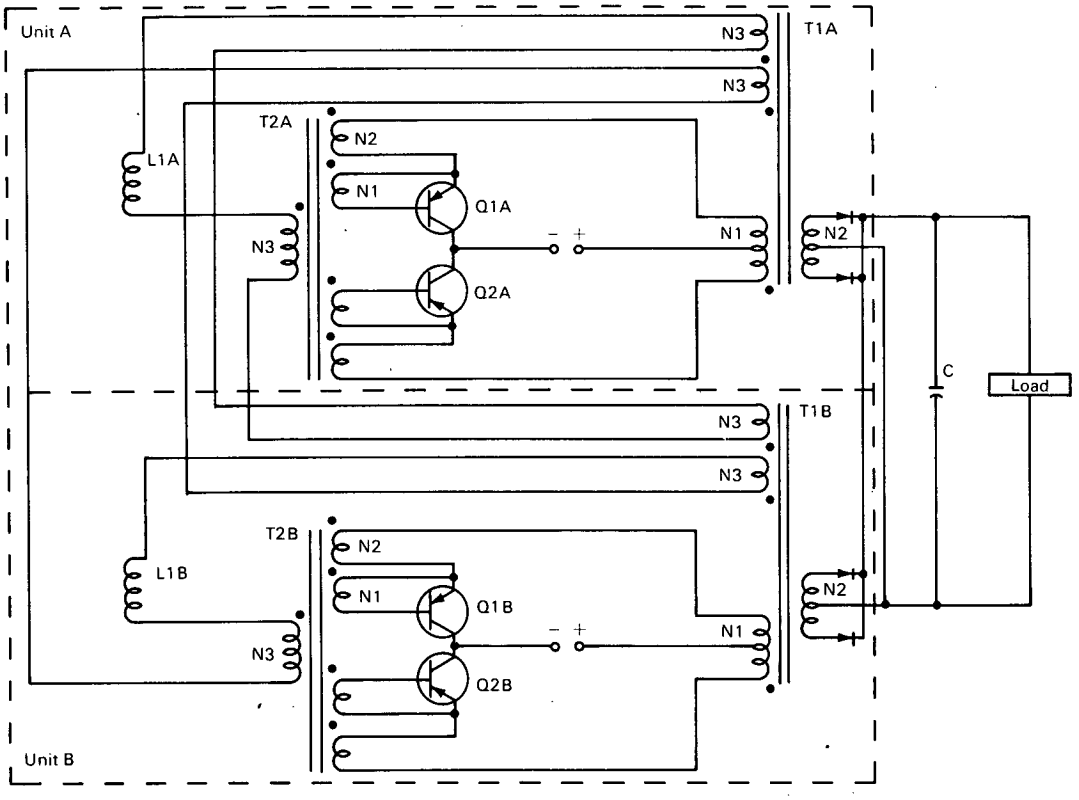
NASA TECH BRIEF

Synchronizing Redundant Power Oscillators



Circuit To Synchronize Two LIVCs

The problem:

In applications where reliability is a prime consideration, redundant electronic circuits are usually provided. Low input voltage converter (LIVC) power oscillators, operating in such a redundant parallel configuration, produce a low and variable frequency oscillation that is caused by the beating of the non-synchronized power oscillators. Since the beat frequency is low and variable, it is difficult to remove by filtering.

The solution:

The oscillators' outputs are synchronized by summing the power transformer phase voltages; the

(continued overleaf)

summed voltages are applied to the frequency-determining inductors of the individual voltage-controlled power oscillators. The beat frequency is eliminated when synchronization is achieved.

How it's done:

The synchronization approach shown in the schematic is ideally suited to conditions where the input voltages are equal. Under this condition reliable synchronization is effected with two LIVCs operating 90° out-of-phase. This phase separation reduces the filtering necessary in the LIVC output and, in the case of a common source connection, on the LIVC input because switching operations of each LIVC are time separated. The synchronization (90° out-of-phase) is realized by applying sum and difference phase voltages of the respective LIVC power transformers to saturating inductors which effect the oscillator switching frequency. The saturating inductors effect switching by allowing a pulse of current to flow upon saturation, which pulse-reverses the current drive transformer voltage.

This circuit operation with minor modifications has been successfully applied to three LIVCs operating 120° out-of-phase.

The synchronization frequency is varied proportionally to the input voltage while maintaining the phase separation between LIVCs, because the inductors have fixed volt-second integrals. Increasing voltages on the LIVC input are applied to the inductors through the transformer windings to cause saturation in less time; therefore, the flux density in the power transformer can be held at a fixed value even as wide voltage variations occur. In the event of one LIVC failure the functional LIVC can operate with no significant decrease in performance.

Notes:

1. An interesting byproduct of the development of the synchronization circuit is that the circuit appears to be directly applicable to the conversion of dc power to polyphase ac.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: TSP69-10546

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: Kenneth J. Jenson of
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