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Suppression of Current Leakage in Semiconductor Laser Diodes

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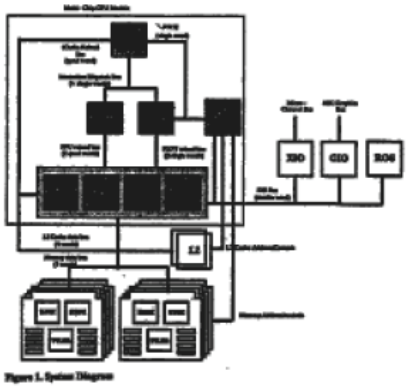
Current leakage is a serious drawback of semiconductor laser diodes. Not only an important part of the injected current is lost and does not contribute to the lasing process, but also current leakage affect strongly operation parameters such as threshold, efficiency, lifetime and thermal resistance. Also, reliability can be affected.

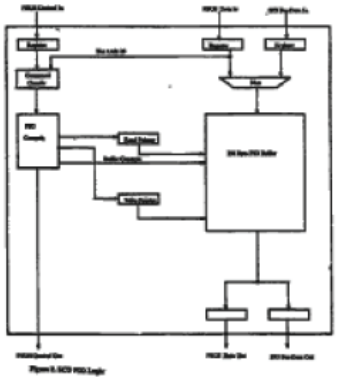
The leakage is due to a bad confienment of the current in the active region. Therefore, only part of it contributes to the lasing process (Fig. 1).

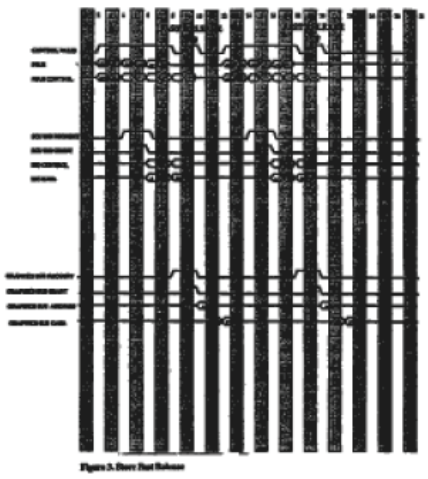
The leakage can be suppressed by improving the confinement of the current in the vicinity of the active region. This is achieved by replacing the normal planar backside contact of the laser by a tip-like contact (Fig. 2). Due to the "tip-effect", the current near the tip is contracted and directed towards the extremity of the tip (Fig. 2).

After standard laser fabrication of the top side of the wafer, a photolithographic mask is formed on the wafer backside aligned to the front side. This mask leaves openings underneath the active laser areas. Using wet etching, V-grooves are etched into the GaAs wafer through the mask openings. The etching process can be performed in such a way that it effectively stops at the A1GaAs cladding layer or at a layer purposely introduced into the vertical epitaxial structure.

After removal of the etching mask, a backside metal contact is evaporated using a tilted and rotating substrate holder. Finally, by electroplating the backside of the wafer, the V-shaped grooves are completely filled with gold.







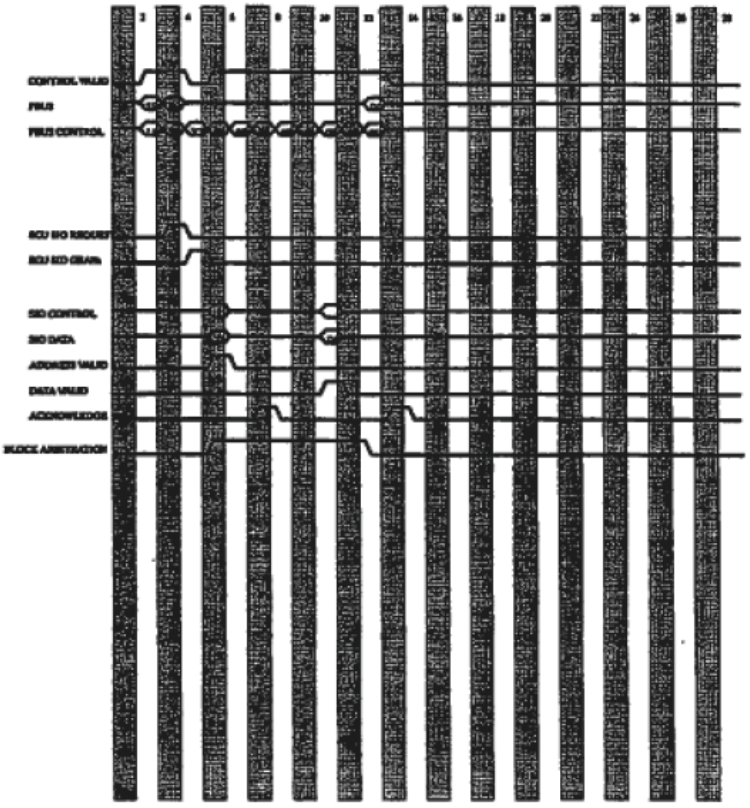


Figure 4. Load With No Disconnect