9961D Signaling Converter DX Subassembly

contents

1. general description

1.01 The Tellabs 9961D Signaling Converter DX subassembly (figure 1) provides extended-range E-and-M-lead (DX) signaling over a 2wire or 4wire metallic transmission facility. The 9961D may be switch-optioned for either DX1 or DX2 operation. When optioned for DX1 operation, either Type I or Type II E-and-M-lead interfacing may be selected.

1.02 The 9961D subassembly is designed expressly for use with the following Tellabs modules: 6461 Common Signaling Module (2W/4W), 6462 4W Common Signaling Module, 6971 Common Interface Module (2W/4W), and 6972 4W Common Interface Module. The 9961D makes electrical and physical connection to these host modules by means of male connectors on the 9961D and receptacles on the host module's printed circuit board. A standoff mounting near the center of the subassembly adds rigidity. *The 6461 (Type 15) and 6971 (Type 16) modules each provide interface between a 4wire transmission facility and a 2wire or 4wire metallic loop or PBX trunk. Both adjustable transmission attenuation and switch-selectable choice of 4wire-to-2wire or 4wire-to-4wire interface are provided. In the 4wire-to-2wire mode, the 6461 and 6971 function as hybrid terminating sets; in the 4wire-to-4wire mode, these modules function as pad/transformers. In 4wire-to-4wire applications, the 6462 (Type 15) and 6972 (Type 16) modules provide functionally equivalent, pin-for-pin compatible, economical alternatives to the 6461 and 6972 modules, respectively. The 6462 module provides all the functions of a 6461 optioned for 4wire operation. Likewise, the 6972 provides all the functions of a 6971 optioned for 4wire operation. In addition, these modules derive 150, 600, or 1200-ohm facility-interface impedance, and each may be equipped with a Tellabs 9961X Signaling Converter subassembly, such as the 9961D described here. When so equipped, the interface module performs the basic E-and-M signaling conversion and extends signaling to the distant terminal via simplex leads derived by the facility interface transformers. These subassemblies are available in several versions to provide various modes of loop-to-E-and-M and E-and-M-to-DX signaling conversion. For complete information on the 6461, 6462, 6971, and 6972 modules, and the other 9961X subassemblies, refer to their respective Tellabs Practices.*

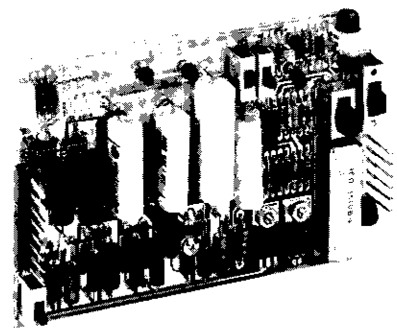


figure 1. 9961D Signaling Converter DX Subassembly

1.03 The 9961D is an electronic DX set designed for end-to-end use with conventional relay-type DX sets as well as with electronic units. Signaling and supervisory range of the 9961D is 5000 ohms of external DX-loop resistance.

1.04 Functions, options, and features of the 9961D include the following: switch-selectable DX1 or DX2 operation, switch-selectable Type I or Type II E-and-M-lead interfacing, selection of balance network capacitance and resistance, choice of simplex-lead (or term set A-and-B-lead) capacitance, and dial-pulse trimming.

1.05 Nominal −48Vdc input power is supplied to the 9961D subassembly via the host module. Current requirement is 60mA nominal plus M-lead current (in DX2 applications).

1.06 As stated above, the 9961D plugs onto the printed circuit board of its host module. The 6461 and 6462 modules each mount in one position of a Tellabs Type 15 Mounting Shelf, which provides mounting for up to 12 modules in either 19-inch or 23-inch relay racks. Each Type 15 shelf occupies 5¼ inches of vertical rack space. The 6971 and 6972 modules each mount in one position of a Tellabs Type 16 Mounting Shelf, which also provides mounting for up to 12 modules in either 19-inch or 23-inch relay racks. Each Type 16 shelf occupies 7 inches of vertical rack space.

2. application

2.01 The 9961D Signaling Converter DX subassembly, when mounted on a host common signaling module, provides E-and-M-to-DX signaling conversion. When used with either the 6462 or 6972 module, the 9961D derives the DX signaling path via simplex leads associated with the 4wire line interface transformers. When used with either the 6461 or 6971 module, the DX path is derived from either the transmit pair or the 2wire A and B leads.

2.02 The 9961D may be switch-optioned for conventional DX1 or DX2 operation. In DX1 operation, the 9961D accepts an M-lead input and derives the appropriate DX current for transmission to the remote location. The 9961D derives the local E-lead state in response to DX current transmitted from the distant location. In DX2 operation, the 9961D accepts an E-lead input for derivation of DX current and derives a local M lead in response to incoming DX current from the distant location.

2.03 When the 9961D is optioned for DX1 operation, either Type I or Type II E-and-M-lead interfacing may be switch selected. In general, Type I interfacing is used with electromechanical switching systems, while Type II interfacing is used in electronic switching environments. Type II E-and-M-lead interfacing permits trunk circuits or signaling units to be directly interconnected without intermediate signaling lead conversion, as is required with conventional Type I E-and-M lead interfacing.

2.04 The 9961D must be resistively balanced against the combined resistance of the signaling loop and the internal resistance of the DX unit at the far end of the DX loop. In 2wire applications, the signaling loop resistance is simply the resistance of the metallic loop between the two DX signaling converters. In 4wire applications, where signaling takes place over the simplex leads of the transmit and receive pairs, signaling loop resistance is equal to one-half of the loop resistance of either pair (i.e., the simplex loop resistance of the transmit and receive pair). The internal resistance of a conventional DX set is 1250 ohms; therefore, the 9961D's resistive balancing network should be set to the signaling loop resistance plus 1250 ± 125 ohms. From 0 to 6750 ohms of resistance may be switched into the balancing network in 250-ohm increments.

2.05 With a maximum of 6μF of capacitance available in the balance network, the 9961D will operate effectively against up to 7μF of facility capacitance. Capacitance values available in the balance network should be matched as closely as possible to the total capacitance of the facility. This capacitance should be selected during installation to ensure that local M-lead (DX1 mode) or E-lead (DX2 mode) transitions do not produce transitions of the local E lead (DX1) or M lead (DX2), respectively. The capacitance of the facility is calculated by summing the cable capacitance (usually 0.083μF/mile) and the capacitance contributed by any transmission devices in the circuit.

2.06 Midpoint capacitance values of 0μF, 2μF or 4μF may be switch-selected. The midpoint capacitor provides capacitance across the midpoint of the signaling leads (A and B leads in 2wire circuits; simplex leads in 4wire circuits). In 2wire circuits, the value may be 0μF, 2μF, or 4μF as required by transmission parameters. If capacitance is contributed across the signaling-lead midpoint by an associated module, e.g., a term set, the 0μF option may be selected to avoid distortion due to excessive capacitance. In 4wire circuits, the midpoint capacitor value is normally set to 0μF. See tables 4, 5, 6, and 7.

2.07 A dial-pulse trimming potentiometer is provided to permit compensation of dial-pulse make/break ratios for optimum performance. The 9961D operates with dial pulsing speeds of between 8 and 14 pulses per second (pps).

2.08 When the 9961D subassembly is used with either the 6462 or the 6972 module, reversal of the simplex leads feeding the 9961D is provided via switch option on the host 6462 or 6972 module. In general, this switch will be optioned for normal operation. The reversal option may be used when a standard wiring scheme is used at both ends of the circuit. The host module at one end is optioned for reverse operation and the host module at the other end is optioned for normal operation.

3. installation

inspection

3.01 The 9961D Signaling Converter DX subassembly 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 and connections

3.02 The 9961D subassembly makes physical and electrical connection to the host 6461, 6462, 6971, or 6972 module via six-pin connector *P1* and eight-pin connector *P2* located on the subassembly. Connector *P1* on the 9961D plugs into receptacle *J1* on the host module, and connector *P2* plugs into receptacle *J2*. The subassembly is further secured to the module's printed circuit board via a standoff mounting. Connections to the subassembly and their corresponding pinouts on the host module are listed in table 1.

9961D connector pin*	designation/ function	externally accessible via host module pin 6971/72	6461/62
P1-1	GND (ground input)	25	1
P1-4	M lead	19	21
P1-5	E lead	21	25
P1-6	−48V (battery)	15	39
P2-5	A lead	51**	7**
P2-6	B lead	49**	9**

*Corresponding receptacles on the host module are designated J1 and J2 respectively.
**Not available on 6462 or 6972

table 1. Connections to 9961D subassembly via host module

options and alignment

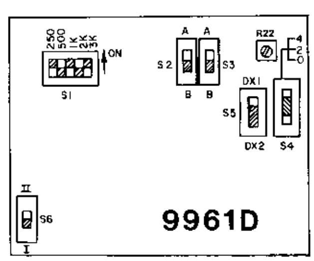


figure 2. Switch locations

3.03 No alignment of the 9961D subassembly is required. Before the subassembly is placed into service, however, six option switches must be set. Locations of these switches on the subassembly are shown in figure 2.

3.04 Switch *S1* is a 5-position DIP switch that selects the resistance value of the balance network.

Resistances of the DX signaling facility and the DX subassembly are calculated (see paragraph 2.04) and matched by the balance network. Resistance of the balance network is determined by adding the resistance values of switch positions *S1-1* through *S1-5* set to the *OFF* position (table 2).

DIP switch	OFF	ON
S1-1	250 ohms	0 ohms
S1-2	500 ohms	0 ohms
S1-3	1000 ohms	0 ohms
S1-4	2000 ohms	0 ohms
S1-5	3000 ohms	0 ohms

table 2. Balance network resistance matching

3.05 Switches *S2* and *S3* select the balance network capacitance. These switches are adjusted at the time of installation to ensure that local M-lead (DX1 mode) or E-lead (DX2 mode) transitions do not produce transitions of the local E lead (DX1) or M lead (DX2). In general, the proper capacitance will equal the amount of capacitance connected across the DX loop, added to the nominal capacitance of the associated cable pair(s). The various settings of switches *S2* and *S3* are summarized in table 3. Tables 4, 5, 6, and 7 approximate the capacitance values required for various facilities.

switch position S2	S3	total capacitance of balance network
A	A	0μF
B	A	2μF
A	B	4μF
B	B	6μF

table 3. Balance network capacitance values

cable length	midpoint capacitance	balance capacitance
0-15 miles	0μF	2μF
15-60 miles	0μF	2μF
60-75 miles	0μF	4μF

table 4. Balance network capacitance matching, 4W circuits

cable gauge	cable length	midpoint** cap.	balance cap.
all gauges	0-30 miles	2μF	2μF
all gauges	30 miles +	2μF	4μF
all gauges	0-30 miles	4μF	4μF
all gauges	30 miles +	4μF	6μF

table 5. Balance ntwk capacitance matching, 2W ckts, no rptrs

cable gauge	cable length	midpoint** cap.	balance cap.
19	0-25 miles	2μF	2μF
19	25 miles +	2μF	4μF
19	0-30 miles	4μF	4μF
19	30 miles +	4μF	6μF
22	0-18 miles	2μF	2μF
22	18 miles +	2μF*	4μF
22	0-20 miles	4μF	4μF
22	20 miles +	4μF	6μF
24	0-12½ miles	2μF	2μF
24	12½ miles +	2μF*	4μF
24	0-14 miles	4μF	4μF
24	14 miles +	4μF	6μF
26	0-9 miles	2μF	2μF
26	9 miles +	2μF*	4μF
26	0-10 miles	4μF	4μF

table 6. Balance ntwk capacitance matching, 2W ckts, w/rptr

cable gauge	cable length	midpoint** cap.	balance cap.
19	0-18 miles	2μF	2μF
19	18 miles +	2μF	4μF
19	0-23 miles	4μF	4μF
19	23 miles +	4μF	6μF
22	0-11 miles	2μF	2μF
22	11 miles +	2μF*	4μF
22	0-13 miles	4μF	4μF
22	13 miles +	4μF	6μF
24	0-5 miles	2μF	2μF
24	5 miles +	2μF*	4μF
24	0-7 miles	4μF	4μF
24	7 miles +	4μF	6μF
26	0-2 miles	2μF	2μF
26	2 miles +	2μF*	4μF
26	0-5 miles	4μF	4μF
26	5 miles +	4μF	6μF

table 7. Balance network capacitance matching, 2wire circuits (with two repeaters)

*May also use 4μF in this application.
**If the midpoint capacitance value listed is provided by associated equipment, set switch S4 to "0μF".

3.06 Switch *S4* selects 0μF, 2μF, or 4μF of midpoint capacitance. Positions *0, 2,* and *4* are indicated on the printed circuit board adjacent to switch *S4* (see paragraph 2.06).

3.07 Switch *S5* selects DX1 or DX2 operation. Positions *DX1* and *DX2* are indicated on the subassembly's printed circuit board.

3.08 Switch *S6* options the 9961D subassembly for either conventional Type I interface or for looped Type II E-and-M-lead interface. Determine the type of switching equipment the 9961D will interface and set switch *S6* to the *I* or *II* position. When the 9961D is optioned for Type II operation, switch *S5* **must** be in the DX1 position. In Type II operation, input signaling (contact closure) is derived via the host module's connector pins designated *M* and *MB/SB.* Output signaling is derived via connector pins *E* and *EG/SG.*

3.09 Dial-pulse trimming potentiometer *R22* provides a nominal degree of dial-pulse make/break ratio compensation for dial pulses transmitted at a rate of 8 to 14pps. Potentiometer *R22* is factory-set and probably will not require adjustment. However, if dial-pulse make/break ratios do not meet circuit specifications, *R22* should be adjusted to provide optimum performance.

Note: *A switch option on both the 6462 and the 6972 host modules permits reverse access to the simplex leads feeding the 9961D (see paragraph 2.08).*

4. circuit description

4.01 This circuit description is intended to familiarize you with the 9961D Signaling Converter DX subassembly for engineering and application purposes only. Attempts to troubleshoot the 9961D internally are not recommended. Troubleshooting procedures should be limited to those prescribed in section 7 of this Practice. Refer to the block diagram, section 5 of this Practice, as an aid in understanding the circuit description.

4.02 The 9961D subassembly is an active DX signaling unit that derives local signaling from currents transmitted over a metallic facility from a distant location. The *DX current sense* circuit is a balanced bridge-type detector which senses differential voltage changes across four 400-ohm resistors that replace the four windings of the DX relay normally used in conventional relay-type DX sets. The differential voltage changes are sensed and directly coupled to a relay driver circuit that includes a *dial pulse adjustment* to compensate for dial-pulse distortion introduced in the transmission facility. A mercury-wetted contact relay is used to derive the local signaling lead output.

4.03 In the transmit signaling direction, a transistorized *M-lead* (DX1) or *E-lead* (DX2) sensor determines the state of the local signaling lead and operates a bipolar *active bidirectional driver* that provides the current changes in the DX loop toward the distant location.

4.04 Input power for the 9961D is conventional −48Vdc, provided by the host module. A metal oxide varistor and clamping diodes are used to eliminate excessive transient voltages and currents that might otherwise harm the associated electronic circuitry.

6. specifications

signaling states (DX1 operation)
input (M lead): on-hook, ground; off-hook, resistance battery
output (E lead): on-hook, open; off-hook, ground

signaling states (DX2 operation)
input (E lead): on-hook, open; off-hook, ground
output (M lead): on-hook, ground; off-hook, resistance battery

signaling states (Type II E and M)
output (E and EG/SG leads): on-hook, open; off-hook, closure
input (M and MB/SB leads); on-hook, open; off-hook, closure

DX loop resistance	*pulsing range*
5000 ohms maximum	**8 to 14pps**

pulsing distortion
±1% via internal adjustment (potentiometer R22)

output capability DX1 (E lead), Type I or II
500mA non-inductive
100mA inductive 60Vdc

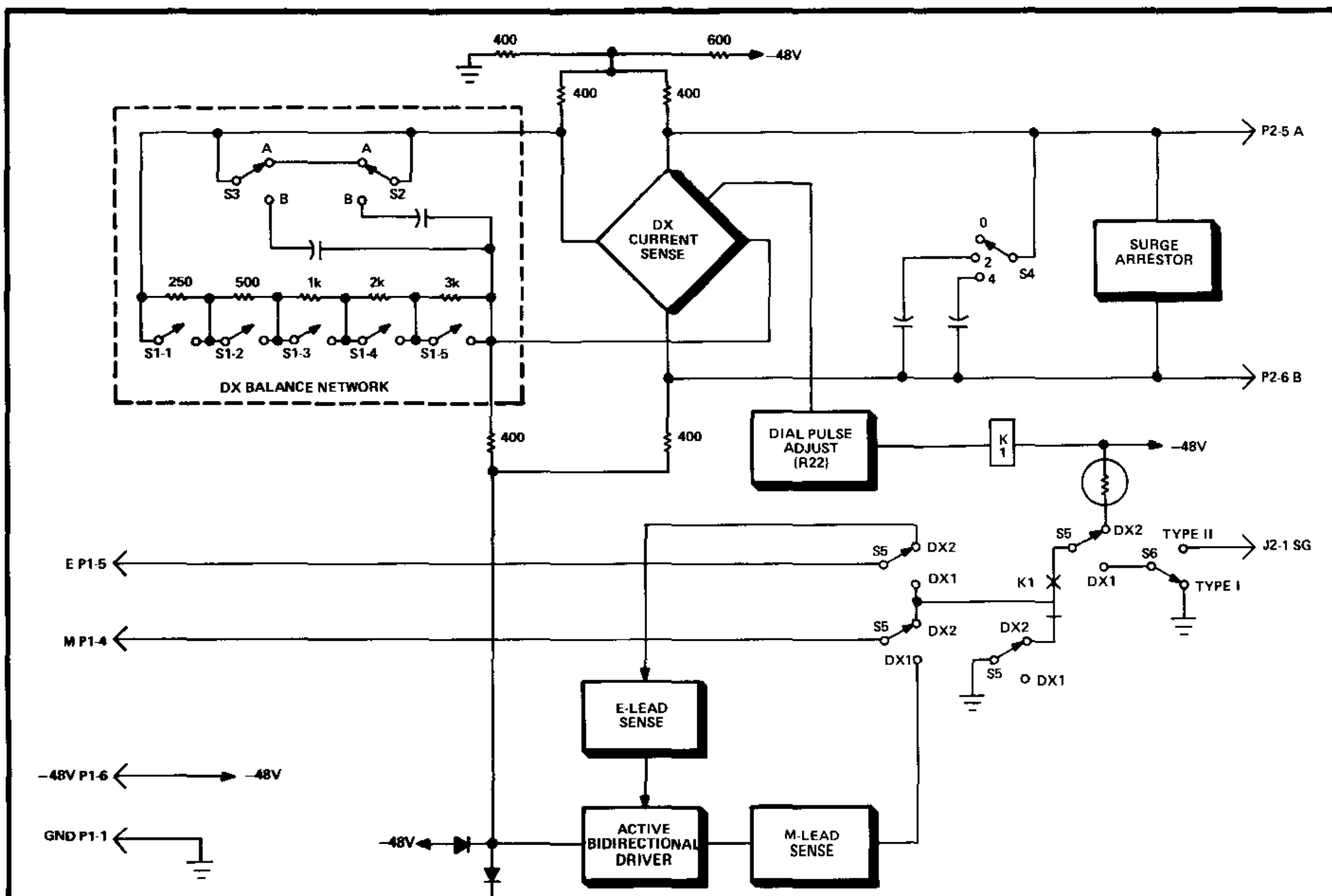
output capability DX2 (M lead)
100mA maximum (resistive battery)

balance network
0 to 6750 ohms in 250-ohm increments; 0, 2, 4 or 6μFd capacitance

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

weight	*dimensions*
5 ounces (142 grams)	**4.1 inches (10.4cm) high** **1.2 inches (3.0cm) wide** **5.1 inches (13.0cm) deep**

mounting
mounts on printed circuit board of the 6461, 6462, 6971, and 6972 modules via two male connectors on 9961D and two receptacles on host module



9961D Signaling Converter DX subassembly 819961D

5. block diagram

7. testing and troubleshooting

7.01 The Testing Guide Checklist may be used to assist in the installation, testing or troubleshooting of the 9961D Signaling Converter DX subassembly. The Testing Guide Checklist is intended as an aid in the localization of trouble to a specific subassembly. If a subassembly is suspected of being defective, a new subassembly should be substituted and the test conducted again. If the substitute subassembly 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 9961D subassembly. Unauthorized testing or repairs may void the 9961D'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 9961D 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 9961D 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 8X9961D part number (from which we can determine the issue of the subassembly in question). Upon notification, we shall ship a replacement 9961D to you. If the warranty period of the defective subassembly has not elapsed, the replacement subassembly will be shipped at no charge. Package the defective 9961D in the replacement subassembly's carton; sign the packing list included with the replacement 9961D and enclose it with the defective subassembly (this is your return authorization); affix the preaddressed label provided with the replacement subassembly to the carton being returned: and ship the equipment prepaid to Tellabs.

repair and return

7.05 Return the defective 9961D subassembly, shipment prepaid, to: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532
Attn: repair and return

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

testing guide checklist

Note 1: *The following test procedures must be performed on a DX signaling converter in actual end-to-end operation with another DX signaling converter over a facility. "Bench" testing of a 9961D will not provide normal conditions as listed.*
Note 2: *While performing the circuit-idle and circuit-busy tests, make sure that the host module's E lead is negatively biased by external equipment; if not, the meter may indicate an open (OV) condition instead of the listed normal condition.*
Note 3: *Test responses assume Type I E-and-M operation.*

test	test procedure	normal conditions	if normal conditions are not met, verify:
circuit idle (DX1 mode)	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's E lead to ground.	More than 44Vdc present ☐.*	Distant-end signaling input ☐. Switch *S5* set to *DX1* ☐. Balance network resistance set correctly ☐. Cable faults ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's M lead to ground.	Less than 1Vdc present ☐.	Switch *S5* set to *DX1* ☐. Input from near-end signaling equipment ☐.
circuit idle (DX2 mode)	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's E lead to ground.	More than 44Vdc present ☐.	Switch *S5* set to *DX2* ☐. Input from near-end signaling equipment ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's M lead to ground.	Less than 1Vdc present ☐. *	Switch *S5* set to *DX2* ☐. Distant-end signaling input ☐. Balance network resistance set correctly ☐. Cable faults ☐.
circuit busy (DX1)	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's E lead to ground.	Less than 1Vdc present ☐. *	Distant-end signaling input ☐. Switch *S5* set to *DX1* ☐. Balance network resistance set correctly ☐. Cable faults ☐.
	Connect VOM (set to 50Vdc to 250Vdc scale) from host module's M lead to ground.	More than 44Vdc present ☐.	Switch *S5* set to *DX1* ☐. Input from near-end signaling equipment ☐.

testing guide continued on page 6

test	test procedure	normal conditions	if normal conditions are not met, verify:
circuit busy (DX2)	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's E lead to ground.	Less than 1Vdc present ☐.	Switch *S5* set to *DX2* ☐. Input from near-end signaling equipment ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from host module's M lead to ground.	More than 44Vdc present ☐. *	Distant-end signaling input ☐. Switch *S5* set to *DX2* ☐. Balance network resistance set correctly ☐. Cable faults ☐.
pulsing (DX1, DX2)	Isolate DX unit at both ends, and connect Pulsing Test Set to E and M leads at each end of circuit. In DX1 mode, send M-lead and receive E-lead. In DX2 mode, send E-lead and receive M-lead.	Distant end sends off-hook (0% break); near-end reads 0% break ☐. Distant end sends on-hook (100% break); near-end reads 100% break ☐. Distant end sends 10pps at 58% break; near-end reads 58% ±4% break while simultaneously sending 10pps ☐; while sending 100% break ☐; and while sending 0% break ☐. Local E lead does not respond to input M-lead transitions (DX1) ☐.	All option switches set correctly ☐. Correct resistance and capacitance values in DX balance network ☐. (Change balance network resistance (switch *S1*) and/or capacitance (switches *S2* and *S3*) to next increment above or below calculated value, and retest ☐.) Power supply voltage between −44 and −52Vdc ☐. Power supply ground ☐. No excessive cable leakage ☐. No excessive longitudinal voltage present on facility (less than 25V rms) ☐.

*The test results shown are only applicable to operation with the host module's reverse/normal switch in the normal (NORM) position. When this switch is set to the REV position, incoming states will be reversed.

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