

**COMMAND POST ALERTING NETWORK (COPAN)  
JOINT CHIEFS OF STAFF ALERTING NETWORK (JCSAN)  
TESTING AND MAINTENANCE OF MAIN STATION**

<b>CONTENTS</b>	<b>PAGE</b>	<b>CONTENTS</b>	<b>PAGE</b>
1. GENERAL . . . . .	1	A. General . . . . .	7
2. FUNCTIONS . . . . .	2	B. Local Sensitivity . . . . .	8
3. TESTING EQUIPMENT . . . . .	2	C. Operating Sensitivity . . . . .	9
4. TESTING VOLTAGES . . . . .	2	D. Frequency Characteristics . . . . .	9
5. REQUIREMENTS . . . . .	2	E. Maximum Sensitivity . . . . .	9
6. OPERATION . . . . .	3	13. VOLCAS—MEASUREMENT OF MASTER RELAY CURRENTS . . . . .	10
7. PREPARATION . . . . .	3	14. VOLCAS—INSERTION LOSS . . . . .	10
8. METHOD . . . . .	3	15. MAINTENANCE AND TESTING REFERENCES . . . . .	11
A. Single-Link Connection to Terminal Switch Point . . . . .	3		
B. Double-Link Connection to Terminal Switch Point . . . . .	4		
9. VOLCAS UNITS . . . . .	5	1. GENERAL	
A. General . . . . .	5	1.01 This section provides information for testing and maintaining the main station equipment consisting of the SC2 selective control system and the associated switching equipment.	
B. Testing Precautions . . . . .	5	1.02 This section is reissued to generally revise the section as needed.	
10. VOLCAS—RELAY ADJUSTMENTS . . . . .	6	1.03 The following abbreviations will apply to this section:	
11. VOLCAS—VACUUM TUBE TESTS . . . . .	6	MCP—Main Command Post	
A. Heater Current . . . . .	6	RCP—Remote Command Post	
B. Cathode Activity . . . . .	6	DO—Duty Officer	
C. Detector Plate Current—Idle Condition . . . . .	7	SC2—SC2 Selective Control System	
D. Maximum Detector Plate Current . . . . .	7		
12. VOLCAS—SENSITIVITY MEASUREMENTS . . . . .	7		

## SECTION 310-504-500

### 2. FUNCTIONS

2.01 This system provides for:

- (a) Transmission of coded signals to pre-empt PBX terminated private line circuits for the establishment of an alerting network
- (b) Receiving pulse replies from the terminal and intermediate switch point to orders or inquiries.
- (c) Receiving CUG codes and signaling the MCP when a reverse pre-emption call is initiated by the RCP duty officer.
- (d) Receiving CUG codes and signaling the MCP when a RCP duty officer hangs up during an alert call
- (e) Proper supervision to the MCP console and PBX during switching operations.

### 3. TESTING EQUIPMENT

3.01 The following testing equipment is required:

Assorted length test clips

Blocking and insulating tools per Section 069-020-801

A Brush Pen Recorder or equivalent

J94021A (21A) Transmission Measuring Set or equivalent

J64035A (35A or 35B) Transmission Measuring Set or equivalent

J64001R, 1R Tube Test Set

J64730B, L1, 2B Signaling Test Set

J68602AH Portable AC Voltage Test Set

Weston Model 281 Portable Milliammeter or equivalent

165C Dummy Plug

Two 328D (600-ohm) Plugs

M4T Cord equipped with 306A and 307A plugs

J68605M (5M) Portable Test Set, L1 or L3

Echo Suppressor Test Set

Oscilloscope

The following cords:

1—W2W cord

2—P3E cords

1—W2C cord

1—P2J cord

1—2W26A cord.

### 4. TESTING VOLTAGES

4.01 All operation and timing tests are to be made with test voltage within the following limits:

	MINIMUM	MAXIMUM
Signaling Battery	-45V	-50V

### 5. REQUIREMENTS

5.01 Operation tests must be made on all functions of the main station and associated switching equipment which applies to the Command Post Alerting Network. These tests determine if each function is performed in a manner specified in the circuit description.

5.02 The SC2 SENDER at the main station shall be tested to ensure that all cross-connections for assigned codes are correct so that the main station generates codes specifically assigned to a switch point.

**5.03** Standard equipment units used on this circuit shall be tested and maintained in accordance with standard sections as follows:

- (a) Ringer-Oscillator units per associated sections in 501-division. (C&P Co. uses a transistorized 1000/20-Hz ringer in some instances.)
- (b) Single Frequency units per Section 179-316-501 or 179-316-502 dependent on the test set provided. The transmitting portion of the single frequency signaling unit is not used and need not be tested. During tests the blocking tools in the HL relay must be removed. All tests covered in the section can be made except Test G. In place of this test, the electrical and mechanical requirements of the RG relay should be checked.

Modifications should be made on these units per SD-1G125-01, Notes 105, 106, and 107.

*Note:* At the RCP equipment, the modification to the E2B or E3B is in SD-1G133-0102, Notes 106, 107, 111, and 112.

- (c) The Voice Operated Loss Control and Suppressor (VOLCAS) units shall be tested and maintained in accordance with Parts 10 through 15 of this section.
- (d) Echo suppressors will be tested in accordance with Section 332-410-500.

**6. OPERATION**

**6.01** A Brush Pen Recorder *or equivalent* should be connected to the M lead of the keyer circuit, SD-1G124-01, Fig. 3, in accordance with the Manufacturer Specification in order to observe the codes transmitted.

*Note:* An SC-2 Register (high-level monitor) is available at the MCP to monitor the codes in the C&P Co. frame room. It can be associated with individual COPAN or JCSAN circuits as required. A Brush Recorder with amplifier is used in a low-impedance monitor jack in the Pentagon 3 Test Room for the same purpose.

**6.02** There are two types of connections that are involved in signaling a terminal switch point. One test is for a single-link connection to the terminal switch point (Test A) and the other is for a double-link connection to a terminal switch point (Test B). Two extra codes are needed when alerting a double-link terminal switch point to switch at the intermediate switch point.

**7. PREPARATION**

**7.01** For these tests, a release for only the alerting operation is necessary. The private line telephone circuit usage between PBXs may stay in service if the following procedure is used.

STEP	ACTION	VERIFICATION
------	--------	--------------

**TESTS A AND B**

- |   |  |  |
|---|--|--|
| 1 | On J1G012CC unit under test—<br>Block the SW and the SIG relays nonoperated. |  |
| 2 | On J1G012CA unit—<br>Block the W relay nonoperated.                          |  |

**8. METHOD**

**A. Single-Link Connection to Terminal Switch Point**

- |   |  |  |
|---|--|--|
| 3 | On J1G012CB unit under test—<br>Manually operate the CALL relay. | SW1 relay operated.<br>On associated console—<br>SEL lamp lights.<br>On J1G012CA unit—<br>Associated C relay operated. |
|---|--|--|

**SECTION 310-504-500**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
4	On J1G012CA unit— Transmit the call code by manually operating the RC relay.	On J1G007EK unit associated with the code transmitted— INQ relay operated for approximately 2 seconds. On associated console— Lamp associated with the MAS OPR key lights when the main station is operating. Observe the code transmitted on the Brush Pen Recorder <i>or equivalent</i> (6.01).
5	On J1G012CB unit under test— Manually operate the SW2 relay.	On associated console— SEL lamp extinguished and SW lamp lights. On J1G012CA unit— C relay (operated in Step 3) released and a new C relay operated.
6	On the J1G012CA unit— Transmit the off-hook inquiry code by manually operating the RC relay.	Same as verification in Step 4.
7	On J1G012CB unit under test— Manually operate the ANS relay.	On associated console— Off-hook lamp lights. On J1G012CA unit— C relay (operated in Step 5) released.
8	On J1G012CB unit under test— Manually release the CALL relay.	On J1G012CA unit— The associated C relay operated.
9	On J1G012CA unit— Transmit the disconnect code by manually operating the RC relay.	Same as verification in Step 4.
10	On J1G012CB unit under test— Manually release the SW2 relay.  <i>Note:</i> Before transmitting a new code, it should be determined that all circuits are idle.	SW1 and ANS relays released. C relay (operated in Step 8) released. On associated console— SW and off-hook lamps extinguished.
11	After completion of the tests— Remove the Brush Pen Recorder <i>or equivalent</i> . On J1G012CC unit— Remove blocking tools from SW and SIG relays. On J1G012CA unit— Remove blocking tool from the W relay.	

**B. Double-Link Connection to Terminal Switch Point**

3	On J1G012CB unit under test— Manually operate the CALL relay.	At associated console— The associated SEL lamp lights. On J1G012CA unit— Associated C relay operates.
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STEP	ACTION	VERIFICATION
4	On J1G012CA unit— Transmit the call switch code by manually operating the RC relay.	Same as verification in Step 4 of Test A.
5	On J1G012CB unit under test— Manually operate SW1 relay.	Same as verification in Step 5 of Test A.
6	On J1G012CA unit— Transmit the call codes by manually operating the RC relay.	Same as verification in Step 4 of Test A. On J1G012CB unit under test— ANS relay released. At terminal switch point— The associated off-hook and SW lamps extinguished. On J1G012CA unit— C relay (operated in Step 3) released, and a new C relay operated.
7	On J1G012CA unit— Transmit the disconnect code by manually operating the RC relay.	Same as verification in Step 4.
8	On J1G012CB unit under test— Manually release the SW1 relay.  <i>Note:</i> Before transmitting a new code, it should be determined that all circuits are idle.	On J1G012CA unit— C relay (operated in Step 6) released. At associated console— All SW lamps extinguished.
9	After completion of the tests— Remove the Brush Pen Recorder <i>or equivalent</i> . On J1G012CC unit— Remove blocking tools from SW and SIG relays. On J1G012CA unit— Remove blocking tool from W relay.	

## 9. VOLCAS UNITS

to terminate 2-wire circuits, mobiles, and other noisy or potentially troublesome circuits.

### A. General

**9.01** The following paragraphs covering the VOLCAS will apply at the Main Command Post, the Terminal Switch Points, and also at the Remote Command Posts.

*Note:* VOLCAS units at RCPs are not associated with the backbone (COPAN or JCSAN) circuits, but are on the "line" side of the console, ICW 2-wire and PBX circuits and mobiles. VOLCAS units at MCP are not associated with individual circuits, but with the so-called "Dirty" Bridges which are used

### B. Testing Precautions

**9.02** All tests on the VOLCAS are to be made with the *circuit* removed from service. Release must be obtained from the Network Control Office.

**9.03** Sensitivity measurements require the use of a multifrequency oscillator since the frequency of maximum sensitivity for the VOLCAS is near 1200 Hz rather than 1000 Hz.

## SECTION 310-504-500

**9.04** In all procedures, the test on the E to W (PA AMP) (line) side is given first, followed by the test on the W to E (PB AMP) (drop) side.

**9.05** In order to obtain a visual indication of VOLCAS operation, a 165C dummy plug is inserted into the VOLCAS TR jack. Similarly, in order to measure detector plate current, a 165C plug is inserted into either the E TST or the W TST jack.

### 10. VOLCAS—RELAY ADJUSTMENTS

**10.01** The 209FA relay adjustments are covered in sections of the central office practices. Relays requiring adjustment should be taken to the nearest office having a 111A or equivalent relay test bench. After adjustment, care should be taken to avoid jarring the relay.

**10.02** A 116C1 relay test panel is included with some COPAN installations for testing 209-type relays. Section 100-343-101 covers the use of this test panel. Follow the tests shown for the 209FG relay. Other sections covering the 209-type relay are listed in 15.01 of this section.

### 11. VOLCAS—VACUUM TUBE TESTS

#### A. Heater Current

**11.01** The current through the vacuum tube heaters may be measured at the FIL jack on the VOLCAS panel, using a portable meter set, without removing the VOLCAS from service.

**11.02** *Apparatus:* A portable meter set consisting of a Weston Model 1 Ammeter, 0-1.8 ampere range, and either a 2W26A or 2W27A (MD) 2-conductor testing cord and plug assembly (or equivalent) is needed. The 1R tube set, for example, is a satisfactory substitute apparatus. Its use is described in Section 103-427-100.

**11.03** *Requirements for Heater Current—Circuit Order and Maintenance Tests:* The heater current should be between 0.580 and 0.700 ampere.

**11.04** The initial adjustment of heater current in a regulated battery office is made with 113A resistances (31.2 ohms  $\pm 1$  percent) substituted for the 310A vacuum tubes. Adjustments in heater current are made by strapping resistances X, Y,

and Z, which are in series with the heaters and filament battery and are mounted on the VOLCAS panel. Any deviation of the battery voltage from its mean value at the time of measurement is considered when making this adjustment as outlined in 11.05 and on Drawing SD-64366-011, not attached. Thereafter, the effect of tube replacements on heater circuit resistance is not expected to be great enough to move the heater current outside of limits and to require restrapping of X, Y, and Z.

#### 11.05 *Requirements for Heater Current—Initial*

*Tests:* When four 113A resistances are substituted for the four 310A vacuum tubes, heater circuit resistances X, Y, and Z should be strapped to obtain  $0.640 + 0.006$  ampere, subject to the following corrections:

Deviation From Mean Voltage Of Fil. Bat.	Correction In Amperes
0.1	.003
0.2	.006
0.3	.009
0.4	.012
0.5	.015

In this table, the correction is added to 0.640 ampere when the filament battery voltage is above the mean value and is subtracted from 0.640 ampere when the voltage is below the mean value.

#### B. Cathode Activity

**11.06** Cathode activity of the amplifier tubes (1) and (2) may be measured with the 1R tube test set, as described in Section 103-427-100. In order to measure the cathode activity of the detector tubes ED and WD, they must be substituted for the amplifier tubes. An M4T cord equipped with 306A and 307A plugs should be used for connecting the test set to the FIL ACT TST jack on the VOLCAS panel. The cord and plug for connecting the test set to the VOLCAS FIL jack are permanently attached to the test set.

**11.07** *Requirements for Cathode Activity—Measured in 1R Tube Test Set:* The

percentage activity should not exceed 15 percent when the heater current is reduced 0.040 ampere from the existing value. This limit applies to the amplifier tubes or to the detector tubes when tested as amplifiers in the amplifier tube socket.

### C. Detector Plate Current—Idle Condition

**11.08** Vacuum tubes which have been tested and found suitable for use as amplifiers occasionally may be unsatisfactory as detectors. A test for plate current in the idle (no input) condition furnishes an additional check on the ability of the tube to function satisfactorily as a detector. For this test, the VOLCAS is assumed to be in working condition. The sensitivity setting is inconsequential.

#### 11.09 Procedure—With Portable Milliammeter

- (a) Terminate the VOLCAS inputs by inserting the 600-ohm plugs into the DROP VLC IN and LINE VLC IN jacks.
- (b) Transfer the east-to-west detector plate circuit to the PLT C jack by inserting a 165C plug into the E TEST jacks.
- (c) Connect the testing cord tips to the 0-5 mA scale of the milliammeter and insert the plug into the PLT C jack.
- (d) Read the milliammeter, being careful to observe that any deflection is in the positive direction.
- (e) To check the west-to-east detector, move the 165C plug from the E TST to the W TST jack and repeat Item (d).

**11.10 Requirements for Detector Plate Current—Idle Condition:** The detector plate current shall be less than 0.1 mA.

### D. Maximum Detector Plate Current

**11.11** Another check on the ability of a particular 310A tube to function satisfactorily as a detector is obtained by measuring its maximum plate current. This test involves measurements of sensitivity using the methods of 12.05.

#### 11.12 Procedure—With Portable Milliammeter

- (a) Transfer the east-to-west detector plate circuit to the PLT C jack by inserting a 165C plug into the E TST jack.
- (b) Connect the testing cord tips to the 0-50 mA scale of the milliammeter and insert the plug into the PLT C jack.
- (c) Terminate the DROP VLC IN jacks with the 217D plug.
- (d) With the 602A input transformer E INT on tap 6, measure the sensitivity of the bare VOLCAS, east-to-west. (The feedback capacitor EB need not be changed from its working connection.)
- (e) Increase the sending power at the VOLCAS input as follows: (Sending power) = +50 dBm - (Sensitivity), where the sending power is in dBm and the sensitivity is as measured in Item (d). The sensitivity is regarded as a positive quantity. For example, if the measured sensitivity = 60 dB, the sending power = +50 dBm - 60 dB = -10 dBm.
- (f) Note the detector plate current on the portable milliammeter while sending as described in Item (e).
- (g) To measure the maximum detector plate current west-to-east, interchange the VOLCAS input connections and move the 165C plug from the E TST to the W TST jack. Repeat Items (d), (e), and (f) for the west-to-east side.
- (h) Remove all patch cords and plugs.

**11.13 Requirements for Maximum Detector Plate Current:** With the interstage transformer secondary connection on tap 6, the maximum plate current shall not be less than 9 mA and the difference between the E-W and W-E maximum plate currents shall be less than 2 mA.

## 12. VOLCAS—SENSITIVITY MEASUREMENTS

### A. General

**12.01** This test is one of the checks on the overall operation of the VOLCAS. Since the relationship between the response of the VOLCAS to single frequencies and its response to voice frequencies is well understood, single-frequency

**SECTION 310-504-500**

sensitivity measurements can be used to determine that the VOLCAS will be adequately sensitive to the lowest speech amplitudes for which operation is desired.

**12.02** There are two local sensitivities of interest.

With the high impedance VOLCAS input connected across a 600-ohm circuit, the sensitivity is determined as the amount of power at the VOLCAS input above or below 1 milliwatt, which will just operate the VOLCAS relays. This amount of power when less than 1 milliwatt is arbitrarily regarded as a *positive* sensitivity value. The other local sensitivity of interest, termed the operating sensitivity, is determined as the amount of power from a 600-ohm source, at the input of the VOLCAS-equipped repeater, which will just operate the VOLCAS relays. As in the case of the VOLCAS alone, this just-operate power is referenced to 1 milliwatt.

**12.03** The input power required to produce 1.5 milliamperes of detector plate current is sometimes specified for sensitivity measurements rather than the just-operate input power. While the difference between these methods is small, the just-operate value is specified in this series of sections since it is of prime interest insofar as the proper operation and maintenance of the overall system is concerned.

**12.04** The sensitivity measurements require a multifrequency oscillator covering the frequency range from 500 to 2000 Hz, a 5A attenuator or equivalent for attenuating the oscillator output in small steps from 0 dBm to -70 dBm, and a means for determining the attenuated output.

**B. Local Sensitivity**

**12.05 Procedure—Bare VOLCAS**

- (a) Locate the 5A attenuator where the operation of the VOLCAS OPR lamp will be visible to the attendant.
- (b) Set the oscillator frequency to 1200 Hz and adjust the sending power to 0 dBm.
- (c) Connect the 2W15A testing cords to the 5A attenuator. With the testing cords, patch the attenuator between the oscillator and the line VOLCAS INP jacks. Terminate the DROP VLC IN jacks with a 328D plug.

(d) Insert a 165C dummy plug in the VOLCAS TR jack, enabling the OPR lamp to light whenever either side of the VOLCAS operates.

(e) With the attenuator on 0 dB, the OPR lamp will light. Increase the attenuator loss until the OPR lamp extinguishes; then decrease the loss slowly, in 0.5-dB steps, until the OPR lamp lights.

(f) The final setting of the attenuator obtained in Item (e) is a measure of the just-operate VOLCAS sensitivity, assuming that the sending power has not changed.

(g) In order to measure the sensitivity of the west-to-east (drop side), shift the patch cord plug from the LINE VLC IN jacks to the DROP VLC IN jacks. At the same time, move the 328D plugs from the DROP VLC IN jacks to the LINE VLC IN jacks. Repeat Items (e) and (f).

(h) Remove all patch cords and plugs.

**12.06 Requirements for 1200-Hz Local Sensitivity—Initial Tests:** Before a VOLCAS is first placed in service and whenever it is desired to make a check test, the 1200-Hz sensitivity of the bare VOLCAS shall be within limits of 59.0 and 66.5 dB. For the maximum sensitivity adjustment, the B capacitor is connected to ground and INT transformer on tap 6. For other sensitivity adjustments, the VOLCAS shall meet the requirements of Table A and Table B.

**TABLE A**

EFFECT OF CHANGING FEEDBACK ADJUSTMENT FROM MAXIMUM SENSITIVITY SETTING		
FEEDBACK OR B CAPACITOR CONNECTION	602A INPUT OR INT TRANSFORMER CONNECTION	REQUIRED SENSITIVITY REDUCTION — dB
Between E and F <sup>(a)</sup>	Fixed — any tap	2.0 ± 0.8
Between F and G	Fixed — any tap	4.0 ± 1.0
Between G and H	Fixed — any tap	6.1 ± 1.2
Off	Fixed — any tap	10.0 ± 3.0
<sup>(a)</sup> See Section 332-432-100, Paragraph 4.06 for information on capacitors E, F, G and H.		



TABLE B

EFFECT OF CHANGING INTERSTAGE TRANSFORMER CONNECTION FROM MAXIMUM SENSITIVITY SETTING		
FEEDBACK OR B CAPACITOR CONNECTION	602A INPUT OR INT TRANSFORMER CONNECTION	REQUIRED SENSITIVITY REDUCTION — dB
Fixed	Tap 5	$5.7 \pm 1.2$
Fixed	Tap 4	$11.7 \pm 1.5$

### C. Operating Sensitivity

**12.07 Procedure—Operating Sensitivity:** In order that requirements for PA and PB VOLCAS units will be the same during test, insert an 89A resistor (0 dB) in the PA pad socket instead of the one originally specified.

- Locate the 5A attenuator where the operation of the VOLCAS OPR lamp will be visible to the tester.
- Set the oscillator frequency to 1200 Hz and adjust the sending power to 0 dBm.
- Connect the 2W15A testing cords to the 1A attenuator. With the testing cords, patch the attenuator between the oscillator and the PA IN jack of the VOLCAS repeater. Terminate the PA OUT jack and PB OUT jack with 328D plugs.

**Note:** Observe that there are no plugs in the VLC IN jacks.

- Insert a 165C dummy plug into the VOLCAS TR jack, thereby operating the transfer relay and enabling the OPR lamp to light whenever either side of the VOLCAS operates.
- With the attenuator on 0 dB, the OPR lamp will light. Increase the attenuator loss until the OPR lamp extinguishes; then decrease the loss slowly, in 0.5-dB steps, until the OPR lamp lights.
- The final setting of the attenuator obtained in Item (e) is a measure of the just-operate operating sensitivity, assuming that the sending power has not changed.

(g) In order to measure the PB VOLCAS repeater sensitivity, shift the patch cord plug from PA IN to PB IN. Repeat Items (e) and (f).

(h) Remove all patch cords and plugs.

**12.08** All VOLCAS units should be adjusted for an operating sensitivity falling between 40 and 45 dB in each direction of transmission. If these limits cannot be met with the black lead on lug 4 of the internal transformer and the red-white lead disconnected from the E, F, G, or H resistors, replace the 5 megohm "U" resistor between lugs 5 and 6 of the input transformer with a one megohm resistor. After replacing the "U" resistor, the red-white lead may be reconnected between resistors E, F, G, and H, if necessary, to bring the sensitivity within the 40- to 45-dB limit.

### D. Frequency Characteristics

**12.09** Measurement of the VOLCAS sensitivity at frequencies other than 1200 Hz may conveniently be made following a measurement at 1200 Hz. The method given in 12.05 should be used substituting the desired frequency for 1200 Hz. Measurements on the bare VOLCAS at 500, 1200, and 2000 Hz ordinarily are considered sufficient for determining the state of this characteristic.

**12.10 Requirements for Sensitivity-Frequency Characteristic—All Tests:** The requirements at 500 and 2000 Hz, relative to 1200 Hz, are given in Table C for a bare VOLCAS with the maximum sensitivity adjustment.

TABLE C

SENSITIVITY-FREQUENCY CHARACTERISTICS BARE VOLCAS WITH MAXIMUM SENSITIVITY ADJUSTMENT	
FREQUENCY IN HZ	REQUIRED SENSITIVITY REDUCTION — dB
500	$15.0 \pm 4.5$
1200	—
2000	$9.5 \pm 2.0$

### E. Maximum Sensitivity

**12.11** In addition to sensitivity measurements at specified frequencies, the tuning of the

## SECTION 310-504-500

VOLCAS in the region of 1200 Hz may be explored when the sensitivity measuring arrangements include a heterodyne-type oscillator. A milliammeter is connected to the plate circuit of the detector tube and observed for maximum deflection, as the oscillator frequency is varied in the region of 1200 Hz.

### 12.12 Procedure

- (a) Connect the testing cord tips to the 0-10 mA scale of the milliammeter. Insert the plug into the PLT C jack at the VOLCAS.
- (b) Insert a 165C dummy plug into the E TST jack of the VOLCAS, thereby connecting the PLT C jack to the east-to-west detector plate circuit.
- (c) Using the local sensitivity measuring method given in 12.05, arrange the test connections for a measurement of sensitivity in the east-to-west direction (line side). Adjust the sending power until a detector plate current of 3 mA is obtained. Vary the oscillator frequency between about 1000 and 1400 Hz and observe the milliammeter reading. (Reverse the meter connections, if necessary, to obtain a positive indication.) Note the frequency at which the maximum deflection of the meter occurs.
- (d) Shift the 165C dummy plug from the E TST to the W TST jack for measurements on the W-E (drop) side.
- (e) Remove all patch cords and plugs.

**12.13 Requirement for Frequency of Maximum Sensitivity:** The frequency of maximum sensitivity shall be higher than 1000 Hz and lower than 1400 Hz. No tuning adjustments are provided on the VOLCAS. Any appreciable departure from these limits probably indicates a trouble condition.

### 13. VOLCAS—MEASUREMENT OF MASTER RELAY CURRENTS

**13.01** Measurements of just-operate and just-release master relay current provide a check on the adjustment of this relay and, to a certain extent, on the condition of the hangover relay as well. The test involves the use of the local sensitivity measuring methods of 12.05 together with a milliammeter for measuring the detector

plate (master relay operate winding) current. The testing arrangements are therefore the same as those used for measuring the frequency of maximum sensitivity.

**Note:** The operate and release current values can be approximated to the nearest 0.15 mA.

### 13.02 Procedure

- (a) Connect the testing cord tips to the 0-10 mA scale of the milliammeter. Insert the plug into the PLT C jack.
- (b) Insert a 165C dummy plug into the E TST jack of the VOLCAS, thereby connecting the PLT C jack to the detector plate circuit.
- (c) Measure the E-W (line) side sensitivity at 1200 Hz using one of the methods given in Part 12. Observe the detector plate current corresponding to the just-operate and just-release values of sending power as determined from the OPR lamp signals. In other words, first increase the sending power slowly from below the operate value. The detector plate current reading at the moment the OPR lamp lights is the master relay operate current. Then reduce the sending power slowly until the OPR lamp extinguishes. The detector plate current at this point is the master relay release current.
- (d) Shift the 165C dummy plug from the E TST to the W TST jack for measurements on the W-E (drop) side.
- (e) Remove all patch cords and plugs.

**13.03 Requirements for Master Relay Operate Current:** The master relay shall operate on currents between 1.2 and 1.8 milliamperes. If the master relay fails to meet these limits, it requires adjustment or is defective.

**13.04 Requirements for Master Relay Release Current:** The master relay shall release on not less than 0.6 milliamperes. Otherwise, the relay requires adjustment.

### 14. VOLCAS—INSERTION LOSS

**14.01** All VOLCAS units should be strapped for maximum insertion loss. This consists of

strapping out the EA, EB, WA, and WB (17.6- and 13.6-ohm) resistors. In units installed in the G Bays, also strap out R3, R4, R5, and R6 (25-ohm) resistors. In units installed in the J Bays, also strap out R45, R46, R47, and R48 (25-ohm) resistors.

310-435-303	SC2 Signaling Circuit
332-015-100	Simplified Theory of Singing Point Tests
332-410-101	1A Echo Suppressor
332-410-500	1A Echo Suppressor Tests
332-432-500	VOLCAS
982-305-100	SC2 Selective Control System

**15. MAINTENANCE AND TESTING REFERENCES**

**15.01**

SECTION	SUBJECT
040-231-701	209 FA Relay—Requirements and Adjustments
040-231-801	209 FA Relay—Piece Parts
100-343-101	116C1 Relay Test Panel
100-633-101	Vacuum Tube Test Set
103-105-100	Echo Suppressor Test Set
103-427-100	1R Tube Test Set
179-305-501	Signal Load Transfer Tests
179-316-501	Single Frequency Signaling
179-316-502	Single Frequency Signaling
310-435-300	SC2 Main Station Maintenance

**15.02**

DRAWINGS	SUBJECT
SD-1G057-01	Main Station
SD-1G124-01	Alerting Circuit
SD-1G125-01	Line Switching Circuit
SD-1G155-01	Trunk Circuit
SD-64366-01	VOLCAS
SD-64419-01	Ringer Oscillator
C-9023-5	E&M Trunk Circuit (C&P Co. drawing)