Serial No. 30,001 and later

CRF-230

SONY®

SERVICE MANUAL

TABLE OF CONTENTS

SECTION 1
OUTLINE

1-1. SPECIFICATIONS

Circuit System:	Superheterodyne (FM-1, FM-2, MW, LW, SW-1) Double superheterodyne (SW-2 ~ SW-19)
Semiconductor:	27 transistors, 3 FET for reception, 18 transistors for auxiliary functions, 34 diodes, 1 thermistor
Frequency Coverage:	FM-1 ; 64 - 90 MHz FM-2 ; 87 - 108 MHz MW ; 530 - 1,605 kHz (566 - 187 m) LW ; 150 - 400 kHz (2,000 - 750 m) SW-1 ; 1.6 - 2.2 MHz (160 m) SW-2 ; 2.0 - 2.6 MHz (120 m) SW-3 ; 3.0 - 3.6 MHz (90 m) SW-4 ; 3.5 - 4.1 MHz (75 - 81 m) SW-5 ; 4.5 - 5.1 MHz (60 m) SW-6 ; 5.8 - 6.4 MHz (49 m) SW-7 ; 7.0 - 7.6 MHz (40 - 41 m) SW-8 ; 9.5 - 10.1 MHz (31 m) SW-9 ; 11.5 - 12.1 MHz (25 m) SW-10; 14.0 - 14.6 MHz (20 m) SW-11; 15.0 - 15.6 MHz (19 m) SW-12; 17.5 - 18.1 MHz (16 m) SW-13; 21.0 - 21.6 MHz (15 m) SW-14; 21.4 - 22.0 MHz (13 m) SW-15; 25.5 - 26.1 MHz (11 m) SW-16; 26.8 - 27.4 MHz (11 m) SW-17; 28.0 - 28.6 MHz (10 m) SW-18; 28.6 - 29.2 MHz (10 m) SW-19; 29.2 - 29.8 MHz (10 m)
Intermediate Frequency:	FM ; 10.7 MHz MW, LW, SW-1 ; 455 kHz SW-2 ~ SW-19 ; 1st : 1.6 - 2.2 MHz 2nd: 455 kHz
Antenna System:	FM ; telescopic antennas 1,000 mm 2 pcs external antenna terminals (300 Ω, 75 Ω) are provided SW-1, MW, LW; built-in ferrite bar antenna, 10φ × 180 mm external antenna terminal is provided SW-2 ~ SW-19 ; telescopic antenna 1,470 mm external antenna terminal is provided
Power Requirement:	AC 100, 117, 220, 240 V, 50/60 Hz (c/s) DC 9 V, battery size "D" 6 pcs DC 12 V, with SONY car battery cord DCC-2AW
Power Output: at 10% distortion	3 W with AC power supply 1 W with DC power supply
Current Drain: at zero signal	AC 250 mA DC 140 mA
Maximum Sensitivity: at output 50 mW, S/N 6 dB	FM ; -2 dB (0.8 μV) MW ; 28 dB/m (25 μV/m) LW ; 36 dB/m (63 μV/m) SW ; 0 dB (1 μV); average

Selectivity:	LW, MW; 30 dB at BROAD position 45 dB at SHARP position SW ; 50 dB at BROAD position 60 dB at SHARP position
Muting Level:	10 ~ 30 dB (adjustable)
Signal-to-Noise Ratio:	FM ; 63 dB at 54 dB input, 400 Hz, 30% modulation MW; 37 dB at 60 dB input, 400 Hz, 30% modulation LW ; 30 dB at 60 dB input, 400 Hz, 30% modulation SW ; 44 dB at 44 dB input, 400 Hz, 30% modulation
Image Frequency Rejection:	FM-1 ; 77 dB at 77 MHz FM-2 ; 72 dB at 98 MHz MW ; 60 dB at 1,605 kHz LW ; 80 dB at 360 kHz SW-1 ; 70 dB at 2 MHz SW-2 ; 80 dB at 2.5 MHz SW-19; 30 dB at 29 MHz
Frequency Response:	100 - 20,000 Hz ±3 dB (flat response)
AUX Input Jack	
input impedance:	5 kΩ
maximum sensitivity:	-53 dB (1.7 mV) at 50 mW output
MPX Output Jack	
output impedance:	5 kΩ
output level:	-24 dB (49 mV) at 5 kΩ load impedance
Recording Jack	
output impedance:	2.2 kΩ
output level:	-50 dB (2.5 mV)
Recording Connector	
output impedance:	80 kΩ
output level:	-50 dB (2.5 mV)
External Speaker Jack:	3 ~ 8Ω speakers can be connected
Headphone Jack:	8Ω headphone can be connected
Earphone Jack:	8Ω earphone can be connected
Other Controls:	Battery check switch Calibrator reset knob AGC/MGC knob BFO control knob Selectivity switch Noise limiter switch Muting switch Sensitivity switch
Dimensions:	17 13/16" (W) x 12 13/16" (H) x 7 1/2" (D) (452 mm x 325 mm x 190 mm)
Weight:	31 lb, 14 kg (without batteries)
Supplied Accessories:	AC power cord polishing cloth

1-2. BLOCK DIAGRAM

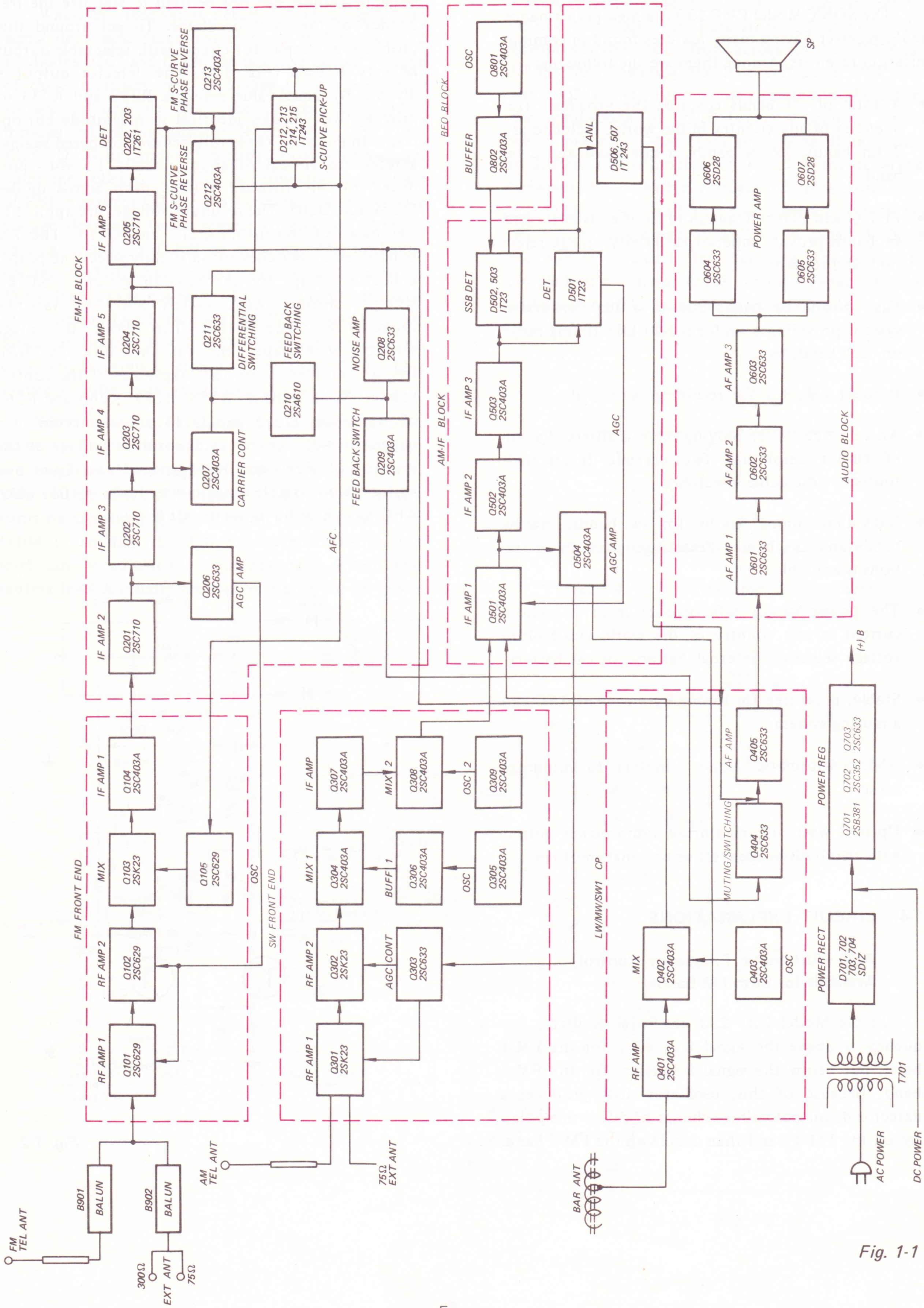


Fig. 1-1

1-3. TECHNICAL FEATURES

The SONY Model CRF-230 is a high-performance radio receiver having many features found in communication receivers. Among them are the following:

- A total of 23 bands covering the broadcast frequencies of any country in the world. Included are 2 fm bands, 19 sw bands, a mw band and a lw band.
- FET (Field Effect Transistor) front ends in fm and sw bands provide superior sensitivity, image rejection, and stability.
- Easy-to-tune sw bands due to a dual-conversion system providing a uniform 600 kHz tuning range on each band.
- Product detector for receiving ssb signals.
- An fm i-f circuit employing ceramic filters. An a-m i-f circuit employing two ceramic filters with four-step adjustable selectivity.
- Individual tuning knobs for sw bands, mw/lw bands and fm bands. Preset-tuning of three stations is available.
- The power supply will operate from household current in any country of the world (via built-in voltage selector), internal battery, or car battery.
- Stable, noise-free fm tuning by means of AFC and a muting system.
- ANL (Automatic Noise Limiter) to minimize noise.
- Up to 3 watts of undistorted audio power output with two built-in speakers or external speakers.

1-4. CIRCUIT EXPLANATIONS

AFC (Automatic Frequency Control) Available for Both FM Bands:

In the Model CRF-230, the local oscillator frequency is above the signal frequency for the FM-1 band, but below the signal frequency for the FM-2 band. Because of this, oscillator drift produces a detector dc output-voltage change of difference polarity on the FM-1 band than occurs on the FM-2 band. Therefore, dc control voltages taken directly from the detector output can not be used to stabilize the frequency of the local oscillator. To get around this problem, a comparator circuit with selectable output polarity is used (Fig. 1-2). The detector output is divided by equal-value resistors R232 and R233 to provide two voltages identical in magnitude but opposite in polarity. These voltages are compared against a reference voltage of approximately 1.5 volts produced by the forward voltage drop across diodes D204 and D205. The resultant voltages are applied to the bases of transistors Q212 and Q213. The FM band selector switches automatically select the proper collector voltage for the band in use and feed this voltage through AFC switch S903 to variable-capacitance diode D101. This diode is voltage sensitive, so its capacitance (and hence the oscillator frequency) depends on the magnitude of the control voltage. Load resistors R258, R259, R260 and R261 of transistors Q212 and Q213 are connected in a balanced-bridge circuit. The constant voltage at the junction of R260 and R261 is used as a fixed bias voltage for variable-capacitance diode D101 when AFC switch S903 is set to OFF.

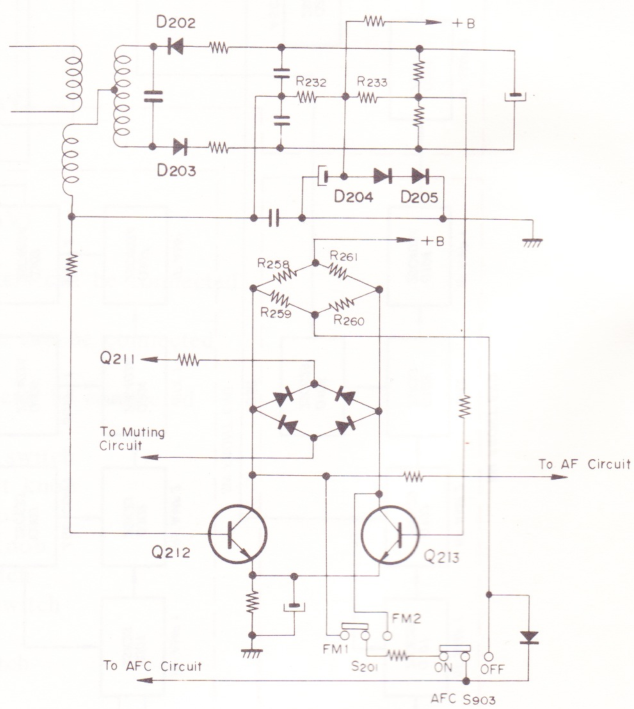


Fig. 1-2

Muting Circuit:

When the receiver is detuned from a signal, the signal decreases. Since less i-f signal is then rectified by diodes D207 and D208, the negative output voltage of these rectifiers can no longer back the positive voltage applied to the base of transistor Q207 through adjustable resistor R265 (Fig. 1-3). This allows Q207 to conduct lowering its collector voltage. Since the collector of Q207 is connected to the base of PNP transistor Q210, Q210 conducts when its base voltage decreases (with respect to ground), thereby causing transistor Q209 to conduct. The collector voltage of Q209 then drops to near ground potential. The voltage at the collector of Q209 is fed to the base of transistor Q405 through MUTING switch S904. Since this voltage is so low Q405 cannot conduct and complete the emitter circuit of transistor Q404. This prevents Q404 from amplifying the detector output.

When tuned to a signal, the opposite actions occur. I-f signal through capacitor C228 is rectified into negative d-c voltage by diodes D207 and D208. This voltage cuts off transistor Q207 and eventually turns on transistor Q405, thereby enabling transistor Q404 to amplify the detector output. The muting level can be adjusted by potentiometer R265. The muting level is usually set approximately 20 dB lower than the signal level. If the receiver tuning is shifted within range B of Fig. 1-4, the difference between the collector voltages of transistors Q212 and Q213 becomes large enough drops across resistors R254 and R255, thus lowering the base voltage of PNP transistor Q210 and results in its conduction. As before, the conduction of Q210 begins a chain of events which prevents Q404 from amplifying. If the tuning is shifted within range C of Fig. 1-4, the difference between the collector voltages of transistors Q212 and Q213 is so small that transistor Q211 is turned off within this range as well as in range A. Noise components caused by detuning, however, are coupled to transistor Q208 through capacitor C234 and resistor R249 from the detector output.

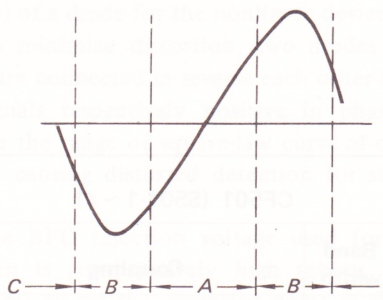


Fig. 1-4 Discriminator characteristic

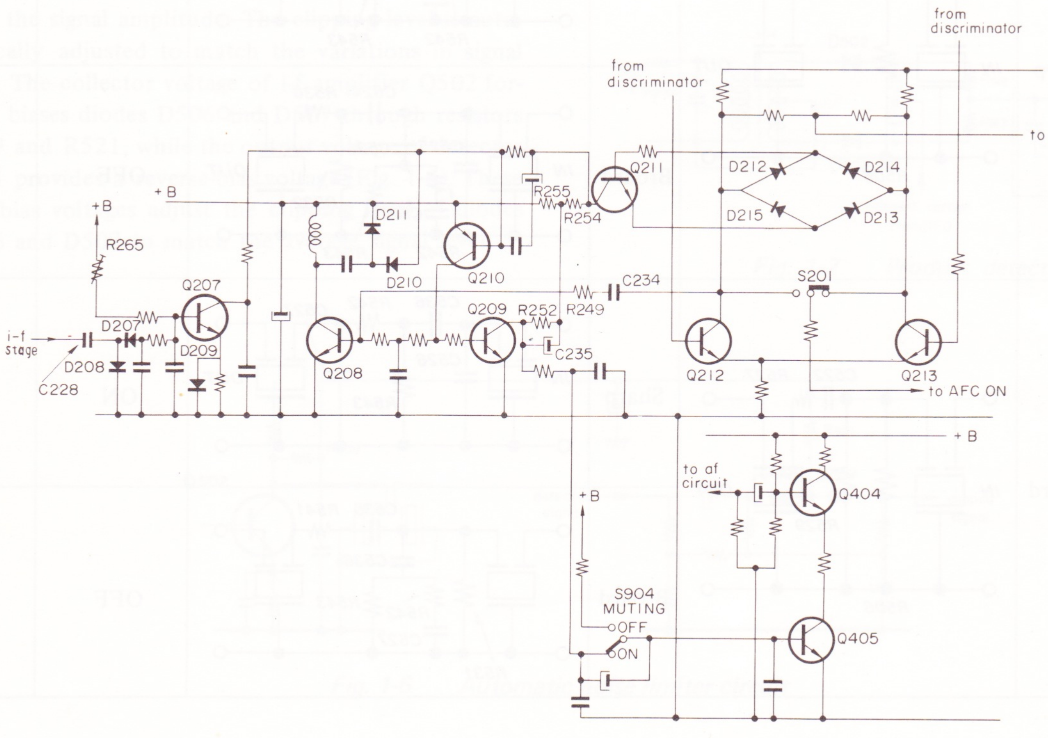


Fig. 1-3

The noise is amplified, rectified into negative d-c voltage by diodes D210 and D211, and applied to the base of transistor Q210 to turn it on. Since the base voltage of Q208 is controlled by the collector voltage of Q210, the amplification of transistor Q208 increases due to increased base bias, and transistor Q210 is held conducting quite reliably. As before, transistor Q404 cuts off the detector output.

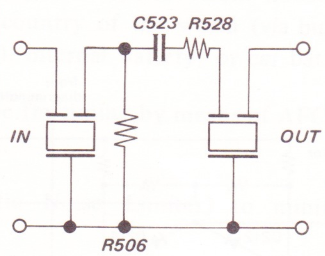
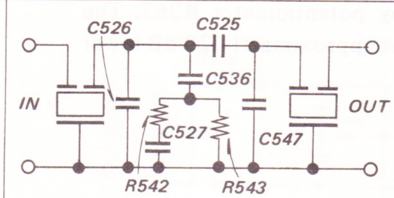
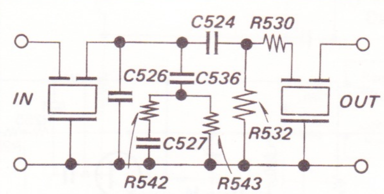
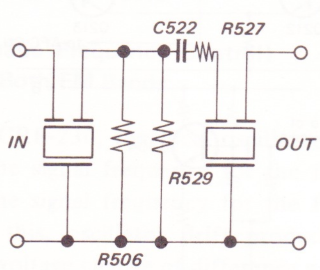
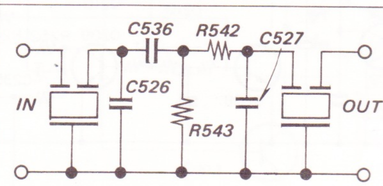
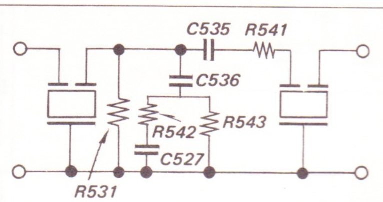
Positive feedback through resistor R252 and capacitor C235 from transistor Q210 aids in turning off Q209.

Adjustable Selectivity Employing Ceramic Filters:

The bandwidth in a-m reception can be altered by changing the coupling between the sections of ceramic filters in the a-m i-f circuit. When bands SW2 through SW19 are selected, ceramic filter CF501 is automatically set to narrow bandwidth by switch S501. Similarly, when bands LW, MW or SW1 are selected, a wide bandwidth is automatically selected.

Ceramic filter CF502 can be manually set to narrow or wide bandwidth by switch S502. When set to SHARP, switch S502 also connects in the high-cut filter consisting of coil L507 and capacitors C537, C538 and C541.

The net result of the switch manipulations on the ceramic filter circuits are summarized in Table. The overall selectivity curves of the a-m i-f strip at each of the four possible switch combinations are shown in Fig. 1-5.

<table>
<tr><th rowspan="2">Band setting</th><th colspan="2">CF501 (S501-1 ~ 4)</th><th colspan="2">CF502 (S502-1 ~ 4)</th><th rowspan="2">High-cut filter (S502-5, 6)</th><th rowspan="2">Overall response (Fig. 1-5)</th></tr>
<tr><th>Band width</th><th>Coupling</th><th>Band width</th><th>Coupling</th></tr>
<tr><td rowspan="2">SW2 through SW19</td><td rowspan="2">Sharp</td><td rowspan="2">
</td><td>Sharp</td><td>
</td><td>ON</td><td>A</td></tr>
<tr><td>Broard</td><td>
</td><td>OFF</td><td>B</td></tr>
<tr><td rowspan="2">LW
MW
SW1</td><td rowspan="2">Broard</td><td rowspan="2">
</td><td>Sharp</td><td>
</td><td>ON</td><td>C</td></tr>
<tr><td>Broard</td><td>
</td><td>OFF</td><td>D</td></tr>
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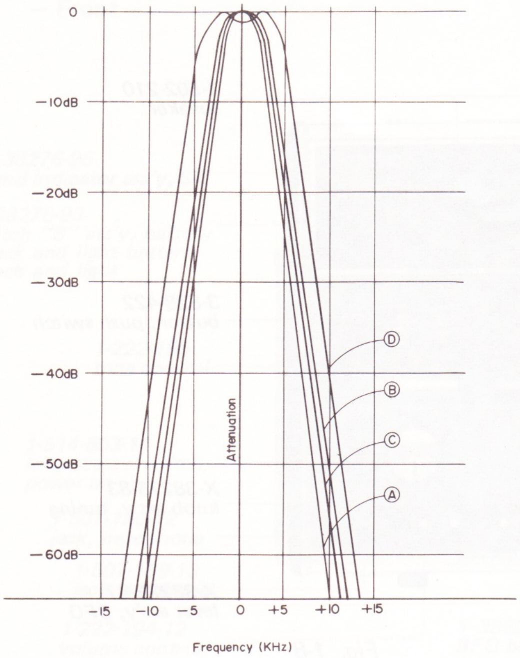

Fig. 1-5 Overall i-f response curve

ANL (Automatic Noise Limiter):

This limiter in the a-m section clips any noise pulses accompanying the signal to a level no longer than the signal amplitude. The clipping level is automatically adjusted to match the variations in signal level. The collector voltage of i-f amplifier Q502 forward biases diodes D506 and D507 through resistors R509 and R521, while the output voltage of detector D501 provides a reverse-bias voltage (Fig. 1-6). These two bias voltages adjust the clipping level of diodes D506 and D507 to match the average signal level.

Product Detector for Single-Sideband Reception:

A product detector is a type of heterodyne detector. Single-sideband signals can be recovered by passing them through nonlinear device after being mixed with a carrier identical in frequency to that used during modulation at the transmitter. That is, these two signals, sideband and carrier, are converted into two beat signals, upper and lower, against the carrier frequency by heterodyne action. The upper beat signal is eliminated by passing through the filter circuit and the lower beat signal is fed to the next stage as audio signals.

In the model CRF-230, the detector utilizes the square-low characteristic (output current proportional to the square of the effective value of the input voltage) of a diode for the nonlinear device.

To minimize distortion, two diodes D502, and D503 are connected in reverse each other and applied the signals respectively positive in phase. That is because the range of square-law curve of one diode is narrow causing distorted detection for strong input signal.

The BFO injection voltage used for carrier reinsertion is comparatively high (about 0.8 volt is optimum) to set the operating point of the detector within a linear portion of the diodes' characteristic. This results to minimize distortion of the recovered audio signal.

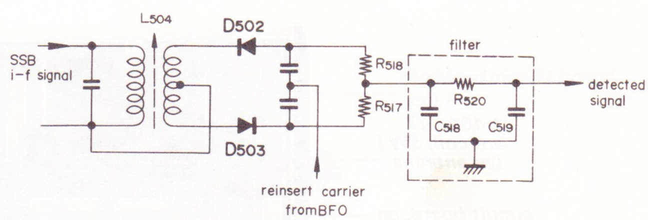

Fig. 1-7 Product detector

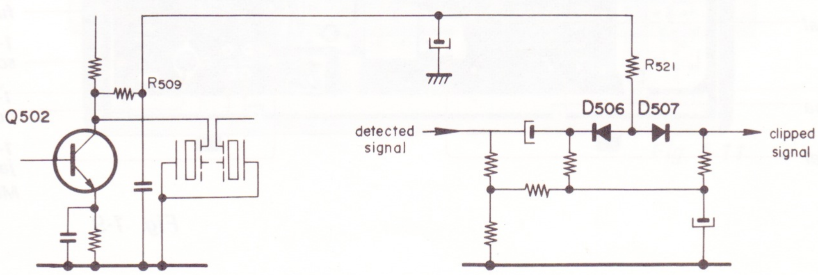

Fig. 1-6 Automatic noise limiter circuit

1-5. EXTERNAL VIEW

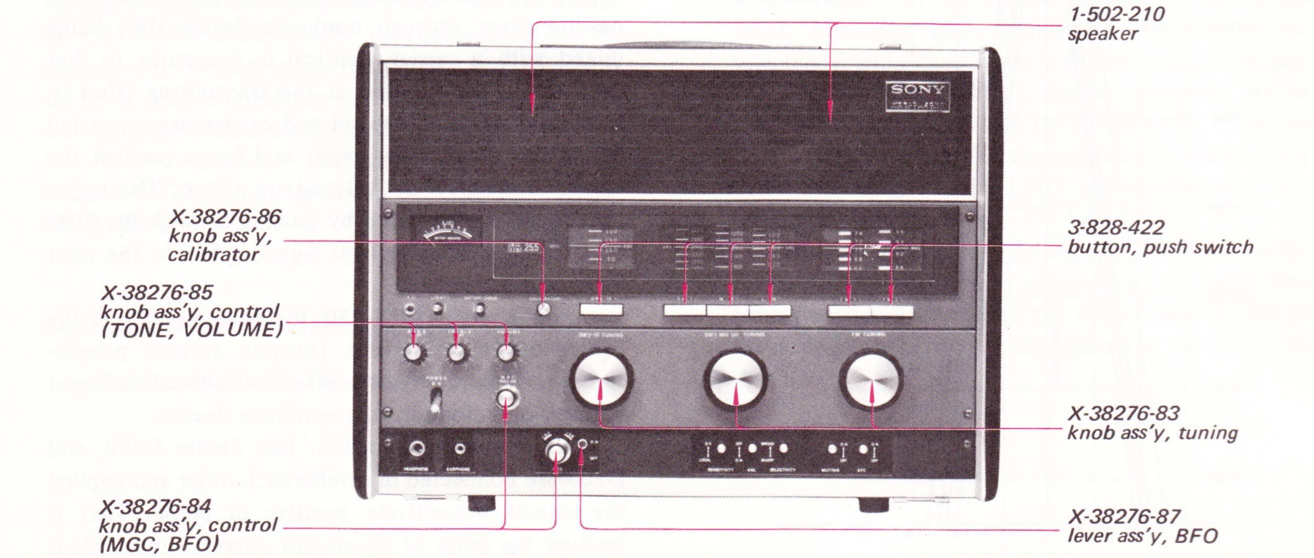

Fig. 1-8

1-6. INTERNAL VIEW

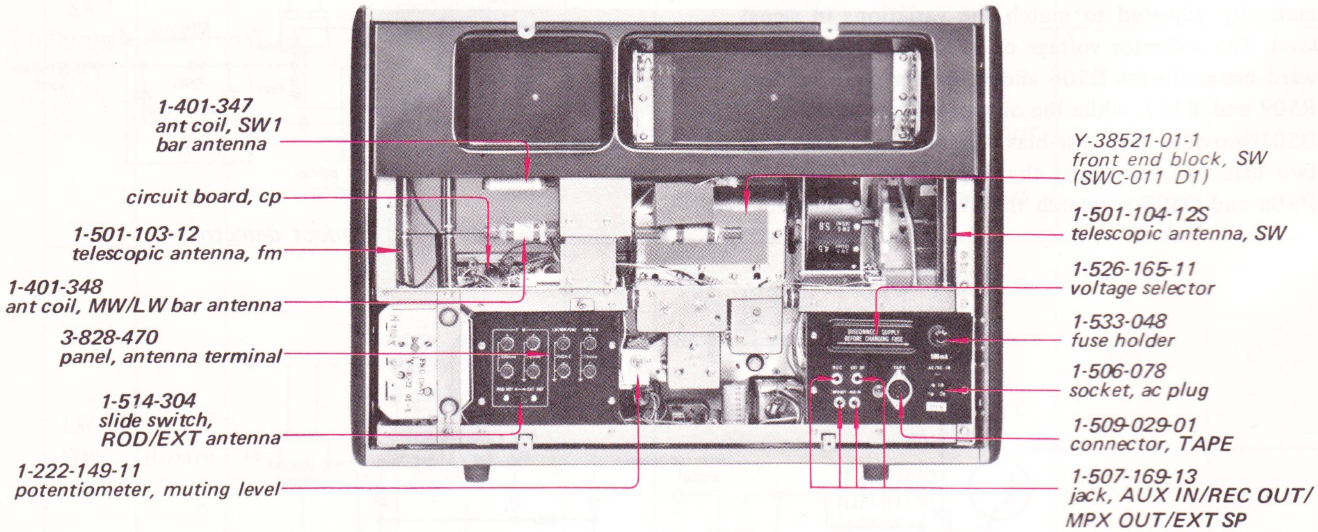

Fig. 1-9

1-7. CHASSIS VIEW

– Front –

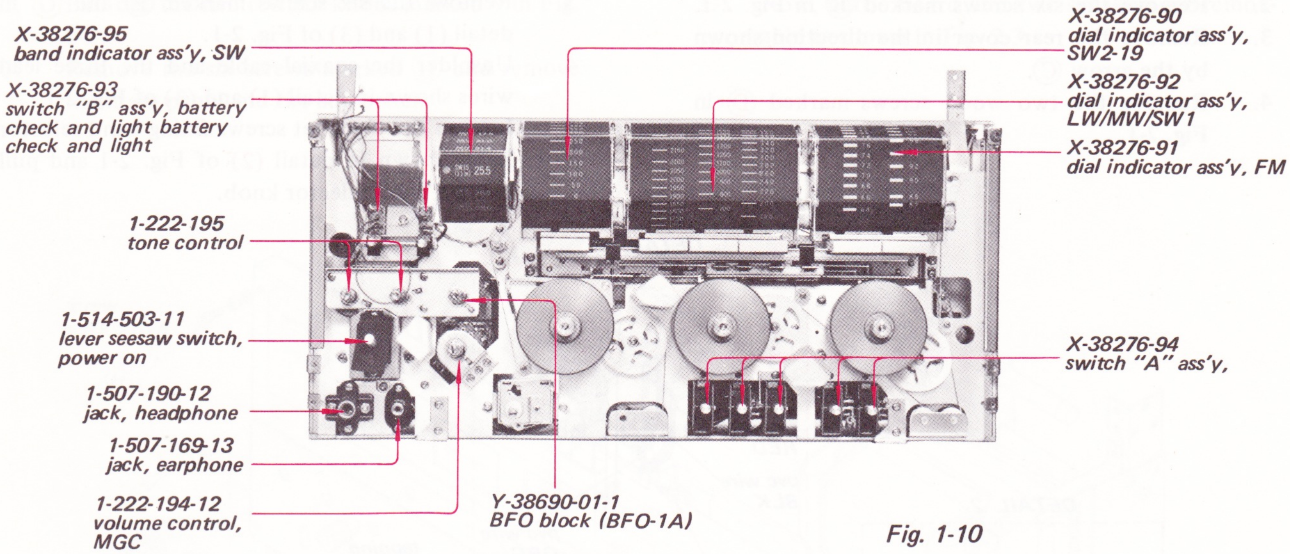

Fig. 1-10

– Bottom –

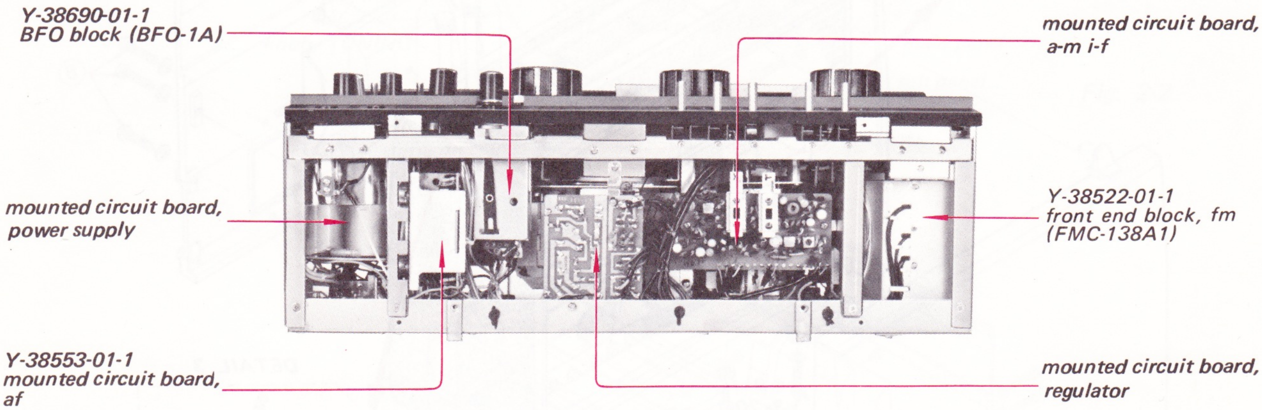

Fig. 1-11