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NASA TECH BRIEF



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The problem: Designing an efficient dc to ac converter for low input voltages (0.5 to 4.0 volts). Recently developed electrical power sources (fuel cells, thermionic diodes, thermoelectric generators, and solar cells) produce high-current, low-voltage dc outputs which must be converted to ac for many applications. Since the output voltages from these power sources are very low, the converter used must be extremely efficient. Performance reliability is decreased when a large number of power sources are connected in series to increase the net output voltage to a sufficiently high level for operation with a less efficient converter.

The solution: A self-oscillating dc to ac converter which uses transistor switching to produce a squarewave output. The efficiency of the circuit approaches the maximum efficiency of the transistor switches.

How it's done: The converter consists of two switching transistors Q_1 and Q_2 , output transformer T_1 , and a saturable core transformer T_2 . When a dc input voltage is applied to the circuit, one of the transistors, e.g., Q_1 , starts to conduct. The emitter-to-base-voltage drop in transistor Q_1 appears across winding N₅ of transformer T_2 and establishes the direction of flux change in the core of T_2 . When T_2 becomes saturated, decoupling occurs between N₄ and N₅. The base (continued overleaf)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government, nor NASA, nor any person acting on behalf of NASA: A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe privately-owned rights; or B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this document. current to Q_1 decreases and Q_1 is turned off. Energy stored in T_2 is returned to the circuit and Q_2 is turned on. As T_2 cyclically saturates and desaturates, the input voltage is impressed first across N_1 and then across N_2 , thereby inducing an alternating square wave in the output winding N_3 connected to the load. **Notes:**

- 1. This converter is also suitable for use with higher-voltage power sources.
- 2. Tests have shown that the converter has a high efficiency throughout a wide range of loads. For a 20-ampere dc input, the efficiency increased from 79% at a 1-volt input to 94% at a 3-volt input.
- 3. The converter is able to withstand relatively large overloads for short time intervals without transistor damage.
- 4. The transistors should be reasonably well matched. To compensate for the effects of temperature on transistors with dissimilar characteristics, they

should be mounted in close proximity on a common heat sink. A high degree of mismatch between the emitter-base voltage drops of the two transistors can be compensated by adjusting the relative number of turns in windings N_5 and N_6 .

5. Inquiries concerning this invention may be directed to:

Technology Utilization Officer Goddard Space Flight Center Greenbelt, Maryland, 20771 Reference: B65-10178

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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