

**A.8: Development of 5T pulse magnetizer for magnetization of Nd-Fe-B magnets**

Pulse Magnetizer ( $\mu J=5$  Tesla) has been designed & developed for hard magnetization of NdFeB magnet disks (100 mm dia) used in Ferrite Circulator development at RRCAT. Magnetized Nd-Fe-B magnets are required to develop permanent magnetic circuit for biasing of ferrite resonator in below resonance mode. This article presents an impulse magnetizer system and successful generation of 5T magnetic field in the cylindrical fixture.

Pulsed magnetizer system is shown in Fig. A.8.1. The system consists of capacitor bank, capacitor charging electronics & solenoidal magnetizing fixture.

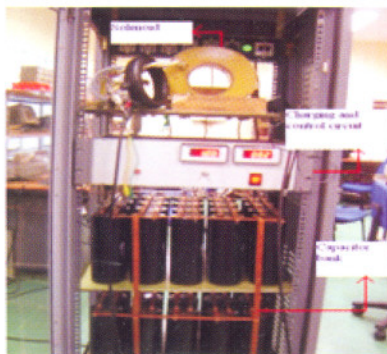


Fig.A.8.1: Pulse magnetizer system

A capacitor discharge type magnetizer is selected because extremely high current and consequently high fields may be obtained without undue heating. This impulse magnetizer works on principal of conversion of electrostatic energy into magnetic energy by discharging a capacitor bank through a unidirectional switch (SCR) into a magnetizing fixture. Series resonant topology is adapted to charge the capacitor bank. The resonant frequency of 40 kHz was chosen. An advantage of this approach is that all MOSFET switches are turned ON and OFF at zero current so that switching losses are reduced to minimum. A capacitor bank is charged by constant current producing linear voltage build up across the bank. Capacitor bank charges upto 450 V in 15 minute with 165 mA average current. Freewheeling diode in parallel with solenoid was connected to prevent the reverse charging of capacitor bank. A schematic diagram for series resonant charging scheme is shown in Fig. A.8.2.

In order to produce large field, we have developed multilayer solenoid. Electrical design of solenoidal magnetizing fixture has been optimized to generate exponentially damped magnetic field with rise time of 10 ms so that field penetrate inside the NdFeB disk to uniformly magnetize the disk.

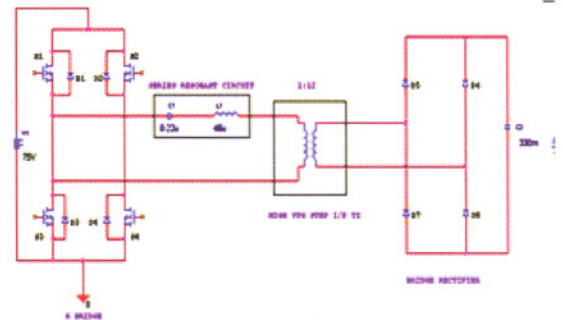


Fig.A.8.2: Schematic diagram of series resonant capacitor charging

The magnetizer system has been successfully operating to generate 5T magnetic field (with rise time 10 ms). Strontium ferrite magnet disks (100 mm diameter) were magnetized & used for biasing of resonator. The pulse current and magnetic field are measured by rogowski coil and axial search coil with integrator. The observed pulse waveforms are shown in Fig. A.8.3.

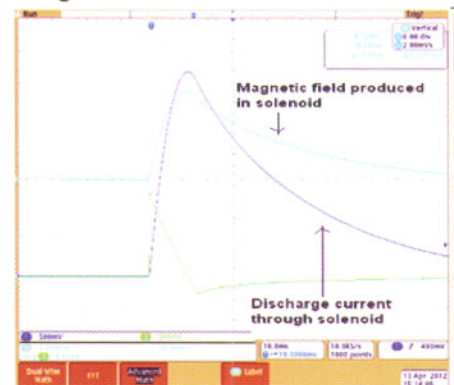


Fig.A.8.3: Magnetic field and current waveform

Composite magnetic circuit for ferrite circulator was developed & tested for their stability & reliability over one year. Technical parameters of impulse magnetizer are shown in Table A.8.1.

Table A.8.1: Pulse magnetizer system

|                              |        |
|------------------------------|--------|
| Energy stored @ 16kA         | 16kJ   |
| Peak magnetic field @ 9.3 ms | 5T     |
| Inductance of solenoid       | 125 uH |
| Capacitor Bank               | 330mF  |
| Capacitor voltage            | 450 V  |
| Electrical Energy stored     | 33 kJ  |

Reported by:  
Prashant Pareek( ppareek@rrcat.gov.in), Karan Singh and  
R.S. Shinde.