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Design of High-voltage Nanosecond Fast Repetitive Pulse Generator Based on Avalanche Transistor

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A high voltage, nanosecond pulse generator is designed to get the high resolution and accurate results in Pulse electro acoustic (PEA) equipment to measure space charge test. There's more and more requirement for fast rise time pulse generator especially with high repetition frequency and high voltage. Several technologies are being used for generation of nanosecond pulses such as spark gas, draft-step-recovery diode (DSRD), semiconductor opening switch (SOS) and fast-ionization device(FID), photoconductive semiconductor switch. Mostly are limited by its life time and low repetition frequency. The semiconductor switches such as FID, DSRD and SOS are hard to manufacture and expensive. Serial avalanche transistors technique is used in this design. By carefully designing the serial transistor circuit and PCB, the stray inductance and voltage reflection are reduced effectively, which make the output rectangular pulse obtain 2.5 ns rise time. The amplitude output pulse can reach up to 2.5 kV with 12.5 ns width. The pulse time jitter is less than 100 ps even in10 kHz high repetition frequency output mode. The high voltage DC power supply can provide high voltage in the range of 0 to 6000V for the rectangular wave forming line. The serial avalanche transistors connected to the rectangular wave forming line can discharge to the 50Ω load under the control of triggering signal. Then a rectangular pulse with amplitude of the half DC charging voltage is formed on the load by the shaping effect of the rectangular wave forming line. The pulse width is determined by the length of the forming line. The avalanche operation mode can ensure the fast turn-on speed, therefore obtaining fast rise-time pulse. The series of avalanche transistors can enhance withstand voltage and make the pulse amplitude reach to several kV.

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