2400- OR 2600-HZ E1B, E2B, E3B, OR E4B SINGLE-FREQUENCY SIGNALING CIRCUITS OUT-OF-SERVICE TESTS USING TESTING CIRCUIT SD-96519-01 OR SD-96519-02

1. GENERAL

1.01 This section describes a method of making out-of-service tests of 2400- or 2600-Hz single-frequency signaling circuits per SD-98085-01, SD-98090-01, SD-98124-01, SD-98124-02, or SD-98124-03 using testing circuit SD-96519-01 or SD-96519-02. It also describes a method of making potentiometer adjustments to correct changes 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 because special techniques are involved in testing and clearing trouble on some of the components.

> ***Note:*** 291- and 303-type relays shall be maintained in an upright position for not less than 1 minute before beginning any tests.

1.02 This section is reissued to revise steps in Tests E and G and to correct attenuator settings in Test I. This reissue does not affect the Equipment Test List.

1.03 The tests covered are:

PAGE

1.04 The 2400- or 2600-Hz single-frequency signaling unit is referred to in this section as an SF unit.

1.05 The 13A or the J94021A (21A) transmission measuring set is referred to in this section as the TMS.

1.06 The dial switch on the 13A TMS or the DET INPUT switch on the 21A TMS is referred to in this section as the TMS attenuator switch. The specific settings of the TMS attenuator switch are not given in the procedure unless necessary to prevent overload and possible damage to the instrument. The proper setting will be that which results in an on-scale reading on the TMS meter and will depend upon whether the 13A or 21A TMS is used and the specific value to be measured.

1.07 The 2B signaling test set is referred to in this section as 2B test set.

1.08 Slowly make percent break adjustments of the 2B test set above 70 percent to prevent pulsing out incorrect values. Incorrect values will be obtained if the rate of vibration of the PERCENT BREAK meter pointer is not the same as that of the PULSES PER SECOND meter pointer. To restore correct percent break values, turn the ADJ % BK control counterclockwise until both pointers are vibrating at the same rate; then turn the control slowly clockwise until the desired percent break value is obtained. It may also be necessary to change the coarse ADJ % BK switch from S, M, or L setting to obtain desired range on the PERCENT BREAK meter.

1.09 The J98613AY test panel (SD-96519-01 or SD-96519-02) is referred to in this section as test circuit. KEYERS switch 1 and RECEIVER switch 2 on this panel are referred to as SW1 and SW2, respectively.

1.10 Two values of transmitted power are specified in Test C and four values of attenuator setting are specified in Test I. The value to be used is determined from the following, depending upon the circuit transmission levels and whether 4- or 2-wire (4W or 2W) line facilities are provided.

(a) ***+4 Line, -13 Line (4W or 2W):*** The connection of the signaling receiver to the circuit at a point where the transmission level is +4 dB is indicated by ***+4 line.*** ***-13 line*** indicates that the associated signaling transmitter connects to the circuit at a point where the transmission level is -13 dB.

(b) ***+7 Line, -16 Line (4W or 2W):*** The term ***+7 line*** indicates that the signaling receiver connects to the circuit at a point where the transmission level is +7 dB. ***-16 line*** indicates that the associated signaling transmitter connects to the circuit at a point where the transmission level is -16 dB.

1.11 Since many steps in this section relate to different procedures for the talk-off improved, partially improved, and unmodified units, the designations shown below are used to identify groups of units. The E3B unit is used in this example. Similar notations will be used for the E1B, E2B, and E4B units.

DESIGNATION USED IN SECTION	DESIGNATION ON SF UNIT
E3B	E3B
E3B-10	E3B-10 (Number will be specified)
E3B stampings followed by any dash numbers	E3B-( )
All E3B units with or without series numbers	All E3B

1.12 ***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 upon 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.

1.13 ***A Brief Test for New and Modified Units:*** The steps listed below are to be used only when it is reasonably certain that the units have not suffered damage; otherwise, the complete test must be performed. These limited tests are not extensive enough to assure that a unit will meet all requirements; however, they provide a reasonable degree of assurance of proper operation.

TEST FOR	TEST	STEPS
M Relay	A	25 through 30
CO and	B	26 through 45g,
HL Relays		50g, and 56
REC or REV	E	15 through 18,
Pot.		32, and 40
SS Pot.	F	15 through 20
OT, RT, and PM	G	25 through 38,
Pots. and G Relay		45 through 48,
		50 through 71h,
		86 through 97r
		113 and 114t

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 2B test set, J64730B (SD-56134-02) W option or later, includes power cords and patch cords for E and M leads (2P1D and 2P3B cords).

2.04 The 13A or J94021A (21A) transmission measuring set (TMS). The 21A TMS must be used if test circuit is mounted in a REVERTIVE-TERMINATING bay.

TABLE A

APPARATUS	TESTS								
	A	B	C	D	E	F	G	H	I
Test circuit (2.02)	1	1	1	1	1	1	1	1	1
2B Test set (2.03)	1	1	1	1			1		
TMS (2.04)		1	1		1	1		1	1
Cord (2.05)	1	1	1	1			1		
Cord (2.06)	1	1	1	1			1		
Cord (2.07)		1	1		1	1		1	
Cord (2.08)				1	1				
Cord (2.09)							1		
Tool (2.10)	1	1	1	1	1	1	1	1	1
258D (dummy) plug	1	1	1	1			1		
Screwdriver									
R-8210					1	1	1		1
Tool (2.11)		1				1	1		
Tool (2.12)			√						

√ As required.

2.05 Patching cord, P2A cord, 6 feet long, equipped with two 347A plugs (2P1D cord).

2.06 Patching cord, P2A cord, 6 feet long, equipped with two 347B plugs (2P3B cord).

2.07 Testing cord: for 13A TMS, W2DL cord, 6 feet long, equipped with 310 plug and two 35 cord tips (2W42A cord); for 21A TMS, P3N cord, 6 feet long, equipped with a 241A plug and a 310 plug (3P17B cord). If test circuit is mounted in a REVERTIVE-TERMINATING bay, two 3P17B cords are required.

2.08 Patching cord, P3E cord, 6 feet long, equipped with two 310 plugs (3P7A cord).

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

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

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

2.12 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	On test circuit— 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 a vertical position and normal when the white line is in a 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	Set SF key of test circuit to 2400 or 2600, depending on receiver frequency.	
6a	If test circuit is mounted in a REVERTIVE-TERMINATING bay, J98613AP— Turn CT key to operate position.	
Tests B, C, E, F, G, H, and I		
7	Connect 2W42A cord to IN terminals of 13A TMS or 241A plug of 3P17B cord to DET IN jack of 21A TMS.	
8	TMS should be known to be correctly calibrated.	
9	Connect TMS cord to SF SUP jack of test circuit.	If using -13 LINE— TMS meter indicates -11.6 to -13.1 dB. If using -16 LINE— TMS meter indicates -14.6 to -16.1 dB.
10	Set TMS attenuator switch to 0.	

STEP	ACTION	VERIFICATION

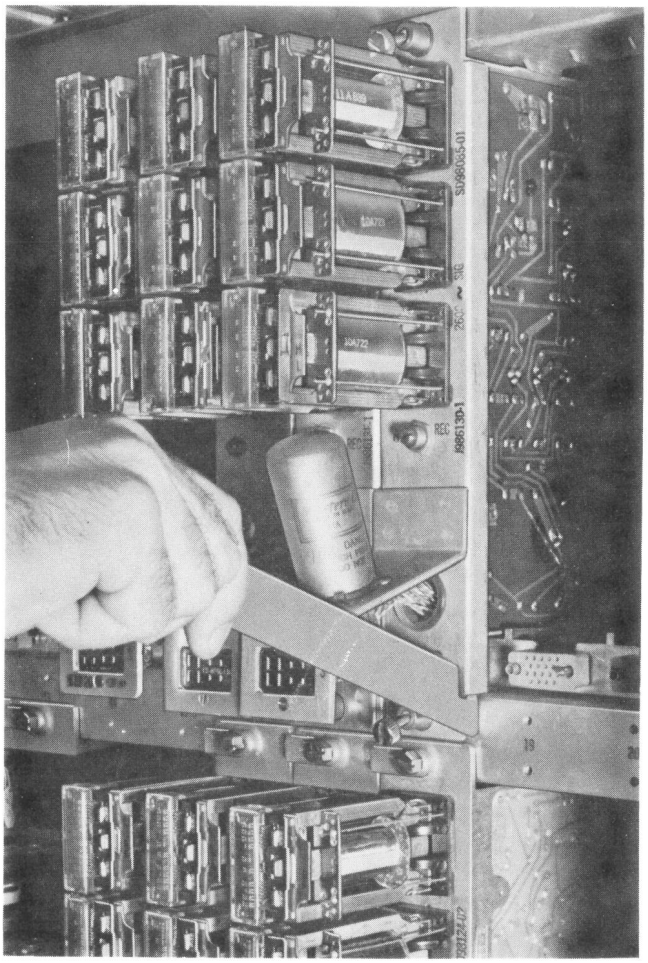

Fig. 1—Method of Removal of Fabricated Chassis

11	Disconnect plug from SF SUP jack; connect to AMP OUT jack of test circuit.	
12	Set SW2 to position 2.	TMS indicates 0 dB. See Step 13b.
13b	If requirement of Step 12 is not met—Adjust gain control of MON AMPL to exactly 0 dB.	
14	Disconnect plug from AMP OUT jack; connect to TMS jack of test circuit.	
Tests A, B, C, D, and G		
15	Patch E and M jacks of test circuit to E and M jacks of 2B test set, using 2P3B and 2P1D cords.	

STEP	ACTION	VERIFICATION

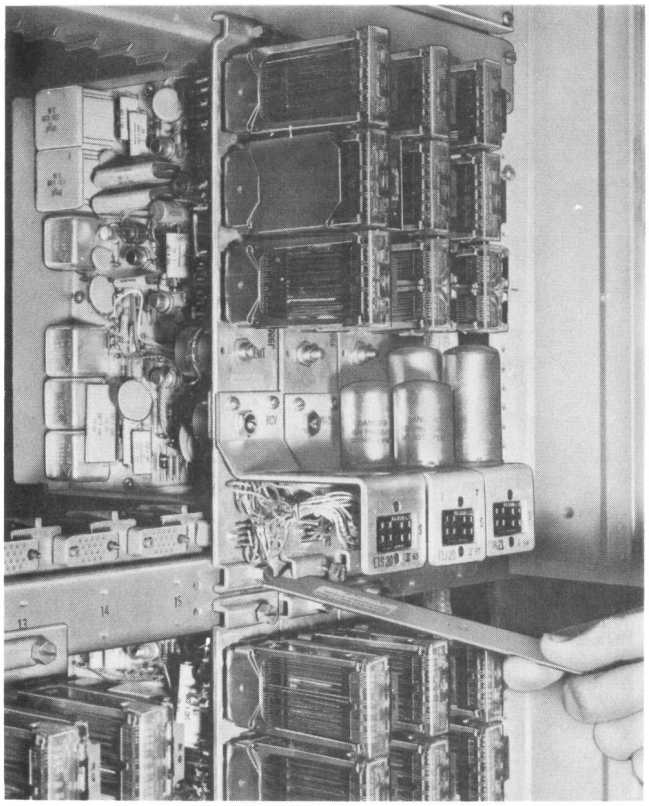

Fig. 2—Method of Removal of Die-Cast Chassis

16	On 2B test set— Set all keys to normal position.	
17	Set SCALE SEL switch to PPS.	
18	Plug power cords of 2B test set into A and B jacks of test circuit.	After 1 minute, PULSES PER SECOND meter indicates other than 0.
19	Operate CONT PLS key to DIAL PLS.	PERCENT BREAK meter indicates 0 on ***black*** scale. See Step 20c.
20c	If requirement of Step 19 is not met— Adjust pointer adjustment screw of PERCENT BREAK meter to obtain 0 reading.	
21	Insert 258D plug into P jack.	PERCENT BREAK meter indicates 100 on ***black*** scale. See Step 22d.

STEP	ACTION	VERIFICATION
22d	If requirement of Step 21 is not met— Unlock CAL % BK control, adjust to obtain reading of 100, and relock control taking care not to change 100 reading. ***Note:*** The proper performance of the tests covered in this section depends upon the correct pulse-per-second calibration and range of the 2B test set. See Section 100-263-501 for calibration if accuracy is not known.	
23	Remove 258D plug. ***Note:*** Repeat Steps 21, 22d, and 23 if test extends beyond 30 minutes.	
24	Restore CONT PLS key to normal.	

4. METHOD

STEP	ACTION	VERIFICATION
	A. Pulsing of Transmitter M Relay	
25	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter (0 to 20 scale).	
26	With coarse ADJ % BK switch on M— Adjust ADJ % BK control to minimum, then to 45 on ***black*** scale of PERCENT BREAK meter.	
27	On test circuit— Set SW1 and SW2 to position 1.	
28	Operate M key.	
29	On 2B test set— Operate TWD L key to OFF HK; then operate PLS and MEAS % BK keys to LINE.	On SF unit— M relay pulses while HL relay operates and remains operated. PERCENT BREAK meter indicates on ***black*** scale: TEST—between 41 and 53 READJUST—between 44 and 53. See Step 33e.
30	On 2B test set— Set all keys to normal.	M and HL relays release.
31	Adjust ADJ % BK control to 70 on ***black*** scale of PERCENT BREAK meter.	

STEP	ACTION	VERIFICATION
32	Operate TWD L key to OFF HK; then operate PLS and MEAS % BK keys to LINE.	On SF unit— M relay pulses while HL relay operates and remains operated. PERCENT BREAK meter indicates on ***black*** scale: TEST—between 65 and 75 READJUST—between 65 and 72. See Step 33e.
33e	If requirements of Steps 29 or 32 are not met— Change armature back tension on M relay so as to meet the READJUST pulsing requirements. The relay must also meet the requirements shown in the circuit requirements of the SD.	
34	Restore all keys on 2B test set to normal.	M and HL relays release.
35	On test circuit— Restore M key to normal.	
36	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	

B. Hold of HL Relay and, for all E2B, all E3B, or all E4B Units, Release of CO Relay

HL Relay

25	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
26	With coarse ADJ % BK switch on M— Adjust ADJ % BK control to 66.5 on ***black*** scale of PERCENT BREAK meter.	
27	Adjust ADJ PPS control for lower PPS reading until 20 on ***black*** scale of PERCENT BREAK meter is obtained.	PPS meter indicates between 2.5 and 3.5 pps.
28e	If testing E1B, E2B, E3B, or E3B-2 through -6— With ADJ % BK switch on M— Adjust ADJ % BK control to 30 on the ***black*** scale of PERCENT BREAK meter.	
29f	If testing E1B-( ), E2B-( ), E3B-7 or higher, or E4B-( )— With ADJ % BK switch on L—	

STEP	ACTION	VERIFICATION
	Adjust ADJ % BK control to 80 on the ***black*** scale of PERCENT BREAK meter.	
30	On test circuit— Set SW1 to position 2 and SW2 to position 1.	
31	Operate M key.	
32	On 2B test set— Operate TWD L key to OFF HK.	M and HL relays operate.
33	Operate PLS key to LINE.	M relay pulses. HL relay should remain operated.
34	Restore PLS key to normal.	M and HL relays operated.
35	Restore TWD L key to normal.	M relay releases, and HL relay releases in less than 1 second.
CO Relay		
36g	If testing all E2B, all E3B, or all E4B units— Adjust ADJ PPS control to 8 pps on PULSES PER SECOND meter.	
37g	With coarse ADJ % BK switch on M— Adjust ADJ % BK control to 40 on ***black*** scale of PERCENT BREAK meter.	
38g	On test circuit— Operate CO key.	
39g	Set attenuator switch of TMS to 20.	TMS indicates between -19 and -22 dB.
40g	On 2B test set— Operate TWD L key to OFF HK; then operate PLS key to LINE.	M relay pulses. HL relay operated on E3B-12, E3B-15 through E3B-18, E3B-22 or higher, and E4B-( ). HL relay may not operate on all other units.
41g	Set attenuator switch of TMS to 30.	No reading on TMS.
42g	On 2B test set— Restore PLS key to normal.	
43g	Adjust ADJ % BK control to 76 on ***black*** scale of PERCENT BREAK meter.	
44g	Operate PLS key to LINE.	M relay pulses. No reading on TMS.
45g	Restore PLS key to normal.	

STEP	ACTION	VERIFICATION
46g	Adjust ADJ PPS control to 4 pps on PULSES PER SECOND meter.	
47g	With coarse ADJ % BK switch on L— Adjust ADJ % BK control to 80 on ***black*** scale of PERCENT BREAK meter.	
48g	Operate PLS key to LINE.	M relay pulses. No reading on TMS.
49g	On 2B test set— Restore TWD L and PLS keys to normal.	M and HL relays release.
50g	On test circuit— Restore M and CO keys to normal.	
51g	On 2B test set— Operate TWD L key to ON HK.	TMS indicates -25 to -35 dB.
52h	If testing E2B-( ), E3B-7 or higher, and E4B-( )— Manually operate RG relay.	TMS indicates less power than -45 dBm.
53h	Allow RG relay to release.	TMS indicates -25 to -35 dB.
54i	If testing E4B-( )— Manually operate M relay.	TMS indicates less power than -45 dBm.
55i	Allow M relay to release.	TMS indicates -25 to -35 dB.
56	On 2B test set— Restore TWD L key to normal.	
57	Set coarse ADJ % BK switch to M.	
58i	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	

C. Transmitter Voice Path and Transmitted Tone Level

Transmitter Voice Path

25	On test circuit— Operate M key.	
26	Operate 1000~ A key.	
27	Set SW1 to position 2 and SW2 to position 2.	

STEP	ACTION	VERIFICATION
28	On 2B test set— Operate TWD L key to OFF HK.	M and HL relays operate.
29	Set attenuator switch of TMS to 0.	
30	Press TMS A and TMS B keys simultaneously.	TMS indicates between 0 and -0.2 dB.
31	Release TMS A and TMS B keys.	
32	Set SW2 to position 1.	
33	Restore 1000~ A key to normal.	
34	On 2B test set— Restore TWD L key to normal.	M and HL relays release.
Transmitted Tone Level		
35	On test circuit— Set SW1 to position 3.	
36	Press TMS A and TMS B keys simultaneously.	If testing on -13 LINE— TMS meter indicates between -32 and -34 dB. If testing on -16 LINE— TMS meter indicates between -35 and -37 dB.
37	Release TMS A and TMS B keys.	
38	Set attenuator switch of TMS to 30.	
39	Block HL relay on SF unit operated.	
40	On TMS— Set attenuator switch to 20.	
41	On test circuit— Press TMS A and TMS B keys simultaneously.	If testing on -13 LINE— TMS meter indicates between -19.5 and -22.5 dB. If testing on -16 LINE— TMS meter indicates between -22.5 and -25.5 dB.
42	Release TMS A and TMS B key.	
43	Set SW1 to position 4.	TMS indicates less power than -45 dBm after M relay operates.
44	Remove block from HL relay.	HL relay remains operated. TMS indicates less power than -45 dBm after M relay operates.

STEP	ACTION	VERIFICATION
45	Set attenuator switch of TMS to 0.	
46	Restore M key to normal.	M and HL relays release.
47e	◗If no other tests are to be made— Remove all cords, restore all keys to normal, and return unit to service or spare position.◖	
D. Voice Amplifier Cutoff Transistor		
25	On 2B test set— Set SCALE SEL switch to 20V.	
26	Using 3P7A cord— Patch SENS 1 jack on test circuit to VM jack of 2B test set.	
27	Set SW1 to position 5.	On 2B test set— VOLTS meter indicates less than 0.20 volt.
28	Remove patch cord.	
29	On 2B test set— Set SCALE SEL switch to PPS.	
30e	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	
E. Gain of Receiver Voice Amplifier and Insertion of Band-Elimination Filter		
Receiver Voice Amplifier		
15	Set attenuator switch of TMS to 0.	
16	Set SW1 to position 5 and SW2 to position 2.	
17	Operate M key.	M and HL relays operate.
18	Operate 1000~ B key.	TMS indicates 0 dB. See Step 19c.
19c	If requirement of Step 18 is not met— Adjust REC or RCV potentiometer of SF unit under test to obtain exactly 0 dB.	
20	Set attenuator switch of TMS to +5.	
21	On test circuit— Set SW1 to position 6, SW2 to position 1.	

STEP	ACTION	VERIFICATION
22	Restore 1000~ B key.	
23	Set ATT attenuator to 18.6.	
24	Patch between 1000-0-600 jack and SF TST jack using 3P7A cord.	Record TMS reading.
25	Set SW2 to position 2.	TMS indicates within ±0.3 dB of reading recorded in Step 24.
26	Set SW1 to position 5.	
27	Operate 1000~ B key.	
28	Remove 3P7A cord from 1000-0-600 jack and SF TST jack.	
29	Set attenuator switch of TMS to 0.	TMS indicates 0 dB.
Band Elimination Loss at 1000 Hz		
30	Manually operate RG relay of SF unit.	TMS indicates between 0 and -0.7 dB.
31	◗Manually restore RG relay.◖	
32	On test circuit— Restore 1000~ B key to normal.	
33	Set SW1 to position 6 and SW2 to position 4.	M and HL relays release.
34	Set ATT attenuator to 10.	TMS indicates 0 ±0.2 dB. See Step 35d.
35d	If requirement of Step 34 is not met— Adjust gain control of TEST AMPL for 0 dB.	
Electronic Cut Operation		
36	Hold RG relay nonoperated for duration of Step 37; see caution. (Maximum time—30 seconds.) ***Caution: RG relay should not be blocked in nonoperated position with blocking tool, as continued application of high-level tone can damage transistors and/or resistors. As soon as verification of Step 37 has been made, allow RG relay to operate.***	
37	Set SW2 to position 3.	TMS indicates less power than -35 dBm. Allow RG relay to operate.

STEP	ACTION	VERIFICATION
		Note: Operation of RG relay depends on proper setting of SS potentiometer. If it does not operate, perform Test F, then repeat Test E, Steps 33 through 37.
Band-Elimination Loss at 2400 or 2600 Hz		
38	Set SW2 to position 2.	TMS indicates -30 dBm or less power or if circuit is mounted in a REVERTIVE-TERMINATING bay and CT key is operated (see Step 6a), a TMS reading of -28 dBm or less power is satisfactory.
39e	If test circuit is mounted in a REVERTIVE-TERMINATING bay and the CT key is operated and the requirement of Step 39a is not met— Adjust oscillator of 21A TMS to 2600 ±10 Hz, to a level of -15.6 dB; and connect it to SF TST jack.	TMS indicates -30 dBm or less power.
40	Restore M key to normal.	
41f	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	
F. Operate Sensitivity of Receiver Signaling Amplifier		
	Note: This test should be performed if the receiver of the SF unit is connected in a 4-wire, +7 line office or in any other office if Tests G and H are to be performed. Also, it is important to have the test amplifier properly adjusted per Test E, Steps 33 through 35d. The operation and release of the G relay, in those units having one, depends upon the release and operation of the RG relay. See Test G for checking the G relay.	
15	Set attenuator switch of TMS to 0.	
16	On test circuit— Set SW1 to position 6, SW2 to position 4.	
17	Set ATT attenuator to 33.	
18	Change SW2 to position 3.	RG relay should not operate. See Step 19c.
19c	If RG relay does operate— Adjust SS potentiometer slightly counterclockwise until RG relay releases.	RG relay releases.

STEP	ACTION	VERIFICATION
20	Set ATT attenuator to 32.	RG relay should operate. See Step 21d.
21d	If RG relay does not operate— Adjust SS potentiometer slightly clockwise until it operates.	
22d	Repeat Steps 17 through 21d, starting with Sw2 in position 4, until requirements of these steps are met.	
23	Set ATT attenuator to 40.	RG relay should release.
24e	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	

G. Timing of Receiver R, RG, and G Relays

Note: The requirements of this test depend upon the setting of the SS potentiometer. Perform Test F first if setting of SS potentiometer is not known.

25	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter (0 to 20 scale).	
26	With coarse ADJ % BK switch on M— Adjust ADJ % BK control to 55 on ***black*** scale of PERCENT BREAK meter.	
27	On test circuit— Set SW1 to position 7.	
28	On 2B test set— Set TWD L key to OFF HK; then operate PLS and MEAS % BK keys to LINE.	M relay of test circuit pulses. PERCENT BREAK meter indicates 55 on ***black*** scale. See Step 29e.
29e	If requirement of Step 28 is not met— Adjust M potentiometer of test circuit to 55 on ***black*** scale of PERCENT BREAK meter.	
30	On test circuit— Set ATT attenuator to 11.	

Adjust OT Potentiometer

31	On 2B test set— Adjust ADJ % BK control to 31 on ***black*** scale of PERCENT BREAK meter.	

STEP	ACTION	VERIFICATION
32	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
33	On test circuit— Set SW1 to position 8 and SW2 to position 3.	RG relay should not operate as indicated by PERCENT BREAK meter ***red*** scale reading of between 0 and 6. See Step 39f.
34	Set SW1 to position 7.	
35	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
36	Adjust ADJ % BK control to 35 on ***black*** scale of PERCENT BREAK meter.	
37	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
38	On test circuit— Set SW1 to position 8.	RG relay should pulse uniformly as indicated by a reading of 8 or more on PERCENT BREAK meter ***red*** scale. See Step 39f.
39f	If requirement of Step 33 or 38 is not met— Set SW1 to position 7.	
40f	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
41f	Adjust ADJ % BK control to 33 on ***black*** scale of PERCENT BREAK meter.	
42f	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
43f	On test circuit— Set SW1 to position 8.	
44f	Adjust OT potentiometer of SF unit fully clockwise and then slowly counterclockwise until RG relay pulses uniformly.	RG relay pulses uniformly as indicated by a reading of 8 or more on PERCENT BREAK meter ***red*** scale.
Adjust RT Potentiometer		
45	Set SW1 to position 7.	
46	On 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	

STEP	ACTION	VERIFICATION
47	Adjust ADJ % BK control to 45 on ***black*** scale of PERCENT BREAK meter.	
48	On test circuit— Set SW1 to position 8.	PERCENT BREAK meter indicates between 48 and 50 on ***red*** scale for E1B, E2B, and E3B and between 50 and 52 on ***red*** scale for E4B. See Step 49g.
49g	If requirement of Step 48 is not met— Turn RT potentiometer of SF unit fully counterclockwise; then slowly rotate it clockwise until a reading of 49 for E1B, E2B, and E3B or 51 for E4B is obtained.	
50	Set SW1 to position 7.	
51h	If testing E4B-( )— On 2B test set— Restore all keys to normal.	
52h	Set coarse ADJ % BK switch to S and OG-BG key to BG.	
Adjust PM Potentiometer		
53h	Remove the cords which connect the E and M jacks of the 2B test set to the E and M jacks of the test circuit.	
54h	Patch the D jack of the 2B test set to the E&M jacks of the test circuit using a 3P17B cord. The notched end of the 241A plug should be inserted in the M jack.	
55h	On the 2B test set— Set the TWD-D key to OFF-HK.	
56h	Set the PLS key to DROP.	
57h	Set the MEAS % BK key to DROP.	
58h	Turn ADJ % BK control to its full clockwise position.	
59h	Adjust ADJ PPS control to 12 pps on PULSES PER SECOND meter (0 to 20 scale).	
60h	Adjust ADJ % BK control counterclockwise to 75 on ***black*** scale of PERCENT BREAK meter.◀	
61h	On test circuit— Set SW1 to position 8.	PERCENT BREAK meter indicates between 66.5 and 68.5 on ***red*** scale. See Step 62i.

STEP	ACTION	VERIFICATION
62i	If the requirement of Step 61h is not met— Turn the PM potentiometer of SF unit until a reading of 67.5 is obtained on ***red*** scale of PERCENT BREAK meter.	
63h	On test circuit— Set SW1 to position 7.	
64h	On 2B test set— Restore all keys to normal.	
65h	Set ADJ % BK switch to M.	
66h	Set OG-BG key to OG.	
67h	Remove the 3P17B patch cord between the D jack of the 2B test set and the E and M jacks of the test circuit.	
68h	Patch the E and M jacks of the test circuit to the E and M jacks of the 2B test set using 2P3B and 2P1D cords.	
69h	On 2B test set— Set TWD-L key to OFF-HK.	
70h	Set PLS key to LINE.	
71h	Set MEAS % BK key to LINE.	
72	◗Adjust ADJ PPS control to 12 pps on PULSES PER SECOND meter (0 to 20 scale).◖	
73	Adjust ADJ % BK control to 75 on ***black*** scale of PERCENT BREAK meter.	
74	On test circuit— Set SW1 to position 8.	Unit pulses uniformly with PERCENT BREAK meter reading between 59 and 72 on ***red*** scale. ***Note:*** The total fluctuation of meter needle should not exceed one-half division during 5-second observation interval. Look for momentary upward or downward needle deflections. If such deflections are observed, the requirement is ***not*** met.
75j	If requirement of Step 74 is not met— On test circuit— Set SW1 to position 7.	

STEP	ACTION	VERIFICATION
76j	On 2B test set— Adjust ADJ % BK control to 76 on ***black*** scale of PERCENT BREAK meter.	
77j	On test circuit— Set SW1 to position 8.	Unit pulses uniformly (see note, Step 74) with PERCENT BREAK meter reading between 59 and 72 on ***red*** scale.
78k	If the requirement of Step 77j is not met— Adjust OT potentiometer slightly clockwise until unit begins to pulse uniformly with PER CENT BREAK reading between 59 and 72 on ***red*** scale. (See note, Step 74.)	
Set	SW1 to position 7.	
80	On 2B test set— Adjust ADJ % BK control to minimum and then to 50 on ***black*** scale of PERCENT BREAK meter.	
81	On test circuit— Set SW1 to position 8.	Unit pulses uniformly (see note, Step 74) with PERCENT BREAK meter reading between 54 and 64 on ***red*** scale.
81l	If requirement of Step 81 is not met— Adjust OT potentiometer slightly counterclockwise until unit begins to pulse uniformly with PERCENT BREAK meter reading between 54 and 64 on ***red*** scale.	
83m	If any adjustment was made to the OT potentiometer— Repeat Steps 31 through 38 beginning with SW1 in position 7 and PULSES PER SECOND meter reading 10 pps.	Same as Steps 31 through 38.
84n	If the OT potentiometer was adjusted and the requirements of Steps 31 through 38 are not met— Adjust the RG relay to meet electrical and mechanical requirements as follows. If there is a momentary downward deflection of the meter needle, adjust the armature back tension toward the minimum. If there is an upward deflection of the meter needle, adjust the armature back tension toward the maximum. After readjusting the RG relay, return to Step 31 and complete test.	

STEP	ACTION	VERIFICATION
85p	If uniform pulsing cannot be achieved by readjustment of the RG relay, replace the R relay and return to Step 31 and complete test.	
G Relay		
86	Set SW1 to position 7.	
87	On 2B test set— Adjust ADJ PPS control to 10 on PULSES PER SECOND meter.	
88q	▶If testing E1B-11 or higher, E2B-11 or higher, E3B-11 through -18, E3B-21 or higher, and E4B-( )— Adjust ADJ % BK control to 75 on ***black*** scale of PERCENT BREAK meter.◀	
89q	On test circuit— Set SW1 to position 8.	RG relay pulses with G relay operated.
90q	Manually release G relay.	RG relay stops pulsing and should remain in operated position.
91q	Set SW1 to position 7.	
92r	If testing E1B-( ), E2B-( ), E3B-7 or higher, and E4B-( )— Adjust ADJ % BK control to 66.5 on ***black*** scale of PERCENT BREAK meter.	
93r	Adjust ADJ PPS control counterclockwise until 20 on ***black*** scale of PERCENT BREAK meter is obtained.	PULSES PER SECOND meter indicates between 2.5 and 3.5 pps.
94r	On test circuit— Set SW1 to position 8.	RG relay pulses while G relay remains operated.
95r	On 2B test set— With coarse ADJ % BK switch on L— Adjust ADJ % BK control clockwise to 40 on ***red*** scale of PERCENT BREAK meter.	RG relay pulses while G relay remains operated.
96r	Adjust ADJ % BK control clockwise to 70 on ***red*** scale of PERCENT BREAK meter.	RG and G relays both pulse.
97r	With ADJ % BK switch on M— Adjust ADJ % BK control to about 20 on ***red*** scale of PERCENT BREAK meter.	RG relay pulses while G relay remains operated.

STEP	ACTION	VERIFICATION
Rering Response		
98	On test circuit— Set SW1 to position 7.	
99	On 2B test set— With PULSES PER SECOND meter reading 10— Adjust ADJ % BK control to 70 on ***black*** scale of PERCENT BREAK meter.	
100	Adjust ADJ PPS control until 28 on ***black*** scale of PERCENT BREAK meter is obtained.	PULSES PER SECOND meter indicates between 3.5 and 4.5 pps.
101	On test circuit— Operate M key.	
102	Set SW1 to position 8 and SW2 to position 2.	PERCENT BREAK meter indicates between 26 and 34 on ***red*** scale.
103	Change ATT attenuator setting in 2-dB increments from 5 to 17.	Reading of Step 102 should not change more than ±2 percent.
104	Set ATT attenuator to 11.	
105	Change SW1 to position 7.	
106	On 2B test set— Adjust ADJ % BK control to 50 on ***black*** scale of PERCENT BREAK meter. ***Note:*** On some 2B sets, it may not be possible to obtain 50 with coarse ADJ % BK switch on M; therefore, change it to L and readjust for reading of 50.	
107	On test circuit— Change SW1 to position 8.	PERCENT BREAK meter indicates between 42 and 56 on ***red*** scale.
108s	If testing E3B-( ) and E4B-( ) units— Set SW1 to position 7.	
109s	On 2B test set— Adjust ADJ % BK control to 16 on ***black*** scale of PERCENT BREAK meter.	
110s	On test circuit— Change SW1 to position 8.	RG relay remains released as indicated by a reading of 0 on ***red*** scale of PERCENT BREAK meter.
111	Restore M key to normal.	

STEP	ACTION	VERIFICATION
112	Set SW2 to position 4.	
113	On 2B test set— Restore keys to normal and set coarse ADJ % BK switch to M if it was changed in Step 106.	
114t	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	

H. Receiver Guard Action and 2-Wire Controls

	Note: The requirements of this test depend upon the setting of the SS potentiometer. Test F should be performed first if setting of SS potentiometer is not known.	
15	On test circuit— Set SW1 to position 5 and SW2 to position 6.	
16	Set attenuator switch of TMS to 10 or 15.	TMS indicates between -18.5 and -19.5 dB.
17	Set ATT attenuator to: 31 for E1B, E2B, E3B, E3B-2, and E3B-4; 26 for E1B-( ), E2B-( ), E4B-( ), and E3B-( ), except E3B-2 and E3B-4.	
18	Set SW2 to position 5.	RG relay should be released.
19	Set SW1 to position 6.	RG relay remains released.
20	Set SW1 to position 5.	
21	Change ATT attenuator to: 26 for E1B, E2B, E3B, E3B-2, and E3B-4; 21 for E1B-( ), E2B-( ), E4B-( ), E3B-( ), except E3B-2 and E3B-4.	
22	Set SW1 to position 6.	RG relay operates.
23	Change SW1 to position 5.	RG relay releases.
24	Set SW2 to position 7.	
25	Operate M key.	M and HL relays operate.
26	Change ATT attenuator to: 28 for E1B, E2B, and E3B; 24 for E1B-( ), E2B-( ), E3B-( ), and E4B-( ).	

STEP	ACTION	VERIFICATION
27	Change SW1 to position 6.	RG relay remains released. F lamp should be lighted, except for E4B-( ) where F lamp remains extinguished.
28	Set SW1 to position 5.	
29	Change ATT attenuator to: 20 for E1B, E2B, and E3B; 17 for E1B-(.), E2B-( ), E3B-( ), and E4B-( ).	
30	Set SW1 to position 6.	RG relay operates, extinguishing F lamp, except for E1B-13 or higher where F lamp remains lighted.
31	Restore M key to normal.	M and HL relays release. On E1B-13 or higher— F lamp extinguished.
32	Set SW1 to position 5 and SW2 to position 4.	RG relay releases. On E1B-13 or higher— F lamp is lighted.
33c	If no other tests are to be made— Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	

I. Final Adjustment of Receiver Sensitivity

Note: This adjustment is made only in 2-wire or 4-wire offices where a +4 receiving level is used or in 2-wire offices where a +7 receiving level is used. It is important to have the test amplifier properly adjusted per Test E, Steps 33 through 35d, for this test.

STEP	ACTION
15	Set SW1 to position 6 and SW2 to position 4.
16	Set attenuator switch of TMS to 0.
17	Set ATT attenuator to level shown for particular office.

OFFICE	ATT
4-wire, +4 line	36
2-wire, +7 line	35
2-wire, +4 line	37

STEP	ACTION	VERIFICATION
18	Change SW2 to position 3.	RG relay should not operate. See Step 19c.
19c	If RG relay does operate— Adjust SS potentiometer slightly counterclockwise until RG relay releases.	RG relay releases.
20	Set ATT attenuator to level shown for particular office.	RG relay should operate. See Step 21d.

OFFICE	ATT
4-wire, +4 line	35
2-wire, +7 line	34
2-wire, +4 line	35

21d	If RG relay does not operate— Slowly increase setting of SS potentiometer until it operates; repeat Steps 17 through 21d until requirements of these steps are met, starting with SW2 in position 4.	
22	Remove all cords, restore all keys to normal, and return SF unit to service or spare position.	