NASA TECH BRIEF

Switching-Type Regulator Circuit Has Increased Efficiency
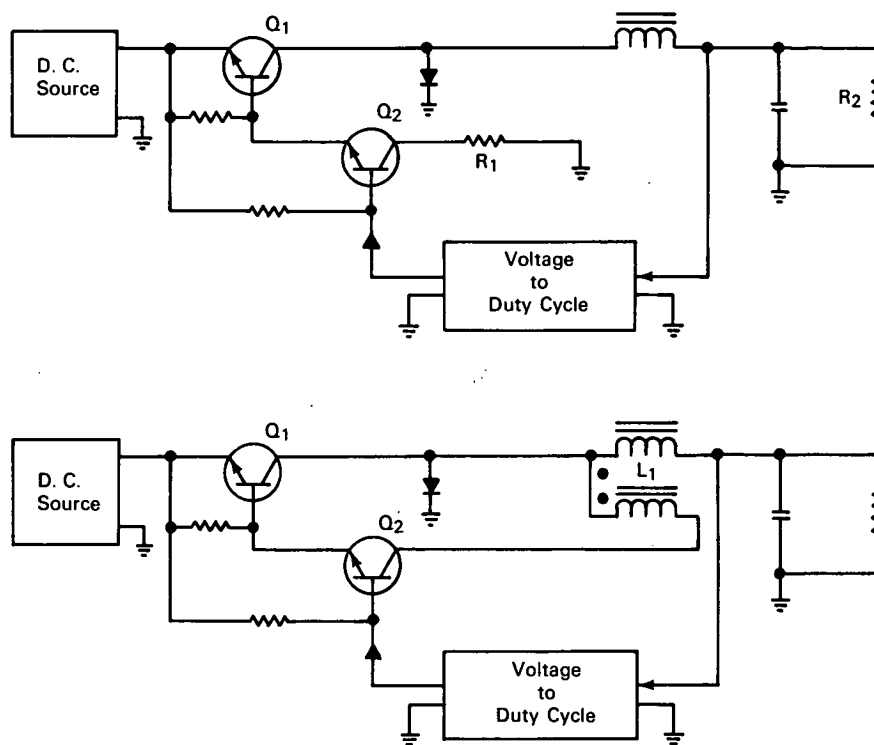
The problem:

Switching series regulators have required control networks for the transistor or electron tube switching element. Such control networks are usually operated by the source supplying power to the load and draw considerable amounts of power which is dissipated in the form of resistive losses. Such resistive losses must be removed from the regulator by means of bulky heat sinks for the switching element to operate in a stable manner. These losses result in reduced efficiency of the regulator circuit.

The solution:

A switching series regulator circuit in which substantially all of the current applied to the control circuit is fed to the load via an inductive network.

How it's done:

The significant increase in efficiency of the new circuit over that of the old may be seen by comparison of the two circuits. In the upper figure, the driver transistor Q_2 derives its collector K_c current I_c^2 through R_1 which causes a considerable power loss

(continued overleaf)

$I_c^2 R$. In the lower figure, collector current I_c is obtained from secondary winding, or tap, on inductance L_1 which is otherwise unchanged. In this way, current I_c is obtained from a low impedance circuit with resultant low $I_c^2 R$ losses. Additionally, I_c contributes to the load current flowing through R_2 by transformer action of the modified inductance L as load current increases. Thus, Q_1 base driving current increases as load current is increased and this causes Q_1 saturation voltage to remain low.

Notes:

1. By this approach, the overall efficiency of a regulator has been raised from a measured 83.8% to 94.5%.
2. With virtually no increase in complexity or cost, appreciable reduction in size is achieved by elimination of the previous heat sink requirement.

3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Manned Spacecraft Center
Houston, Texas 77058
Reference: B67-10190

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: William M. Clapp
of Sanders Associates, Inc.
under contract to
Manned Spacecraft Center

(MSC-1063)