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rev B

practice section 836962/826962A

6962 and 6962A 4Wire E&M SF Signaling Sets with Gain

contents

1. general

1.01 The 6962 and 6962A 4Wire E&M SF Signaling Set modules with gain (figure 1) each provide signaling and transmission interface between a 4wire facility that uses single-frequency (SF) signaling and a 4wire trunk (typically, a PBX trunk) or a 4wire line that uses E&M signaling. Both modules provide prescription active level control in the transmit and receive paths as well as full-duplex conversion between the SF signaling on the facility and the E&M signaling on the trunk or line. Both modules can also provide prescription active slope-type amplitude equalization in one or both channels. On the 6962, receive-channel equalization is standard while transmit-channel equalization is optionally available via a plug-on subassembly. On the more economical 6962A, equalization is optionally available in both channels via plug-on subassemblies (one per channel). Conventional 2600Hz SF tone is standard on both modules; other frequencies are optionally available by special order. The 6962 and 6962A differ from ordinary 4wire E&M SF signaling sets (e.g., the Tellabs 6942) in that they contain integral amplifiers to accommodate a variety of facility interface levels.

1.02 This practice section is revised to cover both the 6962 and 6962A modules and to incorporate a variety of changes and improvements to the text, tables, and illustrations. In those parts of this practice that apply equally to the 6962 and 6962A, the two modules are, for convenience, referred to collectively as the *6962/A* module.

1.03 Features and options of the 6962/A include the following: full prescription alignment capability; balanced, switchable 1200, 600, or 150-ohm terminating impedances on the facility side; fixed, balanced 600-ohm terminating impedances on the terminal side; facility-side amplifiers and terminal-side attenuators for interface with a variety of levels; active, slope-type amplitude equalization in one or both channels of the 6962 and in none, one, or both channels of the 6962A as described above; switch-selectable Type I, II, or III E&M signaling interface; minimum-break transmit pulse correction; full precision receive pulse correction; switch-selectable normal or inverted M-lead signaling states; an integral SF tone oscillator (use of an external [master] oscillator is optional); and internal access points available at each modules' card-edge connector for switched-access testing or use with an associated echo-control device. The 6962 alone features alarm leads compatible with most carrier-group-alarm (CGA) formats and busy-indicating output leads that function when the module is forced to the idle or busy state via the CGA leads.

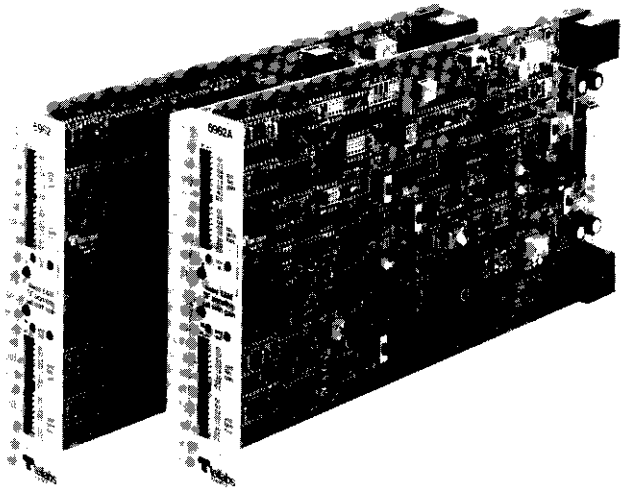


figure 1. 6962 and 6962A 4Wire E&M SF Signaling Set modules with Gain

1.04 Prescription-set transmit and receive amplifiers on the facility side of the 6962/A allow the module to interface the SF signaling facility directly, i.e., without a separate facility-side line amplifier. These integral amplifiers, in conjunction with prescription-set transmit and receive attenuators on the terminal side, provide for full coordination between facility-side and terminal-side levels. Both facility-side amplifiers on each module provide from 0 to 24dB of gain in switch-selectable 0.1dB increments, and both terminal-side attenuators provide from 0 to 24dB of loss in switch-selectable 0.1dB increments. In the receive channel only, an option switch allows an additional 7dB of terminal-side loss to be introduced if necessary. Thus, in the receive channel, input TLP's (transmission level points) from −17 to +7 can be accommodated and output TLP's from +7 to −24 can be derived. In the transmit channel, input TLP's from −16 to +8 can be accommodated and output TLP's from +8 to −16 can be derived. The overload point at all four ports of the 6962/A is +5dBm0.

1.05 An active slope equalizer for nonloaded cable in the receive channel of the 6962 module permits from 0 to 7.5dB of equalized gain to be introduced at 2804Hz (re 1004Hz) in switch-selectable 0.5dB increments. Because this equalizer

does not affect 1004Hz levels, equalization can be introduced not only before but also **after** receive-channel levels are set, with no interference between level and equalization adjustments. This same active slope-type equalization can be optionally provided in the transmit channel of the 6962 and in either or both channels of the 6962A by means of the optional Tellabs 9908A Active Slope Equalizer subassembly. The 9908A plugs into a four-pin receptacle on the host module's printed circuit board. The 6962 has one such receptacle to accommodate a 9908A for the transmit path; the 6962A has two such receptacles to accommodate one 9908A for each transmission path.

1.06 On the 6962, transformer coupling is provided at all four ports. On the 6962A, both facility-side ports are transformer coupled, and both terminal-side ports are capacitively coupled. The two facility-side ports on each module can be independently switch-optioned for 1200, 600, or 150-ohm terminating impedance, and the two terminal-side ports provide fixed 600-ohm terminating impedance. The 150-ohm facility-side impedance options provide approximately 2dB of slope equalization when the facility-side ports interface long sections of nonloaded cable. (For the 6962, this is in addition to any equalization provided by the integral receive-channel active slope equalizer and/or by a 9908A Active Slope Equalizer subassembly serving the transmit channel. For the 6962A, this is in addition to any equalization provided by one or two 9908A subassemblies serving either or both channels.) Both transformers on the facility side of the 6962 and 6962A and both transformers on the terminal side of the 6962 are center-tapped to derive balanced simplex leads. These leads can be used, for example, to apply sealing current from an external source to metallic facility-side pairs and, for the 6962, to metallic terminal-side pairs as well.

1.07 The transmit portion of the 6962/A converts dc input signals to outgoing SF tone signals. A minimum-break transmit pulse corrector ensures transmission of recognizable tone pulses. A transmission-path-cut circuit with a nominal 15ms pre-cut delay interval prevents transient interference with outgoing signaling tones. The 6962/A's M-lead signaling-state-inversion option allows two E&M SF signaling sets to be connected back-to-back without an intermediate signaling-lead conversion device.

1.08 The receive portion of the 6962/A converts incoming SF tone signals to dc output signals. A full precision receive pulse corrector ensures transmission of recognizable dc pulses. Recognition delays prevent response to spurious SF tone bursts and to momentary tone interruptions. A switch option on the 6962/A conditions the module to provide a constant off-hook indication on the E lead when SF tone modulated at 20Hz with 30% to 75% break is present at the receive input port.

1.09 The 6962/A can be switch-optioned for Type I (single-lead) E&M signaling interface, which is often used with electromechanical switching systems, or for Type II (looped-signaling-lead) E&M interface, which is often used with electronic switching systems. The 6962/A is compatible with a Type III (looped) interface when optioned for Type I.

1.10 Because the 6962/A contains an integral SF signaling tone oscillator, an external (master) SF tone source is not required. Provision is made, however, for operation with a master oscillator if desired. A switch option conditions the 6962/A for use either with its integral oscillator or with an external SF tone source.

1.11 In addition to precision facility-gain and terminal-loss DIP switches for both channels, the front panel of each module contains E-lead and M-lead busy-indicating LED's and four test points. The test points provide access to the module's facility-side ports (transmit output tip and ring, and receive input tip and ring) to facilitate testing and maintenance activities.

1.12 The 6962/A module operates from filtered, ground-referenced −22 to −56Vdc input. Maximum current requirements range from 55mA at idle to 95mA when busy.

1.13 The 6962/A module is a member of Tellabs' 6900 family of CO-configured signaling, terminating, and echo-control modules. It is electrically and mechanically interchangeable with all other 6900-family modules (except the component modules of Tellabs' 25X-series multichannel Digital Echo Canceller Systems) and with all modules of Tellabs' 4900 family of terminating and level-control modules. Common pin assignments in the 6900 and 4900 families (with the aforementioned exception) permit the use of a universal wiring scheme to increase system flexibility.

1.14 The 6962/A is a Type 16 module. As such, it mounts in one position of a Tellabs Type 16 Mounting Shelf or in one position of the lower shelf of a Tellabs 269-series Mounting Assembly. Type 16 Shelves are available in versions for 19 and 23-inch relay-rack installation. Both versions accommodate up to 12 modules and occupy 4 vertical mounting spaces (7 inches) in a standard relay rack. Furthermore, Type 16 Shelves can be provided (at the customer's option) either unwired, equipped with jumpers to bypass switched-access testing points, completely universally wired, or universally wired with a connectorized backplane.

2. application

2.01 The 6962/A 4Wire E&M SF Signaling Set module with Gain is designed 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 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. Thus, the 6962/A is a **complete** 4wire E&M SF signaling and terminating circuit, less power and ringing, on a single Type 16

module. As such, the 6962/A provides full-duplex signaling conversion and transmission interface between the 4wire SF facility and the 4wire E&M trunk or line. The 6962 and 6962A modules differ only in the following respects:

- The 6962's terminal-side ports are transformer coupled; those of the 6962A are capacitively coupled.
- The 6962 contains an integral active slope-type amplitude equalizer in its receive channel and accepts an optional plug-on active slope equalizer subassembly for its transmit channel; the 6962A has no integral receive equalizer but instead accepts optional plug-on active slope equalizer subassemblies for both channels.
- The 6962 provides three carrier-group-alarm (CGA) input leads and two associated busy-indicating output leads; the 6962A lacks these five leads.

terminal interface

2.02 As stated above, signaling and transmission between the 6962/A and the local (near-end) terminal equipment take place over a 4wire link. On the 6962, transformer coupling is provided at both terminal-side ports (transmit input and receive output), while on the 6962A, both terminal-side ports are capacitively coupled. On the 6962, both terminal-side transformers are center-tapped to derive balanced simplex leads. These leads can be used to provide sealing current to a metallic terminal-side link from an *external* source. Fixed, balanced 600-ohm terminating impedance at each terminal-side port on the 6962/A allows interface with a 4wire E&M trunk or line or with an E&M carrier channel. **For the capacitively coupled 6962A only**, metallic facilities directly interfacing the module's terminal side should not exceed approximately 500 feet in length. (Longer cable runs are susceptible to noise problems.) On both the 6962 and 6962A, transient protection is provided for each port on the terminal side.

facility interface

2.03 The 6962/A interfaces the 4wire facility-side (SF) transmission facility via transformers at the transmit output and receive input ports. Each of the two facility-side transformers provides balanced, independently 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 approximately 2dB of slope equalization for long sections of cable through the deliberate impedance mismatch. (In the 6962's receive channel, this is in addition to any equalization provided by the integral active slope equalizer. In the 6962's transmit channel and in the 6962A's transmit and receive channels, this is in addition to any equalization provided by the 9908A Active Slope Equalizer subassembly, when present). Both facility-side transformers on the 6962/A are center-tapped to derive balanced simplex leads. These simplex leads can be used to provide sealing current to a metallic facility from an *external* source.

level control

2.04 Prescription-set transmit and receive amplifiers on the facility side of the 6962/A allow each 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 2). In the receive channel, the facility-side amplifier is set to provide the gain necessary to derive a +7 transmission level point

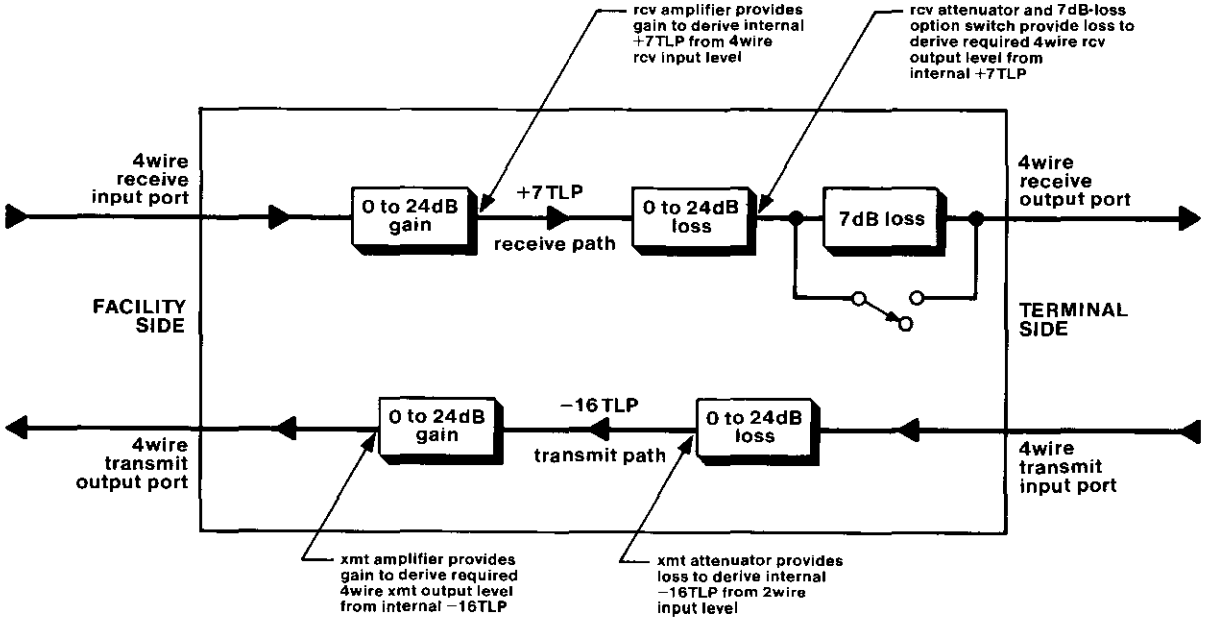


figure 2. Level coordination in 6962/A

(TLP) within the module. This internal TLP is then used as a reference as the module's terminal-side recieve 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 necessary to derive the required facility-side transmit output level. Both facility-side amplifiers in the 6962/A provide from 0 to 24dB of gain in 0.1dB increments. Both terminal-side attenuators provide from 0 to 24dB of loss in 0.1dB increments, with an additional 7dB of terminal-side loss available via switch option in the receive channel only. Thus, receive input TLP's from −17 to +7 can be accommodated and receive output TLP's from +7 to −17 or, optionally, from 0 to −24 can be derived. In a similar manner, transmit input TLP's of −16 to +8 can be accommodated and transmit output TLP's of +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 gain* and *term loss* switches set to the *IN* position. The overload point at all four ports of the 6962/A is +5dBm0.

amplitude equalization

Note: *Because introduction of equalization into the receive and transmit channels of the 6962/A does not affect 1004Hz levels, equalization can be introduced not only before but also* **after** *transmission levels are set.*

2.05 **6962 Module.** A prescription active slope-type amplitude equalizer in the 6962's receive channel provides post-equalization of the facility-side receive pair. From 0 to 7.5dB of gain at 2804Hz (re 1004Hz) can be introduced into the module's receive path in switch-selectable 0.5dB increments to compensate for the frequency response of nonloaded cable. Typical flatness achievable with the module's receive equalizer is ±0.3dB from 400 to 3200Hz re 1004Hz. The module's equalized gain response is not affected by flat gain and loss adjustments, which are used to provide precise transmission alignment

2.06 Equalization similar to that which is integral to the 6962's receive channel can be optionally provided in the module's transmit channel. This is done by equipping the 6962 with the Tellabs 9908A Active Slope Equalizer subassembly, which plugs into a five-pin female connector on the module's printed circuit board. The transmit-channel equalization thus provided is primarily intended for pre-equalization of facility-side transmit pairs consisting of nonloaded cable when post-equalization is unavailable at the distant end of the SF facility. Like the integral receive equalizer, the 9908A provides up to 7.5dB of gain at 2804Hz (re 1004Hz) in switch-selectable 0.5dB increments. Also, typical flatness achievable with the 9908A is similar to that achievable with the receive equalizer. Typical frequency response of the two equalizers, however, differs slightly at the same equalized gain setting. Figure 3 shows how both equalizers operate, including how the various frequency-response curves achievable via the two equalizers "pivot" at 1004Hz. Not shown in figure 3 are the slight frequency-response differences between the 6962's integral receive equalizer and the 9908A subassembly. Instead, these differences are indicated in tables 1 and 2, which provide specific frequency-response information for typical applications of the 6962's receive equalizer and the 9908A subassembly, respectively.

2.07 **6962A Module.** Although the 6962A has no integral equalizers, it can be optionally equipped with one or two 9908A Active Slope Equalizer subassemblies to provide equalization in either the receive channel, the transmit channel, or both channels. Two 5-pin female connectors on the

receive equalizer switch setting (dB)	equalized gain (in dB) introduced at various frequencies								
	300Hz	400Hz	500Hz	800Hz	1004Hz	1500Hz	1800Hz	2500Hz	2804Hz
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	−0.23	−0.19	−0.15	−0.06	0.0	+0.15	+0.24	+0.43	+0.50
1.0	−0.52	−0.42	−0.33	−0.13	0.0	+0.32	+0.52	+0.93	+1.07
1.5	−0.75	−0.60	−0.49	−0.18	0.0	+0.46	+0.74	+1.33	+1.54
2.0	−1.00	−0.80	−0.64	−0.24	0.0	+0.61	+0.98	+1.76	+2.04
2.5	−1.22	−0.98	−0.78	−0.29	0.0	+0.75	+1.20	+2.15	+2.49
3.0	−1.50	−1.20	−0.95	−0.36	0.0	+0.90	+1.45	+2.60	+3.01
3.5	−1.71	−1.37	−1.09	−0.41	0.0	+1.03	+1.65	+2.97	+3.45
4.0	−2.02	−1.63	−1.29	−0.49	0.0	+1.22	+1.95	+3.54	+4.12
4.5	−2.25	−1.79	−1.42	−0.53	0.0	+1.33	+2.14	+3.90	+4.56
5.0	−2.49	−1.98	−1.57	−0.59	0.0	+1.47	+2.36	+4.32	+5.08
5.5	−2.68	−2.14	−1.69	−0.63	0.0	+1.58	+2.53	+4.67	+5.51
6.0	−2.89	−2.30	−1.81	−0.68	0.0	+1.69	+2.72	+5.05	+5.99
6.5	−3.07	−2.44	−1.93	−0.72	0.0	+1.79	+2.87	+5.38	+6.41
7.0	−3.29	−2.61	−2.05	−0.76	0.0	+1.89	+3.05	+5.76	+6.90
7.5	−3.45	−2.74	−2.15	−0.78	0.0	+1.98	+3.19	+6.06	+7.30

table 1. Typical equalization provided by 6962's integral receive equalizer

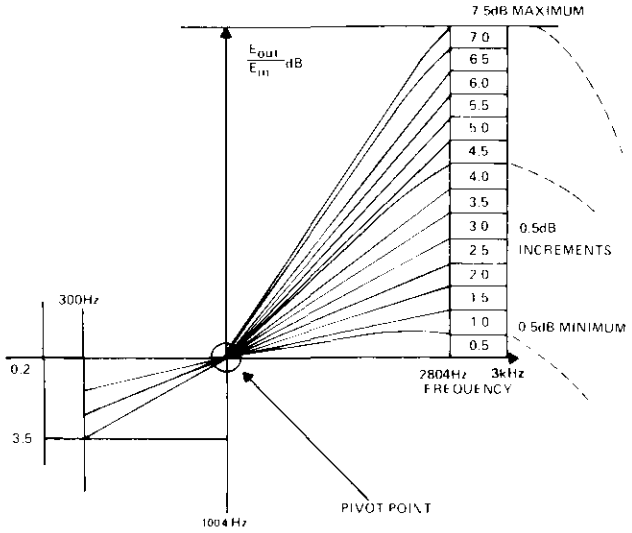


figure 3. Basic operation of 6962's integral receive equalizer and 9908A Active Slope Equalizer subassembly

6962A's printed circuit board, one for each channel, accept the optional 9908A subassemblies. Again, the active prescription slope equalization provided by the 9908A is similar to that provided by the 6962's integral receive equalizer (see paragraph 2.06).

E&M signaling interfaces

2.08 The 6962/A accommodates either a Type I (single-lead) or a Type II or III (looped-signaling-lead) E&M interface. The conventional Type I interface is often used in electromechanical-switching-system (e.g., SxS) environments, while the newer Type II and III interfaces are often used in electronic-switching-system environments. Figure 4 shows the connections required for Type I, II, and III E&M interfaces.

E&M signaling modes

2.09 In conventional E&M-signaling applications (M lead switch-optioned for **normal** signaling states), the 6962/A 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. A switch option on the 6962/A conditions the module to provide a constant E-lead open when SF tone modulated at 20Hz with 30% to 75% break is present at the receive input port. This option prevents the sporadic E-lead pulsing that could otherwise occur when SF tone modulated at 20Hz with 50% break is received. In the transmit channel, SF tone is transmitted when the M lead is either open or at ground potential, and tone transmission ceases when the M lead is at negative battery potential.

2.10 The E-lead output from the 6962/A is derived via a mercury-wetted relay with a normally open (E) and a normally closed (N) contact. These contacts can be externally wired to accommodate any desired E-lead interface (Type I, II, or III). Regardless of the contact wiring, however, the relay is energized when the module detects no SF tone at the receive input port and is de-energized when SF tone is detected. The full precision **receive** pulse corrector is arranged to control the pulsing relay such that, during pulsing, the relay is de-energized for 58±2 percent of the pulsing cycle. The minimum-break **transmit** pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms.

2.11 When the 6962/A is switch-optioned for **inverted** M-lead signaling states, it transmits SF tone whenever the M lead is at negative battery potential or open and ceases SF tone transmission when the M lead is at ground potential. With inverted (as with normal) M-lead signaling states, the minimum-break transmit pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms. The 6962/A's M-lead signaling-state inversion capability allows two E&M signaling sets to be connected back-to-back without an intermediate signaling-lead conversion unit.

9908A switch setting (in dB)	frequency										
	300Hz	400Hz	500Hz	800Hz	1000Hz	1500Hz	1800Hz	2500Hz	2804Hz	3000Hz	3200Hz
0	−0.2	−0.1	−0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	−0.5	−0.4	−0.3	−0.1	0.0	+0.2	+0.3	+0.4	+0.5	+0.5	+0.5
1.0	−0.8	−0.7	−0.6	−0.2	0.0	+0.4	+0.6	+0.9	+1.0	+1.0	+1.0
1.5	−1.1	−0.9	−0.8	−0.2	0.0	+0.6	+0.9	+1.3	+1.4	+1.5	+1.5
2.0	−0.8	−0.6	−0.5	−0.2	0.0	+0.4	+0.7	+1.5	+1.9	+2.2	+2.5
2.5	−1.1	−0.9	−0.7	−0.2	0.0	+0.6	+1.0	+2.0	+2.4	+2.7	+3.0
3.0	−1.5	−1.2	−1.0	−0.3	0.0	+0.8	+1.3	+2.4	+2.9	+3.2	+3.5
3.5	−1.8	−1.5	−1.2	−0.4	0.0	+1.0	+1.6	+2.8	+3.4	+3.7	+4.7
4.0	−1.8	−1.5	−1.1	−0.4	0.0	+1.1	+1.8	+3.4	+4.1	+4.5	+4.9
4.5	−2.2	−1.7	−1.4	−0.5	0.0	+1.3	+2.1	+3.9	+4.6	+5.1	+5.4
5.0	−2.5	−2.0	−1.6	−0.6	0.0	+1.5	+2.4	+4.3	+5.1	+5.5	+5.9
5.5	−2.8	−2.3	−1.8	−0.6	0.0	+1.7	+2.7	+4.7	+5.5	+6.0	+6.5
6.0	−2.5	−2.0	−1.6	−0.6	0.0	+1.5	+2.5	+5.0	+6.0	+6.7	+7.4
6.5	−2.8	−2.2	−1.8	−0.6	0.0	+1.7	+2.8	+5.4	+6.5	+7.2	+7.9
7.0	−3.2	−2.5	−2.0	−0.7	0.0	+1.9	+3.1	+5.8	+7.0	+7.7	+8.4
7.5	−3.5	−2.8	−2.3	−0.8	0.0	+2.1	+3.4	+6.3	+7.5	+8.2	+8.9

table 2. Typical equalization provided by 9908A Active Slope Equalizer subassembly

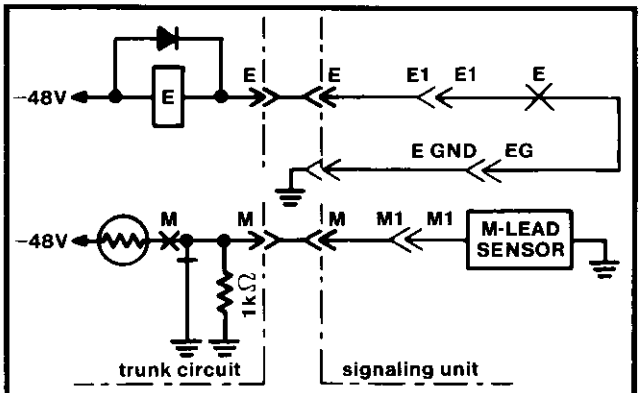


figure 4a. Type I E&M signaling interface

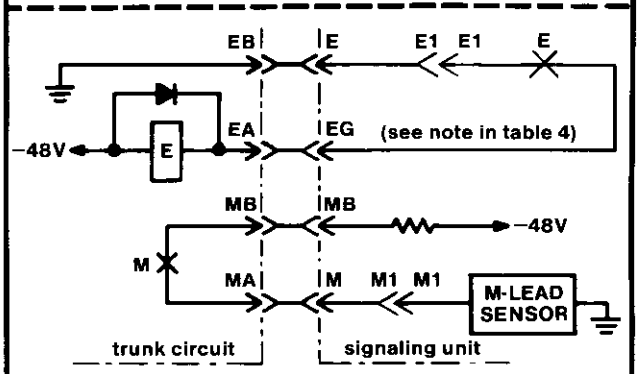


figure 4b. Type II E&M signaling interface

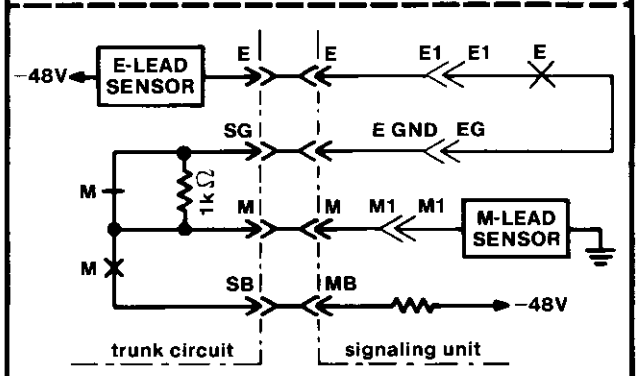


figure 4c. Type III E&M signaling interface

figure 4. E&M signaling interfaces

incoming SF tone detection

2.12 The 6962/A is designed to interface the receive path on the facility side at any TLP from −17 to +7. Idle-state SF tone is received at a level of −20dBm0. A higher level of −8dBm0 is received during break portions of dial pulses and for about 400 milliseconds at the beginning of each tone interval. The SF tone detector in each module reliably detects tone levels as low as −31dBm0 provided that the SF tone energy is at least 10dB above the level of all other signals simultaneously present at the receive input. 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.

2.13 Within approximately 13 milliseconds 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.

2.14 The 6962/A's SF tone detector is designed to ignore momentary losses of SF tone up to 50 milliseconds in duration during periods of otherwise continuous receipt of tone, and to ignore momentary tone bursts shorter than about 33 milliseconds. The module's full precision receive pulse corrector adds a nominal 58-millisecond pulse-recognition delay to the 33-millisecond E-lead-break recognition delay, resulting in a nominal pulsing break delay of about 90 milliseconds. Seizure recognition delay, however, is somewhat shorter at about 70 milliseconds. The 6962/A recognizes signaling-state changes in the receive path regardless of the local M-lead state.

outgoing SF tone transmission

2.15 The 6962/A is designed to interface the transmit path on the facility side at any TLP from +8 to −16 and to transmit SF tone at either of two levels. 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

2.16 A symmetrical delay of approximately 20ms is provided between the M-lead input 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 2.21.

2.17 A minimum-break pulse corrector in the transmit path ensures a 50-millisecond minimum-break 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 state changes longer than 50 milliseconds.

transmit path cut

2.18 The transmit voice path through the 6962/A is cut (opened) during idle circuit conditions and is restored when the M lead 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

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

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
local 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

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

off-hook state. These path cuts prevent transmission of noise, transients, speech, and other interfering signals during critical signaling intervals.

2.19 The transmit path cut is inserted within 5ms of an M-lead state change. Tone transmissions in response to M-lead 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

2.21 The 6962/A contains an integral 2600Hz SF tone oscillator and therefore does not require an external SF tone supply. This makes the 6962/A especially convenient for use in low-density applications. If operation from a master SF tone oscillator is desired, provision can be made via switch option for connection of the external SF tone source, rather than the internally generated signal, to the tone control circuitry. The external signal should be 0.5±0.1Vrms, 2600±2Hz, unbalanced. Input to the 6962/A is capacitively coupled and presents a load impedance of greater than 100 kilohms to the tone source.

power

2.22 The 6962/A is designed to operate on filtered, ground-referenced input potentials between −22 and −56Vdc. The positive side of the dc power supply should be connected to earth ground. Maximum current required is 95mA.

carrier group alarm (6962 only)

2.23 Carrier group alarm (CGA) input leads on the 6962 allow the module to be forcibly removed from service when an associated carrier system malfunctions so that seizure of a disabled circuit is prevented. These leads, designated *ALM* (alarm master), *ALO* (alarm override), and *ALB* (alarm battery), are compatible with most CGA formats and can be independently enabled or disabled via switch option. With these leads enabled, either of two externally derived CGA functions can be communicated to the 6962. The first is forced release of any call in progress. This is effected by application of an external ground (from the CGA unit) to either the ALM or ALO lead, which forces the module's E lead to the idle state. The second is forced busy, which is often used following forced release. The forced-busy function is effected by application of external negative battery (from the CGA unit) to the ALB lead, which forces the module's E lead to the busy state. Application of negative battery to the ALB lead always busies the 6962 (when the ALB lead is enabled), regardless of the state of the ALM or ALO input.

2.24 To provide for forced release, only the ALM or ALO lead (not both) need be enabled. Enabling the ALO lead provides the capability of restoring to service a 6962 that was previously forced to the idle or busy state during a failure of the associated carrier system. The ALO lead is normally wired to a local override control (usually located on the CGA unit) that overrides the 6962's forced-idle or forced-busy state. The 6962 is then patched to an alternate carrier system for the duration of the failure. If this capability is not desired, the ALM lead should be enabled instead. Both leads plus the ALB lead may be wired and enabled in prewired installations.

2.25 When the forced-idle or forced-busy function is enabled, the 6962 can be optioned to provide an external busy indication (e.g., an all-trunks-busy indication) to a local trunk scanner or register during alarm intervals. This indication can be a contact closure or a ground output, as selected via switch option. Furthermore, this indication can be provided upon receipt of either the first (ALM or ALO-lead) or second (ALB-lead) carrier-failure alarm indication, as selected via switch option.

echo-control devices and switched-access testing

2.26 Certain internal points in the 6962 are brought out to access points at the module's 56-pin card-edge connector. These access points are normally jumpered at the connector to provide circuit continuity. However, the use of an associated echo-control device or an application involving switched-access testing requires external connections to these access points. An echo suppressor or canceller, for example, is inserted into the circuit via connector access between the 6962's SF signaling section and its transmit and receive attenuators. For in-service switched-access testing of the 6962, connector access is provided to the input and output ports of the module's signaling section and to the E and M leads. See paragraphs 3.03 and 3.04 for additional information.

3. installation

inspection

3.01 The 6962/A 4Wire E&M SF Signaling Set module with Gain should be visually inspected upon arrival to find possible 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

> **Caution:** *The 6962/A uses a mercury-wetted relay for E-lead output. Before installation, the module should be held in an upright position and tapped gently on a hard surface to ensure that the mercury is properly positioned within the relay. After it is tapped, the module should be kept upright until installation and installed in a vertical, upright position.*

3.01 The 6962/A mounts in one position of a Tellabs Type 16 Mounting Shelf, which is available either unwired or in several prewired versions for 19-inch or 23-inch relay-rack installation. The 6962/A can also be mounted in one position of a Tellabs 267S Mounting Assembly, which is fully prewired. The module plugs into a 56-pin connector at the rear of its shelf or assembly position.

installer connections

3.03 In applications where the 6962/A module is to be installed in a prewired Type 16 Shelf or in a 267S Assembly, no external connections to the module need be made. Instead, appropriate external connecitons must be made to terminal blocks or cable connectors on the shelf or assembly as directed in the respective Tellabs practice or wiring diagram. If, however, the 6962/A is to be installed in an unwired Type 16 Shelf, external connections to the module are required. Before making any connections to the shelf or assembly, ensure that power is **off** and modules are **removed**. Modules should be inserted into their positions only **after** they are properly optioned and **after** wiring is completed.

3.04 All external connections to the 6962/A are made by wire-wrapping to the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector. In all applications except those involving switched-access testing or use of an associated echo-control device, 13 jumper wires must be installed at the connector to provide continuity

across internal access points that are brought out to the connector. (Access to internal sections of the 6962/A is provided at the connector to permit operation with echo-control devices or switched-access testing systems that must interface the module between its various subcircuits.) Factory-wired shelves with jumpers already installed may be used, or the jumpers may be installed in the field per table 5. If field-installed, jumpers should be wired **before** external connections are made. If the 6962/A module is to be used in an application involving switched-access testing, consult Tellabs' Customer Service Group at (312) 969-8800 for drawings and details. If the module is to be used in conjunction with a Tellabs 6920 Echo Suppressor or 6921-family Echo Canceller, see table 6 for wiring information.

Note: *In applications where the 6962/A is located on the terminal-equipment side of an echo suppressor or echo canceller (this, incidentally, is the usual arrangement so that the echo-control device does not have to contend with SF signaling tone), the 6962A's terminal-side interface levels must be set to provide either* **+7 and −16** *TLP's or* **0 and 0** *TLP's at the transmit input and receive output ports, respectively. Also, the interface levels on the facility side of the echo suppressor or canceller must be set accordingly for compatibility with the 6962/A.*

connect 6962/A pin:		
RCV ATT OUT	56 to 54 52 to 50	LOCAL RCV OUT
(used for universal wiring only)	48 to 46 44 to 42	(used for universal wiring only)
(used for universal wiring only)	40 to 38 36 to 34	(used for universal wiring only)
EG	28 to 26	E GND
E1 (internal E lead)	24 to 22	E1 (internal E lead)
M1 (internal M lead)	20 to 18	M1 (internal M lead)
(used for universal wiring only)	16 to 14 12 to 10	(used for universal wiring only)
LOCAL XMT IN	8 to 6 4 to 2	XMT ATT IN
Note: *If receive signaling other than conventional E-lead ground during busy is to be used, remove the jumper wire between connector pins 26 and 28. This jumper removal is required, for instance, in Type II interface applications.*		

table 5. Jumper wiring for applications without switched-access testing or echo-control devices

connect 6962/A pin:		to 6920 or 6921X pin:
RCV ATT OUT	56 to 55 52 to 53	RCV IN
LOCAL RCV OUT	54 to 51 50 to 49	RCV OUT
LOCAL XMT IN	8 to 7 4 to 5	XMT IN
XMT ATT IN	6 to 3 2 to 1	XMT OUT
Jumper wiring is the same as that listed in table 3 except for those pins listed above that interconnect with the 6920 or 6921X.		

table 6. Interconnections and jumper wiring for applications where 6962/A is used with 6920 Echo Suppressor or 6921-family Echo Canceller

3.05 External connections for the 6962/A are listed in table 7. Those connections **not** marked by an asterisk are mandatory for normal operation of the module. Those marked by **one** asterisk (*) are optional on both the 6962 and 6962A. Those marked by **two** asterisks (**) are optional on the 6962 only. Those marked by **three** asterisks (***) are not applicable to the 6962/A but are required as part of the universal wiring scheme for all 6900 and 4900-family signaling, terminating, level-control, and analog-voice-circuit echo-control modules. A Type 16 (or equivalent) shelf wired in accordance with all connections listed in table 7 will accept any 6900 or 4900-family module of the types mentioned above on an interchangeable basis, provided either that jumpers are installed per table 5 or that the shelf is wired for switched-access testing or for use with an echo-control device per table 6. If an installation is dedicated for use with only the 6962/A module and no flexiblility or interchangeability requirements are expected, wiring time may be saved by making only the mandatory connections (i.e., those without asterisks) listed in table 7. Be aware that, while lead nomenclature may vary from one module to the next among the aforementioned types of 6900 and 4900-family modules, basic function (and wiring) remains universal.

connect:	to pin:
4WIRE RCV IN TIP	55
4WIRE RCV IN RING	53
4WIRE XMT OUT TIP	3
4WIRE XMT OUT RING	1
4WIRE RCV OUT TIP	51
4WIRE RCV OUT RING	49
4WIRE XMT IN TIP	7
4WIRE XMT IN RING	5
E lead	21
M lead	19
−BATT (−22 to −56Vdc filtered input)	15
GND (ground)	25
*4WIRE RCV IN SX (rcv simplex, facility side)	41
*4WIRE XMT OUT SX (xmt simplex, facility side)	9
*MB (MB lead for looped M-lead operation)	32
*N lead	30
*EXT. OSC. (external SF oscillator)	11
**4WIRE RCV OUT SX (rcv simplex, terminal side)	33
**4WIRE XMT IN SX (xmt simplex, terminal side)	35
**ALM (CGA alarm master)	47
**ALO (CGA alarm override)	45
**ALB (CGA alarm battery)	43
**BY1 (make-busy ground output/contact closure)	39
**BY2 (make-busy contact closure)	37
***D lead	31
***F lead	29
***G lead	27
***ring generator	23

* Optional.
** Optional, 6962 only.
*** Not applicable to 6962/A but, like optional 6962/A leads, required as part of universal wiring scheme for all 6900/4900 modules.

table 7. External connections to 6962/A

option selection

3.06 All options on the 6962 and 6962A modules are selected via slide or DIP switches whose locations on the modules' printed circuit boards are shown in figures 5 and 6. The location of the

single four-position equalization DIP switch on the optional 9908A Active Slope Equalizer subassembly is shown, for reference, in figure 7. Table 8 summarizes these options and their switch settings, which are explained in detail below. Each module should be completely optioned and its optioning verified before alignment is attempted.

Note 1: *Included in table 8 is a checklist for* **prescription** *optioning of the 6962/A. Prior to installation, check marks can be placed in the appropriate boxes to indicate the required options. During installation, the module can then be quickly and easily optioned as indicated in the table without referring to the detailed optioning instructions in the text. A similar table and checklist are provided later in this section for the alignment switches on the 6962/A module.*

Note 2: *Although a four-position DIP switch that controls the amount of equalization introduced by the 6962's integral receive equalizer is located on the module's printed circuit board instead of on its front panel, introduction of equalization is more closely related to alignment than to switch-optioning. Thus, instructions for setting the 6962's receive equalization DIP switch are provided under* **alignment** *later in this section.*

Note 3: *One of the option switches on the 6962/A conditions the module to provide a constant off-hook indication (E-lead open) when 20Hz modulated SF tone is present at the receive input port. Please be aware that this switch, although common to both modules, is configured as a one-position DIP switch on the 6962A and as the first position of a six-position DIP switch on the 6962.*

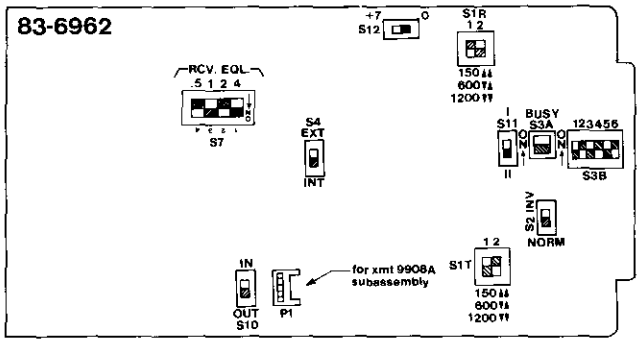


figure 5. 6962 option switch locations

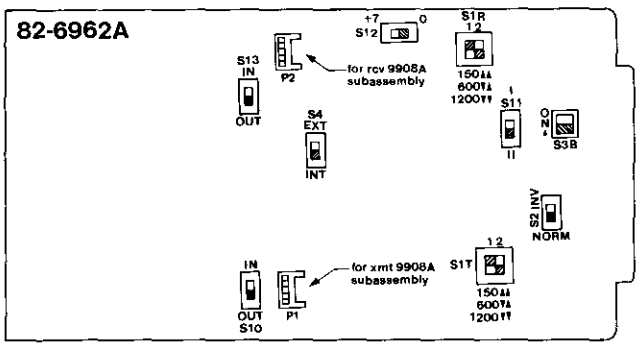


figure 6. 6962A option switch locations

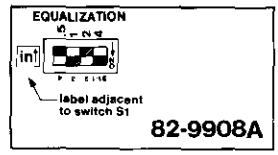


figure 7. 9908A equalization switch location

receive-input-port impedance

3.07 Terminating impedance at the 6962/A's receive input port is selected via two-position DIP switch *S1R*. To select 1200 ohms (for loaded cable), set *S1R-1* and *S1R-2* to *OFF*. To select 600 ohms (for nonloaded cable or carrier), set *S1R-1* to *OFF* and *S1R-2* to *ON*. To select 150 ohms (which provides approximately 2dB of extra slope equalization for nonloaded cable), set *S1R-1* and *S1R-2* to *ON*.

transmit-output-port impedance

3.08 Terminating impedance at the 6962/A's transmit output port is selected via two-position DIP switch *S1T*. To select 1200 ohms (for loaded cable), set *S1T-1* and *S1T-2* to *OFF*. To select 600 ohms (for nonloaded cable or carrier), set *S1T-1* to *OFF* and *S1T-2* to *ON*. To select 150 ohms (which provides approximately 2dB of extra slope equalization for nonloaded cable), set *S1T-1* and *S1T-2* to *ON*.

E&M signaling interface

3.09 Switch *S11* conditions the 6962/A for Type I, Type II, or Type III E&M signaling interface. Generally, the single-lead Type I interface is used when the module interfaces an electromechanical switching system or a station loop and tel set, while the looped-lead Type II or Type III interface is used when the module interfaces an electronic switching system. Determine the type of E&M signaling interface required, and set *S11* to the *I* position (for Type I or Type III) or to the *II* position (for Type II) as appropriate.

Note: *For Type I E&M interface, a common equipment ground must be used.*

normal or inverted M-lead operation

3.10 Normal or inverted M-lead operation is selected via switch *S2*. (The M-lead inversion option allows two E&M SF signaling sets to be connected back-to-back without an intermediate signaling-lead conversion unit.) For normal M-lead operation (outgoing SF tone on when M lead is open or grounded, off when M lead is at negative battery), set *S2* to *NORM*. For inverted M-lead operation (outgoing SF tone on when M lead is open or at negative battery, off when M lead is grounded), set *S2* to *INV*.

internal or external SF oscillator

3.11 Switch *S4* conditions the 6962/A for use with its own internal (integral) SF tone oscillator or for use with an external (master) oscillator. If the 6962/A's internal oscillator is to be used, set *S4* to the *INT* position. If an external oscillator is to be used, set *S4* to the *EXT* position.

switch option or alignment function	switch	selection	settings	check-list
terminating impedance, receive input port	S1R	1200 ohms (loaded cable)	S1R-1 OFF S1R-2 OFF	
		600 ohms (nonloaded cable or carrier)	S1R-1 OFF S1R-2 ON	
		150 ohms (extra equalization for nonloaded cable)	S1R-1 ON S1R-2 ON	
terminating impedance, transmit output port	S1T	1200 ohms (loaded cable)	S1T-1 OFF S1T-2 OFF	
		600 ohms (nonloaded cable or carrier)	S1T-1 OFF S1T-2 ON	
		150 ohms (extra equalization for nonloaded cable)	S1T-1 ON S1T-2 ON	
E&M signaling interface	S11	Type I or Type II interface	I	
		Type II interface	II	
normal or inverted M-lead operation*	S2	normal M-lead operation*	NORM	
		inverted M-lead operation*	INV	
use of internal (integral) or external (master) SF tone oscillator	S4	internal osc.	INT	
		external osc.	EXT	
conditioning of transmit channel for operation with or without 9908A equalizer subassembly	S10	9908A subassembly to be used in xmt channel	IN	
		9908A subassembly not used in xmt channel	OUT	
exclusion or inclusion of 7dB of extra terminal-side loss in receive channel (for normal or optional 7dB-lower range of TLP's that can be derived at receive output port)	S12	no extra loss provided (allows derivation of +7 to −17TLP at rcv out port)	+7	
		7dB extra loss provided (allows derivation of 0 to −24TLP at rcv out port)	0	
conditioning of module for proper on-hook indication (E-lead open) during receipt of constant or 20Hz-modulated SF tone	S3B-1**	E lead remains open only during presence of incoming SF tone. (use this setting when incoming tone is not modulated)	OFF	
		constant E-lead open provided during receipt of 20Hz-modulated SF tone (this setting recommended to prevent sporadic E-lead pulsing that could otherwise occur during receipt of modulated SF tone)	ON	
carrier-group-alarm (CGA) forced release via ALM lead, pin 47 (6962 only)	S3B-3	ALM lead (forced release) enabled	S3B-3 ON and ALM lead connected to pin 47	
		ALM lead (forced release) disabled	S3B-3 OFF and/or no connection made to pin 47	
carrier-group-alarm (CGA) forced release via ALO lead, pin 45 (6962 only)	S2B-4	ALO lead (forced release) enabled	S3B-4 ON and ALO lead connected to pin 45	
		ALO lead (forced release) disabled	S3B-4 OFF and/or no connection made to pin 45	
carrier-group-alarm (CGA) forced busy via ALB lead, pin 43 (6962 only)	S3B-2	ALB lead (forced busy) enabled	S3B-2 ON and ALB lead connected to pin 43	
		ALB lead (forced busy) disabled	S3B-2 OFF and/or no connection made to pin 43	
mode of external busy indication via BY1 and BY2 leads (pins 39 and 37, respectively) during CGA forced release or forced busy (6962 only)	S3B-5 (BY1) and S3B-6 (BY2)	contact closure between BY1 and BY2 leads	S3B-5 OFF S3B-6 ON	
		ground output on BY1 lead	S3B-5 ON S3B-6 OFF	
		no external busy indication	S3B-5 OFF S3B-6 OFF	

table 8 continued on next page

switch option or alignment function	switch	selection	settings	check-list
selection of time at which external busy indication (if enabled) is provided during CGA forced release or forced busy (6962 only)	S3A (BUSY) **Note:** Switch *S3A* is nonfunctional when both *S3B-5* and *S3B-7* are set to *OFF*.	busy indication upon receipt of first (ALM or ALO-lead) carrier-failure alarm input	ON	
		busy indication upon receipt of second (ALB-lead) carrier-failure alarm input	OFF	
conditioning of 6962A's receive channel for operation with or without 9908A equalizer subassembly (6962A only)	S13	9908A subassembly to be used in 6962A's rcv channel	IN	
		9908A subassembly not used in 6962A's rcv channel	OUT	

* With **normal** N-lead operation, outgoing SF tone is on when the 6962/A's M lead is open or grounded and is off when the M lead is at negative battery. With **inverted** M-lead operation, outgoing SF tone is on when the 6962/A's M lead is open or at negative battery and is off when the M lead is grounded.

** On the 6962, switch *S3B-1* is the first position of a six-position DIP switch. On the 6962A, switch *S3B-1* is a one-position DIP switch.

table 8. 6962/A switch-option summary and checklist

optional transmit-channel equalizer subassembly use

3.12 Switch *S10* conditions the 6962/A's transmit channel for operation with or without the optional Tellabs 9908A Active Slope Equalizer subassembly. If the 9908A subassembly is to be used in in the transmit channel, set *S10* to the *IN* position. If the 9908A will not be used in the transmit channel, set *S10* to the *OUT* position.

receive-output interface-level range

3.13 Switch *S12* either excludes or includes an extra 7dB of receive-channel terminal-side loss. (This is in addition to the 0 to 24dB of terminal-side loss that can be introduced into the 6962/A's receive channel via the module's front-panel *rcv term loss* DIP switch.) Exclusion of the extra 7dB of loss allows receive-output TLP's of +7 to −17 to be derived, while inclusion of the extra 7dB of loss allows receive-output TLP's of 0 to −24 to be derived. If the required receive-output TLP in your application will fall within the +7 to −17 range, set *S12* to the *+7* position to exclude the extra 7dB of loss. If the required receive-output TLP in your application will fall within the 0 to −24 range, set *S12* to the *0* position to include the extra 7dB of loss.

on-hook indication during receipt of SF tone

3.14 Switch *S3B-1* conditions the 6962/A for a proper off-hook indication (E-lead open) during the receipt of constant or 20Hz-modulated SF tone. If incoming SF tone will be constant in your application, set *S3B-1* to *OFF* so that the E lead remains open only while incoming tone is actually present at the receive input port. If incoming SF tone will be modulated at a 20Hz rate with 30 to 75% break in your application, set *S3B-1* to *ON* to provide a constant E-lead open during receipt of the modulated SF tone. This option prevents the sporadic E-lead pulsing that could otherwise occur during the receipt of SF tone modulated at 20Hz with 50% break.

Note: *On the 6962, switch* S3B-1 *is the first position of a six-position DIP switch. On the 6962A, switch* S3B-1 *is a one-position DIP switch.*

CGA options (6962 only)

3.15 Carrier-group-alarm options on the 6962 are used to forcibly remove the module from service when an associated carrier system malfunctions so that seizure of a disabled circuit is prevented and, if desired, to provide an external busy indication to a local trunk scanner or register during alarm intervals. All CGA options are selected via positions *2* through *6* of six-position DIP switch *S3B* plus one-position DIP switch *S3A*. Instructions for selecting those options are provided below.

3.16 Forced release of any call in progress can be effected (by application of ground from the CGA unit) via either the ALM (alarm master) or the ALO (alarm override) lead. To enable either or both leads for CGA forced release, the appropriate option switch(es) must be set and the appropriate external lead connection(s) made. If the ALM lead is to be used, set position *3* of DIP switch *S3B* to the *ON* position and ensure that the ALM lead is connected to pin 47. If the ALO lead is to be used, set position *4* of *S3B* to the *ON* position and ensure that the ALO lead is connected to pin 45. If, at a later time, either or both of these leads must be disabled, this can be done simply by setting *S3B-3* (ALM lead) and/or *S3B-4* (ALO lead) to *OFF*; no actual lead disconnections are required. If neither of the CGA options is to be used, ensure that no external connections are made to pins 47 and 45. With no connections present at these pins, both *S3B-3* and *S3B-4* are nonfunctional and can therefore be left in either the *OFF* or *ON* position.

3.17 Forced busying of the 6962, which is often used following a forced release, is effected by application of externally derived negative battery to the ALB (alarm battery) lead by the CGA unit. To enable the ALB lead for CGA forced busy, set position *2* of six-position DIP switch *S3B* to the *ON*

position and ensure that the ALB lead is connected to pin 43. If, at a later time, this lead must be disabled, this can be done simply by setting *S3B-2* to *OFF*; no actual lead disconnections are required. If this CGA option is not to be used, ensure that no external connection is made to pin 43. With no connection present at this pin, switch *S3B-2* is nonfunctional and can therefore be left in either the *OFF* or *ON* position.

3.18 When optioned for the CGA forced-idle or forced-busy function, the 6962 can also be optioned to provide an external busy indication (e.g., an all-trunks-busy indication) to a local trunk scanner or register via the BY1 and BY2 leads (pins 39 and 37, respectively) on the 6962. This busy indication can be in the form of either a contact closure between the BY1 and BY2 leads or a ground output on the BY1 lead. Also, this busy indication can be provided upon receipt of either the first (ALM or ALO-lead) or second (ALB-lead) carrier-failure alarm indication. If a contact closure is desired, set switch *S3B-5 (BY1)* to *OFF* and *S3B-6 (BY2)* to *ON*. If a ground output is desired, set *S3B-5 (BY1)* to *ON* and *S3B-6 (BY2)* to *OFF*. If the chosen busy indication is to be provided upon receipt of the first alarm input, set switch *S3A* to *ON*. If this busy indication is to be provided upon receipt of the second alarm input, set *S3A* to *OFF*. If an external busy indication is not desired, set both *S3B-5* and *S3B-6* to *OFF* (*S3A* may be left either *ON* or *OFF*, as it is nonfunctional when both *S3B-5* and *S3B-6* are *OFF*).

optional receive-channel equalizer subassembly use (6962A only)

3.19 Switch *S13* on the 6962A conditions the module's receive channel for operation with or without the optional Tellabs 9908A Active Slope Equalizer subassembly. If the 9908A is to be used in the 6962A's receive channel, set *S13* to the *IN* position. If the 9908A will not be used in the 6962A's receive channel, set *S13* to the *OUT* position.

installation of optional equalizer subassembly(s)

3.20 If an optional Tellabs 9908A Active Slope Equalizer subassembly will be used in the transmit channel of the 6962 or 6962A, plug the subassembly into five-pin connector *P1* on the module's printed circuit board, and install and tighten the screw that secures the subassembly's standoff post to the main board. If a 9908A subassembly will be used in the receive channel of the 6962A, plug that 9908A into five-pin connector *P2* on the module's printed circuit board, and install and tighten the screw that secures the subassembly's standoff post to the main board. Locations of connector *P1* on the 6962 and of connectors *P1* and *P2* on the 6962A are shown in figures 5 and 6, respectively.

alignment (general)

3.21 Alignment of the 6962/A comprises up to four main parts:

A. Introducing facility-side gain into the receive channel to derive an internal +7 transmission level point (TLP) from the receive input level; then introducing terminal-side loss to derive the desired receive output level.
B. Introducing prescription active slope-type amplitude equalization, if required, to post-equalize the input to the receive channel (requires an optional 9908A Active Slope Equalizer subassembly on the 6962A).
C. Introducing terminal-side loss into the transmit channel to derive an internal −16TLP from the transmit input level; then introducing facility-side gain to derive the desired transmit output level.
D. Introducing prescription active slope-type amplitude equalization, if required, to pre-equalize the output from the receive channel (requires an optional 9908A Active Slope Equalizer subassembly on both the 6962 and 6962A).

prescription alignment

3.22 The 6962/A is designed to allow **prescription alignment.** In prescription alignment, all gain, loss, and amplitude-equalization switch settings are determined from circuit records prior to installation of the module. These settings are then noted in the **checklist** column of table 9, which is the alignment-switch summary table, or on the circuit layout record (CLR). During installation, the module can then be quickly and easily aligned without performing the detailed alignment procedures that follow in the text. Simply refer to the **checklist** column of table 9 (or to the CLR) and set all gain, loss, equalization, and loopback-level switches as indicated.

Introduction to non-prescription alignment

3.23 In applications where prescription alignment settings are unavailable (and in applications where prescription alignment does not provide adequate results), non-prescription alignment of the 6962/A is necessary. Access to the appropriate ports of the module is most conveniently provided via a Tellabs 9807 Card Extender (or equivalent) or an external jackfield. Additional equipment required for non-prescription alignment consists of a transmission measuring set (TMS), preferably one with independent transmit and receive impedance settings.

prealignment switch settings for non-prescription alignment

3.24 Before beginning actual non-prescription alignment of the 6962/A, do the following:

A. Ensure that all option switches (see table 8 for a listing), especially those that select the module's receive input and transmit output port impedances, are properly set.
B. On the 6962, ensure that the integral receive equalizer and, if present, the optional transmit equalizer (9908A subassembly) are set for zero equalization (all four positions of *S7* on the 6962 and *S1* on the 9908A set to the *OFF* position, as indicated on the switch body). On the 6962A, ensure that the optional receive and transmit equalizers (9908A subassemblies), if

alignment function	switch	selections	settings	check-list
receive-channel facility-side flat gain	front-panel *rcv fac gain* DIP switch*	0.1dB gain	0.1 to IN	
		0.2dB gain	0.2 to IN	
		0.4dB gain	0.4 to IN	
		0.8dB gain	0.8 to IN	
		1.5dB gain	1.5 to IN	
		3.0dB gain	3.0 to IN	
		6.0dB gain	6.0 to IN	
		12.0dB gain	12.0 to IN	
receive-channel terminal-side flat loss	front-panel *rcv term loss* DIP switch*	0.1dB loss	0.1 to IN	
		0.2dB loss	0.2 to IN	
		0.4dB loss	0.4 to IN	
		0.8dB loss	0.8 to IN	
		1.5dB loss	1.5 to IN	
		3.0dB loss	3.0 to IN	
		6.0dB loss	6.0 to IN	
		12.0dB loss	12.0 to IN	
receive-channel slope equalization for nonloaded cable (2804Hz gain re 1004Hz)	S7-1 through S7-4 on 6962; S1-1 through S1-4 on optional 9908A subassembly plugged into connector *P2* on 6962A**	0.5dB	S7-4 or S1-4 to .5**	
		1dB	S7-3 or S1-3 to 1**	
		2dB	S7-2 or S1-2 to 2**	
		4dB	S7-1 or S1-1 to 4**	
transmit-channel terminal-side flat loss	front-panel *xmt term loss* DIP switch*	0.1dB loss	0.1 to IN	
		0.2dB loss	0.2 to IN	
		0.4dB loss	0.4 to IN	
		0.8dB loss	0.8 to IN	
		1.5dB loss	1.5 to IN	
		3.0dB loss	3.0 to IN	
		6.0dB loss	6.0 to IN	
		12.0dB loss	12.0 to IN	
transmit-channel facility-side flat gain	front-panel *xmt fac gain* DIP switch*	0.1dB gain	0.1 to IN	
		0.2dB gain	0.2 to IN	
		0.4dB gain	0.4 to IN	
		0.8dB gain	0.8 to IN	
		1.5dB gain	1.5 to IN	
		3.0dB gain	3.0 to IN	
		6.0dB gain	6.0 to IN	
		12.0dB gain	12.0 to IN	
transmit-channel slope equalization for nonloaded cable (2804Hz gain re 1004Hz)	S1-1 through S1-4 on optional 9908A subassembly plugged into connector *P1* on 6962 or 6962A**	0.5dB	S1-4 to .5**	
		1dB	S1-3 to 1**	
		2dB	S1-2 to 2**	
		4dB	S1-1 to 4**	

* All front-panel *fac gain* and *term loss* DIP-switch positions are cumulative. Total flat gain introduced at a channel's facility-side port or total flat loss introduced at a channel's terminal-side port is the sum of that channel's *fac gain* or *term loss* DIP-switch positions set to *in*. For zero gain or zero loss at a particular port, set all positions of the appropriate *fac gain* or *term loss* DIP switch to *out*.

** The *.5, 1, 2,* and *4* settings for DIP switches *S7* (6962) and *S1* (9908A) are the *OFF* (open) settings as indicated on the actual switch body. On the 9908A, a small label adjacent to the switch indicates an **in** setting with an arrow; please note that this is the setting that introduces equalization, i.e., it is the *OFF* (open) setting as indicated on the switch body itself. The four positions of switches *S7* (6962) and *S1* (9908A) are cumulative. Total equalized gain introduced at 2804Hz (re 1004Hz) is the sum of those *S7* or *S1* positions set to *OFF* (as indicated on switch body) or *in* (as indicated on 9908A's label). For no equalization, set all four positions of *S7* or *S1* to *ON* (as indicated on switch body) or *out* (switch setting **opposite** arrowhead on 9908A label), or simply remove the appropriate subassembly(s) and reoption the module for no equalizer in the appropriate channel(s). See table 8 or paragraphs 3.12 and 3.20 for appropriate optioning instructions.

table 9. 6962/A alignment-switch summary and checklist

present, are similarly set for zero equalization.

C. Set all positions of both front-panel *fac gain* DIP switches (*xmt* and *rcv*) and all positions of both front-panel *term loss* DIP switches (*xmt* and *rcv*) to the *out* position for zero gain or loss in either channel.

non-prescription receive-channel alignment

3.25 Alignment of the receive channel consists of the following: adjustment of the front-panel *rcv fac gain* switches to derive the receive channel's internal +7TLP, adjustment of the receive-channel slope equalizer, if necessary, to provide the required

amount of equalization, and adjustment of the front-panel *rcv term loss* switches to provide the specified receive-channel output level. Align the receive channel as follows (jack designations are those on the Tellabs 9807 Card Extender):

facility gain:

A. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the *4W rcv drop or bal net out* jack (opening jack, receive output port).
B. Request the distant facility-side location to send 1004Hz and 2804Hz tone at the level specified on the circuit layout record (CLR). Measure and record each level.
C. With **1004Hz tone** being sent from the distant facility-side location, set the proper combination of front-panel *rcv fac gain* DIP switch positions to *in* so that a +7dBm level is achieved. If post-equalization of a receive input pair consisting of nonloaded cable is desired, proceed to step D. If no receive-channel equalization is desired, proceed to step F.

nonloaded-cable equalization:

D. Subtract the 2804Hz level measured in step B from the 1004Hz level also measured in step B. This is the amount of equalized gain required.
E. Set to *OFF* (switch-body designation) or *in* (adjacent label designation on 9908A) the proper combination of positions on DIP switch *S7* (6962) or *S1* (receive-channel 9908A on 6962A) that approximates as closely as possible the difference determined in step D, as directed in table 10. (The receive-channel 9908A on the 6962A plugs into five-pin connector *P2*.) Proceed to step F.

1000Hz-2804Hz difference	amount of equalized gain required
0.0 to 0.2dB	0.0dB
0.3 to 0.7dB	0.5dB
0.8 to 1.2dB	1.0dB
1.3 to 1.7dB	1.5dB
1.8 to 2.2dB	2.0dB
2.3 to 2.7dB	2.5dB
2.8 to 3.2dB	3.0dB
3.3 to 3.7dB	3.5dB
3.8 to 4.2dB	4.0dB
4.3 to 4.7dB	4.5dB
4.8 to 5.2dB	5.0dB
5.3 to 5.7dB	5.5dB
5.8 to 6.2dB	6.0dB
6.3 to 6.7dB	6.5dB
6.8 to 7.2dB	7.0dB
7.3 to 7.7dB	7.5dB

table 10. Equalized gain settings for nonloaded-cable slope equalizers (integral for rcv channel on 6962, optional via 9908A subassembly for xmt channel on 6962, both channels on 6962A)

terminal loss:

F. Refer to the CLR for the specified receive output level.
G. Calculate the difference between this specified output level and the internally derived +7dBm level.
H. Set to *in* the proper combination of front-panel *rcv term loss* DIP-switch positions that adds up to this difference, thus achieving the desired receive output level. If the desired receive output level is lower than that which can be derived via the front-panel *rcv term loss* DIP switch, set switch *S12* on the module's printed circuit board to the *0* position for 7dB of extra terminal-side loss (see paragraph 3.13 or table 8). Then reset the *rcv term loss* DIP switch as required to derive the proper receive output level. This completes alignment of the receive channel. Disconnect the TMS from the card extender or jackfield.

non-prescription transmit-channel alignment

3.26 Alignment of the transmit channel consists of the following: adjustment of the front-panel *xmt term loss* switches to derive the transmit channel's internal −16TLP, adjustment of the front-panel *xmt fac gain* switches to provide the specified transmit output level, and adjustment of the transmit-channel slope equalizer, if necessary, to provide the required amount of equalization. Align the transmit channel as follows:

terminal loss:

A. Remove the transmit path cut either by seizing the circuit from the local trunk or line, by placing battery on the M lead (pin 19), or by removing incoming SF tone. As an alternative, the transmit path cut can be removed by setting switch *S2* to the *INV* position with the M lead at ground potential.
B. Set switches *S1T-1* and *S1T-2* for 600-ohm terminating impedance at the transmit output port if they are not already set for 600 ohms.
C Arrange the transmit portion of the TMS for 1004Hz tone output at the CLR-specified transmit input level. (If the TMS has a transmit impedance setting, select 600 ohms.) Connect this signal to the *4W xmt drop or 2W in* jack (opening jack, transmit input port).
D. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the *xmt SF out* jack (opening jack, transmit output port).
E. Set the proper combination of front-panel *xmt term loss* DIP-switch positions to *in* so that a −16dBm level is achieved.

facility gain:

F. Refer to the CLR for the specified transmit output level.
G. Calculate the difference between this specified output level and the internally derived −16dBm level.
H. Set to *in* the proper combination of front-panel *xmt fac gain* DIP-switch positions that adds up to this difference, thus achieving the desired 4wire transmit level. If the required transmit-output-port terminating impedance is other than 600 ohms, reser switches *S1T-1* and *S1T-2* for the proper impedance. If transmit-channel equalization is not required, proceed

to step M. If pre-equalization of a transmit output pair consisting of nonloaded cable is desired, proceed to step I.

nonloaded-cable equalization:

I. Disconnect the receive portion of the TMS from the card extender or jackfield.

J. Leave the transmit portion of the TMS connected as is, and do not change its output level. Send 1004Hz and 2804Hz tone toward the distant facility-side location. Have personnel at that end measure and report the received levels.

K. Subtract the 2804Hz level reported in step J from the 1004Hz level also reported in step J. This is the amount of equalized gain required.

L. Set to *OFF* (switch-body designation) or *in* (adjacent label designation) the proper combination of DIP-switch *S1* positions on the transmit-channel 9908A that approximates as closely as possible the difference determined in step K, as directed in table 10. (The transmit-channel 9908A on the 6962/A plugs into five-pin connector *P1*.)

M. This completes alignment of the 6962/A. Disconnect the TMS and, if present, the card extender.

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6962/A 4Wire E&M SF Signaling Set module with Gain, function sequence flowcharts (figures 8 through 10) that illustrate operation of the modules on incoming and outgoing calls 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. These flowcharts can be used to determine whether a module is performing normally by observing the module's response and comparing it to that shown in the flowchart. Reference to the 6962/A 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 6962/A for engineering, application, and troubleshooting purposes only. Attempts to test or troubleshoot this module internally are not recommended and may void your 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

Note: *Except where indicated, specifications apply to both the 6962 and the 6962A.*

transmission specifications

alignment levels
receive input port: −17 to +7TLP
receive output port: +7 to −17TLP or, via switch option (see terminal-side loss specification), 0 to −24TLP
transmit input port: −16 to +8TLP
transmit output port: +8 to −16TLP

overload points
+5dBm0 at all four ports

terminal return loss
ERL greater than 23dB

facility-side gain (xmt and rcv)
0 to 24dB in switch-selectable 0.1dB increments

terminal-side loss (xmt and rcv)
0 to 24dB in switch-selectable 0.1dB increments, with an extra 7dB of loss available via switch option in receive channel only for 7dB-lower rcv out TLP range

insertion loss
0±0.25dB at 1004Hz with gain and loss switches set to zero

receive-channel slope equalization (integral on 6962, available via Tellabs 9908A plug-on subassembly on 6962A)
0.0 to 7.5dB of gain (in switch-selectable 0.5dB increments) at 2804Hz re 1004Hz

transmit-channel slope equalization (optional on both 6962 and 6962A via Tellabs 9908A plug-on subassembly)
0.0 to 7.5dB of gain (in switch-selectable 0.5dB increments) at 2804Hz re 1004Hz

terminal-side port impedances (xmt in, rcv out)
600 ohms, balanced, 300 to 4000Hz

facility-side port impedances (xmt out, rcv in)
1200, 600, or 150 ohms, balanced, 300 to 4000Hz, independently switchable at each facility-side port

facility return loss
ERL greater than 23dB at 1200 and 600-ohm facility-side port impedance settings, greater than 20dB at 150-ohm facility-side port impedance settings

frequency response
±1dB re 1004Hz level, 300 to 4000Hz

noise
20dBrnC0 maximum at maximum gain (no equalization)

longitudinal balance, all ports
greater than 60dB, 200 to 4000Hz

delay distortion
less than 100μs (6962) or 125μs (6962A), 400 to 4000Hz, without equalization; P/AR (peak-to-average ratio) ≥ 98

total harmonic distortion, all ports
4wire ports: less than 1% at +5dBm0

cross-coupling loss between xmt and rcv channels
greater than 75dB at 1000 and 300Hz

crosstalk loss between adjacent modules in shelf
greater than 85dB, 200 to 4000Hz

SF transmit section

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

SF tone levels
low (idle) level: −20dBm0±1dB
high level: −8dBm0±2dB

SF tone states
idle: tone transmitted
busy: not tone transmitted
dialing: tone transmitted during the break portions of dial pulses

specifications continued on page 21

INCOMING CALL (A-SIDE SIGNALING)

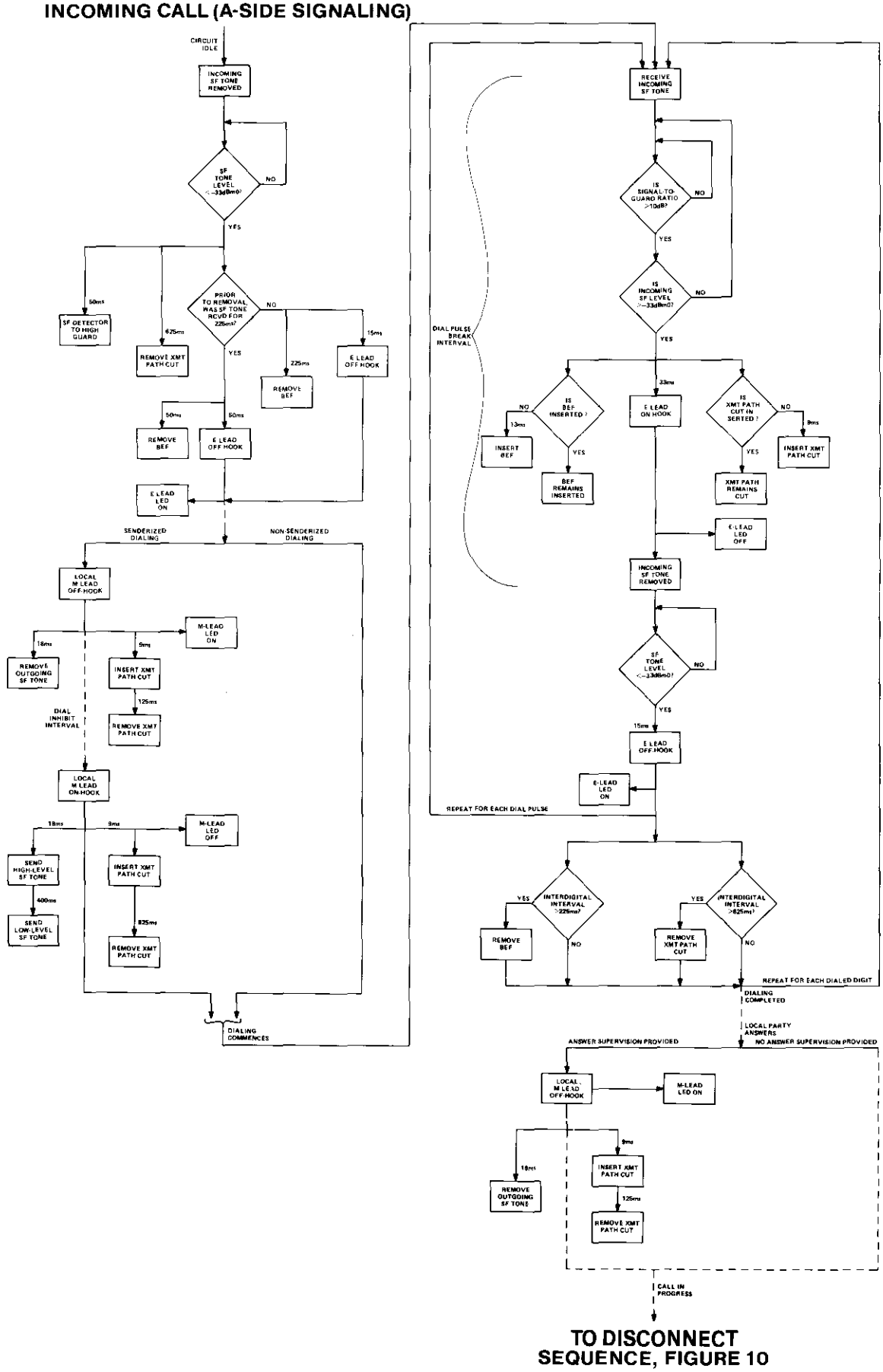


figure 8. Function sequence flowchart, incoming call

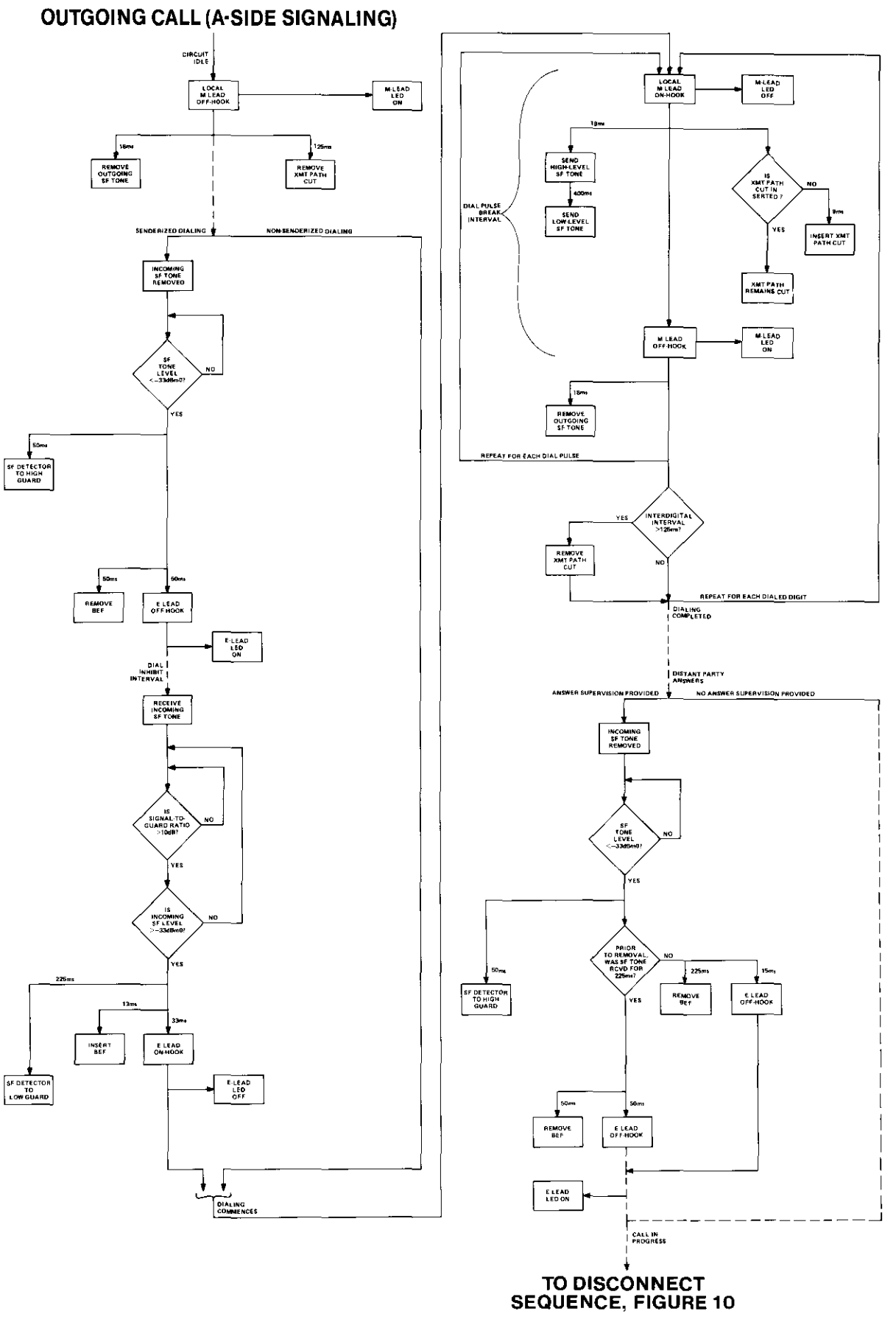


figure 9. Function sequence flowchart, outgoing call

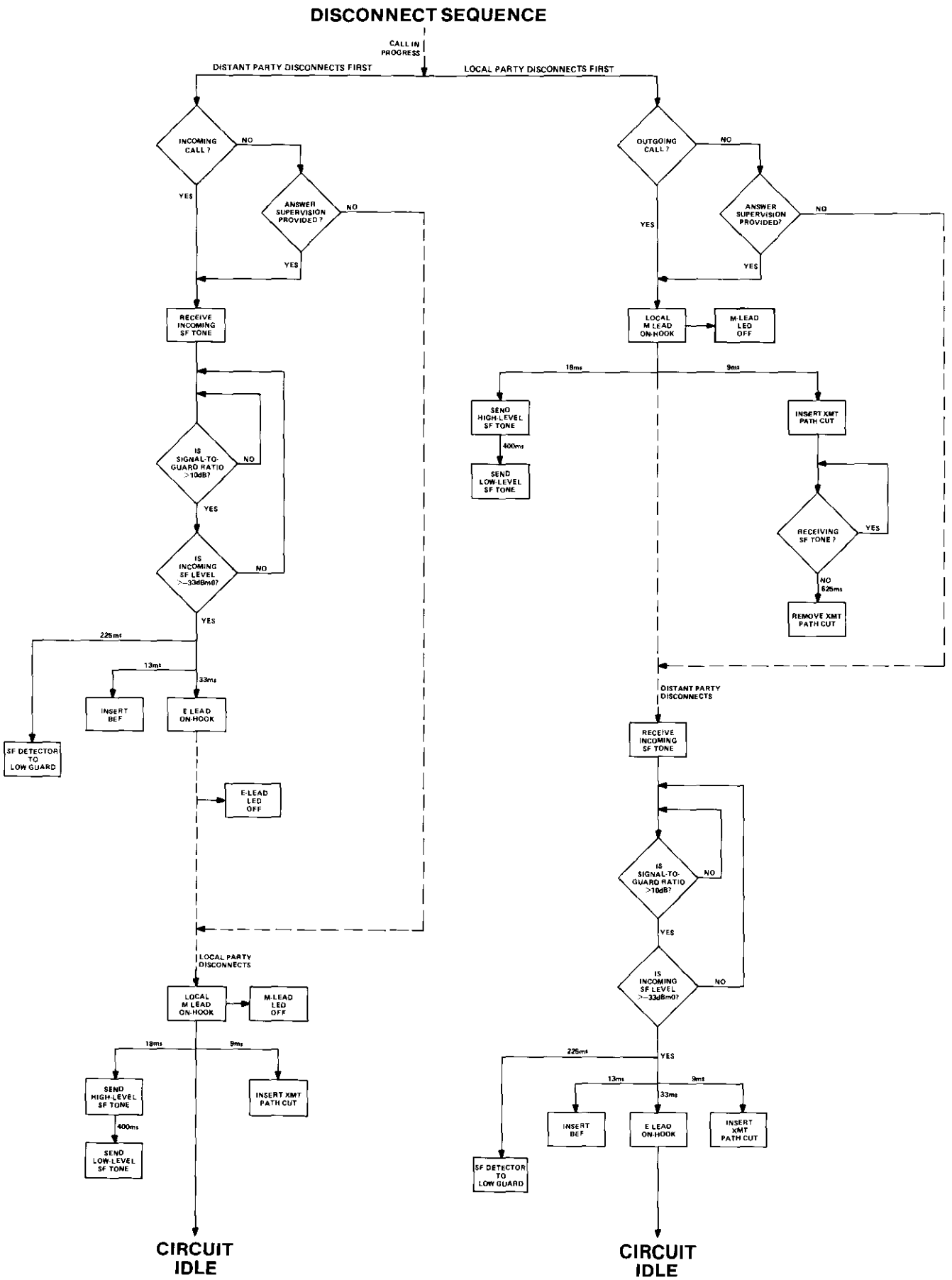
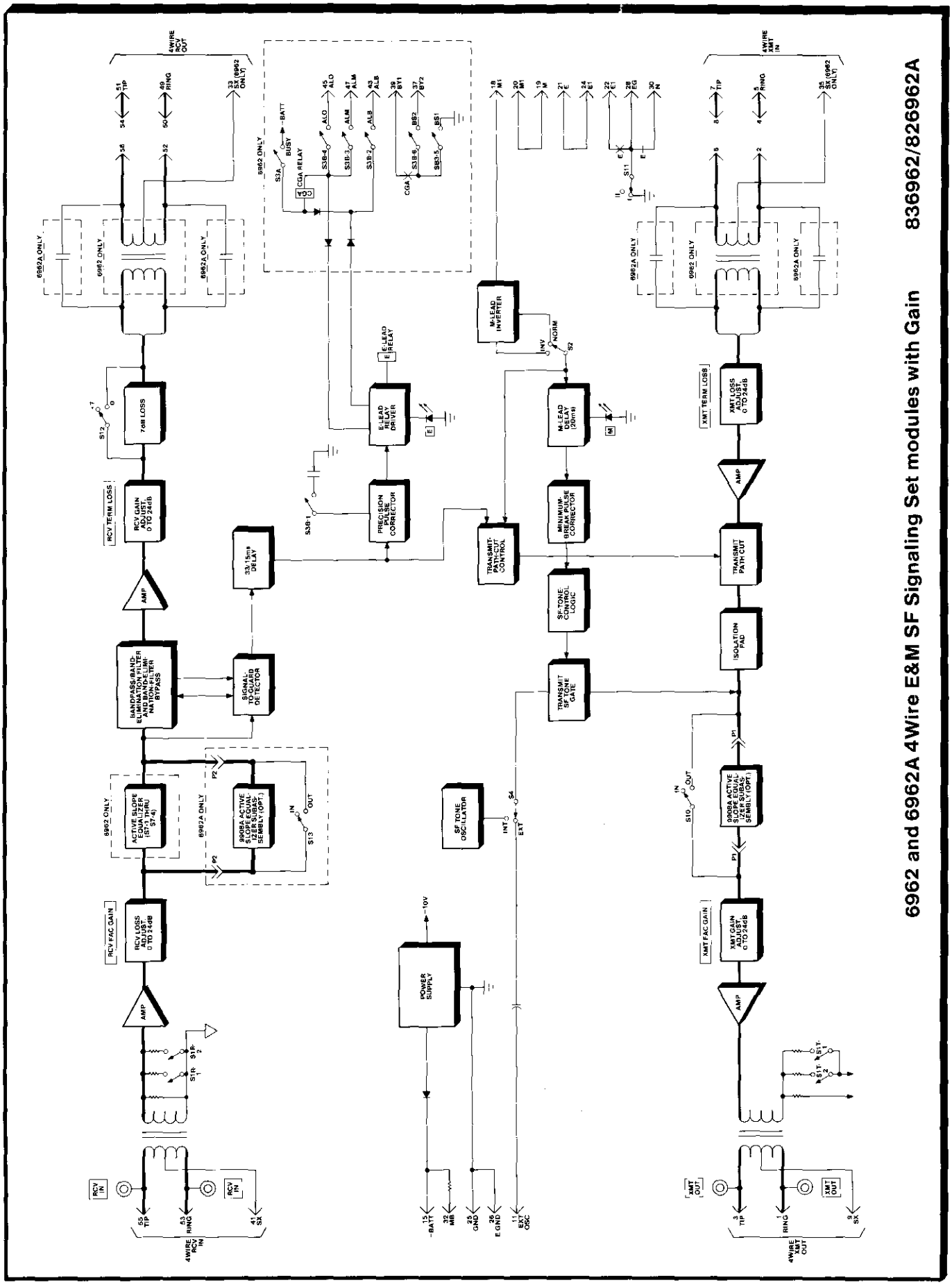


figure 10. Function sequence flowchart, disconnect sequence for incoming and outgoing calls


6962 and 6962A 4Wire E&M SF Signaling Set modules with Gain
836962/826962A
4WIRE RCV OUT
4WIRE XMT IN
RCV TERM LOSS
RCV GAIN ADJUST, 0 TO 24dB
7dB LOSS
RCV FAC GAIN
RCV LOSS ADJUST, 0 TO 24dB
XMT TERM LOSS
XMT LOSS ADJUST, 0 TO 24dB
XMT FAC GAIN
XMT GAIN ADJUST, 0 TO 24dB
AMP
6962 ONLY
6962A ONLY
E-LEAD RELAY DRIVER
E-LEAD RELAY
PRECISION PULSE CORRECTOR
33/15Hz DELAY
SIGNAL-TO-GUARD DETECTOR
M-LEAD INVERTER
M-LEAD DRIVER (20mA)
MINIMUM-RESISTANCE CORRECTOR
TRANSMIT PATH-CUT CONTROL
SF-TONE CONTROL LOGIC
TRANSMIT SIGNATURE GATE
TRANSMIT PATH CUT
ISOLATION PAD
SF TONE OSCILLATOR
POWER SUPPLY
CGA RELAY
4WIRE RCV IN
4WIRE XMT OUT
RCV IN
XMT OUT
TIP
RING
SX
-BATT
MB
GND
E GND
EXT OSC

high-level timing
high-level tone is transmitted for 400±100ms following each off-hook-to-on-hook transition of M lead

M-lead states, normal mode
idle: open or ground
busy: negative battery (−22 to −56Vdc)

M-lead states, inverted mode
idle: negative battery (22 to −56Vdc) or open
busy: ground

M-lead delay
18±5ms delay between M-lead state change and SF-tone state change

pulsing characteristics (M lead to SF)
- **input breaks (M-lead on-hook intervals) shorter than M-lead delay are not recognized**
- **input breaks of a duration between that of M-lead delay and 50ms are transmitted as 50ms tone bursts**
- **input breaks longer than 50ms are transmitted as tone bursts equal in duration to the input break 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

SF receive section

SF tone frequency
2600±15Hz

SF tone detection threshold
−26.5dBm±2.5dB

SF tone rejection
50dB minimum, 2590 to 2610Hz

signaling bandwidth (high-guard state)
75Hz nominal

signal-to-guard ratio for signal detection
10±2dB nominal

maximum line noise
58dBrnC0

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

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**

seizure delay, removal of SF tone to E-lead ground
50±10ms

release delay, application of SF tone to E-lead open
90±20ms

dial pulse characteristics, SF to E lead

pulse rate	input break ratio	output break
8pps	30 to 85%	57±2%
10pps	35 to 85%	58±2%
12pps	40 to 80%	59±2%

current limiting
provided for M lead

E-lead-relay contact rating
maximum current: 1 ampere
maximum voltage: 200Vdc
contact resistance: 20 milliohms maximum
contact protection: external transient protection required with inductive loads

simplex leads

simplex current (facility and terminal sides)
100mA maximum with 2mA maximum unbalance

external oscillator requirements (optional)

frequency
2600±2Hz

level
0.5Vrms

load impedance
75 kilohms minimum, unbalanced

power requirements

input voltage
−22 to −56Vdc, filtered, ground referenced

input current
55mA maximum at idle, 95mA maximum when busy

physical

operating environment
20° to 130°F (−7° to +54°C), humidity to 95% (no condensation)

dimensions
5.71 inches (17.04cm) high
1.42 inches (3.61cm) wide
12.94 inches (32.87cm) deep

weight
6962: 18 ounces (397 grams)
6962A: 14 ounces (510 grams)
9908A subassembly: 1 ounce (28 grams)

mounting
relay rack via one position of a Tellabs Type 16 Mounting Shelf; can also be mounted in one position of lower shelf of a Tellabs 269-series Mounting Assembly

7. testing and troubleshooting

7.01 Due to the complexity of the 6962/A 4Wire E&M SF Signaling Set module with Gain, a detailed testing guide checklist is not included in this practice. Such a checklist would be so long and complicated as to be of dubious value for troubleshooting in the field. Proper operation of each module can be verified, however, by observing its actual operation while referring to the function sequence flowcharts (figures 8 through 10) that summarize the module's correct operation on incoming and outgoing calls. In addition, a *troubleshooting guide* in this section lists a variety of trouble conditions along with possible causes and possible solutions for each. If a module is not performing properly,

look up the problem in the *troubleshooting guide* and check all the possible causes listed opposite the problem. If this does not correct the problem, substitute a new module, if possible, and observe its operation. If the substitute module operates correctly, the original 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 on the 6962/A module. Unauthorized testing or repairs may void the module's warranty.

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 at your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, headquarters. Telephone numbers are as follows:

US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (702) 827-3400
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

7.03 If a 6962/A is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is more expedient, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

7.04 To obtain a replacement 6962/A module, notify Tellabs via letter (see addresses below), telephone (see numbers above), or twx (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6962(A) part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement module to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective 6962/A in the replacement module'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 module prepaid to Tellabs.

repair and return

7.05 Return the defective 6962/A module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532

in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 39
Mississauga, Ontario, Canada L4W 2S7

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

Note: *To ensure that improper positioning of mercury within the module's mercury-wetted E-lead output relay will not be a cause of malfunction, ensure that the module has been tapped gently on a hard surface and kept upright until installation as directed in the* **caution** *notice preceding paragraph 3.02.*

trouble condition	possible causes (check before assuming module is defective)
module completely inoperative	1) No input power. 2) Improper wiring.
cannot derive proper transmission levels	1) *Fac gain* and/or *term loss* level switches improperly set for one or both channels. 2) Receive-input and transmit-output impedance DIP switches (*S1T* and *S1R*, respectively) improperly set. 3) Receive and transmit equalization DIP switches (*S7* for rcv eql on 6962, *S1* on 9908A subassembly for optional xmt eql on 6962 and for optional xmt and rcv eql on 6962A) improperly set. 4) TMS impedance improperly set or TMS not terminated.
no signaling in one or both directions	1) M-lead normal/invert switch (*S2*) improperly set. 2) Improper level and/or frequency of incoming SF tone. 3) Improper level and/or frequency of outgoing SF tone. 4) *Fac gain* and/or *term loss* level switches improperly set for one or both channels.
no transmission on transmit path	1) incoming SF tone not removed or M lead not seized, resulting in unwanted transmit path cut.
E lead closed (*E* LED lighted) during idle	1) Incoming SF tone frequency not 2600±10Hz. 2) Incoming SF tone frequency below −24dBm.
E lead open (*E* LED unlighted) during busy	1) SF tone (2600Hz) present at receive input port.
no SF tone transmitted (*M* LED lighted) during idle	1) M-lead input not at ground potential or open. 2) M-lead normal/invert switch (*S2*) improperly set.
SF tone transmitted (*M* LED unlighted) during busy	1) M-lead input not at battery potential. 2) M-lead normal/invert switch (*S2*) improperly set.

Tellabs Incorporated
4951 Indiana Avenue, Lisle, Illinois 60532
telephone (312) 969-8800 twx 910-695-3530