

All-Solid-State High Current FID Switches and High Voltage Nanosecond Pulsers

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Two variants of compact all-solid-state sources with maximum peak current of up to 1 MA and rate of rise of current from 20 kA/ns to 500 kA/ns have been developed.

The first variant of high current sources is based on FID switches with maximum peak current of 10-50 kA and rate of rise of current of 1-2 kA/ns.

FID modules including FID switch and storage capacitors are placed on a circle with diameter of 30 cm. 30 FID modules are triggered simultaneously. A testing of one FID module has been carried out. A value of storage capacitor can be chosen from 10 to 50 nF. Maximum operating voltage is 25 kV, maximum peak current on short circuit is 35 kA. Rise time of current is about 50 ns. It is possible to increase rate of rise of current by increasing operating voltage and lowering inductance of FID module design. This makes the maximum estimated current of about 1MA, rise time of current of about 50 ns. The total energy of the storage capacitor is 600 J.

The second variant of high current sources is based on high voltage nanosecond pulse modules FPM 100-1KM, FPM 100-1PM with maximum amplitude of 50-100 kV, peak current of 2-4 kA, rise time of 0,2-1 ns, pulse duration of 1-5 ns.

Modules FPM 100-1KM and FPM 100-1PM have a high stability of all specifications and can be synchronized with accuracy of 20-30 ps. Amplitude of the output voltage can be adjusted in a range from 30% to 100%. Modules can operate in short and open circuit modes. Dimensions of modules 300x300x200 mm. Output voltage pulsed are fed to a load by a cable or a strip line.

Connecting 100 modules with amplitude of 100 kV and peak current of 2-4 kA, rise time 1-2 ns to a load allows achieving peak current of 200-400 kA with rise time of 1-2 ns.

Using FPM 100-1PM which outputs maximum peak voltage of 100 kV, 2 kA, rise time of 0,2 ns into a common load it is possible to achieve a rise time of less than 1 ns, but this specification strongly depends on details of a load construction. The simultaneous operation of 100 generators with amplitude of 15 kV and rise time of 120 ps has been experimentally proved. The synchronization accuracy in this case is 20-30 ps. It is possible to increase peak voltage up to 200-500 kV keeping rise time of 1-2 ns.