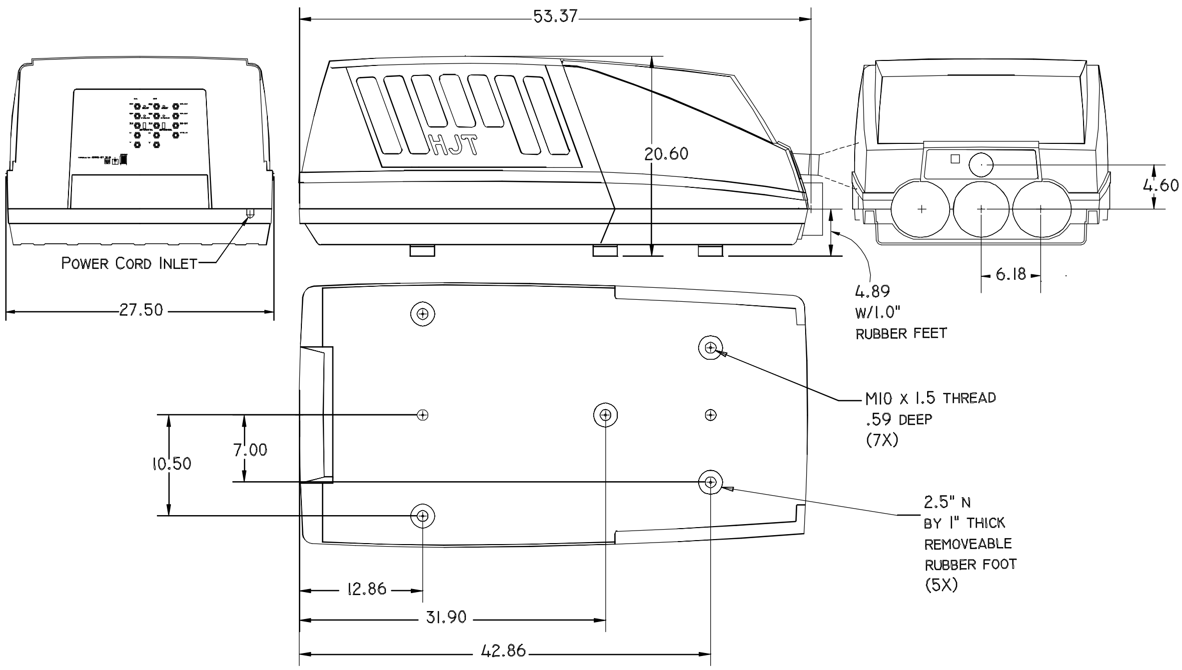
2.0 System Description

Contents

2.1 Features of the Series 300 Projector

The Series 300 Projector (Models 310E, 315, and 320) is housed in an enclosure 20.6 inches high, 27.50 inches wide, and 53.37 inches deep (see *Figure 2-1*). The dimensions for Model 335 vary slightly, due to the larger arc lamp. Information pertaining specifically to the Model 335 is contained in a separate supplement included with each Model 335 projector.

MODEL 320/310E OUTLINE & MOUNTING DIMENSIONS



MODEL 335 OUTLINE & MOUNTING DIMENSIONS

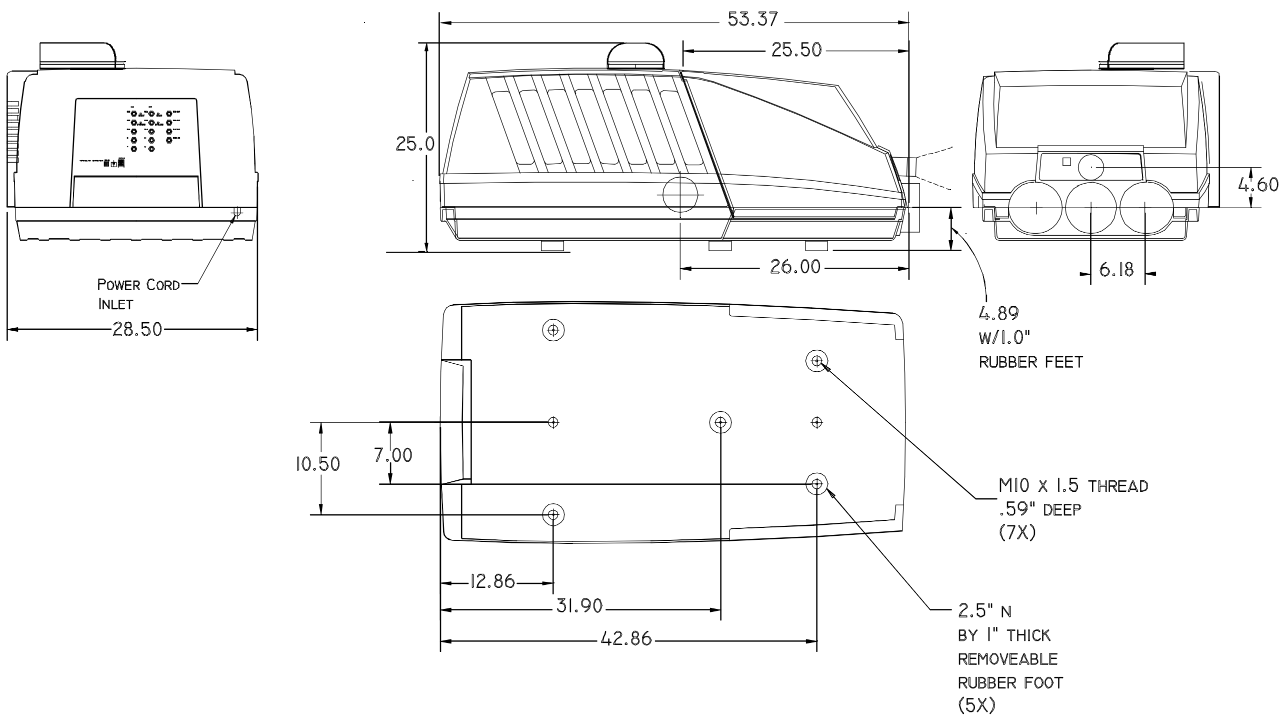


Figure 2-1. Projector enclosure dimensions

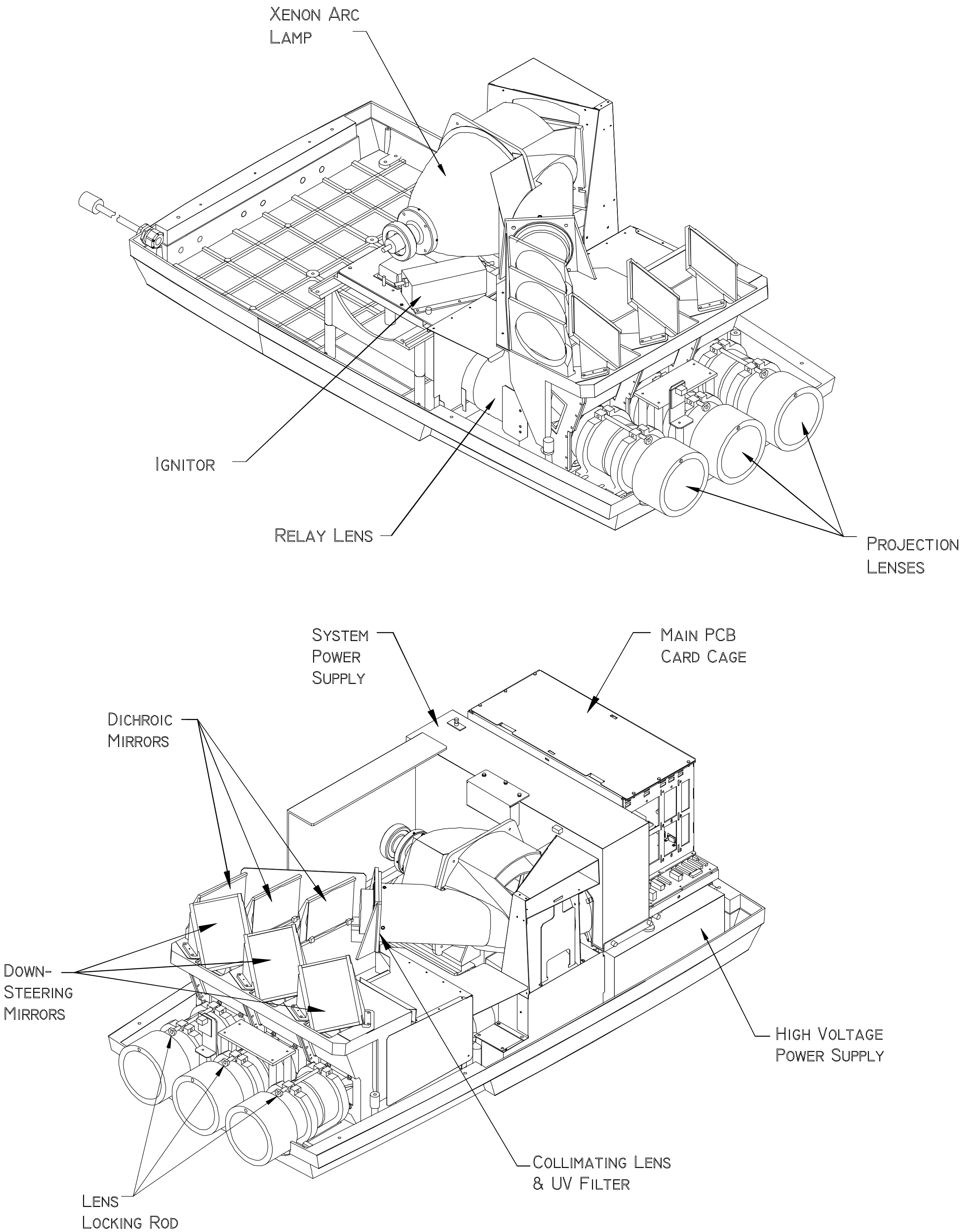


Figure 2-2. Major components of the Series 300 Projector.

The Series 300 housing is divided into three main sections:

- The **Optics path** includes the relay lens, Image Light Amplifier, prisms, projection lens, dichroic mirrors, down-steering mirrors, an ultraviolet filter and a condensing lens. The Optics assembly is located in the front area of the projector.
- **The Arc Lamp section** occupies the right, center area of the unit. It contains the arc lamp, elliptical reflector, arc lamp ignitor circuit assembly and a "cold" mirror. (The term "cold mirror" is used because the mirror passes infrared light through it so that its reflection contains only "cold' light that does not transmit appreciable heat. As a result of this absorption of infrared heat radiation, "cold" mirrors can get quite hot.)
- **The Electronics** area contains the electronics circuit boards, high voltage power supply, system power supply and 3 CRT assemblies. It is located in the rear area of the projector.

2.2 Optics Assembly

The Optics assembly divides white light into its three color components, red, green and blue, modulates the light to form three single color images and then transmits the light to the projector screen. The Optics assembly contains three sets, (for red, green and blue), of relay lenses, image light amplifiers, prisms, dichroic mirrors, down-steering mirrors and projector lenses and one ultraviolet filter/condensing lens. The explanation that follows is the same for the red, green or blue optical path. *Refer to Figure 2-3*.

CAUTION!!!

The alignment of system optical components is critical. Replacement of individual mirrors or prisms requires removing the projector cover and must be performed only by Hughes Certified technicians. Consult the factory before removing or aligning any mirrors or prisms.

Relay Lens: The relay lens picks up the video image from the face of the CRT and focuses the image to the **ILA**® assembly.

Image Light Amplifier (ILA®) Assembly: The CRT video image is received from the relay lens on the input side of the **ILA**® assembly. The input and output sides of the **ILA**® assembly are isolated from each other electrically and optically but are coupled electrostatically. This means that the video image signal on the input side of the **ILA**® assembly is sensed on its output side, (through the liquid crystal material), and modulates (changes) the outgoing signal.

At the same time as the video image is received at the input side of the **ILA**® assembly, the output side of the **ILA**® assembly is receiving high intensity light from the arc lamp through the prism. This high intensity light is then phase modulated (altered) by the video signal from the input side of the **ILA**® assembly and then reflected back out of the output side and then travels through the prism to be picked up by the projection lens.

NOTE: The prism reflects horizontally polarized light and passes vertically polarized light. Light from the arc lamp is polarized horizontally and reflects from the prism into the **ILA**® assembly then back out again, after being phase modulated by the video signal into vertically polarized light. The vertically polarized light then passes through the prism to the projector lens. The **ILA**® assembly combines the video signal from the CRT with the high intensity light from the arc lamp. Thus, the brightness of the video image does not depend on the brightness of the CRT but on the light from the xenon arc lamp. (A more detailed explanation of how the **ILA**® assembly works is in Section 2.5 at the end of this chapter.)

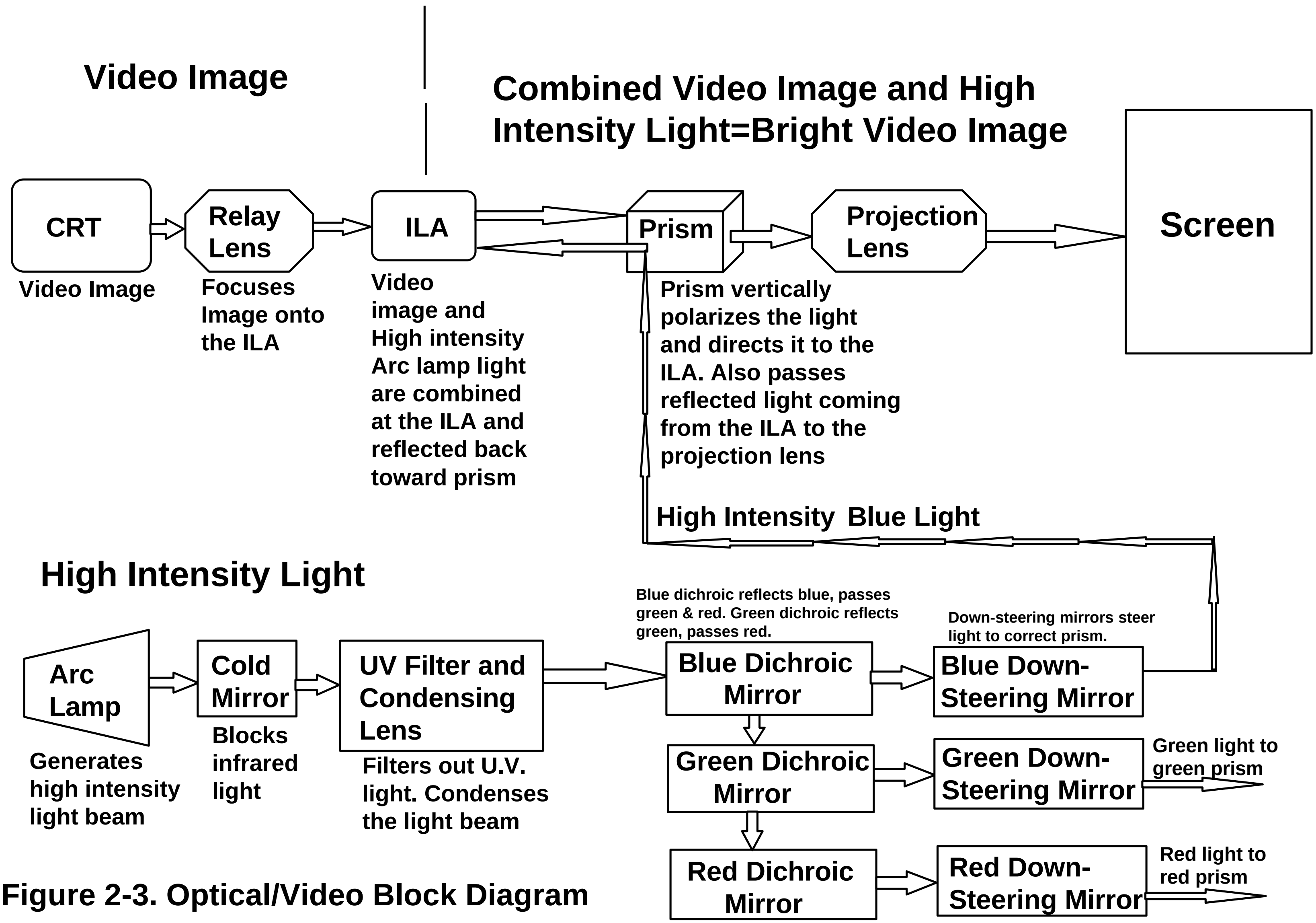


Figure 2-3. Optical/Video Block Diagram

Prism: The prism receives the high intensity light from the xenon arc lamp and polarizes the light horizontally. The prism reflects virtually all of this light toward the **ILA**® assembly. This light is then phase modulated into a vertical plane by the video image on the input side of the **ILA**® assembly and then reflected back toward the same prism. Since the prism reflects only horizontal light and passes vertical light, this high intensity, vertically polarized video image goes straight through the prism and into the projection lens.

Projection Lens: The projection lens picks up the high intensity video image from the prism and transmits it to the projector screen. The projection lenses are individually mounted so they can be focused and aligned separately. The green lens is fixed horizontally and the red and blue lenses allow horizontal movement to align them with the green lens. Various focal lengths, (focal length=throw distance/screen width), are available for different sized rooms and screens, (*see section 3.6, under "Lens Selection"*).

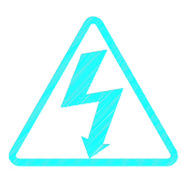
Dichroic Mirrors, Down-Steering Mirrors, Ultra-Violet Filter and Condensing Lens: For a better understanding of the optical flow, these are described in the Arc Lamp section below.

2.3 Arc Lamp Section

The Arc Lamp section produces the high intensity light used to transmit bright video images to the screen. It consists of a Xenon Arc Lamp containing xenon gas under 50 psi pressure when cold, (several times that when hot), an ignitor assembly that provides the spark to light the arc lamp, and a cold mirror to reflect light toward the prism. Cooling fans blow directly toward the arc lamp. The description below is in the sequence of the light path. (*See Figure 2-3)*.

WARNING!!!

The ignitor circuit contains high voltages and high currents capable of causing severe injury.



Ignitor: The Ignitor circuit provides a momentary High Voltage, (40,000 volts), which excites the xenon gases inside the Xenon Arc Lamp. After the arc lamp is struck and turns on, it is maintained by a high-current, low-voltage, (approximately 65 amps and 23 volts) power supply. The arc lamp ignitor circuit is mounted next to or under the arc lamp.

WARNING!!!

The Xenon Arc Lamp produces high intensity white, ultraviolet and infrared light capable of severe eye injury. **Never look directly at or touch the Xenon Arc Lamp. Service is for Hughes-JVC certified technicians only.**

Xenon Arc Lamp and Reflector Assembly: High pressure, ionized xenon gas supports a high-current electrical arc to produce the intense, white light used in the Series 300 projectors. The high intensity light output from the xenon arc lamp is reflected by a elliptical metal reflector to a cold mirror.

NOTE: To protect equipment and personnel against explosion hazard, the arc lamp is covered with a safety glass plate and is mounted in a protective metal housing. This housing provides protection and ensures accurate alignment of the arc lamp optical axis with the projector housing by means of machined surfaces and precision alignment pins.

Cold Mirror: The Cold Mirror lets most of the infrared light pass through and reflects the rest of the light toward the prism through an ultraviolet filter/condensing lens, dichroic mirrors and down-steering mirrors. The infrared light is absorbed in a series of fan-cooled screens.

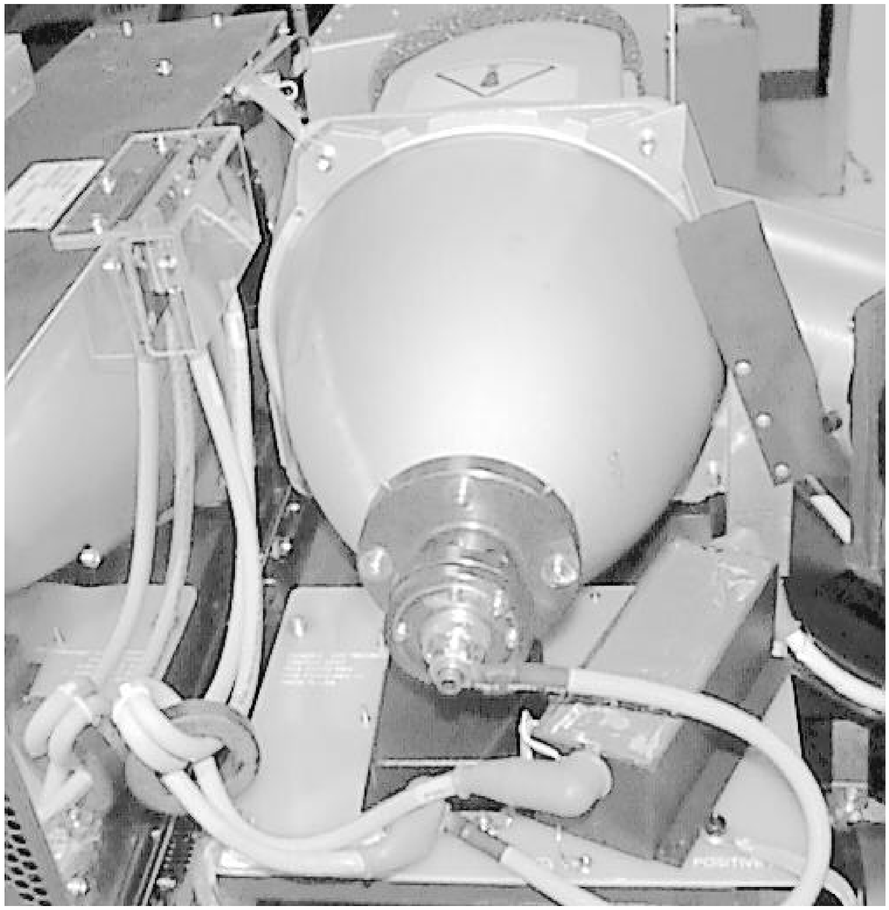


Figure 2-4. Xenon Arc Lamp Assembly (Model 320).

Ultraviolet Filter and Condensing Lens: The arc lamp light beam reflected off the cold mirror passes through the Ultraviolet Filter/Condensing Lens which removes most of the Ultraviolet light and condenses the light beam. Therefore, most of the infrared and ultraviolet light is filtered out before the beam enters the more sensitive portions of the optics, leaving only the visible portion. Without these filters, the infrared light would overheat the prisms and the **ILA**® assemblies, and the ultraviolet light would damage the **ILA**® assemblies and be hazardous to personnel.

Dichroic Mirrors and Down-Steering Mirrors: The condensed light beam strikes the first dichroic mirror which is designed to pass red and green light but reflect blue light. The blue light is reflected to a down-steering mirror which reflects it again directly to the prism in the blue system. The red and green light travel on to the next dichroic mirror which passes the red light and reflects the green light to the down-steering mirror and prism in the green system. The red light travels on to the last dichroic mirror which reflects the remaining red light to the last down-steering mirror and prism in the red system. Each of these three light beams independently combine with the video image in their own (red, green or blue) color systems at the **ILA**® assemblies as described in the optics Section **2.2** above.

CAUTION!!!

Do not attempt to realign any of these mirrors. They require the use of a complex laser beam alignment fixture.

2.4 Electronics

The electronics section provides all the controlling voltages and signals to adjust and correct for position, size blanking etc. as described in Chapter 4. All necessary voltages are also provided for the CRTs, raster, and video.

The projector's electronics are located primarily at the rear of the projector. They include the High Voltage Power Supply for the three CRTs, the Printed Circuit Assemblies and Card Cage, three Video Amplifiers, three CRTs, the System Low Voltage Power Supply, and the I/R Receivers.

Figure 2-5 shows the location of the pnted circuit boards in the Series 300 card cage. The card cage printed circuit boards contain the CRT and **ILA**® assembly controls as well as memory and logic circuits for interface between the controlling microprocessor and the CRT and video circuits.

HORIZONTAL DEFLECTION BOARD
VERTICAL DEFLECTION BOARD
SYSTEM CONTROL BOARD
RASTER TIMING GENERATOR BOARD
VIDEO PROCESSOR BOARD

Figure 2-5. PCB Card Cage. Projector rear is at bottom.

The **System Power Supply** is located in a separate section just in front of the circuit board card cage (*see Figure 2-2*). It provides all the source voltages required by the electronic circuit boards, ignitor, arc lamp and the high voltage power supply. In the standby mode it provides the voltages necessary to operate the fans and the System Controller Board.

The **High Voltage Power Supply** is located in a separate section next to the CRT assembly area (*see Figure 2-2*). It provides the high voltages necessary to operate the three CRTs.

The **System Controller Board** controls the electronics system and is the brains of the Series 300 Projector. It contains digital and analog circuits that direct and control the operation of video and raster circuits, input/output data, power supply operation and camera operation. The System Controller Board receives commands, interprets them and then issues internal commands. It sets the limits of the video system such as brightness and contrast. It also produces internal test patterns and generates on-screen displays. Raster and video data such as phasing, geometry, threshold, sensitivity and convergence are all controlled by the System Controller Board.

The **Raster Timing Generator** provides timing signals to the System Controller Board, selects the appropriate incoming sync signal and produces the timing signals for controlling the raster geometry and convergence. An internal HDTV (High Definition Television) sync source is also provided by the Raster Timing Generator for use when an external source is not available.

The **Vertical Deflection Board** provides for the vertical sweep of the raster and the correction functions for vertical and horizontal directions. The corrections provided for are pincushion, keystone, vertical height, vertical centering (for Green, Blue and Red) horizontal edge linearity and overall linearity. Convergence correction is also performed with information imported from the System Controller Board.

The **Horizontal Deflection Board** provides the drive to the horizontal deflection coils to produce the horizontal sweep of the raster. It also works in conjunction with the System Controller Board to control width, horizontal centering (for Red, Green and Blue) side pincushion and keystone correction.

The **Video Processor Board** controls, amplifies and modifies video signals by selecting the video source (internal or external) and adjusting its contrast and brightness to produce the best picture. It performs shading corrections, **ILA®** assembly biasing, gamma correction and provides for taking in video and sync inputs from any of four sources (RGB1, RGB2, Composite or S-Video).

There are three separate **Video Amplifier Boards,** one each for the Red, Green and Blue CRTs. They are located just behind the CRTs (the CRTs plug into them) in the CRT Assembly. The **Video Amplifier Boards** amplify the video signal and direct it to the CRT. They provide the power amplification needed to take the small video signal output from the Video Processing Board and use it to control the CRT image. The Video Amplifier Boards also provide for protective CRT beam shutdown.

The **CRT Assembly** is located beneath the circuit board card cage. It contains the three CRTs, their related yokes and the three Video Amplifier Boards. Mechanical alignment of the CRTs is accomplished by adjusting their associated focus rods at the rear of the projector as shown in Section 4.8.

2.5 Image Light Amplifier Technology

What is an "Image Light Amplifier"?

An Image Light Amplifier (**ILA®**) assembly is a device that uses low-intensity images to phase modulate a high-intensity light through a liquid crystal layer. It is the key component in producing very bright, high resolution images from Hughes-JVC large-screen projectors. The **ILA®** assembly itself is about the size of a deck of cards (*See Fig. 2-6*).

Why use an Image Light Amplifier? In the Hughes-JVC Series 300 Projector System, by incorporating the Image Light Amplifier, the brightness of the projected image is not produced by the CRTs, as it is in other projectors, but is produced by a separate projection arc lamp. This factor makes it possible to project an image with high light output and very high resolution.

How Does an Image Light Amplifier Work?

Optically, there are two sides to an **ILA®** assembly (a light-blocking layer is in the center). On the input side there is an amorphous silicon photo conductive layer where the image from a high resolution cathode ray tube (CRT) is focused. This image is electrostatically coupled through the light blocking layer and mirror to a liquid crystal layer on the output side of the **ILA®** assembly.

High intensity light from a xenon arc lamp is sent through a prism assembly where it is polarized and then sent to the output side of the **ILA®** assembly where the liquid crystal layer is located. The polarized light passing through the liquid crystal is phase modulated, then reflected back out of the **ILA**® assembly, into the prism assembly, then projected onto the screen.

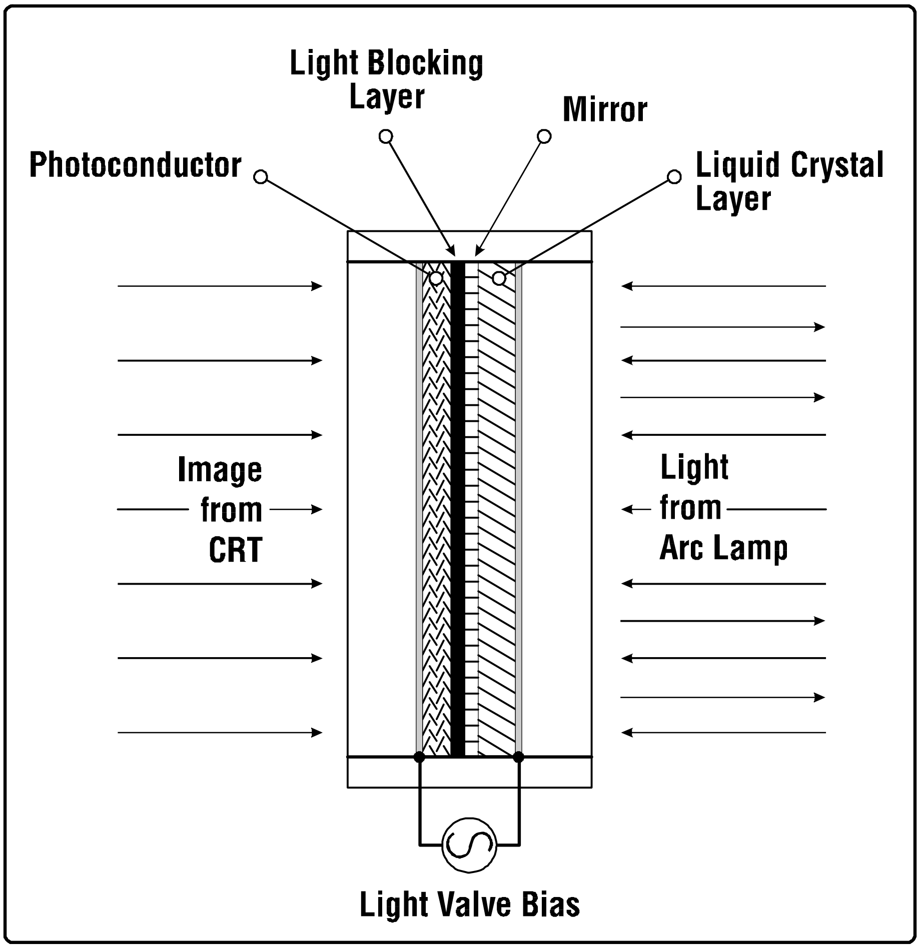


Figure 2-6. The Hughes-JVC Image Light Amplifier.

A closer examination of the output side of the **ILA**® assembly helps in understanding its operation (*See Figure 2-6*).

- Visible light from the arc lamp passes through dichroic mirror assemblies and is then reflected into a prism assembly which polarizes the light horizontally. The horizontally polarized light is sent through the liquid crystal layer of the **ILA**® assembly, reflected by a dielectric mirror surface, and then sent back through the liquid crystal layer on the way out of the **ILA**® assembly.
- The polarized light is phase modulated, or rotated, up to 90º by the liquid crystal layer; 45º of rotation for the first pass through, and another 45º after being reflected by the internal mirror.

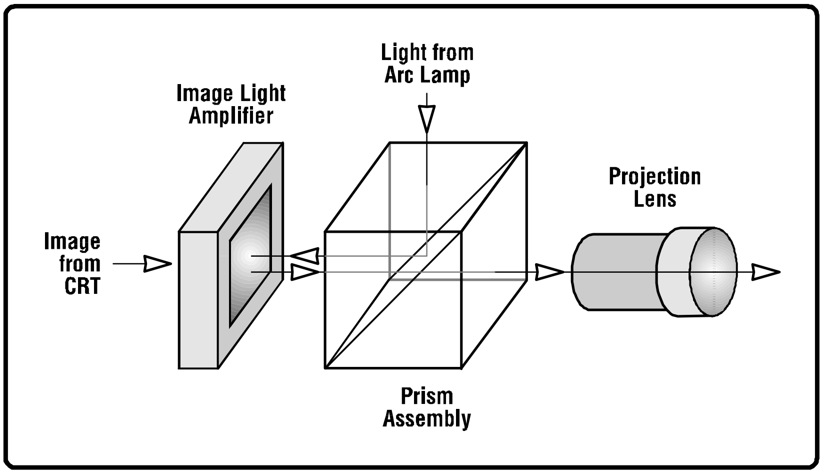


Figure 2-7. A simplified illustration of the Series 300 Projector optical path.

- The axis of the polarized light is proportional to the brightness on the input side of the **ILA**® assembly. For example, when the photoconductor on the input side is not illuminated, the liquid crystal does not rotate the polarized light from the arc lamp. Conversely, when the input side is fully illuminated, the liquid crystal rotates the polarized light a full 90º from a horizontal direction to a vertical direction. Ninety-nine percent (99%) of the light energy entering the **ILA**® assembly is reflected.
- The phase modulated light exiting the **ILA**® assembly re-enters the prism assembly which, in this direction, passes vertically polarized light to the projection lens and onto the screen. Horizontally polarized light re-entering the prism assembly is rejected. Light that is not fully horizontally or vertically polarized will pass through the prism assembly in varying degrees of brightness.

Do ILA® Assemblies Produce a Particular Color Like CRTs?

No. All **ILA**® assemblies in a Hughes-JVC projector are interchangeable and are not color specific.

How Many ILA® Assemblies are in the Series 300?

There are three **ILA**® assemblies in each projector. There are also three CRTs, three prism assemblies and three projection lenses. The red, green and blue (RGB) color components are processed separately and are then converged on the screen.

How are the RGB Signals Processed?

With the exception of the **ILA**® assemblies, arc lamp and special optics, the Series 300 Projector has the same basic components as a standard CRT projector.

Everything from the CRTs back to the rear of the projector will be familiar to a technician with experience on traditional projectors. The three CRTs used in the projector use the same phosphor color and are interchangeable. Each CRT is sent a specific red, green or blue signal, but there is no need for the CRTs to emit a red, green or blue color as required by traditional projectors.

The CRTs in the Series 300 are not being used as a light source for the projected image (which also means they do not need to be pushed too hard for maximum luminance). Light output to the screen is the job of the xenon arc lamp. Essentially, the purpose of the CRTs is to generate an image and control the degree to which the **ILA**® assemblies modulate light from the arc lamp.

How are the Colors Produced on Screen?

The white light of the xenon arc lamp is separated into Red, Green and Blue by means of *dichroic mirrors* (dichroic mirrors reflect only one color and pass all others). The first of three dichroic mirrors reflects Blue light to the Blue **ILA**® assembly through a down-steering mirror and prism, the second reflects Green light to the Green **ILA**® assembly and the third reflects Red light to the Red **ILA**® assembly. Each **ILA**® assembly is sent only one color of light, which is in turn controlled by one color signal via a CRT (*See Figure 2-8*).

The separate red, green and blue images projected from the Series 300 Projector must be converged onto the screen in the same manner as with a standard CRT projector. A hand-held Infrared remote, tethered technician remote, PC or terminal is used for this purpose.

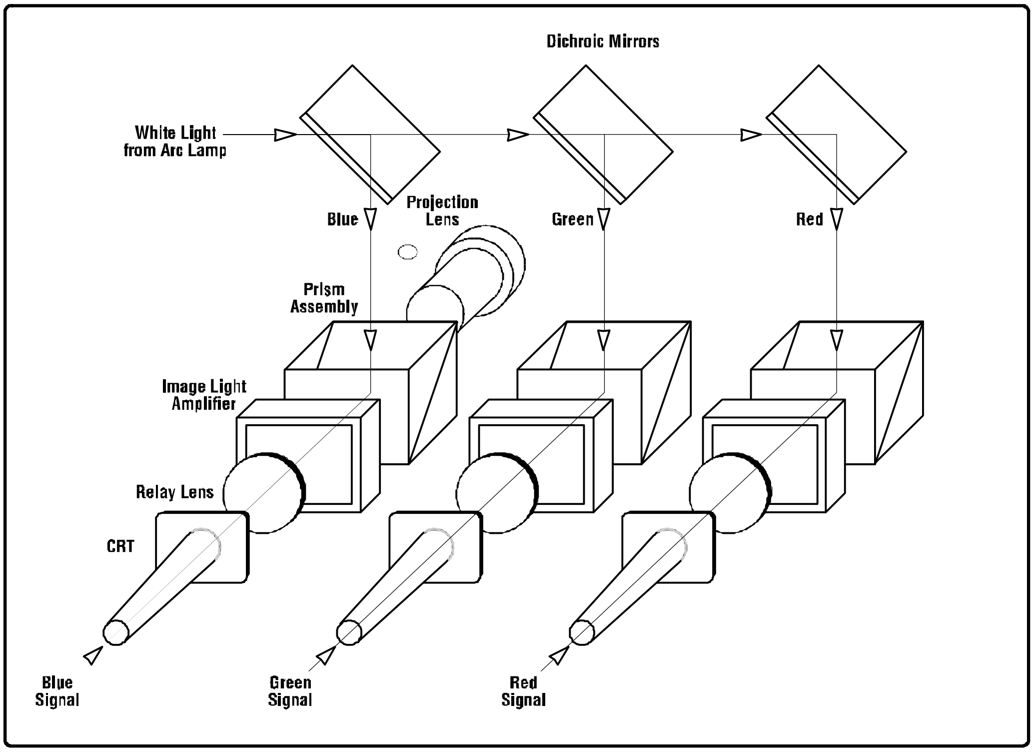


Figure 2-8. Series 300 Projector light path block diagram.

What are the Advantages of an ILA® Assembly?

The two major advantages of using an **ILA®** projector instead of a traditional CRT projector are; increased brightness and higher resolution. CRTs are capable of producing very high resolution images. But high resolution is achieved from a CRT at the expense of image brightness.

The Series 300 Projector uses high resolution CRTs to generate the images but does not try to use them as the source of light for projection to the screen. The **ILA®** projector approach combines the resolution capabilities of CRTs and the high light output of a xenon arc lamp to project images that are both bright and capable of very high resolution. The **ILA®** assembly itself is not a limiting factor in resolution capability because it has the capacity for up to 3,000 lines of resolution.