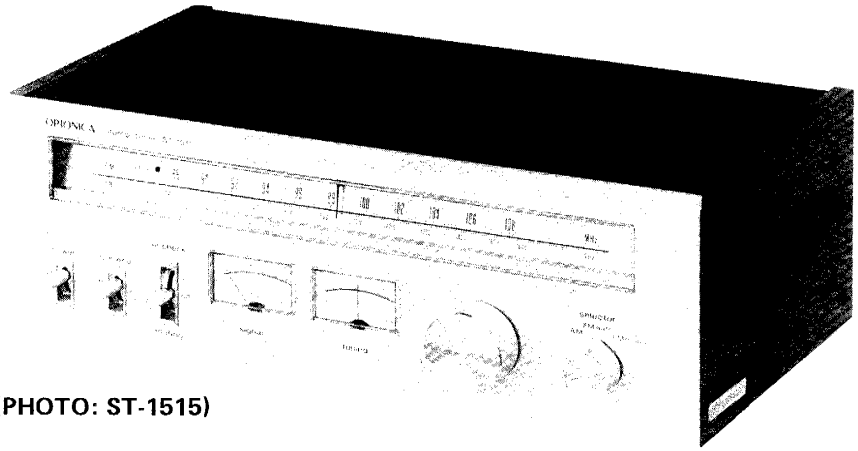
OPTONICA SERVICE MANUAL

ST-1515B
ST-1515



(PHOTO: ST-1515)

SIMULATED WALNUT GRAINED VINYL ON WOOD PRODUCT MATERIAL

FM/AM STEREO TUNER

MODEL ST-1515 (Silver Panel)

ST-1515B (Black Panel)

SPECIFICATIONS

GENERAL DESCRIPTION

Power source:	AC 120V, 50/60Hz
Power consumption:	10W
Circuit:	Superheterodyne system, FM/AM 2-band tuner, with PLL Stereo Demodulator, FM muting circuit, air check calibrator circuit, high blend circuit
Semiconductors:	3-IC (Integrated circuit) 1-FET (dual gate, MOS type) 3-transistor plus 5-aux. transistor 14-Diode (2-Zener Diode) 1-LED
Dimensions:	Width: 408 mm (16-1/16") Height: 144 mm (5-11/16") Depth: 275 mm (10-13/16")
Weight:	4.5 kg (9.9 lbs.)

FM

Tuning range:	87.6 ~ 108 MHz
IF:	10.7 MHz
Sensitivity (IHF):	1.7μV (New IHF 9.8 dBf)
Image rejection:	82 dB (at 98 MHz)
I.F. rejection:	90 dB (at 98 MHz)
Selectivity:	60 dB
Capture ratio:	1.2 dB
AM suppression:	50 dB
Output voltage:	700 mV (75 kHz deviation)
S/N:	72 dB (75 kHz deviation)
Distortion:	mono: 0.2% stereo: 0.3%
Stereo separation:	45 dB (1 kHz)

AM

Tuning range:	520 ~ 1620 kHz
IF:	455 kHz
Quieting sensitivity:	250μV/m
Image rejection:	45 dB (at 1400 kHz)
I.F. rejection:	30 dB (at 600 kHz)
Distortion:	0.7%
Output voltage:	250 mV (400 Hz, 30% modulation)

SHARP ELECTRONICS CORPORATION

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FEATURES

- 4-gang variable capacitor is used for FM front-end circuit and it assures a better high-frequency characteristic. As a result of the employment of high-precision wide-gap variable capacitor, highly accurate frequency display is available for FM oscillation section.
- Variable capacitors for both FM and AM receptions are of frequency linear display type and thus easier to read.
- Low noise dual-gate MOS-FET is employed in FM RF (high frequency) amplifier section and it further improves crossmodulation characteristic and spurious characteristic.
- As a result of the employment of quadraure detection, the linear region of detection is made larger so that distortion factor be further reduced as well as better dynamic range be ensured.
- P.L.L. (Phase Locked Loop) stereo demodulator circuit, being outstanding in stability and highly resisting the aging change, assures very stabilized stereo separation in a wider range.
- Built-in IC soft muting circuit is to eliminate station-to-station noises in FM reception and detuning noises, which ensures agreeable reception in any conditions.
- Built-in air check calibrator enables easier record level setting when recording FM reception on a tape, thus preventing any trouble of recording.
- Large-scaled two meters, the tuning meter and signal meter provide easier and yet more accurate reception of broadcasts.
- Including a long dial scale (220mm-travel distance) and a large-scaled flywheel, the tuning mechanism is further ameliorated.
- As a result of the employment of a wider range ceramic filter with priority given to FM Hi-Fi reproduction, high-selectivity and high-fidelity design is achieved.

DISASSEMBLY

Prior to removing the chassis, be sure to disconnect the power cord plug from wall outlet. Then proceed with the following steps after removing all of the connection cords located at the rear of the set.

(1) How to remove the cabinet
   1. Remove the 8 screws (1) retaining the decoration plates provided at both lateral surfaces of the set, then take out the decoration plates.
   2. Remove the 2 screws (2) located at both sides of the cabinet, then the cabinet can be taken out of the set.

(2) How to remove the bottom plate
   Turn the set over and remove the 2 screws (3) retaining the bottom plate, then the bottom plate can be taken out if withdrawed frontward.
   Then, it becomes able to repair the PWB. However, in order to further remove the front panel, take the following procedures.

(3) How to remove the front panel
   1. Draw the 5 knobs (4) out of the front panel.
   2. Remove the 4 screws (5) retaining the front panel, then the front panel can be taken out.

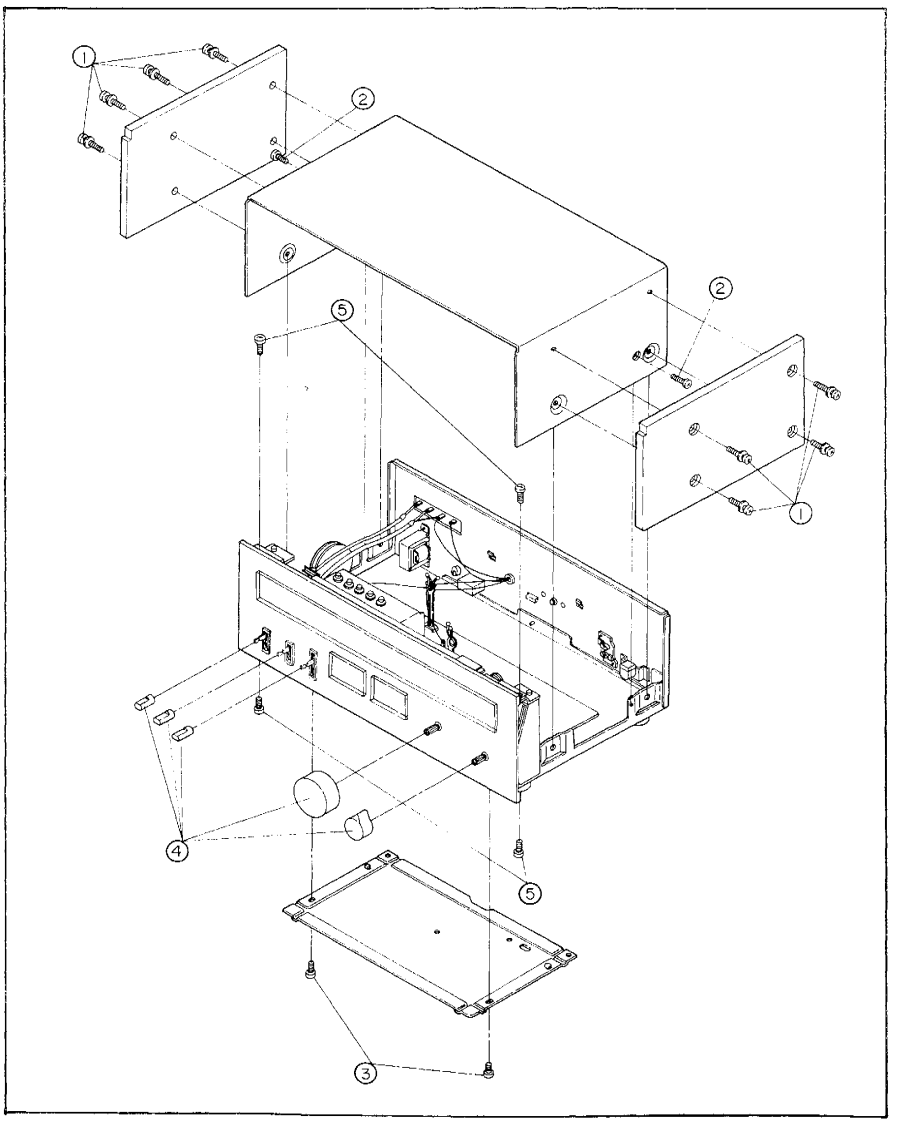


Figure 1 DISASSEMBLY

(1) Setting of the dial cord

1. Turn the drum fully clockwise (at the highest frequency position).
2. Put a hook of the spring on the central hole of the drum.
3. Then proceed with stringing in the numerical order from ① to ⑧. At this work, while holding a hand at the position ⑥ to temporarity fix a dial string, wind the string on the drum by 1-1/2 turns at the position ⑦ (which is an extention of the string wound at the position ⑥) and bring it through the position ⑧. Then release a hand from the position ⑥ and thus the stringing is completed.

(2) Setting of the pointer

1. Turn the tuning shaft fully counter-clockwise (at the lowest frequency position).
2. Align the pointer to the center of LED (stereo indicator) of the dial scale plate. (Fig. 2-A)

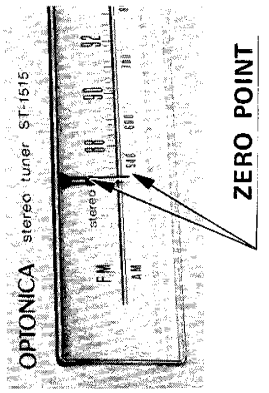


Figure 2-A

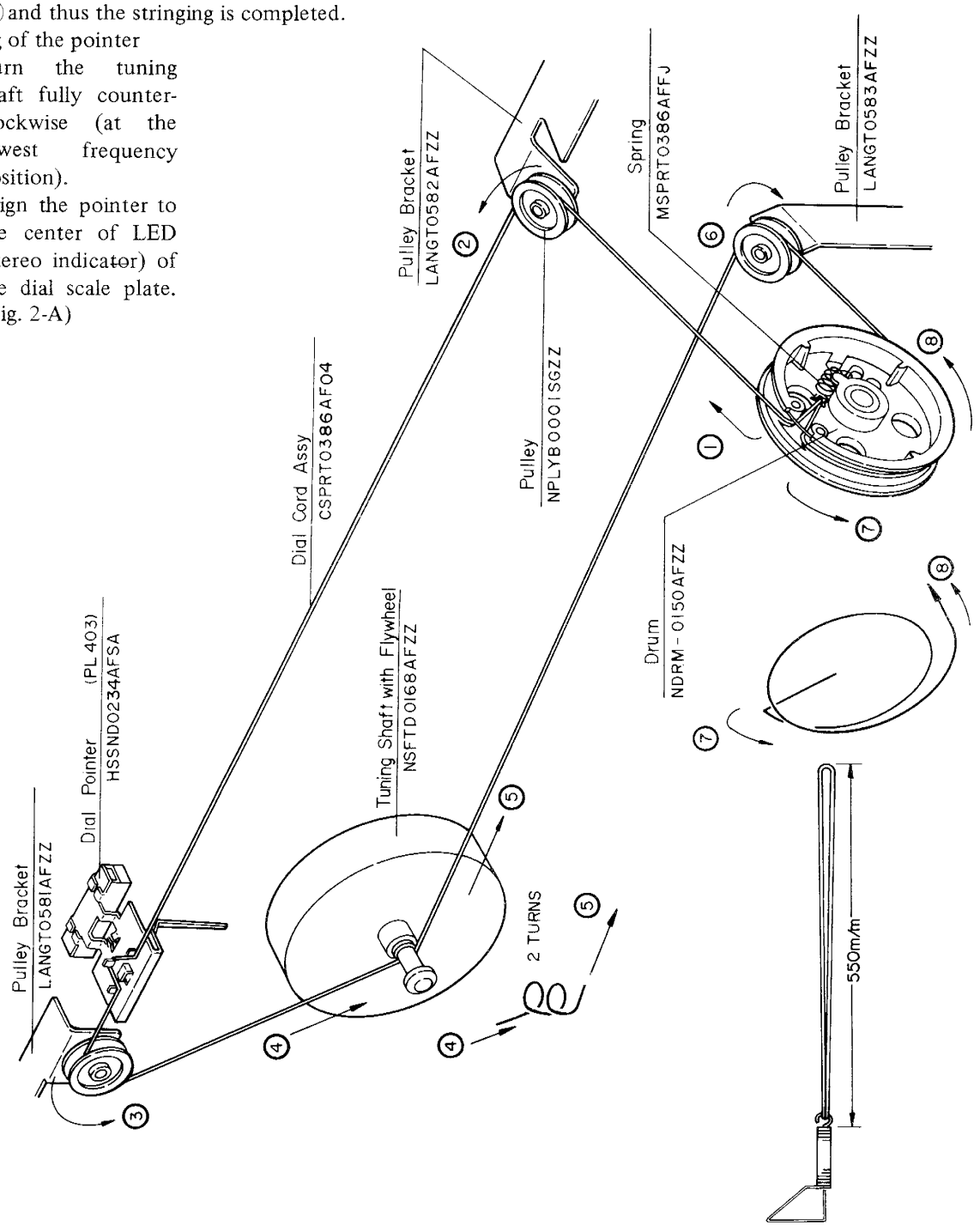


Figure 2 DIAL CORD STRINGING

FRONT PARTS LAYOUT

(PHOTO: ST-1515)

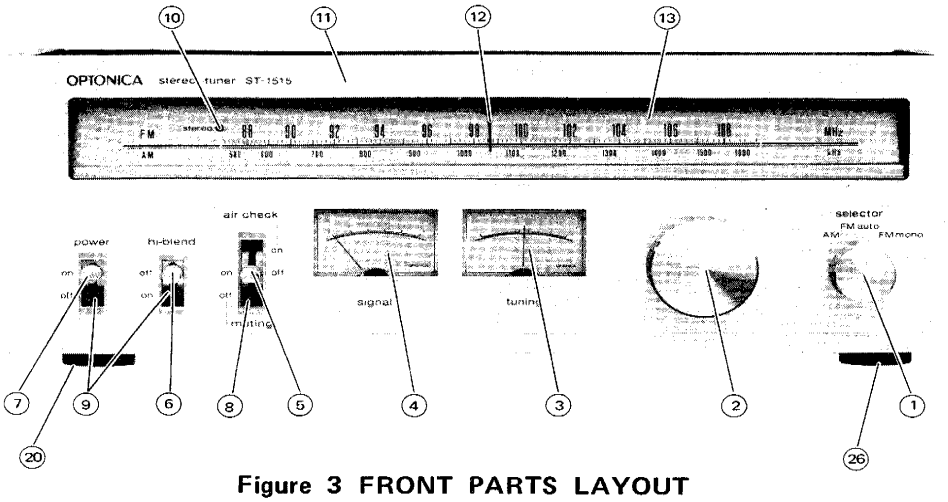


Figure 3 FRONT PARTS LAYOUT

① Band Selector Knob (ST-1515 JKNBN0330AFSA/ ST-1515B JKNBN0318AFSB)
② Tuning Knob (ST-1515 JKNBN0317AFSA/ ST-1515B JKNBN0317AFSB)
③ Tuning (center) Meter (RMTRL0129AFSA)
④ Signal Meter (RMTRL0130AFSA)
⑤ Air Check/Muting Knob (ST-1515 JKNBP0070AFSA/ ST-1515B JKNBP0070AFSB)
⑥ Hi-blend Knob (ST-1515 JKNBP0070AFSA/ ST-1515B JKNBP0070AFSB)
⑦ Power Knob (ST-1515 JKNBP0070AFSA/ ST-1515B JKNBP0070AFSB)
⑧ Guide (Large), Lever Switch (ST-1515 GCOVA1075AFSC/ ST-1515B GCOVA1075AFSB)
⑨ Guide (Small) Lever Switch (ST-1515 GCOVA1076AFSC/ ST-1515B GCOVA1076AFSB)
⑩ Stereo Indicator LED (VHPGL32AR//-1)
⑪ Front Panel (ST-1515 HPNLC3279AFSA/ ST-1515B HPNLC5207AFSA)
⑫ Dial Pointer (HSSND0234AFSA)
⑬ Dial Scale (HDALM0172AFSA)

REAR PARTS LAYOUT

(PHOTO: ST-1515)

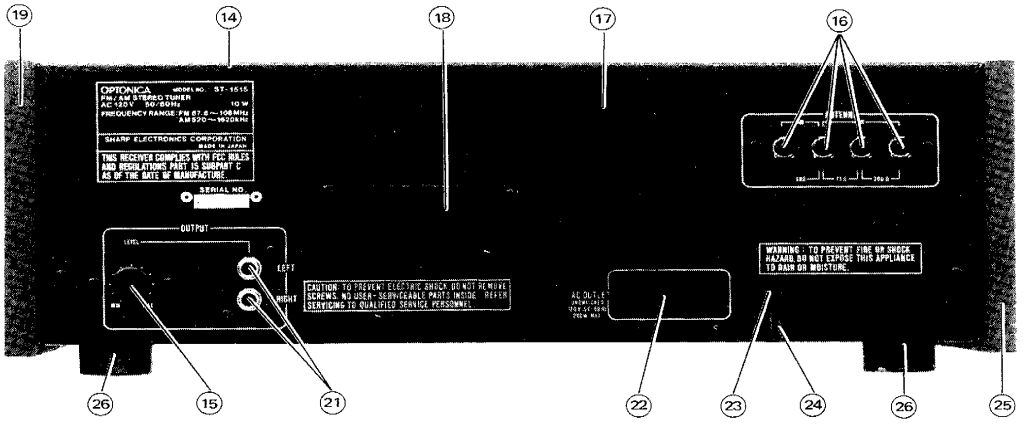


Figure 4 REAR PARTS LAYOUT

⑭ Cabinet (GCAB-3034AFSA)
⑮ Output Level Control Knob (JKNBN0227AFSA)
⑯ Antenna Terminals, SO401 (QTANN0452AFZZ)
⑰ Rear Panel (ST-1515 LANGQ0513AFSA/ ST-1515B LANGQ0524AFSA)
⑱ Cover, AM Bar Antenna (GCOVH1161AFSA)
⑲ Decoration Plate, Right (HDECW0063AFSB)
⑳ Leg (GLEGP0058AF08)
㉑ Output Socket, SO403 (QSOCJ2452AFZZ)
㉒ AC Outlet Socket, SO402 (QSOCA2150AFZZ)
㉓ Bushing, Power Supply Cord (LBSHC0007AFZZ)
㉔ Power Supply Cord (QACCU0002AF00)
㉕ Decoration Plate, Left (HDECW0058AFSB)
㉖ Leg (GLEGP0055AF00)

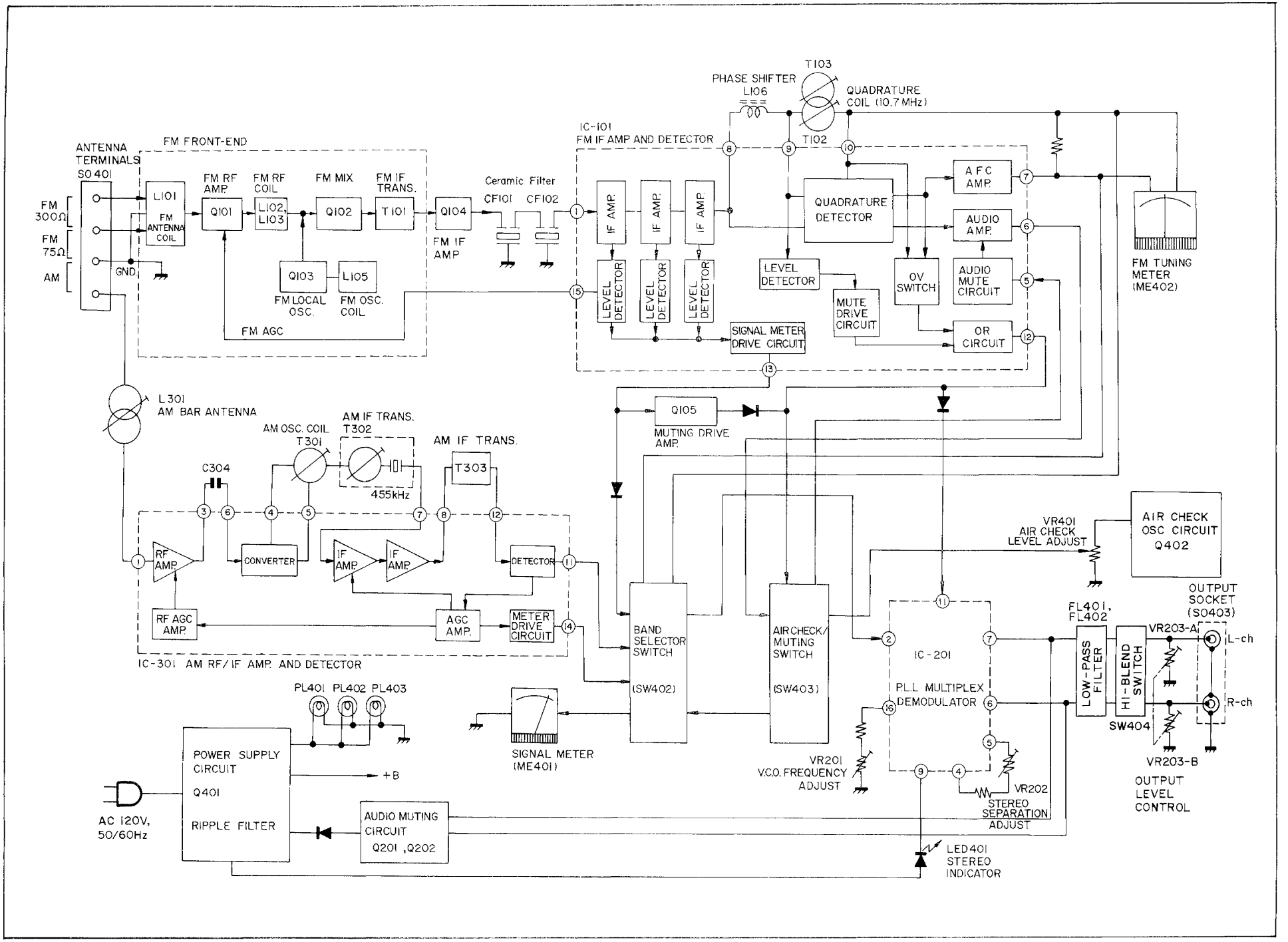


Figure 5 BLOCK DIAGRAM

AM SECTION

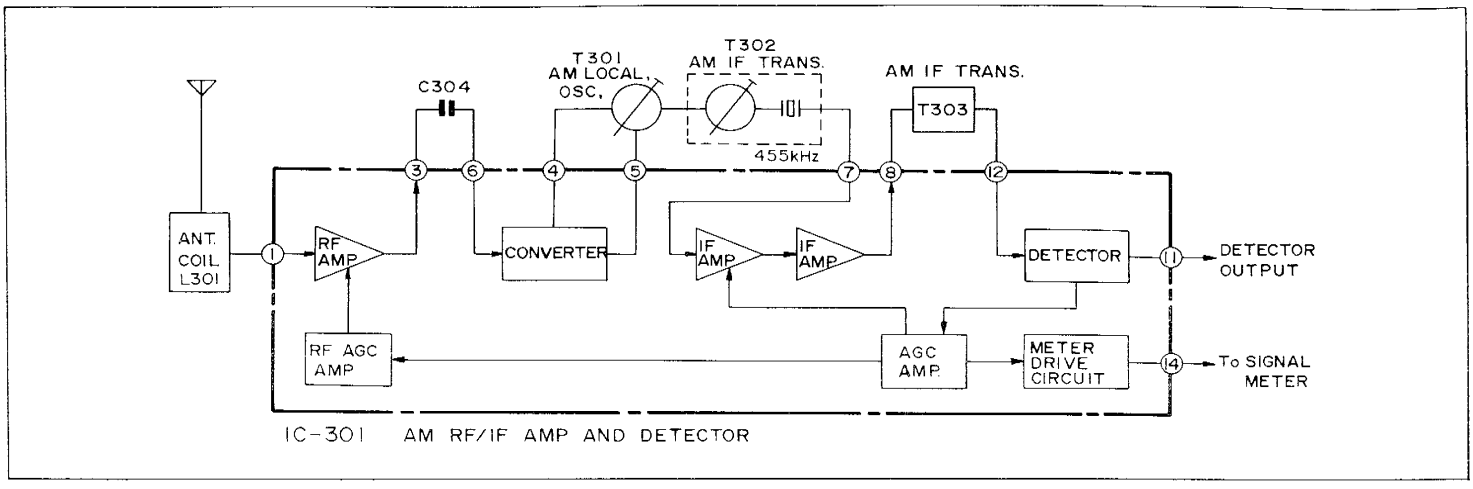


Figure 6 BLOCK DIAGRAM OF IC301

Fig. 6 is a block diagram of IC301. The coil L301 is AM ferrite bar antenna and it serves as antenna tuning circuit. Being received by the coil L301, AM broadcast signal is applied to the terminal (1) of the integrated circuit IC301 to be amplified by RF amplifier and then be supplied to the converter via the capacitor C304. T301 is an oscillation coil for AM local oscillation circuit. AM broadcast signal is thus converted to 455kHz IF signal by the converter to be applied to the transformer T302 which works as intermediate frequency selection element including ceramic filter and the signal will further be amplified by 1st and 2nd IF amplifiers to be applied to the transformer T303. Then the signal is finally detected by the detector circuit and it will be output at the terminal (11).

This IC301 also includes signal meter drive circuit which enables easier tuning and the output at the terminal (14) is connected to the signal meter (ME401).

FM RF SECTION

There are two input terminals (75 ohm and 300 ohm) at FM antenna input circuit. The 75 ohm input terminal is for the purpose to make connection between the FM antenna and the set by using coaxial cable while the 300 ohm input terminal, to make such connection by using balanced type feeder.

Fig. 7 shows FM front-end circuit. The front-end section is composed of one dual-gate MOS-FET and two transistors. Q101 refers to the dual-gate MOS-FET and it has the almost same characteristic as a vacuum tube. As a result of employment of this MOS-FET, crossmodulation characteristic and spurious characteristic are remarkably improved compared to conventional transistor-type products (Sharp-made ones). It is so designed that to the gate 2 (G_2) of Q101 is applied AGC voltage and this results in the amplification of the MOS-FET Q101 will be reduced if over-gain input signal is applied to the antenna so that

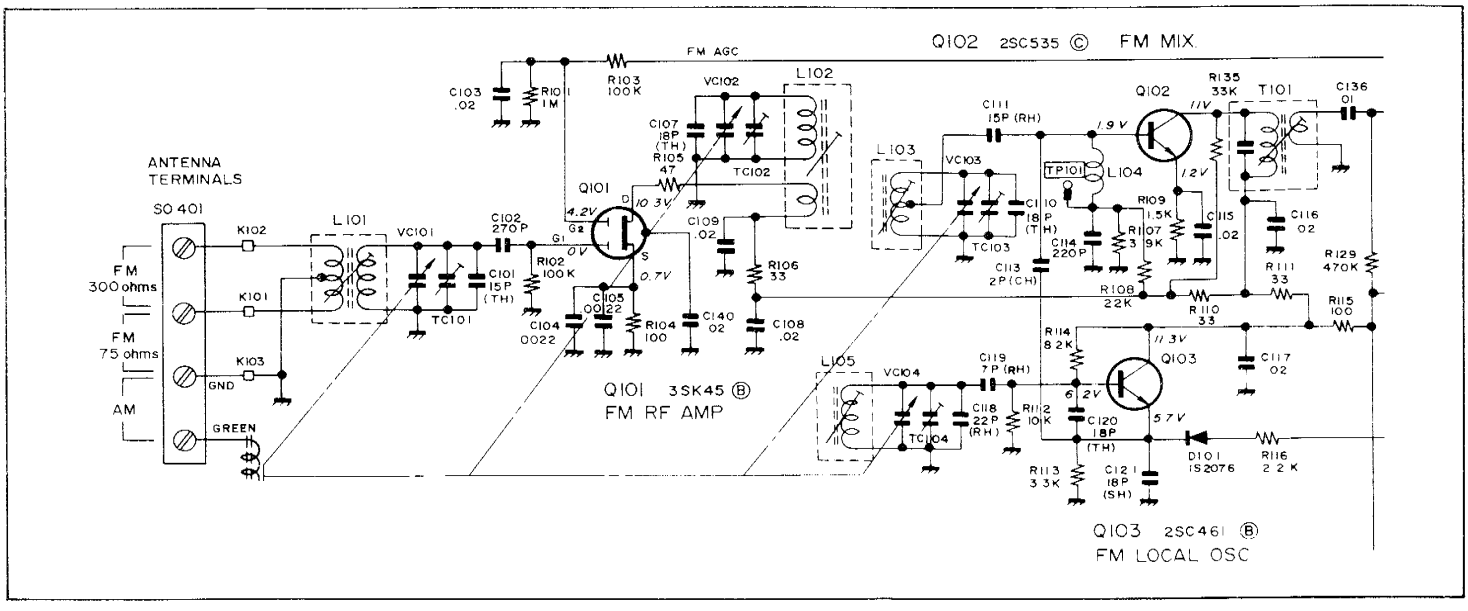


Figure 7 FM FRONT-END CIRCUIT

the reception be made always stabilized. The voltage applied to the gate 2 (G_2) of Q101 is of about 4V when there is no signal input but it will be gradually reduced as input signal at the antenna becomes larger – it becomes lower than about 1V when the input signal reaches 100dB. As a result, amplification of the Q101 is attenuated by about 30dB or more.
The dual-gate MOS-FET Q101 is for FM RF amplification. The transistor Q102 serves as frequency mixer and it receives high-frequency signal (from the MOS-FET Q101) and local oscillation signal (from the transistor Q103) to produce 10.7MHz intermediate frequency (IF) to apply it to IF tuning transformer T101. The transistor Q103 works for FM local oscillation and it will apply oscillation voltage to the base of transistor Q102 via the capacitor C113 (2 pF). The coil L101 is provided for FM antenna tuning and the coils L102 and L103, for FM RF amplification and tuning while the coil L105, for local oscillation.
Meanwhile, during AM broadcast reception, it is so designed that +B voltage is applied to the emitter of the transistor Q103 via the diode D101 and resistor R116 to stop the oscillation.

FM IF AMPLIFIER SECTION

IF signal, having been converted to 10.7MHz signal at the FM front-end section, is amplified by the transistor Q104 to be applied to the ceramic filters CF101 and CF102 so that there will be higher selectivity (this is required in order to amplify IF signal without distorsion and to obtain higher selectivity.) This IF signal is further applied to the terminal ① of IC101 where the signal gain will be amplified by about 66dB by the 3-stage differential amplifier, thus being subjected to appropriate limiter operation.

FM DETECTION SECTIONS (Quadrature Detector Circuit)

(1) FM Detector Circuit
This unit employs "Quadrature Detector" based on newly developed IC (Integrated Circuit), which is substituted for ratio detector and Foster-Seeley's detector that have been so far used. The basic structure of quadrature detector circuit is as shown in Fig. 8.

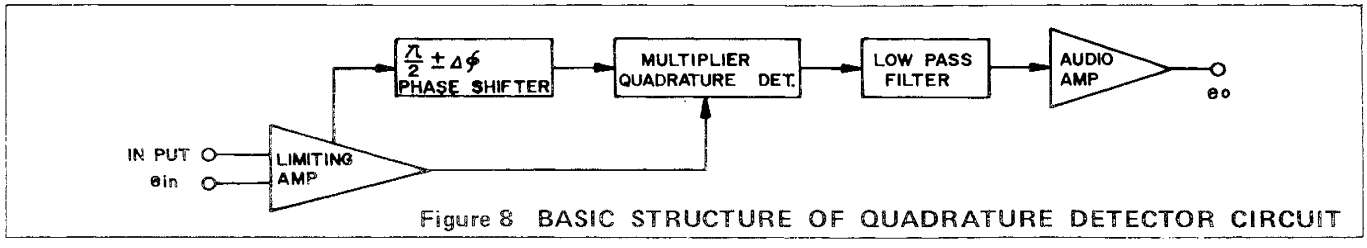
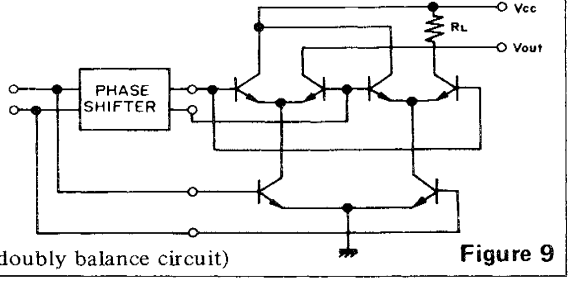


Figure 8 BASIC STRUCTURE OF QUADRATURE DETECTOR CIRCUIT

With this detection system, the multiplier (quadrature detector) circuit receives two types of input signals, one is the signal which has been amplified by the limiting amplifier and another which has passed through the phase shift circuit. (about $\pi/2$). Thus, the quadrature detector circuit produces demodulation signal.
The term "quadrature" is resulted from that the phase difference between these two signal is $\pi/2$. The multiplier consists of doubly balance circuit as shown in the following circuit drawing. Phase characteristic of the phase shift circuit is as shown in Fig. 10.
This circuit is featured by:
(1) Good linearity and low distortion.
(2) Operates on small signal and less higher harmonics.
(3) Wide-band detection of as much as 1.0MHz.
Therefore, this circuit assures low distortion even with the overmodulation of more than 100% thereby reproducing high quality sound.
Actually saying, the detecting circuit ST-1515/ST-1515B uses L106 as phase-shift coil. T102 and T103 are 10.7MHz tuning quadrature coil.
Detection output appears at the terminal ⑥ of IC101 and it is supplied to the terminal ② of P.L.L. multiplex integrated circuit IC201.



(doubly balance circuit) Figure 9

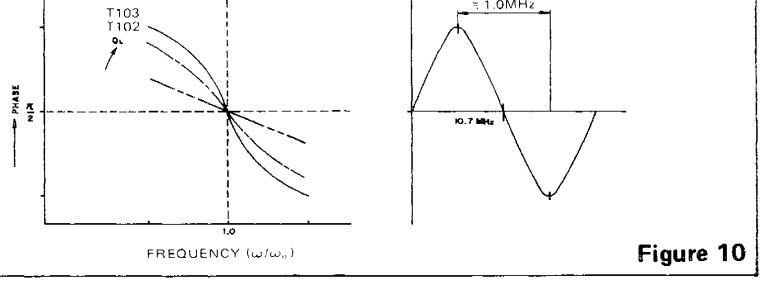


Figure 10

FM AGC

FM AGC voltage is developed at terminal ⑮ of IC101, and is supplied to the gate 2 (G_2) of Dual gate MOS-FET Q101 through resistor R103.

The AGC voltage is developed in IC101 as delayed AGC voltage, and the AGC starts to operate when antenna input reaches approx. 60dB and thus a voltage at terminal ⑮ of IC101 starts to drop.

FM STEREO DEMODULATOR SECTION

(1) Features of P.L.L. stereo demodulator circuit

This set incorporates a stereo demodulator circuit that comprises IC's with the PLL (Phase Locked Loop) system applied. The PLL (Phase Locked Loop) FM demodulator circuit is provided with such characteristics as mentioned below.

In order to demodulate stereo composite signals, it is necessary to take a 19kHz pilot signal out of the stereo composite signals and to make it a 38kHz signal.

Most of the conventional methods to obtain such a 38 kHz signal are frequency doubling ones which utilize a nonlinearity of the elements. Compared with the conventional type, the recently developed IC-ed demodulator provides more sufficient separation effects. However, since it also requires 2 or 3 coils like the conventional one, if even one of them is dislocated from the initially adjusted point due to a secular change the separation effects will be deteriorated. Moreover there is such a contradiction that the more the efficiencies of the coils are increased enough to withstand the outer pulse signals like automobil ignition noises, the more the coils suffer secular changes.

To eliminate such disadvantages as above, PLL (Phase Locked Loop) system is employed in the method to make a 38kHz signal using a 19kHz pilot signal.

The PLL system stereo demodulator gives such three merits as:

1. Since the phases of a pilot signal and a 38kHz signal are automatically made the same with each other, the deterioration of separation effect is strongly minimized.
2. Since only one of variable resistor, being newly employed, plays the role of 2 to 3 pieces of conventional coils, troubles of the parts due to secular changes are decreased. In addition, even if this variable resistor is slightly dislocated, the separation effect will never be deteriorated because of the merit as mentioned in 1 by which the automatic phase adjustment is assured.
3. Compared with the conventional one, the PLL system demodulator shows a more noise withstanding characteristic since it has such performances as the selection of frequencies and the continuity of oscillation frequencies (short-time memory), thus assuring a stable stereo demodulation.

(2) FM stereo demodulator circuit of ST-1515/ST-1515B

IC201 is an integrated circuit for P.L.L. stereo demodulation and its block diagram is as shown in Fig. 11.

V.C.O. free-running frequency is to be adjusted to 76kHz by adjusting semi-fixed resistor VR201 (10K ohm). TP204 is the test point for frequency observation. (See the paragraph "Adjustment" described later.)

During AM reception, +B voltage is supplied to the terminal ⑯ of IC201 through diode D204 and resistor R409 so that oscillation frequency of V.C.O. will be stopped. Semi-fixed resistor VR202 (200K ohm) aims at the adjustment of stereo separation and with this resistor it is possible to minimize crosstalk to the opposite channel. +B voltage is supplied to the terminal ⑪ to force stereo signals to become monaural ones.

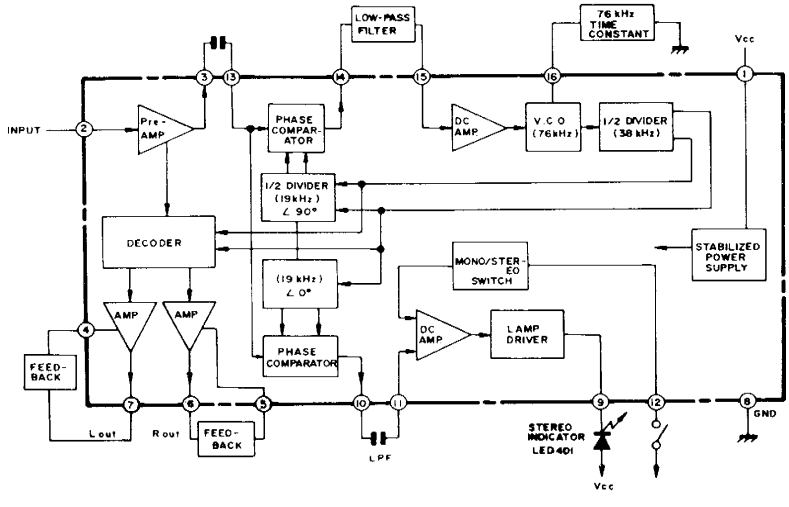


Figure 11 BLOCK DIAGRAM OF IC201

AIR CHECK CALIBRATION CIRCUIT

This circuit is to make appropriate the recording level in advance when recording FM broadcast into the tape recorder. The circuit shown in Fig. 12 hereof is CR type oscillator circuit to be used for the air check calibration (about 400Hz). When the air check/muting switch (SW403) located at the front panel is set to the position "air check on", the air check calibrator circuit begins to operate and oscillation voltage thus produced by the air check calibrator circuit will appear as air check signal at the output terminal (SO403) located at the rear of the set. The air check signal level is set to 60% (−4.4dB) of the output voltage obtained when the tuner receives FM broadcast signal (modulation, 75kHz deviation) and this level voltage appears at the output terminal of the rear panel through the air check oscillator circuit. VR401 is semi-fixed resistor to be used for adjusting the air check signal level.

How to record FM broadcast using the air check calibration system is described below.

Set the air check/muting switch to "air check on" position, put the tape recorder in record mode, apply air check signal to the tape recorder and adjust the record level so that the record level meter of tape recorder indicates "0 VU" (Fig. 13). After that, set the air check/muting switch to "air check off" position and proceed with recording FM broadcast.

[Note]

In the case of AM reception, in other words, when the band selector switch is kept to the position AM, air check level signal does not appear at the output terminal located at the rear of the set since the air check calibrator is not functioning at the time.

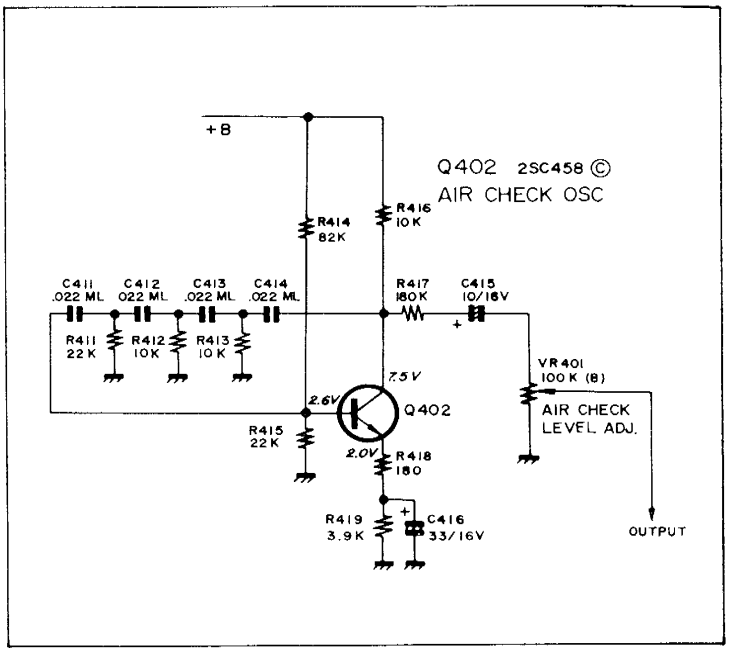


Figure 12 AIR CHECK CAL. CIRCUIT

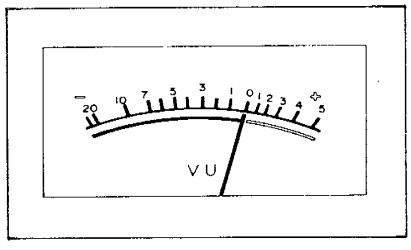


Figure 13 "0 VU"

FM MUTING CIRCUIT

In ST-1515/ST-1515B, IC101 incorporates muting circuit and this circuit is so designed that if FM input signal to the antenna terminal becomes about 14dB when the muting/air check switch (SW403) is kept at "muting on", the muting is released and the signal appears at the output without undergoing muting.

This muting release is carried out on the basis of two signals, the one appears at the terminal ⑫ of IC101 to specify the muting width to about 200kHz and another is signal meter signal which appears at the terminal ⑬ of IC101. While being so designed as to be released after being polarity-inversed by the transistor Q105, these two signals will be added to each other to be applied to the muting circuit at the terminal ⑤ of IC101 via the muting/air check switch (SW403). In this way, the FM muting circuit becomes able to function. The signal to release the muting will be applied to the terminal ⑪ of the P.L.L. stereo multiplex demodulator IC201 to be forced to mono-operation.

Fig. 14 shows the output voltage of two outputs, one is at the terminal ⑫ of IC101 and another, at the collector of transistor Q105, to be added to each other.

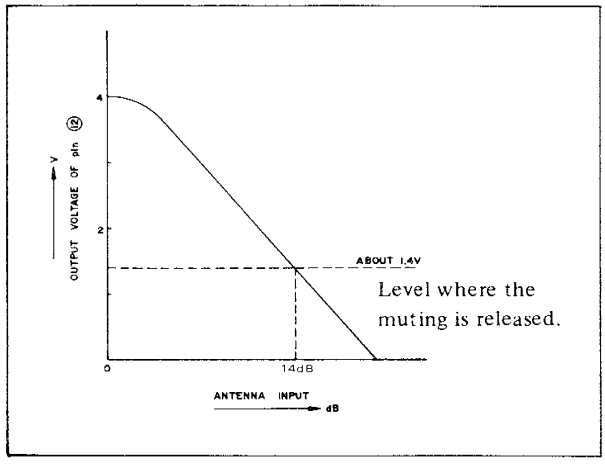


Figure 14

POWER SUPPLY CIRCUIT

In dealing with +B power supply, the power voltage is full-wave rectified by diodes D401 and D402 to be supplied to each section. Diode ZD402 is zener diode to be used for voltage regulation and the zener voltage is about 13.2V. Transistor Q401 is to remove ripples from the rectification current.

LOW-PASS FILTER

FL401 and FL402 are low-pass filters to remove carrier signals (19kHz and 38kHz) leaking from the P.L.L. stereo multiplex demodulator IC201.
The characteristic is as shown in the figure 15.

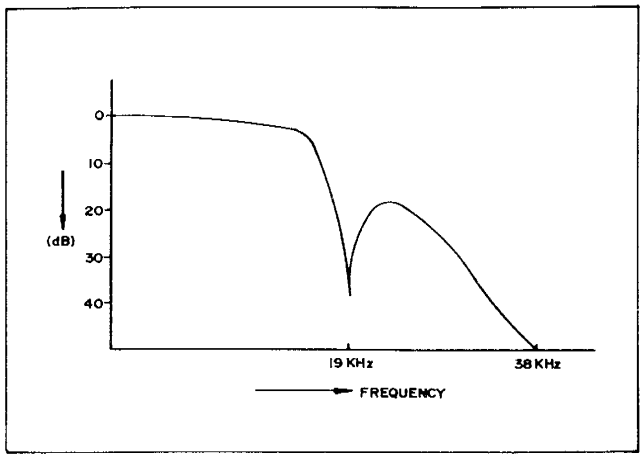


Figure 15

HIGH-BLEND CIRCUIT

The high-blend circuit consists of high-blend switch and capacitor C216 as shown in the figure 16. In the reception of stereo broadcast, noises possibly caused in both channels are reverse in phase to each other. The high-blend circuit is to offset these two noises each other thus increasing tone quality. The high-blend circuit functions when the high-blend switch is set to "on" position. With the high-blend switch set to "on", however, the separation in high-frequency band becomes a little decreased.

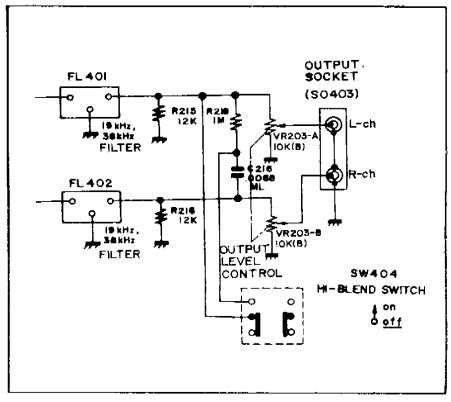


Figure 16

AUDIO MUTING CIRCUIT

The audio muting circuit consists of transistors Q201 and Q202, diodes D403 and D404, resistors R406, R407 and R408 and capacitor C407 and it is able to reduce possible shock noises caused when the power switch (SW401) is turned off.
When the set is normally operating, the base voltage of the transistors Q201 and Q202 is of about −3.8V and these transistors Q201 and Q202 are keeping open condition (cut-off). However, when the power switch is turned off, in no time the base voltage of the transistors Q201 and Q202 becomes positive value since there is no rectification caused at the diodes D403 and D404 – this results in that the transistors Q201 and Q202 go to close condition (turned-on). Thus, shock noises having been generated at the preceeding stage will escape to the earth so that there will be no shock noises available at the output terminal.
Moreover, zener diode ZD401, resistor R403 and diodes D201 and D202 are provided to reduce possible shock noises caused when the power switch is turned on and off alternately in sequence.
When the set is normally operating, the diodes D201 and D202 are keeping open condition but they become close condition instantly when the power switch is turned off. As a result, the charged voltage at the capacitors C204 and C211 will be discharged.
When the power switch is again turned on, the internal amplifier at PPL multiplex demodulator IC201 is kept stationary until the capacitors C204 and C211 are charged up, so that shock noises, possibly caused when the power switch is turned on, will be reduced.

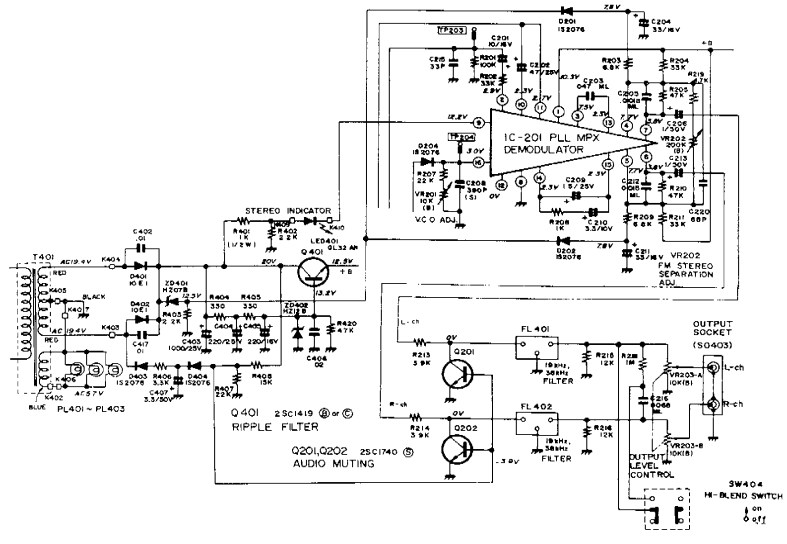


Figure 17

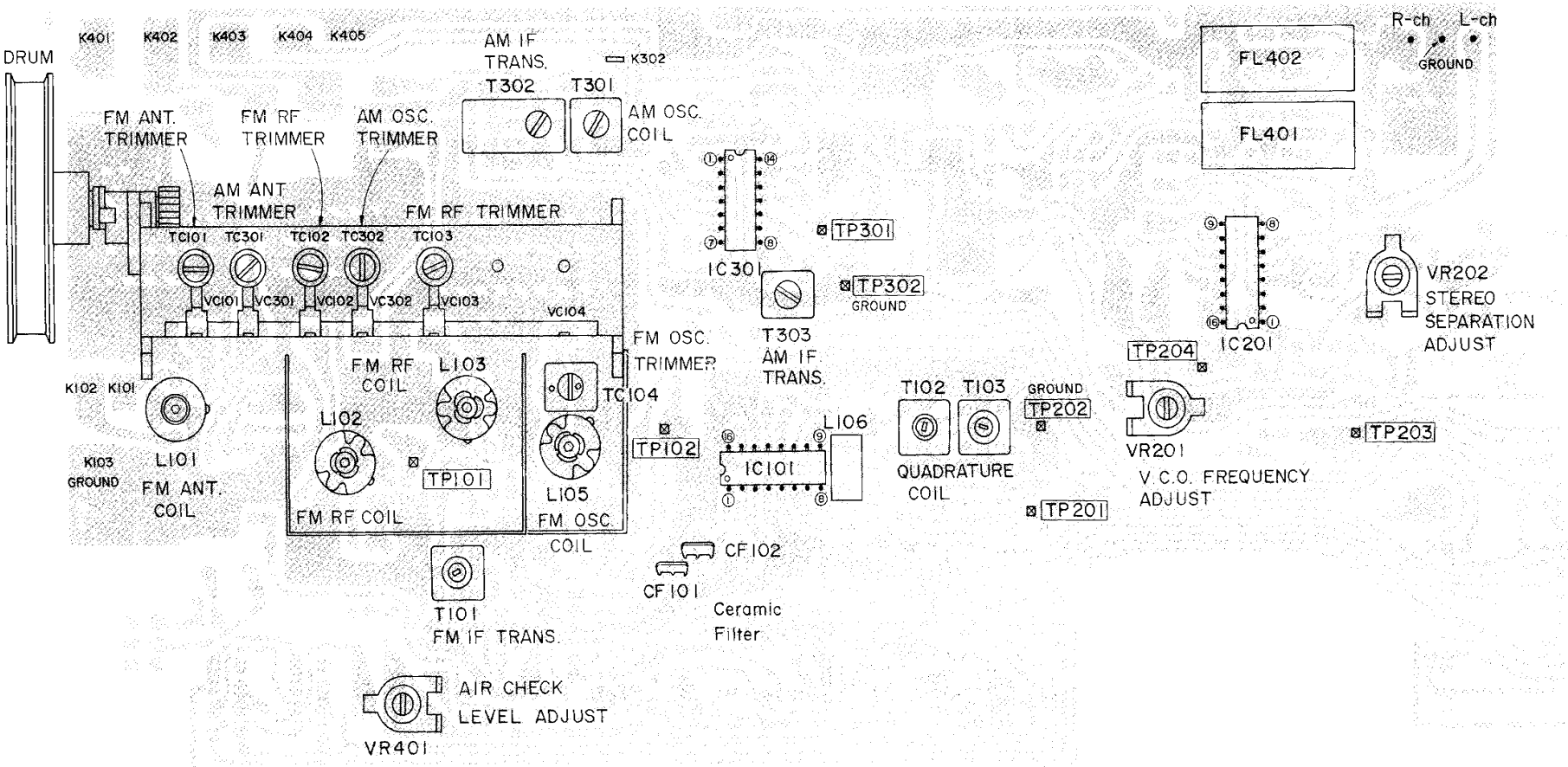


Figure 18 ALIGNMENT POINTS

ALIGNMENT INSTRUCTIONS

Alignment is an exacting procedure and should be undertaken only when necessary. If alignment of AM and FM is required, either section may be done first. The FM stereo section, however, should be done only if the FM monaural section is properly adjusted.

REQUIRED EQUIPMENT

1. Signal generator with a frequency range of 450kHz to 1650kHz; AM
2. Signal generator with a frequency range of 86.1MHz to 109.2MHz; FM
3. Signal generator with a frequency output of 10.7MHz ± 0.5MHz; FM
4. Vacuum tube voltmeter (AC-VTVM)
5. Sweep signal generator with a sweep range of at least 500kHz and center frequency of 10.7MHz with at least a 10.7MHz marker may be used.
6. Oscilloscope with a wide range amplifier of approximately 100kHz.
7. Test loops, a coil of any size wire, one turn or more; AM
8. Vacuum tube voltmeter (DC-VTVM)
9. FM stereo signal generator.
10. Audio signal generator with a frequency range of 20Hz to 100kHz.
11. Frequency counter with a frequency range of approximately 100kHz.

Notes: Allow the set at least five minutes to warm up before attempting alignment. During alignment keep the signal generator output at the lowest level that will maintain a useble output from the set.

For the adjustment of stereo separation, the FM stereo generator output is usually 1,000μV. Incorrect grounding to the metal chassis may pick up an unwanted 10.7MHz signal from the final IF stage, which will cause a regenerative sweep response on the sweep curve and result in misalignment.

Therefore always connect a ground to point.

Ground connection of signal generator	Chassis ground
Generator modulation (AM)	30%, 400Hz
Generator modulation (FM)	75kHz, 400Hz
Generator modulation (FM stereo)	Ch. L. or Ch. R. 75kHz, 1,000Hz Mod.

AM ALIGNMENT (Refer to Figure 19)

PROCEDURE NUMBER	TEST STAGE	SIGNAL GENERATOR		DIAL POINTER SETTING	SELECTOR SETTING	METER CONNECTION	ADJUSTMENT	REMARKS
		CONNECTION	FREQUENCY					
1	IF	Connect AM sweep generator to the TC301 and variable capacitor case (ground). (Keep the input be closed as small as possible.)	455kHz (SG or sweep) Modulated	High end of dial	Band selector (AM)	Connect oscilloscope between test points TP301 and TP302 (ground)	T303 T302	Adjust for maximum response at 455kHz. Repeat 2 or 3 times.
2	Remove AM bar antenna cover at the rear panel.							
3	Band Coverage	Connect a loop antenna to AM signal oscillator to place it near the bar antenna coil (L301). (For the adjustment, keep the output of the oscillator as small as possible.)	515kHz Modulated	Low end of dial	Same as step 1	Connect oscilloscope between test points TP301 and TP302 (ground)	Oscillator coil T301	Adjust for maximum output.
4		Same as above.	1650kHz Modulated	High end of dial	Same as step 1	Same as above	Oscillator trimmer TC302	Adjust for maximum output. Repeat steps 3 and 4, 2 or 3 times.
5	Tracking	Same as step 3	1400kHz Modulated	1400kHz	Same as step 1	Same as step 3	Antenna trimmer TC301	Same as step 3
6		Same as step 3	600kHz Modulated	600kHz	Same as step 1	Same as step 3	Antenna coil L301	Same as step 4. Repeat steps 5 and 6, 2 or 3 times.

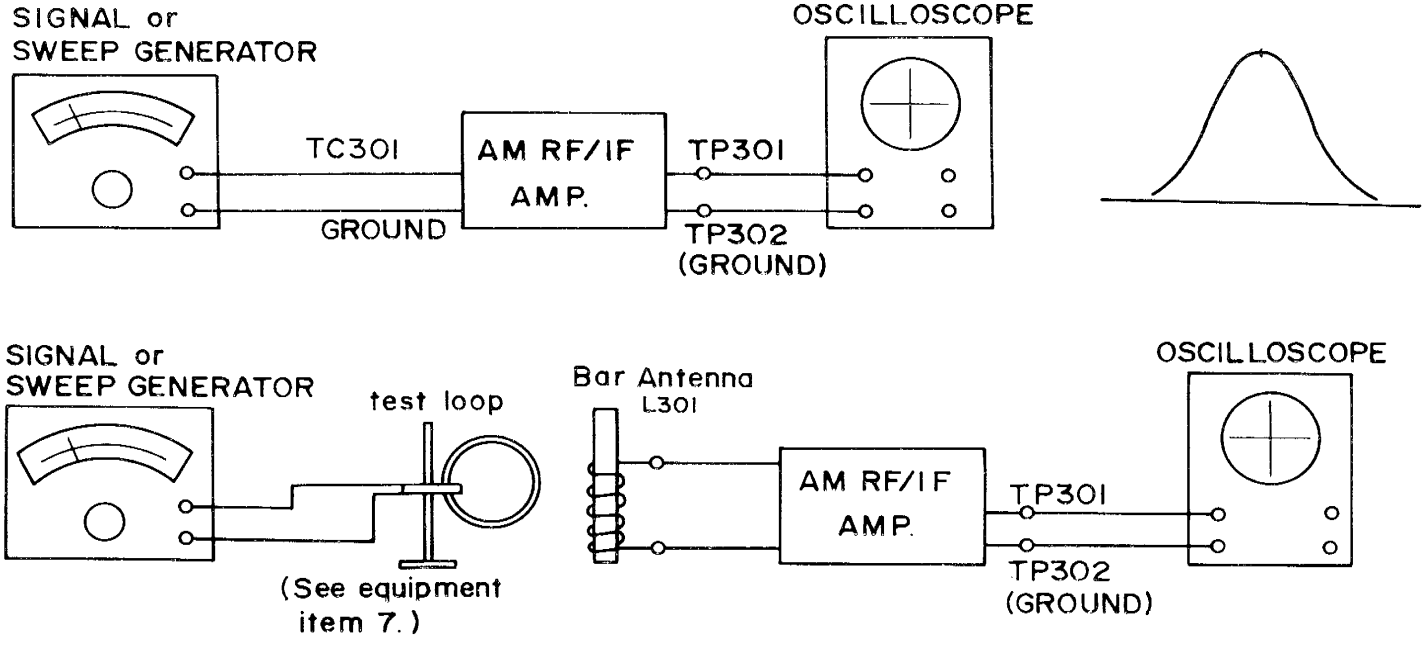


Figure 19 AM RF/IF ALIGNMENT EQUIPMENT CONNECTIONS

FM ALIGNMENT (Refer to Figure 20)

Set the muting switch (SW403) at "off" position.

PROCEDURE NUMBER	TEST STAGE	SIGNAL GENERATOR		DIAL POINTER SETTING	SELECTOR SETTING	METER CONNECTION	ADJUSTMENT	REMARKS
		CONNECTION	FREQUENCY					
1	IF (NOTE A)	Connect FM sweep generator, through 6pF capacitor, to the test point TP101. Connect the ground to the variable capacitor case.	10.7MHz ±500kHz as small as possible. (Modulated)	High end of dial	FM-MONO	Connect an oscilloscope to the test points TP102 and TP202 (ground)	T101	Rotate the core of T101 to adjust so that the waveform becomes symmetrical in right and left and attains the maximum in height and width. (Fig. 21)
2	Detector	Same as above	No-signal	Same as above	Same as above	Connect an oscilloscope to the test points TP201 and TP202 (ground)	T102	Adjust T102 so that the pointer of tuning meter indicates its center.
3		Same as above	Same as step 1	Same as above	FM-MONO	Same as above	T102, T103	Rotate the core to adjust so that the waveform (Fig. 22) becomes symmetrical in the upper and lower with the best linearity.
4	Repeat steps 1 and 3 until no further improvement can be made.							
5	Band Coverage	Connect FM signal generator to the FM antenna terminals	87.0MHz as small as possible (Modulated)	Low end of dial	FM-MONO	Connect VTVM to the test point TP201 and ground	Oscillator coil L105	Adjust for maximum output.
6		Same as above	109MHz (Modulated) as small as possible	High end of dial	FM-MONO	Same as above	Oscillator trimmer TC104	Same as above. Repeat steps 5 and 6 until no further improvement can be made.
7	Tracking	Same as step 5	90MHz (Modulated) as small as possible	90MHz	FM-MONO	Same as step 5	Antenna coil L101 and RF coil L102, L103	Same as step 5.
8		Same as step 5	106MHz (Modulated) as small as possible	106MHz	FM-MONO	Same as step 5	Antenna trimmer TC101 and RF trimmer TC102, TC103	Same as above. Repeat steps 7 and 8 until no further improvement can be made.
9	After the adjustment, make sure that the tuning meter (ME 402) indicates its center for non-signal reception. (This is adjustable by using T102.)							

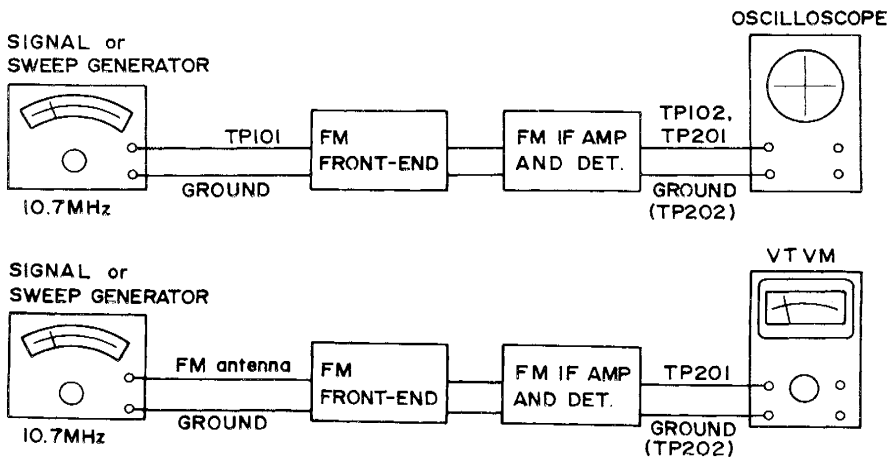


Figure 20 FM ALIGNMENT EQUIPMENT CONNECTIONS

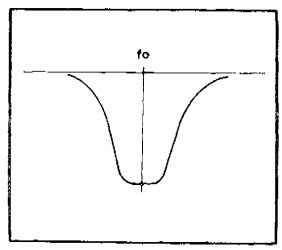


Figure 21

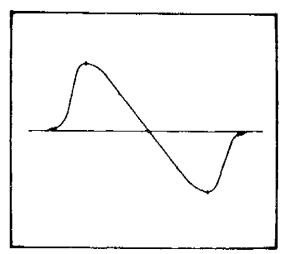


Figure 22

NOTE A

The ceramic filter used for this set is available in 5 types and each of them is given a color indication to differentiate the central frequency from that of the others, as described below.
In the actual use, be sure to make 2 ceramic filters of the same type (the same color) as a pair to put them in the set.
When other ceramic filters than that given a red color indication (with the central frequency of 10.7MHz) are used, note that with such filters the marker (10.7MHz) of FM sweep generator will be deviated; therefore be sure to cut off the marker at the time of the adjustment.

Central Frequency (fo)	D	Black	10.64MHz ±30kHz
	B	Blue	10.67MHz ±30kHz
	A	Red	10.70MHz ±30kHz
	C	Orange	10.73MHz ±30kHz
	E	White	10.76MHz ±30kHz

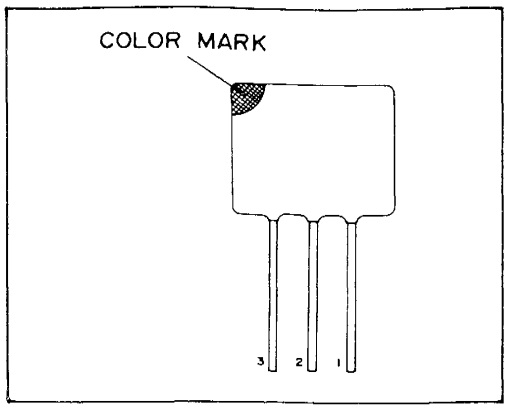


Figure 23

ADJUSTMENT OF AIR CHECK CAL.

Produce 98MHz, 60dB FM mono signal (75kHz deviation, 400Hz) by a signal generator to apply it to the antenna of the unit and read the tuner output voltage.

Next, set air check/muting switch to "air check on" position, then the output voltage will vary. Adjust semi-fixed resistor VR401 so that the output voltage with air check/muting switch set to "air check on" becomes about 60% (–4.4dB) of that with air check/muting switch kept at "off".

FM STEREO V.C.O. AND SEPARATION ADJUSTMENT

1. Place the band selector switch (SW402) of the set to the position "FM auto", the air check/muting switch to "muting off" and the high-blend switch to "off".
2. Connect FM signal generator to FM antenna terminal of the set and regulate the oscillation frequency to 98MHz (75kHz deviation, 400Hz) and the output to 60dB (mono signal). Then tune the set exactly in such signal.
3. Connect VTVM to the test point TP204 of the set via 3.3 Meg. ohm resistor and connect frequency counter to the output terminal of VTVM.
4. Have the test point TP201 of the set and the earth be connected (shorted) and adjust the semi-fixed resistor VR201 so that V.C.O. frequency becomes 76.00kHz ±200Hz. (After adjustment of V.C.O. frequency, disconnect the TP201 and the earth from each other.)
5. Connect FM stereo modulator to FM signal generator. Regulate FM stereo modulator to modulation frequency 1kHz, modulation degree L+R 33.75kHz deviation, L–R 33.75kHz deviation, pilot (19kHz) 7.5kHz deviation. (FM signal generator is being set so that the output will be 60dB with the frequency 98MHz.)
6. Regulate FM signal generator to set the frequency to 98MHz and the output to 60dB, tune in the set so that the tuning meter will indicate its center and make only L-channel of the stereo modulator be subjected to modulation. And consider L-channel output thus produced from the set to be 0dB.
7. Connect VTVM to R-channel output terminal of the set and adjust the semi-fixed resistor VR202 so that there will be the maximum separation (in order to limit the output leaking to the opposite channel to the minimum.) Also adjust the separation available with only R-channel undergoing the modulation so that the outputs of both right and left channels be equal to each other.

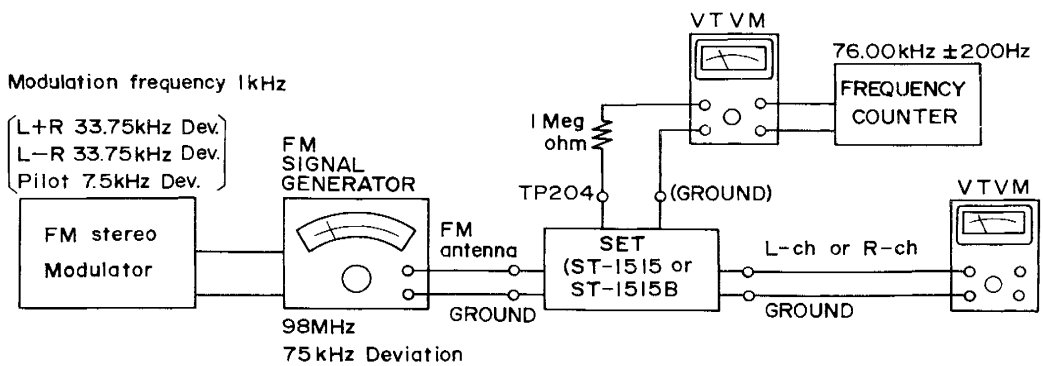
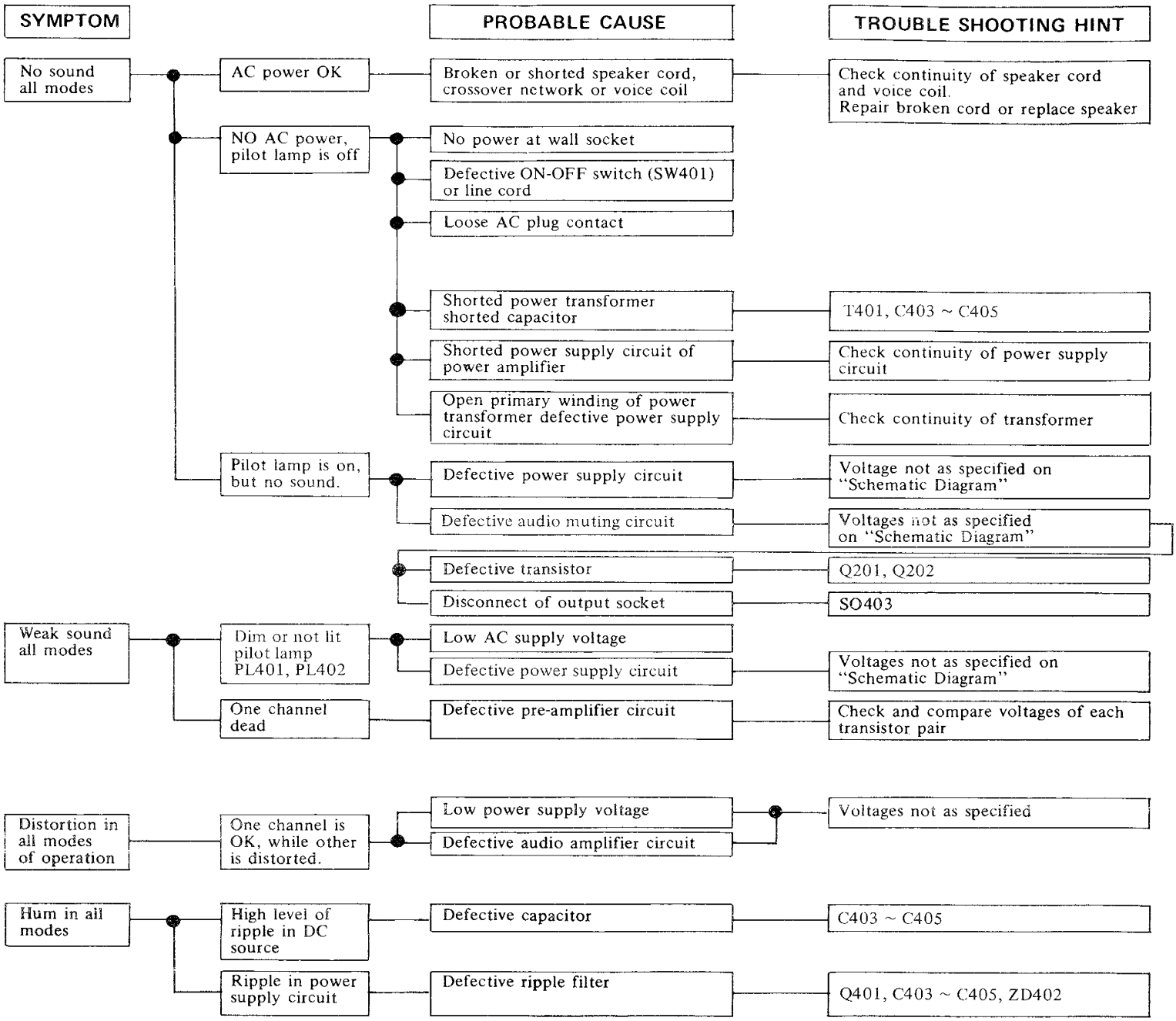


Figure 24 FM STEREO ALIGNMENT EQUIPMENT CONNECTIONS

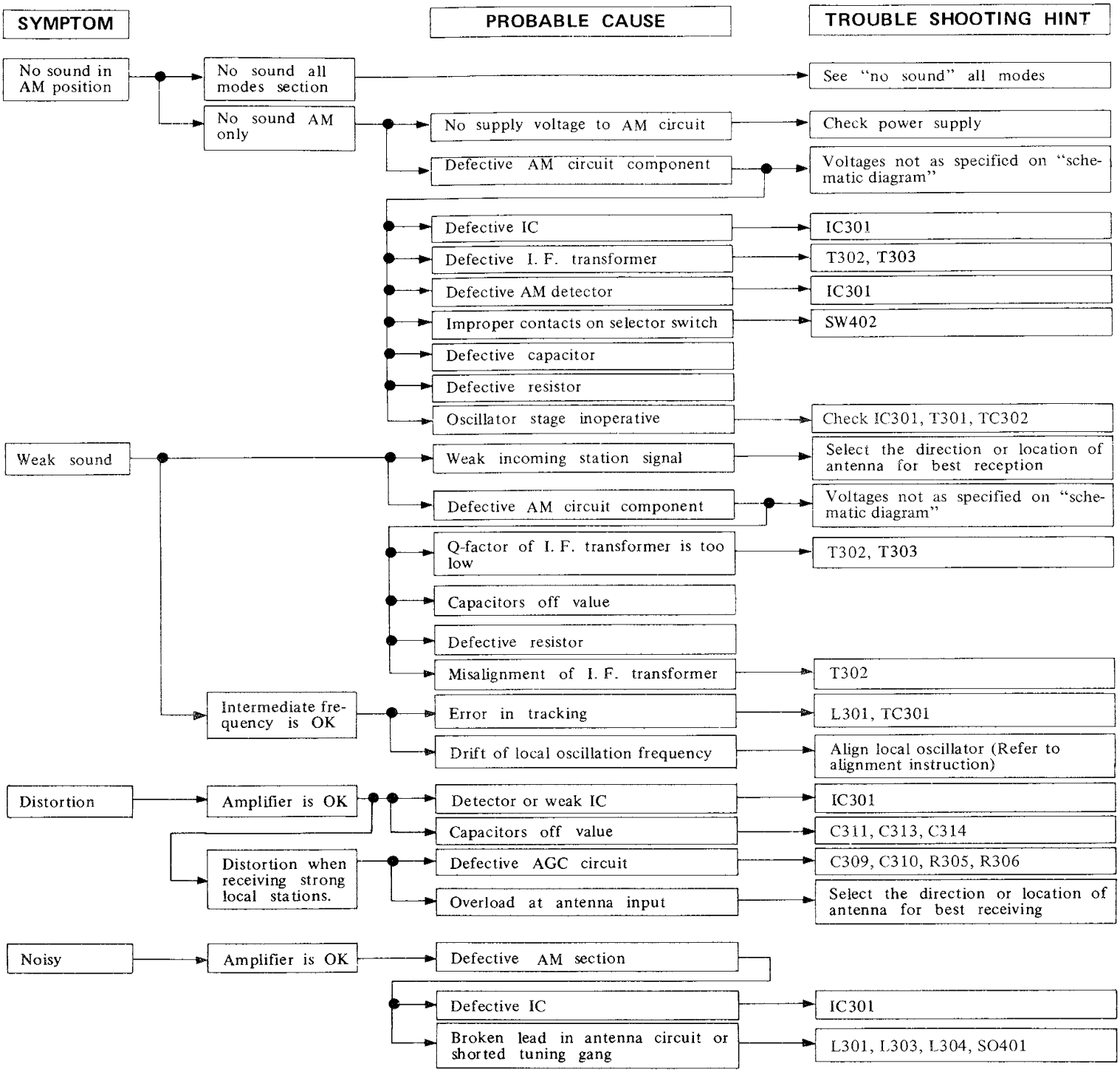
TROUBLE SHOOTING GUIDE (1)

ALL OPERATIONAL MODES



TROUBLE SHOOTING GUIDE (2)

AM RECEPTION



TROUBLE SHOOTING GUIDE (3)

FM RECEPTION

SYMPTOM		PROBABLE CAUSE	TROUBLE SHOOTING HINT
No sound in FM position	No sound in AM position, also	Defective power supply of IF stage	Voltage not as specified in "Schematic Diagram"
	FM detected signal is OK at TP203	Defective FM multiplex stage	Refer to the guide for FM multiplex reception
	Weak or no voltage of FM power supply	Open or defective circuit from power supply to FM tuner	Check continuously between tuner and power supply
		Poor contact of selector switch	SW402
	FM power supply is OK.	Defective FM IF circuit	
		Low voltage in IF circuit	
		Weak IC	IC101
		Defective transistor	Q104, Q105
		Defective ceramic filter	CF101, CF102
		Defective IF transformer	T101, T102, T103
		Defective resistors and capacitors	
	FM IF is OK	Defective FM tune circuit	FM front-end circuit
		Defective power supply circuit to FM front end	Voltage not as specified in "Schematic Diagram"
No signal but sufficient background noise	Not tune in FM range	Local oscillator dead	Q103, L105, TC104, C119, C113
Weak signal but loud background noise		Weak station signal	Use more sensitive antenna
		Loose antenna connection	
		Open antenna circuit	
		Weak RF circuit	FM front-end
		Misadjustment of tracking or IF transformers	Realign following the alignment chart
Distortion in FM		Defective IF stage or low voltage in IF stage	Measure voltages in FM section and repair or replace defective part
		Misalignment	T101, T102, T103
		Weak integrated circuit	IC101, IC201
Hum	Ripple in FM power supply	Capacitor off value	C403 ~ C405, C207
Noisy		Defective FM IF stage or FM tuner	Voltage not as specified in "Schematic Diagram"
		Aging or weak IC	IC101, IC201
Dial calibration off	Pointer does not move smoothly.	Pointer off of track or hits obstruction	
	Pointer runs over dial scale.	Pointer does not start at zero point of dial	Mechanically rese pointer at zero

TROUBLE SHOOTING GUIDE (4)

FM MULTIPLEX RECEPTION

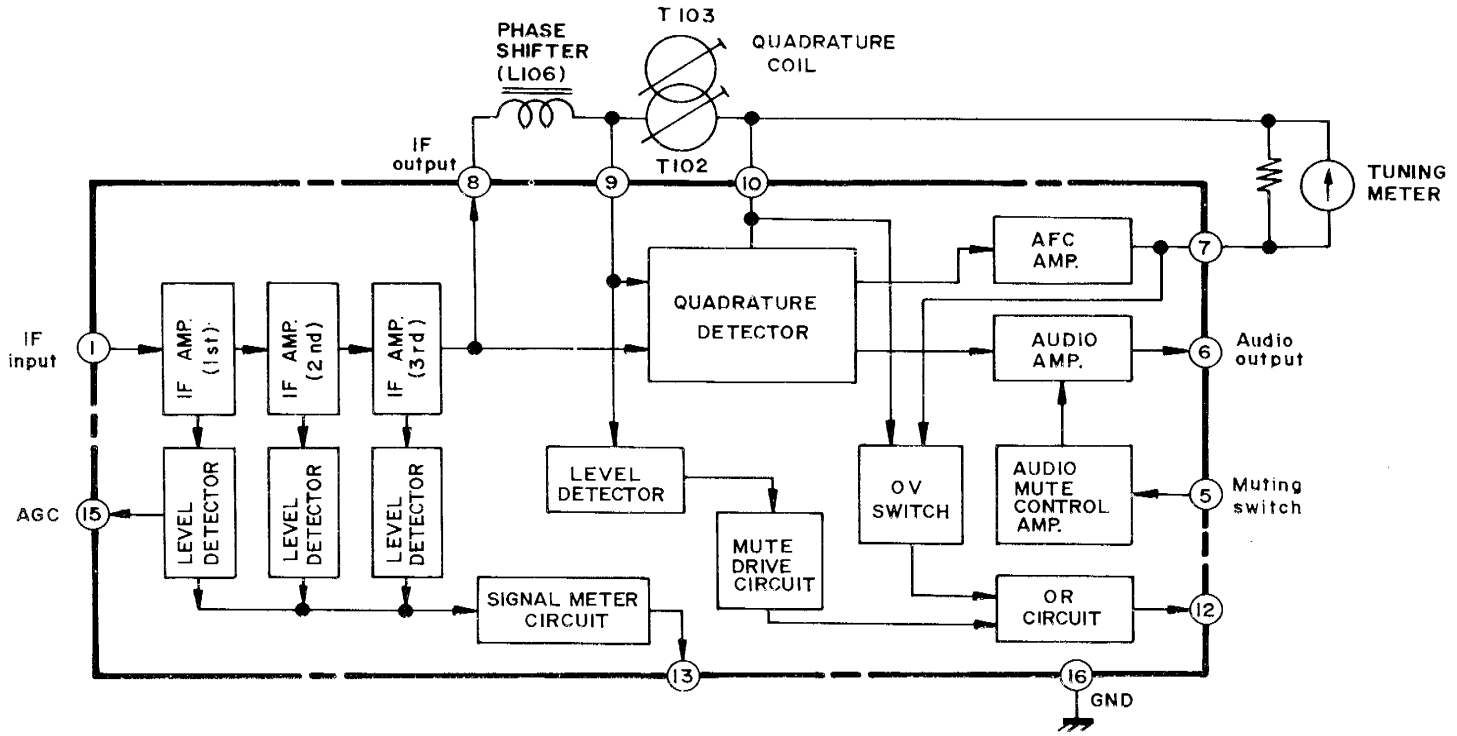
SYMPTOM		PROBABLE CAUSE	TROUBLE SHOOTING HINT
No stereo separation	Stereo light operates normally.	Components in one channel physically touching parts for other channel in tone circuit, main amp or multiplex circuit	SW402, SW403, SW404
	Stereo light does not light when receiving stereo signal.	Aging or weak IC or transistor	IC201, Q105
		Aging or weak semi-fixed resistor	VR202, VR201
		Defective resistors and capacitors	
Distortion		Weak or defective IC	IC201
Poor separation	Stereo light does not operate.	Defective transistor and IC	IC201, Q105
	Stereo light operates normally.	Drift of VCO frequency	Realign following the alignment chart VR201
Stereo light does not operate	Multiplex amplifier checks OK	Defective indicator lamp	LED401
		Defective power circuit to stereo light	R401, R402

USING WITH EXTERNAL INPUTS OR OUTPUTS (TAPE, ETC.)

SYMPTOM		PROBABLE CAUSE	TROUBLE SHOOTING HINT
No sound	Unit operates properly on AM or FM	Input source defective	Switch input sources to check
		Loose contacts of input socket	SO403
		Broken lead between printed wiring board and terminals	Check and repair
Tape play does not work	Amplifier is OK	Tape recorder defective	
		Loose contact of output socket	SO403

OTHER TROUBLES

Signal meter does not operate	At FM and AM	Loose contacts of band selector switch	SW402
		Meter open	
		Weak or defective IC and diode	IC101, IC301, D103
	At only AM	Defective AM circuit	Refer to AM reception
Tuning meter does not operate	At FM	Meter open	
		Weak or defective IC	IC101, SW402
High Blend switch does not operate	At FM	Defective high-blend switch	SW404, R218, C216
Air check circuit does not operate The air check circuit does not function.	At FM	Defective air check/muting switch	SW403
		Defective air check oscillator circuit	C411 ~ C414, R411 ~ R413, Q402



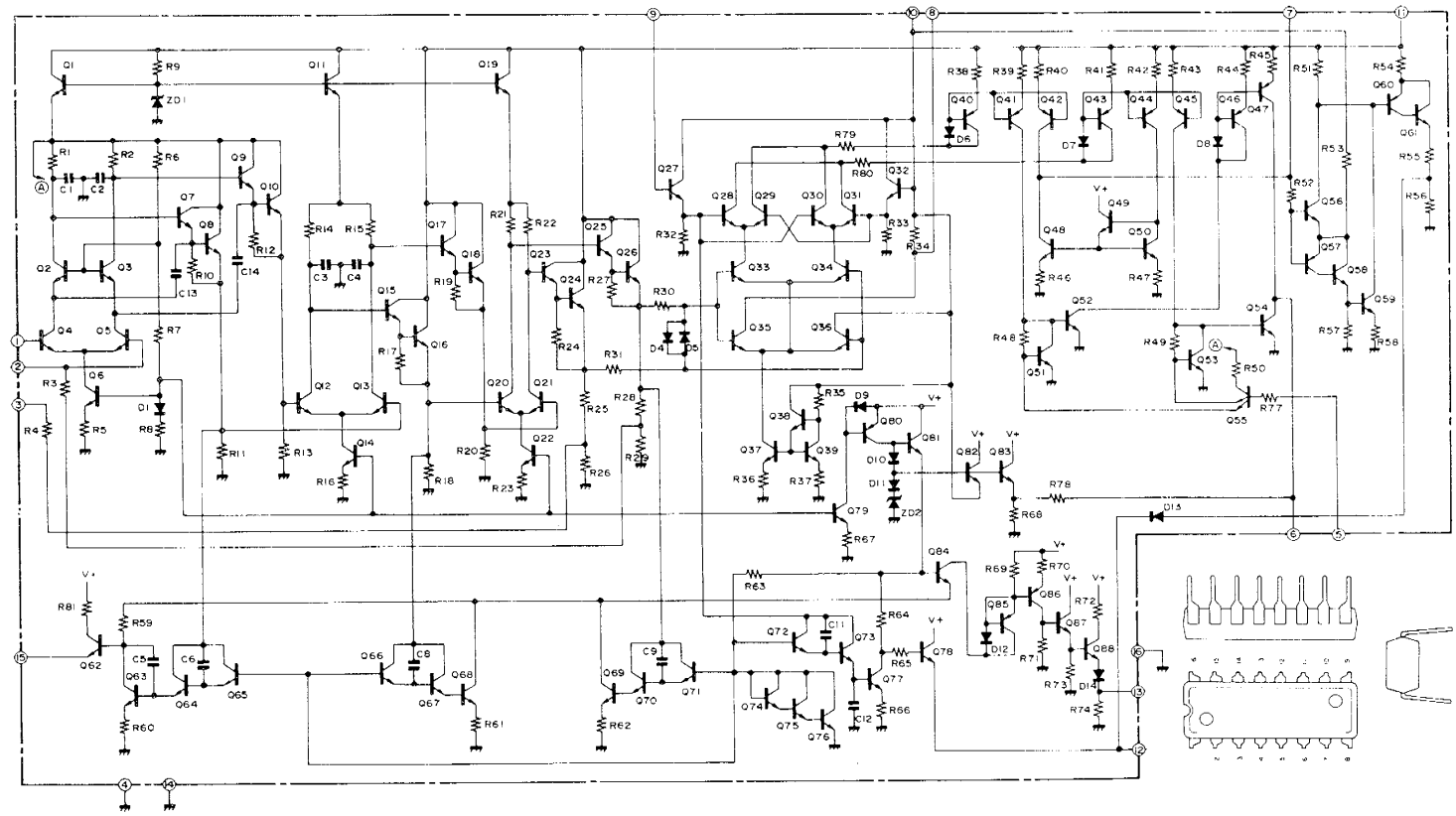
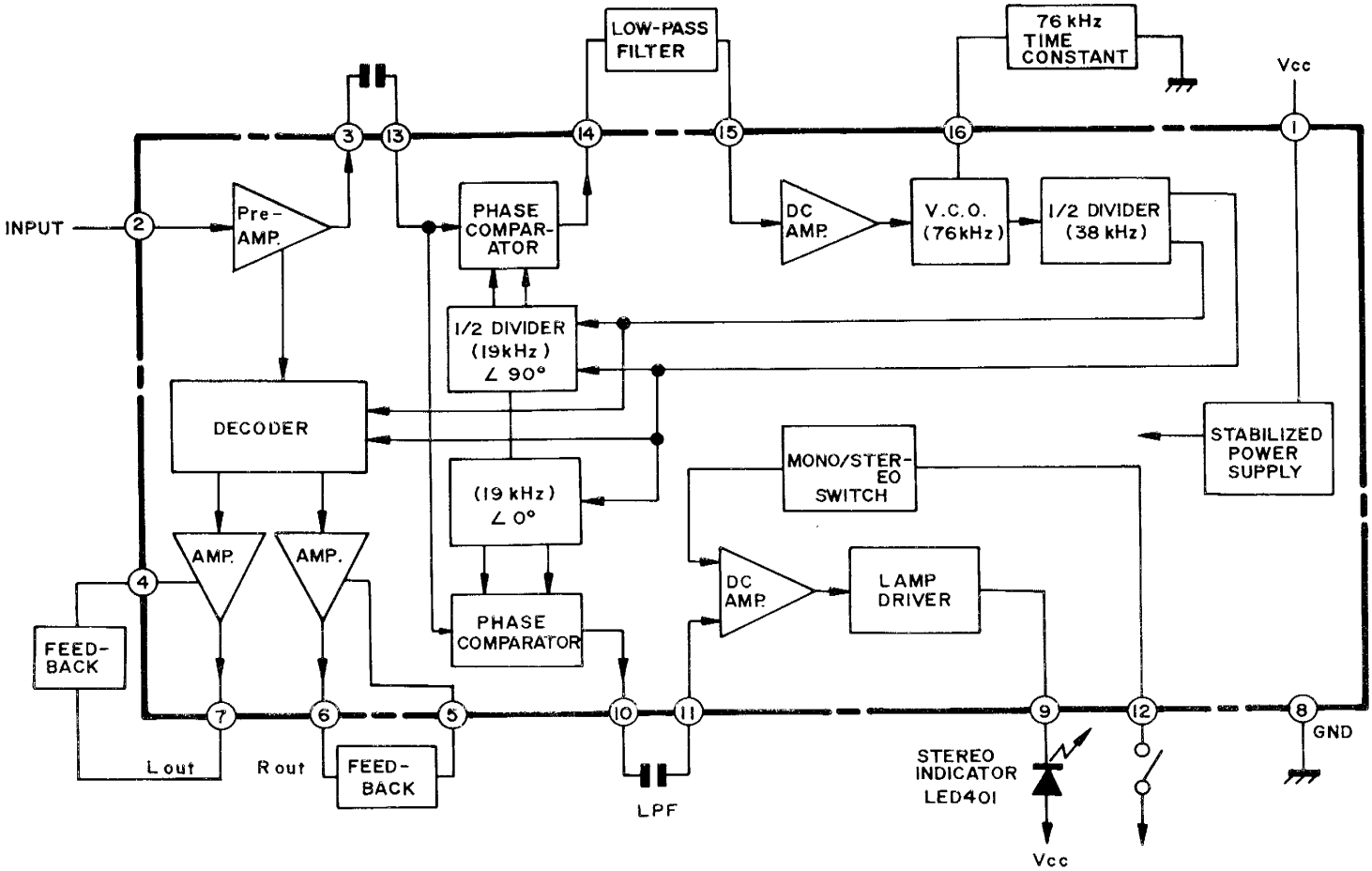


Figure 25 EQUIVALENT CIRCUIT OF INTEGRATED CIRCUIT (IC101)



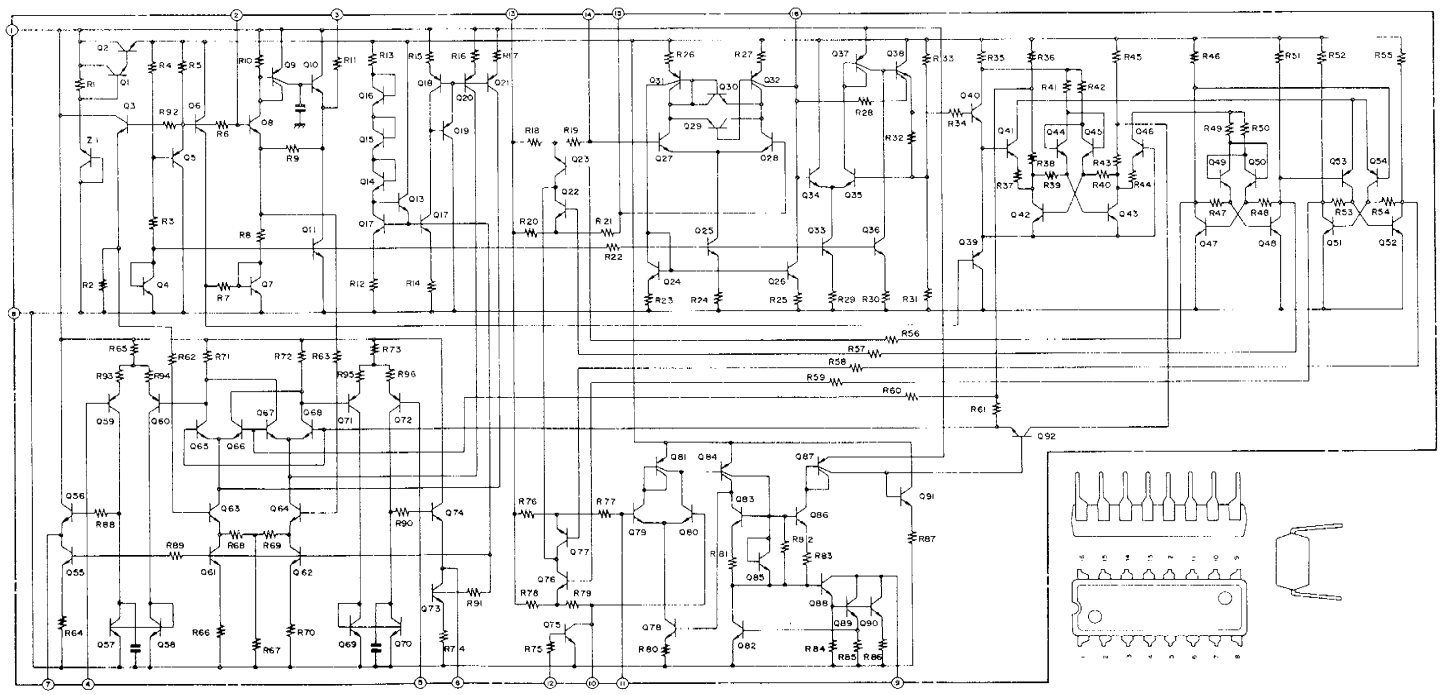
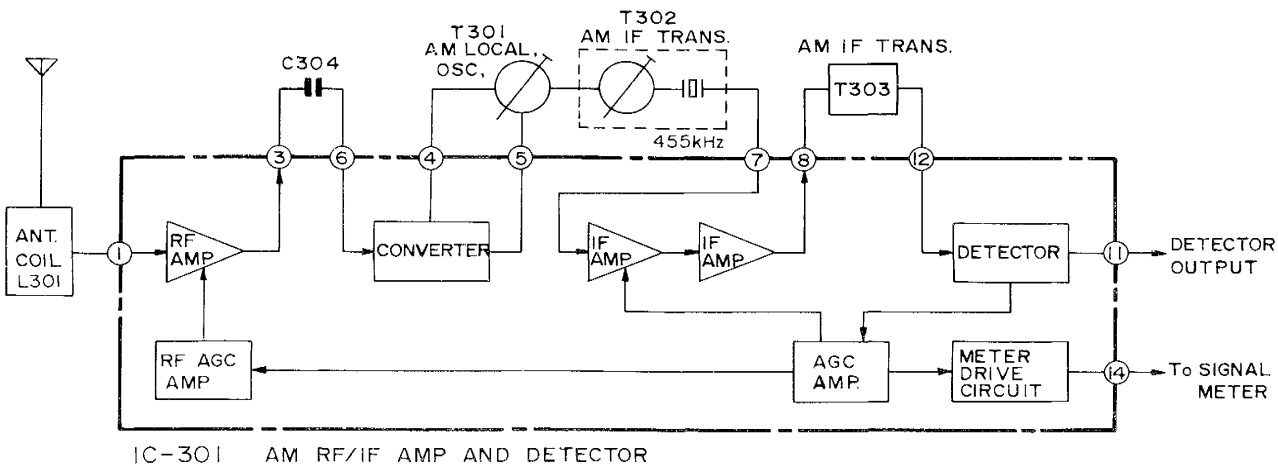
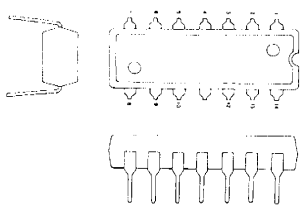


Figure 26 EQUIVALENT CIRCUIT OF INTEGRATED CIRCUIT (IC201)



IC-301 AM RF/IF AMP AND DETECTOR



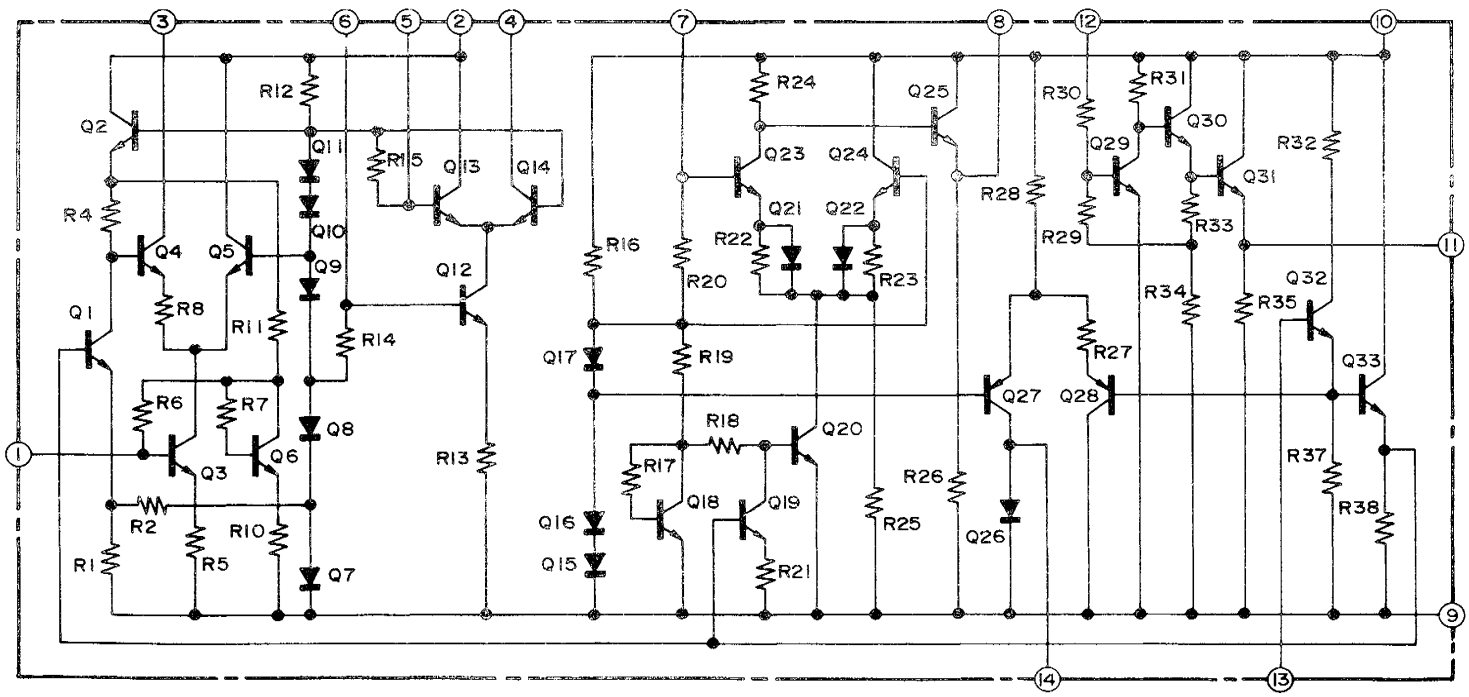
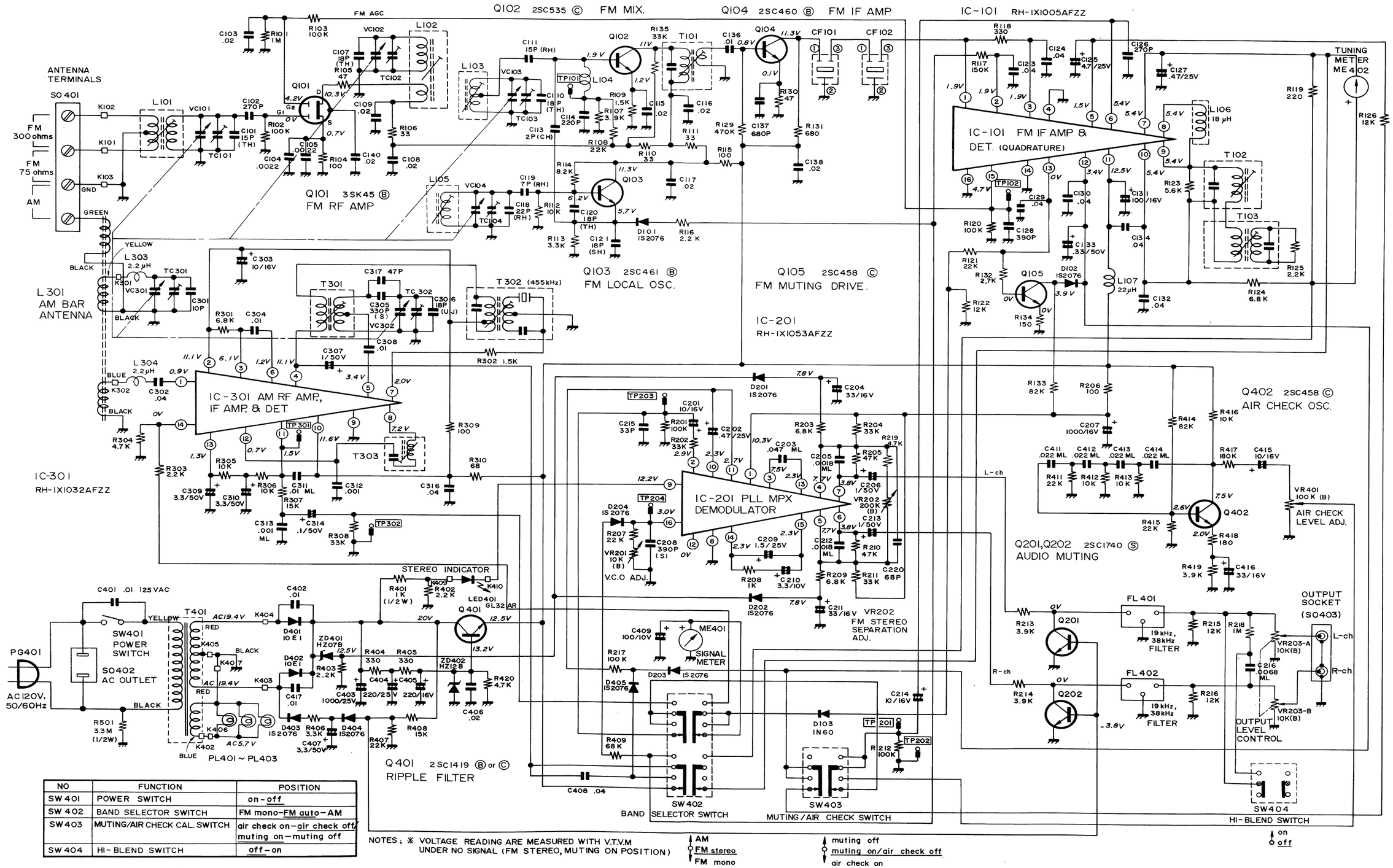


Figure 27 EQUIVALENT CIRCUIT OF INTEGRATED CIRCUIT (IC301)



NO	FUNCTION	POSITION
SW 401	POWER SWITCH	on-off
SW 402	BAND SELECTOR SWITCH	FM mono-FM auto-AM
SW 403	MUTING/AIR CHECK CAL. SWITCH	air check on-air check off, muting on-muting off
SW 404	HI-BLEND SWITCH	off-on

NOTES; ※ VOLTAGE READING ARE MEASURED WITH V.T.V.M UNDER NO SIGNAL (FM STEREO, MUTING ON POSITION)

(Specifications or wiring diagrams of this model are subject to change for the improvement without prior notice.)

Figure 28 SCHEMATIC DIAGRAM

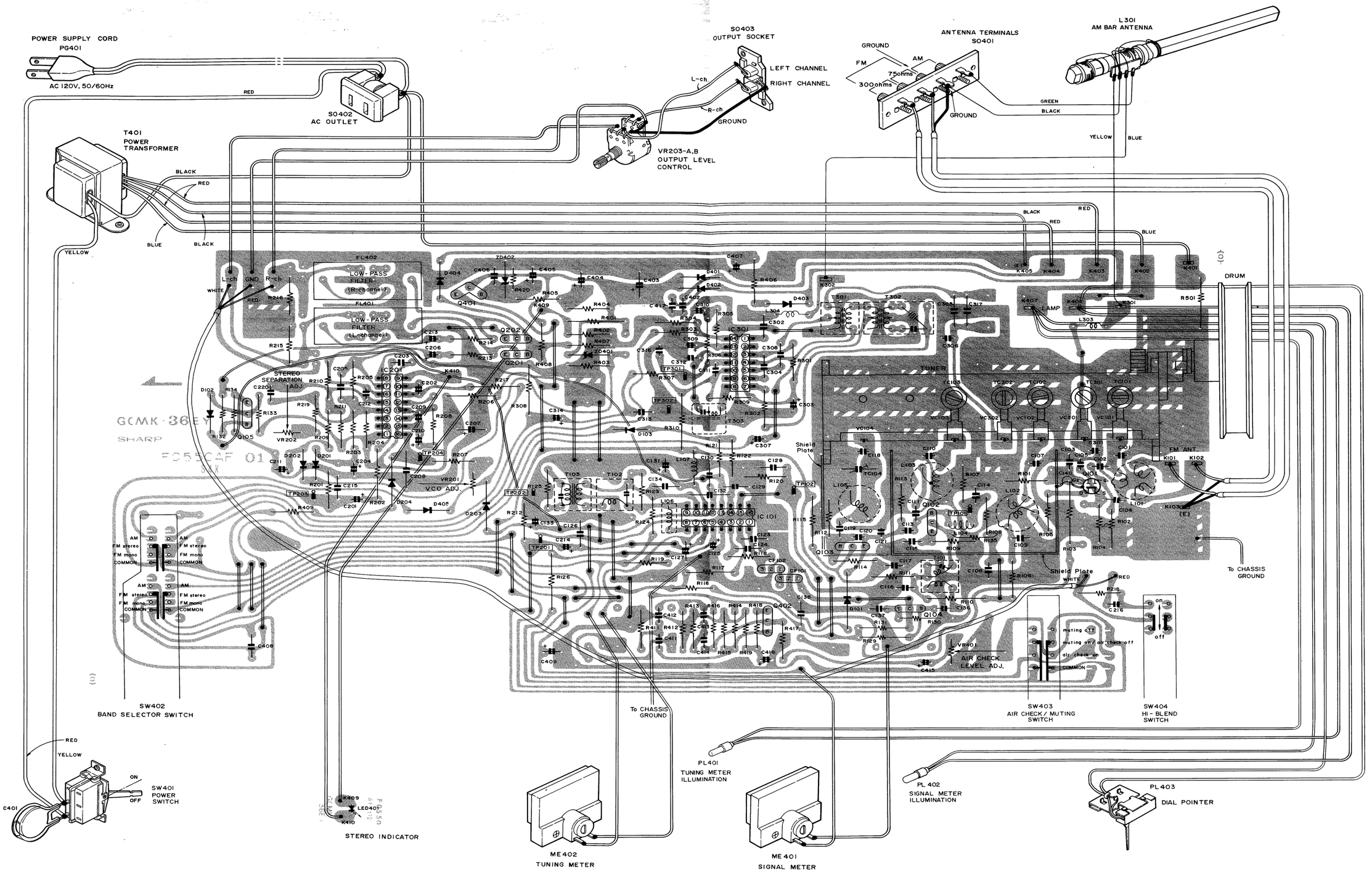


Figure 29 WIRING SIDE OF P.W. BOARD

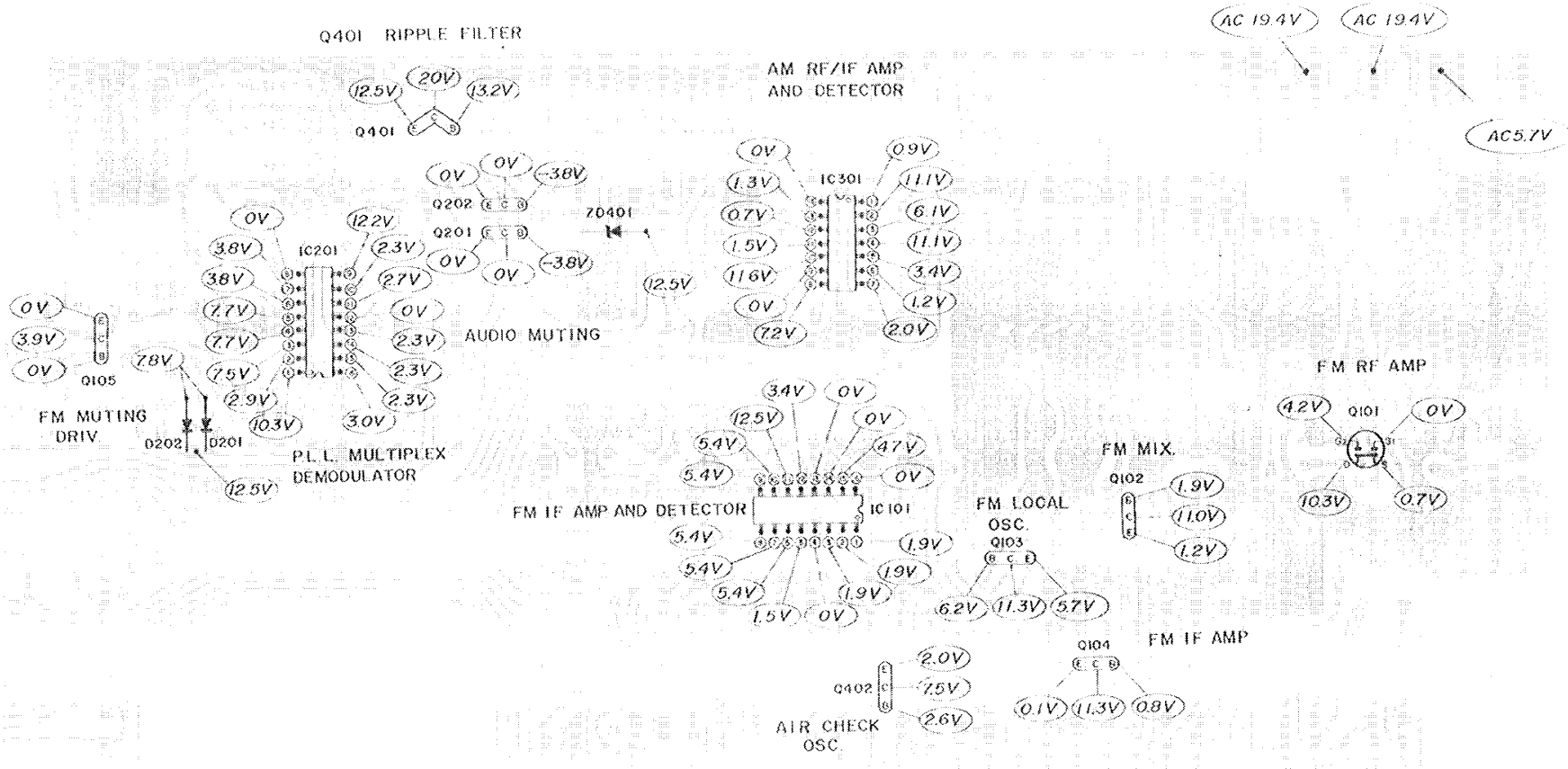
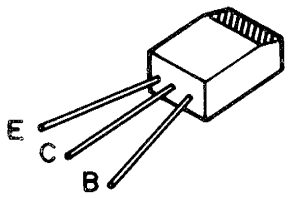
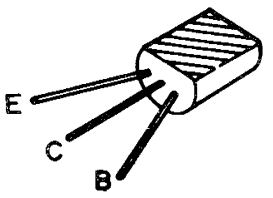

Q401 RIPPLE FILTER
12.5V
20V
13.2V
Q401
AM RF/IF AMP
AND DETECTOR
AC 19.4V
AC 19.4V
AC5.7V
0V
0V
-38V
Q202
Q201
0V
0V
-38V
ZD401
12.5V
IC301
0V
1.3V
0.7V
1.5V
11.6V
0V
7.2V
0.9V
1.1V
6.1V
11.1V
3.4V
1.2V
2.0V
0V
3.8V
3.8V
7.7V
7.7V
7.5V
2.9V
10.3V
IC201
12.2V
2.3V
2.7V
0V
2.3V
2.3V
2.3V
3.0V
AUDIO MUTING
0V
3.9V
0V
Q105
7.8V
FM MUTING
DRIV
D202
D201
12.5V
P.L.L. MULTIPLEX
DEMODULATOR
FM RF AMP
4.2V
Q101
0V
10.3V
0.7V
3.4V
12.5V
5.4V
5.4V
0V
0V
4.7V
0V
FM IF AMP AND DETECTOR
IC101
5.4V
5.4V
5.4V
1.9V
1.9V
1.9V
1.5V
0V
FM MIX.
Q102
1.9V
11.0V
1.2V
FM LOCAL
OSC.
Q103
6.2V
11.3V
5.7V
Q104
FM IF AMP
0.1V
11.3V
0.8V
Q402
2.0V
7.5V
2.6V
AIR CHECK
OSC

Figure 30

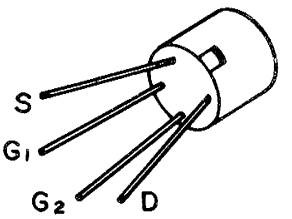


2SC458 Ⓒ
2SC535 Ⓒ
2SC461 Ⓑ
2SC460 Ⓑ



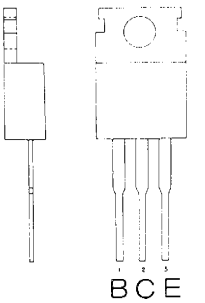
2SC1740 Ⓢ

E: Emitter
C: Collector
B: Base

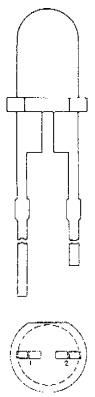


3SK45

S: Source
G_1: Gate 1
G_2: Gate 2
D: Drain

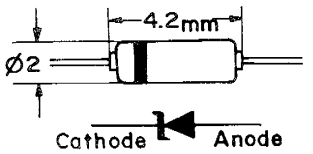


2SC1419

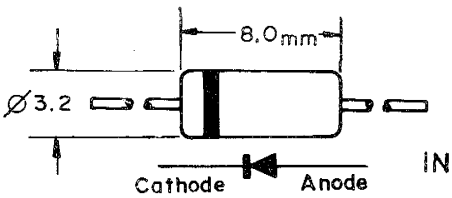


GL 32AR

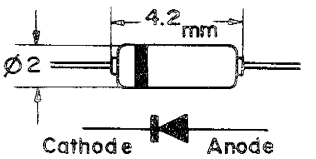
1. ANODE
2. CATHODE



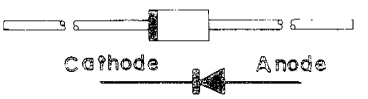
HZ-12 Ⓑ
HZ07 Ⓑ



IN60

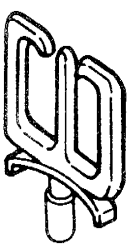


IS2076

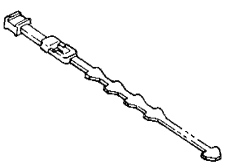


IOEI

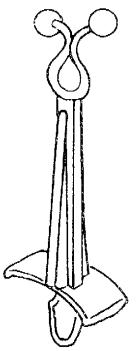
Figure 31 TRANSISTOR AND DIODE TYPES



LHLDW1027AGZZ



LHLDW1052AFZZ



LHLDW1053AFZZ

Figure 32 WIRE CLIP

REPLACEMENT PARTS LIST

"HOW TO ORDER REPLACEMENT PARTS"

To have your order filled promptly and correctly, please furnish the following informations.

1. MODEL NUMBER
2. REF. NO.
3. PART NO.
4. DESCRIPTION

Order to : Parts Center

P.O. Box 664 Paramus, New Jersey 07652 (201) 265-5600
P.O. Box 20394 Long Beach, Calif. 90801 (213) 830-4470

REF. NO.	PART NO.	DESCRIPTION	PRICE
		INTEGRATED CIRCUITS	
IC101	RH-IX1005AFZZ	FM IF Amplifier and Detector (Quadrature) (HA1137W)	
IC201	RH-IX1053AFZZ	P.L.L. Multiplex Demodulator (HA1196)	
IC301	RH-IX1032AFZZ	AM RF/IF Amplifier and Detector (HA1151)	
		TRANSISTORS	
Q101	VS3SK45-B//1F	Dual gate MOS-FET, FM RF Amplifier (3SK45Ⓑ)	
Q102	VS2SC535-C/-1	FM Mixer (2SC535Ⓒ)	
Q103	VS2SC461-B/-1	FM Local Oscillator (2SC461Ⓑ)	
Q104	VS2SC460-B/-1	FM IF Amplifier (2SC460Ⓑ)	
Q105	VS2SC458-C/-1	FM Muting Driver (2SC458Ⓒ)	
Q201, Q202	VS2SC1740S/-1	Audio Muting (2SC1740Ⓢ)	
Q401	VS2SC1419-K1F	Ripple Filter (2SC1419Ⓑ or Ⓒ)	
Q402	VS2SC458-C/-1	Air Check Oscillator (2SC458 Ⓒ)	
		DIODES	
D101	VHD1S2076//-1	Oscillation Stop (1S2076)	
D102	VHD1S2076//-1	FM Muting (1S2076)	
D103	VHD1N60////-1	Meter (1N60)	
D201	VHD1S2076//-1	Audio Muting (1S2076)	
D202	VHD1S2076//-1	Audio Muting (1S2076)	
D203	VHD1S2076//-1	FM Muting (1S2076)	
D204	VHD1S2076//-1	V.C.O. Frequency Stop (1S2076)	
D401	VHD10E1////-1	Power Rectifier (10E1)	
D402	VHD10E1////-1	Power Rectifier (10E1)	
D403	VHD1S2076//-1	Voltage Rectifier, Audio Muting (1S2076)	
D404	VHD1S2076//-1	Voltage Rectifier, Audio Muting (1S2076)	
D405	VHD1S2076//-1	+B (1S2076)	
LED401	VHPGL32AR//-1	Light Emitting Diode, Stereo Indicator (GL-32AR)	
ZD401	VHEHZ7/////1F	Zener Diode, Voltage Regulator (7.1 ± 0.4V) (HZ07B)	
ZD402	VHEHZ12-BBK-1	Zener Diode, Voltage Regulator (13.1 ± 0.4V) (HZ-12Ⓑ)	
		COILS	
L101	RCILA0407AFZZ	FM Antenna	
L102	RCILR0312AFZZ	FM RF	
L103	RCILR0313AFZZ	FM RF	
L104	RCILC0003AGZZ	FM Trap	
L105	RCILB0386AFZZ	FM Local Oscillator	
L106	RCILZ0052AFZZ	18μH, Phase Shifter	
L107	VP-LH220M0000	22μH, +B Choke	
L301	RCILA0405AFZZ	AM Bar Antenna	
L303	VP-LH2R2M0000	2.2μH, Choke	
L304	VP-LH2R2M0000	2.2μH, Choke	
		TRANSFORMERS	
T101	RCILI0202AFZZ	FM IF	
T102	RCILD0055AFZZ	Quadrature (10.7MHz)	
T103	RCILD0056AFZZ	Quadrature (10.7MHz)	
T301	RCILB0395AFZZ	AM Local Oscillator	
T302	RCILI0200AFZZ	AM IF with Ceramic Filter	
T303	RCILI0216AFZZ	AM IF	
T401	RTRNP0490AFZZ	Power	
		FILTERS	
CF101, CF102	RFILF0009AFZZ	FM IF, Ceramic	
FL401, FL402	RFILL0050AFZZ	Low-Pass Filter (19kHz and 38kHz)	
		CONTROLS	
VC101, VC102, VC103, VC104, VC301, VC302, TC101, TC102, TC103, TC301, TC302	RVC-C0054AFZZ	Variable Capacitors, Tuning with Trimmers TC101: FM Antenna Trimmer TC102: FM RF Trimmer TC103: FM RF Trimmer TC301: AM Antenna Trimmer TC302: AM Local Oscillator Trimmer	
TC104	RTO-H1030AGZZ	Trimmer Capacitor, FM Local Oscillator	
VR201	RVR-M0127AFZZ	10K (B) ohm, V.C.O. Frequency Adjust	
VR202	RVR-M0132AFZZ	200K (B) ohm, Stereo Separation Adjust	
VR203-A, VR203-B	RVR-B0120AFZZ	10K (B) ohm, Output Level Control	
VR401	RVR-M0131AFZZ	100K (B) ohm, Air Check Level Adjust	
		ELECTROLYTIC CAPACITORS	
C125	VCEAAU1EW475A	4.7MFD, 25V, +75 −10%	
C127	VCAAAU1EB474K	.47MFD, 25V, ±10%, Aluminum	
C131	VCEAAU1CW107Y	100MFD, 16V, +50 −10%	
C133	VCEALU1HW334M	.33MFD, 50V, ±20%, Yellow	
C201	VCEAAU1CW106Y	10MFD, 16V, +50 −10%	
C202	VCAAAU1EB474K	.47MFD, 25V, ±10%, Aluminum	
C204	VCEAAU1CW336Y	33MFD, 16V, +50 −10%	
C206	VCEAAU1HW105A	1MFD, 50V, +75 −10%	
C207	VCEAAU1CW108Y	1000MFD, 16V, +50 −10%	

PARTS LIST

REF. NO.	PART NO.	DESCRIPTION	PRICE
C209	VCAAAU1EB155K	1.5MFD, 25V, ±10%, Aluminum	
C210	VCAAAU1AB335M	3.3MFD, 10V, ±20%, Aluminum	
C211	VCEAAU1CW336Y	33MFD, 16V, +50 −10%	
C213	VCEAAU1HW105A	1MFD, 50V, +75 −10%	
C214	VCEAAU1CW106Y	10MFD, 16V, +50 −10%	
C303	VCEAAU1CW106Y	10MFD, 16V, +50 −10%	
C307	VCEAAU1HW105A	1MFD, 50V, +75 −10%	
C309, C310	VCEAAU1HW335A	3.3MFD, 50V, +75 −10%	
C314	VCEALU1HW104M	.1MFD, 50V, ±20%, Yellow	
C403	VCEAAU1EW108Y	1000MFD, 25V, +50 −10%	
C404	VCEAAU1EW227Y	220MFD, 25V, +50 −10%	
C405	VCEAAU1CW227Y	220MFD, 16V, +50 −10%	
C407	VCEAAU1HW335A	3.3MFD, 50V, +75 −10%	
C409	VCEAAU1AW107Y	100MFD, 10V, +50 −10%	
C415	VCEAAU1CW106Y	10MFD, 16V, +50 −10%	
C416	VCEAAU1CW336Y	33MFD, 16V, +50 −10%	

CAPACITORS

(Unless otherwise specified capacitors are 50V, +80 −20%, Ceramic Type)

C101	VCCTPU1HH150J	15PF (Blue), 50V, ±5%, Ceramic	
C102	VCCSPU1HL271K	270PF, 50V, ±10%, Ceramic	
C103	VCKZPU1HF203Z	.02MFD	
C104, C105	VCKZPU1HF222Z	.0022MFD	
C107	VCCTPU1HH180J	18PF (Blue), 50V, ±5%, Ceramic	
C108, C109	VCKZPU1HF203Z	.02MFD	
C110	VCCTPU1HH180J	18PF (Blue), 50V, ±5%, Ceramic	
C111	VCCRPU1HH150J	15PF (Yellow), 50V, ±5%, Ceramic	
C113	VCCCPU1HH2R0C	2PF (Black), 50V, ±0.25PF, Ceramic	
C114	VCCSPU1HL221K	220PF, 50V, ±10%, Ceramic	
C115, C116, C117	VCKZPU1HF203Z	.02MFD	
C118	VCCRPU1HH220J	22PF (Yellow), 50V, ±5%, Ceramic	
C119	VCCRPU1HH7R0D	7PF (Yellow), 50V, ±0.5PF, Ceramic	
C120	VCCTPU1HH180J	18PF (Blue), 50V, ±5%, Ceramic	
C121	VCCSPU1HH180J	18PF (Green), 50V, ±5%, Ceramic	
C123, C124	VCKZPU1HF403Z	.04MFD	
C126	VCCSPU1HL271K	270PF, 50V, ±10%, Ceramic	
C128	VCCSPU1HL391K	390PF, 50V, ±10%, Ceramic	
C129, C130, C132, C134	VCKZPU1HF403Z	.04MFD	
C136	VCKZPU1HF103Z	.01MFD	
C137	**VCCSPU1HL681K**	**680PF, 50V, ±10%, Ceramic**	
C138, C140	VCKZPU1HF203Z	.02MFD	
C203	VCQYKU1HM473K	.047MFD, 50V, ±10%, Mylar	
C205	**VCQYKU1HM182J**	**.0018MFD**, 50V, ±5%, Mylar	
C208	VCQSMT1HS391J	390PF, 50V, ±5%, Styrol	
C212	**VCQYKU1HM182J**	**.0018MFD**, 50V, ±5%, Mylar	
C215	VCCSPU1HL330K	33PF, 50V, ±10%, Ceramic	
C216	VCQYKU1HM682K	.0068MFD, 50V, ±10%, Mylar	
C220	**VCCSPU1HL680K**	**68PF, 50V, ±10%, Ceramic**	
C301	VCCSPU1HL100K	10PF, 50V, ±10%, Ceramic	
C302	VCKZPU1HF403Z	.04MFD	
C304	VCKZPU1HF103Z	.01MFD	
C305	VCQSMT1HS331J	330PF, 50V, ±5%, Styrol	
C306	VCCUPU1HJ180J	18PF (Violet), 50V, ±5%, Ceramic	
C308	VCKZPU1HF103Z	.01MFD	
C311	VCQYKU1HM103K	.01MFD, 50V, ±10%, Mylar	
C312	VCKZPU1HF102Z	.001MFD	
C313	VCQYKU1HM102K	.001MFD, 50V, ±10%, Mylar	
C316	VCKZPU1HF403Z	.04MFD	
C317	VCCSPU1HL470K	47PF, 50V, ±10%, Ceramic	
C401	**RC-KZ020UAFZZ**	**.01MFD, 125VAC, +80−20%, Ceramic**	
C402	VCKZPU1HF103Z	.01MFD	
C406	VCKZPU1HF203Z	.02MFD	
C408	VCKZPU1HF403Z	.04MFD	
C411, C412, C413, C414	VCQYKU1HM223M	.022MFD, 50V, ±20%, Mylar	
C417	VCKZPU1HF103Z	.01MFD	

RESISTORS

(Unless otherwise specified resistors are 1/4W, ±5%, Carbone Type)

R101	VRD-ST2EE105J	1 Meg ohm
R102	VRD-ST2EE104J	100K ohm
R103	VRD-ST2EE104J	100K ohm
R104	VRD-ST2EE101J	100 ohm
R105	VRD-ST2EE470J	47 ohm
R106	VRD-ST2EE330J	33 ohm
R107	VRD-ST2EE392J	3.9K ohm
R108	VRD-ST2EE223J	22K ohm
R109	VRD-ST2EE152J	1.5K ohm
R110	VRD-ST2EE330J	33 ohm
R111	VRD-ST2EE330J	33 ohm
R112	VRD-ST2EE103J	10K ohm
R113	VRD-ST2EE332J	3.3K ohm
R114	VRD-ST2EE822J	8.2K ohm
R115	VRD-ST2EE101J	100 ohm
R116	VRD-ST2EE222J	2.2K ohm
R117	VRD-ST2EE154J	150K ohm
R118	VRD-ST2EE331J	330 ohm
R119	VRD-ST2EE221J	220 ohm
R120	VRD-ST2EE104J	100K ohm
R121	VRD-ST2EE223J	22K ohm
R122	VRD-ST2EE123J	12K ohm
R123	VRD-ST2EE562J	5.6K ohm
R124	VRD-ST2EE682J	6.8K ohm
R125	VRD-ST2EE222J	2.2K ohm
R126	VRD-ST2EE123J	12K ohm
R129	VRD-ST2EE474J	470K ohm
R130	VRD-ST2EE470J	47 ohm
R131	VRD-ST2EE681J	680 ohm
R132	VRD-ST2EE272J	2.7K ohm
R133	VRD-ST2EE823J	82K ohm
R134	VRD-ST2EE151J	150 ohm
R135	**VRD-SU2EY333J**	33K ohm
R201	VRD-ST2EE104J	100K ohm
R202	VRD-ST2EE333J	33K ohm
R203	VRD-ST2EE682J	6.8K ohm
R204	VRD-ST2EE333J	33K ohm
R205	VRD-ST2EE473J	47K ohm
R206	VRD-ST2EE101J	100 ohm
R207	VRD-ST2EE223J	22K ohm
R208	VRD-ST2EE102J	1K ohm
R209	VRD-ST2EE682J	6.8K ohm
R210	VRD-ST2EE473J	47K ohm
R211	VRD-ST2EE333J	33K ohm
R212	VRD-ST2EE104J	100K ohm
R213	VRD-ST2EE392J	3.9K ohm

PARTS LIST

REF. NO.	PART NO.	DESCRIPTION	PRICE
R214	VRD-ST2EE392J	3.9K ohm	
R215	VRD-ST2EE123J	12K ohm	
R216	VRD-ST2EE123J	12K ohm	
R217	VRD-ST2EE104J	100K ohm	
R218	VRD-ST2EE105J	1 Meg ohm	
R219	VRD-ST2EE472J	4.7K ohm	
R301	VRD-ST2EE682J	6.8K ohm	
R302	VRD-ST2EE152J	1.5K ohm	
R303	VRD-ST2EE222J	2.2K ohm	
R304	VRD-ST2EE472J	4.7K ohm	
R305	VRD-ST2EE103J	10K ohm	
R306	VRD-ST2EE103J	10K ohm	
R307	VRD-ST2EE153J	15K ohm	
R308	VRD-ST2EE333J	33K ohm	
R309	VRD-ST2EE101J	100 ohm	
R310	VRD-ST2EE680J	68 ohm	
R401	VRD-ST2HD102J	1K ohm, 1/2W, ±5%, Carbon	
R402	VRD-ST2EE222J	2.2K ohm	
R403	VRD-ST2EE222J	2.2K ohm	
R404	VRD-ST2EE331J	330 ohm	
R405	VRD-ST2EE331J	330 ohm	
R406	VRD-ST2EE332J	3.3K ohm	
R407	VRD-ST2EE223J	22K ohm	
R408	VRD-ST2EE153J	15K ohm	
R409	VRD-ST2EE683J	68K ohm	
R411	VRD-ST2EE223J	22K ohm	
R412	VRD-ST2EE103J	10K ohm	
R413	VRD-ST2EE103J	10K ohm	
R414	VRD-ST2EE823J	82K ohm	
R415	VRD-ST2EE223J	22K ohm	
R416	VRD-ST2EE103J	10K ohm	
R417	VRD-ST2EE184J	180K ohm	
R418	VRD-ST2EE181J	180 ohm	
R419	VRD-ST2EE392J	3.9K ohm	
R420	VRD-SU2EY472J	4.7K ohm	
R501	VRC-MT2HG335J	3.3Meg ohm, 1/2W, ±5%, Solid	

MISCELLANEOUS

	CSPRT0386AF04	Dial Cord Assembly
	GCAB-3034AFSA	Cabinet
	GCOVA1075AFSC	Guide (Large), Lever Switch (ST-1515)
	GCOVA1075AFSB	Guide (Large), Lever Switch (ST-1515B)
	GCOVA1076AFSC	Guide (Small), Lever Switch (ST-1515)
	GCOVA1076AFSB	Guide (Small), Lever Switch (ST-1515B)
	GCOVH1161AFSA	Cover, AM Bar Antenna
	GFTAU3061AFZZ	Cabinet, Bottom
	GLEGP0055AF00	Leg } Refer to Figure 3 and 4.
	GLEGP0058AF08	Leg } Refer to Figure 3 and 4.
	GMADD0051AFSA	Window, Transparent
	HDALM0172AFSA	Dial Scale
	HDECW0058AFSB	Decoration Plate, Left
	HDECW0063AFSB	Decoration Plate, Right
	HSSND0234AFSA	Dial Pointer with Lamp (PL403)
	HPNLC3279AFSA	Front Panel (ST-1515)
	HPNLC5207AFSA	Front Panel (ST-1515B)
	JKNBN0317AFSA	Knob, Tuning (ST-1515)
	JKNBN0317AFSB	Knob, Tuning (ST-1515B)
	JKNBN0330AFSA	Knob, Band Selector (ST-1515)
	JKNBN0318AFSB	Knob, Band Selector (ST-1515B)
	JKNBP0070AFSA	Knob, Power, Air Check/Muting, Hi-blend (ST-1515)
	JKNBP0070AFSB	Knob, Power, Air Check/Muting, Hi-blend (ST-1515B)
	JKNBN0227AFSA	Knob, Output Level Control
	LANGQ0513AFSA	Rear Panel (ST-1515)
	LANGQ0524AFSA	Rear Panel (ST-1515B)
	LANGR0369AFZZ	Bracket, Output Level Control Volume
	LANGT0581AFZZ	Bracket, Pulley } Refer to Figure 2.
	LANGT0582AFZZ	Bracket, Pulley } Refer to Figure 2.
	LANGT0583AFZZ	Bracket, Pulley } Refer to Figure 2.
	LBSHC0007AFZZ	Bushing, Power Supply Cord
	LBSHZ0001AF00	Bushing, Lamp, Antenna Lead Wire
	LCHSM0250AFZZ	Chassis
	LHLDA1001SG00	Holder, Bar Antenna Core
	LHLDW1027AGZZ	Wire Clip } Refer to Figure 32.
	LHLDW1052AFZZ	Wire Clip } Refer to Figure 32.
	LHLDW1053AFZZ	Wire Clip } Refer to Figure 32.
	LSTPK0003SEZZ	Coil Stopper, Bar Antenna Core
	LX-JZ0001AFFF	Screw, Antenna Cover
	MSPRT0386AFFJ	Spring, Dial Cord
	NDRM-0150AFZZ	Drum, Dial Cord
	NPLYB0001SGZZ	Pulley, Dial Cord
	NPLYC0101AFFD	Shaft, Pulley
	NSFTD0168AFZZ	Tuning Shaft with Flywheel
	PCOVP1155AFZZ	Cover, Capacitor C401
	PCOVZ8051AFZZ	Cap, Lamp, Green
	PCUSG0069AF00	Cushion, Rubber
	PCUSS0076AFZZ	Cushion, Meter
	PFLT-0316AF00	Felt, Front Panel
	PFLT-0318AF00	Felt, Chassis
	PSHEF0110AFZZ	Felt, Air Check/Muting Switch, Power Switch, Hi-blend Switch
	PSHEF0048AG00	Sheet, Cabinet
	PSLDM3121AFZZ	Shield Plate, FM RF Section
	PSLDM3125AFZZ	Shield Plate, FM OSC. Section
	PSPAF0054AF00	Spacer, Bushing (Power Supply Cord)
	PSPAZ0060AFZZ	Spacer, LED401
PG401	QACCU0002AF00	Power Supply Cord with Plug
	QANTW0051AFZZ	FM Indoor Antenna, T-shape
	QCNW-0117AFZZ	Connection Cord, RCA Type
	QPWBF0550AFZZ	Printed Wiring Board
SO401	QTANN0452AFZZ	Antenna Terminal (FM 300/75 ohms and AM)
SO402	QSOCA2150AFZZ	Socket, AC Outlet
SO403	QSOCJ2452AFZZ	Socket, Output
SW401	QSW-B9071AFZZ	Switch, Power
SW402	QSW-R0113AFZZ	Switch, Band Selector (AM/FM stereo/FM mono)
SW403	QSW-B0064AFZZ	Switch, Air Check/Muting
SW404	QSW-B0051AFZZ	Switch, Hi-blend
ME401	RMTRL0130AFSA	Meter, Signal
ME402	RMTRL0129AFSA	Meter, Tuning (Center)
PL401, PL402	RLMPM0062AFZZ	Lamp, Meter Illumination (6.3V, 0.15A)
	SPAKA0457AFZZ	Packing Add., Cushion
	SPAKC0995AFZZ	Packing Case (ST-1515)
	SPAKC1026AFZZ	Packing Case (ST-1515B)
	SSAKH0015SEZZ	Polyethylene Bag
	XHBSF40P18XSO	Flange Head Screw, Cabinet

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