5E001-01	
	J58837AW (Note D)	SD-65895-01	809-803-153
	J58837CK (Note D)	SD-5E045-01	
	J58837E (Note E)	SD-65850-01	
711*	J58824A ‡	SD-65657-01	809-201-153
	J58824CC	SD-5E001-01	
740E*	J58824A ‡	SD-65657-01	809-201-153
	J58824CC	SD-5E001-01	
755†	J58819R ‡ (Note F)	SD-66503-01	809-819-150
756*	J58829M	SD-65752-01	809-820-150
757*	J58838EL	SD-5E016-01	809-821-150
	J58838CJ	SD-66749-01	
	J58838CK	SD-66750-01	
770A*	J58876UL	SD-1E340-01	809-830-150
	J58876UM	SD-1E341-01	
800A*	J58860L	SD-1E013-01	809-850-151
	J58860M	SD-1E015-01	
	J58860N		
801A*	J58872AA	SD-1E306-01 SD-1E307-01	809-850-160
	J58872AB		
	J58872AC		
	J58872AD		
805A*	J58873AA	SD-1E213-02	809-852-150
	J58873AE		

* Ground Start

† Loop Start

‡ A&M Only

Notes:

A. Ground start operation requires that the PBX recognize ground on the tip from the central office as a seizure signal. The central office equipment recognizes ground on the ring from the PBX as a seizure signal. The dial PBX must recognize the removal of ground from the tip conductor as a disconnect signal. The central office equipment must recognize the opening of the ring conductor as a disconnect signal.

B. Each PBX is arranged to function with various switchboards or consoles which vary according to customer requirements. (See Table H.)

C. A dial PBX is a switching system located on the customer premises. The connections between two stations or from station to trunks may be machine switched under control of the PBX station dial. Incoming calls from central office trunks are received by the PBX attendant who extends them to the desired station via a cord switchboard or a console.

D. Trunk arranged for key termination on consoles.

E. Trunk arranged for call distribution terminations for use with consoles.

F. Loop start operation requires placing a loop condition across the line toward the switching end as a request for service.

TABLE E

CENTRAL OFFICE TRUNKS ASSOCIATED WITH CORD SWITCHBOARDS MANUAL PBX (NOTES A, B, AND C)

ATTENDANT FACILITY	J SPECIFICATION	CIRCUIT	SECTION
552B,E	J53120A	SD-66592-01	809-201-151
	J58824AY	SD-65781-01	809-201-153
555	J59023E	SD-65715-01	809-720-150
	J59013F	SD-66520-01	809-718-150
605A	J53120A	SD-66592-01	809-201-151
	J58824AY	SD-65781-01	809-201-153
606A,B	J53120J	SD-66617-01	809-201-151
607A,B	J58824AY	SD-65781-01	809-201-153
608A,D	J53120A	SD-66592-01	809-201-151
	J58824AY	SD-65781-01	809-201-153
	J53125N	SD-66719-01	809-755-150

Notes:

A. A manual PBX is a switching system located on the customer premises. All connections (between two stations or between stations and trunks) are made by a PBX attendant.

B. Loop start operation requires placing a loop condition across the line toward the switching end as a request for service.

C. Ground start operation requires that the PBX recognize ground on the tip from the central office as a seizure signal. The central office equipment recognizes ground on the ring from the PBX as a seizure signal. The manual PBX must recognize the removal of ground from the tip conductor as a disconnect signal. The central office equipment must recognize the opening of the ring conductor as a disconnect signal.

TABLE F

CENTRAL OFFICE TRUNKS ASSOCIATED WITH CORDLESS SWITCHBOARDS OR CONSOLES MANUAL PBX (NOTES A, B, AND C)

ATTENDANT FACILITY	J SPECIFICATION	CIRCUIT	SECTION
507A,B	J59019	SD-65680-01	809-701-150
558A	J59027	SD-5E060-01	809-721-150

Notes:

A. A manual PBX is a switching system located on the customer premises. All connections (between two stations or between stations and trunks) are made by a PBX attendant.

B. Loop start operation requires placing a loop condition across the line toward the switching end as a request for service.

C. Ground start operation requires that the PBX recognize ground on the tip from the central office as a seizure signal. The central office equipment recognizes ground on the ring from the PBX as a seizure signal. The manual PBX must recognize the removal of ground from the tip conductor as a disconnect signal. The central office equipment must recognize the opening of the ring conductor as a disconnect signal.

TABLE G

CENTRAL OFFICE TRUNKS ASSOCIATED WITH AUTOMATIC CALL DISTRIBUTORS

AUTOMATIC CALL DISTRIBUTOR	J SPECIFICATION	CIRCUIT	SECTION
2A ACD	J53127AA	SD-66777-01	809-135-151
2B ACD	J53134AA, AB, AC	SD-1E088-01	809-135-153
3A ACD	J53131F	SD-65961-01	809-135-152
	J53131R	SD-65978-01	

TABLE H

PBX SYSTEMS AND ASSOCIATED ATTENDANT FACILITIES

PBX SYSTEM	ATTENDANT FACILITY	
	CONSOLE TYPE	SWITCHBOARD
558A	29	
701A	5, 6	552A, 552D, 605A, 606B, 607A, 607B, 608A, 608D
701B	1, 2, 5, 6, 21, 41	552A, 552D, 605A, 607A, 607B, 608A, 608D
701A-B (MOD)	1, 2, 1A1 & 1A2 Selector (DSS)	608B, 608D
701PK		552A, 552D, 608A, 608D
702A		606A
740E	5, 6	552A, 552D, 556A, 608A, 608D
756A	3, 4	556A, 608A, 608D
757A	1, 2, 23, 43, 1A1 & 1A2 Selector (DSS)	608A, 608D
770A	1, 2, 23, 43, 53	
800A	14, 15, 16, 24, 34	608A, 608D
801A	24, 34, 54	
805A	15	
810A	25, 35, 45, 55, 1A1 & 1A2 Selector (DSS)	
812A	45	
#101ESS	1, 2, 26, 36, 46, 56	
# 5 X BAR	1, 2, 28, 48, 1A1 & 1A2 Selector (DSS)	608A
# 1 ESS	1, 2, 27, 47	
# 2 ESS	1, 2, 27, 47	
2A ACD	10, 11, 12	
2B ACD	10, 11, 13, 15	
3A ACD	10, 11, 12	

GENERAL FIGURE NOTES

1. The range of this circuit is limited by resistance. The permissable conductor loop resistance must be reduced by the resistance of the V4 repeater and/or other associated equipment.

2. The simplex inductors should be included in the circuit to minimize noise.

3. The simplex inductors should not be included in the circuit.

4. Switch S1 of the terminating set should be open to remove the capacitor.

5. Switch S1 of the terminating set should be closed to provide the capacitor.

6. When the A and B leads are connected to the trunk or Long Line circuit, switch S1 of the terminating set shall be open to remove the capacitor. Otherwise switch S1 should be closed.

7. Components for 24V4 repeaters are determined by transmission considerations and shall be provided as required. Information is provided in Section 812-002-290.

8. When an idle circuit termination is not provided in the associated trunk, it shall be provided as required. Component information is provided in Section 812-002-270.

9. For application of transfer arrangements (if required) refer to Section 812-002-270.

10. Ground start operation must be employed when both the station end and switching end may be accessed on a dial basis. Loop signaling may be employed if the station end terminates on a manual basis in an appropriate central office trunk.

11. For typical circuit layouts of this arrangement, refer to Section 812-002-200.

12. Leads D, F, and G associated with the 24V4 repeater shall be connected as needed. Lead D is for pad control, and leads F and G are for idle circuit termination.

13. Provide trunk applicable to PBX or Automatic Call Distributor, as needed.

14. When a loop-to-loop Dial Long Line is used for signaling, provide modifications as outlined in Section 812-002-270.

15. Terminating sets with inductors in series with the A and B leads shall be provided for this application. (Terminating Sets 1K, 1L, 1M, or 1N).

16. This arrangement is required when the range of the PBX is exceeded or split dial pulse problems are encountered. These are described in Section 179-100-303 or SD-99421-03.

17. An external repeat coil shall be provided per Section 812-002-270, as required.

18. Provide central office trunk per tables D through F, as required.

19. Loop operation at switching end and out-of-band signaling required if used with a carrier system.

20. Manual operation required at station end.

21. Manual operation at station end and out-of-band signaling required if used with a carrier system.