tellabs
technical manual

practice section 826923

6923 2Wire FXS SF Signaling Set

contents

1. general description

1.01 The Tellabs 6923 2Wire Foreign Exchange Station-End (FXS) SF Signaling Set module (figure 1) provides signaling and transmission interface between a 4wire transmission facility and the station end of a 2wire foreign-exchange (FX) or off-premise extension (OPX) signaling link. Specifically, the 6923 provides single-frequency (SF) signaling over the 4wire facility, conversion between that SF signaling and the loop signaling used at the station end of an FX or OPX circuit, and extension of this loop signaling toward the 2wire termination (a station loop or PBX trunk circuit). Conversion from 4wire to 2wire operation is accomplished via an integral toll-grade hybrid terminating set. Level coordination in both the transmit and receive paths is provided by means of adjustable precision attenuators. Conventional 2600Hz SF tone is standard. Other frequencies are optionally available.

1.02 The 6923 module (the functional equivalent of Western Electric's FSA/FSB Signaling Unit) is designed to operate in association with a foreign exchange office-end (FXO) SF signaling set (Tellabs 6924 or 6944 or equivalent) at the opposite end of the 4wire facility.

1.03 Features and options of the 6923 include switch selection of all options, operation in either the loop-start or ground-start supervisory mode, ring trip during both ringing and silent intervals, switchable 600 or 900 ohm terminating impedance on the 2wire (station) side of the module, an internal SF oscillator (use of an external master SF tone source is optional), an internal compromise balance network (use of an external or plug-on precision balance network (PBN) is optional), adjustable network build-out (NBO) capacitance, and minimum-break transmit pulse correction. A front-panel LED indicates busy, and front-panel test points access 4wire (facility) side transmit and receive ports. The 6923 module provides a circuit status lead that may be used as a local sleeve lead or as a traffic-monitoring lead. Alarm leads compatible with most carrier group alarm (CGA) formats are also available. Access points on the module provide compatibility with switched-access testing.

1.04 In the transmit direction, the 6923 converts local-station supervisory and dialing states to out-

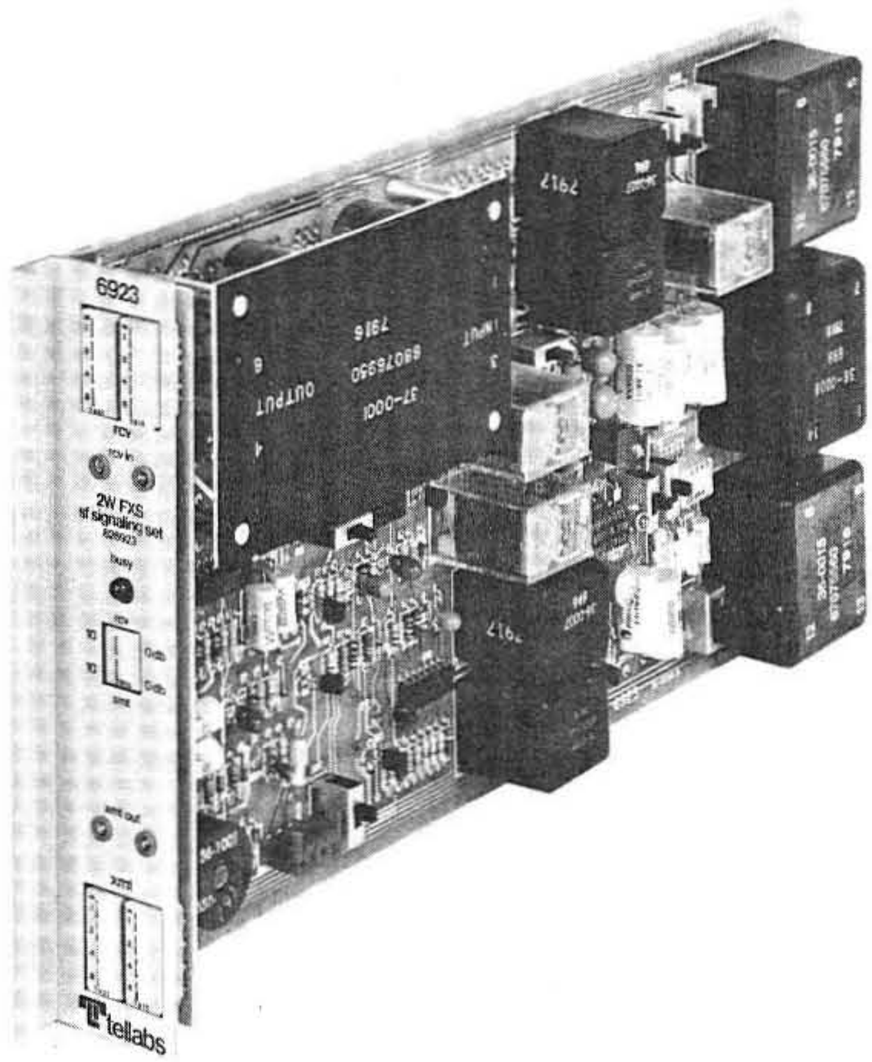
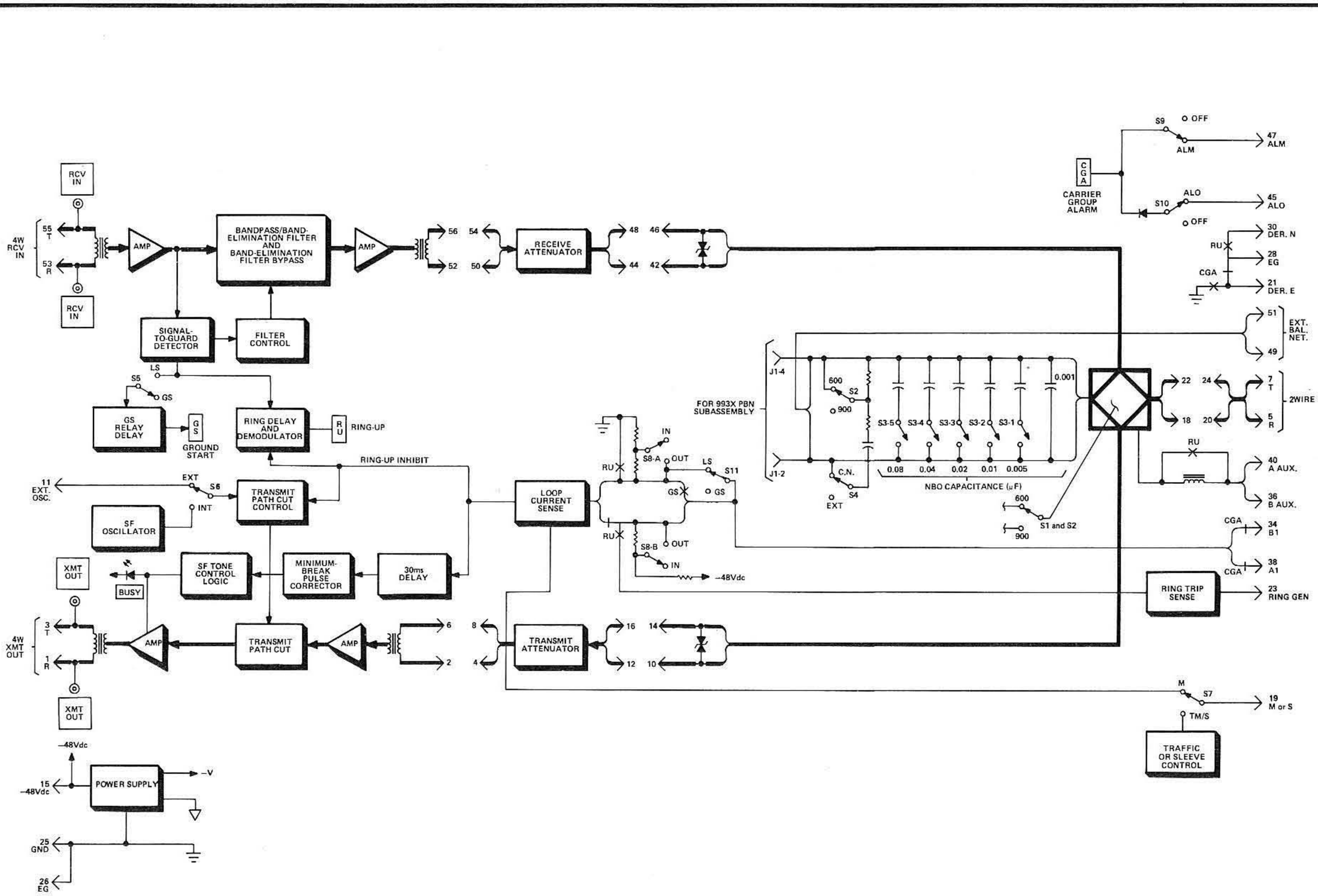


figure 1. 6923 2Wire FXS SF Signaling Set module

going SF tone conditions. Transmission of SF tone indicates station idle or the break portion of a dial pulse. A minimum-break pulse corrector in the transmit circuit ensures transmission of recognizable tone pulses.

1.05 The receive portion of the 6923 converts incoming SF signaling tones to local ringing and seizure (tip-ground) states. In the loop-start mode, appearance of SF tone activates local ringing. In the ground-start mode, loss of received tone causes the loop to be completed toward the station, and detection of SF tone modulated by central office ringing frequency activates local ringing. Local ring trip is provided in either supervisory mode during both ringing and silent intervals.

1.06 The 6923 incorporates an integral toll-grade hybrid terminating set for 4wire-to-2wire conversion. Balanced, switch-selectable 600 or 900 ohm (in series with 2.15μF) terminating impedance is provided at the 2wire port, while fixed, balanced 600 ohm terminating impedance is provided at the 4wire transmit and receive ports. Network build-out capacitors associated with the terminating set's internal compromise balance network provide from 0 to 0.155μF of NBO capacitance in 0.005μF increments. The internal compromise network may be excluded from the circuit by means of an option switch when use of a PBN is preferred. This PBN may be provided either as an external PBN module (e.g., Tellabs' 423X) or, more conveniently, as a Tellabs 993X PBN subassembly, which plugs into a



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5. block diagram

specifications continued from page 7

SF receive section

alignment level, facility interface
+7dBm

insertion loss
0 ±0.2dB at 1000Hz

frequency response
±0.2dB re 1000Hz level, 200 to 4000Hz, with band elimination filter out

4wire line impedance (receive input port)
600 ohms ±5%, balanced, 200 to 4000Hz

internal noise
less than 10dBrnC0

nonlinear distortion
less than 1% THD at 0dBm0

overload
no clipping below +5dBm0

envelope delay
less than 20μs, 400 to 4000Hz, term set excluded

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

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

SF tone threshold
−24dBm (maximum)

SF tone rejection
55dB minimum, 2590 to 2610Hz

signaling bandwidths
high guard state, 75Hz; low guard state, 300Hz

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

maximum line noise
58dBrnC

guard circuit transition
high-to-low, 225 ±60ms; low-to-high, 50 ±10ms

band elimination filter
insertion time, 13 ±7ms; removal time, 50 ±10ms after cessation of SF tone at 4wire receive input port

seizure delay
loop-start mode: 75 ±15ms
ground-start mode: 100 ±25ms

incoming ringing frequency range (ground start)
17 to 50Hz modulated onto incoming SF

common specifications

crosstalk coupling loss
equal-level crosstalk coupling loss between transmit and receive channels exceeds 75dB

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

external oscillator (optional)

frequency
2600 ±2Hz

level
0.5Vrms

load impedance
75 kilohms minimum, unbalanced

2wire loop conditions

maximum loop resistance
2000 ohms plus telephone set

loop current, 0-ohm loop
120mA with BOR's optioned out of loop current supply circuit, 80mA with BOR's optioned in

longitudinal balance
60dB minimum, 200 to 4000Hz

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

external ringing supply

frequency
17 to 67Hz

bias
must be referenced to −48 ±6Vdc

level
130Vac maximum

power requirements

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

input current
idle: 20 to 28mA
busy: loop start, 20 to 28mA plus loop current;
ground start, 40 to 45mA plus loop current
ringing: loop start, 45 to 50mA;
ground start, 65 to 70mA

physical

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

weight
49 ounces (1.39kg)

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 Tellabs 269-series Mounting Assembly

7. testing and troubleshooting

7.01 The Testing Guide Checklist may be used to assist in the installation, testing or troubleshooting of the 6923 2Wire FXS SF Signaling Set module. The Testing Guide Checklist is intended as an aid in the localization of trouble to a specific module. If a module is suspected of being defective, a new module should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. It is strongly recommended that no internal (component level) testing or repairs be attempted on the 6923 module. Unauthorized testing or repairs may void the module's warranty.

7.02 If a situation arises that is not covered in the Checklist, contact Tellabs Customer Service at (312) 969-8800 or your Tellabs Regional Office for further assistance.

7.03 If a 6923 is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is the more expedient method, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

7.04 If a defective 6923 is encountered, notify Tellabs via telephone [(312) 969-8800], letter [see below], or twx [910-695-3530]. Notification should include all relevant information, including the 8X6923 part number (from which we can determine the issue of the module in question). Upon notification, we shall ship a replacement 6923 to you. If the warranty period of the defective module has not elapsed, the replacement module will be shipped at no charge. Package the defective 6923 in the replacement module's carton; sign the packing list included with the replacement 6923 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 equipment prepaid to Tellabs.

repair and return

7.05 Return the defective 6923 module, shipment prepaid, to: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532
Attn: repair and return dept.
Enclose an explanation of the module's malfunction. Follow your company's standard procedure with respect 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.

testing guide checklist

Note 1: *The testing procedure for the 6923 module is most conveniently performed when a Tellabs 9807 Card Extender or an external jackfield is used to provide access to the appropriate points in the module. Thus, the following procedure is based on the assumption that a Card Extender or jackfield will be used. Jack designations are those on the 9807.*
Note 2: *Certain of the following tests require that an option switch or an alignment control be adjusted to a specific setting to perform the test. Be sure that all option switches and alignment controls are returned to the required settings for your particular application at the conclusion of the test.*

test	test procedure	normal conditions	if normal conditions are not met, verify:
receive-channel idle (loop start)	Insert terminating plug into *rcv SF in* jack. Insert opening plug into *4W xmt drop or 2W in* jack.	Front-panel *busy* LED extinguished ☐.	Switches *S5* and *S11* set to *LS* ☐. Wiring ☐. Replace module and retest ☐.
ring-up (loop start), module only	Connect transmission measuring set (TMS) arranged to transmit 2600Hz tone at −20dBm and 600 ohms into *rcv SF in* jack. Connect volt-ohm-milliammeter (VOM) arranged to measure 250Vac to *4W xmt drop or 2W in* jack.	With tone applied, front-panel *busy* LED lighted ☐. VOM indicates 65Vac minimum (reading may be higher on VOM's that combine ac and dc voltage readings in ac mode) during ringing interval (48Vdc present during silent interval if interrupted ringing applied) ☐.	Power ☐. Ringing voltage supply and biasing ☐. Tone level (−20dBm) ☐. Tone frequency (2600±10Hz) ☐. Test set connections ☐. Wiring ☐. Replace module and retest ☐.
ring-up (loop start), module and 2wire facility	Connect TMS arranged to transmit 2600Hz tone at −20dBm and 600 ohms into *rcv SF in* jack. Connect VOM arranged to measure 250Vac to *4W xmt drop or 2W mon* jack.	Same as above ☐. Station instrument associated with signaling unit rings ☐.	Power ☐. Ringing voltage supply and biasing ☐. Tone level (−20dBm) ☐. Tone frequency (2600±10Hz) ☐. Test set connections ☐. Wiring ☐. Local station on-hook ☐. Excessive cable capacitance and/or loop leakage not causing pre-trip ☐. Replace module and retest ☐.
receive-channel idle (ground start)	Connect pulsing test set arranged to transmit 2600Hz tone at −20dBm and 600 ohms into *rcv SF in* jack. Insert opening plug into *4W xmt drop or 2W in* jack.	Front-panel *busy* LED extinguished ☐.	Switches *S5* and *S11* set to *GS* ☐. Tone level (−20dBm) ☐. Tone frequency (2600±10Hz) ☐. Test set connections ☐. Wiring ☐. Replace module and retest ☐.

test	test procedure	normal conditions	if normal conditions are not met, verify:
ring-up (ground start), module only	Arrange pulsing test set to transmit 2600Hz tone bursts at −1dBm and 600 ohms at 20pps and 50% break, and connect it to *rcv SF in* jack. Connect VOM arranged to measure 250Vac to *4W xmt drop or 2W in* jack.	With pulsed tone applied, front-panel *busy* LED lighted ☐. VOM indicates 65Vac minimum (reading may be higher on VOM's that combine ac and dc voltage readings in ac mode) during ringing interval (48Vdc present during silent interval if interrupted ringing applied) ☐.	Power ☐. Ringing voltage supply and biasing ☐. Tone burst speed and duration (20pps and 50% break) ☐. Wiring ☐. Replace module and retest ☐.
ring-up (ground start), module and 2wire facility	Arrange pulsing test set to transmit 2600Hz tone bursts at −1dBm and 600 ohms at 20pps and 50% break, and connect it to *rcv SF in* jack. Connect VOM arranged to measure 250Vac to *4W xmt drop or 2W mon* jack.	Same as above ☐. Station instrument associated with signaling unit rings ☐.	Power ☐. Ringing voltage supply and biasing ☐. Tone burst speed and duration (20pps and 50% break) ☐. Wiring ☐. Local station on-hook ☐. Excessive cable capacitance and/or loop leakage not causing pre-trip ☐. Replace module and retest ☐.
ring trip, module only	Initiate ring-up, module only, by inserting either continuous 2600Hz tone (loop start) or modulated 2600Hz tone (ground start) into *rcv SF in* jack as outlined in appropriate section above. Connect VOM arranged to measure 250Vac to *4W xmt drop or 2W in* jack and, after ringing is initiated, connect 2000 ohm (or less) resistor across (i.e., in parallel with) VOM connections.	During ringing interval, VOM indicates 65Vac minimum (reading may be higher on VOM's that combine ac and dc voltage readings in ac mode) ☐. After resistor is connected across VOM leads, RU relay on 6923 releases, ringing ceases, and VOM indicates approximately 48Vdc (talk battery) ☐.	Value of tripping resistor used is 2000 ohms or less ☐. Ringing voltage supply biasing ☐. Wiring ☐. Replace module and retest ☐.
ring trip, module and 2wire facility	Remove connection (if present) from *4W xmt drop or 2W in* jack. Initiate ring-up, module and 2wire facility, by inserting either continuous 2600Hz tone (loop start) or modulated 2600Hz tone (ground start) into *rcv SF in* jack as outlined in appropriate section above. Request that station instrument associated with 6923 be placed off-hook after ringing begins.	Station instrument stops ringing as soon as it is taken off-hook, with no detectable ringing in station receiver, regardless of whether station goes off-hook during ringing or silent interval (if interrupted ringing is used) ☐.	Resistance of station loop plus instrument less than 2000 ohms ☐. Ringing voltage supply biasing ☐. Build-out resistors optioned OUT of circuit in loops exceeding 500 ohms resistance ☐. Wiring ☐. Replace module and retest ☐.
receive-channel transmission	Connect TMS arranged for 1004Hz output at 0dBm and 600-ohm impedance to *rcv SF in* jack. Connect receive portion of TMS terminated in 600 ohms to *rcv pad out* jack. Set module's front-panel *rcv* attenuator switches for 0dB loss.	TMS indicates 0±0.2dBm ☐.	Power ☐. Front-panel *rcv* pads set for 0dB loss ☐. Oscillator output impedance ☐. Input tone level ☐. Wiring ☐. Proper TMS termination ☐. Replace module and retest ☐.
	To verify attenuator function, introduce loss specified on circuit level record (CLR) card via front-panel *rcv* attenuator switches and note TMS reading.	TMS indicates comparable decrease in level ☐.	Replace module and retest ☐.

testing guide checklist continued on page 14

test	test procedure	normal conditions	if normal conditions are not met, verify:
transmit-channel idle	Set switch *S6* to *INT* position or verify external SF tone supply if *S6* is set to *EXT*. Connect pulsing test set arranged to transmit loop signals (idle = loop open, busy = loop closed) to *4W xmt drop or 2W in* jack. Connect receive portion of TMS terminated in 600 ohms to *xmt SF out* jack.	With loop open (idle), tone level of −36±1dBm observed ☐. Front-panel *busy* LED extinguished (tone must be absent on receive side for LED to be off in loop-start mode; tone must be present on receive side for LED to be off in ground-start mode) ☐.	Power ☐. Switch *S6* properly set ☐. Test set connections ☐. Proper termination of TMS ☐. Replace module and retest ☐.
transmit-channel busy	Maintain connections as above but arrange pulsing test set to provide loop closure. (On ground-start circuits, it is necessary to momentarily ground the B lead (connector pin 34) to seize the circuit.)	No SF tone present at *xmt SF out* jack ☐. Front-panel *busy* LED lighted ☐.	Power ☐. Switch *S6* properly set ☐. Test set connection ☐. Replace module and retest ☐.
transmit-channel pulsing	Maintain connections as above but arrange pulsing test set to transmit loop dial pulses at various speeds and percent breaks.	Input pulses between 28 and 50ms break corrected to 50±2ms tone burst at a level of −24±1dBm ☐. Input pulses longer than 50ms repeated as tone bursts with duration equal to that of input pulses ±2ms ☐.	Same as above ☐.
transmit-channel disconnect	Maintain connections as above but arrange pulsing test set to provide loop closure followed by sustained (not pulsed) loop open.	For 300 to 500ms after opening of loop, tone level of −24±1dBm observed ☐. Level then decreases to −36±1dBm and remains at this level for duration of loop open ☐.	Same as above ☐.
transmit path cut	Connect TMS arranged to transmit 1004Hz tone at −16dBm and 600 ohm output impedance to *xmt pad in* jack. Connect receive portion of TMS terminated in 600 ohms to *xmt SF out* jack. Connect pulsing test set arranged to transmit loop signals to *4W xmt drop or 2W in* jack. Set module's front-panel *xmt* attenuator switches for 0dB loss.	With loop open (idle), tone level of −36±1dBm observed ☐. When loop closed (busy), signal level at *xmt SF out* jack increases to −16±0.2dBm within 125±50ms, indicating removal of path cut ☐. While pulsing loop at 10pps and 50% break, path is cut and signal level of −30dBm (−24dBm, 50% duty cycle) observed ☐. After transition from loop closed to loop open, tone level of −24dBm observed for first 400±100ms after loop opening ☐.	Power ☐. Wiring ☐. Test set connections ☐. Switch *S6* set to *INT* ☐. Front-panel *xmt* pads set for 0dB loss ☐. Proper impedances and terminations on test equipment ☐. Replace module and retest ☐.
	To verify attenuator function, introduce loss specified on circuit level record (CLR) card via front-panel *xmt* attenuator switches and note TMS reading ☐.	TMS indicates comparable decrease in level ☐.	Replace module and retest ☐.
2wire receive level	Connect TMS terminated in proper 2wire impedance to *4W xmt drop or 2W in* jack. Request distant end to seize circuit and answer call with holding coil (either built into test set or externally connected). Request distant end to send 1004Hz tone at proper test level for circuit.	Level within ±0.2dB of level specified on CLR card ☐. Level varies as front-panel *rcv* attenuator switches adjusted ☐.	Receive level from 4wire facility ok; measure via TMS (in bridging mode) connected to *rcv line mon* jack ☐. If above level ok, verify settings of option switches *S1* through *S4* ☐. Wiring ☐. Replace module and retest ☐.

test	test procedure	normal conditions	if normal conditions are not met, verify:
4wire transmit level	Connect TMS arranged for 1004Hz output at level and impedance specified on CLR card to *4W xmt drop or 2W in* jack. Request distant end to measure incoming 1004Hz tone level.	Level at distant end within ±0.2dB of level specified on CLR card ☐. Level varies as front-panel *xmt* attenuator switches adjusted ☐.	With 6923 properly aligned, 4wire transmit level from module is −16±0.1dBm; measure via TMS connected to *xmt SF out* jack ☐. If this level ok, verify alignment of 4wire facility ☐. If this level not ok, verify front-panel *xmt* attenuator switch settings ☐ and *S1* through *S4* settings ☐. Replace module and retest ☐.
4wire return loss (transhybrid loss)	Request distant end to seize circuit. Answer call by placing 2wire equipment associated with module off-hook, and have distant end send 1004Hz tone at circuit alignment level. Connect receive portion of TMS terminated in 600 ohms to *xmt SF out* jack.	Signal level at *xmt SF out* jack at least 15dB below alignment level if integral compromise balance network is used ☐. Signal level at *xmt SF out* jack at least 27dB below alignment level if precision balance network (PBN) is used ☐.	If external or plug-on PBN is used, switch *S4* set to *EXT* ☐. Otherwise, *S4* set to *C.N.* ☐. Switches *S1* and *S2* (impedance) and *S3* (NBO capacitance) properly set ☐. If module's internal compromise balance network in use, no connections on pins 49 and 51 ☐. Proper 2wire termination ☐. Circuit alignment (including facility) ☐. Replace module and retest ☐.

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receptacle on the 6923's printed circuit board (Issue 2 modules or later). Refer to the 423X and 993X Tellabs Practices for details on these modules and subassemblies.

1.07 Adjustable precision attenuators (controlled by front-panel switches) are provided in both the transmit and receive paths for 2wire level coordination with −16 transmit and +7 receive transmission level points (TLP's) at the module's 4wire ports. Attenuation range is 0 to 26.5dB in 0.1dB increments.

1.08 The 6923 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 6923 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 6923 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 four 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 connectorized backplane.

1.11 The 6923 operates from nominal −48Vdc battery supply. Maximum current requirements range from 28mA at idle to 45mA plus loop current when busy and to 70mA when ringing.

2. application

2.01 The 6923 2Wire FXS SF Signaling Set module is designed to interface a 4wire transmission facility with a 2wire station loop or PBX trunk circuit in conventional station-end foreign-exchange (FX) or off-premise-extension (OPX) SF signaling applications. The module provides SF signaling over the 4wire facility, loop signaling toward the 2wire termination, and conversion between the two modes of signaling. An integral toll-grade hybrid terminating set provides 2wire-to-4wire conversion. The 2wire station loop or PBX trunk circuit interfaced by the 6923 may operate in either the loop-start or ground-start supervisory mode (see 2.06).

loop interface

2.02 The 2wire (terminal-side) interface is accomplished via the 6923's integral toll-grade hybrid terminating set. This hybrid provides switch-selectable 600 or 900 ohm (in series with 2.15μF) 2wire terminating impedance to permit interface with various terminal-side facilities and equipment. The 600 ohm option is selected when the 6923 interfaces nonloaded cable directly. The 900 ohm option is selected for interface with loaded cable. Direct interface with a PBX trunk may require either 600 or 900 ohms. Two-wire loop current is accommodated via the term set's A and B leads.

2.03 The 6923 module's hybrid may be switch-optioned to function with its own internal compromise balance network or with an external precision balance network (PBN). This external PBN may be provided either as a separate module (e.g., Tellabs' 423X) or as a Tellabs 993X Precision Balance Network subassembly, which plugs into receptacle *J1* on the printed circuit boards of Issue 2 6923 modules (those identified by part number 826923 on the module's front panel). A five-position DIP switch on the 6923's printed circuit board allows from 0 to 0.155μF of NBO capacitance, in 0.005μF increments, to be connected across the balance port.

facility interface

2.04 The 6923 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 490X Pad Module (or equivalent) will be required in conjunction with the 6923. 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 terminal-side levels in accordance with good transmission design. 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* (closed) position.

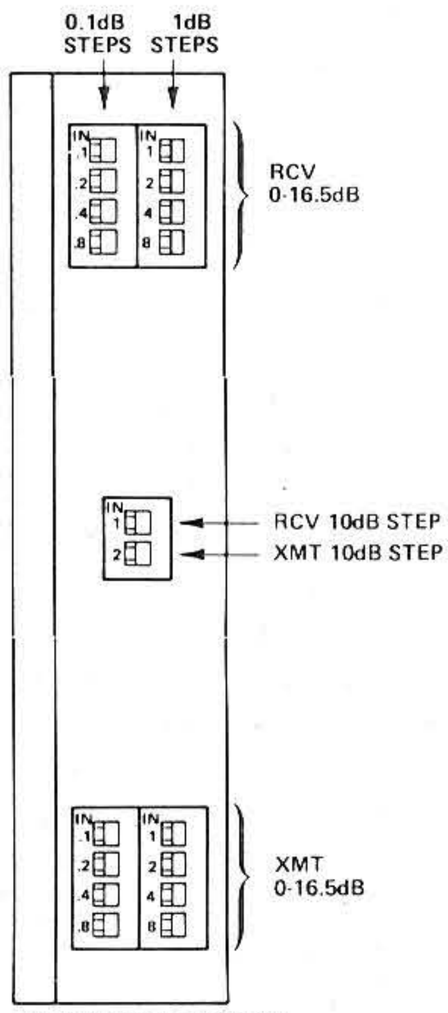

figure 2. 6923 front-panel switches

supervisory states

2.06 The 6923 module accommodates conventional loop-start and ground-start supervisory formats. In **loop-start operation**, receipt of incoming SF tone activates ringing toward the station or PBX trunk circuit. Loop current is supplied to the station or trunk circuit through matched resistances in the 6923 module's A and B

leads. In **ground-start operation**, the tip-lead path is opened to ground whenever incoming SF signaling tone is detected, except during ringing. Presence of SF tone at the 4wire receive input port indicates that the associated CO circuit is idle (tip lead open), and local ringing is initiated by receipt of SF tone amplitude-modulated by the CO ringing frequency. Outgoing seizure is initiated in ground-start operation by application of ground to the local ring conductor.

signaling tone states

2.07 Signaling tone states for the 6923 are consistent with the conventional F-signaling formats of FXS and OPX 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. Signaling states — loop start

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

table 2. Signaling states — ground start

signaling tone levels

2.08 Normal idle SF tone level is −20dBm0 in both directions of transmission. The 6923 interfaces the 4wire transmission facility at −16 transmit and +7 receive TLP's; thus, the nominal received SF tone level is −13dBm at the 4wire receive input port, and the transmitted SF tone level is −36dBm. For the first 400 milliseconds of any SF tone transmission by the 6923 (or by the associated FXO signaling unit at the opposite end of the facility), however, SF tone is transmitted at an augmented level of −24dBm. Also, SF tone is always transmitted at the augmented level during dialing. This momentarily increased tone level aids in the detection of supervisory state changes and incoming dial pulsing.

supervisory limits and build-out resistors

2.09 The 6923 incorporates internal build-out resistors (BOR's) in the loop current supply circuit to limit current on short loops. When the BOR's are optioned into the circuit, the battery supply resistance is 600 ohms; with the BOR's optioned out of the circuit, the battery supply resistance is 400 ohms. The BOR's should be optioned into the circuit in applications involving external loop resistances of less than about 500 ohms (including the station or PBX trunk resistance), and out of the circuit for loops exceeding 500 ohms. With the BOR's optioned out, the 6923 will accurately sense loop conditions for external loop resistances up to 3000 ohms.

Note: *Although the 6923 will operate with external loop resistance up to 3000 ohms, loop resistances exceeding 1687 ohms will result in loop current less than 23mA.*

2.10 In ground-start operation, the 6923 senses application of ground to the ring conductor to initiate seizure toward the distant terminal. The ring ground sensor in the 6923 will sense application of this ground through external resistances of up to 2000 ohms on the ring conductor.

ring trip and ring-trip range

2.11 The 6923 provides for removal of local ringing when the station or PBX trunk responds to incoming seizure. For proper operation of this circuit, the external ringing source must be referenced to a potential of −48±6Vdc. The 6923 will reliably detect ring trip through 2000 ohms of external loop resistance and will tolerate up to 4μF of capacitance bridged across tip and ring without pre-tripping. The 6923 will tolerate a loop leakage resistance of 30 kilohms without falsely indicating off-hook or ring trip. An internal inhibit circuit prevents operation of the ring-up circuit when the local station or PBX trunk is off-hook.

delay circuit and transmit pulse correction

2.12 The 6923 incorporates 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 30 milliseconds to prevent false detection of short transients typically associated with station loops. A minimum-break pulse corrector ensures that the break portion of any transmitted dial pulse will be no shorter than 50 milliseconds, regardless of input break or pulsing rate. The minimum-break pulse corrector has no effect on pulsing breaks longer than 50 milliseconds.

transmit path cut

2.13 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 6923 module is cut (opened) during dialing and whenever SF tone is transmitted. The path cut is inserted within a few milliseconds of interruption of local loop current and is removed about 125 milliseconds after SF signaling tone is removed. The transmit path is always cut about 15 milliseconds before any transmission of SF signaling tone.

tone source

2.14 The 6923 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 a slide switch) for connection of the external SF tone source, rather than the internally generated signal, to the tone control circuitry. The external signal should be 0.5±0.1Vrms, 2600±2Hz, unbalanced. Input to the 6923 is capacitively coupled and presents a load impedance of approximately 75 kilohms to the tone source.

power and ringing

2.15 The 6923 operates on input potentials between −42 and −56Vdc, ground referenced. The positive side of the dc power supply must be connected to earth ground. Ground-start operation of the station-end equipment (e.g., a PBX or telephone set) requires a low-resistance ground that is common with the ground of the 6923 module.

2.16 The ringing circuits in the module will operate with any ringing frequency between 16 and 67Hz, but the ringing generator **must** be referenced to (or superimposed upon) a potential between −40 and −56Vdc for reliable operation of the ring-trip detector. In the ground-start mode, the 6923 will respond to any modulated ringing frequency between 16 and 50Hz.

carrier group alarm

2.17 Carrier group alarm (CGA) input leads on the 6923 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 and can be independently enabled or disabled via switch option. With either lead enabled, forced release of any call in progress may be effected by application of an external ground (from the CGA unit, e.g., Tellabs' 6858 CGA Module) to that 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.

2.18 To provide for forced release, only the ALM or ALO lead (not both) need be enabled. Enabling the ALO lead provides the capability of restoring to service a 6923 that was previously forced to the idle state during a failure of the associated carrier system. The ALO lead is normally wired to a local override control (usually located on the CGA unit) that may be activated to override the 6923's forced-idle state. The 6923 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 CGA option switch-selected at the time of module installation.

echo control devices and switched-access testing

2.19 Certain internal points in the 6923's circuitry 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 the connector access points. An echo suppressor or canceller, for example, is inserted into the circuit via connector access between the 6923's SF signaling section and the transmit and receive attenuators. For in-service switched-access testing of the 6923, connector access is provided to the input and output ports of the module's signaling sections, to the attenuator pads, and to all ports of the hybrid terminating set. See paragraphs 3.03 and 3.04 for additional information.

traffic-monitoring provision and E and M capability

2.20 A switch option on the 6923 permits traffic monitoring of circuit seizures. The module's traffic-monitoring output, which functions much like a local sleeve lead, provides ground output when the local station is off-hook and is open when the circuit is idle. The lead remains grounded during the break portion of dial pulses. When usage monitoring is not desired, the same connector pin may be used as an M-lead override of the loop signaling detector to allow the 6923 to function as a "pseudo" E and M SF signaling set. When optioned for M-lead override, the module transmits SF tone when ground is applied to connector pin 19, and removes SF tone when battery potential is applied.

3. installation

inspection

3.01 The 6923 2Wire FXS 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 6923 module mounts in one position of a Tellabs Type 16 Mounting Shelf. 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.

wiring

3.03 All external connections to the 6923 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 6923 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 6923 module is to be used in an application involving switched-access testing, consult Tellabs' Customer Service group 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 Echo Digital Canceller, see table 4 for wiring information.

connect pin:		
SF RCV OUT	56 to 54 52 to 50	RCV PAD IN
RCV PAD OUT	48 to 46 44 to 42	TERM SET 4W RCV
A AUX (2W A lead) B AUX (2W B lead)	40 to 38 36 to 34	A1 (internal A lead) B1 (internal B lead)
EG	28 to 26	E GND
2W TIP 2W RING	24 to 22 20 to 18	TERM SET TIP TERM SET RING
XMT PAD IN	16 to 14 12 to 10	TERM SET 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

connect 6923 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 4. Interconnections and jumper wiring for applications where 6923 module is used with 6920 Echo Suppressor or 6921 Echo Canceller

3.04 External connections to the 6923 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 6923 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 5 will accept any 6900 or 4900 module on an interchangeable basis, provided that either jumpers are installed per table 3 or the Shelf is wired for switched-access testing or for use with an echo control device. If an installation is dedicated for use only with the 6923 module and no flexibility or interchangeability requirements are anticipated, 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 another in the 6900 and 4900 families, basic function (and wiring) remain universal.

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
2W T (2wire tip)	7
2W R (2wire ring)	5
RING GEN (ringing generator)	23
−Vin (−48Vdc input)	15
GND (ground)	25
*EXT. BAL. NET. (external precision balance network)	51 and 49
*ALM (CGA alarm master)	47
*ALO (CGA alarm override)	45
*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
**A lead	35
**B lead	33
**MB lead for looped M-lead operation	32
**D lead	31
**F lead	29
**G lead	27

*Optional
**Not applicable to 6923 but required as part of universal wiring scheme for all 6900/4900 modules.

table 5. External connections to 6923

option selection

3.05 All 6923 option selections are made via slide switches or DIP switches located as shown in figure 3. Table 6 lists all options and indicates the option choices, which are explained below. The 6923 should be completely optioned and its optioning verified before alignment is attempted.

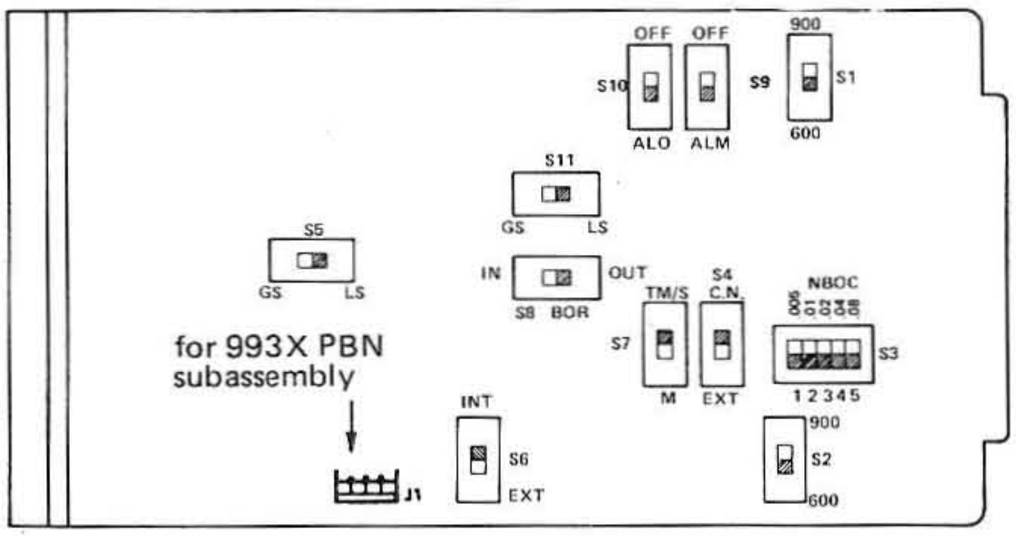

figure 3. Option switch locations

terminating set options

3.06 In the 6923 module's terminating set section, switches *S1* and *S2* are used to select 600 or 900 ohm 2wire port impedance. Set both *S1* and *S2* to either the *600* or *900* position, as required. Switches *S3-1* through *S3-5* may be set as necessary to introduce NBO capacitance of 0 to 0.155μF in 0.005μF increments. Total NBO capacitance introduced is the sum of those switches set to the *ON* (closed) position. Capacitance values are shown on the printed circuit board next to each *S3* switch

position. Switch *S4* permits use of the module's internal compromise balance network or an external or plug-on precision balance network (PBN). Set *S4* to the *C.N.* position if the internal compromise network is to be used or to the *EXT* position if an external PBN module or a Tellabs 993X PBN plug-on subassembly is to be used.

section of 6923	switch	option	function
terminating set	S1 and S2	600 or 900	select 600 or 900 ohm 2wire port impedance
	S3-5 S3-4 S3-3 S3-2 S3-1	ON (closed) or OFF (open)	0.08μF 0.04μF 0.02μF 0.01μF 0.005μF when ON, introduce indicated amts. of NBO capacitance
	S4	C.N. or EXT	includes (C.N. position) or excludes (EXT position) internal compromise balance network from circuit
signaling and supervision	S5 and S11	LS or GS	selects supervisory mode: loop start (LS position) or ground start (GS pos.)
	S6	INT or EXT	includes (INT position) or excludes (EXT position) integral SF tone oscillator from circuit
	S7	TM/S or M	selects either traffic-monitoring function (TM/S position) or M-lead override of loop signaling detector (M position); see 3.07
	S8	IN or OUT	options build-out resistors into (IN position) or out of (OUT position) loop current supply circuit
CGA options	S9	ALM or OFF	in ALM pos., enables forced-release function via ALO lead (S10 OFF)
	S10	ALO or OFF	in ALO pos., enables forced-release function via ALO lead (S9 OFF)

table 6. Switch options

signaling and supervision options

3.07 In the 6923's SF signaling and loop supervision section, switches *S5* and *S11* are used to select the loop-start or ground-start supervisory mode. Set both *S5* and *S11* to the *LS* (loop start) position or to the *GS* (ground start) position, as required. Switch *S6* conditions the module for use with its integral SF tone oscillator or with an external master SF tone source. Set *S6* to the *INT* position if the module's integral SF oscillator is to be used or to the *EXT* position if an external SF tone source is to be used. Switch *S7* is enabled only when an external connection is made to the traffic-monitoring/sleeve lead (pin 19). If traffic monitoring is desired, set *S7* to the *TM/S* (traffic-monitoring/sleeve) position. If traffic monitoring is not desired but M-lead override of the loop signaling detector is necessary (to allow the 6923 to function as a "pseudo" E and M SF signaling set), set *S7* to the *M* position. Switch *S8* is used to option the build-out resistors (BOR's) in the loop-current supply circuit into or out of the circuit. If current limiting is necessary on short loops (see paragraph 2.05), option the BOR's into the circuit by setting *S8* to *IN*. If not, set *S8* to *OUT*.

CGA options

3.08 Carrier group alarm (CGA) switch options on the 6923 are used to forcibly remove the module from service when the associated carrier system malfunctions so that seizure of a disabled circuit is is prevented. This is done by forcing the release of any existing call via either the ALM (alarm master) lead (pin 47) or the ALO (alarm override) lead (pin 45) as described in paragraphs 2.17 and 2.18. To enable either lead for CGA forced release, two option switches must be set. If the ALM lead is to be used, set switch *S9* to the *ALM* position and switch *S10* to *OFF*. If the ALO lead is to be used, set switch *S9* to *OFF* and switch *S10* to the *ALO* position. Setting both *S9* and *S10* to *OFF* disables the forced-release function.

alignment

3.09 Alignment of the 6923 consists of adjusting the *xmt* and *rcv* front-panel attenuator switches to accommodate the desired 2wire transmit and receive levels, and introducing NBO capacitance to optimize performance of the integral hybrid terminating set. Before aligning the 6923, verify that associated transmission equipment is aligned for facility-side interface transmission levels of +7dB receive and −16dB transmit.

3.10 Access to the appropriate ports of the 6923 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):

3.11 receive section:

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

B. With the receive portion of the TMS terminated in either 600 or 900 ohms (as appropriate), measure the level at the *4W xmt drop or 2W in* jack. Adjust the module's *rcv* attenuator switches until the desired 2wire receive level is achieved.

3.12 transmit section:

A. Before alignment of the transmit channel, the transmit speech path cut must be removed. This can be accomplished either by seizing the circuit (causing loop current flow) or by using the external M-lead input. If the TMS used in aligning the 6923 is equipped with a holding coil, this may be used to seize the circuit. (If the TMS provides a dc path, switch the BOR's (switch *S8*) *IN* during alignment to limit loop current.) If the TMS will not accommodate loop current flow, set option switch *S7* to the *M* position and temporarily connect battery potential to connector pin 19.

B. Condition the TMS for the output level and impedance specified for the 2wire interface (transmit direction), set the frequency for 1000Hz, and insert the signal at the *4W xmt drop or 2W in* jack.

C. Condition the TMS for 600 ohm terminated measurement and measure the signal level at the *xmt SF out* test jack. Adjust the module's *xmt* attenuator switches until a level of −16.0 ±0.1dBm is measured.

D. This completes alignment of the transmission path attenuators. Remove the test cords and return switches *S7* and *S8* to their appropriate settings.

network build-out capacitors

3.13 Optimum performance of the module's terminating set may require adjustment of the NBO capacitors to compensate for cable capacitance. Using the 9807 Card Extender or a prewired jackfield; determine the proper NBO capacitance as follows:

A. Seize the circuit by placing the associated station or PBX trunk off-hook.

B. Condition the TMS for an output level of +7dBm (into a 600 ohm load) at 2000Hz, and insert the signal at the *rcv SF in* test jack.

C. Set the receive portion of the TMS for a 600 ohm terminated measurement and connect it to the *xmt SF out* test jack.

D. Verify that the 2wire impedance of the terminating set is proper (either 600 or 900 ohms), that the external precision balance network is connected properly (if used), and that the associated station equipment is seized.

E. Adjust the NBOC option switches (*S3-1* through *S3-5)* to **minimize** the level measured at the *xmt SF out* test jack. A more precise adjustment may be achieved by varing the test frequency over the voice band as the NBO switches are set.

F. Remove the test cords and verify proper optioning of the module.

4. circuit description

4.01 To provide the clearest possible understanding of the operation of the 6923 2Wire FXS 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 6923 functional block diagram (section 5 of this Practice) may aid in understanding the sequence charts.

6. specifications

terminating set section

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

2wire return loss
40dB minimum, echo band, vs. either 600 or 900 ohms in series with 2.15μF

4wire port impedance
600 ohms, balanced, transmit and receive

insertion loss
4.2 ±0.3dB at 1000Hz

frequency response
±1.0dB re 1000Hz level, 300 to 4000Hz

transhybrid loss
50dB minimum, 200 to 4000Hz, with matched terminations

network build-out (NBO) capacitance
0 to 0.155μF, switch-selectable in 0.005μF increments

4wire attenuators

range
0 to 26.5dB in 0.1dB increments

impedance
600 ohms, unbalanced

accuracy
±0.05dB for 0.1, 0.2, 0.4, and 0.8dB steps; ±0.1dB for 1, 2, 4, 8 and 10dB steps

SF transmit section

alignment level, facility interface
−16dBm

insertion loss
0 ±0.2dB at 1000Hz

frequency response
±1.0dB re 1000Hz level, 300 to 4000Hz

4wire line impedance (transmit output port)
600 ohms ±5%, balanced, 300 to 4000Hz

noise
20dBrnC0 maximum

nonlinear distortion
less than 1% THD at 0dBm0

overload
overload point greater than +10dBm0

envelope delay
less than 20μs, 400 to 4000Hz, term set excluded

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

internal oscillator frequency and stability
2600 ±2Hz for 6 months, 2600 ±5Hz for life of unit (other frequencies are available by special order)

SF tone levels
−36 ±1.0dBm at idle
−24 ±2dBm, augmented (high) level

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

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

pulsing characteristics
input breaks shorter than 22ms will not cause transmission of SF tone.
input breaks between 28 and 50ms will be transmitted as 50 ±2ms tone bursts.
input breaks longer than 50ms will be transmitted as tone bursts with a duration equal to that of the input break ±2ms.

transmit path cut
transmit speech path is cut 15 ±5ms before transmission of SF tone. The path cut is removed 125 ±50ms after detection of an off-hook condition.

specifications continued on page 11

INCOMING CALL

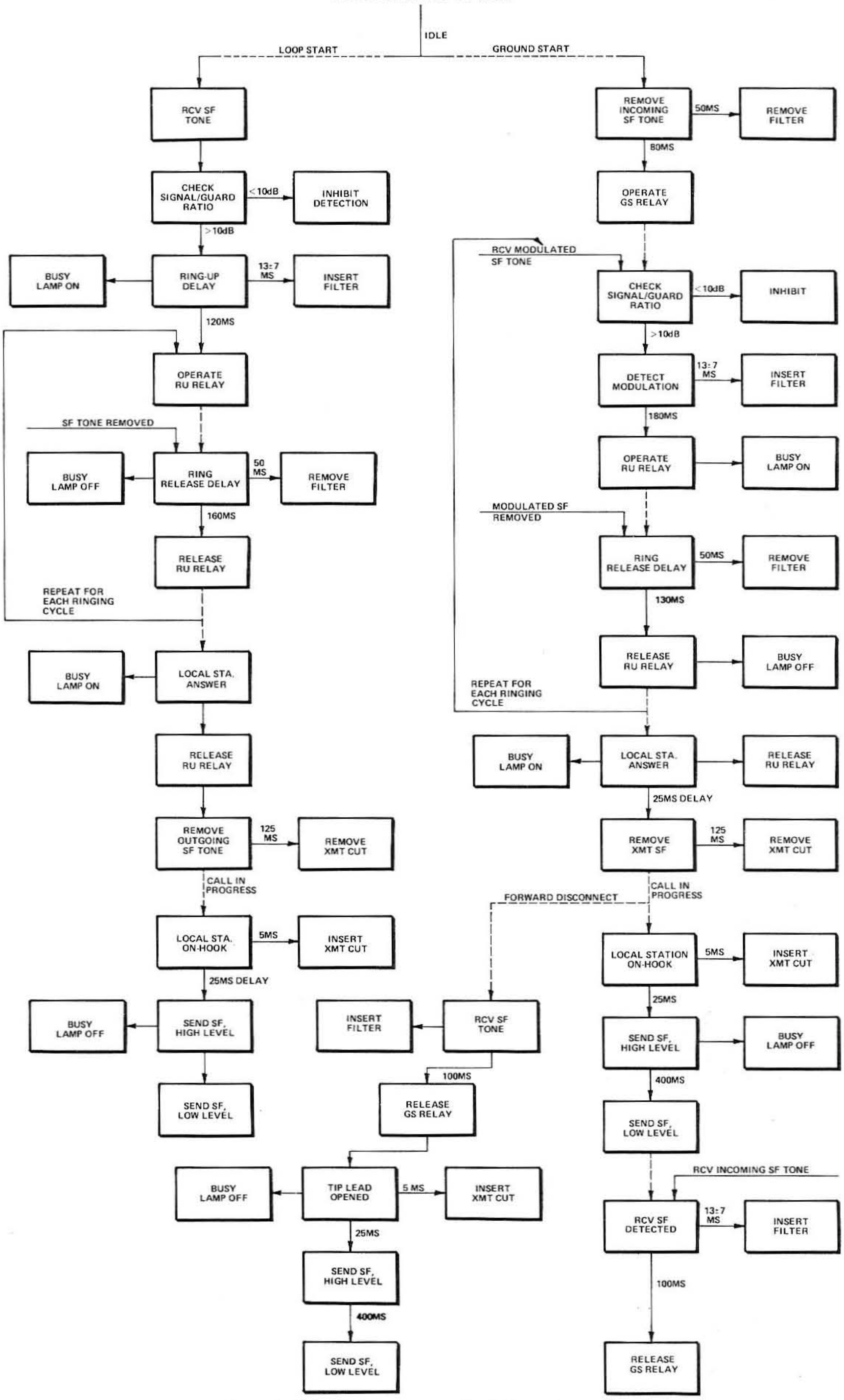

figure 4. Function sequence chart, incoming call

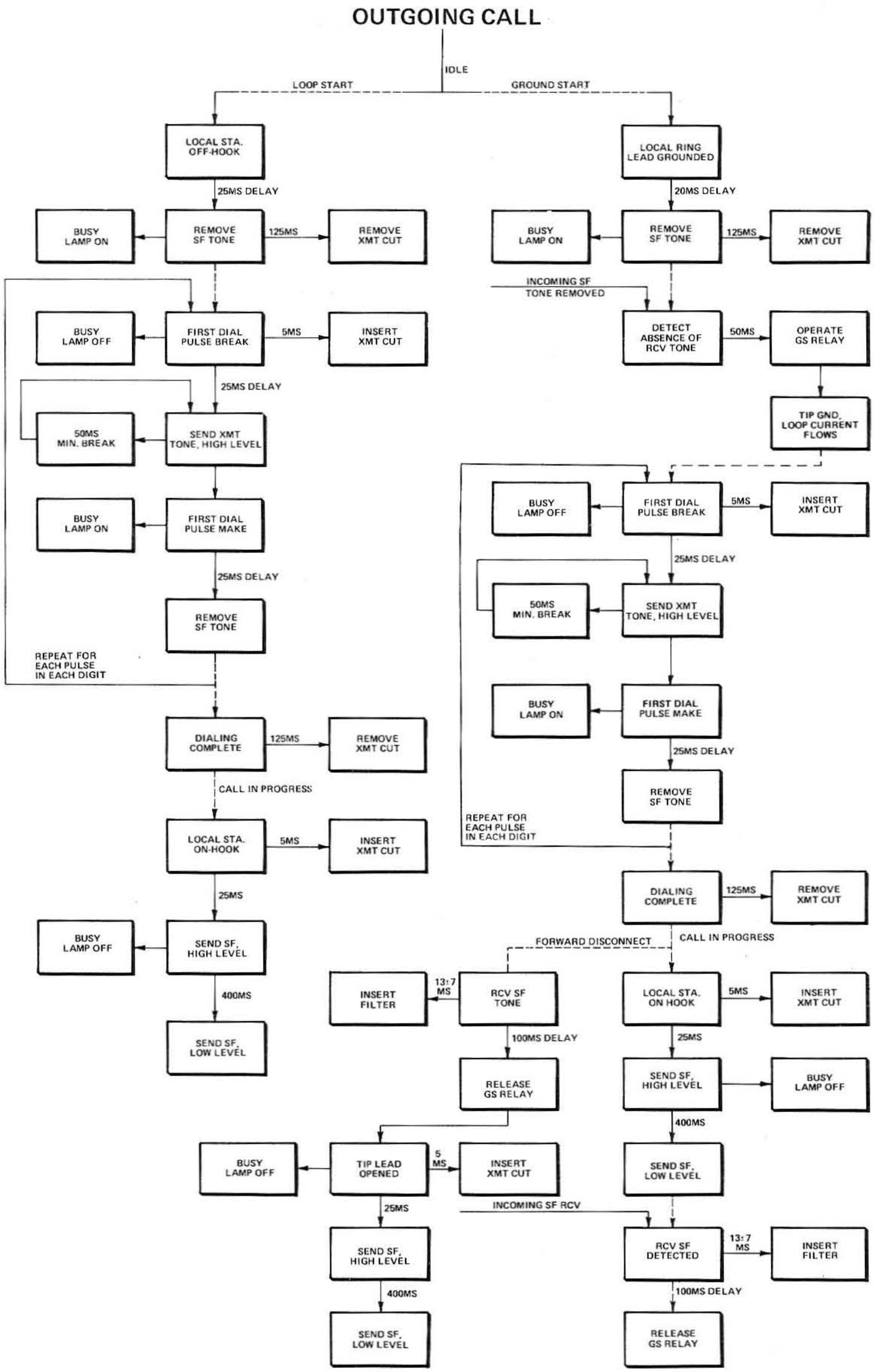

figure 5. Function sequence chart, outgoing call