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practice section 816122/826122A

P/O

6122 and 6122A 2Wire E&M SF Signaling Sets

contents

1. general description

1.01 The 6122 2Wire E&M SF Signaling Set module with Gain and the 6122A 2Wire E&M SF Signaling Set module with Gain and Loopback (figure 1) each provide signaling and transmission interface between a 4wire facility that uses single-frequency (SF) signaling and a 2wire trunk (typically, a PBX trunk) or a 2wire line that uses E&M signaling. Both modules provide active level control in the transmit and receive paths, receive-path amplitude equalization, and full-duplex signaling conversion between the SF signaling on the 4wire facility and the E&M signaling on the 2wire trunk or line. Conventional 2600Hz SF tone is supplied by an integral oscillator. The 6122 and 6122A differ from ordinary 2wire E&M SF signaling sets in that they each contain an integral line amplifier to accommodate a variety of facility interface levels. Unlike the 6122, the 6122A contains integral loopback circuitry to facilitate local or remote testing of the module and the facility. As members of Tellabs' 262U Universal Network Terminating System of modules and enclosures, the 6122 and 6122A each fulfill Registered Facility Interface Codes TC11E, TC11M, TC12E, TC12M, TL11E, TL11M, TL12E, and TL12M for network-terminating applications where the serving telephone company uses SF signaling.

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

1.03 Features and options of the 6122 and 6122A include the following: full prescription alignment capability; balanced, switchable 1200, 600, or 150-ohm terminating impedances on the 4wire (facility) side; balanced, switchable 900 or 600-ohm terminating impedance (in series with 2.15μF) on the 2wire (terminal) side; facility-side amplifiers and terminal-side attenuators for interfacing at a variety of levels; active slope-type receive equalization; an integral compromise balance network; switch-selectable network build-out capacitance; switch-selectable A-side or B-side E&M signaling; switch-selectable Type I, II, or III E&M interface; minimum-break transmit and receive pulse correction; and an integral sealing-current source. The 6122A alone contains the aforementioned loop-

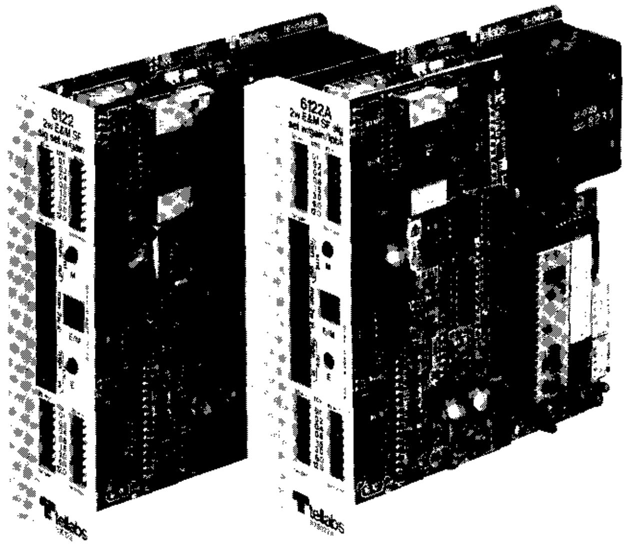


figure 1. 6122 and 6122A 2Wire SF Signaling Set modules with Gain

back circuitry with both local (manual) and remote (two-tone) loopback-state control. In place of this loopback circuitry, the 6122 makes provision for use of an optional precision balance network subassembly. Except for these differences, the two modules are identical.

1.04 Prescription-set transmit and receive amplifiers on the 4wire side of the 6122 and 6122A allow each 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 2wire side (but located in the 4wire paths), 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 attenauators provide from 0 to 24dB of loss in switch-selectable 0.1dB increments. In the receive channel, 4wire input TLP's from −17 to +7 can be accommodated and 2wire output TLP's from +7 to −17 can be derived. In the transmit channel, 2wire input TLP's from −16 to +8 can be accommodated and 4wire output TLP's from +8 to −16 can be derived. Overload points at each module's ports are as follows: 4wire receive port, +5dBm0; 4wire transmit port, +5dBm0; 2wire-port input, +5dBm0; 2wire-port output, +8dBm.

1.05 An active slope equalizer for nonloaded cable in the receive channel of the 6122 and 6122A 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.

1.06 On the 4wire side, the 6122 and 6122A each provide transformer coupling at both ports (4wire receive and 4wire transmit). The transformers at these ports can be independently switch-optioned for balanced 1200, 600, or 150-ohm terminating impedance. The 150-ohm options provide approximately 2dB of slope equalization (in the receive channel, this is in addition to any provided by the active slope equalizer) when the facility-side (4wire) ports interface long sections of nonloaded cable. Both facility-side transformers are center-tapped to derive balanced simplex leads.

1.07 An integral sealing-current source on each module can be switch-optioned into the circuit for application of nominal 20mA sealing current to metallic 4wire-side pairs. Switching the internal sealing-current source out of the circuit provides access to the facility-side simplex leads. These leads can be used, for example, to apply sealing current to the 4wire facility from a source external to the module.

1.08 On the 2wire side, the 6122 and 6122A each contain a hybrid terminating set for 4wire-to-2wire conversion. This hybrid provides balanced, switchable 900 or 600-ohm terminating impedance in series with 2.15μF of capacitance at each module's 2wire port. At the hybrid's balance port (opposite the 2wire port), an integral compromise balance network (CBN) likewise provides 900 or 600 ohms in series with 2.15μF. On both modules, the CBN can be switch-optioned out of the circuit when use of a precision balance network (PBN) is preferred. For the 6122, this PBN can be supplied either as an external module (e.g., a Tellabs 423X) or, more conveniently, as a Tellabs 9930 (Issue 3 or later) or 9932 (Issue 2 or later) PBN subassembly, which plugs into a receptacle on the module's printed circuit board. For the 6122A, which lacks the PBN-subassembly receptacle of the 6122, the PBN must be supplied as an external module. (Please refer to the 423X and 993X Tellabs practices for details on these modules and subassemblies.) Both the 6122 and the 6122A contain network build-out (NBO) capacitors that provide from 0 to 0.030μF of NBO capacitance in switch-selectable 0.002μF increments. These NBO capacitors can be used in conjunction with the modules' integral CBN or with an optional plug-on or external PBN.

1.09 The transmit portion of the 6122 and 6122A 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.

1.10 The receive portion of the 6122 and 6122A converts incoming SF tone signals to dc output signals. A minimum-break receive pulse corrector ensures transmission of recognizable dc pulses. Recognition delays prevent response to spurious SF tone bursts and to momentary tone interruptions.

1.11 When the 6122 or 6122A is optioned for A-side (conventional terminal-side) E&M signaling, the transmit portion of the module converts incoming M-lead states to outgoing SF tones, and the receive portion converts incoming SF tones to outgoing E-lead states. When the module is optioned for B-side (also referred to as "facility-side") E&M signaling, the transmit portion converts incoming E-lead states to outgoing SF tones, and the receive portion converts incoming SF tones to outgoing M-lead states.

1.12 When the 6122 or 6122A is optioned for either A-side or B-side E&M signaling, it can also be optioned for Type I (single-lead) E&M 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. With A-side signaling only, the 6122 and 6122A are compatible with a Type III (looped) E&M interface when optioned for Type I.

1.13 Unlike the 6122, the 6122A contains integral loopback circuitry that loops 4wire receive input signals back to the 4wire transmit output port for testing of signaling and transmission within the module and also on the facility. Switch options allow a choice of manual or two-tone loopback. Manual loopback is activated and deactivated via a DIP switch on the 6122A's loopback subassembly. Two-tone loopback is activated by application of nominal 2713Hz tone to the 4wire receive input pair and is deactivated by application of a second 2713Hz tone. With two-tone loopback, the 6122A can be further optioned for no timeout, i.e., for loopback deactivation by application of a second tone only, or for automatic loopback deactivation after a 2.6-minute or 20.8-minute timeout interval if no second tone is applied prior to expiration of the interval. Another loopback-related switch option conditions the 6122A to busy out the associated terminal equipment (with A-side signaling and Type I E&M interface only) during loopback to prevent the trunk circuit or line circuit from being inadvertently seized. A prescription loopback-level-control circuit introduces from 0 to 23dB of loss or gain into the loopback path in switch-selectable increments (23dB loss; 0.5, 1.5, 3, 6, and 12dB gain) to provide true equal-level loopback.

1.14 Both the 6122 and 6122A contain an integral 2600Hz SF signaling tone oscillator and therefore do not require an external (master) SF tone source. Provision for use of a master oscillator, however, is available via factory modification.

1.15 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 seven bantam-type test jacks. An opening jack facing the module and a monitoring jack bridging the transmission pair are provided at both 4wire ports and at the 2wire port. The seventh jack is an E&M-lead breaking (opening) jack.

1.16 Both modules operate from filtered, ground-referenced −22 to −56Vdc input. Maximum current requirements range from 100mA at idle to 105mA when busy, with an additional 25mA required when the internal sealing-current option is selected and, for the 6122A only, another 40mA required when loopback is activated.

1.17 The 6122 and 6122A are Type 10 modules. As such, each module mounts in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay-rack and apparatus-case installation. In relay-rack applications, up to 12 modules can be mounted across a 19-inch rack, while up to 14 modules can be mounted across a 23-inch rack. In either case, 6 inches of vertical rack space is used.

1.18 Both the 6122 and 6122A are members of Tellabs' 262U Universal Network Terminating System of modules and enclosures. Thus, each module can also be mounted in any of Tellabs' prewired 262U Mounting Assemblies, versions of which are available for relay-rack and apparatus-case installation. For details, please refer to Tellabs' 262U System brochure. In addition, the 6122 and 6122A can be used in the prewired Mounting Assemblies of Tellabs' 262 Network Terminating System and 260A SF Signaling and Terminating System. For details, please refer to the Tellabs brochures and practices on the 262 and 260A Systems,

2. application

2.01 The 6122 and 6122A 2Wire E&M SF Signaling Set modules are each designed to interface a 4wire SF transmission facility with a 2wire E&M trunk or line associated with a two-way dial/supervisory telephone circuit. These modules combine the functions of a 4wire line amplifier, an SF transceiver, an SF-to-E&M signaling converter, and a 4wire-to-2wire hybrid terminating set. Thus, the 6122 and 6122A are **complete** 2wire E&M SF signaling and terminating circuits, less power and ringing, on single Type 10 modules. As such, each module provides full-duplex signaling conversion and transmission interface between the 4wire SF facility and the 2wire E&M trunk or line. The two modules differ as follows: the 6122A contains integral loopback circuitry that permits testing of both the module and the facility from a local or remote location. The 6122 lacks this loopback circuitry but, in the same location on the printed circuit board, makes provision for use of a Tellabs 993X Precision Balance Network plug-on subassembly.

2.02 The 6122 and 6122A are well suited to a variety of 4wire-to-2wire SF-to-E&M applications, both network-terminating and otherwise. In network-terminating applications where the serving telephone company uses facility-side SF signaling, each module fulfills Registered Facility Interface Codes TC11E, TC11M, TC12E, TC12M, TL11E, TL11M, TL12E, and TL12M. Figures 2 through 4 show three typical network-terminating tie-trunk applications of the 6122 and 6122A: short-haul, long-haul involving analog carrier, and long-haul involving digital carrier, respectively.

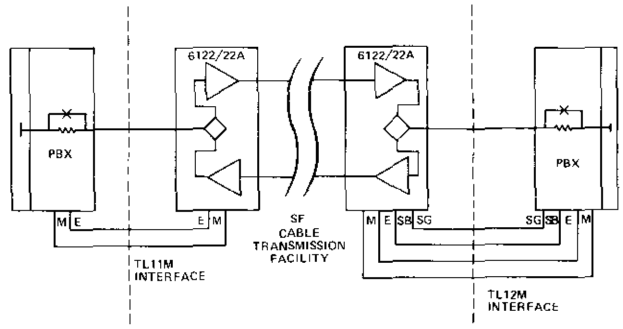


figure 2. Typical short-haul tie-trunk circuit using 6122 or 6122A (network-terminating application)

terminal (2wire) interface, balance network, and NBO capacitance

2.03 The 6122 or 6122A interfaces the local 2wire E&M trunk or line via its integral hybrid terminating set. This magnetic hybrid provides switch-selectable 900 or 600-ohm terminating impedance (in series with 2.15μF) at the 2wire port. The 900-ohm option is selected for interface with loaded cable or with a switched network involving both loaded and nonloaded cable. The 600-ohm option is selected for interface with nonloaded cable or

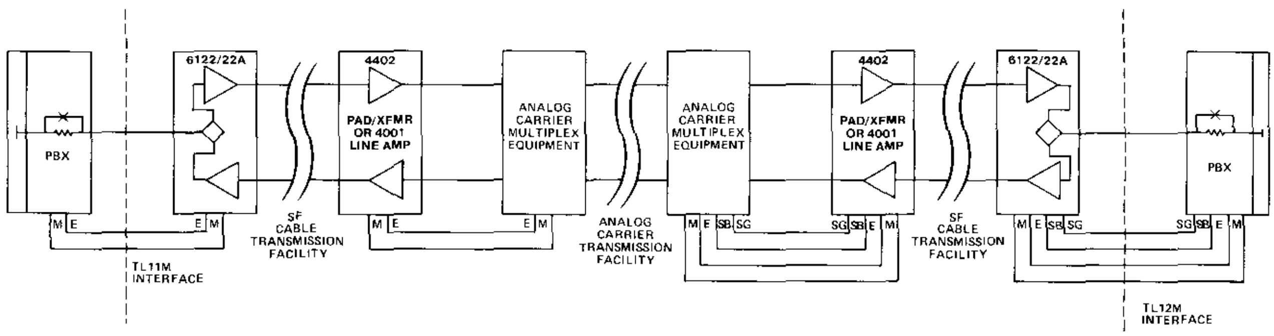


figure 3. Typical long-haul analog tie-trunk circuit using 6122 or 6122A (network-terminating application)

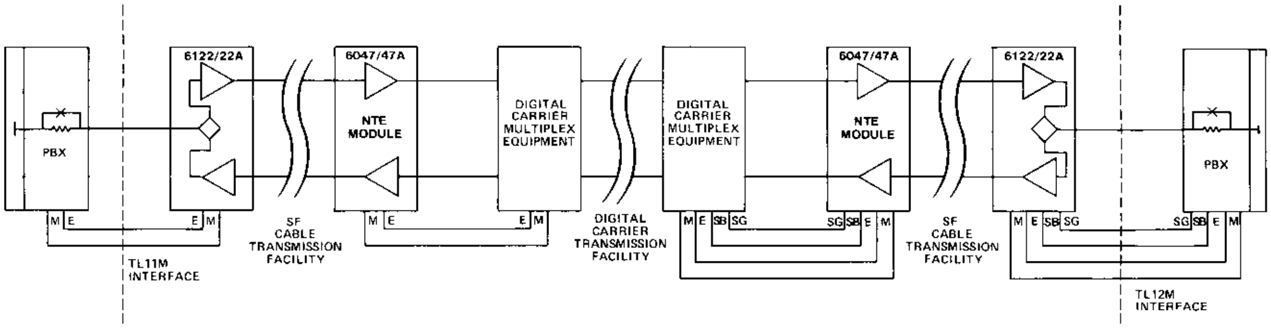


figure 4. Typical long-haul digital tie-trunk circuit using 6122 or 6122A (network-terminating application)

station equipment. The hybrid derives A and B leads to accommodate loop current, if required.

2.04 To ensure that adequate hybrid balance (i.e., enough transhybrid loss) is provided in any application, the hybrid in the 6122 or 6122A can be switch-optioned to function with the module's internal compromise balance network (CBN) or with a separate precision balance network (PBN). The CBN can be optioned for the same impedances as the 2wire port: 900 ohms (in series with 2.15μF) when the 2wire port interfaces loaded cable or a switched network, or 600 ohms (in series with 2.15μF) when the 2wire port interfaces nonloaded cable. A third CBN option accommodates direct 2wire-port interface with a short nonloaded station loop terminated in a Type 500 (or equivalent) telephone set. If, in these applications, the CBN does not provide adequate hybrid balance (i.e., sufficient transhybrid loss), a separate PBN is required. Generally, a separate PBN is also necessary in applications where the module's 2wire port interfaces a long length of nonloaded cable.

2.05 The PBN used with the **6122 module** can be provided either as a Tellabs 423X PBN module or, more conveniently, as a Tellabs 9930 (Issue 3 or later) or 9932 (Issue 2 or later) PBN subassembly. While the 423X PBN is a separate Type 10 module, the 993X is a subassembly that plugs physically and electrically into 4-pin receptacle *J2* on the 6122's printed circuit board. Because the **6122A module** makes no provision for a plug-on PBN (due to the presence of loopback circuitry in place of the 6122's PBN subassembly receptacle), any PBN used with the 6122A must be a separate device, such as a Tellabs 423X PBN module. The 993X and 423X PBN's are available in several versions to approximate the impedances of specific transmission facilities and station equipment. For complete information on these PBN's, please refer to the Tellabs 993X and 423X practices.

2.06 To further improve hybrid balance, especially in applications where a **PBN for loaded cable** is used with the 6122 or 6122A, from 0 to 0.030μF of network build-out (NBO) capacitance can be introduced across the module's balance port. This NBO capacitance can also be used to compensate for the capacitance of office cables or other equipment or to compensate for drop build-out (DBO) capacitors on the 2wire loop. Please note that while NBO capacitance **can be used** with a CBN or with a PBN for nonloaded cable or a tel set, the NBO capacitance introduced in these cases may or may not result in significantly improved hybrid balance. The amount of additional transhybrid loss obtained in such applications depends upon individual circuit characteristics.

2.07 Located on the 4wire side of the hybrid are "terminal-side" prescription attenuators in the transmit and receive paths. These attenuators, in conjunction with transmit and receive prescription amplifiers on the 4wire side, provide full coordination between 4wire-side and 2wire-side levels, as described in paragraph 2.10.

facility (4wire) interface and sealing-current source

2.08 The 6122 or 6122A interfaces the 4wire-side (SF) transmission facility via prescription amplifiers in the transmit and receive paths and via transformers at the 4wire transmit and 4wire receive ports. Both facility-side transformers provide 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 approximately 2dB of extra slope equalization for nonloaded cable through the deliberate impedance mismatch. Both facility-side transformers are center-tapped to derive balanced simplex leads (see paragraph 2.09).

2.09 An integral sealing-current source in the 6122 and 6122A can be switch-optioned into the circuit to apply 20mA of sealing current to metallic facility-side transmit and receive pairs. This current flows outward from the 4wire transmit port (pins 41 and 47) and returns via the 4wire receive port (pins 7 and 13). When the internal sealing-current source is switched out of the circuit, normal simplex leads are derived on the facility side. These simplex leads can be used to provide sealing current to the facility from a source *external* to the module if such an arrangement is desired.

level control

2.10 Prescription-set transmit and receive amplifiers on the facility side of the 6122 and 6122A allow each module to interface the 4wire 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 (4wire) and terminal-side (2wire) levels (see figure 5). In the receive channel, the facility-side amplifier is set to provide the gain 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 2wire output level. In the transmit channel, the terminal-side attenauator 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 6122 and 6122A 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. Thus, 4wire receive TLP's from −17 to +7 can be accommodated and 2wire output TLP's from +7 to −17 can be derived. In a similar manner, 2wire input TLP's of −16 to +8 can be accommodated and 4wire transmit 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.

receive-channel amplitude equalization

2.11 A prescription active slope-type amplitude equalizer in the 6122 and 6122A provides post-equalization of the facility-side (4wire) receive pair. From 0 to 7.5dB of gain at 2804Hz (re 1004Hz) can be introduced into the 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. Frequency response of the equalizer is shown graphically in figure 6 and in tabular form in table 1. **Note:** *Because introduction of equalization into the receive channel of the 6122 or 6122A does not affect 1004Hz levels, equalization can be introduced not only before but also* **after** *transmission levels are set.*

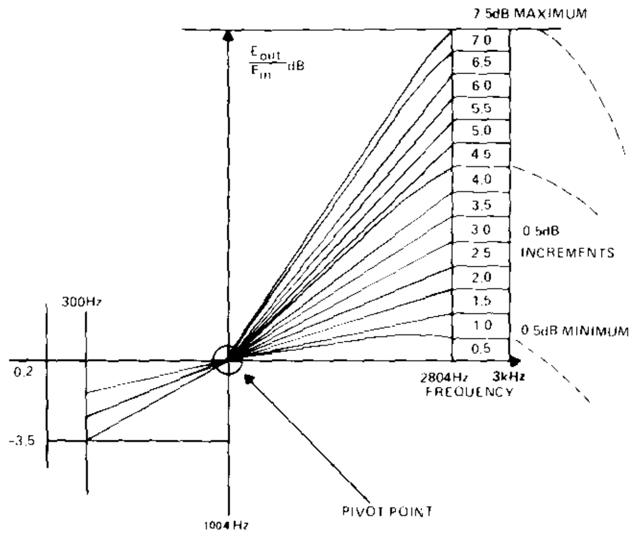


figure 6. Typical response curves for receive-channel active slope equalizer

E&M signaling interfaces

2.12 The 6122 and 6122A can each be switch-optioned to derive either a Type I (single-lead) or a Type II or III (looped-signaling-lead) E&M interface.

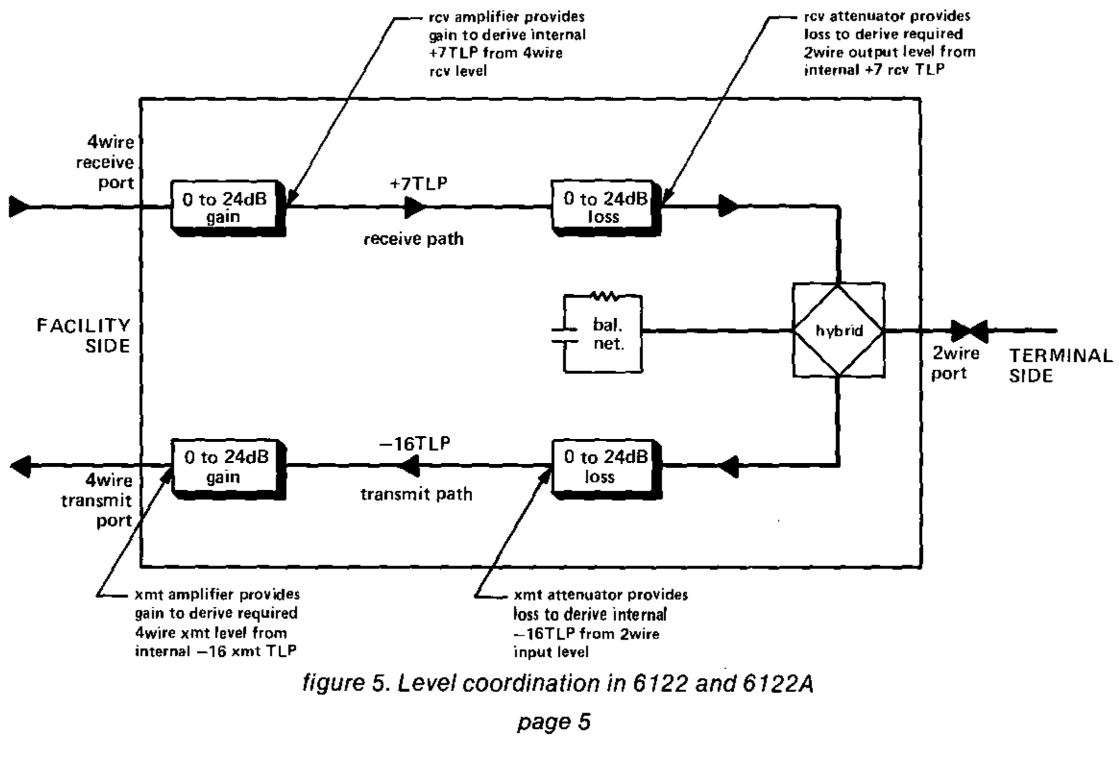


figure 5. Level coordination in 6122 and 6122A

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 receive-channel slope equalization

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. The Type I and Type II interfaces can be used with either A-side or B-side E&M signaling (see paragraphs 2.13 through 2.17). The Type III interface can be used with A-side signaling only. Figure 7 shows the connections required for Type I, II, and III E&M signaling interfaces.

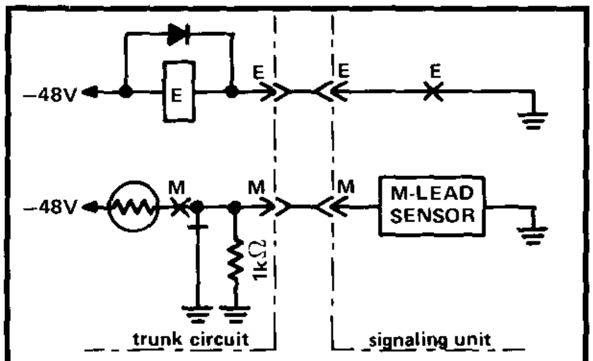


figure 7a. Type I E&M signaling interface

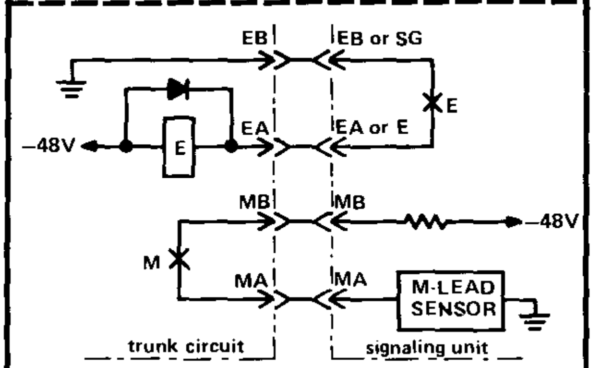


figure 7b. Type II E&M signaling interface

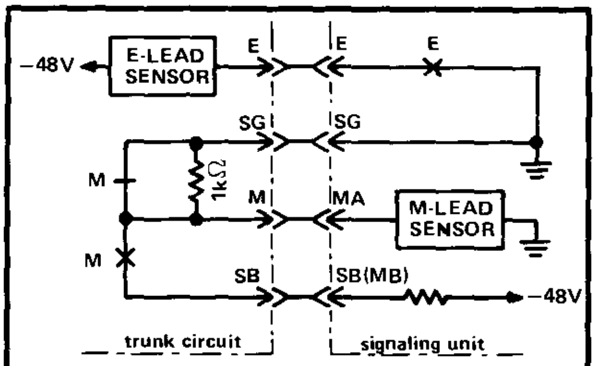


figure 7c. Type III E&M signaling interface

figure 7. E&M signaling interfaces

E&M signaling modes

2.13 Both the 6122 and 6122A can be switch-optioned for either A-side or B-side E&M signaling. A-side (conventional terminal-side) signaling is used when the associated registered terminal equipment provides a ground on the E-lead for call origination. B-side (sometimes referred to as "facility-side") signaling is used when the associated registered terminal equipment provides battery on the M lead for call origination. Each of these E&M signaling modes is described in detail below.

2.14 **A-Side E&M Signaling.** A-side E&M signaling is used with Registered Facility Interface Codes TC11M, TL11M, TC12M, and TL12M. In typical A-side SF-to-E&M signaling applications (with a Type I interface), the 6122 or 6122A provides an E-lead output that is open when SF tone is detected at the 4wire receive 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 either open or at ground potential, and tone transmission ceases when the M lead is at negative battery potential.

2.15 The E-lead output from the 6122 or 6122A is derived via a mercury-wetted relay with a normally open contact. This contact 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 4wire receive port and is de-energized when SF tone is detected. The minimum-break **receive** pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is de-energized for a minimum of 50ms. After this 50ms 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.

2.16 **B-Side E&M Signaling.** B-side E&M signaling is used with Registered Facility Interface Codes TC11E, TL11E, TC12E, and TL12E. In typical B-side SF-to-E&M signaling applications (with a Type I interface), the 6122 or 6122A provides an M-lead output that is at ground potential when SF tone is detected at the 4wire receive 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.

2.17 The M-lead output from the 6122 or 6122A is derived via a mercury-wetted relay with a normally open contact. This contact can be externally wired to accommodate either Type I or Type II M-lead interface (Type III **cannot** be used with B-side signaling). Regardless of the contact wiring, however, the relay is de-energized when the module senses no SF tone at the 4wire receive port and is energized when SF tone is detected. The minimum-break **receive** pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is energized for a minimum of 50ms. After this 50ms input break interval, the relay de-energizes upon absence of tone. The minimum-break **transmit** pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms.

incoming SF tone detection

2.18 The 6122 and 6122A are designed to interface the receive path on the facility (4wire) side at any TLP from −17 to +7. Idle-state SF tone is received at a nominal −20dBm0 level. 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.

2.19 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 2 and 3 for details concerning BEF insertion.

2.20 The minimum-break pulse corrector in the receive path is designed to ignore momentary losses of SF tone of up to 50ms in duration. This corrector also ensures that E-lead breaks (in A-side signaling) or M-lead breaks (in B-side signaling) have a minimum duration of 50ms. The module recognizes signaling-state changes in the receive direction 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

2.21 The 6122 and 6122A are 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 modules transmit SF tone at −20dBm0. During dial pulsing and also for the first 400ms each time they apply tone to the facility, the modules transmit 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

2.22 A symmetrical delay of approximately 20ms 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 2.25.

2.23 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 (in A-side signaling) or E-lead (in B-side signaling) state changes longer than 50 milliseconds.

transmit path cut

2.24 The transmit voice path through the 6122 and 6122A is cut (opened) during idle circuit conditions and is restored when the M lead (A-side signaling) or 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.

2.25 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 2 and 3.

SF tone source

2.26 The 6122 and 6122A each contain an integral 2600Hz SF tone oscillator and therefore do not require an external SF tone supply. This makes these modules especially convenient for

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 2. 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

*E-lead transition for B-side signaling.

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

use in low-density applications. If operation from a master SF tone oscillator is desired, provision can be made via factory modification 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 6122 and 6122A is capacitively coupled and presents a load impedance of greater than 100 kilohms to the tone source.

power

2.27 The 6122 and 6122A are 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 without the internal-sealing-current and loopback options activated is 105mA. When the sealing-current option is activated on either module, an additional 25mA is required; when the 6122A is placed into loopback, another 40mA is required.

loopback (6122A only)

2.28 Integral facility-side (4wire-side) loopback circuitry in the 6122A allows signals at the 4wire receive port to be looped back to the 4wire transmit port for testing of both the module and the facility. Figure 8 shows the loopback path through the module. Prescription loopback-level-control circuitry introduces from 0 to 23dB of gain or loss into the loopback path in switch-selectable increments (23dB loss; 0.5, 1.5, 3, 6, and 12dB gain) to provide true equal-level loopback. A switch option busies out the terminal equipment during loopback, if desired, to prevent inadvertent seizure of the trunk circuit or line circuit. **This option can only be used, however, with A-side signaling and Type I E&M interface.** In such applications, the option busies out the terminal equipment by grounding the E lead.

2.29 **Manual Loopback.** Manual loopback, which is convenient for local testing, is controlled by DIP-switch position *S2-2* on the 6122A's loopback subassembly. Loopback is activated by setting this switch to the *ON* position and is deactivated by setting the switch to *OFF*. (Loopback **cannot** be activated by applying nominal 2713Hz tone to the 6122A's 4wire receive pair when the module is in the manual loopback mode.)

2.30 **Two-Tone Loopback.** Two-tone loopback, which is convenient for remote testing, is activated by applying nominal 2713Hz tone to the 6122A's receive input pair (pins 7 and 13). This tone must fall within a 35Hz bandwidth centered at 2713Hz and must be at a level above −20dBm. The duration of this activation tone must be at least 1.4 seconds, and loopback is activated only upon **removal** of the tone. With two-tone loopback, three loopback-deactivation options are available. The first is **no timeout**, i.e., deactivation by a second tone only. With this option, the module remains in loopback until nominal 2713Hz tone is applied again, this time for at least 0.7 second, after which loopback is deactivated regardless of whether or not the tone is removed. (The difference in the required durations of the loopback-activation and loopback-deactivation tones prevents the accidental looping back of other modules that may be in the circuit.) The second and third loopback-deactivation options are automatic deactivation after a **2.6-minute timeout** or a **20.8-minute timeout** if nominal 2713Hz tone is not applied for at least 0.7 second prior to the expiration of the selected timeout interval. These timeout modes not only allow a choice of test-period duration but also provide the additional benefit of preventing the 6122A from being left in the loopback state after testing is completed.

3. installation

inspection

3.01 The 6122 and 6122A 2Wire E&M SF Signaling Set modules 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 modules should be visually inpsected again prior to installation.

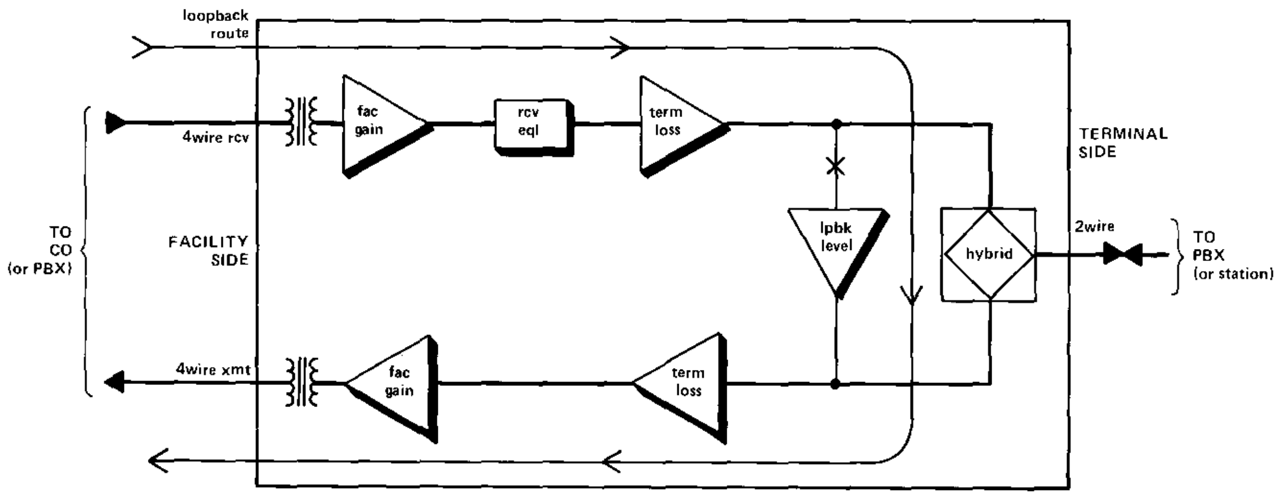


figure 8. Loopback route through 6122A

mounting

> **Caution:** *The 6122 and 6122A each use a mercury-wetted relay for E-lead (A-side signaling) or M-lead (B-side signaling) output. Before installation, each 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.*

3.02 The 6122 and 6122A each mount in one position of a Tellabs Type 10 Mounting Shelf or in one position of a Tellabs 262, 262U, or 260A Mounting Assembly. The modules plug physically and electrically into 56-pin connectors at the rear of their shelf or assembly positions.

installer connections

3.03 In applications where the 6122 or 6122A module is to be installed in a 262, 262U, or 260A Assembly, no external connections to the module itself need be made. All internal connections in these assemblies are factory-prewired, and all external wiring is simplified through the use of female 25-pair micro-ribbon connector-ended cables arranged in accordance with Universal Service Order Code (USOC) RJ2HX. If the customer's terminal equipment is cabled in accordance with USOC RJ2HX, direct cable connection to the 262, 262U, or 260A Assembly and to the customer's equipment is possible. If not, cross-connections between the assembly and the local terminal equipment must be made at an intermediate connectorized terminal block.

3.04 When a 6122 or 6122A module is to be installed in a conventional Type 10 Shelf, external connections to the module must be made. Before making any connections to the shelf, ensure 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.

3.05 Table 4 lists external connections to the 6122 and 6122A modules. All connections are made (to non-connectorized mounting shelves) via wire-wrapping to the 56-pin connectors at the rear of the modules' shelf positions. Pin numbers are found on the body of each connector.

connect:	to pin:
4WIRE RCV TIP	7
4WIRE RCV RING	13
4WIRE XMT TIP	41
4WIRE XMT RING	47
2WIRE TIP	55
2WIRE RING	49
E lead	23
M lead	21
−BATT (−22 to −56Vdc filtered input)	35
GND (ground)	17
SB (signal battery)*	1
SG (signal ground)*	19
EXT BAL NET (external balance network)**	5 and 15
T1 (intermodule tip)**	25
R1 (intermodule ring)**	31
RB TONE IN (ringback tone input)**	37
4WIRE RCV SX (receive simplex, facility side)**	11
4WIRE XMT SX (transmit simplex, facility side)**	45
XMT PATH CUT lead**	27
A lead†	43
B lead†	51
EXT OSC (external SF tone oscillator)††	39

* Mandatory for Type II and III E&M interfaces only.
** Optional.
*** Optional; a ground on this lead cuts (opens) the transmit voice path.
† Not available for external connection to module.
†† Available only by factory modification.

table 4. External connections to 6122 and 6122A

option selection

3.06 All options on the 6122 and 6122A modules are selected via slide or DIP switches whose locations on the modules' printed circuit boards are shown in figure 9. Table 5 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.

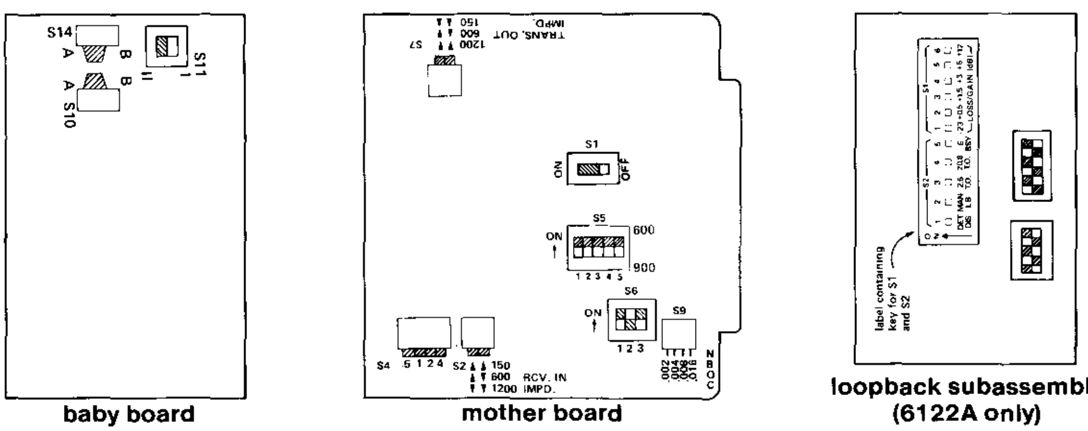


figure 9. 6122 and 6122A option switch locations

Note 1: *Included in table 5 is a checklist for* **prescription** *optioning of the 6122 or 6122A. 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 each module.*

Note 2: *Although the receive equalization DIP switch and the network build-out (NBO) capacitance DIP switch of the 6122 and 6122A are located on their printed circuit boards instead of on their front panels, introduction of equalization and NBO capacitance are more closely related to alignment than to switch-optioning. Thus, instructions for setting the equalization and NBO capacitance switches are provided under* **alignment** *later in this section.*

2wire port impedance

3.07 Terminating impedance at the 2wire port of the 6122 or 6122A is selected via five-position DIP switch *S5* on the module's main printed circuit board. On some modules, *S5* is a ganged DIP switch, in which case all five switch positions are set simultaneously. On other modules, *S5* is a conventional DIP switch, in which case the five switch positions must be set individually. In either case, to select 600 ohms in series with 2.15μF, set **all five positions** (*S5-1* through *S5-5*) of switch *S5* to *ON*. To select 900 ohms in series with 2.15μF, set **all five positions** of switch *S5* to *OFF*.

balance-network options

3.08 Balance-network options are selected via three-position DIP switch *S6* on the main board. To include the module's internal compromise balance network (CBN) in the circuit and to select 600 ohms plus 2.15μF (as is typically used with nonloaded cable), set *S6-1* and *S6-3* to *ON* and *S6-2* to *OFF*. To include the CBN and to select 900 ohms plus 2.15μF (as is typically used with loaded cable), set *S6-1* to *ON* and *S6-2* and *S6-3* to *OFF*. To include the CBN and to provide proper balance for a short nonloaded station loop and a Type 500 (or equivalent) telephone, set *S6-2* to *ON* and *S6-1* and *S6-3* to *OFF*. To exclude the CBN from the circuit when a precision balance network is to be used instead, set *S6-1*, *S6-2*, and *S6-3* to *OFF*.

4wire receive port impedance

3.09 Terminating impedance at the module's 4wire receive port is selected via two-position DIP switch *S2* on the main board. To select 1200 ohms (for loaded cable), set *S2-1* and *S2-2* to *OFF*. To select 600 ohms (for nonloaded cable or carrier), set *S2-1* to *ON* and *S2-2* to *OFF*. To select 150 ohms (which provides approximately 2dB of extra slope equalization for nonloaded cable), set *S2-1* and *S2-2* to *ON*.

4wire transmit port impedance

3.10 Terminating impedance at the module's 4wire transmit port is selected via two-position DIP switch *S7* on the main board. To select 1200 ohms (for loaded cable), set *S7-1* and *S7-2* to *OFF*. To select 600 ohms (for nonloaded cable or carrier), set *S7-1* to *ON* and *S7-2* to *OFF*. To select 150 ohms (which provides approximately 2dB of extra slope equalization for nonloaded cable), set *S7-1* and *S7-2* to *ON*.

simplex-lead/sealing-current selection

3.11 Switch *S1* on the main board either provides access to the module's facility-side simplex leads or connects the module's integral sealing-current source such that current flows from the 4wire receive port and returns via the 4wire transmit port. If the module's own sealing-current source is to be used, set *S1* to *ON*. If access to the module's simplex leads is required (e.g., for application of externally generated sealing current), set *S1* to *OFF*.

E&M signaling interface

3.12 Switch *S11* on the module's baby board (for the 6122A, this is the **large** baby board, not the smaller loopback subassembly) conditions the 6122 or 6122A 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 2wire 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* (on) position (for Type I or Type III) or to the *II* (off) position (for Type II) as appropriate.

Note 1: *For Type I E&M interface, a common equipment ground must be used.*

Note 2: *The Type III E&M interface can be used only with A-side E&M signaling (see paragraph 3.15).*

A-side/B-side E&M signaling

3.13 Switches *S10* and *S14* on the module's baby board select either A-side (conventional terminal-side) or B-side (sometimes referred to as "facility-side") E&M signaling. For A-side E&M signaling, set both *S10* and *S14* to the *A* position. For B-side E&M signaling, set both *S10* and *S14* to the *B* position. **These switches function together, and both must always be set to the same position.**

loopback options (6122A only)

3.14 All loopback options on the 6122A (except loopback-level adjustment, which is covered under **alignment** later in this section) are selected via five-position DIP switch *S2* **on the module's loopback subassembly.** (This subassembly is the smaller of the two baby boards on the 6122A.) Switch *S2-2* controls manual loopback of the 6122A. To activate manual loopback, set *S2-2* to *ON*. To deactivate manual loopback, set *S2-2* to *OFF*. Switches *S2-1*, *S2-3*, and *S2-4* control two-tone loopback of the 6122A. If two-tone loopback (activated by application of 2713Hz tone to the 4wire receive pair) is desired, set *S2-1* to *ON* to enable the module's tone-loopback detector. If two-tone loopback is not

option	switch	selections	settings	checklist
2wire-port terminating impedance	S5-1 through S5-5* on main board	600 ohms + 2.15μF	S5-1 through S5-5 ON*	
		900 ohms + 2.15μF	S5-1 through S5-5 OFF*	
internal compromise-balance-network options	S6-1 through S6-3 on main board	CBN excluded from circuit (for use of PBN)	S6-1 OFF S6-2 OFF S6-3 OFF	
		CBN included in circuit; 600 ohms +2.15μF (for nonloaded cable)	S6-1 ON S6-2 OFF S6-3 ON	
		CBN included in circuit; 900 ohms +2.15μF (for loaded cable)	S6-1 ON S6-2 OFF S6-3 OFF	
		CBN included in circuit; short-loop and Type 500 tel-set interface	S6-1 OFF S6-2 ON S6-3 OFF	
4wire-receive-port terminating impedance	S2-1 and S2-2 on main board	1200 ohms (loaded cable)	S2-1 OFF S2-2 OFF	
		600 ohms (nonloaded cable or carrier)	S2-1 ON S2-2 OFF	
		150 ohms (extra equalization for nonloaded cable)	S2-1 ON S2-2 ON	
4wire-transmit-port terminating impedance	S7-1 and S7-2 on main board	1200 ohms (loaded cable)	S7-1 OFF S7-2 OFF	
		600 ohms (nonloaded cable or carrier)	S7-1 ON S7-2 OFF	
		150 ohms (extra equalization for nonloaded cable)	S7-1 ON S7-2 ON	
facility-side sealing current or simplex leads	S1 on main board	nominal 20mA of internally generated sealing current applied to 4wire xmt and rcv pairs	ON	
		access provided to 4wire-side simplex leads (e.g., for application of externally generated sealing current)	OFF	
E&M signaling interface	S11 on large baby board	Type I or Type III interface	I (ON)	
		Type II interface	II (OFF)	
A-side or B-side E&M signaling	S10 and S14 on large baby board	A-side signaling	S10 to A S14 to A	
		B-side signaling	S10 to B S14 to B	
manual loopback (6122A only)	S2-2 on loopback subassembly	loopback activated	S2-2 ON	
		loopback deactivated	S2-2 OFF	
tone loopback detector for 2713Hz two-tone loopback (6122A only)	S2-1 on loopback subassembly	detector enabled for two-tone loopback	S2-1 ON	
		detector disabled for **no** two-tone loopback	S2-1 OFF	
loopback timeout interval for 2713Hz two-tone loopback (6122A only)	S2-3 and S2-4 on loopback subassembly	2.6-minute timeout	S2-3 ON S2-4 OFF	
		20.8-minute timeout	S2-3 ON S2-4 ON	
		no timeout (second-tone deactivation only)	S2-3 OFF S2-4 OFF	
E-lead forced busy during loopback (6122A only)**	S2-5 on loopback subassembly	E-lead grounded (busy) during loopback**	S2-5 ON**	
		E-lead open (not busy) during loopback	S2-5	

* On some 6122 and 6122A modules, *S5* is a ganged DIP switch, in which case all five positions (*S5-1* through *S5-5*) are set to *ON* or *OFF* simultaneously. On other 6122 and 6122A modules, *S5* is a conventional (non-ganged) DIP switch, in which case it is necessary to set all five positions to *ON* or *OFF* individually.

** The E-lead forced-busy option can be used only when the 6122A is optioned for A-side signaling and Type I E&M interface.

table 5. 6122 and 6122A switch-option summary and checklist

desired, set *S2-1* to *OFF* (this also disables *S2-3* and *S2-4*; set them to *OFF* as well). If two-tone loopback is selected and loopback deactivation by a second tone only (i.e., **no** automatic loopback deactivation after a timeout interval) is desired, set *S2-3* and *S2-4* to *OFF*. If two-tone loopback is selected and automatic loopback deactivation after a 2.6-minute timeout is desired, set *S2-3* to *ON* and *S2-4* to *OFF*. If two-tone loopback is selected and automatic loopback deactivation after a 20.8-minute timeout is desired, set *S2-3* and *S2-4* to *ON*. (In either timeout mode, loopback can be deactivated prior to timeout by application of 2713Hz tone.) If, when the 6122A is optioned for A-side signaling and Type I E&M interface, it is desired that the E lead be forced busy (grounded) during loopback to prevent seizure of the associated terminal-side equipment, set *S2-5* to *ON*. If forced busying of the E lead during loopback is not desired, and/or if the 6122A is **not** optioned for A-side signaling and Type I E&M interface, set *S2-5* to *OFF*.

alignment (general)

3.15 Alignment of the 6122 comprises four main parts, with one additional part required for the 6122A. These parts are as follows:

A. Introducing facility-side gain into the receive channel to derive an internal +7 transmission level point (TLP) from the 4wire receive level; then introducing terminal-side loss to derive the desired 2wire output level.
B. Introducing prescription active slope-type amplitude equalization, if required, to post-equalize the input to the receive channel.
C. Introducing terminal-side loss into the transmit channel to derive an internal −16TLP from the 2wire input level; then introducing facility-side gain to derive the desired 4wire transmit level.
D. Adjusting the module's NBO capacitors to achieve optimum hybrid balance either when a PBN for loaded cable is used instead of the module's internal CBN or when it is necessary to compensate for office cable capacitance.
E. For the 6122A only, introducing the proper amount of gain or loss into the loopback path to provide true equal-level loopback (if desired).

prescription alignment

3.16 The 6122 and 6122A are primarily intended for **prescription alignment**. In prescription alignment, all gain, loss, equalization, NBO capacitance, and loopback-level switch settings are determined from circuit records prior to installation of the module. These settings are then noted in the **checklist** column of table 6, 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 6 (or to the CLR) and set all gain, loss, equalization, NBO-capacitance, and loopback-level switches as indicated.

introduction to non-prescription alignment

3.17 In applications where prescription alignment settings are unavailable (and in applications where prescription alignment does not provide adequate results), non-prescription alignment of the 6122 or 6122A is necessary. Access to the appropriate ports of the module is conveniently provided via its six front-panel bantam jacks. Equipment required for non-prescription alignment consists of a transmission measuring set (TMS), preferably one with independent transmit and receive impedance settings. If the module's receive equalizer and/or NBO capacitors or the 6122A's loopback-level-adjustment circuitry is to be used, a Tellabs 9801 or 9802 Card Extender (or equivalent) will facilitate alignment by allowing access to the equalization and NBO-capacitance DIP switches on each module's printed circuit board and the loopback-level DIP switch on the 6122A's loopback subassembly while the module is in place and operating.

prealignment switch settings for non-prescription aligment

3.18 Before beginning actual non-prescription alignment of the 6122 or 6122A, do the following:

A. Ensure that all option switches (see table 6 for a listing), especially those that select the module's 4wire receive, 4wire transmit, and 2wire port impedances, are properly set.
B. Ensure that the module's receive equalizer is excluded from the circuit (all four positons of DIP switch *S4* set to *ON*).
C. Ensure that no NBO capacitance is introduced (all four positions of DIP switch *S9* set to *OFF*).
D. For the 6122A only, ensure that the loopback level is set for zero loss or gain (all six positions of DIP switch *S1* on the loopback subassembly set to *OFF*).
E. 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

3.19 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, insertion and adjustment of the receive-channel slope equalizer 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:

facility gain:

A. Arrange the receive portion of the TMS for 600 or 900-ohm terminated measurement, as appropriate, and connect it to the module's *2w* jack. (If the receive portion of the TMS does not have a 900-ohm setting and the 2wire port is optioned for 900 ohms, reoption the 2wire port for 600 ohms by setting *S5-1* through *S5-5* to the *600* position. Then arrange the TMS for

alignment function	switch	selections	settings	checklist
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 (2804Hz gain re 1004Hz)	S4-1 through S4-4** on main board	0.5dB	S4-1 OFF	
		1.0dB	S4-2 OFF	
		2.0dB	S4-3 OFF	
		4.0dB	S4-4 OFF	
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	
NBO capacitance	S9-1 through S9-4 on main board†	0.002μF	S9-1 ON	
		0.004μF	S9-2 ON	
		0.008μF	S9-3 ON	
		0.016μF	S9-4 ON	
loopback gain/loss (6123A only)	S1-1 through S1-6 on loopback subassembly††	23dB loss	S1-1 ON	
		0.5dB gain	S1-2 ON	
		1.5dB gain	S1-3 ON	
		3dB gain	S1-4 ON	
		6dB gain	S1-5 ON	
		12dB gain	S1-6 ON	

* 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 four positions of receive-equalizer DIP switch *S4* are cumulative. Total equalized gain introduced at 2804Hz (re 1004Hz) is the sum of those *S4* positions set to *OFF*. For no receive equalization, set *S4-1* through *S4-4* to *ON*.

† The four positions of DIP switch *S9* are cumulative. Total NBO capacitance introduced is the sum of those *S9* positions set to *ON*. For no NBO capacitance, set *S9-1* through *S9-4* to *OFF*.

†† The six positions of loopback-level DIP switch *S1* on the loopback subassembly (6122A only) are cumulative. Total gain or loss introduced into the loopback path is the sum of those *S1* positions set to *ON*. For zero gain or loss in the loopback path, set *S1-1* through *S1-6* to *OFF*.

table 6. 6122 and 6122A alignment-switch summary and checklist

600-ohm terminated measurement and connect it as directed above.)

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 end, set the proper combination of front-panel *rcv fac gain* DIP switch positions to *in* so that a +7dBm level is achieved. If equalization for nonloaded cable is desired, proceed to step D. If no receive-channel equalization is desired, proceed to step F.

nonloaded-cable equalization:

D. If the 4wire facility consists of nonloaded cable, subtract the 2804Hz level measured in step B from the 1004Hz level also measured in step B.

E. Set to *OFF* the proper combination of DIP-switch *S4* positions that approximates as closely as possible the difference determined in step D (the amount of equalized gain required), as directed in table 7.

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 7. Receive-channel equalized gain settings for nonloaded cable

terminal loss:

F. Refer to the CLR for the specified 2wire 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 2wire output level.

I. If the required 2wire-port terminating impedance is 900 ohms, wait until the transmit channel is aligned before resetting *S5-1* through *S5-5* to the *900* position. This completes alignment of the receive channel. Disconnect the TMS from the module.

non prescription transmit-channel alignment

3.20 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 transmit-channel slope equalizer to provide the required amount of equalization, and adjustment of the front-panel *xmt fac gain* switches to provide the specified transmit output level. Align the transmit channel as follows:

terminal loss:

A. Remove the transmit speech path cut by seizing the circuit from the 2wire side (thus causing loop current to flow). As an alternative, if the TMS being used for alignment is equipped with a holding coil, this can be used to seize the circuit.

B. Set switches *S7-1* and *S7-2* for 600-ohm terminating impedance at the 4wire transmit port if they are not already set for 600 ohms.

C. Set switches *S5-1* through *S5-5* for 600-ohm terminating impedance at the 2wire port if they are not already set for 600 ohms.

D. Arrange the transmit portion of the TMS for 1004Hz tone output at the CLR-specified 2wire input level. (If the TMS has a transmit impedance setting, select 600 ohms.) Connect this signal to the module's *2w* jack.

E. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the module's *4w xmt out* jack.

F. Set the proper combination of front-panel *xmt term loss* DIP-switch positions to *in* so that a −16dBm level is achieved.

facility gain:

G. Refer to the CLR for the specified 4wire transmit level.

H. Calculate the difference between this specified output level and the internally derived −16dBm level.

I. 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.

J. If the required 4wire-transmit-port terminating impedance is other than 600 ohms, reset switches *S7-1* and *S7-2* for the proper impedance.

K. If the required 2wire-port terminating impedance is 900 ohms, set *S5-1* through *S5-5* to the *900* position. This completes alignment of the transmit channel. Disconnect the TMS from the module.

non-prescription PBN alignment and introduction of NBO capacitance

3.21 **Determining Transhybrid Loss.** If it is not known whether the module's internal CBN will provide adequate hybrid balance (transhybrid loss) in a particular application, make this determination as follows:

A. Ensure that the CBN is inserted and properly optioned (DIP switch *S6*) as directed in table 5 or paragraph 3.08.

B. Arrange the transmit portion of the TMS for 1004Hz tone output at the CLR-specified 4wire receive level. (If the transmit portion of the TMS has a separate impedance setting, select the impedance for which the module's 4wire receive port is optioned.) Connect this signal to the module's *4w rcv in* jack.

C. Arrange the receive portion of the TMS for terminated measurement at the impedance selected for the 4wire transmit port. Connect the receive portion of the TMS to the module's *4w xmt out* jack.

D. If the measured output level is too high (i.e., if transhybrid loss is insufficient) to meet the circuit requirements of the application, a PBN may be required or, infrequently, introduction of NBO capacitance in conjunction with the CBN may be necessary to compensate for office cable capacitance or for drop build-out (DBO) capacitors on the 2wire loop. These situations are covered in paragraphs 3.22 through 3.25.

3.22 **Using a PBN.** If the module's internal CBN does not provide sufficient hybrid balance (transhybrid loss), which will probably be the case if the 2wire port interfaces a long length of nonloaded cable and may be the case otherwise, a PBN can be used to improve hybrid balance. When an external PBN (for the 6122 or 6122A) or plug-on PBN (for the 6122 only) is used, exclude the module's internal CBN from the circuit by setting switches *S6-1*, *S6-2*, and *S6-3* to OFF. Then adjust the PBN as directed in the PBN practice.

3.23 To further improve hybrid balance, especially when a **PBN for loaded cable** is used, proceed as follows:

A. Doublecheck that the module's internal CBN is excluded from the circuit (all three positions of DIP switch *S6* set to *OFF*).

B. Refer to table 6 and set to *ON* that combination of DIP-switch *S9* positions which introduces the appropriate amount of NBO capacitance. This amount should be determined from information in the PBN practice or on the CLR. **If this amount is not known, proceed to paragraph 3.24 or 3.25, as applicable. Otherwise, disconnect the TMS from the module. At this point, if NBO capacitance is already introduced**, alignment of the 6122 is complete. For the 6122A, however, one procedure remains; proceed to paragraph 3.26.

3.24 **Introducing NBO Capacitance by TMS Measurement When Required Amount Is Unknown (CBN and PBN Applications).** To introduce NBO capacitance to compensate for office cable capacitance or for DBO capacitors on the 2wire loop when the module's internal CBN is used, or to achieve optimum hybrid balance with a PBN (especially with one for loaded cable) when the required amount of NBO capacitance is unspecified, proceed as follows:

A. Ensure that the CBN is included in the circuit and properly optioned if it is being used or that it is excluded from the circuit if a PBN is being used (DIP switch *S6*).

B. Arrange the transmit portion of the TMS for 1004Hz tone output at the CLR-specified 4wire receive level. (If the transmit portion of the TMS has a separate impedance setting, select the impedance for which the module's 4wire receive port is optioned.) Connect this signal to the module's *4w rcv in* jack.

C. Arrange the receive portion of the TMS for terminated measurement at the impedance selected for the 4wire transmit port. Connect the receive portion of the TMS to the module's *4w xmt out* jack.

D. Using the four positions of DIP switch *S9*, add NBO capacitance until the TMS level reading is at its *lowest* point (i.e., add NBO capacitance until the TMS reading reaches a minimum and then starts to rise; then return to the *S9* setting that produced the minimum reading). Disconnect the TMS from the module. At this point, alignment of the 6122 is complete. For the 6122A, however, one procedure remains; proceed to paragraph 3.26.

3.25 **Introducing NBO Capacitance by Formula When Required Amount Is Unknown (Some CBN Applications).** If the module's internal CBN is being used and an easier method of introducing NBO capacitance (generally, to compensate for office cable capacitance) is desired than the procedure in paragraph 3.24, proceed as follows:

Note: *The amount of NBO capacitance introduced by this method should provide adequate results in most applications. If it does not, the procedure in paragraph 3.24 must be performed.*

A. From table 8, calculate the required amount of NBO capacitance for the type and length of cable interfacing the module's 2wire port. (For example, if 1.2 kilofeet of high-capacitance cable interfaces the module's 2wire port, multiply **1.2** kilofeet by **0.016μF** per kilofoot to obtain 0.0192μF.)

B. Set to *ON* that combination of DIP-switch *S9* positions which most closely approximates the calculated amount of NBO capacitance. (For the example in step A, you would set *S9-4* and *S9-2* to *ON* to introduce 0.020μF, the closest possible amount to 0.0192μF.) At this point, alignment of the 6122 is complete. For the 6122A, however, one procedure remains; proceed to paragraph 3.26.

type of cabling interfacing 2wire port:	amount of NBO capacitance to be introduced for each kilofoot of cable between module and local office equipment:
high capacitance (0.083μF per mile)	0.016μF per kilofoot
low capacitance (0.066μF per mile)	0.012μF per kilofoot

table 8. Guidelines for introducing NBO capacitance (in conjunction with CBN) by formula to compensate for office cable capacitance

non-prescription loopback-level adjustment (6122A only)

3.26 To adjust the 6122A's loopback-level-control circuitry to provide true equal-level loopback, proceed as follows:

A. From the CLR, determine the specified 2wire input and output levels.
B. Subtract the 2wire input level from the 2wire output level. The result will be the amount of **loss** required in the loopback path, as indicated in the following equation (also see example below):

2wire output level − 2wire input level = amount of loss to be inserted in loopback path

C. On the 6122A's loopback subassembly, set to *ON* that combination of DIP-switch *S1* positions which most closely approximates the amount of loss determined in step B.

Example: In a hypothetical application, the CLR-specified 2wire input level is −2dBm and the CLR-specified 2wire output level is +dBm. Thus, we subtract −2dBm from +dBm as follows:

+2dBm − (−2dBm) = +4dB

Thus, 4dB is the amount of **loss** to be introduced into the loopback path via DIP switch *S1* on the loopback subassembly. (If the result of the subtraction were **negative**, this would be the amount of **gain** required in the loopback path.) To introduce the required amount of loss, we first set switch *S1-1* to *ON* to introduce 23dB of loss and then set the remainder of the *S1* positions to provide the closest possible approximation of 19dB of gain without exceeding it (23dB of loss plus 19dB of gain equals 4dB of loss, the required amount). In this example, the closest we can get to 19dB of gain without exceeding it is 18.5dB (*S1-6*, *S1-5*, and *S1-2* set to *ON*, *S1-4* and *S1-3* set to *OFF*). Thus, we end up introducing 4.5dB of loss (23dB of loss plus 18.5dB of gain) into the loopback path, which puts us within 0.5dB of true equal-level loopback, a tolerance that should suffice in nearly all applications.

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6122 and 6122A 2Wire E&M SF Signaling Set modules, function sequence flowcharts (figures 10 through 12) that illustrate operation of the modules 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. 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 6122 and 6122A block diagram (section 5 of this practice) may aid in understanding flowcharts.

4.02 The flowcharts are intended to familiarize you with the operation of the 6122 and 6122A for engineering, application, and troubleshooting purposes only. Attempts to test or troubleshoot these modules 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 noted, specifications apply to both the 6122 and the 6122A.*

transmission specifications

alignment level range, 4wire rcv port
+7 to −17TLP

alignment level range, 4wire xmt port
+8 to −16 TLP

alignment level ranges, 2wire port
input levels: +8 to −16TLP
output levels: +7 to −17TLP

overload points
4wire rcv port: +5dBm0
4wire xmt port: +5dBm0
2wire port input: +5dBm0
2wire port output: +8dBm

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

insertion loss
0±0.2dB at 1004Hz with gain and loss switches set to zero

receive-channel slope equalization
0.0 to 7.5dB of gain (in switch-selectable 0.5dB increments) at 2804Hz re 1004Hz

2wire port impedance
900 or 600 ohms, balanced, switchable, in series with 2.15μF

4wire port impedances
1200, 600, or 150 ohms, balanced, 300 to 4000Hz, independently switchable at each 4wire port

terminal (2wire) return loss
ERL greater than 28dB

facility (4wire) return loss
ERL greater than 23dB at all three 4wire-port impedance settings

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

transhybrid loss
greater than 35dB ERL, intrinsic

compromise balance network
switch-selectable for 600 ohms plus 2.15μF, 900 ohms plus 2.15μF, or short loop and Type 500 (or equivalent) telephone set

network build-out (NBO) capacitance
0 to 0.030μF in switch-selectable 0.002μF increments

noise
20dBrnC0 maximum at maximum gain (no equalization)

specifications continued on page 21

INCOMING CALL (A-SIDE SIGNALING)

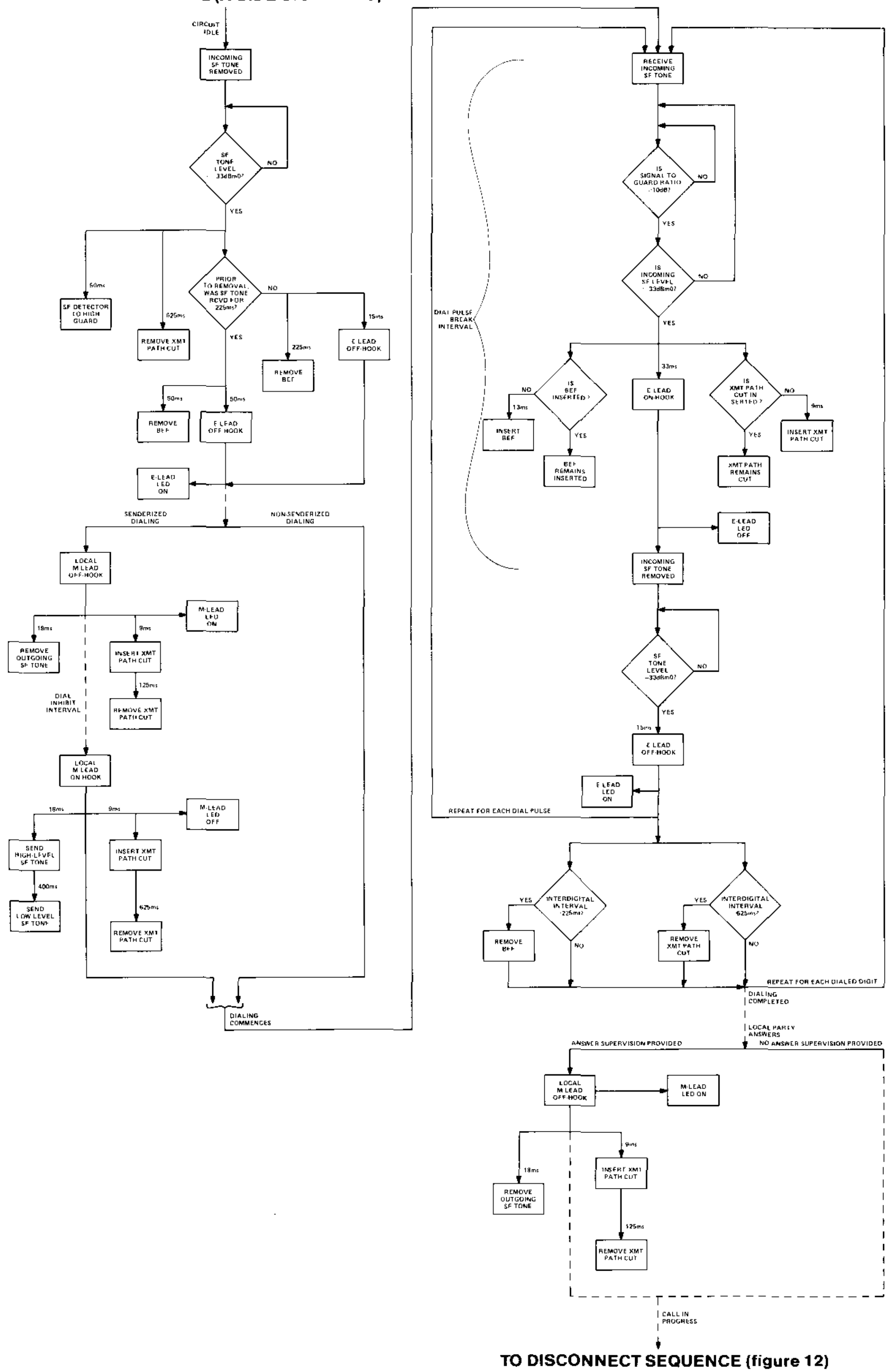


figure 10. Function sequence flowchart, incoming call

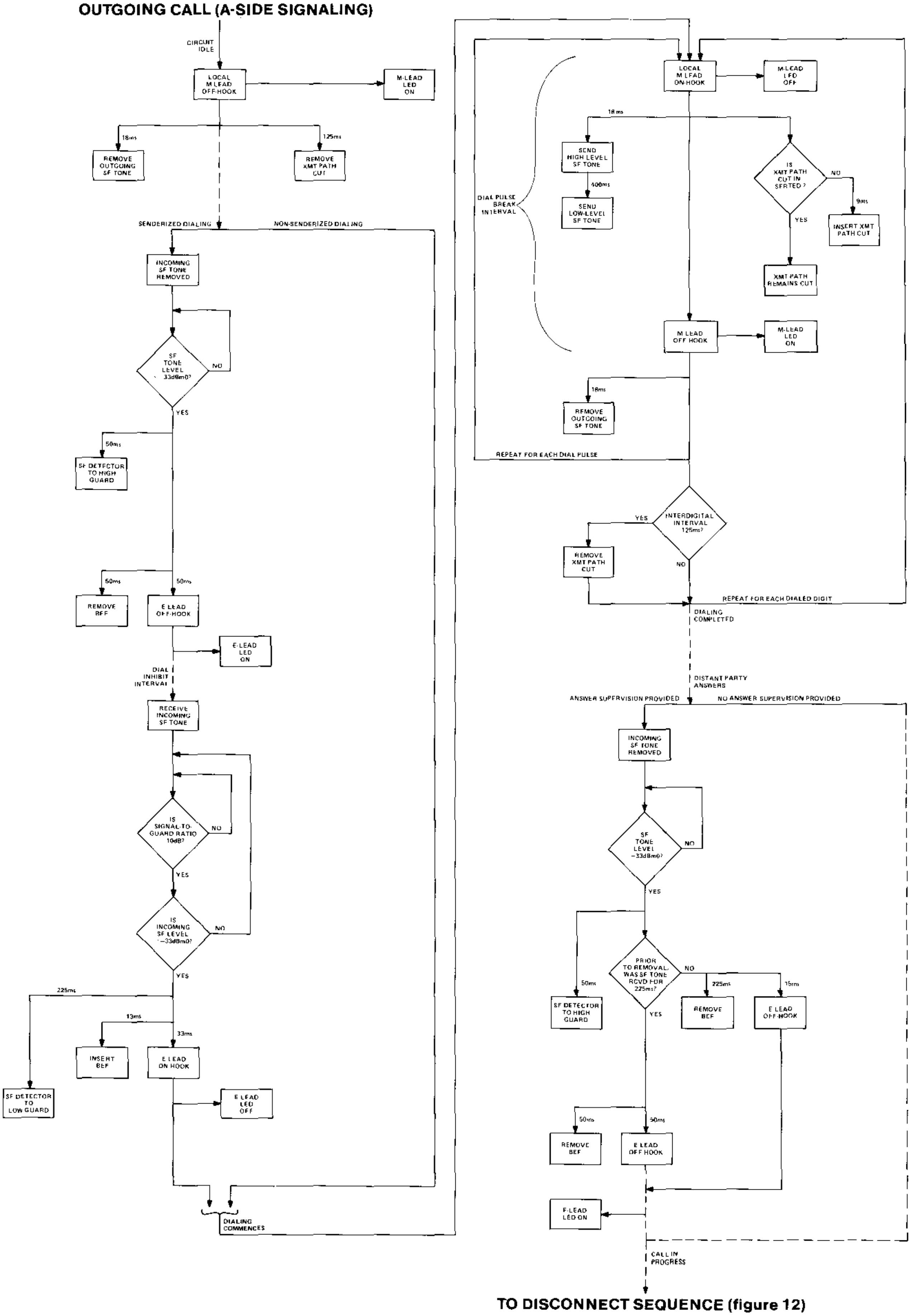


figure 11. Function sequence flowchart, outgoing call

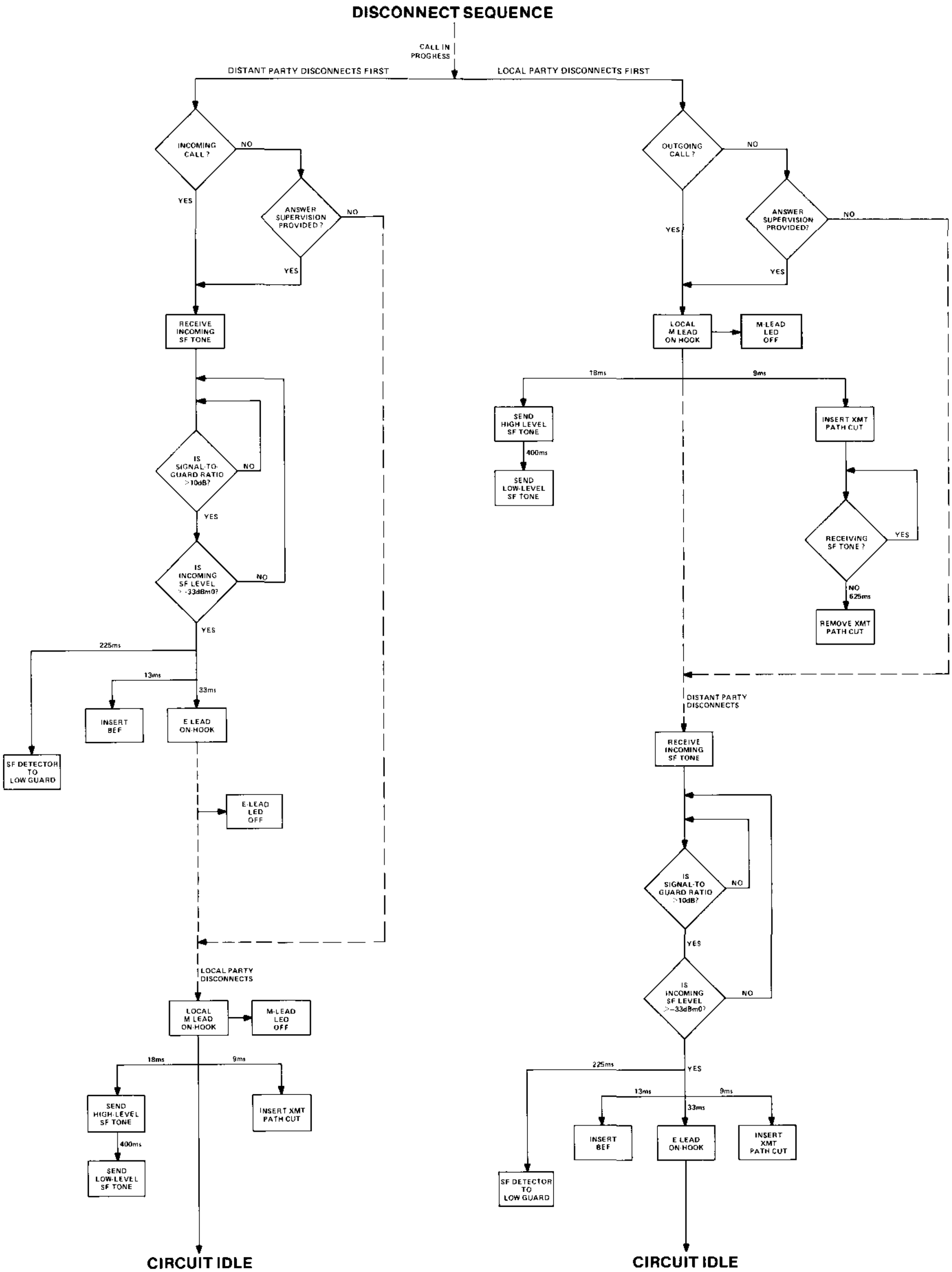


figure 12. Function sequence flowchart, disconnect sequence for incoming and outgoing calls

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

delay distortion
< 200μs, 500 to 4000Hz re 1800Hz, no equalization

total harmonic distortion
4wire ports: less than 1% at +5dBm0
2wire port: less than 1% at +8dBm

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

simplex current
100mA maximum with 5mA maximum unbalance

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: no tone transmitted
dialing: tone transmitted during the break portions of dial pulses

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 states, A-side signaling
idle: open or ground
busy: negative battery (−22 to −56Vdc)

E-lead states, B-side signaling
idle: open
busy: ground

M-lead delay (A-side signaling) or E-lead delay (B-side signaling)
18±5ms delay between M-lead (A-side) or E-lead (B-side) 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 (M-lead or E-lead on-hook intervals) 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 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
−33.5dBm0±2.5dB

SF tone rejection
50dB minimum, 2590 to 2610Hz

signaling bandwidth (high-guard state)
75Hz nominal

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

maximum line noise
51dBrnC0

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 (A-side, Type I), to E-SG contact closure (A-side, Type II), to M-lead battery (B-side, Type I), or to M-SB contact closure (B-side, Type II)
60±20ms

release delay, application of SF tone to E-lead open (A-side, Type I), to E-SG contact release (A-side, Type II), to M-lead ground (B-side, Type I), or to M-SB contact release (B-side, Type II)
33±3ms

dial pulse characteristics, SF to E lead (A-side) or SF to M lead (B-side)

pulse rate	input break ratio
8pps	30 to 80%
10pps	36 to 79%
12pps	44 to 76%

- **input breaks shorter than E-lead seizure delay are ignored**
- **input breaks of a duration between that of E-lead seizure delay and 50ms are transmitted as breaks of 50±2ms**
- **input breaks longer than 50ms are transmitted as breaks equal in duration to input break duration ±2ms**

current limiting
provided for M (Type I, B side) and SB (A side) leads

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

sealing-current source and simplex leads

sealing current
20mA sealing current, excludable via switch option for normal facility-side simplex-lead derivation

simplex current
100mA maximum with 2mA maximum unbalance

external oscillator requirements (optional by factory modification)

frequency	*level*
2600±2Hz	**0.5Vrms**

load impedance
75 kilohms minimum, unbalanced

loopback specifications (6122A only)

loopback control modes

loopback control mode	activation: 2713Hz tone	activation: option switch	deactivation: 2713Hz tone	deactivation: option switch	deactivation: automatic timeout
manual		X		X	
two-tone w/ no timeout	X		X		
two-tone w/ timeout	X		X		2.6-minute timeout
two-tone w/ timeout	X		X		20.8-minute timeout

tone-loopback frequency
2713±35Hz

tone-loopback detection threshold (at 2713Hz)
−26.0dBm0

tone-loopback guard ratio
greater than 3.0dB

tone-loopback activation timing
loopback is activated upon *removal* **of 1.4 ±0.2-second or longer tone**

tone-loopback deactivation timing
loopback is deactivated after receipt of 0.7±0.15-second or longer tone (removal of tone not necessary for deactivation)

loopback level adjustment
0 to 23dB of loss or gain in switch-selectable increments (23dB loss; 0.5, 1.5, 3, 6, and 12dB gain)

power requirements

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

input current
100mA maximum at idle, 105mA maximum when busy, with an additional 25mA required when the internal-sealing-current option is selected and, for the 6122A only, another 40mA required when loopback is activated

physical

operating environment
20° to 130°F (−7° to +54°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
6122: 18 ounces (510 grams)
6122A: 20 ounces (567 grams)

mounting
relay rack or apparatus case via one position of a Tellabs Type 10 Mounting Shelf; can also be mounted in one position of a Tellabs 262U, 262, or 260A Mounting Assembly

7. testing and troubleshooting

7.01 Due to the complexity of the 6122 and 6122A 2Wire E&M SF Signaling Set modules, 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 10 through 12) 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 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 on the 6122 or 6122A module. Unauthorized testing or repairs may void the module's warranty.

Note: *Warranty service does not include removal of permanent customer markings on 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.*

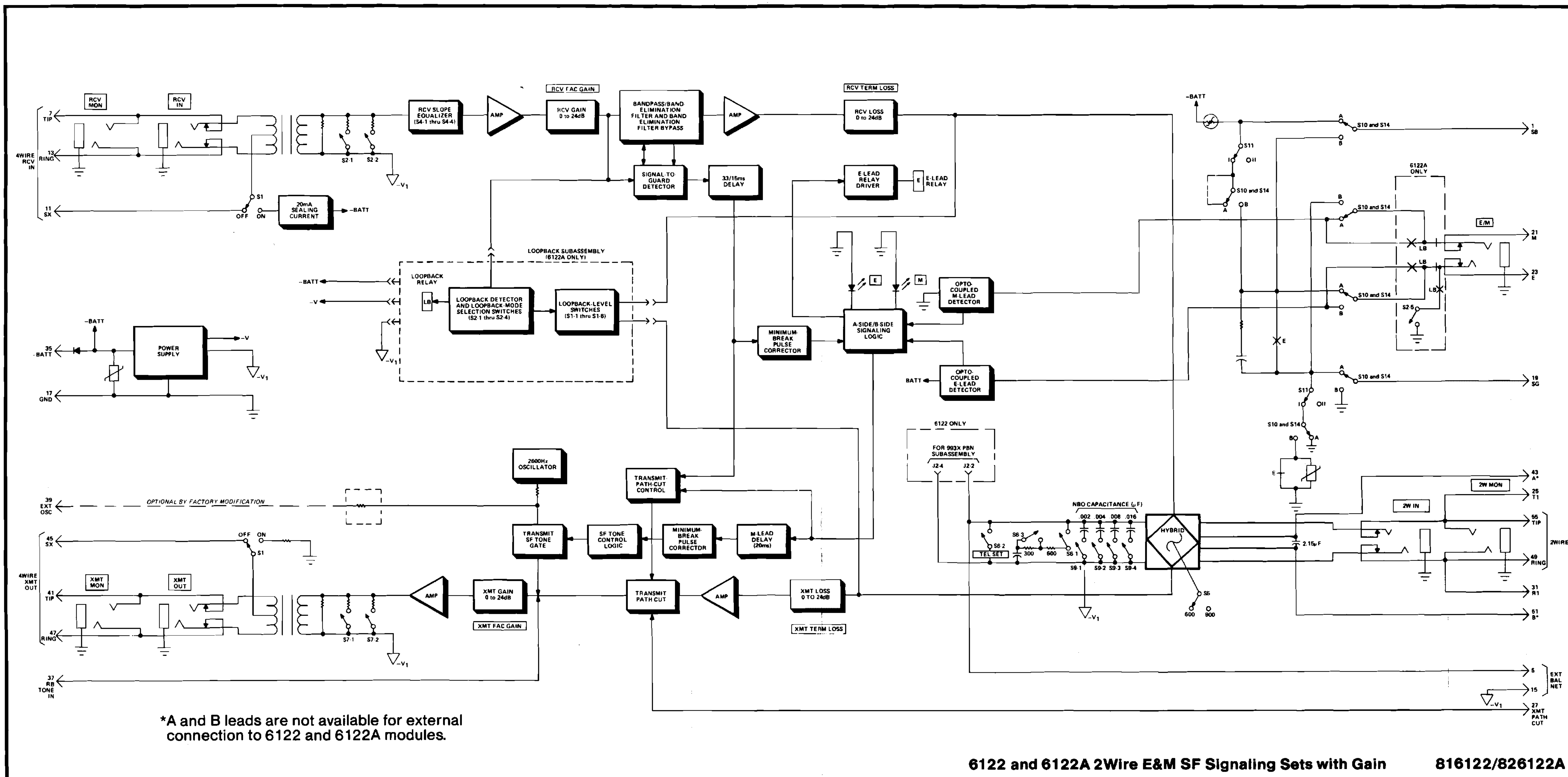
7.02 If a situation arises that is not covered in the troubleshooting guide, contact Tellabs Customer Service at your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, headquarters. Telephone numbers are as follows:

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 6122 or 6122A 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 6122 or 6122A 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 8X6122(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 6122 or 6122A 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.



5. block diagram

repair and return

7.05 Return the defective 6122 or 6122A 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/M-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 3.20.*

trouble condition	possible causes (check before assuming module is defective)
module completely inoperative	1) No input power. 2) Improper wiring.
cannot derive proper 4wire-to-2wire transmission levels	1) *Rcv fac gain* and/or *rcv term loss* level switches improperly set. 2) 4wire-receive-impedance and 2wire-impedance DIP switches (*S2* and *S5* on main board) improperly set. 3) Receive equalization DIP switch (*S4* on main board) improperly set. 4) TMS impedance improperly set or TMS not terminated.
cannot derive proper 2wire-to 4wire transmission levels	1) *Xmt term loss* and/or *xmt fac gain* level switches improperly set. 2) 2wire-impedance and 4wire-transmit-impedance DIP switches (*S5* and *S7* on main board) improperly set. 3) TMS impedance improperly set or TMS not terminated.
no 2wire-to-4wire transmission	1) Ground on XMT PATH CUT lead (pin 27). 2) Incoming SF tone not removed or M lead not seized, resulting in unwanted transmit path cut.
objectionable echo or "hollow" sound at distant end of 4wire facility	1) Inadequate transhybrid loss due to any of the following causes: A) Internal CBN DIP switch (*S6* on main board) improperly set. B) NBO capacitance DIP switch (*S9* on main board) improperly set. C) External or plug-on PBN (if used) misaligned. D) External PBN (if used) improperly wired. 2) Level switches improperly set. 3) Receive equalization DIP switch (*S4* on main board) improperly set. 4) Impedance switches improperly set.
E lead closed (*E* LED lighted) during idle	1) *Rcv fac gain* switches improperly set. 2) Receive equalization DIP switch (*S4* on main board) improperly set. 3) 4wire receive impedance DIP switch (*S2* on main board) improperly set. 4) Incoming SF tone frequency not 2600±10Hz. 5) Incoming SF tone frequency below −24dBm. 6) One or more of the following option switches on large baby board improperly set: *S10*, *S11*, *S14*.
E lead open (*E* LED unlighted) during busy	1) SF tone (2600Hz) present at 4wire receive port. 2) One or more of the following option switches on large baby board improperly set: *S10*, *S11*, *S14*.
no SF tone transmitted (*M* LED lighted) during idle	1) M-lead input not at ground potential. 2) One or more of the following option switches on large baby board improperly set: *S10*, *S11*, *S14*.
SF tone transmitted (*M* LED unlighted) during busy	1) M-lead input not at battery potential. 2) One or more of the following option switches on large baby board improperly set: *S10*, *S11*, *S14*.
SF tone transmitted at incorrect level during idle	1) *Xmt fac gain* switches improperly set. 2) 4wire-transmit-impedance DIP switch (*S7* on main board) improperly set.
cannot activate or deactivate tone loopback (6122A only)	1) Switches *S2-1* through *S2-4* on loopback subassembly (loopback activation mode) improperly set. 2) Tone not applied for proper duration and, for activation only, then removed. 3) Tone at improper frequency or below −26dBm0 detection threshold.
cannot derive transmission loopback (6122A only)	1) Module not in loopback.
cannot derive proper loopback transmission level (6122A only)	1) Loopback-level DIP switch (*S1* on loopback subassembly) improperly set. 2) Module not in loopback.
cannot derive signaling loopback (6122A only)	1) Module not in loopback.

tellabs
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4951 Indiana Avenue, Lisle, Illinois 60532
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