
**L4 CARRIER
REPEATERS
TESTS
REGULATING REPEATER J68877AB**

This section contains procedures for performance and preinstallation tests of regulating repeater J68877AB (SD-50669). Performance tests are to ensure that repeaters received from the manufacturer operate correctly and to check that repeaters suspected of being faulty are actually defective. Preinstallation tests are to prepare a repeater for a specific location in the L4 system.

This section is reissued to correct the following:

- (a) The attenuator setting in Charts 1 and 2 to reflect 0.1 dB steps.
- (b) The BSP reference for operation of the L4 line repeater test stand.
- (c) Minor errors in Fig. 6.

In-service adjustments for the regulating repeater are in Section 359-205-502.

Note: Procedures for the J68899A test set (Section 103-457-000) which is manufacture discontinued were provided in Issue 3 of this section. Consequently, those L4 main stations using the J68899A test set should retain Issue 3 of this section for reference.

Arrows are used to indicate changes. Equipment Test Lists are not affected.

A regulating repeater (Fig. 1, Fig. 6, and Fig. 7) provides:

- (a) **Gain** to compensate for the loss of 2 miles of coaxial line.
- (b) **Fixed deviation equalization** to compensate for predictable gain deviations resulting from a number of basic repeaters in tandem.
- (c) **LBO** (line building-out) **connections** for LBO networks to build out short lengths of coaxial line to the nominal 2-mile spacing between line repeaters.
- (d) **Regulation** to correct for line loss variations caused by changes in cable temperature. Regulation is divided into two parts: **post-regulation** controlled by the received 11.648-MHz pilot and **preregulation** controlled by ground temperature via a buried thermistor.

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

Regulating repeaters are provided in four list numbers, as follows:

- List 5:** post-regulator goes to maximum gain when the 11.648-MHz pilot is lost.
- List 6:** post-regulator goes to minimum gain when the 11.648-MHz pilot is lost.
- List 7:** post-regulator, upon loss of the 11.648-MHz pilot, is controlled by the buried thermistor.
- List 8:** post-regulator control is similar to that of List 7. This repeater also has improved gain shape and regulating range.

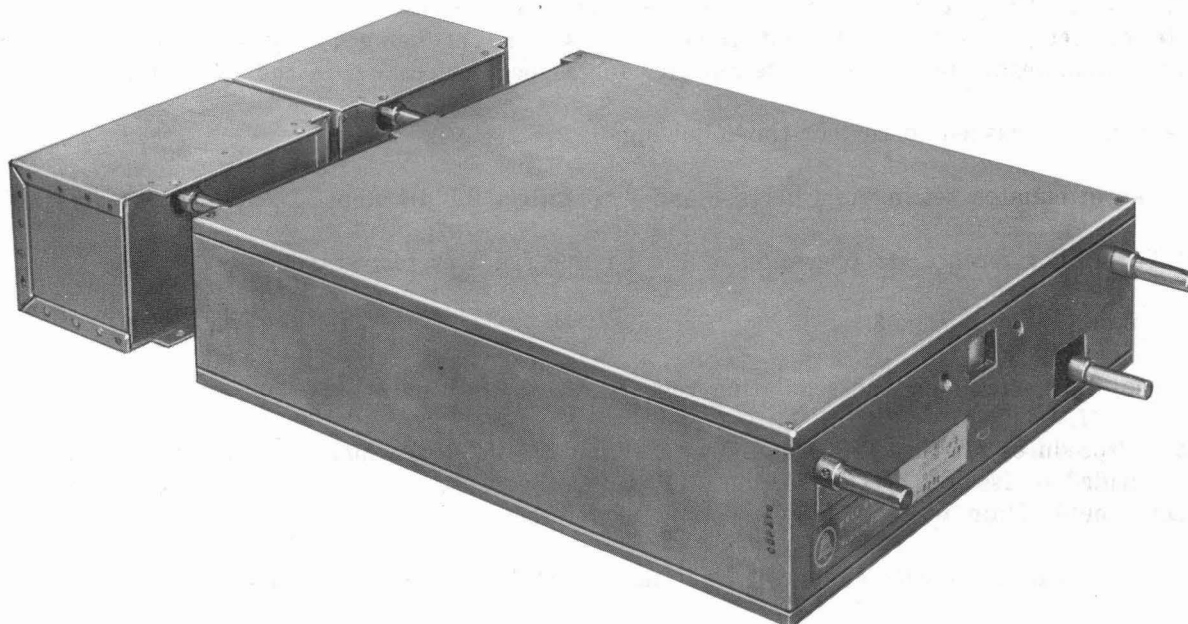


Fig. 1—Regulating Repeater J68877AB

There are no List 1 through List 4 repeaters installed in L4 lines. List 5 and List 6 repeaters are converted to List 7 when returned to a maintenance center for repair.

Performance tests in Chart 1 include:

- (a) **Gain** measurements at five frequencies in the L4 band.
- (b) **Preregulator** adjustment for nominal gain, if necessary.
- (c) **Post-regulation** checked by varying the power of the 11.648-MHz pilot and by observing the effect on repeater gain.
- (d) **Preregulation** checked by simulating ground temperature changes and by observing the effects on repeater gain.

- (e) **Post-regulation control transfer** checked by removing the 11.648-MHz pilot and by observing the effects on repeater gain.
- (f) **Noise** measurement at 17.5 MHz.
- (g) **Test for 20-kHz harmonic signals** to ensure that the 20-kHz oscillator does not produce harmonics when the preregulator is sensing a high cable temperature.

Preinstallation tests in Chart 2 include:

- (a) Installation of required LBO networks.
- (b) Adjustment of preregulator gain for the location in which the repeater is to be installed.
- (c) Test of pilot-off gain.

Note: Remove deviation equalizer and LBO networks from repeaters to be returned for repair.

SPECIAL CONSIDERATIONS

Warm-Up

Test results will not be conclusive unless the repeater has been preheated for at least 4 hours.

A preheating rack (ED-50887-30) is available for supplying the repeater with 520-mA constant current for warm-up (Section 359-205-500). After being heated, the repeater should not be downpowered for more than 3 minutes, then it should be heated for at least 5 minutes in the test stand.

R1 Access Protection Arrangements

Various arrangements for R1 access protection exist; these are:

- (a) Early List 5 and List 6 repeaters have several factory-adjustment access holes and an R1 field-adjustment access hole in the repeater covers. A nylon setscrew is provided in a phenolic block to protect the R1 control.
- (b) Some List 7 and List 8 repeaters have the nylon setscrew omitted, and a snap-in dust cap is used to seal the R1 access hole in the repeater cover.
- (c) Newer List 8 repeaters have only the R1 access hole in the repeater covers. A nylon binding-head screw is used in the phenolic block to protect the R1 control, and an adhesive-backed metal plate is used to seal the R1 access hole in the receiver cover.
- (d) Newer List 7 repeaters, converted from List 5 or List 6, have all factory-adjustment holes permanently sealed. A nylon binding-head setscrew is used to plug the R1 access hole in the phenolic block, and an adhesive-backed metal plate is used to seal the R1 access hole in the repeater cover.

When preparing a repeater for test, **see warning below** before removing the nylon setscrew or binding-head screw from the R1 access hole. After completion of test, reinstall the nylon screw in the phenolic block and reseal the R1 access hole in the repeater cover with the snap-in dust cap or adhesive-backed metal plate, if provided.

Warning: Determine if there is a nylon setscrew in the R1 access hole before attempting to remove the screw. Attempting to remove the screw when none is present will result in damage to the R1 control. When reinstalling the nylon setscrew, make sure that it is not turned in far enough to disturb the R1 adjustment.

If test requirements are *not* met, local procedures should be followed to return the unit to the factory or maintenance center for repair.

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CHART 1

PERFORMANCE TESTS

Operation of L4 line repeater test set J68906B or J68906C should be verified as prescribed in Section 103-458-100 before proceeding with these tests. The test set is shown in Fig. 2; test arrangements

CHART 1 (Contd)

are shown in Fig. 3. For transmission measurements, sending and receiving test equipment normally provided at the L4 main station is used.

APPARATUS:

L4 Line Repeater Test Set J68906B or J68906C (Section 103-458-100)¶

Precision Attenuator, adjustable from 0.0 to 50.0 dB in 0.1-dB steps

4100A LBO Network (two required)

4152A Deviation Equalizer (test standard used with List 5, 6, and 7 repeaters)

4152B Deviation Equalizer (test standard used with List 8 repeater)

Note: Mark the LBO and deviation equalizer networks as *test* units and retain at the test set for use in all regulating repeater tests.

STEP**PROCEDURE**

Note 1: In these tests, after performing certain operations, it is necessary to allow the repeater to stabilize before making a measurement. The repeater can be considered stable when the RTE indication changes no more than 0.1 dB in one minute.

Note 2: When making gain measurements, the attenuator should be adjusted so that the receiving test equipment expanded scale indication is in the +dB range. This will aid in computing gain values.

Caution 1: *The preregulator section of the repeater should not be adjusted until the repeater has fully warmed up. Adjustment of a cold repeater will result in misalignment.*

Caution 2: *Dirt or foreign matter inside the repeater case could cause severe damage because of the high operating voltages present when the repeater is operating in the L4 line. Extreme care should be taken to prevent any foreign matter from entering the opened repeater case.*

A. Preparation for Tests

- 1 Place the repeater so the two coaxial plugs are near your left hand and remove the cover which is on top.

Note: Refer to Fig. 6 for helpful information in performing Steps 2 through 7.

- 2 Remove the regular deviation equalizer, if one is installed, and retain for reinstallation.

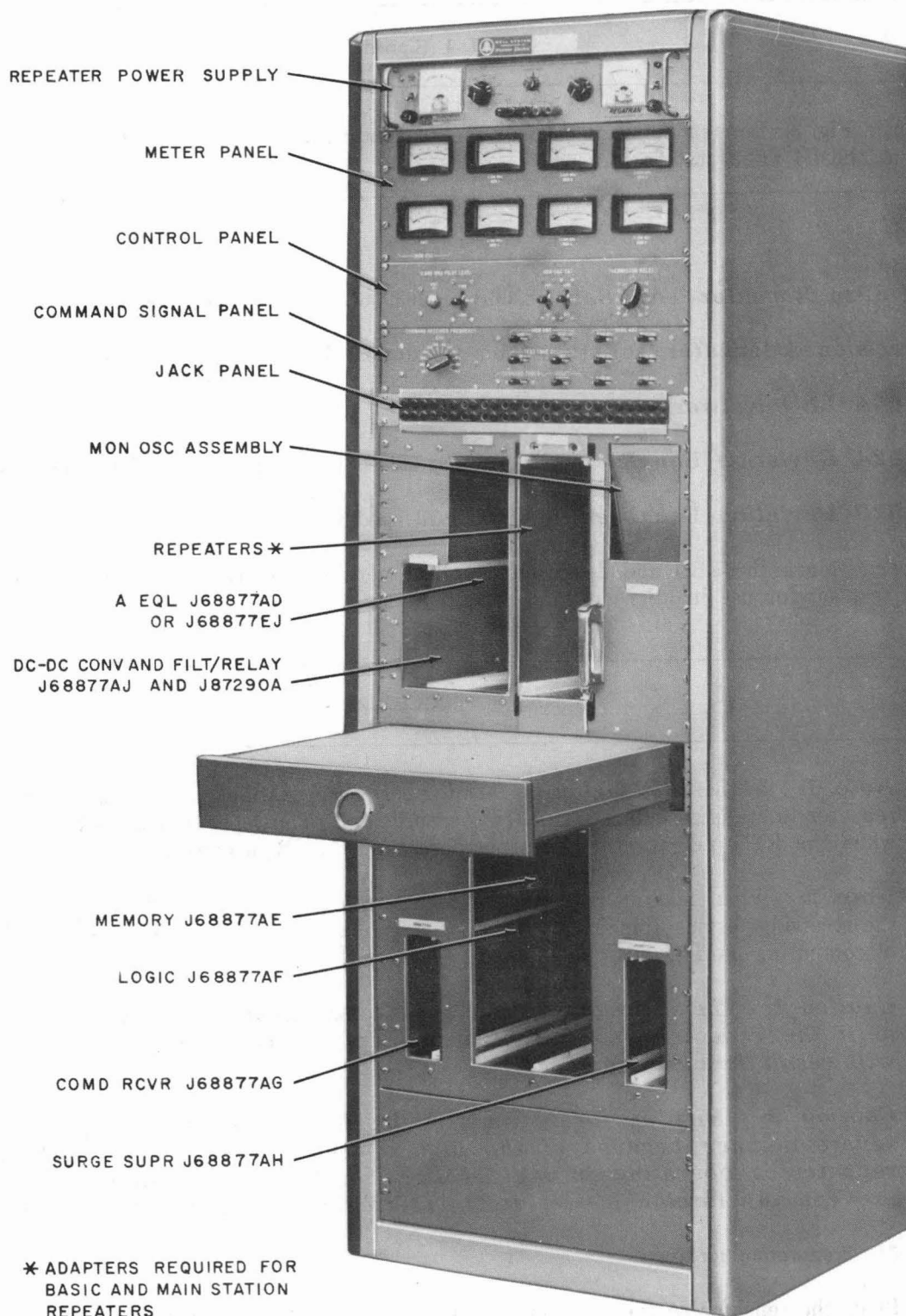


Fig. 2—L4 Line Repeater Test Set J68906B

CHART 1 (Contd)

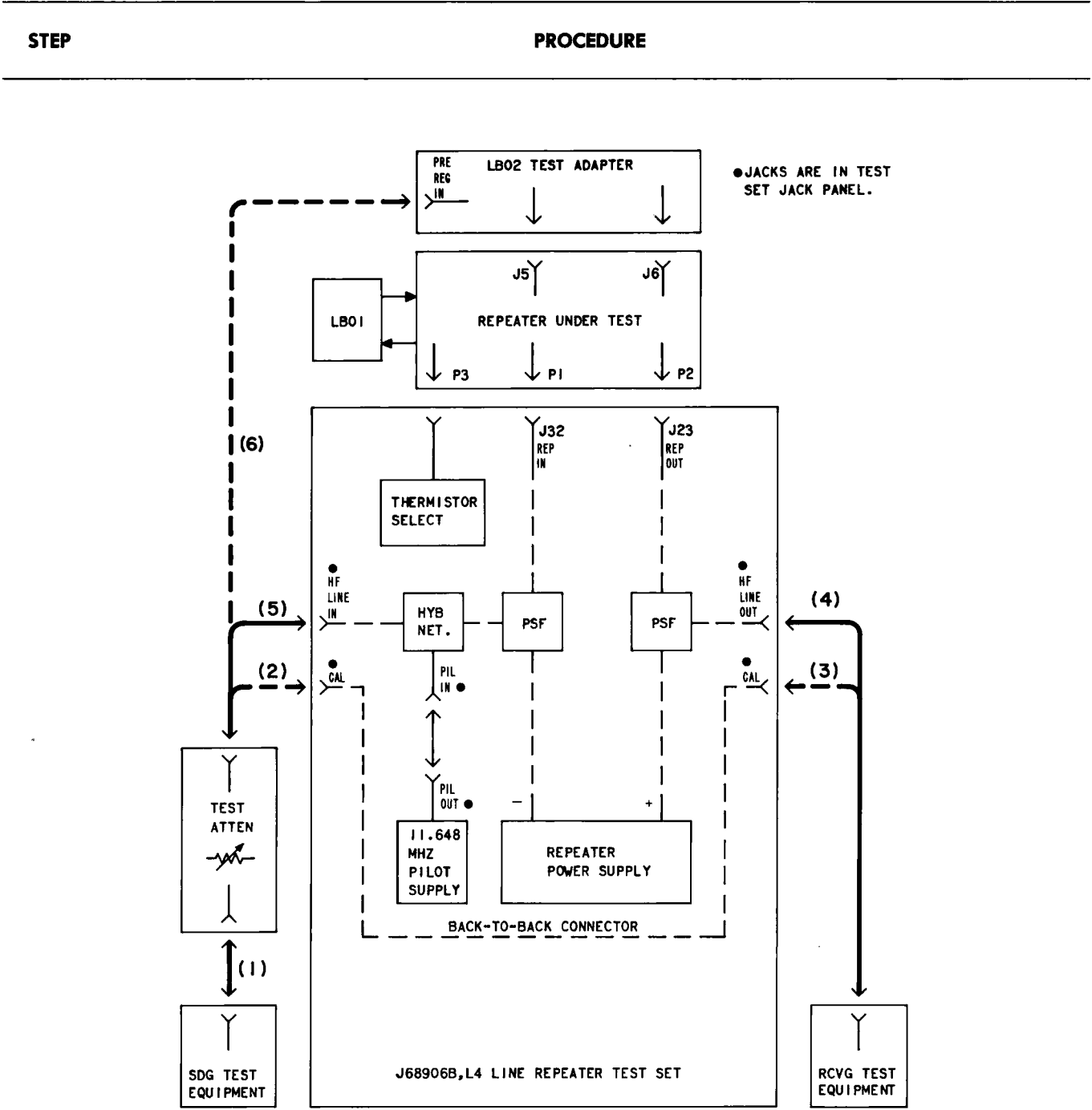


Fig. 3—Test Arrangements Using L4 Line Repeater Test Set

CHART 1 (Contd)

STEP	PROCEDURE
3	Install a deviation equalizer network as follows: (a) For a List 5, 6, or 7 repeater, use a 4152A network. (b) For a List 8 repeater, use a 4152B network.
4	Check the 859C network to ensure that all the screw switches are open (turned out).
5	Remove, and retain for reinstallation, the nylon screw which is used to plug the R1 adjustment access hole. (See SPECIAL CONSIDERATIONS .)
6	Replace the repeater cover.
7	Install 4100A LBO networks in LBO1 and LBO2 positions.
8	Set switches and controls on the test set as shown in Table A.
9	Insert a patch plug between the PILOT OUT and PILOT IN jacks on the test set jack panel.
10	Insert the repeater under test in the test set mounting position marked J68877AB or AC.

TABLE A

TEST SET SWITCH AND CONTROL SETTINGS

LOCATION	CONTROL	SETTING
Rear of test set	Power switch	ON
Repeater power supply	MAIN voltage control	0
	VERNIER voltage control	0
	CURRENT AMPS control	0
	DC switch	OFF
	LINE switch	ON
Control panel	11.648 MHz PILOT LEVEL	NORM
	THERMISTOR SELECT	55° F
Command signal panel	COMMAND TONES key	OFF

CHART 1 (Contd)

STEP	PROCEDURE
11	Apply power to the repeater as follows: (a) Operate the DC switch, on the repeater power supply, to ON. Requirement: Power indicator lamp lights. (b) Turn the MAIN voltage control to approximately 80 volts. (c) Adjust the CURRENT AMPS control to obtain a current indication of 0.52 ampere on the DC AMPERES meter. Requirement: The DC VOLTS meter indicates between 64 and 72 volts. Note: The repeater power supply is providing 520-mA constant current to the repeater.
	B. Gain Test
	Note: The preregulator is adjusted at the factory for nominal gain. Preregulator adjustment should not be necessary on repeaters received from the manufacturer. If a repeater has been previously adjusted for installation at a particular location, perform the preregulator adjustment in Part C before this gain test.
12	Obtain, from test set calibration records, the test set loss at each of the frequencies listed in Fig. 4. Record test set loss values in column D of Fig. 4.
13	Patch the STE (sending test equipment) through the attenuator to the CAL jack associated with the HF LINE IN jack [patches (1) and (2), Fig. 3].
14	Set the attenuator for 0.00-dB loss.
15	Adjust the RTE (receiving test equipment) to measure 20.448 MHz at -20 dBm.
16	Patch the RTE to the CAL jack associated with the HF LINE OUT jack [patch (3), Fig. 3].
17	Adjust the STE to deliver 20.448 MHz so as to obtain exactly -20.00 dBm on the RTE.
18	Set the test attenuator to provide a loss approximately equal to the repeater maximum gain shown in column C of Fig. 4.
19	Transfer the RTE to the HF LINE OUT jack [patch (4), Fig. 3] and transfer the attenuator output to the HF LINE IN jack [patch (5), Fig. 3].
20	Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.
21	Record the attenuator setting and the RTE expanded scale indication in columns E and F of Fig. 4.

REGULATING REPEATER J68877AB

DATE OF TEST _____		BY _____		REPEATER SERIAL NO. _____		
A	B	C	D	E	F	G
TEST FREQ (MHZ)	REQUIRED GAIN (DB)		TEST SET LOSS (DB)	FINAL ATTEN SETTING (DB)	RTE EXPANDED SCALE (DB)	REPEATER GAIN (D+E+F)
	MIN	MAX				
<i>List 5, List 6, or List 7 Repeater</i>						
20.448	34.95	36.95				
17.500	33.25	34.45				
12.000	27.18	27.78				
4.000	15.96	16.76				
0.512	5.70	6.50				
<i>List 8 Repeater</i>						
20.448	33.26	35.26				
17.500	32.40	33.60				
12.000	27.13	27.73				
4.000	16.26	17.06				
0.512	5.53	6.33				
Post-regulation _____ Preregulation _____ Pilot-off regulation _____ Noise _____ Remarks _____						

Fig. 4—Performance Test Record

22 Compute the repeater gain as in the following example:

CHART 1 (Contd)

STEP	PROCEDURE
	Value in column D: 4.05 ♦Plus value in column E: 32.80♦ Plus value in column F: <u>0.02</u> ♦Repeater gain: 36.87♦
	Requirement: Within minimum and maximum values in columns B and C of Fig. 4.
23	Record the repeater gain in column G of Fig. 4.
24	Repeat Steps 13 through 23 for each of the remaining frequencies listed in Fig. 4.
25	Proceed to Step 43 if the requirements of Steps 22 and 24 are met. Otherwise, the preregulator may be out of adjustment; proceed to Part C to adjust the preregulator.
	C. Preregulator Adjustment
	Note: The preregulator is adjusted at the factory for nominal gain. Preregulator adjustment should not be necessary on repeaters received from the manufacturer. If a repeater has been previously adjusted for installation at a particular location, perform the preregulator adjustment in this part before the gain test in Part B.
26	Insert a patch plug between PILOT OUT and PILOT IN jacks on the test set jack panel.
27	Remove the LBO network from LBO2 position.
28	Install the LBO2 test adapter (ED-51002-30) in LBO2 position on the repeater.
29	Patch the STE through the attenuator to the CAL jack associated with the HF LINE IN jack [patches (1) and (2), Fig. 3].
30	Set the attenuator to equal the loss of the LBO2 test adapter (ED-51002-30).
	Note: This loss is approximately 10 dB. The exact loss is stamped on the LBO2 test adapter.
31	Set the RTE to measure 11.648 MHz at -20.00 dBm.
32	Patch the RTE to the CAL jack associated with the HF LINE OUT jack [patch (3), Fig. 3].
33	Adjust the STE to deliver 11.648 MHz so as to obtain exactly -20.00 dBm on the RTE.
34	Patch the RTE to the HF LINE OUT jack [patch (4), Fig. 3].
35	Set the attenuator for ♦8.6-dB♦ loss.
36	Transfer the patch from the CAL jack associated with HF LINE IN jack to the PRE REG IN jack on the LBO2 test adapter [patch (6), Fig. 3].

CHART 1 (Contd)

STEP	PROCEDURE
37	Observe the RTE (use expanded scale meter). Requirement: -20.00 dBm $\pm$ 0.1 dB.
38	Proceed to Step 39 if the requirement is met. Otherwise, adjust control R1 on the 859C network to obtain an indication of -20.00 dBm. Note: The R1 control is accessible through a hole located near the front of the repeater case.
39	Allow a minimum of 3 minutes for repeater gain to stabilize and readjust R1, if required. Requirement: -20.00 dBm.
40	Remove the LBO2 test adapter.
41	Install a 4100A LBO network in LBO2 position.
42	Repeat the gain test in Part B.
D. Post-Regulator Range Check	
43	Measure the repeater gain at 12 MHz using a procedure as in Steps 13 through 22.
44	Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication obtained in Step 43.
45	Set the 11.648 MHz PILOT LEVEL key, on test set control panel, to the +3DB position.
46	Observe the RTE. Requirement: RTE indicates a decreasing level. Note: This indication verifies that the preregulator responds correctly to an increase in pilot level. Responses to a decrease in pilot level are checked in Steps 51 and 52. To check the full regulating range, perform the steps in order.
47	Allow a minimum of 2 minutes for the repeater gain to stabilize.
48	Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.
49	Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.

CHART 1 (Contd)

STEP**PROCEDURE**

50 Compute the decrease in repeater gain as in the following example:

Value recorded in Step 44: 23.55 dB

Minus value recorded in Step 49: 20.72 dB

Decrease in repeater gain: 2.83 dB

Requirement: Between 2.65 and 3.00 dB.

51 Set the 11.648 MHz PILOT LEVEL key to the -3DB position.

52 Observe the RTE.

Requirement: RTE indicates an increasing level.

Note: To check the full regulating range, proceed with the following steps in the order listed; otherwise, proceed to Step 57.

53 Allow a minimum of 2 minutes for the repeater gain to stabilize.

54 Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.

55 Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.

56 Compute the increase in repeater gain as in the following example:

Value recorded in Step 55: 26.47 dB

Minus value recorded in Step 44: 23.55 dB

Increase in repeater gain: 2.92 dB

Requirement: Between 2.65 and 3.00 dB.

57 Set the 11.648 MHz PILOT LEVEL key to the NORM position.

58 Allow a minimum of 2 minutes for the repeater gain to stabilize.

59 Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.

60 Record the algebraic sum of the attenuator setting and the expanded scale meter indication.

Requirement: Within ± 0.2 dB of the value recorded in Step 44.

CHART 1 (Contd)

STEP

PROCEDURE

E. Preregulator Range Check

61 Set the THERMISTOR SELECT switch, on test set control panel, to 75°F.

62 Observe the RTE.

Requirement: RTE indicates an increasing level.

Note: To check the full regulating range, allow a minimum of 2 minutes for the repeater gain to stabilize.

63 Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.

64 Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.

65 Set the THERMISTOR SELECT switch to 35°F.

66 Observe the RTE.

Requirement: RTE indicates a decreasing level.

67 Allow a minimum of 2 minutes for the repeater gain to stabilize.

68 Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.

69 Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.

70 Compute the preregulator range as in the following example:

Value recorded in Step 64: 26.47 dB

Minus value recorded in Step 69: 22.03 dB

Preregulator range: 4.44 dB

Requirement: Between 3.90 and 4.90 dB.

F. Pilot-Off Regulating Test

71 Set the THERMISTOR SELECT switch to 55°F.

72 Allow a minimum of 2 minutes for the repeater gain to stabilize.

73 Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.

CHART 1 (Contd)

STEP	PROCEDURE
74	Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.
75	Compute the repeater gain as in the following example: Value recorded in Step 74: 23.50 dB Plus test set loss from Fig. 4: 4.08 dB Repeater gain: 27.58 dB Requirement: List 5, 6, or 7: between 27.18 and 27.78 dB. List 8: between 27.13 and 27.73 dB.
76	Remove the patch plug between the PILOT OUT and PILOT IN jacks.
77	Allow a minimum of 2 minutes for the regulating action to stabilize.
78	Repeat Steps 73 through 75. Requirement: List 5: between 29.00 and 31.50 dB. List 6: between 21.50 and 24.00 dB. List 7: between 26.81 and 28.21 dB. List 8: between 26.73 and 28.13 dB.
79	Insert the patch plug between the PILOT OUT and PILOT IN jacks.
80	Allow a minimum of 2 minutes for the regulating action to stabilize.
81	Repeat Steps 73 through 75. Requirement: List 5, 6, or 7: between 27.18 and 27.78 dB. List 8: between 27.13 and 27.73 dB.
G. Noise Measurement	
82	Remove the STE from the HF LINE IN jack.
83	Terminate the repeater input in 75 ohms by placing a 368A plug in the HF LINE IN jack.

CHART 1 (Contd)

STEP	PROCEDURE
84	Adjust the RTE and measure the noise at 17.5 MHz using the 3500-Hz bandwidth of the RTE.
	Requirement: Less than -94 dBm (-95 dBm is less).
	H. 20-kHz Harmonic Signals Check
85	Set the THERMISTOR SELECT switch to 75°F.
86	Allow a minimum of 5 minutes for the repeater gain to stabilize.
87	Prepare the RTE to measure signals at -80 dBm.
88	Tune the RTE slowly from 280 kHz to 500 kHz while monitoring the power indication.
	Requirement: No 20-kHz harmonic signal higher than -75.0 dBm (-74 dBm is higher).
	Note: Line switching signals and command carrier signals (used in L4 systems with a remote control system) are in the band from 280 to 500 kHz.
89	Reset the THERMISTOR SELECT switch to 55°F.
90	Turn the MAIN VOLTAGE control, on the repeater power supply, to 0 and set the DC switch to OFF.
	I. Restore Repeater to Normal
91	Remove the repeater from the test set.
92	Remove the LBO networks.
93	Proceed to Chart 2 if the repeater is to be prepared for installation at a particular location. Otherwise, proceed to Step 94.
94	Remove the repeater cover.
95	Remove the test standard deviation equalizer.
96	Install the regular deviation equalizer removed in Step 2.
97	Reinstall the nylon screw in the R1 access hole and seal the R1 access hole in the repeater cover with the snap-in dust cap or adhesive-backed metal plate, if provided.
98	Replace the repeater cover.
99	Store the repeater in accordance with local procedures.

CHART 2
PREINSTALLATION TESTS

As a prerequisite to preparing a repeater for installation at a specific location in the L4 system, the repeater must have met the requirements of the tests in Chart 1 of this section.

Preparation for installation is as follows:

- (a) Installing proper deviation equalizer
 - (b) Adjusting the preregulator according to the mean cable temperature and length of the regulating section for which the repeater is being prepared
 - (c) Measuring repeater gain at 12 MHz.
-

STEP**PROCEDURE**

Caution: *Do not adjust the preregulator until the repeater has fully warmed up. Adjustment of a cold repeater will result in misalignment.*

Warning: *Dirt or foreign matter inside the repeater case could cause severe damage because of the high operating voltages present when the repeater is operating in the L4 line. Exercise extreme care to prevent any foreign matter from entering the opened repeater case.*

A. Preparation for Tests

- 1 Place the repeater so the two coaxial plugs are near your left hand and remove the cover which is on top.
- 2 Install the proper deviation equalizer according to the repeater list number and the location for which the repeater is being prepared.

Note: Refer to office records for correct deviation equalizer and refer to Fig. 6 for deviation equalizer connections.
- 3 Obtain the following from office records:
 - (a) Mean annual ground temperature for the repeater location
 - (b) Distance in cable miles to the next regulating repeater.
- 4 Refer to Table B to determine which 859C screw switch should be closed, according to the information obtained in Step 3.
- 5 Close the proper screw switch by turning fully clockwise and check that the other five screw switches are open, that is; turned fully counterclockwise.

CHART 2 (Contd)

STEP

PROCEDURE

TABLE B

859C NETWORK SCREW SWITCH SETTINGS

REGULATING SECTION LENGTH IN MILES*	SCREW SWITCH CLOSED‡	
	45° F TO 62° F	63° F TO 70° F
8	B3	A1
10	B2	A3
12	A2	A2
14†	B1	B1
16†	None	None

* Miles to succeeding regulating repeater

† Used only in original Washington-to-Miami L4 system.

‡ Obtain mean annual ground temperature from office records.

- 6 Remove, and retain for reinstallation, the nylon screw which is used to plug the R1 adjustment access hole. (See **SPECIAL CONSIDERATIONS.**)
- 7 Replace the repeater cover.
- 8 Install a 4100A LBO network in LBO1 position.
- 9 Install an LBO2 test adapter in LBO2 position.
- 10 Set switches and controls as shown in Table A.
- 11 Insert a patch plug between the PILOT OUT and PILOT IN jacks.
- 12 Set the THERMISTOR SELECT switch to the mean ground temperature of the location in which the repeater is to be installed.

Note: Refer to office records for mean ground temperature.

CHART 2 (Contd)

STEP	PROCEDURE
13	Insert the repeater in the test set mounting position marked J68877AB or AC.
14	Apply power to the repeater as follows: (a) Operate the DC switch, on the repeater power supply, to ON. Requirement: Power indicator lamp lights. (b) Turn the MAIN voltage control to approximately 80 volts. (c) Adjust the CURRENT AMPS control to obtain a current indication of 0.52 ampere on the DC AMPERES meter.
	Requirement: The DC VOLTS meter indicates between 64 and 72 volts.
	Note: The repeater power supply is supplying 520-mA constant current to the repeater.
	B. Preregulator Adjustment
15	Patch the STE (sending test equipment) through the attenuator and back-to-back connector to the RTE (receiving test equipment) [patches (1), (2), and (3), Fig. 3].
16	Set the attenuator to equal the loss of the LBO2 test adapter ED-51002-30.
	Note: This loss is approximately 10 dB. The exact loss is stamped on the LBO2 test adapter.
17	Set the RTE to measure an 11.648-MHz signal at -20.00 dBm.
18	Adjust the STE as required to deliver an 11.648-MHz signal to obtain an exact -20.00 dBm indication on the RTE.
19	Patch the output of the attenuator to the PRE REG IN jack on the LBO2 test adapter [patch (6), Fig. 3].
20	Patch the RTE to the HF LINE OUT jack on the test set jack panel [patch (4), Fig. 3].
21	Set the attenuator to 8.6 dB.
22	Observe the RTE.
	Requirement: -20.00 dBm $\pm$ 0.1 dB.
23	If the requirement is met, proceed to Step 24. Otherwise, adjust control R1 on the 859C network to obtain exactly -20.00 dBm. Wait one minute for repeater to stabilize and adjust again if necessary.

CHART 2 (Contd)

STEP	PROCEDURE
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Note: The repeater gain can be considered stable when the power of the 11.648-MHz signal changes no more than 0.1 dB in one minute.

- | | |
|----|---|
| 24 | Remove the LBO2 test adapter. |
| 25 | Install a 4100A LBO network in the LBO2 position. |

C. Pilot-Off Regulating Test

- | | |
|----|---|
| 26 | Patch the STE through the attenuator and back-to-back connector to the RTE [patches (1), (2), and (3), Fig. 3]. |
| 27 | Remove the patch plug between the PILOT OUT and PILOT IN jacks. |
| 28 | Set the attenuator to 0.00 dB. |
| 29 | Set the RTE to measure 12 MHz at -20.00 dBm. |
| 30 | Adjust the STE to deliver a 12-MHz signal to obtain an indication of -20.00 dBm on the RTE. |
| 31 | Set the attenuator for 35-dB loss. |
| 32 | Patch the RTE to the HF LINE OUT jack located on the test set jack panel [patch (4), Fig. 3]. |
| 33 | Patch the output of the attenuator to the HF LINE IN jack on the test set jack panel [patch (5), Fig. 3]. |
| 34 | Allow a minimum of 3 minutes for the repeater gain to stabilize. |
| 35 | Adjust the attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE. |
| 36 | Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication. |
| 37 | Compute and record the repeater gain as in the following example: |

Test set loss at 12 MHz (from test set calibration records): 3.95 dB

Plus value recorded in Step 36: 21.05 dB

Repeater gain: 25.00 dB

Requirement: List 5: between 29.00 and 31.50 dB.

CHART 2 (Contd)

STEP

PROCEDURE

List 6: between 21.50 and 24.00 dB.

List 7: between 26.81 and 28.21 dB.

List 8: between 26.73 and 28.13 dB.

- 38 Remove the 4100A LBO network from the repeater.
- 39 Install LBO network appropriate for the location at which the repeater is to be installed.
- Note:** Refer to office records for required LBO networks.
- 40 Adjust the test attenuator to obtain, as near as possible, a -20.00 dBm indication on the RTE.
- 41 Record the algebraic sum of the attenuator setting and the RTE expanded scale meter indication.
- 42 Compute the overall repeater gain at 12 MHz as in **Example A**; compute the net gain as in **Example B**.

Example A:

Test set loss at 12 MHz: 3.95 dB

Plus value recorded in Step 41: 13.70 dB

Overall repeater gain at 12 MHz: 17.65 dB

Example B:

Overall repeater gain at 12 MHz: 17.65 dB

Plus combined loss of the two LBO networks*: 9.59 dB

Net gain: 27.24 dB

*Assume 4100AD and 4100AE networks are used; from Table C, the combined loss of the LBO networks is $4.11 + 5.48 = 9.59$ dB.

Requirement: Net gain within ± 0.5 dB of gain value recorded in Step 37.

- 43 Turn the MAIN voltage control, on the repeater power supply, to 0 and set the DC switch to OFF.

CHART 2 (Contd)

STEP

PROCEDURE

TABLE C

LINE BUILDING-OUT NETWORKS

LBO NETWORK CODES		BUILD-OUT DISTANCE (MILES)	LOSS AT 12 MHZ (DB)
LB01	LB02		
4100A	4100A	0.0	0.00
—	4100B	0.1	1.37
4100AC	4100C	0.2	2.74
4100AD	4100D	0.3	4.11
4100AE	4100E	0.4	5.48
4100AF	4100F	0.5	6.85
4100AG	4100G	0.6	8.22
4100AH	4100H	0.7	9.59
4100AJ	4100J	0.8	10.96
4100AK	4100K	0.9	12.33
4100AL	4100L	1.0	13.70

D. Prepare Repeater for Installation

- 44 Remove the repeater.
- 45 Reinstall the nylon screw in the R1 access hole, and seal the R1 access hole in the repeater cover with the snap-in dust cap or adhesive-backed metal plate, if provided.
- 46 Record the following on a form similar to the one shown in Fig. 5:
 - (a) Repeater serial number
 - (b) Identification number of the deviation equalizer installed
 - (c) Codes of the LBO networks installed in LB01 and LB02 positions
 - (d) Screw switch closed on the 859C network.

Note: The form shown in Fig. 5 is recommended for use as an office record of equipment installed at a regulating repeater location.

CABLE SECTION _____

REGULATING MANHOLE STATION _____ AREA _____

AVERAGE ANNUAL UNDERGROUND TEMPERATURE _____ °F

L4 LINE	REPEATER SERIAL NO.	DEV EQL	859C NET SWITCH SET	LBO NO. 1 CODE	LBO NO. 2 CODE	APPARATUS CASE	
						COAX	SLOT
L401						1-2	1
L403						3-4	1
L405						5-6	1
L407						7-8	1
L409						9-10	1
L411						11-12	1
L413						13-14	1
L415						15-16	1
L417						17-18	1
L419						19-20	1
L402						1-2	2
L404						3-4	2
L406						5-6	2
L408						7-8	2
L410						9-10	2
L412						11-12	2
L414						13-14	2
L416						15-16	2
L418						17-18	2
L420						19-20	2

MON OSC CODE 66 _____ 4103A NETWORK OUTPUTS A=____DB, B=____DB, C=____DB, D=____DB.

COMMENTS _____

Fig. 5—Typical Station Inventory Form

CHART 2 (Contd)

STEP

PROCEDURE

- 47 Place a gummed label, similar to the one shown, on LBO1 network just below the network handle.

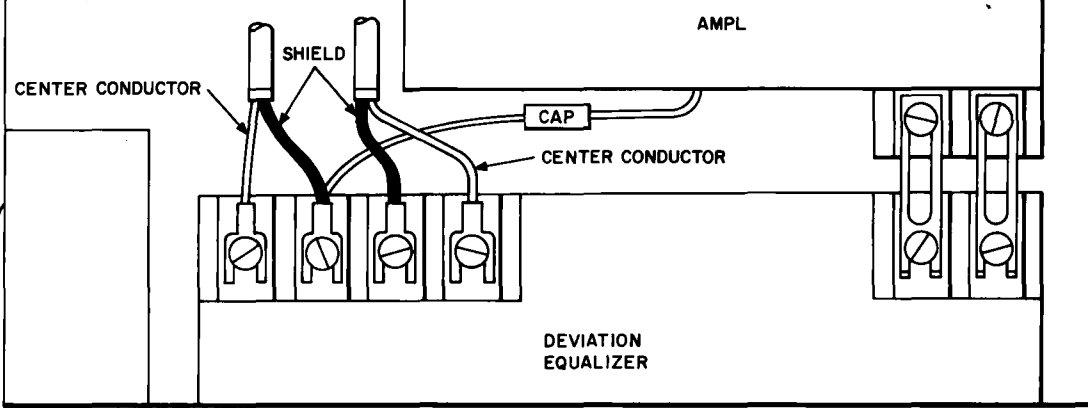
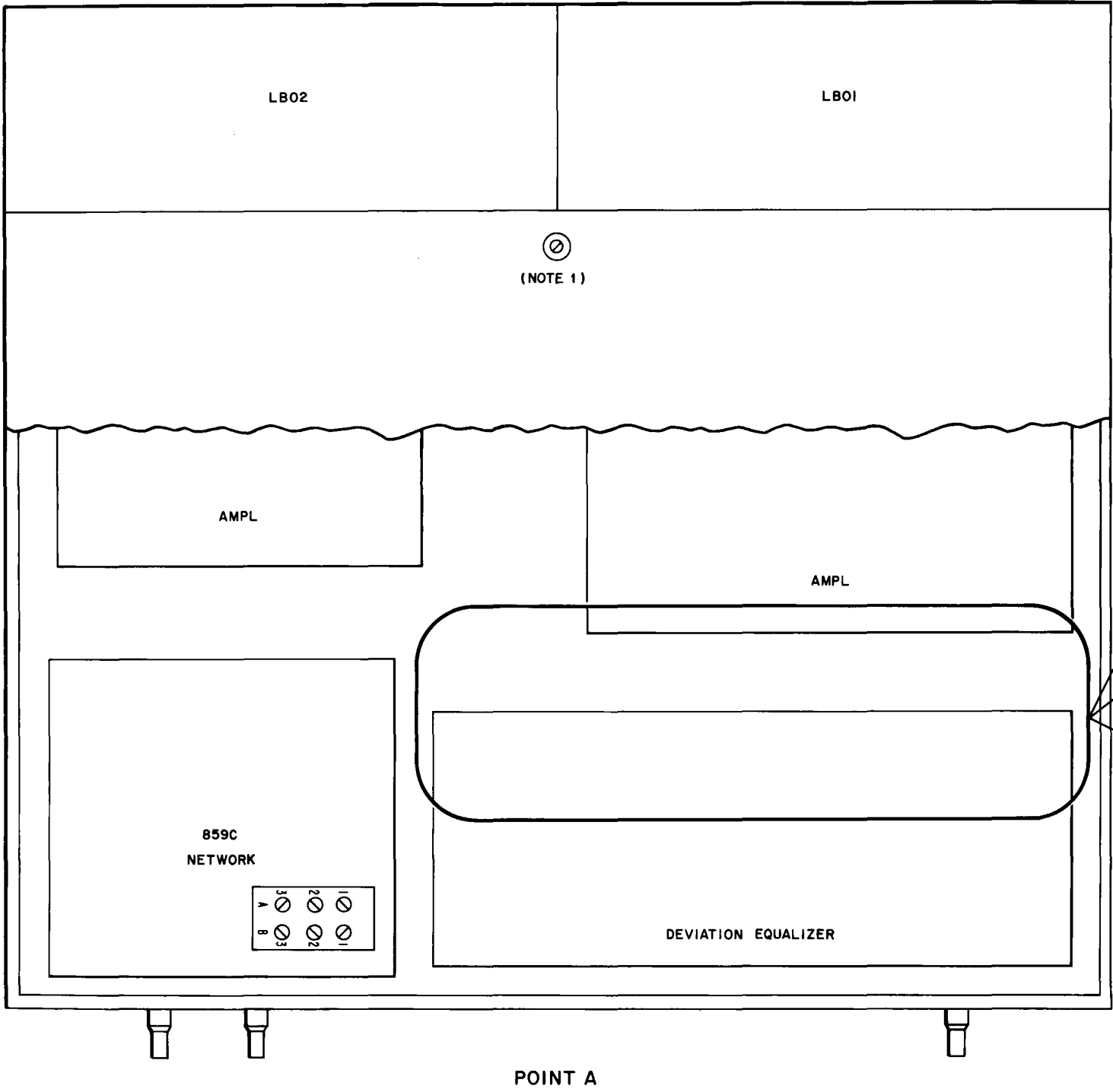
FORM ST1 8-67		
TYPE *	SER. NO. *	
IN SERVICE *	LOCATION *	
OUT SERVICE	TUBE *	
GP	db D.E. TYPE	
LBO #1 *	LBO #2 *	
STRAP	PORTS 1 & 3	2 & 4
REASON OUT		

Equipment Identification Tag

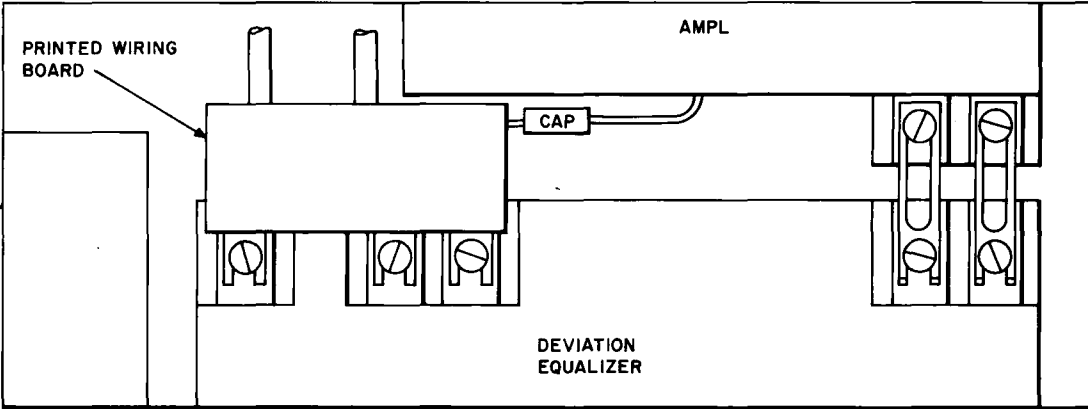
Note: Form ST-1 may be ordered in rolls of 500 or 1000 from:
Chambers, Inc.
2171 Hawkins Street
Charlotte, North Carolina 28203

- 48 Enter the applicable information for the items marked by an asterisk (*) on the form.

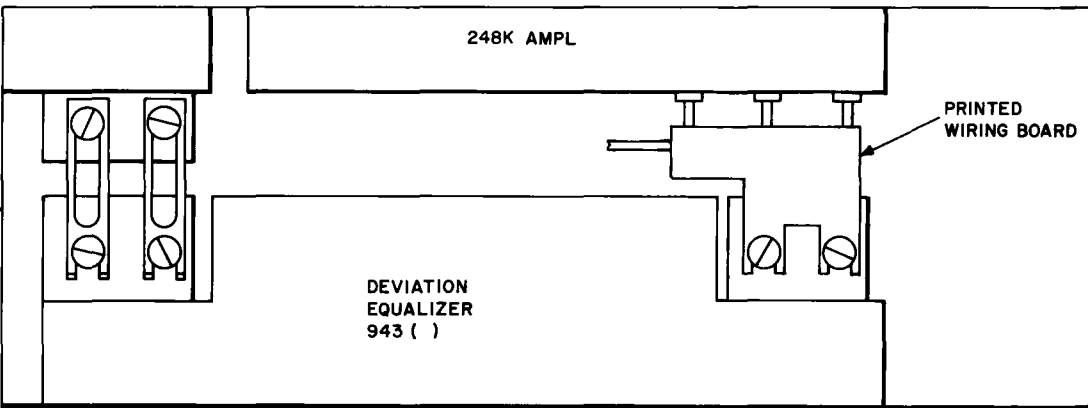
- NOTES:
1. ACCESS TO RI IS THROUGH THE HOLE IN THE REPEATER COVER. A NYLON SCREW MUST BE REMOVED WHILE THE REPEATER COVER IS OFF TO GAIN ACCESS TO THE RI ADJUSTMENT.
 2. FOR ACCESS TO THE DEVIATION EQUALIZER, 859C NETWORK SCREW SWITCHES AND NYLON SCREW IN THE RI ACCESS HOLE, LOCATE THE TWO COAXIAL JACKS THAT ARE CLOSEST TOGETHER ON THE LEFT, AS VIEWED FROM POINT A, AND THEN REMOVE THE COVER WHICH IS ON TOP.



A. VERY EARLY LIST 5 UNIT



B. LATER LIST 5, 6 AND 7 UNITS



C. LIST 8 UNIT

Fig. 6—Regulating Repeater Pictorial

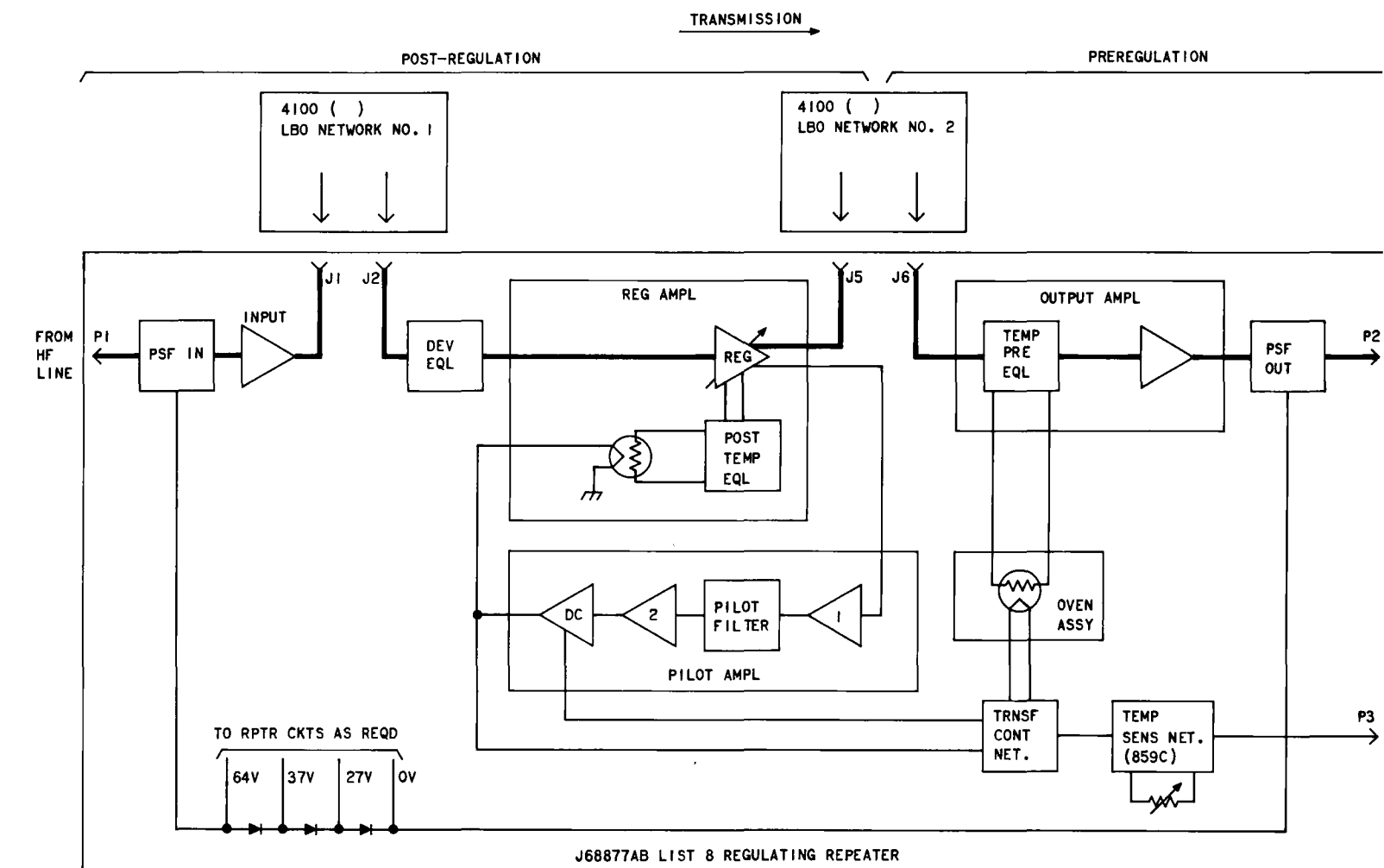
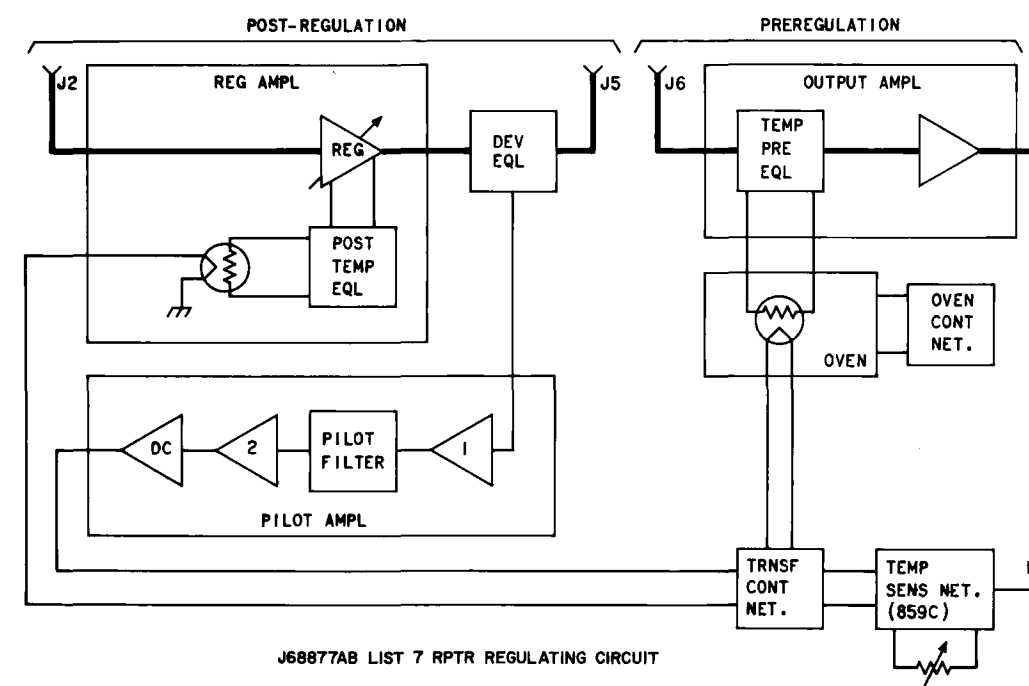
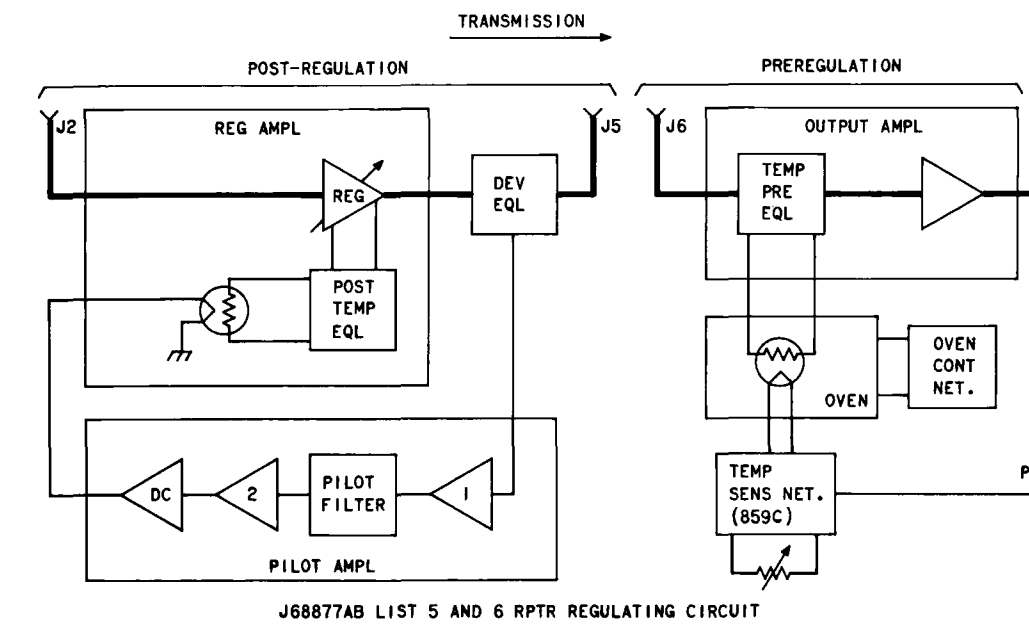


Fig. 7—Regulating Repeater Block