High Speed Addressing

White Paper

Why Choose BNS?

BNS has been continuously developing liquid crystal spatial light modulators for over 15 years. Through this development process, there has been an advancement of SLM performance not matched by other SLM manufacturers.
Such performance enhancement includes:

1) Sub-millisecond frame loading to prevent phase droop and addressing latency;
2) 100% fill factor to reduce higher-order diffraction;
3) Intra-pixel-pair modulo-2 π transitions to maximize space bandwidth product;
4) Unique LC modulators.

High-speed Addressing

BNS loads every pixel with an 8-bit control signal several times per millisecond. This high speed addressing scheme eliminates phase droop as demonstrated in Figure 1. In Figure 1, oscilloscope traces from a high speed detector show the temporal response of an Electrically-Controlled Birefringent (ECB) modulator being addressed at different rates. The ECB modulator is placed between crossed polarizers with its optic axis at 45° with respect to the polarizers. As shown in Figure 1, there is significant datadependent ripple caused by slowly addressing the modulator (left trace). That is, the rate used to toggle the field driving the ECB modulator is slower than its free relaxation response. The ripple represents a
phase error when the ECB modulator is used in its phase-only mode (input polarization aligned with ECB modulator's optic axis). To eliminate the ripple, the toggle rate needs to be several times faster than the modulator's response (right trace). This requires active matrix backplanes and drive electronics capable of sub-millisecond load rates.

Phase droop and pattern latency is a problem for several applications such as holographic beam forming where the integrity of the phase pattern over the whole array determines the outcome. Phase droop increases when ECB modulators with a fast free relaxation time are used to decrease pattern latency. Less pattern latency improves system operation, since SLM response times are a limiting factor in real time applications. The way to address both issues is to use sub-millisecond drive schemes and faster LC modulators (refer to the section on unique LC modulators).

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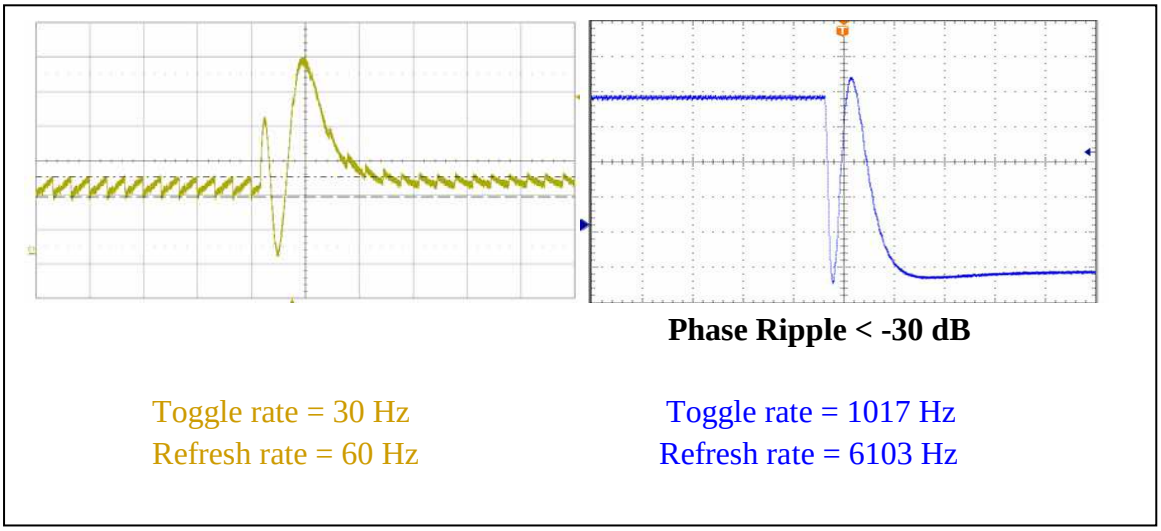

Figure 1 ~ ECB modulators addressed at different rates. The left trace shows a strong data-dependent ripple that is synchronous with the video rate addressing period. The right trace shows the ripple being suppressed by sub-millisecond refresh rates.

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