tellabs
technical manual
76-836943
rev A

practice section 836943

6943 4Wire FXS SF Signaling Set

contents

1. general description

1.01 The 6943 4Wire FXS (Foreign-Exchange, Station-End) SF Signaling Set module (figure 1) provides signaling and transmission interface between a 4wire facility that uses single-frequency (SF) signaling and a 4wire metallic link that uses the type of loop signaling normally associated with the station end of a foreign-exchange (FX) or off-premises-station (OPS) circuit. Specifically, in addition to providing full-duplex conversion between the SF signaling on the 4wire facility and the FXS signaling on the 2wire link, the 6943 contributes passive level control (attenuation) in both the transmit and receive channels and bump-type amplitude equalization in the transmit channel. Conventional 2600Hz SF tone is standard; other frequencies are optionally available by special order.

1.02 This practice section is reissued to cover the Issue 3 version of the 6943 module (Tellabs part number **836943**). Please note that there is no Issue 2 version of the 6943. Functionally, the Issue 3 module is virtually identical to its Issue 1 predecessor, differing mainly through the use of microprocessor control for increased circuit simplicity and reliability and through the ability to operate on nominal −24Vdc as well as nominal −48Vdc input power. Also, the conventional DIP-switch attenuator controls on the front panel of the Issue 1 6943 have been replaced by piano-style DIP switches on the Issue 3 module, and the carrier-group-alarm (CGA) option straps on the Issue 1 module have been replaced by option switches on the Issue 3 version. In addition, the infrequently used option switch that allows separation of the signaling path from the transmission path on the Issue 1 6943 has been replaced by option straps on the Issue 3 module.

1.03 Functionally equivalent to the Western Electric FRA Signaling Unit, the 6943 is designed to operate in association with a 4wire or 2wire FXO (foreign-exchange, office-end) SF signaling set (Tellabs 6944, 6924, or equivalent) at the opposite end of the 4wire (SF) facility.

1.04 Features and options of the 6943 include the following: prescription optioning and alignment capability in applications where transmit-channel post-equalization is not required; balanced 600-ohm terminating impedance on the facility side; balanced, switchable 1200, 600, or 150-ohm terminating impedance on the terminal (station) side; minimum-break transmit pulse correction; switch-selectable loop-start or ground-start operation; switch-selectable build-out resistors (BOR's) for currrent limiting on short 4wire links; strap options that allow the signaling path (A and B leads) to be separated from the transmission path; an integral SF tone oscillator (use of an external [master] oscillator is optional); a circuit-status lead that can be used either as a local sleeve lead or as a traffic-monitoring lead; alarm leads compatible with most CGA formats; and internal access points available at the module's card-edge connector for switched-access testing or use with an associated echo-control device.

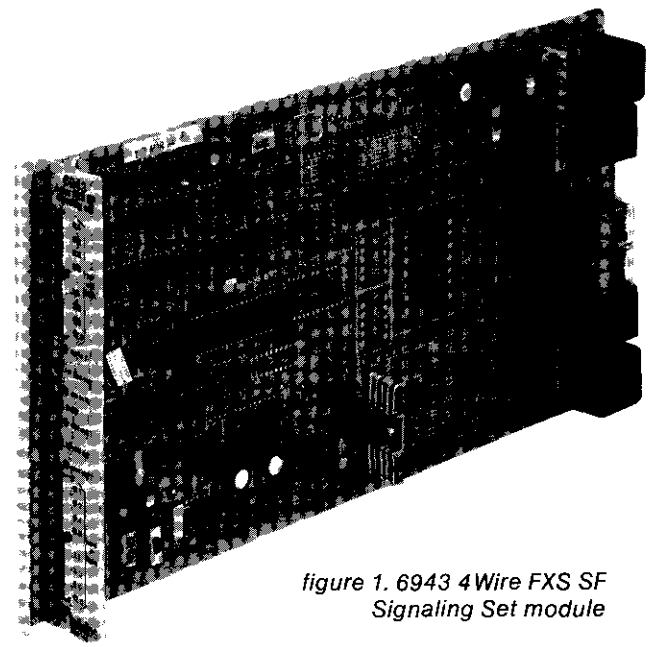


figure 1. 6943 4Wire FXS SF Signaling Set module

1.05 The transmit portion of the 6943 converts station-end supervisory and dialing states to outgoing SF tone signals. Tone is transmitted during station idle and also during the break portions of dial pulses. A minimum-break transmit pulse corrector ensures transmission of recognizable tone pulses. A transmission-path-cut circuit with a nominal 15ms pre-cut delay interval prevents transient interference with outgoing SF signaling.

1.06 The receive portion of the 6943 converts incoming SF tone signals to station-end ringing and seizure states. Recognition delays prevent response to spurious SF tone bursts and to momentary tone interruptions. In the loop-start supervisory

mode, detection of incoming SF tone activates local ringing. In the ground-start supervisory mode, loss of incoming tone causes the loop to be completed toward the station, and detection of SF tone modulated by the incoming ringing frequency activates local ringing. In either supervisory mode, ring trip is provided during either ringing or silent intervals.

1.07 The 6943's adjustable precision attenuators (which are controlled by front-panel switches) are located electrically on the terminal (station) side of the module in both the transmit and receive paths. Thus, they can be thought of, and are so labeled, as providing receive-output and transmit-input loss. Both attenuators provide from 0 to 24.0dB of loss (not including insertion loss) in switch-selectable 0.1dB increments for coordinating terminal- (station-) side levels with the required interface levels (conventional −16 transmit and +7 receive transmission level points [TLP's]) at the module's facility-side ports. Coordination between these mandatory TLP's and actual levels on the 4wire facility, plus the necessary facility impedance matching, are then provided (in most cases) by a separate facility-interface device, usually a line amplifier (Tellabs 4944, 4744, 400X, or equivalent). Transformer coupling with fixed, balanced 600-ohm terminating impedance is provided at both facility-side ports (transmit output and receive input) on the 6943 for interfacing such a device.

1.08 The bump-type amplitude equalizer in the 6943's transmit channel is designed to provide post-equalization for terminal-side links consisting of nonloaded cable. The high-frequency section introduces an amplitude bump of 0 to 3dB at 3400Hz (re 1000Hz) via a continuously adjustable front-panel *HF eql* control, and the low-frequency section introduces from 0 to 3dB of roll-off at 300Hz (re 1000Hz) via a continuously adjustable front-panel *LF eql* control.

1.09 As is the case with the 6943's facility-side ports, transformer coupling is likewise provided at the module's terminal-side ports (transmit input and receive output). Each of these two ports can be independently switch-optioned for balanced 1200, 600, or 150-ohm terminating impedance. The 150-ohm options provide approximately 2dB of slope equalization when the module's terminal-side ports interface long sections of nonloaded cable.

1.10 Current limiting for short 4wire station-side links is available via the switch-selectable BOR's in the 6943's A&B-lead current supply circuitry. With the BOR's optioned into the circuit, the module provides 600 ohms of battery-supply resistance. With the BOR's optioned out of the circuit, battery-supply resistance is 400 ohms. In the latter case (BOR's optioned out), the 6943 accurately senses loop conditions with up to 3000 ohms of external loop resistance and provides 23mA of loop current with up to 1687 ohms of external loop resistance.

1.11 Because the 6943 contains an integral SF signaling tone oscillator, an external (master) SF tone source is not required. Provision is made, however, for operation with a master oscillator if desired. A switch option conditions the 6943 for use either with its integral oscillator or with an external SF tone source.

1.12 In addition to the aforementioned transmit and receive attenuator DIP switches and equalizer controls, the front-panel of the 6943 contains four test points and an LED that lights during circuit-busy conditions. The test points provide access to the module's facility-side ports (transmit output tip and ring, and receive input tip and ring) to facilitate testing and maintenance activities.

1.13 The 6943 module operates from filtered, ground-referenced −22 to −56Vdc input. Maximum current requirements at −48Vdc range from 60mA at idle to 80mA plus A&B-lead current when busy and 100mA when ringing.

1.14 The 6943 module is a member of Tellabs' 6900 family of CO-configured signaling, terminating, and echo-control modules. It is electrically and mechanically interchangeable with all other 6900-family modules (except the component modules of Tellabs' 25X-series multichannel Digital Echo Canceller Systems) and with all modules of Tellabs' 4900 family of terminating and level-control modules. Common pin assignments in the 6900 and 4900 families (with the aforementioned exception) permit the use of a universal wiring scheme to increase system flexibility.

1.15 The 6943 is a Type 16 module. As such, it mounts in one position of a Tellabs Type 16 Mounting Shelf or in one position of the lower shelf of a Tellabs 269-series Mounting Assembly. Type 16 Shelves are available in versions for 19 and 23-inch relay-rack installation. Both versions accommodate up to 12 modules and occupy 4 vertical mounting spaces (7 inches) in a standard relay rack. Furthermore, Type 16 Shelves can be provided (at the customer's option) either unwired, equipped with jumpers to bypass switched-access testing points, completely universally wired, or universally wired with a connectorized backplane.

2. application

2.01 The 6943 4Wire FXS SF Signaling Set module is designed to interface a 4wire SF transmission facility with a 4wire metallic station-end FX or OPS signaling link (loop start or ground start). The module combines the functions of an SF transceiver, an SF-to-FXS signaling converter, and a 4wire pad/transformer module. As such, the 6943 provides full-duplex signaling conversion between the 4wire SF facility and the 4wire station-end FX or OPS link. Passive level control (attenuation) is provided in both the transmit and the receive channel of the 6943 to coordinate terminal- (station-) side levels with the required interface levels at the module's facility-side ports.

terminal (station-side) interface

2.02 As stated above, signaling and transmission between the 6943 and the local terminal equip-

ment (station telephone or a PBX) take place over a 4wire metallic link. The FXS-type (station-end FX or OPS) signaling path is normally extended from the 6943 to the local termination via simplex (SX) connection of locally derived A and B leads to transformers at the module's station-side ports (transmit input and receive output). If desired, however, the signaling (A&B-lead) path can be separated from the transmission path by cutting or removing a pair of option straps on the module's printed circuit board (see section 3 of this practice for details). The two transformers at the 6943's station-side ports can be independently switch-optioned for 1200, 600, or 150-ohm terminating impedance. The 1200-ohm option is used for interface with loaded cable; the 600-ohm option, for interface with nonloaded cable (or for direct interface with 600-ohm station-end equipment); and the 150-ohm option, to provide approximately 2dB of slope equalization for nonloaded cable through the deliberate impedance mismatch.

facility interface

2.03 On the facility side, the 6943 provides transformer coupling at both ports (transmit output and receive input). Both transformers provide fixed, balanced 600-ohm terminating impedance. A choice of impedances is not provided because, in most applications, the 6943 does not interface the 4wire SF signaling facility directly but rather via a companion line amplifier or other device located between the 6943 and the SF facility (see paragraph 2.04).

facility-interface alignment levels and level control

2.04 The 6943 is designed to interface the 4wire SF transmission facility at conventional transmission level points (TLP's) of −16 transmit and +7 receive. If these TLP's are not present, a companion facility-interface device is required between the 6943 and the SF facility. Generally, this device is a line amplifier (Tellabs 4944, 4744, 400X, or equivalent), although in some cases a pad or pad/transformer module (Tellabs 490X, 440X, or equivalent) can be used. The facility-interface device not only provides an appropriate impedance match with the SF facility, it also provides the necessary level coordination between the facility and the 6943 (see figure 2). Specifically, the receive channel of the facility-interface device provides the gain (or loss) necessary to derive the +7TLP required at the 6944's receive input port from the actual receive input level on the facility, and the transmit channel of the facility-interface device provides the gain (or loss) necessary to derive the required 4wire transmit output level on the facility from the −16TLP present at the 6943's transmit input port.

2.05 The prescription attenuators on the 6943 itself are located (electrically) on the terminal (station) side of the module. Thus, because of their location in the circuit, they can be thought of, and are so labeled, as providing receive-output and transmit-input loss. These attenuators are used to coordinate terminal-side levels with the mandatory TLP's at the module's facility-side ports. Specifically, the transmit attenuator provides the loss necessary to derive the required −16TLP at the module's transmit output port from the actual transmit input level, and the receive attenuator provides the loss necessary to derive the required receive output level from the +7TLP at the module's receive input port. The attenuation range in both channels is 0 to 24dB of loss in switch-selectable 0.1dB increments.

transmit-channel amplitude equalization

2.06 A bump-type amplitude equalizer in the 6943's transmit channel provides post-equalization

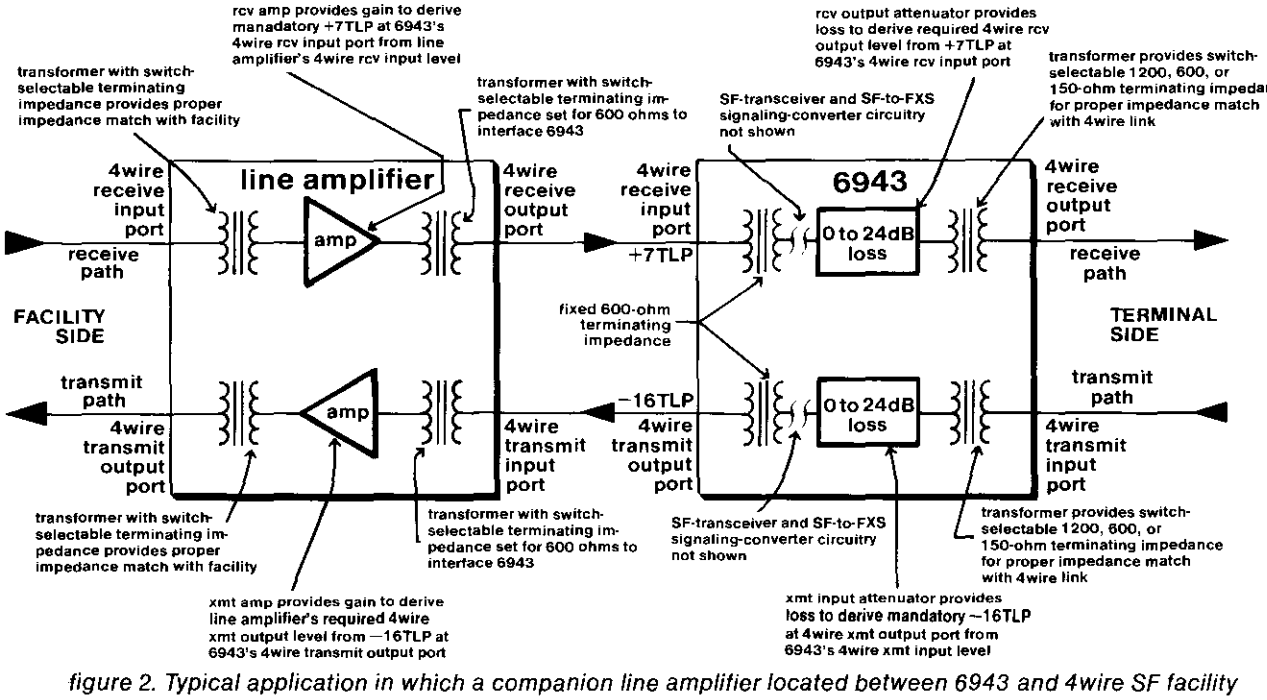


figure 2. Typical application in which a companion line amplifier located between 6943 and 4wire SF facility provides the necessary facility-side level coordination and impedance matching

for terminal- (station-) side links consisting of non-loaded cable. The equalizer's high-frequency section introduces an amplitude bump of 0 to 3dB at 3400Hz (re 1000Hz), and the low-frequency section provides from 0 to 3dB of roll-off at 300Hz (re 1000Hz). A pair of continuously adjustable high-frequency equalization *(HF eql)* and low-frequency equalization *(LF eql)* controls on the 6943's front panel allows the high-end bump and the low-end roll-off to be introduced independently of one another.

supervisory states

2.07 The 6943 module accommodates conventional loop-start and ground-start supervisory formats. In **loop-start operation,** detection of incoming SF tone activates ringing toward the station or PBX trunk circuit. Loop current is supplied to the station-side link through matched resistances in the mdoule's A and B leads. In **ground-start operation**, the A-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 office-end circuit is idle (tip lead open), and local ringing is initiated by receipt of SF tone amplitude-modulated by a ringing frequency of 16 to 67Hz. Outgoing seizure is initiated in ground-start operation by application of ground to the 6943's B lead, which causes transmission of SF tone to cease.

supervisory limits and build-out resistors

2.08 The 6943 contains internal build-out resistors (BOR's) in its A&B-lead current supply circuitry. These BOR's are used to limit current on short 4wire links when the module is operating on nominal −48Vdc battery supply. With the BOR's optioned into the circuit, the battery-feed resistance is 600 ohms; with the BOR's optioned out of the circuit, the battery-feed resistance is 400 ohms. When nominal −48Vdc battery supply is used, the BOR's are normally optioned into the circuit in applications where external loop resistance (including that of the station instrument or PBX trunk circuit) is less than 500 ohms, and are normally optioned out of the circuit in applications where external loop resistance is 500 ohms or greater. When powered from nominal −48Vdc battery supply and with the BOR's optioned out, the 6943 can accurately sense loop conditions at up to 3000 ohms of external loop resistance.

Note: *Although the 6943 can operate with external loop resistance up to 3000 ohms when powered from −48Vdc battery and up to 1300 ohms when powered from −24Vdc battery, loop resistance exceeding 1687 ohms with −48Vdc battery and exceeding 643 ohms with −24Vdc battery will result in loop current less than 23mA.*

2.09 In ground-start operation, the 6943 senses application of ground to the B lead to initiate seizure toward the distant end. The ring-ground sensor in the 6943 can sense application of this ground through external resistance of up to 2000 ohms on the B lead.

ring trip and ring-trip range

2.10 The 6943 provides for removal of local ringing when the station or PBX trunk responds to incoming seizure. For proper operation of the ring-trip circuit, the external ringing source must be referenced to a potential of −22 to −56Vdc. The 6943 can reliably detect ring trip at up to 2000 ohms of external loop resistance with −48Vdc biased ringing and at up to 800 ohms of external loop resistance with −24Vdc biased ringing. The module tolerates to 4μF of capacitance in series with 5.1 kilohms bridged across tip and ring without pre-tripping. Furthermore, the 6943 tolerates 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.

signaling-tone states

2.11 Signaling-tone states for the 6943 are consistent with the conventional F-signaling formats of FXS and station-end OPS service. These states are listed in tables 1 and 2 for loop-start and ground-start operation, respectively.

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

table 1. Loop-start signaling-tone states

local loop condition	SF tone	
	receive	transmit
idle	on	on
seizure from CO	off	on
ringing	off-on-off	on
busy	off	off
CO release	on	off until detection of incoming SF tone, then on
idle	on	on
local seizure	on	off
CO seizure acknowledgement	off	off
dialing	off	off-on-off
busy	off	off
local station disconnect first	off	on
CO release	on	on
idle	on	on

table 2. Ground-start signaling-tone states

incoming SF tone detection

2.12 The 6943 interfaces the receive path on the facility side at a +7TLP. Idle-state SF tone is received at a level of −20dBm0 (−13dBm). A higher level of −8dBm0 (−1dBm) is received during break portions of dial pulses and for about 400 milliseconds at the beginning of each tone interval. The SF tone detector in the 6943 reliably detects tone levels as low as −31dBm0, provided that the SF tone energy is approximately 10dB above the level of all other signals simultaneously present at the 4wire receive input port. The SF tone detector

is actually a signal-to-guard ratio comparator that compares energy in a narrow band of frequencies centered at the SF tone frequency with energy in the entire voice band. This detection arrangement aids significantly in prevention of talk-off, but it places an upper bound on allowable circuit noise. In general, received noise in excess of 51dBrnC0 may interfere with detection of low-level signaling tones.

2.13 Within approximately 13 milliseconds of detection of incoming SF tone, a band-elimination filter (BEF) is inserted into the receive transmission path to prevent propagation of SF tone beyond the module. An internal timing circuit ensures that the BEF remains inserted during dial pulsing and during momentary losses of tone continuity.

outgoing SF tone transmission

2.14 The 6943 is designed to interface the transmit path on the facility side at a −16TLP and to transmit SF tone at either of two levels. During the idle state, the module transmits SF tone at −20dBm0. During dial pulsing and also for the first 400ms each time it applies tone to the facility, the module transmits SF tone at a higher level of −8dBm0. This momentarily increased tone level aids in office-end detection of supervisory state changes and incoming dial pulsing.

delay circuit and transmit pulse correction

2.15 The 6943 module contains a 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 18 milliseconds to prevent false detection of short transients typically associated with station loops. A minimum-break pulse corrector in the transmit path ensures that the break portion of any transmitted dial pulse is 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

2.16 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 the 6943 module is cut (opened) during dialing and whenever SF tone is transmitted. The path cut is inserted within a few milliseconds of any interruption of local loop current and approximately 20 milliseconds before any transmission of SF tone. The path cut is removed approximately 125 milliseconds after transmission of SF tone ceases.

SF tone source

2.17 The 6943 is equipped with an integral SF tone oscillator and therefore does not require an associated master SF tone supply. 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 6943 is capacitively coupled and presents a load impedance of approximately 150 kilohms to the tone source.

power

2.18 The 6943 operates on filtered, ground-referenced input potentials between −22 and −56Vdc. The positive side of the dc power supply must be connected to earth ground. Ground-start operation of the station-end equipment requires a low-resistance ground that is common with the ground of the module. Maximum current required at −48Vdc is 60mA at idle, 80mA plus loop current when busy, and 100mA when ringing.

ringing

2.19 The ringing circuits in the 6943 operate with any ringing frequency between 16 and 67Hz, but the ringing generator **must** be referenced to (or superimposed upon) a potential of −22 to −56Vdc for reliable operation of the ring-trip detector. In the ground-start mode, the module responds to any modulated ringing frequency between 16 and 50Hz.

traffic-monitoring provision and E&M capability

2.20 A switch option on the 6943 permits traffic monitoring of outgoing circuit seizures. When enabled (see paragraph 3.13), the module's traffic-monitoring output lead (pin 19) functions much like a local sleeve lead, providing a ground output when the local station is off-hook and remaining open when the circuit is idle and also during the break portions of dial pulses. When traffic monitoring is not desired, the same connector pin can be used to provide M-lead override of the loop-signaling detector, in which case the 6943 functions as a "pseudo" E&M SF signaling set. When optioned for M-lead override, the module transmits SF tone when ground is applied to pin 19 and removes outgoing SF tone when battery potential is applied to pin 19.

carrier group alarm

2.21 Carrier group alarm (CGA) input leads on the 6943 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 6943's two CGA option switches appropriately set (see paragraph 3.12), forced release of any call in progress can be effected by application of an external ground (from the CGA unit) 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.

2.22 To provide for forced release, only the ALM or ALO lead (not both) need be enabled, i.e., only one of the CGA option switches need be set and the respective external lead connection made. Enabling the ALO lead provides the capability of restoring to service a 6943 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 can be activated during a carrier failure to override the 6943's forced-idle state. The 6943 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 option switch when the module is installed.

echo-control devices and switched-access testing

2.23 Certain internal points in the 6943's circuitry are brought out to access points at the modules' 56-pin card-edge connector. These access points are normally jumpered at the connector to provide circuit continuity. However, the use of an associated echo-control device or an application involving switched-access testing requires external connections to these access points. An echo suppressor or canceller, for example, is inserted into the circuit via connector access between the 6943's SF signaling section and its transmit and receive attenuators. For in-service switched-access testing of the 6943, connector access is provided to the input and output ports of the modle's signaling section, 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 6943 4Wire FXS SF Signaling Set module should be visually inspected upon arrival in order 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 6943 module mounts in one position of a Tellabs Type 16 Mounting Shelf, which is available either unwired or in several prewired versions for 19-inch or 23-inch relay-rack installation. The 6943 can also be mounted in one position of the lower shelf of a Tellabs 269-series prewired Mounting Assembly. The module plugs physically and electrically into a 56-pin connector at the rear of the shelf or assembly.

installer connections

3.03 In applications where the 6943 module is to be installed in a prewired Type 16 Shelf or in a 269-series Mounting Assembly, no external connections to the module need be made. Instead, appropriate external connections must be made to terminal blocks or cable connectors on the shelf or assembly as directed in the respective Tellabs practice or wiring diagram. If, however, the 6943 is to be installed in an unwired Type 16 Shelf, external connections to the module are required. Before making any connections to the shelf or assembly, ensure that power is **off** and modules are **removed**. Modules should be inserted into their positions only **after** they are properly optioned and **after** wiring is completed.

3.04 All external connections to the 6943 are made by wire-wrapping to the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector. In all applications except those involving switched-access testing or use of an associated echo-control device, 13 jumper wires must be installed at the connector to provide continuity across internal access points that are brought out to the connector. (Access to internal sections of the 6943 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 3. If field-installed, jumpers should be wired **before** external connections are made. If the 6943 module is to be used in an application involving switched-access testing, consult Tellabs' Customer Service group at your Tellabs Regional Office (in Canada, at our Canadian headquarters) for drawings and details. If the module is to be usd in conjunction with a Tellabs 6920 Echo Suppressor or 6921-family Echo Canceller, see table 4 for wiring information.

connect 6943 pin:		
SF RCV OUT	56 to 54 52 to 50	RCV PAD IN
RCV PAD OUT	48 to 46 44 to 42	LOCAL 4W RCV
A AUX (A lead) B AUX (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	LOCAL 4W XMT
XMT PAD OUT	8 to 6 4 to 2	SF XMT IN

table 3. Jumper wiring for applications without switched-access testing or echo-control devices

3.05 External connections to the 6943 are listed in table 5. 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 6943 but are required as part of the universal wiring scheme for all 6900 and 4900-family signaling, terminating, level-control, and analog-voice-circuit echo-control modules. A Type 16 (or equivalent) shelf wired in accordance with all

connect 6943 pin:		to 6920 or 6921X 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 6921X.		

table 4. Interconnections and jumper wiring for applications where 6943 module is used with 6920 Echo Suppressor or 6921X-family Echo Canceller

connections listed in table 5 will accept any 6900 or 4900-family module of the types mentioned above on an interchangeable basis, provided either that jumpers are installed per table 3 or that the shelf is wired for switched-access testing or for use with an echo-control device per table 4. If an installation is dedicated for use with only the 6943 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 5. Be aware that, while lead nomenclature may vary from one module to the next among the aforementioned types of 6900 and 4900-family modules, basic function — and wiring — remain universal.

connect:	to pin:
4WIRE RCV IN TIP	55
4WIRE RCV IN RING	53
4WIRE RCV OUT TIP	51
4WIRE RCV OUT RING	49
4WIRE XMT IN TIP	7
4WIRE XMT IN RING	5
4WIRE XMT OUT TIP	3
4WIRE XMT OUT RING	1
RING GEN (ringing generator)	23
−BATT (−22 to −56Vdc filtered input)	15
GND (ground)	25
*ALM (CGA alarm master)	47
*ALO (CGA alarm override)	45
*A lead	35
*B lead	33
*DER. N (derived N lead)	30
*DER. E (derived E lead)	21
*M or S (M lead or traffic-monitoring/sleeve 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
**MB lead for looped M-lead operation	32
**D lead	31
**F lead	29
**G lead	27

*Optional on 6943.
**Not applicable to 6943 but required as part of universal wiring scheme for all 6900 and 4900 signaling, terminating, level-control, and analog-voice-circuit echo-control modules.

table 5. External connections to 6943

prescription optioning and alignment

3.06 Prescription optioning and alignment of the 6943 are possible **in applications where transmit-channel post-equalization for loaded cable is not required.** Table 6 summarizes all switch options, strap options (see note below), and alignment-switch settings. For prescription optioning and alignment, all required options and all required receive-output-loss and transmit-input-loss switch settings should be determined from circuit records prior to installation of the module. These required options and alignment-switch settings should then be noted in the **checklist** column of table 6 or on the circuit layout record (CLR). During installation, the module can then be quickly and easily optioned and aligned without reference to the detailed optioning and alignment instructions that follow in the text. Simply refer to the **checklist** column of table 6 (or to the CLR) and set all option switches and alignment switches (and, if necessary, install and/or remove option straps) as indicated. Then ensure that the front-panel *(HF eql* and *LF eql* controls are adjusted fully counterclockwise for no equalization.

Note: *Changing or removing the 6943's factory-installed option straps is rarely required. See paragraph 3.14 for details on these options.*

non-prescription switch-optioning

3.07 Seven option switches on the 6943 must be set before the module is placed into service. All are two- or three-position slide switches except for one two-position DIP switch. Locations of these switches on the 6943's printed circuit board are shown in figure 3. Instructions for setting these switches are provided below (see table 6 for a summary and checklist).

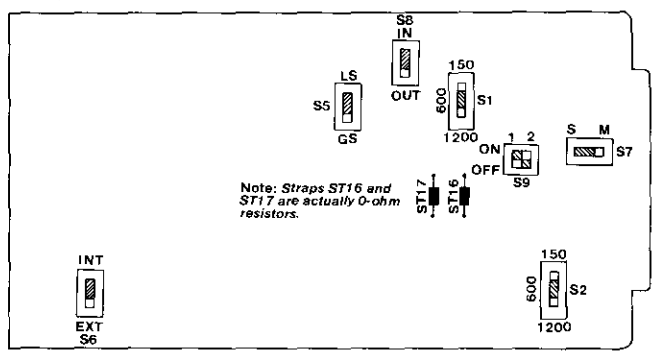


figure 3. Locations of option switches and option straps on 6943 module

3.08 **Terminal-Side Port Impedances.** On the 6943's terminal (station) side, terminating impedances at the module's 4wire transmit input port and 4wire receive output port are selected by switches *S1* and *S2*, respectively. For 1200-ohm impedance (as is normally required for interface with loaded cable), set *S1* and *S2* to the *1200* position. For 600-ohm impedance (as is normally required for interface with nonloaded cable), set *S1* and *S2* to the *600* position. For 150-ohm impedance (which provides approximately 2dB of slope equalization for long sections of nonloaded cable), set *S1* and *S2* to the *150* position.

switch/strap option or alignment function	switch/strap	selection	settings	check-list
terminating impedance, 4wire receive output port (terminal [station] side)	S1	1200 ohms (loaded cable)	1200	
		600 ohms (nonloaded cable)	600	
		150 ohms (2dB of slope equalization for nonloaded cable)	150	
terminating impedance, 4wire transmit input port (terminal [station] side)	S2	1200 ohms (loaded cable)	1200	
		600 ohms (nonloaded cable)	600	
		150 ohms (2dB of slope equalization for nonloaded cable)	150	
loop-start or ground-start operation	S5	loop start	LS	
		ground start	GS	
use of internal (integral) or external (master) SF tone oscillator	S6	internal oscillator	INT	
		external oscillator	EXT	
optioning of build-out resistors (BOR's) into loop-current supply circuitry for current limiting on short station-side links	S8	BOR's optioned into circuit (for station-side links of less than 500 ohms when −48Vdc input power is used)	IN	
		BOR's optioned out of circuit	OUT	
carrier-group-alarm (CGA) forced release via ALM lead (pin 47)	S9-2	ALM lead (forced release) enabled	S9-2 ON and ALM lead connected to pin 47	
		ALM lead (forced release) disabled	S9-2 OFF and/or no connection made to pin 47	
carrier-group-alarm (CGA) forced release via ALO lead (pin 45)	S9-1	ALO lead (forced release) enabled	S9-1 ON and ALO lead connected to pin 45	
		ALO lead (forced release) disabled	S9-1 OFF and/or no connection made to pin 45	
traffic monitoring of outgoing seizures on pin 21 or operation of 6943 module as "pseudo" E&M SF signaling unit **Note:** *If neither of these options is desired, make no external connections to pins 21 and 19.*	S7	traffic monitoring: circuit seizure (local station off-hook) causes metering output (PNP-transistor ground) on pin 21	TM/S (also ensure that external metering lead is connected to pin 21)	
		E&M operation: ground on M lead (pin 19) causes 6943 to transmit SF tone; battery on M lead causes 6943 to remove outgoing SF tone	M (also ensure that external M lead is connected to pin 19 and that external E lead is connected to pin 21)	
extension of signaling path from 6943 to local termination via simplex (SX) connection of locally derived A&B leads to transformers at 6943's station-side ports, or separation of signaling path from transmission path	straps ST16 (xmt SX) and ST17 (rcv SX)*	extension of signaling path via SX connection of A&B leads to transformers at station-side ports	straps ST16 and ST17 installed*	
		separation of signaling path from transmission path	straps ST16 and ST17 cut or removed	
receive-channel attenuation**	front-panel rcv out loss DIP switch**	0.1dB loss	0.1 to IN	
		0.2dB loss	0.2 to IN	
		0.4dB loss	0.4 to IN	
		0.8dB loss	0.8 to IN	
		1.5dB loss	1.5 to IN	
		3.0dB loss	3.0 to IN	
		6.0dB loss	6.0 to IN	
		12.0dB loss	12.0 to IN	
transmit-channel attenuation**	front-panel xmt in loss DIP switch**	0.1dB loss	0.1 to IN	
		0.2dB loss	0.2 to IN	
		0.4dB loss	0.4 to IN	
		0.8dB loss	0.8 to IN	
		1.5dB loss	1.5 to IN	
		3.0dB loss	3.0 to IN	
		6.0dB loss	6.0 to IN	
		12.0dB loss	12.0 to IN	

* Unless otherwise specified, straps *ST16* and *ST17* are factory-installed on all 6943 modules.

** The front-panel *rcv out loss* and *xmt in loss* DIP-switch positions are cumulative. Total loss introduced into the 6943's receive and transmit channels (on the module's terminal [station] side) is the sum of that channel's *loss* DIP-switch positions set to *in*. For zero loss in a channel, set all positions of that channel's *loss* DIP switch to *out*.

table 6. Summary and checklist of 6943 switch options, strap options, and front-panel switches

3.09 **Loop-Start or Ground-Start Operation.** The loop-start or ground-start supervisory mode is selected via switch *S5*. For loop-start operation, set *S5* to the *LS* position. For ground-start operation, set *S5* to the *GS* position.

3.10 **Internal or External SF Oscillator.** Switch *S6* conditions the 6943 for use with its own internal (integral) SF tone oscillator or for use with an external (master) oscillator. If the 6942's internal oscillator is to be used, set *S6* to the *INT* position. If an external oscillator is to be used, set *S6* to the *EXT* position.

3.11 **Build-Out Resistors.** Switch *S8* options the 6943's BOR's into the A&B-lead current supply circuit for current limiting on short station-side loops or excludes the BOR's from the circuit when current limiting is not necessary. Generally, current limiting is required when the 6943 is operating from nominal −48Vdc input power and the total external resistance on the station-side loop is less than 500 ohms (see paragraph 2.08). To include the BOR's in the circuit for current limiting on short station-side loops, set *S8* to the *IN* position. To exclude the BOR's from the circuit when external station-side loop resistance is 500 ohms or greater and/or when the module is powered from nominal −24Vdc input power, set *S8* to the *OUT* position.

3.12 **CGA Options.** Carrier-group-alarm options on the 6943 are used to forcibly remove the module from service when an associated carrier system malfunctions so that seizure of a disabled circuit is prevented. This is done by forcing the release of any call in progress (by application of ground from the CGA unit) via either the ALM (alarm master) lead or the ALO (alarm override) lead. To enable either or both leads for CGA forced release, the appropriate option switch(es) must be set and the appropriate external lead connection(s) made. If the ALM lead is to be used, set position *2* of two-position DIP switch *S9* to the *ON* position and ensure that the ALM lead is connected to pin 47. If the ALO lead is to be used, set position *1* of *S9* to the *ON* position and ensure that the ALO lead is connected to pin 45. If, at a later time, either or both of these leads must be disabled, this can be done simply by setting *S9-2* (ALM lead) and/or *S9-1* (ALO lead) to *OFF*; no actual lead disconnections are required. If neither of the CGA options is to be used, ensure that no external connections are made to pins 47 and 45. With no connections present at these pins, both *S9-2* and *S9-1* are nonfunctional and can therefore be left in either the *OFF* or *ON* position.

3.13 **Traffic Monitoring or E&M Operation.** Switch *S7* provides a choice of either traffic monitoring of outgoing circuit seizures (local station off-hook) or operation of the 6943 as a "pseudo" E&M SF signaling unit. If traffic monitoring of outgoing seizures is required, set *S7* to the *TM/S* (traffic-monitoring/sleeve) position and ensure that an external traffic-monitoring lead is connected to pin 21. If it is desired that the 6943 function as a "pseudo" E&M SF signaling unit, set *S7* to the *M* (M-lead) position and ensure that external E and M leads are connected to pins 21 and 19, respectively.

> **Caution:** *With switch S7 set to TM/S, the module's traffic-metering-lead output is derived by means of a PNP transistor that is ON when the circuit is busy and OFF during idle. If this lead is used to drive a relay, diode suppression must be provided across the relay coil to prevent damage to the transistor caused by transients that occur during the relay's release.*

signaling-path strap options

3.14 Two strap options on the 6943 provide a choice either of simplex (SX) connection of the signaling (A&B-lead) path to the transformers at the module's terminal- (station-) side ports or of separation of the signaling path from the transmission path. Locations of these straps on the module's printed circuit board are shown in figure 3. If the normal arrangement—extension of the signaling path from the 6943 to the local termination via SX connection of locally derived A&B leads to the module's station-side-port transformers—is desired, leave straps *ST16* and *ST17* in place. (Both straps are normally factory-installed on all 6943 modules.) If separation of the signaling path from the transmission path is desired, cut or remove straps *ST16* and *ST17*. (If you must either *remove* or *reinstall* straps *ST16* and *ST17*, be certain to observe the **caution** notice 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.*

alignment (general)

3.15 Alignment of the 6943 comprises either two or three main parts. These are as follows:

A. Introducing receive-channel loss to derive the required 4wire receive output level from the +7TLP at the 4wire receive input port.
B. Introducing transmit-channel loss to derive the required −16TLP at the 4wire transmit output port from the 4wire transmit input level.
C. Adjusting the transmit-channel bump equalizer, if necessary, to post-equalize a terminal- (station-) side 4wire link consisting of loaded cable.

prescription alignment

3.16 As stated previously, prescription alignment of the 6943 is possible **in applications where transmit-channel post-equalization for loaded cable is not required.** See paragraph 3.06 for details on prescription optioning and alignment.

introduction to non-prescription alignment

3.17 In applications where prescription alignment settings are unavailable (and in applications where prescription alignment does not provide

adequate results), non-prescription alignment of 6943 is necessary. Access to the appropriate ports of the module is most conveniently provided via a Tellabs 9807 Card Extender (or equivalent) or an external jackfield. Additional equipment required for non-prescription alignment consists of a transmission measuring set (TMS), preferably one with independent transmit and receive impedance settings.

prealignment switch settings for non-prescription alignment

3.18 Before beginning actual non-prescription alignment of the 6943, do the following:

A. Ensure that all option switches (see table 6 for a listing), especially those that select the module's 4wire receive output and 4wire transmit input port impedances, are properly set.
B. Ensure that no transmit-channel equalization is introduced (front-panel *HF eql* and *LF eql* controls adjusted fully counterclockwise [CCW]).
C. Set all positions of the front-panel *rcv out loss* and *xmt in loss* DIP switches to the *out* position for zero loss.

non-prescription receive-channel alignment

3.19 Alignment of the receive channel consists of setting the module's front-panel *rcv out loss* DIP switch to derive the required 4wire receive output level from the +7TLP at the 4wire receive input port. Align the receive channel as follows (jack designations are those on the Tellabs 9807 Card Extender):

A. Arrange the transmit portion of the TMS for 1004Hz tone output at +7dBm. (If the TMS has a separate transmit impedance setting, select 600 ohms.) Connect this signal to the *rcv SF in* jack (opening jack, 4wire receive input port).
B. Arrange the receive portion of the TMS for 150, 600, or 1200-ohm terminated measurement, as appropriate, and connect it to the *4W rcv drop or bal net out* jack (opening jack, 4wire receive output port).
   Note: *If the 6943's 4wire receive output port is optioned for 150 ohms and the receive portion of the TMS has a 135-ohm setting instead of 150 ohms, use the 135-ohm setting; the slight impedance mismatch will not affect level measurements appreciably. If the 6943's 4wire receive output port is optioned for 1200 ohms and the receive portion of the TMS does not have a 1200-ohm setting, reset switch* S1 *on the 6943 for 600 ohms and use the 600-ohm receive impedance setting on the TMS. Then reset* S1 *for 1200 ohms after alignment is completed.*
C. Set the proper combination of front-panel *rcv out loss* DIP-switch positions to *in* so that the desired 4wire receive output level is achieved.
D. If the required 4wire receive output port impedance is 1200 ohms, wait until the transmit channel is aligned before resetting switch *S1* to the *1200* position. This completes alignment of the receive channel. Disconnect the TMS from the card extender or jackfield.

non-prescription transmit-channel alignment

3.20 Alignment of the transmit channel consists of the following:

- Introducing bump-type amplitude equalization, if necessary, via the front-panel *HF eql* and *LF eql* controls in applications where the 4wire terminal- (station-) side link consists of loaded cable.
- Setting the front-panel *xmt in loss* DIP switch to derive the required −16TLP at the 4wire transmit output port from the 4wire transmit input level.

Align the transmit channel of the 6943 as follows (jack designations are those on the 9807 Card Extender):

A. Remove the transmit path cut as follows: If the TMS being used for alignment is equipped with a holding coil (i.e., if the TMS provides a dc path for A&B-lead current), use the holding coil to seize the circuit, thereby causing A&B-lead current to flow and the transmit path cut to be removed. If the TMS has no holding coil, set switch *S7* to the *M* position and connect negative input battery to pin 19 during the alignment procedure to remove the transmit path cut.
   Note: *If the holding coil of a TMS is being used to seize the circuit and the module is operating from nominal −48Vdc input, set switch* S8 *to the* IN *position during alignment (if this has not already been done) to include the BOR's in the A&B-lead current supply circuitry and thus provide current limiting.*
B. If the terminal- (station-) side 4wire link consists of nonloaded cable, or if it is known that post-equalization for a link consisting of loaded cable **is not required**, proceed to step D. If, however, the link consists of loaded cable and equalization is required (or the need for equalization has not yet been determined), proceed to step C.
C. To determine the need for post-equalization of a terminal-side loaded-cable link and, if equalization is required, to introduce the proper amount, proceed as follows:
   1. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the *xmt SF out* jack (opening jack, 4wire transmit output port).
   2. Have the station-equipment end of the terminal-side link send 1004Hz tone at the CLR-specified level. Measure and record the level at which this tone is received.
   3. Then have the station-equipment end send tone (at the same level) at various frequencies across the voice band (e.g., every 100Hz from 300 to 3400Hz). Measure and record the level at which each frequency is received. If the measured frequency response is acceptably flat, no equalization is required; therefore, proceed to step C. Otherwise, proceed to substep 4.
   4. Request the station-equipment end to send 300 and 1004Hz tones, both at the CLR-specified level. Measure the levels at which

these tones are received (the 300Hz level will be lower).

5. Adjust the 6943's front-panel *LF eql* control clockwise (CW) until the 300Hz level equals the 1004Hz level. This adjustment will change the 1004Hz level because, as the *LF eql* control is adjusted closkwise, levels are boosted across much of the voice band, with low frequencies boosted more than midband frequencies. Therefore, have 1004Hz and 300Hz tone sent again, and readjust the 300Hz level (via the *LF eql* control) to match the 1004Hz level. Proper low-frequency equalization is attained when no further adjustment of the 300Hz level is required to match (within acceptable tolerances) the 1004Hz level. Several rounds of measurements and adjustments may be required for low-frequency equalization.
6. Now have the station-equipment end send 1004 and 3000Hz tone at the CLR-specified level. Measure the levels at which these tones are received (the 3000Hz level will be lower).
7. Adjust the *HF eql* control CW until the 3000Hz level equals the 1004Hz level. This adjustment will change the 1004Hz level because as the *HF eql* control is adjusted clockwise, levels are boosted across much of the voice band, with high frequencies boosted more than midband frequencies. Therefore, have 1004Hz and 3000Hz tone sent again and readjust the 3000Hz level (via the *HF eql* control) to match the 1004Hz level. This single repetition is usually sufficient for high-frequency equalization. Proceed to step D.

D. Arrange the transmit portion of the TMS for 1004Hz tone output at the CLR-specified 4wire transmit input level. (If the TMS has a separate transmit impedance setting, select the impedance for which the 6943's 4wire transmit input port is optioned. Connect this signal to the *4W xmt drop or 2W in* jack (opening jack, 4wire transmit input port).

Note: *If the 6943's 4wire transmit input port is optioned for 150 ohms and the transmit portion of the TMS has a 135-ohm setting instead of 150 ohms, use the 135-ohm setting; the slight impedance mismatch will not affect level measurements appreciably. If the 6943's 4wire transmit input port is optioned for 1200 ohms and the transmit portion of the TMS does not have a 1200-ohm setting, reset switch* S2 *on the 6943 for 600 ohms and use the 600-ohm transmit impedance setting on the TMS. Then reset* S2 *for 1200 ohms after alignment is completed.*

E. Arrange the receive portion of the TMS for 600-ohm terminated measurement and connect it to the *xmt SF out* jack (opening jack, 4wire transmit output port).

F. Set the proper combination of front-panel *xmt out loss* DIP-switch positions to *in* so that a −16.0dBm level is achieved.

G. This completes alignment of the transmit channel and, therefore, of the entire 6943 module. If the required terminating impedance at the module's terminal- (station-) side ports is 600 ohms, reset switch *S1* (4wire receive output port) and switch *S2* (4wire transmit input port) to their *600* positions. If the holding coil of a TMS was used to seize the circuit and thereby remove the transmit path cut, release the circuit via the TMS and disconnect the TMS from the card extender or jackfield. Also, if the BOR's were switched into the circuit for A&B-lead current limiting during alignment but are not required during normal operation, set switch *S8* to the *OUT* position. If switch *S7* was set to the *M* position and negative input battery was applied to pin 19 to remove the transmit path cut, reset *S7* to the *TM/S* position (unless "pseudo" E&M operation is required) and remove negative input battery from pin 19. If a card extender was used, unplug both it and the 6943 module; then plug the module back into the shelf or assembly position.

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6943 4Wire FXS SF Signaling Set module, function sequence flowcharts (figures 4 and 5) that illustrate 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 flowcharts can be used to determine whether a module is performing normally by observing the module's response and comparing it to that shown in the flow chart. Reference to the 6943 functional block diagram, section 5 of this practice, may aid in understanding the flowcharts.

4.02 The flowcharts are intended to familiarize you with the operation of the 6943 for engineering, application, and troubleshooting purposes only. Attempts to test or troubleshoot this module internally are not recommended and may void your Tellabs warranty. Procedures for recommended testing and troubleshooting in the field should be limited to those prescribed in section 7 of this practice.

6. specifications

transmission specifications

alignment level, 4wire transmit output port
−16TLP

alignment level, 4wire receive input port
+7TLP

specifications continued on page 15

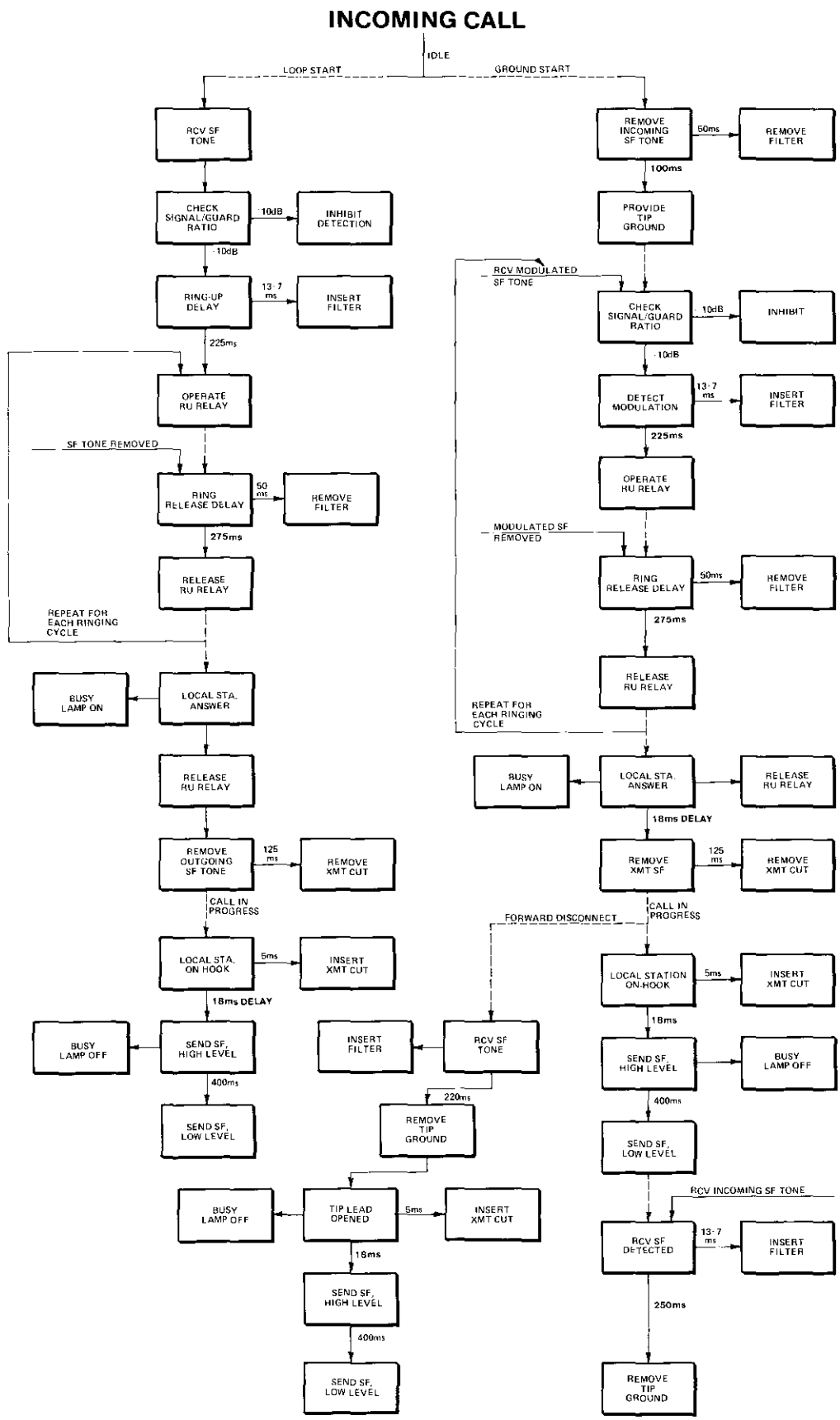


figure 8. Function sequence flowchart, incoming call

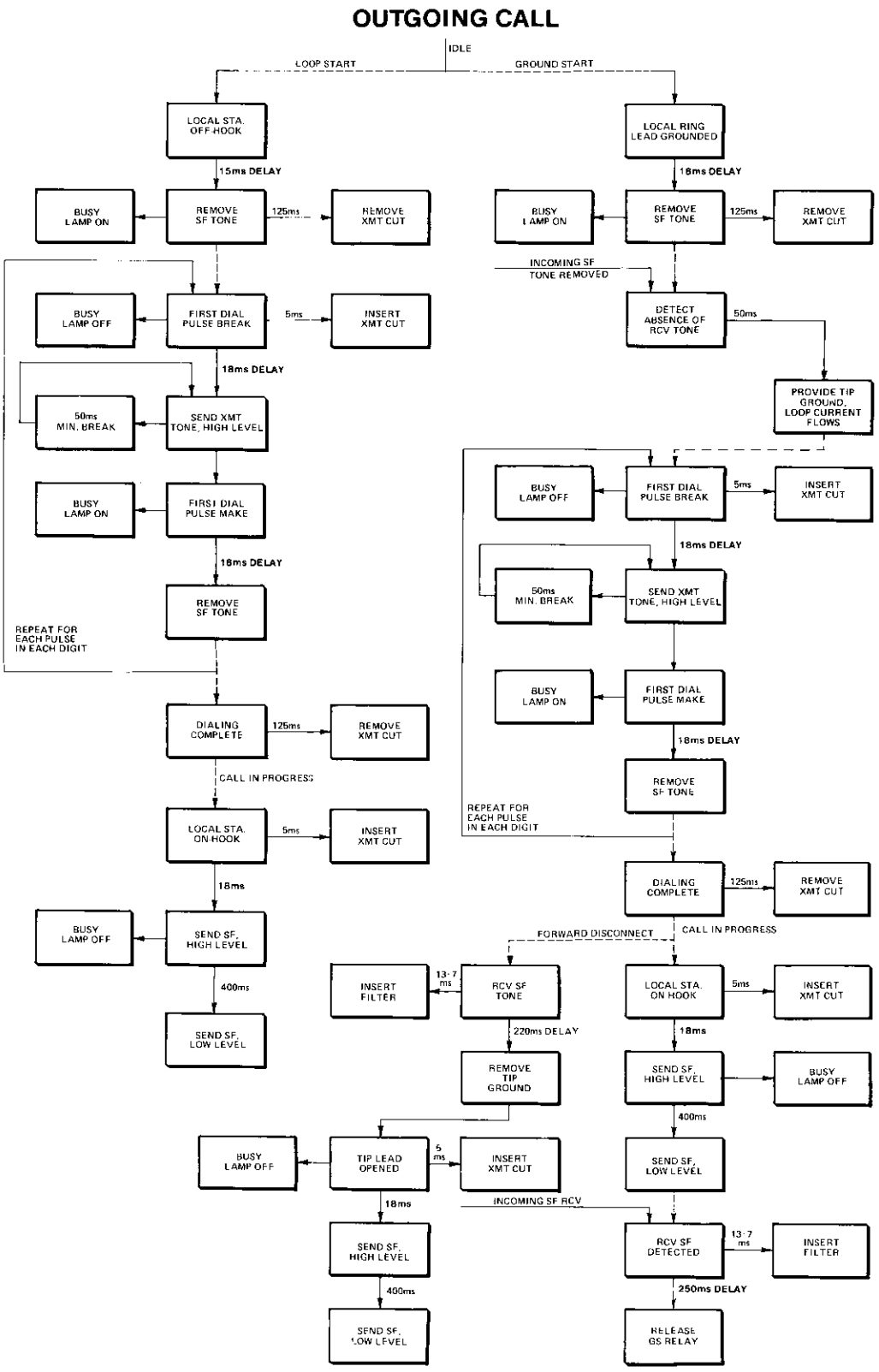
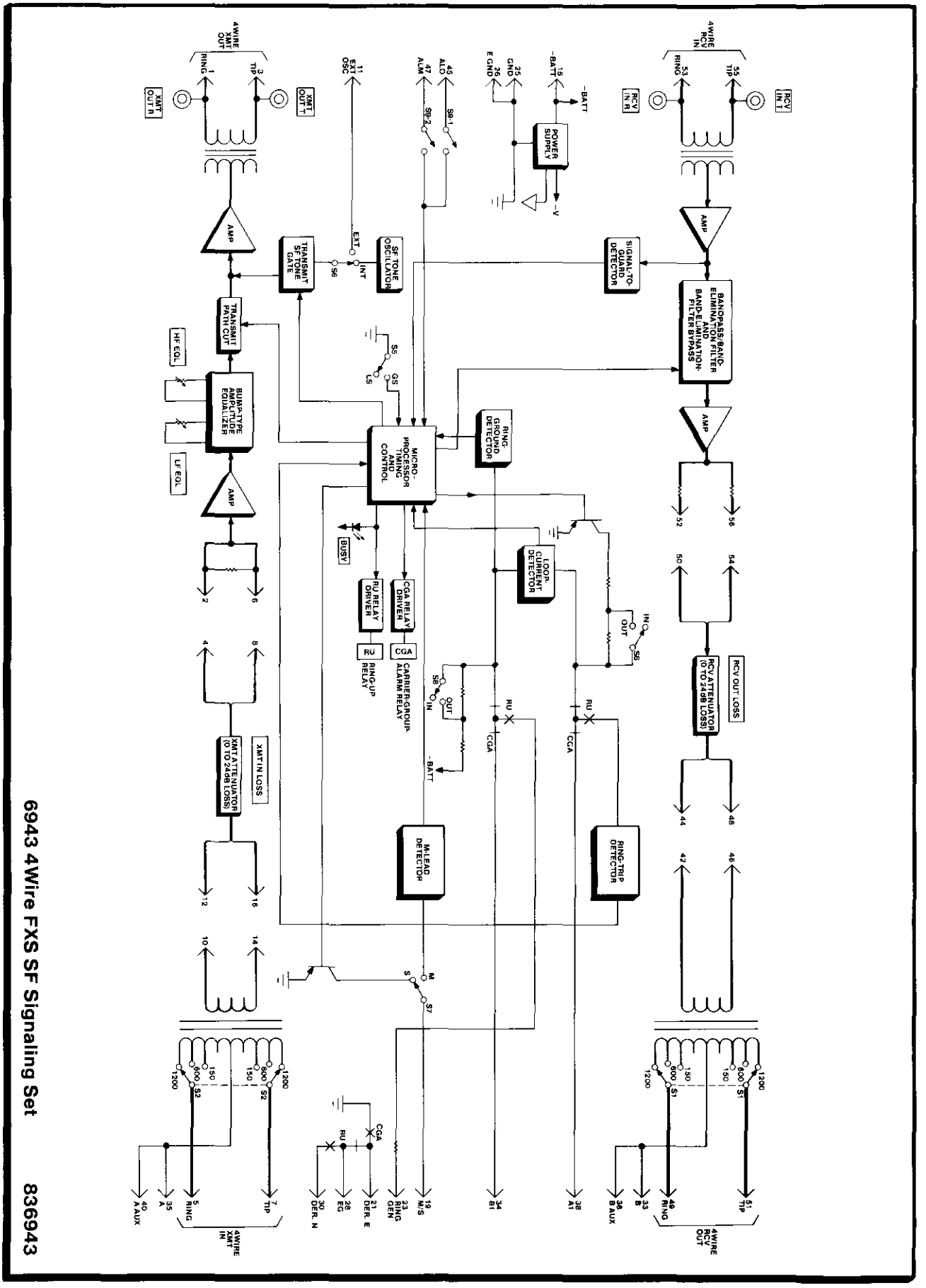


figure 9. Function sequence flowchart, outgoing call



5. block diagram

6943 4Wire FXS SF Signaling Set 836943

overload point, all four ports
+5dBm0

receive output loss
0 to 24dB in switch-selectable 0.1dB increments

transmit input loss
0 to 24dB in switch-selectable 0.1dB increments

attenuator impedance, transmit and receive
600 ohms, nominal

attenuator accuracy, transmit and receive
±0.1dB

insertion loss, transmit and receive channels
0±0.25dB at 1000Hz

terminal- (station-) side terminating impedances
1200 ohms ±10%, 600 ohms ±10%, or 150 ohms ±15%, balanced, 300 to 4000Hz, individually switch-selectable at each terminal-side port (4wire transmit input, 4wire receive output)

facility-side terminating impedances
600 ohms ±5%, fixed, balanced, 300 to 4000Hz at both facility-side ports (4wire transmit output, 4wire receive input)

frequency response, transmit and receive channels
±0.5dB re 1000Hz level, 300 to 4000Hz

noise, transmit and receive channels
20dBrnC0 maximum

envelope delay distortion, transmit and receive channels
less than 20μs, 500 to 3000Hz, term set and (for receive channel only) band-elimination filter excluded

longitudinal balance
greater than 60dB at all four ports

total harmonic distortion
less than 1% at +5dBm0 at all four ports

crosstalk loss between transmit and receive paths
75dB

SF transmit section

internal SF tone oscillator frequency and stability
2600±5Hz for life of unit (other frequencies are available by special order)

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

SF tone states
idle: tone transmitted
busy: no tone transmitted
dialing: tone transmitted during the break portions of dial pulses

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

pulsing characteristics
input breaks shorter than 25ms do not cause transmission of SF tone
input breaks between 34 and 50ms are transmitted as 50±2ms tone bursts
input breaks longer than 50ms are transmitted as tone bursts with a duration equal to that of the input break±3ms

transmit path cut insertion
transmit speech path is cut (opened) 9±5ms before transmission of SF tone

transmit path cut removal
transmit speech path cut is removed 135±50ms after detection of an off-hook condition

SF receive section

SF tone frequency
2600±15Hz (other frequencies are available by factory modification)

SF tone detection threshold
−33.5dBm0±2.5dB

SF tone rejection
50dB minimum, 2590 to 2610Hz

signaling bandwidth (high-guard state)
75Hz nominal

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

maximum line noise
51dBrnC0

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

band-elimination-filter timing
insertion time: 13±7ms
insertion duration for SF tones shorter than 175±60ms: 225±50ms (with BEF insertion duration longer than tone duration in all cases)
insertion duration for SF tones longer than 175±60ms: duration of SF tone plus 50±10ms
removal time: 50±10ms or duration of SF tone +50±10ms, whichever is longer

seizure delay
loop-start mode: 225±50ms
ground-start mode: 225±50ms

incoming ringing frequency range (ground-start mode)
16 to 67Hz modulated onto incoming SF tone

station-side loop conditions

maximum loop resistance (with BOR's optioned out)
3000 ohms with −48Vdc input battery
1300 ohms with −24Vdc input battery

maximum loop resistance for 23mA loop current
1687 ohms with −48Vdc input battery
643 ohms with −24Vdc input battery

loop current, 0-ohm loop
120mA at −48Vdc input battery with BOR's optioned out
80mA at −48Vdc input battery with BOR's optioned in

external ringing supply requirements

frequency
17 to 67Hz

bias
must be referenced to negative battery supply

level
130Vac maximum

external oscillator requirements (optional)

frequency
2600±2Hz

level
0.5Vrms

load impedance
approximately 80 kilohms

traffic-monitoring (sleeve) lead

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

power requirements

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

maximum input current at −48Vdc
idle: 60mA
busy, loop start or ground start: 80mA plus A&B-lead current
ringing, loop start or ground start: 100mA

physical

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

weight
21 ounces (953 grams)

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

7. testing and troubleshooting

7.01 Due to the complexity of the 6943 4Wire FXS 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. In addition, a *troubleshooting guide* in this section lists a variety of trouble conditions along with possible causes for each. If the module is not performing properly, look up the problem in the *troubleshooting guide* and check all the possible causes listed opposite the problem. If this does not correct the problem, substitute a new module (if possible) and observe its operation. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6943 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**, *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 central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (702) 827-3400
Canada: (416) 624-0052

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

replacement

7.04 To obtain a replacement module, notify Tellabs via letter or telephone (see addresses and numbers below) or via TWX (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6943 part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement module to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective module in the replacement module's carton, sign the packing slip included with the replacement, and enclose it with the defective module (this is your return authorization). Affix the preaddressed label provided with the replacement module to the carton being returned, and ship the module prepaid to Tellabs.

repair and return

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

in the USA: Tellabs, 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

trouble condition	possible causes (check before assuming module is defective)
module completely inoperative	1) No input power 2) Improper wiring.
cannot derive proper receive transmission levels	1) *Rcv out loss* level switches improperly set. 2) Receive-output impedance switch *(S1)* improperly set.
cannot derive proper transmit transmission levels	1) *Xmt in loss* level switches improperly set. 2) Transmit-input impedance switch *(S2)* improperly set. 3) Front-panel *HF eql* and *LF eql* equalization controls not fully counterclockwise for no equalization during alignment.
no signaling in one or both directions	1) Loop-start/ground-start option switch *(S5)* improperly set. 2) Improper level and/or frequency of incoming SF tone. 3) Improper level and/or frequency of outgoing SF tone. 4) *Rcv out loss* and/or *xmt in loss* level switches improperly set.
no local-station ringing in loop-start mode	1) Switch *S5* set to *G3* (ground start). 2) Local ring generator improperly wired or defective. 3) Level switches improperly set (too high or too low). 4) No incoming SF tone (check facility and distant-end equipment). 5) Excessive ringing load on 4wire loop.
no local ring trip in loop-start mode	1) Ring generator not superimposed on module's input battery. 2) Excessive loop resistance.
no off-hook detection (i.e., cannot draw dial tone) in loop-start mode	1) Excessive loop resistance (in which case outgoing SF tone may not be removed when local station goes off-hook). 2) Switch *S5* set to *GS* (ground start).
cannot dial in loop-start mode	1) Excessive loop resistance (see preceding problem, cause 1). 2) Switch *S5* set to *GS* (ground start).
no local-station ringing in ground-start mode	1) Switch *S5* set to *LS* (loop start). 2) Local ring generator improperly wired or defective. 3) Level switches improperly set (too high or too low). 4) No incoming modulated (at 18 to 33Hz) SF tone.
no local ring trip in ground-start mode	1) Ring generator not superimposed on module's input battery. 2) Excessive loop resistance.
no off-hook detection (i.e., cannot draw dial tone) in ground-start mode	1) Excessive loop resistance (in which case outgoing SF tone may not be removed when local station goes off-hook). 2) Switch *S5* set to *LS* (loop start). 3) Excessive ground differential (i.e., no common ground) between module and station. 4) No ring ground from station. 5) No tip ground from module (this can be caused by lack of common ground between module and station or by problem with facility of distant-end equipment).
cannot dial in ground start-mode	1) Excessive loop resistance (see preceding problem, cause 1). 2) Switch *S5* set to *LS* (loop start).

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