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TECHNICAL REPORT

SOLID STATE HIGH VOLTAGE PULSER

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The diagram of a circuit which will produce a moderately fast rising high voltage pulse is shown in the accompanying figure. Some of the advantages of this circuit are: all solid state components, and therefore no filament supplies, etc.; low voltage requirements at the input for turn-on; with the rapidly increasing BV_{CEO} of PNP transistors, the availability of either polarity pulse without transformer coupling; the inherent protection against high voltage breakdown provided by the biasing arrangement.

The biasing arrangement, which is very simple, guarantees that the voltage across each transistor will always be less than some fraction of the supply voltage set by resistive dividers, R_3, R_4, and R_5. If very long pulses are required, then the backup capacitors, C_1, C_2, and C_3 should be increased.

The operation of the circuit is as follows. A positive pulse of approximately 2 or 3 volts at the input switches T_1 on. A simple emitter follower is very adequate for driving T_1. When T_1 starts to conduct, its collector voltage falls. This turns on T_2 because of the base current now flowing to T_2 through R_1. The same thing happens when the collector of T_2 falls, switching on T_3 with base current through R_2. The switching times of T_2 and T_3 are limited only by the f_α of the transistors, since they are switched with emitter drive. Therefore, the switching speed of the complete circuit is limited almost entirely by the switching of T_1.

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[*] This circuit developed in connection with work being conducted on hypervelocity impact phenomena under NASA Contract NASw-936.

Diodes D_1 and D_2 are high voltage rectifier diodes with breakdown voltages greater than the supply voltage. They protect the transistor string from spurious high voltage spikes that may be fed back from the circuit being driven with the output pulse. The protection afforded by the diodes depends upon their switching time from off to on. Since this is quite fast even for slow rectifier diodes, they may be used.

This circuit was constructed and used as a driving source for a 20-kv pulse tube. 2N3439 transistors were used. The rise and fall times of the pulse were approximately 800 nsec. These times could be decreased by using higher frequency transistors, and in particular, a faster switching transistor for T_1.

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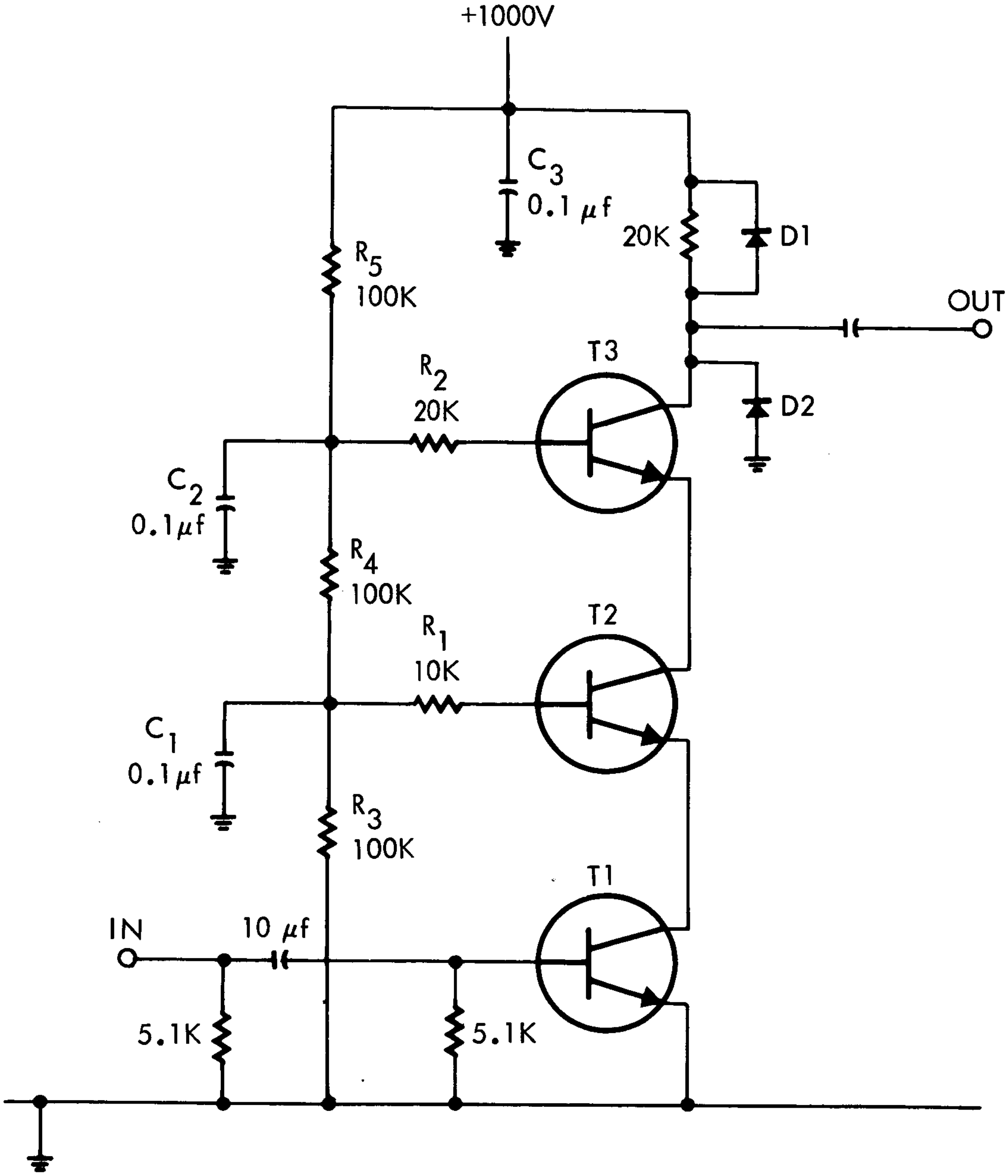

T_1 TO T_3 2N3439