

32-channel Spatial Light Modulator Driver Subsystem

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The second most important component of a high-speed Analog Spatial Light Modulator (SLM) system is the drive electronics. This driver is responsible for providing a high-speed user-friendly interface between the user's data and the SLM optical head while maintaining proper signal conditioning to optimize the performance of the SLM. This paper describes the basic principles used in our 32-channel driver used for our analog liquid crystal 512x512 pixel SLM.

Background

The drive subsystem of the Spatial Light Modulator (SLM) system is designed to provide an interface between the drive computer or camera system and the SLM head. This subsystem provides an electrical and software interface necessary to present analog information to the SLM at the proper rate and with the proper program control.

The 32-channel driver consists of several different components, all designed to work together. These components are divided into three functional and physical blocks, shown in Figure 1, the Interface Board, the Driver Board and the Signal Conditioning Board.

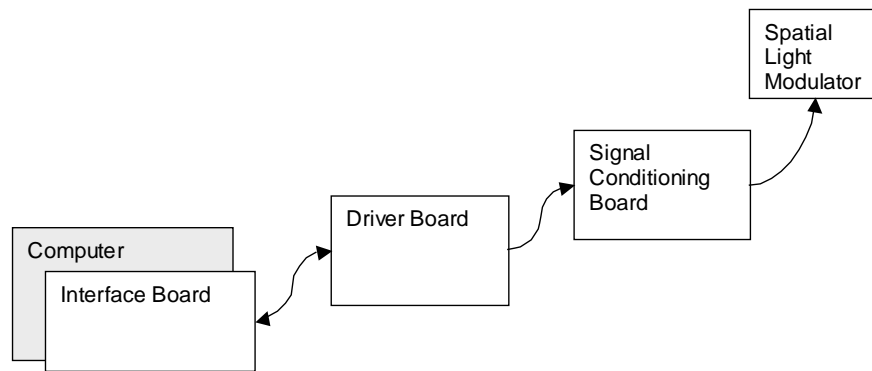


Figure 1 - Functional block diagram of the 32-channel driver.

Interface Board

The Interface Board plugs into a full-length PCI slot in a standard PC type of computer chassis. This board, as the name implies, provides the external interfaces to the SLM driver system. There are two types of interfaces provided. The simplest is via the PCI bus and allows the user to load data already located in the computer directly into the SLM system. This data can be loaded either directly to the SLM, or into a bank of memory that can be configured as large as 512-MBytes. Data loaded into memory can then be randomly displayed to the SLM in any order or speed the users chooses.

The other interface is via an external 128-bit data port located on the PCI card. This is designed

as a modular interface such that a new interface can be defined by developing a new daughter board that plugs directly into this 128-bit data port. The functionality of the daughter boards can range from a simple RS-170 video interface to a much more complicated high-speed digital camera interface. The possibilities are limited only by the format and data rate of the SLM.

Integration Signals

The Interface Board also provides electrical signals that are useful when integrating the SLM into highly integrated optical systems. These signals can be used for modulating a laser diode, driving a light shutter, triggering a detector, or other similar timing purposes. In addition to these signals, a standard synchronization signal is available to coordinate the display of two or more SLMs, or to synchronize an SLM with an external hardware input.

Driver Board

The Driver Board contains the nuts and bolts to keep the SLM running. This includes an asynchronous interface to the Interface Board, analog conversion circuitry, and logic inversion circuitry for providing the SLM with the required DC-balanced drive signal. This board also includes the timing logic for maintaining exact timing on the data clocking into the SLM to insure a properly DC-balanced drive signal. The Driver Board can receive data from the Interface Board at rates up to 2.13-Gbits/s, and is always sending data to the SLM at an effective rate of 12.8-Gbits/s. As an example, for the 512x512 SLM, the board generates a new image rate of 1015-Hz and a data refresh rate of 6092-Hz. This board is mounted in an anodized aluminum housing that is 4.125" x 8.125" x 1.563".

Signal Conditioning Board

The Signal Conditioning Board receives data from the Driver Board and provides for gain and impedance matching between the Driver Board and the SLM itself. This provides the SLM chip with the appropriate voltage levels for both power and data lines, while also providing the appropriate voltage level to the cover-glass of the SLM assembly. The Signal Conditioning Board is 3.25" x 3.25" and is attached to the back of the integrated tip/tilt stage.

Spatial Light Modulator

The Spatial Light Modulator receives data, power and control signals from the Signal Conditioning Board. The SLM chip is mounted in a ceramic Pin Grid Array (PGA) package. This PGA package connects to the Signal Conditioning Board via a Flexible Circuit cable. The size of the PGA and Flexible Circuit cable vary from one SLM type to another, but in all cases the length of the Flexible Circuit cable is approximately 4". The PGA attaches to an anodized aluminum housing mounted to the integrated tip/tilt stage.

System Interface

The 32-channel SLM Driver Subsystem provides a very high-speed interface to a BNS analog liquid crystal SLM. This subsystem is designed to allow easy integration with both hardware and software. This is done via a user-friendly PCI-based architecture that provides a very simple software interface and convenient hardware interrupts to the computer system. All critical timing functions and power are handled automatically to prevent damage to the SLM chip. This driver represents the pinnacle in current technology for liquid crystal spatial light modulators.