993X Precision Balance Networks

contents

1. description and application

1.01 Tellabs' 9930 and 9932 Precision Balance Network (PBN) plug-on subassemblies (figure 1) approximate the impedances of specific transmission facilities and equipment to provide precision balancing (i.e., improvement of the transhybrid loss when unacceptably low) of terminating sets connected to these facilities and equipment. Improving a term set's transhybrid loss reduces the level of cross-coupling between the hybrid's 4wire transmit and receive paths.

1.02 This Practice is reissued to cover the Issue 3 9930 (Tellabs part number **839930**) and the Issue 2 9932 (Tellabs part number **829932**). The Issue 3 9930 differs from its Issue 2 counterpart in that it combines the functions of the 9930 and 9930A on a single subassembly. In addition, both the 9930 and 9932 have been slightly reduced in size and thus occupy a smaller mounting area on the host module.

1.03 A minimum of 20dB of transhybrid loss is provided by the 993X PBN subassemblies. In typical applications, however, these PBN's may provide as much as 35dB of transhybrid loss. The 993X subassemblies are designed for optional use on Tellabs' 4201 Terminating Set module (Issue 2 or later), 692X 2Wire SF Signaling Sets (Issue 2 or later), 4024 Repeater (24V4), 6122 2Wire SF Signaling Set with Gain, and 6461 Common Signaling module. These modules incorporate the necessary connectors and circuitry on their printed circuit boards to accept the 993X subassemblies on an interchangeable basis. The 993X subassemblies can also be used on Tellabs' single-circuit 4232 PBN module to convert this module to a dual-circuit unit (see paragraph 1.05).

1.04 Two different 993X subassemblies are available. The 9930 subassembly is designed for use when the 2wire circuit consists of 19 to 26 gauge H88 loaded cable; the 9932 is designed for use with 2wire nonloaded cable circuits or when the associated term set directly interfaces a Type 500 telephone set.

1.05 The 4232 PBN module contains circuitry identical to that of the 9932. Thus, when a 9930 subassembly is installed on a 4232, the 9930 subassembly creates a dual-circuit PBN that allows a

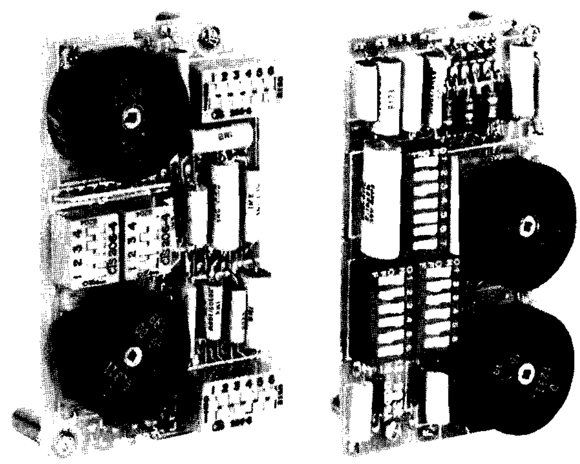


figure 1. 9930 and 9932 Precision Balance Network subassemblies

50 percent saving in rack space. This is especially advantageous in large 2wire system applications.

1.06 The 4201 Term Set, 4024 Repeater, 6461 Common Signaling module, and 692X 2Wire SF Signaling Sets can be switch-optioned for use with their own integral compromise balance networks or with external PBN's. The 993X subassemblies provide the latter in an extremely convenient form since no additional rack space or wiring is required.

1.07 For ease of alignment, all 993X PBN subassemblies feature DIP switches that can be prescription-set to achieve optimum balance in a given application.

2. installation

inspection

2.01 The 993X PBN subassembly 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 subassembly should be inspected again prior to installation.

mounting and connections

2.02 The 993X PBN subassembly plugs physically and electrically into a 4-pin receptacle on the printed circuit board of the host module. All connections to the subassembly are provided through this 4-pin receptacle. The subassembly is secured to the host module via two standoff mounting posts.

alignment — single gauge cable

2.03 For all 993X subassemblies, optimum balance is achieved in any application by setting the

cable type	cable capacitance (μF/mile)	set following switches to ON or CLOSED position:				on associated term set, build out to ½ section capacitance (μF)
		S1	S2	S3	S4	
19 ga. H88 hi-cap.	0.084	1, 2, 3, 4	2	4, 5, 6	1, 2, 3	0.033
22 ga. H88 hi-cap.	0.082	1, 2, 3, 4	2	4	1, 2, 3	0.033
24 ga. H88 hi-cap.	less than 0.0816	2	1, 3, 4	1, 3	1, 2, 3	0.028
	0.0816 to 0.0832	2, 4	1, 3, 4	1, 3	1, 2, 3	0.029
	0.0833 to 0.0848	2, 3	1, 3, 4	1, 3	1, 2, 3	0.029
	greater than 0.0848	2, 3, 4	1, 3, 4	1, 3	1, 2, 3	0.030
24 ga. H88 low-cap.	less than 0.0702	none	1, 3, 4	2, 3	1, 2, 3	0.023
	0.0702 to 0.0714	4	1, 3, 4	2, 3	1, 2, 3	0.024
	0.0715 to 0.0726	3	1, 3, 4	2, 3	1, 2, 3	0.024
	greater than 0.0726	3, 4	1, 3, 4	2, 3	1, 2, 3	0.024
26 ga. H88 low-cap.	less than 0.0656	none	1, 3	4, 5	4	0.022
	0.0656 to 0.0678	none	1, 3	4, 5	1, 4	0.023
	0.0679 to 0.700	3, 4	1, 3	4, 5	4	0.024
	greater than 0.0700	3, 4	1, 3	4, 5	1, 4	0.024
26 ga. H88 hi-cap.	less than 0.0742	none	1, 3	4, 5	4, 5, 6	0.026
	0.0742 to 0.0773	none	1, 3	4, 5	1, 4, 5, 6	0.027
	0.0774 to 0.0806	3, 4	1, 3	4, 5	4, 5, 6	0.028
	greater than 0.0806	3, 4	1, 3	4, 5	1, 4, 5, 6	0.028

table 1. Switch settings for 9930

subassembly's DIP switches in various combinations, depending upon such factors as cable type, gauge, capacitance, resistance, and the type of termination at the distant end. These switch settings are summarized in table 1 (9930 subassembly) and in tables 2 through 5 (9932 subassembly). Switch locations on the subassemblies are shown in figure 2.

alignment – mixed-gauge loaded cable

Note: *We shall refer to the several portions of the loop, each consisting of a separate cable gauge, as "segments" of the loop.*

2.04 When a 9930 PBN (and its associated term set) is used on a facility consisting of mixed-gauge loaded cable, determine the type, gauge and capacitance of the cable segment adjacent to the term set. For alignment purposes, assume that the entire mixed-gauge loop consists of this type of cable and align the PBN in accordance with table 1. However, if the cable segment adjacent to the term set is an entrance cable less than 500 feet long, disregard it and base your alignment on the cable segment adjacent to the entrance cable, again assuming the entire loop consists of this type of cable.

alignment – mixed-gauge nonloaded cable

Note: *We shall refer to the several portions of the loop, each consisting of a separate cable gauge, as "segments" of the loop.*

2.05 When a 9932 PBN (and its associated term set) is used on a facility consisting of mixed-gauge nonloaded cable, determine the total length of the entire loop and the gauge and length of the cable segment adjacent to the term set. For alignment purposes, assume that the entire mixed-gauge loop is the same cable gauge as the cable segment adjacent to the term set and align the PBN in accordance with tables 2 and 3. However, if the cable segment adjacent to the term set is an entrance cable less than 500 feet long, disregard it and base your alignment on the cable segment adjacent to the entrance cable, again assuming that the entire loop consists of this cable gauge.

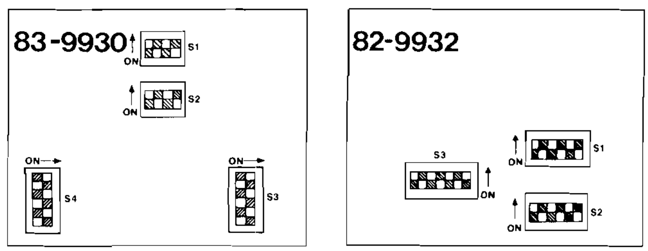


figure 2. 9930 and 9932 PBN subassembly option switch locations

Notes:

1. *When using the 9930 subassembly, it is also necessary to set the network build-out capacitance on the associated term set module as indicated in table 1.*
2. *When a 9932 subassembly directly interfaces a Type 500 tel set, switch* S1 *should be set for 0 kilofeet and 0 ohms (see table 2), switch* S2 *should be set for 0 kilofeet and 0μF (see table 3), and switch* S3 *should be set as indicated in table 4.*
3. *When a 9932 subassembly is used with a nonloaded cable facility, switches* S1 *and* S2 *should be set appropriately for the particular facility and switch* S3 *should be set as indicated in table 5.*
4. *If the cable loop is longer than the maximum lengths listed in these tables, use settings for the longest loop listed.*

boundaries length (kilofeet)*				resistance (ohms)*	set following S1-X switches to "on" or "closed" pos.:
26 ga.	24 ga.	22 ga.	19 ga.		
0	0	0	0	0	1, 2, 3, 4, 5, 6
0.4	0.7	1.1	2.2	35	2, 3, 4, 5, 6
1.1	1.8	2.9	5.9	95	1, 3, 4, 5, 6
1.5	2.4	3.8	7.8	130	2, 3, 4, 6
2.0	3.2	5.0	10.2	165	2, 3, 4, 5
2.6	4.1	6.6	13.4	215	1, 3, 4, 5
3.0	4.8	7.6	15.6	250	2, 3, 4
3.4	5.5	8.7	17.7	285	1, 3, 4
4.1	6.6	10.5	21.5	345	3, 4
4.7	7.6	12.0	24.5	395	1, 4, 5
5.0	8.1	12.8	26.1	420	2, 4
5.3	8.6	13.6	27.6	445	2, 3, 6
5.6	9.1	14.3	29.2	470	1, 4
5.9	9.5	15.5	30.8	495	2, 3, 5
6.4	10.2	16.3	33.0	530	4
6.7	10.7	16.9	34.5	555	1, 3, 5
6.8	11.0	17.4	35.4	570	2, 3
7.3	11.6	18.4	37.6	605	1, 3
7.9	12.6	20.0	40.8	655	1, 6
8.2	13.2	20.9	42.5	690	3
8.6	13.8	21.8	44.5	715	1, 5
8.9	14.2	22.5	46.0	740	2
9.3	14.9	23.5	48.1	775	1
10.0	16.1	25.5	52.0	835	none
10.8	17.3	27.4	56.0	900	

*If resistance or length required is a boundary value, use switch settings for lower interval.

table 3. Resistance switch (S1) settings for 9932

2.06 To further optimize balance beyond the listed switch settings, transhybrid loss measurements can be made and the PBN "trimmed". Transhybrid loss is normally measured by means of a 4wire return loss test set. The PBN, along with the NBO capacitors on the host module, should be adjusted against the terminated 2wire facility for maximum return loss (closest impedance match). Refer to the associated module's (term set, repeater, etc.) practice for additional information.

3. circuit description

3.01 The 9930 PBN subassembly consists of three sections, the impedance of which simulates that of metallic cable facilities. These sections are an inductor-capacitor high-frequency impedance

boundaries length (kilofeet)*				capacitance (μF)*	set following S2-X switches to "on" or "closed" position:
any ga., 0.083μF/mile	26 ga., 0.069μF/mile	24 ga., 0.072μF/mile	19 ga., 0.066μF/mile		
0	0	0	0	0.0000	none
1.7	2.1	2.0	2.2	0.0275	4
2.7	3.2	3.1	3.4	0.0425	1, 4
3.3	4.0	3.9	4.2	0.0524	5
4.0	4.8	4.6	5.0	0.0623	1, 5
4.9	5.9	5.7	6.2	0.0773	1, 4, 5
5.6	6.7	6.4	7.0	0.0872	2, 5
6.2	7.4	7.1	7.8	0.0971	2, 4, 5
7.1	8.6	8.2	9.0	0.1121	1, 2, 4, 5
8.1	9.8	9.4	10.2	0.1275	2, 6
9.1	10.0	10.5	11.4	0.1429	1, 2, 6
10.0	12.1	11.6	12.6	0.1579	1, 2, 4, 6
11.0	13.2	12.7	13.8	0.1733	3, 6
11.9	14.3	13.8	15.0	0.1875	3, 4, 6
12.9	15.5	14.9	16.2	0.2025	1, 3, 4, 6
13.6	16.4	15.7	17.0	0.2136	3, 5, 6
14.2	17.1	16.4	17.8	0.2235	1, 3, 5, 6
15.2	18.2	17.5	19.0	0.2385	1, 3, 4, 5, 6
15.8	19.0	18.2	19.8	0.2484	2, 3, 5, 6
16.4	19.8	19.0	20.6	0.2583	2, 3, 4, 5, 6
17.4	21.0	20.1	21.8	0.2733	1,2,3,4,5,6
19.0	23.0	22.0	21.0	0.3000	

*If capacitance or length required is a boundary value, use switch settings for lower interval.

table 4. Capacitance switch (S2) settings for 9932

direct current supplied to Type 500 Tel Set when off-hook (milliamperes)	set following S3-X switches to "on" or "closed" position:
36 or less	1, 7
37 to 50	1, 6
51 to 61	1, 5
62 or more	1, 4

table 5. Type 500 Tel Set termination network switch settings (S3) for 9932

compromise network value to approximate impedance of distant termination	set following S3-X switches to "on" or "closed" position:
900 ohms + 2.15μF	3
600 ohms +2.15μF	2

table 6. Compromise termination network switch settings (S3) for 9932

simulator, an inductor-capacitor midband impedance simulator, and a resistor-capacitor low-frequency impedance simulator.

3.02 The 9932 PBN subassembly consists of resistor-capacitor lattice networks that simulate the impedance of nonloaded cable over all frequency bands. In addition, three choices of facility-end terminating impedances are available. These facility-end terminating impedances are simulated at the end of the nonloaded-cable simulated impedance. Two of these impedances are provided by compromise networks consisting of 600 ohms in series with 2.15μF and 900 ohms in series with 2.15μF. The third terminating impedance is provided by a network of resistors and inductors that simulate the impedance of a Type 500 tel set.

4. specifications

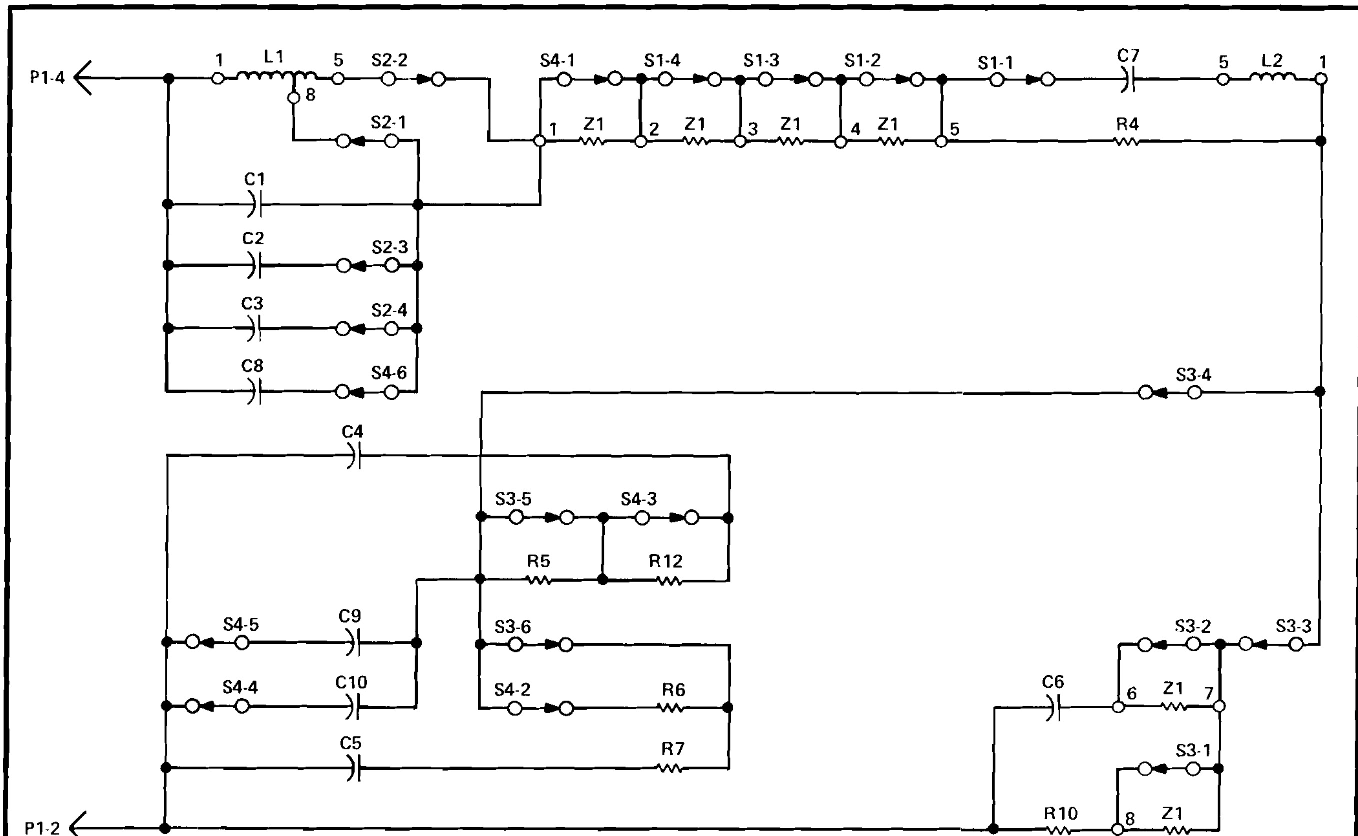
transhybrid loss achievable with all 993X subassemblies
20dB minimum, 35dB typical

nominal cable capacitances for 9930
19 gauge H88: 0.084μF/mile
22 gauge H88: 0.082μF/mile
24 gauge H88: 0.070 through 0.085μF/mile
26 gauge H88: 0.065 through 0.083μF/mile

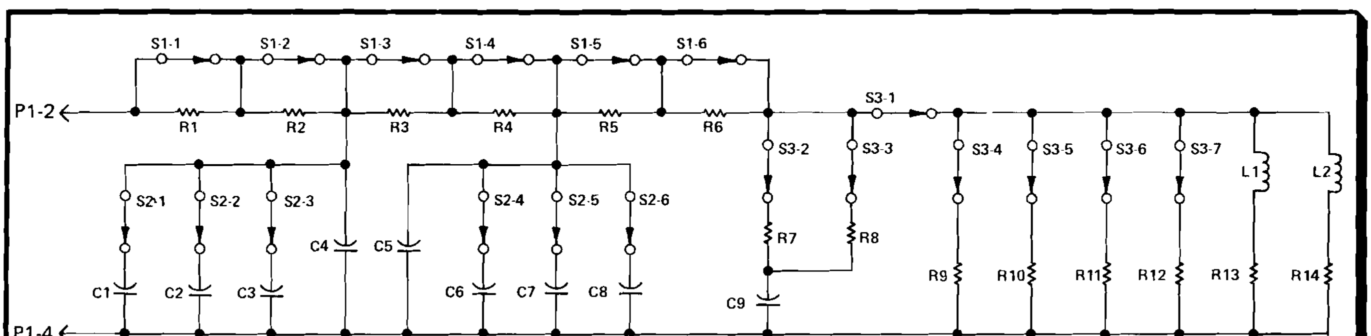
PBN impedance, 9930
approximates impedance of 5100-foot end section

maximum cable lengths for 9932 (0.083μF/mile, nonloaded)
19 gauge: 19.0 kilofeet
22 gauge: 19.0 kilofeet
24 gauge: 17.3 kilofeet
26 gauge: 10.8 kilofeet

9932 termination networks
900 ohms + 2.15μF, 600 ohms + 2.15μF, or Type 500 tel set



9930 PBN subassembly 839930



9932 PBN subassembly 829932

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

dimensions
2.50 inches (6.35cm)
1.15 inches (2.92cm)
2.95 inches (7.49cm)

weight
9930: 2.5 ounces (70.9 grams)
9932: 2.5 ounces (70.9 grams)

mounting
plugs onto printed circuit board of 3410A and 3410B SST 2Wire PBX Trunk Access Modules, 4201 Term Set module (Issue 2 or later), 4232 PBN module, 692X 2Wire SF Signaling Set module (Issue 2 or later), 4024 Repeater, 6461 Common Signaling module, 6122 2Wire SF Signaling Set module w/Gain, and others as specified

6. testing and troubleshooting

6.01 The Testing Guide Checklist in this section may be used to assist in the installation, testing, or troubleshooting of the 993X PBN Subassembly. The Checklist is intended as an aid in the localization of trouble to a specific subassembly. If a subassembly is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute operates correctly, the original should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 993X subassembly. Unauthorized testing or repairs may void the warranty.

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.*

6.02 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: (702) 827-3400
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

6.03 If a 993X 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

6.04 To obtain a replacement 993X, 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 8X993X part number that indicates the issue of the subassembly in question. Upon notification, we shall ship a replacement to you. If the subassembly in question is in warranty, the replacement will be shipped at no charge. Pack the defective 993X in the replacement's carton, sign the packing slip included with the replacement, and enclose it with the defective subassembly (this is your return authorization). Affix the preaddressed label provided with the replacement subassembly to the carton being returned, and ship the unit prepaid to Tellabs.

repair and return

6.05 Return the defective 993X, 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 39
Mississauga, Ontario, Canada L4W 2S7

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