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practice section 846001/846002
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6001 and 6002 DX1/DX2 Signaling Modules

contents

1. general description

1.01 The Tellabs 6001 and 6002 DX Signaling modules (figure 1) provide extended-range E & M duplex (DX) signaling over 2wire or 4wire metallic transmission facilities. Both modules may be switch-optioned for either DX1 or DX2 operation. In the DX1 mode, either Type I or Type II E & M-lead interfaces may be accommodated. The two modules differ in that the 6002 provides an integral repeat coil while the 6001 does not.

1.02 Terminating impedance options of 600 and 900 ohms on both sides of the 6002's integral repeat coil permit the 6002 to be used on 2wire circuits, while the 6001 is generally used on 4wire circuits. A switch option on the 6002 electrically removes the repeat coil from the circuit, thus conditioning the module for use on 4wire circuits as the equivalent of a 6001. A reverse/normal switch, provided on both modules, permits DX signaling lead reversal on both 2wire and 4wire circuits.

1.03 As stated previously, both modules may be switch-optioned for either the DX1 or DX2 mode of operation. In the DX1 mode, M-lead signals are input to and E-lead signals are output from the module. In the DX2 mode, M-lead signals are output from and E-lead signals are input to the module.

1.04 When either module is arranged for DX1 operation, either Type I or Type II E & 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. Figures 3 and 4 in section 2 of this Practice show Type I and Type II E & M-lead interfacing arrangements, respectively.

1.05 Both the 6001 and 6002 incorporate a resistive and capacitive DX balancing network and A & B-lead midpoint capacitors. The balancing network may be switch-optioned to provide up to 6750 ohms of balancing resistance (in 250-ohm increments) and up to approximately 6μF of capacitive balance (in roughly 2μF increments). The A & B-lead midpoint capacitors associated with the line (DX signaling) side of each module may be switch-optioned for 0, 2, or 4μF of capacitance. On the 6002 only, an additional option switch allows a 2μF drop-side midpoint capacitor to be connected across either the A and B leads or the A and D leads.

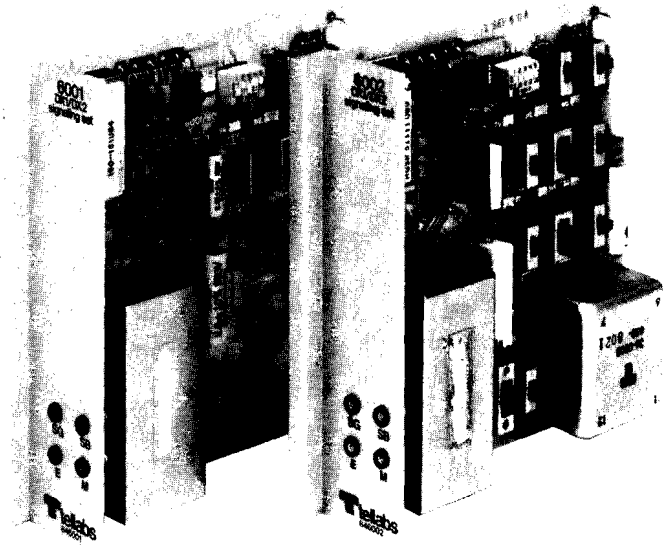


figure 1. 6001 and 6002 DX1/DX2 Signaling Modules

1.06 Front-panel test points on both modules allow test access to the E and M signaling leads and to the SG and SB leads when Type II interfacing is used.

1.07 The 6001 and 6002 each operate on filtered −44 to −52Vdc input. Current requirement for each module is 60mA, not including M-lead current in DX2 applications.

1.08 The 6001 and 6002 DX Signaling modules each mount in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay rack or KTU apparatus case installation. In relay rack applications, up to 12 modules mount across a 19-inch rack, while up to 14 modules may be accommodated across a 23-inch rack. In either case, 6 inches of vertical rack space is used.

2. application

2.01 The 6001 and 6002 DX Signaling modules may be used in any commonly encountered DX signaling application. A DX Signaling unit (6001, 6002 or equivalent) must be used at each end of the metallic facility to which DX signaling is applied. Maximum range between DX Signaling modules is 5000 ohms loop resistance. *DX Signaling units may therefore be used over a longer continuous metallic span than Dial Long Line units.* DX signaling provides two-way E & M signaling and supervision, allowing the use of 6001 and 6002 DX Signaling modules in various applications requiring bidirectional signaling and supervision.

2.02 The 6002 module, with its integral repeat coil, is designed for use on 2wire facilities employing A & B-lead (composite) signaling. The 6001 is generally used on 4wire circuits employing simplex-lead signaling (see figure 2). A switch option on the 6002 module allows the repeat coil to be bypassed, thus conditioning the 6002 as the equivalent of a 6001 and allowing it to be used in 4wire applications. The 6001 can also be used with an external repeat coil in 2wire applications.

2.03 A choice of 600 or 900-ohm terminating impedances may be independently switch-selected on both the facility and drop sides of the 6002's repeat coil interface with the 2wire facility. The 600-ohm option allows the 6002 module to interface nonloaded cable, 600-ohm tie trunks, or carrier, while the 900-ohm option provides a better interface for loaded cable, 900-ohm trunk circuits, or networks switched between loaded and nonloaded cable. The 6001's application in 4wire circuits does not require impedance matching.

2.04 In either module, the DX1 or DX2 mode of operation is selected via switch option. In the DX1 mode, M-lead signals are input to and E-lead signals are output from the module. The DX2 mode inverts this scheme to provide M-lead output and E-lead input. This inverted (DX2) mode is required in tandem applications of DX Signaling units (see paragraph 2.06) or in other situations where an E & M-lead signaling interface (drop side) must be accommodated. (See figure 2, location A and location B). The DX2 mode eliminates the need for a pulse link repeater in these situations.

2.05 When the 6001 or 6002 is optioned for DX1 operation, either Type I or Type II E & M-lead interfacing may be switch-selected (see figures 3 and 4). In general, Type I interfacing is used with electromechanical switching systems while Type II interfacing is used in electronic switching environments. With Type I interfacing, incoming and outgoing signaling consists of the presence of either ground, battery, or an open condition on the E & M leads. With Type II operation, incoming signaling consists of a contact closure between the M lead and the MB/SB (M-lead battery/signal battery) lead, while outgoing signaling consists of a contact closure between the E lead and the EG/SG (E-lead

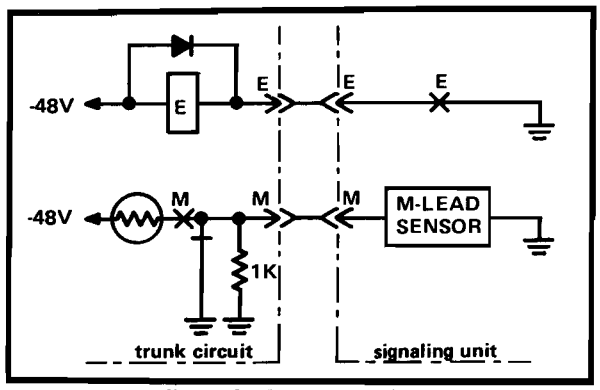


figure 3. Type I interfacing

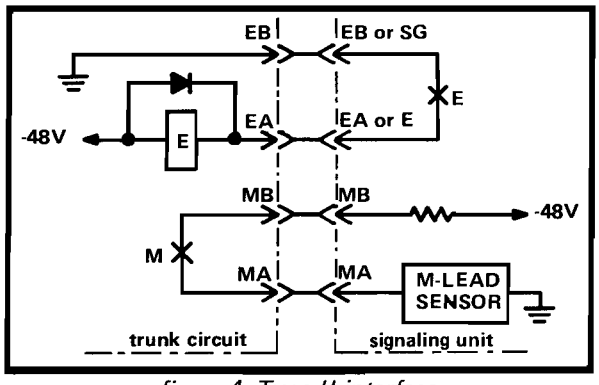


figure 4. Type II interfacing

ground/signal ground) lead. Type II E & M-lead interfacing permits direct interconnection of trunk circuits or signaling units without intermediate signaling lead conversion (which is required with conventional Type I E & M-lead interfacing).

2.06 Tandem operation of DX Signaling modules may be used on loops longer than 5000 ohms. To provide tandem operation (see figure 2), an intermediate point (not exceeding 5000 ohms from the DX signaling module on either side, and where mounting and power are available) is selected, and two DX signaling modules are installed. In Type I interfacing applications, one module must be optioned for DX1 operation and the other optioned for DX2 operation. Because these modules interface each other only through E & M signaling leads, the inverted (DX2) mode must be assumed by one of the two modules. In Type II interfacing applications, both modules are optioned for DX1 opera-

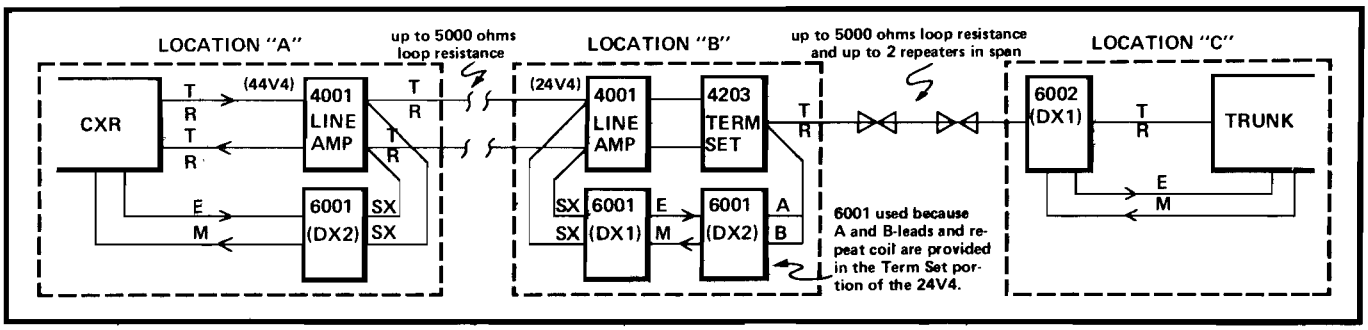


figure 2. Hypothetical circuit employing 6001 and 6002 DX modules in DX1 and DX2 modes

tion. The DX Signaling modules at the ends of the facility may be optioned for either DX1 or DX2, as required, regardless of the DX1/DX2 optioning of modules at the tandem point. The practical limitation on tandem applications is three tandem points, with the limiting factor being dial pulse distortion. Because of the extremely long distances encountered on circuits employing intermediate (tandem) DX operation, transmission requirements usually necessitate that a 4wire repeatered circuit be used.

2.07 In 2wire applications, maximum range may be limited by cable capacitance as well as by resistance. With 19-gauge cable, for example, the capacitive limit (75 miles) is reached before the 5000-ohm resistive limit. If transmission devices are used on this circuit, their contributed capacitance reduces the limit to less than 75 miles.

2.08 With a maximum capacitance of 6μF available in their balance networks, the 6001 and 6002 modules will operate effectively with up to 7μF of facility capacitance. Switched capacitance values available in the balance network of the 6001 or 6002 should be matched as closely as possible to the total capacitance of the facility. The capacitance of the facility is calculated by summing the cable capacitance (usually 0.083μF/mile) and the capacitance contributed by any transmission devices (repeat coils, voice frequency repeaters, etc.) in the circuit.

2.09 A DX signaling unit must be resistively balanced against the resistance of the signaling loop plus the internal resistance of the unit itself. In 2wire applications, signaling loop resistance is simply the resistance of the metallic facility between the DX signaling modules. 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 the DX set itself is 1250 ohms; therefore, the DX set's resistive balance network should be set for the signaling-loop resistance plus 1250 ohms. From 0 to 6750 ohms of resistance may be switched into the balance network in 250-ohm increments.

2.10 Switchable midpoint capacitors on the line (DX signaling) side of the 6001 and 6002 allow either 0, 2, or 4μF of capacitance to be introduced across the midpoint of the DX signaling leads. In 2wire circuits, these are the A and B leads; in 4wire circuits, these are the simplex leads of the transmit and receive pairs. In 2wire circuits, the capacitance value may be 0μF, 2μF, or 4μF, as required by transmission parameters (see tables 5 through 8). In 4wire circuits, the midpoint capacitance value is normally 0μF. If an associated device (e.g., a repeat coil or term set) contributes capacitance across the midpoint of the signaling leads, the 0μF option may be selected to reduce excessive midpoint capacitance, which may cause dial pulse distortion.

2.11 An option switch *(S11)* on the 6002 allows a 2μF midpoint capacitor to be connected across either the A and D leads (for use with PBX's that use D-lead control of the drop side for pad switching or dial pulse distortion improvement or both) or the A and B leads (for use with PBX's that use conventional A & B-lead control).

2.12 A reverse/normal option switch on both the 6001 and the 6002 may be used to reverse the reference and signal assignments applied, respectively, to the B lead (receive pair) and the A lead (transmit pair) of the circuit. This reversal option may be used when a standard wiring scheme (such as that employed in a universally wired Tellabs 261 Signaling and Terminating Assembly) is used at both ends of the circuit. The DX module at one end is optioned for *REV* and the DX module at the other end is optioned for *NORM*. It does not matter at which end of the circuit the reversal takes place.

2.13 In 2wire circuits, the reverse/normal switch provides a convenient means (as opposed to rewiring) of contending with a transmission pair reversal in the circuit.

2.14 The 6001 and 6002 modules are commonly used in Tellabs Type 261 Signaling and Terminating System packages. In these applications, the 6001 or 6002 DX Signaling module is directly interchangeable with an SF Transceiver module, thus allowing field conversion from SF to DX signaling by the exchange of a single module. The 261 System can provide facility-side DX signaling in conjunction with terminal-side E and M, foreign-exchange, or ringdown signaling in either 2wire or 4wire circuits.

3. installation

Caution: *Because the 6001 and 6002 each employ mercury-wetted relays, these modules should always be held in an upright position and* **gently** *tapped on a hard surface before installation. The module should then be kept in an upright position (i.e., with the front handle perpendicular to the ground and nomenclature right side up) until installed. This procedure ensures that the mercury is in the proper location within the relays (not shorting the contacts, etc.).*

inspection

3.01 The 6001 or 6002 DX Signaling 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 DX module should be visually inspected again prior to installation.

mounting

3.02 The 6001 and 6002 each mount in one position of the Tellabs Type 10 Mounting Shelf, which is available in configurations for both relay

rack and apparatus case installation. Each module plugs physically and electrically into a 56-pin connector at the rear of the Type 10 Shelf.

installer connections

3.03 Before making any connections to the mounting shelf, make sure that power is off and modules are **removed**. The 6001 and 6002 modules should be put into place only **after** they are properly optioned and **after** wiring is completed.

3.04 Tables 1 and 2 list external connections to the 6001 and 6002. Use table 1 for installation of all 6001 modules, and for 6002 modules when the 6002's repeat coil is switched out of the circuit. Use table 2 for installation of the 6002 module in 2wire circuits. All connections 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.

connect:	to pin:
T LINE (A lead)	1
R LINE (B lead)	3
E (E lead)	23
M (M lead)	21
SB/MB (signal battery)	33
SG/EG (signal ground)	29
BATT (−44 to −52Vdc battery in)	35
GND (ground in)	17

table 1. External connections, 4wire applications

connect:	to pin:
T LINE (Tip, facility-side)	1
R LINE (Ring, facility-side)	3
T1 (Tip 1, terminal-side)	41
R1 (Ring 1, terminal-side)	47
A1 (A lead, terminal-side)	43
B1 (B lead, terminal-side)	45
D (D lead, terminal-side)	19
E (E lead)	23
M (M lead)	21
SB/MB (signal battery)	33
SG/EG (signal ground)	29
BATT (−44 to −52Vdc in)	35
GND (ground in)	17

table 2. External connections, 2wire applications

option selection

3.05 All options on the 6001 and 6002 modules are selected via slide or DIP switches located as shown in figure 5. Please note that switches *S7, S8, S11,* and *S14* are **not** provided on the 6001 module; all other switches are in the location shown. Switch designations are indicated on the printed circuit board adjacent to each switch.

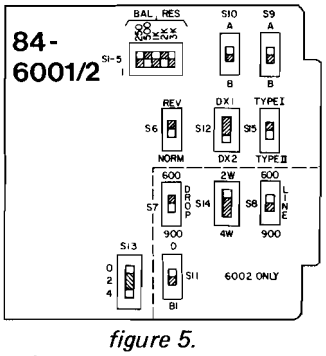


figure 5. Option switch locations

3.06 Switch *S8* (6002 module only) is used to select 600 or 900-ohm terminating impedance on the facility (line) side of the 6002's repeat coil. Set *S8* to the *600* or *900* position, as appropriate.

Switch *S7* (6002 module only) is used to select 600 or 900-ohm terminating impedance on the module's terminating (drop) side. Set *S7* to the *600* or *900* position, as appropriate.

3.07 Switch *S14* (6002 module only) is used to include or exclude the integral repeat coil from the 6002's circuitry. In all 4wire applications or in 2wire applications where an external repeat coil is provided, set *S14* to the *4W* position to exclude the repeat coil. In normal 2wire applications, set *S14* to the *2W* position to include the repeat coil.

3.08 Switch *S11* (6002 module only) is used to select conventional A & B-lead operation or A & D-lead operation. Set *S11* to the *B1* position for A & B-lead operation or to the *D* position for A & D-lead operation.

3.09 Switch *S12* (6001 and 6002 modules) is used to select DX1 or DX2 operation. Set *S12* to either the *DX1* or *DX2* position as appropriate.

3.10 Switch *S15* (6001 and 6002 modules) is used to select either Type I or Type II E and M-lead interfacing. Set *S15* to either the *TYPE 1* or *TYPE II* position, as appropriate.

Note: *To operate in the Type II mode, the 6001 or 6002 module* **must** *be optioned for* **DX1** *operation via switch S12.*

3.11 Switch *S6* (6001 and 6002 modules) is used to select reverse or normal operation of the facility-side DX signaling leads. Set *S6* to the *NORM* position for normal DX-lead operation or to the *REV* position for reversed DX-lead operation.

3.12 Switch *S13* (6001 and 6002 modules) is used to select 0μF, 2μF or 4μF A & B-lead midpoint capacitance. See paragraph 2.10 for an explanation of these settings and refer to tables 5 through 8.

3.13 Switches *S1* through *S5* (6001 and 6002 modules), provided in a five-position DIP switch, are used to set the resistance value of the DX balance network. Determine the required amount of balancing resistance by adding 1250 ohms to the signaling loop resistance as described in paragraph 2.09. Then set switches *S1* through *S5* to match this amount as closely as possible. Switch positions are cumulative; total resistance introduced is the sum of those positions set to *OFF* (open), as indicated in table 3. From 0 ohms (all positions *ON*) to 6750 ohms (all positions *OFF*) may be provided in 250-ohm increments.

dip switch positions	OFF	ON
S1	250 ohms	0 ohms
S2	500 ohms	0 ohms
S3	1000 ohms	0 ohms
S4	2000 ohms	0 ohms
S5	3000 ohms	0 ohms

table 3. Balance network resistance values

3.14 Switches *S10* and *S9* (6001 and 6002 modules) are used to select the capacitance values of the DX balance network. Each switch has two positions, labeled *A* and *B*. Combinations of these positions allow selection of either 1.3, 2, 4, or 6μF of

balancing capacitance, as indicated in table 4. Midpoint and balance-network capacitance values for various facilities are listed in tables 5 through 8.

switch S10	switch S9	total capacitance of balance network
B	A	1.3μF
B	B	2μF
A	A	4μF
A	B	6μF

table 4. 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 5. Balance network capacitance matching, 4W circuits

cable gauge	cable length	midpoint* capacitance	balance capacitance
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 6. Balance network capacitance matching, 2wire circuits (no repeaters)

cable gauge	cable length	midpoint* capacitance	balance capacitance
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 7. Balance network capacitance matching, 2wire circuits (with one repeater)

cable gauge	cable length	midpoint* capacitance	balance capacitance
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 8. Balance network capacitance matching, 2wire circuits (with two repeaters)

*If the midpoint capacitance value listed is provided by associated equipment, set the midpoint capacitance (switch S13) for 0μF.

**Use of 4μF rather than 2μF midpoint capacitance is recommended.

4. circuit description

4.01 This circuit description is intended to familiarize you with the 6001 and 6002 DX Signaling modules for engineering and application purposes only. Attempts to troubleshoot the 6001 and 6002 internally are not recommended. Procedures for recommended testing and troubleshooting in the field are limited to those prescribed in section 7 of this Practice. Please refer to the 6001/6002 functional schematic, section 5, as an aid in understanding this circuit description.

4.02 Both ends of a DX signaling system are balanced symmetrical circuits connected by two metallic conductors. These may be the conductors used for voice transmission, conductors separate from those of the transmission path, or derived metallic simplex conductors. One conductor in the DX signaling system carries supervisory and pulsing signals, using combinations of local ground and battery. Differences in ground or battery potentials between each end of the DX signaling system create nonsupervisory currents in the signaling conductor. The second conductor in the DX system acts as a reference for these differences in end office potentials. The DX signaling unit is arranged so that the unbalance created in the second conductor is equal to and opposite that created in the first conductor. The current in the second conductor cancels the effect of these unwanted potential differences in the first conductor, thus providing compensation for ground potential and battery supply variations. Additionally, the circuit is balanced against longitudinal ac line voltages and currents.

4.03 The signaling portion of the 6001 and 6002 DX Signaling modules consists of a polar bistable relay (K1), an input pulsing relay (K2), and a resistive and capacitive DX balance network. While the input leads at both ends of the DX circuit are idle, current flows through windings 2 and 3 of relay K1 and the balance network, causing the K1 relay to maintain its contacts.

4.04 A seizure of the near-end DX unit via its M lead (DX1) or E lead (DX2) operates relay K2, reversing the direction of current through windings 2 and 3. If the DX unit is properly balanced, however, relay K1 does not change state as a result of the current flow through winding 4. Operation of K1 in response to a local input signaling state change is an indication of improper balance network adjustment.

4.05 Seizure of the far-end DX unit changes the state of relay K1. With the far-end unit off-hook, the current flow through winding 1 is greater than the current flow through windings 2 and 3, causing the K1 relay to change state.

4.06 Winding 4 provides a current reference for counteracting any end-to-end ground or battery potential differences.

4.07 A repeat coil is provided in the 6002 module to accommodate 2wire transmission. This repeat coil may be switched out of the circuit when it is not required.

6. specifications

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

signaling states (DX1 operation, Type II)
input (M, SB leads): contact closure
output (E, SG leads): contact closure

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

loop resistance
5000 ohms maximum

pulsing range
8 to 14pps

pulsing distortion
5% maximum, 0-ohm loops, at 10pps and 58% break
4% maximum, 200 to 5000-ohm loops, at 10pps and 58% break

input power
−44 to −52Vdc, 60mA nominal (does not include M-lead current in DX2 applications)

output capability DX1 (E lead)
500mA non-inductive
100mA inductive 60Vdc

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

repeat coil (6002 only)
impedance: 600 or 900 ohms, switchable, either port
insertion loss: 0.4 ±0.1dB at 1000Hz
frequency response: ±0.5dB, re 1000Hz level, 300 to 4000Hz
current capacity: max. 100mA total unbalanced current
envelope delay distortion: less than 100μs, 500 to 4000Hz

balance network
0 to 6750 ohms in 250-ohm increments; 1.3, 2, 4, or 6μF capacitance

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

weight	*dimensions*
6001: 11 ounces (0.30kg)	**5.58 inches (14.17cm) high**
6002: 19 ounces (0.53kg)	**1.42 inches (3.61cm) wide**
	5.96 inches (15.14cm) deep

mounting
relay rack or apparatus case via one position Tellabs Type 10 Mounting Shelf

7. testing and troubleshooting

7.01 The Testing Guide Checklist may be used to assist in the installation, testing or troubleshooting of the 6001 and 6002 DX1/DX2 Signaling modules. 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 6001 or 6002 modules. 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 6001 or 6002 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

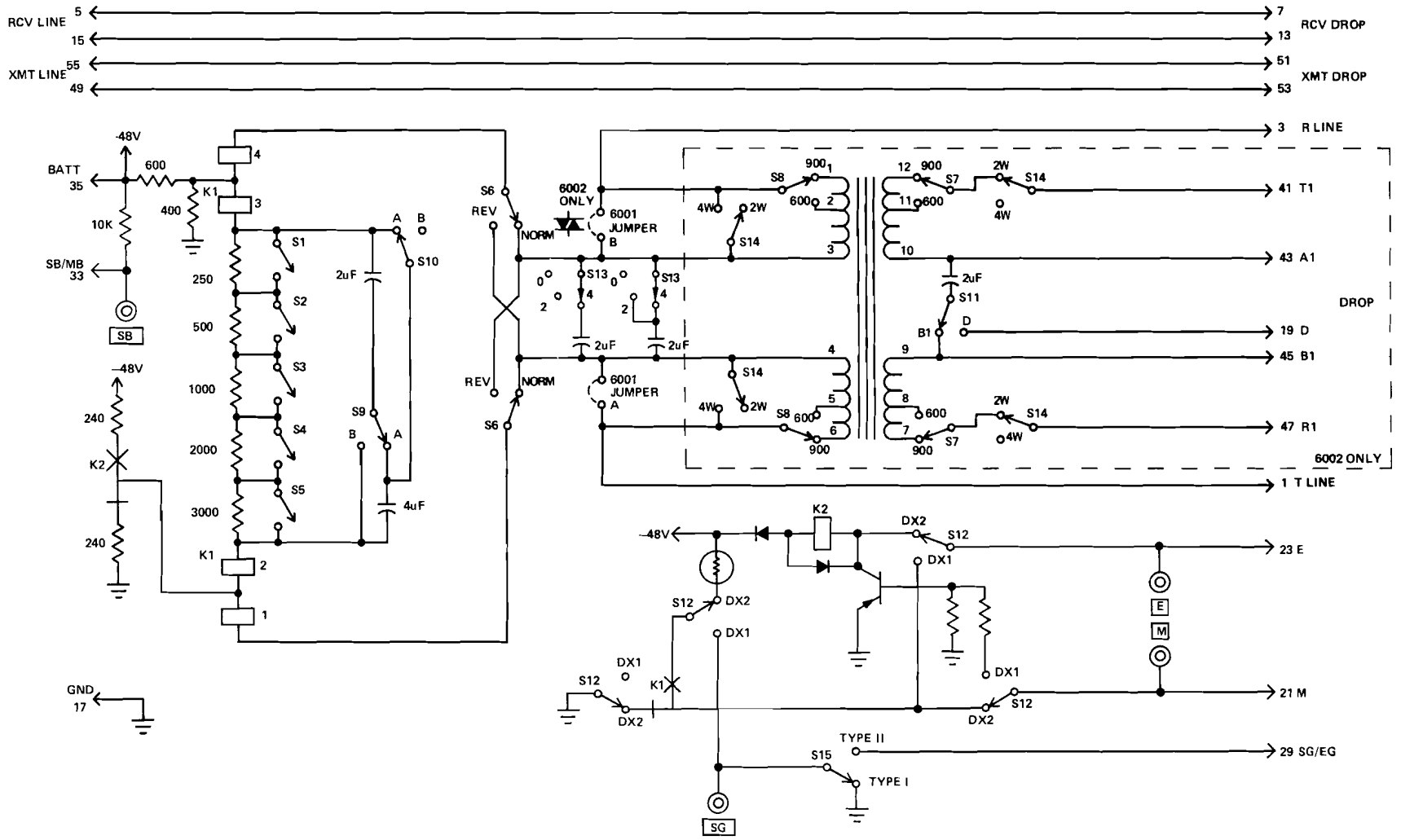
7.04 If a defective 6001 or 6002 is encountered, notify Tellabs via telephone [(312) 969-8800], letter [see below], or twx [910-695-3530]. Notification should include all relevant information, including the 8X600X part number (from which we can determine the issue of the module in question). Upon notification, we shall ship a replacement module 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 module in the replacement module's carton; sign the packing list included with the replacement module 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 6001 or 6002 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 appears on page 8



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5. functional schematic

Note: *Due to the variety of signaling potentials that may be encountered in Type II E & M-lead interfaces, the following Testing Guide Checklist assumes a Type I interface. In Type II applications, the E and EG and the M and SB test points on the module's front panel may be used to monitor the E and M-lead states, respectively. Normal idle and busy conditions on these leads must be determined from the specifications of the equipment being interfaced.*

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 E-lead test point to ground.	More than 44Vdc present ☐.	Power ☐. Wiring ☐. Switch *S12* set to DX1 ☐. Distant-end signaling input idle ☐. Reverse/normal switch *S6* set correctly ☐. Balance network resistance set correctly ☐. Wiring to near-end signaling equipment ☐. Cable faults ☐. Replace and retest ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from M-lead to ground.	Less than 1Vdc present ☐.	Switch *S12* set to DX1 ☐. Wiring ☐. Input from near-end signaling equipment idle ☐. Replace and retest ☐.
circuit idle (DX2 mode)	Connect VOM (set to 50Vdc or 250Vdc scale) from E-lead test point to ground.	More than 44Vdc present ☐.	Power ☐. Wiring ☐. Switch *S12* set to DX2 ☐. Input from near-end signaling equipment idle ☐. Replace and retest ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from M-lead test point to ground.	Less than 1Vdc present ☐.	Switch *S12* set to DX2 ☐. Wiring ☐. Distant-end signaling input idle ☐. Reverse/normal switch *S6* set correctly ☐. Balance network resistance set correctly ☐. Wiring to near-end signaling equipment ☐. Cable faults ☐. Replace and retest ☐.
circuit busy (DX1)	Connect VOM (set to 50Vdc or 250Vdc scale) from E-lead test point to ground.	Less than 1Vdc present ☐.	Switch *S12* set to DX1 ☐. Switch *S15* set to Type I ☐. Distant-end signaling input busy ☐. Reverse/normal switch *S6* set correctly ☐. Balance network resistance set correctly ☐. Wiring to near end signaling equipment ☐. Cable faults ☐. Replace and retest ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from M-lead test point to ground.	More than 44Vdc present ☐.	Power ☐. Wiring ☐. Switch *S12* set to DX1 ☐. Input from near-end signaling equipment busy ☐. Replace and retest ☐.
circuit busy (DX2)	Connect VOM (set to 50Vdc or 250Vdc scale) from E-lead test point to ground.	Less than 1Vdc present ☐.	Power ☐. Wiring ☐. Switch *S12* set to DX2 ☐. Distant-end signaling input busy ☐. Replace and retest ☐.
	Connect VOM (set to 50Vdc or 250Vdc scale) from M-lead test point to ground.	More than 44Vdc present ☐.	Reverse/normal switch *S6* set correctly ☐. Balance network resistance set correctly ☐. Cable faults ☐. Replace and retest ☐.
pulsing (DX1, DX2)	Isolate DX circuit at both ends, and connect Pulsing Test Set to E and M leads at each end of circuit. In DX1 mode, send via M lead and receive via E lead. In DX2 mode, send via E lead and receive via 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 ☐.	All option switches set correctly ☐. Correct resistance and capacitance values in DX balance network ☐. [Change balance network resistance and/or capacitance to next increment above or below, and retest ☐.] Power supply voltage between −44 and −52Vdc ☐. Power supply grounding ☐. No excessive cable leakage ☐. No excessive longitudinal voltage present on facility (less than 25Vrms) ☐.

***Note:** *If trouble is encountered upon initial installation of a 6001 or 6002, ensure that proper installation precautions are taken as directed in the* **Caution** *notice on page 3 before taking further corrective action.*