TWO-POINT PRIVATE LINE TELEPHONE CIRCUITS

VOICE ONLY

TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section describes the routine and circuit order transmission maintenance test procedures applicable to two-point private line voice-only telephone circuits.

1.02 This section is reissued to:

(a) Eliminate references to all services other than two-point private line voice-only circuits

(b) Revise test equipment list

(c) Revise test requirements.

1.03 Since this is a general revision, arrows ordinarily used to denote changes have been omitted.

1.04 The figures used in this section are representative of the circuit configurations in common use. Many other arrangements are also widely used.

1.05 The transmission level points (TLPs) shown in the figures are those commonly found on private line circuits of the types described in this section. The circuit layout records (CLRs) should always be referred to for TLP levels, as engineering considerations may dictate deviations from normal levels.

1.06 The test signal levels for transmission tests in this section correspond to the TLP levels. Lower signal levels (10 to 15 dB below TLP) may be used when investigating certain troubles, such as intermittent opens, as the application of normal test levels will often clear troubles making location difficult. Test signal levels higher than TLP levels should not be used since this will cause crosstalk and noise in other circuits sharing common facilities.

1.07 Test requirements for the tests covered are contained in tables located in Section 310-300-300.

1.08 Section 310-300-100 contains descriptive information on two-point voice-only private line telephone services.

2. REQUIRED TESTS

2.01 Table A shows the tests required for two point private line telephone circuits.

A. Circuit Order Tests

2.02 Circuit order tests are to be performed on initial installations and whenever any subsequent changes or rearrangements are made that might affect the operating or transmission characteristics of the circuit.

2.03 Before starting circuit order tests, the following preliminary checks should be performed.

(a) Physically check all equipment to determine that it is exactly as called for on the CLR. Any deviations should be cleared with the engineering forces.

TABLE A

TEST	CIRCUIT ORDER	ROUTINE	TROUBLE
Loop Tests	X		X
1000-Hz Loss	X	X	X
Frequency Response	X	X	X
Message Circuit Noise	X	X	X
Return Loss Tests*	X		X
Operational Tests	X		X

* Return loss tests are required only when a 2-wire station is used in conjunction with 4-wire facilities.

(b) Verify screw switch settings on 4-wire terminating sets, 359-type equalizers, 227-type amplifiers, etc.

(c) Align 227-type amplifiers to the gains specified on the CLR.

(d) Test local loop cable pairs.

2.04 On the face of each 227-type amplifier, there are three screw-type switches. They must be adjusted as follows:

GAIN RANGE IN dB	SCREW SWITCH 0–13	SCREW SWITCH 10–24	SCREW SWITCH 21–36
21–36	UP	DOWN	DOWN
10–24	UP	DOWN	UP
0–13	DOWN	UP	UP

2.05 The 1-type terminating set has several screw-type switches on the face of the unit. These should be adjusted as follows:

SWITCH	POSITION		
COMP NET	***Down***—unless an external balancing network is specified.	—	***Up***—when an 849-type network is used in the REC AMPL socket
S1	***Down***		
NBOC	***Up***—unless additional capacitance is required with the COMP NET for improving return loss	TR NO AMPL	***Down***—when an 849-type network is used in the TR AMPL socket
TR AMPL	***Down***—when an amplifier is used in the TR AMPL socket	—	***Up***—when an amplifier is used in the TR AMPL socket
		REC AMPL	***Down***—when an amplifier is used in the REC AMPL socket

REC NO AMPL	***Down***—when an 849-type network is used in the REC AMPL socket
—	***Up***—when an amplifier is used in the REC AMPL socket
SX NORM	Refer to CLR for the position of these screw switches. Either the SX NORM or SX REV screws should be down. All four screws should never be down as this shorts the SX leads together.
SX SHORT INDR	***Up***—unless specified otherwise on CLR card.

Note: The TR AMPL, REC AMPL, TR NO AMPL, and REC NO AMPL screw switches are found only on the 1A or 1K and 1B or 1L type terminating sets. When other types of terminating sets are specified, disregard these settings.

2.06 Circuit order test results often prove to be valuable bench marks during trouble locating procedures. For this reason, the results should be recorded and filed with CLRs or at some other location readily available for reference.

B. Routine Tests

2.07 Routine tests are performed to detect faults developing in a circuit before they become trouble conditions. Tests of the 1000-Hz loss, frequency response, and message circuit noise are usually adequate to detect these problems.

2.08 The equipment test list (ETL) (Section 310-001-011) should be referred to for routine test intervals.

C. Trouble Tests

2.09 Trouble tests are listed as an aid in locating troubles. Judgment should be used to determine which tests are necessary based on the trouble being experienced.

D. Operational Tests

2.10 Operational tests consist of test calls, preferably performed by the customer under direction of the plant control office (PCO).

3. TEST EQUIPMENT

3.01 Accurate measurements require good test equipment. All test equipment should be tested to ensure that it is working and is calibrated properly. Ample warmup time is also important for stable operation of the test equipment.

3.02 Table B is a partial listing of test equipment which may be used. Other standard equivalent test sets may be used when those listed are not available.

3.03 The application of dc voltage to the input of certain test equipment may damage the equipment and affect the accuracy of measurements. To prevent accidental exposure of the test equipment to dc voltage, a voltage measurement with a KS-14510 voltmeter should first be made across the line pair. If 1 volt dc or greater is present, an isolation or (holding) coil arrangement must be used.

3.04 Fig. 1 shows two common methods used to provide dc isolation when required. The J94002AB (2AB) auxiliary transmission test set (Fig. 1A) should be used where it is available. To use the 2AB set for this purpose, prepare it as follows:

(a) Connect the line to be measured to the MEAS jack (selection determined by test cord available).

(b) Connect the OSC to the OSC jack or binding posts.

(c) Connect the TMS to the TMS jack or binding posts.

(d) Operate the DIAL/SLV key to the normal position.

(e) Operate the 2DB PAD IN/OUT key to the OUT position.

(f) Select mode of operation and impedance desired.

TABLE B

TEST EQUIPMENT REQUIRED

MEASUREMENT/TEST	TEST EQUIPMENT REQUIRED
1000-Hz Loss & Slope	Hewlett Packard 3550B Portable Test Set Hewlett Packard 4940A Transmission Impairment Test Set Northeast Electronics TTS 4 BNH Northeast Electronics TTS 4 BNH-N Northeast Electronics TTS 15B Northeast Electronics TTS 35B TTI 1103A, 1103B Digital Transmission Test Set
Message Circuit Noise	Hewlett-Packard 4940A Transmission Impairment Test Set Northeast Electronics TTS 4 BNH-N TTI 1105 Level/Noise Digital Test Set WECO 3A, 3B, 3C Noise Measuring Set
DC Voltage and Ringing Voltage	KS-14510 Volt-Ohm-Milliammeter
Signaling	Northeast Electronics TTS 26B Signaling Test Set WECO 1A, 2B or 4A Signaling Test Set
Return Loss (Echo and Singing)	KS-20501 Return Loss Measuring Set WECo 2D Or 2E Singing Point Test Set WECo 54C Return Loss Measuring Set Wiltron Model 9031 Return Loss Measuring Set

(g) Allow for .5 dB loss in the 2AB set when reading TMS and sending test tones.

3.05 An alternate dc isolation arrangement can be developed locally as shown in Fig. 1B. The loss in this arrangement at voice frequencies is negligible and no corrections are required.

4. TYPICAL EQUIPMENT LAYOUTS AND TEST POINTS

4.01 Fig. 2, 3, 4, and 5 are typical equipment layouts that may be used on two-point voice only private line telephone circuits. The test points shown are representative of those available in most layouts; however, all of them may not be present in any given circuit.

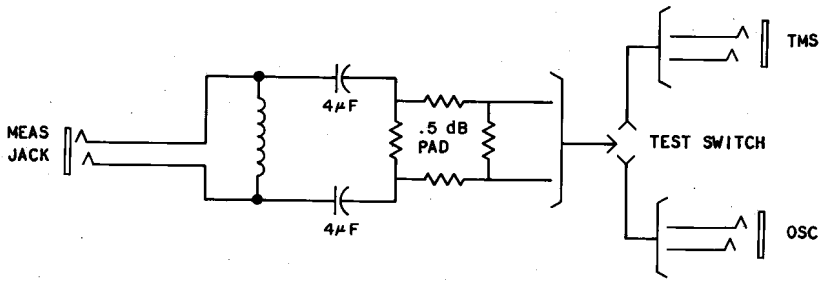


FIG. 1A 2AB SET USED FOR DC ISOLATION

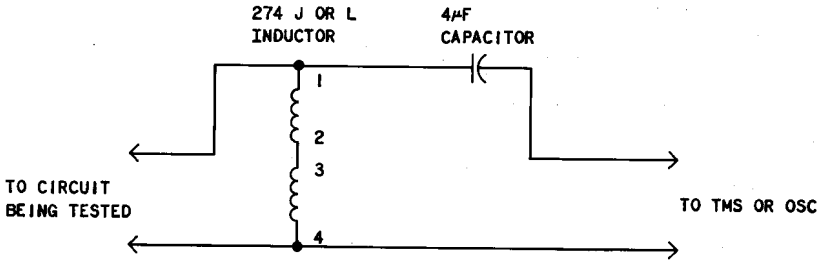


FIG. 1B LOCALLY PREPARED HOLDING ARRANGEMENT

Fig. 1—DC Isolation and Holding Coil Arrangements

4.02 Although there are a number of points where transmission tests may be made, certain ones are not desirable for precise transmission measurements because of unknown impedances and unknown or poorly defined TLPs.

4.03 Desirable transmission testing points are:

(a) Amplifier, equalizer, and pad inputs and outputs

(b) 4-wire terminating set inputs and outputs

(c) Carrier terminals.

4.04 Less desirable transmission test points, unless impedance matching devices are used, are:

(a) Cable pair appearances

(b) Station, tel set, or KTS terminals

(c) Demarcation strips or terminals

(d) Most distributing frame appearances.

4.05 When selecting transmission testing points for overall measurements, they should:

(a) Be at known impedances compatible with test equipment available (usually 600 ohms)

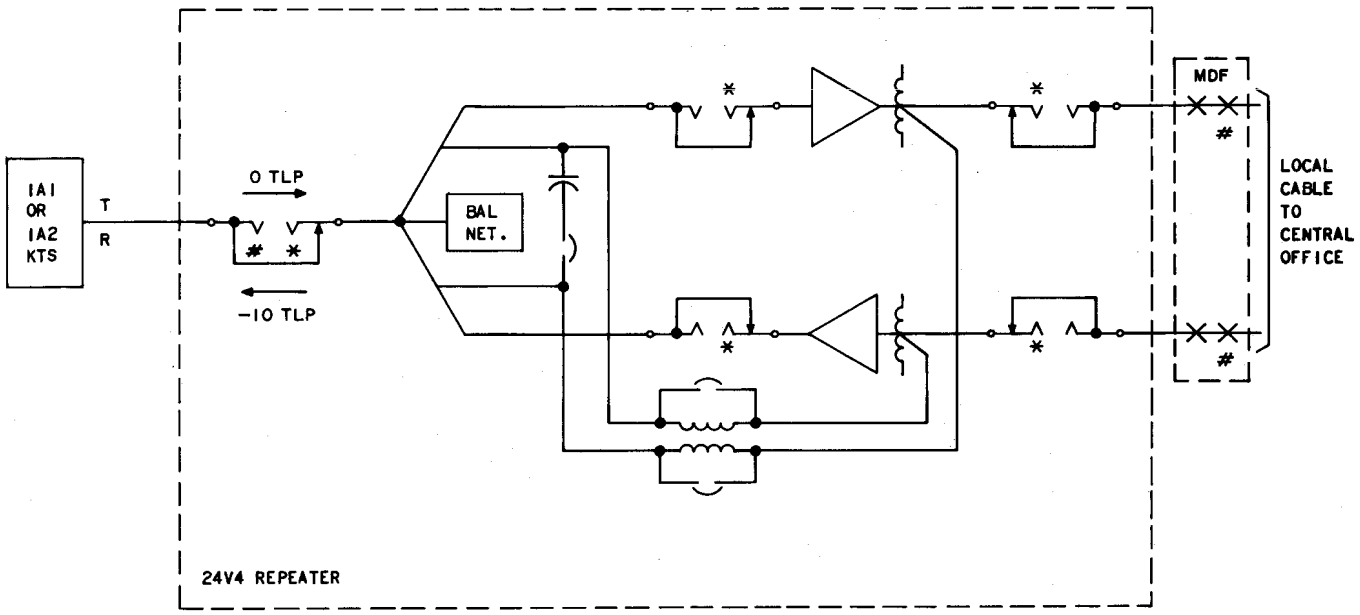
(b) Be at known TLPs

(c) Include as much terminating equipment as possible.

4.06 The TLPs shown in Fig. 2, 3, 4, and 5 are commonly used, however, the CLR should be referred to for actual TLP levels.

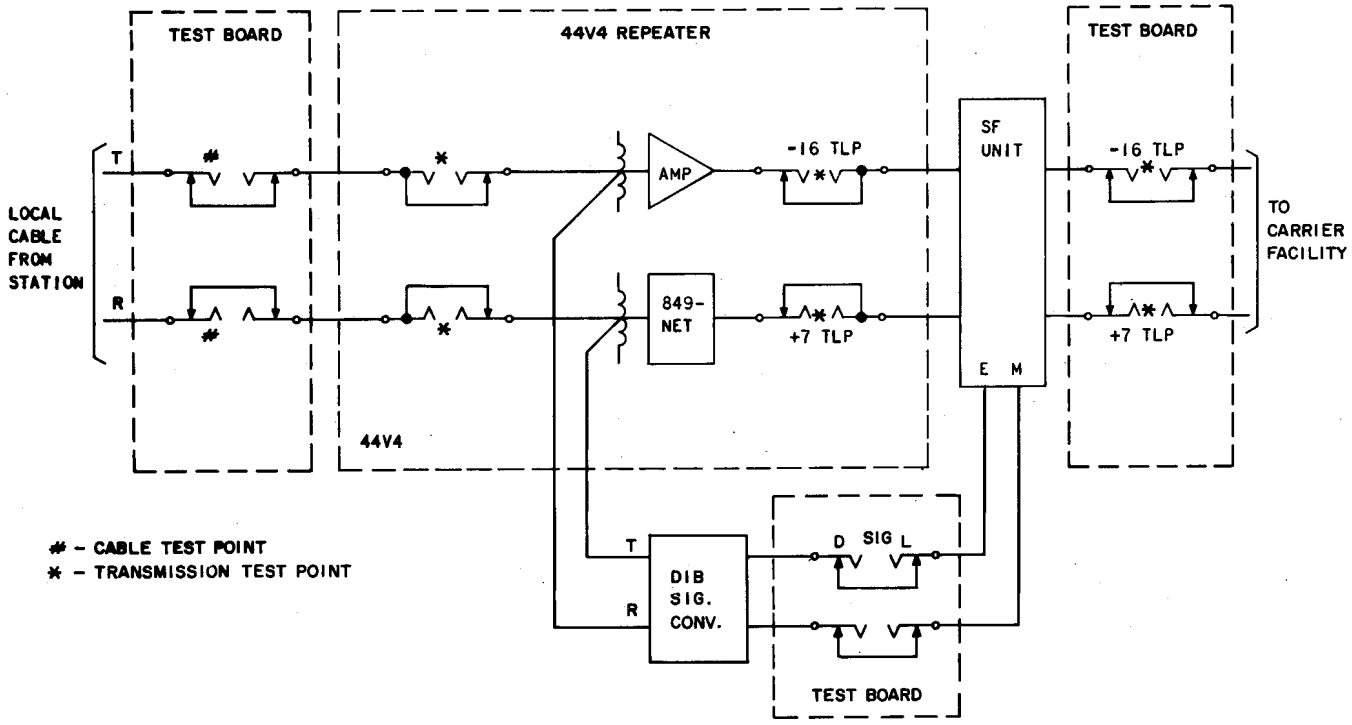
5. TESTING PROCEDURES

5.01 These procedures assume that the circuit has been removed from service and that in the case of circuit order tests, the preliminary checks listed in 2.03 have been completed.



= CABLE TEST POINT
* = TRANSMISSION TEST POINT

Fig. 2—Typical 2-Wire Station Termination Using 24V4 Repeater



- CABLE TEST POINT
* - TRANSMISSION TEST POINT

Fig. 3—Typical Central Office Arrangement

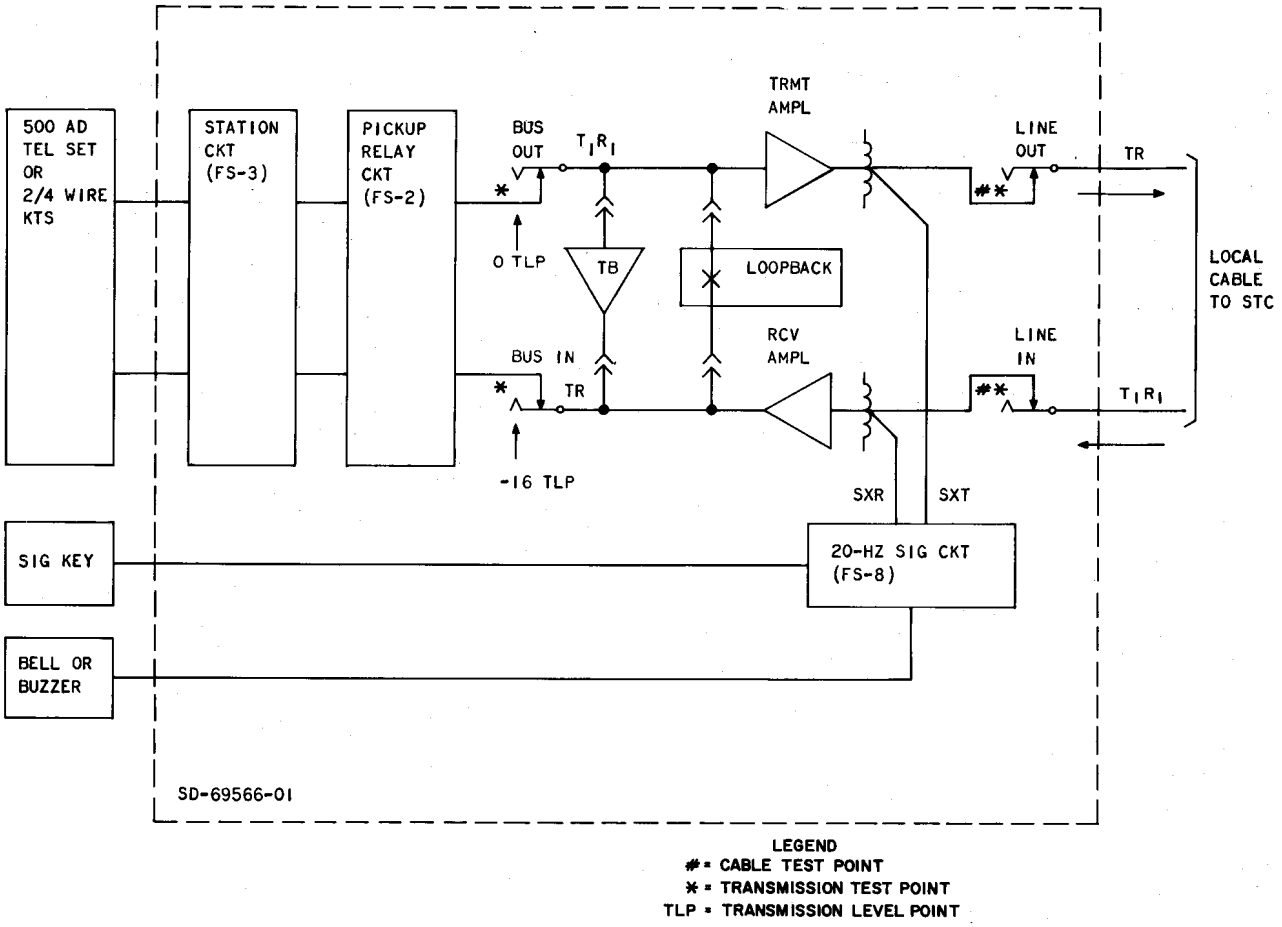


Fig. 4—Typical Two-Point Private Line 4-Wire Termination Using SD-69566-01 Equipment

STEP	PROCEDURE
	1000-Hz LOSS DEVIATION AND FREQUENCY RESPONSE MEASUREMENTS
1	At the customer location, connect an oscillator (OSC) to the transmit test point. Adjust the OSC for 1000 Hz, 600 ohms, and the output level to the required test level (TLP).
2	At the distant customer location, connect a 600 ohm transmission measuring set (TMS) to the receive test point.
3	Measure the received signal. The level measured should be (TLP) $\pm$ 1.0 dB for circuit order tests, and (TLP) $\pm$ 4.0 dB for routine and trouble tests. Record the measurement.
4	Record the 1000-Hz loss deviation.
	Note: The 1000-Hz loss deviation is the difference between the expected measured loss (EML) and the actual measured loss (AML). Excess loss is assigned a (+) sign and excess gain is assigned a (−) sign. Remember, we are talking about LOSS.

STEP	PROCEDURE

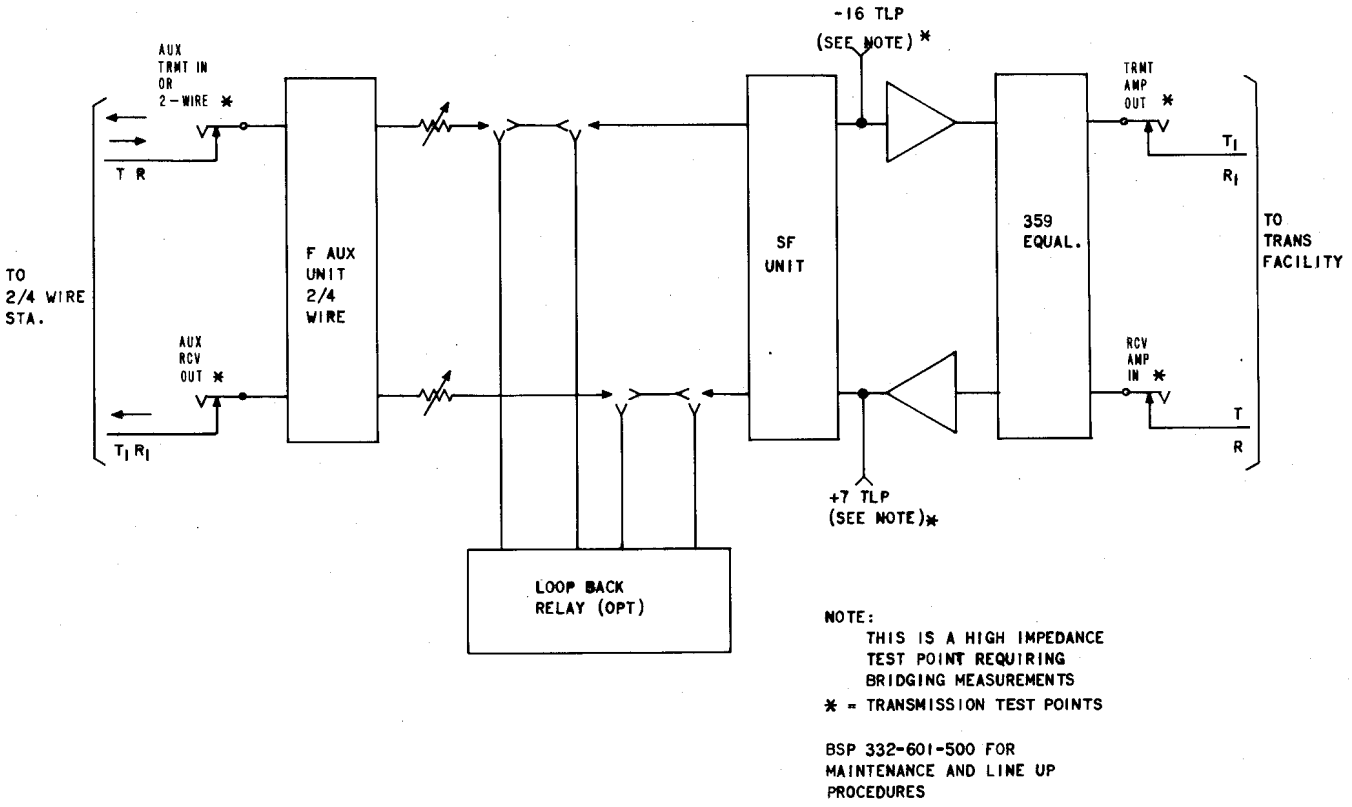


Fig. 5—Customer Premises Facility Terminal With F-Type Signaling Transmission Path and Test Access Points

Example: The CLR shows the receive test point TLP = −10. If the TMS reads −10.8 dBm, the deviation is +.8 dB.

5 If frequency response tests are to be performed at this time, proceed to Step 6. If only 1000-Hz loss deviation tests are to be performed, repeat Steps 1 through 4 in the opposite direction of transmission.

6 Adjust the OSC frequency to 400 Hz.

7 Read and record the TMS indication.

8 Note the difference between the value recorded in Step 3 and the value recorded in Step 7. If the loss at 400 Hz is more than the 1000-Hz loss, assign a (+) sign. Assign a (−) sign if the 400-Hz loss is less than the 1000-Hz loss. The result is frequency response deviation. Record the deviation.

STEP	PROCEDURE

Example 1: TMS at 1000 Hz reads —10.8 dBm
TMS at 400 Hz reads —15.0 dBm
The frequency response deviation = + 4.2 dB

Example 2: TMS at 1000 Hz reads —14.5 dBm
TMS at 400 Hz reads —12.0 dBm
The frequency response deviation = — 2.5 dB

9 Adjust the OSC frequency to 2800 Hz and repeat Steps 7 and 8.

10 Repeat Steps 1 through 9 in the opposite direction of transmission.

STEP	PROCEDURE

MESSAGE CIRCUIT NOISE MEASUREMENTS

1 Prepare the NMS to measure C-message noise at 600-ohm impedance. Rotate the DBRN switch to the 85 position and the meter switch to NORM. Plug the monitoring headphone into the MON jack of the NMS.

2 Connect the NMS to the receive test point.

3 Terminate the far end of the circuit in 600 ohms. If the circuit is a 4-wire circuit, the termination should be in the transmit path toward the station where the measurement is being taken. If test jacks are not available it will be necessary to terminate the loop at the telephone set terminals. The telephone set need not be disconnected for this test, but should be left on-hook.

4 Rotate the DBRN switch until a midrange reading on the NMS meter is obtained.

5 Monitor the circuit with the monitoring headphone. Intelligible crosstalk at the noise measurement level is an indication of trouble which should be corrected.

6 The setting of the DBRN switch plus the meter reading is the noise level present expressed in dBrnc.

7 Correct the dBrnc measurement to dBrnc0.

STEP	PROCEDURE

Note: To convert dBrnc to dBrnc0, determine from the CLR the TLP at the point where the measurement is being taken. Subtract the TLP value from the NMS reading. The difference is the noise level expressed in dBrnc0.

Example 1:

NMS reads	33 dBrnc
TLP = −8	−(−8)
Noise =	41 dBrnc0

Example 2:

NMS reads	53 dBrnc
TLP = +7	−(+7)
Noise =	46 dBrnc0

STEP	PROCEDURE

RETURN LOSS MEASUREMENTS

1 Connect the KS-20501 return loss measuring set (RLMS) to the circuit as shown in Fig. 6. The station to be measured should be on-hook.

2 Adjust the RLMS switches as follows:

THL	0
TEST LOCATION	+0 dB or TST HYB
ADD DB	0
TEST TYPE	SRL (singing return loss low)
POWER	ON

3 Insert a shorting plug into the 2-wire IN jack of the 24V4 repeater or short pins 12 and 13 (T&R leads) of the 1-type terminating set with a clip lead.

4 Adjust the THL controls of the RLMS for a zero meter reading.

5 Remove the T&R short installed in Step 3.

6 Adjust the ADD DB switch on the RLMS for an on-scale reading of the meter.

STEP	PROCEDURE
7	Read and record the return loss. The return loss is the sum of the ADD DB switch and the meter reading.
8	Adjust the TEST TYPE switch to the SRL-HI position (singing return loss-high).
9	Read and record the return loss.
10	The lowest of the readings recorded in Steps 7 and 9 is the singing return loss (SRL). ***Requirement:*** The SRL shall be equal to or greater than that specified on CLR. If not specified, 10 dB or more.
11	If the requirement is met, disconnect the KS-20501 RLMS. If the requirement is not met, adjust the balancing network and NBOC capacitor as follows.
12	Adjust the RLMS TEST TYPE switch to the ERL position (echo return loss).
13	At the customer station, remove the handset from the cradle and wrap the transmitter with sound-deadening material to exclude room noises.
14	Note the return loss. (ADD DB switch plus the meter reading).
15	Maximize the ERL by adjusting the balancing network and/or the NBOC screws on the 1-type terminating set.
16	Repeat Steps 2 through 10 to verify that the SRL meets requirements.

STEP	PROCEDURE
	OPERATIONAL TEST
1	Verify that all patch cords, test equipment, and plugs are removed from the circuit.
2	Request the customer to place a test call from each end of the circuit.
3	Verify: (a) That the circuit signals and talks satisfactorily (b) That the customer knows how to use the circuit (c) That the station sets and key functions are clearly designated (d) That the customer knows where to report future troubles.

STEP	PROCEDURE
4	Turn the circuit up for service and obtain the name of the person accepting the service.

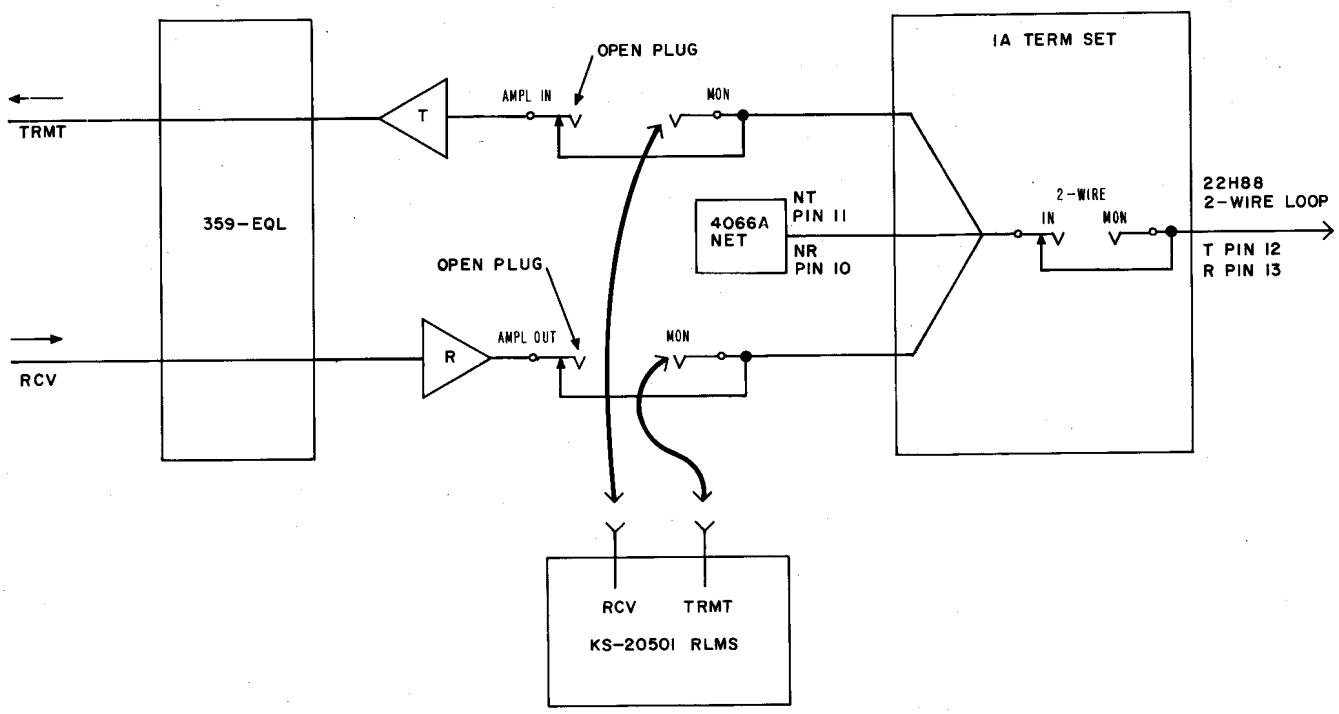


Fig. 6—Test Arrangement for Measuring Return Loss

6. REFERENCES

6.01 The following documents provide additional information applicable to private line telephone service.

SD-, CD-	TITLE
SD-, CD-1C359-01	Metallic Facility Terminal Circuit
SD-, CD-69203-01	Station Systems—Key Telephone System No. 1A1 Line and Signaling Ckt
SD-, CD-69559-01	Station Systems—Key Telephone System No. 1A2 Tie Line and Station Line Circuits
SD-, CD-69566-01	4-wire Private Line Terminating and Station Circuit
SD-, CD-96147-01	Private Line Automatic Ringdown Circuit
SD-, CD-1C475	Customer Premises Facility Terminal for F Type Signaling

SECTION	TITLE
103-106-105	2D and 2E Singing Point Test Set—Description
103-106-110	54C Return Loss Measuring Set—Description

SECTION	TITLE
103-106-115	KS-20501 Return Loss Measuring Set—Description and Operation
310-001-011	Equipment Test List (ETL)
310-300-100	Private Line Telephone Circuits, Voice-Only— Description
310-300-300	Private Line Telephone Circuits Voice-Only—Test Requirements
311-100-552	Special Service Link Lineup CO to CO—2-wire Link Using E6 Repeaters
311-100-553	Special Service Link Lineup CO to Station—2-wire Link Using E6 Repeaters
331-100-100	Message Circuit Noise—General Information
331-850-501	Noise Measurements on 2-wire Subscriber Loops — Methods and Requirements At Stations
331-850-502	Methods for Identifying and Correcting Inductive Noise
332-015-100	Simplified Theory of Singing Point Tests
332-104-100	V4 Telephone Repeater
332-104-500	V4 Telephone Repeater — Initial Lineup
332-104-501	227-Type Amplifiers—Tests and Adjustments
332-105-10Z	24V4 Repeaters—Description
332-115-10Z	849-Type Networks—Description
332-116-10Z	359-Type Equalizers—Description
332-116-20Z	Strapping Charts for 359-Type Equalizers
332-206-100	E6 Repeater—Description
332-206-200	E6 Repeater—Alignment Procedure
332-206-500	E6 Repeater—Tests and Adjustments
332-601-ZZZ	Customer Premises Facility Terminal for Type F Signaling System
332-910-100	Metallic Facility Terminal—General Description
332-910-180 (to be issued)	Metallic Facility Terminal—Application Information
332-911-ZZZ	Metallic Facility Terminal—Signaling Units
332-912-ZZZ	Metallic Facility Terminal—Transmission Units
480-615-100	4-wire Private Line Terminating Circuit—SD-69566-01 Identification, Installation, Connections, and Lineup Procedures
581-YYY-ZZZ	Key Telephone Systems