SWITCHED SERVICES NETWORKS USING CENTRAL OFFICE SWITCHING MACHINES BALANCE TESTING METHODS IN 2-WIRE NO. 5 CROSSBAR OFFICES

CONTENTS PAGE

1. GENERAL

1.01 This section describes and specifies the balance adjustments and tests that are required at all Switched Services Class 3 (SS-3) 2-wire No. 5 X-bar offices. It is assumed that the office is arranged for tandem switching and also serves as a CENTREX PBX in the same SSN. If the office is nontandem or non-CENTREX, some portions of the procedure may be omitted.

1.02 These adjustments and tests are required to optimize the electrical balance between the network and circuitry on the 2-wire side of hybrid coils (4-wire term. sets) which are used to transfer circuits from 4-wire to 2-wire operation for switching purposes at No. 5 X-bar offices. This electrical balance is necessary to assure that the facilities have an adequate margin against echo and singing effects.

1.03 The circuits appearing on the trunk link frame are the network trunks and remote CENTREX access lines and are equipped with 2-way Private Network Trunk Circuits — (SD-27654). The arrangement of these circuits is shown schematically in Fig. 1.

1.04 The circuits appearing on the line link frame are as follows:

(a) Access lines equipped with Line Link Pulsing (LLP) Circuits — (SD-27669-01) and 4-wire term. sets.

(b) 4-wire non-CENTREX station lines equipped with E1L signal units — (SD-98137-01).

(c) 2-wire non-CENTREX station lines.

(d) 2-wire CENTREX station lines (CENTREX PBX).

(e) 4-wire CENTREX tie trunks to satellite or tributary PBX equipped with Line Link Pulsing (LLP) Circuit (SD-27669) and 4-wire term. sets (CENTREX PBX).

(f) 2-wire CENTREX tie trunks to satellite or tributary PBX equipped with Line Link Pulsing (LLP) Circuits (SD-27669) and impedance compensators (CENTREX PBX).

(g) The two line link appearances of each 2-way Private Network Trunk Circuit (SD-27654) (tandem switch). The arrangement of these circuits is also shown schematically in Fig. 1.

1.05 Associated Switch Services Network sections for additional reference are as follows:

Section 310-200-100 — General Description

Section 310-200-300 — Service Maintenance

Section 310-200-500 — Transmission Testing in 4-Wire No. 5 Crossbar Offices

Section 310-200-501 — Transmission Testing in 2-Wire No. 5 Crossbar Offices

Section 310-200-502 — Transmission Testing at PBXs

Section 310-200-503 — Transmission Testing at Subscriber Stations

Section 310-281-501 — 17E Testboard — Operational Tests

1.06 This section assumes the use of 1 type term. sets. Where other types are used, the procedure must be modified as required to produce the same result.

2. TESTING ARRANGEMENTS AND PROCEDURES

2.01 The testing arrangements and procedures have been divided into two parts for greater ease in following the step-by-step procedure. The balance method has been set up to be, as far as possible, independent of facilities outside the office. This permits most of the balancing to be completed before outside plant facilities and customer equipment is assigned, lined up and available and also eliminates operations requiring test personnel at the distant office.

2.02 Offices having VF patch bays adjacent to the testboard may not be equipped with circuit patch bays. The procedures are shown for testing with and without circuit patch bays.

2.03 Dialable test lines are provided for access from both sides of the office. Those terminated on the line link frame are reached by dialing or pulsing a seven-digit telephone number. Those terminated on the trunk link frame are the equivalent of 100 series code test lines, but they can not be reached from station lines or LLP circuits by dialing the 100 series codes. The office must, therefore, be arranged so they can be reached by dialing arbitrary NNX codes or NNX-XXXX numbers. They are, therefore, referred to as equivalent code test lines.

2.04 The steps for setting up circuits (seizing, signaling and holding) are repeated, whenever practical, for each test arrangement, to keep the confusion of "cross-referencing" to a minimum. In setting up test calls through the equipment on which NBO-DBO adjustment tests or balance measurements are to be made, the object is to set up the No. 5 X-bar machine, trunk relay and converter circuits in the same way as would a normal call through the office. This is necessary in order to put the transmission paths in the same state as they would be with normal "OFF-HOOK" supervision from a distant called station.

3. EVALUATION OF OFFICE EQUIPMENT LOCATIONS

3.01 When making measurements to determine the "capacitive length" of circuits from their respective toll terminal equipment to their line or trunk link appearances, samples of all possible paths are chosen. An evaluation of the office should be made to determine the physical locations of trunk relay equipment, signaling circuits and toll terminal equipment assigned to each group of circuits such as network trunks, access lines, station lines, etc. From this inspection, a sample of at least two circuits is selected from each group having common equipment locations and the circuits are listed, on the office evaluation sheet (see Fig. 2). If a particular type of circuit group has the same type of equipment at more than one location, then additional samples should be listed and tested for each location.

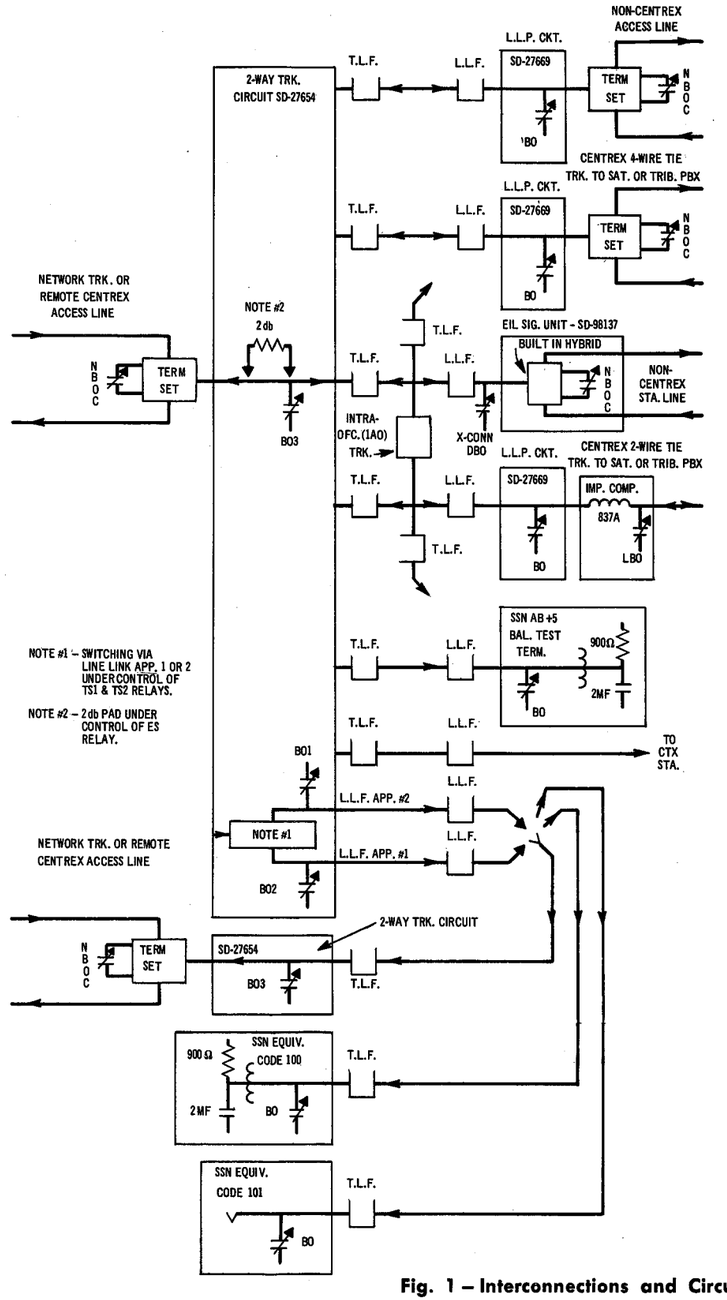


Fig. 1 – Interconnections and Circuit Patches in Class SS-3 2-Wire No. 5 X-Bar Offices

4. PORTABLE TEST EQUIPMENT AND MISCELLANEOUS SYMBOLS

4.01 The portable test equipment, office circuits and test terminations required and the symbols used for this equipment in the drawings are shown in Fig. 3.

4.02 All test sets must be calibrated in accordance with standard instructions before they are used. The calibration should be checked during the test period. Ample warmup time should be allowed for all test sets to insure that they have stabilized.

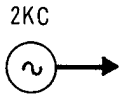
5. LIST OF FIGURES

OFFICE EVALUATION SHEET

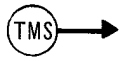
(Plus Record of Normal Capacitive Length of Sample and DBO Required)

CIRCUIT		RELAY RACK LOCATION	EQUIP. NO.	NORMAL CAPACITIVE LENGTH (Figs. 5 & 7)	DBO CAP. REQUIRED
NAME	NO.				

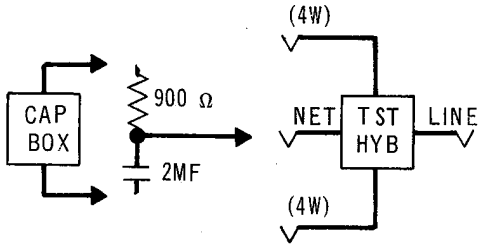
Fig. 2



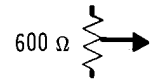
600 – ohm variable frequency oscillator such as the "OSC" section of the 21A Transmission Measuring Set KS-19353 or equivalent oscillator set for an output of 2000 CPS at zero.level.



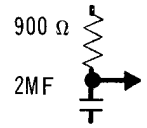
600 – ohm transmission measuring set such as the "DET" section of the 21A TMS or its equivalent.



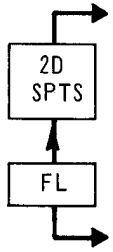
Portable, jack terminated 900 – ohm test hybrid with a decade capacity box across a 900 – ohm + 2MF network (1 type term set, Airtronics Co. model 20B or equivalent). Cap. Box may be 7A, G.R.1419A or similar.



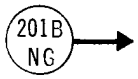
Plug terminated 600 – ohm resistor.



900 – ohm compromise network termination -18FB resistor and 439 QA capacitor or equivalent. (2AB Test Set Switched to "Cal. OSC" provides equivalent termination."



2D or 2E Singing Point Test Set (J 94002D or E) with a 207G high pass filter. Terminals 3-4 of the filter are connected to the 2D SPTS and terminals 1-2 to the test point.

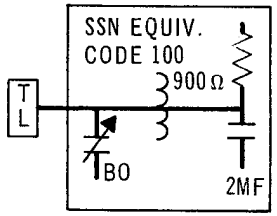


201A or B Noise Generator equipped with a 455B weighting network.

3A Noise Measuring Set equipped with C message weighting network.

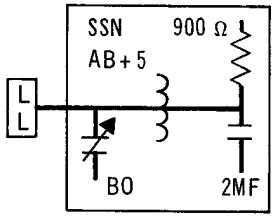
W12A test (octupus) Cord consisting of 12 single conductor cords with one common terminal.

MISC. SYMBOLS

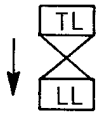


Balance Test Termination for Code NNX or NNX-XXXX Test Line per SD-98100-01

Segregated for SSN service.



Balance Test Termination for SSN AB + 5 Test Line per SD 98100-01. Segregated for SSN service and arranged to provide "off-hook supervision.



Indicates a connection completed thru the switches from the line link (LL) to the trench (TL) or vice versa as shown by the arrow.

Fig. 3 – Test Sets and Associated Facilities

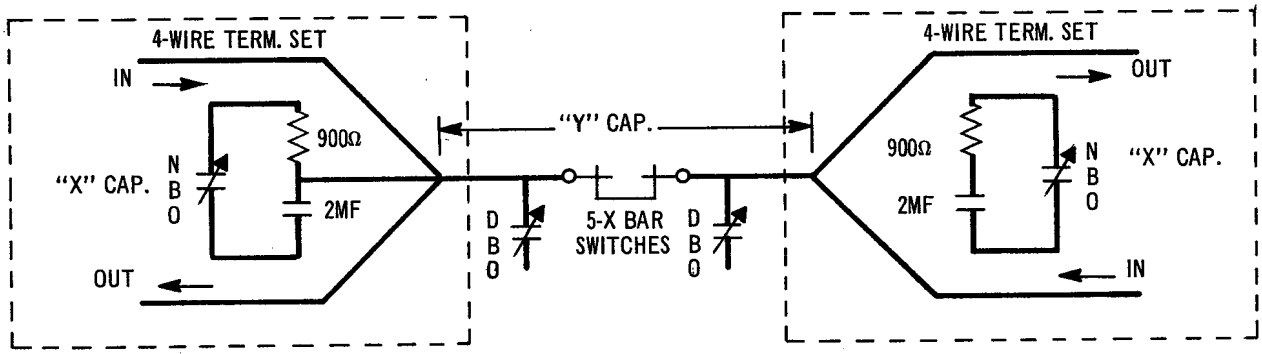
6. BALANCE METHODS — PART I

A. General

6.01 Since the majority of the traffic through the SS3 office will be on a full dial basis, the electrical center of the office is assumed to be the center of the No. 5 X-Bar LLF — TLF switches. Test measurements are made through the switches. Such tests include determining the value of and adjusting the network build-out (NBO) capacitors of the trunk and access line hybrid transformers (4-wire term. sets), and making optimum adjustment of the drop build-out (DBO) capacitors. Fig. 4 shows a simplified picture of the principle behind NBO and DBO adjustment to obtain optimum balance. A summary of the tests in Part I are shown in Table I. An office evaluation sheet for control of the work is shown in Fig. 2.

TABLE I

SUMMARY OF REQUIRED TESTS FOR PART I	
FIG.	TESTS
5	***SELECTION OF LONGEST ACCESS OR STATION LINE PATHS***
5A	Measurement of 4-Wire Non-CENTREX Access Line or CENTREX 4-Wire Tie Trunk to Satellite or Tributary PBX (CENTREX PBX)
5B	Measurement of CENTREX 2-Wire Tie Trunk to Satellite or Tributary PBX (CENTREX PBX)
6	***SELECTION OF NETWORK TRUNK OR REMOTE CENTREX ACCESS LINE HAVING LONGEST "OUTGOING" AND "INCOMING" PATH***
6A	Measurements to Identify Longest Trunk Incoming Path
6B	Measurements to Identify Longest Trunk Outgoing Path
7	***NBO DETERMINATION AND ADJUSTMENT OF ALL CIRCUITS EQUIPPED WITH NO. 1 TYPE 4-WIRE TERM. SETS***
7A	Measurement of NBO Required on a Connection Between Access or Station Lines
7B	Measurement of NBO Required on a Connection Between Reference Trunk Outgoing Path and Access Lines
7C	Measurement of NBO Required on a Connection Between the Reference Trunk INCOMING PATH and the Reference Trunk OUTGOING PATH. Adjustment of the NBOC of all 4-Wire Term. Sets



NOTE – NBO & DBO CAP. ARE ADJUSTED SO THAT "X" CAP. = "Y" CAP

Fig. 4 – Principle of NBO and DBO Adjustment

B. BO Measurements on Access and Station Lines

6.02 The tests in Part 6B are made to determine which of the following access or station line type paths has the longest "capacitive length" from the ***Line Link Frame*** to their respective ***Toll Terminal Equipment:***

(a) Non-CENTREX access lines equipped with LLP circuits and 4-wire term. sets, and CENTREX tie trunks to satellite or tributary PBXs equipped with LLP circuits and 4-wire term. sets.

(b) CENTREX 2-wire tie trunks to satellite or tributary PBXs equipped with LLP circuits and impedance compensators (CENTREX PBX).

(c) 4-wire non-CENTREX station lines equipped with E1L signal units.

6.03 Figs. 5A, 5B and 5C show and outline the circuit setup and test connections necessary to complete Fig. 5.

6.04 The test hybrid recommended for use at the testboard jack (used in Figs. 5 and 6) is a portable jack terminated 900-ohm test hybrid with no capacitor in the center tap of the 2-wire line coils so that a DC short is available for holding purposes. The Airtronics Co. Model 20B test hybrid is also suitable for these tests. If the Airtronics is used, a short must be placed in line pin jacks A & B. This will short out the center tap capacitor so that a DC short will be provided for holding purposes. A 1A term. set may also be used. A capacitor box may be connected to terminals 10 and 11 and used in place of the built-in capacitor to prevent wearing out the screws.

C. BO Measurements on Trunk Circuits

6.05 The tests in Part 6C are made to determine which of the Network Trunks or Remote CENTREX Access Lines has the longest capacitive length from the 4-wire terminating set to the ***line link*** frame (incoming path) and from the 4-wire terminating set to the ***trunk link*** (outgoing path).

6.06 The two longest or two of the longest will be used for ***NBO Determination Tests*** in Part 6D and will be referred to as "Reference Trunk Outgoing Path" and "Reference Trunk Incoming Path."

6.07 The type of test shown in ***Fig. 6A*** is made on the incoming path of a trunk for "tandem" switching. These tests are not required at SS3 offices not arranged for this type of switching. However, it is necessary to provide the proper wiring and cross connections and recheck the office balance, if later rearrangements in the switching plan provide for tandem operation.

6.08 Make measurements on trunk circuits in accordance with Fig. 6. Step-by-step instructions are provided on the figure.

6.09 The trunk circuit with the longest trunk link frame appearance is selected (Reference Trunk Outgoing Path). In tandem offices, the trunk circuit with the longest line link frame appearance is also selected (Reference Trunk Incoming Path).

D. NBOC Adjustment of 4-Wire Terminating Sets

6.10 The tests in Part 6D cover the "setting up" and testing of the three possible types of connections between circuits equipped with No. 1 type or similar 4-wire term. sets. The circuits to be used for the tests are the "Reference Trunk Incoming Path," "Reference Trunk Outgoing Path" as determined in Part 6C, and an LLP circuit from each of the two longest paths found in Fig. 5.

6.11 On each connection, a return loss test determines the value of NBOC required in the 4-wire term. set to balance the capacitance of the office wiring. The results are then analyzed to determine the one requiring the most capacitance (longest). A "growth increment" of .009 mf is then added to the determined capacitance and the total may then be placed (screwed down) in the NBOC of ***all*** the involved 4-wire term. sets in the office.

6.12 The .009 mf "growth increment," which is added to the maximum measured value, is an arbitrary allowance for future additions (growth rearrangements) in the office. It may be desirable to either increase or decrease this allowance in a particular case, if the future plans for a particular office seem to be other than average. If an office is laid out so the growth is "from the outside inward," the growth factor may be omitted.

6.13 Under no conditions should the capacitive length of the 2-wire path between 4-wire term. sets result in an NBO value larger than .075 mf including the .009 mf "growth increment." It is expected that in most Switched Services offices the NBO values will be considerably smaller than this value.

6.14 If abnormal amounts of NBO capacitance (exceeding .075 mf) are experienced when testing per Fig. 7, the circuitry in the 2-wire path should be investigated to determine:

(a) That the "2-wire transmission path" is cut through "clean" with no abnormal shunt paths bridged on. This can be caused by improper relay operations in the trunk equipment.

(b) That tie cable lengths are not excessively long. It may be necessary in some cases to relocate or recable equipment. This should be considered whenever a few circuits are much longer than all the rest.

6.15 Make tests as specified in Fig. 7, and obtain trial values of NBOC "A," "B" and "C." The "C" value is obtained only in tandem offices.

6.16 Determine and adjust the NBOC of all 4-wire term. sets in the OFFICE as follows:

Step 1: From test values "A," "B" and "C" select the one with the ***most*** capacitance and to this add the selected growth factor. Exclude "C" in non-tandem offices.

Step 2: Adjust the screws or straps of the NBOC in all the 4-wire term. sets in the office to the total capacitance as determined in Step 1.

Note: Before strapping all NBOCs, check the path selected in Step 1 with tests as prescribed in Part 8 to be sure that no errors have been made up to this point.

Step 3: The circuits which establish the NBOC should be marked for use in adjustment of test lines per Fig. 8.

Be sure to screw down the comp. net screws in No. 1 type term. sets.

Note: Any subsequent additions of 4-wire term. sets should have their NBOCC adjusted to this value.

7. BALANCE METHODS — PART II

A. General

7.01 Part I of the balance methods determined the office NBOC value and provided for strapping the NBOC value in all 4-wire term. sets. Part II provides for the adjustment of all BO capacitors in trunk circuits and line circuits for the best balance.

7.02 The dial test lines are adjusted first in accordance with Fig. 8. BO capacitors in trunk circuits are then adjusted per Fig. 9. Adjustments of BO capacitors in line circuits are covered in Fig. 10.

7.03 The same testing arrangements and test equipment are required for this part of the work as were used in Part 6.

B. Adjustment of Test Line BO Capacitors

7.04 The line link frame balance test line is adjusted in accordance with Fig. 8A. The trunk circuit selected per Fig. 6B as having the longest trunk link frame termination is used for this test. If this trunk circuit was not a part of the connection which established the NBOC, the longest LLP circuit must be used in its place, and the connection is made via an intra-office trunk circuit.

7.05 The trunk link frame balance test line is adjusted per Fig. 8B. The longest LLP circuit selected per Fig. 5 is used for this test. In tandem offices, if the Reference Trunk Incoming Path is part of the path which established the NBOC, the reference trunk must be used in place of the LLP circuit.

7.06 The trunk link frame equivalent Code 101 test line is adjusted per Fig. 8C. The same LLP circuit is used that was adjusted for the test in Fig. 8B. A portable balance termination is required at the testboard.

C. Adjustment of Trunk Circuit BO Capacitors

7.07 The tests in Fig. 9A serve to adjust BO3 in the trunk equipment of the network trunks and remote CENTREX access lines. (2-Way Private Network Trunk Circuit — SD-27654.)

7.08 The path, which BO3 builds out, is used for:

(a) Both ***incoming and outgoing path*** when network trunks or remote CENTREX access lines are connected to other access lines.

(b) Outgoing path when network trunks or remote CENTREX access lines are connected to each other (tandem office).

D. Adjustment of Access and Station Line BO Capacitors

7.09 The tests in Fig. 9B serve to adjust BO1 and BO2 in trunk circuits arranged for tandem operation. This serves to build out the incoming path to the line link frame when the traffic is routed to another trunk circuit.

7.10 Adjustment of BO capacitors in LLP circuits and E1L signal units is covered in Fig. 10. The tests make use of the SSN equivalent Code 100 test lines which were adjusted in Part 7B.

7.11 The BO capacitors in 4-wire LLP circuits are adjusted per Fig. 10A. The BO capacitors in 2-wire LLP circuits are adjusted per Fig. 10B. The BO capacitors on lines using E1L signal units are adjusted per Fig. 10C.

8. VERIFICATION TESTS

A. General

8.01 At this point, all of the adjustments of NBO and DBO capacitors should be completed. It is now necessary to make echo return loss (ERL) and singing point (SP) measurements to determine the effectiveness of the NBO and DBO adjustments. For the purposes of this practice, the combination of an ERL test and a SP test on a circuit will be referred to as the balance measurement of the circuit.

8.02 A hybrid coil (4-wire term. set) is used to interconnect a 4-wire path and a 2-wire path. Power entering the 4-wire side of the hy-

TABLE II

SUMMARY OF REQUIRED TESTS FOR PART II	
FIG.	**TEST**
8	***ADJUSTMENT OF TEST LINES BO CAPACITORS***
8A	Adjustment of BO of SSN AB+5 Balance Test Lines
8B	Adjustment of BO of SSN Equivalent Code 100 Test Lines
8C	Adjustment of BO of SSN Equivalent Code 101 Test Lines
9	***ADJUSTMENT OF TRUNK CIRCUITS BO CAPACITORS***
9A	Adjustment of BO3 of all Network Trunks and Remote CENTREX Access Lines (SD-27654-0)
9B	Adjustment of BO1 and BO2 of all Network Trunks and Remote CENTREX Access Lines (SD-27654-01)
10	***ADJUSTMENT OF ACCESS OR STATION LINES BO CAPACITORS***
10A	Adjustment of BO of 4-Wire Non-CENTREX Access Lines and CENTREX 4-Wire Tie Trunks to Satellite or Tributary PBX (CENTREX PBX)
10B	Adjustment of BO of 2-Wire CENTREX Tie Trunks to Satellite or Tributary PBX (CENTREX PBX)
10C	Adjustment of BO of 4-Wire Non-CENTREX Station Lines Equipped with EIL Signaling Units

brid over the receive leg, divides at the 2-wire point with part of the power going into:

(a) The 2-wire section.

(b) The network (and dissipated in it).

(c) The transmit leg.

The level of the power which appears in the transmit leg is compared to the sending level at the receive leg. The difference (minus transhybrid loss) is the echo return loss (ERL).

8.03 If the network and the 2-wire section balance each other (impedances or electrical characteristics are nearly identical), the power divides between them and a very small amount of power enters the transmit leg. This is measured at the transmit leg as ***high*** return loss. If the network and 2-wire section do not balance each other (are not identical), more power enters the transmit leg. This is measured at the transmit leg as ***low*** return loss.

8.04 Echo return loss is a weighted average of the return losses of all frequencies in the echo range (500-2500 CPS). It may be determined with a "one-shot" measurement using a 201A or B Noise Generator as the source of test power applied at the REC leg of the hybrid (4-wire term. set). The 201A or B Noise Generator provides a source of random noise whose basic energy is spread evenly over the voice-band. The weighting is accomplished by means of a plug-in 455B weighting network (approximately that of a male voice from an F1 transmitter). The returned power (ERL) is measured at the transmit leg using a 3A NMS equipped with a 497A network.

8.05 Singing point is a measure of balance (in db) between the network and 2-wire section at the critical (or worst) frequency. This critical frequency is usually, but not always, the frequency having the poorest (lowest) return loss. Although the ERL test covers the important voice-band, it will not necessarily indicate individual poor return losses. This is particularly true at the frequencies (200 to 500 CPS and 2500 to 3200 CPS) where singing usually takes place, and where the weighting networks would tend to mask a poor return loss. Therefore, both an echo return loss test and a singing point test are needed to complete the balance picture. The 2D Singing Point Test Set, connected between the transmit and receive legs of the 4-wire set, is generally used for this test. All singing point tests are made at both polings (normal and reversed). Two filters are used — one is the built-in filter of the 2D Set which is "low pass" and the other is a 207G filter which is "high pass" and must be connected externally. The built-in filter cuts off frequencies above about 3500 CPS and the 207G filter cuts off frequencies below about 200 CPS.

8.06 Most methods of measuring return losses and singing points require the application of correction factors. These correction factors consist of the "transhybrid loss" (loss from the receiver leg across to the transmit leg) of the 4-wire term. set and the loss of any other apparatus in the 4-wire path to the measuring sets. The step-by-step procedure is shown in Fig. 11.

B. Test Procedure

8.07 The steps covered in the various parts of Fig. 12 provide descriptions and step-by-step procedures for making balance measurements on the different types of trunks and access lines that switch through the Class SS-3 office. Balance measurements are necessary to cover the following type circuit connections.

(a) Network trunk to network trunk or remote CENTREX access lines. A measurement is required on the incoming path and is made through the 2-way trunk circuit line link appearances to the SSN equivalent Code 100 test termination.

Note: This measurement is only required at SS3 offices arranged to switch network trunks and/or remote CENTREX access lines in tandem.

(b) Network trunk or remote CENTREX access lines to 4-wire access or station lines. This measurement is made through the 2-way trunk circuit trunk link appearance to the SSN AB+5 balance test termination.

(c) 4-wire access to other 4-wire access or station lines, (equipped with LLP circuits or EIL signal units). This measurement is made to the SSN AB+5 balance test termination.

(d) Network trunk or 4-wire access and station lines to 2-wire CENTREX satellite or tributary PBX tie trunks equipped with impedance compensators. This measurement is made through any network trunk or 4-wire access line equipped with a 4-wire term. set and with signal leads appearing at the circuit patch bay or testboard for ease of setting up. The connection is to a 900 ohm plus 2 mf balance test termination at the satellite or tributary PBX.

(e) SSN 4-wire non-CENTREX station lines equipped with EIL signal units. This measurement is made from the 4-wire appearance of the EIL signal unit to the SSN equivalent Code 100 balance test termination.

Note: This balance measurement is made to check the integrity of the NBO and DBO adjustments of each circuit equipped with EIL signal units (built-in hybrids).

8.08 Make measurements on all circuits as detailed in Fig. 12. Record the results for analysis as indicated in Part 9.

9. BALANCE REQUIREMENTS AND RECORDS

9.01 Table II lists the balance requirements for the 2-wire Class SS3 office. It should be noted that, although averages ***are*** applied, distribution grades (standard deviations) ***are not*** used. There is a minimum allowable balance requirement for each individual circuit. The minimum is covered in Table III.

9.02 If the objectives are not met and, having checked the circuit for proper equipment, wiring, and adjustments, the causes of poor balance cannot be determined, the results should be referred through the proper channels for further investigation.

9.03 An office record should be maintained of all final balance measurements. The record should provide for showing new measurements if the facilities or equipment are changed, or if a new circuit is added. This record will be useful when investigating trouble conditions that might be caused by poor balance. It will also be useful when the balance condition of the office is checked.

9.04 Fig. 13 is a suggested Balance Record form which may be reproduced locally.

TABLE III

BALANCE REQUIREMENTS AT A 2-WIRE CLASS SS-3 OFFICE

TYPE OF CIRCUIT	FIG.	ECHO RETURN LOSS AND SINGING POINT		TERMINATION
		AVERAGE (db)	NO MEASUREMENT LESS THAN (db)	
Network Trk. or Remote CENTREX Access Line (Tandem Office)	12A	ERL 27	25	Test Made to SSN Code 100 Bal. Test Term.
Network Trk. or Remote CENTREX Access Line	12B	ERL 27	25	Test Made to SSN AB+5 Bal. Test Term.
4-Wire Access Lines	12C	ERL 27 SP 20	25 16	Test Made to SSN Code 100 Bal. Test Term.
2-Wire CENTREX Satellite or Trib. PBX Tie Trks. e/w with Imp. Comp.	12D	ERL 18	15	Test Made to (900 ohm + 2 mf) Term. at Distant PBX
4-Wire Non-CENTREX Sta. Lines e/w with E1L Sig. Units	12E	ERL 27 SP 20	25 16	Test Made to SSN Code 100 Bal. Test Term.

RECORD OF

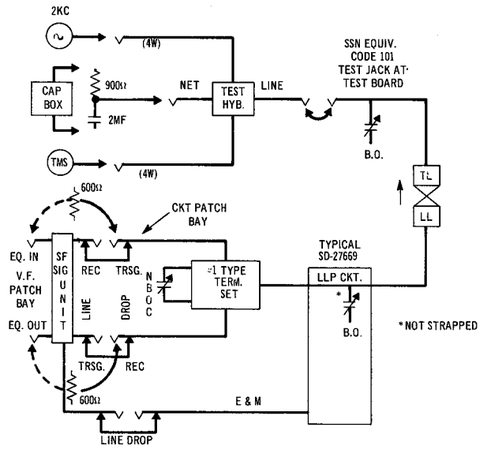
MEASUREMENTS OF ECHO RETURN LOSS

AND SINGING POINTS — SS3 OFFICES

CIRCUIT		ECHO RETURN LOSS	SINGING POINT	NOTES
NAME	NO.			

Fig. 13

Fig. 5A – Measurement of 4-Wire Non-CENTREX Access Lines and CENTREX 4-Wire Tie Trunks to Satellite or Tributary PBX (CENTREX PBX)



Step 1: From the office evaluation sheet select one circuit of the type shown above and busy out all but one SSN equivalent Code 101 test line. This ***same*** equivalent 101 test line should be used for all tests in Figs. 5 and 6.

Step 2: ***Circuit Patch Bay Provided***

(a) Connect a Signal Test Circuit to the E and M leads of the selected circuit and provide a seizure toward the drop.

(b) Dial pulse the necessary digits to route the call to the SSN equivalent Code 101 test jack at the testboard.

(c) Connect the test equipment as shown above and provide the 600-ohm terminations at the circuit patch bay as shown by solid lines. ***(Verify that the circuit has switched through as shown above.)***

Circuit Patch Bay Not Provided

(a) At the testboard connect a Signal Test Circuit to the E and M leads of the selected circuit and provide a seizure toward ***both*** the line and drop.

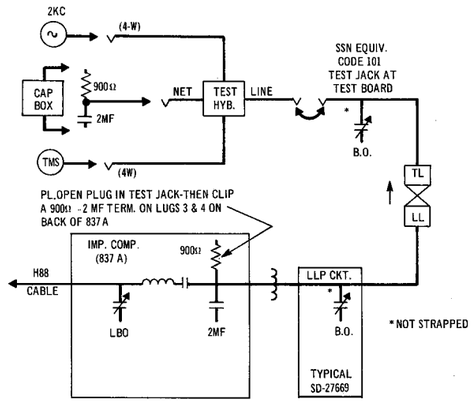
(b) Dial pulse the necessary digits toward the drop to route the call to the SSN equivalent Code 101 test jack at the testboard.

(c) Connect the test equipment as shown above and provide the 600-ohm termination at the VF patch bay as shown by dotted lines. ***(Verify that the circuit has switched through as shown above)***

Step 3: Vary the capacitance of the CAP. BOX until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (of the CAP. BOX) on the Office Evaluation Sheet opposite the circuit under test. ***There should be no strap in the indicated (*) B.O. capacitors.***

Step 4: Repeat the same test and record the results the same way on all the remaining Fig. 5A type connections that are listed on the Office Evaluation Sheet.

Fig. 5B – Measurement of CENTREX 2-Wire Tie Trunk to Satellite or Tributary PBX (CENTREX PBX)



Step 1: From the Office Evaluation Sheet select one circuit of the type shown above.

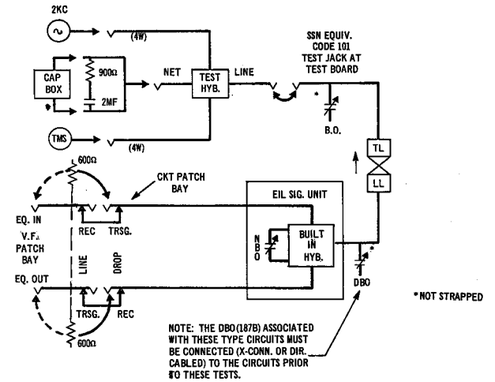
Step 2: At the line link frame connect a dial handset, equipped with a "351A SHOE," to the appearance of the circuit selected in Step 1 and dial the necessary digits to route the call to the SSN equivalent Code 101 test jack at the testboard.

Step 3: Connect the test equipment as shown above and remove the dial handset. ***(Verify that the circuit is established as shown above.)***

Step 4: Vary the capacitance of the CAP. BOX until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (of the CAP. BOX) on the Office Evaluation Sheet opposite the circuit under test. ***There should be no strap in the indicated (*) B.O. capacitors.***

Step 5: Repeat the same test and record the results the same way on all the remaining Fig. 5B type circuits that are listed on the Office Evaluation Sheet.

Fig. 5C – Measurement of Non-CENTREX 4-Wire Station Line



Step 1: From the Office Evaluation Sheet select one circuit of the type shown above.

Step 2: At the line link frame connect a dial handset, equipped with a "351A SHOE," to the appearance of the circuit selected in Step 1 and dial the necessary digits to route the call to the SSN Code 101 test jack at the testboard.

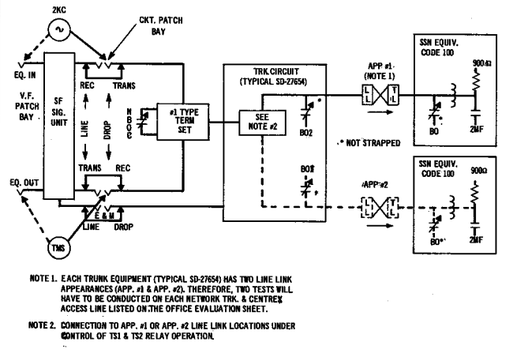
Step 3: Connect the test equipment as shown above (600 ohm termination connector as shown by solid lines if circuit patch bay is provided or by dotted lines if circuit patch bay is not provided) and then remove the dial handset. ***(Verify that the circuit has switched through as shown above.)***

Step 4: Vary the capacitance of the CAP BOX until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (of the CAP. BOX) on the Office Evaluation Sheet opposite the circuit under test. ***There should be no strap in the indicated (*) B.O. capacitors.***

Step 5: Repeat the same test and record the results the same way on all the remaining Fig. 5C type connections that are listed on the Office Evaluation Sheet.

Fig. 5 – Selection of Longest Access Line Paths

Fig. 6A – Measurements to Identify the Network Trunk or CENTREX Access Line Having the Longest "Capacitive Length" from Its 4-Wire Terminating Set to the Line Link Frame (Tandem Office)



NOTE 1. EACH TRUNK EQUIPMENT (TYPICAL SD-27654) HAS TWO LINE LINK APPEARANCES (APP. #1 & APP. #2). THEREFORE, TWO TESTS WILL HAVE TO BE CONDUCTED ON EACH NETWORK TRK. & CENTREX ACCESS LINE LISTED ON THE OFFICE EVALUATION SHEET.

NOTE 2. CONNECTION TO APP. #1 OR APP. #2 LINE LINK LOCATIONS UNDER CONTROL OF TS1 & TS2 RELAY OPERATION.

Step 1: From the Office Evaluation Sheet select one circuit of the type shown above (network trunk or remote CENTREX access line). Make busy all but one SSN equivalent Code 100 test line so that all subsequent calls are driven to the same termination.

Step 2: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, using a signal test circuit, provide a seizure toward the drop (trunk circuit).

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay and MF pulse the necessary digits to connect through to the SSN NNX Code balance test termination. Arrange the X-Bar equipment so the call will route via the line link ***appearance No. 1.***

Circuit Patch Bay Not Provided

(a) At the testboard, using a signal test circuit, provide a seizure toward the drop (trunk circuit).

(b) At the VF patch bay, plug locally arranged MF pulsing into the "EQ. IN" jack and MF pulse the necessary digits to connect through to the SSN equivalent Code 100 test termination. Arrange the X-Bar equipment so that the call will route via the line link ***appearance No. 1.***

(c) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Step 3: Remove the MF pulsing as used in Step 2 and connect the test equipment as shown in Fig. 7A by solid lines if testing at a circuit patch bay or by dotted lines if testing at a VF patch bay. ***Verify that the circuit is cut through to the desired termination.***

Step 4: Screw down the COMP NET screw of the 4-wire term. set.

Note: At this point it will be necessary to "patch out" any echo suppressors that may be in the circuit. See Section E33.353 for a guide.

Step 5: Vary the screw settings of the NBOC on the 4-wire term. set until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (total CAP. of NBOC screws down) on the Office Evaluation Sheet opposite the selected circuit under test. ***There should be no strap in the indicated (*) B.O. capacitors.***

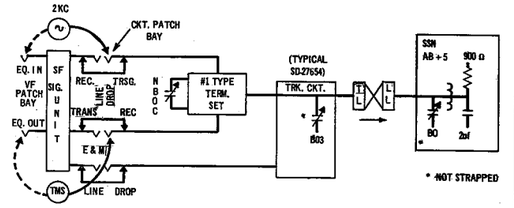
Step 6: Remove the test equipment, ***back off all NBOC screws*** and release the connection.

Step 7: Repeat Steps 2-6 inclusive, on the same trunk but this time force the call through ***line link appearance No. 2*** to the SSN equivalent Code 100 test termination.

Step 8: Repeat Steps 1-7 inclusive, on all the remaining network trunks and remote CENTREX access lines that are listed on the Office Evaluation Sheet.

Step 9: After all of the selected paths have been tested and recorded, label the one with the most capacitance as the "reference trunk incoming path." (If more than one, arbitrarily choose one.)

Fig. 6B – Measurements to Identify the Network Trunk or Remote CENTREX Access Line Having the Longest Outgoing Path from Its 4-Wire Terminating Set to the Trunk Link Frame



Step 1: From the Office Evaluation Sheet select one circuit of the type shown above (network trunk or remote CENTREX access line).

Step 2: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, connect a signal test circuit to the E and M jacks and provide a seizure toward the drop (trunk circuit).

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay and MF pulse the necessary digits to switch through to the SSN AB+5 balance test termination.

Circuit Patch Bay Not Provided

(a) At the testboard, using a signal test circuit, provide a seizure toward the drop (trunk circuit).

(b) At the VF patch bay, plug locally arranged MF pulsing into the "EQ. IN" jack and MF pulse the necessary digits to switch through to the SSN AB+5 balance test termination.

(c) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Step 3: Remove the MF pulsing as used in Step 2 and connect the test equipment as shown at a circuit patch bay or by dotted lines if testing at a VF patch bay. ***Verify that the circuit is cut through to the desired termination.***

Step 4: Screw down the COMP NET screw of the 4-wire term. set.

Note: At this point it will be necessary to "patch out" any echo suppressors that may be in the circuit. See Section E33.353 for a guide.

Step 5: Vary the screw settings of the NBOC on the 4-wire term. set until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (total capacitance of NBOC screws down) on the Office Evaluation Sheet opposite the selected circuit under test. ***There should be no strap in the indicated (*) B.O. capacitors.***

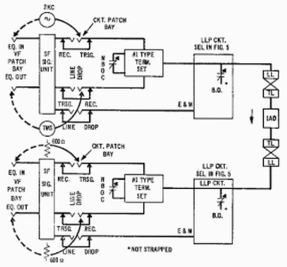
Step 6: Remove the test equipment, ***back off all NBOC screws*** and release the connection.

Step 7: Repeat Steps 1-6 inclusive on all the remaining network trunks and remote CENTREX access lines that are listed on the Office Evaluation Sheet.

Step 8: After all of the selected paths have been tested and recorded, label the one with the most capacitance as the "reference trunk outgoing path." (If more than one, arbitrarily choose one.)

Fig. 6 – Selection of Network Trunk or Remote CENTREX Access Line Having Longest Outgoing and Incoming Paths

Fig. 7A – Measurement of NBOC Required on a Connection Between Access Lines (LLP Type)



Step 1: Select any two LLP circuits in the two longest paths found in Fig. 5 and busy out all others in the same groups (Fig. 7A).

Note: If the longest paths are 2-wire CENTREX tie trunks or 4-wire non-CENTREX station lines using E1L units, temporarily adjust the BO capacitors in the LLP circuit to the equivalent of the longest path before the tests are started.

Step 2: ***Circuit Patch Bay Provided***

(a) To the E and M appearances of each LLP circuit, connect a signal test circuit (2 required).

(b) Arrange one signal test circuit for ***on-hook.***

(c) Arrange the other signal test circuit to provide a drop seizure and dial the necessary digits so that the call will switch through to the other LLP circuit (see path desired above).

(d) When the call has switched through, arrange the signal test circuit referred to in (b) for ***off-hook.***

Circuit Patch Bay Not Provided

(a) Follow the same procedure as shown above (a)-(d).

(b) At both signal test circuits, provide an ***off-hook*** also toward the line.

Step 3: Connect the test equipment as shown above by solid lines if testing at a circuit patch bay or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has connected through as shown above.***

Note: At this point it will be necessary to "patch out" any echo suppressor that may be in the circuit if testing is done at a VF patch bay. See Section E33.353 for a guide.

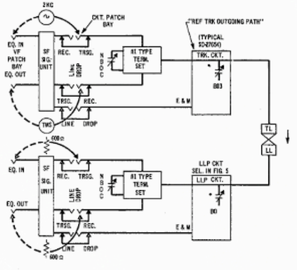
Step 4: Screw down the COMP NET screw of the 4-wire term. set.

Step 5: At the 4-wire term. set connected to the OSCILLATOR (2 KC) and TMS, vary the screw settings of the NBOC until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (total CAP. of NBOC screws down) as value "A".

Step 6: Disconnect the test equipment, back off all the NBOC screws and release the circuit.

Step 7: Repeat Steps 1-6 at least five times, using the same LLP circuits. If there are some variations in the answer due to the selection of different IAO circuits, use the average of the values obtained from the tests.

Fig. 7B – Measurement of NBOC Required on a Connection Between a "Reference Trunk Outgoing Path" and an "LLP Circuit"



Step 1: At the circuit patch bay (or toll testboard if no circuit patch bay is provided), connect a signal test circuit (arranged for ***on-hook***) to drop E and M leads of the longest LLP circuit as selected in Fig. 5 and busy out all other LLP circuits in the same group (Fig. 7B).

Step 2: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay connect a signal test circuit to the E and M drop leads of the "reference trunk outgoing path" (identified in Part 6C) and provide a seizure toward the drop (trunk circuit).

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay, and MF pulse the necessary digits to route the call to the selected LLP circuit.

(c) When the call has been pulsed through, arrange the signal test circuit on the selected LLP circuit for ***off-hook.***

Circuit Patch Bay Not Provided

(a) At the testboard, using a signal test circuit, provide a seizure toward the drop (trunk circuit).

(b) At the VF patch bay, plug locally arranged MF pulsing into the "EQ. IN" jack, and MF pulse the necessary digits to route the call to the selected LLP circuit.

(c) When the call has been pulsed through, arrange both signal test circuits for ***off-hook*** toward both the line and drop.

Step 3: Remove the MF pulsing as used in Step 2 and connect the test equipment as shown above by solid lines if testing at a circuit patch bay, or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has been switched through as shown above.***

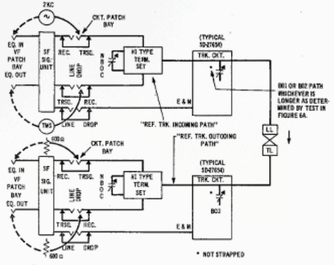
Step 4: Screw down the "COMP NET" screw of the 4-wire term. set associated with the "reference trunk incoming path."

Note: At this point it will be necessary to "patch out" any echo suppressor that may be in the circuit if testing is done at a VF patch bay. See Section E33.353 for a guide.

Step 5: At the 4-wire term. set, connect to the OSCILLATOR (2 KC) and TMS, vary the screw settings of the NBOC until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (total capacitance of NBOC screws down) as value "B". ***There should be no strap in the indicated (*) B.O. capacitors.***

Step 6: Disconnect the test equipment, back off all the NBOC screws and release the circuit.

Fig. 7C – Measurement of NBOC Required on a Connection Between the "Reference Incoming Trunk Path" and the "Reference Outgoing Trunk Path" (Tandem Office)



Step 1: The trunks to be used for this test will be the "reference trunk incoming path" and "reference trunk outgoing path" as determined in Part 6C.

Step 2: ***Circuit Patch Bay Provided***

(a) Make busy all trunks except the reference outgoing path in the trunk group in which it appears (Fig. 7C).

(b) At the circuit patch bay, connect a signaling test circuit to the E and M drop jacks of both trunks.

(c) Arrange the signal test circuit (No. 2), associated with the "reference trunk outgoing path" E and M leads, to provide an ***on-hook*** condition to the drop of the trunk. With the other signal test circuit (No. 1), seize the drop of the "reference trunk incoming path."

(d) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay, and MF pulse the necessary digits to route the call to the "reference trunk outgoing path."

(e) Watch for a seizure on signal test circuit No. 2 and when it is observed, ***flash*** an ***off-hook*** with signal test circuit No. 2 and then return to ***on-hook.***

(f) When a "cut-through" is recognized, arrange signal test circuit No. 2 for ***off-hook.***

(g) Remove the MF pulsing from the "DROP TRSG" jack.

Circuit Patch Bay Not Provided

(a) Make busy all trunks except the two referred to in Step 1.

(b) At the testboard connect signaling test circuits to the E and M jacks of both trunks.

(c) Arrange the signal test circuit (No. 2) associated with the "reference trunk outgoing path" E and M leads, to provide an ***on-hook*** condition to the drop of the trunk. With the other signal test circuit (No. 1), seize the drop of the "reference trunk incoming path."

(d) Plug locally arranged MF pulsing into the "EQ. IN" jacks at the VF patch bay, and MF pulse the necessary digits to route the call to the "reference trunk outgoing path."

(e) Watch for seizure on signal test circuit No. 2 and when it is observed, ***flash*** an ***off-hook*** with signal test circuit No. 2 and then return to ***on-hook.***

(f) When a "cut-through" is recognized, arrange signal test circuit No. 2 for ***off-hook.***

(g) Remove the MF set from the "EQ. IN" jack.

(h) Arrange both signal test circuits for ***off-hook*** toward both the line and drop.

Step 3: Connect the test equipment as shown above by solid lines if testing at a circuit patch bay, or by dotted lines if testing at VF patch bay. ***Verify that the circuit has been switched through as shown above.***

Step 4: Screw drown the COMP NET screw of the 4-wire term. set associated with the "reference trunk incoming path."

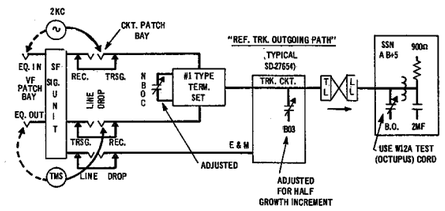
Note: At this point it will be necessary to "patch out" any echo suppressor that may be in the circuit if testing is to be done at a VF patch bay. See Section E33.353 for a guide.

Step 5: At the 4-wire term. set, associated with the "reference trunk incoming path" vary the screw settings of the NBOC until the highest return loss is read on the TMS. Record the ***resultant capacitance*** (total CAP. of NBOC screws down) as value "C." ***There should be no strap in the indicated (*) B.O. capacitors.***

Step 6: Disconnect the test equipment, back off all the NBOC screws and release the circuit.

Fig. 7 – NBO Determination and Adjustment of All Circuits Equipped with 4-Wire Terminal Sets

Fig. 8A – Adjustment of the BO Capacitor of the SSN AB+5 Balance Test Termination



Note: Before starting this test, strap BO3 in the trunk circuit to half the growth factor for the office. If the reference trunk outgoing path was not a part of the connection which established the NBOC, use the longest LLP circuit or equivalent for this adjustment. Set the circuit up as in Fig. 8B.

Step 1: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, connect a signal test circuit to the "reference trunk outgoing path" and provide a seizure toward the drop (trunk circuit) (Fig. 8A).

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay, and MF pulse the necessary digits to switch through the SSN AB+5 balance test termination.

Circuit Patch Bay Not Provided

(a) At the testboard, connect a signal test circuit to the "reference trunk outgoing path" and E and M jacks, and provide a seizure toward the drop trunk circuit.

(b) At the VF patch bay, plug a locally arranged MF pulsing into the "EQ. IN" jack, and MF pulse the necessary digits to switch through to the SSN AB+5 balance test termination.

(c) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Step 2: Remove the MF pulsing set as used in Step 1, and connect the test equipment as shown above by solid lines if testing at a circuit patch bay, or by dotted lines if testing at a VF patch bay. ***Verify that the circuit is connected through to the SSN AB+5 balance test termination.***

Note: At this point it will be necessary to "patch out" any echo suppressors that may be in the circuit, if testing is to be done from the VF patch bay. See Section E33.353 for a guide.

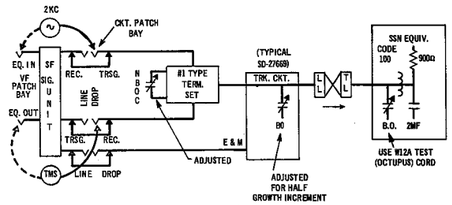
Step 3: Using a W12A test (octopus) cord, vary the amount of capacitance in the BO (187B) capacitor associated with the SSN AB+5 balance test termination until the highest return loss is read in the TMS.

Step 4: Permanently strap the resultant amount of capacitance (as determined in Step 3) into the BO (187B) capacitor associated with the SSN AB+5 balance test termination.

Step 5: Disconnect the test equipment and release the circuit.

Step 6: If more than one balance test line is installed, adjust the remaining circuits in the same manner.

Fig. 8B – Adjustment of BO Capacitor of the SSN Equivalent Code 100 Test Termination



Note: Before starting this test, strap the BO in one of the longest LLP circuits to half the growth increment for the office. In tandem offices, if the reference trunk incoming path is part of the path which established the NBOC, the reference trunk must be substituted for the LLP circuit. The circuit is seized and held as shown in Fig. 6A.

Step 1: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, using a signal test circuit, provide a seizure toward the drop and dial the necessary digits to reach the equivalent Code 100 test line as shown above, using the longest LLP circuit.

(b) When the call has switched through, arrange the signal test circuit for off-hook.

Circuit Patch Bay Not Provided

(a) At the testboard, using a signal test circuit, provide a seizure toward the drop and proceed as in (a) and (b) above.

Step 2: Connect the test equipment as shown above by solid lines if testing at a circuit patch bay, or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has connected through as shown above.***

Note: At this point it will be necessary to "patch out" any echo suppressor that may be in the circuit if testing is done at a VF patch bay. See Section E33.353 for a guide.

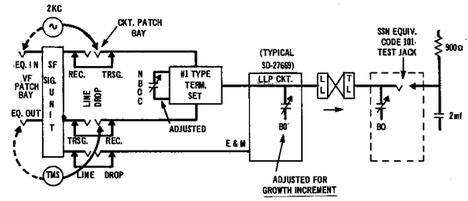
Step 3: Using a W12A test (octopus) cord, vary the amount of capacitance in the BO (187B) capacitor in the SSN equivalent Code 100 test termination until the highest return loss is read on the TMS.

Step 4: Permanently strap the resultant amount of capacitance (as determined in Step 3) into the BO of the SSN equivalent Code 100 test termination.

Step 5: Disconnect the test equipment and release the circuit.

Step 6: If more than one termination is provided, adjust the BO of all terminations as shown above.

Fig. 8C – Adjustment of the BO Capacitor of the SSN Equivalent Code 101 Test Line



Note: Use the same circuit used in Fig. 8B.

Step 1: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, using a signal test circuit, provide a seizure toward the drop and dial the necessary digits to reach the equivalent Code 101 test line as shown above, again using the longest LLP circuit.

(b) When the call has switched through, arrange the signal test circuit for off-hook.

Circuit Patch Bay Not Provided

(a) At the testboard, using a signal test circuit, provide a seizure toward the drop and proceed as in (a) and (b) above.

Step 2: Connect the test equipment as shown by solid lines if testing at a circuit patch bay, or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has been switched through as shown above.***

Step 3: At the testboard, terminate the 101 test line in a balance termination.

Step 4: Using a W12A test (octopus) cord, vary the amount of capacitance in the BO (187B) capacitor associated with the SSN equivalent Code 101 test line until the highest return loss is read on the TMS.

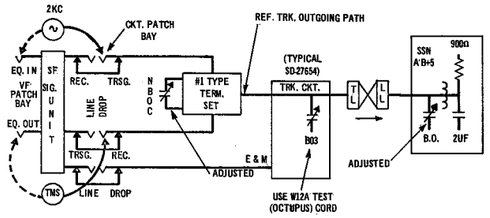
Step 5: Permanently strap the resultant amount of capacitance (as determined in Step 3) into the BO (187B) capacitor associated with the SSN Code equivalent 101 test line.

Step 6: Disconnect the test equipment and release the circuit.

Step 7: Repeat Steps 1-6 inclusive on all other SSN equivalent Code 101 test lines in the office.

Fig. 8 – Adjustment of Test Line BO Capacitors

Fig. 9A – Adjustment of BO3 of the "Trunk Outgoing Path"



Step 1: ***Circuit Patch Bay Provided***

(a) Connect a signal test circuit to the E and M jacks (at the testboard) of the "reference trunk outgoing path," and provide a drop seizure.

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jacks on the circuit patch bay and MF pulse the necessary digits to switch through to the selected LLP circuit.

(c) When the call has been pulsed through, arrange the signal test circuit set on the LLP circuit for ***off-hook.***

Circuit Patch Bay Not Provided

(a) Connect a signal test circuit to the E and M jack (at the testboard) of the "reference trunk outgoing path," and provide a drop seizure.

(b) Plug locally arranged MF pulsing into the "EQ. IN" jack at the VF patch bay and MF pulse the necessary digits to switch through to the selected LLP circuit.

(c) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Step 2: Remove the MF pulsing set as used in Step 1 and connect the test equipment as shown above by solid lines if testing at a circuit patch bay or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has connected through as shown above.***

Note: At this point it will be necessary to "patch out" any echo suppressor that may be in the circuit if testing is to be done at the VF patch bay. See Section E33.353 for a guide.

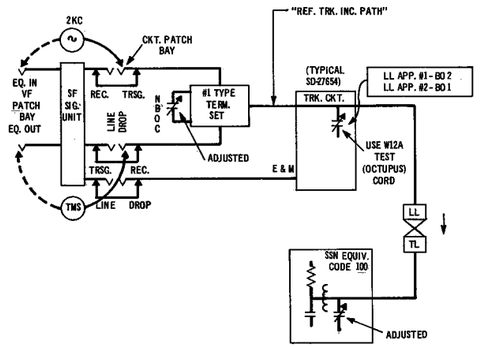
Step 3: Using a W12A test (octopus) cord, vary the amount of capacitance in BO3 of the trunk circuit until the highest return loss is read on the TMS.

Step 4: Permanently strap the resultant amount of capacitance (as determined in Step 3) into the BO3 of the trunk circuit.

Step 5: Disconnect the test equipment and release the circuit.

Step 6: Repeat Steps 1-5 and adjust BO3 on all other trunk circuits per SD-27654-01.

Fig. 9B – Adjustment of BO1 and BO2 of the Trunk Incoming Path (Tandem Offices)



Step 1: ***Circuit Patch Bay Provided***

(a) At the circuit patch bay, connect a signaling test circuit to the E and M drop jacks of both trunks. Provide a seizure toward the drop.

(b) Plug locally arranged MF pulsing into the "DROP TRSG" jack on the circuit patch bay and MF pulse necessary digits to route the call to the SSN equivalent Code 100 test line. Force the call to switch via the trunk's line link appearance No. 2.

(c) When a cut-through is recognized, arrange the signal test circuit for ***off-hook.***

(d) Remove the MF pulsing from the "DROP TRSG" jack.

(e) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Circuit Patch Bay Not Provided

(a) At the testboard, connect signal test circuits to the E and M jacks of the trunks. Provide a seizure toward the drop.

(b) Plug locally arranged MF pulsing into the "EQ. IN" jacks at the VF patch bay and MF pulse the necessary digits to route the call to the SSN equivalent Code 100 test line. Force the call to switch via the trunk's line link appearance No. 2.

(c) When a "cut-through" is recognized arrange the signal test circuit for ***off-hook.***

(d) Remove the MF set from the "EQ. IN" jack.

(e) Arrange the signal test circuit for ***off-hook*** toward both the line and drop.

Step 2: Connect the test equipment shown above by solid lines if testing at a circuit patch bay or by dotted lines if testing at a VF patch bay. ***Verify that the circuit has been switched through as shown above.***

Note: If the trunk under test is equipped with an echo suppressor, it will be necessary at this point to patch out the echo suppressor. See Section E33.353 for a guide.

Step 3: Using a W12A test (octopus) cord, vary the capacitance in BO1 until the highest return loss is read on the TMS.

Step 4: Permanently strap the resultant amount of capacitance (as determined in Step 4) into the BO1 (187B) capacitor.

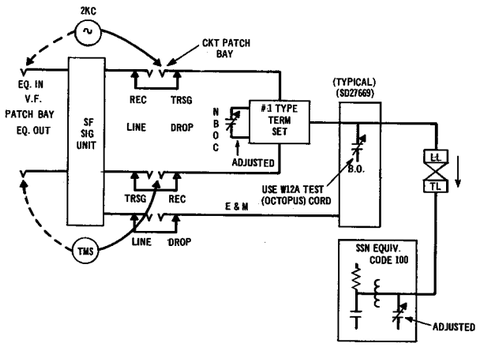
Step 5: Disconnect the test equipment and release the circuit.

Step 6: Repeat Steps 1-6 inclusive on the same trunk. This time force the call to switch through the trunk's line link appearance No. 1 and strap BO2.

Step 7: Repeat Steps 1-6 inclusive on all other trunk circuits until all BO1 and BO2 capacitors are strapped.

Fig. 9 – Adjustment of Trunk Circuit BO Capacitors

Fig. 10A – Adjustment of BO of 4-Wire LLP Circuits Non-CENTREX Access Lines and CENTREX Tie Trunks to Satellites or Tributary PBX (CENTREX PBX)



Step 1: ***Circuit Patch Bay Provided***

(a) Connect a signal test circuit to the E and M appearances of an LLP circuit at the testboard.

(b) Provide a drop seizure and dial the necessary digits to reach the SSN equivalent Code 100 test line.

(c) When the call is switched through, arrange the signal test circuit for ***off-hook.***

Circuit Patch Bay Not Provided

(a) Follow the same procedure as in (a)-(c) above.

Step 2: Connect the test equipment as shown above.

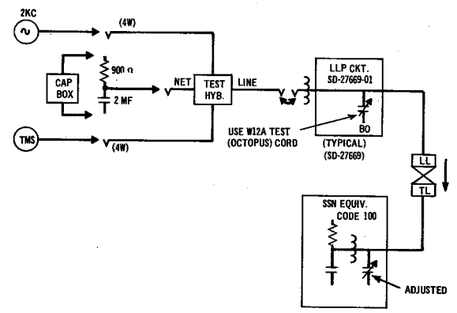
Step 3: Using the W12A cord, vary the capacitance of the BO in the LLP circuit until the highest return loss is read on the TMS.

Step 4: Permanently strap the BO in the LLP circuit to the resultant amount as determined in Step 3.

Step 5: Disconnect the test equipment and release the circuit.

Step 6: Repeat Steps 1-5 inclusive on all 4-wire LLP circuits in the office.

Fig. 10B – Adjustment of BO of 2-Wire LLP Circuits CENTREX Tie Trunks to Satellite or Tributary PBXs (CENTREX PBX)



Step 1: ***Circuit Patch Bay Provided***

(a) Connect a signal test circuit to the E and M appearance of an LLP circuit at the testboard.

(b) Provide a drop seizure and dial the necessary digits to reach the SSN equivalent Code 100 test line.

(c) When the call is switched through, arrange the signal test circuit for ***off-hook.***

Circuit Patch Bay Not Provided

(a) Follow the same procedure as in (a)-(c) above.

Step 2: Connect the test equipment as shown above. The test hybrid should be connected to the drop at the drop side of the impedance compensator. The capacitance box should be set to the value of the office NBOC.

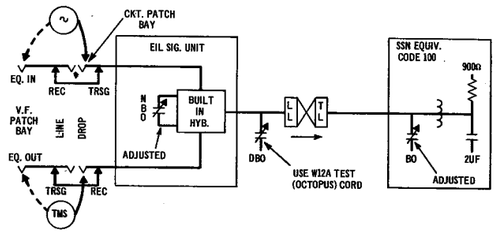
Step 3: Using the W12A cord, vary the capacitance of the BO in the LLP circuit until the highest return loss is read on the TMS. ***(There should be no strap in the indicated (*) BO capacitors.)***

Step 4: Permanently strap the BO in the LLP circuit to the resultant amount as determined in Step 3.

Step 5: Disconnect the test equipment and release the circuit.

Step 6: Repeat Steps 1-6 inclusive on all similar 2-wire LLP circuit groups in the office.

Fig. 10C – Adjustment of BO of 4-Wire Non-CENTREX Station Lines Equipped with E1L Signal Units



Step 1: Select one circuit of the type shown above.

Step 2: At the line link frame, connect a dial handset equipped with a "351A SHOE," to the appearance of the circuit and dial the necessary digits to route the call to the SSN equivalent Code 100 test line.

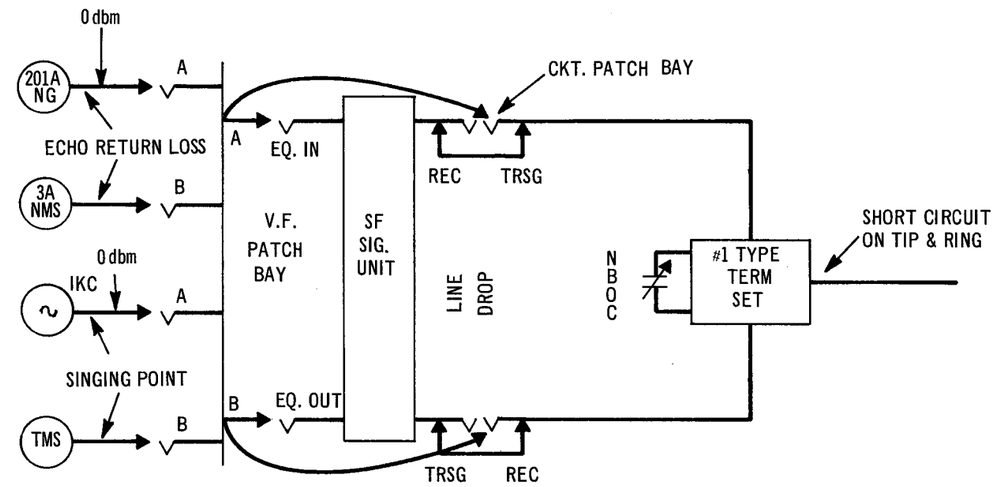
Step 3: Connect the test equipment as shown above (by solid lines if circuit patch bay is provided, or by dotted lines if circuit patch bay is not provided), and then remove the dial handset. ***(Verify that the circuit has switched through as shown above.)***

Step 4: Vary the capacitance of the BO, using a W12A (octopus) cord, until the highest return loss is read on the TMS. Strap the BO capacitor to this value. Release the circuit.

Step 5: Repeat the same test and strap BO capacitors the same way on all the remaining circuits of the same type.

Fig. 10 – Adjustment of Access and Station Line BO Capacitor

Fig. 11 – Test Arrangement to Determine Correction Factors for Test Hybrid



NOTE: CONNECT TO V.F. PATCH BAY AS SHOWN BY DOTTED LINES IF CKT. PATCH BAY IS NOT PROVIDED.

Step 1: Place a short circuit across the 2-wire line terminals (12 and 13 of the socket for the No. 1 type) of the 4-wire term. set associated with the circuit under test as shown above.

Note: The short circuit is placed at the 4-wire term. set itself and not at a distributing frame or other point.

Step 2: Connect the TMS to the circuit as shown in Fig. 11. Set the oscillator on 1000 cps and adjust its output to 0 dbm.

Step 3: Record the reading on the meter of the TMS. This loss is the correction factor for the SP measurement of the ***circuit under test.***

Step 4: Remove the TMS and connect the 201A or B NG and 3A NMS as shown in Fig. 11.

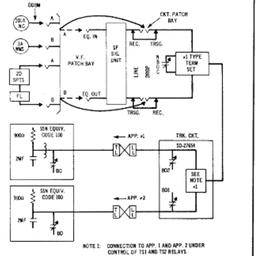
Note: 201A or B NG must be equipped with 455B weighting network. 3A NMS must be equipped with 497A (C-message weighting) network.

Step 5: Set the 201A or B NG output to 0 dbm. 0 dbm is obtained when the meter needle is on the red mark (+15 dbm) and the output attenuator is set on 15 db.

Step 6: Record the reading of the 3A NMS (dbrn dial plus meter). This reading is the reference for the echo return loss measurement of the circuit under test. The difference between this reading and the reading made through the complete circuit is the ERL of the circuit.

Fig. 11 – Test Arrangement to Determine Correction Factors for Test Hybrid

Fig. 12A – Measurements on Network Trunks and Remote CENTREX Access Lines to SSN Equivalent Code 100 Test Line



Step 1: Select any network trunk or remote CENTREX access line and set up the call to the SSN equivalent Code 100 test termination using the seizing and signaling procedure as used in Fig. 9B. ***Verify that the circuit has cut through to the code 100 termination.***

Step 2: Connect the test equipment as shown in Fig. 11 and determine the correction factors by following the procedure as outlined in Fig. 11.

Step 3: Remove the short from the 2-wire side of the 4-wire term. set.

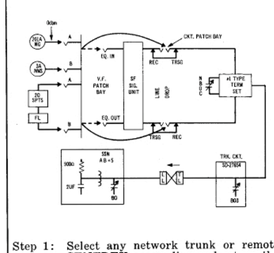
Step 4: Connect the 201A or B NG (sending 0 dbm) and the 3A NMS to circuit as shown above. Note the loss indicated by the 3A NMS reading and subtract this from the ERL reference reading as determined in Step 2. Record the difference as the final ERL on a chart similar to Fig. 13.

Step 5: Remove the NG and 3A NMS and connect the 2D SPTS and 207G filter as shown above. Operate the 2D SPTS filter key to IN. Measure SP at both polings (normal and reversed). Subtract the SP correction factor as determined in Step 2 from the poorest reading and record the difference as the final SP on the chart.

Step 6: Disconnect the test equipment and release the connection.

Step 7: Repeat Steps 1-6 on all other network trunks and remote CENTREX access lines in the office.

Fig. 12B – Measurements on Network Trunks and Remote CENTREX Access Lines to SSN AB+5 Balance Test Termination



Step 1: Select any network trunk or remote CENTREX access line and set up the call to the SSN AB+5 balance test termination in using the seizing and signaling procedure as used in Fig. 9A. ***Verify that the circuit has cut through to the SSN AB+5 balance test termination.***

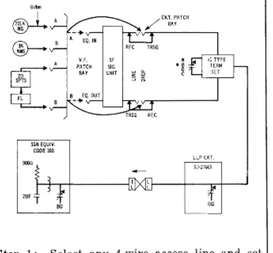
Step 2: Connect the test equipment as shown in Fig. 11 and determine the correction factors.

Step 3: Remove the short from the 2-wire side of the 4-wire term. set.

Step 4: Measure and record the ERL and SP using the procedure described in Steps 4, 5, and 6 of Fig. 12A.

Step 5: Repeat Steps 1-4 on all other network trunks and remote CENTREX access lines in the office.

Fig. 12C – Measurement of 4-Wire Access Lines to SSN AB+5 Balance Test Termination



Step 1: Select any 4-wire access line and set up the call to the SSN AB+5 balance test termination using a signal test circuit on the E and M leads at the circuit patch bay (if provided) or at the testboard if circuit patch bay is not provided.

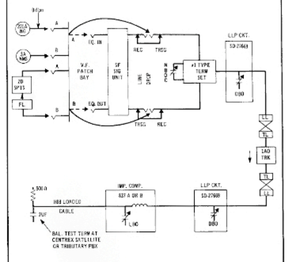
Step 2: Connect the test equipment as shown in Fig. 11 and determine the correction factors by following the procedure as outlined in the figure.

Step 3: Remove the short from the 2-wire side of the 4-wire term. set.

Step 4: Measure and record the ERL and SP using the procedure described in Steps 4, 5, and 6 of Fig. 12A.

Step 5: Repeat Steps 1-4 on all other 4-wire access lines in the office.

Fig. 12D – Measurements of 2-wire CENTREX Satellite or Tributary PBX Tie Trunks Equipped with Impedance Compensators (CENTREX PBX)



Step 1: Select any 4-wire access line.

Note: This 4-wire access line will be used to test all of the 2-wire CENTREX satellite or tributary PBX tie trunks.

Step 2: Busy out all of the 2-wire CENTREX satellite or tributary PBX tie trunks except the one to be tested.

Step 3: Set up the signal test circuit to the 4-wire access line E and M leads at the testboard and DP (Dial Pulse) the necessary digits to route the call to the 900 ohm +2 mf balance test termination at the CENTREX satellite or tributary PBX.

Note: Line facilities must meet 1000-cycle net loss requirements before these tests.

Step 4: Connect the test equipment as shown in Fig. 11 and determine the correction factor by following the procedure as outlined in the figure.

Note: These correction factors can be applied to all of the remaining tests in this figure because the same 4-wire access line is used for all tests.

Step 5: Remove the short from the 2-wire side of the 4-wire term. set.

Step 6: Connect the 201A or B NG and 3A NMS as shown above. Vary the LBO of the impedance compensator (837A or B) until the lowest reading is obtained on the 3A NMS. Subtract this reading from the ERL reference reading obtained in Step 4 and record the difference as the ERL of the circuit.

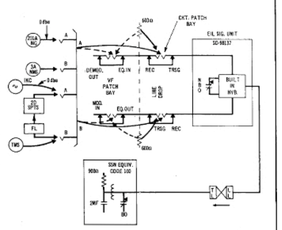
Step 7: Disconnect the 201A or B NG and 3A NMS and connect the 2D SPTS and 207G filter. Measure the singing point and subtract the SP correction factor as determined in Step 4. Record the result as the final singing point.

Step 8: Disconnect the test equipment and release the circuit.

Step 9: Repeat Steps 2, 3, 6, 7, and 8 in order on all of the 2-wire CENTREX satellite or tributary PBX tie trunks in the office.

Note: In some offices the LBO may already be strapped, and the adjustment of Step 6 may not be required. If the distant PBX is not equipped with a dial test line, the balance termination must be connected manually.

Fig. 12E – Measurements of SSN 4-Wire Non-CENTREX Station Lines Equipped with E1L Signal Units



Step 1: At the line link frame connect a dial handset, equipped with a 351A SHOE, to the appearance of a selected 4-wire non-CENTREX station line and dial the SSN equivalent Code 100 test line.

Step 2: Plug in 600-ohm terminations at the circuit patch bay (solid lines) if provided, or at the VF patch bay (dotted lines) if a circuit patch bay is not provided.

Step 3: Remove the dial handset from line link appearance of the circuit.

Step 4: Place a short on the 2-wire side of the E1L signal unit.

Note: The short is placed at the E1L mounting and not at a distributing frame or other point.

Step 5: Connect the 201A or B NG and 3A NMS as shown by solid lines if a circuit patch bay is provided or by dotted lines if a circuit patch bay is not provided. Note the reading on the 3A NMS. (This is the ERL correction factor.)

Step 6: Remove the short from the 2-wire side of the E1L signal unit.

Step 7: Note the loss indicated by the reading on the 3A NMS. Subtract the correction factor from Step 5. The result is the final ERL of the circuit.

Step 8: Disconnect the 201A or B Noise Generator and 3A NMS.

Step 9: Connect the TMS to the circuit as shown by solid lines if a circuit patch bay is provided, or by dotted lines if a circuit patch bay is not provided. Set the oscillator on 1000 CPS and adjust its output to 0 db.

Step 10: Replace the short on the 2-wire side of the E1L signal unit and note the reading on the TMS. (This is the SP correction factor.)

Step 11: Remove the short from the 2-wire side of the E1L signal unit.

Step 12: Disconnect the TMS and connect the 2D SPTS and 207G filter as shown by solid lines if a circuit patch bay is provided, or by dotted lines if a circuit patch bay is not provided.

Step 13: Measure the singing point and subtract the SP correction factor determined in Step 10. The resultant figure is recorded as the final SP of the circuit.

Step 14: Disconnect the test equipment and release the circuit.

Step 15: Repeat Steps 1-14 on all of the SSN 4-wire non-CENTREX station lines, equipped with E1L signal units, in the office.

Fig. 12 – Balance Measurements (ERL and SP) Description and Procedures