

TRAFFIC SERVICE POSITION SYSTEM NO. 1/  
REMOTE TRUNK ARRANGEMENT/POSITION SUBSYSTEM NO. 2

BALANCE

RTA

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1. GENERAL

1.01 This section provides the procedures required to determine and verify buildout capacitor values. This is necessary to meet echo return loss (ERL) and singing return loss (SRL) balance requirements for Remote Trunk Arrangement (RTA) locations. These procedures are required to establish initial office balance and to verify that balance requirements are met when new trunk circuits are added to previously balanced systems.

1.02 When this section is reissued, the reason for reissue will be given in this paragraph. This section does not affect the Equipment Test List.

1.03 All measurement results should be recorded and retained. Section 660-463-010 describes

the forms required and the suggested method of record retention.

1.04 The transmission engineer should be actively involved in the measurements and selection of NBOC and DBOC values.

1.05 The procedures to determine and verify network build-out capacitor (NBOC) and drop build-out capacitor (DBOC) values necessary to impedance balance a RTA office can be summarized as follows:

(a) For a sample of 2-wire toll connecting (2W TC) trunks, determine the compromise NBOC value necessary to build out the network in the 1P 4-wire terminating set (4WTS), or equivalent, of the remote trunk, base-remote (BR) circuit. Adjust all NBOCs associated with BR trunk circuits to this value.

(b) For all 2W TC trunks, verify the previously determined compromise NBOC value.

(c) For all 4-wire TC trunks containing TSPS 4-wire bridging repeaters, determine the DBOC values necessary to build out the 2-wire port on the repeater.

(d) For all trunks in (c) above, determine NBOC values necessary to build out the balancing networks associated with the terminating set in the TSPS 4-wire bridging repeater and 24V4 repeaters.

A general discussion on office balance of the RTA is contained in Section 660-463-100.

1.06 If the RTA serves TC trunks that provide *only TSPS 4-wire bridging access*

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with **TSPS 4-wire bridging repeaters**, the same procedure will be followed on samples of 4-wire TC trunks.

**Note:** If at a later date 2-wire RTA bridging access is added to the RTA serving only 4-wire TC trunks the RTA will have to be rebalanced completely.

**1.07** Before the procedures of this section are performed, all TC trunks between the toll office and the class 5 offices must meet or exceed the noise, transmission, and balance requirements. The toll office **must** be certified balanced.

**Caution: Balance testing must be performed on an out-of-service basis. The proper out-of-service procedures should be made on any working trunk prior to performing any balance tests.**

**2. CAPACITANCE MEASUREMENTS FOR DETERMINATION OF NBOC VALUE FOR RTA 1P 4WTS BALANCING NETWORKS**

**2.01** Measurements should be performed on a sample of 2W TC trunks from each of the class 5 offices served by the toll offices to which the RTA is associated. Each selected sample, one for each class 5 office should include the TC trunk expected to have the greatest cable capacitance and the TC trunk expected to have the least cable capacitance. It should also include a sufficient number of TC trunks randomly selected from the total group of TC trunks from that class 5 office. The size of each sample should be determined according to the following table.

Total Number of TC Trunks	Number of TC Trunks in Sample
5 or less	all
6-10	5

11-15	6
16-25	7
26-50	8
50 or greater	approximately 18 percent of total

**2.02** In selecting TCTs for the sample expected to have the least and greatest cable capacitance, consideration should be given the following:

- (a) Cable length between the TC trunk appearance on the Main Distributing Frame (MDF), or equivalent, of the toll office and,
  - (1) The 4WTS of the TC trunk facilities when carrier or 4-wire metallic facilities are used.
  - (2) The 837-type network (ie, impedance compensator on E-repeater TC trunks).
  - (3) The MDF, or equivalent of the class 5 office or intrabuilding TC trunks, and short nonrepeated interbuilding TC trunks.
- (b) Different facilities and/or routines used in the design of the TC trunks from a given class 5 office.
- (c) In-bay location of the associated trunk circuits in the toll office with respect to its MDF location, and its switching network location.
- (d) Toll office switching multiples and service observing bridges.

**2.03** This procedure is performed using a properly built-out code 970 balance test circuit at the toll office. At the RTA TDC, the balance test circuit which has been properly tested according to Section 660-463-504 is used.

**APPARATUS:**

- 1—KS-20501 return loss measuring set.
- 1—7A capacitor box or equivalent.
- 1—5A attenuator or equivalent.
- 1—J99338CB 3-way, 4-wire bridging repeater test extender

**APPARATUS:**

- 1—ED-1C336-30 extender cable.
- 8—262B 600-ohm terminating plugs
- 1—6-foot 2-conductor test cord with 354C plug at one end, and 310 plug at other end
- 1—3P15A patching test cord assembly consisting of P3K cord 6 feet long, equipped with two 310 plugs
- 1—2-conductor test cord with suitable insulated alligator clip at one end
- 1—310-type 450 ohm plus 4.3  $\mu\text{F}$  terminating plug
- 1—349 shorting plug

STEP	PROCEDURE
1	At the RTA office, connect a 7A capacitor box across the balance network of the 1P 4WTS associated with the Test and Display Circuit (TDC) balance test circuit. See Fig. 1 or 2.
2	Adjust the capacitance value of the 7A capacitor box to zero (0.000 $\mu\text{F}$ ).
3	Connect a RLMS to the 24V4-type repeater associated with the TDC Balance Test Circuit.
4	At the class 5 office, using the equipment in that office, seize and key pulse (dial) 959-1210 (the directory number assigned to the TSPS jack ended test line) into the trunk selected.
5	At the RTA office, when the MTL lamp flashes and buzzer sounds indicating an incoming test call, depress MTL key/lamp and establish voice communication with the class 5 office.
6	Transfer call to TDC access line 0 by depressing MASTER TEST LINE-TR key. Depress TS XMSN and XMT TALK keys to establish voice communication with the class 5 office. After voice communication is established, release the XMT-TALK key before proceeding.
7	At the class 5 office, place appropriate test termination (900 ohm +2.16 $\mu\text{F}$ ) across the transmission path of the selected trunk.
8	At the RTA office, outpulse code 100 to establish a switched connection to a code 970 BAL TST TERM at the toll office by using the teletype input message TKT-77-970-XXXX. Depress the BAL key and release the TS-XMSN key to connect the trunk to the balance test circuit. A bridge connection with the local and toll offices has now been established. See Fig. 1.
9	At the toll office, terminate the transmit and receive legs of the balance test hybrid associated with the code 970 circuit.
10	Set the TEST TYPE switch of the RLMS to SRL-HI.

STEP	PROCEDURE
11	Adjust the capacitor box to a value giving the greatest return loss and record the capacitance value and the return loss measurement.
12	Set the TEST TYPE switch of the RLMS to SRL-LO and record the measurement.
13	Set the TEST TYPE switch of the RLMS to SRL-HI and record the measurement.
14	Repeat Steps 10, 12, and 13 for each value of capacitance set in the capacitor box as follows:  Value obtained in Step 11 minus .012 $\mu$ F Value obtained in Step 11 minus .010 $\mu$ F Value obtained in Step 11 minus .008 $\mu$ F Value obtained in Step 11 minus .006 $\mu$ F Value obtained in Step 11 minus .004 $\mu$ F Value obtained in Step 11 minus .002 $\mu$ F Value obtained in Step 11 plus .002 $\mu$ F Value obtained in Step 11 plus .004 $\mu$ F Value obtained in Step 11 plus .006 $\mu$ F Value obtained in Step 11 plus .008 $\mu$ F Value obtained in Step 11 plus .010 $\mu$ F Value obtained in Step 11 plus .012 $\mu$ F
15	At the class 5 office, remove the test termination established in Step 7.
16	At the RTA, release the BAL and TS XMSN keys.
17	Depress TS REL key to release connection.
18	Repeat Steps 4 through 17 for each trunk in the sample.
19	Remove test connection after all trunks have been tested.

### 3. DETERMINING NBOC VALUE

**3.01** The optimum value of NBOC of the 1P 4WTS or equivalent used in all applications shall be determined by the transmission engineer based on the measurements made in the preceding procedures. The optimum value of the NBOC is that which will allow 50 percent of the 2-wire TC trunks to meet an ERL  $\geq$  15 dB and SRL  $\geq$  6 dB and 98 percent of the 2-wire TC trunks to meet an ERL  $\geq$  13 dB and SRL  $\geq$  4 dB when tested from the balance test circuit of the CDT.

**3.02** Strap or screw down the NBOC adjustments on all 1P 4WTS or equivalent associated with BR trunks and balance test circuit on the TDC.

### 4. VERIFICATION TESTS OF THE NBOC VALUE

**4.01** This procedure is used to verify the NBOC value determined in Part 3 or to certify office balance requirements for groups of 2-wire TC trunks added after initial office balancing. This procedure is performed on all 2-wire TC trunks in each trunk group as described in paragraphs 2.01 and 2.02. The toll office code 970 balance test circuit and the RTA TDC balance test circuit, both properly built-out, are used in this procedure.

STEP	PROCEDURE
1	At the RTA office, connect the RLMS to the 24V4-type repeater associated with the TDC balance test circuit as shown in Fig. 3.
2	At the class 5 office, seize and key pulse (dial) 959-1210 (the directory number assigned to the TSPS jack-ended test line) into the trunk selected.
3	At the RTA office when the MTL key/lamp flashes and buzzer sounds indicating an incoming test call, depress the MTL key and establish voice communication with the class 5 office.
4	Transfer the call to TDC access line 0 by depressing MTL TR key. Depress TS XMSN and XMT TALK keys to establish voice communication with the class 5 office. After voice communication has been established, release the XTM TALK key before proceeding.
5	At the class 5 office, place the appropriate test termination (900 ohm + 2.16 $\mu$ F) across the transmission path of the selected trunk.
6	At the TSPS office, outpulse 970 to establish a switched connection to a code 970 balance test circuit at the toll office by using the teletype input message TKT-77-970. A bridged connection, as indicated by the BRDG lamp, has been established between the toll and local offices.
7	Depress the BAL key and release the TS XMSN key to connect the trunk to the balance test circuit.
8	Set up the test equipment to perform ERL, SRL-LO, and SRL-HI as described in Section 660-463-504.
9	Measure the ERL, SRL-LO, and SRL-HI.  <b>Note:</b> The measurement results must meet the requirements in Section 660-463-301.
10	Record the measurement results.
11	At the class 5 office, remove the test termination established in Step 5.
12	At the RTA office, release the BAL and TS XMSN keys.
13	Depress the TL REL key to release connection.
14	Repeat Steps 2 through 13 for all 2-wire TC trunks included in the samples in procedure 2.03.  <b>Note:</b> The measurement must meet the requirements in Section 660-463-301. If the requirements are not met, the NBOC selection process may have to be repeated.
15	Repeat Steps 2 through 13 for all 2-wire TC trunks in the sample if the requirements in Step 14 are met.

STEP	PROCEDURE
16	Remove all test equipment after all trunks have been tested.

**4.02** This procedure is used to verify the compromise NBOC value on all 1P 4WTS associated with the Base-Remote trunks at the RTA concentrator. The TDC access line 1 must be properly built-out before this procedure can be used. See Section 660-463-504.

STEP	PROCEDURE
1	<p>Connect the selected Base-Remote trunk to the TDC access line 1 by using the teletype input message TKT-25-tgn-c-mem-ACS</p> <p>tgn = trunk group number</p> <p>c = 0</p> <p>mem = member number.</p>
2	Depress the TRANSMISSION TEST - BRXM key.
3	Depress the TRANSMISSION TEST - QUIET TERM key.
4	Connect a KS-20501 RLMS to the 24V4 type repeater associated with the selected Base-Remote trunk as shown in Fig. 4.
5	Set up the test equipment to perform ERL and SRL measurements as described in Section 660-463-504.
6	Measure the ERL, SRL-LO and SRL-HI.
	<b>Note:</b> The measurement results must meet the requirements in Section 660-463-301.
7	Record the measurement results.
8	Release the connection by depressing the BR REL key.
9	Repeat Steps 1 through 8 for all position circuits to be tested.
10	Remove all test connections after all trunks have been tested.

**5. SELECTION AND VERIFICATION OF DBOC AND NBOC VALUES ASSOCIATED WITH 2-WIRE PORTS AND 4WTS CONTAINED IN RTA 4-WIRE BRIDGING REPEATER (SD-7C022-01)**

**5.01** This procedure is performed on all 3-way, 4-wire bridging repeaters associated with RTA 4-wire TCTs. The RTA TDC balance test circuit, with the NBOC properly built-out, is used in this procedure.

**5.02** Steps 6 through 10 of this procedure can be omitted for a trunk connection if the DBOC value is determined by prescription. However, if the ERL and SRL requirements given in Section 660-463-301 are not met, Steps 6 through 10 of

this procedure should be performed to determine the optimum DBOC value.

**5.03** Steps 18 through 23 of this procedure can be omitted for a trunk connection if the NBOC value is determined by prescription. However, if the ERL and SRL requirements given in Section 660-463-301 are not met, Steps 18 through 23 of this procedure should be performed to determine the optimum value.

**5.04** Step 3 and Steps 27 through 30 should be performed for all base RTA 4-wire TC trunks containing 4WTS in the transmission path between the RTA and the toll office.

STEP	PROCEDURE
1	At the RTA office, connect a RLMS to the 24V4-type repeater associated with the RTA TDC balance test circuit as shown in Fig. 5 or 6.
2	Connect the selected 4-wire trunk to the CDT access line 0 by using the teletype input message TKT-25-tgn-0-mem-ACS.  tgn = trunk group number  mem = member number
	<b>Note:</b> Proceed to Step 4 if the selected 4-wire trunk does not contain a 4WTS in the toll office.
3	Outpulse 970 to establish a switch connection to a code 970 balance test circuit at the toll office by using the teletype input message TKT-77-970-XXXX.
4	Depress the BAL key to connect the trunk to the TDC balance test circuit.
5	Terminate the 4-wire ports (1 and 2) of the TSPS 4-wire Bridging Repeater (SD-7C022-01) as in Fig. 5. If the 3-way, 4-wire bridging repeater is a separately mounted item, remove the plug-in from its mounting and insert it into the J99338CB test extender; install terminating plugs and connect the test cable as in Fig. 6.  <b>Note:</b> If the DBOC value is determined by prescription, set the DBOC associated with the 2-wire port to the prescription value and skip to Step 11. The DBOC is an integral part of SD-7C022-01 but is a separately mounted item when SD-99782-01 is used.
6	Connect a 7A capacitor box (or equivalent) to the MON 2W-4W pin jacks on the face of the 3-way, 4-wire bridging repeater plug in or at the DBOC mounting.
7	Set the TEST TYPE switch of the RLMS to SRL-HI.

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STEP	PROCEDURE
8	Adjust the capacitor decade box in small increments of capacitance and record ERL, SRL-LO and SRL-HI. Keep repeating until ERL and SRL-HI reach maximum and then start to drop. A trade-off pattern will be found to exist between ERL and SRL-HI. Record the capacitance and measurement value.
9	Remove the 7A capacitor box from the MON 2W-4W jacks.
10	Set the DBOC of the bridging repeater to the value recorded in Step 7 above.
11	Verify that the return loss measured by the RLMS is approximately the same as that recorded in Step 7. If it is not, the DBOC must be readjusted. When large changes in the DBOC are required to obtain the same measurement as that obtained in Step 7, investigation should be made for trouble.
12	Set up the test equipment to perform ERL or SRL measurement as described in Section 660-463-504.
13	Measure the ERL and SRL.  <i>Note:</i> The measurement results must meet the requirements in Section 660-463-301.
14	Record the measurement results.
15	Remove the RLMS from the TDC balance test circuit.
16	Terminate with 262B plugs the R AMPL IN and T AMPL OUT jacks in the test jack field of the 24V4-type repeater associated with the TDC balance test circuit. See Fig. 7 or 8.
17	Connect the KS-20501 RLMS to the TSPS 4-wire bridging repeater as in Fig. 7 or 8.  <i>Note:</i> If the value of the NBOC is determined by prescription, set the NBOC of the bridging repeater 4WTS to that value by turning down or tightening the appropriate screw switches and skip to Step 12.
18	Connect a 7A capacitor box to the J99338CB test extender jack J7 HYB NET.
19	Set the TEST TYPE switch of the RLMS to SRL-HI.
20	Adjust the capacitor decade box in small increments of capacitance and record ERL, SRL-LO and SRL-HI. Keep repeating until ERL and SRL-HI reach maximum and then start to drop. A trade-off pattern will be found to exist between ERL and SRL-HI. Record the capacitance and measurement value.
21	Set the NBOC of the bridging repeater to the capacitance value recorded in Step 8 by turning down or tightening the appropriate NBOC screw switches.
22	Remove the 7A capacitor box for the J7 HYB NET jack of the test extender.

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STEP	PROCEDURE
23	Verify that the return loss measured by the RLMS is approximately the same as that observed in Step 9. If not, the NBOC of the bridging repeater must be readjusted.
24	Set up the test equipment to perform ERL or SRL measurements as described in Section 660-463-504.
25	Measure the ERL and SRL.  <b>Note:</b> The measurement results must meet the requirements in Section 660-463-301.
26	Record the measurement results.  <b>Note:</b> Proceed to Step 20 if the 4-wire trunk does not contain a 4WTS as described above.
27	Reconnect the RLMS and terminating plugs as shown in Fig. 9 or 10.
28	Set up the test equipment to perform ERL or SRL measurements as described in Section 660-463-504.  <b>Note:</b> The measurement results must meet the requirements in Section 660-463-301.
30	Record the measurement results.
31	Remove all test connections from the test extender and return the 3-way, 4-wire bridging repeater to its proper mounting.
32	Release the BAL keys.
33	Depress the TS REL key to release the connection.
34	Repeat Steps 2 through 22 for all 4-wire trunks containing 3-way, 4-wire bridging repeaters.
35	Remove the test plugs from 24V4-type repeaters associated with the TDC balance test circuit after all trunks have been tested.

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SECTION 660-463-502

CLASS 5 OFFICE

2-WIRE TOLL OFFICE

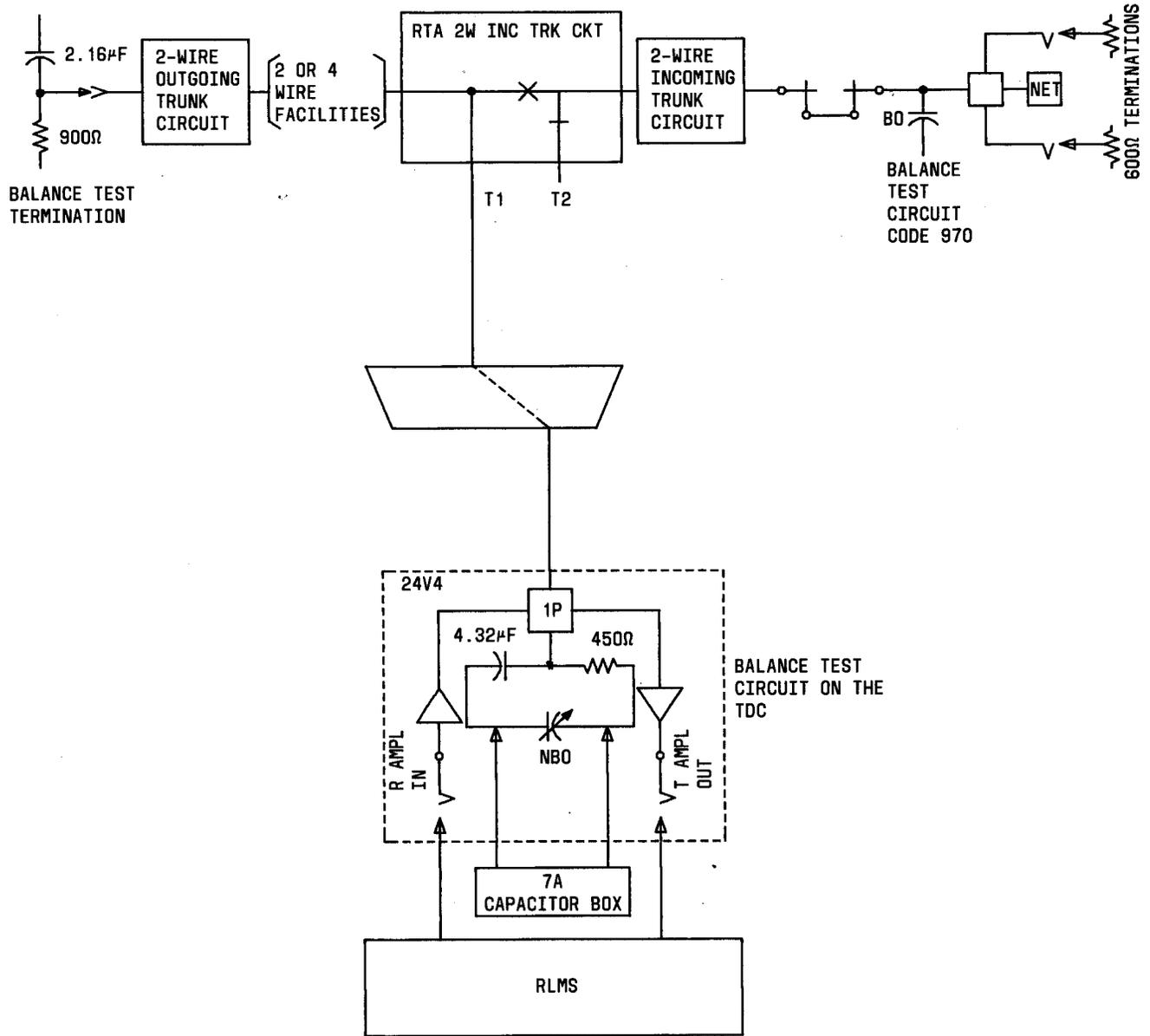


Fig. 1—Test Connection for NBOC Value Selection in 1P 4WTS

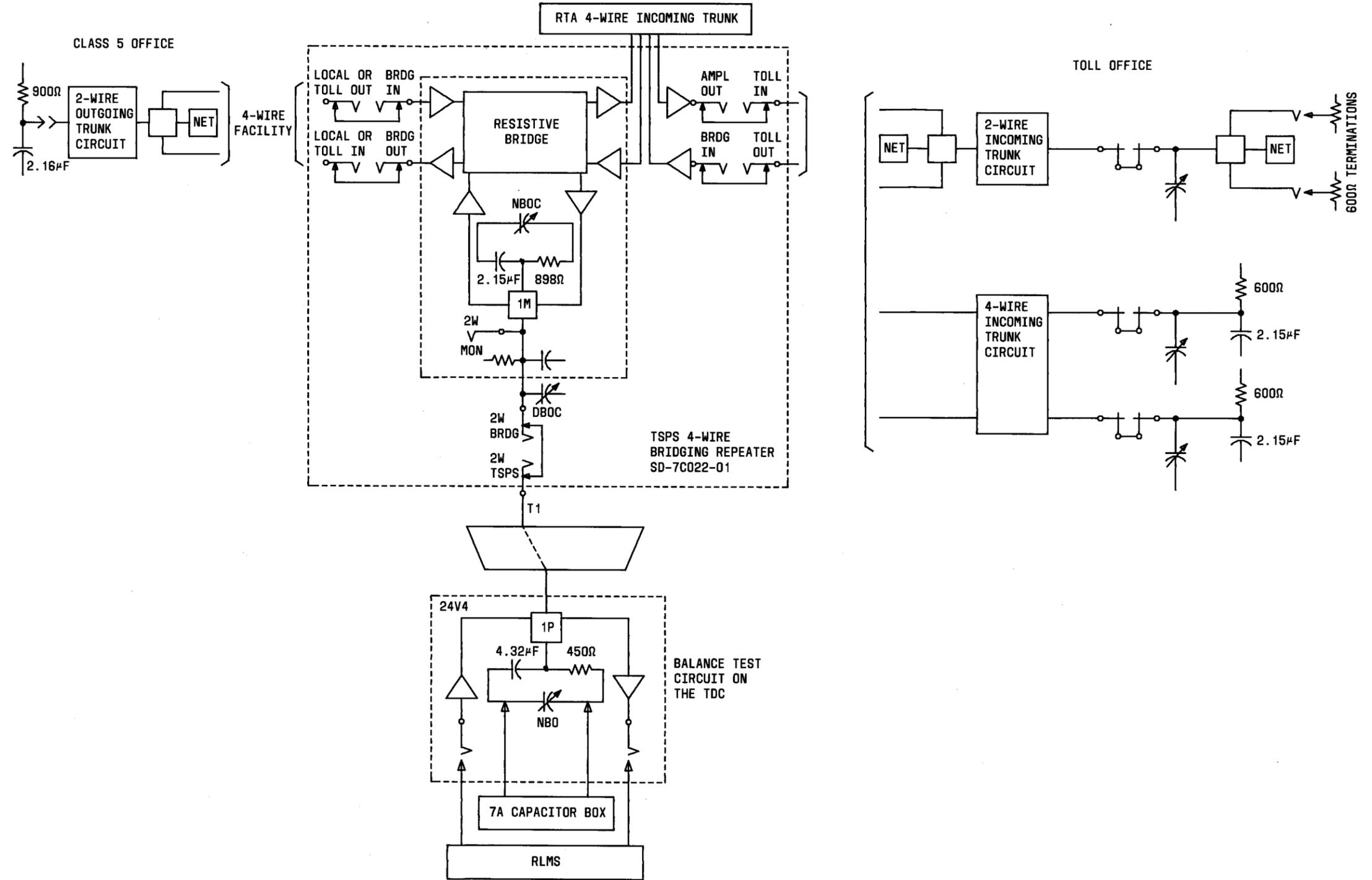


Fig. 2—Test Connection for NBOC Value Selection in 1P 4WTS in RTA Offices With 4-Wire Trunks Only

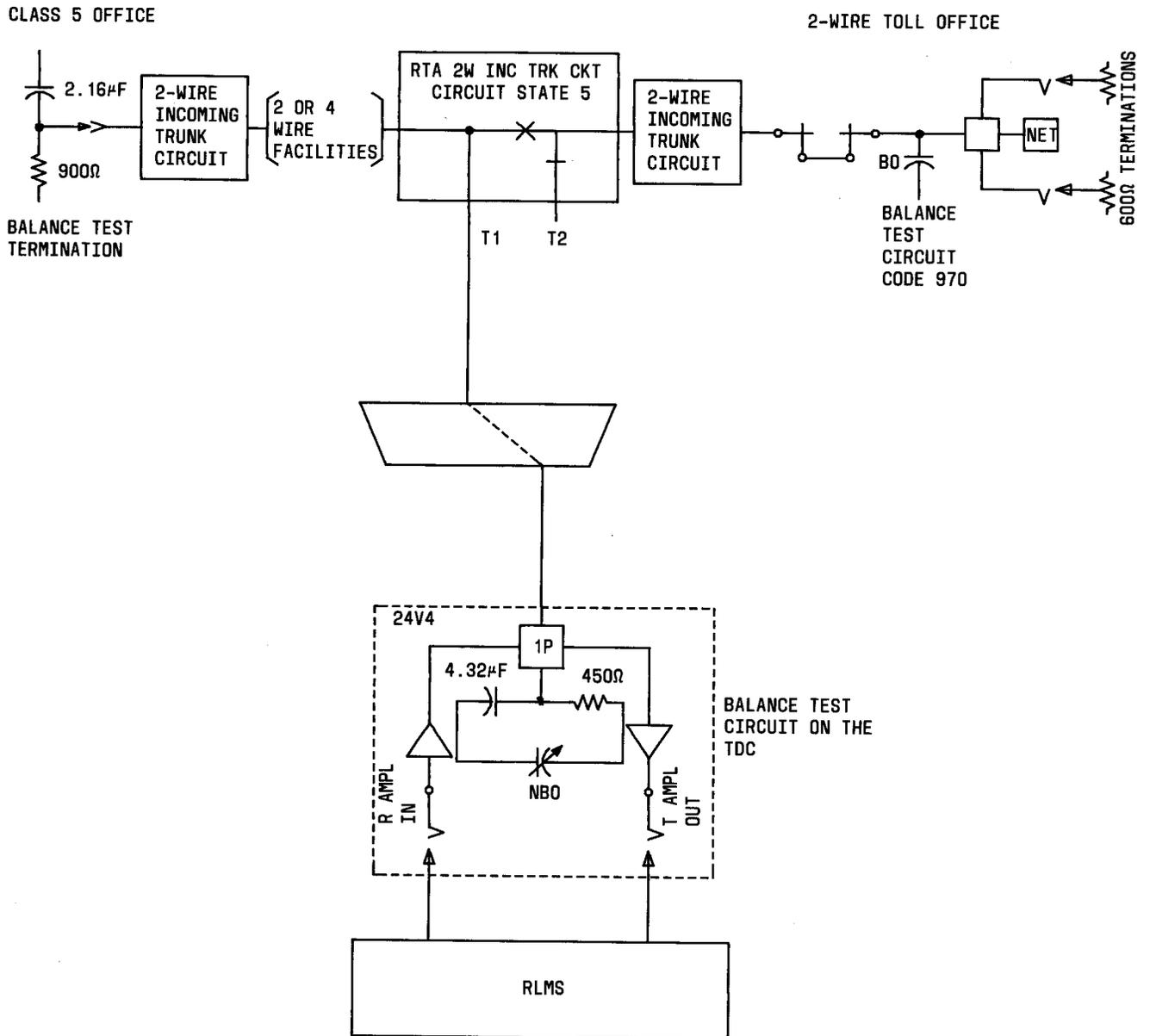


Fig. 3—Test Connection for 1P 4WTS NBOC Verification Tests on 2-Wire TC Trunks

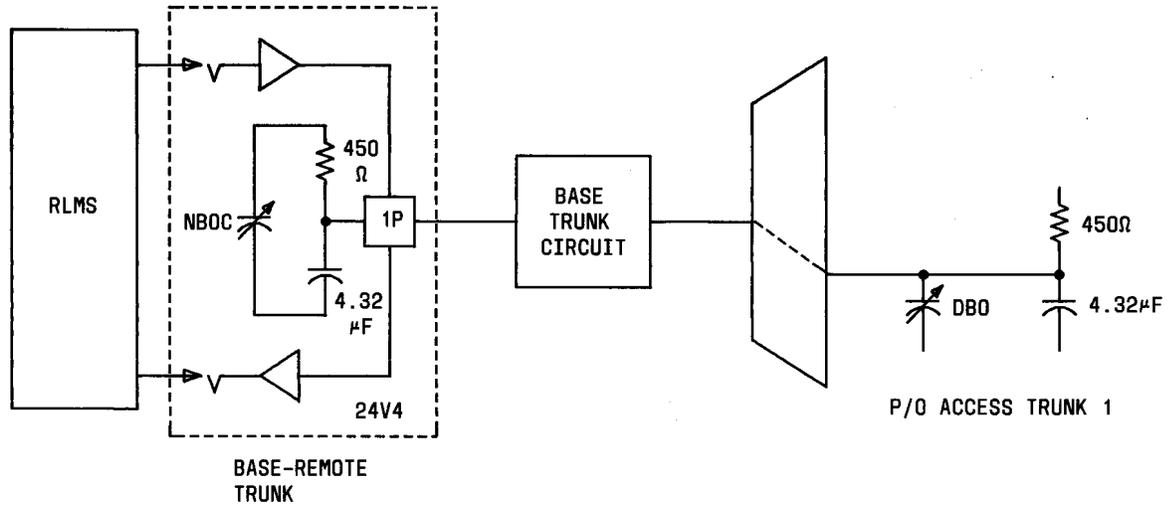


Fig. 4—Test Connection for Verification Tests on Operator Position Trunks

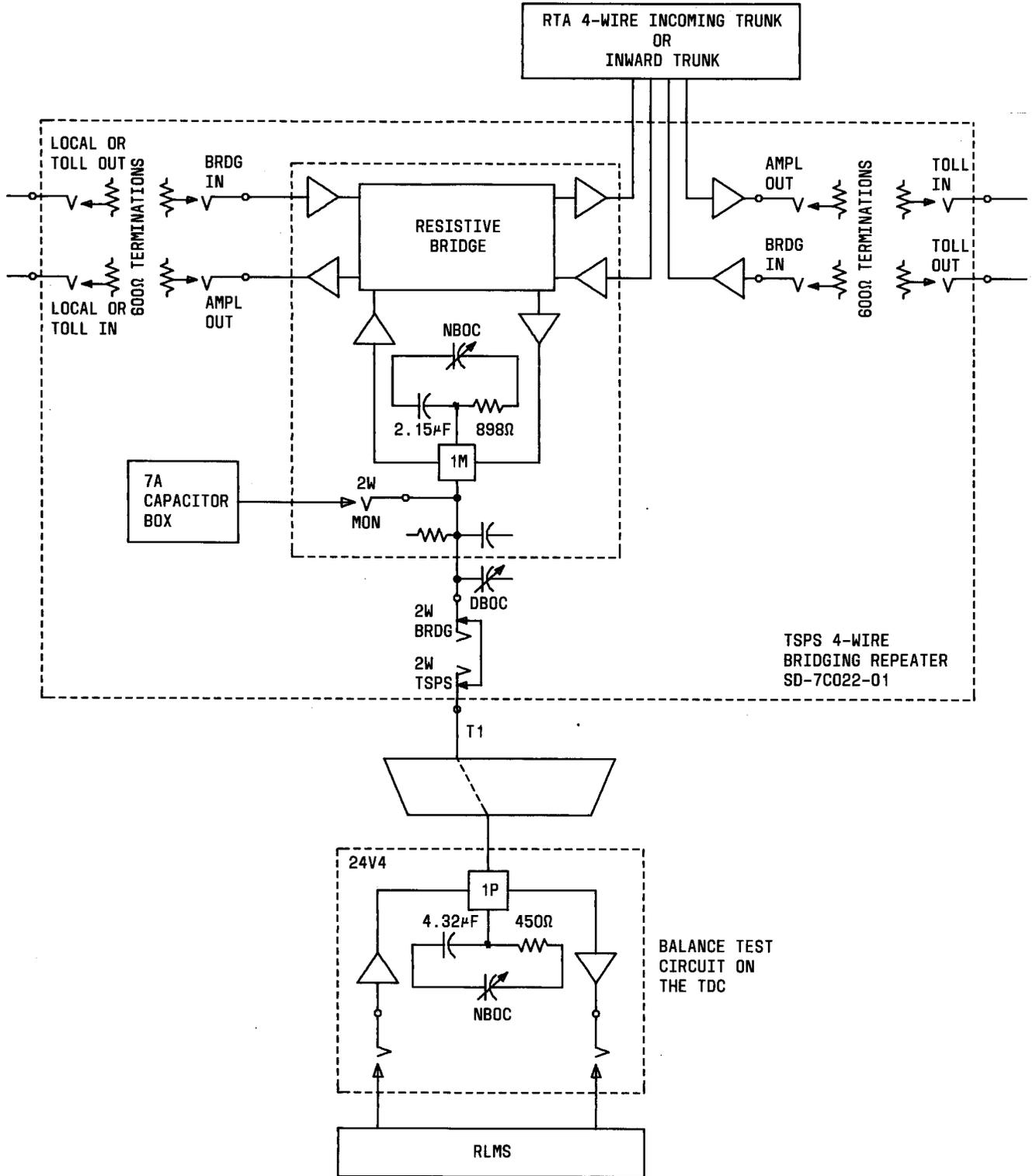


Fig. 5—Test Connection for DBOC Value Selection on TSPS 4-Wire Bridging Repeater

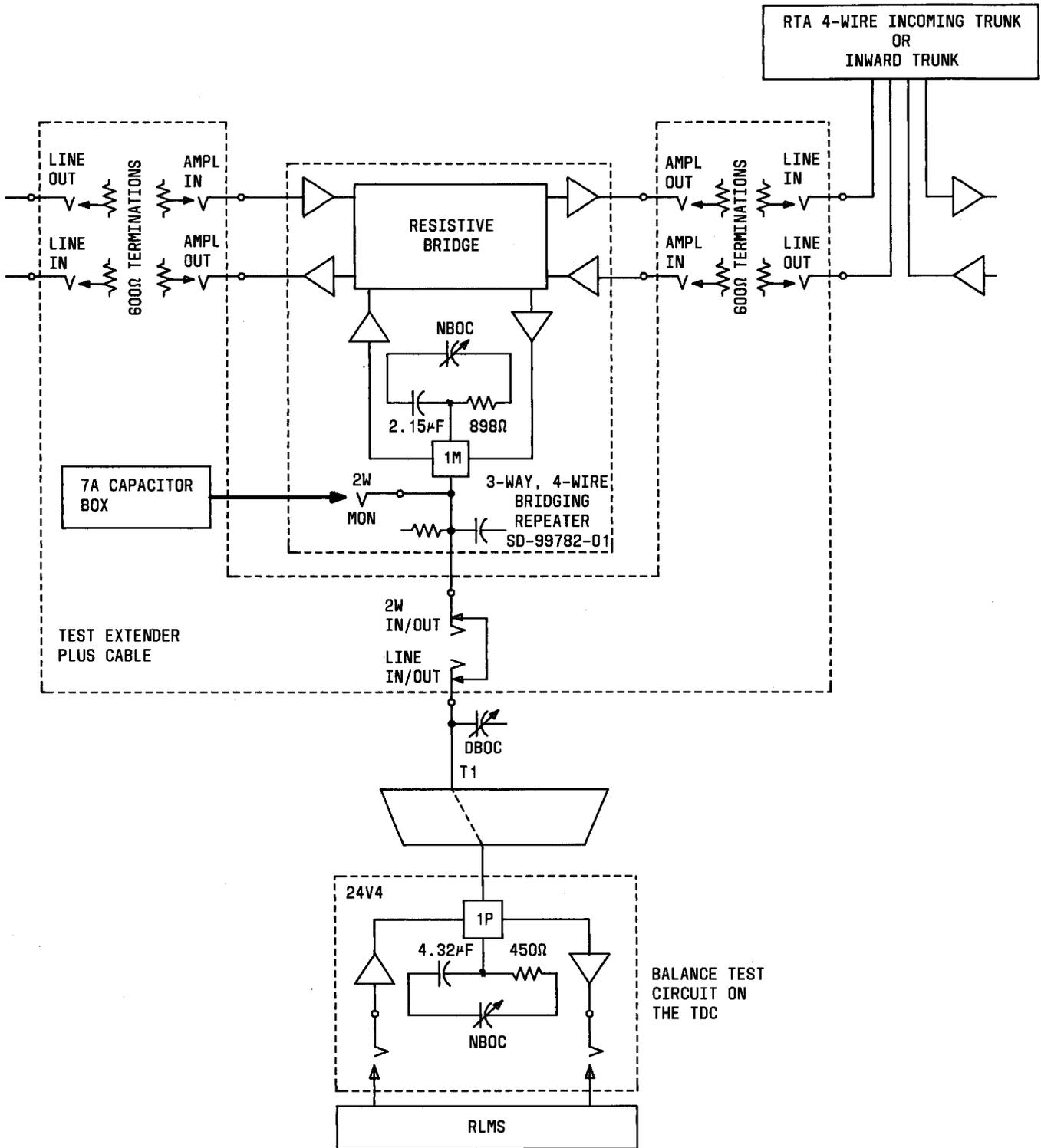


Fig. 6—Test Connection for DBOC Value Selection on 3-Way, 4-Wire Bridging Repeater Using Test Extender

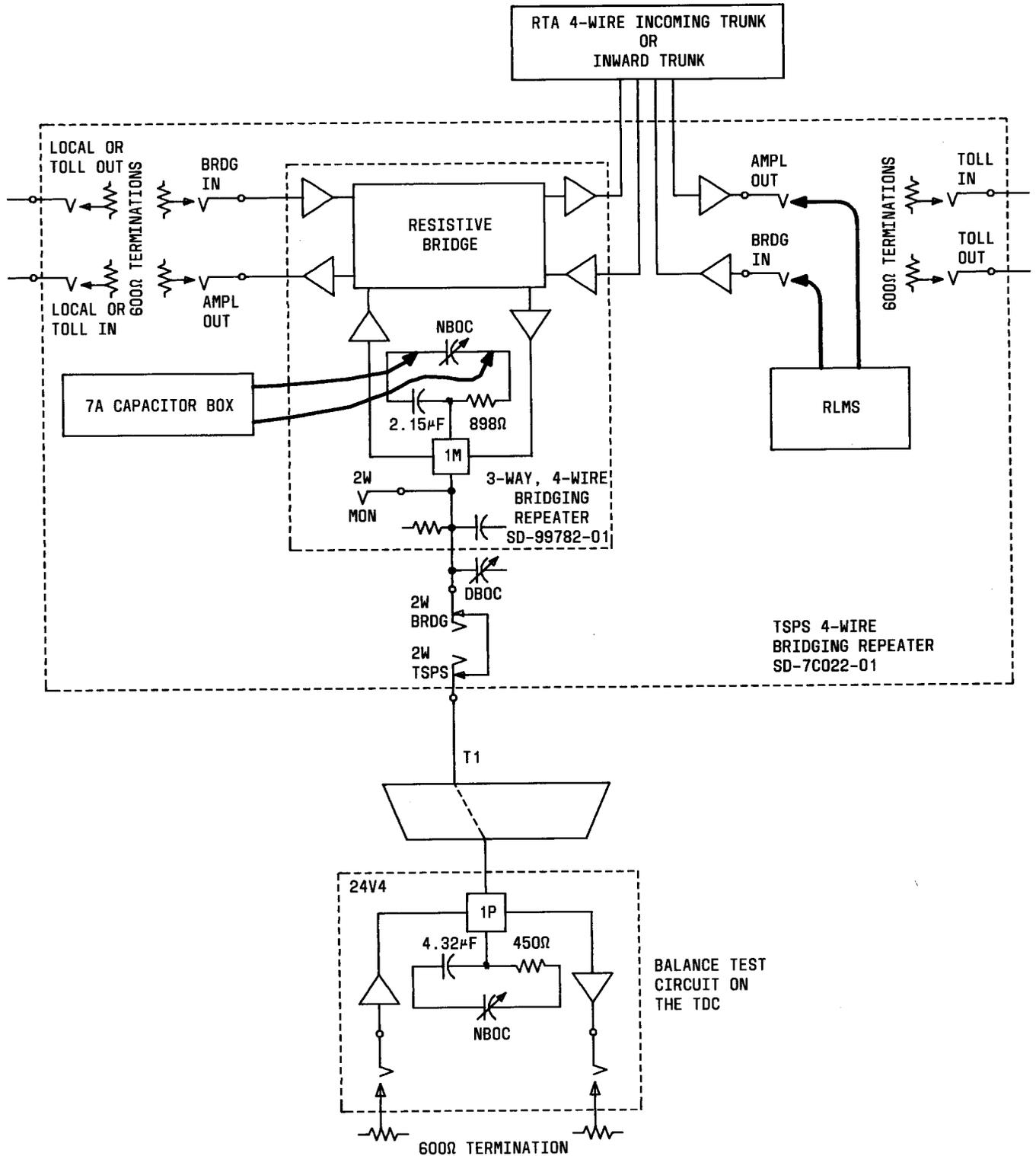


Fig. 7—Test Connection for NBOC Value Selection on TSPS 4-Wire Bridging Repeater

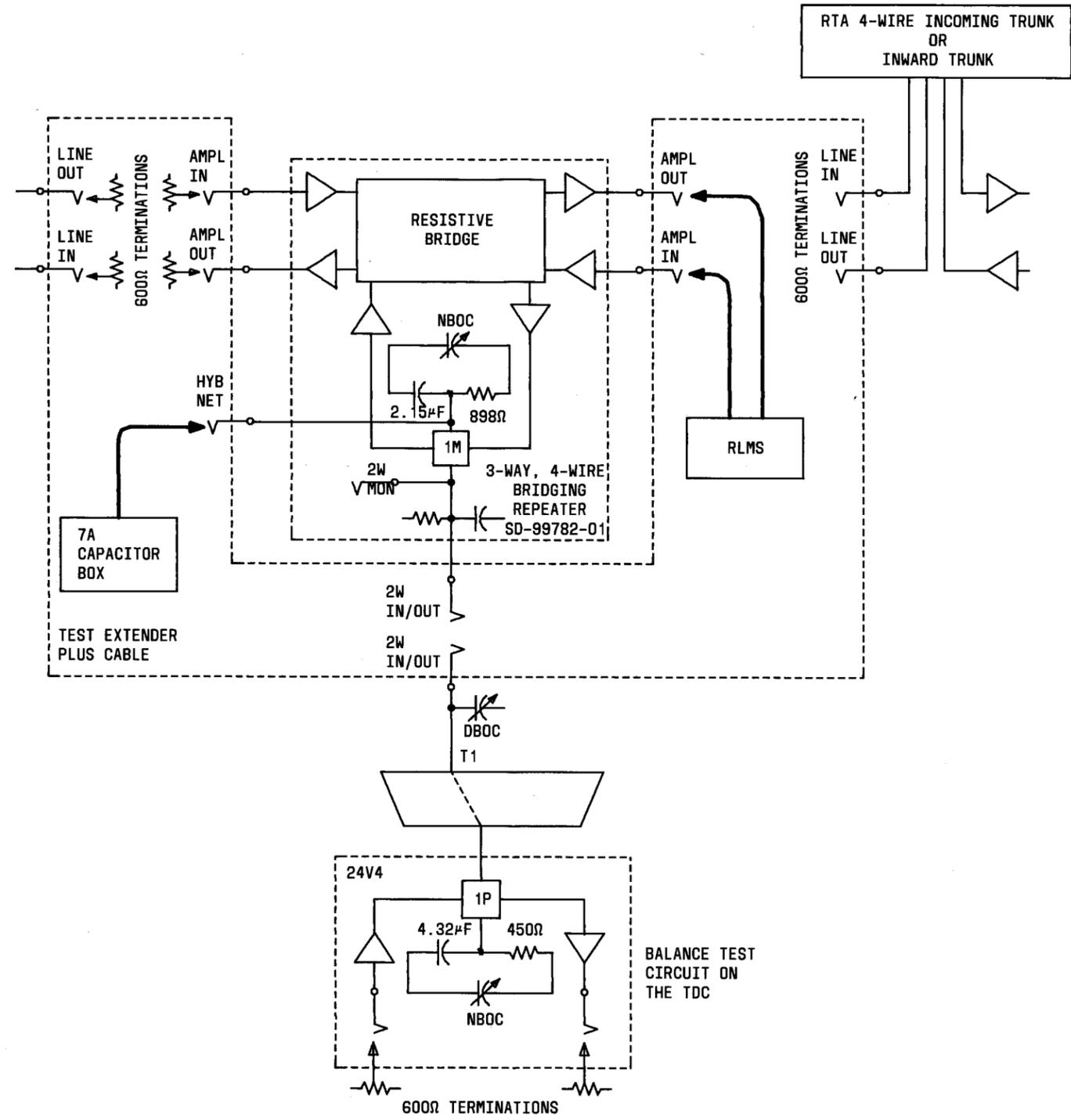


Fig. 8—Test Connection for NBOC Value Selection on 3-Way 4-Wire Bridging Repeater Using Test Extender

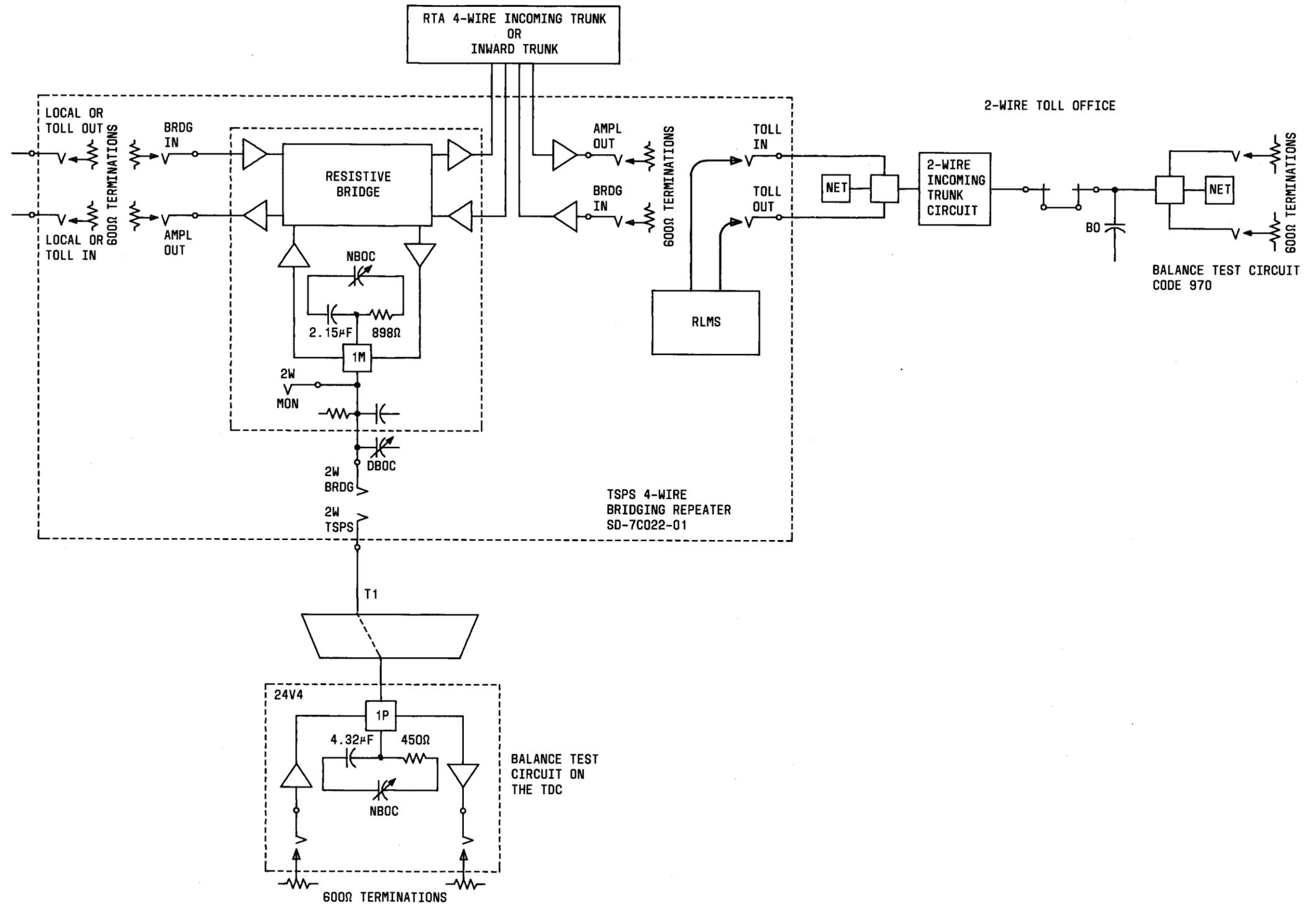


Fig. 9—Test Connection for Verification Test of 4WTS in Toll Office

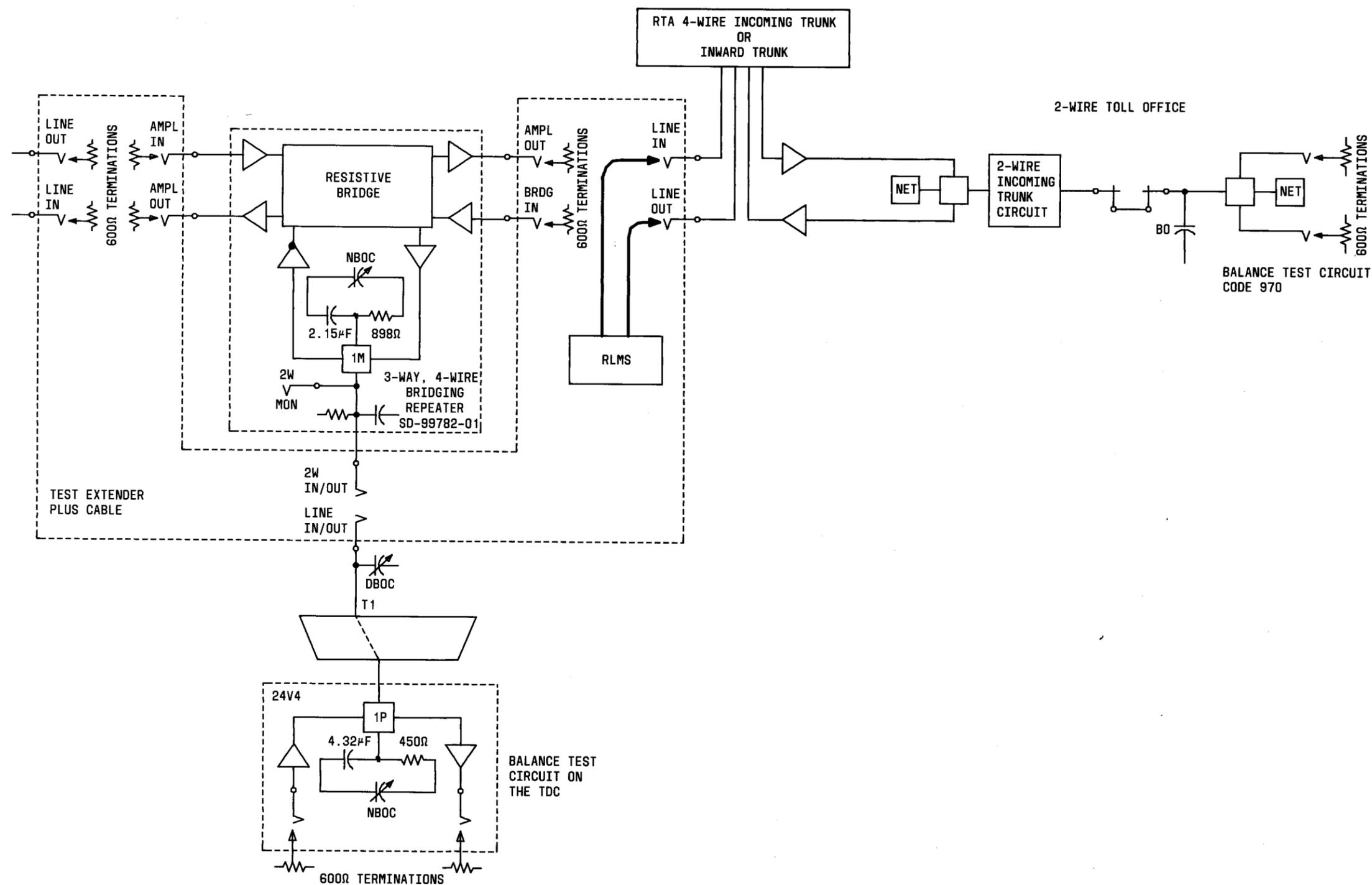


Fig. 10—Test Connection for Verification Test of 4WTS in Toll Office Using Test Extender