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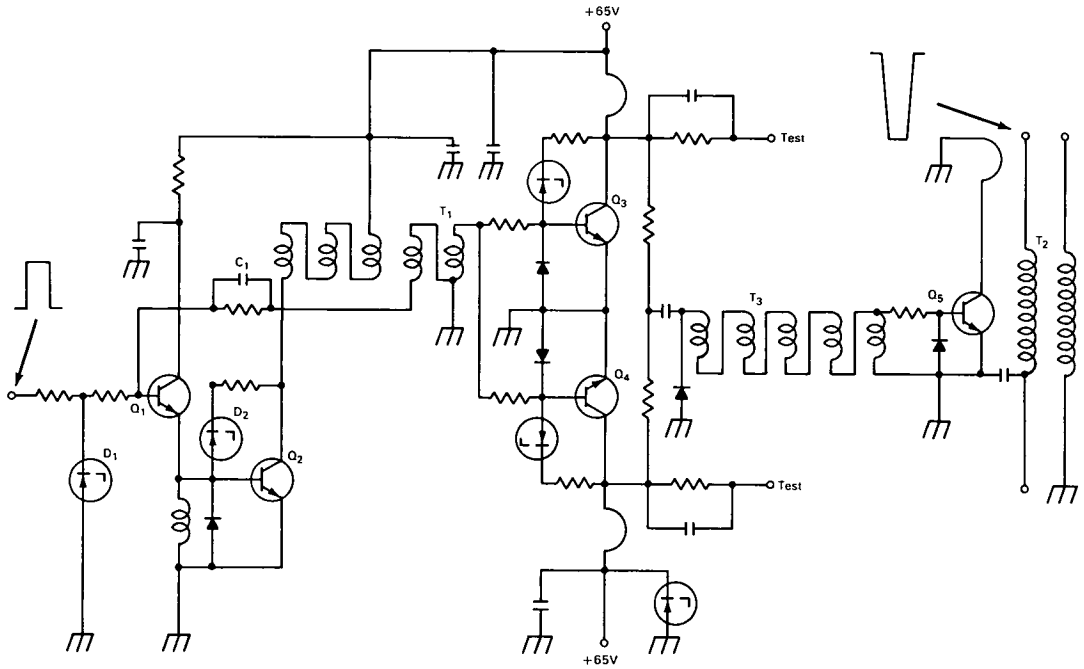
NASA TECH BRIEF

Solid State High-Voltage Pulser Operates with Low Supply Voltage



This solid state, high-speed circuit has been designed for application as a klystron cathode pulser. The circuit delivers 3-kilowatt, 3-kilovolt pulses from a bifilar filament transformer. Unlike most state-of-the-art pulsers, which require high supply voltages to generate high-voltage pulses, the new circuit requires only 65 volts to generate 3-kilovolt pulses. The circuit offers advantages in operational safety and reliability and in improved packaging design. Special components which make low-voltage operation possible are broadband video transformers. These transformers are wound in two configurations: (1) transmission line, multifilar toroids and (2) loop coupling toroids. Choice of core material for the transformers depends on pulse width and duty cycle requirements.

Operation of the klystron cathode pulser can be understood from the circuit diagram. Transistors Q_1 and Q_2 form a stabilized amplifier, providing a 15 dB power gain for the base drive requirements of transistors Q_3 and Q_4. Stabilization is achieved by negative feedback from one secondary of transformer T_1 to the summation point of the base of Q_1. Zener D_1

(continued overleaf)

is incorporated in the signal input network of Q_1 to regulate the drive voltage. Zener D_2, connected between the base and collector of Q_2, is used to prevent the backswing of T_1 from exceeding the supply voltage. When such transients occur, the zener avalanche causes Q_2 to conduct, thus preventing collector-to-base avalanche. The transistor will therefore operate at near its full voltage capabilities within its safe secondary breakdown region. Coupling and matching from the drive amplifier to the dual base input circuit of transistors Q_3 and Q_4 are made via a transmission line toroidal transformer to minimize capacitance and leakage reactance. Parallel lines of known constants are used to approximate a true transmission line, providing a unity power factor or VSWR over many frequency decades. For the same load conditions, a conventional transformer resulted in a 1 MHz bandwidth compared to a bandwidth of more than 100 MHz for the transmission line device.

Notes:

1. Experiments have shown that the circuit can be adapted to generate high-speed, high-voltage, high-stability power pulses at megawatt levels.
2. Complete details may be obtained from:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B68-10308

Patent status:

No patent action is contemplated by NASA.

Source: W. E. Milberger
of Westinghouse Electric Corporation
under contract to
Marshall Space Flight Center
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