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heatsink shrinker

The designer of a heavy-duty, variable-voltage, regulated power supply unit always meets the problem of having to allow for the very high dissipation that can occur in the series regulator transistor. When a high output current is drawn at low voltage (TTL!) it may even be necessary to use a cooling fan at the heatsink.

Perhaps an extreme example is the case of a supply unit capable of delivering 5 amps at between 5 and 50 volts. Such a unit will have typically a 60 volt unregulated supply. Suppose this unit is to supply TTL circuits at its full rated current. The series element in the circuit must now dissipate 275 watts! The cost of providing adequate cooling is likely to be exceeded only by the cost of the series transistor needed.

If the voltage drop across the regulator transistor could be limited to 5 .5 volts, independently of the selected output voltage, the dissipation would be drastically reduced – in the above example to 10% of its original value.

This can be achieved by using three semiconductor devices and two resistors (figure 1).

This is what happens: thyristor Thy is normally kept conductive by means of R1. However, when the voltage drop across T2 – the series regulator – exceeds 5.5 volts, T1 will start to conduct, causing the thyristor to 'open' at the next zerocrossing of the rectifier output. This arrangement continuously controls the charge supplied to Cl – the reservoir capacitor – so that the unregulated supply is held at 5.5 volts above the regulated output voltage.

The value required for R1 is found as follows:

$$R_1 = \frac{1.4 \times V_{sec} - (V_{min} + 5)}{50} k\Omega,$$

where Vsec is the RMS secondary voltage of the transformer and Vmin the minimum value of the regulated output. The thyristor must be capable of carrying the peak ripple current, and its working voltage must be at least 1.5 Vsec. The series regulator transistor must be rated to carry the maximum output current, Imax, and be provided with a heatsink on which it can dissipate 5.5 X Isec watts.