

**E1F 2000- AND 2600-CYCLE SINGLE-FREQUENCY SIGNALING
AND
4-WIRE TERMINATING UNIT
REVERSE BATTERY SUPERVISION — REVERTIVE PULSING
TERMINATING OFFICE END
COMMON SYSTEMS**

1. GENERAL

1.01 The E1F single-frequency (SF) signaling unit is made for the terminating end of one-way trunks with loop reverse battery supervision and revertive pulsing. Its 4-wire terminating set is suitable for exchange, tandem, and toll connecting trunks that use carrier channels for line facilities. DC loop supervisory signals (battery reversals) from the office side are converted to 2600-cycle signals for transmission over the line facility to an E1E 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 supervisory signals (loop closures) on the office side. In addition, a "no-current" revertive pulse condition on the 2-wire "T" and "R" leads is converted into a 2000-cycle signal for transmission to the originating office.

1.02 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 E2B unit. The E1F must be used with a complementary E1E unit at the originating end of the trunk. It will not function with any other unit in the E series nor will it function with an electron tube 2600-cycle unit. Conversion from 2-wire office to 4-wire line facility is accomplished by a 4-wire terminating circuit which is an integral part of the E1F.

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. Nominal 2600-cycle supervisory tone is -20 dbm referred to zero transmission level. The 2000-cycle revertive pulsing tone is nominally transmitted at 0 dbm referred to zero transmission level.

2.02 Six leads are required to insert the signaling transmitter-receiver between the office terminal and line facility. These leads may be cabled to an intermediate distributing frame for cross connection. Fig. 1 shows a typical circuit layout with an E1F at the right terminal, and a complementary E1E unit at the left terminal.

2.03 The 2-wire side of the 4-wire terminating circuit is designed for a nominal 900 ω and 2-mf impedance. The 4-wire side matches 600 ω facilities. A group of four building-out capacitors is included with the compromise network in the terminating circuit for use as required to balance the capacitance of the 2-wire office cabling. The terminating circuit has a 10:1 impedance ratio between the net and 2-wire side instead of the usual 1:1 ratio. This was done to reduce transmission loss in the receive path (4-wire to 2-wire) as much as possible without exceeding 16 db loss in the transmit path (2 wire to 4 wire). Nominal receive and transmit losses are 2 db and 15.8 db respectively.

2.04 The maximum allowable frequency shift is ± 10 cycles, and the transmission variation should be within ± 6 db at the signaling frequencies in the 4-wire facility. The conductor loop resistance on the 2-wire side cannot exceed 100 ω . The E1F will function with all revertive pulsing circuits incoming to crossbar offices, repeated incoming circuits in ground cutoff-type panel offices, and long range incoming circuits in battery cutoff-type panel offices.

3. OPERATIONAL PRINCIPLES

3.01 A block diagram showing the basic elements of the E1F circuit appears in Fig. 2. The transmitter converts dc (battery-reverse battery) signals on the 2-wire "T" and "R" leads into the presence or absence of 2600-cycle tone on the "T" and "R" line transmit leads. A "no-current" condition on the 2-wire leads representing a revertive pulse is converted to a pulse of a 2000-cycle tone. The transmitter consists of two relays, C and RP, two diode keyers, and the line transmitting portion of the 4-wire terminating circuit. Normal battery from the office equipment (idle condition) allows 2600 cycles to pass through one diode keyer to the line. On reverse battery, this keyer removes the tone. The RP relay is operated by either battery or reverse battery on the 2-wire loop. It releases only during a revertive pulse at which time its associated diode keyer applies 2000-cycle tone to the line. In releasing, the RP relay also operates the C relay which opens the talking path between the 2-wire and the line transmit "T" and "R" leads. The C relay causes the talking path to remain open throughout a given train of revertive pulses due to its slow release characteristic. Transients generated in the office equipment are thereby prevented from reaching the distant office receiver and interfering with its operation.

3.02 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 path in a backward direction to prevent noise or speech originating in the office equipment from reaching the receiver (over the T1 and R1 leads) and interfering with its operation. In addition, it makes up for the insertion loss of the receiver 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 network plus separate half-wave rectifiers, (3) a dc amplifier, (4) R and AL relays, and (5) a signal elimination network.

3.04 The amplifier-limiter stage receives 2600 cycles from the line through a third winding on the input transformer. A potentiometer at the input of this stage permits setting the re-

ceiver operate sensitivity of -28 dbm referred to zero transmission level. Since nominal 2600-cycle signal power is -20 dbm (at OTL), an 8 db operate margin is obtained. This allows for variations in the sending power at the distant terminal, loss variations 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 applied to the signal-guard network where they are separated into signal and guard components. The signal network in this detector develops ac voltages proportional to incoming 2600-cycle tone and/or signaling frequency appearing in speech. The guard network develops ac voltages proportional to all frequencies except 2600-cycle 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 R and AL relays.

3.06 In the idle condition, the signal output is the larger of the two voltages and the receiver is held operated. In the talking condition (no 2600-cycle tone being received), the guard has the greater output which prevents the receiver from operating falsely. To initiate a call, the originating office sends a connect signal by removing 2600-cycle tone. The AL relay releases and places a low resistance bridge across the 2-wire loop. The terminating equipment then proceeds to send back revertive pulses (2000 cycles) which are counted down by the originating sender or register. When the correct number of pulses for a given digit have been received, the originating end applies a pulse of 2600-cycle tone as a "stop" signal. The terminating office receiver must recognize this signal and convert it to a high resistance bridge on the 2-wire loop through operation of the R relay. The "stop" signal must be applied in time to prevent the incoming equip-

ment from generating a false pulse. To aid in meeting this requirement, the transmitter C relay in operating (3.01) disconnects the signal-guard net, and increases the receiver sensitivity. Removing this network eliminates its inherent delay which effectively decreases receiver response time. Raising the receiver sensitivity also improves the receiver relay operate speed. After revertive pulsing is completed, the network is reinserted and receiver sensitivity is restored to normal. Upon receipt of a disconnect signal from the originating end (2600-cycle tone on), the AL

relay operates and releases the incoming equipment.

4. MISCELLANEOUS

4.01 The E1F unit is 2 inches wide by 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.

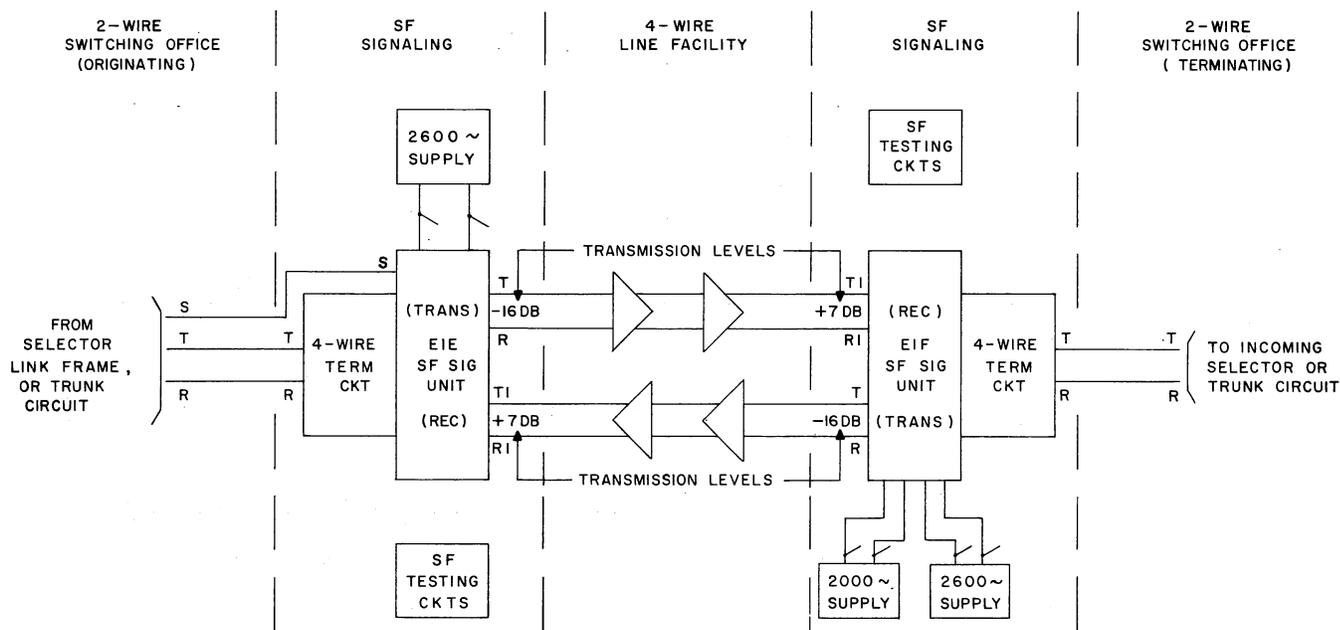


Fig. 1 - Circuit Layout Using E1F SF Signaling Unit

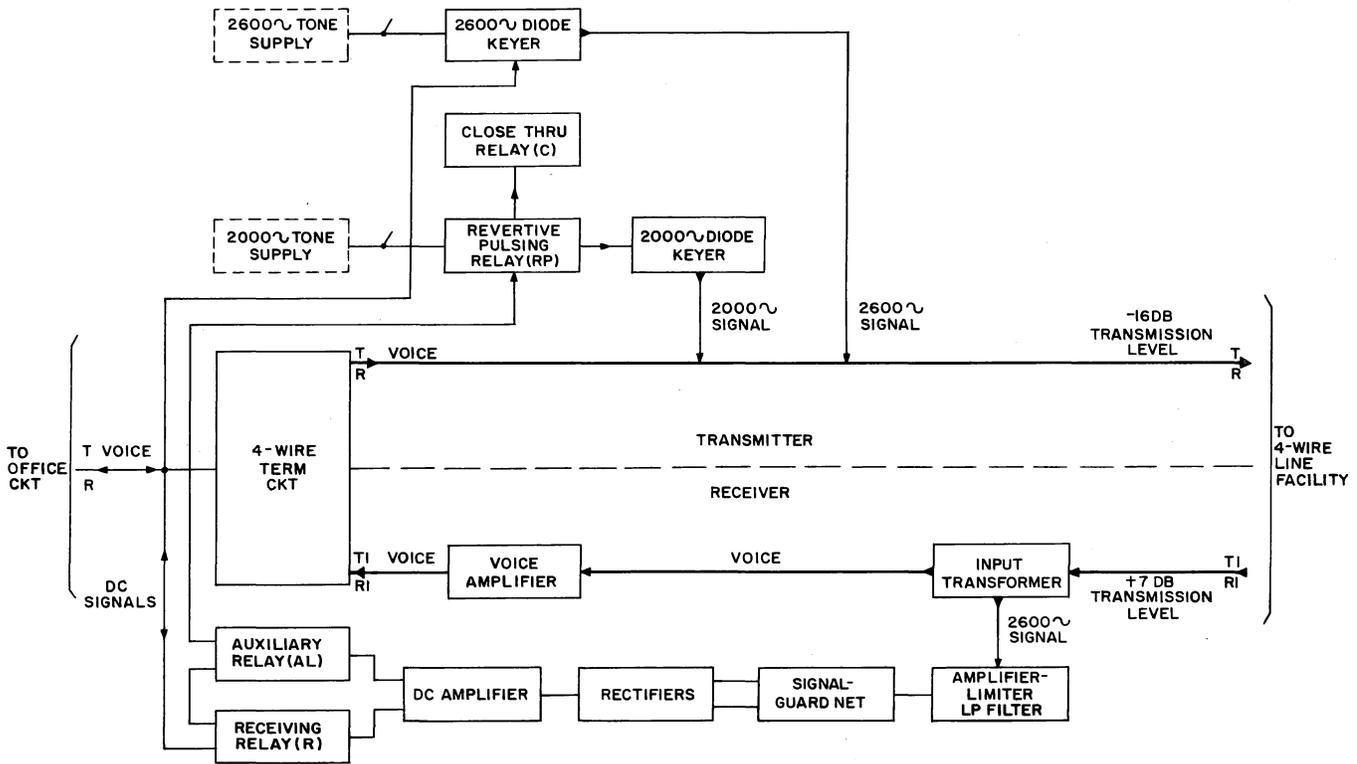


Fig. 2 - Basic Elements of EIF Circuit

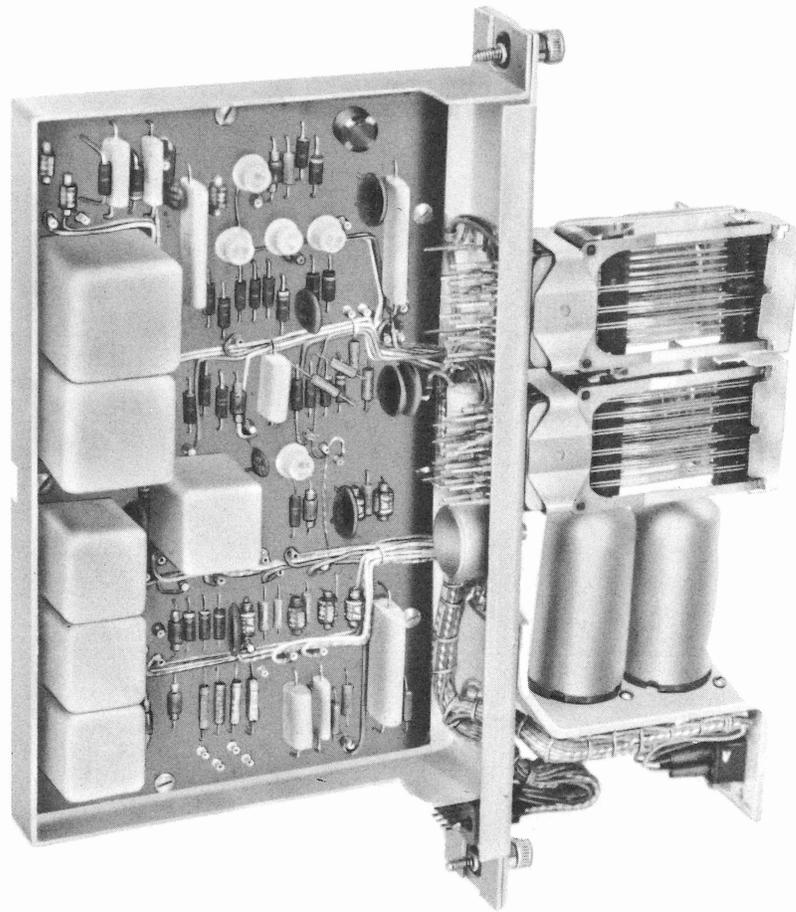


Fig. 3 – E1F SF Signaling Unit