LINE CONCENTRATOR NO. 2A

TROUBLE LOCATION

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1. GENERAL

1.01 This section describes methods and procedures that may be followed in locating trouble in the line concentrator No. 2A remote circuit SD-94816-01 and control circuit SD-94815-01.

1.02 This section is reissued to:

- Revise Table of Contents to add Part 7
- Revise 2.02 to specify a new counter and additional substitute counters
- Revise 6.12 to add location of CP6
- Revise 6.211 to add location of CP11
- Revise 6.321 to add location of CP13
- Revise 6.412 to add location of CP9
- Revise 6.52 to add location of CP12
- Revise 6.611 to add location of CP8
- Revise 6.712 to add location of CP13
- Revise 6.812 to add location of CP9
- Revise 6.92 to add location of CP10
- Add Part 7.

1.03 Trouble conditions at the remote circuit are generally indicated by a lamp display or a lamp display in addition to an alarm. A trouble in the control circuit, in addition to a lamp display, takes a trouble record indicating line and trunk number, type of call, and progress of a call at the time of failure.

1.04 Part 4 is to be followed for trouble investigations in the remote circuit and Part 5 for the control circuit. To determine which circuit is in trouble, the record of the trouble lamp display at the remote circuit and the trouble record cards at the control circuit should be analyzed.

1.05 If trouble conditions seem to appear and disappear and a trouble analysis using these parts does not uncover the trouble, check adjustments on the circuit boards as covered in Part 6 or 7.

1.06 If trouble conditions indicate false starts of the concentrator (trouble record card at control circuit or lamp display at the remote circuit with no information), it may be the transmission facilities. The quality of the facilities used for the signaling control channel is to be such that the impulse noise as measured with a 6A impulse counter should not exceed 35 counts in 15 minutes at a noise level of 48-53 dBrn.

2. APPARATUS AND REFERENCE MATERIAL

2.01 ***Logic Circuit Test Set 908A (J79908A):*** Use as covered in Section 100-171-101. (Logic Test Set BSP)

2.02 ▶***Hewlett-Packard Model 5304A Timer/ Counter and Model 5300 A Measuring System Main Frame*** (Both of Which Comprise a Complete Electronic Counter): This counter in this practice will be referred to as the 5304A counter. Instructions are also included for the Hewlett-Packard 552B electronic counter. Suitable substitutes, if already available, would be Hewlett-Packard Models 5233L, 5326A, or 5326B.◀

2.03 ***Tektronix* 453 Oscilloscope:*** The Tektronix 535A with a CA- or B-type vertical plug-in unit is a suitable equivalent if already available.

*Registered trademark of Tektronix, Inc.

2.04 Hewlett-Packard 412A voltmeter or equivalent capable of reading voltages in the range of 0 to 15 volts ±1 percent.

2.05 Hewlett-Packard 400H voltmeter or equivalent capable of reading RMS voltages in the range of 0.10 to 15.0 volts with a dB scale calibrated to read dBm into 600 ohm circuits.

2.06 Trouble Recorder Card Reading Mask Form E-5185.

2.07 Circuit Board Extender (ED-94866-30).

2.08 Blocking and insulating tools as required. Apply as covered in Section 069-020-801.

2.09 5A Attenuating Pad.

2.10 High impedance test receiver or hand test set.

REFERENCE MATERIALS

2.11 CD and SD-94816-01, common systems, Line Concentrator No. 2A Remote Circuit.

2.12 CD and SD-94815-01, common systems, Line Concentrator No. 2A Control Circuit.

2.13 CD and SD-94817-01, common systems, Line Concentrators No. 2A and 2B Circuit Pack Schematics.

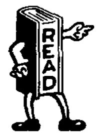
2.14 067-109-502 Line Concentrator No. 2A System Test.

3. TESTING PROCEDURE

3.01 Test points referred to in this part are located on terminal blocks on their respective frames (remote and control). Each test point is represented by a letter and a number (eg, A32). The letter refers to the terminal block, while the number refers to the test location on the terminal block. For example, test point A32 would be found (a) in the third row from the right, (b) at the second position from the bottom, and (c) on the A terminal block.

3.02 All test equipment used should be properly calibrated.

3.03 If any of the boards listed below are replaced in the course of trouble analysis, they must be checked for calibration according to Part 6 or 7 and, if necessary, recalibrated. These boards are CP6, 8, 9, 10, 11, 12, and 13.



Battery should not at ANY TIME be connected to any of the test points. This could cause damage to the transistors on the circuit boards. Ground, however, may be applied at any time to any test point. Conduct tests in accordance with Section 032-173-301.

3.04 The TA test call referred to in Parts 4 and 5 is a test substitute for a service request or terminating call. A TA test call is initiated from the remote circuit by connecting the T and R leads of the line to be tested at the frame terminal strip. A TA test call is initiated from the control circuit by placing ground on the S(00-77) lead corresponding to the line being tested. A terminating test call can be substituted for the TA test call from the control circuit provided the failure does not occur on the initial part of the test call which prepares the circuit for the terminating call. If the terminating test call fails on the initial part of the call, see 3.07.

3.05 If trouble occurs only on disconnect calls, a disconnect test call can be substituted for the terminating TA test call in Parts 4 and 5. The disconnect test call can be started at the control circuit by blocking the D0/1 relay released and releasing any operated TK_ relays in the group being tested. Release the circuit, and then remove the blocking tool from the D0/1 relay allowing it to operate and start a disconnect call. Parts 4 and 5 can be used to analyze the trouble since the solid-state functions are identical on a disconnect and terminating call. The relays associated with a disconnect call replace the relays associated with a terminating call. The sequence charts should be used to determine the proper relay operation on the disconnect call.

3.06 If trouble occurs on a special-type call (service denial, release service denial, permanent signal denial, or test calls associated with line 79), Parts 4 and 5 can still be used to analyze the trouble since the solid-state function is identical on each call. The control relay operations will be different for each special-type call, and the sequence charts should be used to determine proper relay operation.

3.07 In all tests, block the TM1, TM2, TM4, TM5, and TM6 relays released and the TM3 and TRB1 relays operated in the control circuit and the RT, TM3, and TM5 relays released at the remote circuit, unless otherwise specified in the test section.

3.08 Before attempting to analyze a trouble condition in the concentrator, it should first be determined whether the trouble is occurring on service request, terminating-type calls, or both. The conditions under which the trouble occurs will dictate the type of test call to be used in localizing the trouble.

3.09 When the message received or the message to be transmitted is observed on the oscilloscope, the "mark" indications are positive and the "space" indications are at ground unless otherwise indicated. The length of a "space" or "mark" is 5 milliseconds unless otherwise specified. When using an oscilloscope to check a message, the time scale of the scope should be set at 10 milliseconds.

3.10 When a relay is listed as a possible trouble, the operate or release path for the relay should be checked as well as the relay itself.

4. REMOTE CIRCUIT TROUBLE ANALYSIS

Trouble display lamps at the remote circuit are as follows:

SF—Signal Failure
TCF—Trunk Check Failure
TM3—Hold Magnet Failure
CF—Control Failure
DL—Display Lost—Indicates that at least one trouble occurred after the first trouble display.

Information lights indicating type of call and progress of the call are as follows:

D—Disconnect
SD1—Service Denial
SD2—Release Service Denial
SR—Service Request
TER—Terminating
C1, 1, 4, 8, 16—Clock Phase Indication (Binary)
U0, 1, 2, 4, 7—Line Units (2 out of 5)
T0, 1, 2, 4, 7—Line Tens (2 out of 5)
TK0-7—Trunk Select Level
TK8/9—Trunk Steering Level

4.1 ***CF Lamp (Control Failure):*** A CF lamp indicates trouble in the control circuit. If the SR lamp is lighted, go to 5.301. If the SR lamp is dark, go to 5.201.

4.2 *TMS Lamp (Hold Magnet Failure)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.201	Check the lamp indications to determine the type of call.	SR lamp indication. Go to Step 4.202.	
		D or SD2 lamp indications. Go to Step 4.204.	
		SD1 or TER lamp indications. Go to Step 4.205.	
4.202	Block the TM3 and SQ1 relays released. Start a TA test call from the remote circuit and observe the OH relay.	OH operates.	Hold magnet, HMK, XPK, XPK1, or SQ1 relay. If the trouble is not associated with any of these relays, check the TM3 timer circuit.
		OH remains released. Go to Step 4.203.	
4.203	Check the XPK1 relay.	XPK1 released.	Select magnets LS, T_, U_, UA_, LRK, TRK, or SMK relay.
		XPK1 operated.	False operation of the XPK1 relay, or the trunk that was preselected was still connected to a line.
4.204	Block the TM3 and SQ2 relays released. Initiate the type call which has failed and observe the RH relay. (This call must be made on a trunk which is connected to an idle line.)	RH operates.	Hold magnet, HRK or SQ2 relay.
		RH remains released.	SI1, T_, U_, UA_, or LRK relay.
4.205	Block the TM3 and SQ2 relays released. Initiate the type of call which has failed and observe the OH relay.	OH operates.	Hold magnet or HMK relay. Also, the XPK or XPK1 relay on terminating calls.
		OH remains released. Go to Step 4.206.	

***Caution:** Battery should not, at any time, be connected to any of the test points. This could cause damage to the transistors on the circuit boards. Ground may be applied to any test point at any time. Conduct tests in accordance with Section 032-173-301.*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.206	Check the XPK1 relay.	XPK1 released.	Select magnet, TRK, SMK, SI1, T_, U_, UA_, or LKR relay.
		XPK1 operated.	False operation of the XPK1 relay, or the trunk that was preselected was still connected to a line.

4.3 *TCF Lamp (Trunk Check Failure)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.301	Make repeated TA test calls from the remote circuit to find a trunk which causes a trunk failure. Block the TCF relay released and preselect the faulty trunk. Check to insure that the same trunk is preselected in the control circuit. Initiate a TA test call from the remote circuit and observe the TKA relay.	TKA operates. Go to Step 5.302.	
		TKA remains released.	ST, SQ2, SO1, or TKA relay.
4.302	Check the TNK relay.	TNK released. Go to Step 4.303.	
		TNK operated. Go to Step 4.304.	
4.303	Observe the operated A_ and B_ relays and compare with the trunk preselected at the start of the TA test call.	A_, B_ information matches the TK_ information.	TNK relay.
		A_, B_ information fails to match the TK_ information. Go to Step 4.520.	
4.304	Remove the blocking tool from the TCF relay and observe that relay.	TCF operates.	False operate path for the TCF relay.
		TCF remains released. Circuit functioned properly. Go to Step 4.301 and repeat test.	

4.4 *AL Lamp (No Other Trouble Lamp Indications)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.401	Originate a TA test call from the remote or control circuit and observe relays TM1, TM2, and TM5. If the alarm does not return, try initiating TA test calls from the other remote or control circuit.	TM2 releases. Go to Step 4.402 if trouble occurs on a TA test call from the remote circuit and go to Step 4.428 if the call started from the control circuit.	
		TM1 releases. Go to Step 4.407.	
		TM5 operates. Go to Step 4.426.	
4.402	Block the TM2 relay operated and the TM5 relay released. Initiate a TA test call from the remote circuit. Observe the RL2 relay.	RL2 operates and releases.	OL relay or contact in associated release path; TM2 timer.
		RL2 operates and fails to release. Go to Step 4.403.	
4.403	Check the state of the RL1 relay.	RL1 released.	Relays or relay contacts in check down (locking) path of the RL2 relay.
		RL1 operated. Go to Step 4.404.	
4.404	Use the 908A test set and check the frequency at test point A12 (limiter test point). Set the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading 40.5 ± 2. Go to Step 4.405.	
		Scale reading 0. Go to Step 4.901.	
4.405	Change the rotary switch to TRL (+) and check the potential at test point A33 (output of STA gate) with the 908A test set.	Lamp on.	STA, TA, RL1 relays.
		Lamp off. Go to Step 4.406.	
4.406	Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the ac potential across test points E34 and E44 (input to RPT coil).	Reading is −18 dBm ± 7 dB.	CP9 or CP13. When replacing either of these boards, adjustments of the guard interval timer and the signal present detector must be made in accordance with 6.3 and 6.4, respectively. If a previously adjusted pair of spares is available, they may be used to replace CP9 and CP13.
		Reading less than −25 dBm. Go to Step 5.901.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.407	Block the TM1 relay operated and the SR and SR1 relays released. Release the circuits and make a TA test call from the remote circuit. Observe the EP relay.	EP operates. Go to Step 4.408.	
		EP remains released. Go to Step 4.409.	
4.408	Remove the block from the SR and SR1 relays.	SR and SR1 operate.	TM1 timer.
		SR and/or SR1 remain released.	SR, SR1 relays.
4.409	Use the 908A test set to check the potential at test point E25 (input to SRG gate). Set the rotary switch to TRL (+).	Lamp on.	LT_, LU_, SO1, or LK relay. SQ2 or TA contact.
		Lamp off. Go to Step 4.410.	
4.410	Release the circuits and check the potential at test point B17 (output of CP11 gate).	Lamp on. Go to Step 4.411.	
		Lamp off. Go to Step 4.414.	
4.411	Block the TM5 relay operated and check the potential at E55 (output of RLS gate).	Lamp on. Go to Step 4.413.	
		Lamp off. Go to Step 4.412.	
4.412	Check the potential at test point E16 (input to RLS gate).	Lamp on. Remove block from the TM5 relay.	Contacts associated with test point E16.
		Lamp off. Remove block from the TM5 relay.	(RLS) gate, RLS resistor.
4.413	Check the potential at test points C21, C11, C41, C31, and C51 (output of CTR binary cells).	Lamp on at any test point.	Binary cell associated with that test point.
		Lamp off at all test points. Go to Step 4.701.	
4.414	With the TM1 relay blocked operated and the SR and SR1 relays blocked released, make a TA test call from the remote circuit on the same line used in Step 4.407. Check the potential at test point B17 (output of CP11 gate).	Lamp on. Go to Step 4.423.	
		Lamp off. Go to Step 4.415.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.415	Check the potential at test point B36 (output of CC1 gate).	Lamp on. Go to Step 4.416.	
		Lamp off. Go to Step 4.425.	
4.416	Check the potential at test point D26 (output of SR flip-flop).	Lamp on. Go to Step 4.417.	
		Lamp off. Go to Step 4.421.	
4.417	Check the potential at test point B54 (output of SRG gate).	Lamp on.	(SR) flip-flop.
		Lamp off. Go to Step 4.418.	
4.418	Check the potential at test point E55 (output of RLS gate).	Lamp on. Go to Step 4.419.	
		Lamp off. Go to Step 4.420.	
4.419	Check the potential at test point E16 (input to RLS gate).	Lamp on.	(RLS) gate, RLS resistor.
		Lamp off.	RLS1 resistor, contacts associated with test point E16 or false ground on E16.
4.420	Check the potential at test point A55 (output of INC flip-flop).	Lamp on.	(INC) flip-flop.
		Lamp off.	(SRG) gate.
4.421	Check the potential at test point B46 (output of CC2 gate).	Lamp on.	(CC1) gate.
		Lamp off. Go to Step 4.422.	
4.422	Check the potential at test point B56 (output of CC2 gate).	Lamp on. Go to Step 4.701.	
		Lamp off.	(CC2) gate.
4.423	Check the potential at test point B37 (output of P110 gate).	Lamp on. Go to Step 4.424.	
		Lamp off.	SEP, EP relays.
4.424	Check the potential at test point A58 (output of P11 flip-flop).	Lamp on.	(P110) gate.
		Lamp off.	(P11) flip-flop, CP11 capacitor.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.425	Change the rotary switch setting to 500 Hz and check the frequency at test point B51 (output of T4 monopulser).	→Scale reading 20 ± 2. Go to Step 4.701. →Scale reading 0. Go to Step 4.601.	
4.426	The TM5 timer is an overall timer which will release the remote circuit if the trouble release feature fails. Operation of the TM5 relay indicates that the control of the RLS mercury relay or the RLS relay itself is not functioning properly. This trouble is an electromechanical failure and can be checked by blocking the TM5 relay released and determining which relay fails to function properly in the release.		
4.5	***SF Lamp (Signal Failure)***		
4.501	Determine whether the failure occurs on service request calls or terminating-type calls.	→Failure on service request calls. Go to Step 4.502. →Failure on terminating-type calls. Go to Step 4.539.	
	Note: This lamp will light if the transmission facilities should go open momentarily at any time when the circuit is idle. If the trouble cannot be repeated by making TA test calls, the lamp indication was probably caused by a momentary open in the transmission facilities.		
4.502	Block the SQ2 and RT relays released in the remote circuit and the TM1 relay released in the control circuit. Initiate a TA test call from the remote circuit and observe the SQ2 relay. If the call does not fail, repeat TA test calls on different line and trunk combinations until the circuit fails.	→SQ2 fails to operate. Go to Step 4.503. →SQ2 operates. Go to Step 4.517.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.503	Check the EP relay.	EP operated. Go to Step 4.504.	
		EP released. Go to Step 4.409.	
4.504	Use the 908A test set to check the potential at test point A16 (output of PP flip-flop). Set the rotary switch to TRL (+).	Lamp on. Go to Step 4.505.	
		Lamp off. Go to Step 4.506.	
4.505	Check the potential at test point A17 (output of PP0 gate).	Lamp on.	(PP0) gate.
		Lamp off.	ST, SQ2 relays.
4.506	Use the 908A test set to check test point A13 (output of ST gate). Set the rotary switch to MP (+). Release the circuits and initiate a TA test call from the remote circuit on a failing line.	Lamp winks one or more times. Go to Step 4.507.	
		Lamp fails to wink. Go to Step 4.508.	
4.507	Repeat Step 4.506, checking test point A24 (output of MP monopulser).	Lamp winks one or more times.	(PP) flip-flop.
		Lamp fails to wink.	Guard interval timer board (CP13). When replacing (CP13), a (CP9) board must also be replaced since these boards are a matched pair. If a matched pair is not available for replacement, check the adjustments in accordance with 6.3 and 6.4.
4.508	Use the oscilloscope to observe the message at test point A11 (input to modulator). Release the circuits and initiate a TA test call from the remote circuit. Set the time scale of the oscilloscope to 10 milliseconds per division.	Correct message observed. If this trouble check started in Part 5, go to Step 4.901. If this trouble check started in Part 4, go to Step 5.306.	
		Incorrect message or no message observed. Go to Step 4.509.	
4.509	Repeat Step 4.508 observing the message at test point B33 (output of OS flip-flop).	Correct message observed. Go to Step 4.510.	
		Incorrect message or no message observed. Go to Step 4.511.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.510	Repeat 4.508 observing the message at test point B23 (output of M gate).	Correct message observed.	(INV7) gate.
		Incorrect message observed.	TBL1, TBL resistors, TBL capacitor, TBL contacts 1 and 3, or (M) gate.
4.511	Ground test point B36 (input to clock) and check the frequency at test points D36 (output of INV3) and B44 (output of INV4) with the 908A test set. Set the rotary switch to 500 Hz and the slide switch to DF.	Scale reading 20 ± 2 at both test points. Go to Step 4.512. Remove ground from B36.	
		Scale reading 0 at both test points. Go to Step 4.607.	
		Scale reading 0 at one of the test points and 20 ± 2 at the other test points. Remove ground from B36.	(INV3), (INV4) gates.
4.512	Release the circuits and ground test point B34 (output of clock). Use the 908A test point to check for a pulse at test point B13 (output of INV5 and INV9). Set the rotary switch to MP (+). Initiate a TA test call from the remote circuit on a failing line.	Lamp winks. Go to Step 4.513.	
		Lamp remains off. Go to Step 4.514.	
4.513	Use the 908A test set to check the potential at test points E17, E56, E37, E27, or E57 for "A" digits 7, 4, 2, 1, or 0, respectively; and test points E47, E28, E18, E48, or E38 for "B" digits 7, 4, 2, 1, or 0, respectively. (LT_ and LU_ input to shift register). Set the rotary switch to TRL (+).	Lamp off at all test points corresponding to "A" and "B" digits to be transmitted. Go to Step 4.801.	
		Lamp on at any test point corresponding to "A" and "B" digits to be transmitted.	LT_, LU_, or SO1 relay associated with that digit.
4.514	Rpeat Step 4.512 checking test point B41 (output of T1 monopulser).	Lamp winks.	(INV5), (INV9) gates.
		Lamp remains off. Go to Step 4.515.	
4.515	Repeat Step 4.512 checking the output at test point A45 (output of SR flip-flop).	Lamp remains off.	(SR) flip-flop.
		Lamp winks. Go to Step 4.516.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.516	Change the setting of the rotary switch to TRL (+) and check the potential at test point A37 (input to T1 monopulser).	Lamp on.	CKT resistor, CKT relay, or (CKT) gate.
		Lamp off.	(T1) monopulser.
4.517	Check the RO relay.	RO operated. Go to Step 4.518.	
		RO released.	RT relay and timer circuit or SF1 or SF2 relay operating falsely.
4.518	Check the ABK relay.	ABK operated.	RT relay timer circuit or SF1 or SF2 relay operating falsely.
		ABK released. Go to Step 4.519.	
4.519	Check the A_ and B_ relays to see which bits of information are in error.	A_, B_ relays operated correctly.	ABK relay.
		Error in A_, B_ relays. Go to Step 4.520.	
4.520	Use the oscilloscope to observe the message at test point A13 (output of ST gate). Release the circuits and initiate a TA test call from the remote circuit on the trunk that is failing. Set the time scale of the oscilloscope to 10 milliseconds per division.	Correct message observed. Go to Step 4.532.	
		Incorrect or no message observed. If this trouble check started in Part 5, go to Step 5.901. If this trouble check started in Part 4, go to Step 5.351 if incorrect message is observed or to Step 4.508 if no message is observed.	
4.521	Repeat Step 4.510 observing test point B31 (output of T3 monopulser).	Four marks observed in the proper place for the information being received. These marks are represented by positive pulses of a 10-microsecond duration. Go to Step 4.522.	
		Incorrect message observed. Go to Step 4.536.	
4.522	Check the RO relay.	RO operated. Go to Step 4.525.	
		RO released. Go to Step 4.523.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.523	Use the 908A test set to measure the potential at test point B27 (output of P220 gate). Set the rotary switch to TRL (+).	Lamp off.	SRO, RO relays.
		Lamp on. Go to Step 4.524.	
4.524	Ground test point B36 (clock input). Set the rotary switch of the 908A set to 500 Hz and the slide switch to DF. Check the frequency at test point B51 (output of T4 monopulser).	Scale reading 20 ± 2. Got to step 4.701.	
		Scale reading 0. Go to Step 4.515.	
4.525	Check the ABK relay.	ABK operated. Go to Step 4.526.	
		ABK released. Go to Step 4.534.	
4.526	Remove the blocking tool from the SQ3 relay and check the RL1 relay.	RL1 released. Go to Step 4.527.	
		RL1 operated. Go to Step 4.531.	
4.527	Check the TA relay.	TA operated. Go to Step 4.528.	
		TA released. Go to Step 4.529.	
4.528	Check the SQ3 relay.	SQ3 relay operated.	RL1 relay.
		SQ3 relay released.	SQ3 relay.
4.529	Measure the frequency at test point A12 (limiter output) with the 908A test set. Set the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading greater than 10. Go to Step 4.911.	
		Scale reading 0. Go to Step 4.530.	
4.530	Check the potential at test point A33 (output of STA gate) with the 908A test set. Set the rotary switch to TRL (+).	Lamp on.	Board A3, (CP13). When replacing CP13, CP9 must also be replaced as they are a matched pair. If a matched pair is not available for replacement, check adjustments in accordance with 6.3 and 6.4.
		Lamp off.	STA, TA relays.
4.531	Check the OL relay.	OL operated. Go to Step 4.533.	
		OL released. Go to Step 4.532.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.532	Check the RL2 relay.	RL2 released.	RL2 relay.
		RL2 operated.	OL relay.
4.533	Check the frequency at terminal 1 of the FS filter with the 908A test set. Set the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading greater than 10.	OL relay contact 6.
		Scale reading 0. Go to Step 5.911.	
4.534	Use the 908A test set to measure the frequency at test point B31 (output of T3 monopulser). Ground test points B36 (input to clock) and A54 (output of DMO gate). Set the rotary switch on the 908A test set to 500 Hz and the slide switch to DF.	Scale reading 20 ± 2. Go to Step 4.535.	
		Scale reading 0. Go to Step 4.611.	
4.535	Ground test point B36 (input to clock). Measure the frequency at test points D36 and B44 output of INV3 and INV4, respectively, with the 908A test set. Set the rotary switch to 500 Hz.	Scale reading 0 at either test point. Go to Step 4.605.	
		Scale reading 20 ± 2. Go to Step 4.801.	
4.536	Repeat Step 4.519 observing the output at test point B32 (output of WG gate) with the oscilloscope.	Four marks observed in the proper place for the information being received. These marks are represented by 156 microsecond pulses.	(T3) monopulser.
		Incorrect message observed. Go to Step 4.537.	
4.537	Repeat 4.520 observing test point A54 (output of DMO gate).	Five marks observed in the proper place for the information being received. (Marks are negative with respect to spaces at this test point.) Go to Step 4.538.	
		Incorrect message observed.	(DMO) gate.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.538	Ground test point B36 (input to clock). Use the 908A test set to measure the frequency at test point B42 (output of INV6 gate). Set the rotary switch of the 908A test set to 500 Hz and the slide switch to DF.	Scale reading 20 ± 2.	(WG) gate, adjustment on multivibrator.
		Scale reading 0. Go to Step 4.605.	
4.539	Block the RT relay released in the remote circuit and the TM1 relay released in the control circuit. Initiate a TA test call from the control circuit and observe the ABK relay. If the call does not fail, repeat TA test calls on different line and trunk combinations until the circuit fails.	ABK fails to operate. Go to Step 4.540.	
		ABK operates. Go to Step 4.549.	
4.540	Check the RO relay.	RO operated. Go to Step 4.541.	
		RO released.	RT relay and timer circuit or SF1 or SF2 operating falsely.
4.541	Check the A_, B_, and C_ relays to see which bits of information are in error.	A_, B_, C_ relays operated correctly.	ABK relay.
		Error in A_, B_ relays. Go to Step 4.543.	
		Error in C_ relays. Go to Step 4.542.	
4.542	Initiate a TA test call from the control circuit and check for a pulse at test point B28 (output of CP6A gate).	Lamp winks. Go to Step 4.543.	
		Lamp does not wink. Go to Step 4.701.	
4.543	Use the oscilloscope to observe the message at test point A13 (output of ST gate). Release the circuits and initiate a TA test call from the control circuit on the trunk that is failing. Set the time scale of the oscilloscope to 10 milliseconds per division. A total of six marks should be observed.	Correct message observed. Go to Step 4.544.	
		Incorrect message observed. If this trouble check started in Part 5, go to Step 5.901. If this trouble check started in Part 4, go to Step 5.213.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.544	Repeat Step 4.528 observing test point B31 (output of T3 monopulser).	Four marks observed in the proper place for the information being received. These marks are represented by 10 microsecond positive pulses. Go to Step 4.545.	
		Incorrect message observed. Go to Step 4.547.	
4.545	Check the RO relay.	RO operated. Go to Step 4.534.	
		RO released. Go to Step 4.546.	
4.546	Use the 908A test set to measure the potential at test point B47 (output of P160 gate). Set the rotary switch to TRL (+).	Lamp on. Go to Step 4.524.	
		Lamp off.	SRO, RO relays.
4.547	Repeat Step 4.543 observing test point B32 (output of WG gate).	Four marks observed in the proper place for the information being received. These marks are represented by 156 microsecond positive pulses.	(T3) monopulser.
		Incorrect message observed. Go to Step 4.548.	
4.548	Repeat Step 4.543 observing test point A54 (output of DMO gate).	Four marks observed in the proper place for the information being received. Marks are negative with respect to spaces at this test point. Go to Step 4.538.	
		Incorrect message observed.	(DMO) gate.
4.549	Check the EP relay.	EP operated. Go to Step 4.550.	
		EP released.	RT relay and timer circuit or SF1 or SF2 operating falsely.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.550	Check the OL and TA relays.	TA operated and OL released.	OL relay.
		TA and OL operated. Go to Step 4.551.	
		TA released and OL operated.	SQ3 relay.
		TA and OL released. Go to Step 4.555.	
4.551	Check the potential at terminal 1 of the A4 connector with the 908A test set. Set the rotary switch to TRL (+).	Lamp on. Go to Step 4.553.	
		Lamp off. Go to Step 4.552.	
4.552	Check the potential at test point A33 (output of STA gate).	Lamp on.	STA, TA relays.
		Lamp off.	(STA) gate. The (STA) gate is part of CP13. When replacing CP13, CP9 must also be replaced since they are a matched pair. If a matched pair is not available for replacement, the adjustments must be checked in accordance with 6.3 and 6.4.
4.553	Check the frequency at test point A12. Use the 908A test set with the rotary switch set to 2500 Hz and the slide switch set to AF.	Scale reading 20 ± 2. Go to Step 4.554.	
		Scale reading 0. Go to Step 5.103.	
4.554	Check the frequency at test point A32 (output of limiter).	Scale reading 0.	CP9, refer to Step 4.552. (Possible Trouble).
		Scale reading 20 ± 2.	CP13, refer to Step 4.552. (Possible Trouble).
4.555	Use the oscilloscope to observe the message at test point A11 (input to modulator). Release the circuits and initiate a TA test call from the control circuit. Set the time scale of the oscilloscope to 10 milliseconds per division. A total of five marks should be observed, each mark being 5 milliseconds in duration.	Correct message observed. If this trouble check started in Part 5, go to Step 4.901. If this trouble check started in Part 4, go to Step 5.212.	
		Incorrect message or no message observed. Go to Step 4.556.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.556	Check the EP relay.	EP operated. Go to Step 4.557.	
		EP released. Go to Step 4.558.	
4.557	Check the OL and TA relays.	TA operated and OL released.	OL relay.
		TA and OL operated. Go to Step 4.551.	
		TA released and OL operated.	SQ3 relay.
		TA and OL released. Go to Step 4.560.	
4.558	Check the potential at test point B57 (output of P270 gate) with the 908A test set. Set the rotary switch to TRL (+).	Lamp on. Go to Step 4.559.	
		Lamp off.	SEP, EP relays.
4.559	Ground test point B36 (input to clock). Set the rotary switch of the 908A test set to 500 Hz and the slide switch to DF. Check the frequency at test point B51 (output of T4 monopulser).	Scale reading 20 ± 2. Go to Step 4.701.	
		Scale reading 0. Go to Step 4.616.	
4.560	Repeat Step 4.555 observing test point B33 (output of OS flip-flop).	Correct message observed. Go to Step 4.561.	
		Incorrect message observed. Go to Step 4.562.	
4.561	Repeat Step 4.555 observing test point B23 (output of M gate).	Correct message observed.	(INV7) gate.
		Incorrect message observed.	TBL1, TBL resistor, TBL capacitor, TBL contacts 1 and 3, or (M) gate.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.562	Release the circuits and ground test point A37 (output of CKT gate). Start a TA test call from the control circuit. When the circuit stops, ground test point B34 (output of clock). Use the 908A test set to look for a positive pulse at test point B13 (output of INV5, 9 gate). Set the rotary switch to MP (+). Remove the ground from test point A37 and observe the 908A test set.	Lamp winks. Go to Step 4.563.	
		Lamp remains off. Go to Step 4.564.	
4.563	Use the 908A test set to check the potential at test points E17, E56, E37, E27, and E57 for "A" digits 7, 4, 2, 1, or 0, respectively; (TK_ input to shift register) and test points E47, E28, E18, E48, or E38 for "B" digits 7, 4, 2, 1, or 0, respectively; (TK_ input to shift register). Set the rotary switch to TRL (+).	Lamp off at all test points corresponding to "A" and "B" digits to be transmitted. Go to Step 4.801.	
		Lamp on at any test point corresponding to "A" and "B" digits to be transmitted. Go to Step 4.570.	
4.564	Repeat Step 4.562 checking test point B41 (output of T1 monopulser).	Lamp winks.	(INV5), (INV9) gates.
		Lamp remains off. Go to Step 4.571.	
4.565	Change the setting of the rotary switch on the 908A test set to TRL (+) and check the potential at test point A37 (output of CKT gate).	Lamp on. Go to Step 4.566.	
		Lamp off. Go to Step 4.567.	
4.566	Check the potential at test point A45 (output of SR flip-flop).	Lamp on.	(SD) flip-flop, (SRG) gate or control of (SRG) gate.
		Lamp off.	(T1) monopulser.
4.567	Check the potential at test point D16 (output of INC flip-flop).	Lamp on.	(INC) flip-flop, relay contact controlling (RLS) gate.
		Lamp off. Go to Step 4.568.	
4.568	Check the potential at test point E35 (input to CKT gate).	Lamp on.	CKT, SQ3 relays.
		Lamp off. Go to Step 4.569.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.569	Check the potential at test point E46 (output of R16 gate).	Lamp on.	R16 gate, R16 resistor, or contacts associated with (R16) gate.
		Lamp off. Go to Step 4.570.	
4.570	Check the potential at test point A56 (output of INV8 gate).	Lamp on.	(INV8) gate.
		Lamp off.	(CKT) gate, CKT capacitor.
4.571	Check the TK_ relays which should be operated for the trunk information to be transmitted.	TK_ relays operated correctly. Go to Step 4.572.	
		TK_ relays not operated properly.	TK_ relay.
4.572	Check the SO2 relay.	SO2 operated. Go to Step 4.573.	
		SO2 released.	SO2 relay.
4.573	Check the potential at test point B36 (clock input) with the 908A test set. Set the rotary switch to TRL (+).	Lamp on. Go to Step 4.574.	
		Lamp off.	Open connection associated with wiring run for the test point in trouble in Step 4.563.
4.574	Check the potential at test point B26 (output of CC3 gate).	Lamp on.	(CC1) gate.
		Lamp off. Go to Step 4.575.	
4.575	Check the potential at test point A36 (output of CKT1 gate).	Lamp on.	(CKT1) gate.
		Lamp off. Go to Step 4.576.	
4.576	Check the potential at test point B16 (output of CP27 gate).	Lamp on.	(CP27) gate.
		Lamp off.	(CC3) gate.
4.577	Check the TA relay in the remote circuit which is not being served.	TA relay operated. Go to Step 4.580.	
		TA relay not operated. Go to Step 4.578.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.578	Check the frequency at test point E44 with the 908A test set. Set the rotary switch to 5000 Hz.	Scale reading 0. Go to Step 4.579.	
		Scale reading greater than 10.	Transmission facilities.
4.579	Check the potential at test point A33 with the 908A test set. Set the rotary switch to TRL (+).	Lamp off.	STA, TA relays.
		Lamp on.	Signal present detector (CP13). When replacing (CP13), (CP9) must also be replaced since they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
4.580	Check the OL relay.	OL operated.	Contact 6 of OL relay, transmission facility.
		OL not operated. Go to Step 4.581.	OL relay.

4.6 ***Clock and Clock Control Check***

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.601	Ground test point B36 (input to clock). Set the rotary switch of the 908A test set to 5000 Hz and the slide switch to DF. Check the frequency at test point B34 (output of multivibrator).	Scale reading 32 ± 3. Go to Step 4.602.	
		Scale reading 0.	(K) multivibrator.
4.602	Check the frequency at test point B55 (output of CIG gate).	Scale reading 32 ± 3. Go to Step 4.603.	
		Scale reading 0.	(CIG) gate.
4.603	Check the frequency at test point D17 (output of P21 gate).	Scale reading 8 ± 1. Go to Step 4.604.	
		Scale reading 0.	(P1), (P2) binary cell boards.
4.604	Set the rotary switch to 500 Hz. Check the frequency at test point D37 (output of P80 gate).	Scale reading 20 ± 2. Go to Step 4.605.	
		Scale reading 0.	(PA), (P8) binary cell boards.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.605	Check the shift pulse as follows: Set the rotary switch of the 908A test set to 500 Hz and the slide switch to DF. Ground test point B36. Check the frequency at test point D36 (output of INV3 gate).	Scale reading 20 ± 2. Go to Step 4.606.	
		Scale reading 0. Go to Step 4.607.	
4.606	Check the frequency at test point B44 (output of INV4 gate).	Scale reading 0. Go to Step 4.607.	
		Scale reading 20 ± 2. Go to Step 4.611.	
4.607	Check the frequency at test point A57 (output of RS gate).	Scale reading 0. Go to Step 4.608.	
		Scale reading 20 ± 2. Remove ground from test point B36.	(INV3), (INV4) gates.
4.608	Check the frequency at test point A38 (output of T5 monopulser).	Scale reading 0. Go to Step 4.609.	
		Scale reading 20 ± 2. Remove ground from test point B36.	(RS) gate.
4.609	Check the frequency at test point B11 (output of PG1 gate).	Scale reading 0. Go to Step 4.610.	
		Scale reading 20 ± 2. Remove ground from test point B36.	(T5) monopulser.
4.610	Check the frequency at test points D56, D46, D37, D34, and D47 (inputs to PG1 gate).	Scale reading equal to or greater than 20 ± 2 at all test points. Remove ground from test point B36.	(PG1) gate, SP capacitor.
		Scale reading 0 at any test point. Remove ground from test point B36.	Binary cell associated with test point.
4.611	Check the write pulse as follows: Ground test point B36 (input to clock) and test point A54 (output of DM0 gate). Set the rotary switch of the 908A test set to 500 Hz and the slide switch to DF. Check the frequency at test point B31 (output of T3 monopulser).	Scale reading 0. Go to Step 4.612.	
		Scale reading 20 ± 2. Go to Step 4.616.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.612	Check the frequency at test point B32 (output of WG gate).	Scale reading 0. Go to Step 4.613.	
		Scale reading 20 ± 2. Remove ground from test point B36 and test point A54.	(T3) monopulser.
4.613	Check the frequency at test point B42 (output of INV6 gate).	Scale reading 0. Go to Step 4.614.	
		Scale reading 20 ± 2. Remove ground from test points B36 and A54.	(WG) gate.
4.614	Check the frequency at test point B24, (output of PG2 gate).	Scale reading 0. Go to Step 4.615.	
		Scale reading 20 ± 2. Remove ground from test point A54 and B36.	(INV6) gate capacitor.
4.615	Check the frequency at test points D27, D17, D37, B34, and D47 (input of PG2 gate).	Scale reading equal to or greater than 20 ± 2 at every test point B36. Remove ground from test points B36 and A54.	(PG2) gate.
		Scale reading 0 at any test point. Remove ground from test points B36 and A54.	Binary cell associated with test point.
4.616	Check the counter advance pulse as follows: Ground test point B36. Set the rotary switch of the 908A test set to 500 Hz and the slide switch to DF. Check the frequency at test point B51 (output of T4 monopulser).	Scale reading 0. Go to Step 4.617.	
		Scale reading 20 ± 2.	Trouble is intermittent. Return to point where trouble was encountered and perform test twice at each step.
4.617	Check the frequency at test point B21 (output of PG3 gate).	Scale reading 0. Go to Step 4.618.	
		Scale reading 20 ± 2. Remove ground from test point B36.	(T4) monopulser.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.618	Check the frequency at test points D37, D17, D56, B34, and D47 (input of PG3 gate).	→ Scale reading equal to or greater than 20 ± 2 at every test point. Remove ground from test point B36.	→ (PG3) gate, CA capacitor.
		→ Scale reading 0 at any test point. Remove ground from test point B36.	→ Binary cell associated with test point.

4.7 *Clock Pulse Counter Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.701	Ground test point B36. Check the frequency at test point B51 (output of T4 monopulser) with the 908A test set. Set the rotary switch to 500 Hz and the slide switch to DF.	→ Scale reading 0. Go to Step 4.601.	
		→ Scale reading 20 ± 2. Go to Step 4.702.	
4.702	Check the frequency at test point A51 (output of CTR21 gate). Set the rotary switch to 50 Hz.	→ Scale reading 0. Remove ground from (B36).	→ (CTR1), (CTR2) binary cell boards.
		→ Scale reading 50 ± 5. Go to Step 4.703.	
4.703	Check the frequency at test point D38 (output of CTR81 gate).	→ Scale reading 0. Remove ground from B36.	→ (CTR4), (CTR8) binary cell boards.
		→ Scale reading 12.5 ± 1. Go to Step 4.704.	
4.704	Check the frequency at test point D58 (output of CTR161).	→ Scale reading 0. Remove ground from B36.	→ (CTR16) binary cell board.
		→ Scale reading 62.5 ± 0.5. Go to Step 4.705.	
4.705	Check the frequency at test point B28 (output of CP6A gate).	→ Scale reading 0. Go to Step 4.710.	
		→ Scale reading 6.25 ± 0.5. Go to Step 4.706.	
4.706	Check the frequency at test point B17 (output of CP11 gate).	→ Scale reading 0. Go to Step 4.711.	
		→ Scale reading 6.25 ± 0.5. Go to Step 4.707.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.707	Check the frequency at test point B47 (output of P160 gate).	Scale reading 0. Go to Step 4.712.	
		Scale reading 6.25 ± 0.5. Go to Step 4.708.	
4.708	Check the frequency at test point B27 (output of P220 gate).	Scale reading 0. Go to Step 4.713.	
		Scale reading 6.25 ± 0.5. Go to Step 4.709.	
4.709	Check the frequency at test point B57 (output of P270 gate).	Scale reading 0. Go to Step 4.714.	
		Scale reading 6.25 ± 0.5. Clock pulse counter is operative. Remove ground from B36.	Trouble is intermittent. Return to point at which trouble was encountered and perform test twice at each step.
4.710	Check the frequency at test points D28, D48, A21, A51, and D18 (inputs to CP6 gate).	Scale reading equal to or greater than 6.25 ± 0.5 at all test points. Remove ground from B36.	Board A19, CP6 capacitor.
		Scale reading 0 at any test point. Remove ground from B36.	Binary cell associated with test point.
4.711	Check the frequency at test points A51, D57, D48, A31, and D38 (inputs to CP11 gate).	Scale reading equal to or greater than 6.25 ± 0.5 at all test points. Remove ground from B36.	CP11 gate, CP11 capacitor.
		Scale reading 0 at any test point. Remove ground from B36.	Binary cell associated with test point.
4.712	Check the frequency at test points A41, D57, D28, A21, and D58 (inputs to CP16 gate).	Scale reading equal to or greater than 6.25 ± 0.5 at all test points. Remove ground from B36.	Board A18.
		Scale reading 0 at any test point. Remove ground from B36.	Binary cell associated with test point.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.713	Check the frequency at test points D58, D18, A51, D28, and A21 (inputs to CP22 gate).	Scale reading equal to or greater than 6.25 ± 0.5 at all test points. Remove ground from B36.	Board A17, CP22 capacitor.
		Scale reading 0 at any test point. Remove ground from B36.	Binary cell associated with test point.
4.714	Check the frequency at test points D58, D38, A51, D57, and A31 (inputs to CP27 gate).	Scale reading equal to or greater than 6.25 ± 0.5 at all test points. Remove ground from B36.	Board A18.
		Scale reading 0 at any test point. Remove ground from B36.	Binary cell associated with test point.

4.8 ***Shift Register Check***

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.801	Check the input to the shift register in the following manner: Ground test point B13. Ground test points E17, E56, E37, E27, and E57 for "A" digits 7, 4, 2, 1, and 0, respectively. Ground test points E47, E28, E18, E48, and E38 for "B" digits 7, 4, 2, 1, and 0, respectively. Set the rotary switch of the 908A test set to TRL (+). Check the potential at test points C36, C26, C56, C46, and C27 for "A" digits 7, 4, 2, 1, and 0, respectively, and at test points C17, D21, D11, D41, and D31 for "B" digits 7, 4, 2, 1, and 0, respectively.	Lamp on at associated test point. Go to Step 4.802.	
		Lamp off at associated test point. Remove test leads.	Shift register cell associated with failing digit.
4.802	Check the potential at test points C38, C28, C18, C58, and C48 for "A" digits 7, 4, 2, 1, and 0, respectively. Check the potential at test points D32, D22, D12, D52, and D42 for "B" digits 7, 4, 2, 1, and 0, respectively.	Lamp off at associated test point. Go to Step 4.803. Remove test leads.	
		Lamp on at associated test point. Remove test leads.	Relay driver associated with failing digit.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.803	Check the serial input to the shift register in the following manner: Ground test points A54 and B36. Set the rotary switch to 500 Hz. Set the slide switch to DF. Check the frequency at test point D43 (output of SA2 flip-flop).	Scale reading 0. Go to Step 4.809.	
		Scale reading 20 ± 2. Go to Step 4.804.	
4.804	Check the frequency at test point D44 (output of SA0 flip-flop).	Scale reading 0. Go to Step 4.810.	
		Scale reading 20 ± 2. Go to Step 4.805.	
4.805	Check the frequency at test point D15 (output of SB4 flip-flop).	Scale reading 0. Go to Step 4.811.	
		Scale reading 20 ± 2. Go to Step 4.806.	
4.806	Check the frequency at test point D35 (output of SB1 flip-flop).	Scale reading 0. Go to Step 4.812.	
		Scale reading 20 ± 2. Go to Step 4.807.	
4.807	Check the frequency at test point D55 (output of BS flip-flop).	Scale reading 0. Go to Step 4.813.	
		Scale reading 20 ± 2. Go to Step 4.808.	
4.808	Block the EP relay released. Check the frequency at test point B33 (output of OS flip-flop).	Scale reading 0.	(BS), (OS) shift register boards.
		Scale reading 20 ± 2. Remove block from EP relay. Remove ground from A54 and B36. Shift register is operative for serial pulsing. Go to Step 4.814 if "C" digit information is in error.	
4.809	Check the frequency at terminal 3 of the B6 connector (input to SA2 flip-flop).	Scale reading 0. Remove leads from A54 and B36.	(SA7), (SA4) shift register boards.
		Scale reading 20 ± 2. Remove leads from A54 and B36.	(SA2), SA1) shift register boards.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.810	Check the frequency at terminal 3 of the B7 connector (input to SA2 flip-flop).	→ Scale reading 0. Remove leads from A54 and B36.	→ (SA2), (SA1) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A54 and B36.	→ (SA0), (SB7) shift register boards.
4.811	Check the frequency at terminal 3 of the B9 connector (input to SB4 flip-flop).	→ Scale reading 0. Remove leads from A54 and B36.	→ (SA0), (SB7) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A54 and B36.	→ (SB4), (SB2) shift register boards.
4.812	Check the frequency at terminal 3 of the B10 connector (input to SB1 flip-flop).	→ Scale reading 0. Remove leads from A54 and B36.	→ (SB4), (SB2) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A54 and B36.	→ (SB1), (SB0) shift register boards.
4.813	Check the frequency at terminal 3 of the B11 connector (input of BS flip-flop).	→ Scale reading 0. Remove leads from A54 and B36.	→ (SB1), (SB0) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A54 and B36.	→ (BS), (OS) shift register boards.
4.814	Check the "C" digit information in the following manner: Ground test point B53. Ground test points D23, D13, D43, D33, and D44 corresponding to "C" digits 7, 4, 2, 1, and 0, respectively. Check the potential at points C34, C44, C16, C33, and C43 for "C" digits 7, 4, 2, 1, and 0, respectively. Set the rotary switch to TRL (+).	→ Lamp on at associated test point. Go to Step 4.815.	
		→ Lamp off at associated test point. Remove test leads.	→ (CI_) gate corresponding to failing digit.
4.815	Check the potential at test points C24, C14, C53, C23, and C13 for "C" digits 7, 4, 2, 1, and 0, respectively.	→ Lamp on at associated test point. Go to Step 4.816.	
		→ Lamp off at associated test point, remove test leads.	→ Flip-flop associated with failing digit.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.816	Check the potential at test points C35, C25, C15, C55, and C45 for "C" digits 7, 4, 2, 1, and 0, respectively.	Lamp on at associated test point. Remove test leads.	Relay driver (CO_) associated with failing digit.
		Lamp off at associated test point. Remove test leads.	SC_ relay associated with failing digit.

4.9 *Signal Circuit Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.901	*Send Circuit Check*		
	Use the 908A test set and check the frequency at terminal 1 of the FS filter to ground. Set the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading 21.4 ± 2. Go to Step 4.902.	
		Scale reading 44.5 ± 4. Go to Step 4.904.	
		Scale reading 0. Go to Step 4.906.	
4.902	Change the rotary switch of the 908A test set to TRL (+) and measure the potential at test point A11.	Lamp on.	Modulator board. When replacing modulator board, check adjustments in accordance with 6.2.
		Lamp off. Go to Step 4.903.	
4.903	Check the potential at B23 (output of M gate).	Lamp on. Go to Step 4.907.	
		Lamp off.	(INV7) gate.
4.904	Change the rotary switch of the 908A test set to TRL (+) and measure the potential at test point A11.	Lamp on. Go to Step 4.905.	
		Lamp off.	Modulator board. When replacing modulator board, check adjustments in accordance with 6.2.
4.905	Check the potential at B23 (output of M gate).	Lamp on.	(INV7) gate.
		Lamp off. Go to Step 4.907.	
4.906	Check the frequency at terminal 8 of the A1 connector.	Scale reading 0.	Modulator board. When replacing modulator board, check the adjustments in accordance with 6.2.
		Scale reading greater than 10.	Contact 6 of OL relay, the OL relay or contacts associated with OL relay.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.907	Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential across E32 and E42 (output of RPT coil).	*Reading is –18 dBm ± 7 dB + the measured loss of the transmission facility. Go to Step 5.911.	
		Reading is less than –25 dBm + measured loss of the transmission facility. Go to Step 4.908.	
4.908	Measure the ac potential across test points E12 and E22 (output of power amplifier).	Reading is –18 dBm ±7 dB + meassured loss of the transmission facility.	CRA or CRB diodes or TA transformer.
		Reading is less than –25 dBm + measured loss of the transmission facility. Go to Step 4.909.	
4.909	Measure the ac potential from terminal 3 of the FS filter to ground.	Reading is 0.71 ± .1 volt RMS.	Power amplifier board or adjustment thereof. When replacing the power amplifier board, check the adjustments in accordance with 6.22.
		Reading is less than .61 volt RMS. Go to Step 4.910.	
4.910	Measure the ac potential from terminal 1 of the FS filter to ground.	Reading is 0.71 ± .1 volt RMS.	FS filter.
		Reading is less than 0.61 volt RMS.	Modulator board. When replacing the modulator board, check the adjustments in accordance with 6.22.
4.911	*Receive Circuit Check:* Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential across test points E34 and E44 (input to RPT coil).	*Reading is –18 dBm ± 7 dB. Go to Step 4.912.	
		Reading is less than –25 dBm.	Transmission facility or control circuit send circuit if it has not been checked.

* The reading at this point should be –18 dBm + measured loss of the transmission facility. The circuit should function with a ± 7 dB variation of this figure. However, when a variation occurs from the indicated level, the transmission facility and/or the adjustment of the modulator board should be checked.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.912	Check the ac potential across test points E14 and E24 (input to transformer).	Reading is −18 dBm ± 7 dB. Go to Step 4.913.	
		Reading is less than −25 dBm.	CRD, CRC diodes or TB transformer.
4.913	Check the ac potential from terminal 15 of the A2 connector to ground.	Reading is less than −25 dBm.	Input transformer. When replacing board CP13, board CP9 must also be replaced since they are a matched pair, or adjustments must be checked in accordance with 6.3 and 6.4 for the guard interval timer and the signal present detector, respectively.
		Reading is −18 dBm ± 7 dB. Go to Step 4.914.	
4.914	Check the ac potential from terminal 3 of the FR filter to ground.	Reading is −21 dBm ± 7 dB. Go to Step 4.916.	
		Reading is less than −28 dBm. Go to Step 4.915.	
4.915	Check the ac potential from terminal 1 of the FR filter to ground.	Reading is −21 dBm ± 7 dB.	FR filter.
		Reading is less than −28 dBm.	Limiter board. When replacing board CP9, board CP13 must also be replaced since they are a matched pair, or adjustments must be checked in accordance with 6.3 and 6.4 for the guard interval timer and the signal present detector, respectively.
4.916	Check the ac potential from A42 to ground (input to discriminator).	Reading is less than 7.0 volts RMS.	Limiter board. When replacing board CP9, board CP13 must also be replaced since they are a matched pair, or adjustments must be checked in accordance with 6.3 and 6.4 for the guard interval timer and the signal present detector, respectively.
		Reading is greater than or equal to 7.0 volts. Go to Step 4.917.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
4.917	Release the circuits and ground test point C45 (output of M gate) at the control circuit. Use the 908A test set to check the frequency at A12 (limiter test point) in the remote circuit. Set the rotary switch to 2500 Hz and the slide switch to AF.	Reading is 44.5 ± 2. Go to Step 4.918.	
		Reading is 40.5 ± 2.	Control circuit send circuit. Go to Step 5.901.
4.918	Check the potential at A13 (output of ST gate) with the 908A test set. Change the rotary switch to TRL (+).	Lamp on. Receive circuit operative to the guard interval timer.	Intermittent trouble. Go to Step 4.907 and repeat test twice at each step.
		Lamp off. Go to Step 4.919.	
4.919	Check the potential at terminal 1 of the A4 connector (output of signal present detector).	Lamp on. Go to Step 4.920.	
		Lamp off.	Discriminator board. When replacing CP12, check the adjustments in accordance with 6.5.
4.920	Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential from test point A2 to ground.	Scale reading less than 2 volts RMS.	Limiter board (CP9). When replacing either CP9 or CP13, the replacements should be adjusted in accordance with 6.3 and 6.4.
		Scale reading greater than 2 volts RMS.	Signal present detector board. (CP13). See Note 1.

5. CONTROL CIRCUIT TROUBLE ANALYSIS

Trouble display lamps at the control circuit are as follows:

- RLT — Release Timeout
- RSF0/1 — Remote Signal Failure
- SF0/1 — Signal Failure
- TF — Trunk Failure
- TM5 — Timer 5
- TRT — Trouble Timeout

Trouble recorder punches indicating type of call and progress of the call are as follows:

- FT — Frame Tens
- FU — Frame Units
- GRP — Group (0/1)
- LT — Line Tens
- LU — Line Units
- TT — Trunk Tens
- TU — Trunk Units
- SR — Service Request Call
- TER — Terminating Call
- DIS — Disconnect Call
- SD — Service Denial Call
- RSD — Release Service Denial Call
- CP — Clock Phase
- TM5 — Timer Phase

5.1 *RLT Lamp (Release Failure)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.101	Initiate a TA test call from the remote or control circuit. Observe the TM2 and TM3 relays.	→ TM2 relay operates. Go to Step 5.102.	
		→ TM3 relay releases. Go to Step 5.106.	
5.102	Block the TM2 relay normal. Repeat the same TA test call as in Step 5.101. Observe the RL1 relay.	→ RL1 operates and releases. Go to Step 5.103.	
		→ RL1 operates and does not release. Go to Step 5.105.	
5.103	Check the operate time of the TM2 relay.	→ Operate time between 28 and 84 milliseconds. Go to Step 5.104.	
		→ Operate time less than 28 milliseconds.	→ TM2 relay.
5.104	Check the operate time of the RL2 relay.	→ Operate time greater than 12 milliseconds.	→ RL2 relay.
		→ Operate time less than 12 milliseconds.	→ Release time of relays in RL1 locking path.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.105	Release the circuit. Repeat the same TA test call as in Step 5.101 and check the operation of the RL2 relay.	RL2 operates.	Contacts in RL1 locking path.
		RL2 does not operate.	RL2 relay, contacts in RL2 operate path.
5.106	Block the TM3 relay operated. Initiate the same TA test call as in Step 5.101. Observe the RL2 relay.	RL2 relay operates and does not release. Go to Step 5.107.	
		RL2 relay operates and releases.	TM3 relay or associated control contacts.
5.107	Check TA0/1 relay for group 0/1, respectively.	TA0/1 operated. Go to Step 5.112.	
		TA0/1 released. Go to Step 5.112.	
5.108	Check output at test point A26 or A52 (for group 0/1, respectively) with a 908A test set. Set the rotary switch to TRL (+).	Lamp lights.	ITA0/1, TA0/1 relays.
		Lamp does not light. Go to Step 5.109.	
5.109	Check the potential at test point A27/A53 for group 0/1, respectively.	Lamp does not light.	(STA0/1) gate.
		Lamp lights. Go to Step 5.110.	
5.110	Check the OL0/1 relay in the control circuit for group 0/1, respectively.	OL0/1 operated.	OL0/1 relay.
		OL0/1 released. Go to Step 5.111.	
5.111	Use the 908A test set to measure the frequency at terminal 1 of the FS0/1 filter for group 0/1, respectively. Set the rotary switch of the 908A test set to 2500 Hz and the slide switch to AF.	Scale reading greater than 10. Go to Step 5.911.	
		Scale reading 0. Go to Step 5.906.	

***Caution:** Battery should not, at any time, be connected to any of the test points. This could cause damage to the transistors on the circuit boards. Ground may be applied to any test point at any time. Conduct tests in accordance with Section 032-173-301.*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.112	Check the potential at test point F27 (output of RLS gate) with a 908A test set. Set the rotary switch to TRL (+).	Lamp lights. Go to Step 5.113.	
		Lamp does not light.	(RLS) gate, resistor I17 open.
5.113	Check the NK relay.	NK relay operated.	RL2 relay, relay contacts in locking path of RL2 relay.
		NK relay not operated.	A_, B_, SA_, SB_ relays and associated drivers; NK, IR relays.

5.2 *TRT Lamp (Terminating-Type Calls)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.201	Block the RL1 relay normal. Originate a TA test call from the control circuit. Check the LK relay.	LK operates. Go to Step 5.202.	
		LK does not operate.	Contacts of LT_, LU_ relays, LK0/1 relay.
5.202	Check the EP relay.	EP relay operates. Go to Step 5.211.	
		EP relay does not operate. Go to Step 5.203.	
5.203	Set the rotary switch of the 908A test set to TRL (+). Check the potential at test point F15 (OTG flip-flop).	Lamp off. Go to Step 5.206.	
		Lamp on. Go to Step 5.204.	
5.204	Check the potential at test point A28 (output of TP gate).	Lamp on.	(OTG) flip-flop.
		Lamp off. Go to Step 5.205.	
5.205	Check the potential at the following test points: C55, B43, A21, E38, and E13.	Lamp off at all test points.	(TP) gate.
		Lamp on at any test point.	Relay contacts or solid-state components associated with test point.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.206	Check the trouble record for the counter phase.	Counter has not been advanced. Go to Step 5.207.	
		Counter advanced but has not reached counter phase 16. Go to Step 5.701.	
		Counter advanced to counter phase 16. Go to Step 5.209.	
5.207	Check the potential at test point C52 (output of CC gate) with the 908A test set. Set the rotary switch to TRL (+).	Lamp off. Go to Step 5.701.	
		Lamp on. Go to Step 5.208.	
5.208	Check the potential at test point E23 and C12 (output of CP16 and CP27 gates, respectively).	Lamp off at both test points.	Board A23.
		Lamp on at either test point.	(CP_) gate associated with test point.
5.209	Check trouble record card on several calls for counter phase.	Counter phase 16 on all calls.	(P160) gate, contact of TCA0/1 relay, IEP, EP relays.
		Counter runs beyond counter phase 16. Go to Step 5.210.	
5.210	Check the frequency at test point C13 (output of K multivibrator). Set the rotary switch to 5000 Hz and the slide switch to DF.	Scale reading 0.	(CP16) gate.
		Scale reading 32 ± 3.	Board A23.
5.211	Check the PP relay.	PP relay does not operate. Go to Step 5.212.	
		PP relay operates. Go to Step 5.234.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.212	Connect oscilloscope to test point A37/A14 for group 0/1, respectively (output of the ST0/ST1 gate). Release both the remote and control circuits. Originate a TA test call from the control circuit and observe the message received. A total of five marks should be received. Each mark is 5 milliseconds in duration.	Incorrect message received. If this trouble check started in Part 5, go to Step 4.555. If this trouble check started in Part 4, go to Step 4.901.	
		Correct message received. Go to Step 5.224.	
		No message received. Go to Step 5.213.	
5.213	Release the control circuit. Connect the oscilloscope to test point A11 (input to M0/M1 modulator). Originate a TA test call from the control circuit and observe the message being sent. A total of six marks should be observed. Each mark is 5 milliseconds in duration.	Correct message observed. If this trouble check started in Part 5, go to Step 4.543. If this trouble check started in Part 4, go to Step 4.901.	
		No message observed. Go to Step 5.214.	
		Incorrect message observed. Go to Step 5.801.	
5.214	Repeat Step 5.213 observing the message at test point B31 (output of the shift register).	No message observed. Go to Step 5.216.	
		Incorrect message observed. Go to Step 5.223.	
		Correct message observed. Go to Step 5.215.	
5.215	Check the potential at test point E28 (input of M gate) with the 908A test set. Set the rotary switch to TRL (+).	Lamp on.	Contact of RLS relay.
		Lamp off.	Board A28.
5.216	Place ground on test point C52 (input of the K multivibrator). Set the rotary switch of the 908A test set to 500 Hz. Check the frequency at test point D36 (output of INV12 gate).	Scale reading 20 ± 2. Go to Step 5.217.	
		Scale reading 0. Go to Step 5.220.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.217	Check the frequency at test point D26 (output of INV11 gate).	Scale reading 20 ± 2. Go to Step 5.218.	
		Scale reading 0. Go to Step 5.220.	
5.218	Check the frequency at test point C56 (output of INV5 gate).	Scale reading 20 ± 2. Go to Step 5.219.	
		Scale reading 0. Go to Step 5.220.	
5.219	Check the frequency at test point C58 (output of INV10 gate).	Scale reading 20 ± 2. Go to Step 5.228.	
		Scale reading 0. Go to Step 5.220.	
5.220	Check the frequency at test point B35 (output of RS gate).	Scale reading 20 ± 2. Remove ground from C52.	(INV12), (INV11), (INV15), or (INV10) gate.
		Scale reading 0. Go to Step 5.221.	
5.221	Check the frequency at test point B15 (output of T5 monopulser).	Scale reading 20 ± 2. Go to Step 5.222.	
		Scale reading 0. Go to Step 5.605.	
5.222	Check the potential at test point F37 (output of R16 gate). Set the rotary switch to TRL (+).	Lamp off.	(RS) gate.
		Lamp on.	(R16) gate, R16 capacitor.
5.223	Release the circuits. Ground test point C52 (input of the K multivibrator). Change the rotary switch on the 908A test set to 50 Hz and check the frequency at test point C36 (output of INV1, 9, 13 gates).	Scale reading 0. Go to Step 5.224.	
		Scale reading 6.25 ± 1. Go to Step 5.227.	
5.224	Check the frequency at test point D24 (output of T1 monopulser).	Scale reading 0. Go to Step 5.225.	
		Scale reading 6.25 ± 1.	(INV1), (INV9), (INV13) gates — board B11.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.225	Check the frequency at test point B32 (output of IGC gate).	Scale reading 0. Go to Step 5.226.	
		Scale reading 6.25 ± 1.	(T1) monopulser.
5.226	Check the frequency at test point B23 (output of INV6 gate).	Scale reading 0.	(INV6), (CP0) gates — board A22.
		Scale reading 6.25 ± 1.	(IGC) gate.
5.227	Check the frequency at test point F47 (output of INV14, 15 gates).	Scale reading 0.	(INV14), (INV15) gates — board A30.
		Scale reading 6.25 ± 1. Go to Step 5.807.	
5.228	Release the circuits. Use the 908A test set to check for a pulse at test point A17/A43 for group 0/1, respectively (output of MT0/1 monopulser). Set the rotary switch to MP (+). Initiate a TA test call from the control circuit and observe the lamp on the 908A test set.	Lamp winks. Go to Step 5.231.	
		Lamp remains dark. Go to Step 5.229.	
5.229	Repeat Step 5.228 checking test point A55/A32 for group 0/1, respectively (output of DM0/1 gate).	Lamp winks.	CP13, board A4/A7 for group 0/1. When replacing board A4/A7, board A6/A3 (CP9) must also be replaced since they are a matched pair. If a matched pair is not available for replacement, adjustments for the guard interval timer and the signal present detector should be checked in accordance with 6.7 and 6.8, respectively.
		Lamp remains dark. Go to Step 5.230.	
5.230	Repeat Step 5.228 checking test point B11/A38 for group 0/1, respectively (output of INV3/INV4 gate).	Lamp winks.	(DM0/DM1) gate.
		Lamp remains dark.	(INV3/INV4) gate.
5.231	Use the 908A test set to check the potential at test point B33 (output of INV16 gate). Change the rotary switch to TRL (+).	Lamp on. Go to Step 5.232.	
		Lamp off. Go to Step 5.233.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.232	Check the potential at test point B52 (output of PP0 gate).	Lamp on.	(PP0) gate.
		Lamp off.	IPP, PP relays.
5.233	Check the potential at test point A21/B43 for group 0/1, respectively (output of PP0/1 flip-flop).	Lamp on.	(PP) or (INV16) gate — board A29.
		Lamp off.	(PP0/PP1) flip-flop.
5.234	Check the ABK relay.	ABK operated. Go to Step 5.249.	
		ABK did not operate. Go to 5.235.	
5.235	Check the TA0/1 relay.	TA0/1 operated. Go to Step 5.238.	
		TA0/1 not operated. Go to Step 5.236.	
5.236	Check the OL0/1 relay.	OL0/1 released.	T1S, OL0/1 relays.
		OL0/1 operated. Go to Step 5.237.	
5.237	Use the 908A test set to measure the frequency at terminal 1 of the FS0/FS1 filter for group 0/1, respectively. Change the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading greater than 10.	OLA0/1 relay
		Scale reading 0. Go to Step 4.556.	
5.238	Check the NK relay.	NK operated. Go to Step 5.239.	
		NK not operated.	T1S, NK relays.
5.239	Check the A and B relays.	A and B relays check on a 2-out-of-5 basis.	ABK relay, contacts of A_, B_ or NK relay.
		A and B relays do not check on a 2-out-of-5 basis. Go to Step 5.240.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.240	Ground test point D52 (output of A00 gate). Check the potential at terminal 1 of the IR relay with a Hewlett-Packard dc voltmeter, Model 412A or equivalent.	Potential at terminal 1 is 12 ± 1.2 volts. Go to Step 5.243. Remove ground from test point D52.	
		Potential at terminal 1 is near ground. Go to Step 5.241. Remove ground from test point D52.	
5.241	Check the potential at test point B37 (output of the P270 gate). With the 908A test set. Set the rotary switch to TRL (+).	Lamp off.	Contacts of NK, TA0/1 relays, or IR relay.
		Lamp on. Go to Step 5.242.	
5.242	Check the potential at test point C12 (output of CP27 gate).	Lamp on.	(P270) gate.
		Lamp off. Go to Step 4.701.	
5.243	Release both the remote and control circuits. Connect oscilloscope to test point A55/A32 for group 0/1, respectively (output of DM0/DM1 gate). Originate a TA test call from the control circuit and observe the message being received. A total of five marks should be received. Each mark is 5 milliseconds in duration.	Incorrect message received. Trouble is in remote circuit. Go to Step 4.555.	
		Correct message received. Go to Step 5.244.	
5.244	Repeat Step 5.234 with the oscilloscope connected to test point C16 (output of T3 monopulser). Each mark is represented by a 10-microsecond pulse.	Correct message observed. Go to Step 5.248.	
		Incorrect message observed. Go to Step 5.245.	
5.245	Connect the oscilloscope to test point B42 (output of DMO1 gate). Repeat Step 5.234. Each mark is represented by a 5-millisecond negative going pulse.	Correct message observed. Go to Step 5.246.	
		Incorrect message observed.	(DMO1) gate.
5.246	Check the potential at test point A48 (output of WI gate) with the 908A test set. Set the rotary switch to TRL (+).	Lamp off. Go to Step 5.601.	
		Lamp on. Go to Step 5.247.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.247	Check the potential at test point B22 (output of CTR160 gate).	Lamp on.	(WI) gate.
		Lamp off.	(CTR16) binary cell.
5.248	Ground test point C52. Check the frequency at test points C58, C56, D26, and D36 (output of INV10, INV5, INV11, and INV12) with the 908A test set. Set the rotary switch to 500 Hz.	Scale reading 20 ± 2. At all test points. Go to Step 5.801.	
		Scale reading 0. At any test point. Go to Step 5.220.	
5.249	Remove the block from the RL1 relay.	RL1 operates, does not release. Go to Step 5.105.	
		RL1 does not operate. Go to Step 5.250.	
		RL operates and releases. Go to Step 5.251.	
5.250	Check the TCK relay.	TCK operated.	CTK relay, hold magnet, select magnet, CT_ relay.
		TCK does not operate.	Trunk check failure, TIS relay.
5.251	Check the RL2 relay.	RL2 operated.	Contact in RL2 locking path.
		RL2 released.	RL2 relay, contacts in RL2 operate path.

5.3 *TRT Lamp (Service Request Calls)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.301	Block the RL1 relay normal. Initiate a TA test call from the remote circuit. Observe the ABK relay.	ABK operated. Go to Step 5.336.	
		ABK did not operate. Go to Step 5.302.	
5.302	Check the A and B relays.	A and B relays check on a 2-out-of-5 basis.	ABK relay, contact of SRC2.
		A and B relays do not check on a 2-out-of-5 basis. Go to Step 5.303.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.303	Check the RTR relay.	RTR operated. Go to Step 5.319.	
		RTR not operated. Go to Step 5.304.	
5.304	Check the SRC1 relay.	SRC1 operated. Go to Step 5.305.	
		SRC1 not operated. Go to Step 5.306.	
5.305	Check the PP relay.	PP operated.	RTR, SRC2 relays.
		PP not operated. Go to Step 5.314.	
5.306	Check the potential at test point F56/F46 for group 0/1, respectively (output of SR0/SR1 gate).	Lamp on. Go to Step 5.307.	
		Lamp off. Go to Step 5.308.	
5.307	Check the potential at test point D34/B41 for group 0/1, respectively (output of SR00/SR10 gate).	Lamp on.	(SR00/SR10) gate.
		Lamp off.	ISR0/ISR1, SR0/SR1, SRC1 relays.
5.308	Check the potential at test point D44/D54 for group 0/1, respectively (output of PP0/PP1 flip-flop).	Lamp on. Go to Step 5.317.	
		Lamp off. Go to Step 5.309.	
5.309	Check the potential at test point B12/B51 for group 0/1, respectively (output of SRG0/SRG1 gate).	Lamp on. Go to Step 5.313.	
		Lamp off. Go to Step 5.310.	
5.310	Check the potential at test point B23 (output of INV6 gate).	Lamp on. Go to Step 5.311.	
		Lamp off. Go to Step 5.312.	
5.312	Check the potential at test point A58/B21 for group 0/1, respectively (output of SR0/SR1 flip-flop).	Lamp on.	(SR0/SR1) flip-flop.
		Lamp off.	(SRG0/SRG1) gate.
5.313	Check the potential at test point D15/D25 for group 0/1, respectively (input of SR0/SR1 gate).	Lamp on.	(SR0/SR1) flip-flop.
		Lamp off.	(SR0/SR1) gate.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.314	Check the potential at test point A21/B43 for group 0/1, respectively, with the 908A test set (output of PP0/PP1 gate). Set the rotary switch of the 908A test set to TRL (+).	Lamp on. Go to Step 5.315.	
		Lamp off. Go to Step 5.317.	
5.315	Check the potential at test point B33 (output of INV16 gate).	Lamp on. Go to Step 5.316.	
		Lamp off.	(PP), (INV16) gates — board A29.
5.316	Check the potential at test point B52 (output of PP0 gate).	Lamp on.	(PP0) gate.
		Lamp off.	IPP, PP relays.
5.317	Use the 908A test set to check for pulses out of the (MT0/MT1) monopulsers. Set the rotary switch to MP (+) and originate a TA test call from the remote circuit. Check for pulses at test point A17/A43 (for group 0/1, respectively).	Lamp winks.	(PP0/PP1) flip-flop.
		Lamp remains dark. Go to Step 5.318	
5.318	Repeat Step 5.317 checking test point A55/A32 for group 0/1, respectively (output of DM0/DM1 gate).	Lamp winks.	CP13, board A7/A4 for group 0/1. When replacing board A7/A4, board A8/A5 must also be replaced since they are adjusted as a matched pair. If a matched pair is not available for replacements, CP13 and CP9 must be checked in accordance with 6.7 and 6.8.
		Lamp remains dark. Go to Step 5.319.	
5.319	Release the remote and control circuits. Connect oscilloscope to test point A55/A32 for group 0/1, respectively (output of DM0/1 gate). Request the remote circuit to originate several TA test calls using a different line for each call. Observe the message being received. The message should contain a total of five marks. Each mark is 5 milliseconds in duration.	Calls fail on all lines. Correct message observed. Go to Step 5.320.	
		Incorrect message or no message observed on all calls that fail. If trouble check was started in Part 5, go to Step 4.508. If trouble check was started in Part 4, go to Step 4.901.	
		Calls fail on certain lines. Correct message observed on calls that fail. Go to Step 5.807.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.320	Repeat Step 5.319 checking the message at test point C16 (output of T3 monopulser). A total of four marks should be observed.	Correct message observed. Go to Step 5.333.	
		Incorrect message observed. Go to Step 5.321.	
5.321	Repeat Step 5.319 checking the message being received at test point B42 (output of DMO1 gate).	Correct message observed. Go to Step 5.322.	
		Incorrect message observed.	(DMO1) gate.
5.322	Check the potential at test point A48 with the 908A test set (output of WI gate). Set the rotary switch to TRL (+).	Lamp off. Go to Step 5.323.	
		Lamp on. Go to Step 5.331.	
5.323	Check the trouble record card for counter phase.	Counter has not been advanced. Go to Step 5.324.	
		Counter has been advanced to Phase 11. Go to Step 5.608.	
5.324	Check the potential at test point B13 with the 908A test set (output of SRO1 gate). Set the rotary switch to TRL (+).	Lamp off. Go to Step 5.325.	
		Lamp on.	(SRO1) gate.
5.325	Check the potential at test point C44 (output of CKT1 gate).	Lamp off. Go to Step 5.326.	
		Lamp on. Go to Step 5.237.	
5.326	Check the potential at test point C32 (output of CP22 gate).	Lamp off. Go to Step 5.328.	
		Lamp on.	(CP22) gate.
5.327	Check the potential at test point C35 (output of INV7 gate).	Lamp off. Go to Step 5.330.	
		Lamp on.	(CKT1) gate.
5.328	Check the potential at test point C42 (output of CC2 gate).	Lamp on. Go to Step 5.329.	
		Lamp off.	(CC2) gate.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.329	Check the potential at test point C52 (output of CC1 gate).	Lamp on.	(CC1) gate.
		Lamp off. Go to Step 5.601.	
5.330	Check the potential at test point C51 (output of CP11 gate).	Lamp on.	(CP11) gate.
		Lamp off.	(INV7) gate.
5.331	Check the potential at test point F15 (output of OTG flip-flop).	Lamp on. Go to Step 5.311.	
		Lamp off.	(OTG) flip-flop.
5.332	Release the circuit and check the potential at test point B22 (output of CTR160 gate).	Lamp on.	(CTR16) binary cell.
		Lamp off.	(WI) gate.
5.333	Check the potential at terminal 1 of the IR relay with Hewlett-Packard Model 412A dc voltmeter or equivalent.	+1.2 volts at terminal 1. Go to Step 5.334.	
		0 volt at terminal 1. Go to Step 5.335.	
5.334	Ground test point C52 and check the frequency at test points D36, D26, D56, and C58 (output of INV12, INV11, INV5, and INV10) with the 908A test set. Set the rotary switch to 500 Hz.	Scale reading 20 ± 2 at all test points. Go to Step 5.807.	
		Scale reading 0 at one or more test points. Go to Step 5.219.	
5.335	Check the potential at test point B27 with the 908A test set (output of P110 gate). Set the rotary switch to TRL (+).	Lamp off.	IR relay, contact of RTR.
		Lamp on. Go to Step 5.706.	
5.336	Check the TISR relay.	TISR operated. Go to Step 5.339.	
		TISR has not operated. Go to Step 5.337.	
5.337	Check the SMK relay.	SMK operated. Go to Step 5.338.	
		SMK has not operated.	TRK, SR0/1, E/OSM0/1, SMK relays; select magnets.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.338	Check the TUK relay.	TUK operated.	Hold magnet, HMK relay.
		TUK has not operated.	T_, U_, UA relays, TUK relay.
5.339	Check the EP relay.	EP operated. Go to Step 5.346.	
		EP has not been operated. Go to Step 5.340.	
5.340	Check the potential at test point C32 with the 908A test set (output of CP22 gate). Set the rotary switch to TRL (+).	Lamp on. Go to Step 5.345.	
		Lamp off. Go to Step 5.341.	
5.341	Check the trouble record card for counter phase.	Counter has not been advanced beyond counter phase 11. Go to Step 5.342.	
		Counter advanced but did not stop in counter phase 22. Go to Step 5.708.	
5.342	Check the potential at test point F54 (input of CKT gate).	Lamp off. Go to Step 5.343.	
		Lamp on.	SS relay.
5.343	Check the potential at the test point B54 (output of CKT gate).	Lamp off.	(CKT) gate.
		Lamp on. Go to Step 5.344.	
5.344	Check the potential at test point C44 (output of CKT1 gate).	Lamp on.	(CKT1) gate.
		Lamp off. Go to Step 5.326.	
5.345	Check the potential at test point C28 (output of P220 gate).	Lamp off.	SRC1 contact, IEP or EP relay.
		Lamp on.	(P220) gate.
5.346	Check the TA0/1 relay for group 0/1, respectively.	TA0/1 relay operated. Go to Step 5.355.	
		TA0/1 relay has not been operated. Go to Step 5.347.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.347	Check the OL0/1 relay for group 0/1, respectively.	OL0/1 not operated.	OL0/1 relay.
		OL0/1 operated. Go to Step 5.348.	
5.348	Check the frequency at terminal 1 of the FS0/FS1 filter for group 0/1, respectively. Use the 908A test set with the rotary switch set to 5000 Hz.	Scale reading greater than 10.	False ground on OLA0/1.
		Scale reading 0. Go to Step 5.349.	
5.349	Check the potential at test point A26/A52 (for group 0/1, respectively) with the 908A test set (output of STA0/STA1 gate). Set the rotary switch to TRL (+).	Lamp on.	ITA0/1 relay. False ground on TA0/1 relay.
		Lamp off. Go to Step 5.350.	
5.350	Check the frequency at test point A25/A51 (for group 0/1, respectively) with the 908A test set. Set the rotary switch to 2500 Hz and the slide switch to AF.	Scale reading 0.	Board A7/A4 for group 0/1, respectively. When replacing board A7/A4, board A8/A5 must also be replaced since they are a matched pair. Otherwise, replacements should be checked in accordance with 6.7 and 6.8.
		Scale reading greater than 10. Go to Step 5.351.	
5.351	Release the remote and control circuits. Connect oscilloscope to test point A11 (input of M0/M1 modulator). Initiate a service request call from the remote circuit information sent to the remote circuit. A total of five marks should be observed. Each mark is 5 milliseconds in duration.	Correct message observed. If trouble check was started at the remote circuit, go to Step 5.901. If trouble check was started in control circuit, go to Step 4.519.	
		No message observed. Go to Step 5.352.	
		Partial or incorrect message sent. Go to Step 5.801.	
5.352	Connect the oscilloscope to test point B31 (output of shift register). Repeat Step 5.351 and observe message.	Five marks observed.	Board A28.
		No marks observed. Go to Step 5.353.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.353	Connect the 908A test set to test point C26 (output of INV1, 9, 13 gates). Ground test points C52 (input to clock) and F54 (input to CKT gate). Set the rotary switch of the 908A test set to 50 Hz and check the frequency at test point C26.	Scale reading 6.25 ± 1.0. Go to Step 5.801.	
		Scale reading 0. Go to Step 5.354.	
5.354	Check the frequency at test point D24 (output of T1 monopulser).	Scale reading 0.	(T1) monopulser.
		Scale reading 6.25 ± 1.0.	(INV1), (INV9), (INV13) gates — board B11.
5.355	Remove the block from the RL1 relay.	RL1 does not operate.	RL1 relay.
		RL1 operates and releases. Go to Step 5.101.	
		RL1 operates and does not release. Go to Step 5.101.	

5.4 *RSF0/1 Lamp (Remote Signal Failure)*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.401	Initiate a TA test call from the control circuit to group 0/1, respectively. Check the TA0/1 relay in the group that is not being served.	TA0/1 relay not operated in the group not being served. Go to Step 5.402.	
		TA0/1 relay operated in group not being served. Go to Step 5.406.	
5.402	Check the potential at test point A27 if group 0 is not being served or at test point A53 if group 1 is not being served. Use the 908A test set with the rotary switch set to TRL (+).	Lamp off. Go to Step 5.405.	
		Lamp on. Go to Step 5.403.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.403	Check the frequency at test point A25/A51 for group 0/1, respectively (group not being served). Use the 908A test set with the rotary switch set to 5000 Hz and the slide switch set to AF.	Scale reading greater than 10. Go to Step 5.404.	CP13—board A7/A4 for ground 0/1. When replacing A7/A4 (CP13), board A8/A9 (CP9) must also be replaced as they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
		Scale reading 0.	
5.404	Check the frequency at terminal 1 of the FS0/1 filter (group not being served).	Scale reading greater than 10.	OLA0/1 relay.
		Scale reading 0. Go to Step 4.577. (For remote circuit not being served.)	
5.405	Check the potential at test point A26/A52 for group 0/1, respectively (group not being served). Set the rotary switch of the 908A test set to TRL (+).	Lamp off.	CP13—board A7/A4 for group 0/1. When replacing A7/A4 (CP13), board A8/A5 (CP9) must also be replaced as they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
		Lamp on.	ITA0/1, TA0/1 relays; TM6 timer.
5.406	Check the type of call on which an RSF indication occurs.	RSF occurs on service request calls.	Contact of EP, SCR1 relays; TM6 timer.
		RSF occurs on terminating-type calls. Go to Step 5.407.	
5.407	Check the TA0 and TA1 relays.	Both TA0 and TA1 are operated.	Faulty TM6 timer, contact on TA0/1 relay.
		TA0/1 relay not operated in group being served. Go to Step 5.408.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.408	Check the frequency at test point A25/A51 for group 0/1, respectively (group being served). Use the 908A test set with the rotary switch set to 5000 Hz and the slide switch set to AF.	Scale reading 10 ± 3. Go to Step 5.409.	
		Scale reading 0. Go to Step 5.410.	
5.409	Check the frequency at terminal 1 of the FS0/1 filter (group being served).	Scale reading greater than 10. Go to Step 4.557.	
		Scale reading 0.	OLA0/1, OL0/1 relays.
5.410	Check the potential at test point A27/A53 for group 0/1, respectively (group being served). Use the 908A test set with the rotary switch set to TRL (+).	Lamp on. Go to Step 5.411.	
		Lamp off.	CP13—board A7/A4 for group 0/1. When replacing A7/A4, board A8/A5 (CP9) must also be replaced as they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
5.411	Check the potential at A26/A52 for group 0/1, respectively (output of STA0/STA1 gate).	Lamp on.	CP13—board A7/A4 for group 0/1. When replacing A7/A4, board A8/A5 (CP9) must also be replaced as they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
		Lamp off at test point A27/A53.	ITA0/1, TA0/1 relays.

5.5 ***SF Lamp (Signal Failure)***

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.501	Check OL0/1 relay.	OL0/1 operated. Go to Step 5.502.	
		OL0/1 normal. Go to Step 5.503.	
5.502	Check OP relay.	OP relay operated.	Contact of OP relay, false ground on SF0/1 relay.
		OP relay normal.	Contact on OL0/1 relay, OP relay faulty.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.503	Check the frequency at test point A25/A51 for group 0/1, respectively. Use the 908A test set with the rotary switch set to 5000 Hz.	Scale reading greater than 10. Go to 5.504.	
		Scale reading 0. Go to Step 5.506.	
5.504	Check the potential at test point A27/A53 for group 0/1, respectively. Use the 908A test set with the rotary switch set to TRL (+).	Lamp off. Go to Step 5.505.	
		Lamp on. Go to Step 5.911.	
5.505	Check the potential at test point A26/A52.	Lamp on.	ITA0/1 relay, false ground on TA0/1 relay.
		Lamp off.	(STA0/1) gate — CP13 — board A7/A4 for group 0/1. When replacing A7/A4, board A8/A5 (CP9) must also be replaced as they are a matched pair. If a matched pair is not available, adjustments must be checked in accordance with 6.7 and 6.8.
5.506	Check the frequency at terminal 1 of the FS0/FS1 filter for group 0/1.	Scale reading greater than 10. Go to remote circuit Step 4.577.	
		Scale reading 0.	OLA0/1 relay.

5.6 *Clock and Clock Control Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.601	Ground test point C52 (input to K multivibrator). Check the frequency at test point C43 (output of P8 binary cell) with the 908A test set. Set the rotary switch to 500 Hz and the slide switch to DF.	Scale reading 20 ± 2. Go to Step 5.605.	
		Scale reading 0. Go to Step 5.602.	
5.602	Check the frequency at test point C13 (output of K multivibrator). Set the rotary switch to 5000 Hz.	Scale reading 32 ± 2. Go to Step 5.603.	
		Scale reading 0.	(K) multivibrator.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.603	Check the frequency at test point C23 (output of CIG gate).	Scale reading 32 ± 2. Go to Step 5.604.	
		Scale reading 0.	(CIG) gate.
5.604	Check the frequency at test point C15 (output of P21 gate).	Scale reading 8 ± .8.	(P4), (P8) binary cell boards.
		Scale reading 0.	(P4), (P8) binary cell boards.

Shift Pulse Check

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.605	Check the frequency at test point B15 with the 908A test set (output of T5 monopulser). Set the rotary switch to 500 Hz and the slide switch to DF. Ground test point C52 (input to K multivibrator).	Scale reading 0. Go to Step 5.606.	
		Scale reading 20 ± 2. Go to Step 5.608.	
5.606	Check the frequency at test point B14 (output of PG1 gate).	Scale reading 0. Go to Step 5.607.	
		Scale reading 20 ± 2.	T5 monopulser, SP capacitor.
5.607	Check the frequency at test points C13, C34, C24, C33, and C43 (inputs to PG1 gate).	Scale reading equal to or greater than 20 ± 2 at all test points.	(PG1) gate.
		Scale reading 0 at any test point.	(K) multivibrator or binary cell associated with test point.

Write Pulse Check

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.608	Ground test points A48, B42, and C52. Check the frequency at test point B45 with the 908A test set (output of WG gate). Set the rotary switch to 500 Hz and the slide switch to DF.	Scale reading 0. Go to Step 5.609.	
		Scale reading 20 ± 2. Remove ground from all test points.	(T3) monopulser.
5.609	Check the frequency at test point B55 (output of INV8 gate).	Scale reading 0. Go to Step 5.610.	
		Scale reading 20 ± 2.	(WG) gate.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.610	Check the frequency at test point C54 (output of PG2 gate).	Scale reading 0. Go to Step 5.611.	
		Scale reading 20 ± 2. Remove ground from all test points.	(INV8) gate.
5.611	Check the frequency at test points C13, C25, C15, C33, and C43 (inputs to PG2 gate).	Scale reading equal to or greater than 20 ± 2 at all test points. Remove ground from all test points.	(PG2) gate.
		Scale reading 0 at any test point. Remove ground from all test points.	(K) multivibrator or binary cell associated with the test point.

Counter Advance Check

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.612	Check the frequency at test point B34 with the 908A test set (output of T4 monopulser). Set the rotary switch to 500 Hz and the slide switch to DF. Ground test point C52 (input to K multivibrator).	Scale reading 0. Go to Step 5.613.	
		Scale reading 20 ± 2.	Clock and clock control operative. Remove ground from C52. Return to point at which trouble check started and repeat tests.
5.613	Check the frequency at test point B24 (output of PG3 gate).	Scale reading 0. Go to Step 5.614.	
		Scale reading equal to or greater than 20 ± 2 at all test points. Remove leads from all test points.	T4 monopulser or CA capacitor.
5.614	Check the frequency at test points C13, C34, C15, C33, and C43 (inputs to PG3 gate).	Scale reading equal to or greater than 20 ± 2 at all test points. Remove leads from all test points.	
		Scale reading 0 at any test point. Go to Step 5.601.	(PG3) gate.

5.7 *Clock Pulse Counter Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.701	Ground test point C52 (input to K multivibrator). Check the frequency at test point C11 with the 908A test set (output of CTR21 gate). Set the rotary switch to 50 Hz and the slide switch to DF.	Scale reading of 50 ± 5. Go to Step 5.703.	
		Scale reading 0. Go to Step 5.702.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.702	Check the frequency at test point B34 (output of T4 monopulser). Set the rotary switch to 500 Hz.	Scale reading 20 ± 2.	(CTR1), (CTR2) binary cell boards.
		Scale reading 0. Go to Step 5.612.	
5.703	Check the frequency at test point B48 (output of CTR81 gate).	Scale reading 12.5 ± 1.5. Go to Step 5.704.	
		Scale reading 0.	(CTR4), (CTR8) binary cell boards.
5.704	Check the frequency at test point C31 (output of CTR161 gate).	Scale reading 6.25 ± .5 end of test. Remove ground from test point (C52).	
		Scale reading 0.	(CTR16) binary cell board.
5.705	Ground test point C52 and check the frequency at test points B22, B57, C21, B18, and B47 (inputs to CP0 gate) with the 908A test set. Set the rotary switch to 50 Hz.	Scale reading equal to or greater than 6.25 ± .5 at all test points.	Board A22.
		Scale reading 0 at any test point. Go to Step 5.701.	
5.706	Ground test point C52 and check the frequency at test points B58, C11, C21, B48, and B22 (inputs to CP11 gate) with the 908A test set. Set the rotary switch to 50 Hz.	Scale reading equal to or greater than 6.25 ± .5 at all test points.	Board A20.
		Scale reading 0 at any test point. Go to Step 5.701.	
5.707	Ground test point C52 (input to K multivibrator). Check the frequency at test points B18, C31, C21, B57, and B47 (inputs to CP11 gate) with the 908A test set. Set the rotary switch to 50 Hz.	Scale reading equal to or greater than 6.25 ± .5 at all test points.	Board A21.
		Scale reading 0 at any test point. Go to Step 5.701.	
5.708	Ground test point C52 (input to K multivibrator). Check the frequency at test points B47, C11, C31, B18, and B16 (inputs to CP22 gate) with the 908A test set. Set the rotary switch to 50 Hz.	Scale reading equal to or greater than 6.25 ± .5 at all test points.	(CP22) gate.
		Scale reading 0 at any test point. Go to Step 5.701.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.709	Ground test point C52 (input to K multivibrator). Check the frequency at test points C31, C21, C11, B58, and B48 (inputs to CP27 gate) with the 908A test set. Set the rotary switch to 50 Hz.	Scale reading equal to or greater than 6.25 ± .5 at all test points.	(CP27) gate.
		Scale reading 0 at any test point. Go to Step 5.701.	

5.8 *Shift Register Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.801	Check the input to the shift register with the 908A test set. Set the rotary switch to TRL (+). Ground test point C13 (output of K multivibrator) and initiate a TA test call from the control circuit. Check the potential at test points F11, F21, F31, F41, and F51 for "A" digits 7, 4, 2, 1, and 0, respectively. Check the potential at test point F12, F22, F32, F42, and F52 for "B" digits 7, 3, 2, 1, and 0, respectively. Check the potential at test points F13, F23, F33, F43, and F53 for "C" digits 7, 4, 2, 1, and 0, respectively.	Lamp does not light at associated test point. Go to Step 5.802.	
		Lamp lights at associated test point. Remove ground from test point C13.	Contacts of LT_, LU_, or LI relay if line information is missing. Contacts of T1SR, DT1, TRC2, TK_, G0/1 or E/OT0/1 relay if trunk information is missing. Contacts of D1S 02/12, RSD 0/1, SD 0/1, or TER 01/11 relay if class of call information is missing.
5.802	Connect the 908A test set to test point D24 (output of T1 monopulser). Set the rotary switch to 50 Hz. Connect test points F15 and C52 to ground.	Scale reading 6.25 ± .5. Go to Step 5.804.	
		Scale reading 0. Go to Step 5.803.	
5.803	Check the frequency at test point B32 (output of IGC gate).	Scale reading 6.25 ± .5.	(T1) monopulser or CKT capacitor.
		Scale reading 0.	(IGC) gate.
5.804	Check the frequency at test point C26 (output of INV1, 9, 13 gates).	Scale reading 6.25 ± .5. Go to Step 5.805. Remove ground leads from the circuit.	
		Scale reading 0.	(INV1), (INV9), (INV13) gates, board B11.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.805	Repeat 5.801 this time checking the potential at test points C46, C36, C27, C17, and C47 for "A" digits 7, 4, 2, 1, and 0, respectively. Check the potential at test points C37, C18, C57, C48, and C28 for "B" digits 7, 4, 2, 1, and 0, respectively. Check potential at test points D21, D11, D41, D31, and D12 for "C" digits 7, 4, 2, 1, and 0, respectively. Set the rotary switch on the 908A test set to TRL (+).	→ Lamp lights at associated test point. Go to Step 5.806.	
		→ Lamp does not light at associated test point.	→ Shift register call associated with failing digit.
5.806	Check potential at test points D42, D32, D22, D13, and D52 for "A" digits 7, 4, 2, 1, and 0, respectively. Check potential at test point D43, D33, D23, D14, and D53 for "B" digits 7, 4, 2, 1, and 0, respectively.	→ Lamp lights at associated test point.	→ Relay driver associated with failing digit.
		→ Lamp does not light at associated test point.	→ IR relay, SA_, SB_, A_, B_ relays associated with failing digit.
5.807	Check that the message is being shifted in the following manner. Ground test points A48 (output of WI gate), B42 (output of DMO1 gate), and C52 (input to K multivibrator). Check the frequency at test point B45 with the 908A test set. Set the rotary switch to 500 Hz and the slide switch to DF.	→ Scale reading 0.	→ (WG) gate.
		→ Scale reading 20 ± 2. Go to Step 5.808.	
5.808	Check the frequency at test point C16 (output of T3 monopulser).	→ Scale reading 0.	→ (T3) monopulser.
		→ Scale reading 20 ± 2. Go to Step 5.809.	
5.809	Check the frequency at test point B15 (output of T5 monopulser).	→ Scale reading 0.	→ (T5) monopulser.
		→ Scale reading 20 ± 2. Go to Step 5.810.	
5.810	Check the frequency at test point B35 (output of RS gate).	→ Scale reading 0.	→ (RS) gate.
		→ Scale reading 20 ± 2. Go to Step 5.811.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.811	Check the frequency at test point D36 (output of INV12 gate).	Scale reading 0.	(INV12) gate.
		Scale reading 20 ± 2. Go to Step 5.812.	
5.812	Check the frequency at test point D26 (output of INV11 gate).	Scale reading 0.	(INV11) gate.
		Scale reading 20 ± 2. Go to Step 5.813.	
5.813	Check the frequency at test point C56 (output of INV5 gate).	Scale reading 0.	(INV5) gate.
		Scale reading 20 ± 2. Go to Step 5.813.	
5.814	Check the frequency at test point C58 (output of INV10 gate).	Scale reading 0.	(INV10) gate.
		Scale reading 20 ± 2. Go to Step 5.815.	
5.815	Check the frequency at test point D27 (output of SA2 flip-flop).	Scale reading 0. Go to Step 5.823.	
		Scale reading 20 ± 2. Go to Step 5.816.	
5.816	Check the frequency at test point D47 (output of SA0 flip-flop).	Scale reading 0. Go to Step 5.824.	
		Scale reading 20 ± 2. Go to Step 5.817.	
5.817	Check the frequency at test point D18 (output of SB4 flip-flop).	Scale reading 0. Go to Step 5.825.	
		Scale reading 20 ± 2. Go to Step 5.825.	
5.818	Check the frequency at test point D38 (output of SB1 flip-flop).	Scale reading 0. Go to Step 5.826.	
		Scale reading 20 ± 2. Go to Step 5.819.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.819	Check the frequency at test point D58 (output of SC1 flip-flop).	Scale reading 0. Go to Step 5.827.	
		Scale reading 20 ± 2. Go to Step 5.820.	
5.820	Check the frequency at test point D45 (output of SC2 flip-flop).	Scale reading 0. Go to Step 5.828.	
		Scale reading 20 ± 2. Go to Step 5.821.	
5.821	Check the frequency at test point D16 (output of SC0 flip-flop).	Scale reading 0. Go to Step 5.829.	
		Scale reading 20 ± 2. Go to Step 5.822.	
5.822	Block the EP relay normal. Check the frequency at test point B31 (output of OS flip-flop).	Scale reading 0. Go to Step 5.830.	
		Scale reading 20 ± 2. Remove block from EP relay. Shift register is operative.	
5.823	Check the frequency at terminal 3 of the B2 connector (input to SA2 flip-flop).	Scale reading 0. Remove leads from A48, B42, and C52.	(SA7), (SA4) shift register boards.
		Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	(SA2), (SA1) shift register boards.
5.824	Check the frequency at terminal 3 of the B3 connector (input to SA0 flip-flop).	Scale reading 0. Remove leads from A48, B42, and C52.	(SA2), (SA1) shift register boards.
		Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	(SA0), (SB7) shift register boards.
5.825	Check the frequency at terminal 3 of the B4 connector (input to SB4 flip-flop).	Scale reading 0. Remove leads from A48, B42, and C52.	(SA0), (SB7) shift register boards.
		Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	(SB4), (SB2) shift register boards.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.826	Check the frequency at terminal 3 of the B5 connector (input to SB1 flip-flop).	→ Scale reading 0. Remove leads from A48, B42, and C52.	→ (SB4), (SB2) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	→ (SB1), (SB0) shift register boards.
5.827	Check the frequency at terminal 3 of the B6 connector (input to SC7 flip-flop).	→ Scale reading 0. Remove leads from A48, B42, and C52.	→ (SB1), (SB0) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	→ (SC7), (SC4) shift register boards.
5.828	Check the frequency at terminal 3 of the B7 connector (input to SC2 flip-flop).	→ Scale reading 0. Remove leads from A48, B42, and C52.	→ (SC7), (SC4) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	→ (SC2), (SC1) shift register boards.
5.829	Check the frequency at terminal 3 of the B8 connector (input to SC0 flip-flop).	→ Scale reading 0. Remove leads from A48, B42, and C52.	→ (SC2), (SC1) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A48, P42, and C52.	→ (SC0), (BS) shift register boards.
5.830	Check the frequency at terminal 17 of the A10 connector (input to OS flip-flop).	→ Scale reading 0. Remove leads from A48, B42, and C52.	→ (SC0), (BS) shift register boards.
		→ Scale reading 20 ± 2. Remove leads from A48, B42, and C52.	→ (OS) flip-flop, (RLS) gate.

5.9 *Signal Circuit Check*

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.901	***Send Circuit Check:*** Use the 908A test set and check the frequency at terminal 1 of the FS0/1 filter for group 0/1, respectively. Set the rotary switch to 2500 Hz and the slide switch to AF.	→ Scale reading 40.5 ± 2. Go to Step 5.902.	
		→ Scale reading 44.5 ± 2. Go to Step 5.904.	
		→ Scale reading 0. Go to Step 5.906.	

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.902	Change the rotary switch of the 908A test set to TRL (+) and measure the potential at test point A11 (input to modulator).	Lamp on.	Modulator board in position A1/A2 for group 0/1, respectively. When replacing the modulator board, check adjustments in accordance with 6.6.
		Lamp off. Go to Step 5.903.	
5.903	Check the potential at test point C45 (input of INV2 gate).	Lamp on. Go to Step 5.907.	
		Lamp off.	(INV2) gate.
5.904	Change the rotary switch of the 908A test set to TRL (+) and measure the potential at test point A11 (input to modulator).	Lamp on. Go to Step 5.905.	
		Lamp off.	Modulator board in position A1/A2 for group 0/1. When replacing modulator board, check adjustments in accordance with 6.6.
5.905	Check the potential at test point C45 (output of M gate).	Lamp on.	(INV2) gate.
		Lamp off. Go to Step 5.907.	
5.906	Check the frequency at terminal 17 of the A1/A2 connector for group 0/1, respectively.	Scale reading 0.	Modulator board in position A1/A2 for group 0/1. When replacing the modulator board, check adjustments in accordance with 6.6.
		Scale reading greater than 10.	Contacts 13 and 12 of OLA0 relay, contacts 23 and 22 of OLA1 relay for group 0 or 1, respectively — or contacts associated with OL0/1 or OLA0/1 relays.
5.907	Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential across test points E32 and E42 for group 0, respectively, or E34 and E44 for group 1, respectively (output of TA/TB coil).	*Reading is -18 dBm $\pm$ 7 dB + measured loss of the transmission facility. Go to Step 4.911.	
		Reading is less than -25 dBm + measured loss of the transmission facility. Go to Step 5.908.	

* The reading at this point should be -18 dBm + measured loss of the transmission facility. The circuit should function with a $\pm$ 7 dB variation from this figure. However, if a variation occurs from the indicated level, the transmission facility and/or the adjustments of the modulator board at the remote circuit should be checked.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.908	Measure the ac potential across test points E12 and E22 for group 0, respectively, or E14 and E42 for group 1, respectively (output of PA0/PA1).	Reading is −18 dBm ± 7 dB + measured loss of the transmission facility.	CRA, CRB diodes or TA repeat coil for group 0 or CRC, CRD diodes or TB repeat coil for group 1.
		Reading is less than −25 dBm + measured loss of the transmission facility. Go to Step 5.909.	
5.909	Measure the ac potential from terminal 3 of the FS0/1 filter to ground for group 0/1, respectively.	Reading is 0.95 ± .1 volt RMS.	Power amplifier board cross-connections on this board or adjustment thereof. When replacing the power amplifier board, check the adjustment in accordance with 6.62.
		Reading is less than 0.75 volt RMS. Go to Step 5.910.	
5.910	Measure the ac potential from terminal 1 of the FS0/1 filter to ground for group 0/1, respectively.	Reading is 0.95 ± .1 volt RMS.	FS0/1 filter for group 0/1.
		Reading is less than 0.75 volt RMS.	Modulator board. When replacing the modulator board, check the adjustments in accordance with 6.62.
5.911	*Receive Circuit Check:* Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential across test points E37 and E47 for group 0, respectively, or E35 and E45 for group 1, respectively (input to TC/TD coil).	*Reading is −18 dBm ± 7 dB. Go to Step 5.813.	
		Reading is less than −25 dBm.	Transmission facility or the remote circuit send circuit if it has not been checked.
5.912	Check the ac potential cross test points E17 and E27 for group 0 or E15 and E25 for group 1, respectively (input to T0/T1 transformer).	*Reading is −18 dBm ± 7 dB. Go to Step 5.813.	
		Reading is less than −25 dBm.	CRE, CRF diodes or TC repeat coil for group 0 or CRG, CRH diodes or TD repeat coil for group 1.

* The reading at this point should be −18 dBm. The circuit should function with a ± 7 dB variation from −18 dBm. However, if a variation occurs from −18 dBm, the transmission facility and/or adjustment of the modulator at the remote circuit should be checked.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.913	Check the ac potential at terminal 15 of the A6/A3 connector for group 0/1, respectively.	Reading is less than −25 dBm.	Input transformer. When replacing board CP13 (A7/A4 for group 0/1), board CP9 (A6/A3 for group 0/1) should also be replaced since they are each a matched pair. If a matched pair is not available adjustments must be made in accordance with 6.7 and 6.8 for the guard interval timer and the signal present detector, respectively.
		Reading is −18 dBm ± 7 dB. Go to Step 5.914.	
5.914	Check the ac potential at terminal 3 of the FR0/1 filter to ground for group 0/1, respectively.	Reading is −21 dBm ± 7dB. Go to Step 5.916.	
		Reading is less than −28 dBm. Go to Step 5.915.	
5.915	Check the ac potential at terminal 1 of the FR0/1 filter to ground for group 0/1, respectively.	Reading is −21 dBm ± 7dB.	FR0/1 filter for group 0/1.
		Reading is less than −28 dBm.	Limiter board. When replacing board C19 (A6/A3 for group 0/1), board CP13 (A7/A4 for group 0/1) should also be replaced since they are each a matched pair. If a matched pair is not available, adjustments must be made in accordance with 6.7 and 6.8 for the guard interval timer and the signal present detector, respectively.
5.916	Check the ac potential from test points A35/A12 to ground for group 0/1, respectively (output of limiter).	Reading is less than 7.0 volts RMS.	
		Reading is greater than or equal to 7.0 volts. Go to Step 5.917.	
5.917	Release the circuits and ground test point B23 (output of M gate) at the remote circuit. Use the 908A test set to check the frequency at test point A54/A31 (limiter test point) for group 0/1, respectively, in the control circuit. Set the rotary switch to 2500 Hz and the slide switch to AF.	Reading is 25.4 ± 2. Go to Step 5.918.	
		Reading is 21.4 ± 2.	Remote send circuit. Go to Step 4.901.

STEP	ACTION	RESULT	POSSIBLE TROUBLE
5.918	Check the potential at test points A55/A32 for group 0/1, respectively, with the 908A test set (output of DM0/1 gate). Change the rotary switch to TRL.	→ Lamp on. Receive circuit operative up to the guard interval timer.	→ Trouble is intermittent. Go to Step 4.901 and perform test twice at each step.
		→ Lamp off. Go to Step 5.919.	
5.919	Check the potential at A37/A14 for group 0/1, respectively (output of ST0/1 gate).	→ Lamp on. Go to Step 5.920.	
		→ Lamp off. Go to Step 5.921.	
5.920	Check the potential at B11/A38 for group 0/1, respectively (output of INV3/INV4 gate).	→ Lamp on.	→ (INV3/INV4) gate for group 0/1.
		→ Lamp off.	→ (DM0/DM1) gate for group 0/1 or false battery on other inputs to this gate.
5.921	Check the potential at test point A27/A53 for group 0/1, respectively (input to STA0/1 gate).	→ Lamp on. Go to Step 5.922.	
		→ Lamp off.	→ Discriminator board A8/A5 for group 0/1. When replacing CP1, check the adjustments in accordance with 6.9.
5.922	Use an electronic ac voltmeter, Hewlett-Packard Model 400H or equivalent, to measure the potential from test point A25/A51 to ground for group 0/1, respectively (output of limiter).	→ Scale reading less than 2 volts RMS.	→ Limiter board A6/A3 for group 0/1. When replacing either the limiter board or the signal present detector board, the replacements should be adjusted in accordance with 6.7 and 6.8 since these boards must be adjusted as a matched pair.
		→ Scale reading greater than 2 volts RMS.	→ Signal present detector board A7/A4 for group 0/1. When replacing either the limiter board or the signal present detector board, the replacements should be adjusted in accordance with 6.7 and 6.8 since these boards must be adjusted as a matched pair.

6. ADJUSTMENTS (CIRCUIT PACK) (USING HEWLETT-PACKARD 522B ELECTRONIC COUNTER)

6.1 *Clock and Clock Control*

6.11 Connect a 115-Vac power source to Hewlett-Packard 522B electronic counter or equivalent, and operate the POWER switch to ON. Set the controls as follows:

CONTROL	POSITION
TRIGGER INPUT	COM
TRIGGER SLOPE (START)	+
TRIGGER LEVEL VOLTS (START)	+3
TRIGGER SLOPE (STOP)	–
TRIGGER LEVEL VOLTS (STOP)	+1
TIME UNIT	MILLISEC
STANDARD FREQUENCY COUNTER	100 kHz
FUNCTION SELECTOR	TIME INTERVAL
DISPLAY TIME	MIN

Using the cord supplied with the 522B counter, connect one end to the START jack of the 522B counter. Connect the other end to the B34 terminal of FS14 clock and clock control circuit of the line concentrator No. 2A remote circuit or the C13 terminal of FS32 clock and clock control circuit of the line concentrator No. 2A control circuit.

6.12 Using any cord, apply ground potential to the B36 terminal of FS14 clock and clock control circuit (remote circuit) or to the C52 terminal of FS32 clock and clock control circuit (control circuit). Operate the RESET switch on the Hewlett-Packard 522B counter. The reading of the 522B counter should read between 150 and 160 microseconds. This is accomplished when the last digit column just flashes between 5 and 6. Adjust R1 on CP6, ▶location A16,◀ to attain 150 to 160 microseconds if necessary. (R1 has 25 revolutions from one extreme to another.) At the Hewlett-Packard 522B counter, operate the RESET switch between each adjustment. Use the card extender ED-94866-( ) for access to the RL potentiometer on CP6.

6.13 Set the controls of the 522B counter as follows:

CONTROL	POSITION
FREQUENCY UNIT	10 kHz
FUNCTION SELECTOR	FREQUENCY
DISPLAY TIME	MIN

Change the cord at the Hewlett-Packard 522B counter from the START jack to the INPUT jack.

6.14 Operate the RESET switch on the Hewlett-Packard 522B counter. After 10 seconds, the reading of the 522B counter should be 3200 $\pm$0.5 Hz. If the reading is not 3200 $\pm$0.5 Hz, adjust R2 on CP6 to attain the required value. (R2 has 25 revolutions from one extreme to another.) At the Hewlett-Packard 522B counter, operate the RESET switch between each adjustment. The clock frequency may not hold within the $\pm$0.5 Hz tolerance once the card is inserted back in the tray. A drift of $\pm$8 Hz is not abnormal and should not inhibit any circuit operation. Remove all cords from the line concentrator circuit and remove the board extender.

6.2 *Remote Signal Circuit Adjustment*

6.21 *Modulator (Remote Circuit)*

6.211 Set up the controls of a Hewlett-Packard 522B counter or equivalent as follows:

CONTROL	POSITION
FREQUENCY UNIT	10 kHz
FUNCTION SELECTOR	FREQUENCY
DISPLAY TIME	MIN

Using the proper cord, connect one end to the INPUT jack of the 522B counter and the other end to relay (OL) contact 6B. Using any test lead, apply ground to the A11 test point terminal of FS11 signal circuit. The reading of Hewlett-Packard 522B counter should be 1070 Hz $\pm$0.1 Hz. If the reading is not correct, adjust (T1) of CP11, ▶location A1,◀ with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

6.212 Remove the ground from the A11 test point terminal. Operate the RESET switch on the 522B counter. The reading should be exactly identical with the value obtained in 6.211.

6.213 Using a test cord, apply ground to the B23 terminal of the signal circuit. Operate the RESET switch once on the Hewlett-Packard 522B counter. The reading should be 1270 $\pm$0.1 Hz. If the reading is not correct, adjust (T2) of CP11 with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

6.214 At the completion of this test, remove the ground potential from the B23 terminal and the input cord from the (OL) relay and from the 522B counter INPUT jack.

6.22 *Power Amplifier (Remote Circuit)*

6.221 Connect the power cord of a Hewlett-Packard 400H ac vacuum tube voltmeter or equivalent to a 115-Vac power source, and operate the ON switch. Allow 5 minutes to warm up. Using a pair of test cords, connect the input jacks of the Hewlett-Packard 400H to the E12 and E22 test points of the signal circuit. After verifying the proper cross-connections with the operating company, adjust R10 of CP11 until the desired output level is −18 dBm + the measured loss of the transmission facility.

6.23 At the completion of test, return the power switch to OFF and remove the 115-Vac power source and the input test cord from the Hewlett-Packard 400H ac vacuum tube voltmeter. Remove the test cords from the E12 and E22 test points.

CROSS-CONNECTION INFORMATION OF CP11

CONNECT TERM.	TO TERM.	TELEPHONE COMPANY FACILITY LOSS
C	H	8 to 0 dB
C G	F H	0 to −8 dB
C E	D H	−8 to −15 dB
F G	E H	−15 to −23 dB

6.3 *Guard Interval Timer (Remote Circuit)*

6.31 *Preparation*

6.311 Connect a 115-Vac power source to the Hewlett-Packard 522B counter or equivalent, and operate the POWER switch to ON. Set the controls as follows:

CONTROL	POSITION
TRIGGER INPUT	COM
TRIGGER SLOPE (START)	+
TRIGGER LEVEL VOLTS (START)	+1.5
TRIGGER SLOPE (STOP)	−
TRIGGER LEVEL VOLTS (STOP)	+1.5
TIME UNIT	MILLISEC
STANDARD FREQUENCY COUNTED	100 kHz
FUNCTION SELECTOR	TIME INTERVAL
DISPLAY TIME	MIN

Using the cord supplied with the 522B counter, connect one end to the START jack of the 522B counter. Connect the other end to the A53 terminal of the signal circuit (FS11) (remote circuit).

6.312 Using a test lead equipped with alligator clips, connect one end to test point A13 and the other end to the A21 terminal of FS15 clock pulse counter circuit of the remote circuit.

6.32 *Procedure for Test*

6.321 Using a test lead, apply ground potential to the B36 terminal of FS14. The reading of the Hewlett-Packard 522B counter should be 4.06 $\pm$0.01 milliseconds. If the reading is different than the specified time, adjust R5 of CP13, ▶location A3,◀ and operate the RESET switch between each adjustment.

6.322 At the completion of test, remove test leads from B36, A53, A13, and A21 terminals. Remove the cord from the trigger input of the 522B counter.

6.4 *Signal Present Detector (Remote Circuit)*

6.41 *Procedure for Test*

6.411 Take the control circuit out of service. This will insure that the proper signal is being received from the control circuit for test purposes. Connect the Hewlett-Packard 400H vacuum tube voltmeter or equivalent across test points E24 and E14 (remote circuit). Plug a 5A attenuating pad in jacks R0DR and R0L1 of the FS11 signal circuit. Adjust the attenuator until a reading of −38.5 dBm or 9.1 millivolts RMS is on the Hewlett-Packard 400H meter.

6.412 Connect a Hewlett-Packard 412A voltmeter or equivalent to test point A33. If the voltmeter reads 11-12 volts, adjust potentiometer R2 on CP9, ➧location A2,➧ until the voltage changes to less than 1 volt. Then adjust potentiometer R2 in the opposite direction until the voltage just changes to the required level of 11-12 volts. If the voltage reading is less than 1 volt at the start, potentiometer R2 is to be adjusted until the voltage just changes to 11-12 volts. (R2 is the 10K potentiometer on the rear half of CP9.)

6.413 At completion of the test, remove all test leads and put both units back into service.

6.5 *Discriminator (Remote Circuit)*

6.51 Connect a 115-Vac power source to the Hewlett-Packard 522B counter or equivalent, and operate the power switch to ON. Set the controls as follows:

CONTROL	POSITION
TRIGGER INPUT	COM
TRIGGER SLOPE (START)	+
TRIGGER SLOPE (STOP)	−
TRIGGER LEVEL VOLTS (START)	+2
TRIGGER LEVEL VOLTS (STOP)	+2
TIME UNIT	MILLISEC
STANDARD FREQUENCY COUNTED	10 kHz
FUNCTION SELECTOR	TIME INTERVAL
DISPLAY TIME	MIN

Using the cord supplied with the 522B counter, connect one end to the START jack of the 522B counter. Connect the other end to terminal A44 of the FS11 signal circuit.

6.52 *Procedure for Test*

Initiate a TA test call from the control circuit. The 522B counter should read either (1) 5.0 ±0.25 milliseconds, (2) 10.0 ±0.5 milliseconds, or (3) 15.0 ±0.5 milliseconds. Operate the RESET switch and repeat test twice. If readings are not consistently correct, adjust potentiometer R3 on CP12, ➧location A4,➧ remote unit discriminator.

6.53 Change the controls of the 522B counter as follows:

CONTROL	POSITION
TRIGGER SLOPE (START)	−
TRIGGER SLOPE (STOP)	+

Operate the RESET switch on the Hewlett-Packard 522B to clear the counter. Initiate a TA test call from the control circuit. When triggered, the counter should read (1) 5.0 ±0.25 milliseconds, (2) 10.0 ±0.5 milliseconds, (3) 15.0 ±0.5 milliseconds, or (4) some other multiple of 5.0 milliseconds. If a multiple of 5.0 milliseconds is obtained, repeat until one of the first three readings is obtained. If one of the above is not obtained consistently, adjust R3 on CP12 and repeat the test in 6.52 for the positive pulse.

6.6 *Control Signal Circuit Adjustment*

6.61 *Modulator (Control Circuit)*

6.611 Set up the controls of the Hewlett-Packard 522B counter or equivalent as follows:

CONTROL	POSITION
FREQUENCY UNIT	10 kHz
FUNCTION SELECTOR	FREQUENCY
DISPLAY TIME	MIN

Using the proper cord, connect one end to the INPUT jack of the 522B counter and the other end to (1) terminal 17 of the A1 connector if board A1 was changed or (2) to terminal 17 of the A2 connector if board A2 was changed. Using any test lead, apply ground to the A11 terminal of FS28 send circuit. The reading of the Hewlett-Packard 522B counter should be 2025 Hz ± 0.2 Hz. If the reading is not correct, adjust (T1) of CP8, location A1 (location A2 for L2 only), with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

6.612 Remove the ground from the A11 terminal. Operate the RESET switch in the 522B counter. The reading should be exactly identical with the value obtained in 6.611.

6.613 Using a test cord, apply ground potential to test point C45 of the signal circuit. Operate the RESET switch once on the Hewlett-Packard 522B counter, and the reading should be 2225 ± 0.2 Hz. If the reading is not correct, adjust (T2) of CP8 with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

6.614 At the completion of this test, remove the ground potential from the C45 terminal and the input cord from terminal 17 or the A1/A2 connector and from 522B counter INPUT jack.

6.62 *Power Amplifier (Control Circuit)*

6.621 Connect the power cord of a Hewlett-Packard 400H ac vacuum tube voltmeter or equivalent to a 115-Vac power source, and operate the power switch to ON. Allow 5 minutes to warm up. Using a pair of test cords, connect the input jacks of Hewlett-Packard 400H to the E12/E14 and E22/E24 test points (for group 0/1, respectively) of the send circuit. After verifying the proper cross-connections with the operating company, adjust R10 of CP8 until the desired output level is -18 dBm + the measured loss of transmission facilities.

6.63 At completion of the test, return the power switch to OFF and remove the 115-Vac power source and the input test cord from the Hewlett-Packard 400H ac vacuum tube voltmeter. Remove the test cords from the E12/E14 and E22/E24 test points.

CROSS-CONNECTION INFORMATION OF CP8

CONNECT TERM.	TO TERM.	TELEPHONE COMPANY FACILITY LOSS
C	H	8 to 0 dB
C G	F H	0 to −8 dB
C E	D H	−8 to −15 dB
F G	E H	−15 to −23 dB

6.7 *Guard Interval Timer (Control Circuit)*

6.71 *Preparation*

6.711 Connect a 115-Vac power source to the Hewlett-Packard 522B counter or equivalent, and operate the power switch to ON. Set the control as follows:

CONTROL	POSITION
TRIGGER INPUT	COM
TRIGGER SLOPE (START)	+
TRIGGER LEVEL VOLTS (START)	+1.5
TRIGGER SLOPE (STOP)	−
TRIGGER LEVEL VOLTS (STOP)	+1.5
TIME UNIT	MILLISEC
STANDARD FREQUENCY COUNTED	100 kHz
FUNCTION SELECTOR	TIME INTERVAL
DISPLAY TIME	MIN

Using the cord supplied with the 522B counter, connect one end to the START jack of the 522B counter. Connect the other end to the A46/A23 terminal (for group 0/1, respectively) of the signal circuit (FS29).

6.712 Using a test lead equipped with alligator clips, connect one end to terminal No. 2 of CP13, ♦location A7 (location A4 for L2 only),♦ and the other end to test point B47 of FS33, clock pulse counter circuit of the control circuit.

6.72 *Procedure for Test*

6.721 Using a test lead, apply ground potential to the C52 terminal of FS29. The reading of the Hewlett-Packard 522B counter should be 4.06 $\pm$0.01 milliseconds. If the reading is different than the specified time, adjust R5 on CP13 and operate the RESET switch between each adjustment.

6.722 At the completion of test, remove test leads from C52, A46/A23, and B47 terminals and from terminal 2 of CP13. Remove the cord from the trigger input of the 522B counter.

6.8 *Signal Present Detector (Control Circuit)*

6.81 *Procedure for Test*

6.811 Take the remote circuit out of service. This will insure that the proper signal is being received from the remote circuit for test purposes. Connect the Hewlett-Packard 400H vacuum tube voltmeter or equivalent across test points E47 and E37 or E45 and E35 for group 0/1, respectively. Plug a 5A attenuator pad in jacks R0DR and R0LI or R1DR and R1DI (for group 0/1, respectively) of the FS29 signal circuit. Adjust the attenuator until a reading of −38.5 dBm or 9.1 millivolts RMS is obtained on the Hewlett-Packard 400H meter.

6.812 Connect a Hewlett-Packard 412A voltmeter or equivalent to the proper test terminal (A26/A52 for group 0/1). If the voltmeter reads 11-12 volts, adjust potentiometer R2 on CP9, ♦location A6 (location A3 for L2 only),♦ until the voltage changes to less then 1 volt. Then adjust potentiometer R2 in the opposite direction until the voltage just changes to the required level of 11-12 volts. If the voltage reading is less than 1 volt at the start, the potentiometer R2 is to be adjusted until the voltage just changes to 11-12 volts. (R2 is the 10K potentiometer on the rear half of CP9.)

6.813 At completion of the test, remove all test leads and put both units back into service.

6.9 *Discriminator (Control Circuit)*

6.91 Connect a 115-Vac power source to a Hewlett-Packard 522B counter or equivalent, and operate the power switch to ON. Set the controls as follows:

CONTROL	POSITION
TRIGGER INPUT (START)	COM
TRIGGER SLOPE (STOP)	−
TRIGGER LEVEL VOLTS (START)	+2
TRIGGER LEVEL VOLTS (STOP)	+2
TIME UNIT	MILLISEC
STANDARD FREQUENCY COUNTED	10 kHz
FUNCTION SELECTOR	TIME INTERVAL
DISPLAY TIME	MIN

Using the cord supplied with the 522B counter, connect one end to the START jack of the 522B counter. Connect the other end to test point A57/A34 (for group 0/1, respectively) of the FS29 receive circuit.

6.92 *Procedure for Test*

Initiate a TA test call from the remote circuit. The 522B counter should read either (1) 5.0 $\pm$0.25 milliseconds, (2) 10.0 $\pm$0.5 milliseconds, or (3) 15.0 $\pm$0.5 milliseconds. Operate the RESET switch and repeat twice. If readings are not consistently correct, adjust potentiometer R3 on CP10, ♦location A8 (location A5 for L2 only),♦ control circuit discriminator.

6.93 Change the controls of the 522B counter as follows:

CONTROL	POSITION
TRIGGER SLOPE (START)	−
TRIGGER SLOPE (STOP)	+

Operate the RESET switch on the Hewlett-Packard 522B to clear the counter. Initiate a TA test call from the remote circuit. When triggered, the counter should read (1) 5.0 ±0.25 milliseconds, (2) 10.0 ±0.5 milliseconds, (3) 15.0 ±0.5 milliseconds, or (4) some other multiple of 5.0 milliseconds. If a multiple of 5.0 milliseconds is obtained, repeat until one of the first three readings is obtained. If one of the above is not obtained consistently, adjust R3 on CP10 and repeat the test in 6.92 for the positive pulse.

7. ♦ADJUSTMENTS (CIRCUIT PACK) (USING HEWLETT-PACKARD 5300A/5304A ELECTRONIC COUNTER) (HEREAFTER REFERRED TO AS THE 5304A COUNTER)

7.1 *Clock and Clock Control*

7.11 Connect a 115-Vac power source to Hewlett-Packard 5304A counter. Turn ac power ON with 5304A SAMPLE RATE control. Set the controls as follows:

CONTROL	POSITION
COM/SEP/CHK	COM
ATTEN (INPUT A)	X10
AC/DC (INPUT A)	AC
SLOPE (INPUT A)	+
LEVEL (INPUT A)	2 O'CLOCK POS
ATTEN (INPUT B)	X1
AC/DC (INPUT B)	AC
SLOPE (INPUT B)	−
LEVEL (INPUT B)	MAX CLOCKWISE
T.I. A TO B/FREQ A	1 μsec
SAMPLE RATE	MAX CLOCKWISE

Note: None of the tests in this section require the DELAY feature found on the 5304A counter. To disable this feature, turn the DELAY knob fully counterclockwise.

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter. Connect the other end to the B34 terminal of FS14 clock and clock control circuit of the line concentrator No. 2A remote circuit or to the C13 terminal of FS32 clock and clock control circuit of the line concentrator No. 2A control circuit.

7.12 Using any cord, apply ground potential to the B36 terminal of FS14 clock and clock control circuit (remote circuit) or to the C52 terminal of FS32 clock and clock control circuit (control circuit).

Operate the RESET switch on the Hewlett-Packard 5304A counter. The reading of the 5304A counter should read between 150 and 160 microseconds. Adjust R1 on CP6, location A16, to attain 150 to 160 microseconds if necessary. (R1 has 25 revolutions from one extreme to another.) At the Hewlett-Packard 5304A counter, operate the RESET switch between each adjustment. Use the card extender ED-94866-( ) for access to the RL potentiometer on CP6.

7.13 Set the controls of the 5304A electronic counter as follows:

CONTROL	POSITION
T.I. A TO B/FREQ A	10S
COM/SEP/CHK	SEP

7.14 Operate the RESET switch on the Hewlett-Packard 5304A counter. After 10 seconds, the reading of the 5304A counter should be 3200 ±0.5 Hz. If the reading is not 3200 ±0.5 Hz, adjust R2 on CP6 to attain the required value. (R2 has 25 revolutions from one extreme to another.) At the Hewlett-Packard 5304A counter, operate the RESET switch between each adjustment. The clock frequency may not hold within the ±0.5 Hz tolerance once the card is inserted back in the tray. A drift of ±8 Hz is not abnormal and should not inhibit any circuit operation. Remove all cords from the line concentrator circuit and remove the board extender.

7.2 *Remote Signal Circuit Adjustment*

7.21 *Modulator (Remote Circuit)*

7.211 Set up the controls of a Hewlett-Packard 5304A counter or equivalent as follows:

CONTROL	POSITION
T.I. A T0 B/FREQ A	10S
COM/SEP/CHK	SEP

Using a BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter and the other end to relay (OL) contact 6B. Using any test lead, apply ground to the A11 test point terminal of FS11 signal circuit. The reading of Hewlett-Packard 5304A counter should be 1070 Hz ±0.1 Hz. If the reading is not correct, adjust (T1) of CP11, location A1, with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

7.212 Remove the ground from the A11 test point terminal. Operate the RESET switch on the 5304A counter. The reading should be exactly identical with the value obtained in 7.211.

7.213 Using a test cord, apply ground to the B23 terminal of the signal circuit. Operate the RESET switch once on the Hewlett-Packard 5304A counter. The reading should be 1270 ±0.1 Hz. If the reading is not correct, adjust (T2) of CP11 with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

7.214 At the completion of this test, remove the ground potential from the B23 terminal and the input cord from the (OL) relay and from the 5304A counter INPUT A jack.

7.22 *Power Amplifier (Remote Circuit)*

7.221 Connect the power cord of a Hewlett-Packard 400H ac vacuum tube voltmeter or equivalent to a 115-Vac power source, and operate the ON switch. Allow 5 minutes to warm up. Using a pair of test cords, connect the input jacks of the Hewlett-Packard 400H to the E12 and E22 test points of the signal circuit. After verifying the proper cross-connections with the operating company, adjust R10 of CP11 until the desired output level is −18 dBm + the measured loss of the transmission facility.

7.23 At completion of the test, return the power switch to OFF and remove the 115-Vac power source and the input test cord from the Hewlett-Packard 400H ac vacuum tube voltmeter. Remove the test cords from the E12 and E22 test points.

CROSS-CONNECTION INFORMATION OF CP11

CONNECT TERM.	TO TERM.	TELEPHONE COMPANY FACILITY LOSS
C	H	8 to 0 dB
C	F	0 to −8 dB
G	H	
C	D	−8 to −15 dB
E	H	
F	E	−15 to −23 dB
G	H	

7.3 *Guard Interval Timer (Remote Circuit)*

7.31 *Preparation*

7.311 Connect a 115-Vac power source to the Hewlett-Packard 5304A counter or equivalent, and apply ac power with the 5304A SAMPLE RATE control. Set the controls as follows:

CONTROL	POSITION
COM/SEP/CHK	COM
ATTEN (INPUT A)	X1
AC/DC (INPUT A)	AC
SLOPE (INPUT A)	+
LEVEL (INPUT A)	MAX CLOCKWISE
ATTEN (INPUT B)	X1
AC/DC (INPUT B)	AC
SLOPE (INPUT B)	−
LEVEL (INPUT B)	MAX CLOCKWISE
T.I. A TO B/FREQ A	1 μsec
SAMPLE RATE	MAX CLOCKWISE

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter. Connect the other end to the A53 terminal of the signal circuit (FS11) (remote circuit).

7.312 Using a test lead equipped with alligator clips, connect one end to test point A13 and the other end to the A21 terminal of FS15 clock pulse counter circuit of the remote circuit.

7.32 ***Procedure for Test***

7.321 Using a test lead, apply ground potential to the B36 terminal of FS14. The reading of the Hewlett-Packard 5304A counter should be 4.06 $\pm$0.011 milliseconds. If the reading is different than the specified time, adjust R5 of CP13, location A3, and operate the RESET switch between each adjustment.

7.322 At completion of the test, remove test leads from B36, A53, A13, and A21 terminals. Remove the cord from the trigger input of the 5304A counter.

7.4 ***Signal Present Detector (Remote Circuit)***

7.41 ***Procedure for Test***

7.411 Take the control circuit out of service. This will insure that the proper signal is being received from the control circuit for test purposes. Connect the Hewlett-Packard 400H vacuum tube voltmeter or equivalent across test points E24 and E14 (remote circuit). Plug a 5A attenuating pad in jacks R0DR and R0LI of the FS11 signal circuit. Adjust the attenuator until a reading of −38.5 dBm or 9.1 millivolts RMS is on the Hewlett-Packard 400H meter.

7.412 Connect a Hewlett-Packard 412A voltmeter or equivalent to test point A33. If the voltmeter reads 11-12 volts, adjust potentiometer R2 on CP9, location A2, until the voltage changes to less than 1 volt. Then adjust the potentiometer R2 in the opposite direction until the voltage just changes to the required level of 11-12 volts. If the voltage reading is less than 1 volt at the start, potentiometer R2 is to be adjusted until the voltage just changes to 11-12 volts. (R2 is the 10K potentiometer on the rear half of CP9.)

7.413 At the completion of the test, remove all test leads and put both units back into service.

7.5 ***Discriminator (Remote Circuit)***

7.51 Connect a 115-Vac power source to the Hewlett-Packard 5304A counter or equivalent, and apply ac power with the 5304A SAMPLE RATE control. Set the controls as follows:

CONTROL	POSITION
COM/SEP/CHK	COM
ATTEN (INPUT A)	X10
AC/DC (INPUT A)	AC
SLOPE (INPUT A)	+
LEVEL (INPUT A)	2 O'CLOCK POS
ATTEN (INPUT B)	X10
AC/DC (INPUT B)	AC
SLOPE (INPUT B)	−
LEVEL (INPUT B)	2 O'CLOCK POS
T.I. A TO B/FREQ A	10 μsec
SAMPLE RATE	MAX CLOCKWISE

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter. Connect the other end to terminal A44 of the FS11 signal circuit.

7.52 ***Procedure for Test***

Initiate A TA test call from the control circuit. The 5304A counter should read either (1) 5.0 $\pm$0.25 milliseconds, (2) 10.0 $\pm$0.5 milliseconds, or (3) 15.0 $\pm$0.5 milliseconds. Operate the RESET switch and repeat the test twice. If readings are not consistently correct, adjust potentiometer R3 on CP12, location A4, remote unit discriminator.

7.53 Change the controls of the 5304A counter as follows:

CONTROL	POSITION
SLOPE (INPUT A)	−
SLOPE (INPUT B)	+

Operate the RESET switch on the Hewlett-Packard 5304A to clear the counter. Initiate a TA test call from the control circuit. When triggered, the counter should read (1) 5.0 $\pm$0.25 milliseconds, (2) 10.0 $\pm$0.5 milliseconds, (3) 15.0 $\pm$0.5 milliseconds, or (4) some other multiple of 5.0 milliseconds. If a multiple of 5.0 milliseconds is obtained, repeat until one of the first three readings is obtained. If one of the above is not obtained consistently, adjust R3 on CP12 and repeat the test in 7.52 for the positive pulse.

7.6 ***Control Signal Circuit Adjustment***

7.61 ***Modulator (Control Circuit)***

7.611 Set up the controls of the Hewlett-Packard 5304A counter or equivalent as follows:

CONTROL	POSITION
T.I. A to B/FREQ A	10S
COM/SEP/CHK	SEP
SAMPLE RATE	MAX CLOCKWISE

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter and the other end to (1) terminal 17 of the A1 connector if board A1 was changed or (2) to terminal 17 of the A2 connector if board A2 was changed. Using any test lead, apply ground to the A11 terminal of FS28 send circuit. The reading of the Hewlett-Packard 5304A counter should be 2025 Hz $\pm$0.2 Hz. If the reading is not correct, adjust (T1) of CP8, location A1 (location A2 for L2 only), with a nonmagnetic screwdriver. Operate the RESET switch between each adjustment.

7.612 Remove the ground from the A11 terminal. Operate the RESET switch in the 5304A counter. The reading should be exactly identical with the value obtained in 7.611.

7.613 Using a test cord, apply ground potential to test point C45 of the signal circuit. Operate the RESET switch once on the Hewlett-Packard 5304A counter, and the reading should be 2225 $\pm$0.2 Hz. If the reading is not correct, adjust (T2) of CP8 with a nonmagnetic screwdriver and operate the RESET switch between each adjustment.

7.614 At the completion of the test, remove the ground potential from the C45 terminal and the input cord from terminal 17 of the A1/A2 connector and from 5304A counter INPUT A jack.

7.62 ***Power Amplifier (Control Circuit)***

7.621 Connect the power cord of a Hewlett-Packard 400H ac vacuum tube voltmeter or equivalent to a 115-Vac power source, and operate the power switch to ON. Allow 5 minutes to warm up. Using a pair of test cords, connect the input jacks of Hewlett-Packard 400H to the E12/E14 and E22/E24 test points (for group 0/1, respectively) of the send circuit. After verifying the proper cross-connections with the operating company, adjust R10 to CP8 until the desired output level is −18 dBm + the measured loss of the transmission facilities.

7.63 At completion of the test, return the power switch to OFF and remove the 115-Vac power source and the input test cord from the Hewlett-Packard 400H ac vacuum tube voltmeter. Remove the test cords from the E12/E14 and E22/E24 test points.

CROSS-CONNECTION INFORMATION OF CP8

CONNECT TERM.	TO TERM.	TELEPHONE COMPANY FACILITY LOSS
C	H	8 to 0 dB
C	F	0 to −8 dB
G	H	
C	D	−8 to −15 dB
E	H	
F	E	−15 to −23 dB
G	H	

7.7 ***Guard Interval Timer (Control Circuit)***

7.71 ***Preparation***

7.711 Connect 115-Vac power source to the Hewlett-Packard 5304A counter or equivalent, and apply ac power with the 5304A SAMPLE RATE control. Set the controls as follows:

CONTROL	POSITION
COM/SEP/CHK	COM
ATTEN (INPUT A)	X1
AC/DC (INPUT A)	AC
SLOPE (INPUT A)	+
LEVEL (INPUT A)	MAX CLOCKWISE
ATTEN (INPUT B)	X1
AC/DC (INPUT B)	AC
SLOPE (INPUT B)	−
LEVEL (INPUT B)	MAX CLOCKWISE
T.I. A TO B/FREQ A	1 μsec
SAMPLE RATE	MAX CLOCKWISE

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter. Connect the other end to the A46/A23 terminal (for group 0/1, respectively) of the signal circuit (FS29).

7.712 Using a test lead equipped with alligator clips, connect one end to terminal No. 2 of CP13, location A7 (location A4 for L2 only), and the other end to test point B47 of FS33, clock pulse counter circuit of the control circuit.

7.72 *Procedure for Test*

7.721 Using a test lead, apply ground potential to the C52 terminal of FS29. The reading of the Hewlett-Packard 5304A counter should be 4.06 $\pm$0.01 milliseconds. If the reading is different than the specified time, adjust R5 on CP13 and operate the RESET switch between each adjustment.

7.722 At completion of the test, remove test leads from C52, A46/A23, and B47 terminals and from terminal 2 of CP13. Remove the cord from INPUT A jack of the 5304A counter.

7.8 *Signal Present Detector (Control Circuit)*

7.81 *Procedure for Test*

7.811 Take the remote circuit out of service. This will insure that the proper signal is being received from the remote circuit for test purposes. Connect the Hewlett-Packard 400H vacuum tube voltmeter or equivalent across test points E47 and E37 or E45 and E35 for group 0/1, respectively. Plug a 5A attenuator pad in jacks R0DR and R0LI or R1DR and R1DI (for group 0/1, respectively) of the FS29 signal circuit. Adjust the attenuator until a reading of −38.5 dBm or 9.1 millivolts RMS is obtained on the Hewlett-Packard 400H meter.

7.812 Connect a Hewlett-Packard 412A or equivalent voltmeter to the proper test terminal (A26/A52 for group 0/1). If the voltmeter reads 11-12 volts, adjust potentiometer R2 on CP9, location A6 (location A3 for L2 only), until the voltage changes to less than 1 volt. Then adjust potentiometer R2 in the opposite direction until the voltage just changes to the required level of 11-12 volts. If the voltage reading is less than 1 volt at the start, potentiometer R2 is to be adjusted until the voltage just changes to 11-12 volts. (R2 is the 10K potentiometer on the rear half of CP9.)

7.813 At completion of the test, remove all test leads and put both units back into service.

7.9 *Discriminator (Control Circuit)*

7.91 Connect a 115-Vac power source to a Hewlett-Packard 5304A counter or equivalent, and apply ac power with the 5304A SAMPLE RATE control. Set the controls as follows:

CONTROL	POSITION
COM/SEP/CHK	COM
ATTEN (INPUT A)	X10
AC/DC (INPUT A)	AC
SLOPE (INPUT A)	+
LEVEL (INPUT A)	2 O'CLOCK POS
ATTEN (INPUT B)	X10
AC/DC (INPUT B)	AC
SLOPE (INPUT B)	−
LEVEL (INPUT B)	2 O'CLOCK POS
T.I. A TO B/FREQ A	10 μsec
SAMPLE RATE	MAX CLOCKWISE

Using a BNC to BNC coaxial cable (or cord), connect one end to the INPUT A jack of the 5304A counter. Connect the other end to test point A57/A34 (for group 0/1, respectively) of the FS29 receive circuit.

7.92 *Procedure for Test*

7.921 Initiate a TA test call from the remote circuit. The 5304A counter should read either (1) 5.0 ±0.25 milliseconds, (2) 10.0 ±0.5 milliseconds, or (3) 15.0 ±0.5 milliseconds. Operate the RESET switch and repeat twice. If readings are not consistently correct, adjust potentiometer R3 on CP10, location A8 (location A5 for L2 only), discriminator.

7.93 Change the controls of the 5304A counter as follows:

CONTROL	POSITION
SLOPE (INPUT A)	−
SLOPE (INPUT B)	+

Operate the RESET switch on the Hewlett-Packard 5304A counter to clear the counter. Initiate a TA test call from the remote circuit. When triggered, the counter should read (1) 5.0 ±0.25 milliseconds, (2) 10.0 ±0.5 milliseconds, (3) 15.0 ±0.5 milliseconds, or (4) some other multiple of 5.0 milliseconds. If a multiple of 5.0 milliseconds is obtained, repeat until one of the first three readings is obtained. If one of the above is not obtained consistently, adjust R3 on CP10 and repeat the test in 7.92 for the positive pulse.