TD-3 MICROWAVE RADIO
J68386G AND J68386H TRANSMITTER-RECEIVER BAYS
COMMON EQUIPMENT TESTS USING KRUSE 52011 IF/RF TEST SET
J68387R–( ) MICROWAVE GENERATOR AND 4-GHz MULTIPLIER

This appendix supplements Section 411-502-504.

It is reissued to include:

- Microwave generator J68387R-1 (Charts A and B), Lists 1, 2, and 4 through 20.
- Microwave generator J68387R-2 (Charts C through E), Lists 81 and 82 through 99, 132 or 133 and 134 or 135.
- A caution to be observed when working on systems equipped with Hot Standby/Space Diversity switching.

Note: Marginal change indicators are omitted.

It contains the procedures necessary to align spare generator units or to realign generators which have been in service but fail to meet the requirements of Section 411-502-500.

Notes:

1. A microwave generator exhibits its greatest changes in output power and oscillator frequency during the first 30 minutes after the power is applied. These changes occur as the temperature-sensitive components reach a stable operating temperature. After the initial tuning of a replacement generator or sub-unit, allow it to warm up for 30 minutes. Then slightly readjust its tuning controls for optimum output power and/or frequency in accordance with this appendix.
2. All tests are performed with the microwave generator installed in the radio bay and connected to the appropriate plugs and jacks.
3. Frequencies for the J68387R-1 are shown as L4 through L20 in Table A. Frequencies for the J68387R-2 are shown as L28 through 99 in Table B.
4. Use a P48Q352 adjustment tool to adjust all tuning controls on the microwave generator except the LEV ADJ control of the J68387R-1 generator. For this control, use the KS-20114, L2 adjustment tool.
5. Use a 388A tool (1/4-inch spanner wrench) to loosen lock nuts on the 4-GHz multiplier tuning adjustments.
6. Use a 5/16-inch open end wrench to remove P15.
7. Use a 3/32-inch Allen wrench to loosen the OUT TUN control on the 1-GHz multiplier.

Caution 1: These tests are to be performed on an out-of-service basis. Check that the channel is not being used and has been removed from service. Alarms originated while performing the following tests may be disregarded.

Caution 2: On Hot Standby/Space Diversity equipped bays, consult Section 411-600-500 for forced switching procedures to remove service from BOTH the transmitter and receiver. Exercise extra caution during the tests since service will be present in some waveguide and IF cabling within this bay.

TABLE A

FREQUENCY VERSUS LIST NUMBER OF J68387R-1 MICROWAVE GENERATOR

GENERATOR LIST NO.	GENERATOR FREQUENCY (MHz)	CRYSTAL FREQUENCY (MHz)
4	3780	118.12500
5	3800	118.75000
6	3820	119.37500
7	3840	120.00000
8	3860	120.62500
9	3880	121.25000
10	3900	121.87500
11	3920	122.50000
12	3940	123.12500
13	3960	123.75000
14	3980	124.37500
15	4000	125.00000
16	4020	125.62500
17	4040	126.25000
18	4060	126.87500
19	4080	127.50000
20	4100	128.12500

TABLE B

FREQUENCY VERSUS LIST NUMBER OF J68387R-2 MICROWAVE GENERATOR

GENERATOR LIST NO.	GENERATOR FREQUENCY (MHz)	CRYSTAL FREQUENCY (MHz)
82	3780	118.12500
83	3800	118.75000
84	3820	119.37500
85	3840	120.00000
86	3860	120.62500
87	3880	121.25000
88	3900	121.87500
89	3920	122.50000
90	3940	123.12500
91	3960	123.75000
92	3980	124.37500
93	4000	125.00000
94	4020	125.62500
95	4040	126.25000
96	4060	126.87500
97	4080	127.50000
98	4100	128.12500
99	4120	128.75000

CHART A

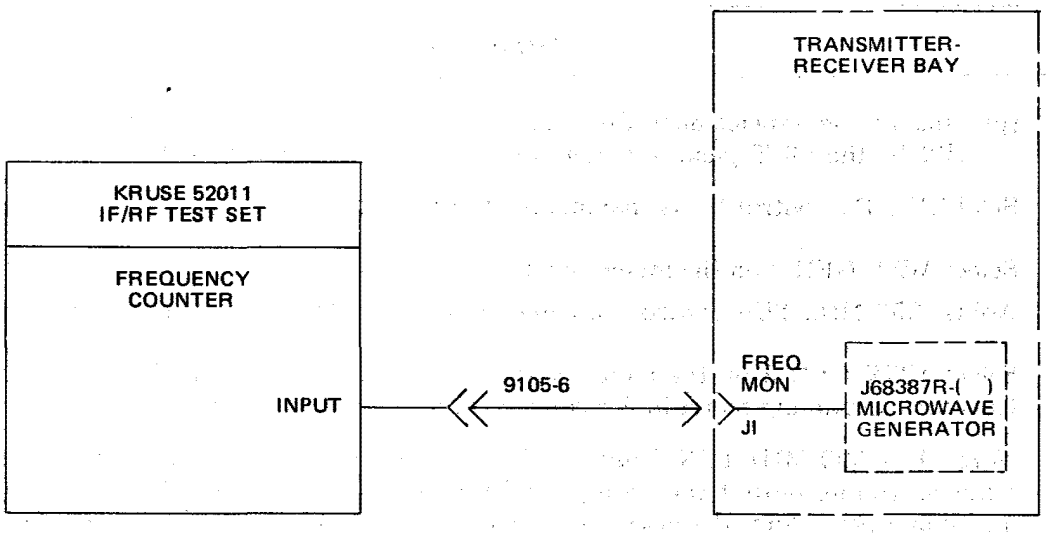
500-MHz GENERATOR ADJUSTMENT
(J68327R-1 Generator)

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
	Note: The presence of a tuning adjustment tool inserted in the FREQ ADJ control will cause the frequency to shift. Adjust the FREQ ADJ control for a frequency within 500 Hz of the crystal frequency with the adjustment tool inserted. When the adjustment tool is removed, note the shift in frequency. Use this information to readjust the FREQ ADJ control such that the frequency is within limits when the adjustment tool is removed.
1	Select MWV GEN 1 on the bay meter panel.
2	Adjust FREQ ADJ control to the maximum clockwise position, and then adjust the 125 MHz TUN control for a maximum indication on the panel meter. (See Fig. 1 in main section, for locations of adjusting controls.)
3	Set up test connections according to Fig. 1.
4	Adjust FREQ ADJ control for a frequency equal to f_o ±10 Hz (f_o is the crystal frequency). If this condition is met, proceed to Step 6; if not, replace the crystal as given in Step 5, and repeat Steps 1 through 4. If this condition cannot be met by replacing the crystal, replace the 500-MHz generator with a spare unit as given in Step 5, and adjust the replaced generator as outlined in this chart.

CHART A (Cont)



Preparation For Test

Operate test set controls to the following position.

UNIT	CONTROL	POSITION
COUNTER	RESOLUTION	1
	ATTENUATOR	X1

Oscillator Frequency Measurement
J68387R-( ) Generator
Fig. 1

STEP	PROCEDURE
5	Replace 500-MHz generator and/or crystal Y1 as follows: (a) Disconnect two power plugs, P1 and P10, and the coaxial output connector, P16. All are located on the connector mounting bracket on the right side of the microwave generator chassis. (b) Loosen fasteners on left and right sides of the microwave generator chassis, and remove entire generator from the bay. (c) To replace the crystal, remove the top cover from the 500-MHz generator unit. (d) Remove crystal Y1 from its socket, and replace it with one having the required frequency (value stamped on package). (e) Replace the top cover on the 500-MHz generator unit, and reinstall microwave generator in the bay. (f) To remove 500-MHz generator unit from the generator chassis, disconnect the 500-MHz output connector, P2, located on the right side of the unit, and then remove the four retaining screws that hold the unit in the chassis.

CHART A (Cont)

STEP	PROCEDURE
	(g) Install the replacement 500-MHz generator unit in the generator chassis; reconnect P2 to the OUT jack, and reinstall microwave generator in the bay.
6	Set LEV ADJ control to its maximum CW position.
7	Select MWV GEN 2 on the meter panel.
8	Adjust 250 MHz TUN control for a maximum indication on the panel meter.
9	Select MWV GEN 3 on the meter panel, and adjust the 500 MHz TUN 1 and TUN 2 controls for a maximum meter indication using the following procedure. *Note:* The 500 MHz TUN 1 and TUN 2 controls interact, and, for a given frequency, the same maximum output can be obtained for slightly different combinations. In the following tuning procedure, the intent is to first tune the 500 MHz TUN 2 control for a maximum meter indication or output, and then to tune the 500 MHz TUN 1 control slightly beyond the peak or maximum meter indication. By repeating this procedure a few times, the circuit can be quickly tuned. The circuit is then adjusted for the required output power by means of the LEV ADJ control. (a) Adjust 500 MHz TUN 1 control four turns counterclockwise from the full clockwise position. (b) Adjust 500 MHz TUN 2 control for a maximum meter indication. (c) Adjust 500 MHz TUN 1 control counterclockwise such that the meter indication drops approximately 3 units on the meter. (d) Adjust 500 MHz TUN 2 control for a maximum meter indication. (e) If the meter indication obtained in (d) is greater than that obtained in (b), repeat (c) and (d) until further adjustments no longer cause an increase in the meter indication. (f) If the meter indication obtained in (d) is less than that obtained in (b), adjust the 500 MHz TUN 1 control clockwise such that the meter indication drops approximately 3 units. Then adjust the 500 MHz TUN 2 control for a maximum meter indication. Repeat the adjustments until further minor adjustments no longer cause an increase in the meter indication. (g) Select MWV GEN 2 on the meter panel. (h) Adjust 250 MHz TUN control for a maximum indication on the meter. (i) Select MWV GEN 3 on the meter panel. (j) Slowly adjust the 500-MHz TUN 2 control clockwise until the meter indication drops 6 units or equals the MWV GEN 3 indication stamped on the generator housing, whichever occurs first. (k) Adjust LEV ADJ control for a meter indication equal to that stamped on the 500 MHz generator unit.

CHART A (Cont)

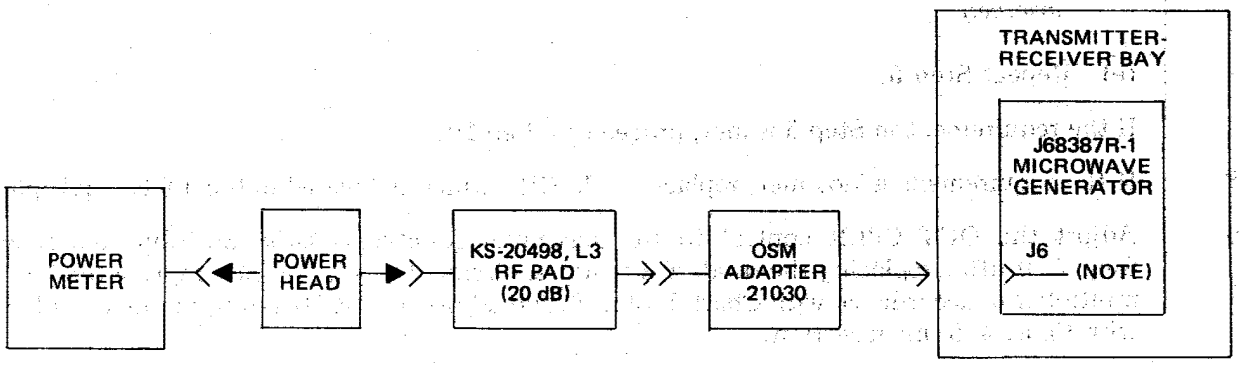
STEP	PROCEDURE
	Note: The 500 MHz generator unit has three meter indications stamped on it which correspond to three crystal frequencies (one labeled MG 3 stamped on the front of the unit and two stamped on the right side). *For the unit in the bay*, the frequency stamped on the front is the same as that of the crystal in the unit. The LEV ADJ control should be adjusted to obtain the MWV GEN 3 indication associated with this frequency. *If a spare unit is inserted in the bay*, adjust LEV ADJ control for the MG3 indication nearest in frequency to that of the crystal in the spare generator unit, and write the crystal frequency and MWV GEN 3 indication on the front of the unit. (l) Adjust FREQ ADJ control for a frequency equal to f_0 ±10 Hz (f_0 is the crystal frequency). If the conditions of (k) and (l) are met, proceed to Chart 3, in main section; if not, replace the 500 MHz generator with a spare unit as given in Step 5. Adjust the replaced 500-MHz generator as outlined in this chart.
10	Adjust LEV ADJ control for the indication stamped on the meter panel.

CHART B

4-GHz MULTIPLIER ADJUSTMENT
(J68387R-1 Generator)

APPARATUS

1—Kruse 52011 IF/RF Test Set



Output Power Adjustment—Test Arrangement
(J68387R-1 Generator)
Fig. 2

CHART B (Cont)

STEP	PROCEDURE
1	Select MWV GEN 3.
2	Adjust LEV ADJ control to obtain the MWV GEN 3 indication equal to that stamped on the generator housing. If the indication cannot be obtained, perform Chart A.
3	Remove connector P15 from the output filter of the 4-GHz multiplier. (To do this, remove connector P16 that connects the generator to the bay; then disconnect P15, and remove the cable assembly. Use the 5/16-inch open-end wrench).
4	Connect test apparatus to the microwave generator as shown in Fig. 2.
5	Loosen locknuts on both tuning controls and adjust the two controls on the 4-GHz multiplier for maximum output power. Depress power meter DBM 50 ohm key. *Requirement:* The power meter indication shall be greater than +25 dBm minus the loss of the calibrated test cable and 20 dB pad.
6	If the requirement is met, proceed to Step 10. If the above requirement is not met, adjust the OUT CPLR of the 1-GHz multiplier three more turns clockwise. If there are no more clockwise turns left, adjust the OUT CPLR control to the maximum CCW position and perform Step 7.
7	While monitoring the MWV CUR MON meter indication, adjust the 1-GHz multiplier tuning controls using the following procedure. (a) Adjust IN TUN control for a maximum meter indication. (b) Adjust OUT TUN control for a minimum meter indication. (c) Adjust CUR ADJ control for an indication as close as possible to 50 units on the MWV CUR MON meter. (d) Repeat (a) through (c) making (b) the last step until no further control interaction is observed. (e) Repeat Step 5. If the requirement in Step 5 is met, proceed to Step 10.
8	If the requirement is not met, replace diode CR4 which is located in the 4-GHz multiplier.
9	Adjust the OUT CPLR control to the maximum counterclockwise position, and repeat Step 7. If after replacing the diode CR4 the requirement is still not met, replace the 1-GHz multiplier in accordance with Chart 3, Step 8, and adjust the 1-GHz multiplier in accordance with Chart 4, in main section.
10	Make the following adjustments for output power. (a) Adjust LEV ADJ control for an output power of 23.0 ±0.5 dBm. (b) Adjust both tuning controls on the 4-GHz multiplier for maximum power output. (c) Since the adjustments in (a) and (b) interact, repeat (a) and (b) until the output power of 23.0 ±0.5 dBm is obtained after completing (b).

	CHART B (Cont)
STEP	**PROCEDURE**
11	Lock both tuning controls by turning the locknuts snuggly against the stop. *Note:* It will be necessary to keep the tuning controls from turning while the locking adjustment is made.
12	Lock the OUT TUN control on the 1-GHz multiplier using the Allen wrench.
13	Repeat Steps 1 through 4 in Chart A.
14	Remove test apparatus and replace cable assembly.
15	Perform the checks in Section 411-502-500, Chart 3.

CHART C

500-MHz GENERATOR ADJUSTMENT
[J68387R-2 L81, ( ), L132, or L133 GENERATOR]

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	**PROCEDURE**
	Note: The presence of a tuning adjustment tool, inserted in the FREQ ADJ control, will cause the frequency to shift. Adjust the FREQ ADJ control for a frequency within 500 Hz of the crystal frequency with the adjustment tool inserted. When the adjustment tool is removed, note the shift in frequency. Use this information to readjust the FREQ ADJ control such that the frequency is within limits when the adjustment tool is removed.
1	Select MWV GEN 1 on the bay meter panel.
2	Adjust FREQ ADJ control to the maximum clockwise position, and then adjust the 125 MHz TUN control for a maximum indication on the panel meter.
3	Set up test connections according to Fig. 1.
4	Adjust FREQ ADJ control for a frequency equal to f_0 ±10 Hz (f_0 is the crystal frequency). If this condition is met, proceed to Step 6; if not, replace the crystal as given in Step 5, and repeat Steps 1 through 4. If this condition cannot be met by replacing the crystal, replace the 500-MHz generator with a spare unit as given in Step 5, and adjust the replaced generator as outlined in this chart.

	CHART C (Cont)
STEP	**PROCEDURE**
5	Replace 500-MHz generator and/or crystal Y1 as follows. (a) Disconnect two power plugs, P1 and P10, and the coaxial output connector, P16 or P20. All are located on the connector mounting bracket on the right side of the microwave generator chassis. (b) Loosen fasteners on left and right sides of the microwave generator chassis, and remove entire generator from the bay. (c) To replace the crystal, remove the top cover from the 500-MHz generator unit. (d) Remove crystal Y1 from its socket, and replace it with one having the required frequency (value stamped on package). (e) Replace the top cover on the 500-MHz generator unit, and reinstall microwave generator in the bay. (f) To remove 500-MHz generator unit from the generator chassis, disconnect the 500-MHz output connector, P2, located on the right side of the unit, and then remove the four retaining screws that hold the unit in the chassis. (g) Install the replacement 500-MHz generator unit in the generator chassis; reconnect P2 to the OUT jack, and reinstall microwave generator in the bay.
6	Set LEV ADJ control to its maximum CW position.
7	Select MWV GEN 2 on the meter panel.
8	Adjust 250 MHz TUN control for a maximum indication on the panel meter.
9	Select MWV GEN 3 on the meter panel and adjust the 500 MHz TUN control for a maximum meter indication.
10	Select MWV GEN 2 on the meter panel.
11	Adjust 250 MHz TUN control for a maximum indication on the meter.
12	Select MWV GEN CUR MON on the meter panel.
13	Adjust 500-MHz filter fine-frequency tuning control (FLT TUN) for a maximum panel meter indication.
14	Select MWV GEN 3 on the meter panel.
15	Readjust 500 MHz TUN control for a maximum meter indication.
16	Adjust LEV ADJ control for a meter indication equal to that stamped on the 500-MHz generator unit.

CHART C (Cont)

STEP	PROCEDURE
	For the unit in the bay, the frequency stamped on the front is the same as that of the crystal in the unit. The LEV ADJ control should be adjusted to obtain the MWV GEN 3 indication associated with this frequency. *If a spare unit is inserted in the bay*, adjust the LEV ADJ control for the MG3 indication stamped on the front of the 500-MHz generator and write the crystal frequency on the front of the unit.
17	Adjust FREQ ADJ control for a frequency equal to f_0 ±10 Hz (f_0 is the crystal frequency). If the conditions of Steps 16 and 17 are met, proceed to Chart 8, in the main section; if not, replace the 500-MHz generator with a spare unit as given in Step 5. Adjust the replaced 500-MHz generator as outlined in this chart.

CHART D

4-GHz MULTIPLIER ADJUSTMENT
(J68387R-2 GENERATOR)

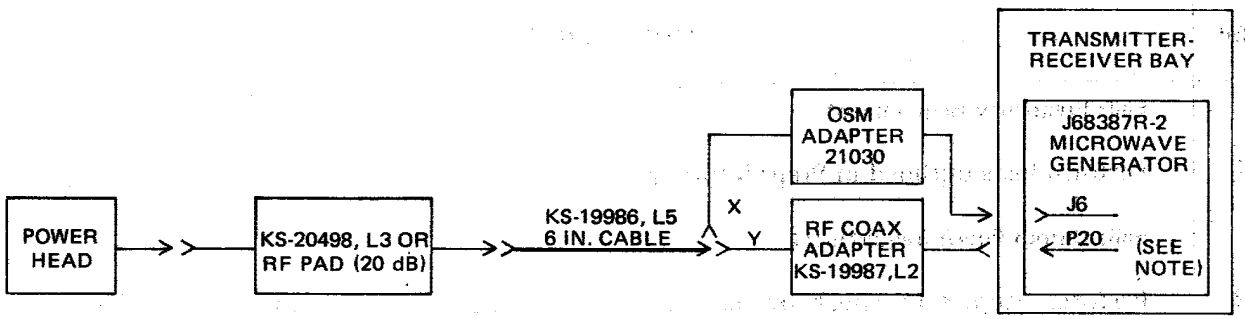
APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
1	Remove connector P15 from the output filter of the 4-GHz multiplier. (To do this, remove connector P16 that connects the generator to the bay; then disconnect P15, and remove the cable assembly. Use the 5/16-inch open-end wrench).
2	Connect test apparatus to the microwave generator as shown in Fig. 3.
3	Loosen locknuts on both tuning controls and adjust the two controls on the 4-GHz multiplier for maximum output power. Depress power meter DBM 50 ohm key. *Requirement:* The power meter indication shall be greater than +25 dBm minus the loss of the calibrated test cable and 20-dB pad.
4	If the requirement is met, proceed to Step 8. If the above requirement is not met, adjust the OUT CPLR of the 1-GHz multiplier three turns clockwise. If there are no more clockwise turns left, adjust the OUT CPLR control to the maximum CCW position and perform Step 5.
5	While monitoring the MWV CUR MON meter indication, adjust the 1-GHz multiplier tuning controls using the following procedure. (a) Adjust IN TUN control for a maximum meter indication.

CHART D (Cont)	
STEP	**PROCEDURE**
	(b) Adjust OUT TUN control for a minimum meter indication. (c) Adjust CUR ADJ control for an indication as close as possible to 50 units on the MWV CUR MON meter. (d) Repeat (a) through (c) making (b) the last step until no further control interaction is observed. (e) Repeat Step 3. If the requirement in Step 3 is met, proceed to Step 8.
6	If the requirement is not met, replace diode CR4 which is located in the 4-GHz multiplier.
7	Adjust the OUT CPLR control to maximum counterclockwise position, and repeat Step 5. If after replacing the diode CR4 the requirement is still not met, replace the 1-GHz multiplier in accordance with Chart 8, Step 9 and adjust the 1-GHz multiplier in accordance with Chart 9 in the main section.
8	Make the following adjustments for output power. (a) Adjust LEV ADJ control for an output power of +23.0 ±0.5 dBm. (b) Adjust both tuning controls on the 4-GHz multiplier for maximum power output. (c) Since the adjustments in (a) and (b) interact, repeat (a) and (b) until the output power of +23.0 ±0.5 dBm is obtained after completing (b).
9	Lock both tuning controls by turning the locknuts snuggly against the stop. *Note:* It will be necessary to keep the tuning controls from turning while the locking adjustment is made.
10	Lock OUT TUN control on the 1-GHz multiplier using the Allen wrench.
11	Repeat Steps 1 through 4 in Chart C.
12	Remove test apparatus and replace cable assembly.
13	Perform the checks in Section 411-502-500, Chart 3.

CHART D (Cont)



NOTES:

1. THE SMALL SEMIRIGID COAXIAL CABLES WHICH ARE SOLDERED TO THE CONNECTING PLUGS MUST BE HANDLED WITH CARE AND SHOULD NOT SUPPORT WEIGHT FOR THEY ARE EASILY BROKEN.
2. USE OPTION (Y) WHEN USING LISTS 134 OR 135 GENERATORS.

Output Power Adjustment – Test Arrangement
J68387R-2 Generators
Fig. 3

CHART E

ADJUSTMENT OF GENERATOR EQUIPPED WITH 0.5- TO 4-GHz MULTIPLIER
[J68387R-2, L81, ( ), L134, OR L135 GENERATOR]

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
	Notes: *1.* The presence of a tuning adjustment tool, inserted in the FREQ ADJ control, will cause the frequency to shift. Adjust the FREQ ADJ control for a frequency within 500-Hz of the crystal frequency with the adjustment tool inserted. When the adjustment tool is removed, note the shift in frequency. Use this information to readjust the FREQ ADJ control such that the frequency is within limits when the adjustment tool is removed. *2.* This chart is intended to direct maintenance personnel to the specific step and test procedure to be followed when the microwave generator fails to meet the frequency and/or output power requirements specified in other sections.

CHART E (Cont)

STEP	PROCEDURE
	Fails Frequency Requirement
1	Perform tests outlined in Steps 5 through 8.
	Fails Output Power Requirement
2	Perform Step 3 to check overall output power performance of the 500-MHz generator.
3	Select MWV GEN 3 on the meter panel.
	Requirement: Stamped meter indication ±5 units.
	If this requirement is not met, perform adjustments outlined in Steps 5 through 25.
4	Replace diode CR5 if the above requirement is met, and perform Steps 22 through 25.
5	Select MWV GEN 1 on the bay meter panel.
6	Adjust FREQ ADJ control to the maximum clockwise position, and then adjust the 125 MHz TUN control for a maximum indication on the panel meter.
7	Set up test connections according to Fig. 1.
8	Adjust FREQ ADJ control for a frequency equal to f_o ±10 Hz (f_o is the crystal frequency).
	If this condition is met, proceed to Step 10; if not, replace the crystal as given in Step 9, and repeat Steps 5 through 8. If this condition cannot be met by replacing the crystal, replace the 500-MHz generator with a spare unit as given in Step 9 and adjust the replaced generator as outlined in this chart.
9	Replace 500-MHz generator and/or crystal Y1 as follows.
	(a) Disconnect power plug P1 and the coaxial output connector P20. All are located on the connector mounting bracket on the right side of the microwave generator chassis.
	(b) Loosen fasteners on left and right sides of the microwave generator chassis, and remove entire generator from the bay.
	(c) To replace the crystal, remove the top cover from the 500-MHz generator unit.
	(d) Remove crystal Y1 from its socket, and replace it with one having the required frequency (value stamped on package).
	(e) Replace the top cover on the 500-MHz generator unit, and reinstall microwave generator in the bay.
	(f) To remove 500-MHz generator unit from the generator chassis, disconnect the 500-MHz output connector, P2, located on the right side of the unit, and then remove the four retaining screws that hold the unit in the chassis.

CHART E (Cont)	
STEP	**PROCEDURE**
	(g) Install the replacement 500-MHz generator unit in the generator chassis; reconnect P2 to the OUT jack, and reinstall microwave generator in the bay.
10	Set LEV ADJ control to its maximum CW position.
11	Select MWV GEN 2 on the meter panel.
12	Adjust 250 MHz TUN control for a maximum indication on the panel meter.
13	Select MWV GEN 3 on the meter panel and adjust the 500 MHz TUN control for a maximum meter indication.
14	Select MWV GEN 2 on the meter panel.
15	Adjust 250 MHz TUN control for a maximum indication on the meter.
16	Unscrew P20 and loosen connector P19 at the output of the 0.5- to 4-GHz multiplier. Carefully swing the semirigid coaxial cable out to the front. Tighten connector P19.
17	Connect test apparatus to microwave generator as shown in Fig. 3. Support test apparatus so that its weight will not strain the soldered plug connections on the small piece of the semirigid coaxial cable.
18	Adjust 500-MHz filter fine-tuning frequency control (FLT TUN) for a maximum power meter indication. *Note:* It is assumed that the filter is approximately adjusted for the generator frequency and only a minor adjustment of the filter fine-tuning frequency control (FLT TUN) may be required.
19	Select MWV GEN 3 on the meter panel.
20	Readjust 500-MHz TUN control for a maximum meter indication.
21	Adjust LEV ADJ control for a meter indication equal to that stamped on the 500-MHz generator unit. *Requirement:* The power meter indication shall be greater than +9 dBm minus the loss of the calibrated test cable and the 20-dB pad. If the requirement is met, proceed to Step 22. If the requirement is not met, replace diode CR5 which is located in the 0.5- to 4-GHz multiplier. *Note:* No controls are provided for field adjustment of the 0.5- to 4-GHz multiplier.

CHART E (Cont)

STEP	PROCEDURE
22	Adjust LEV ADJ control to obtain a power meter indication of +9 dBm minus the loss of the calibrated test cable and the 20-dB pad.
23	Repeat Steps 5 through 8.
24	Remove test apparatus and replace cable assembly.
25	Perform checks in Section 411-502-500, Chart 3.