Technical Note: 3

Designing SIMMER POWER SUPPLIES
For Flash Pumped Pulsed Solid State Lasers

The purpose of the simmer power supply, as outlined earlier, is to maintain a relatively low-amplitude keep-alive current through the flash lamp at all times irrespective of whether the lamp is flashing or not. The simmer power supply maintains a steady state partial ionization of the flash lamp during the time the lamp is not flashing. Simmer module must be designed with due consideration to I-V characteristics of the flash lamp. Initially, the simmer module generates a high voltage trigger pulse, typically 10 kV to 15 kV, to create pre-ionization before the simmer power supply can take over and deliver the keep alive current through the flash lamp. The simmer power supply is a high voltage DC power supply producing an output voltage in the range of 800 V to 1500 V depending upon the characteristics of the flash lamp and the required magnitude of simmer current. The output of the simmer power supply is applied to the flash lamp through a series resistor called ballast resistor. The magnitude of the simmer current therefore depends upon the difference between the simmer supply output voltage, voltage across the flash lamp in the simmer mode (partial ionization state) and the value of the ballast resistance. The value of the ballast resistance should be slightly higher than the negative impedance offered by the flash lamp in the simmer regime. It may be mentioned here that the flash lamp offers negative impedance while operating in such a regime. The voltage (v) across the lamp in this condition varies as given by equation 3.1.

$$v \propto (i)^{-0.3} \qquad \text{............. 3.1}$$

Where (i) is the simmer current

The above equation indicates the existence of V-I characteristics with negative impedance. **Figure 3.1** shows a simplified arrangement depicting simmer mode of operation. The power supply portion can be configured around a flyback converter topology.

Ideally, one would be required to monitor the status of the flash lamp and disable the high-voltage trigger-generation part of the simmer module as soon as the flash lamp starts simmering. One could think of giving a single high-voltage pulse to the flash lamp with the presumption that the simmer operation would be established with the first pulse itself and probably get rid of the additional circuitry needed to do flash lamp status monitoring. But this is not advisable. The flash lamp may not strike with the first pulse or even if it does so, it can extinguish during operation due to some reason or the other. In that case, one would be required to supply a fresh HV trigger to restore the simmer mode.

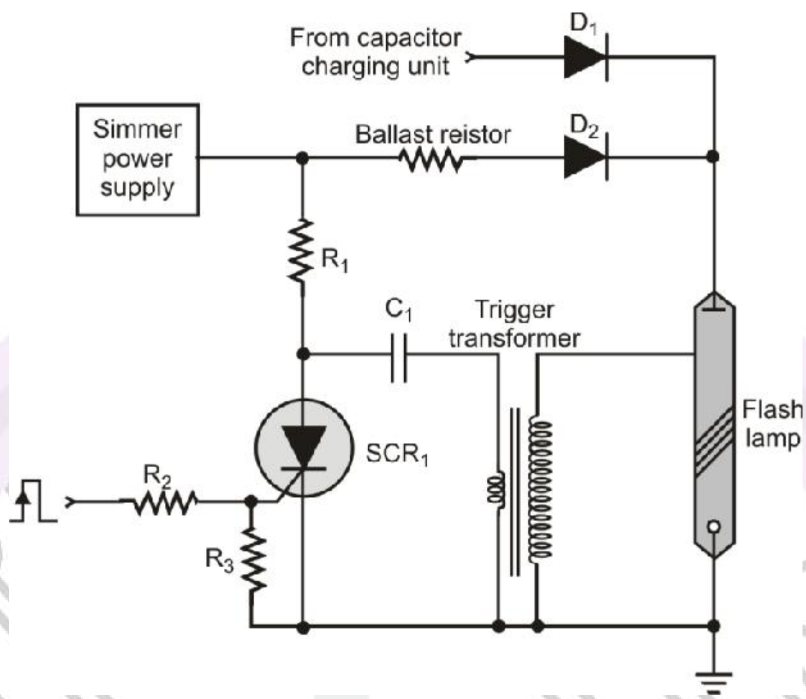

Figure 3.1
Simmer power supply schematic

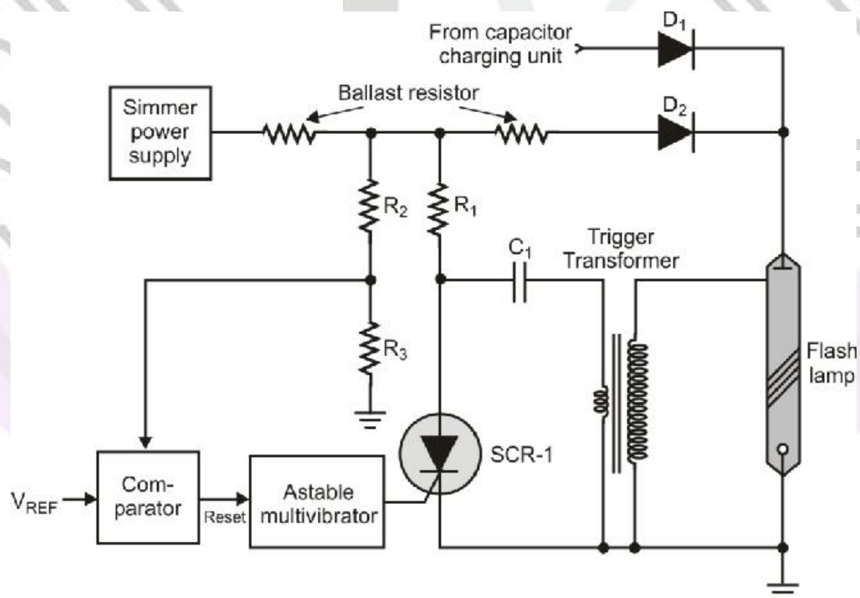

Figure 3.2
Modified simmer module

Figure 3.2 shows the block schematic of a simmer module that takes care of any eventuality of lamp getting extinguished during operation. The ballast resistance connected from the output of the simmer supply in series with the lamp is split as two series connected resistors and a part is used to monitor current through the flash lamp. The ‘off’ and ‘on’ conditions of the lamp are used to enable or disable an astable multivibrator, whose output, in turn, could be used to trigger the SCR-based HV trigger generating circuit. The repetition rate of the trigger pulses could be anywhere between 20 and 50 PPS.

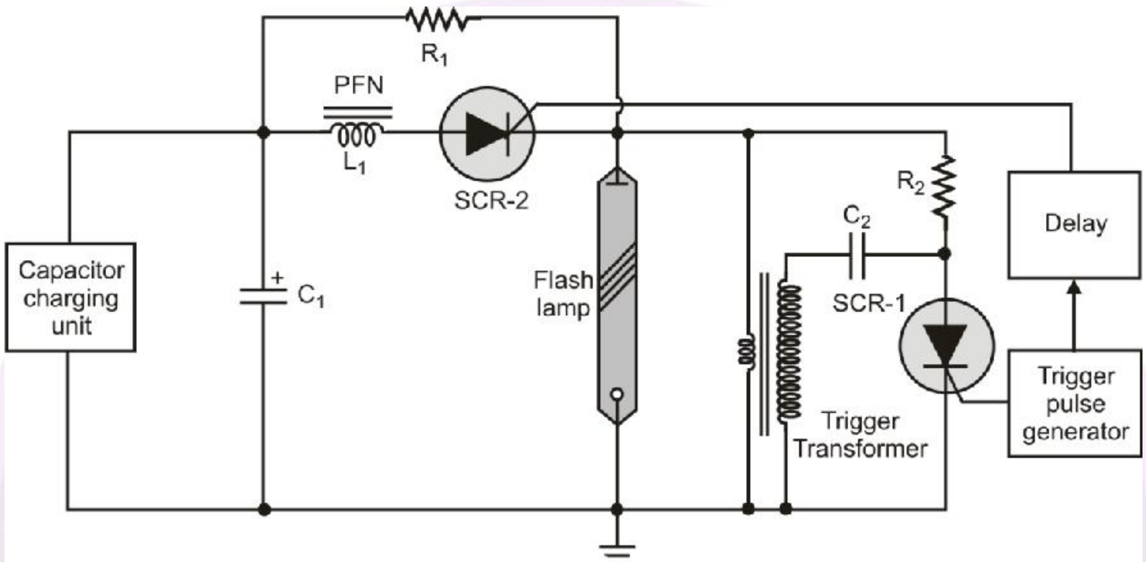

Figure 3.3
Pseudo-simmer module

Pseudo-Simmer Mode

For pulse repetition frequencies that are not very high, simmer mode of operation leads to significant power loss during the long time intervals between the two flashes. That is why; simmer mode of operation is usually preferred for pulse repetition frequencies in excess of 50 Hz. For relatively lower PRF, pseudo simmer mode of operation is employed. It has all the advantages of simmer mode of operation with some added circuit complexity. In this, the lamp remains in the non-conducting state for most of the time between two consecutive flashes and the partial state of ionization (or simmer mode) is activated about 100 to 200 µs before every flash trigger pulse. Figure 3.3 shows the typical schematic arrangement. Simmer initiation trigger pulse activates the partial discharge state. A delayed trigger pulse fires the SCR allowing the energy stored in the capacitor to discharge through the lamp producing a flash.

