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Studio Production and Directing

Light

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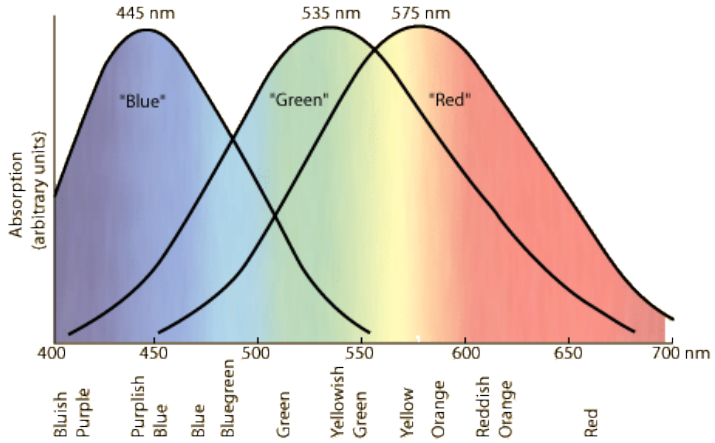
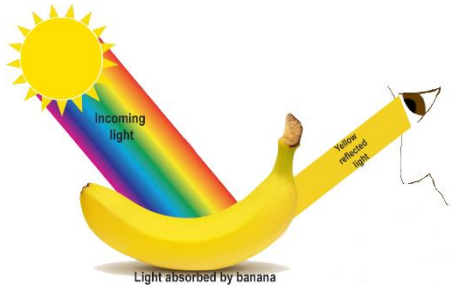
Image perception

•Light is electromagnetic radiation that is visible to the human eye in the range of 350 nm to 780 nm



•**The role of light sources in a TV studio:**
  - •Shapes the visual appearance of the image on the screen.
  - •It directly affects white balance and color reproduction.
  - •Determines the atmosphere and style of the program.

•**Basic division of light sources:**
  - •**Natural sources** – daylight (sun).
  - •**Artificial sources** – tungsten, HMI, fluorescent and LED systems.

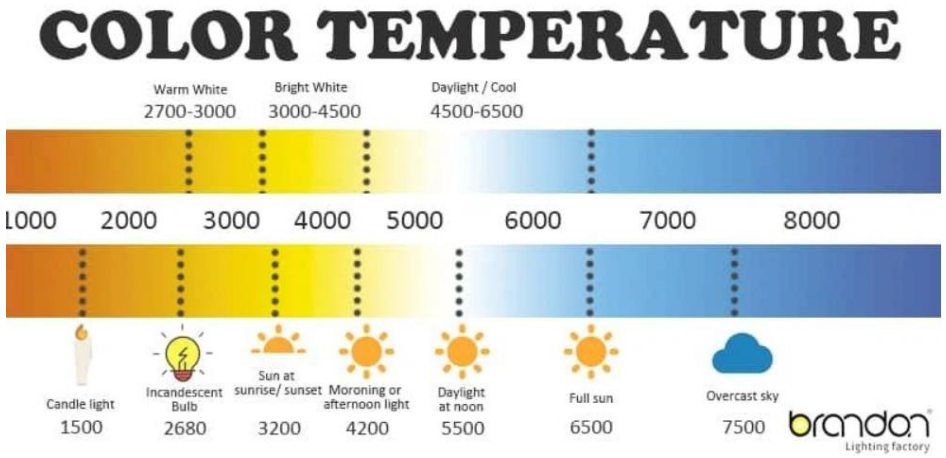


Brightness

- **Color temperature (Kelvin - K):**
  - 3200 K – warm (tungsten).
  - 5600 K- Daylight.

- **CRI (Color Rendering Index):**
  - Color quality measure – the closer to 100, the more natural the colors.
  - In a TV studio, the minimum CRI is ≥ 90.

- **Efficiency (lm/W):**
  - How much luminous flux you get per energy consumed.



Parameters

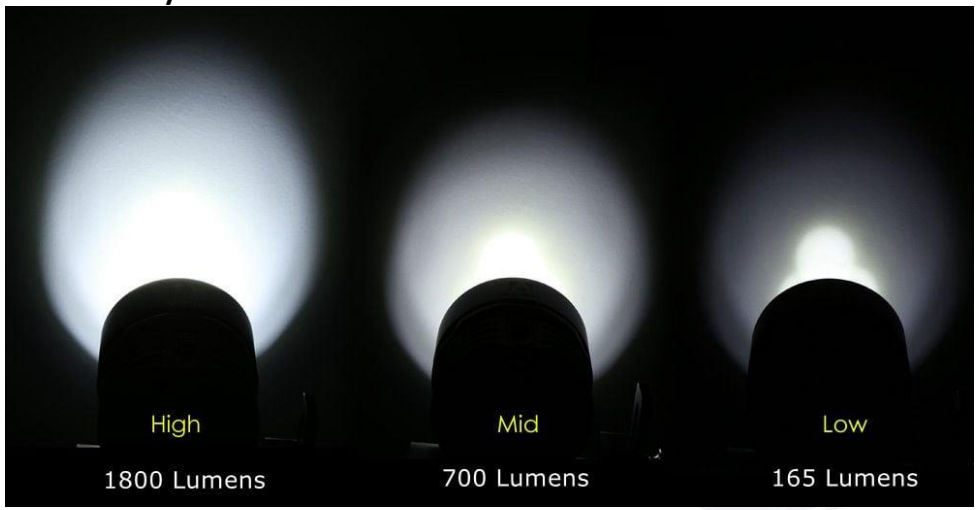
- Lumen (lm) is the **basic unit for the total amount of luminous flux emitted** by a light source.
  - It represents the "amount of light" a light bulb or reflector emits in all directions.
  - The higher the number of lumens, the stronger and brighter the light source.
- **Examples:**
  - 100W incandescent bulb (classic): approx. 1200lm.
  - A professional LED spotlight: 20,000 lm.

If we know the luminous flux and beam angle, we can calculate the light intensity:

$$\Phi = \int I(\theta, \phi) d\Omega$$

gde je:

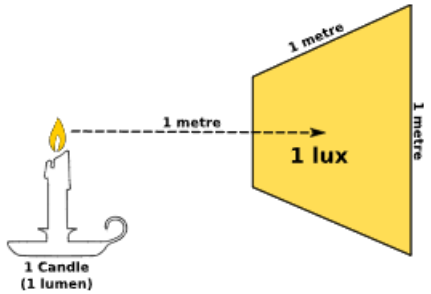
- Φ – ukupni svetlosni tok (lm),
- I – intenzitet svetla (cd),
- $d\Omega$ – ugao posmatranja (steradijan).



Parameters

Lux (lx) represents the **amount of light that falls on a specific surface**.

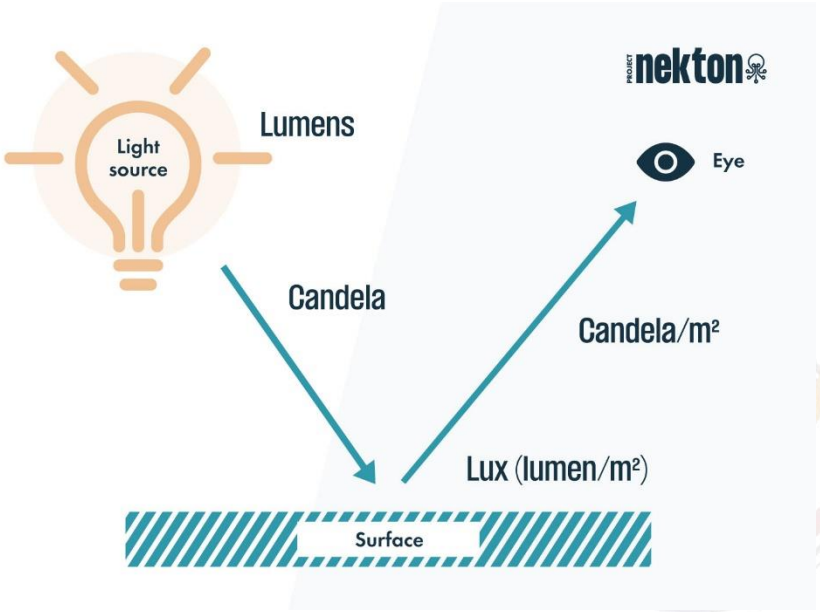
- 1 lux = 1 lumen evenly distributed over an area of 1 m².
- It measures how much light illuminates a surface, not how much light the source emits.



$$E = \frac{\Phi}{A}$$

gde je:

- E – osvetljenost u lux-ima,
- Φ – svetlosni tok u lumenima,
- A – površina u metrima kvadratnim.
- **Primeri:**
  - Svetlost u kancelariji: 300 – 500 lx.
  - TV studio za HD produkciju: 1500 – 2000 lx.
  - Sportski teren za TV prenos: 2000 – 3000 lx.



Luminous efficiency (lm/W)

Luminous efficiency indicates **how much luminous flux (lumens) is obtained for each watt (W) of electrical energy consumed**.

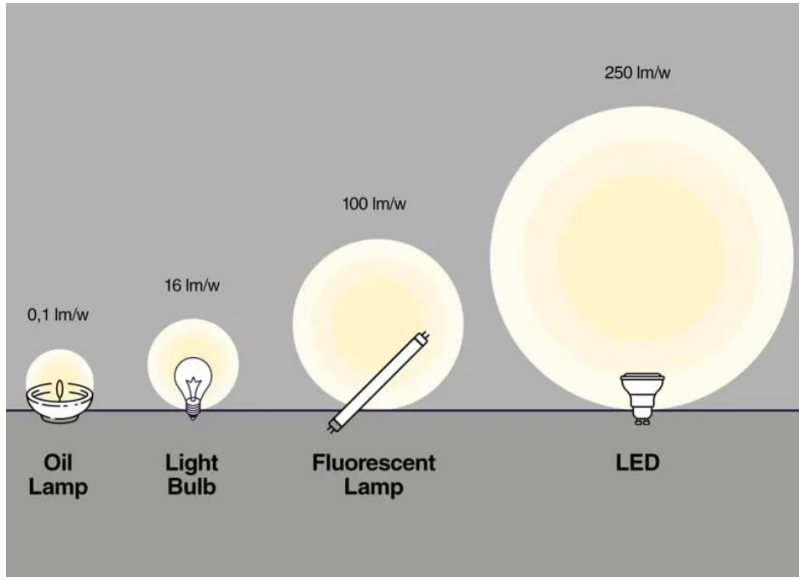
•The higher the value, the more energy efficient the light source is.

•A 100W LED spotlight can replace a 650W halogen spotlight while consuming six times less energy.

$$\eta = \frac{\Phi}{P}$$

gde je:

- η – efikasnost u lumenima po vatu (lm/W),
- Φ – ukupni svetlosni tok (lm),
- P – snaga u vatima (W).
- **Tipične vrednosti:**
  - Klasična sijalica (tungsten): 12–18 lm/W.
  - Fluorescentna cev: 60–100 lm/W.
  - LED rasveta: 90–150 lm/W.



Example of application in TV studio

TV studio area: 80 m²

- Target illuminance: 1500 lx.

- Total amount of light required:

$$\Phi = E \times A = 1500 \times 80 = 120.000\,\text{lm}$$

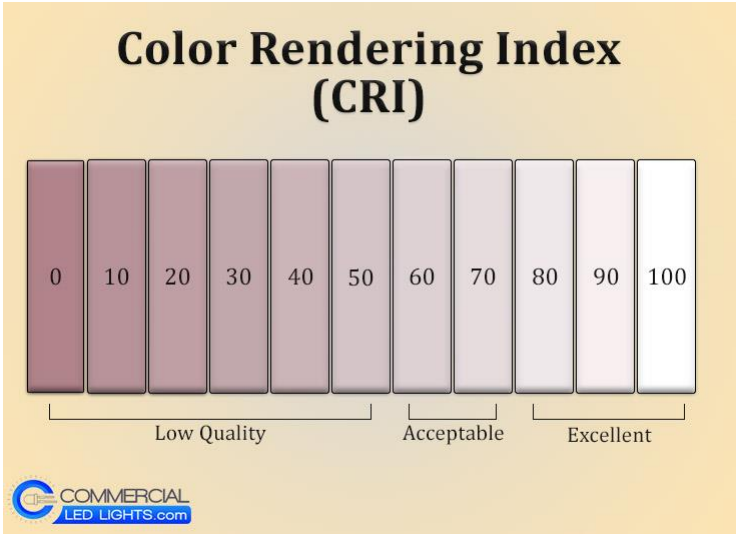
- Ako koristimo LED reflektore od 20.000 lm:

$$\frac{120.000}{20.000} = 6\,\text{reflektora}$$

Example of application in TV studio

- **CRI (Color Rendering Index)** indicates the quality of color reproduction.

- Scale from 0 to 100:
  - CRI < 80 – poor color quality.
  - CRI 80-89 – acceptable for smaller productions.
  - CRI ≥ 90 – professional TV and film production.
  - High-quality LED spotlights typically have CRI 95+.



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Lighting

•Stage lighting is a key element of theatre and TV production.

•It enables:
- •Visibility of performers and set design.
- •Creation of atmosphere and emotions.
- •Emphasis on dramatic elements.

- Stanley McCandless is considered the founder of the modern approach to lighting design (Yale University, 1930s).

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The Meaning of Lighting

The stage light functions define what we aim to achieve:

1.Visibility

1. Ensures clear perception of subjects and spaces.
2. Allows the audience to clearly see faces, movements, and scene details.

2.Plausibility

1. Creates a realistic representation of the setting and time of action.
2. Lighting should apper natural and logical within the story’s context.

3.Composition

1. The arrangement of light and shadow shapes the visual structure of the frame.
2. It directs the viewers' attention to the key elements of the scene.

4.Atmosphere

1. Uses color, intensity, and contrast to evoke emotion.
2. Helps build the dramatic effect and tone of the story.

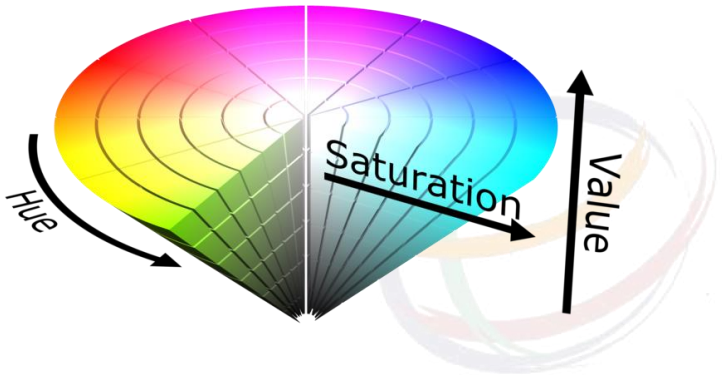
Light attributes

•**Controlled parameters define how light is shaped, ajusted and used in TV and stage production.**

•**Intensity** – *light intensity*
- •Measured in **candelas (cd)** or lux (lx).
- •Determines how strong the light is and how it affects camera exposure.
- •Used to balance different light sources on set.

•**Color** – *hue and tone of light*
- •Defines the visual impresson and atmosphere.
- •Controlled by using **gel filter**, **RGB LED technology** or changing colour temperature.

•**Distribution** – *direction and shape of the beam*
- •Determines how light spreads across the scene.
- •Can be narrowly focused (spot) or widely diffused (flood).
- •Achieved by using **lenses, reflectors, barn door** and diffusers.



•**Movement** – *dynamic changes over time*
- •Includes variations in intensity, color and direction during a show or performance.
- •Crucial for music programs, concerts and dynamic TV productions.
- •Implemented using **moving head reflector** and a DMX controllers.

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Other parameters

1.Reflection – *surfaces reflect light*

1. Different materials reflect light in variuos ways (matte, polished, glossy).
2. Reflection control is important to avoid unwanted glare on camera lenses.
3. Example: matte surfaces are used in green screen studios to prevent reflections.

2.Contrast – *ratio of light and dark*

1. High contrast creates dramatic effects and emphasizes details.
2. Low contrast gives the image a softer, more natural look.
3. Crucial for defining the atmosphere and readability of the frame.

3.Glow and glare – *issues with strong lighting*

1. Excessive light can cause a "burn out" effect on cameras.
2. Occurs on metal and glass surfaces.
3. Solved by using diffusers and the correct lighting angle.

4.Eye Adaptation – *Human Eye adjustment*

1. The human eye automatically adapts to changes in lighting.
2. Cameras lack the same adaptative capacity, requiring manual lighting control.
3. Essential when switching from dark to lit scenes in the studio.

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Light sources – division

- **Light sources are bodies that emit visible electromagnetic energy, crucial for TV production.**

- **Natural sources:** The Sun – natural light is rarely used in TV studios due to its unpredictability.
- **Artificial sources:**
  - Thermal (tungsten, halogen reflectors)
  - Gas (HMI, neon)
  - Fluorescent (SRGB systems)
  - LED (dominant today)
- For TV production, artificial sources are dominant because they allow **complete control**.

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Light sources – division

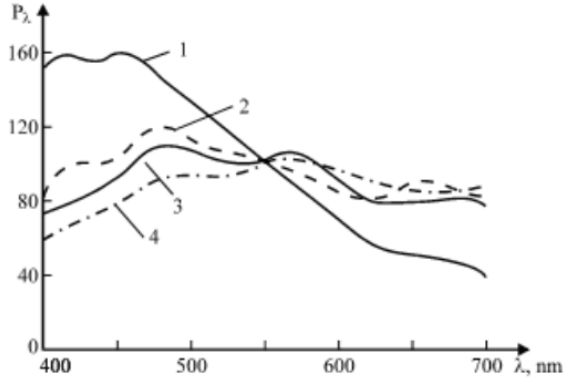
- **Light sources are bodies that emit visible electromagnetic energy, crucial for TV production.**

- **Natural sources:** Sun – use of natural light rarely in TV studios due to unpredictability.
- **Artificial sources (hot and cold):**
  - Thermal (tungsten, halogen reflectors)
  - Gas (HMI, neon) – 95 lm/W
  - Fluorescent (SRGB systems) – 70 / 100 lm/W
  - LED (dominant today) – 30-65 lm/W
- For TV production, artificial sources are dominant because they allow **complete control**.

Light sources – division

•The color of natural light varies depending on several environmental factors:
- •**Season** – winter light is cooler, summer light is warmer.
- •**Time of day** – morning light is warmer (reddish), midday light is neutral, evening light becomes warmer again.
- •**Geographical latitudes** – northern regions tend to have cooler, bluer daylight.

•TV studios **avoid natural light** because it is difficult to control and changes during filming, which can disrupt color consistency and exposure.



Krive spektralne raspodele snage Sunčevog svetla
1- nebo; 2-oblačno nebo; 3-Sunce+vedro nebo; 4-direktno Sunčevo svetlo

Worm sources

•They are obtained by heating the tungsten fiber (solid bodies) to high temperatures (~3200 K)

•Excellent CRI (color rendering), making them suitable for productions where accurate color reproduction is crucial.

•Today, they are rarely used, except in the film industry.

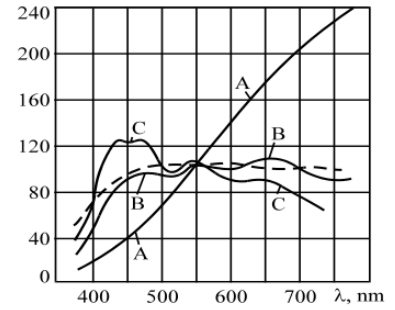
•Thermal energy is above 680nm

• 75% of their energy is lost as heat, which makes them very inefficient.

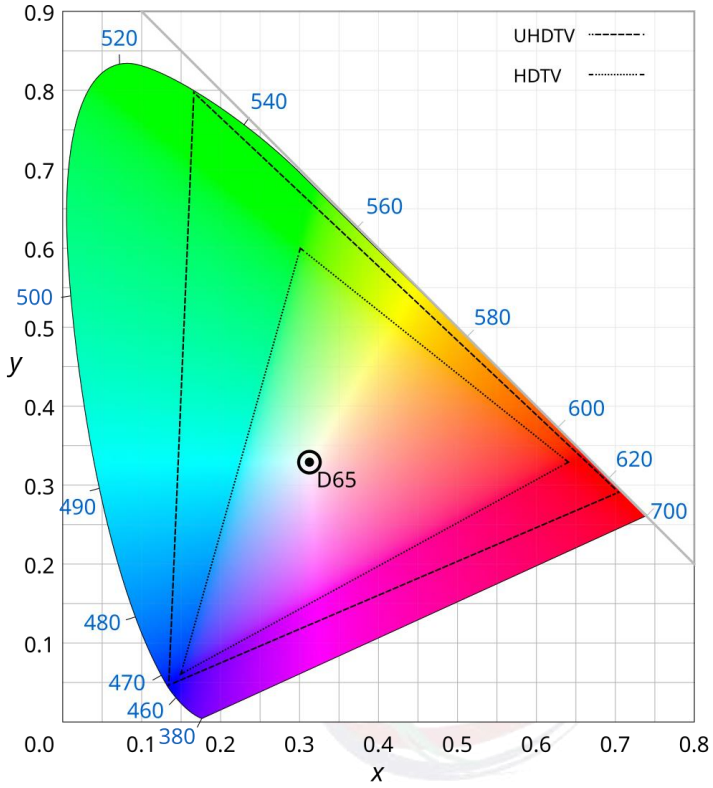
Artificial sources – CIE standard

- For consistency, CEE defines **standard light sources**:
  - **A** – simulates a tungsten bulb (2800 K).
  - **B** – simulates midday sunlight (4800 K).
  - **C** – standard daylight (6500 K).
  - **W** – reference white used for TV and monitor calibration.

- In practice, **D65 (6500 K)** is essential for TV production because it represents neutral white color, i.e. daylight.



Spektralna raspodela snage za CIE standardna svetla
A - tungsten sijalica,
B – fluorescentna sijalica (sunčevo svetlo u podne),
C- tipična fluorescentna sijalica (mešano svetlo sunca i neba)



SRGB / fluorescent light

- Inside the tube, the coating contains fluorescent powders (phosphors) based on the three primary colors.
- Each phosphorus emits a specific color:
  - R (red)
  - G (green)
  - B (blue0
- By combining these emissions, the lamp produces white light with a defined **color temperature**:
  - 3000K- warm lighht
  - 5600K- daylight.
  - 6500 K –neutral studio light

- Suitable for **soft-light systems** and green screen sets.

Cool sources

- In the past, TV studios used **SRGB fluorescent lamps** with phosphor coatings on the inside of the tube.
  These lamps emitted light in **narrow spectral bands** of red (R), green (G), and blue (B). Although this was efficient for camera sensors, it caused **color-rendering problems** because the spectrum had gaps (“holes”) that certain pigments and materials did not reflect correctly.
- Today, **LED light sources** have completely replaced fluorescent lamps.
  LED advantages include:
  - **adjustable color temperature** (2700 K – 10,000 K and beyond),
  - **wide and even light spectrum**, without pronounced gaps,
  - **RGB / RGBWW combinations** for creative effects and precise color control
  - **high CRI and TLCI** (>95), which means accurate color rendering on camera.
  - Modern LED panels often use RGB or RGBWW (RGB + Warm White + Cool White) combinations for precise color control.

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Cool sources - LED

Former SRGB sources advantages:

- Energy consumption **4–10 times lower than halogen lamps**,
- Lifespan: around **10,000 hours** (halogen: 200–600 hours),
- They did not develop high heat → suitable for studios with poor ventilation,
- Mild, diffuse light that is comfortable for cameras and speakers.

Today, LED lighting provides even greater benefits:

- **Even lower power consumption**, the **90W** LED spotlight replaces the **1kW** halogen unit,
- **Lifespan 50,000 + hours**,
- No overheating, minimal need for ventilation,
- **Precise color and intensity control** via DMX or wireless systems,
- Possibility of dynamic effects and color change in real time,
- Compact and lightweight design.

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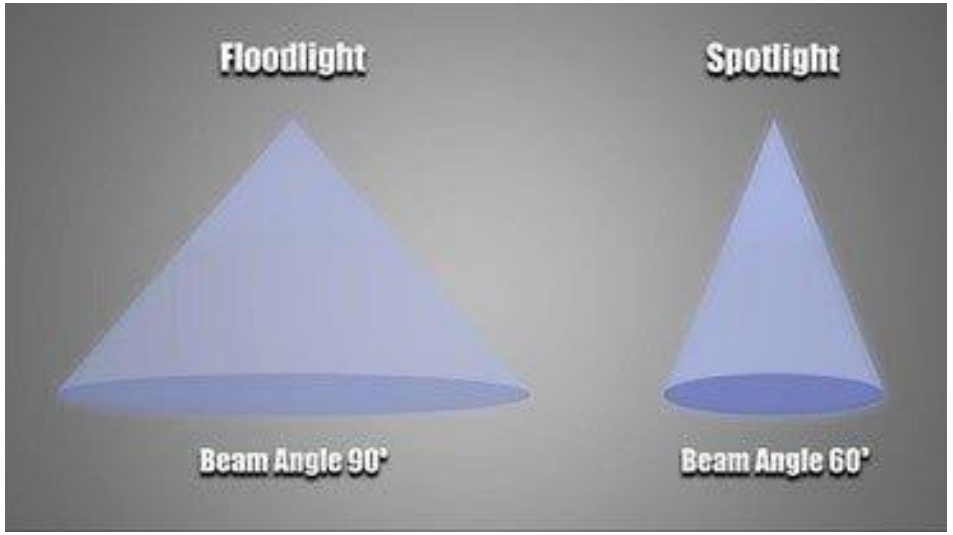
Lighting Criteria

- **Beam width:** determines how much space one fixture covers.
- **Beam uniformity:** crucial for green screen and talk show productionss.
- **Light quality:** depends on CRI, spectral distribution and color temperature.
- **Control capability:** dimming, color, beam movement.
- **Efficiency:** lumen/W ratio, important for energy optimization.

Distribution of luminaires by beam width

- **Wide beam (>60°)** – flood lights, used to illuminate large areas (broad lights, lensless reflectors)
- **Narrower beam (<60°)** – spot lights, used when precise control and focused lighting is required.
- Modern LED fixtires can **adjust the beam angle electronically** or with interchangeable lenses.



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Hard light

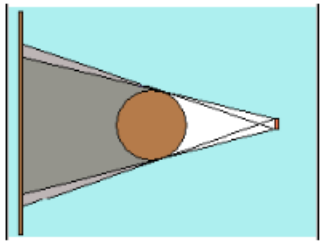
•**Hard light** emanates from **a small, strong source**, resulting in **sharp shadows** and clear contours

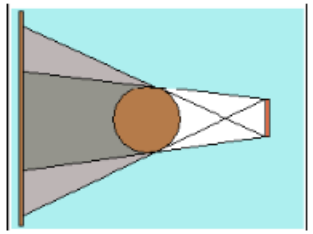
•Typical sources: LED fixtures, spot lights, afternoon sunlight.

•It is used to emphasize textures and shapes, for example in advertisements or when a dramatic effect is desired.

•Disadvantage: It can highlight facial imperfections and create a sharp, unflattering look for the TV.

•Today, it is most often used in combination with soft light.





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Hard light

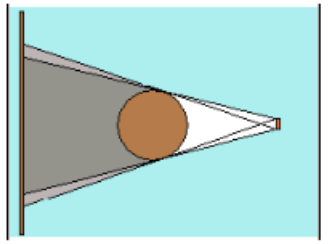
•**Hard light** emanates from **a small, strong source**, resulting in **sharp shadows** and clear contours

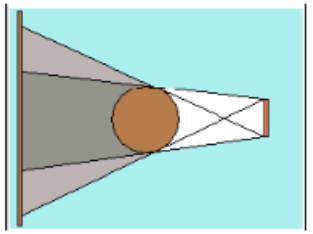
•Typical sources: LED spotlights, spot lights, afternoon sun.

•It is used to emphasize textures and shapes, for example:
- •When such a light illuminates the face, then it highlights all the shortcomings of that face - the flaw
- •But in other applications, such as highlighting skin texture or engraving on a piece of jewelry – an advantage

•Disadvantage: It can accentuate facial imperfections and create a TV.

•Today, it is most often used in combination with soft light.





Soft light

•**Soft light** comes from **large surface sources** or is achieved using a diffusers (frosted glass, panglas, diffusion foil).

•It creates gentle shadows and a natural look on the face – ideal for live shows, news and talk shows.

•It softens wrinkles and imperfections on the face, creating a glamour effect.

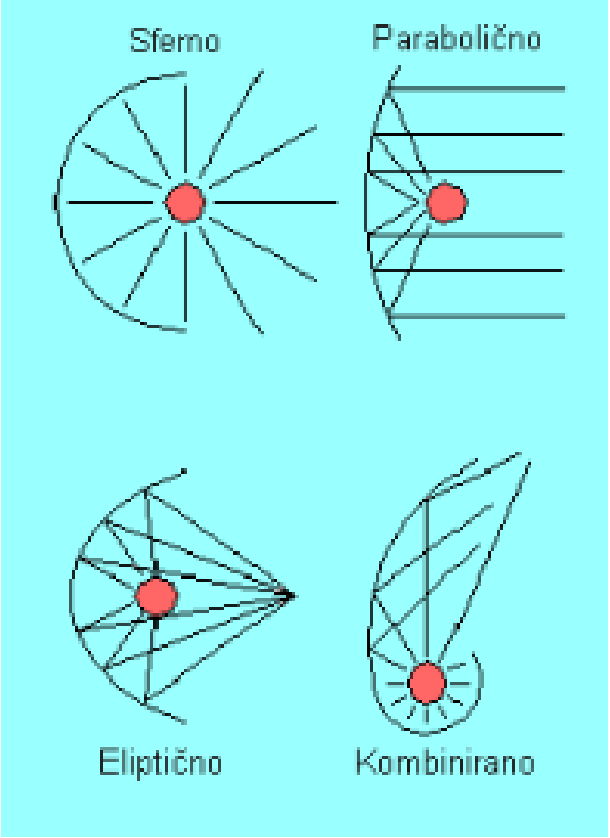
•Today, LED panels have **built-in diffusers** and allow soft light to be produced directly without additional equipment.

Reflectors/mirrors in lighting fixtures

- Reflector/mirror types:
  - **Spherical:** basic shape, reflects light backwards.
  - **Parabolic:** produces a directional beam.
  - **Elliptical:** focuses light into a single point.
  - **Asymmetrical:** a mix of effects for special lighting applications.

- They are used in PAR fixtures and specialized lighting units.

- With LED spotlights, the shape and position of the reflectors/mirrors are often integrated into the light design for efficiency.



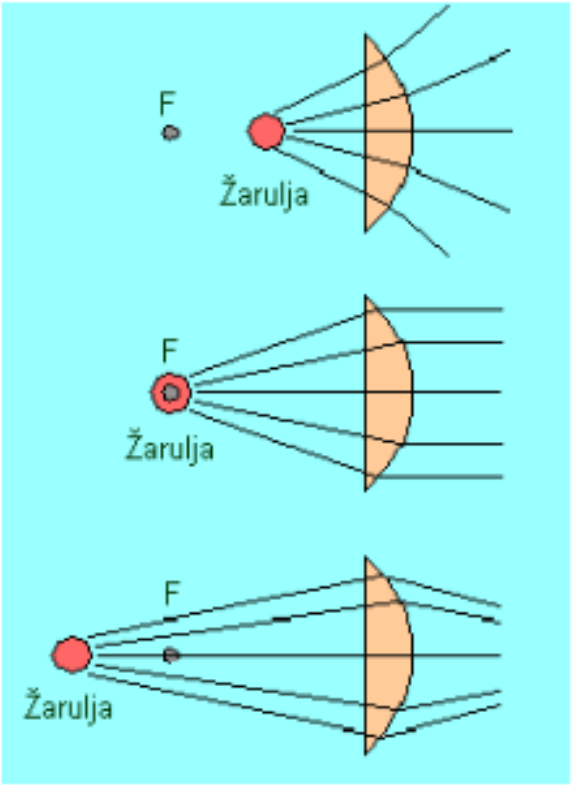
Lenses

•**Fresnel lenses** allow control beam width without losing too much light.

•The effect depends on the position of the light source relative to the lens:

- Wire behind the focal point – rays spread out (flood).
- Wire at the focal point – parallel rays (spot).
- Wire between the focal point and lens – rays converge (focused light).

Modern LED fixtures often feature **motorized lens positioning** for precise control.



Lighting types

- **Two types: spot and flood (illuminators)**

- **Flood lights / broad lights**– used to illuminate large areas
- **Fresnel fixtures** – precise control of directional light
- **LED panels** – energy efficient, adjustable color temperature
- **Soft light lighting** – even, diffused light for faces and green screens
- **PAR lights** – effects and background illumination
- **Moving head lights** – special effects and dynamic scene
- **Follow spotlights** – track a presenter or guest in motion





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Flashlights, illuminators (flood)

•Used to illuminate large areas,

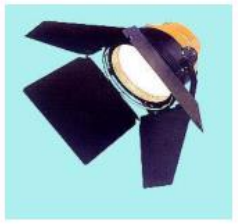
•They consist of: **bulb, reflector/mirror and housing.**

•They produce a very wide beam of light over 60°, and have great efficiency because their simple design, light has nowhere to be lost.

•The light from a flood fixture has a dual character: **The part comes directly from the bulb, and part is reflected from the reflector/mirror.**

•Light directly from the lamp is **harder and more intense**, while the reflected light from the reflector is **softer and weaker**.

•Many illuminators are equipped with barn doors to help direct the light.

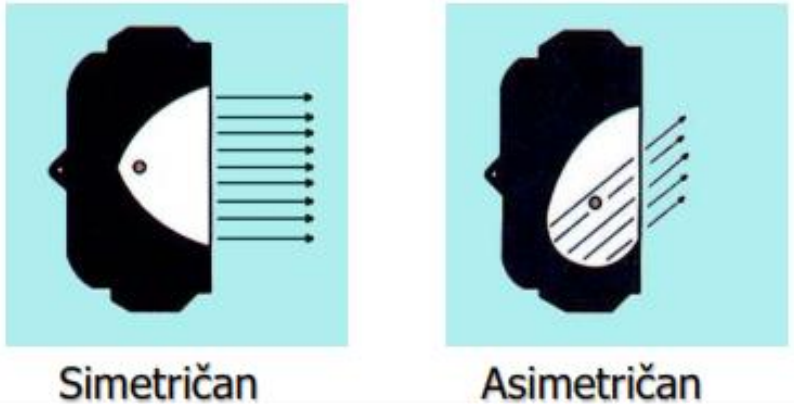


Tungsten Floodlight

Flashlights, illuminators (flood)

•**Symmetrical illuminators (flood lights)** use **spherical or parobolic reflectors/mirrors** and the light beam spreads with equal intensity in all directions.

•**Asymmetric illuminators (flood lights)** use **spherical or other types of reflectors/mirrors** and direct most of the beam in one direction. **They are used to illuminate large areas at close range.**



Flashlights, illuminators (flood)

• A cyclorama is the term for a **curved background** in TV studios.
The same term is used for illuminators designed to illuminate these backgrounds.
•They are placed on the floor or hung from telescopic mounts at a distance of 2 - 3 m from the background.
•The best effect is achieved by simultaneous illumination from above and below, using both floor and overhead cyclorama lights (a combination of top cyc and ground cyc lights).

•They can be LED or flood lights.

ColorSource CYC

Fresnel

•The Fresnel fixture uses a characteristic ringed lens that allows control of the light beam width.
•Beam width: 10°–55° (spot–flood).
•Typical power: 650W, 1kW, 2kW halogen; 75-300W LED models.
•CRI ≥ 90 for accurate color rendering.
•Adjustable color temperature (LED models: 2700–10.000 K).
•**Accessories:** doors, diffusers, gel filters.

Application:

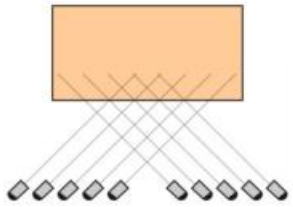
- •Key light for presenters and guests.
- •Backlight for separating the subject from the background.
- •Precise facial modeling.

Desire Fresnel

Source Four Fresnel

PAR SPOTLIGHTS

•It produces hard light. Placing a panglass in front softens the light.
•The beam width is controlled by moving the bulb and reflector/mirror towards the lens (expansion) and away from the lens (narrowing).
•They have a door for controling and shaping the light.
•**PAR reflectors** consists of: **light bulbs, a parabolic mirror and a lens enclosed in a common glass balloon, today they are LED.**
• It is the most efficient lighting fixture in stage lighting, as there is practically no light loss.



PAR reflektori

PAR reflektori

PAR reflektori

Soft-lighting

- Very soft, diffused light, no pronounced shadows.
- **Applications:**
  - Information programs.
  - Green screen backgrounds.
  - Even illumination of faces and panel shows.

LED

- The most modern standard in TV studios
- They allows RGBW color control, adjustable color temperature and intensity.
- High energy efficiency, low heating.
- Suitable for dynamic shows.
- CCT range: 2700-10.000 K.
- RGBW functionality
- Control:DMX, RDM, Art-Net, WiFi.
- Power: 100-600 W
- Flicker-free operation up to 2000 fps.

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LED

Moving head lights

- Rotating head lights for dynamic lighting.

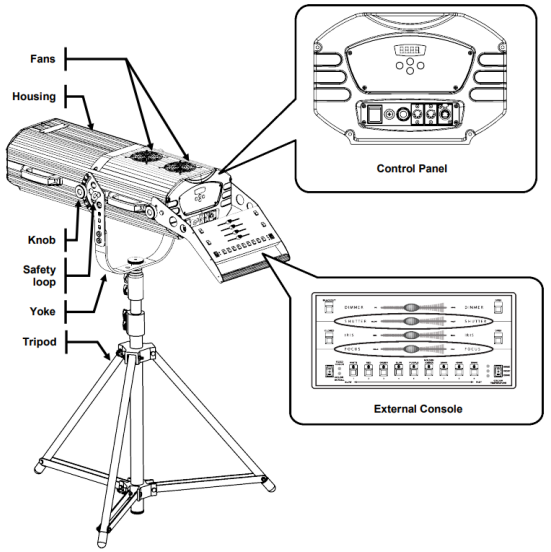
- Types:
  - Beam – narrow beam for spectacular effects.
  - Wash – Wide wash area.
  - Spot – shape projections and highlighting.

- Music shows, entertainment programs, concerts.

- DMX, Art-Net, RDM control.
- Beam angles: beam 2–10°, spot 10–30°, wash 30–60°.
- Functions: rotation, gobo projections, colors, dimmer, strobe

Follow spot

- Live tracking of moving subjects.
- Essential for shows with audiences and performers.
- Controlled beam width and intensity.
- Beam: 5–15°.
- Power: 575-1200W halogen or LED.
- DMX control for dimmer.
- Iris for precise tracking.



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Grid

- **In order to install all lighting fixtures in a studio, a grid is typically used**. It allows quick scene changes and safe overhead cabling.

  It is a system of interconnected metal pipes or rails hung horizontally below the ceiling.

- Floors and walls are matt black, without windows.

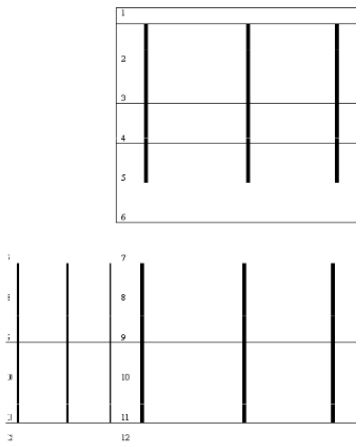
•The grid pipes are usually installed according to the following scheme: the length of pipe (rail) is approximately 2.4m; the distance between two adjacent pipes (rails) is usually around 1.2m.

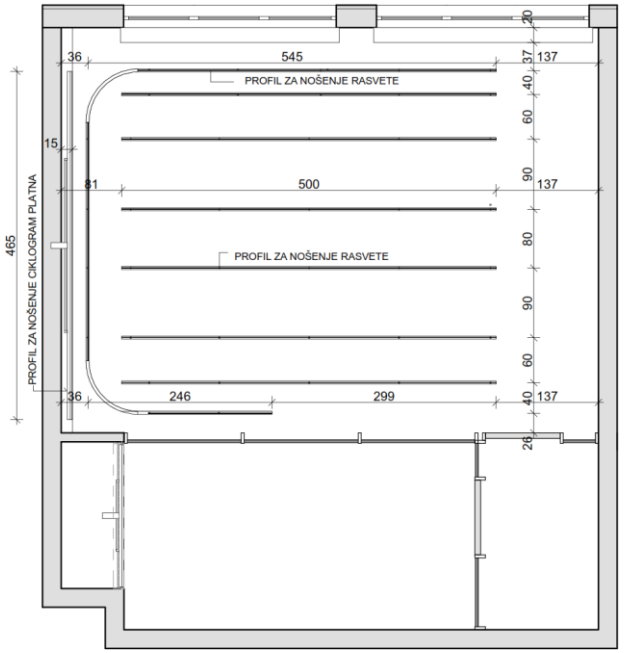
•For a medium-sized studio measuring 22 x 30m, the grid is installed at a height of 10m.

- **Lighting is placed on the grid in three ways:**
  - •by direct **fixing** to the parts of the grid
  - •by placing the reflector on the **telescopic holders**
  - •by placing the spotlight by means **of a pantograph**

Grid

- Spotlight pipes (grid) with a diameter of about 50(48)mm,
- distance from the ceiling as small as possible, about 10 cm,
- Distance from the wall around 1m,
- Curtain structure about 25cm from the wall,
- Silumin monophase sockets with IP54 protection,
- Socket density about 1pc/2m²,
- Non-flammable cables – halogen free 3x2.5mm (30% more expensive),
- Comb-style switches with two or three positions,
- Each fixture: secondary safety cable; clamp rated for load,
- Load capacity marked per section; “over-reach” installation prohibited.





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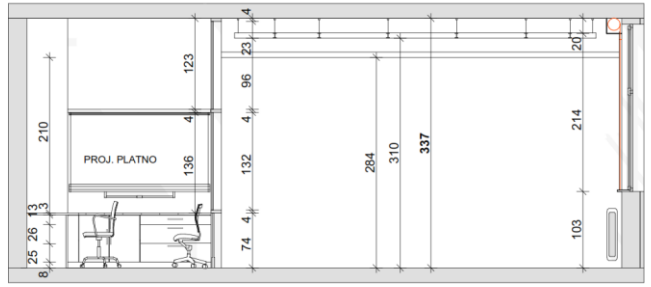

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Power & Electricity

•Avoid **neon** lighting in technical rooms with AV equipment (RF interference)
•Use **incandescent/halogen** or LED with **electronic ballasts**
•If thyristor dimmers are used: provide **RF filters**

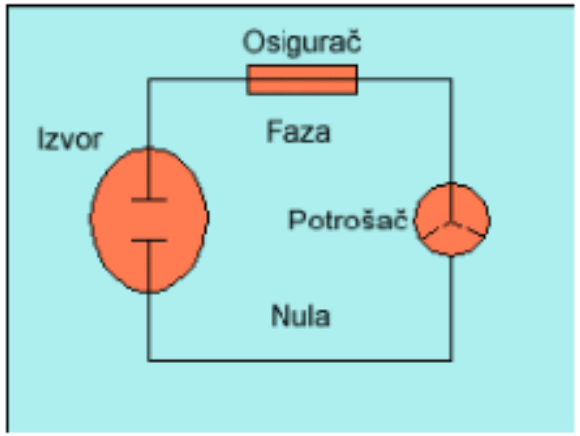
Separation of phases and circuits:
•Lighting and general power on separate phases from A/V power.
•It is recomented that all **A/V equipment be on the same phase** (reference, humming)

Labeling of sockets and phases
•Color/label standard: technological, general power, aggregate, phases **R,S,T.**
•Clearly number circuits and fuses.
Image suggestion: panel with sockets of different colors/labels.

Power & Electricity

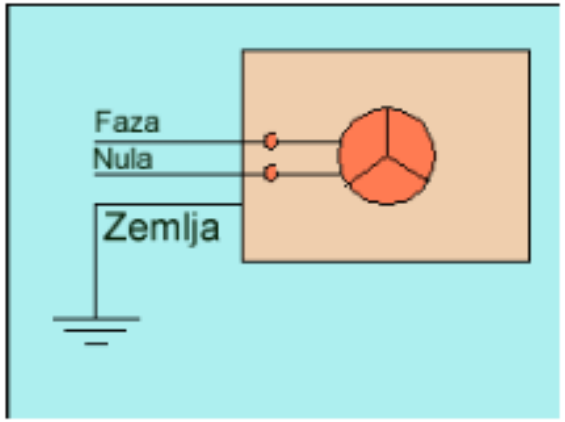
Circuits and fuses:

- **Each circuit has its own fuse**;
- Example: **2 kW** reflector at **230 V** → **I ≈ 8.7-9.1 A** → fuse **10 A**



- **Protection and grounding:**
- RCD/RCBO protection, mandatory **grounding of the housing**
- Use of devices without a PE conductor is prohibited.

- **Panic/evacuation light**
- In all technical rooms – **panic lighting** independent of stage lighting.
- Powered by UPS/emergency circuit



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Light control and dimmers

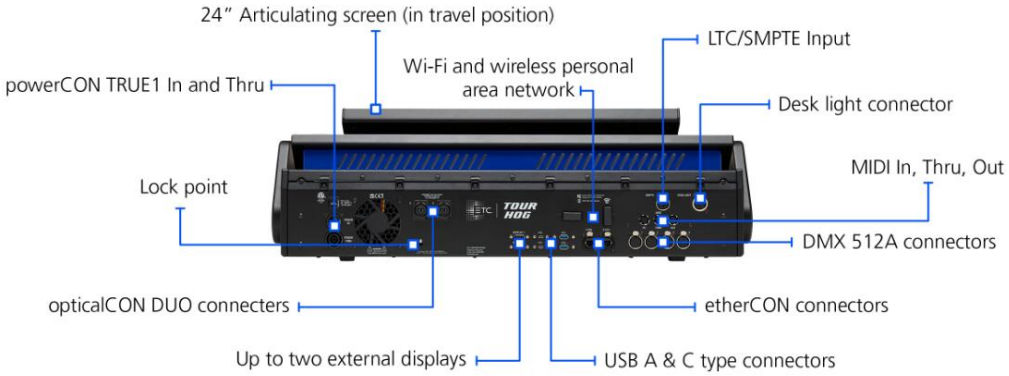
- Stage lighting control involves managing movement, intensity (using dimmers), and the distribution of electrical power within the electrical systems
- Power distribution is one of the control systems.

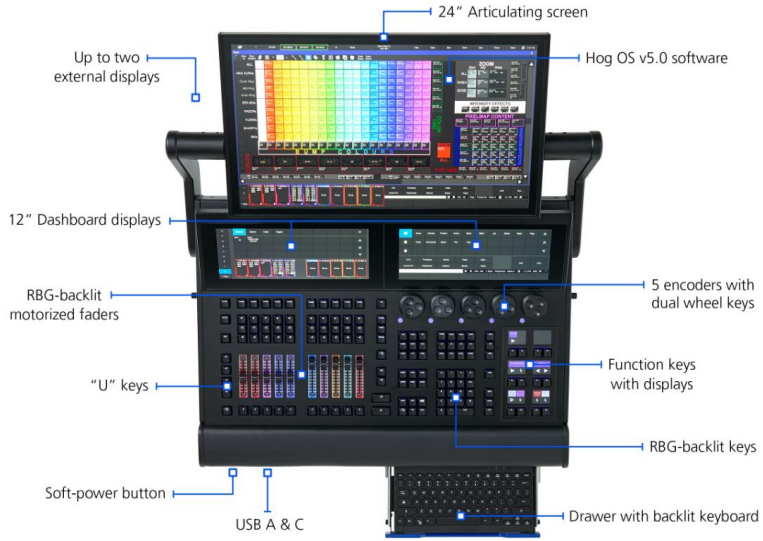
Lighting systems consist of:

- Spotlights/fixtures
- Dimmers and power distribution
- Cable infrastructure
- Lighting control desk (lighting console)

Light control and dimmers

- Most modern consoles have a digital interface used for programming lighting, but some still include faders for manual control of lights.
- With the console, you can ajust intensity, color, movements, timing, scene configuration, presets …
- All inputs and outputs are referred to as channels (cue state).





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Light control and dimmers

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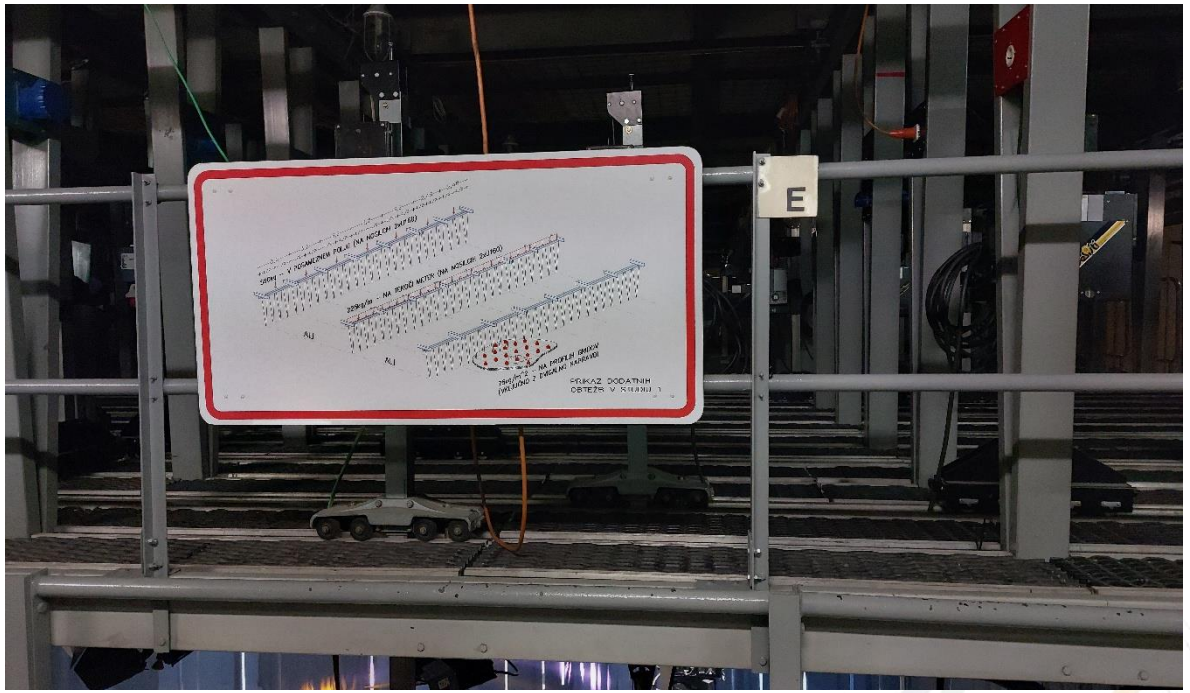
Light control and dimmers



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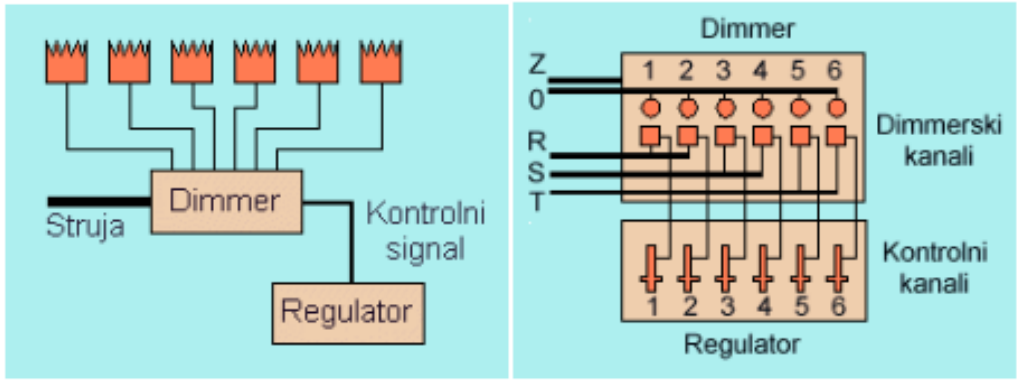
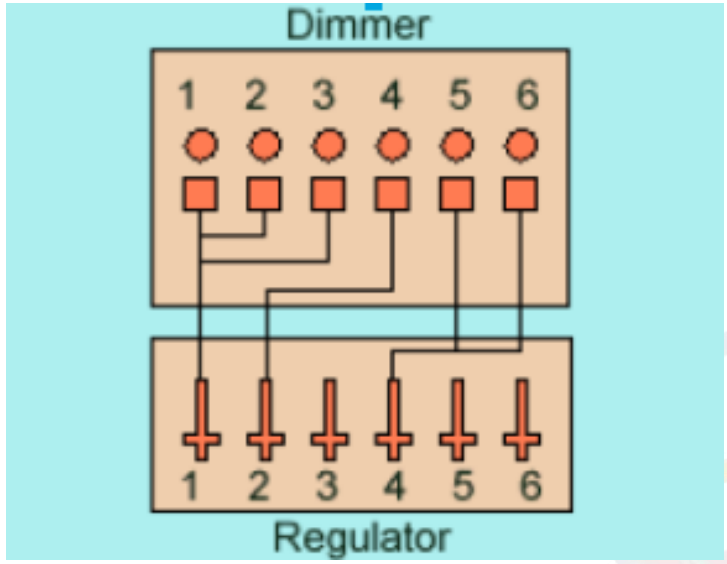
Light control and dimmers

- When using tungsten lights, dimmers are needed to control intensity
- A dimmer, or thyristor regulator, is a distribution box that receives three-phase power, usually up to 30 kW, and has multiple (typically 6 or 12) single-phase outputs to regulate voltage on each output.
- The voltage on each single-phase output can range from 0 V to 220 V – this voltage directly affects the light intensity.
- A lighting console (mixer) is connected to the dimmer via a DMX cable and controls the voltage on each output, thereby adjusting the intensity of the light emitted by each fixture.

Light control and dimmers

- Each circuit is called a dimmer channel.
- The regulators transmit information about the required voltage via control channels.
- Electrical power is distributed from the main power line to:
  - Path panels
  - Circuits (dimmer channels)
  - Stage lighting instruments





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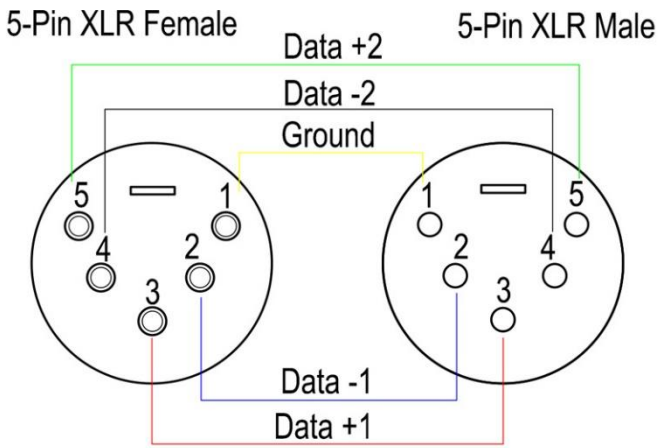
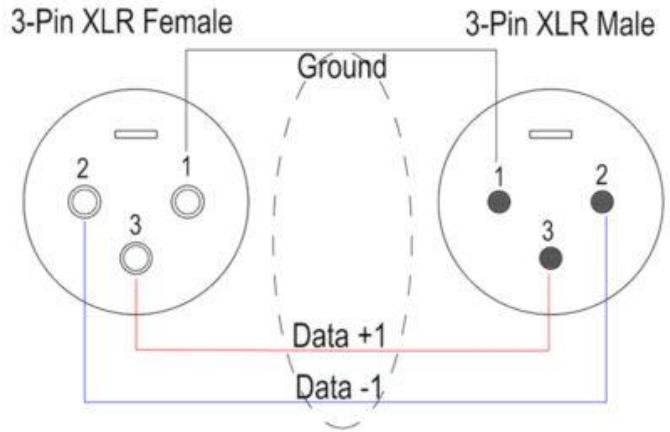
Dimmer and electricity distribution

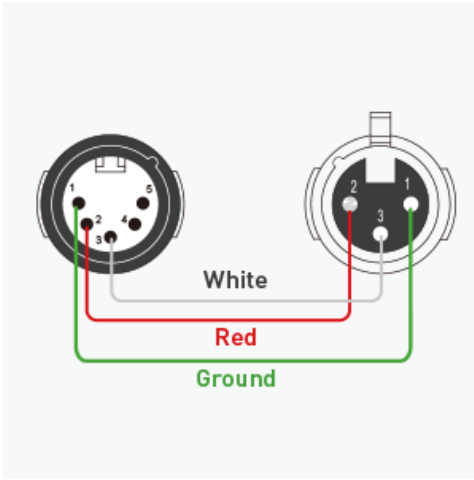
Communication - DMX

- The control data is transmitted via **the** DMX-512A standard (or similar) which connects the console, dimmers and LED / moving lights.

- Connection: a 5-pin XLR connector is commonly used, although some devices use a 3-pin connector.







Communication - DMX

•The console is the source of the DMX signal; the signal is first sent to dimmers, then to LEDs and moving lights.

•if you have a large lighting system, the console can have multiple DMX outputs (“universes”), allowing control of a greater number of devices

•Modern consoles feature **RDM (Remote Device Management)** functionality:

- •Automates device address assignment
- •Reduces the possibility of errors and speeds up system setup.

•**All channels can be tested** using the "flash" function.

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Connectivity

- Patching is the process of linking lights to the lighting console.
- The lights are already physically connected to dimmers or DMX cables.
- Patching is used to map the virtual channels on the console to the physical devices.
- This process allows the console to know which light it controls and with which commands.
- As the system becomes more complex, patching simplifies device control and organization.

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Connectivity

There are two main types of patching:

- **Hard patching**
  - Physical connection of devices directly to a dimmer or lighting output.
  - A simpler system, but limits flexibility.
- **Soft patching**
  - Logical mapping of devices within the console itself.
  - Connects specific channels to lights without changing physical connections.
  - Allows channel reorganization at any time.

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Benefits of soft patching

- Facilitates channel numbering in a way that makes sense to the technician.
- Provides flexibility when adjusting and reorganizing the system.
- Especially useful when using multiple devices, such as:
- LED fixtures,
- Moving head lights,
- Various special effects.
- Accelerates work during event or show setup.

Addresses and Channels

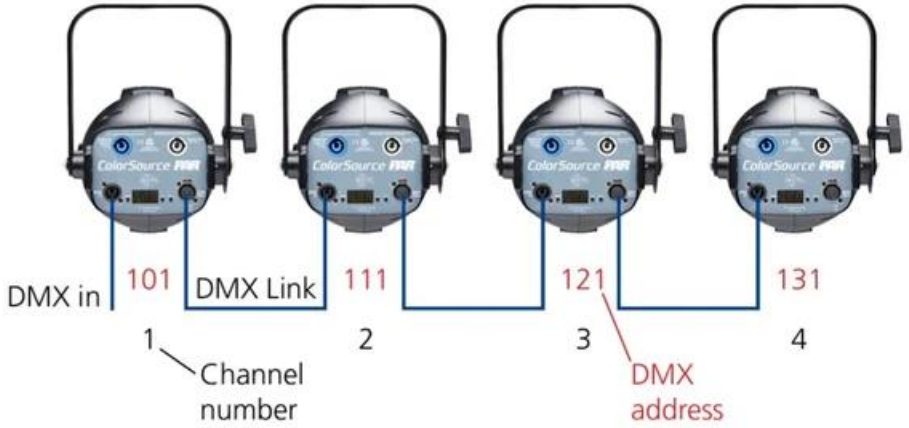
- Each device must have **a unique DMX address**.
- Addresses must not **overlap,** as this would cause a conflict in the system.
- A single device can have **multiple channels**, for example:
  - Intensity:
  - Red color,
  - Green color,
  - Blue color,
  - Strobe effect.

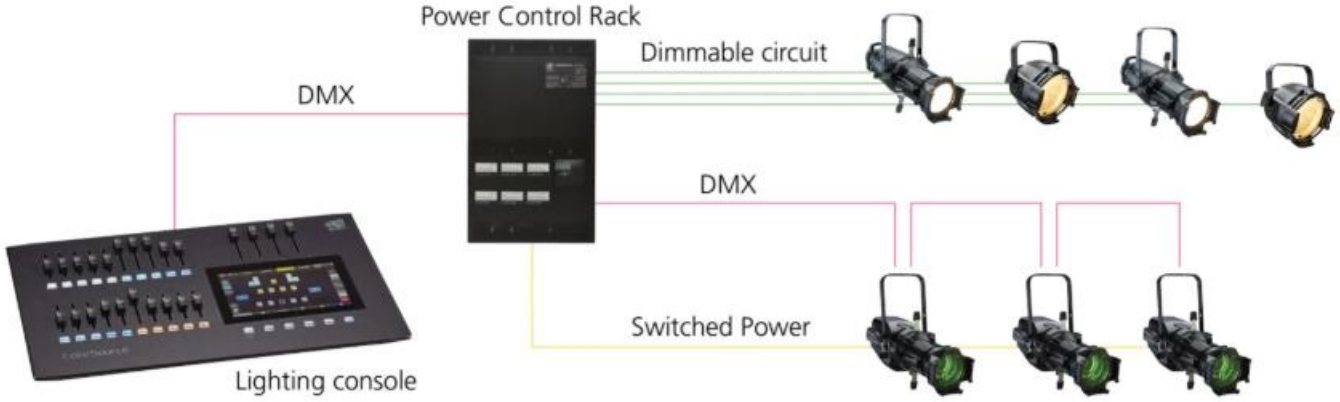
Parameter	Default Address	Patched Address
Intensity	1	101
Red	2	102
Green	3	103
Blue	4	104
Lime	5	105
Strobe	6	106

- On the console, the **starting address** is set, which determines the layout of all subsequent channels for that device.

Example.

Unique DMX address setting





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Questions & Answers

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