

2400- OR 2600-CYCLE E1B, E2B, OR E3B SINGLE-FREQUENCY SIGNALING CIRCUITS OUT-OF-SERVICE TESTS USING TESTING CIRCUITS SD-56335-01 AND SD-95874-01

1. GENERAL

1.01 This section describes out-of-service tests of 2400- or 2600-cycle single-frequency signaling circuits in accordance with SD-98085-01, SD-98090-01, SD-98124-01, or SD-98124-02, using testing circuits SD-56335-01 and SD-95874-01. It also describes potentiometer adjustments to correct for changes in the characteristics of some circuit elements. If, because of special techniques involved in testing and clearing trouble on some of the components, the requirements of this section cannot be met after readjustment of potentiometers or relays, the unit should be returned to a repair center.

Caution: 291- and 303-type relays shall be maintained in an upright position for at least 1 minute before beginning any tests.

1.02 This section is reissued:

- (a) To incorporate a test which ensures proper signal tone level in the test circuit.
- (b) To change requirements of M relay pulsing test.
- (c) To incorporate a test which checks filter insertion loss at 1000 cycles.
- (d) To change the signal tone input level and simplify adjusting procedure of SS potentiometer.
- (e) To change adjustment requirement of OT potentiometer and include pulsing tests for 12 pulses per second.
- (f) To provide a test for the operate and release time of the G relay.
- (g) To provide a test which checks proper limiting of signal amplifier.
- (h) To change test requirements of receiver guard for modified units having improved talk-off protection.
- (i) To provide a brief test for new units.

Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The tests covered are:

- A. Pulsing of Transmitter M Relay:** This test checks that the M relay is properly following pulses.
- B. Hold of HL Relay and Also, for All E2B and All E3B Units, Release of CO Relay:** This test checks that the HL and CO relays release within the desired time limits.
- C. Transmitter Voice Path and Transmitted Tone Level:** This test checks the transmitter voice path and the level of the transmitted single-frequency tone.
- D. Voice Amplifier Cutoff Transistor:** This test checks the base voltage on transistors Q84 (used in E1B, E2B) and Q94 (used in E3B) with no signal input.
- E. Gain of Receiver Voice Amplifier and Insertion of Band-Elimination Filter:** This test checks transmission of the voice path through the receiver and blocking of the signal tone when present on the line. A method of adjusting the REC or RCV potentiometer to get zero transmission loss is provided.
- F. Operate Sensitivity of Receiver Signaling Amplifier:** This test checks the receiver sensitivity and describes its adjustment by means of the SS potentiometer.
- G. Timing of Receiver R, RG, and G Relays:** This test checks the operate and release time of the R and RG relays and describes the adjustment of the OT and RT potentiometers to meet the requirements. It also provides a test which ensures proper limiting of the signal amplifier. The operate and release time of the G relay is also checked at this time.
- H. Receiver Guard Action and 2-Wire Controls:** This test checks the receiver guard circuit in limiting operation by voice signals. Control for the insertion of the echo-eliminating network for 2-wire line facilities is also checked.

I. Final Adjustment of Receiver Sensitivity:

This test describes the adjustment of the SS potentiometer for obtaining the sensitivity needed in 2- or 4-wire offices where +4 receiving levels are used, or in 2-wire offices where +7 receiving levels are used.

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

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

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

1.07 The abbreviations cw and ccw used herein refer to clockwise and counterclockwise, respectively.

1.08 The J68602CS test panel (SD-56335-01) is referred to in this section as CS panel. KEYERS switch 1 and RECEIVER switch 2 on this panel are referred to as SW1 and SW2, respectively. Jacks and keys associated with this circuit are located on the jack strip just below the unit which is the J98613P test panel (SD-95874-01, FS2), referred to in this section as P panel.

1.09 The J98613N test panel (SD-95874-01, FS1) is referred to in this section as N panel. Jacks and keys associated with this circuit are located on the jack strip just above the CS panel.

1.10 Make per cent break adjustments of the 2B test set slowly, above 70 per cent to prevent pulsing out incorrect values. Incorrect values will be obtained if the rate of vibration of the PER CENT BREAK meter pointer is less than that of the PULSES PER SECOND meter pointer. To restore correct per cent break values, turn the ADJ % BK control counterclockwise until both pointers are vibrating at the same rate, then turn the control more slowly clockwise until the desired per cent break value is obtained. It may also be necessary to change the coarse ADJ % BK switch from S, M, or L setting to obtain the desired range of the PER CENT BREAK meter.

1.11 Two values of transmitted power are specified in Test C and four values of attenuator settings in Test I. The value to be used is determined from the following, depending on

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):** "+4 line" indicates that the signaling receiver connects to the circuit at a point where the transmission level is +4 dbm. "-13 line" indicates that the associated signaling transmitter connects to the circuit at a point where the transmission level is -13 dbm.

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

1.12 Since many steps in this section require different actions for the talk-off improved, partially improved, and unmodified units, the following designations are used to identify the units. The E3B unit is used in this example. Similar notations will be used for the E1B and E2B units.

DESIGNATION	DESCRIPTION
E3B	— E3B units without series number (unmodified)
E3B-2	— E3B units, series 2
E3B-()	— All E3B units with series numbers
All E3B	— All E3B units with or without series numbers
(no designation)	— All units with or without series numbers covered by the practice

1.13 **Lettered Steps:** The letters a, b, c, etc, added to a step number in Part 3 or 4 of this section indicate an action which may or may not be required, depending on local conditions. The condition under which a lettered step or series of steps should be made are 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.

A Brief Test for New Units and Units Modified or Repaired by WECO

1.14 The following steps for this section are to be used only when it is reasonably certain that the units have not suffered damage. Other-

wise the complete test must be performed. These limited tests are not extensive enough to ensure that a unit will meet all requirements, however, they provide a reasonable degree of assurance of proper operation.

TEST FOR	TEST	STEPS
M	A	Steps 23 through 28. If Step 26 is met, go to Test B.
CO and HL	B	Steps 24 through 38c, 47, and 48. If Steps 29, 31, and 37c are met, go to Test E.
REC or RCV Pot.	E	Steps 11 through 16 and 20. If Step 16 is met, go to Test F.
SS Pot.	F	Steps 15 through 19. If Steps 17 and 19 are met, go to Test G.
OT and RT Pot. and G relay	G	Steps 23 through 36, 43 through 46, 60 through 70, and 85. If Steps 31, 36, 46, 69, and 70 are met, unit now has potentiometers properly adjusted and relays are checked. Insert unit in working or spare position.

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.

APPARATUS	TESTS								
	A	B	C	D	E	F	G	H	I
Testing 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	1
Cord (2.08)	-	-	1	1	-	-	-	-	-
Cord (2.09)	-	1	1	-	1	-	-	-	-

TABLE A (Cont)

APPARATUS	TESTS								
	A	B	C	D	E	F	G	H	I
258D Dummy (Plug)	1	1	-	1	-	-	1	-	-
Screwdriver, R-8210	-	-	-	-	1	1	1	-	1
Tool (2.10)	1	1	1	1	1	1	1	1	1
Tool (2.11)	1	1	1	1	1	1	1	1	1
Tool (2.12)	-	1	-	-	-	-	1	-	-
Tool (2.13)	-	-	√	-	-	-	-	-	-

√ As required.

2.02 Testing circuit includes J68602CS, J98613N, J98613P, and folding test fixture J98613AC.

2.03 The 2B test set, W option or later, J64730B (SD-56134-02), including power cords.

2.04 The 13A or 21A TMS.

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

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

2.07 Testing cord for TMS: for 13A, W2BP cord, 6 feet long, equipped with a 241A plug and two 35 cord tips (2W15B cord); for 21A, P2AA cord, 6 feet long, equipped with two 241A plugs (2P13B cord).

2.08 Patching cord, P2B cord, 3 feet long, equipped with two 310 plugs (2P4A cord).

2.09 Patching cord, P2AA cord, 6 feet long, equipped with two 241A plugs (2P13B cord).

2.10 Disengaging tool P-43C851, for removing signaling unit from working position.

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

2.12 The 603A tool for removing 291-type relays. Use in accordance with Section 040-263-501.

2.13 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	Obtain release of signaling circuit in usual manner, as required.	
2	Remove signaling unit from its in-service position using disengaging tools.	
3	Plug signaling unit into folding test fixture.	
4	Connect cord of folding test fixture to A2 connector on N panel or to 20-pin connector adjacent to CS panel if N panel is not provided.	
5	See that all twist keys are in normal position: white line horizontal (552A key) or arrow pointing up (552E key).	
6	Set SF key of testing circuit to 2400 or 2600 depending on receiver frequency.	
Tests B, C, E, F, H, and I		
7	Connect 2W15B cord to IN terminals of TMS.	
8	TMS should be known to be correctly calibrated.	
9	Connect TMS to SF SUP jack on P panel.	Reading on TMS: -13 LINE -16 LINE -12.1 to -13.1 db -15.1 to -16.1 db Record for Test E.
10	Disconnect TMS from SF SUP jack, connect to TMS jack on P panel.	
Tests A, B, C, D, and G		
11	On 2B test set — Set all keys to normal.	
12	Connect TST BAT cords A (-48), B (-24 +130) to P panel A, B battery supply jacks, designated: 2B W Option	
13	Set SCALE SEL switch to 20 MA. Adjust, if necessary, pointer adjustment screw of PULSES PER SECOND meter to obtain 0 reading.	PULSES PER SECOND meter reads 0.
14	At 2B test set — Set SCALE SEL switch to PPS.	PULSES PER SECOND meter reads other than 0.

STEP	ACTION	VERIFICATION
15	Operate CONT PLS key to DIAL PLS.	PULSES PER SECOND meter reads 0 to 0.5. PER CENT BREAK meter reads 0 on <i>black</i> scale. See Step 16a.
16a	If requirement of Step 15 is not met — For PER CENT BREAK meter — Adjust pointer adjustment screw. For PULSES PER SECOND meter — Check 2B test set.	
17	Insert 258D plug into P jack. <i>Note:</i> Repeat Steps 17, 18b, and 19 if testing interval extends beyond 30 minutes.	PER CENT BREAK meter reads 100 on <i>black</i> scale. See Step 18b.
18b	If requirement of Step 17 is not met — Unlock CAL % BK control, adjust to obtain reading of 100, then relock control taking care not to change reading.	
19	Remove 258D plug from P jack. <i>Note:</i> 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 of 2B test set is not known.	PER CENT BREAK meter reads 0 on <i>black</i> scale.
20	Restore CONT PLS key to normal.	
21	Patch E jack of 2B test set to E jack of P panel using 2P3B cord.	
22	Patch M jack of 2B test set to M jack of P panel using 2P1D cord.	

4. METHOD

STEP	ACTION	VERIFICATION
A. Pulsing of Transmitter M Relay		
23	On 2B test set — 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 45 on <i>black</i> scale of PER CENT BREAK meter.	
25	On test circuit — Set SW1, SW2 to position 1.	

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STEP	ACTION	VERIFICATION
26	On 2B test set — Operate TWD L key to OFF HK, then PLS, MEAS % BK keys to LINE.	On SF unit — M relay pulses while HL operates and re- mains operated. PER CENT BREAK meter reads 43 mini- mum, 53 maximum on <i>black</i> scale. See Step 27c.
27c	If requirement of Step 26 is not met — Proceed to Step 31d.	
28	On 2B test set — Set all keys to normal.	
29	Adjust ADJ % BK control to 70 on <i>black</i> scale of PER CENT BREAK meter.	
30	Operate TWD L key to OFF HK, then PLS, MEAS % BK keys to LINE.	On SF unit — M relay pulses while HL relay operates and remains operated. PER CENT BREAK meter reads at least 65 but no more than 73 on <i>black</i> scale. See Step 31d.
31d	If requirements of Steps 26 and 30 are met — Proceed to Step 38, otherwise see the fol- lowing note. <i>Note:</i> An increase or decrease in per cent break can be obtained by increasing or de- creasing armature back tension of the M relay on unit under test. If the relay has been changed in any way, the mechanical and electrical requirements must still be met, and Steps 32d to 37d, inclusive, must be performed.	
32d	On 2B test set — Set all keys to normal.	
33d	Adjust ADJ % BK control to 45 on <i>black</i> scale of PER CENT BREAK meter.	
34d	Operate TWD L key to OFF HK, then PLS, MEAS % BK keys to LINE.	On SF unit — M relay pulses while HL relay operates and remains operated. PER CENT BREAK meter reads 44 mini- mum, 53 maximum on <i>black</i> scale.
35d	Restore all keys to normal.	
36d	Adjust ADJ % BK control to 70 on <i>black</i> scale of PER CENT BREAK meter.	
37d	Operate TWD L key to OFF HK, then PLS, MEAS % BK keys to LINE.	On SF unit — M relay pulses while HL relay operates and remains operated. PER CENT BREAK meter reads at least 65 but no more than 72 on <i>black</i> scale.

STEP	ACTION	VERIFICATION
38	When requirements of Steps 26 and 30 or Steps 34d and 37d have been met — Set all keys to normal.	
39e	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	
B. Hold of HL Relay and Also, for all E2B and all E3B Units, Release of CO Relay		
HL Relay		
23	On 2B test set — Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
24	With coarse ADJ % BK control to M — Adjust ADJ % BK control to 66.5 on <i>black</i> scale of PER CENT BREAK meter.	
25	Adjust ADJ PPS control for lower pps reading until 20 on <i>black</i> scale of PER CENT BREAK meter is obtained.	PULSES PER SECOND meter reads between 2.5 and 3.5 pps.
26	For E1B, E2B, E3B, and E3B-2 through E3B-6, with ADJ % BK switch to M, turn ADJ % BK control fully ccw and then adjust to 30 on <i>black</i> scale of PER CENT BREAK meter. For E1B-(), E2B-(), and E3B-7, and higher, set ADJ % BK switch to L, turn ADJ % BK control fully ccw, and then adjust to 80 on <i>black</i> scale of PER CENT BREAK meter.	
27	On test circuit — Set SW1 to position 2, SW2 to position 1.	
28	On 2B test set — Operate TWD L key to OFF HK.	M, HL relays operate.
29	Operate PLS key to LINE.	M relay pulses while HL relay remains operated.
30	Restore PLS key to normal.	M, HL relays operated.
31	Restore TWD L key to normal.	M relay releases and HL relay releases in less than 1 second.

CO Relay

Note: The following Steps 32c to 46c, inclusive, are performed only in the tests on all E2B or all E3B signaling circuits per SD-98090-01, or SD-98124-01, or SD-98124-02 and are for testing the CO relay.

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STEP	ACTION	VERIFICATION
32c	If testing E2B or E3B units — With coarse ADJ % BK switch on L, adjust ADJ % BK control to 60 on <i>black</i> scale of PER CENT BREAK meter.	
33c	Adjust PPS control until 80 on <i>black</i> scale of PER CENT BREAK meter is obtained.	PULSES PER SECOND meter reads between 3.5 and 4.5 pps.
34c	Connect LINE TRANS jacks to SF SUP jacks on P panel using patch cord 2P13B.	
35c	Set dial switch of TMS to 10 or 15.	TMS reads between -14 and -17 db.
36c	On 2B test set — Operate TWD L key to OFF HK, then PLS key to LINE.	M relay pulses. HL relay operated.
37c	Set dial switch of TMS to 30.	No reading on TMS.
38c	On 2B test set — Restore PLS key to normal.	
39c	Adjust ADJ % BK control to 70 on <i>black</i> scale of PER CENT BREAK meter.	
40c	Operate PLS key to LINE.	M relay pulses. No reading on TMS.
41c	Restore TWD L, PLS keys to normal.	M, HL relays release.
42c	Set dial switch of TMS to 25.	
43c	Remove patch cord between LINE TRANS, SF SUP jacks.	
44c	On 2B test set — Operate TWD L key to ON HK.	TMS reads -25 to -35 db.
45c	For E2B-() and E3B-7 or higher — Operate RG relay by hand.	TMS reads less power than -45 dbm.
46c	Allow RG relay to release.	TMS reads -25 to -35 db.
47	Restore all keys to normal.	
48	Set coarse ADJ % BK switch to M.	
49d	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

C. Transmitter Voice Path and Transmitted Tone Level

Transmitter Voice Path

Note: If the N panel is not provided, omit Steps 23 through 31, inclusive. The transmitter voice path can be tested in service.

- 23 On test circuit —
Set SW1 to position 2.

STEP	ACTION	VERIFICATION		
24	Set dial switch of TMS to 0.			
25	Disconnect TMS from TMS jacks, connect to T, R jacks on P panel.			
26	Patch T & R jack on P panel to 0-1000~ jack on N panel using 2P4A patch cord.	TMS reads 0 db.		
27	Disconnect TMS from T, R jacks, reconnect to TMS jacks.			
28	Patch T, R jacks on P panel to LINE TRANS jacks on P panel using patch cord 2P13B.			
29	On 2B test set — Operate TWD L key to OFF HK.	M, HL relays operate. TMS reads between 0 and -0.2 db.		
30	Remove patch cords between 0-1000~ jack and T & R jack and between T, R jacks and LINE TRANS jacks.			
31	On 2B test set — Operate TWD L key to normal.	M, HL relays release.		
Transmitted Tone Level				
32	On test circuit — Set SW1 to position 3.			
33	Set dial switch of TMS to 30 (for -13 line) or 35 (for -16 line).	Reading on TMS: <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">-13 LINE between -32 and -34 db</td> <td style="text-align: center;">-16 LINE between -35 and -37 db</td> </tr> </table>	-13 LINE between -32 and -34 db	-16 LINE between -35 and -37 db
-13 LINE between -32 and -34 db	-16 LINE between -35 and -37 db			
34	Set dial switch TMS to 20.			
35	Block operated HL relay.	Reading on TMS: <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">-13 LINE between -19.5 and -22.5 db</td> <td style="text-align: center;">-16 LINE between -22.5 and -25.5 db</td> </tr> </table>	-13 LINE between -19.5 and -22.5 db	-16 LINE between -22.5 and -25.5 db
-13 LINE between -19.5 and -22.5 db	-16 LINE between -22.5 and -25.5 db			
36	Set SW1 to position 4.	TMS reads less power than -45 dbm after M relay operates.		
37	Remove block from HL relay.	HL relay remains operated, same reading as in Step 36.		
38	Set dial switch of TMS to 0.			
39	Set SW1 to position 5.	M, HL relays release.		
40c	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.			

STEP	ACTION	VERIFICATION
D. Voice Amplifier Cutoff Transistor		
23	Patch SENS test jack on P panel to VM jack of 2B test set using 2P4A patch cord.	
24	Set SCALE SEL switch of 2B test set to 20 volts.	
25	On test circuit — Set SW1 to position 5.	VOLTS meter reads less than 0.20 volt.
26	Remove patch cord between SENS, VM jacks.	
27	On 2B test set — Set SCALE SEL switch to PPS.	
28c	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

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

11	On test circuit — Set SW1 to position 8, SW2 to position 6.	
12	Set ATT attenuator to reading obtained in Step 9, plus additional 10-db loss. <i>Example:</i> Reading recorded in Step 9: -15.6 db. Set ATT to 25.6 db.	
13	Set dial switch of TMS to 0.	
14	Patch SF TST jacks to 1 MW SUP jacks of P panel using patch cord 2P13B.	TMS reads 0 db. See Step 15c.
15c	If requirement of Step 14 is not met — Adjust GAIN potentiometer of V3 test amplifier on CS panel to obtain TMS reading of exactly 0 db.	

Receiver Voice Amplifier

16	On test circuit — Set SW2 to position 7.	TMS reads 0 db. See Step 17d.
17d	If requirement of Step 16 is not met — Adjust REC or RCV potentiometer of signaling unit under test to obtain reading of 0 db.	

Band-Elimination Loss at 1000~

18	Operate RG relay of SF unit by hand.	TMS reads between 0 and -0.7 db.
19	Allow RG relay to release.	

STEP	ACTION	VERIFICATION
20	Remove patch between 1MW SUP, SF TST jacks.	
21	On test circuit — Set SW1 to position 6, SW2 to position 4.	
22	Set ATT attenuator to 10 db.	TMS reads 0 ± 0.2 db. See Step 23e.
23e	If requirement of Step 22 is not met — Adjust gain potentiometer of V3 test amplifier on CS panel to obtain reading of 0 db.	
Band-Elimination Loss at 2600~		
24	Set SW2 to position 2.	TMS reads less power than -30 dbm. RG relay is operated.
25	Set SW2 to position 4.	RG relay releases.
Electronic Cut		
26	Hold RG relay nonoperated momentarily for duration of Step 27 (maximum, 30 seconds).	
	<i>Caution: RG relay should not be blocked in nonoperated position with blocking tool as continued application of high level tone can damage resistors and/or transistors. Allow RG relay to operate as soon as reading in Step 27 is obtained.</i>	
27	Set SW2 to position 3.	TMS reads less power than -35 dbm. Allow RG relay to operate.
28	Set SW2 to position 2.	TMS reads less power than -30 dbm. RG relay is operated.
	<i>Note: Operation of RG relay depends on sensitivity adjustment. If RG relay does not operate, do Test F, then come back to this test, and repeat Steps 25 through 28.</i>	
29f	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

F. Operate Sensitivity of Receiver Signaling Amplifier

Note: This test should be performed if the receiver of the signaling unit is connected in a 4-wire "+7 line" office, or in any office, if Tests G and H are to be done. The operation and release of the G relay in units having one depends on the release and operation of the RG relay. See Test G for checking it.

- 11 On test circuit —
Set SW1 to position 6, SW2 to position 4.

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STEP	ACTION	VERIFICATION
12	Set dial switch of TMS to 0.	
13	Set ATT attenuator to 10.	TMS reads 0 ± 0.2 db. See Step 14a.
14a	If reading in Step 13 is not met — Adjust gain control of V3 test amplifier on CS panel for 0 db.	
15	Set SW1 to position 5, SW2 to position 3.	
16	Set ATT attenuator to 33 db.	
17	Change SW1 to position 6.	RG relay remains released. See Step 18b
18b	If RG relay does operate — Adjust SS potentiometer slightly ccw until RG relay releases.	RG relay releases.
19	Set ATT attenuator to 32 db.	RG relay should operate. See Step 20c.
20c	If RG relay does not operate — Adjust SS potentiometer slightly cw until relay just operates.	
21c	Repeat Steps 16 to 19, inclusive, starting with SW1 in position 5, until requirements of these steps are met.	
22	Set ATT attenuator to 40.	RG relay should release.
23d	If no other tests are to be made — Remove all cords, restore all keys to nor- mal, return signaling unit to service or spare position.	

G. Timing of Receiver R and RG Relays

Note: If setting of SS potentiometer is unknown, do Test F before performing any parts of this test. The G relay in those units having one is operated when the RG relay is released or pulsing. See Steps 60 to 72, inclusive, for test of its operate and release time.

23	On 2B test set — Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter (0 to 20 scale).	
24	With coarse ADJ % BK switch on M — Adjust ADJ % BK control to 55 on black scale of PER CENT BREAK meter.	
25	On test circuit — Set SW1 to position 7.	
26	On 2B test set — Set TWD L key to OFF HK, then set PLS, MEAS % BK keys to LINE.	PER CENT BREAK meter reads 55 on black scale. See Step 27c.

STEP	ACTION	VERIFICATION
27c	If requirement of Step 26 is not met — Adjust M potentiometer of testing circuit to 55 on <i>black</i> scale of PER CENT BREAK meter.	
28	On test circuit — Set ATT attenuator to 11 db.	
Adjust OT Potentiometer		
29	On 2B test set — Adjust ADJ % BK control to 31 on <i>black</i> scale of PER CENT BREAK meter.	
30	Turn ADJ PPS control ccw to 3 pps on PULSES PER SECOND meter.	
31	On test circuit — Set SW1 to position 8, SW2 to position 3.	RG relay should not operate as indicated by PER CENT BREAK meter <i>red</i> scale reading of between 0 and 6. See Steps 37d to 42d, inclusive.
32	Set SW1 to position 7.	
33	On 2B test set — Adjust ADJ PPS control cw to 10 pps on PULSES PER SECOND meter.	
34	Adjust ADJ % BK control to 35 on <i>black</i> scale of PER CENT BREAK meter.	
35	Turn ADJ PPS control ccw to 3 pps on PULSES PER SECOND meter.	
36	On test circuit — Set SW1 to position 8.	RG relay should pulse uniformly as indicated by 8 or more on PER CENT BREAK meter <i>red</i> scale. See Steps 37d to 42d, inclusive.
37d	If requirement of Step 31 or 36 is not met — Set SW1 to position 7.	
38d	On 2B test set — Adjust ADJ PPS control cw to 10 pps on PULSES PER SECOND meter.	
39d	Adjust ADJ % BK control to 33 on <i>black</i> scale of PER CENT BREAK meter.	
40d	Turn ADJ PPS control ccw to 3 pps on PULSES PER SECOND meter.	
41d	On test circuit — Set SW1 to position 8.	
42d	Adjust OT potentiometer of signaling unit first fully cw and then ccw until RG relay just pulses uniformly.	RG relay pulses uniformly as indicated by 8 or more on the PER CENT BREAK meter <i>red</i> scale.

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STEP	ACTION	VERIFICATION
Adjust RT Potentiometer		
43	Set SW1 to position 7.	
44	On 2B test set — Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
45	Adjust ADJ % BK control to 45 on <i>black</i> scale of PER CENT BREAK meter.	
46	On test circuit — Set SW1 to position 8.	PER CENT BREAK meter reads between 50 and 52 on <i>red</i> scale. See Step 47e.
47e	If requirement of Step 46 is not met — Turn RT potentiometer of signaling unit fully ccw, then rotate cw until reading of 51 is obtained.	
48	Set SW1 to position 7.	
49	On 2B test set — Adjust ADJ % BK control to 70 on <i>black</i> scale of PER CENT BREAK meter.	
50	On test circuit — Set SW1 to position 8.	PER CENT BREAK meter reads at least 55 and at most 70 on <i>red</i> scale.
<i>Note:</i> The following Steps 51 to 59, inclusive, are to be performed for E1B-(), E2B-(), E3B-(), except E3B-2.		
51	Set SW1 to position 7.	
52	On 2B test set — Adjust ADJ PPS control to 12 pps on PULSES PER SECOND meter (0 to 20 scale).	
53	Adjust ADJ % BK control to 50 on <i>black</i> scale of PER CENT BREAK meter.	
54	On test circuit — Set SW1 to position 8.	Unit pulses uniformly with PER CENT BREAK meter reading between 54 and 64 on <i>red</i> scale. See Step 55f.
55f	If requirement of Step 54 is not met — Adjust OT potentiometer slightly ccw until unit just begins to pulse uniformly.	
56	Set SW1 to position 7.	
57	On 2B test set — Adjust ADJ % BK control to 75 on <i>black</i> scale of PER CENT BREAK meter.	

STEP	ACTION	VERIFICATION
58	On test circuit — Set SW1 to position 8.	Unit pulses uniformly with PER CENT BREAK meter reading between 59 and 72 on <i>red</i> scale. See Step 59.
59	Repeat Steps 29 to 47e, inclusive, if any adjustment is made in the OT potentiometer beginning with SW1 in position 7 and PULSES PER SECOND meter on 10 pps.	
G Relay		
Note: Perform Steps 60 to 65, inclusive, for E1B-11, E2B-11, and E3B-21 and higher.		
60	Set SW1 to position 7.	
61	On 2B test set — Adjust ADJ PPS control to 10 on PULSES PER SECOND meter.	
62	Adjust ADJ % BK control to 80 on <i>black</i> scale of PER CENT BREAK meter	
63	On test circuit — Set SW1 to position 8.	RG relay pulses with G relay operated.
64	Release G relay by hand.	RG relay stops pulsing and should remain in operated position.
65	Set SW1 to position 7. Note: The following Steps 66 to 72, inclusive, are to be performed on E1B-(), E2B-(), and E3B-7 and higher.	
66	Set ADJ % BK switch to L. Adjust ADJ % BK control to 66.5 on <i>black</i> scale of PER CENT BREAK meter.	
67	Adjust ADJ PPS control ccw to 20 on <i>black</i> scale of PER CENT BREAK meter.	PULSES PER SECOND meter reads between 2.5 and 3.5 pps.
68	On test circuit — Set SW1 to position 8.	RG relay pulses while G remains operated.
69	On 2B test set — With coarse ADJ % BK switch on L — Adjust ADJ % BK control cw until 40 on <i>red</i> scale of PER CENT BREAK meter is obtained.	RG relay pulses while G remains operated.
70	Adjust ADJ % BK control cw to 70 on <i>red</i> scale of PER CENT BREAK meter.	RG and G relays both pulse.

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STEP	ACTION	VERIFICATION
71	On 2B test set — With ADJ % BK switch on M — Adjust ADJ % BK control to 20 on <i>red</i> scale of PER CENT BREAK meter.	RG relay pulses while G relay remains operated.
Rering Response		
72	On test circuit — Set SW1 to position 7.	
73	On 2B test set — With PULSES PER SECOND meter read- ing 10 pps — Adjust ADJ % BK control to 70 on <i>black</i> scale of PER CENT BREAK meter.	
74	Adjust ADJ PPS control to 28 on <i>black</i> scale of PER CENT BREAK meter.	PULSES PER SECOND meter reads about 4 pps.
75	On test circuit — Set SW1 to position 8, SW2 to position 2.	PER CENT BREAK meter reads between 26 and 34 on <i>red</i> scale.
76	Change ATT attenuator in 2-db increments from 5 to 17.	Reading in Step 75 should not change more than $\pm 2\%$ BREAK.
77	Set ATT attenuator to 11.	
78	Change SW1 to position 7.	
79	On 2B test set — Adjust ADJ % BK control to 50 on <i>black</i> scale of PER CENT BREAK meter.	
80	On test circuit — Change SW1 to position 8.	PER CENT BREAK meter reads between 42 and 56 on <i>red</i> scale.
<i>Note:</i> Steps 81 to 83, inclusive, are to be performed only when testing E3B-() units.		
81	Change SW1 to position 7.	
82	On 2B test set — Adjust ADJ % BK control to 18 on <i>black</i> scale of PER CENT BREAK meter.	
83	On test circuit — Change SW1 to position 8.	RG relay remains released as indicated by a reading of 0 on <i>red</i> scale of PER CENT BREAK meter.
84	On 2B test set — Restore keys to normal.	
85	If no other tests are to be made — Remove all cords, restore all keys to nor- mal, return signaling unit to service or spare position.	

STEP	ACTION	VERIFICATION
H. Receiver Guard Action and 2-Wire Controls		
Note: If setting of SS potentiometer is unknown, do Test F before performing any parts of this test.		
11	Check that TL key is in +7 position.	
12	Set SW1 to position 5, SW2 to position 6.	
13	Set dial switch of TMS to 15.	TMS reads between -18.5 and -19.5 db.
14	Set ATT attenuator to: 31 db for E1B, E2B, E3B, E3B-2, and E3B-4; 26 db for E1B-(), E2B-(), E3B-(), except E3B-2 and E3B-4.	
15	Set SW2 to position 5.	RG relay should be released.
16	Set SW1 to position 6.	RG relay remains released.
17	Set SW1 to position 5.	
18	Change ATT attenuator to: 26 db for E1B, E2B, E3B, E3B-2, and E3B-4; 21 db for E1B-(), E2B-(), E3B-(), except E3B-2 and E3B-4.	
19	Set SW1 to position 6.	RG relay operates.
20	Set SW1 to position 5.	RG relay releases.
21	Set ATT attenuator to: 28 db for E1B, E2B, E3B; 24 db for E1B-(), E2B-(), E3B-().	
22	Set SW2 to position 7.	M, HL relays operate.
23	Set SW1 to position 6.	RG relay remains released. F lamp lights.
24	Set SW1 to position 5.	
25	Change ATT attenuator to: 20 db for E1B, E2B, E3B; 17 db for E1B-(), E2B-(), E3B-().	
26	Set SW1 to position 6.	RG relay operates, extinguishing F lamp.
27	Set SW1 to position 5, SW2 to position 4.	RG, M, HL relays release.
28a	If no other tests are to be made — Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

STEP	ACTION	VERIFICATION
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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.

- | 11 | On test circuit—
Set SW1 to position 6, SW2 to position 4. | | | | | | | | | |
|------------------|---|---|-----|------------------|----|------------------|----|------------------|----|--|
| 12 | Set dial switch of TMS to 0. | | | | | | | | | |
| 13 | Set ATT attenuator to 10. | TMS reads 0 ± 0.2 db.
See Step 14a. | | | | | | | | |
| 14a | If reading in Step 13 is not met—
Adjust gain control of V3 test amplifier on CS panel for 0 db. | | | | | | | | | |
| 15 | Set ATT attenuator to level shown for particular office condition. | | | | | | | | | |
| | <table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;">OFFICE</th> <th style="text-align: left;">ATT</th> </tr> </thead> <tbody> <tr> <td>4-wire "+4 line"</td> <td>36</td> </tr> <tr> <td>2-wire "+7 line"</td> <td>35</td> </tr> <tr> <td>2-wire "+4 line"</td> <td>37</td> </tr> </tbody> </table> | OFFICE | ATT | 4-wire "+4 line" | 36 | 2-wire "+7 line" | 35 | 2-wire "+4 line" | 37 | |
| OFFICE | ATT | | | | | | | | | |
| 4-wire "+4 line" | 36 | | | | | | | | | |
| 2-wire "+7 line" | 35 | | | | | | | | | |
| 2-wire "+4 line" | 37 | | | | | | | | | |
| 16 | Set SW2 to position 3. | RG relay should not operate.
See Step 17b. | | | | | | | | |
| 17b | If RG relay operates—
Adjust SS potentiometer slightly ccw until RG relay releases. | RG relay releases. | | | | | | | | |
| 18 | Set ATT attenuator to level shown for particular office condition. | RG relay should operate.
See Step 19c. | | | | | | | | |
| | <table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: left;">OFFICE</th> <th style="text-align: left;">ATT</th> </tr> </thead> <tbody> <tr> <td>4-wire "+4 line"</td> <td>35</td> </tr> <tr> <td>2-wire "+7 line"</td> <td>34</td> </tr> <tr> <td>2-wire "+4 line"</td> <td>35</td> </tr> </tbody> </table> | OFFICE | ATT | 4-wire "+4 line" | 35 | 2-wire "+7 line" | 34 | 2-wire "+4 line" | 35 | |
| OFFICE | ATT | | | | | | | | | |
| 4-wire "+4 line" | 35 | | | | | | | | | |
| 2-wire "+7 line" | 34 | | | | | | | | | |
| 2-wire "+4 line" | 35 | | | | | | | | | |
| 19c | If RG relay does not operate—
Increase setting of SS potentiometer until it just operates. | | | | | | | | | |
| 20c | Repeat Steps 15 to 18, inclusive, until requirements of these steps are met, starting with SW2 in position 4. | | | | | | | | | |
| 21 | Remove all cords, restore all keys to normal, return signaling unit to service or spare position. | | | | | | | | | |