

2600-HZ E1R SINGLE-FREQUENCY SIGNALING UNIT

DESCRIPTION

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and (2) loop-start (LS). In the GS mode, the unit uses the A and B leads for signaling between the connecting equipment; in the LS mode, either the A and B or E and M leads can be used. The LP-GS switch on the face of the unit controls the mode of operation.

1. GENERAL

1.01 This section describes the E1R single-frequency (SF) signaling unit. The E1R SF unit, SD-99780-01, is a component part of the Type E signaling system. It is used at the station end of special access circuits.

1.02 This section is reissued to correct information in Parts 1, 2, and 3 of the section.

1.03 The E1R SF unit (Fig. 1) will function on 4-wire trunk facilities having -16 dBm and $+7$ dBm voice transmission level points (TLP) such as J, K, L, N, O, and T carrier trunks. The E1R unit should be located near enough to the above TLPs so that the local cabling transmission loss at 2600 Hz does not exceed 3 dB. A and B or E and M lead signaling is used between the SF unit and the connecting equipment. The E1R SF unit has two modes of operation: (1) ground-start (GS)

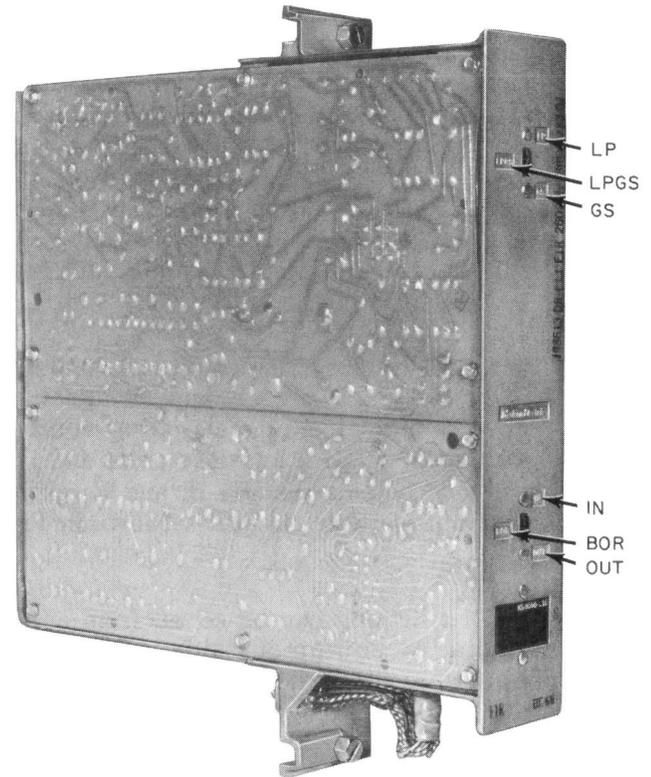


Fig. 1—E1R SF Unit

1.04 Also appearing on the face of the E1R SF unit is a BOR switch and an S socket. The BOR switch adds resistance in series with the A and B leads when operated to the IN position and removes it in the OUT position. If the external loop resistance of the A and B leads is less than 520 ohms, the BOR switch should be operated to the IN position. The S socket is provided for monitoring and making in-service tests of the E1R

unit. The following transmission and signaling ports can be monitored at the S socket: LINE RCV, EQUIP RCV, LINE TRMT, and E and M leads.

1.05 The circuit components of the E1R SF unit are mounted on printed circuit boards which are bolted to the two sides of a die cast aluminum frame with the circuit components on the inside. The overall dimensions of the unit are approximately 11-3/4 inches high by 1-3/4 inches wide by 10 inches deep. All interconnecting wiring is brought out on the P1 connector. The P1 connector on the E1R unit mates with the J1 socket in the signaling unit bay. To place the E1R unit in its in-service position, line up the guides of the P1 connector and J1 socket and gently slide it forward until all pins have made contact. Secure the E1R unit to the bay by tightening the screws on the top and bottom of the unit. To remove the unit from the bay, loosen the screws at the top and bottom of the unit and using a 725A tool, pry the unit loose from the J1 socket and slide the unit out from the bay.

1.06 The E1R SF unit provides a 4-wire transmission path with A and B or E and M signaling leads. The transmitting and signaling control circuits contain the A, HC, and RT relays and the receiving circuit contains the GS, H, and R relays. A block diagram of these circuits is shown in Fig. 2 and 3.

1.07 The E1R SF unit can be seized from either the line or equipment side. On a line (switching) seizure, its basic functions are: (1) to convert a 2600-Hz tone signal into 20-Hz ringing current, (2) recognize a station off-hook condition and trip the ringing, and (3) provide a transmission path. On equipment (station) seizures, the functions of the E1R unit are: (1) recognize a station off-hook condition, (2) convert dc pulses into 2600-Hz tone pulses, and (3) provide a transmission path.

1.08 The E1R SF unit is the replacement for the E1S, E2S, E1S-A, and E2S-A SF units. For ground start applications where an E-S and E-S-A must be mounted side by side and interconnected, a single E1R unit with the LP-GS switch in the GS position will perform the same functions. ♦The E1R SF unit offers many transmission and signaling improvements such as reduced talk-off; prevention of false ringing due to transient office conditions, allowing of ringing

into a station off-hook, and protection against false disconnects.♦

1.09 ♦The E1R SF unit offers improved stability over other E-type SF units. This is due to improved circuit design and to the circuit components used. Environmental changes, such as temperature, aging, etc., have a minimal effect upon this design and components.♦

1.10 ♦A 1-type terminating set (or equivalent) with inductors must be connected to the equipment side of the E1R SF unit (except when E1R unit connects to a 4-wire extension circuit or a 4-wire station). If a terminating set, other than a 1-type is used, it must not exceed the range of SX signaling. The terminating set is used to convert from 2-wire to 4-wire transmission (or vice versa).♦

2. TRANSMISSION AND SIGNALING PERFORMANCE

A. Transmitting Circuit

2.01 The transmitting circuit consists of a speech transmission path, a signal transmitter, and a high and low level 2600-Hz gate circuit. The speech path and 2600-Hz tone gate circuit are switched by means of contacts of the A and HC relays. With the A relay released, low level 2600-Hz tone is transmitted towards the line and the transmit speech path is cut and terminated in 600 ohms. During pulsing, the HC relay is operated raising the level of the 2600-Hz tone by 12 dB and terminating the transmitting speech path with 600 ohms. The transmitting speech path is cut through when the A relay is operated and the HC relay released (Fig. 2). The transmitting circuit is under control of the A and B or E and M lead circuits.

2.01 Whenever a change of state from off-hook to on-hook is received from the station and signaling tone is to be transmitted, the HC relay is operated before the A relay is released. Thus, the transmit speech path is "precut" and terminated by contacts of the HC relay 2 to 10 milliseconds before signaling tone is applied to the line. Once operated, the HC relay remains operated until its control circuit times out (395 ± 105 milliseconds) unless another off-to-on-hook transition is received sooner.

2.03 When a change of state from on-hook to off-hook is received from the station, both

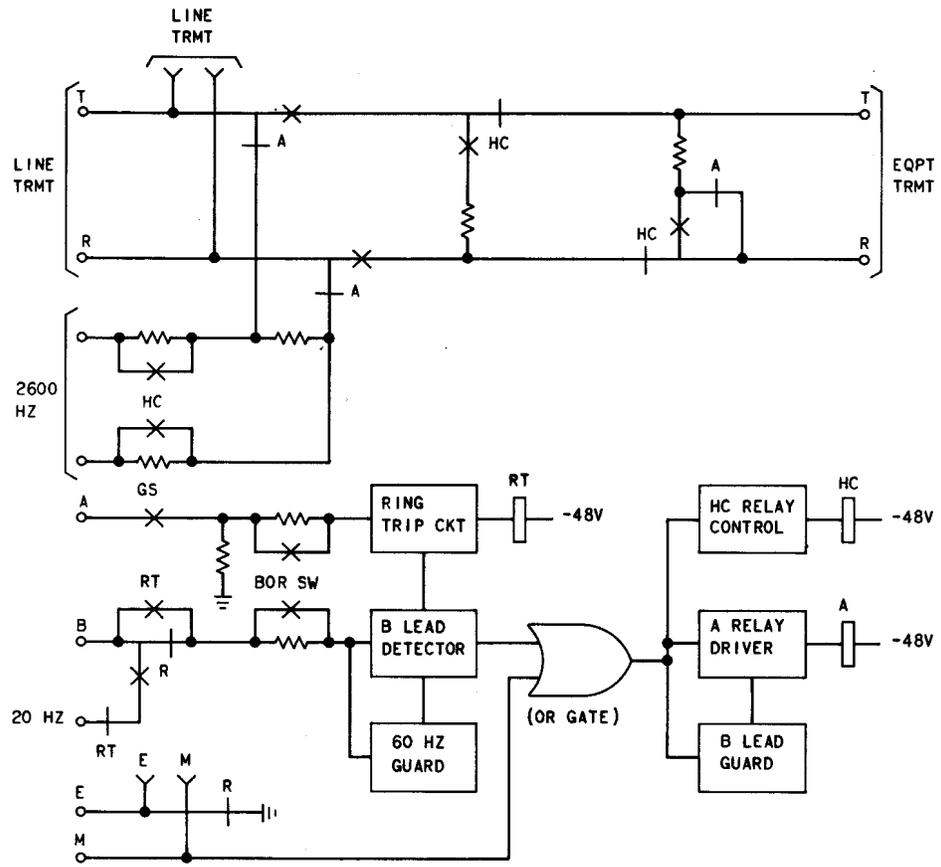


Fig. 2—E1R Transmit and Signaling Lead Circuits

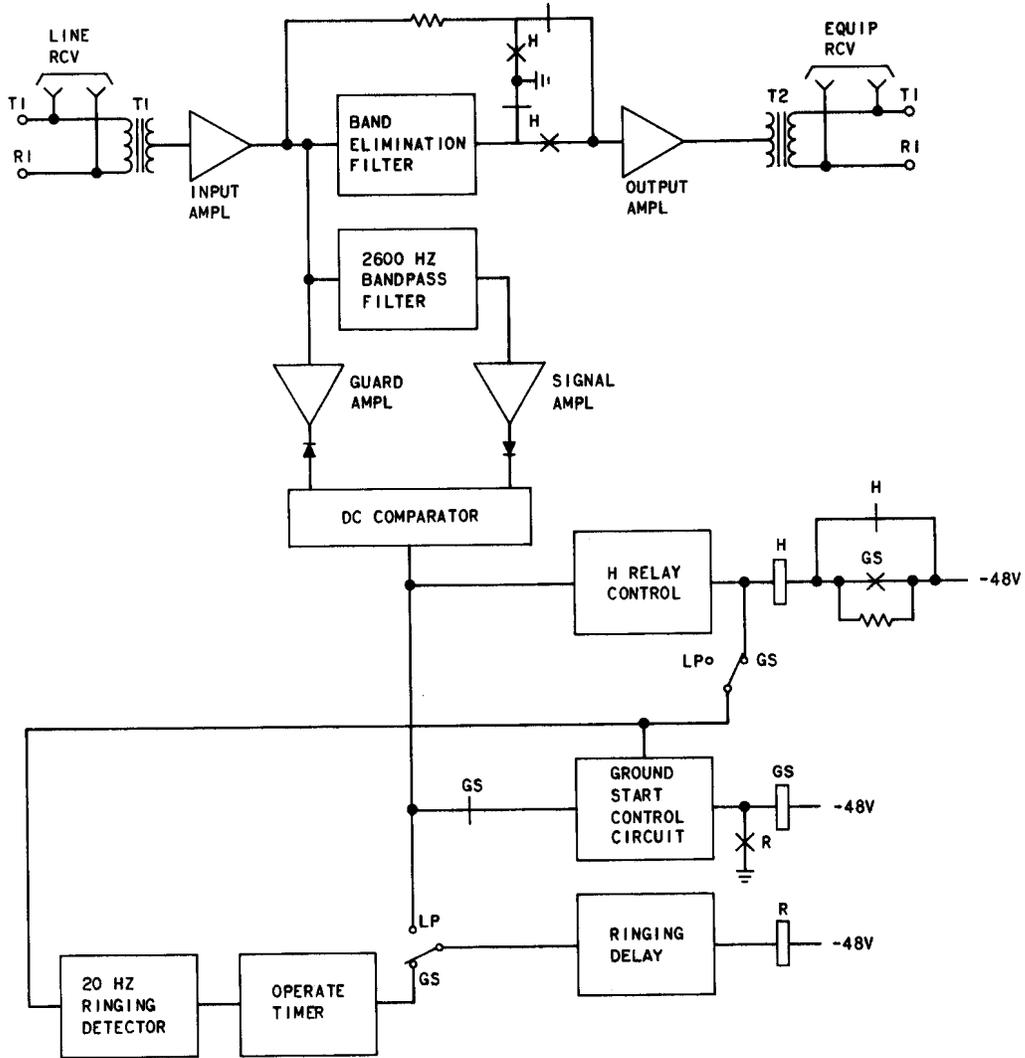


Fig. 3—E1R Receiving Circuit

the A and HC relays operate. The A relay remains operated as long as the station is off hook but the HC relay is released when its control circuit times out. As a result, the transmitting speech path remains cut and terminated by contacts of the HC relay for 135 ± 40 milliseconds after the outgoing signal tone is removed.

2.04 The envelope delay distortion in the transmitting and receiving circuits is shown in Fig. 4. Envelope delay distortion is expressed in microseconds of delay and is a function of frequency. In the transmitting circuit, it can be seen on Fig. 4 that there is no envelope delay distortion present within the voice frequency range.

2.05 The transmission loss through the transmit path for frequencies between 100 and 5000-Hz is shown in Fig. 5. This loss would normally not be shown on circuit layout records.

B. Receiving Circuit

2.06 The receiving circuit consists of a speech transmission path, signal and guard detector circuits, a dc comparator, a ground-start circuit, and H and R relay control circuits. The primary functions of the receiving circuit are: (1) convert a 2600-Hz ringing signal into 20-Hz ringing or a removal of ground from the E lead and (2) provide a transmission path.

2.07 The transmission path through the receive circuit (Fig. 3) is via input transformer T1, an input buffer amplifier, a 2 dB pad, an output amplifier and output transformer T2. A band elimination filter is also inserted in the receiving speech transmission path when 2600-Hz tone is being received. The output level of the receiving speech transmission path is within ± 0.2 dB of the input level between 300 and 3000-Hz.

2.08 The band elimination filter is switched under control of the H relay. With the H relay operated, the band-elimination filter is connected to the output amplifier stage. The band elimination filter prevents 2600-Hz tone signals from being passed on to subsequent signaling links and affecting call progress or annoying the terminating customer. The voice transmission performance of the receive paths is shown in Fig. 6 and 7 with the filter in and out of the circuit.

2.09 Voice frequency currents entering the LINE RCV port are passed through the receive circuit with no insertion loss (excluding 2600-Hz tone when signaling). The voice frequencies are dropped 2 dB before passing to the input buffer amplifier. The 2 dB drop guards the input amplifier against peak voice currents. The input buffer amplifier is of the emitter-follower transistor configuration. The voice frequencies from the input buffer amplifier pass through either the band elimination filter or a resistor circuit. In either case they are dropped another 7 dB before entering an output amplifier. The output amplifier is of the hybrid feedback variety. It provides the receive circuit with 9 dB of gain and an output impedance of 600 ohms.

2.10 The harmonic distortion of input signals passing through the receiving circuit is shown in Fig. 8. Most of the distortion is second harmonic. Signals entering the receive circuit below +5 dBm will have a total harmonic distortion affect of less than -55 dB at the output. Internal noise of the receive circuit which includes battery noise is less than 20 dBm.

2.11 The E1R SF unit provides high return loss and longitudinal balance characteristics. At frequencies between 250 and 4000-Hz, the return loss at the LINE RCV or the EQUIP RCV ports against 600 ohms is a minimum of 30 dB. There is a minimum of 65 dB of longitudinal balance at the input. For frequencies between 200 and 3000 Hz, the longitudinal balance at the output is at least 60 dB.

2.12 The approximate envelope delay distortion of the receive speech circuit in the voice frequency range in the talking condition is shown in Fig. 4. For frequencies above 1000-Hz the delay is less than 10 microseconds.

2.13 All ac signals are directed through a guard amplifier, rectified, and presented to the dc comparator. 2600-Hz tone signals are directed through a band-pass filter to the signal amplifier, rectified, and presented to the dc comparator. The dc comparator is preset to function only if the power ratio between the two inputs (signal amplifier/guard amplifier) is at least 10 dB. The dc comparator controls the H and R relays.

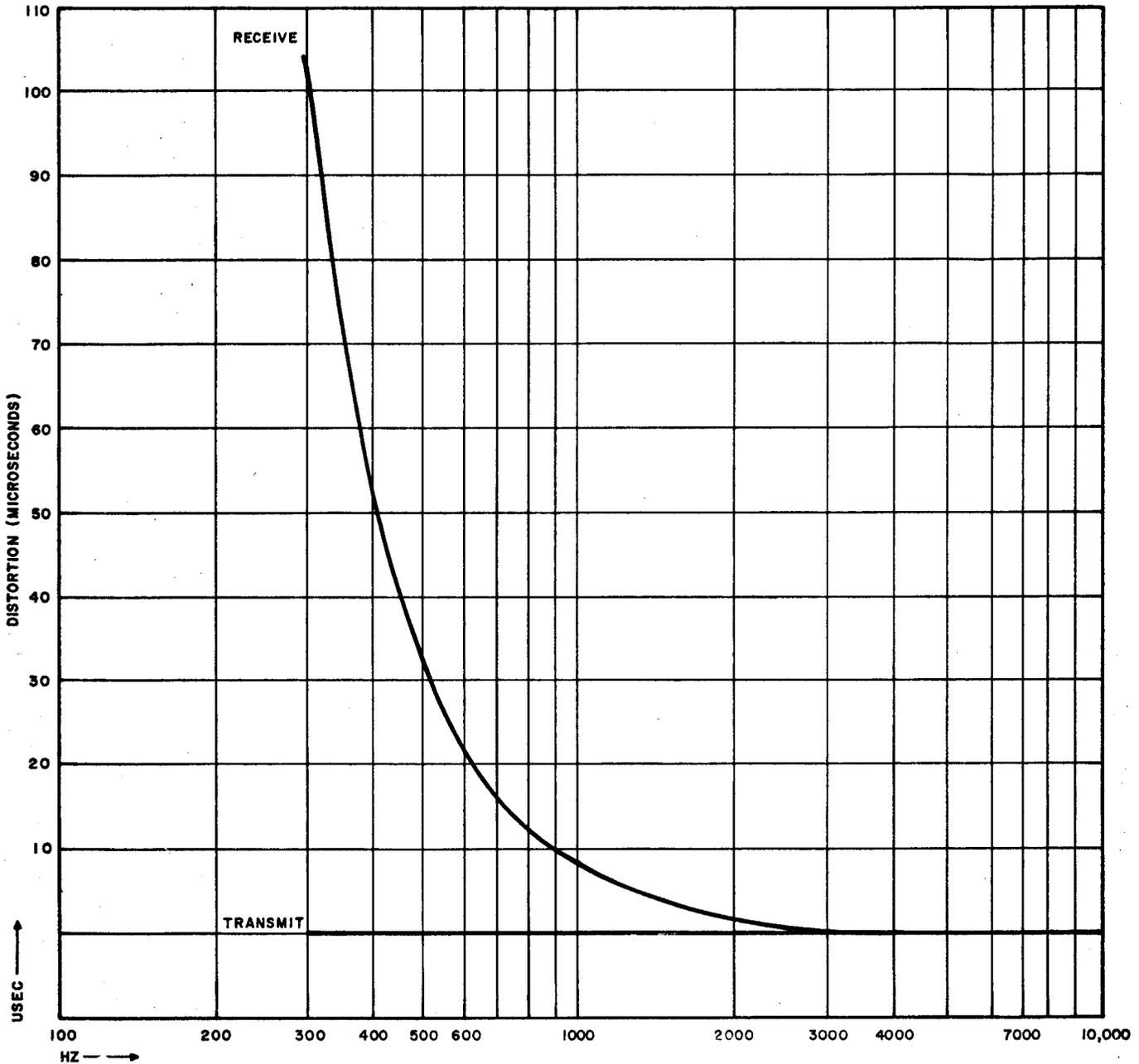


Fig. 4—Envelope Delay Distortion

2.14 A ringing detector (which provides 20 pps discrimination) and operate timer (which provides ringing delay) are switched into the receive circuit under control of the LP-GS switch. In the GS mode, the functions of these circuits are to convert the 20 pps ringing signal (which is originated at the switching end of the trunk) into an on-off signal for the ringing delay and R relay circuits. When 20 pps ringing is being received, the operate

timer will remain turned on for the duration of the ringing interval, thus keeping the R relay operated. The R relay contacts connect 20-Hz ringing to the B lead.

C. Signaling Leads

2.15 The signaling lead circuitry is illustrated in Fig. 2. The A and B lead circuitry consists

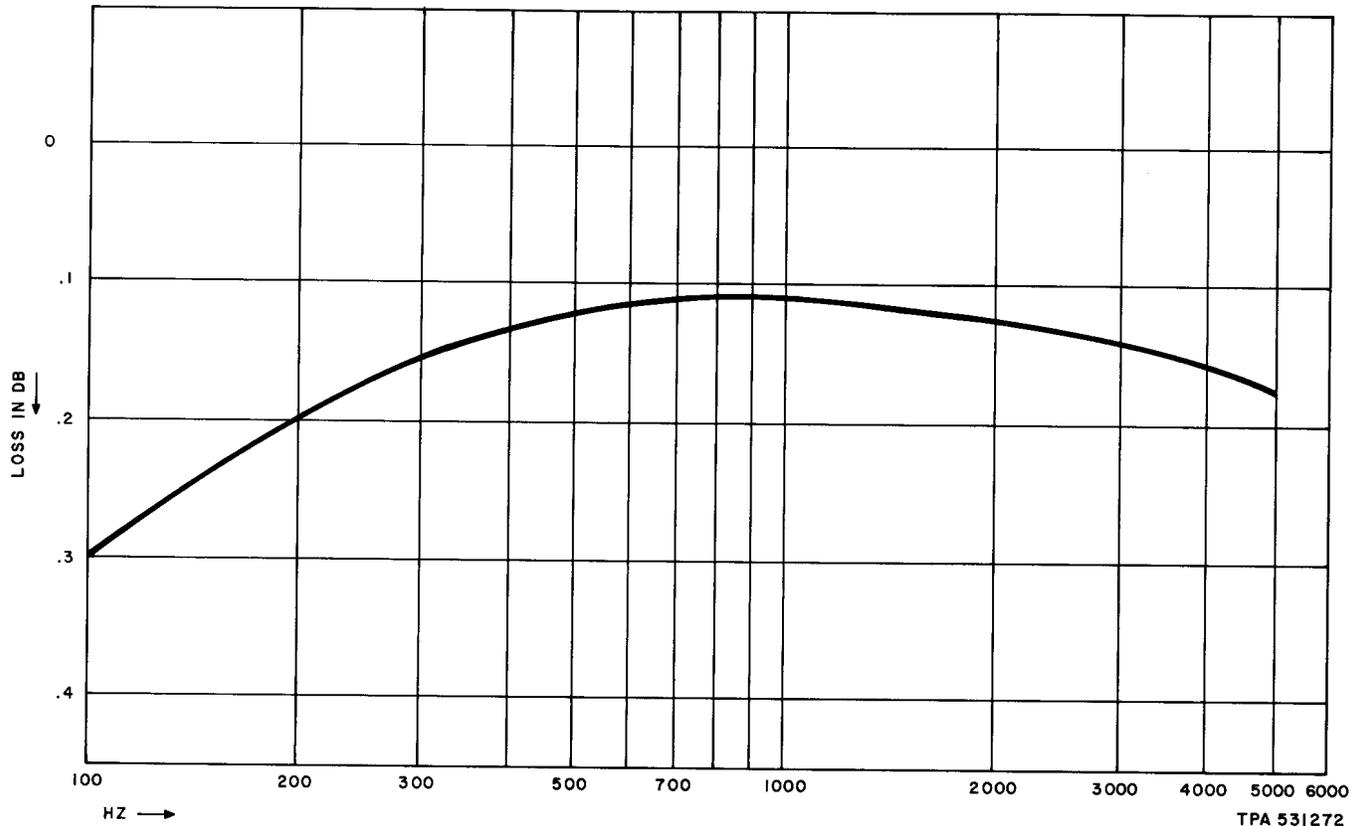


Fig. 5—Transmit Circuit Insertion Loss

of contacts of the GS, R and RT relays, build out resistors, a B lead detector, 60-Hz guard circuit, an A lead driver circuit, a ring trip circuit, an HC relay control circuit, and B lead guard circuit. The E and M lead circuitry uses contacts of the R relay, the A relay driver, and HC relay control circuits. On calls originating at the station, the functions of the A and B or E and M lead circuitry is: (1) recognize a station off-hook condition by the presence of ground on the B lead or battery on the M lead, (2) cause 2600-Hz tone to be removed toward the line on a station off-hook condition, (3) provide a 50 ± 3 millisecond minimum guaranteed tone pulse output toward the line during pulsing, and (4) convert dc pulses on the A and B or M leads to 2600-Hz tone pulses for transmission over the line facility. ◀

2.16 The E1R SF unit passes signals to and from the equipment side (station) via the A and B or E and M leads. In ground-start applications, the A and B leads must be used. Either the A

and B or E and M leads can be used for loop-start applications.

2.17 The E1R SF unit will accept dc pulses on the B or M lead between 7.5 and 12.5 pulses per second (pps) within the following percent break limitations:

PPS	% BREAK RANGE
7.5	16-84
10.0	21-79
12.5	26-74

The A relay driver circuit contains a pulse stretcher that will guarantee a minimum tone output towards the line of 50 ± 3 milliseconds when the dc pulses on the B or M lead are within the preceding pps

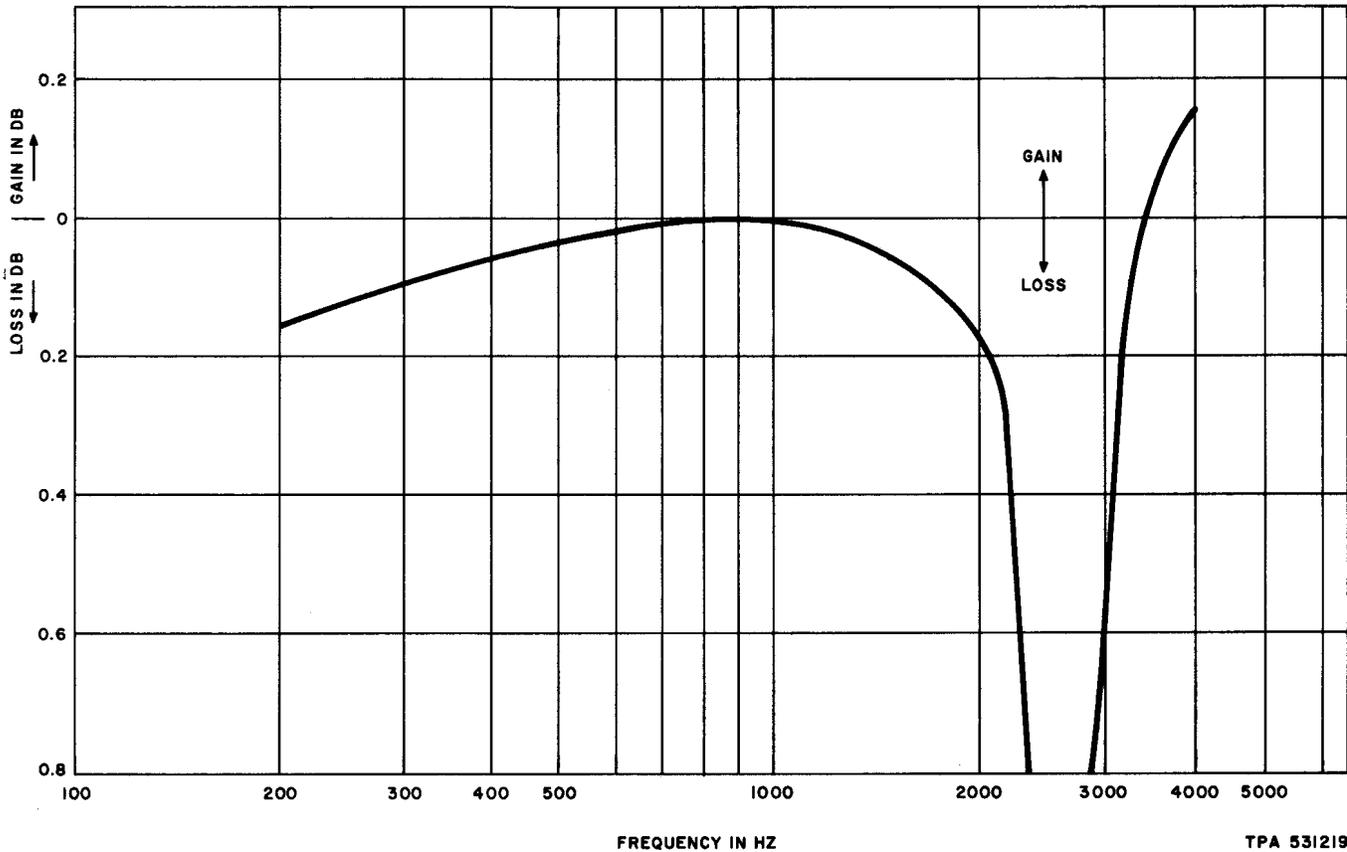


Fig. 6—Receive Circuit Insertion Loss With Band Elimination Filter In

and percent break values. The respective output towards the line is as follows:

PPS	MIN-MAX % BK
7.5	35-40
10.0	47-53
12.5	59-66

2.18 A ringing delay circuit is provided to guard against voice simulation and to compensate for shortening of the ringing signal by an E1P unit at the switching end. In the on-hook condition, the delay is 210 ± 30 milliseconds at the start of the ringing and 260 ± 60 milliseconds at the end of ringing. The delay at the start of ringing is increased to 360 ± 50 milliseconds if the station is off-hook.

2.19 The functions of the signaling lead circuit on calls that originate from the line (switching

end) are: (1) supply 20-Hz ringing to the B lead or ground the E lead as a ringing signal, (2) upon station answer (off-hook) trip the ringing, and (3) cut through the transmitting speech path. 20-Hz ringing is supplied to the B lead through contacts of the RT and R relays. The ring trip circuit is used only on A and B lead applications. It is connected to the A lead and is activated when the station goes off-hook.

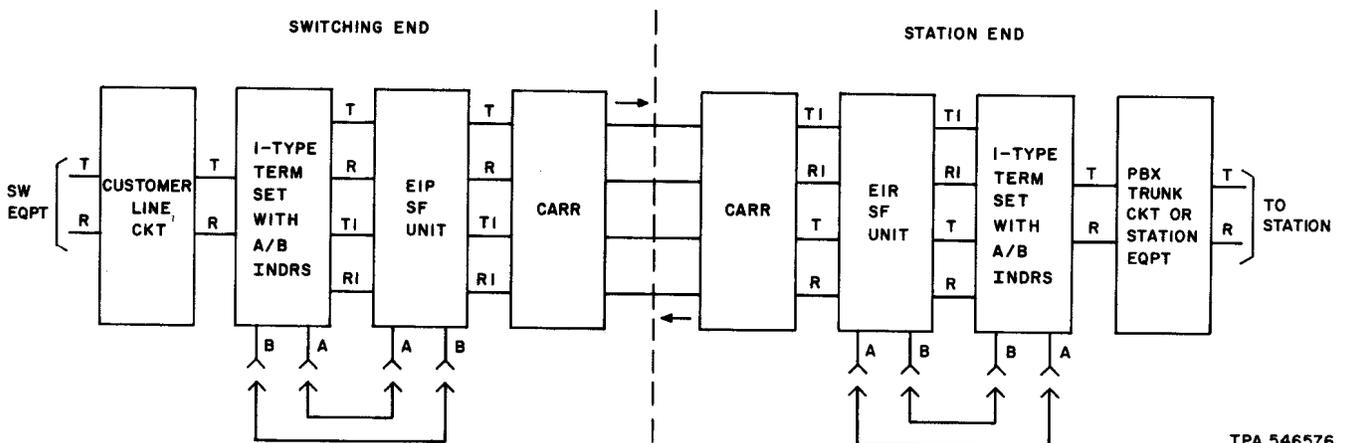
3. OPERATIONAL PRINCIPLES

3.01 The condition of the 2600-Hz tone in either the loop-start or ground-start modes of operation and under various circuit conditions is shown in Table A. A typical application showing an E1P SF unit at the switching end of the trunk and an E1R SF unit at the station end is shown in Fig. 9. It may be helpful to refer to Table A and Fig. 2, 3, and 9 for the discussion that follows.

TABLE A

	MODE OF OPERATION	CONDITION OF TRUNK	CONDITION OF 2600-HZ TONE	
			TRANSMIT	RECEIVE
E1R ORIGINATING CALL	LOOP START	IDLE	ON	OFF
		SEIZURE	OFF	OFF
		PULSING	ON-OFF	OFF
		TALKING	OFF	OFF
	GROUND START	IDLE	ON	ON
		SEIZURE	OFF	ON
		PULSING	ON-OFF	ON
		TALKING	OFF	OFF
E1R TERMINATING CALL	LOOP START	IDLE	ON	OFF
		SEIZURE	ON	OFF
		RINGING	ON	ON
		TALKING	OFF	OFF
	GROUND START	IDLE	ON	ON
		SEIZURE	ON	OFF
		RINGING	ON	ON*
		TALKING	OFF	OFF

*2600-HZ Tone is interrupted at 20 pps rate (ground-start mode only) during the interval in which the ringing signal is being received.



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Fig. 9—Typical Application Diagram of E1R SF Unit

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switching office. The switching office makes a dial tone connection and returns dial tone towards the E1R unit. Pulsing is the same as described in 3.04.

3.09 When the switching office originates a call, 20-Hz ringing is converted into a 2600-Hz tone signal by the SF unit at the switching office. This results in 2600-Hz tone being transmitted toward the E1R unit during the 2-second ringing period and no tone during the 4-second interval between rings. When SF tone is received at the E1R unit, it is converted into a dc signal and directed to the ringing delay circuit. This provides for operation of the R relay. The R relay contacts apply 20-Hz ringing to the B lead. Station answer is the same as described in 3.06.

C. E and M Lead—Loop-Start

3.10 The LPGS switch on the face of the E1R unit is in the LP position for this mode of operation. During the idle circuit condition, the E1R unit transmits low level 2600-Hz tone towards the switching office but it *does not* receive 2600-Hz tone from the distant SF unit.

3.11 On outgoing calls, -48 volts is connected to the M lead into the E1R unit when the station goes off-hook. This causes the A relay in the E1R unit to operate and remove the 2600-Hz tone transmitted toward the switching office. The switching office responds to the removal. Pulsing is the same as described in 3.04.

3.12 When the switching office originates a call, it transmits 2600-Hz tone towards the E1R unit during the ringing period (as in A and B lead loop-start operation). The E1R unit responds

to the presence of tone and operates the R relay. The R relay contacts remove ground from the E lead towards the station during the ringing interval. There is *no* 20-Hz ringing applied at the E1R unit for E and M lead operation. Station answer is the same as described in 3.06.

D. TOUCH-TONE

3.13 The E1R unit can be used for applications using TOUCH-TONE signals. The E1R unit on a station originating call would function as described in 3.03, 3.08, 3.11 and then the tone signals can be transmitted to the distant office over the voice transmission path. The operation of the E1R unit for a call that originates at the switching office is the same as described in 3.05, 3.06, 3.07, 3.09, and 3.12.

4. MAINTENANCE

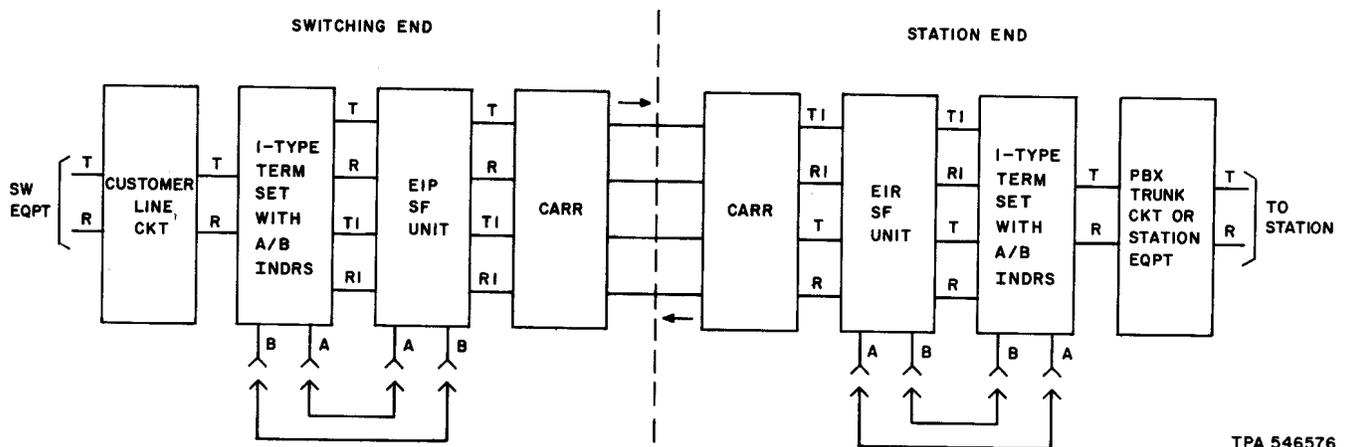
4.01 There are no field adjustments to be made on the E1R unit except for the LP-GS and BOR switches. The circuit layout record (or equivalent) determines the position of these switches. E1R units not meeting circuit requirements should be sent to Western Electric Co. for repair. Defective units should be replaced with spare units.

4.02 The E-type signaling test extender (SD-99384-01) can be used to gain access to the transmission and signaling ports of the E1R unit. The E1R unit is removed from its inservice position and placed in a receptacle located on the test extender. The test extender provides for terminated measurements for isolating trouble conditions. Section 179-313-101 provides a description of the test extender.

TABLE A

	MODE OF OPERATION	CONDITION OF TRUNK	CONDITION OF 2600-HZ TONE	
			TRANSMIT	RECEIVE
E1R ORIGINATING CALL	LOOP START	IDLE	ON	OFF
		SEIZURE	OFF	OFF
		PULSING	ON-OFF	OFF
		TALKING	OFF	OFF
	GROUND START	IDLE	ON	ON
		SEIZURE	OFF	ON
		PULSING	ON-OFF	ON
		TALKING	OFF	OFF
E1R TERMINATING CALL	LOOP START	IDLE	ON	OFF
		SEIZURE	ON	OFF
		RINGING	ON	ON
		TALKING	OFF	OFF
	GROUND START	IDLE	ON	ON
		SEIZURE	ON	OFF
		RINGING	ON	ON*
		TALKING	OFF	OFF

*2600-HZ Tone is interrupted at 20 pps rate (ground-start mode only) during the interval in which the ringing signal is being received.



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to the presence of tone and operates the R relay. The R relay contacts remove ground from the E lead towards the station during the ringing interval. There is *no* 20-Hz ringing applied at the E1R unit for E and M lead operation. Station answer is the same as described in 3.06.

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