'Zener-less' Battery Eliminator

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Designed as a variable-voltage battery eliminator, this circuit provides a stabilised output without Zener diodes as the reference source. Instead, a V_{be} multiplier is employed so that the output voltage may be continuously varied by PR1 over the range 6-10V.

The V_{be} multiplier is shown schematically in the inset. Provided that V_{cc} is high enough, the potential across R1 will be about 600 mV for a silicon transistor. The current through R1 can thus be adjusted so that the base current of the transistor may be ignored for practical purposes. In this case, the current through R1 will equal the current through R2. The potential at point A is thus given by:

$$V = V_{be} \times \frac{(R1 + R2)}{R1}$$

—hence the name V_{be} multiplier.

R3 limits the current through the parallel combination of the transistor and R1/R2. Suppose as an example that V_{cc} tries to rise. The potential divider formed by the three resistors will try to raise the voltage across R1. This will tend to increase the collector current and thus increase the potential drop across R3, leading to a stabilising effect at point A. This is a case of voltage-derived series feedback.

In the practical circuit, R3 also provides base current for the series transistor Q2. Q3 and R4 form a current limiter. If the output current exceeds approximately 100mA, Q3 starts to turn on, reducing the output voltage. If desired, Q3 and R4 may be omitted, in which case R3 may be derated to ½W. The whole unit fits easily inside a transistor radio battery case.

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