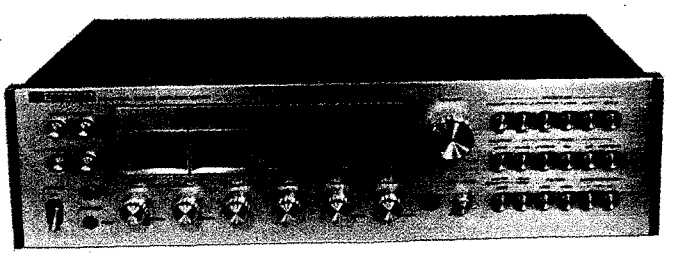
# TOSHIBA 4 CHANNEL STEREO AMPLIFIER

# SERVICE DATA

## MODEL SB-514

FILE NO. 170-012



## SPECIFICATIONS

### Main Amplifier

**Output:**
IHF Music Power 180W (8Ω) BTL
(Distortion 0.2%)
Continuous 35W x 4 (8Ω)
Pomer (r.m.s) 70W x 2 (8Ω)BTL
(Distortion 0.2%)

**Distortion Factor:**
Total Harmonic Distortion Factor
At rating output (8Ω) 0.2%
IM Distortion Factor
At rating output (8Ω) 0.2%

**Frequency Response:** 10Hz - 70kHz +0, -1dB

**Input Sensitivity and Impedance:** MAIN IN 0.55V (47kΩ)

**Residual Noise:** 1.0mV (8Ω)

**Damping Factor:** 100 (8Ω)

**Speaker Impedance:** 4-16Ω (BTL 8-16Ω)

### Pre-amplifier

**Input Sensitivity and Impedance:**

| | | |
|---|---|---|
| PHONO 1 | CC | 20mV (47kΩ) |
| PHONO 2 | MAG | 2mV (70kΩ) |
| PHONO 3 | | 2mV (47kΩ) |
| TUNER | | 150mV (47kΩ) |
| AUX-1 (4CH) | | 150mV (47kΩ) |
| AUX-2 (4CH) | | 150mV (47kΩ) |
| 4CH TAPE | | 150mV (47kΩ) |

**Recording Output:**

| | |
|---|---|
| TAPE REC | 150mV |
| PRE OUT | 0.5V (MAX 4.2V) |

**Frequency Response:** 15Hz ~ 40kHz +1, -3dB

**Total Harmonic Distortion Factor:** At rating output 0.03%

**Maximum Input Voltage:**

| | | |
|---|---|---|
| PHONO MAG | 240mV | (1kHz) |
| CC | 1V | (1kHz) |

**Tone Control:** BASS (100Hz) +10dB, -10dB
TREBLE (10kHz) +10dB, -10dB

**Equalizer:** RIAA Standard
+0.2dB, -0.2dB Curve

**Signal-To-Noise Ratio:**

| | | |
|---|---|---|
| PHONO MAG | (2mV) | 65dB |
| CC | (30mV) | 70dB |
| AUX | (150mV) | 75dB |

**Power Source Voltage:** AC 100/120/220/240V
50/60Hz

**Power Consumption:** 230W (At no signal 16W)

**Transistors:** 74 Transistors
38 Diodes

**Dimensions:**

| | |
|---|---|
| W 450 (mm) | (17 23/32") |
| D 376 | (14 13/16") |
| H 126 | (5") |

**Weight:** 11.5kg


**TOKYO SHIBAURA ELECTRIC CO., LTD.**

2-1, 5-CHOME, GINZA, CHUO-KU, TOKYO, JAPAN

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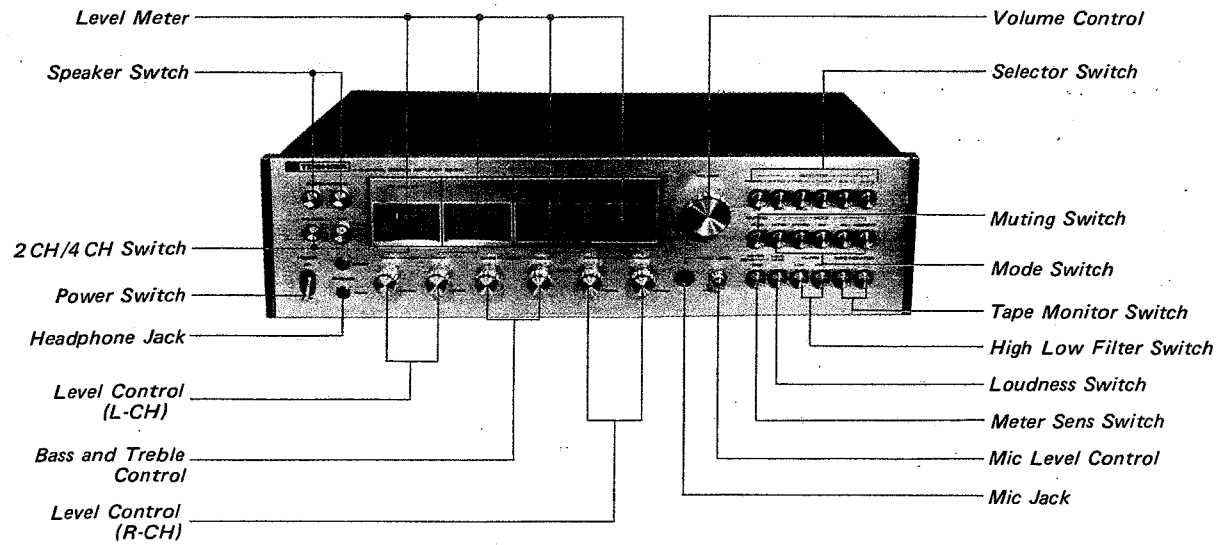
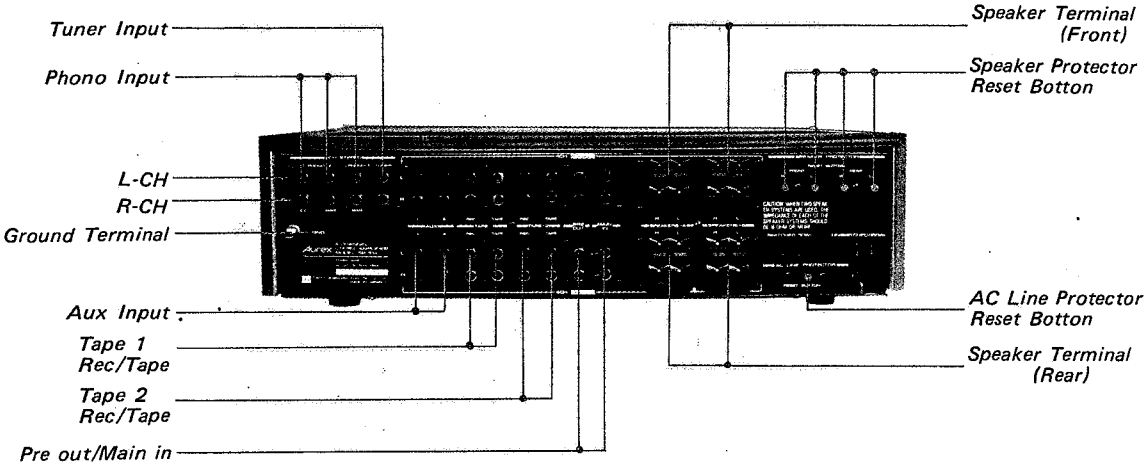
## 1. OPERATING CONTROLS

### 1-1. FRONT VIEW

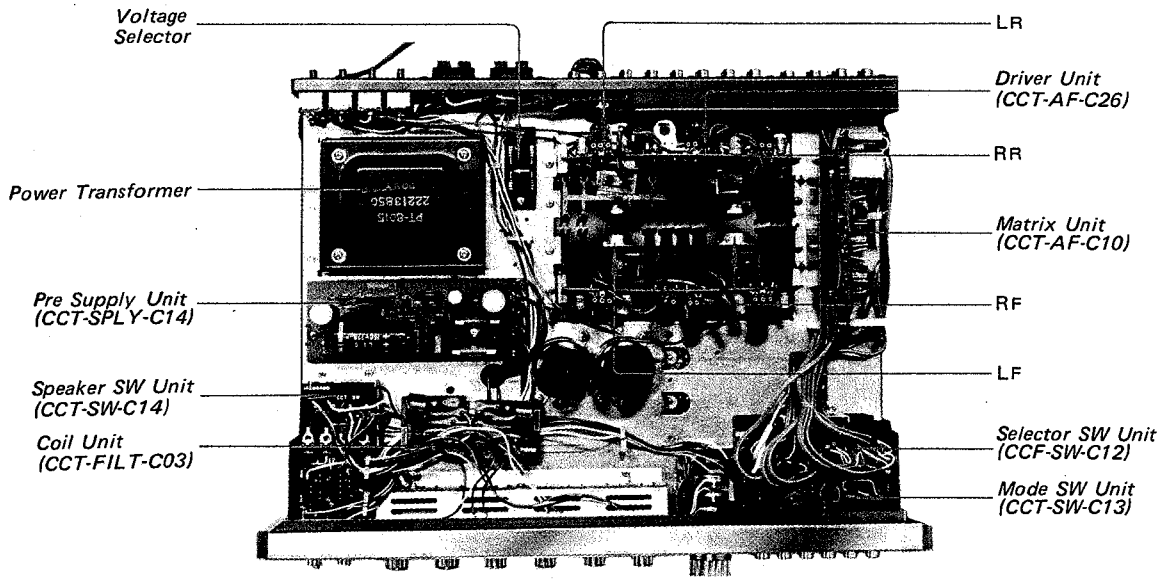


### 1-2. REAR VIEW

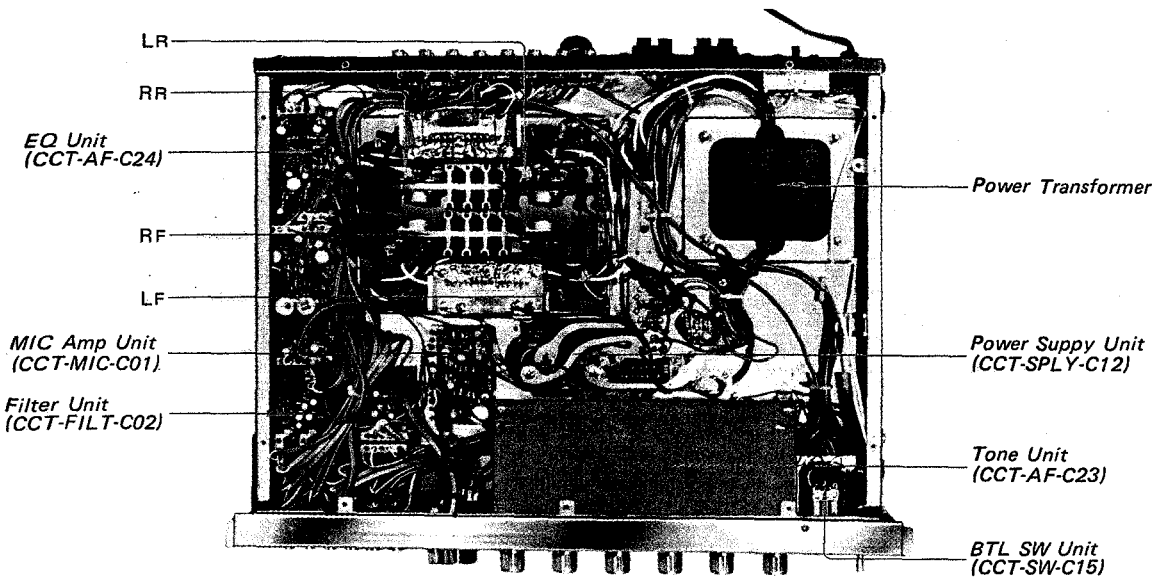



## 2. PARTS LOCATION

### 2-1. CHASSIS TOP VIEW

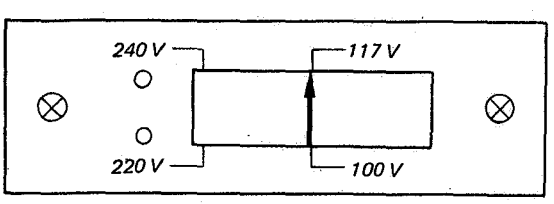


## 2-2. CHASSIS BOTTOM VIEW




## 3. VOLTAGE ADJUSTMENT

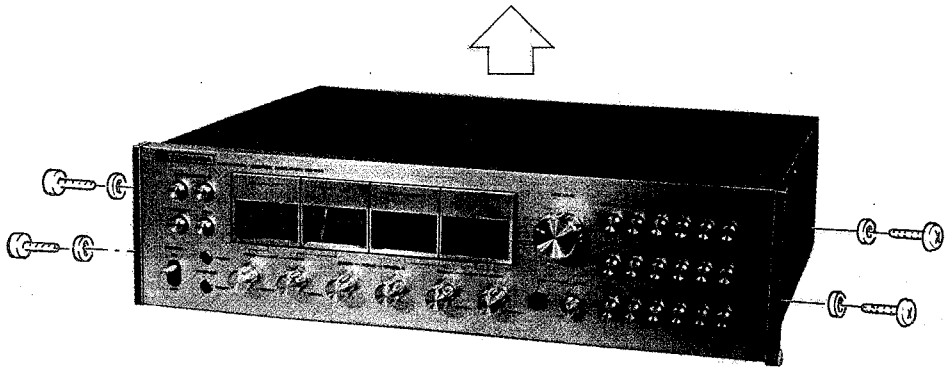
Insert the pin, adjusting the arrow in the direction of the power supply voltage applied.



# 4. DISASSEMBLY

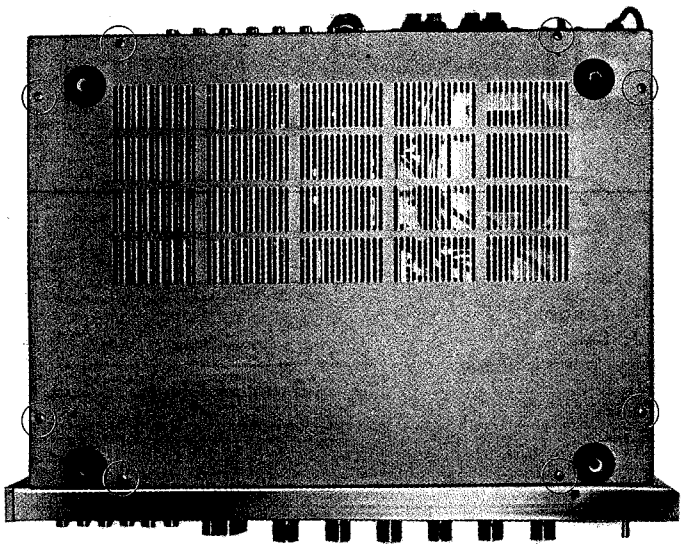
## 4-1. CABINET REMOVAL

1. Remove the four screws.
2. Remove the cabinet.

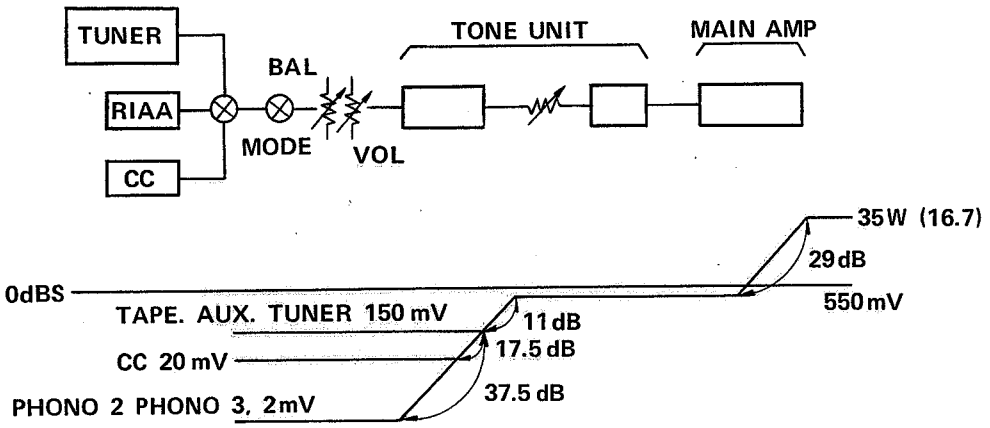


## 4-2. BACK COVER REMOVAL

1. Remove the eight screws.
2. Remove the back cover.

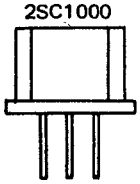


## 5. LEVEL DIAGRAM



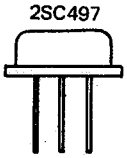

## 6. TRANSISTOR BASE DIAGRAMS

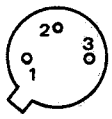
2SC1000



1. Emitter
2. Collector
3. Base

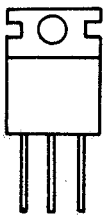
2SA497
2SC497

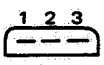




1. Emitter
2. Base
3. Collector (Case)

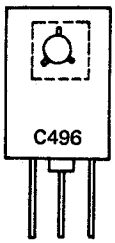
2SC1569

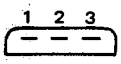




1. Base
2. Collector (Radiation Board)
3. Emitter

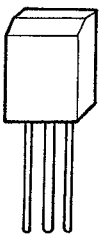
2SC496



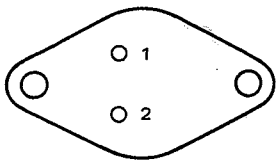
1. Emitter
2. Collector
3. Base

2SC983



1. Emitter
2. Collector
3. Base

2SC793
2SA663



1. Emitter
2. Base
3. Case Collector

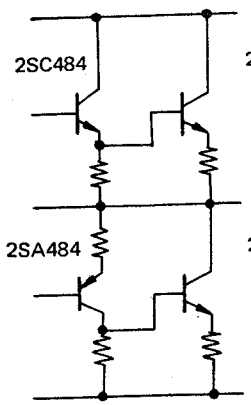
# 7. TECHNICAL POINTS

## 7-1. PURE COMPLEMENTARY CIRCUIT SYSTEM

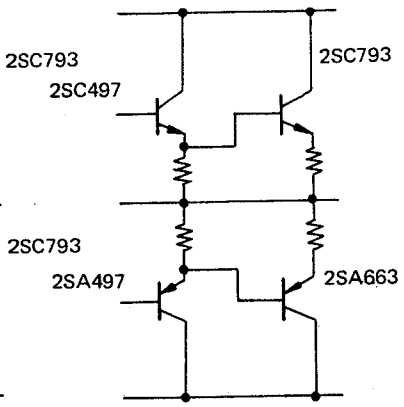
The difference between the Pure Complementary Circuit and the Quasi Complementary Circuit is that the Darlington connections in the lower part are, as shown in the figure below, connected to PNP-NPN for the Quasi Complementary Circuit and to PNP-PNP for the Pure Complementary Circuit. This difference results in the cross-over distortion in the unit. Although the switching distortion is inevitable with B class P-P amplifier, the Pure Complementary Circuit, where both upper and lower transistors are symmetrical each other, these distortions are canceled each other and the action similar to A class action is provided.

This can be afforded only with the newly developed PNP transistors, 2SA663, which are produced by the Toshiba's semiconductor manufacturing technology.

The distortion can be kept under 0.1% even with 10kHz at rated output and PBW is also greatly improved with the use of this transistor.




Quasi Complementary Circuit
(SA-20, SA-15)




Pure Complementary Circuit
(SB-514, SA-504)

## 7-2. DIRECT-COUPLING OUTPUT CAPACITOR LESS CIRCUIT SYSTEM

The following features are available by adopting the Output Capacitor Less of the direct-coupling two-power source system:

(1) Stable extension of frequency characteristic to the ultra low frequency range becomes possible.

(2) The output impedance (Damping Factor) does not vary even in the ultra low frequency range.

This feature together with the Pure Complementary Circuit system mentioned above is regarded as the one for the most ultimate and perfect amplifier today.

The most serious problems with the direct-coupling amplifier are the DC drift due to the temperature variation and the possibility of the occurrence of excess direct current to the speaker, which is caused by the transient shock at the moment of switching on the power supply and the unlikely break of the power transistors. In the model SB-514, these problems are resolved in such ways as follows: A differential amplifier consisting of the transistors of high current amplification factor, HFE, is incorporated in this unit in order to raise its DC stability. This shock at the moment of supply of power is reduced to some extent by inserting the twin-T type filter in the unit.

The speaker is safely protected against unlikely accident of transistor break by incorporating the circuit breaker between the speaker terminal and output circuit. On the contrary, in the case of shorting of the speaker terminal, the output circuit is protected by the circuit breaker built-in.

## 7-3. BUILT-IN SPECIAL AMPLIFIER FOR CONDENSER-CARTRIDGE

There are two types of cartridge, the velocity proportional type (MM, MC, etc.) and the amplitude proportional type (photoelectric cartridge, etc.).

The condenser-cartridge belongs to the latter type and a special correction curve different from the conventional one is necessary. The power for the ICs in the cartridge is supplied through the ground of the input terminal R channel. This amplifier can be directly connected with the condenser-cartridge (This is not the case for the photoelectric cartridge).

## 7-4. BTL CIRCUIT

When the four channel amplifier is used for reproduction with two speakers, this circuit is used in order to operate the four amplifiers effectively. The output voltage of two factors of magnitude can be supplied between the output terminals of each amplifier when the one speaker is operated in phase and the other out of phase with the use of the phase reverse circuit. Although the output power is theoretically of the four factors of magnitude from the relation, $(2V)^2/R = 4V^2/R$, that is in practice reduced to about two factors of magnitude due to losses such as the regulation of the transformer, the emitter resistance, etc.

## 7-5. MATRIX DECODER

All the two channel program sources (record, open reel, cassette, cartridge tape, FM broadcasting, etc.)

can be reproduced in the four channel fashion with the built-in MATRIX Decoder.

### 7-6. SQ

Fig. 1 shows signal components LT and RT recorded on SQ record disc. Decoder shown in Fig. 1-b changes composite two-channel signals into four-channel stereo signals FL, RL, FR and RR. Such a decoder produces sound field extended in right and left directions but not so extended in front and rear directions.

To improve front and rear channel separation, SQ decoder mixes LT and RT signals in proper proportion as shown in Fig. 2.

Note: *14 dB between front left and front right channels.
*6 dB between front and rear channels.
*6 dB between rear left and rear right channels.

Matrix circuits shown in Fig. 3-a, 3-b, 3-c and 3-d mixes LT + 0.2RT, RT + 0.2LT, LT - 0.4RT and RT - 0.4LT signals respectively. TR04, TR03, TR06 and TR05 amplifies signals attenuated by matrix circuits.

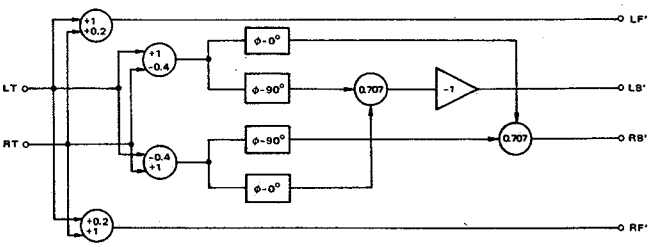
Circuit shown in Fig. 4-a has a phase characteristic in Fig. 4-b. Low Frequency signal output is almost the same phase as the input. As frequency becomes higher, output phase negatively shifts. Combination of such two circuits, one shifts 90 degrees at F1 and the other 90 degrees at F2, makes 90 degrees phase difference in some range. This circuit is called phase-shifter.

RL' and RR' signals are mixed through phase-shifter in Fig. 5-a and 5-b and amplified by TR09 and TR07 respectively to set the levels.

### 7-7. R-MTX

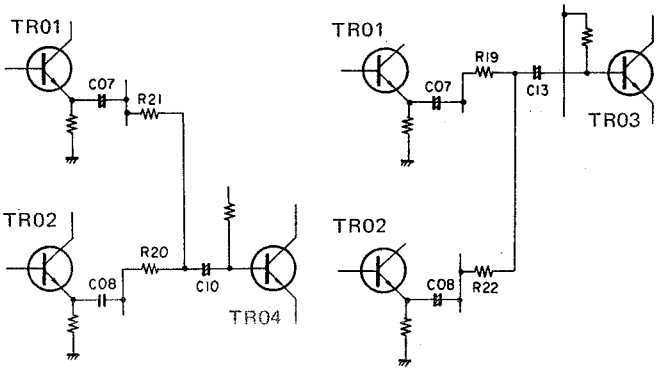
R-MTX circuit mixes front-left and front-right signals in the same proportion as SQ to improve front and rear channel separation.

Rear channel signals are mixed in the proportions such as RR = R - 0.4L and RL = L - 0.4R as shown in Fig. 6.




80° ~ 100° phase difference at approx. 100 ~ 760 Hz

*Fig. 2*



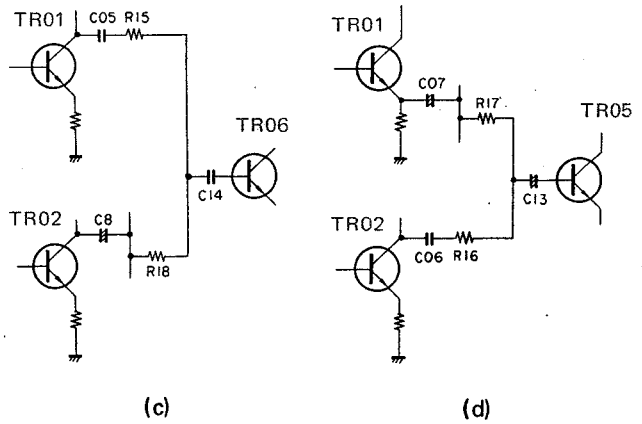




*Fig. 3*

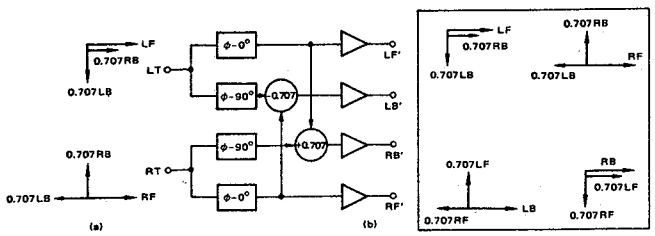



*Fig. 1*

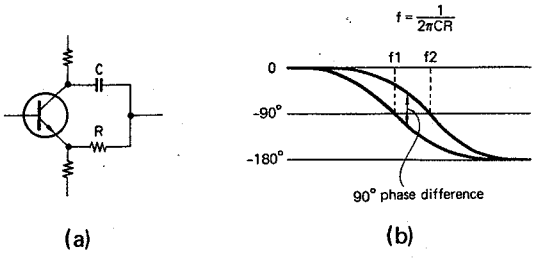
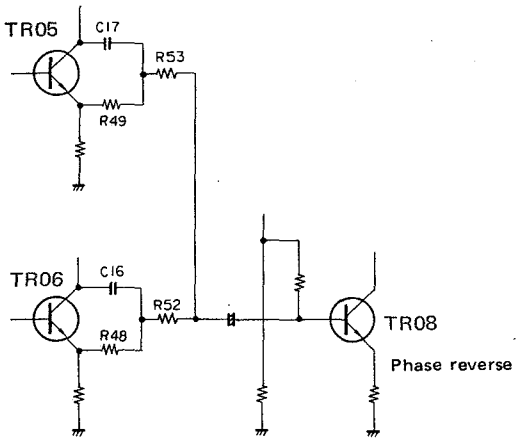
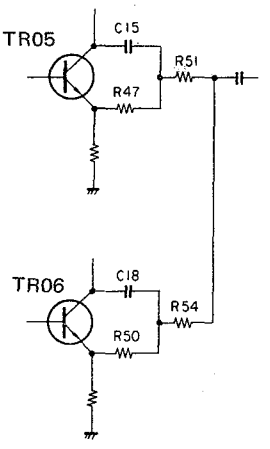



*Fig. 4*




(a)




(b)

*Fig. 5*

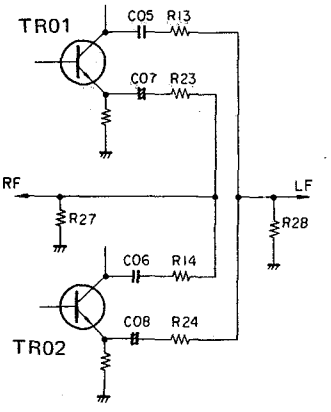



*Fig. 6*

## 8. SERVICE POINTS

### ADJUSTING METHOD OF LEVEL METER SENSITIVITY

| No. | Connection/Adjustment | Remarks |
|---|---|---|
| 1. | Connect load resistance (8Ω, 50W) to speaker terminal (each channel). | |
| 2. | Connect voltmeter in parallel to load resistance. | |
| 3. | Set speaker switch to 4 CH. | |
| 4. | Connect frequency oscillator to AUX-1 (4CH) of input terminal. | Keep frequency to 1 kHz. |
| 5. | Set selector switch to AUX-1 (4CH) and mode switch to DISCRETE. | Turn volume and level controls fully clockwise and set bass and treble controls to mid-position. |
| 6. | Put power supply switch on. | Set METER SENSITIVITY |
| 7. | Increase input power until 15 V is indicated on the voltmeter and then adjust VR01 (VR02, VR03, VR04) until 0 dB is indicated on the voltmeter etc. (VR01, VR02, VR03, VR04) are semi-fixed resistor on SPEAKERS SW PCB. | Switch to −10 dB. |

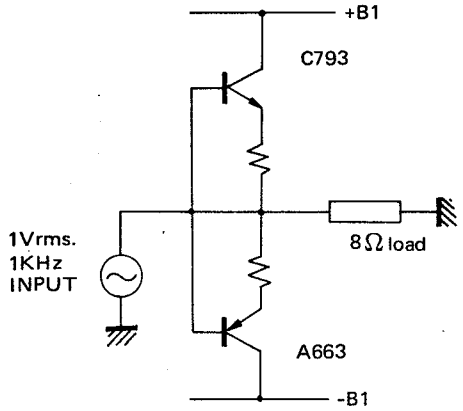
## 9. TROUBLE SHOOTING HINTS

**How to examine the output power transistors:**

Step 1. Remove the driver unit (AF-C04) from the connector. Also TR13 and TR14 (2SC496) are to be removed.

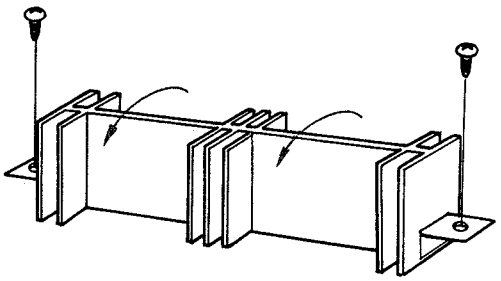
Step 2. Measure the voltage at the speaker output terminal or terminals 13 & 14 using a tester, with the power switch on.
OV (± 0.3V) indication is normal.

Step 3. Waveforms observation. Normal waveform illustrated below.

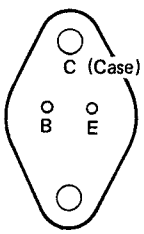



**Replacement of defective power transistors:**

Step 1. Remove the self-tap screws on both sides of the transistor and incline it forward as illustrated below.



Step 2. Remove the mounting screws securing the collector of the power transistor and pull out the transistor. (This is easily replaceable because TR socket is in use.)




**How to examine the drive unit:**

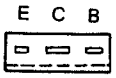
Note: If it is likely to break the power transistors during examination, disconnect the leads to the bases of 2SC793 and 2SA663.

**Can one get correct mid-voltage?**

Step 1. If OK ..... Does the voltage between the collector and the emitter of TR13 or TR14 (2SC496) change with variation of VR03 or VR04 (500 ohm)? (1.9V-3.5V)

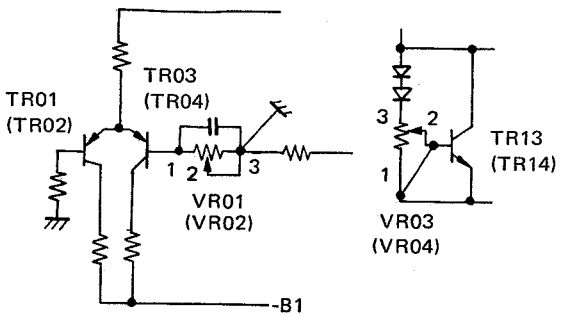
Step 2. OK ..... Normal
Adjust IC idle by VR03, VR04 with power transistors connected.
NO ..... 2SC496 is defective.

Step 3. If NOT .... If perfect adjustment to zero voltage is not possible (normally this is variable to both + and −, but in this case it is impossible), this is due to the rank difference between $h_{FE}$s of TR01/03 or TR02/04. Adjust the rank.




Check if the correct mid-voltage is obtainable or not.

Step 4. Examine TR, removing TR09 and TR11 (TR10 and TR12).
(Note) In many cases one meets troubles with TR09 and TR11.




Step 5. As shown above, connect the terminal 3 of VR01 to the ground, where TR09 and TR11 are kept removed and VR01 fully turned to the terminal 3 side. Short-circuit the base with emitter.

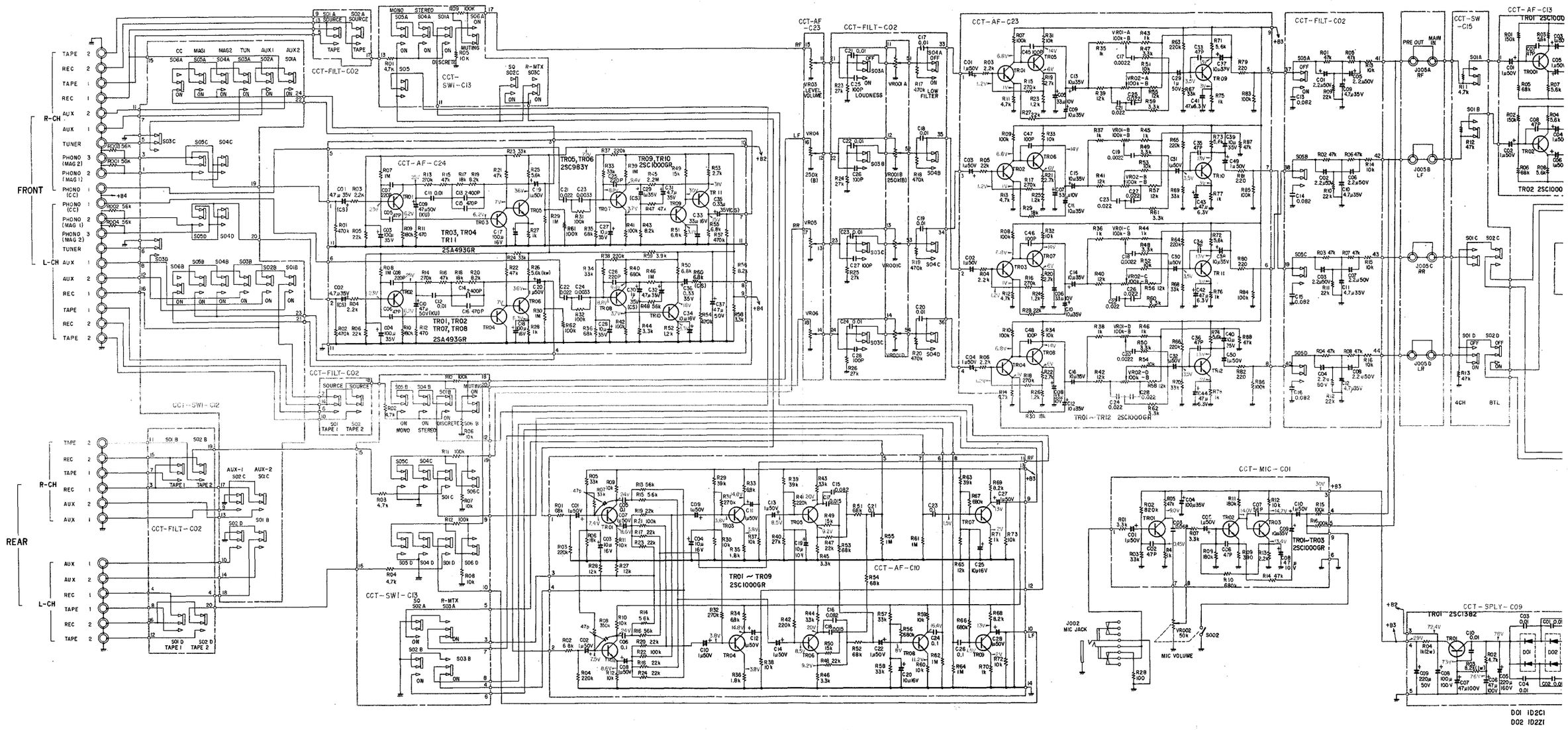
Examine if collector voltage of TR05 (TR06) is adjustable to zero voltage with the power switch on.

If OK ..... Examine if the voltage between collector and emitter of TR13 changes with variation of the semi-fixed VR03 (VR04) when the short-circuit between the base and the emitter of TR13 is released. (Step 1.)

If NOT ..... Check the transistors, TR01, TR03, TR05 and TR06.

# 10. SCHEMATIC DIAGRAMS

## 10-1. GENERAL




**CCT-SW-C12 (SELECTOR)**

| | | |
|---|---|---|
| S06 | PHONO 1 (CC) | [ON] |
| S05 | PHONO 2 (MAG) | |
| S04 | PHONO 3 (MAG) | |
| S03 | TUNER | |
| S02 | AUX-1 (4 CH) | |
| S01 | AUX-2 (4 CH) | |

**CCT-SW-C14 (SPEAKER)**

| | | |
|---|---|---|
| S01 | SPEAKER A | |
| S02 | SPEAKER B | [ON] |

**CCT-SW-C13 (MODE · MUTING)**

| | | |
|---|---|---|
| S06 | MUTING | |
| S05 | MONO | |
| S04 | STEREO | |
| S03 | R-MTX | [ON] |
| S02 | SQ | |
| S01 | DISCRETE | |

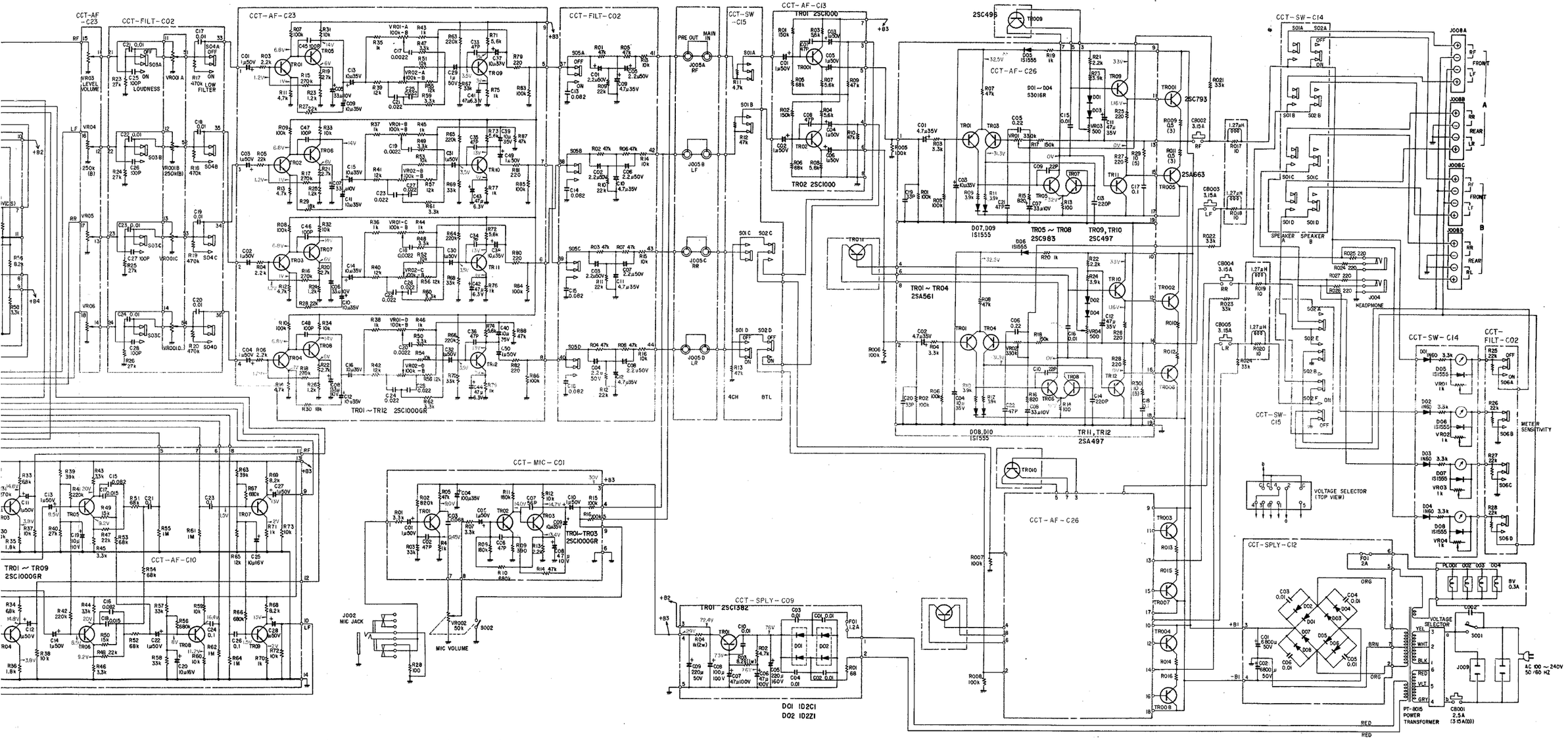
**CCT-SW-C15 (BTL · 4 CH)**

| | | |
|---|---|---|
| S02 | BTL (2 CH) | |
| S01 | 4 CH | [ON] |

**CCT-FILT-C02 (TAPE · FILTER)**

| | | |
|---|---|---|
| S06 | METER SENSITIVITY | |
| S03 | LOUDNESS | |
| S04 | LOW FILTER | |
| S05 | HIGH FILTER | |
| S01 | TAPE 1 | [SOURCE] |
| S02 | TAPE 2 | [SOURCE] |

SB-514




**CCT-SW-C15 (BTL · 4 CH)**

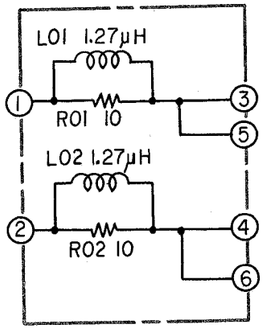
| | | |
|---|---|---|
| S02 | BTL (2 CH) | |
| S01 | 4 CH | [ON] |

**CCT-FILT-C02 (TAPE · FILTER)**

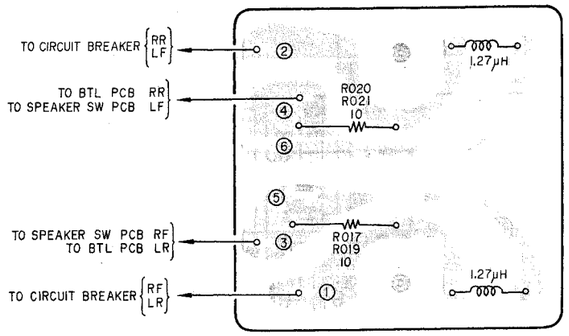
| | | |
|---|---|---|
| S06 | METER SENSITIVITY | |
| S03 | LOUDNESS | |
| S04 | LOW FILTER | |
| S05 | HIGH FILTER | |
| S01 | TAPE 1 | [SOURCE] |
| S02 | TAPE 2 | [SOURCE] |

## 10-2. COIL CIRCUIT BOARD (CCT-FILT-C03)

### SCHEMATIC DIAGRAM

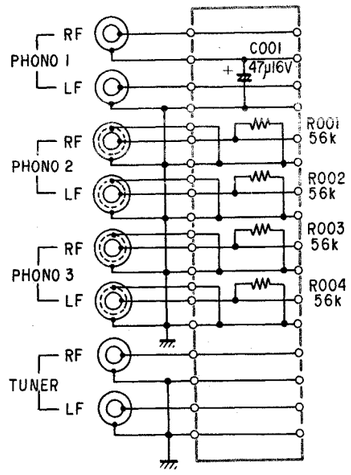



### BOTTOM VIEW

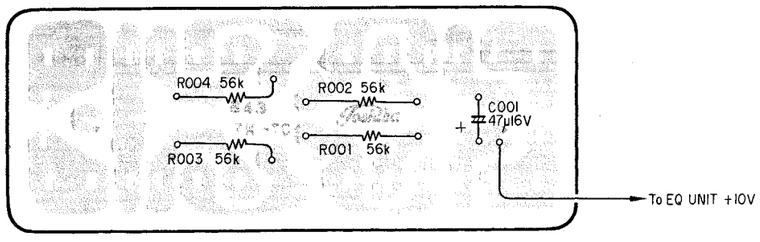



## 10-3. US SHORT PIN CIRCUIT BOARD (CCT-PIN-C01)

### SCHEMATIC DIAGRAM




### BOTTOM VIEW

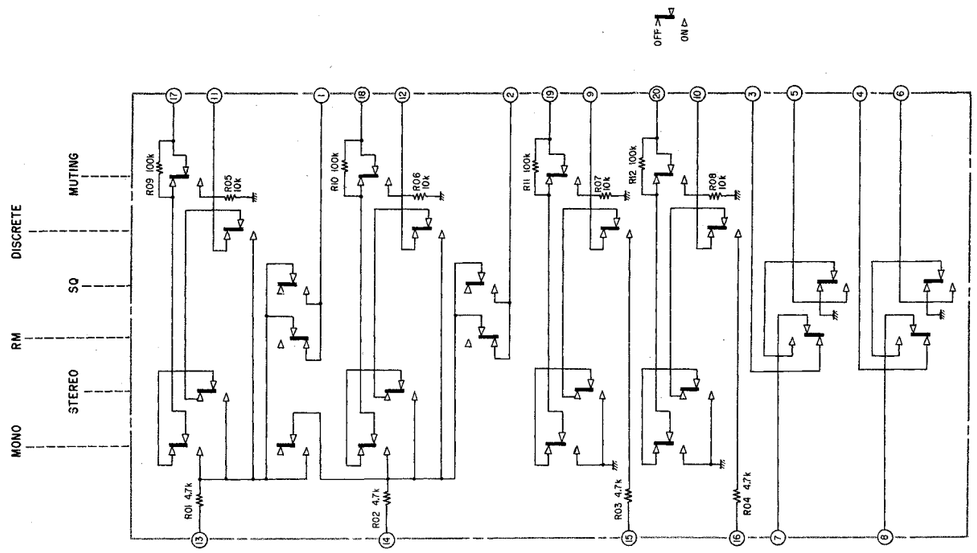




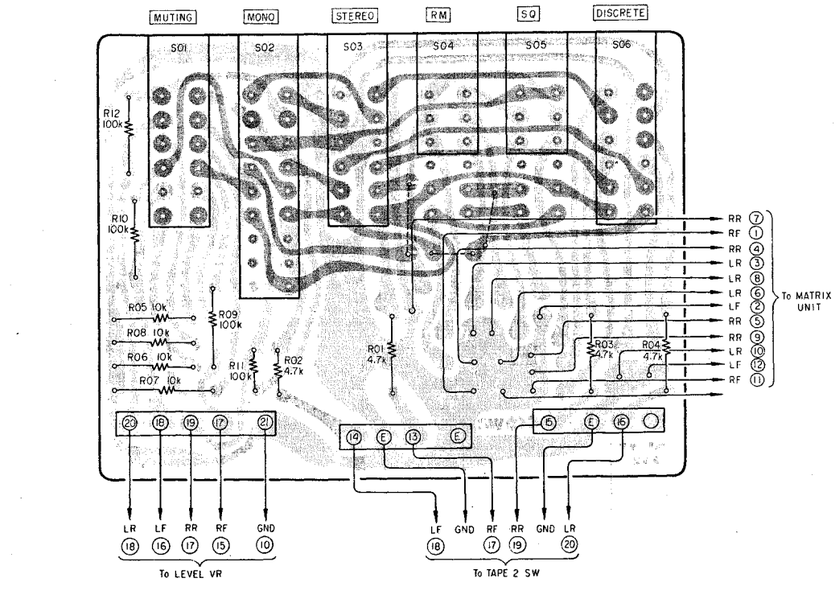



## 10-4. MODE CIRCUIT BOARD (CCT-SW-C13 and C13A)

### SCHEMATIC DIAGRAM

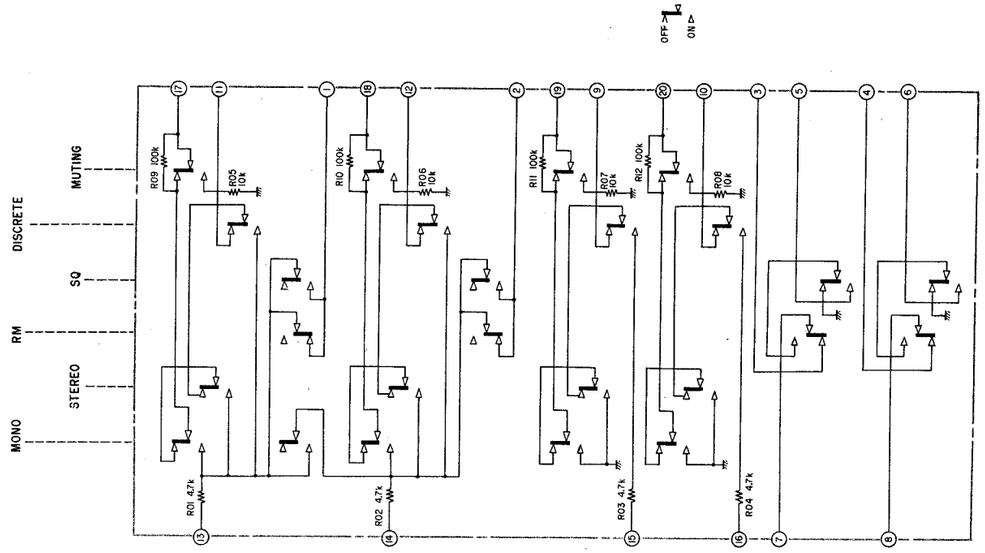



### BOTTOM VIEW

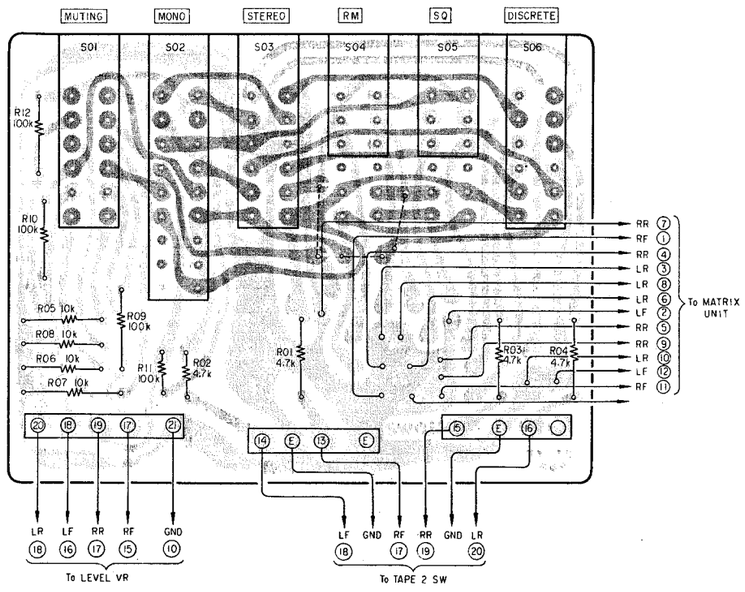


## 10-4. MODE CIRCUIT BOARD (CCT-SW-C13 and C13A)

### SCHEMATIC DIAGRAM



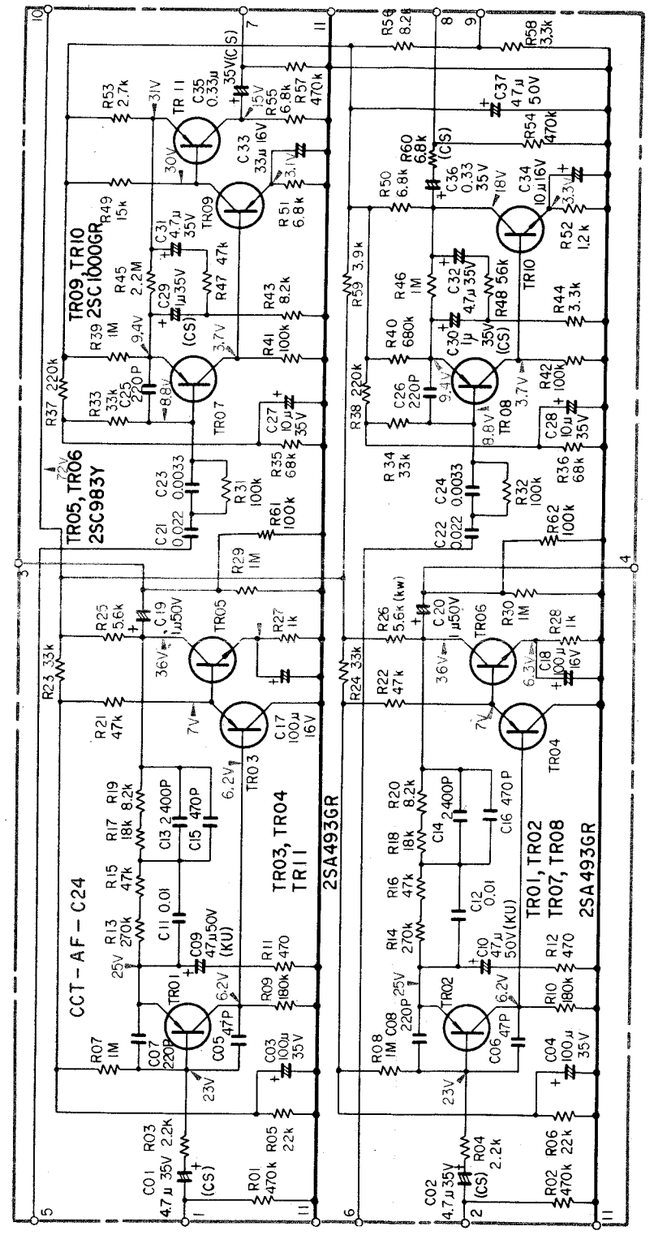

### BOTTOM VIEW



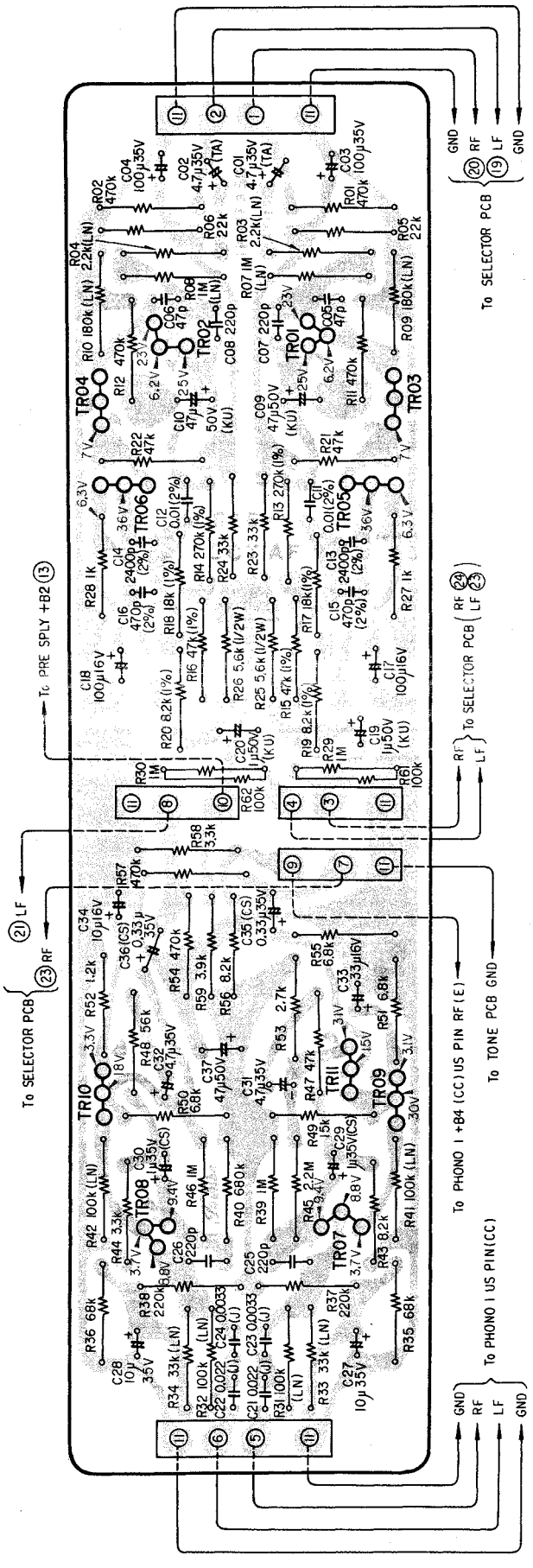



## 10-5. EQ CIRCUIT BOARD (CCT-AF-C24)

### SCHEMATIC DIAGRAM

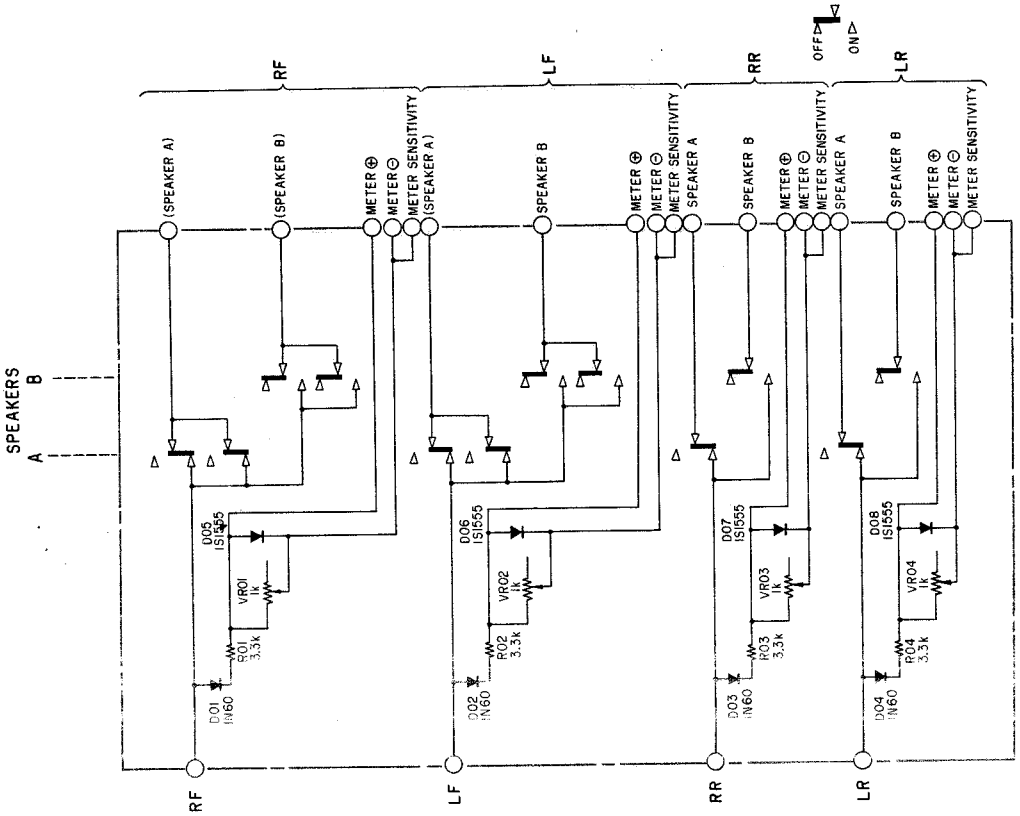


## BOTTOM VIEW

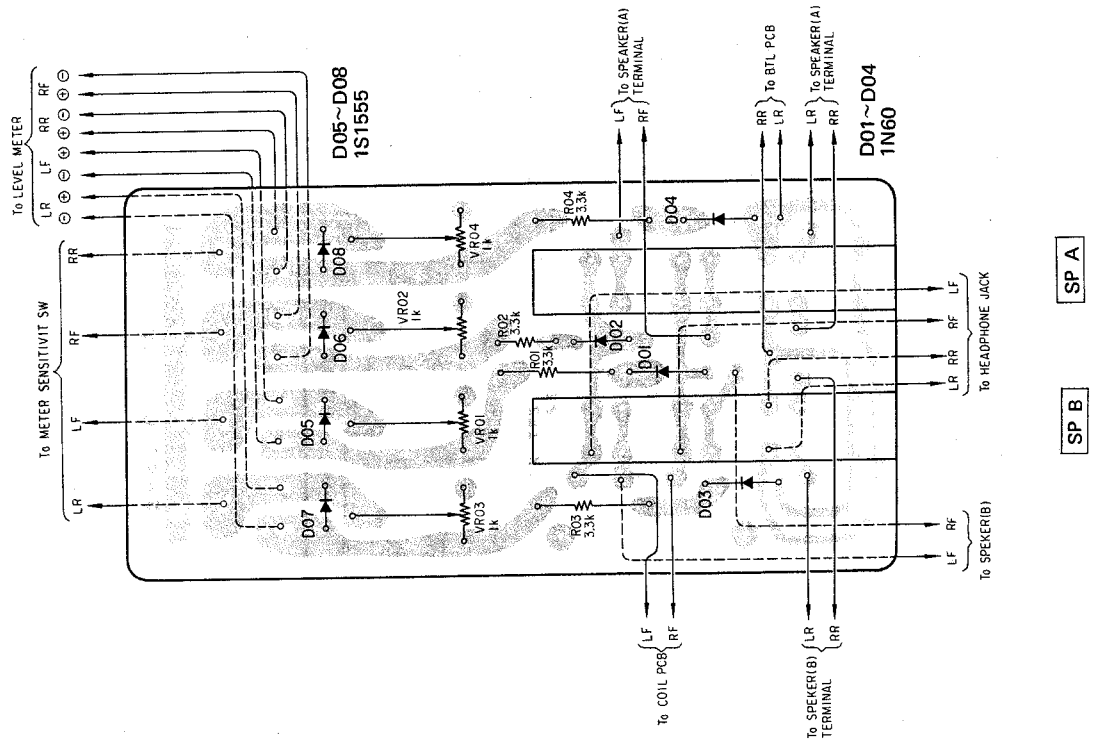

To PRE SPLY +B2 (13)
To SELECTOR PCB (23) RF (21) LF
To SELECTOR PCB RF (24) LF (23)
To SELECTOR PCB (20) GND (19) RF (1) LF (11) GND
To PHONO I +B4 (CC) US PIN RF(E)
To TONE PCB GND
To PHONO I US PIN(CC)
GND RF LF GND
TR01
TR02
TR03
TR04
TR05
TR06
TR07
TR08
TR09
TR10
TR11

## 10-6. SPEAKER SWITCH CIRCUIT BOARD (CCT-SW-C14)

### SCHEMATIC DIAGRAM

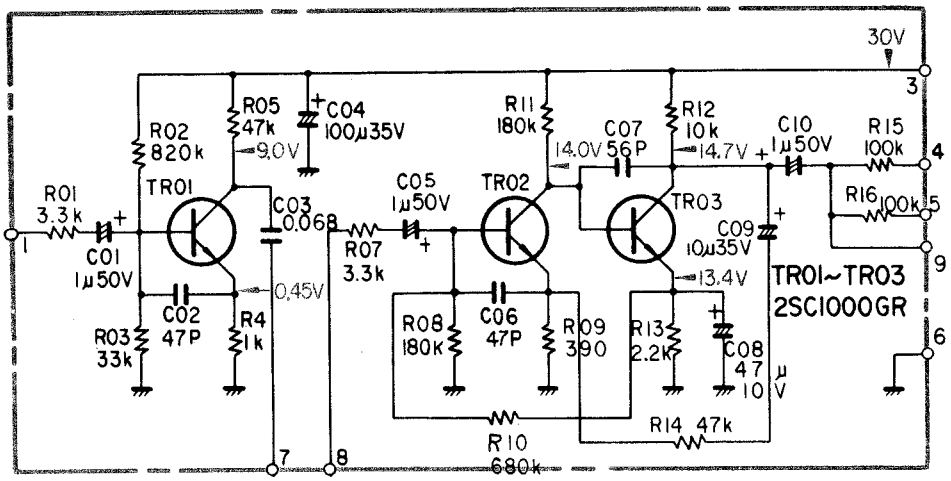



### BOTTOM VIEW

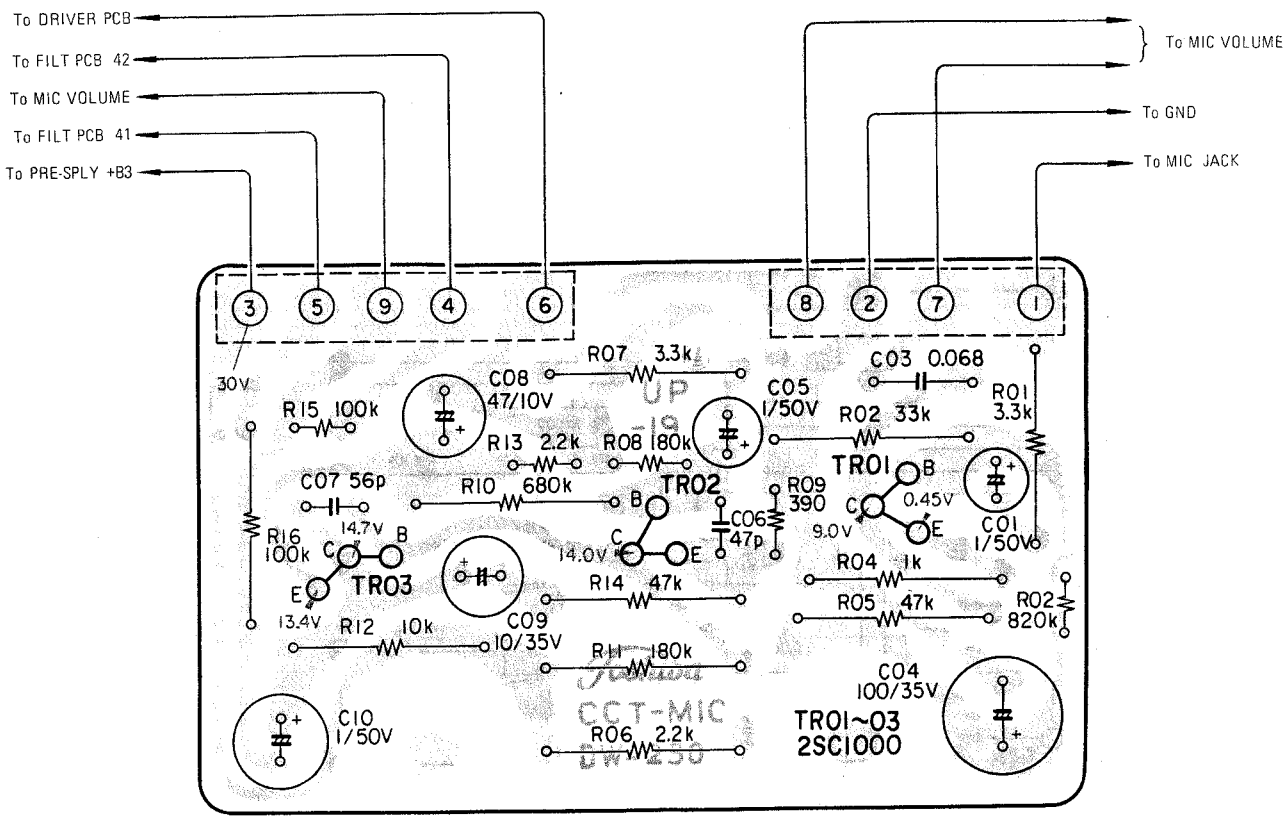


## 10-7. MIC CIRCUIT BOARD (CCT-MIC-C01)

### SCHEMATIC DIAGRAM

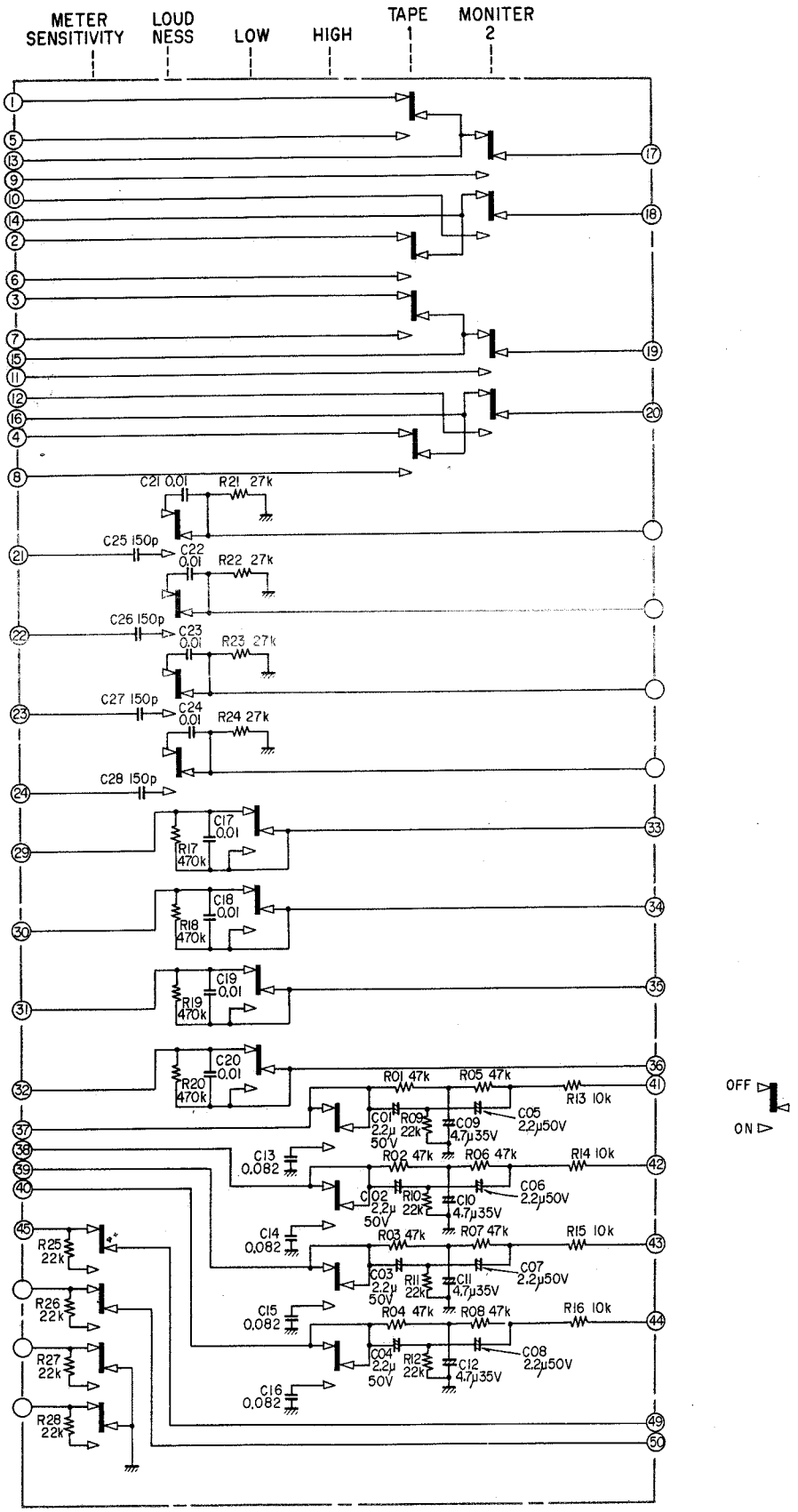



### BOTTOM VIEW

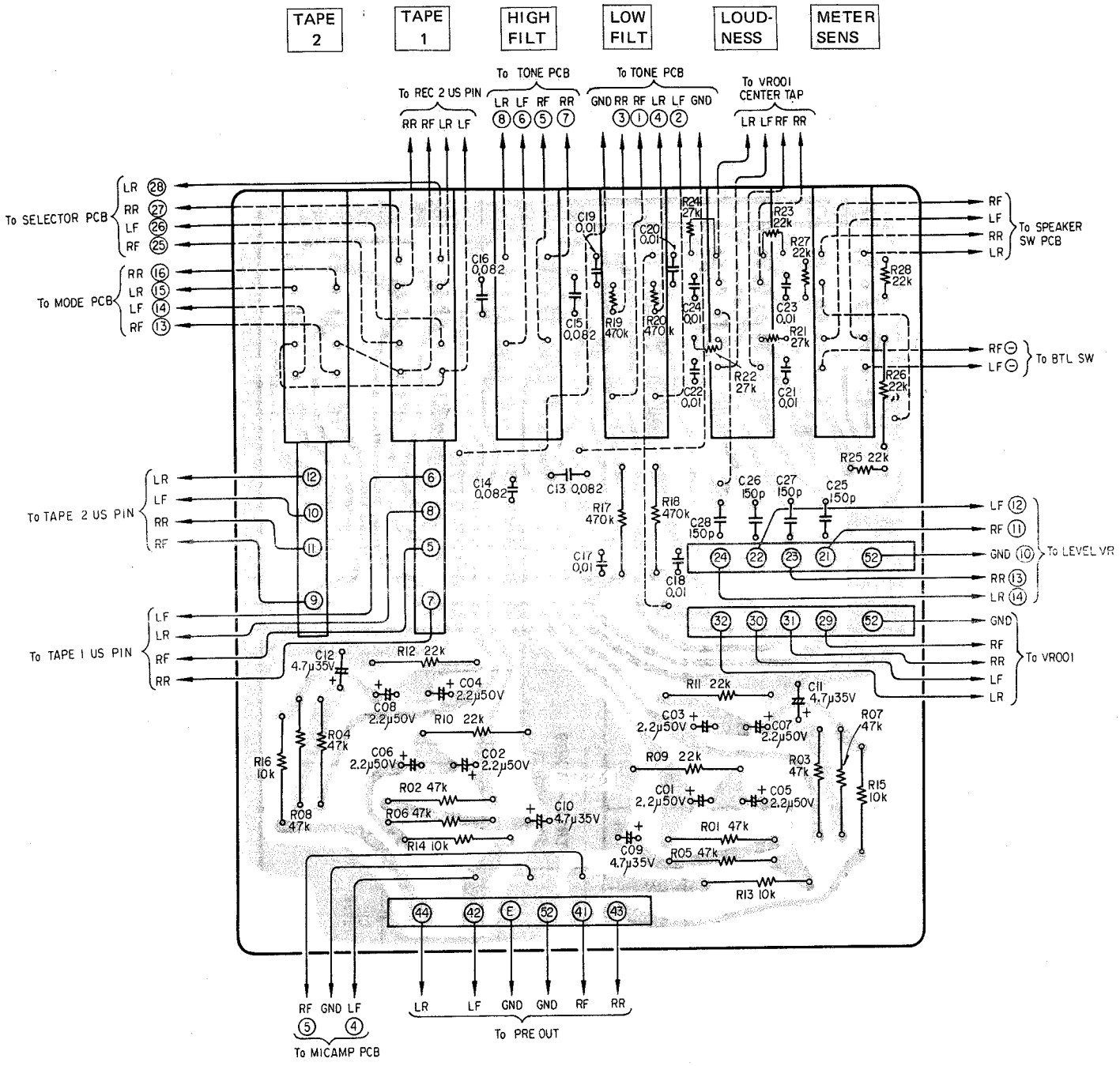


## 10-8. ACCESSORY CIRCUIT BOARD (CCT-FILT-C02)

### SCHEMATIC DIAGRAM

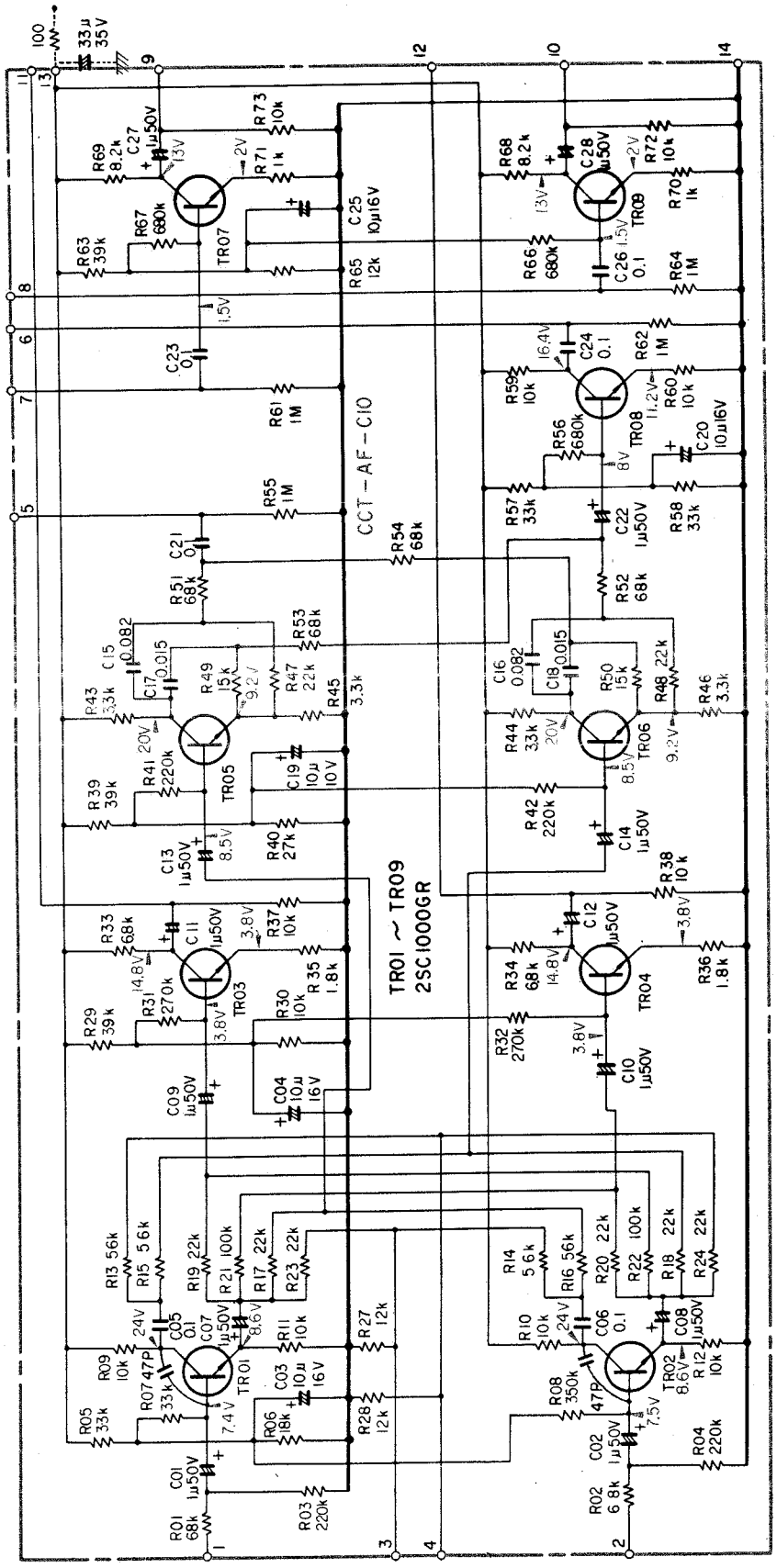


## BOTTOM VIEW

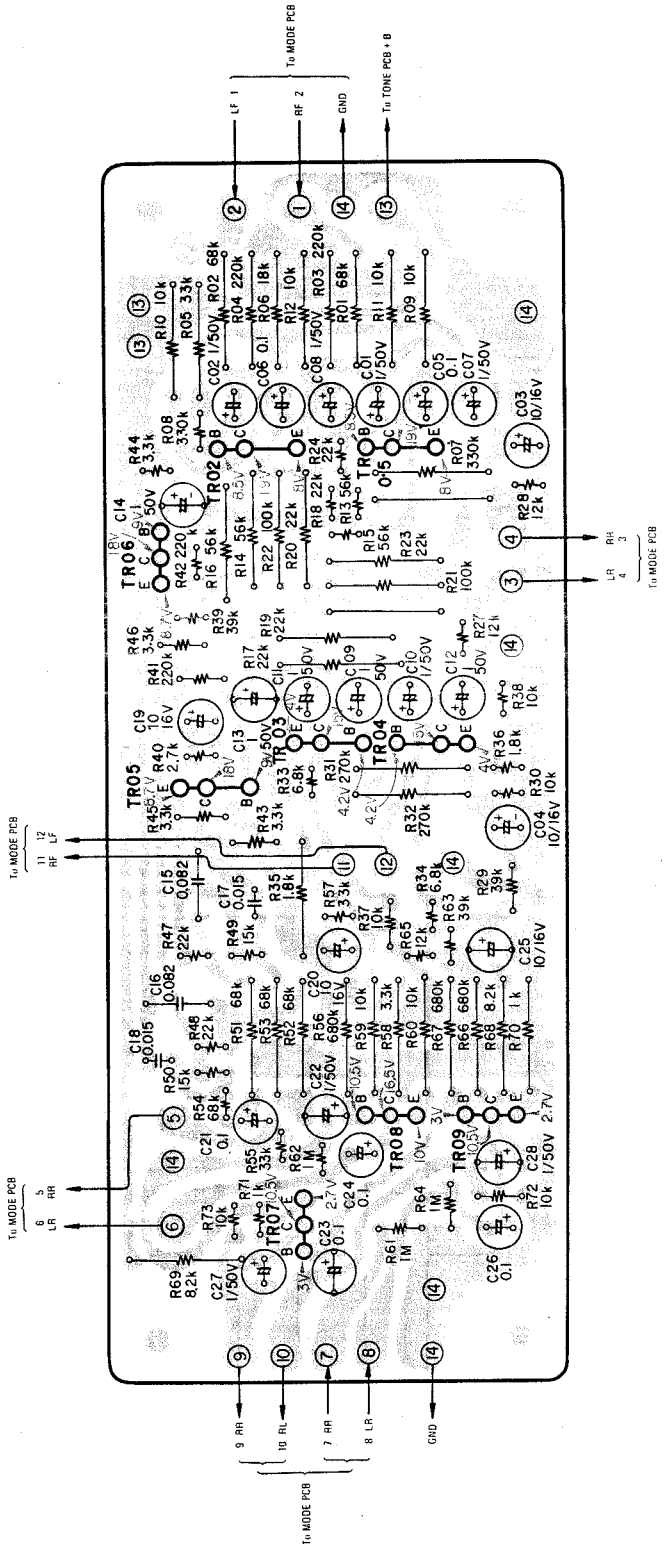

TAPE 2
TAPE 1
HIGH FILT
LOW FILT
LOUD-NESS
METER SENS
To REC 2 US PIN
RR RF LR LF
To TONE PCB
LR LF RF RR
8 6 5 7
To TONE PCB
GND RR RF LR LF GND
3 1 4 2
To VR001 CENTER TAP
LR LF RF RR
To SELECTOR PCB
LR 28
RR 27
LF 26
RF 25
To MODE PCB
RR 16
LR 15
LF 14
RF 13
To TAPE 2 US PIN
LR
LF
RR
RF
To TAPE 1 US PIN
LF
LR
RF
RR
To SPEAKER SW PCB
RF
LF
RR
LR
To BTL SW
RF⊖
LF⊖
To LEVEL VR
LF 12
RF 11
GND 10
RR 13
LR 14
To VR001
GND
RF
RR
LF
LR
RF GND LF
5 4
To MICAMP PCB
LR LF GND GND RF RR
To PRE OUT
C01 2.2µ50V
C02 2.2µ50V
C03 2.2µ50V
C04 2.2µ50V
C05 2.2µ50V
C06 2.2µ50V
C07 2.2µ50V
C08 2.2µ50V
C09 4.7µ35V
C10 4.7µ35V
C11 4.7µ35V
C12 4.7µ35V
C13 0.082
C14 0.082
C15 0.082
C16 0.082
C17 0.01
C18 0.01
C19 0.01
C20 0.01
C21 0.01
C22 0.01
C23 0.01
C24 0.01
C25 150p
C26 150p
C27 150p
C28 150p
R01 47k
R02 47k
R03 47k
R04 47k
R05 47k
R06 47k
R07 47k
R08 47k
R09 22k
R10 22k
R11 22k
R12 22k
R13 10k
R14 10k
R15 10k
R16 10k
R17 470k
R18 470k
R19 470k
R20 470k
R21 27k
R22 27k
R23 22k
R24 27k
R25 22k
R26 22k
R27 22k
R28 22k

## 10-9. MATRIX CIRCUIT BOARD (CCT-AF-C10)

### SCHEMATIC DIAGRAM

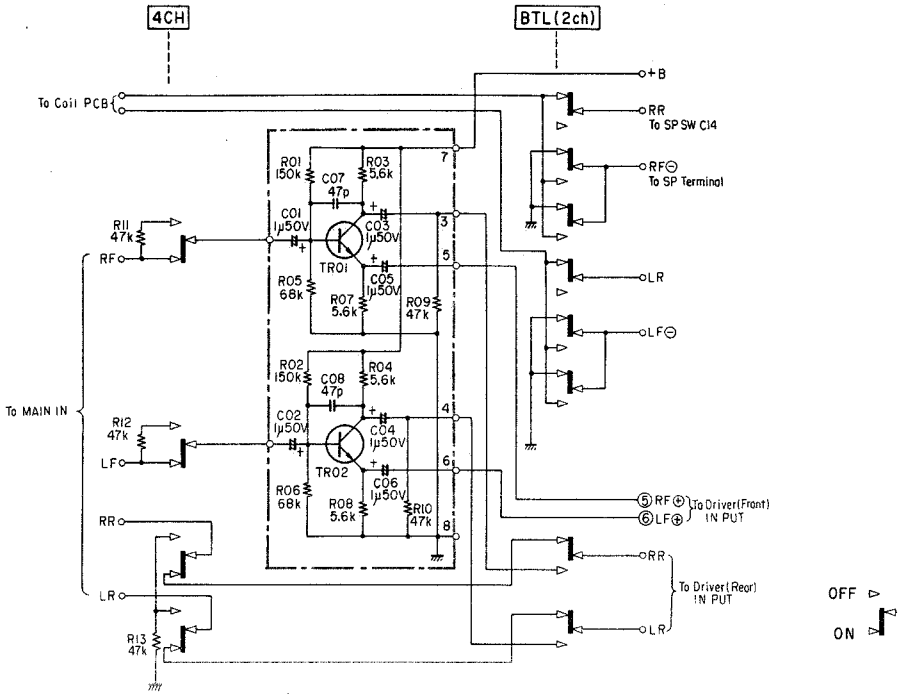


## BOTTOM VIEW

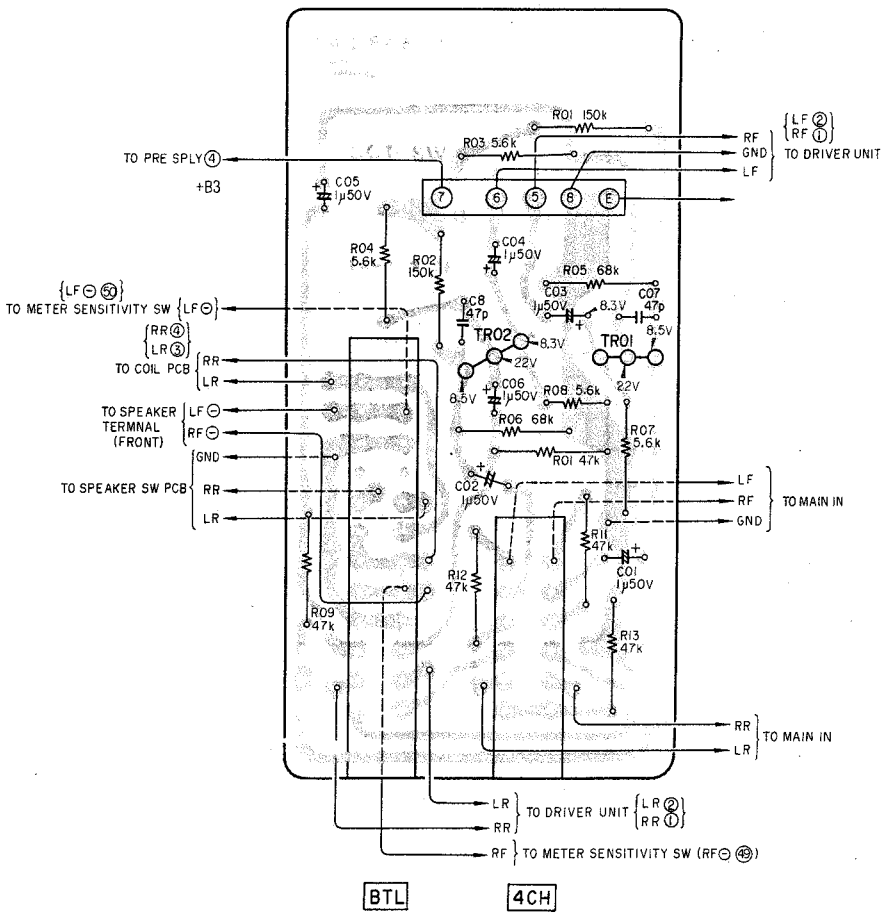

LF 1
RF 2
GND
To MODE PCB
To TONE PCB + B
TR01
TR02
TR03
TR04
TR05
TR06
TR07
TR08
TR09
9 RR
10 RL
7 RR
8 LR
GND
To MODE PCB

## 10-10. BTL CIRCUIT BOARD (CCT-AF-C13)

### SCHEMATIC DIAGRAM

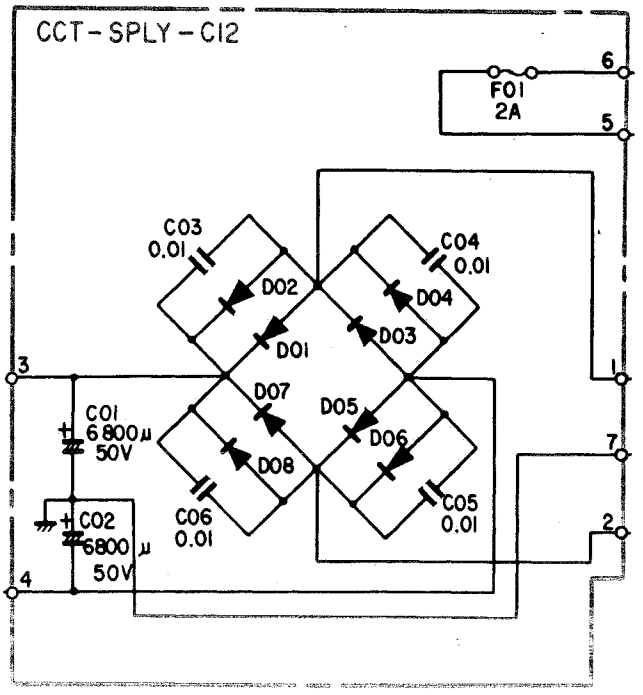



### BOTTOM VIEW

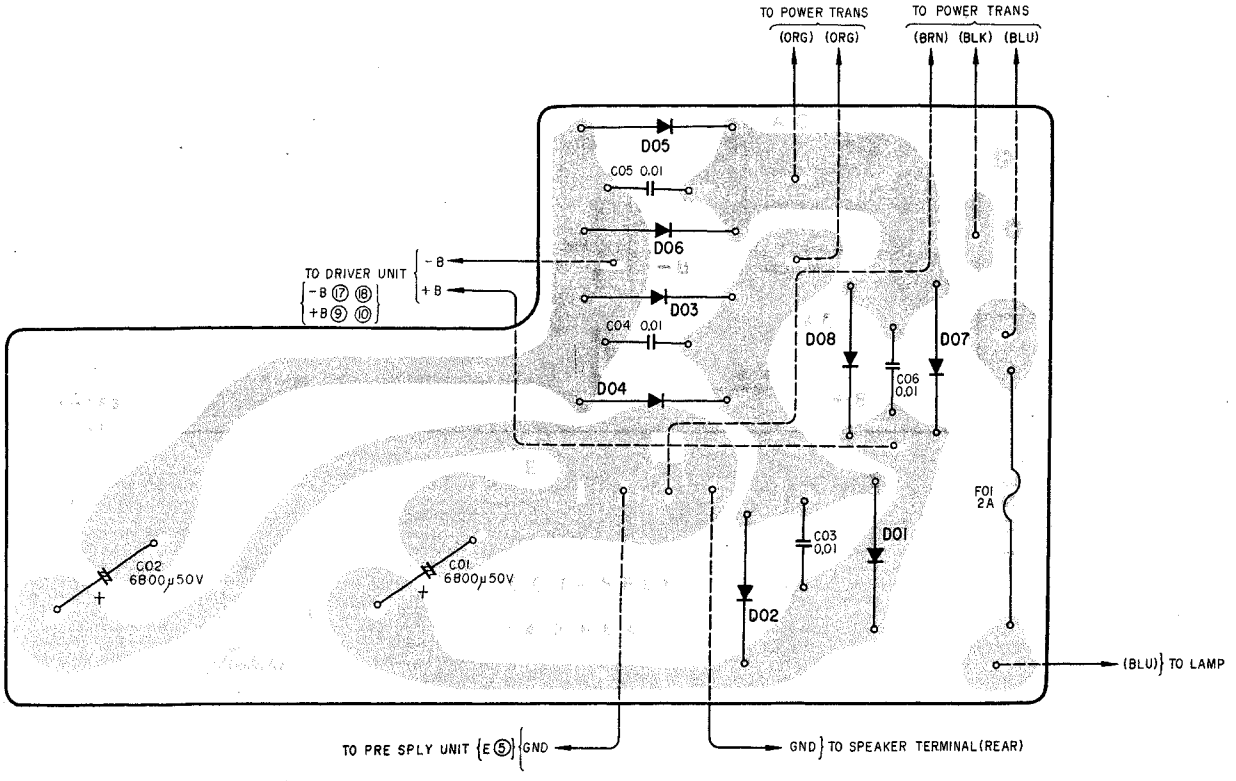


## 10-11. MAIN SUPPLY CIRCUIT BOARD (CCT-SPLY-C12)

### SCHEMATIC DIAGRAM

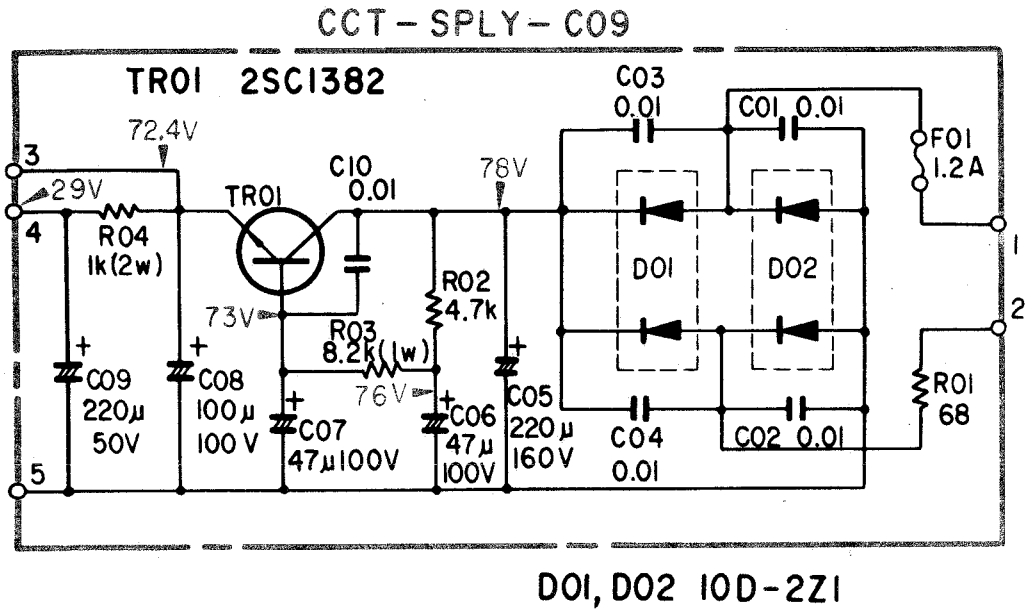



### BOTTOM VIEW



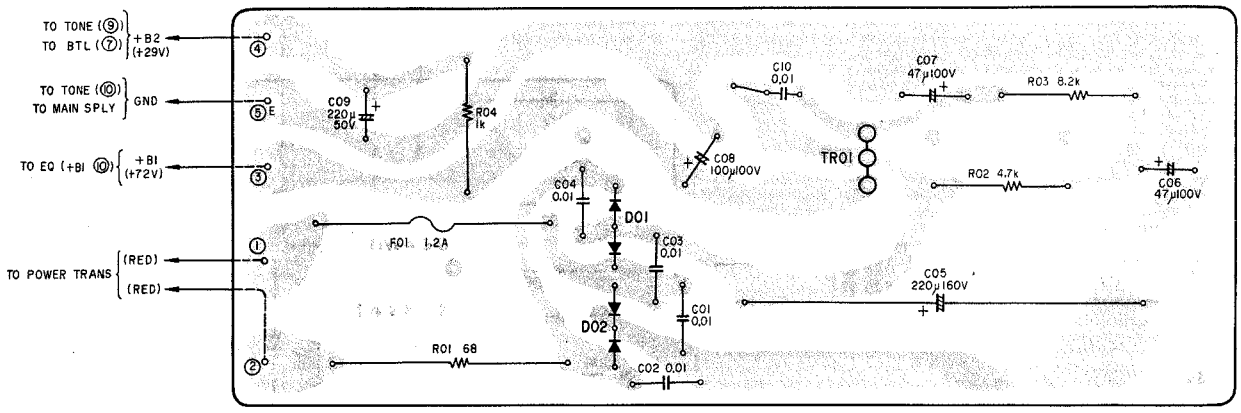
## 10-12. PRE SUPPLY CIRCUIT BOARD (CCT-SPLY-C14)

### SCHEMATIC DIAGRAM



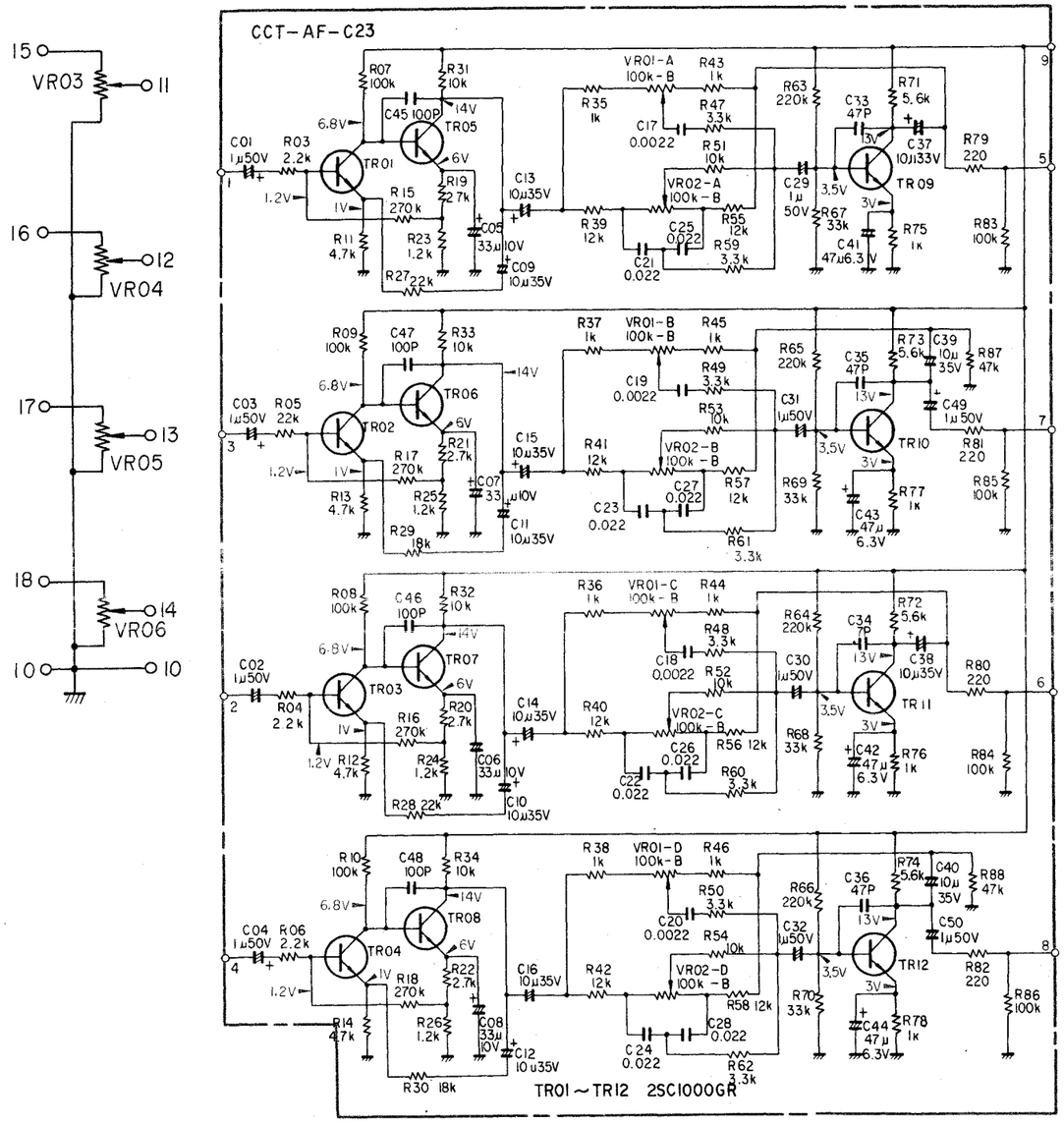

D01, D02 10D-2Z1

### BOTTOM VIEW

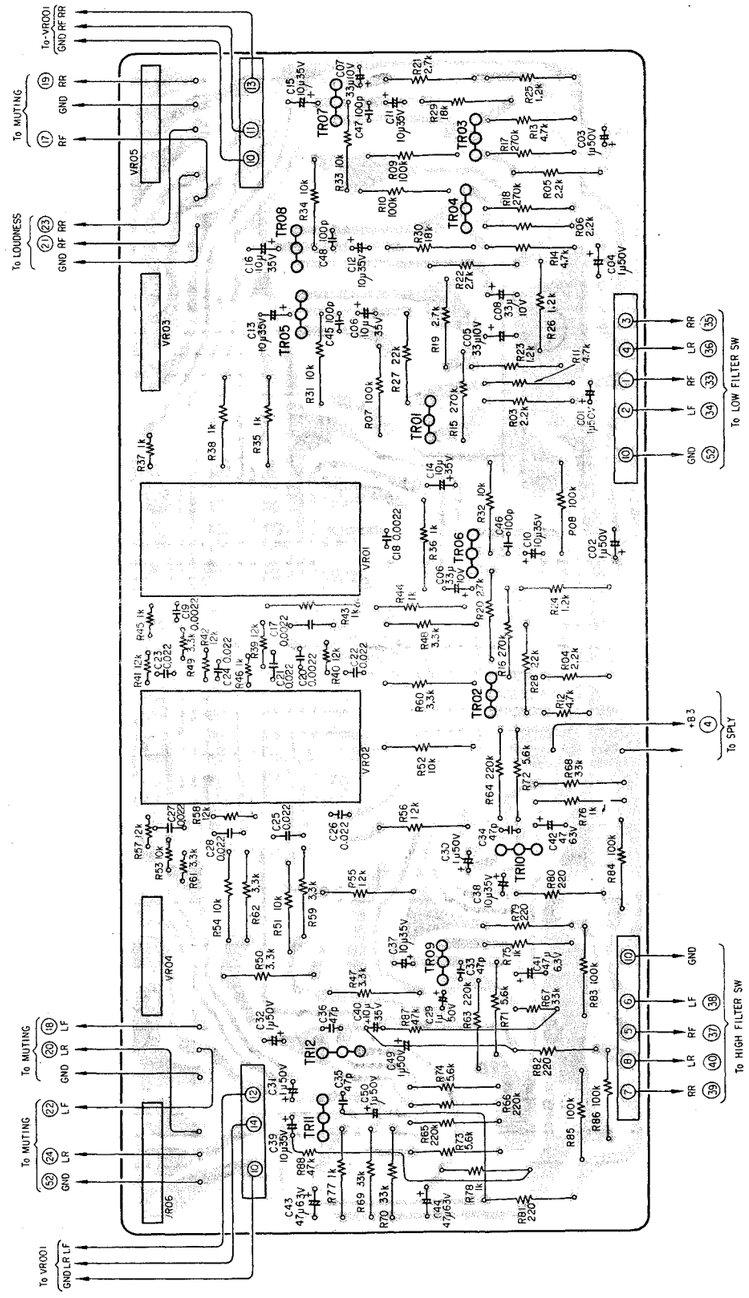


## 10-13. TONE CIRCUIT BOARD (CCT-AF-C23)

### SCHEMATIC DIAGRAM

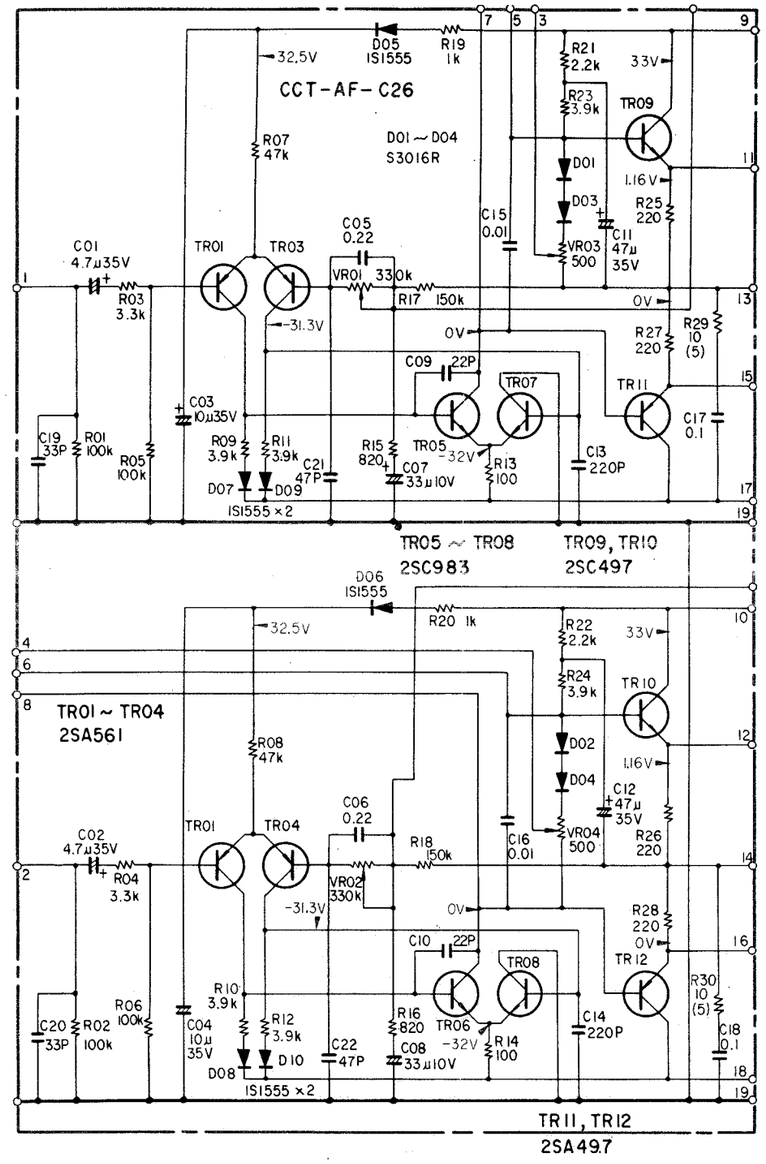



### BOTTOM VIEW

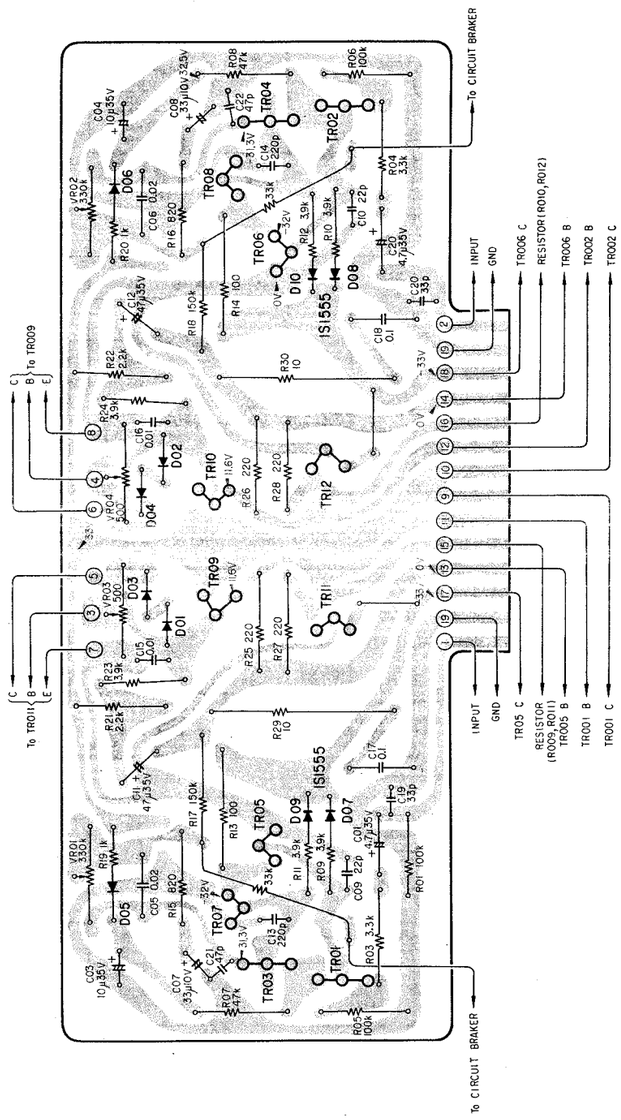


## 10-14. DRIVER CIRCUIT BOARD (CCT-AF-C26)

### SCHEMATIC DIAGRAM

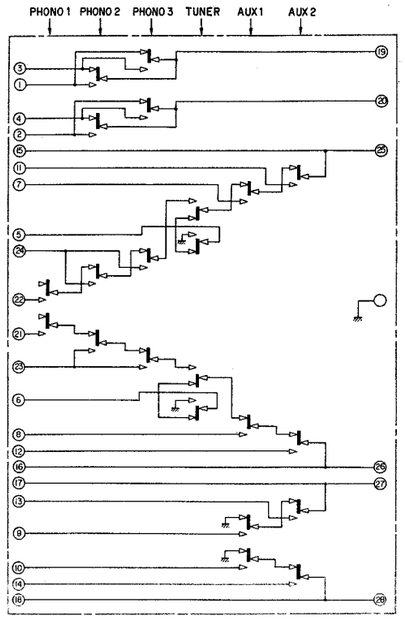



### BOTTOM VIEW

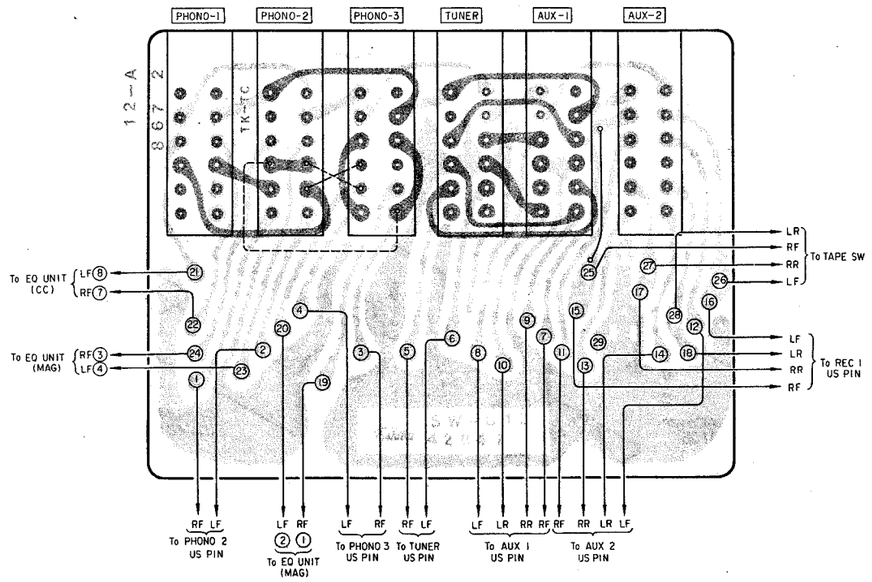


## 10-15. SELECTOR CIRCUIT BOARD (CCT-SW1-C12 & C12A)

### SCHEMATIC DIAGRAM



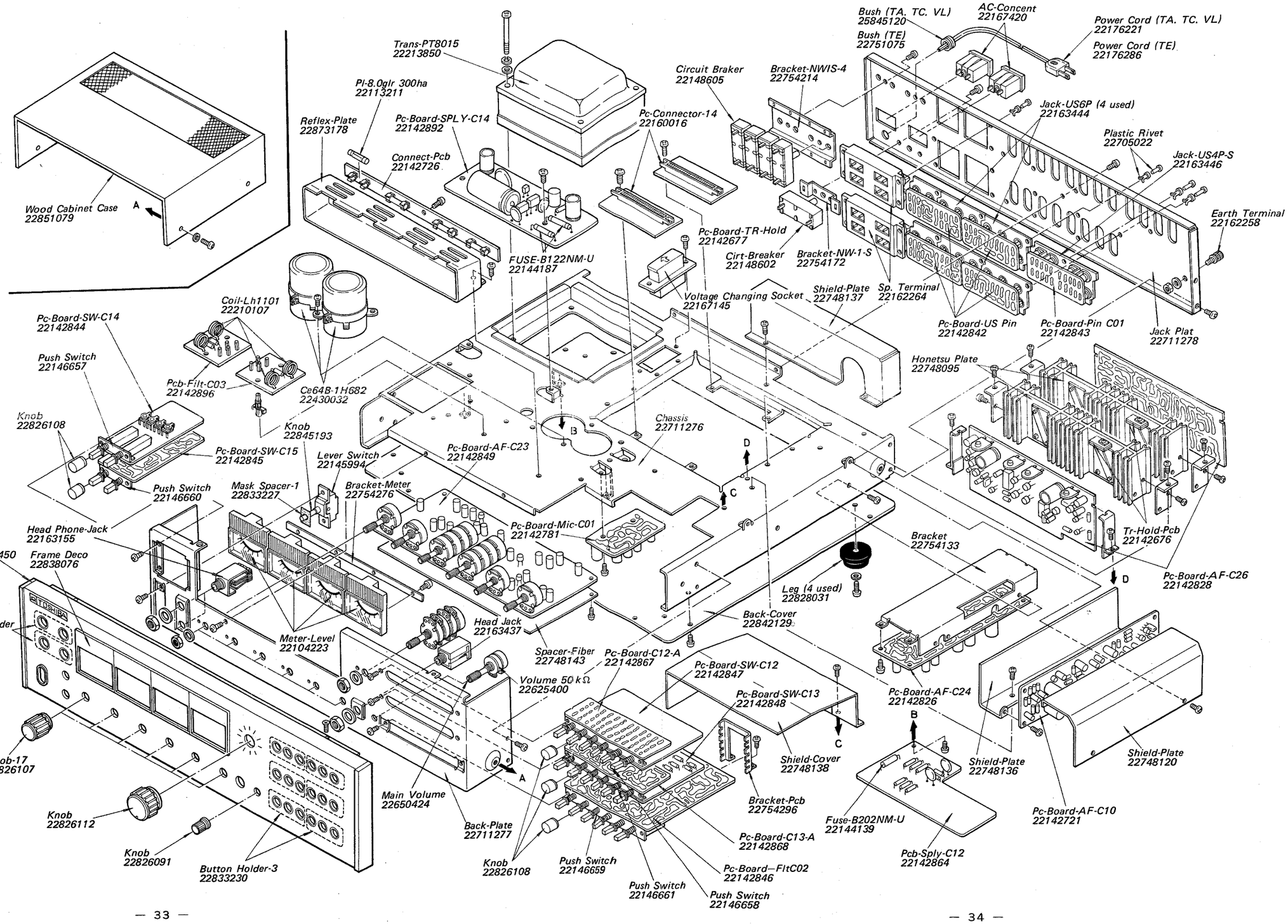

### BOTTOM VIEW






## MEMO

## 11. EXPLODED VIEW



## 12. PARTS LIST

| SYMBOL NO. | PABT NO. | DESCRIPTION |
|---|---|---|
| **Pre SUPPLY UNIT ASSEMBLY (CCT-SPLY-C14)** | | |
| **RESISTORS** | | |
| R01 | 22570011 | 68 ohm ±10% 1W RD |
| R02 | 22570057 | 4.7k ohm ±10% 2W RD |
| R03 | 22570066 | 8.2k ohm ±10% 2W RD |
| R04 | 22570024 | 1k ohm ±10% 2W RD |
| **CAPACITORS** | | |
| C01,02,03,04 | 22340030 | 0.01μF 500V |
| C05 | 22450016 | 220μF 160WV |
| C06,07 | 22440036 | 47μF 100WV |
| C08 | 22440101 | 100μF 100WV |
| C09 | 22448221 | 220μF 50WV |
| **SEMICONDUCTORS** | | |
| D01 | 37682020 | 1D-2C1 |
| D02 | 37682060 | 1D-2Z1 |
| TR01 | 31231382 | 2SC1382-O |
| F01 | 22144187 | FUSE 1.2A |
| **MAIN SUPPLY UNIT ASSEMBLY (CCT-SPLY-C12)** | | |
| **CAPACITORS** | | |
| C01,02,03,04 | 22340030 | 0.01μF 500V |
| **SEMICONDUCTORS** | | |
| D01,02,03,04 05,06,07,08 | | 1S2583 |
| F01 | 22144139 | FUSE 2A |
| **MIC UNIT ASSEMBLY (CCT-MIC-C01)** | | |
| **RESISTORS** | | |
| R01 | 22544332 | 3.3k ohm ±10% 1/8W RD |
| R02 | 22554824 | 820k ohm ±10% 1/8W Single Ended |
| R03 | 22544333 | 33k ohm ±10% 1/8W RD |
| R04 | 22544102 | 1k ohm ±10% 1/8W RD |
| R05 | 22544473 | 47k ohm ±10% 1/8W RD |
| R06 | 22544222 | 2.2k ohm ±10% 1/8W RD |
| R07 | 22544332 | 3.3k ohm ±10% 1/8W RD |
| R08 | 22554184 | 180k ohm ±10% 1/8W Single Ended |
| R09 | 22554391 | 390k ohm ±10% 1/8W Single Ended |
| R10 | 22544684 | 680k ohm ±10% 1/8W RD |
| R11 | 22544184 | 180k ohm ±10% 1/8W RD |
| R12 | 22544103 | 10k ohm ±10% 1/8W RD |
| R13 | 22554222 | 2.2k ohm ±10% 1/8% Single Ended |
| R14 | 22544473 | 47k ohm ±10% 1/8W RD |
| R15 | 22554104 | 100k ohm ±10% 1/8W Single Ended |
| R16 | 22544104 | 100k ohm ±10% 1/8W RD |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| **CAPACITORS** | | |
| C01 | 22448109 | 1μF 50WV CF |
| C02 | 22362470 | 47 pF ±10% 50V CC (SL) |
| C03 | 22373683 | 0.068μF ±20% 50V Mylar |
| C04 | 22447101 | 100μF 35WV CE |
| C05 | 22448109 | 1μF 50WV CE |
| C06 | 22362470 | 47 pF ±10% 50V CC (SL) |
| C07 | 22362560 | 56 pF ±10% 50V CC (SL) |
| C08 | 22447470 | 47μF 35WV CE |
| C09 | 22447100 | 10μF 35WV CE |
| C10 | 22448109 | 1μF 50WV CE |
| **SEMICONDUCTORS** | | |
| TR01,02,03 | 31231000 | 2SC 1000-GR |
| **TONE UNIT ASSEMBLY (CCF-AF-C23)** | | |
| **RESISTORS** | | |
| R03,04,05,06 | 22543222 | 2.2k ohm ±5% 1/8W RD |
| R07,08,09,10, R83,84,85,86 | 22543104 | 100k ohm ±5% 1/8W RD |
| R11,12,13,14 | 22543472 | 4.7k ohm ±5% 1/8W RD |
| R15,16,17,18 | 22543274 | 270k ohm ±5% 1/8W RD |
| R19,20,21,22 | 22543272 | 2.7k ohm ±5% 1/8W RD |
| R23,24,25,26 | 22543122 | 1.2k ohm ±5% 1/8W RD |
| R27,28 | 22543223 | 22k ohm ±5% 1/8W RD |
| R29,30 | 22543183 | 18k ohm ±5% 1/8W RD |
| R31,32,33,34 51,52,53,54 | 22543103 | 10k ohm ±5% 1/8W RD |
| R35,36,38,43, 44,75,76,77,78 | 22543102 | 1k ohm ±5% 1/8W RD |
| R37,45,46 | 22553102 | 1k ohm ±5% 1/8W Single Ended |
| R39,40,41,42 57,58 | 22553123 | 12k ohm ±5% 1/8W Single Ended |
| R47,48,50,59 60,62 | 22543332 | 3.3k ohm ±5% 1/8W RD |
| R49,61 | 22553332 | 3.3k ohm ±5% 1/8W Single Ended |
| R55,56 | 22543123 | 12k ohm ±5% 1/8W RD |
| R63,64,65,66 | 22543224 | 220k ohm ±5% 1/8W RD |
| R67 | 22553333 | 33k ohm ±5% 1/8W Single Ended |
| R68,69,70 | 22543333 | 33k ohm ±5% 1/8W RD |
| R71,72,73,74 | 22543562 | 5.6k ohm ±5% 1/8W RD |
| R79,80,81,82 | 22543221 | 220k ohm ±5% 1/8W RD |
| R87,88 | 22543473 | 47k ohm ±5% 1/8W RD |
| VR01,02 | 22650425 | 100k ohm Bx4 Tone |
| VR03,04,05,06 | 22640402 | 250k ohm B Volume |
| **CAPACITORS** | | |
| C01,02,03,04 29,30,31,32, 49,50 | 22448109 | 1μ 50V CE |
| C05,06,07,08 | 22443330 | 33μ ±20% 10V CE |
| C09,10,11,12, 13,14,15,16, 37,38,39,40 | 22447100 | 10μ 35V CE |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| C17,18,19,20 | 22373222 | 0.0022μF ±20% 50V Mylar |
| C21,22,23,24 | 22373223 | 0.022μF ±20% 50V Mylar |
| 25,26,27,28 | | |
| C33,34,35,36 | 22362470 | 47p ±10% 50V (SL) |
| C41,42,43,44 | 22442470 | 47μF ±10% 6.3V |
| C45,46,47,48 | 22362101 | 100p ±10% 50V (SL) |
| **SEMICONDUCTORS** | | |
| TR01,02,03,04 05,06,07,08, 09,10,11,12 | 31231000 | 2SC-1000 GR |
| **MATRIX UNIT ASSEMBLY (CCT-AF-C10) RESISTORS** | | |
| R01,02,51,52, 53 | 22544683 | 68k ohm ±10% 1/8W RD |
| R03,04 | 22544224 | 220k ohm ±10% 1/8W RD |
| R05,58 | 22544333 | 33k ohm ±10% 1/8W RD |
| R06 | 22544183 | 18k ohm ±10% 1/8W RD |
| R07 | 22544334 | 330k ohm ±10% 1/8W RD |
| R08 | 22554334 | 330k ohm ±10% 1/8W Single Ended |
| R09,10,11,12, 59,60 | 22544103 | 10k ohm ±10% 1/8W RD |
| R13,15 | 22554563 | 56k ohm ±10% 1/8W Single Ended |
| R14,16 | 22544563 | 56k ohm ±10% 1/8W RD |
| R17,19,20,23 | 22544223 | 22k ohm ±10% 1/8W RD |
| R18,24,47,48 | 22554223 | 22k ohm ±10% 1/8W Single Ended |
| R21,22 | 22544104 | 100k ohm ±10% 1/8W RD |
| R27,28 | 22554123 | 12k ohm ±10% 1/8W Single Ended |
| R29,39,63 | 22554393 | 39k ohm ±10% 1/8W Single Ended |
| R30,37,38,72, 73 | 22554103 | 10k ohm ±10% 1/8W Single Ended |
| R31,32 | 22544274 | 270k ohm ±10% 1/8W RD |
| R33,34 | 22554682 | 6.8k ohm ±10% 1/8W Single Ended |
| R35 | 22544182 | 1.8k ohm ±10% 1/8W RD |
| R36 | 22554182 | 1.8k ohm ±10% 1/8W Single Ended |
| R40 | 22554273 | 27k ohm ±10% 1/8W Single Ended |
| R41,42 | 22554224 | 220k ohm ±10% 1/8W Single Ended |
| R43,44,45,46 | 22554332 | 3.3k ohm ±10% 1/8W Single Ended |
| R49,50 | 22554153 | 15k ohm ±10% 1/8W Single Ended |
| R54 | 22554683 | 68k ohm ±10% 1/8W Single Ended |
| R55,61,62,64 | 22554105 | 1M ohm ±10% 1/8W Single Ended |
| R56,66,67 | 22544684 | 680k ohm ±10% 1/8W RD |
| R57 | 22554333 | 33k ohm ±10% 1/8W Single Ended |
| R65 | 22554123 | 12k ohm ±10% 1/8W Single Ended |
| R68,69 | 22544822 | 8.2k ohm ±10% 1/8W RD |
| R70 | 22544102 | 1k ohm ±10% 1/8W RD |
| R71 | 22554102 | 1k ohm ±10% 1/8W Single Ended |
| **CAPACITORS** | | |
| C01,02,07,08, 09,10,11,12,13 14,22,27,28 | 22448109 | 1μF 50WV EC |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| C03,04,19,20, 25 | 22445100 | 10μF 16WV EC |
| C05,06,21,23, 24,25 | 23373104 | 0.1μF 50V ±20% Mylar |
| C15,16 | 22373823 | 0.082μF 50V ±20% Mylar |
| C17,18 | 22373153 | 0.015μF 50V ±20% Mylar |
| **SEMICONDUCTORS** | | |
| TR01,02,03 04,05,06,07 08,09 | 31231000 | TR-2SC1000-GR |
| **DRIVER UNIT ASSEMBLY (CCT-AF-C26) RESISTORS** | | |
| R01,02,05,06 | 22544104 | 100k ohm ±10% 1/8W RD |
| R03,04 | 22544332 | 3.3k ohm ±10% 1/8W RD |
| R07,08 | 22544473 | 47k ohm ±10% 1/8W RD |
| R09,10,11,12 | 22544392 | 3.9 ohm ±10% 1/8W RD |
| R13,14 | 22570021 | 100 ohm ±10% 2W RN |
| R15,16 | 22544821 | 820 ohm ±10% 1/8W RD |
| R17,18 | 22544154 | 150k ohm ±10% 1/8W RD |
| R19,20 | 22544102 | 1k ohm ±10% 1/8W RD |
| R21,22 | 22544222 | 2.2k ohm ±10% 1/8W RD |
| R23,24 | 22544392 | 3.9k ohm ±10% 1/8W RD |
| R25,26,27,28 | 22544221 | 220 ohm ±10% 1/8W RD |
| R29,30 | 22500047 | 10 ohm ±10% 5W RW |
| VR01,02 | 22658188 | 300k ohm Semifixed |
| VR03,04 | 22658189 | 500 ohm Semifixed |
| **CAPACITORS** | | |
| C01,02 | 22447479 | 4.7μF 35WV CE |
| C03,04 | 22447470 | 47μF 35WV CE |
| C05,06 | 22373224 | 0.22μF 50V ±20% Mylar |
| C07,08 | 22443330 | 33μF 10WV CE |
| C09,10 | 22362220 | 22pF 50V ±10% CC (SL) |
| C11,12 | 22447221 | 220μF 35WV CE |
| C13,14 | 22362221 | 220pF 50V ±10% CC (SL) |
| C15,16 | 22373103 | 0.01μF 50V ±10% Mylar |
| C17,18 | 22373104 | 0.1μF 50V ±20% Mylar |
| C19,20 | 22362330 | 33pF 50V ±10% CC (SL) |
| C21,22 | 22362470 | 47pF 50V ±10% CC (SL) |
| **SEMICONDUCTORS** | | |
| TR01,02,03,04 | 31210561 | 2SA561-Y |
| TR05,06,07,08 | 31230983 | 2SC983-Y |
| TR09,10 | 31230493 | 2SC497-Y |
| TR11,12 | 31210497 | 2SA497-Y |
| D01,02,03,04 | 31193016 | S3016-R |
| D05,06 | 31111555 | 1S1555 |
| D07,08,09,10 | 31111555 | 1S1555 |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| **EQ UNIT ASSEMBLY (CCT-AF-24)** | | |
| **RESISTORS** | | |
| R01,02,57 | 22543474 | 470k ohm ±%5 1/8W RD |
| R03,04 | 22541222 | 2.2k ohm ±5% 1/8W LN |
| R05,06 | 22543223 | 22k ohm ±5% 1/8W RD |
| R07,08 | 22541105 | 1M ohm ±5% 1/8W JN |
| R09,10 | 22541184 | 180k ohm ±5% 1/8W LN |
| R11,12,54 | 22543471 | 470k ohm ±5% 1/8W RD |
| R13,14 | 22570072 | 270k ohm ±1% 1/8W RD |
| R15,16 | 22570069 | 47k ohm ±1% 1/8W RD |
| R17,18 | 22570071 | 18k ohm ±1% 1/8W RD |
| R19,20 | 22570070 | 8.2k ohm ±1% 1/8W RD |
| R21,22 | 22543473 | 47k ohm ±5% 1/8W RD |
| R23,24 | 22543333 | 33k ohm ±5% 1/8W RD |
| R25,26 | 22547562 | 5.6k ohm ±5% 1/2W RD |
| R27,28 | 22543102 | 1k ohm ±5% 1/8W RD |
| R29,30,39,40 | 22543105 | 1M ohm ±5% 1/8W RD |
| R31,32,41,42 | 22541104 | 100k ohm ±5% 1/8W LN |
| R33,34 | 22541333 | 33k ohm ±5% 1/8W LN |
| R35,36 | 22543683 | 68k ohm ±5% 1/8W RD |
| R37,38 | 22543224 | 220k ohm ±5% 1/8W RD |
| R43,56 | 22543822 | 8.2k ohm ±5% 1/8W RD |
| R44,58 | 22543332 | 3.3k ohm ±5% 1/8W RD |
| R45 | 22543225 | 2.2M ohm ±5% 1/8W RD |
| R46 | 22543105 | 1M ohm ±5% 1/8W RD |
| R47 | 22543473 | 47k ohm ±5% 1/8W RD |
| R48 | 22543563 | 56k ohm ±5% 1/8W RD |
| R49 | 22543153 | 15k ohm ±5% 1/8W RD |
| R50,51,55,60 | 22543682 | 6.8k ohm ±5% 1/8W RD |
| R52 | 22543122 | 1.2k ohm ±5% 1/8W RD |
| R53 | 22543272 | 2.7k ohm ±5% 1/8W RD |
| R59 | 22543392 | 3.9k ohm ±5% 1/8W RD |
| R61,62 | 22543104 | 100k ohm ±5% 1/8W RD |
| **CAPACITORS** | | |
| C01,02 | 22401026 | 4.7μF 35V CS |
| C03,04 | 22447101 | 100μF 35V |
| C05,06 | 22362470 | 47pF 50V ±10% CC |
| C07,08,25,26 | 22343221 | 220pF ±20% CK |
| C09,10 | 22440039 | 47μF 50V KU |
| C11,12 | 22370031 | 0.01μF 50V ±2% Mylar |
| C13,14 | 22380019 | 2400pF 50V |
| C15,16 | 22380018 | 470pF 50V |
| C17,28 | 22445101 | 100μF 16V |
| C19,20 | 22440038 | 1μF 50V KU |
| C21,22 | 22371223 | 0.022μF 50V ±5% Mylar |
| C23,24 | 22371332 | 0.0033μF 50V ±5% Mylar |
| C27,28 | 22447100 | 10μF 35V |
| C29,30 | 22401003 | 1μF 35V CS |
| C31,32 | 22440047 | 4.7μF 35V |
| C33 | 22445330 | 33μF 16V |
| C34 | 22445100 | 10μF 16V |
| C35 | 22401025 | 0.33μF 35V CS |
| C37 | 22448470 | 47μF 50V |
| **SEMICONDUCTORS** | | |
| TR01,02,03,04,07,08,11 | 31210493 | 2SA493-GR |
| TR05,06 | 31230983 | 2SC983-Y |
| TR09,10 | 31231000 | 2SC1000-GR |
| **BTL SW UNIT ASSEMBLY (CCT-SW-C15)** | | |
| **RESISTORS** | | |
| R01,02 | 22543154 | 150k ohm ±5% 1/8W RD |
| R03,04,07 | 225 3562 | 5.6k ohm ±5% 1/8W RD |
| R05,06 | 22543683 | 68k ohm ±5% 1/8W RD |
| R09,10,11,12,13 | 22543473 | 47k ohm ±5% 1/8W RD |
| R08 | 22553562 | 5.6k ohm ±5% 1/8W Single Ended |
| **CAPACITORS** | | |
| C01,02,03,04,05,06 | 22448109 | 1μF 50V |
| C07,08 | 22362470 | 47p ±10% 50V CC |
| **SEMICONDUCTORS** | | |
| TR01,02 | 31231000 | 2SC-1000 |
| S01 | 22146660 | Push Switch |
| **SPEAKER SW UNIT ASSEMBLY (CCT-SW-C14)** | | |
| **RESISTORS** | | |
| R01,03,04 | 22543332 | 3.3k ohm ±5% 1/8W RD |
| R02 | 22553332 | 3.3k ohm ±5% 1/8W Single Ended |
| VR01,02,03,04 | 22658186 | 1k ohm Semifixed |
| **SEMICONDUCTORS** | | |
| D01,02,03,04 | 31120060 | 1N60 |
| D05,06,07,08 | 31111555 | 1S1555 |
| S01 | 22146657 | Push Switch |
| **MODE SW UNIT ASSEMBLY (CCT-SW-C13)** | | |
| **RESISTORS** | | |
| R01,02,03,04 | 22543472 | 4.7k ohm ±5% 1/8W RD |
| R05,06,07,08 | 22543103 | 10k ohm ±5% 1/8W RD |
| R09,10,11,12 | 22543104 | 100k ohm ±5% 1/8W RD |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| | | **SEMICONDUCTORS** |
| S01 | 22146661 | Push Switch |
| | | **SELECTOR UNIT ASSEM BLY (CCT-SW-c12)** |
| | | **SEMICONDUCTORS** |
| S01 | 22146658 | Push Switch |
| | | **ACCESSORY UNIT ASSEMBLY (CCT-FILT-C02)** |
| | | **RESISTORS** |
| R01,02,03,04, 05,06,07,08 | 22543473 | 47k ohm ±5% 1/8W RD |
| R09,10,11,12, 26 | 22543223 | 22k ohm ±5% 1/8W RD |
| R13,14,15,16 | 22543100 | 10k ohm ±5% 1/8W RD |
| R17,18,29,20 | 22543474 | 470k ohm ±5% 1/8W RD |
| R21,22,23,24 | 22543273 | 27k ohm ±5% 1/8W RD |
| R25,27,28 | 22553223 | 22k ohm ±5% 1/8W Single Ended |
| | | **CAPACITORS** |
| C01,02,03,04 05,06,07,08 | 22448229 | 2.2μF 50WV |
| C09,10,11,12 | 22447479 | 4.7μF 35WV |
| C13,14,15,16 | 22373823 | 0.082μF ±20% 50WV |
| 17,18,19,20 21,22,23,24 | 22373823 | 0.01μF ±20% 50WV |
| C25,26,27,28 | 22362151 | 150p ±10% 50WV |
| | | **SEMICONDUCTORS** |
| S01 | 22146659 | Push Switch |
| | | **US-PIN UNIT ASSEMBLY (CCT-PIN-C01)** |
| | | **RESISTORS** |
| R01,02,03,04 | 22543563 | 56k ohm ±5% 1/8W RD |
| | | **CAPACITORS** |
| C01 | 22445470 | 47μF 16V |
| | | **COIL UNIT ASSEMBLY (CCT-FILT-C03)** |
| | | **RESISTORS** |
| R01,02 | 22563100 | 10 ohm ±10% 1/2W RD |
| | | **SEMICONDUCTOR** |
| L01,02 | 22210107 | 1.27 mH |

| SYMBOL NO. | PART NO. | DESCRIPTION |
|---|---|---|
| | | **ELECTRICAL PARTS** |
| | 22213850 | TRANS-PT8015 |
| | 22104223 | METER-LEVEL |
| | 22113211 | LAMP.-METER |
| | 22116086 | SOCKET-RT |
| S001 | 2214599 | LEVER Switch |
| CB001, | 22148605 | CIRKIT BREAKER |
| CB002,003, | 22148605 | CIRKIT BREAKER |
| CB004,005 | 22160016 | PC, CONNECTOR-14 |
| | 22162258 | Terminal (Earth) |
| | 22162264 | Terminal (Speaker) |
| | 22162290 | Terminal |
| | 22162305 | Terminal (1P) |
| | 22162306 | Terminal (4P) |
| | 22162307 | Terminal (5P) |
| J001 | 22163443 | Jack US 4P |
| J002 | 22163446 | Jack US4P-S |
| J003 | 22163444 | Jack US6P |
| J004 | 22163437 | Jack Mic |
| J005 | 22164392 | PLUG-2P-B |
| J006,007 | 22163155 | Jack Headphon |
| J008,009 | | |
| J010 | 22167145 | Voltage Selector |
| | 22167420 | Ac Concent |
| | 22184158 | Wire Clip |
| R001 | 22544101 | 100 ohm ±10% 1/8W RD |
| R002,003, 004,005 | 22554104 | 100k ohm ±10% 1/8W Single Ended |
| R006,007 008,009 | 22546333 | 33k ohm ±10% 1/4W RD |
| R010,011,012 013,014,015, 016 | 22500048 | 0.5 ohm ±10% 3W Cement Resistor |
| R017,018,019 020 | 22500047 | 220 ohm ±10% 2W M.Film Resistor |
| VR001 | 22650424 | 250k ohm B Variable Resistor (Main) |
| VR002 | 22625400 | 50k ohm A Variable Resistor (Mic) |
| | 22142677 | PC Poard (Connector) |
| C001 | 22321201 | 0.022μF±20% 250V Film Capacitor |
| C002,003 | 22430032 | 6800μF 50WV Electric Capacitor |
| TR001,002 003,004 | 31230793 | 2SC793-BL |
| TR005,006 007,008 | 31210663, | 2SA663-BL |
| TR009,010 011,012 | 31230496 | 2SC496 |