tellabs
technical manual
76-814444
rev B

practice section 814444/814446

4444 4Wire 4Way and 4446 4Wire 6Way Active Bridges

contents

1. general description

1.01 The 4444 4Wire 4Way and 4446 4Wire 6Way Active Bridge modules (figure 1) provide, respectively, full 4way and 6way bridging of 4wire transmission facilities. The input of each 4wire port accesses the outputs of all other ports. Both Bridge modules are designed for use in voice conference applications.

1.02 This practice section is revised to update the text portion of section 7.

1.03 The 4444 and 4446 are *Active* Bridges, i.e., they contain integral amplification circuitry. An option switch on each module permits any of three amounts of port-to-port insertion loss to be selected: 23dB, 16dB, or 0dB in the 4444, and 23dB, 19dB, or 0dB in the 4446. The insertion loss level for which the Bridge is set is common to all bridge ports. Maximum output level of either Bridge module is +10dBm.

1.04 Terminating impedance at both the input and output ports of the 4444 and 4446 is 600 ohms, unbalanced. The modules' active circuitry allows unused ports to be left unterminated without affecting transmission performance of the ports in use.

1.05 The 4444 and 4446 each incorporate an internally regulated power supply that permits operation on −22 to −56Vdc input. Current requirement is 20mA when powered from a nominal −24Vdc source and 30mA when powered from a nominal −48Vdc source. Reverse-battery protection is provided in the modules' internal power supply circuits.

1.06 As Type 10 modules, the 4444 and 4446 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 The 4444 4Wire 4Way and 4446 4Wire 6Way Active Bridge modules are designed for

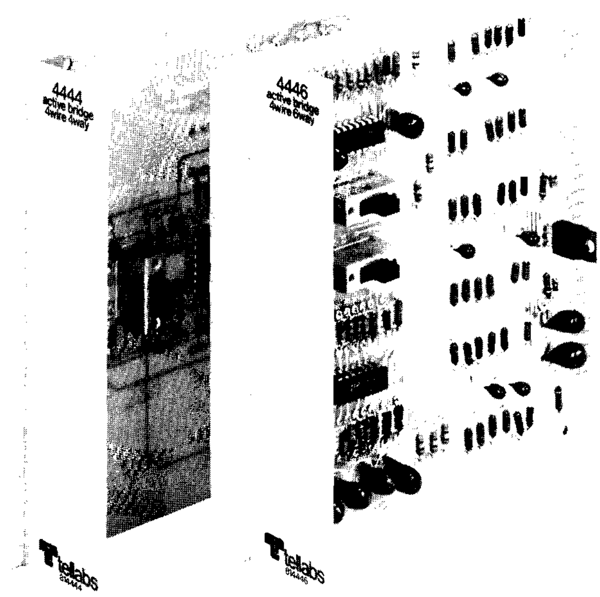


figure 1. 4444 and 4446 Active Bridges

use in voice conference applications to provide, respectively, full 4way and 6way bridging of 4wire transmission facilities. The 4444 is normally used where three or four 4wire facilities are interconnected, and the 4446 is normally used where up to six 4wire facilities are interconnected. Both Bridges provide full port interconnection, i.e., the input of each port is connected to the outputs of all other ports.

2.02 Both the 4444 and 4446 afford a choice of three switch-selectable amounts of port-to-port insertion loss to permit interfacing with a variety of facilities and equipment. When levels normally encountered with a resistive-type bridge are required, the 16dB (4444 module) or 19dB (4446 module) loss option is selected. If a carrier channel or other standard-level 4wire interface (+7dB receive, −16dB transmit) is required, the 23dB loss option is selected. When lossless bridging is required, the 0dB option is selected.

2.03 All input and output-port terminating impedances on the 4444 and 4446 are 600 ohms, unbalanced. Because of the modules' active circuitry, unused ports need not be terminated, as insertion loss variation and loss variation from port inputs to the same port outputs are negligible when an input or output port termination is removed.

2.04 Because the input and output ports of the 4444 and 4446 are unbalanced, each port requires a balanced transmission line interface device, which is normally an associated level-control module. Because the 4444 and 4446 are *Active* Bridges, as opposed to more conventional *resistive* bridges, the level and impedance control functions may be performed by a pad/transformer module (e.g., Tellabs' 4402, 4403, or 4404) instead of by more expensive line amplifiers. One pad/transformer module is required for each input and output port used. If more gain is required at a particular port than can be provided by the Bridge module's active circuitry, a line amplifier (e.g., Tellabs' 4001 or 4002) may be used instead of a pad or pad/transformer module.

2.05 If the facility being interfaced at a particular port requires only level control and not a balancing device, a pad module (e.g., Tellabs' 4401) may be used at that port. For example, a 4401 may be used when another transmission device that does provide balance is in close proximity or when a carrier channel is interfaced.

2.06 The 4444 and 4446 may be used in tandem to increase the number of available ports in a 4wire bridge network. This is done by connecting the input and output of one port (usually the last) of one Bridge module to the output and input, respectively, of one port (usually the first) of another Bridge module. Tandem connection of two 4446 Bridges, for example, provides a 4wire 10way bridge. Tandem applications are generally accommodated in the lossless mode, as loss in this mode through all input and output port combinations is constant at 0dB.

2.07 The limiting factor in the number of 4444 and/or 4446 modules that can be used in tandem is cross-port coupling (crosstalk). The cumulative effect of cross-port coupling generally limits the number of Bridge modules that can be used in tandem to three or four.

3. installation

inspection

3.01 The 4444 4Wire 4Way and 4446 4Wire 6Way Active Bridge 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 module should be visually inspected again prior to installation.

mounting

3.02 Each 4444 or 4446 module mounts in one position of the Tellabs Type 10 Mounting Shelf, which is available in configurations for both relay rack and 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 1 lists external connections to the 4444 and 4446 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 4444 pin:	to 4446 pin:
INPUT PORT 1 TIP	3	1
INPUT PORT 1 RING*	5	2
INPUT PORT 2 TIP	7	10
INPUT PORT 2 RING*	9	12
INPUT PORT 3 TIP	41	22
INPUT PORT 3 RING *	43	24
INPUT PORT 4 TIP	45	26
INPUT PORT 4 RING*	47	28
INPUT PORT 5 TIP	–	46
INPUT PORT 5 RING*	–	48
INPUT PORT 6 TIP	–	55
INPUT PORT 6 RING*	–	56
OUTPUT PORT 1 TIP	27	5
OUTPUT PORT 1 RING*	33	3
OUTPUT PORT 2 TIP	11	4
OUTPUT PORT 2 RING*	29	7
OUTPUT PORT 3 TIP	13	8
OUTPUT PORT 3 RING*	31	6
OUTPUT PORT 4 TIP	15	51
OUTPUT PORT 4 RING*	25	53
OUTPUT PORT 5 TIP	–	40
OUTPUT PORT 5 RING*	–	39
OUTPUT PORT 6 TIP	–	13
OUTPUT PORT 6 RING*	–	11
BATT (−22 to −56Vdc input)	35	35
GND (input power ground)	17	17

*Internally grounded via module circuitry.

table 1. External connections to 4444 and 4446

4444 options and alignment

3.05 The 4444 contains a single option switch, *S1*, that is used to select the insertion loss (0, 16, or 23dB) of all four ports simultaneously. The location of *S1* on the module's printed circuit board is shown in figure 2. Set *S1* to the *0* position for lossless (0dB insertion loss) bridging. Set *S1* to the *16* position to select 16dB insertion loss, as is required for interfacing with levels normally associated with resistive bridges. Set *S1* to the *23* position to select 23dB insertion loss, as is required for carrier-channel or other standard-level (+7/−16dB) 4wire interfacing. After *S1* is set, no further optioning or alignment of the 4444 is required.

4446 options and alignment

3.06 The 4446 contains two option switches, *S1* and *S2*. Locations of these switches on the module's printed circuit board are shown in figure 2. Switch *S1* is used to select the insertion loss (0, 19, or 23dB) of ports 1 through 4 simultaneously, and switch *S2* is used to select the insertion loss of ports 5 and 6 simultaneously. These switches are normally set for the same amount of insertion loss, although they may be set for different amounts if desired.

3.07 Set *S1* and/or *S2* to the *0* position for lossless (0dB insertion loss) bridging. Set *S1* and/or *S2* to the *19* position to select 19dB insertion loss, as is required for interfacing with levels normally associated with resistive bridges. Set *S1* and/or *S2* to the *23* position to select 23dB insertion loss, as is required for carrier-channel or other standard-level (+7/−16dB) 4wire interfacing. After *S1* and *S2* are set, no further optioning or alignment of the 4446 is required.

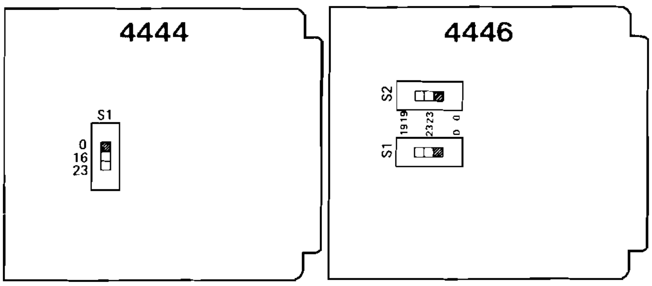


figure 2. Option switch locations

4. circuit description

4.01 This circuit description is intended to familiarize you with the 4444 4Wire 4Way and 4446 4Wire 6Way Active Bridge modules for engineering and application purposes only. Attempts to troubleshoot the 4444 and 4446 internally are not recommended. Troubleshooting procedures should be limited to those prescribed in section 7 of this Practice. Please refer to the 4444 and 4446 block diagrams, section 5 of this Practice, as an aid in following the circuit description.

4.02 The active bridge circuitry is identical for each port of the 444 and 4446. This circuitry consists of a three-input (4444) or five-input (4446) *summing circuit* and, for each port output, an integrated-circuit operational amplifier (*op amp*). The *summing circuit* provides unbalanced 600 ohm terminating imedance for each input port. For a particular output port, the *summing circuit* adds the transmission energy from all other input ports (i.e., all input ports except the one with the same number as the output port) at a low-impedance summing point. The low impedance of this summing point provides input port isolation.

4.03 The *op amp* provides switch-controlled gain to overcome the loss of the summing circuit. The 4444 has four *op-amp* networks, and the 4446 has six such networks.

4.04 An internally regulated *power supply* allows operation on external −22 to −56Vdc input. The internal power supply furnishes −21Vdc, −10.5Vdc, and ground.

6. specifications

insertion loss
4444: 0dB, 16dB, or 23dB ±0.5dB, switch-selectable
4446: 0dB, 19dB, or 23dB ±0.5dB, switch-selectable

maximum output level (overload point)
+10dBm

input port impedance
600 ohms ±5%, unbalanced

output port impedance
600 ohms ±5%, unbalanced

frequency response
±0.5dB re 1000Hz level, 300 to 10,000Hz

harmonic distortion
less than 1% at +10dBm output level

output noise
23dBrnC maximum

transbridge loss (port input-output isolation)
90dB minimum

input power requirements
voltage: −22 to −56Vdc, ground referenced
current: 20mA when powered from nominal −24Vdc source, 30mA when powered from nominal −48Vdc source

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
4444: 4.5 ounces (128 grams)
4446: 5 ounces (142 grams)

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

7. testing and troubleshooting

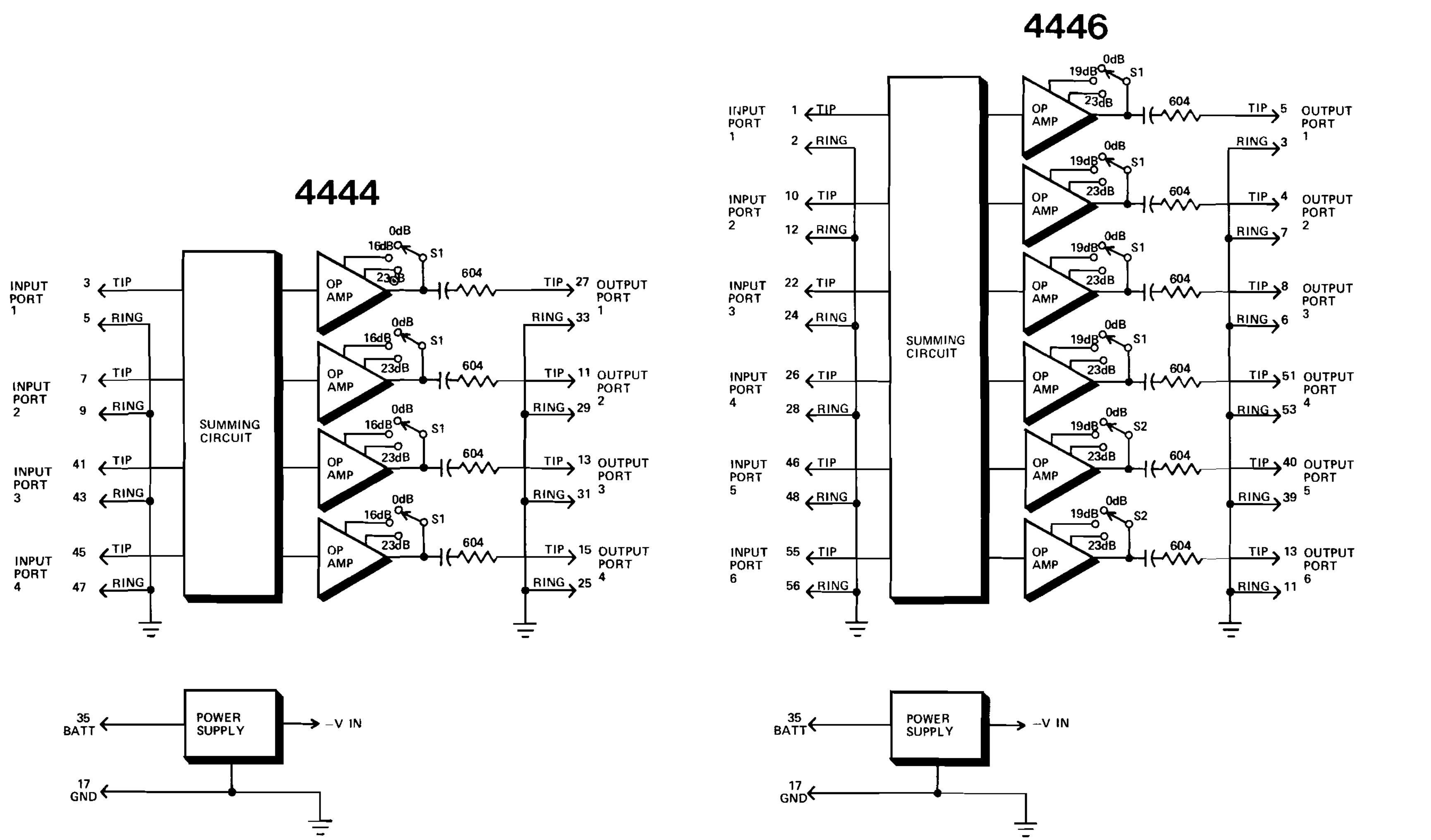
7.01 The **testing guide checklist** in this section may be used to assist in the installation, testing, or troubleshooting of the 4444 4Wire 4Way and 4446 4Wire 6Way Active Bridge modules. The checklist is intended as an aid in the localization of trouble to this specific equipment. If the equipment 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.



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5. block diagram

region	telephone	office location
US Atlantic	(203)798-0506	Danbury, CT
US Capital	(703)478-0468	Washington, DC
US Central	(312)357-7400	Chicago, IL
US Southeast	(305)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)624-0052.

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
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 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. When we receive the defective equipment (within 30 days of our issuing the replacement), the invoice will be adjusted to reflect only service charges (if applicable). Please note that OEM, modified, and manufacture-discontinued equipment is not available via overnight express service.

testing guide checklist on next page

testing guide checklist

Note: *When a signal is inserted at any input port of the 4444 or 4446 and/or when measurements are made at any output port, be certain that the test equipment is arranged to accommodate the unbalanced 600 ohm impedances at these ports.*

test	test procedure	normal result	if normal conditions are not met, verify:
insertion loss, 4444 module	Connect test oscillator arranged for 1000Hz signal at 0dBm to any input port (see table 1 for pin assignments). Using transmission measuring set, measure output level at any output port except the one with same number as input port to which oscillator is connected.	With *S1* set to *23* position, output level approx. 23dB lower than input ☐. With *S1* set to *16* position, output level approx. 16dB lower than input ☐. With *S1* set to *0* position, output level approx. same as input ☐.	Power applied to module ☐. Wiring ☐. Proper impedance terminations (check for double terminations) ☐. Switch *S1* in proper poisition ☐. Input level ☐.
insertion loss, 4446 module	Connect test oscillator arranged for 1000Hz signal at 0dBm to any input port (see table 1 for pin assignments). Using transmission measuring set, measure output level first at output port 1,2,3, or 4 and then at output port 5 or 6. Do not, however, use output port with same number as input port to which oscillator is connected.	With *S1* (which controls output ports 1 through 4) or *S2* (which controls output ports 5 and 6) set to *23* position, output level approx. 23dB lower than input ☐. With *S1* or *S2* set to *19* position, output level approx. 19dB lower than input ☐. With *S1* and *S2* set to *0* position, output level approx. same as input ☐.	Power applied to module ☐. Wiring ☐. Proper impedance terminations (check for double terminations) ☐. Switch *S1* and/or *S2* in proper position ☐. Input level ☐.
noise, 4444 module	Connect shorting straps between tip and ring connector pins of all input ports (see table 1 for pin assignments). Using noise test set, measure noise level across tip and ring connector pins of any output port.	Noise level less than 23dBrnC for all three insertion loss settings of switch *S1* ☐.	All input ports shorted as directed ☐. Noise test set at proper terminating impedance ☐. High RF environment affecting test set ☐.
noise, 4446 module	Connect shorting straps between tip and ring connector pins of all input ports (see table 1 for pin assignments). Using noise test set, measure noise level across tip and ring connector pins of output port 1, 2, 3, or 4 and also across tip and ring connector pins of output port 5 or 6.	Noise level less than 23dBrnC for all three insertion loss settings of switches *S1* and *S2* ☐.	All input ports shorted as directed ☐. Noise test set at proper terminating impedance ☐. High RF environment affecting test set ☐.