

PRIVATE LINE TELEPHONE SERVICE
600/1500-CYCLE SELECTIVE SIGNALING SYSTEM
MAINTENANCE AND TROUBLE LOCATION TESTS
CENTRAL OFFICE

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1. GENERAL

1.01 This section describes the maintenance and trouble location tests on the 600/1500-cycle selective signaling system adapted for use on multistation private line circuits per Drawing SD-69168-01.

1.02 Tests should be made at the customer's convenience and, where possible, during minimum or light load periods on the private line circuit. During performance of tests, keep alert for subscriber's possible need for the circuit. In all cases restore circuit to service as soon as practicable.

2. MAINTENANCE AND TROUBLE LOCATION

2.01 The tests may be divided into three groups:

- (1) In service tests.
- (2) Tests made between the customer location and central office test room.
- (3) Equipment tests.

(A) In Service Tests

2.02 If a subscriber reports that he is unable to signal any station on the circuit, or switch a connection or equipment, he may dial his own code or codes to determine if his station signal circuit operates. This should result in a momentary buzzer operation because the off-hook condition will prevent a locked-in audible signal.

The two-tone signals operate the customer's receiving circuit via a talk-back path in the test room.

2.03 A subscriber's location may be assigned a 4 or 5-digit code. If a 5-digit code is assigned, the operation of the oscillator may be checked by dialing the first digit (2) and noting that 600-cycle or low-frequency tone is heard on the circuit, then by dialing the second digit (1) and noting that the tone changes to 1500-cycle or high-frequency tone. The remainder of the subscriber's code should then be dialed to restore the oscillator control to idle condition. If the code consists of four digits, the function performed by dialing the digit 2 in the 5-digit code is performed by pulling the dial off normal for the first digit (1). In order to allow sufficient time for the operation of the relays involved, it may be necessary to hold the dial momentarily against the finger stop. The remainder of the code is then dialed to release the oscillator control circuit. If a station is in the "off-hook" condition and the dial is moved off normal without completing the dialing of all digits of the code, tone will remain on the circuit unless:

- (1) The telephone is replaced on the hook in the case of a hand set station, and the talk key is operated to monitor. if one is provided.
- (2) The plug of a head telephone set is removed from the telephone set jack and the associated talk key is operated to monitor.
- (3) The line key is restored to normal in case of key equipment.
- (4) The plug is removed from the dial jack in case of P. B. X. equipment.

(B) Test between Customer Location and Central Office Test Room

2.04 One or more test rooms on each private line employing two-tone signaling may have a testing arrangement that can be patched to the circuit for test purposes. In general, the test room

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controlling the private line circuit will have the two-tone testing arrangement. Only that part of the arrangement, shown in Drawing SD-95463-01, dealing with tests on circuits employing two-tone signaling is discussed in this section. The following functions may be performed by using this testing arrangement.

- (1) Talk or monitor on the circuit.
- (2) Signal any subscriber equipped to receive two-tone signals by dialing the proper code.
- (3) Receive two-tone signals from any subscriber equipped with a sending unit by having the subscriber dial a special test code. If the subscriber's equipment is arranged to use a 5-digit code, the test code is 21300. If the equipment is arranged for dialing 4-digit codes, the test is 1300, and should be dialed as described in Paragraph 2.03.
- (4) Measure the 600-cycle or 1500-cycle tone from a subscriber's location.

2.05 The use of this signaling system on 2-wire private line facilities is not contemplated at this time. Accordingly, signaling tests on such facilities are not discussed in this practice.

2.06 Tests on a 4-Wire Circuit: The patching arrangement between the subscriber's loop appearance at the central office test room and the testing arrangement is shown in Chart 1. The latter indicates the methods of making various tests.

(C) Equipment Tests

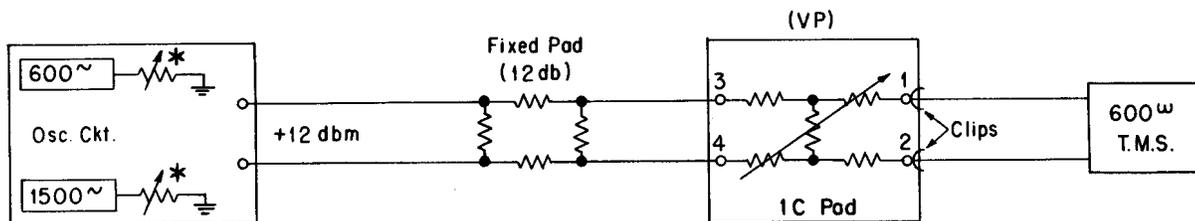
2.07 Portable equipment for local tests may include a volt-ohm-milliammeter such as the Western Electric KS-14510 or equivalent and a 600-ohm transmission measuring set such as the Type 12A or 13A.

2.08 Before local tests are made on other than the sending circuit, the (S) relay of the latter should be blocked non-operated to prevent interference to other stations on the private line.

2.09 The two-tone selective signaling system is designed to operate with station equipment employing 10 pulse-per-second dials. The dial speed should be maintained between 8 and 11 pulses per second. Section 028-300-701 details the methods of testing and adjusting dial speeds.

2.10 Electron Tubes: The filament activity of each tube is checked with a KS-15560 Hickok tube tester or equivalent and shall meet the requirements given in the section covering the test set. The heater currents of the tubes in the oscillator circuit are checked with a milliammeter such as described in Paragraph 2.07, and a suitable cord connected to a 110-type plug. Insert the 110-type plug into the AMP or OSC jack on the oscillator panel and read the heater current. The limits are as follows:

Type of Tube	Limits - Amp.
310A	0.29-0.35
328A	0.375-0.475



* Adjust so T.M.S. reading is same as value of (VP)

Fig. 1 - Test of the Output of the Sending Unit

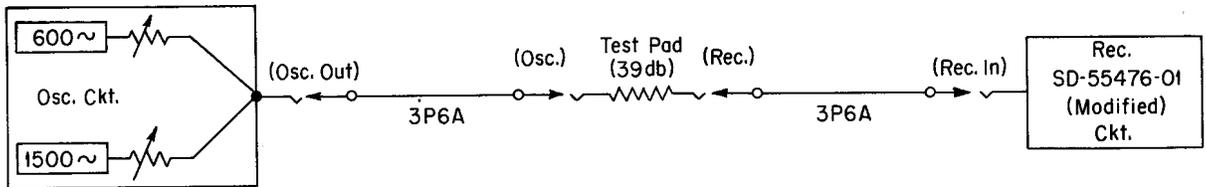


Fig. 2 - Combined Local Test of Sending and Receiving Circuits

2.11 Sending Unit: A check and adjustment of the output of the entire sending unit may be made by setting up the arrangement indicated in Fig. 1. Since the input to the pad (VP) in the sending circuit is designed to be at a 0 dbm level, the oscillator output is adjusted until the reading on the TMS is the same as the value of the pad (VR) which is of the 1C type.

2.12 Oscillator Control Circuit: If trouble is indicated in this circuit, the relays and selector should be checked for proper operation. Table I gives references to sources of maintenance information.

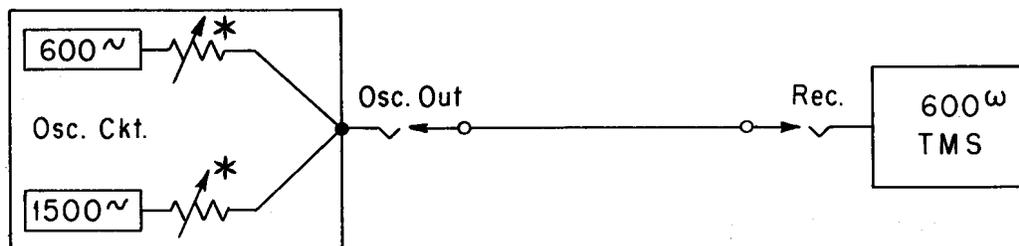
2.13 Oscillator Circuit: If trouble is indicated in this circuit, the following tests will aid in isolating the trouble:

(1) A combined check of correct oscillator output level and receiving circuit sensitivity may be made by use of the 39 db test pad and the two 3P6A patch cords furnished with each installation. Fig. 2 shows the testing arrangement for making this check. When the local station

code is dialed the station signal circuit should operate momentarily. Failure of this test indicates that the oscillator, receiving circuit, or both, require maintenance work.

(2) If the circuit fails to deliver either 600 or 1500-cycle tone, a check of the oscillator may be obtained by means of a head receiver equipped with a clip and pick. With the clip grounded check that 600-cycle tone appears on terminal 3 of the (SW) relay with the latter in the non-operate position. A similar test on terminal 4 of the (SW) relay with the latter operated will check for 1500-cycle output. Failure of these tests indicates trouble in the oscillator which may be due to the electron tube, frequency control capacitor or failure of one of the resistors, capacitors or the inductor of the oscillator circuit.

(3) The operation, including sequence of operation, of the switching relay circuit (relays P, SR, PD1, PD2, PD3 and SW) may be checked by dialing the first digit (2) if a 5-digit code is employed, and observing the relay sequence.



* Adjust to obtain level of $+12\text{ dbm} \pm 0.2\text{ db}$ for each tone dialed.

Fig. 3 - Local Test of Oscillator Circuit Output

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If a 4-digit code is assigned, the first digit (1) is dialed and the dial is held momentarily against the finger stop to allow the relays to operate. CD-64691-01 details the sequence of operation of these relays. If trouble is indicated, the relays should be checked. Table I lists sources of information for maintenance of these relays.

(4) A local check for the correct output of the oscillator circuit may be made per Fig. 3. Failure of this test, assuming results of Tests 1 and 2 are satisfactory, is an indication of trouble in the oscillator amplifier circuit.

(5) An approximate check of the output of the oscillator circuit may be obtained by measurement on the loop at the central office serving the customer. The loop should be released. Since this is not strictly a local test, the (S) relay must not be blocked nonoperated. Fig. 4 shows the testing arrangement during the periods of dialing. If the subscriber's location is equipped to dial 5-digit codes, the digit 2 should be dialed first. This will place 600-cycle tone on the loop. After measuring the level of this tone at the central office, digit 1 should be dialed, which action will change the tone to 1500 cycles. The measurement is repeated at this frequency. If 4-digit codes are employed, it will be necessary to hold the dial against the finger stop when the first digit (1) is dialed. This serves the same purpose as dialing the digit 2. The dial is held against the finger stop long enough to obtain the 600-cycle tone measurement. Releasing the dial allows it to return, which action will change the tone to 1500 cycles which is then measured. These measured values should agree with the 1000-cycle computed value within 3 db. The computed value may be obtained by adding the loss of the (VP) pad in the sending circuit at

the subscriber's location, to the loss of the loop including that of any line transformers as shown on the TCLO cards, but excluding the loss due to station equipment.

(6) A frequency check of the oscillator circuit is made by beating each of the 600 and 1500-cycle frequencies of the two-tone station equipment with an oscillator in a central office. This oscillator should be stable and should be maintained for a high degree of accuracy. The two tones are transmitted as described in the preceding paragraph. The test may be made at the serving central office or at any other central office on the circuit depending upon conditions involving release of the circuit or loop, and the availability of an accurate variable oscillator. The 600-cycle tone should be within ± 4 cycles and the 1500-cycle tone within ± 10 cycles of the central office oscillator. Adjustments are made by varying the frequency control capacitors (LF and HF) in the oscillator circuit.

2.14 Receiving Circuit: Trouble in this circuit may be located by setting up the arrangement shown in Fig. 5 and making the following tests:

(1) The arrangement in Fig. 5 provides an input level of -27 dbm to the receiving circuit for an oscillator output of +12 dbm. Dial digit 1 which will furnish 1500-cycle tone to the receiving circuit. Read the rectified current at the jack designated 1500 and located on the left side of the panel. The (AMP) potentiometer, which is located in approximately the center of the receiving circuit panel between the two tubes, should be adjusted, if necessary, to obtain a reading of at least 4.5 ma. Move the milliammeter to the jack, designated 600 and located above the 1500-cycle jack, to

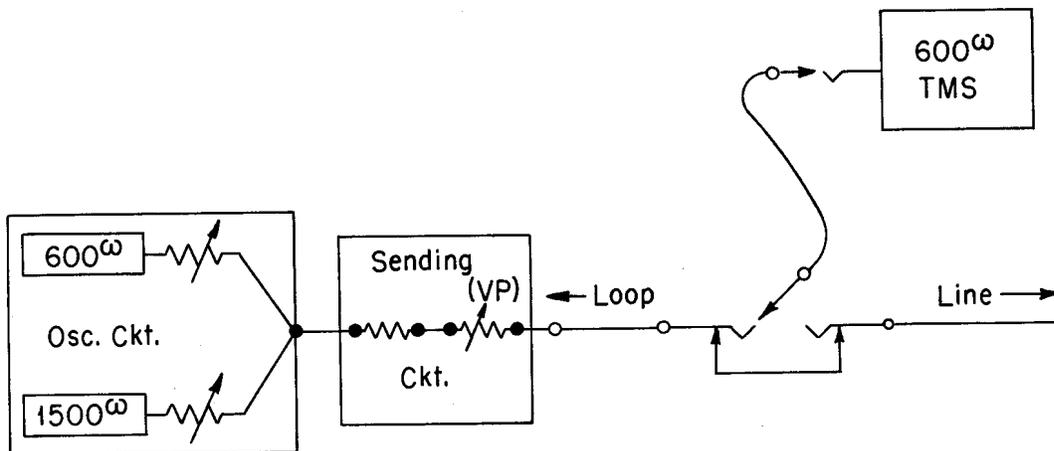


Fig. 4 - Test of Oscillator Circuit Output at Central Office

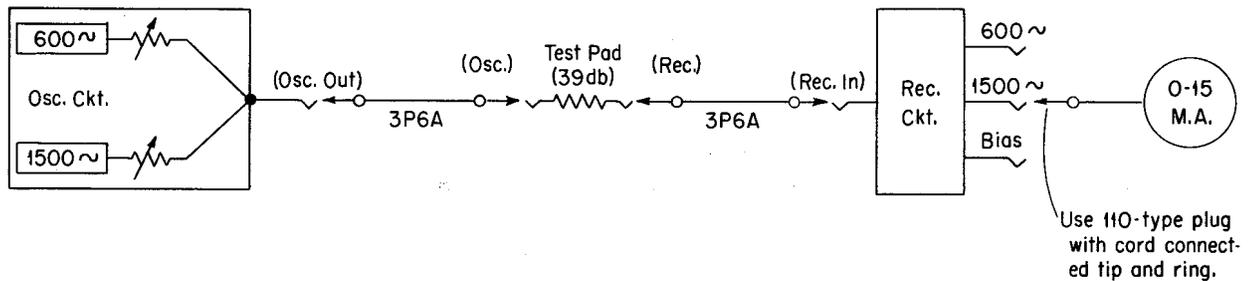


Fig. 5 - Arrangement for Testing Receiving Circuit

obtain the 1500-cycle leakage current. This should not exceed 20 per cent of the 1500-cycle rectified current. Leave the milliammeter plugged in the 600-cycle jack and again dial digit 1 which should change the input frequency to the receiving circuit to 600 cycles. Read the 600-cycle rectified current and adjust the (AMP) potentiometer, if necessary, to obtain a reading of at least 4.5 ma. Move the milliammeter to the 1500-cycle jack and read the 600-cycle leakage current. The latter should not exceed 20 per cent of the rectified current.

(2) The bias current is checked by plugging the milliammeter in the BIAS jack which is located on the left side of the panel below the 600 and 1500 jacks. The bias current should be in the range of 2.0 to 2.5 ma. The rectified current values may vary from a minimum of 4.5 ma to about 12 ma. An operating value of 8 ma is about average. Normally the rectified current should be at least twice the sum of the bias current and the leakage current of the op-

posite frequency. Failure of this test at both frequencies indicates probable trouble in the receiving amplifier circuit. Failure of this test at only one of the two frequencies could be caused by a defect either in the corresponding varistor bridge or in the 92A-type filter.

(3) A further check of the receiving amplifier may be made by repeating Tests 1 and 2 above, substituting a variable attenuator for the 39 db test pad. Set the attenuator initially for 39 db loss, then gradually reduce this loss, noting the reading on the milliammeter. A constant reading of 4.5 ma or better, ± 1 ma should be obtained as the attenuator loss is reduced from 39 db to 12 db.

(4) If trouble is suspected either in a varistor bridge or in the 92A-type filter, another similar part should be substituted.

(5) If trouble is suspected in a 60-type selector it should be replaced.

TABLE I

Multistation Private Lines
600/1500-Cycle Selective Signaling System
Information Relative to Relay Maintenance

<u>Circuit</u>	<u>Relay</u>	<u>Type</u>	<u>B.S.P.</u>	<u>Requirements</u>
Osc. Control	A	U730	040-518-701	SD-69168-012
" "	B	Y281	040-522-701	"
" "	C	U1138	040-518-701	"
" "	Selector	204E	026-708-701	"
Oscillator	P	S518	040-514-701	SD-64691-01
"	SR	Y84	040-522-701	"
"	PD1	S504	040-514-701	"
"	PD2	S66	"	"
"	PD3	S504	"	"
"	SW	239GG	040-228-701	"
		or		
		280AN	040-267-701	"
Sending	S	U	040-518-701	SD-69168-012
Receiving	A	239GY	040-228-701	SD-69168-012
		or		
		280R	040-267-701	"
"	Selector	60	026-700-701	SD-55476-01

CHART 1
600/1500-CYCLE SELECTIVE SIGNALING SYSTEM
MULTISTATION PRIVATE LINE TELEPHONE CIRCUITS

Tests on 4-Wire Loops

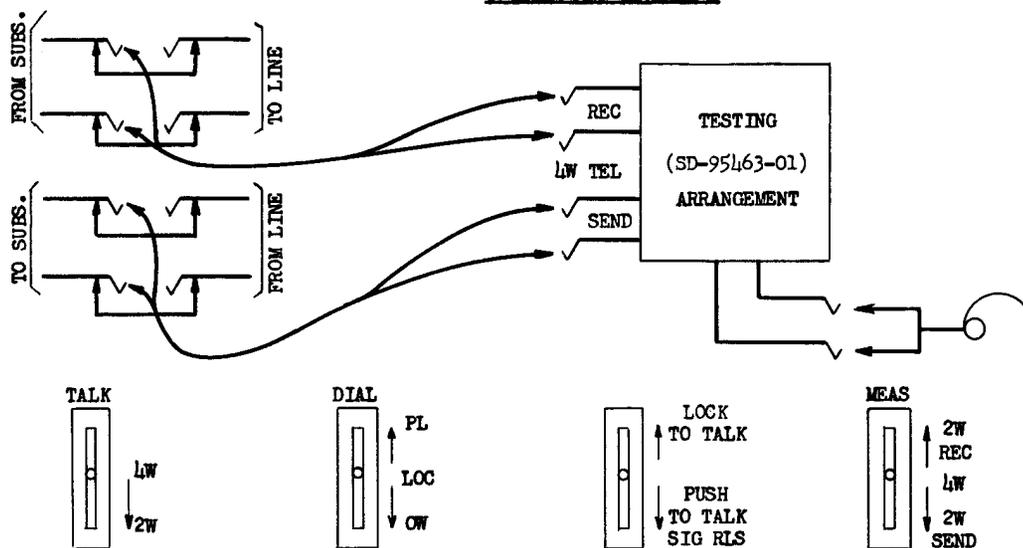


CHART 2-A: MONITORING TESTS

STEP	PROCEDURE	REMARKS
1	All keys in normal position	Monitor conversations on circuit.

CHART 2-B: TALKING TESTS

STEP	PROCEDURE	REMARKS
1	Operate LOCK TO TALK key, or push-to-talk key on hand set	Operator's telephone set or hand set connected to circuit for talking.

CHART 2-C: SIGNALING SUBSCRIBER'S LOCATION

STEP	PROCEDURE	REMARKS
1	Operate DIAL key to PL	Dial subscriber's code. Restore DIAL key immediately after code is dialed.

CHART 2-D: RECEIVING 2-TONE SIGNALS FROM SUBSCRIBER'S LOCATION

STEP	PROCEDURE	REMARKS
1	All keys in normal position	Upon receipt of signal from subscriber's location, the SIG lamp will light and the buzzer operates. Operate SIG RLS key to clear the lamp and buzzer signals.

CHART 2-E: TO MEASURE 600-CYCLE AND 1500-CYCLE TONES

STEP	PROCEDURE	REMARKS
1	Operate MEAS key to LW	Operate scale keys as necessary to obtain reading on hOB set. See Paragraph 2.13(5) for requirement.
2	Operate REC key	