Owner's Manual

PW-200

RADIO SYSTEMS
RESEARCH
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INTRODUCTION

In recent years, a great deal of study and effort has been directed towards understanding and overcoming the obstacles limiting accurate sound reproduction. Power amplifiers, in particular, have undergone intense scrutiny because standard test procedures had failed to detect subtle types of distortions. Now that the more elusive distortion mechanisms are understood, they shed new light on design criteria.

The situation has been further confused by many manufacturers who insist on playing a game of "specmanship", forever heralding lower THD figures. Ironically, some highly acclaimed tube amps spec THD at 1% and, most loud speakers exhibit distortion orders of magnitude higher than any high quality, contemporary amplifier. Obviously, steady state distortion figures alone do not tell the whole story. In fact, the large amounts of negative feedback utilized to achieve these figures can actually be counterproductive. The nature of music and loudspeakers demands a no compromise amplifier design.

We believe that, bounded only by the limits of voltage clipping, an amplifier should drive any loudspeaker during a high speed asymetrical transient without audible degradation, while the loudspeaker presents a low impedance reactive load to the amplifier. The amp should recover from clipping without generating spurious waveforms, and should be symmetrical in all respects, especially slewing rates. Finally, it should be highly linear and exhibit no baseline shift during large low frequency signal excursions.

The Radio Systems' PW200 meets all of these criteria and may be one of the finest amplifiers available, at any price. It is offered as a partial kit or completely wired and tested. The PW200 may be considered a transparent power standard and, the tool you'll need to put the rest of your system to the test.

The following are some of the ways that the PW200 meets these high specification and performance standards:

1) 8 output transistors per channel - 25 amp peak output capability.
2) A 90 joule power supply with 50,000 mfds. of filter capacitance- about 2 1/2 times normal for an amp of this power rating.
3) Three voltage gain stages, each using degeneration for wide bandwidth and high linearity. (Open loop distortion less than 1%; open loop bandwidth flat beyond 20 kHz.)
4) A dual low noise FET input stage for high linearity and high slew rate.
5) No feedback loop blocking capacitors or servo loops.
6) Ring emitter output and driver transistors for high speed and high gain without the heat of heavily forward biased MOSFETS.
7) Film capacitors and precision metal film resistors used exclusively. No electrolytics in the signal path.
8) Double differential DC topology with overshoot control.

INSTALLATION INSTRUCTIONS

CAUTION:
The right channel (-) output jack (black) is the actual amplifier output and not ground. Allowing this lead to contact chassis or the left channel (-) output jack (black) will cause the right channel speaker fuse to blow.

Connecting a common ground load such as headphones, 3 conductor speaker wiring harness or certain types of stereo attenuators and matrixing systems will cause either short circuits or phasing problems.

The PW200 can be easily modified to alleviate this problem at the cost of losing mono capability. Contact the factory for instructions.

A. Two Channel (stereophonic) Use

The hookup for stereo use is straightforward. The input jacks accept standard phono plugs. The output binding posts accomodate a variety of terminations. It is important to note the phase (polarity) of the output. For proper speaker phasing, be sure to take note of the markings and colors and connect speaker (+) to amplifier (+).

B. Single Channel(mono) Use

Because the right channel inverts, it is possible to bridge the amp for single channel high power use.

Connect the inputs in parallel using a Y connector or similiar device. The speaker connects to the lower binding posts. Note the polarity for mono.

C. Speaker Wire

To maintain damping factor, heavy gauge speaker wire should be used. Significant peak voltages are present and appropriate precautions should be followed. It is adviseable to tin wire ends for speaker connections. If this is not possible, twist ends tightly.

The following table is a guide to speaker wire sizes. Smaller AWG number means larger wire size.

Speaker ohms	length 10'	length 20'
2	12	8
4	16	12
8	18	16
	wire AWG	wire AWG

D. Input Connections

Only shielded wire with quality phono plugs should be used. Lengths are not critical unless preamp output impedance is high. Run input cables directly and never dress them along side of AC or speaker wires.

E. Power Switching

The PW200 can be plugged into a switched preamp outlet capable of at least 500 watts. If this can not be done, use the PW200 front panel switch. To avoid thumps, turn the preamp on first and off last.

F. Speaker Fusing

For output short circuit protection and speaker overdrive protection, speaker fuses are integral to the PW200. For normal operation, use fuse values recommended by speaker manufacturer. If none are given, 3 amp, fast blo will usually suffice.

Fast blo fuses as large as 6 amps may be used during amplifier performance testing or when driving loudspeakers of very large power capability.

NOTE: Use of fuses larger than 6 amps voids the warranty.

G. Ventilation

The PW200 relies on free air flow for cooling. Under normal use, the PW200 stays relatively cool. Driving low impedance speakers at high levels, can warm the unit appreciably. Keep heat sink fins unobstructed. In the event the unit overheats, thermal cutouts will turn it off. When a safe temperature is reached, it will automatically reset.

H. Hum and RFI

The use of shielded cables usually keeps interference from radio frequency sources to a minimum. Radio station, TV, CB and similiar interference problems usually are associated with preamps. Good earth grounding and wire re-routing may help reduce the effects.

Hum pickup usually results either from bad ground connections or from pickup of AC magnetic fields. Phonograph cartridges and tape deck heads are sensitive to magnetic fields produced by power transformers. Maintain at least two feet between the PW200 and those types of equipment to minimize the problems. Dress input cables away from line cords where possible.

AMPLIFIER PERFORMANCE TESTING

For those who desire to put the PW200 through its paces on the test bench, some words of advice.

1) Use 6 amp speaker fuses if you intend to work at maximum power.
2) Keep unit well ventilated. Under full power RMS conditions the PW200 heat sinks get quite warm.
3) At high power and high frequencies, above 50 kHz, load resistors R50 and R51 will get very hot. Limit these types of tests to short periods. The output transistors are capable of sustained high frequency output at high levels, the resistors are not, and will begin to smoke if overstressed.
4) Most of the specifications for the PW200 were done in accordance with IHF-202A. To verify performance, test procedures must be duplicated.

NOTE: When connecting test equipment to the PW200, care must be taken so as not to inadvertently ground the right channel output. Connect scope or other equipment grounds only to the top two binding posts.

In Case of Difficulty

The PW200 is protected by fuses and thermal cutouts. It is possible that due to component malfunction or external complications, a fuse will blow.

If the line fuse blows, replace with identical type and value. Failure of the replacement indicates internal failure and service is required.

Speaker fuses may fail for one of three reasons; amplifier malfunction, speaker or speaker wire short circuit or overdriving the speaker. Replace speaker fuse with identical type and value. Turn on the amp with low volume setting and increase volume slowly. If no problem occurs until high levels are reached then the most likely cause is undersized fusing. If fuse blows immediately, check speaker and wiring for malfunction. If speaker and wire are OK, consult factory for amplifier servicing.

A lit pilot lamp indicates the power line fuse is intact and both thermal cutouts are in their normal condition. Loss of either or both channels will usually be a result of blown speaker fuses. If speaker fuses are OK and the lamp is lit, then the internal DC supply fuses may have blown. Disconnect the speakers and AC line cord. Remove lid. Visually examine the DC fuses that are on each amplifier module. If any are blown, replace with identical type and value. Leave speakers disconnected, replace AC line and turn unit on. If fuses remain intact procede normally. If fuse blows again, service is required, consult factory.

Circuit Description

Input Stage

Dual FET, Q1, is biased by a constant current source, Q2. Potentiometer R6 provides offset adjustment to maintain DC output at 0V±10 mv. C2 provides DC blocking to eliminate output offset due to any DC level present on the input signal. R2 and C1 filter out RF and supersonic signals. For operating point stability, D5 and D4 regulate the input stage power supply to ±18V. D6 and D7 limit differential excursions during overdrive conditions.

Stage II

Q3, one half of which is loaded by current mirror Q4, provides additional voltage gain. Pre-drivers Q5, Q6 and Q7, Q8 provide the remaining voltage gain and symmetrical drive to Q10 and Q15. R25 and R31 provide loading for this stage. R26 sets the quiescent current on the driver and output stages by adjusting the Vce of Q9. Q9, mounted on the main heatsink, thermally tracks the output transistors for bias stability.

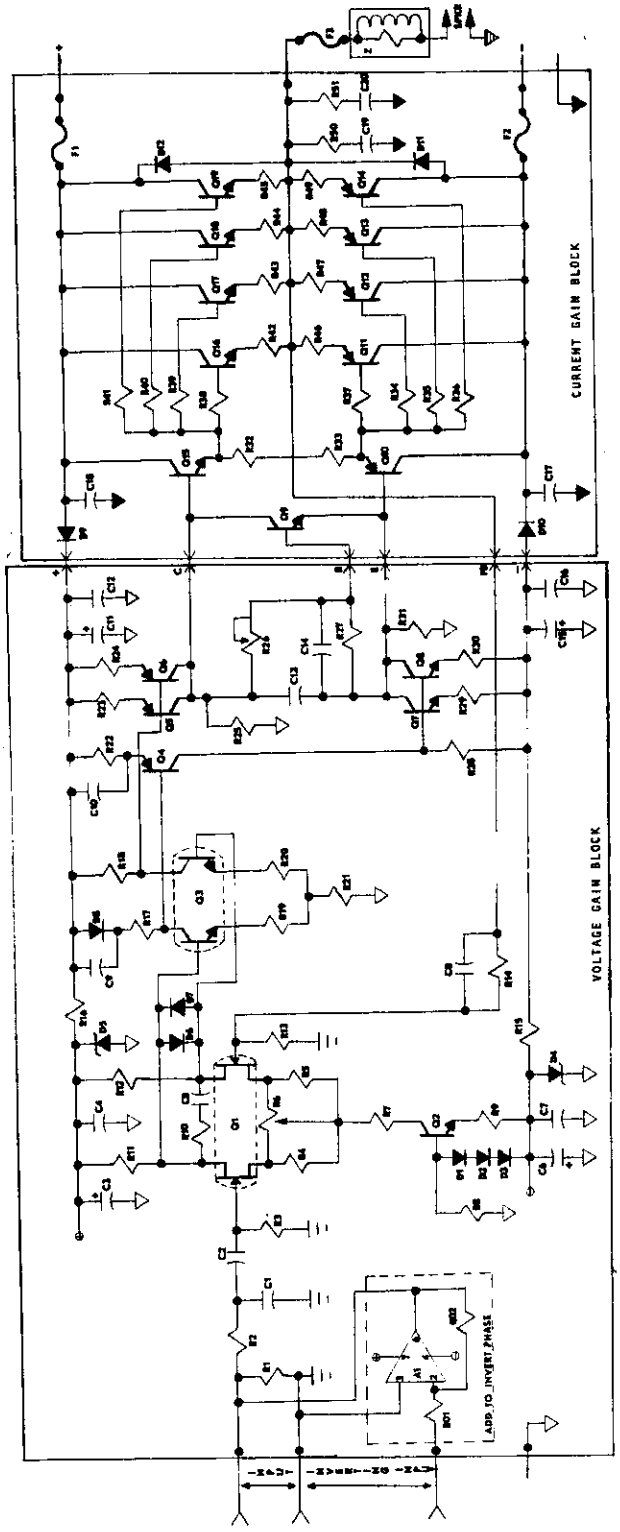
Output Stage

Q10 and Q15 are the drive transistors. To assure equal drive, base resistors are used on each output transistor. Since the output and drive transistors are high gain, ring emitter types, the loading of the pre-drivers by Q15 and Q10 is small, eliminating the need for triple darlington outputs. R50, C19 and R51, C20 provide a high frequency load. Z isolates capacitive loads that might cause stability problems.

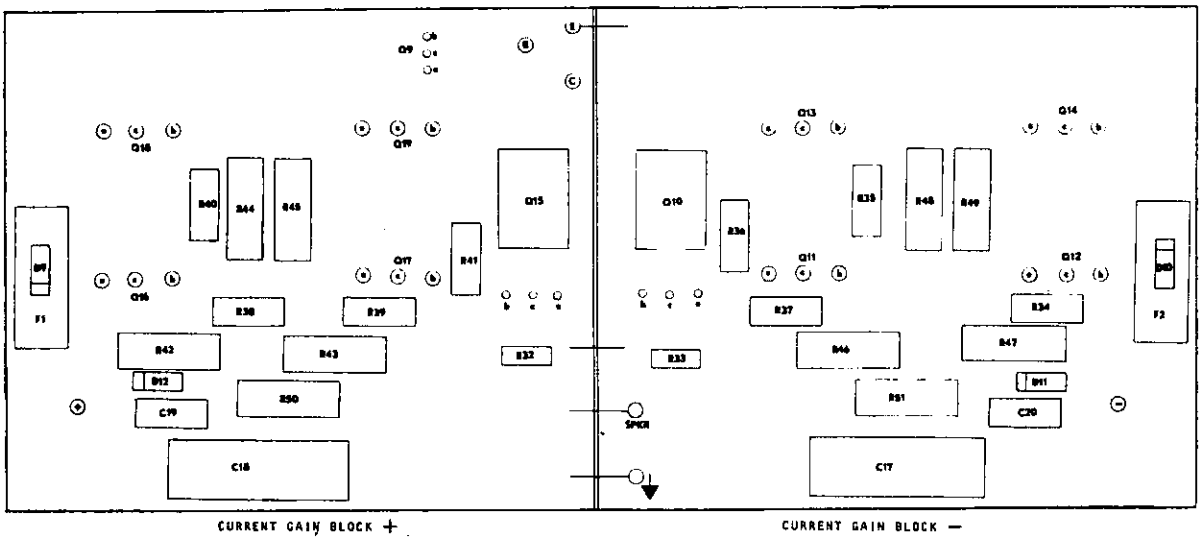
General

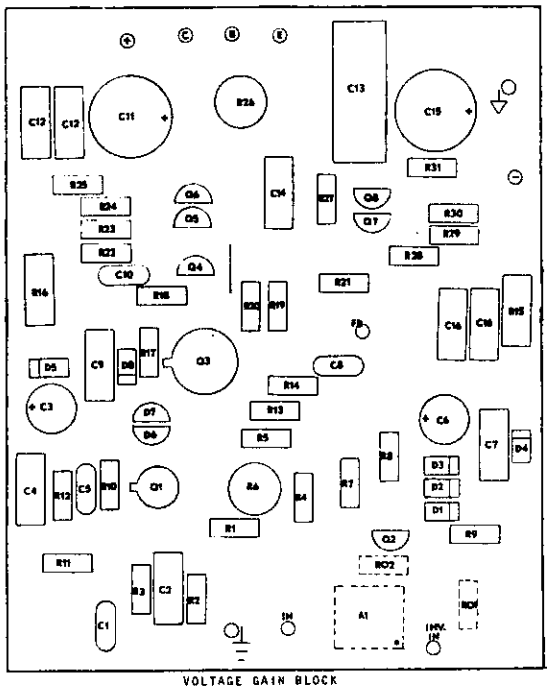
The PW200 is stable under all load conditions. It incorporates DC protection F1 and F2, short circuit protection F3, thermal protection Q9, and thermal cutouts.

To provide phase inversion for bridging use, A1 is added. A1 has no effect on amplifier performance.



AMPLIFIER MODULE SCHEMATIC DIAGRAM





MODULE CIRCUIT BOARD PARTS LAYOUT

MODULE PARTS LIST

All Resistors in ohms ¼W 1% film unless noted

R1	20K
R2	2K
R3	1 meg.
R4	100
R5	100
R6	100 Pot (offset)
R7	1.5K
R8	10K
R9	2K
R10	1.5K
R11	10K
R12	10K
R13	200
R14	5.62K
R15	3.9K ½W 5%
R16	3.9K ½W 5%
R17	1.5K
R18	1.5K
R19	47.5
R20	47.5
R21	3.32K
R22	1.5K
R23	402
R24	402
R25	10K
R26	1K Pot (bias)
R27	1K
R28	1.5K
R29	402
R30	402
R31	10K
R32	100
R33	100
R34	10 ½W 2%
R35	10 ½W 2%
R36	10 ½W 2%
R37	10 ½W 2%
R38	10 ½W 2%
R39	10 ½W 2%
R40	10 ½W 2%
R41	10 ½W 2%
R42	1 2W 5%
R43	1 2W 5%
R44	1 2W 5%
R45	1 2W 5%
R46	1 2W 5%
R47	1 2W 5%
R48	1 2W 5%
R49	1 2W 5%
R50	2x10 2W 5%
R51	2x10 2W 5%

C1	330 Pf polystyrene
C2	.1 mfd mylar
C3	15 mfd Al.
C4	.1 mfd mylar
C5	330 pf polystyrene
C6	15 mfd Al. elec.
C7	.1 mfd mylar
C8	56 pf polystyrene
C9	.1 mfd mylar
C10	24 pf polystyrene
C11	330 mfd 63V Al.
C12	.1+ .1 mfd mylar
C13	1.0 mfd mylar
C14	.1 mfd mylar
C15	330 mfd 63V Al.
C16	.1+.1 mfd mylar
C17	3.3 mfd mylar
C18	3.3 mfd mylar
C19	.1 mfd mylar
C20	.1 mfd mylar

D1	IN4148
D2	IN4148
D3	IN4148
D4	IN4746
D5	IN4746
D6	MBD101
D7	MBD101
D8	IN4148
D9	IN4004
D10	IN4004
D11	IN4004
D12	IN4004

Q1	2N3955A
Q2	2N3904
Q3	2N2914
Q4	2N5401
Q5	2N5401*
Q6	2N5401*
Q7	2N5551*
Q8	2N5551*
Q9	2N6037°
Q10	2SA1078°°
Q11	2SA1076°
Q12	2SA1076°
Q13	2SA1076°
Q14	2SA1076°
Q15	2SC2528°°
Q16	2SC2526°
Q17	2SC2526°
Q18	2SC2526°
Q19	2SC2526°

F1	6 amp AGC
F2	6 amp AGC
F3	6 amp ACC(max)
Ƶ	10T #20 on 1 ohm 2W res.

NOTE: F3 and Ƶ are not on module but must be used.

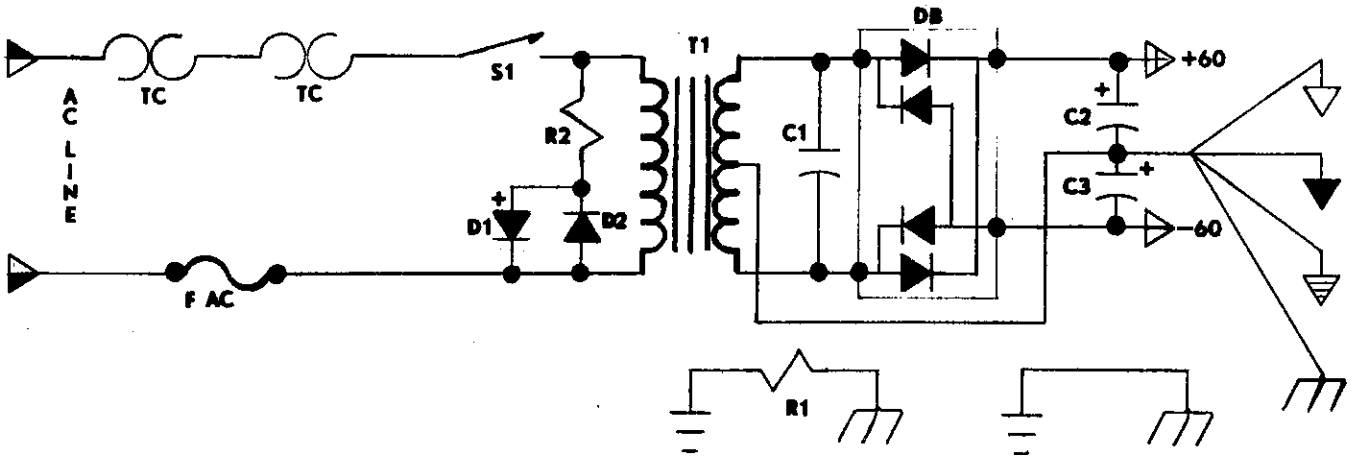
R01	20K **
R02	20K **
A1	LF351 **

°° on Aavid 5771B heat sink
* with Staver F2-7 heat sink
° on main heat sink
** parts used for inverting module only

AMPLIFIER POWER SUPPLY SECTION PARTS LIST

TC	Thermal cutout
TC	Thermal cutout
R1	2.2 ¼W rt. ch. only
R2	10K 2W
C1	.1 mfd mylar 200V
C2	25,000 mfd 75V
C3	25,000 mfd 75V
D1	panel mount LED
D2	IN4148
T1	9136A
DB	Bridge PK20F
FAC	4 amp slo-blo
S1	SPDT

AMPLIFIER POWER SUPPLY SECTION SCHEMATIC



PW 200 SPECIFICATIONS *

Continuous average power output per channel with no more than .03% THD, 20-20 kHz.

100 watts 8 ohms
150 watts 4 ohms
175 watts 2 ohms

Mono 300 watts 8 ohms
300 watts 4 ohms

Dynamic headroom - 2 db min. for all loads
Frequency response - (2 Hz - 170 kHz) - 3 db, (20-20 kHz) ± .1 db
Sensitivity - .1 volt RMS
Signal to noise - 85 db min.
Gain - 29 db
Input impedance - 20K ohms, 10K ohms mono
Clipping headroom - 1 db min. all loads
Wideband damping - 125 (20-20 kHz) (8 ohms)
Crosstalk - 65 db min.
SMPTE IM. - .02% max all power ratings
IHF IM. - .01% max all power ratings
Transient recovery time - unmeasurable
Slew rate - 100v/microsec.
Reactive load - 1 db
Capacitive load - 0-2 mf.
Channel gain difference - .2 db max
Rise time - 1.5 microsec.
T.I.M. 100 - .005% max
Peak output current capability - 25 amps
Phase response - within 10° (20-20 kHz)

*Where applicable per IHF-A-202