



file

**LOCAL LOOP
TESTS AND REQUIREMENTS
CIRCUIT SWITCHED DIGITAL CAPABILITY (CSDC)**

	CONTENTS	PAGE
1.	GENERAL	2
	A. Test Access at Serving Central Office (SCO) and Station	3
2.	TEST EQUIPMENT	4
	A. General	4
	B. Apparatus Required at the Serving Central Office for Chart 1 Tests	4
	C. Apparatus Required at the Serving Central Office for Chart 2 Tests	5
	D. Apparatus Required at the Station for Chart 2 Tests	5
3.	OVERALL LOOP TESTS	5
	A. Test Records	5
	B. Serving Central Office Tests	5
	C. Serving Central Office-to-Station Tests	6
4.	REFERENCES	8
5.	TEST PROCEDURES	8
	Chart 1 Local Loop Testing at the Serving Central Office	8
	Chart 2 Local Loop Tests: SCO-to-Station	9

Figures

1.	Test Access for CSDC Cable Pair Tests	4
----	--	---

PROPRIETARY

BELLCORE AND AUTHORIZED CLIENTS ONLY

This document contains proprietary information that shall be distributed or routed only within Bell Communications Research (Bellcore) and its authorized clients, except with written permission of Bellcore.

Copyright © 1985 Bell Communications Research, Inc.
All rights reserved.

Figures	CONTENTS	PAGE
2.	Test Connection for Noise Measurement	14
Tables		
A.	INSERTION LOSS LIMITS	7

1. GENERAL

1.01 This practice provides the local loop testing procedures to ensure that the cable pair is suitable for circuit switched digital capability (CSDC). The tests are conducted when the CSDC service is installed and as required for maintenance purposes. The cable pair is part of the special service access line that connects a CSDC customer to a CSDC equipped 1A ESS* office. The access line extends from an interface point on a customer premises to one of the following:

- a termination at the line equipment network in a CSDC office,
- the RXS plug-in of a D4 channel bank, or
- the RXS plug-in of a SLC-96 remote terminal bank.

1.02 Whenever this practice is reissued, the reason for the reissue will be given in this paragraph.

1.03 The following tests (A through C) are considered to be tests that can be done by one person at the serving central office (SCO):

- (a) *Test A. Foreign voltage:* This test checks for foreign voltage on the cable pair.
- (b) *Test B. Insulation resistance:* This test checks the insulation (leakage) resistance between the cable pair and ground.
- (c) *Test C. On-hook or open circuit:* This test verifies that there is no short-circuit on the cable pair. The test may not be conclusive if the customer provided terminal equipment is connected to the line.

1.04 The following tests (D through I) require a person at both the SCO and the data station.

- (a) *Test D. Foreign voltage:* This test checks for foreign voltage on the cable pair. The terminating equipment must be removed at the station end and the cable pair must be open-circuited.
- (b) *Test E. Insulation resistance:* This test checks the resistance between the cable pair and ground. The terminating equipment must be removed at the station end and the cable pair must be open-circuited.
- (c) *Test F. Loop resistance:* The loop resistance test verifies that the resistance of the cable pair does not exceed the maximum resistance allowed for CSDC service. In later tests, this test result should approximate the benchmark resistance value that is recorded on the circuit layout record or the loop record card.
- (d) *Test G. Insertion loss:* These test measurements are made at three frequencies:

*Trade Mark of AT&T Technologies

- 1004Hz to verify the circuits ability to pass voice
- 4.8KHz to verify that there are no load coils on the loop
- 72KHz to verify that the loop can pass the data signal and that there are not excessive bridge taps on the loop.

Note: 72KHz is the Nyquist frequency (one-half the bit rate of the data signal).

(e) *Test H. Circuit noise:* This test measures the combined background (steady state) noise from many sources. Some sources of noise include thermal or circuit component noise, 60Hz power and harmonics of it, and inter-modulation products caused by nonlinearity. Steady state noise depends on facility type and length. For best results, the measurement should be made during a central office traffic-busy time. The measurement can be made either at the station or at the serving central office.

(f) *Test I. Impulse noise:* This test checks the short interval noise spikes that are primary causes of data errors. Impulse noise is measured by counting the number of noise spikes that occur in a certain time frame at a specified threshold. The impulse noise test follows the circuit noise test, therefore, the same measuring set and test setup is used for both tests.

1.05 The maintenance procedures consist of making tests A through C (Chart 1) to aid trouble isolation. These tests are made in the serving central office either at the plug-in mounting or from the local test desk (LTD). Tests D through I (Chart 2) may also be required to help locate trouble if tests A through C are not successful.

1.06 The cable pair tests (Chart 2) that are done with circuit installation, are two-people tests made between the serving central office plug-in location and the station. These tests are made before the installation of the customer provided terminal equipment and should be done when the cable pair is assigned to a circuit so that any defect may be corrected before the plant test date. The test results should be recorded on the loop record card for use during maintenance testing.

1.07 The 2-wire local loop connects the customer provided terminal equipment on the customer premises with either of the following:

- a metallic facility terminal (MFT)
- a D4 channel plug-in at the serving central office
- or to a SLC-96 terminal plug-in at a remote location.

The remote location on the SLC-96 route may be named as the serving central office.

A. Test Access at Serving Central Office (SCO) and Station

1.08 Figure 1 is a typical arrangement showing test access for cable pair tests. The SCO plug-in associated with the cable pair is removed and the appropriate test extender containing test jacks and test points is inserted in its place. Each type of plug-in requires a specific test extender. The jacks accept the 310-type plugs and provide direct access to the tip (T) and ring (R) of the cable pair. Two test points connect to office ground (GRD) and battery (BAT). Test points T1 and R1 are not used for these tests (Fig. 1). The test extenders are identified in the apparatus list provided in Charts 1 and 2.

1.09 Tests A,B,C,D,E, and F may be made from the local test desk. Test cords are used for accessing to the cable pair at the main distributing frame (MDF). When long test trunks are used, the resistance of the test trunk must be measured separately and subtracted from the overall loop resistance.

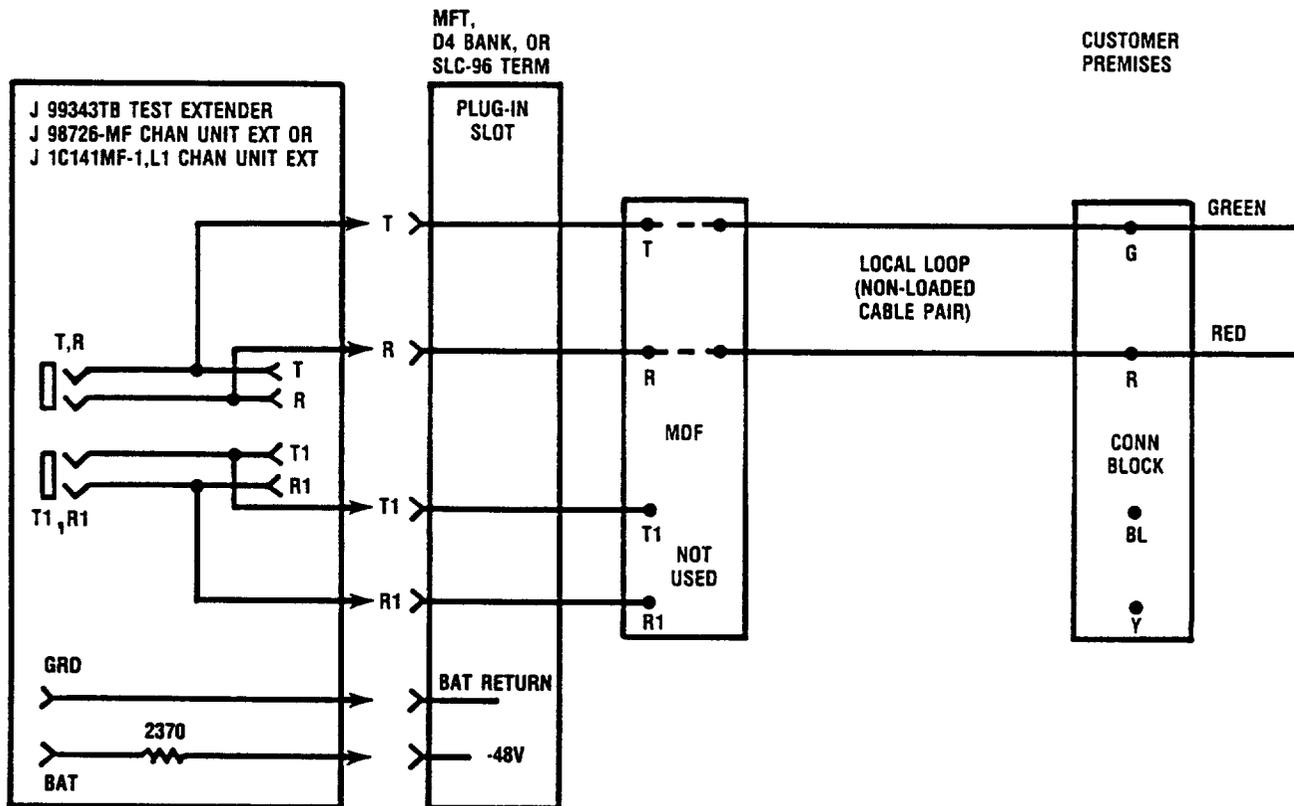


Fig. 1—Test Access for CSDC Cable Pair Tests

2. TEST EQUIPMENT

A. General

2.01 Provided here is a brief description of suggested test equipment that may be used for testing CSDC local loops, however, this does not preclude the use of other equivalent test equipment. For example, other noise-measuring sets having the appropriate weighting networks and a built-in selectable 135-ohm impedance may be used rather than the 6F Noise Measuring Set. Other transmission measuring sets capable of accurately measuring 72KHz at 135-ohms impedance may be substituted for the HP-3550B transmission test set.

B. Apparatus Required at the Serving Central Office for Chart 1 Tests

2.02 The apparatus required at the serving central office for tests A through C (Chart 1) is as follows:

- One volt-ohm-milliammeter (VOM) such as the KS-14510-L1, KS-16979-L1, or equivalent.
- One test extender (see Chart 1 for details).

PROPRIETARY

See proprietary notice on title page

C. Apparatus Required at the Serving Central Office for Chart 2 Tests

2.03 The serving central office-to-station tests require one person at each end of the local channel. Therefore, the Apparatus required at the serving central office is listed separately (Paragraph 2.04) from the apparatus required at the station (paragraph 2.05).

2.04 The apparatus required at the SCO is as follows:

- One VOM such as the KS-14510-L1 or KS-16979-L1 or equivalent meter having a resistance of at least 20,000-ohms per volt
- One test extender (see Chart 2 for details)
- One P2ES cord or equivalent (specify 8 or 12-foot length for use with 7 or 11-foot bay)
- One HP-3550B transmission test set or equivalent
- One 6F NMS equipped with a 497F weighting network (wide-band 50kb/s network) or equivalent set and network
- One 135-ohm resistor (loop termination).

D. Apparatus Required at the Station for Chart 2 Tests

2.05 The apparatus required at the station is as follows:

- One HP-3550B transmission test set
- One 135-ohm resistor (loop termination).

3. OVERALL LOOP TESTS**A. Test Records**

3.01 The loop record card lists the measurements to be made and provides space for recording the measurement results. In addition to measurement results, other information that may be helpful in maintaining the local loop should be recorded on the card.

B. Serving Central Office Tests

3.02 The serving central office tests consist of three measurements that can be made by one person. These tests contained in Chart 1 should be made in the order presented. If any of the test requirements are not met, follow the instructions given in BR 660-101-319.

Warning: Do not apply a dc voltage exceeding 50 volts to the loop because the station terminating equipment may be damaged.

3.03 If the loop voltage measurement is made from the local test desk or main distributing frame, the voltage is measured between the T and R of the pair looking toward the metallic facility terminal, D4 plug-in or the SLC-96 terminal. If zero dc voltage is measured, do the following:

- (a) Be sure the proper plug-in is installed

- (b) Verify cable pair continuity between the equipment bay and the MDF or LTD
- (c) Replace the plug-in.

C. Serving Central Office-to-Station Tests

3.04 These tests consist of cable pair dc and transmission measurements made between the customer data station and the serving central office, and require a person at both the customer station and the serving central office for test coordination. The customer provided terminal equipment must be removed from the cable pair and the serving central office plug-in must be replaced by the appropriate test extender for making the tests.

3.05 The cable pair installation tests (Chart 2) should be made before the customer provided terminal equipment is installed and should be completed far enough ahead of the plant test date to allow time for making necessary tests to isolate and correct troubles that may exist.

3.06 The Chart 2 dc tests are for checking the cable pair for a foreign voltage, opens, short-circuits, crosses, or ground. These tests are similar to the Chart 1 tests except that two people are required. The customer provided terminal equipment must be removed from the circuit while the following tests are made.

- Foreign voltage
- Insulation resistance
- Loop resistance.

3.07 The transmission tests in Chart 2 are to ensure that the cable pair meets the insertion loss and noise requirements for CSDC service. These tests, that should be made before the start of CSDC service, include:

- Insertion loss
- Circuit (steady state) noise
- Impulse noise.

If the noise requirements cannot be met, the problem may be caused by cable pair unbalance and should be referred to the cable repair group.

Insertion Loss

3.08 The insertion loss tests requires one HP-3550B transmission test set (or equivalent) and a patch cord at each end of the local loop and a test extender at the serving central office.

3.09 This test verifies that the cable loss is correct and that the cable pair is free of load coils. The actual measured loss (AML), taken at 1004Hz, is compared to the expected measured loss (EML) taken from the WORD document or CLR. The insertion loss limits are given in Table A. The AML should be recorded on the CLR as a benchmark value (for future reference). Insertion maintenance loss test measurement must be within 3dB of the measurement value recorded at installation. The measurement results of 72KHz, must never exceed 45dB for ESS wire centers or 40dB for wire centers that contain one or more electromechanical switching systems.

Circuit Noise and Impulse Noise

3.10 Noise measurements are made with 135-ohm resistors terminating the cable pair at each end with the noise measuring set in the bridging (high Z) mode. Both circuit noise and impulse noise measurements can be made using the same test setup. A suggested noise test procedure is provided in Chart 2.

TABLE A
INSERTION LOSS LIMITS

IMPEDANCE SETTING	TEST FREQ	HP3550B FREQ RANGE	REQUIREMENTS
VOICE 1. 600-OHMS	1004Hz	>5KHz	AML = EML WITHIN +5 TO -2.5 dB
DATA 2. 135-OHMS	4.8 KHz	<5KHz	AML cannot exceed twice the 1004Hz AML Value
3.	72 KHz	>5KHz	AML cannot exceed 45 dB* AML = EML Within +5 to 2.5dB

SUGGESTED ACTION IF REQUIREMENT NOT MET

TEST 1. REQUEST FACILITY CHANGE

TEST 2. CHECK PAIR FOR LOAD COILS

TEST 3. CHECK PAIR FOR EXCESSIVE BRIDGE TAPS

** Limit is 40dB if a mechanical crossbar
switching system is located in the wire center.*

3.11 If the cable pair test requirements of Chart 2 are met, the local loop is considered suitable for CSDC service.

4. REFERENCES

4.01 The following practices contain additional information on test equipment and maintenance procedures:

SECTION	TITLE
100-520-101	KS-14510 Meter (Portable Volt-Ohm Milliammeter) - Description and Operation
103-626-100	6F and 6FR Voiceband Noise Measuring Sets-(J94006F and J94006FR)-Description, Operation, and Maintenance
363-202-100	"SLC"96 Subscriber Loop Carrier System- General Description
363-202-401	"SLC"96 Subscriber Loop Carrier System- Remote Terminal
363-202-601	"SLC"96 Subscriber Loop Carrier System- Remote Terminal Cabinet (AT-8908M)- Installation of Shelves
365-170-100	Description- D4 Channel Bank
634-310-501	Locating Cable Faults with the 96A Test Set.

5. TEST PROCEDURES

5.01 Charts 1 and 2 provide step procedures for testing the local loop for installation, maintenance, and trouble. An understanding of the text (Parts 1 through 3) in this practice and familiarity with the specified test equipment will be helpful in using the charts that follow.

Chart 1 Local Loop Testing at the Serving Central Office

5.02 This chart provides the procedures for three one-person tests (A through C) made at the serving central office on cable pairs assigned to CSDC service. The following apparatus is required for these tests:

- 1— Volt-Ohm-Milliammeter (VOM) such as the KS-14510-L1 or KS-16979-L1 or equivalent
- 1— Test extender such as the J99343TB for MFT plug-ins, the J98726-MF CHAN UN EXT for D4 channels, or the J1C141MF-1,L1 CHAN UN EXT for SLC-96 terminals.

STEP

PROCEDURE

Test A. Foreign Voltage

- 1 Select a VOM range as close as possible to 60 VOLT DC. Remove the plug-in associated with the cable pair being tested and insert the test extender into the slot.
- 2 At the test extender, connect the VOM test probes to the following test points and measure the voltage.
 - T and R

STEP	PROCEDURE
	<ul style="list-style-type: none"> • T and GRD • R and GRD <p>Note: If little or no voltage is read, change the meter range to a range close to 1-volt and recheck the test points.</p> <p><i>Requirement:</i> The VOM shall indicate less than 1 volt dc.</p>
3	If the requirement is not met, stop the tests and have the pair changed or repaired.
	Test B. Insulation Resistance
4	Select a VOM range as close as possible to OHMS X10,000 and zero adjust the meter.
5	At the test extender, connect the VOM to the following test points and measure the resistance. <ul style="list-style-type: none"> • T and GRD • R and GRD <p><i>Requirement:</i> The insulation resistance reading between each pair of test points must be greater than 120K ohms.</p>
6	If the requirement is not met, stop the test and have the pair changed or repaired.
	Test C. On Hook or Open Circuit Resistance
7	Select a VOM range as close as possible to OHMS X100 and zero adjust the meter.
8	At the test extender, connect the VOM to test points T and R and read the resistance. <p><i>Requirement:</i> The measured resistance must be greater than 10Kohms if the customer provided terminal equipment is connected to the loop and is on-hook or the measured resistance must be greater than 300Kohms if the customer equipment is not connected to the loop.</p>
9	If the on-hook requirement is not met, further testing of the loop using the Chart 2 tests is required. If the open circuit requirement is not met, stop the tests and have the pair changed or repaired.

Chart 2 Local Loop Tests: SCO-to-Station

5.03 This chart provides the procedure tests where a person is required at both the SCO and the station. This chart consists of six tests (D through I) for which the following apparatus is required.

At the SCO:

- 1— VOM such as the KS-14510-L1 or KS-16979-L1 or equivalent

- 1— HP 3550B Transmission Test Set or equivalent
- 1— 6F Voiceband NMS equipped with a 497F weighting network or equivalent set and network
- 1— Test extender such as the J99343TB for MFT plug-ins, the J98726-MF CHAN UN EXT for D4 channels, or the J1C141MF-1,L1 CHAN UN EXT for SLC-96 terminals
- 1— P2ES Patch cord or equivalent (8 or 12-foot length for use with 7 or 11-foot bays)
- 1— 135-Ohm resistor (loop termination)

At the station:

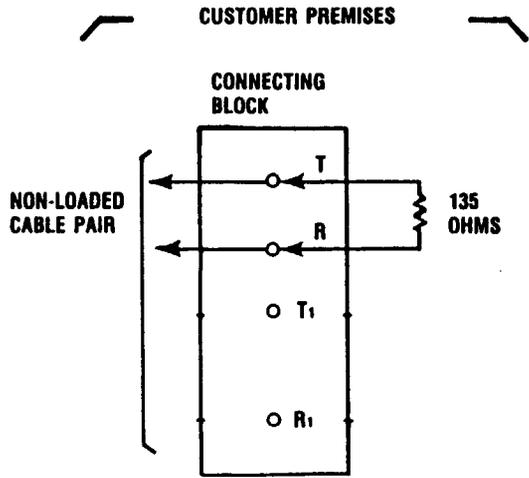
- 1— HP 3550B Transmission Test Set or equivalent
- 1— 135-Ohm resistor (loop termination)
- Miscellaneous cords

STEP	PROCEDURE
Test D. Foreign Voltage	
1	At the station, disconnect the customer provided terminal equipment from the connecting block and leave the cable pair open-circuited.
2	At the SCO, select a VOM range as close as possible to 60 VOLT DC.
3	Remove the plug-in associated with the loop being tested and insert the test extender into the slot. At the test extender, connect the meter leads to the following test points and check for a voltage indication: <ul style="list-style-type: none"><li data-bbox="436 1206 563 1232">• T and R<li data-bbox="436 1272 604 1298">• T and GRD<li data-bbox="436 1338 607 1364">• R and GRD
<i>Note:</i> If little or no voltage is read, change the meter range to a range close to 1-volt and recheck the test points.	
<i>Requirement:</i> The VOM shall indicate less than 1-volt dc.	
4	If the requirement is met, go to the insulation resistance test.
5	If a voltage reading exceeds the requirement, stop the tests and have the pair changed or repaired.
Test E. Insulation Resistance	
6	At the station, verify that the cable pair is open (not terminated or shorted).

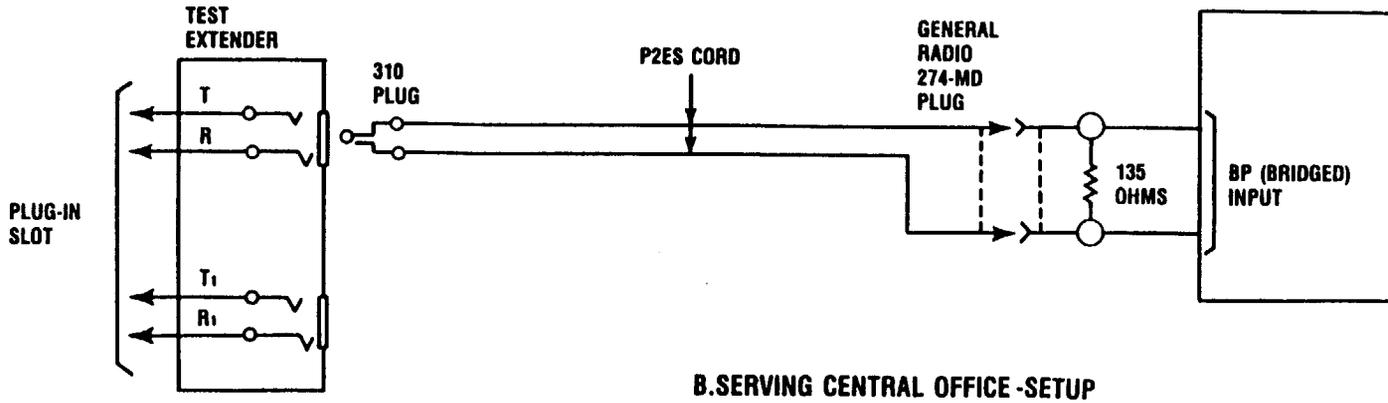
STEP	PROCEDURE
7	At the SCO, select a VOM range as close as possible to OHMS X10.000 and adjust the meter to zero.
8	At the test extender, connect the meter to the following test points and measure the resistance: <ul style="list-style-type: none"> <li data-bbox="419 417 546 442">• T and R <li data-bbox="419 480 591 506">• T and GRD <li data-bbox="419 544 591 570">• R and GRD <p data-bbox="351 608 1179 634"><i>Requirement:</i> Each resistance reading must be greater than 300Kohms.</p>
9	If the requirement is met, go to the loop resistance test. If the requirement is not met, stop the tests and have the pair changed or repaired.
	Test F. Loop Resistance
10	At the station, short the T and R of the cable pair at the connecting block.
11	At the SCO, select a VOM range as close as possible to OHMS X100 and zero adjust the meter.
12	Connect the VOM to test extender points T and R. Read the resistance.
	<i>Requirement:</i> The resistance reading must be less than 900 ohms. Record the measured value as RL 1 on the CLRC. If this test is being done for maintenance purposes, the resistance reading must be within 30 percent of the previously recorded RL 1 value but, the reading plus 30 percent must not exceed 900-ohms except as follows. The loop resistance can exceed 900-ohms if the circuit design employs MFT equipment and the design includes a J99343GE plug-in for range extension and voice treatment.
13	If the requirement is met, remove the short from the cable pair and go to the insertion loss test. If the requirement is not met, the cable pair must be changed or repaired.
	Test G. Insertion Loss
14	At the SCO (or SLC-96 remote terminal), set the HP-3550B controls as follows: <p data-bbox="351 1442 898 1527"><i>Oscillator:</i> FREQ to 1004Hz AMPLITUDE to minimum (ccw)</p> <p data-bbox="351 1566 750 1651"><i>Voltmeter:</i> FUNCTION to ON RANGE to 0dB</p> <p data-bbox="351 1689 855 1842"><i>Patch panel:</i> MEAS-CAL to CAL IMPEDANCE to 600-ohms FREQ to 1004Hz FREQ RANGE to <5KHz</p>

STEP	PROCEDURE
15	Connect one side (terminal) of the oscillator OUTPUT to the oscillator ground terminal.
16	Connect the black terminal of the voltmeter input to the voltmeter ground terminal.
17	Connect the OUTPUT and INPUT center taps (CT) to the voltmeter ground terminal.
18	Using the P2ES patch cord, connect the oscillator output of the HP-3550B set to the TR jack on the test extender.
19	With the patch panel MEAS-CAL switch in the calibrate position, adjust the oscillator AMPLITUDE control to obtain a 0-dBm reading on the voltmeter.
20	Operate the patch panel MEAS-CAL switch to MEAS.
21	At the station, connect the HP-3550B test set input to the T and R of the cable pair using a twisted-pair patch cord. Note: This connection should be made at the customer connecting block.
22	On the HP-3550B test set, connect one side (terminal) of the oscillator OUTPUT to the oscillator ground terminal. Connect the black terminal of the voltmeter input to the voltmeter ground terminal.
23	Set the HP-3550B controls as follows.
	Patch panel:
	<ul style="list-style-type: none"> • MEAS-CAL to MEAS • IMPEDANCE to 600-ohms • FREQ to 1004Hz • FREQ RANGE to <5KHz
	Voltmeter:
	<ul style="list-style-type: none"> • FUNCTION to ON • RANGE to 0dB
24	Decrease the voltmeter RANGE setting until a meter indication is obtained.
25	Read and record the received level on the loop record card.
	<i>Requirement:</i> See Table A.
	<i>Note:</i> The insertion loss (dB)=0dBm (transmit level) minus the receive level (dBm). For example; the received level is -20dBm therefore, the insertion loss is +20dB.
26	Repeat Steps 14 through 25 using 4.8 and 72KHz at 135-ohms impedance shown in Table A.

STEP	PROCEDURE
	<i>Note:</i> Reset the FREQ RANGE switch to >5KHz to measure 72KHz.
27	If the test requirements of Table A are met, disconnect the test equipment from both ends of the local loop and continue by making the noise measurement. If the Table A requirements are not met, take action per the table or request a cable pair change.
	Test H. Circuit Noise
28	At the station, connect the 135-ohm resistor to the T and R of the cable pair (Fig. 2A).
29	At the SCO, insert the appropriate test extender (Fig. 2B).
30	Connect a 135-ohm resistor to the BP input of the 6F NMS.
31	Using the P2ES cord, connect the 6F NMS to the TR jack on the test extender (see Fig. 2B).
32	Insert the 497F weighting network in the 6F NMS and calibrate the set.
33	Set the FUNCTION switch on the 6F NMS to 600 OHM BRIDGING position.
34	Adjust the DBRN dial to obtain a meter indication in the upper half of the meter scale. The noise level is the sum of the DBRN dial setting and the meter indication.
	<i>Requirement:</i> The measured noise level must be less than 28dB _{rn} . <i>Note:</i> Some equivalent noise measuring sets have a selectable, built-in 135-ohm input. Therefore, the external 135-ohm resistor is not needed across the bridging input. To account for using a NMS with a built-in 135-ohm termination, add 7dB to the test requirement.
35	If the circuit noise requirement is met, go to the impulse noise test. If the circuit noise requirement is not met, request the cable pair be repaired or request a pair change.
	Test I. Impulse Noise
36	Verify that the test equipment is still connected as it was for the circuit noise test.
37	Adjust the 6F NMS for an impulse noise threshold of 44 dB _{rn} .
38	Reset the counter to 00 and set the timer for 15-minutes. When the timer is finished, read the total counts recorded on the counter.
	<i>Requirement:</i> The number of noise counts must not exceed seven.
39	If the impulse noise requirement is met, disconnect all test equipment and test leads and restore the circuit to normal. If the requirement is not met, request a cable pair change and repeat this chart.



A. STATION-SETUP



B. SERVING CENTRAL OFFICE - SETUP

Fig. 2—Test Connection for Noise Measurement

PROPRIETARY

See proprietary notice on title page