

**2600-CYCLE E1J**  
**SINGLE-FREQUENCY SIGNALING CIRCUIT**  
**OUT-OF-SERVICE TESTS USING**  
**TESTING CIRCUIT SD-96519-01 OR SD-96519-02**  
**AND 4A SIGNALING TEST SET (J-94743)**

**1. GENERAL**

**PAGE**

**1.01** This section describes a method of making out-of-service tests of 2600-cycle single-frequency signaling circuits SD-99762-01 using testing circuit SD-96519-01 or SD-96519-02. It also describes procedures for making potentiometer adjustments to correct for changes in the characteristics of some circuit elements.

the RCV potentiometer for zero transmission loss is provided. . . . .

*Caution: 303-type relays shall be maintained in an upright position for not less than 1 minute before beginning any tests.*

**E. Operate Sensitivity of Receiver Signaling Amplifier:** This test checks the receiver sensitivity and describes its adjustment by means of the SS potentiometer. . . . .

**1.02** The tests covered are:

**PAGE**

**A. Adjustment of Transmitter M Relay:** This test checks that the M relay is properly following pulses and describes procedures for adjusting the M ADJ potentiometer. . . . .

**F. Timing of Receiver R, RG, and G Relays:** This test checks the operate and release time of the R and RG relays and describes a method of adjusting the OT and RT potentiometers to meet requirements. It also provides a test to assure proper limiting of the signal amplifier. The operate and release time of the G relay is also checked. . . . .

**B. Hold of HL Relay and Release of CO Relay:** This test checks that the HL and CO relays release within the desired time limits. . . . .

**G. Voice Amplifier Cutoff Translator:** This test checks the voice amplifier cut feature by pulsing SF tone through the LINE REC and measuring, at the EQPT REC, the initial portion of each pulse which is gated through the amplifier before the cut takes place. . . . .

**C. Transmitter Voice Path and Transmitted Tone Level:** This test checks the transmitter voice path and the level of the transmitted single-frequency tone. . . . .

**H. Receiver Guard Action:** This test checks the receiver guard circuit in limiting operation by voice signals. . . . .

**D. Gain of Receiver Voice Amplifier and Insertion of Band-Elimination Filter:** This test checks transmission of the voice path through the receiver and blocking of the signal tone when present on the line. A procedure for adjusting

**Note:** Tests A through H must always be performed on new units or units repaired by WECO prior to installation.

**1.03** The E1J 2600-cycle single-frequency signaling unit is referred to in this section as SF unit.

**SECTION 179-327-502**

- 1.04** The transmission measuring set is referred to in this section as TMS.
- 1.05** The 4A signaling test set is referred to in this section as 4A test set.
- 1.06** The J98613AY test panel (SD-96519-01 or SD-96519-02) is referred to in this section as test circuit.
- 1.07 *Lettered Steps:*** A letter a, b, c, etc, added to a step number in Part 3 or 4 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.
- 1.08** If the requirements of this section cannot be met after readjustment of potentiometers or relays, the units should be returned to a repair center because of special techniques involved in testing and clearing trouble on some of the components.

**2. APPARATUS**

- 2.01** The apparatus required for each test is shown in Table A. The details of each item are covered in the paragraph indicated by the number in parentheses.
- 2.02** Testing circuit, J98613AY (SD-96519-01 or SD-96519-02), includes folding test fixture J98613AC.
- 2.03** The 4A test set, J94743A (SD-1C244-01), including E&M interface unit, J9A743AD and SF interface unit, J94743AA.
- 2.04** The 21A TMS. (J94021A)  
  
*Note:* The 21A TMS requires that the DET INPUT switch be set to the proper position for each measurement. The TMS indications called for as verification in this section are the combined total of the DET INPUT switch setting and the meter indication. The TMS should also be correctly calibrated before using.
- 2.05** KS-20538 Volt-Ohm-Milliammeter, equipped with testing cords.

**TABLE A**

APPARATUS	TESTS							
	A	B	C	D	E	F	G	H
Test Circuit (2.02)	1	1	1	1	1	1	1	1
4A Test Set (2.03)	1	1	1	1			1	
TMS (2.04)		1	1		1	1		1
KS-20538 VOM (2.05)				1				
Cord (2.06)	1	2	2	1	1	1	1	1
Cord (2.07)				1				
Tool (2.08)	1	1	1	1	1	1	1	1
Screwdriver, C	1				1	1	1	
Tool (2.09)		1				1	1	
Tool (2.10)		√						

√ As required.

**2.06 Testing Cord.** For 4A test set and 21A TMS, P3N cord, 6 feet long, equipped with a 241A plug and a 310 plug (3P17B cord).

**2.07** W2CF cord, 1 foot long, equipped with 1 310 plug, 1 360B tool, and 1 360C tool (2W17D cord).

**2.08** The 725A tool used to gain mechanical advantage in prying loose the signaling units from connectors.

**2.09** The 603A tool for removing 291- or 303-type relays. Use in accordance with Section 040-263-501.

**2.10** Blocking and insulating tools as required. Use tools and apply as covered in Section 069-020-801.

### 3. PREPARATION

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

#### All Tests

- |   |  |  |
|---|--|--|
| 1 | Set all keys to normal position before starting any tests. |  |
|---|--|--|

**Note:** The twist keys in the testing circuit are operated when white line is in vertical position and normal when white line is in horizontal position.

- |   |   |  |
|---|---|--|
| 2 | Obtain release of signaling circuit in accordance with approved procedures. |  |
|---|---|--|

- |   |  |  |
|---|--|--|
| 3 | Remove signaling unit from its in-service position using disengaging tool. See Fig. 1 and 2. |  |
|---|--|--|

- |   |  |  |
|---|--|--|
| 4 | Plug signaling unit into folding test fixture. |  |
|---|--|--|

- |    |   |  |
|----|---|--|
| 5a | If test circuit is mounted in a REVERTIVE—TERMINATING bay, J98613AP—<br>Operate CT key. |  |
|----|---|--|

#### Tests B, C, D, E, and H

- |   |  |  |
|---|--|--|
| 6 | At test circuit—<br>Connect 241 plug of P3N cord to input jack of TMS. |  |
|---|--|--|

- |   |  |   |
|---|--|---|
| 7 | Connect 310 plug of P3N cord to SF SUP jack of test circuit. | TMS indicates -14.6 to -16.1 dB. (See 2.04) |
|---|--|---|

- |   |   |  |
|---|---|--|
| 8 | Disconnect cord from SF SUP jack of test circuit and connect to AMP OUT jack. |  |
|---|---|--|

- |   |                                    |                     |
|---|------------------------------------|---------------------|
| 9 | Set RECEIVER switch to position 2. | TMS indicates 0 dB. |
|---|------------------------------------|---------------------|

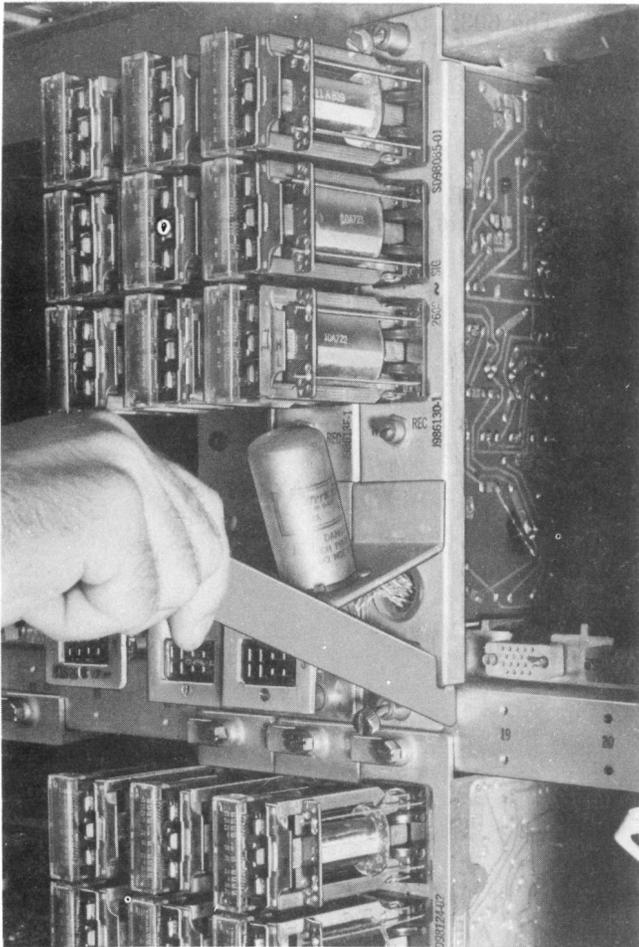


Fig. 1—Method of Removal of Fabricated Chassis

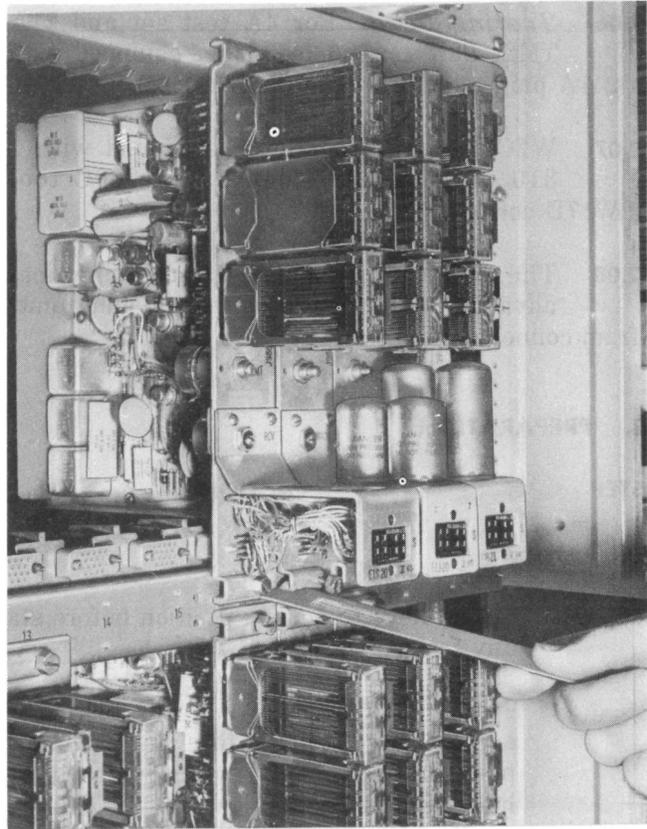


Fig. 2—Method of Removal of Die-Cast Chassis

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
-------------	---------------	---------------------

- |     |  |  |
|-----|--|--|
| 10b | If requirement in Step 9 is not met—<br>Adjust gain control of MON amplifier on test circuit to obtain 0 dB reading. |  |
| 11  | Disconnect cord from AMP OUT jack and connect to TMS jack.   |  |

**Tests A, B, C, F, and G**

- |    |  |  |
|----|--|--|
| 12 | Connect 4A test set to 110 volts ac.   |  |
| 13 | Operate POWER switch to ON.  |  |
| 14 | Equip 4A test set with E&M and SF interface units.                                     |  |
| 15 | Connect 241 plug of P3N cord to E and M jacks with notched side of plug toward E jack. |  |

STEP	ACTION	VERIFICATION
16	Connect 310 plug of P3N cord to LINE/R jack of 4A test set.	
17	At 4A test set— Set MS RANGE switch to 999.	
18	Set SELECTOR switch to NORM.	
19	Set FUNCTION switch to MSEC MK or MSEC BK.	
	<i>Note:</i> When verification calls for an indication in ms make or ms break, set the FUNCTION switch accordingly to obtain the proper indication.	
21	Set RECEIVER switch and SEND switch to EM.	
22	Set PULSE MODE switch to CONT.	
23	Operate GEN SUPV key to OFF HK.	
24	Set E&M/CX-S/R switch to E&M/CX.	
25	Operate TWD DROP key to ON HK.	

#### 4. METHOD

STEP	ACTION	VERIFICATION
<b>A. Adjustment of Transmitter M Relay</b>		
26	Set PULSE PERIOD switch to 200.	
27	Set PULSE WIDTH switch to 100.	
28	At test circuit— Set KEYERS switch to position 1.	
29	Set RECEIVER switch to position 1.	
30	Operate M key.	
31	Operate PULSE/MEAS key to LINE.	
32	Operate OPERATE-CLEAR key.	

*Note:* The OPERATE-CLEAR key and the START-STOP key are released when the lamp behind the key is extinguished and operated when the lamp is lighted.

**SECTION 179-327-502**

STEP	ACTION	VERIFICATION
33	Operate START-STOP key.	
34	Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and remains operated during pulsing.
35	Adjust M ADJ potentiometer on SF unit until 4A display indicates 100 ms make.	After approximately 10 seconds verify that display indication has not changed.
36c	If requirement of Step 35 is not met— Adjust armature back tension of M relay.	
	<i>Note:</i> An increase or decrease in ms make can be obtained by increasing or decreasing armature back tension of M relay. If the relay has been changed in any way, mechanical and electrical requirements must still be met as specified in the circuit requirements table of SD-99762-01.	
37	At 4A test set— Operate TWD LINE key to ON HK.	M, HL relays release.
38	Set PULSE PERIOD switch to 100.	
39	Set PULSE WIDTH switch to 45.	
40	Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and remains operated during pulsing. 4A display indicates between 41 and 50 ms make.
41	Set PULSE WIDTH switch to 70.	4A display indicates between 65 and 74 ms make.
42	Operate TWD LINE key to ON HK.	At SF unit— M, HL relays release.
43	At test circuit— Release M key.	
44d	If no further tests are to be made— Restore all circuits to normal.	

STEP	ACTION	VERIFICATION
<b>B. Hold of HL Relay and Release of CO Relay</b>		
<b>HL Relay Hold</b>		
26	At 4A test set— Set PULSE PERIOD switch to 333.	
27	Set PULSE WIDTH switch to 266.	
28	At test circuit— Set KEYERS switch to position 2.	
29	Set RECEIVER switch to position 1.	
30	Operate M key.	
31	At 4A test set— Operate OPERATE-CLEAR key.	
32	Operate PULSE/MEAS key to LINE.	
33	Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and remains operated during pulsing.
34	At 4A test set— Release OPERATE-CLEAR key.	At SF unit— M, HL relays operated steady.
35	At 4A test set— Operate TWD LINE key to ON HK.	At SF unit— M relay releases. HL relay releases in less than one second.
<b>CO Relay Release</b>		
36	At 4A test set— Set PULSE PERIOD switch to 250.	
37	Set PULSE WIDTH switch to 200.	
38	At test circuit— Operate CO key.	TMS indicates between -19 and -22 dB.
39	At 4A test set— Operate OPERATE-CLEAR key.	
40	Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and remains operated during pulsing. No indication on TMS.

**SECTION 179-327-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
41	At 4A test set— Set PULSE WIDTH switch to 175.	At SF unit— M relay continues pulsing. No indication on TMS.
42	At 4A test set— Operate TWD LINE key to ON HK.	At SF unit— M, HL relays release.
43	At test circuit— Release CO key.	TMS indicates between -25 and -35 dB.
44	At SF unit— Manually operate RG relay.	TMS indicates less power than -45 dB.
45	Release RG relay.	TMS indicates between -25 and -35 dB.
46	Manually operate M relay.	TMS indicates less power than -45 dB.
47	Release M relay.	TMS indicates between -25 and -35 dB.
48c	If no other tests are to be made— Restore all circuits to normal.	

**C. Transmitter Voice Path and Transmitted Tone Level****Transmitter Voice Path**

26	At test circuit— Operate 1000 ~ A key.	
27	Operate M key.	
28	Set KEYERS switch to position 2.	
29	At 4A test set— Operate TWD LINE key to OFF HK.	At SF unit— M, HL relays operate.
30	At test circuit— Simultaneously depress TMS A, TMS B keys.	TMS indicates between 0 and -0.2 dB.
31	Release TMS A, TMS B keys.	
32	Set RECEIVER switch to position 1.	
33	Restore 1000 ~ A key.	
34	At 4A test set— Operate TWD LINE key to ON HK.	At SF unit— M, HL relays release.

STEP	ACTION	VERIFICATION
<b>Transmitted Tone Level</b>		
35	At test circuit— Set KEYERS switch to position 3.	
36	Simultaneously depress TMS A, TMS B keys.	TMS indicates between -35 and -37 dB.  <i>Note:</i> If requirement is not met, recheck tone supply as set forth in Step 7.
37	Release TMS A, TMS B keys.	
38	At SF unit— Block operated HL relay.	
39	At test circuit— Simultaneously depress TMS A, TMS B keys.	TMS indicates between -22.5 and 25.5 dB.
40	Release TMS A, TMS B keys.	
41	Set KEYERS switch to position 4.	M relay operates in SF unit. TMS indicates less power than -45 dB.
42	At SF unit— Remove blocking tool from HL relay.	HL relay remains operated. Same TMS indication as in Step 41.
43	On test circuit— Release M key.	M, HL relays release.
44c	If no other tests are to be made— Restore all circuits to normal.	

**D. Gain of Receiver Voice Amplifier and Insertion of Band-Elimination Filter**

**Receiver Voice Amplifier**

12	Set KEYERS switch to Position 5.	
13	Operate M key.	M, HL relays operate in SF unit.
14	Operate 1000~B key.	TMS indicates 0 dB.
15c	If requirement of Step 14 is not met— Adjust RCV potentiometer of SF unit under test to obtain exactly 0 dB.	

**Band Elimination Filter Loss at 1000 Hz**

16	At SF unit— Manually operate RG relay.	TMS indicates between 0 and -0.7 dB.
17	Release RG relay.	

**SECTION 179-327-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
18	At test circuit— Restore 1000~B key.	
19	Set KEYERS switch to position 6.	
20	Set RECEIVER switch to position 4.	M, HL relays release.
21	Set attenuator to 10.	TMS indicates $0 \pm .2$ dB.
	<i>Note:</i> See Step 5a of Preparation.	
22d	If requirement of Step 21 is not met— Adjust gain control of TEST AMPL for 0 db.	

**Electronic Cut Operation**

23	At SF unit— Hold RG relay nonoperated.	
24	At test circuit— Set RECEIVER switch to position 3.	TMS indicates less power than $-35$ dBm. RG relay operates.
25	At SF unit— Allow RG relay to operate.	<i>Note:</i> Operation of RG relay depends on proper setting of SS potentiometer. If it does not operate, perform Test F, then repeat Test E, Steps 19 through 25.

**Band Elimination Loss at 2600**

26	At test circuit— Set RECEIVER switch to position 2.	TMS indicates $-30$ dBm or less power.
27e	If test circuit is in a REVERTIVE-TERMINATING bay and CT key is operated (see Step 5a) but requirement of Step 26 is not met— A TMS indication of $-28$ dBm or less power is satisfactory.	
28f	If requirement of Step 27e is not met— Adjust oscillator of 21A TMS to 2600 $\pm 10$ cycles, to level of $-15.6$ dB, and connect it to SF TST jack.	TMS indicates $-30$ dBm or less power.
29	Restore M key.	
30g	If no other tests are to be made— Restore all circuits to normal.	

STEP	ACTION	VERIFICATION
<b>E. Operate Sensitivity of Receiver Signaling Amplifier</b>		
<i>Note:</i> This test should be performed if Tests G and H are to be done. Also it is important to have the test amplifier properly adjusted per Test E, Steps 19 through 22d. The operation and release of G relay depend on the release and operation of RG relay. See Test G for checking G relay.		
12	At test circuit— Set KEYERS switch to position 6.	
13	Set RECEIVER switch to position 4.	
14	Set attenuator to 33.	
15	Set RECEIVER switch to position 3.	RG relay not operated.
16c	If RG relay does operate— Adjust SS potentiometer slightly counterclockwise until RG relay releases.	
17	Set attenuator to 32.	RG relay operated.
18d	If RG relay does not operate— Adjust SS potentiometer slightly clockwise until it just operates.	
19d	Repeat Steps 14 through 18d until requirements of these steps are met.	
20	Set attenuator to 40.	RG relay released.
21e	If no other tests are to be made— Restore all circuits to normal.	
<b>F. Timing of Receiver R, RG, and G relays</b>		
<i>Note:</i> Test F should be performed before beginning Test G.		
26	At 4A test set— Set PULSE PERIOD switch on 100.	
27	Set PULSE WIDTH switch to 50.	
28	At test circuit— Set KEYERS switch on position 7.	
29	At 4A test set— Operate PULSE/MEAS key to LINE.	

**SECTION 179-327-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
30	At 4A test set— Operate TWD LINE key to OFF HK.	At test circuit— M relay operates.
31	Operate START-STOP key.	
32	Operate OPERATE-CLEAR key.	At test circuit— M relay pulses.
33	Adjust the M potentiometer on test circuit until the 4A test set display indicates 50 ms break.	
34	At test circuit— Set attenuator to 11.	
<b>Adjust OT Potentiometer</b>		
35	At 4A test set— Set PULSE PERIOD switch to 333.	
36	Set FUNCTION switch to MSEC BK.	
37	At test circuit— Set KEYERS switch to position 8.	
38	Set RECEIVER switch to position 3.	
39	At SF unit— Adjust OT potentiometer fully clockwise then counterclockwise until RG relay just pulses uniformly.	At SF unit— RG relay pulses uniformly. 4A display indicates 27 ms break or more.
40	Set PULSE WIDTH switch to 48.	At SF unit— RG relay does not pulse uniformly. At 4A test set— Display indication unstable between 0 and 20 ms break.
41c	If requirement of Step 39 is not met— Turn OT potentiometer slightly clockwise until the requirement is met.	
42	Set PULSE WIDTH switch to 50.	At SF unit— RG relay pulses uniformly. At 4A test set— Display indicates 27 ms break or more.
43d	If requirement in Step 42 is not met— Repeat Steps 39 and 40 until requirements in Steps 39 and 40 are met.	

STEP	ACTION	VERIFICATION
<b>Adjust RT Potentiometer</b>		
44	At test circuit— Set KEYERS switch to position 7.	
45	At 4A test set— Set PULSE PERIOD switch to 200.	
46	Set PULSE WIDTH switch to 90.	M relay of test circuit pulses. Display on 4A test set indicates 110 ms break.  <b>Note:</b> If 110 ms break is not indicated, adjust the M potentiometer of the test circuit to meet this requirement. If this requirement still cannot be met, adjust the armature back tension of the M relay of test circuit, being sure not to exceed the limits as specified in the circuit requirements table of SD-96519-01 or -02.
47	At test circuit— Set KEYERS switch to position 8.	
48	Set PULSE WIDTH switch to 110.	At SF unit— RG relay pulses. At 4A test set— Display indicates 110 ms break.  <b>Note:</b> If 110 ms break is not indicated, adjust Rt potentiometer on SF unit to meet this requirement.
49	At test circuit— Change attenuator setting in steps of 2 dB from 5 to 17, observing 4A display during this time.	At 4A test set— Display indicates 110 ms, $\pm 5$ .
50	At test circuit— Restore attenuator to 11.	
<b>G Relay</b>		
51	At 4A test set— Set PULSE PERIOD switch to 333.	
52	Set PULSE WIDTH switch to 67.	At SF unit— RG relay pulses. G relay remains operated during pulsing.
53	At 4A test set— Raise PULSE WIDTH switch setting until display indicates 133 ms break.	At SF unit— RG relay pulses. G relay remains operated during pulsing. Setting on PULSE WIDTH switch is 133, $\pm 10$ .

**SECTION 179-327-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
54	At 4A test set— Raise PULSE WIDTH switch setting until display indicates 233 ms break.	At SF unit— RG, G relays pulse. Setting on PULSE WIDTH switch is 233, $\pm 10$ .
55	At 4A test set— Lower PULSE WIDTH switch setting until display indicates 67 ms break.	At SF unit— RG relay pulses. Setting on PULSE WIDTH switch is 67, $\pm 5$ .  G relay remains operated during pulsing.
56e	If no other tests are to be made— Restore all circuits to normal.	

**G. Voice Amplifier Cutoff Transistor**

26	Disconnect cord from DET IN jack of TMS, connect to FROM EQPT jack of SF interface unit.	
27	At 4A test set— Set MS RANGE switch to 99.9.	
28	Set RECEIVE switch to SF.	
29	Set PULSE PERIOD switch to 500.	
30	Set PULSE WIDTH switch to 50.	
31	At SF interface unit— Operate PULSE/MEAS key to LINE.	
32	Operate TWD EQPT key to MON.	
33	Operate TWD LINE key to MON.	
34	Set NB-BB switch to NB.	
35	At E&M interface unit— Operate TWD LINE key to OFF HK.	
36	At test circuit— Set KEYERS switch to position 8.	
37	Set RECEIVER switch to position 3.	
38	Set attenuator to 11.	
39	At 4A test set— Operate START-STOP key.	
40	Operate OPERATE-CLEAR key.	4A display indicates 5 to 25 ms break.

STEP	ACTION	VERIFICATION
41c	If no other tests are to be made— Restore all keys, remove all cords, restore all circuits to normal.	
<b>H. Receiver Guard Action</b>		
<i>Note:</i> Test F should be performed before beginning Test H.		
12	At test circuit— Set KEYERS switch to position 5.	
13	Set RECEIVER switch to position 6.	TMS indicates between $-18.5$ and $-19.5$ dBm.
14	Set attenuator to 24.	
15	Set RECEIVER switch to position 5.	At SF unit— RG relay releases.
16	Set KEYERS switch to position 6.	RG relay remains released.
17	Set KEYERS switch to position 5.	
18	Set attenuator to 16.	
19	Set KEYERS switch to position 6.	RG relay operates.
20	Set KEYERS switch to position 5.	RG relay releases.
21	Set RECEIVER switch to position 4.	
22	Restore all circuits to normal.	