

Technical Manual

STEREO DC INTEGRATED AMPLIFIER RA-2020

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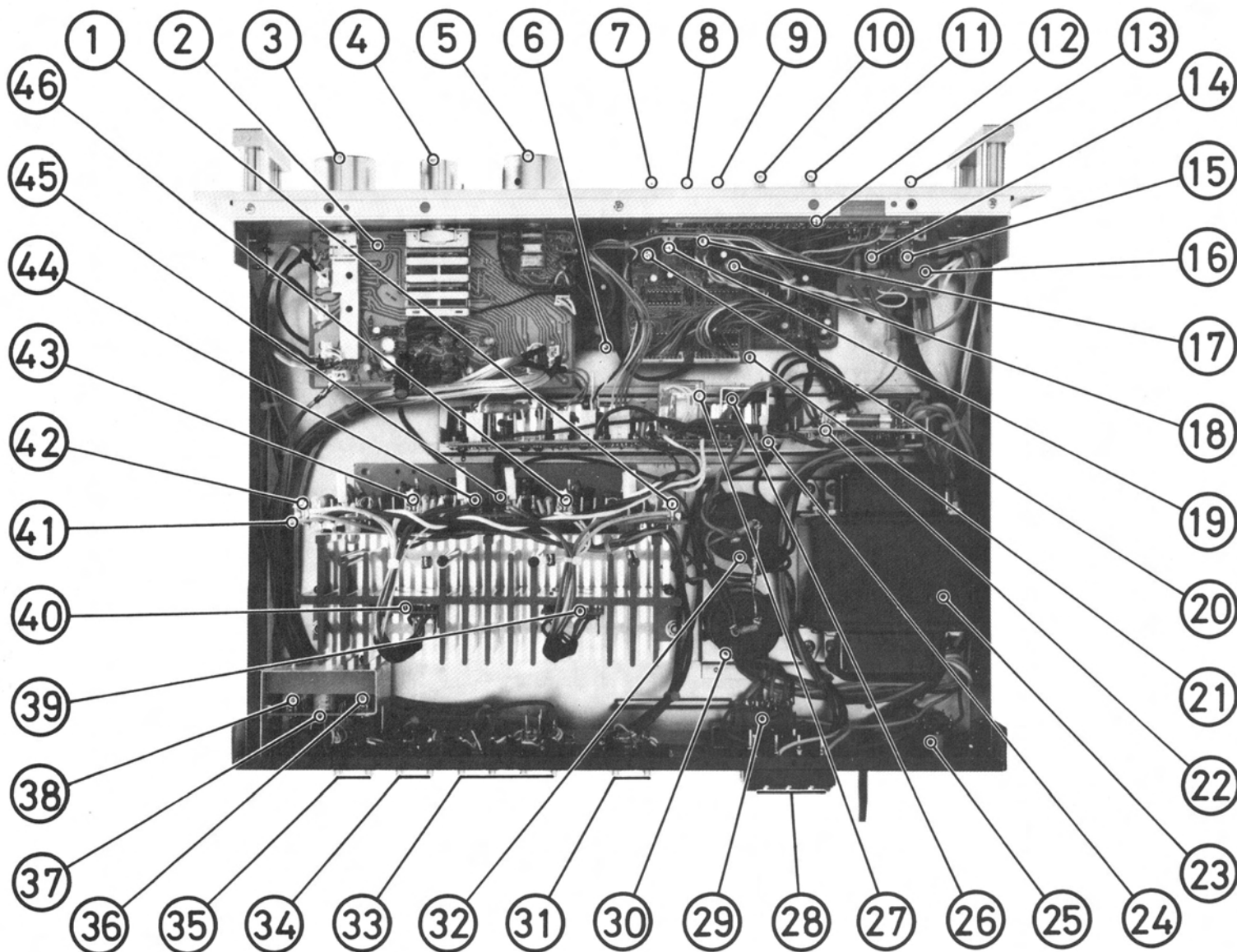
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**Serial No. Beginning
NB77329**

**THE ROTEL CO., LTD.
ROTEL ELECTRONICS CO., LTD.
ROTEL OF AMERICA, INC.**

1-36-8 OHOKAYAMA, MEGURO-KU, TOKYO 152, JAPAN
2ND FLOOR, EVERGLORY BLDG., NO. 305, SECTION 3,
NANKING E. ROAD, TAIPEI, TAIWAN, REPUBLIC OF CHINA
1055 SAW MILL RIVER ROAD, ARDSLEY, N.Y. 10502, U.S.A.

Chassis Layout (Top View)



- | | |
|-------------------------------------------------------|-------------------------------------------------------|
| 1. VR405, L-CH OVERLOAD PROTECTION LEVEL ADJ | 24. POWER SUPPLY PC BOARD (B-137) |
| 2. FUNCTION AND PHONO EQUALIZER AMP PC BOARD (TC-146) | 25. AC OUTLET |
| 3. FUNCTION SELECTOR | 26. D708, RECTIFIER |
| 4. RECORDING SELECTOR | 27. RY701, SPEAKER RELAY |
| 5. VOLUME CONTROL | 28. SPEAKER TERMINALS |
| 6. TONE CONTROL AMP PC BOARD (TC-147) | 29. VOLTAGE SELECTOR (not used on chassis for Europe) |
| 7. SUPERSONIC SWITCH | 30. C002, SMOOTHING CAPACITOR FOR -B |
| 8. SUBSONIC SWITCH | 31. PRE/MAIN JACKS |
| 9. TONE DEFEAT SWITCH | 32. C001, SMOOTHING CAPACITOR FOR +B |
| 10. TREBLE CONTROL | 33. TAPE MONITOR-1, -2 JACKS |
| 11. BASS CONTROL | 34. AUX, TUNER JACKS |
| 12. PEAK LEVEL INDICATOR PC BOARD (X-275) | 35. PHONO-1, -2 JACKS |
| 13. POWER SWITCH | 36. VR402, R-CH MC HEAD-AMP DISTORTION ADJ |
| 14. SPEAKER B SWITCH | 37. MC HEAD-AMP PC BOARD (X-283) |
| 15. SPEAKER A SWITCH | 38. VR401, L-CH MC HEAD-AMP DISTORTION ADJ |
| 16. SPEAKER SWITCH PC BOARD (X-301) | 39. POWER AMP, L-CH |
| 17. LEVEL INDICATOR SENSITIVITY SWITCH | 40. POWER AMP, R-CH |
| 18. VR601, L-CH LEVEL INDICATOR CAL | 41. DRIVER PC BOARD (AF-113) |
| 19. LEVEL INDICATOR OFF SWITCH | 42. VR406, R-CH OVERLOAD PROTECTION LEVEL ADJ |
| 20. VR602, R-CH LEVEL INDICATOR CAL | 43. VR404, R-CH IDLING CURRENT ADJ |
| 21. PEAK LEVEL INDICATOR DRIVER PC BOARD (X-298) | 44. VR402, R-CH DC BALANCE ADJ |
| 22. FUSE PC BOARD (X-296) | 45. VR401, L-CH DC BALANCE ADJ |
| 23. T001, POWER TRANSFORMER | 46. VR403, L-CH IDLING CURRENT ADJ |

Adjustment

Instruments: Audio Generator, Oscilloscope, AC voltmeter, DC millivoltmeter, HD Analyzer.

Note:

Set Balance Control to mid-position, Muting and Filter Switches to OFF, Mode Switch to STEREO and Tape Monitor Switch to SOURCE.

A. Main Amp DC Balance Adjustment

Before starting this adjustment, calibrate the oscilloscope as follows: set the vertical gain control at 0.1 volt/cm. Set AC-GND-DC switch to GND to determine zero point on the screen. Then set the switch to DC position.

1. Short-circuit Main-In terminals. Set UNITE-SEPARATE switch to SEPARATE. Connect the oscilloscope to the speaker terminals, and adjust potentiometer VR401 (VR402 for R-channel) so that the horizontal line on the oscilloscope screen, which indicates voltage, comes to 0-volt position.
2. Next, check that when Main-In terminals are opened, or when UNITE-SEPARATE switch is set to UNITE position with Main-In terminals open, fluctuation of voltage is within ± 0.04 volts.

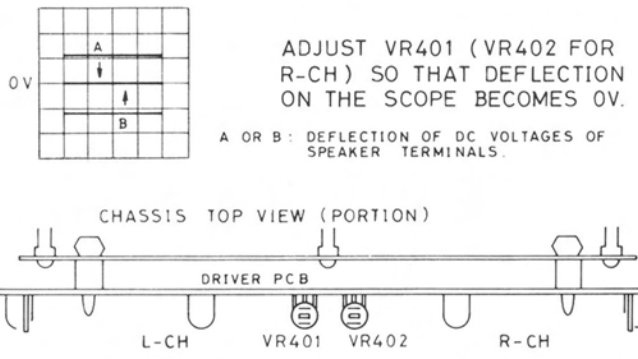


Fig. 1. Main Amp DC Balance Adjustment

B. Idling Current (Bias) Adjustment

Before starting this adjustment, warm up the unit for 3 minutes or so to stabilize the power transistors and the heat sink, with Volume Control set at minimum.

1. Connect the plus lead of DC millivoltmeter to pin 19 (pin 20 for R-channel) and the minus lead to pin 13 (pin 14 for R-channel) on the Driver PC board.
2. Adjust potentiometer VR403 (VR404 for R-channel) on the Driver PC board so that DC millivoltmeter reads 10mV.

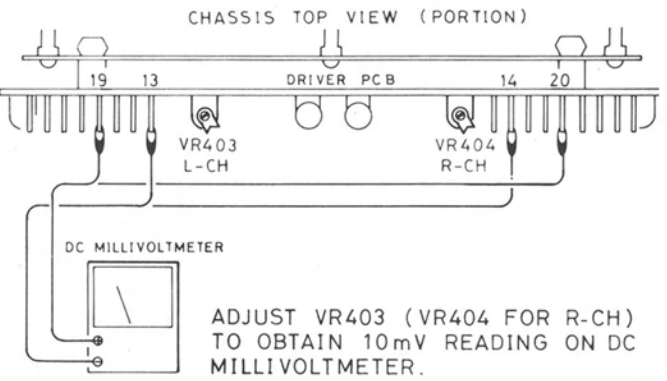


Fig. 2. Idling Current (Bias) Adjustment

C. Overload Protection Level Adjustment

Make this adjustment for left and right channels separately (feed signal only to the channel to be adjusted).

- Before making adjustment, warm up the unit adequately to prevent fluctuation of the preset level caused by temperature rise.
- Do not short-circuit the output pins for more than one minute. This requires the adjustment to be made bit by bit by repeating the action of turning the potentiometer a bit and short-circuiting the pins momentarily.

Note that short-circuiting output pins for a prolonged period of time when the protection circuit is not activated will damage power transistors, etc.

1. Connect an 8-ohm load resistor to speaker terminals. Connect AC voltmeter in parallel with the load resistor. Set Volume Control to maximum. Connect Audio Generator to AUX input jack and feed in 1,000Hz (sine wave) signal. Adjust the input level with the attenuator of Audio Generator to obtain 0.38-volt reading on AC voltmeter.
2. Adjust potentiometer VR405 (VR406 for R-channel) on Driver PC board so that the protection circuit is activated (i.e. Speaker relay is set to OFF) the instant pins 15 and E3 (pins 16 and E2 for R-channel) are short-circuited.
3. Reduce the input level until AC voltmeter reads 0.33 volts. Then, make certain that the protection circuit is not activated (i.e. Speaker Relay keeps ON) when pins 15 and E3 (pins 16 and E2 for R-channel) are shorted.

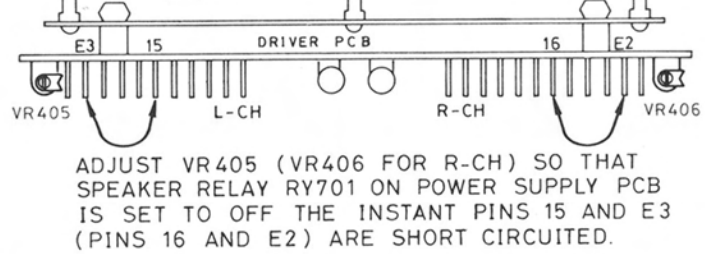


Fig. 3. Overload Protection Level Adjustment

D. Distortion Adjustment of PHONO-2 (MC) Head Amp

1. Connect HD Analyzer to Tape Monitor Out jack. Connect Audio Generator to PHONO-3 (MC) jack. Feed in 1,000Hz (sine wave) signal and adjust input level to obtain 3-volt reading on HD Analyzer.
2. Adjust potentiometer VR101 (VR102 for R-channel) on MC Head Amp PC board so that HD Analyzer gives minimum distortion.

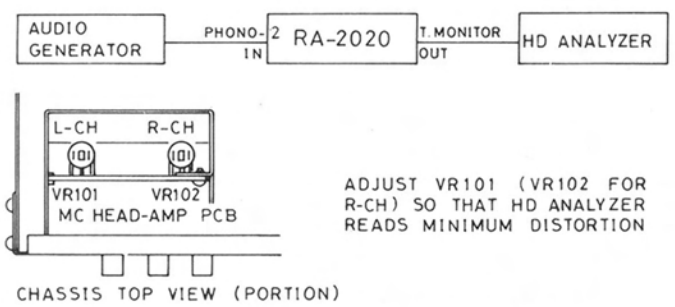
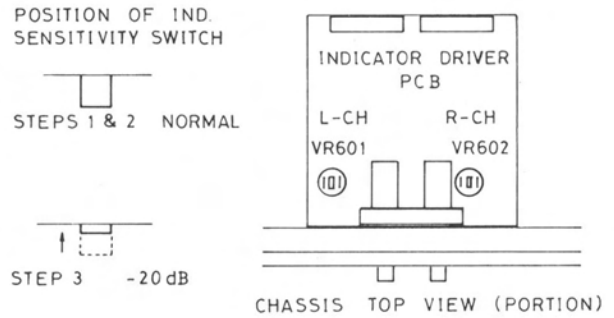


Fig. 4. Distortion Adjustment of Phono-2 (MC) Head Amp

E. Peak Level Indicator Calibration

1. Connect an 8-ohm load resistor to speaker terminals. Connect AC voltmeter in parallel with the resistor. Connect Audio Generator to AUX input and feed in 1,000Hz (sine wave) signal. Adjust the input level to obtain 23.7-volt reading on AC voltmeter. Set the sensitivity changeover switch for Peak Level Indicator to NORMAL.
2. Maintaining this state, adjust by turning potentiometer VR601 (VR602 for R-channel) on the Indicator Driver PCB so that the Level Indicator lights up to 0dB position.
3. Adjust the input level so that AC voltmeter indicates the point 20dB lower than that at 23.7-volt reading. Push on the sensitivity changeover switch to -20dB position. Check that the Peak Level Indicator lights up to 0dB position.

Fig. 5. Peak Level Indicator Adjustment



Specifications

A. EQUALIZER AMP SECTION (measured at Tape Out)

- Output Voltage/Impedance (at 1,000Hz)
 - Rated Output:
 - Pin Jack Output 150mV/2kΩ
 - DIN Socket Output 50mV/80kΩ
 - Maximum Output:
 - Pin Jack (at 0.5% THD) 15V
- Harmonic Distortion (20Hz to 20,000Hz at 5V output)
 - Phono-1 0.006%
 - Phono-2 (MC) 0.008%
- Phono Equalization (20Hz to 20,000Hz)
 - Phono-1 RIAA STD. . . ±0.5dB
 - Phono-2 (MC) RIAA STD. . . ±0.5dB
- Hum and Noise (IHF A-network)
 - Phono-1 75dB
 - Phono-2 (MC) 62dB
- Input Sensitivity/Impedance (at rated output)
 - Phono-1 2mV/50kΩ
 - Phono-2 (MC) 200μV/150Ω
- Crosstalk (at 20,000Hz) 50dB
- Overload (at 1,000Hz, 0.1% THD)
 - Phono-1 200mV
 - Phono-2 (MC) 5mV

B. PREAMPLIFIER SECTION (measured at preamp out)

- Output Voltage/Impedance (at 1,000Hz)
 - Rated Output 1V/600Ω
 - Maximum Output 7V (at 0.5% THD)
- Harmonic Distortion (20Hz to 20,000Hz at rated output) 0.01%
- Frequency Response
 - +0dB, -1dB 5Hz to 120kHz
- Hum and Noise (IHF, A-network)
 - Tuner, AUX 92dB
 - Tape Monitor-1, -2 92dB
 - Residual (Volume Control at minimum) 8μV/100dB
- Input Sensitivity/Impedance
 - Tuner, AUX 150mV/50kΩ
 - Tape Monitor-1, -2 150mV/50kΩ
- Overload (at 1,000Hz, 0.5% THD)
 - Tuner, AUX 15V
 - Tape Monitor-1, -2 15V

- Crosstalk (at 1,000Hz) 70dB AVE
- Intermodulation Distortion (60Hz:7,000Hz = 4:1) 0.015%
- Tone Controls
 - Bass (at 100Hz) ±10dB
 - Treble (at 10,000Hz) ±10dB
- Loudness (at 100Hz/10,000Hz) . . +8dB/+4dB
- Supersonic Filter (at 24,000Hz) . -12dB/oct
- Subsonic Filter (at 15,000Hz) . . -12dB/oct
- Audio Muting -15dB±1dB

C. POWER AMPLIFIER SECTION

- Continuous Power Output . . . 60W* per channel min. RMS both channels driven at 8Ω from 20Hz to 20,000Hz with no more than 0.02% total harmonic distortion.
- Harmonic Distortion (at 1,000Hz, 8Ω load)
 - 30W Output per Channel . . . 0.008%
 - 1W Output per Channel . . . 0.01%
- Intermodulation Distortion (60Hz:7,000Hz = 4:1)
 - 30W Output per Channel . . . 0.02%
 - 1W Output per Channel . . . 0.01%
- Frequency Response (at 1W output, 8Ω load)
 - +0dB, -1dB 4Hz to 80,000Hz
 - +0dB, -3dB 2Hz to 160kHz
- Input Sensitivity/Impedance . . . 1V/50kΩ
- Damping Factor (20Hz to 20,000Hz) 50
- Hum and Noise (IHF A-network) .100dB
- Crosstalk (at 10,000Hz) 57dB

MISCELLANEOUS

- Power Requirement 120V/60Hz, 220V/50Hz, 240V/50Hz or 100V, 120V, 220V or 240V/50Hz or 60Hz (switchable)
- Power Consumption 450W

Note: Specifications and design are subject to change without prior notice.

* Measured pursuant to Federal Trade Commission's Trade Regulation Rule on Power Claims for Amplifiers. (Applicable to U.S. only.)

Addendum

1. IC (HA-12002) used in the protection circuit has been changed to a new IC marked HA-12002W*. This change is applicable to all units with serial nos. NB83146 or over.

HA-12002W is listed in the repair parts noted in this manual.

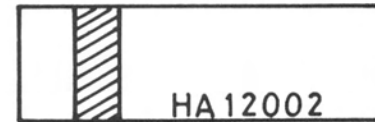
(N.B. The new IC has the same number on the IC molding as on the old one. To distinguish them, note carefully the shape of the band printed on the molding. See Marking of IC in Fig. A.)

As the circuit constant of the new IC is different from conventional ones, when using the new IC, be sure to remove R713 and R714 (82kΩ) on the protection circuit, replacing them with 56kΩ resistors.

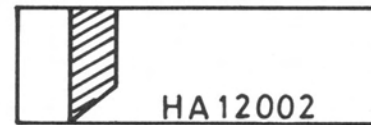
Fig.A. Marking on IC Molding

* Shape of band (portion in oblique lines) differs.

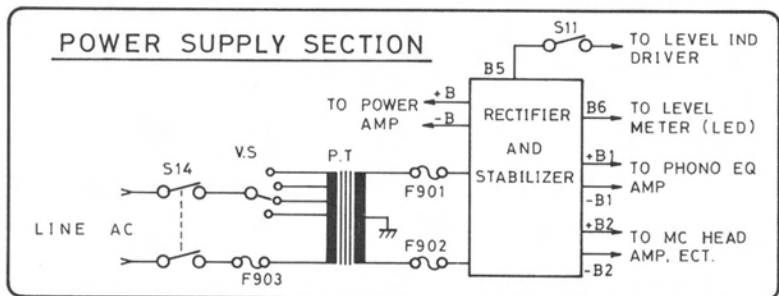
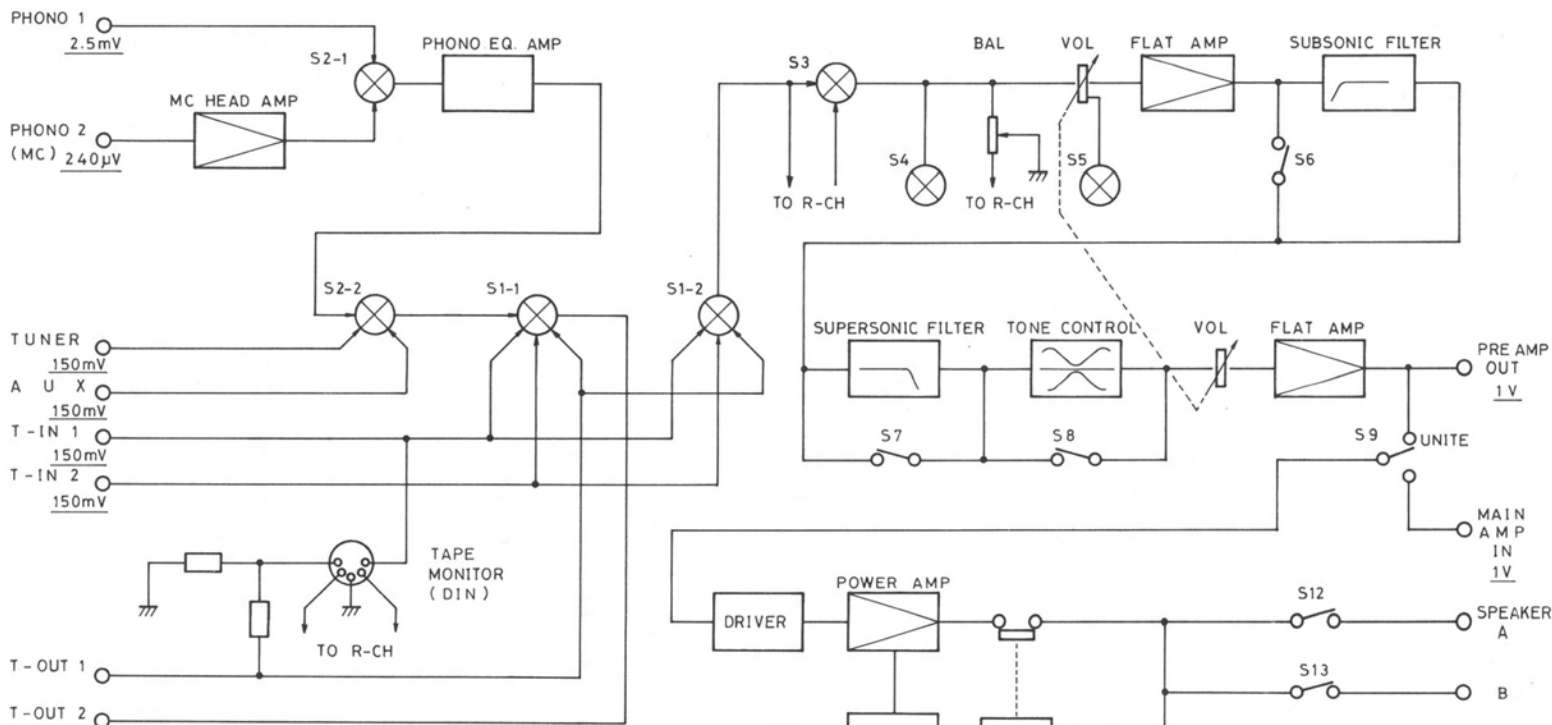
Conventional marking



"W" type marking



Block Diagram



RIGHT CHANNEL IS SAME AS ABOVE

- | | | | |
|----|--------------|-----|-----------------------|
| S1 | TAPE MONITOR | S8 | TONE DEFEAT |
| S2 | FUNCTION | S9 | UNITE / SEPARATE |
| S3 | MODE | S10 | INDICATOR SENSITIVITY |
| S4 | MUTING | S11 | INDICATOR OFF |
| S5 | LOUDNESS | S12 | SPEAKER A |
| S6 | SUBSONIC | S13 | SPEAKER B |
| S7 | SUPERSONIC | S14 | POWER |

Repair Parts List

Schematic Location	Part No.	Description
TRANSISTORS, DIODES AND IC'S		
Q101, 102, 103, 104, 105, 106 } Q107, 401, 402 } 403, 404, 413, 414, 415, 416, 704 }	302001113 301201146	2SK68A (M) 2SC1885 (S) or (T)
Q301, 302* Q303, 304, 409 } 410, 411, 412 }	302001113 301001142	2SK68A (M) 2SA912 (S) or (T)
Q305, 306, 307 } 308, 421, 422 }	301001145	2SA921 (S) or (T)
Q309, 310, 407, 408 }	301201171	2SC1980 (S) or (T)
Q405, 406 Q417, 418, 701 } 703 }	302001122 301201165	μ PA63H, Dual FET 2SC1913 (Q) or (R)
Q419, 420, 702, Q423, 424 Q425, 426 Q901 Q902 D401, 402	301001143 301301134 301101124 301201190 301001160 300313007	2SA913 (Q) or (R) 2SD571 (K) or (L) 2SB605 (K) or (L) 2SC2581 (R), (Q), (Y) 2SA1106 (R), (Q), (Y) BZ-210, Zener Regulator, 21V, 1W
D403, 404, 405, 406 } D407, 408, 409, 410, 704, 705 }	300212008 300111010	KB-165, Varistor 1S2472
D601, 602, 603, 604 } D701, 702	300313028 300313009	{WZ-050, Zener Regulator, 5V, 0.5W BZ-240, Zener Regulator, 24V, 1W
D703 D706, 707 D708 D901	300313004 300919024 300919032 300414021	BZ-120, Zener Regulator, 12V, 1W SR1K-4, Rectifier for Protection S-5VB-20, Rectifier SLP-237, LED (GRN), Power Ind
D902 to 908 D001, 002 IC101	300414020 300212015 303452189	SLP-137B, LED (RED), Protection and Level Ind SV-03S, Varistor NJM 78L-15A, Stabilizer 15V
IC201, 202, 301, 302 } IC601, 602, 603, 604 } IC701	303452191 303452188 303452187	{HA-1457, Phono Amp, etc. {LB-1405S, Level Ind (LED) Driver HA-12002W, Protection
VARIABLE RESISTORS		
VR101, 102** VR201 VR301, 302 VR303 VR401, 402 VR403, 404 VR405, 406 VR601, 602	510502178 525121142 525101157 515121129 510502176 510502147 510502146 510502138	330B, MC Head Amp Distortion Adj 100KBTx2 + 20KCx2, Volume Control 50KBx2, Bass and Treble Control 250KW, Balance Control 100B, DC Balance Adj 10KB, Idling Current Adj 5KB, Overload Protection Level Adj 10KB, Level Indicator Cal

Schematic Location	Part No.	Description
SWITCHES		
S1 S2 S3 S4, 5 S6, 7, 8 S9 S10, 11 (1 set) S12, 13 (1 set) S14	601011275 601011338 601011335 611001268 611001275 613000022 614020425 614020426 611001272 611001271	Tape Monitor Function Selector Mode Muting, Loudness Subsonic Filter, Supersonic, Tone Defeat SEPARATE-UNITE Indicator Speaker A, B Power Power (Sweden only)
OTHERS		
F901, 902 F903 C004 RY701	341221700 345952630 341221700 341221350 345952315 205001443 206001443 470101118 470101126 626110028 624200204 648211141 642400111 648211121 625001114 240111241 141710305 141710307 141810844 141810828 141810842 141810845 141810730 141610318 141810843 141810837	Fuse 7A-3AG, Secondary AC, (STD Type) Fuse 6.3AT (ϕ 5.2x20mm), (European Type) Fuse 7A-3AG, Primary AC (STD Type), 100V/120V Fuse 3.5A-3AG, Primary AC (STD Type), 220V/220V/240V Fuse, 3.15AT (ϕ 5.2x20mm), (European Type) Power Transformer (Multivoltage), (STD Type) Power Transformer (220V/240V), (European Type) Noise Canceller, NSK-135 (STD Type) Noise Canceller, 0.047 μ F, ECQ-EC (European Type) Headphone Jack Pin Jack, 4P AC Outlet (not used on units for UK) Speaker Terminal Strip Voltage Selector (not used on European Type) DIN Socket, 5P Relay, Speaker Phono Equalizer Amp PC Board Ass'y Tone Control Amp PC Board Ass'y Level Indicator Driver PC Board Ass'y Level Indicator (LED) PC Board Ass'y Speaker Switch PC Board Ass'y Phono-2 (MC) Head Amp PC Board Ass'y DIN Socket PC Board Ass'y Driver PC Board Ass'y Power Supply PC Board Ass'y Fuse PC Board Ass'y (STD Type, 100V/120V)

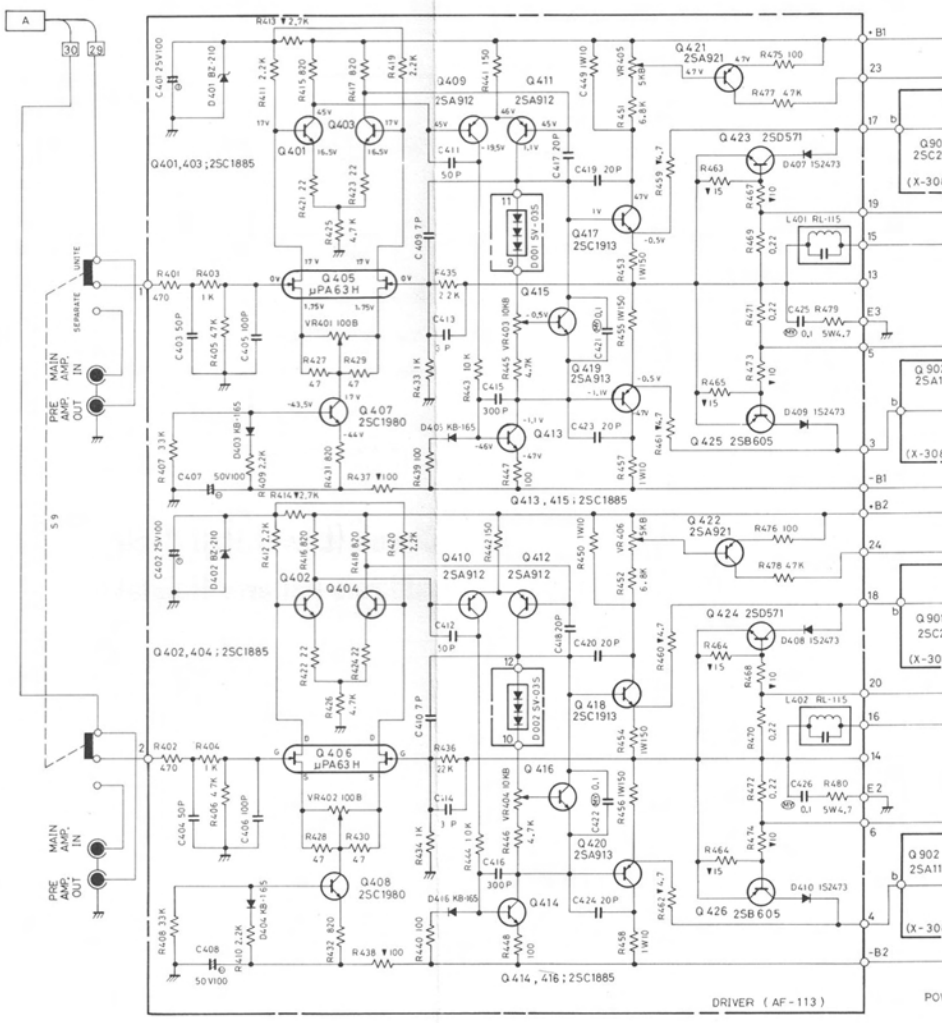
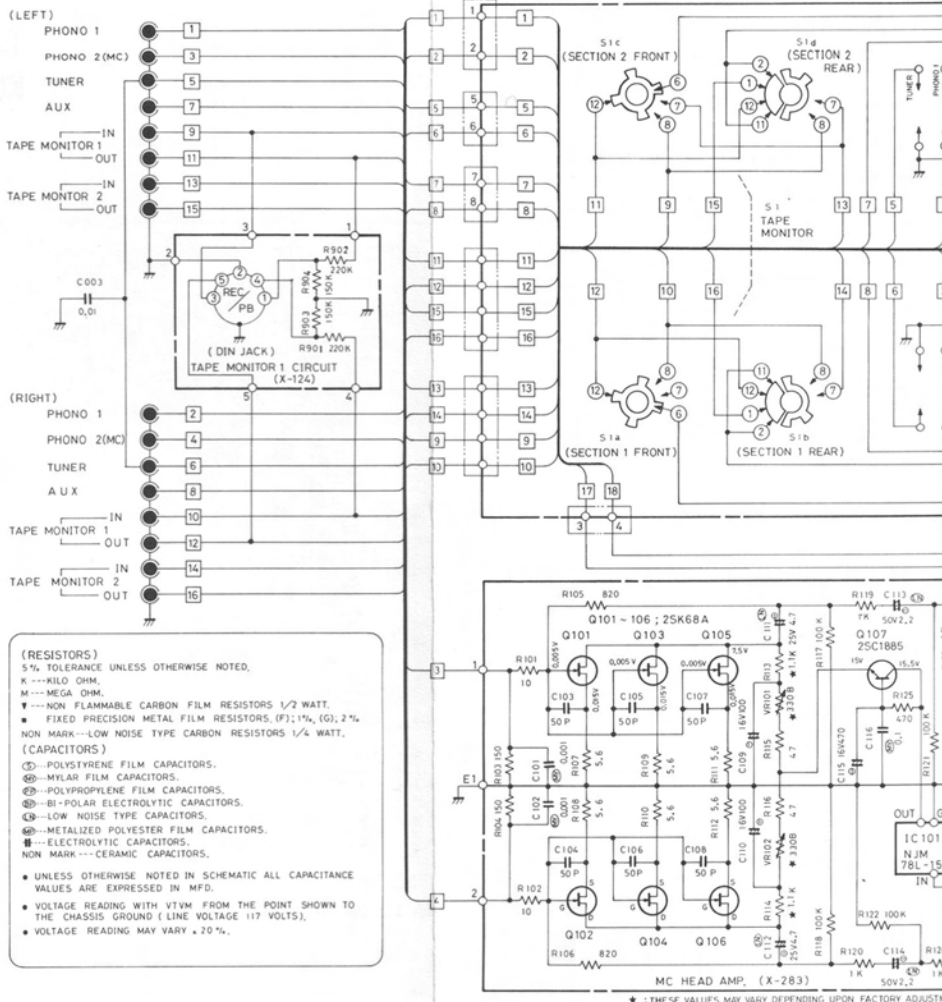
*For Q301 and 302, "2SK136(S)/302001118" can also be used. Check polarity in the schematic diagram.

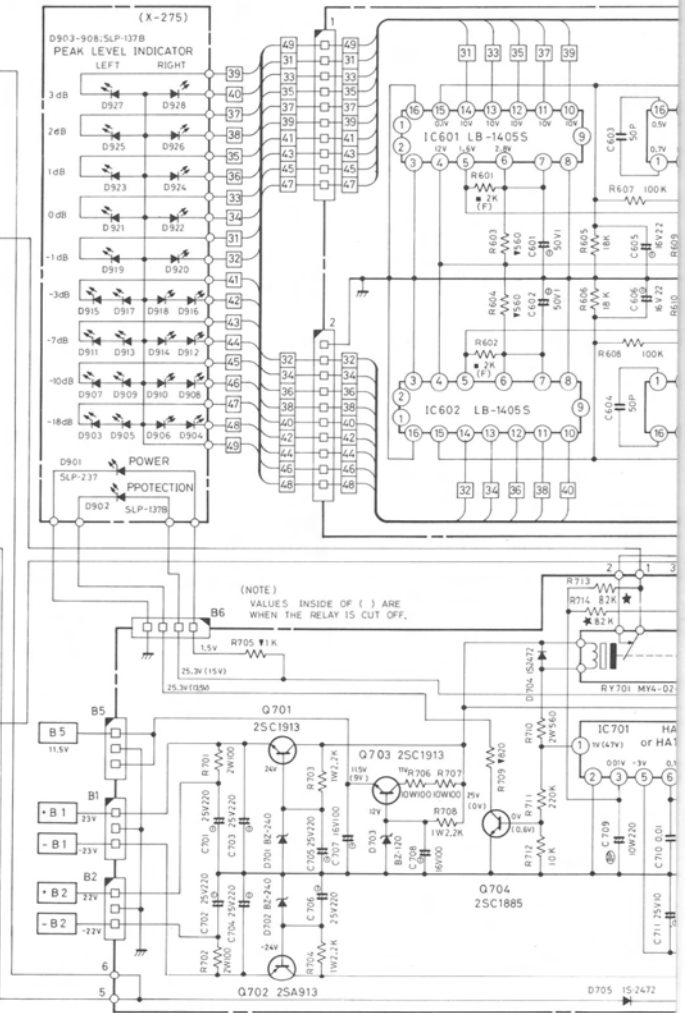
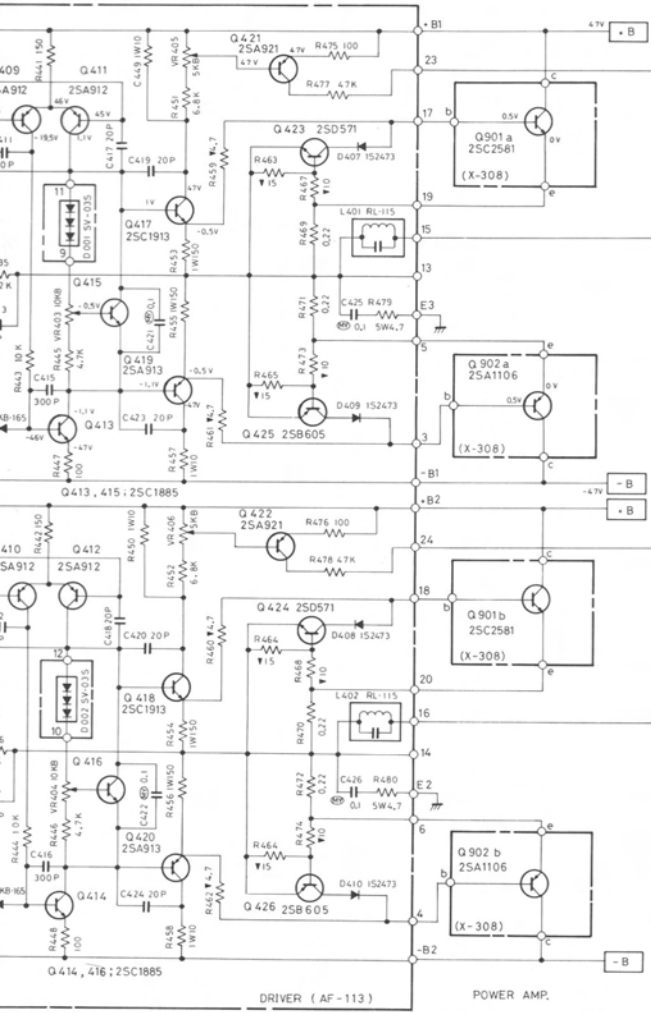
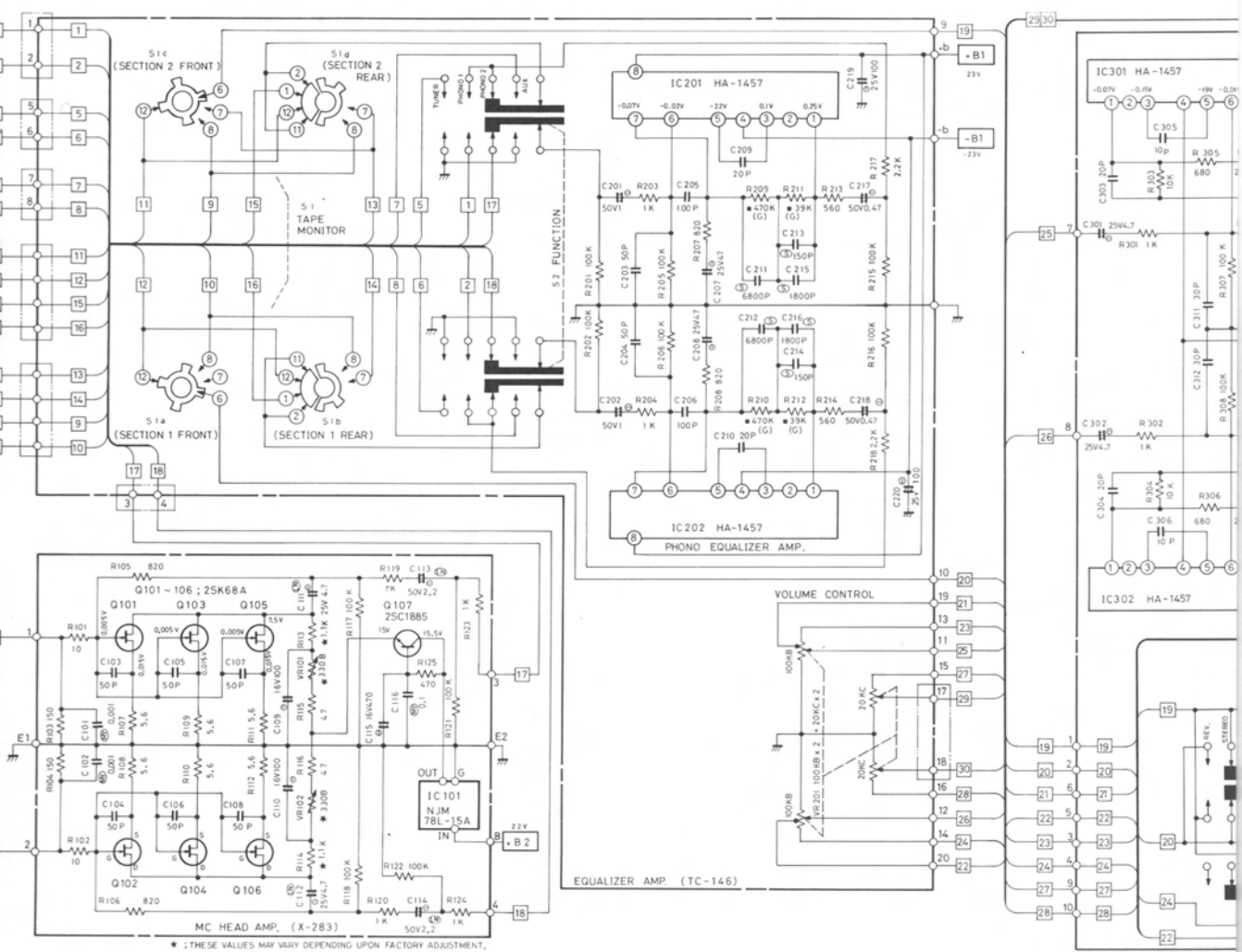
**Some units employ "1KB/510502169" depending on FET for VR101 and VR102.

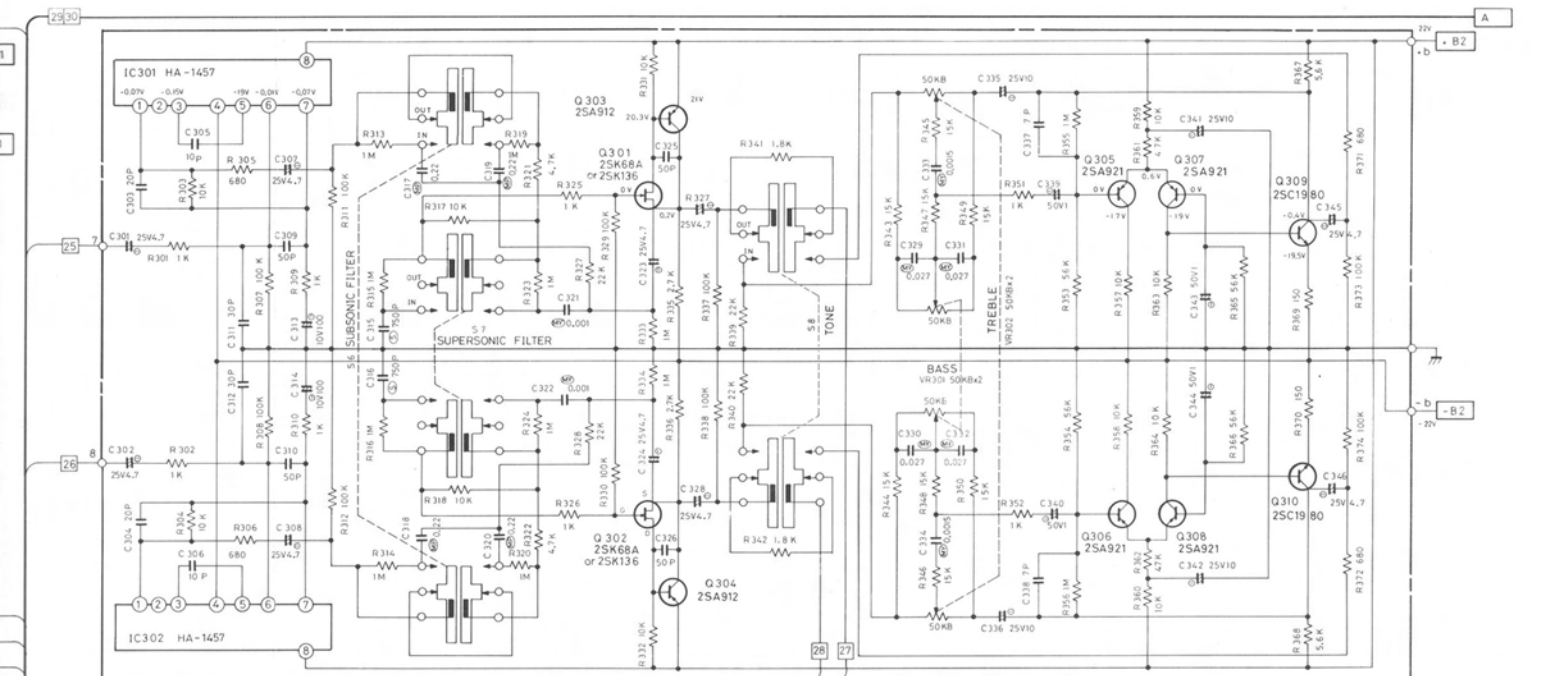
Schematic Location	Part No.	Description
	141810838	Fuse PC Board Ass'y (STD Type, 220V/240V)
	141810839	Fuse PC Board Ass'y (European Type)
	141810888	Power Amp (Upper Half Cycles) PC Board Ass'y
	141810889	Power Amp (Lower Half Cycles) PC Board Ass'y
	796301115	Line Cord (STD Type)
	796301139	Line Cord (Europe)
	796301125	Line Cord (Australia)
	796301130	Line Cord (UK)
	796301121	Line Cord (Sweden)
	111911410	Front Panel Ass'y
	670101118	Handle
	116310235	Knob, Function, Volume
	116310236	Knob, Mode, Balance
	116310237	Knob, Tape Monitor
	116310238	Knob, Bass, Treble
	116310242	Knob, Loudness, Power, etc.
	116210046	Button, Speaker, Indicator
	673402018	Foot
	770911216	Collar, Handle Mtg
	770911209	Cap Screw, 6x40mm, Handle Mtg
	770911211	Spacer for Rack Mounting
	762213008	Screw, 3x8mm, Tap-tight, Oval Countersunk
	766213008	Screw, 3x8mm, Tap-tight, (Ni)
	766223008	Screw, 3x8mm, Tap-tight, (BLZ)
	765224008	Screw, 4x8mm, Tap-tight, (BLZ)
	766223012	Screw, 3x12mm, Tap-tight, (BLZ)
	766213006	Screw, 3x6mm, Tap-tight, (Ni)
	762213006	Screw, 3x6mm, Tap-tight, (Ni), Oval Countersunk
	725223008	Screw, 3x8mm, Tapping, (BLZ), Terminal Mtg, etc.
	705213004	Screw, 3x4mm, (Ni), Binding, MC Head Amp PC Board Mtg
	770911166	Screw, 3x6mm, (BLZ), Flat Head
	766213010	Screw, 3x10mm, (Ni), Tap-tight
	725213014	Screw, 3x14mm, (Ni), Tapping, Power Transistors Mtg
	725213008	Screw, 3x8mm, (Ni), Tapping, LED PC Board Mtg
	765224012	Screw, 4x12mm, (BLZ), Tap-tight, Foot Mtg
	765214008	Screw, 4x8mm, (Ni), Tap-tight
	705214008	Screw, 4x8mm, (Ni), Binding, Power Trans Mtg
	770402209	Nut, M12, Hex Phone Jack Mtg.
	770402206	Nut, M8, Hex, Tape Monitor SW Mtg

Schematic Location	Part No.	Description
	770402205	Nut, M7, Hex, Vol Mtg, etc.
	770402201	Nut, M3, Hex
	770911144	Nut, M3, Square, Transistor Mtg
	770402210	Nut, M5, Hex, Heat Sink Mtg
	770402204	Nut, M6, Hex, Handle Mtg
	770500009	Washer, ϕ 12
	770500007	Washer, ϕ 8
	770500006	Washer, ϕ 7
	770500003	Washer, ϕ 3
	770500010	Spring Washer, ϕ 3
	770500033	Washer, ϕ 5
	770500029	Spring Washer, ϕ 5
	770500044	Washer, ϕ 4
	770500011	Spring Washer, ϕ 4
	770500012	Spring Washer, ϕ 6
	770911119	GND Terminal
	992001111	Spacer, Tr Mtg, etc.

Schematic Diagram







TONE CONTROL AMP. (TC-147)

SHEET 1 of 2
MODEL RA-2020
SCHEMATIC DIAGRAM

ITEM	SCHEMATIC LOCATION (LAST)
MC HEAD AMP.	(X-283) R 125 C 116
EQUALIZER AMP.	(TC-146) R 218 C 220
TONE CONTROL AMP.	(TC-147) R 386 C 350
DRIVER	(AF-113) R 480 C 426
LED DRIVE CIRCUIT	(X-298) R 622 C 612
POWER SUPPLY CIRCUIT	(B-137) R 718 C 714
SPEAKER SWITCH	(X-301) R 804 C —
OTHERS (X-124 X-308 X-296 X-275)	R 904 C —
CHASSIS	R — C 005

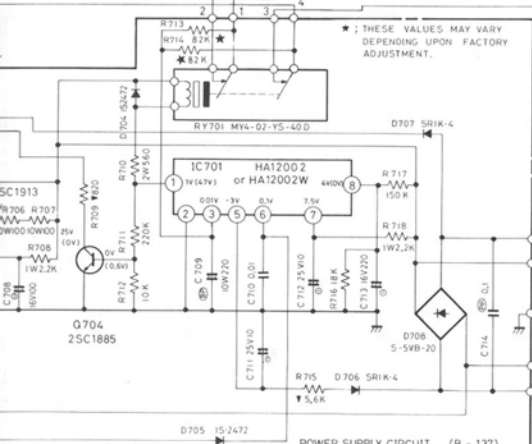
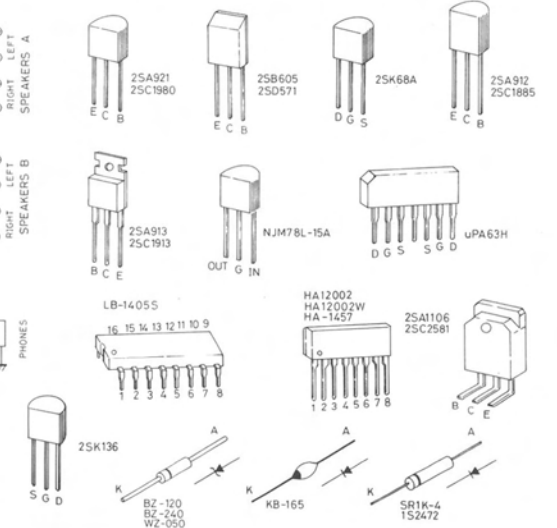
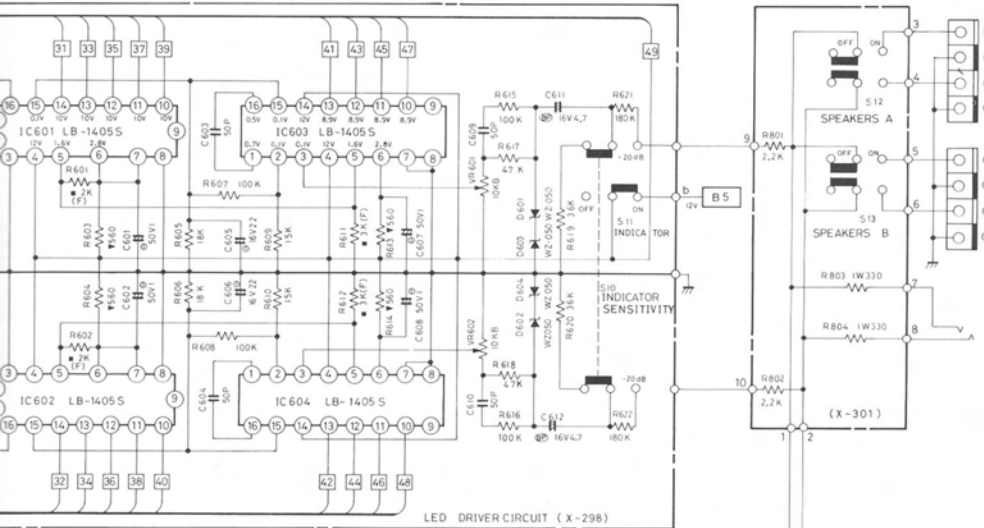
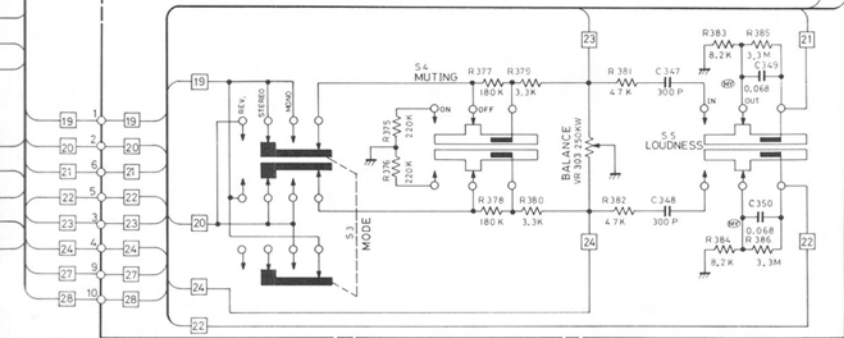
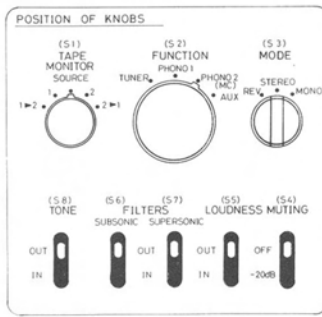
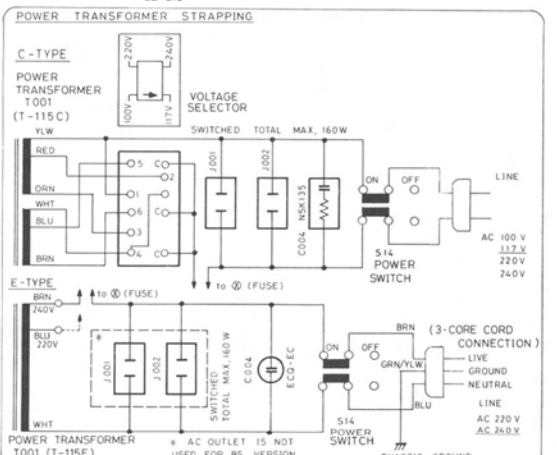
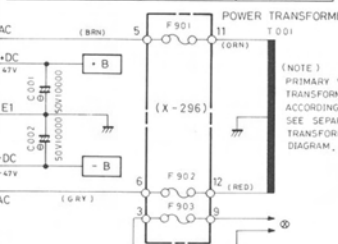


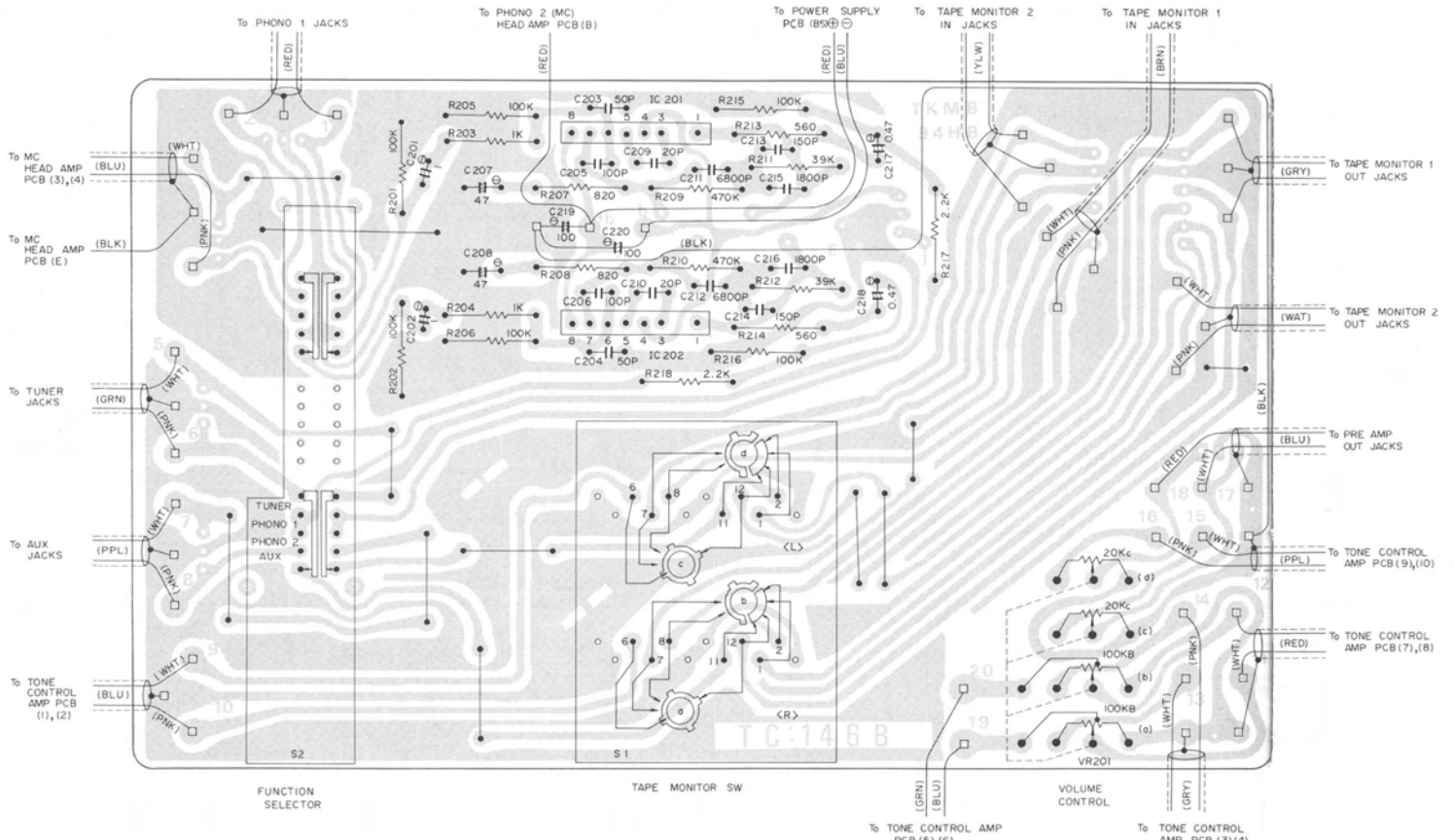
TABLE OF FUSE VALUE

STANDARD TYPE (LONG FUSE)	EUROPEAN TYPE (MIDGET FUSE)	
	220 or 240V	220 or 240V
F 901	7 A	6.3 AT
F 902	7 A	6.3 AT
F 903	7 A	3.15 AT

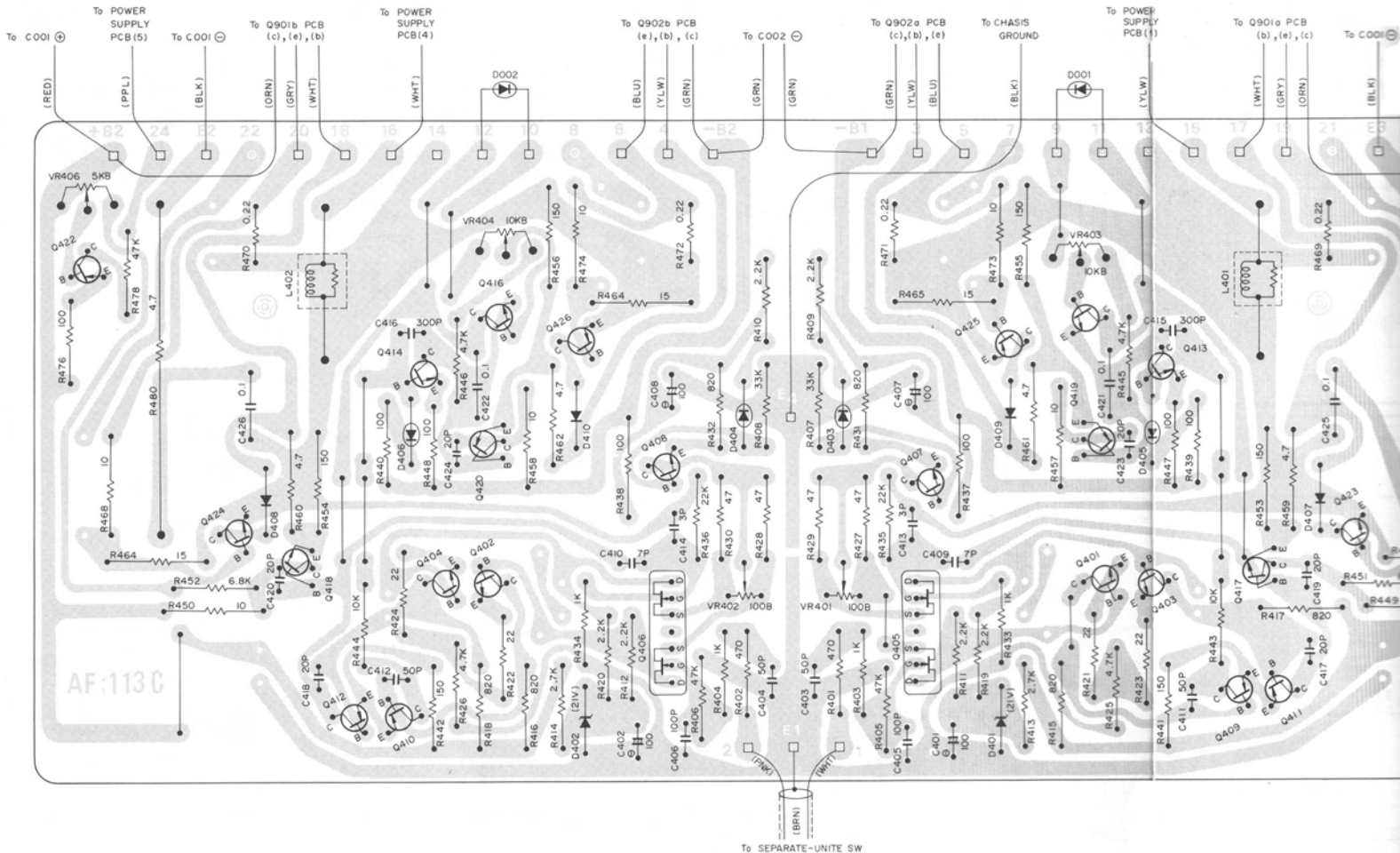


PC BOARD DIAGRAMS

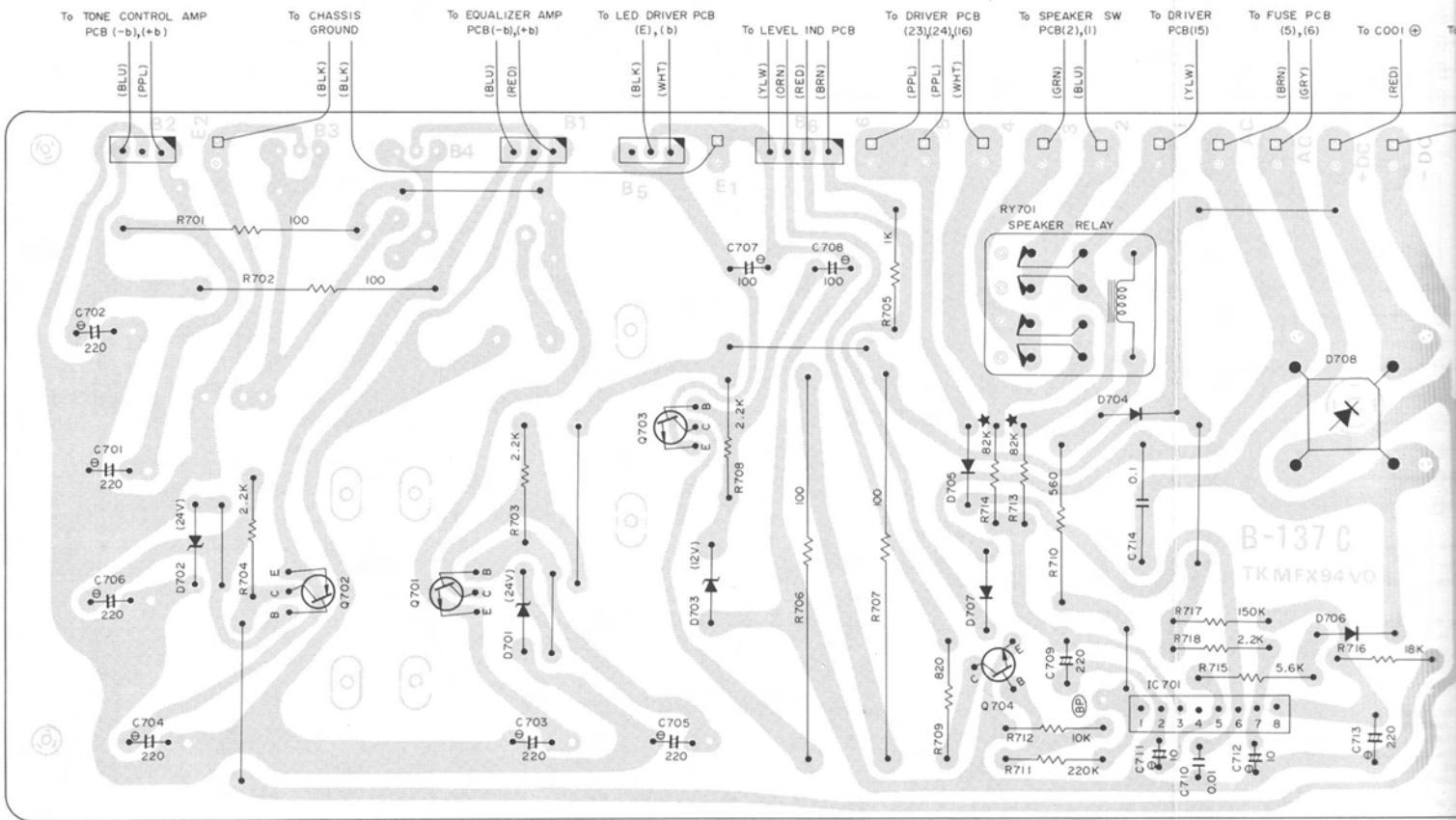
Phono Equalizer Amp and Function Selector Circuit



Driver Circuit

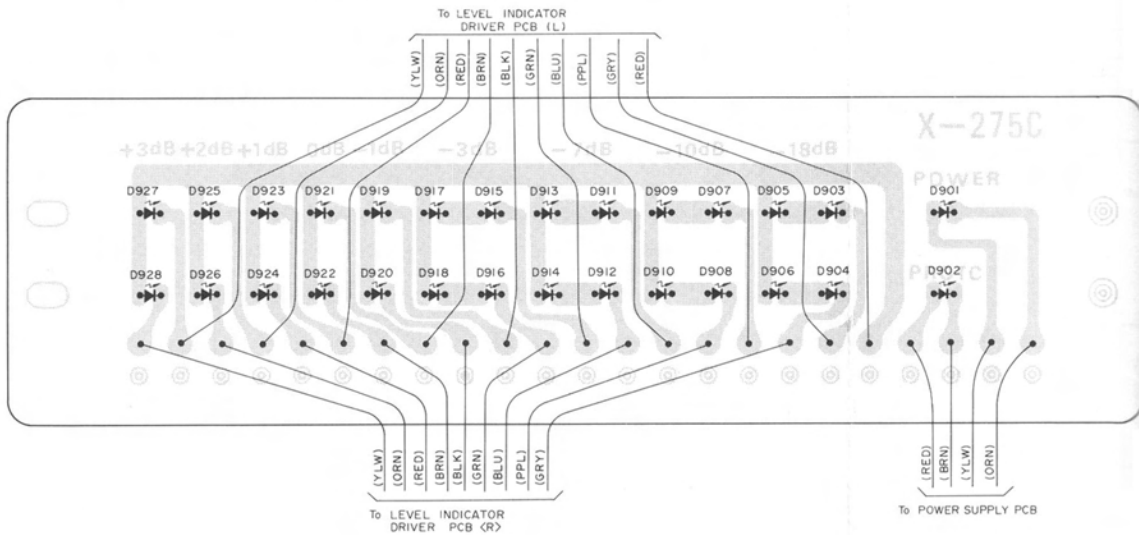


Power Supply and Protection Circuit

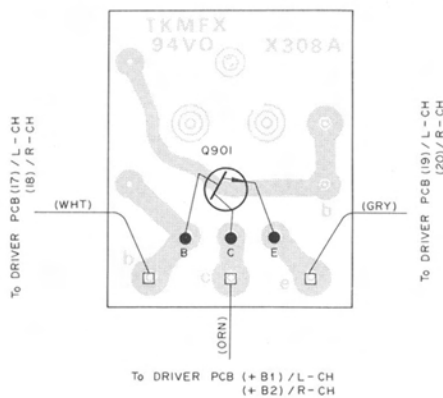


*These values must be changed to 5.6kΩ when using HA-12002W instead of HA-12002 for IC701 (see Add)

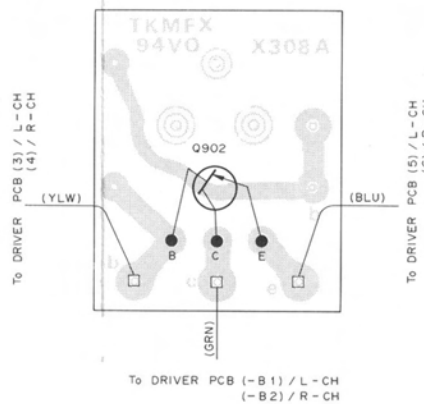
Peak Level Indicator Circuit



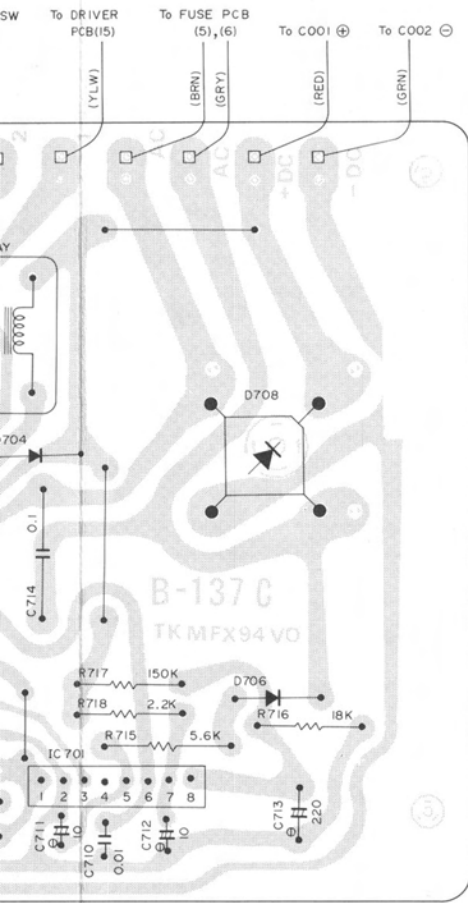
Power Amp Circuit (Upper Half Cycles)



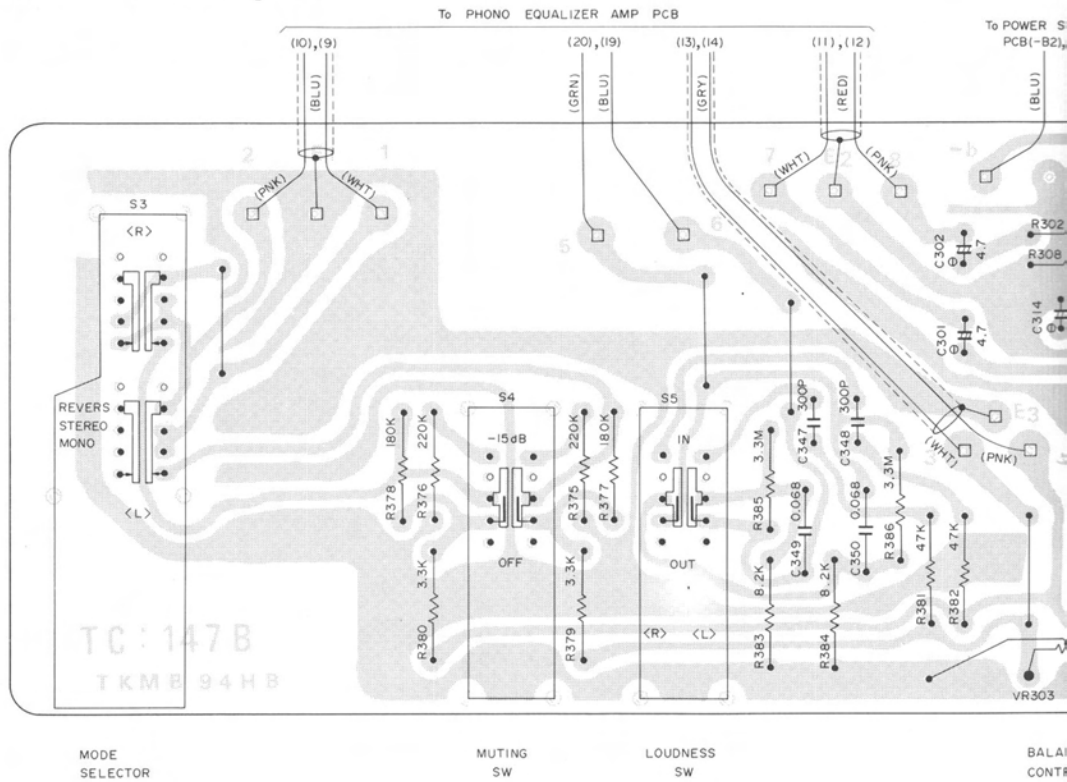
Power Amp Circuit (Lower Half Cycles)



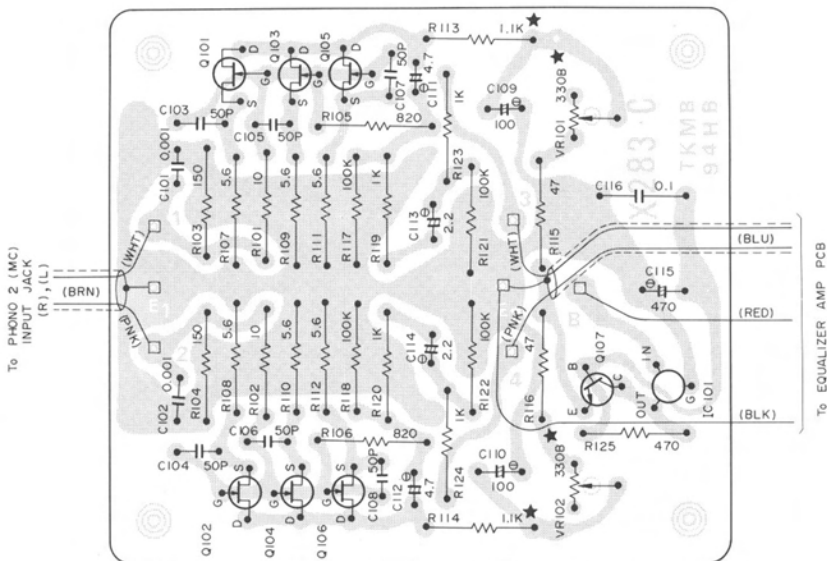
Tone Control Amp Circuit



Use HA-12002 for IC701 (see Addendum).



Phono-2 (MC) Head Amp Circuit



*These values may vary according to factory adjustment.

Speaker Switch Circuit

