
L3 CARRIER
REPEATER AND ASSOCIATED EQUIPMENT AT
MAIN REPEATERS
MAINTENANCE PROCEDURES

This section provides procedures for (a) replacing amplifiers and regulators, (b) measuring the pilot supply of L3 carrier repeater, and (c) testing associated equipment at main repeater stations.

This section is reissued for the following reasons:

- (1) Delete the tube bias and activity tests.
- (2) Change the power requirements at the TRSG HY OUT B jack per Table A.

Other changes have been made to clarify the maintenance procedures. Since this section has been completely revised, arrows are not used to indicate changes. Equipment Test Lists are affected.

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CHART 1

AMPLIFIERS AND REGULATORS

APPARATUS:

J68839B (39B) Thermistor Control Set

J68815K Change Load

J64001AL Power Test Set

STEP	PROCEDURE
	A. Replacement of Amplifiers
1	Check that the equipment is out of service.
2	Proceed to Step 3 for an amplifier powered from a constant-current source. Proceed to Step 4 for an amplifier powered from a constant-voltage source.
	Note 1: Constant-current power supplies are normally located at equalizing, switching main, and terminal main repeaters.
	Note 2: Constant-voltage power supplies are normally located at auxiliary repeaters or equalizing auxiliary repeaters.

CHART 1 (Contd)

STEP	PROCEDURE
3	Connect the change load unit to the V TEST jack on the transmission panel in which the amplifier to be serviced is mounted.
4	Disconnect the PWR IN and PWR OUT jacks on the amplifier. Warning: <i>Extreme care should be taken to minimize mechanical shocks while handling or transporting amplifiers. Delicate apparatus inside.</i>
5	Remove the defective amplifier by disengaging the catches and replace with new one. When the amplifier is replaced:
6	Connect the power test set to the TEST plug on the amplifier under test.
7	Operate the power test set METER switch to the PLT 1 position.
8	Connect the PWR IN and PWR OUT jacks on the amplifier and observe the PLT voltage on the power test set.
9	When the meter stabilizes at a lower value, disconnect the change load unit, if used.
10	Measure and, if necessary, adjust pilots per Chart 2. B. Replacement of Regulators Regulators can be serviced on an in-service basis or on an out-of-service basis. When regulators are serviced on an in-service basis, the equalizer thermistor control is transferred from automatic to manual control by the use of a J68839B thermistor control set. When regulators are serviced on an out-of-service basis and the supply is the constant-voltage source, a regulator may be disconnected from its power supply without affecting other regulators. When the supply is a constant-current source, a J68815K change load is required so that a constant current is maintained on the power supply when the regulator is removed.
11	If the equipment to be serviced is out of service, proceed to Step 20 or 21.
12	Set the SEL switch to the REL NET position and check that the 39B thermistor control set DYN EQ1 through 5 and the REG NET toggle switches are in their NORM positions.
13	Plug the connecting cord into the TH TST jack in the repeater bay under test.
14	Operate the REG NET toggle switch to the ADJ position. Note: The thermistor control set is now in control.
15	Adjust the TH CUR control on the 39B thermistor control set for correct pilot power.

CHART 1 (Contd)

STEP	PROCEDURE
	Note: The pilot measurement is described in Chart 2C.
16	If thermistor current is changed, observe the pilot power for several minutes to see that it remains at the adjusted value.
17	If thermistor resistance values are specified by initial lineup procedures, set the TH RES controls to those resistance values and operate the DYN EQ toggle switch corresponding to the regulator under test to the BAL position. Adjust the BAL control to read 0 on the BAL indicator, then proceed to Step 20.
18	If thermistor values are <i>not</i> specified by initial lineup procedures, operate the SEL rotary switch to the regulator under test and record the TH CUR meter reading.
19	Operate the appropriate DYN EQ toggle switch to the BAL position and adjust the DYN EQ BAL control to indicate the same thermistor current recorded in Step 18.
20	If operation is from a constant-voltage source, disconnect the regulator from its power supply. Proceed to Step 24 after the regulator is replaced.
21	If operation is from a constant-current source, connect the change load on the V TST jack on the transmission panel in which the regulator is mounted.
22	Disconnect the PWR and REG IN jacks on the regulator. Warning: <i>Extreme care should be taken to minimize mechanical shocks while handling or transporting regulator. Delicate apparatus inside.</i>
23	Disengage the catches and remove the regulator to be serviced. Replace with new regulator. After the regulator is replaced:
24	Allow sufficient time for the regulator to warm up before proceeding.
25	Connect the power test set to the TEST plug on the regulator under test.
26	Operate the power test METER switch to the PLT 1 position.
27	Connect the PWR and REG IN jacks on the regulator, and observe the PLT voltage on the power test set.
28	When the meter stabilizes at a lower value, disconnect the change load.
29	On the thermistor control set, operate the DYN EQ 1 through 5 and the REG NET toggle switches to NORM.
30	Disconnect the thermistor control set.

CHART 1 (Contd)

STEP	PROCEDURE
31	Measure and, if necessary, adjust pilots per Chart 2.

CHART 2

PILOT MEASUREMENTS

APPARATUS:

11B Attenuator

Receiving Test Equipment (RTE) capable of measuring signals between 200 and 10,000 kHz at powers from 0 to -110 dBm

P2BJ Cords, as required.

STEP	PROCEDURE
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A. Pilot Supply Measurements

When a system is in service, the pilot supply can be measured only at a PIL jack that is not patched to a TRSG HY NET jack. Since pilots are adjusted individually in the pilot combining circuit, the pilots measured at one PIL jack may vary from other pilot jacks (Fig. 1). This procedure can be performed only at a PIL jack which is unassigned or **out of service**.

Note: The following test applies to repeaters where pilot generating equipment (regular, protection, or emergency) is provided.

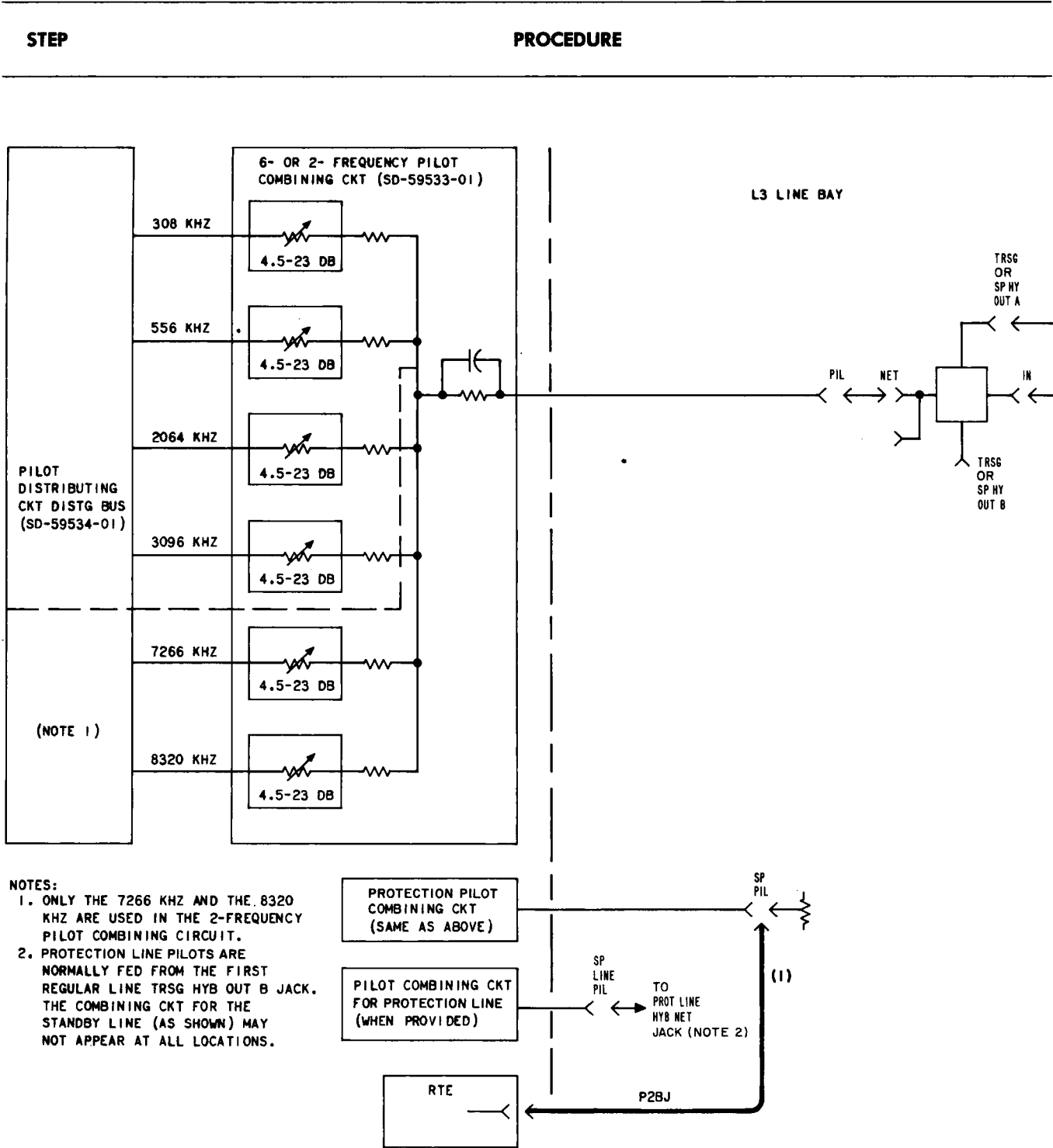
- 1 Make patch in Fig. 1.
- 2 Measure level received for each frequency given in Table A.

Requirement 1: For pilots with automatic control: Value listed in Table A ± 0.12 dB.

Requirement 2: For pilots without automatic control: Value listed in Table A ± 0.3 dB.

Note: Table B shows where automatic pilot control is provided for each pilot frequency tested.

CHART 2 (Contd)



- NOTES:
1. ONLY THE 7266 KHZ AND THE 8320 KHZ ARE USED IN THE 2-FREQUENCY PILOT COMBINING CIRCUIT.
 2. PROTECTION LINE PILOTS ARE NORMALLY FED FROM THE FIRST REGULAR LINE TRSG HYB OUT B JACK. THE COMBINING CKT FOR THE STANDBY LINE (AS SHOWN) MAY NOT APPEAR AT ALL LOCATIONS.

Fig. 1—Pilot Combining Circuit—Output Measurements

CHART 2 (Contd)

STEP

PROCEDURE

TABLE A

PILOT FREQ (kHz)	PIL JACK (dBm)	TRSG HY OUT A OR B JACK (dBm)	PIL HY OUT A JACK (dBm)	TH TEST JACK (dBm)
308	-66.80	-69.80	-36.0	-34.6
556	-66.80	-69.80	-36.0	-34.6
2064	-66.80	-69.80	-36.0	-34.6
3096	-66.80	-69.80	-36.0	-34.6
7266	-46.80	-49.80	-16.0	-14.6
8320	-56.80	-59.80	-26.0	-24.6

TABLE B

AUTOMATIC PILOT CONTROL PROVIDED		PILOT FREQ (kHz)	CONTROLLING EQUALIZER
SWITCHING MAIN AND TERMINAL MAIN REPEATERS	EQUALIZING MAIN REPEATER		
Yes	Yes	308	EQ4
Yes	No	556	EQ3
Yes	Yes	2064	EQ2
Yes	No	3096	EQ1
Yes	Yes	7266	REG NET
Yes	No	8320	EQ5

- 3 If the requirements are not met, make tests in accordance with Sections 356-079-501 and 356-179-501.

B. Transmitted Pilot Measurements

For 2-line switching only:

- 4 Remove the protection line from service in accordance with Section 359-075-500. Proceed to Step 11.

For multiline and expanded multiline switching:

- 5 *To test the first regular line,* have the receiving terminal lock the protection line normal.

CHART 2 (Contd)

STEP	PROCEDURE
6	At the transmitting terminal, apply protection pilots to the FLAT AMP T IN jack of the transmitting protection line.
7	Remove the patch plug between the TRSG HYB OUT B and SW IN jacks of the first regular line and proceed to Step 11.
8	To test all lines except the first regular line , have the craftsman at the receiving terminal check the L3 miscellaneous bay to ensure that the LPSS-1 switching system is normal (that no lines are switched or locked normal).
9	At the transmitting terminal, remove the patch plugs from the TRSG HY OUT B jack and the SW IN jack on the line to be tested.
10	If a failure occurs on the line under test, discontinue testing and replace the patches removed in Step 9. Do not resume testing until the trouble has been cleared.
11	At the TRSG HY OUT B jack, measure the power of the pilot frequencies listed in Table A. Requirement: Within ± 0.1 dB of values shown in Table A.
12	If the requirement is not met at terminal main repeaters or if the pilots are generated locally at switching main repeaters, check the pilot supply per Part A of this chart. Otherwise, replace all patch plugs removed and restore circuit to normal. C. Received Pilot Measurements Note: The following tests apply to terminal main, switching main, and equalizing main repeaters. Caution: <i>The line must be in service during the following steps.</i>
13	Connect the 11B attenuator between the receiving test equipment (RTE) and the PIL HY OUT A jack in the line under test.
14	At main stations equipped with the PEARL test and access circuit, remove the patch plug from the PEARL TRK IN and multiple SW IN jacks, and connect the attenuator between the multiple SW IN jack and the RTE.
15	Measure only the regulated pilots per Table B. Note: At an equalizing main repeater, the 308-kHz pilot is regulated and the 556-kHz pilot is not. Requirement: Value listed in Table B corrected by -30 dBm ± 0.1 dB.
16	Remove the attenuator from the circuit and proceed to Part D.

CHART 2 (Contd)

STEP	PROCEDURE
D. Terminated Measurements at PIL HY OUT A Jack	
17	Determine that the protection line is available for service. Use manual switching to switch service from the regular line to the protection line.
18	At the PIL HY OUT A jack, measure the power of the pilot frequency (Table A). Requirement: Within ± 0.02 dB of value shown in Table A.
19	If the requirement is not met, make adjustments in accordance with Section 359-076-500.
E. Pilot Indicators	
20	Check that the repeater to be tested is out of service.
21	Remove the patch plug from the PIL HY OUT A jack and connect the RTE to that jack.
22	Select the regulated pilot frequency to be measured from Table B.
23	Adjust the GAIN control associated with the measured pilot to indicate, on the pilot indicator, the value listed for the PIL HY OUT A jack in Table A.
24	If the range of the GAIN control is not sufficient for adjustment, position the GAIN control to midrange and rotate the GAIN ADJ control (on the regulator associated with the pilot indicator under test) to give a better range of adjustment for the GAIN control.
25	Adjust the zero control on the IND meter to indicate zero when the value listed for the PIL HY OUT A jack is obtained.
26	Repeat Steps 22 through 25 for all regulated pilots.
27	Restore repeater to service.

CHART 3

LINE CONNECTING EQUIPMENT**APPARATUS:**

Sending Test Equipment capable of delivering into 75-ohm circuit, signals between 200 and 10,000 kHz at powers from -10 to -40.0 dBm

Receiving Test Equipment capable of measuring signals from 200 to 10,000 kHz at powers from 0 to -110 dBm.

CHART 3 (Contd)

STEP	PROCEDURE
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A. Routine Testing

With the line-connecting equipment in service, the power is measured at the TRSG HY OUT B jack. The level shall be within ± 0.1 dB of values listed in Table A. If not, the cable equalizer test is performed.

- 1 Verify that all pilot indicating meters have been calibrated per Chart 2C.
- 2 Switch the line connecting equipment into service if service is not already provided.
- 3 For each frequency listed in Table A, measure the pilot power at TRSG HY OUT B jack.

Requirement: Within ± 0.1 dB of values shown in Table A.

- 4 Adjust the appropriate controls listed in Table C, if necessary, to meet the requirement.

TABLE C

PILOT FREQ (kHz)	TELEPHONE BLOCKING IN ALL-MESSAGE SYSTEM			
	NONE	MG1	SG112-118	SG125-128
308	Affected by 7266	308	308	Adjust after 2064 308 EQ
556	Affected by 7266	556	556	Affected by 2064
2064	Affected by 7266	2064	2064	FINE 300-2100 COARSE 300-2100
3096	Affected by 7266	3096	Affected by 7266	3096
7266	Through Telephone Attenuator	7266	7266	7266
8320	Affected by 7266	Affected by 7266	Affected by 7266	Affected by 7266

CHART 3 (Contd)

STEP	PROCEDURE
5	Adjust to within ± 0.05 dB where individual adjustment of pilot power is provided. Adjust to within ± 0.3 dB when no control is provided. Note: When no control is provided, the pilot power is affected by the control listed.
6	If the requirement of Step 3 cannot be met, perform the cable equalizer measurement per Part B or C.
B. Cable Equalizer Out-of-Service Measurements	
7	Check that the line-connecting equipment is out of service.
8	If mastergroup 1 is blocked, perform the routine emergency bypass test detailed in Chart 4A.
9	If pilots are available, measure and record the power in accordance with Chart 2D. Proceed to Step 12.
10	If pilots are not available, supply pilots at the frequency and the power listed for the PIL HY OUT A jack in Table A.
11	Patch the sending test equipment to the REC BR HY IN jack.
12	Remove the patches from the REC BR HY OUT B and the TRSG BR HY IN A jacks. Terminate these jacks with 75-ohm plugs.
13	Remove the patch from the TRSG HY IN jack and connect the RTE to that jack. Measure the power of each frequency listed in Table A.

Requirement: Same as the power listed for the PIL jack in Table A, corrected by the deviation recorded in Step 9.

Note: The allowable requirement deviation after correction is listed in Table D.

TABLE D

CABLE EQUALIZING TESTS	TEST FREQUENCY (kHz)		REQUIREMENT
MG1 Blocked	*	7266	
SG112-118 Blocked	3096	7266	± 0.11 dB
SG125-128 Blocked	556	2064	± 0.07 dB
None Blocked	308	7266	± 0.17 dB

* Perform cable equalizing tests described in chart 3B and C.

CHART 3 (Contd)

STEP	PROCEDURE
14	If the loss measured at the higher frequency is greater than the loss at the lower frequency by more than the amount specified in Table D, replace the actual cable equalizer by a longer cable equalizer.
C. Cable Equalizer In-Service Measurements	
15	Read the PIL IND meters associated with the line under test. If the meters indicate tolerance of ± 0.05 dB, proceed to Step 17.
16	If the PIL IND meters are not within tolerance, calibrate per Chart 2E.
17	Measure the power at the TRSG HY OUT B jack for the pilot frequencies listed in Table D.
Note: Table A lists the nominal power at the TRSG HY OUT B jack.	
Requirement: Within ± 0.2 dB of the nominal powers.	
18	If the requirement is not met, repeat the procedures for cable equalizer out-of-service measurement.

CHART 4

EMERGENCY BYPASS**APPARATUS:**

Receiving Test Equipment capable of measuring signals from 200 to 10,000 kHz at powers from 0 to -110 dBm.

STEP	PROCEDURE
A. Routine Emergency Bypass Test	
1	Determine that the line-connecting equipment to be tested is locked out of service.
2	At the PIL HY OUT A jack, measure the 308- and 7266-kHz pilot powers.
3	Remove the patch plugs from:
(a) The REC BR HY OUT A TRK and REC BLKG HY IN jacks.	

CHART 4 (Contd)

STEP	PROCEDURE
	(b) The TRSG BLKG HY OUT A and CA EQ IN jacks.
4	Remove the patch from the TRSG BR HY IN A and the REC BR HY OUT B jacks. Terminate those jacks with 75-ohm plugs.
5	Make patches from the REC BLKG HY OUT A TRK jack and the BE FLT IN jack of the bypass circuit and the BLKG PASS PAD jack to the CA EQ IN jack.
6	At the TRSG HY OUT A jack, measure the pilot power at 3096 kHz.
7	Adjust the BLKG PASS ATT control to as near -70.0 dBm as possible.
8	Measure the pilot power at the pilot frequencies listed in Table B and compare with the power listed for the TRSG HY OUT A jack.
	Requirement: ± 0.07 dB corrected by the deviation in Step 7.
9	If the power measured at a higher frequency is lower than the power measured at a lower frequency by more than the specified amount, replace the actual cable equalizer by a shorter cable equalizer.
B. Emergency Bypass Test	
	Note: Any or all of the pilot frequencies may indicate trouble. For this test, it is assumed that the regulated 3096-kHz pilot frequency is troubled.
10	If any one pilot frequency other than the regulator is troubled, perform Steps 11 through 26 using the troubled pilot frequency. Perform Step 27 after the trouble has been bypassed.
11	At the PIL HY OUT B jack, measure the 3096-kHz pilot power.
12	At the TRSG HY OUT B jack, measure the power of the pilot under test.
	Requirement: As shown in Table A.
13	If the requirement is not met, perform the following steps.
14	Remove the input patch to the TRSG BR HY OUT A jack (local service discontinued). Terminate the jack with a 75-ohm plug.
15	Set the emergency THRU TEL ATT control in accordance with recorded station requirements.
16	Make a patch from the parallel REC BR HY OUT A TRK jack to the BLKG FLT IN jack of the bypass circuit and from the BLKG PASS PAD OUT jack to the parallel CA EQ IN jack.

CHART 4 (Contd)

STEP	PROCEDURE
17	Remove the patch from the REC BR HY OUT A TRK jack to the REC BLK HY IN jack and from the TRSG BLKG HY OUT A jack to the CA EQ IN jack.
18	At the TRSG HY OUT B jack, measure the power of the pilot under test.
19	If the power is the same as listed in Table A, proceed to Step 27. Otherwise, proceed to Step 20.
20	Replace the patch from the parallel REC BR HY OUT A TRK jack to the REC BLKG HY IN jack and from the TRSG BLKG HY OUT A jack to the CA EQ IN jack.
21	Remove the parallel patch from the REC BR HY OUT A TRK jack to the BLK FLT IN jack and remove the patch from the BLKG PASS PAD OUT jack to the parallel CA EQ IN jack.
22	Discontinue the dropped telephone service by removing the REC BR HY OUT B plug. Terminate the jack with a 75-ohm plug.
23	Set the THRU TEL ATT control for the long path loss in accordance with station requirements.
24	Patch the parallel SW OUT jack to the BR PAD IN jack and the BR PASS PAD OUT jack to the BLKG FLT IN TRK jack (L301 and L302 transmitting bay).
25	Patch the BR PASS PAD OUT TRK jack to the BLKG FLT IN jack and the BLKG PASS PAD OUT jack to the parallel TRSG HY IN jack.
26	Remove the parallel patches from the TRSG HY IN jack and from the SW IN to the REC BR HY IN jacks.
27	At the TRSG HY OUT B jack, measure the 3096 kHz pilot power.
	Requirement: -69.8 dBm $\pm$ 0.1 dB.
28	Adjust the THRU TEL ATT control, if necessary, to meet the requirement.

CHART 5

PILOT ALARMS

STEP	PROCEDURE
A. Local Location	
Note: Pilot alarm units are provided only at type A auxiliary repeaters (those which are regulated by the 7266-kHz pilot).	
1	At the distant office, check that the BRDG key on [J687695 ()] alarm control panel is in the OFF position to prevent application of the bridge battery to the alarm pair.
2	When the pilot alarm pair measured is equipped with alarm features at its distant end and is not arranged for remote control, request that the distant office operate the ACO and LINE key associated with the line in alarm to remove alarm battery from the pair.
3	If the location circuit is arranged for remote B1 control by another office, operate the TST CLR key to check that all relays are released.
Requirement: CLR lamp lights.	
4	If the CLR lamp does not light, operate the CLR key.
5	Set the LINE RES dials and key to the maximum resistance positions and the BAT control to the extreme counterclockwise position.
6	Operate the LINE key, identified by office name and coaxial numbers, to connect the alarm pair to the [J687695 ()] alarm location panel.
Caution: The reading at the L point should not be exceeded. Otherwise the failure of an amplifier at an auxiliary repeater can activate the pilot alarm units at each successive A type auxiliary repeater in the direction of transmission that was affected by the failure.	
7	Operate the BRDG key to the MEAS position and rotate the BAT control slowly in the clockwise direction to obtain a reading at the L point on the LINE METER.
8	Balance the bridge in the alarm location panel by holding depressed the SHUNT 1 button while operating the LINE RESISTANCE (LINE RES) key and switches until the GALVANOMETER (GALV) meter indicates as close to zero as possible.
Caution: Current in excess of that indicated at the H point may reset relays at succeeding alarmed repeaters.	
9	With the bridge balanced, slowly rotate the BAT control clockwise to obtain a reading at the (RED) H point on the LINE meter.
10	Rebalance the bridge.

 CHART 5 (Contd)

STEP

PROCEDURE

Requirement: Either no resistance change or a decrease of 100 ohms.

- 11 Operate the BAT CONTROL to indicate L on the line meter and then operate the BRDG key to the OFF position.
- 12 If this is the last measurement in a series, clear the LPA and operate the BAT control to the extreme counterclockwise position.
- 13 Record the final measured resistance value.
- 14 Restore the operated line and ACO key to the normal position.
- 15 If the location circuit is arranged for remote control via the B alarm system, operate the CLR key.

Note 1: If the ALM lamp remains lighted, it indicates that the alarm so located did not clear or that there is an alarm from an auxiliary repeater beyond the point where the measurement was made.

Note 2: If the resistance measured at H point is lower than the resistance measured at L current by nearly 100 ohms, the alarm is activated in the even direction of transmission. If the resistance is approximately the same, the alarm is in the odd direction of transmission.

- 16 To locate other alarms, make measurements from the main repeater at the transmitting end of the coaxial operating in the direction of transmission causing the alarm.

Note: When two measurements indicate the same result, a permanent alarm exists.

- 17 Make measurements from the other end of the alarm pair until a permanent alarm is encountered.
- 18 To determine from measured resistances which repeater caused an alarm, refer to the table of resistance value versus repeater location which is posted in the alarm location bay.
- 19 Using the column for cable temperature that is closest to the known cable temperature, determine from the high-current resistance (H point reading) measurement which repeater caused the alarm.

B. Remote Location

Note 1: This procedure is for use at an office equipped with the sending director and the indication receiving portions of the B1 Alarm and Control System, which are installed only at control offices.

Note 2: This procedure is to locate alarms from the far end as well as alarms originating in sections of pilot alarm pair isolated from the control office.

CHART 5 (Contd)

STEP	PROCEDURE
20	When dialing is specified, dial the code for the office at which the action is to take place.
21	Dial the "Start Indicator" code to determine the situation at each main repeater adjacent to the one from which the alarm was received.
22	Check to see if a line switch took place at either end of the switching section.
23	Make the first location measurements from the transmitting end.
24	Examine the record of lighted lamps to determine the nature of the alarm.
25	If the PA LOC CLR lamp is not lighted, dial the "Clear Pilot Alarm Location Circuit" code.
26	Dial the code for Short Pilot Alarm Extension Pair.
27	Operate the LINE key to connect the line circuit to the extension pair and operate the BRDG key to the MEAS position.
28	Operate the LINE RES controls as required to obtain close to 0 reading of the GALV meter. Depress the SHUNT 1, then test SHUNT 2 button. Note: The bridge is balanced.
29	Adjust the BAT control to obtain a reading at the (red) H point on the LINE meter.
30	Measure and record the resistance at the H point.
31	Operate the BAT switch to obtain a reading at the L point on the LINE CURRENT meter and operate the BRDG key to the OFF position.
32	Dial the "Cut Pilot ALARM through to Pilot ALARM Extension Pair" code assigned to the alarm pair to be measured.
33	Operate the BRDG key to the MEAS position.
34	Slowly operate the BAT control in the clockwise direction to increase the current reading on the LINE meter to the (red) H point.