## A.7: Development of compact power supplies for explosive detection system

RRCAT, Indore has developed high voltage pulsed and DC power supplies for an Explosive Detection System being developed at ECIL, Hyderabad. When a gaseous ion at atmospheric pressure is placed in a constant electric field, it accelerates in the field until it collides with a neutral molecule, accelerates again until it experiences another collision and so forth. This chaotic sequence of accelerations and collisions at the molecular level results in a constant drift velocity decided by the mobility. The separation of ions on the basis of mobility differences is called ion mobility spectrometry (IMS). Because it can measure ion currents below $10^{-12}$ A, IMS is highly sensitive as a detection technique. Explosives, chemical warfare agents, drugs of abuse, and atmospheric and workplace pollutants are found to produce strong IMS responses. Pulsed and DC power supplies for this system have been developed at RRCAT. The size of both the supplies is 55 X 105 X 240 $mm^3$. It uses a full bridge LC resonant topology with variable frequency control to generate the required DC output.

### 1. -5 kV / 250 µA DC Power Supply

The output is settable from -1 kV to -5 kV DC. The bridge feeds a step up pulse transformer which uses a Cockcroft Walton multiplier circuit to achieve the required output high voltage. The supply operates in a closed loop control with an output ripple of less than 5 volts peak to peak. The output is controlled through a DC reference input and enable signal fed externally to the supply through a D connector. A LED indication provides the HV ON or trip status of the supply.

### 2. -5 kV / 200 µA Pulsed Power Supply

The high and the low output of the HV pulse are settable from -1 kV to -5 kV DC individually. The bridge feeds a step up pulse transformer which uses a Cockcroft Walton multiplier circuit to achieve the required output high voltage. The supply operates in a closed loop control with an output ripple of less than 30 volts peak to peak, PRR of 10 Hz and typical pulse width of 3ms. The output is controlled through a pulse reference input and enable signal fed externally to the supply through a D-connector. A LED indication provides the HV ON or trip status of the supply.

A simplified circuit block diagram of the power supply is shown in Fig. A.7.1.

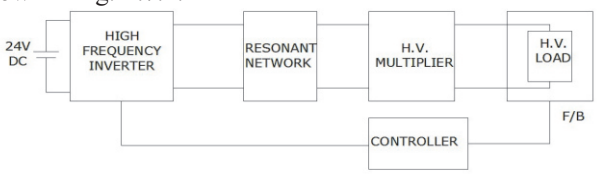


*Fig. A.7.1: Block diagram of the basic scheme used for both the power supplies.*

The power loss in both the supplies is within 10 watts and they incorporate output over voltage, arcing and short circuit protections.

Both the power supplies were integrated and tested with Explosive Detection System at ECIL, Hyderabad. The required modifications were carried out at RRCAT, and the improved supplies were re-tested at ECIL, Hyderabad. Figure A.7.2 below shows different versions of the power supplies as they evolved.

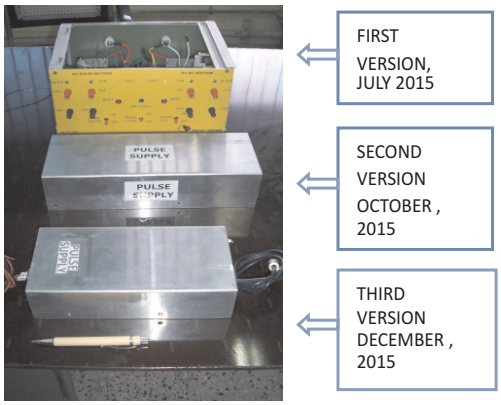


*Fig. A.7.2: Three versions of the power supplies developed*

The explosive detection system with integrated RRCAT supplies was used to detect Oxygen and TNT at ECIL, Hyderabad. Satisfactory results were obtained. Figure A.7.3 below shows the detection signal obtained on scope for TNT detection.

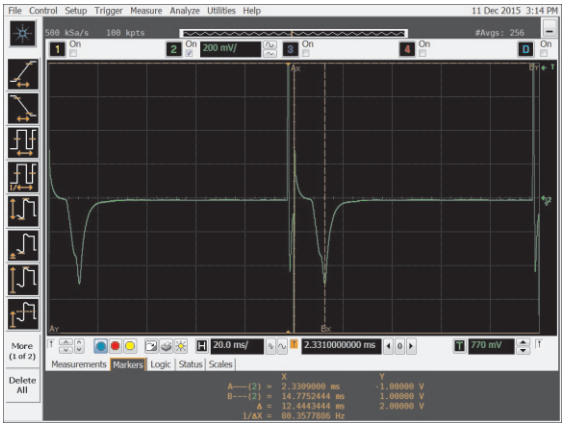

*Fig. A.7.3: TNT Detection Pulse on Scope with RRCAT Pulse and DC supplies integrated with Detection system.*

Three sets of the final version of the power supplies are under fabrication and will be deployed for field testing.

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