

AFM 2
MAINTENANCE
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Radiometer Electronics a/s
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AFM 2

CHECK AF WIDE FILTER :

INPUT: $2\text{Mc} / 100\text{mV}$ (-10dB 1 ATT).

TÆLLER FORBINDES TIL MÅLESENDER

~~VED 2Mc~~ VTVM FORBINDES TIL IF OUTPUT. (RV 35)

VED 2Mc STILLES "LEVEL-POTM" TIL 0dB PÅ VTVM.

MÅLESENDER FREQ. VARIERES $\pm 200\text{Kc}$ (J: $1,8 - 2,2\text{Mc}$)

DÆMPNINGEN SKAL LIGGE INDEFOR 1dB pkt. symmetrisk.

-HVIS IKKE JUSTERES L 205 MEGET FORSIGTIG.

CHECK AF NARROW FILTER :

INPUT : $2\text{Mc} / 100\text{mV}$ (-10dB 1 ATT.).

TÆLLER FORBINDES TIL MÅLESENDER

VTVM FORBINDES TIL IF OUTPUT. (RV 35).

VED 2Mc STILLES "LEVEL-POTM" TIL 0dB PÅ VTVM.

MÅLESENDER FREQ. VARIERES $\pm 25\text{Kc}$ (J: $1,975 - 2,025\text{Mc}$)

DÆMPNINGEN SKAL LIGGE INDEN FOR 3dB pkt. SYMMETRISK.

-HVIS IKKE JUSTERES L 405 MEGET FORSIGTIG.

GENERAL

The following maintenance procedure is based on the assumption that any printed circuit found defective is replaced by a new one delivered by Radiometer and prealigned at the factory. This procedure reduces adjustments in the field to a minimum. However, the test instruments necessary to make these field adjustments must be of high quality to achieve the required standard of performance of the AFM2.

TEST INSTRUMENTS REQUIRED

The following is a list of preferred instruments. Any alternatives must have equivalent specifications and should possess the same degree of accuracy.

Signal Generator:

Radiometer electronic
type: RE101

Freq. range: 0.15 - 30 MHz
86 - 130 MHz

Counter:

200 MHz sensitivity: 30 mV,
or a Sig. Gen. with freq. range
30-200 MHz

Oscilloscope:

Freq. band 2 MHz

DC DVM:

4 1/2 digit, sensitivity: 1 volt
least significant digit: 100 μ V

AC VTVM:

Sensitivity 20 mV f.s.d.
Freq. range: 20 Hz - 2 MHz.

Miscellaneous:

1 Hexagonal Key, 2.5 mm (at least 75 mm)

1 Extender PC-board, Code 900-254.

DISMANTLING

To remove the AFM2 from its case proceed as follows:

- a) Stand the instrument on its rear panel.
- b) Remove the four hexagonal bolts located beside the carrying handles on the front panel.
- c) Carefully lift the instrument out of the case.

REPLACEMENT AND REALIGNMENT PROCEDURE OF THE PRINTED CIRCUIT BOARDS

PRELIMINARY INSTRUCTIONS

When asked to feed a 2 MHz signal into the INPUT CONNECTOR of the AFM2 during the following checks, proceed as follows:

1. a) Connect the Sig. Gen. to the RF INPUT of the AFM2 and feed in 2 MHz at 100 mV_(rms).
- b) Set the RANGE selector of the AFM2 between ranges E and F.
- c) Set the FUNCTION switch to LEVEL.
- d) If there is no deflection on the meter, turn the RANGE selector knob back and forth a little to obtain a deflection.
- e) Set the FUNCTION switch to IF CHECK.
- f) Check that the meter deflects to the IF CHECK mark.
- g) Set the FUNCTION switch to LEVEL.
- h) Adjust the LEVEL potentiometer until the meter deflects to the LEVEL mark.
- i) The AFM2 is now ready for check or realignment.

2. Check the mechanical zero-point at the meter on AFM 2.

POWER SUPPLY

(see circuit diagrams 1196-A1 and 1198-A1)

- 1) Connect a DC DVM between J1100/8 (+12 V) and J1100/10 (0.V).
- 2) Adjust R1115 until the DC DVM indicates +12 V $\pm 1\%$.
- 3) Move the DC DVM from J1100/8 to J1100/13.
- 4) Check that DC DVM indicates -12.0 V ± 0.3 V.
- 5) Disconnect DC DVM.

LIMITER

(see circuit diagrams 1197-A1 and 1198-A1)

- 1) Connect the DC DVM between tags chassis and J600/16 (+10 V).
- 2) Using a trimming tool, adjust potentiometer R660 (shown in Fig. G7) until the DC DVM indicates +10 V dc $\pm 0.5\%$.
- 3) Move DC DVM from J600/16 (+10V) to J600/14 (-10 V).
- 4) Using a trimming tool, adjust potentiometer R668 (fitted only in the latest versions of the AFM2) until the DC DVM indicates -10 V dc $\pm 0.5\%$.
- 5) Disconnect the DC DVM.

TUNER printed circuit board

DISMANTLING/REMOUNTING

- 1) Fig. G4 shows the location of the TUNER and Fig. G5 shows a top view of the TUNER assembly.
- 2) To remove the TUNER printed circuit rotor, first remove the cover plate of the TUNER (pry up).
- 3) Remove the 7 screws retaining the circular printed rotor. Carefully pull the rotor out of the fixed contacts and then lift out. Replace the new rotor in the opposite sequence. Check the orientation of the rotor and take extreme care not to damage the contacts on the fixed printed circuit board. Before securing the 7 retaining screws, check that the rotor does not foul the fixed printed circuit board. Check that it is properly centred and that the contacts mesh correctly (no overlapping of the contacts).
- To remove the fixed TUNER printed circuit board, proceed as follows:
- 4) Remove the TUNER printed circuit rotor as described in 3) above.
- 5) Turn the TUNING knob fully anticlockwise.
- 6) Insert the 2.5 mm hexagonal key through the hole in the bottom chassis support plate and loosen the set screw in the coupling of the variable capacitor.
- 7) Unsolder the leads and cables soldered to the printed board, taking care not to damage the leads or the cable insulation. Do not use excessive heat when unsoldering the connections.
- 8) Remove the three screws securing the printed circuit board.
- 9) Using the blade of a screwdriver inserted through the hole in the bottom chassis support, hold the coupling in place and carefully pull out the printed circuit board.
- 10) To replace the printed circuit board, proceed as follows:
- 11) Again using the blade of a screwdriver inserted through the hole in the bottom chassis support, guide the coupling into position on the shaft of the variable capacitor and mount the replacement PC board in position.

- 12) Insert the 3 retaining screws, but do not tighten them at this point.
- 13) Mount the printed circuit rotor as described above in 3).
- 14) Secure the 3 retaining screws when both the rotor and the fixed printed circuit boards are orientated correctly.
- 15) Rotate the variable capacitor until fully meshed.
- 16) Tighten the screw in the coupling, using the 2.5 mm hexagonal key.

TUNER (Adjusted with Counter)

- 1) Connect a 200 MHz counter to the RF INPUT connector of the AFM2. (A 20 MHz counter in connection with a ten-divider may be used).
- 2) Set RANGE switch to A.
- 3) Set TUNING to the lowest frequency.
- 4) Using an insulated trimming tool, adjust the core of the oscillator coil for RANGE A (marked on the circular printed circuit rotor) to the same frequency as the TUNING knob is set to.
Tolerance: 3%.
- 5) Set TUNING to the highest frequency.
- 6) Using an insulated trimming tool, adjust the oscillator trimming capacitor for RANGE A (located next to the oscillator coil for RANGE A) to the same frequency as the TUNING knob is set to.
Tolerance: 3%.
- 7) Because of interaction between these adjustments it will be necessary to repeat items 3) to 6) inclusive, several times, until the respective TUNING points can be set without readjustment.
- 9) Repeat items 3) to 7) on the remaining ranges B, C, D, E and F at the appropriate range frequencies.

TUNER (Adjusted with a Signal Generator)

- 1) Proceed to the electrical adjustments as follows:
- 2) Set the following controls:
 - a) RANGE switch to A
 - b) TUNING to 7 MHz
 - c) MAN/AUTO switch to MAN.
 - d) FUNCTION switch to LEVEL
 - e) LEVEL potentiometer to 10

- 3) Connect the Sig. Gen. to the RF INPUT connector of the AFM3.
- 4) Set the Sig. Gen. to 9 MHz. CW, 100 mV.
- 5) Adjust the Sig. Gen. output until a suitable deflection of the meter of the AFM3 is obtained.
- 6) Using an insulated trimming tool, adjust the core of the oscillator coil for RANGE A (marked on the circular printed circuit rotor) for a maximum deflection on the meter. If the meter overshoots, turn the LEVEL knob anticlockwise until again a suitable deflection is obtained.
- 7) Reset the Sig. Gen. to 10 MHz.
- 8) Reset the TUNING to 12 MHz.
- 9) Using an insulated trimming tool, adjust the oscillator trimming capacitor for RANGE A (located next to the oscillator coil for RANGE A) for a maximum deflection on the meter.
- 10) Because of interaction between these adjustments it will be necessary to repeat items 2a) and 2b), 6) to 9) inclusive several times until the maximum deflection occurs at the respective TUNING settings without readjustment.
- 11) Repeat items 1) to 10) on the remaining ranges B, C, D, E and F at the appropriate range frequencies, choosing the Sig. Gen. necessary to cover the range in question.

IF FILTER (WIDE) and IF AMPLIFIER/IF ATTENUATOR printed circuit boards

These two printed circuit boards are matched at the factory and must be replaced as a matched pair. No realignment adjustments are necessary.

REPLACEMENT

- 1) To replace the IF FILTER (WIDE), proceed as follows:
- 2) Remove the cover plate by unscrewing the four screws A (two shown in Fig. G6).
- 3) Unsolder the input and output cables to the printed circuit, taking extreme care not to damage the cables or the nearby components by overheating.
- 4) Using a posidrive angle screwdriver, unscrew the four screws securing the printed circuit board to the housing.
- 5) Lift the printed circuit board out.
- 6) Replace in the opposite sequence, again taking extreme care when resoldering the input and output cables.
- 7) When the IF FILTER (WIDE) is replaced, the IF AMP/ATTENUATOR printed circuit board must also be changed out (or vice versa), as these two boards are matched at the factory in pairs.
- 8) To change out any of the printed circuit boards, first remove the retaining bar C by unscrewing the two securing screws D (shown in Fig. G6).
- 9) The printed circuit boards may now be withdrawn. Some resistance will be felt when disengaging the multiconnectors.
- 10) When replacing the boards, first make sure that they are located in the correct position and then slide them into the guides. Some resistance will be felt when

IF AMPLIFIER/IF ATTENUATOR PC-board

(see circuit diagrams 1193-A1 and 1198-A1)

Sensitivity Realignment:

- 1) Set LEVEL potm. fully CCW.
- 2) Set MAN/AUTO to MAN.
- 3) Set INPUT-ATT. to 0dB.
- 4) Connect a Sig. Gen. to the INPUT of the AFM2.
- 5) Set Sig. Gen. to 100 MHz CW, $100 \text{ mV}_{(\text{rms})} \pm 1 \text{ dB}$.
- 6) Set the RANGE to E.
- 7) Set to IF CHECK with TUNING.
- 8) Set FUNCTION to LEVEL (LEVEL still fully CCW.) and adjust R345 until the meter indicates 90 % of full scale deflection.
- 9) Disconnect the Sig. Gen.

AM DETECTOR + IF AMPLIFIER

(see circuit diagrams 1194-A1 and 1198-A1)

- 1) Connect a DC DVM to the IF LEVEL (DC) jacks (placed at the rear panel).
- 2) Turn the LEVEL potentiometer counter clock wise.
- 3) Adjust the potentiometer R558 (shown in Fig G) until the DC DVM indicates $0 \text{ V} \pm 2 \text{ mV}$.
- 4) Disconnect the DC DVM.
- 5) Connect a Sig. Gen. to the INPUT of the AFM2.
- 6) Set the Sig. Gen. to 2 MHz CW, $100 \text{ mV}_{(\text{rms})}$.
- 7) Set the RANGE selector between ranges E and F, and refer to the PRELIMINARY INSTRUCTIONS at the beginning of this Section.
- 8) Set the FUNCTION switch to LEVEL.
- 9) Set the MAN/AUTO switch to AUTO.
- 10) Set the LEVEL potentiometer to 5.
- 11) Adjust the potentiometer R553 (shown in Fig. G4) until the meter deflects to the LEVEL mark.
- 12) Connect an oscilloscope to tags J500/5 (centre conductor of cable W6) and chassis on the AM DET. PC-board.
- 13) Set the MAN/AUTO switch to MAN.

14) Check that the display shows a sine-wave form.

15) Turn the LEVEL potentiometer clockwise until the display just shows the commencement of "flats" on the peaks.

16) Adjust the potentiometer R514 (location shown in Fig. G4) until the limitation is symmetrical, with respect to the x-axis.

17) Disconnect the oscilloscope.

18) Withdraw the AM DET. printed circuit board (V) and refer to Fig. G1 and Fig. H5.

Proceed as follows:

a) Refer to Fig. H5 and locate the tag block TB501.

b) Disconnect the strap on the tag block TB501 marked A in Fig. G1.

c) Temporarily connect strap C as shown in Fig. G1.

(In the latest versions of the AFM2 it is necessary to short circuit C530 (68 μ F) directly, and strap C is not necessary).

d) Replace the board into circuit.

19) Connect a DC DVM between tags 2 and 3 on TB501.

20) Set the FUNCTION switch to LEVEL and adjust the LEVEL potentiometer until the meter deflects to 100 exactly.

21) Adjust the trimmer potentiometer R539 (location shown in Fig. G1 and G6) until the DC DVM indicates 185.0 mV.

This value will be referred to as U1.

22) Reduce the LEVEL potentiometer 6 dB exactly, this is referred to as 50 on the meter.

23) Note the voltage indicated on the DC DVM.

This value will be referred to as U2.

24) Check that $U2 - U1 = 94.9 \text{ mV} \pm 0.2 \text{ mV}$.

25) If $U2 - U1$ is greater than 94.9 by a value x (i.e., $U2 - U1 = 94.9 + x$), readjust R539 until the value indicated on the DC DVM = $185.0 \text{ mV} - x$, (referred to items 16) and 17).

26) Repeat 16) to 20) until $U2 - U1 = 94.9 \text{ mV}$.

27) Disconnect the DC DVM and the Sig. Gen.

28) Disconnect the temporary strap C (location shown in Fig. G1) on TB501 (AM DETECTOR PC-board) and reconnect the strap at A.

LIMITER

(see circuit diagrams 1197-A1 and 1198-A1)

- 1) Connect the Sig. Gen. 2 MHz CW, 100 mV_(rms).
- 2) Withdraw LIMITER PC-board and replace it with a code 900-254 Extender Board. Plug the LIMITER PC-board into the Extender PC-board.
- 3) Connect an oscilloscope between J600/15 and the collector of Q602.
- 4) Set the LEVEL potm. to 5.
- 5) Adjust the potentiometer R612 (shown in Fig. 3) until the square-waveform have a duty-circle at 50%.
- 6) Disconnect the Sig. Gen., and the oscilloscope.

FM DETECTOR + IF CHECK realignment

(see diagrams 1281-A1 and 1303-A1)

- 1) Connect the Sig. Gen. to INPUT.
- 2) Set the Sig. Gen. to 2 MHz \pm 1 kHz, CW, 100 mV.
- 3) Set the FUNCTION switch to IF CHECK.
- 4) Set the MAN/AUTO switch to AUTO.
- 4a) Set the LEVEL potm. to 5.
- 5) Set the FILTER/DEEMPHASIS switch to 50 Hz - 15 kHz.
- 6) Set the RANGE selector between ranges E and F (refer to the preliminary instructions).
- 7) Using a trimming tool, adjust the potentiometer R737 (shown in Fig. G7) until the meter deflects to the IF CHECK mark on the scale.
- 8) Set the Sig. Gen. to 2.2 MHz \pm 1 kHz CW, and check that the meter indicates +200 with respect to the IF CHECK mark.
- 9) Set the Sig. Gen. to 1.8 MHz \pm 1 kHz, and check that the meter indicates -200 with respect to the IF CHECK mark.
- 10) If not, adjust R739 and repeat items 7) to 10) until this is achieved.
- 11) Connect the DC DVM between J700/5 and J700/8.
- 12) Using a trimming tool, adjust the potentiometer R708 (shown in Fig. G6) until the DC DVM indicates 3848.4 mV. (Be sure that the meter is still exactly at IF CHECK).
- 13) Repeat items 7) to 12).
- 14) Disconnect the DC DVM and the Sig. Gen..

- AF AMPLIFIER I-II see circuit diagram 1815-A2
 + AF AMPLIFIER III - V see circuit diagram 1813-A2
 + AF DETECTOR see circuit diagram 1816-A2
 for all see circuit diagram 1198-A1

- 1) Set the FILTER/DEEMPHASIS switch to 6 dB/oct.
 - 2) Connect a DC DVM between tags J800/2 and J800/3.
 - 3) Using a trimming tool, adjust the potentiometer R803 (shown in Fig. G3) until the DC DVM indicates $0\text{ V} \pm 10\text{ mV}$.
 - 3a) Disconnect the DC DVM and the meter on the AFM1.
 - 4) Set FUNCTION to +AM.
 - 5) Set RANGE selector to G.
 - 6) Set METER RANGE to 100.
 - 7) Using a trimming tool, adjust potentiometer R929 (shown in Fig. G7) until the meter indicates zero.
 - 8) Connect the Sig. Gen. to INPUT.
 - 9) Set METER RANGE to 30.
 - 10) Set the FILTER/DEEMPHASIS switch to 200kHz.
 - 11) Set RANGE selector between any two ranges.
 - 12) Set the Sig. Gen. at 2 MHz/30% AM, 100 mV.
 - 13) Connect an AC VTVM between tags J800/15 and chassis , (AF AMP. tags I-II).
 - 14) Adjust the LEVEL potentiometer until the AC VTVM indicates 20 mV (rms value).
 - 15) Disconnect the AC VTVM from the tags J800/15 and chassis and reconnect it to the AF OUTPUT connector.
 - 16) Using a trimming tool, adjust R29 (shown in Fig. H1) until the AC VTVM indicates 0.671 V (rms value).
-
- 22) Using a trimming tool, adjust the potentiometer R923 (shown in Fig. G4) until the meter on the AFM2 indicates 30.
 - 23) Disconnect the Sig. Gen. and the AC VTVM.
 - 24) Set the FUNCTION switch to -AM.
 - 25) Set the METER RANGE to 100.
 - 26) Using a trimming tool, adjust potentiometer R1002 (shown in Fig. G7) until the meter on the AFM2 indicates zero.

METER

- 1) If the meter has been changed out, it will be necessary to realign the following printed circuits:
 - a) AF AMPLIFIER I-II
 - b) AF AMPLIFIER III-V
 - c) AF DETECTOR
- 2) With models of serial number 173610 and above, no realignment adjustment is necessary after replacement of the meter.

RF ATTENUATOR printed circuit board

- 1) No realignment is necessary after replacing the RF ATTENUATOR printed circuit board.
- 2) To replace the RF ATTENUATOR, proceed as follows:
- 3) Remove the TUNER cover plate (pry up).
- 4) Remove the cover of the attenuator by unscrewing the two securing screws and loosening the 8 mm nut.
- 5) Unsolder the input lead of the RF INPUT connector and loosen the nut securing the connector. (To give further access to the attenuator and RF INPUT connector, it is recommended that the left-hand side frame of the chassis be removed by unscrewing its 6 mounting screws, 2 on the front panel, 2 on the side frame and 2 on the rear frame.
- 6) Unsolder the cable from the attenuator inside the TUNER and withdraw it from the screening tube between the TUNER and the attenuator.
- 7) Remove the screw located to the right-hand side of the attenuator pushbuttons, and lift the attenuator assembly out of the chassis.

NOTE: When replacing the attenuator assembly, secure the screws carefully and check that the front panel does not foul the pushbuttons.

REPLACEMENT OF THE SCALE CORDS

Refer to Figs. G8 and G9.

Two cords are used, a long and a short. The long cord couples the cursor to the drive wheel. The short cord couples the TUNING knob shaft to the drive wheel.

To facilitate replacement, remove first the scale drum. This is done by unscrewing the screws at either side of the scale window. Take care not to scratch the window, which is retained in place by the screws securing the scale drum. After replacement of the cords, remount the scale drum and window, taking care not to scratch the window. Check that the scale exposed in the window corresponds to the RANGE setting.

Using a hexagonal key, loosen the two screws securing the drive wheel to the shaft. Turn the TUNING knob until the cursor is in its extreme left-hand position. Check that the capacitor in the TUNER is fully meshed. Set the reference line on the cursor over the trimming mark to the left of the scale and tighten the screws securing the drive wheel.

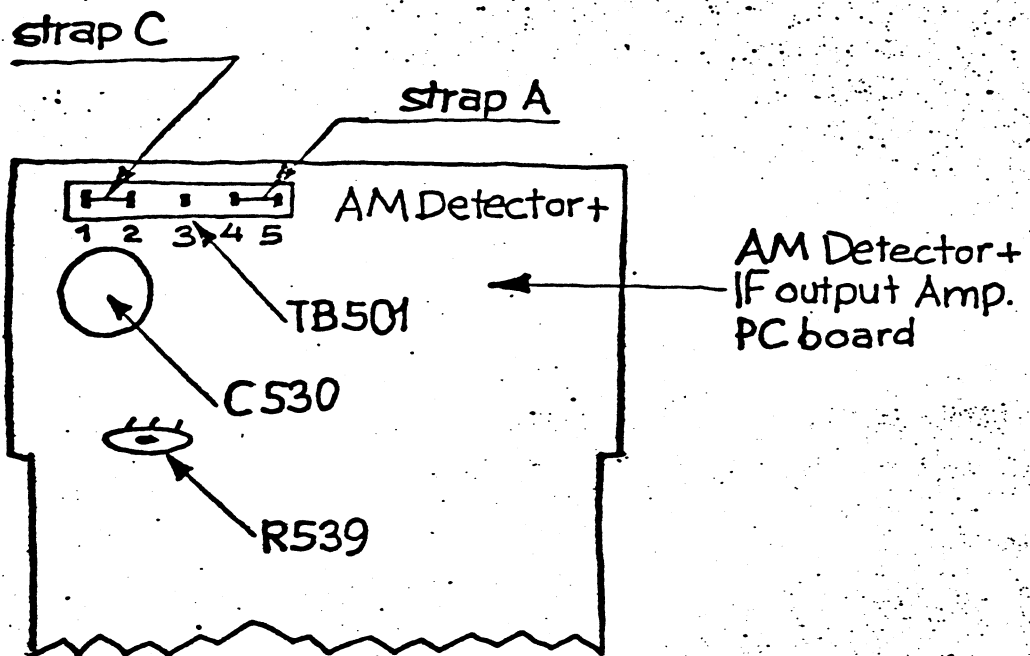


Fig. G-1

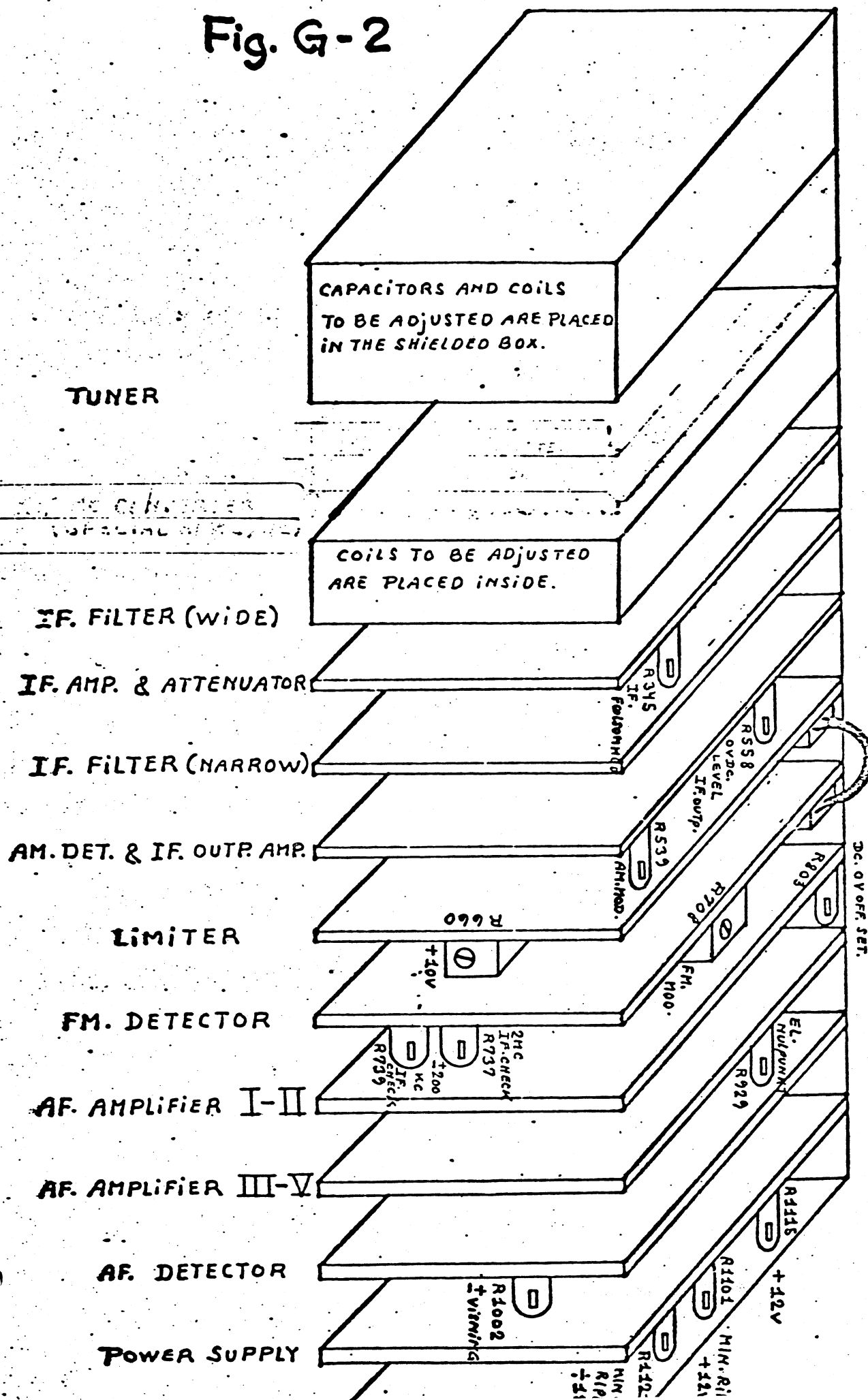
LOCATION OF PRINTED CIRCUIT BOARDS AND TAILMEAS.

27-3-74.

Nn.

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Fig. G-2



FRONT VIEW OF AFM 2.

LOCATION OF PRINTED CIRCUIT
BOARDS AND TRIMMERS.

27-3-74.

Nh.

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Fig. G-3

TUNER

IF FILTER (WIDE)

IF AMP. & ATTENUATOR

IF FILTER (NARROW)

AM. DET. & IF. OUTP. AMPL.

LIMITER

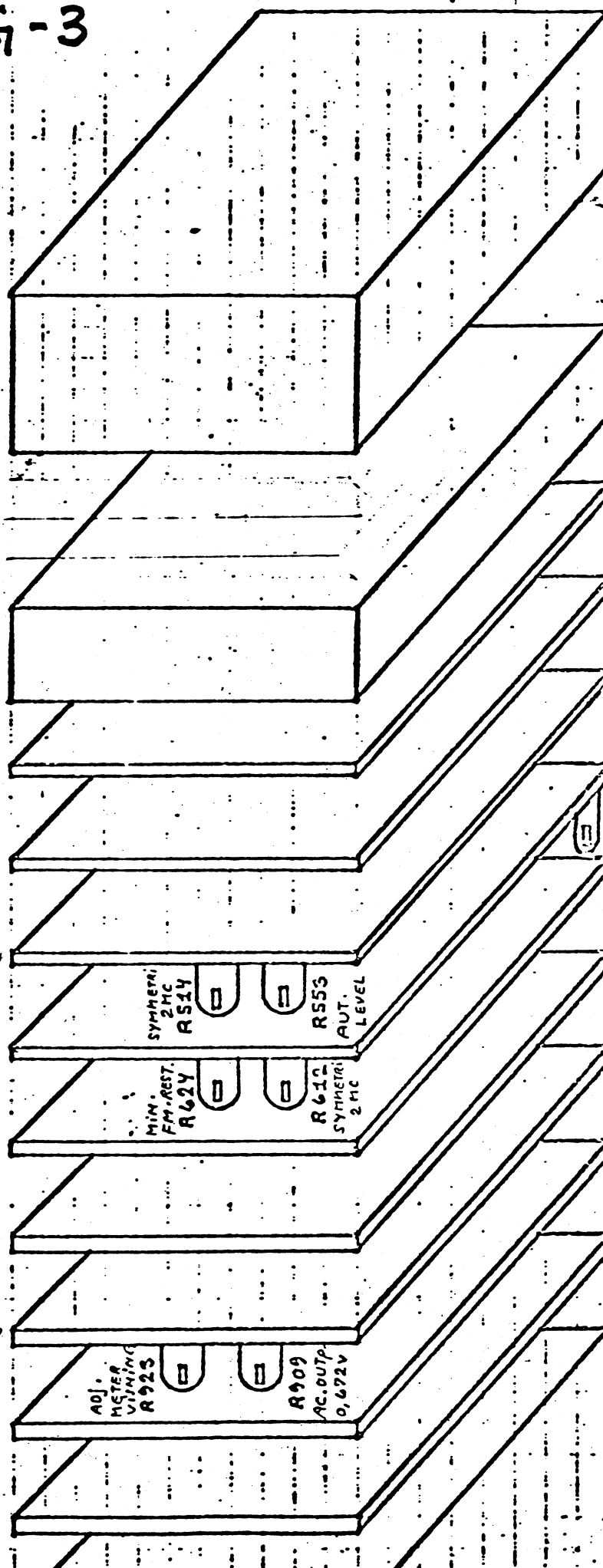
FM. DETECTOR

AF. Amplifier I-II

AF. Amplifier III-V

AF. DETECTOR

POWER SUPPLY



R668
-10V

REAR VIEW OF AFM2.

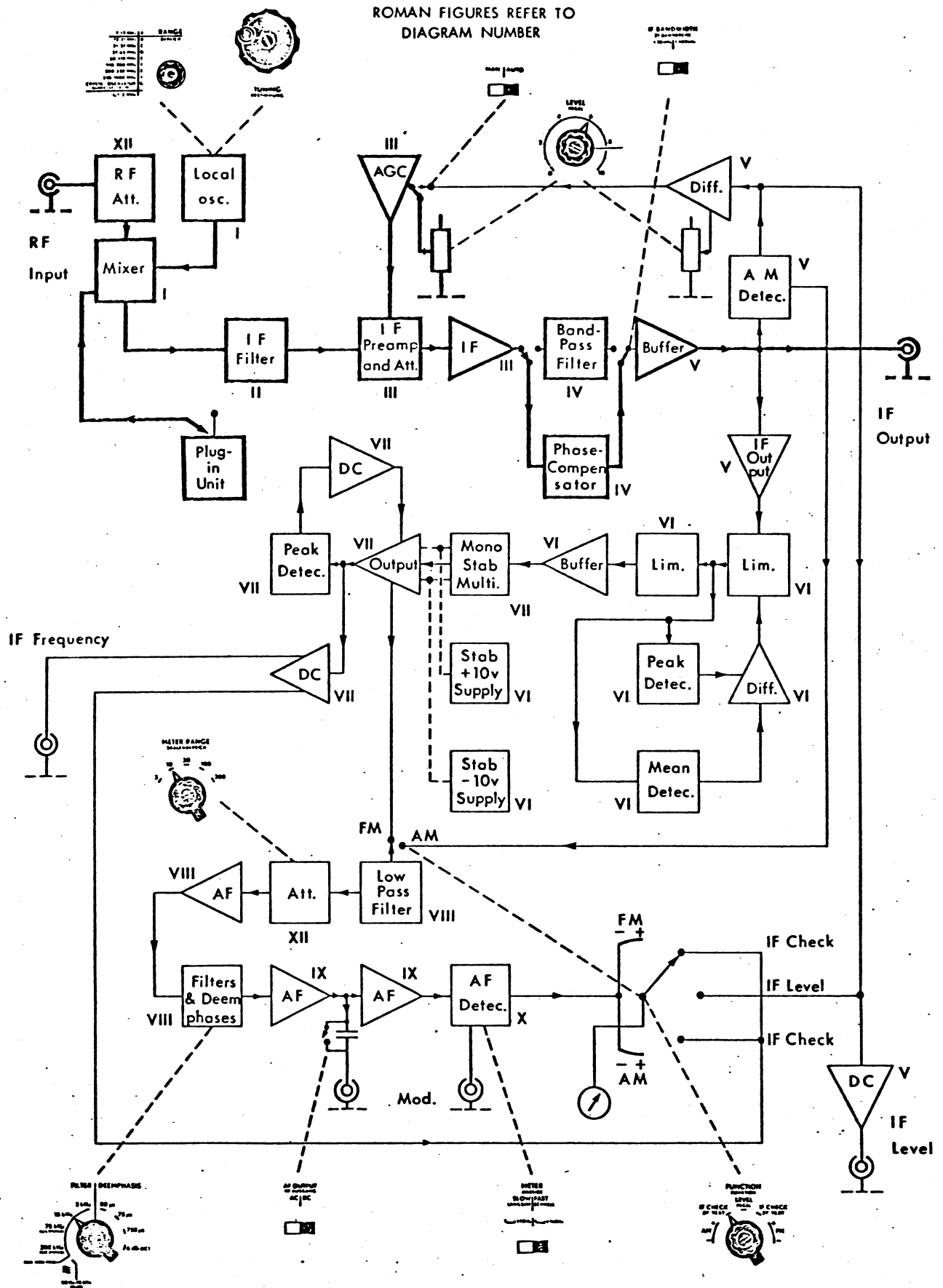


Fig.H1. Intermediate Frequency Check.

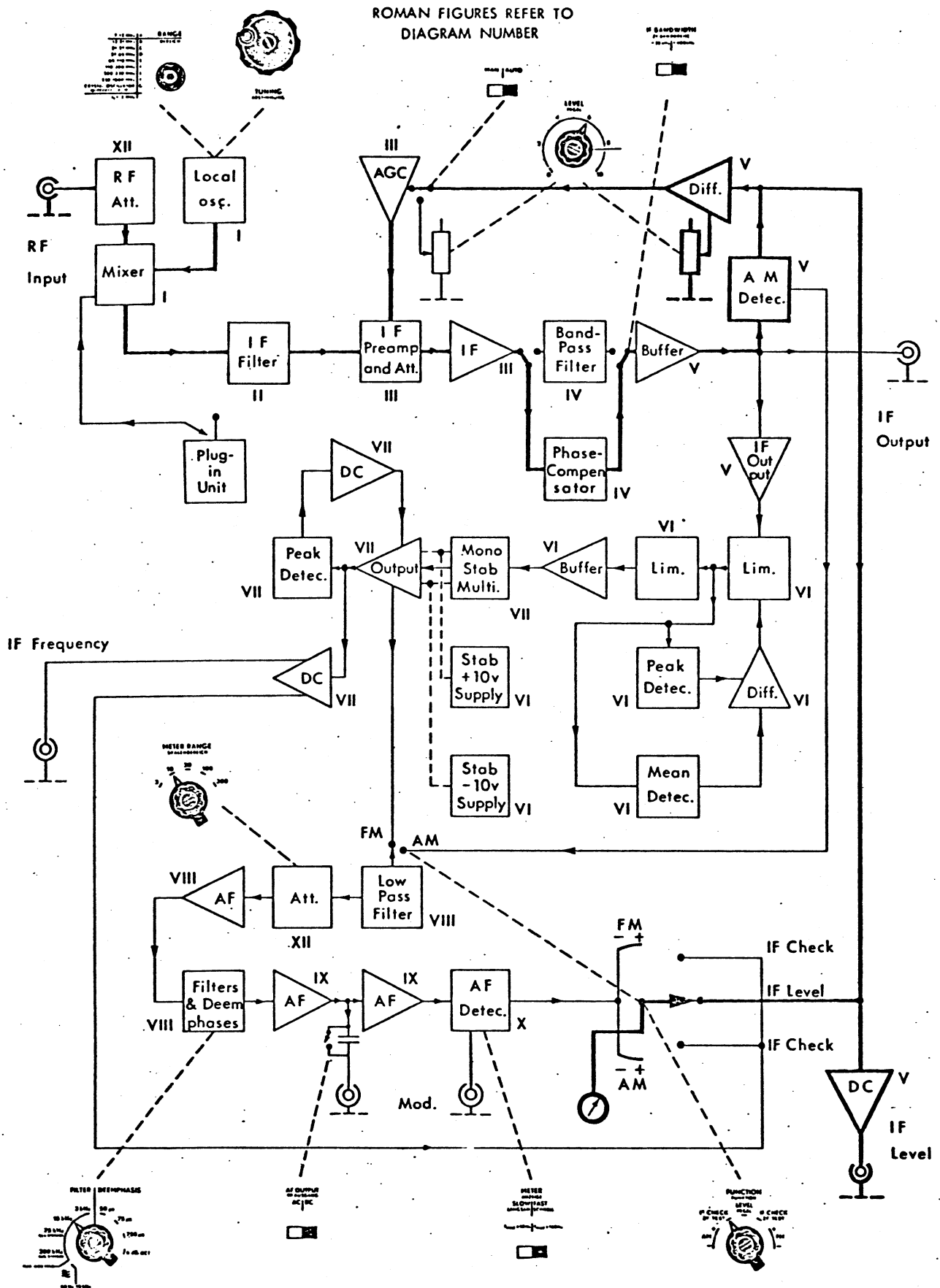


Fig.H2. Level Check.



Fig.H3. AM Modulation Check.

ROMAN FIGURES REFER TO
DIAGRAM NUMBER

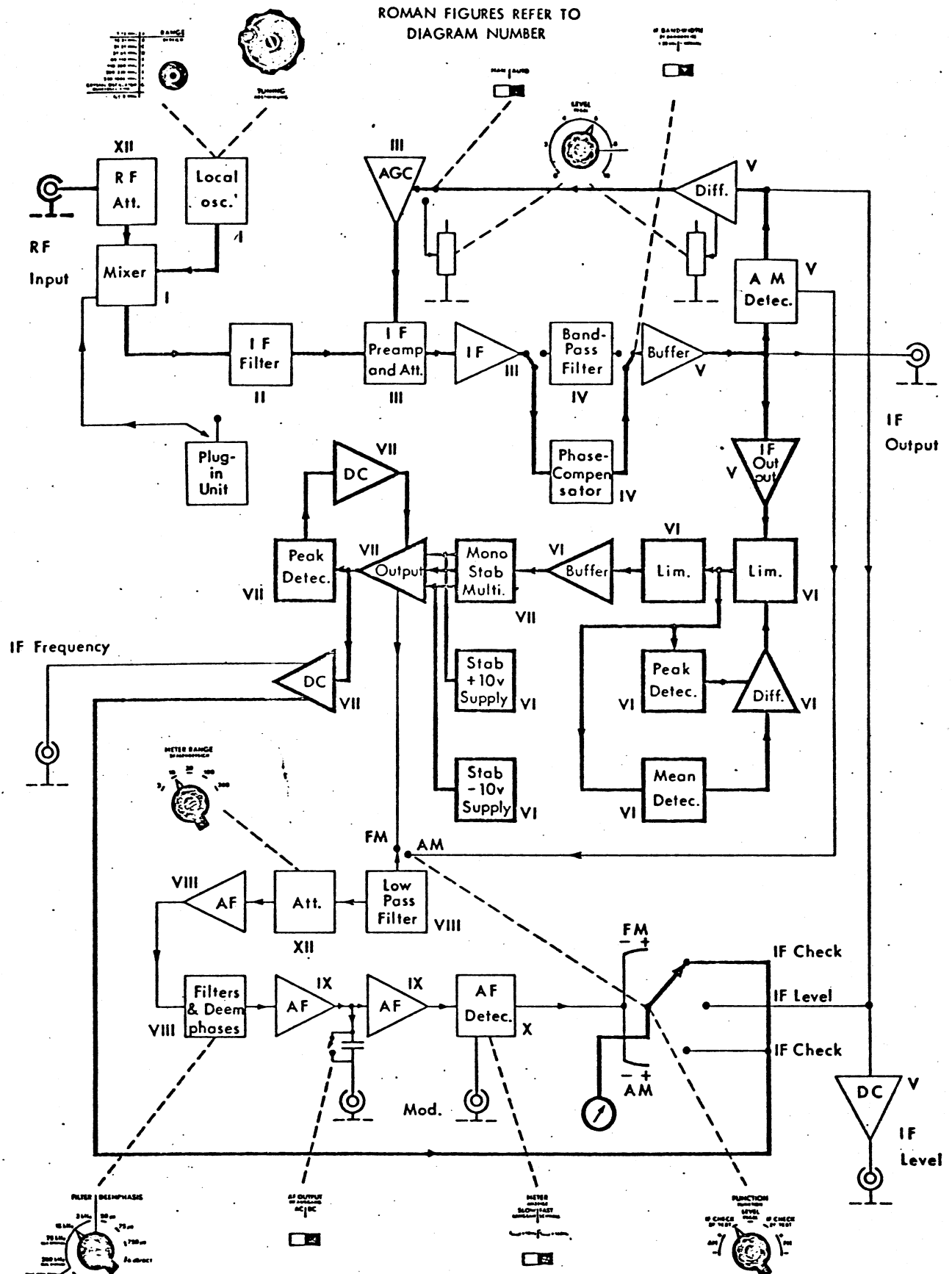


Fig.H4. FM Modulation and IF Check.

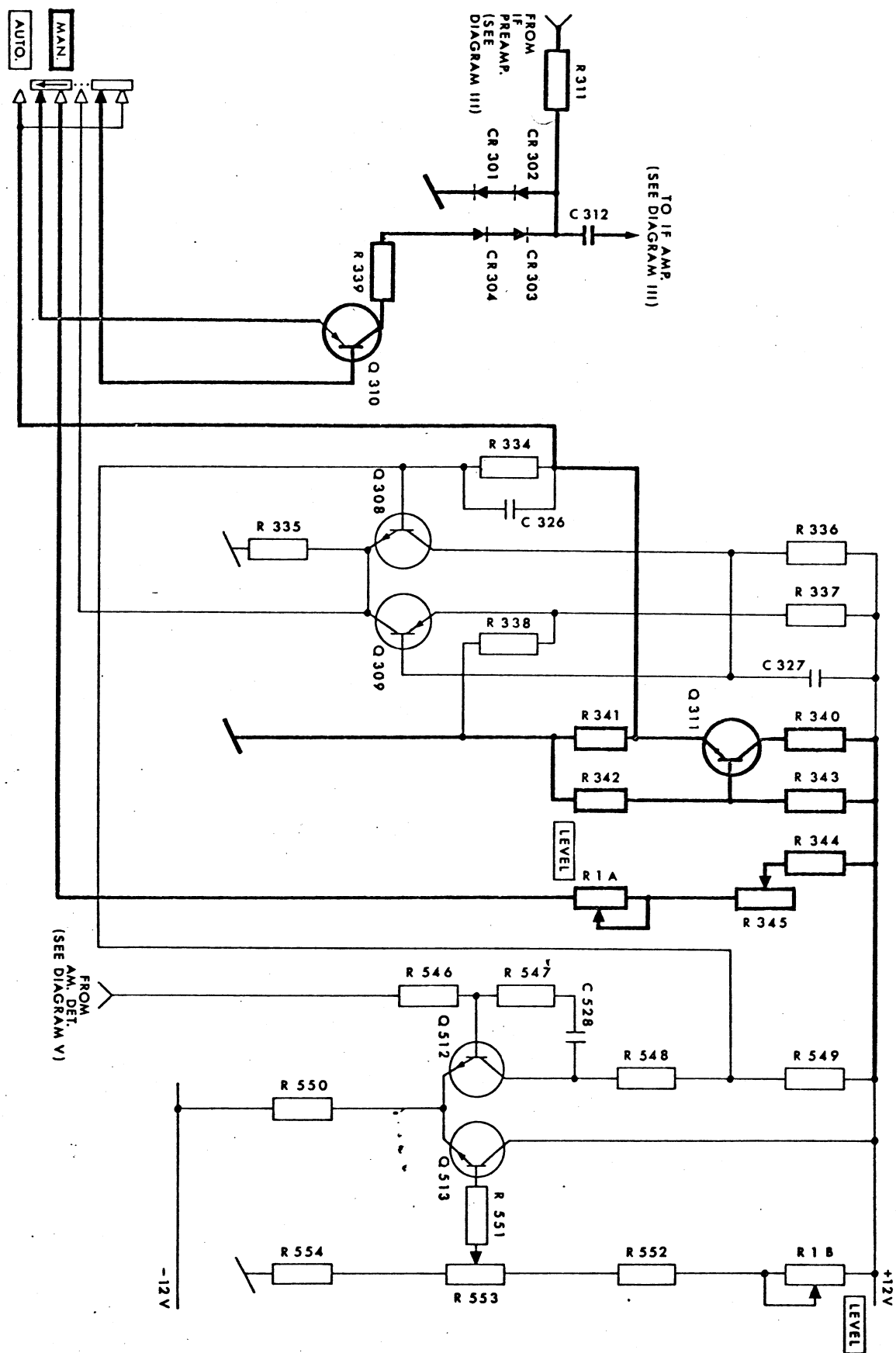


Fig.H5. IF Attenuator and AGC Amplifier in position **MAN.**

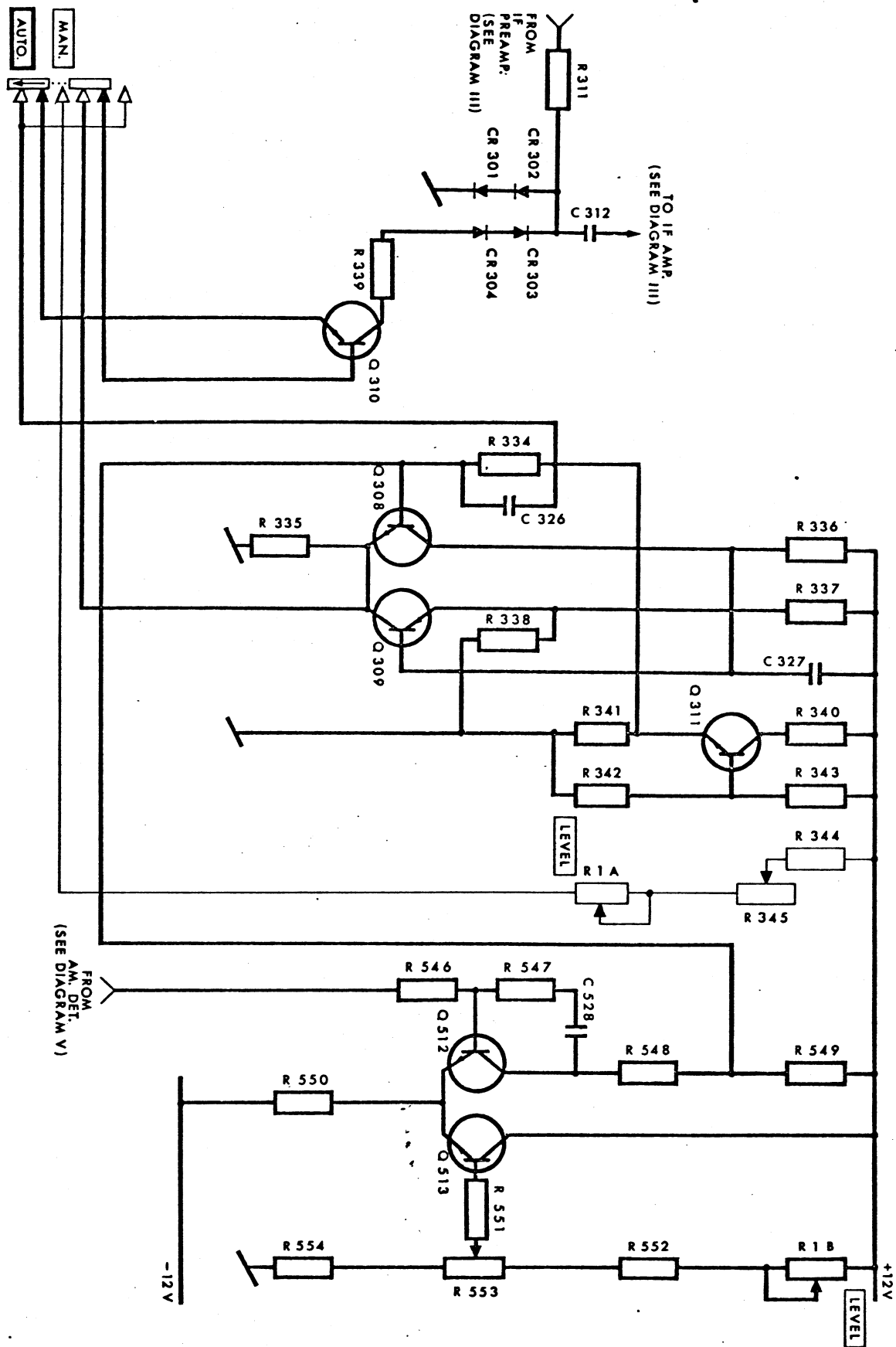


Fig.H6. IF Attenuator and AGC Amplifier in position AUTO.