Service Manual

Quartz Synthesizer
FM STEREO TUNER

F-28

MC-Service

PIONEER

MODEL F-28 COMES IN TWO VERSIONS DISTINGUISHED AS FOLLOWS:

Type	Voltage	Remarks
KU	120V only	U.S.A. model
S/G	110V, 120V, 220V, 240V (Switchable)	U.S. Military model

This service manual is applicable to the KU type. When repairing the S/G type, please see the additional service manual (P.53 to P.67).

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1. SPECIFICATIONS

Semiconductors

ICs 21
FETs 10
Transistors 63
Diodes 56

FM Tuner Section

Unsable Sensitivity	MONO;	10.3dBf (1.8μV)	
50dB Quieting Sensitivity . .	MONO;	14.1dBf (2.8μV)	
	STEREO;	36dBf (35μV)	
Signal-to-Noise Ratio			
at 85dBf	MONO;	84dB	
	STEREO;	81dB	
Distortion at 65dBf		MONO	STEREO
WIDE:	100Hz;	0.05%	0.06%
	1kHz;	0.04%	0.05%
	6kHz;	0.06%	0.05%
NARROW:	1kHz;	0.08%	0.15%

Stereo Separation (WIDE)
1kHz 55dB
20Hz to 15kHz 40dB
Frequency Response . . . . . 20Hz to 15kHz $^{+0.1}_{-0.3}$dB
Capture Ratio . . . . . WIDE; 0.8dB
NARROW; 1.5dB
Alternate Channel
Selectivity . . . . . WIDE; 35dB (400kHz)
NARROW; 65dB (300kHz)
More than 80dB (400kHz)
Spurious Response Ratio . . 120dB
Image Response Ratio 120dB
IF Response Ratio 120dB
AM Suppression Ratio
at 65dBf 65dB
Subcarrier Product Ratio . . 75dB
SCA Rejection Ratio 65dB
Muting Threshold 19.2dBf (5μV)
Antenna Input . . . . . 300-ohms balanced
75-ohms unbalanced
75-ohms coaxial ("F" type connector)

Audio Section

Output terminal (Level/Impedance)
(100% Mod.) . . . . . FIXED; 650mV/2.2kΩ
VARIABLE; 50mV to 1.3V/3.0kΩ

Miscellaneous

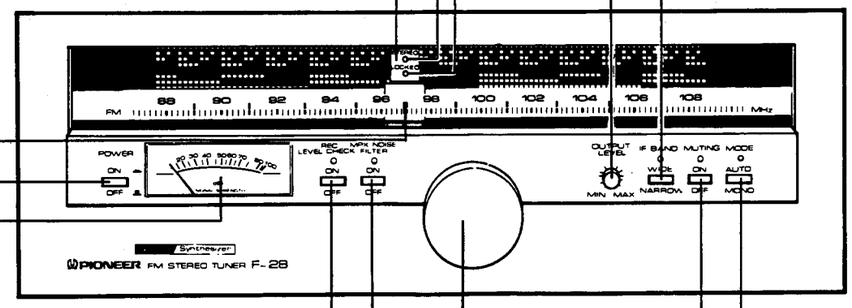
Power Requirements 120V 60Hz
Power Consumption 25W
Dimensions . . . . . 420(W) x 156(H) x 376(D) mm
16-9/16(W) x 6-1/8(H) x 14-13/16(D)" in
Weight: Without package . . . . . 9.0kg (19 lb 13 oz)
With package . . . . . 10.1kg (22 lb 4 oz)

Furnished Parts

FM T-type Antenna 1
Connection Cord with Pin Plugs 1
Hex. Wrench 1
F type Plug (RG59U only) 1
Operating Instructions 1

NOTE:
Specifications and the design subject to possible modification without notice.

2. FRONT PANEL FACILITIES



POINTER

As with ordinary pointers, this pointer will move along the dial scale when the tuning knob is rotated and the desired station selected. The pointer is provided with a built-in STEREO indicator, LOCKED indicator and station indicator, and it also self-contains the code pattern readout mechanism.

LOCKED INDICATOR

This indicator will light up when the pointer reaches the optimum tuning position for a broadcasting station. It indicates that the frequency of the broadcasting station has been locked by the actuation of the built-in quartz lock synthesizer.

STEREO INDICATOR

This indicator lights up when the tuner is receiving a stereo program if the MODE switch is set to AUTO.

STATION INDICATOR

This indicator lights up every 200kHz as the pointer moves when the tuning knob is rotated.

POWER SWITCH

Use this switch to turn the power to the tuner on and off. Push the switch and the power will come on. The dial scale and the meter will also light up.
As soon as the POWER switch is set to ON, the IF BAND, MUTING and MODE switches are set to WIDE, ON and AUTO, respectively.

SIGNAL METER

This meter indicates the strength of the antenna input field level of the broadcast signals in dBf units. The pointer will deflect more to the right as the input level increases. When tuning in a station, the meter pointer will deflect to the far right and it will then stop at that place where the station indicator lights up.

REC LEVEL CHECK SWITCH

When this switch is set to ON, and the indicator lights up 330Hz signals (a level which is equivalent to 50% FM modulation) are made continuously available. Use this switch to set the recording level of the tape deck.

MPX NOISE FILTER SWITCH

Set this switch to ON (and the indicator lights up) while you are listening to a program if you are bothered by relatively high frequency noise.

TUNING KNOB

Use this knob to tune in the FM stations. Watch the SIGNAL meter pointer, rotate the tuning knob and select a station.

OUTPUT LEVEL KNOB

This knob is used to adjust the output level of the VARIABLE (OUTPUT) jacks. When it is rotated in the direction of MAX, the output level is increased.

IF BAND SWITCH

This switch is used to select between WIDE (wide band) and NARROW (narrow band). In this way, it is possible to change over the pass bandwidth of the intermediate frequency signals.
This switch is set to WIDE as soon as the POWER switch is set to ON, and the indicator lights up.
If the switch is already set to WIDE and there is interference from neighboring broadcasting stations, push it lightly and set it to NARROW. The indicator will go off and the switch will be set to NARROW.

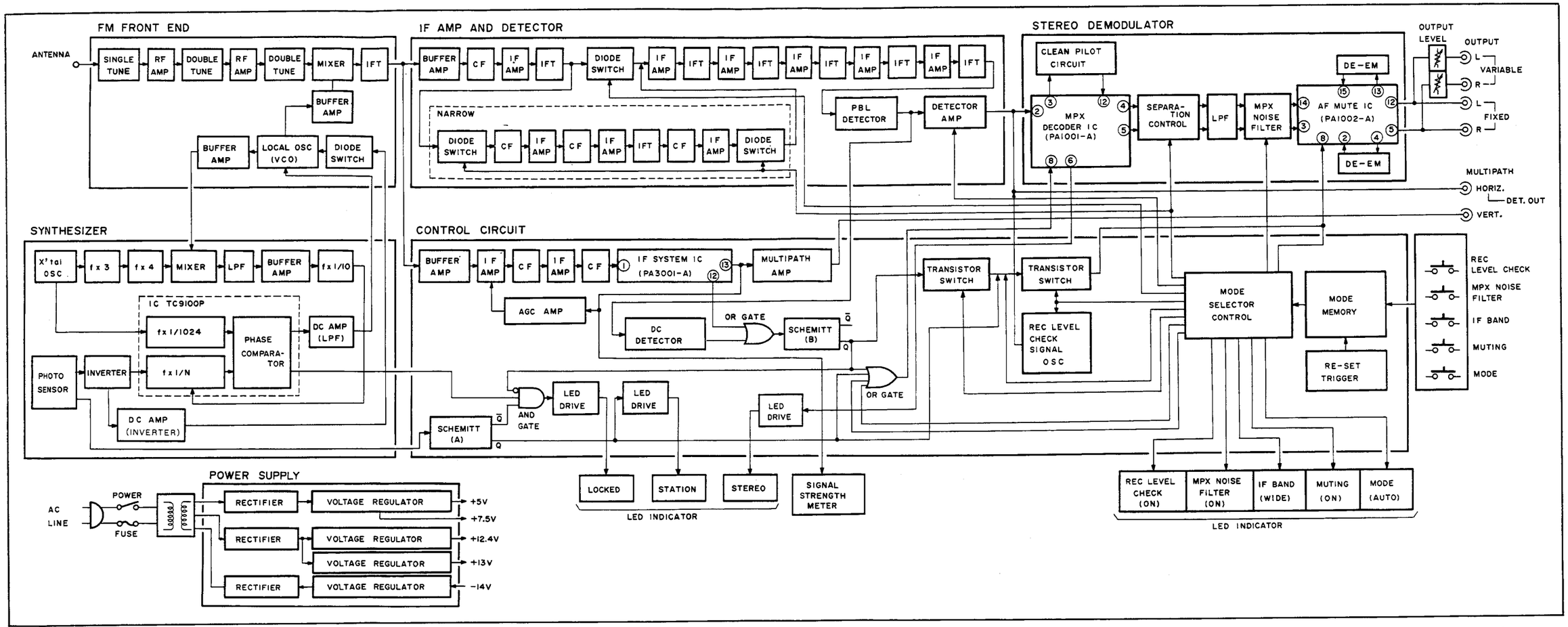
MODE SWITCH

This switch is set to AUTO as soon as the POWER switch is set to ON, and the indicator lights up. Keep this switch at this position when receiving FM programs in stereo.

MUTING SWITCH

This switch is set to ON as soon as the POWER switch is set to ON, and the indicator lights up. There will now be no unpleasant interstation noise heard when selecting stations. Set this switch to OFF by pushing it lightly in areas where the signals are extremely weak.

3. BLOCK DIAGRAM



4. CIRCUIT DESCRIPTIONS

4.1 SIGNAL CIRCUIT

FM Front End

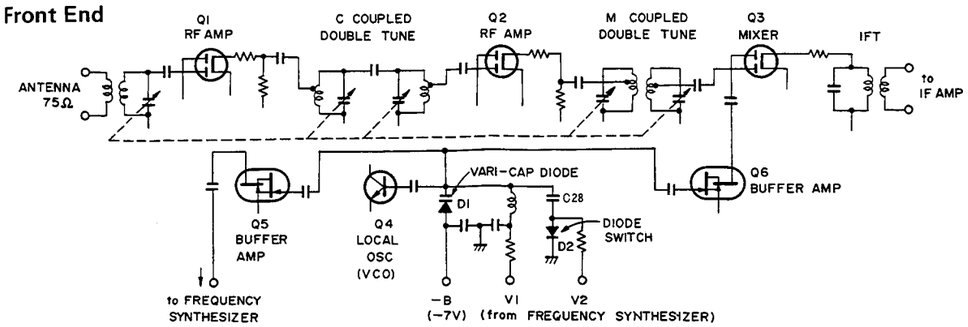


Fig. 1 FM front end

The FM front end of this tuner employs a 5 ganged frequency linear type tuning capacitor in the RF circuit and a vari-cap diode in the local oscillator circuit. The circuit is shown in Fig. 1.

The antenna input is unbalanced (75Ω), feeding into an M-coupled single tuned circuit. Dual gate MOS FETs (Q_1, Q_2) having excellent high frequency characteristics are employed as amplifying elements in the RF stage, while both C-coupled and M-coupled double tuned circuits are employed between stages, making for excellent reception performance, particularly in respect to phase and interference rejection characteristics. A dual gate MOS FET (Q_3) is also employed at the mixer stage, thus minimizing the influence of strong signals on the local oscillator. The local oscillator has a VCO (Voltage Controlled Oscillator) circuit containing a vari-cap diode (D_1) instead of a tuning capacitor. The frequency of oscillation is controlled by the voltage obtained from a PLL synthesizer circuit (Refer to page 8). D_2 in the local oscillator is a diode switch. When receiving frequencies in the range 87.5MHz to 99.3MHz, this diode switch is turned on and C_{28} (7pF) is connected in parallel with the vari-cap

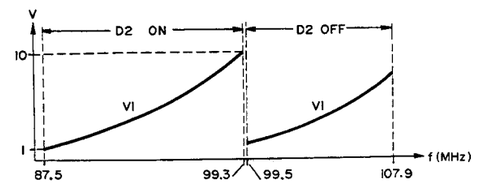


Fig. 2

diode, thus reducing the tuning capacity of the vari-cap diode and thereby stabilizing the tuning operating (For details of the control of D_2, refer to the PLL synthesizer circuit on page 8.). Fig. 2 shows the relation-ship between the input carrier frequency and the control voltage of the vari-cap diode.

IF Amp

This tuner employs a dual IF amplifier consisting of a wide band IF amplifier designed for high separation, low distortion reproduction, and a narrow band IF amplifier used for rejection of interference signals (Fig. 3).

The wide band IF amplifier has been designed with the minimum number of frequency selective elements, with emphasis being placed on linear phase characteristics. The narrow band IF amplifier, on the other hand, has been designed with emphasis on selectivity. When the selector switch is in the wide position, the signal path is FM front end → Q_1 → F_1 → Q_2 → T_1 → D_3 → D_4 → IF limiter, while in the narrow position it is FM front end → Q_1 → F_1 → Q_2 → T_1 → narrow IF amplifier → IF limiter. The changeover between wide and narrow is performed of diode switches (D_1 to D_6). When the selector switch is in the wide position, D_3 and D_4 are biased in the forward direction and D_1, D_5 and D_6 are biased in the reverse direction, thus bypassing the narrow IF amplifier. When the selector switch is in the narrow position, D_1, D_5 and D_6 are forward biased and D_3 and D_4 are reverse biased (For details of control of the diode switches, refer to the key switch circuit on Page 14).

Parallel Balanced Linear Detector (P.B.L.D.)

This detection circuit is a distributed constant type (line) detector. Whereas, common line detectors use a delay line in a series resonant circuit, the P.B.L. detector uses a coil and capacitor equivalent to the distributed constants of a delay line (Fig. 4). As a result, a detection bandwidth of ±3MHz and a linear region of ±500kHz have been achieved. Moreover, since the drive amp (M5109PR) consists of two differential amps connected in parallel, detection efficiency is high and an S/N of 92dB or greater is guaranteed at the detector.

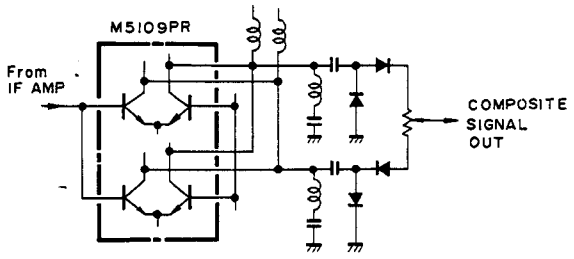


Fig. 4 P.B.L. detector

Multiplex Decoder

An IC (PA1001-AG) and clean pilot circuit developed by Pioneer are used in the stereo demodulation circuit. PA1001-AG contains a PLL system VCO (Voltage Controlled Oscillator), NFB demodulator, automatic pilot canceller, and stereo/mono automatic switch. The NFB demodulator and automatic pilot canceller are special features of this IC. The NFB demodulator suppresses distortion caused by the non-linearity of the demodulation circuit. The automatic pilot canceller cancels the pilot signal (19kHz) in the stereo demodulation signal. This circuit cancels the pilot signal (19kHz) in the stereo demodulated signal by applying the 19kHz from the VCO synchronized with the pilot signal (19kHz) in the composite signal to the stereo demodulated signal thru an AGC amp. Moreover, since the cancel signal level tracks the input pilot signal level by means of the AGC amp, the rejection ratio remains the same even with changes in input pilot signal level.

The clean pilot circuit extracts the pilot signal from the composite signal and applies it to the PLL system (Fig. 5). Since the composite signal is applied directly to the PLL system in a common stereo demodulation circuit, beat interference is applied to the VCO by the audio signal in the composite signal and the PLL lock state is disturbed.

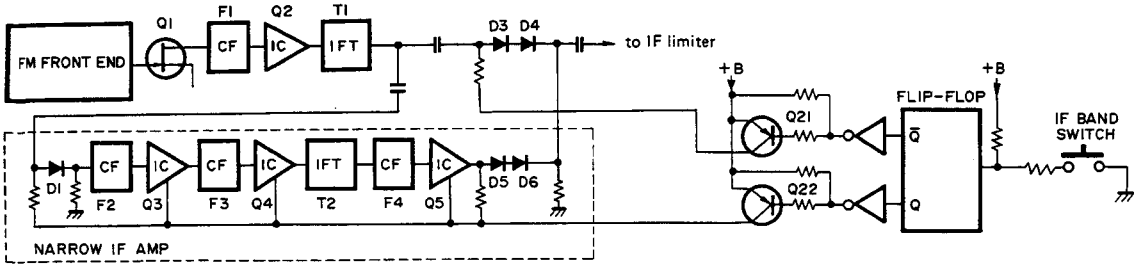


Fig. 3 IF amp

As a result, beat distortion and jitter appear in the stereo demodulated signal. The clean pilot circuit is provided to eliminate this phenomena. This circuit extracts the pilot signal by maximizing the gain at 19kHz by reducing the negative feedback at 19kHz by means of the series resonant circuit consisting of C_{15} and T_1.

A 2-stage direct-coupled linear amp is provided at the output of PA1001-AG for separation control.

A 3-pole LPF having a No. 1 attenuation pole at 23kHz is used to remove the subcarrier signal (23kHz—53kHz).

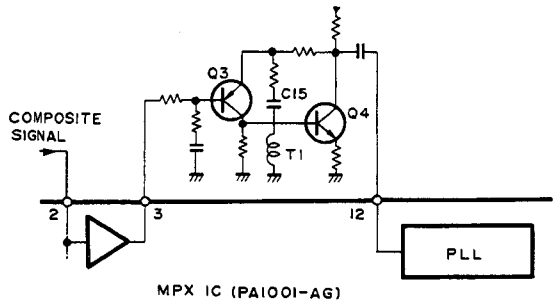


Fig. 5 Clean pilot circuit

Output Amplifier

An AF MUTE IC (PA1002-A) is employed in the final stage of the tuner. This IC contains two AF amplifiers for L and R channels, together with a muting gate circuit. These AF amplifiers employ time constant NFB to provide de-emphasis characteristics. The muting gate circuit is electrically connected to the signal circuit when a DC voltage is applied to Pin 8 of the PA1002-A (Refer to muting control on Page 12.).

4.2 PLL SYNTHESIZER CIRCUIT

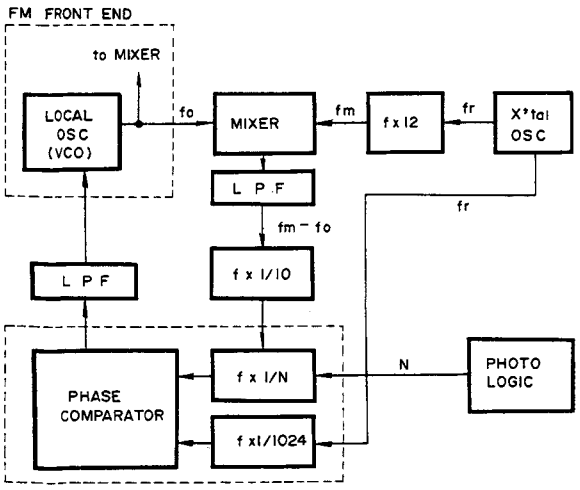


Fig. 6 Block diagram of PLL synthesizer circuit

A photo-logic type quartz PLL synthesizer circuit is used to control the frequency of the local oscillator in the FM front end. The synthesizer detects the position of the dial pointer in the form of a 7-bit binary code, and uses this to determine the frequency of the local oscillator. As a result, there is absolutely no graduation error.

Fig. 6 shows the block diagram of the PLL synthesizer circuit. The subsequent description is based on this block diagram.

Photo-sensor

The photo sensor reads off a 7-bit binary code corresponding to the frequency of the received carrier from a code plate mounted behind the graduation plate on the dial (Fig. 8). The binary code is a binary representation of the frequency division ratio N which corresponds to the frequency of the received carrier, and is printed on the code plate (Fig. 7).

Fig. 9 shows the circuit of the photo-sensor. The code plate is read off using eight photo-transistors. The code plate is located between the lamp and the photo-transistors. Thus, the light illuminates the photo-transistors at the transparent parts of the code plate, while at the opaque parts the light is cut off. Photo-transistors which receive light from the lamp will be turned on, while those which do not receive light will be turned off. In this way, the code printed on the code plate will be read off and converted into an electrical signal. The output of each photo-transistor is then passed through an inverter and fed into a programmable counter (Refer to following section "PLL Synthesizer".).

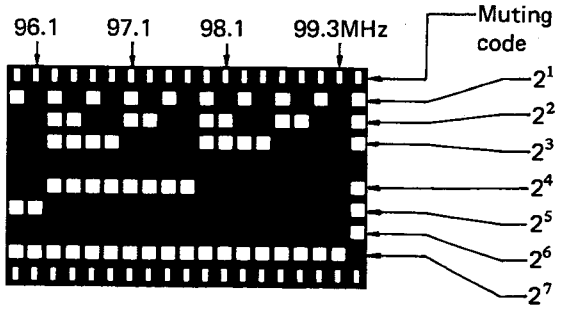


Fig. 7 Code pattern plate

• *Reference signal frequency: 10.2325MHz*

Input carrier frequency (MHz)	Local oscillator frequency (MHz)	Frequency division ratio N	Binary code						
			2^1	2^2	2^3	2^4	2^5	2^6	2^7
			2	4	8	16	32	64	128
87.5	98.2080	246	1	1	0	1	1	1	1
87.7	98.4079	244	0	1	0	1	1	1	1
87.9	98.6077	242	1	0	0	1	1	1	1
88.1	98.8076	240	0	0	0	1	1	1	1
90.1	100.8061	220	0	1	1	1	0	1	1
98.1	108.8003	140	0	1	1	0	0	0	1
100.1	110.7988	120	0	0	1	1	1	1	0
107.1	117.7938	50	1	0	0	1	1	0	0
107.3	117.9935	48	0	0	0	1	1	0	0
107.5	118.1934	46	1	1	1	0	1	0	0
107.7	118.3932	44	0	1	1	0	1	0	0
107.9	118.5931	42	1	0	1	0	1	0	0

Table 1

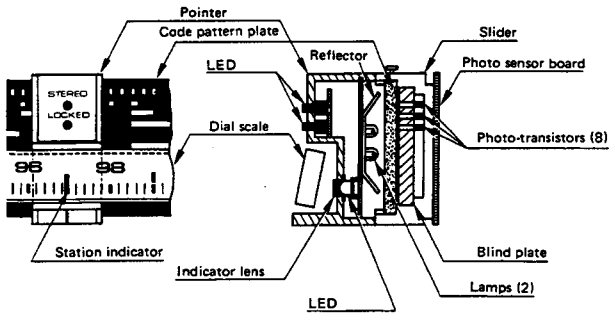


Fig. 8

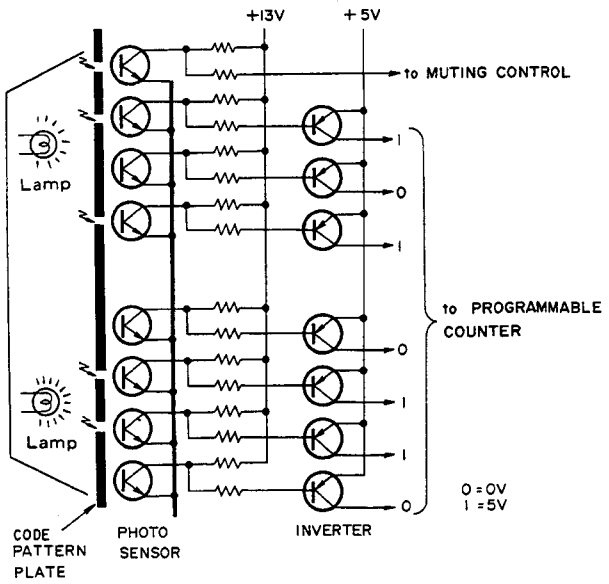


Fig. 9 Photo sensor

PLL Synthesizer

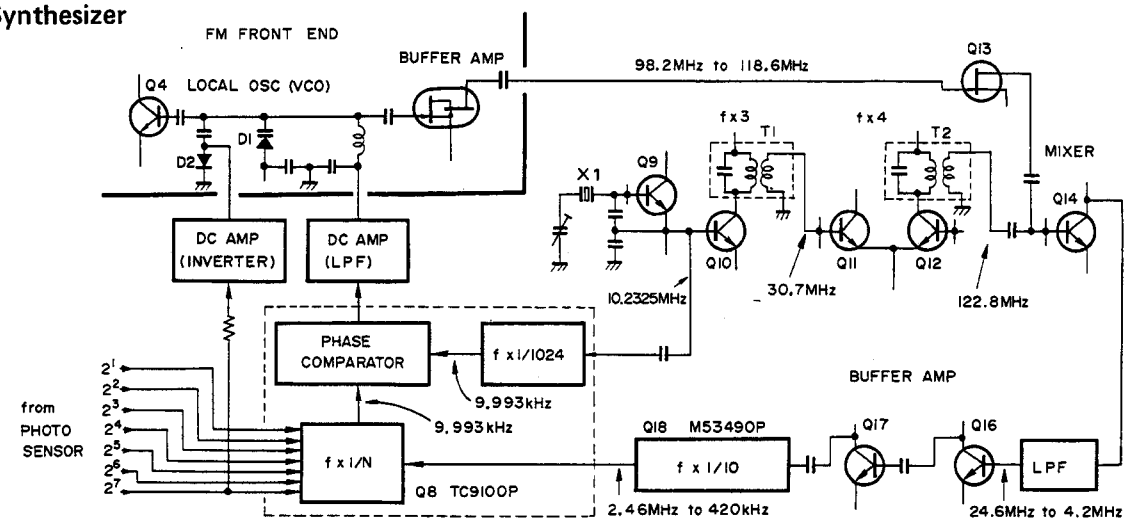


Fig. 10 PLL Synthesizer circuit

Fig. 10 shows the circuit diagram of the PLL synthesizer. Q_9 and X_1 (frequency crystal) constitute a 10.2325MHz *1 (reference frequency) oscillator circuit. Q_{10} and T_1 constitute a frequency tripler, while Q_{11} and Q_{12} form a frequency quadrupler. In this way the reference frequency is increased 12-fold to produce a 122.8MHz signal. Q_{14} constitutes the mixer which heterodynes the 122.8MHz signal with the local oscillator frequency (98.2MHz to 118.6MHz) at the front end of the tuner, to produce a signal in the range 24.6MHz to 4.2MHz. This signal is passed through a low-pass filter and a buffer amplifier (Q_{16} and Q_{17}), and then applied to Q_{18} (M53490P). M53490P is a frequency divider which divides the signal obtained by heterodyning (24.6MHz to 4.2MHz), by a factor of 10 (i.e. into a signal of between 2.46MHz and 420kHz). Q_8 (TC9100P) is an IC used in the PLL synthesizer. It contains a programmable counter *2, a digital phase comparator *3 and a 10-bit frequency divider (division ratio: 1024). The signal from Q_{18} (2.46MHz to 420kHz) is divided by a factor of N (246 to 42) at the programmable counter (N is determined from the binary code detected by the photo-sensor). The reference frequency (10,2325MHz) is applied to Pin 3 of TC9100P, resulting in the generation of a 9,993kHz signal at the 10-bit frequency divider (division ratio: 1024). This 9,993kHz signal is sent, together with the output of the programmable counter into a digital phase comparator. The output of the phase comparator is converted, using a low-pass filter, into a DC signal which is fed back to the local oscillator circuit to control its frequency so that the output frequency of the programmable counter is maintained at 9,993kHz.

Notes:

**1 When the reference frequency is 10.2325MHz, the error in the IF frequency (10.7MHz) when the carrier frequency of the incoming signal is 87.5MHz will be about +7kHz; and, in the case of a carrier frequency of 107.9MHz it will be about −8kHz.*

**2 A programmable counter is a frequency divider whose division ratio corresponds to a binary code to which the program terminals (Pins 7 to 15) of the TC9100P have been set.*

**3 A digital phase comparator is made up of a combination of NAND gates. Fig. 11 shows the waveform of the phase comparator output. The comparator output is applied to a low-pass filter (loop filter), and the voltage obtained by charging and discharging the filter capacitor is used as a control voltage.*

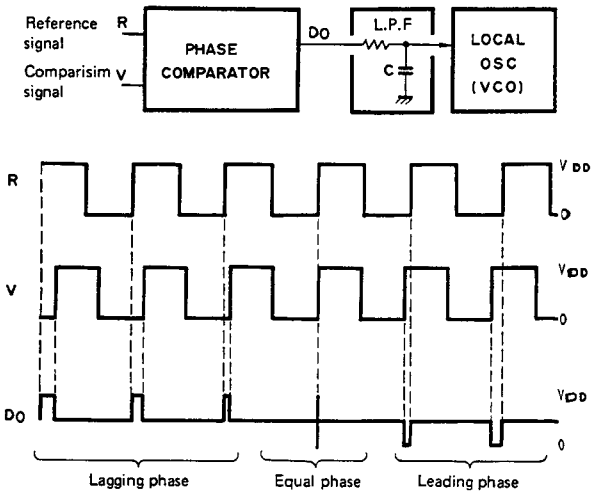


Fig. 11

A 1-bit output from the photo-sensor is used to control the diode switch (D_2) in the local oscillator. It is turned on when receiving carrier frequencies in the range 87.5MHz to 99.3MHz, and turned off when receiving carrier frequencies in the range 99.5MHz to 107.9MHz. The control circuit is shown in Fig. 12. Q_{13} is a voltage comparator employing an operation amplifier. The reference voltage is applied to Pin 2, while the 1-bit sensor output is applied to Pin 3. When the voltage at Pin 3 becomes higher than the voltage at Pin 2, the output voltage will be negative, and vice-versa. Thus, when the output of Q_1 is 1, the voltage at Pin 3 will become greater than the voltage at Pin 2. The voltage at Pin 1 will thus become negative and also D_2 will be turned off. When the output of Q_1 is 0, the voltage at Pin 3 will become less than the voltage at Pin 2. The voltage at Pin 1 will thus become positive, and also D_2 will be turned on. Fig. 13 shows the code pattern in the vicinity of 99.5MHz.

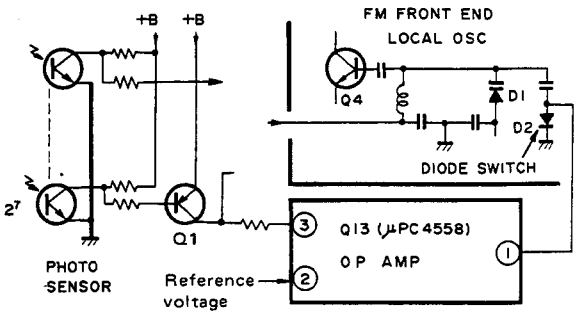


Fig. 12

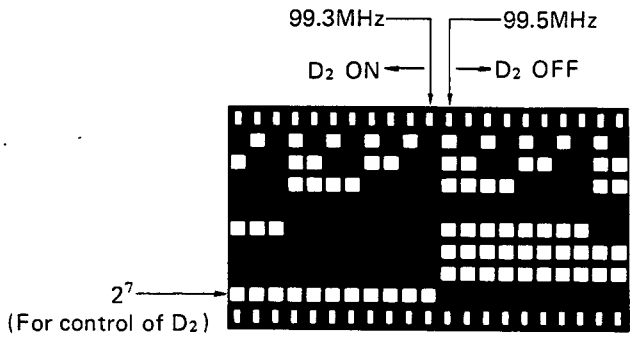


Fig. 13

4.3 CONTROL CIRCUIT

Control IF Amplifier

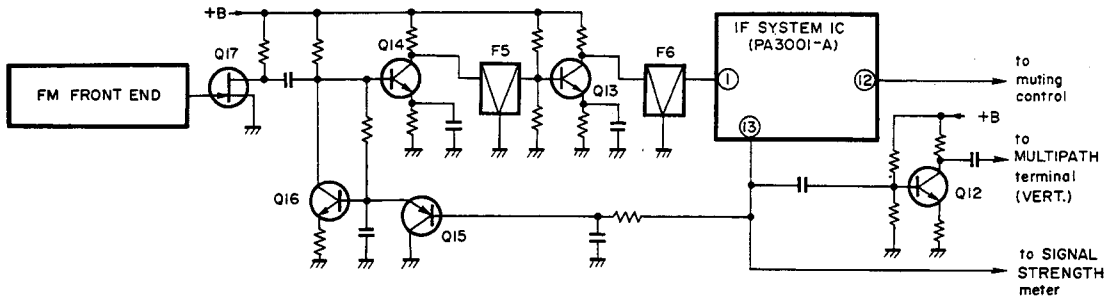


Fig. 14 Control IF amplifier

This tuner incorporates a special control IF amplifier which is separate from the signal IF amplifier. It is used to drive the SIGNAL STRENGTH meter, for MULTIPATH detection and also for muting control. The circuit of the control IF amplifier is shown in Fig. 14.

Q_{15} and Q_{16} constitute the AGC circuit. When the antenna input level becomes large, the voltage at Pin 13 of PA3001 will rise, turning Q_{15} off and Q_{16} on. This in turn causes the base bias of Q_{14} to be reduced. In this way the input signal applied to PA3001 is controlled to such a level that the internal limiter does not operate. This circuit enables a reading of 100dBf (antenna input) on the SIGNAL STRENGTH meter to be obtained without saturation.

The signal to the MULTIPATH terminals is obtained by detecting the AC component of the output from Pin 13 of PA3001.

The muting control signal is obtained from the output of Pin 12 of PA3001 (Refer to the following section).

Muting Control

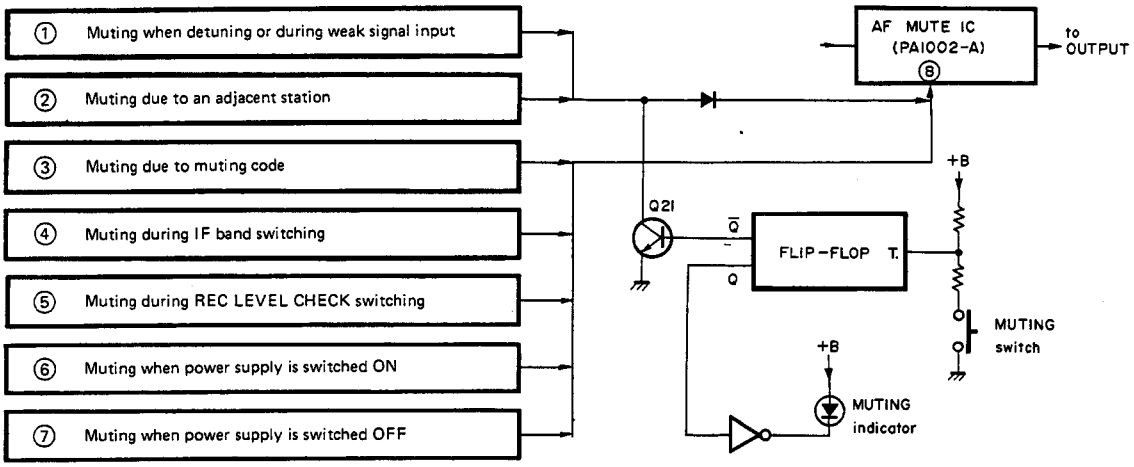


Fig. 15 Muting control circuit block diagram

Fig. 15 is the muting control circuit block diagram. Muting action is effected by turning on and off the electronic switch contained in the AF MUTE IC (PA1002-A) used as the output amplifier. Muting modes ① and ② are not effective when Q_{21} is on. Muting modes ③ to ⑦ are effective regardless of the state of Q_{21}. The on/off states of Q_{21} are controlled by the muting switch (Refer to control of circuit control using key switches.).

1. Muting when detuning or during weak signal input

This muting mode operates when there is no broadcast station (emission of noise between stations) or the antenna input level is low (19.2dB or less). The muting circuit is shown in Fig. 16.

When detuning or if the antenna input is low, a DC voltage will appear at Pin 12 of PA3001 in the control IF amplifier. This voltage will be momentarily applied to the Schmitt circuit, thus turning Q_{23} on and Q_{22} off. Consequently, the collector voltage of Q_{22} will be applied to Pin 8 of PA1002-A, putting the circuit into a muting mode.

2. Muting due to an adjacent station

When receiving a weak station which is adjacent to a strong station, with the IF amplifier in the WIDE mode, the strong station will also appear in the detected output. This is prevented by employing a window comparator which detects the DC component in the detected output, and effects muting control. The muting circuit is shown in Fig. 16.

If a DC component exists in the detected output, the output voltage of the window comparator will become 0V. As a result, the emitter voltage of Q_{28} will rise, turning Q_{23} on and Q_{22} off. The collector voltage of Q_{22} will thus rise and be applied to Pin 8 of PA1002-A, putting the circuit into a muting mode.

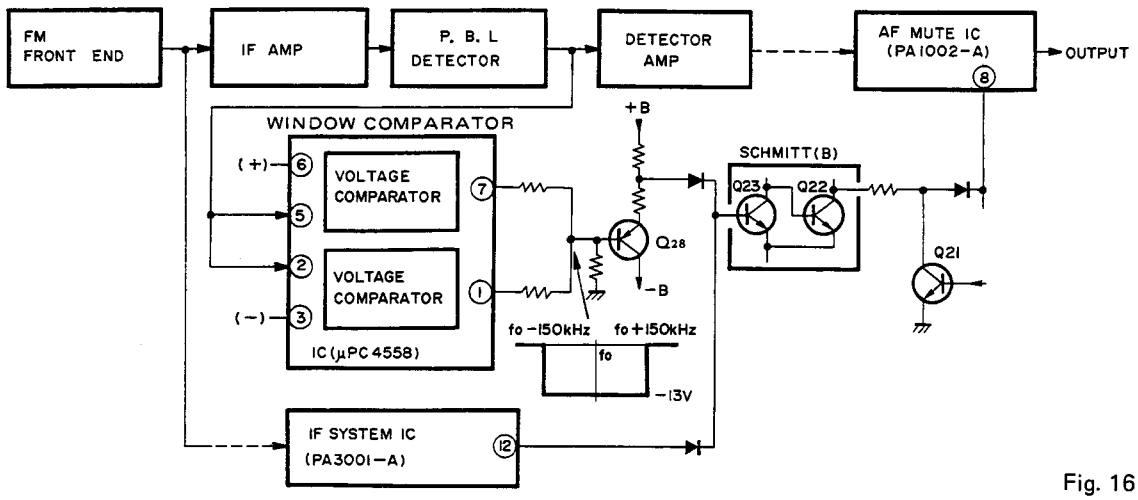


Fig. 16

3. Muting due to muting code

The muting code is generated by means of light transmission windows located every 200kHz along the tuning dial. When the dial pointer appears between these windows, the circuit will be muted. The muting circuit is shown in Fig. 17.

When the photo-transistor (Q_1) does not receive light from the lamp (i.e. the light is in front of an operational amplifier will be negative, and vice-versa. Consequently, the output voltage of the operational amplifier will be applied to Pin 8 of PA1002-A, putting the circuit into a muting mode.

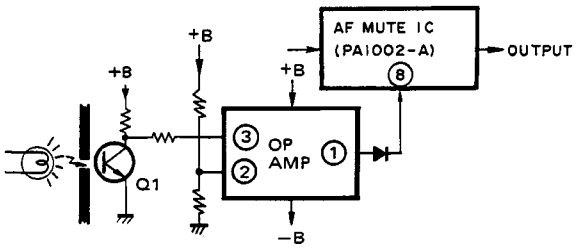


Fig. 17

4. Muting during IF BAND switching

This muting mode operates when the IF band is being switched. The muting circuit is shown in Fig. 18.

When the IF BAND changeover key switch is pressed, the base voltage of Q_{16} will be pulled down by D_6, and Q_{16} will be turned on. As a result, a voltage will be applied to Pin 8 of PA1002-A, putting the circuit into a muting mode. C_{40} and R_{69} constitute a time constant circuit which serves to maintains the muting mode for approximately one minute after the key switch has been pressed.

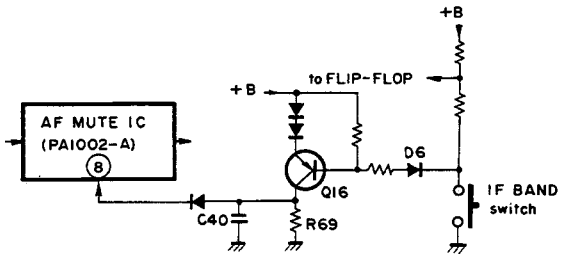


Fig. 18

5. Muting during REC LEVEL CHECK switching

This muting mode operates when the REC LEVEL CHECK key switch is operated. Both the circuit and its operation are the same as that of Fig. 18.

6. Muting when power supply is switched on

This muting mode is effective from the instant the power supply is switched on until steady state conditions are obtained. The muting circuit is contained within PA1002-A, with muting being effected by the timing trigger circuit of Pin 11 which operates an electronic switch.

7. Muting when power supply is switched off

This muting mode is designed to eliminate residual noise emitted when the power supply is switched off. When the power switch is turned off, a trigger pulse from the reset circuit causes the muting gate in the PA1002-A to operate (Refer to reset circuit.).

STATION Indicator Control

The STATION indicator is illuminated every 200kHz. This enables the photo-sensor to read off the muting code (Light transmitted every 200kHz.) and to control muting by means of the resulting electrical signal. The STATION circuit is shown in Fig. 19.

When light enters the photo-transistor (Q_1), the output voltage (Pin 1) of the operation amplifier will be negative. As a result Q_{12} which drives the STATION indicator will also be turned on, causing the STATION indicator to light up.

LOCKED Indicator Control

The LOCKED indicator lights up when the PLL synthesizer has locked on to a broadcast (19.2dBf or greater) which is free from interference signals. The indicator control circuit is shown in Fig. 19.

During reception of a broadcast station which produces an antenna input of at least 19.3dBf, and in the absence of interference signals, the voltage appearing at Pin 12 of the PA3001 together with the output of the window comparator will become zero; consequently, Q_{23} will be turned

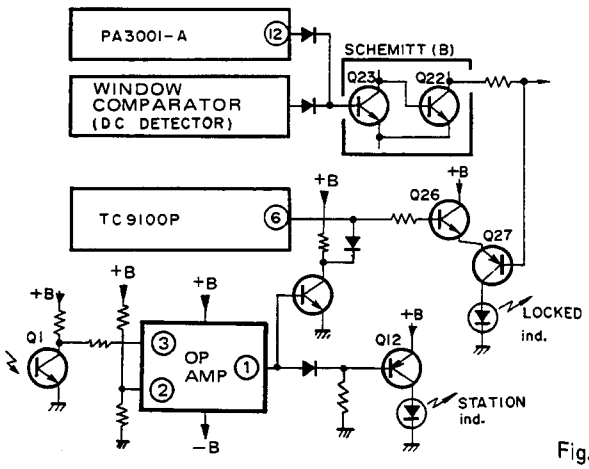


Fig. 19

off and Q_{22} will be turned on. At the same time, the voltage output on Pin 6 of the PLL synthesizer IC (TC9100P) will become 5V. Thus, Q_{27} and Q_{26} will be turned on, causing the LOCKED indicator to light up.

REC LEVEL Signal Generator Circuit Operation

Fig. 20 shows the block diagram of the REC LEVEL signal generator.

The signal generator emits a continuous 330Hz signal. When the circuit operates, Q_{20} causes the muting gate of PA1002-A to open up. At the same time, the detector amplifier in the signal circuit is rendered non-operational (Refer to Circuit Control using Key Switches).

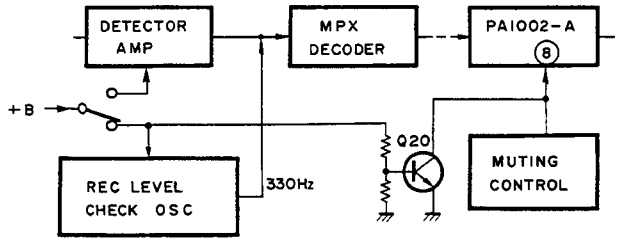


Fig. 20

Circuit Control Using Key Switches

Switching of MUTING, MODE, IF BAND, MPX NOISE FILTER and REC LEVEL CHECK is performed electronically by the key switch and the flip-flop circuit.

MUTING (Fig. 21)

When the key switch is pressed once, the flip-flop is triggered, and thus its outputs (Q, $\overline{Q}$) are inverted. When the Q output is 0, Q_{21} is turned off, and the circuit goes into a MUTING ON condition. Simultaneously, the $\overline{Q}$ output becomes 1 and the inverter output becomes 0. As a result, the MUTING indicator will light up.

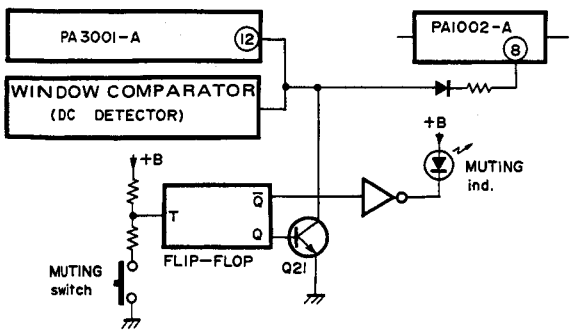


Fig. 21

MODE (Fig. 22)

When the Q output of the flip-flop is 0, the circuit will go into the FM AUTO condition. Simultaneously, the $\overline{Q}$ output will become 1, and hence the inverter output will be 0, resulting in the AUTO indicator lighting up.

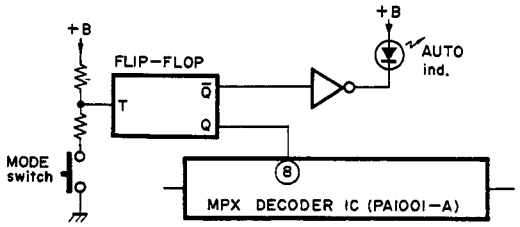


Fig. 22

IF BAND (Fig. 23)

When the $\overline{Q}$ output of the flip-flop is 1, Q_{21} will be turned on. In this way, +B will put the FM IF amplifier in the WIDE condition and also cause the WIDE indicator to light up.

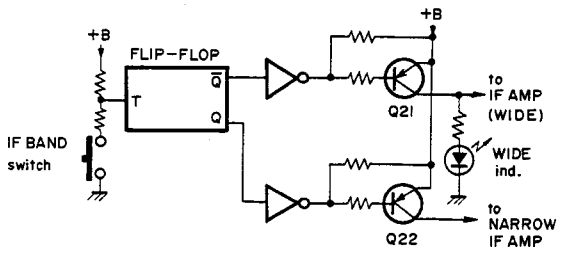


Fig. 23

MPX NOISE FILTER (Fig. 24)

When the Q output is 1, the relay will be energized, and a capacitor will be inserted between L and R in the signal circuit (This only applies when the REC LEVEL CHECK function is off.). At the same time, the MPX NOISE FILTER indicator will light up.

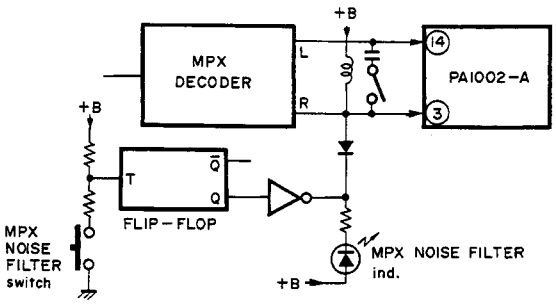


Fig. 24

REC LEVEL CHECK (Fig. 25)

When the $\overline{Q}$ output is 1, Q_{20} is turned on. Simultaneously, +B is supplied to the REC signal generator circuit and also the REC LEVEL CHECK indicator comes on. Because the Q output is 0, Q_{23} will be turned off and +B will be removed from the detector amplifier in the signal circuit, thus cutting off the received signal.

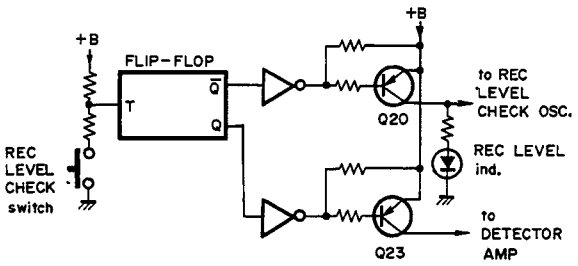


Fig. 25

Reset Circuit

This circuit is used to reset the flip-flop, to put each of the MUTING, MODE, IF BAND, MPX NOISE FILTER and REC LEVEL CHECK functions into the normal condition (i.e. MUTING in ON, MODE in AUTO, IF BAND in WIDE, MPX NOISE FILTER in OFF, and REC LEVEL CHECK in OFF) when the power supply is switched on.

The schematic diagram is shown in Fig. 26.

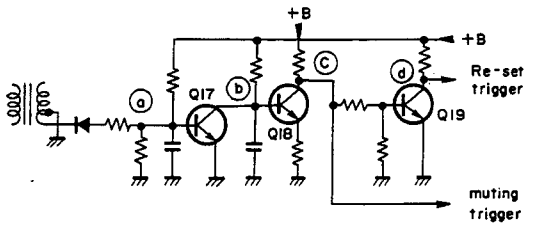


Fig. 26

When the power supply is switched on, Q_{17} is immediately turned off. Consequently, the various circuit voltages change as shown in Fig. 27. The trigger pulse ⓓ generated at the collector of Q_{19} is applied to each flip-flop, thus resetting the respective circuits to the normal condition. The trigger pulse ⓒ generated when the power supply is switched off is used for muting control.

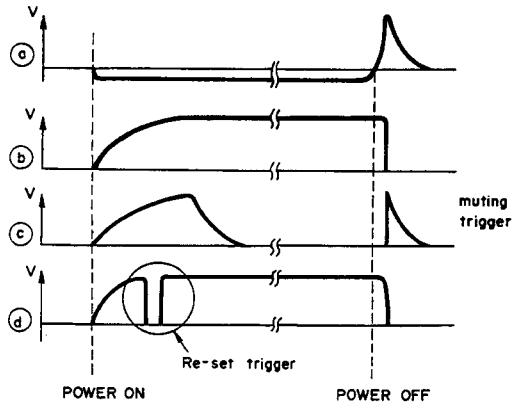


Fig. 27

4.4 POWER SUPPLY CIRCUIT

The S-N ratio of a tuner which employs a varicap diode can easily be degraded by power supply hum and ripple. It is thus necessary to keep both of these to a minimum. To this end, this tuner employs a large ripple filter, a voltage stabilizing IC (PA2002) having a ripple compression factor of at least 80dB and 5 transistors.

The voltages provided by the power supply are +5V for digital ICs, +12.4V and +13V for signal circuits and +13V and −14V for control circuits.

5. DISASSEMBLY

Top Cover

Undo the four screws (❶ ~ ❹).

Bottom Plate

Undo the eight screws (❺ ~ ⓬).

Front Panel

1. Loosen the set-screw, and remove the tuning knob.
2. Pull off the output level knob.
3. Undo the four screws (⓭ ~ ⓰).

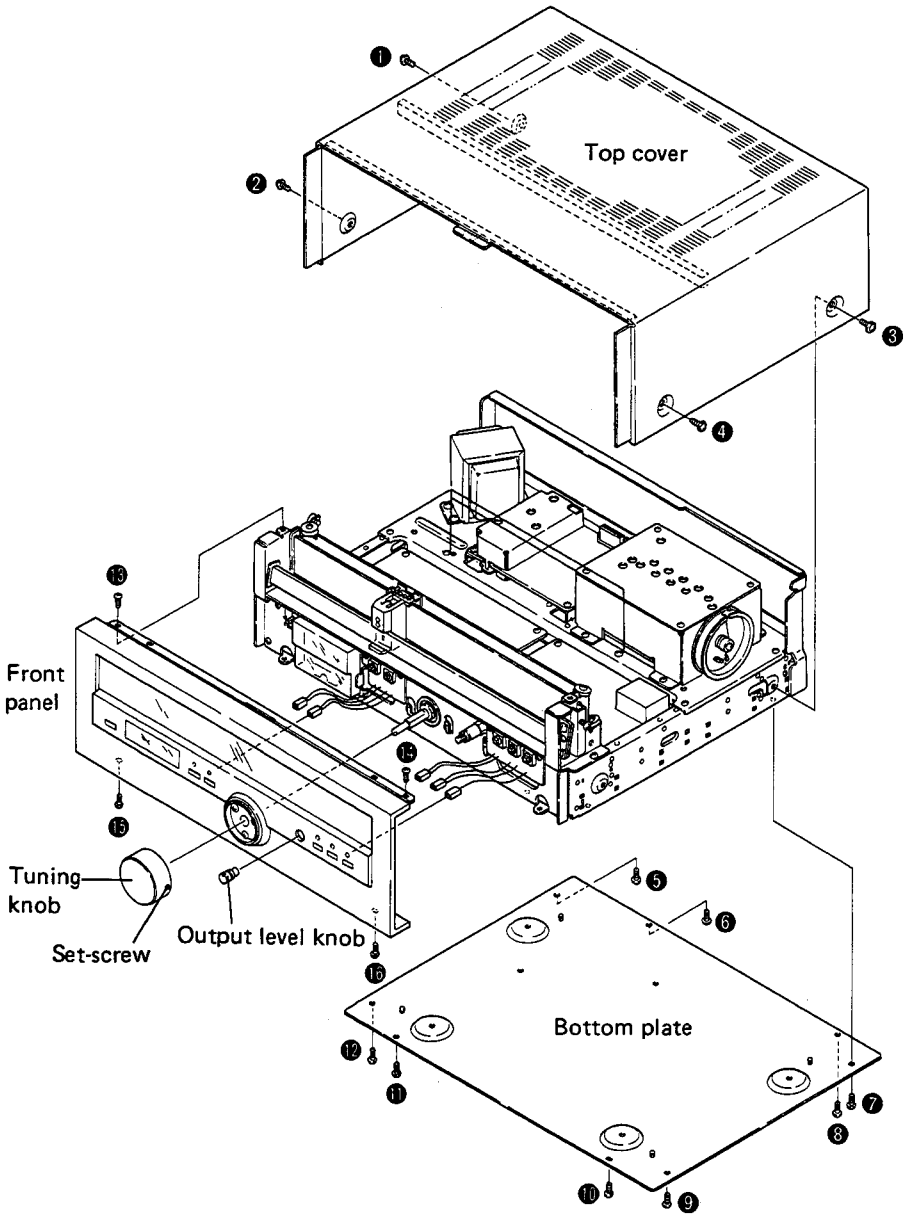


Fig. 28

IF Assembly and MPX AF Assembly

1. Undo the ten screws (⑰ ~ ㉖) and boss (Fig. 29).
2. Undo the three screws (㉗ ~ ㉙), and remove the IF assembly and MPX AF assembly(Fig.30).

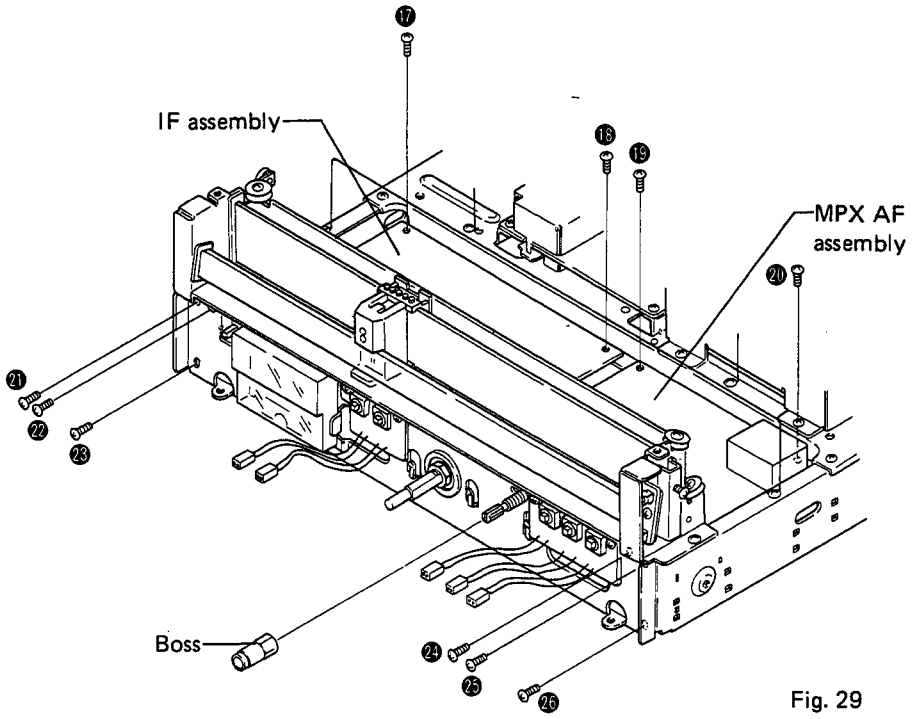


Fig. 29

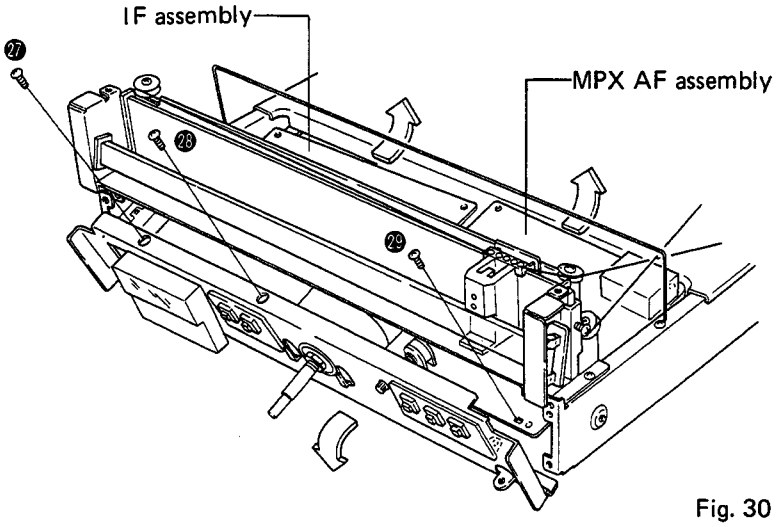
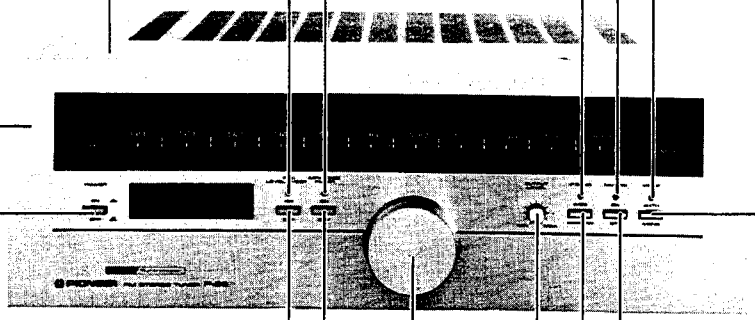


Fig. 30

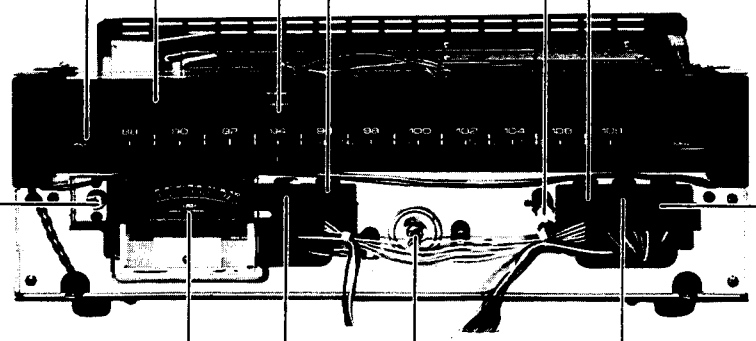
6. PARTS LOCATIONS

- *The ⚠ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.*

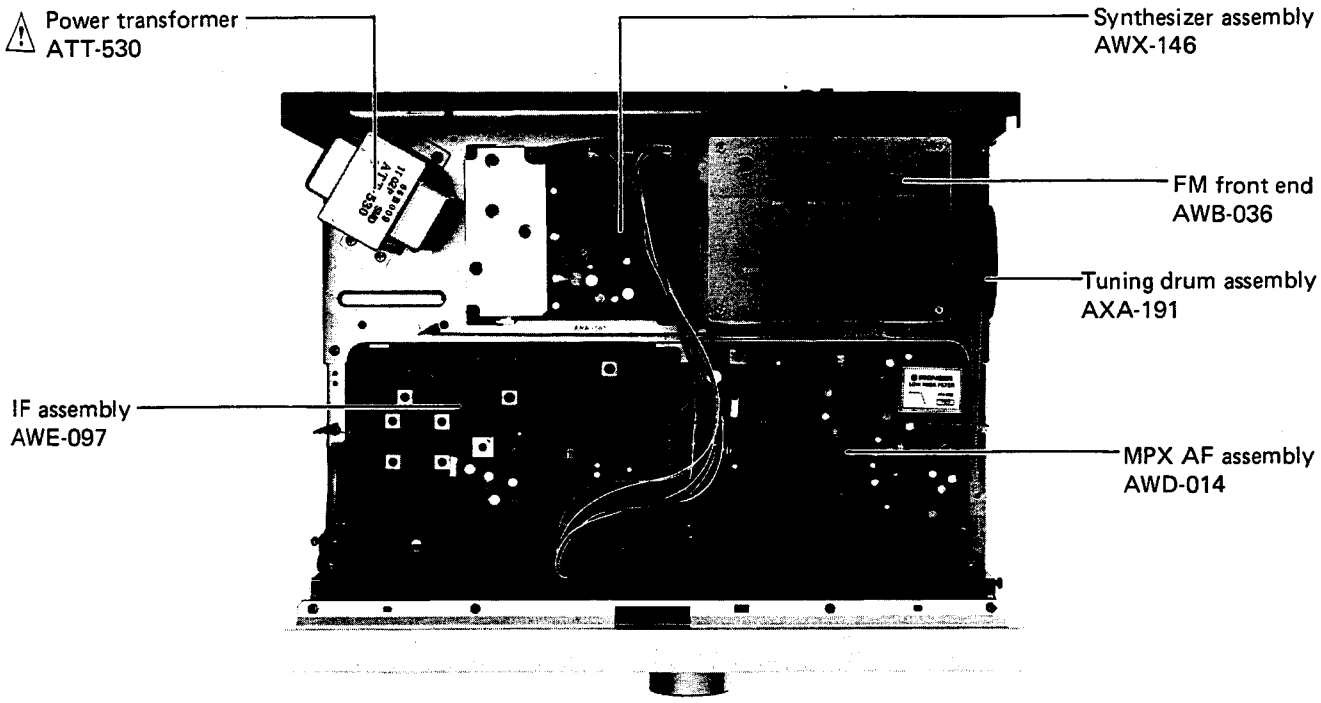
6.1 FRONT PANEL VIEW



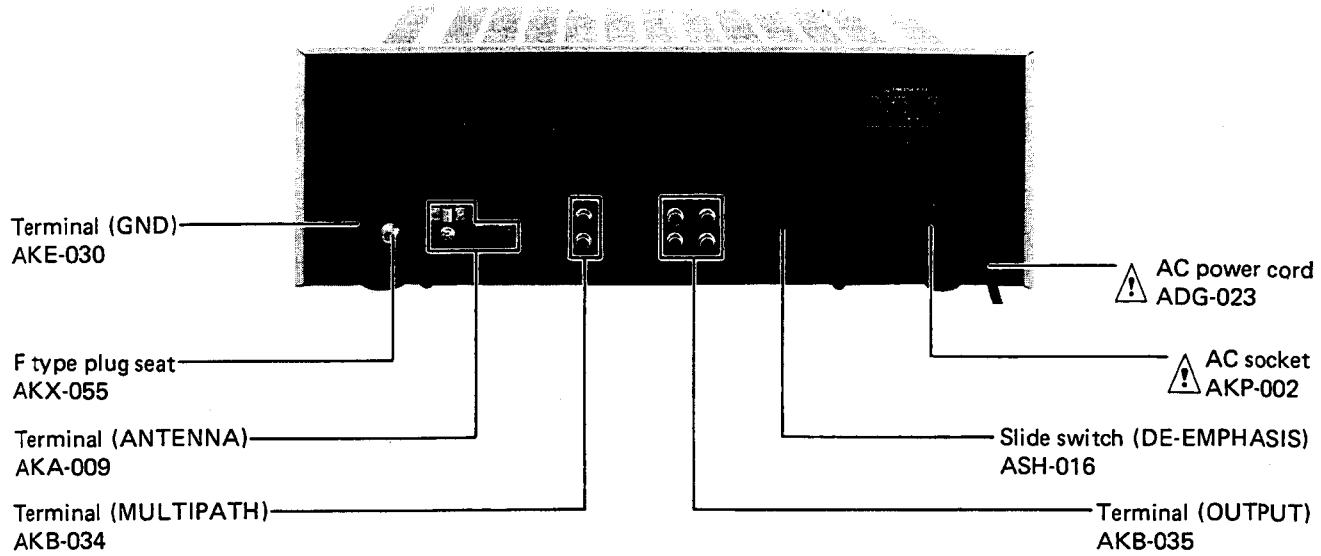
6.2 FRONT VIEW WITH PANEL REMOVED



6.3 TOP VIEW



6.4 REAR PANEL VIEW



7. DIAL CORD STRINGING

1. Remove the top cover, referring to the instructions of Page 16.
2. Remove the tuning drum from the tuning capacitor shaft.
3. Tie one end of the dial cord to the hook on the inside of the tuning drum.
4. Turn the tuning capacitor shaft fully clockwise. (Fig. 31).
5. Fix the tuning drum to the tuning capacitor shaft so that the set-screw is uppermost.
6. Pass the cord through the cutout section in the tuning drum. Wind it once around the tuning drum, and then take it over pulleys A, B, C and D in that sequence.
7. Wind the cord around the tuning shaft 3 times. Pass it over pulley E, wind it around the tuning drum 3 times, and finally tie it to the spring hook so that it is tensioned.
8. Turn the tuning knob and check that the cord moves smoothly. Cut off any excess cord.
9. Turn the tuning knob counterclockwise as far as it will go.
10. Turn the power switch on.
11. Align the dial pointer with the starting point of the dial scale (third division from the left), and then pass the cord over it.
12. Check that the dial pointer is in line with the starting point of the dial scale.
13. Adjust the mounting position of the code pattern panel using screws ❶ and ❷, so that the station indicator on the dial pointer lights up (Fig. 32).
14. Apply lacquer to the cord on the pointer and also to the knot in the cord.

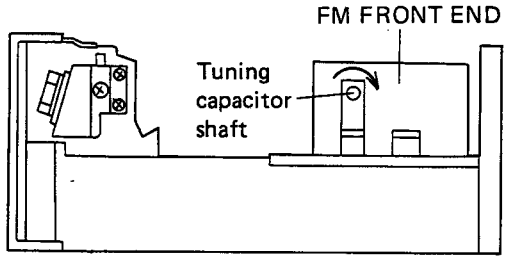


Fig. 31 Side view

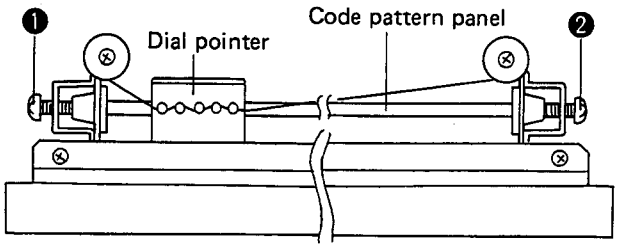


Fig. 32 Top view

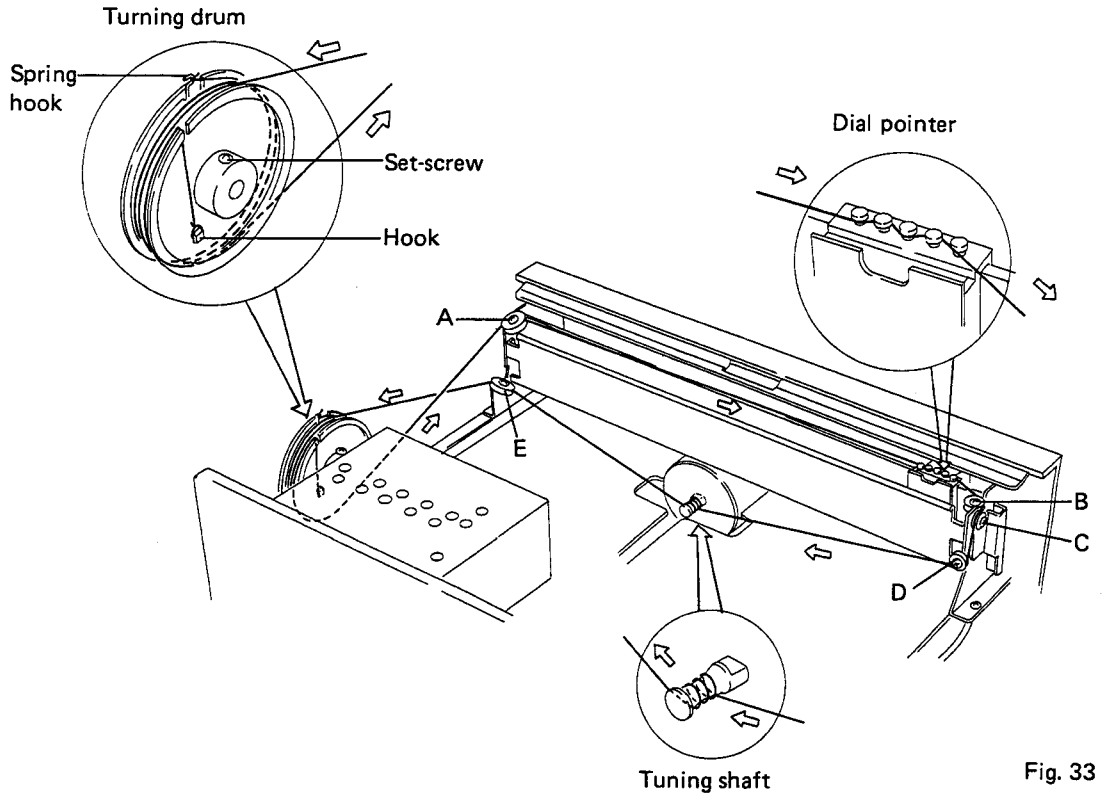


Fig. 33

8. ADJUSTMENTS

8.1 SYNTHESIZER ASSEMBLY

1. Unplug the coaxial cable from the VCO IN terminal of the synthesizer assembly.
2. Connect a frequency counter to Terminal 16 of the synthesizer assembly.
3. Adjust TC_1 of the synthesizer assembly until the counter indication is 10.2325MHz. After adjustment, remove the frequency counter.
4. Connect the frequency counter and an RF voltmeter to Terminal 20 of the synthesizer assembly.
5. Adjust the cores of T_1 and T_2 of the synthesizer assembly so that a maximum indication is obtained on the RF voltmeter when the frequency is 122.8MHz. After adjustment, disconnect both the frequency counter and the RF voltmeter
6. Plug the coaxial cable from the FM front end into the VCO IN terminal on the synthesizer assembly.
7. Align the dial pointer of F-28 to 87.5MHz.
8. Connect an oscilloscope to Terminal 19 of the synthesizer assembly.
9. Adjust the core of T_3 of the synthesizer assembly to stabilize the 2.46MHz square wave trace on the oscilloscope. After adjustment, remove the oscilloscope.

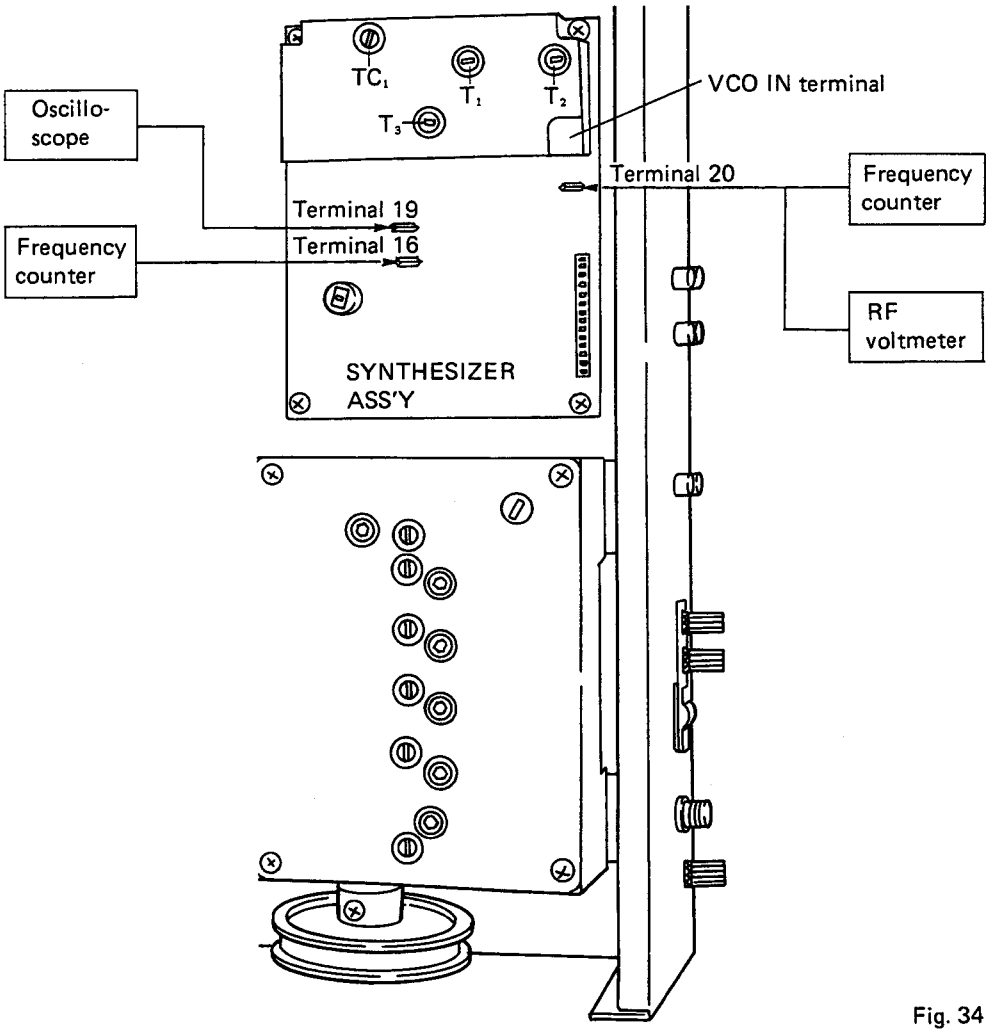


Fig. 34

8.2 FM FRONT END

Local Oscillator

1. Disconnect the wiring from Terminals 6 and 8 at the FM front end, and connect up a measuring instrument as shown in Fig. 35.
2. Set the dial pointer of F-28 to any position.
3. Adjust the voltage setting VR until the reading on the DC voltmeter is +8V.
4. Adjust L_6 at the FM front end so that the frequency counter indicates 97.5MHz.
5. Adjust the voltage setting VR until the reading on the DC voltmeter is +17V.
6. Adjust TC_6 at the FM front end so that the frequency counter indicates 110.5MHz.
7. Repeat Steps 3 to 6.
8. Replace wiring on Terminals 6 and 8 of the FM front end.

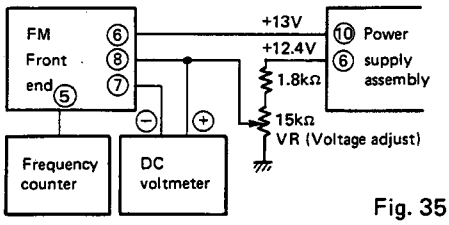


Fig. 35

RF Amplifier

NOTE: Check that the dial pointer is aligned with the starting point on the dial (Refer to Dial Cord Stringing, Page 20.).

1. Connect up the various measuring instruments as shown in Fig. 36.
2. Set the FM signal generator (FM SG) to a modulation frequency of 400Hz, FM deviation of 75kHz and an output level of 20 to 30dB.
3. Mechanically center TC_1 to TC_5 at the FM front end.
4. Align the output frequency of FM SG and the dial reading of F-28 to 90.1MHz.
5. Adjust the cores of L_1 to L_5 and T_1 at the FM front end until the indication on the SIGNAL meter becomes a maximum.
6. Align the output frequency of FM SG and the dial reading of F-28 to 106.1MHz.
7. Adjust TC_1 to TC_5 of the FM front end so that the indication on the SIGNAL meter becomes a maximum.
8. Repeat Steps 4 to 7.

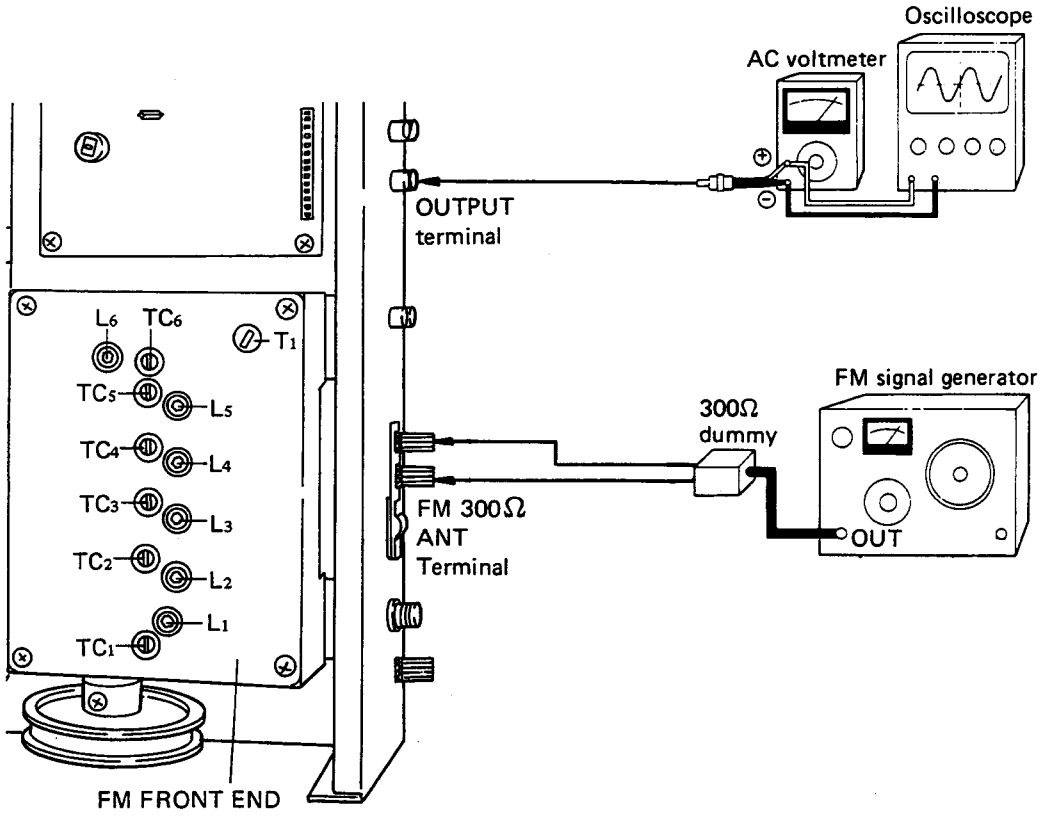


Fig. 36

8.3 IF ASSEMBLY

Control Circuit

NOTE:
- *Use the DC 200μA range of the multimeter.*

1. Connect up the various measuring instruments as shown in Fig. 37.
2. Set FM SG to a modulation frequency of 400Hz, FM deviation of 75kHz and an output level of 60dB.
3. Set the dial pointer of F-28 to an unoccupied frequency in the vicinity of 98MHz.
4. Adjust the lower core of T_8 on the IF assembly until the indication on the multimeter becomes 0.
5. Align FM SG and the dial pointer of F-28 to 98.1MHz (so that the multimeter indication becomes 0).
6. Adjust the TC_1 in the synthesizer assembly until the indication on the distortion meter becomes a minimum.
7. Adjust the upper core of T_8 on the IF assembly until the indication on the distortion meter becomes a minimum.
8. Repeat Steps 3 to 7.
9. Adjust the output level of FM SG to 100dB.
10. Align FM SG and the dial pointer of F-28 to 98.1MHz.
11. Adjust VR_3 on the IF assembly so that the indication on SIGNAL meter becomes a maximum.

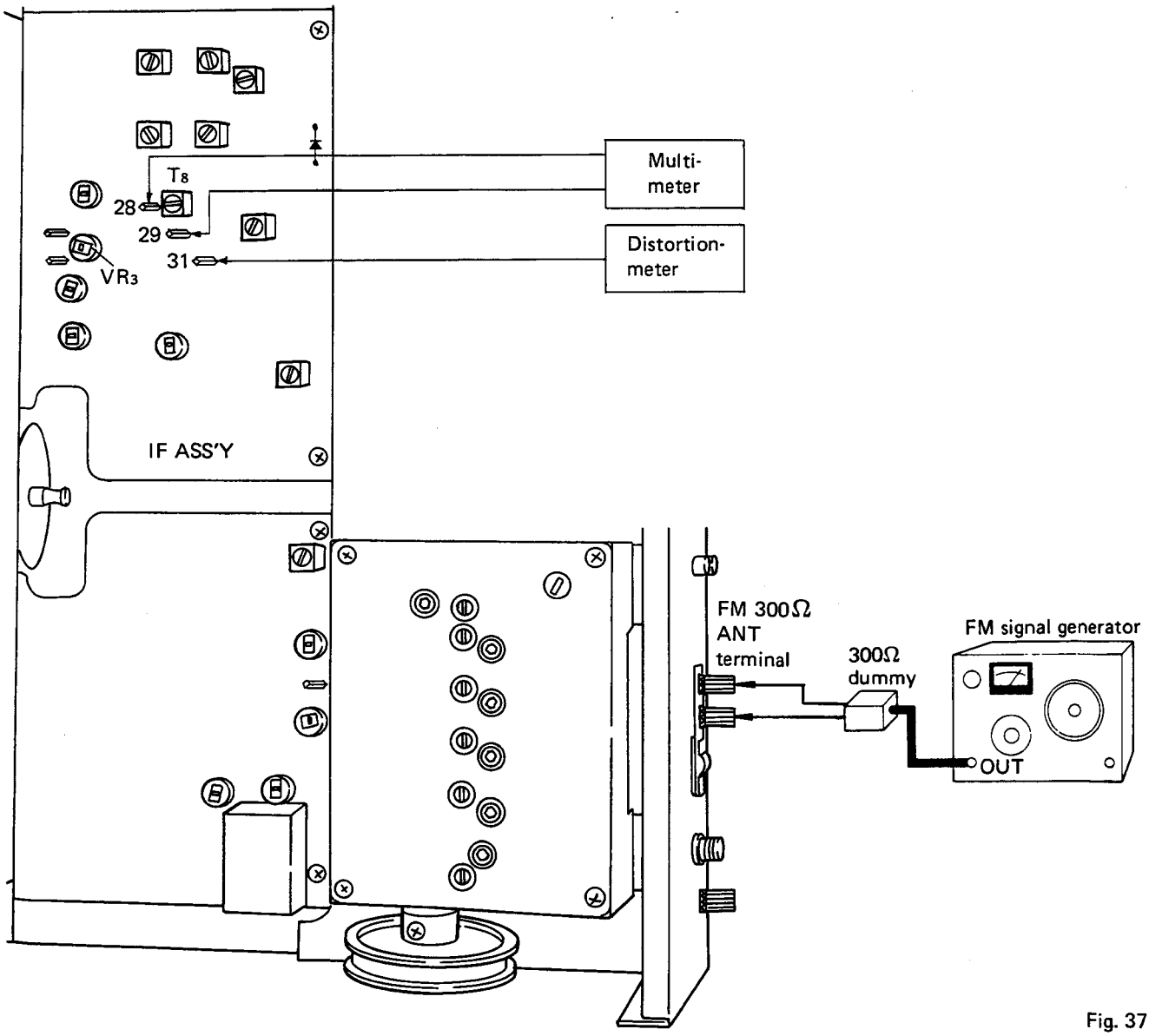


Fig. 37

Signal Circuit

NOTE:

- *Use the DC 200μA range of the multimeter.*

1. Connect up the various measuring instruments as shown in Fig. 38.
2. Set FM SG to a modulation frequency of 400Hz and an FM deviation of 75kHz.
3. Set the IF BAND switch on the front panel of F-28 in the WIDE position.
4. Set the output level of FM SG to 20 ~ 30dB.
5. Align the output frequency of FM SG and the dial pointer of F-28 to 98.1MHz.
6. Adjust the core of T_1 so that the multimeter indication becomes a maximum.
7. Turn the IF BAND switch to NARROW.
8. Adjust the core of T_2 so that the multimeter indication becomes a maximum.
9. Turn the IF BAND switch to WIDE.
10. Set the output level of FM SG to 60dB.
11. Adjust VR_1 until the indication on the distortion meter becomes a minimum.
12. Adjust VR_5 so that the indication on the digital voltmeter is 0V±50mV.
13. Turn the MUTING switch to ON.
14. Set the output level of FM SG to 20dB.
15. Adjust VR_2 to the point where muting takes place.
16. Set the output level of FM SG to 60dB, and record the output level of F-28.
17. Turn the REC LEVEL CHECK switch to ON.
18. Adjust VR_4 so that the REC LEVEL CHECK signal (330Hz) appearing at the output of F-28 is 6dB lower than the level recorded in Step 16.

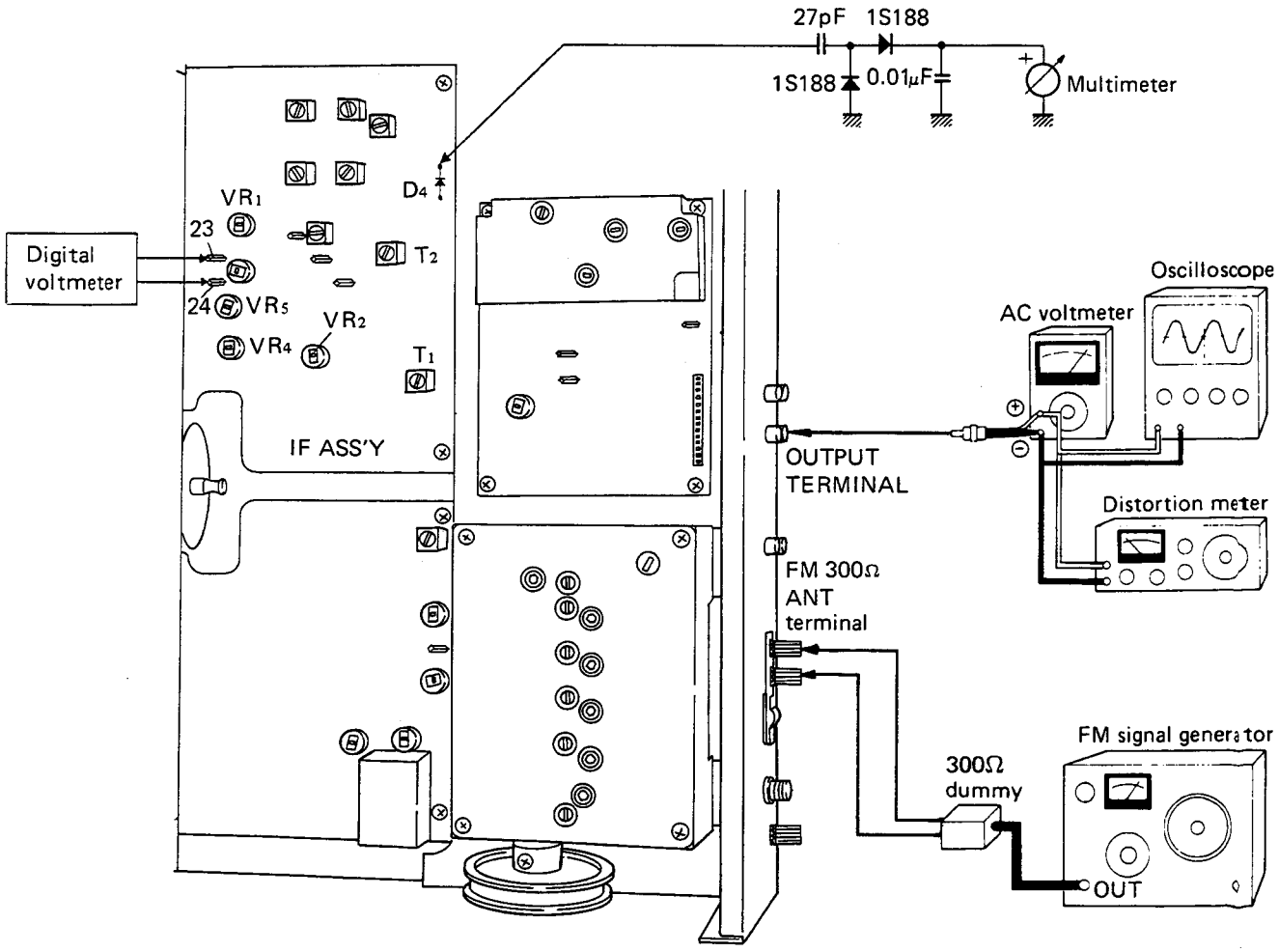


Fig. 38

8.4 MPX AF ASSEMBLY

Note: The FM SG shall be externally modulated, and set to an output frequency of 98.1MHz. The dial pointer of F-28 shall also be aligned to 98.1MHz.

1. Connect up the various measuring instruments as shown in Fig. 39.
2. Set the output level of FM SG to 60dB.
3. Turn the MPX SG modulator output to zero.
4. Connect a frequency counter to Terminal 13 of the MPX AF assembly.
5. Adjust VR_1 until the indication on the frequency counter becomes 76kHz (±50Hz). After adjustment, disconnect the frequency counter.
6. Use the modulation output of the MPX SG only as a pilot signal (19kHz), and set the FM deviation at 7.5kHz.
7. Set the output level of the FM SG at 80dB.
8. Adjust VR_2 so that the output level (carrier leak) of F-28 becomes a minimum.
9. Set the FM deviation of the MPX SG, at L or R (200Hz), to 33.75kHz, and the deviation of the pilot signal (19kHz) to 7.5kHz.
10. Adjust the core of T_1 in the MPX AF assembly so that the distortion of the L or R output becomes a minimum.
11. Repeat Steps 6 to 10.
12. Set the IF BAND switch to the WIDE position.
13. Set the FM deviation of the MPX SG, at L or R (1kHz), to 33.75kHz, and the deviation of the pilot signal (19kHz) to 7.5kHz.
14. Adjust VR_3 to obtain the optimum L-R separation.
15. Adjust the core of T_1 in the IF assembly until the distortion in either the L or R output becomes a minimum
16. Set the IF BAND switch to the NARROW position.
17. Adjust VR_4 to obtain the optimum L-R separation.
18. Adjust the core of T_2 in the IF assembly until the distortion in either the L or R output becomes a minimum.

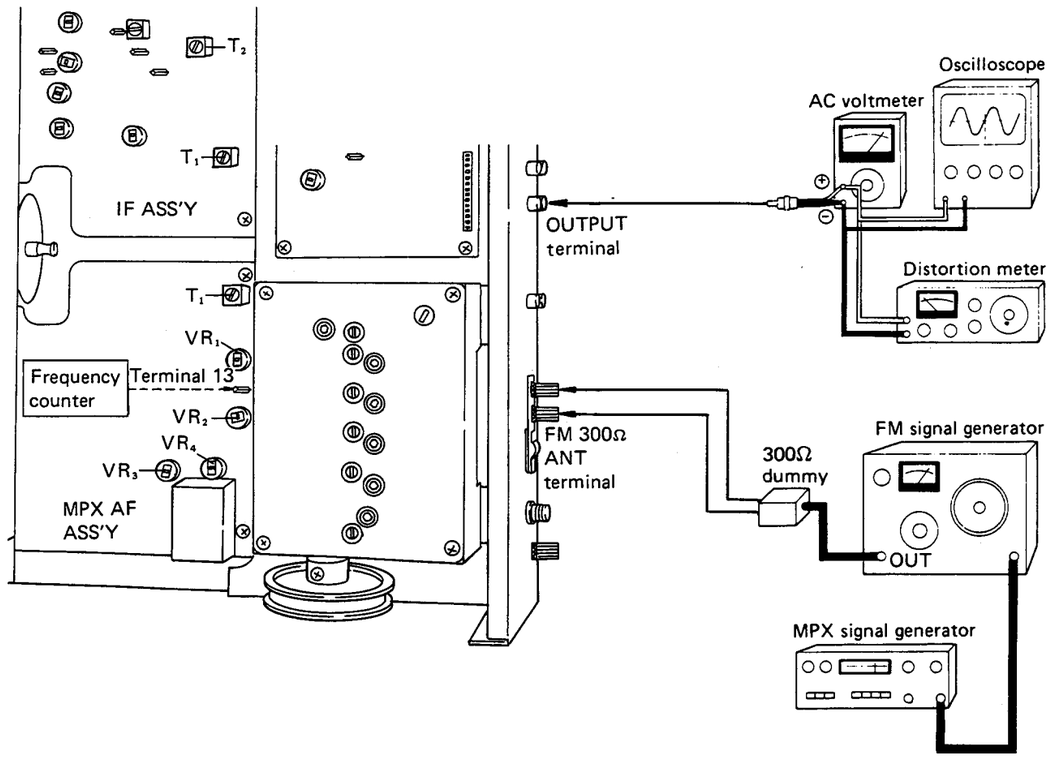
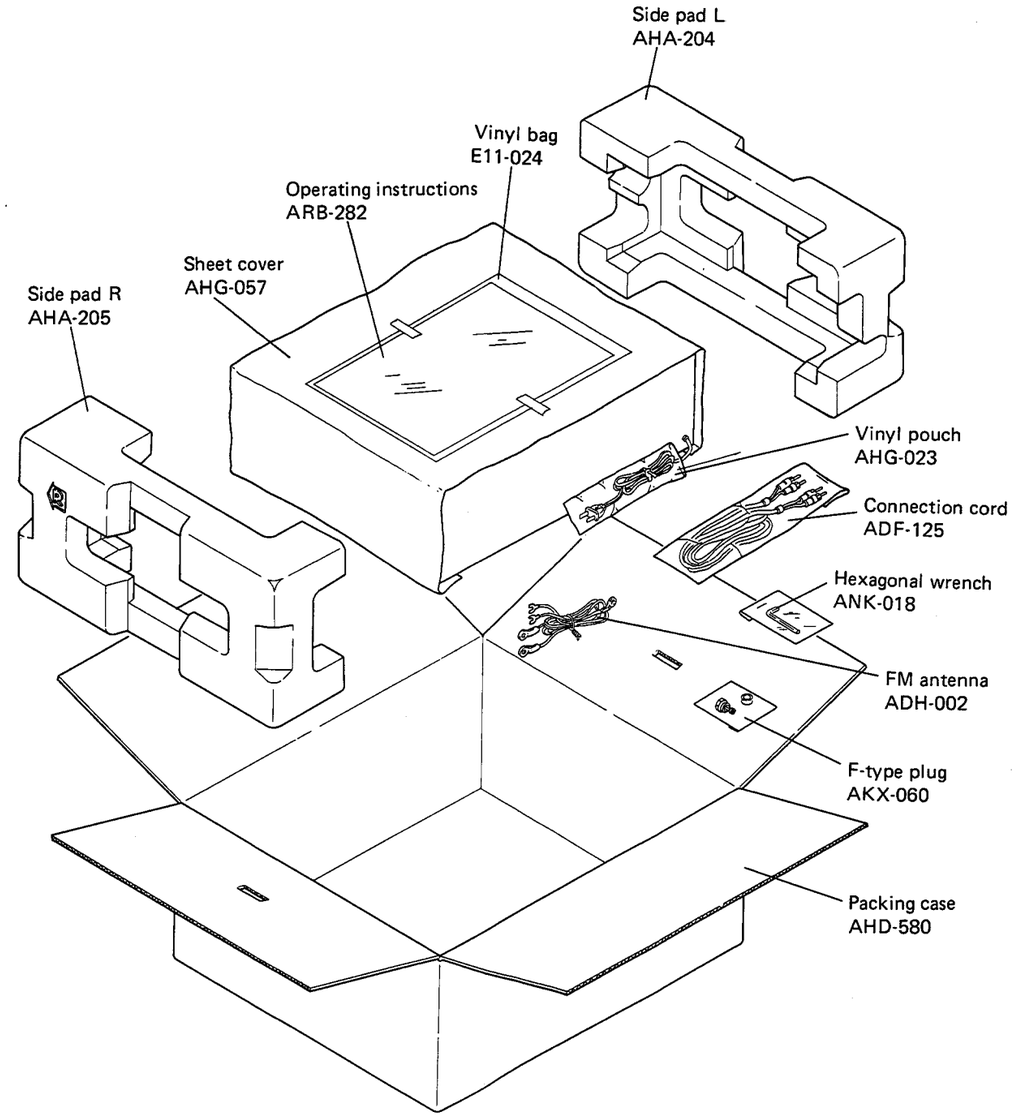


Fig. 39

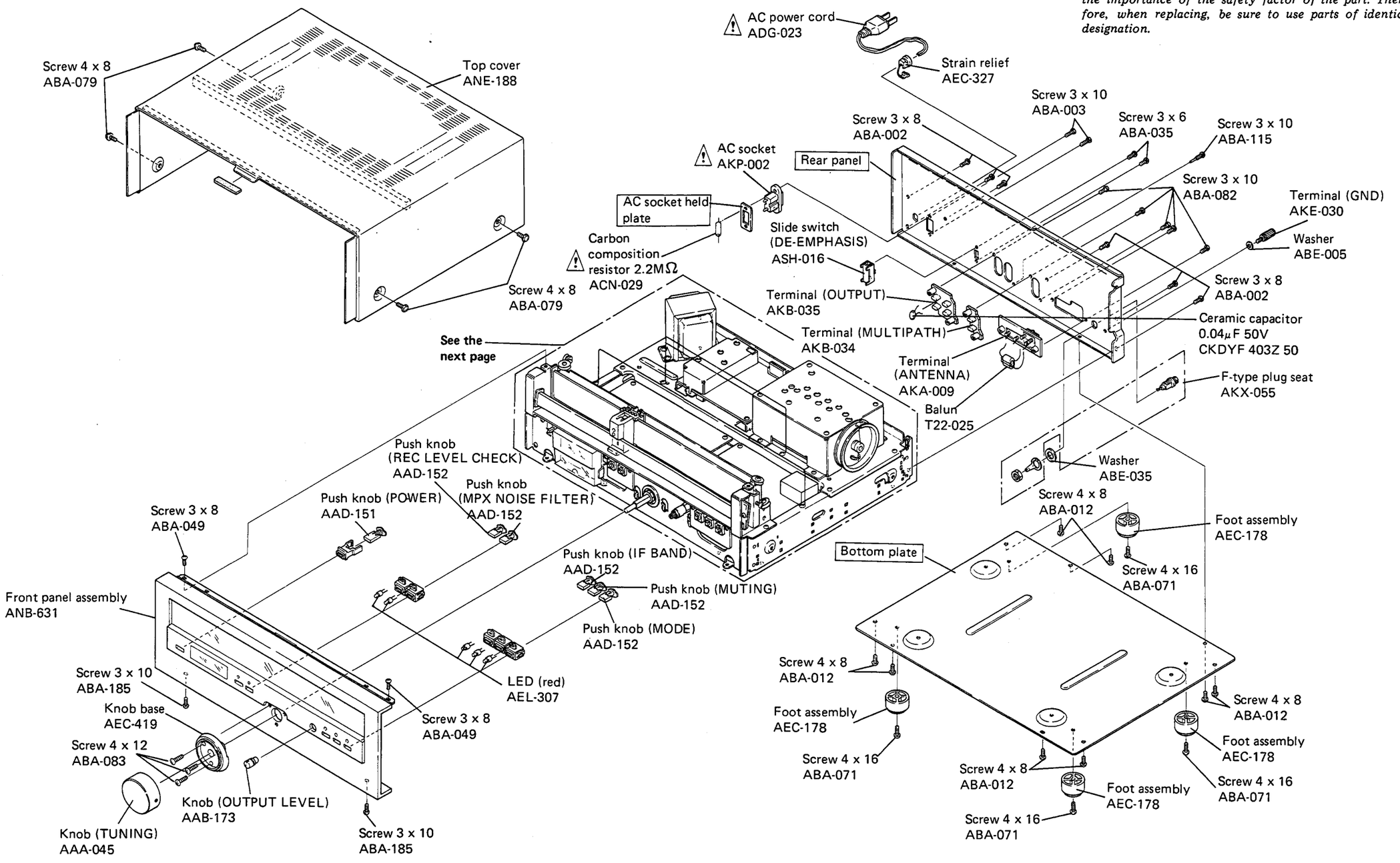
9. PACKING



10. EXPLODED VIEWS

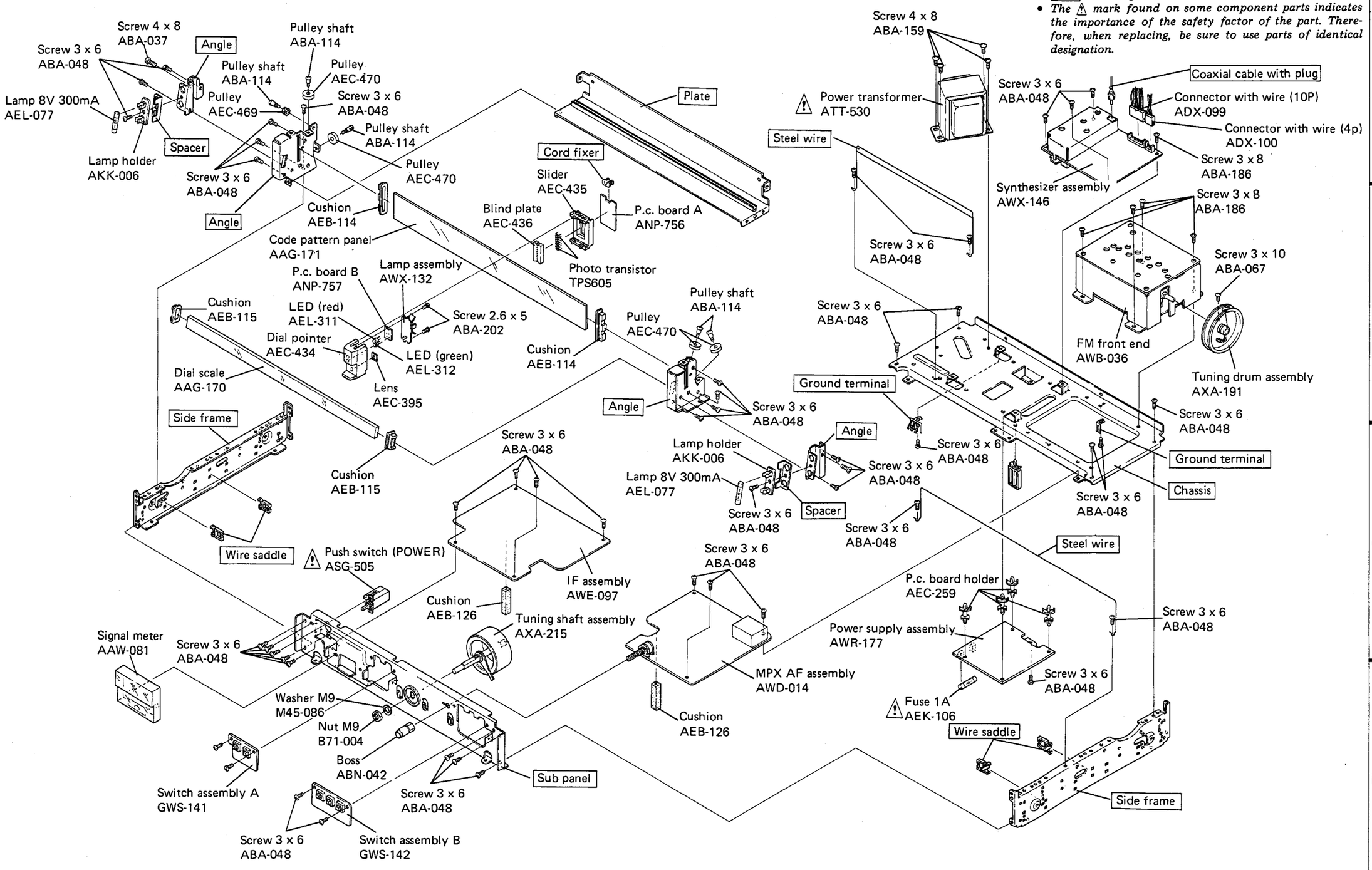
10.1 EXTERNAL PARTS

NOTES:
- ▭ *marked parts cannot be supplied.*
- *The ⚠ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.*



10.2 INTERNAL PARTS

NOTES:
- ▭ *marked parts cannot be supplied.*
- *The ⚠ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.*



11. SCHEMATIC DIAGRAMS, P. C. BOARD PATTERNS AND PARTS LIST

NOTE:

- *When ordering resistors, first convert resistance values into code form as shown in the following examples.*

Ex. 1 When there are 2 effective digits (any digit apart from 0), such as 560 ohm and 47k ohm (tolerance is shown by J = 5%, and K = 10%).

560Ω——56 ×10¹——561 . . . . . RD¼PS 5 6 1 J
47kΩ——47 ×10³——473 . . . . . RD¼PS 4 7 3 J
0.5Ω——0R5 . . . . . RN2H 0 R 5 K
1Ω——010 . . . . . RS1P 0 1 0 K

Ex. 2 When there are 3 effective digits (such as in high precision metal film resistors).

5.62kΩ 562 × 10¹ 5621 . . . . . RN¼SR 5 6 2 1 F

- *The ⚠ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.*

11.1 MISCELLANEA

Miscellaneous Parts

CAPACITOR

Part No.	Symbol & Description
CKDYF 403Z 50	C1

SEMICONDUCTORS

Part No.	Symbol & Description	
TPS605	Q1–Q8	Photo transistor
AEL-311	D1	LED (green)
AEL-307	D2–D6	LED (red)
AEL-312	D7	LED (red)

LAMPS AND FUSE

Part No.	Symbol & Description	
AEL-077	PL1, PL2	Lamp 8V, 300mA
⚠ AEK-106	FU1	Fuse 1A

SWITCHES

Part No.	Symbol & Description	
⚠ ASG-505	S1	Push switch (POWER)
ASH-016	S7	Slide switch (DE-EMPHASIS)

RESISTOR

Part No.	Symbol & Description	
⚠ ACN-029	R1	Carbon composition 2.2MΩ

TRANSFORMERS

Part No.	Symbol & Description	
⚠ ATT-530	T1	Power transformer
T22-025	T2	Balun

P.C. BOARD ASSEMBLIES

Part No.	Description
AWB-036	FM front end
AWE-097	IF assembly
AWD-014	MPX AF assembly
AWR-177	Power supply assembly
AWX-146	Synthesizer assembly
GWS-141	Switch assembly A
GWS-142	Switch assembly B
AWX-132	Lamp assembly
ANP-756	P.c. board A
ANP-757	P.c. board B

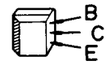
OTHERS

Part No.	Description
AAW-081	Signal meter
AKB-034	Terminal (MULTIPATH)
AKB-035	Terminal (OUTPUT)
AKA-009	Terminal (ANTENNA)
AKE-030	Terminal (GND)
AKX-055	F-tyep plug seat
⚠ AKP-002	AC socket
AKK-006	Lamp holder
⚠ ADG-023	AC power cord
ADX-099	Connector with wire (10P)
ADX-100	Connector with wire (4P)

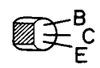
External Appearance of Transistors and ICs

2SC1919
2SA726S

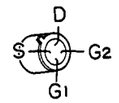
2SC535
2SC461



2SA733
2SC945A
2SC1923



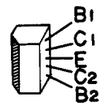
3SK45



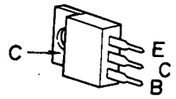
2SK61

2SK19

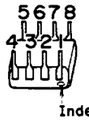
2SA798



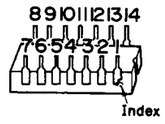
2SB507
2SD712



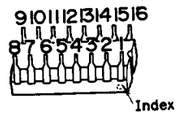
HA1201
LA1222
μPC4558C



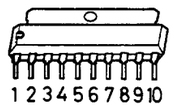
M53273P
M5109PR
M53490P



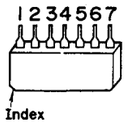
PA3001
PA1001
PA1002
TC9100P



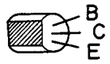
PA2002



TA7302



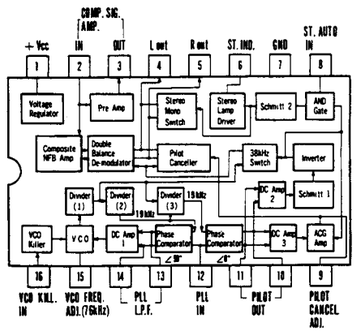
2SA912



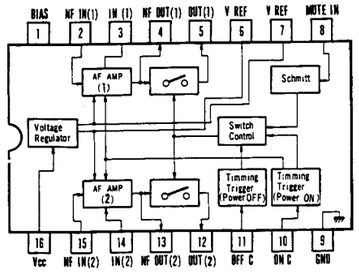
2SK34

Block Diagrams of ICs

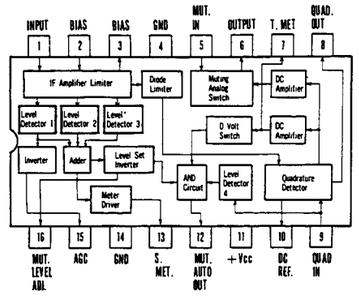
PA1001



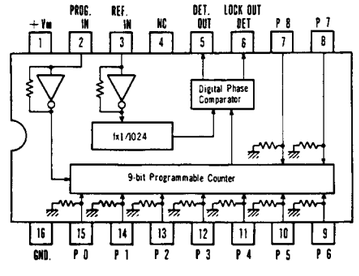
PA1002



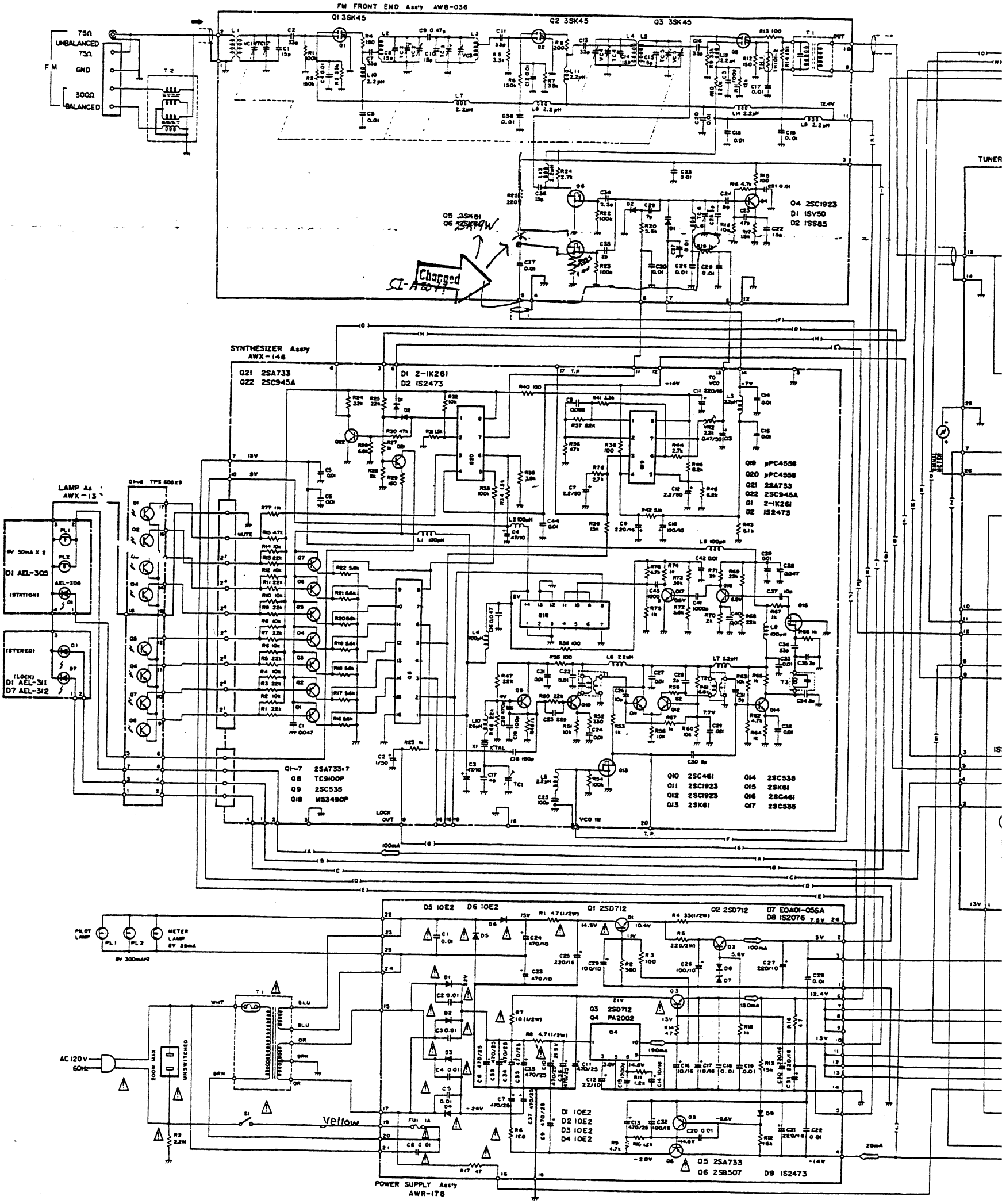
PA3001



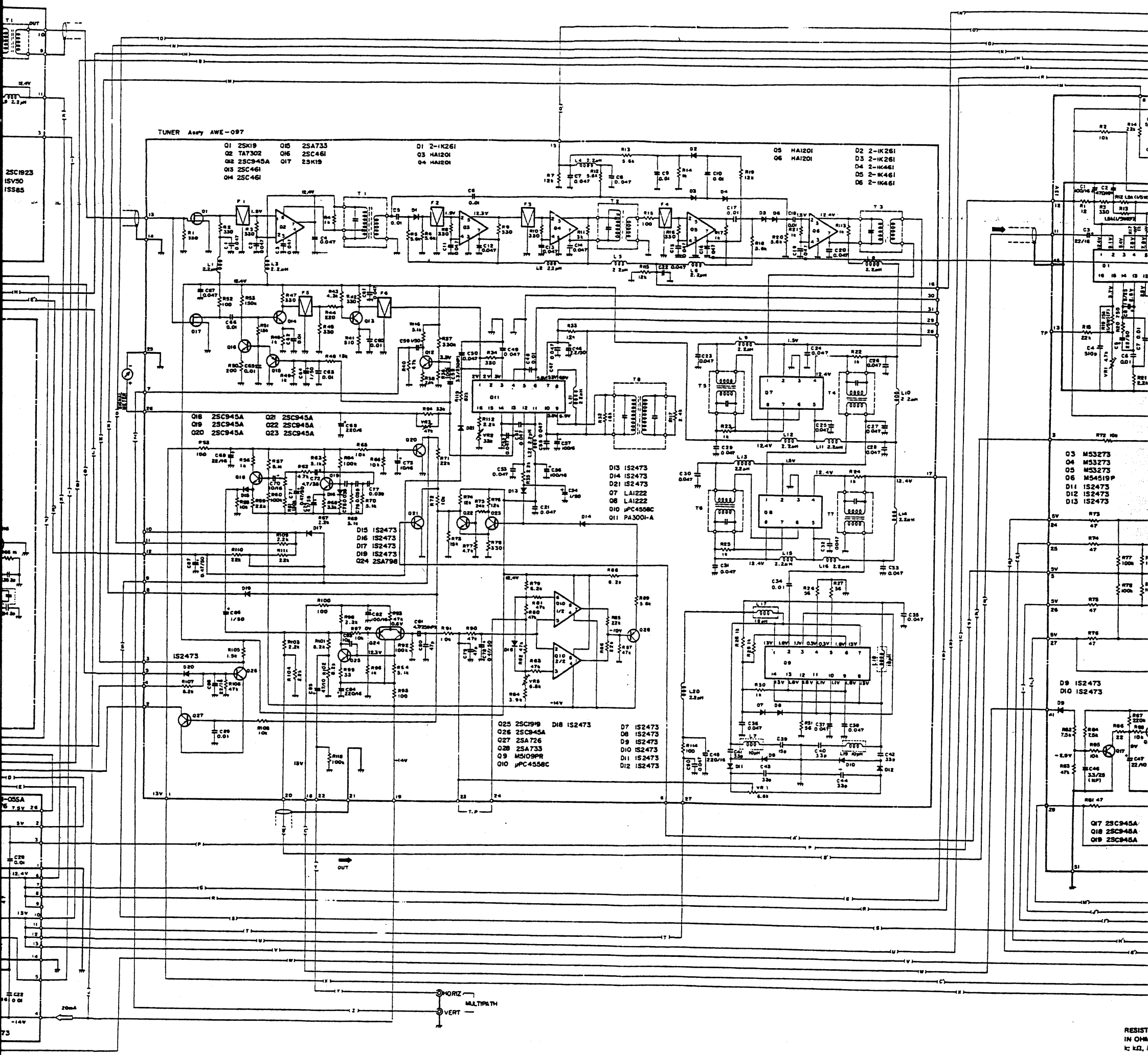
TC9100P



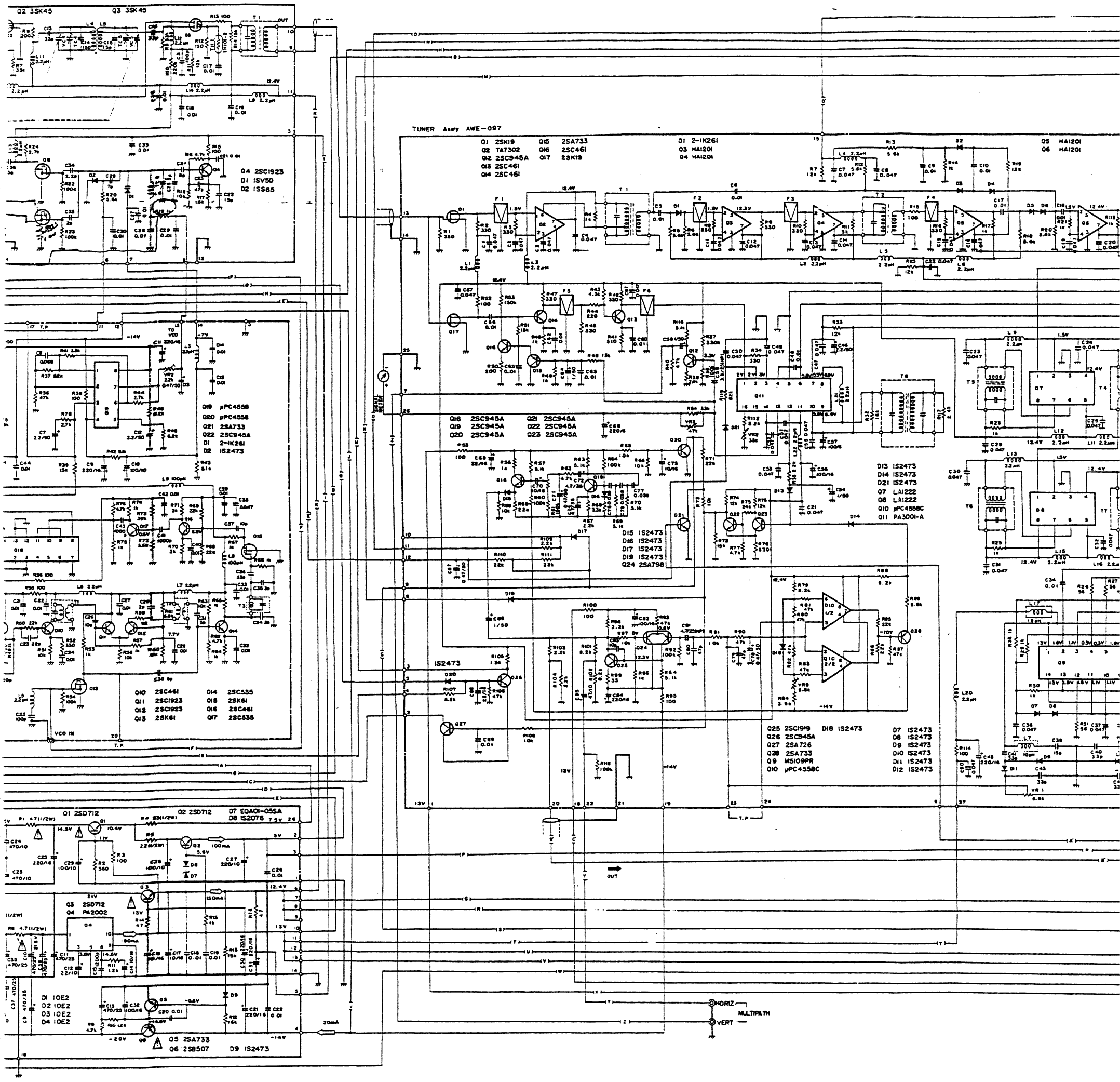
11.2 SCHEMATIC DIAGRAM

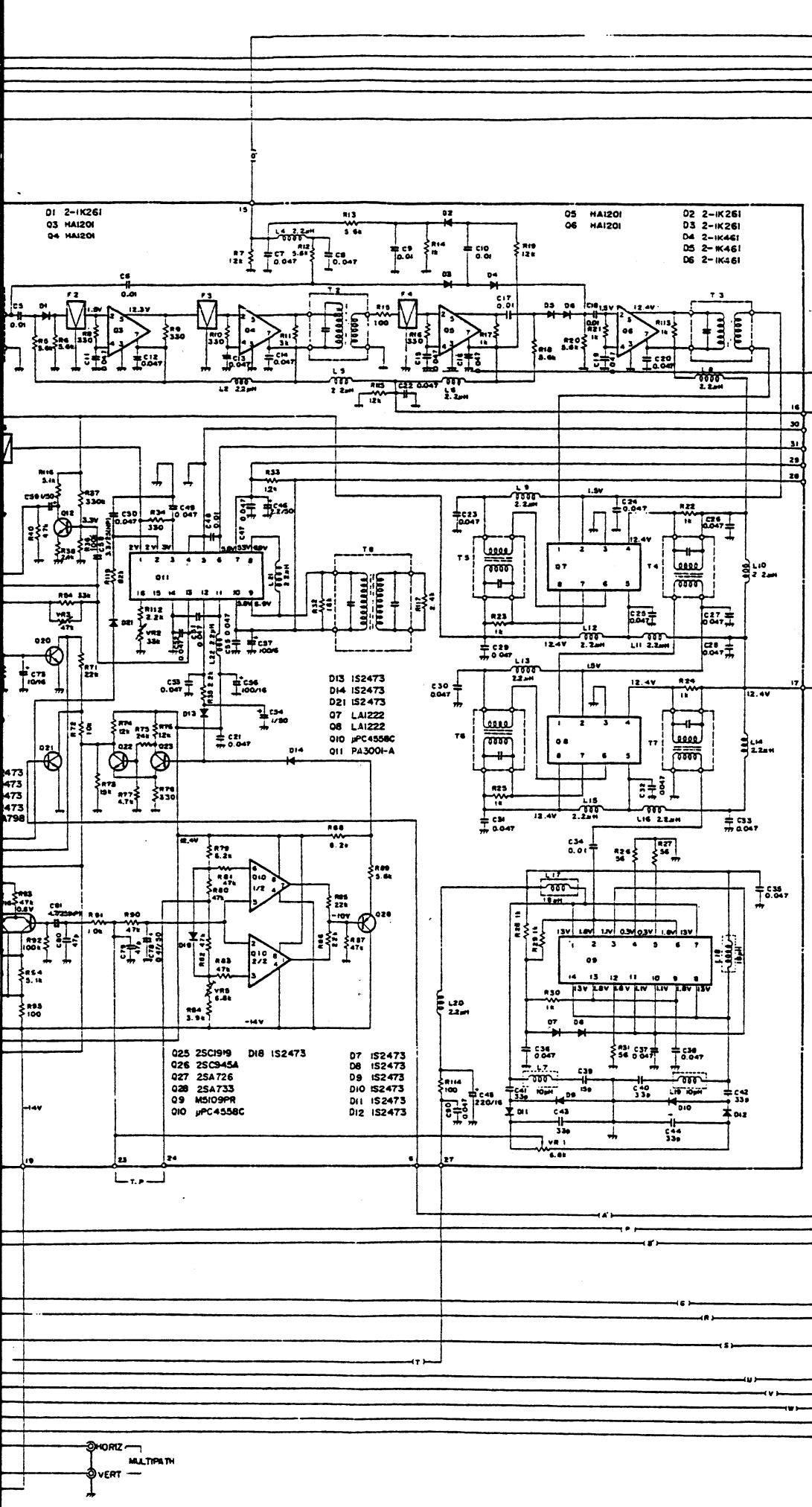


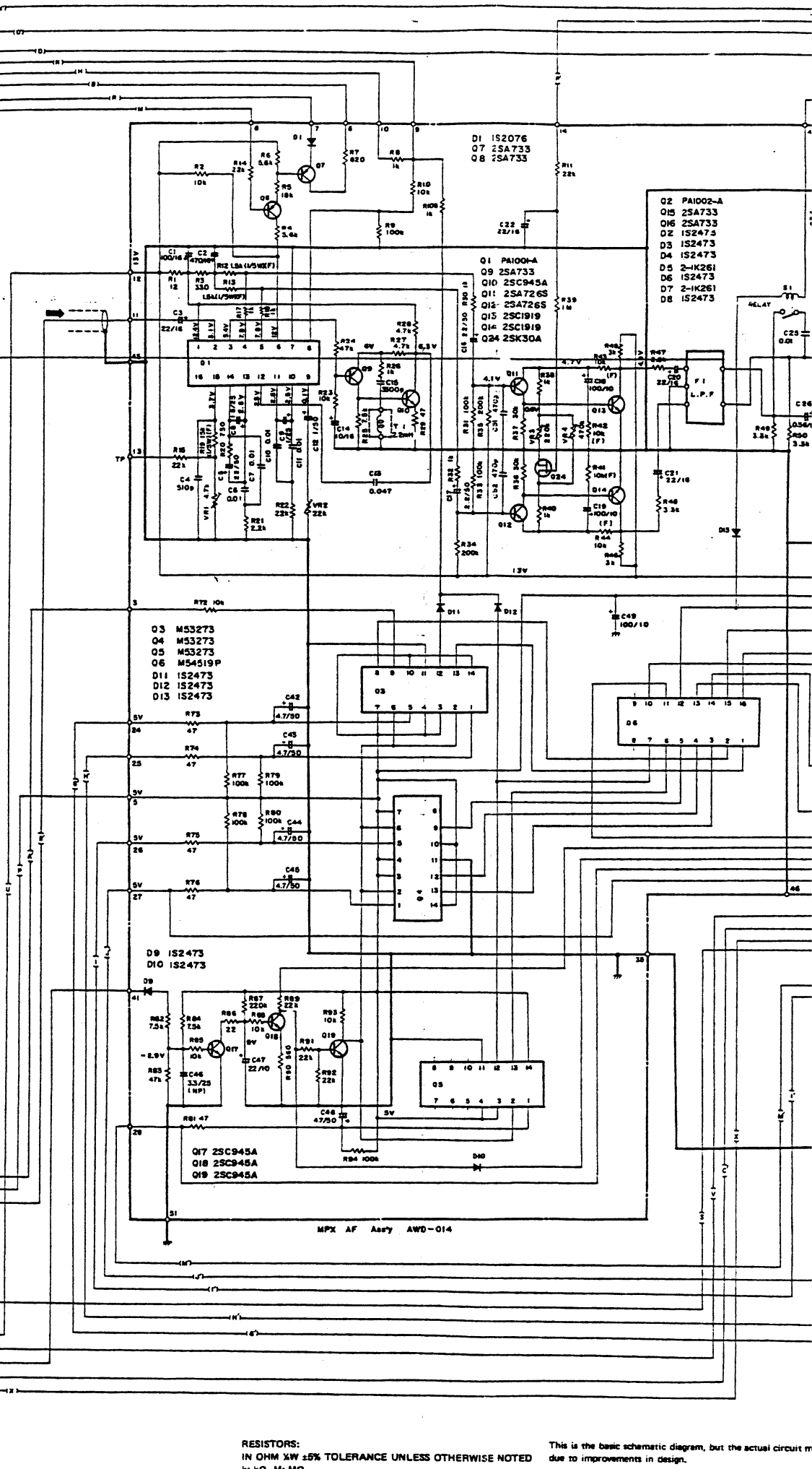
MC-Service


TUNER Assy AWE-097
Q1 2SK19
Q2 TA7302
Q12 2SC945A
Q13 2SC461
Q14 2SC461
Q15 2SA733
Q16 2SC461
Q17 2SK19
D1 2-1K261
D3 HAI201
D4 HAI201
Q5 HAI201
Q6 HAI201
D2 2-1K261
D3 2-1K261
D4 2-1K461
D5 2-1K461
D6 2-1K461
Q18 2SC945A
Q19 2SC945A
Q20 2SC945A
Q21 2SC945A
Q22 2SC945A
Q23 2SC945A
D13 1S2473
D14 1S2473
D21 1S2473
Q7 LA1222
Q8 LA1222
D10 μPC4558C
Q11 PA3001-A
D15 1S2473
D16 1S2473
D17 1S2473
D19 1S2473
Q24 2SA798
Q25 2SC1919
Q26 2SC945A
Q27 2SA726
Q28 2SA733
Q9 M5109PR
Q10 μPC4558C
D18 1S2473
D7 1S2473
D8 1S2473
D9 1S2473
D10 1S2473
D11 1S2473
D12 1S2473
D3 M53273
D4 M53273
D5 M53273
D6 M54519P
D11 1S2473
D12 1S2473
D13 1S2473
D9 1S2473
D10 1S2473
Q17 2SC945A
Q18 2SC945A
Q19 2SC945A
2SC1923
1SV50
1SS85
1S2473
OUT
HORIZ
MULTIPATH
VERT
20mA
T.P

MC-Service


TUNER Assy AWE-097
Q1 2SK19
Q2 TA7302
Q12 2SC945A
Q13 2SC461
Q14 2SC461
Q15 2SA733
Q16 2SC461
Q17 2SK19
D1 2-1K261
D3 HA1201
D4 HA1201
Q5 HA1201
Q6 HA1201
Q4 2SC1923
D1 1SV50
D2 1SS85
Q10 2SC461
Q11 2SC1923
Q12 2SC1923
Q13 2SK61
Q14 2SC535
Q15 2SK61
Q16 2SC461
Q17 2SC535
Q18 2SC945A
Q19 2SC945A
Q20 2SC945A
Q21 2SC945A
Q22 2SC945A
Q23 2SC945A
D15 1S2473
D16 1S2473
D17 1S2473
D19 1S2473
Q24 2SA798
D13 1S2473
D14 1S2473
D21 1S2473
Q7 LA1222
Q8 LA1222
Q10 μPC4558C
Q11 PA3001-A
Q19 μPC4558
Q20 μPC4558
Q21 2SA733
Q22 2SC945A
D1 2-1K261
D2 1S2473
Q25 2SC1918
Q26 2SC945A
Q27 2SA726
Q28 2SA733
Q9 M5109PR
Q10 μPC4558C
D18 1S2473
D7 1S2473
D8 1S2473
D9 1S2473
D10 1S2473
D11 1S2473
D12 1S2473
Q1 2SD712
Q2 2SD712
D7 EQA01-05SA
D8 1S2076
Q3 2SD712
Q4 PA2002
D1 10E2
D2 10E2
D3 10E2
D4 10E2
Q5 2SA733
Q6 2SB507
D9 1S2473
HORIZ
VERT
MULTIPATH
OUT





RESISTORS:
IN OHM ¼W ±5% TOLERANCE UNLESS OTHERWISE NOTED
k: kΩ, M: MΩ

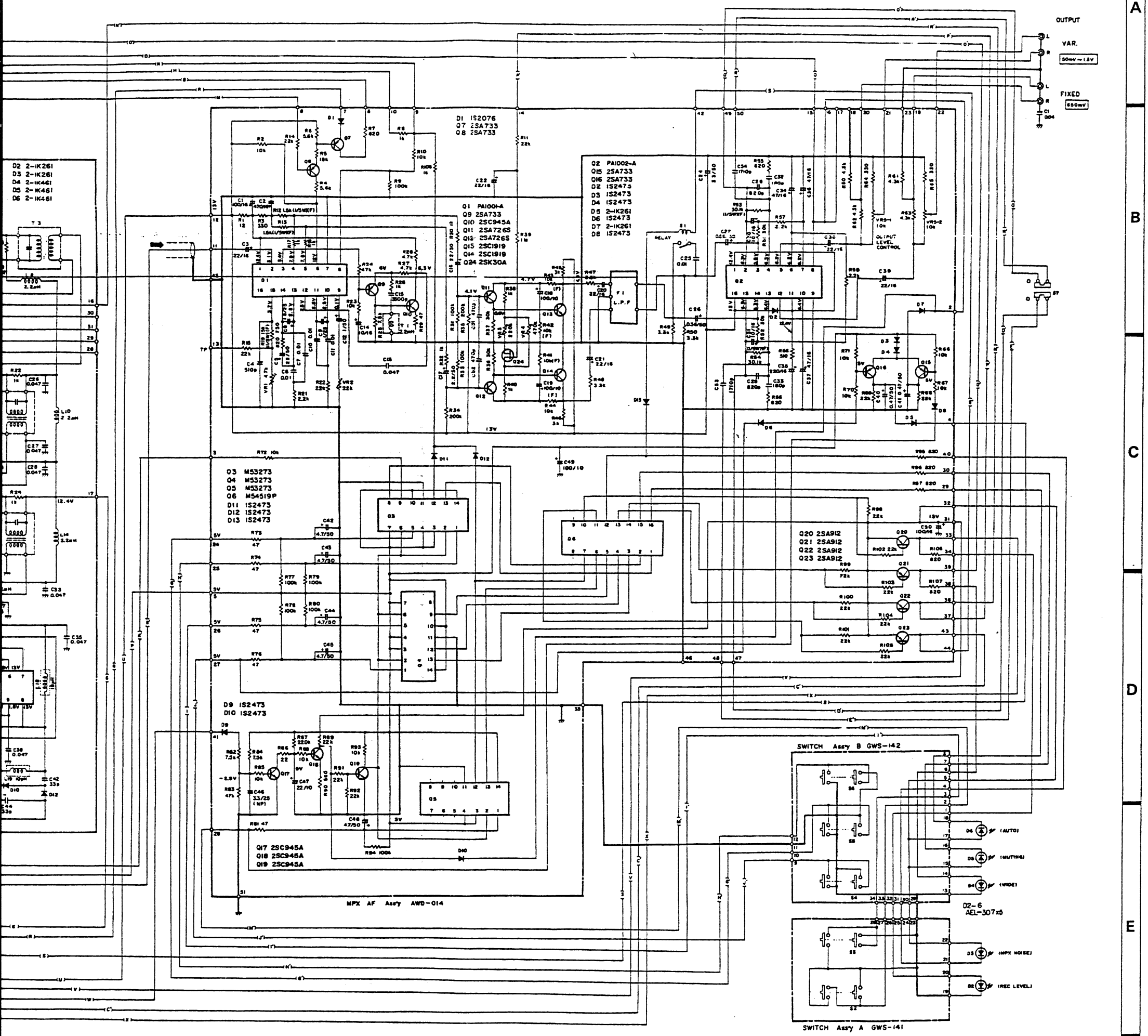
CAPACITORS:
IN μF UNLESS OTHERWISE NOTED p: pF

V: DC VOLTAGE AT NO INPUT SIGNAL
mA: DC CURRENT AT NO INPUT SIGNAL
mV: SIGNAL VOLTAGE AT FM 400Hz 75kHz DEV.

This is the basic schematic diagram, but the actual circuit m
due to improvements in design.

The ⚠ mark found on some component parts indicates
portance of the safety factor of the part.
Therefore, when replacing, be sure to use parts of ine
designation.

MC-Service



RESISTORS:
IN OHM ¼W ±5% TOLERANCE UNLESS OTHERWISE NOTED
k: kΩ, M: MΩ

CAPACITORS:
IN μF UNLESS OTHERWISE NOTED p: pF

V: DC VOLTAGE AT NO INPUT SIGNAL
⇦ mA: DC CURRENT AT NO INPUT SIGNAL
mV: SIGNAL VOLTAGE AT FM 400Hz 75kHz DEV.

This is the basic schematic diagram, but the actual circuit may vary due to improvements in design.

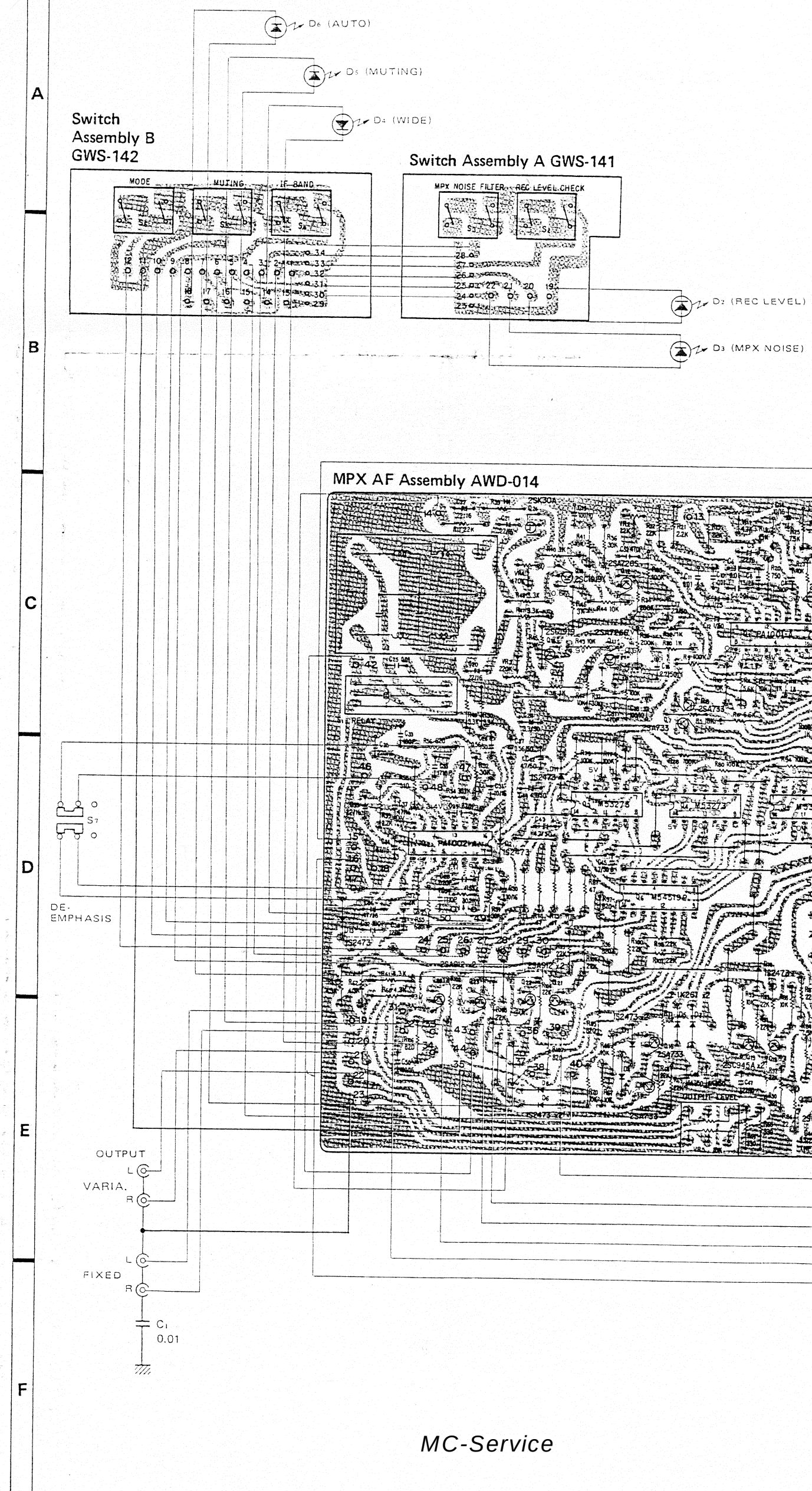
The ⚠ mark found on some component parts indicates the importance of the safety factor of the part.
Therefore, when replacing, be sure to use parts of indentical designation.

SWITCHES:
- S1. POWER ON-OFF
- S2. REC LEVEL CHECK ON-OFF
- S3. MPX NOISE FILTER ON-OFF
- S4. IF BAND WIDE-NARROW
- S5. MUTING ON-OFF
- S6. MODE AUTO-MONO
- S7. DE-EMPHASIS 75μs–25μs

The underlined indicates the switch position.

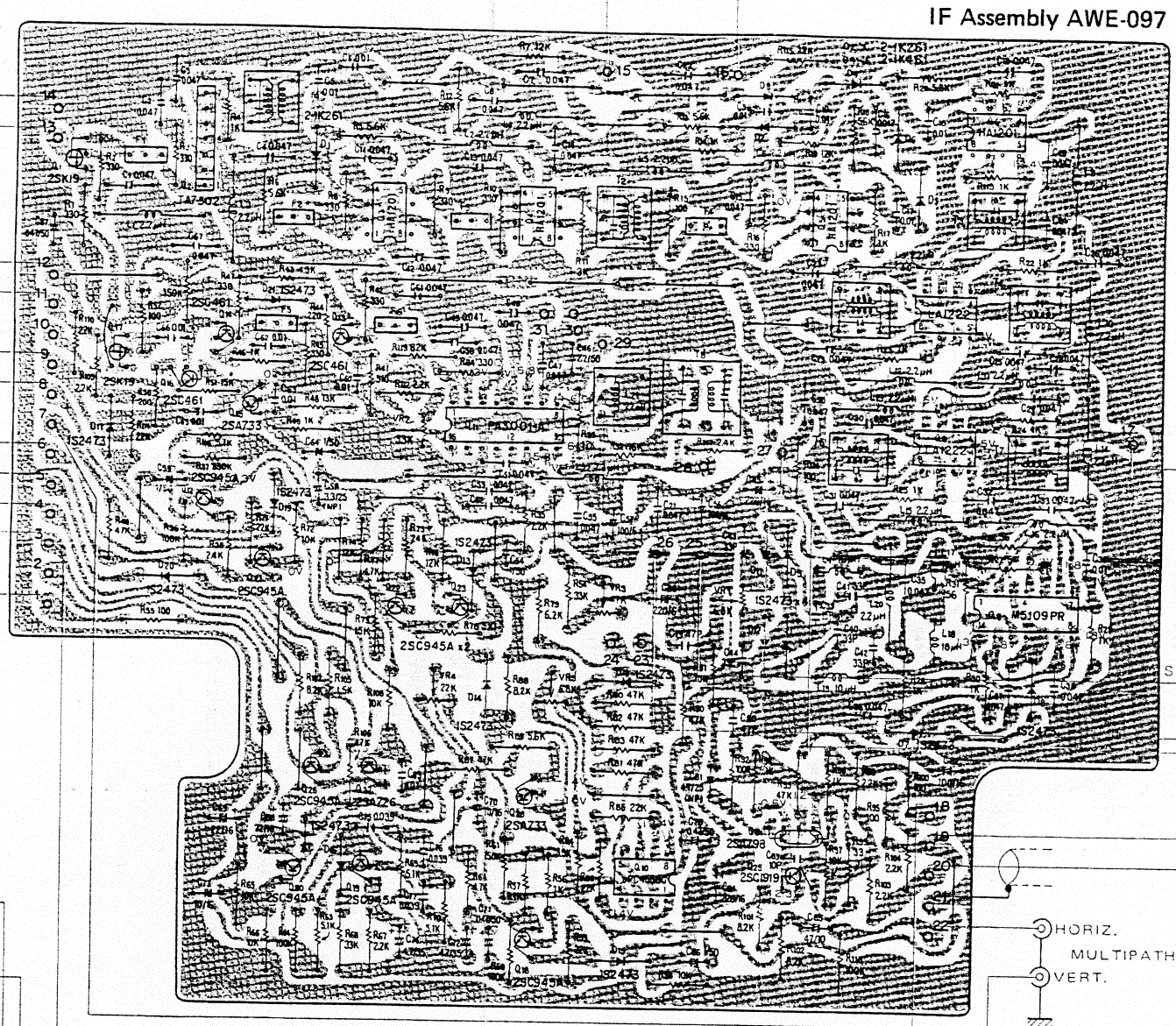
MC-Service

11.3 P.C. BOARD CONNECTION DIAGRAM



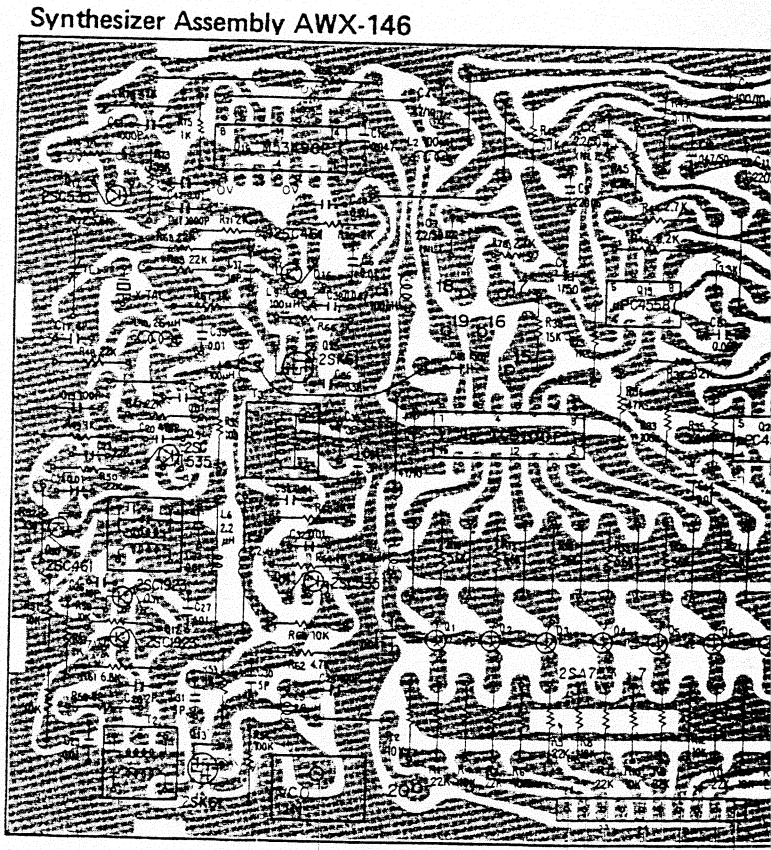
5 6 7 8 9

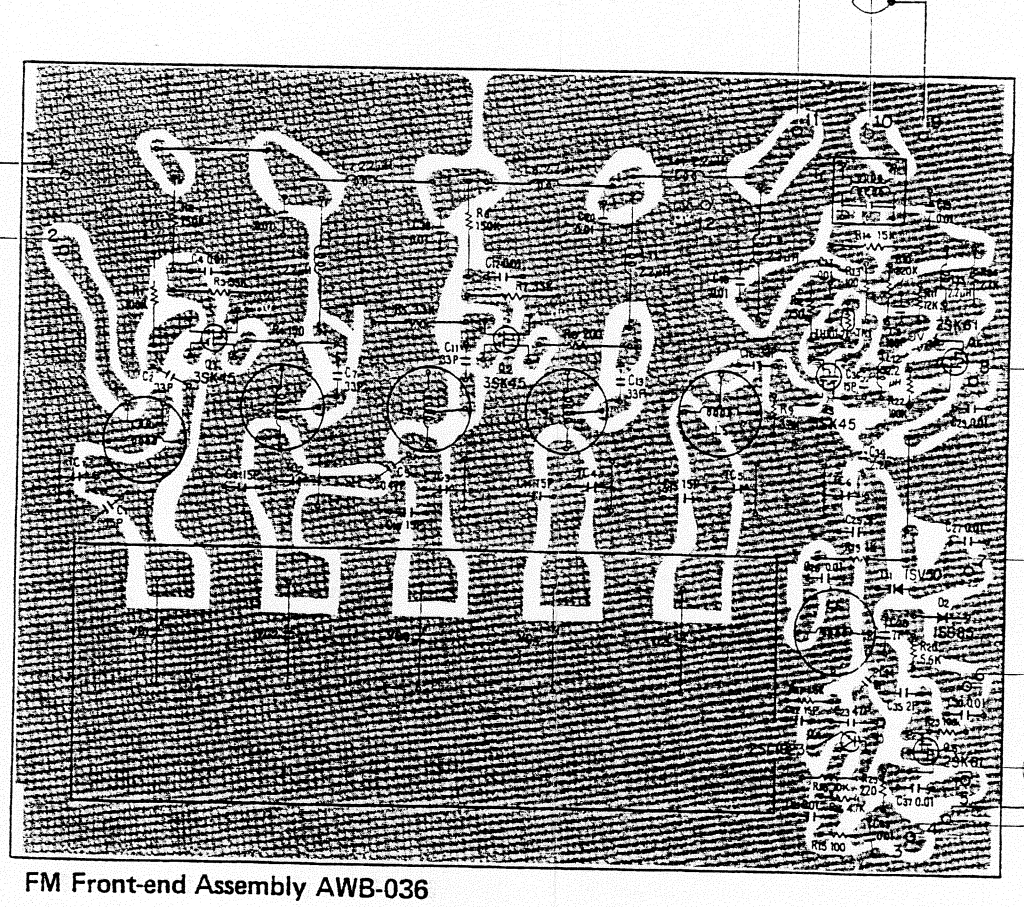
IF Assembly AWE-097



Power Su

Synthesizer Assembly AWX-146





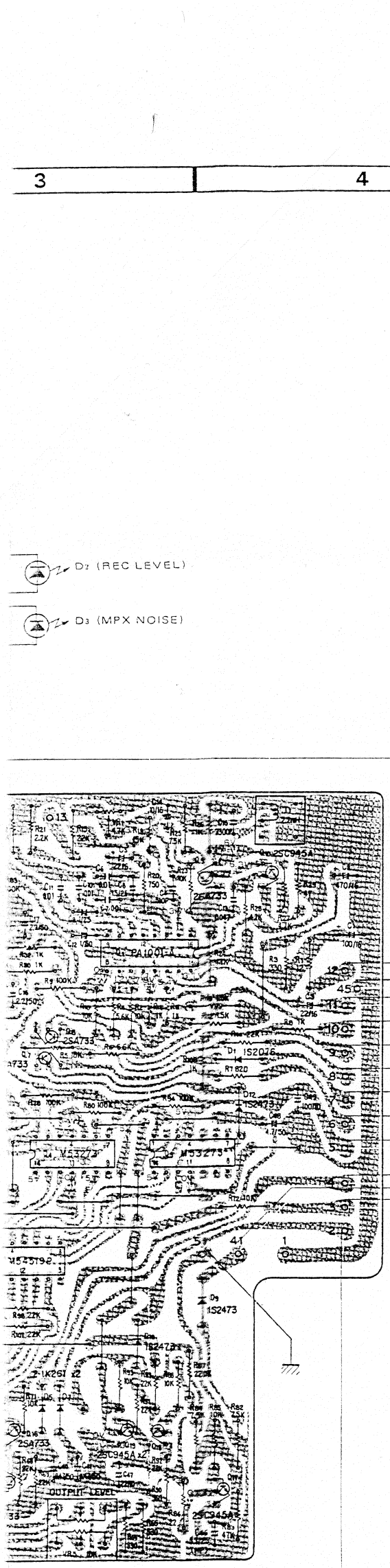
FM Front-end Assembly AWB-036

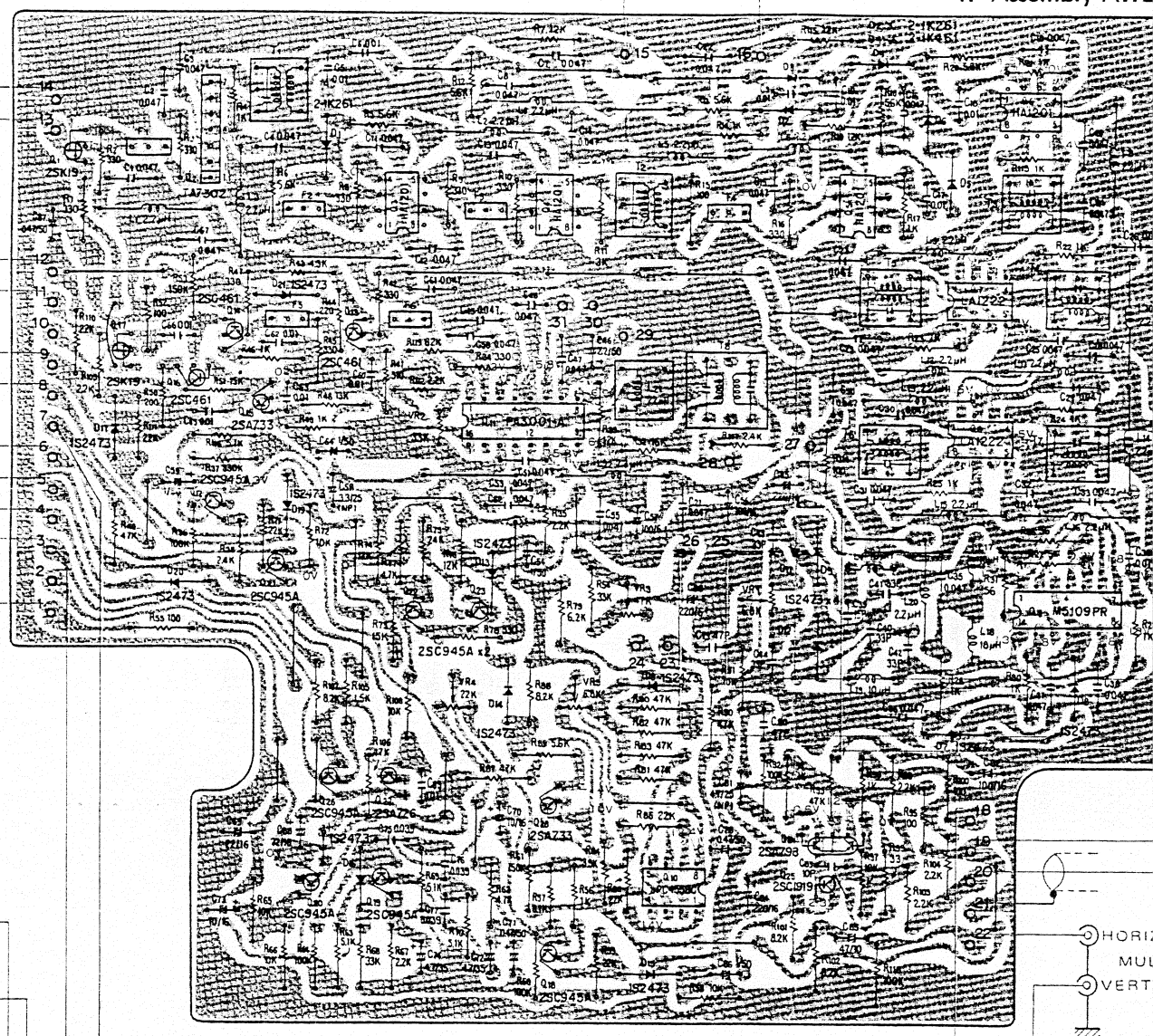
5 6 7 8 9

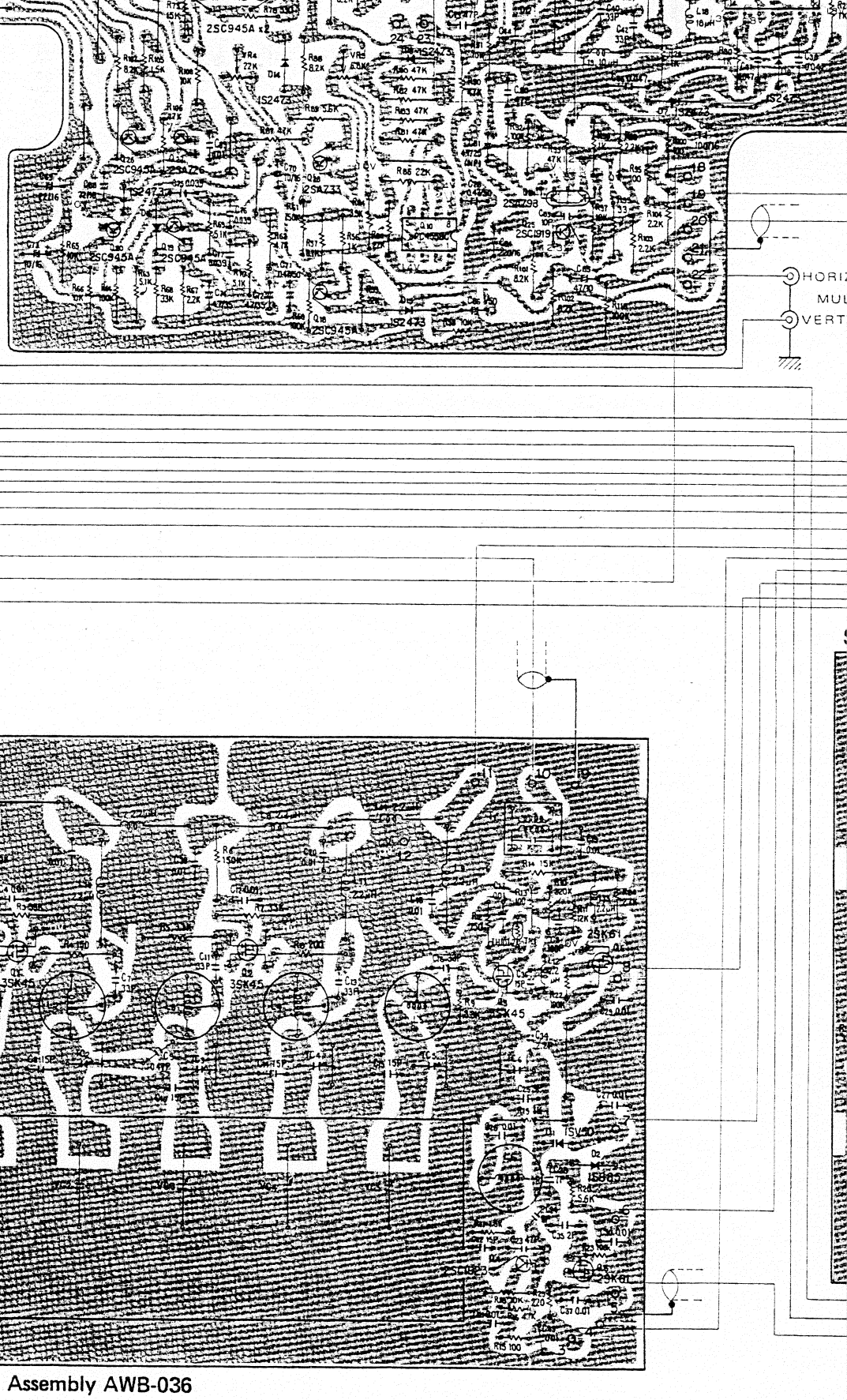
IF Assembly AWE

D2 (REC LEVEL)

D3 (MPX NOISE)

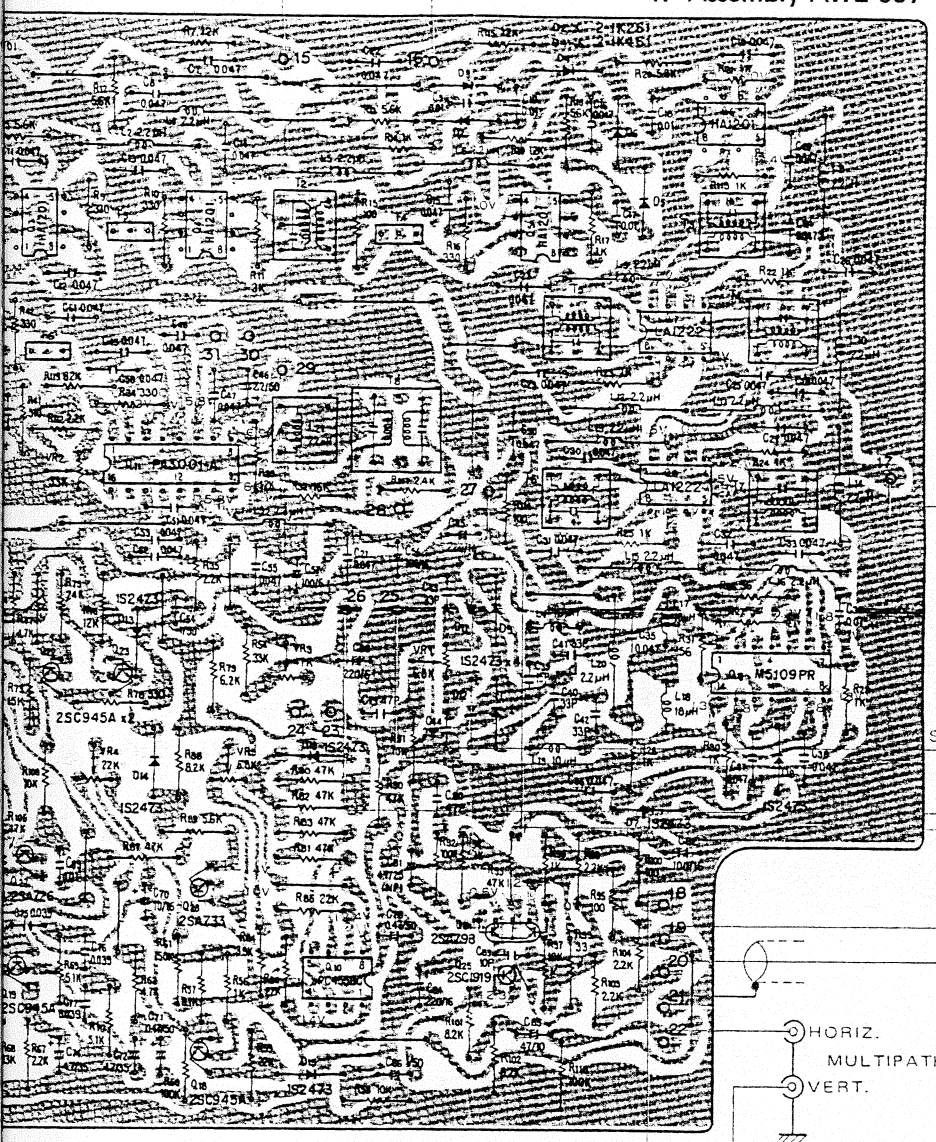






FM Front-end Assembly AWB-036

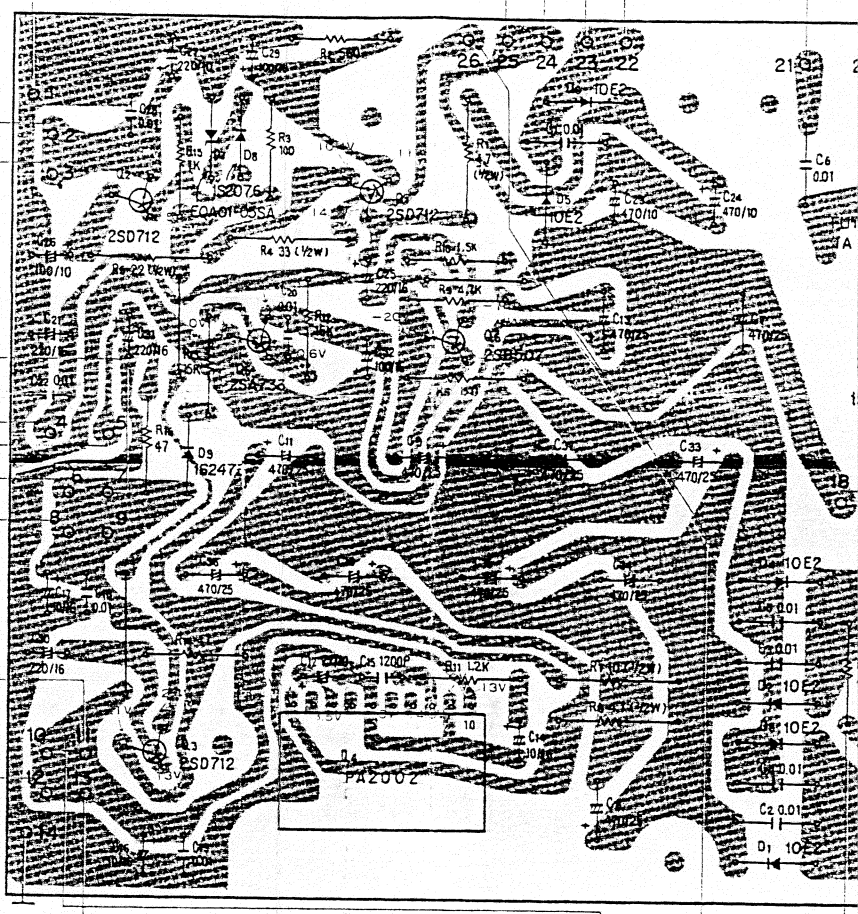
IF Assembly AWE-097



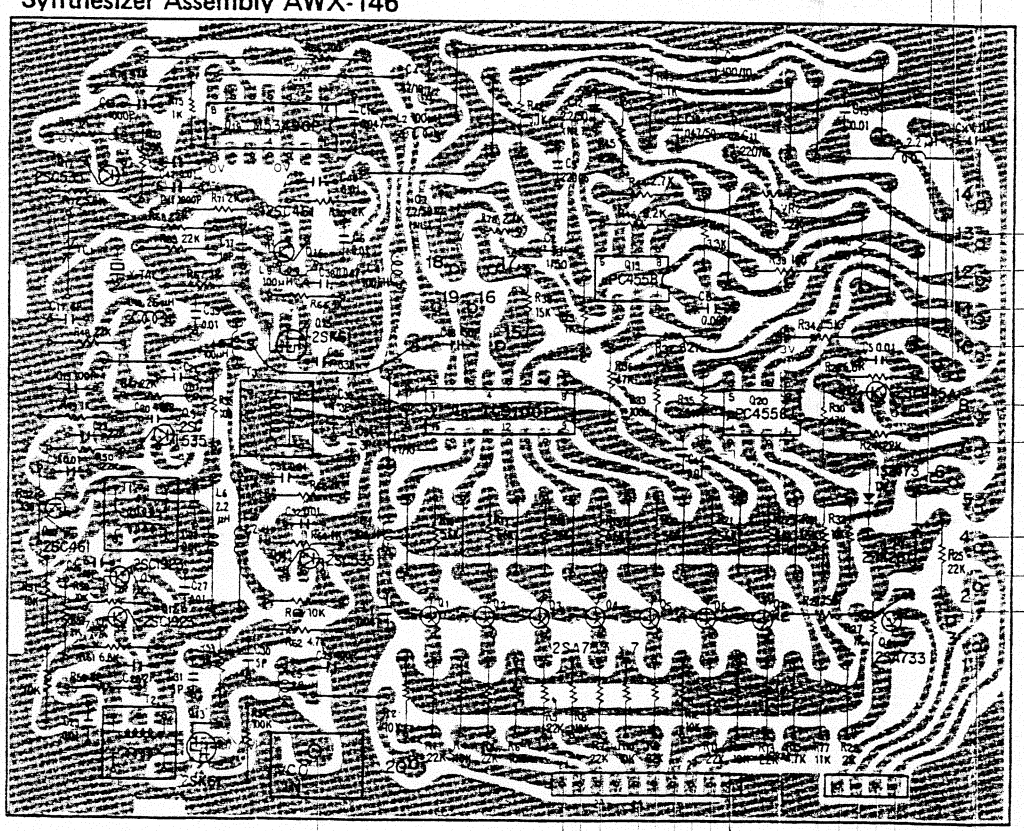
SIGNAL METER

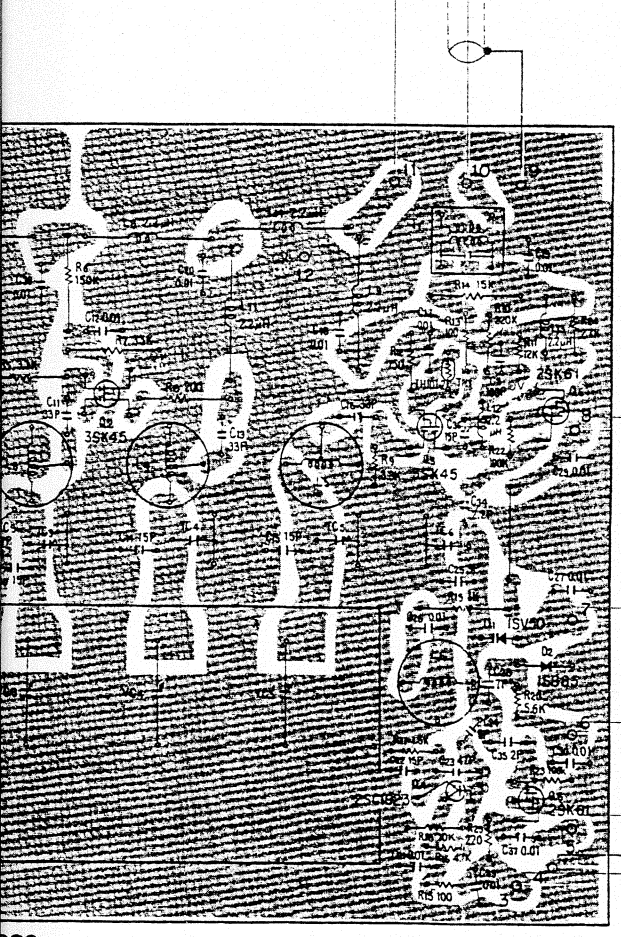
HORIZ.
MULTIPATH
VERT.

Power Supply Assembly AWR-177



Synthesizer Assembly AWX-146



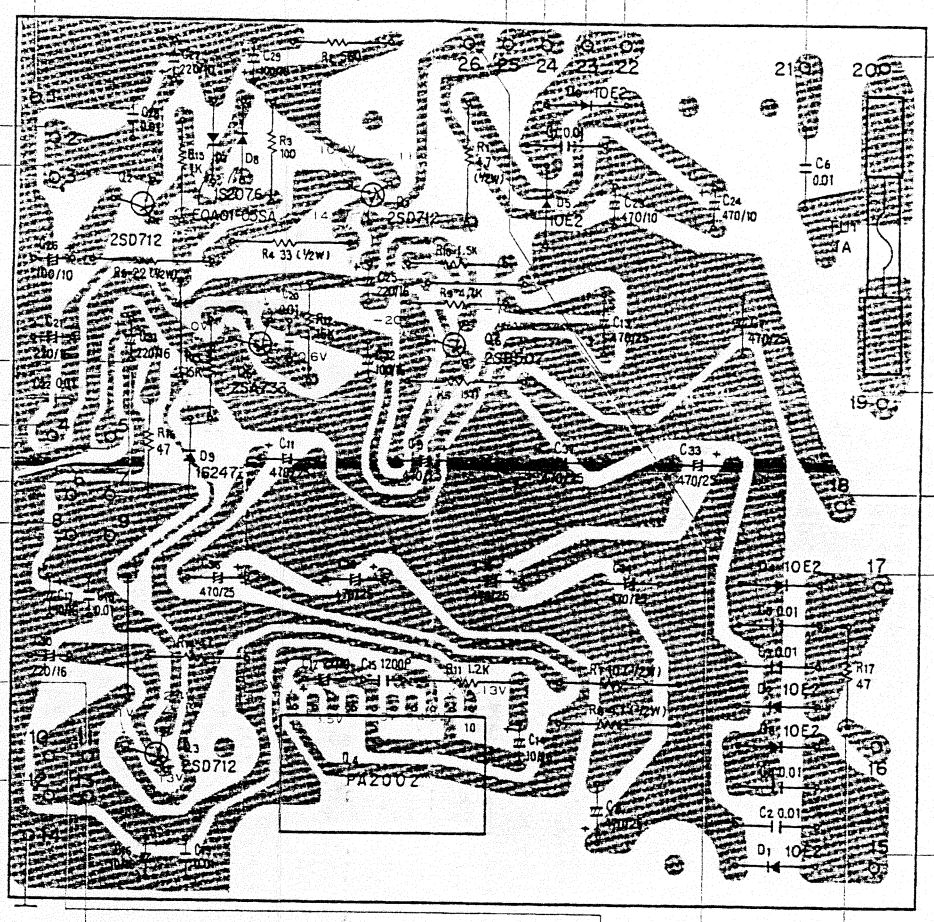


036

E-097

METER LAMP
PL1
PL2
PILOT LAMP

Power Supply Assembly AWR-177

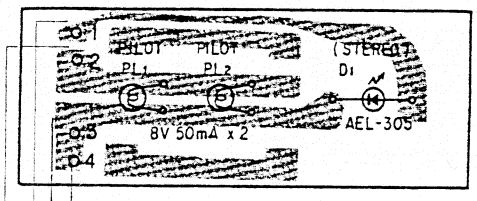


POWER TRANSFORMER
BLU
BLU
OR
BRN
OR
BRN
WHT
AC 120V 60Hz
S1 POWER
R2 2.2M

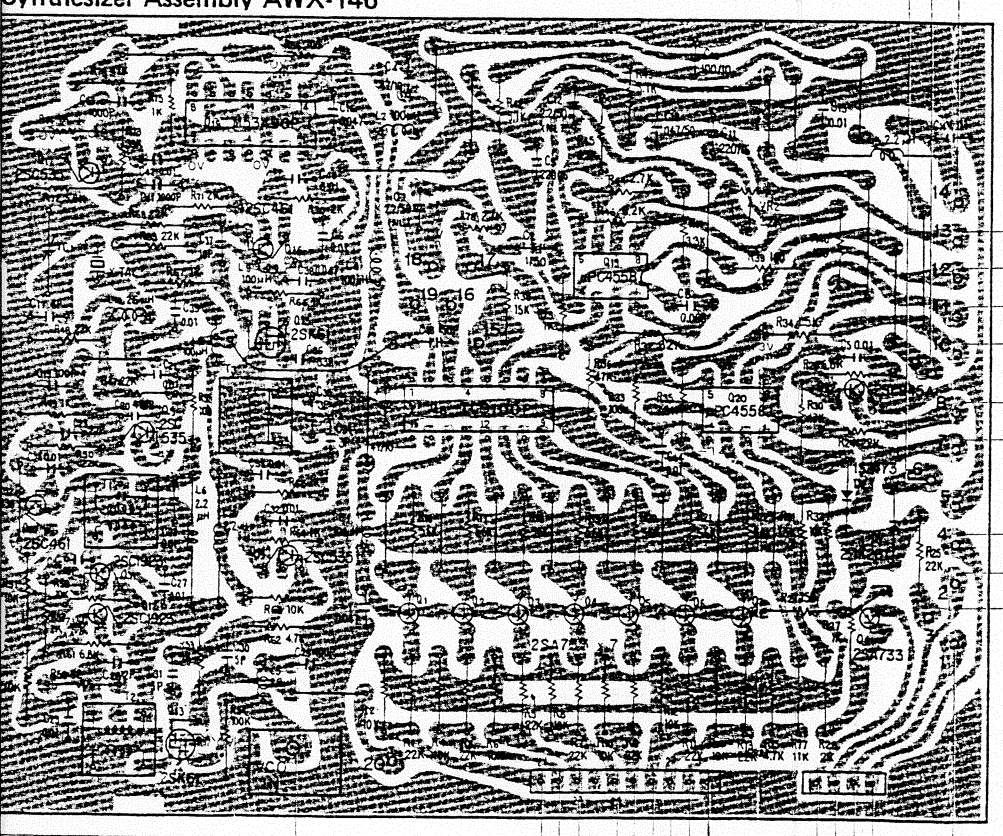
SIGNAL METER

Z.
LTIPATH

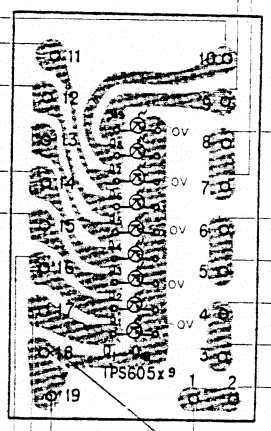
Lamp Assembly AWX-132



Synthesizer Assembly AWX-146



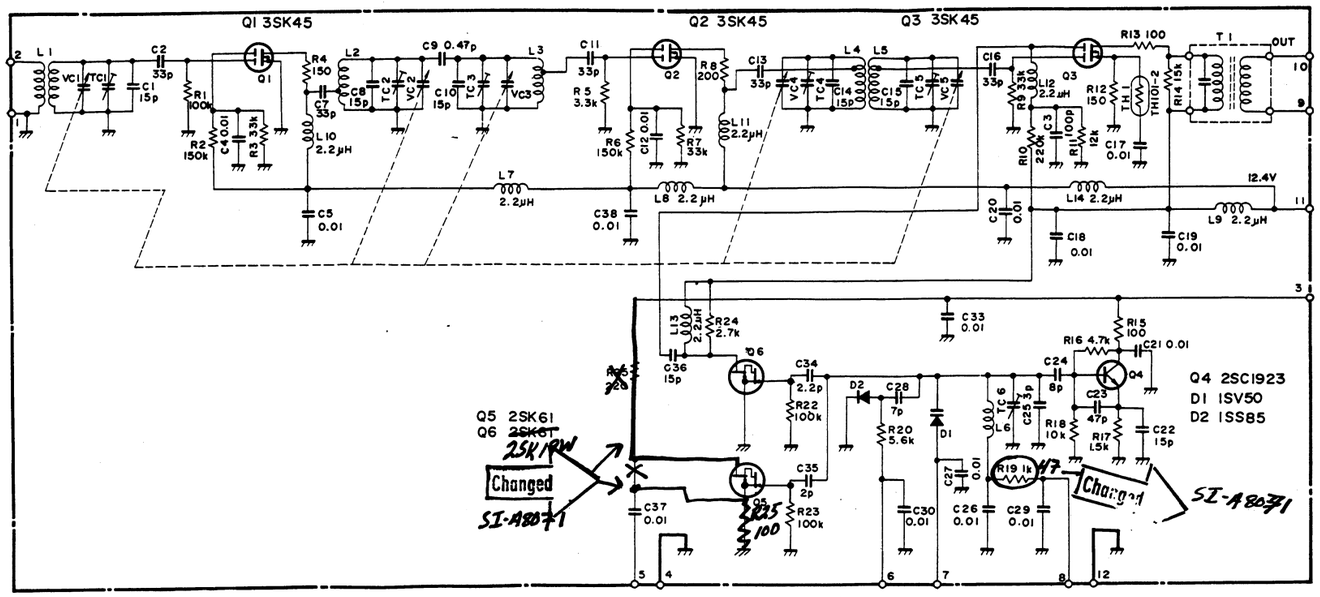
ANP-756



ANP-757

D1 AEL-311
D7 AEL-312

11.4 FM FRONT-END (AWB-036)



Parts List

COILS AND TRANSFORMERS

Part No.	Symbol & Description	
ATC-070	L1	FM ANT coil
ATC-076	L2–L4	FM RF coil
ATC-071	L5	FM RF coil
ATC-077	L6	FM OSC coil
T24-028	L7–L14	RF choke coil
ATE-042	T1	FM transformer

CAPACITORS

Part No.	Symbol & Description	
ACK-023	VC1	Tuning capacitor
ACM-006	TC1–TC6	Trimmer
CCDRH 150K 50	C1, C8, C10, C14, C15	
CCDCH 330K 50	C2, C7, C11, C13, C16	
CCDSL 101K 50	C3	
CKDYF 103Z 50	C4, C5, C12, C17–C20, C29, C30, C33, C37,	
CKDYF 103Z 50	C38	
CGB R47K 500	C9	

Part No.	Description
CCDCH 470K 50	C23
CCDRH 080F 50	C24
CCDTH 030L 50	C25
CKDYB 103K 50	C21, C26, C27
CCDSH 070F 50	C28
CGB 2R2K 500	C34
CCDCH 020C 50	C35
CCDCH 150K 50	C22, C36

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

RESISTORS

Part No.	Symbol & Description
RD¼PS □□□J	R1–R8, R14, R19
RD¼VS □□□J	R9–R13, R15–R18, R20, R22–R25

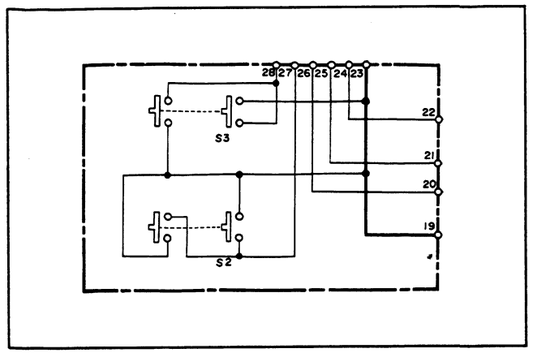
SEMICONDUCTORS

Part No.	Symbol & Description
3SK45-B	Q1–Q3
2SC1923-O or R	Q4
2SK61-GR	Q5, Q6
1SV50	D1
1SS85	D2
TH101-2	TH1

OTHERS

Part No.	Description
ABA-186	Screw 3 x 8
ABA-078	Screw 3 x 8

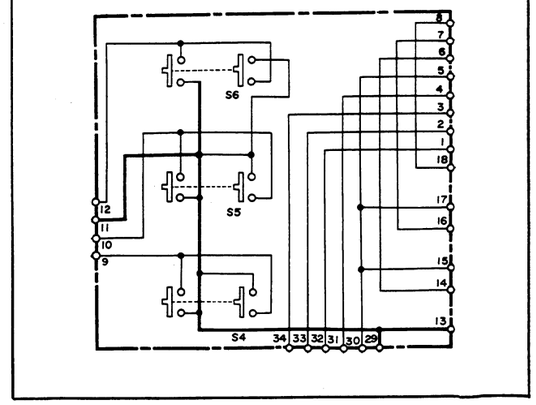
11.5 SWITCH ASSEMBLY A (GWS-141)



Parts List

Part No.	Symbol & Description	
ASG-134	S2, S3	Key switch (REC LEVEL CHECK, MPX NOISE FILTER)
ADX-096		LED Socket

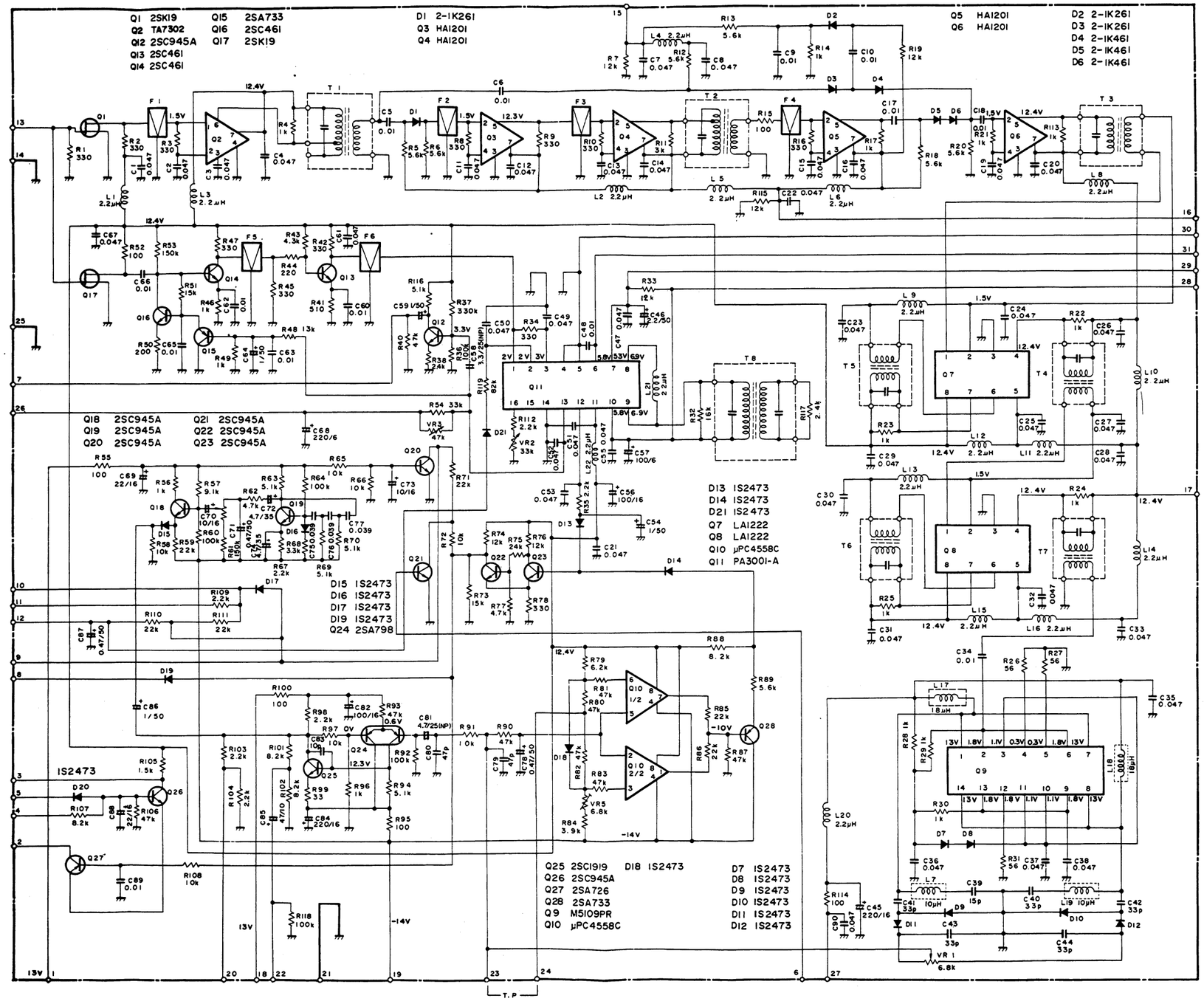
11.6 SWITCH ASSEMBLY B (GWS-142)



Parts List

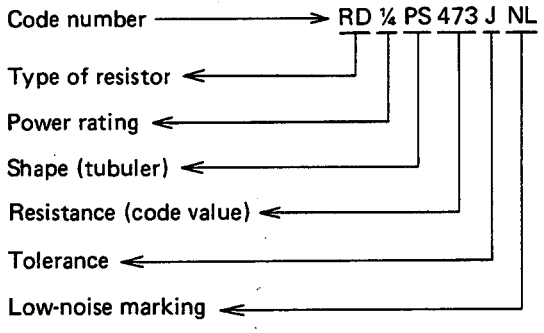
Part No.	Symbol & Description	
ASG-134	S4–S6	Key switch (IF BAND, TUNING, MODE)
ADX-096		LED Socket

11.7 IF ASSEMBLY (AWE-097)



RESISTANCE VALUE CODES

Code numbers of resistors used in Pioneer equipment are expressed in the following way:—



Furthermore, in the list of parts found in the Service Manual, the resistance (code value) part of the above code number is expressed as □□□ or □□□□.

Resistors included in the Service Manual list of parts

↓

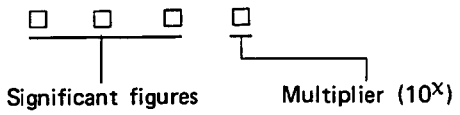
Ex. RD ¼ PS □□□ JNL

When ordering resistor components, first ascertain the actual resistance value from the circuit diagram, and then convert it into code no. form as shown in the following examples.

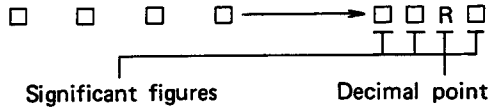
For further details on code numbers, refer to "Tuning Fork" VOL. 1.

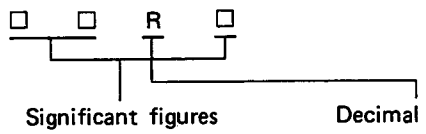
Ex. 1 For □□□□ Codes

* **General resistors**



* **Resistors with fractional values**



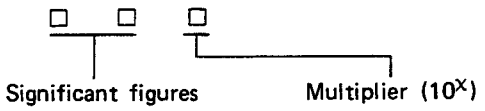


Ex. 1

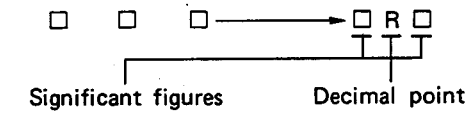
Nominal resistance (Ω)	Significant figure (three figures)	Multiplier (10X)	Resistance value code
5.1	510	.....	5R10
5.62	562	.....	5R62
10	100	.....	10R0
22.5	225	.....	22R5
110	110	$\times 10^0$	1100
1k (1000)	100	$\times 10^1$	1001
1.56k (1560)	156	$\times 10^1$	1561
10k (10000)	100	$\times 10^2$	1002
33.6k (33600)	336	$\times 10^2$	3362
112k (112000)	112	$\times 10^3$	1123
1M (1000000)	100	$\times 10^4$	1004
1.56M (1560000)	156	$\times 10^4$	1564

Ex. 2 For □□□ Codes

* **General resistors**



* **Resistors with fractional values**



Ex. 2

Nominal resistance (Ω)	Significant figure (two figures)	Multiplier (10X)	Resistance value code
0.5	05	.....	0R5
1.5	15	.....	1R5
1	01	$\times 10^0$	010
22	22	$\times 10^0$	220
330	33	$\times 10^1$	331
1k (1000)	10	$\times 10^2$	102
5.6k (5600)	56	$\times 10^3$	562
68k (68000)	68	$\times 10^3$	683
820k (820000)	82	$\times 10^4$	824
1M (1000000)	10	$\times 10^5$	105
2.2M (2200000)	22	$\times 10^5$	225

Parts List of IF Assembly (AWE-097)

COILS AND TRANSFORMERS

Part No.	Symbol & Description		
T24-028	L1–L6, L8–L16, L20, L22		
		RF choke coil	2.2μH
ATH-010	L7, L19	Coil	10μH
ATH-007	L17, L18	Coil	18μH
ATE-041	L21	Coil	22μH
ATE-035	T1, T2	IFT	
ATE-023	T3–T7	IFT	
ATE-040	T8	IFT	
ATF-050	F1	Ceramic filter	
ATF-044	F2–F4	Ceramic filter	
ATF-051	F5, F6	Ceramic filter	

CAPACITORS

Part No.	Symbol & Description		
CKDBC 473Z 25	C1–C4, C7, C8, C11–C16, C19, C20–C33		
CKDBC 473Z 25	C35–C38, C47, C49–C53, C55, C61, C67, C90		
CKDYB 103K 50	C5,C6,C9,C10,C17,C18,C34,C48,C60,C62		
CKDYB 103K 50	C63, C65, C66, C89		
CCDUJ 150J 50	C39		
CCDUJ 330J 50	C40		
CCDSL 330K 50	C41–C44		
CEA 221P 16	C45, C84		
CEA 2R2P 50	C46		
CEA 010P 50	C54, C59, C64, C86		
CEA 101P 16	C56, C82		
CEA 101P 6	C57		
ACH-302	C58	Electrolytic	3.3/2.5V
CEA 221P 6	C68		
CEA 220P 16	C69, C88		
CEA 100P 16	C70, C73		
CEA R47P 50	C71, C78, C87		
CEA 4R7P 35	C72, C74		
CQMA 393K 50	C75–C77		
CCDSL 470K 50	C79, C80		
ACH-318	C81	Electrolytic	4.7/2.5V
CCDSL 100F 50	C83		
CEA 470P 10	C85		

Note: When ordeirng resistors, convert the resistance value into code form, and then rewrite the part no. as before.

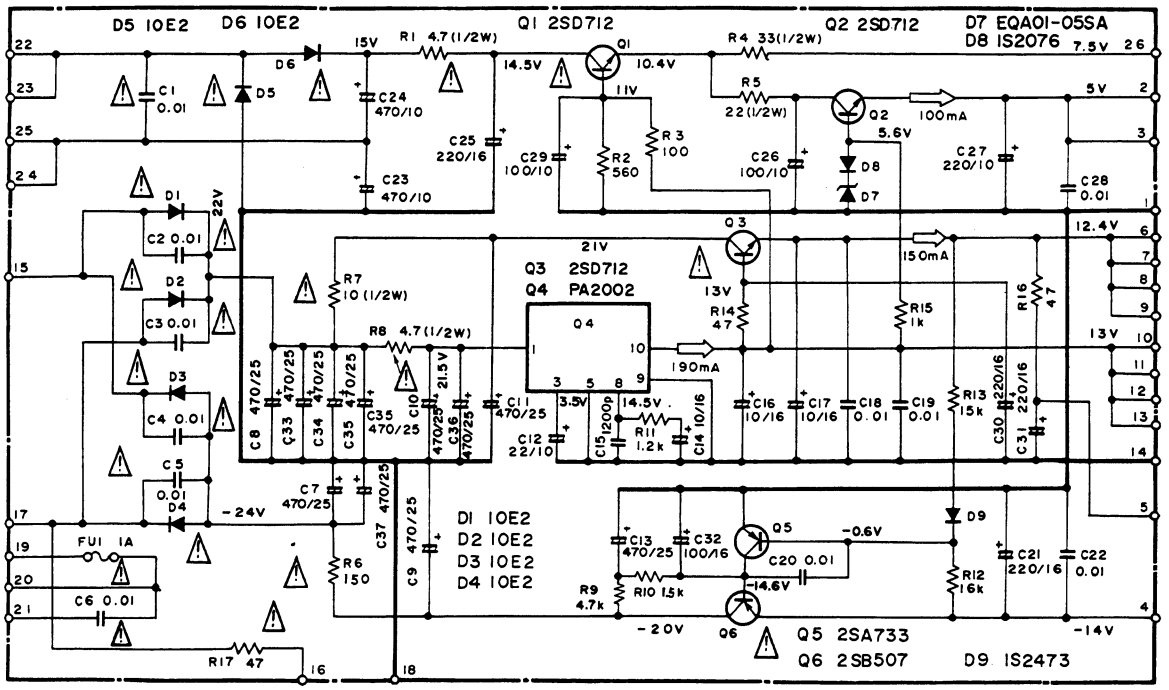
RESISTORS

Part No.	Symbol & Description		
RD¼PM □□□J	R1–R38, R40–R119		
ACP-023	VR1, VR5	Semi-fixed	6.8kΩ
ACP-025	VR2	Semi-fixed	33kΩ
C92-048	VR3	Semi-fixed	47kΩ
ACP-056	VR4	Semi-fixed	22kΩ

SEMICONDUCTORS

Part No.	Symbol & Description
2SK19-W	Q1, Q17
TA7302	Q2
HA1201	Q3–Q6
LA1222	Q7, Q8
M5109PR	Q9
μPC4558C	Q10
PA3001-A	Q11
2SC945A-Q	Q12, Q18–Q23, Q26
2SC461-B	Q13, Q14, Q16
2SA733-Q	Q15, Q28
2SA798-F	Q24
2SC1919-G	Q25
2SA726S-G	Q27
2SK261	D1–D6
1S2473 (1S2076)	D7–D21

11.8 POWER SUPPLY ASSEMBLY (AWR-177)



Parts List of Power Supply Assembly (AWR-177)

CAPACITORS

Part No.	Symbol & Description		
⚠ ACG-004	C1–C5	Ceramic	0.01/150V
⚠ ACG-003	C6	Ceramic	0.01/125V
CEA 471P 25	C7–C11, C13, C33–C37		
CEA 220P 10	C12		
CEA 100P 16	C14, C16, C17		
CKDYB 122K 50	C15		
CKDYF 103Z 50	C18–C20, C22, C28		
CEA 221P 16	C21, C25, C30, C31		
CEA 471P 10	C23, C24		
CEA 101P 10	C26, C29		
CEA 221P 10	C27		
CEA 101P 16	C32		
CEA 471P 25	C37		

OTHERS

Part No.	Description
AKR-030	Fuse clip
ANH-117	Heat sink

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

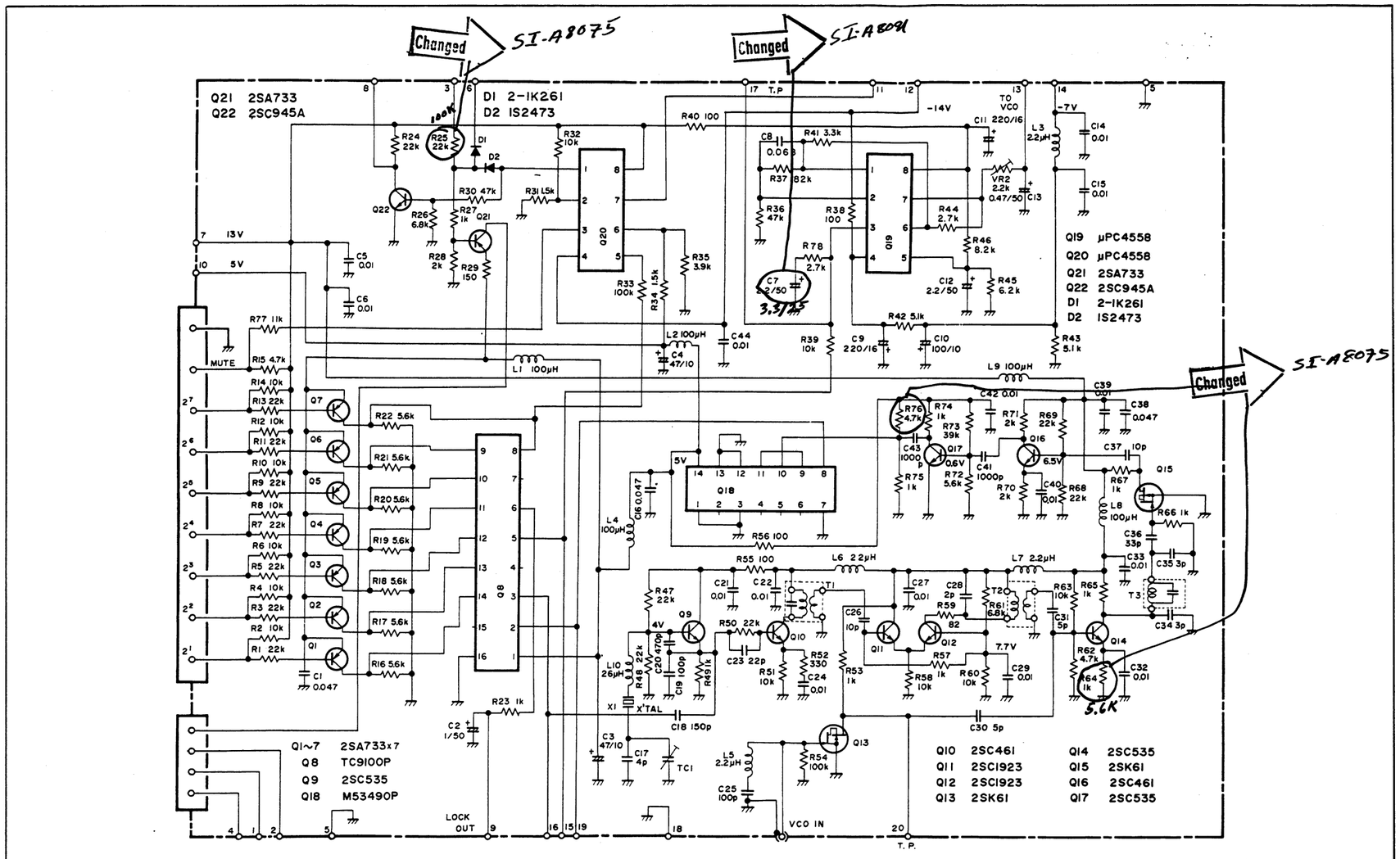
RESISTORS

Part No.	Symbol & Description
⚠ RD¼PS □□□ J	R1, R7, R8
RD½PS □□□ J	R4, R5
RD¼PS □□□ J	R2, R3, R9–R16
⚠ RD¼PS □□□ J	R6, R17

SEMICONDUCTORS

Part No.	Symbol & Description
⚠ 2SD712-C or D	Q1, Q3
2SD712-C or D	Q2
PA2002	Q4
2SA733-Q or R	Q5
⚠ 2SB507-D or E	Q6
⚠ 10E2 (SIB01-02)	D1–D6
EQA01-05SA	D7
1S2076	D8
1S2473	D9

11.9 SYNTHESIZER ASSEMBLY (AWX-146)



Parts List of Synthesizer Assembly (AWX-146)

TRANSFORMERS AND COILS

Part No.	Symbol & Description	
ATC-073	T1	Tune coil
ATC-074	T2	Tune coil
ATC-075	T3	LPF coil

Part No.	Symbol & Description		
T24-030	L1, L2, L4, L8, L9	RF coil	100μH
T24-028	L3, L5–L7	RF choke coil	2.2μH
ATH-020	L10	RF coil	26μH

CAPACITORS

Part No.	Symbol & Description	
ACM-010	TC1	Trimmer
CKDYF 473Z 50	C1, C16, C38	
CEANL 010P 50	C2	
CEA 470P 10	C3, C4	
CKDYB 103K 50	C5, C6, C14, C15, C21, C22, C24, C27	
CKDYB 103K 50	C29, C32, C33, C39, C40, C42, C44	
CQMA 683K 50	C8	
CEANL 2R2P 50	C7, C12	
CEANL R47P 50	C13	
CEA 221P 16	C9, C11	
CEA 101P 10	C10	
CCDTH 040D 50	C17	
CCDSL 151K 50	C18	
CCDSL 101K 50	C19, C25	
CKDYB 471K 50	C20	
CCDSL 220K 50	C23	
CCDSL 100F 50	C26, C37	
CCDRH 020C 50	C28	
CCDCH 050D 50	C30, C31	
CCDCH 030C 50	C34, C35	
CCDSL 330K 50	C36	
CKDYB 102K 50	C41, C43	

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

RESISTORS

Part No.	Symbol & Description		
ACP-001	VR2	Semi fixed	2.2kΩ
RD¼PM □□□J	R1–R77		
RD¼VS □□□J	R78		

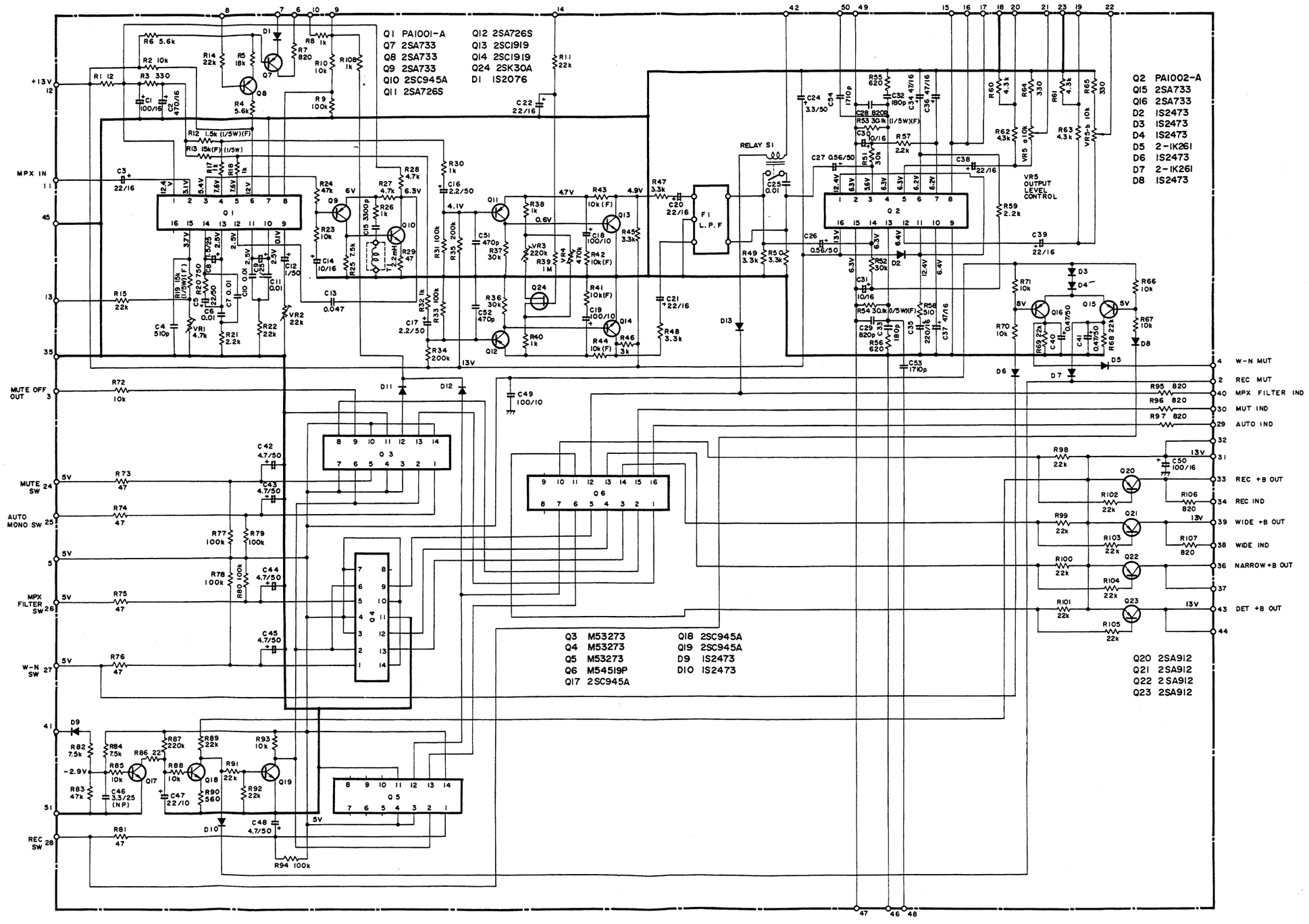
SEMICONDUCTORS

Part No.	Symbol & Description
2SA733-Q or P	Q1–Q7, Q21
TC9100P	Q8
2SC535-B or C	Q9, Q14, Q17
2SC461-B or C	Q10, Q16
2SC1923-O or R	Q11, Q12
2SK61-Y, or GR	Q13, Q15
M53490P	Q18
μPC4558C	Q19, Q20
2SC945A-Q or P	Q22
2-1K261	D1
1S2473 (1S2076)	D2

OTHER

Part No.	Symbol & Description	
ASS-005	X1	Crystal resonator

11.10 MPX AF ASSEMBLY (AWD-014)



Parts List of MPX AF Assembly (AWD-014)

FILTER AND COIL

Part No.	Symbol & Description	
ATM-016	T1	19kHz transformer
ATF-046	F1	Low pass filter

CAPACITORS

Part No.	Symbol & Description	
CEA 101P 16	C1, C50	
CEA 471P 16	C2	
CEANL 220P 16	C3, C20, C21, C38, C39	
CQSH 511J 50	C4	
CSZA 220M 6	C5	
CKDYF 103Z 50	C6, C7, C10, C11	
CSZA 1R5M 25	C8	
CSZA 010M 25	C9	
CEA 010P 50	C12	
CQMA 473J 50	C13	
CEA 100P 16	C14, C30, C31	
CQSA 332J 50	C15	
CEANL 2R2P 50	C16, C17	
CEA 101P 10	C18, C19, C49	
CEA 220P 16	C22	
CEA 3R3P 50	C24	
CQMA 103K 50	C25	
ACH-328	C26, C27	Electrolytic 0.56/50
CQSA 821G 50	C28, C29	
CCDSL 181K 50	C32, C33	
CEA 470P 16	C34, C36, C37	
CEA 221P 16	C35	
CEA R47P 50	C40, C41	
CEA 4R7P 50	C42–C45, C48	
CEA 220P 10	C47	
CQSA 471J 50	C51, C52	
ACE-043	C53, C54	Polystyrene 1710p

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

RESISTORS

Part No.	Symbol & Description		
RD¼PM □□□J	R1–R11, R14, R15, R17, R18, R20–R40, R45–R52, R55–R108		
RN½SQ □□□□F	R12, R13, R19, R41–R44, R53, R54		
ACP-018	VR1	Semi-fixed	4.7kΩ
ACP-056	VR2	Semi-fixed	22kΩ
ACP-016	VR3	Semi-fixed	220kΩ
ACP-011	VR4	Semi-fixed	470kΩ
ACT-121	VR5	Variable	10kΩ (OUTPUT)

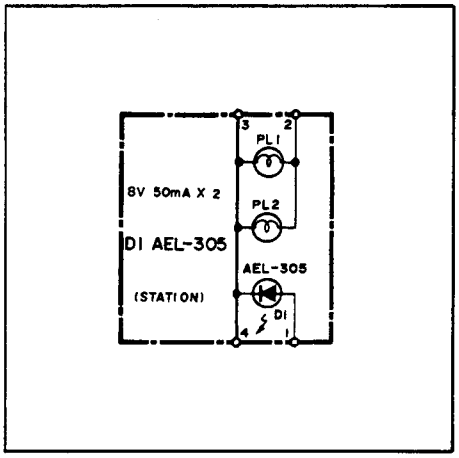
SEMICONDUCTORS

Part No.	Symbol & Description
PA1001-AG	Q1
PA1002-A	Q2
M53273P	Q3–Q5
M54519P	Q6
2SA726S-G or F (2SA750-F or E)	Q7, Q8, Q11, Q12
2SA733-Q	Q9, Q15, Q16
2SC945A-Q	Q10, Q17, Q18, Q19
2SC1919-G	Q13, Q14
2SA912-Q or R	Q20–Q23
2SK34-C (2SK30A-Y)	Q24
1S2076 (1S2473) (1S1555)	D1, D6, D8
1S2473 (1S1555) (1S2076)	D2–D4, D9–D13
2-1K261	D5, D7

OTHER

Part No.	Symbol & Description	
ASR-043	S1	Reed relay

11.11 LAMP ASSEMBLY (AWX-132)



Parts List

Part No.	Symbol & Description		
AEL-098	PL1, PL2	Lamp	8V, 50mA
AEL-305	D1	LED (red)	
AEB-116		Lamp holder	

ADDITIONAL

Service Manual

PIONEER

Quartz synthesizer

FM STEREO TUNER

F-28 S/G

NOTE:

- For detailed instructions on adjustments, circuit descriptions, exploded views, etc., please refer to this Service Manual (p3 to p52).

1. CONTRAST OF MISCELLANEOUS PARTS

P.C. BOARD ASSEMBLIES

Symbol	Description	Part No.		Remarks
		KU type	S/G type	
	FM front end	AWB-036	AWB-036	
	IF assembly	AWE-097	AWE-097	
	MPX AF assembly	AWD-014	AWD-015	
	Power supply assembly	AWR-177	AWR-178	
	Synthesizer assembly	AWX-146	AWX-146	
	Switch assembly A	GWS-141	GWS-141	
	Switch assembly B	GWS-142	GWS-142	
	Lamp assembly	AWX-132	AWX-132	
	Switch assembly	.....	AWX-147	

SWITCHES

Symbol	Description	Part No.		Remarks
		KU type	S/G type	
⚠S1	Push switch (POWER)	ASG-505	ASG-502	
S7	Slide switch (DE-EMPHASIS)	ASH-016	.....	
⚠S8	Voltage selector	.....	AKR-031	

CAPACITORS

Symbol	Description	Part No.		Remarks
		KU type	S/G type	
C1	Ceramic 0.04/50V	CKDYF 403Z 50	CKDYF 403Z 50	
⚠C2	Ceramic 0.01/250V	.....	ACG-001	

RESISTOR

Symbol	Description	Part No.		Remarks
		KU type	S/G type	
⚠R1	Carbon composition 2.2MΩ	ACN-029	.....	

OTHERS

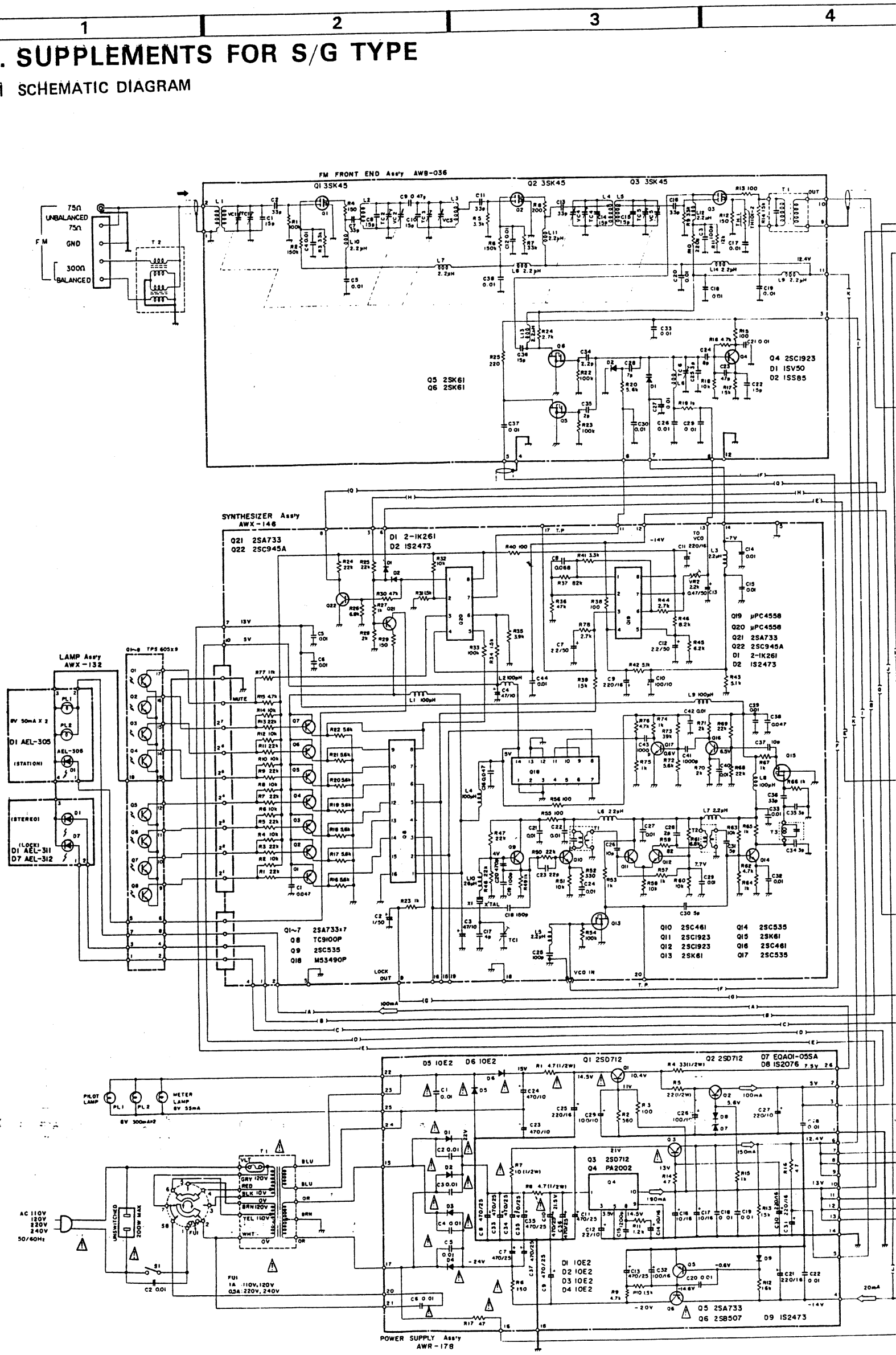
Symbol	Description	Part No.		Remarks
		KU type	S/G type	
⚠T1	Power transformer	ATT-530	ATT-534	
⚠	AC socket	AKP-002	AKP-018	
⚠	AC power cord	ADG-023	ADG-016	

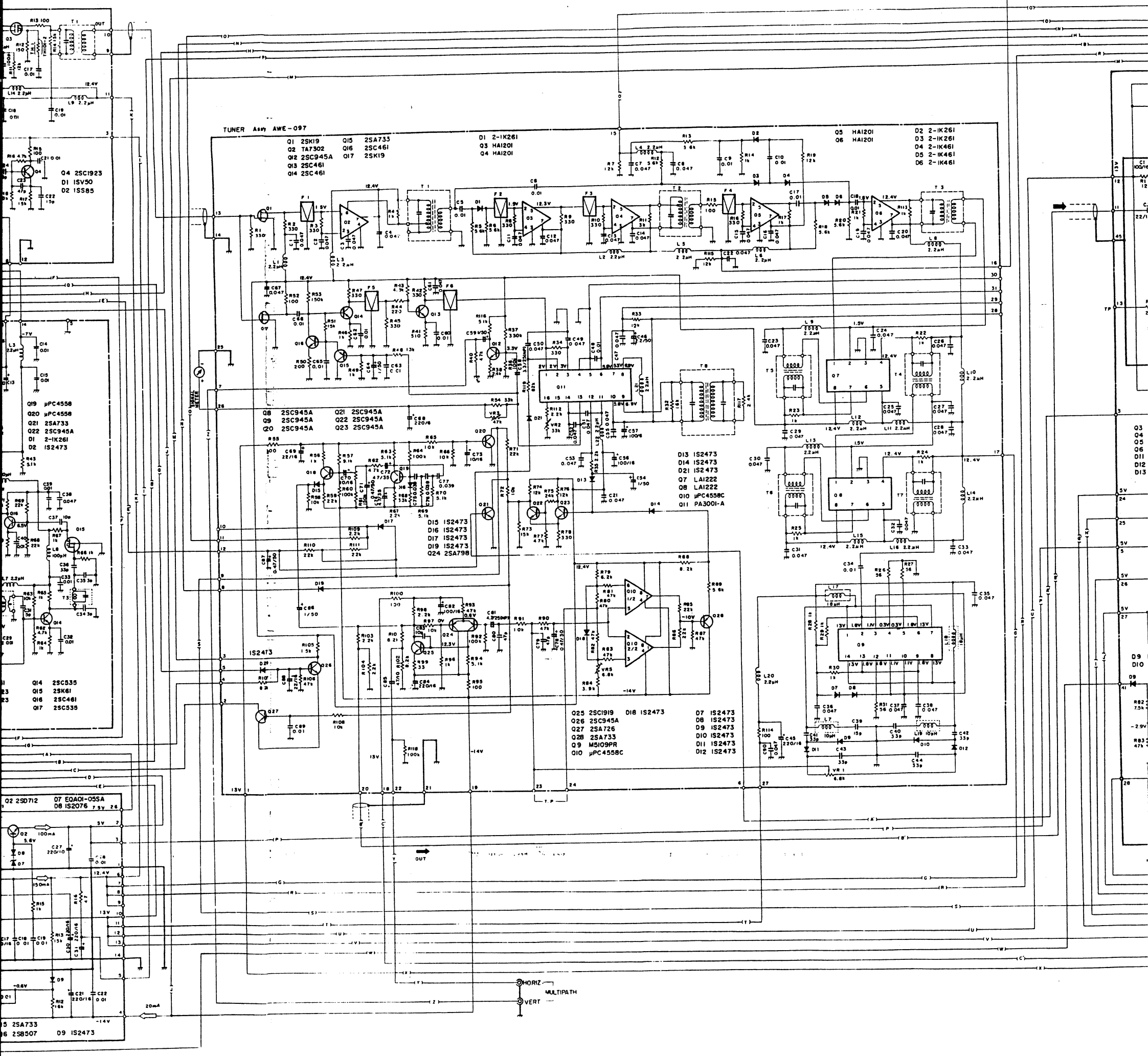
PACKING AND FURNISHED PARTS

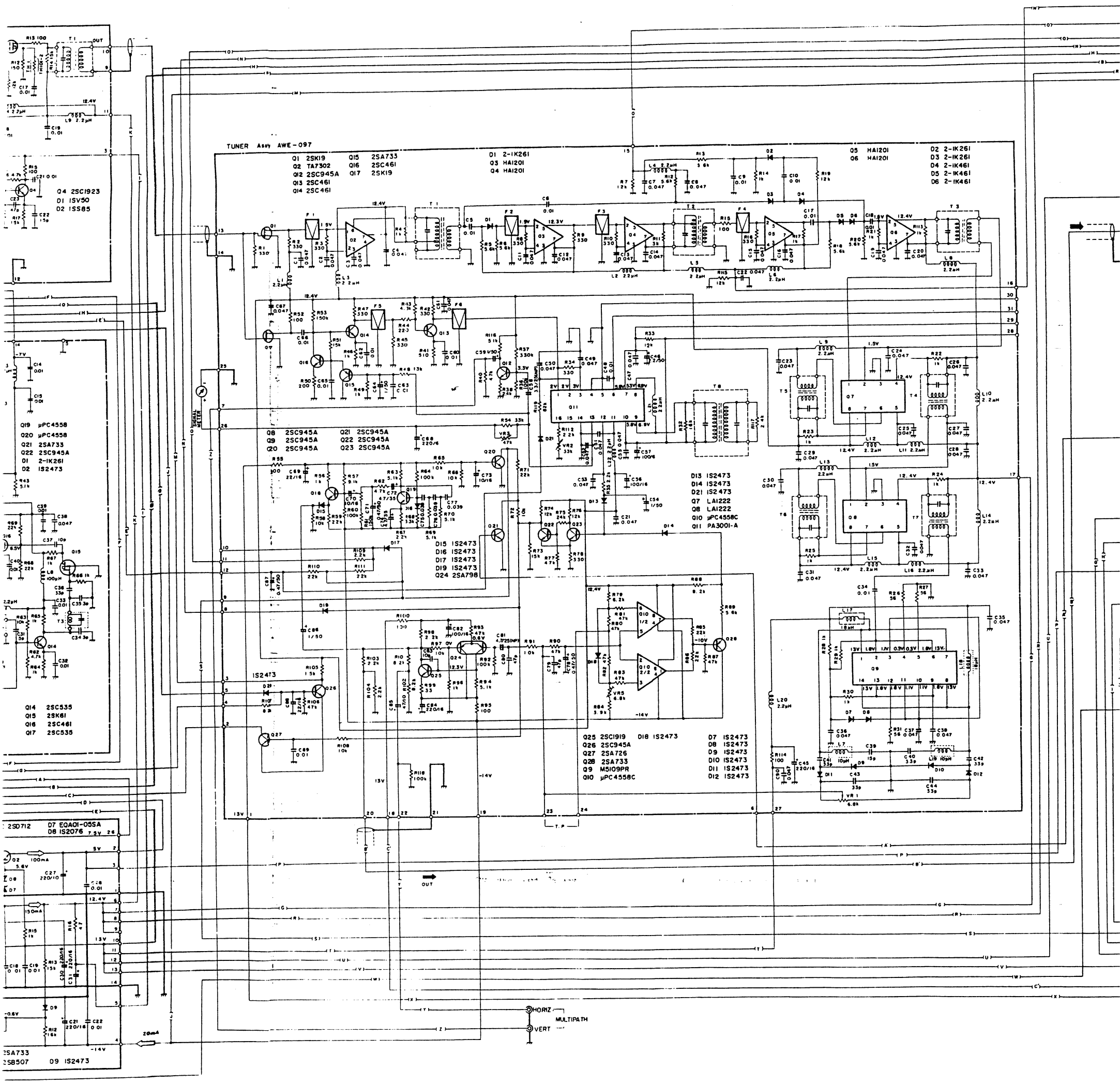
Symbol	Description	Part No.		Remarks
		KU type	S/G type	
	Operating instructions	ARB-282	ARB-283	
	Fuse 1A	.....	AEK-106	
	Fuse 0.5A	.....	AEK-107	
	Vinyl pouch (for fuse)	.....	E11-033	
	Packing case	AHD-580	AHD-581	
	Spacer	.....	AHB-097	

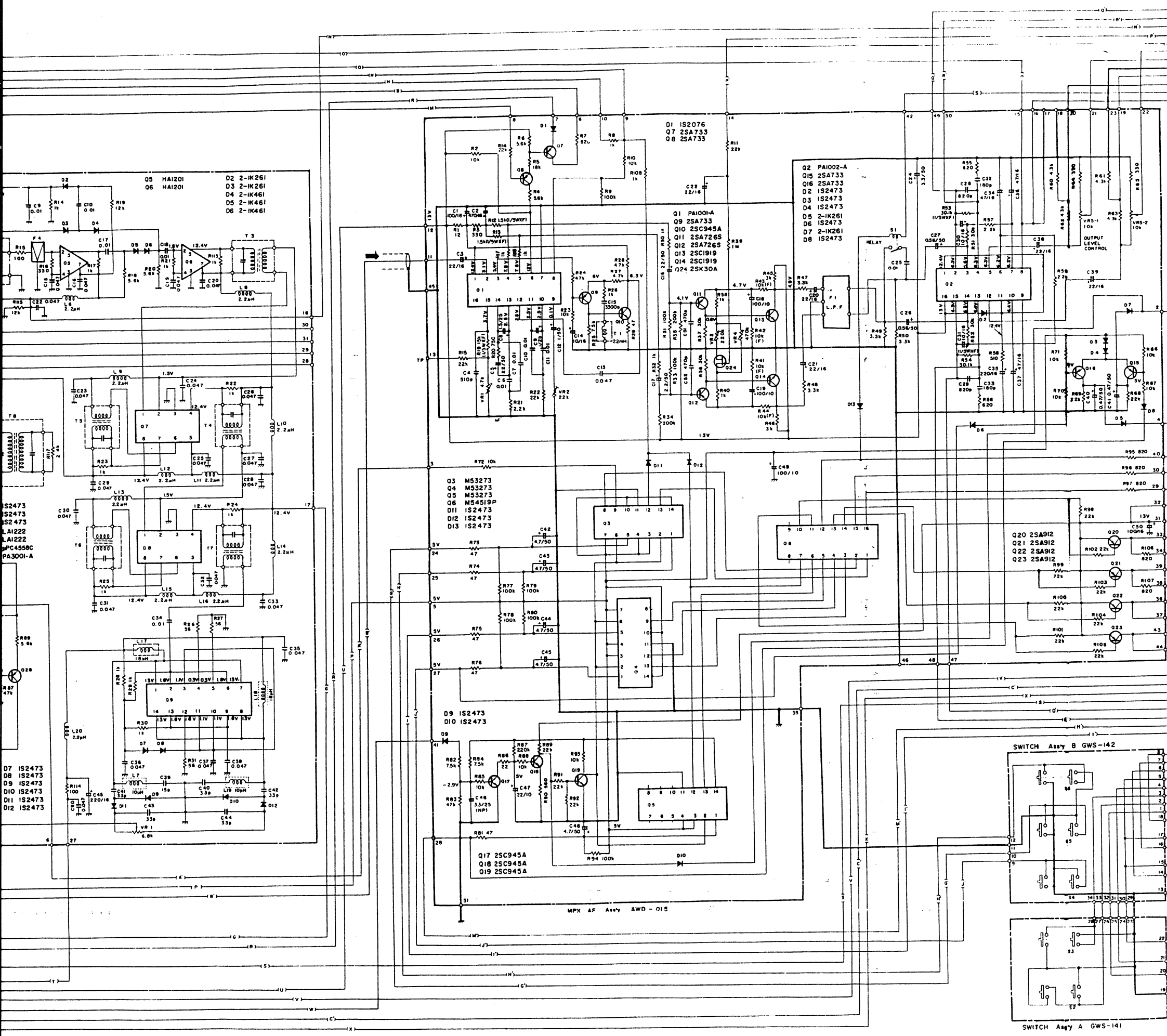
2. SUPPLEMENTS FOR S/G TYPE

2.1 SCHEMATIC DIAGRAM




TUNER Assy AWE-097
Q1 2SK19
Q2 TA7302
Q12 2SC945A
Q13 2SC461
Q14 2SC461
Q15 2SA733
Q16 2SC461
Q17 2SK19
D1 2-IK261
Q3 HAI201
Q4 HAI201
Q5 HAI201
Q6 HAI201
D2 2-IK261
D3 2-IK261
D4 2-IK461
D5 2-IK461
D6 2-IK461
Q4 2SC1923
D1 1SV50
D2 1SS85
Q19 μPC4558
Q20 μPC4558
Q21 2SA733
Q22 2SC945A
D1 2-IK261
D2 IS2473
Q14 2SC535
Q15 2SK61
Q16 2SC461
Q17 2SC535
Q8 2SC945A
Q9 2SC945A
Q20 2SC945A
Q21 2SC945A
Q22 2SC945A
Q23 2SC945A
D15 IS2473
D16 IS2473
D17 IS2473
D19 IS2473
Q24 2SA798
D13 IS2473
D14 IS2473
D21 IS2473
Q7 LA1222
Q8 LA1222
Q10 μPC4558C
Q11 PA3001-A
Q25 2SC1919
Q26 2SC945A
Q27 2SA726
Q28 2SA733
Q9 M5109PR
Q10 μPC4558C
D18 IS2473
D7 IS2473
D8 IS2473
D9 IS2473
D10 IS2473
D11 IS2473
D12 IS2473
Q2 2SD712
D7 EQA01-05SA
D8 IS2076
Q5 2SA733
Q6 2SB507
D9 IS2473
OUT
HORIZ
MULTIPATH
VERT


TUNER Assy AWE-097
Q1 2SK19
Q2 TA7302
Q12 2SC945A
Q13 2SC461
Q14 2SC461
Q15 2SA733
Q16 2SC461
Q17 2SK19
D1 2-1K261
Q3 HAI201
Q4 HAI201
Q5 HAI201
Q6 HAI201
D2 2-1K261
D3 2-1K261
D4 2-1K461
D5 2-1K461
D6 2-1K461
Q4 2SC1923
D1 1SV50
D2 1SS85
Q19 μPC4558
Q20 μPC4558
Q21 2SA733
Q22 2SC945A
D1 2-1K261
D2 1S2473
Q14 2SC535
Q15 2SK61
Q16 2SC461
Q17 2SC535
Q8 2SC945A
Q9 2SC945A
Q20 2SC945A
Q21 2SC945A
Q22 2SC945A
Q23 2SC945A
D15 1S2473
D16 1S2473
D17 1S2473
D19 1S2473
Q24 2SA798
D13 1S2473
D14 1S2473
D21 1S2473
Q7 LAI222
Q8 LAI222
Q10 μPC4558C
Q11 PA3001-A
Q25 2SC1919
Q26 2SC945A
Q27 2SA726
Q28 2SA733
Q9 M5109PR
Q10 μPC4558C
D18 1S2473
D7 1S2473
D8 1S2473
D9 1S2473
D10 1S2473
D11 1S2473
D12 1S2473
2SD712
D7 EQA01-05SA
D8 1S2076
2SA733
2SB507
D9 1S2473
OUT
HORIZ
VERT
MULTIPATH



RESISTORS:
IN OHM ¼W ±5% TOLERANCE UNLESS OTHERWISE NOTED
k; kΩ, M; MΩ

CAPACITORS:
IN μF UNLESS OTHERWISE NOTED p; pF

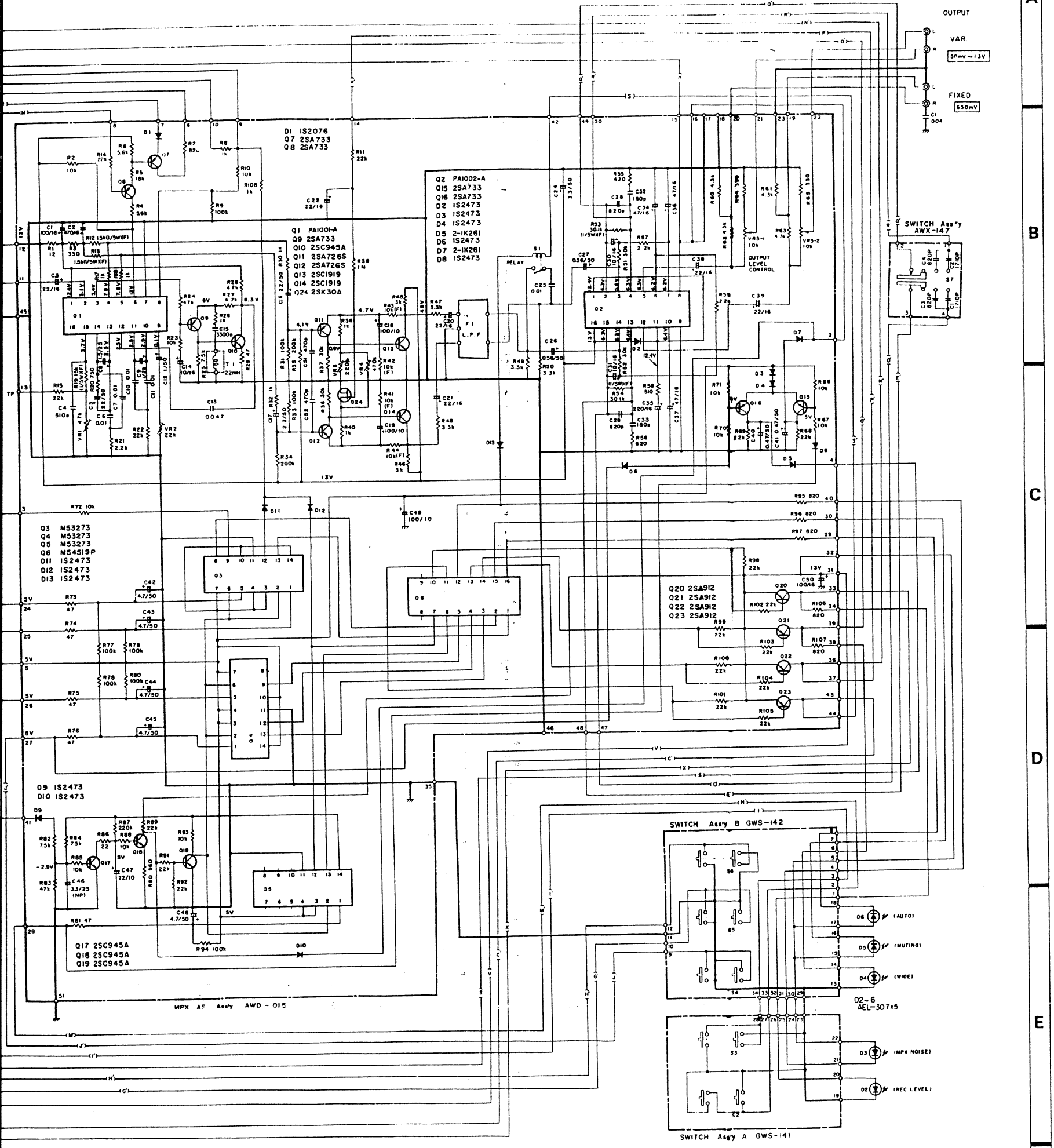
V: DC VOLTAGE AT NO INPUT SIGNAL
⇦ mA: DC CURRENT AT NO INPUT SIGNAL
mV: SIGNAL VOLTAGE AT FM 400Hz 75kHz DEV.

This is the basic schematic diagram, but the actual circuit may vary due to improvements in design.

The ⚠ mark found on some component parts indicates the importance of the safety factor of the part.
Therefore, when replacing, be sure to use parts of indentical designation.

SWITCHES:
- S1. POWER ON-OFF
- S2. REC LEVEL CHECK ON-OFF
- S3. MPX NOISE FILTER ON-OFF
- S4. IF BAND WIDE-NARROW
- S5. MUTING ON-OFF
- S6. MODE AUTO-MONO
- S7. DE-EMPHASIS 25μs – 50μs – 75μs
- S8. LINE VOLTAGE SELECTOR 110V – 120V – 220V

The underlined indicates the switch position.



RESISTORS:
IN OHM ¼W ±5% TOLERANCE UNLESS OTHERWISE NOTED
k; kΩ, M; MΩ

CAPACITORS:
IN μF UNLESS OTHERWISE NOTED p: pF

V: DC VOLTAGE AT NO INPUT SIGNAL
⇦ mA: DC CURRENT AT NO INPUT SIGNAL
mV: SIGNAL VOLTAGE AT FM 400Hz 75kHz DEV.

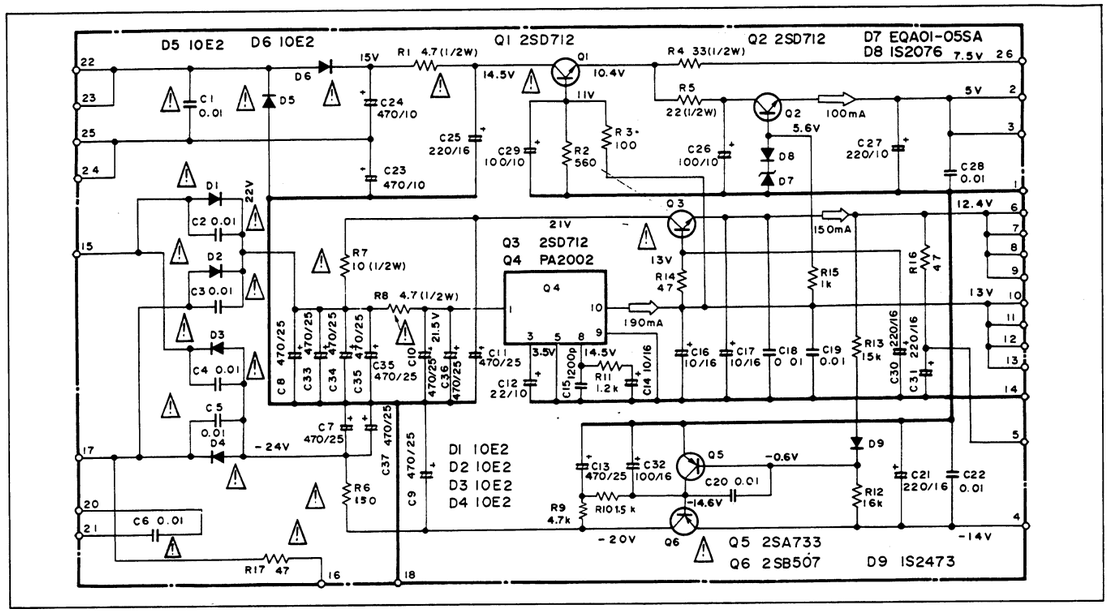
This is the basic schematic diagram, but the actual circuit may vary due to improvements in design.

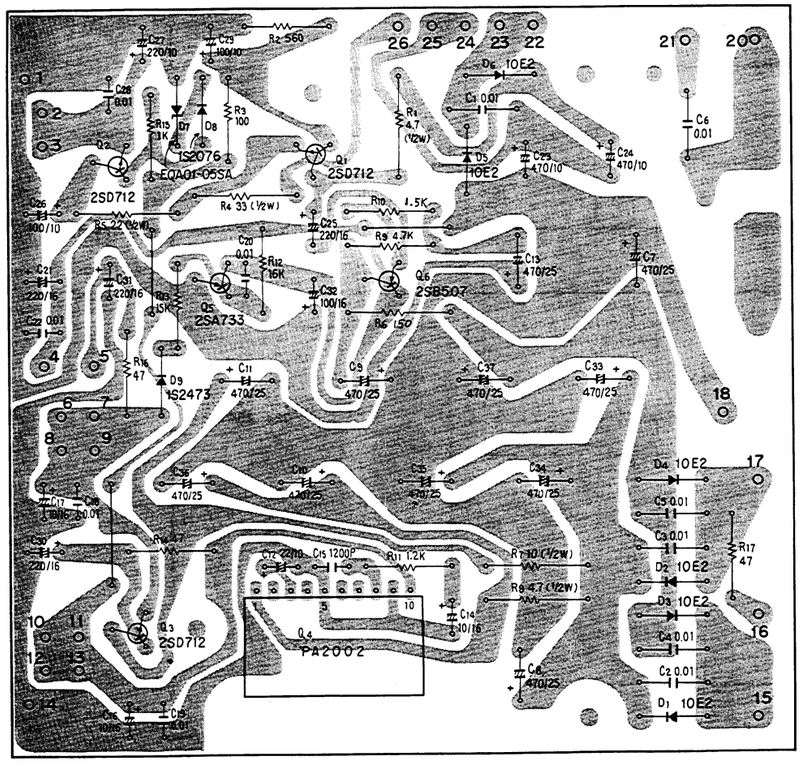
The ⚠ mark found on some component parts indicates the importance of the safety factor of the part.
Therefore, when replacing, be sure to use parts of indentical designation.

SWITCHES:
- S1. POWER ON-OFF
- S2. REC LEVEL CHECK ON-OFF
- S3. MPX NOISE FILTER ON-OFF
- S4. IF BAND WIDE-NARROW
- S5. MUTING ON-OFF
- S6. MODE AUTO-MONO
- S7. DE-EMPHASIS 25μs – 50μs – 75μs
- S8. LINE VOLTAGE SELECTOR 110V – 120V – 220V – 240V

The underlined indicates the switch position.

2.2 POWER SUPPLY ASSEMBLY (AWR-178)





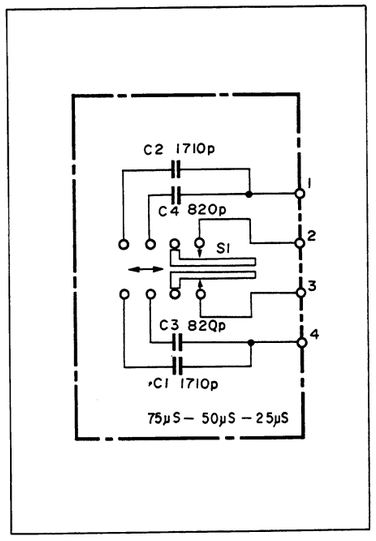
Parts List

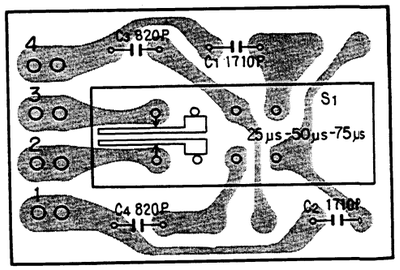
NOTE:
The parts of the AWR-178 is the same as the AWR-177 (for KU type) except for following sections.

CAPACITOR

Part No.	Symbol & Description		
⚠ ACG-001	C6	Ceramic	0.01/250V

2.3 SWITCH ASSEMBLY (AWX-147)





Parts List of Switch Assembly (AWX-147)

CAPACITORS

Part No.	Symbol & Description	
ACE-043	C1, C2	Polystyrene 1710p
CQSA 821G 50	C3, C4	

SWITCH

Part No.	Symbol & Description	
ASH-017	S1	Slide (DE-EMPHASIS)

2.4 MPX AF ASSEMBLY (AWD-015)

Q1 PA1001-A
Q7 2SA733
Q8 2SA733
Q9 2SA733
Q10 2SC945A
Q11 2SA726S
Q12 2SA726S
Q13 2SC1919
Q14 2SC1919
Q24 2SK30A
D1 IS2076

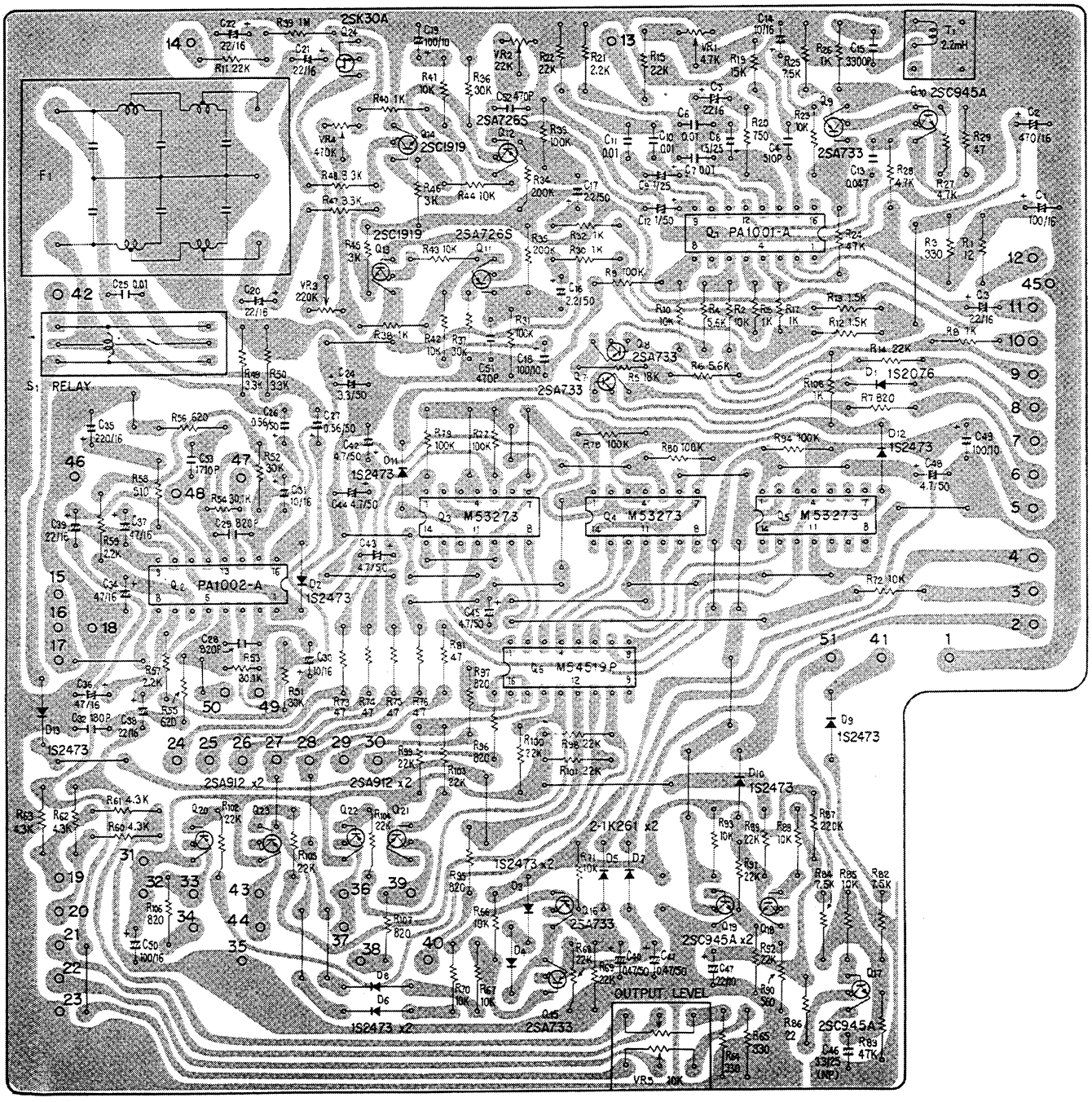
Q2 PA1002-A
Q15 2SA733
Q16 2SA733
D2 IS2473
D3 IS2473
D4 IS2473
D5 2-1K261
D6 IS2473
D7 2-1K261
D8 IS2473

Q3 M53273
Q4 M53273
Q5 M53273
Q6 M54519P
Q17 2SC945A
Q18 2SC945A
Q19 2SC945A
D9 IS2473
D10 IS2473

Q20 2SA912
Q21 2SA912
Q22 2SA912
Q23 2SA912

+13V
MPX IN
MUTE OFF OUT
MUTE SW
AUTO MONO SW
MPX FILTER SW
W-N SW
REC SW
RELAY S1
F1 L.P.F
VR5 OUTPUT LEVEL CONTROL
W-N MUT
REC MUT
MPX FILTER IND
MUT IND
AUTO IND
REC +B OUT
REC IND
WIDE +B OUT
WIDE IND
NARROW +B OUT
DET +B OUT

MC-Service



NOTE:
The parts of the AWD-015 is the same as the AWD-014 (for KU type), with the exception of C53 and C54 which are left out.