

# 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 termination on the 2wire side, while 4wire impedance terminations 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 This practice section is revised to update the *transhybrid loss* specification in section 5 of the practice.

1.03 The 4201 is the basic 600/900 ohm-term set. The 4203 adds an A-and-B-lead isolation coil (inductor) and an optional filter capacitor to the basic term set circuitry. On 4201 and 4203 modules built after May, 1986, two varistors provide lightning protection for the 4wire-side ports.

1.04 Fixed-impedance variable attenuators (adjustable T-pads) are provided at both the 4wire transmit and 4wire receive ports for level coordination. An attenuation range of approximately 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.

1.05 An internal compromise balance network in the 4201 and 4203 modules provides 600 or 900-ohm impedance in series with  $2.15\mu\text{F}$  capacitance. A switch option removes the internal compromise balance network when use of an external precision balance network (PBN) is preferred. For Issue 2 or later 4201 Term Sets, this external PBN can be a Tellabs 993X PBN subassembly, which plugs into a receptacle on the module's printed circuit board. On Issue 1 4201 Term Sets and all issues of 4203 Term Sets, a Tellabs 423X PBN module may be used, as no provision is made for the 993X subassembly on these modules.

1.06 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. These NBO capacitors can be used in conjunction with the internal compromise network or with an external or plug-on PBN.

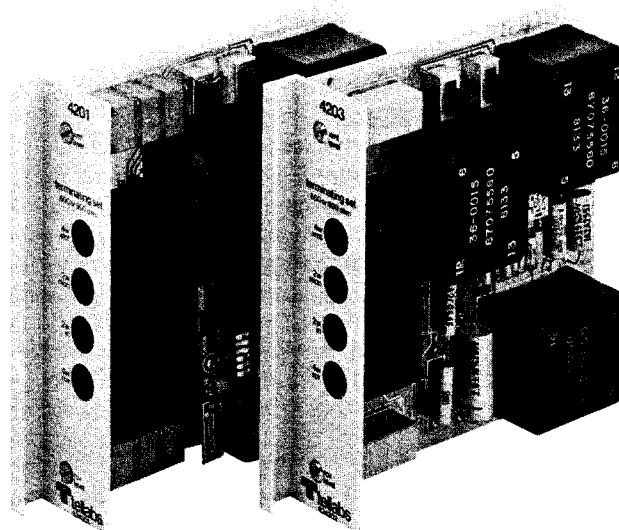


figure 1. 4201 and 4203 Terminating Sets

1.07 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 4203's A-and-B-lead filter capacitor; removal of the internal compromise balance network for use with an external PBN; selection of NBO capacitance values; and selection of D-lead operation in the 4201 module.

1.08 In addition to the aforementioned transmit and receive attenuator controls, the front panel of each module contains a complement of four test jacks to facilitate alignment and maintenance. An opening jack faces the facility at the module's 4wire receive port. Opening jacks also face the module's 4wire transmit port and the module's 2wire port. The fourth jack is a bridging (monitor) jack at the 2wire port.

1.09 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, up to 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 used.

## 2. application

2.01 As toll-grade Terminating Sets, the 4201 and 4203 can be used in applications requiring balanced 600 or 900-ohm 2wire impedance termination and 600-ohm 4wire impedance termination. The modules' switch-selectable 600 or 900-ohm (in series with  $2.15\mu\text{F}$ ) 2wire port impedance permits

★ A Tellabs Videotape Training Program is available for this product.

interface with various terminal-side facilities and equipment. The 600-ohm option is selected when the Term Set interfaces nonloaded cable or terminal equipment, 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 (approximately 0 to 30dB) 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. The 4203 (unlike the 4201) 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 used. The filtering derived from the inductor, together with its associated filter capacitor, reduces 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. Both modules can accommodate 2wire (A and B lead) direct current up to 100mA without degradation of performance.

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 degrades the 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 — in accordance with the considerations expressed in the following paragraphs.

2.05 The A-and-B-lead filter capacitor in the 4203 may sometimes 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 optioned out of the circuit. (A switch is on the 4203's printed circuit board options this capacitor into or 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; that is, the loss of filtering will not normally be as big a problem as dial pulse distortion or ringing pretrip.

2.06 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 modules' internal compromise balance network. For these applications, the compromise network may be switch-optioned out of the circuit and a precision balance network (PBN) used instead.

For 4201 modules of Issue 2 or later, this PBN is most conveniently provided as a Tellabs 993X PBN subassembly, which plugs into a 4-pin receptacle on the 4201's printed circuit board. For Issue 1 4201's and all 4203's, a separate PBN module (e.g., Tellabs 423X) must be connected to the module's *EXT. BAL. NETWORK* leads (pins 7 and 13). The 993X subassemblies and 423X modules are available in several versions to approximate the impedances of specific transmission facilities and station equipment.

2.07 To compensate for capacitance of office cables or other devices, both the 4201 and 4203 modules provide network build-out (NBO) capacitance of 0 to 0.155 $\mu$ F. NBO capacitance is introduced into the circuit in 0.005 $\mu$ F increments via option switches on the modules' printed circuit boards. When the 2wire side of the 4201 or 4203 interfaces loaded cable or short lengths of nonloaded cable terminated in 600 ohms + 2.15 $\mu$ F or 900 ohms + 2.15 $\mu$ F, the internal NBO capacitors will provide sufficient hybrid balance. If, however, the 2wire side is terminated directly into a tel set or into nonloaded cable and a tel set, an external PBN is recommended to optimize transhybrid loss. External PBN's are also recommended when the Term Set is used in toll applications where the 2wire terminating impedances depart from 900 ohms + 2.15 $\mu$ F or 600 ohms + 2.15 $\mu$ F. The various Tellabs PBN's and the types of facilities or station equipment with which they are used are listed in table 1.

993X PBN subassemblies	423X PBN Type 10 modules	facilities/eqpt.
9930	4230	19-24ga. H88
9930A	4230A	26ga. H88
9932	4232	nonloaded cable with termination of 900 $\Omega$ +2.15 $\mu$ F, 600 $\Omega$ +2.15 $\mu$ F, or Type 500 tel set
9933	4232	Type 500 tel set

table 1. External and plug-on PBN information

2.08 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 between 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.

2.09 Front-panel test jacks facilitate circuit alignment with the module mounted in place. On the 2wire side, the *2w mon* jack provides bridged access toward the 2wire facility. With an opening plug inserted into the *2w in* jack, the *2w mon* jack can be used for a terminated measurement of levels coming into the Term Set on the 2wire drop. To make a terminated measurement of levels coming out to the 2wire facility from the Term Set, the *2w in* jack is used.

2.10 On the 4wire side, the *4wxmt* jack provides access for terminated measurement of signals from the Term Set out to the 4wire facility. The *4wrcv* jack provides access for terminated measurement from the 4wire facility into the Term Set, so it can be used to measure levels coming into the Term Set, but it cannot be used to send tone into the Term Set's 4wire receive port. To insert tone locally into the Term Set from the 4wire facility, a card extender (e.g., Tellabs 9801) can be used if other modules providing appropriate jacks are not being aligned in conjunction with the Term Set.

2.11 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.

2.12 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.

2.13 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** they are properly optioned and **after** wiring is completed.

3.04 Table 2 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.

#### option selection

3.05 Three option switches, one of which is an eight-position DIP switch, must be set before the

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 (external PBN) . . . . .	7 and 13
D (D lead, 4201 only) . . . . .	51

table 2. External connections to 4201 and 4203

4201 or 4203 is placed in service. These switches and their functions are summarized in table 3. Locations of these switches on the modules' printed circuit boards are shown in figure 2. Set all option switches as directed in the following paragraphs.

switch	function	option choice
S1 and S2	2wire transmit and receive impedance	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 S3-4 S3-3 S3-2 S3-1	NBO capacitance	ON (0.005 $\mu$ F) or OFF ON (0.01 $\mu$ F) or OFF ON (0.02 $\mu$ F) or OFF ON (0.04 $\mu$ F) or OFF ON (0.08 $\mu$ 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 immaterial.  
 \*\*The D lead is functional on 4201 only. However, on 4203, S3-7 must always be set to ON (closed) position.

table 3. 4201 and 4203 switch options

3.06 Selection of 600 or 900-ohm terminating impedance at the 2wire port is accomplished via slide switches *S1* and *S2*. Both switches must be set to either the 600 or 900-ohm position to derive proper impedance at all ports. Switch *S2* also automatically selects the proper internal compromise balance network impedance in series with a 2.15 $\mu$ F capacitive component.

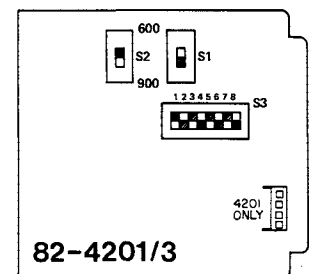


figure 2. Switch locations

3.07 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, a 423X PBN module or equivalent) is to be used in lieu of the internal compromise network.

3.08 Network build-out capacitance is introduced via positions S3-1 through S3-5 of DIP switch S3. Values of these switch positions are listed in table 3. 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 $\mu$ F. Determine the amount of NBO capacitance required as directed in paragraph 3.16.

3.09 Inclusion or exclusion of the A-and-B-lead filter capacitor (4203 only; see paragraph 2.05) 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.

**Caution:** *When the 4203 is used in conjunction with a Tellabs 6103 FX STA Signaling Converter module, a 6105 ARD module or a 6106 ARD (Data) module, the 4201's A-and-B-lead filter capacitor must be optioned out of the circuit (switch S3-8 set to OFF). Excessive ring generator loading, pretrip, and/or dial pulse distortion may otherwise result.*

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 (see paragraph 2.11).**

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

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

#### alignment

3.12 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.

**Note:** *A condensed alignment procedure (figure 3) is included to facilitate alignment of the 4201 or 4203.*

#### transmit attenuator

3.13 Condition a transmission measuring set (TMS) to output 1000Hz at the level and impedance specified for the circuit and insert this tone into the 2w in jack. Condition the receive portion of the TMS for 600-ohm terminated measurement, and measure the transmit level at the 4w xmt jack. Adjust the xmt level attenuator to derive the level specified for the circuit under test.

#### receive attenuator

3.14 To adjust receive levels when the Term Set is used alone, a card extender (e.g., Tellabs 9801) is

needed to provide access into the Term Set from the 4wire facility if tone is to be inserted locally. Using a TMS conditioned to output 1000Hz tone at the impedance and level specified for the circuit, insert this test tone into the Term Set at the 4wire rcv out jack of the 9801 Card Extender or any other external jack that will serve the same purpose. With the properly terminated TMS (receive) connected to the 2w in jack, measure the receive level. Adjust the rcv level attenuator to derive the level specified for the circuit under test.

#### balance network

3.15 When an external PBN is used, position 6 of switch S3 must be set to *OFF*, regardless of whether the PBN is a subassembly or a separate module. Adjust the PBN as directed in the related Practice. If the internal compromise balance network is used instead of a PBN, S3-6 should be set to *ON*.

#### NBO capacitance

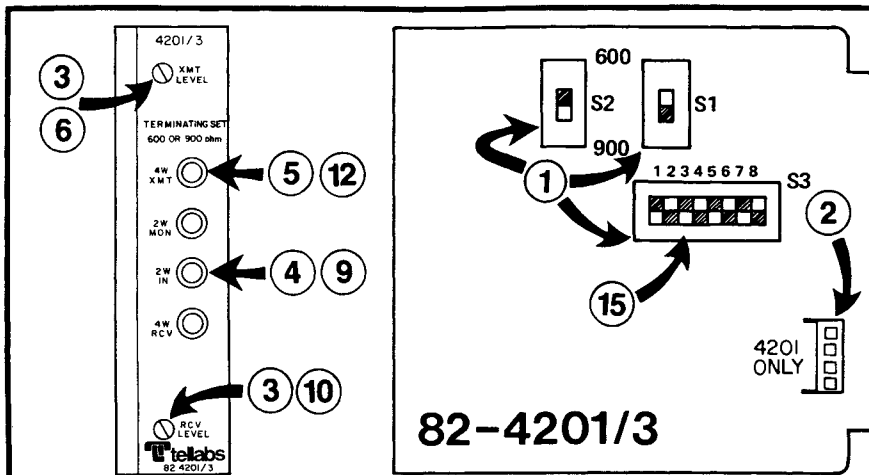
3.16 Using a TMS conditioned to send a 2000Hz tone at 600 ohms and at the level specified for the circuit, insert test tone into the 4w out jack of a Tellabs 9801 Card Extender (or any other external jack that will serve the same purpose). At this time the 2wire facility must be seized. That is, if the drop terminates in a tel set, the tel set must be off-hook. If the drop terminates in a PBX or CO, a connection must be completed to that PBX or CO. With the 600-ohm terminated TMS (receive), measure the level at the Term Set's 4w xmt jack. The NBO capacitors should be trimmed (via S3-1 through S3-5) for maximum return loss, as indicated by the minimum reading at the 4w xmt jack.

3.17 This concludes alignment of the 4201 and 4203 Terminating Sets. In loop dialing applications with the 4203, make one additional test. 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*). If insertion of the filter capacitor produces excessive dial pulse distortion or pretrip, S3-8 must be set to *OFF* to option the A-and-B-lead capacitor out of the circuit.

## 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 both primary and secondary windings. Selection of 2wire port impedance is accomplished by switch selection of taps on the 4wire ports of both transformers. On 4201 and 4203 modules built after May, 1986, two varistors provide lightning protection for the 4wire-side ports.

4.02 In the 4203 only, a balanced, magnetically coupled isolation coil (inductor) isolates the term set A and B leads from external impedances. A tertiary



This condensed alignment procedure is provided to facilitate alignment of the 4201 and 4203. Detailed alignment instructions are provided in paragraphs 3.06 through 3.17.

**1 Option switches set correctly.** Verify the optioning of the module (see paragraphs 3.05 through 3.11). Be sure switches S1 and S2 match the impedance of the test equipment they will interface during testing.

**2 If precision balance network required, pre-option and attach correct PBN subassembly.** When using a 4201 Term Set with a PBN subassembly, consult the Practice for that subassembly to determine the initial adjustment for the PBN and the 4201's NBO capacitors, switch S3-7 through S3-5. Any external PBN modules can also be optioned, inserted and connected to the Term Set at this point.

**3 Rotate xmt and rcv level controls fully counterclockwise.** Verify that the front-panel controls for transmit

and receive levels are turned fully counterclockwise.

#### transmit channel alignment

**4 Inject 1000Hz tone into 2w in jack.** Arrange a properly terminated TMS to send 1000Hz test tone at the 2wire in level specified on the CLR. Insert this tone at the 2w in jack.

**5 Measure tone at 4w xmt jack.** Use the receive portion of the TMS to measure the output level at the 4w xmt jack.

**6 Adjust xmt level control for correct transmit level.** Turn the xmt level control clockwise until the 4wire transmit level matches that specified on the CLR (usually -16dBm).

**7 Remove all test cords.**

#### receive channel alignment

**8 Inject 1000Hz tone into 4w out jack on card extender, line amp, or carrier channel.** Using a TMS arranged to send tone, insert a 1000Hz test

tone at 600 ohms impedance at the CLR-specified level (usually +7dBm) into the Term Set by use of a card extender, associated line amplifier or carrier channel 4w out jack.

**9 Measure tone at 2w in jack.** Connect a TMS arranged for receive to the Term Set's 2w in jack.

**10 Adjust rcv control for correct 2wire output level.** Turn the rcv level control clockwise until the 2wire output level measured at the 2w in jack matches the level specified in the CLR.

#### balance network (4w return loss)

**11 Send side of TMS into 4wire out jack of card extender.** To measure return loss, test tone must be inserted (through the 4w out jack of a card extender, associated line amp, or carrier) to the Term Set. The 2wire facility must be seized.

**12 Remove cord from 2w in jack and plug into 4w xmt jack.** Connect a TMS arranged to receive into the 4wire xmt jack.

**13 Send 2000Hz at specified 4wire input level.** Use the TMS to send a 2000Hz test tone at the level specified on the CLR.

**14 Verify return loss at TMS.** Compare input and output levels at the TMS to determine the level of return loss through the Term Set.

**15 To optimize return loss, change PBN and NBOC switch settings, via trial and error.** To obtain the best possible return loss, balance networks must be adjusted in the operating environment by trial and error.

**Note:** These instructions coincide with the summary of Tellabs 4201/4203 Videotape Training Program. figure 3. Condensed alignment procedure

winding on the same core, using a silicon varistor for limiting, suppresses dial pulse transients.

## 6. specifications

### 2wire impedance

switchable 600 or 900 ohms in series with 2.15 $\mu$ F, balanced

### 4wire port impedance

600 ohms, balanced

### attenuation range

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

transhybrid loss (including approximately 8dB of insertion loss, measured with matched terminations on 2wire and balance network ports)

4201: 58dB minimum, 200 to 4000Hz

4203: 50dB minimum, 200 to 500Hz; 58dB minimum, 500 to 4000Hz; A&B-lead filter capacitor excluded

### 2wire echo return loss

40dB minimum vs. 900 ohms or 600 ohms + 2.15 $\mu$ F, as appropriate

### 4wire echo return loss

20dB 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

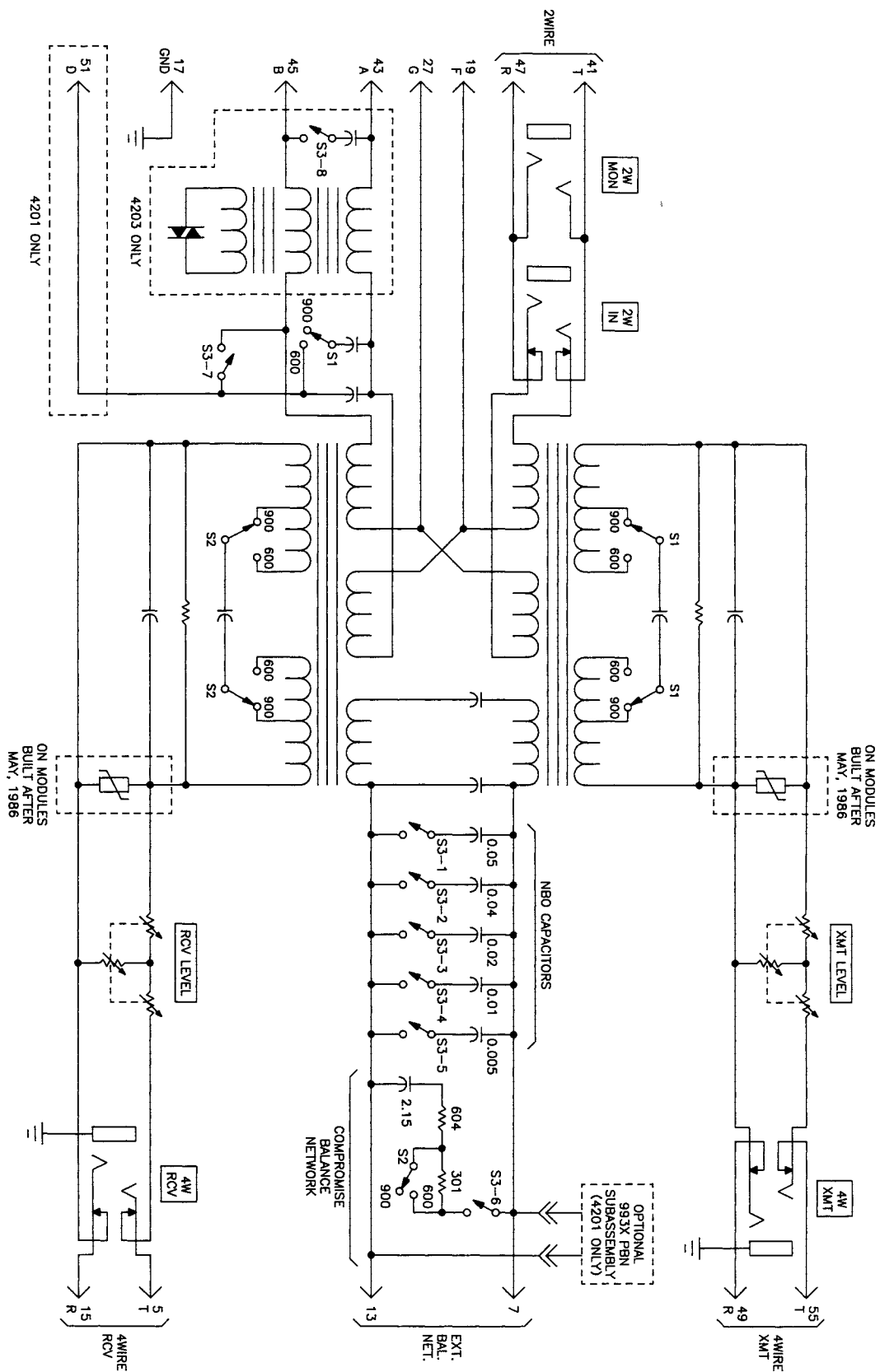
internal compromise network, 604 or 905 ohms in series with 2.15 $\mu$ F

### NBO capacitance

0 to 0.155 $\mu$ F in 0.005 $\mu$ F increments, switch-selected

### dc current capability

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



## 5. block diagram

### 4201 and 4203 Terminating Sets 824201/824203

*operating environment*

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

*weight*

4201: 22 ounces (624 grams)

4203: 30 ounces (850 grams)

*dimensions*

5.58 inches (14.17cm) high

1.42 inches (3.61cm) wide

5.96 inches (15.14cm) deep

*mounting*

relay rack or apparatus case via one position of Tellabs

Type 10 Mounting Shelf

## 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 4201 and 4203 Terminating Set modules. The checklist is intended as an aid in the localization of trouble to this specific equipment. If the equipment is suspected of being defective, substitute new equipment (if possible) and conduct the test again. If the substitute operates correctly, the original 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 equipment. Unauthorized testing or repairs may void its warranty. Also, if the equipment is part of a registered system, unauthorized repairs will result in noncompliance with Parts 15 and/or 68 of the FCC Rules and Regulations.

**Note:** *Although repair service always includes an attempt to remove any permanent markings made by customers on Tellabs equipment, the success of such attempts cannot be guaranteed. Therefore, if equipment must be marked **defective** or **bad**, we recommend that it be done on a piece of tape or on a removable stick-on label.*

### technical assistance via telephone

7.02 If a situation arises that is not covered in the **testing guide checklist**, contact Tellabs Customer Service as follows:

**USA customers:** Contact your Tellabs Regional Office listed below.

region	telephone	office location
US Northeast	(203) 798-0506	Danbury, CT
US Capital	(703) 359-9166	Washington, DC
US Central	(312) 357-7400	Chicago, IL
US Southeast	(407) 834-8311	Orlando, FL
US Southwest	(214) 869-4114	Dallas, TX
US Western	(714) 850-1300	Orange County, CA

**Canadian customers:** Contact our Canadian headquarters in Mississauga, Ontario. Telephone (416) 858-2058.

**International customers:** Contact your Tellabs distributor.

## selecting correct product service procedure

7.03 If equipment is diagnosed as defective or if in-service equipment needs repair, follow the **product return procedure** in paragraph 7.04 in all cases except those where a critical service outage exists (e.g., where a system or a critical circuit is down and no spares are available). In critical situations, or if you wish to return equipment for reasons other than repair, follow the **product replacement procedure** in paragraph 7.05.

### product return procedure (for repair)

7.04 To return equipment for repair, first contact Tellabs Product Services (see addresses and numbers below) to obtain a Material Return Authorization (MRA). A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the repair transaction). The service representative will then give you an MRA number that identifies your particular transaction. After you obtain the MRA number, send the equipment prepaid to Tellabs (attn: Product Services).

#### in the USA:

Tellabs, Inc.

4951 Indiana Avenue

Lisle, Illinois 60532-1698

telephone (312) 969-8800

#### in Canada:

Tellabs Communications Canada, Ltd.

2433 Meadowvale Boulevard

Mississauga, Ontario, Canada L5N 5S2

telephone (416) 858-2058

Enclose an explanation of the malfunction, your company's name and address, the name of a person to contact for further information, and the purchase order number for the transaction. Be sure to write the MRA number clearly on the outside of the carton being returned. Tellabs will inspect, repair, and retest the equipment so that it meets its original performance specifications and then ship the equipment back to you. If the equipment is in warranty, no invoice will be issued. Should you need to contact Tellabs regarding the status of a repair, call or write the Product Services department at our Lisle or Mississauga headquarters as directed above.

### product replacement procedure

7.05 For critical service outages, Tellabs offers a choice of two replacement services (if the product is in replacement stock) in lieu of the 15-day repair and return service described above. These are **overnight express service** (at extra cost) anywhere in the USA and **five-day expedited delivery** (at no extra cost) anywhere in the USA and Canada. To obtain replacement equipment via either of these services, contact your Tellabs Regional Office in the USA or our Canadian headquarters in Mississauga, Ontario, for details, costs (if applicable), and instructions.

Telephone numbers are given in paragraph 7.02. A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the replacement transaction). Tellabs will then ship the replacement to you in accordance with the replacement service you request. An invoice in the amount of the replacement's current price plus any applicable service charges will be issued after the replacement is shipped. When you receive the replacement, pack the equipment to be returned in the replacement's carton, sign and enclose the packing list, affix to the carton the preaddressed label provided, and ship the

carton prepaid to Tellabs at our USA or Canadian headquarters. The defective equipment must be received within 30 days of the replacement's ship date. When we receive the defective equipment, a credit will be issued, leaving a balance due on the replacement's invoice that reflects only the express service and/or out-of-warranty charges, if any. Returns received more than 30 days after the replacement's ship date **will not be accepted for credit** but instead will be returned to you, thereby rendering the replacement's invoice due and payable. Please note that OEM, modified, and manufacture-discontinued equipment is not available via overnight express service.

## testing guide checklist

test	test procedure	normal result	if normal conditions are not met, verify:
2wire receive level	Measure 2wire receive level at <i>2w in</i> jack, using properly terminated TMS, with 1000Hz tone transmitted over 4wire facility from distant location.	Level within 0.2dB of specified value, and variable as <i>rcv</i> attenuator is adjusted <input type="checkbox"/> .	Receive level at <i>4w rcv</i> 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 <i>4w xmt</i> 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 <i>2w in</i> test jack. With properly terminated TMS, measure level at <i>4w xmt</i> jack.	Level within 0.2dB of specified level, and variable as <i>xmt</i> attenuator is adjusted <input type="checkbox"/> .	Circuit not "singing" (by inserting an opening plug into <i>4w rcv</i> jack) <input type="checkbox"/> . Change 420X <input type="checkbox"/> .
4wire return loss	Request distant location send test tone (2000Hz) over 4wire facility at test level. Seize 2wire facility, and measure level at <i>4w xmt</i> jack with terminated (600 ohm) TMS.	Signal level at <i>4w xmt</i> jack at least 20dB below alignment level <input type="checkbox"/> .	Option switch S3-6 set to <i>OFF</i> (open) if external precision balance network used <input type="checkbox"/> . Switch S3-6 set to <i>ON</i> (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"/> . <i>Xmt</i> and <i>rcv</i> 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"/> .)