TL-1 MICROWAVE RADIO
RECEIVER TESTS
COMPONENT AND SUBASSEMBLY REPLACEMENT

This section contains replacement procedures for the following:

(a) Beat-oscillator (BO) klystron tube

(b) KS-16411, List 1 diodes

(c) J99262G IF and baseband unit.

This section is reissued to add replacement procedures for the following:

(a) J99296AA-2, List 3 modulator-preamplifier unit

(b) J99296G-2 receiver IF and baseband unit

(c) J99351E-1 IF amplifier unit and J99351J-1 FM receiver unit.

Because this reissue is a general revision, change arrows ordinarily used to indicate changes have been omitted.

This reissue affects the Equipment Test List.

Caution: Service Interruption—Removing any of the above items from the receiver will interrupt service on a working channel. Before removing any of these items, the receiver shall be removed from service in accordance with Chart 1. The BO klystron uses circuits which are common to the transmitter and to the receiver which are mounted on the same panel. Before removing the klystron, the transmitter and receiver shall be removed from service in accordance with Chart 1.

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CHART 1

REMOVING AND RESTORING TL-1 RADIO SERVICE

This chart contains the recommended procedures for removing and restoring service on a TL-1 radio channel (Fig. 1). The necessity for this action and the proper procedures to be followed must be positively established prior to any action that affects service.

APPARATUS:

1—KS-14510 Volt-Ohm-Milliammeter (VOM)

STEP	PROCEDURE
	Removing Service—Nondiversity System
1	Once the necessity for removing service from a receiver on a nondiversity channel has been established and permission is obtained, the alarm and control center need only be informed of the time and duration of the service interruption and then to proceed with the maintenance or test procedures.
	Removing Service—Diversity System
2	Secure the necessary permission and inform the alarm and control center of the time and duration of the receiver down time.
3	Check with the alarm and control center that no alarm condition exists. If none exist, proceed directly to Step 5.
4	If an alarm does exist, measure the dc voltage on the PIL MON LEV (pilot-tone monitor level) jacks for each channel in turn with the VOM. ***Note:*** The PIL MON LEV jacks for the regular channel are accessible on the diversity switch panel behind the duct cover. ***Requirement:*** The VOM indicates −5 to −10 volts. ***Note 1:*** If the requirement is met, the pilot tone is present; if the requirement is not met (−3 volts or less indicated on the VOM), the pilot tone is absent.

CHART 1 (Cont)

STEP	PROCEDURE

Note 2: The diversity system alarm conditions are as follows:

(a) Pilot tone present on both channels—no alarm

(b) Pilot tone absent on both channels—no diversity alarm (but a major alarm due to total absence of pilot tone)

(c) Pilot tone present on one channel, absent on the other—diversity alarm.

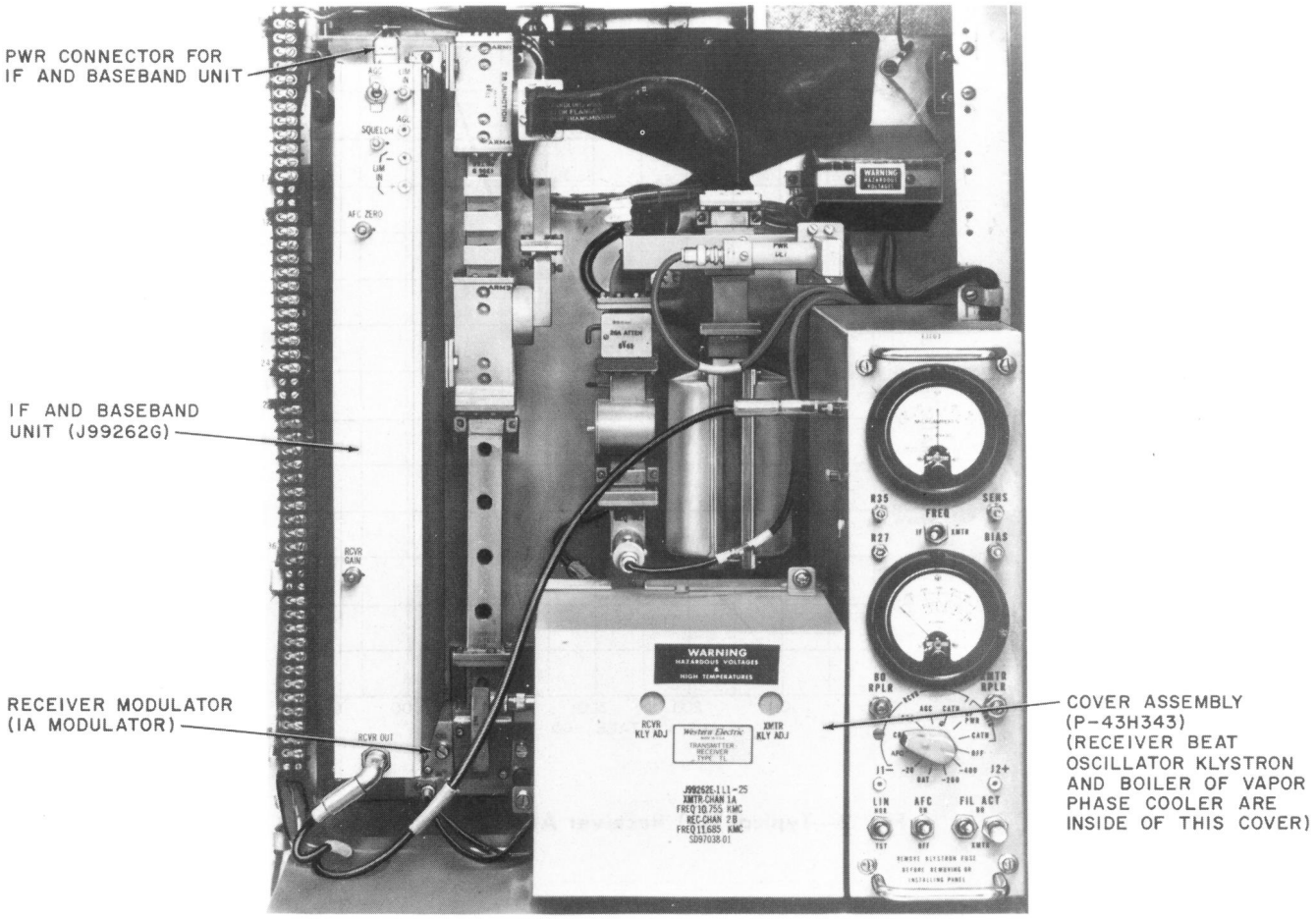

Fig. 1—Transmitter-Receiver Panel—Front View

CHART 1 (Cont)

STEP	PROCEDURE

Caution: Do not proceed until the alarm condition is resolved.

5 Determine the active channel by measuring with the VOM (use 3-Vdc scale) from the K4 jack to ground at the diversity switch panel.

Note: The presence of approximately −3 Vdc indicate that the diversity channel is active. Zero volt indicates that the regular channel is active.

6 To determine that the transmission on the channel which will carry the service is stable and that no fading is apparent, set the selector switch to AGC. Then, reference to Fig. 2, 3, 4, or 5 will indicate the approximate received signal level based on the automatic gain control indication obtained for the channel being measured.

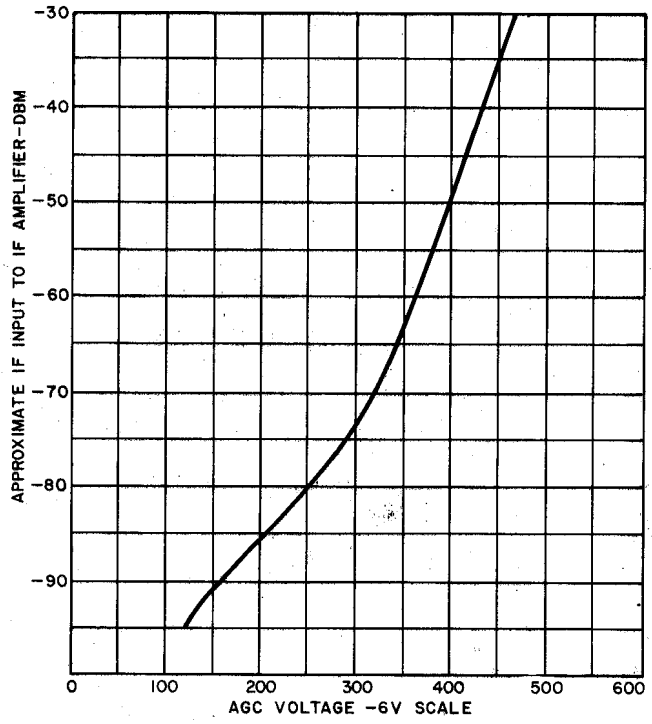

Fig. 2—Typical TL-1 Receiver AGC Characteristics

CHART 1 (Cont)

STEP	PROCEDURE

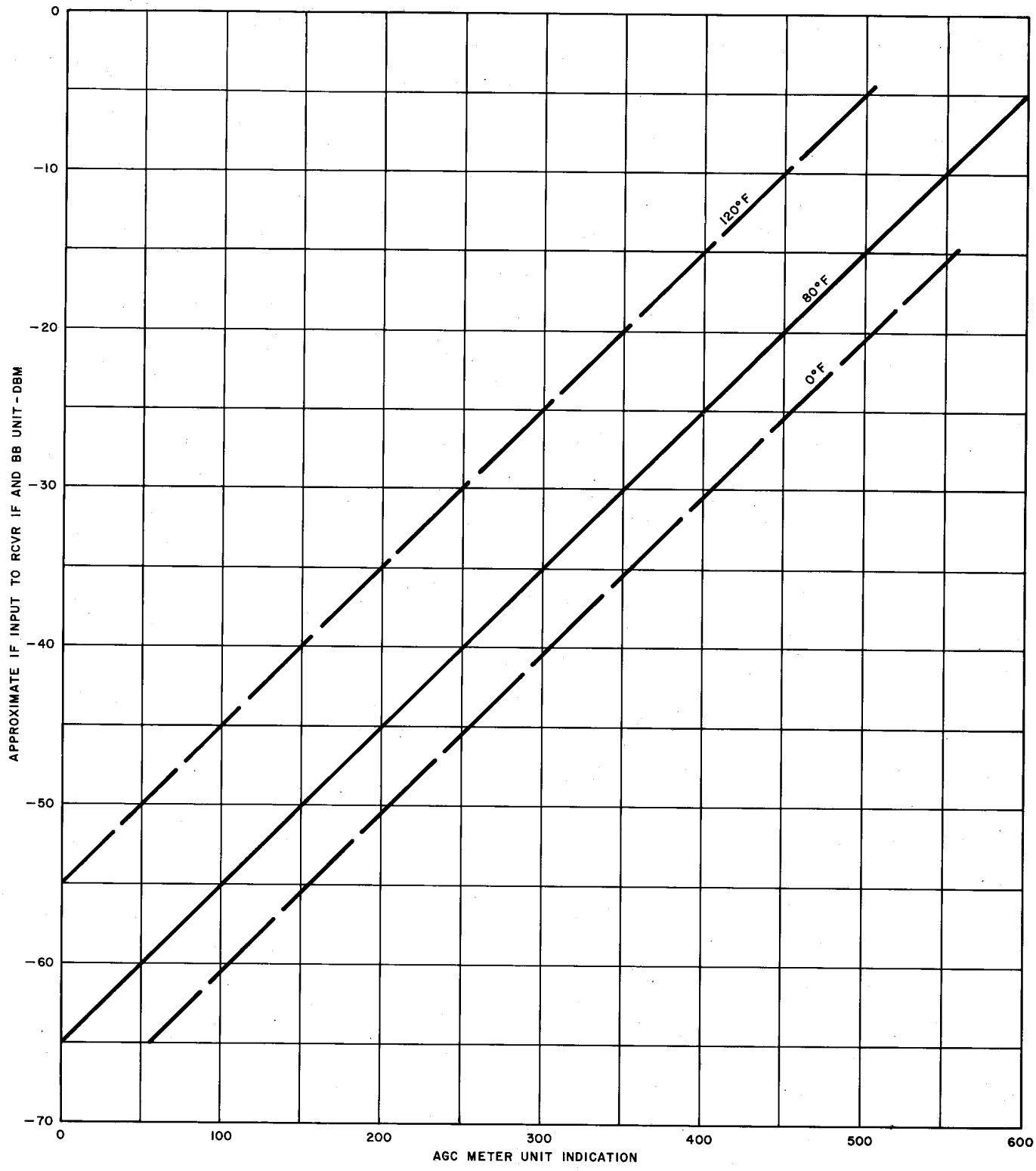

Fig. 3—Receiver AGC Characteristics—All J99296G-1 Units Prior to Lists 3, H Units

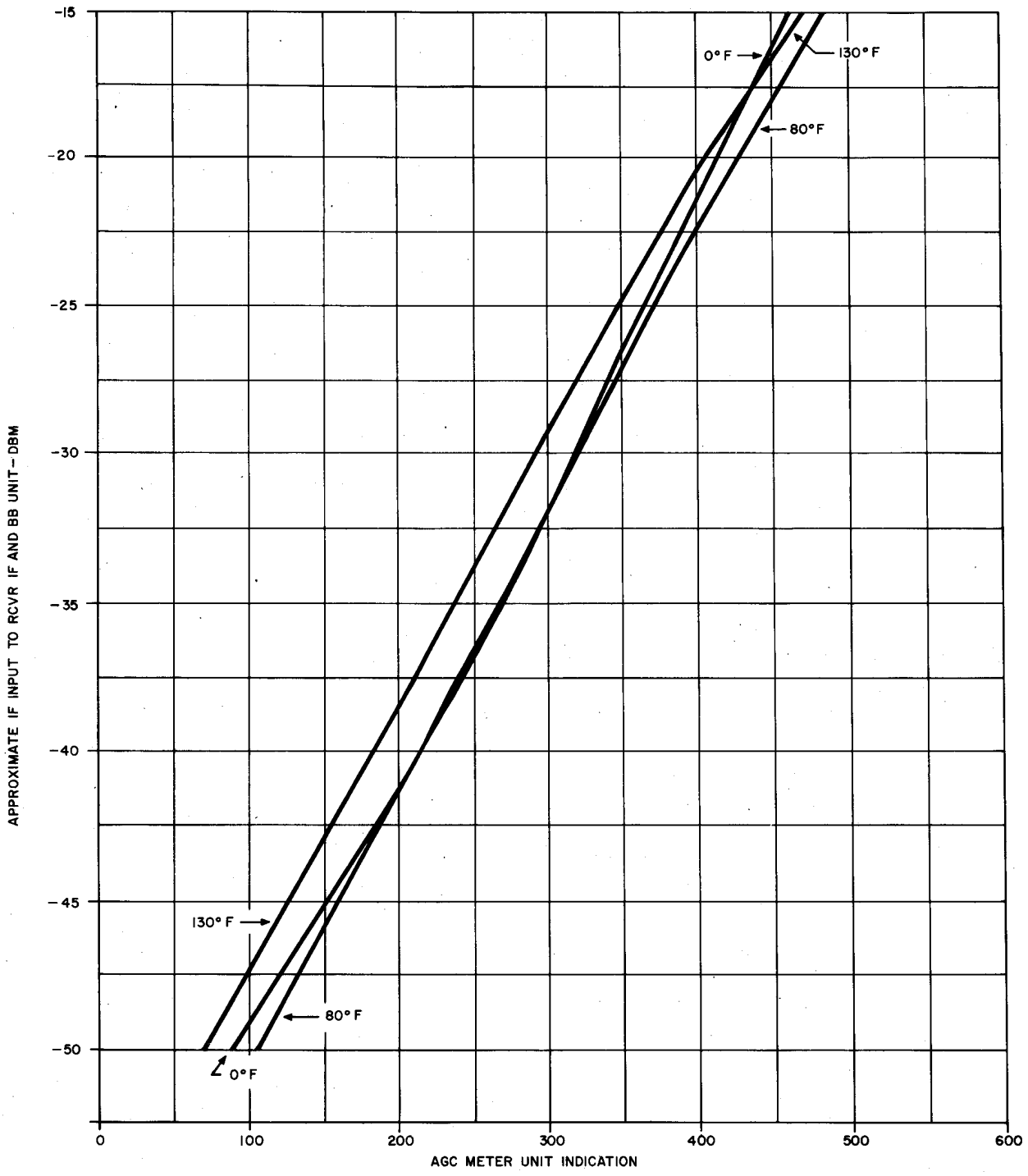

Fig. 4—Receiver AGC Characteristics—J99296G-1, List 3, H Units

CHART 1 (Cont)

STEP	PROCEDURE

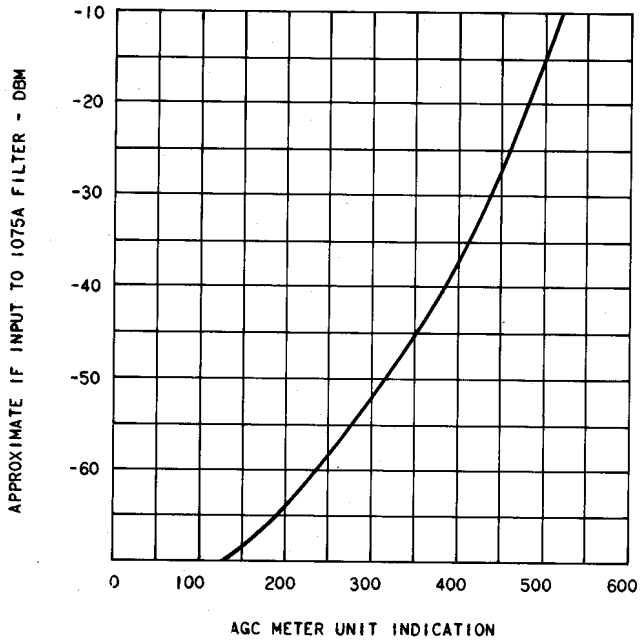

Fig. 5—Receiver AGC Characteristics—J99351E Unit

7 Once it is determined that the transmission conditions are suitable, operate the MAN switch from the AUTO position to the channel which is to remain active (REG or DIV).

8 If the transmitter is equipped with a J99302BF disconnect unit, proceed directly to Step 11.

9 Remove the patch cord at the BB IN jack on the transmitter baseband amplifier.

Note: Whenever the patch cord to a transmitter baseband amplifier BB IN jack is removed, a level rise of approximately 3.5 dB occurs on the adjacent channel of the diversity pair. To restore the signal to the proper level, perform Step 10.

10 Attach the 75-ohm termination that is provided with the TL test set to the end of the patch cord after removal from the BB IN jack.

Note: The transmitter and receiver are now removed from service. The remaining steps apply only to systems that have transmitters equipped with a J99302BF disconnect unit.

11 On the XMTR DISC ATTEN unit, operate rotary switch S1 to DISC.

CHART 1 (Cont)

STEP	PROCEDURE
12	Operate the ATTEN rotary switch counterclockwise to MAX.
13	Remove the patch cord between XMTR DISC ATTEN jack J2 and the XMTR CONT jack BB IN.
	Caution: Do not remove the connection to XMTR DISC ATTEN jack J1 since this will introduce hits on the system.
	Restoring Service—Nondiversity System
14	When restoring service on a nondiversity system, be certain that all connections are made. Before restoring service, contact the alarm and control center for verification of service continuity and assurance that no alarms exist.
	Restoring Service—Diveristy System
15	When restoring service on a diversity system, be certain that all connections are in place and notify the alarm and control center that the units are being restored to service.
16	If the system has a transmitter that is equipped with a J99320BF disconnect unit, proceed directly to Step 22.
17	Detach the 75-ohm termination from the patch cord.
18	Reconnect the patch cord to the BB IN jack.
19	On the diversity switch panel, operate the MAN switch to the AUTO position.
20	On the radio bay, check that the waveguide switch is in the ON position.
21	Verify, with the alarm and control center, that service continuity is established and that no alarms exist.
	Note: The transmitter and receiver are now restored to service. The remaining steps apply only to systems that have transmitters equipped with a J99302BF disconnect unit.
22	Reconnect the patch cord between XMTR DISC ATTEN jack J2 and XMTR CONT jack BB IN.
23	Operate the ATTEN rotary switch clockwise to the NORM position.
24	Operate rotary switch S1 to the NORM position.
25	On the diversity switch panel, operate the MAN switch to the AUTO position.
26	On the radio bay, check that the waveguide switch is in the ON position.

CHART 1 (Cont)

STEP	PROCEDURE
27	Verify with the alarm and control center that service continuity is established and that no alarms exist.

CHART 2

BEAT-OSCILLATOR KLYSTRON TUBE

APPARATUS:

1—KS-6854 Screwdriver

1—3414 Spintite 7/16-inch Hexagon Socket Wrench or equivalent

Heat-Resistant Gloves

Warning: Regarding High Temperature Inside the P-43H343 Cover Assembly—Portions of the vapor-phase cooler, the shells of the klystrons, and the P-43H345 clamp assembly are normally too hot to handle with bare hands. Gloves, a folded wiping cloth, or a handkerchief shall be used to protect personnel when handling any of these items.

Note: External surfaces of the klystron and its assembly are at ground potential.

STEP	PROCEDURE
1	Remove the transmitter and receiver from service in accordance with Chart 1.
2	Turn the selector switch on the meter and control panel to −400.
3	Remove the klystron fuse from the front of the power supply.
4	Observe that the voltmeter indication on the meter and control panel drops to zero.
5	Remove the P-43H343 cover assembly (Fig. 1).
6	Release the flange of the flexible waveguide on the rear of the klystron on the left by pulling the two slides approximately 1/4 inch toward the left (Fig. 6).

CHART 2 (Cont)

STEP	PROCEDURE

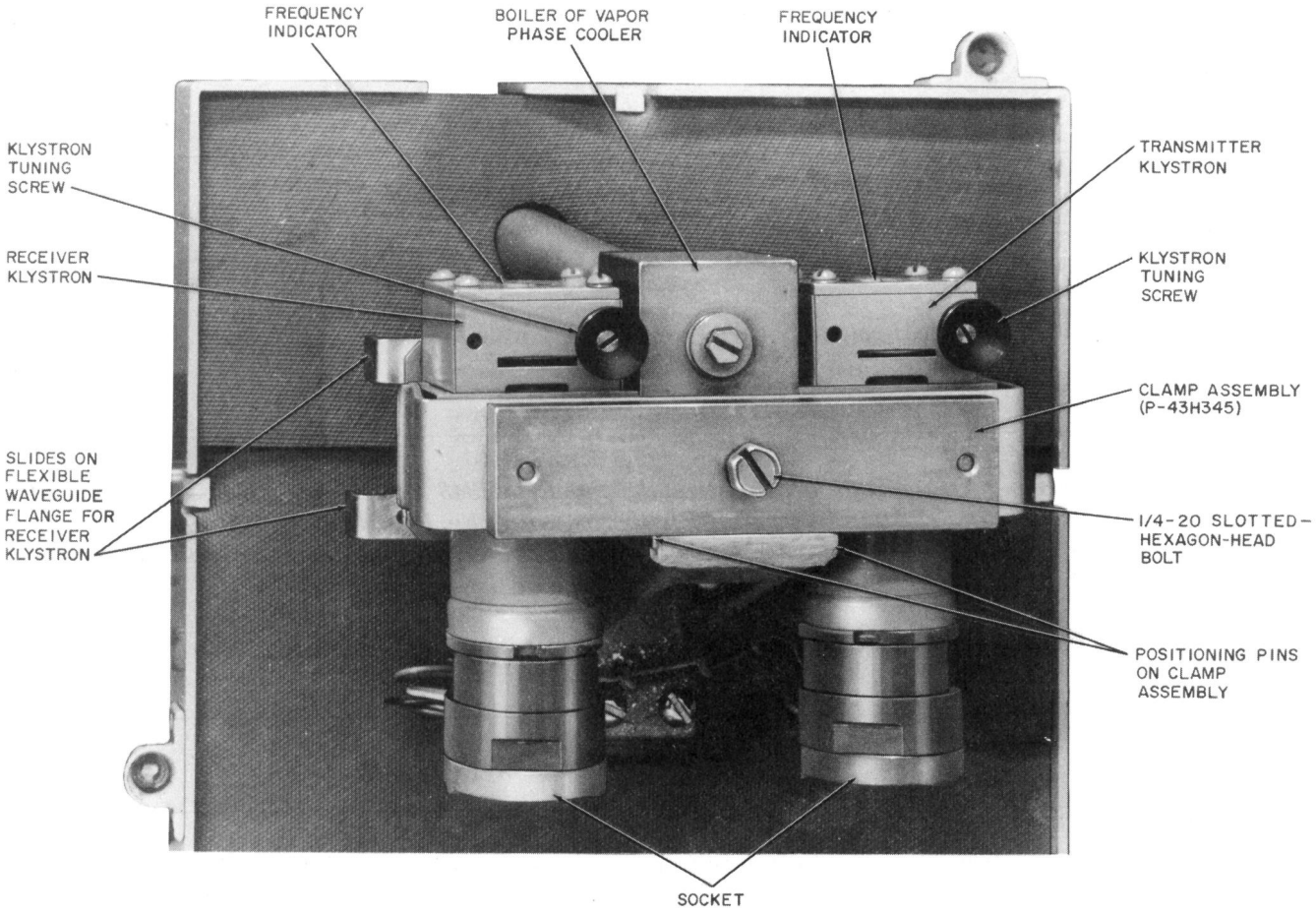

Fig. 6—Transmitter and Receiver Klystrons and Boiler of Vapor-Phase Cooler—Cover Assembly Removed

7 Using a 7/16-inch hexagon Spintite wrench or equivalent, loosen the P-43H345 clamp assembly by turning the 1/4-20 slotted hexagon-head bolt clockwise until both klystrons are loose with respect to the boiler. ***Do not overloosen.***

8 While holding the tube socket of the klystron on the left in one hand, lift the P-43H345 clamp assembly (use glove or folded cloth to protect hand from the heat) approximately 3/16 inch until the clamp is free of the positioning-pin holes and remove the clamp assembly.

CHART 2 (Cont)

STEP	PROCEDURE
9	Disengage the klystron from the waveguide flange of the flexible waveguide by pulling the klystron forward and remove the klystron from the tube socket. Note the indication of the indicator on top of the klystron so that the new klystron to be installed may be set to approximately the same frequency before power is applied.
10	Using a dry cloth, wipe the accumulated dirt from: (a) The left vertical surface of the boiler. (b) The contact surface of the flange on the flexible waveguide. (Take care not to introduce foreign matter into the opening of the flexible waveguide.) (c) The surface of the klystron which will butt against the boiler. (d) The surface of the klystron and the waveguide window which will mate with the flexible waveguide.
11	Install the tube socket on the lower end of the new klystron.
12	Connect the klystron to the flexible waveguide by: (a) Registering the alignment pins (b) Butting the klystron to the waveguide flange (c) Pushing the two slides on the flange toward the right. Avoid overstressing the flexible waveguide by holding the klystron reasonably close to its installed position (Fig. 6).
13	Position the klystron so that it butts against the left side of the boiler. Position the transmitter klystron on the right so that it butts against the right side of the boiler. Seat both klystrons against the lips of the aluminum support which project from under the boiler.
14	Install the clamp assembly, making sure that the positioning pins are in place and that both klystrons are seated against the boiler. Turn the 1/4-20 slotted hexagon-head bolt counterclockwise until the bolt is at least one full turn beyond the point that it begins to turn freely.
15	Using the tuning screw on the klystron, adjust the klystron until the indicator on the top surface of the klystron has approximately the same indications as the kystron which was removed in Step 9.
16	Replace the P-43H343 cover assembly.

CHART 2 (Cont)

STEP	PROCEDURE
17	Turn the meter selector switch on the meter and control panel to −400.
18	Replace the klystron fuse in the front panel of the power supply.
	Note: When service conditions permit the transmitter and receiver to be out of service for a 30-minute warm-up period, omit Steps 19 through 22. In nondiversity systems or in other cases where it is important to restore service quickly, include Steps 19 through 22.
19	Retune the receiver klystron in accordance with Section 409-306-502 and adjust the transmitter klystron frequency in accordance with the in-service frequency check procedure in Section 409-304-501.
20	Return the transmitter and receiver to service in accordance with Chart 1.
21	For a minimum of 30 minutes, while the transmitter and receiver are in service and the klystrons are warming up, "ride" the transmitter klystron frequency in accordance with the in-service frequency check procedure in Section 409-304-501.
22	When service conditions permit interruption of service on the transmitter and receiver, remove the transmitter and receiver from service in accordance with Chart 1. Omit the 30-minute warm-up period and proceed with Steps 23 and 24.
23	Allow a warm-up period of 30 minutes and then retune the receiver klystron in accordance with Section 409-306-502. Check the tuning of the transmitter klystron in accordance with Section 409-304-501.
24	Return the transmitter and receiver to service in accordance with Chart 1.

CHART 3

DIODES CR1 AND CR2

When a diode in the receiver modulator fails, ***both*** diodes CR1 and CR2 must be replaced with a matched pair in accordance with KS-16411, List 1.

APPARATUS:

1—KS-16598, List 1 Crystal Extractor

1—2358UG Quick-Wedge Screwdriver or equivalent

CHART 3 (Cont)

STEP	PROCEDURE
1	Remove the receiver from service in accordance with Chart 1.
2	Insert a flat piece of paper or cardboard under the receiver modulator to prevent loose parts from dropping into the power supply.
3	Remove the knurled cap, P-11C400, from the CR1 position on the receiver-modulator block. (See Fig. 7.)
4	Using the KS-16598, List 1 crystal extractor or needle-nose pliers, remove diode CR1.
5	Using the KS-16598, List 1 crystal extractor, insert a new KS-16411, List 1A diode in the CR1 position.
6	Replace a knurled cap, P-11C400. (Extra P-11C400 knurled caps are provided with the spare parts in the event that the knurled cap is lost.)

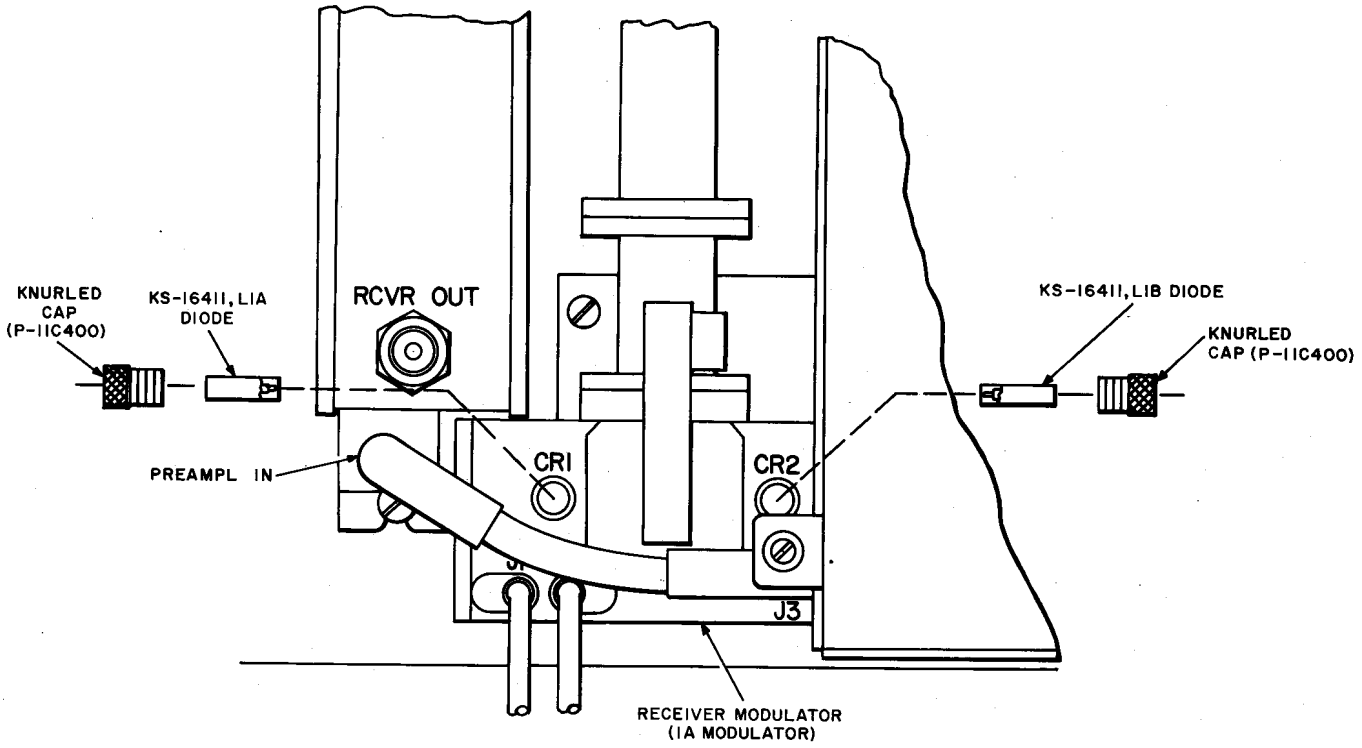

Fig. 7—Receiver Modulator—Diode Replacement Illustration

CHART 3 (Cont)

STEP	PROCEDURE
7	Remove diode CR2 and insert a new KS-16411, List 1B diode in its place using the procedure outlined in Steps 1 through 6 for replacing CR1. Remove the flat paper or cardboard.
8	Operate the meter selector switch on the meter and control panel to RCVR CR1 and RCVR CR2. Note the indication on the meter at each switch position, and adjust the 25A attenuator AT1 which is located behind the klystron oven on the output waveguide of the receiver klystron until the sum of the two indications is 1.6 $\pm$0.01 mA. The full scale deflection of the meter is 6 mA.
9	Return the receiver to service in accordance with Chart 1.

CHART 4

J99296AA MODULATOR-PREAMPLIFIER UNIT

Note: Since J99296AA, List 1 and 2 units are rated MD, the Western Electric Company has withdrawn from rotating stock on all such assemblies which have been held for servicing field replacements. List 3 units only will be included in rotating stock.

APPARATUS:

1—388A Tool (Wrench)

1—P44Q870 Waveguide Wrench Assembly (6 inches)

1—P49R560 Waveguide Assembly (10 inches)

STEP	PROCEDURE
1	Remove the receiver from service in accordance with Chart 1.
2	Remove the cables from jacks J1, J2, J3, and J4 on the front of the J99296AA modulator-preamplifier.
3	Remove the four screws from the flange at the junction of the waveguide bend and front port (local oscillator input) of the modulator-preamplifier.
4	Remove the eight screws from the upper flange of the 1307-type filter.

CHART 4 (Cont)

STEP	PROCEDURE
5	Remove the two screws which hold the upper flange of the 1307 filter to the bracket.
6	Remove the two screws which hold the modulator bracket to the back plate.
7	Remove the modulator-preamplifier assembly from the RF panel.
8	Remove the modulator-preamplifier from the 9A isolator (Fig. 8).
9	Remove the top waveguide port cover from the replacement modulator-preamplifier.
10	Reassemble the 9A isolator to the modulator-preamplifier.
11	Reinstall the modulator-preamplifier to the RF panel.
12	Install the two screws which hold the modulator-preamplifier bracket to the back plate.
13	Install the two screws which hold the upper flange of the 1307 filter to the bracket.
14	Install the eight screws in the upper flange of the 1307-type filter.
15	Install the four screws to the flange at the junction of the waveguide bend and front port (local oscillator input) of the modulator-preamplifier.
16	Connect coaxial cable assemblies: (a) P-45R660 to J1 (b) P-45R659 to J2 (c) IF cable from baseband receiver unit to J3 (d) BNC cable to J4
17	Retune the receiver in accordance with Section 409-306-502.
18	Return the receiver to service in accordance with Chart 1.

CHART 5

J99262G IF AND BASEBAND UNIT

This chart contains the replacement procedures for the J99262G IF and baseband unit. If the receiver is equipped with the J99296G-2 receiver IF and baseband unit, refer to Chart 6. If the receiver is

CHART 5 (Cont)

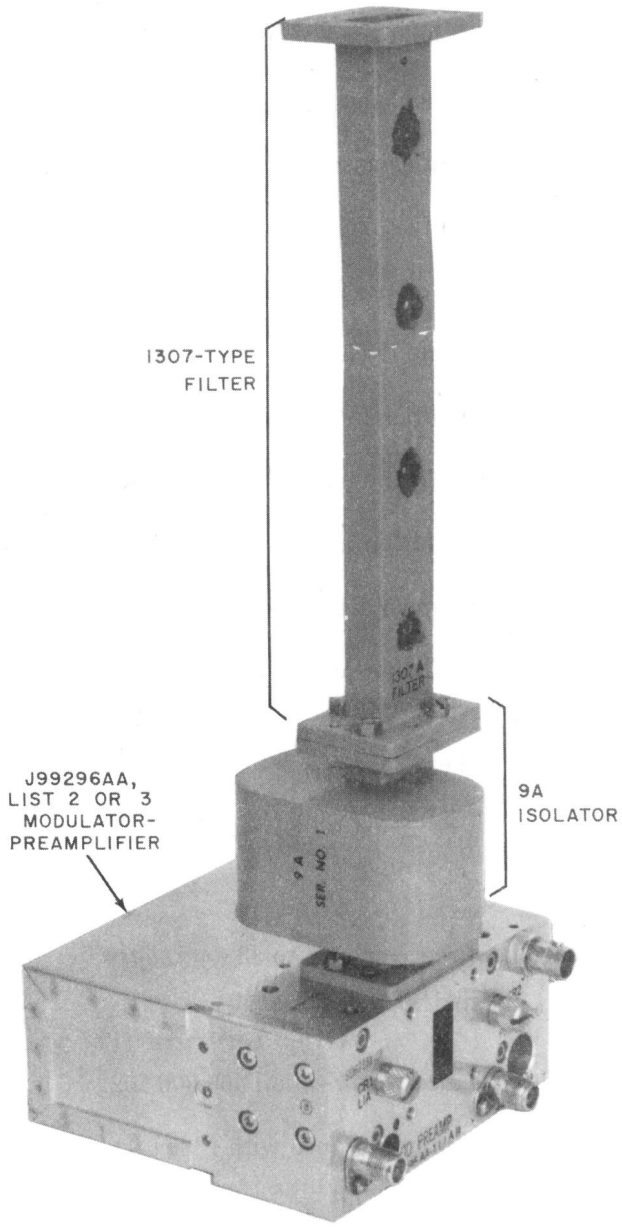

Fig. 8—J99296AA, L2 or L3 Modulator-Preamplifier Unit, 9A Isolator, and 1307-Type Filter

CHART 5 (Cont)

equipped with the J99351E-1 IF amplifier unit and the J99351J-1 FM receiver unit, refer to Chart 7.

APPARATUS:

None

STEP	PROCEDURE
1	Remove the receiver from service in accordance with Chart 1.
2	Remove the cables at the following: (a) RCVR OUT jack on the lower part of the front surface of the IF and baseband unit (b) PREAMPL IN jack on the bottom surface of the IF and baseband unit (c) PWR connector on top surface of the IF and baseband unit (Fig. 1).
3	Loosen the two top-mounting screws on the upper-foot support and the single-mounting screw on the bottom-foot support. Lift the assembly approximately 1/4 inch and remove the assembly from the transmitter-receiver panel.
4	Align a replacing assembly with the mounting screws and tighten the three mounting screws.
5	Install the cable at the PWR connector on the top surface of the IF baseband unit.
6	Operate the AGC switch on the upper part of the front surface to the ON position.
7	Perform the receiver checks covered in Section 409-306-501 and check the receiver baseband amplifier gain adjustment in Section 409-306-501. If the IF and baseband unit has not been checked recently, it is also desirable to check the squelch circuit alignment in Section 409-306-504.
8	Connect the cables at the RCVR OUT and PREAMPL IN jacks, and return the receiver to service in accordance with Chart 1.

CHART 6

J99296G RECEIVER IF AND BASEBAND UNIT

This chart contains the replacement procedures for the J99296G-2 receiver IF and baseband unit (Fig. 9). If the receiver is equipped with the J99262G IF and baseband unit, refer to Chart 5. If the receiver is equipped with the J99351E-1 IF amplifier unit and the J99351J-1 FM receiver unit, refer to Chart 7.

APPARATUS:

None

STEP	PROCEDURE
1	Remove the receiver from service in accordance with Chart 1.
2	Disconnect the coaxial cable assemblies from the IF IN jack and from the RCVR OUT jack.
3	Remove the 368A plug (75-ohm coaxial termination) from the IF MON jack.
4	Disengage the wing nut and bracket and remove the J99296G receiver IF and baseband unit using the two panel-mounted jacks as handles.
5	Slide the replacing J99296G receiver IF and baseband unit into place, making sure that the tracks are registered with the cover, and push the assembly into the frame.
6	Connect coaxial cable assemblies: (a) P-45R662 to IF IN jack (b) Cable equipped with 358A plug to RCVR OUT jack.
7	Replace the 3A clip on the RCVR OUT jack and plug.
8	Reinstall the 368A plug (75-ohm coaxial termination) in the IF MON jack.
9	Retune the receiver in accordance with Section 409-306-502.
10	Return the receiver to service in accordance with Chart 1.
11	Realign the diversity switch bistable comparator, where provided, in accordance with Section 409-312-501.

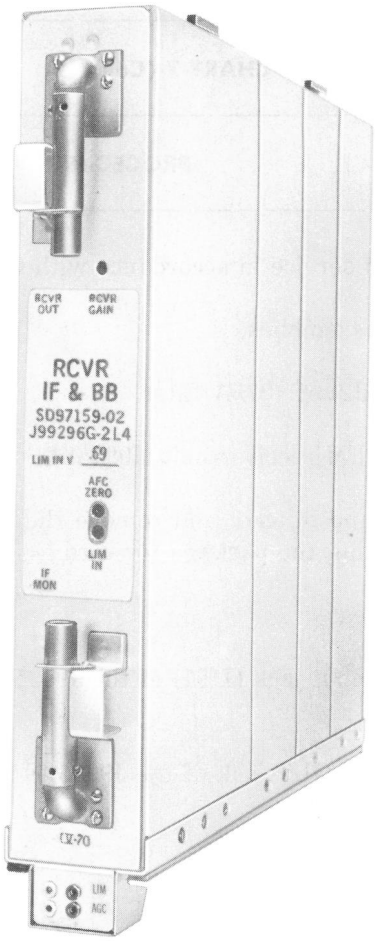

Fig. 9—J99296G Receiver IF and Baseband Unit

CHART 7

J99351E IF AMPLIFIER UNIT AND J99351J FM RECEIVER UNIT

This chart contains the replacement procedures for the J99351E-1 IF amplifier unit and the J99351J-1 FM receiver unit (Fig. 10). If the receiver is equipped with the J99262G IF and baseband unit, refer to Chart 5. If the receiver is equipped with the J99296G-2 receiver IF and baseband unit, refer to Chart 6.

APPARATUS:

None

CHART 7 (Cont)

STEP	PROCEDURE
1	Remove the receiver from service in accordance with Chart 1.
2	Disconnect coaxial cable assemblies: (a) IF input jack (J1 or J2) of 1075A filter (b) RCVR OUT jack of FM receiver unit (J99351J).
3	Disengage the wing nut and bracket and remove the IF amplifier and FM receiver package from the RF panel by sliding the package forward.
4	Disconnect cable assemblies: (a) 840881718 from IF input jack (J101) of the J99351E unit (b) 840881692 between IF OUT jack of the J99351E unit and RCVR IN jack of the J99351J unit.

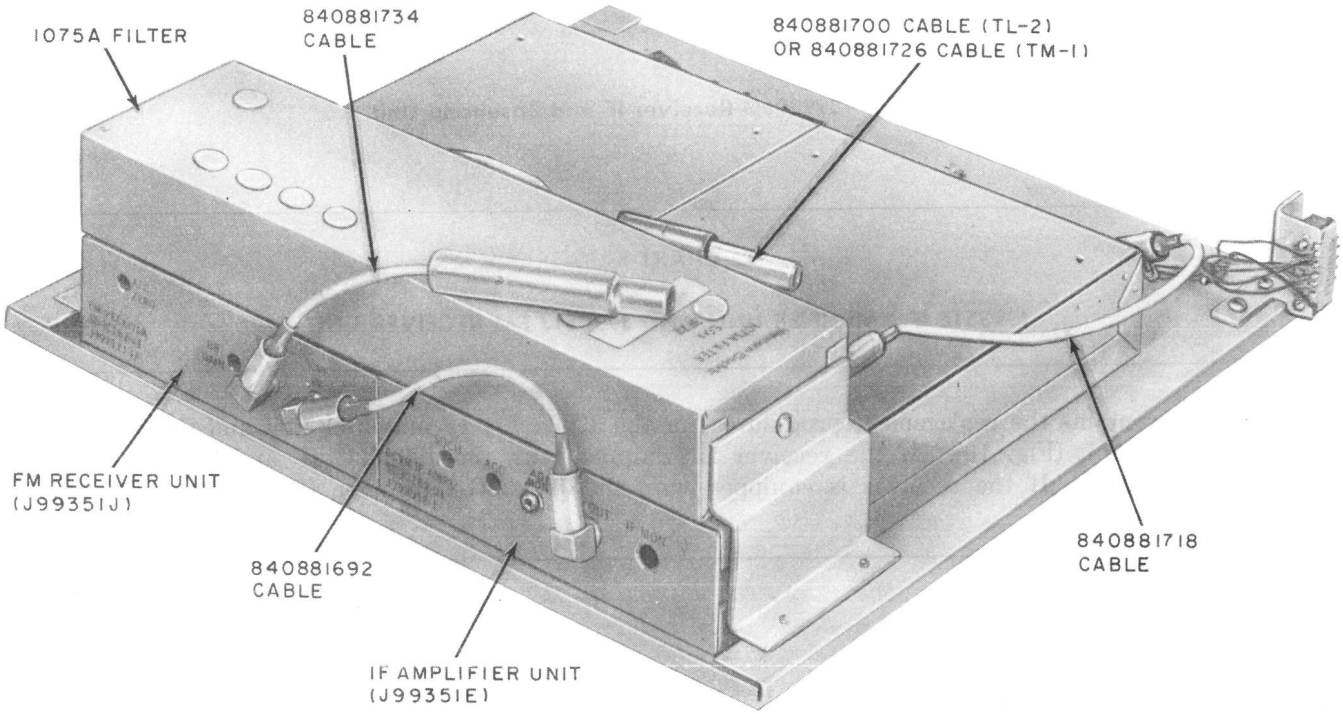

Fig. 10—J99351E IF Amplifier Unit and J99351J FM Receiver Unit Assembly

CHART 7 (Cont)

STEP	PROCEDURE
5	Disconnect local cable connector J701 from P101 of the J99351E unit or J702 from P201 of the J99351J unit, depending on which of the two units is to be replaced.
6	Remove the four screws which secure the J99351E or J99351J unit to be replaced.
7	Install the J99351E or J99351J replacement unit, as required, securing the unit with four screws removed in Step 6.
8	Connect local cable connectors J701 to P101 or J99351E unit J702 to P201 of J99351J unit, depending on unit replaced.
9	Connect cable assemblies: (a) 840001718 to IF input jack (J101) of J99351E unit (b) 840881692 between IF OUT of the J99351E unit and RCVR IN of the J99351J unit.
10	Slide the package into the tracks of the RF panel and secure the wing nut and bracket.
11	Connect cable assemblies: (a) IF input jack (J1 or J2) or 1075A filter (b) RCVR OUT jack of J99351J unit.
12	Retune the receiver in accordance with Section 409-306-502.
13	Return the receiver to service in accordance with Chart 1.
14	Realign the diversity switch bistable comparator, where provided, in accordance with Section 409-312-501.