

Model 500PM Loudspeaker



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Note: This manual has been updated using information from supplement 197275-S1. This affects part numbers for PTC1, PTC2 and PTC3.

CAUTION: The Model 500PM Loudspeaker contains no user serviceable parts. To prevent warranty infractions, refer servicing to warranty service centers or factory service.

PROPRIETARY INFORMATION

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ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICE HANDLING

This unit contains ESDS devices. We recommend the following precautions when repairing, replacing, or transporting ESDS devices:

- Perform work at an electrically grounded work station.
- Wear wrist straps that connect to the station or heel straps that connect to conductive floor mats.
- Avoid touching the leads or contacts of ESDS devices or PC boards even if properly grounded. Handle boards by the edges only.
- Transport or store ESDS devices in ESD protective bags, bins, or totes. Do not insert unprotected devices into materials such as plastic, polystyrene foam, clear plastic bags, bubble wrap, or plastic trays.

WARRANTY INFORMATION

The Model 500PM Loudspeaker is covered by a 5-year transferable limited warranty.

SPECIFICATIONS

External Dimensions, Single Speaker, including grille:

18.09"L x 11.77"D x 10.10"H
(45.95 x 29.90 x 25.65 cm)

Weight:

Packed Pair, 60lb (27.3kg)

Shading Network Assembly:

5.6uF capacitor with 0.13mH series inductor, 33uF capacitor with 0.5mH series inductor, 33uf capacitor with 3.9Ω parallel resistor and 0.8mH parallel inductor.

Internal Cabinet Volume:

19 Liters net

Port (each side):

Flared slot port tuned to 58Hz

Impedance:

6Ω nominal, 4.8Ω minimum from 20Hz to 20kHz

Power Handling:

200W (34.6Vrms) continuous per IEC-268-5.

Sensitivity:

85dB SPL @ 1W/1m, free-field, per IEC-268-5 for octave band centered at 400Hz.

SmartProtect:

Turn on voltage of the transistors of the electronic switch:

1.5-1.8Vrms

Resistance prior to turn on:

3Ω

On resistance:

<0.2Ω

Max audio voltage applied to speaker:

70Vrms

Maximum cont. sinusoidal current, 1Khz:

3.6Arms ± 15%

Maximum cont. sinusoidal current, 150Hz:

5Arms ± 15%

Reset time:

200-400ms

Time to trip, as a function of speaker current:

Speaker Current I/I_{∞}	Time to Trip
3.3	1-5ms
3	0.8ms
2	2s
1.5	3s
1	∞

DC turn-off current:

5A

THEORY OF OPERATION

Model 500PM Loudspeaker SmartProtect Crossover PCB

Note: Refer to Figure 7. Model 500PM Loudspeaker SmartProtect Crossover Assembly Schematic Diagram, for the following explanation.

The SmartProtect PCB is an electronic switch, in series with the speaker, used to protect the drivers from high current and power levels. It has a fast turn-on time of about 100 milliseconds. At turn-on, current flows through R1, C1, D1, D2, C2, Q1, C3 and R18. Capacitors C2 and C3 form a virtual power supply which is used to power the SmartProtect circuit to provide the bias to FET's Q8 and Q9, limited by the Zener diode D6 to 10 V. Diodes D1 and D2 form a voltage doubler. Once C2 is charged, Q1 will conduct and provide a charge path for C3. Once C3 is charged, if the input audio voltage becomes lower than 4V, Q1 will turn off, and the charge on C3 provides a voltage used to operate the circuit for up to 5 hours. PTC1 provides the current path if the speaker must play for a long time at very low volume when input AC voltage to the speaker is less than 1.5V.

Resistors R16 and R17 form the current sensor. It allows the circuit to sense the speaker current and protect it from the following types of the abuse:

1. DC offset - when too high a DC offset level is detected one, of the two transistors Q6 or Q7 will be turned on through resistor R19, thus tripping the monostable multivibrator Q2, Q3.
2. Fast DC/AC transients - works the same way for both transient polarities, threshold depends on the ratio of resistors R19 and R20.
3. Thermal overload - When the AC current is too high for a prolonged time, transistor Q4 turns on through resistor R13, tripping the monostable multivibrator Q2, Q3. The time constant of current integration depends on C6, R13 while the time constant of "memory" is defined by R6 and C6. AC voltage divider R15, R14, and C7 defines the frequency dependent threshold of current protection.

The protection portion of the circuit works as follows: When monostable multivibrator Q2, Q3 is tripped, by one of the above conditions, transistors Q2 and Q3 turn on, reducing the gate voltage of Q8 and Q9 to zero, and shutting them off. At this moment the speaker load is disconnected from the amplifier. During the off cycle, capacitor C4 is charging through resistor R3, and when the charging is completed, Q2 and Q3 will shut off again, turning Q8 and Q9 back on, and allowing the speaker to operate again. If the overload condition persists, the monostable multivibrator will trip the circuit again, and shut off the speaker again. Duty cycle depends on the current through the speaker.

Troubleshooting

1. If PTC1 is open, the unit will not play at low volume levels ($V_{in} < 1.5\text{ V}$) when the system is first turned on, but as the volume is increased, the SmartProtect circuit will turn on, and the speaker will operate. It will then operate for approximately 5 hours, until the charge on C3 is too low to keep the circuit running, and then the speaker will shut off again.
2. If either R18, R1, D2 is open, or D1 is shorted there will be no charge of the virtual power supply formed by C2 and C3, and the circuit will never turn on. The symptom will be that the speaker will play at low volume levels, but as the volume is turned up, the speaker will stop operating. This may also happen if for any reason Q7, Q8 or any other component in the circuit fails, and internal safety "watchdog" C5 turns the Q3 on preventing the Q8 and Q9 from being overheated.

Shading Network

The shading network consists of one 5.6 μF capacitor, one RXE040 PTC, and one 0.13mH inductor across the two front array drivers, one 33 μF capacitor, one RXE040 PTC and one 0.5mH inductor across the driver nearest the port and a trap filter consisting of a 3.9 Ω resistor, a 33 μF capacitor, and a 0.8mH inductor. The inductors are iron core.

DISASSEMBLY/ASSEMBLY PROCEDURES

Note: Refer to Figure 3. Model 500PM Loudspeaker Exploded View, for the following procedures.

1. Grille Removal

1.1 Using your fingers, grasp the grille (14) edge nearest the curved end and gently pull the grille away from the cabinet until it comes free.

1.2 Grasp the opposite edge of the grille and gently pull it away from the cabinet until it comes free as well.

2. Grille Replacement

2.1 Align the two grille posts on the curved grille (14) edge with the cabinet grille socket grommets (5) located on the speaker cabinet curved section and press the grille edge into place.

2.2 Align the two grille posts at the opposite grille edge with the cabinet grille socket grommets and press the grille in place. The grille should be neat and flush with the cabinet.

3. StarDriver™ Removal

3.1 Remove the grille (14) using procedure 1.

3.2 Remove the three screws (2 or 18) that secure the StarDriver (6) you wish to remove from the cabinet.

Note: The StarDriver located on the angled portion of the baffle is secured using (2), the two StarDrivers located on the plastic baffle are secured using (18).

3.3 Using your fingers, grasp the plastic basket of the StarDriver and pull gently. The StarDriver should come free.

3.4 Note the driver wiring color code, and cut the wires from the harness assembly (3) as close to the terminals as possible.

4. StarDriver replacement

4.1 Observing polarity, solder the wires from the harness assembly (3) to the StarDriver (6) terminals.

4.2 Align the StarDriver correctly into the cabinet and secure it using the screws (2 or 18) removed in procedure 3.2. Do not overtighten the screws.

4.3 Replace the grille (14) using procedure 2.

5. Woofer Removal

Note: In order to gain access to the woofers, you must first remove the array bezel on which the forward-firing StarDrivers are mounted.

5.1 Using a phillips-head screwdriver, remove the twelve screws (2) that secure the array bezel (12) to the loudspeaker cabinet.

5.2 Gently pull the array bezel away from the loudspeaker cabinet. Be careful not to break any wires. Slide the array bezel off to one side to allow access to the woofer assembly (11).

5.3 Remove the batting material located behind the array bezel. Retain it for replacement later.

Note: In order to remove the woofer assembly located behind the rod, you must first remove the StarDriver located on the angled portion of the loudspeaker cabinet using procedure 3. It is not necessary to cut the StarDriver wires, as it can be moved out of the way to allow removal of the woofer.

5.4 Using a phillips-head screwdriver, remove the four screws (2) securing the woofer assembly to the loudspeaker cabinet.

DISASSEMBLY/ASSEMBLY PROCEDURES

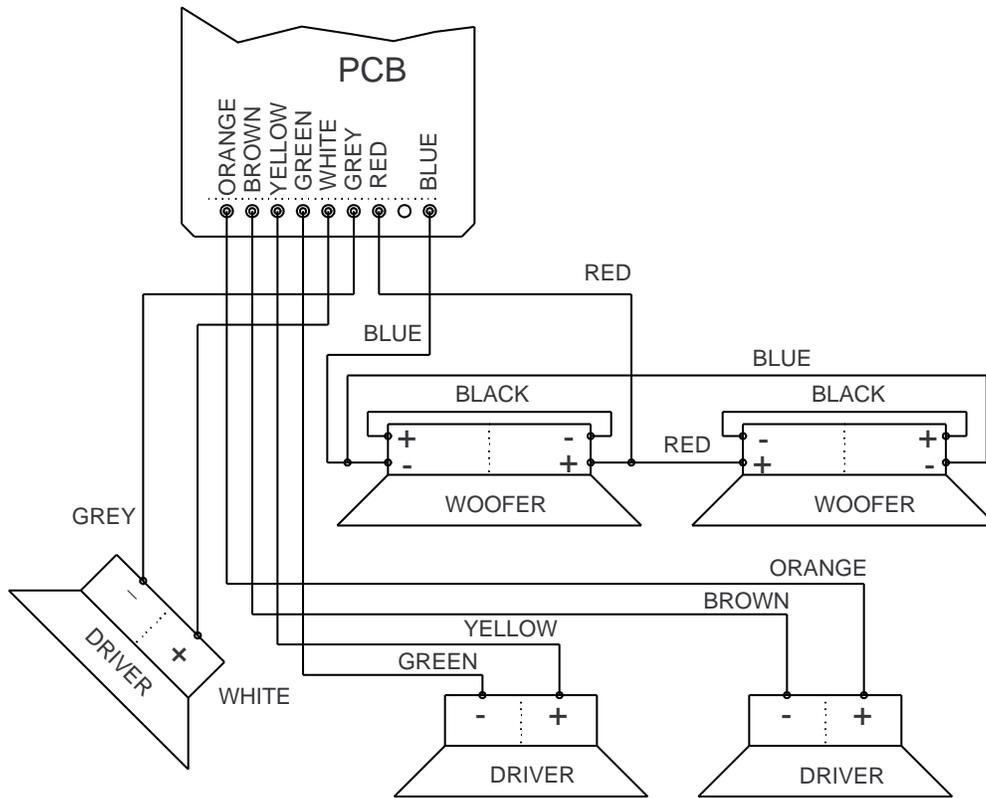


Figure 1. Model 500PM Loudspeaker Driver Wiring Diagram

Note: When removing the woofer assembly, it is not necessary to cut the black wire used to connect the dual voice coils in series. Refer to Figure 1.

5.5 Make a note of the wiring color code, and cut the blue and red wires of the harness assembly (3) as close to the terminals as possible.

5.6 Once you have the woofer assembly out of the loudspeaker cabinet, remove the black wire used to connect the dual voice coils in the woofer assembly in series. Retain it for use on the replacement woofer assembly.

6. Woofer Replacement

6.1 Using the wiring diagram, solder the blue and red wires to the correct terminals on the woofer assembly (11) to be replaced.

Note: Be sure to replace the black wire used to connect the dual voice coils on the woofer assembly in series.

6.2 Align the woofer assembly (11) into the speaker cabinet, making sure that the woofer gasket (10) is located properly behind the driver.

6.3 Secure the woofer assembly to the speaker cabinet using the four screws (2) removed in procedure 5.4.

6.4 Replace the batting material removed in procedure 5.3.

6.5 Align the array bezel (12) so that the tabs located on the sides of the array bezel are located toward the center of the speaker cabinet.

6.6 Secure the array bezel to the speaker using the twelve screws (2) removed in procedure 5.1.

DISASSEMBLY/ASSEMBLY PROCEDURES

6.7 Replace the grille (14) using procedure 2.

7. Crossover Assembly and Binding Post Connector Removal

7.1 On the rear of the speaker cabinet, use a phillips-head screwdriver to remove the four screws (2) that secure the binding post connector (7) to the cabinet.

7.2 Gently pull the binding post connector straight out of the speaker cabinet until you see the crossover assembly (8).

7.3 Angle the binding post connector so that the crossover assembly can be pulled out through the opening on the rear of the speaker cabinet. Gently pull the crossover assembly out of the speaker cabinet. Be careful not to damage any components on the crossover assembly.

Note: Be sure to retain the rubber bumper that is mounted in the center of the PCB. You will need to reinstall it with the crossover assembly. It is used to prevent vibration of the crossover assembly during loudspeaker operation.

7.4 Unplug the speaker harness (3) connector from the crossover assembly.

7.5 Use a phillips-head screwdriver to remove the four screws (9) that secure the binding post connector to the crossover assembly.

7.6 Slide the crossover assembly straight off of the tabs on the binding post connector.

8. Crossover Assembly and Binding Post Connector Replacement

8.1 Slide the crossover assembly (8) onto the tabs located on the binding post connector (7).

8.2 Using the four screws (9) removed in procedure 7.5, secure the crossover assembly to the binding post connector.

8.3 Plug the speaker harness (3) connector onto the crossover assembly.

8.4 Gently slide the crossover assembly into the the speaker cabinet, taking care not to damage any components. Be sure that the black rubber bumper is installed into the center of the crossover assembly, and that it remains in place during this procedure.

8.5 Secure the binding post connector to the speaker cabinet using the four screws (2) removed in procedure 7.1. Do not overtighten the screws.

TEST PROCEDURES

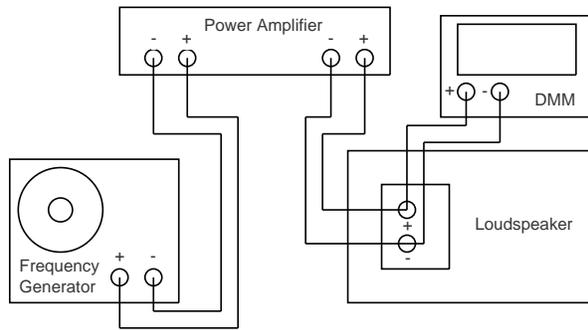


Figure 2. Model 500PM Loudspeaker Test Setup Diagram

Note: Refer to Figure 1. Model 500PM Driver Wiring Diagram, for the following procedure.

1. Phase Test

1.1 Remove the speaker grille using Disassembly/Assembly procedure 1.

1.2 Observing polarity, apply an +8Vdc level to the input terminals on the rear of the loudspeaker. The drivers should move outward.

1.3 Replace the grille using procedure 2.

Note: Refer to Figure 2. Model 500PM Loudspeaker Test Setup Diagram, for the following tests.

2. Rub and Tick Test

2.1 Remove the grille using procedure 1.

2.2 Apply a 6Vrms, 60Hz signal to the input terminals on the rear of the speaker cabinet.

2.3 Listen carefully for any buzzes, rattles, or other extraneous noises from the drivers or trim parts.

Note: There is a normal suspension noise. To distinguish between a rub or a tick and suspension noise, displace the driver cone slightly with a finger. If the noise stays the same, it is suspension noise.

2.4 Replace the grille using procedure 2.

3. Air Leak Test

3.1 Remove the grille using procedure 1.

3.2 Apply a 6Vrms, 60Hz signal to the input terminals on the rear of the speaker cabinet.

3.3 Test duration should be 15 seconds minimum.

3.4 Listen carefully for air leaks along all glue joints, at the binding post connector, and at transducer mounting locations. Air leaks will be heard as a hissing or sputtering sound. All repairs must be hidden.

3.5 Replace the grille using procedure 2.

4. Power Sweep Test

4.1 Apply a 6Vrms, 10Hz signal to the input terminals on the rear of the speaker cabinet. Leave the speaker port open.

4.2 Sweep the input frequency from 10Hz to 5kHz, and then back down to 10Hz.

Note: The whooshing noise from the port at approximately 60Hz is acceptable.

4.3 Replace any transducer that has a buzzing noise. There shall not be any buzzes or rattles from the internal connecting wires or components. Redress any buzzing wires.

MAIN PART LIST

Model 500PM Loudspeaker (see Figure 3)

Item Number	Description	Part Number	Qty.	Note
1	INSERT, THREADED, M8	189769	2	
2	SCREW, TAPP, 8-11x.75, PAN, XRC/SQ	172672-12	27	
3	HARNESS, 500PM	189772	1	
4	ROD, .375-16UNCx8.5"	189768	1	
5	GROMMET, GRILLE SOCKET	176068	6	
6	DRIVER ASSY, 4.5"	187233-001	3	
7	CONN, BINDING POST, GREY	187232-003	1	
8	CROSSOVER ASSY, 500PM	189781	1	
9	SCREW, HILO, #6 X .375, PAN, XREC	175972-06	4	
10	GASKET, WOOFER, 6.5"	104794-08	2	
11	WOOFER ASSY, 5.25", DUAL	189824-001	2	
12	BEZEL, ARRAY	189766	1	
13	NUT, HEX, .437-14	103236-4414	2	
14	GRILLE, 500PM	189778	1	
15	TAPE, FOAM	103068	4	
16	SPACER, ROUND, .561DX.44LG	189525-001	2	
17	WASHER, LOCK, .456, .437, EXT T	108261-43	2	
18	SCREW, HILO, 8-18, HEXW, HEX, BLK	185207-12	6	
19	NAMEPLATE	122812-0	1	
20	BOLT, MOUNTING, FLAT, HEX	143580	2	

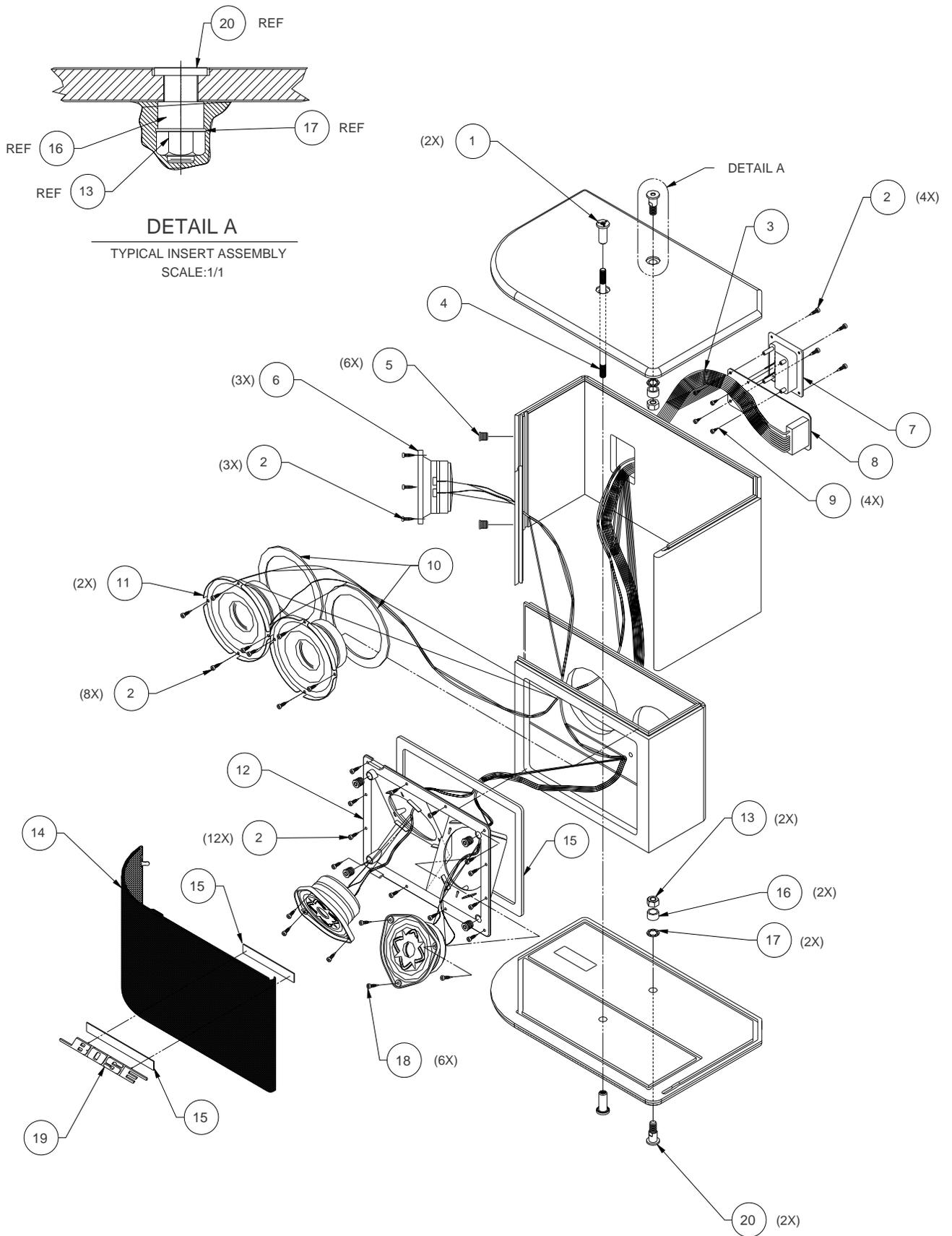


Figure 3. Model 500PM Loudspeaker Exploded View

ELECTRICAL PART LIST

Resistors

Reference Designator	Description	Part Number	Note
R1	2K Ω , MET OX, 2W, 5%	177962-2025	
R2	100 Ω , CF, 1/4W, 5%	120968-1015	
R3	1MEG Ω , CF, 1/4W, 5%	120968-1055	
R4, 5	20K Ω , CF, 1/4W, 5%	120968-2035	
R6, 8, 11, 12	51K Ω , CF, 1/4W, 5%	120968-5135	
R7, 19	3.3K Ω , CF, 1/4W, 5%	120968-3325	
R9, 10	270K Ω , CF, 1/4W, 5%	120968-2745	
R13	1.5K Ω , CF, 1/4W, 5%	120968-1525	
R14	2.7K Ω , CF, 1/4W, 5%	120968-2725	
R15, 20	1.2K Ω , CF, 1/4W, 5%	120968-1225	
R16, 17	0.20 Ω , MET OX, 3W, 5%	183483-R205	
R18	2K Ω , MET OX, 1W, 5%	171259-2025	
R21	3.9 Ω , WW, 15W, 5%	138372-3R9	

Capacitors

Reference Designator	Description	Part Number	Note
C1	.33 μ F, FILM, 85, 100V, 5%	120388-334	
C2	.47 μ F, BOX, 85, 50V, 5%	137127-474	
C3, 5, 8	100 μ F, EL, 85, 25V, 20%	119941-101E	
C4	.27 μ F, BOX, 85, 50V, 5%	137127-274	
C6	300 μ F, EL, 85, 16V, 20%	149948-331C	
C7	0.047 μ F, BOX, 85, 63V, 5%	137127-473	
C10	5.6 μ F, EL, BP, 50V, 20%	189786	
C11, 12	33 μ F, EL, 85, 50V, 20%	131974	

Diodes

Reference Designator	Description	Part Number	Note
D1, 2, 3, 4, 5, 7, 8, 9, 10, 11	SWITCHING, 75V, 300mA, 1N4148	121501	
D6	ZENER, 1W, 10V, 5%, 1N4740	116995-4740A	

Transistors

Reference Designator	Description	Part Number	Note
Q1, 2	BPLR, P, 60V, 200mA, TO92, 2SA608	119168	
Q3, 4, 5, 6, 7	BPLR, N, 60V, 200mA, TO92, 2SC536	117921	
Q8, 9	HEXFET, N-CHANNEL, IRL540N or IRL1540N	190347	

ELECTRICAL PART LIST

Miscellaneous

Reference Designator	Description	Part Number	Qty.	Note
J1	CONN, HEADER, 9 POS, MALE	137489-09	1	
L1	130uH, .17Ω, FERRITE	189787	1	
L2	0.8mH	189783	1	
L3	500uH	173008	1	
PTC1	POLYSWITCH, 60V, 4MM	190348-1	1	
PTC2, 3	POLYSWITCH, 60V, 4MM	191995-1	2	
W1, 2	CONN, TERMINAL, 1 POS, FEMALE	147946	2	
-	CLIP, HEATSINK	188599	2	
-	BUMPER, BUTTON	189520	1	
-	SCREW, MACH, 4-40x1, PAN, XREC	103146-16	3	
-	WASHER, FLAT, .141", #5	108258-05	3	
-	NUT, HEX, 4-40	103234-440	3	

PACKING LIST

Model 500PM Loudspeaker (see Figure 4)

Item Number	Description	Part Number	Qty.	Note
1	PACKING, END CAP, 500PM	189770	2	
2	BAG, POLY, 13.5x33.5x9.13.3mil	106595	2	
3	CARTON, RSC, 500PM	189771-001	1	

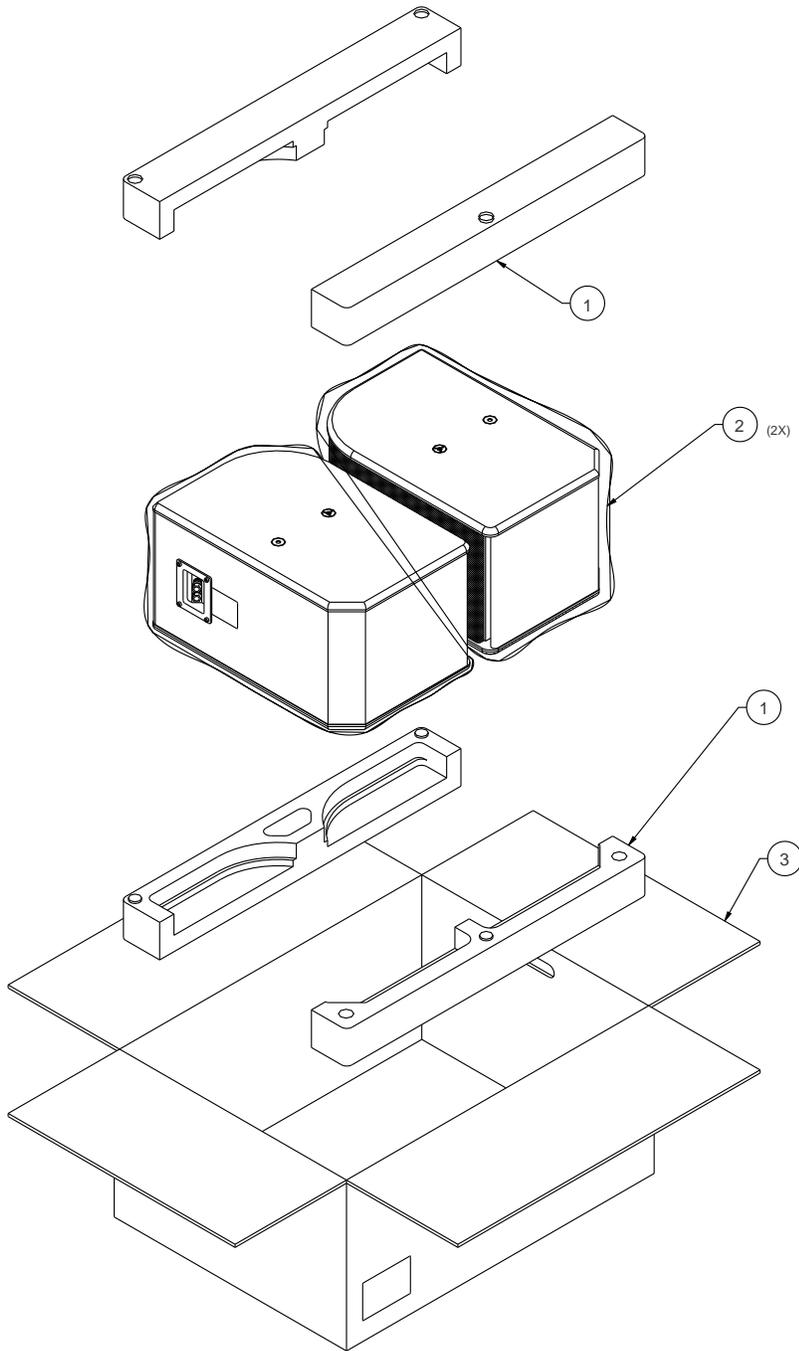


Figure 4. Model 500PM Loudspeaker Packing View

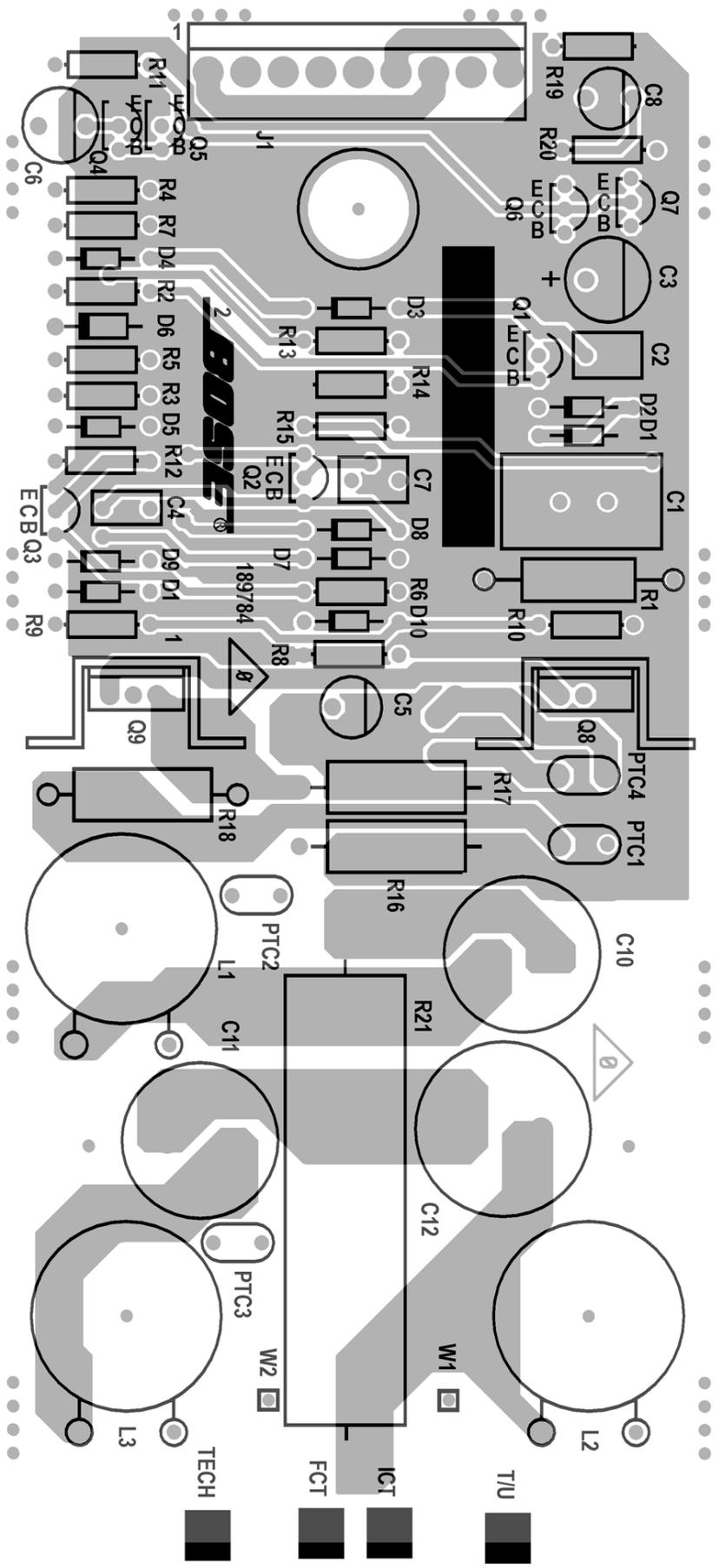


Figure 5. Model 500PM Loudspeaker Crossover PCB Topside Component and Etch Layout Diagram

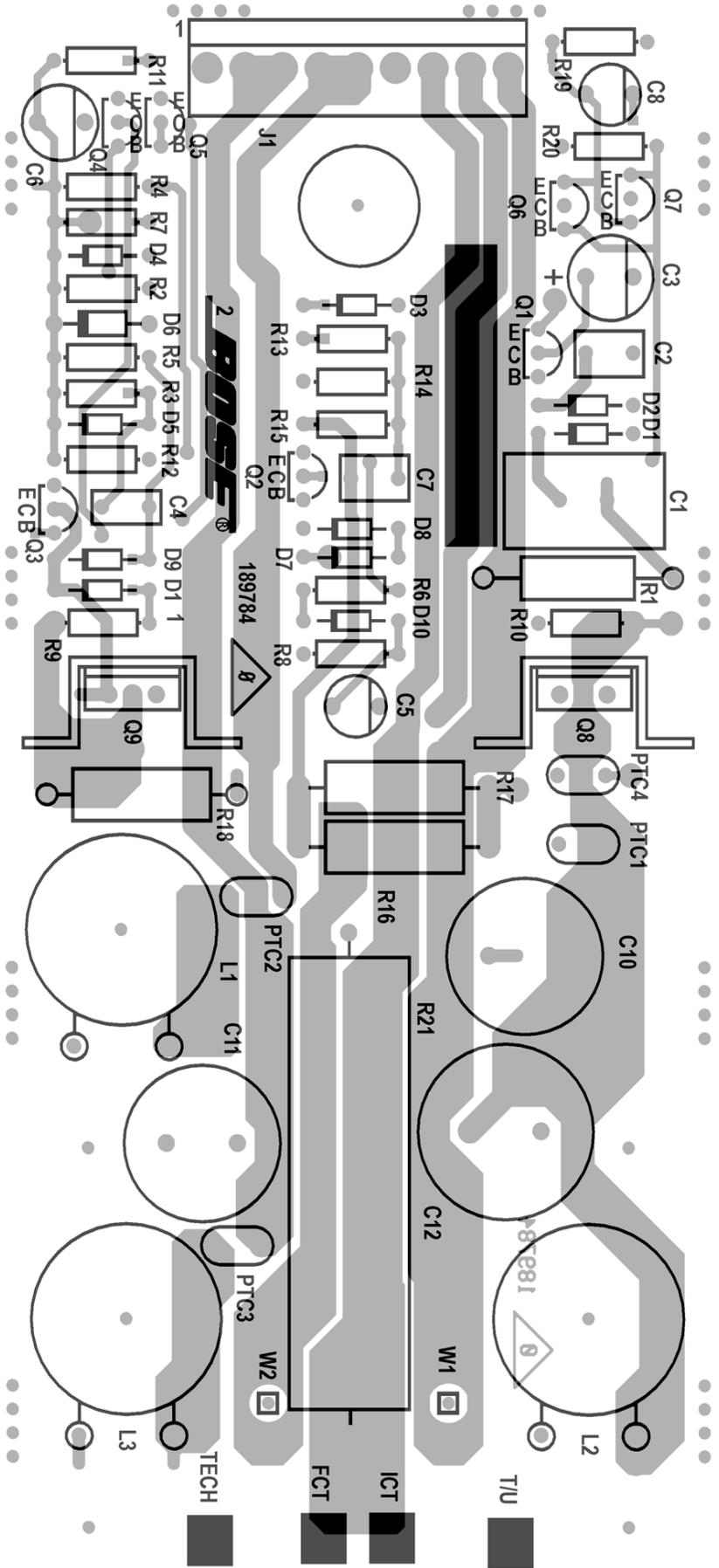


Figure 6. Model 500PM Loudspeaker Crossover PCB Bottom Side Etch Layout Diagram

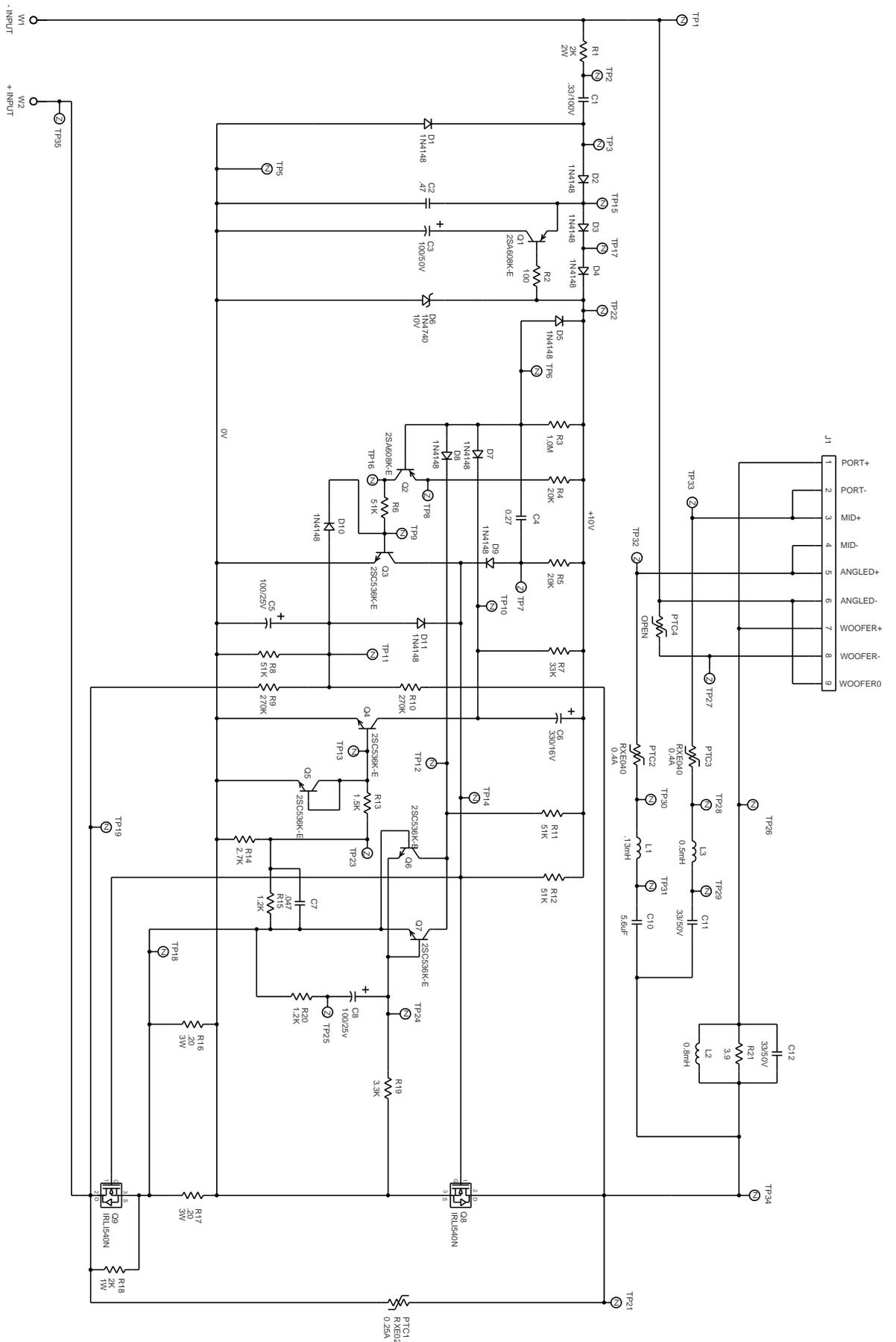


Figure 7. Model 500PM Loudspeaker SmartProtect Crossover Assembly Schematic Diagram

SPECIFICATIONS AND FEATURES SUBJECT TO CHANGE WITHOUT NOTICE

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