practice section 816170

6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater

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1. general description

1.01 The 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module (figure 1) provides both active transmission interface and bidirectional signaling conversion between a 4wire facility that uses 2600Hz single-frequency (SF) signaling and a 4wire trunk or line that uses E&M signaling. The 6170 module is designed in accordance with the specifications given in AT&T Technical Reference Pub 43001: Functional Criteria for Voice-Frequency Terminating Equipment/Metallic Facilities/Central Office.

1.02 In the event that this practice section is revised or reissued, the reason for revision or reissue will be stated in this paragraph.

1.03 The 6170 module offers the following features and options:

- From 0 to 24dB of prescription-set loss or gain, in switch-selectable 0.1dB increments, in both the transmit and receive channels at the facility-side ports.
- From 0 to 24dB of prescription-set loss, in switch-selectable 0.1dB increments, in both the transmit and receive channels at the terminal-side ports.
- Active prescription slope-type or bump-type amplitude equalization equivalent to that provided by the Western Electric 309B Prescription Equalizer in both the transmit and receive channels.
- Independently switch-selectable post-equalization operation, pre-equalization operation, or equalizer bypass (exclusion) for both the transmit and receive equalizers.
- Isolation transformers that are center-tapped to derive balanced simplex (SX) leads at all four ports.
- Terminal-side SX-lead reversal switch.
- Independently switch-selectable 150, 600 or 1200-ohm terminating impedance at all four ports.
- Integral 2600Hz SF tone oscillator.
- Switch-selectable Type I, II, or III E&M interface.
- Switch-selectable A-side or B-side E&M signaling.
- Minimum-break transmit pulse correction.
- Full precision receive pulse correction.

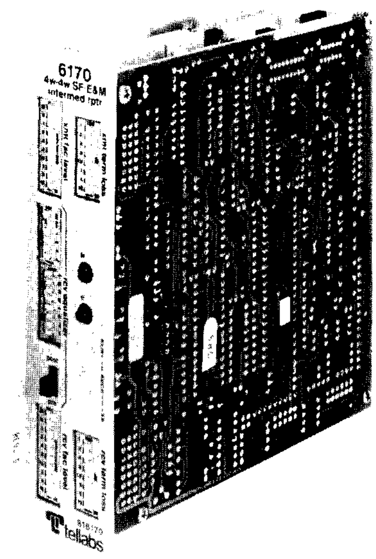


figure 1. 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module

- Front-panel LED's that light to indicate local E-lead and M-lead busy.
- Lightning surge protection at all transmission ports.
- Reverse-battery protection, transient-limiting circuitry, and RC (resistance-capacitance) filtering and decoupling networks to minimize crosstalk coupling and the effects of noise on the input power leads.
- Operation on filtered, ground-referenced −42 to −54Vdc input power with current requirements of 80mA typical at idle (at −48Vdc) and 100mA maximum (at −54Vdc).
- Type 10 module for mounting in a variety of Tellabs Type 10 Mounting Shelves, which are available in versions for relay-rack (occupying 6 inches of vertical rack space) and apparatus-case installation.

2. application

2.01 The 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module is typically used to interface a 4wire SF transmission facility with a 4wire E&M trunk or line associated with a two-way dial/supervisory telephone circuit. The 6170 module combines the functions of a 4wire line amplifier, an SF transceiver, an SF-to-E&M signaling converter, and a 4wire pad/transformer module. No external interface circuitry is required because the 6170 is a complete SF signaling and terminating circuit, less power, on a single Type 10 card. Thus, the module provides not only bidirectional signaling conversion but also active transmission interface (impedance matching, level control, and amplitude equalization) between the SF facility and the E&M trunk or line. Figure 2 shows a typical application.

terminal interface

2.02 The 6170 interfaces the terminal-side 4wire E&M trunk or line via prescription attenuators in the transmit and receive paths (see paragraph 2.04) and via transformers at the transmit input and receive output ports. Each terminal-side transformer provides balanced, switch-selectable 1200, 600, or 150-ohm terminating impedance. The 1200-ohm option is used for interface with loaded cable; the 600-ohm option, for interface with nonloaded cable or carrier; and the 150-ohm option, to provide a small amount of slope-type amplitude equalization for nonloaded cable through the deliberate impedance mismatch. Both terminal-side transformers are center-tapped to derive balanced simplex (SX) leads, which can be used to provide sealing current to a metallic facility from a local source external to the module. An option switch on the module selects either a normal or reversed arrangement for the terminal-side SX leads. In the normal arrangement, the transmit input simplex (XMT IN SX) lead is associated with the transmit input pair, and the receive output simplex (RCV OUT SX) lead is associated with the receive output pair. In the reversed arrangement, the XMT IN SX lead is associated with the receive output pair, and the RCV OUT SX lead is associated with the transmit input pair. The SX-lead reversal option is provided for use in applications involving polarity-sensitive dc signaling.

facility interface

2.03 The 6170 interfaces the facility-side 4wire SF signaling facility via prescription amplifiers in the transmit and receive paths (see paragraph 2.04) and via transformers at the transmit output and receive input ports. Like the terminal-side transformers, each facility-side transformer provides balanced, switch-selectable 1200, 600, or 150-ohm terminating impedance. Also, both facility-side transformers are center-tapped to derive balanced SX leads, which can be used to provide sealing current to a metallic facility from a local source external to the module, or which can be strapped together to establish a return path for sealing current applied at the distant end of the facility.

level control

2.04 Prescription-set transmit and receive amplifiers on the facility side of the 6170 allow the module to interface the SF signaling facility directly, i.e., without a separate facility-side line amplifier. The module's amplifiers, in conjunction with the prescription-set transmit and receive attenuators on the module's terminal side, provide for full coordination between facility-side and terminal-side levels (see figure 3). In the receive channel, the facility-side amplifier is set to provide the gain or loss necessary to derive a +7 transmission level point (TLP) within the module. This internal TLP is then used as a reference as the module's terminal-side receive attenuator is set to provide the loss necessary to derive the required terminal-side receive output level. In the transmit channel, the terminal-side attenuator is set to provide the loss necessary to derive a −16TLP within the module. This internal TLP is then used as a reference as the module's facility-side transmit amplifier is set to provide the gain or loss necessary to derive the required facility-side transmit output level. Both facility-side amplifiers in the 6170 provide from 0 to 24dB of gain or 0 to 24dB of loss in switch-selectable 0.1dB increments. Both terminal-side attenuators provide from 0 to 24dB of loss in switch-selectable 0.1dB increments. Thus, receive input TLP's from −17 to +7 can be accommodated and receive output TLP's from +7 to −17 can be derived. In a similar manner, transmit input TLP's from −16 to +8 can be accommodated and transmit output TLP's from +8 to −16 can be derived. Total facility-side gain and total terminal-side loss introduced into a channel are the respective sums of that channel's front-panel *fac level* and *term loss* switches set to *IN*. The overload point for the receive input and receive output ports is 0dBm0. The overload point for the transmit input and transmit output ports is +3dBm0.

receive-channel amplitude equalization

2.05 Active prescription amplitude equalization functionally equivalent to that provided by the Western Electric 309B Prescription Equalizer is available in the receive channel of the 6170. This equalizer provides low-end slope equalization down to 404Hz and high-end bump equalization centered at 3250Hz for loaded or nonloaded cable, as selec-

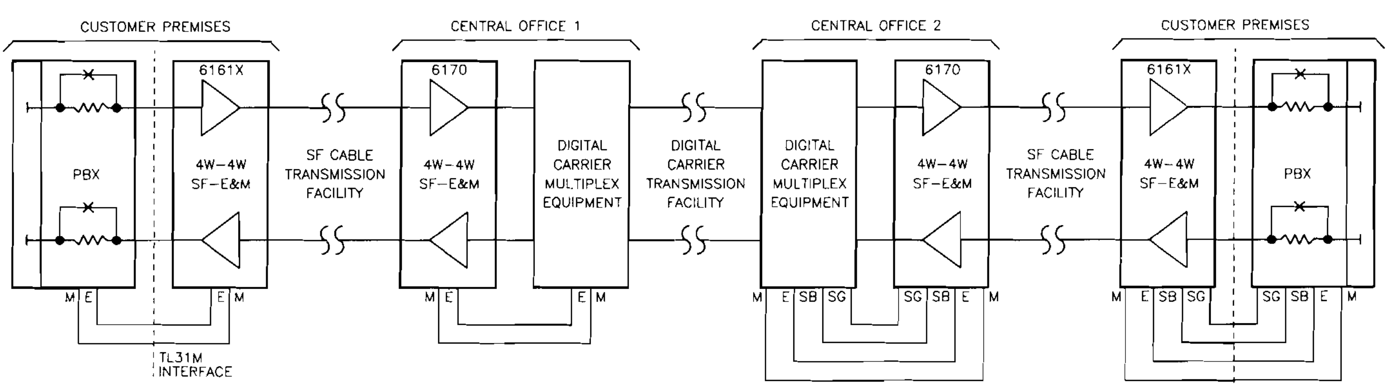


figure 2. Typical long-haul digital tie-trunk circuit using Tellabs 6170 and 6161X

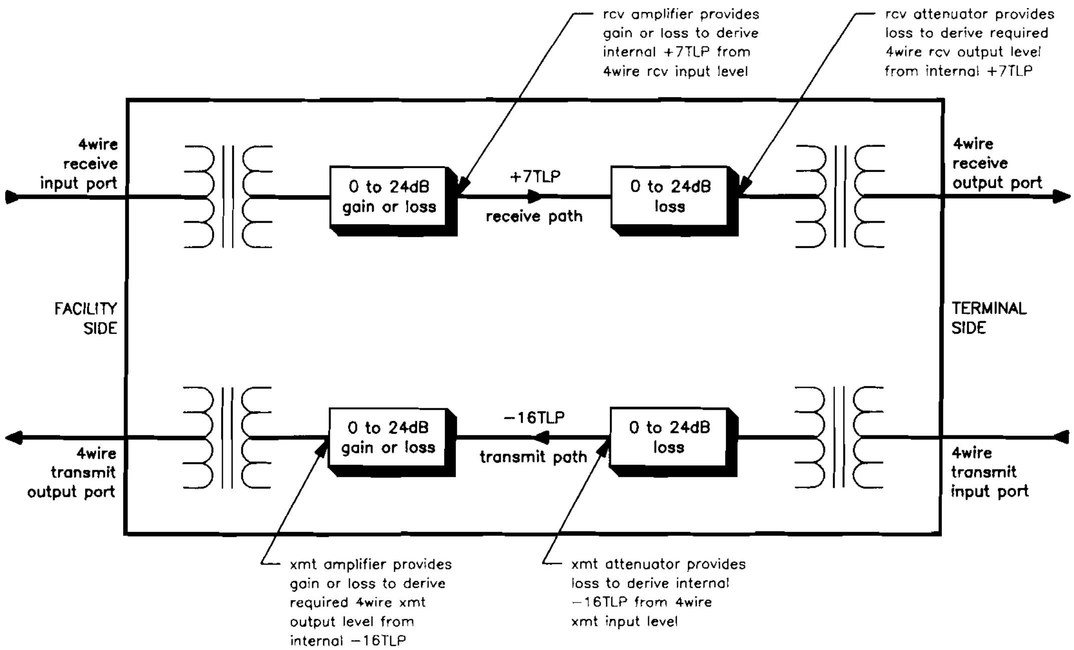


figure 3. Level coordination in 6170

ted via switch option. Degree of slope, height of bump, and affected bandwidth are also controlled by option switches on the module. An additional switch option conditions the equalizer to provide either post-equalization of the receive input pair or pre-equalization of the receive output pair, as required. For post-equalization, the equalizer is inserted before the receive-channel band-elimination filter (see paragraph 2.16). For pre-equalization, the equalizer is inserted after the band-elimination filter. If no equalization is required, the equalizer can be electrically bypassed by means of another switch option.

2.06 Figure 4 and 5 show typical response curves for the 309B-equivalent equalizer in the slope mode. Figure 4 shows the curves for nonloaded cable, while figure 5 shows the curves for loaded cable. For comparison purposes, all frequency-response curves in both figures are drawn with the same 0dB-gain reference point (1004Hz). Actually, all of these curves except those for a *SLOPE* switch setting of *0* are raised above the 0dB level at 1004Hz by as much as 11.4dB. The exact amount by which a particular curve is raised depends upon the *SLOPE* and *NL* (nonloaded/loaded) switch settings selected. These amounts are listed in table 1.

2.07 Figures 6 and 7 show typical response curves for the 309B-equivalent equalizer in the bump mode. Figure 6 shows the curves representing various height settings versus a wide bandwidth setting, while figure 7 shows the curves representing various height settings versus a narrow bandwidth setting. For comparison purposes, all frequency-response curves in both figures are drawn with the same 0dB-gain reference point (1004Hz). Actually, all of these curves except those

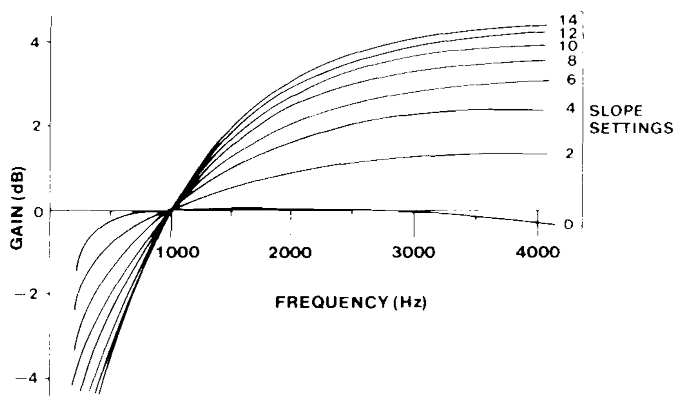


figure 4. Typical response curves for receive and transmit equalizers in slope mode, nonloaded cable

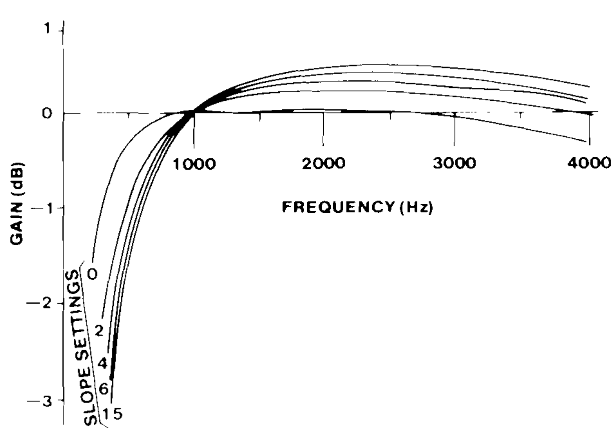


figure 5. Typical response curves for receive and transmit equalizers in slope mode, loaded cable

SLOPE switch setting	L/NL (loaded/nonloaded) switch setting	
	L	NL
0 (slope disabled)	0.0dB	0.0dB
1	1.4	0.4
2	2.6	0.9
3	3.7	1.4
4	4.7	1.8
5	5.5	2.3
6	6.3	2.8
7	7.2	3.4
8	7.8	3.7
9	8.4	4.2
10	9.0	4.6
11	9.5	5.0
12	10.0	5.4
13	10.5	5.8
14	11.0	6.2
15	11.4	6.6

table 1. Equalized gain (in dB) at 1004Hz in slope mode

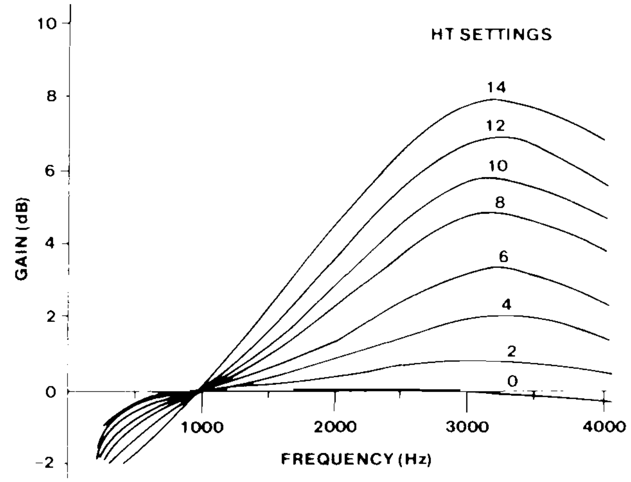


figure 6. Typical response curves for receive and transmit equalizers in bump mode, BW switch = 14

for a height (*HT*) switch setting of *1* or *0* and/or for a bandwidth (*BW*) switch setting of *5* or less are raised above the 0dB level by as much as 3.9dB. The exact amount by which a particular curve is raised depends upon the *HT* and *BW* switch settings selected. These amounts are listed in table 2.

transmit-channel amplitude equalization

2.08 Active 309B-equivalent prescription amplitude equalization identical to that provided in the receive channel is available in the 6170's transmit channel as well. A switch option conditions the transmit equalizer to provide either post-equalization of the transmit input pair or pre-equalization of the transmit output pair. For post-equalization, the equalizer is inserted into the transmit path before the transmit path cut (see paragraphs 2.21 and 2.22). For pre-equalization, the equalizer is inserted into the transmit path after the point at which SF tone is inserted (see the 6170 block diagram, section

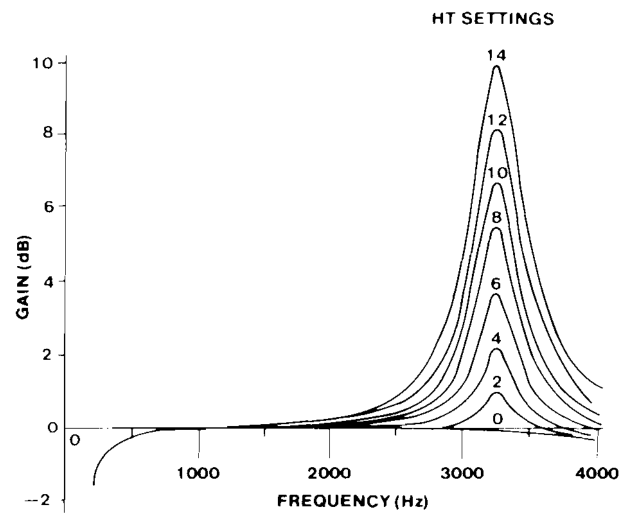


figure 7. Typical response curves for receive and transmit equalizers in bump mode, BW switch = 3

HT switch setting*	BW switch setting**									
	6	7	8	9	10	11	12	13	14	15
2	0.0dB	0.0dB	0.0dB	0.0dB	0.0dB	0.0dB	0.0dB	0.1dB	0.1dB	0.2dB
3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3
4	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.4
5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.5
6	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.7
7	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.9
8	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.7	1.2
9	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.8	1.5
10	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.6	1.0	1.7
11	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.7	1.2	2.0
12	0.1	0.1	0.2	0.3	0.3	0.4	0.6	0.9	1.4	2.4
13	0.1	0.2	0.3	0.3	0.4	0.6	0.8	1.1	1.7	2.8
14	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.3	2.0	3.3
15	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.7	2.5	3.9

* An *HT* switch setting of *0* disables the bump function. An *HT* switch setting of *1* introduces 0.1dB of gain or less at 1004Hz.
** A *BW* switch setting of *0* through *5* introduces 0.1dB of gain or less for all *HT* switch settings.

table 2. Equalized gain (in dB) at 1004Hz in bump mode

5 of this practice). If no equalization is required, the equalizer can be electrically bypassed by means of another switch option.

E&M signaling interfaces

2.09 The 6170 can be switch-optioned to derive either a Type I (single-lead) or a Type II or III (looped-signaling-lead) E&M interface. The Type I and Type II interfaces can be used with either A-side or B-side E&M signaling (see paragraphs 2.10 through 2.14). The Type III interface can be used with A-side signaling only. Figures 8 through 12 show the connections required for Type I, II, and III E&M interfaces with A-side and B-side signaling.

E&M signaling modes

2.10 The 6170 can be switch-optioned for either A-side or B-side E&M signaling. A-side signaling is selected when the associated terminal equipment provides M-lead outputs and receives E-lead inputs. B-side signaling is selected when the associated terminal equipment provides E-lead outputs and receives M-lead inputs. Each of these E&M signaling modes is described in detail below.

2.11 **A-Side E&M Signaling.** In typical A-side SF-to-E&M signaling applications (with a Type I interface), the 6170 provides an E-lead output that is open when SF tone is detected at the receive input port and that is at circuit ground when no tone is detected. In the transmit channel, SF tone is transmitted when the M lead is at ground potential (or open), and tone transmission ceases when the M lead is at negative battery potential.

2.12 The E-lead output from the 6170 is derived via a relay with a normally open contact. This contact can accommodate a Type I, II, or III E-lead interface. The relay is energized when the module detects no SF tone at the receive input port and is de-energized when the SF tone is detected. The full precision **receive** pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is de-energized for 58 ±4 percent of the pulsing cycle. After the input break interval, the relay energizes upon absence of tone. The minimum-break **transmit** pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms and that the minimum duration of any silent (no tone) interval is 25ms.

2.13 **B-Side E&M Signaling.** In typical B-side SF-to-E&M signaling applications (with a Type I interface), the 6170 provides an M-lead output that is at ground potential when SF tone is detected at the receive input port and that is at negative battery potential when no tone is detected. In the transmit channel, SF tone is transmitted when the E lead is open, and tone transmission ceases when the E lead is at ground potential.

2.14 The M-lead output from the 6170 is derived via a relay with a normally open contact. This contact accommodates either a Type I or Type II M-lead interface (Type III **cannot** be used with B-side signaling). The relay is energized when the module senses no SF tone at the receive input port and is

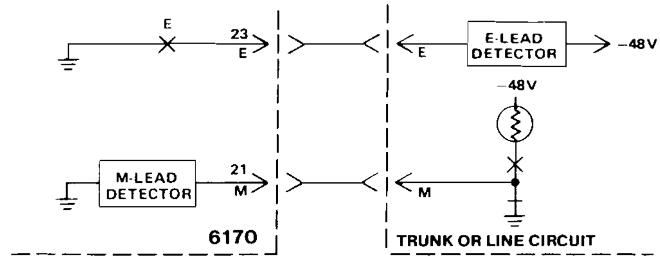


figure 8. 6170 optioned for Type I E&M interface and A-side signaling

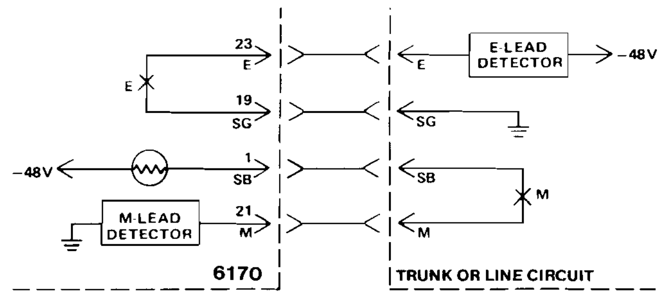


figure 9. 6170 optioned for Type II E&M interface and A-side signaling

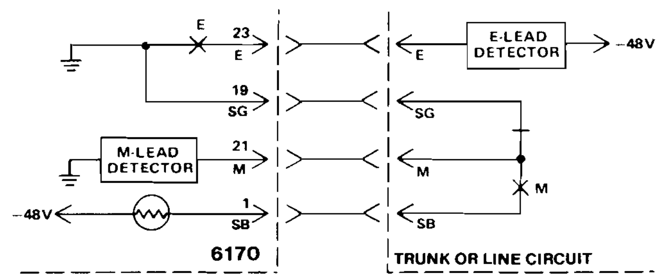


figure 10. 6170 optioned for Type III E&M interface and A-side signaling

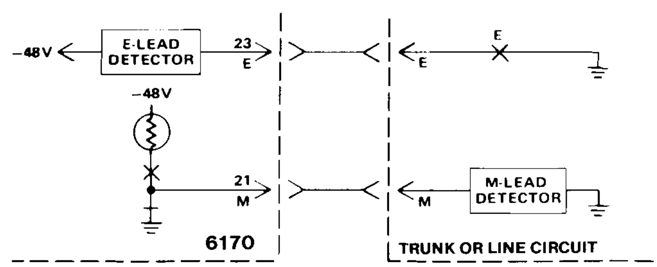


figure 11. 6170 optioned for Type I E&M interface and B-side signaling

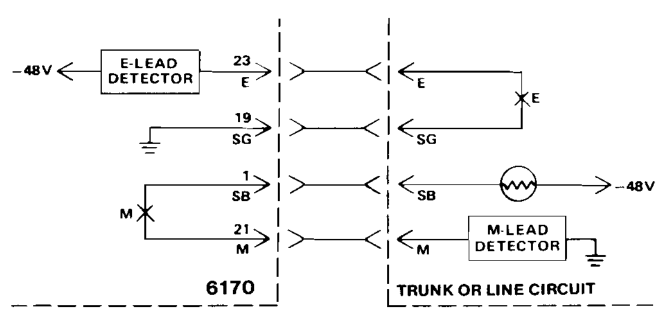


figure 12. 6170 optioned for Type II E&M interface and B-side signaling

de-energized when SF tone is detected. The full precision **receive** pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is de-energized for 58 ±4 percent of the pulsing cycle. After this input break interval, the relay energizes upon absence of tone. The minimum-break **transmit** pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms and that the minimum duration of any silent (no tone) interval is 25ms.

incoming SF tone detection

2.15 The 6170 is designed to interface the receive path on the facility side at any TLP from −17 to +7. Idle-state SF tone is normally received at a level of −20dBm0. A higher level of −8dBm0 is normally received during break portions of dial pulses and for about 400ms at the beginning of each tone interval. The SF tone detector in each module reliably detects tone levels as low as −27dBm0, provided that the SF tone energy is approximately 12dB above the level of all other signals simultaneously present at the receive input port. The SF tone detector is actually a signal-to-guard ratio comparator that compares energy in a narrow band of frequencies centered at the SF tone frequency with energy in the entire voice band. This detection arrangement aids significantly in prevention of talk-off, but it places an upper bound on allowable circuit noise. In general, received noise in excess of 51dBrnC0 may interfere with detection of low-level signaling tones.

2.16 The 6170's SF tone detector is designed to ignore momentary losses of SF tone during periods of otherwise continuous receipt of tone and to ignore momentary tone bursts to prevent false signaling. Withing approximately 13ms of detection of incoming SF tone, a band-elimination filter (BEF) is inserted into the receive transmission path to prevent propagation of SF tone beyond the module. An internal timing circuit ensures that the filter remains inserted during dial pulsing and during momentary losses of tone continuity. See tables 3 and 4 for details concerning BEF insertion.

receive pulse correction

2.17 To ensure optimum pulsing toward the local termination, the 6170's full precision receive pulse corrector corrects incoming pulsing (tone bursts) at 8 to 12 pulses per second to provide outgoing pulsing at 58 ±4 percent break (i.e., the module's E-lead for A-side or M-lead for B-side signaling relay is de-energized for 58 ±4 percent of the pulsing cycle). The module recognizes signaling-state changes in the receive path regardless of the local M-lead state (in A-side signaling) or the local E-lead state (in B-side signaling).

outgoing SF tone transmission

2.18 The 6170 is designed to interface the transmit path on the facility side at any TLP from +8 to −16. During the idle state, the module transmits SF tone at −20dBm0. During dial pulsing and also for the first 400ms each time it applies tone to the facility, the module transmits SF tone at a higher level of −8dBm0. This momentarily increased tone level aids in detection of supervisory-state changes and incoming dial pulsing.

delay circuit and transmit pulse correction

2.19 A symmetrical delay of approximately 18ms is provided between the M-lead input (A-side signaling) or the E-lead input (B-side signaling) and the tone transmission gate. This delay prevents inadvertent transmission or interruption of SF tone in response to momentary transitions of the signaling-lead inputs. This delay is also instrumental in prevention of transient interference with SF tone transmission, as noted in paragraph 2.22.

2.20 A minimum-break pulse corrector in the transmit path ensures a 50ms minimum break duration and a 25ms minimum make duration during dialing. This type of pulse correction does not interfere with supervisory winks and momentary signaling-state changes and helps to ensure that recognizable pulses are transmitted. The pulse corrector does not alter the duration of tone intervals resulting from M-lead (in A-side signaling) or E-lead (in B-side signaling) state changes longer than 50ms.

transmit path cut

2.21 The transmit voice path through the 6170 is cut (opened) during idle circuit conditions and is restored when the M lead (A-side signaling) or the E lead (B-side signaling) is in the busy condition. The path is also cut during dialing in either direction and is momentarily cut in response to any transition of the M lead while the E lead is in the off-hook state (A-side signaling) or in response to any transition of the E lead while the M lead is in the off-hook state (B-side signaling). These path cuts prevent transmission of noise, transients, speech, and other interfering signals during critical signaling intervals.

2.22 The transmit path cut is inserted within 5ms of an M-lead (A-side signaling) or E-lead (B-side signaling) state change. Tone transmissions in response to M-lead (A-side signaling) or E-lead (B-side signaling) state changes are delayed for 18 ± 5ms, resulting in a pre-cut interval of 8 to 22ms. This ensures that any transients associated with signaling-state changes in the local trunk circuit or line circuit do not affect SF tone transmission. Details concerning insertion and removal of the transmit path cut are provided in tables 3 and 4.

SF tone source

2.23 The 6170 is equipped with an integral SF tone oscillator and therefore does not require an associated master SF tone supply.

power

2.24 The 6170 operates on filtered, ground-referenced input potentials between −42 and −54Vdc. The positive side of the dc power supply should be connected to earth ground. Maximum current required at −54Vdc is 100mA, not including M-lead current in B-side signaling.

circuit condition	SF tone states		local condition of xmt path cut			local rcv-path band-elimination-filter (BEF) insertion
	xmt	*rcv*	*before*	*change*	*after*	
idle	on	on	cut	none	cut	inserted
seizure	on/off transition	on	cut	stays cut 125±50ms after seizure	not cut	inserted
distant end returns *delay-dial* signal	off	on/off transition	not cut	none	not cut	removed 50±5ms after cessation of SF tone
distant end sends *start-dial* signal	off	off/on transition	not cut	none	not cut	inserted 13±7ms after receipt of SF tone
local-end dialing	off/on and on/off transitions, ending with on/off transition	on	not cut	precut 15±7ms; remains cut as long as M-lead make/break transitions are less than 125±25ms apart; remains cut 125±50ms after last break/make transition*	not cut	inserted
distant end answers (free call	off	on	not cut	none	not cut	inserted
distant end answers (toll call)	off	on/off transition	not cut	none	not cut	removed 50±5ms after cessation of SF tone
talking	off	off	not cut	none	not cut	out of circuit
disconnect, local end first	off/on transition	off	not cut	precut 15±7ms; cut 625±125ms after M-lead transition from battery to ground*	not cut	out of circuit
disconnect, distant end	on	off/on transition	not cut	cut within 35ms	cut	inserted 13±7ms after receipt of SF tone
idle	on	on	cut	none	cut	inserted
*E-lead transition for B-side signaling.						

table 3. SF tone states and status of transmit path cut and receive BEF for local call origination

circuit condition	SF tone states		local condition of xmt path cut			local rcv-path band-elimination-filter (BEF) insertion
	xmt	*rcv*	*before*	*change*	*after*	
idle	on	on	cut	none	cut	inserted
seizure, distant end	on	on/off transition	cut	remains cut 625±125ms after cessation of SF tone	not cut	removed 50±5ms after cessation of SF tone
distant end returns *delay-dial* signal	on/off transition	off	not cut	cut 125±50ms after M-lead transition from ground to battery*	not cut	out of circuit
local end returns *start-dial* signal	off/on transition	off	not cut	precut 15±7ms; remains cut 625±125ms after M-lead transition from battery to ground*	not cut	out of circuit
distant end transmits dial pulses	on	off/on and on/off transitions, ending with on/off transition	not cut	cut within 7ms of receipt of first tone pulse; remains cut as long as incoming break/make transitions are less than 625±125ms after last incoming on/off transition	not cut	inserted 13±7ms after receipt of first tone pulse; remains in circuit until 50±5ms after last incoming on/off transition or 225±50ms, whichever is longer
local-end answers (free call)	on	off	not cut	none	not cut	out of circuit
local end answers (toll call)	on/off transition	off	not cut	cut 125±50ms after M-lead transition from ground to battery*	not cut	out of circuit
talking	off	off	not cut	none	not cut	out of circuit
disconnect, distant end	off	off/on transition	not cut	none	not cut	inserted 13±7ms after receipt of SF tone
disconnect, local end	off/on transition	on	not cut	precut 15±7ms; then continuously cut	cut	inserted
idle	on	on	cut	none	cut	inserted
*E-lead transition for B-side signaling.						

table 4. SF tone states and status of transmit path cut and receive BEF for distant-location call origination

3. installation

inspection

3.01 The 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module should be visually inspected upon arrival to find any damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

mounting

3.02 The 6170 mounts in one position of a Tellabs Type 10 Mounting Shelf. The module plugs physically and electrically into a 56-pin connector at the rear of its shelf position.

installer connections

3.03 When a 6170 module is to be installed in a non-prewired Type 10 Shelf, external connections to the module must be made. Before making any connections to the shelf, make sure that power is **off** and modules are **removed.** Modules should be put into place only **after** they are properly optioned and **after** wiring is completed.

3.04 Table 5 lists external connections to the 6170 module. All connections to non-prewired mountings are made via wire-wrapping to the 56-pin connector at the rear of the module's shelf position. Pin numbers are found on the body of the connector.

connect:	**to pin:**
RCV IN TIP	7
RCV IN RING	13
XMT OUT TIP	41
XMT OUT RING	47
RCV OUT TIP	5
RCV OUT RING	15
XMT IN TIP	55
XMT IN RING	49
RCV In SX (simplex, facility side)	9
XMT OUT SX (simplex, facility side)	43
RCV OUT SX (simplex, terminal side)	3
XMT IN SX (simplex, terminal side)	51
E lead	23
M lead	21
SB lead	1
SG lead	19
−BATT (−42 to −56Vdc filtered input)	35
GND (ground)	17

table 5. External connections to 6170

option selection

3.05 Several option switches must be set before the 6170 is placed into service. Locations of these switches on the module's printed circuit board are shown in figure 13. Table 6 summarizes all switch options and provides a convenient **checklist** that can be filled out either prior to installation for prescription optioning or during installation to serve as a record for later reference. Refer to figure 13 and to table 6, and set each option switch on the 6170 as required.

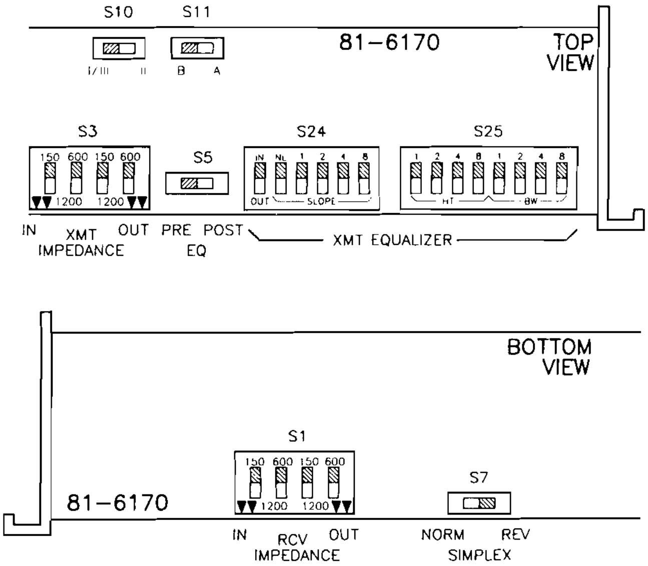


figure 13. 6170 option switch locations

alignment overview

3.06 Alignment of the 6170 module comprises the following procedures (all option switches should already be properly set as described above):

A. Setting the receive-channel facility-side and terminal-side levels.
B. Introducing receive-channel equalization, if necessary.
C. Setting the transmit-channel terminal-side and facility-side levels.
D. Introducing transmit-channel equalization, if necessary.

prescription alignment

3.07 The 6170 module is primarily intended for **prescription alignment.** This involves setting all level-control and equalization switches in accordance with specifications on the circuit layout record (CLR) before plugging the module into its shelf position. Table 7 in this practice summarizes all alignment switches on the 6170 and provides a convenient **checklist** for prescription alignment. To use this table, simply indicate all required alignment-switch settings in the **checklist** column. Then, at installation time, align the 6170 by setting each switch as indicated in the table (or on the CLR, if preferred).

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module, function sequence flowcharts (figures 14 through 16) that illustrate operation of the module on incoming and outgoing calls with A-side E&M signaling are presented in lieu of a more conventional circuit description. Horizontal paths identify events occurring simultaneously, and vertical paths denote sequential events. Dotted lines indicate elapsed time.

option	switch	selection	setting	checklist
terminating impedance, receive input port (facility side)	*RCV IMPEDANCE (S1) IN* switches (lefthand *150* and *600* switches) on main board	1200 ohms (for loaded cable)	150 switch toward 1200, 600 switch toward 1200	
		600 ohms (for nonloaded cable or carrier)	150 switch toward 1200, 600 switch toward 600	
		150 ohms (extra equalization for nonloaded cable)	150 switch toward 150, 600 switch toward 1200	
terminating impedance, receive output port (terminal side)	*RCV IMPEDANCE (S1) OUT* switches (righthand *150* and *600* switches) on main board	1200 ohms (for loaded cable)	150 switch toward 1200, 600 switch toward 1200	
		600 ohms (for nonloaded cable or carrier)	150 switch toward 1200, 600 switch toward 600	
		150 ohms (extra equalization for nonloaded cable)	150 switch toward 150, 600 switch toward 1200	
terminating impedance, transmit input port (terminal side)	*XMT IMPEDANCE (S3) IN* switches (lefthand *150* and *600* switches) on main board	1200 ohms (for loaded cable)	150 switch toward 1200, 600 switch toward 1200	
		600 ohms (for nonloaded cable or carrier)	150 switch toward 1200, 600 switch toward 600	
		150 ohms (extra equalization for nonloaded cable)	150 switch toward 150, 600 switch toward 1200	
terminating impedance, transmit output port (facility side)	*XMT IMPEDANCE (S3) OUT* switches (righthand *150* and *600* switches) on main board	1200 ohms (for loaded cable)	150 switch toward 1200, 600 switch toward 1200	
		600 ohms (for nonloaded cable or carrier)	150 switch toward 1200, 600 switch toward 600	
		150 ohms (extra equalization for nonloaded cable)	150 switch toward 150, 600 switch toward 1200	
normal or reversed terminal-side SX leads	*SIMPLEX NORM/REV* switch (*S7*) on main board	normal (XMT IN SX associated with xmt input pair, RCV OUT SX associated with rcv output pair)	NORM	
		reversed (XMT IN SX associated with rcv output pair, RCV OUT SX associated with xmt input pair)	REV	
A-side or B-side E&M signaling*	*S11* on baby board	A-side signaling*	A	
		B-side signaling*	B	
E&M signaling interface	*S10* on baby board	Type I interface	I/III	
		Type II interface	II	
		Type III interface (available with A-side signaling only)	I/III	

* Select A-side signaling when the associated terminal-side equipment provides M-lead outputs and receives E-lead inputs. Select B-side signaling when the associated terminal-side equipment provides E-lead outputs and receives M-lead inputs.

table 6. Summary and checklist of 6170 switch options

alignment function	switch	selection	setting	checklist
selection of receive-channel facility-side flat gain or loss	*GN* and *LS* positions of front-panel *rcv fac level* DIP switch	gain	GN to IN LS to OUT	
		loss	GN to OUT LS to IN	
amount of receive-channel facility-side gain or loss, as selected above*	dB-value positions of front-panel *rcv fac level* DIP switch*	0.1dB	.1 to IN	
		0.2dB	.2 to IN	
		0.4dB	.4 to IN	
		0.8dB	.8 to IN	
		1.5dB	1.5 to IN	
		3.0dB	3 to IN	
		6.0dB	6 to IN	
		12.0dB	12 to IN	
receive-channel terminal-side flat loss*	front-panel *rcv term loss* DIP switch*	0.1dB	.1 to IN	
		0.2dB	.2 to IN	
		0.4dB	.4 to IN	
		0.8dB	.8 to IN	
		1.5dB	1.5 to IN	
		3.0dB	3 to IN	
		6.0dB	6 to IN	
		12.0dB	12 to IN	
inclusion or bypass (exclusion) of receive-channel equalizer	*IN/OUT* position of front-panel *rcv equalizer SLOPE* DIP switch	equalizer included in circuit	IN	
		equalizer bypassed (excluded)	OUT	
post-equalization or pre-equalization operation for receive-channel equalizer	front-panel *rcv equalizer post/pre* switch	post-equalization	post	
		pre-equalization	pre	
introduction of receive-channel 309B-equivalent equalization	*SLOPE NL* position of front-panel *rcv equalizer SLOPE* DIP switch	nonloaded cable	toward NL	
		loaded cable	away from NL	
	SLOPE 1, 2, 4, 8 positions of front-panel *rcv equalizer SLOPE* DIP switch**	degree of slope	SLOPE 1 to 1	
			SLOPE 2 to 2	
			SLOPE 4 to 4	
			SLOPE 8 to 8	
	HT 1, 2, 4, 8 positions of front-panel *rcv equalizer HT/BW* DIP switch**	height of bump	HT 1 to 1	
			HT 2 to 2	
			HT 4 to 4	
			HT 8 to 8	
	BW 1, 2, 4, 8 positions of front-panel *rcv equalizer HT/BW* DIP switch**	affected bandwidth	BW 1 to 1	
			BW 2 to 2	
			BW 4 to 4	
			BW 8 to 8	
selection of transmit-channel facility-side flat gain or loss	*GN* and *LS* positions of front-panel *xmt fac level* DIP switch	gain	GN to IN LS to OUT	
		loss	GN to OUT LS to IN	
amount of transmit channel facility-side gain or loss, as selected above*	dB-value positions of front-panel *xmt fac level* DIP switch*	0.1dB	.1 to IN	
		0.2dB	.2 to IN	
		0.4dB	.4 to IN	
		0.8dB	.8 to IN	
		1.5dB	1.5 to IN	
		3.0dB	3 to IN	
		6.0dB	6 to IN	
		12.0dB	12 to IN	
transmit-channel terminal-side flat loss*	front-panel *xmt term loss* DIP switch*	0.1dB	.1 to IN	
		0.2dB	.2 to IN	
		0.4dB	.4 to IN	
		0.8dB	.8 to IN	
		1.5dB	1.5 to IN	
		3.0dB	3 to IN	
		6.0dB	6 to IN	
		12.0dB	12 to IN	

table 7 continued on next page

alignment function	switch	selection	setting	checklist
inclusion or bypass (exclusion) of transmit-channel equalizer	*IN/OUT* position of main-board *XMT EQUALIZER SLOPE* DIP switch (*S24*)	equalizer included in circuit	IN	
		equalizer bypassed (excluded)	OUT	
post-equalization or pre-equalization operation for transmit-channel equalizer	*POST/PRE EQ* switch (*S5*) on main board	post-equalization	POST	
		pre-equalization	PRE	
introduction of transmit-channel 309B-equivalent equalization	*SLOPE NL* position of main-board *XMT EQUALIZER SLOPE* DIP switch (*S24*)	nonloaded cable	toward NL	
		loaded cable	away from NL	
	SLOPE 1, 2, 4, 8 positions of main-board *XMT EQUALIZER SLOPE* DIP switch (*S24*)**	degree of slope	SLOPE 1 to 1	
			SLOPE 2 to 2	
			SLOPE 4 to 4	
			SLOPE 8 to 8	
	HT 1, 2, 4, 8 positions of main-board *XMT EQUALIZER HT/BW* DIP switch (*S25*)**	height of bump	HT 1 to 1	
			HT 2 to 2	
			HT 4 to 4	
			HT 8 to 8	
	BW 1, 2, 4, 8 positions of main-bard *XMT EQUALIZER HT/BW* DIP switch (*S25*)**	affected bandwidth	BW 1 to 1	
			BW 2 to 2	
			BW 4 to 4	
			BW 8 to 8	

* The eight dB-value positions of the front-panel *rcv fac level* and *xmt fac level* DIP switches are cumulative, as are all eight positions of the *rcv term loss* and *xmt term loss* DIP switches. Total facility-side gain or loss and total terminal-side loss introduced into a channel are the sums of that channel's *fac level* and *term loss* switch positions set to *IN*.

** The *1, 2, 4,* and *8* positions of the *SLOPE, HT,* and *BW* receive and transmit equalization DIP switches are cumulative. These switch positions may be set in any combination as required.

table 7. Summary and checklist of 6170 alignment switches

These flowcharts can be used to verify normal operation by observing the module's response and comparing it to that shown in the flowcharts. Reference to the 6170 block diagram (section 5 of this practice) may aid in understanding the flowcharts.

4.02 The flowcharts are intended to familiarize you with the operation of the 6170 for engineering, application, and troubleshooting purposes only. Attempts to test or troubleshoot this module internally are not recommended and may void its Tellabs warranty. Procedures for recommended testing and troubleshooting in the field should be limited to those prescribed in section 7 of this practice.

6. specifications

transmission

alignment level ranges, facility-side ports
receive input port: −17 to +7TLP
transmit output port: −16 to +8TLP

alignment level ranges, terminal-side ports
receive output port: +7 to −17TLP
transmit input port: +8 to −16TLP

overload points
receive input and receive output ports: 0dBm0
transmit input and transmit output ports: +3dBm0

facility-side gain or loss (xmt and rcv)
0 to 24dB of gain or 0 to 24dB of loss in switch-selectable 0.1dB increments, with gain or loss selected via switch option

terminal-side loss (xmt and rcv)
0 to 24dB of loss in switch-selectable 0.1dB increments

insertion loss, xmt and rcv channels (600-ohm termination at all ports)
0 ± 0.2dB at 1004Hz with all level-control switches set to zero

amplitude equalization, xmt and rcv channels
active prescription slope or bump-type equalization for nonloaded or loaded cable, functionally equivalent to that provided by the WECo 309B Prescription Equalizer. Each channel's equalizer can be conditioned for post- or pre-equalization operation or electrically bypassed (excluded) via switch option.

terminating impedances, all four ports
1200, 600, or 150 ohms, balanced, individually switch-selectable at each port

frequency response, xmt and rcv channels, with no equalization and with rcv-channel BEF removed
+0.0, −2.0dB at 200Hz, re 1004Hz
+0.3, −0.6dB, 300 to 3000Hz, re 1004Hz
+0.0, −1.3dB at 3400Hz, re 1004Hz

total harmonic distortion, all ports
less than 1% at overload points

internal noise, xmt and rcv channels
17dBrnC0 maximum at maximum gain

longitudinal balance, all four ports
greater than 60dB, 200 to 3000Hz

return loss, terminal and facility
greater than 23dB at all three impedance settings

specifications continued on page 15

INCOMING CALL (A-SIDE SIGNALING)

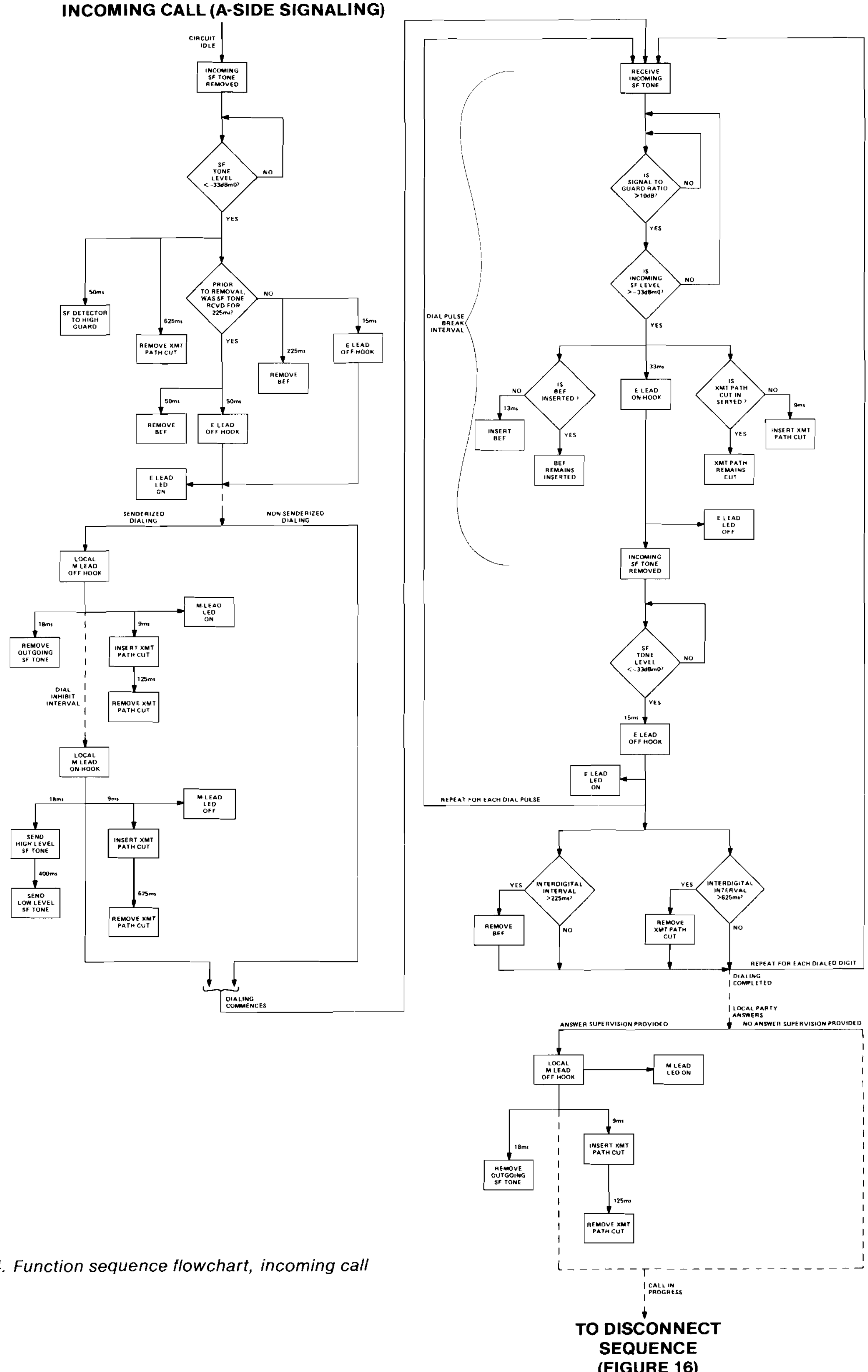


figure 14. Function sequence flowchart, incoming call

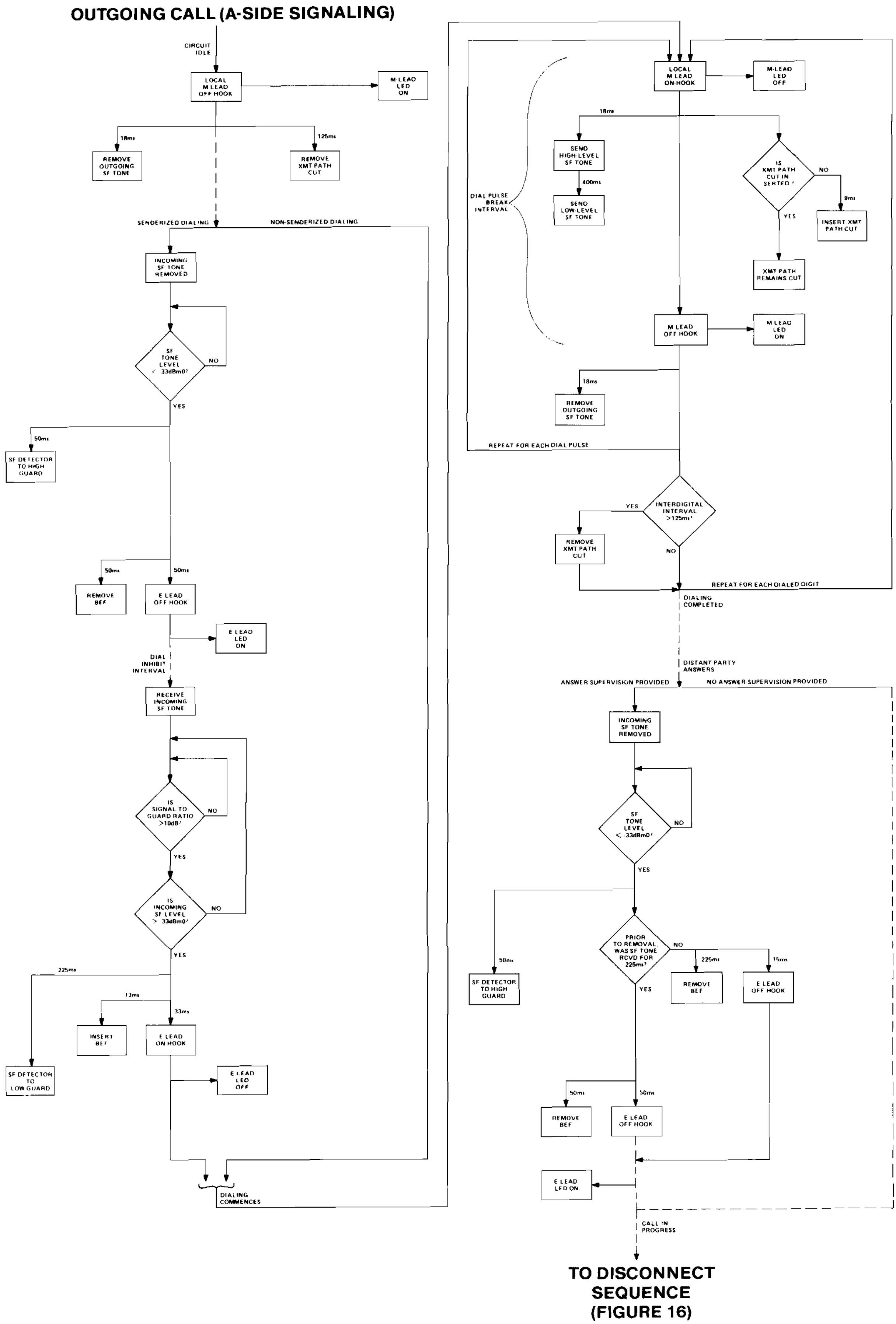


figure 15. Function sequence flowchart, outgoing call

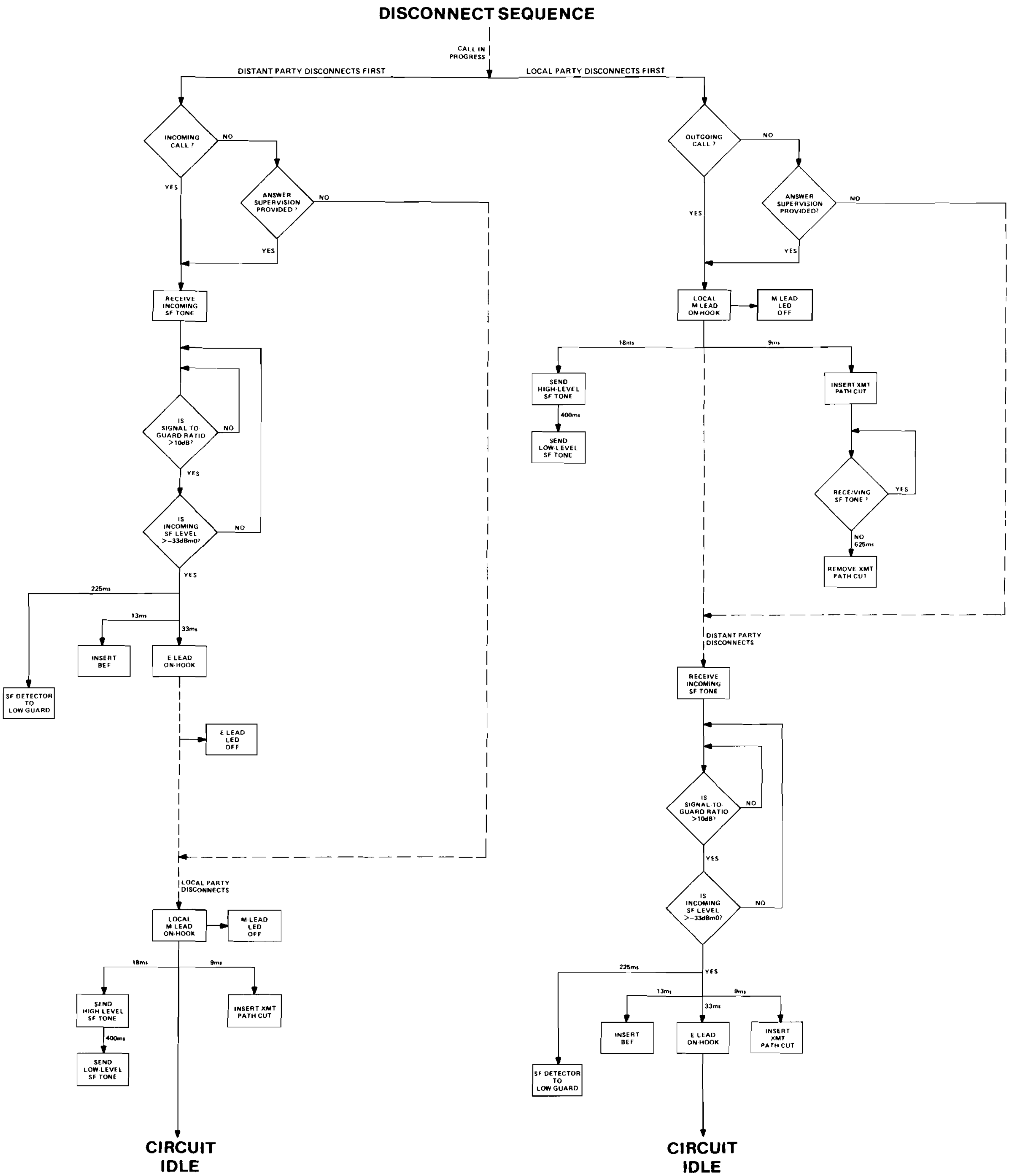


figure 16. Function sequence flowchart, disconnect sequence for incoming and outgoing calls

peak-to-average ratio (P/AR), receive-channel BEF removed
98 minimum, without equalization

crosstalk loss between xmt and rcv channels
75dB minimum, 200 to 3400Hz

crosstalk loss between adjacent modules in shelf
80dB minimum, 200 to 3400Hz

SF transmit section

internal SF tone oscillator frequency and stability
2600 ± 5Hz for life of unit

SF tone levels
low level: −20dBm0 ± 1dB
high level: −8dBm0 ± 1dB

outgoing SF tone states
see table 3 (local call origination) and table 4 (distant call origination) in section 2 of this practice

high-level timing
high-level tone is transmitted for 400 ± 100ms following each off-hook-to-on-hook transition of M lead (A-side signaling) or E lead (B-side signaling)

M-lead delay (A-side signaling) or E-lead delay (B-side signaling)
18±5ms delay between M-lead or E-lead state change and SF-tone state change

pulsing characteristics (M lead to SF for A-side, E lead to SF for B-side)
- **input breaks and makes shorter than M-lead or E-lead delay are not recognized**
- **input breaks of a duration between that of M-lead or E-lead delay and 50ms are transmitted as 50 ± 2ms tone bursts**
- **input makes of a duration between that of M-lead or E-lead delay and 25ms are repeated as 25 ± 2ms silent (no tone) intervals**
- **input breaks longer than 50ms are transmitted as tone bursts equal in duration to the input break duration ± 2ms**
- **input makes longer than 25ms are repeated as silent (no tone) intervals equal in duration to the input make duration ± 2ms**

transmit-path-cut insertion
transmit speech path is cut (opened) 18 ± 5ms before transmission of SF tone

transmit-path-cut removal
transmit speech path cut is removed 125 ± 50ms after detection of an off-hook condition if SF tone is being received

SF receive section

SF tone detection
frequency: 2600 ± 15Hz
range: 0 to −27dBm0

SF tone rejection threshold
−37dBm0

signal-to-guard ratio for signal detection
6 to 12dB

incoming SF tone states
see table 3 (local call origination) and table 4 (distant call origination) in section 2 of this practice

guard-circuit transition timing
high-to-low: 225 ± 60ms
low-to-high: 50 ± 10ms

maximum line noise
51dBrnC0

band-elimination-filter timing
- **insertion time: 13 ± 7ms**
- **insertion duration for SF tones shorter than 175 ± 60ms: 225 ± 50ms (with BEF insertion duration longer than tone duration in all cases)**
- **insertion duration for SF tones longer than 175 ± 60ms: duration of SF tone plus 50 ± 10ms**

minimum SF pulse duration accepted
33 ± 3ms

dial pulse characteristics, SF to E lead (A side) or SF to M lead (B side) for pulse rates of 8, 10, and 12pps
input break: 50% to 75%
output break: 58% ± 4%

signaling relay (A-side E-lead, B-side M-lead) contact rating
maximum current: 1 ampere
maximum voltage: 200Vdc
contact resistance: 50 milliohms maximum
contact protection: internal transient protection is provided

E&M signaling, A side

E-lead current rating
500mA maximum (resistor-capacitor contact protection provided)

E-lead resistance
less than 0.5 ohm

M-lead sensitivity
−20Vdc minimum threshold; 500 ohms maximum external M-lead resistance from −48Vdc, will not detect external M-lead resistance of 20 kilohms or greater

E&M signaling, B side

M-lead current rating
500mA maximum (resistor-capacitor contact protection provided)

M-lead current from battery (Type I interface only)
100mA with less than 5-volt drop; current limiting above 200mA

E-lead sensitivity
500 ohms maximum external E-lead resistance to ground, will not detect external E-lead resistance of 20 kilohms or greater

common specifications

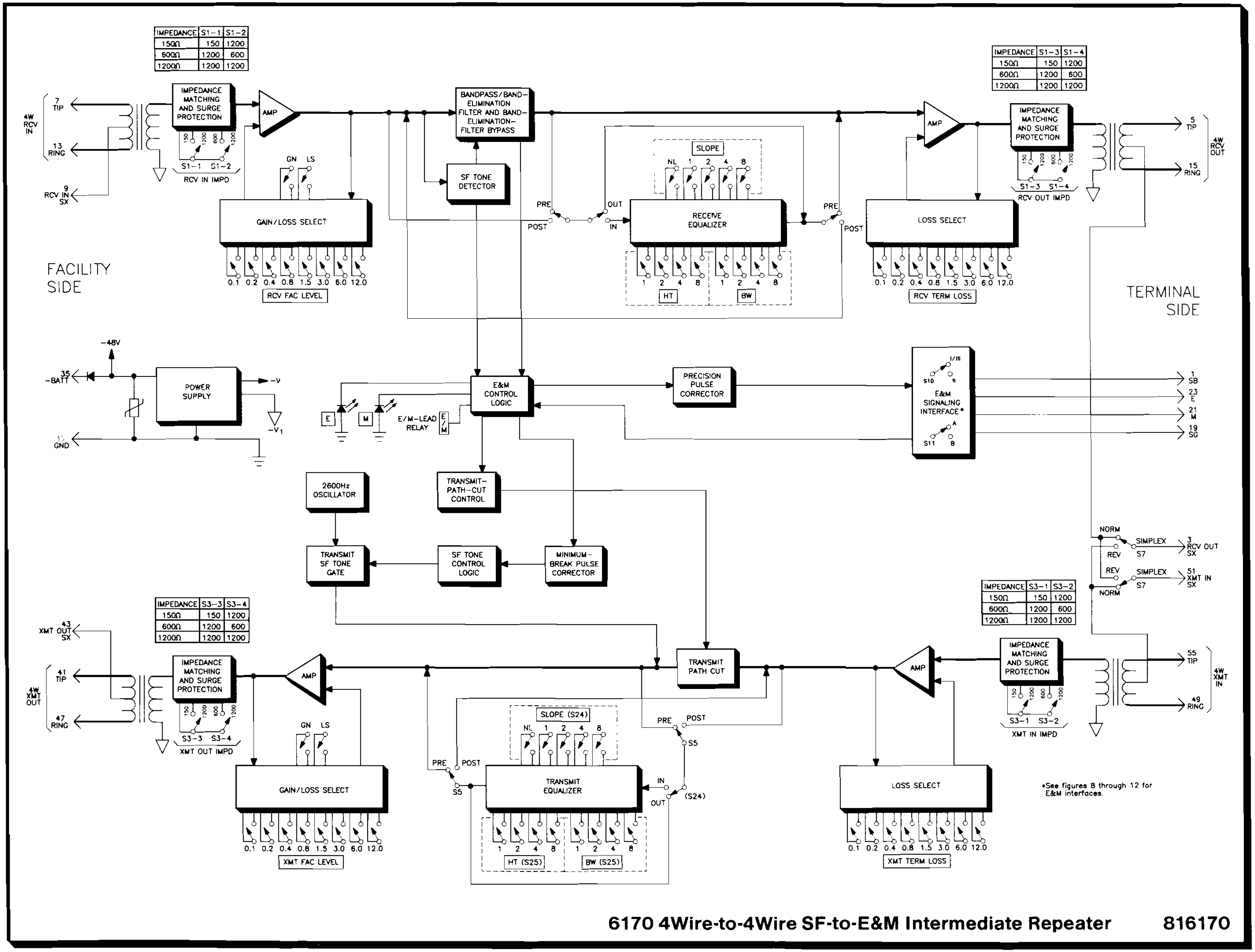
input power requirements
voltage: −42 to −54Vdc, filtered, ground-referenced
current: 80mA typical at idle (at −48Vdc), 100mA maximum (at −54Vdc)

operating environment
32° to 122°F (0° to 50°C), humidity to 95% (no condensation)

dimensions
5.58 inches (14.17cm) high
1.42 inches (3.61cm) wide
5.96 inches (15.14cm) deep

weight
11.5 ounces (326 grams)

mounting
relay rack or apparatus case via one position of a Tellabs Type 10 Mounting Shelf



5. block diagram

7. testing and troubleshooting

7.01 The *troubleshooting guide* in this section may be used in conjunction with the function sequence flowcharts (figures 14 through 16) in section 4 of this practice to assist in the installation, testing, or troubleshooting of the 6170 4Wire-to-4Wire SF-to-E&M Intermediate Repeater module. The guide is intended as an aid in the localization of trouble to a specific module. If a module is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted. Unauthorized testing or repairs may void the module's warranty. Also, if the module is part of a registered system, unauthorized repairs will result in noncompliance with Part 68 of the FCC Rules and Regulations.

Note: *Warranty service does not include removal of permanent customer markings on the front panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked* **defective,** *we recommend that it be done on a piece of tape or on a removable stick-on label.*

7.02 If a situation arises that is not covered in the *troubleshooting guide,* contact Tellabs Customer Service as follows (telephone numbers are given below):

USA customers: Contact Tellabs Customer Service at your Tellabs Regional Office.
Canadian customers: Contact Tellabs Customer Service at our Canadian headquarters in Mississauga, Ontario.
International customers: Contact your Tellabs distributor.

US atlantic region: (203) 798-0506
US capital region: (703) 478-0468
US central region: (312) 357-7400
US southeast region: (305) 834-8311
US southwest region: (214) 869-4114
US western region: (714) 850-1300
Canada: (416) 624-0052

7.03 If a 6170 is diagnosed as defective, follow the *replacement* procedure in paragraph 7.04 when a critical service outage exists (e.g., when a system or a critical circuit is down and no spares are available). If the situation is not critical, follow the *repair and return* procedure in paragraph 7.05.

replacement

7.04 To obtain a replacement 6170 module, notify Tellabs via letter or telephone (see addresses and numbers below), or via TWX (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6170 part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective module in the replacement's carton, sign the packing slip included with the replacement, and enclose it with the defective module (this is your return authorization). Affix the preaddressed label provided with the replacement module to the carton being returned, and ship the carton prepaid to Tellabs.

repair and return

7.05 Return the defective 6170 module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA:
Tellabs, Inc.
4951 Indiana Avenue
Lisle, Illinois 60532
telephone (312) 969-8800

in Canada:
Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 39
Mississauga, Ontario, Canada L4W 2S7
telephone (416) 624-0052

Enclose an explanation of the module's malfunction. Follow your company's standard procedure with regard to administrative paperwork. Tellabs will repair the module and ship it back to you. If the module is in warranty, no invoice will be issued.

troubleshooting guide on page 18

troubleshooting guide

trouble condition	possible causes (check before assuming module is defective)
module completely inoperative	1) No input power. 2) Improper wiring.
cannot derive proper receive-channel transmission levels	1) Front-panel *rcv fac level* and/or *rcv term loss* DIP switches improperly set. 2) Main-board receive impedance DIP switch (*S1*) improperly set. 3) Front-panel receive post-/pre-equalization switch and/or receive equalizer bypass switch improperly set. 4) Front-panel receive equalization DIP switches (*SLOPE, HT,* and *BW*) improperly set. 5) Circuit not seized. 6) Test-equipment impedance improperly set or test equipment not terminated.
cannot derive proper transmit-channel transmission levels	1) Front-panel *xmt fac level* and/or *xmt term loss* DIP switches improperly set. 2) Main-board transmit impedance DIP switch (*S3*) improperly set. 3) Main-board transmit post-/pre-equalization switch (*S5*) and/or transmit equalizer bypass switch (*IN/OUT* position of *S24*) improperly set. 4) Main-board transmit equalization DIP switches (*S24* [*SLOPE*] and *S25* [*HT* and *BW*]) improperly set. 5) Circuit not seized. 6) Test-equipment impedance improperly set or test equipment not terminated.
improper signaling	1) Incorrect transmission level settings (see preceding trouble condition and possible causes). 2) Switch *S10* or *S11* improperly set. 3) Internal receive and/or transmit TLP's improperly derived. 4) Improper wiring. 5) Excessive noise in circuit. 6) Excessive SF tone leak at receive input port. 7) Incorrect incoming SF tone level..