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rev C

practice section 826042
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6042 4W-2W DX-E&M Network Terminating Module

contents

1. general description

1.01 The 6042 4W-2W DX-E&M Network Terminating Module (figure 1) provides signaling conversion and transmission interface between a 4wire metallic facility and a 2wire PBX tie trunk. Along with active level control (gain or loss) in the transmit and receive channels and active slope equalization in the receive channel, the 6042 provides duplex (DX) signaling (which is extended-range E&M signaling) over simplex leads derived from the 4wire facility, conversion between the DX signaling and terminal-side E&M signaling, and extension of the E&M signaling toward the 2wire termination. Conversion from 4wire to 2wire operation is provided via an integral toll-grade hybrid terminating set. The 6042 offers switch-selectable DX1 or DX2 operation with a choice of either Type I, Type II, or Type III E&M interface. As a member of Tellabs' 262U Universal Network Terminating System of modules and enclosures, the 6042 fulfills Registered Facility Interface Codes TL11E, TL11M, TL12E, and TL12M for applications where the serving telephone company uses facility-side DX signaling.

1.02 This practice section covers the Issue 2 version of the 6042 module (Tellabs part number **826042**). The Issue 2 module differs from its Issue 1 counterpart in that DX2 operation is provided via switch option, the transmit and receive gain and the receive equalization ranges are revised, and power requirements are reduced through use of low-power DX-signaling circuitry. The practice is revised to provide current regional office telephone numbers in section 7.

1.03 The 6042's transmit and receive amplifiers each provide from −16 to +16dB of continuously adjustable gain. Maximum output level of each channel is +12dBm, with no more than 1% distortion.

1.04 Active slope equalization is available in the module's receive channel to compensate for the frequency response characteristics of loaded or nonloaded cable. The module's equalizer can be continuously adjusted from essentially flat (±0.5dB, 300 to 4000Hz, re 1000Hz) to 7.5dB (at 2804Hz, re 1000Hz) via a front-panel control.

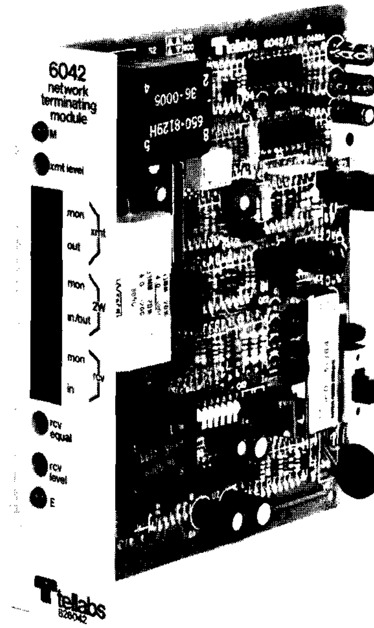


figure 1. 6042 Network Terminating Module

1.05 Impedance-matching transformers facing the 4wire facility can be independently switch-optioned for balanced 1200-, 600-, or 150-ohm terminating impedances. These transformers are center-tapped to derive simplex leads required for DX signaling; a switch option permits normal or reversed operation of these leads. Balanced, switch-selectable 600 or 900-ohm impedance (in series with 2.15μF) is provided at the 2wire terminal-side port.

1.06 The 6042 contains a low-power electronic DX set designed for end-to-end use with conventional relay-type DX sets or other electronic units. Signaling range of the 6042 is 5000 ohms of external loop resistance.

1.07 The 6042 can be switch-optioned for DX1 or DX2 operation. With DX1 operation, M-lead signals are input to and E-lead signals are output from the module. With DX2, E-lead signals are input to and M-lead signals are output from the module. Either Type I, II, or III E&M lead interfacing (see figures 4 through 6 in section 2 of this Practice) can also be switch selected. Please note that while the Type I and II interfaces can be used with either DX1 or DX2 operation, the Type III interface can **only** be used with DX1.

1.08 The 6042 incorporates a resistive and capacitive DX balance network. This network can be switch optioned to provide up to 6750 ohms of balancing resistance (in 250-ohm increments) and up to approximately 7μF of capacitance balance

(4μF of fixed capacitance, plus an additional 3μF in switch-selectable 1μF increments).

1.09 The front panel of the 6042 is designed so that all level and equalization adjustments can be made while the module is mounted in place. Continuously adjustable level and equalization controls are complemented by a complete set of bantam-type test jacks. Both bridging and opening jacks are provided at all three ports (4wire transmit output, 4wire receive input, and 2wire). Front-panel LED's light to indicate seizure in either direction, i.e., to indicate local E-lead and M-lead status.

1.10 A dial-pulse trimming control compensates receive dial-pulse make-break ratios for optimum performance. The 6042 accommodates dial pulsing speeds from 8 to 14 pulses per second (pps).

1.11 The 6042 operates on filtered, ground-referenced −44 to −56Vdc input. At idle, maximum current requirement is 40mA (during DX1 operation) or 45mA (during DX2 operation); busy-state maximum current requirement is 80mA.

1.12 A Type 10 module, the 6042 mounts in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay-rack or apparatus-case installation. In relay rack applications, up to 12 modules can be mounted across a 19-inch rack, while up to 14 modules can be mounted across a 23-inch rack. In either case, 6 inches of vertical rack space is used.

1.13 As a member of Tellabs' 262U Universal Network Terminating System of modules and enclosures, the 6042 can also be mounted in any of Tellabs' prewired 262U Mounting Assemblies, versions of which are available for both relay-rack and apparatus-case installation. For more detailed information, refer to Tellabs' brochure describing the 262U Universal Network Terminating System and to the Tellabs practices describing the 6041 and the 6044 Network Terminating Modules.

2. application

2.01 The 6042 Network Terminating Module provides transmission interface and signaling conversion between a 4wire metallic facility using DX signaling and a 2wire PBX tie trunk using E&M signaling (see figures 2 and 3). This single module combines the functions of a 4wire line amp, a DX-to-E&M signaling converter, and a terminating set. In applications where the serving telephone company uses DX signaling, the 6042 fulfills Registered Facility Interface Codes TL11E, TL11M, TL12E, and TL12M.

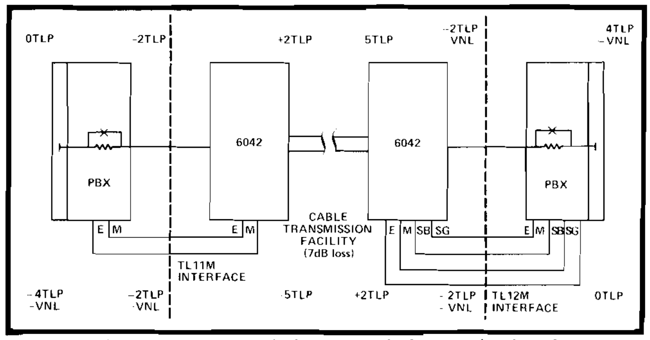


figure 2. Typical short-haul tie-trunk circuit using 6042 modules.

2.02 Gain or loss in the transmit and receive channels of the 6042 is continuously adjustable from −16 to +16dB via front-panel controls. Maximum output level of each channel is +12dBm, with no more than 1% distortion.

2.03 Up to 7.5dB of slope equalization at 2804Hz (re 1000Hz) is available in the receive channel of the 6042 to compensate for the frequency-response characteristics of loaded or nonloaded cable. Because the transmit channel is generally used to coordinate levels rather than to reduce facility loss, no transmit equalization capability is provided.

2.04 Balanced, terminating-impedance options of 1200, 600, and 150 ohms at both 4wire facility-side ports (transmit output and receive input) allow the 6042 to interface loaded cable (1200 ohms) or nonloaded cable (600 or 150 ohms) at these ports. *The 150-ohm option presents a deliberate impedance mismatch that yields a small amount of slope equalization for nonloaded cable.* Balanced, terminating-impedance options of 600 and 900 ohms (in series with 2.15μF) at the module's 2wire port allow the 6042 to interface nonloaded cable (600 ohms) or loaded cable (900 ohms) on the 2wire terminal side.

2.05 The impedance-matching transformers at the 6042's facility-side ports are center-tapped to derive simplex leads required for DX signaling. A reverse/normal option switch can be used to reverse the reference and signal assignments applied, respectively, to the B lead (receive pair) and the A lead (transmit pair). This reversal option is used in tandem applications of DX sets. The DX module at

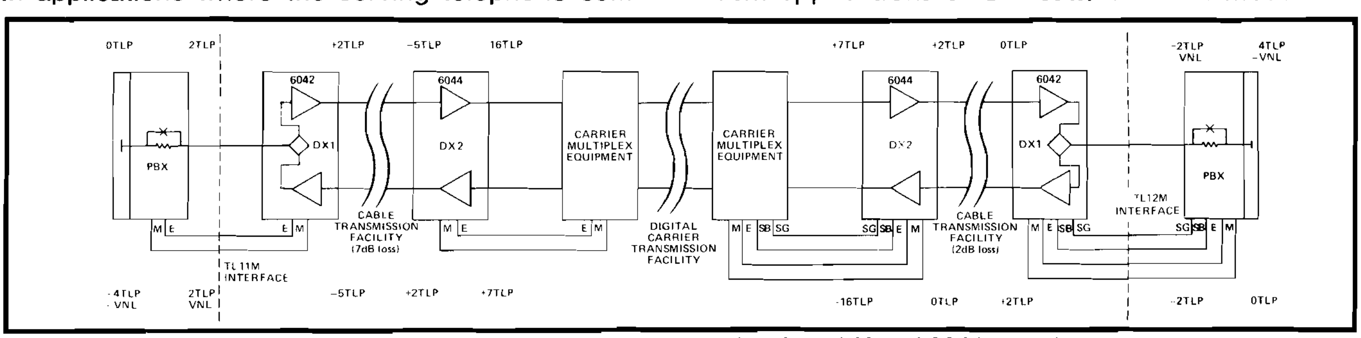


figure 3. Typical long-haul tie-trunk circuit using 6042 and 6044 modules.

one end of the circuit 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.

2.06 As stated above, the electronic DX set in the 6042 is designed to operate in either the DX1 mode (where M-lead signals are input to and E-lead signals are output from the module) or in the DX2 mode (where E-lead signals are input to and M-lead signals are output from the module). The DX2 mode is generally used in tandem applications of DX sets, in applications where the 6042 interfaces carrier or other signaling sets, or in other situations where a terminal-side E&M-lead interface must be accommodated. Both the DX1 and DX2 modes eliminate the need for a pulse-link repeater in applications where the module interfaces a carrier channel or in tandem DX-set applications. Either Type I, II, or III E&M lead interfacing can be switch-selected (see figures 4 through 6). The Type I and II interfaces can be used with either DX1 or DX2 signaling, while the Type III interface can **only** be used with DX1 signaling. In general, Type 1 interfacing is used with electromechanical switching systems while Type II and Type III interfacing are used in electronic switching environments.

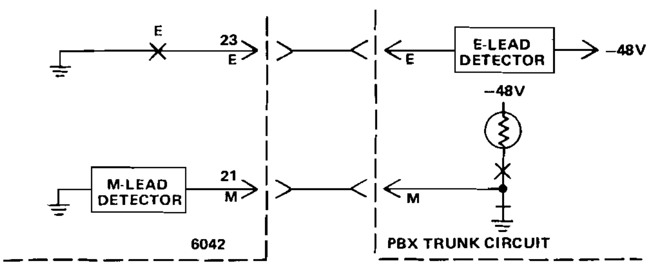


figure 4. DX1/Type I E&M interface

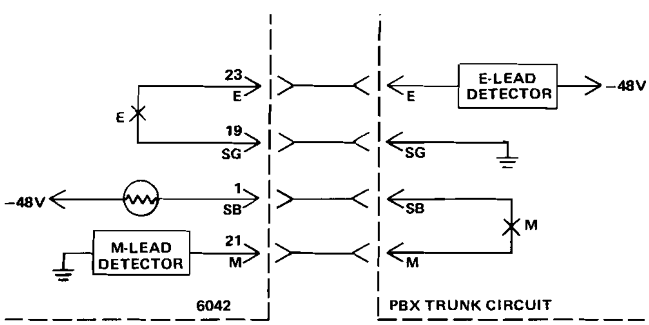


figure 5. DX1/Type II E&M interface

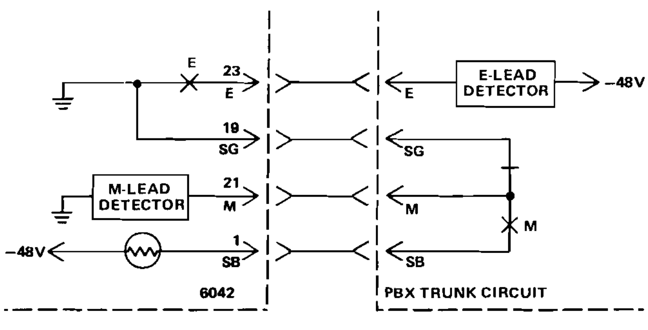


figure 6. DX1/Type III E&M interface

2.07 With Type I interfacing, incoming and outgoing signaling each consist of the presence of either ground, battery, or an open condition on the E and 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 ground/signal-ground) lead. The Type III interface is a compromise: a partially looped format, essentially identical to the Type I interface with the exception that battery and ground for M-lead signaling are supplied via the SB and SG leads, respectively. Type II E&M-lead interfacing permits direct interconnection of trunk circuits or signaling units without intermediate signaling-lead conversion (which is required with Type I and Type III E&M-lead interfacing).

2.08 The 6042 uses relay contacts to derive E-lead and M-lead signaling, thereby facilitating interfacing with nonstandard E-lead and M-lead voltage levels and polarities. When used to derive a Type II interface, terminal-side equipment can use any convenient voltage or polarity.

2.09 As with loop-signaling equipment, current requirements for DX sets depend upon loop length. In addition, these requirements depend upon the differences of voltage and ground between DX sets. A DX set draws its maximum current when it is busy and the distant-end DX set is idle. Under these conditions, the 6042 draws 70mA (80mA maximum) on a 0-ohm loop. As loop length increases current requirements drop. On a 1000-ohm loop, the 6042 draws 55mA (65mA maximum); on a 5000-ohm loop, current requirement is 35mA (50mA maximum).

2.10 In general, a DX unit must be resistively balanced against the resistance of the signaling loop plus 1250 ohms. This is **not** the case with the 6042, however, because this module incorporates 1250 ohms of internal balance-network resistance. Therefore, *the 6042 must be resistively balanced against the resistance of the signaling loop alone.* In DX 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). From 0 to 6750 ohms of resistance can be switched into the 6042's balance network in 250-ohm increments.

2.11 The 6042 provides up to 7μF of balance-network capacitance. Switched capacitance values in the balance network should be matched as closely as possible to the total capacitance of the facility to ensure that local M-lead transitions do not cause transitions of the local E-lead. In general, the required amount of capacitance is equal to the amount of capacitance connected across the DX loop plus the nominal capacitance of the associated cable pair. The 6042 contains a fixed 4μF capacitor in its balance network. An additional 3μF of capacitance can be switched into the balance network in 1μF increments. In most cases, however, this additional switched capacitance is not required in 4wire DX applications.

3. installation

Caution: *Because the 6042 contains a mercury-wetted relay, the module should always be held in an upright position and tapped gently 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 relay (not shorting the contacts, etc.).*

inspection

3.01 The 6042 Network Terminating module should be visually inspected upon arrival in order to find possible damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

mounting

3.02 The 6042 module mounts in one position of the Tellabs Type 10 Mounting Shelf or in one position of a 262U Universal Network Terminating System Assembly, both of which are available in configurations for relay-rack and apparatus-case installation. The module plugs physically and electrically into a 56-pin connector at the rear of its Shelf or Assembly mounting position.

3.03 In applications where a 6042 module is to be installed in a 262U Universal Network Terminating System Assembly no external connections need be made. This is because all of the Assembly's internal connections are factory-prewired and because external wiring is simplified through use of female 25-pair micro-ribbon connector-ended cables arranged in accordance with Universal Service Order Code (USOC) RJ2HX. If the customer's terminal equipment has been cabled in accordance with USOC RJ2HX, direct cable connection to the 262U System Assembly and the customer's equipment is possible. If not, cross-connections between the 262U Assembly and the local terminal equipment must be made at an intermediate connectorized terminal block.

installer connections

3.04 When a 6042 module is to be installed in a conventional Type 10 Shelf, external connections to the module must be made. Before making any connections to the shelf, make sure that power is off and modules are removed. Modules should be put into place only after they are properly optioned and after wiring is completed.

3.05 Table 1 lists external connections to the 6042 module. All connections are made via wire wrapping to the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector.

connect:	to pin:
XMT TIP OUT (facility side)	41
XMT RING OUT (facility side)	47
XMT SIMPLEX OUT (facility side)	45
RCV TIP IN (facility side)	7
RCV RING IN (facility side)	13
RCV SIMPLEX IN (facility side)	11
2W TIP IN (terminal side)	55
2W RING OUT (terminal side)	49
E (E lead)	23
M (M lead)	21
SG (signal ground lead)	19
SB (signal battery lead)	1
−BATT (−44 to −56Vdc, filtered)	35
*GND (ground in)	17

*In Type I E&M interfacing arrangements, the 6042 and the terminal (drop)-side equipment must share a common power-supply ground connection.

table 1. External connections to 6042

option selection

3.06 Eight option switches must be set before the 6042 can be placed into service. The location of each switch on the module's printed circuit board is shown in figure 7. Switch designations are indicated adjacent to each switch.

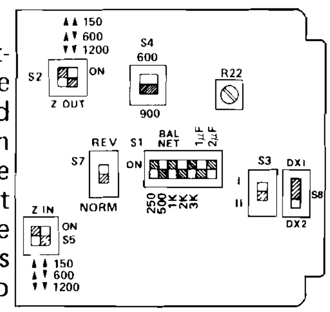


figure 7. 6042 option switch locations

3.07 Switch *S1* is a seven-position DIP switch that is used to select the resistance value of the DX balance network (positions *S1-1* through *S1-5*) and the balance network capacitance (positions *S1-6* and *S1-7*). Determine the required amount of loop resistance (see paragraph 2.10) and set positions *S1-1* through *S1-5* to match this amount as closely as possible. Switch positions are cumulative; total resistance introduced is the sum of those switch positions set toward the resistance values indicated adjacent to *S1* (i.e, set to *OFF*), as indicated in table 2. From 0 ohms (*S1-1* through *S1-5 ON*) to 6750 ohms (*S1-1* through *S1-5 OFF*) may be introduced in 250-ohm increments.

DIP switch *S1* positions	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 values

3.08 Switch positions *S1-6* and *S1-7* are used to select up to 3μF of balance network capacitance over and above the fixed 4μF of capacitance provided by the module. These switch positions are set at the time of installation to ensure that local M-lead transitions do not cause transitions of the local E-lead. In general, the proper capacitance is equal to the sum of the capacitance connected across the DX loop plus the nominal capacitance of the cable pair. Switch positions are cumulative; total capacitance introduced is the sum of those positions set set toward the capacitance values indicated adjacent to *S1* (i.e., set to *ON*), as indicated in table 3.

DIP switch *S1* positions		switched capacitance of balance network*
S1-6	*S1-7*	
OFF	OFF	0μF
ON	OFF	1μF
OFF	ON	2μF
ON	ON	3μF

*Total capacitance equals switched capacitance plus 4μF

table 3. Balance network capacitance values

3.09 Switch *S2* (labelled *Z OUT*) is used to select 1200, 600, or 150-ohm terminating impedance at the module's 4wire facility-side transmit output port, while switch *S5* (labelled *Z IN*) is used to select 1200, 600, or 150-ohm terminating impedance at the module's 4wire facility-side receive input port. The various settings of *S2* and *S5* are indicated on the module's printed circuit board and summarized in table 4.

xmt out impedance	*S2-1*	*S2-2*
rcv in impedance	*S5-1*	*S5-2*
1200 ohms	off	off
600 ohms	on	off
150 ohms	on	on

table 4. Facility-side impedance-matching options

3.10 Switch *S3* is used to select Type I, Type II or Type III E&M-lead interfacing. Determine the type of terminal equipment that the module interfaces and set *S3* to either *I* (Type I or Type III) or *II* (Type II), as appropriate.

Note: *If Type III operation is required, ensure that switch* S8 *is set to* DX1.

3.11 Switch *S4* is used to select either 600 or 900-ohm terminating impedance (in series with 2.15μF) at the 6042's 2wire (terminal-side) port. Set *S4* to either *600* or *900*, as appropriate.

3.12 Switch *S7* is used to select reversed or normal operation of the facility-side DX signaling leads. Set *S7* to the *NORM* position for normal DX-lead operation or to the *REV* position for reversed DX-lead operation.

3.13 Switch *S8* is used to select either DX1 or DX2 operation. Set *S8* to the *DX1* position for DX1 operation or to the *DX2* position for DX2 operation.

3.14 Dial-pulse-trimming potentiometer *R22* provides a nominal degree of dial-pulse make-break ratio compensation (±5%) 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.

alignment

Note: *A condensed alignment procedure, figures 8 and 9, is included to simplify alignment of the 6042.*

3.15 **Receive Level Adjustment.** After all option switches are set and verified, turn all front-panel controls fully counterclockwise. Adjust the receive-channel level for the desired gain (or loss) as follows:

A. Connect the transmit portion of a transmission measuring set (TMS), arranged for 1004Hz output at the level and impedance specified on the circuit layout record (CLR), to the *rcv in* jack.

B. Connect the receive portion of the TMS, arranged for terminated measurement at the 2wire impedance selected on the 6042, to the *2wire in/out* jack.

C. Turn the *rcv level* control clockwise until the receive portion of the TMS indicates the required level.

D. Make a frequency run, measuring and recording levels at appropriate intervals. If the measured levels meet the conditioning requirements of the circuit, equalization is not required and no further receive-channel adjustments are necessary. If equalization is required, proceed to paragraph 3.16.

3.16 **Receive Equalization Adjustment.** If the equalization is required, the following procedure should be performed (end-to-end measurements must be made to correctly adjust the equalizer):

A. Disconnect the transmit portion of the TMS from the *rcv in* jack while leaving the receive portion of the TMS connected to the *2wire in/out* jack.

B. Request that personnel at the distant (4wire receive-channel) end send 300, 1004, and 3000Hz tones at the level and impedance specified on the CLR. Measure and record the level of each tone.

C. Turn the *rcv equal* control clockwise until the 3000Hz level is equal to the 300Hz level.

D. Have 300, 1004, and 3000Hz tones sent again. Measure and record the level of each tone.

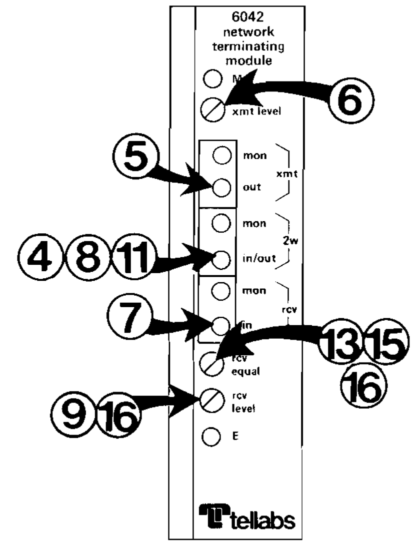
E. Turn the *rcv equal* control clockwise until the 3000Hz level is equal to the 300Hz level measured in step D.

F. Repeat steps D through E until the measured frequency response satisfies the conditioning requirements of the circuit.

G. Have the distant (4wire receive-channel) end send 1004Hz tone at the CLR-specified level and impedance. Readjust the *rcv level* control for the specified level.

3.17 **Transmit Level Adjustment.** Adjust the transmit-channel level as follows:

A. Connect the transmit portion of the TMS, arranged to output 1004Hz tone at the 2wire



This condensed alignment procedure is included to simplify alignment of the 6042 module. Detailed alignment instructions are provided in paragraphs 3.15 through 3.17.

To prepare for alignment:

1 Set all option switches for your particular application. See paragraphs 3.07 through 3.14 for optioning information.

2 Tap the module gently and plug it into a prepared mounting. Hold the 6042 upright and gently tap the module in the palm of your hand to ensure that the mercury is properly seated within the 6042's mercury-wetted relay.

3 Turn all front-panel controls fully counterclockwise.

Align the transmit channel.

4 Connect the transmit portion of a TMS, arranged for 1004Hz output at the 2wire impedance selected on the 6042 and the level specified on the CLR, to the *2wire in/out* jack.

5 Connect the receive portion of the TMS, arranged for terminated measurement at the impedance specified on the CLR, to the *xmt out* jack.

6 Turn the front-panel *xmt level* control clockwise until the receive portion of the TMS indicates the required level.

Align the receive channel.

7 Connect the transmit portion of a TMS, arranged for 1004Hz output at the impedance and level specified on the CLR, to the *rcv in* jack.

8 Connect the receive portion of the TMS, arranged for measurement at the impedance specified on the 6042, to the *2wire in/out* jack.

9 Turn the front-panel *rcv level* control clockwise until the receive portion of the TMS indicates the required level.

Perform receive-channel frequency response and equalize if necessary.

10 Make a frequency run, measuring and recording levels at 300, 1004, and 3000Hz. If the measured levels meet the conditioning requirements of the circuit, equalization is not required. If not, perform the equalization procedure described in the following steps.

11 With the transmit portion of the TMS disconnected, connect the receive portion of the TMS, arranged for terminated measurement at the 2wire impedance selected on the 6042, to the *2wire in/out* jack.

12 Request that personnel at the distant (receive channel) end of the circuit send 300, 1004, and 3000Hz tones at the level and impedance specified on the CLR. Measure and record the level of each tone.

13 Turn the *rcv equal* control clockwise until the 3000Hz level is equal to the 300Hz level measured in step 12.

14 Have 300, 1004, and 3000Hz tones sent again. Measure and record the level of each tone.

15 Turn the *rcv equal* control clockwise until the 3000Hz level is equal to the 300Hz level measured in step 14. Repeat steps 14 and 15 until the measured frequency response satisfies the conditioning requirements of the circuit.

16 Have the distant (receive channel) end send 1004Hz tone at the CLR-specified level and impedance. Readjust the *rcv level* control for the required level.

figure 8. Transmit and receive channel alignment

impedance selected on the 6042 and at the level specified on the CLR, to the *2wire in/out* jack.

B. Connect the receive portion of the TMS, arranged for terminated measurement at the impedance specified on the CLR, to the *xmt out* jack.

C. Turn the *xmt level* control clockwise until the receive portion of the TMS indicates the required level.

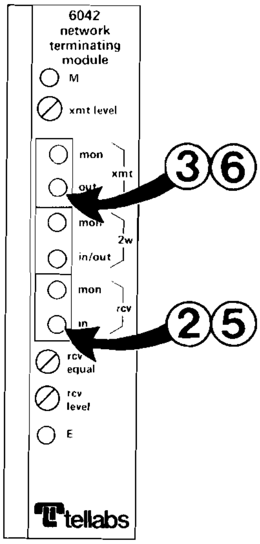
3.18 **Signaling-Lead and Reference-Lead Voltage Check.** To ensure that dc potentials on the DX-signaling and reference leads are correct for both on-hook and off-hook states, proceed as follows:

A. **On-Hook.** With the E and M leads from the trunk circuit disconnected, connect a pulsing test set arranged to send an **on-hook** to either the 6042's M lead (for DX1 operation) or E lead (for DX2 operation). Verify that the *M* LED (DX1) or the *E* LED (DX2) is not lit. Connect a test cord to the module's *rcv in* jack and use a VOM to measure the voltage at the plug (either tip or ring). Acceptable voltages are summarized in table *5*. Disconnect the test cord from the *rcv in* jack, connect it to the *xmt out* jack, and measure the voltage at the plug. Again, see table *5* for acceptable voltages.

on-hook	xmt out	rcv in
S7 set to *NORM* *S7* set to *REV*	−19Vdc −1Vdc	−1Vdc −19Vdc
off-hook	**xmt out**	**rcv in**
S7 set to *NORM* *S7* set to *REV*	−20Vdc −47Vdc	−47Vdc −20Vdc

table 5. Signaling and reference lead voltages

B. **Off-Hook.** With the E and M leads from the trunk circuit disconnected, connect a pulsing



Check signaling-lead reference-lead voltages on-hook.

1 With the E and M leads from the trunk circuit disconnected, connect a pulsing test set, arranged to send an on-hook, to the 6042's M lead (DX1) or E lead (DX2). Verify that the *M* LED (DX1) or *E* LED (DX2) is not lit.

2 Connect a test cord to the *rcv in* jack and measure the voltage at the plug (either tip or ring). The measured voltage should be approximately −1Vdc (*S7* set to *NORM*) or −19 Vdc (*S7* set to *REV*).

3 Connect the test cord to the *xmt out* jack and measure the voltage at the plug. The measured voltage should be approximately −19Vdc (*S7* set to *NORM*) or −1Vdc (*S7* set to *REV*).

Check signaling-lead and reference-lead voltages off-hook.

4 With the E and M leads from the trunk circuit disconnected, connect a pulsing test, arranged to send an off-hook, to the M lead (DX1) or E lead (DX2). Verify that the *M* LED (DX1) or *E* LED (DX2) is lit.

5 Connect a test cord to the *rcv in* jack and measure the voltage at the plug (either tip or ring). The measured voltage should be approximately −47Vdc (*S7* set to *NORM*) or −20Vdc (*S7* set to *REV*).

6 Connect the test cord to the *xmt out* jack and measure the voltage at the plug. The measured voltage should be approximately −20Vdc (*S7* set to *NORM*) or −47Vdc (*S7* set to *REV*).

Perform an end-to-end alignment and signaling check.

After local alignment of the 6042 is completed, end-to-end measurements should be made to verify overall operation of the circuit in which the 6042 is used. These checks should include verification of transmit and receive channel transmission levels, receive channel frequency response, and pulsing speed and per cent break.

figure 9. Signaling-lead and reference-lead voltage check

test set arranged to send an **off-hook** to either the 6042's M lead (for DX1 operation) or E lead (for DX2 operation). Verify that the *M* LED (DX1) or the *E* LED (DX2) is lit. Connect a test cord to the module's *rcv in* jack and use a VOM to measure the voltage at the plug (either tip or ring). See table *5* for acceptable voltages. Disconnect the test cord from the *rcv in* jack, connect it to the *xmt out* jack, and measure the voltage at the plug. Again, see table *5* for acceptable voltages.

4. circuit description

4.01 This circuit description is intended to familiarize you with the 6042 Network Terminating Module for application and engineering purposes only. Attempts to troubleshoot the 6042 internally are not recommended and may void your warranty. Procedures for recommended testing and troubleshooting in the field are limited to those prescribed in section 7 of this Practice. Please refer to the 6042 block diagram, section 5 of this Practice, as an aid in following this circuit description.

4wire receive section

4.02 The 4wire receive section of the 6042 uses an input transformer to interface the tip and ring leads of the 4wire facility and to derive the receive input simplex lead. A switch option provides for normal or reverse operation of the simplex lead. A secondary of the transformer is connected to the receive channel's flat *gain amplifier* and to the input impedance circuit, which consists of three resistors. Switch selection of one, two, or all three resistors provides the 1200, 600, or 150-ohm receive input impedance.

4.03 Diodes limit the *gain amplifier's* input voltage to external power potentials and provide lightning protection for the amplifier. Following the *gain amplifier* is a *slope equalizer* section that provides up to 7.5dB of equalization at 2804Hz (re 1000Hz). The receive channel *power amplifier* follows the *slope equalizer*. The gain of the *power amp* is controlled by the *gain amp* to provide the −16 to +16dB gain range in the receive channel. The output of the *power amp* is connected to the *electronic hybrid* and then to the 2wire port.

4wire transmit section

4.04 The transmit section of the 6042 uses an output transformer to interface the tip and ring leads of the 4wire facility and to derive the transmit output simplex lead. A switch option provides for normal or reverse operation of the simplex lead. A secondary of the transformer is connected to the transmit channel's *gain amplifier* and to the output impedance circuit, which consists of three resistors. Switch selection of one, two, or all three resistors provides the 1200, 600, or 150-ohm transmit output impedance.

4.05 Diodes limit the *gain amplifier's* input voltage to external power potentials and provide lightning protection for the amplifier. The transmit channel's *power amplifier* follows the *gain amplifier*. The gain of the *power amplifier* is controlled by the *gain amp* to provide the −16 to +16dB gain range in the transmit channel. The remaining transmit circuitry connects the *power amp's* output to the output of the *electronic hybrid*.

2wire section

4.06 A cancelling-type *electronic hybrid* with switch-selectable input impedance (600 or 900 ohms in series with 2.15μF) interfaces the 2wire side. Connected to the *electronic hybrid* are conventional transmit, receive, and balance-network leads. The balance network consists of the 600 or 900 ohm (in series with 2.15μF capacitance) impedance termination and the network build-out capacitors.

DX signaling section

4.07 Both ends of a DX signaling system are balanced symmetrical circuits connected by two metallic conductors. In the case of the 6042, these conductors are 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.

4.08 The 6042 uses an active DX signaling unit that derives local signaling from currents transmitted over derived metallic simplex conductors. The *DX current sense* circuit is a balanced bridge-type detector that 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 E-lead output (in the DX1 mode) or the local M-lead output (in the DX2 mode). In the DX1 mode, the output relay is operated during busy and not operated during idle. In the DX2 mode, these states are reversed. Resistor-capacitor contact protection is provided for both the relay's normally open and normally closed contacts.

4.09 In the transmit signaling path, an *M-lead opto-coupler* (DX1) or *E-lead opto-coupler* (DX2) determines the state of the local M-lead (DX1) or E-lead (DX2) and operates an active bidirectional driver that provides the current changes in the DX loop toward the distant location.

4.10 The *power supply* in the 6042 module is a series-regulated bipolar supply that uses a zener diode as a reference source. A series diode in the negative input lead protects the circuit against reversed input power connections.

6. specifications

input/output impedance
4wire facility side: 1200, 600, or 150 ohms, balanced, switch selectable
2wire terminal side: 600 or 900 ohms (in series with 2.15μF), balanced, switch selectable

gain range (transmit and receive)
−16 to +16dB, continuously adjustable via front-panel controls

frequency response (no equalization)
±0.5dB, 300 to 4000Hz, re 1000Hz
±0.25dB, 500 to 3000Hz, re 1000Hz

equalization (receive channel only)
0 to +7.5dB at 2804Hz re 1000Hz, continuously adjustable via front-panel control

maximum output level
+12dBm

harmonic distortion
1% maximum at +12dBm output level

2wire return loss
35dB ERL maximum

transhybrid loss
44dB minimum with 2wire port terminated in either 600 or 900 ohms in series with 2.15μF, calibrated from 2wire short or open

delay distortion
150μs maximum, 500 to 3000Hz, re 1800Hz, no equalization

noise
16dBrnC maximum at maximum gain adjustment

longitudinal balance
60dB maximum, 200 to 4000Hz

adjacent-module crosstalk
80dB minimum, 200 to 4000Hz

DX loop resistance
5000 ohms maximum

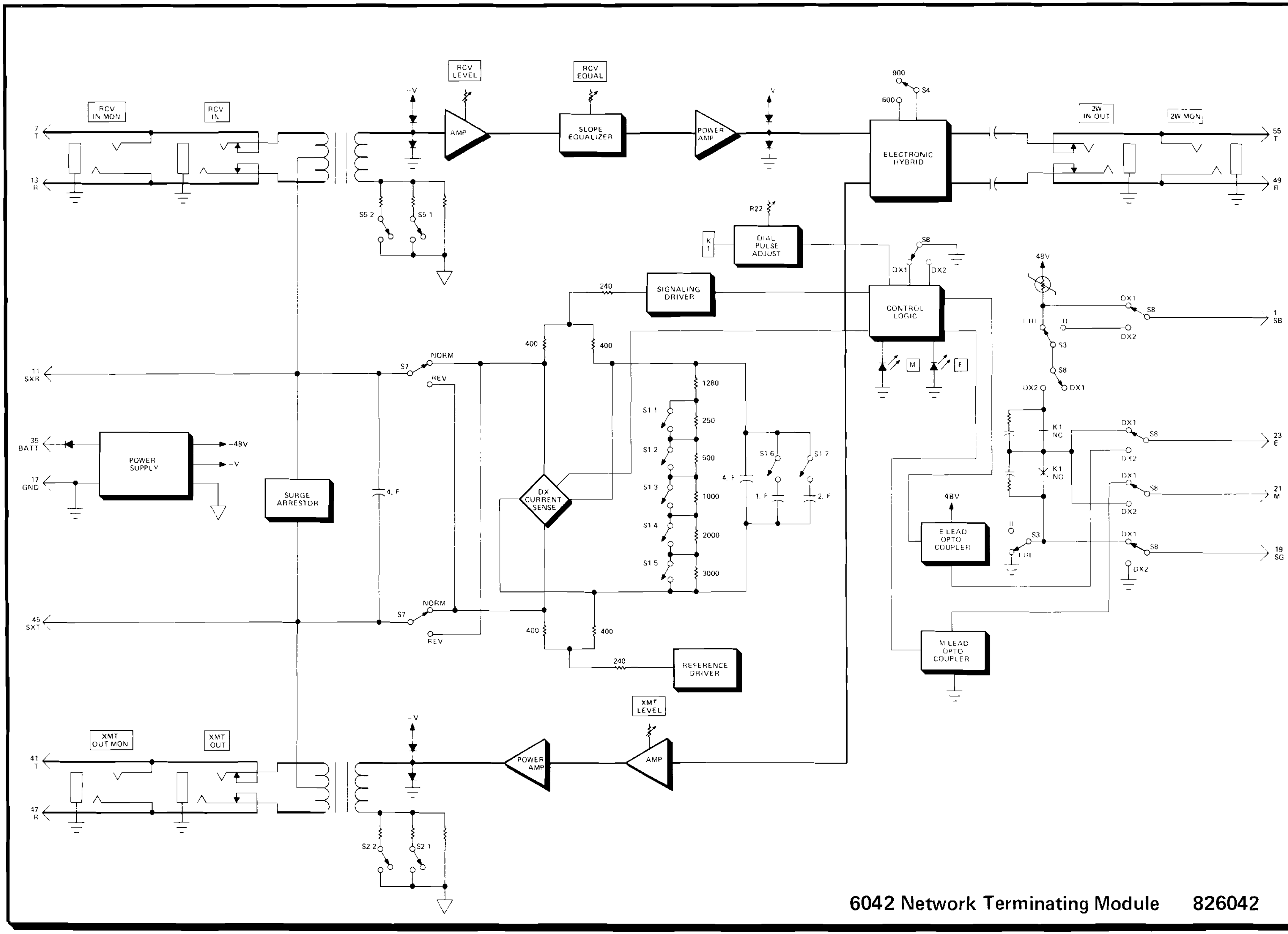
pulsing range
8 to 14pps

pulsing distortion
±3% without adjustment
±1% via internal adjustment (potentiometer *R22*)

balance network
resistance: 0 to 6750 ohms in switch-selectable 250-ohm increments
capacitance: 7μF total (4μF of fixed capacitance plus an additional 3μF in switch-selectable 1μF-increments)

midpoint capacitance
4μF, fixed

E&M signaling
DX1 mode:
- **E-lead current rating**
  - **500mA maximum (resistor-capacitor contact protection provided)**
- **E-lead resistance**
  - **less than 0.5 ohms**



6042 Network Terminating Module 826042

5. block diagram

M-lead sensitivity
−20Vdc minimum threshold
5000 ohms maximum external M-lead resistance from −48Vdc

DX2 mode:
M-lead current rating
500mA maximum (resistor-capacitor contact protection provided)
M-lead current from battery (Type I interface only)
100mA with less than 5-volt drop, current limiting above 200mA
E-lead sensitivity
5000 ohms maximum external E-lead resistance to ground

power requirement
−44 to −56Vdc, filtered, ground referenced

current requirements (0-ohm loop)

	at −48Vdc, typical	at −53Vdc, maximum
idle (DX1)	35mA	40mA
idle (DX2*)	40mA	45mA
busy (0dBm output level*)	70mA	80mA

*add M-lead current in DX2 mode

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

dimensions
5.58 inches (14.17cm) high
1.42 inches (3.61cm) wide
5.96 inches (15.14cm) deep

weight
10 ounces (280 grams)

mounting
relay rack or apparatus case via one position of Tellabs Type 10 Mounting Shelf, or one position of a 262U Universal Network Terminating System Assembly

7. testing and troubleshooting

7.01 The *testing guide checklist* in this section may be used to assist in the installation, testing or troubleshooting of the 6042 4W-2W DX-E&M Network Terminating Module. The 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 one 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 as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6042 module. Unauthorized testing or repairs may void the module's warranty. Also, if the module is part of a registered system, unauthorized repairs will result in noncompliance with Part 68 of the FCC Rules and Regulations.

Note: *Warranty service does not include removal of permanent customer markings on the front panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked* **defective,** *we recommend that it be done on a piece of tape or on a removable stick-on label.*

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

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

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

International customers: Contact your Tellabs distributor.

US atlantic region: (203) 798-0506
US capital region: (703) 478-0468
US central region: (312) 357-7400
US southeast region: (305) 834-8311
US southwest region: (214) 869-4114
US western region: (714) 850-1300
Canada: (416) 624-0052

7.03 If a 6042 is diagnosed as defective, follow the *replacement* procedure in paragraph 7.04 when a critical service outage exists (e.g., when a system or a critical circuit is down and no spares are available). If the situation is not critical, follow the *repair and return* procedure in paragraph 7.05.

replacement

7.04 To obtain a replacement 6042 module, notify Tellabs via letter or telephone (see addresses and numbers below), or via TWX (910-694-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6042 part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement module to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective 6042 in the replacement module's carton, sign the packing slip included with the replacement, and enclose it with the defective module (this is your return authorization). Affix the preaddressed label provided with the replacement module to the carton being returned, and ship the carton prepaid to Tellabs.

repair and return

7.05 Return the defective 6042 module, shipment prepaid, to Tellabs (attn: repair and return).

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

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

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

test	test procedure	normal result	if normal conditions are not met, verify:
pulsing (DX1)	Isolate DX circuit at both ends, and connect pulsing test set to E and M leads at each end of circuit. Send via M lead and receive via E 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 −56Vdc ☐. Power supply grounding ☐. No excessive cable leakage ☐. No excessive longitudinal voltage present on facility (less than 25Vrms) ☐.
pulsing (DX2)	Same as above except send via E lead and receive via M lead.	Same as above ☐.	Same as above ☐.
2wire to 4wire* transmit gain	Connect properly terminated TMS (receive) to *xmt out* jack. Using transmit portion of TMS, insert 1004Hz test signal at *2wire* jack.	With *xmt level* control adjusted fully counterclockwise (CCW), output level apprx. 16dB lower than input level ☐. With *xmt level* control fully clockwise (CW), output level apprx. 16dB higher than input level ☐.	Power ☐. Wiring ☐. Impedance terminations (check for double terminations) ☐. Impedance switches properly set ☐. Output not exceeding +12dBm overload point ☐.
4wire to 2wire* receive gain	Connect properly terminated TMS (receive) to *2wire* jack. Using transmit portion of TMS, insert 1004Hz test signal at *rcv in* jack.	With *rcv level* control fully CCW, output level approx. 16dB lower than input ☐. At full CW, output level about 16dB higher than input ☐.	Power applied to module ☐. Wiring ☐. Terminating impedances correct ☐. Output level not exceeding +12dBm overload point ☐.

*Do not use an unbalanced measuring device or signal source for 2wire level measurements since erroneous readings will occur.

Note: *Where dissimilar facilities are encountered (i.e., where 4wire facility is nonloaded cable and the 2wire facility is loaded cable or vice versa), the test tone level must be measured by a separate measuring set connected to the appropriate monitor jack (e.g.,* rcv 4wire mon *when testing receive levels).*

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Supplement: 6042A 4Wire-to-2Wire DX Network Terminating Module with Loopback

1.01 This supplement to practice section 826042A dated 1 February 1984 provides additional information on the 6042A module's loopback capabilities. Special emphasis is placed upon signaling loopback, which (unlike transmission loopback) is not covered in the 6042A practice.

1.02 After loopback is activated in the 6042A module—either by 2713Hz tone, by external ground, or manually as described in the practice—the module provides both transmission and signaling loopback until loopback is deactivated as described in the practice. Transmission and signaling loopback allow the module to be tested remotely. The figure below shows, in simplified form, the transmission and signaling loopback paths through the module.

1.03 Transmission loopback in the 6042A establishes a transmission path from the 4wire receive port to a point on the 4wire receive path after the 2wire driver stage (*POWER AMP* on block diagram in practice), thence through the loopback level control stage in the loopback path to a point on the 4wire transmit path before the 2wire input buffer stage (*AMP* on block diagram in practice), and finally to the 4wire transmit port. The loopback level control stage (*LB LEVEL ADJUST* on block diagram in practice) provides for true equal-level loopback, if desired.

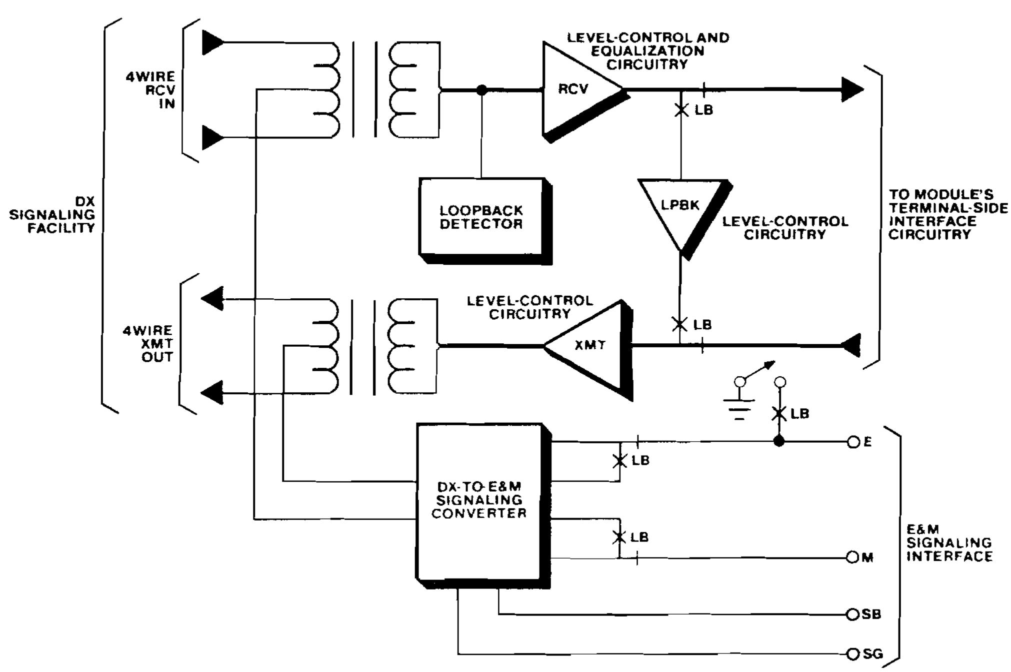
1.04 Signaling loopback allows the 6042A's DX-to-E&M signaling converter circuitry and the E&M signaling relay (*K1* on block diagram in practice) to be tested in either of the following operating modes:

- Type I E&M interface, DX1 signaling.
- Type I E&M interface, DX2 signaling.

1.05 In addition, the aforementioned signaling circuitry can be tested with Type II E&M interface if a common ground is present between the 6042A and the 2wire terminal equipment. If DX1 signaling is selected, the 6042A's SG lead must be connected to ground as well. If DX2 signaling is selected, the 6042A's SB lead must be connected to negative input battery as well.

1.06 If the 6042A's signaling converter circuitry and E&M signaling relay are operational and, if applicable, the above requirements for a Type II E&M interface are met, the module repeats all signaling states that it receives. For example, if an on-hook (ground) is sent to a 6042A under test and in loopback, the module responds by transmitting an on-hook (ground). If an off-hook (negative battery) is sent to the 6042A, it responds by transmitting an off-hook (negative battery).

1.07 When in loopback, the 6042A offers a terminal-side (2wire-side) busy-out feature that can be used when the module is optioned for Type I E&M interface and DX1 signaling. This option, which places a ground on the E lead to busy out the customer's E&M trunk circuit during loopback, is advantageous because it prevents the trunk circuit from being seized during loopback. Without this option, calls could be lost if, for example, a trunk in a hunt group were placed into loopback.



Simplified transmission and signaling loopback paths