# E1C 2600-CYCLE SINGLE-FREQUENCY SIGNALING AND 4-WIRE TERMINATING UNIT REVERSE BATTERY SUPERVISION ORIGINATING OFFICE END COMMON SYSTEMS

## 1. GENERAL

**1.01** The E1C single-frequency (SF) signaling unit is used at the originating end of one-way automatic or dial trunks with loop reverse battery supervision and MF or nominal 10 pulse-per-second dial pulsing. It is suitable for exchange, tandem, or toll connecting trunks that use carrier channels for line facilities. DC loop signals from the office (equipment) side are converted to 2600-cycle signals for transmission over the line facility to an SF unit at the distant terminal. Conversely, it receives 2600-cycle signals from the line facility (which are originated by the SF unit at the far end), and converts them to dc signals (battery reversals) on the office side.

**1.02** This unit transmits supervisory signals and dial pulses to, and receives supervisory signals from the carrier facility. When associated with an automatic trunk or a trunk using MF pulsing, the signaling unit is used only for supervision. In step-by-step offices the E1C will replace the outgoing repeater. Audible tone and flashing signals are passed without distortion over a maximum of three SF signaling links in tandem, providing none of these links transmit the flashing signals with an E1B or E2B unit. The E1C is primarily intended to be used with a type E1D at the terminating end. Substitutions may be made for the E1D however, and are noted in 2.02. A 4-wire terminating circuit is included as an integral part of the E1C.

**1.03** Present design does not provide for trunks that use any other kind of loop supervision, 20 pps dialing, revertive or PCI pulsing, 20-cycle or 130-volt ringing, or remote control zone registration. In addition, it can not be used with CAMA crossbar tandem trunks which dial pulse against an off hook, or can be made busy from the terminating office.

## 2. APPLICATION

**2.01** This unit will function with N-, O-, or ON-type carrier systems. Office transmission levels for the transmitter and receiver are −16 db and +7 db, respectively. Normal signal tone (in the idle condition) is −20 dbm; high signal tone (for pulsing) is −8 dbm referred to zero transmission level.

**2.02** A minimum of six leads is required to insert the transmitter receiver between the office and line facility. Seven are used when an office requires a sleeve lead. All leads may be cabled to an intermediate distributing frame for cross connection. Fig. 1 shows a typical circuit layout with an E1C at the left terminal, and a complementary E1D unit at the right terminal. It is expected that the E1C will normally be used with an E1D at the terminating end, but the E1C will also function properly if an E1A, E1B, or E2B 2600-cycle unit is substituted for the E1D.

**2.03** The 2-wire side of the 4-wire terminating circuit is designed to be used with a 900ω and 2 MF impedance circuit. The 4-wire side matches 600ω facilities. A group of four building-out capacitors is included across the compromise network in the terminating circuit, any combination of which may be wired in when required to balance the capacitance of the office cabling on the 2-wire side of the terminating circuit.

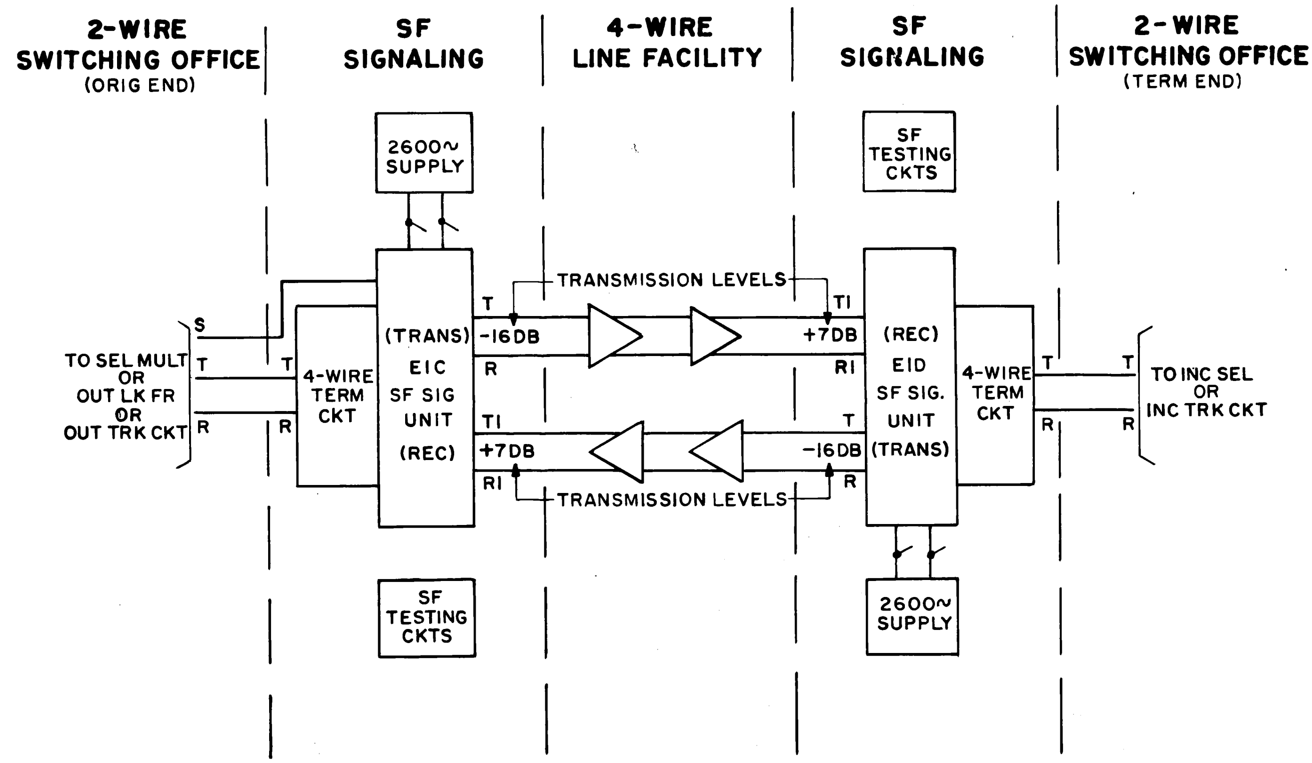


**Fig. 1 – Circuit Layout Using E1C SF Signaling Unit**

**2.04** The maximum allowable frequency shift within the 4-wire facility is ±10 cycles, and the transmission variation limits should be held within ±6 db at the signaling frequency.

**2.05** This unit will function with loop signaling subscriber lines or office circuits which require reverse battery supervision. Maximum external circuit loop resistance for subscriber pulsing is:

| 45 VOLTS MIN TYPE OF DIAL | | | 48 VOLTS MIN TYPE OF DIAL | | |
|---|---|---|---|---|---|
| 2, 4 or 5 | 6 | 7 | 2, 4 or 5 | 6 | 7 |
| 750ω | 1200ω | 1100ω | 850ω | 1500ω | 1400ω |

Maximum external circuit loop resistance for office (trunk) pulsing is:

| LOOP PULSING | BATTERY AND GROUND PULSING |
|---|---|
| 1200ω | 2400ω |

Pulses are satisfactorily transmitted at speeds from 8 to 12 pulses per second with per cent break ranging from 46 to 76 per cent.

## 3. OPERATIONAL PRINCIPLES

**3.01** A block diagram showing the basic elements of the E1C circuit appears in Fig. 2. The transmitter converts dc loop signals on the 2-wire T and R leads into SF tone pulses to the T and R line transmit leads. It consists of two relays (A,B), a 14-db pad, and the line transmitting portion of the 4-wire terminating circuit. The A relay supplies battery and ground to the 2-wire T and R leads through transfer contacts on the R relay. Each dial pulse received on the 2-wire T and R leads causes the A relay to release and operate, thereby alternately applying and removing SF tone from the line. The A relay also operates the B relay which short circuits the 14-db pad. The B relay is slow releasing, allowing it to remain operated while the A relay is following a train of dial pulses on the 2-wire T and R leads. The use of this high-level tone for pulsing provides a better signal to noise ratio during the critical dialing period. In addition, the A relay opens the line transmit T lead toward the 4-wire terminating circuit each time a pulse of high-level tone is transmitted. This prevents noise from the office equipment

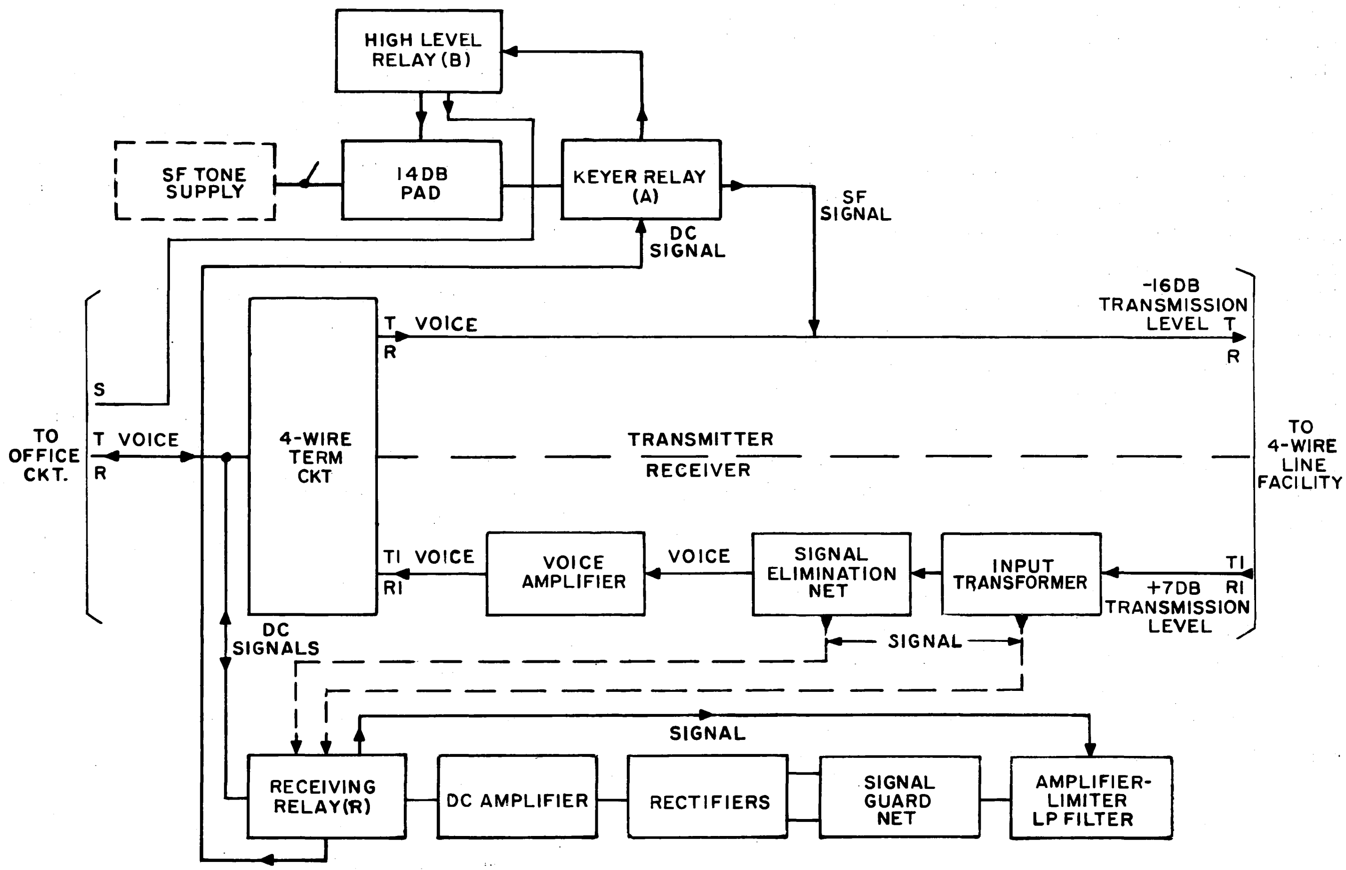


**Fig. 2 — Basic Elements of E1C Circuit**

from entering the line facility which might have an adverse effect on the distant receiver's operation.

**3.02** To simplify the block diagram in Fig. 2, the voice amplifier is shown as part of the receiver, although technically it is a separate circuit. The amplifier's primary function is to provide a high loss in a backward direction to prevent noise or speech originating in the office equipment from reaching the receiver (over the T1, R1 leads) and interfering with its operation. In addition, it makes up for the insertion loss of the receiver (approximately 2.0 db) and by means of its associated potentiometer allows the required trunk net loss to be established.

**3.03** The receiver consists of (1) an amplifier-limiter input stage, (2) a signal and guard frequency detector plus separate half-wave rectifiers, (3) a dc amplifier, (4) a receiving relay (R), and (5) two networks.

**3.04** The amplifier-limiter stage receives ac signals from the line through either a third winding on the input transformer or the signal elimination network depending on whether the RG relay is released or operated. A potentiometer at the input of this stage permits setting the proper receiver operate sensitivity of −29 dbm referred to zero transmission level. Since nominal signal power is −20 dbm (at 0TL), a 9-db operate margin is obtained. This compensates for variations in the sending power at the distant terminal, loss variation in the line facility, and sensitivity drift in the receiver itself. At low input levels, the amplifier-limiter produces maximum gain, while at higher input levels limiting takes place and gain is reduced. An output transformer and capacitor arrangement forms a low-pass filter to sharply attenuate harmonics of the signal frequency that might be generated as a result of limiting. These harmonics, if not suppressed, would produce an excess amount of guard voltage which might prevent proper receiver operation, as described below.

**3.05** The amplifier-limiter output voltages are then applied to the signal-guard detector where they are separated into signal and guard components. The signal network in this detector develops ac voltages proportional to incoming SF tone and/or signaling frequency appearing in speech. The guard network develops ac voltages proportional to all frequencies except SF tone and/or speech-simulated signaling frequency. These components are individually rectified, combined in opposing polarity, and are then fed to the dc amplifier for control of the receiving relay (R).

**3.06** The signal-guard relationship determines the operate time of the receiver. A high signal-guard ratio produces fast operate time; low signal-guard ratio, a slow operate time. This ratio is established by the R relay which controls the bandpass characteristic of the signal channel, the efficiency of the guard channel, and the signal elimination network. Whenever the R relay is operated, the signal elimination network, consisting of two individual tuned circuits, is inserted into the 4-wire receive leg. One circuit is used to feed the receiver input and has maximum response at 2600 cycles. The second circuit has maximum attenuation at 2600 cycles and is inserted in series with the voice amplifier input to prevent received SF tone from reaching the office equipment. When the trunk is idle (R relay operated), the guard channel is at its lowest efficiency and the signal channel is broadband. The resultant signal-guard ratio is maximum and the receiver should not be released falsely by line noise. In the talking condition (R relay released), the guard channel is at its maximum efficiency and the signal channel is narrow band. Signal-guard ratio is now minimum and any signal frequencies appearing in speech should not cause false operation of the receiver.

**3.07** Contacts on the R relay furnish supervisory dc signals to the office equipment on the 2-wire T and R leads. When the R relay is operated, −48-volt battery is applied to the R lead and ground to the T lead. Release of the R relay applies a battery and ground reversal.

## 4. MISCELLANEOUS

**4.01** The E1C unit is 2 inches wide and 12 inches high. Ten units mounted side by side require the space taken by six 2- by 23-inch mounting plates. For 19-inch relay rack bays, eight units use approximately the same amount of space as seven 1-3/4- by 19-inch mounting plates. Fig. 3 is a view of the unit.

**4.02** Typical relay rack bay arrangements for the E1C units are described and pictured in Section 987.200.20.

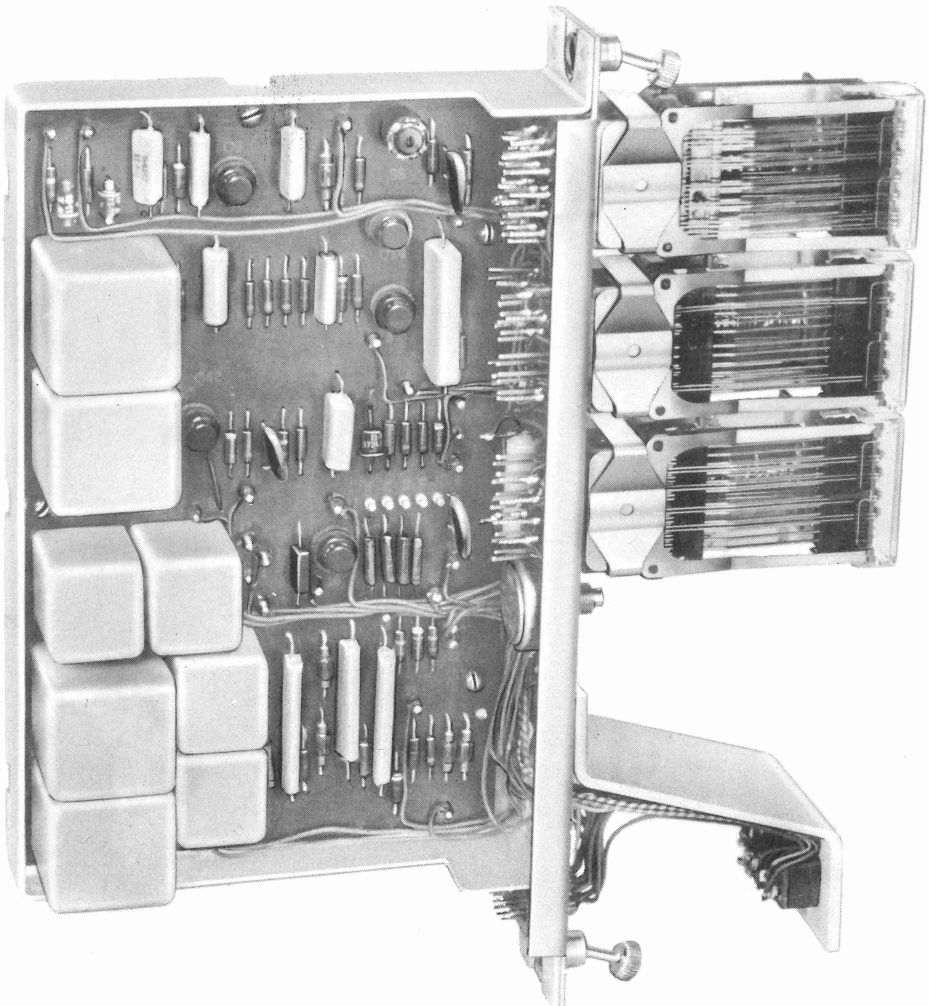

Fig. 3 – E1C SF Signaling Unit