E1B 2600-CYCLE SINGLE FREQUENCY SIGNALING UNIT WITH E AND M LEADS COMMON SYSTEMS

1. GENERAL

1.01 The E1B single-frequency (SF) signaling unit can be used in all classes of trunks that have 4-wire line facilities with the proper transmission levels and frequency band pass, and with trunk relay circuits having E and M leads. DC signals from the M lead of the trunk circuit 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 on the E lead of the trunk circuit.

1.02 This unit transmits and receives both supervisory signals and dial pulses. When associated with a trunk using MF pulsing, the signaling unit is used only for supervision. It can also be used with ringdown circuits if the proper type signal converter is employed. The E1B will not transmit the audible tone which accompanies flashes, and tone appliers must be added if both flashing and audible signals are required. When an E1B unit is used at one end of a circuit, the distant end can be equipped with either an E1A, E1B, E2B, E1C, or E1D unit. The E1B is not compatible with an electron tube type 2400- or 2600-cycle SF unit.

2. APPLICATION

2.01 This unit will function with any repeatered 4-wire line facility having the required transmission levels and frequency band pass, types C-5, J, K, L, N, O, or ON carrier systems, TD-2 radio transmission systems, or any microwave radio system multiplexed with terminals of the above carrier systems. Office transmission levels for the transmitter and receiver are −16 db and +7 db (or −13 db and +4 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 The equipment (drop) side of the unit is designed to work with 4-wire office trunk circuits. Two-wire office trunk circuits can also be used by adding an external 4-wire terminating set. The two dc signaling leads (E and M) join the signaling unit to the trunk relay circuit and eight additional leads are required to insert the transmitter-receiver between the office and line facility. All ten leads may be cabled to an intermediate distributing frame for cross connection. Fig. 1 shows a typical circuit layout with the terminal at the left equipped with an external 4-wire terminating set as mentioned above. Both offices are considered to be class 4 or higher.

2.03 The maximum allowable frequency shift within the 4-wire line facility is ±10 cycles and the transmission variation limits should be held within ±6.5 db at the signaling frequency.

2.04 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.

2.05 M lead pulses at speeds from 8 to 12 pulses-per-second with per cent break ranging from 46 to 76 per cent will be transmitted satisfactorily. 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.

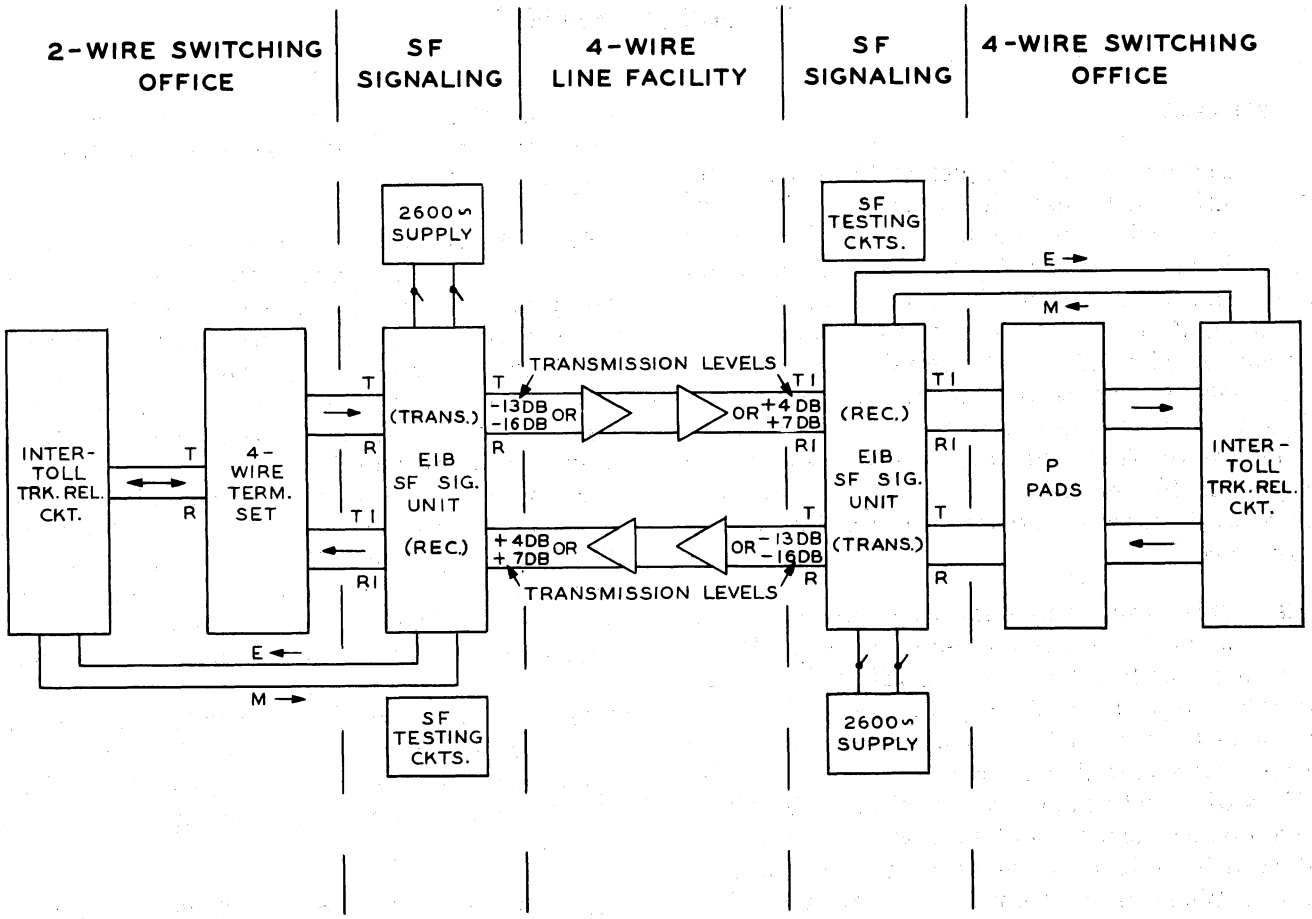

Fig. 1 – Circuit Layout Using E1B SF Signaling Units

3. OPERATIONAL PRINCIPLES

3.01 A block diagram showing the basic elements of the E1B circuit appears in Fig. 2. The transmitter converts dc signals from the M lead into SF signals to the T and R line transmit leads. It consists of two relays (M, HL), a 12-db pad, and a retardation coil. The M relay releases and operates with each dial pulse received on the M lead, thereby alternately applying and removing tone from the line. The M relay also operates the HL relay which short-circuits the 12-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 higher level tone for pulsing provides

a better signal-to-noise ratio during the critical dialing period. Each time a pulse of high-level tone is transmitted, the T and R leads are short-circuited toward the equipment and terminated with 560ω toward the line. This prevents noise from the drop entering the line facility which might have an adverse effect on the distant receiver's operation. The retardation coil is bridged across the T and R leads and has its center tap grounded. This serves to drain off longitudinal currents that may develop in the equipment and which might interfere with signaling.

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 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 0.1 db).

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 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 in-

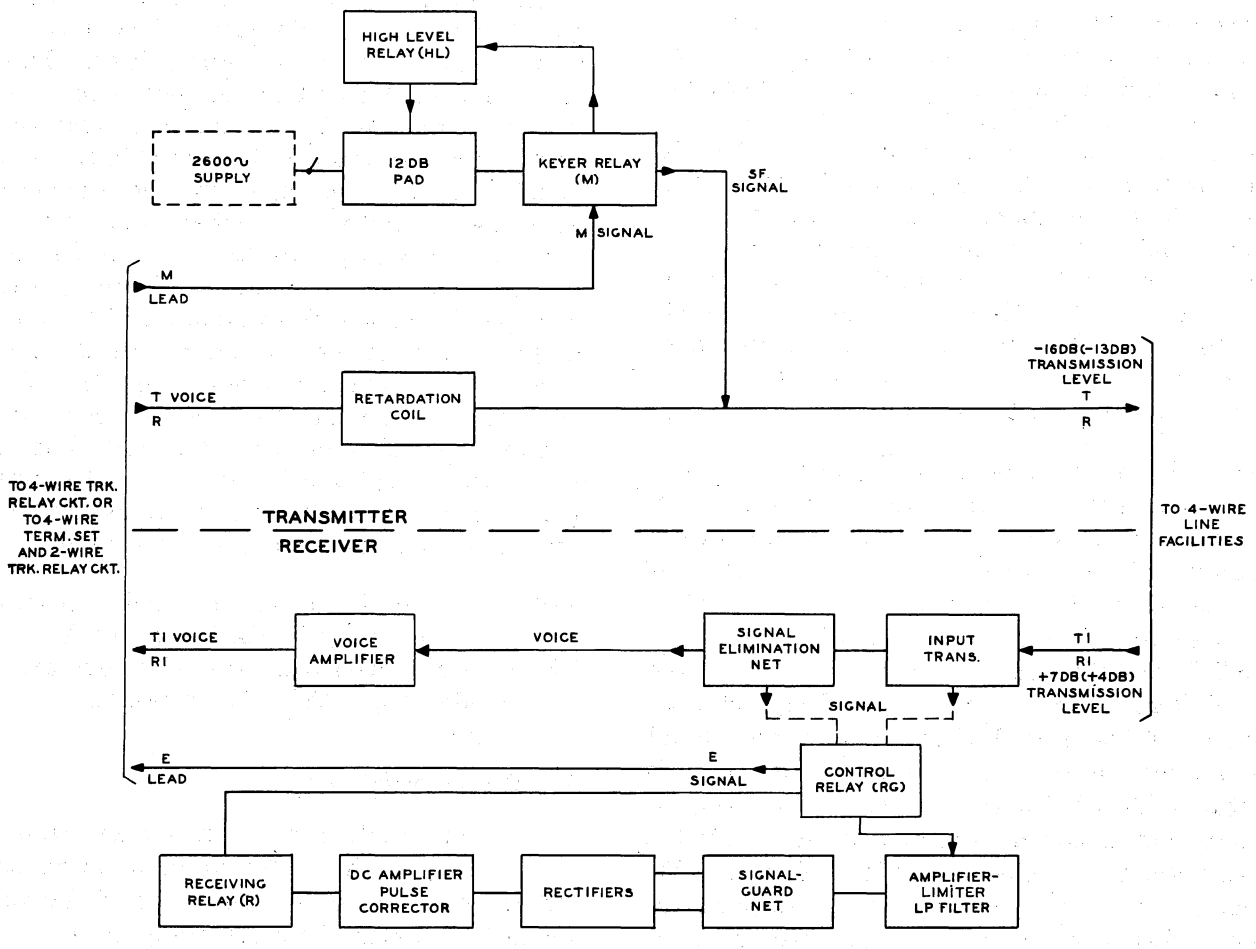

Fig. 2 – Basic Elements of E1B Circuit

put 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 OTL) 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 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 amplifiers for control of the receiving relay (R). The R relay in turn controls the RG relay. The pulse correcting feature mentioned in 2.05 consists of an RC network and is included in the dc amplifier circuitry.

3.06 The signal-guard relationship together with the time constants in the pulse corrector circuit 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 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 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 passing through 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 broadband. 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.

3.07 On a call terminating in intercept or a free call, 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 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.

3.08 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 E1B 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. Typical relay rack bay arrangements are described and pictured in Section 987.200.20. Fig. 3 is a view of the unit.

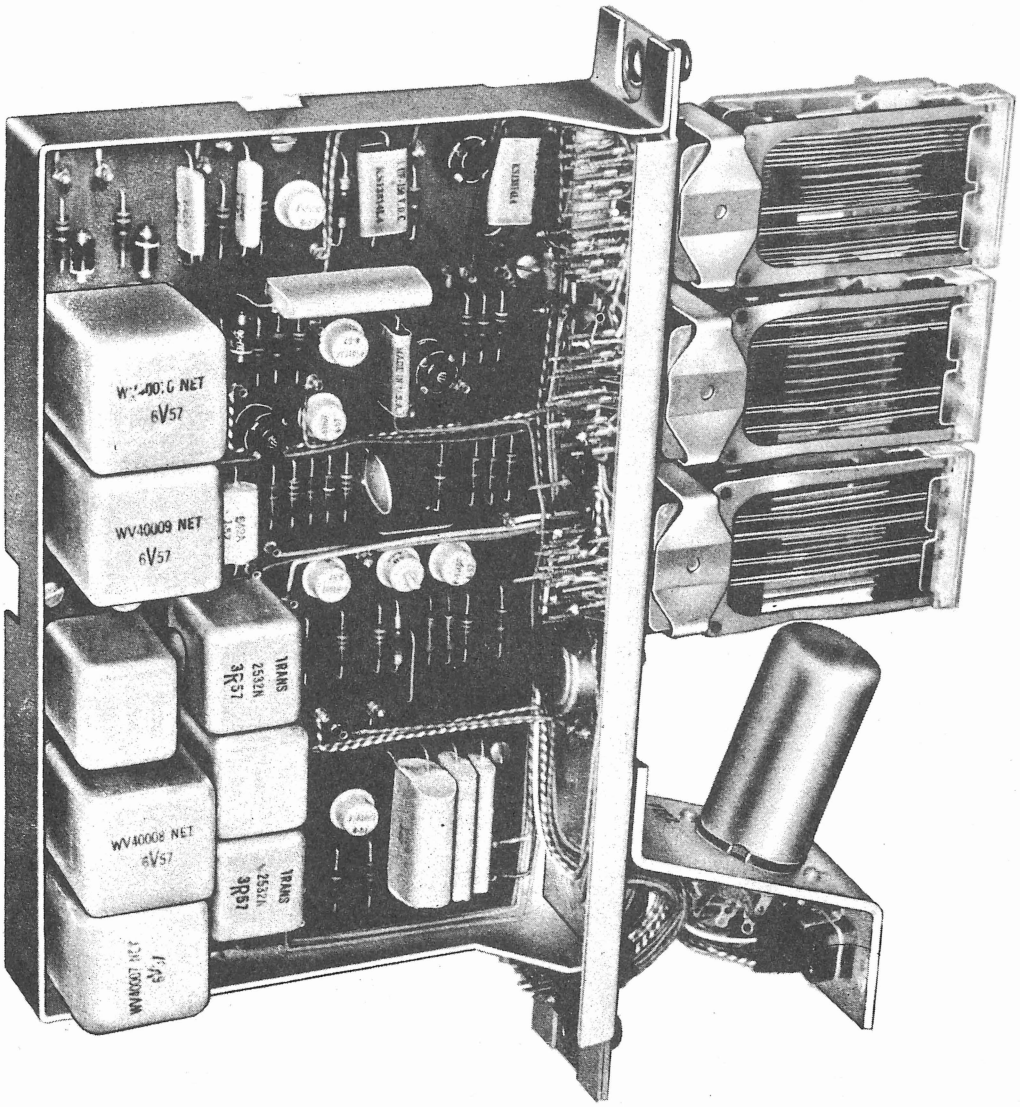

Fig. 3 – E1B SF Signaling Unit