This training course explains field service for the above series of projectors.

Overview

- This is a series of LCD projectors.
- There are 5 models: Y006, Y007, Y008, Y009, Y010

Slide 2

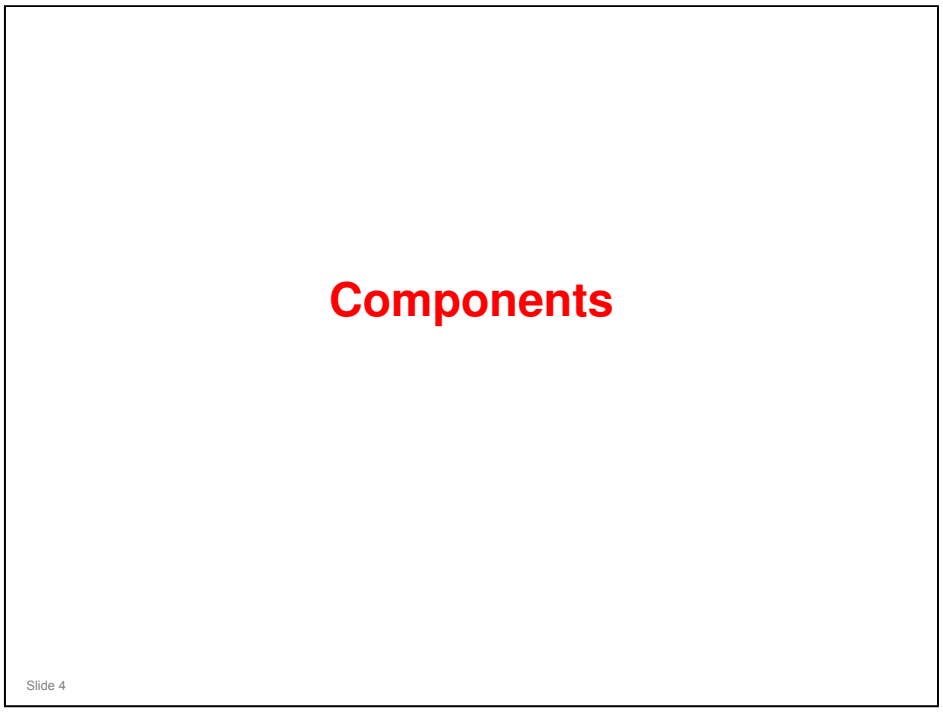
- These are LCD projectors. Later in the course, we will take a brief look at this and other types of projector.

Main Differences Between the Models

- **Y006:**
  - Screen resolution: 786,432 pixels (1024 × 768)
  - LAN/Wireless LAN: No
- **Y007:**
  - Screen resolution: 786,432 pixels (1024 × 768)
  - LAN/Wireless LAN: Yes
  - Brighter image than Y006
- **Y008:**
  - Screen resolution: 786,432 pixels (1024 × 768)
  - LAN/Wireless LAN: No
  - Brighter image than Y006
- **Y009:**
  - Screen resolution: 1,024,000 pixels (1280 × 800)
  - LAN/Wireless LAN: No
- **Y010:**
  - Screen resolution: 1,024,000 pixels (1280 × 800)
  - LAN/Wireless LAN: Yes

Slide 3

No additional notes



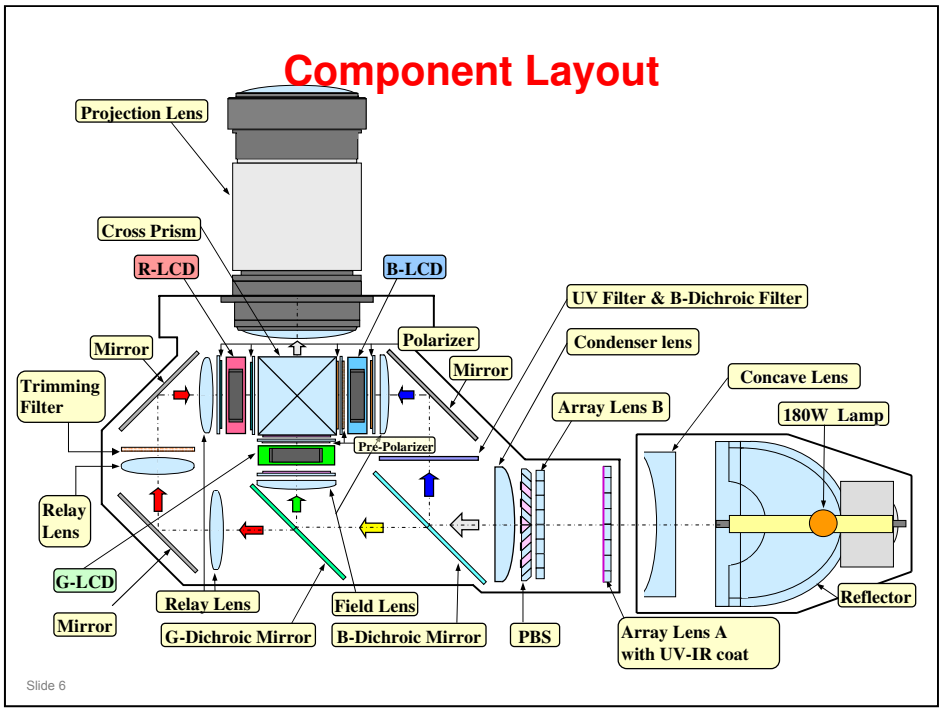
This section explains the main components of an LCD projector.

LCD Projector: Theory of Operation

- A polarizer polarizes light emitted from a lamp.
- This light is then split into three components: red, green, and blue.
- Each beam passes through an LCD plate.
- The LCD plates each receive an electrical signal (R, G, or B) from the image-generating device (such as a computer).
- After the beams pass through the LCD plates, they carry the R, G, and B components of the image to be projected.
- The R, G, and B beams are combined inside a cross prism.
- The resulting combined beam, carrying the image, is projected out of the projector onto a screen.

Slide 5

No additional notes



❒ We will study the most important of these components on the next few slides.

Main Assemblies

Lamp Unit

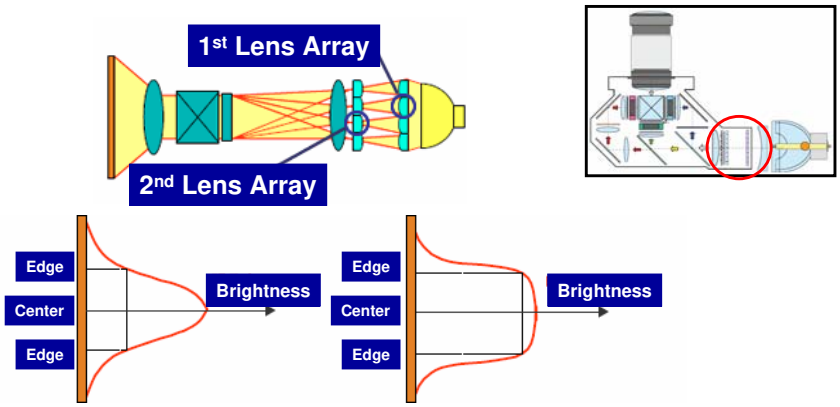
Lamp Ballast

Optics Engine

Slide 7

No additional notes

Lens Arrays

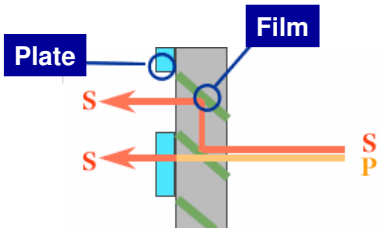


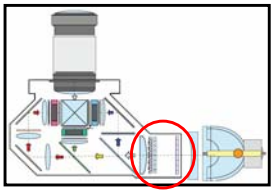
- Light from the lamp is a lot brighter in the center.
- To correct this, light from the lamp is passed through lens arrays.

Slide 8

No additional notes

PBS (Polarizing Beam Splitter)

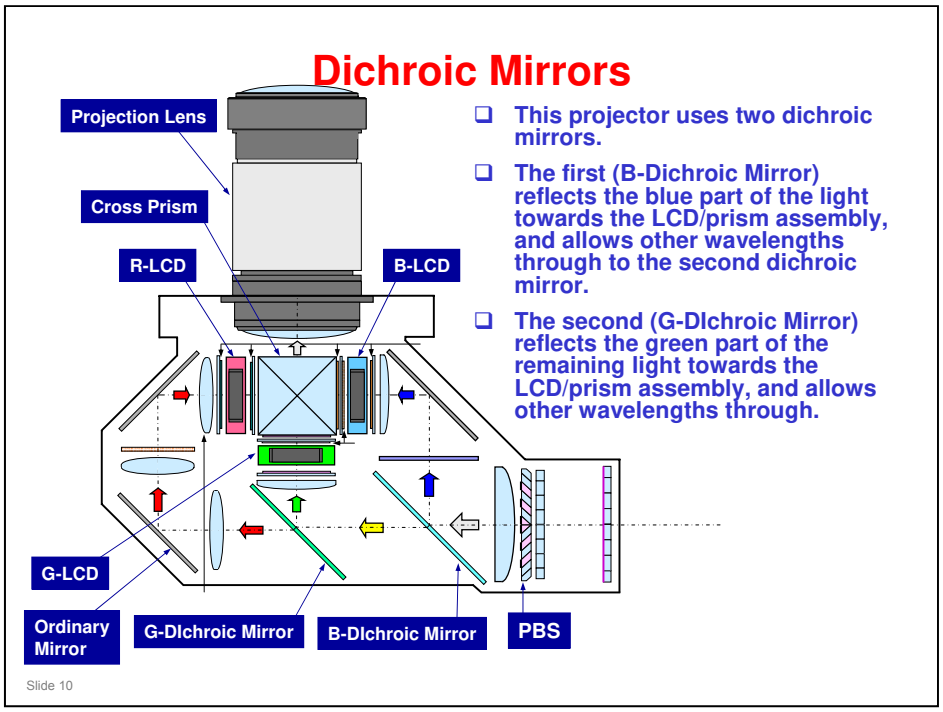




- **After the lens arrays, the light goes through a PBS.**
- **The PBS allows only s-polarized light through.**
  - The films reflect s-polarized light through the PBS unchanged.
  - The films allow p-polarized light through, and plates rotate the plane of polarization by 90 degrees, to convert the p-polarized light to s-polarized light.

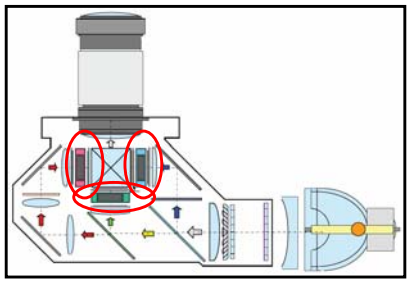
Slide 9

- The light that is polarized perpendicular to the plane of incidence on the PBS is called s-polarization.
- The light that is polarized parallel to the plane of incidence on the PBS is called p-polarization.



- A dichroic mirror reflects some light wavelengths and allows others to pass through.
- The name is taken from the light that it reflects (for example, G-dichroic mirrors reflect green light and allow other wavelengths to pass).

LCD Panels

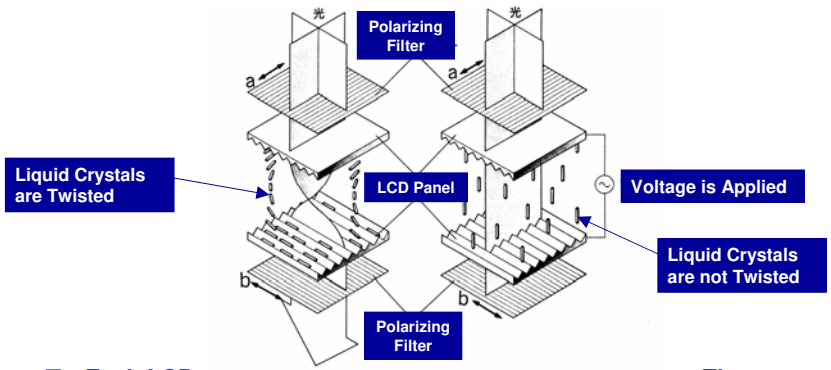


- Signals from the computer (or other image-creating device) generate greyscale images on the LCD panels.

Slide 11

No additional notes

LCD Panel: Polarizers



- Each LCD panel is sandwiched between two polarizers. The polarization planes are at 90 degrees (crossed polarizers).
- In the initial state, the LCD rotates the plane of polarization by 90 degrees, so the light goes through the assembly of LCD panel and two polarizer plates.
- When voltage is applied, the LCD does not change the plane of polarization, so light does not go through the assembly.

Slide 12

No additional notes

Combination of LCD Panels

- **There are two types of LCD, based on the direction of twist in the molecules that are used in the liquid crystal.**
  - R: Counterclockwise
  - L: Clockwise
- **Using these two types of LCD panel, there are two types of optics engines, as shown below.**
  - The classification (L-type, R-type) depends on the type of LCD panel that is used for green.

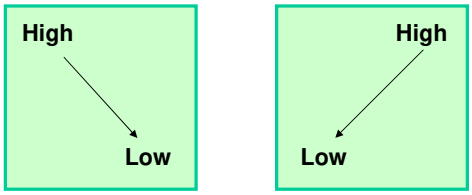
	LCD Panel		
	R	G	B
Type 1 (L-type)	R	L	R
Type 2 (R-type)	L	R	L

Slide 13

No additional notes

Contrast of Images Projected by LCD Panels

- **The contrast of images projected by LCD panels is not constant.**
  - In an L-type LCD panel, the top left part of the projected image has a high contrast, and the bottom right has a low contrast.
  - In an R-type LCD panel, the top right part of the projected image has a high contrast, and the bottom left has a low contrast.



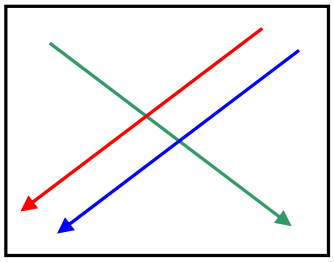
L-type R-type

Slide 14

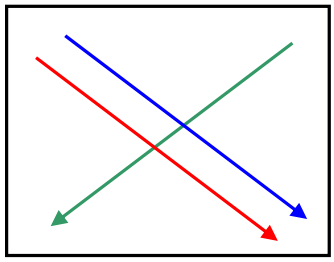
- The diagrams show light projected onto a screen through a green filter.

Contrast of Images Projected by Optics Engines

- **There are L-type and R-type optics engines, as explained earlier.**
  - L-type engine: The green LCD panel is an L-type and the others are R-type.
  - R-type engine: The green LCD panel is an R-type and the others are L-type.



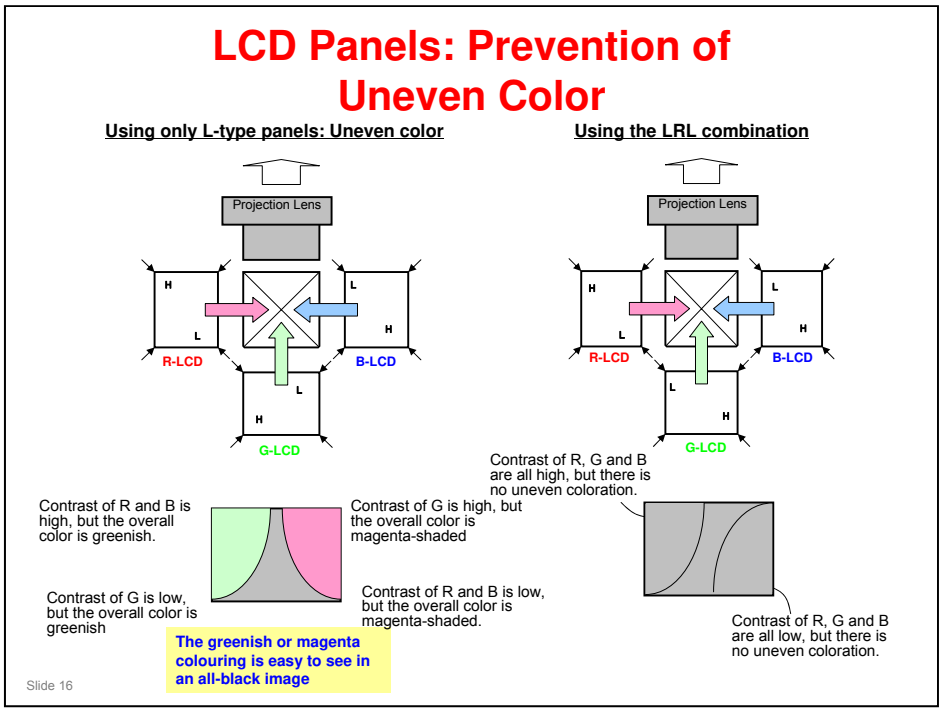
L-type Optics Engine



R-type Optics Engine

Slide 15

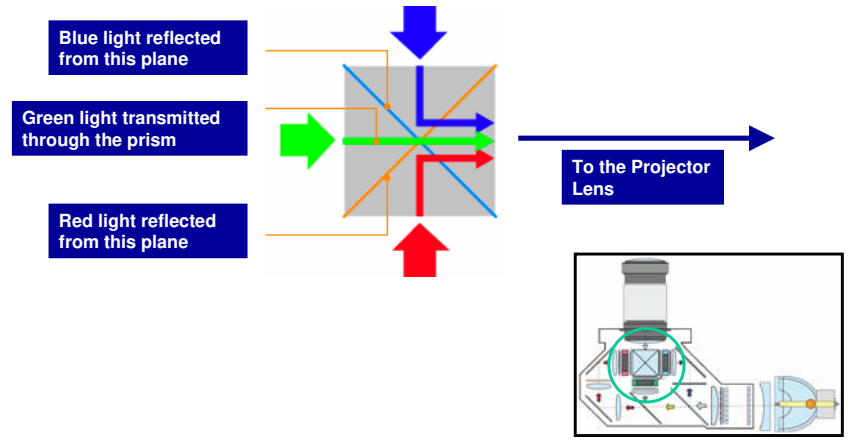
- The arrows show the variation in contrast from top left to bottom right (or from top right to bottom left) for R, G, and B in each of the two types of optics engine.
- The next slide shows why optics engines are assembled as either L-type or R-type, to prevent uneven color reproduction.



- The example shows the R-type optics engine.
- Note that the correct combination of LCD panels prevents uneven color, but uneven contrast from one corner of the screen to the other is not prevented.

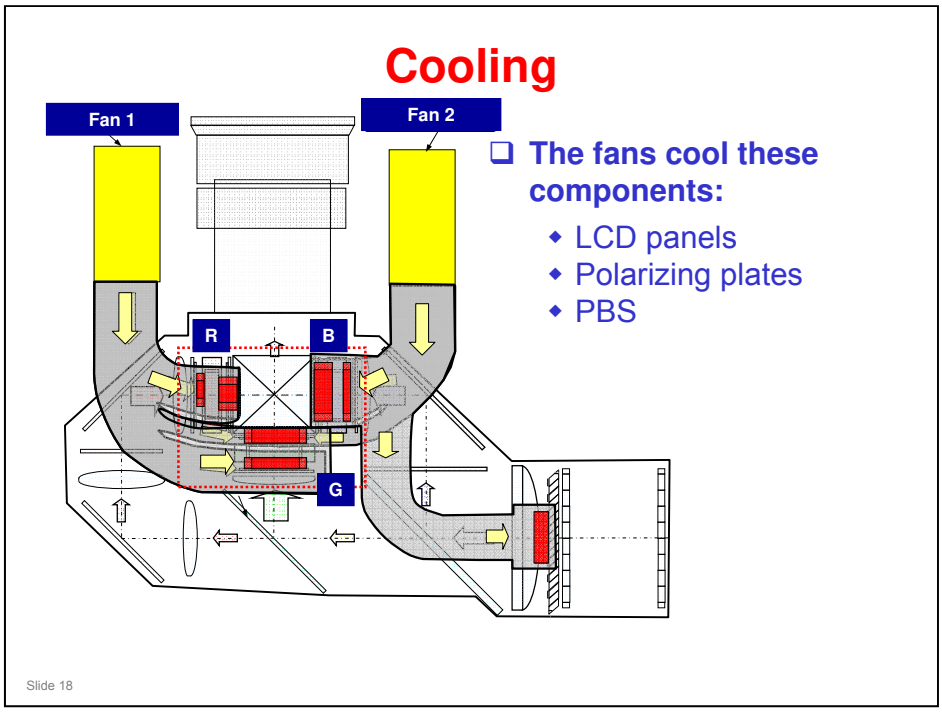
Cross Prism

- The cross prism combines the beams that pass through the three LCD panels.



Slide 17

No additional notes



Target temperatures for various components

- PBS: 80 °C maximum
- LCD plates: 70 °C maximum (red, green), 65 °C maximum (blue)
- Pre-polarizers (just before the LCD plates): 70 °C maximum
- Output polarizers (just after the LCD plates): 70 °C maximum

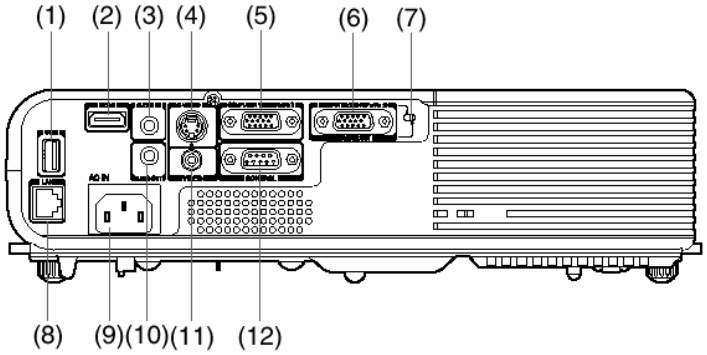
Disposal of Broken Lamps

- **Projector lamps normally contain mercury vapour.**
- **These lamps can rupture due to impact or being used longer than their life expectancy.**
  - The time that the breakage will occur differs widely for each lamp and its circumstances of use.
- **These lamps must be disposed of in accordance with local environmental regulations.**

Slide 19

No additional notes

Terminals on the Rear Panel



- The service manual contains tables of supported signals that can be accepted on each of these interfaces.

Slide 20

(1) USB terminal (Y007/Y010 only): Connects to a commercial USB memory device.

(2) HDMI™ terminal (Y007/Y010 only): Input for digital signals from a HDMI (High-Definition Multimedia Interface) compatible digital source.

(3) AUDIO IN terminal: Input for audio signals from a computer or video equipment. (Multiple use for COMPUTER 1 IN/2 IN, VIDEO and SVIDEO)

(4) S-VIDEO terminal: Input for S video signals from video equipment.

(5) COMPUTER 1 IN (Y/CB/CR 1) terminal: Input for analog RGB signals from a computer or a component video signal (Y/PB/PR) from video equipment.

(6) COMPUTER 2 IN (Y/CB/CR 2) terminal/MONITOR OUT terminal: Input for analog RGB signals from a computer or a component video signal (Y/PB/PR) from video equipment. It can also be used as a MONITOR OUT terminal by switch (7).

(7) Switch: Switches (6) between COMPUTER 2 IN and MONITOR OUT.

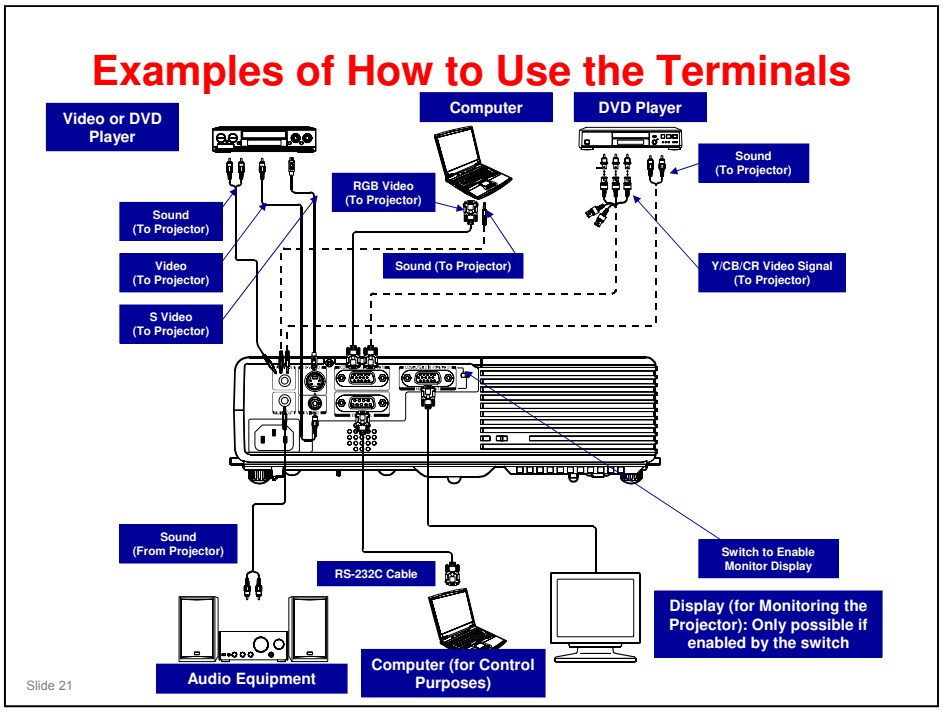
(8) LAN terminal (Y007/Y010 only): Connects a network cable.

(9) AC IN socket: Connects the supplied power cord.

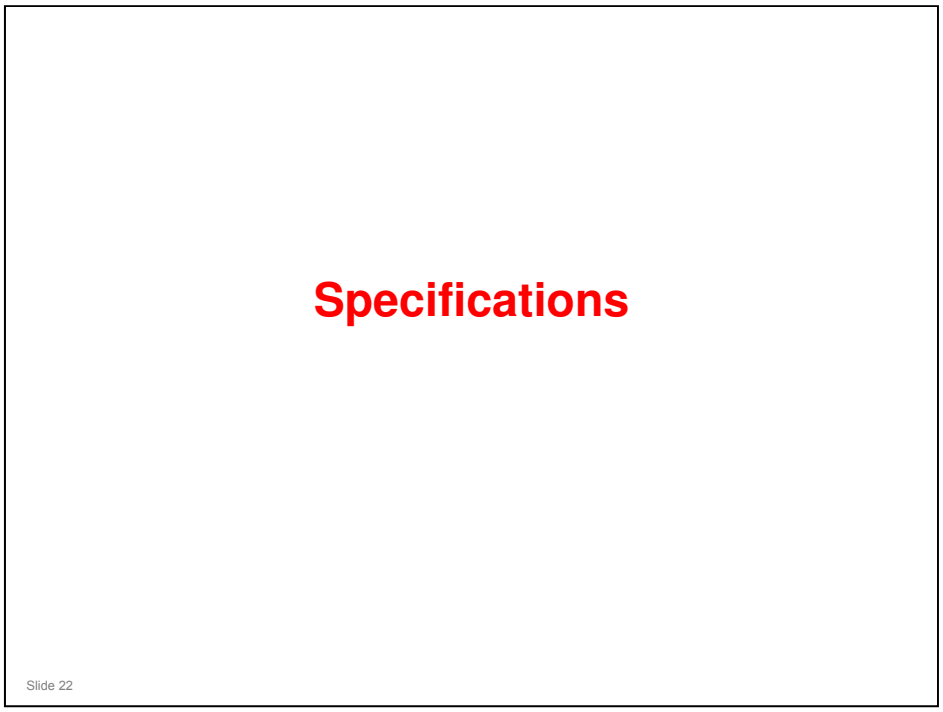
(10) AUDIO OUT terminal: Outputs audio signals.

(11) VIDEO terminal: Input for video signals from video equipment.

(12) CONTROL terminal: When operating the projector via a computer, connect this to the controlling computer's RS-232C port.



- The Y007 and Y010 also have a HDMI™ terminal (not shown above), used for input for digital signals from a HDMI (High-Definition Multimedia Interface) compatible digital source.



❒ This section shows the main specifications.

Main Specifications

- **Power Consumption**
  - Y006/Y007: 270 W
  - Y008/Y009/Y010: 280 W
- **LCD panel resolution:**
  - Y006/Y007/Y008: 786,432 pixels (1024 H × 768 V)
  - Y009/Y010: 1,024,000 pixels (1280 H × 800 V)
- **Lens:**
  - Y006/Y009/Y010: F=1.70–1.87, f=19.2–23.1 mm
  - Y007/Y008: F=1.60–1.76, f=21.5–25.8 mm
- **Lamp: High-pressure mercury lamp (180 W)**
- **Projection screen size: 30-300 inches**
- **Projection distance:**
  - Y006: 0.89 m–10.93 m
  - Y007/Y008: 0.89 m–10.94 m
  - Y009/Y010: 0.94 m–11.58 m
- **Speaker: 1 W (Mono)**

Slide 23

No additional notes

Software Provided for the User

- **Network Utility**
  - This tool allows the projector to be used to project files from a network computer.
- **PJLink**
  - This software allows the user to monitor the projector over a network, but not operate it.
  - For a projector to comply with the PJLink standard, it must be possible for a PC on the same LAN to be able to turn projectors on/off and monitor them.
- **JPEG Conversion Tool**
  - This software converts from various image formats to JPEG format.
  - In addition, it can convert from some types of application software to JPEG, such as from Power Point files.
  - This tool is useful when connecting a USB memory device to the projector.

Slide 24

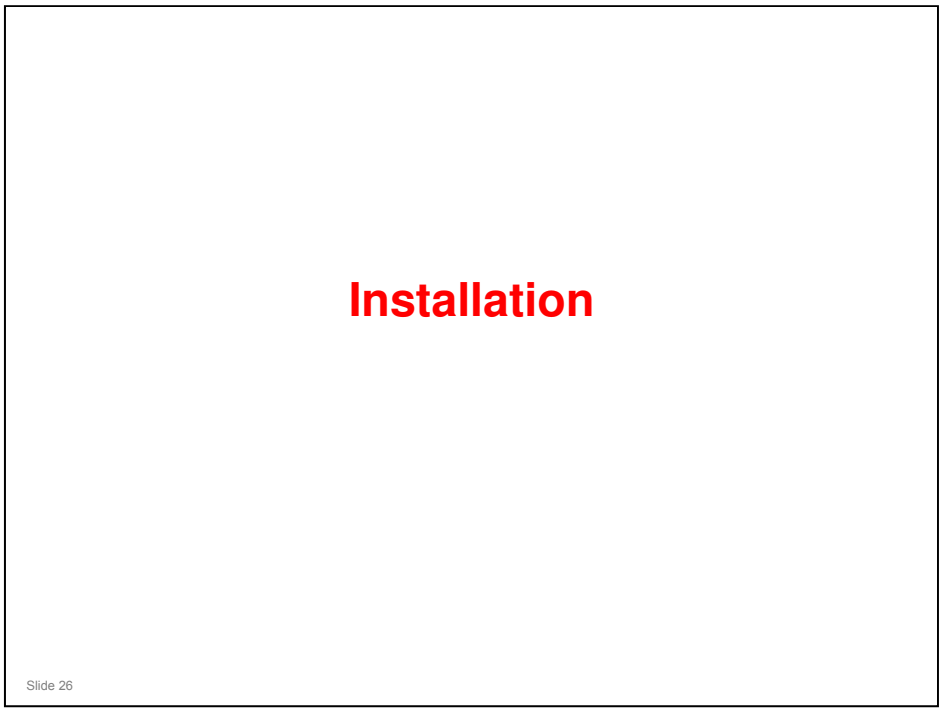
No additional notes

Software used by the Field Technician

- **Firmware Upgrader**
  - Use this to update the projector's firmware.
- **DPJAdjustmentTool_2008.exe**
  - Use this to calibrate the projector after replacing the main board or optics engine.

Slide 25

No additional notes



❒ This section explains the main points about installation. Normally, installation is done by the user.

Installation Requirements (1)

- Do not place in hot locations, such as near heating equipment. Doing so could cause a malfunction, and shorten the life of the projector.
- Avoid locations with oil or cigarette smoke. Doing so will make the optical parts dirty, shortening their lives, and darkening the screen.
- Do not use this product in the upright position or tilt it up or down by more than 20° from level. Doing so may cause a failure or shorten the life of the product.
- Using this instrument near a TV or radio may cause interference to the images or audio sound. If this happens, move it away from the TV or radio.
- Moving the projector from a low-temperature room to a high-temperature room may cause condensation on the lens or internal parts. If you continue to use it in that situation, it may malfunction. Wait until the condensation naturally disappears.

Slide 27

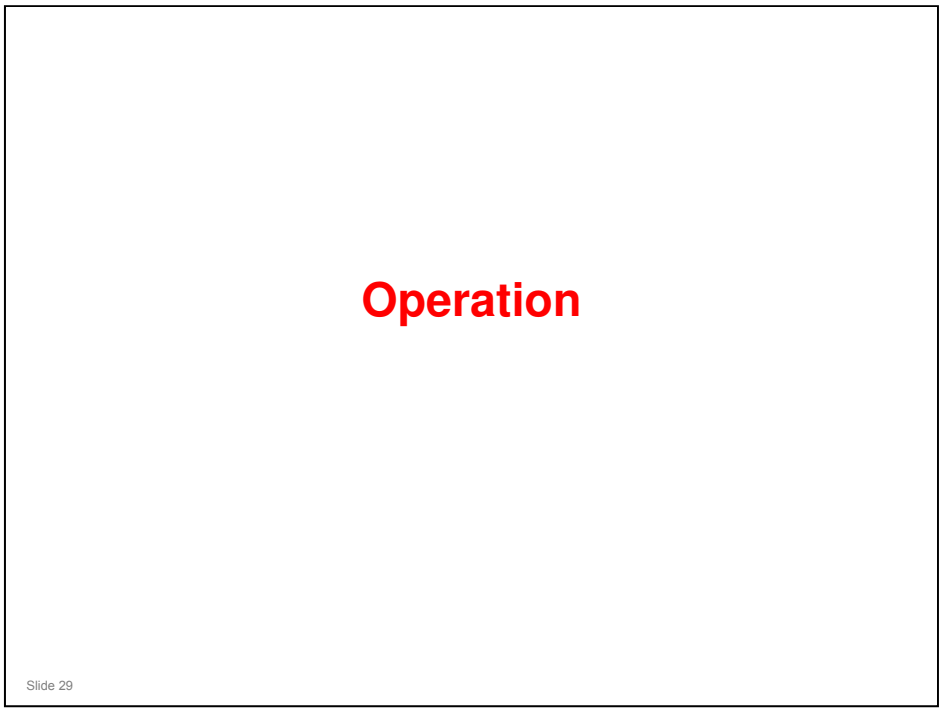
- The customer installs the unit, but you should be aware of these installation requirements, to check if the customer has installed the projector correctly. These notes could help you when trooubleshooting.

Installation Requirements (2)

- In a high-altitude location where air is thin, cooling efficiency is reduced, so use the projector with [Fan mode] set to [High].
- Only plug the power cord into outlets rated for use with the power cord's specified voltage range. Do not overload extension cords or power strips as this can result in fire or electric shock.
- Route the power cable or the connecting cable away from where people could trip over it. The projector may fall down, which could result in severe injury.
- Be sure the power cord is easily reached for unplugging in case of emergency. Do not place any obstacles near the wall outlet in which the cord is plugged.

Slide 28

No additional notes



❒ This section explains the main points about how to use the operation panel and the menus, and how to update firmware.

Foot Adjusters

Slide 30

No additional notes

Operation Panel

- The colors and status of the Lamp, Temp, and On/Standby lamps are used for troubleshooting.
- The circular button is used to navigate menus.
- The Menu and Return buttons are used to enter and exit from the menus.
- The Menu, Return, and Input buttons are used to enter service mode.

Slide 31

No additional notes

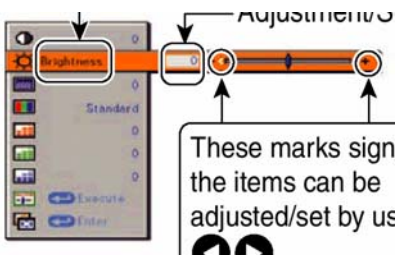
Menus (1)

- Press the Menu button on the operation panel.
- This screen appears.
- The 5 icons at the top represent 5 menus. From left to right, these are:
  - Image adjustment menu
  - Display setting menu
  - Default setting 1 menu
  - Default setting 2 menu
  - Status display menu
- Use the left and right arrow buttons to move across to a different menu.
- Press the 'Enter' button (or the down arrow button) to enter the currently selected menu.

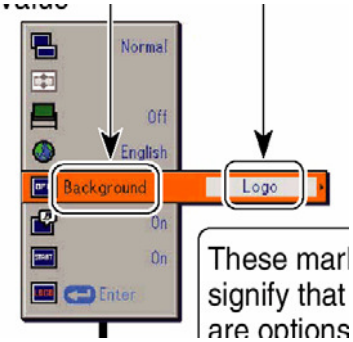
Slide 32

- Arrow buttons: On the edges of the circular button on the operation panel.
- Enter button: Center of the circular button on the operation panel.

Menus (2)



This item can be adjusted with the left and right arrow buttons.



This item has a list of settings, or an on/off switch. Press Enter or the down button to see the possible settings.

Slide 33

No additional notes

Menus (3)

- **If you press the Network button on the remote controller, then the Menu button twice, this screen appears.**
- **The 5 icons at the top represent 5 menus. From left to right, these are:**
  - Network utility setup
  - Network Projector setup
  - Slideshow setup
  - Status display
  - Control setting
- **Be sure to set up the network settings before you start to use the projector.**
  - The default settings are not safe from a network security viewpoint.

Slide 34

❒ Items in grey cannot be adjusted while the projector is in the current condition.

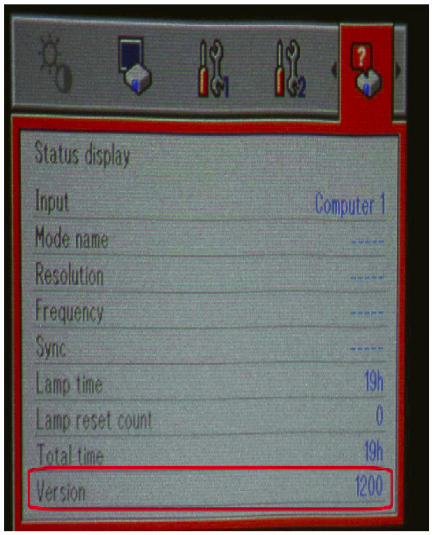
Updating Firmware

- Connect an RS-232C cable between the projector and a computer.
- Start the 'Firmware Upgrader' software and follow the instructions in the manual and on the screen.
- The update takes 3 minutes.

Slide 35

No additional notes

Checking that the Update was Successful



- To check that the firmware was updated correctly, look at the version number on the status display.

Slide 36

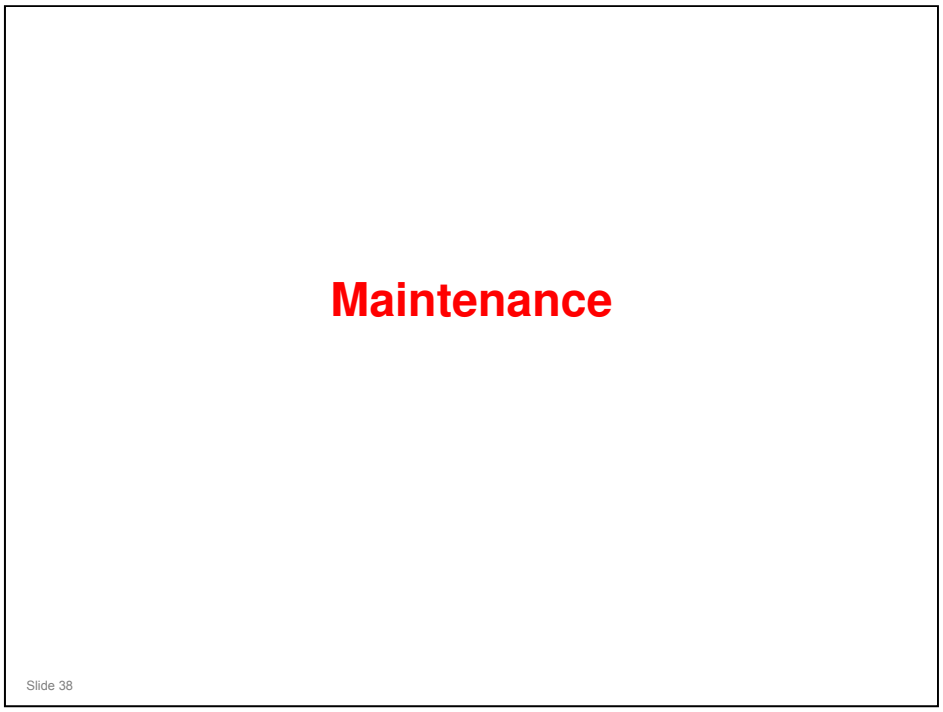
No additional notes

Updating the Network Firmware

- **Extract the new firmware to the root directory of a USB memory device.**
  - NOTE: The firmware file name, NK.bin, is the same for all the models. So, make sure that you have the correct file for the model that you are working on.
- **Connect the USB device to the USB socket of the projector.**
  - Make sure that the projector's power is off first.
- **Operate the projector as explained in the service manual.**
  - The update takes about 5 minutes.
- **To check that the update was successful, look at the status display in the menus that are accessed from the remote controller.**
  - OSD menu of Network input: See the procedure in the service manual for how to access.
- **Turn off the projector and remove the USB memory.**

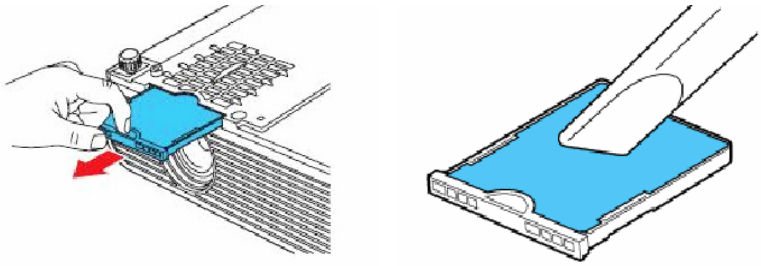
Slide 37

❒ This procedure is for Y007 and Y010 only.



❒ Maintenance is done by the user.

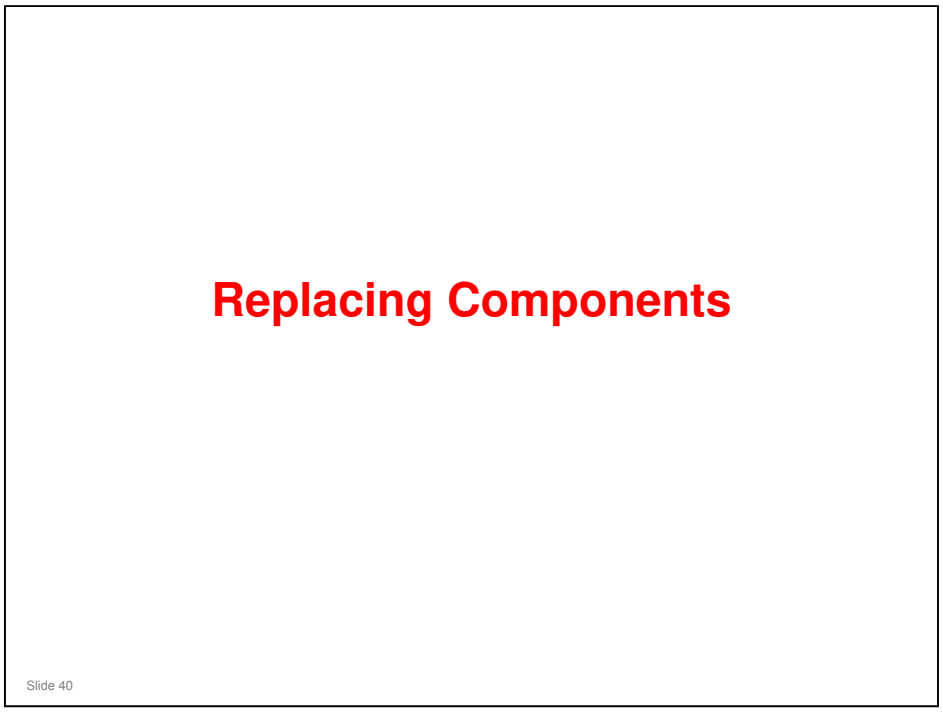
Air Filter



- This filter prevents dust from being pulled into the projector by the fans.
- Every 100 hours of operation, a message appears, asking for the filter to be cleaned.
- The user normally does this.

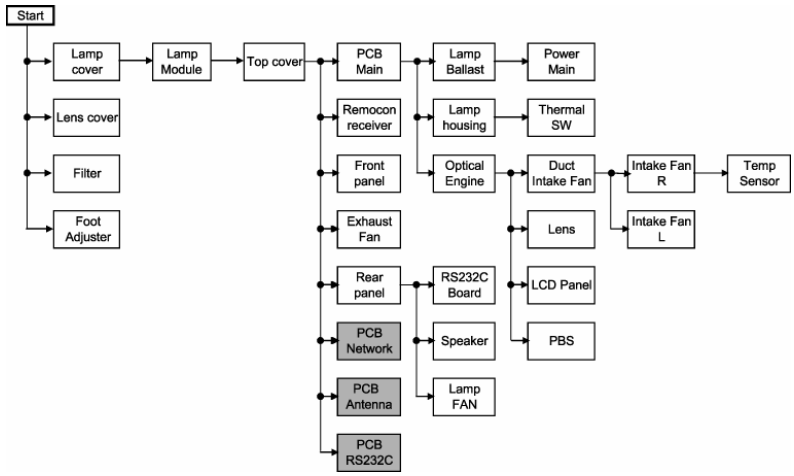
Slide 39

No additional notes



❒ This section shows the main points about replacing parts, and how to calibrate the machine after installing new parts.

Replacement Flow Chart



- **This shows which parts must be removed to access the various components of the machine.**

Slide 41

- See the service manual for details of the procedures. The next few slides will cover the main points.

Replacing Optics Components

- When you replace each part, use a blower brush to make sure that no dust adheres to the components.
- Do not touch the glass side of optical parts.

Slide 42

No additional notes

Lamp Unit

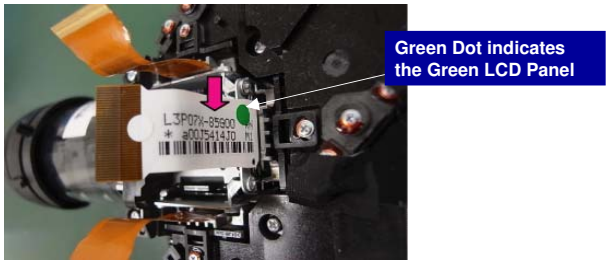
- This is replaced by the user.
- After replacing the lamp unit, the user must reset the operating hours counter.

Slide 43

No additional notes

Optics Engine

- **When replacing the optics engine with a new one, make a note of the type of optics engine (L-type or R-type) you are installing, and then perform electrical adjustments.**
  - Example: In an R-type optics engine, the green LCD panel is an R-type LCD.
  - You will need to know this during the electrical adjustments.
- **The type of LCD can be identified by checking the model number of the G (green) panel.**
  - The replacement procedure in the service manual contains instructions on how to use the model number on the label to recognize an L or R type engine for each model.



Slide 44

No additional notes

Adjustments Required after Replacement

	Keystone, Sub Contrast, Altitude: Special Key Operations	VCOM, Gamma, Gamma Shading: DPJAdjustmentTool_2008
Main Board	Yes	Yes
Optical Engine	No	Yes

- The above table shows which adjustments are needed after replacing the Main Board or Optics Engine.
- The adjustments are in the service manual.

Slide 45

Keystone

- When you project an image onto a surface at an angle (because the projector is not quite centered on the screen), the image will be larger at the top than at the bottom (in the case when the projector is on a table pointing up at the screen).
- Modern projectors correct for this digitally, but calibration is needed.

Sub-contrast

- Inputs from both computer interfaces must be calibrated.

VCOM, Gamma, Shading

- These require the DPJ Adjustment Tool.

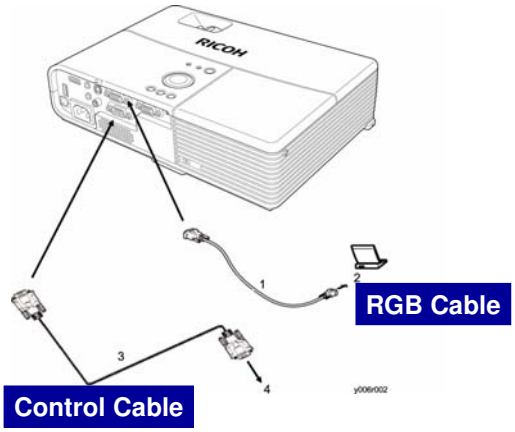
Equipment Required for the Adjustments

- Personal computer (Windows PC, using Windows 98SE, ME, 2000, or XP)
- Adjustment software: DPJAdjustmentTool_2008.exe
- Cables: RGB Cable and Control (RS232C) Cable
- Protractor: Used to measure angles for the Keystone Calibration

Slide 46

No additional notes

Connecting the Computer to the Projector



- Both cables go to the same PC (the diagram does not show this well).

Slide 47

No additional notes

Before you Start the Adjustments

- **Copy the current settings data to EEPROM: Press the [Up], [Down], [Left] and [Right] buttons simultaneously.**
- **All LEDs light up in orange and the buzzer beeps for 3 seconds.**
- **Enter service mode.**
  - The procedure to use depends on the model.
- **The buzzer beeps for 3 seconds if you enter service mode successfully.**
- **To exit service mode, disconnect the power cord.**

Slide 48

❒ The EEPROM is a backup area to hold the old settings if the adjustments do not go well.

Adjustments

- **Do the necessary adjustments as described in the service manual.**
  - Keystone Calibration
  - Sub Contrast
  - Altitude
  - VCOM
  - Gamma
  - Shading

Slide 49

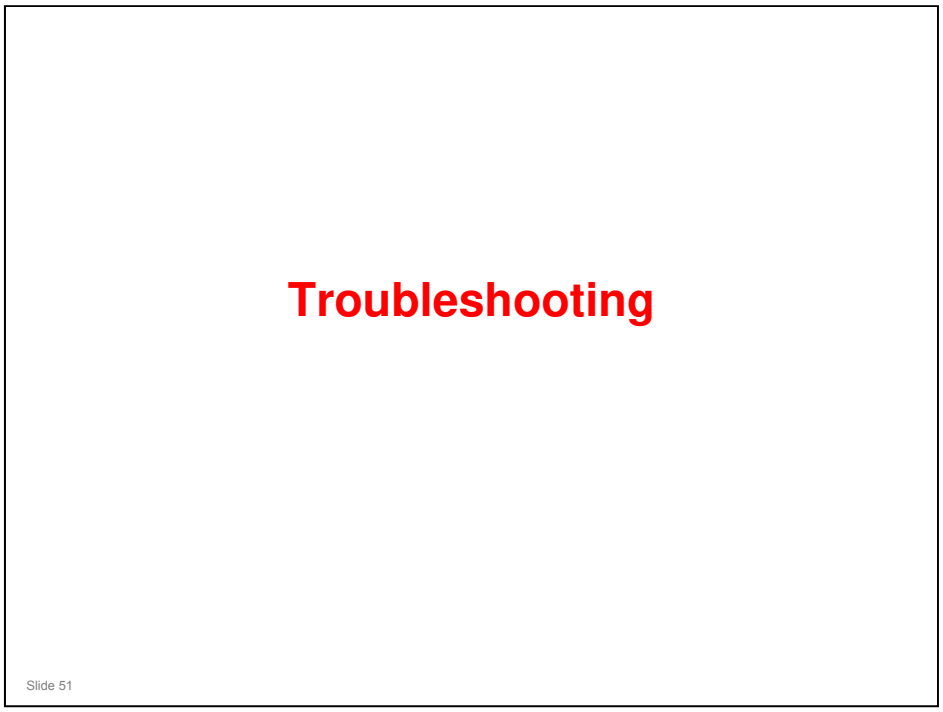
No additional notes

Functional Tests

- **After the adjustments, do the Functional Tests as described in the service manual.**
- **Required equipment:**
  - DVD player
  - Commercially produced video
  - Cables
  - Remote control
  - Projector screen
  - Personal computer (PC)
- **Connect the projector as follows:**
  - Video player through Composite Video and S-video ports.
  - Audio sources through Audio ports (RCA) or 3.5mm mini-jack.
  - Personal computer through an RGB cable.

Slide 50

No additional notes



- For basic troubleshooting procedures, see the service manual.
- This section discusses some problems related to the image quality.

LED Display

- **The combination of LED indicators show if a problem has occurred.**
  - These are the Lamp, Temp, and On/Standby indicators.

Slide 52

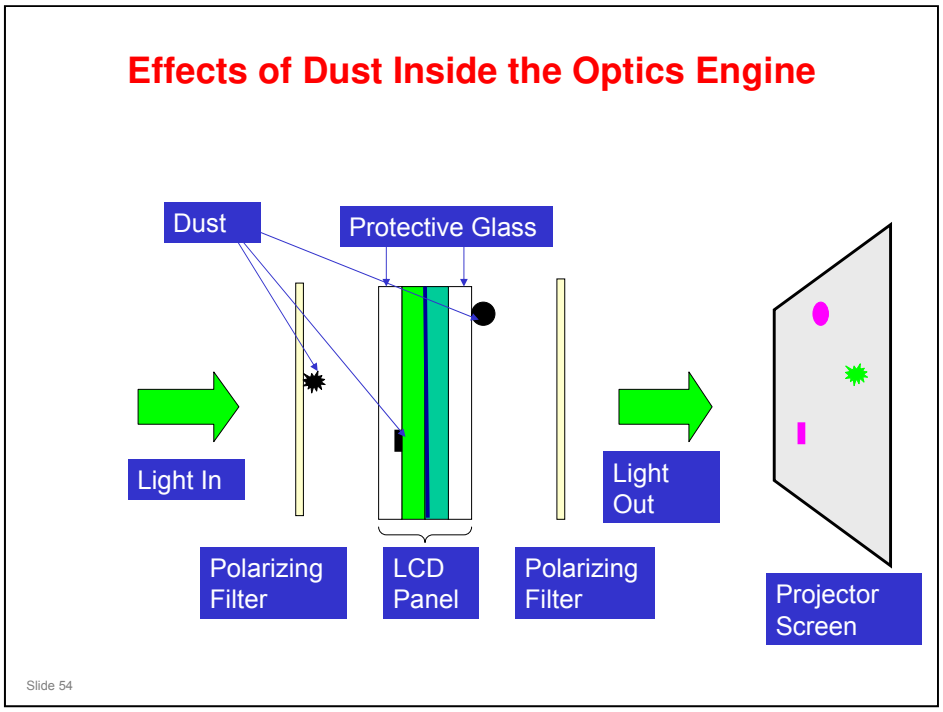
No additional notes

Symptom

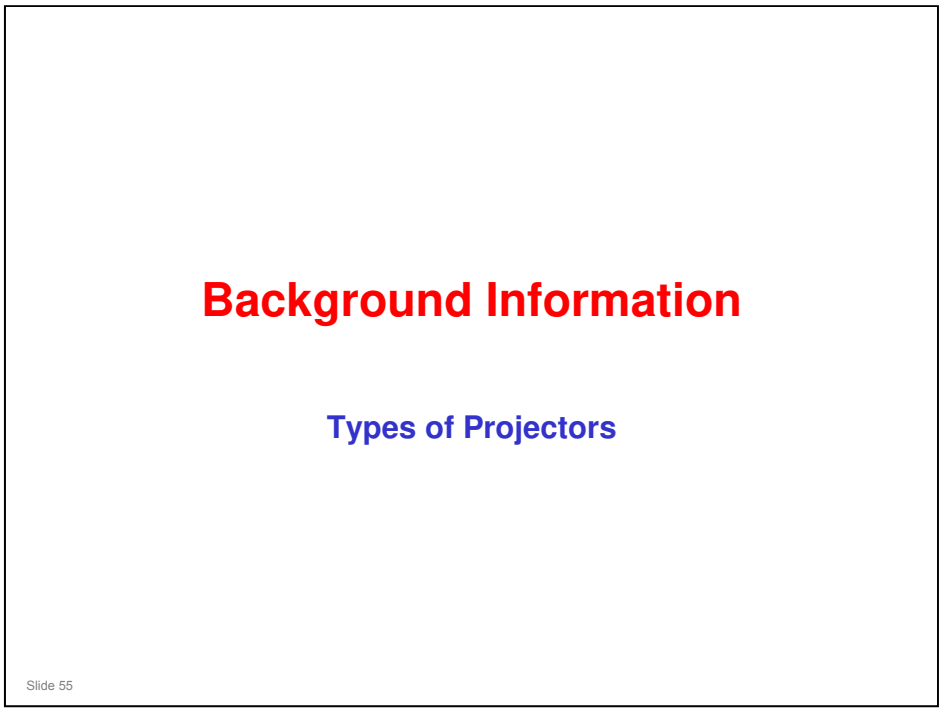
- **The Troubleshooting section of the service manual contains some notes on symptom troubleshooting.**
  - Power problems
  - Image problems
  - Audio problems
  - Remote Control problems
  - Keypad problems
  - Menu problems
  - Network problems

Slide 53

No additional notes



- Dust on LCD panel: If light for the green LCD panel is blocked by dust on either side of panel, you get magenta spot on the projector screen.
- Dust in any other place than the LCD panel: The dust reflects the light irregularly and green irregular spot(s) will appear somewhere on the projector screen.



❒ This section briefly explains the various projector technologies on the market.

Types of Projectors

- **There are 4 main types.**
  - CRT projectors: These use three cathode ray tubes (blue, green, and red).
  - LCD projectors: These use three LCD filters to create red, green, and blue images.
  - DLP projectors: DLP (Digital Light Processing) was developed by Texas Instruments. It uses micro-mirror devices and rotating color wheels
  - LCOS projectors: LCOS (liquid crystal on silicon) uses liquid crystals as mirrors, instead of filters

Slide 56

No additional notes

CRT Projectors

- These use three cathode ray tubes (blue, green, and red).
- They have better contrast than LCD and DLP projectors.
- They also have good resolution. But they are bulky, heavy, and difficult to adjust.

Slide 57

No additional notes

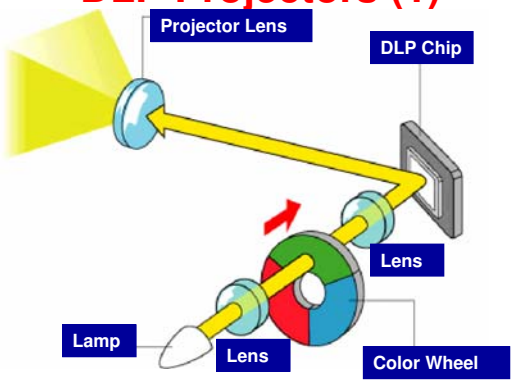
LCD Projectors

- LCD projectors appeared during the early 1990s, and are now the main type of projector.
- Three LCDs receive electrical signals from an image-generating device. One receives signals for the red part of the image, one the green, and one the blue. In this way, each LCD holds a pattern of pixels.
- Then, red light is shone through the LCD with the red part of the image, and green and blue light are used for the other two LCDs.
- After passing through the LCD filters, the three beams are combined and projected.
- LCD projectors give bright, high-resolution output, and they are easy to adjust. They are also cheap.

Slide 58

- For more details on how an LCD projector works, see earlier in this course, where the basic optical components of this LCD projector are explained.

DLP Projectors (1)



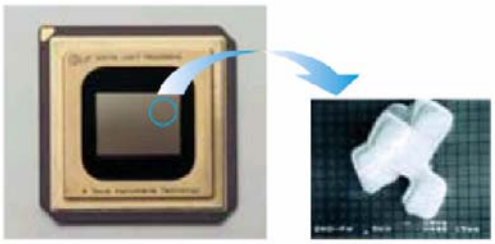
- The DLP chip is the central part of this type of projector.
- A DLP chip consists of many small pixel-sized mirrors laid out on a semi-conductor chip. Light shone on the DLP chip is reflected by all these tiny mirrors. (For a chip with 1024 x 768 resolution, there are 786,432 small mirrors.)
- Light is shone onto the chip through a fast-spinning wheel that has a red sector, a green sector, and a blue sector. This light is reflected off the chip and out through a lens onto a screen.

Slide 59

- DLP (Digital Light Processing) was developed by Texas Instruments in 1987.
- The DLP chip is also known as a Digital Micromirror Device (DMD).
- DLP technology uses light reflection, which leads to a brighter image than a light-transmission type of device such as an LCD projector.

DLP Projectors (2)

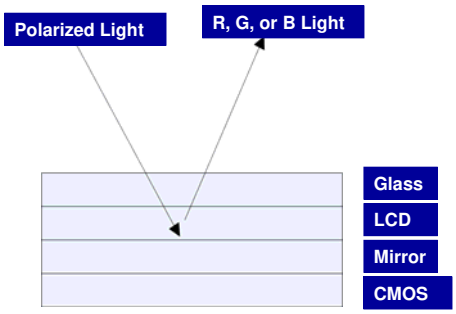
- R, G, and B signals from the image generating device are sent to the DLP chip, and timed so that the red signal arrives at the same time that the red part of the wheel is in the beam path, and similarly for the green and blue signals.
- The DLP chip generates the R, G, and B images by re-positioning the micromirrors using micromachined hinges to make different pixelated images for each colour (meaning that each micromirror has an ON and an OFF position).
- The mirrors can switch over every 15 microseconds, so moving images can be projected.
- For SVGA resolution, the mirrors are 16-micrometer squares, with a gap of about 0.8 micrometers between each mirror. Below, we can see the size of the mirrors compared to a grain of table salt.



Slide 60

No additional notes

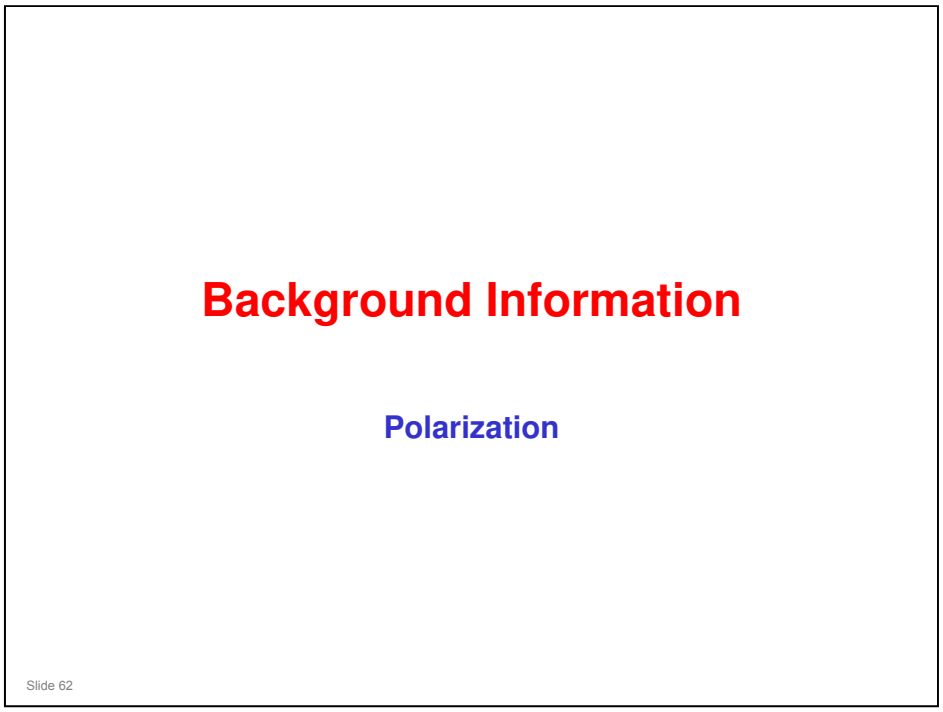
LCOS Projectors



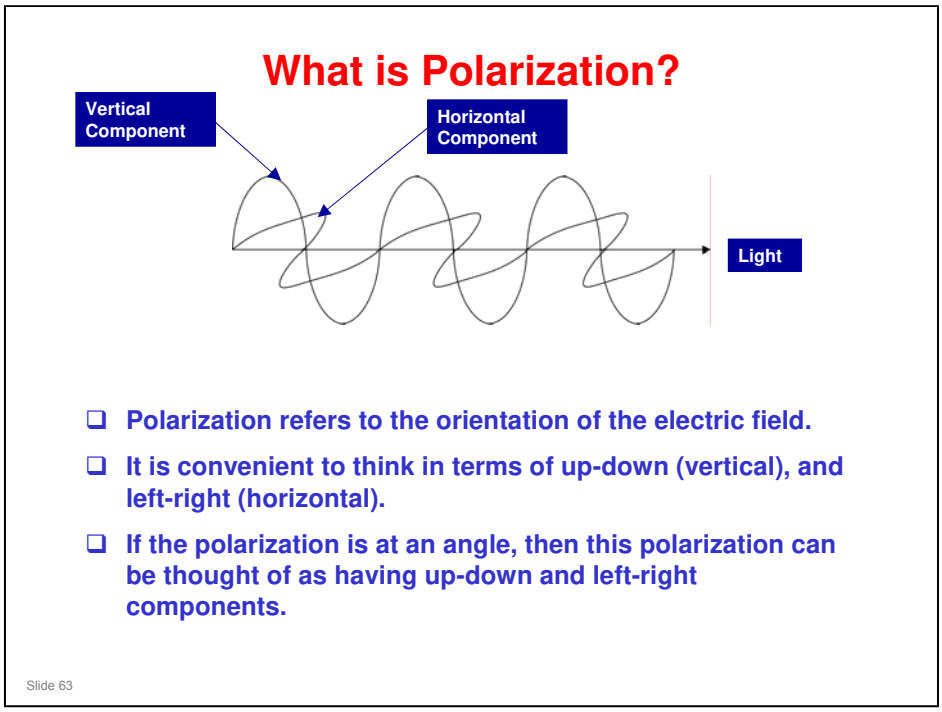
- In LCoS, a liquid crystal cover is applied to the surface of a semiconductor chip that has a highly reflective coating. There are one of these assemblies for red, green, and blue.
- The RGB images are sent to these semiconductors, and beams of light are reflected off these and recombined before being projected to the screen.
- LCD projectors give bright, high-resolution/high-contrast output, and they are easy to adjust. But they are adversely affected by dust and vibrations.
- The layout of the machine is similar to the LCD projector, except that LCoS plates are used instead of LCD plates.

Slide 61

- LCOS: Liquid Crystal on Silicon
- The diagram shows a simplified cross section of an LCoS panel.



No additional notes



No additional notes

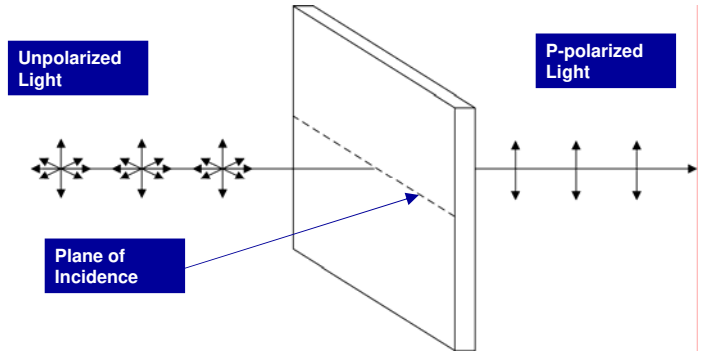
Polarizing Filter

- **In a polarizing filter, the arrangement of the molecules allows (for example) the up-down component to pass through, but not the left-right component.**
  - Think of a rope passing through a picket fence (with vertical slits).
  - If you vibrate the rope in a horizontal direction, the fence will block the vibrations.
  - If you vibrate the rope in a vertical direction, the vibrations in the rope will pass thought the gaps in the fence.

Slide 64

No additional notes

S- and P- Polarization

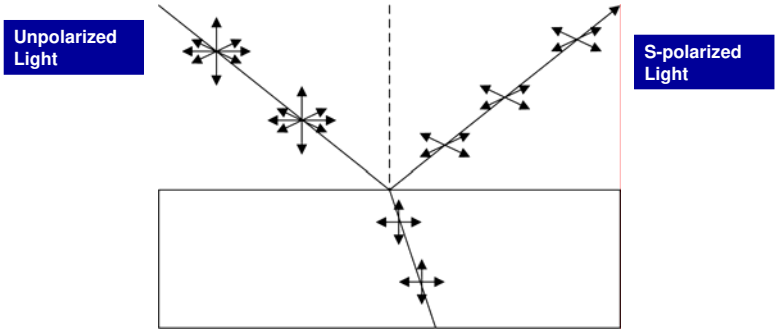


- If the electrical field is polarized parallel to the plane of incidence (in other words, horizontal), it is said to be p-polarized.
- If the field is polarized perpendicularly to the plane of incidence (vertical), it is said to be s-polarized.

Slide 65

- This diagram shows the case of a p-polarizing filter.

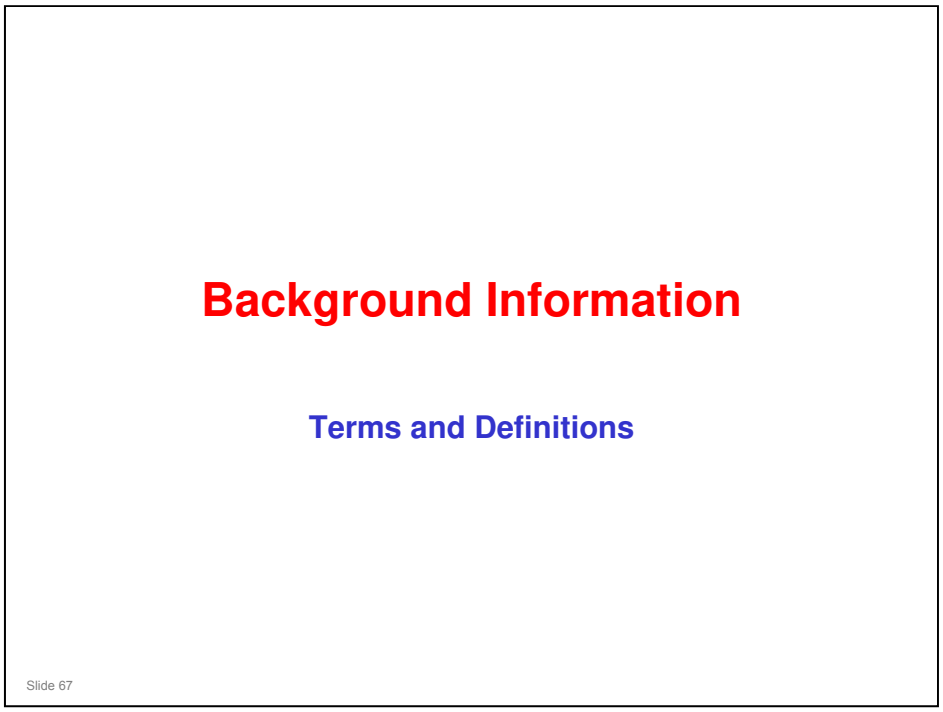
Polarization by Reflection



- Reflection off certain non-metallic substances can polarize light.
- If the angle is correct (different for each mineral, depends on the arrangement of molecules in the mineral), the reflected light will be completely s-polarized.
  - The refracted light will be at least partially p-polarized.

Slide 66

No additional notes



No additional notes

Terms and Definitions - 1

- **Aspect Ratio**
  - This is the ratio of the horizontal to vertical dimensions of the screen. For a normal television, the aspect vratio is 4:3. For HDTV, it is 16:9. For SXGA, it is 5:4.
- **Resolution**
  - This is expressed as the number of dots across the image versus the number of dots down the image. the larger the number, the higher the resolution.
  - Here are the resolutions of some common video graphic standards.
    - » VGA (Video Graphic Array): 40 x 480
    - » SVGA (Super VGA): 800 x 600
    - » XGA (Extended Graphic Array): 1024 x 768
    - » WXGA (Wide VGA): 1280 x 800
    - » SXGA (Super XGA): 1280 x 1024
    - » UXGA (Ultra XGA): 1600 x 1200

Slide 68

No additional notes

Terms and Definitions - 2

- **Dichroic Mirror**
  - A dichroic mirror reflects light of a certain frequency range and allows all other light to pass through.
  - LCD projectors contain two of these mirrors, to split the light up into three beams.
- **Polarized Light**
  - Light waves oscillate in the same way as sound waves.
  - If the waves oscillate in one plane only, the light is said to be polarized.
  - Light reflected by a polarizing screen is polarized, and is brighter than light reflected from a non-polarizing screen.
- **Residual Image**
  - When an image on a display changes, a residual image of the previous image can remain for some time.
  - In serious cases, it can last for more than 1 minute.
  - LCD panels normally do not have this problem.

Slide 69

No additional notes

Terms and Definitions - 3

- **Air Filter**
  - Air is drawn into the projector to cool its internal components. The air filter prevents dust from being pulled into the projector with this air. If the filter becomes dirty, air cannot pass through properly, and it will become hot inside the projector.
  - Every 100 hours, a message will appear, asking the user to clean the air filter.
  - Do not operate the projector without the filter.
  - The message will appear the first time the user switches the power on after the 100-hour limit has been reached. The message will stay on-screen for 30 seconds, or until the user operates the projector.
- **Brightness and Focus of Outer Parts of the Projected Image**
  - Generally, when an image is projected, there are differences between the center of the image and the outer parts. The center is typically brighter than the outer parts. The focus can be better or worse at the center than at the edges.

Slide 70

No additional notes

Terms and Definitions - 4

- **Suspension from the Ceiling**
  - This machine can be suspended from the ceiling, if the required metal supports are fitted.
  - These metal supports are not supplied with the projector.
- **Changing the Lamp**
  - The first time that the power is turned on after the lamp has been used for 3000 hours, a message is displayed for the user.
  - The message disappears if you press the center part of the circular 'arrow' button.
  - The hours of lamp use are calculated as follows: Lamp use time + Normal mode usage time - Low-power mode usage time.

Slide 71

- Low power mode is the lower brightness mode that can be selected by the user. It is not an Energy Star function.

Terms and Definitions - 5

- **Lux, Lumen, Candela**
  - The brightness of a lamp is generally measured in lumens, and ambient brightness and light reflected from a screen is generally expressed in lux.
  - Lumen
    - » This ANSI unit is used to measure the amount of light emitted from a light source. In the ANSI procedure for measuring the brightness of a source, the light is directed onto a screen. The area of the screen is divided by 9, and the brightness at the center of each of these is measured. The average of these is taken to be the brightness of the source in lumens.
  - Lux (lx)
    - » This is a measure of the intensity of illumination. It can be expressed as lumens/square meter.
    - » Outside on a sunny day, the intensity is 15,000 to 20,000 lux.
    - » Inside a room with electric light, it is 1,500 lux.
    - » In a room lit by candlelight, it is 2 lux.
  - Candela
    - » This is often used for projectors with a built-in light source, such as a television. It is normally expressed as candelas per square meter. The candela is a measure of the strength of a light source, and cd/m2 expresses its brightness.
    - » cd/m2 = (lumens x screen gain)/(screen area m2 x π)
    - » Screen gain: Brightness increases with screen size.

Slide 72

❒ Example of conversion between lumen, lux, candela

➢ 1. From lumen (lm) to lux (lx)

For a 40-inch screen with a 4:3 aspect ratio, the area is about 0.5 m2.

For 1000 ANSI lumens, the amount in lux is: =1000/0.5, = 2000 lux

➢ 2. From lumen (lm) to candelas (cd/m2)

For a 40-inch projector with a screen gain of 2 (double that of an OHP projector screen), cd/m2 is:

(1000x2)/(0.5×3.14) = 2000/1.57 = 1274 cd/m2

Terms and Definitions - 6

- **Uneven colour**
  - This term is used when the contrast and color of the image is not constant. There are many possible causes for this.
- **Gradation**
  - Between white and black, there are shades of grey. The number of levels between white and black are called gradations. The higher the number of gradations, the greater effect on the image, but if the contrast is not high, this effect is cancelled.
- **Color Separation**
  - A computer video signal is separated into a black-and-white signal and a colour signal. In a projector, it is separated into three colors (red, green, blue). THe condition of the components that separate the light will have an effect on the quality of the image.

Slide 73

No additional notes

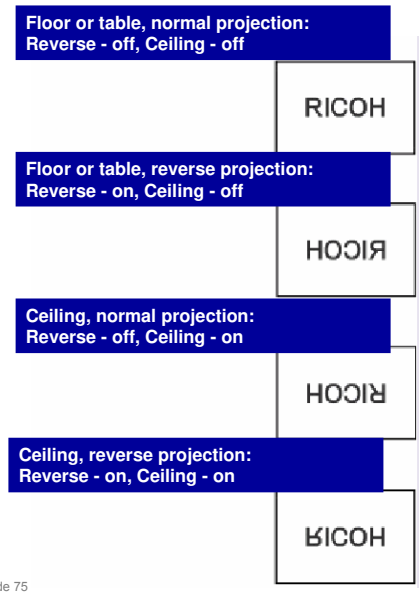
Terms and Definitions - 7

- **Contrast**
  - In general, this is the ratio between the bright and dark parts of an image. A high contrast gives a clear image. A projector with an internal light source is unaffected by external light sources gives a high contrast image that is clear.
- **Jitter, Flickering**
  - Jitter is noise in the image that is mainly caused by temporary fluctuations in the movement of rotating components, such as the motors that drive the heads in a VCR unit. The effects can be seen on vertical lines in the image.
  - Flickering of the image also can occur.

Slide 74

No additional notes

Terms and Definitions - 8



- **Image Adjustments**
  - If the projected image is flickering or blurred, in the wrong position, and so on, the horizontal position, vertical position, and synchronization can be adjusted.
    - » Flickering is often caused by inaccurate synchronization of the image data signal to the LCD panel.
  - The image settings (reverse, ceiling) depend on how the projector is set up.
  - The following settings from the image adjustment menu can be used to adjust the projected image.
    - » Contrast (weak/strong), brightness (dim/bright), colour strength for red green and blue, image quality (soft/sharp).

Slide 75

❒ Reverse, ceiling: These are in the customer settings menu.

Terms and Definitions - 9

- **Gamma correction**
  - This adjusts the signal level to get the correct VT response characteristics (V: input voltage, T: amount of transmitted light).
- **Trapezoidal image correction (Keystone correction)**
  - Depending on the angle of projection, the projected image will be distorted into a trapezoidal shape, instead of a rectangular shape.
  - The projector contains a sensor that detects the angle of projection in 15-degree increments, and the image is automatically corrected. This is known as Keystone Correction.
- **Projection Distance**
  - This is the distance from the projection lens to the screen. For a larger screen, the distance becomes longer (the distance is directly proportional to the screen size).

Slide 76

No additional notes

Terms and Definitions - 10

- **Screen Gain**
  - A measure of how brightly a screen displays an image.
  - The higher the screen gain, the brighter the screen.
- **Relation between Screen Gain and Brightness**
  - Generally, the larger the screen, the darker it is. If you choose a screen with a higher gain, the brightness is preserved to some extent.
  - Also, choose a screen to suit the room. In a long room, use a high luminance screen. In a wide room, a high viewing angle screen.

	White screen for OHP projection	High viewing angle screen	High luminance screen
Viewing angle (horizontally)	1 (wide)	2	3
Brightness	3 (dark)	2	1
Price	1 (cheap)	2	3
Screen gain	3 (low)	2	1

Slide 77

Screen Size Conversion Table

- Screen size (inches) is measured diagonally across the screen from top left to bottom right.

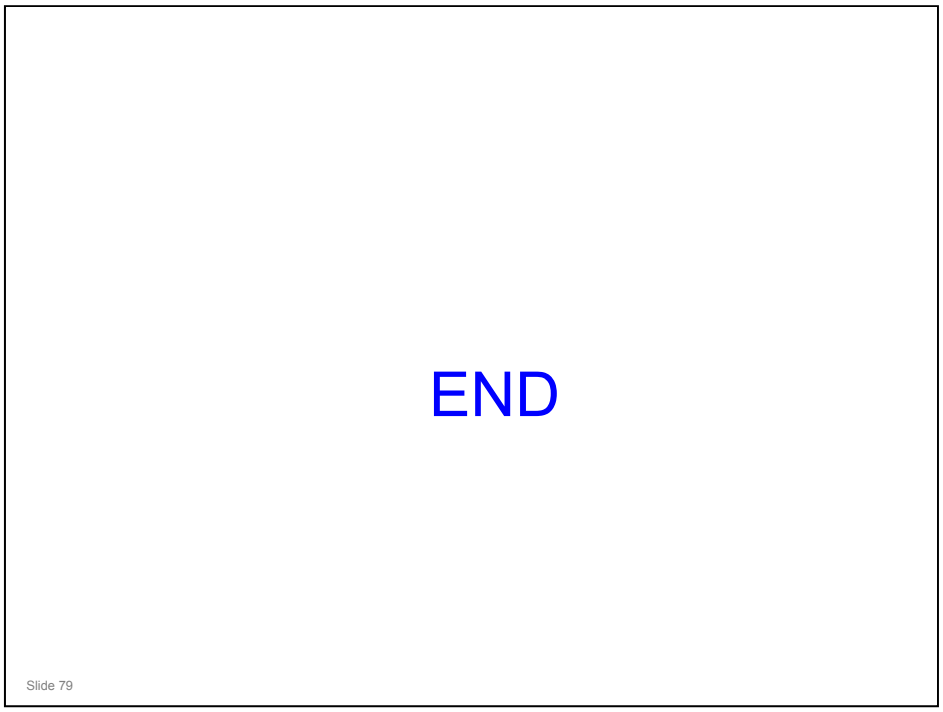
	4:3		16:9			4:3		16:9	
Size (in)	L (mm)	W (mm)	L (mm)	W (mm)	Size (in)	L (mm)	W (mm)	L (mm)	W (mm)
30	457	610	374	664	170	2591	3454	2116	3757
40	610	813	498	885	180	2743	3648	2240	3978
50	762	1016	623	1107	190	2896	3861	2365	4199
60	914	1219	747	1328	200	3048	4064	2489	4420
70	1067	1422	871	1547	210	3200	4267	2614	4641
80	1219	1626	996	1768	220	3353	4470	2738	4862
90	1372	1829	1120	1989	230	3505	4674	2863	5083
100	1524	2032	1245	2210	240	3658	4877	2987	5304
110	1676	2235	1369	2431	250	3810	5080	3112	5525
120	1829	2438	1494	2652	260	3962	5283	3236	5745
130	1981	2642	1618	2873	270	4115	5486	3360	5966
140	2134	2845	1742	3094	280	4267	5690	3485	6187
150	2286	3048	1867	3315	290	4420	5893	3609	6408
160	2438	3251	1991	3536	300	4572	6096	3734	6629

Terms and Definitions - 11

- **Ad hoc mode and Infrastructure mode**
  - There are two ways to connect to a PC using W-LAN.
  - Ad hoc mode is used to connect to a PC without using a W-LAN access point.
  - Infrastructure mode is used to connect to a PC through a W-LAN access point. In this mode, connection to the internet is possible, so security is provided by means of MAC address filtering.
- **JPEG Joint Photographic Experts Group**
  - This is a compression technology to facilitate the storage and transmission of still colour images. The data is reduced in a manner that is not visible to the eye, but a compression of 1/100 is achieved.
- **MPEG Motion Picture Experts Group**
  - This is a compression technology to facilitate the storage and transmission of moving colour images. There is more data than in a still image, so compression is important for efficient storage and transmission.
  - Depending on the degree of compression, there are MPEG-1、MPEG-2、and MPEG-4 standards.
  - MPEG-2 gives better results than MPEG-1, but a dedicated circuit is required for playing the image.

Slide 78

No additional notes



No additional notes