

## TONE DETECTOR CIRCUIT SD-94800-01

### TESTS AND ADJUSTMENTS

**1. GENERAL**

PAGE

**1.01** This section describes the methods of testing and adjusting the tone detector circuit SD-94800-01.

ing of the gate control circuit using the MVG lamp as a start indicator. . . . .

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**1.02** This section is reissued for the following reasons:

- Add 23A transmission measuring set (TMS) under APPARATUS
- Revision of Test A to provide information on options ZX and ZY dealing with high loss trunk groups tested by automatic outgoing trunk test frame (AOTT) or incoming trunk test (ITT) frame test circuits
- Incorporate Addendum 1 to Issue 6
- Add information in Test E dealing with options YA and YC
- Change format of test procedures in Part 3.

**D. Monopulser and Multivibrator Timing:** This test checks the pulse timing of the monopulsers and multivibrators. . . . .

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**E. Second and Third Ring Detection:** This test checks the ability of the circuit to detect audible ringing tone. . . . .

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**F. Pretrip Failure (Option M):** This test checks for an audible ring followed by a reorder tone. This test is only to be performed when provided with option M. . . . .

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**G. Announcement Detection (Option K):** This test checks for the operation of the announcement detection circuit. This test is only to be performed when provided with option K. . . . .

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**H. Audible Ring Follower (Option ZJ):** This test checks the ability of crossbar tandem and No. 1 crossbar offices not arranged for second- and third-ring detection to follow audible ringing tone. . . . .

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**I. Guard Timer Timing (CP12 Option ZP):** This test checks the timing of the guard timer. . . . .

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Revision arrows are used to emphasize the more significant changes. This reissue does not affect the Equipment Test List.

**1.03** The tests covered are as follows:

PAGE

**A. Broadband and Selective Channel Gain:** This test checks the ability of the circuit to distinguish between low-frequency and high-frequency tones. . . . .

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**B. Direct Current Voltage Reference:** This test checks the negative voltage potential at the various test points when no audio signal is present. . . . .

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**C. Gate Control Circuit Start Timing:** This test checks the start tim-

**1.04** When taking voltage indications, circuit ground must be used instead of frame ground to ensure accurate alignment of circuit.

**1.05** When using KS-19353, L1 oscillator, the output level must be adjusted, using a 23A trans-

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mission measuring set (TMS) as reference, before being used and after each change in frequency.

**1.06** When the tone detector circuit is arranged for operation in Electronic Switching System (ESS) offices, the ON relay in Tests A through I is initially operated. Therefore, all references to blocking or removing blocking tools from the ON relay in all tests should be disregarded when the circuit is arranged for operation in ESS offices.

**1.07** Under no circumstances are tone detector circuit boards CP5 through CP8 and CP12 per option ZP to be mixed up with boards from another tone detector unit if more than one exists per location. The manufacturer aligns these boards to time correctly with the supply voltage, as regulated by a zener diode, in the unit that they are shipped in. Moving the boards to another unit will cause the tone detector to time differently, as all zener diodes are not exactly alike. Boards may experimentally be swapped to check for a bad one, but again, do not lose track of which unit they are associated with.

**1.08** Tests D and I provide procedures for alignment of circuit packs when one or more of the following is believed to exist:

- (a) If doubt exists that the boards in the unit are not those originally shipped with the unit
- (b) If new boards have been installed and have not yet been aligned
- (c) If a test failed in this section and it is believed to be due to a faulty or misaligned circuit board.

**1.09 *Lettered Steps:*** A letter a, b, c, etc, added to a step number in Part 3 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. When a condition does not apply, all steps designated by that letter should be omitted.

**2. APPARATUS**

**2.01** KS-14510, L1 volt-ohm-milliammeter (VOM) and one pair of L3 test leads equipped with KS-14530 connectors on one end and alligator clips on the other end.

**2.02** KS-19353, L1 or L4 oscillator, or equivalent.

**2.03** Electronic counter. Any of the following units are acceptable:

- Universal EPUT and Timer
- Fairchild 8200
- Beckman 7360 or 7370
- Hewlett Packard 5223, 5233, 5325B, 5326, 5327, 5328, 5300 with 5302A, 5300 with 5304A, 5300 with 5308A, 5246 with 5247A, or an equivalent of any of the preceding.

**2.04** Adapter, 159A, as required for extending circuit packs for potentiometer adjustment.

**2.05** KS-3008 stopwatch, or equivalent.

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

**2.07** Patching cord, W2W cord, 6 feet long, equipped with a 310 plug and two 360 tools and two 639A tools (2W17A cord, for connecting to fixed contacts of wire-spring relays).

**2.08** Patching cord, 893 cord, 3 feet long, equipped with two 360A tools and two 419A test connectors (1W13A cord, for short-circuiting contacts of ST relay).

**2.09** 651A tools as required for holding 639A tools on wire-spring relays.

**2.10** #23A TMS as required for adjusting output level of KS-19353 OSCILLATOR.♦

## 3. METHOD

STEP	ACTION	VERIFICATION
<b>A. Broadband and Selective Channel Gain</b>		
1	◆At tone detector circuit—◆ Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
2a	◆If equipped with options ZX and ZY—  <b>Note:</b> CP-1 must be equipped according to ED-54086.  Connect ground to terminal 13 of terminal strip B.◆	
3	Insulate make contacts 2 and 4 of ST relay.	
4	Set oscillator FUNCTION switch to 600.	
5	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
6	Set oscillator to 600 Hz adjusted to -30 dBm.	
7a	◆If equipped with options ZX and ZY— Set oscillator to 600 Hz adjusted to -37 dBm.◆	
8	Connect oscillator to fixed contacts 2 and 4 of ST relay.	
9	Set VOM to volts setting and connect between circuit ground (terminal 28 of terminal strip A) and TP1 (terminal 11 of terminal strip TP).	Voltmeter indicates -2.0 volts.
10b	If Step 9 verification is not obtained— Adjust P1 potentiometer until verification is obtained.	
11a	◆If equipped with options ZX and ZY— Remove ground from terminal 13 of terminal strip B.	◆Voltmeter indicates less than -2.0 volts.
12a	Increase oscillator gain to -30 dBm.	Voltmeter indicates -2.0 volts.◆

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STEP	ACTION	VERIFICATION
13c	If Step 12a verification is not obtained— Adjust R290 potentiometer until verification is obtained.⚡	
14	Disconnect VOM.	
15	Remove blocking tool from ON relay.	
16d	If circuits are arranged for 2225-Hz tone detection only— Set oscillator to 2225 Hz at an output level of -25 dB.	
17d	<b>Note:</b> See paragraph 1.06.	
	Block ON relay operated.	HTF relay operated.
18e	If Step 17d verification is not obtained— Adjust P2 potentiometer until HTF just operates.	
19f	If Step 17d verification is obtained— Adjust P2 potentiometer counterclockwise to release HTF relay, and then readjust P2 potentiometer until HTF relay just operates.	
20d	If circuits are arranged for 2225-Hz tone tone detection only— Remove blocking tool from ON relay.	HTF relay released.
21d	Set oscillator to 2050 Hz at an output level of -3 dB.	
22d	Momentarily operate ON relay.	HTF relay not operated.
23d	Set oscillator to 2420 Hz at an output level of -3 dB.	
24d	Momentarily operate ON relay.	HTF relay not operated.
25g	If circuits are arranged for 1000-Hz tone detection only— Set oscillator to 1000 Hz at an output level of -18 dB.	
26h	⚡If MWT relay is provided—⚡ Block MWT relay operated.	

STEP	ACTION	VERIFICATION
27g	If circuits are arranged for 1000-Hz tone detection only—  <i>Note:</i> See paragraph 1.06.  Block ON relay operated.	HTF relay operated.
28i	If Step 27g verification is not obtained— Adjust P2 potentiometer until HTF relay just operates.	
29j	◆If Step 27g verification is obtained— Adjust P2 potentiometer counterclockwise to release HTF relay, and then readjust P2 potentiometer until HTF relay just operates.◆	
30g	If circuits are arranged for 1000-Hz tone detection only— Remove blocking tool from ON relay.	HTF relay released.
31g	Set oscillator to 820 Hz at an output level of 0 dB.	
32g	Momentarily operate ON relay.	HTF relay not operated.
33g	Set oscillator to 1150 Hz at an output level of 0 dB.	
34g	Momentarily operate ON relay.	HTF relay not operated.
35h	If MWT relay is provided— Remove blocking tool.	
36k	◆If circuits are arranged for both 2225-Hz and 1000 Hz tone detection— Set oscillator to 2225 Hz at an output level of -25 dB.	
37k	<i>Note:</i> See paragraph 1.06.  Block ON relay operated.	◆HTF relay operated.
38l	If Step 37k verification is not obtained— Adjust P2 potentiometer until HTF just operates.	

STEP	ACTION	VERIFICATION
39m	If Step 37k verification is obtained— Adjust P2 potentiometer counterclockwise to release HTF relay, and then readjust P2 potentiometer until HTF relay just operates.	
40k	If circuits are arranged for both 2225-Hz and 1000 Hz tone detection— Remove blocking tool from ON relay.	HTF relay released.
41k	Set oscillator to 2050 Hz at an output level of -3 dB.	
42k	Momentarily operate ON relay.	HTF relay not operated.
43k	Set oscillator to 2420 Hz at an output level of -3 dB.	
44k	Momentarily operate ON relay.	HTF relay not operated.
45k	Set oscillator to 1000 Hz at an output level of -18 dB.	
46h	If MWT relay is provided— Block MWT relay operated.	
47k	If circuits are arranged for both 2225-Hz and 1000-Hz tone detection—  <b>Note:</b> See paragraph 1.06.  Block ON relay operated.	HTF relay operated.  <b>Comment:</b> If HTF relay did not operate, trouble is indicated in 1000-Hz filter circuit or MWT relay wiring.
48k	Remove blocking tool from ON relay.	HTF relay released.
49k	Set oscillator to 820 Hz at an output of 0 dB.	
50k	Momentarily operate ON relay.	HTF relay not operated.
51k	Set oscillator to 1150 Hz at an output of 0 dB.	
52k	Momentarily operate ON relay.	HTF relay not operated.⚡
53h	If MWT relay is provided— Remove blocking tool.⚡	
54	Remove blocking tool from ST relay.	

STEP	ACTION	VERIFICATION
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- 55 Remove test connections.
- 56 Remove insulators and short-circuiting cord from ST relay.

**B. Direct Current Voltage Reference**

- 1 ♦At tone detector circuit—♦  
Insulate make contacts 2 and 4 of ST relay.
- 2 **Note:** See paragraph 1.06.  
  
Block ON and ST relays operated.
- 3 Set VOM to volts setting and connect between circuit ground (terminal 28 of terminal strip A) and test points as shown in Table A. Voltmeter indicates voltages as shown in Table A.

**TABLE A**

DIRECT VOLTAGES			
TP	TERM. T.S. "TP"	VOLTAGES	WHEN THIS CP PROVIDED
2	12	-1.7V Max	CP2
3	13	-0.3V Max	CP5
4	14	-0.3V Max	CP6
5	15	-15.5V Min	CP6
6	16	-0.3V Max	CP5
7	17	-0.3V Max	CP7
8	18	-0.3V Max	CP8
8	18	-15V Min	CP14
12	24	-0.3V Max	CP6 (OPTION ZM)

- 4 Using 893 cord, short-circuit contacts 5B and 5F of ST relay.
- 5 Set oscillator to 600 Hz adjusted to -30 dBm.
- 6 Connect oscillator to fixed contacts 2 and 4 of ST relay.

STEP	ACTION	VERIFICATION
7	Connect VOM between circuit ground (terminal 28 of terminal strip A) and TP2 (terminal 12 of terminal strip TP).	Voltmeter indicates -19 volts minimum.
8	Remove test connections.	
9	Remove blocking tools from ON and ST relays.	All relays in circuit normal.
10	Remove insulators and short-circuiting cord from ST relay.	
<b>C. Gate Control Circuit Start Timing</b>		
1	◆At tone detector circuit—◆ Insulate make contacts 2 and 4 of ST relay.	
2	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
3	Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
4a	If AR1 relay is furnished in circuit— Block AR1 relay not operated.	
5b	If CP6 is equipped with ZM option (MVG lamp not provided)— Set VOM to volts setting (40V scale) and connect between circuit ground (terminal 28 of terminal strip A) and TP12 (terminal 24 of terminal strip TP).	
6	Set oscillator to 600 Hz adjusted to -30 dBm.	
7c	If W, Z, W1, and Z1 relays are furnished— Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	W relay operated when tone applied. Z and W1 relays operated when tone removed. MVG lamp not lighted (option ZL) or voltmeter indicates -0.5V maximum (option ZM).
8c	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	W relay released when tone applied. Z relay released when tone removed. Z1 relay operated when tone removed. MVG lamp not lighted, (option ZL) or voltmeter indicates -0.5V maximum (option ZM).
9c	Apply tone to T and R of tone detector circuit for about 0.5 seconds.	MVG lamp lighted on removal of tone ◆(option ZL) or voltmeter indicates -10V minimum (option ZM).◆



STEP	ACTION	VERIFICATION
10d	If provided with App. Fig. 19 (CP14 and CP15)— Connect negative lead of VOM to TP8 (terminal 18 of terminal strip TP).	Voltmeter indicates $-0.5V$ maximum.
11e	If W, Z, W1, and Z1 relays are not furnished— Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	MVG lamp lighted on removal of tone (option ZL) or voltmeter indicates $-10V$ minimum (op- tion ZM).
12	Remove test connections.	
13	Remove blocking tool from AR1 relay.	
14	Remove blocking tools from ON and ST relays.	
15	Remove insulators and short-circuiting cord from ST relay.	All relays in circuit normal.

#### D. Monopulser and Multivibrator Timing

- 1 **Note:** If the following test fails at any point,  
the circuit pack under test at time of failure  
should be replaced with a new circuit pack and  
the test rechecked.
- 2 At the tone detector circuit—  
Insulate make contacts 2 and 4 of ST relay.
- 3 **Note:** See paragraph 1.06.  
  
Block ON and ST relays operated.
- 4 Using 893 cord, short-circuit contacts 5B and 5F  
of ST relay.
- 5 Block ST1 relay nonoperated.
- 6a If MB and Z1 relays are furnished—  
Block MB relay nonoperated, and block Z1 relay  
operated.
- 7 Set counter for time interval function with trig-  
gering for  $-Start$  and  $+Stop$  operation and trig-  
ger level for  $-6$  to  $-10$  volts.
- 8 Set oscillator at 600 Hz adjusted to  $-30$  dBm.
- 9 Connect counter to TP3 (terminal 13 of terminal  
strip TP).

STEP	ACTION	VERIFICATION
10	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	Counter indicates a pulse of $20 \pm 1$ milliseconds on removal of tone.
11b	If verification of Step 10 is not obtained— Remove blocking tools from ON and ST relays.	
12b	Remove CP5 and reinsert on 159A adapter.	
13b	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
14b	Adjust P8 potentiometer and repeat Step 10 until verification is obtained.	
15	Connect counter to TP6 (terminal 16 of terminal strip TP).	
16	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	Counter indicates a pulse of $15 \pm 1$ milliseconds on removal of tone.
17c	If verification of Step 16 is not obtained— Remove blocking tools from ON and ST relays.	
18c	Remove CP5 and reinsert on 159A adapter.	
19c	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
20c	Adjust P9 potentiometer and repeat Step 16 until verification is obtained.	
21	Block ST1 relay operated.	
22	Connect counter to TP4 (terminal 14 of terminal strip TP).	Counter indicates no pulses.
23	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	Counter indicates pulses of $360 \pm 1.5$ milliseconds for ZL option boards or $390 \pm 1.5$ milliseconds for ZM option boards.
24d	If verification of Step 23 is not obtained— Remove blocking tools from ON and ST relays.	
25d	Remove CP6 and reinsert on 159A adapter.	
26d	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	

STEP	ACTION	VERIFICATION
27d	Adjust P10 potentiometer and repeat Step 23 until verification is obtained.	
28	Connect counter to TP5 (terminal 15 of terminal strip TP).	Counter indicates pulses of $180 \pm 1$ millisecond for ZL option boards or $185 \pm 1$ millisecond for ZM option boards.
29e	If verification of Step 28 is not obtained— Remove blocking tools from ON and ST relays.	
30e	Remove CP6 and reinsert on 159A adapter.	
31e	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
32e	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	
33e	Adjust P11 potentiometer and repeat Step 28 until verification is obtained.	
34	Connect counter to TP7 (terminal 17 of terminal strip TP).	Counter indicates pulses of $180 \pm 5$ milliseconds.
35f	If verification of Step 34 is not obtained— Remove blocking tools from ON and ST relays.	
36f	Remove CP7 and reinsert on 159A adapter.	
37f	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
38f	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	
39f	Adjust P12 potentiometer and repeat Step 34 until verification is obtained.	
40g	If provided with App. Fig. 19 (CP14 and CP15)— Omit Steps 41 through 46h.	
41	Connect counter to TP8 (terminal 18 of terminal strip TP).	Counter indicates pulses of $590 \pm 35$ milliseconds.

STEP	ACTION	VERIFICATION
42h	If verification of Step 41 is not obtained— Remove blocking tools from ON and ST relays.	
43h	Remove CP8 and reinsert on 159A adapter.	
44h	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
45h	Apply tone to fixed contacts 2 and 4 of ST relay for about 0.5 seconds.	
46h	Adjust P13 potentiometer and repeat Step 41 until verification is obtained.	
47	Remove test connections.	
48	Remove blocking tool from ST1 relay.	
49	Remove blocking tools from MB and Z1 relays.	
50	Remove blocking tools from ON and ST relays.	All relays in circuit normal.
51	Remove insulators and short-circuiting cord from ST relay.	

**E. Second and Third Ring Detection**

1	◆At the tone detector circuit◆ Insulate make contacts 2 and 4 of ST relay.	
2	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
3	Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
4	Set oscillator to 600 Hz adjusted to -30 dBm.	
5	Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR and AR1 relays operated when tone applied. (Approximately 750-millisecond delay.) AR1 relay released when tone removed.
6	Within 1 second— Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR1 relay operated when tone applied. (Approximately 750-millisecond delay.) AR1 relay released when tone removed. RAR relay not operated.

STEP	ACTION	VERIFICATION
7	After 3 seconds— Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR1 and RAR relays operated when tone applied. (Approximately 750-millisecond delay.) AR1 relay released when tone removed. TRD relay not operated. ◆RTR relay operated (option YC).◆
8a	◆If equipped with options YA and YC— Within 1 second— Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.◆	◆TRD relay not operated.◆
9a	After 3 seconds— Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR1 and TRD relays operated when tone applied. (Approximately 750-millisecond delay.) AR1 relay released when tone removed.
10	Remove blocking tools from ON and ST relays.	All relays in circuit normal.
11	Remove test connections.	
12	Remove insulators and short-circuiting cord from ST relay.	
<b>F. Pretrip Failure (Option M)</b>		
1	◆At the tone detector circuit—◆ Insulate make contacts 2 and 4 of ST relay.	
2	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
3	Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
4	Set oscillator to 600 Hz adjusted to -30 dBm.	
5	Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR relay which prepares ground on PTF lead operated.
6	Manually operate RO relay.	Ground connection completed on PTF lead. After CT relay operates RO lead now grounded.
7	Release ST relay.	RO relay normal.
<b>G. Announcement Detection (Option K)</b>		
1	◆At tone detector circuit—◆ Insulate make contacts 2 and 4 of ST relay.	

STEP	ACTION	VERIFICATION
2	<i>Note:</i> See paragraph 1.06. Block ON and ST relays operated.	
3	Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
4	Set oscillator to 600 Hz adjusted to -30 dBm.	
5a	If AR1 relay is provided— Block AR1 nonoperated.	
6	Apply tone three times to fixed contacts 2 and 4 of ST relay for about 1.0 second.	MVG lamp lighted (option ZL).
7	<i>Note:</i> Each pulse, when keyed in, should be over 200 milliseconds in length.  Key in pulses at a random rate or interval.	RO or BY relay may operate before ANN relay.
8	<i>Note:</i> ♦At least four pulses should be keyed.♦  Continue keying for about 2 seconds.	ANN relay operated. CT relay operated.  <i>Comment:</i> ANN relay must operate before the CT relay operates.
9	Remove blocking tools from ON and ST relays.	All relays in circuit normal.
<b>H. Audible Ring Follower (Option ZJ)</b>		
1	♦At tone detector circuit—♦ Insulate make contacts 2 and 4 of ST relay.	
2	<i>Note:</i> See paragraph 1.06. Block ON and ST relays operated.	ANN relay operated.
3	Using 893 cord, short circuit contacts 5B and 5F of ST relay.	
4	Set oscillator to 600 Hz adjusted to -30 dBm.	
5	Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR and AR1 relays operated when tone applied. (Approximately 750-millisecond delay). AR1 relay released when tone removed.

STEP	ACTION	VERIFICATION
6	Within 1 second— Apply tone to fixed contacts 2 and 4 of ST relay for about 1.0 second.	AR1 relay operated when tone applied. (Approximately 750-millisecond delay.) AR1 relay released when tone removed.
7	Remove blocking tools from ON and ST relays.	All relays in circuit normal.
8	Remove test connections.	
9	Remove insulators and short-circuiting cord from ST relay.	
<b>I. Guard Timer Timing (CP12 Option ZP)</b>		
1	◆At tone detector circuit—◆ Insulate make contacts 2 and 4 of ST relay.	
2	<b>Note:</b> See paragraph 1.06.  Block ON and ST relays operated.	
3	Using 893 cord, short-circuit contacts 5B and 5F of ST relay.	
4	Block any relay required to remove ground from STTM lead if grounded.	
5	Arrange counter to read in seconds plus two digits below decimal.	
6	Set function switch of counter to time an interval from A to B or arrange an equivalent to this function.	
7	Arrange counter to begin timing on a negative slope and cease timing with a positive slope.	
8	<b>Note:</b> Should RO lead not have resistance battery on it from the connecting circuit, connect a test receiver tied to battery to the RO lead.  Connect starting input probe to CP12 pin 17, and connect stopping input to RO lead on terminal strip A, terminal 42.	
9	Block RO relay operated.	CT relay operated in approximately 3 seconds. Counter indicates $2.75 \pm .01$ seconds.

STEP	ACTION	VERIFICATION
10a	If counter reading is out of tolerance— Adjust P16 potentiometer on CP 12 (clockwise- increases time interval, counter-clockwise- decreases time interval).	
11	Strap pin 17 of CP12 to ground.	CT relay released.
12a	If counter reading is out of tolerance— Remove strap from pin 17 to repeat timing test.	
13	Release relays ST and ON.	
14	Remove blocking tool from PRO relay.	
15	Remove insulator from contacts 2 and 4 of ST relay.	
16	Release any relay blocked in a connecting cir- cuit.	
17	Disconnect frequency counter.	