Scaleable Power Amplifier Module

Powering the Module

The scaleable amplifier module is just that, an amplifier which can be powered from a variety of power sources, without any modification other than bias adjustment.
Shown below are the suggested power supply components for each power level.
See also the schematic diagram for more detail...

50 Watts into 8 Ohms Mono

1 x Torodial Transformer 100VA, secondary windings 2 x 20 VAC
2 x 4700uf 50 volt electrolytic capacitors
2 x 2200 Ohms 1 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 10 amp bridge rectifier

50 Watts into 8 Ohms Stereo

1 x Torodial Transformer 160VA, secondary windings 2 x 20 VAC
4 x 4700uf 50 volt electrolytic capacitors
2 x 2200 Ohms 1 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 10 amp bridge rectifier

100 Watts into 8 Ohms Mono

1 x Torodial Transformer 200VA, secondary windings 2 x 35 VAC
2 x 10,000uf 63 volt electrolytic capacitors
2 x 4700 Ohms 5 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 35 amp bridge rectifier

100 Watts into 8 Ohms Stereo

1 x Torodial Transformer 200VA, secondary windings 2 x 35 VAC
4 x 10,000uf 63 volt electrolytic capacitors
2 x 4700 Ohms 5 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 35 amp bridge rectifier

200 Watts into 8 Ohms Mono

1 x Torodial Transformer 300VA, secondary windings 2 x 50 VAC
4 x 10,000uf 75 or greater volt electrolytic capacitors
2 x 4700 Ohms 5 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 35 amp bridge rectifier

200 Watts into 8 Ohms stereo

1 x Torodial Transformer 500VA, secondary windings 2 x 50 VAC
4 x 10,000uf 75 or greater volt electrolytic capacitors
2 x 4700 Ohms 5 watts 5% resistors
1 x 100nf MKP mains rated capacitor
1 x 400 volt 35 amp bridge rectifier

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Circuit Description

The amplifier consists of three main sections plus current sources and input filter.

1. The Input Stage or Differential Error Amplifier
2. The Voltage Amplification Stage
3. Current Amplification Output stage

The Input Stage.

The input stage is made up from Q1, Q2, Q4, Q9, R1, R2, R3, R4, R13, and R17. The main error amplifier is formed by Q1 and Q2 and it's function is to compare the input signal with the output signal via the feedback resistors R6, R7, and coupling cap E3 and amplify only the difference via the collector of Q1.
Q4, Q9, R3, R8 form a Current Mirror Load for the differential input stage. It doubles the available slew rate, forces equal current sharing in Q1 and Q2 and increases bandwidth. R1 is the main bias resistor for the input stage and sets the input impedance. R2, C1 forms a low pass filter, which limits the maximum rate of change that is allowed into the amplifier, therefore reducing TIM distortion.
C4 is just the input coupling cap.
R3, R8, R13, R17, are gain degeneration resistors for the stage.
Q11, R4, D1, D2, R5, R15, Q10 form a dual current source for the error amp and the voltage amp stages.

The Voltage Amplification stage.

Q3 produces most of the voltage gain for the whole amplifier and operates in Single Ended Class A mode, the same as the first stage. C2 provides frequency compensation, R16 sets local feedback for Q3. The current sources are set to 6.8 milliamps for the first stage and about 9 milliamps for the second stage. This current setting provides more than enough to drive the gate capacitance of the power MOSFET's.
P1 provides a neat way of setting the bias for the O/P stage.

The Current Amplifier Stage.

The current amplifier takes all that volt gain and converts it into useable power to drive the loudspeaker. Q6, Q8, Q5, Q7, R9, R12, R10, R11, C3, C6 form the current amplifier the gate resistors stop parasitic oscillation form happening by isolating the low O/P impedance of Q3 from the high I/P impedance of the MOSFET Gates.
C3, C6 add total stability by balancing the Output capacitance of the complementary pairs. R14, C5 form a High frequency load for the amplifiers O/P stage.
E1, E2 provide supply rail decoupling.

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The construction Notes

Construction of the power module is very straightforward. Simply follow the component overlay, which shows what component values are required for that position.
It is usually best to load the components in-groups. Resistors, capacitors then semiconductors. Solder and trim the leads of each component group as you go.
For the links in the output stage area, some heavy-duty solid copper wire is the best.
The overlay shows also the Base, Emitter, Collector pinouts for the MJE340, MJE350 devices. The pinouts for these devices is as follows. With the metal tab face down the Base Pin is on the Left. Followed by Collector and then Emitter on the Right.
The Output devices are the last component's you should load onto the PCB. Allow only about 5 millimeter's of each pin to protrude passed the bottom of copper side of the PCB, before soldering.

Once the components are all loaded and soldered onto the PCB; accept C3 and C6 which are the ceramic 68pf caps. These are mounted on the copper side of the PCB across the Gate and Drain pins of the 2SK2221 or 2SK1058. Turn P1 Trim pot anti-clockwise in order to set for minimum resistance. Check with an Ohmmeter on low Ohms range for zero resistance. This is very important!

To Mount the MOSFET's on a suitable heat sink (0.5 degree's/Watt rating or less for power levels at or greater than 100 Watts into 8 Ohms) M3 nuts and bolts and Mica Washers and heat sink compound. Apply heat sink compound to both sides of the Mica washers, which must go in between each Output device metal tab an the heat sink.
Once the O/P devices are bolted down check for any shorts circuits between the drain pin and the heat sink on each device.

Now the module is finished and ready for testing.

Connect the desired supply voltages and ground connection as per the tables shown on the previous page, and connect in series with the positive supply rail an ampere meter with a full scale deflection of 300 milliamps or greater if necessary.
Also insert some 100 Ohm 5 Watt resistors in each supply rail. Across the fuse clips with the fuses removed is a good idea at this stage. It will prevent any damage to the module if you have made a mistake with the supply rails, incorrect component placement or setting.

Now hold your breath and apply power. I am hoping now that you haven't seen all your hard work go up in smoke. If you have a VARIAC or have access to one then use it.

Assuming all is well, get a voltmeter and set the range to 100 volts and measure the offset voltage between speaker O/P and supply ground. If it reads near zero then switch to 300mv range and you should measure below 100mv offset. If this is so then all seems OK. If it doesn't, then switch off the power and check for any mistakes and or any solder shorts on the PCB.

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Check also the voltage drop across R3 and R8 it should be close to equal. If its OK then it would seem that the amplifier is functioning.

Construction Notes continued....

Now, turn off the power and remove the 100 Ohm 5 Watt resistors across the fuse clips and reinsert the fuses. Now reapply power and check for correct operation as before.
Once correct operation is established adjust P1 for a 200 milliamp reading on the ampere meter.
Leave the module running for about half an hour and check for correct operation. If all is well then remove power and connect supply cables for permanent operation.

You are now ready to listen to the Amplifier. Connect the Loudspeaker between the O/P and Supply central grounding point and apply power with no signal connected you should hear nothing but silence's from the loudspeaker.

Now turn off power and connect a pre-amp and a favorite CD or Record, Happy listening....

Postscript Notes....

You would have noticed the extra schematic showing the MOSFET voltage amp transistor as an option. You might want to give it a try. It provides a high impedance load for the first stage and it matches well with driving the gate capacitance of the Output stage devices. I believe it actually sounds much better also. The IRF610 is a very good choice for this stage. It just drops straight in. Gate = Base, Drain = Collector, Source = Emitter.
Also at supply levels of 50 volts and more you might wish to heat sink the Q3 and Q10 with small heat sinks.
Also Other Hitachi Power MOSFET's can be used in the Output stage this design, such as 2SK1058 and 2SJ162.
Please don't attempt to use any IRFP240 or IRFP9240 devices in this design, It simply won't work and you will blow up the output stage in seconds after turn on. This design is only suitable for Lateral type Power MOSFET's

All the Best...

Anthony Holton

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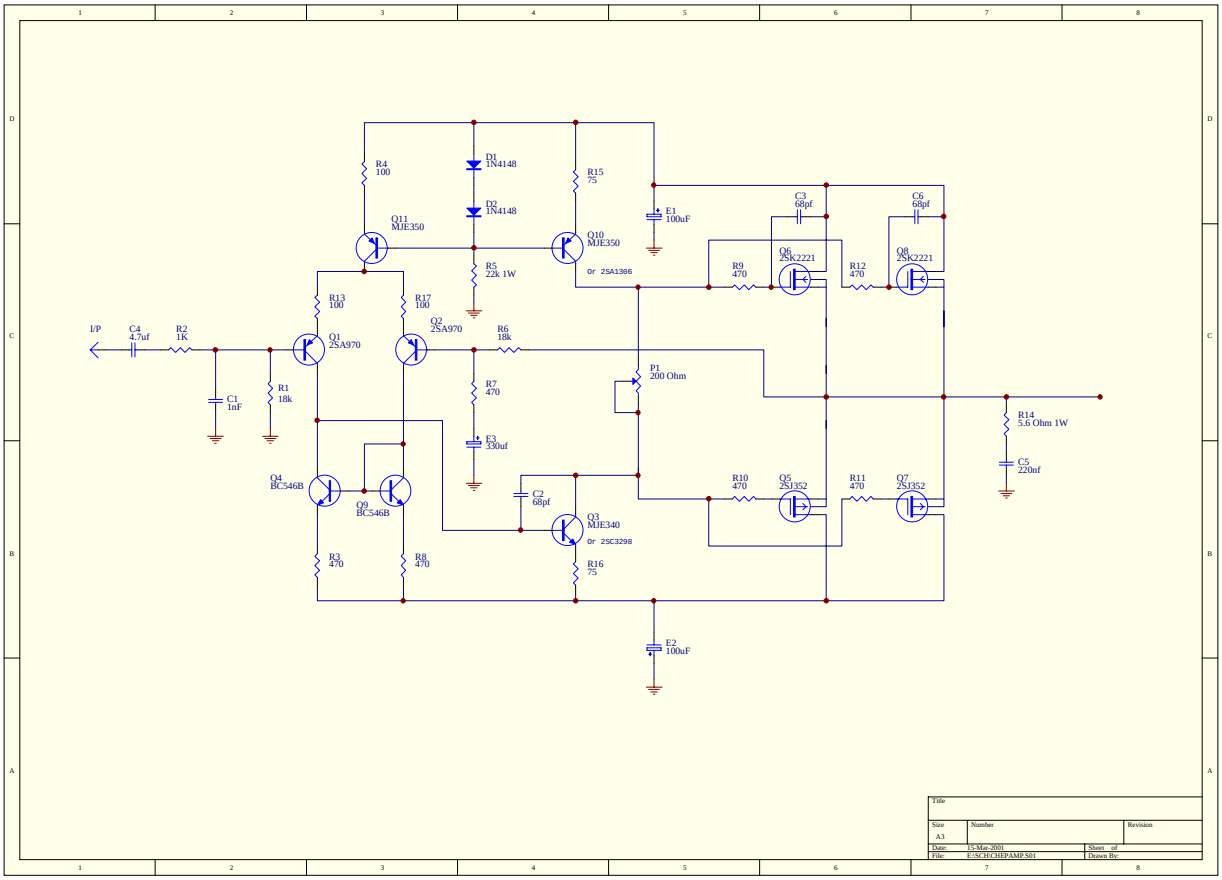
To get a better view use the Zoom function in Acrobat 4.0



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Bill of Material for E:\SCH\CHEPAMP.Sch

Used	Part Type	Designator	Footprint	Description
1		I/P		
3	100	R13 R17 R4		
2	100uF	E1 E2	CAPV.3	
2	18k	R1 R6		
1	1K	R2		
2	1N4148	D1 D2		
1	1nF	C1	CAPR.2	
1	200 Ohm	P1	CERMET	
1	220nf	C5	CAPR.2	
1	22k 1W	R5		
2	2SA970	Q1 Q2	TRANS	
2	2SJ352	Q5 Q7		
2	2SK2221	Q6 Q8	FET-T03P	
1	330uf	E3	CAPV.2B	
1	4.7uf	C4	CAPR.2	
7	470	R10 R11 R12 R3 R7 R8 R9		
1	5.6 Ohm 1W	R14		
3	68pf	C2 C3 C6		
2	75	R15 R16		
2	BC546B	Q4 Q9		
1	MJE340	Q3	TRANS	
2	MJE350	Q10 Q11	TRANPR	