Transistor Voltage Regulators

Dual Rail Floating Pre-Regulator Ripple Filters (~30-35dB noise out. Common Collector Amp configuration, load is after the emitter.)

These are also called “capacitance multipliers” and will seemingly increase capacitance by Cb2 * transistor beta. A transistor in this configuration forms a type of variable voltage divider to keep the output voltage constant. Effective drop out for usability is about 0.5V below the ripple (beta=100, Rload=100). 40Hz noise and below are reduced less.

For low ripple sources, Rb can be low wattage. For higher ripple sources, Rb should be a higher wattage and maybe used with a heat sink. If Cb2 is electrolytic, observe polarity. Smaller capacitors can be paralleled for lower ESR. Cb1 should have a good HF response (ceramic).

The NPN one is for the positive rail. The PNP one is for the negative rail.

This is also a slow turn on with the capacitor charging up first before the transistor fully opens. When ripple voltage swings high, the transistor sinks it. When ripple voltage swings low, the capacitor sources the transistor base.

Rb=Cb1=Cb2 also forms a high pass zero/bipolar filter to ground for noise.

For large capacitors, Qp protects against the possibility of reverse biasing the transistor. Rb is a feedback resistor to essentially form a little BJT amplifier (provides negative feedback to the stable capacitor levels).

Cb size depends on the transistor beta. Lower beta, higher power models need more base current (lower voltage resistor).

Add large filter capacitors at V_in and V_out to handle peak current draw.

Higher Rb means more smoothing (at a point) and more voltage drop on output. Higher impedance means a slower Cb2 charge rate and slower turn on. Higher Cb2 means more low frequency smoothing. Too large will cause sluggishness and excessive turn on times. Cb1 and Cb2 can be split into cascading RC filters for better performance (second order 120Hz/steep filter).

Rg is usually 10k–22k and stabilizes the circuit against variations in transistor gain. Lower Rg increases transistor dissipation and lowers V_out more (larger increase output noise). Choose this so that the voltage drop across the transistor is a handleable noise.

Rb typical range: 100–3500. Cb2 typical range: 10–470uF.

Option: split Rb to fixed + variable for an adjustable floating regulator.

Common transistors: BD139+TIP3055 NPN, BD140+TIP2955 PNP.

Example Noise Reduction: Rb=1000, Cb=220uF, beta=100, Rload=100:
Set the output voltage about a half volt below the base of the ripple voltage.

Common collectors: BD139+TIP3055 NPN, BD140+TIP2955 PNP.

Example: Split Rb to Rb1 and Rb2, variable for a 100 Ohm–variable amplifier.

Rb1 typical range: 100–3500. Rb2 typical range: 10–470uF.

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