

4201 and 4203 Terminating Sets

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1. general description

1.01 Tellabs' 4201 and 4203 Terminating Sets (figure 1) provide toll-grade interfacing between 2wire and 4wire voice-frequency transmission facilities. Both modules feature switchable 600 or 900 ohm impedance matching on the 2wire side, while 4wire port impedances are fixed at 600 ohms. In each case, the resistive 600 or 900 ohm component of the impedance at a particular port is in series with a $2.15\mu\text{F}$ capacitive component.

1.02 The 4201 is the basic 600/900 ohm Term Set. The 4203 adds an A and B-lead isolation coil (inductor) and filter capacitor to the basic Term Set circuitry.

1.03 Fixed-impedance variable attenuators (adjustable T-pads) are provided in both 4wire transmit and 4wire receive ports for level coordination. A nominal attenuation range of 0 to 30dB is provided in each direction. The variable attenuators are accessible from the module's front panel to allow level adjustments with the module inserted in its mounting shelf.

1.04 Front-panel test jacks also facilitate circuit alignment with the module mounted in place. Access toward the 2wire port is provided by the *2w in* jack, which opens the connection toward the 2wire facility. A *2w mon* jack bridges the 2wire port and, when used with an opening plug in the *2w in* jack, affords direct access to the 2wire facility. The *4w xmt* jack accesses the 4wire transmit port of the Term Set, opening the circuit toward the 4wire facility; and the *4w rcv* jack accesses the 4wire facility, opening the circuit toward the Terminating Set.

1.05 The internal compromise balance network of the 4201 and 4203 Terminating Sets provides 600 or 900 ohm impedance in series with $2.15\mu\text{F}$ capacitance. Network build-out (NBO) capacitors associated with the balance network provide NBO capacitance from 0 to $0.155\mu\text{F}$ in $0.005\mu\text{F}$ increments. A switch option removes the internal compromise balance network when use of an external precision balance network (PBN) is preferred. For 4201 Term Sets of Issue 2 or later, this external PBN may be a Tellabs 993X PBN subassembly, which plugs into a receptacle on the module's printed circuit board. Refer to the 993X Practice

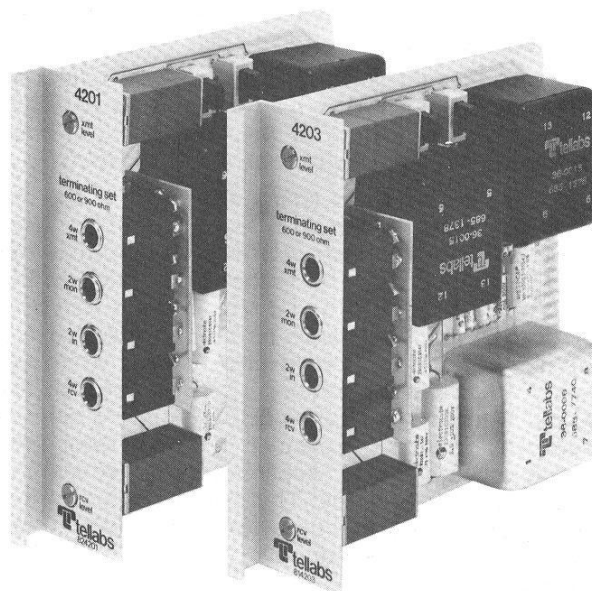


figure 1. 4201 and 4203 Terminating Sets

for detailed information on the PBN subassemblies. **Note that there is no provision for the 993X subassembly on the 4203 module.**

1.06 All options are selected via slide switches or DIP switches. These options are selection of 600 or 900 ohm 2wire impedance; insertion or removal of the A and B-lead filter capacitor provided by the 4203 module; removal of the internal balance network for use with an external balance network; selection of NBO capacitance values; and selection of D-lead operation in the 4201 module.

1.07 As Type 10 modules, the 4201 and 4203 each mount in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay rack and KTU apparatus case installation. In relay rack applications, a maximum of 12 modules may be mounted across a 19 inch rack, and up to 14 modules may be mounted across a 23 inch rack. In either case, 6 inches of vertical rack space is utilized.

2. application

2.01 As toll-grade Terminating Sets, the 4201 and 4203 modules may be used in any application requiring balanced 600 or 900 ohm 2wire impedance termination and 600 ohm 4wire termination. Both modules will accommodate 2wire (A and B-lead) direct current up to 100mA without degradation of performance. For the 4203, when the A and B-lead inductor is optioned into the circuit, loop current may be supplied to the 2wire facility from

a low-impedance battery supply without sacrificing performance. The modules' switch-selectable 600 or 900 ohm (in series with 2.15 μ F) 2wire port impedance permits interface with various terminal-side facilities and equipment. The 600 ohm option is selected when the Term Set interfaces nonloaded cable or terminal apparatus, while the 900 ohm option is used when the Term Set interfaces loaded cable or switched networks accessing loaded or nonloaded cable.

2.02 Adjustable transmit and receive attenuators provide a sufficient attenuation range (0 to 30dB, nominal) to permit use of the 4201 or 4203 in all conventional 2wire/4wire term set applications.

2.03 In applications characterized by a low impedance across the A and B leads, the 4203 Term Set should be used instead of the 4201. Unlike the 4201, the 4203 provides inductive isolation of the A and B leads, permitting direct A and B-lead connection to low-impedance terminations or battery supplies. The 4203 should also be used when signaling units that derive loop signaling through the A and B leads are employed. The filtering derived from the inductor, together with its associated switch-selectable filter capacitor, will reduce the effects of battery noise. This permits use of a less well-filtered battery source for loop current than could be used if inductive isolation were not provided.

2.04 Because the 4201 lacks the A and B-lead inductive isolation of the 4203, the 4201 should **not** be used in applications characterized by low impedance across the A and B leads. In such applications, the shunting effect of this low impedance will degrade a 4201's performance somewhat (especially transhybrid loss) unless an isolation coil is used. A high-impedance (greater than 800 ohms) battery supply circuit, however, permits either the 4201 or 4203 module to be used — with deference to the considerations expressed in the following paragraphs.

2.05 The filter capacitor in the 4203 that may be switch-optional across the A and B leads to attenuate noise introduced by the battery supply and to provide additional A and B-lead isolation **may** cause excessive ring generator loading when ringing through the A and B leads at higher ringing frequencies. This excessive ringing current can result in low ring voltage and possible pretrip. Use of the filter capacitor may also contribute to dial pulse distortion. If either of these problems occurs, the filter capacitor should be optional out of the circuit. If filtered talk battery is used, no degradation will occur. If filtered talk battery is **not** used, some filtering will be lost, but this will probably be the lesser of two evils.

2.06 Regardless of whether the 4201 or 4203 is used, care should be exercised when connections are made to the A and B leads. Such connections must provide balanced, matched ac impedance to ground and/or battery to preserve the longitudinal balance capability of the Terminating Set. The

effect of external unbalance in the A and B leads will be less with the 4203 than with the 4201, but, in any case, matched impedance to ground and/or battery in the A and B leads is highly desirable.

2.07 Some applications of the 4201 and 4203 Term Sets may require hybrid balance (transhybrid loss) greater than that which can be achieved by using the internal compromise balance network. For these applications, the compromise network may be switch-optional out and an external precision balance network connected to the module's EXT BAL NETWORK leads. For 4201 modules of Issue 2 or later, the external precision balance network may be a Tellabs 993X PBN subassembly, which plugs into a receptacle on the 4201's printed circuit board (connections to the EXT BAL NETWORK leads are not required when a 993X subassembly is used). The 993X subassemblies are available in several versions to approximate the impedances of specific transmission facilities and equipment. (The 993X subassembly cannot be fitted to a 4203 module.)

2.08 Both the 4201 and 4203 provide integral network build-out (NBO) capacitors to compensate for capacitance of office cables or associated gain devices. Network build-out capacitance should be added to optimize transhybrid loss (or 4wire return loss). From 0 to 0.155 μ F of NBO capacitance, in 0.005 μ F increments, may be switch-optional into the circuit.

2.09 Auxiliary G, F, and D leads are provided on the 4201 for level control and pad switching. An option switch allows the D lead to be either connected or bypassed, as desired. The D lead is typically used in applications such as tie-trunk interfacing when switched level control must be implemented. The 4203 provides the same G and F leads as the 4201 but lacks the 4201's D lead.

2.10 Either the 4201 or 4203 Term Set may be used in conjunction with a Tellabs 4001 or 4002 Line Amplifier to provide a 2wire-to-4wire (24V4) voice-frequency repeater.

2.11 These Term Sets may also be provided as part of a Tellabs prewired system, such as a 260 or 261 Signaling and Terminating System. Information pertinent to the 4201 or 4203's use in a specific system may be found in the Tellabs Practice on that system.

3. installation inspection

3.01 The 4201 and 4203 Terminating Set modules 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 modules should be visually inspected again prior to installation.

mounting

3.02 Each 4201 or 4203 module mounts in one position of the Tellabs Type 10 Mounting Shelf, versions of which are available for relay rack or

apparatus case installation. The 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**. Modules should be put into place only **after** properly optioned and **after** wiring has been completed.

3.04 Table 1 lists connections to the 4201 and 4203 modules. All connections are made via wire wrap at the 56-pin connector at the rear of each module's mounting shelf position. Pin numbers are found on the body of the connector.

connect:	to pin:
T (2wire tip)	41
R (2wire ring)	47
A (A-lead)	43
B (B-lead)	45
G (G-lead)	27
F (F-lead)	19
GND (ground)	17
XMT (4wire transmit pair)	55 and 49
RCV (4wire receive pair)	5 and 15
EXT BAL NETWORK	7 and 13
D (D-lead) (4201 only)	51

table 1. External connections to 4201 and 4203

option selection

3.05 Three option switches, one of which is an eight-position DIP switch, must be set before the 4201 or 4203 is placed in service. These switches and their functions are summarized in table 2. Lo-

switch	function	option choice
S1	2wire transmit impedance	600 or 900 ohms
S2	2wire receive	600 or 900 ohms
S3-8*	inclusion of A and B-lead filter capacitor	ON (capacitor included) or OFF (capacitor excluded)
S3-6	inclusion of internal compromise balance network	ON (internal comp. bal. net. optioned in) or OFF (internal comp. bal. net. optioned out)
S3-5	NBO CAPACITANCE	ON (0.005 μ F) or OFF
S3-4		ON (0.01 μ F) or OFF
S3-3		ON (0.02 μ F) or OFF
S3-2		ON (0.04 μ F) or OFF
S3-1		ON (0.08 μ F) or OFF
S3-7**	D-lead use	ON (D lead excluded) or OFF (D lead enabled)

*Switch S3-8 is functional on 4203 only; its setting on 4201 is irrelevant.

**The D lead is functional on 4201 only. However, on 4203, S3-7 must always be set to ON (closed) position.

table 2. 4201 and 4203 switch options

cations of these switches on the modules' printed circuit boards are shown in figure 2. Set all option switches as directed in the following paragraphs.

3.06 Selection of 600 or 900 ohm impedance matching at the 2wire transmit and receive ports is accomplished via slide switches S1 and S2, respectively. Both switches must be set to either the 600

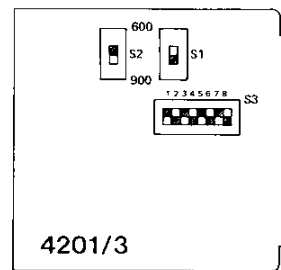


figure 2. Switch locations

or 900 ohm position to derive proper impedance at all ports. Switch S2 also automatically selects the proper internal compromise balance network impedance when set to the 600 or 900 ohm position.

3.07 Network build-out capacitance is introduced via five positions, S3-1 through S3-5, of DIP switch S3. Values of these switch positions are listed in table 2. These values are additive; thus, the amount of NBO capacitance introduced is the sum of those switches set to the *ON* (closed) position. For example, positions S3-3 and S3-5 set to *OFF* (open) and positions S3-1, S3-2, and S3-4 set to *ON* (closed) provide NBO capacitance of 0.13 μ F. Determine the amount of NBO capacitance required as directed in paragraph 3.15.

3.08 Inclusion or exclusion of the A and B-lead filter capacitor (4203 only; see paragraph 2.04) is accomplished via position 8 of DIP switch S3. Set S3-8 to the *ON* (closed) position to include the A and B-lead capacitor in the circuit. Set S3-8 to the *OFF* (open) position to exclude the capacitor.

3.09 Inclusion or exclusion of the Term Set's internal compromise balance network is accomplished via position 6 of DIP switch S3. Set S3-6 to the *ON* (closed) position if the module's internal compromise balance network is to be used. Set S3-6 to the *OFF* (open) position if an external precision balance network (either a Tellabs 993X PBN subassembly or other external PBN) is to be used in lieu of the internal compromise network.

3.10 On the 4201 Term Set, position 7 of DIP switch S3 controls the module's D lead. Unless an external D lead is required for pad-switching applications, set S3-7 to the *ON* (closed) position to enable transmission through the module. When S3-7 is set to the *OFF* (open) position, voice-frequency continuity between the A and B leads is interrupted and an external path must be provided between the B and D leads.

Note: Nearly all 4201 applications will require that switch S3-7 be set to *ON*.

The 4203 Term set provides no D lead, and switch S3-7 on this module **must always** be set to the *ON* (closed) position (see paragraph 2.09).

alignment

3.11 Alignment of the 4201 and 4203 Term Sets consists of adjusting the variable attenuators at the 4wire ports in accordance with circuit requirements, and introducing appropriate NBO capacitance, as required, to optimize transhybrid loss. Align the 4201 or 4203 as described in the following paragraphs.

3.12 transmit attenuator:

Using a voice frequency oscillator adjusted to 1000Hz at the impedance and level specified for the circuit, insert a signal at the 2w in jack. With a

terminated ac voltmeter (600 ohms) connected to the *4w xmt* jack, measure the transmit level. Adjust the *xmt* attenuator to derive the level specified for the circuit under test.

3.13 receive attenuator:

Request the distant location to send 1000Hz tone toward the local terminal. Using a terminated ac voltmeter (600 ohm termination), measure the received level at the *4w rcv* test jack. When this level is consistent with circuit specifications, remove the cord from the *4w rcv* jack and connect the voltmeter (with 600 or 900 ohm termination, as required) to the *2w in* test jack. Adjust the *rcv* attenuator to realize the receive level specified for the circuit at the 2wire port.

3.14 balance network:

Before introducing NBO capacitance, the type of balance network to be used must be determined. If the module's internal compromise balance network is to be used, set position 6 of DIP switch S3 to *ON* and make no connections to connector pins 7 and 13. If an external precision balance network is to be used, set S3-6 to *OFF* and connect the external PBN to pins 7 and 13. If the PBN is a Tellabs 993X PBN plug-on subassembly, no external connections need be made, although S3-6 must still be set to *OFF*.

3.15 NBO capacitance:

Request the distant location to send test tone at 2000Hz and at the level specified for the circuit. Verify that the received level is within limits for the circuit by connecting a terminated (600 ohm) ac voltmeter to the *4w rcv* jack. Remove the test set from the *4w rcv* jack and connect it to the *4w xmt* jack. Seize the circuit (the 2wire facility must be connected to connector pins 41 and 47 for this measurement), and set DIP switches S3-7 through S3-5 to **minimize** the signal level measured at the *4w xmt* jack. A more precise adjustment may be achieved if the test frequency is varied over the voice band as the NBO adjustment is made.

3.16 This concludes alignment of the 4201 and 4203 Terminating Sets. If the 4203 unit is used and loop dialing is to be accommodated, one additional test should be made. Before placing the circuit into service, perform a dial pulse test with the filter capacitor inserted (S3-8 set to *ON*) and removed (S3-8 set to *OFF*). Unless insertion of the filter capacitor produces excessive dial pulse distortion or pretrip, S3-8 should be set to *ON*.

4. circuit description

4.01 The 4201 and 4203 Terminating Sets are conventional two-transformer hybrids using capacitive tuning of the 2wire ports. Trimming capacitors are used across both 4wire ports and across the balance port to mitigate the effects of interwinding capacitances. Trimming resistors are used across the 4wire ports to compensate for dc resistance of both primary and secondary windings. Selection of 2wire port impedance is accomplished by switch selection of taps on the 4wire ports of both transformers.

4.02 In the 4203 Term Set, a balanced, magnetically-coupled retard coil is used to isolate the term set A and B-leads from external impedances. A tertiary winding on the same core is used to suppress dial pulse transients, using a silicon varistor for limiting.

6. specifications

2wire impedance

switchable 600 or 900 ohms in series with 2.15 μ F

4wire port impedance

600 ohms, nominal

attenuation range

transmit and receive: 0 to 30dB (nominal), continuously adjustable

transhybrid loss

58dB minimum, 200 to 4000Hz (including insertion loss correction of approximately 8dB, measured with matched terminations on 2wire and balance network ports)

2wire echo return loss

40dB minimum vs. 900 ohms or 600 ohms + 2.15 μ F, as appropriate

4wire echo return loss

27dB minimum vs. 600 ohms resistive termination

insertion loss

4.3 \pm 0.5dB, 300 to 4000Hz

longitudinal balance

60dB minimum, 200 to 4000Hz, any port

balance network

internal compromise network, 604 or 905 ohms in series with 2.15 μ F

NBO capacitance

0 to 0.155 μ F, in 0.005 μ F increments, switchable

dc current capability

no performance degradation for A and B-lead current up to 100mA

operating environment

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

dimensions

5.58 inches (14.17cm) high	4201: 22 ounces (624 grams)
1.42 inches (3.61cm) wide	4203: 30 ounces (850 grams)
5.96 inches (15.14cm) deep	

mounting

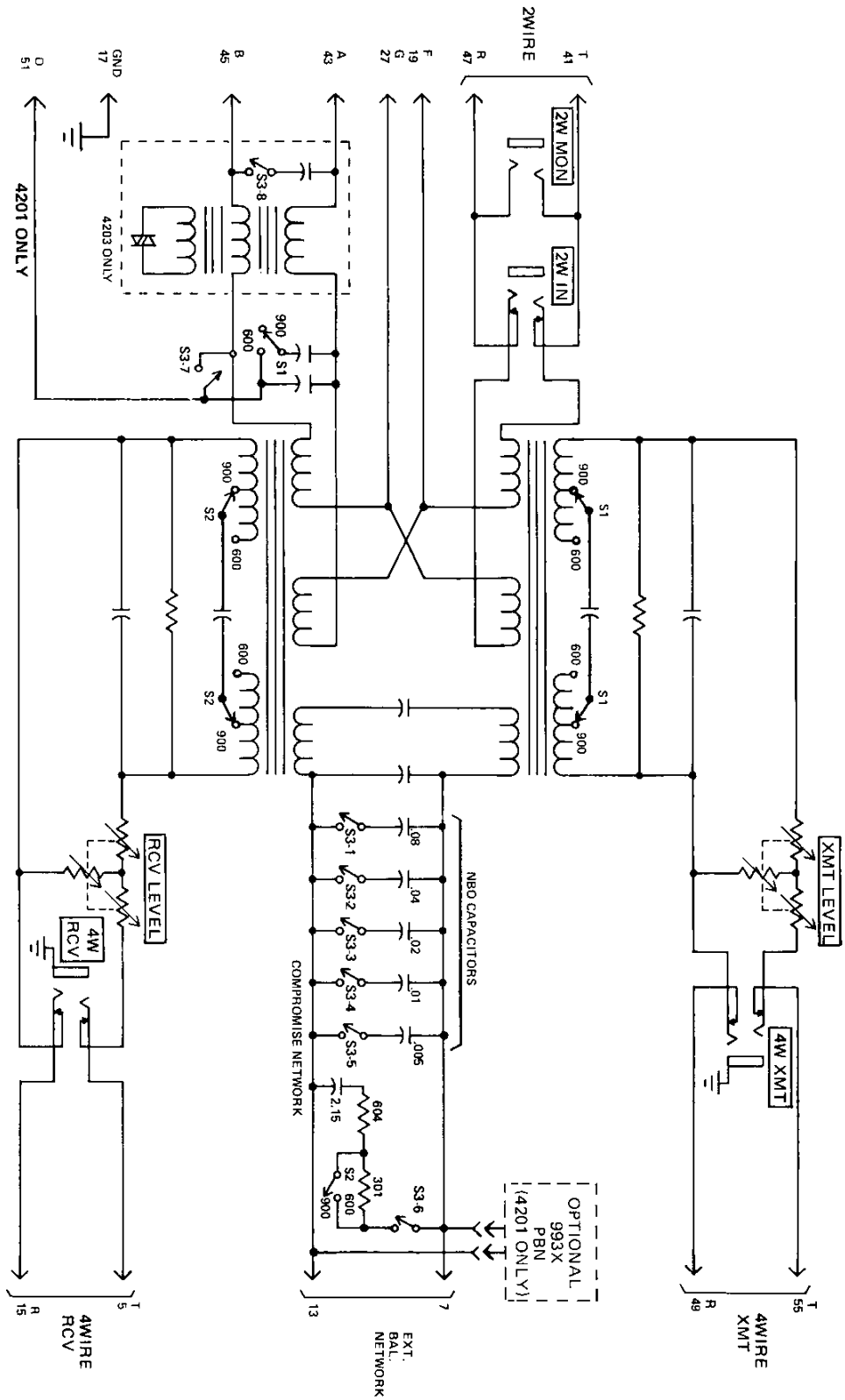
relay rack or apparatus case via one position of Tellabs

Type 10 Mounting Shelf or one position of Wescom Type

400 Shelf

7. testing and troubleshooting

7.01 The Testing Guide Checklist may be used to assist in the installation, testing or troubleshooting of the 4201 and 4203 Terminating Set 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 4201 or 4203 module. Unauthorized testing or repairs may void the module's warranty.



5. functional schematic

4201 and 4203 Terminating Sets 824201/824203

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

7.03 If a 4201 or 4203 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 4201 or 4203 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 8X420X 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 mod-

ule 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 pre-addressed 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 4201 or 4203 module, shipment prepaid, to: Tellabs Inc.

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

test	test procedure	normal result	if normal conditions are not met, verify:
2wire receive level	Measure 2wire receive level at 2w in jack, using properly terminated ac voltmeter, with 1000Hz tone transmitted over 4wire facility from distant location.	Level within 0.2dB of specified value, and variable as rcv attenuator is adjusted <input type="checkbox"/> .	Receive level at 4w rcv jack proper <input type="checkbox"/> . If not, check alignment of 4wire facility <input type="checkbox"/> . If level too high, circuit instability may be involved. To test, insert opening plug into 4w xmt jack and remeasure 2wire receive level. If levels now normal, check levels and terminations throughout circuit <input type="checkbox"/> . If not normal, substitute new 420X unit <input type="checkbox"/> .
4wire transmit level	Insert test tone at impedance and level specified for circuit, at 2w in test jack. With properly terminated ac voltmeter, measure level at 4w xmt jack.	Level within 0.2dB of specified level, and variable as xmt attenuator is adjusted <input type="checkbox"/> .	Circuit not "singing" (by inserting an opening plug into 4w rcv jack) <input type="checkbox"/> . Change 420X <input type="checkbox"/> .
4wire return loss	Request distant location send test tone (1000Hz) over 4wire facility at test level. Seize 2wire facility, and measure level at 4w xmt jack with terminated (600 ohm) ac voltmeter.	Signal level at 4w xmt jack at least 27dB below alignment level <input type="checkbox"/> .	Option switch S3-6 set to OFF (open) if external precision balance network used <input type="checkbox"/> . Switch S3-6 set to ON (closed) if an external PBN not used <input type="checkbox"/> . Switches S1 and S2 set properly <input type="checkbox"/> . If compromise network used, no connections made to connector pins 7 and 13 <input type="checkbox"/> . 2wire connection to pins 41 and 47 intact <input type="checkbox"/> . Xmt and rcv attenuators properly adjusted <input type="checkbox"/> . NBO capacitor selection <input type="checkbox"/> . If 4201 Term Set used, remove external connections to A and B-leads, and measure 4wire return loss <input type="checkbox"/> . (If condition improves when external connections to A and B-leads removed, substitute 4203 Term Set or install external A and B-lead inductors <input type="checkbox"/> .)