

**2600-HZ E1S, E2S, AND E3S SINGLE-FREQUENCY SIGNALING CIRCUIT  
OUT-OF-SERVICE TESTS USING TESTING CIRCUIT SD-96519-01  
OR SD-96519-02**

**1. GENERAL**

**PAGE**

**1.01** This section describes methods of making out-of-service tests on 2600-Hz single-frequency signaling circuits per SD-98138-01 or SD-98138-02 using testing circuit SD-96519-01 or SD-96519-02. It also describes methods of making potentiometer adjustments to compensate for 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 of the special techniques involved in testing and clearing trouble on some of the components.

- (a) Transmission loss from 2- to 4-wire transmit
- (b) Transmission loss from 4-wire receive to 2-wire
- (c) Approximate adjustment of REC or RCV and XMT or TRMT potentiometers
- (d) Trans-hybrid loss from 4-wire receive to 4-wire transmit.

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**1.02** This section is reissued to revise Test D.

This reissue does not affect the Equipment Test List.

**1.03** The tests covered are:

**PAGE**

**A. Pulsing of Transmitter A Relay—Using the 2B Signaling**

**Test Set:** This test checks that the A relay is properly following pulses and that the pulse corrector and cut circuit are functioning . . . . .

**7**

**B. Pulsing of Transmitter A Relay—Using the 4A Signaling Test**

**Set:** This test checks that the A relay is properly following pulses and that the pulse corrector and cut circuit are functioning. . . . .

**11**

**C. Transmitted Tone Level:** This test checks the level of the transmitted 2600-Hz tone. . . . .

**14**

**D. 4-Wire Terminating Circuit and Receiver Voice Amplifier:** The following features are checked.

**E. Sensitivity of Receiver Amplifier and Timing of Receiver R Relay:**

This test checks the receiver sensitivity and describes the adjustment of the SS potentiometer. This test also checks the operate and release time of the R relay and describes the adjustment of the SENS and RT potentiometers. . . . .

**18**

**F. Voice Amplifier Cutoff Transistor—Using 2B Test Set of VOM:**

This test checks that Q1 transistor is not conducting when there is no signal input. . . . .

**21**

**G. Voice Amplifier Cutoff Transistor—Using 4A Test Set:**

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. . . . .

**22**

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

**23**

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## PAGE

- I. RT Relay Operation:** This test checks the RT relay and the performance required to trip ringing. **23**
- 1.04** The J94021A (21A) transmission measuring set is referred to in this section as the 21A.
- 1.05** The 2B signaling test set is referred to in this section as 2B test set.
- 1.06** The 4A signaling test set is referred to in this section as the 4A test set.
- 1.07** The test set for timing tests, J24753A, is referred to in this section as TTS.
- 1.08** 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. Jacks and keys mentioned in this section are part of the test circuit unless otherwise specified.
- 1.09** Adjust the 2B test set slowly to prevent pulsing out incorrect values, especially above 70 percent. Incorrect values will be obtained if the rate of vibration of the PERCENT BREAK meter pointer is not the same as 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 slowly turn the control clockwise until the desired percent break value is obtained. It may be necessary to change the coarse ADJ % BK switch from S, M, or L setting to obtain the desired range on the PERCENT BREAK meter.
- 1.10 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 paragraph indicated by the number in parentheses.
- 2.02** Test circuit, J98613AY (SD-96519-01 or SD-96519-02), including folding test fixture J98613AC.
- 2.03** 2B test set, *W* option and subsequent options, J64730B (SD-56134-02), including power cords and patch cords for E and M leads (2P1D and 2P3B cords).
- 2.04** J94021A (21A) transmission measuring set.
- 2.05** Test set for timing tests, TTS, J24753A (SD-25707-01) furnished with one 3P17B and two 3P15A patch cords.
- 2.06** 4A test set J94743A (SD-1C244-01), equipped with E&M interface unit, J94743AD and SF interface unit, J94743AA.
- 2.07** VOM, KS-14510, equipped with testing leads.
- 2.08** Patching cord, P3E cord, 6 feet long, equipped with two 310 plugs (3P7A cord assembly).
- 2.09** Patching cord, P3N cord, 6 feet long, equipped with 241A plug and 310 plug (3P17B cord assembly).
- 2.10** Patching cord, 2 feet long, equipped with 8-pin (male) Jones plug, KS-8585 L10 and 347 plug (P1P cord assembly).
- 2.11** Patching cord, P2A cord, 6 feet long, equipped with two 347A plugs (2P1D cord assembly).
- 2.12** Patching cord, P2A cord, 6 feet long, equipped with two 347B plugs (2P3B cord assembly).

TABLE A

APPARATUS	TEST								
	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			
TMS (2.04)	1		1	1	1			1	
TTS (2.05)					1				
4A Test Set (2.06)		1					1		
VOM (2.07)						1			
Cord (2.08)					1		1		1
Cord (2.09)	1	1	1	1	2		1	1	
Cord (2.10)	1	1							
Cord (2.11)	1								
Cord (2.12)	1								
Cord (2.13)					2	1			1
Tool (2.15)	1	1	1	1	1	1		1	1
Screwdriver, C	1	1		1	1				
258D (dummy) Plug	1	1							
Blocking Tool (2.16)	✓	✓	✓	✓	✓			✓	✓

✓As required

**2.13** Two testing cords, W3M cord, 6 feet long, equipped with a 310 plug and 360A, 360B, 360C tools (3W4A cord assembly).

**2.14** 725A tool, used to gain mechanical advantage in prying loose the signaling units from connectors.

**2.15** 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 At test circuit—  
Set all keys to normal position before starting any tests and check test circuit per Section 179-315-501 if calibration is unknown.

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

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

STEP	ACTION	VERIFICATION
3	Remove signaling unit from its in-service position using 725A tool, as shown in Fig. 1 or 2.	

**Note:** In order to perform the tests in this section, all units must be provided with loop start wiring. If signaling circuit is not provided with loop start wiring (*Z* option), strap terminals 1 to 2, 3 to 4, and 6 to 7 on the PLR connector. An adapter plug can be made using a Cinch-Jones plug, type 8PB, and steel snap-on shield, type F16. Strap pins 1 to 2, 3 to 4, and 6 to 7. Stencil E2S on shield. When testing units not provided with loop start wiring, plug the adapter into the PLR socket.

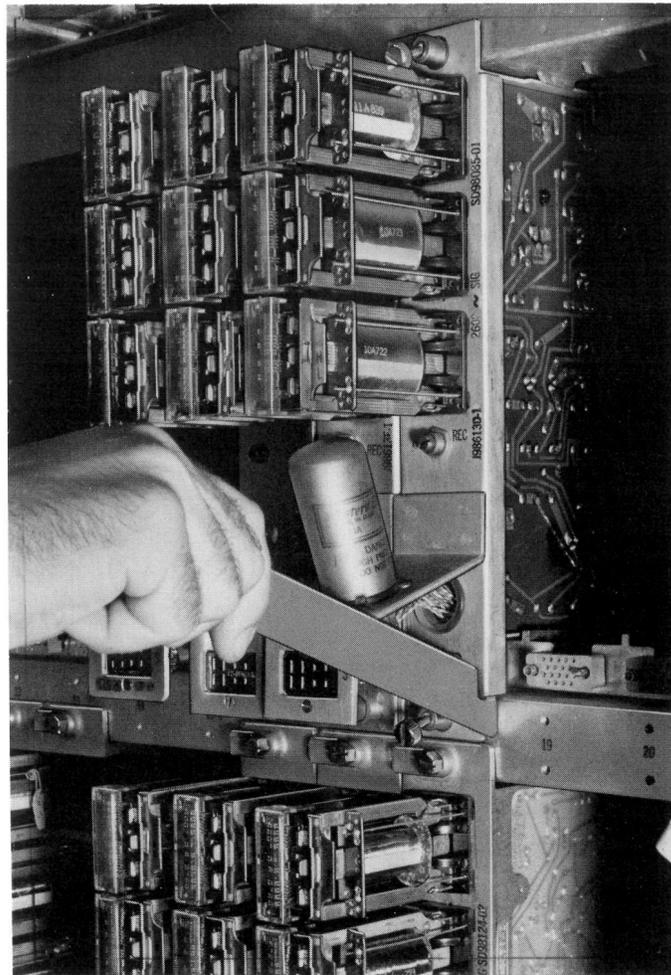


Fig. 1—Method of Removal of Fabricated Chassis

## STEP

## ACTION

## VERIFICATION

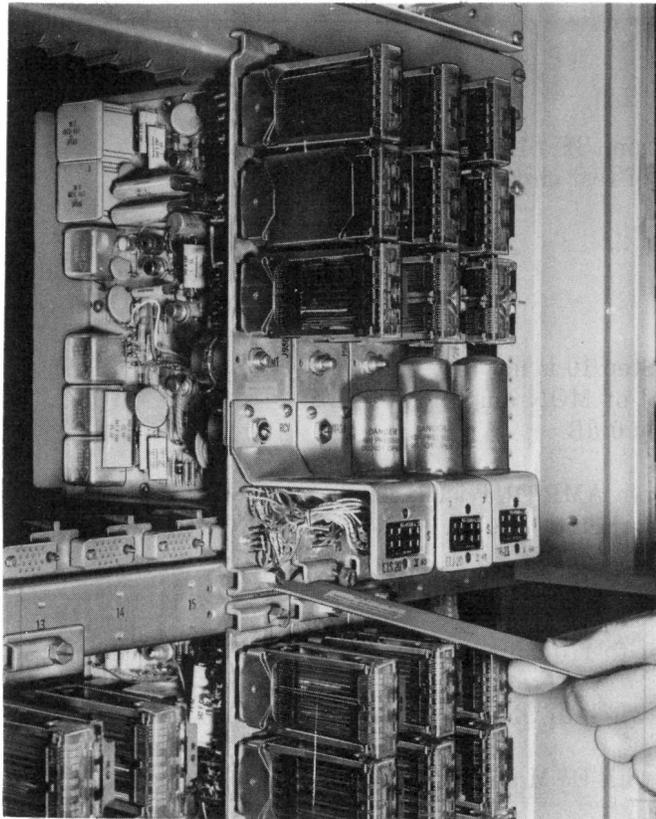


Fig. 2—Method of Removal of Die-Cast Chassis

- 4 Plug signaling unit into folding test fixture.
- 5 Operate 2-WIRE key on test circuit.
- 6a If test circuit is mounted in a REVERTIVE-TERMINATING bay, J98613AP—  
Operate CT key.

**Tests A, B, C, D, E, G, and H**

- 7 Calibrate 21A, if necessary.
- 8 Using P3N cord, connect DET IN jack of 21A to SF SUP jack of test circuit.

At 21A—  
Meter indicates between  $-15.1$  and  $-16.1$  dB.

**Note:** The 21A TMS requires that the DET INPUT switch be set to the proper position for each measurement. The 21A indications called for as verification in this section are

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
		the combined total of the DET INPUT switch setting and the meter indication.
9	At test circuit— Disconnect plug from SF SUP jack, connect to AMP OUT jack of test circuit.	
10	Set SW2 to position 2.	At 21A— Meter indicates 0 dB. See Step 11b.
11b	If requirement of Step 10 is not met— Adjust gain control of MON amplifier to give indication of exactly 0 dB.	
12	Disconnect plug from AMP OUT jack; connect to TMS jack of test circuit.	

**Tests B and G**

- 13 Connect 4A test set to 110 volts ac.
- 14 Operate POWER switch to ON.
- 15 Equip 4A test set with E&M and SF interface
- 16 Using P3N cord, connect 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 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.
- 18 Set SELECTOR switch to NORM.
- 19 Set READ switch to MSEC UPDATE.
- 20 Set SEND switch to EM.
- 21 Set PULSE MODE switch to CONT.
- 22 Operate GEN SUPV key to OFF HK.
- 23 At 4A E&M interface unit—  
Operate PULSE/MEAS key to LINE.
- 24 Set E&M/CX—S/R switch to E&M/CX.

STEP	ACTION	VERIFICATION
25	Operate TWD DROP key to ON HK.	
26	Operate TWD LINE key to OFF HK.	

#### 4. METHOD

STEP	ACTION	VERIFICATION
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##### A. Pulsing of Transmitter A Relay—Using 2B Signaling Test Set

13	Using P2A cords, patch E and M jacks of test circuit to E and M jacks of 2B test set.	
14	At 2B test set— Set all keys to normal position.	
15	Set SCALE SEL switch to PPS.	
16	Plug power cords of 2B test set into A, B jacks of test circuit.	After 1 minute, PULSES PER SECOND meter indicates other than 0.
17	Operate CONT PLS key to DIAL PLS.	PERCENT BREAK meter reads 0 on <i>black</i> scale. See Step 18c.
18c	If requirement of Step 17 is not met— Adjust pointer adjustment screw of PERCENT BREAK meter to 0.	
	<i>Note:</i> Perform Steps 19 through 21 as often as necessary if test extends beyond 30 minutes.	
19	At 2B test set— Insert 258D plug into P jack.	PERCENT BREAK meter indicates 100 on <i>black</i> scale. See Step 20d.
20d	If requirement of Step 19 is not met— Unlock CAL % BK control, adjust to 100, relock control taking care not to change 100 reading.	
21	Remove 258D plug.	
22	Restore CONT PLS key to normal.	
23	Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter (0 to 20 scale).	
24	With coarse ADJ % BK switch to M— Adjust ADJ % BK control to 55 on black scale of PERCENT BREAK meter.	

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STEP	ACTION	VERIFICATION
25	At test circuit— Set SW1 to position 7, SW2 to position 1.	
26	At 2B test set— Operate TWD L key to OFF HK, then PLS, MEAS % BK keys to LINE.	PERCENT BREAK meter indicates 55 on <i>black</i> scale. See Step 27e.
27e	If requirement of Step 26 is not met— Adjust M potentiometer of testing circuit to 55 on <i>black</i> scale of PERCENT BREAK meter on 2B test set.	
28	Connect P1P test cord from S socket of SF signaling unit to M1 jack on test circuit.	At 2B test set— PERCENT BREAK meter indicates 0 on <i>black</i> scale.
29	At test circuit— Set SW1 to position 2.	
30	Operate E1C-1 key.	
31	Depress MIN LP key.	At SF unit— A relay pulses. At 2B test set— PERCENT BREAK meter indicates 45 to 55 on <i>black</i> scale. See Step 39g and 41i.
32f	If testing E2S units— At 2B test set— Adjust ADJ % BK control fully counterclockwise and then clockwise until 90 on <i>black</i> scale of the PERCENT BREAK meter is obtained.	
33f	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates -45 dBm or less power. See Step 40h.
34f	At test circuit— Release TMS A, TMS B keys.	
35f	At 2B test set— Adjust ADJ % BK control clockwise until 70 on <i>black</i> scale of the PERCENT BREAK meter is obtained.	
36f	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates between -26 and -31 dB with pulsating swings of approximately 1 dB. See Step 40h.

STEP	ACTION	VERIFICATION
37f	<p>At 2B test set— Adjust ADJ % BK control slowly clockwise observing 21A indication. At one point the pulsating indication on the 21A will start to shift to a lower indication, indicating greater power. (This may be repeated by adjusting the ADJ % BK control counterclockwise and then clockwise until the <i>just-start-to-shift</i> point is reached.) Observe the PERCENT BREAK meter.</p>	<p>Indication on PERCENT BREAK meter <i>black</i> scale should be between 35 and 53 percent. See Step 40h.</p>
38	<p>At test circuit— Release MIN LP, TMS A, and TMS B keys.</p>	
39g	<p>If requirement of Step 31 is not met— Mechanical and electrical requirements of A relay on unit under test should be checked.</p>	
40h	<p>If requirement of Step 31 is met but the requirements of Steps 33f, 36f, or 37f are not met— Perform Test C; if its requirements are met, the pulse corrector is not functioning properly and unit under test must be returned to a repair center.</p>	
41i	<p>If any adjustments were made on the A relay— Repeat Steps 25 through 38 beginning with E1C 1 key normal, and P1P cord disconnected.</p>	
42	<p>At test circuit— Set SW1 to position 7.</p>	
43	<p>Remove P1P cord from M1 jack only.</p>	
44	<p>At 2B test set— Adjust ADJ % BK control to 70 on <i>black</i> scale of PERCENT BREAK meter.</p>	
45	<p>At test circuit— Set SW1 to position 2.</p>	
46	<p>Insert P1P cord into M1 jack.</p>	
47	<p>Depress MAX LP key.</p>	<p>At SF unit— A relay pulses. At 2B test set— PERCENT BREAK meter indicates between 15 and 30 on <i>black</i> scale of 2B test set. See Steps 52j and 54l.</p>

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STEP	ACTION	VERIFICATION
48f	If testing E2S units— At 2B test set— Adjust ADJ % BK control slowly clockwise until 10 on the <i>black</i> scale of the PERCENT BREAK meter is obtained.	
49f	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates between -24 and -28 dB with pulsating swings of approximately 0.7 dB. See Step 53k.
50f	At 2B test set— Adjust ADJ % BK control slowly counterclockwise while observing 21A indication. At one point the pulsating indication on the 21A will start to shift to a higher indication, indicating less power. (This may be repeated by slowly adjusting the ADJ % BK control clockwise and then counterclockwise until the <i>just-start-to-shift</i> point is reached.) Observe the PERCENT BREAK meter.	Indication on PERCENT BREAK meter <i>black</i> scale should be between 18 and 35 percent. See Step 53k.
51	At test circuit— Release MAX LP, TMS A, TMS B keys.	
52j	If requirement of Step 47 is not met— Mechanical and electrical requirements of A relay on unit under test should be checked.	
53k	If requirement of Step 47 is met but the requirements of Steps 49f and 50f are not met— Perform Test C; if its requirements are met, the pulse corrector is not functioning properly and unit under test must be returned to a repair center.	
54l	If any adjustments were made on the A relay per Step 52j— Repeat Steps 25 through 51 beginning with E1C 1 key normal and P1P cord disconnected.	
55f	If testing E2S units— At 2B test set— Adjust ADJ PPS control to 3 pps on PULSES PER SECOND meter.	
56f	At test circuit— Insert dummy plug into SF SUP jack.	
57f	Simultaneously depress MIN LP, TMS A, TMS B keys.	

STEP	ACTION	VERIFICATION
58f	At 2B test set— Adjust ADJ % BK control to 70 on <i>black</i> scale of PERCENT BREAK meter.	Pointer on 21A pulsates at 3 pps. See Step 63m.
59f	At test circuit— Release MIN LP, operate MAX LP simultaneously with TMS A and TMS B keys.	
60f	At 2B test set— Adjust ADJ % BK control slowly clockwise until pointer on 21A just stops pulsating. (For greater range, set coarse ADJ % BK to L.)	PERCENT BREAK meter indicates between 28 and 50 on <i>black</i> scale. See Step 63m.
61f	At test circuit— Release MAX LP, TMS A, and TMS B keys.	
62f	Remove dummy plug from SF SUP jack.	
63m	If requirement of Step 58f or 60f is not met— Cut circuit is not functioning properly and unit under test must be returned to a repair center.	
64	Remove test cord from S socket of SF signaling unit and M1 jack of test circuit.	
65	At 2B test set— Restore keys to normal.	
66	At test circuit— Restore E1C 1 key to normal.	
67n	If no other tests are to be made— Remove all cords, restore all keys to normal, remove loop start wiring <i>only if added for this test</i> , and return signaling unit to service or spare position.	

**B. Pulsing of Transmitter A Relay—Using 4A Signaling Test Set**

27	At 4A test set— Set RECEIVE switch to EM.
28	Set MS RANGE switch to 999.
29	Set PULSE PERIOD switch to 100.
30	Set PULSE WIDTH switch to 55.
31	Depress START-STOP key.

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
32	Depress OPERATE-CLEAR key.	
	<i>Note:</i> The OPERATE-CLEAR key and the START-STOP key lamps are lighted when keys are depressed and extinguished when keys are released.	
33	At test circuit— Set SW1 to position 7.	
34	Set SW2 to position 1.	4A test set display indicates 45 ms make. See Step 35C.
35c	If requirement of Step 34 is not met— Adjust M potentiometer of test circuit to obtain 45.	
36	Using P1P cord, connect S socket of SF unit to M1 jack of test circuit.	At 4A test set— 4A display indicates 0 ms make.
37	At test circuit— Set SW1 to position 2.	
38	Operate E1C-1 key.	
39	Depress MIN LP key.	At SF unit— A relay pulses. At 4A test Set— 4A display indicates 45 to 55 ms make. See Step 40d.
40d	If requirement of Step 39 is not met— Mechanical and electrical requirements for the A relay should be checked, then repeat Steps 33 through 39, beginning with E1C-1 key normal and P1P cord disconnected.	
41e	If testing E2S unit— At 4A test set— Adjust PULSE WIDTH switch until 4A display indicates 10 ms make or less.	4A display indicates 10 ms or less.
42e	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates -45 dBm or less power. See Step 48f.
43e	At test circuit— Release TMS A, TMS B keys.	
44e	At 4A test set— Adjust PULSE WIDTH switch until 4A display indicates 30 ms make or less.	4A display indicates 30 ms make or less.

STEP	ACTION	VERIFICATION
45e	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates $-26$ to $-31$ dB with pulsating swings of approximately 1 dB. See Step 48f.
46e	At 4A test set— Slowly raise the PULSE WIDTH switch setting until TMS begins to indicate greater power.	4A display indicates 47 to 65 ms make. See Step 48f.
47	At test circuit— Release MIN LP, TMS A, TMS B keys.	
48f	If requirement of Step 42e, 45e, or 46e is not met— Perform Test C; if requirements of Test C are met, the pulse corrector is not functioning properly and unit should be returned to repair center.	
49	At 4A test set— Set PULSE WIDTH switch to 70.	
50	At test circuit— Depress MAX LP key.	At SF unit— A relay pulses. At 4A test set— 4A display indicates 70 and 85 ms make. See Step 51g.
51g	If requirement of Step 50 is not met— Mechanical and electrical requirements of the A relay should be checked, then repeat Steps 33 through 50, beginning with E1C-1 key normal and P1P cord disconnected.	
52e	If testing E2S unit— At 4A test set— Adjust PULSE WIDTH switch until 4A display indicates 90 ms make or less.	4A display indicates 90 ms make or less.
53e	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates $-24$ to $-28$ dB with pulsating swings of approximately 0.7 dB. See Step 56h.
54e	At 4A test set— Slowly lower the PULSE WIDTH switch setting until 21A begins to indicate less power.	4A display indicate 65 to 82 ms make. See Step 56h.
55	At test circuit— Release MAX LP, TMS A, TMS B keys.	

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
56h	If requirement of Step 53e or 54e is not met— Perform Test C; if requirements of Test C are met, the pulse corrector is not functioning properly and unit should be returned to repair center.	
57e	If testing E2S unit— At 4A test set— Set PULSE PERIOD switch to 333.	
58e	Set PULSE WIDTH switch to 233.	
59e	At test circuit— Insert dummy plug into SF SUP jack.	
60e	Simultaneously depress MIN LP, TMS A, TMS B keys.	At 21A— Meter indicates 10 to 20 dB and pointer pulsates at 3-pps rate. See Step 63i.
61e	At test circuit— Release MIN LP key and depress MAX LP key.	
62e	At 4A test set— Raise PULSE WIDTH switch setting until 21A pointer just stops pulsating.	4A display indicates 167 to 240 ms break. See Step 63i.
63i	If requirement of Step 60e or 62e is not met— Cut circuit is not functioning properly and unit should be returned to repair center.	
64e	At test circuit— Release MAX LP, TMS A, TMS B keys.	
65e	Remove dummy plug from SF SUP jack.	
66j	If no other tests are to be made— Remove all cords, restore all keys to normal, and restore all circuits to normal.	

**C. Transmitted Tone Level**

13	At test circuit— Set SW1 to position 2, SW2 to position 1.	At SF unit— A relay is released. At 21A— Meter indicates -45 dBm or less power.
14	At test circuit— Set SW1 to position 3.	At SF unit— A relay operated. At 21A— Meter indicates -45 dBm or less power.

STEP	ACTION	VERIFICATION
15	At test circuit— Operate E1C 1 key.	At SF unit— A relay released. At 21A— Meter indicates between -34 and -37 dB.
16	At test circuit— Operate E1E 2 key.	At 21A— Meter indicates between -19.5 and -22.5 dB for E1S units and between -23 and -25 dB for E2S units.
17	At test circuit— Restore E1C 1, E1E 2 keys to normal.	At SF unit— A relay operated.
18	At test circuit— Simultaneously depress TMS A, TMS B keys.	
19	Operate E1C 1 key. (This may be repeated until verification is obtained.)	For E1S— Momentary peak indication on 21A between -20.5 and -24.5 dB as A relay releases. For E2S— Momentary peak indication as above; then, hesitates at -23 to -25 dB for approximately 1/2 second and finally falls to same level as that in Step 15.
20	At test circuit— Release TMS A, TMS B keys.	
21	Restore E1C 1 key to normal.	
22	Set SW1 to position 5.	
23c	If no other tests are to be made— Remove all cords, restore all keys to normal, remove loop start wiring <i>only if added for this test</i> . Return signaling unit to service or spare position.	

**D. 4-Wire Terminating Circuit and Receiver Voice  
Amplifier**

13	At test circuit— Operate 100~A key.	
14	Set SW1 to position 5, SW2 to position 2.	At SF unit— A relay released.
15	Operate BAT LP key.	
16	Operate LP CUR 1 key.	At SF unit— A relay operated.

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STEP	ACTION	VERIFICATION
17	At test circuit— Simultaneously depress TMS A, TMS B keys.	
18	Adjust XMT or TRMT potentiometer of SF signaling unit under test to obtain 21A indication of -16.0 dB.	
19	At test circuit— Restore LP CUR 1 key to normal.	At 21A— Meter indicates -45 dBm or less power.
20	At test circuit— Release TMS A, TMS B keys.	
21	Operate LP CUR 1 key.	
22	Restores 1000~A key to normal.	
23	Operate 1000~B key.	
	<b>Note:</b> Minor adjustments of SF unit REC or RCV potentiometer of less than 1 dB may be made to meet overall trunk net loss requirements in an in-service condition.	
24	At SF unit— Adjust REC or RCV potentiometer to full counterclockwise position.	At 21A— Meter indicates -39 dB or less power.
25	At SF unit— Adjust REC or RCV potentiometer to full clockwise position.	At 21A— Meter indicates +1.5 dBm or greater power.
26	At SF unit— Adjust REC or RCV potentiometer for 21A meter indication $-8.8 \pm 0.2$ plus $(-0.2)$ dB or specified loss shown on trunk layout record $\pm 0.2$ plus $(-0.2)$ dB. Additional 0.2 dB is caused by measuring a 900-ohm circuit using a 600-ohm 21A.	
27	At test circuit— Simultaneously depress TMS A, TMS B keys.	At 21A— Meter indicates between -22.8 and -26.8 dB. Note indication.
28	At test circuit— Operate 2W TER key.	For E1S, 21A indicates at least 30 dB less power than indicated in Step 27. For E2S, 21A indicates at least 27 dB less power than indicated in Step 27.

**Note:** This test is made without straps on build-out capacitors. Restrap, if necessary, before inserting unit in service.

STEP	ACTION	VERIFICATION
29	At test circuit— Restore LP CUR 1, 2W TER keys to normal.	At SF unit— A relay released. At 21A— Meter indicates $-45$ dBm or less power.
30	At test circuit— Release TMS A, TMS B keys.	
31	Restore 1000~B key to normal.	
32	Set SW1 to position 6, SW2 to position 4.	
33	Set attenuator to 11.	At 21A— Meter indicates $-1.0 \pm 0.2$ dB.
34c	If requirement of Step 33 is not met— Adjust gain potentiometer of TST amplifier to obtain $-1.0$ dB.	
35	At test circuit— Set SW1 to position 5, SW2 to position 3.	
36	At SF unit— Block R relay nonoperated.	
37	At test circuit— Set SW1 to position 6.	At 21A— Meter indicates $-44$ dBm or less power.
38	At SF unit— Remove blocking tool from R relay.	R relay operated. At 21A— Meter indicates $-55$ dBm or less power.
		<b>Note:</b> If R relay does not operate, perform Test E; then, repeat Steps 32 through 38.
39	At test circuit— Set SW1 to position 5, SW2 to position 2.	
40	Operate LP CUR 1 key.	At SF unit— A relay operated.
41	At test circuit— Operate 1000~B key.	At 21A— Meter indicates between $-8.6$ and $-9.0$ dB.
42	At test circuit— Restore 1000~Bkey to normal.	
43	Operate 1000~A key.	
44	Simultaneously depress TMS A, TMS B keys.	AT 21A— Meter indicates $-16.0$ dB.

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
45	At test circuit— Release TMS A, TMS B keys.	
46	Restore LP CUR 1, 1000~ A keys to normal, BAT LP key to BAT.	At SF unit— A relay released.
47	At test circuit— Set SW2 to position 4.	
48d	If no other tests are to be made— Remove all cords, restore all keys to normal, remove loop start wiring <i>only if added for this test</i> . Return signaling unit to service or spare position.⚡	
<b>E. Sensitivity of Receiver Amplifier and Timing of Receiver R Relay</b>		
<i>Note:</i> The KS-14510 VOM, or equivalent, may be used instead of the 2B test set in this test.		
13	At test circuit— Set SW1 to position 6, SW2 to position 4.	
14	Set attenuator to 32.	At 21A— Meter indicates between -21.8 and -22.2 dB.
15c	If using voltmeter on 2B— Set SCALE SEL switch to 20V.	
16c	Using 3P7A cord, patch between SENS 1 jack on test circuit and VM jack on 2B test set.	
17d	If using VOM— Set scale selector switch to 12 VOLTS DC.	
18d	Using 2W17D cord, connect between SENS 1 jack on test circuit and VOM, connecting positive lead of VOM to 360C (white) tool and negative lead of VOM to 360B (black) tool of 2W17D cord.	
19	At test circuit— Set SW2 to position 3.	At SF unit— R relay operated. At 2B test set— 2B voltmeter or VOM indicates 7 volts or more. See Step 23e.

STEP	ACTION	VERIFICATION
20	At test circuit— Set attenuator to 40.	At SF unit— R relay released. See Step 26c.
21	At test circuit— Set attenuator to 37.	At SF unit— R relay remains released.
22	At test circuit— Set attenuator to 32.	At SF unit— R relay operated.
23e	If requirements of Step 19 through 21 are not met— At test circuit— Set SW2 to position 4.	
24e	At SF unit— Block R relay nonoperated.	
25e	At test circuit— Set SW2 to position 3.	
26e	Turn SENS potentiometer on signaling unit to extreme clockwise position.	
27e	Turn SS potentiometer on signaling unit to extreme clockwise position.	
28c	Set SCALE SEL switch to 200V.	See verification in Step 29d.
29d	Set scale selector switch to 60 VOLTS DC.	2B voltmeter or VOM indicates between 30 and 35 volts for E1S and between 31 and 36 volts for E1S(-) or E2S. Note indication.
30e	Adjust SS potentiometer on signaling unit in counterclockwise direction until slight deflection is observed on voltmeter.	
31e	Adjust SS potentiometer for minimum clockwise setting to obtain exact voltmeter indication noted in Step 29d.	
32e	At SF unit— Remove blocking tool from R relay.	R relay operated.
33	At test circuit— Set SW2 to position 4.	At SF unit— R relay released.
34	Disconnect patch cord between SENS 1 jack on test circuit and VM jack on 2B test set or VOM.	

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
35	At test circuit— Set SW1 to position 8.	
36	Set SW2 to position 3.	
37	Using 3W4A patch cord, patch 48V jack on TTS to -48 on tip (white) conductor, and ground on sleeve (red) conductor.	
38	At TTS— Operate BAT key to BAT ON.	BAT lamp on TTS lighted.
39	Set MIL SEC switch to 0-500.	
40	Set MCF key to normal.	
41	Calibrate TTS per Section 100-130-101.	
42	Using 3P17B patch cord, patch between TST1 jack on TTS and E, M jacks on test panel. (Plug double end in E, M jacks with grooved side to the right.)	
43	Using 3W4A patch cord, patch between EXT jack on TTS and -48V on tip conductor.	
44	Set TTS REC switch to GRD, 48V, or OC position.	
45	Set SEND key to BK.	
46	Operate TST key to OPR.	TTS meter indicates between 40 and 50. See Step 48f.
47	Release TST key.	
48f	If requirement of Step 46 is not met— Adjust SENS potentiometer on signaling unit clockwise to decrease indication counterclockwise to increase indication until indication of between 43 and 47 is obtained. (Steps 46 and 47 may be repeated until requirement is met.)	
49	At TTS— Set REC switch to OC GRD.	
50	Set SEND key to MK.	At SF unit— R relay operated.
51	Check calibration of TTS.	

STEP	ACTION	VERIFICATION
52	At TTS— Operate TST key to OPR.	TTS meter indicates between 40 and 50. See Step 54g.
53	Release TST key.	
54g	If requirement of Step 52 is not met— Adjust RT potentiometer on signaling unit clockwise to decrease indication counterclockwise to increase indication until indication of between 43 and 47 is obtained. (Steps 52 and 53 may be repeated until indication is met.)  <i>Note:</i> There may be some interaction between SENS and RT potentiometers. If the requirement of Step 52 cannot be met, turn the RT potentiometer until TTS meter indicates 50. When proceeding per Step 55h use 50 as requirement for indication on TTS in Step 46.	
55h	If RT potentiometer was adjusted in Step 54g— Repeat Steps 44 through 53 until requirements of Steps 46 and 52 are equal.	
56	Restore BAT ON key on TTS to normal.	
57	Disconnect patch cords between TTS and test circuit.	
58i	If no other tests are to be made— Remove all cords, restore all keys to normal, remove loop start wiring <i>only if added for this test</i> . Return signaling unit to service or spare position.	
<b>F. Voice Amplifier Cutoff Transistor—Using 2B Test Set or VOM</b>		
7	At test circuit— Set SW1 to position 5.	
8	Set SW2 to position 1.	
9b	If using 2B test set— Using P3E cord, connect SENS 1 jack of test circuit to VM jack of 2B test set.	
10b	At 2B test set— Set SCALE SEL switch to 20V.	Voltmeter of 2B test set indicates 0.5 to 1.5 volts for E1S units or 0.2 volt or less for E1S(-), E2S units.

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
11b	Remove cord from SENS 1 jack on test circuit and 2B test set.	
12c	If using VOM— Connect the 310 plug of W2CF cord to SENS 1 jack of test circuit.	
13c	At VOM— Set selector switch to 3 VOLTS DC.	
14c	Connect positive (+) lead of VOM to 360C (white) tool of W2CF cord.	
15c	Connect negative (-) lead of VOM to 360B (black) tool of W2CF cord.	VOM indicates 0.5 to 1.5 volts for E1S units or 0.2 volt or less for E1S(-), E2S units.
16c	Remove cord from SENS 1 jack on test circuit and VOM.	
17d	If no other tests are to be made— Remove all cords, restore all keys, and restore all circuits to normal.	

**G. Voice Amplifier Cutoff Transistor—Using 4A Test Set**

- 27 Disconnect cord from DET IN jack of 21A connect to FROM LINE jack of 4A test set
- 28 At 4A test set—  
Set MS RANGE switch to 99.9.
- 29 Set RECEIVE switch to SF.
- 30 Set PULSE PERIOD switch to 500.
- 31 Set PULSE WIDTH switch to 50.
- 32 At 4A test set—  
Operate PULSE/MEAS key to LINE.
- 33 Operate TWD EQPT key to MON.
- 34 Operate TWD LINE key to MON.
- 35 Set NB-BB switch to NB.
- 36 At test circuit—  
Set SW1 to position 8.
- 37 Set SW2 to position 3.

STEP	ACTION	VERIFICATION
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.
41c	If no other tests are to be made— Restore all keys, remove all cords, and restore all circuits to normal.	

#### H. Receiver Guard Action

**Note:** If any doubt exists as to the setting of the SS potentiometer on SF unit, Test E should be performed before proceeding with this test.

13	At test circuit— Set SW1 to position 5, SW2 to position 6.	At 21A— Meter indicates between $-18.5$ and $-19.5$ dB.
14	At test circuit— Set attenuator to 29.	
15	Set SW2 to position 5.	At SF unit— R relay released.
16	At test circuit— Set SW1 to position 6.	At SF unit— R relay remains released.
17	At test circuit— Set attenuator to 19.	At SF unit— R relay operated.
18	At test circuit— Set SW2 to position 4.	At SF unit— R relay released.
19c	If no other tests are to be made— Remove all cords, restore all keys to normal, remove loop start wiring <b>only if added for this test</b> . Return signaling unit to service or spare position.	

#### I. RT Relay Operation

7	At test circuit— Set SW1 to position 5, SW2 to position 3.	
8	At SF unit— Block R relay operated.	
9	Block A relay nonoperated.	

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STEP	ACTION	VERIFICATION
10	At test circuit— Operate E1C 1 key.	
11	Using a 3W4A cord, patch between SENS 2 jack on test circuit and -48V office battery on ring (black) conductor.	
12	At test circuit— Depress E1C MAX LP key.	At SF unit— RT relay operated.
13	At test circuit— Release E1C MAX LP key.	At SF unit— RT relay remains operated.
14	At SF unit— Remove blocking tool from R relay.	RT relay released.
15	Remove blocking tool from A relay.	A relay released.
16	Remove cord from SENS 2 jack on test circuit and disconnect -48V office battery from ring conductor.	
17	At test circuit— Restore E1C 1 key to normal.	
18	Restore 2-WIRE key to normal.	
19	Operate 2W TER key.	
20	At SF unit— Block R relay operated.	
21	Block A relay nonoperated.	
22	At test circuit— Set SW1 to position 2.	
<p><b>Caution:</b> To avoid blowing the 20~fuse when the 20~P key is not provided, follow sequence exactly as stated. Never leave one end of a cord hanging loose while the other end is plugged into the 20~T or 20~R jack, because the loose end may touch frame ground. Also be sure to hold the plugs of the cord by the insulating jackets to avoid shock when inserting into or removing from the 20~T or 20~R jack.</p>		
23	Using 3P7A cord, connect to 20 R jack first, then to SENS 2 jack on test circuit.	At SF unit— RT relay remains released.

STEP	ACTION	VERIFICATION
24b	If 20 P key is provided— At test circuit— Depress 20 P key.	At SF unit— RT relay remains released.
25b	At test circuit— Release 20 P key.	
26	Remove patch cord end from SENS 2 jack first; then, remove other end from 20 R jack.	
27	At SF unit— Remove blocking tool from R relay.	
28	Remove blocking tool from A relay.	
29	At test circuit— Restore 2W TER key to normal.	
30	Operate 2-WIRE key.	
31	Remove all cords, restore all keys to normal, remove loop start wiring <i>only if added for this test</i> . Return signaling unit to service or spare position.	