E1A 2600-CYCLE SINGLE FREQUENCY SIGNALING AND 4-WIRE TERMINATING UNIT WITH E AND M LEADS COMMON SYSTEMS

1. GENERAL

1.01 This circuit was designed for use in trunks between two class 5 offices or class 4 and 5 offices using carrier channels for line facilities and trunk circuits with E and M leads. DC signals received from and transmitted to the equipment or office side are converted to or from 2600-cycle signals on the line side. This unit is capable of transmitting and receiving supervisory signals and dial pulses. When associated with a trunk using MF pulsing, the signaling unit will be used only for supervision. Audible tone signals will be passed without distortion over a maximum of three signaling links in tandem. A 4-wire terminating circuit is included as an integral part of the unit.

2. APPLICATION

2.01 The unit will function with types N, O, ON, or P1T carrier systems or with any 4-wire voice-frequency line facility having the required transmission levels and frequency bandpass. Office transmission levels required for the transmitter and receiver are −16 db and +7 db (or 0 db), respectively. This necessitates a line facility gain of 23 db (or 16 db). The 0 db receive level is for use with P1T carrier only. A switch located on the front of the unit adapts the SF receiver for use with either the +7 db or 0 db level. Normal signal tone (in the idle condition) is −20 dbm, high-signal tone (for pulsing) is −8 dbm referred to zero transmission level. When used with P1T carrier these tones are −18 dbm and −4 dbm, respectively.

2.02 The unit is designed to operate with 4-wire line and 2-wire trunk circuits. The two dc signaling leads (E and M) join the signaling unit to the trunk relay circuit and six additional leads are required to insert the transmitter-receiver between the office and line facility. All eight leads appear at an intermediate distributing frame for cross connection.

2.03 The 2-wire side of the 4-wire terminating circuit is designed to be used with a 900ω and 2MF impedance circuit. The 4-wire side matches 600ω facilities. A group of four building-out capacitors is included in the terminating circuit, any combination of which may be wired in to compensate for small variations that may exist in the office cabling of the 2-wire facility.

2.04 A separate repeating coil is always required between the SF unit and the 2-wire trunk circuit. The built-in 4-wire terminating circuit cannot handle the dc flow of a trunk circuit having A and B (D) leads for signaling and this is one reason a repeating coil must be used. A type 120C is used with 900ω circuits and a type 120E with 600ω circuits. Fig. 1 shows a typical circuit layout.

2.05 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.

2.06 M lead resistance affects the SF unit operation and should not exceed 25ω. Where separate battery supplies are used for the trunk relay circuit and the SF unit no more than ±1 volt ground potential difference may exist between the two supplies. The allowable E lead resistance is governed by the particular trunk relay circuit but, in general, will be within the 25ω limit set for the M lead.

2.07 Pulses can be satisfactorily transmitted at speeds from 8 to 12 pulses per second with per cent break ranging from 46 to 76 per cent. The receiver portion of the signaling unit contains a pulse-correcting network to improve the characteristics of incoming SF pulses before they are applied to the E lead as dc signals.

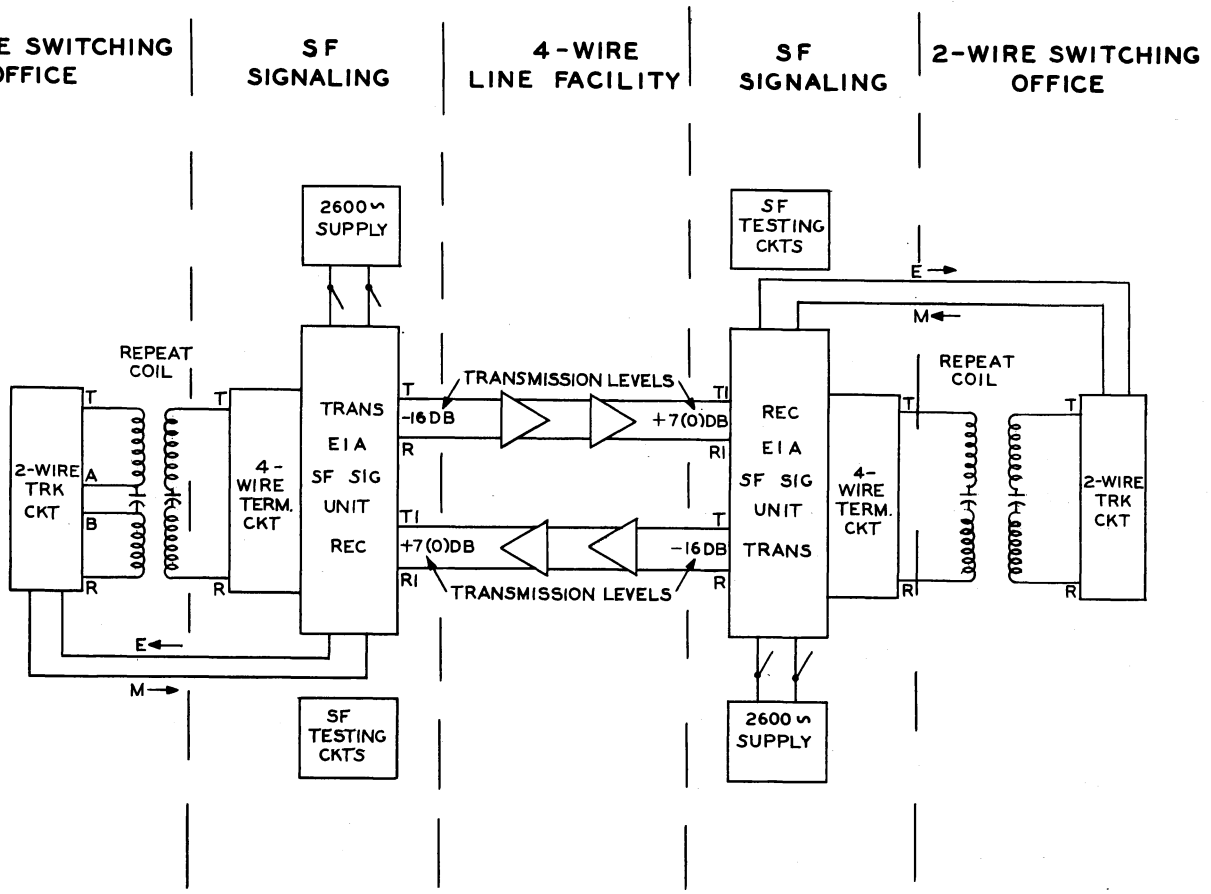

Fig. 1 – Circuit Layout Using E1A SF Signaling Unit

3. OPERATIONAL PRINCIPLES

3.01 A block diagram showing the basic elements of the E1A circuit appears in Fig. 2. The transmitter converts dc signals from the M lead into SF tone pulses to the T and R line transmit leads. It consists of two relays (M, HL), a 14-db pad, and the line transmitting portion of the 4-wire terminating circuit. The M relay releases and operates with each dial pulse received from the M lead, thereby alternately applying and removing tone from the line. The M relay also operates the HL relay which short-circuits the 14-db pad. The HL is slow releasing allowing it to remain operated while the M relay is following a train of dial pulses on the M lead. The use of this higher level tone for pulsing provides a better signal to noise ratio during the critical dialing period. In addition, the M relay opens the T and R line transmit leads toward the 4-wire terminating circuit each time a pulse of high-level tone is transmitted. This prevents noise from the drop entering the line facility which might have an adverse affect 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 considered a separate circuit. The amplifier's primary function is to provide a high-loss path to prevent noise or speech orignating 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 0.2 db) and by means of its associated potentiometer allows the required trunk net loss to be established.

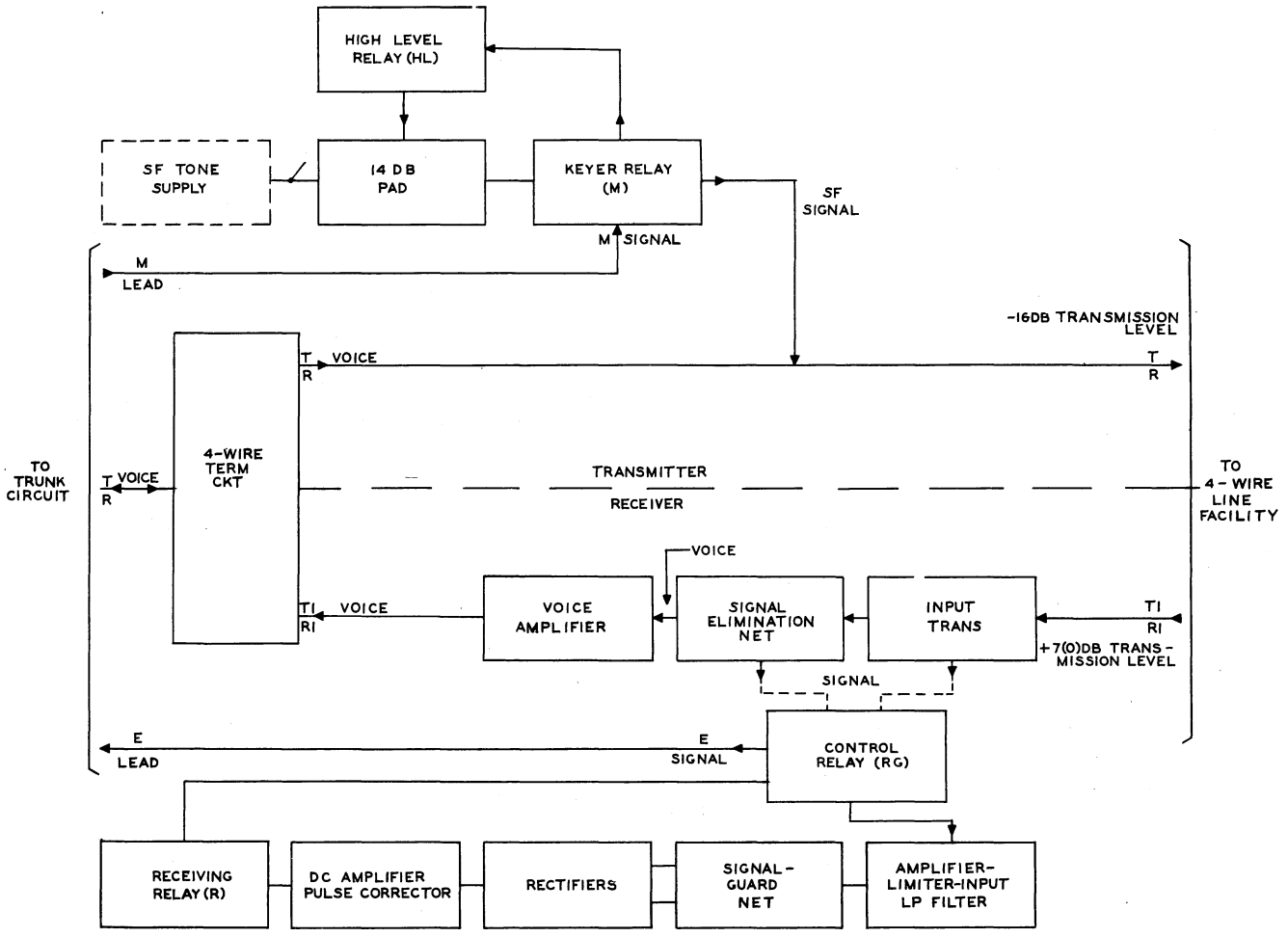

Fig. 2 – Basic Elements of E1A Circuit

3.03 The receiver consists of (1) an amplifier-limiter input stage, (2) a signal and guard frequency detector device plus separate half-wave rectifiers, (3) a 2-stage dc amplifier and pulse correcting circuit, (4) two relays (R, RG), 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. 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 SF 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 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 the 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. 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 incoming 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 amplifiers for control of the receiving relay (R). The R relay in turn controls the RG relay. The pulse correcting feature mentioned in 2.08 consists of an RC network, and is included in the dc amplifier circuitry.

3.05 The signal-guard relationship together with the time constants in the pulse corrector circuit determine 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 M and RG relays which control the efficiency of the guard channel, the frequency band-pass characteristic of the signal channel, and the signal elimination network. Whenever the RG relay is operated, the signal elimination network, consisting of two individual tuned circuits, is inserted into the 4-wire receive leg. One 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 circuit is idle (M relay released, RG relay operated) the guard channel is at its lowest efficiency and the signal channel is broad-band. The resultant signal-guard ratio is maximum and the receiver should not be released falsely by line noise. In the talking condition (M relay operated, RG 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.

3.06 On a call terminating in intercept or a free line, the SF receiver at the terminal originating the call will have still another signal-guard ratio. The M relay will be operated and the RG will also be energized because on-hook supervision (SF tone on) is sent from the called end during conversation. The signal channel frequency characteristic is broad-band and the guard channel is moderately efficient resulting in a signal-guard ratio slightly lower than for the idle condition. While this does not appear to provide maximum protection against false release of the receiver when it is needed most, it does insure proper response to flashing signals such as busy-back and reorder where audible tone accompanies flashing. The RG relay in the calling end SF receiver will be operated during the on-hook portion of a flashing signal, and the receiver will be in the same condition described for intercept. Audible tone is applied during the off-hook portion of the flash and the receiver may be held operated by harmonics of this tone. The lower signal guard ratio established in the on-hook period permits the receiver to release when SF tone is removed and audible tone is applied.

3.07 DC signals to the trunk relay circuit are furnished by contacts on the RG relay. The E lead is open when the RG is operated and is grounded when the relay releases.

4. MISCELLANEOUS

4.01 The 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 the same amount of space as six 2- by 19-inch mounting plates. Fig. 3 is a view of the unit.

4.02 Typical relay rack bay arrangements for the E1A units are described and pictured in Section 987.200.20.

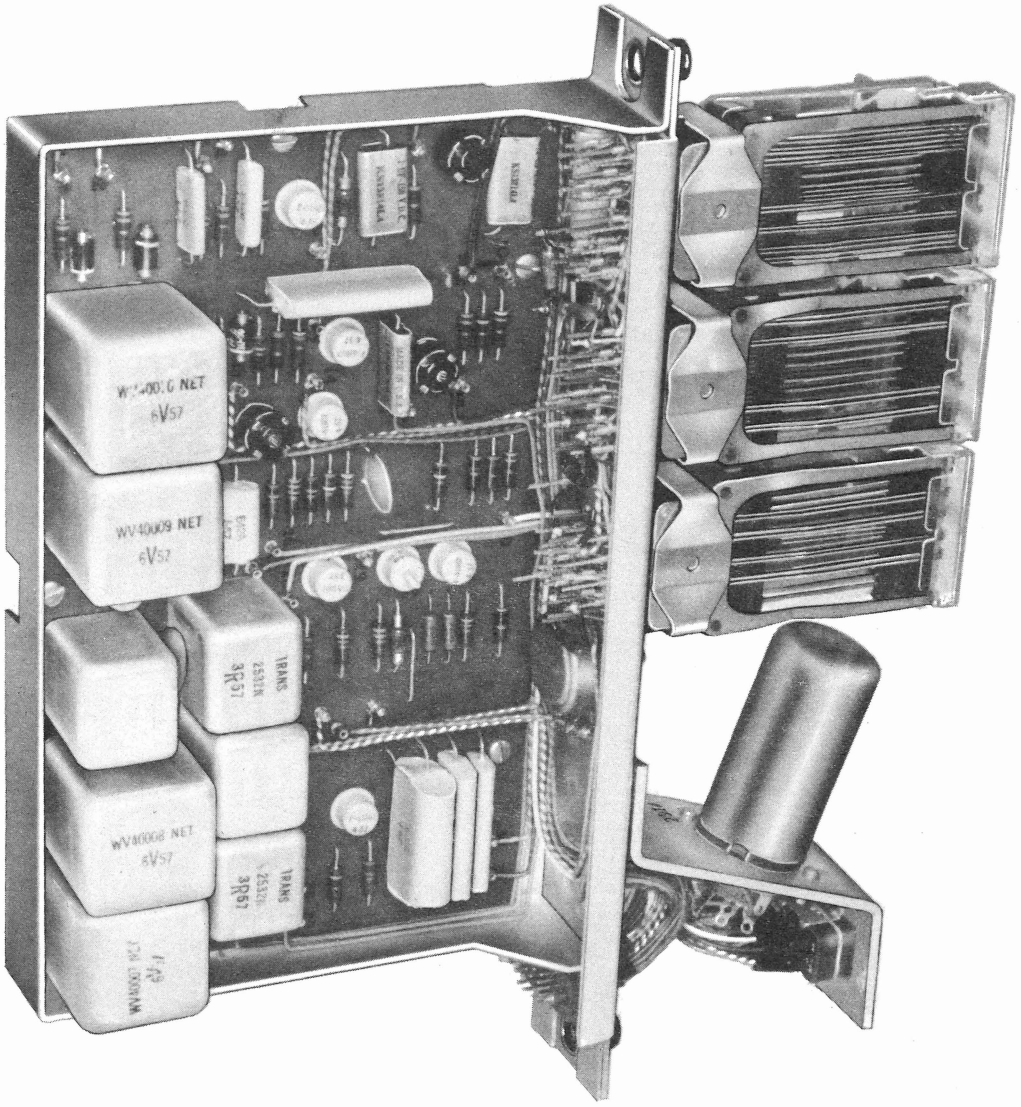

Fig. 3 – E1A SF Signaling Unit