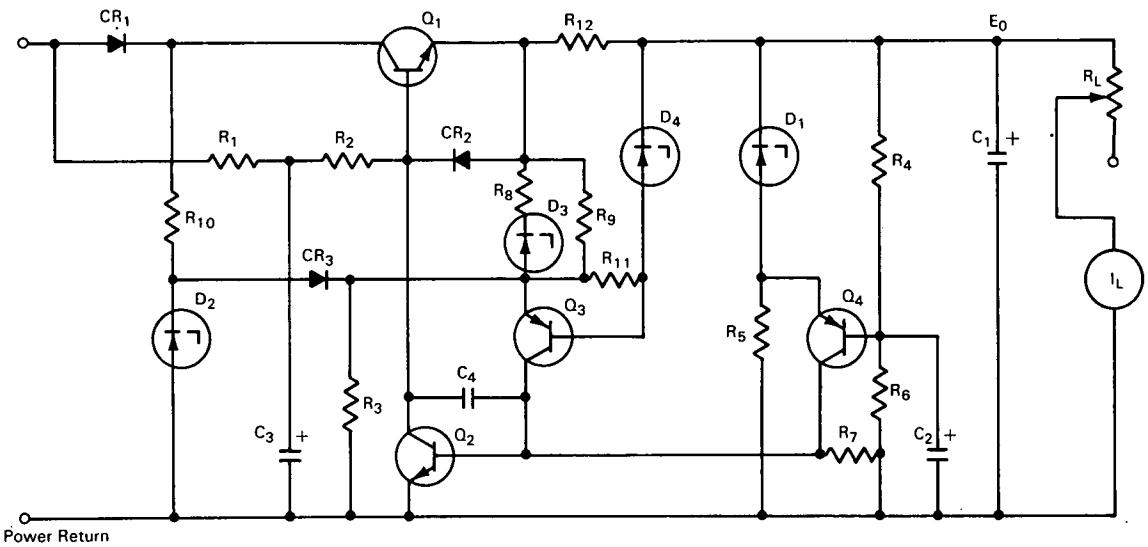
NASA TECH BRIEF

Current-Limiting Voltage Regulator



A voltage regulator has been designed to operate within preset current limits. The regulator acts as a circuit breaker to prevent overload failure and automatically resets when the overload is removed.

Normal voltage control is accomplished by the voltage sampling circuit consisting of Q_4 and associated components, R_4, R_6, C_2, R_7, R_5, and zener diode D_1. An increase in the output voltage (E_0) causes an increase in the current through Q_2 with subsequent starving of the base of Q_1. This results in an output voltage drop (E_0) to the level set by R_4.

Transistor Q_3 is the current-limiting control device. Current sampling resistor R_{12} controls the current available through D_4 to the base of Q_3. Zener diode D_4 is forward biased as a conventional diode except under very light load conditions. Q_3 exercises some control as an output voltage regulating element under normal operating conditions to supplement the action of Q_4. Current limiting level is adjusted by the choice of R_9. The combination of R_9 and R_3 sets the operating level at the emitter of Q_3 below current-limiting levels. Above the current-limiting level, the combination of R_9, R_{10}, and R_3 sets the voltage at the emitter of Q_3 so that, as Q_1 is shut off, excess power is dissipated in the parallel circuits of R_1, R_2, Q_2, and R_{10}, CR_3 and R_3.

The combination of R_8 and D_3 and the elements CR_2, R_{11}, and D_4 serve to provide temperature compensation. The remaining components are typical of series-type regulator circuits and do not deserve special mention.

(continued overleaf)

Notes:

1. The important feature of this circuit is the power dissipated in the series transistor Q_1, which is approximately constant from normal load to short-circuit condition. In the conventional current-limiting approach, the power dissipation of Q_1 increases from normal load to short-circuit condition.
2. Details may be obtained from:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B68-10305

Patent status:

This invention is owned by NASA, and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

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