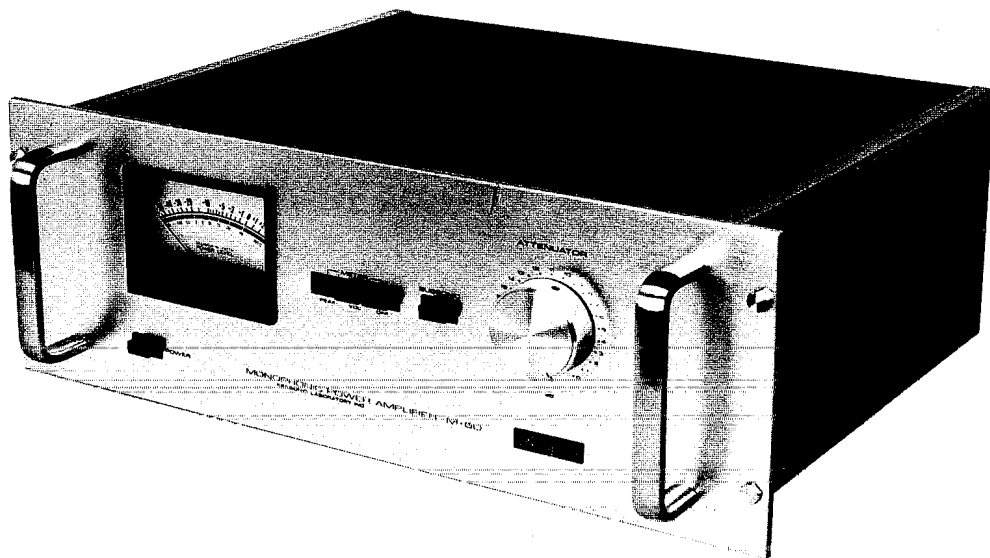


Accuphase

MONOPHONIC POWER AMPLIFIER M-60



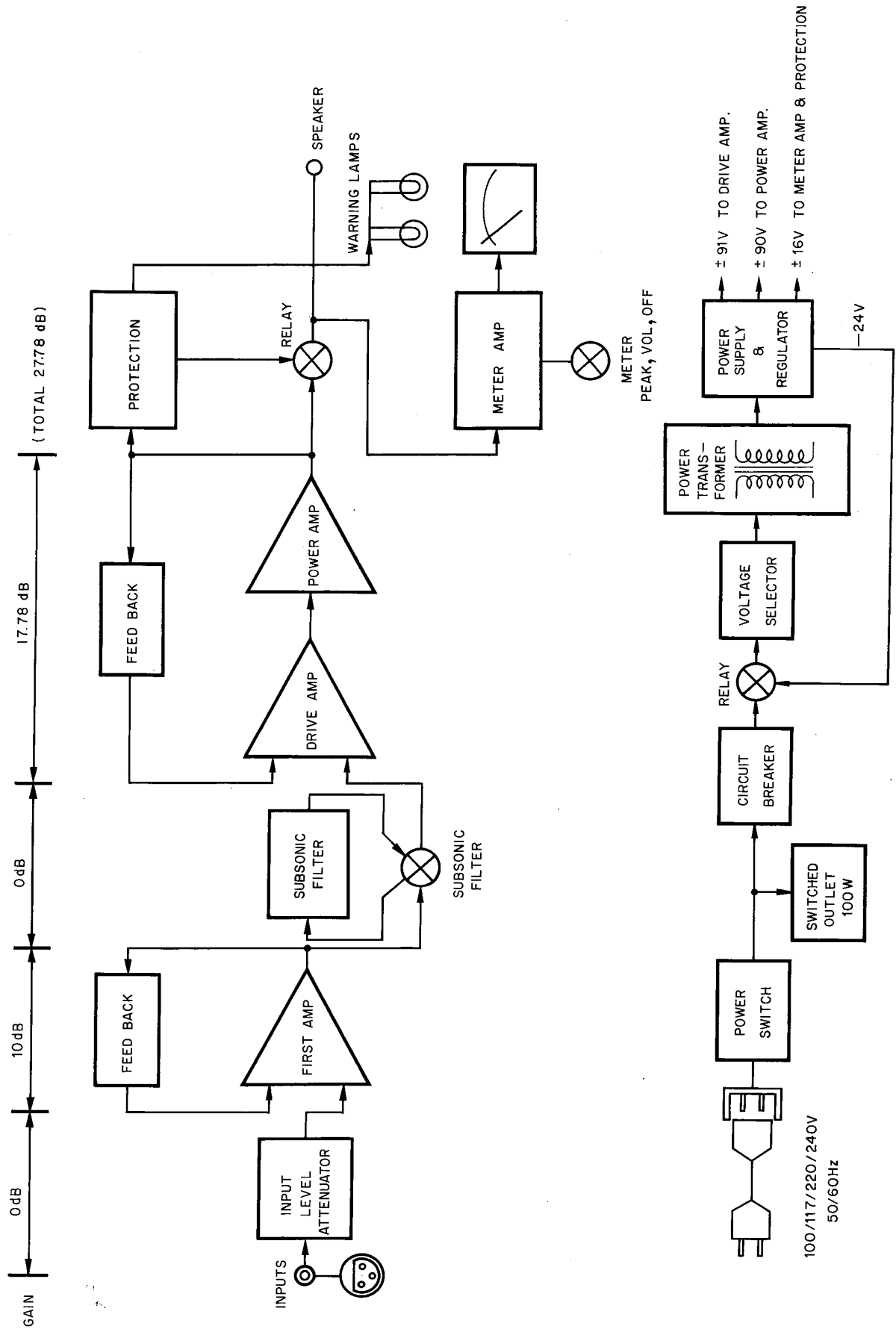
Service Information

STARTING WITH SERIAL NO. G5Y001

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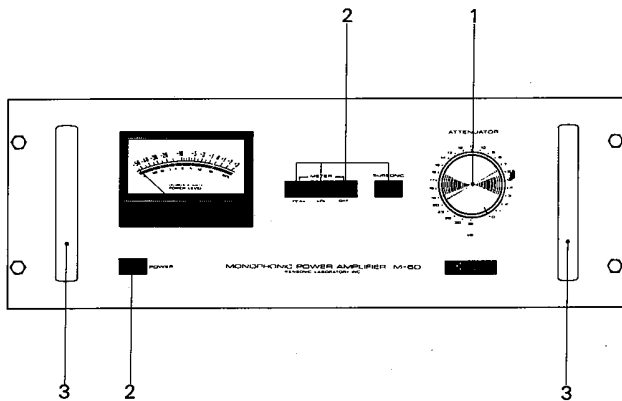
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BLOCK DIAGRAM

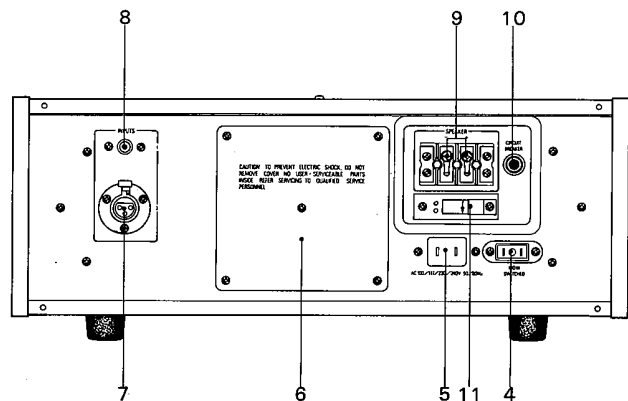


EXTERNAL VIEW

●FRONT



●REAR



●PARTS LIST

No.	Description	Part No.	Remarks
1	Knob for ATTENUATOR	381-5001-04	Ref. EXPLODED VIEW No.16
2	Push-button for POWER, METER, SUBSONIC	389-5001-14	Ref. EXPLODED VIEW No.14
3	Handle	132-0007-04	Ref. EXPLODED VIEW No. 1
4	AC Outlet	305-1201-00	
5	AC Connector Plug	301-3201-00	
6	AC Connector Plug	301-3301-00	for 3-Conductor
6	Square Plate	159-0003-04	

No.	Description	Part No.	Remarks
7	Cannon Receptacle	304-5301-00	XLR-3-13 for INPUT 2
8	Pin Jack 1-Pin	302-0101-00	for INPUT 1
9	Speaker Terminal	313-5021-00	
10	Circuit Breaker	311-0101-00	10A at 100, 117V(Black)
10	Circuit Breaker	311-0051-00	5A at 220, 240V(Red)
11	Voltage Selector Jack	302-4001-00	
11	Voltage Selector Plug	301-4001-00	
11	Voltage Selector Fixed Bracket	248-0001-14	

HOW TO REPLACE THE FOLLOWING PARTS

POWER TRANSISTOR Ref: INTERNAL VIEW NO.2

1. Remove the Side Plate held by 6 screws.
2. Transistors located above the heat sink can be replaced after removing the transistor locking screws.

LOAD CIRCUIT RELAY Ref: INTERNAL VIEW NO.11

1. Remove the Bottom Plate (6 screws) and the Side Plate (Left side: 8 screws).
2. The Relay can be removed from the Bottom Plate side after taking off the 4 screws.

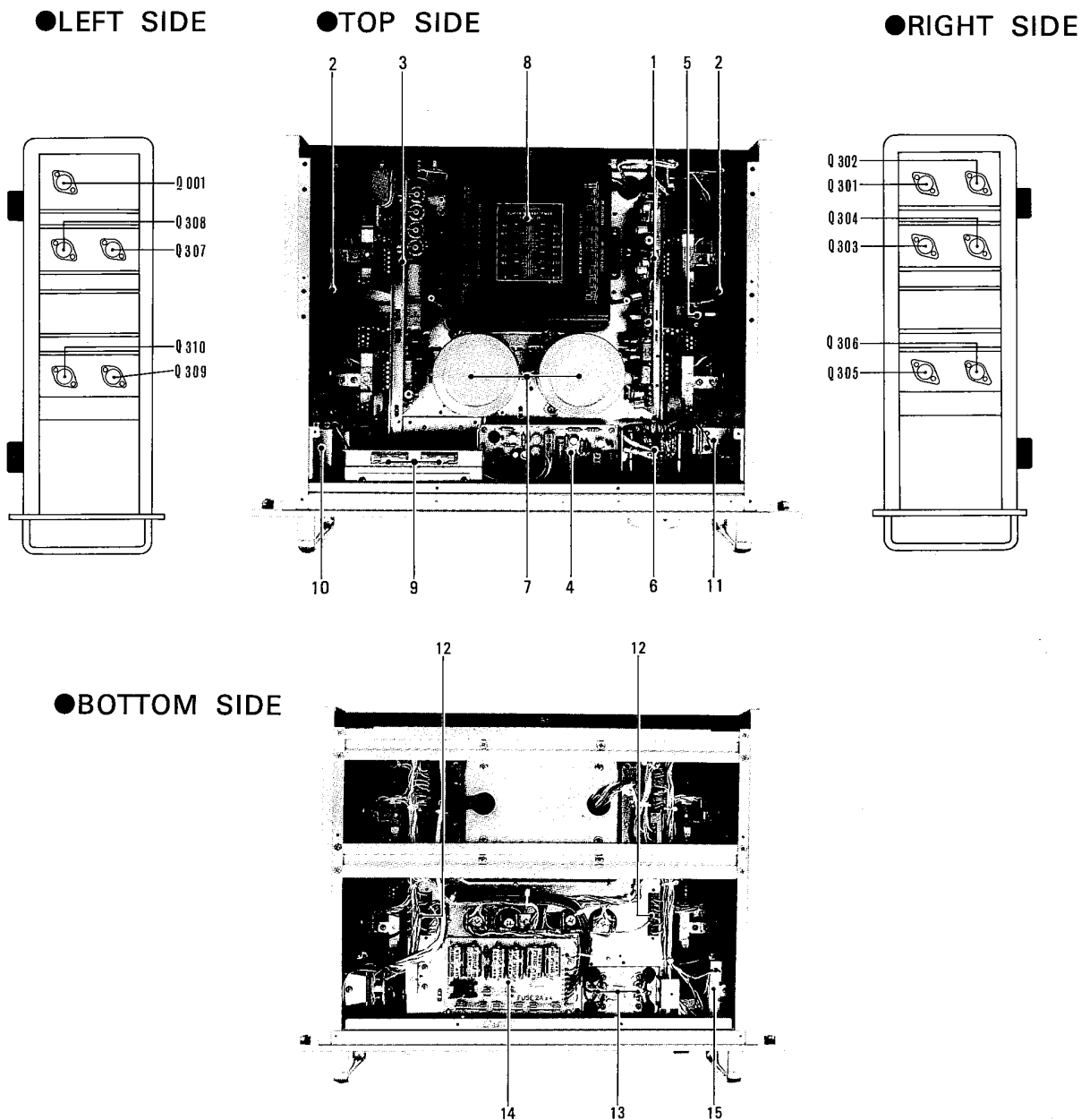
METER CIRCUIT ASSEMBLY Ref: INTERNAL VIEW NO.4 & EXPLODED VIEW

1. Remove in the following order: Top Plate, Sub-chassis Shield Cover.
2. Remove the Meter Selector and the Subsonic Filter Push-buttons.
3. Remove the Printed Board Connector Jacks (2 pcs).
4. The Meter Circuit Assembly can be removed when two screws holding the printed board are removed.

METER Ref: EXPLODED VIEW NO.16

1. Remove the Top Plate.
2. First remove a knob on the Front Panel. Then take off the Front Panel after removing the Hex. Head Bolt, Hex. nut and the six locking screws.
3. The entire Meter Assembly can be pulled forward after unscrewing the three screws attached to the Meter Fix Bracket.
4. The Meter can then be removed after taking off the 4 nuts attached to the Meter Fixed Bracket at the rear side of the Meter.

INTERNAL VIEW

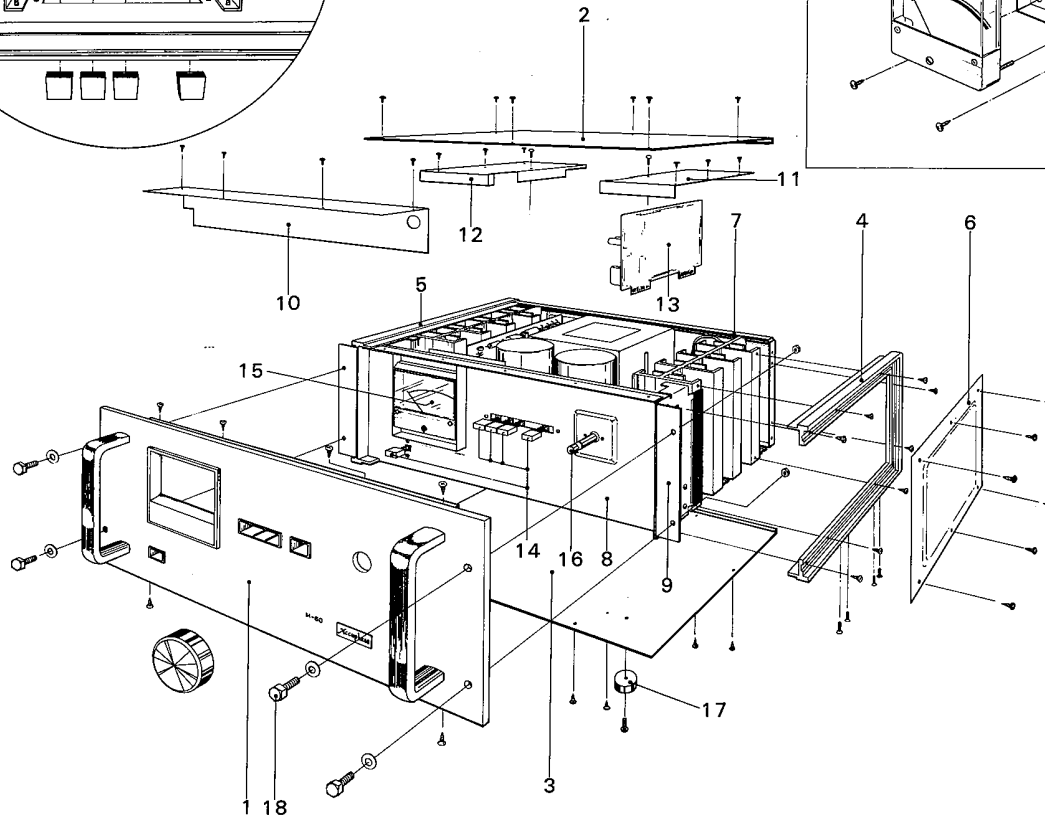
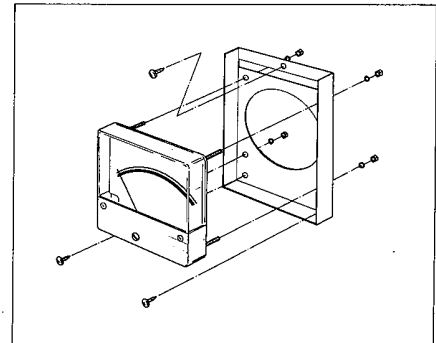
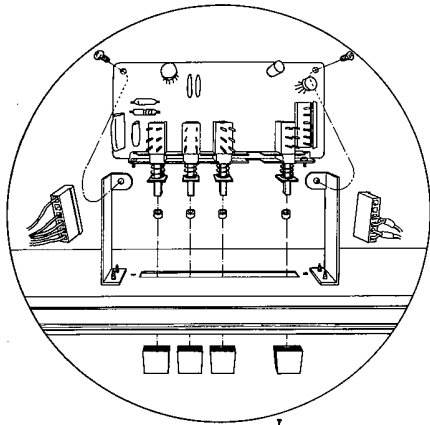


●PARTS LIST

No.	Description	Part No.	Remarks
1	Main Drive Amp. Assembly	710-0003-00	
2	Heat Sink	240-0003-02	for Power Transister
	Transistor PNP	28B554-0-K	Q ₃₀₄ , 308, 308, 310
	Transistor PNP	2SB555-K	Q ₃₀₂
	Transistor NPN	2SD424-0-K	Q ₃₀₃ , 305, 307, 309
	Transistor NPN	2SC1195-K	Q ₃₀₁
	Transistor NPN	2SD371-R or Y	Q ₃₀₁
	Silicon Varistor	STV-3H-0	D ₂₀₁ , 202
	Transistor Insulator	318-0001-00	
	Cement Coated Wirewound Resistor	RW864AG1ROK	1Ω ±10% 10W
3	Protection Circuit Assembly	720-0002-00	
4	Meter Circuit Assembly	716-0018-00	
5	Phase Correct Circuit Assembly	716-0017-00	
6	ATTENUATOR	578-1251-00	

No.	Description	Part No.	Remarks
7	Electrolytic Capacitor	CE33W2A223	22,000μF 100WV
8	Power Transformer	510-2002-00	
9	Pilot Lamp.	176-5201-00	8V-300mA
	Lamp Socket	306-1001-00	
10	Relay	362-2204-00	LY2-US (For Power Supply Circuit)
11	Relay	362-2203-10	MM2XL-K55 (Load Relay Circuit)
12	Printed Circuit Bord Connector	303-1001-00	10-pin
13	Rectifier	SG-5T(+)	D ₀₀₁
		SG-5T(-)	D ₀₀₂
	Transistor Insulator	318-0001-00	
	Insulating Bushing	318-1102-00	
14	Fuse Circuit Assembly	716-0016-00	
	Fuse	310-0201-00	2A F1, 2, 3, 4
15	Cement Coated Wirewound Resistor	RW864DG2R2K	2.2Ω ±10% 20W

EXPLODED VIEW



● PARTS LIST

No.	Description	Part No.	Remarks
1	Front Panel Assembly	130-0007-03	
	Front Panel	131-0007-02	
	Handle	132-0007-04	
	Handle Fixed Bracket	247-0049-04	
	Meter Frame	113-0004-03	
	Push-button Frame	113-0008-14	for Meter Switch
	Push-button Frame	113-0010-04	for Power Switch and Subsonic Switch
	Badge	182-1001-04	Accuphase
	Rubber Cushion	250-2008-04	
2	Top Plate	150-0004-02	
3	Bottom Plate	155-0005-02	
4	Frame Assembly (R)	112-0004-02	
	Frame D	112-1004-23	Upper
	Frame E	112-1005-23	Lower
	Frame F	112-1006-04	Back
	Frame Fixed Bracket	244-0011-04	
	Flat Head B Type Self Tapping Screw	613-0308-04	3×8mmdia.
	Frame Assembly (L)	112-0003-02	
5	Frame A	112-1001-23	Upper
	Frame B	112-1002-23	Lower
	Frame F	112-1006-04	Back

No.	Description	Part No.	Remarks
	Frame Fixed Bracket	244-0011-04	
	Flat Head B Type Self Tapping Screw	613-0308-04	3×8mmdia.
6	Side Plate	151-0003-02	
7	Rear Panel	135-0008-02	
8	Sub Chassis	111-2003-02	
9	Front Panel Fixed Bracket	247-0048-04	
10	Sub Chassis Shield Cover	231-0027-03	
11	Shield Cover (R)	231-0015-03	
12	Shield Cover (L)	231-0014-03	
13	Main Drive AMP. Assembly	710-0003-00	Right Side Only
14	Push-button Switch		
		354-4003-00	for METER & SUBSONIC Switch
15	Power Meter	178-2004-00	
	Meter Fixed Bracket	246-0004-04	
16	ATTENUATOR	578-1251-06	
	Shaft	203-5004-04	
17	Plastic Foot	238-0001-14	
18	Hex. Head Bolt	630-0601-04	6×12mm
	Hex. Nut	633-2061-03	6mmdia.
	Nylon Washer	637-0061-59	6mmdia.

● MISCELLANEOUS

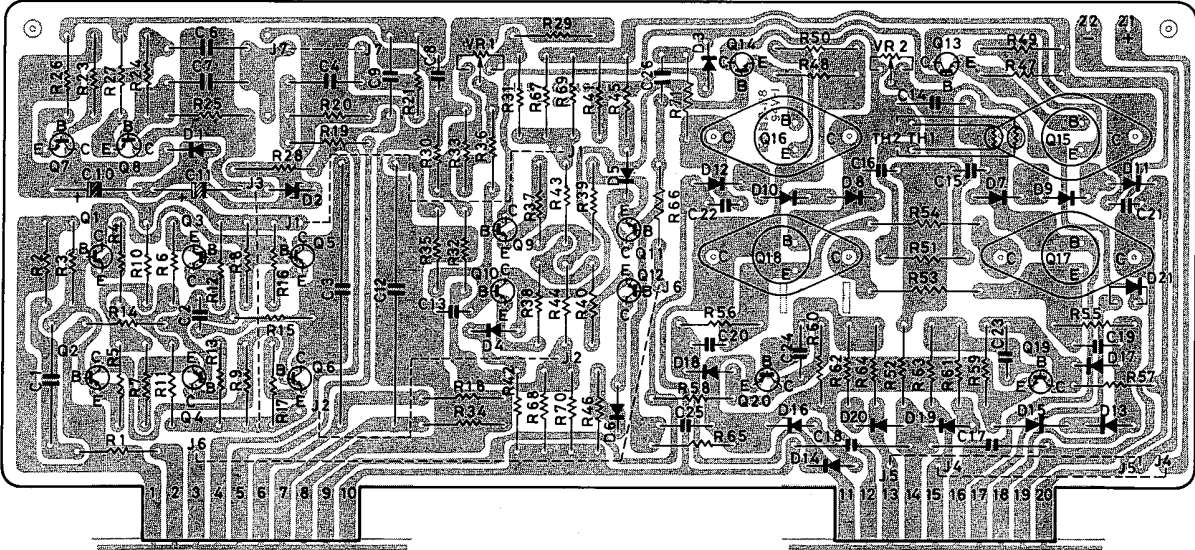
No.	Description	Part No.	Remarks
	Screws for		
	Top Plate	614-0308-02	3×8mm (3) 6pcs
	Nylon Washer	637-1031-50	3mm dia. 6pcs
	Front Panel	613-0308-04	3×8mm (2) 6pcs
	Hex. Head Bolt	630-0601-04	6×12mm 4pcs
	Hex. Nut	633-2061-03	6mm dia. 4pcs
	Nylon Washer	637-0061-59	6mm dia. 4pcs
	Frame Assembly	613-0308-04	3×8mm (2) 16pcs
	Handle	600-0510-04	5×10mm (1) 4pcs
	Side Plate	614-0306-02	3×6mm (3) 12pcs
	Bottom Plate	614-0306-02	3×6mm (3) 8pcs
	Rear Panel	614-0308-02	3×8mm (3) 10pcs
	Square Plate	600-0306-04	3×6mm (1) 4pcs
	Power Transistor	600-0312-04	3×12mm (1) 22pcs
	Rectifier (SG-5T)	600-0308-04	3×8mm (1) 4pcs
	Plastic Foot	600-0414-04	4×14mm (1) 4pcs
			Notes.
			(1) Pan Head ISO Metric Screw
			(2) Flat Head B Type Self Tapping Screw
			(3) Binding Head B Type Self Tapping Screw
Q001	Transistor NPN	2SD371-R or Y	for Voltage Regulator
Q301	Transistor NPN	2SC1195-K	for driver Stage
Q302	Transistor PNP	2SB555-K	for driver Stage
Q303, 305, 307, 309	Transistor NPN	2SD424-O-K	for Final Stage
Q304, 306, 308, 310	Transistor PNP	2SB554-O-K	for Final Stage
D001	Rectifier	SG-5T (+)	
D002	Rectifier	SG-5T (-)	
D201, 202	Silicon Varistor	STV-3H-O	
R001, 002	Carbon Film Resistor	RD142HA183J	18kΩ ± 5% ½W
R003	Cement Coated Wirewound Resistor	RW864DG2R2K	2.2Ω ± 10% 20W
R101, 102, 107, 108	Carbon Film Resistor	RD142HA123J	12kΩ ± 5% ½W
R103, 104, 105, 106	Carbon Film Resistor	RD142HA133J	13kΩ ± 5% ½W
R109	Carbon Film Resistor	RD142HA113J	11kΩ ± 5% ½W
R110	Carbon Film Resistor	RD142HA103J	10kΩ ± 5% ½W

No.	Description	Part No.	Remarks
R111	Carbon Film Resistor	RD142HA912J	9.1kΩ ± 5% ½W
R112	Carbon Film Resistor	RD142HA822J	8.2kΩ ± 5% ½W
R113	Carbon Film Resistor	RD142HA752J	7.5kΩ ± 5% ½W
R114	Carbon Film Resistor	RD142HA622J	6.2kΩ ± 5% ½W
R115	Carbon Film Resistor	RD142HA562J	5.6kΩ ± 5% ½W
R116, 122	Carbon Film Resistor	RD142HA472J	4.7kΩ ± 5% ½W
R117	Carbon Film Resistor	RD142HA432J	4.3kΩ ± 5% ½W
R118	Carbon Film Resistor	RD142HA392J	3.9kΩ ± 5% ½W
R119	Carbon Film Resistor	RD142HA332J	3.3kΩ ± 5% ½W
R120	Carbon Film Resistor	RD142HA302J	3kΩ ± 5% ½W
R121, 124	Carbon Film Resistor	RD142HA682J	6.8kΩ ± 5% ½W
R301~308	Cement Coated Wirewound Resistor	RW864AG1R0K	1Ω ± 10% 10W
R309, 310	Metal Film Resistor	RS143AA180J	18Ω ± 5% 1W
R311~318	Carbon Film Resistor	RD142HA132J	1.3kΩ ± 5% ½W
C001	Mylar Film Capacitor	CQ93M2E103MUL	0.01μF ± 20% 250 WV
C002~005, 301	Ceramic Capacitor	CK45F2H103P	0.01μF +100% - 0% 500 WV
C006, 007	Electrolytic Capacitor	CE33W2A223	22,000μF 100 WV
C201	Bipolar Electrolytic Capacitor	559-0001-00	100μF 10 WV
C302, 303	Metallized Film Capacitor	CQ91M2E474K	0.47μF 250 WV
	Accessories		
	Power Supply Cord	680-2201-00	
	Power Supply Cord	680-3401-00	3-Conductor
	Case	801-0011-03	
	Owner's Manual	820-2009-00	
	Poly Bag	812-2536-04	
	Packing Materials		
	Shipping Carton		
	Outer Carton	800-0007-04	
	Inner Carton	801-0011-04	
	Plastic Cover	810-5153-04	Clear (Outside)
	Plastic Cover	810-5052-04	White (Inside)
	Front Protector	803-0018-03	
	Rear Protector A	803-0019-03	
	Rear Protector B	803-0020-03	

MAIN DRIVE AMP. ASSEMBLY (710-0003-00)

●PRINTED CIRCUIT BOARD

* Printed circuit board as seen from the reverse side.



●PARTS LIST

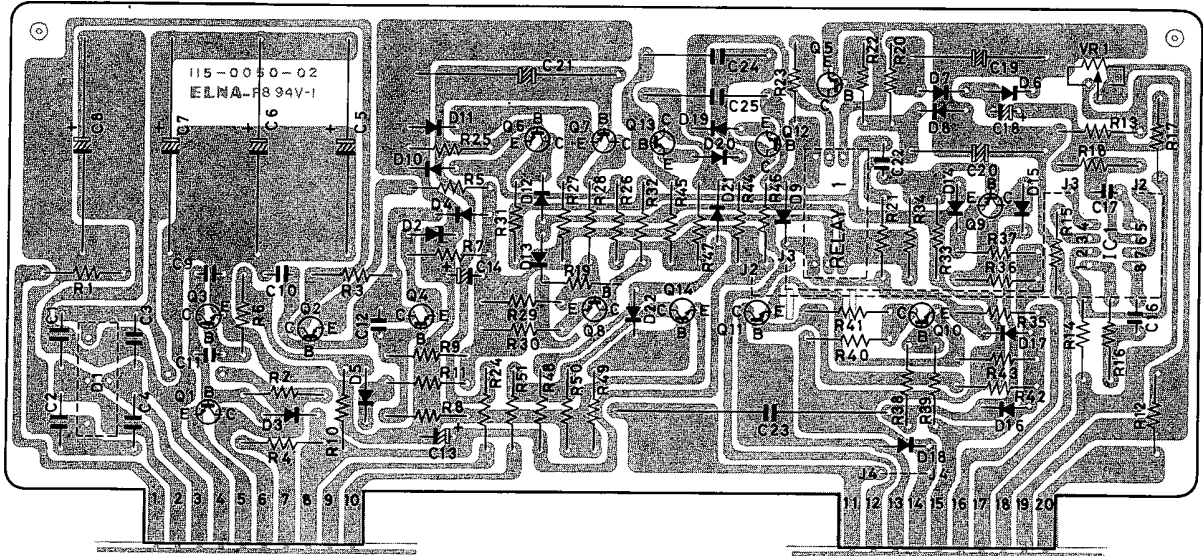
No.	Description	Part No.	Remarks
Q1, 3	Transistor NPN	2SC1746A-GRorBL-K	
Q2, 4	Transistor PNP	2SA856A-GR or BL-K	
Q5, 8, 10, 12	Transistor PNP	2SA809-V/002	
Q6, 7, 9, 11	Transistor NPN	2 SC1451-V/004	
Q13	Transistor PNP	2SA810-B/101	
Q14	Transistor NPN	2 SC1452-B/101	
Q15, 18	Transistor PNP	2SA483-OrY-K1	
Q16	Transistor NPN	2SC515A	
Q17	Transistor NPN	2SC783-OrY-K1	
Q19	Transistor NPN	2SC497-O or Y	
D1, 2	Zener Diode	YZ-350	
D3-6	Silicon Diode	1S1555	
D7-14, 17, 18	Silicon Diode	1S1553	
D15, 16	Zener Diode	CZ-060	
D19, 20	Silicon Diode	1S2091-BL	
D21	Silicon Varistor	STV-3H-0	
TH1, 2	Thermistor	5TP-31L	
VR1	Potentiometer 5kΩ B	581-0532-00	for Center Voltage Adj.
VR2	Potentiometer 200Ω B	581-0221-00	for Bias Current Adj.
R1, 35	Carbon Film Resistor	RD142HA222J	2.2kΩ ± 5% ½ W
R2	Metal Film Resistor	RN142HA125JL	1.2MΩ ± 5% ½ W
R3	Metal Film Resistor	RN142HA244J	240kΩ ± 5% ½ W
R4-7, 16, 17, 29, 30, 33, 47, 48	Carbon Film Resistor	RD142HA102J	1kΩ ± 5% ½ W
R8, 9, 12, 13	Metal Film Resistor	RN142HA163J	16kΩ ± 5% ½ W
R10, 11	Metal Film Resistor	RN142HA164J	160kΩ ± 5% ½ W
R14	Carbon Film Resistor	RD142HA1502G	15kΩ ± 2% ½ W
R15	Carbon Film Resistor	RD142HA3302G	33kΩ ± 2% ½ W
R18, 20, 34	Carbon Film Resistor	RD142HA105J	1MΩ ± 5% ½ W
R19	Carbon Film Resistor	RD142HA391J	390Ω ± 5% ½ W
R21	Carbon Film Resistor	RD142HA203J	20kΩ ± 5% ½ W
R23, 25	Carbon Film Resistor	RD142HA204J	200kΩ ± 5% ½ W
R24	Carbon Film Resistor	RD142HA103J	10kΩ ± 5% ½ W
R26, 27	Carbon Film Resistor	RD142HA221J	220Ω ± 5% ½ W
R28	Carbon Film Resistor	RD142HA184J	180kΩ ± 5% ½ W
R31, 32	Carbon Film Resistor	RD142HA333J	33kΩ ± 5% ½ W

No.	Description	Part No.	Remarks
R36	Carbon Film Resistor	RD142HA513J	51kΩ ± 5% ½ W
R37-40	Carbon Film Resistor	RD142HA121J	120Ω ± 5% ½ W
R41, 42, 45, 46	Carbon Film Resistor	RD142HA152J	1.5kΩ ± 5% ½ W
R43, 44	Carbon Film Resistor	RD142HA183J	18kΩ ± 5% ½ W
R49, 50	Oxide Metal Film Resistor	RS143AA101J	100Ω ± 5% 1 W
R51	Carbon Film Resistor	RD142HA100J	10Ω ± 5% ½ W
R52	Carbon Film Resistor	RD142HA750J	75Ω ± 5% ½ W
R53, 54	Oxide Metal Film Resistor	RS143DA103J	10kΩ ± 5% 2 W
R55, 56	Oxide Metal Film Resistor	RS143AA331J	330Ω ± 5% 1 W
R57, 58	Carbon Film Resistor	RD142HA104J	100kΩ ± 5% ½ W
R59, 60	Carbon Film Resistor	RD142HA623J	62kΩ ± 5% ½ W
R61, 62	Oxide Metal Film Resistor	RS143AA822J	8.2kΩ ± 5% 1 W
R63, 64	Carbon Film Resistor	RD142HA331J	330Ω ± 5% ½ W
R65	Carbon Film Resistor	RD142HA1692G	16.9kΩ ± 2% ½ W
R66	Carbon Film Resistor	RD142HA2401G	2.4kΩ ± 2% ½ W
R67-70	Oxide Metal Film Resistor	RS143AA103J	10kΩ ± 5% 1 W
R71	Carbon Film Resistor	RD142HA823J	82kΩ ± 5% ½ W
C1	Metallized Film Capacitor	CQ93M2E105K	1μF ± 10% 250 WV
C2, C25	Mica Capacitor	CM93D2A200J	20pF ± 5% 100 WV
C3, 12	Metallized Film Capacitor	CQ91M2E335K	3.3μF ± 10% 250 WV
C4, 9	Metallized Film Capacitor	CQ93M2E224K	0.22μF ± 10% 250 WV
C6, 7, 14	Metallized Film Capacitor	CQ93M2E104K	0.1μF ± 10% 250 WV
C8	Mica Capacitor	CM93D2A470J	47pF ± 5% 100 WV
C10, 11	Electrolytic Capacitor	CE02W1H4R7	4.7μF 50 WV
C13, 15, 16	Mica Capacitor	CM93D2A101J	100pF ± 5% 100 WV
C17, 18	Metallized Film Capacitor	CQ93M2E474K	0.47μF ± 10% 250 WV
C19, 20	Mica Capacitor	CM93D2A561J	560pF ± 5% 100 WV
C21, 22	Mica Capacitor	CM93D2F331J	330pF ± 5% 315 WV
C23, 24	Ceramic Capacitor	CK45F2H103P	0.01μF +100% - 0% 500 WV
C26	Mica Capacitor	CM93D2A100D	10pF ± 0.5% 100 WV
	Pan Head ISO Metric Screw	600-0312-01	3×12mm for Q15-18
	Nex. Nut	633-2031-01	3mm dia. for Q15-18
	Lock Washer	639-2031-01	for Q15-18
	Transistor Spacer	250-0003-00	for Q19, 20

PROTECTION CIRCUIT ASSEMBLY (720-0002-00)

●PRINTED CIRCUIT BOARD

* Printed circuit board as seen from the reverse side



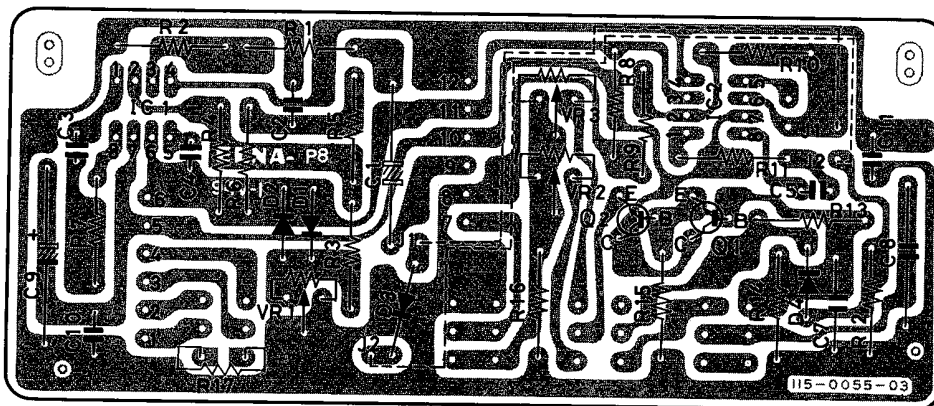
●PARTS LIST

No.	Description	Part No.	Remarks	No.	Description	Part No.	Remarks
RELAY 1	Reed Relay	363-2201-00	LAB2-24V	R26, 27, 33	Carbon Film Resistor	RD142HA332J	3.3kΩ ± 5% ½W
Q1, 11	Transistor NPN	2SC497-O or Y		R29	Carbon Film Resistor	RD142HA222J	2.2kΩ ± 5% ½W
Q2, 9	Transistor PNP	2SA485-Y		R31, 32	Carbon Film Resistor	RD142HA104J	100kΩ ± 5% ½W
Q3, 5, 6, 8	Transistor NPN	2SC1746-GR or BL		R38, 39 45, 46	Carbon Film Resistor	RD142HA334J	330kΩ ± 5% ½W
Q10	Transistor NPN	2SC1746-BL-Ⓢ	Ⓢ : Selected	R43	Carbon Film Resistor	RD142HA470J	47Ω ± 5% ½W
IC1	IC	LM709CH		R44, 47, 49	Carbon Film Resistor	RD142HA223J	22kΩ ± 5% ½W
D1	Full Wave Bridge	S1RB-10		R48	Carbon Film Resistor	RD142HA242J	2.4kΩ ± 5% ½W
D2	Zener Diode	XZ-060		R50	Oxide Metal Film Resistor	RS143AA221J	220Ω ± 5% 1W
D3, 5	Silicon Varistor	SV-03		R51	Metal Film Resistor	RN143AA5R6J	5.6Ω ± 5% 1W
D4	Silicon Varistor	SV-02		C1~4	Ceramic Capacitor	CK45F2H103P	0.1μF +100% -0% 500WV
D6-11, 14-16 19-22	Silicon Diode	1S1555		C5~8	Electrolytic Capacitor	CE02W1V471	470μF 35WV
D12, 13	Silicon Diode	1S1553		C9~12	Ceramic Capacitor	CC45SL1H470K	47pF ±10% 50WV
D17	Zener Diode	XZ-245		C13, 14, 18	Tantalum Solid Capacitor	CS15E1V100M	10μF ±20% 35WV
VR1	Potentiometer 10kΩB	581-0142-00	for Protection Level Adj.	C16	Mylor Film Capacitor	CQ93M1H472K	4700pF ±10% 50WV
R1	Carbon Film Resistor	RD142HA101J	100Ω ± 5% ½W	C17	Ceramic Capacitor	CC45SL1H221K	220pF ±10% 50WV
R2, 3	Carbon Film Resistor	RD142HA392J	3.9kΩ ± 5% ½W	C19	Bipolar Electrolytic Capacitor	CE02DIH3R3(B.P.)	3.3μF 50WV
R4	Metal Film Resistor	RN143AAR47J	0.47Ω ± 5% 1W	C20	Bipolar Electrolytic Capacitor	CE02DIH100(B.P.)	10μF -35WV
R5	Carbon Film Resistor	RD142HA6R8J	6.8Ω ± 5% ½W	C21	Bipolar Electrolytic Capacitor	CE02DIA221(B.P.)	220μF 10WV
R6, 30	Carbon Film Resistor	RD142HA100J	10Ω ± 5% ½W	C22	Mylar Film Capacitor	CQ93M1H102K	1000pF ±10% 50WV
R7	Carbon Film Resistor	RD142HA122J	1.2kΩ ± 5% ½W	C23	Metallized Film Capacitor	CQ91M2E475K	4.7μF ±10% 250WV
R8	Carbon Film Resistor	RD142HA1002G	10kΩ ± 2% ½W	C24, 25	Metallized Film Capacitor	CQ93M2E105K	1μF ±10% 250WV
R9	Carbon Film Resistor	RD142HA1472G	14.7kΩ ± 2% ½W	※	Transistor Spacer	250-0003-00	for Q1, 2, 9, 11, 14
R10, 11	Carbon Film Resistor	RD142HA2002G	20kΩ ± 2% ½W		Heat Sink	240-2001-00	for Q2
R12, 40	Carbon Film Resistor	RD142HA472J	4.7kΩ ± 5% ½W				
R13	Metal Film Resistor	RN143AA1R0J	1Ω ± 5% 1W				
R14, 15	Carbon Film Resistor	RD142HA271J	270Ω ± 5% ½W				
R16	Carbon Film Resistor	RD142HA152J	1.5kΩ ± 5% ½W				
R17	Carbon Film Resistor	RD142HA564J	560kΩ ± 5% ½W				
R18	Carbon Film Resistor	RD142HA330J	33Ω ± 5% ½W				
R19, 36, 37	Carbon Film Resistor	RD142HA153J	15kΩ ± 5% ½W				
R20, 24, 28 35, 41, 42	Carbon Film Resistor	RD142HA103J	10kΩ ± 5% ½W				
R21	Carbon Film Resistor	RD142HA513J	51kΩ ± 5% ½W				
R22	Carbon Film Resistor	RD142HA102J	1kΩ ± 5% ½W				
R23	Carbon Film Resistor	RD142HA240J	24Ω ± 5% ½W				
R25, 34	Carbon Film Resistor	RD142HA333J	33kΩ ± 5% ½W				

METER CIRCUIT ASSEMBLY (716-0018-00)

●PRINTED CIRCUIT BOARD

* Printed circuit board as seen from the reverse side.



●PARTS LIST

No.	Description	Part No.	Remarks
	Connector Plug	304-0603-00	
	Push-button Switch	354-4003-00	
Q1	Transistor NPN	2SC1746-GR or BL	
Q2	Transistor NPN	2SC1451-B or G	
IC1, 2	IC	LM709CH	
D1, 2, 4	Silicon Diode	1S1555	
D3	Silicon Varistor	SV-07	
VR1	Potentiometer 100Ω B	580-0121-00	for -40dB Calibration Adj.
VR2, 3	Potentiometer 470Ω B	580-0521-00	VR2 for PEAK 0dB Adj. VR3 for VOL 0dB Adj.
R1	Carbon Film Resistor	RD142HA823J	82kΩ ± 5% ½W
R2	Carbon Film Resistor	RD142HA301J	300Ω ± 5% ½W
R3	Carbon Film Resistor	RD142HA471J	470Ω ± 5% ½W
R4	Metal Film Resistor	RN142HA225JL	2.2MΩ ± 5% ½W
R5, 6, 13	Carbon Film Resistor	RD142HA473J	47kΩ ± 5% ½W
R7, 11	Carbon Film Resistor	RD142HA152J	1.5kΩ ± 5% ½W
R8	Carbon Film Resistor	RD142HA393J	39kΩ ± 5% ½W
R9	Carbon Film Resistor	RD142HA433J	43kΩ ± 5% ½W

No.	Description	Part No.	Remarks
R10	Carbon Film Resistor	RD142HA474J	470kΩ ± 5% ½W
R12	Carbon Film Resistor	RD142HA562J	5.6kΩ ± 5% ½W
R14	Metal Film Resistor	RN142HA475JL	4.7MΩ ± 5% ½W
R15	Carbon Film Resistor	RD142HA104J	100kΩ ± 5% ½W
R16	Carbon Film Resistor	RD142HA331J	330Ω ± 5% ½W
R17	Carbon Film Capacitor	RD142HA331J	330Ω ± 5% ½W
C1	Bipolar Electrolytic Capacitor	CE02DH2R2(B.P.)	2.2μF 50 WV
C2	Bipolar Electrolytic Capacitor	CE02D1C330(B.P.)	33μF 16 WV
C3	Ceramic Capacitor	CK45B1H471K	470pF ±10% 50 WV
C4	Ceramic Capacitor	CC45SL1H100D	10pF ±0.5% 50 WV
C5	Ceramic Capacitor	CC45SL1H331K	330pF ±10% 50 WV
C6	Ceramic Capacitor	CC45SL1H040C	4pF ±0.25% 50 WV
C7	Metallized Film Capacitor	CQ93M2E154K	0.15μF ±10% 250 WV
C8	Metallized Film Capacitor	CQ93M2E334K	0.33μF ±10% 250 WV
C9	Electrolytic Capacitor	CE02W1C101	100μF 16 WV
C10, 11	Ceramic Capacitor	CK45F1H103Z	0.01μF +80% -20% 50 WV

FUSE CIRCUIT ASSEMBLY (716-0016-00)

●PARTS LIST

No.	Description	Part No.	Remarks
	Fuse Holder	306-1101-00	
F1~4	Fuse	310-0201-00	2A
D1	Full Wave Bridge	S1RB-40	
R1, 2	Oxide Metal Film Resistor	RS143AA221J	220Ω ± 5% 1 W
C1~4	Ceramic Capacitor	CK45F2H103P	0.01μF +100% - 0% 500 WV
C5-10	Electrolytic Capacitor	CE02W2C470	47μF 160 WV

PHASE CORRECT CIRCUIT ASSEMBLY (716-0017-00)

●PARTS LIST

No.	Description	Part No.	Remarks
L1	Choke Coil	506-0001-00	2μH
R1	Cement Coated Wirewound Resistor	RW983HG100J	10Ω ± 5% 5 W
R2, 3, 4	Metal Film Resistor	RN143JA150J	15Ω ± 5% 6.3 W
C1	Metallized Film Capacitor	CQ93M2E224K	0.22μF ±10% 250 WV

IMPROVED METER CIRCUIT FOR M-60

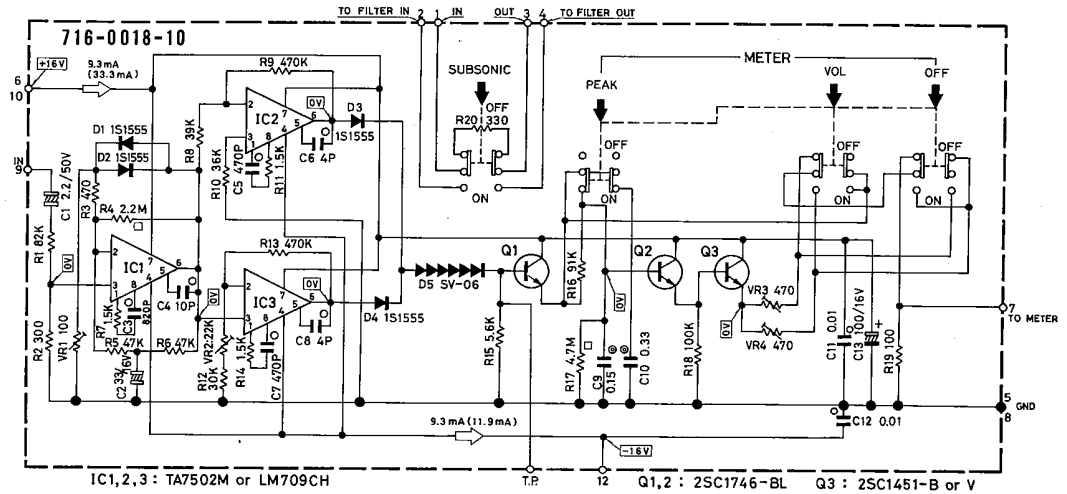
METER CIRCUIT ASSEMBLY (716-0018-10)

The Meter Circuit has been improved and revision details are explained in this service sheet. Please, attach it between pages 8 and 9 of

the M-60 Service Manual for future reference.

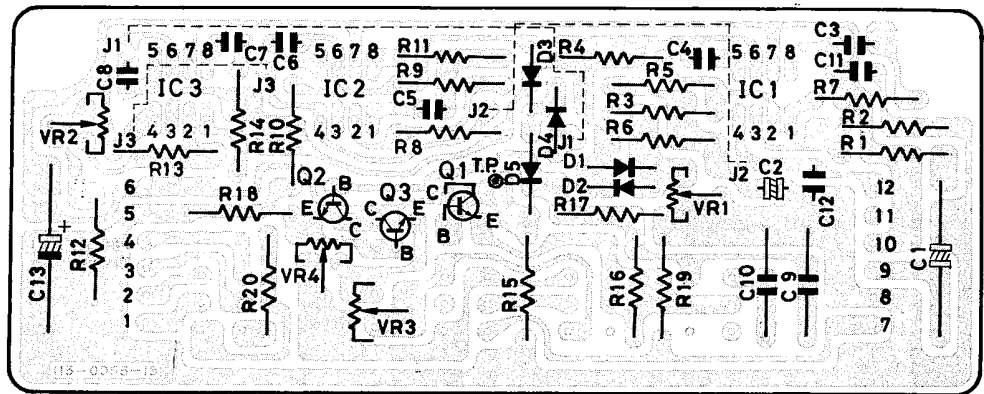
* It applies only to M-60 units from Serial No. B6Y301 and up. (It does not apply to units from Serial No. G5Y001 ~ J5Y300.)

SCHEMATIC DIAGRAM



PRINTED CIRCUIT BOARD

*Printed Circuit Board as seen from the reverse side.



PARTS LIST

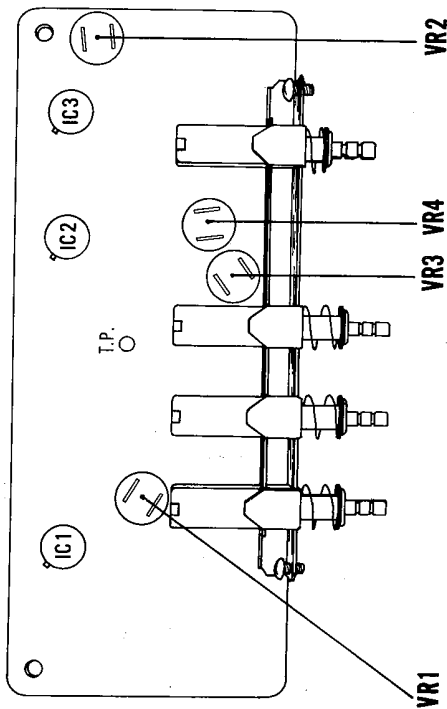
No.	Description	Part No.	Remark
	Connector Plug	304-0603-00	
	Push-button Switch	354-4003-00	
Q1, 2	Transistor NPN	2SC1746-BL	
Q3	Transistor NPN	2SC1451-V or S	
IC1-3	IC	TA7502M or LM709CH	
D1-4	Silicon Diode	1S1555	
D5	Silicon Varistor	SV-06	
VR1	Potentiometer 100ΩB	580-0121-00	for -40dB Calibration Adj.
VR2	Potentiometer 22kΩB	580-0241-00	for Level Adj.
VR3	Potentiometer 470ΩB	580-0521-00	for PEAK 0dB Adj.
VR4	Potentiometer 470ΩB	580-0521-00	for VOL 0dB Adj.
R1	Carbon Film Resistor	RD142HA823J	82kΩ ±5% ½W
R2	Carbon Film Resistor	RD142HA301J	300kΩ ±5% ½W
R3	Carbon Film Resistor	RD142HA471J	470Ω ±5% ½W
R4	Metal Film Resistor	RN142HA225JL	2.2MΩ ±5% ½W
R5, 6	Carbon Film Resistor	RD142HA473J	47kΩ ±5% ½W
R7, 11, 14	Carbon Film Resistor	RD142HA152J	1.5kΩ ±5% ½W
R8	Carbon Film Resistor	RD142HA393J	39kΩ ±5% ½W
R9, 13	Carbon Film Resistor	RD142HA474J	470kΩ ±5% ½W

No.	Description	Part No.	Remark
R10	Carbon Film Resistor	RD142HA363J	36kΩ ±5% ½W
R12	Carbon Film Resistor	RD142HA303J	30kΩ ±5% ½W
R15	Carbon Film Resistor	RD142HA562J	5.6kΩ ±5% ½W
R16	Carbon Film Resistor	RD142HA913J	91kΩ ±5% ½W
R17	Metal Film Resistor	RN142HA475JL	4.7MΩ ±5% ½W
R18	Carbon Film Resistor	RD142HA104J	100kΩ ±5% ½W
R19	Carbon Film Resistor	RD142HA101J	100Ω ±5% ½W
R20	Carbon Film Resistor	RD142HA331J	330Ω ±5% ½W
C1	Bipolar Electrolytic Capacitor	CE02D1H2R2 (B.P.)	2.2μF 50WV
C2	Bipolar Electrolytic Capacitor	CE04D1C330 (B.P.)	33μF 16WV
C3	Ceramic Capacitor	CK45B1H821K	820pF ±10% 50WV
C4	Ceramic Capacitor	CC45SL1H100D	10pF ±0.5% 50WV
C5, 7	Ceramic Capacitor	CK45B1H471K	470pF ±10% 50WV
C6, 8	Ceramic Capacitor	CC45SL1H040C	4pF ±0.25% 50WV
C9	Mylar Film Capacitor	CQ93M1H154J	0.15μF ±5% 50WV
C10	Mylar Film Capacitor	CQ93M1H334J	0.33μF ±5% 50WV
C11, 12	Ceramic Capacitor	CK45K1H103Z	0.01μF +80% -20% 50WV
C13	Electrolytic Capacitor	CE02W1C101	100μF 16WV

RE: CIRCUIT CHANGE

The Meter Circuit has been revised to indicate full waveform peaks instead of former halfwaves in order to detect full waveform peaks perfectly. Comparison of Meter indications will show a slight difference when measuring waveforms that are not symmetrical such as voice signals, etc.

CIRCUIT ADJUSTMENT



(When Meter or Printed Circuit Board is replaced, please adjust as follows.)

*VTVM registers 48.98V when an output of 300 watts is being fed into an 8 ohm load.
Repeat steps 1 and 2 until precise calibration is completed.

STEP	ADJUST ITEM	INPUT SIGNAL	LOAD	TEST EQPT	PROCEDURE CONNECTING POINT	ADJUST	REMARKS
2	PEAK LINEARITY ADJUSTMENT	1kHz Sine Wave	No Load (Open)	VTVM	"SPEAKER" Terminal	Meter Circuit Assembly "VR1"	Adjust input signal so that VTVM reads 0.49V. Then adjust VR1 so that PEAK meter reads -40 dB.
3	OFFSET VOLTAGE ADJUSTMENT	1kHz Sine Wave	No Load (Open)	SCOPE	Meter "T.P." Terminal	Circuit Assembly "VR2"	Adjust VR2 to obtain exact peak heights of rectified full waveform on scope screen. Repeat steps 1 and 2.
4	VOL 0dB CALIBRATION	1kHz Sine Wave	No Load (Open)	VTVM	"SPEAKER" Terminal	Meter Circuit Assembly "VR4"	Adjust input signal so that PEAK meter reads 0 dB. Then adjust VR4 so that VOL meter reads 0 dB.

PROTECTION CIRCUIT DESCRIPTION

This unit has, in addition, five other protection circuits, namely: an ASO (Area of Safety Operation) limiter circuit, an abnormal load impedance detector circuit, an abnormal DC output voltage detector circuit, a relay control circuit which triggers a relay in the output load circuit and a warning protection circuit. These various protection circuits are described below.

1. ASO LIMITER CIRCUIT

This circuit employs Q19, Q20, D17, D18, D19 and D20 which are located in the Main Drive Assembly (710-0003-00). In case of a short circuit in the speaker connecting network, or when the load impedance drops to an abnormally low value, this circuit limits the input signal level to the drive stage transistors Q301 and Q302. This serves to clip their output and protect the power transistors by keeping them working within the area of safe operation (ASO).

A special feature of this circuit is that it protects the power transistors against exceptionally strong pulse surges of short duration without having to activate the circuit breaking protection relay.

2. ABNORMAL LOAD IMPEDANCE PROTECTION CIRCUIT

If AC power is turned ON when the output impedance happens to be extremely low or non-existent as in the case of a shorted or near-short speaker circuit, this situation is quickly detected by this circuit which then prevents the load circuit relay from closing. This protection circuit employs IC1, D6, D7 and Q5 which are located within the Protection Circuit Assembly (720-0002-00).

When power is turned on under normal conditions, an AC line frequency signal is applied to IC1 via terminal 20 of the Protection Circuit Assembly. This is amplified by IC1, and is supplied as a minus voltage to the base of Q5 after being rectified by the voltage doubler rectifier D6 and D7. This causes Q5 to turn OFF and permits normal operation of the Relay Control Circuit to close the relay shortly after power is turned on.

In case of an abnormally low load impedance, or a short circuited output, however, the AC line frequency signal is not applied to IC1, Q5 is then biased to plus by R21 (51 Kohms) which turns it ON. This causes the relay control circuit to keep the load circuit relay open and prevent connection to the output load.

3. DC OUTPUT VOLTAGE DETECTOR CIRCUIT

When a large, very low frequency voltage is applied to the speakers, or when a high DC voltage is created in the output circuit due to a fault in the power transistor circuit, damage may be caused to the speakers. This protection circuit prevents this possibility by causing the relay to open the speaker circuit and consists of Q6, Q7, Q8, D10 ~ 13, R24, R25 and C21 in the Protection Circuit Assembly (720-0002-00). When the output voltage potential is more than DC 2V and it is "+", Q6 is turned ON. When it is "-", Q7 is turned ON. This reduces the collector voltage and triggers the relay to break the speakers circuit. For signal frequencies above 5 Hz, however, the relay will remain closed up to the full rated power output due to the time constant of R24, R25 and C21. For signal frequencies below 5 Hz, the relay will break the speaker circuit before full power is reached.

4. LOAD CONNECTING RELAY CONTROL CIRCUIT

This circuit consists of Q9, Q10, Q11, D14, D15 and D16 located in the Protection Circuit Assembly (720-0002-00). It controls relay action in accordance with signals from the protection circuits explained in "b" and "c" above. In addition, it has two other functions, namely to prevent the relay from closing for an interval of about 3 seconds after power is turned ON and enable circuits to stabilize. It also breaks the speaker circuit when power is turned OFF and prevents reproduction of residual output energy.

-Checking circuit action

- (1) When power turned ON under normal conditions.
Stages preceding Q9 have no relation to this circuit action. For a 3 second interval immediately after power is turned on capacitor C23 is charging. This causes Q10 to remain at ON and Q11 at OFF, and the relay remains open. After about 3 seconds the fully charged condition of C23 creates a "0" base bias which causes Q10 to turn OFF and Q11 to turn ON to close the relay.
- (2) When power is OFF.
As explained in "b" above, the disappearance of the AC line frequency signal supplied to IC1 causes the load circuit relay to open and at off the speaker immediately. The circuit is designed to prevent reproduction of residual output energy.
- (3) Circuit action in case of trouble.
When an abnormal situation occurs, as explained under "b" and "c" above, action of these respective circuits causes Q9 to turn

ON. This further causes Q10 to turn ON, and Q11 to turn OFF. The relay which was open in the case of "b" remains open. The relay which was closed in the case of "c" then opens. Power transistors and speakers are thus protected in this manner.

5. WARNING PROTECTION CIRCUIT

A Warning Circuit using a multivibrator and centered around Q12 and Q13 within the 720-0002-00 assembly is provided for protection against incorrect speaker connection. The circuit remains inactive when the speaker system is connected correctly and operating normally.

The Meter Lamp will glow continuously to indicate this whenever the amplifier is on since Q14 will be ON to pass a steady current to the lamp.

In case of a shorted output circuit, however, RELAY-1 activates this Warning Circuit causing the multivibrator to turn Q14 ON and OFF repeatedly, which in turn causes the Meter Lamp to flash an on-off, on-off warning signal.

CHECKING THE POWER SUPPLY

A circuit breaker is provided in the power supply on the primary side of the power transformer. It functions if a fault should occur in the supply circuit to the power transistors or in the power transformer. Moreover, a fuse protects the power transformer from overheating in case of a short circuit in the secondary circuit that may not trigger the primary side circuit breaker. It is located on the printed circuit board that is mounted beneath the main chassis. It should be checked in the following cases.

- If the Meter Lamp fails to light or when the RELAY does not go ON although the circuit breaker works normally. → F1, F2 (2A)
- If no sound can be heard although the Meter Lamp lights up and the Relay goes ON. → F3, F4 (2A)
- If the Meter Lamp flashes the "ON-OFF" warning signal and the Relay does not go ON despite the fact that the speaker is disconnected. → F2 (2A)
- If hum increases substantially when the Subsonic Filter is turned ON. → F3, F4 (2A)

CIRCUIT DESCRIPTION

The bias current of a Main Drive amplifier must be stable under all operating conditions.

This is particularly so in the case of Main Drive amplifiers whose every stage is direct-coupled since instability in any one stage will adversely affect current flow in the final output stage. Good stability is ensured in this Monophonic Amplifier with the following methods. (Refer to the schematic diagram)

- (a) Careful matching of transistors Q9, Q10, Q11 and Q12 used in the first differential amplifier stage.
- (b) Constant, regulated voltage to the differential amplifier due to the use of Zener Diodes D1 and D2.
- (c) Non-drift of the differential amplifier due to the use of D3, D4, D5 and D6.
- (d) No V_{BE} drift in Q17 and Q18, as well as the driver stages Q301, Q302 and the final stages Q310 due to function of Silicon Varistor (D201:STV-3H) and Thermistor (TH1, TH2: 5TP-31L) connected between the base elements of Q17 and Q18.

The bias current for the final stage is the sum total requirement of the 4 pair power transistors and is set at 100mA.

Power consumption during no signal condition is limited to this small current drain and so creates hardly and heat.

If the amplifier operated continuously at an average power output of 50 watts, both sides of upper top plate should heat up to about 30 ~ 40 degrees centigrade (about 95 ~ 105 degrees fahr.)

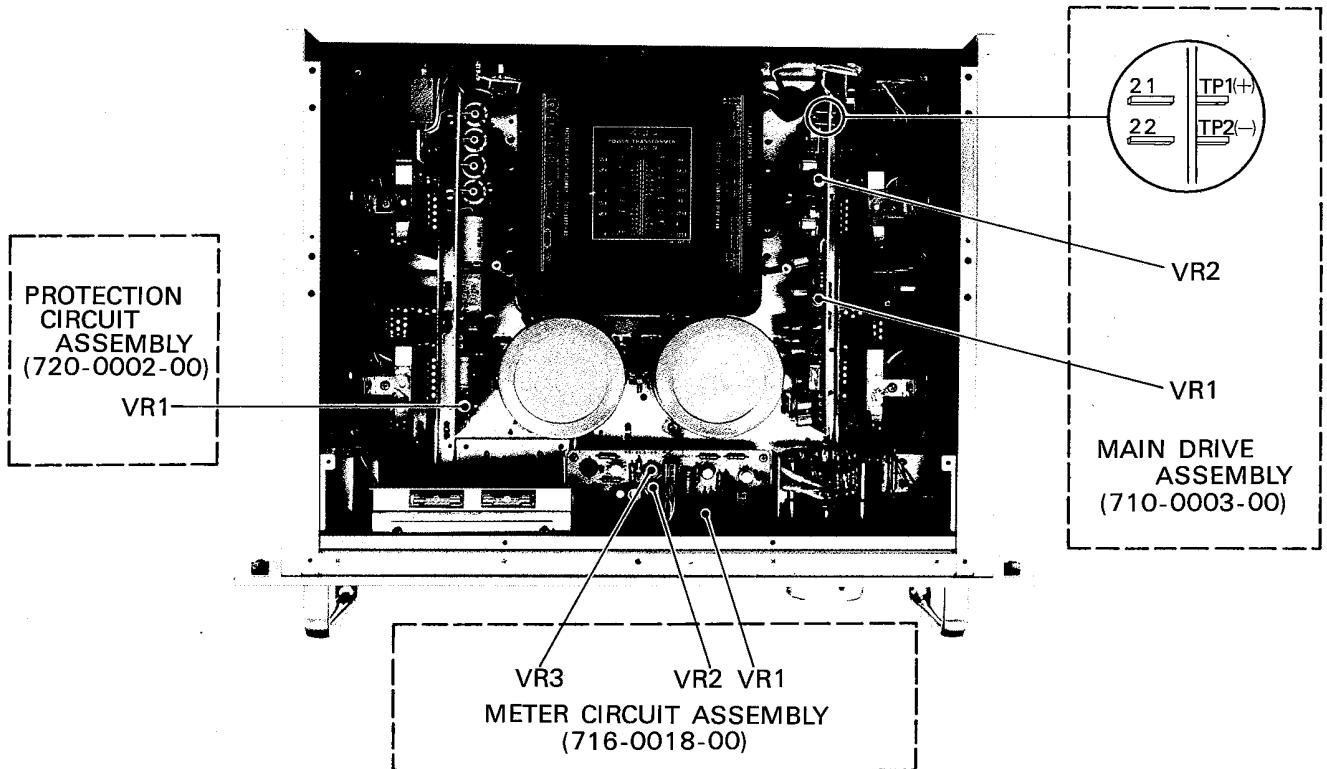
If the amplifier heats up, bias current adjustment should be made, as explained on the following page.

Bias current adjustment is also necessary when the Main Drive Assembly printed circuit board or the power transistors are replaced.

Bias current calculation and adjustment are made by means of measuring voltage as explained below.

$$I = V/R$$

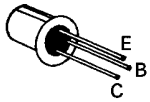
where V is the voltage measured across E to E in the final push-pull stage with a VOM tester; and R is 0.5 ohms, the resultant value of the emitter resistor in the final stage.



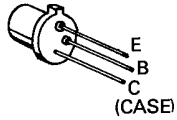
CIRCUIT ADJUSTMENT

STEP	ADJUST ITEM	INPUT SIGNAL	LOAD	PROCEDURE		ADJUST	REMARKS
				TEST EQPT.	CONNECTING POINTS		
MAIN DRIVE AMP. Assembly (When overheating is suspected, or when Printed Circuit Board or Power Transistors are replaced)							
1	CENTER VOLTAGE ADJ.	No Input	No Load (Open)	V. O. Meter (D. C. Range)	"SPEAKER" Terminals	Main Drive Assembly "VR 1"	For Meter Indication within $0 \pm 50\text{mV}$
2	BIAS CURRENT ADJ.	No Input	No Load (Open)	V. O. Meter (D. C. Range)	TP1(+), TP2(-)	Main Drive Assembly "VR 2"	For Meter Indication of 50mV
3	Same as above	Sine Wave or Program Source	Speaker or Dummy Load				Feed 1-10W output for about 15 minutes.
4	Same as above	No Input	No Load (Open)	V. O. Meter (D. C. Range)	TP1(+), TP2(-)	Main Drive Assembly "VR 2"	For Meter Indication of 50mV. Repeat step 1.
PROTECTION CIRCUIT Assembly (When Printed Circuit Board is replaced)							
1	MINIMUM LOAD IMPEDANCE	No Input	1 Ω Resistor	Power Meter Lamp	None	Protection Circuit Assembly "VR 1"	1 : Power : OFF - Set VRI fully clockwise. 2 : Power : ON - Turn VRI counterclockwise to the point where lamp stops flashing.
2	ABNORMAL LOAD IMPEDANCE	No Input	0.75 Ω Resistor	Power Meter Lamp	None		Turn power off. Then turn power on Lamp should flash "on-off" warning.
METER CIRCUIT Assembly (When Printed Circuit Board is replaced)							
1	PEAK-0dB CALIBRATION	1kHz Sine Wave	No Load (Open)	VTVM	"SPEAKER" Terminals	Meter Circuit Assembly "VR 2"	Adjust input signal so that VTVM reads 48.98V. Then adjust VR2 so that PEAK meter reads 0 dB.
2	PEAK-LINEARITY ADJUSTMENT	1kHz Sine Wave	No Load (Open)	VTVM	"SPEAKER" Terminals	Meter Circuit Assembly "VR 1"	Adjust input signal so that VTVM reads 0.49V. Then adjust VR1 so that PEAK meter reads -40 dB.
3	VOL-0dB CALIBRATION	1kHz Sine Wave	No Load (Open)	VTVM	"SPEAKER" Terminals	Meter Circuit Assembly "VR 3"	Adjust input signal so that PEAK meter reads 0 dB. Then adjust VR3 so that VOL meter reads 0 dB.

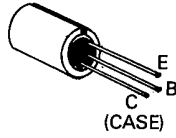
TRANSISTOR



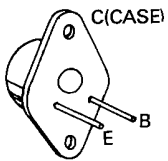
2SA856
2SA856A
2SC1746
2SC1746A



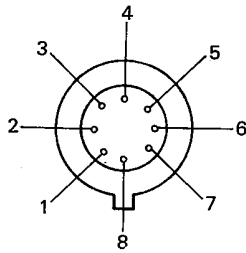
2SA485
2SC497



2SA809
2SA810
2SC1451
2SC1452

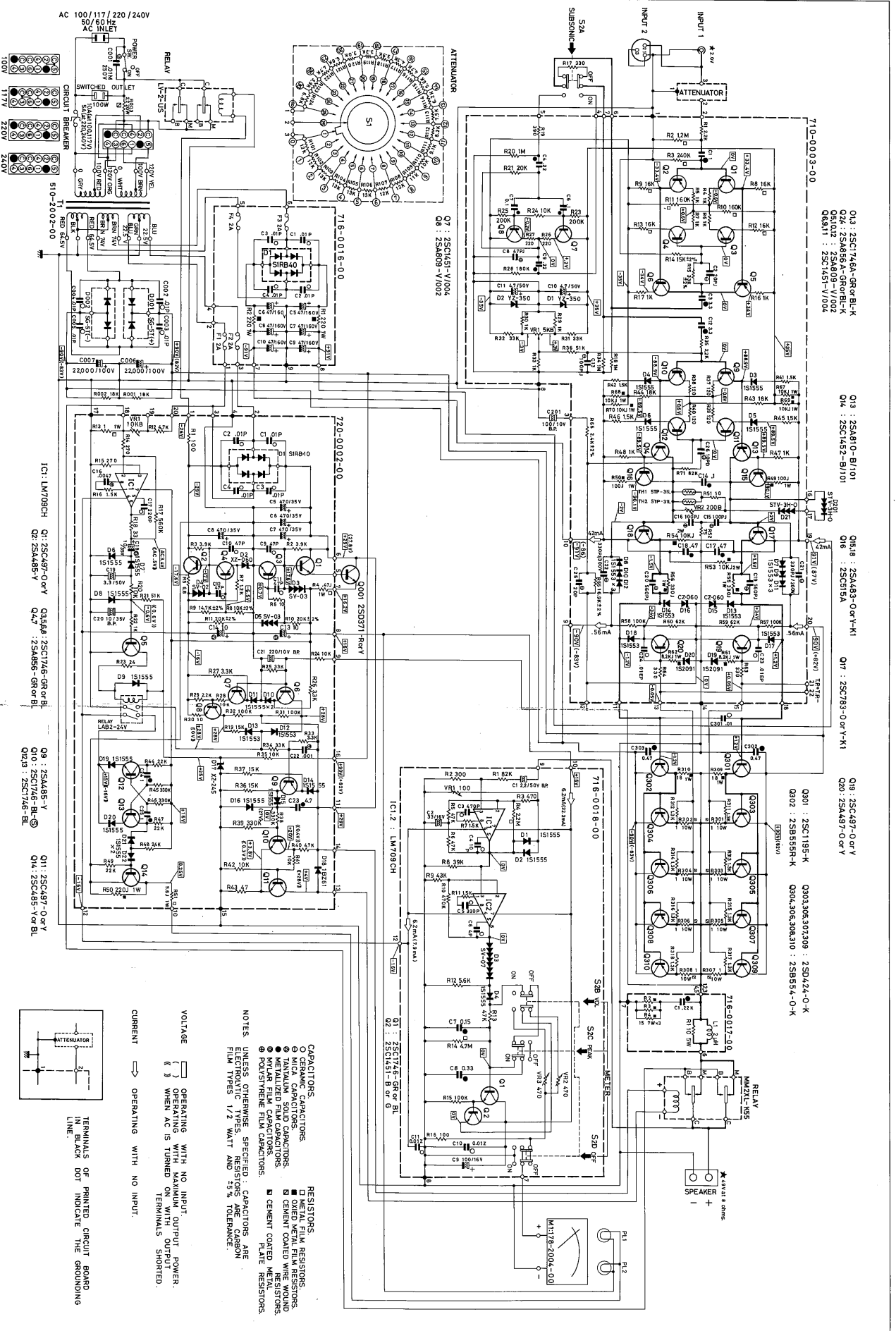


2SA483
2SB554
2SB555
2SC515A
2SC783
2SC1195
2SD371
2SD324
2SD424



IC LM709CH

SCHEMATIC DIAGRAM



Indicated values of parts in the schematic diagram may be changed in case of performance improvement.

SPECIFICATIONS

POWER OUTPUT (from 20Hz to 20,000Hz with no more than 0.1% total harmonic distortion):

450 watts, min., RMS, at 4 ohms
300 watts, min., RMS, at 8 ohms
150 watts, min., RMS, at 16 ohms

TOTAL HARMONIC DISTORTION (from 20Hz to 20,000Hz at any power output from 1/4 watt to rated power):

4 ohms; 0.1% max.
8 ohms; 0.1% max.
16 ohms; 0.1% max.

INTERMODULATION DISTORTION:

will not exceed 0.1% at rated power output for any combination of frequencies between 20Hz and 20,000Hz

FREQUENCY RESPONSE:

20Hz to 20,000Hz: +0, -0.2dB at rated power output
2Hz to 90,000Hz: +0, -3dB at rated power output

DAMPING FACTOR:

45 (at 8 ohms load, 20Hz to 20,000Hz)

RISE TIME:

3 μ Sec.

SLEWING RATE:

25 V/ μ Sec.

INPUT SENSITIVITY AND IMPEDANCE:

2.0 Volts, 100Kohms, for rated output at the maximum level

HUM AND NOISE

100 dB below rated output

OUTPUT LOAD IMPEDANCE:

4, 8 and 16 ohms

SUBSONIC FILTER:

cutoff frequency: 17Hz 18dB/oct.

POWER LEVEL METER:

switchable for Volume Level and Peak Level.

calibrated to read OdB = 300 watts into 8 ohms load and capable of directly reading down to -50dB (3 mW)

ATTENUATOR:

precision, 1dB stepping type

POWER REQUIREMENT:

voltage selector for 100V, 117V, 220V, 240V 50/60Hz operation

CONSUMPTION:

540 watts at zero signal output
800 watts at rated output (8 ohms load)

SEMICONDUCTOR COMPLIMENT:

47 transistors, 51 diodes, 3 IC's

DIMENSIONS:

462mm (19 inches) wide, 170mm (6-5/16 inches) high,

346mm (13-3/4 inches) deep

*mountable on 19" standard rack

rack mount pitch: 100mm (4")

WEIGHT: rack inside horizontal measurement: 430mm (16-15/16")

27kgs (59.4 lbs) net, 32kgs (70.4 lbs) in shipping carton



KENSONIC LABORATORY INC.
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