Single Lens Color ILA® Projector

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INTRODUCTION

To meet the growing demands of the large screen projection market a new single lens color ILA® projector was developed. In addition to its motorized-zoom lens, this projector has 100V input power operation, multi-scan capability, on-screen menus, and simultaneous high brightness and high resolution. Many technological hurdles were overcome during the joint development of this projector.

OPTICS

A 750W xenon arc lamp was chosen as the illumination source because of small arc size and a broad, stable output spectrum. Safety is insured against mechanical lamp failure during replacement by integrating the condenser lens, lamp, and reflector in a self-aligned modular housing.

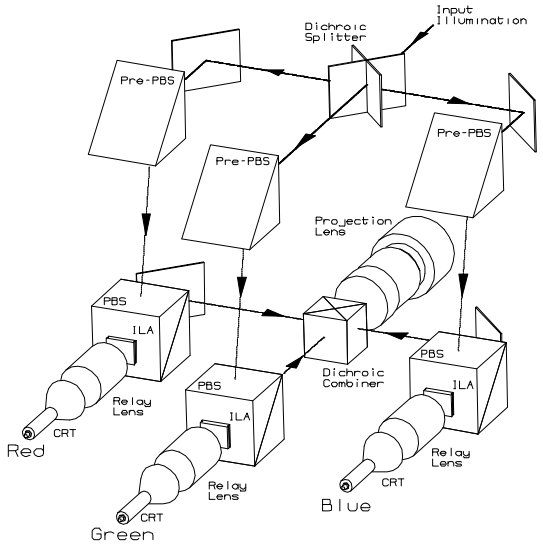

Figure 1. Schematic of light path through optics.

The color combining prism uses crossed dichroics formed from four separate BK7 triangle prisms with very high transmittance and little alteration of characteristics for angle of incidence. High resolution requirements demanded extreme precision and very small angular error in assembly. For this an improved manufacturing process was created.

Contrast is maximized by the use of a 54.6° angle in the polarizing beam splitter. For best performance the PBS is immersed in a special optical fluid having the same index of refraction as the glass. A special assembly process was needed to prevent minute dust particles and smudges which could adversely affect picture quality.

Development of a new high resolution 2:1 zoom ratio projection lens was successfully achieved with a long back focal length and a full color spectrum. Special attention to coatings reduced ghosts and maximized contrast.

A high efficiency and compact 1:0.8 relay lens design eased the requirements of the CRT allowing a lower beam current and thus a smaller spot size. Careful system design tradeoffs such as this maximized resolution while minimizing costs.

A new high performance projection type 3.5" CRT was developed specifically optimized for driving an ILA®. Improvements in spot size were accomplished by using a small diameter G1 electrode. To facilitate this in manufacturing the side pin method of mounting electrodes was adopted for consistency and a round spot. A special fine grain IR phosphor required the use of a centrifugal sedimentation technique for deposition to minimize spot size growth due to scattering by the phosphor itself.

MECHANICS

An rigid and lightweight aluminum chassis provides a stable platform for optics and electronics. Plastic covers offer both styling and easy access for maintenance. Removable adjustment feet allow for upside-down mounting.

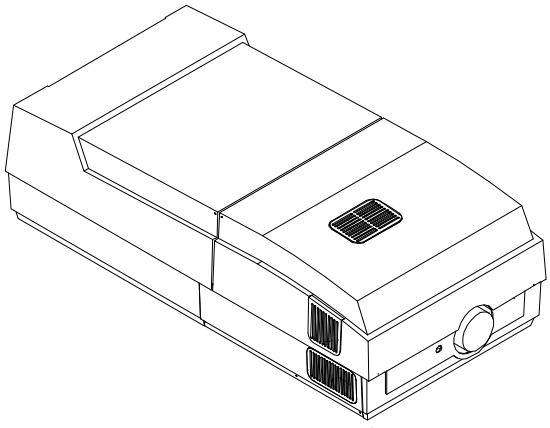

Figure 2. External view of single lens ILA® projector.

Serviceability was achieved by a modular design approach. A card cage in the rear contains all of the electronics except for the video output amplifier. Each board is easily removed and replaced. The card cage is hinged and swings up to reveal access to the CRTs, relay lenses, and ILA®s. The front cover opens for lamp module replacement. Careful grounding and placement of the power supplies near the front, away from the CRTs, reduced image noise.

ELECTRONICS

The electronics and software were designed to maximize both performance and operator ease-of-use. A cascaded on-screen menu system similar to Windows™ provides a powerful interface to the operator. The genlocked menus include built-in test patterns facilitating setup. A simple 22 key remote control links via IR or a tether for rear screen applications. An optional Technician's remote is available with advanced keys to bypass menus for the experienced operator.

Convergence is digital using proprietary variable analog (post DAC) filtering circuits and a curved interpolation algorithm based on a serpentine. Fast operation is insured by the use of a RISC processor with built-in DSP. FLASH type memory for both program and data allows field upgrades of software through the RS-232 port and provides enough storage for 99 channels.

Three Video Input Card (VIC) slots allow custom configurations of video inputs. There are presently four different VICs available: a standard single channel RGBHV, a quad-standard video decoder, a YPbPr HDTV processor, and a 4:1 RGBHV input switcher. Adjustable analog gamma correction circuits guarantee high quality gray scale and color tracking performance.

PERFORMANCE

These developments and improvements in ILA® projection technology result in a display with very high picture quality. The non-pixelated image structure assures maximum information presentation without the addition of moiré, scintillation, or other artifacts introduced by competing technologies.

Measured performance meets or exceeds the specifications listed in Table 1.

Item	Specification
Resolution	1280 x 1024 pixels, >900 HDTV lines
Brightness	1200 lumens
Contrast (sequential)	>200:1
Color temperature	5400°K
Horizontal scan rates	15kHz to 90kHz (auto)
Vertical scan rates	45Hz to 120Hz (auto)
Video bandwidth	100MHz
Size	126cm x 82cm x 41cm
Input power	1500W maximum

Table 1. Specifications.

Measured projector performance for MTF and color gamut are shown in Figures 3 and 4 respectively.

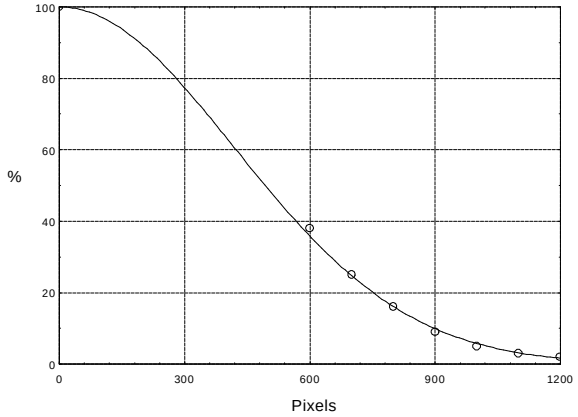

Figure 3. Measured horizontal MTF.

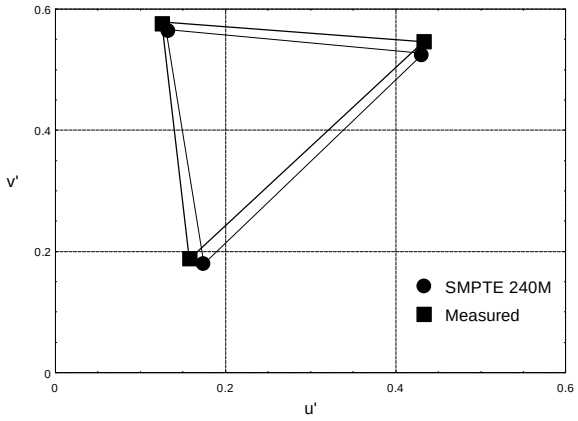

Figure 4. Measured color gamut.

SUMMARY

This projector represents the latest generation of ILA® based displays. Improved technology and new developments in optics, CRTs, mechanics, electronics, and software resulted in a smaller, easier to use, and high quality projector.

ACKNOWLEDGMENTS

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REFERENCES

1. W. P. Bleha, Symposium Record of the 18th International Television Symposium — Montreaux, June, 1993.