SYSTEM CENTURY®
DIGITAL CENTRAL OFFICE

TRUNK CIRCUITS
DESCRIPTION

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont)

1. INTRODUCTION

1.01 This section provides functional descriptions of the various trunk circuits used in SYSTEM CENTURY® Digital Central Offices equipped with a local line switch (LLS). The digital trunk interface (DTI) and fire reporting system are also described. Also included are descriptions of the physical arrangement of circuits on the associated assemblies, indications of the effect of component failures in the circuits, and special physical or electrical characteristics.

2. RELATED INFORMATION

2.01 General.

A Sales and Instructional Literature Index of latest available publications can be obtained from your Stromberg-Carlson sales representative or from Publications Services, Stromberg-Carlson Corporation, 400 Rinehart Road, Lake Mary, Florida 32746.

2.02 Related Section.

The following section is recommended for use with this document. To determine the actual section number, refer to the *DCO Index of Related Sections* provided with your set of Stromberg-Carlson Practices (SCPs).

23-YYY-51 Equipment Location

3. GENERAL

3.01 Trunk circuits are defined as those circuits that serve as an interface between the switching network, by way of the port grouping circuits, and the interoffice trunks that enter the office and are terminated at the combined distributing frame (CDF). Figure 1 is an orientation diagram showing relative positions of circuits in the system.

4. EQUIPMENT DESCRIPTION AND LOCATION

4.01 Trunk and DTI circuits are mounted on PWBAs that are 7.15 inches (18.2 cm) high and 15 inches (38.1 cm) deep. These PWBAs mount in equipment cells that are 24 inches (61 cm) wide, 8.75 inches (22.2 cm) high, and 16 inches (40.6 cm) deep. Cells are mounted in line/trunk frames that are 8 feet (244 cm) high, 32 inches (81.3 cm) wide, and 22 inches (56 cm) deep. See figures 2 and 3.

4.02 The fire-reporting circuits are mounted on PWBAs that are 5.5 inches (14 cm) by 5.5 inches (14 cm). These PWBAs mount in equipment cells that are 17.5 inches (44.5 cm) wide, 5.9 inches (14.9 cm) high, and 9 inches (22.9 cm) deep. A complete fire-reporting system (30 lines) occupies 26.75 inches (67.9 cm) of vertical space in the power, ringing, and test access selector frame.

4.03 The location of trunk, DTI, and fire-reporting circuits are provided in the section titled *Equipment Location*, referenced in paragraph 2.02.

5. E&M TRUNK CIRCUITS

5.01 Two-to-Four-Wire Circuit.

a. Each E&M trunk circuit is arranged for a two-to-four-wire mode of transmission with two wires connected to the external trunk (at the CDF) and four wires to the switching system. Two E&M trunk circuits and associated CODEC circuits are contained on one E&M trunk PWBA. Each trunk circuit can have either Type I or Type II E&M signaling leads through a strapping arrangement. Another strapping arrangement allows for 600- or 900-ohm termination.

b. Two-way analog signals on the tip and ring leads are converted to two 1-way (send and receive) analog signals. These signals are converted to/from pulse code modulation (PCM) digital bit streams in the CODEC circuit before/after processing by the switching system. See figure 4.

c. Under direction of the port group control (PGC) circuit, the E&M trunk circuit allows test access of the tip, ring, and E&M leads. Control

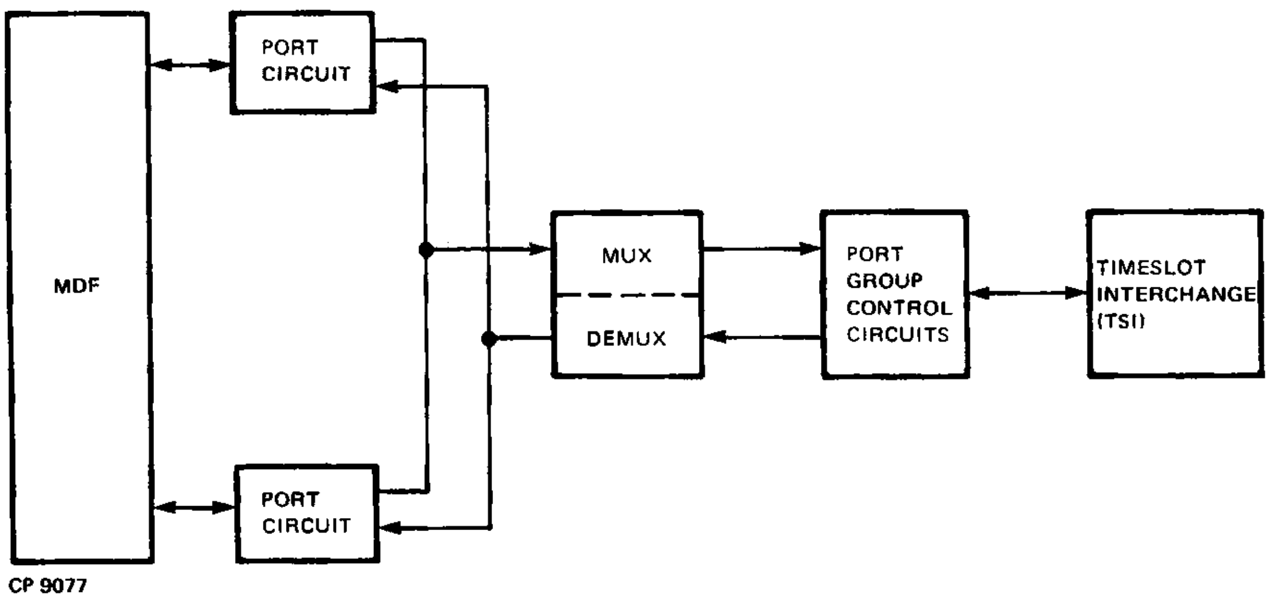
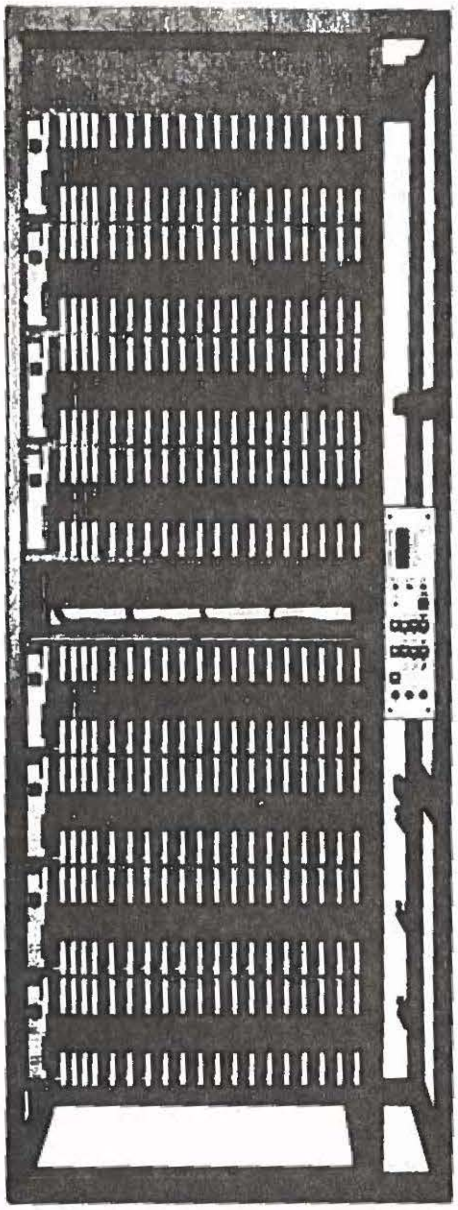


Figure 1. Port Circuits, Orientation Diagram

from the PGC can also generate outgoing signals on the M lead.

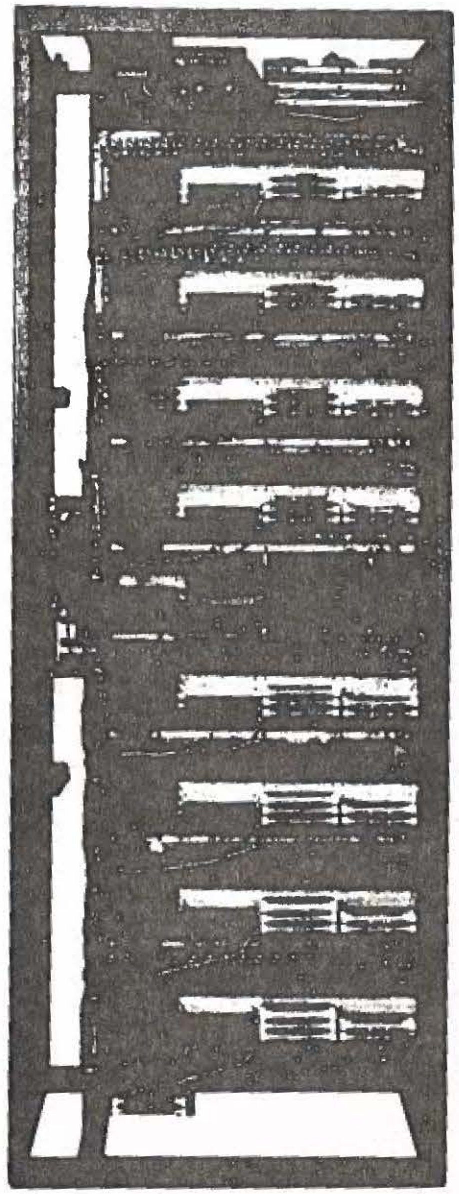
d. Figure 4 shows the voice, signaling, and test paths through the trunk circuit. Relays in each trunk circuit are operated by supervisory control bits from the port control system (PCS). The pulsing relay is used in interoffice signaling on the signaling leads. The test access A relay provides test access to the tip and ring leads. Similarly, the test access B relay provides test access to the signaling leads.

e. Analog voice signals received from a local or distant office on the tip and ring leads of the E&M trunk circuit are terminated in a basic audio interface. This circuit transfers the signals on the bidirectional tip and ring leads to undirectional transmit and receive lines to and from the CODEC circuit.



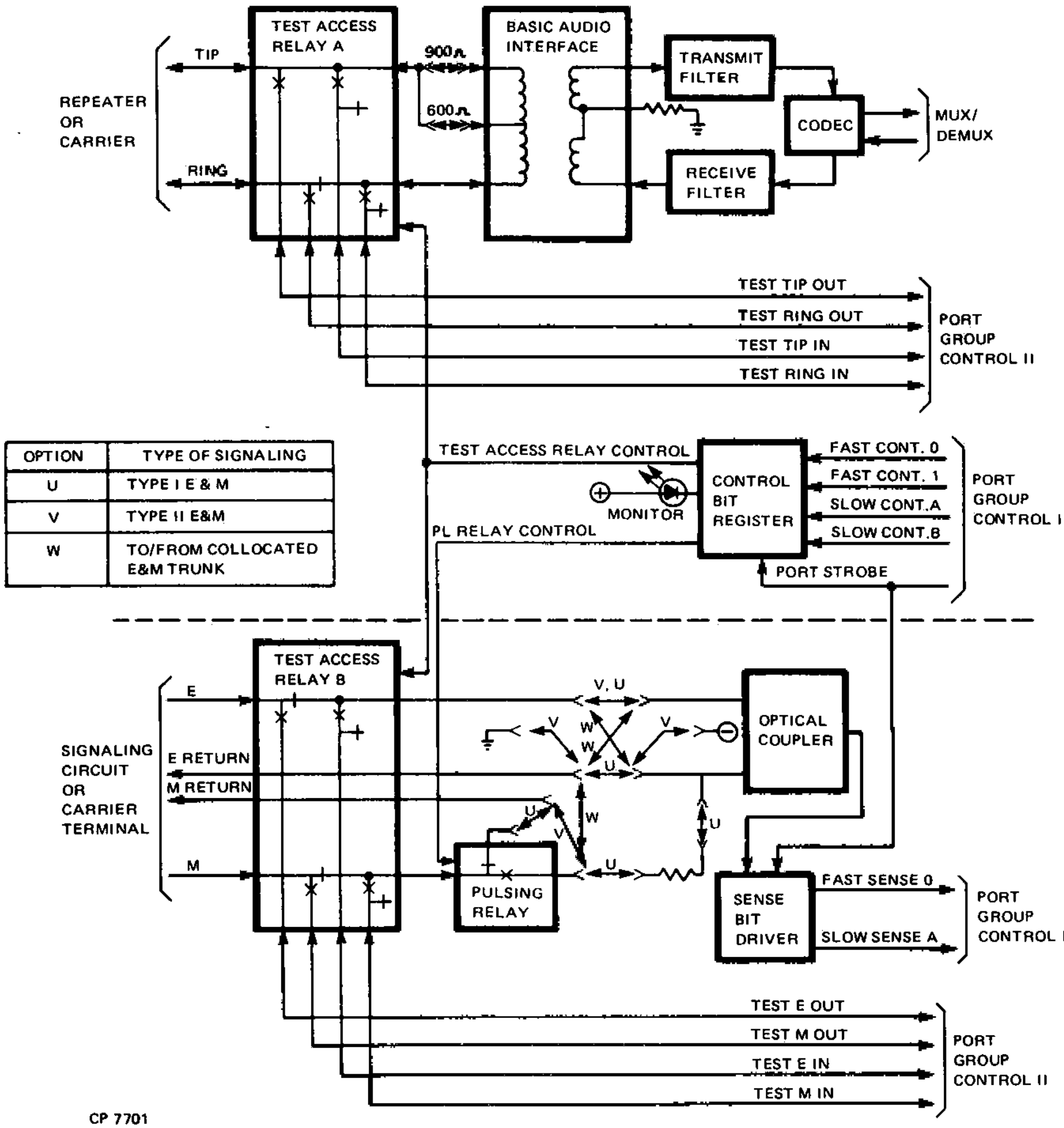
HT 10282

Figure 2. Line/Trunk Frame, Front View



HT 10280

Figure 3. Line/Trunk Frame, Rear View



OPTION	TYPE OF SIGNALING
U	TYPE I E & M
V	TYPE II E&M
W	TO/FROM COLLOCATED E&M TRUNK

Figure 4. Two-to-Four-Wire E&M Trunk, Block Diagram

f. Signaling from the trunk circuit to another office is done using the pulsing relay. When operated, this relay switches from ground to −48V on the M lead in a Type I interface. In a Type II interface, the relay closes the loop formed by the M and M-return leads. Return signaling is detected on the E lead in a Type I interface and on the loop formed by the E and E-return leads in a Type II interface. In either type of circuit, detection of return signaling generates fast sense bit 0 that is sent to the PGC I circuit when a port strobe is addressed to the trunk circuit. Slow sense bit A is sent to the PGC I as an indication that the trunk circuit is installed in the system.

g. Test access relays A and B provide test access to the voice path and to the signaling path, respectively. The test access A relay breaks the tip and ring leads, then switches the line side of tip and ring to the test-tip-out and test-ring-out leads, respectively. It connects the equipment side of tip and ring to the test-tip-in and test-ring-in leads, respectively. These connections allow the line side and the equipment side to be tested independently.

h. The test access B relay breaks the E lead and switches the line side to the test-E-out lead and the equipment side to the test-E-in lead. At the same time, the relay breaks the M lead and switches the line side to the test-M-out lead and the equipment side to the test-M-in lead. Thus, the line side and the equipment side of each signaling lead can be tested independently.

i. A failure of any component on the PWBA normally affects only the single associated trunk circuit. A component failure can affect incoming supervision and signaling, outgoing supervision and signaling, transmission, testing, and/or miscellaneous metering. Normally, a failure of one or two trunk circuits is considered to be a minor failure.

5.02 Four-Wire Circuit.

a. This E&M trunk circuit is used to interface a collocated four-wire carrier channel or a collocated single-frequency signaling system to the DCO switching system. Two trunk circuits and associated CODEC circuits are contained on one four-wire E&M trunk PWBA. Each circuit can be strapped for either Type I or Type II E&M signaling.

b. Two-way analog signals on the tip and ring transmit and receive leads are converted to two 1-way (send and receive) analog signals. These signals are converted to/from digital bit streams in the CODEC circuit before/after processing by the switching system. See figure 5.

c. Under direction of the PGC circuit, the E&M trunk circuit allows test access of the tip, ring, and E&M leads. Control from the PGC can also generate outgoing signals on the M lead.

d. Figure 5 shows the voice, signaling, and test paths through the trunk circuit. Analog voice signals received from signaling or carrier equipment on the tip and ring transmit (TT and RT) leads are transferred through the transmit repeat coil, attenuator, and filter to the CODEC circuit. The attenuator is used to meet the level requirements of the filter and CODEC circuits.

e. The digital signals from the mux/demux are converted to analog form by the CODEC. The analog signal is filtered and then transferred through the attenuator and repeat coil to the tip and ring receive (TR and RR) leads. The receive attenuator is used to meet the level requirements of the four-wire trunk.

f. Signaling from the trunk circuit to the carrier or signaling equipment is done using the pulsing relay. When operated, this relay switches from ground to −48V on the M lead in a Type I interface. In a Type II interface, the relay closes the loop formed by the M and M-return leads. Return signaling is detected on the E lead in a Type I interface and on the loop formed by the E and E-return leads in a Type II interface. In either type of circuit, detection of return signaling generates fast sense bit 0 that is sent to the PGC I circuit when a port strobe is addressed to the trunk circuit. Slow sense bit A is sent to the PGC I circuit as an indication that the trunk circuit is installed in the system.

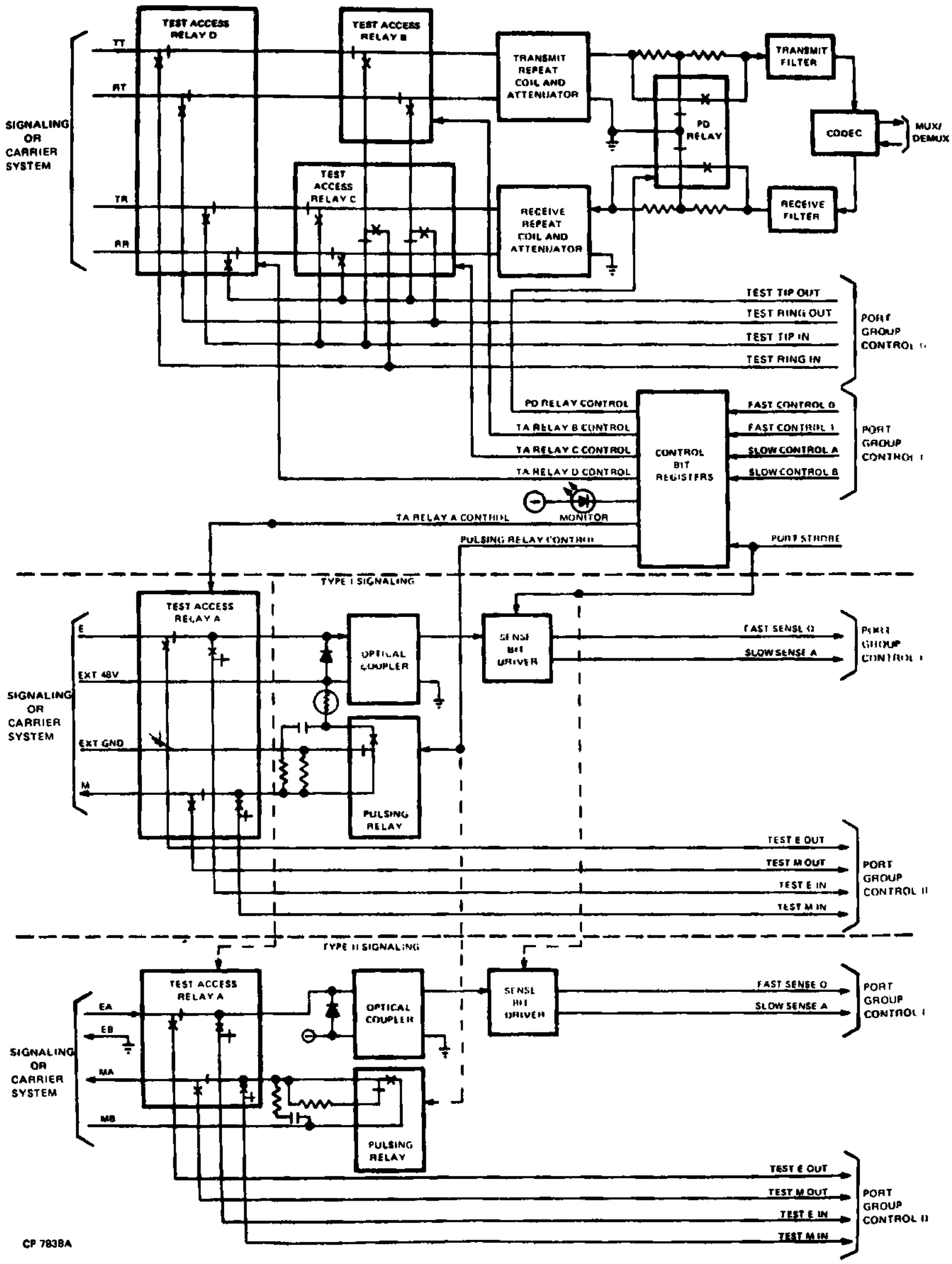


Figure 5. Four-Wire E&M Trunk, Block Diagram

g. Test access relays provide test access to both the voice and signaling paths. Test access relay A breaks the E lead and switches the port side to the test-E-in (TEI) lead and the equipment side to the test-E-out (TEO) lead. At the same time, the relay breaks the M lead and switches the port side to the test-M-in (TMI) lead and the equipment side to the test-M-out (TMO) lead. Thus, the port side and the equipment side of each signaling lead can be tested independently.

h. Test access relay B breaks the TR and RR leads and switches the test-transmit-in (TTI) lead to the port side of lead TR and the test-receive-in (TRI) lead to the port side of lead RR. This allows TTI and TRI to access the receive path only.

i. Test access relay C breaks the TT and RT leads and switches lead TTI to the port side of lead TT and lead TRI to the port side of lead RT. This allows leads TTI and TRI to access the transmit path only.

j. Test access relay D breaks leads TR, RR, TT, and RT and switches leads TTO, TRO, TTI, and TRI to the equipment side of leads TR, RR, TT, and RT, respectively.

k. A failure of any component on the PWBA normally affects only the single associated trunk circuit. A component failure can affect incoming supervision and signaling, outgoing supervision and signaling, transmission, testing, and/or miscellaneous metering. Normally, a failure of one or two trunk circuits is considered a minor failure.

6. LOOP, REVERSE-BATTERY TRUNK CIRCUIT

6.01 The loop, reverse-battery trunk circuit serves as a controlled interface for two-way communication between the DCO switching system and a loop reverse-battery trunk from another office. Each trunk circuit is arranged for two-to-four-wire mode of transmission with two wires connected to the external trunk (at the CDF) and four wires to the switching system. One trunk circuit is provided on each loop reverse-battery trunk circuit PWBA.

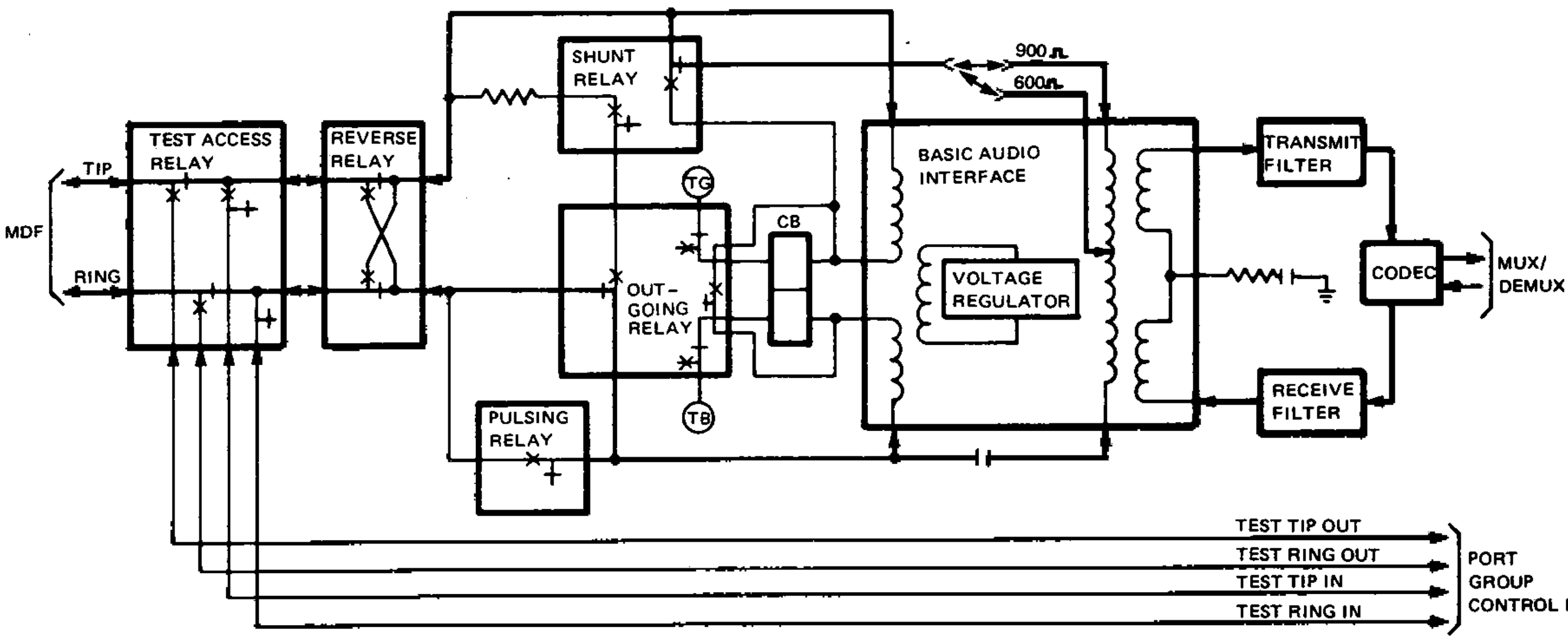
6.02 The basic circuitry and the normal data path through this circuit are shown in the general block diagram provided in figure 6. The bidirectional tip and ring voice path is terminated in the basic audio interface circuit. Here, the bidirectional paths are converted to unidirectional transmit and receive lines that carry analog data to or from the CODEC circuit on the trunk PWBA. The CODEC converts the analog data being sent from the trunk to digital data for transmission through the timeslot interchange (TSI). For data transfers from the TSI to the trunk, the CODEC converts digital data bits to analog signals.

6.03 Software-controlled relays determine the operating mode of the loop reverse-battery trunk circuit. The relays shown in the block diagram are standard in each loop reverse-battery trunk circuit. In addition to providing a path through the trunk circuit for normal call data, the relays in the circuit do various signaling and test-related functions. The reverse relay reverses the polarity of the tip and ring leads as a way of signaling the other office. The pulsing relay is used for outpulsing to the other office. The outgoing relay transfers the trunk from incoming call service to outgoing call service; it disconnects battery and ground from the loop and switches the pulsing relay into the loop to make pulsing possible. The shunt relay allows the overall inductance in the loop to be reduced during outpulsing to ensure accurate signals at the receiving end. The CB relay is the detector of incoming off-hook signals on the loop. For testing purposes, the test access relay is the device for splitting the incoming and outgoing tip and ring leads and for monitoring or inserting test signals.

6.04 A failure of any component on the PWBA affects only the trunk circuit. A component failure can affect incoming supervision and signaling, outgoing supervision and signaling, transmission, testing, and/or miscellaneous metering. Normally a failure of a trunk is considered to be a minor failure.

7. BATTERY- AND GROUND-PULSING, LOOP TRUNK CIRCUIT

7.01 This trunk is similar to the loop, reverse-battery trunk previously described, except that during outpulsing it pulses resistance battery and resistance ground to the T and R leads, respectively, of the distant office, to enable operation over longer loops (up to 2000 ohms) than with loop pulsing. One trunk circuit is provided on each PWBA.



NOTE: Heavy line represents normal analog path.

CP 7699

Figure 6. Loop Reverse-Battery Trunk, Block Diagram

7.02 The basic circuitry and the normal data path through it are shown in the block diagram in figure 7. Software-controlled relays determine the operating mode of the trunk circuit. The six relays shown in the block diagram are standard in each trunk circuit. In addition to providing a path through the trunk circuit for normal call data, the relays in the circuit do various signaling and test-related functions. The reverse relay reverses the polarity of the tip and ring leads as a way of signaling the other office. The pulsing relay is used for outpulsing to the other office. The outgoing relay transfers the trunk from incoming call service to outgoing call service; it disconnects battery and ground from the loop and prepares the pulsing relay contacts for pulsing. On outgoing calls, the shunt relay (by way of contacts of the pulsing relay) switches resistance battery and resistance ground to the T and R leads, respectively, to the distant office. On incoming calls, it allows the overall inductance in the loop to be reduced during outpulsing to ensure crisper signals at the receiving end. The CB relay is the detector of incoming off-hook signals on the loop. The test access relay provides for splitting the incoming and outgoing tip and ring leads and monitoring or inserting test signals.

7.03 The bidirectional tip and ring voice path is terminated in the basic audio interface circuit. Here the bidirectional paths are converted to unidirectional transmit and receive lines that carry analog data to or from the CODEC circuit. The CODEC converts the analog data being sent from the trunk to digital data for transmission through the TSI. For data transfer from the TSI to the trunk, the CODEC converts digital data bits to analog signals.

8. STEP-BY-STEP INCOMING TRUNK CIRCUIT

8.01 The step-by-step (S x S) incoming trunk serves as an interface between S x S analog switching equipment and a DCO switching system, both located in the same office. The trunk provides only one-way incoming service since the loop can be seized only by S x S equipment for incoming calls. One trunk circuit is provided on each S x S trunk circuit PWBA.

8.02 Four leads are provided to the S x S equipment by each trunk circuit. In addition to the tip and ring leads for handling voice and pulsing, the circuit provides a sleeve (S) lead and a helping sleeve (HS) lead. The S lead is a holding circuit for the S x S switching mechanism. The HS lead carries supervisory signals for those S x S installations requiring more than reverse-battery supervision. As shown in the general block diagram in figure 8, the tip, ring, S, and HS leads are terminated at relays in the trunk circuit. The tip and ring leads are terminated in the CB relay by way of contacts of the RV relay. The S and HS leads are terminated in contacts of the RD relay and the RV relay, respectively.

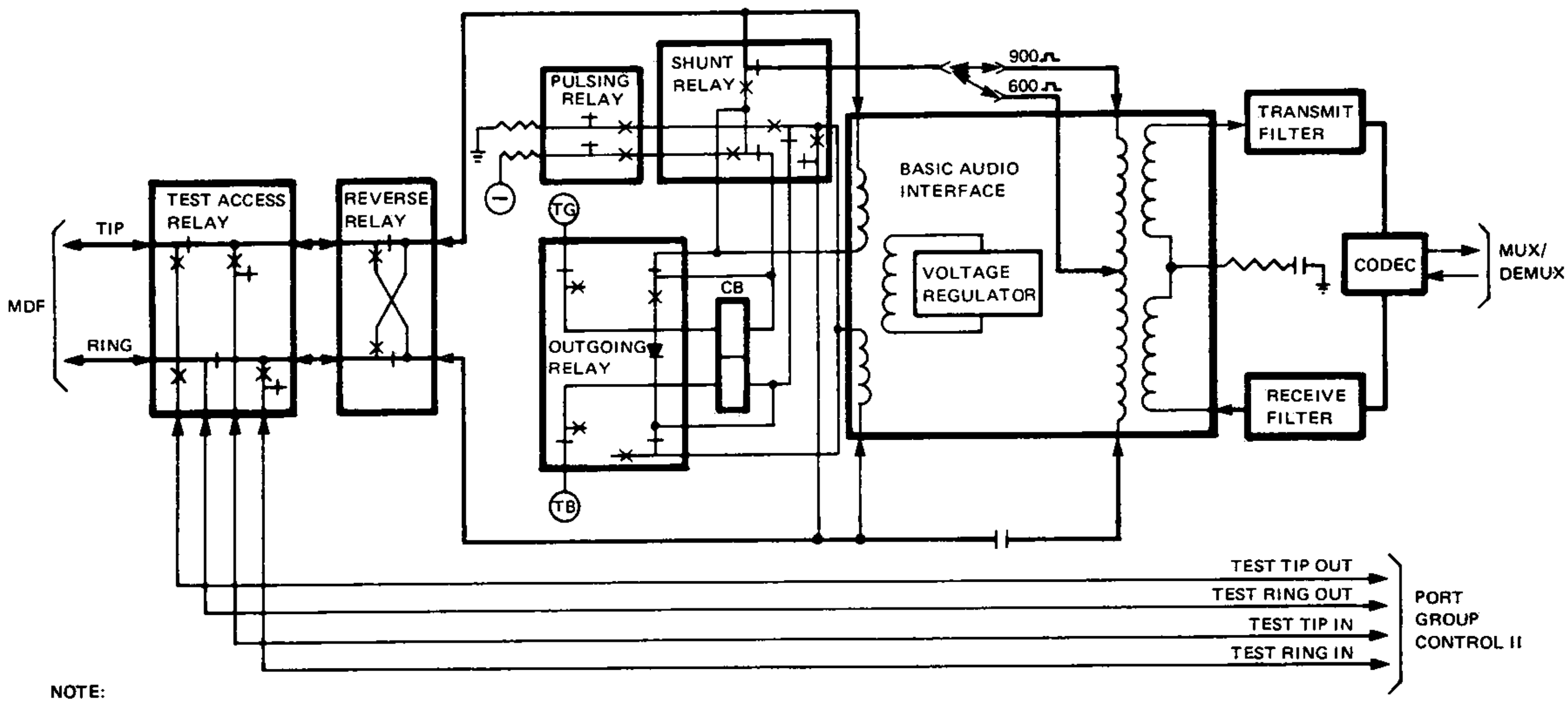
8.03 The test access relay allows for testing of the tip, ring, S, and HS leads. The RV relay reverses battery and ground between the tip and ring leads for those S x S installations that recognize loop supervision. For other types of S x S equipment requiring a separate line for supervision, the RV relay is used for signaling by way of the HS lead. The CB relay detects off-hook conditions originating in the S x S equipment.

8.04 The analog signal from the S x S equipment is switched through the RV relay and then transferred from the bidirectional tip and ring leads to the unidirectional transmit line in the basic audio interface circuit. The CODEC converts the analog signal to digital form for transfer through the port group control to the TSI. During voice transfers in the opposite direction, digital data bits are converted to an analog signal by the CODEC. The analog signal on the unidirectional receive line is transferred to the bidirectional tip and ring leads by the basic audio interface circuit. Tip and ring are then switched through RV relay contacts and out to the S x S equipment.

9. STEP-BY-STEP OUTGOING TRUNK CIRCUIT

9.01 The S x S outgoing trunk serves as an interface between S x S analog switching equipment and a DCO switching system, which are located in the same office. The trunk provides only one-way outgoing service because it interconnects with either an incoming selector or preselector of the S x S trunk. One trunk circuit is provided on each S x S trunk circuit PWBA.

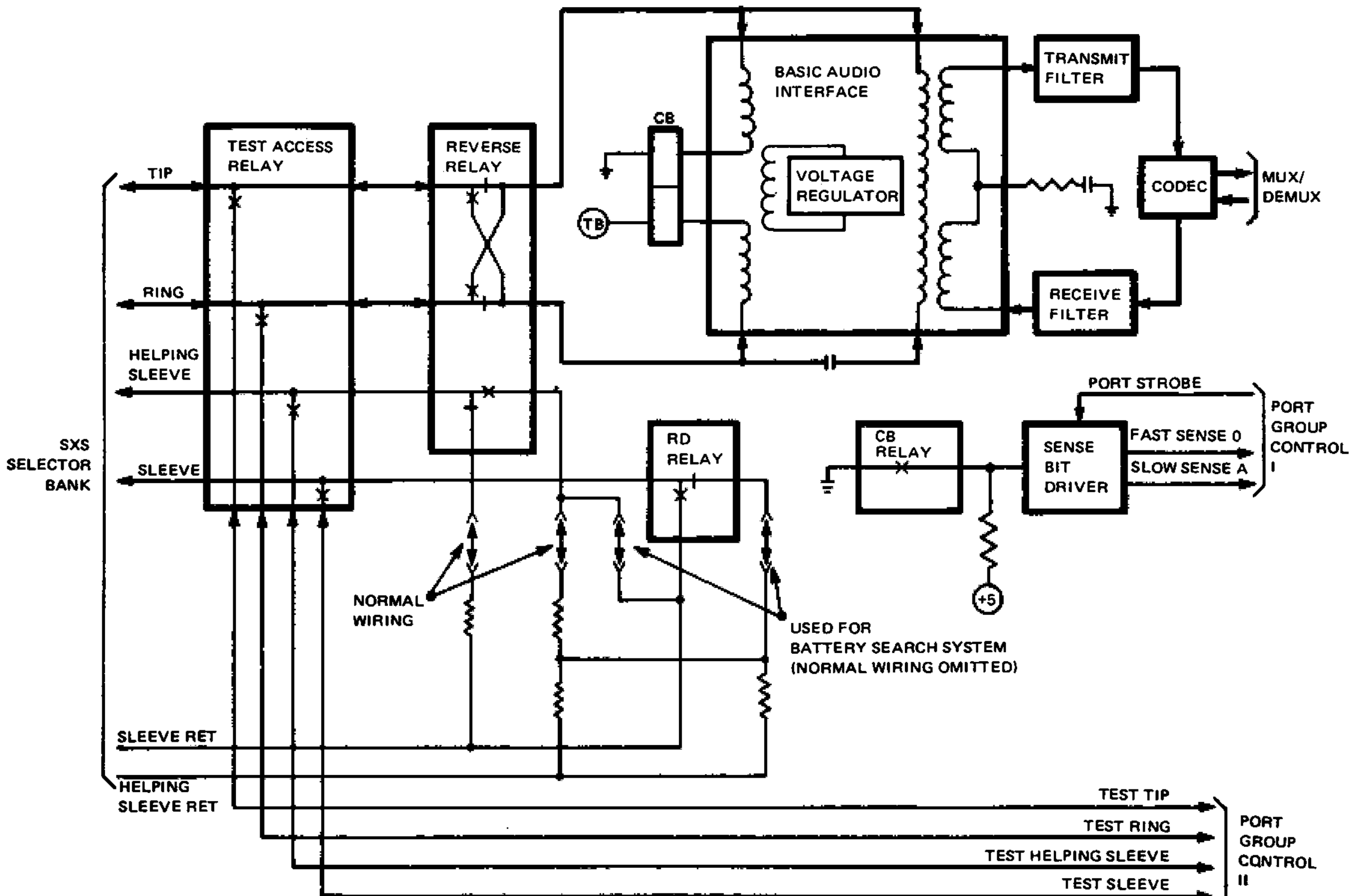
9.02 Four leads are provided to the S x S equipment by each trunk circuit. In addition to the tip and ring leads for handling voice and pulsing, the circuit provides an S and HS lead. The DCO system uses the S lead to seize the S x S equipment by way of the SS relay. The S x S equipment grounds the S lead when seized or when its incoming selector or preselector is out of service. The HS lead is used when the S x S equipment provides resis-



NOTE:
Heavy line represents normal analog path

CP 7695

Figure 7. Battery-and Ground-Pulsing Loop Trunk, Block Diagram



NOTE: Heavy line represents normal analog path.

CP 7696

Figure 8. Step-by-Step Incoming Trunk, Block Diagram

tance battery answer supervision on the HS lead. As shown in the general block diagram in figure 9, the tip and ring leads are terminated in relay SR and the S and HS leads are terminated in optical couplers, which provide supervisory sense bits.

9.03 The test access relays allow for testing of the tip, ring, sleeve and helping sleeve leads, both out to the S x S equipment and in toward the DCO system. The pulsing relay is used for outpulsing to the S x S equipment. The shunt relay reduces the overall inductance in the loop during outpulsing to ensure accurate signals at the S x S equipment. If reverse-battery answer supervision is provided by the S x S equipment, relay SR operates to generate a supervisory sense bit.

9.04 The analog signal from the S x S equipment is switched through test access relay A and then transferred from the bidirectional tip and ring leads to the unidirectional transmit line in the basic audio interface circuit. The CODEC converts the analog signal to digital form for transfer through the PGC to the TSI. During voice transfers in the opposite direction, digital data bits are converted to an analog signal by the CODEC. The analog signal on the unidirectional receive line is transferred to the bidirectional tip and ring leads by the basic audio interface circuit. Tip and ring are then switched through RV relay contacts and out to the S x S equipment.

10. DIGITAL TRUNK INTERFACE

10.01 General.

a. The Digital Trunk Interface (DTI) provides the means for the internal digital network of the DCO system to directly interface with a T-1 carrier span on a digital basis. Direct connection to the T-1 span line eliminates the need for PCM carrier channel banks and analog trunk circuits.

b. The DTI can be used to interface the system to trunks from any distant analog central office that is equipped with D2/D3 channel banks, or from any distant digital central office that contains a D2/D3-compatible direct T-1 interface. If the distant central office is part of a synchronous digital network, a synchronous network clock must be installed with the DCO common equipment. The clock ensures that all timing signals within the digital network occur at the correct rate.

c. The basic function of the DTI is to provide data rate and data format conversions for the digital signals that are sent between the DCO system and the T-1 carrier system. Pulse-code modulated signals that are transmitted over T-1 span lines are in bipolar form at a 1.544 megabit-per-second (Mb/s) rate. The DCO system, however, uses a 2.048 Mb/s rate in non-return-to-zero (NRZ) form. The DTI transforms the rate and format of the received T-1 data to that used by the DCO system, and, for transmission in the opposite direction, converts the digital signals from the DCO system to the rate and format required by the T-1 carrier span.

d. Each DTI cell in a DCO trunk frame serves one 24-channel, T-1 span line. Four PWBAs make up one DTI, as described in paragraphs 10.02 through 10.05. See figure 10.

10.02 DTI Interface.

The DTI interface PWBA provides transformer isolation of the T-1 span and functions as a buffer between the DTI and the port group highway (PGH) of the DCO system. The circuit converts outgoing data from NRZ to bipolar form, converts incoming data from bipolar to NRZ form, and regenerates the incoming T-1 clock signal. A red indicator on the PWBA lights if the received clock signal is not synchronized with the PGH clock. Another red indicator lights when the DTI is in the loop-back mode, which is used for testing.

10.03 T-1 Receiver.

The T-1 receiver PWBA transposes the received data to a rate and format that are compatible with the DCO port group highway. A frame synchronizer circuit on the PWBA locks the receiver onto the received data format. A red indicator lights when the receiver is not synchronized with the received data. A phase detector is used to compensate for phase errors between the T-1 frame and the PGH frame. The incoming voice signals require attenuation on a per-channel basis as a function of call routing. Digital pads, under control of the DCO call processor, provide the required attenuation.

10.04 T-1 Transmitter.

The T-1 transmitter PWBA transposes data from the PGH to a rate and format that are compatible with the T-1 span. A bits/frame counter and sync gener-

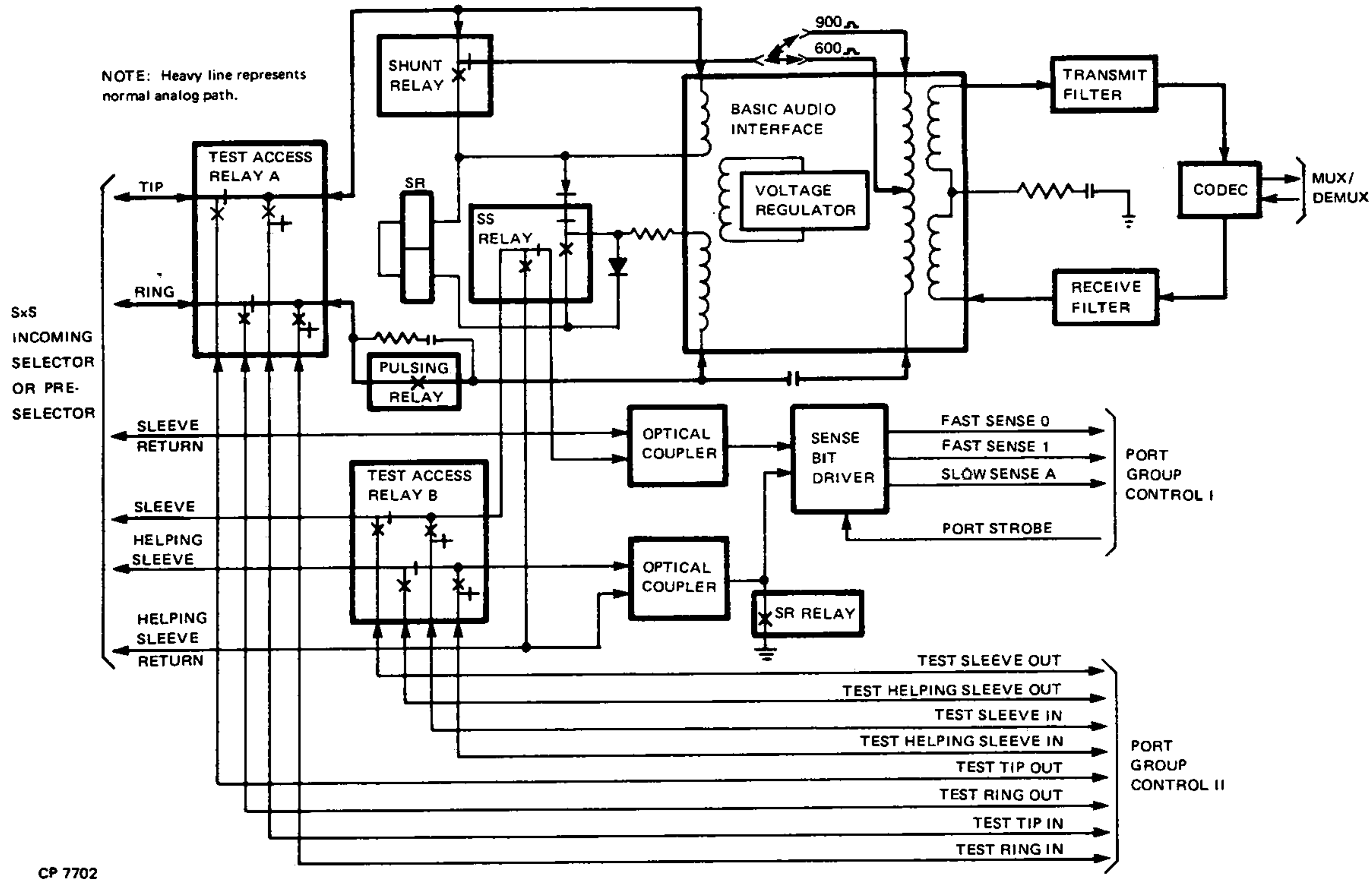


Figure 9. Step-by-Step Outgoing Trunk, Block Diagram

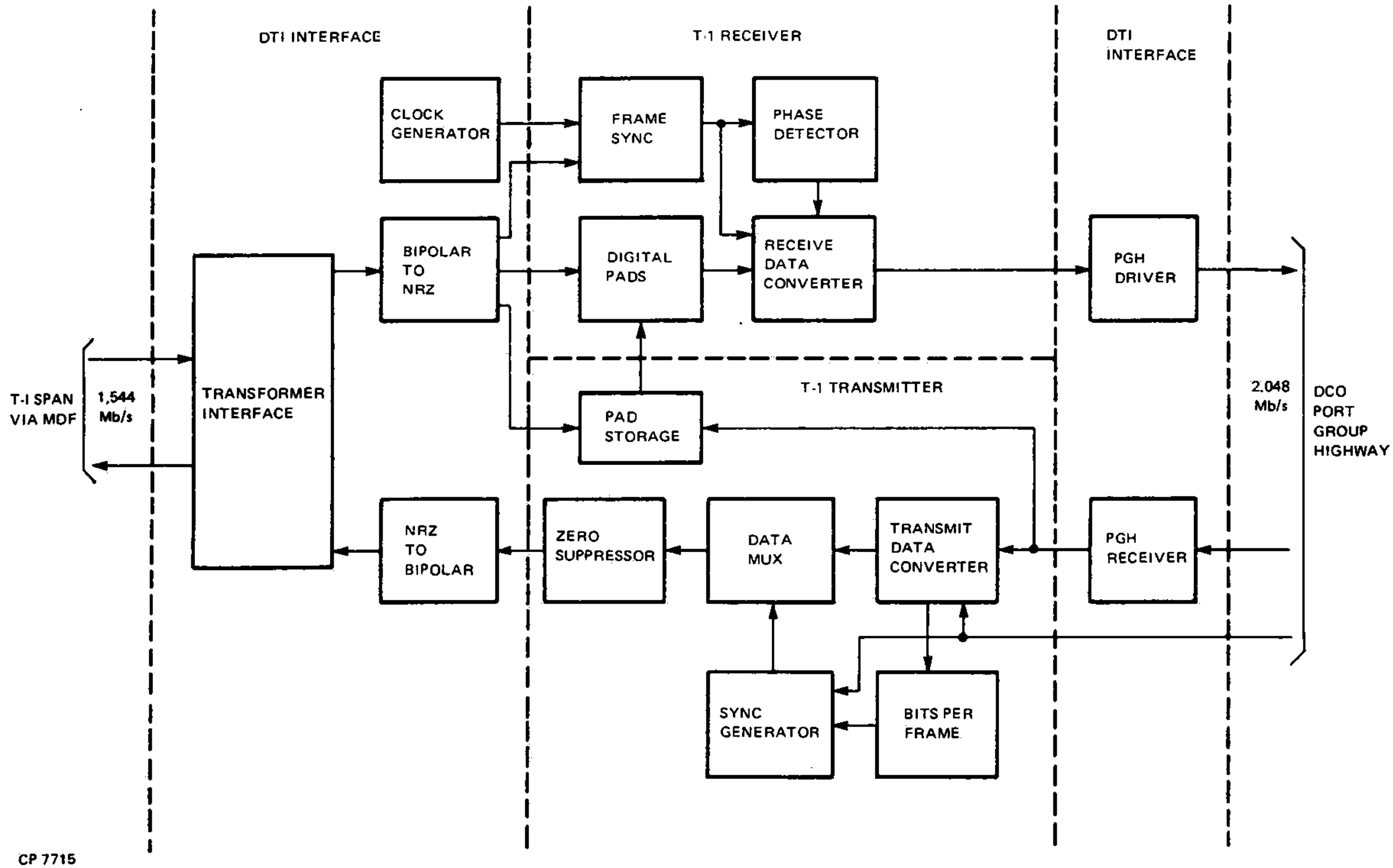


Figure 10. Digital Trunk Interface, Basic Block Diagram

ator are used to generate the correct sync bit pattern for transmission. Data from the PGH, after conversion, goes to a data multiplexer and the output is determined by an output decoder. To prevent transmission of all zeros, the data multiplexer output passes through a zero suppressor before being sent to the DTI interface PWBA. An additional function of the T-1 transmitter is to store the attenuation pad values for use by the receiver.

10.05 **DTI Diagnostics.**
The DTI diagnostics PWBA provides alarm and test capabilities for the DTI. Information received from common equipment alarm indicators is used to initiate diagnostic testing. The diagnostics PWBA contains a data pattern generator for testing the data path of each DTI port. Circuits are also provided to initiate span switching and to do loop-back and frame synchronization tests.

11. TAPE ANNOUNCER CONTROL CIRCUIT

11.01 The functions of a tape announcer control circuit are provided by an E&M trunk circuit PWBA. The tape announcer control is an interface for termination of calls routed to a tape announcer. It provides start/stop operation of the tape drive and indicates the start of a recorded message to the DCO common control. Calling lines routed to the tape announcer are connected to ringback tone until the message starts. Because the DCO timeslot interchange can connect a single source to any number of ports, the tape announcer control circuit (E&M trunk) is designed so that one tape announcer can serve the entire office (broadcast method). Two identical tape announcer control circuits are provided by each E&M trunk PWBA used for this purpose; each circuit is used for control of a separate tape announcer.

11.02 The voice path (fig. 4) is coupled from the low-impedance output of the tape announcer on the tip and ring leads by test access relay A and the basic audio interface to the CODEC. The 900-ohm wiring option is used to match the impedance of the tape announcer.

11.03 The tape announcer is activated by a ground on its START lead, which is connected to the M lead of the E&M trunk. The ground is applied by operating the pulsing relay under control of fast control bit 0 and the port strobe from PCG1. The ground comes from the M RETURN lead by way of wiring option V, which is used when the E&M trunk functions as a tape announcer control.

11.04 With the broadcast method, each calling line routed to the tape announcer is first connected to ringback tone. When the message is about to begin, the tape announcer grounds its PU or SR lead (E&M trunk E lead) to indicate the start of the message. The signal is isolated and coupled by the optical coupler and then makes fast sense bit 0 low when the port strobe pulse is applied. The low sense bit causes the DCO common control to switch all calling lines that are awaiting the start of the message from ringback tone to the message. All calling lines are disconnected at the end of the message.

11.05 While the PWBA is plugged in, slow sense bit A goes low during the port timeslot of each tape announcer control circuit. Removal of the PWBA allows this bit to go high, indicating to the common control that the circuit is out of service.

11.06 The tape announcer control (E&M trunk) PWBA is mounted in a trunk group cell in a trunk frame; it is nonredundant. A component failure in either circuit on this PWBA normally affects only the associated circuit. Even if both circuits are affected, a circuit failure does not prevent normal telephone operation by the subscriber. Failure of a circuit prevents receipt of the recorded announcement from the associated port.

12. FIRE-REPORTING SYSTEM

12.01 The fire-reporting system, located in the power, ringing, and test frame, provides up to 30 line circuits for special signaling and talking features. The system consists of a Tellabs 291 Conference/Alerting System and a line circuit for each firefighter. The line circuit is a standard single-party bridged-ringing line circuit. This arrangement provides for the return of ringback tone to the calling party when the called party is engaged in a fire conference call.

12.02 When the conference circuit is seized, all free firefighter's lines are disengaged from the DCO switching system and distinctive ringing is applied to their lines. Busy firefighter's lines can either have warning tone applied to the connection or the existing conversation can be immediately cut off. The choice, an onsite system option, is described in the manufacturers instructions supplied with the equipment. If alerting tone is chosen, the firefighter need only depress the hookswitch long enough to break down the existing connection to be automatically routed to the conference circuit. The basic system provides siren control activated by pushbutton from any or selected firefighter's lines. Once activated, the siren sounds until the conference circuit is released.

12.03 Several options available with the Tellabs system are:

a. Automatic Conference Activation.

1. This is the same as most existing fire alarm systems. A caller dials a fire-reporting number that automatically initiates a fire conference.

2. The automatic conference activation equipment can be furnished either as a single unit or with redundancy.

3. One line circuit, single-party, bridged ringing, is required for the fire-reporting line.

b. Manual Conference Activation.

1. In this mode, a caller dialing the fire-reporting number is connected to a telephone located in the fire company's dispatch office. When the dispatcher has ascertained the caller's needs, the dispatcher can activate the fire conference from a second telephone directly connected to the fire system.

2. Manual activation equipment can be furnished either as a single unit or with redundancy.

3. In this mode, one single-party line circuit is required for the fire-reporting line. In addition, the telephone company must supply two dial-less telephones at the dispatch office; one connected to the DCO switching system line circuit, and one to the Tellabs unit.