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technical manual
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rev B

practice section 816947/816947A

6947 & 6947A 4W Universal SF Signaling Sets w/Gain

contents

1. general description

1.01 The Tellabs 6947 and 6947A 4Wire Universal SF Signaling Set modules with Gain (figure 1) each provide single-frequency (SF) signaling over a 4wire facility, full-duplex conversion between that SF signaling and any one of three types of terminal-side loop signaling, and extension of this loop signaling toward a 4wire termination. Specifically, the 6947 and 6947A may be switch-optioned to function as a 4wire E&M, foreign-exchange office-end (FXO), or foreign-exchange station-end (FXS) signaling unit. Level control (gain and attenuation) in the transmit and receive channels is provided by means of adjustable amplifiers and attenuators. Conventional 2600Hz SF tone is standard; other frequencies are optionally available.

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

1.03 The 6947 differs from the 6947A only in the method in which transmit-channel and receive-channel levels are adjusted. On the 6947, these levels are adjusted via front-panel potentiometers, while on the 6947A, these levels are adjusted via precision front-panel DIP switches. In all other respects, the two modules are identical.

1.04 Features and options of the 6947 and 6947A include the following: switch selection of all options; balanced 600-ohm terminating impedance on the terminal side; balanced, switchable 150, 600 or 1200-ohm terminating impedance on the facility side; switch-selectable FXO, FXS or E&M operation; adjustable amplifiers and attenuators; optional plug-on transmit and receive active slope equalizer subassemblies (Tellabs 9908A); an internal SF oscillator (use of an external master SF tone source is optional); switchable normal or inverted M-lead signaling; transmit minimum-break pulse correction and receive precision full pulse correction. Front-panel LED's indicate signaling and supervision, while front-panel test points access facility-side transmit and receive ports. Alarm leads compatible with most carrier group alarm (CGA) formats are available.

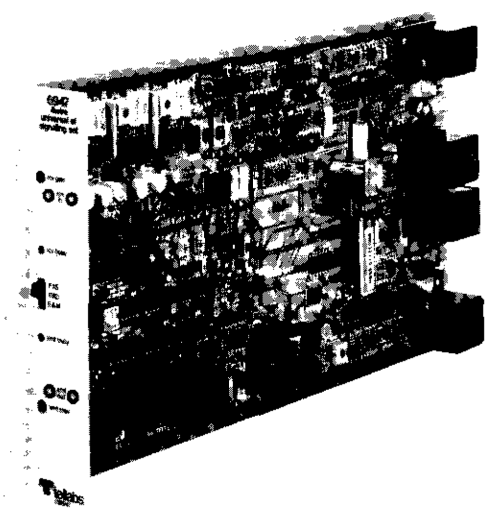


figure 1. 6947 and 6947A Universal SF Signaling modules with Gain

1.05 Adjustable attenuators and amplifiers in the transmit and receive channels of both modules coordinate facility-side transmission level points (TLP's) with various terminal-side levels. In the transmit channel, terminal-side attenuators can be set to provide from 0 to 24dB of loss, while facility-side level-control switches can be set to provide a +5, +3, 0 or −16 TLP with respect to the conventional −16 transmit TLP. In the receive channel, facility-side amplifiers can be set to provide from 0 to 24dB of gain while terminal-side level-control switches can be set to provide a +7, +2, −2, or −4TLP with respect to the conventional +7 receive TLP.

1.06 Equalization for nonloaded cable may be optionally provided in either or both channels via one or two Tellabs 9908A Active Slope Equalizer Subassemblies. The 9908A provides up to 7.5dB of slope equalization at 2804Hz (re 1000Hz) in 0.5dB increments. The subassemblies plug physically and electrically into connectors located on the modules' printed circuit board.

1.07 Balanced 600-ohm terminating impedance is provided at the 4wire terminal ports, while balanced, switch-selectable 150, 600, or 1200-ohm terminating impedance is provided at the 4wire facility.

E&M operation

1.08 When optioned for E&M operation, both the 6947 and 6947A provide SF signaling over a 4wire facility, full-duplex conversion between that

SF signaling and terminal-side E&M signaling, and extension of conventional E&M signaling toward a 4wire termination. The receive portion converts incoming SF signaling tones to local E-lead states and provides precision pulse correction to ensure optimum output pulsing in response to a variety of input pulsing rates and make-break ratios. Recognition delays prevent response to spurious SF tone bursts and to momentary tone interruptions. The transmit portion converts local M-lead inputs to outgoing SF tone signals and provides minimum-break-pulse correction to ensure 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.

FXO operation

1.09 When optioned for FXO operation, the 6947 and 6947A provide SF signaling over a 4wire facility, conversion between that SF signaling and the terminal signaling used at the office end of an FX or OPX circuit, and extension of this terminal signaling toward the 4wire termination. The receive portion converts incoming SF tones to local supervision and dial pulse states corresponding to those at the station end of the signaling path. A precision pulse corrector ensures loop dial pulsing with optimum make-break ratio toward the local switching equipment. The transmit portion converts local office ringing and supervisory states to outgoing SF tone conditions. An integral 20Hz modulator provides outgoing SF tone modulated at a 20Hz rate during ringing, independent of local ringing frequency in ground start operation. The ringing detector recognizes incoming ringing at any frequency between 18 and 33Hz and is compatible with most conventional ringing schemes.

FXS operation

1.10 When optioned for FXS operation, the 6947 and 6947A provide SF signaling over a 4wire facility, conversion between that SF signaling and the terminal signaling used at the station end of an FX or OPX circuit, and extension of this signaling toward the 4wire termination. The receive portion converts incoming SF signaling tones to local ringing and seizure (tip-ground) states. In the loop-start mode, appearance of SF tone activates local ringing. In the ground-start mode, loss of received tone causes the loop to be completed toward the station, and detection of SF tone modulated by central office ringing frequency activates local ringing. The transmit portion converts local-station supervisory and dialing states to outgoing SF tone conditions. Transmission of SF tone indicates station idle or the break portion of a dial pulse. In addition, a minimum-break pulse corrector in the transmit circuit ensures transmission of recognizable tone pulses.

1.11 The 6947 and 6947A are equipped with an integral SF signaling tone oscillator and thus do not require an external (master) SF tone source. Provision is made, however, for operation with such a tone supply if desired. Selection of internal or external tone source is made via slide switch on the module.

1.12 Both modules are members of Tellabs' 6900 family of signaling and terminating modules. They are electrically and mechanically compatible with the other modules in the 6900 family and with the modules in the 4900 family of terminating and level control modules. Common pin assignments in the 6900 and 4900 families permit the use of a universal wiring scheme to increase system flexibility.

1.13 Each module mounts in one position of a Tellabs Type 16 Mounting Shelf, or in one position of the Tellabs 267S SF Signaling and Terminating Assembly. The Type 16 shelf is available in 19 and 23-inch relay rack versions, both of which mount 12 modules and occupy four vertical mounting spaces (7 inches) in a standard relay rack. The 267S SF Signaling and Terminating Assembly is a two module, wall-mounted enclosure, optionally equipped with power and ringing.

2. application

2.01 The 6947 and 6947A Universal SF Signaling modules with Gain are designed to interface a 4wire transmission facility with a 4wire station loop or PBX trunk circuit in conventional E&M, office-end foreign-exchange (FXO), or station-end foreign-exchange (FXS) signaling applications. These modules provide SF signaling over the 4wire facility, switch-selectable choice of three modes of signaling toward the 4wire termination, and conversion between the two (facility to terminal) signaling modes. The 4wire station or PBX trunk circuit interfaced by the 6947 or 6947A may operate in either the loop-start or ground-start supervisory mode.

terminal interface

2.02 The terminal side is designed to interface the station end with adjustable transmit-channel attenuators and receive channel level-control circuitry to accommodate a wire range of circuit interface levels. Terminal-side transformers provide a balanced terminating impedance of 600 ohms. Each terminal-side transformer is center-tapped.

facility interface

2.03 The 6947 and 6947A are designed to interface the 4wire transmission facility via adjustable receive-channel amplifiers and transmit-channel level-control circuitry to accommodate a wide range of circuit interface levels. Facility-side transformers may be switch-optioned for a balanced terminating impedance of 150, 600, or 1200 ohms. Each facility-side transformer is center-tapped to derive a balanced simplex lead.

level control

2.04 Adjustable attenuators and level-control switches in the transmit channel in conjunction with adjustable amplifiers and level-control switches in the receive channel provide for interfacing transmit and receive facility-side TLP's with terminal-side levels in accordance with good transmission design. In the transmit channel, terminal-side attenuators can be set to provide from 0 to 24dB of loss, while facility-side level-control switches can be set to provide a +5, +3, 0 or −16TLP with respect to the conventional transmit TLP of −16. If other facility-side TLP's are required, transmit level-adjust potentiometer *(R189)* provides continuously adjustable level control to a −20TLP. (Note: Level-control switch *S7* must be set to the *+5* position in order for potentiometer *R189* to be inserted into the circuit. In the receive channel, facility-side amplifiers can be set to provide from 0 to 24dB of gain, while terminal-side level-control switches can be set to provide +7, +2, 0 or −2TLP with respect to the conventional receive TLP of +7. Level-control in the receive channel can also be continuously adjusted to a −24TLP via a receive level adjust potentiometer *(R63)*. Please note that level-control switch *S2* must be in the +7 position for potentiometer *R63* to be inserted into the circuit.

2.05 Prescription slope equalization for nonloaded cable may be introduced into the transmit and receive channels by equipping each module with two 9908A Active Slope Equalizer Subassemblies. Each 9908A provides up to 7.5dB of equalization at 2804Hz (re 1000Hz) in 0.5dB increments. Each 9908A plugs into a 5-pin connector that provides electrical as well as physical connection to the 6947 and 6947A modules. Frequency response of the Equalizer is shown graphically in figure 2 and in tabular form in table 1.

E&M operation

2.06 In conventional E&M SF signaling applications, the 6947 and 6947A provide an E-lead output that is open when SF tone is present at the 4wire receive input port and at circuit ground when no SF tone is present. In the transmit direction, SF tone is transmitted when the local M lead is either open or at ground potention, and is removed from the transmission facility when the M lead is at negative battery potential.

2.07 The E-lead output is derived via a mercury-wetted relay that provides a normally open (E) and a normally closed (N) contact. These contacts may be externally wired to accommodate any desired E-lead interface. Regardless of the contact wiring, however, the relay is energized when the 6947A senses no SF tone present at the 4wire receive input port and de-energized when SF tone is detected. The receive pulse corrector is arranged to control the pulsing relay such that during pulsing, the relay is de-energized during 58 ±2 percent of the pulsing cycle.

2.08 An M-lead option switch allows the 6947 and 6947A to accommodate either normal or inverted M-lead signaling states. In the normal state, SF tone is transmitted when the local M lead is

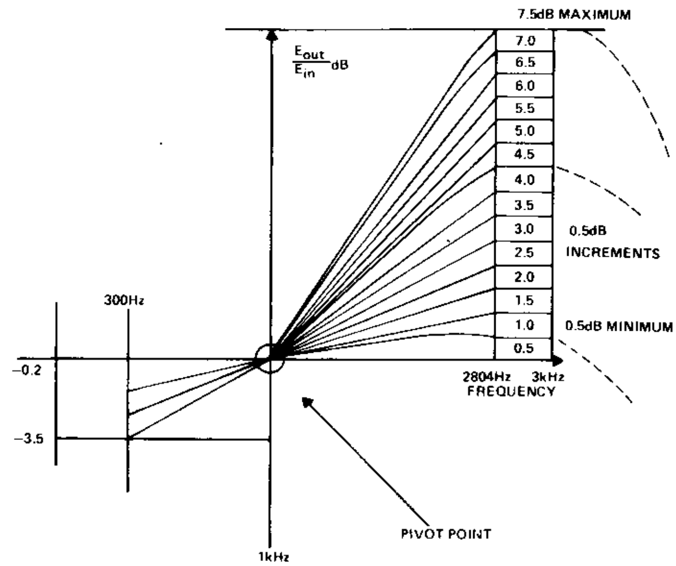


figure 2. Typical response curves for 9908A Equalizer subassemblies

9908A switch setting (in dB)	frequency										
	300Hz	400Hz	500Hz	800Hz	1000Hz	1500Hz	1804Hz	2500Hz	2800Hz	3000Hz	3200Hz
0	−0.2	−0.1	−0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	−0.5	−0.4	−0.3	−0.1	0.0	+0.2	+0.3	+0.4	+0.5	+0.5	+0.5
1.0	−0.8	−0.7	−0.6	−0.2	0.0	+0.4	+0.6	+0.9	+1.0	+1.0	+1.0
1.5	−1.1	−0.9	−0.8	−0.2	0.0	+0.6	+0.9	+1.3	+1.4	+1.5	+1.5
2.0	−0.8	−0.6	−0.5	−0.2	0.0	+0.4	+0.7	+1.5	+1.9	+2.2	+2.5
2.5	−1.1	−0.9	−0.7	−0.2	0.0	+0.6	+1.0	+2.0	+2.4	+2.7	+3.0
3.0	−1.5	−1.2	−1.0	−0.3	0.0	+0.8	+1.3	+2.4	+2.9	+3.2	+3.5
3.5	−1.8	−1.5	−1.2	−0.4	0.0	+1.0	+1.6	+2.8	+3.4	+3.7	+4.7
4.0	−1.8	−1.5	−1.1	−0.4	0.0	+1.1	+1.8	+3.4	+4.1	+4.5	+4.9
4.5	−2.2	−1.7	−1.4	−0.5	0.0	+1.3	+2.1	+3.9	+4.6	+5.1	+5.4
5.0	−2.5	−2.0	−1.6	−0.6	0.0	+1.5	+2.4	+4.3	+5.1	+5.5	+5.9
5.5	−2.8	−2.3	−1.8	−0.6	0.0	+1.7	+2.7	+4.7	+5.5	+6.0	+6.5
6.0	−2.5	−2.0	−1.6	−0.6	0.0	+1.5	+2.5	+5.0	+6.0	+6.7	+7.4
6.5	−2.8	−2.2	−1.8	−0.6	0.0	+1.7	+2.8	+5.4	+6.5	+7.2	+7.9
7.0	−3.2	−2.5	−2.0	−0.7	0.0	+1.9	+3.1	+5.8	+7.0	+7.7	+8.4
7.5	−3.5	−2.8	−2.3	−0.8	0.0	+2.1	+3.4	+6.3	+7.5	+8.2	+8.9

table 1. Frequency response of the 9908A Equalizer subassemblies

open or at ground potential and removes SF tone when the local M lead is at negative battery potential. In the inverted state, SF tone is transmitted when the M lead is at negative battery potential and removes SF tone when either open or ground is applied to the M lead. (In either case, the transmit pulse corrector ensures that the minimum duration of any outgoing tone pulse will be 50 milliseconds.) When the 6947 or 6947A's M-lead inversion capability is used, two signaling sets may be connected back-to-back without an intermediate signaling lead conversion unit.

signaling interface

2.09 Each module accommodates both single-lead and looped-signaling-lead interfaces. The conventional single-lead (Type I) format is used in electromechanical switching system environments, while the newer looped format (Type II and Type III interfaces) is used in electronic switching system environments.

incoming tone detection

2.10 The 6947 and 6947A are designed to interface the receive side of a transmission facility at a programmed TLP of +7 to −17, idle SF tone is received at a nominal level of −20dBm0. An augmented level of −8dBm0 is typically received during break portions of dial pulses and for about 400 milliseconds at the beginning of each tone interval. Each module's receiver will reliably detect SF 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 58dBrnC may interfere with detection of low-level signaling tones.

2.11 Within 13 milliseconds of detection of received SF tone, a band-elimination filter (BEF) is inserted in the receive transmission path to prevent propagation of SF tone beyond the local SF unit. An internal timing circuit ensures that the filter remains inserted during dial pulsing and during momentary losses of tone continuity. (Tables 2 and 3 provide details concerning BEF insertion.)

2.12 The 6947 and 6947A incorporate a precision pulse corrector in the SF receiver to ensure optimum pulsing toward the local switching equipment. The pulse corrector corrects incoming dial pulses to provide 58 ±2 percent break pulses toward the switch for input pulsing rates between 8 and 12 pulses per second. (See section 6 for detailed pulsing specifications.) The pulse corrector will ignore input tone bursts shorter than about 28 milliseconds.

transmit-direction signaling

2.13 The 6947 and 6947A are designed to interface the transmit side of the transmission facility at a programmed TLP of +5, +3, 0 or −16 and to transmit SF tone at either of two levels. Specifically, SF tone is transmitted at −20dBm0 during idle, and at an augmented level of −8dBm0 during dial pulsing and for approximately 400ms each time tone is applied to the facility. This momentarily increased tone level aids in the detection of supervisory state changes and incoming dial pulsing.

delay circuit and transmit pulse correction

2.14 A symmetrical delay of approximately 20 milliseconds is provided between the input M lead and the tone transmission gate. This delay prevents inadvertent transmission of interruption of SF tone in response to momentary M-lead transitions. This delay also aids in prevention of transient interference with tone transmission.

2.15 A minimum-break pulse corrector is used in the transmit path to ensure a 50-millisecond minimum-break duration during dialing. This type of pulse correction does not interfere with supervisory winks and momentary signaling state changes and helps to ensure that recognizable pulses are transmitted. The pulse corrector does not alter the duration of tone intervals resulting from M-lead state changes longer than 50 milliseconds.

transmit path cut

2.16 The transmit voice transmission path through each module is cut (opened) during idle circuit conditions and is not cut (except momentarily in response to E-lead state changes) when the local M lead is in the busy condition. The path is 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. These path cuts prevent transmission of noise, transients, speech, and other interfering signals during critical signaling intervals.

2.17 The transmit path cut is inserted within 5 milliseconds of an M-lead state change. Tone transmissions in response to M-lead state changes are delayed approximately 20 milliseconds, resulting in a nominal pre-cut interval of 15 milliseconds. This ensures that any transients associated with signaling state changes in the local trunk circuit will not affect signaling tone transmission. Details concerning insertion and removal of the transmit path cut are provided in tables 2 and 3.

FXS operation

2.18 Both modules can accommodate conventional loop-start and ground-start supervisory formats. In *loop-start* operation, receipt of incoming SF tone activates ringing toward the station or PBX trunk circuit. Loop current is supplied to the station or trunk circuit through matched resistances in each module's A and B leads. In ground-start operation, the tip-lead path is opened to ground whenever incoming SF signaling tone is detected, except during ringing. Presence of SF tone at the 4wire receive input port indicates that the associated CO circuit is idle (tip lead open), and local ringing

circuit condition	sf tone		local condition of xmt path cut			local rcv path BEF state
	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 *dialing delay*	off	on/off transition	not cut	none	not cut	removed 50±5ms after cessation of tone.
distant end sends *start dial*	off	off/on transition	not cut	none	not cut	inserted 13±8ms after receipt of tone
local end dialing	off/on—on/off transitions, ending with on/off transition.	on	not cut	precut 18±5ms, 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 tone.
talking	off	off	not cut	none	not cut	out of circuit
disconnect, local end first	off/on transition	off	not cut	precut 18±5ms, 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±8ms after receipt of tone
idle	on	on	cut	none	cut	inserted

table 2. SF tone state, transmit cut, and receive filter insertion conditions — local call origination

circuit condition	sf tone		local condition of xmt path cut			local rcv path BEF state
	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 18±5ms, 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—on/off transitions, ending with on/off transition	not cut	cut within 35ms 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±8ms 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
disconnect, distant end	off	off/on transition	not cut	none	not cut	inserted 13±8ms after receipt of sf tone.
talking	off	off	not cut	none	not cut	out of circuit
disconnect, local end	off/on transition	on	not cut	precut 18±5ms then continuously cut	cut	inserted
idle	on	on	cut	none	cut	inserted

table 3. SF tone states, transmit cut, and receive filter insertion conditions — distant - location call origination

is initiated by receipt of SF tone amplitude-modulated by the CO ringing frequency. Outgoing seizure is initiated in ground-start operation by application of ground to the local ring conductor.

signaling tone states

2.19 Signaling tone states for each module are consistent with the conventional F-signaling formats of FXS and OPX service. These states are listed in tables 4 and 5 for loop-start and ground-start operation, respectively.

signaling tone levels

2.20 Normal idle SF tone level is —20dBm0 in both directions of transmission. Each module interfaces the 4wire transmission facility at —16 transmit and +7 receive TLP's; thus, the nominal received SF tone level is —20dBm0 at the 4wire receive input port, and the transmitted SF tone level is —20dBm0. For the first 400 milliseconds of any SF tone transmission by the 6947 and 6947A (or by the associated FXO signaling unit at the opposite end of the facility), however, SF tone is transmitted at an augmented level of —8dBm0. This momentarily increased tone level aids in the detection of supervisory state changes and incoming dial pulsing.

supervisory limits and build-out resistors

2.21 Both modules incorporate internal build-out resistors (BOR's) in the loop current supply circuit to limit current on short loops. The BOR's should be optioned for 600BF (600 ohms) when the battery supply resistance is less than 500 ohms, and for 400BF (400 ohms) when the battery supply resistance is 500 ohms or greater (including the station or PBX trunk resistance). With the BOR's optioned for 400BF the 6947 and 6947A will accurately sense loop conditions for loop resistances up to 3000 ohms.

local loop condition	SF tone	
	receive	transmit
idle	off	on
ringing	on	on
off-hook	off	off
dialing	off	off-on-off

table 4. Signaling states – loop start (FXS)

local loop condition	SF tone	
	receive	transmit
idle	on	on
seizure from CO	off	on
ringing	off-on-off	on
off-hook	off	off
CO release	on	off until detection of received SF then on
local seizure	on	off
CO seizure acknowledgement	off	off
dialing	off	off-on-off
local station disconnect first	off	on
CO disconn. first	on	off
idle	on	on

table 5. Signaling states – ground start (FXS)

Note: *Although the 6947 and 6947A will operate with external loop resistance up to 3000 ohms, loop resistances exceeding 2000 ohms will result in loop current less than 20mA.*

2.22 In ground-start operation, the 6947 and 6947A sense applications of ground to the ring conductor to initiate seizure toward the distant terminal. The ring ground sensor in both modules will sense application of this ground through external resistances of up to 2000 ohms on the ring conductor.

ring trip and ring-trip range

2.23 The 6947 and 6947A provide for removal of local ringing when the station or PBX trunk responds to incoming seizure. For proper operation of this circuit, the external ringing source must be referenced to a potential of –48 ±6Vdc. Each module will reliably detect ring trip through 3000 ohms of external loop resistance and will tolerate an equivalent line capacitance of 4μF and a resistance of 5.1 kilohms bridged across the ringing path without pretripping. Each module will also tolerate a loop leakage resistance of 30 kilohms without falsely indicating off-hook or ring trip. An internal inhibit circuit prevents operation of the ring-up circuit when the local station or PBX trunk is off-hook.

delay circuit and transmit pulse correction

2.24 The 6947 and 6947A incorporate a symmetrical delay circuit in the loop current sensor that delays detection of on-hook-to-off-hook and off-hook-to-on-hook transitions by about 30 milliseconds to prevent false detection of short transients typically associated with station loops. A minimum-break pulse corrector ensures that the break portion of any transmitted dial pulse will be no shorter than 50 milliseconds, regardless of input break or pulsing rate. The minimum-break pulse corrector has no effect on pulsing breaks longer than 50 milliseconds.

transmit path cut

2.25 To prevent speech and transient energy from interfering with detection of SF signaling tone at the distant end of the circuit, the voice path through the transmit portion of each module is cut (opened) during dialing and whenever SF tone is transmitted. The path cut is inserted within a few milliseconds of interruption of local loop current and is removed about 125 milliseconds after SF signaling tone is removed. The transmit path is always cut about 15 milliseconds before any transmission of SF signaling tone.

traffic-monitoring provision and E&M capability

2.26 The module's traffic-monitoring lead (pin 17), which functions much like a local sleeve lead, provides ground output when the local station is off-hook and is open when the circuit is idle. In addition, an M-lead override is provided which overrides the loop-signaling detector. The 6947 and 6947A will transmit SF tone when the local loop is idle and when the M lead is either open or at ground potential. SF tone will be removed when the local loop is busy or when the M lead is at battery potential.

FXO operation

2.27 Both modules are optioned for FXO operation, they can accommodate a conventional loop-start supervisory format. When the distant (station) end is idle (on-hook), the associated foreign-exchange station-end (FXS) signaling unit transmits SF tone. Receipt of this tone by each module holds the 4wire loop open toward the local switching equipment. When the office end is idle, the modules do not transmit SF tone. **On calls from the office end to the station end**, receipt of ringing voltage from the local switching equipment causes each module to transmit SF tone. Receipt of this tone by the FXS signaling unit initiates ringing toward the station or PBX trunk circuit. **On calls from the station end to the office end**, a station-end off-hook condition causes the FXS unit to cease SF tone transmission. Each module, upon this loss of incoming tone, closes the loop toward the local switching equipment. Incoming SF tone pulses indicate dialing.

2.28 In ground-start operation, just as in loop start, the 6947 and 6947A accommodate a conventional supervisory format. When the station end is idle, the associated FXS signaling unit transmits SF tone. Receipt of this tone by the 6947 and 6947A holds the 4wire loop open toward the local switching equipment. Similarly, when the office end is idle, the 6947 and 6947A transmit low-level SF tone. Receipt of this tone by the distant FXS signaling unit holds the tip lead open toward the PBX trunk circuit. **On calls from the office end to the station end**, the local switching equipment grounds the tip lead, causing the 6947 and 6947A to remove outgoing SF tone. Subsequent receipt of ringing voltage from the local switching equipment causes each module to transmit high-level SF tone, amplitude-modulated at 20Hz. Receipt of this tone by the FXS signaling unit causes the unit to close the tip lead and apply ringing toward the PBX trunk circuit. When the PBX answers, the FXS unit ceases SF tone transmission. Upon this loss of incoming tone, the modules close the 4wire loop to trip ringing and establish the connection. **On calls from the station end to the office end**, the distant PBX grounds the ring side of the line, cutting off the SF tone being received. This removal of SF tone grounds the ring side of the 4wire path toward the local switching equipment. The switching equipment returns ground on the tip side, and the modules cease SF tone transmission. This loss of SF tone at the station end closes the tip side toward the PBX, completing the loop. Dialing can commence at this time.

signaling tone states

2.29 Signaling tones states for both modules are consistent with conventional F-signaling formats for FX and OPX service. These states are listed in tables 6 and 7 for loop-start and ground-start operation, respectively.

signaling tone levels

2.30 Normal idle SF tone level is −20dBm0 in both directions of transmission. The 6947 and 6947A interface the 4wire transmission facility at −16 transmit and +7 receive TLP's; thus, the nominal received SF tone level is −20dBm0 at the 4wire receive input port and the transmitted tone level is −20dBm0. For the first 400 milliseconds of any SF tone transmission by the 6947 and 6947A (or by the associated FXS signaling set at the opposite end of the facility), however, SF tone is transmitted at an augmented level of −8dBm0. This momentarily increased tone level aids in detection of supervisory or signaling state changes. During ringing in the ground-start mode, the modules transmit high-level SF tone modulated by an internal 20Hz source.

loop current and supervisory range

2.31 When the distant station is off-hook, the 6947 and 6947A provides a path for loop current flow via the A and B leads simplex-connected to the local transmit and receive pairs. Current limiting is provided by an integral bidirectional current limiter whose resistance at 23mA is approximately 200 ohms. Limiter resistance increases as current through it increases so that the maximum loop current under 0 ohm loop conditions is approximately 70mA. During incoming seizure in the ground-start mode, each module applies ground to the local B lead through the current limiter. Supervisory limits in applications involving the 6947 and 6947A are dependent upon sensitivity of the local switching equipment, and range calculations should take into account the nominal 200-ohm resistance of the current limiter.

loop condition	SF tone receive	SF tone transmit
idle	on	off
ringing	on	on
off-hook	off	off
dialing	off-on-off	off

table 6. Signaling states, loop start

loop condition	SF tone receive	SF tone transmit
idle	on	on
incoming seizure (ground applied to ring lead at station)	off	on
seizure acknowledgement (switch grounds local tip lead)	off	off
dialing	off-on-off	off
busy	off	off
station on-hook	on	off
CO release	on	on
outgoing seizure (switch grounds local tip lead)	on	off
ringing	on	on-off-on at 20Hz rate
station answer	off	off
CO release (forward disconnect)	off until FXS signaling unit opens tip lead, then on	on
idle	on	on

table 7. Signaling states, ground start

receive pulse correction

2.32 The 6947 and 6947A incorporate a precision pulse corrector in the SF receiver to ensure optimum pulsing toward the local switching equipment. The pulse corrector corrects incoming dial pulses to provide 58 ±2 percent break pulses toward the switch for input pulsing rates between 8 and 12 pulses per second. (See section 6 for detailed pulsing specifications.) The pulse corrector will ignore input tone bursts shorter than about 28 milliseconds.

transmit path cut

2.33 To prevent speech and transient energy from interfering with transmission of signaling tone, the voice path through the transmit portion of each module is cut (opened) whenever SF tone is transmitted. The path cut is inserted within a few milliseconds of detection of the idle state (ground-start mode only) or of ringing, and is removed approximately 200 milliseconds after outgoing signaling tone is removed.

tone source

2.34 The 6947 and 6947A are equipped with an integral SF tone oscillator and therefore do not require an associated master SF tone supply. If operation from a master SF tone supply is desired, however, provision is made (via a slide switch) 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 ±0.1 Vrms, 2600 ±2Hz, unbalanced. Input to each module is capacitively coupled and presents a load impedance of approximately 75 kilohms to the tone source.

power and ringing

2.35 The 6947 and 6947A modules operate on filtered input potentials between −42 and −56Vdc, ground referenced. The positive side of the dc power supply must be connected to earth ground. Ground-start operation of the 6947 and 6947A requires a low-resistance ground that is common with the ground of the local switching equipment power supply.

2.36 The ringing detector in each module senses input ringing between the A and B leads, which means that both superimposed and grounded ringing schemes can be accommodated. Local ringing may be applied between either the A or B lead and ground or across tip and ring. The 6947 and 6947A sense any ringing frequency between 18 and 33Hz, with a sensing threshold of about 60Vrms.

carrier group alarm

2.37 Carrier group alarm (CGA) input leads on each module allow the module to be forcibly removed from service when the associated carrier system malfunctions so that seizure of a disabled circuit is prevented. These CGA leads, designated *ALM* (alarm master) and *ALO* (alarm override), are compatible with most CGA formats. With the appropriate CGA option switches, forced release of any call in progress can be effected by application of an external ground (from the CGA unit, e.g., Tellabs' 6858 CGA Module), to either the ALM or ALO lead. This ground causes the module's A and B leads to be opened, preventing both incoming and outgoing seizure and effectively removing the module from service until the carrier system is repaired.

2.38 To provide for forced release, only the ALM or ALO lead (not both) need be enabled. Enabling the ALO lead provides the capability of restoring to service the 6947 or 6947A that was previously forced to the idle state during a failure of the associated carrier system. The ALO lead is normally wired to a local override control (usually located on the CGA unit) that may be activated during a carrier failure to override the 6947 or 6947A's forced-idle state. The module can then be patched to an alternate carrier system for the duration of the failure. If this capability is not desired, the ALM lead should be enabled instead. External connections for both leads may be made in prewired shelf installations, and the desired lead enabled via the appropriate switch option when the module is installed.

3. installation

inspection

3.01 The 6947 and 6947A Universal SF Signaling Set modules with Gain should be visually inspected upon arrival to find possible damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

mounting

3.02 Each module mounts in one position of a Tellabs Type 16 Mounting Shelf, or in one position of the Tellabs 267S SF Signaling and Terminating Assembly. Before inserting a module into position, verify that all options are properly set, connector wiring is correct, and power and ringing generator connections are properly fused and protected. Each module plugs into a 56-pin connector at the rear of the Shelf.

3.03 External connections to the 6947 or 6947A are listed in table 8. Those connections **not** marked by an asterisk are mandatory for normal operation of the module; those marked by **one** asterisk (*) are optional; those marked by **two** asterisks (**) are not applicable to the 6947 or 6947A but are required as part of the universal wiring scheme for all 6900 and 4900-family modules. A Type 16 (or

connect:	to pin:
4W RCV IN T (4wire receive input tip)	55
4W RCV IN R (4wire receive input ring)	53
4W RCV OUT T (4wire receive output tip)	51
4W RCV OUT R (4wire receive output ring)	49
4W XMT IN T	7
4W XMT IN R	5
4W XMT OUT T (4wire transmit output tip)	3
4W XMT OUT R (4wire transmit output ring)	1
FACILITY RECEIVE SIMPLEX LEAD	41
FACILITY TRANSMIT SIMPLEX LEAD	9
TERMINAL RECEIVE SIMPLEX LEADS	36, 33
TERMINAL TRANSMIT SIMPLEX LEADS	40, 35
−BATT (−48Vdc input)	15
GND (ground)	25 and 26
*ALM (CGA alarm master)	47
ALO (CGA alarm override)	45
N (N lead)	30
E or S	21
M (M lead)	19
EXT. OSC. (external SF oscillator)	11
ALB (CGA alarm battery)	43
BY1 (make-busy ground output/contact closure)	39
BY2 (make-busy contact closure)	37
A lead	40
B lead	36
M-Busy (transmit sleeve lead)	17
E-Busy (receive sleeve lead)	13
A1 (SF A lead)	38
B1 (SF B lead)	34
MB lead for looped M-lead operation	32
RING GENERATOR	23
*EA (E lead contact)	28
**D lead	31
**F lead	29
**G lead	27

*Optional

**Not applicable to 6947 and 6947A but required as part of universal wiring scheme for all 6900/4900 modules.

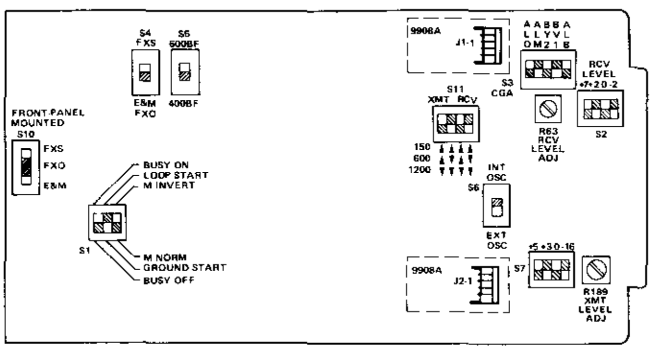
table 8. External connections to the 6947/6947A

equivalent) Shelf wired in accordance with all connections listed in table 8 will accept any 6900 or 4900 module on an interchangeable basis. If an installation is dedicated for use only with the 6947 or 6947A module and no flexibility or interchangeability requirements are expected, wiring time may be saved by making only the mandatory connections (i.e., those without asterisks) listed in table 8. Be aware that, while lead nomenclature may vary from one module to the next in the 6900 and 4900 families, basic function (and wiring) remain universal.

option selection

3.04 All option selections on the 6947 and 6947A modules are made via slide switches or DIP switches located as shown in figure 3. Table 9 lists all options and indicates the option choices, which are further explained in paragraphs 3.05 through 3.11.

Note: *In order to install the two 9908A subassemblies, two straps (one for the transmit and one for the receive channel) must be removed. These straps are located over the standoff posts used to secure the subassemblies to the printed circuit board.*



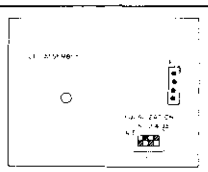


figure 3. 6947/6947A and 9908A option switch locations

E&M options

3.05 In the 6947 and 6947A modules' SF signal section, switch *S1-3* selects normal or inverted M-lead operation. Set *S1-3* to the *M NORM* position for normal M-lead operation or to the *M INVERT* position when inverted M-lead operation is desired. Switch *S6* conditions the module for use with its integral SF tone oscillator or with an external master SF tone source. Set *S6* to the *INT* position if the module's integral SF oscillator is to be used or to the *EXT* position if an external SF tone source is to be used.

CGA (E&M)

3.06 Carrier group alarm (CGA) switch options on the 6947 and 6947A are used to forcibly remove the module from service when the associated carrier system malfunctions so that seizure of a disabled circuit is prevented. The various CGA functions are selected by means of DIP switches *S1* and *S3* as described below.

3.07 The forced-release function may be provided over either the ALM (alarm master) lead (pin 47) or the ALO (alarm override) lead (pin 45) as desired. This function is effected by an externally derived (from the CGA unit) ground signal applied to the selected lead. To enable the forced-release function, two option switches must be set. If the ALM lead is to be used, set switch *S3-2 (ALM)* to the *ON* (closed) position and *S3-1 (ALO)* to the *OFF* (open) position. If the ALO lead is to be used, set switch *S3-1 (ALO)* to *ON* and *S3-2 (ALM)* to *OFF*. Setting both of these switches to the *OFF* (open) position disables the forced-release function.

3.08 The forced-busy function, which is often used following a forced release, is effected by externally derived (from the CGA unit) −48Vdc potential applied to the ALB (alarm battery) lead (pin 43). To enable the forced-busy function, set switch *S3-5 (ALB)* to the *ON* (closed) position. Setting *S3-5* to *OFF* (open) disables the forced-busy function.

3.09 When optioned for the forced-idle or forced-busy function the 6947 and 6947A may also be optioned to provide an external busy indication (e.g., an all-trunks-busy indication) to a local trunk scanner or register via the BY1 and BY2 leads (pins 39 and 37, respectively). This busy indication may be in the form of either a contact closure between the BY1 and BY2 leads or a ground output on the BY1 lead. Also, this busy indication may be provided upon receipt of either the first (ALM or ALO lead) or second (ALB lead) carrier-failure alarm indication. If a contact closure is desired, set switch *S3-3 (BS2)* to the *ON* (closed) position and *S3-4 (BS1)* to the *OFF* (open) position. If a ground output is desired, set *S3-3 (BS2)* to *OFF* and *S3-4 (BS1)* to *ON*. If the chosen busy indication is to be provided upon receipt of the first alarm input, set switch *S1-1 (BSY)* to the *ON* (closed) position. If this busy indication is to be provided upon receipt of the second alarm input, set *S1-1 (BSY)* to *OFF* (open) position.

FXS and FXO options

CGA

3.10 Carrier group alarm (CGA) switch options (ALM and ALO) on the 6947 and 6947A are used to forcibly remove the module from service (i.e., the A and B loop is forced open) when the associated carrier system malfunctions so the seizure of a disabled circuit is prevented (refer to paragraphs 3.06 through 3.09).

alignment

3.11 Alignment of the 6947 or 6947A consists of adjusting the transmit attenuation, receive gain, levels, and equalization to accommodate the desired facility and terminal levels. Before alignment, verify proper options and impedances.

3.12 Access to the appropriate ports of the 6947 and 6947A is conveniently provided by means of a Tellabs 9807 Card Extender or a pre-

selection	switch	option	function
CGA options	S1-1	BUSY ON, BUSY OFF	selects time at which external busy indication is provided either upon receipt of first (ALM or ALO lead) carrier-failure alarm input (BUSY ON) or upon receipt of second (ALB lead) carrier-failure alarm input (BUSY OFF).
supervision	S1-2	LOOP START, GROUND START	selects supervisory mode: LOOP START or GROUND START
SF signaling M lead	S1-3	M INVERT, M NORM	selects normal (M NORM) or inverted (M INVERT) M-lead operation
RCV out level control	S2	+7, +2, 0, −2TLP	selects 4wire output TLP
CGA options	S3-1 (ALO)	ON (closed) or OFF (open)	when ON, enables forced-release function via ALO lead (S3-2 OFF)
	S3-2 (ALM)	ON (closed) or OFF (open)	when ON, enables forced-release function via ALM lead (S3-1 OFF)
	S3-3 (BY2) and S3-4 (BY1)	ON (closed) or OFF (open)	used in combination to select either contact closure (S3-3 ON, S3-4 OFF) or ground output (S3-3 OFF, S3-4 ON)
	S3-5 (ALB)	ON (closed) or OFF (open)	when ON, enables forced-busy function via ALB lead
signaling interface (terminal)	S4	FXS, E&M/FXO	options BOR's into (FXS), or out of (E&M/FXO) loop current supply circuit
	S5	400BF, 600BF	selects either 400 ohms (400BF) or 600 ohms (600BF) of battery feed resistance
SF oscillator	S6	INT OSC, EXT OSC	includes (INT OSC) or excludes (EXT OSC) integral SF oscillator from circuit
transmit level-control (facility)	S7	+5, +3, 0, −16TLP	selects transmit channels' output TLP
signaling mode selection	S10 (front panel)	FXO, FXS, or E&M	selects 6927A's operating mode
transmit channel facility impedance	S11-1, S11-2	S11-1 S11-2 ON ON 150 ON OFF 600 OFF OFF 1200	selects transmit channel facility-side impedance of 150 ohms (non-loaded cable), or 1200 ohms (loaded cable)
receive channel facility impedance	S11-3, S11-4	S11-3 S11-4 ON ON 150 ON OFF 600 OFF OFF 1200	selects receive channel facility-side impedance of 150 ohms (nonloaded cable), 600 ohms (nonloaded cable), or 1200 ohms (loaded cable)
9908A equalizer subassembly (optional xmt and rcv)	S1 on 9908A subassembly	0.5, 1, 2, and 4dB (additive)	selects up to 7.5dB (in 0.5dB increments) of equalization at 2804Hz (re 1000Hz)

table 9. Switch options

wired jackfield. Using a properly terminated transmission measuring set (TMS), align the 6947 or 6947A as directed below.

Note: *Transmit-channel attenuation and receive-channel gain on the 6947 are adjusted via front-panel potentiometers, while transmit-channel attenuation and receive-channel gain on the 6947A are adjusted via precision DIP switches. Use only those jacks on the 9807 specified in the alignment procedure: other jacks may not access the module's circuitry.*

receive channel

3.13 Alignment of the receive channel consists of the following: setting of the level-control switches to provide the specified 4wire output level; adjustment of the front-panel *rcv* gain control (DIP) switches on the 6947A and a potentiometer on the 6947 to derive the receive channel's internal level of +7TLP; and adjustment of the 9908A Active Slope Equalizer Subassembly (if used) to provide the required amount of equalization. Align the receive channel as indicated below (jack designations are those on the 9807):

A. Connect a properly bridged TMS (receive) to the *rcv mon* jack. Request the distant facility-side location to send 1000Hz and 2804Hz tone at a 0dBm0 level. Measure and record each level.

B. Determine the specified receive channel output TLP and set level-control switch *S2* to the +7, +2, 0, or −2 position. Disconnect the TMS (receive) from the *rcv mon* jack and connect it to the *4W rcv drop or bal net out* jack.

C. Request the distant facility-side location to again send 1000Hz tone at 0dBm0. If the module is a 6947A, set the proper combination of front-panel *rcv* gain switches to the *IN* position until the output level corresponds to the level selected by level-control switch *S2*. If the module is a 6947, adjust the front-panel *rcv* gain potentiometer until the output level corresponds to the level selected by the level-control switch *S2*.

Note: *If your specified receive channel output TLP is slightly different from those levels provided by level-control switch* S2, *potentiometer* R63 *may be adjusted to provide this output level.*

D. Equalization: Determine the difference between the 1000Hz and 2804Hz tone levels measured in step A. Referring to figure 3 and table 9, set to *IN* the proper combination of switches on four-position DIP switch *S1* (located on the receive channel's 9908A subassembly) that adds up to this difference (or to the level specified in the CLR).

transmit channel

3.14 Alignment of the transmit channel consists of the following: setting of the level-control switches to provide the specified transmit channel output level; adjustment of the front-panel *xmt* attenuators (DIP switches on the 6947A and a potentiometer on the 6947) to derive the transmit channel's internal level of −16TLP; and adjustment of the 9908A Active Slope Equalizer Subassembly (if used) to provide the required amount of equalization. Align the transmit channel as indicated below (jack designations are those on the 9807):

A. Before alignment of the transmit channel, the transmit speech path cut must be removed. This can be done either by seizing the circuit from the local trunk, by temporarily placing battery on the SF unit's M lead via the *E and M facility (line)* jack (ring contact) on the 9807 Card Extender, or by removing incoming SF tone. As an alternative, the transmit path cut may be removed by setting switch *S1-3* to the *INV* position with the local M lead at ground potential.

B. Determine the specified transmit channel output TLP and set level-control switch *S7* to the −16, 0, 3 or 5 position.

C. Condition the TMS for the output level and impedance specified on the CLR for the 4wire transmit terminal interface, set the frequency for 1000Hz, and insert the signal at the *4W xmt drop or 2W mon* jack.

D. Condition the TMS for 600-ohm terminated measurement and measure the signal level at the *xmt SF out* test jack. If the module is a 6947A, set the proper combination of front-panel *xmt* loss switches to the *IN* position until the output level corresponds to the level selected by level-control switch *S7*. If the module is a 6947, adjust the front-panel *xmt* loss potentiometer until the output level corresponds to the level selected by the level-control switch *S7*.

Note: *If your specified transmit channel output TLP is slightly different from those levels provided by level-control switch* S7, *potentiometer* R189 *may be adjusted to provide this output level. However,* S7 *must be set to the* 5 *position in order for* R189 *to be inserted into the circuit.*

E. Reset switch *S11* for the specified facility-side transmit impedance.

F. Equalization: Refer to the CLR card for the specified transmit channel output level (facility side) at 2804Hz. Referring to table 9, set to *IN* the proper combination of switches on four-position switch *S1* (located on the transmit channel's 9908A subassembly) that adds up to the desired equalization at 2804Hz (re 1000Hz).

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6947 and 6947A Universal SF Signaling modules with Gain, sequence charts (figures 4 through 8) that illustrate sequential operation of the module on incoming and outgoing calls are presented in lieu of a more conventional circuit description. Horizontal paths identify events occurring simultaneously, and vertical paths denote sequential events. Dotted lines indicate elapsed time. These charts may be used to determine whether a module is performing normally by observing the module's response and comparing it to that shown in the chart. Reference to the 6947 and 6947A functional block diagram (section 5) may aid in understanding the sequence charts.

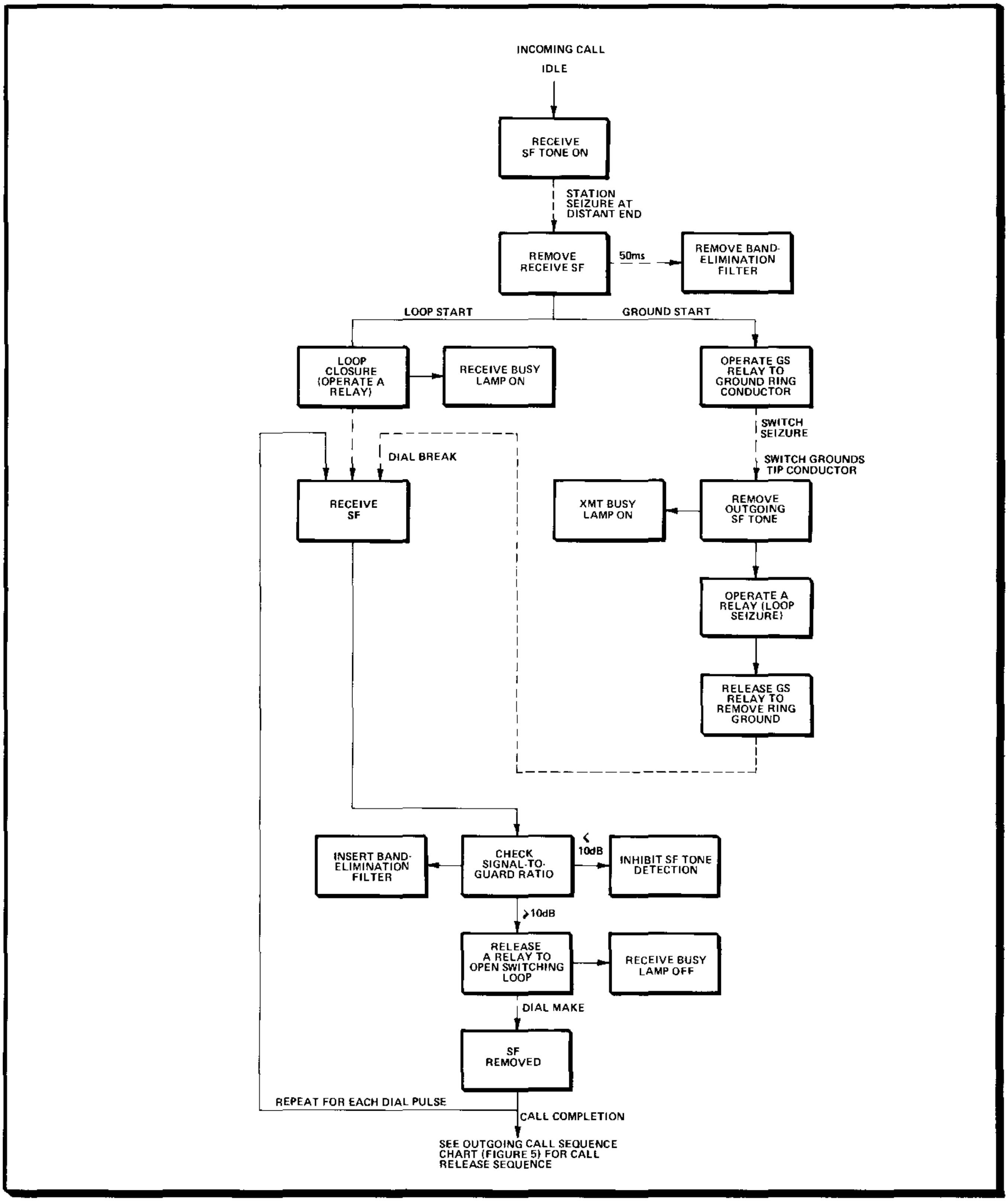


figure 4. Function sequence chart, incoming call, FXO mode

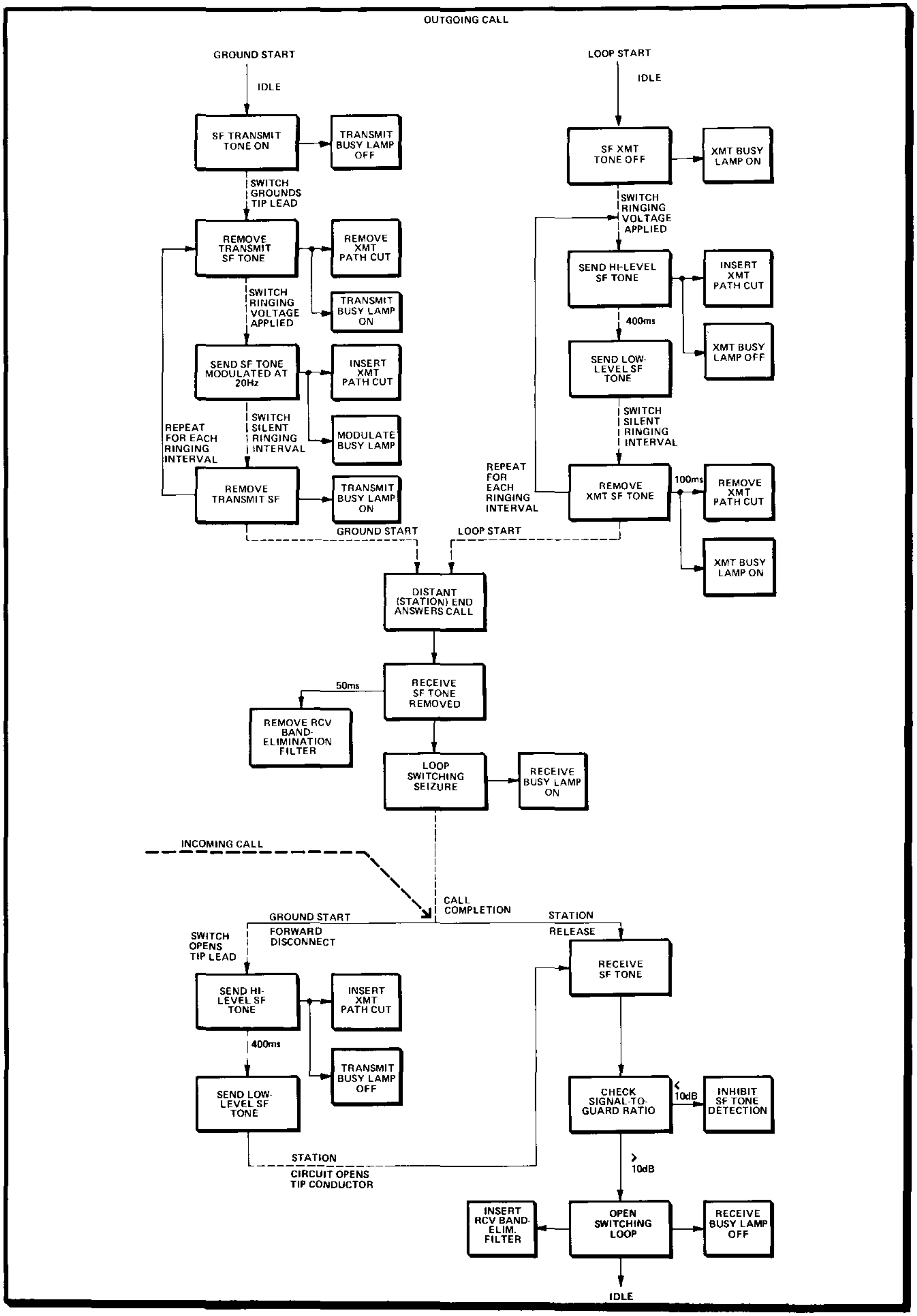


figure 5. Function sequence chart, outgoing call, FXO mode

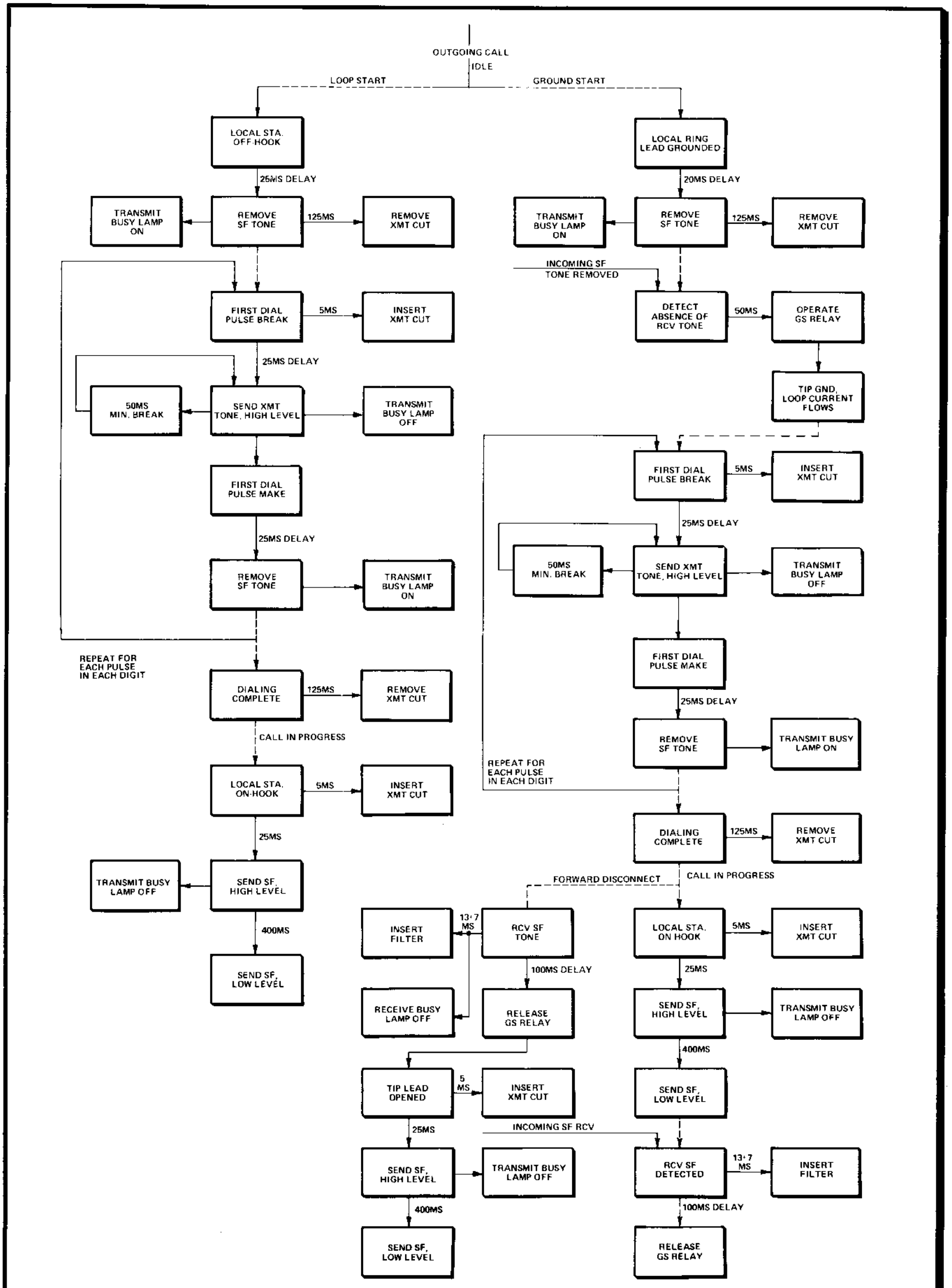


figure 6. Function sequence chart, outgoing call, FXS mode

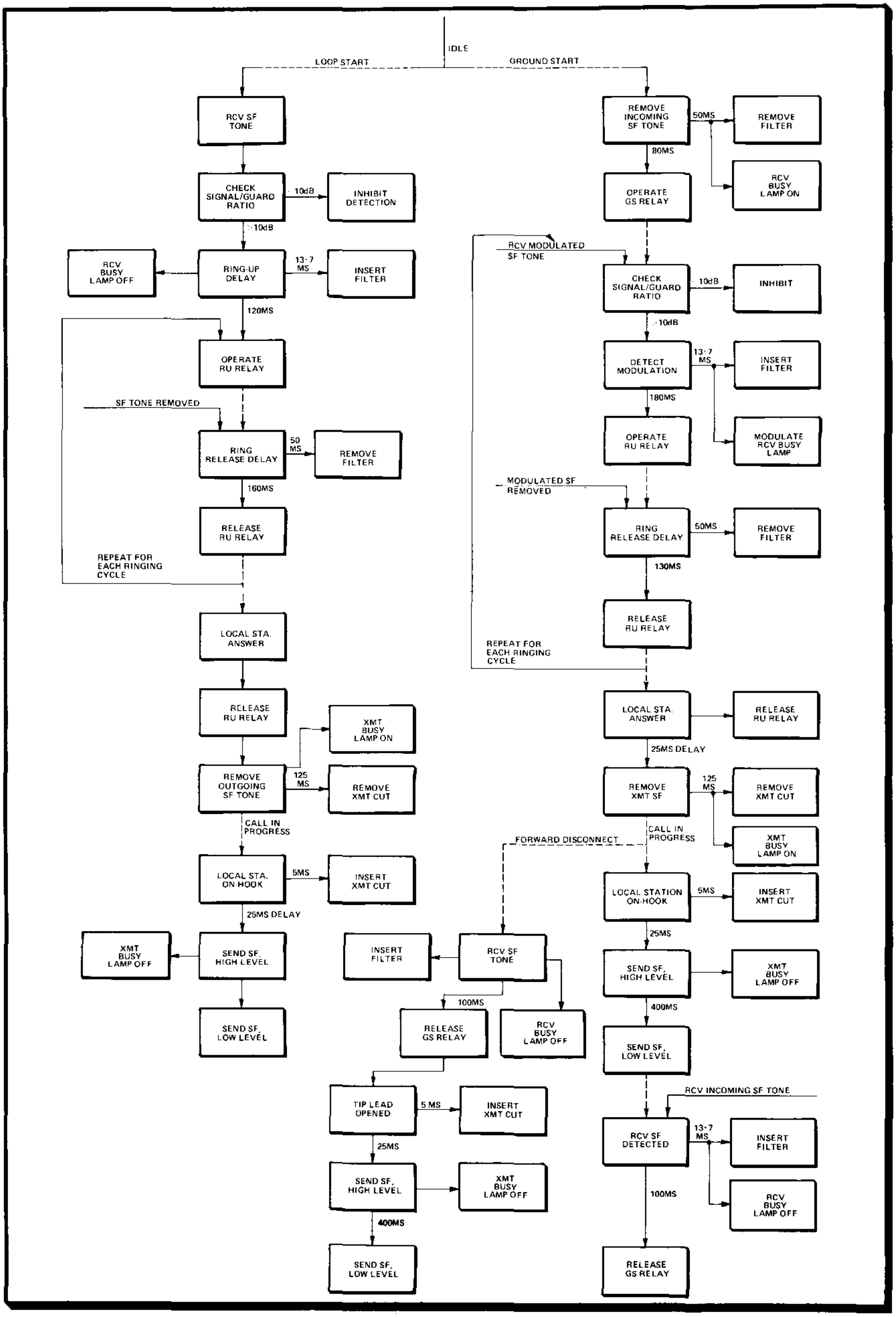


figure 7. Function sequence chart, incoming call, FXS mode

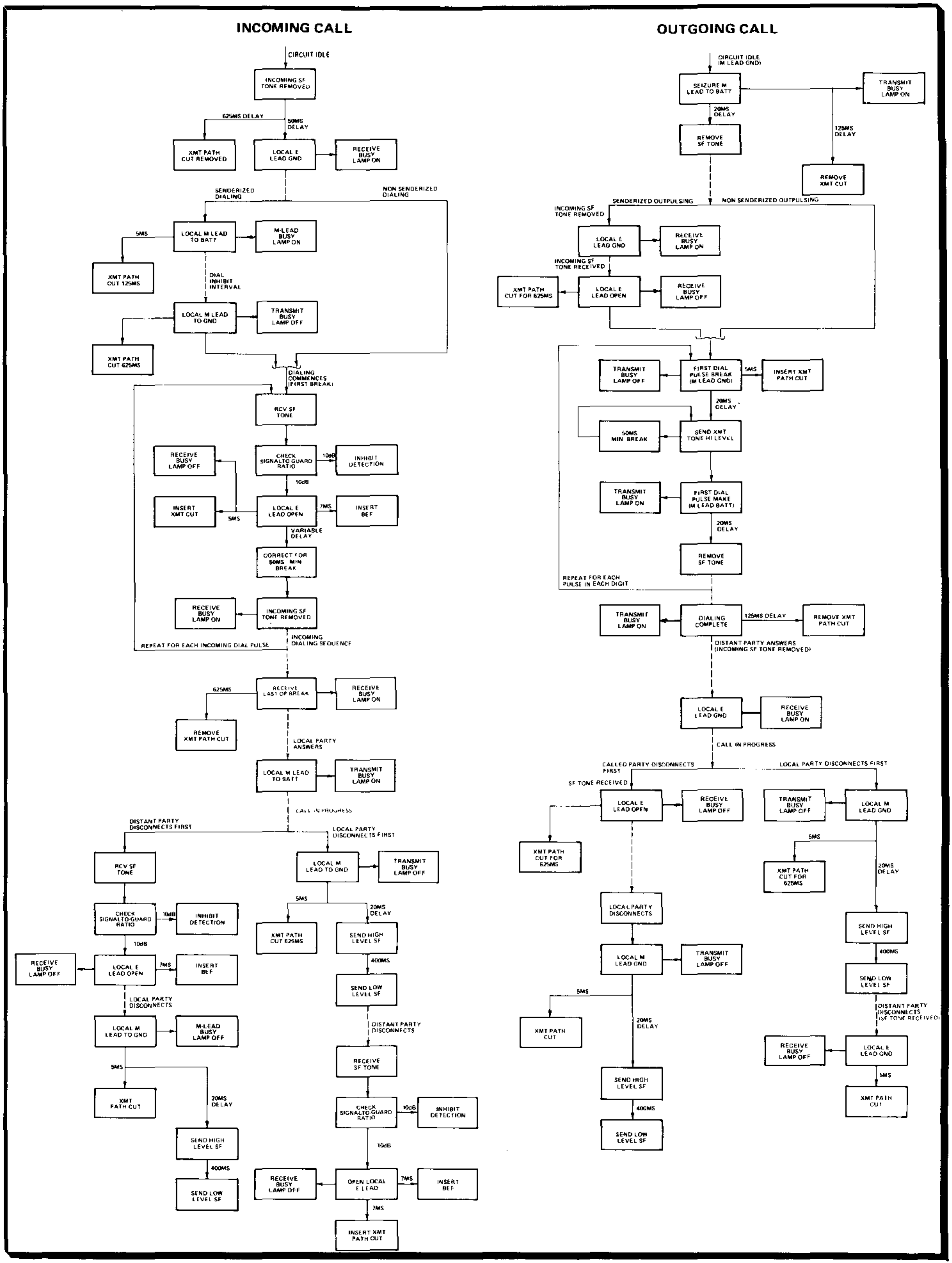
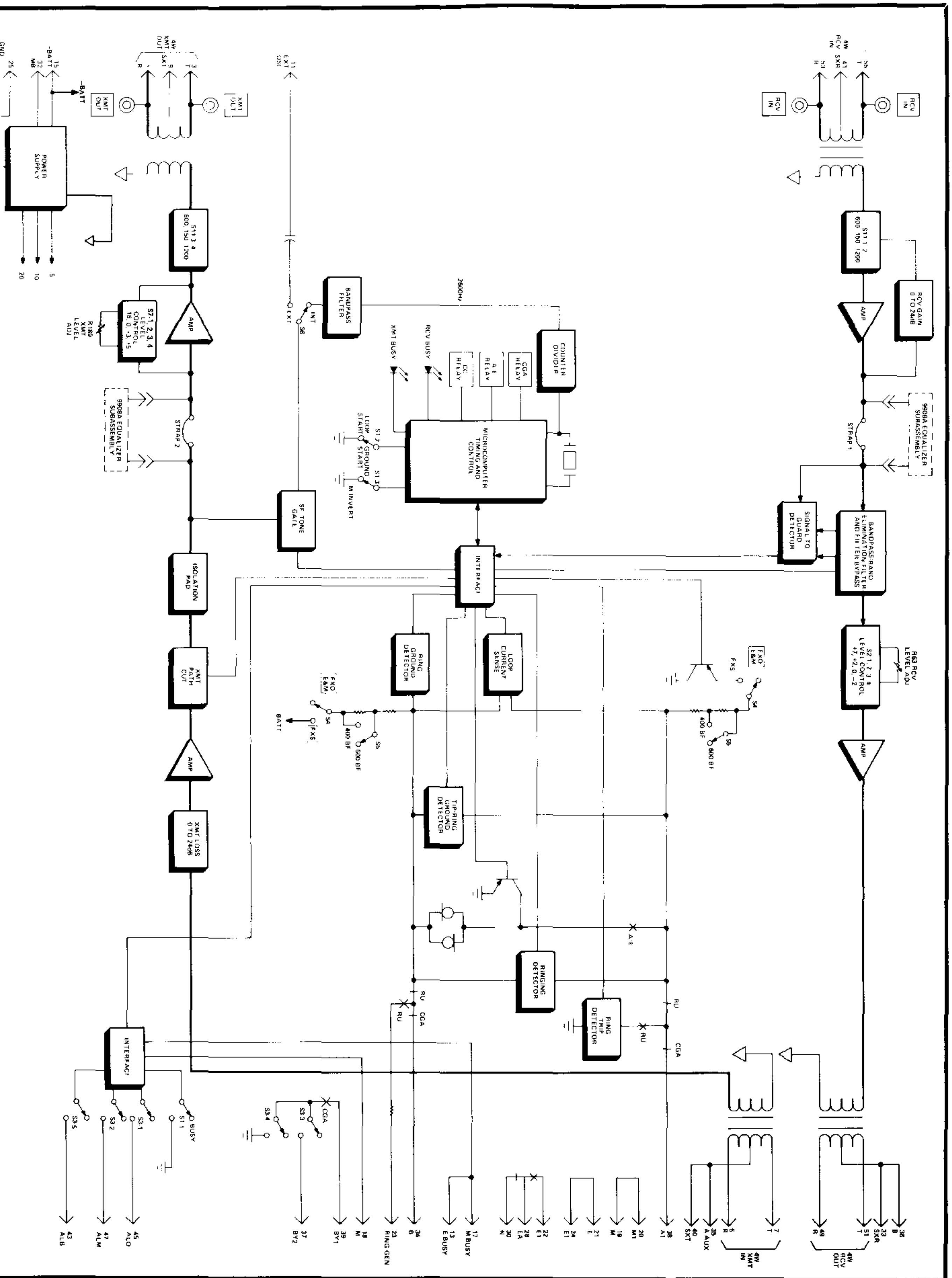


figure 8. Function sequence chart, incoming and outgoing call, E&M mode



6947 and 6947A 4Wire Universal SF Signaling Sets with Gain 816947/47A

5. block diagram

6. specifications

common specifications

terminal impedance
balanced 600 Ω

terminal return loss
ERL ⩾ 20dB

facility impedance (xmt and rcv)
150, 600, or 1200 ohms (switchable), balanced, 400 to 4000Hz

facility return loss

impedance	150 ohms	600 ohms	1200 ohms
ERL	⩾ 20dB	⩾ 20dB	⩾ 20dB

transhybrid loss
44dB minimum ERL, with matched terminations

frequency response
±1.0dB re 1000Hz level in both channels with receive BEF removed, 400 to 4000Hz

transmit attenuation (6947)
0 to 24dB, continuously adjustable

transmit attenuation (6947A)
0 to 24dB, in 0.1dB increments

accuracy
±0.05dB for 0.1, 0.2, 0.4, and 0.8dB steps
±0.1dB for 1.5, 3, 6, and 12dB steps

receive gain (6947)
0 to 24dB, continuously adjustable

receive gain (6927A)
0 to 24dB, in 0.1dB increments

accuracy
±0.05dB for 0.1, 0.2, 0.4, and 0.8dB steps
±0.1dB for 1.5, 3, 6 and 12dB steps

receive alignment levels
+7, +2, 0, −2TLP, switchable

insertion loss
0 ±1.0dB re 1000Hz level, 400 to 4000Hz

SF tone level – idle
−20 ±1dBm0

SF tone level – augmented level
−8 ±2dBm0

augmented level timing
high-level tone is transmitted for 400 ±10ms following each off-hook-to-on-hook transition of the M lead

SF tone detection threshold
−26.5 ±2.5dBm

SF tone rejection
50dB minimum, 2590 to 2610Hz

signaling bandwidths
high guard state, 75Hz nominal

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

maximum line noise
58dBrnC

band elimination filter
insertion delay: 13 ±7ms
removal time: either 225 ±15ms or received tone duration +53 ±5ms, whichever is larger

guard circuit transition timing
high-to-low, 225 ±15ms; low-to-high, 50 ±10ms

envelope delay
less than 150μs, 400 to 4000Hz

longitudinal balance
greater than 60dB at SF receive and transmit ports, 400 to 4000Hz

internal oscillator stability
2600 ±2Hz for life of unit

noise
20dBrnC maximum at +7, −16TLP

nonlinear distortion
less than 1% THD at 0dBm

overload (xmt and rcv)
overload point +5dBm

external oscillator (optional)
frequency: 2600 ±2Hz
level: 0.5Vrms
load impedance: 75 kilohms minimum, unbalanced

simplex current
100ma maximum; 3ma maximum unbalanced

power requirements (excluding loop current)
input voltage: −42 to −56Vdc
input current: idle 80mA, busy 120mA

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

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

mounting
one position of Tellabs Type 16 Mounting Shelf; or one position of the 267S Mounting Assembly

E&M operation

SF tone states
idle: tone transmitted
busy: no tone
dialing tone transmitted during breaks of dial pulses

pulsing characteristics
input breaks shorter than 19ms will not cause transmission of SF tone.
input breaks between 22 and 50ms will be transmitted as 50 ±2ms tone bursts.
input breaks longer than 50ms will be transmitted as tone bursts with a duration equal to that of the input break ±2ms.

M-lead signaling states, normal mode
idle: ground or open
busy: −7 to −56Vdc

M-lead signaling states, inverted mode
idle: −7 to −56Vdc
busy: ground or open

M-lead input impedance
36 kilohm resistance to ground, diode protected

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

transmit path cut
transmit speech path is cut 13 ±5ms before any transmission of SF tone. For further details concerning the insertion and removal of transmit path cut, see table 2 and 3.

dial pulse characteristics — SF to E lead input tone bursts shorter than 31ms are ignored

pulse rate	input break ratio	output break ratio
8pps	30 to 80%	58 ±2%
10pps	36 to 79%	58 ±2%
12pps	45 to 76%	58 ±2%

interdigit timing
185ms, minimum

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

seizure delay — removal of SF to E-lead ground
90 ±10ms

release delay — application of SF to E-lead open
40 ±10ms

FXO operation

SF tone states
loop start: idle — no tone
busy — no tone
ringing — tone transmitted

ground start: idle — continuous tone transmitted
tip lead ground — no tone
ringing — modulated tone

SF tone levels
high level: −8 ±2dBm0
low level: −20 ±1dBm0

transmit path cut
cut removal delay: 225 ±100ms after removal of outgoing SF tone

modulation — ground start
20Hz ±1Hz during ringing

forward disconnect delay — ground start
removal of tip ground to tone on: 320ms

dial pulse characteristics — SF to loop (input pulses shorter than 31ms ignored)

pulse rate	input break ratio	output break
8pps	30 to 80%	58 ±2%
10pps	35 to 79%	58 ±2%
12pps	45 to 76%	58 ±2%

interdigit timing
185ms, minimum

loop current limiting
less than 70mA, 200 ohms at 23mA

ring ground delay (ground start)
70 ±10ms nominal after loss of incoming SF tone

ringing voltage detection threshold
60Vac rms minimum, 17 to 33Hz

FXS operation

SF tone states
idle: tone transmitted
busy: no tone
dialing: tone transmitted during breaks of dial pulses

pulsing characteristics
input breaks shorter than 31ms will not cause transmission of SF tone.
input breaks between 34 and 50ms will be transmitted as 50 ±2ms tone bursts.
input breaks between 50 and 70ms will be transmitted as tone bursts with a duration equal to that of the input break ±2ms.

transmit path cut
transmit speech path is cut 10 ±5ms before transmission of SF tone. The path cut is removed 540 ±10ms after detection of an off-hook condition.

seizure delay
loop-start mode: 225 ± 55ms
ground-start mode: 100 ± 25ms

traffic monitor lead
idle condition: open circuit (diode clamped to input negative potential)
busy condition: ground (100mA maximum source capacity)

external ringing supply frequency
17 to 67Hz

external ring generator bias
−48 ±6Vdc

external ring generator output level
120Vac maximum

7. testing and troubleshooting

7.01 Because of the relative complexity of the 6947 and 6947A Universal SF Signaling Sets with Gain, it is recommended that, in the event of problems in the operation of either module, the function sequence charts (figures 4 through 8) be followed in an attempt to localize the problem. If any step in the functional sequence of events does not coincide with that shown in the charts, verify the facility and power connections and levels, level alignment, and proper option conditioning. If a module is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6947 or 6947A module. Unauthorized testing or repairs may void the module's warranty.

7.02 If a situation arises that is not covered in the flowcharts, 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: (213) 595-7071
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

7.03 If a 6947 or 6947A 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 6947 or 6947A 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 8X6947 or 8X6947A 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 6947 or 6947A 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.

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