PeeCeeBee V5 Rev1 Amplifier Assembly/Setup Guide

MAY 2023

shaan

Hello!

Note 1: This guide focuses on the process of populating and biasing of the PeeCeeBee V5 Rev1 amplifier PCBs. There are many other steps in assembling a complete amplifier successfully, that are not covered in this document. It is expected that the user has prior knowledge of assembling amplifiers.

Note 2: GND and OUT terminal places are swapped from V4H. If you are replacing the V4H modules with V5 (they are mounting hole matched), then keep the GND/OUT place-swap in mind.

Section 1: Assembly

To avoid components getting in the way of the iron tip during soldering on the top layer, this sequence of soldering of the components can be followed:

1. Small resistors
2. Terminals and pins
3. Small signal transistors
4. Ceramic and film capacitors
5. Trimmer resistors
6. Power transistors
7. Inductor
8. Medium size transistors
9. Power resistors
10. Electrolytic capacitors

The BOM file contains the component placement indication for the recommended +/-50V operation. Q25 and Q26 will need small tag type heatsinks. These heatsinks can be 10mm x 25mm with 2mm or 3mm thickness. These can be mounted directly to the transistors without insulation, with care taken to make sure they don't touch the MOSFET metal tags or other metal. After installing the small heatsinks use zip ties to attach the flat surfaces of Q17 to Q25, and Q18 to Q26. To make it easy, keep the smaller transistor's height closer to the

height of the plastic body of the medium transistors while soldering. They can also be attached face-to-face before soldering, with extra care taken to ensure that the correct transistors have been attached together. Thermal paste is not necessary, but will be good to have.

In contrast to its predecessor, the V5 needs only the power tranasistors to be placed on the underside of the PCBs. So no need to match big+small BJT backside surfaces anymore, just make sure the power transistors' plastic front is sitting flat on the PCB's underside.

While soldering the power transistors an M3 screw can be used to align the mounting holes of the PCB with the transistors' holes. This will ease the process of fixing the finished module on the heatsink.

The inductor can be made by rolling 1mm enamelled copper wire 20-21 turns on a 10mm former. An AAA size battery can be used as a former. Make three layers of 7 turns each and you will have a nice coil with wire ends on both sides. Use zip ties to hold the wires in place after removing it from the coil former. The coil does not need to be extremely neat and gap free, but turning it slowly with care will surely make it so. Use a utility knife to completely remove the enamel from the wire ends and solder it to the board.

Note that there are 32 BJTs plus other components on the board. Before proceeding to the setup process make sure that every component is placed in its right place and orientation!

Section 2: Setup

Preliminary Steps:

a. Turn VR1 and VR2 **anticlockwise** to maximum resistance, and VR3 **anticlockwise** to zero resistance. Resistance is measured between pin 1 and 3.

b. Mount the amplifier module on a suitable heatsink with mica/kapton/silpad insulation. Make sure with continuity tester that the metal backs (Pin 2) of the power transistors do not have a short to the heatsink.

c. Make sure that the heatsink's body is connected to power-supply's 0V ground output. Without this the amplifier may start oscillating when powered.
d. Connect power supply rails to the board's ++VCC and VEE-- terminals via a 1R/2Watt resistor in series with each power rail to the amplifier.

g. Set the mumtimeter to mV and connect the probes to the two legs of either R31 or R32 (probe polarity doesn't matter). Clip-type probes would be very helpful here. If you have a second multimeter then set it to mV and connect the red probe to OUT terminal and black probe to power supply's 0V ground.

h. Make sure that the power supply has fuses. 5A/8A rated fast-blow types are recommended.

After doing all the above, turn on power for 1 second and then turn it off. Depending on transistors' DC gain the multimeter may show a few millivolt or zero. This is normal. Slightly touch the 1R/2Watt series resistors. If they feel warm or the fuses were blown, then disconnect power supply from the board, and check for component misplacement, or short between output terminal and heatsink or shorted solder joints. If the resistors are not warm and the fuses are intact, then we are okay to proceed to trimming.

VAS biasing + Offset trimming:

Turn on power and notice multimeter reading. The voltage it shows in millivolts indicates the current flowing through R31/R32 i.e. the VAS bias current in milliamps, which needs to be 3mA, and for which this reading needs to be 660mV.

Turn VR1 and VR2 trimmers clockwise and you should see the reading to increase slowly. If it doesn't increase instantly as you start turning the trimmers then don't worry. Depending on DC gain of the transistors used, sometimes they need more turns to gain control of the VAS bias. Turning both trimmers equally every time will be good, as this will keep the offset close to 0V as we set the VAS bias. If you have the second meter connected then you can directly see how the trimmers change the offset. Check the meter connected to the resistors and when it shows about 600mV, stop turning.

Check output offset in the second meter. If it shows a positive value then turn VR1 clockwise and VR2 anticlockwise, and if it shows a negative value then turn VR1 anticlockwise and VR2 clockwise.

If you don't have a second meter then turn off power, remove the meter from R31 or R32. Connect its red probe to OUT and black probe to power supply's 0V ground. Turn on power. And then turn the VR1 and VR2 trimmers as suggested above. Make sure to turn them equally, so that VAS bias remains relatively unaffected during offset trimming.

Output biasing:

Output biasing is straight-forward. Turn off power. Set the multimeter in mV setting and connect the probes to the two legs of any one of the 1R/2W rail resistors (probe polarity doesn't matter). Turn on power. The reading should show between 5mV and 10mV. This indicates the total amplifier current. For 150mA total Output bias and 5mA of input+VAS bias, it needs to read 155mV. Although I mention 150mA output bias, but the amplifier can perform very well at 100mA or even lower. A bias of at least 70mA is recommended. If 70mA is chosen then the reading we need is 75mV, otherwise we stick with 155mV.

Slowly turn VR3 clockwise while keeping an eye on the reading. After turning 5-6 turns it should start increasing. Stop turning when the reading shows 155mV.

Now keep the multimeter connected, let the amplifier warm up and notice the reading. Depending on heatsink size the reading should slowly increase a little. As the reading increases turn VR3 anticlockwise and keep the reading close to 155mV. Within a couple minutes the reading should settle and be stable.

Now turn off the amplifier, wait for the power supply reservoir caps to drain, remove the two 1R rail resistors and connect the rails directly to the amplifier, connect test speakers (not main speakers), connect input, turn on power and play some music. If everything is okay then turn it off, connect main speakers (through speaker protection) and enjoy.
