

BALANCE TEST PROCEDURES FOR PBX SWITCHED 4-WIRE TIE TRUNKS AND ACCESS LINES

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1. GENERAL

1.01 This section describes detailed procedures for making through and terminal balance tests at 2-wire PBXs. Refer to Section 311-350-100 for discussion of procedures.

1.02 This section is reissued for the following reasons:

- (a) To add information on balance measurement objectives for 600-ohm PBX terminations and the use of the KS-20501 return loss measuring set (RLMS)
- (b) To include a form for recording measurement results when using the KS-20501 RLMS or alternate test equipment.

Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 Switched Service Network (SSN) 4-wire via net loss (VNL) access lines are to be considered the same as 4-wire VNL tie trunks.

1.04 Determine the correct value for the building-out capacitor (NBOC) and strap this value of capacitance into the balancing networks of the 4-wire terminating sets. Then make the echo return loss (ERL) and singing point/singing return loss (SP/SRL) tests to determine whether the objectives given in Tables A and B have been met.

1.05 Test equipment arrangements required for the various test procedures are illustrated in Fig. 1 through 4. The test procedures given in this section are based on the use of the 24V4 repeater equipment with 1-type 4-wire terminating sets and either SD-65718-01 or SD-66799 tie trunk equipment.

1.06 Where other equipment is used, the general procedures outlined are still valid, although some of the detailed steps and test equipment arrangements may have to be adjusted to conform to the equipment used. As in the case of the No. 101 Electronic Switching System (ESS) PBX, all test procedures apply, except that it is not necessary to block a PO relay during the tests, and connections are made by using the control unit teletype input. The procedures are given in the input message manual IM1H000.

1.07 The balance tests involve working with two trunk circuits or with one trunk circuit and one line circuit switched together by the PBX switching machine or the switchboard. To avoid confusion in the test procedures, the tie trunk being balanced is referred to as the *test tie trunk*. The tie trunk or other service line used in the test will be identified as the *connected trunk* or *connected circuit*, as appropriate.

1.08 The tests require that the normal transmission path be established between the test tie trunk and the connected circuit via the PBX switches or switchboard. For terminal balance tests, the transmission path must be established from the 4-wire legs of the test tie trunk through the PBX to the distant termination of the connected circuit.

TABLE A
900-OHM PBX – BALANCE OBJECTIVES

THROUGH BALANCE MEASUREMENT OBJECTIVES						
TYPE OF CONNECTION		CONNECTED CIRCUIT TERMINATION	2-dB SWITCH PAD	TYPE TEST *	AVERAGE OF ALL CIRCUIT MEASUREMENTS	NO CIRCUIT MEASUREMENT LESS THAN
FROM (TEST CIRCUIT)	TO (CONNECTED CKT TERM.)					
4-Wire VNL Tie Trunk	4-Wire VNL Tie Trunk	4-Wire Legs Terminated In 600 Ohms	OUT (Pad Out of Both Tie Trunks)	ERL	27 dB	23 dB
				SP/SRL	20 dB	16 dB
TERMINAL BALANCE MEASUREMENT OBJECTIVES						
4-Wire VNL Tie Trunk at the PBX	4-Wire Non-VNL Tie Trunk	900 Ohms + 2.16 μ F at the Distant PBX	OUT	ERL	22 dB	16 dB
				SP/SRL	15 dB	11 dB
	2-Wire Short-Haul Tie Trunk	900 Ohms + 2.16 μ F at the Distant PBX	OUT†	ERL	18 dB	13 dB
				SP/SRL	10 dB	6 dB
	CO Trunk, FX Trunk, or WATS Trunk	900 Ohms + 2.16 μ F at CO	OUT†	ERL	18 dB	13 dB
				SP/SRL	10 dB	6 dB
	On-Premises or Off-Premises PBX Station Lines	Station Off-Hook	IN	ERL	12 dB	9 dB
				SP/SRL	8 dB	6 dB
	PBX Test Balance Termination	900 Ohms + 2.16 μ F at the PBX	IN	ERL	24 dB	20 dB
				SP/SRL	18 dB	14 dB

* ERL – Echo Return Loss SP – Singing Point SRL – Singing Return Loss

† The 2-dB pad should not be switched out where the loss of the connected facility is less than 2 dB or where these balance objectives are not met.

TABLE B
600-OHM PBX – BALANCE OBJECTIVES

THROUGH BALANCE MEASUREMENT OBJECTIVES						
TYPE OF CONNECTION		CONNECTED CIRCUIT TERMINATION	2-dB SWITCH PAD	TYPE TEST *	AVERAGE OF ALL CIRCUIT MEASUREMENTS	NO CIRCUIT MEASUREMENT LESS THAN
FROM (TEST CIRCUIT)	TO (CONNECTED CKT TERM.)					
4-Wire VNL Tie Trunk	4-Wire VNL Tie Trunk	4-Wire Legs Terminated In 600 Ohms	OUT (Pad Out of Both Tie Trunks)	ERL	27 dB	23 dB
				SP/SRL	20 dB	16 dB
TERMINAL BALANCE MEASUREMENT OBJECTIVES						
4-Wire VNL Tie Trunk at the PBX	4-Wire Non-VNL Tie Trunk	600 Ohms + 2.16 μ F at the Distant PBX	OUT	ERL	22 dB	16 dB
				SP/SRL	15 dB	11 dB
	2-Wire Short-Haul Tie Trunk	600 Ohms + 2.16 μ F at the Distant PBX	OUT†	ERL	18 dB	13 dB
				SP/SRL	10 dB	6 dB
	CO Trunk, FX Trunk, or WATS Trunk	900 Ohms + 2.16 μ F at CO	OUT†	ERL	18 dB	13 dB
				SP/SRL	10 dB	6 dB
	On-Premises PBX Station Lines	Station Off-Hook	IN	ERL	16 dB	10 dB
				SP/SRL	8 dB	6 dB
	Off-Premises PBX Station Lines	Station Off-Hook	IN	ERL	12 dB	9 dB
				SP/SRL	8 dB	6 dB
	PBX Test Balance Termination	600 Ohms + 2.16 μ F at the PBX	IN	ERL	24 dB	20 dB
				SP/SRL	18 dB	14 dB

* ERL – Echo Return Loss SP – Singing Point SRL – Singing Return Loss

† The 2-dB pad should not be switched out where the loss of the connected facility is less than 2 dB or where these balance objectives are not met.

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Assistance will be required at the far end to remove and muffle a telephone handset to provide the off-hook termination when specified.

1.09 Where a station set off-hook is required for a balance termination, the handset transmitter and receiver should be effectively muffled to prevent room noise from overriding the balance test power. The handset may be wrapped in a sound-deadening material to provide this muffling.

Note: *Do not remove the transmitter unit from the handset.*

1.10 Forms on which measurement results can be recorded are recommended. Such forms can be used as a worksheet during tests and, when completed, can provide a permanent record for future reference during trouble tests or installation of additional tie trunks. A typical form is shown in Chart A, which covers the following tests:

Chart A—Measurement Record—Network Building-out Capacitance Tests—Echo Return Loss and Singing Point/Singing Return Loss Tests.

2. TEST EQUIPMENT

2.01 Balance tests can be performed most conveniently by using a KS-20501 RLMS. If it is not available, the following alternate equipment is needed:

(a) Network Building-Out Capacitor (NBOC) Tests

(1) 21A Transmission Measuring Set (TMS) or equivalent

or

(2) KS-19353 Oscillator (OSC) and 23A Transmission Measuring Set (TMS) or equivalent

(b) Echo Return Loss Tests

(1) 201A or B Noise Generator (NG) with 455B Weighting Network and 3A, B, or C Noise Measuring Set (NMS) with C-Message Weighting (497A) Network or equivalent

(c) Singing Point Tests

(1) 2D or 2E Singing Point Test Set (SPTS), 207G Filter, and 52-Type Headset or equivalent.

2.02 In addition, various pieces of general purpose equipment are needed to perform the tests.

(a) Normal test items, such as Voltohmmeters, Dial Hand Test Set, etc.

(b) Appropriate Test Cords, Test Clips, and Connectors for all test equipment.

(c) 7A Decade Capacitance Box or equivalent. (If this is not used, the proper combination of NBOC screw-type switches can be found by directly increasing the NBO capacitance of the terminating set in minimum steps until the highest value of return loss is obtained.)

(d) Shorting Plugs, 600-Ohm Termination Plugs, and Dummy Plugs.

2.03 *All test equipment except the RLMS and 3-type NMS must be accurately calibrated before any tests are attempted.* An inaccurate calibration will result in false readings that may lead to misalignment of facilities and to poor service. Details on the operation and calibration of each instrument are covered in the appropriate Bell System Practices. Adequate warm-up time should be allowed for the measuring sets to stabilize before starting the adjustment procedures.

2.04 Refer to the following sections for each of the measuring sets mentioned in 2.01:

103-106-105—2D and 2E SPTS

103-106-115—KS-20501 RLMS

103-221-100—21A TMS

103-223-100—23A TMS

103-302-105—KS-19353 OSC

103-345-100—201A or B NG

103-611-100—3A or B NMS

103-611-101—3C NMS.

TABLE B
600-OHM PBX – BALANCE OBJECTIVES

THROUGH BALANCE MEASUREMENT OBJECTIVES						
TYPE OF CONNECTION		CONNECTED CIRCUIT TERMINATION	2-dB SWITCH PAD	TYPE TEST *	AVERAGE OF ALL CIRCUIT MEASUREMENTS	NO CIRCUIT MEASUREMENT LESS THAN
FROM (TEST CIRCUIT)	TO (CONNECTED CKT TERM.)					
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				SP/SRL	8 dB	6 dB
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† The 2-dB pad should not be switched out where the loss of the connected facility is less than 2 dB or where these balance objectives are not met.

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1.09 Where a station set off-hook is required for a balance termination, the handset transmitter and receiver should be effectively muffled to prevent room noise from overriding the balance test power. The handset may be wrapped in a sound-deadening material to provide this muffling.

Note: *Do not remove the transmitter unit from the handset.*

1.10 Forms on which measurement results can be recorded are recommended. Such forms can be used as a worksheet during tests and, when completed, can provide a permanent record for future reference during trouble tests or installation of additional tie trunks. A typical form is shown in Chart A, which covers the following tests:

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or

(2) KS-19353 Oscillator (OSC) and 23A Transmission Measuring Set (TMS) or equivalent

(b) Echo Return Loss Tests

(1) 201A or B Noise Generator (NG) with 455B Weighting Network and 3A, B, or C Noise Measuring Set (NMS) with C-Message Weighting (497A) Network or equivalent

(c) Singing Point Tests

(1) 2D or 2E Singing Point Test Set (SPTS), 207G Filter, and 52-Type Headset or equivalent.

2.02 In addition, various pieces of general purpose equipment are needed to perform the tests.

(a) Normal test items, such as Voltohmmeters, Dial Hand Test Set, etc.

(b) Appropriate Test Cords, Test Clips, and Connectors for all test equipment.

(c) 7A Decade Capacitance Box or equivalent. (If this is not used, the proper combination of NBOC screw-type switches can be found by directly increasing the NBO capacitance of the terminating set in minimum steps until the highest value of return loss is obtained.)

(d) Shorting Plugs, 600-Ohm Termination Plugs, and Dummy Plugs.

2.03 *All test equipment except the RLMS and 3-type NMS must be accurately calibrated before any tests are attempted.* An inaccurate calibration will result in false readings that may lead to misalignment of facilities and to poor service. Details on the operation and calibration of each instrument are covered in the appropriate Bell System Practices. Adequate warm-up time should be allowed for the measuring sets to stabilize before starting the adjustment procedures.

2.04 Refer to the following sections for each of the measuring sets mentioned in 2.01:

103-106-105—2D and 2E SPTS

103-106-115—KS-20501 RLMS

103-221-100—21A TMS

103-223-100—23A TMS

103-302-105—KS-19353 OSC

103-345-100—201A or B NG

103-611-100—3A or B NMS

103-611-101—3C NMS.

3. NET LOSS MEASUREMENT OF BALANCE PATH

3.01 While loss is not a balance measurement, in order to meet balance objectives, the connection path between the test tie trunk and the connected circuit must be trouble-free, and in the case of through balance tests, the switched pads must be operated to the *out* position. This is verified by a net loss measurement at 1000 Hz between the test tie trunk and the connected trunk or circuit. Also, all trunks or circuits to which terminal balance tests are made must be operating at the proper loss.

3.02 A net loss check of every balance connection established is not necessary. A net loss measurement should be made in conjunction with the first connection established to each type of circuit group, ie, 4-wire tie trunks, 2-wire tie trunks, station lines, CO trunks, etc. If a balance measurement to any particular circuit within a group varies markedly from the others within that group, a net loss check of the balance path should be made.

3.03 Test equipment and circuit arrangements for such a check measurement between the test tie trunk and any connected circuit are shown in Fig. 1. A net loss measurement not in excess of ± 0.5 dB from the computed value or value on the circuit layout record is satisfactory. For values of equipment losses that may be required to compute the loss of the path through the office, Table III in Section 852-307-101 should be used.

3.04 Since there is generally no suitable jack access point on 2-wire circuits, verification of the balance path will require opening the 2-wire circuit at some point between its trunk circuit and the cable pair and terminating it in a 23A TMS or equivalent. A short must be placed across the circuit between the PBX equipment and the measuring point to hold the connection up during the process of opening it and connecting the TMS. Once the TMS is connected, the connection will be held and the short must be removed.

4. BALANCE TESTS

A. Through Balance Tests

4.01 Through balance tests (Section 311-350-100, Part 4) consist of the following individual test procedures:

(a) **NBOC Adjustment Tests:** Circuit and test equipment arrangements are shown in Fig. 2. Test procedures are given in Part 5. These tests, unless omitted (4.03 through 4.05), must be completed prior to starting ERL or SP/SRL tests.

(b) **ERL Test:** Circuit and test equipment arrangements are shown in Fig. 2. Test procedures are given in Part 6.

(c) **SP/SRL Test:** Circuit and test equipment arrangements are shown in Fig. 2. Test procedures are given in Part 6.

4.02 The ERL and SP/SRL tests may be made in any sequence convenient to the tester.

4.03 The NBOC tests may be omitted where the NBOC value has been previously established on existing tie trunk groups and where the switching path length of the new tie trunk(s) is approximately the same as the existing ones. In this case, the NBOC of the new trunk(s) would be adjusted to the previously established value without additional testing.

4.04 Situations may arise where the equipment for a new trunk(s) is located at some distance from the existing tie trunk equipment. If this cannot be avoided, it may be necessary to determine a new average NBOC value for *all* the tie trunks and to make new ERL and SP/SRL tests.

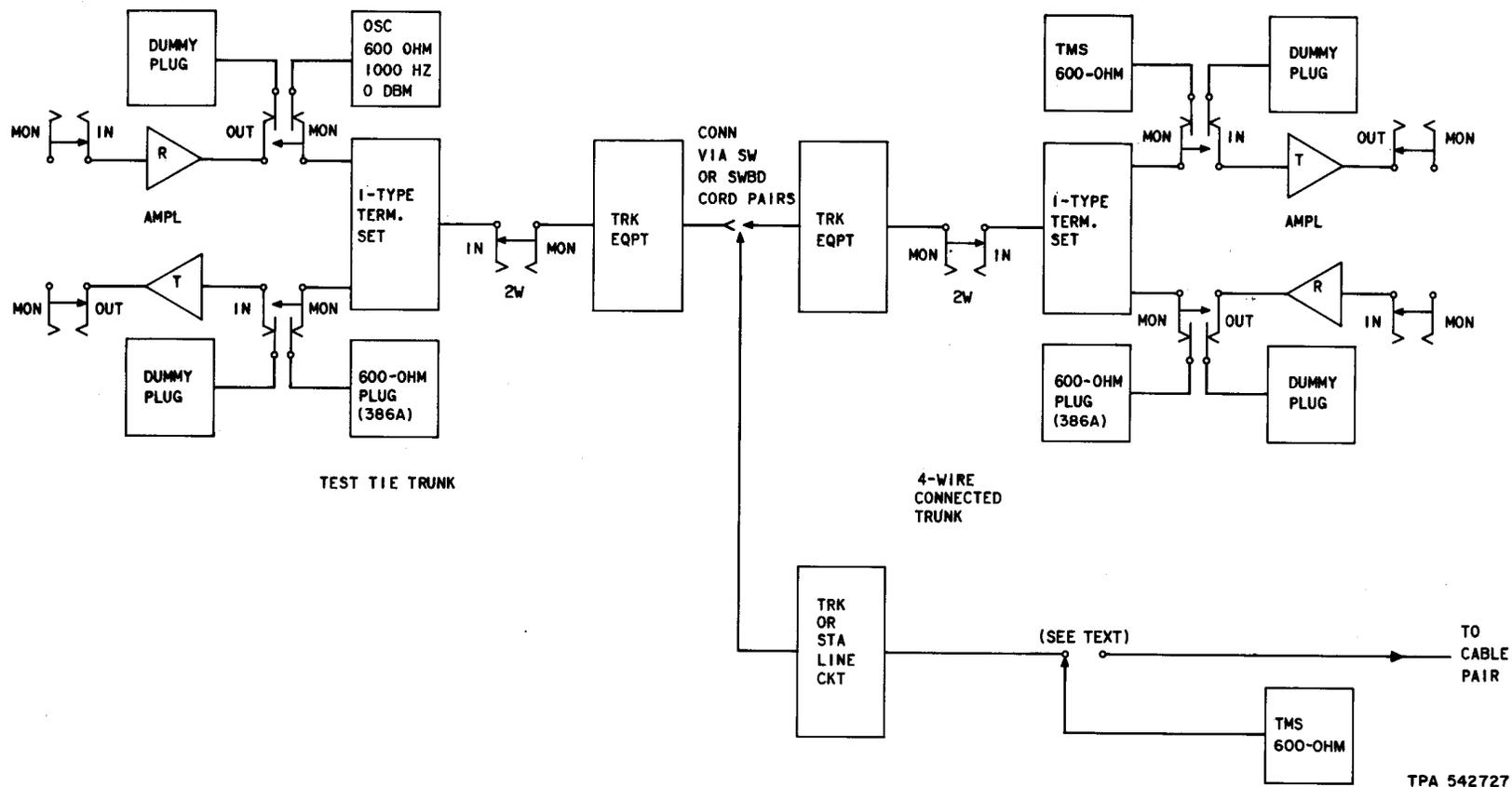
4.05 If there is any question regarding the need for NBOC tests in connection with the installation of a new tie trunk(s), the matter should be referred to the appropriate design or transmission group for consideration.

B. Terminal Balance Tests

4.06 Terminal balance tests (Section 311-350-100, Part 5) are made after completion of the through balance testing and consist of the following test procedures:

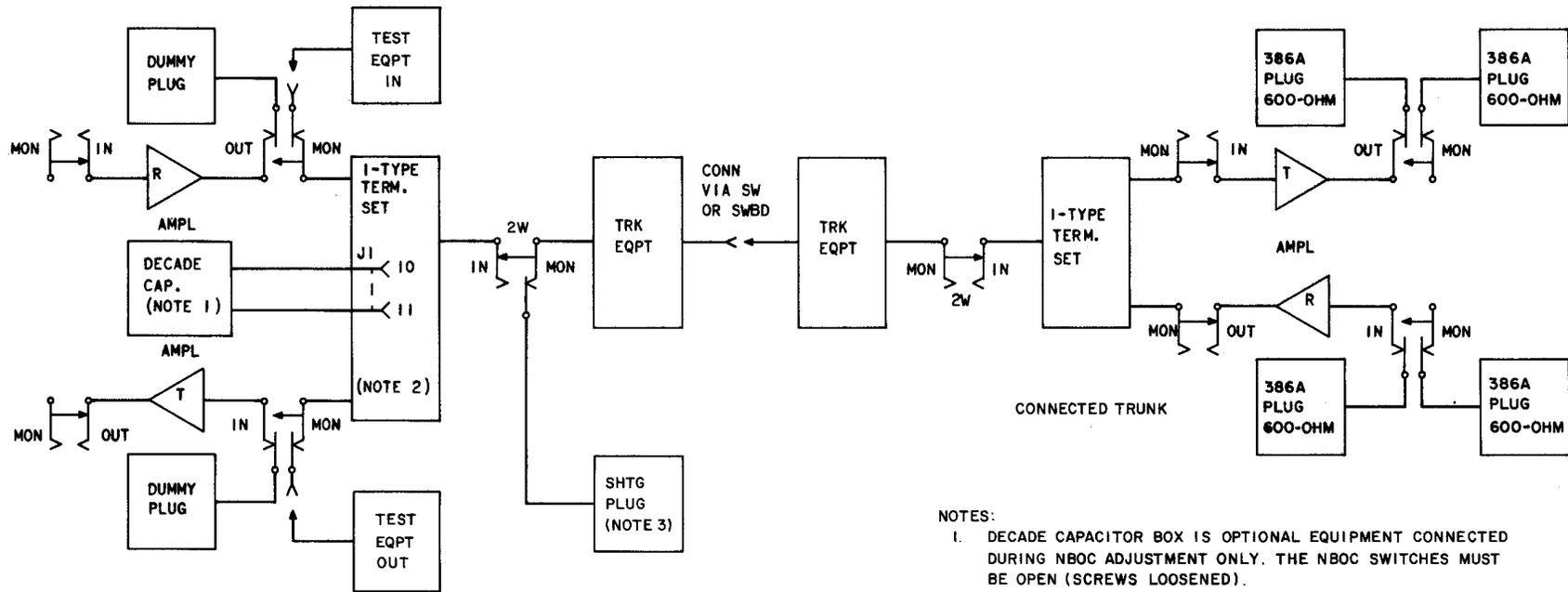
(a) **ERL Test:** Circuit and test equipment arrangements are shown in Fig. 3. Test procedures are given in Part 7.

(b) **SP/SRL Test:** Circuit and test equipment arrangements are shown in Fig. 3. Test procedures are given in Part 7.



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Fig. 1—Test Arrangement for Checking Transmission Loss of Balance Path



TEST TIE TRUNK

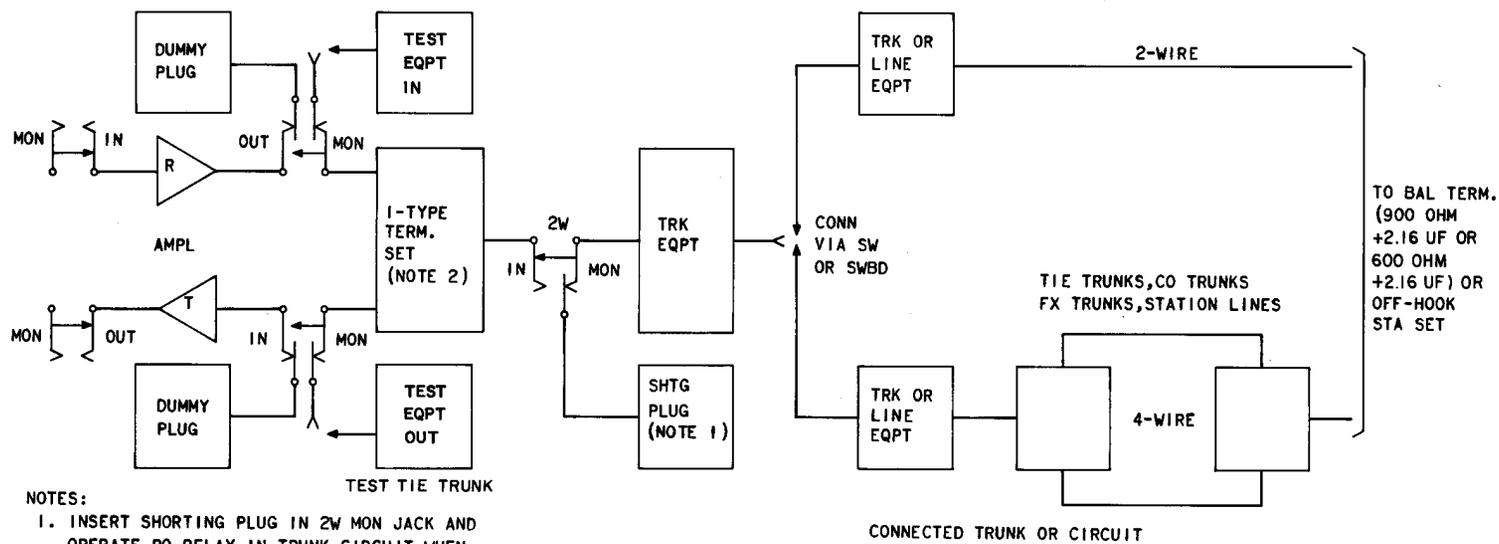
CONNECTED TRUNK

NOTES:

1. DECADE CAPACITOR BOX IS OPTIONAL EQUIPMENT CONNECTED DURING NBOC ADJUSTMENT ONLY. THE NBOC SWITCHES MUST BE OPEN (SCREWS LOOSENED).
2. FOR OTHER TESTS THE SCREW-TYPE SWITCHES MUST BE IN THE POSITION SPECIFIED ON THE CIRCUIT ORDER CARD—THE NBOC SWITCHES IN THE POSITION DETERMINED IN PART 5.
3. INSERT SHORTING PLUG IN 2W MON JACK AND OPERATE PO RELAY IN TRUNK EQUIPMENT WHEN SO DIRECTED IN TEST PROCEDURE.

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Fig. 2—Through Balance Tests—Network Building-Out Capacitor Adjustment



NOTES:

1. INSERT SHORTING PLUG IN 2W MON JACK AND OPERATE PO RELAY IN TRUNK CIRCUIT WHEN SO DIRECTED BY TEST PROCEDURE.
2. THE SCREW-TYPE SWITCHES MUST BE IN THE POSITION SPECIFIED ON THE CIRCUIT ORDER CARD—THE NBOC SWITCHES IN THE POSITION DETERMINED IN PART 5.

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Fig. 3—Terminal Balance Tests—Equipment Arrangement for Echo Return Loss Tests

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4.07 The above tests may be used in any sequence convenient to the tester.

4.08 At PBX locations where only terminal balance tests are required, the NBOC tests may be required (see Section 311-350-100, 5.03 and 5.04).

5. NETWORK BUILDING-OUT CAPACITOR (NBOC) ADJUSTMENT TESTS

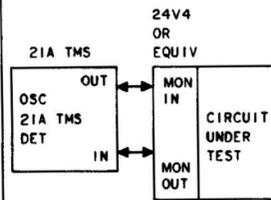
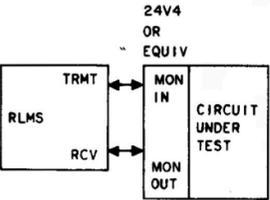
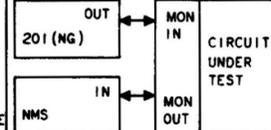
5.01 Equipment arrangements are shown in Fig. 2. Test equipment arrangements are shown in

Fig. 4. The figures and the following step-by-step procedures comprise the necessary testing to determine an NBOC value for PBX 4-wire tie trunks.

A. Connection Via Switches

5.02 The following procedures apply in establishing a connection via the PBX switches between the selected test tie trunk and the connected trunk or circuit:

STEP	PROCEDURE
1	Connect a 1011B or 1013A handset (dial hand test set) between the test tie trunk circuit B1 lead and any convenient ground. The B1 lead appears on the top lug of D jack or on pin 3 of trunk B terminal strip.
2	Dial the appropriate code to connect to the desired 4-wire tie trunk.
3	When connection is established, block the R relay of the connected trunk circuit to give off-hook supervision. This can be done by inserting a 768A tool or equivalent between the right pole piece and the armature of the R relay.
4	Block the R relay of the test trunk circuit in the same manner as in Step 3.
5	Disconnect the handset from the B1 lead and proceed as in the following steps.
6	All screw-type switches on the front of the 1-type terminating sets must be in their normal operating position except the NBOC switches, which must be open (screws loosened).
7	Connect the test equipment and terminate the connected circuit as shown in Fig. 2 and 4. <i>Note:</i> The 24V4 repeaters are terminated in 600 ohms by inserting 386A plugs in the jacks on the 4-wire line side of the amplifiers so that the correct impedance will appear at the terminating set. Other types of 4-wire terminating sets may be terminated at the 4-wire legs of the hybrid coils.
8	A capacitor decade box or the NBOC screw-type switches of the 1-type terminating set may be used for adjusting the NBO capacitance. If the decade box is to be used, connect it as shown in Fig. 2. Starting from zero, increase the capacitance in minimum steps (0.001 μ F), by means of the decade box dials, to obtain the highest return loss (minimum return power) reading on the meter (Fig. 4) (a maximum reading on an RLMS or a minimum reading on a TMS or noise meter). Record the adjusted capacitance value of the decade box in column D of Chart A and then tighten the proper combination of NBOC screws on the 4-wire terminating set to match the decade box value. Disconnect the decade box.
9	If a capacitor decade box is not used, the proper combination of NBOC screw-type switches can be found by directly increasing the NBO capacitance of the terminating set in minimum steps until the highest value of return loss is obtained.

TEST NO.	TYPE OF MEASUREMENT	GENERAL PURPOSE PORTABLE TEST EQUIPMENT				KS-20501 RETURN LOSS MEASURING SET (RLMS)			
		TEST CONNECTIONS	TEST EQPT	SWITCH FUNCTION	SETTING	TEST CONNECTIONS	SWITCH FUNCTION	SETTING	
1	ADJUSTMENT OF NETWORK BUILDING-OUT CAPACITORS (NBOC)		21A TRMSN MEASURING SET	POWER FREQ FREQ MULT OSC OUTPUT DET INPUT	ON 20 X100 BLACK 0 ON BOTH SWITCHES ON SCALE READING		POWER NETWORK TEST LOCATION THL ADD DB TEST TYPE	ON NOT USED TEST HYBRID- WHEN BALANCE TEST CIRCUIT TRANS-HYBRID LOSS IS 10.8 DB OR LESS. VFPB- WHEN CIRCUIT UNDER TEST TRANS-HYBRID LOSS EQUAL TO OR GREATER THAN 23DB THIS INCLUDES BALANCE TEST CIRCUIT. WITH SHORT ON 2-WIRE T+R OF HYBRID OF CIRCUIT UNDER TEST ADJUST FOR 0 DB RETURN LOSS WITH ADD DB SWITCH SET TO 0. ADJUST FOR ON-SCALE READING. RETURN LOSS MEASUREMENT SRL-HI	
	2000-HZ RETURN LOSS READING				EQUAL TO DET IN SETTING PLUS METER			EQUAL TO ADD DB SETTING PLUS METER READING	
2	ERL - TRANS-HYBRID LOSS CALIBRATION PROCEDURE (SHORT THE 2W T+R OF THE HYBRID OF THE CIRCUIT UNDER TEST)		201-TYPE NOISE GEN WITH 455B NETWORK	POWER OUTPUT ATTN ADJ LEVEL	ON 15 RED LINE- (CHECK CAL PER 103-345-100)	SAME AS FIG. 1B	POWER NETWORK TEST LOCATION TEST TYPE	ON NOT USED SAME AS TEST 1 SAME AS TEST 1 ERL	
	TRANS-HYBRID LOSS CALIBRATION FIGURE		3-TYPE NOISE MEASURING SET WITH "C" MSG NETWORK	FUNCTION DAMP-NORM CAL	600 DAMP ON SCALE READING				THE THL SETTING IS EQUAL TO THE TRANS-HYBRID LOSS AND COMPENSATES FOR IT SO NO CORRECTIONS ARE NECESSARY IN TEST 3.

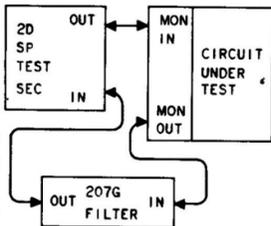
TEST NO.	TYPE OF MEASUREMENT	GENERAL PURPOSE PORTABLE TEST EQUIPMENT				KS-20501 RETURN LOSS MEASURING SET (RLMS)			
		TEST CONNECTIONS	TEST EQPT	SWITCH FUNCTION	SETTING	TEST CONNECTIONS	SWITCH FUNCTION	SETTING	
3	ERL - MEASUREMENT PROCEDURE	SAME AS FIG. 2A	201 (NG)	POWER OUTPUT ATTN ADJ LEVEL	ON 15 SAME AS TEST 2	SAME AS FIG. 1B	POWER NETWORK TEST LOCATION THL TEST TYPE	ON NOT USED SAME AS TEST 1 SAME AS TEST 1 ERL	
	FINAL ERL READING			3-TYPE NMS WITH "C" MSG NETWORK	FUNCTION DAMP-NORM CAL		600 DAMP ON SCALE READING		
4	SP-TRANS HYBRID LOSS CALIBRATION (SHORT THE 2W T+R OF THE HYBRID OF THE CIRCUIT UNDER TEST)	SAME AS FIG. 1A	21A TMS	POWER FREQ MULT OSC OUTPUT DET INPUT	ON 10 X100 BLACK 0 ON BOTH SWITCHES ON SCALE READING	NOT REQUIRED			
	-TRANS-HYBRID LOSS CALIBRATION FIGURE						EQUAL TO THE SUM OF THE DET IN SETTING PLUS METER READING		
5	SP OR SRL-MEASUREMENT PROCEDURE		2D (OR EQUIV) SP TEST SET	POWER FILTER MON GAIN DB POLING	ON IN CONNECT TEST REC. ADJUST TO DETERMINE SINGING POINT PER BSP 103-106-105 SECTION 5	SAME AS FIG. 1B	POWER NETWORK TEST LOCATION THL TEST TYPE ADD DB	ON NOT USED SAME AS TEST 1 SAME AS TEST 2 SRL (THEN) SRL HI ADJUST FOR ON SCALE READING	
	-FINAL SP OR SRL READING						EQUAL TO SUM OF GAIN DB SETTINGS (LOWER OF THE POLINGS) MINUS THE TRANS-HYBRID LOSS CAL. FIGURE MEASURED IN TEST 4.		

Fig. 4—Test Equipment—Connections and Settings

STEP	PROCEDURE
10	Repeat above test procedure on all trunks selected for the NBOC adjustment tests (see Section 311-350-100, 4.06). Where both dial and switchboard switching of these tie trunks are provided for, the NBOC test procedures above should be made over both paths.
11	Determine in accordance with Section 311-350-100, 4.07, the average capacitance value for the PBX and adjust all NBOCs in all 4-wire tie trunks to this value.

B. Connection Via Switchboard

5.03 Procedures for establishing connection via a switchboard cord pair are similar to those given in 5.02 with the following variations:

STEP	PROCEDURE
1	Dial the appropriate code to reach the switchboard attendant.
2	Request the PBX attendant to put up the desired connection and dial up the appropriate termination on the connected circuit. The key associated with the cord pair used must be closed after connection is established.
3	Have PBX attendants use the "Thru" jack appearance of both tie trunks.
4	Proceed by using Steps 6 through 11 of 5.02.

6. THROUGH BALANCE TESTS

6.01 Equipment arrangements are shown in Fig. 2 for through balance. Test equipment arrangements are shown in Fig. 4. The figures and the following step-by-step procedures comprise the necessary testing to verify that the tie trunks

meet the through balance echo return loss requirements.

A. Connection Via Switches

6.02 The following procedures apply in establishing a connection via the PBX switches between the selected test tie trunk and the connected trunk or circuit:

STEP	PROCEDURE
1	Connect a 1011B or 1013A handset (dial hand test set) between the test tie trunk circuit B1 lead and any convenient ground. The B1 lead appears on the top lug of D jack or on pin 3 of trunk B terminal strip.
2	Dial the appropriate code to connect to the desired 4-wire tie trunk.

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STEP	PROCEDURE
3	When connection is established, block the R relay of the connected trunk circuit to give off-hook supervision. This can be done by inserting a 768A tool or equivalent between the right pole piece and the armature of the R relay.
4	Block the R relay of the test trunk circuit in the same manner as in Step 3.
5	Disconnect the handset from the B1 lead and proceed as in the following steps.
6	All screw-type switches on the front of the 1-type 4-wire terminating set must be in the position specified on the circuit order card and the NBOC switches in the position determined in Part 5.
7	Connect the test equipment and terminate the connected circuit as shown in Fig. 2 and 4. Insert a shorting plug into the 2-wire MON jack and block the PO relay of the test tie trunk to switch out the 2-dB pad in the trunk circuit.
8	Determine the trans-hybrid loss per instructions in Fig. 4. <i>Note:</i> The 24V4 repeaters are terminated in 600 ohms by inserting 386A plugs in the jacks on the 4-wire line side of the amplifiers so that the correct impedance will appear at the terminating set. Other types of 4-wire terminating sets may be terminated at the 4-wire legs of the hybrid coils.
9	Remove the shorting plug and release the PO relay.
10	Measure the ERL and SP/SRL per Fig. 4.
11	Record the measurements and other information needed in Chart A.
12	Compare the results of the ERL tests with the objectives in Table A or B for through balance. If the objectives are not met, trouble investigations should be made in accordance with Section 311-350-100, 6.02 through 7.02, and local instructions.
13	Repeat the above test procedures for the remainder of the sample selected for testing (see Section 311-350-100, 4.06 through 4.11).

B. Connection Via Switchboard

6.03 Procedures for establishing connection via a switchboard cord pair are similar to those given in 6.02 with the following variations:

STEP	PROCEDURE
1	Dial the appropriate code to reach the switchboard attendant.

STEP	PROCEDURE
2	Request the PBX attendant to put up the desired connection and dial up the appropriate termination on the connected circuit. The key associated with the cord pair used must be closed after connection is established.
3	Have PBX attendants use the "Thru" jack appearance of both tie trunks.
4	Proceed by using Steps 6 through 13 of 6.02.

7. TERMINAL BALANCE TESTS

meet the terminal balance echo return loss requirements.

7.01 Equipment arrangements are shown in Fig. 3 for terminal balance. Test equipment arrangements are shown in Fig. 4. The figures and the following step-by-step procedures comprise the necessary testing to verify that the tie trunks

A. Connection Via Switches

7.02 The following procedures apply in establishing a connection via the PBX switches between the selected test tie trunk and the connected trunk or circuit:

STEP	PROCEDURE
1	<p>Connect a 1011B or 1013A handset (dial hand test set) between the test tie trunk circuit B1 lead and any convenient ground. The B1 lead appears on the top lug of D jack or on pin 3 of trunk B terminal strip.</p> <p>Perform either Step 2, 3, or 4.</p>
2	<p>If connection is being established for terminal balance to a station line:</p> <ul style="list-style-type: none"> (a) Dial the appropriate code for switching to the desired station or balance test line, if provided. (b) Have the station come off-hook and remain off-hook for the remainder of the test. Muffle the station transmitter per 1.08. (c) When connection is established, block the R relay of the test trunk circuit to give off-hook supervision. This can be done by inserting a 768A tool or equivalent between the right pole piece and the armature of the R relay. (d) Disconnect the handset from the B1 lead and proceed as in Steps 5 through 12 below.
3	<p>If connection is being established for a terminal balance test to the CO or foreign exchange trunk:</p> <ul style="list-style-type: none"> (a) Dial the appropriate code for connection to the desired trunk. Then dial the code that will terminate the trunk in the central office balance test termination (900 ohms and 2.16 μF).

STEP	PROCEDURE
	<p>(b) When connection is established, block the R relay of the test trunk circuit to give off-hook supervision. This can be done by inserting a 768A tool or equivalent between the right pole piece and the armature of the R relay.</p> <p>(c) Disconnect the handset from the B1 lead and proceed with tests outlined in Steps 5 through 12 below.</p>
4	<p>If a connection is being established for terminal balance to a tie trunk:</p> <p>(a) If the far-end PBX (on the connected tie trunk) is equipped with a balance test termination (900 ohms and 2.16 μF or 600 ohms and 2.16 μF), dial the appropriate code to establish connection to this test termination. Omit Steps (b) and (c). This is the preferred method.</p> <p>(b) If there is no test termination to dial into at the far-end PBX, dial the appropriate codes to terminate to an on-premises station (close to the equipment room) at the far-end PBX.</p> <p>(c) Have the station come off-hook and remain off-hook for the remainder of the test. Muffle the station transmitter per 1.08.</p> <p>(d) When connection is established, block the R relay of the test trunk circuit to give off-hook supervision. This can be done by inserting a 768A tool or equivalent between the right pole piece and the armature of the R relay.</p> <p>(e) Disconnect the handset from the B1 lead and proceed with tests outlined in Steps 5 through 12 below.</p>
5	<p>All screw-type switches on the front of the 1-type 4-wire terminating set must be in the position specified on the circuit order card and the NBOC switches in the position determined in Part 5.</p>
6	<p>Connect the test equipment and terminate the connected circuit as shown in Fig. 3 and 4. Insert a shorting plug into the 2-wire MON jack and block the PO relay of the test tie trunk to switch <i>out</i> the 2-dB pad in the trunk circuit.</p>
7	<p>Determine the trans-hybrid loss per Fig. 4.</p>
8	<p>Remove the shorting plug and release the PO relay.</p>
9	<p>Measure the ERL and SP/SRL per Fig. 4.</p>
10	<p>Record the measurements and other information needed on Chart A.</p>
11	<p>Compare the results of the ERL tests with the objectives in Table A or B for terminal balance. If the objectives are not met, trouble investigations should be made in accordance with Section 311-350-100, 6.02 through 7.02, and local instructions.</p>
12	<p>Repeat the above test procedures for the remainder of the sample selected for testing (see Section 311-350-100, 4.06 through 4.11).</p>

B. Connection Via Switchboard

7.03 Procedures for establishing connection via a switchboard cord pair are similar to those given in 7.02 with the following variations:

STEP	PROCEDURE
1	Dial the appropriate code to reach the switchboard attendant.
2	Request the PBX attendant to put up the desired connection and dial up the appropriate termination on the connected circuit. The key associated with the cord pair used must be closed after connection is established.
3	For terminal balance tests to CO foreign exchange and other tie trunks, the "Thru" jack appearance of the test tie trunk is used.
4	For terminal balance tests to station lines, the "Talk" or "Ans" jack of the test tie trunk is used.
5	Proceed by using Steps 5 through 12 of 7.02.