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technical manual
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rev A

practice section 816161/816161A/816161B/816161C
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6161, 6161A, 6161B, and 6161C 4Wire-to-4Wire SF-to-E&M Terminal Repeaters

contents

1. general description

1.01 The 6161, 6161A, 6161B, and 6161C 4Wire-to-4Wire SF-to-E&M Terminal Repeaters (figure 1) are Tellabs Type 10 plug-in modules that provide both active transmission interface and full-duplex SF-to-E&M signaling conversion between a 4wire PBX trunk or 4wire line that uses E&M signaling, and a 4wire metallic facility that uses 2600Hz single-frequency (SF) signaling. All four 6161X modules meet the specifications given in AT&T Technical Reference Pub 43002 for Network Channel Terminating Equipment (NCTE) Criteria, and, in addition, the 6161A and 6161C meet the specifications given in Pub 43004 for Transmission and Signaling Loopback Criteria.

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

1.03 While all four 6161X NCTE modules share the same basic transmission-interface and signaling-conversion circuitry, some are without loopback or front-panel jacks. The differences between the four 6161-family modules are listed in table 1.

module	front-panel jacks	loopback
6161	yes	no
6161A	yes	yes
6161B	no	no
6161C	no	yes

table 1. 6161X-family module selection guide

1.04 The 6161X-family modules offer the following features:

- From −24 to +24dB of prescription-set gain in both the transmit and receive channels at the facility-side ports.
- From 0 to 24dB of prescription-set loss in both the transmit and receive channels at the terminal-side ports.
- Prescription receive-channel amplitude equalization equivalent to that provided by the Western Electric 309B Prescription Equalizer.
- Isolation transformers at both terminal-side and both facility-side ports.
- Independently switch-selectable 600- or 1200-ohm terminating impedance at all four ports.

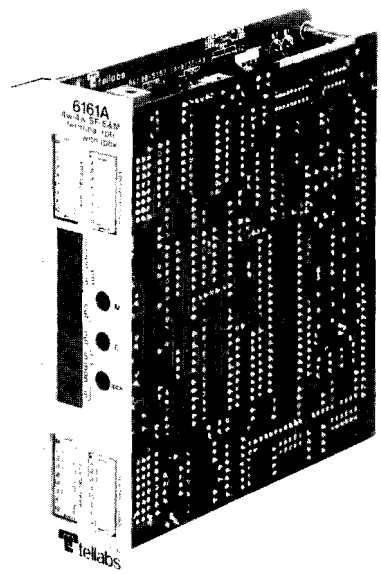


figure 1. 6161A 4Wire-to-4Wire SF-to-E&M Terminal Repeater module

- Switch-selectable Type I, II, or III E&M interface.
- Switch-selectable A-side or B-side E&M signaling.
- Integral 2600Hz SF tone oscillator.
- Front-panel LED's that light to indicate local E-lead and M-lead busy.
- Reverse-voltage and overvoltage protection.
- Opening and monitoring bantam-type jacks at the input ports and opening bantam-type jacks at the output ports (6161 and 6161A only).
- Local or remote signaling and equal-level transmission loopback (6161A and 6161C only).

1.05 The loopback circuitry on the 6161A and 6161C provides the following features:

- Ability to remotely perform facility, level, and equalization transmission tests.
- Ability to remotely test the following signaling circuitry:
  1) SF detector.
  2) SF transmitter (both augmented and normal levels).
  3) Transmit path cut.
  4) E&M detectors and signaling relay.
  5) Signaling logic.
- Manually activated (local) loopback via switch option.
- Manually activated (local) loopback via ground on the MLB lead or contact closure between the MLB and MLBG leads.
- Tone-activated (remote) loopback (2713 Hz) with second-tone or automatic timeout (see below) loopback deactivation.

- Automatic deactivation of tone loopback after switch-selectable 4-minute or 20-minute timeout interval if desired.
- From −23 to +24dB of prescription-set gain (in switch-selectable 1dB increments) for true equal-level loopback.
- Option switch for busying out the module's terminal side during loopback, if desired.
- Front-panel status-indicating LED that lights when the module is in loopback.

2. application

2.01 The 6161X-family 4Wire-to-4Wire SF-to-E&M Terminal Repeater modules are typically used to interface a 4wire SF transmission facility with a 4wire E&M trunk or line associated with a two-way dial/supervisory telephone circuit. No external transmission interface circuitry is needed because the 6161X-family modules combine the functions of a 4wire line amplifier, an SF transceiver, an SF-to-E&M signaling converter and a 4wire pad/transformer module. Figures 2 through 4 show three typical applications.

2.02 All 6161X-family modules provide from 0 to 24dB of prescription gain or loss in 0.1dB increments at each facility-side port, and from 0 to 24dB of prescription loss in 0.1dB increments at each terminal-side port (see block diagram). Prescription receive equalization is provided by a circuit equivalent to the WECo 309B, and the terminating impedance at each port can be independently switch-selected for 600 or 1200 ohms for a variety of facilities and equipment.

2.03 Table 1 in section 1 of this practice will aid in determining which module is best suited for a particular application. Typically, if loopback is required, it need only be provided by one module of a loop-extending pair of 6161X's (usually at the terminal end). Front-panel jacks may be unnecessary if prescription alignment is to be used exclusively.

2.04 In applications where the serving telephone company uses facility-side SF signaling, the 6161X-family modules fulfill the signaling-application requirements listed in table 2. Please note that in this table, A-side and B-side are the E&M signaling arrangements of the port that the 6161X interfaces.

Registered Facility Interface Code	E&M interface	E&M signaling arrangement*	6161X signaling directions	
			E lead	M lead
TL31M or TC31M	Type I	A side	out	in
TL31E or TC31E	Type I	B side	in	out
TL32M or TC32M	Type II	A side	out	in
TL32E or TC32E	Type II	B side	in	out
—	Type III	A side	out	in
* Of port that 6161X is interfacing.				

table 2. SF signaling and E&M interface optioning for Registered Facility Interface Codes

2.05 The 6161X-family modules can be optioned to provide either A-side E&M signaling (where M-lead signals are incoming to and E-lead signals are outgoing from the module) or B-side E&M signaling (where E-lead signals are incoming to and M-lead signals are outgoing from the module) on the terminal side.

2.06 In typical A-side E&M signaling with Type I interface, the 6161X provides an E-lead output that is open when SF tone is detected and that is at ground otherwise. In the transmit channel, SF tone is transmitted when the M lead is either open or at ground, and ceases when the M lead goes negative. The E-lead output from the 6161X is derived via relay contacts, which can be externally wired to accommodate any E-lead interface (Type I, II or III). The relay is energized when the module detects no SF tone at the receive input and is de-energized when the SF tone is detected. The 6161X's full precision receive pulse corrector restricts the pulsing relay to nominal 58% break.

2.07 In typical B-side E&M signaling with Type I interface, the 6161X provides an M-lead output that is at ground when SF tone is detected and is at battery potential otherwise. In the transmit channel, SF tone is transmitted when the E lead is open

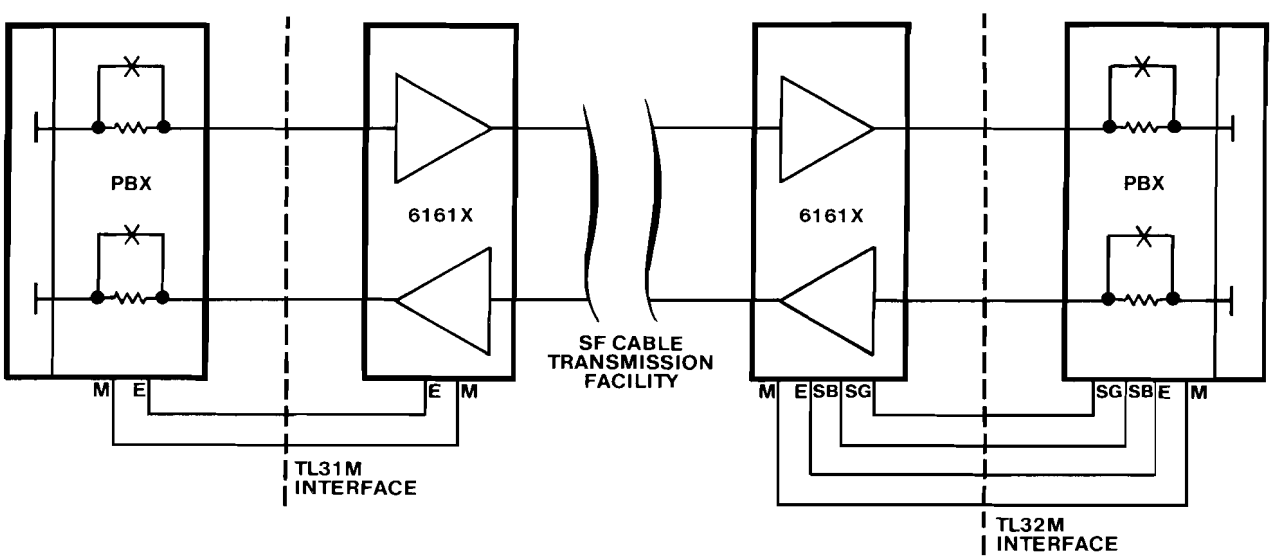


figure 2. Typical short-haul tie-trunk circuit using 6161X-family NCTE modules

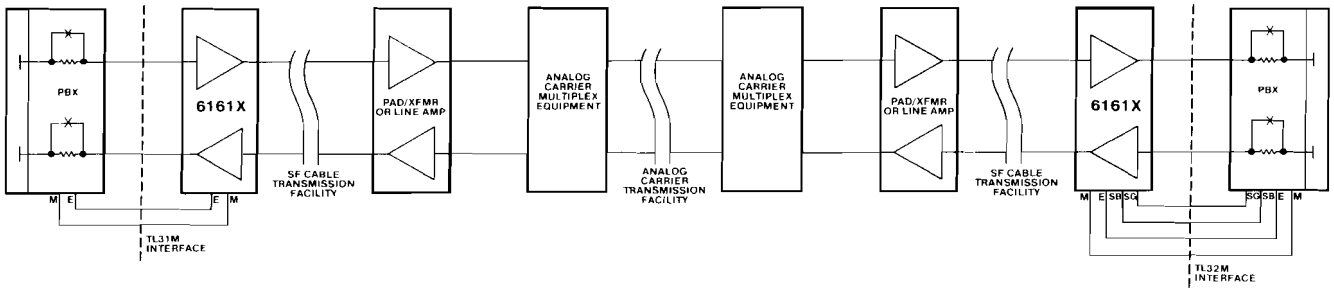


figure 3. Typical long-haul analog tie-trunk circuit using 6161X-family NCTE modules

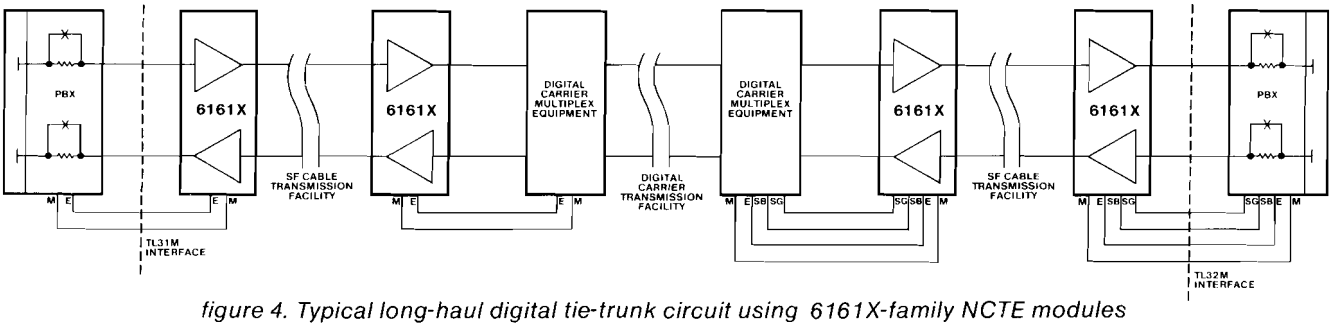


figure 4. Typical long-haul digital tie-trunk circuit using 6161X-family NCTE modules

and ceases when the E lead goes to ground. The E-lead output from the 6161X is derived via relay contacts, which can be externally wired to accommodate either Type I or Type II E&M-lead interface (Type III interface cannot be used with B-side signaling). The relay is de-energized when the module detects no SF tone at the receive input and is energized when the SF tone is detected.

2.08 The 6161X interfaces the receive path on the facility side at any TLP from −17 to +7. Idle-state SF tone is received at a level of −20dBmO. A higher level of −8dBmO is received during break portions of dial pulses and for about 400ms at the beginning of each tone interval. Within approximately 13ms of detection, a band-elimination filter (BEF) is inserted into the receive transmission path to prevent propagation of SF tone beyond the module. See tables 3 and 4 for details concerning BEF insertion.

2.09 The 6161X interfaces the transmit path on the facility side at any TLP from +8 to −16 and transmits tones at either of two levels. During the idle state, the module transmits SF tone at −20dBmO. During dial pulsing and also for the first 400ms each time it applies tone to the facility, the 6161X transmits SF tone at a higher level of −8dBmO. This momentarily increased tone level aids in detection of supervisory-state changes and incoming dial pulsing.

2.10 The transmit voice path through the 6161X is cut (opened) during idle circuit conditions and is restored when the M lead (A-side signaling) or the E lead (B-side signaling) is in the busy condition. The path is also cut during dialing in either direction and is momentarily cut in response to any transition of the M lead while the E lead is in the off-hook state (A-side signaling) or in response to any transition of the E lead while the M lead is in the off-hook state (B-side signaling). These path cuts prevent transmission of noise, transients, speech, and other interfering signals during critical signaling intervals.

2.11 Figures 5 through 9 show the various E&M signaling interfaces listed in table 2. Either Type I, II, or III E&M signaling interface can be selected via switch. Type I is often used with electromechanical switching systems, while Types II and III are often used in electronic switching environments.

2.12 The 6161X-family modules use relay contacts to derive E-lead and M-lead signaling. This facilitates interfacing with nonstandard E-lead and M-lead voltage levels and polarities. When these modules are used with Type II E&M interface, terminal-side equipment can use any convenient voltage or polarity.

2.13 Generally, if loopback is to be used, the terminal-end module will be the one requiring loopback capabilities (6161A or 6161C). Equal-level transmission loopback is made possible via the loopback level switches, which provide from −23 to +24dB of gain in 1dB increments. The loopback circuitry also provides signaling loopback functions for remote testing of the SF and E&M signaling circuitry. Some examples of signaling loopback use are as follows:

A. After loopback is initiated, 2600Hz tone is transmitted toward the terminal end at −10dBmO and again at −20dBmO. In both cases, the receive channel should echo back an SF tone at −20dBmO after an initial 400ms tone burst at an augmented level of −8dBmO.
B. Pulsed SF tone is transmitted toward the terminal end. The receive channel should echo back pulsed SF tone at a nominal 58% break.

2.14 Several modes of loopback initiation and removal are available; all are selected via option switches. These modes are described in section 3 of this practice.

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

*E-lead transition for B-side signaling.

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

circuit condition	SF tone states		local condition of xmt path cut			local rcv-path band-elimination-filter (BEF) insertion
	xmt	*rcv*	*before*	*change*	*after*	
idle	on	on	cut	none	cut	inserted
seizure, distant end	on	on/off transition	cut	remains cut 625±125ms after cessation of SF tone	not cut	removed 50±5ms after cessation of SF tone
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 4. SF tone states and status of transmit path cut and receive BEF for distant-location call origination

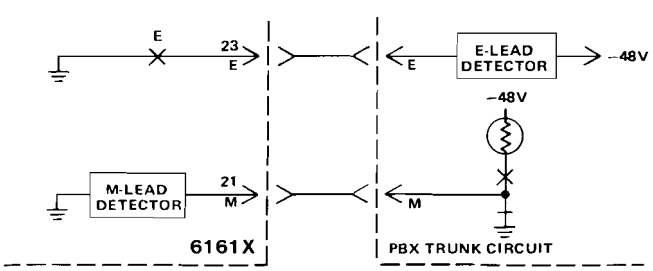


figure 5. Type I E&M interface (TL31M or TC31M); A side

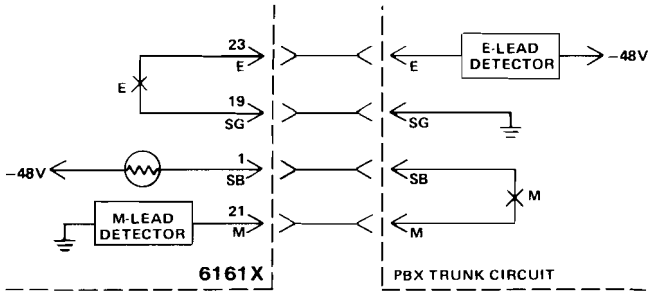


figure 6. Type II E&M interface (TL32M or TC32M); A side

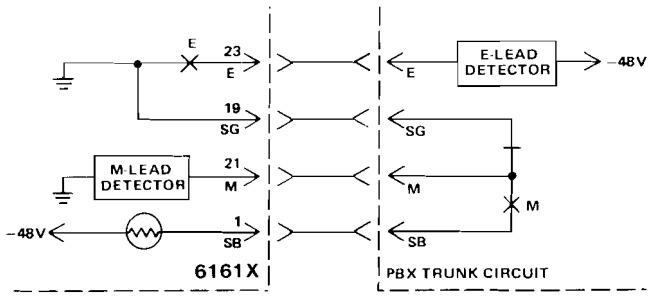


figure 7. Type III E&M interface; A side

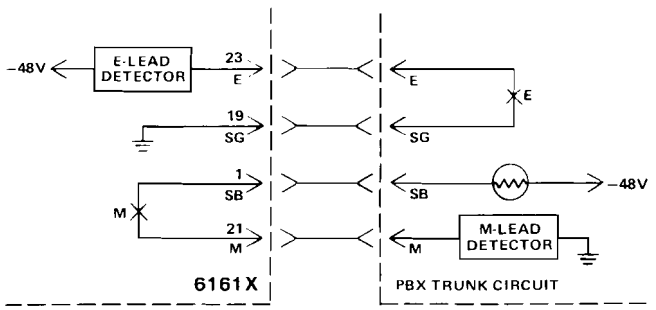


figure 8. Type I E&M interface (TL31E or TC31E); B side

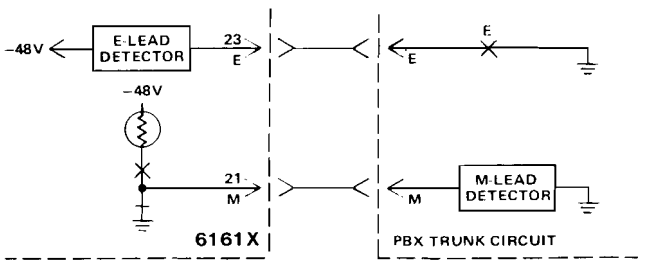


figure 9. Type II E&M interface (TL32E or TC32E); B side

3. installation

inspection

3.01 The 6161X 4Wire-to-4Wire SF-to-E&M Terminal Repeater module should be visually inspected upon arrival to find any damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

mounting

3.02 The 6161X mounts in one position of a Tellabs Type 10 Mounting Shelf, in one position of a Tellabs 262U Universal Network Terminating System Assembly, or in one position of a Tellabs 260A Signaling and Terminating System Assembly, all of which are available in configurations for relay-rack and apparatus-case installation. The module plugs physically and electrically into a 56-pin connector at the rear of its shelf or assembly position.

3.03 In applications where a 6161X module is to be installed in a 262U Assembly, no additional connections need be made. This is because all of the Assembly's internal connections are factory-prewired and because external wiring is simplified through the use of female 25-pair 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 connection between the 262U System Assembly and the customer's equipment is possible. If not, cross-connections between the 262U Assembly and the local terminal equipment must be made at an intermediate connectorized terminal block or by means of an optional adapter cable available as a list number for the 262U Assembly.

installer connections

3.04 When a 6161X 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 mounting shelf, case, or assembly, make sure that power is **off** and modules are **removed**. Modules should be put into place only **after** they are properly optioned and **after** wiring is completed.

3.05 Table 5 lists external connections to the 6161X module. All connections to non-prewired mountings are made via wire-wrapping to the 56-pin connector at the rear of the module's shelf, case, or assembly position. Pin numbers are found on the body of the connector.

connect:	to pin:
RCV IN TIP	7
RCV IN RING	13
RCV OUT TIP	5
RCV OUT RING	15
XMT OUT TIP	41
XMT OUT RING	47
XMT IN TIP	55
XMT IN RING	49
RCV SX IN	9
RCV SX OUT	3
XMT SX IN	51
XMT SX OUT	45
E lead	23
M lead	21
SB lead	1
SG lead	19
MLB (manual loopback)	18
MLBG (manual loopback ground)	37
−BATT (−42 to −54Vdc filtered input)	35
GND (ground)	17

table 5. External connections to 6161X

option selection

3.06 A number of option switches must be set before the 6161X can be placed into service. These switches and their functions are described in paragraphs 3.07 through 3.10. The locations of the switches on the module's printed circuit board are shown in figure 10. Table 6 provides a convenient checklist for optioning the module.

impedance matching

3.07 Two-position DIP switches *S1* and *S2* on the main board select balanced terminating impedance of either 600 ohms in the *up* position or 1200 ohms in the *down* position for each of the module's four ports as follows:

switch	port
S1-1	receive input (facility side)
S1-2	receive output (terminal side)
S2-1	transmit input (terminal side)
S2-2	transmit output (facility side)

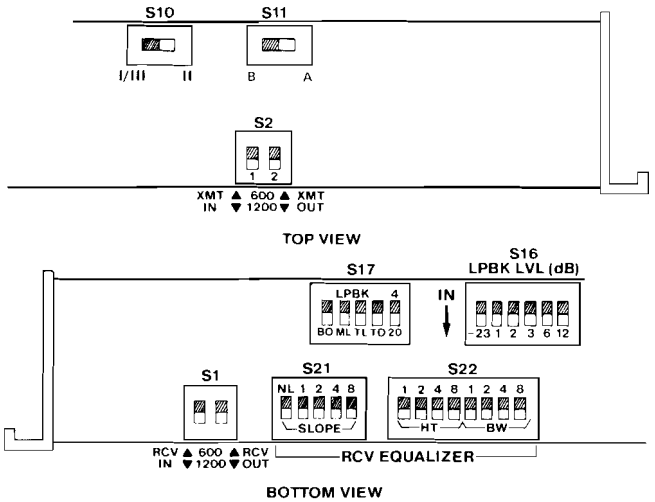


figure 10. 6161X option switch locations

Option the facility-side ports (rcv in and xmt out) for 1200 ohms when interfacing loaded cable or for 600 ohms when interfacing nonloaded cable or carrier. In most cases, the terminal-side ports (rcv out and xmt in) should be optioned for interface with 600 ohms for 600-ohm station equipment.

E&M signaling interface

3.08 Switch *S10* selects Type I, Type II, or Type III E&M interface. Determine the E&M interface of the terminal equipment interfaced by the 6161X and set *S10* to either *I/III* (Type I or Type III) or *II* (Type II), as appropriate.

3.09 Switch *S11* should be set according to which E&M signaling arrangement the terminal equipment uses (A-side or B-side). If the 6161X is to receive M-lead signals and send E-lead signals, set *S11* to *A*. If the module is to send M-lead signals and receive E-lead signals, set *S11* to B. See table 7 for Registered Facility Interface Code cross-references.

loopback optioning (6161A and 6161C only)

3.10 The five-position *LPBK* DIP switch on the module's subassembly is used to select several loopback functions as follows:

BO, busy out terminal side:
Set the *BO* switch toward *BO* if the terminal side is to be busied out during loopback or away from *BO* if not.

ML, manual loopback:
Set the *ML* switch toward *ML* to manually place the module into loopback. Please note that when manual loopback is in effect, loopback cannot be deactivated by 2713Hz tone. Set the *ML* switch away from *ML* to deactivate manual loopback.

TL, tone loopback:
Set the *TL* switch toward *TL* to enable tone-activated loopback. In this mode, loopback is activated when a 2713Hz tone burst is applied to the facility-side receive input pair (pins 7 and 13) for a minimum of 2.5 seconds and then removed. When loopback is activated in this manner, it can be deactivated in either of two ways. One is application of a second 2713Hz tone for a minimum of 1.2 seconds; the other is automatic timeout deactivation after a selected length of time (see below).

TO, loopback timeout:
If automatic deactivation of tone-activated loopback after a timeout period is desired, set the *TO*

option	paragraph	switch	selection	settings	checklist
facility-side transmit out impedance	3.07	S2-2	600 ohms	600	
			1200 ohms	1200	
terminal-side transmit in impedance	3.07	S2-1	600 ohms	600	
			1200 ohms	1200	
facility-side receive in impedance	3.07	S1-1	600 ohms	600	
			1200 ohms	1200	
terminal-side receive out impedance	3.07	S1-2	600 ohms	600	
			1200 ohms	1200	
Type I, Type II or Type III E&M interface	3.08	S10	Type I or III	I/III	
			Type II	II	
A-side or B-side E&M signaling	3.09	S11	A-side int.	A	
			B-side int.	B	
Note: *The following options are on the 6161A and 6161C only.*					
busy out terminal side during loopback	3.10	LPBK BO	no busy out	(up)	
			busy out	BO	
manual loopback activation	3.10	LPBK ML	loopback off	(up)	
			loopback on	ML	
Note: *The following options are on the 6161A and 6161C only.*					
tone loopback activation	3.10	LPBK TL	disabled	(up)	
			enabled	TL	
tone loopback automatic timeout	3.10	LPBK TO	disabled	(up)	
			enabled	TO	
automatic timeout duration	3.10	LPBK 4/20	4 minutes	4	
			20 minutes	20	

table 6. 6161X option switch summary and checklist

Registered Facility Interface Code	E&M signaling interface	terminal-equipment E&M signaling	switch settings S10	S11
TL31M or TC31M	Type I	A side	I/III	A
TL31E or TC31E	Type I	B side	I/III	B
TL32M or TC32M	Type II	A side	II	A
TL32E or TC32E	Type II	B side	II	B
N/A	Type III	A side	I/III	A

table 7. A-side/B-side and Type I/II/III optioning for various Registered Facility Interface Codes

switch toward *TO;* otherwise, tone-activated loopback can only be deactivated by a second tone burst.

4/20, loopback timeout duration:
The *4/20* switch selects the timeout period for automatic deactivation of tone-activated loopback. Set this switch to *4* if a 4-minute timeout period is desired or to *20* if a 20-minute timeout is desired. (This switch is anabled only when loopback timeout is selected via the *TO* switch.)

alignment

3.11 Alignment of the 6161X-family modules comprises the following individual procedures performed in sequence (all option switches should already be properly set as described above):

A. Setting the receive-channel levels.
B. Introducing receive-channel equalization, if necessary.
C. Setting the transmit-channel levels.
D. Setting the loopback-path level (6161A and 6161C only).

3.12 Because internal TLP levels of +7TLP in the receive path and −16TLP in the transmit path must be maintained regardless of external levels, two level control circuits are present in each path. This is shown in figure 11.

3.13 The 6161X-family modules are primarily intended for *prescription* alignment. This involves setting all gain and equalization switches according to specifications on the circuit layout record (CLR) prior to installation of the module. Simply indicate the proper settings in the *checklist* column of table 8; then refer to the table while performing the alignment procedure. In cases where CLR specifications are unavailable or inadequate, the non-prescription method is necessary. This is covered in paragraphs 3.14 through 3.17.

Note: *Because the 6161B and 6161C do not contain test jacks, non-prescription alignment of these modules is not recommended. If, however, non-prescription alignment is necessary, the use of a Tellabs 9801 or 9802 Card Extender or an external jackfield is strongly recommended to simplify alignment. The 6161B/C can also be aligned if measurements are made at the numbered pins at the rear of the module's mounting position and care is taken to avoid double terminations. In some instances, it may be necessary to remove some wire-wrapping connections at the module's mounting-shelf connector before tone can be applied or measured.*

non-prescription alignment

3.14 Initial settings:

A. Ensure that all impedance options are properly set.
B. Set all positions of the front-panel *xmt fac level, xmt term loss, rcv fac level,* and *rcv term loss* DIP switches to the *out* position for no gain or loss.
C. Set all receive equalization DIP switches (SLOPE, HT and BW) to the *out* position for no equalization.
D. Set all loopback level DIP switches to the *up* position (6161A and 6161C only) for no loopback path gain or loss.

3.15 Receive-channel level adjustment:

A. Connect the receive portion (properly terminated) of a transmission measuring set (TMS) to the *rcv out* jack. Request the distant location to send 1004Hz at 0.0dBmO. Verify that tone is present and measure its level.
B. Determine whether the measured level is higher or lower than +7dBm.

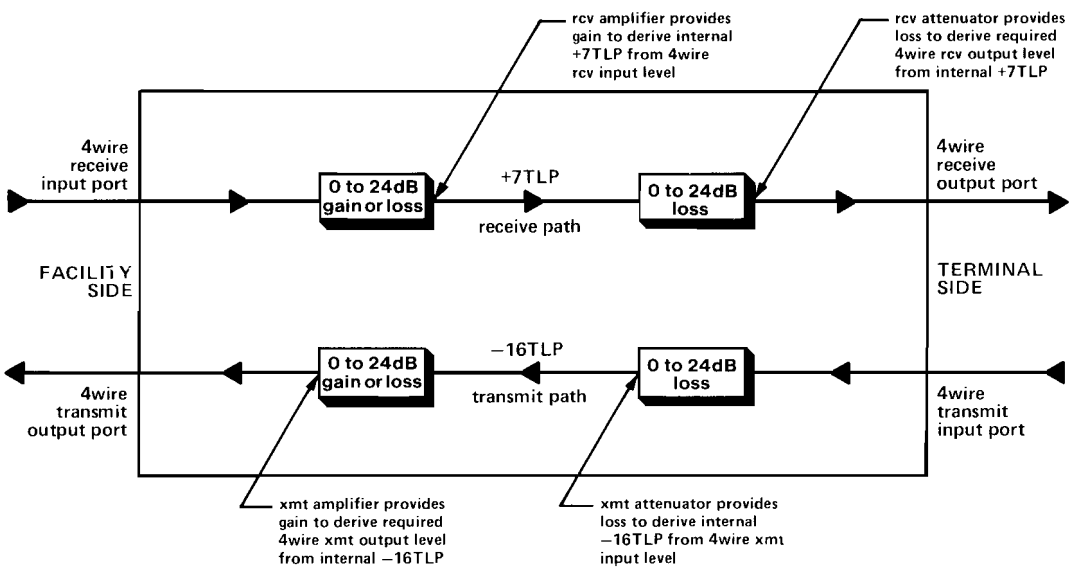


figure 11. Level coordination in the 6161X

alignment function	switch	selections	settings	checklist
transmit-channel loss or gain	front-panel xmt fac level loss/gain	loss	ls	
		gain	gn	
transmit-channel facility-side level adjustment	front-panel xmt fac level DIP switch*	0.1dB (gain or loss)	0.1 to IN	
		0.2dB (gain or loss)	0.2 to IN	
		0.4dB (gain or loss)	0.4 to IN	
		0.8dB (gain or loss)	0.8 to IN	
		1.5dB (gain or loss)	1.5 to IN	
		3.0dB (gain or loss)	3.0 to IN	
		6.0dB (gain or loss)	6.0 to IN	
		12.0dB (gain or loss)	12.0 to IN	
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	
receive-channel loss or gain	front-panel rcv fac level loss/gain	loss	ls	
		gain	gn	
receive-channel facility-side level adjustment	front-panel rcv fac level DIP switch*	0.1dB (gain or loss)	0.1 to IN	
		0.2dB (gain or loss)	0.2 to IN	
		0.4dB (gain or loss)	0.4 to IN	
		0.8dB (gain or loss)	0.8 to IN	
		1.5dB (gain or loss)	1.5 to IN	
		3.0dB (gain or loss)	3.0 to IN	
		6.0dB (gain or loss)	6.0 to IN	
		12.0dB (gain or loss)	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 equalization	slope	loaded or nonloaded cable	down for loaded, up for nonloaded	
		1	1 to IN	
		2	2 to IN	
		4	4 to IN	
		8	8 to IN	
	HT	1	1 to IN	
		2	2 to IN	
		4	4 to IN	
		8	8 to IN	
	BW	1	1 to IN	
		2	2 to IN	
		4	4 to IN	
		8	8 to IN	
loopback gain/loss	LPBK LVL S16-1 through S16-6*	23dB loss	S16-1 to IN	
		0.5dB gain	S16-2 to IN	
		1.5dB gain	S16-3 to IN	
		3dB gain	S16-4 to IN	
		6dB gain	S16-5 to IN	
		12dB gain	S16-6 to IN	

** All level switches are cumulative. Total flat gain introduced is the sum of all DIP-switch positions set to IN. For zero gain or loss, set all DIP-switch positions to OUT.*

table 8. 6161X alignment-switch summary and checklist

1. If the measured level is lower than +7dBm, set the front-panel *rcv fac level gn/ls* switch to *gn.* Then set to *IN* the proper combination of front-panel *rcv fac level* switches that equals the required gain.
2. If the measured terminal-side level is higher than +7dBm, set the front-panel *rcv fac level gn/ls* switch to *ls.* Then set to *IN* the proper combination of front-panel *rcv fac level* switches that equals the required amount of loss.

C. Refer to the CLR for the specified receive output level.
D. Calculate the difference between this specified output level and the internally derived +7dBm level.
E. Set to *in* the proper combination of front-panel *rcv term loss* DIP-switch positions that adds up to this difference.

3.16 Transmit-channel level adjustment:

A. Remove the transmit speech path cut by seizing the circuit from the terminal side.
B. Connect the transmit portion of the TMS (properly terminated) to the *xmt in* jack. Send 1004Hz from the terminal-side location at 0.0dBmO.
C. Connect the receive portion of the TMS (properly terminated) to the *xmt out* jack.
D. Set to *IN* the proper combination of *xmt term loss* DIP-switch positions so that a −16dBm level is acheived.
E. Refer to the CLR for the specified level at the distant end.
F. Request personnel at the distant end to measure their receive level.
G. Calculate the difference between this specified level and the measured level.
H. Determine whether the specified level is higher or lower than the measured level.
   1. If the specified level is lower, then set the front-panel *xmt fac level gn/ls* switch to *gn.* Then set to *IN* the proper combination of front-panel *xmt fac level* switches that equals the calculated difference.
   2. If the specified level is higher, then set the front-panel *xmt fac level gn/ls* switch to *ls.* Then set to *IN* the proper combination of front-panel *xmt fac level* switches that equals the calculated difference.

receive-channel equalization alignment

3.17 The receive-channel equalizer on the 6161X is functionally identical to the Western Electric 309B Prescription Equalizer. Prescription settings for the equalizer can be found in BSP (Bell System Practice) section 332-912-232, and manual alignment procedures for the equalizer can be found in BSP section 332-912-234.

loopback level adjustment

3.18 To adjust the 6161X's loopback-level-control circuitry to provide equal-level loopback, proceed as follows:

A. From the CLR, determine the specified receive input and receive output levels.
B. Subtract the receive output level from the receive input level. The result will be the amount of gain required in the loopback path.
C. On the 6161X's loopback subassembly, set to *on* that combination of *LPBK LVL* DIP-switch *(S16)* positions which most closely approximates the amount of gain determined in step B.

4. circuit description

4.01 This circuit description is intended to familiarize you with the operation of the 6161X 4Wire-to-4Wire SF-to-E&M Terminal Repeater modules. Attempts to troubleshoot these modules internally are not recommended and may void your warranty. Please refer to the 6161X block diagram, section 5 of this practice, as an aid in following this circuit description.

receive path

4.02 A transformer at the 4wire receive input port interfaces the transmission facility and derives tip, ring, and simplex leads. The transformer's secondary windings are coupled to a resistive switch-selectable 600- or 1200-ohm *impedance-matching* network and to a *buffer.*

4.03 Lightning protection is provided for the *buffer* by varistors. The output of the *buffer* is connected to prescription *rcv fac level* circuitry for level coordination and thence to a series-connected active prescription *amplitude equalizer* that is equivalent to the Western Electric 309B Prescription Equalizer. The output of the *amplitude equalizer* is connected to a *band-elimination filter (BEF),* which, at the appropriate time, filters out 2600Hz SF tone. The *rcv term loss* attenuating network provides the proper terminal equipment levels without affecting the levels of the signal that the *SF detector* receives. The *driver* drives the transformer-coupled receive output port via switch-selectable 600- or 1200-ohm impedance-matching circuitry.

transmit path

4.04 The transmit input port is transformer-coupled to a *buffer* which contains switch-selectable 600- or 1200-ohm impedance matching circuitry. The *buffer,* in turn, feeds the prescription *xmt term loss* circuitry for terminal-side level coordination, after which SF tones from the *2600 oscillator* can be inserted via the *SF tone control* circuit. The transmit signal is then routed through the *xmt fac level* prescription level-control circuitry for facility-side level coordination and then is applied to a *driver,* which is protected from lightning by varistors. The *driver,* which contains switch-selectable 600- or 1200-ohm impedance-matching circuitry, drives the 4wire transmit output port via a transformer that derives tip, ring, and simplex leads.

SF signaling

4.05 At the terminal end of the SF signaling path, the *E&M signaling interface* circuit determines the state of the local M lead (A-side signaling) or E lead (B-side signaling) and communicates with the *control logic* to initiate proper transmit path cut and SF tone transmission. The *E&M signaling interface* also

performs the switching functions necessary for signaling-loopback operation. The *control logic* circuit receives an indication from the *SF detector* when tone is received and causes the *E&M signaling interface* to output the proper E-lead or M-lead states. Figures 11, 12, and 13 are function sequence flowcharts that illustrate the signaling operation of the 6161X with A-side signaling. Horizontal paths identify events occuring simultaneously, and vertical paths denote sequential events. Dotted lines indicate elapsed time.

loopback (6161A and 6161C only)

4.06 Loopback of the module is activated when the *LB* relay operates. This relay is controlled by the *loopback detector and control* circuit, which operates the relay when any of three things happens:

A. A 2713Hz tone of correct level and duration is detected in the receive path.
B. The external loopback lead (pin 18) is grounded or connected to pin 37.
C. The *ML* DIP switch is closed.

In the first case (tone loopback), loopback can be deactivated by either a second 2713Hz tone or by automatic timeout circuitry. In the second case, if the external loopback lead is grounded, the ground must be removed to deactivate loopback. In the third case, if the *ML* switch is closed, it must be opened again to deactivate loopback.

4.07 When the module is in loopback, the *LB* relay contacts disconnect the terminal-side ports from the 6161X circuitry and connect the output of the receive-path output *driver* to the input of the transmit-path *buffer.*

power supply

4.08 The *power supply* in the 6161X module is a series-regulated bipolar supply that uses a zener diode to derive a reference source. A diode in series with the negative input lead protects against reversed voltage connections.

6. specifications

transmission

maximum input and output level, transmit channel
+3.0dBmO

maximum input and output level, receive channel
+0.0dBmO

total harmonic distortion
less than 1% at overload point

transmit-channel frequency response re 1004Hz
300 to 500Hz ± 0.8dB
500 to 3400Hz ± 0.5dB

receive-channel frequency response re 1004Hz (BEF removed)
300 to 500Hz +0.0, −1.7dB
500 to 3400Hz ± 0.7dB

terminating impedances (all four ports)
600 or 1200 ohms, balanced, individually switch-selectable

insertion loss
0 ± 0.2dB at 1004Hz

internal noise
17dBrnC maximum at maximum gain

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

echo return loss (all ports)
23dB minimum vs. 600 or 1200 ohms

crosstalk between transmit and receive channels
80dB minimum, 200 to 3400Hz

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

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

SF transmit section

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

SF tone levels
high (augmented) level: −8dBmO ± 1dB
low level: −20dBmO ± 1dB

SF tone states
idle: tone transmitted
busy: tone not 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 delay (A-side signaling) or E-lead delay (B-side signaling)
18 ± 5ms delay between M-lead or E-lead state change and SF-tone state change

pulsing characteristics (M or E lead to SF)
- **input breaks or makes shorter than M-lead or E-lead delay are not recognized**
- **minimum break duration of 50ms ± 2ms**
- **minimum make duration of 25ms ± 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 range
0 to −27dBmO

SF tone rejection
less than or equal to −37dBmO

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

maximum line noise
51dBrnCO

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**

INCOMING CALL (A-SIDE SIGNALING)

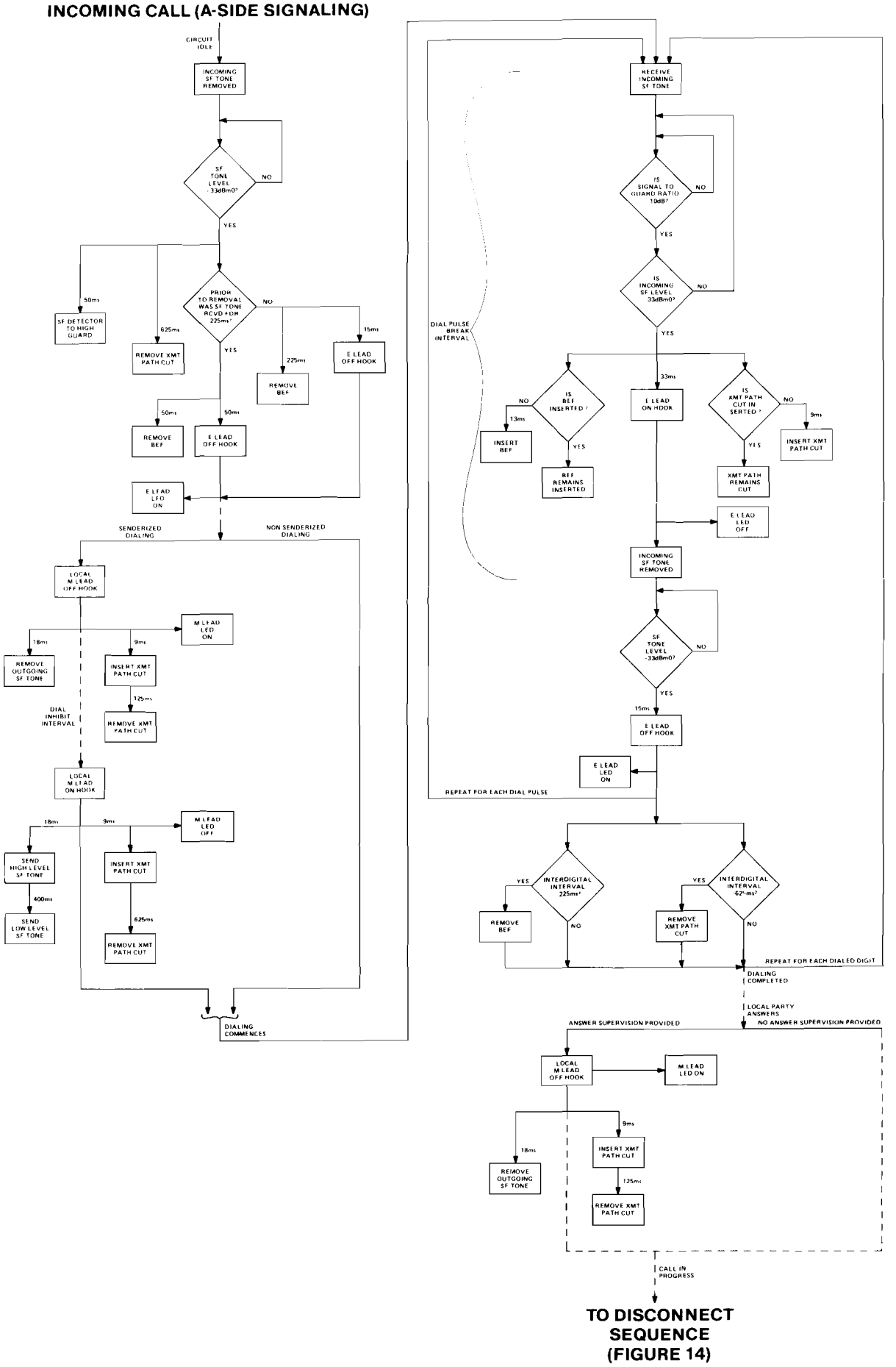


figure 12. Function sequence flowchart, incoming call

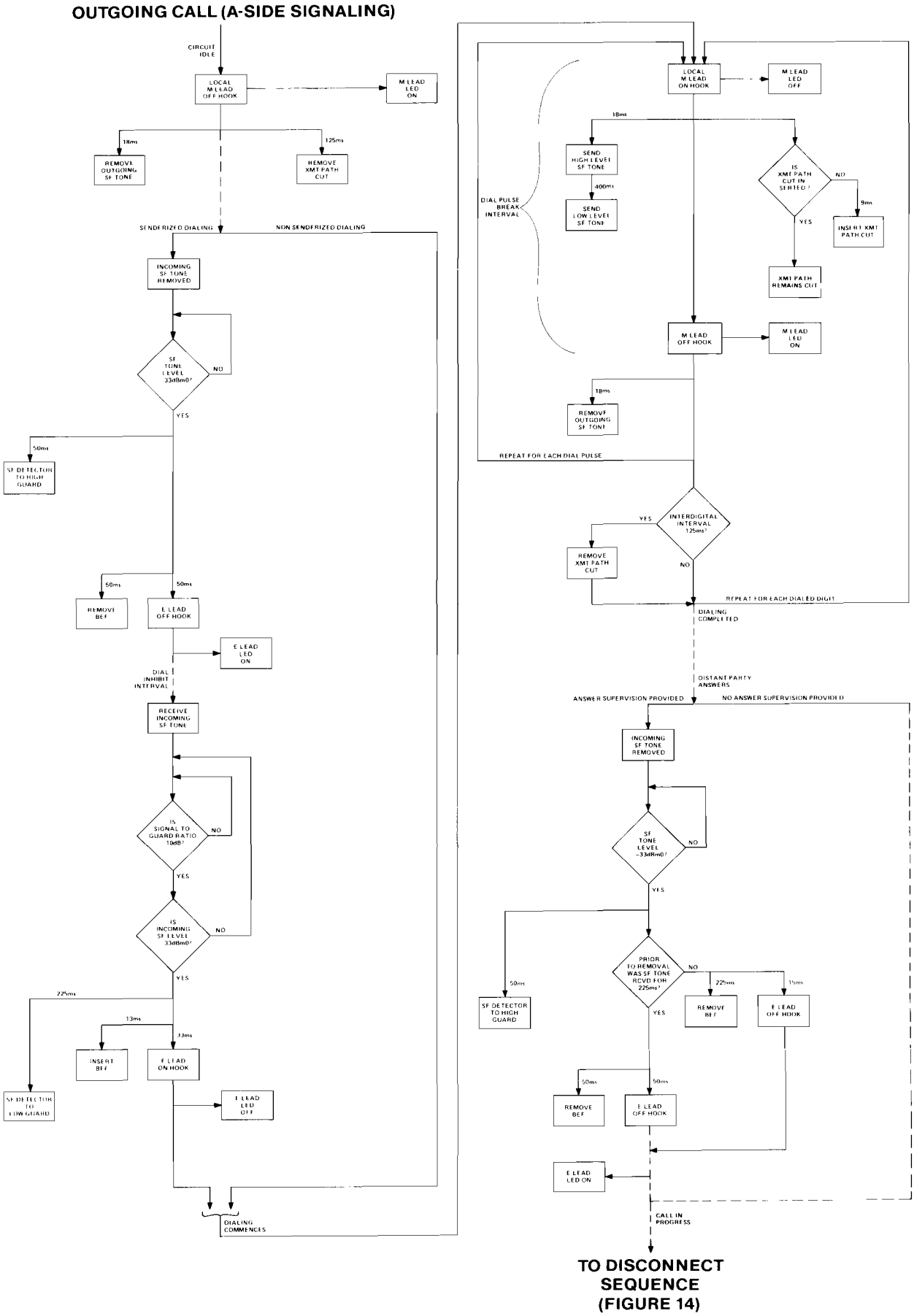


figure 13. Function sequence flowchart, outgoing call

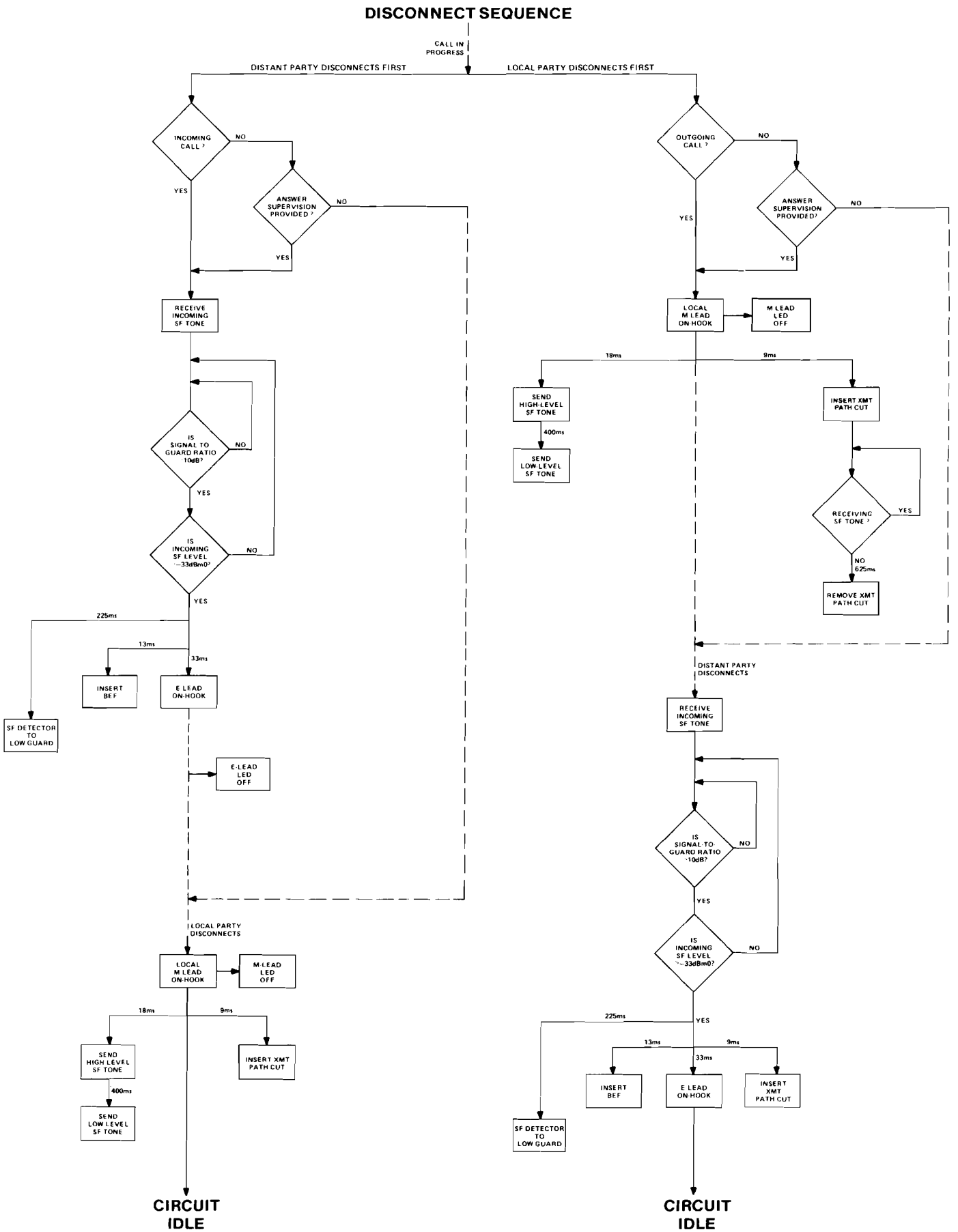
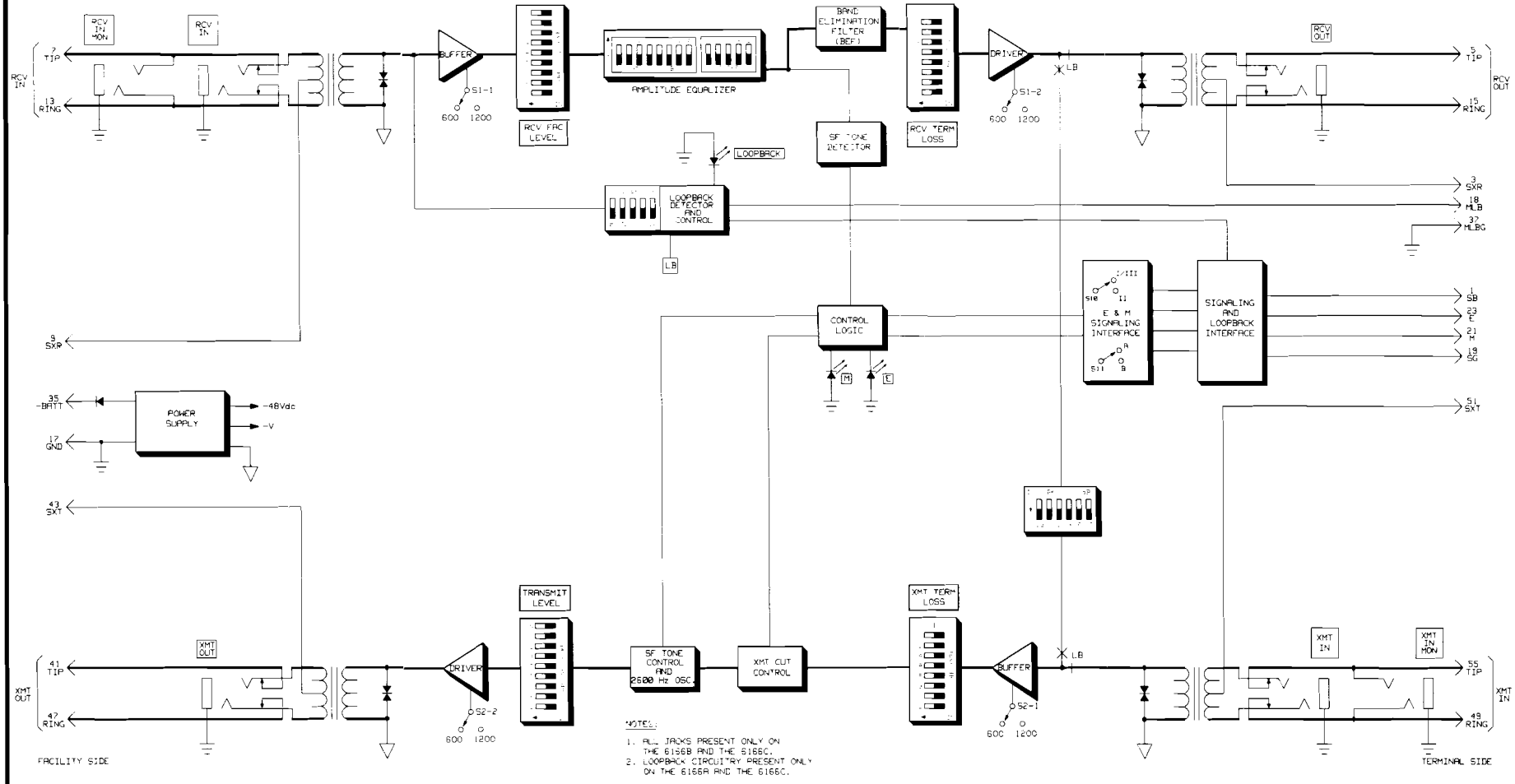


figure 14. Function sequence flowchart, disconnect sequence for incoming and outgoing calls



6161/6161A/6161B/6161C 4Wire-to-4Wire SF-to-E&M Terminal Repeater modules 816161/A/B/C

5. block diagram

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

current limiting
provided for M (B side, Type I) 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

E&M signaling, A side

E-lead current rating
500mA maximum

E-lead resistance
less than 0.5 ohms

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

E&M signaling, B side

M-lead current rating
500mA maximum

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

E-lead sensitivity
500 ohms minimum external M-lead resistance to ground, will not detect 20kohms or greater external E-lead resistance

transmission and signaling loopback (6161A and 6161C only)

tone-loopback frequency
2713Hz ± 7Hz

tone-loopback activation/deactivation level
−30 to −3dBm

tone-loopback activate time
2.5 seconds minimum (activates upon removal of tone)

tone-loopback deactivate time
1.2 seconds minimum (deactivates immediately thereafter)

automatic timeout (tone loopback only)
4 or 20 minutes, switch-selectable

signal-to-guard ratio
greater than 6dB; less than 18dB

loopback-path gain
−23 to +24dB in 1dB increments

loopback level accuracy
± 0.5dB

common specifications

input voltage
−42 to −54Vdc, filtered, positive-ground referenced

current requirements (0-ohm loop)

6161 and 6161B		
condition	**busy**	**idle**
−48Vdc	75mA	60mA
−52Vdc (max. output)	100mA	90mA

6161A and 6161C			
condition	**loopback**	**busy (0dBm)**	**idle**
−48Vdc	on	85mA	70mA
	off	80mA	65mA
−52Vdc (max. output)	on	110mA	100mA
	off	105mA	95mA

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

dimensions
5.58 inches (14.2cm) high
1.42 inches (3.6cm) wide
5.96 inches (15.1cm) deep

weight
10 ounces (284 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 Universal Network Terminating System Assembly or in one position of a Tellabs 260A Signaling and Terminating System Assembly.

7. testing and troubleshooting

7.01 The *troubleshooting guide* in this section may be used to assist in the installation, testing, or troubleshooting of any of the 6161X 4Wire-to-4Wire SF-to-E&M Terminal Repeater modules. The guide is intended as an aid in the localization of trouble to a specific module. Proper operation of the module can be verified by observing its actual operation while referring to the function sequence flowcharts (figures 11, 12, and 13). If a module is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6161X module. Unauthorized testing or repairs may void the module's warranty. Also, if the module is part of a registered system, unauthorized repairs will result in noncompliance with Part 68 of the FCC Rules and Regulations.

Note: *Warranty service does not include removal of permanent customer markings on the front 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 guide, contact Tellabs Customer Service as follows (telephone numbers are given below):

USA customers: Contact Tellabs Customer Service at your Tellabs Regional Office.

Canadian customers: Contact Tellabs Customer Service at our Canadian headquarters in Mississauga, Ontario.

International customers: Contact your Tellabs distributor.

US Atlantic region: (203) 798-0506
US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (702) 827-3400
Canada: (416) 624-0052

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

replacement

7.04 To obtain a replacement module, notify Tellabs via letter or telephone (see addresses and numbers below), or via TWX (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6161X 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 module 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 module, shipment prepaid, to Tellabs (attn: repair and return).

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

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

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

troubleshooting guide

Note: *Because the 6161X contains a mercury-wetted relay, this module should always be held in an upright position and tapped gently on a hard surface before installation. The module should then be kept in an upright position until installed. If trouble is encountered with an installed module, remove it from the mounting shelf and repeat this procedure before taking any further corrective action.*

trouble condition	possible causes
module completely inoperative	1) No input power. 2) Improper wiring.
cannot derive proper transmission levels	1) Front panel *gn/ls* switches improperly set. 2) Impedance option switches improperly set. 3) Receive equalization switches improperly set. 4) TMS impedance improperly set or TMS not terminated. 5) M lead not seized.
E-lead or M-lead LED on when lead is idle	1) Switch *S11* improperly set. 2) Inputs from near end or distant end not idle. 3) Fault in cable.
E-lead or M-lead LED off when lead is busy	1) Switch *S10 or S11* improperly set. 2) Inputs from near end or distant end not busy. 3) Fault in cable.
improper dial pulsing	1) Improperly set option switches. 2) Improper supply voltage (should be between −42 and −54Vdc). 3) Excessive cable leakage. 4) Longitudinal voltage on facility greater than 25Vrms.
loopback not activating or not within 0.5dB of correct level	1) Switch *S17* improperly set. 2) Transmit or receive path not properly aligned. 3) Incorrect level or frequency of incoming loopback tone.

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Addendum: Issue 2 6161/X-Series 4Wire-to-4Wire SF-to-E&M Terminal Repeaters

1.01 This addendum to practice section 816161/816161A/816161B/816161C, revision A (dated 1 September 1984), covers changes to the 6161, 6161A, 6161B, and 6161C 4Wire-to-4Wire SF-to-E&M Terminal Repeater modules resulting in the Issue 2 version of these modules (Tellabs part numbers **826161, 826161A, 826161B, and 826161C**). These modules differ from their Issue 1 counterparts as follows:

- At the facility-side ports (receive input and transmit output), a switch-selectable choice of 1200, 600, or 150-ohm terminating impedance is now available at each port. (The Issue 1 modules offered 1200 or 600 ohms only.)
- At the terminal-side ports (transmit input and receive output), fixed, balanced 600-ohm terminating impedance is now provided. (The Issue 1 modules offered a switch-selectable choice of 1200 or 600 ohms.)
- An option switch that allows the integral receive-channel equalizer to be electrically bypassed has been added to the Issue 2 modules.
- On the front-panel *xmt level* and *rcv level* DIP switches, separate gain (*GN*) and loss (*LS*) switch positions are now provided for selection of transmission-path flat gain or flat loss. (The Issue 1 modules used a single gain/loss position on their front-panel *xmt level* and *rcv level* DIP switches.)

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

impedance optioning information for Issue 2 6161/X modules

1.03 When optioning the Issue 2 6161/X module, please disregard the terminating-impedance optioning information in paragraph 3.07 and table 6 of the attached practice. Instead, refer to figure 1 of this addendum and set the module's *RCV IN IMPD* and *XMT OUT IMPD* option switches (*S1* and *S2*, respectively) as follows:

- To the *1200* position for interface with loaded cable.
- To the *600* position for interface with nonloaded cable or carrier.
- To the *150* position to provide a small amount of amplitude equalization for long sections of nonloaded cable through the deliberate impedance mismatch.

receive-equalizer bypass option on Issue 2 6161/X modules

1.04 When setting switch options on the Issue 2 6161X module, be certain to set the receive-equalizer bypass switch (*EQ IN/OUT, S3*) as follows (see figure 1 of this addendum for the location of *S3*):

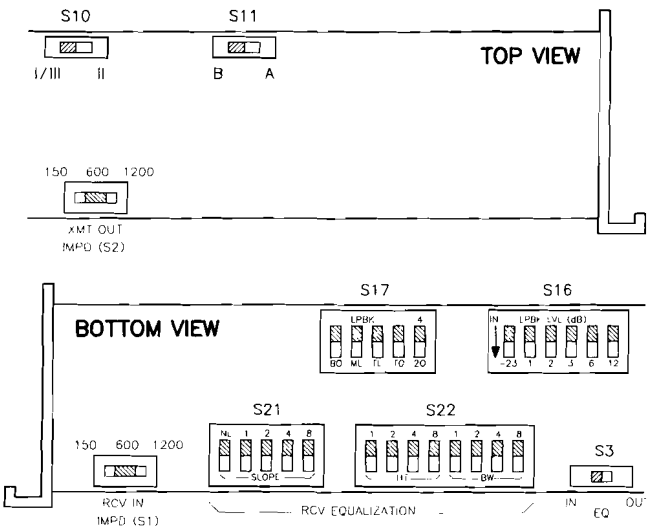


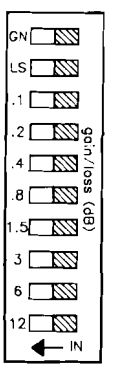
figure 1. Issue 2 6161/X option switch locations

- To the *IN* position if the receive equalizer is to be included in the circuit.
- To the *OUT* position if the receive equalizer is to be excluded from the circuit, i.e., electrically bypassed.

level adjustment information for Issue 2 6161/X modules

1.05 When adjusting receive and transmit transmission levels on the Issue 2 6161/X module, please disregard the information concerning the *rcv gn/ls* switch in paragraph 3.15, step B, and the *xmt gn/ls* switch in paragraph 3.16, step H. Instead, select gain or loss for each channel as follows (see figure 2 of this addendum):

- **To select gain in a channel**, set the *GN* position of that channel's front-panel *level* DIP switch to *IN* and the *LS* position of the same switch to *OUT* (away from *IN*).
- **To select loss in a channel**, set the *GN* position of that channel's front-panel level DIP switch to *OUT* (away from *IN*) and the *LS* position of the same switch to *IN*.



For gain, set GN to IN and LS to OUT.
For loss, set GN to OUT and LS to IN.

figure 2. Issue 2 6161/X front-panel level switch detail