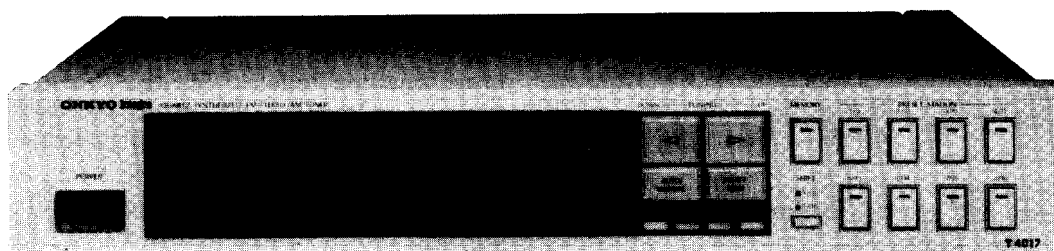


# ONKYO® SERVICE MANUAL

## SYNTHESIZED FM/AM STEREO TUNER MODEL T-4017



UD, UDN, BUD, BUDN	120V AC, 60Hz
UG, UGV, BUG, BUGV	220V AC, 50Hz
UW	120 or 220V AC, 50/60Hz

### SAFETY-RELATED COMPONENT WARNING!!

COMPONENTS IDENTIFIED BY MARK  $\triangle$  ON THE SCHEMATIC DIAGRAM AND IN THE PARTS LIST ARE CRITICAL FOR RISK OF FIRE AND ELECTRIC SHOCK. REPLACE THESE COMPONENTS WITH ONKYO PARTS WHOSE PART NUMBERS APPEAR AS SHOWN IN THIS MANUAL.

MAKE LEAKAGE-CURRENT OR RESISTANCE MEASUREMENTS TO DETERMINE THAT EXPOSED PARTS ARE ACCEPTABLY INSULATED FROM THE SUPPLY CIRCUIT BEFORE RETURNING THE APPLIANCE TO THE CUSTOMER.

### SPECIFICATIONS

– D model –

FM:

Tuning Range:	87.9 – 107.9 MHz (200 kHz steps)
Usable Sensitivity:	Mono: 10.3 dBf, 1.8 $\mu$ V, IHF Stereo: 17.2 dBf, 4.0 $\mu$ V
50 dB Quieting Sensitivity:	Mono: 14.7 dBf, 3.0 $\mu$ V Stereo: 36.0 dBf, 35 $\mu$ V
Capture Ratio:	1.0 dB
Image Rejection Ratio:	80 dB
IF Rejection Ratio:	100 dB
Signal-to-Noise Ratio:	Mono: 81 dB Stereo: 73 dB
Alternate Channel Att:	80 dB IHF ( $\pm$ 400 kHz) (Narrow)
AM Suppression Ratio:	55 dB
Total Harmonic Distortion:	Mono: 0.05% (wide) Stereo: 0.1% (Wide)
Frequency Response:	30 – 15,000 Hz +0.5 dB, –1.5 dB
Stereo Separation:	45 dB at 1 kHz

33 dB at 70 – 10,000 Hz

Output Voltage:	0 – 1.5 V
Muting Level:	17.2 dBf, 4.0 $\mu$ V

(Continued ON next page)



<b>AM:</b>		Selectivity:	70 dB DIN ( $\pm 300$ kHz, 40 kHz dev.) (Narrow)
Tuning Range:	530 – 1620 kHz (10 kHz steps)	AM Suppression Ratio:	55 dB
Usable Sensitivity:	25 $\mu$ V	Total Harmonic Distortion:	Mono: 0.05% (Wide)
Image Rejection Ratio:	40 dB	Frequency Response:	30 – 15,000 Hz $\pm 0.5$ dB, –1.5 dB
Signal-to-Noise Ratio:	40 dB	Stereo Separation:	45 dB at 1 kHz 33 dB at 70 – 10,000 Hz
Total Harmonic Distortion:	0.7 %	Output Voltage:	0 – 1.5 V
Output Voltage:	0 – 500 mV	Muting Level:	17.2 dBf, 4.0 $\mu$ V
<b>General</b>		<b>AM:</b>	
Antennas:	FM: 300 ohms balanced and 75 ohms unbalanced	Tuning Range:	522 – 1611 kHz (9 kHz steps)
	AM: Built-in loop antenna and external terminal	Usable Sensitivity:	25 $\mu$ V
Semiconductors:	FETs: 4 TR: 59 ICs: 16	Image Rejection Ratio:	40 dB
	Diodes: 72 LEDs: 25	IF Rejection Ratio:	40 dB
Dimensions:	435(W) x 77(H) x 373(D) mm (17-1/8" x 3" x 14-3/4")	Signal-to-Noise Ratio:	40 dB
Weight:	4.8 kg., 10.6 lbs.	Total Harmonic Distortion:	0.7 %
		Output Voltage:	0 – 500 mV
<b>– G/W models –</b>		<b>General</b>	
<b>FM:</b>		Antennas:	AM: 300 ohms balanced and 75 ohms unbalanced
Tuning Range:	87.5 – 108.0 MHz (50 kHz steps)		AM: Built-in loop antenna

Capture Ratio:	1.0 dB	Weight:	(17-1/8" x 3" x 14-3/4") 4.8 kg., 10.6 lbs.
Image Rejection Ratio:	100 dB	Specifications and features are subject to change without notice.	
IF Rejection Ratio:	100 dB		
Signal-to-Noise Ratio:	Mono: 81 dB Stereo: 73 dB		

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# SERVICE PROCEDURES

## 1. Replacing the lamps

This unit uses the lamps listed below.

circuit no.	parts no.	description
PL901	210149	PL14V 0.06AW-3.0, Power indicator
PL902	210064A	PL6.3V 250mA, dial plate illumination

Caution; Before replacing the lamps, be sure to unplug the power supply cable.

## 2. Insulation resistance measurement

Connect the insulating-resistance tester between the plug of power supply cable and the screw on the back panel as shown Fig. 1.

Specifications; D model 500V,  $3.3 \pm 0.3M\Omega$   
G/W models 500V, more than  $10M\Omega$

## 3. Handling the CMOS IC

This unit uses the CMOS ICs of Q404, Q418, Q707, Q708 and Q712.

1. All MOS devices should be store transported in materials that are somewhat conductive. MOS devices must not be inserted into conventional plastic "snow" or plastic trays.
2. All MOS devices should be placed on a grounded bench surface and operators should ground themselves prior to handling devices, since a worker can be statically charged with respect to the bench surface.
3. Nylon clothing should not be worn while handling MOS circuit.
4. When lead straightening or hand soldering is necessary, provide ground straps for the apparatus used.
5. Double check test equipment setup for proper polarity of voltage before conducting parametric or functional testing.
6. All unused device inputs should be connected to  $V_{DD}$  or  $V_{SS}$  (Ground).

## 4. Change of AM scan step

W models are equipped with a switch to change the AM scan step frequency from 9kHz to 10kHz. This switch is located on the bottom board. This switch is set to 9kHz at the factory; change to 10kHz if gives better results in your locality.

## 5. Change of De-emphasis

W models are equipped with a  $50\mu\text{sec}$ - $75\mu\text{sec}$  selector switch. This switch is located on the bottom board. This switch is set to  $50\mu\text{sec}$  at the factory, but may have to be reset to  $75\mu\text{sec}$  depending on the area where the unit is used.

## 6. Change of voltage

W models are equipped with a voltage selector to conform with local power supplies. This switch is located on the back panel. Be sure to set this switch to match the voltage of the power supply in your area before turning the power switch on.

This switch is set to 220V at the factory. Voltage is changed by sliding the groove in the switch with the screwdriver to the right or left. Confirm that the switch has been moved all the way to the right or left before turning the power switch on.

## 7. Memory Preservation

This unit does not require memory preservation batteries. A built-in memory power back-up system preserves contents of the memory during power failures and even when the unit is unplugged. The unit must be plugged in and the power switch turned on and off once in order to charge the back-up system. Note that since this is not a permanent memory, the power switch must be turned on and off a few times each month to keep the back-up system operable. The period of time during which memory contents are preserved after power has last been turned off varies depending on climate and the location and placement of the unit. On the average, memory contents are protected over a period of 3 to 4 weeks (a minimum of 2 weeks) after the last time power has been turned off. This period is shorter when the unit is exposed to very high humidity or used in an area with an extremely humid climate.

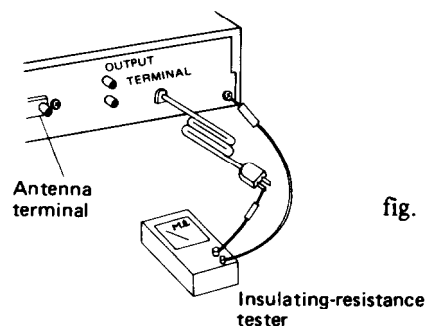


fig. 1

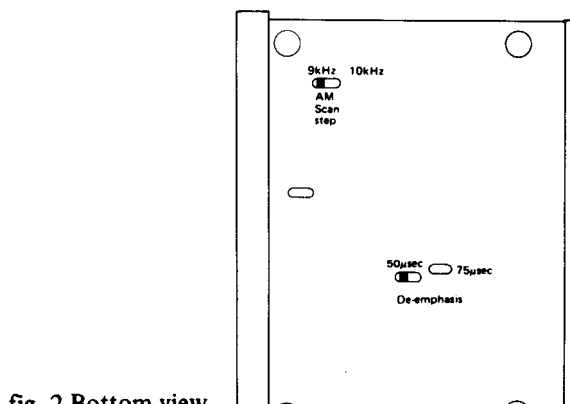
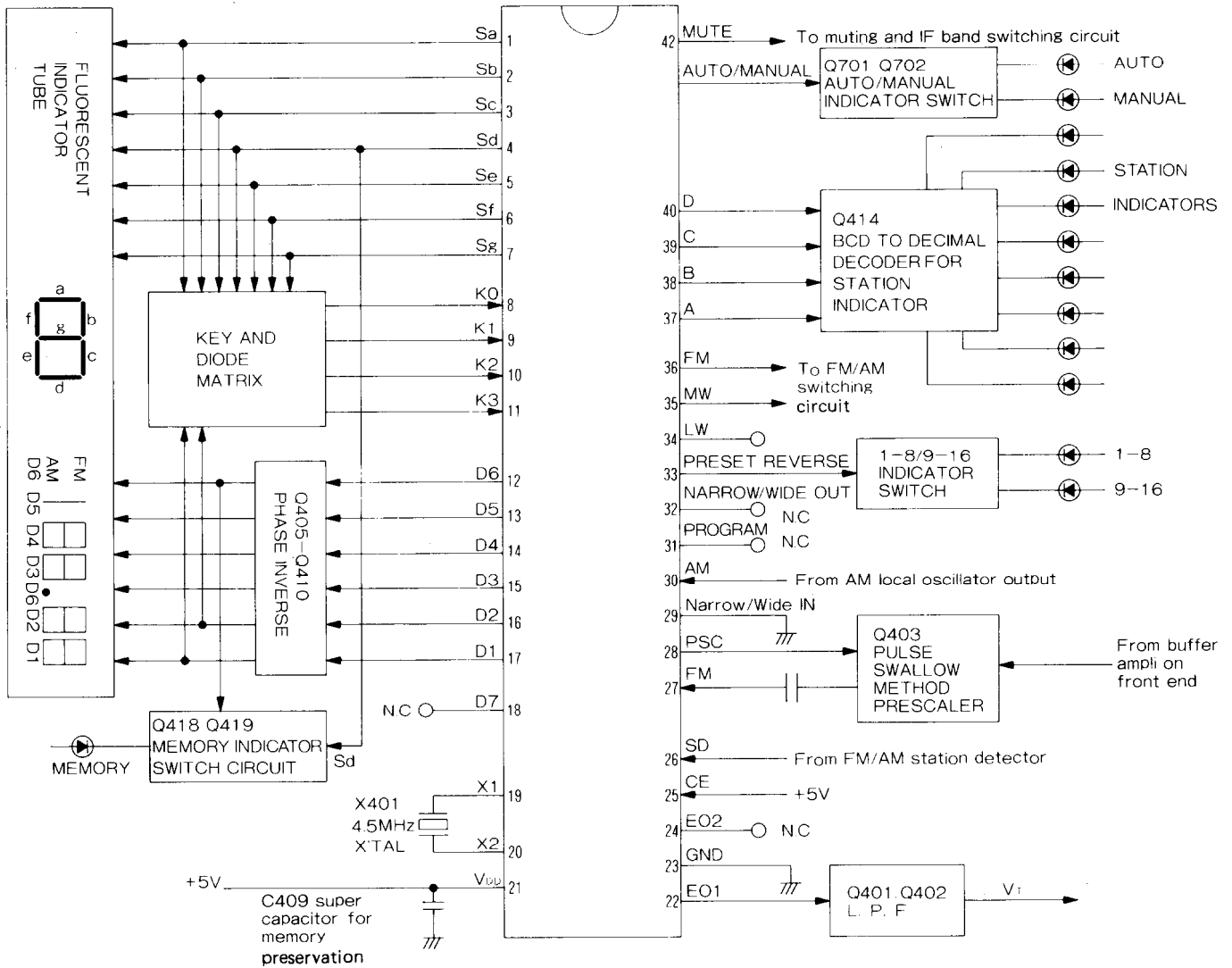


fig. 2 Bottom view

# CIRCUIT DESCRIPTIONS

## 1. Synthesizer and controller description



Pin No.	Symbol	Terminal	Description
1 - 7	Sa - Sg	Segment outputs	Display tube signal terminal output and key return signal source terminals; active high. Since these terminals can handle 30V, they are connected directly to the segment terminals of the fluorescent display tube.
8 - 11	K0 - K3	Key return signal inputs	Terminals for input of the key return signals from external matrix circuit. See page 6.
12 - 18	D1 - D7	Digit outputs	Display tube digit output signal terminals; active low. D1 and D2 are used the key return signal source. See page 6.
19, 20	X1, X2	X'tal	Connect to the 4.5MHz crystal oscillator.
21	V <sub>DD</sub>	Power source input	Device power source terminal; supplies 5V during normal operation and 2.5V from the super capacitor C409 for memory preservation.

Pin No.	Symbol	Terminal	Description
22, 24	E01, E02	Error outputs	Charge pump output of the phase detector with constitutes the PLL. High level is output when the divided oscillation frequency is higher than the reference frequency. In the opposite case, low level is output. Floating occurs when the frequencies match. The output is applied to the variable capacitor diode in the front end through the low pass filter Q401 and Q402. The output from both terminals is same, but only E01 is used.
23	GND	Ground	
25	CE	Chip enable	Device selection signal input terminal. High level ... Normal operation Low level ... Memory preservation
26	SD	Station detector signal input	Input terminal for detecting whether or not a broadcast signal is being received during auto-tuning. Stopped by the high level.
27	FM	FM local oscillator signal input	Input terminal for FM local oscillator is divided by 1/16 or 1/17 by prescaler Q403.
28	PSC	Pulse swallow control output	This terminal outputs a signal that switches the prescaler division ratio of Q403 to 1/16 or 1/17 when the pulse swallow method is used for division. (FM only)
29	NARROW/ Wide out	IF band width output	Terminal for switching narrow and wide of IF band width. Not used.
30	AM	AM local oscillator signal input	Terminal for input of the AM local oscillator signal.
31	PROGRAM	Program selection signal output	Terminal for indicator output whether or not the program mode. Not used.
32	NARROW/ Wide out	IF band width switching output	Terminal for specifications output of IF band width. Not used.
33	Preset Reverse	Preset reverse indication output	Terminal for indication output whether M1 – M8 or M9 – M16 the preset key.
34	LW	Band switching signal outputs	Terminals for signal output switching of each band. High level is output from terminal of FM (pin no. 36) and low level is output from other terminals (pin no. 34 & 35) during FM reception. LW is not used with T-4017.
35	MW		
36	FM		
37 38 39 40	A B C D	Preset station indication outputs	Terminals for BCD code output of preset station indicator. See page 7.
41	AUTO/ MANUAL	Auto/Manual indication output	Terminal for indication output whether or auto the tuning mode. This terminal becomes high during auto mode and low during manual mode.
42	MUTE	Muting output	Output terminal which mutes the shock noise occurring when the PLL is released; active high. The muting signal is output as shown below. UP/DOWN of manual/auto mode, preset memory is recalled, band switching and preset scan.

## 2. Diode and key matrix connection

Input Output	K3 (11)	K2 (10)	K1 (9)	K0 (8)	Remarks
Sa (1)	M1/M9	M2/M10	M3/M11	M4/M12	Segment output
Sb (2)	M5/M13	M6/M14	M7/M15	M8/M16	
Sc (3)	M17/M18 (N. U)	M19/M20 (N. U)	PRESET SCAN		
Sd (4)	FM	MW	LW (N. U)	PRESET REVERSE	Key input
Se (5)	UP	DOWN	MEMORY	AUTO MEMORY (N. U)	
Sf (6)	WIDE/NARROW (N. U)	PROGRAM (N. U)	DISPLAY (N. U)	AUTO/MANUAL	
Sg (7)	IF0	IF1	9N/9N+2	10kHz/9kHz	
D1 (17)	STATIC/DYNA	BAND 2	BAND 1	BAND 0	Output :1
D2 (16)			PRESET 1	PRESET 0	Open :0

(N. U): not used with T-4017. ( ): terminal no.

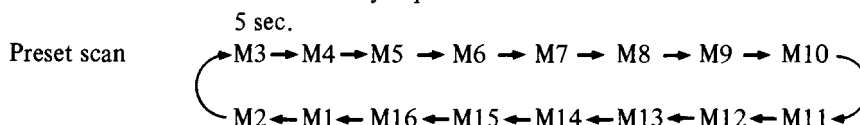
Table 1. Matrix connection

### 1) Diode matrix

Mark	Description																								
IF1 IF0	IF offset value setting for FM. <table border="1"> <thead> <tr> <th>IF1</th> <th>IF0</th> <th>IF offset value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>+10.700MHz</td> </tr> <tr> <td>0</td> <td>1</td> <td>+10.725MHz</td> </tr> <tr> <td>1</td> <td>0</td> <td>+10.650MHz</td> </tr> <tr> <td>1</td> <td>1</td> <td>+10.675MHz</td> </tr> </tbody> </table>	IF1	IF0	IF offset value	0	0	+10.700MHz	0	1	+10.725MHz	1	0	+10.650MHz	1	1	+10.675MHz									
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BAND 2 BAND 1 BAND 0	Geographical FM band setting. <table border="1"> <thead> <tr> <th>BAND2</th> <th>BAND1</th> <th>BAND0</th> <th>Region</th> <th>Frequency range</th> <th>Channel space</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> <td>U.S.A.</td> <td>87.9 – 107.9 MHz</td> <td>200kHz</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>Europe</td> <td>87.50 – 108.00MHz</td> <td>50kHz</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Japan</td> <td>76.1 – 89.9 MHz</td> <td>100kHz</td> </tr> </tbody> </table>	BAND2	BAND1	BAND0	Region	Frequency range	Channel space	0	0	1	U.S.A.	87.9 – 107.9 MHz	200kHz	0	1	0	Europe	87.50 – 108.00MHz	50kHz	0	0	0	Japan	76.1 – 89.9 MHz	100kHz
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10kHz/9kHz	Channel space, reference frequency and frequency range setting for MW. <table border="1"> <thead> <tr> <th>10kHz/9kHz</th> <th>Frequency range</th> <th>Channel space</th> <th>Reference frequency</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>522 – 1,611 kHz</td> <td>9 kHz</td> <td>9 kHz</td> </tr> <tr> <td>1</td> <td>530 – 1,620 kHz</td> <td>10 kHz</td> <td>10 kHz</td> </tr> </tbody> </table>	10kHz/9kHz	Frequency range	Channel space	Reference frequency	0	522 – 1,611 kHz	9 kHz	9 kHz	1	530 – 1,620 kHz	10 kHz	10 kHz												
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1	530 – 1,620 kHz	10 kHz	10 kHz																						
9N/9N+2	Frequency range setting for LW. Not used.																								
PRESET 1 PRESET 0	Preset memory station number setting. <table border="1"> <thead> <tr> <th>PRESET 1</th> <th>PRESET 0</th> <th>Preset memory number</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>10 keys (M1-M8, M17, M19/M9-M16, M18, M20) ... 20 stations</td> </tr> <tr> <td>0</td> <td>1</td> <td>8 keys (M1-M8/M9-M16) ... 16 stations (use with T-4017)</td> </tr> <tr> <td>1</td> <td>0</td> <td>7 keys (M1-M7/M9-M15) ... 14 stations</td> </tr> <tr> <td>1</td> <td>1</td> <td>6 keys (M1-M6/M9-M14) ... 12 stations</td> </tr> </tbody> </table>	PRESET 1	PRESET 0	Preset memory number	0	0	10 keys (M1-M8, M17, M19/M9-M16, M18, M20) ... 20 stations	0	1	8 keys (M1-M8/M9-M16) ... 16 stations (use with T-4017)	1	0	7 keys (M1-M7/M9-M15) ... 14 stations	1	1	6 keys (M1-M6/M9-M14) ... 12 stations									
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### 2) Preset key

When this key is pressed, each station in the memory will be turned in successively for about 5 seconds in order from channel 1 to 16 until the other key is pressed.



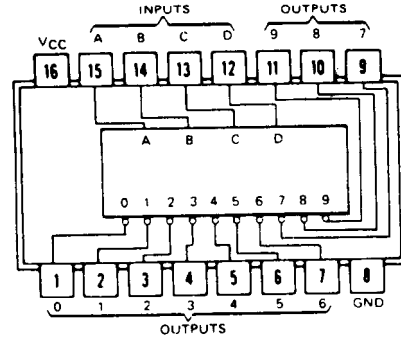
3. Indicator circuit

1) Station indication circuit

The BCD code for preset station indicator are output from terminals 37 to 40 (A to D).

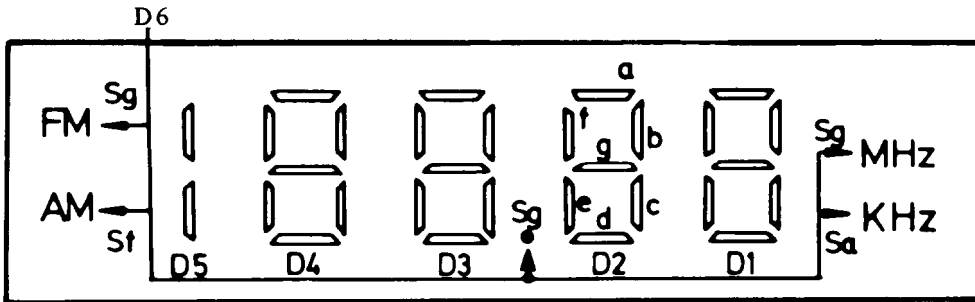
	INPUT				OUTPUT							
	D	C	B	A	2	3	4	5	6	7	9	10
M1/M9	0	0	0	1	0	1	1	1	1	1	1	1
M2/M10	0	0	1	0	1	0	1	1	1	1	1	1
M3/M11	0	0	1	1	1	1	0	1	1	1	1	1
M4/M12	0	1	0	0	1	1	1	0	1	1	1	1
M5/M13	0	1	0	1	1	1	1	1	0	1	1	1
M6/M14	0	1	1	0	1	1	1	1	1	0	1	1
M7/M15	0	1	1	1	1	1	1	1	1	1	0	1
M8/M16	1	0	0	0	1	1	1	1	1	1	1	0

● 74LS42 (BCD to decimal decoder)

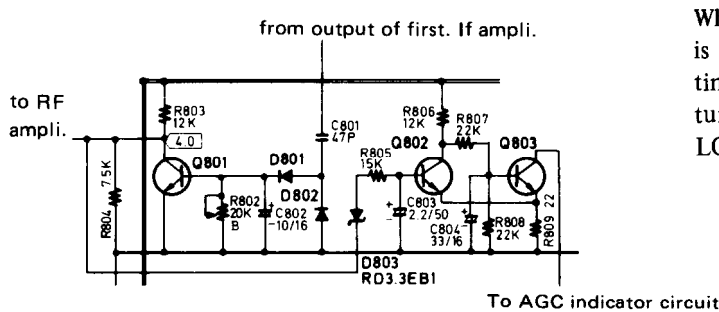


Pin Connection Diagram

2) Fluorescent display tube connection

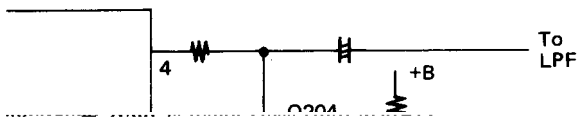


4. AGC circuit



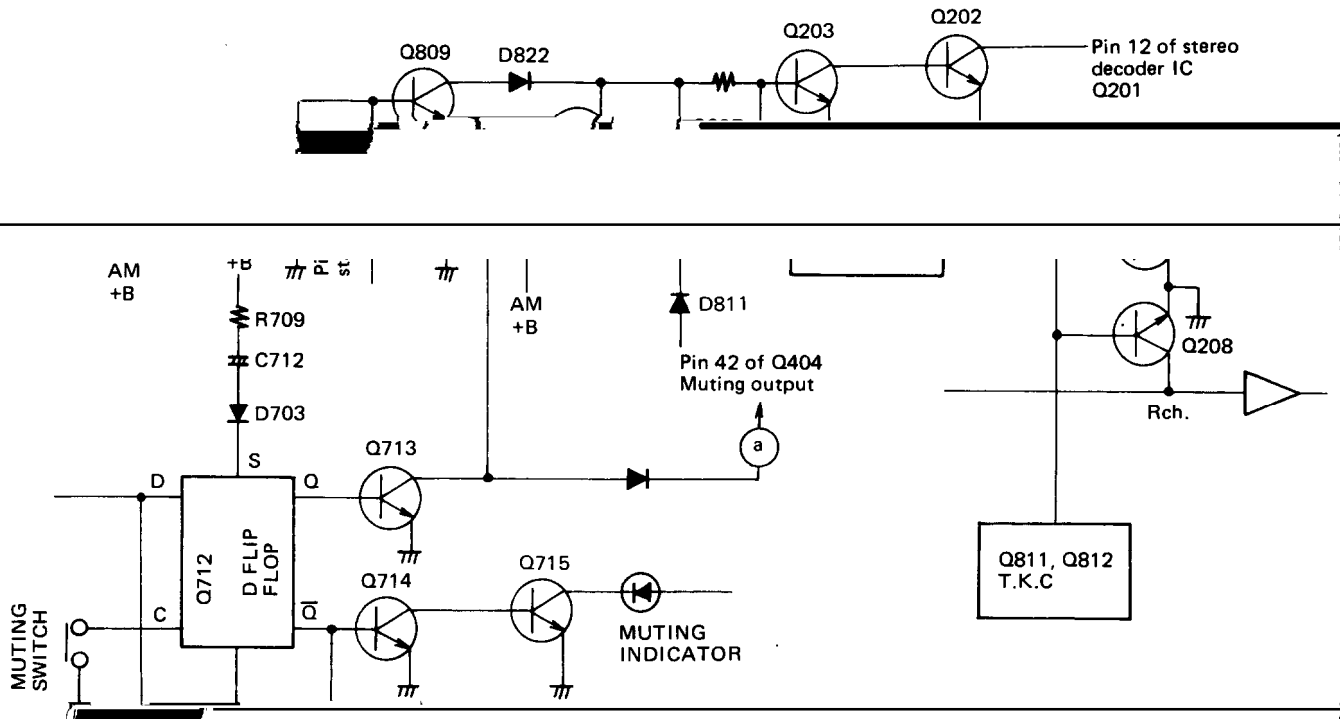
When the broadcast station is received over 85dBf, Q801 is turned on and the AGC circuit operates. At the same time, Q802 is turned off, Q803 is turned on, Q705 is turned off and, the DX indicator lights off and the LOCAL indicator lights.

5. Auto high blend circuit



There is a 3-stage IF level detection circuit in the IC of Q106. A direct current voltage approximately proportional to the electrical field intensity is output from output pin 13. This is used to turn off Q205 and turn on Q204 when the electrical field is weak (less than 40dBf).

## 6. Muting circuit



1. When power is turned on, the charge current goes from +B to R837 to C815, so Q811 is cut off and Q207 and Q208 are turned on. When the voltage at both ends of C815 is more than about 0.6V, Q811 is turned on so Q207 and Q208 are turned off and muting is opened when a station is tuned.
2. When power is turned off, Q812 turns off, the discharging current goes from C816 to D819 to Q207 and Q208 so muting is closed.

When a station is tuned, the output goes to the low level. When muting output goes to the low level, Q810 is turned off, Q809 is turned on, Q806 is turned off, Q807 is turned on and Q207 and Q208 are turned off, so muting is opened.

## Muting switching circuit

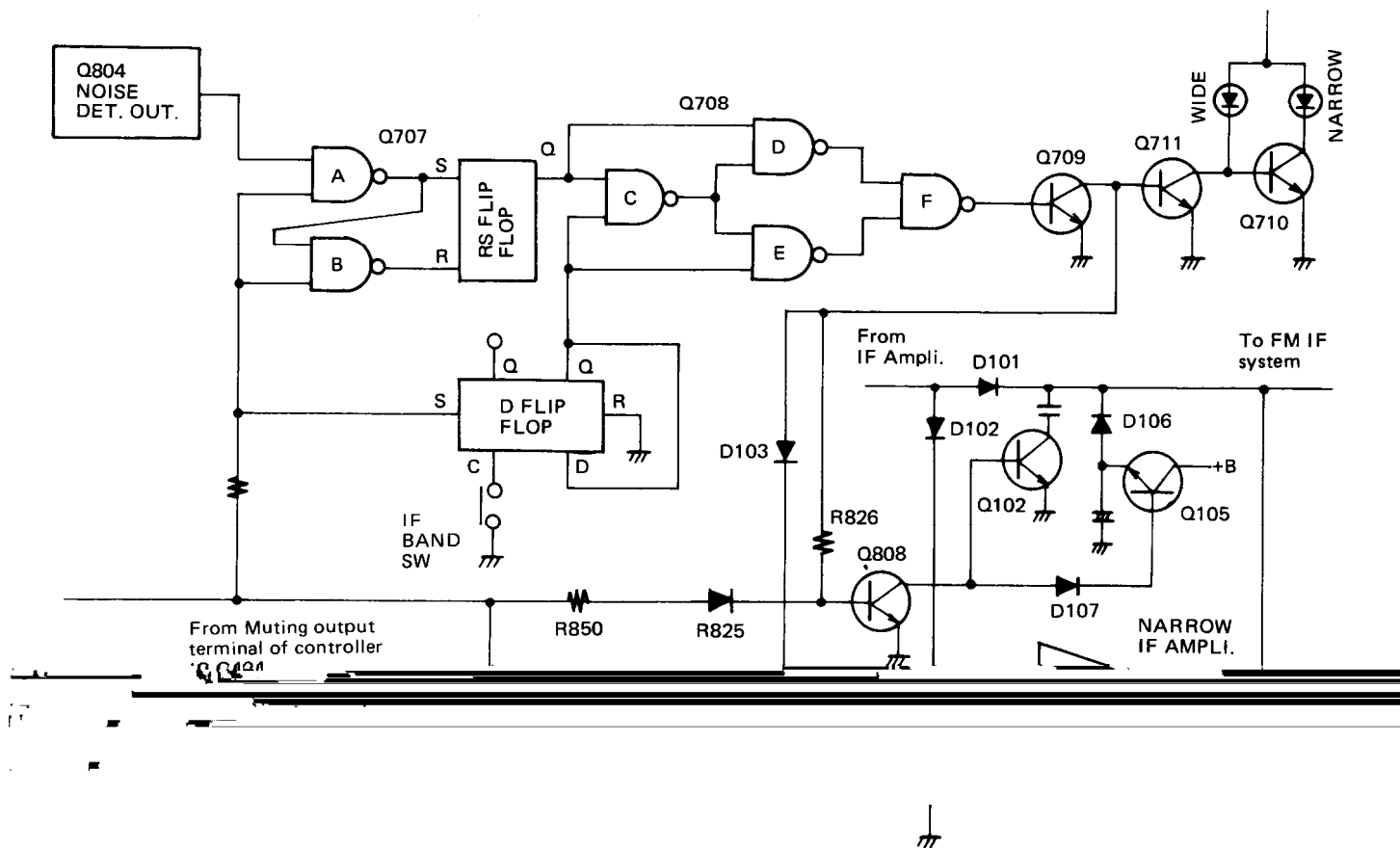
- the memory is recalled, and (3) While a radio station is being received using auto search tuning.
4. When an FM station is not being received (and the muting switch is on).

When the output of the Schmitt trigger goes to high level, Q809 is turned on and Q806 is turned off, so muting is opened. The terminal Q of Q712 goes to the high level so Q713 is turned on, Q805 is turned off and the muting circuit operates. At the same time, the terminal  $\bar{Q}$  goes to the low level so Q714 is turned off,

to high level so the output of Schmitt trigger goes to the high level to turn on Q207 and Q208 and muting is opened.



7. IF band width switching circuit



The IF band auto switching circuit is operated by the noise amplifier. When the noise components over 200kHz in the composite signal are included, the output of noise amplifier goes to the high level.

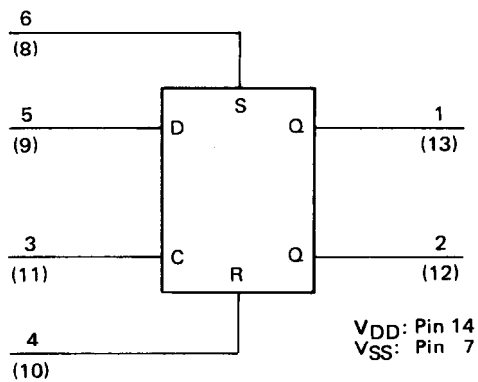
When power is turned, the high level pulse is output from muting output pin 42 of controller IC Q404 and the output  $\bar{Q}$  of D flip-flop goes to the low level.

When the station is tuned (when the output of noise amplifier goes to the low level), the output of RS flip-flop goes to the low level and the output of NAND gate F of Q708 goes to the low level so Q709 is turned

off, Q711 is turned on, Q710 is turned off and the WIDE indicator LED lights. At the same time, Q808 is turned on, Q102 and Q105 is turned off, Q103 is turned on and the IF amplifier goes to the wide mode.

When the IF band switch is pushed or auto/manual tuning is operated (when the output of noise amplifier goes to the high level), the output of NAND gate F is inverted and the transistors listed above operate in the opposite manner so the IF band is turned the narrow operation.

4013B (Dual "D" Flip-Flop with Set/Reset Capability)

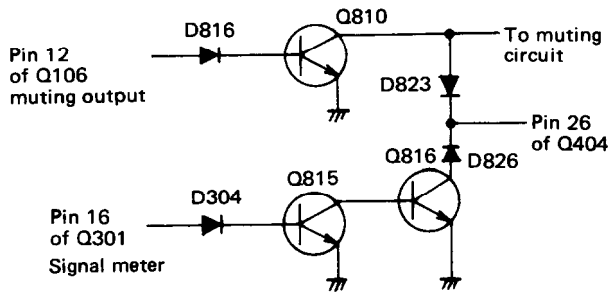


Truth table

CLOCK <sup>+</sup>	INPUTS			OUTPUTS	
	DATA	RESET	SET	Q	Q
	0	0	0	0	1
	1	0	0	1	0
	X	0	0	Q	Q
X	X	1	0	0	1
X	X	0	1	1	0
X	X	1	1	1	1

X = Don't Care  
+ = Level change

8. Station detection circuit

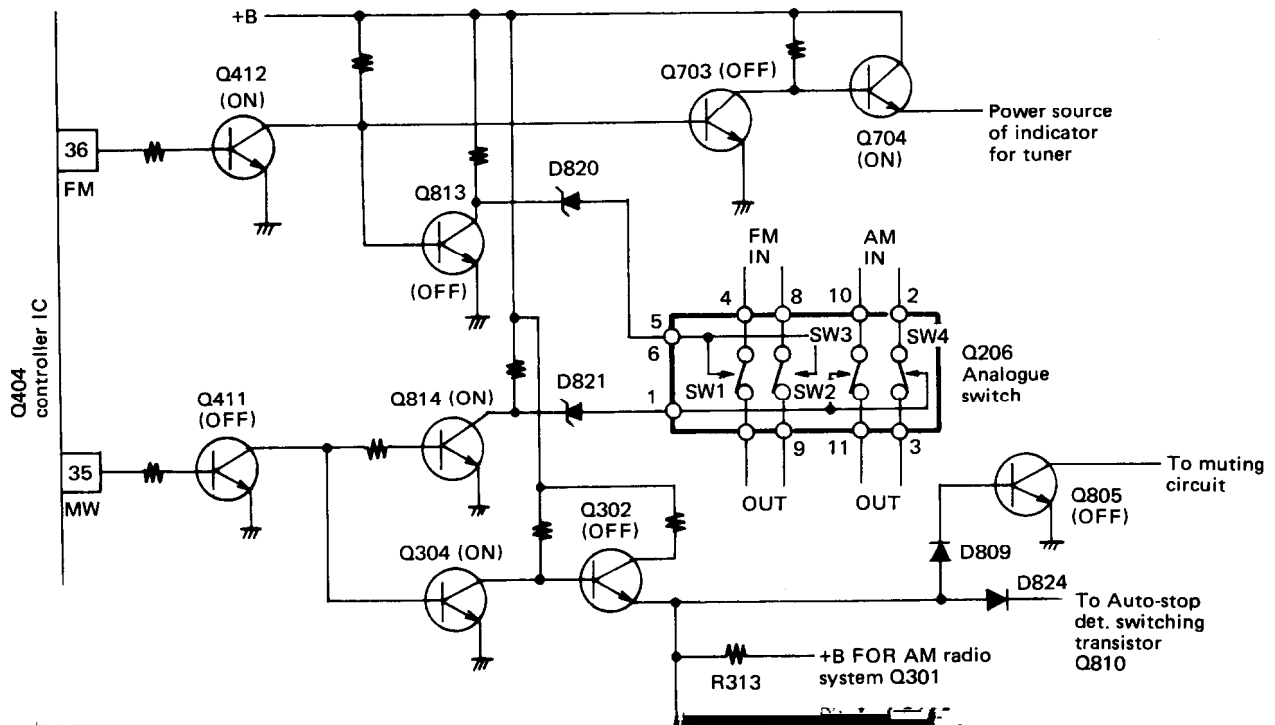


During FM reception, this is operated by the IF level detection (over 23dBf) and zero cross detection circuits included in the FM IF system IC of Q106. When a station is tuned, the muting output pin 12 of Q106 goes to the low level so Q810 goes from on to off, causing pin 28 of the controller IC to go to the high level to complete auto search tuning.

During AM reception, this is operated by the output of signal meter driver included in the AM radio system IC of Q301. When a station is tuned, the meter output pin 16 of Q108 go to the high level so Q815 is turned on and Q816 is turned off, causing pin 28 of the controller IC to go to the high level to complete auto search

tuning

9 FM/AM switching circuit



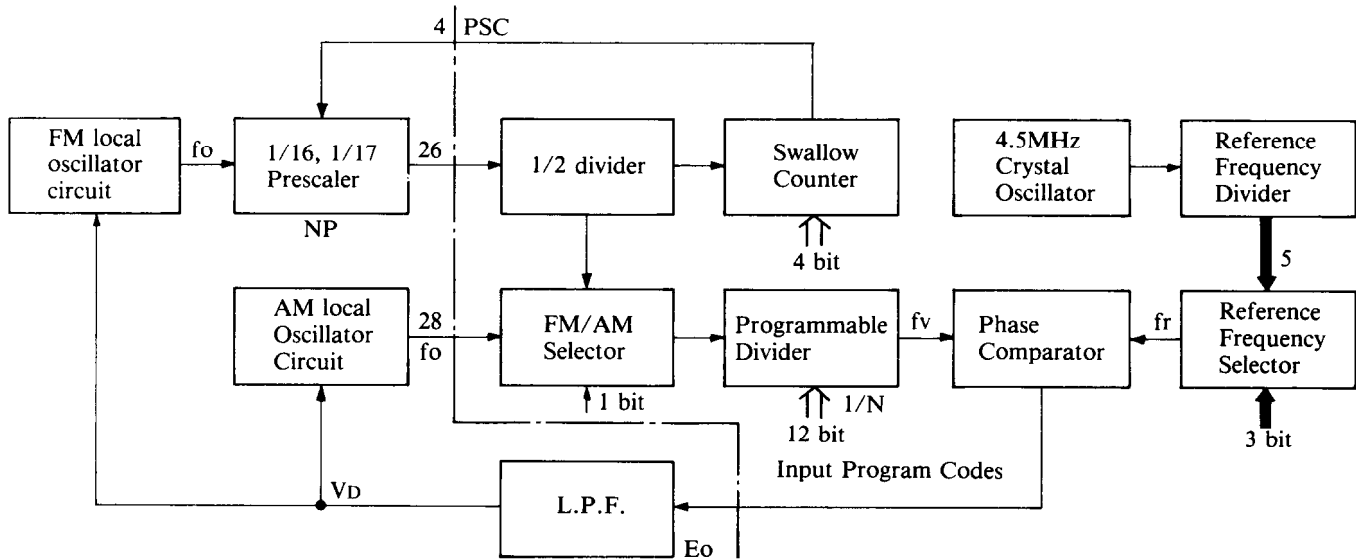
type. For FM reception, pin 36 is high and pin 35 is low; for AM, pin 36 is low and pin 35 is high. Because pin 35 is high and pin 36 is low during AM reception, Q411 is on, Q814 is off, Q412 is off and Q813 is on, the analogue switches SW3 and SW4 of Q206 are on while SW1 and SW2 are off, so an AM signal output. Also, since Q703 goes to on and Q704 to off, the muting, IF band, mode and AGC indicators are turned off. At the same time, Q304 is turned off and Q302 is turned on, So +B is

to the high level so the FM IF amplifier is also switched off.

Also, during AM reception, Q805 is turned on so the muting circuit is off and Q810 is turned on so the FM station detection circuit is off. During FM reception, all of the switching transistors mentioned above perform the opposite operations to the FM mode.

Figures in parentheses indicate transistor operation during FM reception.

10. PLL tuned circuit



A block diagram of the tuned circuit of the PLL is shown above the diagram.

Operation During AM Reception

The reception frequency is applied to the programmable divider where it is divided to  $1/N$  and output as  $f_v$ . This is applied to the phase detector where it is compared with frequency standard  $f_r$  (9kHz for G/W model and 10 kHz for D model). If  $f_r$  and  $f_v$  differ,  $E_o$  equal to the difference in frequency is output. Since error output  $E_o$  is a pulse waveform, it is passed through the low pass filter to change it into DC voltage  $V_D$ , which is applied to the variable capacitor in the front end to change the reception frequency. This continues until  $f_v$  and  $f_r$  are the same and  $E_o = 0$ .

(G/W models)

Since AM signals received range from 522 kHz to 1611kHz, they are changed to 972kHz–2061kHz for reception. Furthermore, since  $f_v=f_o/N$ , the divisor,  $N$ , is changed by program code input so that  $N=972/9-2061/9=108-229$ .

(D model)

Since AM signals received range from 530kHz to 1620kHz, they are changed to 980kHz–2070kHz for reception.

Furthermore, since  $f_v=f_o/N$ , the divisor,  $N$ , is changed by program code input so that  $N=980/10-2070/10=98-207$ .

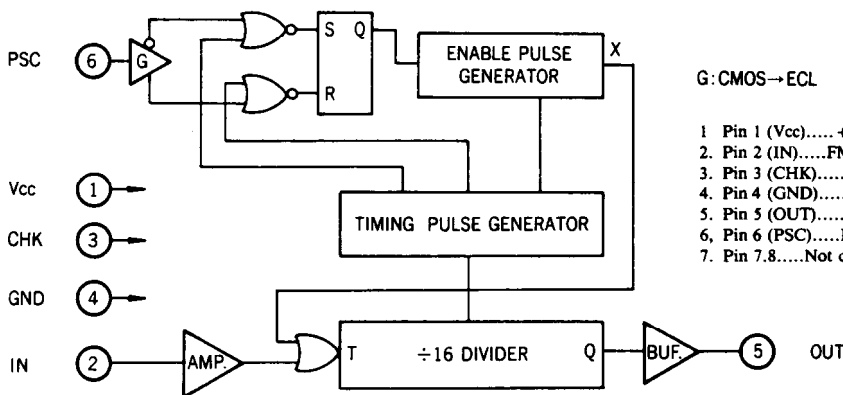
Operation During FM Reception.

The pulse swallow method is used in the prescaler of the T-4017. In this type of prescaler, a supplementary number (changed according to the program code input) and the divided reception frequency from the prescaler are combined in the control counter and the prescaler's division factor is switched between 1/16 and 1/17 according to external control (1/16 when the PSC terminal is "H" and 1/16 when it is "L").

The station oscillation frequency is applied to the programmable divider, but the programmable divider has an upper frequency limit of only 30MHz, so the pulse swallow-type prescaler, which can be used up to 150MHz, is inserted for division to  $1/N_p$ .

The signal is then divided to 1/2 in the microcomputer and applied to the programmable divider and divided to  $1/N$ . The result is compared with a 25 kHz frequency standard in the phase detector and the error is output as  $E_o$  until a match is obtained as in AM operation.

$\mu$ PC553AC (Prescaler)

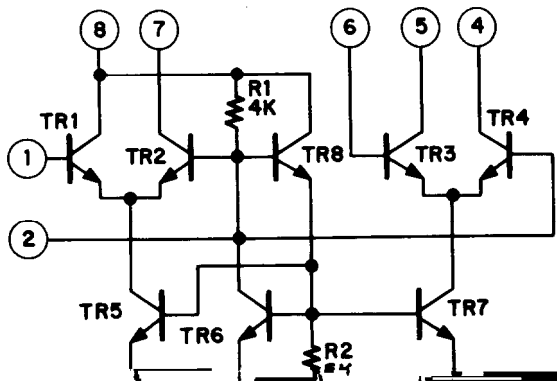


G: CMOS→ECL

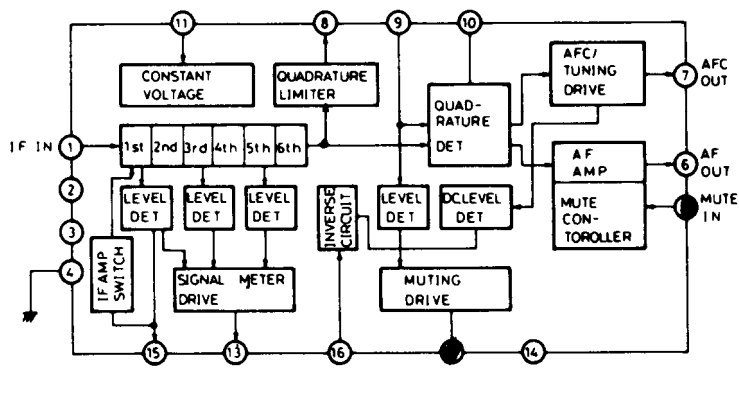
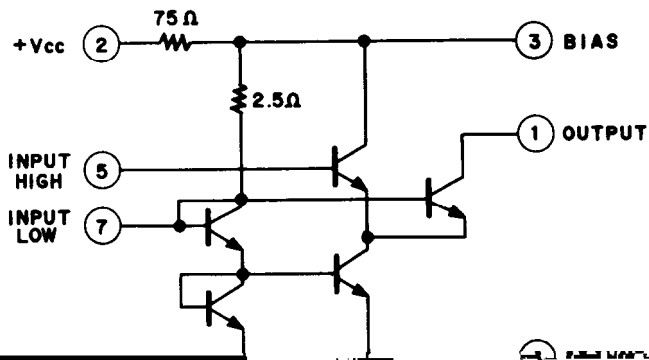
- 1. Pin 1 (Vcc)..... +5 volts Supply
- 2. Pin 2 (IN).....FM local oscillator signal input
- 3. Pin 3 (CHK).....Check terminal
- 4. Pin 4 (GND).....Ground terminal
- 5. Pin 5 (OUT).....Prescaler terminal
- 6. Pin 6 (PSC).....Prescaler control terminal
- 7. Pin 7.8.....Not connected

# LINEAR IC BLOCK DIAGRAM

LA1222 (IF ampli.)

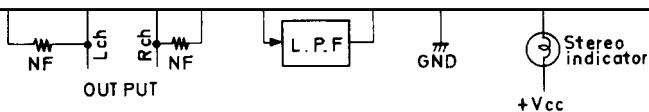
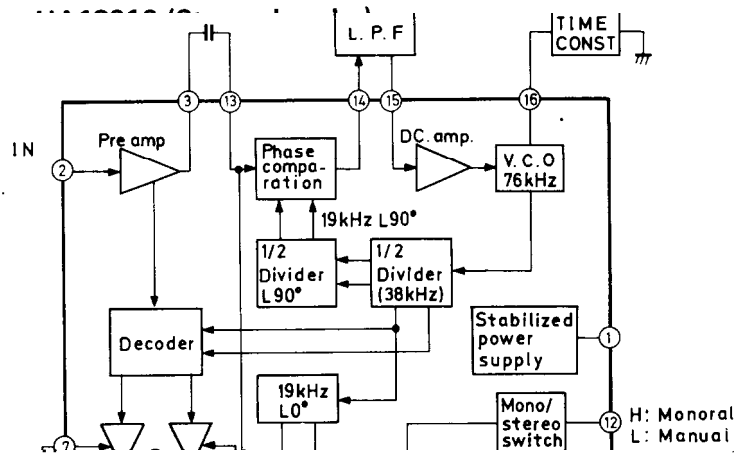
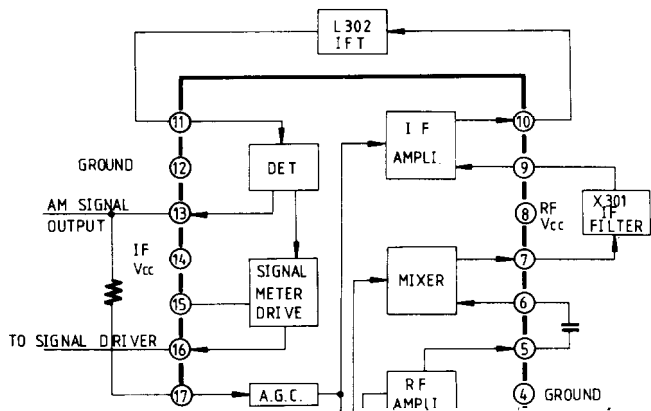


μPC555H (IF ampli.)

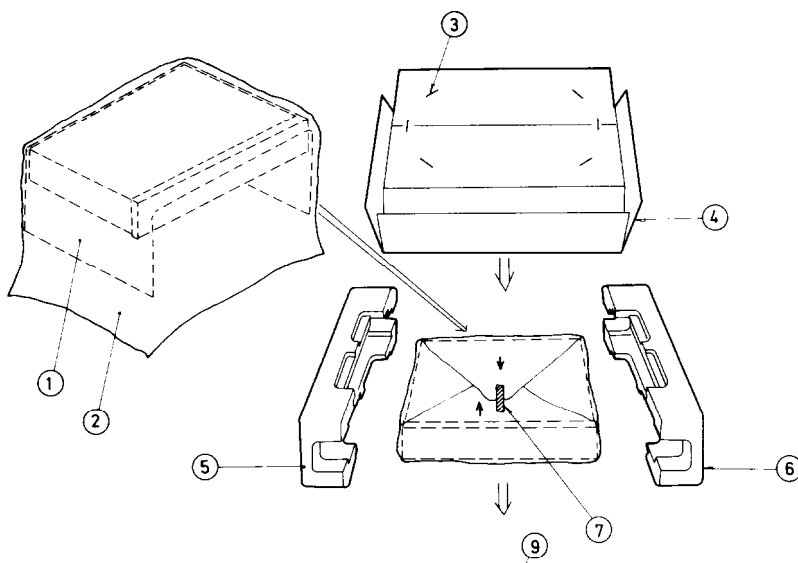
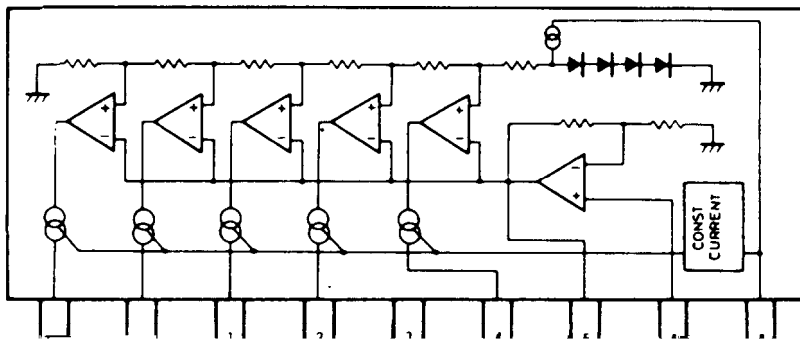


1. IF signal input
2. IF amplifier switch input  
H level: Off
5. Muting switch input
6. Composite signal output
7. AFC output
8. IF amplifier output
9. 10.7MHz input
10. Reference voltage
11. Power supply
12. Muting output  
Tuned: L level
13. Signal strength output
15. AFC output

16. Muting level



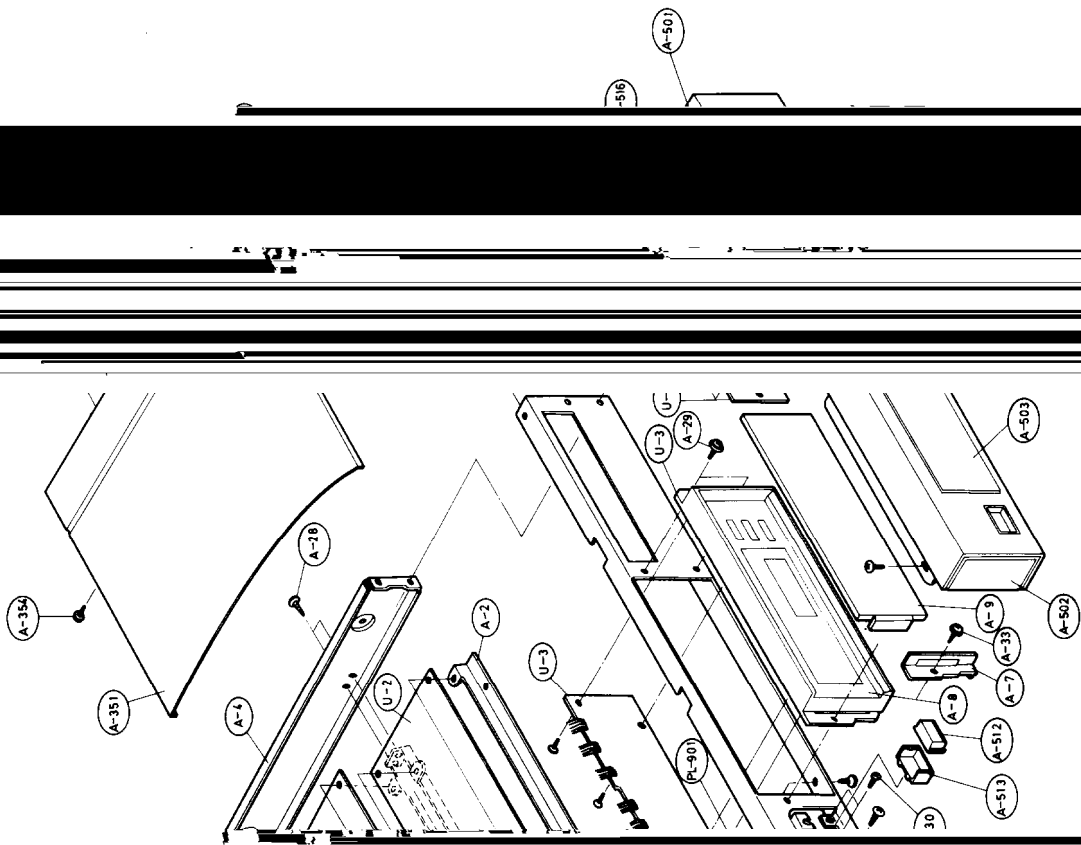
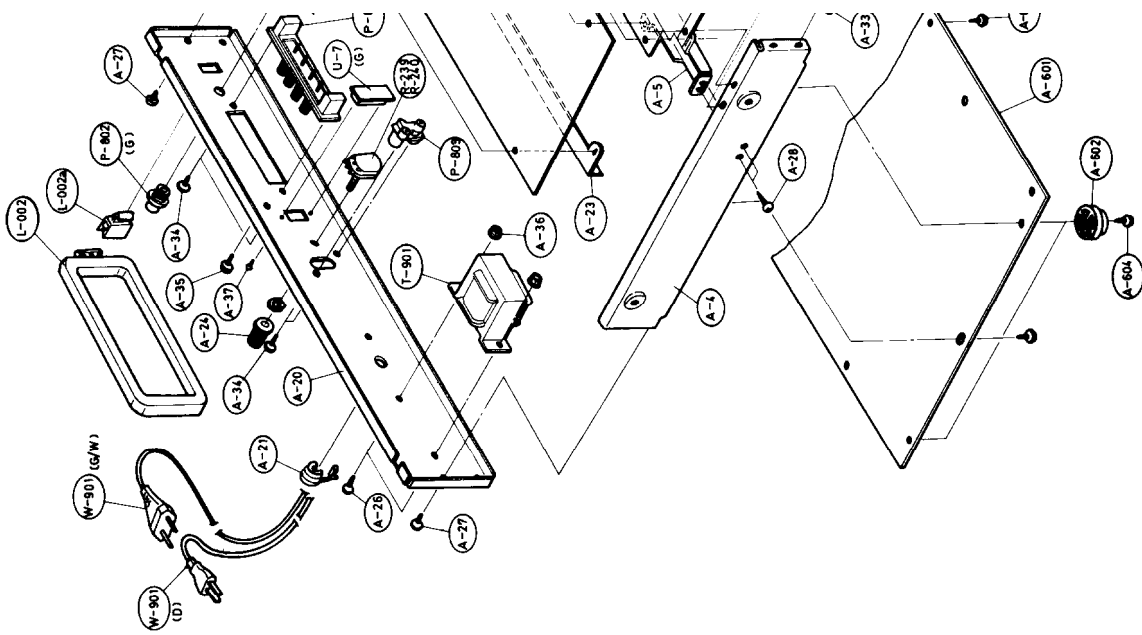
LB1403 (Signal strength indicator driver)



REF. NO.	PARTS NO.	DESCRIPTION	PARTS NO.	DESCRIPTION
1	29095012-1	500x800mm, Protection sheet	29340682	Instruction manual
2	29100036A	550x850mm, Poly-vinyl bag	<b>West Germany model</b>	
3	282301	Sealing hook	292064A	FM antenna
4	29050657	Master carton box	253074	Connection cable
	29050658	Master carton box (black model)	29340683	Instruction manual
5	29090772	Pad R	29365005-3A	Warranty card
6	29090771	Pad L	29358004	Service station list
7	29110032	Adhesive tape	<b>220V model</b>	
8	260012	50x700mm, Dampion tape	292064A	FM antenna
	<b>Accessory bag complete</b>		293074	Connection cable

29358002	Service station list
<b>120V model</b>	
292064A	FM antenna
253074	Connection cable

**EXPLODED VIEW**



# PARTS LIST

REF. NO.	PARTS NO.	DESCRIPTION	REF. NRTS	NO.	DESCRIPTION	REF. NO.	PARTS NO.	DESCRIPTION
A1	27110194B	Front bracket	A507 404	39	Cushion	U1	13098549	NARF-1649, F
A2	27130332	Bracket F	A509 211	36A	Knob ass'y, tuning			power supply (D)
A4	27115014F	Side bracket	211	35A	Knob ass'y, tuning (B)			
A5	27130333	Bracket M	A510 210	39B	Knob ass'y, preset		13104549A	NARF-1649a,
A6	27190198	Holder, lamp	210	70B	Knob ass'y, preset (B)			power supply (G)
A7	27190197	Holder, dial plate	A511 211	39	Knob, M			
A8	28133076A	Back plate	211	10	Knob, M (B)		13100549B	NARF-1649b,
A9	28130184A	Dial plate	A512 210	23	Knob, power			power supply (W)
A10	28175073-1	Insulating plate	210	24	Knob, power (B)			
A20	27120489A	Back panel (D)	A513 208	28C	Knob, base	U2	13098550	NADG-1650, I
	27120490B	Back panel (G)	A514 801	73	Spring			ass'y (D)
	27120491A	Back panel (W)	A516 430	368	3TTS+6B (BC), Tapping screw		13104550A	NADG-1650a,
△ A21	270025	SR-3P-4, Strainrelief (D)	A517 430	380	3TTP+8P (BC), Tapping screw			board ass'y (G)
△ A22	270280	SR-4K-4, Strainrelief (G/W)	A519 404	36	Cushion		13100550B	NADG-1650b,
A23	27140500	Pc bracket B	A601 701	31A	Bottom board	U3	13078551A	board ass'y (W)
A24	28320540	Knob, output	A602 750	39A	Leg			NADIS-1651a,
A26	838440089	4TTB+8C (BC), Tapping screw	A603 430	388	3TTW+8B (BC), Tapping screw			ass'y
A27	801230	3STS+8BQ (BC), Tapping screw	A604 430	108	3TTS+10B (BC), Tapping screw	U4	13098552	NASW-1652, S
A28	834430068	3TTS+6B (BC), Tapping screw	△ C901 1006	3A	0.01F, AC400V, Capacitor IS	U5	13098553	NASW-1653, S
A29	831430088	3TTW+8B (BC), Tapping screw	△ C901a 000	30	Cover, capacitor	U6	13098554	NAPL-1654, D
A30	82143006	3P+6FN (BC), Pan head screw	L001 026	3A	Balloon transformer (G)			lamp pc board
A31	863430	N-3FN (BC), Nut	L002 098	3A	NMA3040, AM loop antenna	U7	13104580	NASW-1680, F
A32	82142004	2P+4F (BC), Pan head screw	L002a 901	29	Holder, antenna			pc board ass'y
A33	833430080	3TTP+8P (BC), Tapping screw	P801 1600	15	NTM4PRMN14, Antenna terminal	△ W901	253083-1	AS-CEE, Powe
A34	834430108	3TTS+10B (BC), Tapping screw	1600	17	(D/W)	△	253099A	AS-UC-3, Powe
A36	86414010	FWN4x10FN, Flange nut			NTM4PRMN16, Antenna terminal			
A37	82141604	2.6P+4F (BC), Pan head screw			(G)			
A351	28184188	Top cover	P802 1450	38	Connector, antenna 75ohm (G)			
A352	28184183	Top cover (B)	P802a 057		M10B, Toothed washer (G)			
A353	28140020	14x10x40mm, Cushion	P803 1450	36	NPJ-2PRBL-43, Output terminal			
A354	838440089	4TTB+8C (BC), Tapping screw	PL90 1149		PL14 V60mAW3.0, Power indicator lamp			
A354	834430068	3TTS+6B (BC), Tapping screw			N16G10KB15, Output level adjustment variable resistor			
A501	13098121	Front panel ass'y	R239, 701		3.3Mohm, 1/2W, Solid resistor (D)			
A502	13078121	Front panel ass'y (B)	△ R901 523	355	NPS-111-L100P, Power switch (D)			
A502	28125137	End cap	△ S901 1351	35	NPS-111-L286P, Power switch (G/W)			
A503	28125138	End cap (B)	△	22	NSS-1258P, Voltage selector switch (W)			
A504	28191191	Clear plate	△		NPT-808D, Power transformer (D)			
A504	27267206	Guide, power	△		NPT-808G, Power transformer (G)			
A504	27267234	Guide, power (B)	△ S902 1651	23	NPT-808DG, Power transformer (W)			

Note: (D): Only 120V model  
 (G): Only 220V model  
 (W): Only 120/220V model  
 (B): Only black model

NOTE: THE COMPONENTS IDENTIFIED BY MARK △ ARE CRITICAL FOR LISK OF FIRE AND ELECTRIC SHOCK. REPLACE ONLY WITH PARTS NUMBER SPECIFIED.

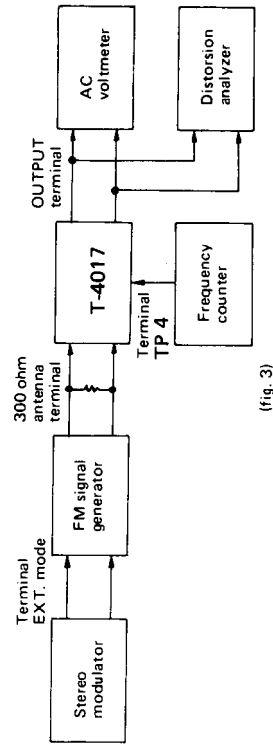
# ADJUSTMENT PROCEDUR

## FM section

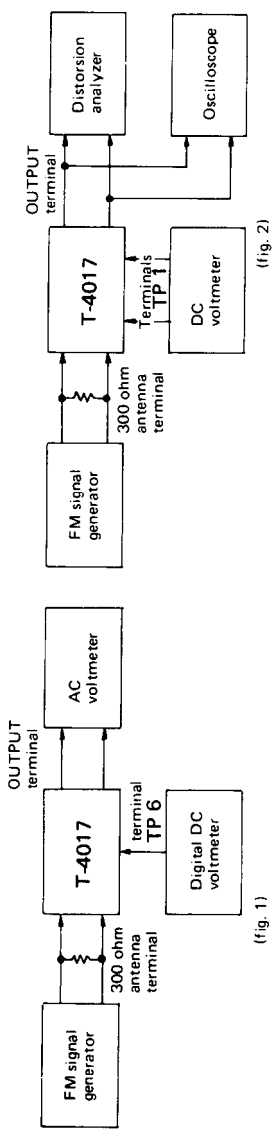
Item	Step	Connection of instrument	FM SG
FM RF	1	Fig. 1	
	2		107.9MHz 1kHz 75k
FM IF	1	Fig. 2	
	2		98.1MHz 1kHz 75k
VCO		Fig. 3	98.1MHz no modul.
Stereo separation	1	Fig. 3	98.1MHz ext. modu
	2		
Distorstion		Fig. 3	98.1MHz ext. modu
Muting level	1	Fig. 2	98.1MHz
	3		98.1MHz
NARROW IF level		Fig. 4	98.1MHz 1kHz 75k
LOCAL indication lighting level	1	Fig. 4	98.1MHz 1kHz 75k
	2		98.1MHz 1kHz 75k

Output indicator	Adjustment	Adjust	Remarks
Digital DC voltmeter	TC0	20.8V	
AC voltmeter	TC1 to TC3	Maximum	D/W models
	TC1 to TC4		G model
DC voltmeter	L101 primary coil	0V	Repeat the steps 1 and 2 until no further adjustment is necessary.
Distorstion analyzer	L101 secondary coil	Minimum	
Frequency counter	R217	76kHz+76Hz	Remove the frequency counter after adjustment.
Rch. AC voltmeter	R208	Minimum	Maximum and same separation at the channels left and right.
		Minimum	
Distorstion analyzer	IF	Minimum	
Oscilloscope	R133	Signal is output	Muting switch to on position
		No output	
DC voltmeter	R118	Same level at the left and right channels.	
LOCAL indicator	R802	lights on	
		lights off	

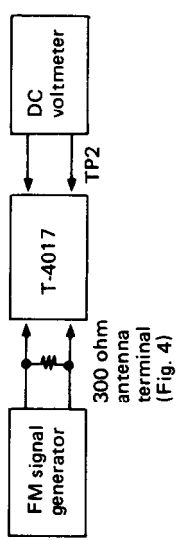




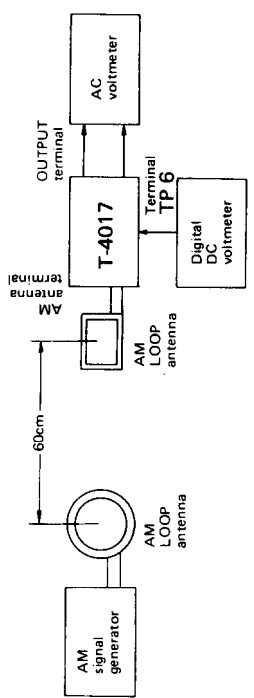
(fig. 3)



(fig. 2)



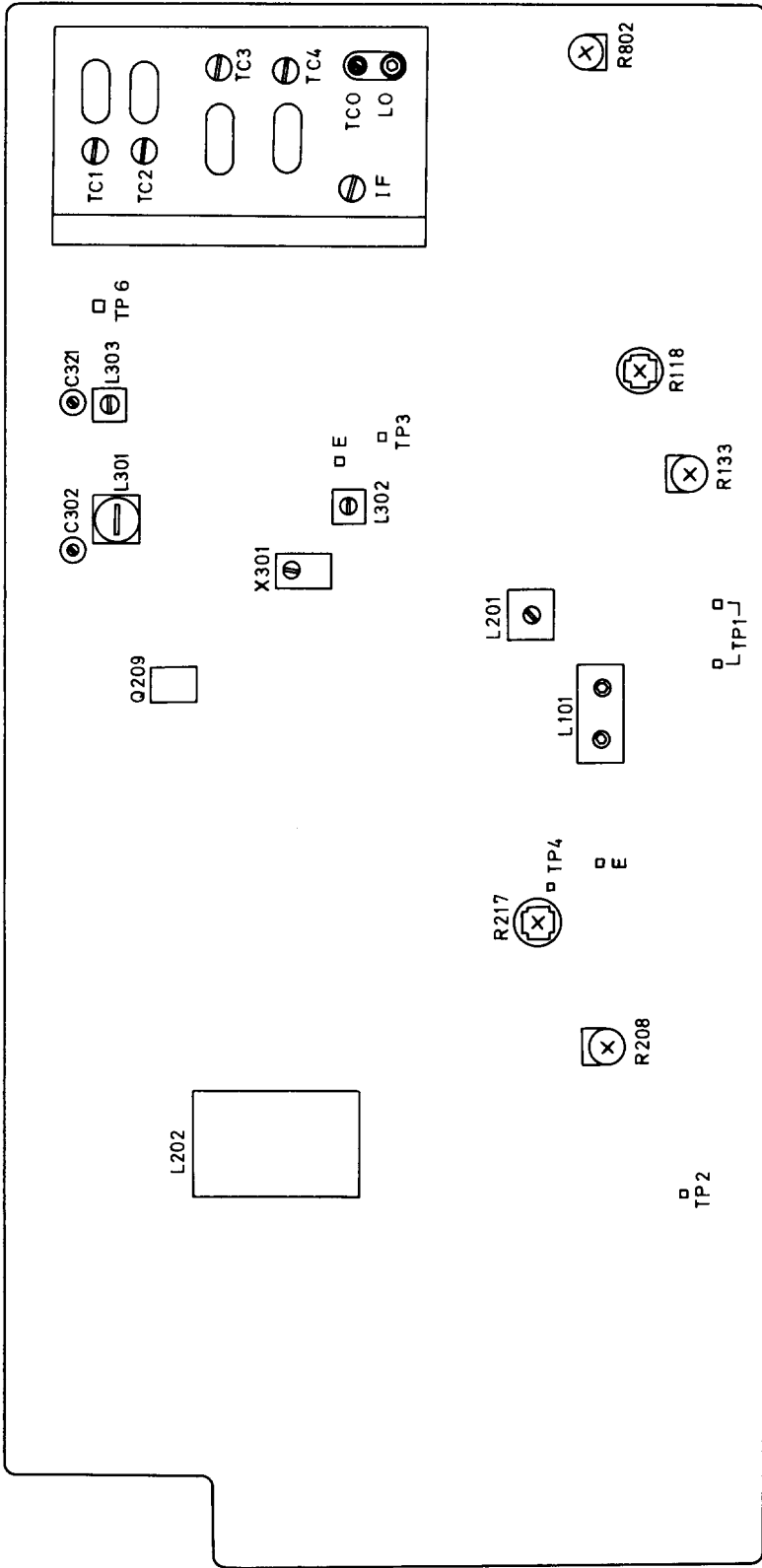
(Fig. 4)



**AM section**

Step	AM SG output	Tuned frequency	Output indicator	Adjustment	Adjust	Remarks
1	999kHz (1000kHz)	999kHz (1000kHz)	AC voltmeter	X301 L302	Maximum	
2		522kHz (520kHz)	Digital DC voltmeter	L303	2.5V	Repeat the steps 2 and 3 until no further adjustment is necessary.
		1611kHz (1610kHz)		C321	15.5V	
4	603kHz (600kHz) 400Hz 30% mod.	603kHz (600kHz)	AC voltmeter	L301	Maximum	Repeat the steps 4 and 5 until no further adjustment is necessary.

Note: ( ) : 120V model



# PRINTED CIRCUIT BOARD — PARTS LIST

## FM/AM TUNER AND POWER SUPPLY CIRCUIT PC BOARD (NARF-1649/a/b)

CIRCUIT NO.	PARTS NO.	DESCRIPTION	CIRCUIT NO.	PARTS NO.	DESCRIPTION
	<b>Front end</b>			<b>Ceramic filters</b>	
TU001	240043A	FD236U14A (D/W)	X101, X102	3010024	SFE10.7ML-A (D/W)
	240062	FD636U (G)	X101	3010006	SFE10.7MA (RED) (G)
	<b>ICs</b>		X102	3010024	SFE10.7MA-A (G)
Q101	222577	LA1222, FM IF amplifier	X103, X104	3010070	SFE10.7MS3GY-A
Q104	222591	$\mu$ PC555H, FM IF amplifier	X301	3010075	SFL450B3
Q106	222540	HA11225, FM IF system	X302	3010076	BFU450C
Q201	222593	HA12016, Stereo decoder		<b>Capacitors</b>	
Q206	222575 or	TC4066BP or	C101	352741009	10 $\mu$ F, 16V, Elect.
	222840661	4066BP, Analogue switch	C107	352741019	100 $\mu$ F, 16V, Elect.
Q209	222502	NJM4558DX, Preamplifier	C110	352750479	4.7 $\mu$ F, 25V, Elect.
Q301	222701	LA1245, AM radio system	C115	352744709	47 $\mu$ F, 16V, Elect.
Q902	222780120	7812, Constant voltage, +12V	C116	352741009	10 $\mu$ F, 16V, Elect.
	<b>Transistors</b>		C119	352780229	2.2 $\mu$ F, 50V, Elect.
Q102	2211255	2SC1815 (GR)	C122	352750479	4.7 $\mu$ F, 25V, Elect.
Q103, Q105	2211255 or	2SC1815 (GR) or	C125	352780109	1 $\mu$ F, 50V, Elect.
Q202, Q203	2210746	2SC945A (P)	C126, C131	352721019	100 $\mu$ F, 6.3V, Elect.
Q204	2212304	2SK381 (D)	C132	352780109	1 $\mu$ F, 50V, Elect.
Q205	2211255 or	2SC1815 (GR) or	C202	352741009	10 $\mu$ F, 16V, Elect.
	2210746	2SC945A (P)	C203	352744719	470 $\mu$ F, 16V, Elect.
Q207, Q208	2211705	2SD655 (E)	C205, C206	352742209	22 $\mu$ F, 16V, Elect.
Q302-Q304	2211255 or	2SC1815 (GR) or	C210	352780339	3.3 $\mu$ F, 50V, Elect.
	2210746	2SC945A (P)	C211	352780109	1 $\mu$ F, 50V, Elect.
Q801	2211255	2SC1815 (GR)	C212	352780339	3.3 $\mu$ F, 50V, Elect.
Q802-Q816	2211255 or	2SC1815 (GR) or	C213	370131024	1,000pF $\pm$ 5%, 100V, APS
Q901, Q903	2210746	2SC945A (P)	C215, C216	352741009	10 $\mu$ F, 16V, Elect.
Q904	2211454	2SA1015 (Y)	C217, C218	352780339	3.3 $\mu$ F, 50V, Elect.
	<b>Diodes</b>		C221	352744719	470 $\mu$ F, 16V, Elect.
D101-D108	223105,	1S1555,	C222	352742219	220 $\mu$ F, 16V, Elect.
D304	223133 or	DS442X or	C223, C224	352780339	3.3 $\mu$ F, 50V, Elect.
D801, D802	223145	1S2076TD	C227, C228	352741009	10 $\mu$ F, 16V, Elect.
D301, D302	223136	KV1226	C229, C230	370134714	470pF $\pm$ 5%, 100V, APS (W)
D303	4000068	VD1222	C232	352741009	10 $\mu$ F, 16V, Elect.
D305, D806	2239471	RD5.6EB1	C233	352744709	47 $\mu$ F, 16V, Elect.
D803	2241291	RD3.3EB1	C302	3060010	NTC-20P09, Trimmer
D804, D805	223105,	1S1555,	C304	392884797	0.47 $\mu$ F, 50V, LL
D809-D814	223133 or	DS442X or	C309	352741009	10 $\mu$ F, 16V, Elect.
D816-D819	223145	1S2076TD	C310	352744709	47 $\mu$ F, 16V, Elect.
D822-D827	223105,	1S1555,	C315	352780339	3.3 $\mu$ F, 50V, Elect.
	223133 or	DS442X or	C317	352750479	4.7 $\mu$ F, 25V, Elect.
	223145	1S2076TD	C319	370135114	510pF $\pm$ 5%, 100V, APS
D820-D821	2241291	RD3.3EB1	C321	3060010	NTC-20P09, Trimmer
D901	223848 or	GP08B or	C323	352741009	10 $\mu$ F, 16V, Elect.
	223804	SR1K-2	C324	352780109	1 $\mu$ F, 50V, Elect.
D902	2239792	RD27EB2	C802	352741009	10 $\mu$ F, 16V, Elect.
D903	223862	WL01	C803	352780229	2.2 $\mu$ F, 50V, Elect.
D904	2239492	RD6.2EB2	C804	352743309	33 $\mu$ F, 16V, Elect.
D905	2239652	RD13EB2	C807	352780109	1 $\mu$ F, 50V, Elect.
D906	2239433	RD4.7EB3	C809	352783399	0.33 $\mu$ F, 50V, Elect.
	<b>Transformers</b>		C810	352780229	2.2 $\mu$ F, 50V, Elect.
L101	233274	NFIF-6041	C811	352780109	1 $\mu$ F, 50V, Elect.
L302	232095	NFIF-6025	C812	352744709	47 $\mu$ F, 16V, Elect.
	<b>Coils</b>		C815	352721019	100 $\mu$ F, 6.3V, Elect.
L102	233105 or	NCCH-1005 or	C816	352744719	470 $\mu$ F, 16V, Elect.
	233024	NCCH-1501	C817	352750479	4.7 $\mu$ F, 25V, Elect.
L201	233236	NMC-6027	C818	352780229	2.2 $\mu$ F, 50V, Elect.
L202	233032A	NMC-8-7	C903	352783319	330 $\mu$ F, 50V, Elect.
L301	232089 or	NMA-3037 or	C904, C906	352780108	1 $\mu$ F, 50V, Elect.
	232107	NMA-3045	C908	352762229	2,200 $\mu$ F, 35V, Elect.
L303	232110	NMO-4027	C909	352753319	330 $\mu$ F, 25V, Elect.
L801	233122	NCH-3013	C912	352741009	10 $\mu$ F, 16V, Elect.
L802	233031	NMC-9-1	C913-C915	352780109	1 $\mu$ F, 50V, Elect.
			C916	352780229	2.2 $\mu$ F, 50V, Elect.

# PC BOARD VIEW FROM COMPONENT

— Controller, display and switch section —

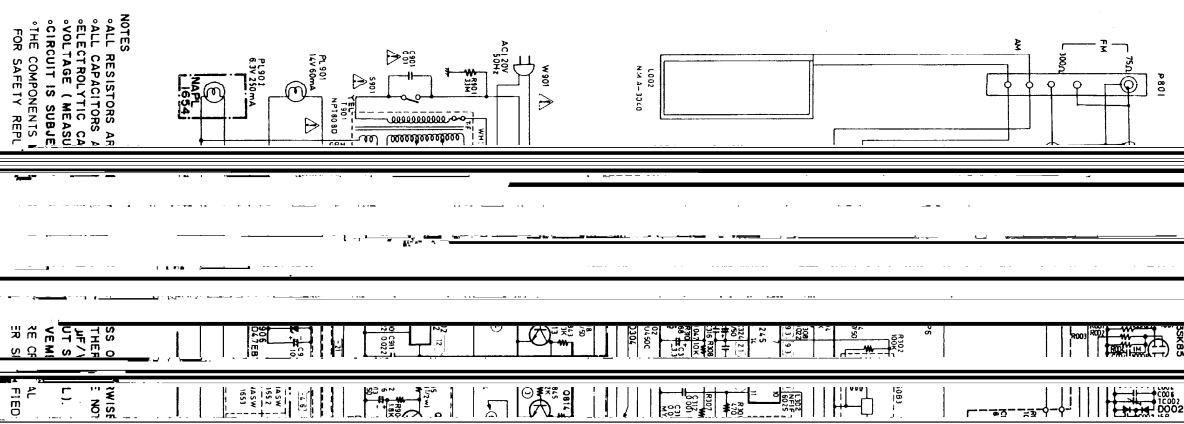
## PC BOARD — PARTS LIST

DIGITAL CIRCUIT PC BOARD ASS'Y (NADG-1650/a/b)

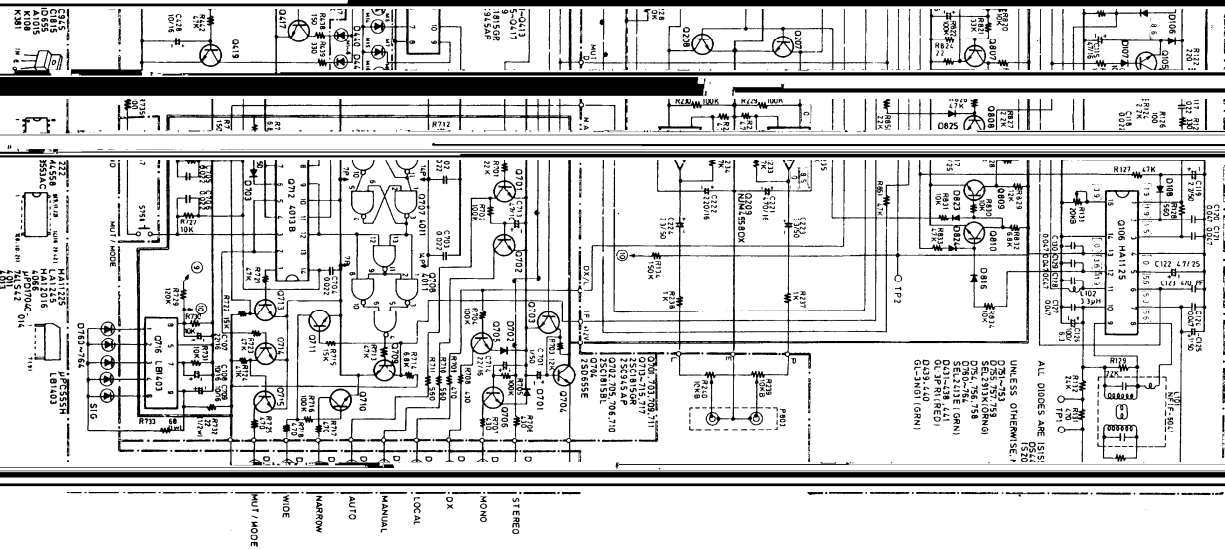
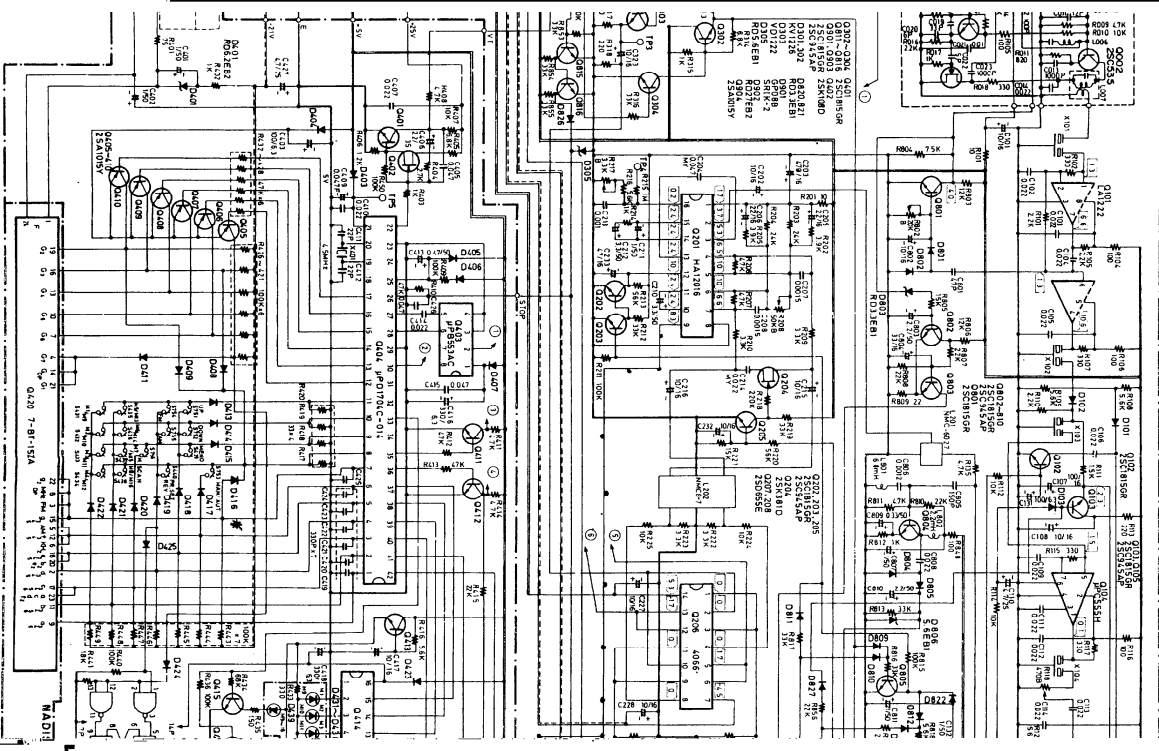
CIRCUIT NO.	PARTS NO.	DESCRIPTION	CIRCUIT NO.	QTY	DESCRIPTION	QTY	DESCRIPTION
Q403	ICs		C427	3	13E, LED		
Q404	222619	μPB553AC, Prescaler	C428	3	13K, LED		
Q414	222702	μPDI704C-014, Controller	C701	3	13E, LED		
Q418, Q707	222740421	74LS42, BCD to decimal decoder	C707	3	13K, LED		
Q708	222513 or	TC4011BP or	C708, C709	3	13K, LED		
Q712	222840111	4011BP, NAND gate	C712	3	10mm, Cushion		
Q716	222840131	4013B, D flip-flop	C713	3	W-1652/1653		
	222866	LB-1403, Signal strength meter driver	C714	3			
Q401	Transistors		R417-R420	4			
Q402	2211255	2SC1815 (GR)	R421-R426	4			
Q405-Q410	2212294	2SK108 (D)	R427-R432	4			
Q411-Q413	2211454	2SA1015 (Y)	R443-R449	4			
Q415-Q417	221255 or	2SC1815 (GR) or	R732	4			
Q419, Q701	2210746	2SC945A (P)	R733	4			
Q703	221255 or	2SC1815 (GR) or	S401	2			
Q702	2210746	2SC945A (P)	DISPLAY PC B				
Q704	2211705	2SC1815 (BL)	CIRCUIT NO.				
Q705, Q706	2211256	2SD655 (E)	Q420				
Q709, Q711	2211255 or	2SC1815 (BL)	D751-D753				
Q713-Q715	2210746	2SC945A (P)					

# SCHEMATIC D

- 120V model -



NOTES:  
 1. ALL RESISTORS ARE 1/4W 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.  
 2. ALL CAPACITORS ARE 50V UNLESS OTHERWISE SPECIFIED.  
 3. ALL ELECTROLYTIC CAPACITORS ARE 20% TOLERANCE UNLESS OTHERWISE SPECIFIED.  
 4. ALL VOLTAGE (V) MEASUREMENTS ARE TO BE TAKEN ACROSS THE COMPONENTS.  
 5. THE CIRCUIT IS SUBJECT TO SAFETY REPAIRS.



STEREO  
 MONO  
 LOCAL  
 MANUAL  
 AUTO  
 NARROW  
 WIDE  
 MUTI/MODE

UNLESS OTHERWISE SPECIFIED:  
 ALL DIMENSIONS ARE IN INCHES  
 DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY  
 DIMENSIONS IN BRACKETS ARE FOR REFERENCE ONLY  
 DIMENSIONS IN DASHES ARE FOR REFERENCE ONLY

CIRCUIT NO.	PARTS NO.	DESCRIPTION
C917	352763319	330 $\mu$ F, 35V, Elect.
C918	352752219	220 $\mu$ F, 25V, Elect.
C919	352741019	100 $\mu$ F, 16V, Elect.
C920	352744709	47 $\mu$ F, 16V, Elect.
C921	352721019	100 $\mu$ F, 6.3V, Elect.
<b>Resistors</b>		
R118	5225026	N10HR470BD, Semi-fixed, narrow IF level adjustment
R133	5215003	N08HR20KBC, Semi-fixed, muting level adjustment
R208	5215046	N08HR50KBC, Semi-fixed, VCO adjustment
R217	5225029	N10HR3.3KBC, Semi-fixed, separation adjustment
R802	5215003	N08HR20KBC, Semo-fixed, AGC level adjustment
R904	441721004	10ohm, 2W, Metal oxide film
R905	442521014	100ohm, 1/2W, Metal oxide film
R908	441622714	270ohm, 1W, Metal oxide film
<b>Radiator</b>		
	27160021	RAD-06B, for Q902
<b>Switch</b>		
S201	250142	NSS-2225, De-emphasis slide (W)

(D): Only 120V model

(G): Only 220V model

(W): Only 120/220V model

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