246 Resistive Data Bridge (RDB) System

contents

1. general description

1.01 The Tellabs 246 Resistive Data Bridge (RDB) System (figure 1) provides active 4wire-common-port, 4wire-multiple-port bridging in multipoint voice-frequency (VF) data networks, i.e., in applications where VF data transmission takes place between a central computer and a number of remote data stations. Because it is modular, the 246 System can be arranged in a variety of ways to provide one or two independent bridge networks. The 246 RDB follows a conventional *split* bridge format, i.e., the common port of the bridge network is interfaced with several multiple ports through separate *splitter* and *combiner* channels. In the splitter channel, the common input port is connected to multiple output ports through a fixed-loss resistive network. In the combiner channel, inputs from the multiple ports are connected through a fixed-loss resistive network to the common output port.

1.02 The basic 246 System comprises three components: the 4001E or 4002E Prescription Line Amplifier module, the 4402S Pad/Transformer module, and the 246 RDB Mounting Assembly. The 246 Assembly consists of a Tellabs 1012 Mounting Shelf equipped with a connectorized printed circuit backplane that contains the fixed-loss resistive bridging networks. Two versions of the 246 RDB Mounting Assembly are available: the 246A, which is a 12-position Assembly designed for 19-inch relay rack installation, and the 246B, which is a 12-position Assembly designed for 23-inch relay rack installation. The 246 Assembly is universally prewired to accommodate Tellabs' 4001E, 4002E, and 4402S modules, which interface both the 4wire common ports and the 4wire multiple ports. Cable connectors on the 246 Assembly's backplane provide the capability to interconnect the bridge networks with a Switched Maintenance Access System (SMAS 5A).

1.03 The 4001E and 4002E Prescription Line Amplifier modules (figure 2) each provide switch-selectable level control and impedance matching in both the transmit and receive channels of a 4wire voice-frequency transmission facility, plus optional amplitude equalization in the receive channel. The 4001E and 4002E are identical in all respects but one: the 4001E contains front-panel test jacks while the 4002E does not.

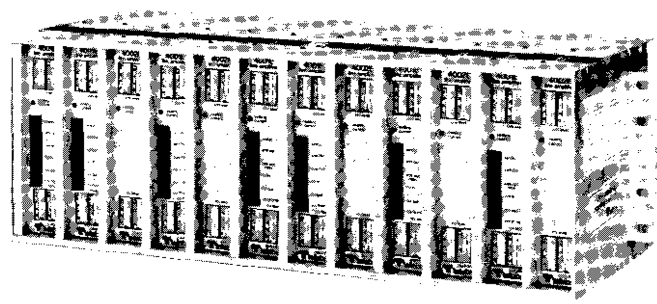


figure 1. 246 Resistive Data Bridge System

1.04 The 4402S Pad/Transformer module (figure 3) is used in applications that do not require gain. The module provides an impedance-matching 4wire line termination as well as attenuation in both the receive and transmit channels. Front-panel test jacks provide access to the transmit and receive channels.

1.05 As stated previously, the 246 System can be arranged as either a single data bridge network or as two individual data bridge networks (figure 4) via an option switch on the 246 Assembly's backplane. A single data bridge configuration consists of one 4wire-common-port circuit accessing up to ten 4wire-multiple-port circuits. When arranged as two independent data bridge networks, a single 246 Assembly contains two 4wire-common-port circuits, each of which serves up to five 4wire-multiple-port circuits. Because of its printed-circuit backplane configuration with connectorized port access and dedicated module positions, one 246 Mounting Assembly accommodates either one or two bridge networks. The number of multiple ports in an established 246 Bridge network can be changed simply by adding or removing 4001E, 4002E, or 4402S modules to accommodate a new multiple-port arrangement. No wiring changes to the 246 Assembly are required. When a bridge is changed in this manner, the remaining multiple ports retain their integrity without rewiring or realignment. Levels are maintained within approximately ±0.2dB, and multiple-port positions from which modules have been removed need not be terminated.

1.06 A significant feature of the 246 System is its ease of alignment. From a system standpoint, the 246 System is easier to align than an active bridge, in which the system bus levels are aligned for the multiple port requiring the most gain and all other multiple ports are then attenuated as required. The 246 System ports are individually aligned; gain, loss, and/or equalization are adjusted for each port separately, without interaction between ports. The

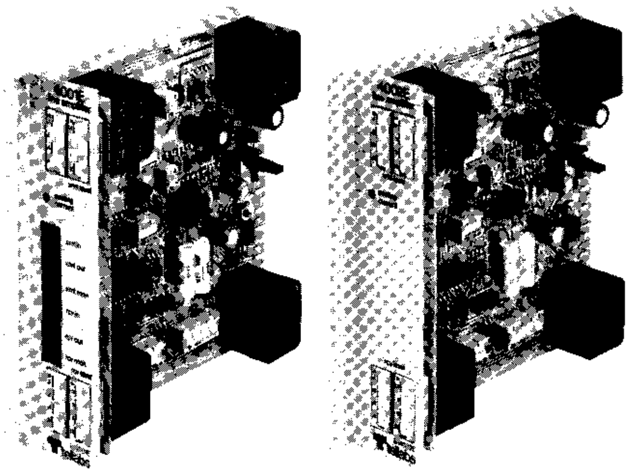


figure 2. 4001E and 4002E Prescription Line Amplifier modules

4001E and 4002E modules used in the 246 System further simplify alignment by providing switch-selectable increments of gain or loss and amplitude equalization for prescription alignment.

1.07 The 246 Mounting Assembly's backplane is equipped with five 25-pair female cable connectors for all external connections except battery and ground. Battery and ground connections are made via a barrier-type terminal strip on the Assembly's backplane.

1.08 The remainder of section 1 contains a brief description of the 246 System modules. For detailed information on these modules, refer to the Tellabs Practice on the 4001E and 4002E Prescription Line Amplifier modules and to the Tellabs Practice on the 4402S Pad/Transformer module.

4001E/4002E prescription line amplifier module

1.09 The 4001E/4002E Prescription Line Amplifier module (figure 2) provides gain, loss, equalization, and level control at the 246 System's common and multiple ports, thereby interfacing the fixed-loss resistive data bridge circuitry with external circuits.

1.10 The transmit and receive amplifiers of both modules may be individually switch-optioned to provide up to 24dB of either flat gain or flat loss in 0.1dB increments. Maximum output of each channel is +15dBm, with less than 1% distortion.

1.11 Equalization in the receive channel may be prescription-set to introduce up to 7.5dB of slope equalization between 1000 and 2804Hz in 0.5dB increments. The module's equalizer provides an additional 2dB of equalization on nonloaded cable when used with the module's 150-ohm terminating impedance option.

1.12 Each module may be switch-optioned for 1200, 600, or 150-ohm terminating impedances on the facility side, i.e., at the receive input and transmit output ports. Bridge-side terminating impedances (receive output port and transmit input port) are fixed at 600 ohms. All four port interfaces are balanced.

1.13 An option switch on each module conditions the facility-side ports for any one of the following:

A. Internally generated 20mA balanced sealing current (fed to the external transmission facility).

B. Acceptance of externally supplied sealing current.

C. Normal simplex lead derivation.

In addition to providing 20mA of balanced sealing current, both the 4001E and 4002E supply a higher initial value of sealing current ("ZAP" feature) for a short duration when inserted into their mountings.

1.14 Level adjustments can be made while the modules are mounted in place. The 4001E features a full complement of front-panel test jacks to facilitate alignment and maintenance activities. Both bridging and opening bantam-type jacks are provided at the receive input and transmit output facility ports while only opening bantam-type jacks are provided at the receive output and transmit input bridge ports. Where test jacks are not required, the 4002E provides all other features and functions of the 4001E.

1.15 The 4001E and 4002E modules incorporate an internally regulated power supply that permits operation on −22 to −56Vdc battery input (internally generated sealing current requires −42 to −56Vdc input battery). Current requirements range from 28mA when idle to 58mA with both the receive and transmit channels at maximum output. An additional 21mA is required with the internally generated sealing current option.

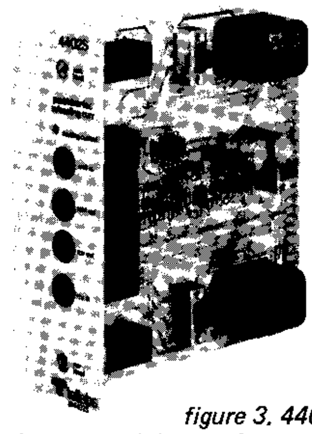


figure 3. 4402S Pad/Transformer module with Sealing Current

1.16 Surge protection is provided at the input and output ports of both the receive and transmit channels. Reverse-battery protection and transient-limiting are provided in each module's internal power supply circuitry.

4402S pad/transformer module with sealing current

1.17 The 4402S Pad/Transformer module with Sealing Current provides level control and termination for a 4wire voice-frequency facility. The 4402S interfaces the facility through two center-tapped balance transformers with switch-selectable balanced terminating impedances of 150, 600, and 1200 ohms. A three-position option switch conditions the module's facility port for normally derived simplex leads, 20mA of internally generated sealing current, or acceptance of externally applied sealing current. Terminal-side (i.e., bridge-side) terminating impedance is fixed at 600 ohms, balanced.

1.18 Level control in the receive and transmit channels is by front-panel T-pad attenuators that provide from 0 to 30dB of attenuation and, when used in conjunction with the front-panel test jacks, permit alignment and testing while the module is in its normal operating position. The 4402S's front panel also contains four opening test jacks. The *rcv in* jack looks back toward the facility, while the *rcv out, xmt in,* and *xmt out* jacks look into the module.

1.19 The 4402S draws current only when optioned for internally generated sealing current. Termination and level-control functions are provided by passive circuitry. Thus, the module introduces 0.5dB of signal attenuation when adjusted for minimum loss and 30.5dB of attenuation when adjusted for maximum loss. When optioned for internal sealing current, the 4402S draws approximately 21mA at –48Vdc.

2. application

2.01 The 246 Resistive Data Bridge System interfaces a common 4wire port with multiple 4wire ports to provide a bridge network normally used for the transmission of VF data signals. As such, the 246 RDB System may be used at a central office or at a remote location to provide a bridging network between, for example, a number of outstation data modems and a centralized computer. This arrangement is commonly found in credit card verification systems and in branch banking operations.

2.02 To perform its data bridging function, the 246 RDB System uses a split bridge design, i.e., the common port is interfaced with the multiple ports through separate splitter and combiner channels. In the splitter channel, data received at the common input port is distributed to the multiple output ports through a 14dB fixed-loss resistive network. In the combiner channel, incoming data at the multiple input ports is coupled to the common output port through a 14dB fixed-loss resistive network. Because the splitter and combiner channels are independent, full-duplex operation (i.e., simultaneous bidirectional data transmission) is permitted.

2.03 The 4001E and 4002E Prescription Line Amplifier modules provide level conditioning and impedance matching for both the common and multiple ports of the 246 RDB System and are housed in the 246 RDB Mounting Assembly. The 246 RDB Mounting Assembly is a Tellabs Type 10 Mounting Shelf with a connectorized printed-circuit backplane containing the fixed-loss bridging networks. The two versions of the 246 Assembly each house up to twelve 246 System modules. The 246A Assembly mounts in a 19-inch relay rack, while the 246B Assembly mounts in a 23-inch relay rack.

2.04 A single 246 Mounting Assembly is normally configured as two separate bridge networks (Bridges A and B) with each bridge having one common port and up to five multiple ports, as shown in figure 4. Optionally, the System may be arranged with the two bridges connected in tandem to provide a single expanded data bridge. This is done by operating a slide switch located on the rear of the Assembly's backplane. A single bridging network consists of one common port (Bridge A common port) and up to ten multiple ports (using both Bridge A and Bridge B multiple ports). The common port of Bridge B is used as an intermediate amplifier to connect the multiple ports of Bridge B to the common port of Bridge A.

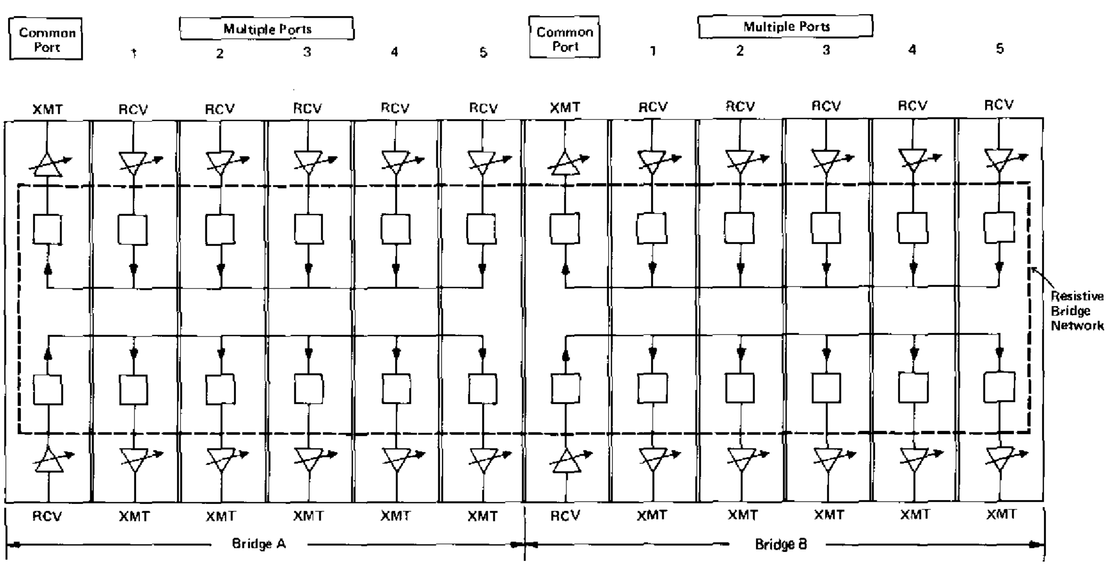
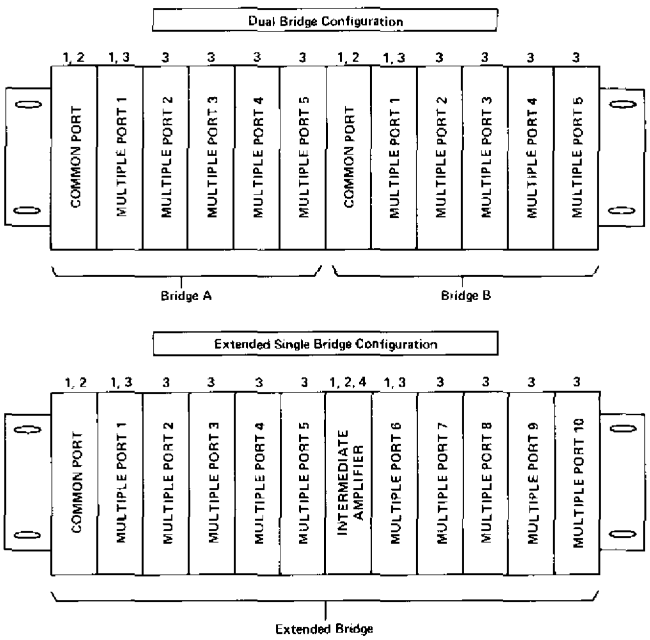


figure 4. 246 Resistive Data Bridge System

2.05 The physical arrangement of the 246 RDB System, as viewed from the front of the 246 Mounting Assembly, is shown in figure 5. Because of the prewired, connectorized printed-circuit backplane, all System module positions are dedicated. The common port of Bridge A is the first module position (leftmost position), and the next five module positions are used for Bridge-A multiple ports. The common port of Bridge B uses the seventh module position, and the remaining five module positions are used for Bridge-B multiple ports.

2.06 The 246 Mounting Assembly permits the number of multiple ports of an existing 246 bridge network to be altered by adding or removing 4001E, 4002E, or 4402S System modules to establish a new multiple-port arrangement without realignment or rewiring of the existing 246 System. Transmission levels at both the common and multiple ports are maintained within approximately ±0.2dB, and vacant multiple port positions need not be terminated.



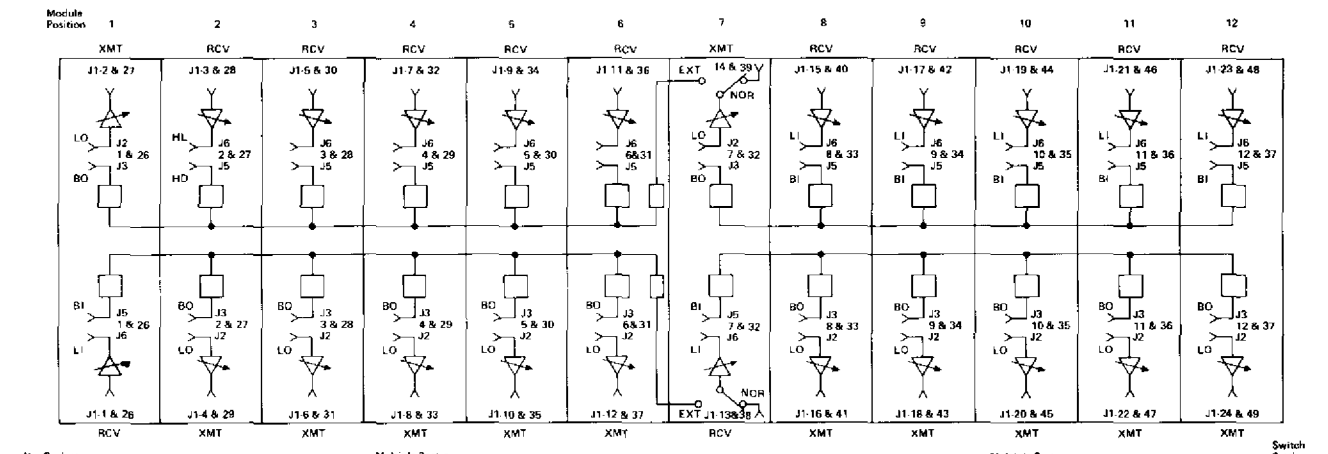
Notes: *1. Minimum modules required to configure 246 RDB System.*
2. Modules in this position must be 4001E or 4002E.
3. Modules in this position can be 4001E, 4002E, or 4402S.
4. 4001E or 4002E must be set for 14dB of gain in both receive and transmit channels.

figure 5. Physical arrangement of 246 System modules (front view)

levels and alignment

2.07 The level of the voice-frequency data signals at the receive (facility input port to resistive bridge network) channel or the transmit (resistive bridge network to facility output port) channel are individually adjustable via the 4001E, 4002E, and 4402S System modules. Up to 24dB of flat gain or loss, in 0.1dB increments, can be selected via the 4001E and 4002E front-panel prescription level switches. Up to 7.5dB of slope equalization at 2804Hz (re 1000Hz) can also be introduced, in 0.5dB increments, in the receive channel of the 4001E and 4002E modules. Refer to the Tellabs Practice on the 4001E/4002E module for detailed information on level and alignment procedures. Up to 30.5dB of attenuation can be introduced into the receive and transmit channels of the 4402S through continuously adjustable front-panel potentiometers; gain and postequalization are not provided. Alignment information is provided in the Tellabs Practice on the 4402S.

2.08 The 246 RDB System is designed for compatibility with the Western Electric Switched Maintenance Access System (SMAS 5A). Four 25-pair female connectors on the 246 Assembly's backplane provide SMAS Type 3 Maintenance Connector access points to the resistive bridge circuitry, as shown in figure 6. Access to tip and ring leads (of all System module positions) that connect the fixed-loss resistive network (bridge out [BO]) to the transmit channel inputs (leg out [LO]) are provided via connectors *J3* and *J2*, respectively. Access



No. Bridges		Multiple Port =						Multiple Port =					Switch Setting
2	BRIDGE A Common	1	2	3	4	5	BRIDGE B Common	1	2	3	4	5	NORMAL
1	EXTENDED BRIDGE Common	1	2	3	4	5	Intermediate Amplifier	6	7	8	9	10	EXTEND

Bridge Loss: 14dB

□ Resistive Fixed Loss Bridge Network

MDF connector: J1

SMAS connectors: J2, J3, J5, J6

figure 6. 246 RDB System — Backplane Connectors

to tip and ring leads (of all System module positions) that connect the receive-channel outputs (leg in [LI]) to the fixed-loss resistive network (bridge in [BI]) are provided via connectors *J6* and *J5*, respectively. Since SMAS 5A is designed to accommodate twenty-four 4wire circuits, a more efficient utilization of SMAS can be achieved by integrating the bridge networks of two 246 RDB Systems into a single Type 3 Maintenance Connector System. Tellabs' 50-4005 Cable Adampter Assembly permits the combining of connectors *J2, J3, J5,* and *J6* of two 246 RDB Systems, as shown in figure 7.

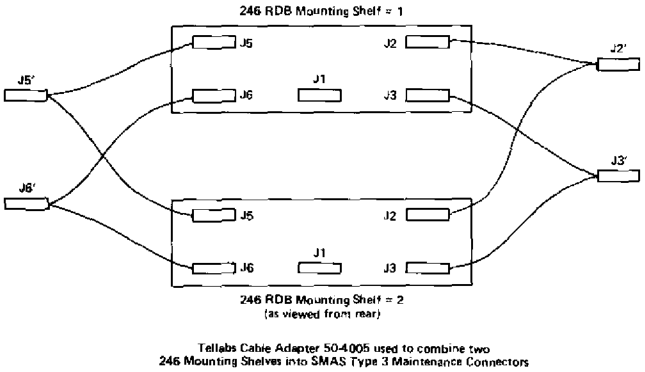


figure 7. Interfacing Two 246 Mounting Shelves into SMAS

Note: *For use of the 246 RDB System in non-SMAS applications, interconnecting cables must be installed between connectors* J2 *and* J3 *and also between connectors* J5 *and* J6 *on the 246 Assembly's backplane, as shown in figure 8. The 246 Assembly is normally supplied with these cables in place.*

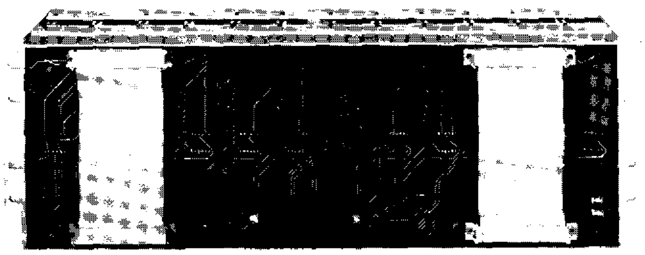


figure 8. Non-SMAS Interconnecting Cables

3. installation

inspection

3.01 The 246 Resistive Data Bridge Assembly and its component modules should be 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 equipment should be inspected again prior to installation.

installer connections

3.02 All external connections to the 246 Assembly except battery and ground are made through five 25-pair female cable connectors (*J1, J2, J3, J5* and *J6*) on the Assembly's backplane. Battery and ground connections are made to a two-position barrier-type terminal strip also located on the Assembly's backplane.

3.03 All facility connections (rcv in and xmt out) are cabled to connector *J1*. Connectors *J2, J3, J5,* and *J6* are part of the SMAS interface and contain, respectively, leg out (LO), bridge out (BO), bridge in (BI), and leg in (LI) conductors. The 246 Assembly includes two plug-ended ribbon cables that are used to jumper between *J2* and *J3* and between *J5* and *J6* when SMAS Type 3 or remote manual connector access is not required. Installer connections are usually made at the cross-connect frame (MDF or IDF), and plug-ended cables are run to the Assembly. These cables are arranged in accordance with the lead-assignment information contained in tables 1 through 5. The connections to connector *J1* are listed in table 1, those to *J2* and *J3* are listed in tables 2 and 3, and those to *J5* and *J6* are listed in tables 4 and 5. If SMAS or remote manual intermediate connector access is **not** required, the only external cabling required is that to connector *J1*. However, the included ribbon cables must be present between *J2* and *J3* and between *J5* and *J6*.

Lead Designation	56-Pin Module Connector		25-Pair Connector				56-Pin Module Connector		Lead Designation
	Module Position	Pin	Color Code	Pin	Pin	Color Code	Pin	Module Position	
RCV IN R	1	13	Bl-W	1	26	W-Bl	7	1	RCV IN T
XMT OUT R	1	47	O-W	2	27	W-O	41	1	XMT OUT T
RCV IN R	2	13	G-W	3	28	W-G	7	1	RCV IN T
XMT OUT R	2	47	Br-W	4	29	W-Br	41	2	XMT OUT T
RCV IN R	3	13	S-W	5	30	W-S	7	3	RCV IN T
XMT OUT R	3	47	Bl-R	6	31	R-Bl	41	3	XMT OUT T
RCV IN R	4	13	O-R	7	32	R-O	7	4	RCV IN T
XMT OUT R	4	47	G-R	8	33	R-G	41	4	XMT OUT T
RCV IN R	5	13	Br-R	9	34	R-Br	7	5	RCV IN T
XMT OUT R	5	47	S-R	10	35	R-S	41	5	XMT OUT T
RCV IN R	6	13	Bl-Bk	11	36	Bk-Bl	7	6	RCV IN T
XMT OUT R	6	47	O-Bk	12	37	Bk-O	41	6	XMT OUT T
RCV IN R	7	13	G-Bk	13	38	Bk-G	7	7	RCV IN T
XMT OUT R	7	47	Br-Bk	14	39	Bk-Br	41	7	XMT OUT T
RCV IN R	8	13	S-Bk	15	40	Bk-S	7	8	RCV IN T
XMT OUT R	8	47	Bl-Y	16	41	Y-Bl	41	8	XMT OUT T
RCV IN R	9	13	O-Y	17	42	Y-O	7	9	RCV IN T
XMT OUT R	9	47	G-Y	18	43	Y-G	41	9	XMT OUT T
RCV IN R	10	13	Br-Y	19	44	Y-Br	7	10	RCV IN T
XMT OUT R	10	47	S-Y	20	45	Y-S	41	10	XMT OUT T
RCV IN R	11	13	Bl-V	21	46	V-Bl	7	11	RCV IN T
XMT OUT R	11	47	O-V	22	47	V-O	41	11	XMT OUT T
RCV IN R	12	13	G-V	23	48	V-G	7	12	RCV IN T
XMT OUT R	12	47	Br-V	24	49	V-Br	41	12	XMT OUT T
-	–	–	S-V	25	50	V-S	–	–	–

table 1. I/O Connector J1
(Input/Output Main Distribution Frame)

Lead Designation	56-Pin Module Connector		25-Pair Connector				56-Pin Module Connector		Lead Designation
	Module Position	Pin	Color Code	Pin	Pin	Color Code	Pin	Module Position	
LO R	1	49	Bl-W	1	26	W-Bl	55	1	LO T
LO R	2	49	O-W	2	27	W-O	55	2	LO T
LO R	3	49	G-W	3	28	W-G	55	3	LO T
LO R	4	49	Br-W	4	29	W-Br	55	4	LO T
LO R	5	49	S-W	5	30	W-S	55	5	LO T
LO R	6	49	Bl-R	6	31	R-Bl	55	6	LO T
LO R	7	49	O-R	7	32	R-O	55	7	LO T
LO R	8	49	G-R	8	33	R-G	55	8	LO T
LO R	9	49	Br-R	9	34	R-Br	55	9	LO T
LO R	10	49	S-R	10	35	R-S	55	10	LO T
LO,R	11	49	Sl-Bk	11	36	Bk-Bl	55	11	LO T
LO R	12	49	O-Bk	12	37	Bk-O	55	12	LO T

table 2. I/O Connector J2 (SMAS Leg Out [LO])

Lead Designation	56-Pin Module Connector		25-Pair Connector				56-Pin Module Connector		Lead Designation
	Module Position	Pin	Color Code	Pin	Pin	Color Code	Pin	Module Position	
BO R	1	25	Bl-W	1	26	W-Bl	21	1	BO T
BO R	2	25	O-W	2	27	W-O	21	2	BO T
BO R	3	25	G-W	3	28	W-G	21	3	BO T
BO R	4	25	Br-W	4	29	W-Br	21	4	BO T
BO R	5	25	S-W	5	30	W-S	21	5	BO T
BO R	6	25	Bl-R	6	31	R-Bl	21	6	BO T
BO R	7	25	O-R	7	32	R-O	21	7	BO T
BO R	8	25	G-R	8	33	R-G	21	8	BO T
BO R	9	25	Br-R	9	34	R-Br	21	9	BO T
BO R	10	25	S-R	10	35	R-S	21	10	BO T
BO R	11	25	Bl-Bk	11	36	Bk-Bl	21	11	BO T
BO R	12	25	O-Bk	12	37	Bk-O	21	12	BO T

table 3. I/O Connector J3 (SMAS Bridge Out [BO])

Lead Designation	56-Pin Module Connector		25-Pair Connector				56-Pin Module Connector		Lead Designation
	Module Position	Pin	Color Code	Pin	Pin	Color Code	Pin	Module Position	
BI R	1	31	Bl-W	1	26	W-Bl	27	1	BI T
BI R	2	31	O-W	2	27	W-O	27	2	BI T
BI R	3	31	G-W	3	28	W-G	27	3	BI T
BI R	4	31	Br-W	4	29	W-Br	27	4	BI T
BI R	5	31	S-W	5	30	W-S	27	5	BI T
BI R	6	31	Bl-R	6	31	R-Bl	27	6	BI T
BI R	7	31	O-R	7	32	R-O	27	7	BI T
BI R	8	31	G-R	8	33	R-G	27	8	BI T
BI R	9	31	Br-R	9	34	R-Br	27	9	BI T
BI R	10	31	S-R	10	35	R-S	27	10	BI T
BI R	11	31	Bl-Bk	11	36	Bk-Bl	27	11	BI T
BI R	12	31	O-Bk	12	37	Bk-O	27	12	BI T

table 4. I/O Connector J5 (SMAS Bridge In [BI])

Lead Designation	56-Pin Module Connector		25-Pair Connector				56-Pin Module Connector		Lead Designation
	Module Position	Pin	Color Code	Pin	Pin	Color Code	Pin	Module Position	
LI R	1	15	Bl-W	1	26	W-Bl	5	1	LI T
LI R	2	15	O-W	2	27	W-O	5	2	LI T
LI R	3	15	G-W	3	28	W-G	5	3	LI T
LI R	4	15	Br-W	4	29	W-Br	5	4	LI T
LI R	5	15	S-W	5	30	W-S	5	5	LI T
LI R	6	15	Bl-R	6	31	R-Bl	5	6	LI T
LI R	7	15	O-R	7	32	R-O	5	7	LI T
LI R	8	15	G-R	8	33	R-G	5	8	LI T
LI R	9	15	Br-R	9	34	R-Br	5	9	LI T
LI R	10	15	S-R	10	35	R-S	5	10	LI T
LI R	11	15	Bl-Bk	11	36	Bk-Bl	5	11	LI T
LI R	12	15	O-Bk	12	37	Bk-O	5	12	LI T

table 5. I/O Connector J6 (SMAS Leg In [IN])

3.04 If two or more 246 Assemblies are to be installed and configured for SMAS Type 3 or remote manual testing, a more economical method of cabling uses the optional Tellabs 50-4005 Cable Adapter shown in figure 7. Connectors *J2, J3, J5,* and *J6* on the rear of each 246 Assembly use only 12 pairs of each 25-pair connector. By installing the *J2'* Y-adapter (for example) between connector *J2* on the first shelf and connector *J2* on the second shelf, it is possible to serve both shelves with a single 25-pair cable. The same is true for connectors *J3, J5,* and *J6,* thus reducing the number of cables required for facility connections and SMAS access. Of course, other cable adapters are available; contact Tellabs' Applications Engineering Department with your requirements.

3.05 After all cables are in place, power connections to the 246 Assembly are made via the two-position barrier-type terminal located on the lower left of the Assembly (as viewed from the rear). Connect −22 to −56Vdc filtered battery (or −42 to −56Vdc filtered battery if the modules' internal sealing current option is to be used) to the negative (−) terminal and ground to the positive (+) terminal on the strip.

3.06 After cabling and powering the 246 Assembly, option switch *S1* on the Assembly must be set to determine the size of the bridge. Switch *S1*, located in module position 7 and accessible from the front of the 246 Assembly when that module is removed, determines whether the 246 Assembly provides one bridge or two completely independent bridges. When *S1* is in the *NORM* position, the 246 Assembly is arranged for two independent bridge networks, Bridge A and Bridge B. Bridge A, encompassing module positions 1 through 6, provides one common port in module position 1 and five multiple ports in module positions 2 through 6. Bridge B provides a common port in module position 7 and five multiple ports in module positions 8 through 12. When *S1* is in the *EXTEND* position, however, it arranges the 246 as a single bridge having a single common port in module position 1, and 10 multiple ports in module positions 2 through 6 and 8 through 12. When *S1* is in the *EXTEND* position, the module in position 7 **must** be adjusted for 14dB of gain in both transmit and receive channels and **must not** be optioned to supply sealing current; instead, the module's switch *S3* should be set to the *SX* position.

3.07 Before inserting the appropriate complement of modules, ensure that each module is properly optioned for its intended application. All options are selected via slide switches or DIP switches located on the printed circuit board, or, in some cases, on the front panel of each module. Refer to the appropriate module Practices for specific optioning information.

expansion of established bridge to vacant module positions

3.08 If an established bridge consisting of, for example, four multiple ports is to be expanded to include one more multiple port (a total of five multiple ports), no wiring changes are required except for the additional transmit and receive drops for that module position. If this hypothetical bridge is to be expanded with from two to six additional ports and the 246 Assembly has vacant module positions (i.e., only one bridge in the Assembly), only the additional transmit and receive drops must be wired and the 4001E or 4002E in module position 7 must be optioned as explained in paragraph 3.06. If, however, vacant module positions are **not** available within the same 246 Assembly, jumper wiring must be completed at the MDF or IDF.

expansion beyond 10 multiple ports

3.09 If the number of multiple ports in the data bridge exceeds the capacity of a single 246 Assembly (10 multiple ports), or if an established bridge is to be expanded beyond the capacity available in a single 246, the necessary interconnections can be most conveniently made at the MDF or IDF. The data bridge shown in figures 9 and 10 is arranged for up to 100 multiple ports. Normally, in smaller data bridges with up to 10 multiple ports, only the module in module position 1 is a common port. The modules in module positions 2 through 6 and 8 through 12 serve as multiple ports, and the module in module position 7 serves as an intermediate amplifier used to maintain bus levels. However, in the 100-multiple-port version shown, the first 246 Assembly (246-1) consists *entirely* of common ports except, of course, for the module in module position 7. In this arrangement, the module in module position 2 acts as a common port that feeds the 10 multiple ports in the second 246 Assembly (246-2), the module in module position 3 feeds 246-3, and so on. The connections between the common ports in 246-1 and their respective multiple ports in 246-2 through 246-11 are made at the cross-connect frame as follows:

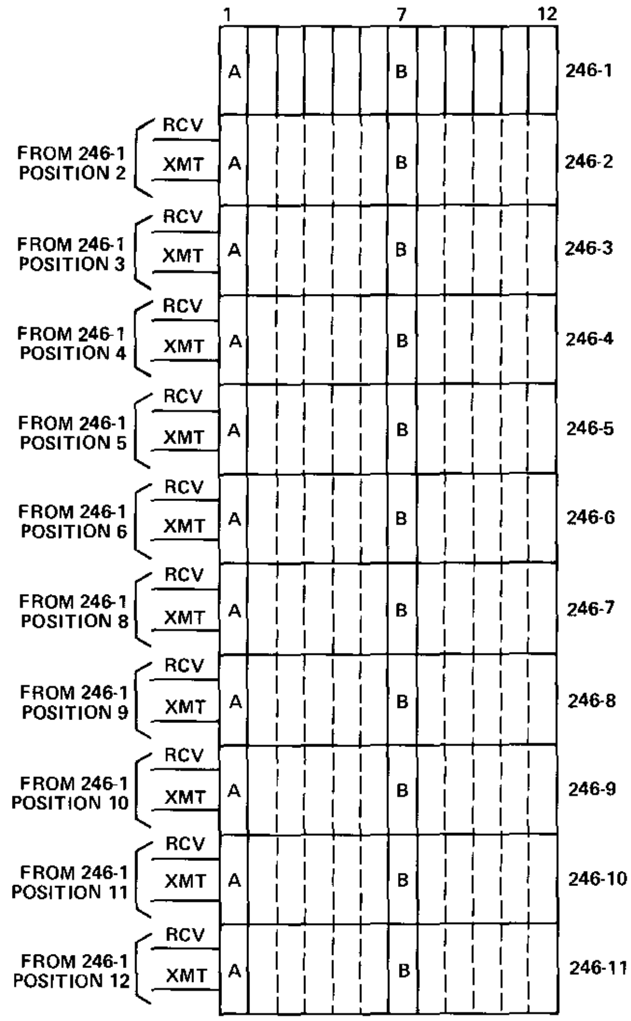
A. The 400XE in module position 1 of 246-1 is connected to the 4wire facility (as described in paragraph 3.03).

B. The transmit output tip and ring of the module in module position 2 of 246-1 is connected to the receive input tip and ring of the 400XE module in module position 1 of 246-2.

C. The receive input tip and ring of the module in module position 2 of 246-1 is connected to the transmit output tip and ring of the 400XE module in module position 1 of 246-2.

D. The same interconnection procedure is followed for the remaining common-port modules in 246-1, connecting them to the module in position 1 of each respective 246-X multiple. This method is recommended to minimize noise. The correspondences between the common-port modules in 246-1 and the multiple-port modules in 246-2 through 246-11 are shown in figure 9.

Note: *The 400XE modules in position 7 in 246-1 through 246-11 must all be optioned for* **14dB** *of gain in both the receive and transmit channels and for* **no** *internal sealing current.*



Note: *Module positions marked "A" must contain a 400XE. Module positions marked "B" must contain a 400XE aligned for 14dB of gain in both the transmit and receive channels, and optioned for* **no** *sealing current. Unmarked module positions may contain a 4001E, 4002E, 4402S, or may be left vacant to allow for future expansion.*

figure 10. 246 RDB expanded to 100 common ports

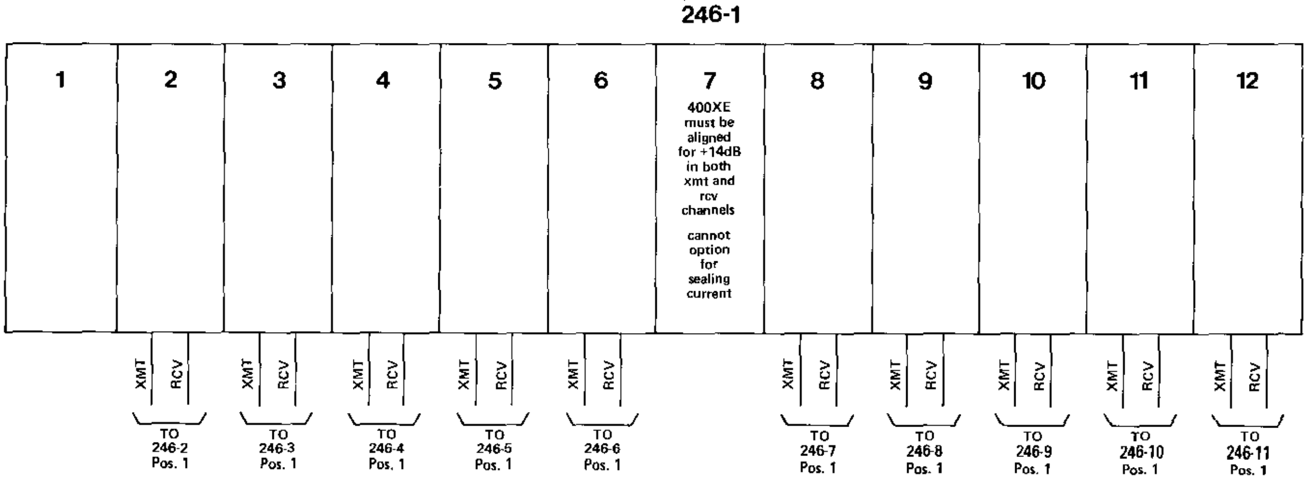


figure 9. 246 RDB Common Port Shelf of 100-Multiple-Port System

3.10 The same principle of expansion explained in paragraph 3.09 can be implemented on a smaller scale for expansion of a 246 RDB when a sufficient number of vacant module positions is not available in the original 246 Assembly. Expansion of a single data bridge beyond 100 multiple ports is not recommended due to the likelihood of noise increasing to objectionable levels.

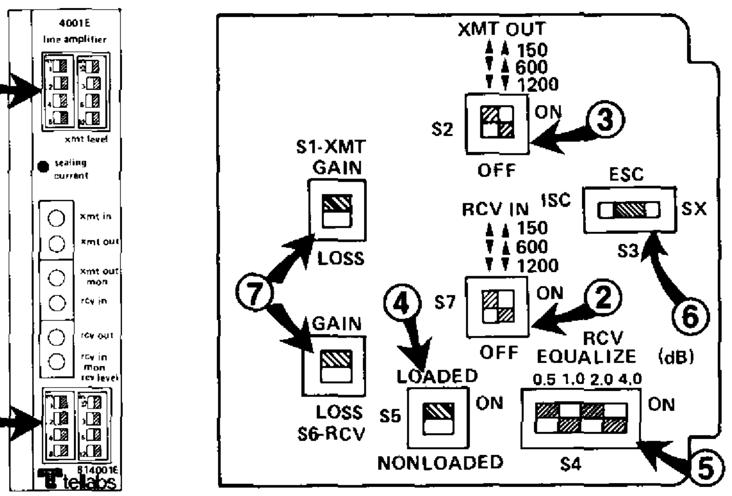
basic alignment

3.11 Gain in the 246 Resistive Data Bridge System is provided by 4001E or 4002E Prescription Line Amplifiers. The 4402S Pad/Transformer module with Sealing Current can be used in multiple ports where only attenuation is required, as this module does not provide gain. The following condensed alignment procedures for the 4402S and 4001E/4002E makes the following assumptions: (1) alignment is being performed locally, (2) all pre-alignment optioning (e.g., impedance matching) is completed, and (3) all facility and power cabling is completed. Basic alignment of the 4402S is described in paragraphs 3.12 through 3.14, and basic alignment for the 4001E/4002E is described in figures 11 through 14. Specific information is presented in greater detail in their respective Tellabs Practices.

4402S basic alignment

3.12 Alignment of the 4402S module consists of adjusting the receive and transmit attenuators to provide levels consistent with circuit specifications.

3.13 To adjust the **receive level**, request the distant end to send 1000Hz test tone at the appropriate level. Using a transmission measuring set (TMS) terminated in 150, 600 or 1200 ohms, as required, measure the input level at the module's *rcv in* test jack. Confirm that the input level is correct; then connect the receive portion of the TMS (terminated in 600 ohms) to the module's *rcv out* jack and adjust the *rcv* attenuator to attain the specified output level.



1 Refer to the CLR and determine the following: receive-channel input impedance, transmit-channel output impedance, receive-channel equalization, the type of facility the module interfaces, and whether gain or loss is required in the receive and transmit channels. Once these requirements are known, proceed to step 2 and perform the remaining preliminary alignment steps in numeric order.

2 Set *S7* to select receive-channel input impedance. Impedance switch-option settings are shown above. Switch positions for various options are also indicated on the module's printed circuit board adjacent to the switch.

3 Set *S2* to select transmit-channel output impedance. Refer to table 2 (4001E/2E Practice) and the module's printed circuit board for optioning information.

4 Set *S5* for the type of facility (loaded or nonloaded cable) that the module interfaces at the input of receive channel. Options are indicated adjacent to this switch.

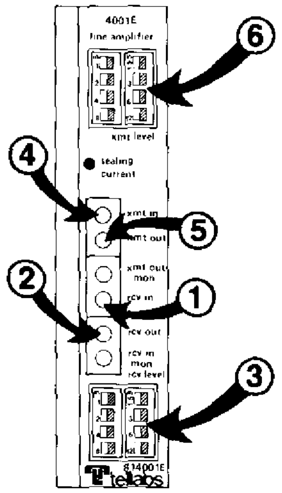
5 Set *S4* for the required receive-channel equalization. Equalization options are indicated adjacent to this switch. If prescription alignment of the module's equalizer is not possible or is unsatisfactory, equalization settings may be determined from frequency response measurements and cable loss data calculations (figure 14) after transmission levels are set.

6 Set *S3* for the required sealing current or SX lead options as described in paragraph 3.11 (4001E/2E Practice) and indicated on printed circuit board adjacent to this switch.

7 Refer to the CLR to determine if gain or loss is required in the receive and transmit channels. If gain is required in the receive channel, set *S6* to *GAIN;* if loss is required, set *S6* to *LOSS*. If gain is required in the transmit channel, set *S1* to *GAIN*; if loss is required, set *S1* to *LOSS*.

8 Set the front-panel *rcv* and *xmt level* switches to *out* (no gain or loss). Insert the module into its mounting and apply power. If the CLR-specified transmission requirement is expressed in terms of expected measured gain (EMG), proceed to figure 12 and perform the gain adjustment procedure. If the transmission requirement is expressed in terms of transmission level points (TLP's), proceed to figure 13 and perform the output level procedure.

figure 11. 4001E preliminary alignment procedure



Note: *When performing this procedure, test equipment must provide a 600-ohm terminating impedance. If this is not possible, option the module to match the impedance of the test equipment while alignment is performed. Be sure to reoption the module appropriately when alignment is completed.*

1 Determine from the CLR the required amount of receive-channel gain or loss and call this amount G. Connect the transmit portion of a TMS, arranged for a −G (see note above) output level at 1000Hz, to the *rcv in* jack.

2 Connect the receive portion of the TMS, terminated in 600 ohms, to the *rcv out* jack.

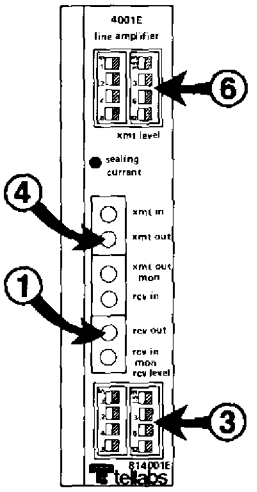
3 Set to *IN* the combination of front-panel *rcv level* switches that adds up to the required amount of gain or loss, as indicated by a 0dBm TMS reading.

4 Determine from the CLR the required amount of transmit-channel gain or loss and call this amount G. Connect the transmit portion of a TMS, arranged for a −G output level (see note above) at 1000Hz, to the *xmt in* jack.

5 Connect the receive portion of the TMS, terminated in 600 ohms, to the *xmt out* jack.

6 Set to *IN* the combination of front-panel *xmt level* switches that adds up to the required amount of gain or loss, as indicated by a 0dBm TMS reading.

figure 12. 4001E gain adjustment procedure



Note: *When performing this procedure, test equipment must match the impedance of the transmission facility. If this is not possible, option the module to match the impedance of the test equipment while alignment is performed. Be sure to reoption the module appropriately when alignment is completed (see paragraph 3.14, 4001E/2E Practice).*

1 Connect the receive portion of a TMS, appropriately terminated, to the *rcv out* jack.

2 Request that personnel at the distant (receive-channel input) end send 1000Hz tone at the CLR-specified level.

3 Calculate the required receive output TLP from the CLR and set to *IN* the combination of front-panel *rcv level* switches that adds up to the required level, as verified on the TMS.

4 Remove the TMS and connect it to the *xmt out* jack.

5 Request that personnel at the distant (transmit-channel input) end send 1000Hz tone at the CLR-specified level.

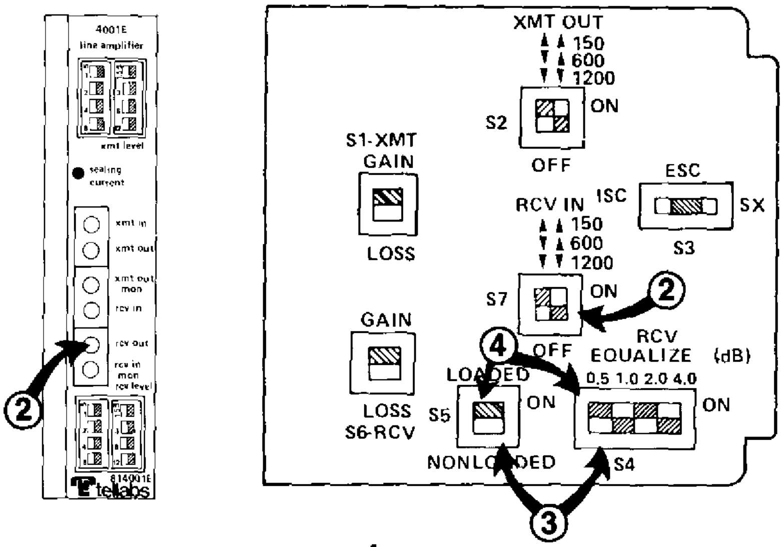
6 Calculate the required transmit output TLP from the CLR and set to *IN* the combination of front-panel *xmt level* switches that adds up to the required level, as verified on the TMS.

figure 13. 4001E output level adjustment

3.14 To adjust the **transmit level**, arrange the transmit portion of the TMS to output 1000Hz at 600 ohms and at the level specified for the circuit. Connect this signal to the *xmt in* jack. Arrange the receive portion of the TMS for properly terminated measurement (150, 600 or 1200 ohms, as required) and connect it to the *xmt out* jack. Adjust the *xmt* attenuator to achieve the specified output level for the circuit, as indicated on the TMS.

404Hz/1000Hz difference (in dB)	required amount of equalization (in dB)
0 to −0.2	0.0
−0.2 to −0.8	0.5
−0.8 to −1.2	1.0
−1.2 to −2.5	1.5

table 6. 4001E/4002E loaded cable equalization from cable loss data



1 Remove the module from its mounting and verify impedance options. Disable any equalizer settings and place the module back into its mounting.

2 Connect the receive portion of a TMS, properly terminated, to the *rcv out* jack. Request that personnel at the distant (receive-channel input) end of the circuit, output 404, 1000, and 2804Hz tones at 0dBm level. On **nonloaded** facilities only, if the 2804Hz level is more than 7.5dB below the 1000Hz level, reset *S7* for 150 ohms and have the distant end retransmit 1000 and 2804Hz tones. Record the 404, 1000, and 2804Hz levels.

3 Loaded Cable: Set *S5* to *LOADED.* Subtract the measured 404Hz level from the measured 1000Hz level (step 2) and, with reference to table 6, set *S4* for the required amount of equalization.

4 Nonloaded Cable: Set *S5* to *NONLOADED.* Subtract the measured 1000Hz level from the measured 2804Hz level (step 2) and, with reference to table 7, set *S4* for the required amount of equalization.

figure 14. 4001E frequency-response measurement and cable-loss data

1000Hz/2804Hz difference (in dB)	required amount of equalization (in dB)
0	0.0
−0.3 to −0.7	0.5
−0.7 to −1.2	1.0
−1.2 to −1.7	1.5
−1.7 to −2.2	2.0
−2.2 to −2.7	2.5
−2.7 to −3.2	3.0
−3.2 to −3.7	3.5
−3.7 to −4.2	4.0
−4.2 to −4.7	4.5
−4.7 to −5.2	5.0
−5.2 to −5.7	5.5
−5.7 to −6.2	6.0
−6.2 to −6.7	6.5
−6.7 to −7.2	7.0
−7.2 to −7.7	7.5

Note: *If 1000Hz-2804Hz differential exceeds 7.5dB, option S7 for 150 ohms, as appropriate.*

table 7. nonloaded cable equalization from cable loss data

4. specifications

Note: *For detailed specifications of the 4001E or 4002E and 4402S modules used in the 246 RDB System, please see the separate Tellabs Practices on those modules.*

bridge specifications

bridge configurations

- **with two 5-multiple-port bridges in 246 Assembly:**
  - **bridge A:** **common port is module position 1; multiple ports are module positions 2 through 6**
  - **bridge B:** **common port is module position 7; multiple ports are module positions 8 through 12**
- **for one 10-multiple-port bridge in 246 Assembly: option switch on 246 Assembly's backplane must be set for tandeming of the two 5-multiple-port bridges; module in Assembly position 7, which provides the tandem interface, must be optioned for 600-ohm facility-side impedance, 14dB of gain in both channels, and no internally generated sealing current**

electrical characteristics

port-to-port loss: 14dB

port impedance: 600 ohms, balanced (unused ports are terminated in 600 ohms via shorting contacts on module printed-circuit-board connectors)

input/output connections

five 25 cable pair rear panel female I/O connectors provide connection to bridge:

- **connector J1 provides module facility connections to MDF or IDF**

  connectors *J2, J3, J5, J6* provide SMAS interface to bridge. For non-SMAS applications, a cable between *J2* and *J3* and a cable between *J5* and *J6* are provided.

mounting
246A Mounting Assembly has 12 module positions, mounts in 19-inch relay rack, occupies 6 inches of vertical rack space; 246B Mounting Assembly has 12 module positions, mounts in 23-inch relay rack, occupies 6 inches of vertical rack space

4001E/4002E module specifications

terminating impedance
facility side: 150 ohms ±15%, 600 ohms ±10%, or 1200 ohms ±10%, balanced, switch-selectable
bridge side: 600 ohms ±10%, fixed, balanced

flat gain/loss
–24 to +24dB in 0.1dB increments, prescription-set via front-panel switches (gain or loss determined by switch option)

deviation from gain setting indicated by front-panel switches
±0.25dB maximum, re 1000Hz

maximum output level
+15dBm

total harmonic distortion
less than 1% at +15dBm output

equalization
0 to 7.5dB at 2804Hz re 1000Hz level, switch-selectable in 0.5dB increments (does not affect 1000Hz level)

frequency response
±1.0dB re 1000Hz level, 300 to 4000Hz

noise
15dBrnC maximum at maximum gain

delay distortion
less than 100μs, 300 to 3000Hz, re 1000Hz (measured with maximum equalization)

interchannel crosstalk loss (zero port-to-port gain)
85dB minimum, re 1000Hz
75dB minimum, re 3000Hz

intermodule crosstalk loss (zero port-to-port gain)
90dB minimum, re 1000Hz
85dB minimum, re 3000Hz

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

4402S module specifications

terminating impedance
facility side: 150 ohms ±15%, 600 ohms ±10%, or 1200 ohms ±10%, balanced, switch-selectable
bridge side: 600 ohms ±10%, fixed, balanced

attenuation range
0.5 to 30.5dB, continuously adjustable

simplex-lead current
120mA maximum, 5mA maximum unbalanced

insertion loss
0.5dB at 1000Hz (minimum)

envelope delay
less than 100μs

longitudinal balance
60dB minimum, 200 to 4000Hz, facility side only

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

5. testing and troubleshooting

5.01 This Testing Guide may be used to assist in the installation, testing, or troubleshooting of the 246 Resistive Data Bridge System. The *testing guide checklist* below identifies the most common types of general trouble conditions, with suggestions as to the probable cause. For specific signaling or transmission difficulties, consult the relevant module practice. Detailed testing information and a sequence diagram for each module installed in the 246 Assembly will be found in the practice for the module. In general, the most expeditious method of isolating trouble is the substitution of a known good module for a suspected defective module while referencing the module's *testing guide checklist* to determine proper operation.

5.02 It is strongly recommended that no internal (component-level) testing or repairs be attempted on the 246 Mounting Assembly or associated modules. Unauthorized testing or repairs may void your Tellabs warranty.

5.03 Tellabs warrants all 246 System Assemblies and modules to be free of defective components, workmanship, and design for a period of two years from the date of manufacture, when applied as outlined in our Practices, subject to handling and installation commensurate with industry standards for solid-state electronic equipment. If a 246 System Assembly or module does not prove to be free of defective components, workmanship, and design under these criteria, Tellabs will replace or repair it free of charge.

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.*

5.04 If a situation arises that is not covered in the Checklist, contact Tellabs Customer Service at your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, Headquarters. Telephone numbers are as follows:

US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (213) 595-7071
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

5.05 If a 246 System Assembly or module is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is more expedient, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

5.06 To obtain a replacement 246 System Assembly or module, notify Tellabs via letter (see addresses below), telephone (see numbers above), or twx (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8XXXXX(X) part number that indicates the issue of the Assembly or module in question. Upon notification, we shall ship a replacement item to you. If the item in question is in warranty, the replacement will be shipped at no charge. Pack the defective item in the replacement item's carton, sign the packing slip included with the replacement, and enclose it with the defective item (this is your return authorization). Affix the preaddressed label provided with the replacement item to the carton being returned, and ship the item prepaid to Tellabs.

repair and return

5.07 Return the defective Assembly or module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532

in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 11
Mississauga, Ontario, Canada L4W 2S7

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

testing guide checklist

trouble condition	possible cause (in order of likelihood)
system inoperative (transmission not occurring)	1) Power connection faulty □. Verify power output (−22 to −56Vdc) by measuring voltage between negative (−) and positive (+) terminals on connector at rear of 246 Assembly (see paragraph 3.05) □. 2) Bypass switches incorrectly set □. 3) External wiring incorrect □.
excessive noise in transmission path	1) Improper grounding, especially existence of ground loops □. 2) Amplifier levels in 400XE misaligned □. 3) Unbalanced facility terminations □. 4) Defective System module. Substitute new module and retest □.
inability to derive proper transmission levels	1) Improper impedance optioning of System module(s) □. 2) Signal levels exceeding overload limits of 400XE □. 3) Defective System module. Substitute new module and retest □.
trouble at multiple port	1) See practice on specific module for troubleshooting instructions □.

Tellabs Incorporated
4951 Indiana Avenue, Lisle, Illinois 60532
telephone (312) 969-8800 twx 910-695-3530