

**PRIVATE LINE TELEPHONE SERVICE
MULTISTATION SYSTEMS
TESTS AND ADJUSTMENTS**

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1. GENERAL

1.01 This section is reissued to include information previously contained in the addendum to the section. Changes are indicated by marginal arrows.

1.02 While this section is applicable to all multistation private line circuits, it pertains particularly to those for the U.S. Armed Forces, Airline Companies and Pipeline Companies. Circuits for the Federal Aviation Agency (FAA) are covered in Sections 310-410-100, 310-410-300 and 310-410-500.

1.03 The Long Lines Department Drawings referred to in this section can be obtained from the following address:

American Telephone and Telegraph
Company
Long Lines Department
32 Avenue of the Americas
New York 13, New York

1.04 Since the circuits covered in this section are in use continuously, precautions should be taken to prevent service interruptions. When it is necessary to interrupt service for maintenance reasons, it should be restored as quickly as possible.

1.05 The standard circuit order and maintenance instructions apply in all cases not covered by these procedures. The provisions of this section should be followed as closely as possible. Where exceptions must be made, they should be reported promptly through the lines of organization.

1.06 The following 4-wire talking and monitoring circuits are available for use in maintaining these circuits:

- (a) Telephone and test set per Drawing SD-95463-01. This provides a means for talking, listening, signaling, and transmission testing on 2- or 4-wire circuits.

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(b) 4-wire talking and monitoring circuit per Long Lines Department Drawing S-9569-142. This provides a means for talking and listening only. It has been superseded by the set per Long Lines Department Drawing 21937-SD.

(c) 4-wire talking and monitoring circuit per Long Lines Department Drawing 21937-SD. This provides a means for talking and listening only.

(d) 4-wire high-impedance monitoring circuit per Long Lines Department Drawing SM-10356-SD. This provides a means for headset or loudspeaker and volume indicator monitoring without causing appreciable loss or interference on the circuit.

2. DEFINITION OF TERMS

2.01 Certain terms are used frequently in this section to describe the tests and service operations. The more frequently used terms are defined below.

2.02 A *Control Office* is an office designated as "control" on a circuit layout card or sketch for a specific private line telephone circuit. The control office is responsible for the circuit.

2.03 A *Subcontrol Office* is an office appointed by the control office to assist in carrying out control office functions. It acts as the control office in those sections where such assistance is required due to communication, circuit arrangement, or other reasons where it is impractical for the control office to handle all the details of service maintenance on a particular circuit. The subcontrol office has no line-up responsibilities unless such responsibilities are specifically assigned by the control office.

2.04 A *Serving Test Center*, usually referred to as an STC, is an office that is designated as being responsible for all matters pertaining to the service received by the station or stations that the STC serves. Nearly always an STC will serve all of the stations that are multiplexed to the same loop. Usually the STC will be the toll

office at which the subscriber's loop connects to the toll portion of the circuit, or a bridging office at the end of a branch that includes both toll and loop facilities. In a few cases, a private line circuit will not be routed through the office of the STC. In this case, the transmission tests to be made at the STC as prescribed by this section will be made by some other suitable office appointed by the STC.

2.05 A *Bridging Office* is one where the circuit is routed through a 2-wire or 4-wire bridging arrangement.

2.06 A *Branch* is that portion of a private line circuit between a bridge and a subscriber's station(s). A branch includes all equipment that is located at the subscriber's station such as pads, loop transformers, induction coil, instrument, etc. It also includes all equipment at the bridging office up to the bridge terminals.

2.07 A *Loop* consists of all of the exchange facilities between a subscriber's station and the toll office from which the exchange facilities are fed. Loops are commonly referred to as "local channels." A loop can be either 2-wire or 4-wire. In the case of 4-wire loops, the loop that is used for transmission from the station is called a transmitting loop. The loop for transmission toward the station is called a receiving loop.

2.08 A *Main-Line Circuit*, sometimes referred to as a backbone circuit, is that portion of a multistation private line telephone circuit that extends from the control office to the most remote toll office. The main-line circuit will usually be routed through one or more intermediate bridging offices from which branches are fed. Where the circuit radiates from the control office in more than one direction, there will be more than one main-line circuit.

2.09 A *Side-Leg Circuit* is that portion of a multistation private line circuit between the main-line circuit and a Serving Test Center (STC). Usually the main-line circuit will be routed through most of the STC's and, therefore, in most cases, a circuit will not have a side-leg section.

3. RESPONSIBILITIES OF ALL OFFICES

3.01 The responsibilities of all offices should be in accordance with those outlined in the section entitled "Toll Telephone Facility Maintenance — Office Responsibilities," and as supplemented by this section.

3.02 No work or testing of any kind should be done on these circuits or the associated station equipment except at the direction of or upon the approval of the control office unless it is necessary to restore service in case it is interrupted. This excludes routine tests on loud-speaker equipment and repeaters covered in Part 7 of this section.

3.03 In those cases where loudspeakers are connected to the circuit at customer locations, testing by Telephone Company forces should be so conducted that the testing does not interfere with normal business activities of the subscriber. The circuit should not be used as an order wire during trouble investigations. If it is necessary to go in on the circuit, the tester should identify himself with the phrase, "This is the Telephone Company at (give office) testing." Only business pertinent to the trouble being investigated should be conducted on the circuit.

3.04 The control office should be responsible for obtaining the release of the circuit from the subscriber for the purposes outlined in Paragraph 3.02.

3.05 Each office should keep complete and accurate records of all action taken by that office in connection with service or tests on these circuits.

4. RELEASE OF CIRCUITS FOR TESTS

4.01 Tests on all new circuits, sections added to existing circuits, and on rearranged sections should be completed prior to the scheduled start of service. This will eliminate the need for obtaining a release once the circuit has been turned up for service to the customer.

4.02 These circuits are not to be taken out of service for test or any other purpose without first obtaining a release from the customer's

authorized contact. The release should be obtained via the control office as outlined in Paragraph 3.04.

4.03 Releases requested should be short in length. When obtained, the circuit should, if possible, be made good with a spare facility. If the circuit is not made good, it should be kept in such condition that it can be restored immediately, if possible, upon request. The customer should be advised of tests, and the control office should monitor to assure it will be restored if the customer attempts to use the circuit during the testing period. Whenever possible, requests for releases should be made to the customer's control 24 hours in advance of the desired release.

5. TESTING EQUIPMENT

5.01 The following test equipment, or equivalent, should be used when testing these circuits:

600-ohm, Variable Frequency Oscillator

2B or 3A Noise Measuring Set

600-ohm Transmission Measuring Set

201A Noise Generator

178F or 181B Induction Coil

1W13A Cords

KS-6278 Clips

Zero db, 89-Type Resistor (89A)

15 db, 89-Type Resistor (89BL)

110-Volt Extension Cord with Multiple Receptacle

5.02 The oscillator should have a frequency range from 300 to 3000 cycles per second. Typical types of oscillators that may be used are the 200CD Hewlett-Packard oscillator and the oscillator associated with a 21A TMS. Both of these are ac operated. The output level of the oscillator should be adjusted by connecting it to the input of a calibrated TMS at the station.

5.03 Typical types of transmission measuring sets that might be used are the 21A TMS (J94021A) or the 13A TMS. Both of these are ac operated. The transmission measuring set should be calibrated at the central office using a standard milliwatt supply known to be the correct level before it is taken to the subscriber's location. In extreme cases it might be necessary to provide a portable 110-volt ac power supply, such as a gasoline motor-generator, for operation of the oscillator and TMS. A method of checking oscillator and TMS calibrations without returning them to the central office is given in Chart I of this practice. This method requires a nonrepeated cable pair between the central office and the station. It is not a substitute for the calibration of the TMS prior to transportation to the station.

6. CIRCUIT ORDER TESTS

(A) General

6.01 The tests required on a circuit order are as follows:

- (1) Central office equipment and transmission tests.
- (2) Tests between the STC and station.
- (3) Over-all tests.

6.02 These tests should be performed on all new circuits, sections added to existing circuits and all rearrangements of existing circuits. All tests discussed in the section entitled "Circuit Order Tests" should be performed except as modified by this practice.

6.03 Circuit Order Tests should be started as soon as possible so that any troubles or potential troubles can be cleared before the circuit or section is placed in service. The control office should set up a definite schedule for the over-all tests. Normally, all loop installations, station equipment installations, central office cross connections, and local tests of central office equipment and station equipment should be completed at least two full working days prior to the scheduled start of service. This is to permit

adequate time for the over-all and other circuit order tests. Occasionally, on a circuit of complex make-up or one having special features, more than two days should be allowed for testing.

6.04 The layout of a typical 4-wire private line circuit is shown in Fig. 3. Typical levels are also shown. The four groups of measurements as shown on the sketch are as follows:

Group 1 — These measurements will check the loss of the loop facilities and are made only if Group 3 test requirements are not met.

Group 2 — These measurements are the over-all transmission tests between all STC's, including the control office. The methods to be used in making these tests are covered later in this practice.

Group 3 — These measurements check the over-all transmission between an STC and the stations that the STC serves. If trouble is encountered on these tests, Group 1 and 4 tests should be made in that order to locate the trouble.

Group 4 — These measurements check the station equipment losses, including the effect of multiplied stations, at the customer's location. These tests are made if the requirements of Group 3 tests are not met and if trouble is not found by making Group 1 tests.

6.05 A series of charts and associated sketches is included in this practice to assist in testing the facilities between STC's and their served stations. Each facility should be measured in both the transmitting and receiving directions. On 4-wire facilities, the talk-back path should also be measured by sending on the transmit path at the station and measuring on the receive path at the station. Selection of the appropriate charts can be made by referring to Table I. On several of the charts where a test oscillator is connected through a coil to the transmitter ter-

minals, a test level of +4.7 dbm is specified. This produces a +3.0 dbm line level. **THIS LEVEL WILL BE OBTAINED ONLY WITH THE USE OF 181B COILS AND A 4 MFD CAPACITOR.** Other equipment arrangements will give approximately the following 1000-cycle through loss:

TEST AND SUBSET (COILS)	CAPACITOR (MFD)	LOSS (DB)
181B — 181B	0	2.1
181B — 181B	2	2.6
181B — 181B	4	1.7
181B — 178F	0	2.5
181B — 178F	4	2.9
181B — 178F	8	1.7
178F — 178F	0	3.0
178F — 178F	2	3.1
178F — 178F	4	1.6

6.07 Special terminating arrangements applicable to a specific customer's arrangements will be covered in appendices or point sections to this practice.

6.08 ALL OF THE 4-WIRE TESTING ARRANGEMENTS IN THIS PRACTICE ASSUME THAT THE CIRCUIT HAS BEEN ENGINEERED SO THAT THE BRIDGING LOSSES AT THE STATIONS REMAIN CONSTANT REGARDLESS OF WHETHER ONE OR ALL OF THE STATION INSTRUMENTS ARE OFF-HOOK. Only in isolated cases will circuits be encountered where idle circuit terminations are not used in a manner that will provide constant station bridging losses. One of the few such cases are FAA circuit terminations per Drawing SD-69164-01 that terminate in 102A

TABLE I

TYPE OF STATION TERMINATION	STC TO STATION	STATION TO STC	TALK-BACK PATH
4-wire termination per SD-69158-01, Fig. 1 or SD-69167-01; Fig. 61	Chart 2 (5 & 7)*	Chart 3 (6 & 8)*	Chart 4
4-wire termination per SD-69254-01	Chart 9 (12, 14, & 16)*	Chart 10 (13, 15, & 16)*	Chart 11
2-wire termination	Chart 17	Chart 17	
PBX termination — 2-wire loop	Chart 18	Chart 18	
PBX termination — 4-wire loop	Chart 19	Chart 19	

() * Indicates numbers of test charts that can be used to locate troubles when over-all tests are not within the specified requirements.

6.06 It would not be practicable to prepare a chart to cover the exact testing procedure for all station arrangements that are likely to be encountered. For this reason, the most frequently used arrangements have been covered, with notes included on the charts, so that the tester can apply them to the majority of the arrangements used. In addition to the detailed testing procedures for the most commonly used 4-wire station arrangements, charts also cover the less frequently encountered 2-wire station arrangements and PBX arrangements although in less detail.

key equipment at Air Route Traffic Control Centers. Section 310-410-500 covers the testing arrangements for these circuits. A circuit whose levels are dependent upon having a specific number of off-hook stations (bridging loss at station dependent upon number of off-hook stations) will have a note on the circuit layout card or sketch to that effect.

6.09 The tester at the STC should thoroughly understand the station arrangement under test before starting the test. It is sometimes helpful for the STC to keep on file copies

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of the SD drawings applicable to the station arrangements and equipment at the stations they serve.

6.10 Nearly all of the charts in this practice refer to the "level reference point" at the stations. This term along with other information on station levels is discussed in detail in Section 310-405-100.

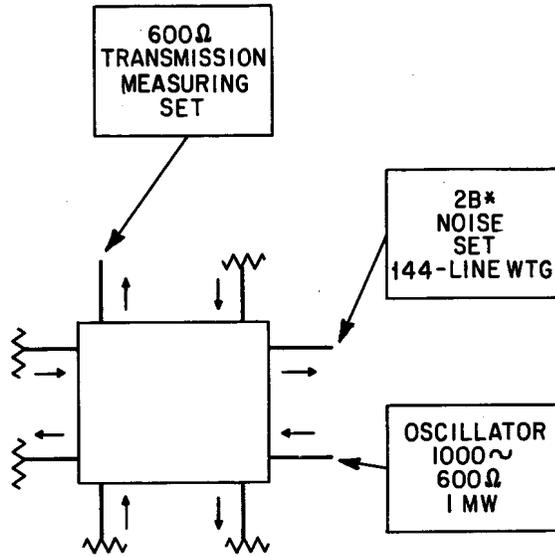
(B) Central Office Equipment Tests

6.11 All repeaters should be adjusted for the gain and equalization that is shown on the circuit layout card or sketch. Records should be checked to ascertain that the electron tubes have been tested within the interval specified for the type of repeater used. *All 101- and 102-type tubes should be of the dome type.* Unit control offices should notify intermediate repeater offices that a private line telephone circuit is being assigned to the unit so that they can properly designate and protect the service.

Bridges

6.12 When a 2-wire, 4-wire, or talk-back bridge is initially assigned to the private line circuit, it should be tested in accordance with the sending and receiving designations given in Tables II, III, and IV. The **REQUIREMENTS** are given in the tables. Fig. 1 shows typical connections for testing a 44-type bridge, and Fig. 2 shows typical connections for testing a talk-back bridge. The same typical connections as shown in Fig. 1 are also used when testing a 46-type bridge. The terminal designations used in Figs. 1 and 2 are for discussion purposes only and are not shown on standard drawings. All terminals to which transmission measuring equipment is not connected should be terminated in 600 ohms.

6.13 It is expected that 2-wire bridging arrangements will be used only in isolated cases on multistation circuits. In those cases, the bridge losses should be within 0.5 db of the loss specified on the circuit layout card or sketch. A description of several 2-wire bridging arrangements is included in Section 310-405-100.



* LOSS IN DBM = 90 MINUS 2B NOISE SET READING

Fig. 1 – Test Equipment Connections for Measurement of 44-Type Bridge Loss

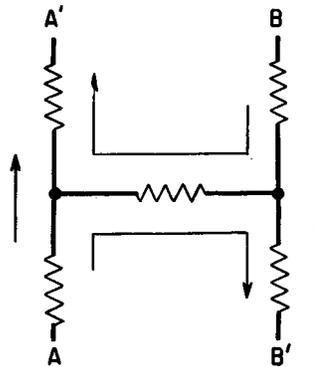


Fig. 2 – Talk-Back Bridge Transmission Paths

(C) Transmission Tests on Central Office Equipment

6.14 At each bridging office and STC, measure the over-all transmission paths through the office. Measurements should be made in both directions over every possible path through the office including talk-back paths and transmission paths completed by switching relays. Transmission testing equipment should be connected at the repeater or carrier channel jacks associated with toll facilities and at the jacks associated

TABLE II
44-Type Bridge

SENDING ON INPUT TERMINALS	LOSS IN DB RECEIVING AT OUTPUT TERMINALS			
	SIDE 1	SIDE 2	SIDE 3	SIDE 4
Side 1	75*	15 ± 0.5	15 ± 0.5	15 ± 0.5
Side 2	15 ± 0.5	75*	15 ± 0.5	15 ± 0.5
Side 3	15 ± 0.5	15 ± 0.5	75*	15 ± 0.5
Side 4	15 ± 0.5	15 ± 0.5	15 ± 0.5	75*

* Loss should be at least 75 db.

TABLE III
46-Type Bridge

SENDING ON INPUT TERMINALS	LOSS IN DB RECEIVING AT OUTPUT TERMINALS					
	SIDE 1	SIDE 2	SIDE 3	SIDE 4	SIDE 5	SIDE 6
Side 1	80*	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5
Side 2	19.5 ± 0.5	80*	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5
Side 3	19.5 ± 0.5	19.5 ± 0.5	80*	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5
Side 4	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	80*	19.5 ± 0.5	19.5 ± 0.5
Side 5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	80*	19.5 ± 0.5
Side 6	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	19.5 ± 0.5	80*

* Loss should be at least 80 db.

TABLE IV
Talk-Back Bridges — Loss in DB

SENDING TERMINAL	RECEIVING TERMINAL	LOW ECHO TYPE TALK-BACK BRIDGE (120C Rep. Coil)	RESISTANCE TALK-BACK BRIDGE	
			With 44 Bridge	With 46 Bridge
A (Loop)	A' (Bridge)	2.75 ± 0.5	3.0 ± 0.5	1.5 ± 0.5
B (Bridge)	B' (Loop)	2.75 ± 0.5	3.0 ± 0.5	1.5 ± 0.5
A (Loop)	B' (Loop)	23.0 ± 0.5	21.0 ± 0.5	23.0 ± 0.5
B (Bridge)	A' (Bridge)	62.0 ± 1.0(1) ↙	21.0 ± 0.5	23.0 ± 0.5

(1) Plus twice the loss of any station loop pads used.

with the station loops. The sending level should be that shown on the circuit layout card or sketch.

REQUIREMENT: The received level should be within 0.5 db of that shown on the circuit layout card or sketch.

6.15 If the requirements given in Paragraph 6.14 are not met, further tests should be made to locate the trouble. If the requirements are exceeded because of small accumulative effects, such as not being able to calibrate a repeater to the exact gain shown or because of pads not being manufactured of the exact value that is specified, slight pad changes and repeater gain changes may be made to bring within limits. **IN NO CASE SHOULD THE FINAL REPEATER GAINS OR THE MEASURED LOSS OF THE PADS DIFFER FROM THE VALUE SHOWN ON THE CIRCUIT LAYOUT CARD OR SKETCH BY MORE THAN 0.2 DB.**

Test of Hybrid Transformers

6.16 The degree of balance at each hybrid transformer arrangement should be checked by making sectional singing point tests. The methods for making these tests are described in other standard practices.

6.17 Where the "line" of a hybrid arrangement connects to a 2-wire loop, the singing point should be checked with the station instrument both on-hook and off-hook. Requirements should be met in both conditions.

6.18 The network of the hybrid arrangement should be adjusted to give the best possible balance condition.

REQUIREMENT: The measured singing point should be at least as good as the value shown on the circuit layout card or sketch.

6.19 One exception to the above is a hybrid arrangement using a 2-wire repeater or a terminating set which is used to connect 4-wire loop facilities to 2-wire toll facilities. In this case the network is adjusted to provide the proper talk-back level at 1000 cycles as shown on the circuit layout card or sketch.

Test of Signaling Equipment

6.20 The operation of all signaling equipment should be checked locally for proper operation by applying the proper signal at one terminal and checking that the signaling equipment converts it to the proper output signal. Where two-way signaling equipment is provided, operation should be checked in both directions. The output of signaling circuits that are used for 20-cycle signaling toward the station should be adjusted for maximum voltage output. Selective signaling equipment, when provided, should be checked for proper operation. The 1000-cycle output of ringers should be adjusted according to the level of the circuit at the point where the ringer is connected. Standard drawings cover this adjustment. The steady 1000-cycle ringer output when measured with a standard TMS should be approximately 2 db below circuit level. When the tone is interrupted, it is approximately 5 db below circuit level.

(D) Tests Between STC and Station

6.21 It should be kept in mind that in some situations it will be necessary for some office other than the STC to make these tests. See Paragraph 2.04.

6.22 When making these tests, continuity between the STC and the subscriber's location should be maintained. Existing local lines, special underlying physical circuits, where provided, or message facilities obtained through traffic department may be used to expedite tests. If none of the above facilities are available, the facilities under test, properly terminated, may be used for communication.

6.23 A 600-ohm terminating plug should be inserted in the bridge leg associated with the section under test. This will maintain a proper impedance to the remainder of the circuit and will also prevent testing tone from interfering with the remainder of the circuit. In case the circuit is not routed through a bridge at the STC, the 600-ohm terminations should be connected at the carrier channel or repeater jacks associated with the incoming facility.

6.24 At the conclusion of these tests, the STC should verify that all terminations, testing equipment, etc, have been removed from the cir-

cuit at both the STC and the subscriber's terminal. The STC should also verify that all straps removed at the subscriber's terminal for the tests are reconnected and that the correct pads are in place in the equipment.

Talking and Signaling Tests

6.25 Since over-all tests require close coordination between a number of offices and also require Telephone Company coverage at a number of private line stations, a trouble condition on a single section between an STC and its served station is likely to delay the over-all tests. This is apt to cause a great deal of inconvenience to personnel at other offices and stations. For this reason, it is desirable that the following talking and signaling tests be made between each STC and its served stations, and all trouble conditions corrected prior to the over-all tests.

6.26 At the STC it is necessary that a telephone set be connected to the private line circuit in such a manner that the transmit and receive levels of the set will be similar to the levels from any other station on the circuit. When available, a 4-wire talking set, such as those discussed in Paragraph 1.06, should be connected to a bridge leg other than the leg associated with the section under test. Testing through the bridge in the above manner is only possible if a spare bridge leg is available or if another bridge leg can be obtained via release or by patching to a spare bridge. If no bridge leg is available for testing, or if the circuit is not routed through a bridge, connect the 4-wire talking set to the section under test at a point so that all signaling equipment, talk-back equipment, and loop repeaters are included between the telephone set and the private line station. If one of the talking sets described in Paragraph 1.06, or equivalent, is not available, testing can be done from the monitor jacks of a carrier channel or repeater or other local arrangements can be made such as using a "test" cord at a No. 5 testboard for transmitting and the "connecting" cord for receiving. When used in this manner no return current path will be introduced in the section under test. When using local arrangements for talking, care should be taken that the proper transmitter level is applied to the circuit.

6.27 Talking Tests: Check the talking transmission between the subscriber's main station and the connected telephone set at the STC. Also check transmission between each extension station and the STC and between each extension station and the main station. The personnel at the subscriber's location and also the tester at the STC should speak at a normal volume directly into the transmitter when making these tests. Satisfactory volume free of echo, noise, crosstalk, clicks, hum, etc, should be obtained.

6.28 Signaling Tests: The proper operation of signaling equipment should be checked by having the main and extension stations apply outward signals and listening at the STC to make sure the proper conversion is accomplished by the signaling equipment. The STC, if possible, should measure the 20-cycle signaling voltage, if used, from the subscriber to make sure that the voltage is sufficient to provide the proper margin of operation for the type of central office signaling equipment that is used. The STC should also apply a signal and check to make sure that the signal circuit at the station operates properly. All selective signaling features should be checked. Two-tone signals and 1000-cycle signals to the main-line circuit should be checked for proper levels. The volume indicator, when connected, can be used for this check. Loudspeaker operation should also be checked at this time to insure that satisfactory volume is obtained and to verify that the loudspeaker is disabled in the manner desired by the subscriber. Usually the loudspeaker will be disabled when an instrument is removed from its mounting or inserted in the station jack. Occasionally, the customer will desire to have it operative at all times except when the push-to-talk button is operated.

(E) Over-all Tests

6.29 After the central office tests and the tests between STC's and their served stations are completed, the following over-all tests should be made. The testing frequency for these tests is 1000 cycles and the level is that shown on the circuit layout card or sketch for the point of test.

Transmission Tests

6.30 The sending and receiving offices for the first portion of the over-all transmission tests are the control office, the last STC on the main-line circuit, and each STC through which the main-line circuit is not routed. When the control office is not at one end of the main-line circuit, the STC at both terminals of the main-line circuit should participate in the tests. Each testing office should send in succession and all other testing offices measure the 1000-cycle net loss.

REQUIREMENT: The received level at each office should agree with the level shown on the circuit layout card or sketch within the limits specified in the section entitled "Circuit Order Tests" for facilities of corresponding length and make-up.

6.31 After the above requirement has been met, make 1000-cycle net loss measurements in each direction between the customer's main station and one or more of the remote stations. The procedures to be followed when sending and receiving at the stations, including the sending and receiving levels, are the same as the procedures used in making tests between the STC and station per Part 6 (D) of this practice.

REQUIREMENT: The received level at each station should agree with the level shown on the circuit layout card or sketch within the limits specified in the section entitled "Circuit Order Tests" for facilities of corresponding length and make-up.

Return Loss

6.32 The return loss of the main-line circuit should be measured using a 201A Noise Generator. The 2B or 3A Noise Measuring Set, with F1A weighting or "C" MESSAGE weighting, respectively, should be used as the detector. The return loss test should start at the control office or STC on the circuit and progress to the last office on the main line. When testing at the control office or first STC, the main line leaving that office should be removed from the circuit and the amplifiers terminated in 600 ohms. The local channels should also be removed from the circuit under test and the amplifiers terminated.

See the Birmingham office in Fig. 3 as an example.

6.33 The test should be made from a spare side of the 4-wire bridge. The talk-back bridges should remain in the circuit under test since they have a bearing on the return loss.

REQUIREMENT: The return loss should not be less than 28 db for the above equipment and circuit arrangement.

6.34 The circuit should be restored to normal at the control office or STC except for the local channel. The control office should then coordinate a similar test with the central office on the main line adjacent to it such as the Montgomery office in Fig. 3. The 4-wire main-line extensions from the 4-wire bridge at Montgomery to Mobile and Adelanto should be removed. Each leg of the bridge should be terminated in 600 ohms. The local channel should also be removed and the line amplifiers terminated in 600 ohms. The return loss should be measured from the same spare leg of the 4-wire bridge at the Birmingham office as previously done.

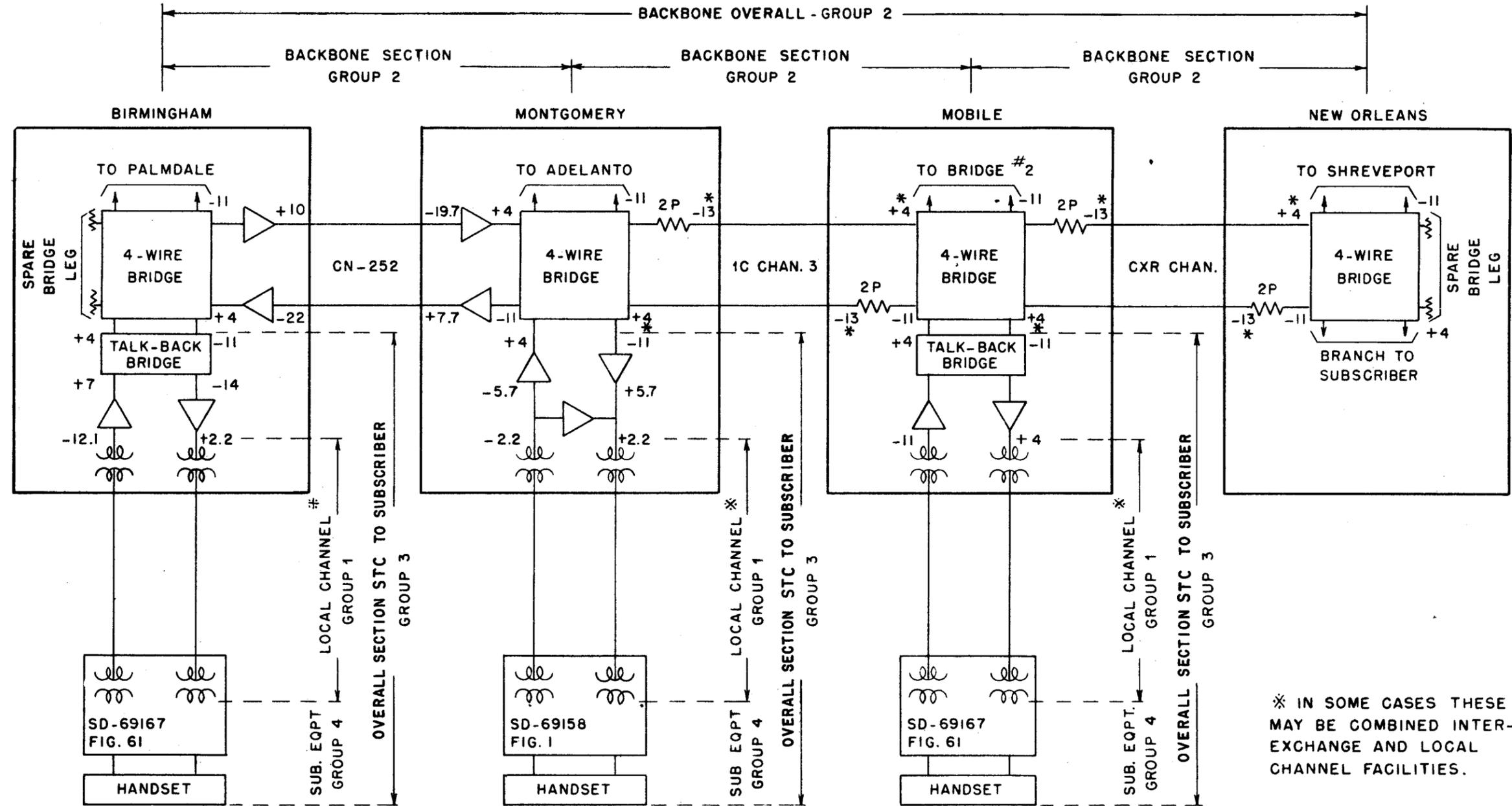
REQUIREMENT: The over-all return loss should be no more than about 2 db worse than that previously measured.

6.35 This procedure should be followed throughout the length of the main line. All local channels should be patched-out of the circuit, progressively, in order to give a good picture of the main-line circuit return loss.

REQUIREMENT: The over-all return loss of the main line should not be worse than 18 db. This is measured with all the main line in the circuit and the local channels removed.

Frequency Response

6.36 The over-all frequency response should be measured on the main line and its branches. These should be made from a spare leg on the 4-wire bridge at each end of the main line with the local channels disconnected and the bridges terminated in 600 ohms. The loss should be measured at 500, 2000 and 2500 cycles in addition to the previous 1000-cycle loss.



GROUP 1 MEASUREMENTS - LOCAL CHANNEL -
 GROUP 2 MEASUREMENTS - BACKBONE CIRCUIT
 GROUP 3 MEASUREMENTS - STC TO STATION.
 GROUP 4 MEASUREMENTS - SUBSCRIBER'S EQUIPMENT

*LEVELS SHOWN ARE FOR OFFICES THAT HAVE NOT BEEN MODIFIED FOR HIGH CHANNEL GAIN. WHERE MODIFIED, THESE LEVELS ARE +7 & -16

FIG. 3
 TYPICAL 4-WIRE PRIVATE LINE CIRCUIT
 SHOWING BRANCH LEGS AND OVERALL BACKBONE CIRCUIT
 WITH BACKBONE SECTIONS

Fig. 3 - Typical 4-wire Private Line Circuit Showing Branch Legs and Over-all Backbone Circuit With Backbone Sections

REQUIREMENTS: Table V gives the limits for these frequencies. The positive number means the facility measures longer than it did at 1000 cycles. The negative number means the facility measures shorter than it did at 1000 cycles.

TABLE V

FREQUENCY (CYCLES)	LIMITS (DB)
500	+5 and -3
2000	+4 and -2
2500	+5* and -3

*If any portion of the facility is C carrier, this limit should be increased to +7.

Noise

6.37 The noise should be measured at the bridging offices or other convenient locations with a 3A Noise Measuring Set using "C" MESSAGE Weighting and corrected to zero transmission level. If a 3A set is not available, a 2B Noise Measuring Set may be used with F1A weighting. Measured noise should not exceed the following values:

CIRCUIT* LENGTH ←	NOISE LIMIT	
	DBRN "C" (O-TLP)	DBA "F1A" (O-TLP)
0 — 249 Mi.	31	25
250 — 299	34	28
300 — 399	35	29
400 — 499	36	30
500 — 599	37	31
600 — 799	38	32
800 — 999	39	33
1000 — 1249	40	34
1250 — 1599	41	35
1600 — 1999	42	36
2000 — 2499	43	37
2500 — 3199	44	38
3200 — 3999	45	39
4000 and over	46	40

* This is the total length of all circuits or legs contributing noise at the point of measurement.

Signaling and Talking Tests

6.38 These tests should be coordinated by the control office. The control office should monitor during the following talking and signaling tests. The monitoring arrangement used at the control office should be such that it intro-

duces no loss and no echo path to the private line circuit. A 4-wire telephone set, such as those described in Paragraph 1.06, when connected to a spare bridge leg, will meet this requirement. Whenever possible, the control office should keep a volume indicator connected to the private line circuit during the talking and signaling tests.

6.39 Make talking tests between the customer's main station and all station drops to insure that satisfactory talking volume is obtained. The volume from all stations should be approximately the same. Check for noise, echo, and for the proper operation of echo suppressors, when assigned.

6.40 Check the operation of the signaling circuit between each combination of stations that has a signaling requirement. Two-tone signaling equipment should be checked in accordance with Section 310-430-500. SS-1 Selective Signaling equipment should be checked in accordance with Section 310-425-500. All selective signaling features should be checked at this time. The control office should check that the signals applied to the private line circuits are at the correct level.

6.41 Check operation of loudspeaker equipment, where provided, at each station drop to determine if volume and quality are satisfactory. If practicable, the volume check should be made during periods of high room noise. Also, check that lifting the handset off the hook, plugging in the handset, or operating a push-to-talk button, as the case may be, silences the loudspeaker.

Operation of Relay Switching Equipment

6.42 Test the operation of relay switching equipment used to connect two circuits or sections of a circuit together where such equipment is provided. This check should be made by operating the dial or switching key equipment at the customer's location in order to check the control circuit as well as the switching relays.

6.43 Where two circuits or sections are connected together by means of relay switching equipment, arrange for talking tests between the stations at the distant terminals of the circuits or section involved to insure that satisfactory transmission is obtained. Observations should be made for noise, crosstalk, and echo.

7. ROUTINE TESTS

(A) Repeater Tests

7.01 The tests to be made are those specified as periodic in the practices covering the respective types of repeater equipment. Test requirements of those practices should apply. These tests may be made on a release basis or by patching in a spare repeater. The interval for routine tests should be in accordance with the practices covering the repeater.

(B) 1000-Cycle Net Loss Tests — Main-Line Section

7.02 Once a month, 1000-cycle net loss measurements should be made on the main-line circuit. The sending offices for this test are the control office and the terminal STC on the main-line circuit. When the control office is intermediate on the main-line circuit, the STC's at both ends of the main-line circuit should participate in the tests in addition to the control office.

7.03 Since these circuits must be available for use on short notice, the test should be made on a coordinated basis. The limits specified in the Sections entitled "Single Frequency Net Loss Measurements" and "Investigation of Excess 1000-cycle Net Loss Deviations on Toll Circuits" apply.

7.04 **Procedure:** During an idle period agreeable to the customer, send 1000-cycle tone at the proper level from the control office and other offices as designated in Paragraph 7.02. The test tones should be sent from each office in succession while the other offices designated as sending offices measure the received level. In addition, receiving only measurements should be made at certain intermediate offices as designated by the control office. The intermediate measurements will be of assistance in sectionalizing trouble if the over-all measurements do not meet requirements. **THE 1000-CYCLE TONE SHOULD NOT BE TRANSMITTED FOR MORE THAN ONE MINUTE AT A TIME WITHOUT A PAUSE SO AS TO PERMIT THE CUSTOMER TO TAKE OVER THE CIRCUIT.** The office sending tone should monitor during the test and if the customer requires the circuit these tests should be delayed until conditions permit their completion.

(C) 1000-Cycle Net Loss Tests — Side Legs

7.05 In some cases the main-line portion of a private line telephone circuit is not routed through all of the STC's, but instead side legs are used to extend the circuit from a bridging office on the main-line section to one or more of the STC's. The side legs are not included in the main-line circuit routine tests that are made on a monthly basis, but instead are tested every three months as outlined in the following paragraph.

7.06 Once every three months the STC's that are connected to the main-line circuit via side legs should participate in the main-line circuit measurements (Paragraphs 7.02-7.04) as both a sending and receiving office. The limits specified in the Sections entitled "Single Frequency Net Loss Measurements" and "Investigation of Excess 1000-cycle Net Loss Deviations on Toll Circuits" apply.

(D) Local Channel Tests

7.07 Tests of circuits between STC's and served stations (local channels) are required only if repeatered or carrier facilities are included. These tests should be scheduled and coordinated by the STC. A release will be required and should be obtained by the STC from the control office as outlined in Part 4 of this practice.

7.08 The local channel should be measured using the procedure applicable to the type of facility involved. Nonrepeatered loop facilities need not be included in the measurements. The facility should be measured every three months or at the interval specified for the type facility involved, whichever is the more frequent.

(E) Station Inspections

7.09 The STC should arrange with the local maintenance forces for an inspection of → the station equipment annually. Particular attention should be paid to loudspeaker operation, talking battery supply, and the physical condition of equipment, such as wiring, protection, and designations. The inspections should be made in accordance with the information and instructions in the practices. Serving Test Centers should participate in these inspections where feasible. Loudspeakers can be routined without

obtaining a release provided the customer monitors the circuit with an instrument while the loudspeaker is out of service.

7.10 Where the talking battery is supplied by dry cells, their condition should be checked quarterly and their cells replaced if necessary.

(F) Carrier Adjustments

7.11 Periodic channel net loss measurements should be made in accordance with the practices for the type carrier involved.

7.12 When periodic tests on carrier channels and associated equipment are to be made, a make-good or reroute channel should be set up and the circuit control office contacted for permission to patch the circuit in accordance with Paragraph 4.02 while tests are being conducted.

(G) Signaling Equipment

7.13 Periodic tests on two-tone and SS-1 signaling equipment at stations should be made in accordance with practices in the "C" Series. Necessary releases should be obtained per Paragraph 4.02.

(H) Noise Tests

7.14 Routine noise tests as described in Paragraph 6.37 should be made every three months.

8. TROUBLE INVESTIGATION

8.01 Reports of service interruptions from the customers should be investigated promptly and close supervision should be exercised so that there will be a minimum amount of circuit outage.

8.02 Circuit trouble should, in general, be investigated in the standard manner which requires that the circuit be released by the customer and removed from service. Where the circuit is distant but usable to one or more points, the 1000-cycle net loss tests per Part 7 (B) in this practice should be made. If the circuit can not be released, the following procedure may be used with the concurrence of the customer.

(a) Select an office to send 1000 cycles in the direction of the trouble. The office will usually be the office at one end of the main-line

circuit. Request other offices involved to arrange their transmission measuring sets for level measurements and connect them to the level jack of their repeater or equivalent. When the circuit is not in use, the sending office should apply 1000 cycles to the line or equipment jacks at the output of the terminal transmitting repeater or equivalent, or to the input jacks associated with a spare bridge leg. If possible, the sending level should be the level shown on the circuit layout card or sketch for the point of signal application. If the circuit is equipped with loudspeakers, the level should be 10 db below the level shown on the circuit layout card or sketch. **IN NO CASE SHOULD THE LEVEL SHOWN ON THE CIRCUIT LAYOUT CARD OR SKETCH BE EXCEEDED.** Simultaneous measurements should be made at each point desired. Offices having 4-wire type bridges associated with such services should arrange to measure normal transmission at these locations.

(b) Tone should not be sent for more than one minute. The sending office should monitor during the test and if the customer requires the circuit, the tests should be delayed until conditions permit their completion.

(c) Where it is necessary to test from level jacks, the procedure should be used only for fairly large troubles (for example, over 6 db) in view of possible errors that may be introduced. Corrections for the sending level should be applied to the measurements so that the corrected readings can be compared with the levels shown on the circuit layout card or sketch.

8.03 The charts included in this section for circuit order tests between an STC and a station should be used in locating troubles on the local channel. If the trouble is of such a nature that the section is not totally inoperable, it should be located and cleared in short release periods only.

8.04 At the end of any release period, the following steps should be taken before restoration of service to the subscriber:

(a) At the subscriber's terminal, verify that all station equipment has been restored to its normal working condition.

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- (b) At the STC, verify that testing equipment, talking sets and test terminations have been removed from all jacks.
- (c) Make talking and signaling tests between the STC and the station. Notify the subscriber that service has been restored to him.
- (d) The STC should notify the control office that the service has been restored.
- (e) The control office should make a continuity test of the circuit and then notify the customer's controlling station of the service restoration.

9. CIRCUIT RESTORATION

- 9.01 These circuits should be made good in accordance with existing priority instructions.
- 9.02 In order that these circuits may be made good promptly in case of trouble, each control office, subcontrol office, and STC should plan in advance various ways of making good that part of the circuit for which they are responsible. Where facility conditions require or permit it, plans should be made for restoring a branch out of another bridge point. If possible, facilities of as good qualities as the regular layout should be used.
- 9.03 For use in extreme cases, plans should be made for making good a drop from some other bridge on the circuit or as a straight bridge on the circuit terminal or other intermediate drop.

9.04 When there is a serious shortage of facilities due to severe storms, etc, it may be possible to make these circuits good temporarily in some normally 4-wire section on a 2-wire basis. This could be done by using 2-wire to 4-wire repeaters or terminating sets with the 4-wire side toward the bridge or existing 4-wire facilities and the 2-wire side toward the temporary line. The application of this method should be limited as it depends on obtaining good balances and requires the use of a 2-wire station arrangement if extended to a customer's station on a 2-wire basis.

9.05 Transmission on the patched layout should be as near the normal value as feasible. The extra time taken for detailed adjustments should depend on the customer's need for the circuit at the moment.

9.06 Patching procedures and the wiring in of patches should be in accordance with the Section entitled "Testing and Operating Precautions for Toll Services."

10. RECORDS AND REPORTS

10.01 The control office should record the results of circuit order tests on Form E2545 and a record of all troubles and trouble reports should be posted on Form E4225. Reports of interruptions for which the customer receives rebates should be prepared in accordance with instructions issued by the Company holding the contract with the customer. Records and reports for the Toll Private Service results plan should be made in accordance with the Sections covering this subject.

Attached:

Charts 1 to 19

CHART 1
FIGS. 4A, 4B, & 4C

PURPOSE OF TEST

This chart outlines a method of checking the calibration of test equipment at a private line station without returning it to the central office. This test *is not a substitute for calibration of test equipment* (oscillator and TMS) *at the central office before it is taken to the private line station for use.* This test can only be made if a nonrepeated cable or open wire pair is available between the private line station and the central office. A local loop can normally be used. All testing frequencies are 1000 cycles.

TEST PROCEDURE

STEP	
1	(Fig. A) At the private line station, connect the oscillator output to the TMS. Adjust the oscillator output until the TMS reads zero dbm. Do not change the oscillator output or TMS calibration during the remaining Steps.
2	(Fig. B) At the central office, connect the output of an oscillator to a nonrepeated open wire or cable pair to the station. The output of the oscillator at the central office <i>must be zero dbm.</i> At the private line station, connect the TMS to the cable pair. Read the TMS and record. Positive readings should be given positive signs and negative readings should be given negative signs. <i>This is reading B.</i>
3	(Fig. C) At the private line station, connect the OSC to the cable or open wire pair. At the central office, connect the TMS to the pair. <i>The TMS must be accurate.</i> At the central office, read and record the TMS indication. Observe positive and negative signs as outlined in Step 2. <i>This is reading C.</i>
4	Compute the error of the output of the oscillator at the private line station as follows: Station Oscillator Output Error = $\frac{C-B}{2}$ (A positive answer means the output of the oscillator is high)
5	Compute the expected error of the private line station TMS as follows: Station TMS Error = $\frac{B-C}{2}$ (A positive answer means the TMS will read high)

EXAMPLE

Assume the following readings were obtained. B = -11.0 dbm C = -9.0 dbm

Oscillator Error = $\frac{(-9.0) - (-11.0)}{2} = \frac{-9.0 + 11.0}{2} = +1.0$ (Oscillator output 1.0 db too high)

TMS Error = $\frac{(-11.0) - (-9.0)}{2} = \frac{-11.0 + 9.0}{2} = -1.0$ (TMS reads 1.0 db low)

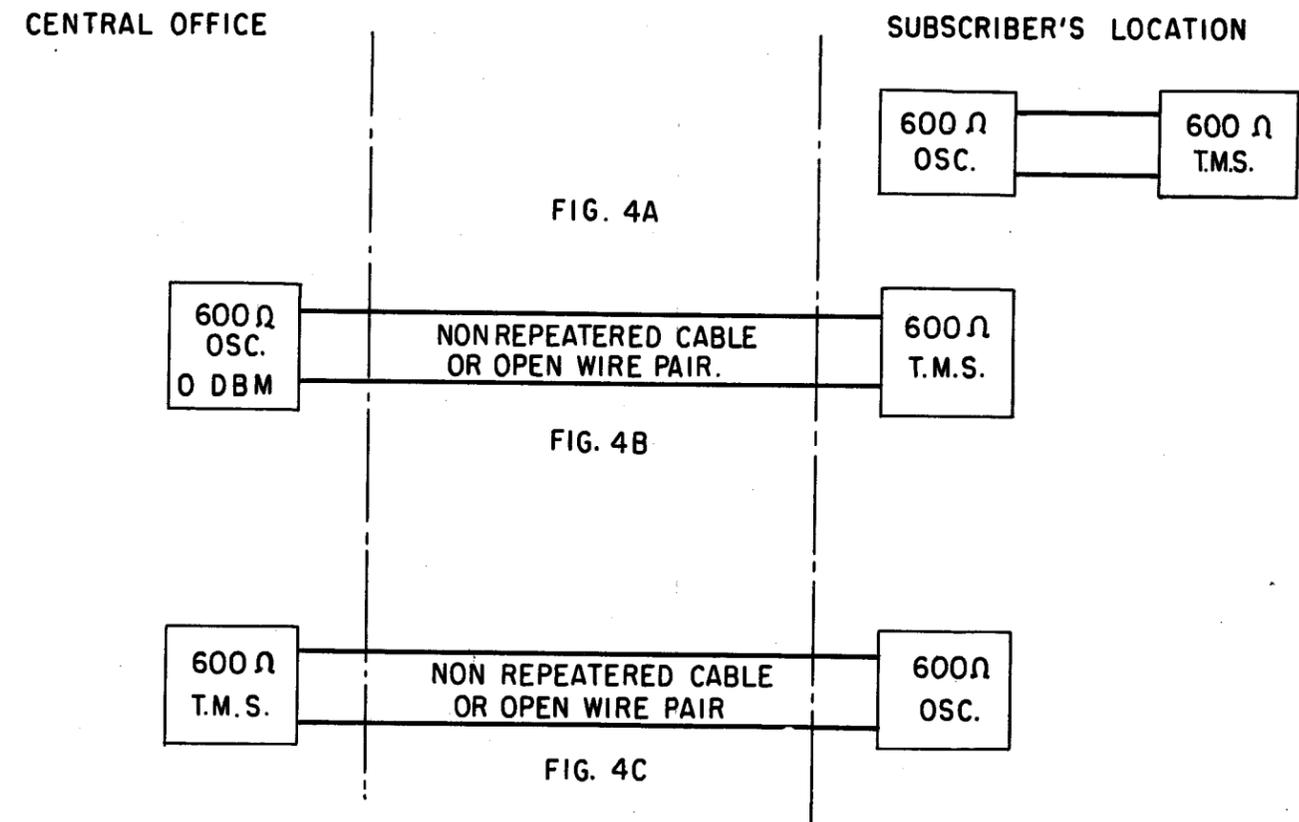


CHART 2
FIG. 5

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the net loss of the receiving 4-wire path from an STC to a served private line station where loop terminating arrangements per SD-69167-01, Fig. 61 or SD-69158-01, Fig. 1 or equivalent are used.

TEST PROCEDURE

- | STEP | |
|------|--|
| 1 | At the STC, adjust the OSC for a frequency of 1000 cycles. Adjust the output of the OSC so that it is the same level as that shown on the circuit layout card or sketch for the receiving loop REP IN. Do not substitute any other level or erroneous readings may result at the subscriber's terminal due to varistor action. Patch OSC output to REP IN jack. |
| 2 | At the STC, measure at the REP OUT jack with a 600 ^w TMS. If this measurement does not agree with the level shown on the circuit layout card or sketch, calibrate the repeater. When the REP OUT level is correct, remove the TMS patch and leave the OSC patched to the REP IN jack. |
| 3 | At the subscriber's location, select one station of the group of multipled stations for test. Do not test from an off-premises extension. |
| 4 | At the subscriber's terminal, remove the receiver unit from the handset and connect the 600 ^w TMS to the handset receiver contact springs. Remove the handset from its mounting and read the power received on the TMS. Report this reading to the STC.
Requirement: The TMS reading should be the same as the level shown on the circuit layout card or sketch.
Limits: Loop facilities only included in section measured — ±1.0 db.
Loop and toll facilities included in section measured — ±2.0 db.
If limits are not met, make tests per Chart 5. |
| 5 | Repeat Steps 1 through 4 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db. |

TEST PROCEDURE NOTES

- | NOTE | |
|------|--|
| 1 | In case key equipment is used to connect the station instrument to the private line termination, operate the associated line key when making measurements. |
| 2 | No correction is required for the TMS readings if the impedance of the removed receiver unit is 600 ohms (HA3, HC4, HC6, or U2 units). For 300-ohm receiver units (HA2, HC1, HC3, or HC5 units), correct the TMS reading 0.5 db. For 150-ohm receiver units (HA1, HA6, HC1, or U1 units), correct the reading of the TMS by 2.0 db, or use a 4:1 transformer and correct for the loss of the transformer. In nearly all cases, 600-ohm receiver units will be used at 4-wire stations. |
| 3 | If the station termination is a jack for a plug-ended instrument, connect the TMS to the sleeves of a 289B-type plug. Insert the 289B-type plug in the station jack to make the measurements. |
| 4 | Multipled station phones may be either "on-hook" or "off-hook" without affecting the measurements. |

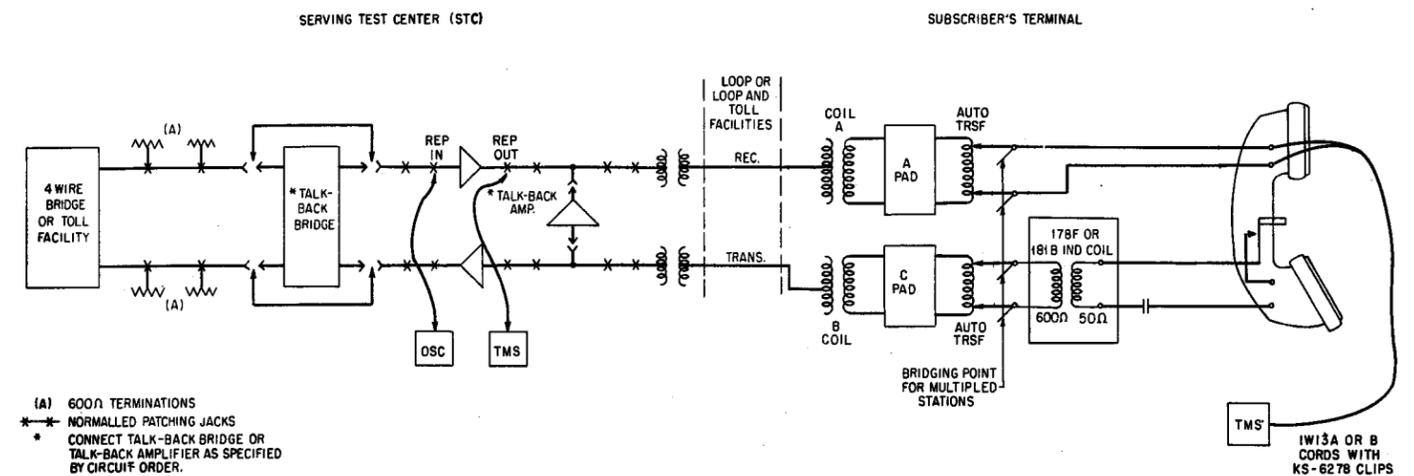


CHART 2
FIG. 5

CHART 3
FIG. 6

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the net loss of the transmitting 4-wire path from a private line station to its STC when loop terminating arrangements per SD-69167-01, Fig. 61, SD-69158-01, Fig. 1, or equivalent are used at the station location.

TEST PROCEDURE

- | STEP | |
|------|---|
| 1 | At the subscriber's location, select one station of the group of multipled stations for test. Do not test from an off-premises extension. |
| 2 | At the subscriber's terminal, adjust output of OSC, set for 1000 cycles, to plus 4.7 dbm as read on a 600 ^w TMS. This assumes that a level of plus 3.0 dbm is shown on the circuit layout card or sketch as being the level at the transmitting level reference point. |
| 3 | At the subscriber's terminal, remove the transmitter unit from the handset. Connect the OSC output to Terminals 1 and 6 of the test 178F or 181B Induction Coil (600 ohms), strap Terminals 2 and 5 and connect Terminals 7 and 8 (50 ohms) to the handset transmitter springs. |
| 4 | At the STC, calibrate the transmitting loop repeater to the level shown on the circuit layout card or sketch by patching the OSC to REP IN and measuring at REP OUT. |
| 5 | At the STC, remove the OSC from the REP IN and leave the TMS patched to REP OUT. |
| 6 | At the subscriber's terminal, operate the handset "push-to-talk" button while the STC measures the 1000 cycles. |
| 7 | At the STC, read the level at REP OUT.
Requirement: The TMS at the STC should read the same level as the level shown on the circuit layout card or sketch.
Limits: Loop facilities only included in section measured — ± 1.0 db.
Loop and toll facilities included in section measured — ± 2.0 db.
If limits are not met, make tests per Chart 6. |
| 8 | Repeat Steps 1 through 7 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db. |

TEST PROCEDURE NOTES

- | NOTE | |
|------|--|
| 1 | In case key equipment is used to connect the station instrument to the private line termination, operate the associated line key when making measurements. |
| 2 | The test level of plus 4.7 dbm assumes a reference level of plus 3.0 dbm which is the reference level for an F1 transmitter unit when operated 4-wire. Should some other type transmitter unit be used, such as an N1 unit (52-type headset), the testing level must be corrected according to the level at the reference point as shown on the circuit layout card or sketch. |
| 3 | If the station termination is a jack for a plug-ended instrument, connect terminals 7 and 8 of the test induction coil to the tips of a 289B-type plug. Insert the plug in the station jack to make the measurements. |
| 4 | Multipled station phones may be either "on-hook" or "off-hook," push-to-talk buttons operated or nonoperated without affecting measurements. |

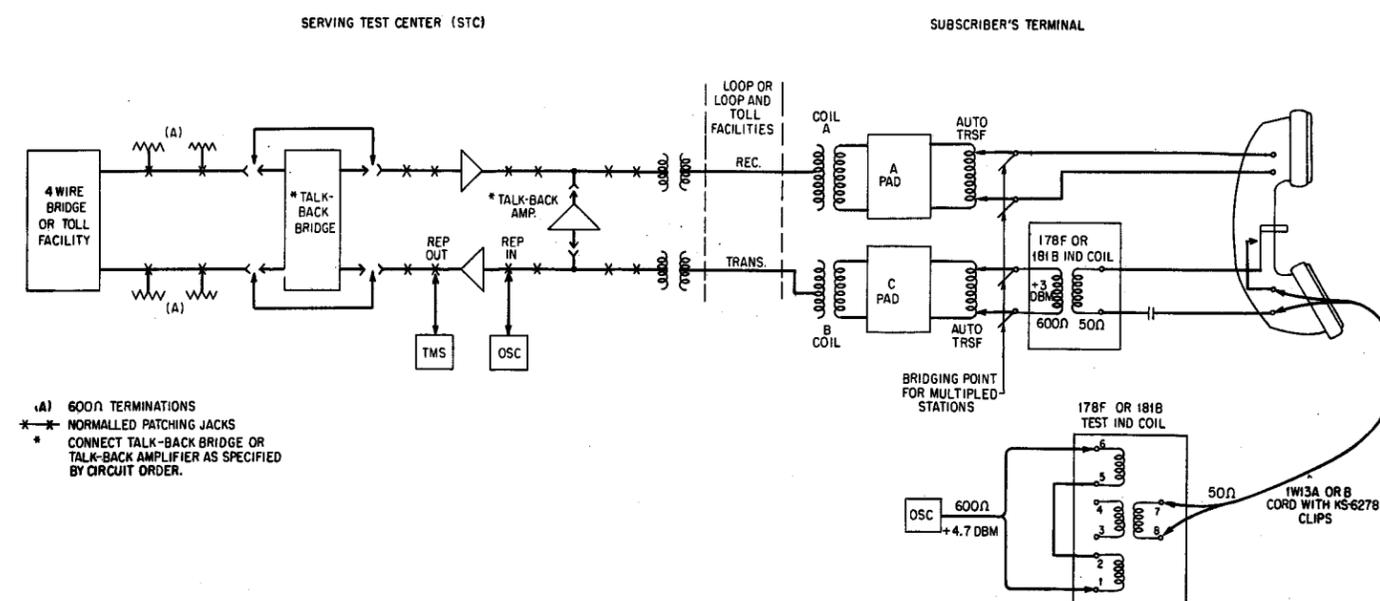


CHART 3
FIG. 6

CHART 5
FIG. 8

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when making transmission tests on the receiving loop facilities that are used to feed stations with terminating arrangements per SD-69167-01, Fig. 61, SD-69158-01, Fig. 1, or equivalent. These tests are only necessary when the over-all receiving path tests from the STC to the station, per Chart 2, do not meet limits. Where both toll facilities and loop facilities were included in the tests per Chart 2, the toll and loop facilities should be measured separately when locating troubles.

TEST PROCEDURE

STEP

- 1 If both toll facilities and loop facilities were included in the section measured per Chart 2, measure the toll facility portion between toll offices in the standard manner for the particular type of facility. The section should meet the limits given in the section entitled "Circuit Order Tests." If limits are met, proceed with the following steps for measurement of the receiving loop.
- 2 At the subscriber's terminal, lift the straps from Coil A, Terminals 2 and 5, on the terminal strip stenciled "pad-coil." (On equipment not modified to include a terminal strip, unsolder wires from lugs 2 and 5 of Coil A.)
- 3 At the subscriber's terminal, connect a 600^w TMS to Terminals 2 and 5 of Coil A.
- 4 At the test room, send 1000 cycles adjusted to zero dbm level into REC LP jack (drop of coil) on the receiving path.
- 5 At the subscriber's terminal, read the power received in the 600^w TMS and inform the test room.

Requirement: The loss of the loop facilities plus the loss of the loop coils at each end should be as shown on the circuit layout card or sketch.

Limits: Plus or minus 1 db.

TEST PROCEDURE NOTES

NOTE

- 1 If the test requirements of this chart *are* met, make tests per Chart 7.
- 2 If the loss for the subscriber's loop coil is not known, use same value as shown on the circuit layout card or sketch for the test room loop coil.
- 3 If the transmitting and receiving loops have identical make-up and exceed requirements by the same amount, the STC should notify the office that issued the circuit order who will advise whether to change pad values at the subscriber's terminal or repeater levels at the test room to correct for the error in computation. A circuit order correction should be submitted in the manner prescribed by the Company that issued the circuit order.

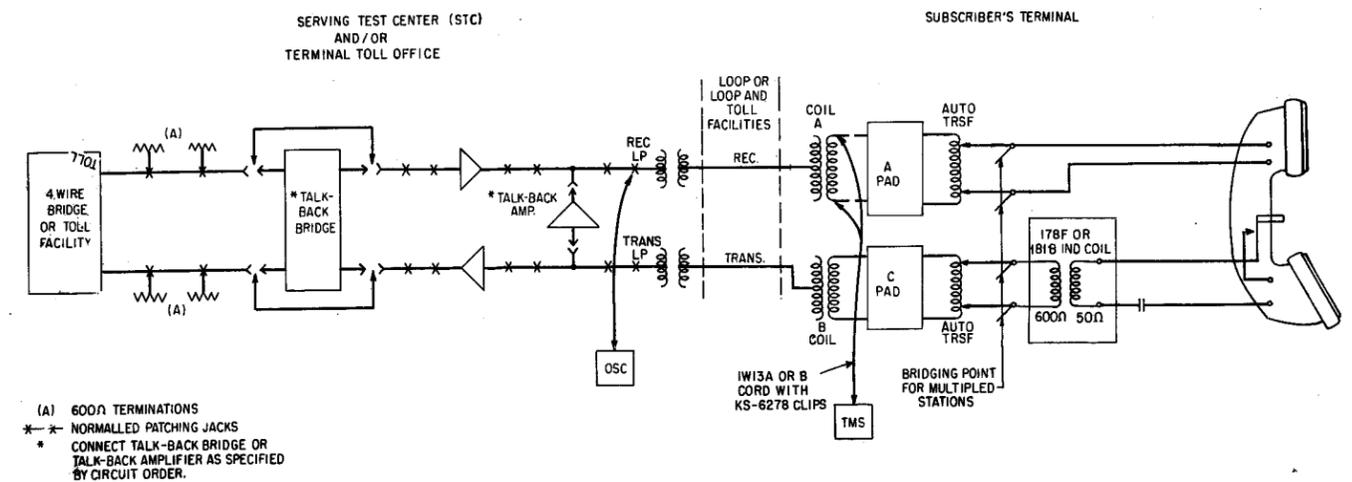


CHART 5
FIG. 8

CHART 6
FIG. 9

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when making transmission tests on the transmitting loop facilities that are used to feed stations with terminating arrangements per SD-69167-01, Fig. 61, SD-69158-01, Fig. 1, or equivalent. These tests are only necessary when the over-all transmitting path tests from the station to the STC, per Chart 3, do not meet limits. Where both toll facilities and loop facilities were included in the tests per Chart 3, the toll and loop facilities should be measured separately when locating troubles.

TEST PROCEDURE

STEP

- 1 If both toll facilities and loop facilities were included in the section measured per Chart 3, measure the toll facility portion between toll offices in the standard manner for the particular type of facility. The section should meet the limits given in the section entitled "Circuit Order Tests." If limits are met, proceed with the following steps for measurement of the transmitting loop.
- 2 At the subscriber's terminal, adjust output of the OSC set for 1000 cycles to zero dbm as read on a 600^w TMS.
- 3 At the subscriber's terminal, lift the straps from Coil B, Terminals 2 and 5, on the terminal strip stenciled "pad-coil." (On equipment not modified to include a terminal strip, unsolder wires from lugs 2 and 5 of Coil B.)
- 4 At the subscriber's terminal, connect the OSC to Terminals 2 and 5 of Coil B.
- 5 At the test room, read the level at the TRANS LP jack (drop of coil) on the transmitting path.

Requirement: The loss of the loop facilities plus the loss of the loop coils at each end should be as shown on the circuit layout card or sketch.

Limits: Plus or minus 1 db.

TEST PROCEDURE NOTES

NOTE

- 1 If the test requirements of this chart *are* met, make tests per Chart 8.
- 2 If the loss for the subscriber's loop coil is not known, use same value as shown on the circuit layout card or sketch for the test room loop coil.
- 3 If the transmitting and receiving loops have identical make-up and exceed requirements by the same amount, the STC should notify the office that issued the circuit order who will advise whether to change pad values at the subscriber's terminal, or repeater levels at the test room to correct for the error in computation. A circuit order correction should be submitted in the manner prescribed by the Company that issued the circuit order.

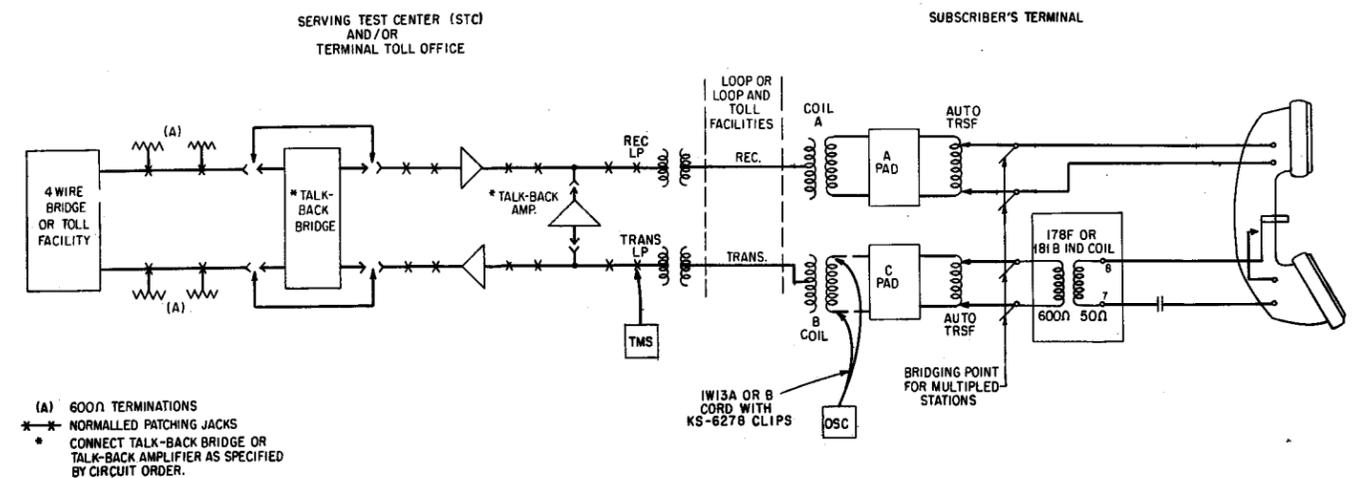


CHART 11
FIG. 14

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the talk-back path from a station transmitter to a station receiver. The procedure is applicable to stations with terminating arrangements per SD-69254-01, Fig. 2.

TEST PROCEDURE

STEP

- 1 At the subscriber's location, select one station of the group of multipled stations for test. Do not test from an off-premises extension.
- 2 At the STC, calibrate the talk-back amplifier if one is used.
- 3 At the subscriber's terminal, adjust output of OSC, set for 1000 cycles, to a level 1.7 db higher than the level at the transmitting level reference point (line terminals of the station induction coil) as shown on the circuit layout card or sketch. For example, if the station instrument is an F-type handset, the reference level in most cases will be +3.0 dbm. In this case the OSC would be connected to the TMS and its output adjusted until a level of +4.7 dbm was read.
- 4 At the subscriber's terminal, remove the transmitter unit from the handset. Connect the OSC output to Terminals 1 and 6 of the test 178F or 181B Induction Coil (600 ohms), strap Terminals 2 and 5 and connect Terminals 7 and 8 (50 ohms) to the handset transmitter springs.
- 5 At the subscriber's terminal, remove the receiver unit from the handset and connect the TMS to the handset receiver contact springs.
- 6 At the subscriber's terminal, operate the "push-to-talk" button on the handset.
- 7 At the subscriber's terminal, read the power received in the 600^w TMS and inform the STC of the reading.

Requirement: The TMS reading should be the same as the level at the receiving level reference point as shown on the circuit layout card or sketch.

Limits: Loop facilities only included between talk-back arrangement and station — ±2.0 db.
Loop and toll facilities included between talk-back arrangement and station — ±4.0 db.

TEST PROCEDURE NOTES

NOTE

- 1 If the station termination is a jack for a plug-ended instrument, connect Terminals 7 and 8 of the test induction coil to the tips of a 289B-type plug. Connect the TMS to the sleeves of the 289B-type plug. Insert the plug in the station jack to make the measurements.
- 2 Multipled station phones may be either "on-hook" or "off-hook," but "push-to-talk" buttons should not be operated except at the station from which the test frequencies are set.

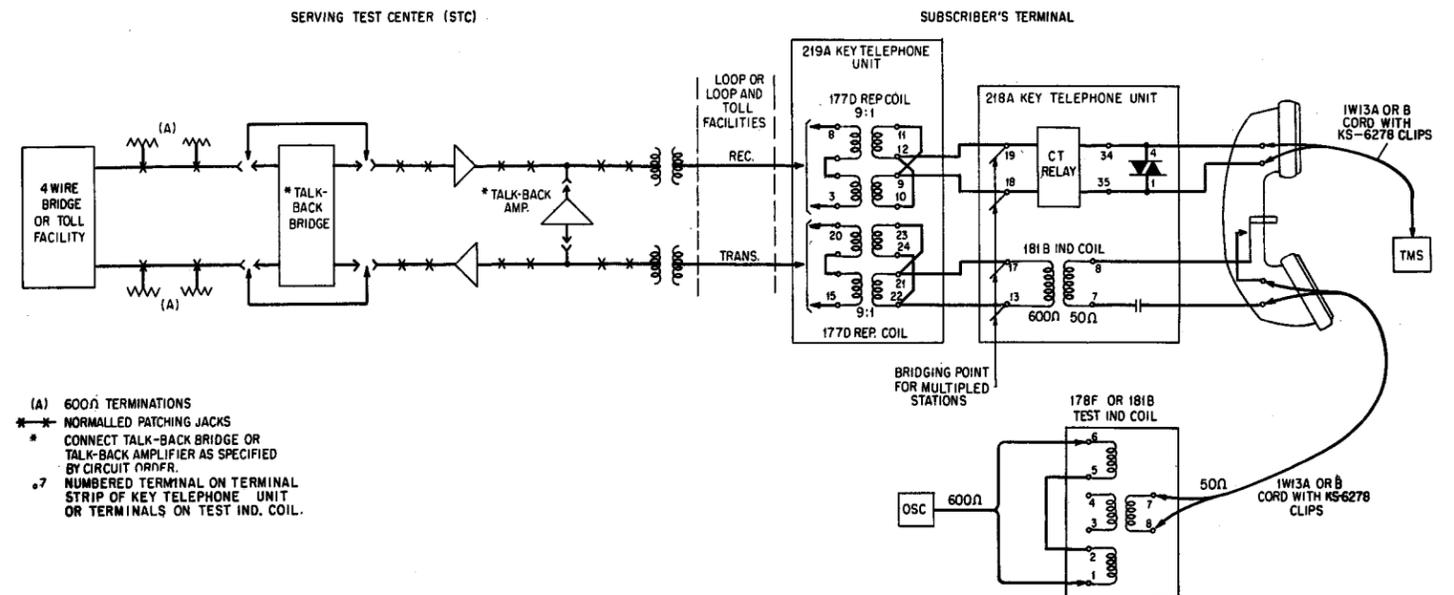


CHART 11
FIG. 14

CHART 12
FIG. 15

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when making transmission tests on the receiving loop facilities that are used to feed stations with terminating arrangements per SD-69254-01, Fig. 2. These tests are only necessary when the over-all receiving path tests from the STC to the station, per Chart 9, do not meet limits. Where both toll facilities and loop facilities were included in the tests per Chart 8, the toll and loop facilities would be measured separately when locating troubles.

TEST PROCEDURE

STEP

- 1 If both toll facilities and loop facilities were included in the section measured per Chart 9, measure the toll facility portion between toll offices in the standard manner for the particular type of facility. The section should meet the limits given in the section entitled "Circuit Order Tests." If limits are met, proceed with the following steps for measurement of the receiving loop.
- 2 On the terminal strip of the 219A Key Telephone Unit at the subscriber's station, remove the leads from Terminals 3 and 8. (At the rear of the Key Telephone Unit.)
- 3 At the subscriber's terminal, connect a 600^w TMS to the leads disconnected from Terminals 3 and 8 in Step 2.
- 4 At the test room, send 1000 cycles adjusted to zero dbm level into the REC LP jack (drop of coil) on the receiving path.
- 5 At the subscriber's terminal, read the power received in the 600^w TMS and inform the test room.

Requirement: The measured loss should equal the sum of the loss of the loop coil at the test room, the loss of the loop facility, and the reflection loss due to connecting the 600-ohm TMS to the loop facility without using an impedance matching device. The first two losses can be determined by referring to the circuit layout card or sketch. To determine the reflection loss, find the basic make-up of the loop from the circuit layout card or sketch and then refer to the following table.

TYPE OF FACILITY	APPROXIMATE REFLECTION LOSS
19 gauge N.L.	0 db
16 & 19 gauge H-44-S	0 db
16 & 19 gauge H-31-S	0 db
16 gauge N.L.	0.4 db
16 & 19 gauge H-88-S	0.5 db
16 & 19 gauge H-172-S	0.9 db
16 & 19 gauge H-174-S	0.9 db
16 & 19 gauge B-88-S	0.9 db

Limits: Plus or minus 1 db.

TEST PROCEDURE NOTES

NOTE

- 1 If the test requirements of this chart *are* met, make tests per Chart 14.
- 2 If the transmitting and receiving loops have identical make-up and exceed requirements by the same amount, the STC should notify the office that issued the circuit order who will advise whether to change pad values or repeater levels at the test room to correct for the error in computation. A circuit order correction should be submitted in the manner prescribed by the Company that issued the circuit order.
- 3 The loop coil at the subscriber's station is not included in the measurements since its 9:1 impedance ratio would cause too great an error due to reflection loss.

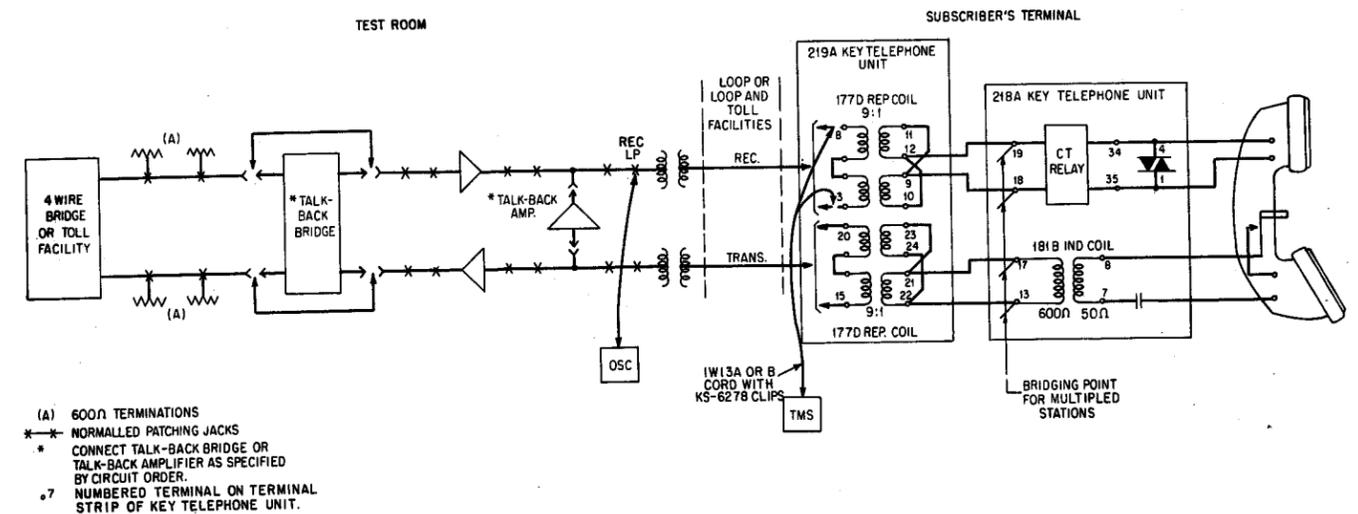


CHART 12
FIG. 15

CHART 13
FIG. 16

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when making transmission tests on the transmitting loop facilities that are used to feed stations with terminating arrangements per SD-69254-01, Fig. 2. These tests are only necessary when the over-all transmitting path tests from the station to the STC, per Chart 10, do not meet limits. Where both toll facilities and loop facilities were included in the tests per Chart 10, they should be measured separately when locating troubles.

TEST PROCEDURE

- STEP**
- 1 If both toll facilities and loop facilities were included in the section measured per Chart 10, measure the toll facility portion between toll offices in the standard manner for the particular type of facility. The section should meet the limits given in the section entitled "Circuit Order Tests." If limits are met, proceed with the following steps for measurement of the transmitting loop.
 - 2 At the subscriber's terminal, adjust output of the OSC set for 1000 cycles to zero dbm as read on a 600^w TMS.
 - 3 At the subscriber's terminal, remove the leads from Terminals 15 and 20 of the 219A Key Telephone Unit terminal strip. (At the rear of the Key Telephone Unit.)
 - 4 At the subscriber's terminal, connect the OSC to the leads disconnected from Terminals 15 and 20 in Step 3.
 - 5 At the test room, read the level at the TRANS LP jack (drop of coil) on the transmitting path.

Requirement: The measured loss should equal the sum of the loss of the loop coil at the test room, the loss of the loop facility, and the reflection loss due to connecting the 600-ohm OSC to the loop facility without using an impedance matching device. The first two losses can be determined by referring to the circuit layout card or sketch. To determine the reflection loss, find the basic make-up of the loop from the circuit layout card or sketch and then refer to the following table.

TYPE OF FACILITY	APPROXIMATE REFLECTION LOSS
19 gauge N.L.	0 db
16 & 19 gauge H-44-S	0 db
16 & 19 gauge H-31-S	0 db
16 gauge N.L.	0.4 db
16 & 19 gauge H-88-S	0.5 db
16 & 19 gauge H-172-S	0.9 db
16 & 19 gauge H-174-S	0.9 db
16 & 19 gauge B-88-S	0.9 db

Limits: Plus or minus 1 db.

TEST PROCEDURE NOTES

- NOTE**
- 1 If the test requirements of this chart *are* met, make tests per Chart 15.
 - 2 If the transmitting and receiving loops have identical make-up and exceed requirements by the same amount, the STC should notify the office that issued the circuit order who will advise whether to change pad values or repeater levels at the test room to correct for the error in computation. A circuit order correction should be submitted in the manner prescribed by the Company that issued the circuit order.
 - 3 The loop coil at the subscriber's station is not included in the measurements since its 9:1 impedance ratio would cause too great an error due to reflection loss.

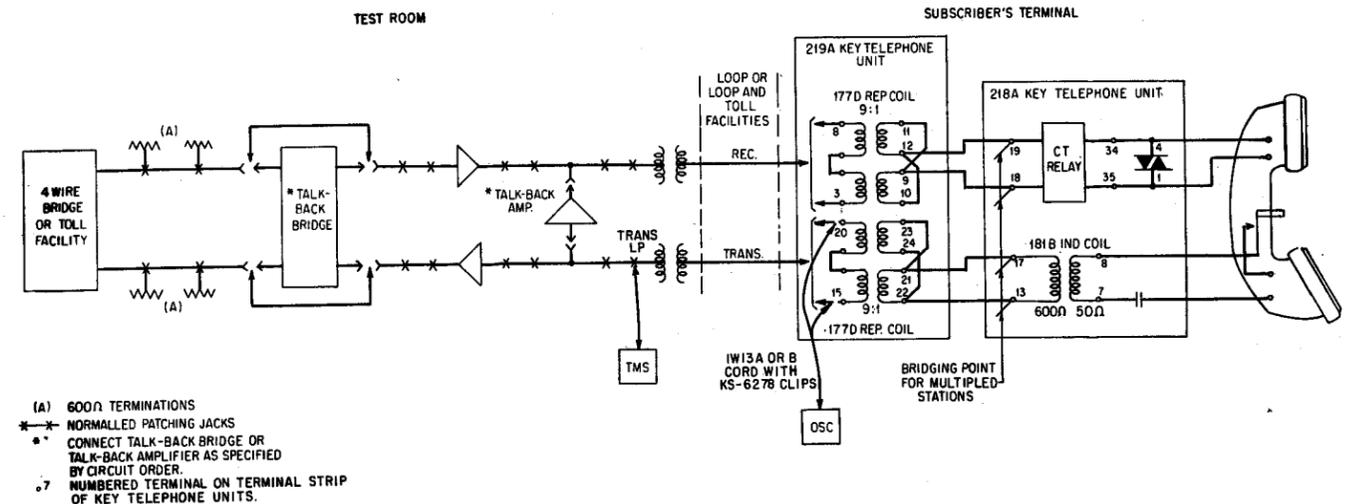


CHART 13
FIG. 16

CHART 14
FIG. 17

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the loss of receiving station equipment at locations that have terminating arrangements per SD-69254-01, Fig. 2. These tests should be made when the over-all test from the STC to a station (Chart 9) does not meet limits and after the facilities from the STC to the station have been found to be satisfactory per Chart 12 tests.

TEST PROCEDURE

STEP

- 1 At the subscriber's terminal, adjust the output of the OSC set for 1000 cycles to -7.0 dbm as read on a 600^w TMS. *Do not substitute any other level* or erroneous readings may result due to varistor action.
- 2 At the subscriber's terminal, disconnect the leads from Terminals 3 and 8 on the back side of the 219A Key Telephone Unit terminal strip.
- 3 At the subscriber's terminal, connect the OSC to Terminals 3 and 8 on the 219A Key Telephone Unit terminal strip.
- 4 At the subscriber's terminal, remove the receiver unit from the handset and connect the TMS to the handset receiver contact springs. Read the power received on the 600^w TMS. Check idle circuit termination for all extension stations by momentarily lifting the handset off and replacing it on the switchhook at each extension station. The meter reading should remain the same during this operation.

Requirements:

No. of Stations	TMS Reading
1	-11.9 dbm
2	-12.7 dbm
3	-13.5 dbm
4	-14.2 dbm
5	-14.8 dbm
6	-15.4 dbm

Limits: Plus or minus 0.5 db.

TEST PROCEDURE NOTES

NOTE

- 1 If requirements are not met, the equipment should be checked for trouble using appropriate drawings applicable to the equipment. One possible cause of trouble would be incorrect strapping of the 177D Repeat Coil. Chart 16 gives the transmission requirements for the coil when strapped for a 9:1 impedance ratio. In some cases a loudspeaker is disabled by the operation of a separate key or by push-to-talk button operation rather than switchhook operation. In this case, the loudspeaker is considered as being an additional receiving station when determining the equipment losses.
- 2 If the station termination is a jack for a plug-ended instrument, connect the TMS to the sleeves of a 289B-type plug. Insert the 289B-type plug in the station jack to make the measurements.
- 3 The required losses as given above will not agree exactly with those shown on the circuit layout card due to connecting a 600-ohm oscillator in place of the cable pair.

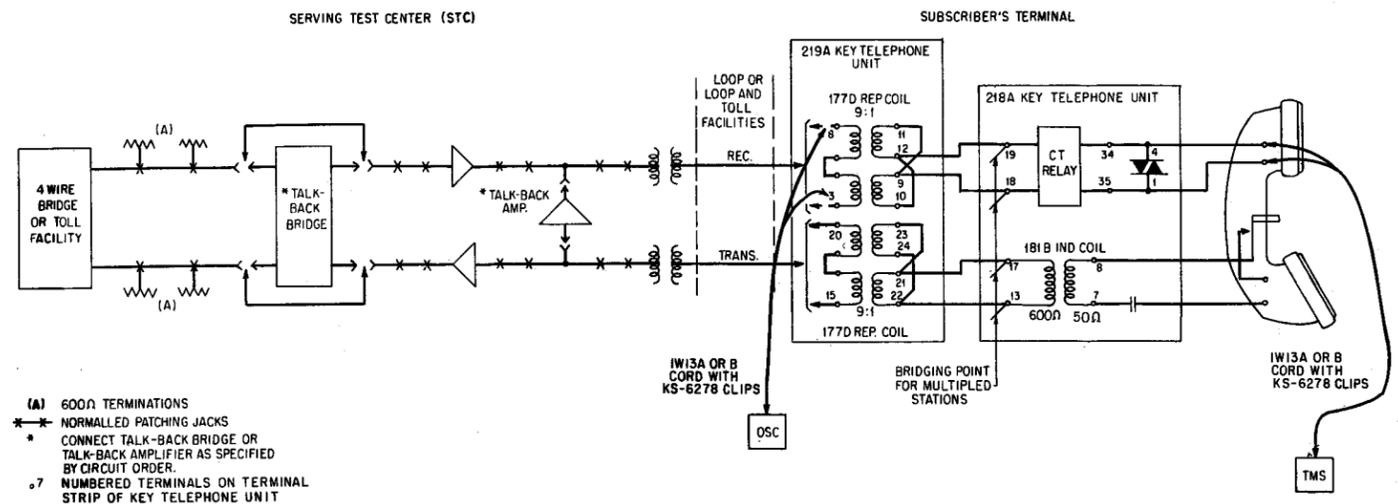


CHART 14
FIG. 17

CHART 15
FIG. 18

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the loss of transmitting station equipment at locations that have terminating arrangements per SD-69254-01, Fig. 2. These tests should be made when the over-all test from a station to its STC (Chart 10) does not meet limits and after the facilities from the station to the STC have been found to be satisfactory per Chart 13 tests.

TEST PROCEDURE

STEP

- 1 At the subscriber's terminal, adjust the output of the OSC set for 1000 cycles to +4.7 dbm as read on a 600^w TMS.
- 2 At the subscriber's terminal, remove the transmitter unit from the handset. Connect the OSC to Terminals 1 and 6 of the 178F or 181B Test Induction Coil (600 ohms), strap Terminals 2 and 5 and connect Terminals 7 and 8 (50 ohms) to the handset transmitter springs.
- 3 At the subscriber's terminal, disconnect the leads from Terminals 15 and 20 on the back side of the 219A Key Telephone Unit terminal strip.
- 4 At the subscriber's terminal, connect the TMS to Terminals 15 and 20 on the 219A Key Telephone Unit terminal strip.
- 5 At the subscriber's terminal, operate the "push-to-talk" button on the handset and read the level on the TMS. Check idle circuit terminations for all extension stations by momentarily lifting the handset off and replacing it on the switchhook at each extension station. The meter reading should remain the same when the "push-to-talk" button is nonoperated and should not change more than 0.5 db when the "push-to-talk" button is operated.

Requirements:

No. of Stations	TMS Reading
1	-2.0 dbm
2	-2.7 dbm
3	-3.2 dbm
4	-3.7 dbm
5	-4.3 dbm
6	-4.8 dbm

Limits: Plus or minus 0.5 db.

TEST PROCEDURE NOTES

NOTE

- 1 If requirements are not met, the equipment should be checked for trouble, using appropriate drawings applicable to the equipment. One possible cause of trouble would be incorrect strapping of the 177D Repeat Coil. Chart 16 gives the transmission requirements for the coil when strapped for a 9:1 impedance ratio.
- 2 If the station termination is a jack for a plug-ended instrument, connect Terminals 7 and 8 of the test induction coil to the tips of a 289B-type plug. Insert the plug in the station jack to make the measurements.

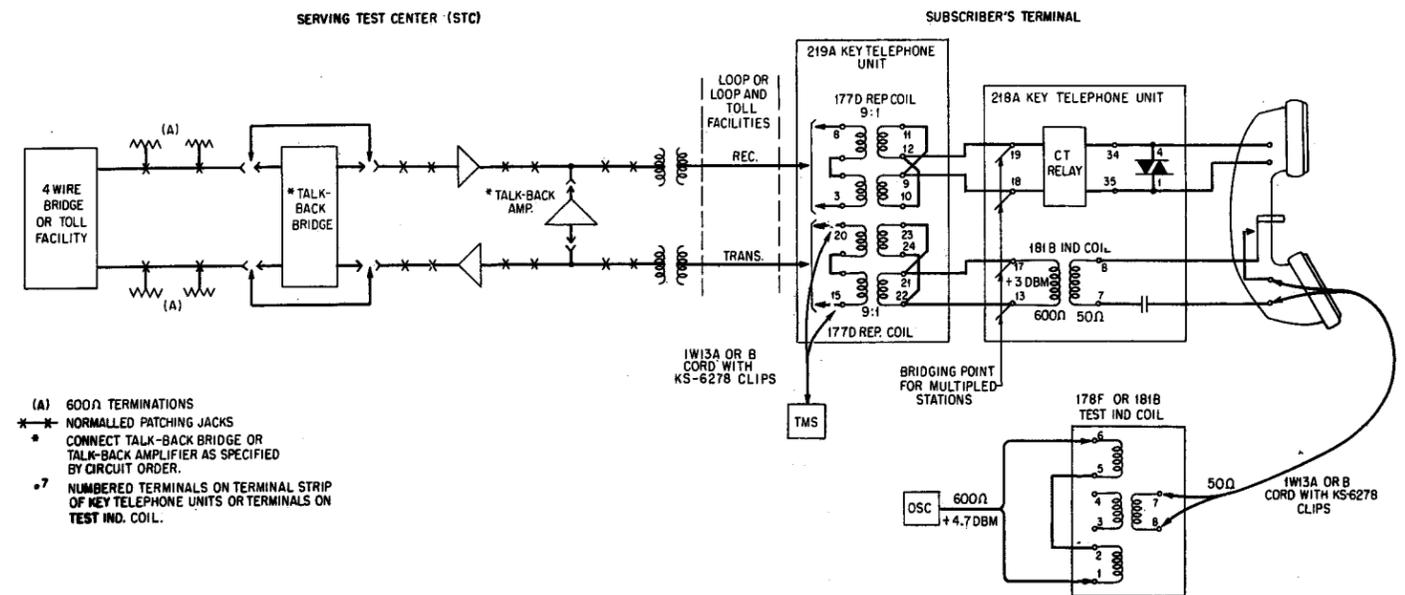


CHART 15
FIG. 18

CHART 16
FIG. 19

PURPOSE OF TEST

This chart and associated figure outline the procedure to follow when checking the loss of the transmitting and receiving 177D-type Repeat Coils that are used at 4-wire private line stations with equipment per SD-69254-01, Fig. 2. It is intended that these tests be made only when investigating troubles. The 177D Repeat Coils are strapped so that they have a 9:1 impedance ratio. These tests will check for correct strapping of the coil and also for the coil loss. The requirements allow for a loss of 4.4 db due to impedance mismatch and for 0.5 db coil loss.

TEST PROCEDURE — TRANSMITTING COIL

STEP

- 1 At the subscriber's terminal, disconnect the leads from Terminals 15 and 20 on the back side of the 219A Key Telephone Unit terminal strip.
- 2 At the subscriber's terminal, adjust the output of the OSC set for 1000 cycles to zero dbm as read on a 600 ω TMS.
- 3 At the subscriber's terminal, connect the TMS to Terminals 15 and 20 on the 219A Key Telephone Unit terminal strip.
- 4 At the subscriber's terminal, disconnect all leads from Terminals 21 and 22 on the back side of the 219A Key Telephone Unit terminal strip except the straps between Terminals 21 and 23 and between Terminals 22 and 24.
- 5 At the subscriber's terminal, connect the OSC to Terminals 21 and 22 on the 219A Key Telephone Unit terminal strip.
- 6 At the subscriber's terminal, read the TMS level.

Requirement: The TMS reading should be -4.9 dbm.

Limits: Plus or minus 0.5 db.

TEST PROCEDURE — RECEIVING COIL

STEP

- 1 At the subscriber's terminal, disconnect the leads from Terminals 3 and 8 on the back side of the 219A Key Telephone Unit terminal strip.
- 2 At the subscriber's terminal, adjust the output of the OSC set for 1000 cycles to zero dbm as read on a 600 ω TMS.
- 3 At the subscriber's terminal, connect the TMS to Terminals 3 and 8 on the 219A Key Telephone Unit terminal strip.
- 4 At the subscriber's terminal, disconnect all leads from Terminals 9 and 12 on the back side of the 219A Key Telephone Unit terminal strip except the straps between Terminals 9 and 11 and between Terminals 10 and 12.
- 5 At the subscriber's terminal, connect the OSC to Terminals 9 and 12 on the 219A Key Telephone Unit terminal strip.
- 6 At the subscriber's terminal, read the TMS level.

Requirement: The TMS reading should be -4.9 dbm.

Limits: Plus or minus 0.5 db.

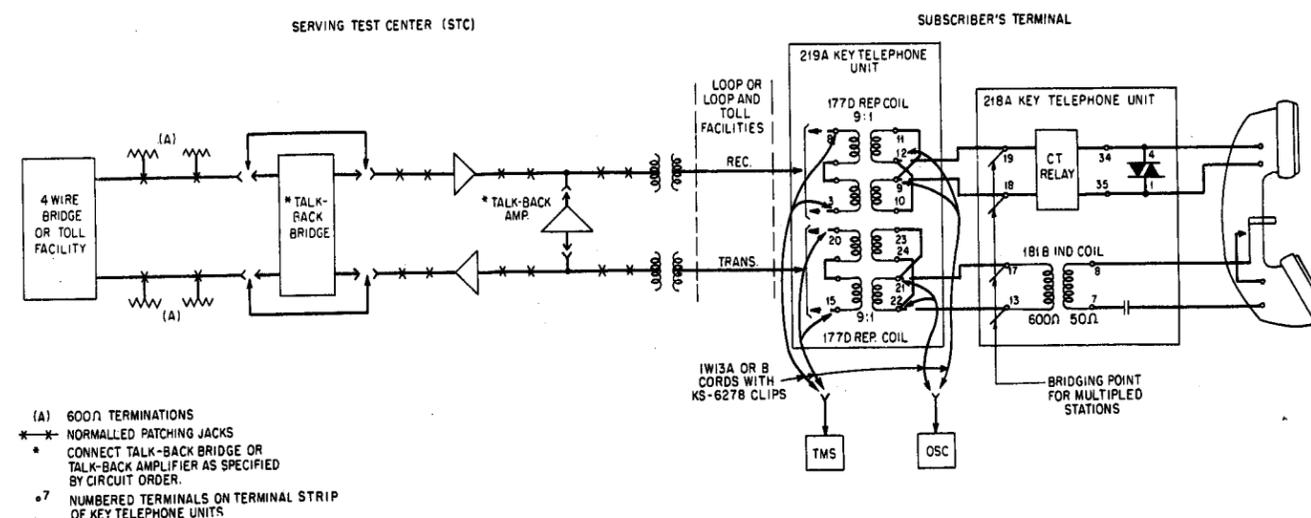


CHART 17
FIG. 20

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the net loss of a 2-wire section from an STC to a served private line station with 2-wire station equipment.

TEST PROCEDURE — RECEIVING DIRECTION

STEP

- 1 At the STC, adjust the OSC for a frequency of 1000 cycles and an output level that is the same as the level shown on the circuit layout card or sketch for the REP IN. Patch the OSC output to the REP IN jack.
- 2 At the subscriber's terminal, disconnect the induction coil of one station from the loop transformer. Care should be taken so that the extension station's induction coil (where provided) remains connected.
- 3 At the subscriber's terminal, connect the TMS to the station side of the loop transformer (repeat coil) and record the level indicated by the TMS. Notify the STC of this reading.

Requirement: The level indicated by the TMS should be the same as the receiving level at the level reference point (line terminals of station induction coil) as shown on the circuit layout card or sketch.

Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db.
- 4 Repeat Steps 1 through 3 using 300- and 3000-cycle test frequencies.

Limits: Should not deviate from 1000-cycle measurement by more than -10 db.

TEST PROCEDURE — TRANSMITTING DIRECTION

STEP

- 5 At the subscriber's terminal, adjust the OSC for a frequency of 1000 cycles and connect its output to the input of the TMS. By referring to the circuit layout card or sketch, determine the transmitting level at the level reference point (line terminals of the station induction coil). Adjust the output of the OSC until the TMS indicates the level just determined. For a handset with an F-type transmitter, the level will usually be 0 dbm.
- 6 Repeat Step 2.
- 7 At the subscriber's terminal, connect the OSC to the station side of the loop transformer.
- 8 At the STC, patch the TMS to the REP OUT jack and read the indicated level.

Requirement: The level indicated by the TMS should be the same as that shown on the circuit layout card or sketch for the REP OUT.

Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db.
- 9 Repeat Steps 5 through 8 using 300- and 3000-cycle test frequencies.

Limits: Should not deviate from 1000-cycle measurement by more than -10 db.

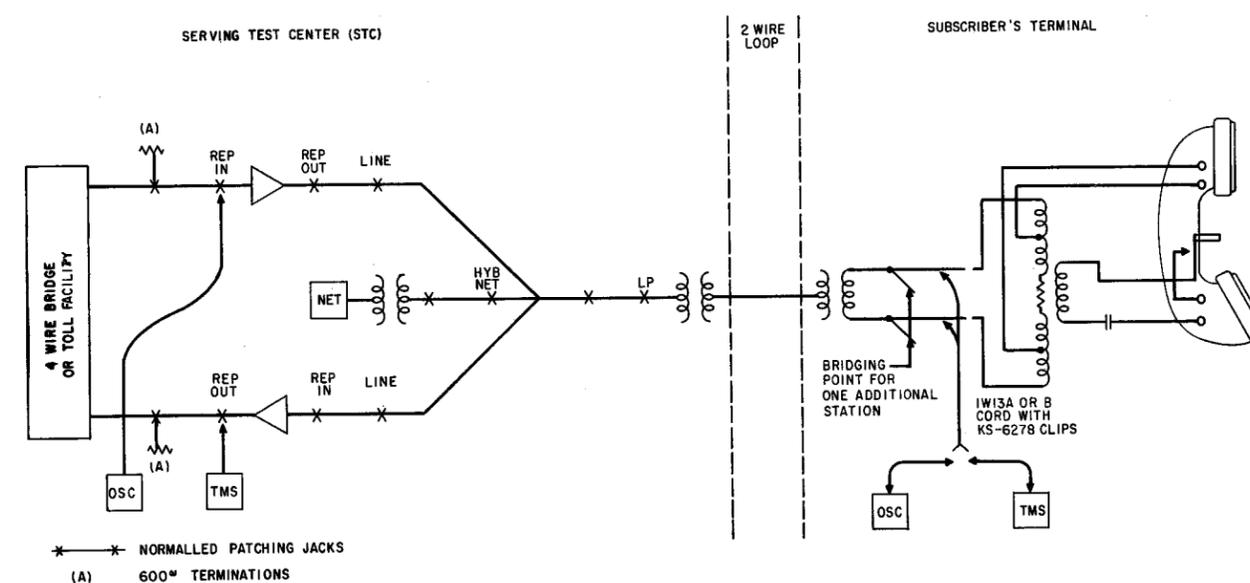


CHART 18
FIG. 21

PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the net loss of a 2-wire section from an STC to a served private line PBX station.

TEST PROCEDURE — RECEIVING DIRECTION

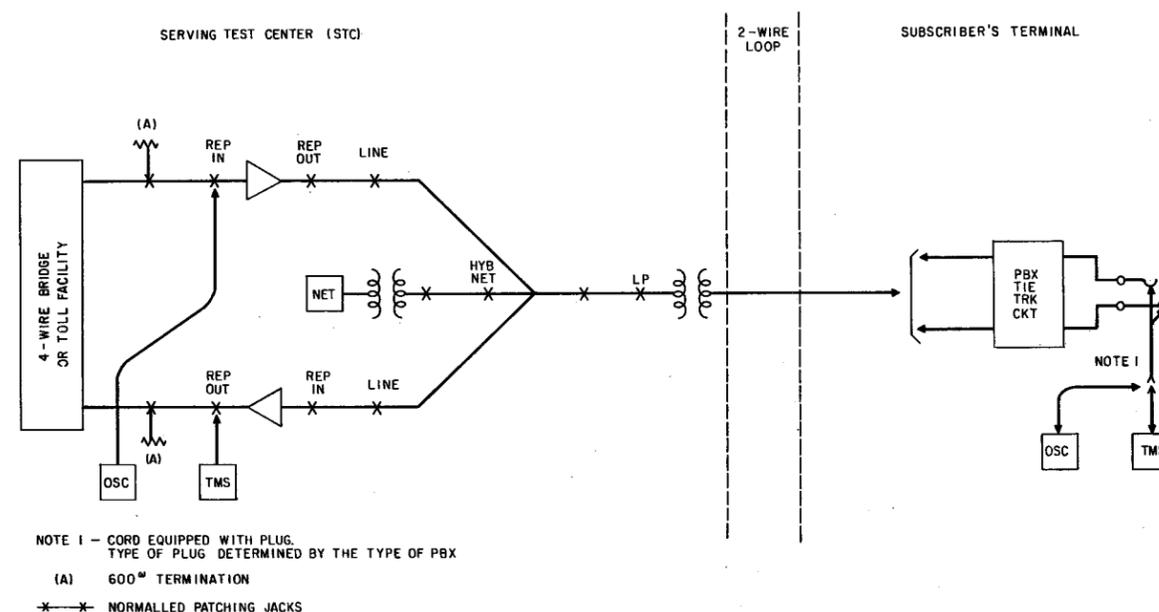
- | STEP | |
|------|--|
| 1 | At the STC, adjust the OSC for a frequency of 1000 cycles and an output level that is the same as the level shown on the circuit layout card or sketch for the REP IN. Patch the OSC output to the REP IN jack. |
| 2 | At the subscriber's terminal, patch the TMS to the PBX jack. |
| 3 | At the subscriber's terminal, read the level indicated by the TMS and pass the reading to the STC.
Requirement: The level read on the TMS should be the same as the level shown on the circuit layout card or sketch for the receiving direction at the PBX jack.
Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db. |
| 4 | Repeat Steps 1 through 3 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db. |

TEST PROCEDURE — TRANSMITTING DIRECTION

- | STEP | |
|------|--|
| 5 | At the subscriber's terminal, adjust the OSC for a frequency of 1000 cycles and connect its output to the input of the TMS. By referring to the circuit layout card or sketch, determine the transmitting level at the PBX jack (usually 0 dbm) and then adjust the output of the OSC until the TMS indicates the same level. |
| 6 | At the subscriber's terminal, patch the OSC to the PBX jack. |
| 7 | At the STC, patch the TMS to the REP OUT jack and read the level indicated by the TMS.
Requirement: The level read on the TMS should be the same as the level shown on the circuit layout card or sketch for the REP OUT.
Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db. |
| 8 | Repeat Steps 5 through 7 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db. |

TEST PROCEDURE NOTES

- | NOTE | |
|------|---|
| 1 | No loop transformer (repeat coil) is normally used since one is usually included as part of the PBX tie trunk circuit. |
| 2 | The loss of the PBX tie trunk circuit can be measured in case the above limits are not met. The expected loss can be determined from the circuit layout card or sketch or by referring to the applicable SD drawing. |
| 3 | If limits are not met, the repeaters should be calibrated and the loss of the 4-wire terminating set checked. Replace the network with a 600 ω termination connected at the HYB NET jack when checking the terminating set loss. |



PURPOSE OF TEST

This chart and associated figure outline the procedure to be followed when measuring the net loss of a 4-wire section from an STC, to a served private line PBX station. This procedure assumes that a 4-wire to 2-wire terminating set per SD-66679-01, Fig. 1 is used at the subscriber's terminal.

TEST PROCEDURE — RECEIVING DIRECTION

STEP

- 1 At the STC, adjust the OSC for a frequency of 1000 cycles and an output level that is the same as the level shown on the circuit layout card or sketch for the REP IN. Patch the OSC output to the REP IN jack.
- 2 At the subscriber's terminal, patch the TMS to the PBX jack.
- 3 At the subscriber's terminal, read the level indicated by the TMS and pass the reading to the STC.
Requirement: The level read on the TMS should be the same as the level shown on the circuit layout card or sketch for the receiving direction at the PBX jack.
Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db.
- 4 Repeat Steps 1 through 3 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db.

TEST PROCEDURE — TRANSMITTING DIRECTION

STEP

- 5 At the subscriber's terminal, adjust the OSC for a frequency of 1000 cycles and connect its output to the input of the TMS. By referring to the circuit layout card or sketch, determine the transmitting level at the PBX jack (usually 0 dbm) and then adjust the output of the OSC until the TMS indicates the same level.
- 6 At the subscriber's terminal, patch the OSC to the PBX jack.
- 7 At the STC, patch the TMS to the REP OUT jack and read the level indicated by the TMS.
Requirement: The level read on the TMS should be the same as the level shown on the circuit layout card or sketch for the REP OUT.
Limits: Loop facilities only — Plus or minus 1.0 db.
Loop and toll facilities — Plus or minus 2.0 db.
- 8 Repeat Steps 5 through 7 using 300- and 3000-cycle test frequencies.
Limits: Should not deviate from 1000-cycle measurement by more than -10 db.

TEST PROCEDURE NOTES

NOTE

- 1 If limits are not met, the following should be checked in the order named until the trouble has been located.
 - (a) Calibrate the repeaters at the central office.
 - (b) Measure the loss of all transmission paths at the central office.
 - (c) Measure the loss of the loops including the loop transformers at both the central office and the station.
 - (d) Measure the loss of the station equipment between the PBX jack and the loop transformers at the station. It will be necessary to disconnect the loop transformer from the terminating set when making these measurements at the station. The transmit and receive A and C pads should be of zero db value when making the measurements.

