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Synchronization of Time Proceeding Axes and Laser Pulses for Spatially Precise Materials Processing.

ABSTRACT - Masterthesis

Picosecond laser ablation is an emerging method in the field of material processing with pulse repetition rate up to 1 MHz and with high average power. Solid state picosecond lasers are able to achieve cost effective, high quality micro laser machining, with picosecond pulses there will be a little or no heat affected zone when machining. Compared to femtosecond laser, picosecond laser performs ablation 5 times faster. Helios OEM laser is a raw picosecond laser which has to be incorporated in 3D micromac CNC laser machine for material ablation. All the axes, scanner and I/O ports of 3D micromac laser machine are controlled by Aerotech A3200 drivers via computer software. In 3D micromac machine material processing can be done with respect to the motion of axes system. The position of the material on certain axis can be acquired from "Position Synchronized Output" of axes. The PSO can acquire and analyze the positions up to 32 axes motion on A3200.

A hardware circuit unit can be used to trigger the Helios OEM laser with respect to the motion of axes. This circuit unit should have capability to limit the PSO counting according to user application. The whole circuit unit is divided into three subsystems, among those one takes the defined pulse count from user and stores in binary counter. Another subsystem is connected to PSO port of Y-axis and stores the pulse count from PSO. Third subsystem consists of logical gates arranged to compare the pulse count from first subsystem with second subsystem. The logical gates are connected so that whenever PSO count reaches user defined pulse count the output must go HIGH and this HIGH signal is used as a trigger signal for Helios laser. A small circuit is designed to RESET PSO subsystem after getting a trigger signal. Whole circuit is operated under 5 Volts power supply.

A D flip-flop is used to hold the HIGH signal from logic circuit before resetting PSO counter. Using this electronic control unit Helios laser can be used for ablation on materials. The relation between the axes speed and the laser pulse distance can also be calculated.