L.11 Laser diode driver

The laser diodes are coupled together to make high power, bright diode arrays, which are then used to pump medium of solid-state laser. The peak optical output power from a laser diode varies linearly with the drive current after the threshold point. In a laser diode driver, no voltage/current spikes are permitted as it can cause irreversible damage to costly laser diode. Another serious electrical threat to laser diode is electro-static buildup. The power supply source to energize laser diode demands reliable protection and failure free operation. A power supply has been developed to energize a string of four laser diodes (type TH-Q1201-A1) rated to deliver a rectangular current pulse of 0-80A, with pulse width of 50-200μS and pulse repetition rate 1Hz to 1kHz.

The laser diode pulsed current source consists of two stages. First stage is a two-switch DC-DC forward converter switching at 100kHz. Output voltage of this stage is set manually depending upon number of laser diodes to be connected in series, which is regulated by a voltage feedback loop. In the second stage, a high-current MOSFET is used in a linear mode. In this mode, drain current of a MOSFET is a function of its gate bias. Thus for a fixed gate bias, this stage behaves as a true current source.

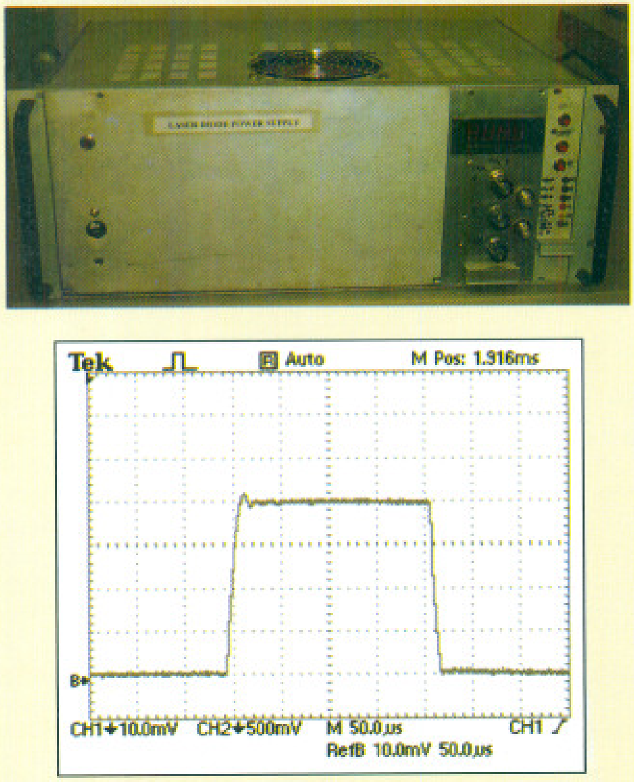

Fig. A.11.1 (a) Driver, (b) Current pulse waveform

The pulse width, frequency and amplitude of the current pulse can be independently set; the latter is regulated by a current control loop. Connection to the laser diode is made through a low-impedance laminated bus-cable to improve transition times in the current pulse as well as to reduce associated voltage spikes. Fig.A.12.1 (a, b) show the photograph of the laser diode driver and typical current pulse waveform (Scale: 50μS/div and 20A/ div).

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L.12 Drop tower furnace

Inertial confinement fusion (ICF) depends critically on high precision microspherical targets. Glass and polymer shells of large size up to 1000-micron diameter typically are needed for moderate size fusion experiments. The hydrodynamic efficiency and laser coupling efficiency improve with aspect ratio and peak values are reached at large aspect ratio of 350- 400. This implies a need for sub-micron to ~1-1.5 micron wall thickness for a 600 –1000 micron diameter shells. Fabrication of such small diameter shells with thin walls and stringent requirements on surface smoothness etc., needs specialized equipment. The large high aspect ratio targets (LHART) of glass as well as polymer is made using vertical drop tower furnaces.

A state-of-art vertical drop tower furnace has been successfully installed for making glass micro balloons (GMB). This furnace incorporates a 1.5meter long vertical hot zone, operating up to 1800 degree centigrade. The furnace works at sub-atmospheric pressure with inert environment and preset temperature. Dried gel granules fall under gravity through the furnace and are collected as high quality glass microballoons. The operating parameters of furnace and composition of granules can be changed to obtain GMBs with desired characteristics.

The drop tower furnace is developed by internationally known 'Thermonuclear Targets Group' at P.N. Lebedev Institute, Moscow. The procurement of furnace was initiated under IX th-Plan and represents one of the major achievements of joint collaboration between CAT and Lebedev Institute under ILTP.

Furnace was installed in December 2002, and has been operated since then regularly to produce high quality glass microballoons (see fig. L.12.1). While initial test runs used gel granules supplied by Lebedev Institute, Targets Laboratory developed their own granules using sol-gel technology. With this, the country joins select fusion research groups in the world, capable of making their own high quality glass micro balloons.