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6945 4Wire Ringdown SF Signaling Set

contents

1. general description

1.01 The Tellabs 6945 4Wire Ringdown SF Signaling Set module (figure 1) provides signaling and transmission interface between a 4wire transmission facility and a metallic 4wire ringdown signaling loop. Specifically, the module provides SF signaling over the 4wire facility, conversion between that SF signaling and the loop signaling used in automatic or manual ringdown applications, and extension of this ringdown signaling toward the 4wire termination. Level coordination in the transmit and receive paths is provided by means of adjustable precision attenuators. Conventional 2600Hz SF tone is standard. Other frequencies are optionally available by special order.

1.02 This practice section is revised to provide updated specifications in section 6 and current Tellabs Regional Office telephone numbers in section 7.

1.03 The 6945 is the functional equivalent of Western Electric's FRD Signaling Unit. It is designed to operate at one end of a two-way ringdown SF circuit in association with another F-type ringdown SF signaling unit (e.g., another 6945, a Tellabs 6925 2Wire Ringdown SF Signaling Set module, or the equivalent of either) at the opposite end of the circuit. In this arrangement, either end of the circuit may originate a call to the other end.

1.04 Features and options of the 6945 include the following: accommodation of both manual and automatic ringdown modes; switch selection of the most frequently used options; local ring trip in all ringdown modes; switchable 150, 600, or 1200-ohm terminating impedance on the terminal (i.e., local 4wire station loop) side of the module; an internal SF oscillator (use of an external master SF tone source is optional); an integral, switch-selectable ringing interrupter; and an integral transmit-path equalizer for use with loaded cable. Two leads for traffic monitoring of incoming and outgoing calls are also provided. A front-panel light-emitting diode (LED) indicates busy, and front-panel test points access facility-side transmit and receive ports. Access points on the module provide compatibility with switched-access testing.

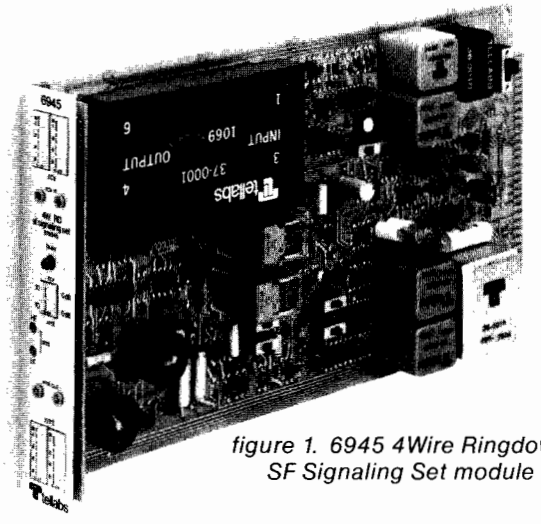


figure 1. 6945 4Wire Ringdown SF Signaling Set module

1.05 The 6945 accommodates a variety of automatic and manual ringdown signaling modes. Automatic modes include timed ringing (2-second burst ringing or 30-second continuous or interrupted ringing) and calling-party-controlled ringing (ringing persists as long as the calling party remains off-hook). Manual modes include dc (grounded key) and ac (switchboard) ringdown. Local ring trip is provided in all modes. A switch option on the module permits interface with either loop-start or ground-start terminal equipment.

1.06 The 6945 contains an integral 4wire station termination network, i.e., transformer coupling is provided to the 4wire loop, with balanced, switch-selectable 150, 600, or 1200-ohm terminating impedance at both ports (transmit input and receive output) toward the local station. Provision is made for either composite (transmit pair) or simplex (transmit and receive pair) signaling toward the local station. A switch-selectable, fixed-loss (10dB) sidetone path is derived between the station-side transmit and receive ports. On the module's facility side, fixed, balanced 600-ohm terminating impedance is provided at both ports (transmit output and receive input).

1.07 Adjustable precision attenuators (controlled by front-panel switches) are provided in both the transmit and receive paths for level coordination with −16 transmit and +7 receive transmission level points (TLP's) at the module's facility-side ports. The attenuation range is 0 to 26.5dB in 0.1dB increments. A front-panel-adjustable amplitude equalizer in the transmit path introduces small amounts of low-end and high-end response-slope correction for post-equalization of a local station loop consisting of loaded cable.

1.08 The 6945 is equipped with an integral SF signaling tone oscillator and thus does 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 a slide switch on the module.

1.09 The 6945 module is a member of Tellabs' 6900 family of central-office-configured signaling and terminating modules. It is electrically and mechanically interchangeable 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.

1.10 The 6945 module mounts in one position of a Tellabs Type 16 Mounting Shelf (as do all other modules in the 6900 and 4900 families) or in one position of the lower shelf of a Tellabs 269-series Mounting Assembly. The Type 16 Shelf is available in versions for 19 and 23-inch relay rack installation. Both versions mount 12 modules and occupy 4 vertical mounting spaces (7 inches) in a standard relay rack. The Shelves are provided (at the customer's option) either unwired, equipped with jumpers to bypass switched-access testing points, completely universally wired, or universally wired with a connectorized backplane.

1.11 The 6945 operates from nominal −48Vdc filtered battery supply. Maximum current requirements range from 28mA at idle to 45mA plus loop current when busy and 60mA when ringing.

2. application

2.01 The 6945 4Wire Ringdown SF Signaling Set module is designed to interface a 4wire transmission facility with a metallic 4wire ringdown signaling loop in either automatic or manual ringdown applications. The 6945 provides transmission of SF signaling tone over the 4wire facility as an indication of local call origination, loop signaling (i.e., local ringing) toward the 4wire termination in response to incoming SF tone, and conversion between the two signaling modes. The 4wire terminal equipment interfaced by the 6945 may operate in either the loop-start or ground-start supervisory mode (see paragraph 2.08).

2.02 The 6945 is intended for use at one end of a two-way ringdown SF circuit in association with another F-type ringdown SF signaling unit at the opposite end. This other unit may be another 6945, a Tellabs 6925 2Wire Ringdown SF Signaling Set, or the equivalent of either as provided by modules of Tellabs' 260 and 261 Signaling and Terminating Systems or by F-type ringdown SF equipment of other manufacturers.

terminal-side interface (4wire station termination)

2.03 The 4wire signaling and transmission path is extended to the local station via transmit and receive-path transformers that each derive 150, 600, and 1200-ohm switch-selectable terminating impedances. The transmit-path transformer derives external A and B leads for composite (transmit pair) signaling toward the local (terminating-end) station equipment and will accommodate loop current up to 100mA without performance degradation. The module's internal A and B leads (designated A1 and B1, respectively) through which local supervisory current and ringing current flow, are connected either to the A and B leads of the transmit-path transformer or to the simplex leads derived from the transmit-path and receive-path transformers. The choice of composite (transmit pair) or simplex (transmit and receive pair) signaling is made via switch option.

facility interface

2.04 The 6945 is designed to interface the 4wire transmission facility at conventional −16 transmit and +7 receive transmission level points (TLP's). If these TLP's are not present, a Tellabs 4744 or 4944 Line Amplifier or a 490X Pad Module (or equivalent) will be required in conjunction with the 6945. Transformer coupling with fixed, balanced 600-ohm terminating impedance is provided at both the transmit and the receive port on the facility side.

level control

2.05 Adjustable attenuators in the transmit and receive paths provide for interfacing the −16 transmit and +7 receive facility-side TLP's with conventional terminal-side levels. From 0 to 26.5dB of loss may be introduced in 0.1dB increments via front-panel DIP switches (see figure 2). Total attenuation in either channel is the sum of that channel's switches set to the *IN* position.

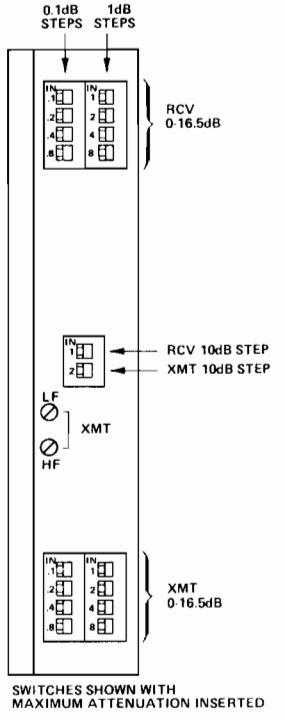


figure 2. 6945 front-panel controls

transmit-path equalization

2.06 High-frequency and low-frequency amplitude equalizers in the 6945's local transmit path provide adjustable post-equalization for local loops consisting of loaded cable. The high-frequency equalizer introduces up to 3dB of "bump" equalization at 3400Hz, and the low-frequency equalizer provides up to 4dB of low-end roll-off beginning at about 1000Hz. Both equalizers are continuously adjustable over their effective ranges via front-panel-accessible controls. No equalization is introduced when these controls are adjusted fully counterclockwise.

sidetone path

2.07 To accommodate 4wire station applications, a fixed-loss sidetone path may be introduced between the 6945's local (terminal-side) transmit

and receive ports. This sidetone path provides 10dB of loss (referred to equal levels) between the transmit and receive ports, which produces the sidetone level most commonly preferred. Adjustment of the module's transmit and receive attenuator switches does not affect the relative sidetone level. The sidetone path is inserted and removed by means of an option switch.

operating modes

2.08 The 6945 accommodates two modes of automatic ringdown operation (timed and calling-party-controlled [CPC] ringing) and two modes of manual ringdown operation (ac switchboard and dc manual key). These modes are selected via option switches on the module's printed circuit board. In all applications except CPC ringdown, the 6945 may be optioned for any desired ringdown mode independently of the ringdown mode selected at the other end of the circuit. In CPC ringdown applications, the signaling units at **both** ends of the circuit **must** be optioned for CPC ringdown. In both the automatic timed and the CPC ringdown mode, the 6945 may be switch-optioned to interface either loop-start or ground-start terminal-side equipment. In all ringdown modes except ac switchboard, loop current is supplied toward the associated station via the module's A and B leads. In all ringdown modes, SF tone is transmitted (at a level of −20dBm0±2dB) only during call initiation and is off during both the busy and the idle state. Paragraphs 2.09 through 2.14 describe the various operating modes in detail.

Note: *The circuits in which the 6945 is used are normally two-way circuits, i.e., either end of a circuit may originate or receive calls. Therefore, to best describe both the call-origination and call-termination functions of the 6945, paragraphs 2.09 through 2.14 are based on the assumption that a 6945 is present at* **both** *ends of each circuit described therein (rather than at only one end, with different F-type ringdown SF equipment at the other).*

automatic timed ringdown

2.09 In the automatic-timed-ringdown operating mode, when the terminal (station) equipment at the originating end of the circuit goes off-hook, the 6945 module at that end transmits a 2-second burst of SF tone toward the terminating end as an indication of circuit seizure. The 6945 at the terminating end initiates local ringing in response to this tone burst and activates a timer that removes ringing after a preselected time interval (see paragraph 2.10) if the call is not answered. Either continuous or interrupted ringing may be provided except in burst ringing applications (see paragraph 2.10), and no answer supervision (i.e., no SF tone burst) is transmitted toward the originating location.

2.10 The 6945 may be switch-optioned to provide a ringing interval (with timeout) of either 2 seconds or 30 seconds. When the 30-second option is selected, either continuous ringing or interrupted ringing (2 seconds on, 4 seconds off) may also be selected. When the 2-second (i.e., burst ringing) option is selected, only continuous ringing must be used. When the 6945 interfaces ground-start terminal (station) equipment, only the 30-second ringing interval should be used because conventional ground-start operation can be provided only if the called station answers before the ringing interval elapses.

CPC automatic ringdown

2.11 In the calling-party-controlled (CPC) ringdown mode (also known as ARD-WES), when the terminal (station) equipment at the originating end of the circuit goes off-hook, the 6945 module at that end transmits SF tone toward the terminating end as an indication of circuit seizure. Tone is transmitted continuously until the station at the terminating end answers or until the originating station goes back on-hook if the call is unanswered. Ringing of the called station in the CPC mode is under control of received SF signaling tone, i.e., ringing is activated only while SF tone is present at the input of the SF receive section of the 6945 at the terminating end. Answer supervision from the terminating-end 6945 is a short burst of SF tone transmitted toward the originating end when the call is answered. Receipt of this tone burst causes the 6945 at the originating end to remove outgoing SF tone. Either continuous or interrupted ringing may be used in the CPC mode, and either loop-start or ground-start operation may be accommodated at either end of the circuit.

Note: *Only in CPC ringdown applications must the signaling units at both ends of the circuit be optioned for the same ringdown mode, i.e., CPC ringdown. This is necessary so that the required answer supervision is provided to the originating end.*

manual ringdown

2.12 Manual ringdown may be initiated in either of two ways: by application of ground potential via a dc ringing switch or key to a dc input of the originating-end 6945 (dc ringdown mode), or by application of ringing potential across the 2wire tip and ring leads of the originating-end 6945 (ac switchboard ringdown mode). In either mode, the originating-end 6945 transmits SF tone while ground or ringing potential is applied, and receipt of this tone by the terminating-end 6945 activates station ringing either for a preselected 2-second or 30-second interval or for the duration of the received SF tone, as selected via switch option. Because application of ground or ringing potential (and, therefore, SF tone transmission) at the originating end can be manually controlled, and because station ringing follows application of ground or ringing potential directly when the terminating-end 6945 is optioned for ringing for the duration of received SF tone, various types of coded ringing arrangements can be provided in the manual ringdown modes.

2.13 In the dc ringdown mode, SF tone is transmitted by the originating-end 6945 in response to application of ground potential (through a maximum resistance of 3000 ohms) to the module's M

lead (connector pin 19). Because the same connector pin is used for outgoing traffic monitoring (see paragraph 2.18), dc ringdown can be provided only if outgoing traffic monitoring is not used.

2.14 In the ac switchboard ringdown mode, SF tone is transmitted by the originating-end 6945 in response to ringing potential (50Vac rms minimum, 17 to 67Hz) across either the station-side transmit tip and ring leads or the (station-side) simplex leads, depending upon the loop signaling mode selected via option switch *S3*. In the ac switchboard ringdown mode, local (originating-end) loop current is supplied via the local switchboard cord circuit, and the associated (originating-end) 6945 module's A and B leads are opened via switch option.

transmit path cut

2.15 In all modes of operation except ac switchboard ringdown, the voice path through the transmit portion of the 6945 is cut (opened) during idle and while SF tone is being transmitted. This prevents speech and transient energy from interfering with detection of SF tone at the distant end of the circuit. The path cut, however, interferes with testing and alignment of the transmit channel unless the circuit is seized before tests are made. An option switch is therefore provided to remove the transmit path cut during idle. This allows the module to be tested and aligned without the need for prior seizure, and also provides for proper operation in the ac switchboard ringdown mode, in which the transmit path must be cut only while SF tone is being transmitted.

SF tone source

2.16 The 6945 contains an integral SF tone oscillator and therefore does not require an associated master SF tone supply. This makes the 6945 particularly convenient for use in low-density applications. If operation from a master SF tone supply is desired, however, provision is made (via an option 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 ±0.1Vrms, 2600 ±2Hz, unbalanced. Input to the 6945 is capacitively coupled and presents a load impedance of approximately 75 kilohms to the tone source.

power and ringing

2.17 The 6945 is designed to operate on filtered input potentials of −42 to −56Vdc, ground referenced. The positive side of the dc power supply should be connected to earth ground. The associated ringing source should provide a nominal 80 to 100Vac ringing signal at any frequency between 17 and 67Hz.

Note: *The ac ringing signal* **must** *be superimposed on −48Vdc battery for proper operation of the ring-trip circuit.*

traffic-monitoring provision

2.18 The 6945 module derives two leads that provide usage data to associated traffic-recording equipment. The outgoing-traffic-monitoring lead provides ground output (from an open circuit) for the duration of a locally originated call. Similarly, the incoming-traffic-monitoring lead provides ground output (from an open circuit) for the duration of an incoming call. These outputs can be used to drive peg-count meters or to provide input to timers or other traffic-recording equipment.

2.19 The 6945 may be switch-optioned so that **incoming** call metering begins either upon local ringing, i.e., when SF tone is received from the distant (originating) end, or when the incoming call is answered at the local station. Similarly the 6945 may be switch-optioned so that **outgoing** call metering begins either upon circuit seizure, i.e., when the local (originating) station goes off-hook, or when the distant station answers a call initiated locally. If both incoming and outgoing metering are to be used, the module **must** be optioned so that incoming metering begins upon ringing and outgoing metering begins upon seizure, or so that both incoming and outgoing metering begin upon answer. Otherwise, incorrect call direction will be indicated.

2.20 Incoming and/or outgoing call metering upon answer can be provided only in the calling-party-controlled (CPC) ringdown mode (in which the signaling units at **both** ends of the circuit must be optioned for CPC ringdown so that answer supervision is provided to the calling location). Outgoing call metering upon seizure (local off-hook) can be provided with either automatic timed ringdown, CPC ringdown, or dc manual ringdown. Incoming call metering upon ringing can be provided with automatic timed ringdown when the 30-second ringing option is selected (but not when 2-second burst ringing is selected) or with CPC or dc manual ringdown. Call metering (incoming or outgoing) **cannot** be provided in the ac switchboard ringdown mode.

echo control devices and switched-access testing

2.21 Certain internal points in the 6945 are brought out to access points at the 56-pin connector. These access points are normally jumpered at the connector to provide circuit continuity. However, use of an associated echo control device or an application involving switched-access testing requires that the connector access points be used. An echo suppressor or canceller, for example, is inserted into the circuit via connector access on the signaling side of the 6945's transmit-path and receive-path attenuators. For in-service switched-access testing of the 6945, connector access is provided to the input and output ports of the module's signaling sections, to the attenuator pads, and to the A and B leads. See paragraphs 3.03 and 3.04 for additional information.

3. installation

inspection

3.01 The 6945 4Wire Ringdown SF Signaling Set module 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 The 6945 module mounts in one position of a Tellabs Type 16 Mounting Shelf or 269-series Mounting 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. The module plugs into a 56-pin connector at the rear of the Shelf or Assembly.

wiring

3.03 All external connections to the 6945 are made via wire wrap at the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector. In all applications except those involving switched-access testing or use of an associated echo control device, 13 jumper wires must be installed at the connector to provide continuity across internal access points that are brought out to the connector. (Access to internal sections of the 6945 is provided at the connector to permit operation with echo control devices or switched-access testing systems that must interface the module between its various subcircuits.) Factory-wired shelves with jumpers already installed may be used, or the jumpers may be installed in the field per table 1. If field-installed, jumpers should be wired **before** external connections are made. If the 6945 is to be used in an application involving switched-access testing, consult Tellabs' Customer Service at (312) 969-8800 for drawings and details. If the module is to be used in conjunction with a Tellabs 6920 Echo Suppressor or 6921 Digital Echo Canceller, see table 2 for wiring information.

on 6945, connect pin:		
SF RCV OUT	56 to 54 52 to 50	RCV PAD IN
RCV PAD OUT	48 to 46 44 to 42	4W RCV
XMT A LEAD XMT B LEAD	40 to 38 36 to 34	A1 (internal A lead) B1 (internal B lead)
EG	28 to 26	E GND
(used for universal wiring only)	24 to 22 20 to 18	(used for universal wiring only)
XMT PAD IN	16 to 14 12 to 10	4W XMT
XMT PAD OUT	8 to 6 4 to 2	SF XMT IN

table 1. Jumper wiring for applications without switched-access testing or echo control devices

3.04 External connections to the 6945 are listed in table 3. 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 6945 but are required as part of the universal wiring scheme for all 6900 and 4900-family modules. A Type 16 (or equivalent) Shelf wired in accordance with all connections listed in table 3 will accept any 6900 or 4900 module on an interchangeable basis, provided either that jumpers are installed per table 1 or the Shelf is wired for switched-access testing or use with an echo control device per table 2. If an installation is dedicated for use only with the 6945 module and no flexibility or interchangeability requirements are anticipated, wiring time may be saved by making only the mandatory connections (i.e., those without

connect 6945 pin:		to 6920 or 6921 pin:
SF RCV OUT	56 to 55 52 to 53	RCV IN
RCV PAD IN	54 to 51 50 to 49	RCV OUT
XMT PAD OUT	8 to 7 4 to 5	XMT IN
SF XMT IN	6 to 3 2 to 1	XMT OUT

Jumper wiring is the same as that listed in table 3 except for those pins listed above that interconnect with the 6920 or 6921.

table 2. Interconnections and jumper wiring for applications where 6945 module is used with 6920 Echo Suppressor or 6921 Echo Canceller

connect:	to pin:
4W RCV IN T (4wire receive input tip)	55
4W RCV IN R (4wire receive input ring)	53
4W XMT OUT T (4wire transmit output tip)	3
4W XMT OUT R (4wire transmit output ring)	1
4W RCV OUT T (4wire receive output tip)	51
4W RCV OUT R (4wire receive output ring)	49
4W XMT IN T (4wire transmit input tip)	7
4W XMT IN R (4wire transmit input ring)	5
−BATT (−48Vdc input)	15
GND (ground)	25
RING GEN (ringing generator)	23
*A (external A lead)	35
*B (external B lead)	33
*EXT. OSC. (external SF oscillator)	11
*EXT. E OR INC. TRAF. MON. (external E lead or incoming traffic monitoring lead)	21
*DC RD IN (M) OR OUTG. TRAF. MON. (dc ring-down input [M lead] or outgoing traffic monitoring lead)	19
*N lead	30
**ALM (CGA alarm master)	47
**ALO (CGA alarm override)	45
** ALB (CGA alarm battery)	43
**BY1 (make-busy ground output/contact closure)	39
**BY2 (make-busy contact closure)	37
**MB lead for looped M-lead operation	32
**D lead	31
**F lead	29
**G lead	27

*Optional

**Not applicable to 6945 but required as part of universal wiring scheme for all 6900/4900 modules.

table 3. External connections to 6945

asterisks) listed in table 3. Be aware that, while lead nomenclature may vary from one module to another in the 6900 and 4900 families, basic function (and wiring) remain universal.

option selection

3.05 All frequently used options on the 6945 are selected via slide switches or DIP switches located on the module's printed circuit board as shown in figure 3. A small number of less frequently used options are implemented by means of wire straps, also shown in figure 3. Tables 4 and 5 list all switch options and strap options, respectively, and indicate the option choices, which are explained below. In addition, tables 6, 7, and 8 summarize the specific switch settings required to implement the 6945's local ringing, outgoing-ringdown-mode, and traffic-monitoring options, respectively. The 6945 should be completely optioned and its optioning verified before alignment is attempted.

section of 6945	switch	option	function
4wire station termination	S1	150, 600, or 1200	selects 150, 600, or 1200-ohm 4wire receive output port impedance
	S2	150, 600, or 1200	selects 150, 600, or 1200-ohm 4wire transmit input port impedance
	S3	A&B or SX	selects loop signaling mode: transmit pair (A&B position) or transmit/receive simplex (SX position)
	S4	ON or OFF	introduces (ON position) or excludes (OFF position) 10dB fixed-loss sidetone path between local transmit and receive ports
signaling and supervision	S5-1 (ANS)	ON (closed) or OFF (open)	permits (OFF position) or prevents (ON position) answer supervision, i.e., momentary SF tone burst, toward originating end upon local answer
	S5-2 (RG INTR)	ON (closed) or OFF (open)	selects continuous (ON position) or interrupted (OFF position) ringing
	S5-4 (C/T RING)	ON (closed) or OFF (open)	selects timed (ON position) or coded (OFF position) ringing
	S5-5 (30/2 T.O.)	ON (closed) or OFF (open)	selects 2-second (ON position) or 30-second (OFF position) ringing timeout
	S6	AUTO or WES ARD	selects transmit tone mode: 2-second burst (AUTO position) or CPC (WES ARD position)
	S7	AUTO or MAN	selects transmit ringdown mode: automatic (AUTO position) or manual (MAN position)
	S8	NORM or AC	selects transmit path cut mode: cut inserted during both idle and SF tone transmission (NORM position) or during idle only (AC position)
	S9	NORM or AC	selects loop current mode: loop current furnished to 4wire drop via module's A and B leads (NORM position) or module's A and B leads opened, necessitating external source of loop current (AC position)
	S10	LS or GS	selects loop-start (LS position) or ground-start (GS position) supervisory mode
	S11	I OSC or E OSC	includes (I OSC position) or excludes (E OSC) integral SF tone oscillator
traffic monitoring	S5-3 (ITS)	ON (closed) or OFF (open)	selects time at which incoming usage metering is initiated: either upon ringing (ON position) or upon detection of answer supervision (OFF position)

table 4. Switch options

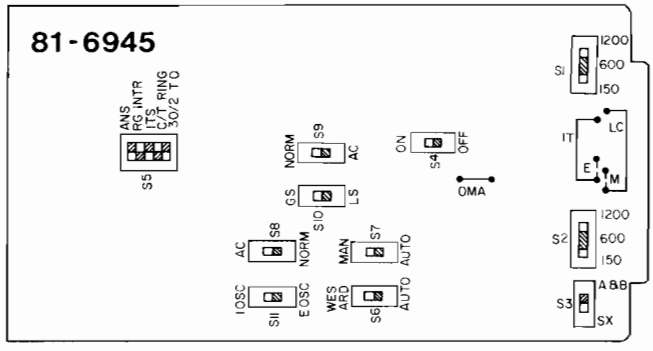


figure 3. Option switch locations

section of 6945	strap	function
traffic monitoring	LC* (loop current sense)	enables outgoing metering: with strap installed, ground is present on pin 19 for duration of outgoing calls
	OMA* (outgoing metering upon answer)	determines time at which outgoing metering is initiated: with strap installed, metering begins upon distant answer (CPC ringdown only); with strap removed, metering begins upon local seizure (off-hook)
	IT* (incoming tone)	enables incoming metering: with strap installed, ground is present on pin 21 for duration of incoming calls
signaling	M** (M lead)	external M/dc-manual-ringdown lead: with strap M installed and strap LC cut or removed, local manual application of ground to pin 19 initiates outgoing dc ringdown
	E** (E lead)	external E lead: with strap E installed and strap IT cut or removed, ground is present on pin 21 during incoming ringing only

*These leads normally factory-installed on all 6945's.
These leads normally **not factory-installed on 6945's.

table 5. Wire strap options

4wire-station-termination switch options

3.06 In the 6945 module's 4wire station termination section, switches *S1* and *S2* are used to select 150, 600, or 1200-ohm terminating impedance for the receive output and transmit input (i.e., terminal-side) ports, respectively. Set *S1* and *S2* to the *1200* position for interface with loaded cable, to the *600* position for interface with nonloaded cable or carrier or for direct interface with station equipment, or to the *150* position for interface with long sections of nonloaded cable (e.g., greater than 14 kilofeet of 24AWG cable). Switch *S3* is used to select the loop signaling mode. Set *S3* to the *A & B* position for transmit-pair (composite) loop signaling or to the *SX* position for transmit/receive simplex loop signaling. Switch *S4* controls the 10dB fixed-loss sidetone path between the local transmit and receive ports. Set *S4* to the *ON* position to introduce the sidetone path or to the *OFF* position if the sidetone path is not desired.

signaling and supervision switch options

3.07 In the 6945 module's SF signaling and loop supervision section, switch *S5-1, ANS,* permits or prevents transmission of answer supervision, i.e.,

incoming ringdown mode	desired ringing arrangement at local (terminating) end		switch settings						
			S5-1	S5-2	S5-4	S5-5	S8	S9	S10
automatic	timed	2 seconds	ON	ON	ON	ON	NORM	NORM	LS
		30 seconds	ON	ON	ON	OFF	NORM	NORM	X
	calling-party-controlled (CPC)		OFF	X	ON	ON	NORM	NORM	X
ac switchboard	timed	2 seconds	ON	X	ON	ON	AC	AC	LS
		30 seconds	ON	X	ON	OFF	AC	AC	LS
	coded		ON	ON	OFF	OFF	AC	AC	LS
dc manual key	timed	2 seconds	ON	X	ON	ON	NORM	NORM	LS
		30 seconds	ON	X	ON	OFF	NORM	NORM	X
	coded		ON	ON	OFF	OFF	NORM	NORM	LS

Note: *When the letter "X" appears instead of a specific switch setting, the switch may be set as required for the particular application in which the module is being used (see paragraphs 3.06 through 3.09).*

table 6. Option switch settings for selection of local (terminating-end) ringing arrangement

outgoing ringdown mode	desired ringing arrangement at distant (terminating) end	switch settings	
		S6	S7
automatic	timed	AUTO	AUTO
	calling-party-controlled (CPC)	WES ARD	AUTO
ac switchboard	timed	AUTO	MAN
	coded	WES ARD	MAN
dc manual key*	timed	AUTO	MAN
	coded	WES ARD	MAN

*Specific strap optioning is also required to implement dc manual ringdown. See paragraph 3.16 for details.

table 7. Option switch settings for selection of outgoing (originating-end) ringdown mode

metering mode (see notes)		strap/switch selection			
		strap LS	strap OMA	strap IT	switch S5-3
outgoing	start upon seizure	IN	OUT	immaterial	immaterial
	start upon distant answer	IN	IN	immaterial	OFF
incoming	start upon ringing	immaterial	immaterial	IN	ON
	start upon local answer	immaterial	immaterial	IN	OFF

Note 1: *If both incoming and outgoing metering are used, the 6945* **must** *be optioned so that outgoing metering starts upon seizure and incoming metering starts upon ringing, or so that both incoming and outgoing metering begin upon answer. Otherwise, incorrect call direction will be indicated.*

Note 2: *The outgoing and incoming start-upon-answer metering modes can be implemented only when the 6945 is arranged for CPC ringdown.*

Note 3: *Incoming metering upon ringing can be provided in the automatic timed ringdown mode only when the 30-second ringing interval (instead of 2-second burst ringing) is selected.*

table 8. Strap and switch optioning for selection of traffic-monitoring (call-metering) mode

a momentary SF tone burst, toward the originating end of the circuit upon local answer. Set *S5-1* to the *OFF* (open) position to provide answer supervision to the originating end. (As indicated in table 6, the *OFF* setting is used only in the CPC ringdown mode.) Set *S5-1* to the *ON* (closed) position for no answer supervision. (As indicated in table 6, the *ON* setting is used for all ringdown modes except CPC.) Switch *S5-2, RG INTR,* controls the module's integral ringing interrupter. Set *S5-2* to the *ON* (closed) position for continuous (noninterrupted) ringing or to the *OFF* (open) position for interrupted ringing (2 seconds on, 4 seconds off). Please note that only continuous ringing should be selected when 2-second burst ringing is used.

3.08 Switch *S5-4, C/T RING,* is used to select either timed or coded local ringing, and switch *S5-5, 30/2 T.O.,* is used to select the ringing timeout interval when timed local ringing is used. Set *S5-4* to the *ON* (closed) position for a 2-second burst of ringing or to the *OFF* (open) position for 30-second ringing or when coded ringing is used.

3.09 Switch *S6* is used to select the transmit SF tone mode, i.e., the mode of outgoing SF tone transmission from the originating end upon circuit seizure (local station off-hook). Set *S6* to the *AUTO* position for a 2-second burst of tone or to the *WES ARD* position for calling-party-controlled (CPC) tone transmission. (In the CPC mode, SF tone is transmitted continuously from the time the local circuit is seized until either the distant station answers or the calling station returns to an on-hook condition if the call is unanswered.) The transmit ringdown mode is selected via switch *S7*. Set *S7* to the *AUTO* position for automatic (timed or CPC) ringdown or to the *MAN* position for ac switchboard or dc manual ringdown. Switch *S8* is used to select the transmit path cut mode. Set *S8* to the *NORM* position for all ringdown modes except ac switchboard ringdown. (When *S8* is set to *NORM*, the transmit path is cut during both the idle state and SF tone transmission.) Set *S8* to the *AC* position for ac switchboard ringdown operation or for testing and alignment in any ringdown mode (see paragraph 2.15). (When *S8* is set to the *AC* position, the transmit path is cut during tone transmission only.)

3.10 Switch *S9* is used to select the loop current mode. Set *S9* to the *NORM* position (loop current

furnished to 4wire drop via module's A and B leads) for all ringdown modes except ac switchboard. Set *S9* to the *AC* position (module's A and B leads opened, necessitating an external source of loop current, i.e., the local switchboard and circuit) for ac switchboard ringdown operation only. Switch *S10* is used to select the loop supervisory mode. Set *S10* to the *LS* position for loop-start operation or to the *GS* position for ground-start operation.

3.11 The one remaining option switch in the 6945's SF signaling and loop supervision section, switch *S11*, conditions the module for use either with its integral SF tone oscillator or with an external master SF tone source. Set *S11* to the *I OSC* position if the module's integral SF oscillator is to be used or to the *E OSC* position if an external SF tone source is to be used.

traffic-monitoring switch options

3.12 In the traffic-monitoring section of the 6945, switch *S5-3, ITS,* is used to select the mode of incoming usage metering. If metering of incoming calls is to begin upon ringing, set *S5-3* to the *ON* (closed) position. (As indicated in table 8, incoming metering upon ringing can be provided in the automatic timed ringdown mode only when 30-second ringing is used.) If metering of incoming and/or outgoing calls is to begin upon answer, i.e., upon detection of answer supervision, set *S5-3* to the *OFF* (open) position. (As indicated in table 8, metering upon answer can be provided only in the CPC ringdown mode.)

Note: *Outgoing call metering is implemented via strap options. See paragraph 3.13 for details.*

wire strap options

3.13 The 6945 contains five strap options, two of which are related to outgoing traffic monitoring, one to incoming traffic monitoring, and two to signaling. These strap options are summarized in table 5 and shown in figure 3. Because certain metering and signaling strap options involve use of the same module connector pins, a choice must be made as to which, if any, of these mutually exclusive options is to be used. Details are provided below.

Caution: *Extreme care must be taken when soldering on printed-circuit boards to prevent damage to the delicate foil. Use a soldering iron whose tip temperature is 800° F or less, use only 60/40 or 63/37 tin/lead rosin-core solder, and do not hold the tip of a hot iron on a solder connection for longer than 2 seconds.*

3.14 Straps *LC* and *OMA* are related to outgoing traffic monitoring. Strap *LC*, when installed, conditions the module to provide continuous ground output on pin 19 for the duration of the outgoing call. Strap *OMA*, when installed, conditions the module so that outgoing usage metering, i.e., ground output, begins upon distant-end answer. Unless specific instructions are given to the contrary, Tellabs ships all 6945's with these two straps factory-installed. Therefore, if outgoing usage metering is desired, leave strap *LC* in place and wire the external outgoing-metering lead to connector pin 19. If outgoing usage metering is to begin upon answer (CPC ringdown mode only), also leave strap *OMA* in place. If, however, outgoing usage metering is to begin upon local (originating-end) seizure, strap *OMA* must be cut or removed.

Note: *Outgoing dc manual ringdown cannot be implemented with strap* LC *installed. See paragraph 3.16 for details.*

3.15 Strap *IT* is related to incoming traffic monitoring. This strap, when installed, conditions the module to provide continuous ground output on pin 21 for the duration of the incoming call. Unless specific instructions are given to the contrary, Tellabs ships all 6945's with strap *IT* factory-installed. Therefore, if incoming usage metering is desired, leave strap *IT* in place and wire the external incoming-metering lead to connector pin 21. The time at which incoming metering, i.e., ground output, is initiated (either upon ringing or upon answer) is selected via switch *S5-3*. See table 4 and paragraph 3.12 for details.

3.16 The two remaining strap options, straps *M* and *E*, are related to signaling. Strap *M*, when installed, conditions the module so that local manual application of ground to the M/dc-ringdown-input lead (pin 19) initiates outgoing dc ringdown. Strap *E*, when installed, conditions the module to provide ground output on the E lead (pin 21) during local (incoming) ringing only. Unless specific instructions are given to the contrary, Tellabs ships all 6945's with straps *M* and *E* **not installed**. If outgoing dc manual ringdown operation is desired, cut or remove strap *LC* on the module's printed circuit board, install strap *M* where indicated (see figure 3), and connect the external M/dc-ringdown-input lead to pin 19. For all other ringdown modes, **do not install** strap *M*; also, leave strap *LC* in place if outgoing usage metering is desired (see paragraph 3.14). If an external indication (e.g., lighting of an indicator lamp) during incoming ringing is desired, cut or remove strap *IT* on the module's printed circuit board, install strap *E* where indicated (see figure 3), and connect the external E lead to pin 21. If, however, continuous ground output for the duration of each incoming call is desired, **do not install** strap *M*; instead, leave strap *IT* in place (see paragraph 3.15).

alignment

3.17 Alignment of the 6945 consists of adjusting the front-panel *xmt* and *rcv* attenuator switches to accommodate the desired terminal-side transmit and receive levels, and, if necessary, adjusting the high-frequency and low-frequency equalizers in the transmit path to compensate for the frequency response characteristics of a local loop consisting of nonloaded cable. Before aligning the 6945, verify that associated transmission equipment is aligned for facility-side interface transmission levels of +7dB receive and −16dB transmit.

3.18 Access to the appropriate ports of the 6945 is conveniently provided by means of a Tellabs 9807 Card Extender or a prewired jackfield. Using a properly terminated transmission measuring set (TMS), align the module as indicated below (jack designations are those on the 9807):

Note: *It is suggested that alignment be performed with the 6945's terminal-side interface transformers (switches* S1 *and* S2*) optioned for 600-ohm terminating impedance. If another terminating impedance is required for a particular application, it may be selected* **after** *alignment.*

3.19 **receive section:**

A. Condition the TMS for 1000Hz output at a +7dBm level into a 600-ohm load, and insert the signal at the *rcv SF in* jack.

B. With the TMS terminated in 600 ohms (see note above), measure the level at the *4W rcv drop or bal net out* jack. Adjust the module's *rcv* attenuator switches until the desired receive level is achieved. This completes alignment of the receive path.

3.20 **transmit section:**

Note: *When the transmit-channel equalizers are to be used, the* **final** *transmit-path level adjustment should not be made until* **after** *the equalizer adjustment is completed because equalizer settings affect levels through the transmit path at all frequencies.*

A. Remove the transmit path cut by setting switch *S8* to the *AC* position.

B. If transmit-path post-equalization of the local (terminal-side) loop is **not** required (e.g., in applications where the loop consists of non-loaded cable), ensure that the front-panel *xmt HF* and *LF* equalizer controls are adjusted fully counterclockwise; then proceed to step C. If transmit-path post-equalization of a local loop consisting of loaded cable **is** required, proceed as follows:

1. Arrange for 1000Hz tone to be sent from the station end at the level specified on the circuit layout record (CLR) card.

2. Condition the TMS for a 600-ohm terminated measurement and measure the 1000Hz signal level at the *xmt SF out* jack. Adjust the module's *xmt* attenuator switches until a level of −16 ±0.1dBm is measured.

3. For high-frequency equalization, leave the TMS connected as described above, arrange for 3000Hz tone to be sent from the station end, and note the received signal level. Adjust the *xmt HF* equalizer control until the desired level (relative to the 1000Hz level) is achieved.

4. For low-frequency equalization, leave the TMS connected as described above and arrange for 300Hz tone to be sent from the station end, and note the received signal level. Adjust the *xmt LF* equalizer control until the desired level (relative to the 1000Hz level) is achieved.

5. Again have 1000Hz tone sent at the level specified on the CLR. Readjust the *xmt* attenuator switches, if necessary, to achieve a level of −16 ±0.1dBm. If desired, a frequency run may be made to verify overall frequency response. Use a representative selection of frequencies between 300 and 3000Hz. If the equalizer adjustment must be altered, the *xmt* attenuator switches must be readjusted again for the required −16 ±0.1dBm level. When all equalizer and attenuator adjustments are completed, proceed to step E.

C. In applications where equalization is not used, condition the TMS for 1000Hz tone output at the level and impedance specified for the terminal-side transmit interface. Insert this signal at the *4W xmt drop or 2W in* jack.

D. Condition the TMS for a 600-ohm terminated measurement and measure the signal level at the *xmt SF out* jack. Adjust the module's *xmt* attenuator switches until a level of −16 ±0.1dBm is measured.

Note: *As an alternative to steps C and D, steps B1 and B2 may be performed instead.*

E. This completes alignment of the transmit path. Remove all test cords, return switches *S1* and *S2* to their proper impedance settings, and return switch *S8* to the *NORM* position for all ringdown modes except ac switchboard.

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6945 4Wire Ringdown SF Signaling Set module, sequence charts (figures 4 and 5) 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 6945 functional block diagram (section 5 of this Practice) may aid in understanding the sequence charts.

6. specifications

4wire station termination

terminal-side port impedances
150, 600, or 1200 ohms, balanced, switch-selectable, transmit and receive

impedance variation
600 or 1200 ohms±10%, 300 to 4000Hz; 150 ohms±15% 300 to 4000Hz

facility-side port impedances
600 ohms, balanced, transmit and receive

insertion loss
0.7dB maximum at 1000Hz

frequency response
±1dB re 1000Hz level, 300 to 4000Hz

specifications continued on page 13

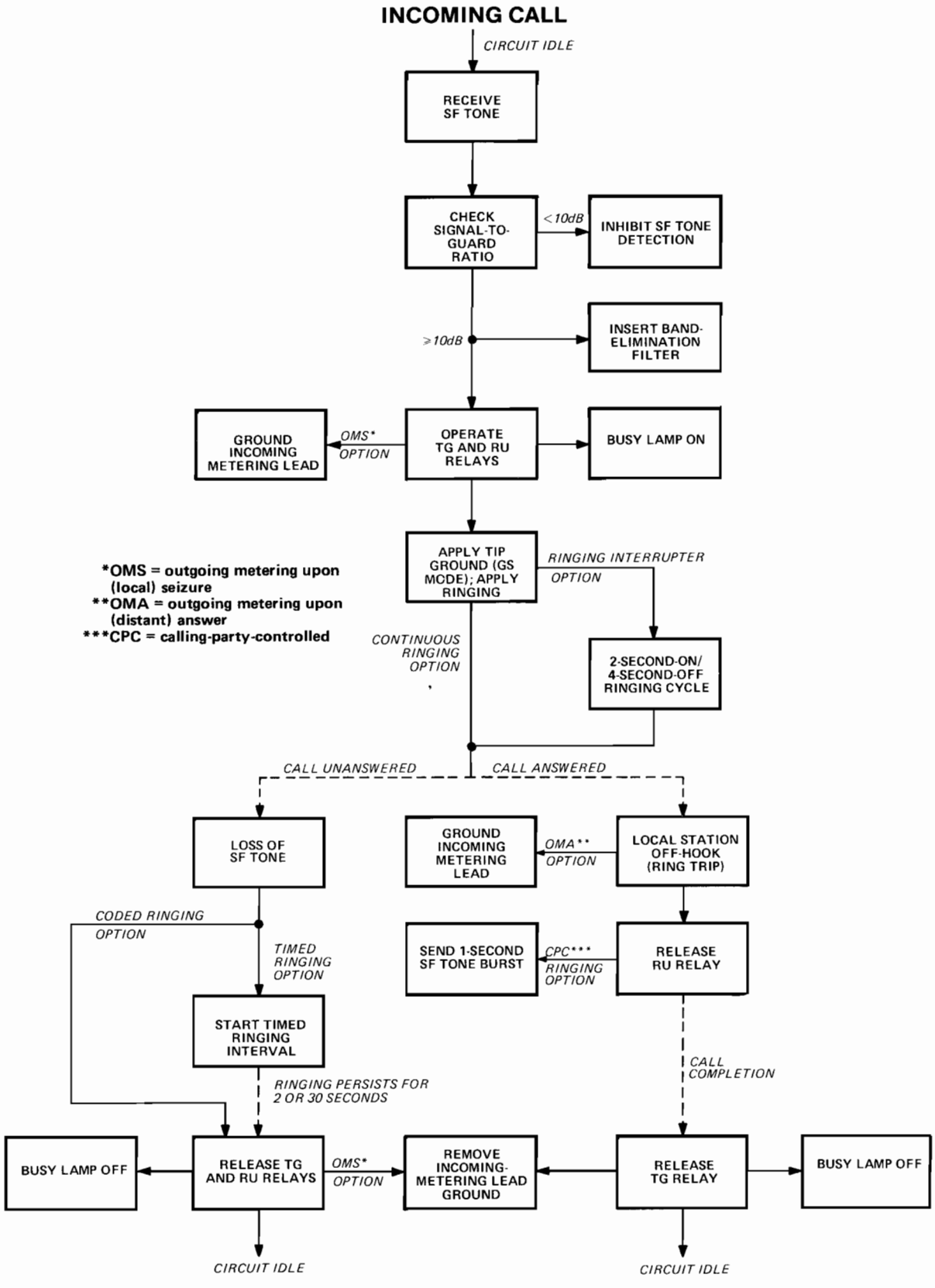


figure 4. Function sequence chart, incoming call

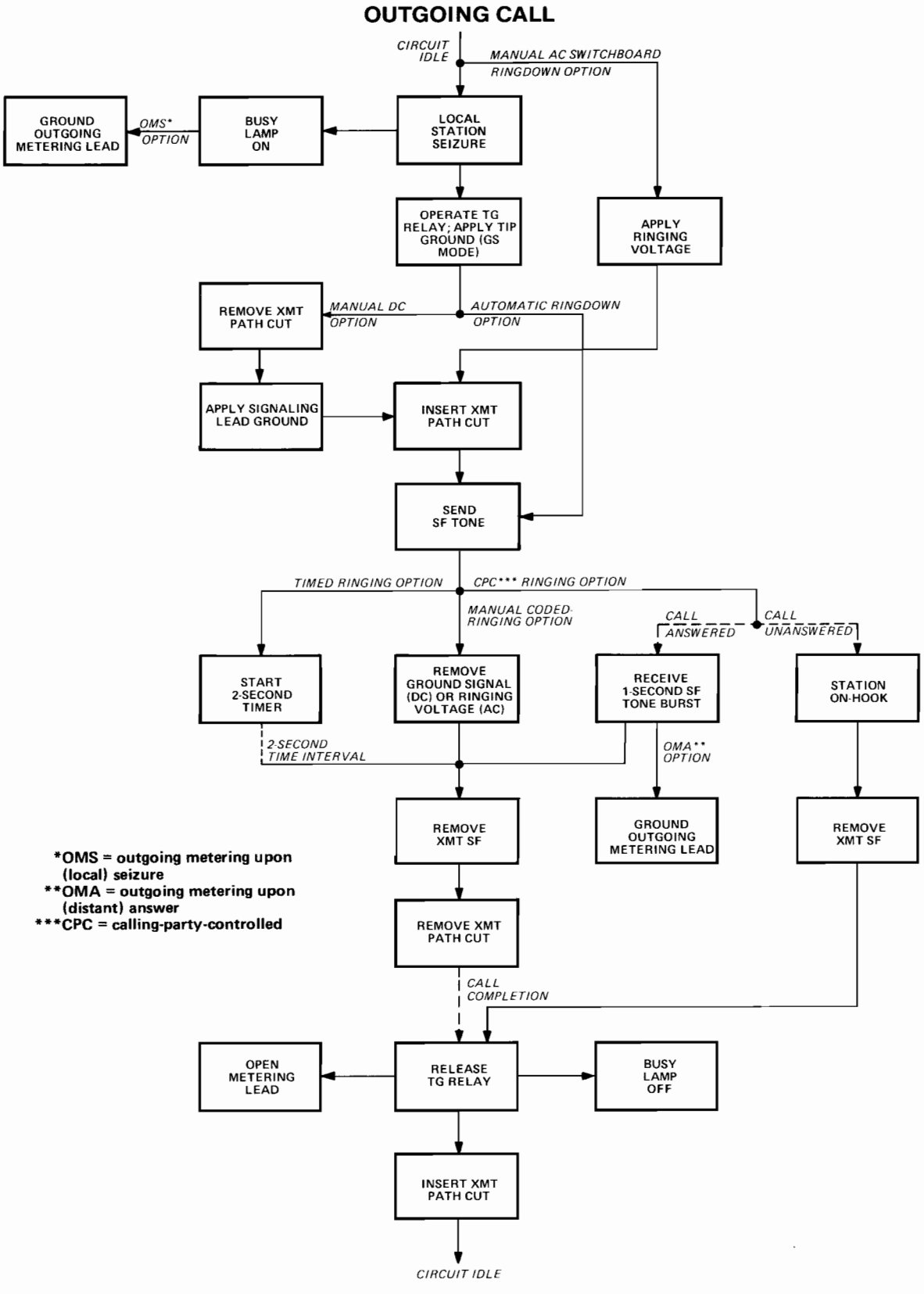
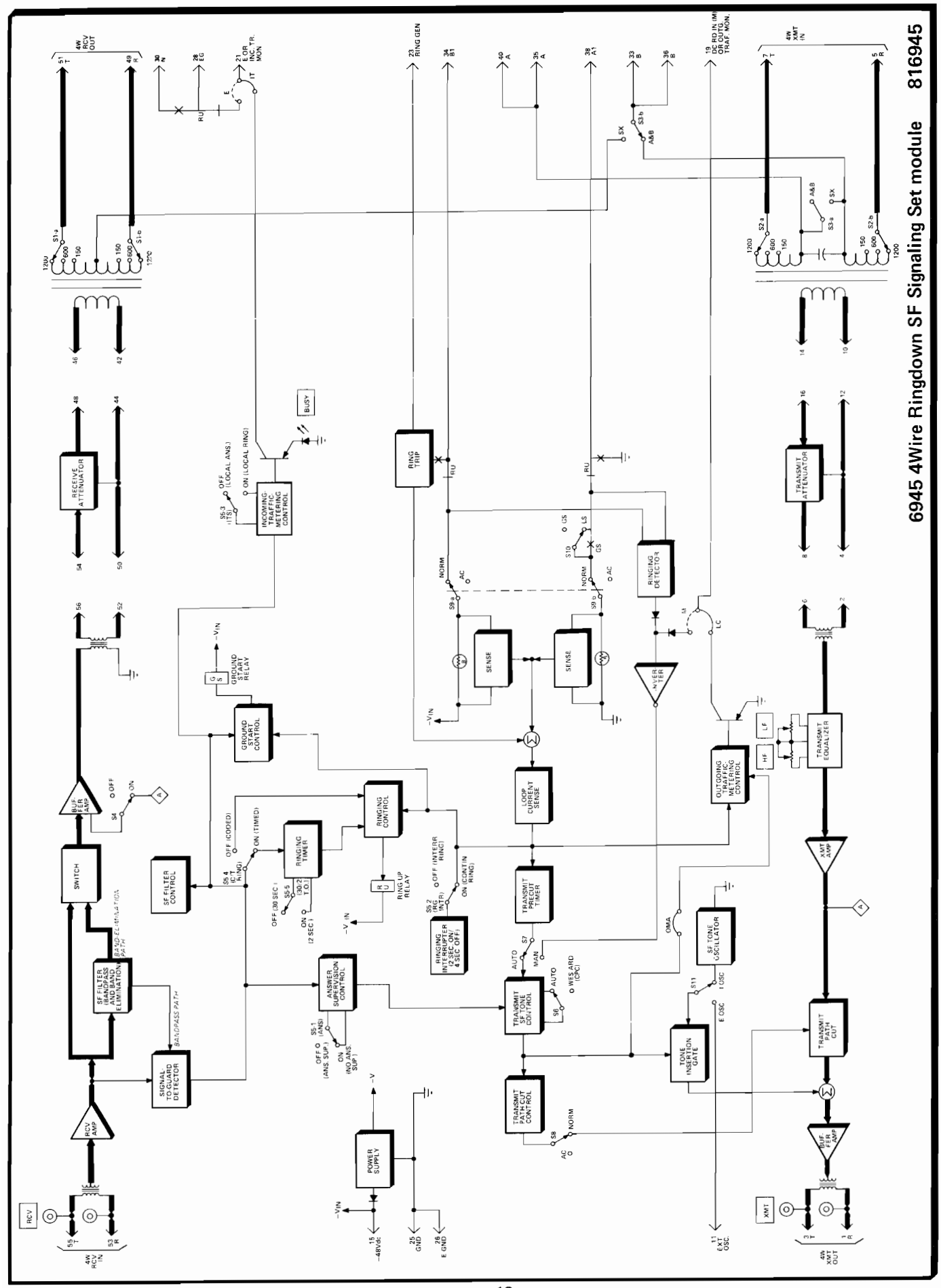


figure 5. Function sequence chart, outgoing call



5. block diagram

maximum A-and-B-lead current (transmit port)
100mA

maximum simplex (SX) current (receive port)
100mA balanced, 5mA maximum unbalance

equalization
high-frequency: 0 to 2.5dB minimum "bump" centered at 3400±50Hz, continuously adjustable
low-frequency: 0 to 1.4dB minimum roll-off at 300Hz re 1000Hz level, continuously adjustable

4wire attenuators

range
0 to 26.5dB in 0.1dB increments

impedance
600 ohms, unbalanced

accuracy
±0.1dB for 0.1, 0.2, 0.4, 0.8, 1, 2, 4, 8, and 10dB steps

SF transmit section, transmission parameters

alignment level, facility interface
−16dBm

insertion loss
0±1.0dB at 1000Hz

frequency response
±0.5dB re 1000Hz level, 300 to 4000Hz

4wire line impedance (transmit output port)
600 ohms±10%, 300 to 4000Hz

noise
20dBrnC0 maximum

nonlinear distorion
less than 1% THD at 0dBm0

overload
overload point greater than +10dBm0

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

longitudinal balance
greater than 60dB at SF transmit port, 200 to 4000Hz

SF transmit section, signaling parameters

SF oscillator (internal)
frequency: 2600Hz; other frequencies must be specified at time of order
stability: ±2Hz for 6 months; ±5Hz for life of unit

SF tone states
idle: no tone
busy: no tone
seizure: tone transmitted
answer: 1-second tone transmission in CPC mode only

SF tone level
−20dBm0±2dB (−36dBm±2dB)

SF receive section, transmission parameters

alignment level, facility interface
+7dBm

insertion loss
0±0.2dB at 1000Hz

frequency response
±0.5dB re 1000hz level, 300 to 4000Hz, with band-elimination filter removed

4wire line impedance (receive input port)
600 ohms ±10%, 300 to 4000Hz

internal noise
less than 10dBrnC0

nonlinear distortion
less than 1% THD at 0dBm0

overload
no clipping below +5dBm0

peak-to-average ratio (P/AR)
98 minimum with band-elimination filter removed

longitudinal balance
greater than 60dB at SF receive port, 200 to 4000Hz

SF receive section, signaling parameters

SF tone frequency
2600±15Hz; other frequencies must be specified at time of order

SF tone detection threshhold
−20dBm (−27dBm0)

SF tone rejection threshold
−30dBm (−37dBm0)

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

maximum line noise
51dBrnC0 (58dBrnC)

guard circuit transition timing
high-to-low, 225 ±60ms; low-to-high, 50 ±10ms after cessation of tone at 4wire receive input port

traffic-monitoring leads

idle condition
open circuit (diode clamped to input negative potential)

busy condition
ground (100mA maximum source capacity)

continuity
will not change state for momentary loop opens shorter than 400ms

external oscillator (optional)

frequency
2600±2Hz

level
0.5Vrms

load impedance
75 kilohms minimum, unbalanced

4wire loop conditions

maximu loop resistance
2000 ohms plus telephone set

loop current (at −48Vdc with 200-ohm tel set drop)
0-ohm loop, 76mA nominal; 2000-ohm loop, 18mA nominal

longitudinal balance
60dB minimum, 200 to 4000Hz

longitudinal environment
will tolerate up to 60Vac longituudinal potential (open circuit) without false supervision

seizure delay
200±100ms

release delay
500±100ms

external ringing supply

frequency
17 to 67Hz

bias
must be referenced to −48±6Vdc

level
130Vac maximum

seizure, manual modes

dc ringdown input
3000-ohm maximum resistance to ground

ac ringdown input
17 to 67Hz, 50Vac rms minimum

power requirements

input voltage
−42 to −56Vdc, filtered, ground referenced

input current
idle: 24 to 28mA
busy: 40 to 45mA plus loop current
ringing: 55 to 60mA

physical

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

weight
2 pounds 5 ounces (1.049kg)

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

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

7. testing and troubleshooting

7.01 Due to the complexity of the 6945 4Wire Ringdown SF Signaling Set module, a detailed testing guide checklist is not included in this practice. Such a checklist would be so long and complicated as to be of dubious value for troubleshooting in the field. Proper operation of the module can be verified, however, by observing its actual operation while referring to the function sequence flowcharts (figures 4 and 5) that summarize the module's correct operation on incoming and outgoing calls. Additional troubleshooting steps are listed in the *troubleshooting guide* below. If none of these steps corrects the problem, substitute a new module (if possible) and observe its operation. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6945 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 panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked* **defective** *or* **bad**, *we recommend that it be done on a piece of tape or on a removable stick-on label.*

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

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

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

International customers: Contact your Tellabs distributor.

US Atlantic Region: (203) 798-0506
US Capital Region: (703) 478-0468
US Central Region: (312) 357-7400
US Southeast Region: (305) 834-8311
US Southwest Region: (214) 869-4114
US Western Region: (714) 850-1300
Canada: (416) 624-0052

7.03 If a 6945 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 6945 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 8X6945 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 replacment will be shipped at no charge. Pack the defective 6945 in the replacement module's carton, sign the packing slip included with the replacment, 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 6945 module, shipment prepaid, to Tellabs (attn: repair and return).

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

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

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

troubleshooting guide

Note: *For in-service testing of the 6945 module, access to the appropriate points in the module is most conveniently provided by means of a Tellabs 9807 Card Extender or an external jackfield.*

A. Verify normal operation of the module on both incoming and outgoing calls as indicated in the function sequence charts (figures 4 and 5) in this Practice.

B. If the module does not operate normally, verify the following:
   1) Power to the module □.
   2) All external connections to the module □.
   3) All option switch settings (and option strapping, if applicable) □.
   4) Level and equalization alignment □.
   5) Facility interface levels (−16 transmit and +7 receive TLP's) □.

C. If the module still does not operate normally, replace the module and retest. If the substitute module operates normally, the original module should be considered defective and returned to Tellabs per the above instructions.