2600-CYCLE E1A SINGLE-FREQUENCY SIGNALING CIRCUIT OUT-OF-SERVICE TESTS USING TESTING CIRCUIT SD-96519-01 OR SD-96519-02 AND 4A SIGNALING TEST SET (SD-1C244-01) J-94743

1. GENERAL

1.01 This section describes a method of making out-of-service tests of 2600-cycle single-frequency signaling circuits per SD-96499-01, using testing circuit SD-96519-01 or SD-96519-02 and 4A signaling test set SD-1C244-01. It also describes procedures for making potentiometer adjustments to compensate for variations in the characteristics of some circuit elements. If the requirements of this section cannot be met after readjustment of potentiometers or relays, the units should be returned to a repair center, since special techniques are involved in testing and clearing trouble on some of the components.

Caution: The 291- or 303-type relays shall be maintained in an upright position not less than 1 minute before beginning any tests.

1.02 The tests covered are:

1.03 The transmission measuring set is referred to in this section as TMS.

1.04 The 4A signaling test set is referred to in this section as 4A test set.

1.05 The single-frequency signaling unit is referred to in this section as SF unit.

1.06 The J98613AY test panel (SD-96519-01 or SD-96519-02) is referred to in this section as test circuit.

1.07 The LEV switch on the signaling unit, when in the +7 position, provides 7-dB attenuation to the line receive level. The tests in this section are made with the LEV switch in the +7 position, except where noted. If the switch was in the 0 position when the unit was removed from service, return it to the 0 setting if the unit is to be placed in the same service as before.

1.08 ***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.

2. APPARATUS

2.01 The apparatus required for each test is shown in Table A. The details of each item are covered in the paragraphs indicated by the number in parentheses.

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	
TMS (2.04)			1	1	1			1
Cord (2.05)	1	2	1	1	1	1	1	1
Tool (2.06)	1	1	1	1	1	1	1	1
Screwdriver, C				1	1	1		
Tool (2.07)						1		
Tool (2.08)			√	√				

√ As required.

2.02 Test circuit J98613AY (SD-96519-01 or SD-96519-02) includes folding test fixture J98613AC.

2.03 4A test set, (SD-1C244-01) J-94743A, equipped with E & M, J-94743AD and SF, J-94743AA interface units.

2.04 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 21A TMS should also be correctly calibrated.

2.05 Patching cord, P3N cord, 6 feet long, equipped with 241A plug and 310 plug (3P17B cord assembly).

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

2.07 Tool, 603A, for removing 291- or 303-type relays. Use in accordance with Section 040-263-501.

2.08 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 test circuit are operated when the white line is in the vertical position, and released when the white line is in the horizontal position.	
2	Obtain release of signaling circuit in accordance with approved procedures.	
3	Remove signaling unit from its in-service position, using 725A tool, as shown in Fig. 1 or 2.	
4	Plug signaling unit into folding test fixture.	
5	Operate 2-WIRE key.	
6a	If test circuit is mounted in a REVERTIVE-TERMINATING bay, J98613AP— Operate CT key.	
7	Operate LEV switch on signaling unit to +7 position.	
Tests C, D, E, F, and H		
8	Connect 241 plug of P3N cord to input jack of TMS.	
9	Connect 310 plug of P3N cord to SF SUP jack of test circuit.	TMS indicates between −14.6 and −16.1 dB.
10	Disconnect plug from SF SUP jack, connect to AMP OUT jack.	
11	Set RECEIVER switch to position 2.	TMS indicates 0 dB. See Step 12b.

STEP	ACTION	VERIFICATION

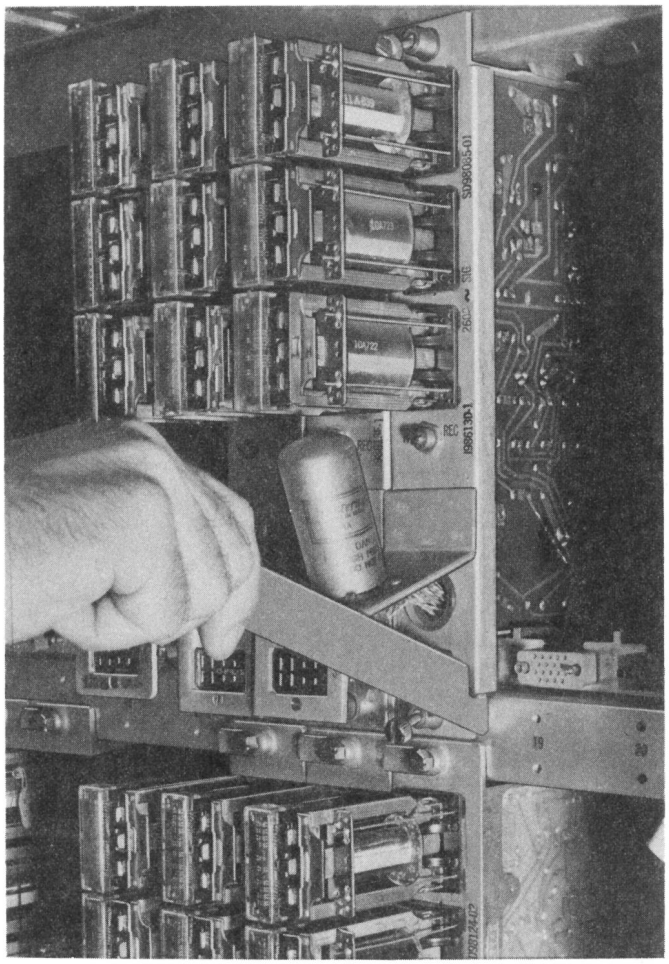

Fig. 1—Method of Removal of Fabricated Chassis

12b If requirement of Step 11 is not met—
Adjust gain control of MON amplifier to exactly 0 dB.

13 Disconnect plug from AMP OUT jack, connect to TMS jack of test circuit.

Tests A, B, F, and G

14 Connect 4A test set to 110V ac power, operate POWER switch to ON.

15 Equip 4A test set with E&M and SF interface units.

STEP	ACTION	VERIFICATION

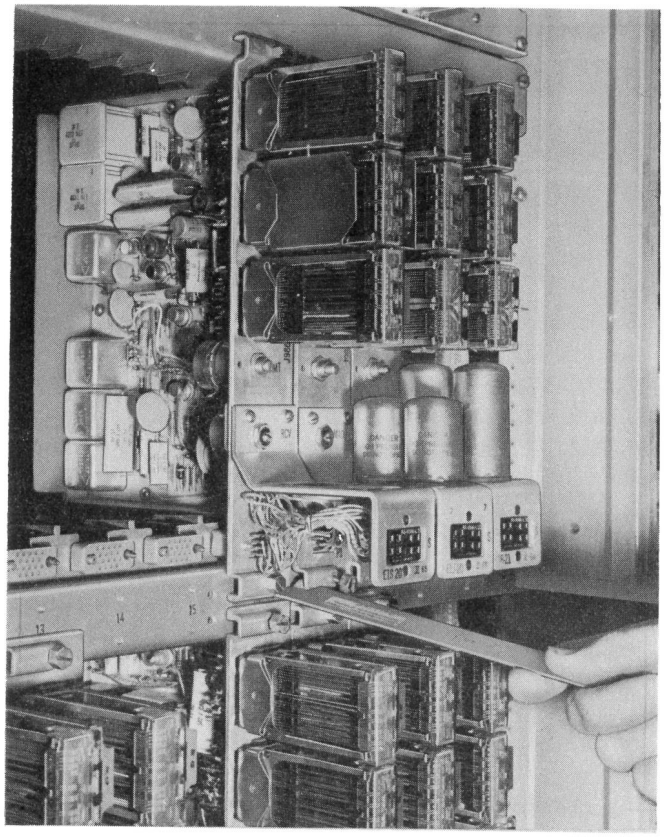

Fig. 2—Method of Removal of Die-Cast Chassis

16 Using P3N cord, patch LINE/R jack of 4A test set to E jack and M jack of test circuit, with notched side of 241 plug toward E jack.

17 At 4A test set—
Set MS RANGE switch to 99.9.

18 Set SELECTOR switch to NORM.

19 Set FUNCTION switch to MSEC BK or MSEC MK.

Note: When verification calls for an indication in ms break or ms make, set the FUNCTION switch accordingly to obtain the proper indication.

20 Set READ switch to MSEC UPDATE.

21 Set RECEIVE switch to EM.

STEP	ACTION	VERIFICATION
22	Set SEND switch to EM.	
23	Set PULSE MODE switch to CONT.	
24	Operate GEN SUPV key to OFF HK.	
25	Set E&M/CX—S/R switch to E&M/CX.	
26	Operate PULSE/MEAS key to LINE.	
27	Operate TWD DROP key to ON HK.	

4. METHOD

A. Pulsing of Transmitter M Relay

28	Set PULSE PERIOD switch to 100.	
29	Set PULSE WIDTH switch to 45.	
30	At test circuit— Set KEYERS switch to position 1.	
31	Set RECEIVER switch to position 1.	
32	Operate M key.	
33	At 4A test set— Operate OPERATE-CLEAR key.	
34	Operate START-STOP 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.	
35	Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and holds during pulsing. 4A display indicates between 44 and 53 ms make. ***Note:*** Any time the M relay does not meet its pulsing requirement, adjust the armature back tension and, if necessary, change R105 resistor as specified in circuit notes of the SD. The relay must still meet the requirements as specified in circuit requirements table of the SD.

STEP	ACTION	VERIFICATION
36	Set PULSE WIDTH switch to 70.	At SF unit— M relay pulses. HL relay operates and holds during pulsing. 4A display indicates between 65 and 72 ms make. (See note in Step 35)
37	Operate TWD LINE key to ON HK.	At SF unit— M, HL relays release.
38	At test circuit— Release M key.	
39c	If no other tests are to be made— Restore all circuits to normal and restore LEV switch on SF unit to original position.	

B. Hold of HL Relay

28	At 4A test set— Set PULSE PERIOD switch to 333.	
29	Set PULSE WIDTH switch to 100 for E1A units or 266 for E1A-( ) units.	
30	At test circuit— Set KEYERS switch to position 2.	
31	Set RECEIVER switch to position 1.	
32	Operate M key.	
33	At 4A test set— Operate TWD LINE key to OFF HK.	At SF unit— M relay pulses. HL relay operates and holds 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.
36	At test circuit— Release M key.	
37b	If no other tests are to be made— Restore all circuits to normal and restore LEV switch on SF unit to original position.	

STEP	ACTION	VERIFICATION
C. Transmitted Tone Level		
14	At test circuit— Operate M key.	
15	Set KEYERS switch to position 3.	
16	Set RECEIVER switch to position 1.	
17	Simultaneously depress TMS A, TMS B keys.	TMS indicates between −32.5 and −35.5 dB.
18	Release TMS A, TMS B keys.	
19	At SF unit— Block HL relay operated.	
20	At test circuit— Simultaneously depress TMS A, TMS B keys.	TMS indicates between −18.5 and −21.5 dB.
21	Release TMS A, TMS B keys.	
22	Set KEYERS switch to position 4.	At SF unit— M relay operated. TMS indicates less power than −45 dBm.
23	Remove blocking tool from HL relay.	HL relay remains operated. TMS indicates same as in Step 22.
24	At test circuit— Release M key.	At SF unit— M, HL relays release.
25c	If no other tests are to be made— Restore all circuits to normal and restore LEV switch of SF unit to original position.	
D. Test of 4-Wire Terminating Circuit, Gain of Receiver Voice Amplifier, Blocking of Amplifier, and Insertion of Band-Elimination Network		
14	Set KEYERS switch to position 5.	
15	Set RECEIVER switch to position 2.	
16	Operate 1000 ∿ A key.	
17	Operate M key.	
18	Simultaneously depress TMS A, TMS B keys.	TMS indicates between −15 and −16.3 dB.
19	Release TMS A, TMS B keys.	
20	Release 1000 ∿ A key.	

STEP	ACTION	VERIFICATION
21	Operate 1000 ~ B key.	
22	At SF unit— Operate LEV switch to position it was in prior to performing Step 7 in Preparation. ***Note:*** Minor readjustment of the REC potentiometer of less than 1 dB may be necessary to meet overall trunk net loss requirements in an in-service condition.	TMS indicates specified value for signaling unit shown on trunk circuit layout record plus 0.2 dB (additional 0.2 dB is caused by measuring a 900-ohm circuit using a 600-ohm TMS). ***Example:*** Specified value shown for signaling unit is 8.8 dB, 8.8 dB +0.2 dB = 9 dB. See Step 23c.
23c	If requirement of Step 22 is not met, and if no tests of the 4-wire terminating circuit return loss (Steps 24 through 29) or voice amplifier blocking and band-elimination network insertion (Steps 30 through 42) are to be made— Proceed to Step 48.	
24	At SF unit— Set LEV switch to −7 position.	
25	Adjust REC potentiometer fully clockwise.	TMS indicates −6 dBm power or greater.
26	Set LEV switch to 0 position.	TMS indicates 7 ±0.3 dB more power than indicated in Step 25.
27	Adjust REC potentiometer to obtain 0 dB.	TMS indicated 0 dB.
28	Simultaneously depress TMS A, TMS B keys.	TMS indicates between −14 and −18 dB.
29	Operate 2W TER key.	TMS indicates between −29 and −39 dB. ***Note:*** This indication obtained when build-out capacitor C86 (3900 uuf) is wired in by strapping terminal A to C on printed wiring board.
30	Release TMS A, TMS B keys.	
31	Release 2W TER key.	
32	Release 1000 ~ B key.	
33	At SF unit— Set LEV switch to +7.	
34	At test circuit— Set KEYERS switch to position 6.	
35	Set RECEIVER switch to position 4.	

STEP	ACTION	VERIFICATION
36	Set attenuator to 10.	TMS indicates between +0.2 and −0.2 dB. See Step 37d.
37d	If requirement of Step 36 is not met— Adjust gain potentiometer of TST amplifier to obtain 0 dB.	TMS indicates 0 dB.
38	Set KEYERS switch to position 5.	
39	Set RECEIVER switch to position 3.	
40	At SF unit— Block nonoperated RG relay.	
41	At test circuit— Set KEYERS switch to position 6.	TMS indicates −40 dBm or less power.
42	At SF unit— Remove blocking tool from RG relay.	RG relay operated. TMS indicates −35 dBm or less power. ***Note:*** Operation of RG relay depends upon sensitivity adjustment. If RG relay does not operate, perform Test E, then repeat Steps 38 through 42 of this test.
43e	If the test circuit is in a REVERTIVE-TERMINATING bay and the CT key is operated (see Step 6a), but the requirement of Step 42 is not met— A TMS indication of −33 dBm or less power is satisfactory.	
44f	If the requirement of Step 43e is not met— Adjust the oscillator of the 21A TMS to 2600 ±10 cycles, at a level of −15.6 dB, and connect it to the SF TST jack.	TMS indicates −35 dBm or less power.
45	At test circuit— Set KEYERS switch to position 5.	
46	Set RECEIVER switch to position 2.	At SF unit— RG relay released.
47	Operate 1000 ∿ B key.	TMS indicates between −6.7 and −7.3 dB.
48	Adjust REC potentiometer of signaling unit under test to specific 4-wire to 2-wire loss with LEV switch of signaling unit set to position required for proper circuit requirements. ***Note:*** Minor readjustment of the REC potentiometer of less than 1 dB may be	TMS indicates specified value for signaling unit shown on trunk layout record plus 0.2 dB (additional 0.2 dB is caused by measuring a 900-ohm circuit using a 600-ohm TMS). ***Example:*** Specified value shown for signaling unit is 8.8 dB + 0.2 dB = 9 dB.

STEP	ACTION	VERIFICATION
	necessary to meet overall trunk net loss requirements.	
49	Set RECEIVER switch to position 4.	
50	Release M and 1000 ~ B keys.	
51g	If no other tests are to be made— Restore all circuits to normal and restore LEV switch of SF unit to original position.	

E. Operate Sensitivity of Receiver Signaling Amplifier

	Note: The operation and release of the G relay, in those units having one, depend upon the release and operation of the RG relay. See Test G for checking the G relay.	
14	Set attenuator to 33.	
15	Set KEYERS switch to position 6.	
16	Set RECEIVER switch to position 4.	TMS indicates between −22.8 and −23.2 dB.
17c	If requirement in Step 16 is not met— Adjust gain control of TEST AMPL in test circuit for −23 dB.	
18	Set RECEIVER switch to position 3.	RG relay not operated. See Step 19d.
19d	If RG relay operated— Adjust SS potentiometer slightly counterclockwise until RG relay releases.	RG relay releases.
20	Set attenuator to 32.	RG relay operated. See Step 21e.
21e	If RG relay not operated— Adjust SS potentiometer slightly clockwise until just operated.	
22	Repeat Steps 14 through 21e, until requirements of these steps are met.	
23	Set attenuator to 40.	RG relay released.
24f	If no other tests are to be made— Restore all circuits to normal and restore LEV switch of SF unit to original position.	

STEP	ACTION	VERIFICATION
F. Timing of Receiver R and RG Relays		
	Note: Test E should be performed before beginning Test F.	
28	At 4A test set— Set PULSE PERIOD switch to 100.	
29	Set PULSE WIDTH switch to 55.	
30	At test circuit— Set KEYERS switch to position 7.	
31	Set RECEIVER switch to position 4.	
32	At 4A test set— Operate OPERATE-CLEAR key.	
33	Operate START-STOP 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.	
34	Operate TWD LINE key to OFF HK.	M relay of test circuit pulses. 4A display indicates 45 ms break. See Step 35c.
35c	If requirement in Step 34 is not met— Adjust M potentiometer of test circuit to obtain 45 ms break.	
36	At test circuit— Set attenuator to 11.	
37	At 4A test set— Set PULSE PERIOD switch to 333.	
38	Set PULSE WIDTH switch to 31.	
39	Set FUNCTION switch to MSEC BK.	
40	At test circuit— Set KEYERS switch to position 8.	
41	Set RECEIVER switch to position 3.	At SF unit— RG relay does not pulse. See Steps 43d through 44d. Display indicates 0 to 20 ms.

STEP	ACTION	VERIFICATION
42	At 4A test set— Set PULSE WIDTH switch to 35.	At SF unit— RG relay pulses uniformly. 4A display indicates 27 ms break or more. See Step 43d through 44d.
43d	If requirements in Steps 41 and 42 are not met— At 4A test set— Set PULSE WIDTH switch to 33.	
44d	At SF unit— Adjust OT potentiometer fully clockwise then counterclockwise until RG relay just pulses uniformly.	RG relay pulses uniformly. 4A display indicates 27 ms break or more.
45	At 4A test set— Set PULSE PERIOD switch to 100.	
46	Set PULSE WIDTH switch to 45.	4A display indicates between 48 and 50 ms break.
47c	If requirements of Step 46 is not met— At SF unit— Adjust RT potentiometer fully counterclockwise then clockwise until requirement is met.	
48	At 4A test set— Set PULSE WIDTH switch to 70.	4A break indicates between 55 and 70 ms break.
	Note: The following Steps 49 through 71 are to be performed for E1A-( ) units only. For E1A units proceed directly to Step 72.	
49	Release OPERATE-CLEAR key.	
50	Set PULSE PERIOD switch to 83.	
51	Set PULSE WIDTH switch to 62.	
52	Operate OPERATE-CLEAR key.	SF unit pulses uniformly. 4A display indicates between 49 and 60 ms break.
53f	If requirement of Step 52 is not met— At 4A test set— Set PULSE WIDTH switch to 63.	SF unit pulses uniformly. 4A display indicates between 49 and 60 ms break.
54g	If requirement of Step 53f is not met— Adjust OT potentiometer sligthly clockwise until unit just begins to pulse uniformly.	4A display indicates between 49 and 60 ms break.

STEP	ACTION	VERIFICATION
55	At 4A test set— Set PULSE WIDTH switch to 43.	SF unit pulses uniformly. 4A display indicates between 45 and 54 ms break.
56h	If requirement of Step 55 is not met— Adjust OT potentiometer sligthly counterclockwise until requirement is met.	4A display indicates between 45 and 54 ms break.
57i	If any adjustmnet was made on OT potentiometer— At test circuit— Set KEYERS switch to position 7.	
58i	Repeat Steps 37 through 42.	Same as Steps 37 through 42.
59j	If OT potentiometer was adjusted and the requirements of Steps 41 and 42 are not met— Adjust RG relay per circuit requirements table of SD.	
60	At 4A test set— Release OPERATE-CLEAR key.	
61	Set PULSE PERIOD switch to 100.	
62	Set PULSE WIDTH switch to 80.	
63	Operate OPERATE-CLEAR key.	At SF unit— G relay operated. RG relay pulses.
64	Manually release G relay.	RG relay operated steady.
65	Release OPERATE-CLEAR key.	
66	Set PULSE PERIOD switch to 333.	
67	Set PULSE WIDTH switch to 67.	
68	Operate OPERATE-CLEAR key.	At SF unit— RG relay pulses. G relay operated.
69	At 4A test set— Raise PULSE WIDTH switch setting until display indicates 133 ms break.	At SF unit— RG relay pulses. G relay operated. Setting on PULSE WIDTH switch is 140, $\pm$10 ms.
70	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 225, $\pm$10 ms.

STEP	ACTION	VERIFICATION
71	At 4A test set— Lower PULSE WIDTH switch setting until display indicates 67 ms break.	At SF unit— RG relay pulses. G relay operated. Setting on PULSE WIDTH switch is 75, ±10 ms.
	Rering Response	
72	At 4A test set— Set PULSE PERIOD switch to 250.	
73	Set PULSE WIDTH switch to 70.	
74	At test circuit— Operate M key.	
75	Set RECEIVER switch to position 2.	4A display indicates between 65 and 85 ms break.
76	At test circuit— Change attenuator setting in 2 dB steps from 5 to 17.	Indication in Step 75 should not change more than ±5 ms.
77	Set attenuator to 11.	
78	At 4A test set— Set PULSE WIDTH switch to 125.	4A display indicates between 90 and 140 ms break.
	Note: Step 79 is to be performed on E1A-( ) units only.	
79	At 4A test set— Set PULSE WIDTH switch to 40.	At SF unit— RG relay released. 4A display indicates 0 ms break.
80	At test circuit— Release M key.	
81	Set RECEIVER switch to position 4.	
82k	If no other tests are to be made— Restore all circuits to normal and restore LEV switch of SF unit to original position.	
	G. Voice Amplifier Cutoff Transistor	
28	Disconnect cord from DET IN jack of TMS, connect to FROM LINE jack of SF interface unit.	
29	At 4A test set— Set MS RANGE switch to 99.9.	

STEP	ACTION	VERIFICATION
30	Set RECEIVE switch to SF.	
31	Set PULSE PERIOD switch to 500.	
32	Set PULSE WIDTH switch to 50.	
33	At SF interface unit— Operte PULSE/MEAS key to LINE.	
34	Operate TWD EQPT key to MON.	
35	Operate TWD LINE key to MON.	
36	Set NB-BB switch to NB.	
37	At E&M interface unit— Operate TWD LINE key to OFF HK.	
38	At test circuit— Set KEYERS switch to position 8.	
39	Set RECEIVER switch to position 3.	
40	Set attenuator to 11.	
41	At 4A test set— Operate START-STOP key.	
42	Operate OPERATE-CLEAR key.	4A display indicates 5 to 25 ms break.
43c	If no other tests are to be made— Restore all keys, remove all cords, restore all circuits to normal.	

H. Receiver Guard Action

	Note: Test E should be performed before performing Test H.	
14	At test circuit— Set KEYERS switch to position 5.	
15	Set RECEIVER switch to position 6.	TMS indicates between −18.5 and −19.5 dB.
16	Set attenuator to 31 for E1A units or 26 for E1A-( ) units.	
17	Set RECEIVER switch to position 5.	At SF unit— RG relay not operated.
18	Set KEYERS switch to position 6.	RG relay not operated.

STEP	ACTION	VERIFICATION
19	Set KEYERS switch to position 5.	
20	Set attenuator to 26 for E1A units or 21 for E1A-( ) units.	
21	Set KEYERS switch to position 6.	RG relay operated.
22	Set KEYERS switch to position 5.	RG relay released.
23	Set RECEIVER switch to position 7.	
24	Operate M key.	M and HL relays operated.
25	Set attenuator to 28 for E1A units or 24 for E1A-( ) units.	
26	Set KEYERS switch to position 6.	RG relay not operated.
27	Set KEYERS switch to position 5.	
28	Set attenuator to 20 for E1A units or 17 for E1A-( ) units.	
29	Set KEYERS switch to position 6.	RG relay operated.
30	Set KEYERS switch to position 5.	
31	Set RECEIVER switch to position 4.	RG, M, and HL relays released.
32	Release M key.	
33	Restore all circuits to normal and restore LEV switch of SF unit to original position.	