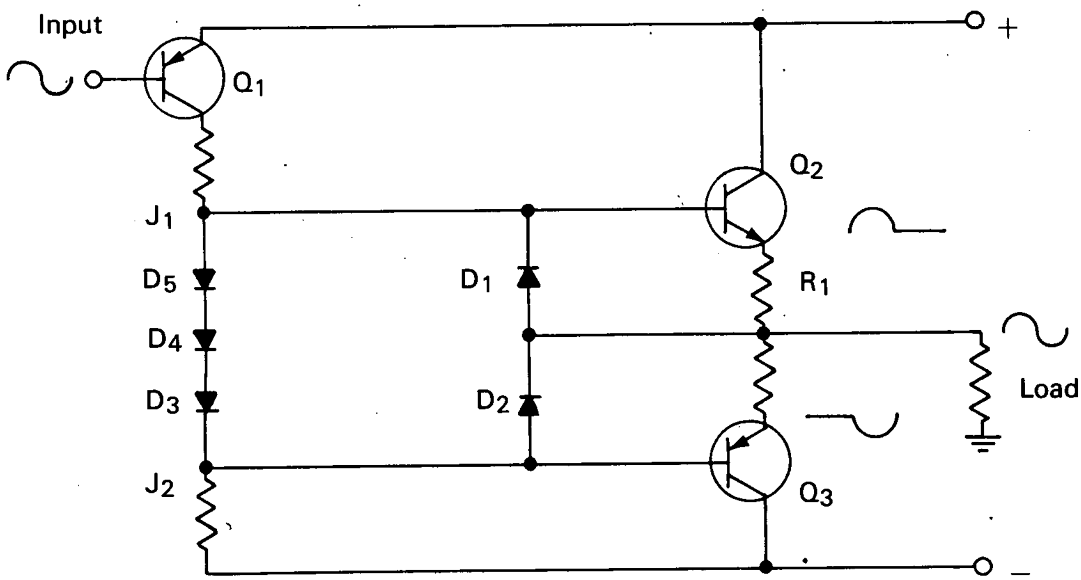
NASA TECH BRIEF

Circuit Provides Overcurrent Protection to Push–Pull Amplifier



The problem:

In many push–pull amplifiers, should the load be short circuited for any reason, the amplifier will be destroyed. Additionally, if complementary system transistors are used, oscillation and storage effects inherent in amplifiers can cause both sides of the push–pull device to conduct simultaneously. This short circuits the two bias supplies and usually destroys the amplifier.

The solution:

An amplifier circuit that limits the current flowing to a predetermined level and provides that overcurrent in one half of the push–pull amplifier turns off the other half.

How it's done:

The circuit is first considered as though diodes D_1 and D_2 are not included. A signal at the input is amplified by Q_1 and appears at junction points J_1 and J_2. If Q_2 and Q_3 are biased class B or class AB, the positive portion of the signal at J_1 is amplified by Q_2 (an NPN) and the negative portion at J_2 by Q_3 (a PNP). The negative portion of the signal at J_1 will turn Q_2 off and the positive portion at J_2 will turn Q_3 off. Thus the load is driven by Q_2 during one half and by Q_3 during the other half cycle, the action from which the term "push–pull amplifier" derives.

The circuit is now considered with D_1 and D_2 included. Within the series circuit formed by R_1, D_2, D_3, D_4, D_5, and the emitter-base junction of Q_2, all the voltage drops are fixed by nonlinear characteristics except for that in R_1. Also, the voltage across the emitter-base junction of Q_2 and the voltage across D_2 balance each other and can be disregarded. The remainder consists of equal and opposite voltage

(continued overleaf)

drops across D_5, D_4, and D_3, and R_1. Thus, the instantaneous voltage across R_1 can be no greater than the voltage across the three diodes or insufficient bias on Q_2 results and it begins to turn off. This means that if an excess current through R_1 causes the voltage across it to equal the sum of the diode voltages, the circuit will start current limiting, the level of which is set by the size of R_1.

If Q_2 tends to draw excessive current, D_2 turns on and impresses a voltage across the emitter-base junction of Q_3 opposite in polarity to that required to maintain Q_3 in the conduction state. Conversely, should Q_3 tend to draw excessive current, equal and opposite action would take place in D_1 and the emitter-base junction of Q_2 to cause Q_2 to turn off. Thus, no high frequency oscillation or driving voltage can cause both Q_2 and Q_3 to conduct at the same time to short circuit the voltage across the two output terminals.

Note:

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Manned Spacecraft Center
Houston, Texas 77058
Reference: B67-10300

Patent status:

No patent action is contemplated by NASA.

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