

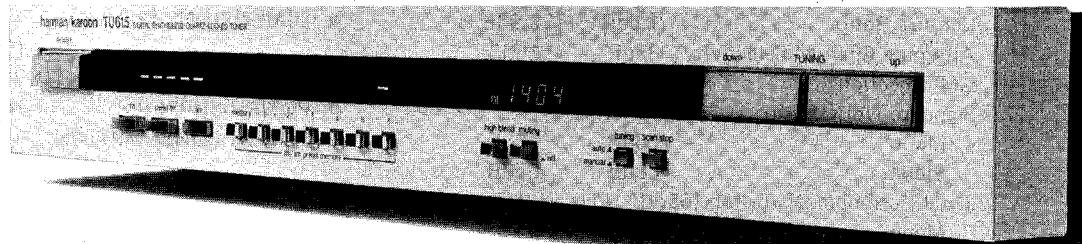
# The Harman Kardon Model TU615

Manual No. 28A

TU615

## DIGITAL SYNTHESIZED QUARTZ-LOCKED TUNER

# Technical Manual



**harman/kardon**

240 CROSSWAYS PARK WEST, WOODBURY, N.Y. 11797  
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## SPECIFICATIONS

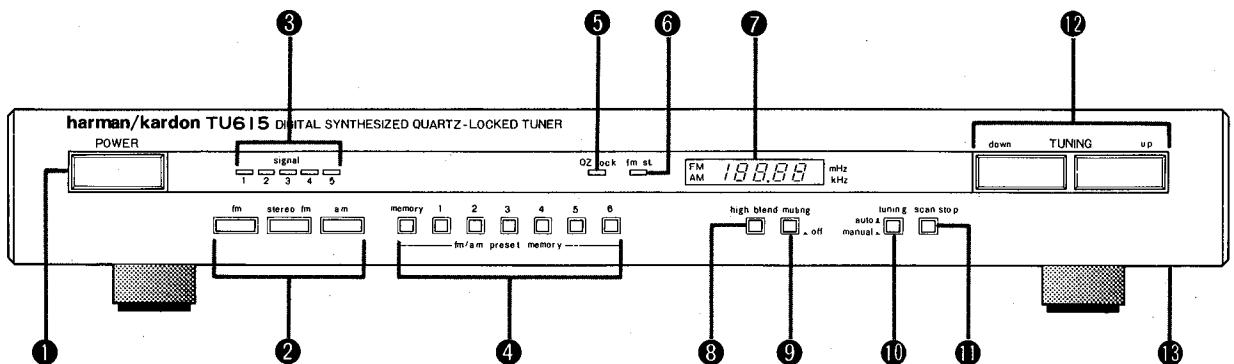
● FM SECTION	Nominal	Limit
Tuning Range	87.9 ~ 107.9MHz	
50dB Quieting Sensitivity		
Mono	17dBf	≤ 20dBf
Stereo	38dBf	≤ 44dBf
Usable Sensitivity	11dBf	≤ 15dBf
Image Ratio	80dB	≥ 70dB
IF Rejection	90dB	≥ 80dB
Spurious Response Rejection	93dB	≥ 85dB
Capture Ratio	1.5dB	≤ 2.5dB
Alternate Channel Selectivity	85dB	≥ 65dB
AM Rejection	55dB	≥ 45dB
Signal to Noise Ratio		
Mono	78dB	≥ 75dB
Stereo	68dB	≥ 65dB
Total Harmonic Distortion (65dBf 1kHz INPUT)		
Mono	0.08%	≤ 0.25%
Stereo	0.07%	≤ 0.3%
Stereo Separation at 1kHz	50dB	≥ 42dB
Output Level/Impedance	750mV	

● AM SECTION	Nominal	Limit
Tuning Range	530 ~ 1,620kHz	
Usable Sensitivity	220μV/m	≤ 320μV/m
Selectivity	45dB	≥ 35dB
Signal to Noise Ratio	53dB	≥ 45dB
Image Rejection	60dB	≥ 50dB
IF Rejection	65dB	≥ 50dB
● SEMICONDUCTOR	56 Transistors, 13 ICs, 4 FETs, 69 Diodes, 15 LEDs	
● DIMENSIONS(WxHxD)	17-1/3"x2-1/6"x12-4/7" (440x55x320mm)	
● WEIGHT	7.7 lbs (3.4 kg)	
● POWER SUPPLIES	AC 120V, 60Hz	
● POWER CONSUMPTION	15W	

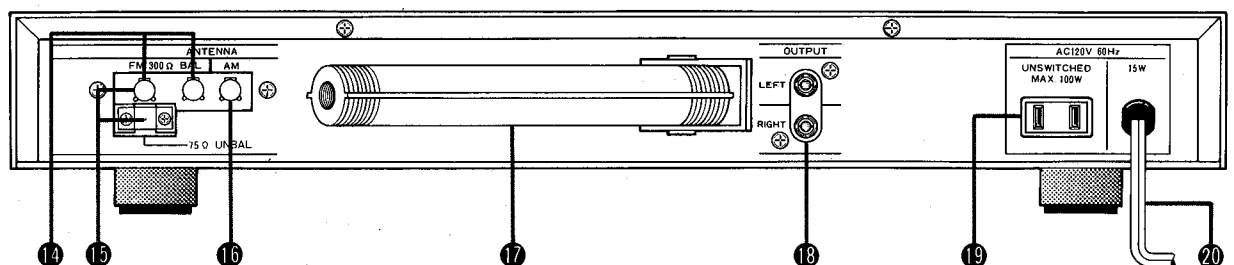
Specifications and components subject to change without notice.  
Overall performance will be maintained or improved.

## COMPONENTS AND THEIR FUNCTIONS

### ■ FRONT PANEL



### ■ REAR PANEL



## ■ FRONT PANEL

### ① POWER SWITCH (POWER)

For power turning on and off.

When this switch is pressed after AC cord connection to an outlet, the STATION DISPLAY indicates the receiving frequency.

### ② FUNCTION SELECTORS

#### ● FM selector (fm)

For selection of FM mode.

Depress this selector to tune to an FM monaural broadcast or a weak FM stereo broadcast.

#### ● STEREO FM selector (stereo fm)

For selection of FM stereo mode.

Depress this selector to tune to an FM stereo broadcast. The tuner will automatically enter monaural mode when it receives a monaural broadcast.

#### ● AM selector (am)

For selection of AM mode.

Depress this selector to tune to an AM broadcast.

### ③ SIGNAL STRENGTH INDICATOR (signal)

5 LEDs for indication of the receiving signal level. As the signal gets stronger, more LEDs will illuminate.

### ④ FM/AM PRESET MEMORY BUTTONS (fm/am preset memory)

#### ● MEMORY button (memory)

To enable PRESET buttons.

Press this button to start presetting of a broadcasting station. The button itself illuminates in green color for about 5 seconds.

#### ● PRESET buttons (1, 2, 3, 4, 5, 6)

For memorizing and recalling broadcasting frequencies. Press one of these buttons while the MEMORY push-button is illuminating. The pressed PRESET button illuminates in green color and the frequency indicated by the STATION DISPLAY is memorized at the position. Each position can memorize one frequency each in the FM and AM bands. The pressed button keeps illuminating until scanning starts. Once a station frequency is memorized, it can be recalled any time the same button is pressed.

### ⑤ QUARTZ LOCK INDICATOR (QZ lock)

For indication of correct tuning to a station.

This indicator illuminates in green color whenever a station is tuned.

### ⑥ STEREO FM INDICATOR (fm st.)

For indication of FM stereo broadcast reception.

### ⑦ STATION DISPLAY

For digital display of the band and frequency of the receiving station.

### ⑧ HIGH BLEND SWITCH (high blend)

For reduction of noise in high frequency zone. Depress this switch to receive a weak FM stereo broadcast with minimal noise.

### ⑨ MUTING SWITCH (muting)

For reduction of interstation noise during scanning through the FM or AM band for a station.

To tune to a weak station, depress this switch to invalidate the muting function.

### ⑩ TUNING MODE SWITCH (tuning)

For selection between automatic and manual scan modes.

#### AUTO position:

Enables automatic scanning.

If the TUNING button (down or up) is pressed, automatic frequency counting down or up starts.

#### MANUAL position:

Enables manual scanning.

As the TUNING button (down or up) is pushed and released, the receiving frequency decreases or increases in steps.

### ⑪ SCAN STOP SWITCH (scan stop)

For stopping automatic scanning.

Press this switch when the desired frequency is tuned in automatic scan mode.

### ⑫ TUNING BUTTONS (TUNING)

For automatic or manual tuning.

Press the "up" button to increase the receiving frequency or the "down" button to decrease it.

### ⑬ ODD (9kHz)/EVEN (10kHz) SELECTOR (location on bottom of cabinet)

For selection of tuning steps between 10kHz and 9kHz depending on the AM station broadcasting frequency intervals in your area.

If AM stations in your area cannot be received, raise the cabinet and change the position of this switch located on the bottom of the cabinet.

## ■ REAR PANEL

### ⑭ FM ANTENNA TERMINALS (FM 300Ω BAL)

Connect an FM dipole antenna or an FM outdoor antenna cable here.

### ⑮ FM ANTENNA TERMINALS (FM 75Ω UNBAL)

Connect an FM coaxial antenna cable (75Ω) here.

### ⑯ AM ANTENNA TERMINAL (AM)

Connect an AM outdoor antenna cable here if the receiving AM wave is weak.

### ⑰ AM FERRITE LOOPSTICK ANTENNA

For AM broadcast reception.

Draw it out and move it to improve reception.

Because of its high-sensitivity design, this built-in antenna is adequate for reception in most receiving conditions except in a fringe reception area where signals are weak.

### ⑱ OUTPUT JACKS (OUTPUT)

Provide fixed stereo outputs. Connect signal cables to tuner (or aux) jacks of your preamplifier or pre-main-amplifier.

### ⑲ AC CONVENIENCE OUTLET (UNSWITCHED)

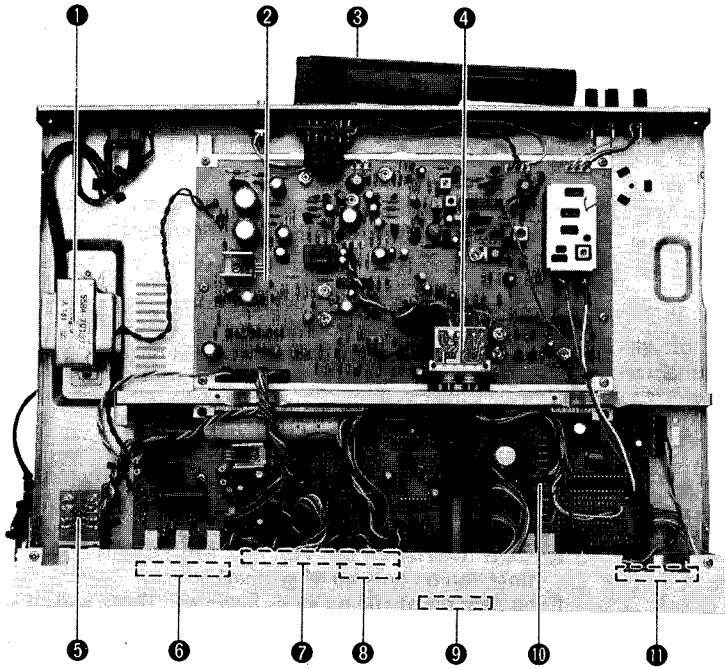
Connect the AC cord of another component here. This outlet always provides power regardless of whether the tuner is turned on or not.

### ⑳ AC CORD

Connect this cord to the UNSWITCHED AC convenience outlet of the amplifier or a mains outlet.

# INTERNAL VIEW

## TOP VIEW



- ① POWER TRANSFORMER
- ② PCB-1 MAIN P.C. BOARD
- ③ AM LOOPSTICK ANTENNA
- ④ PCB-3 HIGH BLEND/MUTING SWITCH P.C. BOARD
- ⑤ PCB-4 POWER SWITCH P.C. BOARD
- ⑥ PCB-7 LEVEL METER P.C. BOARD
- ⑦ PCB-8 MEMORY P.C. BOARD
- ⑧ PCB-6 OZ. LOCK/FM ST. INDICATORS P.C. BOARD
- ⑨ PCB-9 STATION DISPLAY P.C. BOARD
- ⑩ PCB-2 CONTROL P.C. BOARD
- ⑪ PCB-5 TUNING SWITCH P.C. BOARD

## DISASSEMBLY PROCEDURES

### 1 CABINET TOP REMOVAL

Remove screws ① to ⑥ in Fig. 1, and then remove the cover by sliding it to its rear a little.

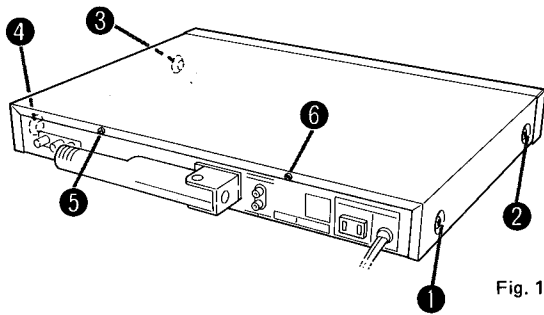


Fig. 1

### 2 CABINET BOTTOM COVER REMOVAL

Remove screws ① to ⑥ in Fig. 2 and then remove the bottom cover.

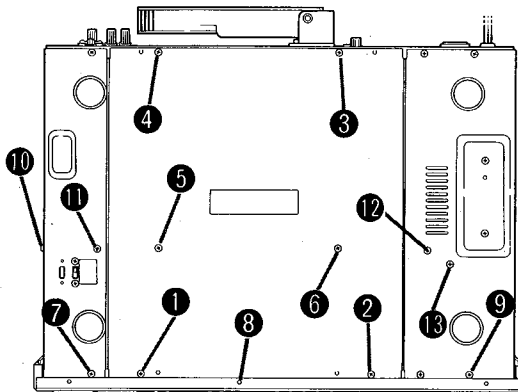


Fig. 2

### 3 FRONT PANEL ASSEMBLY REMOVAL

1. Remove the cabinet top. (Refer to step ①)
2. Remove screws ⑦ to ⑨ in Fig. 2 and ① and ② in Fig. 3. Remove the front panel by pulling it toward you gently.

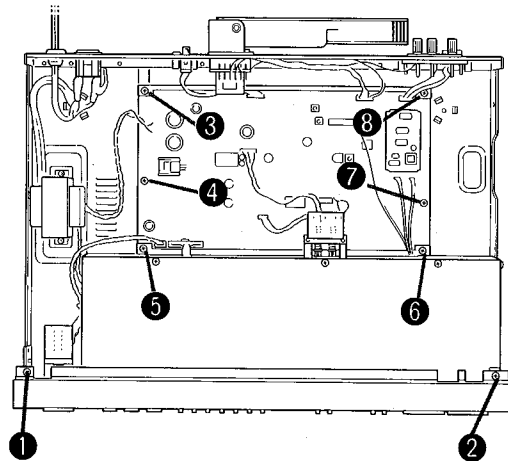


Fig. 3

**4 SHIELD PLATE (COVER) REMOVAL**

1. Remove the cabinet top. (Refer to step 1 )
2. Remove screws 1 to 4 in Fig. 4 and then slide the plate to its rear. Remove the actuator 5 and 6 in Fig. 4 and then remove the shield plate.

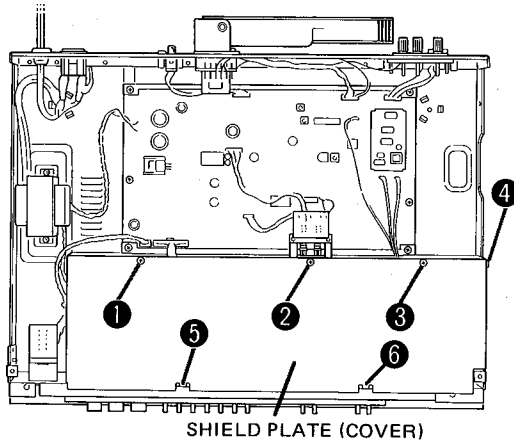


Fig. 4

**5 SHIELD PLATE (BASE) REMOVAL**

1. Remove the shield plate (cover). (Refer to step 4 )
2. Detach the connector 1 to 5 in Fig. 5.
3. Pull out the shaft 2 push button assemblies from high blend and muting switches on the PCB-3.
4. Unsolder the lead wires which are connected to PCB-3.
5. Remove screws 5, 6 and 10 to 13 in Fig. 2 and then remove shield plate.

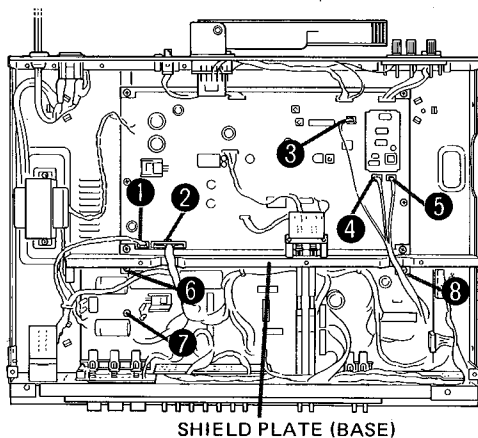


Fig. 5

**6 PCB-1 (MAIN) REMOVAL**

1. Remove the shield plate. (Refer to step 5 )
2. Unsolder the lead wires which are connected to PCB-1.
3. Remove screws 3 to 8 in Fig. 3 and then remove PCB-1.

**7 PLATE ASSEMBLY REMOVAL**

1. Remove the shield plate. (Refer to step 4 )
2. Detach the connector 1 and 2 in Fig. 7.
3. Remove the screw 1 in Fig. 6.
4. Remove actuators 3 to 5 in Fig. 7 and then remove metal fixtures 6 and 7. Remove the plate assembly.

**8 PCB-4 (POWER SWITCH) REMOVAL**

1. Remove the plate assembly. (Refer to step 7 )
2. Unsolder the lead wires which are connected to PCB-4.
3. Remove screws 2 and 3 in Fig. 6 and then remove PCB-4.

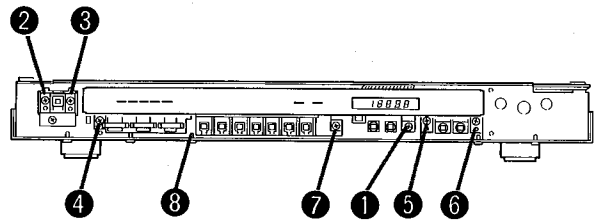


Fig. 6

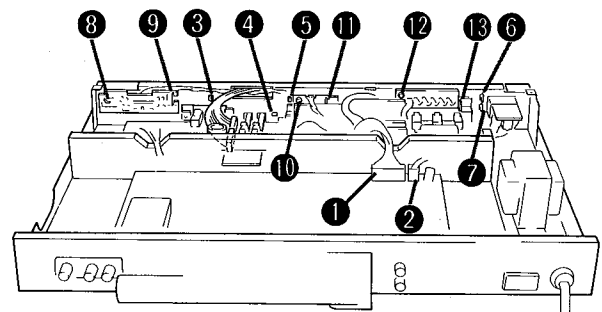


Fig. 7

**9 PCB-2 (CONTROL) REMOVAL**

1. Remove the shield plate. (Refer to step 5 )
2. Unsolder the lead wires which are connected to PCB-2.
3. Remove screws 4 to 6 in Fig. 6.
4. Remove screws 6 to 8 in Fig. 5 and then remove PCB-2.

**10 PCB-8 (MEMORY) REMOVAL**

1. Remove PCB-2. (Refer to step 9 )
2. Unsolder the lead wires which are connected to PCB-8.
3. Remove the screw 7 in Fig. 6.
4. Remove the actuator 8 in Fig. 6 and then remove PCB-8.

**11 PCB-5 (TUNING SWITCH) REMOVAL**

1. Remove the shield plate. (Refer to step 5 )
2. Unsolder the lead wires which are connected to PCB-5.
3. Level the metal fixture 8 in Fig. 7 and then remove PCB-5 from the metal fixture 9 by pulling out it.

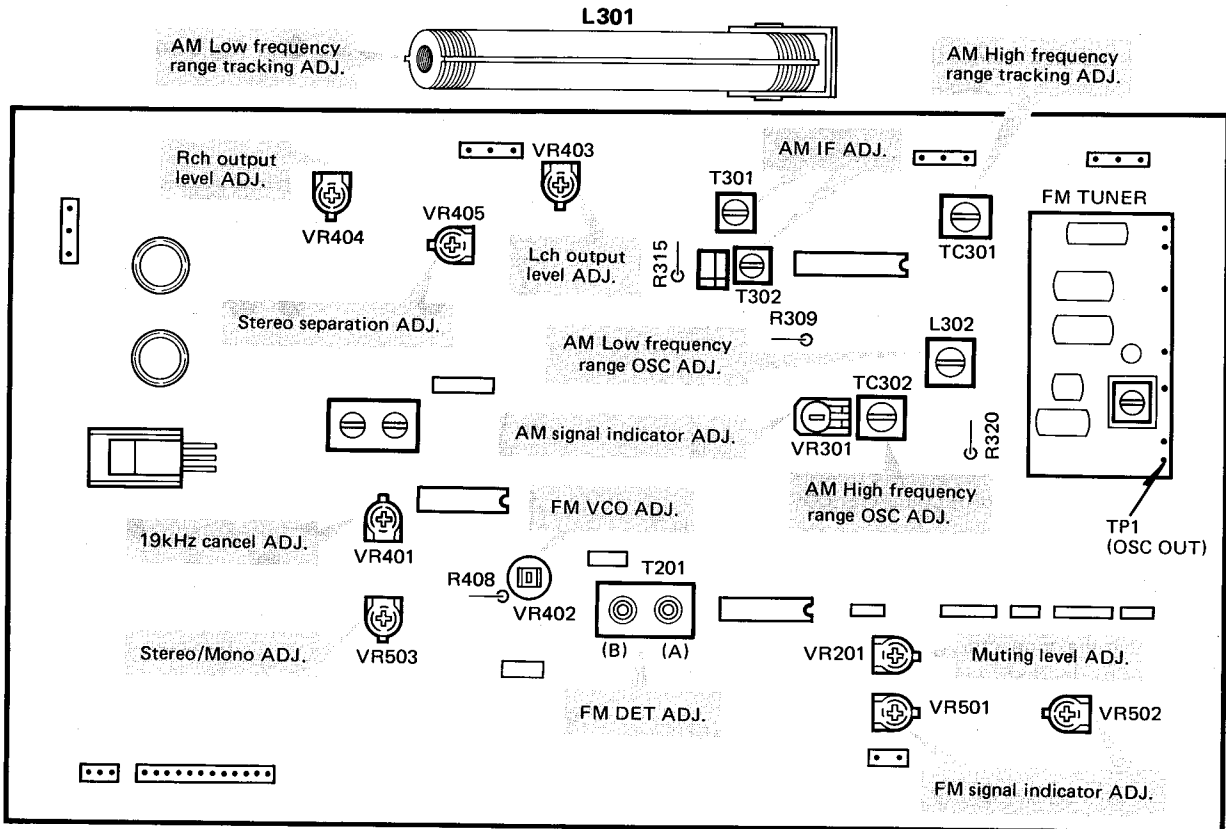
**12 PCB-6 (QZ LOCK/FM ST. INDICATOR) REMOVAL**

1. Remove PCB-8. (Refer to step 10 )
2. Unsolder the lead wires which are connected to PCB-6.
3. Remove the plastic rivet 10 in Fig. 7 and then remove PCB-6 from the metal fixture 11.

**13 PCB-7 (LEVEL METER) REMOVAL**

1. Remove the shield plate. (Refer to step 5 )
2. Unsolder the lead wires which are connected to PCB-7.
3. Remove the plastic rivet 12 in Fig. 7 and then pull out PCB-7 from the metal fixture 13.

# ALIGNMENT PROCEDURES



## 1. STANDARD FREQUENCY CHECK

- Set the FM switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	<ul style="list-style-type: none"> <li>• Connect the frequency counter to TP1 (+) and earth (-).</li> </ul>		98.3MHz		109MHz ± 2kHz

## 2. FM ALIGNMENT

- Set the FM switch to ON and muting switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	<ul style="list-style-type: none"> <li>• Connect FM signal generator (1kHz 100% modulation) to FM 300Ω BAL ANT terminals through the 300Ω balanced dummy.</li> <li>• Connect oscilloscope, distortion meter and AC voltmeter to the output jack terminals.</li> </ul>	98.14MHz (65dBf)	98.1MHz	T201 (A) (frequency range)	Adjust so that the waveform appears.
2		98.06MHz (65dBf)	98.1MHz	T201 (A)	Adjust so that the waveforms in step ① and ② become the same level.
3		98.1MHz (65dBf)	98.1MHz	T201 (B) (distortion)	Reduce distortion to minimum. Adjust T201 (A) and (B) alternately and adjust so that the frequency range center point equals to the minimum distortion point.

## 3. MUTING SENSITIVITY ADJUSTMENT

- Set the FM switch to ON and muting switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	<ul style="list-style-type: none"> <li>• Connect FM signal generator (1kHz 100% modulation) to FM 300Ω BAL ANT terminals through the 300Ω balanced dummy.</li> <li>• Connect oscilloscope to the output jack terminals.</li> </ul>	98.1MHz (19dBf)	98.1MHz	VR201	Adjust so that the waveform appears.

#### 4. SIGNAL INDICATOR ADJUSTMENT

- Set the FM switch to ON and muting switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	● Connect FM signal generator (1kHz 100% modulation) to FM 300Ω BAL ANT terminals through the 300Ω balanced dummy.	98.1MHz (19dBf)	98.1MHz	VR502	Adjust so that one signal meter LED lights.
2		98.1MHz (65dBf)	98.1MHz	VR501	Adjust so that five signal meter LEDs lights.

#### 5. OUTPUT LEVEL ADJUSTMENT

- Set the FM switch to ON and muting switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	● Connect FM signal generator (1kHz 100% modulation) to FM 300Ω BAL ANT terminals through the 300Ω balanced dummy. ● Connect AC voltmeter to the output jack terminals.	98.1MHz (65dBf)	98.1MHz	VR403 (L channel)	Adjust so that output level becomes 750mV.
2		98.1MHz (65dBf)	98.1MHz	VR404 (R channel)	

#### 6. MPX ADJUSTMENT

- Set the stereo FM switch to ON.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	● Connect the stereo modulator (L+R = 45.5%, L-R = 45.5%, 19kHz = 9%) to FM signal generator. ● Apply signal generator output to FM 300Ω BAL ANT terminals through 300Ω balanced dummy. ● Connect the frequency counter between R408 (+) and earth (-). ● Connect oscilloscope and AC voltmeter to the output jack terminals.	98.1MHz (un-modulation)	98.1MHz	VR402	Set for 76kHz.
2		98.1MHz	98.1MHz	VR401	Set the stereo modulator to 19kHz only. Adjust so that L and R output level becomes minimum.
3		98.1MHz	98.1MHz	VR405	Adjust so that the right channel output becomes minimum when only the left channel of the stereo modulator modulated and so that the left channel output becomes minimum when only the right channel modulated.

#### 7. STEREO INDICATOR ADJUSTMENT

- Set the stereo FM switch to ON.

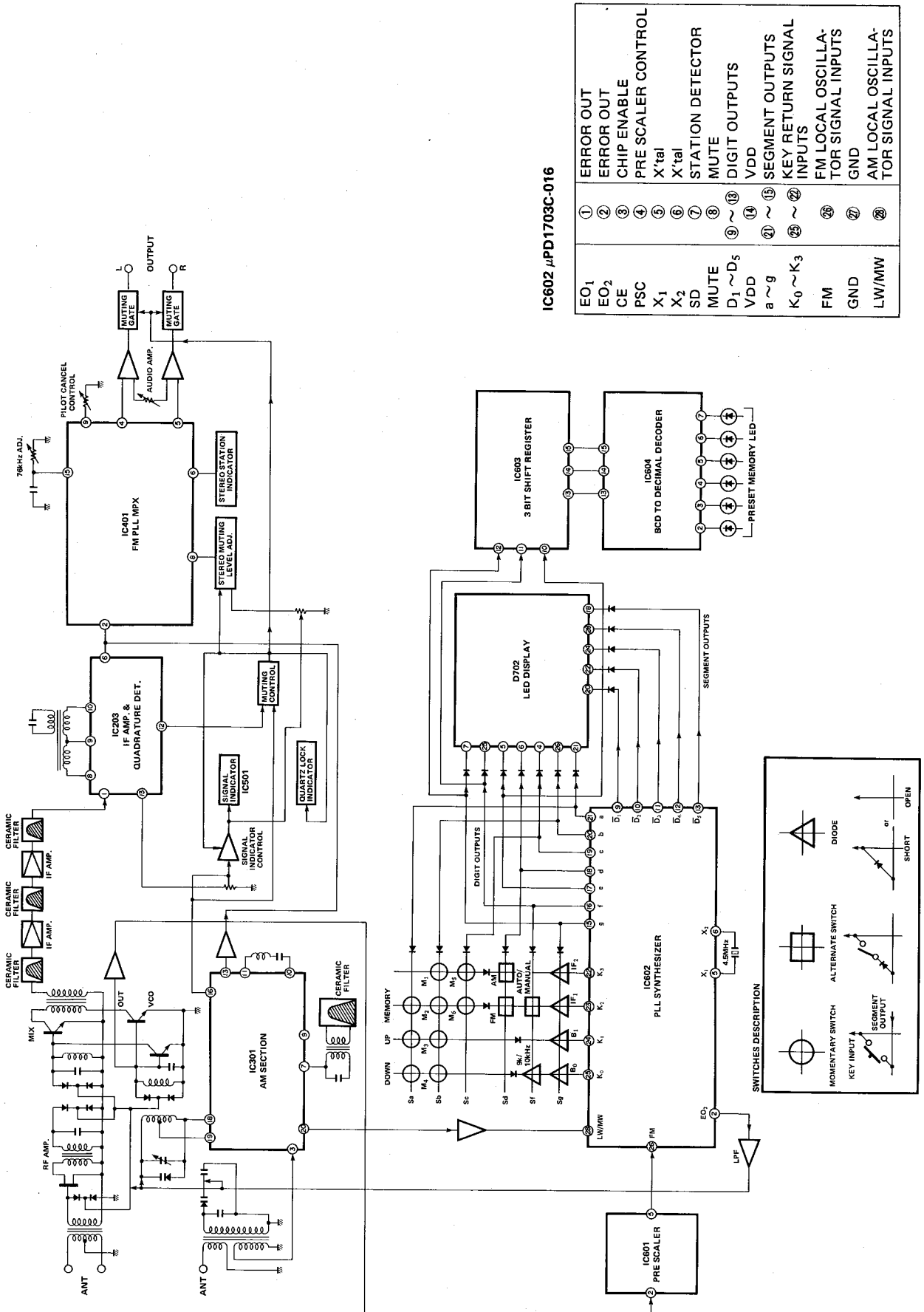
Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method
1	● Connect the stereo modulator (L+R = 45.5%, L-R = 45.5%, 19kHz = 9%) to FM signal generator. ● Apply signal generator output to FM 300Ω BAL ANT terminals through 300Ω balanced dummy.	98.1MHz (21dBf)	98.1MHz	VR503	Adjust so that FM stereo LED lights.

#### 8. AM ALIGNMENT

- Set the AM switch to ON and ODD(9kHz)/Even(10kHz) selector switch to EVEN.

Step	Terminals to be connected	Signal source	Station display	Adjustment location	Adjustment method	
1	● Connect DC voltmeter to R320 (+) and earth (-).		530kHz	L302	1.65V ± 50mV	
2			1620kHz	TC302	22.5V ± 1V	
3	● Radiate output of AM signal generator (400Hz 30% modulation) to AM ferrite loopstic antenna (L301). ● Connect oscilloscope and AC voltmeter to the output jack terminals.	450kHz	1602kHz	T301 T302	Set for the maximum output level and good waveform.	
4			600kHz	600kHz	L301	Set for the maximum output level.
5			1400kHz	1400kHz	TC301	Adjust at weak input level.
6			1000kHz	1000kHz	VR301	Adjust so that the five signal meter LEDs lights at 105dBf input.
7						Check that muting circuit operates at between 43 and 53dBf input level.

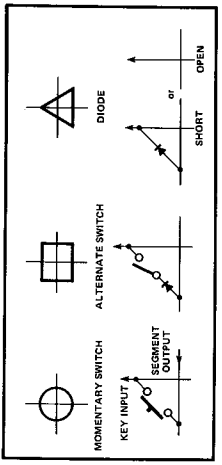
**BLOCK DIAGRAM**



**IC602 μPD1703C-016**

EO <sub>1</sub>	①	ERROR OUT
EO <sub>2</sub>	②	ERROR OUT
CE	③	CHIP ENABLE
PSC	④	PRE SCALER CONTROL
X <sub>1</sub>	⑤	X'tal
X <sub>2</sub>	⑥	X'tal
SD	⑦	STATION DETECTOR
MUTE	⑧	MUTE
D <sub>1</sub> ~ D <sub>5</sub>	⑨ ~ ⑬	DIGIT OUTPUTS
VDD	⑭	VDD
a ~ g	⑰ ~ ⑲	SEGMENT OUTPUTS
K <sub>0</sub> ~ K <sub>3</sub>	⑳ ~ ㉒	KEY RETURN SIGNAL INPUTS
FM	㉓	FM LOCAL OSCILLATOR SIGNAL INPUTS
GND	㉔	GND
LW/MW	㉕	AM LOCAL OSCILLATOR SIGNAL INPUTS

**SWITCHES DESCRIPTION**





## CIRCUIT DESCRIPTION

### [1] SIGNAL PATH

The FM signal is amplified in the RF amp. 3SK101 of the front-end and then mixed with the output of the local oscillator 2SC930 (2SC9687) in high frequency amp. 2SC535 (2SC2686) and converted into a signal of the 10.7MHz intermediate frequency.

The 10.7MHz signal is fed to the ceramic filter CF201 and amplified in IF amp. IC201. The output of IC201 is fed to the ceramic filter CF202 and amplified in the IF amp. IC202. The output of IC202 is fed to the ceramic filter CF203.

After the output signal is amplified in the triple IF limiter amplifiers of IC203 and then quadrature detected and PLL MPX demodulated in IC401 and amplified in the audio amp. Q401 and Q403 (Lch) as well Q402 and Q404 (Rch).

### [2] MUTING CIRCUIT

The muting control voltage is taken out from ⑫ pin of IC203 and then fed to the base of Q501. At the weak station or detuned point the ⑫ pin becomes high level. Q501 becomes low level and then Q502 becomes high level, Q506 becomes low level and then Q512 becomes high level, Q503 becomes low level and then Q504 becomes high level, Q514 becomes high level and then Q515 becomes high level, Q517 (Lch) and Q518 (Rch) becomes low level and muting operation is completed.

### [3] SIGNAL INDICATOR CIRCUIT

#### 1) FM tuner section

The signal indicator drive signal is taken out from ⑬ pin of IC203 and after passing through the volume control VR501, Q509 and Q510 the drive signal is fed to ⑧ pin of LED driver IC501.

#### 2) AM tuner section

The signal indicator drive signal is taken out from ⑯ pin of IC301 and fed to Q509.

### [4] FM STEREO AND QUARTZ LOCK INDICATORS CIRCUIT

- At FM stereo program reception, ⑥ pin of IC401 becomes low level and fm st. indicator LED D521 lights up.
- At FM program reception, ⑫ pin of IC203 becomes low level and then Q501 becomes high level. Q502 becomes low level and Q506 becomes high level and Q507 becomes low level and then quartz lock LED D520 lights up.
- At AM program reception, ⑯ pin of IC301 becomes high level and then Q505 becomes low level. Q506 becomes high level and Q507 becomes low level and then quartz lock LED D520 lights up.

### [5] SYNTHESIZER SECTION

#### 1) FM

The output of local oscillator in the frontend is fed to ② pin of the pre-scaler IC601 and then divided by 16 or 17 and fed to ⑳ pin of the PLL synthesizer IC602. The standard quartz oscillator output (4.5MHz) is divided by 180 in IC602 and 25kHz standard signal is got. The divided local oscillator output is compared with the 25kHz standard signal in the phase comparator. When the divided local oscillator frequency is higher than the standard frequency, ② pin of IC602 becomes high level but when it is lower, ② pin becomes low level when the both frequencies are equal, ② pin becomes floating.

② pin output of IC602 is fed to the vari-cap diode of the frontend through L.P.F. (Q601, Q602) and controls the frequency of VCO (local oscillator frequency).

#### 2) AM

The local oscillator output of AM IC301 is fed to ⑳ pin of the PLL synthesizer IC602 and divided. The standard quartz oscillator output (4.5MHz) is divided by 450 in IC602 and 10kHz standard signal is got.

The divided local oscillator output is compared with the 10kHz standard signal in the phase comparator.

### [6] PRESET MEMORY

#### a) Memorizing

When one of the preset keys, M1 to M6 is depressed within 5 seconds after the memory key is depressed, for M1, the output of ⑳ pin (b) of IC602 is fed to ⑳ pin (K3) and for M2, the output of ⑳ pin is fed to ㉑ pin (K2) and for M3, the output of ⑳ pin is fed to ㉒ pin (K1) and for M4, the output of ⑳ pin is fed to ㉓ pin (KO) and for M5, the output of ⑳ pin (c) is fed to ㉔ pin (K3) and for M6, the output of ⑳ pin (c) is fed to ㉕ pin (K2). The displayed frequency is memorized into the memory (RAM) which correspond to the depressed key.

#### b) Recalling

When one of the preset keys, M1 to M6 is depressed, the contents of the memory (frequency) is recalled.

### [7] FM/AM STATION SCANNING

#### 1) When TUNING mode switch is set to AUTO

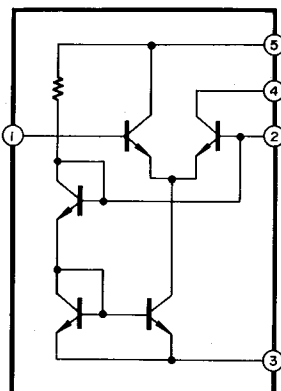
When the UP key is depressed, the frequency rises at saw tooth wave mode and when DOWN key is depressed, the frequency falls. When the high level input is fed to SD terminal (⑦ pin of IC602), the scanning is stopped. When SCAN STOP switch is depressed, SD terminal becomes high level and the scanning is stopped.

#### 2) When TUNING mode switch is set to MANUAL

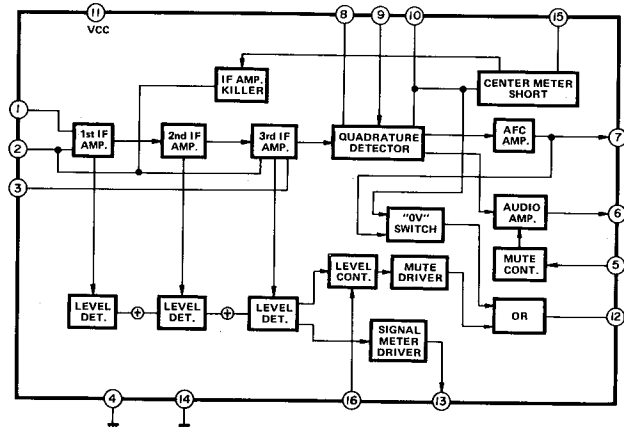
Whenever UP or DOWN key is depressed once the frequency rises or falls by one step (channel space).

## IC FUNCTIONAL BLOCK DIAGRAM

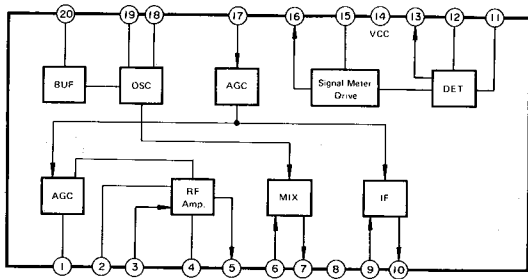
IC201, 202 BA401



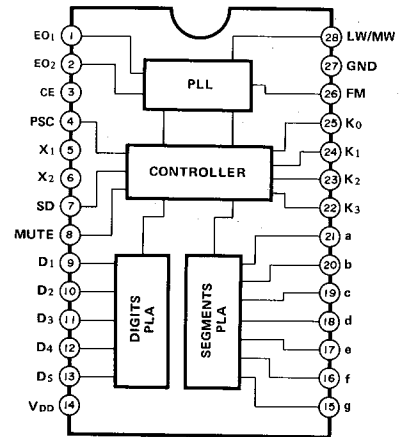
IC203 HA12412



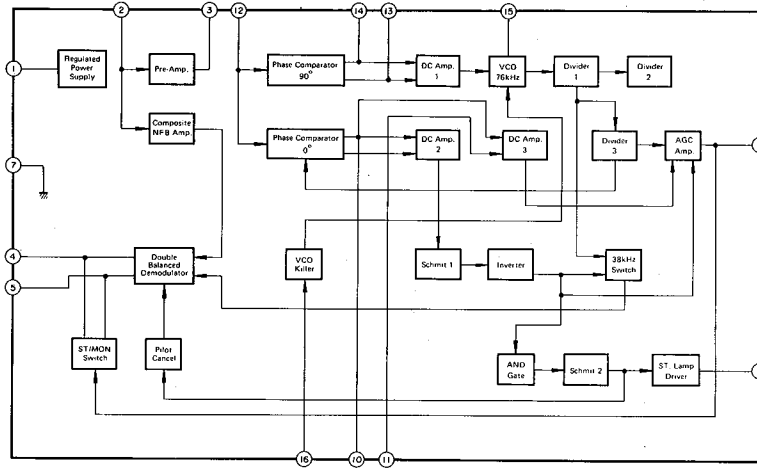
IC301 LA1245



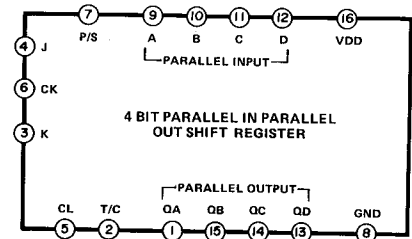
IC602  $\mu$ PD1703C-016



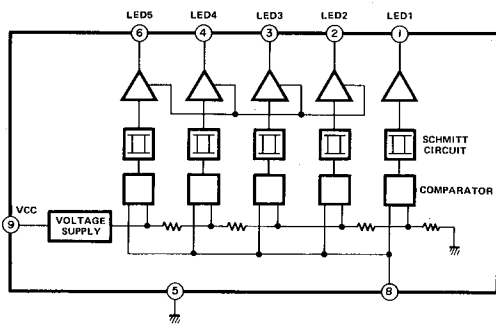
IC401 KB4437



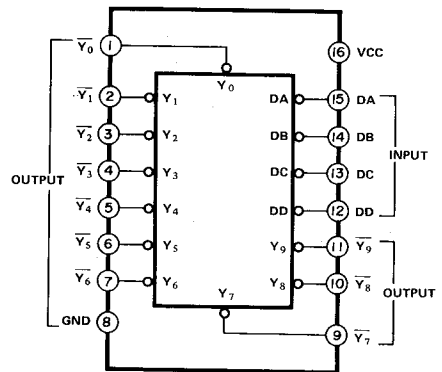
IC603  $\mu$ PD4035C



IC501 AN6875

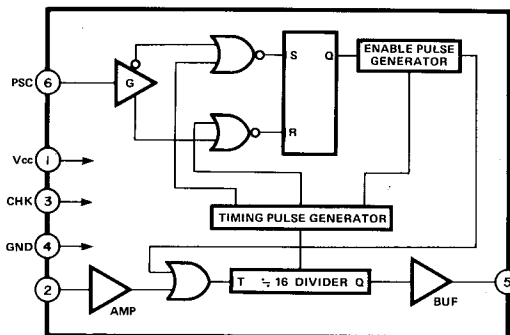


IC604 M74LS145

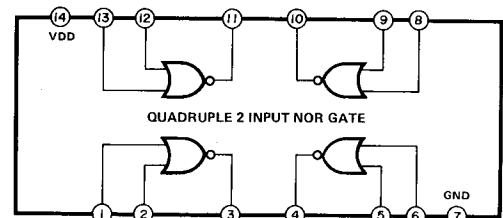


BCD-TO-DECIMAL DECORDER

IC601  $\mu$ PB553AC

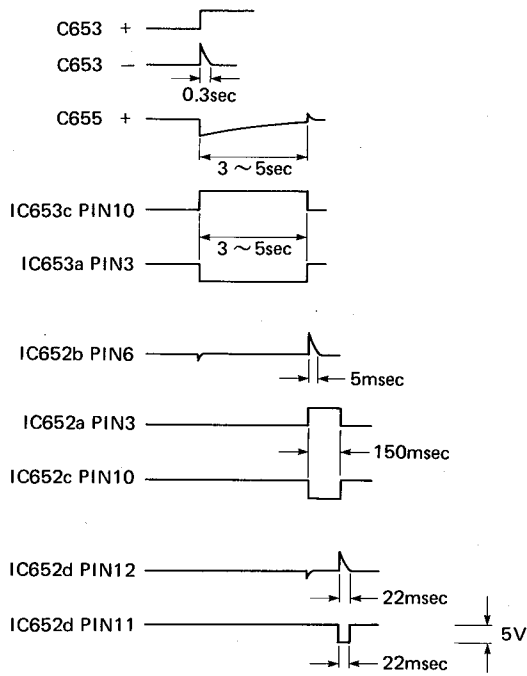


IC651, 652, 653  $\mu$ PD4001

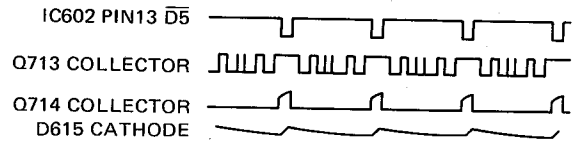


# TIMING CHART

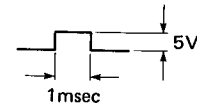
■ Short time hold



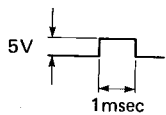
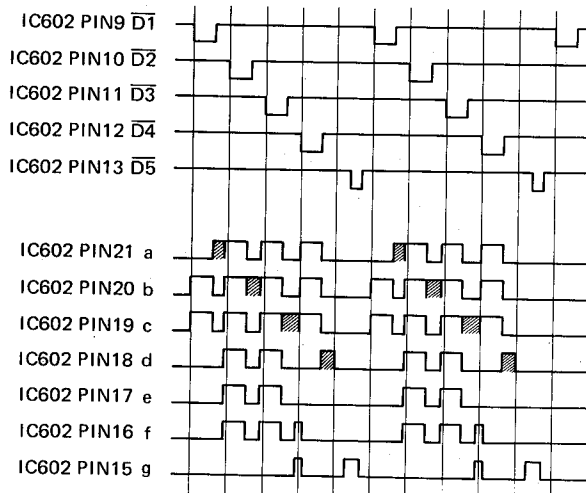
■ Outputs of Q713 to Q716 when MEMORY LED lights up.



The collector voltage of Q715 and Q716 is 0.6V.

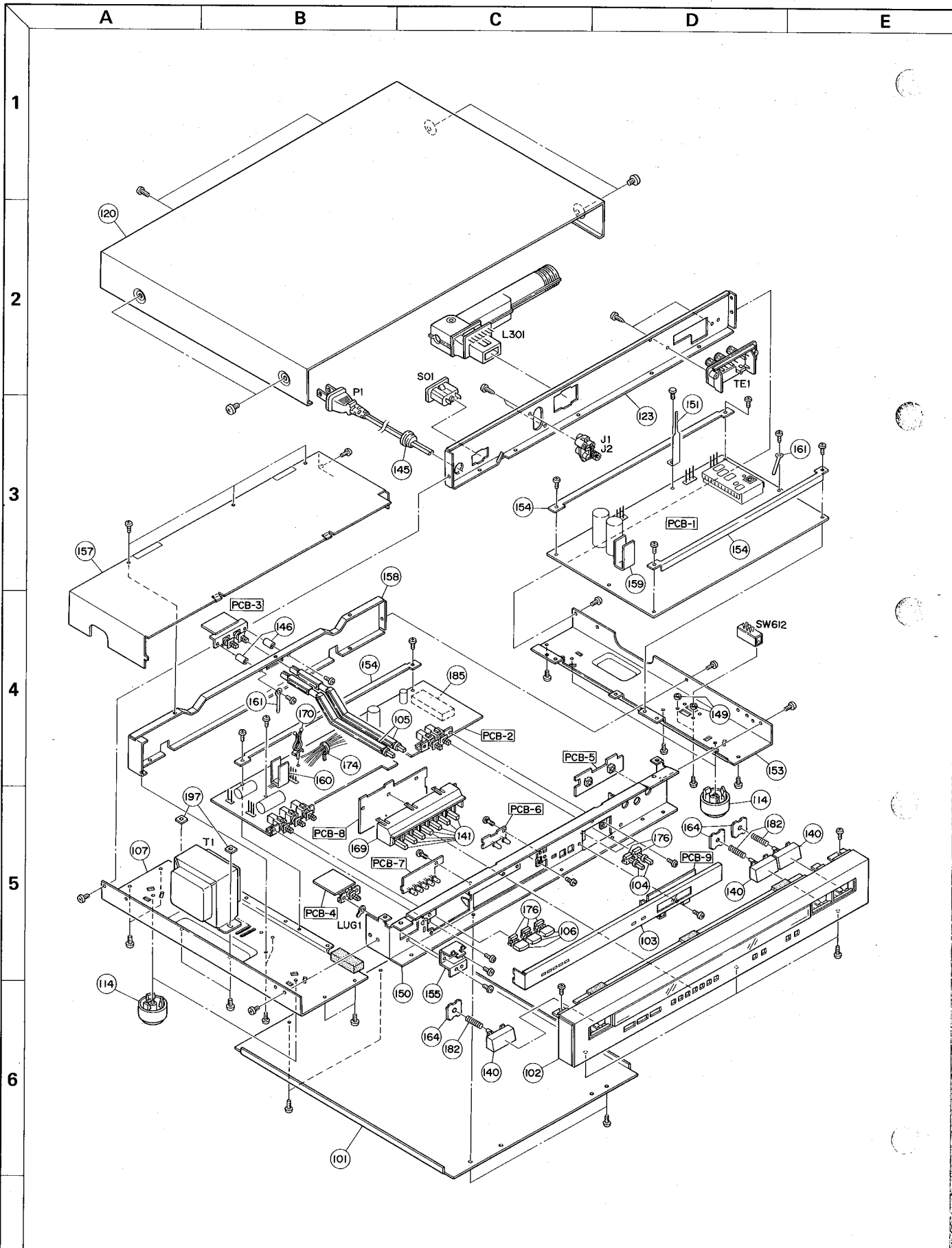


■ When recalling the memory numbered 6 at FM 100.1MHz.



\* When observing the above waveform, apply  $\overline{D1}$  (IC602 PIN9) signal to the external input terminal in the oscilloscope.

GENERAL UNIT EXPLODED VIEW



## GENERAL UNIT PARTS LIST

Ref. No.	Part No.	Description
101	A424-TU615	Cabinet Bottom Cover Assembly
102	A443-TU615	Front Panel Assembly
103	A514-TU615	Plate Assembly
104	A662-TU615-A	Push Button Assembly, Tuning Mode, Scan Stop
105	A662-TU615-B	Push Button Assembly, High Blend, Muting
106	A662-TU615-C	Push Button Assembly, Function Selector
107	B219-TU615	Bracket Assembly
114	1319-0139	Foot
120	1414-02201	Cabinet Top
123	1424-06002	Cabinet Back
140	1662-08001BW	Push Button, Power, Tuning Up, Tuning Down
141	1662-08401	Push Button, Preset Memory
145	2114-415027	Bushing
146	2132-01701	Spacer
149	2132-7016	Spacer
150	2211-7215	Chassis
151	2218-7016	Holding Bracket
153	2219-7785	Bracket
154	2219-7783	Bracket
155	2219-7782	Bracket
157	2216-7118	Shield Plate
158	2216-7119	Shield Plate
159	2222-7043	Heat Sink
160	2222-7043	Heat Sink
161	2218-7001	Holding Bracket
164	2240-7173	Holder
169	2240-7170	Holder
170	2240-7048	Holder
174	2240-7120	Holder
176	2601-7098	Shaft
182	2651-210196	Spring
185	2133-7022	Protector
197	2440-49	Special Nut

## ELECTRICAL PARTS LIST

Ref. No.	Part No.	Description
<b>CHASSIS MISCELLANEOUS</b>		
P1	4161-7387	AC Line Cord
SO1	4474-152	AC Outlet, Unswitched
TE1	4214-104	FM/AM External Antenna Terminal
L301	5911-223	AM Ferrite Loopstick Antenna
L305	5995-470325	Coil
T1	5584-701372	Power Transformer
SW612	4421-0227131	Slide Switch, ODD(9kHz)/Even(10kHz) Selector
J1, 2	4482-7118	2-Pin Jack, Output
J201	4163-73053	Connector with Lead Wire, 2-Pin
J202	4163-72853	Connector with Lead Wire, 2-Pin
J301	4163-72953	Connector with Lead Wire, 2-Pin
J501	4163-72753	Connector with Lead Wire, 11-Pin
J502	4163-73153	Connector with Lead Wire, 3-Pin
J601	4163-70476	Connector with Lead Wire, 7-Pin
J602	4163-70376	Connector with Lead Wire, 10-Pin
J701	4163-70176	Connector with Lead Wire, 7-Pin
J702	4163-70276	Connector with Lead Wire, 9-Pin
LUG1	4211-4	Lug Terminal
<b>PCB-1 MAIN P.C. BOARD</b>		
<b>RESISTORS</b>		
R204, 207, 222, 304	5102-3904715	39 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
R215	5174-222381	2.2k $\Omega$ , $\pm$ 1%, 1/4W, Metal
R401	5102-3304713	33 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
R407	5174-153381	15k $\Omega$ , $\pm$ 1%, 1/4W, Metal
R562	5102-4704713	47 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
R801	5102-1005114	10 $\Omega$ , $\pm$ 5%, 1/2W, Fuse
R802	5102-2204715	22 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
R803	5102-3304715	33 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
R804	5102-1004715	10 $\Omega$ , $\pm$ 2%, 1/4W, Fuse
<b>CONTROLS</b>		
VR201, 403, 404	5101-50371920	50k $\Omega$ B
VR301	5101-30371920	30k $\Omega$ B
VR401, 503	5101-20371920	20k $\Omega$ B
VR402	5101-4727173	4.7k $\Omega$ B
VR405	5101-103083H	10k $\Omega$ B
VR501	5101-10471920	100k $\Omega$ B
VR502	5101-50271920	5k $\Omega$ B
<b>CAPACITORS</b>		
C208, 218	5345-225-50	2.2 $\mu$ F, +75% -10%, 50V, Electrolytic
C210, 503	5345-105-50	1 $\mu$ F, +75% -10%, 50V, Electrolytic
C212, 805	5345-107-16	100 $\mu$ F, +50% -10%, 16V, Electrolytic
C219, 408, 410, 411	5345-L105M50	1 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C220, 305	5345-476-16	47 $\mu$ F, +50% -10%, 16V, Electrolytic
C311	5345-105F0211	1 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C312	5345-475D0211	4.7 $\mu$ F, $\pm$ 20%, 25V, Electrolytic
C313	5345-225F0211	2.2 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C326	5345-475-25	4.7 $\mu$ F, +75% -10%, 25V, Electrolytic
C328	5345-106-16	10 $\mu$ F, +50% -10%, 16V, Electrolytic
C401, 402	5345-L106M16	10 $\mu$ F, $\pm$ 20%, 16V, Electrolytic
C403	5345-226-16	22 $\mu$ F, +50% -10%, 16V, Electrolytic
C404, 426	5345-227-16	220 $\mu$ F, +50% -10%, 16V, Electrolytic
C409	5345-L685M25	6.8 $\mu$ F, $\pm$ 20%, 25V, Electrolytic
C412, 413, 504, 505, 507	5345-L335M50	3.3 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C417, 418, 419, 420	5345-L154M50	0.15 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C423, 424	5342-475C023	4.7 $\mu$ F, $\pm$ 20%, 16V, Electrolytic
C425	5345-108-16	1000 $\mu$ F, +50% -10%, 16V, Electrolytic
C501, 502	5345-L104M50	0.1 $\mu$ F, $\pm$ 20%, 50V, Electrolytic
C506	5342-106C023	10 $\mu$ F, $\pm$ 20%, 16V, Electrolytic
C508	5345-L476M16	47 $\mu$ F, $\pm$ 20%, 16V, Electrolytic

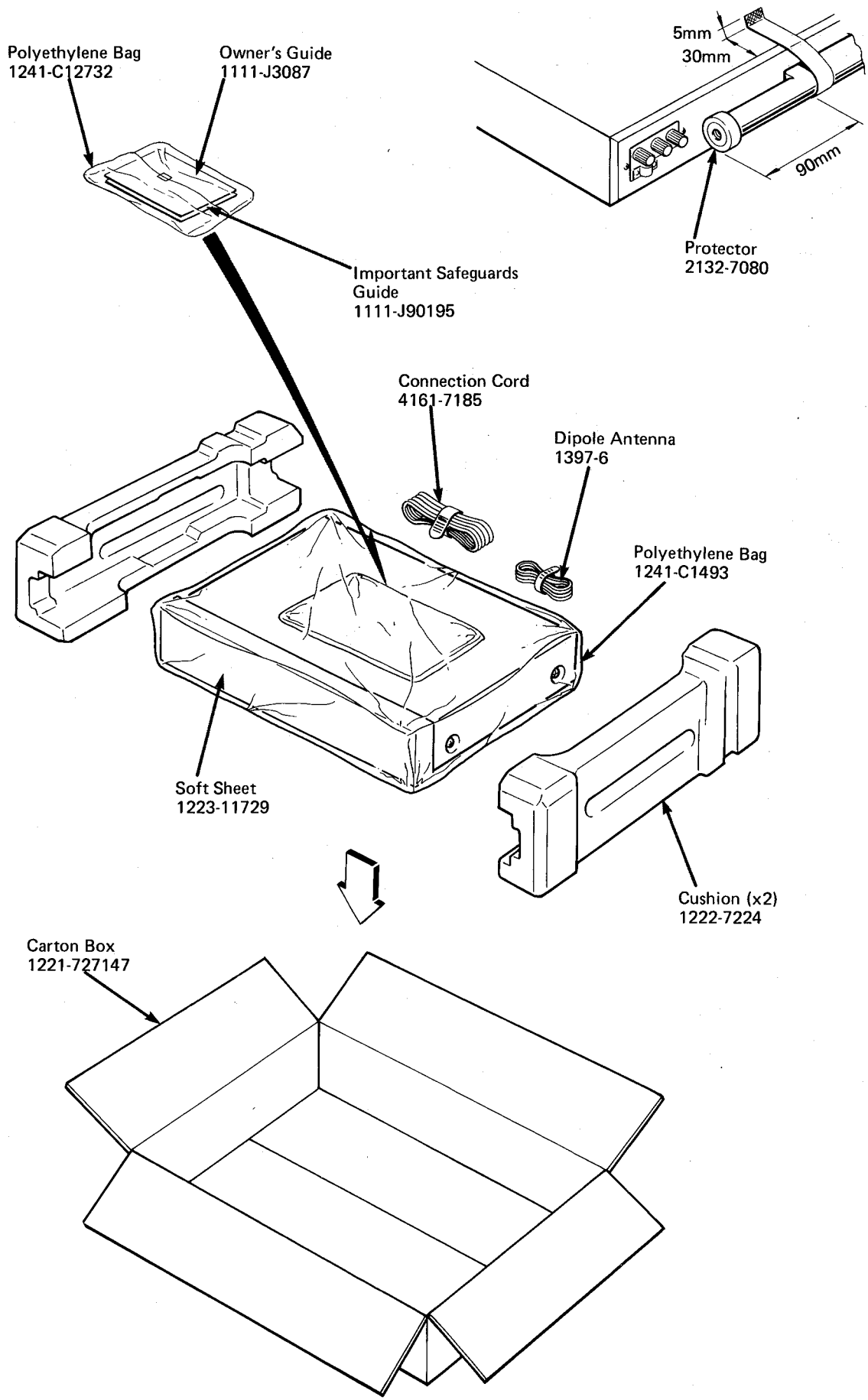
Ref. No.	Part No.	Description
C509, 804, 807	5345-477-16	470 $\mu$ F, +50% -10%, 16V, Electrolytic
C803, 806	5345-228D0211	2200 $\mu$ F, $\pm$ 20%, 25V, Electrolytic
TC301, 302	5371-64	Trimmer Capacitor
<b>INTEGRATED CIRCUITS</b>		
IC201, 202	5652-BA401	BA401
IC203	5652-HA12412	HA12412
IC301	5652-LA1245	LA1245
IC401	5652-KB4437	KB4437
<b>TRANSISTORS</b>		
Q301	5613-2058(N)	2SC2058(N)
Q302, 501, 502, 503, 505, 507, 508, 511, 512, 513, 514, 516, 517, 518, 519, 520, 521, 522	5613-2603(E)or(F)	2SC2603(E) or 2SC2603(F)
Q401, 402	5613-2320(L)(F)or(G)	2SC2320(L)(F) or 2SC2320(L)(G)
Q403, 404, 504, 506, 510, 515, 523, 524	5611-1115(E)or(F)	2SA1115(E) or 2SA1115(F)
Q509	5616-2SK163(N)	F.E.T., 2SK163(N)
Q801	5616-2SK163(M)	F.E.T., 2SK163(M)
Q802	5613-1419(C)or(D)	2SC1419(C) or 2SC1419(D)
Q803	5612-647(B)or(C)	2SB647(B) or 2SB647(C)
<b>DIODES</b>		
D201, 202, 303, 305, 501, 502, 503, 504, 505, 506, 508, 509, 510, 512, 513, 514, 515, 516, 518, 519	5631-1S2473	1S2473
D301/302	5633-KV1226	KV1226Y
D304	5635-RD4R7EB	Zener, RD4.7EB
D401, 507	5635-RD5R1EB1	Zener, RD5.1EB1
D511	5635-RD5R6EB1	Zener, RD5.6EB1
D517	5636-1SS81	1SS81
D801, 802	5632-1SR35-20	1SR35-20
D803, 804	5635-RD15EB3	Zener, RD15EB3
<b>COILS</b>		
L201, 202	5995-100325	
L302	5923-70927	
L303	5995-1R0325	
L304	5995-103256	
<b>TRANSFORMERS</b>		
T201	5574-7014	
T301	5552-7028	
T302	5932-70213	
<b>MISCELLANEOUS</b>		
L401	6114-7122	FM Tuner Assembly
CF201, 202	5214-8	LC Components
CF203	5671-7120A	Ceramic Filter
CF301	5671-7119A	Ceramic Filter
CF302	5671-7138F	Ceramic Filter
P201, 202, 301	5671-7137C	Ceramic Filter
P501	4443-020158	Connector, 2-Pin
P502	4443-110158	Connector, 11-Pin
	4443-030158	Connector, 3-Pin
	2132-7049	Spacer, R801

Ref. No.	Part No.	Description
<b>PCB-2 CONTROL P.C. BOARD</b>		
	<b>RESISTOR</b>	
R809	5102-4R75715	4.7Ω, ±5%, 1/4W, Fuse
	<b>CAPACITORS</b>	
C510	5345-106-16	10μF, +50% -10%, 16V, Electrolytic
C612, 615, 653, 658	5345-105-50	1μF, +75% -10%, 50V, Electrolytic
C614	5345-L474M50	0.47μF, ±20%, 50V, Electrolytic
C651, 652, 659, 660	5345-L334M50	0.33μF, ±20%, 50V, Electrolytic
C655	5345-476-10	47μF, +50% -10%, 10V, Electrolytic
C657	5345-L225M50	2.2μF, ±20%, 50V, Electrolytic
C701	5345-228-10	2200μF, +50% -10%, 10V, Electrolytic
C808	5345-477-50	470μF, +50% -10%, 50V, Electrolytic
C811	5345-228-25	2200μF, +50% -10%, 25V, Electrolytic
C812	5345-107-10	100μF, +50% -10%, 10V, Electrolytic
C813	5345-227-10	220μF, +50% -10%, 10V, Electrolytic
C814	5345-477-10	470μF, +50% -10%, 10V, Electrolytic
C815	5350-4730H651	0.047μF, +80% -20%, 5V, Special
C818	5345-227D0211	220μF, ±20%, 25V, Electrolytic
	<b>INTEGRATED CIRCUITS</b>	
IC501	5652-AN6875	AN6875
IC601	5654-μPB553AC	μPB553AC
IC602	5654-1703C016	μPD1703C-016
IC603	5654-μPD4035C	μPD4035C
IC604	5654-M74LS145	M74LS145
IC651, 652, 653	5654-μPD4001C	μPD4001C
	<b>TRANSISTORS</b>	
Q601	5613-2320L(F)or(G)	2SC2320L(F) or 2SC2320L(G)
Q602	5616-2SK68(M)	F.E.T., 2SK68(M)
Q603, 651, 652, 653, 654, 655, 656, 706, 707, 708, 709, 710, 711, 713, 714, 715, 716	5613-2603(E)or(F)	2SC2603(E) or 2SC2603(F)
Q701, 702, 703, 704, 705	5611-830(B)	2SA830(B)
Q712	5614-571(K)or(L)	2SD571(K) or 2SD571(L)
Q804	5616-2SK163(M)	F.E.T., 2SK163(M)
Q805	5613-1419(C)or(D)	2SC1419(C) or 2SC1419(D)
	<b>DIODES</b>	
D601, 602, 603, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 810	5631-1S2473	1S2473
D663	5635-RD4R7EB1	Zener, RD4.7EB
D701, 805, 806, 807	5632-1SR35-20	1SR35-20
D808	5635-HZ27-3	Zener, HZ27-3
D809	5635-RD6R8EB1	Zener, RD6.8EB1
	<b>COIL</b>	
L601	5995-101325	100μH
	<b>MISCELLANEOUS</b>	
X601	5691-00450019	Crystal Osc.
SW2, 3, 4	4431-03067950	Push Switch, Function Selector
SW601, 602	4431-02047959	Push Switch, Tuning Mode, Scan Stop
P601, 701	4443-070177	Connector, 7-Pin
P602	4443-100177	Connector, 10-Pin
P702	4443-090177	Connector, 9-Pin
	2132-7049	Spacer, D808, D809

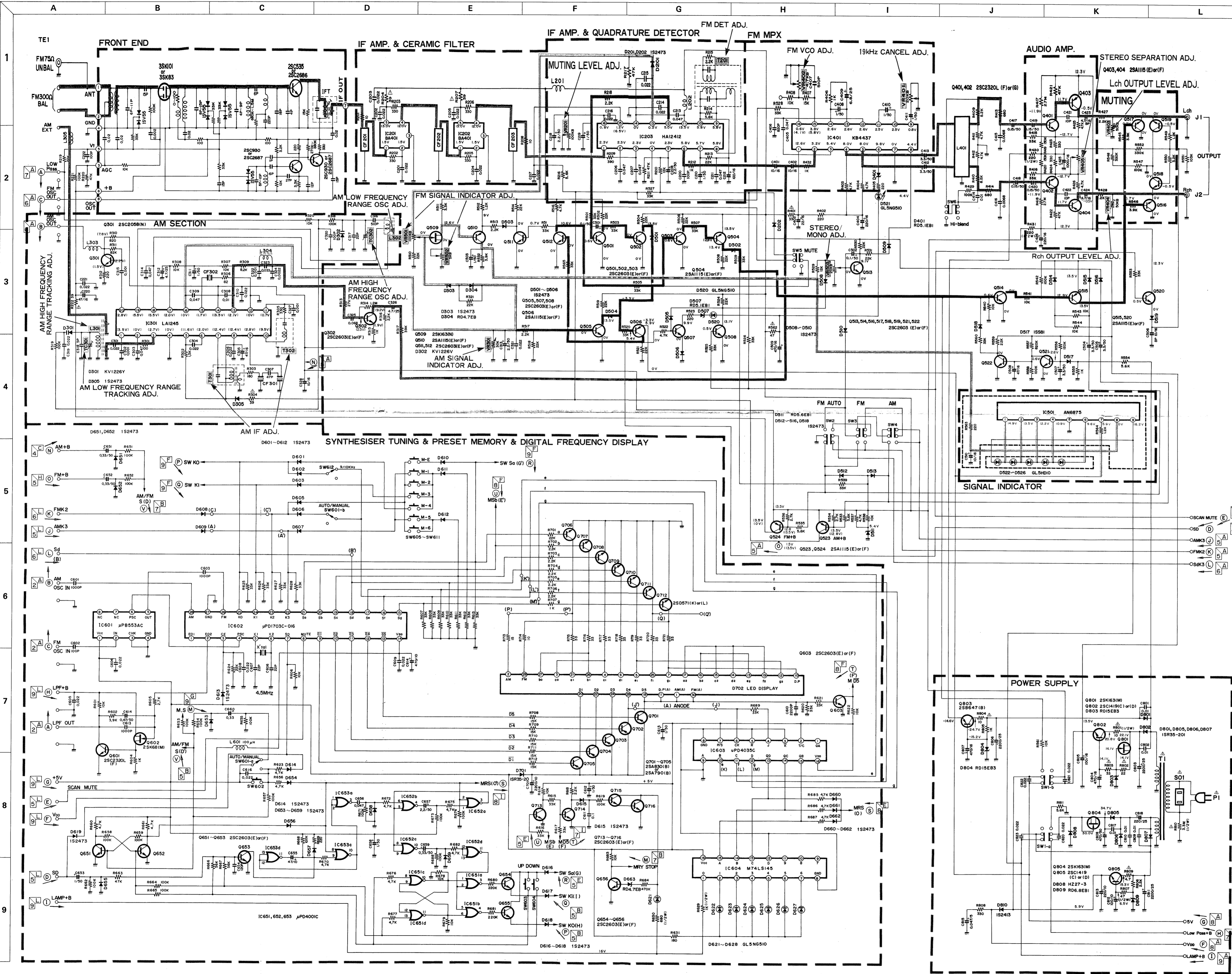


Ref. No.	Part No.	Description
<b>PCB-3 HIGH BLEND/MUTING SWITCH P.C. BOARD</b>		
SW5, 6	4431-02047859	Push Switch, High Blend, Muting
<b>PCB-4 POWER SWITCH P.C. BOARD</b>		
SW1	4431-A047112	Push Switch, Power
<b>PCB-5 TUNING SWITCH P.C. BOARD</b>		
SW603, 604	4431-A01719	Push Switch, Tuning Up, Tuning Down
<b>PCB-6 QZ. LOCK/FM ST. INDICATORS P.C. BOARD</b>		
D520, 521	5637-5NG510(B)or(C) 2132-7016	L.E.D., GL5NG510(B) or GL5NG510(C) Spacer, L.E.D.
<b>PCB-7 LEVEL METER P.C. BOARD</b>		
D522, 523, 524, 525, 526	5637-GL5HD10 2132-7016	L.E.D., GL5HD10 Spacer, L.E.D.
<b>PCB-8 MEMORY P.C. BOARD</b>		
D621, 622, 623, 624, 625, 626, 627	5637-5NG510(B)or(C)	L.E.D., GL5NG510(B) or GL5NG510(C)
SW605, 606, 607, 608, 609, 610, 611	4431-A01719	Push Switch, Preset Memory
<b>PCB-9 STATION DISPLAY P.C. BOARD</b>		
D702	5623-SL2613 2133-7019	LED Display Assembly, SL2613 Protector, LED Display

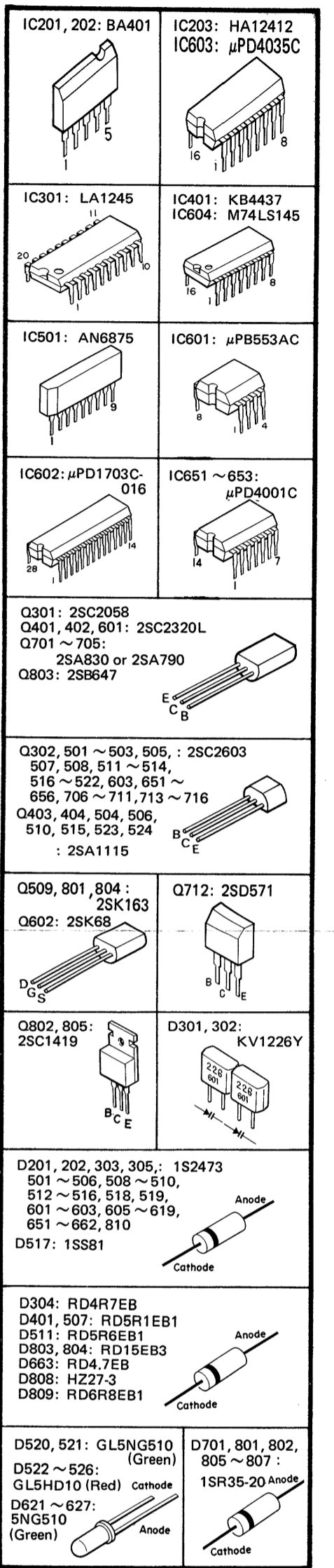
# PACKAGE



SCHEMATIC DIAGRAM



PIN CONNECTION DIAGRAM OF TRANSISTORS, DIODES AND ICs.



— SIGNAL ROUTE  
 - - - MUTING CONTROL  
 ... SIGNAL INDICATOR DRIVE

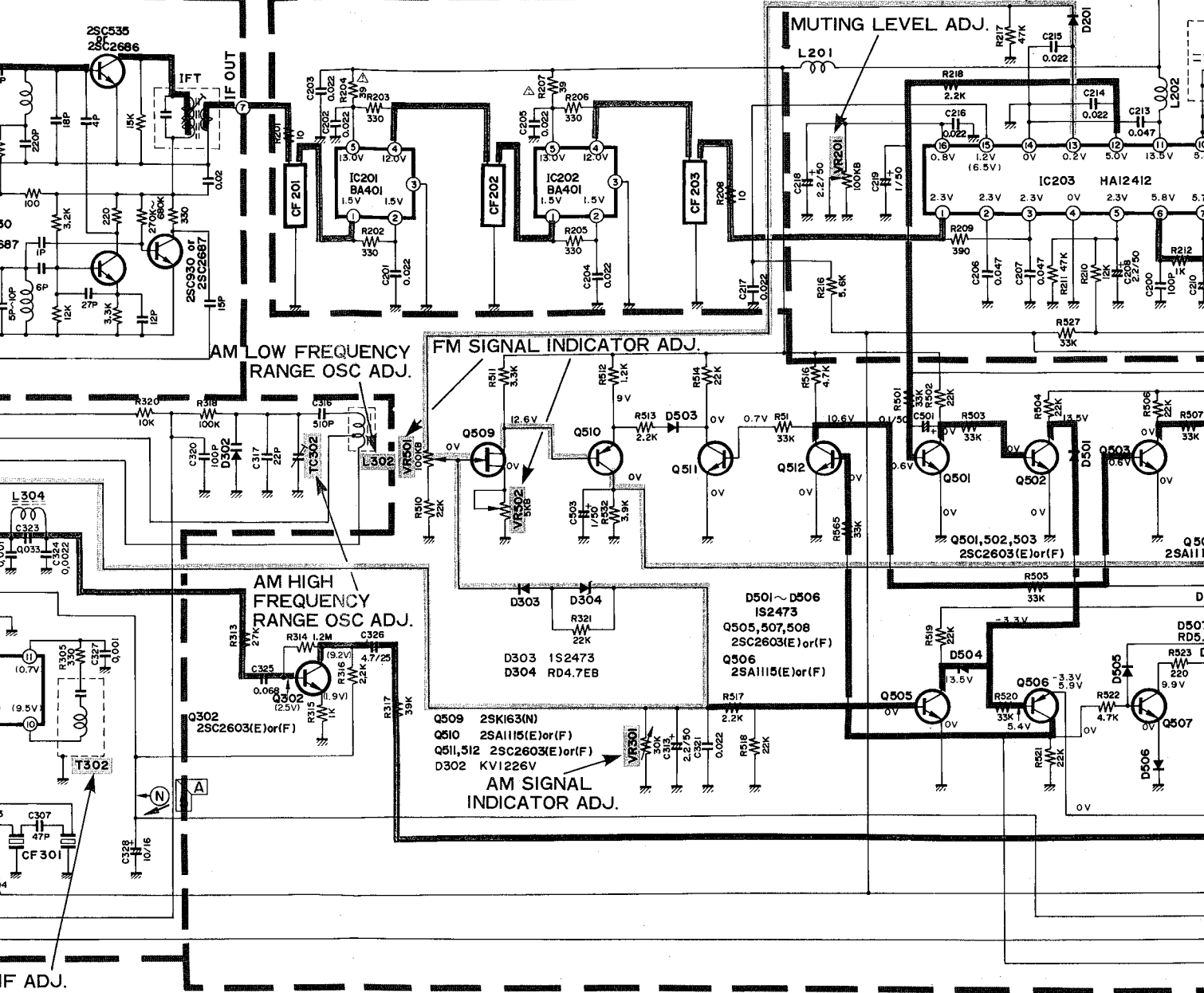
- ALL RESISTANCES ARE 1/4 WATTS, UNLESS OTHERWISE NOTED, VALUES ARE IN OHM, K = 1000Ω, M = 1000Ω.
- ALL CAPACITANCE VALUES ARE IN μF, UNLESS OTHERWISE SPECIFIED. P = μμF
- FUNCTION SWITCHES ARE SHOWN IN FM AUTO POSITION.
- V : DC VOLTAGE AT NO SIGNAL.  
 V FM AUTO POSITION (L, V) AM POSITION.
- SAFETY REQUIREMENTS COMPONENTS IN ACCORDANCE WITH PRESET SAFETY REGULATIONS' THESE COMPONENTS MUST ONLY BE REPLACED BY ORIGINAL PARTS.



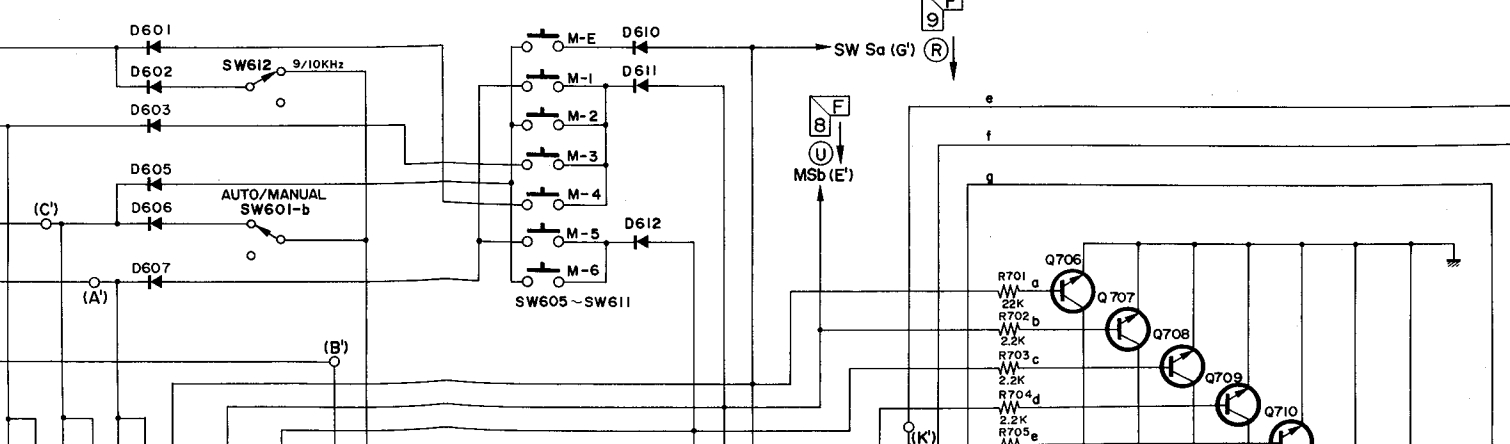
C D E F G

### IF AMP. & CERAMIC FILTER

### IF AMP. & QUADRATURE DETECTOR



### SYNTHESISER TUNING & PRESET MEMORY & DIGITAL FREQUENCY DISPLAY



TEMPERATURE DETECTOR

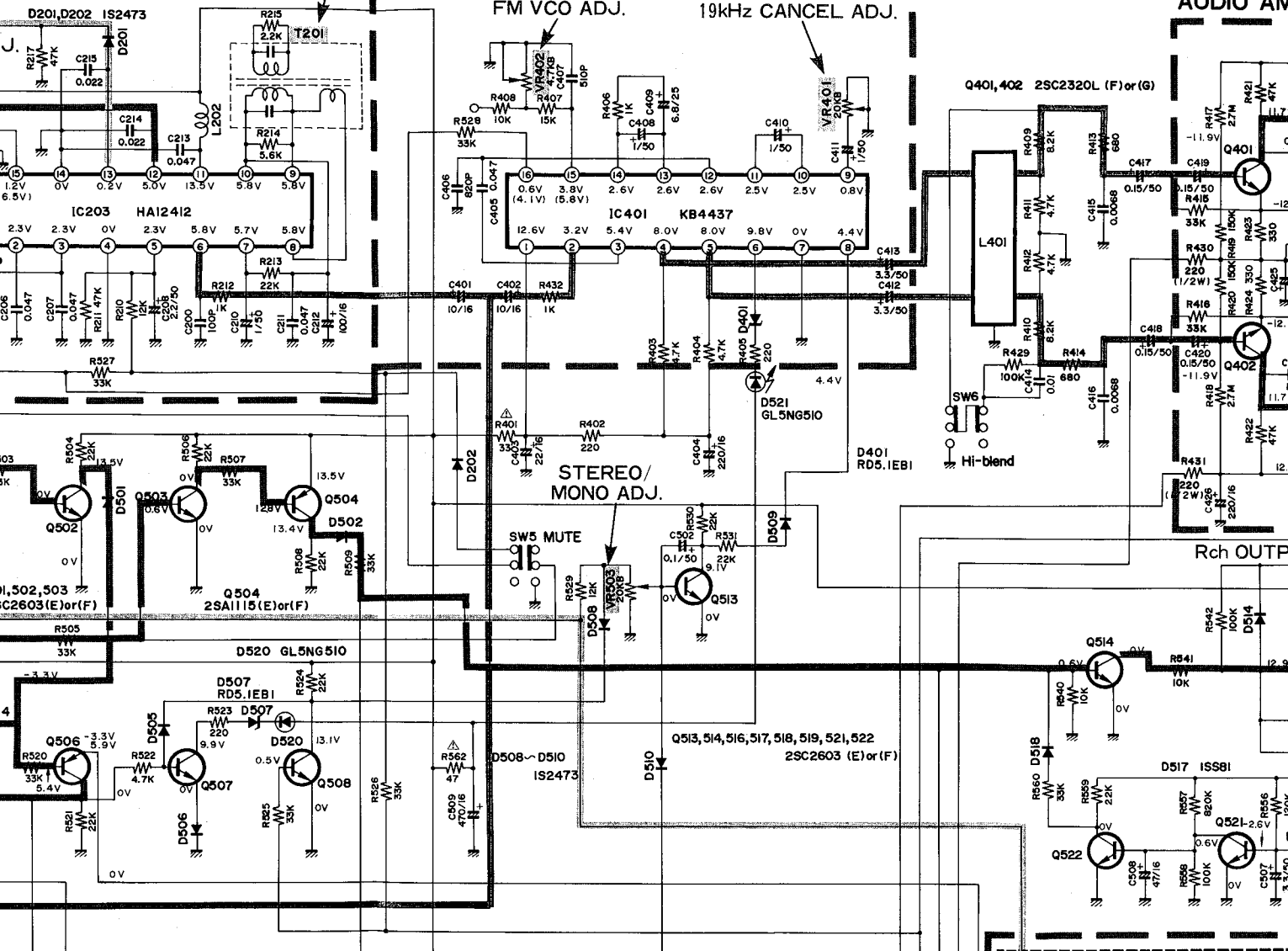
FM DET ADJ.

FM MPX

FM VCO ADJ.

19kHz CANCEL ADJ.

AUDIO AMP



STEREO/MONO ADJ.

SW5 MUTE

SW6 Hi-blend

Rch OUTP

DISPLAY

FM AUTO FM AM

D511 RD5.6EB1 D512~516, D518

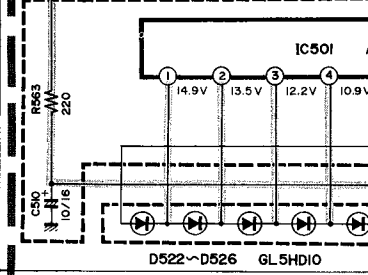
IS2473 SW2 SW3 SW4

D512 D513 R559 33K

13.5V R536 27K R535 5.6K

Q524 FM+B Q523 AM+B

13.5V (13.5V) 1.5V (13.5V) Q523, Q524 2SA1115 (E) or (F)



SIGNAL INDICATOR



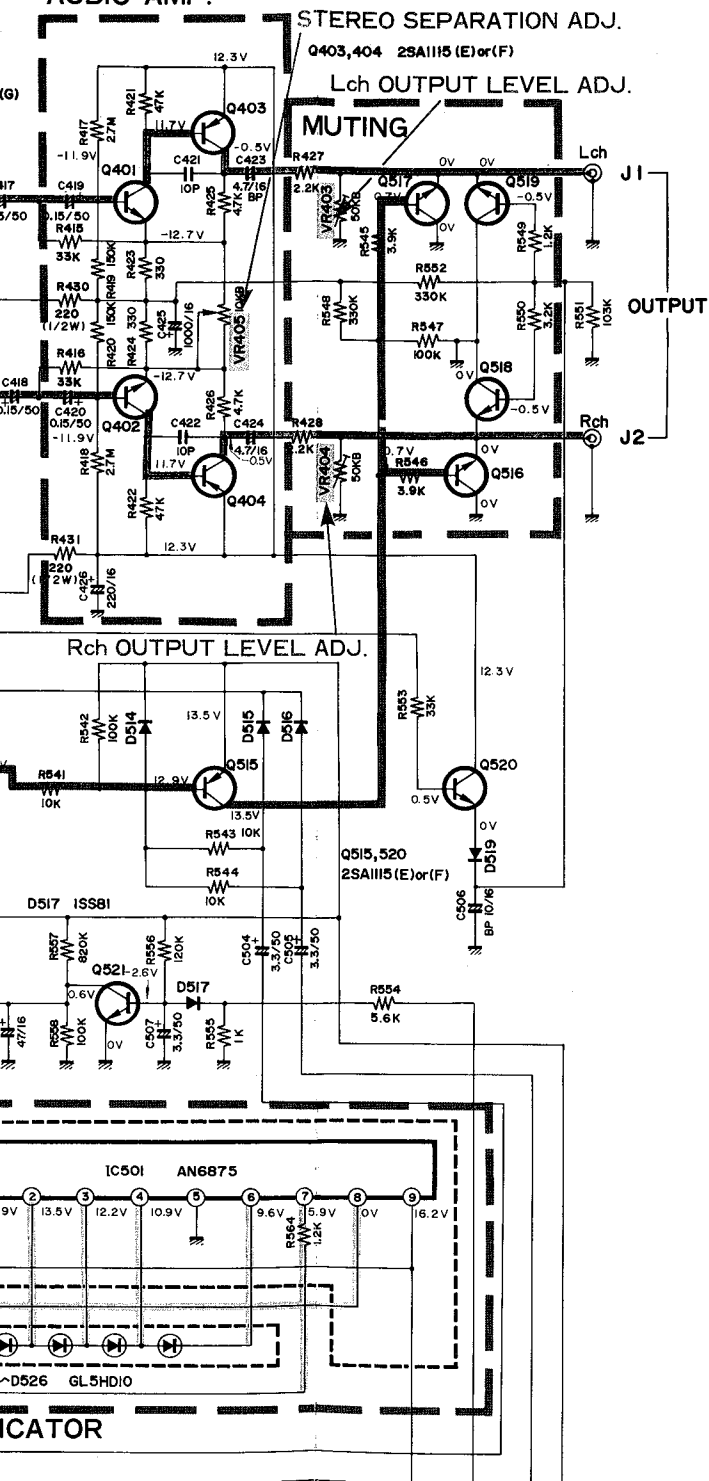
K

L

M

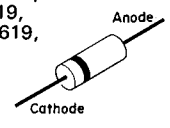
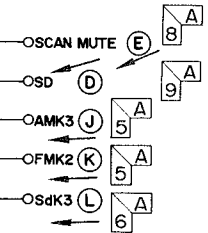
N

AUDIO AMP.



PIN CONNECTION DIAGRAM OF TRANSISTORS, DIODES AND ICs.

<p>IC201, 202: BA401</p>	<p>IC203: HA12412 IC603: μPD4035C</p>
<p>IC301: LA1245</p>	<p>IC401: KB4437 IC604: M74LS145</p>
<p>IC501: AN6875</p>	<p>IC601: μPB553AC</p>
<p>IC602: μPD1703C-016</p>	<p>IC651 ~ 653: μPD4001C</p>
<p>Q301: 2SC2058 Q401, 402, 601: 2SC2320L Q701 ~ 705: 2SA830 or 2SA790 Q803: 2SB647</p>	
<p>Q302, 501 ~ 503, 505, : 2SC2603 507 ~ 508, 511 ~ 514, 516 ~ 522, 603, 651 ~ 656, 706 ~ 711, 713 ~ 716 Q403, 404, 504, 506, 510, 515, 523, 524 : 2SA1115</p>	
<p>Q509, 801, 804 : 2SK163 Q602: 2SK68</p>	<p>Q712: 2SD571</p>
<p>Q802, 805: 2SC1419</p>	<p>D301, 302: KV1226Y</p>
<p>D201, 202, 303, 305,: 1S2473 501 ~ 506, 508 ~ 510, 512 ~ 516, 518, 519, 601 ~ 603, 605 ~ 619, 651 ~ 662, 810 D517: 1SS81</p>	
<p>D304: RD4R7EB D401, 507: RD5R1EB1 D511: RD5R6EB1 D803, 804: RD15EB3</p>	



D651, D652 1S2473

AM IF ADJ.

D601~D612 1S2473

SYNTHESISER TUNING & I

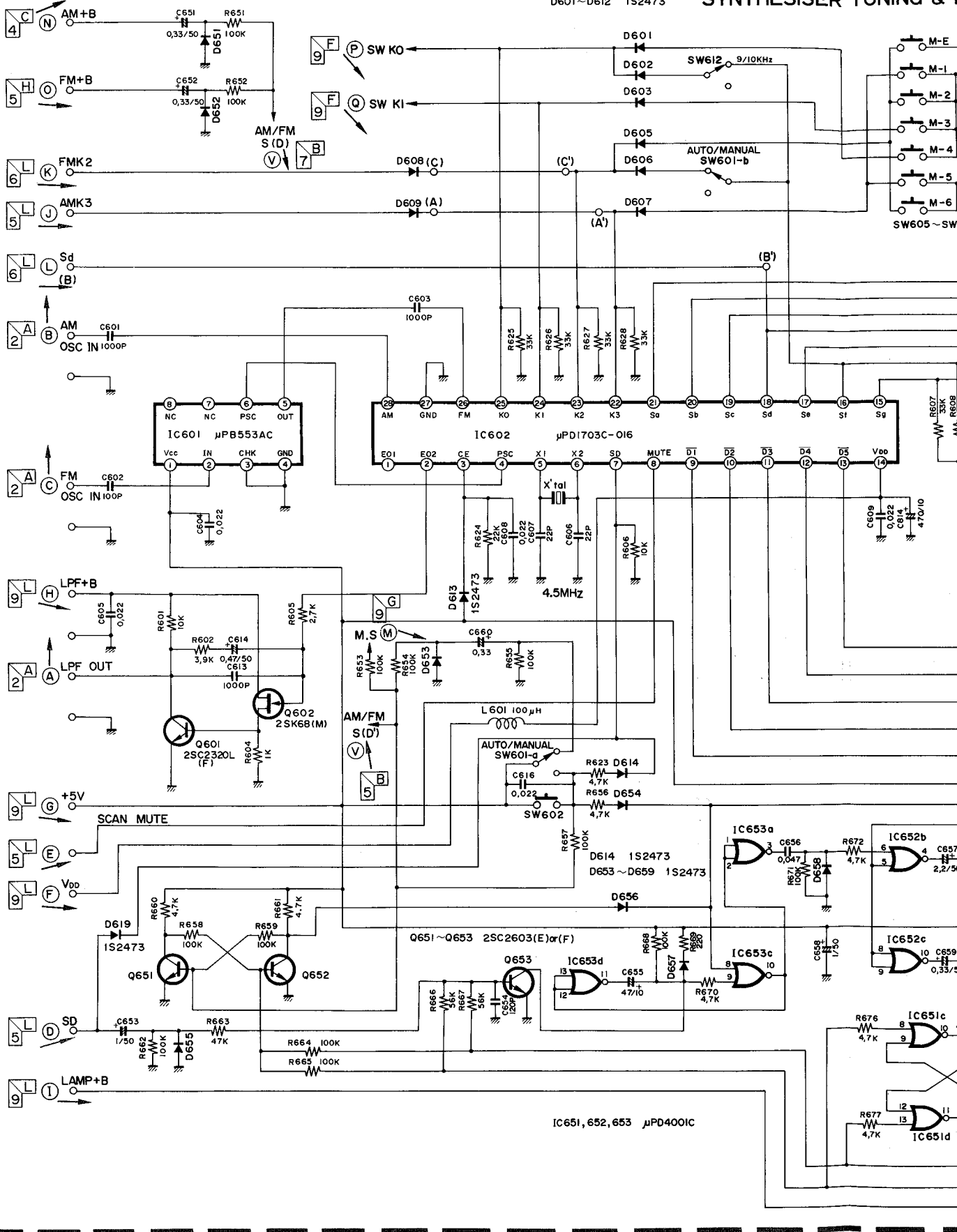
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6

7

8

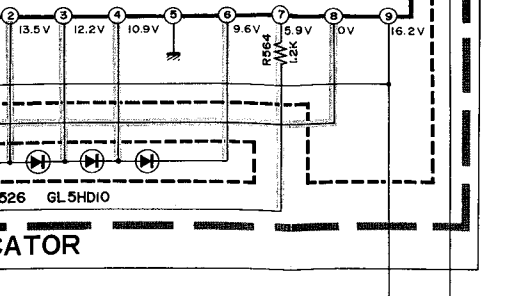
9



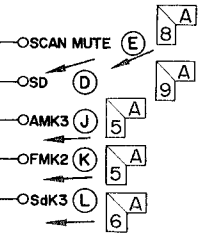




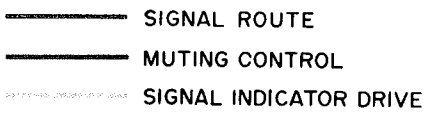
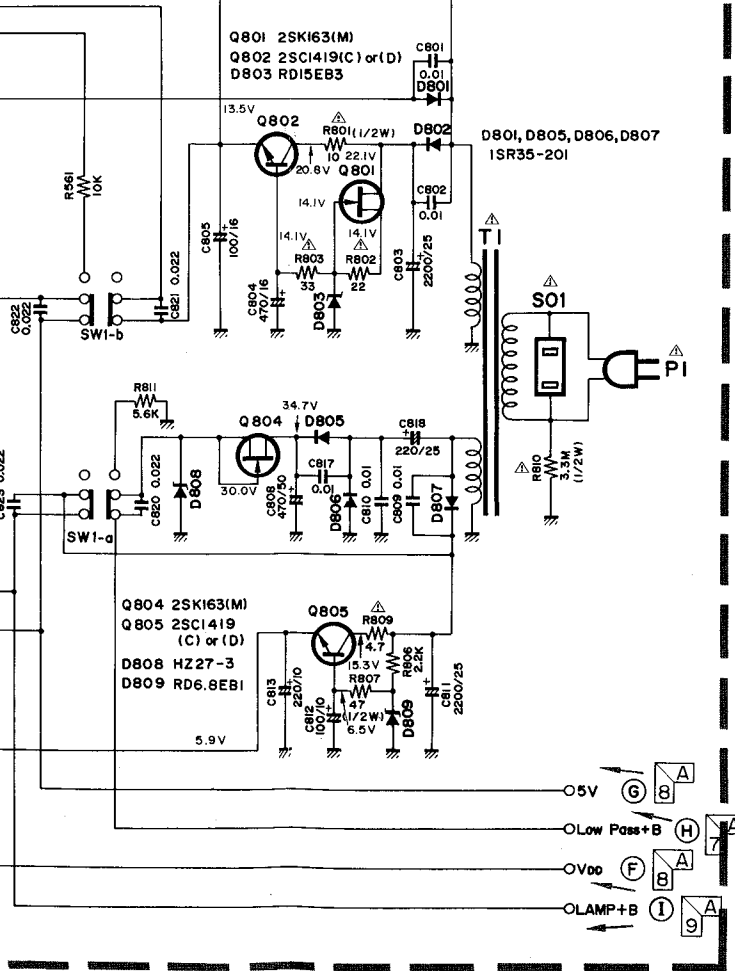




ATOR



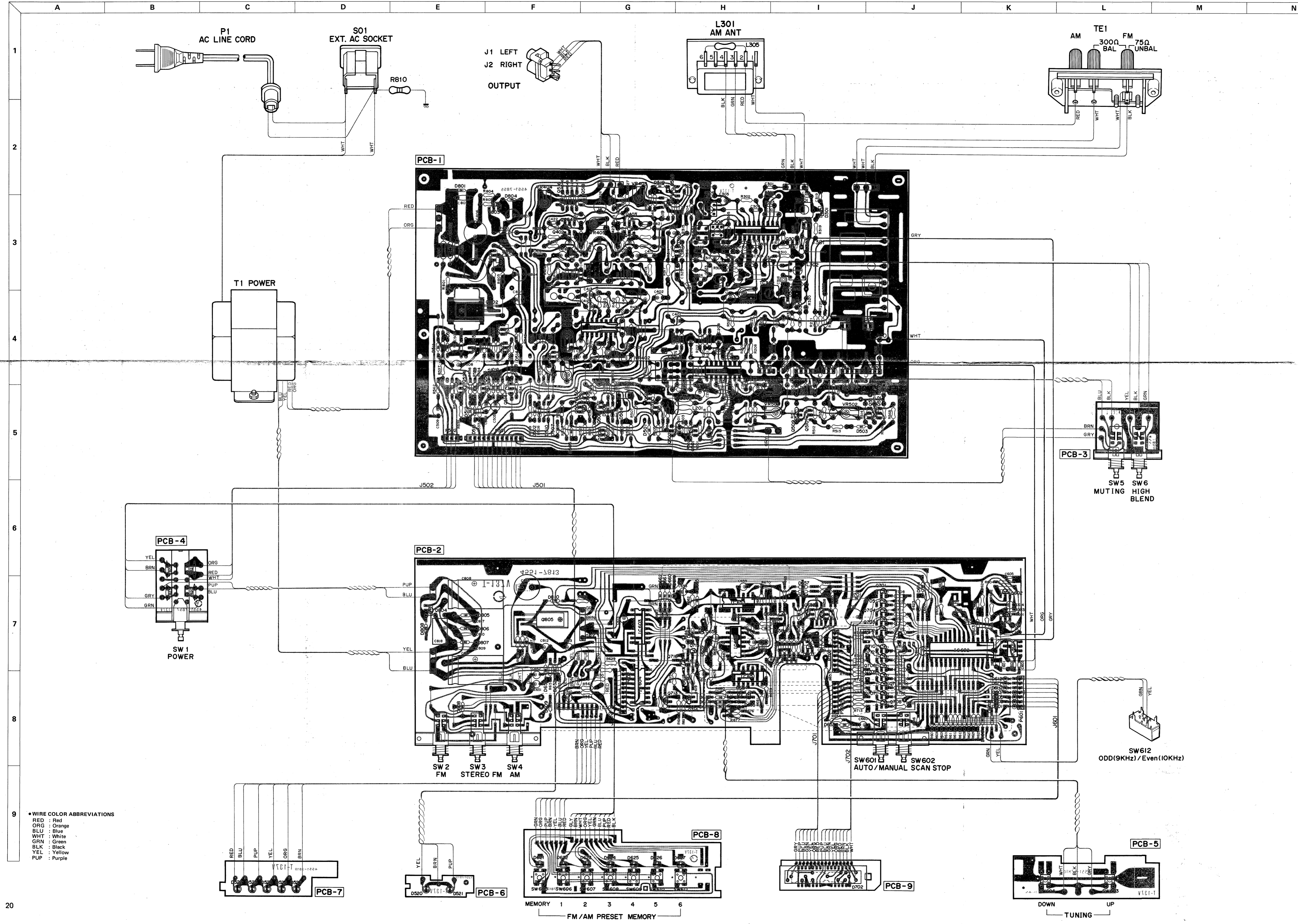
POWER SUPPLY



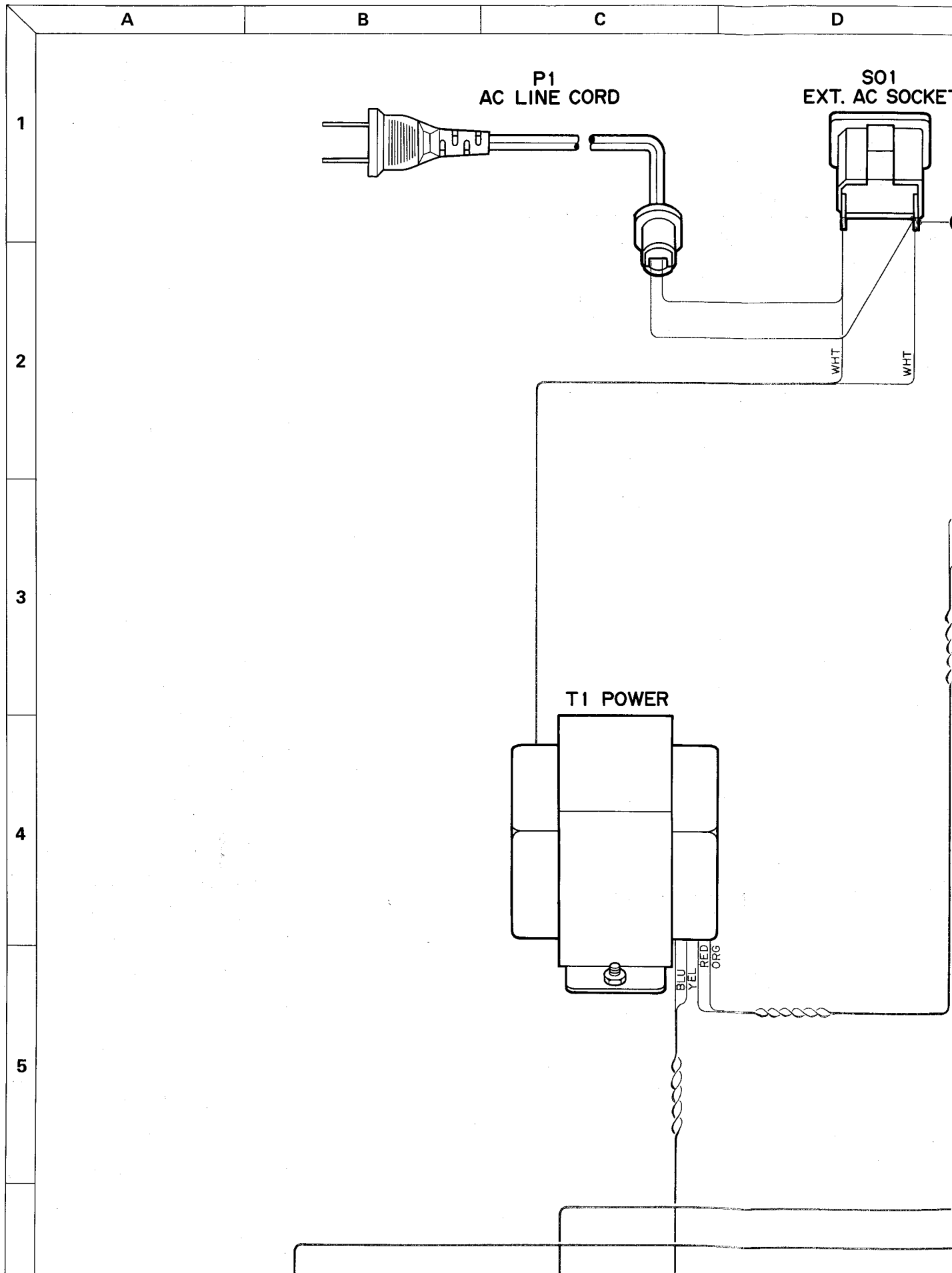
1. ALL RESISTANCES ARE 1/4 WATTS, UNLESS OTHERWISE NOTED, VALUES ARE IN OHM. K = 1000Ω, M = 1000kΩ
2. ALL CAPACITANCE VALUES ARE IN μF, UNLESS OTHERWISE SPECIFIED. P = μμF
3. FUNCTION SWITCHES ARE SHOWN IN FM AUTO POSITION.
4. V : DC VOLTAGE AT NO SIGNAL  
... V FM AUTO POSITION (... V) AM POSITION.
5. SAFETY-REQUIREMENTS COMPONENTS IN ACCORDANCE WITH PRESET SAFETY REGULATIONS' THESE COMPONENTS MUST ONLY BE REPLACED BY ORIGINAL PARTS.

<p>Q802, 805: 2SC1419</p>	<p>D301, 302: KV1226Y</p>
<p>D201, 202, 303, 305.: 1S2473 501 ~ 506, 508 ~ 510, 512 ~ 516, 518, 519, 601 ~ 603, 605 ~ 619, 651 ~ 662, 810</p> <p>D517: 1SS81</p>	
<p>D304: RD4R7EB D401, 507: RD5R1EB1 D511: RD5R6EB1 D803, 804: RD15EB3 D663: RD4.7EB D808: HZ27-3 D809: RD6R8EB1</p>	
<p>D520, 521: GL5NG510 (Green) D522 ~ 526: GL5HD10 (Red) Cathode D621 ~ 627: 5NG510 (Green)</p>	<p>D701, 801, 802, 805 ~ 807 : 1SR35-20 Anode</p>

WIRING DIAGRAM



WIRING DIAGRAM





E

F

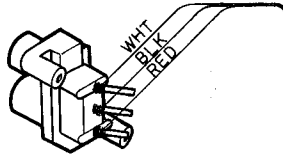
G

H

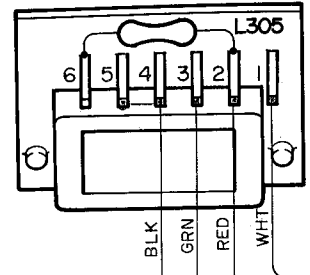
KEY

R810

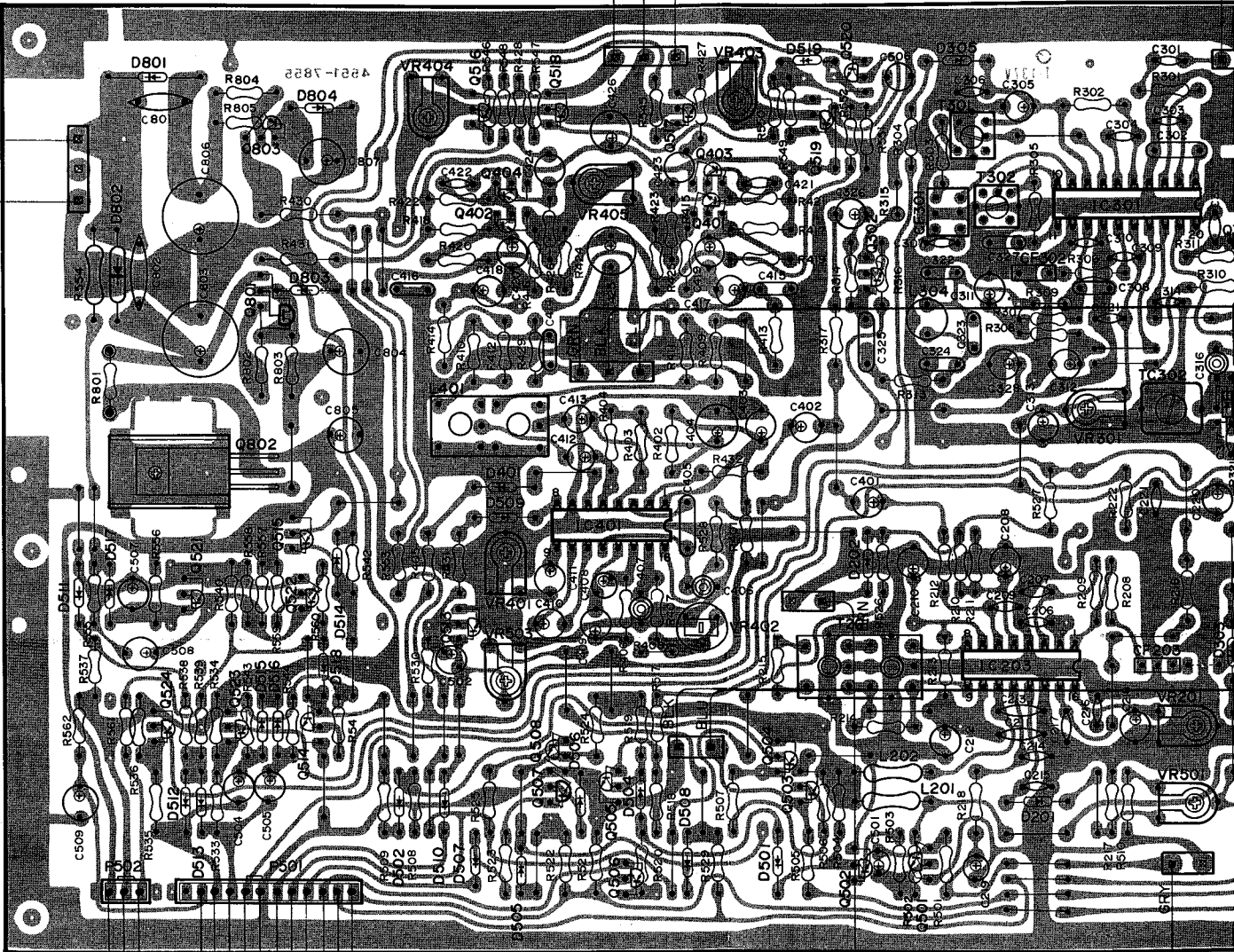
J1 LEFT  
J2 RIGHT  
OUTPUT



L301  
AM ANT



PCB-1



WHT

BLK

RED

GRN

RED

ORG

J502

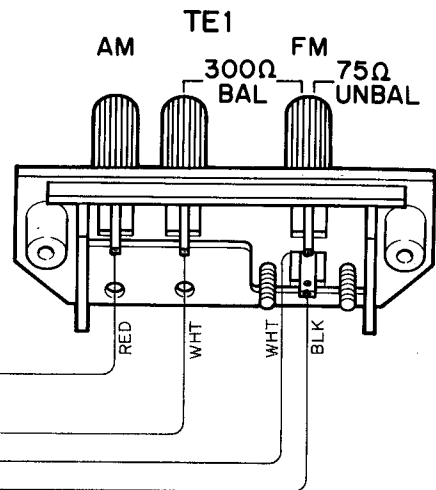
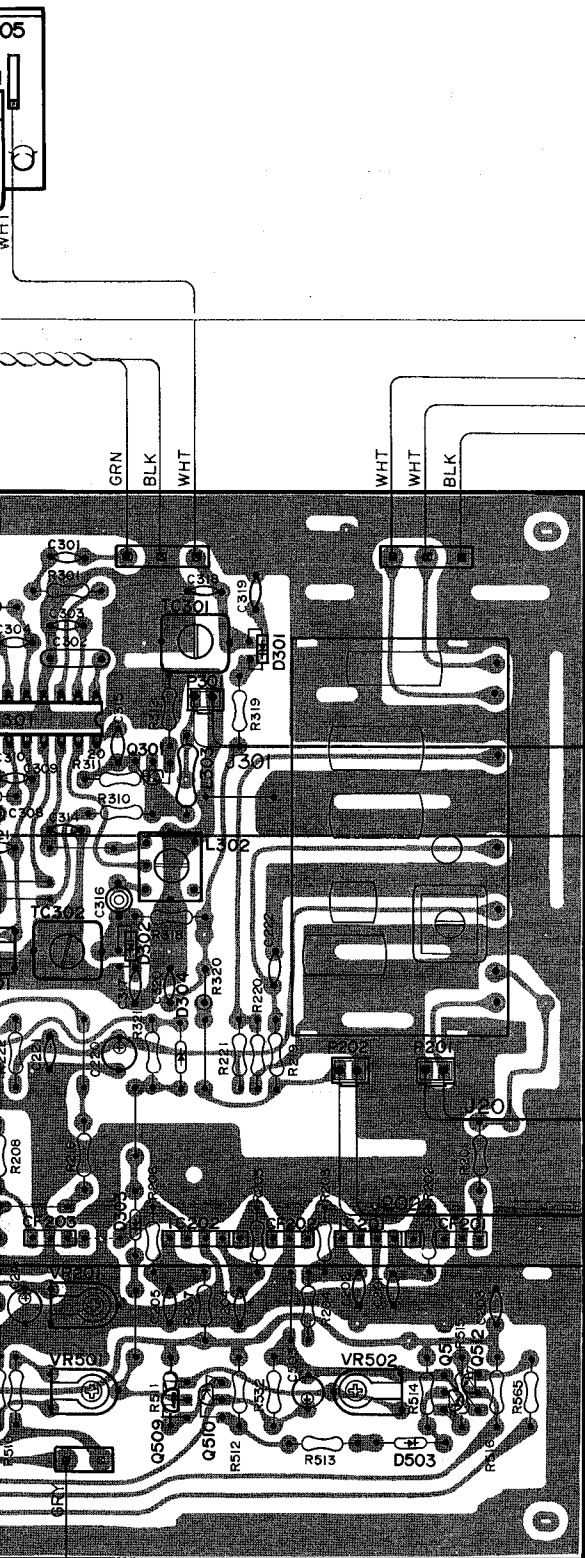
J501

I

J

K

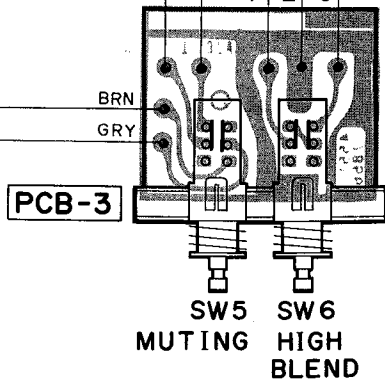
L



GRY

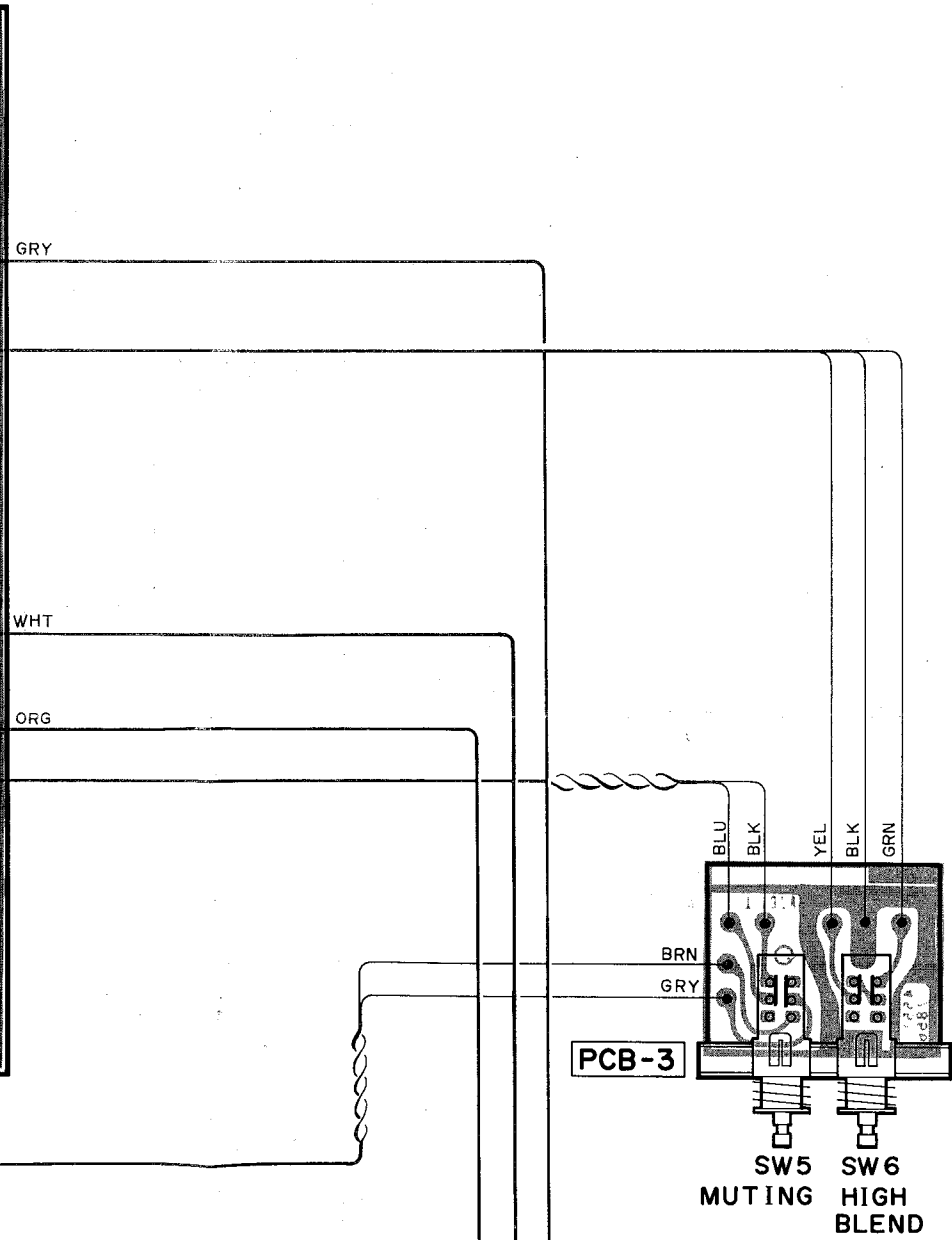
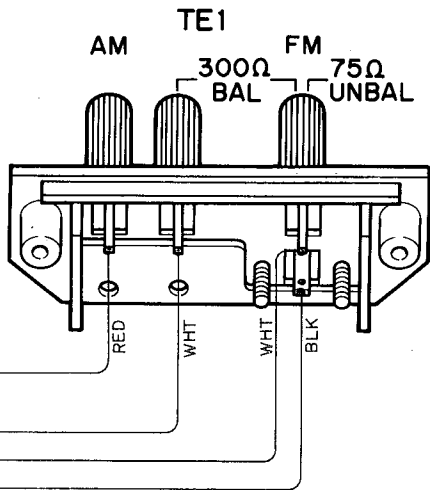
WHT

ORG



SW5  
MUTING

SW6  
HIGH BLEND





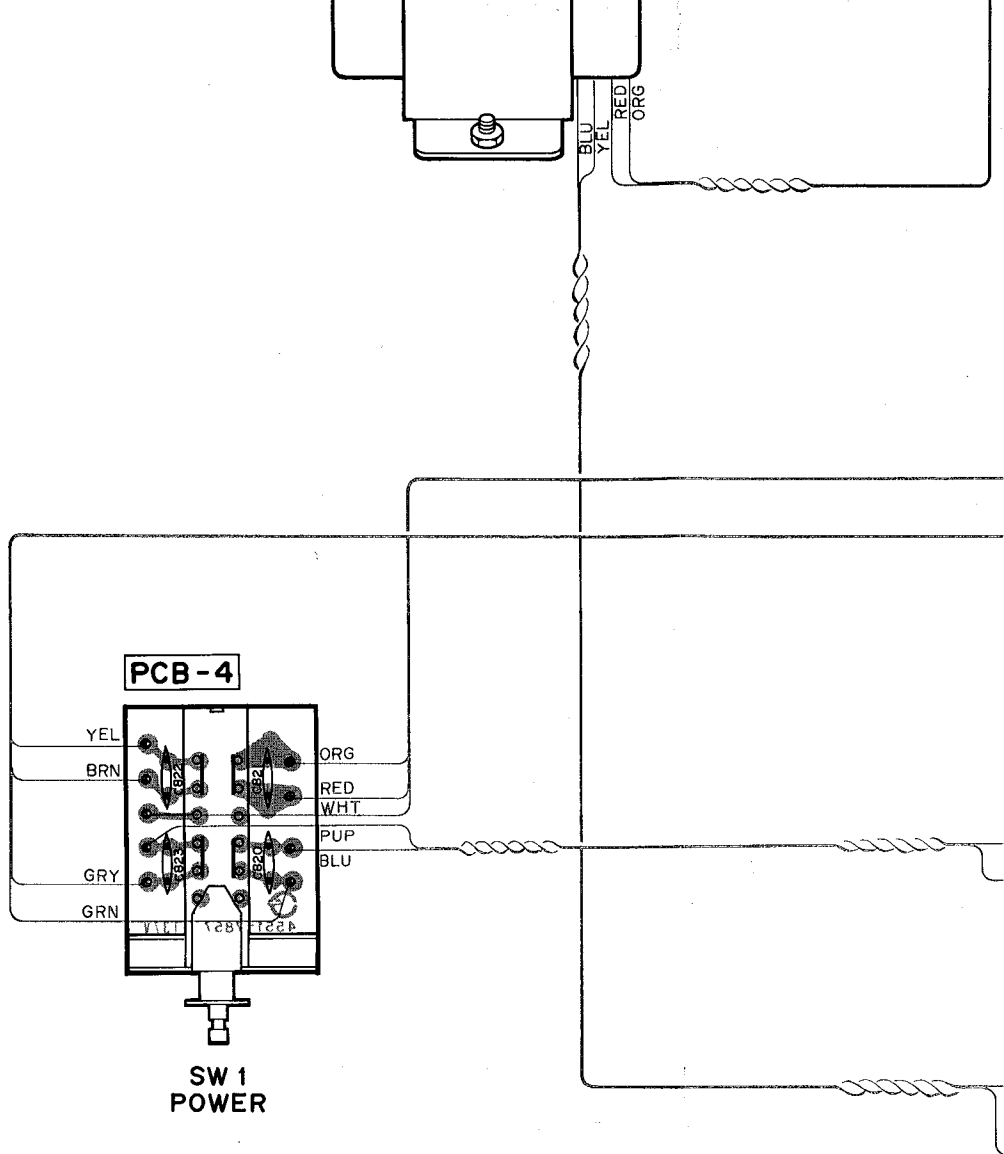
5

6

7

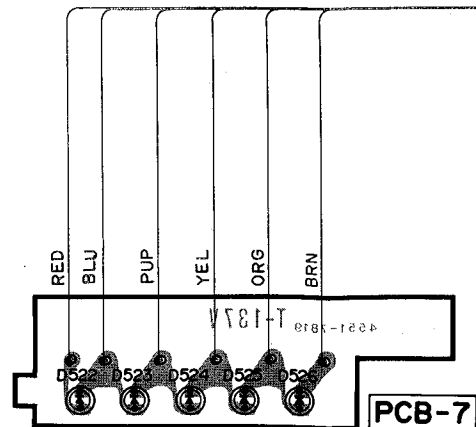
8

9

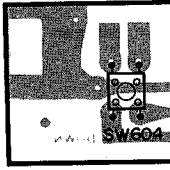
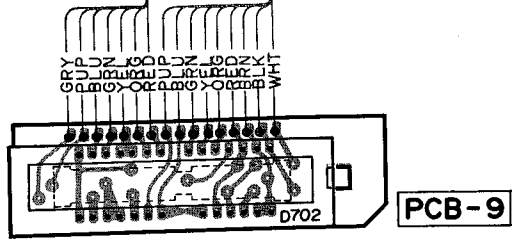
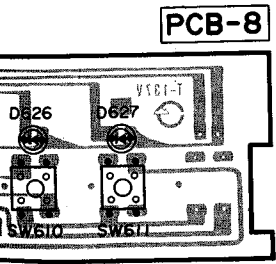
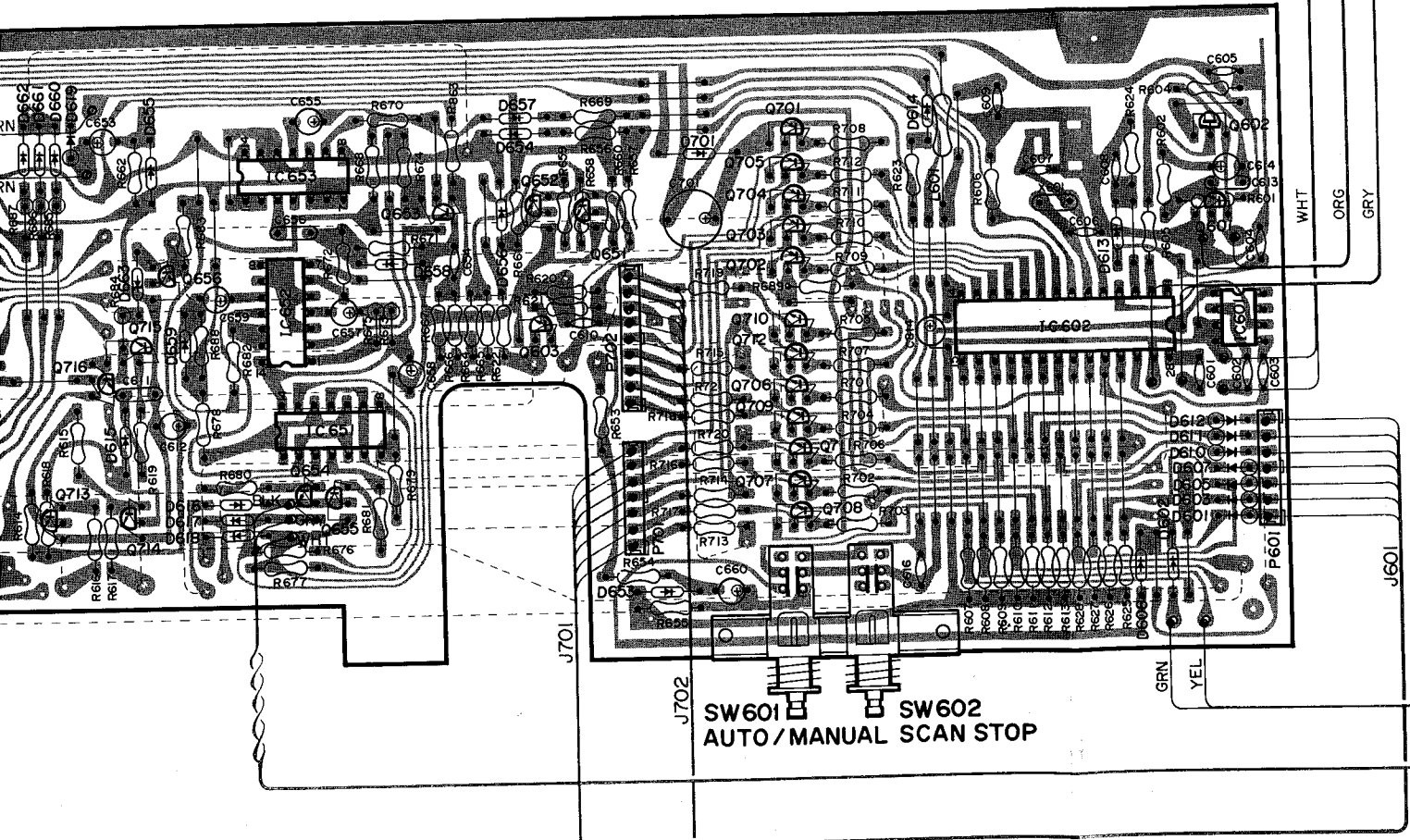
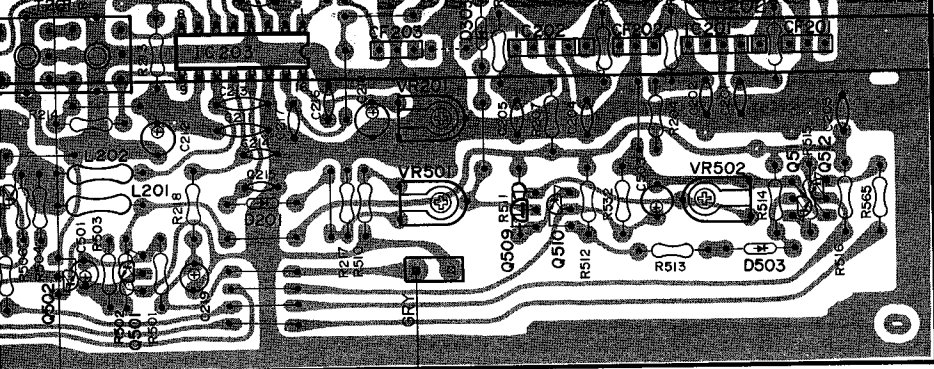


• WIRE COLOR ABBREVIATIONS

- RED : Red
- ORG : Orange
- BLU : Blue
- WHT : White
- GRN : Green
- BLK : Black
- YEL : Yellow
- PUP : Purple

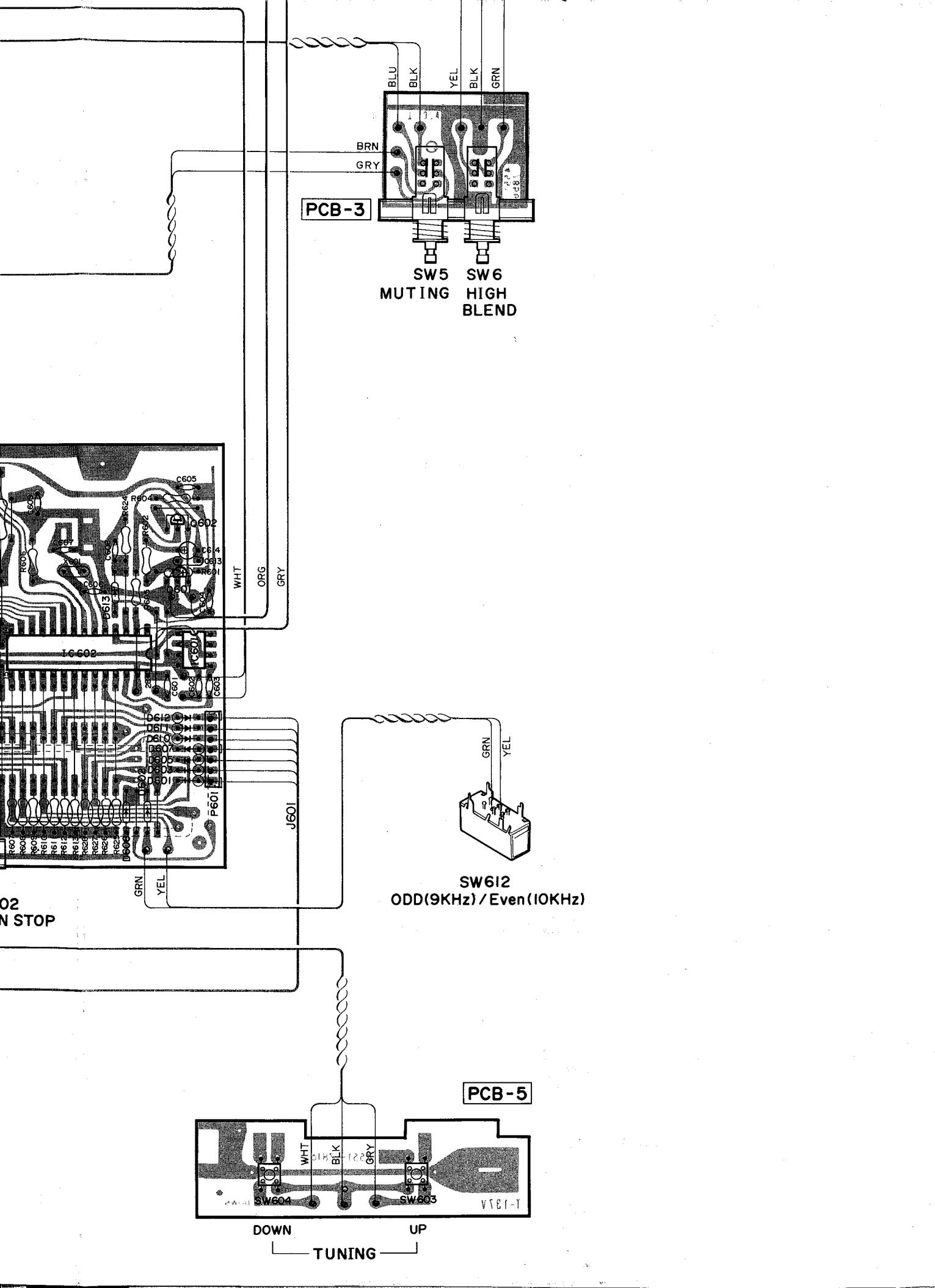






5 6  
RY

DOWN



PCB-3

SW5  
MUTING

SW6  
HIGH BLEND

02  
N STOP

SW612  
ODD(9KHz) / Even(10KHz)

PCB-5

DOWN

UP

TUNING

