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Studio Production and Directing

Rooms and Equipment

Vladimir Maksimovic

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Technical documentation

- The primary tool for technical expression and communication.
- It includes:

1. Project brief
2. Conceptual design
3. Preliminary project
4. Main project
5. Detailed execution project
6. Maintenance documentation
7. Bill of quantities and cost estimate

Project brief and preliminary project

• It defines the project objectives and provides technical, economic, legal, and time frameworks.
• It includes:
  – Information about the investor and the facility,
  – Project goals and purpose,
  – Technical requirements and regulations,
  – Planned timeline and budget.

Preliminary project

• It elaborates the conceptual design in detail.
•Serves as a basis for preparing the investment report and the main project.
•Includes a technical description, technical solution, environmental protection measures, and graphic documentation.

Main project and execution (detailed) project

Main project

- Detailed technical elaboration of the system.
- Basis for the preparation of execution documentation and tenders.
- Includes technical, legal, and administrative documentation.

Main execution project

- Specifies the exact types of equipment and materials:
  - length and type of cables,
  - method of installation and connection,
  - placement and fastening of equipment.
- Adapted to the skill level of the personnel using the system.

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Bill of quantities, cost estimate and standards

Bill of quantities and cost estimate

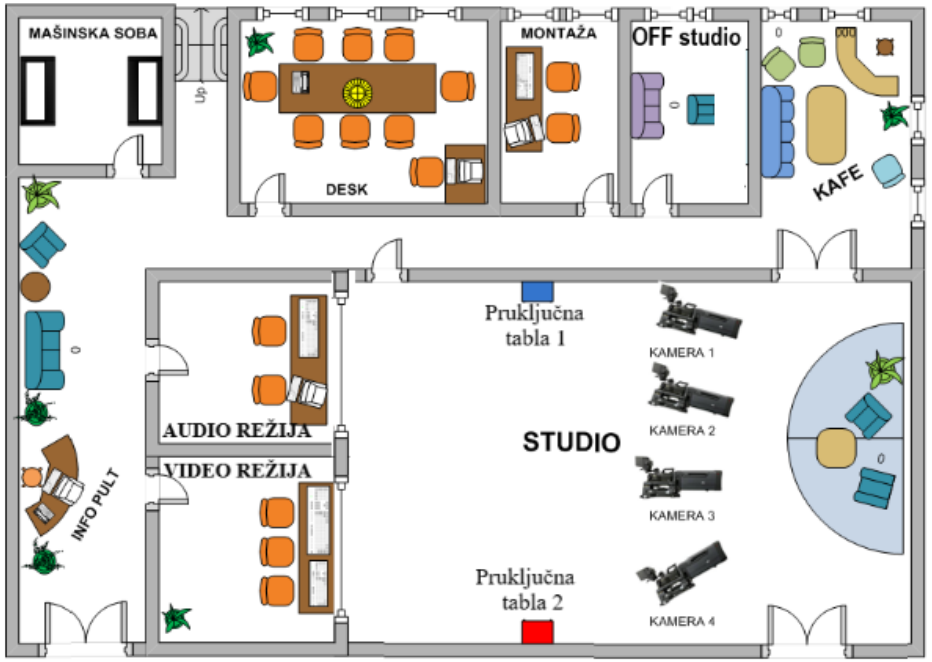
- Shows the costs of equipment, materials, software, and labor.
- Includes tables with quantities, unit prices, and total prices.

Standards

- International: **IEC, ISO, CENELEC**.
- National: **DIN, VDE, BS, NF, GOST-R, actually EN**.
- Examples:
  - EMC (Electromagnetic Compatibility) (radio interference),
  - Ex (explosion protection),
  - CE (EU standards),
  - ISO 9001 (quality).

How the TV should look like?

- **Studio, control room (video and audio), editing, machine room, editorial office, wardrobe, makeup room, storage rooms, off-air room, props/set storage & workshops.**
- **The studio is connected to the control room (ideally also visually, through a window) for communication, and access to the studio and auxiliary spaces must allow unobstructed movement of equipment and personnel.**



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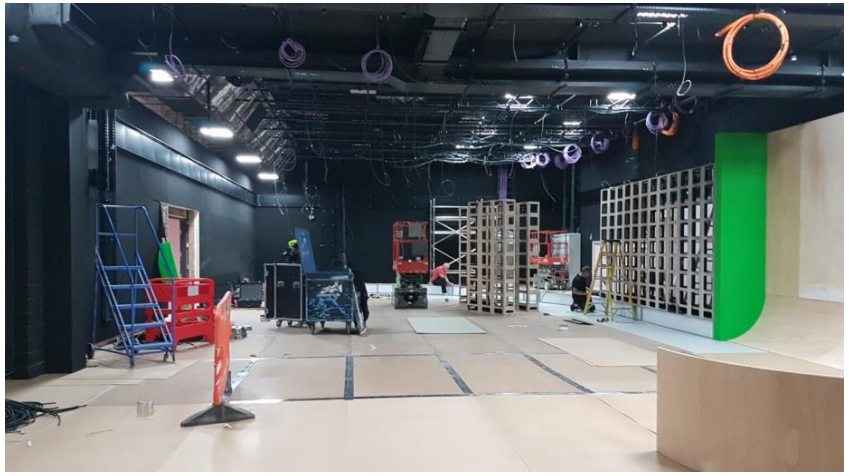
TV studio

- The main production unit of any TV system.
- The studio size (area and height) is planned according to the type of program (small <100 m², medium <400 m², large 400–1000 m²) – or multiple studios.
- Height 4–8 m for the lighting grid.
- Flat, solid, quiet floor.
- Sound insulation from external noise.
- Echo control.
- Quiet HVAC and electrical circuits.
- Positioning and access to rooms

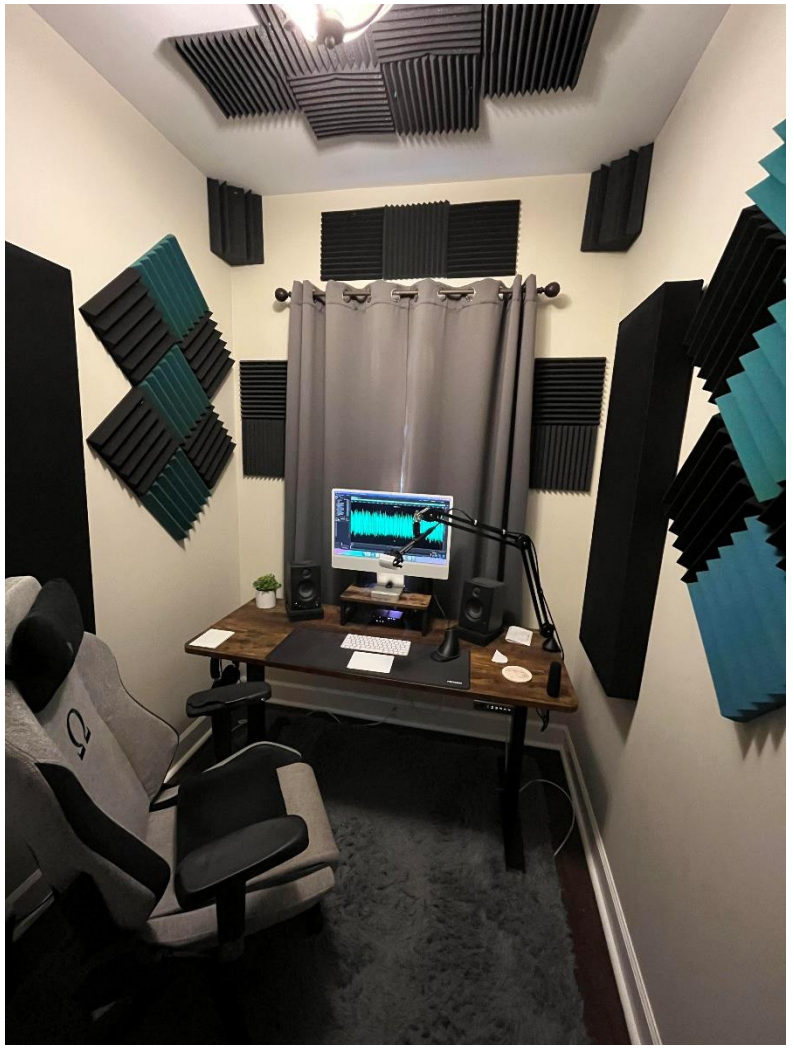


TV studio scenography

• Scenography represents the visual framework of the program – a set of decorations, backdrops, furniture, and props that define the appearance of the scenes.
•It creates the atmosphere and identity of the program, integrated with lighting and graphics
• **Fixed elements:**
    • Backdrops, wall panels, floors, and permanent structures.
• **Movable elements:**
    • Sets that can be moved and changed according to the program's needs.
• **Tehnical components:**
    • Integrated LED lights, video walls, green screen backdrops.
    • Mechanisms for quickly changing scenography elements.

Off room

- The off-studio is a small voice booth designed for recording high-quality spoken audio (e.g., narrations or announcements) delivered by a presenter outside the main studio. Such recorded commentary is later added over specific video material in the control room or during editing.
- Condenser microphone, pop filter
- Direct connection to the editing suite
- Monitoring



The machine room

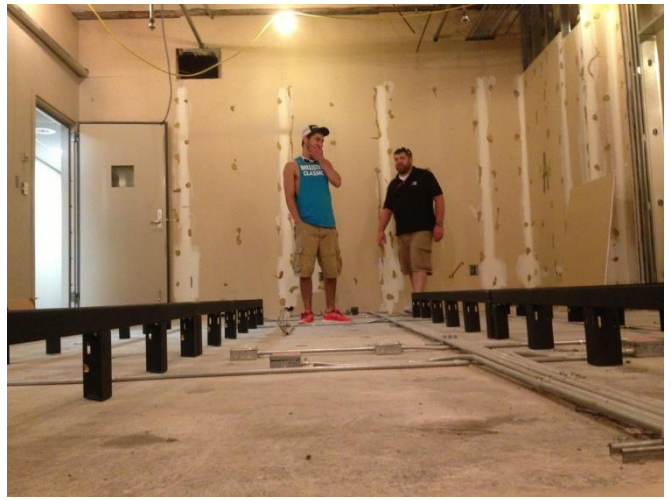
- The machine room is the main technical room of a TV center, housing almost all external equipment that does not need to be located directly in the control room..

Key equipment:

- Video matrix/router, multiview processors
- Video servers (ingest/replay/archive), playout servers
- Encoders/transcoders, IRD receivers, modulators, etc.
- Network switches/routers
- UPS and power distribution (dual feed, A/B

Infrastructure and layout:

- Rack cabinets arranged in a hot/cold aisle configuration; raised floor/cable trays
- (SDI/fiber/XLR), clearly labeled with route documentation
- Grounding and galvanic isolation to reduce interference/hum



TV editing

- Room for non-linear video editing
- Contains a computer workstation with specialized software

- Multi-monitor setup:
  - Reference video monitor
  - Two work monitors for timeline and preview
- Studio speakers and headphones for audio monitoring
- Direct connection to the central server and control room
- High-throughput network (10GbE or higher) for video file transfer
- The room must be quiet, air-conditioned, and acoustically optimized.

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Audio editing

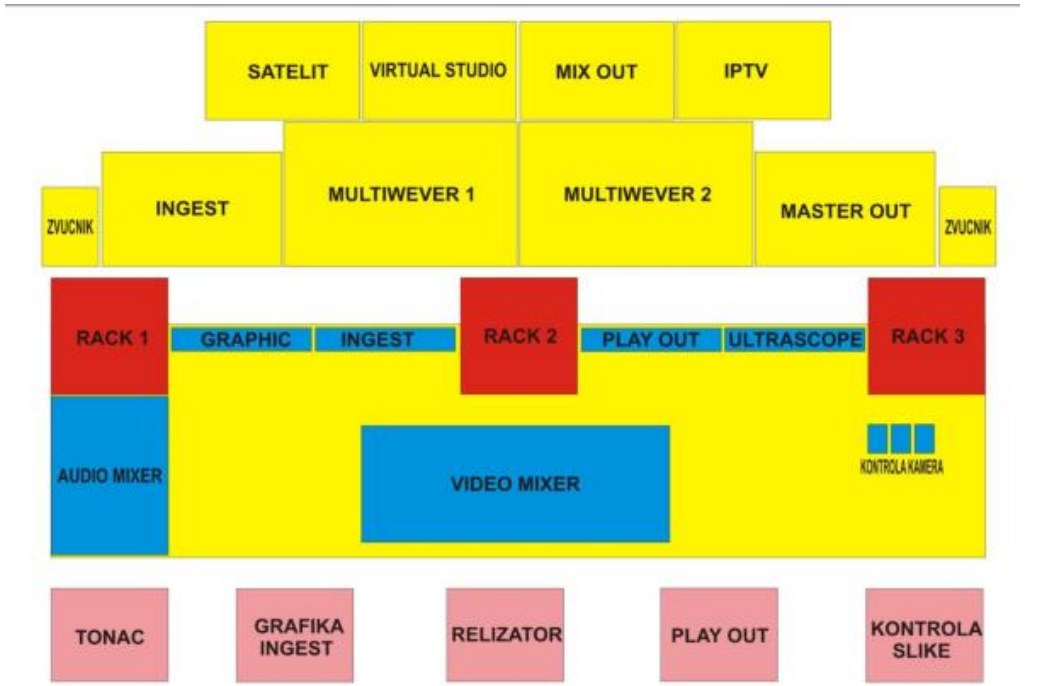
- Room for shaping and finalizing the audio of programs and segments.
    - one balancing, noise removal, addition of effects and music, etc…
- Equipped with digital audio workstations (DAWs)
- Multichannel monitoring (stereo, 5.1, 7.1) for surround mixing
- Reference-quality studio speakers and professional headphones
- Mixer or control surface for precise channel management
- Acoustically treated room – absorbers, diffusers, soundproofing from external noise
- Connected to the central server and video editing suite for audio-video synchronization.

Video control room

- Central place for controlling video and the flow of a program
- Direct connection to the studio and machine room
- Control of all video sources and graphics
- Enables live operation and program recording
- Making creative and technical decisions in real time:
  - Director – leads the program flow and coordinates the team.
  - Technical director – operates the video mixer
  - Graphics operator – inserts captions and visual elements
  - Playout operater – manages video servers and materials
  - Assistant director – monitors the program plan and coordination
  - Communication between team members via intercom.

Video control room

- Wall with monitors (multiview or classic)
- Video mixer (switcher) in the center of the workstation
- CG and playout stations on the sides
- Intercom and control panels in front of each team member
- Quiet, air-conditioned, and acoustically optimized space
- Remote control of cameras, lighting, etc.
- Signaling systems for the active source



Audio control room

- Control center for managing and processing audio during production and broadcasting
- Ensures clean, balanced, and high-quality sound for the TV program
- Close coordination with the video control room and the studio during filming and live broadcasts
- Responsible for mixing all audio sources: microphones, music, effects, voice-over
- Different types of input and output levels (line and microphone)

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Audio control room-equipment

- Digital audio mixer with multiple channels (32, 64, or more)
- Processing modules for EQ, compression, and limiters
- Audio interfaces for connection to servers and the network
- Multichannel speakers for surround monitoring (5.1, 7.1)
- Reference headphones for precise control
- Connected servers for recording and archiving
- VU and peak meters for accurate signal level measurement
- Phase and balance control
- IFB return signal monitoring for presenters
- Visual sound level indicators
- Remote control

Broadcast control

- Real-time monitoring of all incoming and outgoing TV signals
- Management of **playout systems** for automated content broadcasting
- Quality control of picture and sound (color bars, audio meters, waveform monitors)
- Switching to backup sources in case of failure or interruption
- Management of commercial blocks and the program schedule
- Maintaining legal and technical broadcasting standards

Broadcast control

Main equipment::

- Video router/matrix for signal routing
- Playout servers for broadcasting TV content
- Multiview systems
- Waveform monitors and vectorscopes for picture quality control
- Audio monitoring systems for supervising sound levels and quality
- Automated control software for broadcast scheduling
- UPS systems and backup power for continuous operation
- Redundant systems and automatic *failover*

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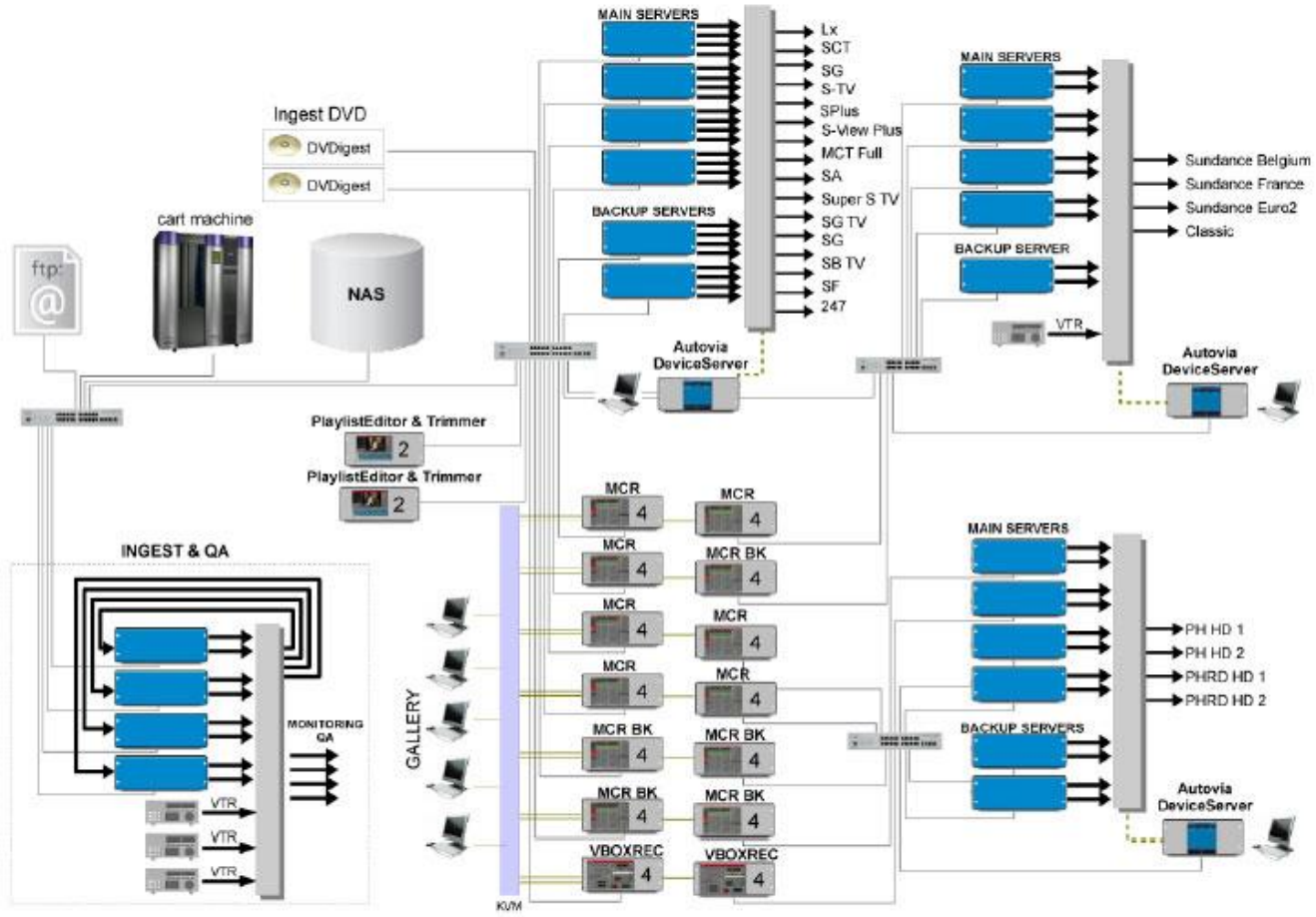
Broadcast control



Example of large-scale implementation

Editorial and support areas

- A place where journalists, editors, and producers work on gathering, verifying, and processing information
- Writing and editing news, scripts, and announcements
- Reviewing and selecting video material received from the field or other sources
- Communication with reporters via intercom, IFB systems, and online platforms
- Organizing show planning and live remote contributions
- Fast content preparation for breaking news situations
- Often divided into zones

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Graphics department

- Central place for creating and processing graphics for TV programs
- Used for producing subtitles, animations, logos, visual effects, and infographics
- Directly connected to the control room and newsroom for rapid live graphics insertion
- Creation of TV identity and branding
- Preparation of graphics for news programs, weather forecasts, sports, and entertainment shows
- Work on special effects for live shows and post-production

Media archive

Description and role:

- Central place for storing and organizing raw and finished TV material
- Provides quick access to video, audio, and graphic files
- Key for rebroadcasts, legal records, and long-term content preservation
- Old archive

Functions:

- Cataloging and indexing recordings with metadata (date, author, program)
- Secure storage of original material and finished broadcasts
- Access control and backup systems

Equipment:

- NAS/SAN storage systems for storing video files
- High-speed servers with redundant power supplies
- System for automatic indexing and searching
- Backup units (LTO tapes, cloud backup)

Support areas

- **Wardrobe:**
  - Organized storage of clothes and costumes for shows and series
  - Space for ironing and preparing wardrobe before filming
  - Inventory tracking and management
- **Costumes:**
  - Separate area for special costumes and stage clothing
  - Dry cleaning and maintenance
- **Props room:**
  - Storage of stage props and equipment
  - Organized according to shows or projects
  - Easily accessible to set design and production staff
- **Makeup room:**
  - Preparation of makeup and hairstyles for on-camera appearances, usually located near the TV studio
  - Professional lighting and mirrors
  - Hygiene standards and tool disinfection

Equipment – Studio cameras

- Designed for use in controlled studio conditions
- Image stability and high-quality sensors
- Large lenses for various shooting angles
- Connection via cables directly to the control room
- Built-in tally and intercom systems
- Pedestal/tripod/crane/slider
- CCU and RCU units
- Servo zoom/focus

Equipment - ENG cameras

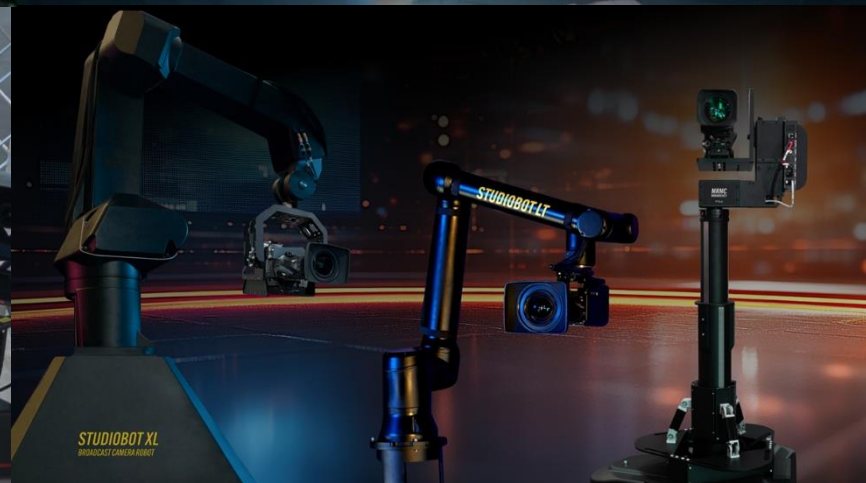
- Portable cameras for field work
- Used for news and live events
- Compact and lightweight, with battery power
- Wireless video transmission to the control room via link sy

Equipment - PTZ cameras

- Automatic movement: horizontal (Pan), vertical (Tilt), and zoom (Zoom)
- Controlled via software or console
- Often used in small studios and broadcasts where no physical camera operator is present
- Capability for integration into IP networks
- Transmission via NDI, SDI, USB, LAN
- AI features

Equipment- PTZ cameras

- Remote control of camera movement and framing
- Precise positioning through software presets
- Current trend



Special cameras and additional equipment

- Specialized cameras such as GoPro and DSLR/mirrorless: for creative shots and series
- Tripods and stands with fluid heads
- Teleprompters
- Tally lights
- Lenses with various focal lengths
- Wireless microphones and intercom system

Equipment - Video mixer

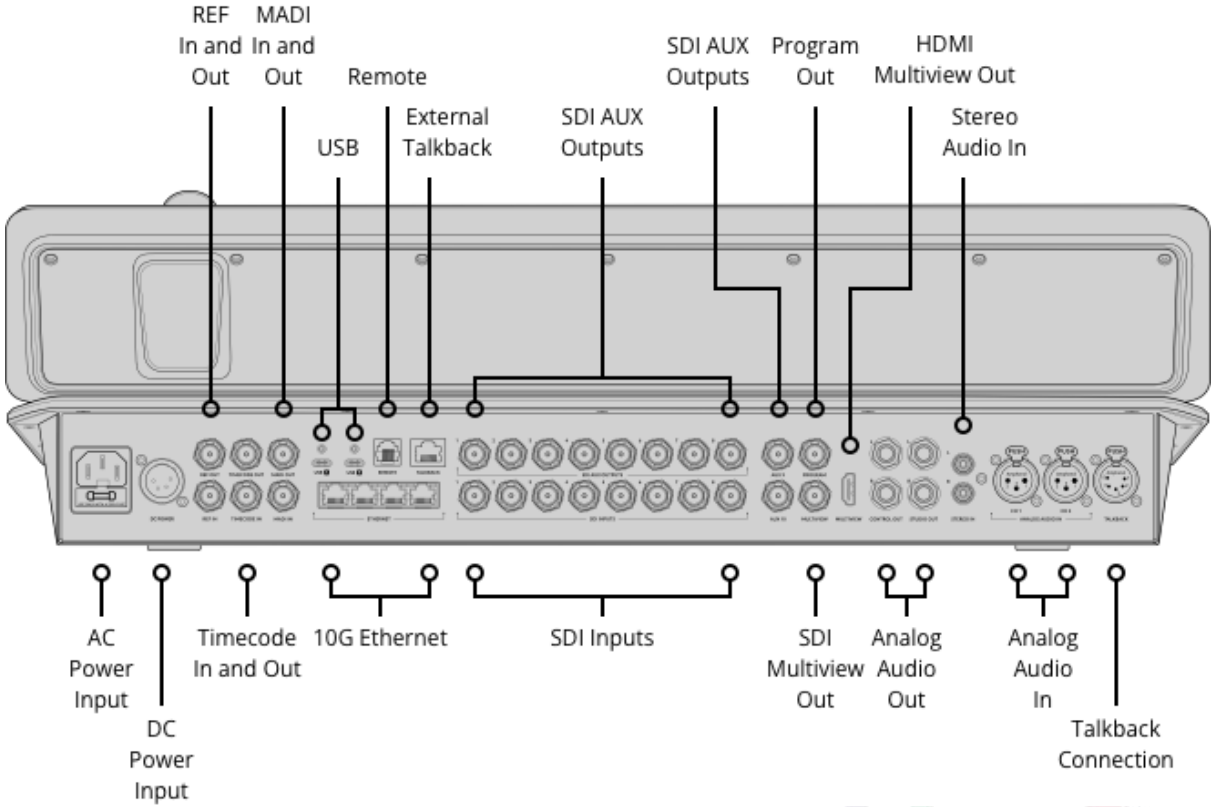
- Central device in the video control room, allowing switching between multiple video sources (cameras, graphics, video servers)
- Used for live shows, broadcasts, and complex studio productions
- Integrated with CG graphics, tally, and intercom systems
- Remote control or separate modules

Key points:

- **Switching** – selecting the video source
- **Transition effects:** cut, mix, wipe
- **M/E buses** for complex productions
- **Chroma key** for green screen
- **Key/fill channels** for titles and graphics
- Multichannel preview through the multiview syst

Equipment - Video mixer

- **Number of inputs:**
  - Studio models: 8–32 inputs
  - Professional models: 32–128+ inputs
- **Types of inputs:**
  - SDI (HD-SDI, 3G-SDI, 12G-SDI)
  - HDMI for smaller setups
  - IP/NDI protocols for IP-based production
  - Analog signals (rarely, via converters)
- **Supported resolutions:**
  - SD (Standard Definition)
  - HD (720p, 1080i/p)
  - UHD/4K and 8K in modern mixers
- **Synchronization:**
  - Genlock for aligning all video sources
  - Frame synchronizer for unsynchronized sources



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Equipment – Video mixer

Equipment – Audio mixer

- Allows mixing, processing, and balancing audio in real time
- Reception and adjustment of various signal types, phase and frequency correction
- Integrated with the video control room and IFB systems
- Software integration and automation
- Real-time audio monitoring through reference monitors
- Management of dedicated audio outputs for different channels

Equipment – Audio mixer

- **Number of inputs:**
  - Small audio mixers: 8–16 channels
  - Professional mixers: 32–128+ channels
- **Types of inputs:**
  - Microphone (XLR) for studio and wireless microphones
  - Line (TRS, XLR) 0.775 V, 600 Ω impedance
  - Digital AES/EBU or Dante/AVB/IP protocols
  - Aux and monitoring
- **Additional features:**
  - Phantom power, aux sends, groups, etc.
  - Gain control and signal limiters, effects, presets, etc.
  - Software control

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Equipment – Audio mixer

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Equipment – Microphones

- **Lavalier (clip-on)** – discreet wireless microphones for hosts and guests
- **Boom/shotgun** – for stage and ambient sound, used with a boom pole
- **Handheld microphones** – interviews, reports, music shows
- **Boundary microphones (PZM)** – placed on tables for debates
- **Headset microphones** – sports, music shows, interactive formats
- Digital wireless systems with multiple channels for simultaneous use

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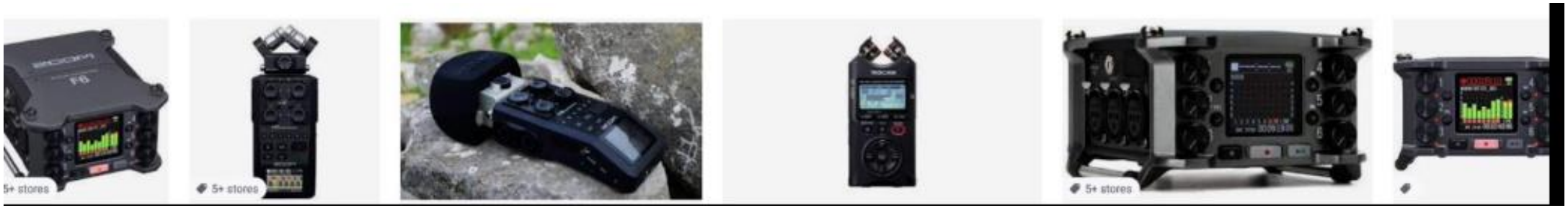
Equipment – Microphones



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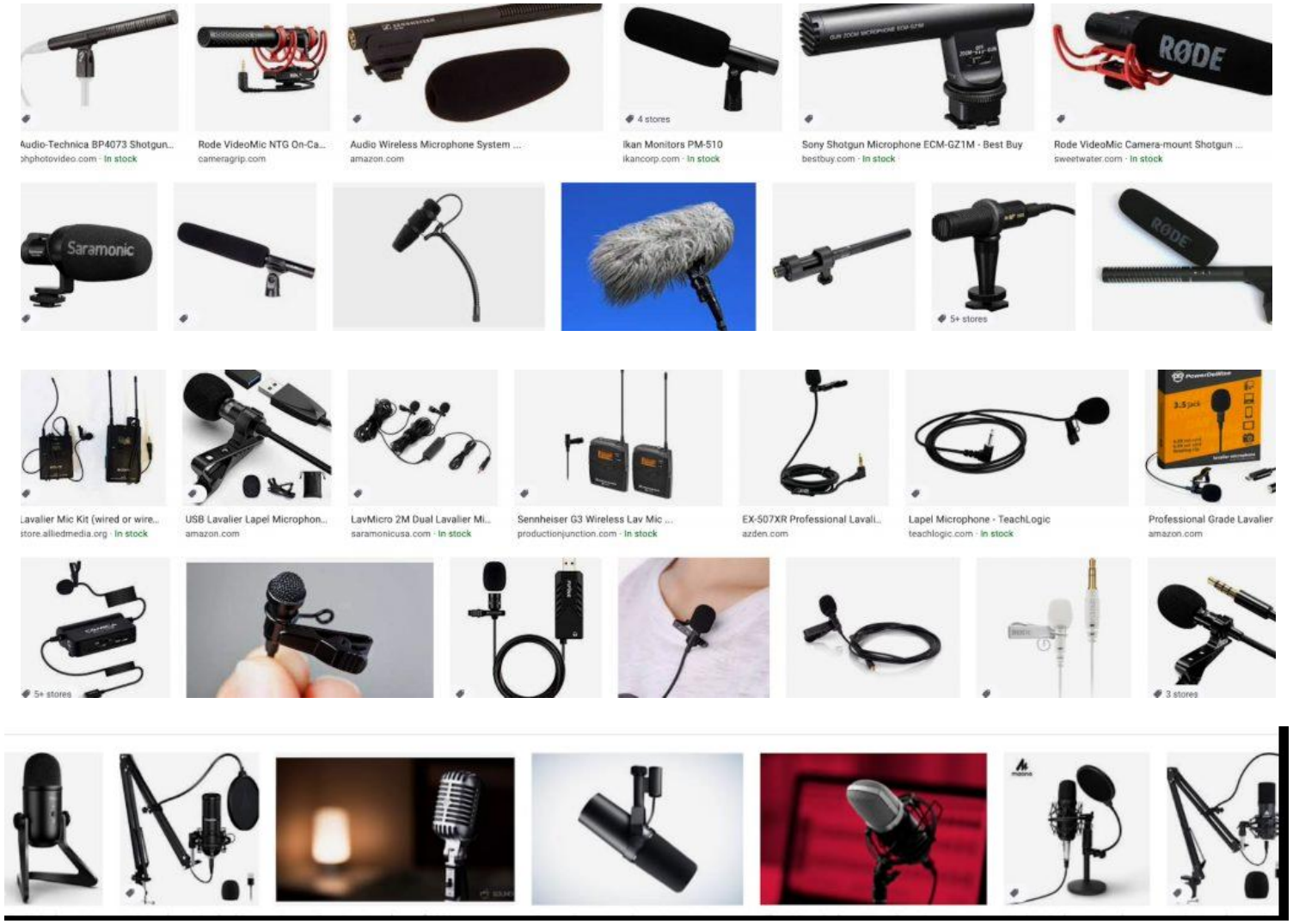
Equipment – Microphones



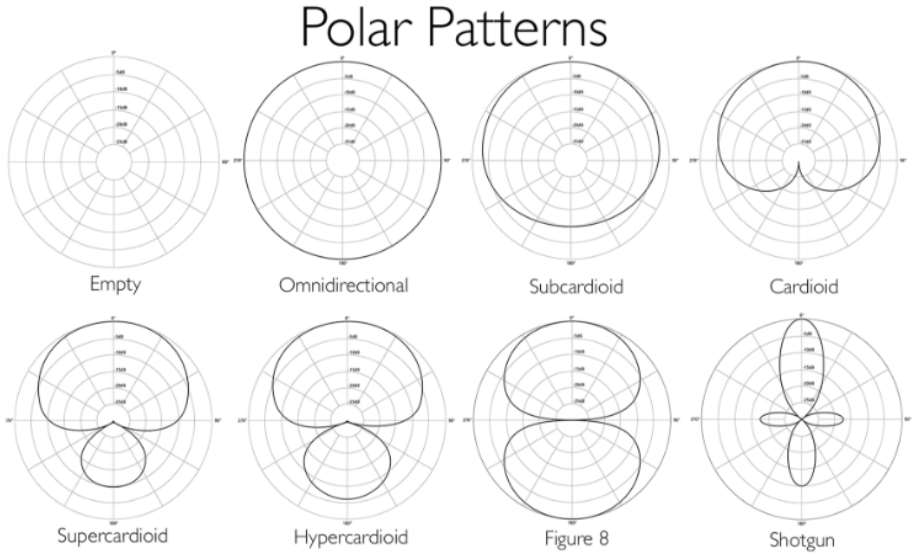
Equipment – Microphones

- **Frequency range:** 20 Hz – 20 kHz for natural sound

- **Polarity / directionality:**
  - Omni-directional – for general sound
  - Cardioid – focused on the speaker
  - Super/Hyper-cardioid – for distant sources (shotgun)

- **Wireless systems:**
  - UHF range 470–870 MHz
  - Diversity reception for signal stability

- **Cables:** balanced XLR for wired microphones
- Connection to audio mixer, IFB systems, and monitoring



Equipment – Video matrix

- Device for managing video signals in studio and

broadcast systems (formerly a patch panel)

- Allows routing any input to any output
- Key for distributing video between studios,

control rooms, and machine rooms

- Provides flexibility in complex systems with

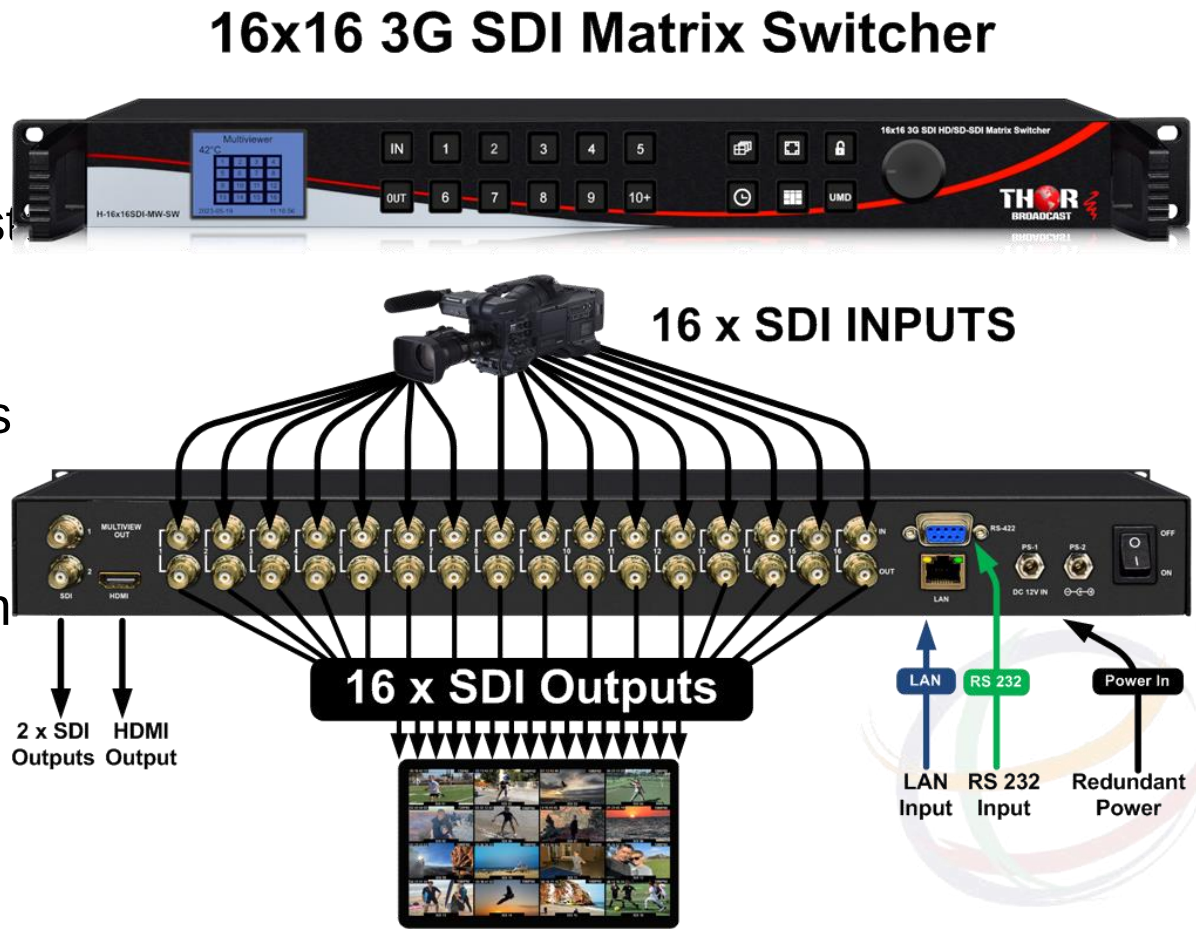
multiple sources

- Used for monitoring, recording, broadcasting, and

backup workflows

Equipment – Video matrix

- **Number of inputs/outputs:**
  - Studio systems: 16×16 to 64×64
  - Broadcast systems: 128×128 or more
- **Supported formats:**
  - SDI (HD-SDI, 3G-SDI, 12G-SDI)
  - IP protocols (SMPTE 2110) in modern syst
  - HDMI and analog signals (via converters)
- **Functions:**
  - Redundant power supplies and controllers
  - Genlock and source synchronization
  - Real-time monitoring of all routes
  - Asynchronous and synchronous operation

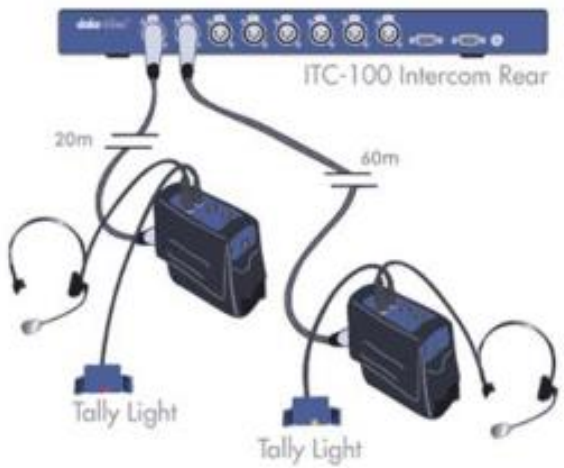


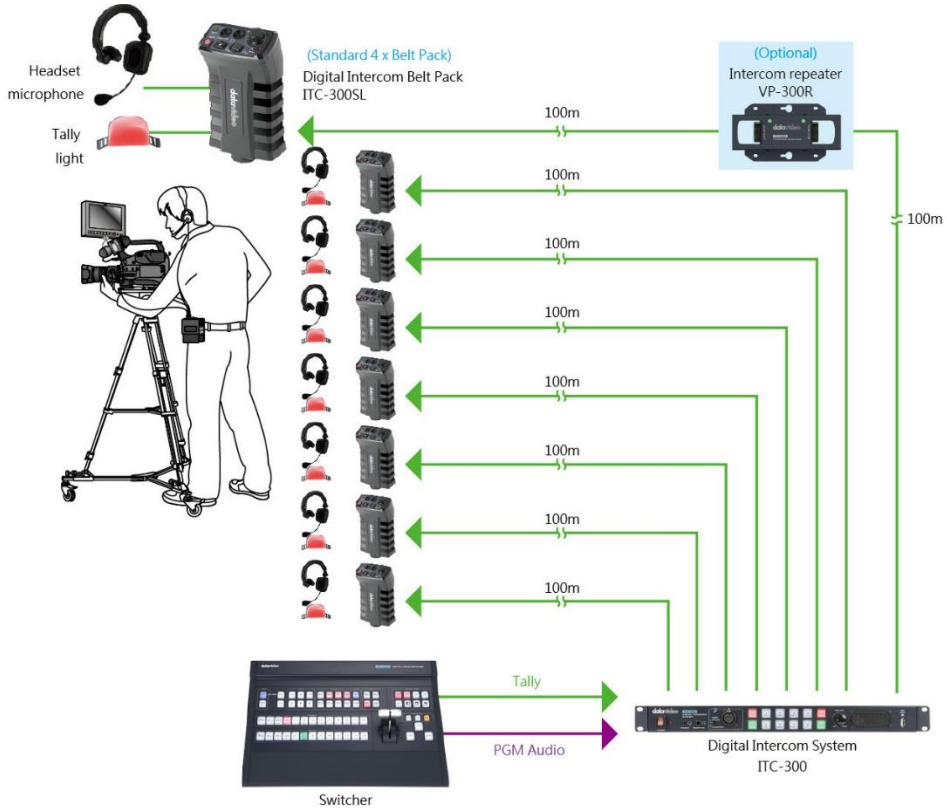
Equipment – Intercom system

- Communication system
- One-way or two-way real-time communication
- Coordination between teams
- Audio return for hosts and reporters
- Integration with other systems (video mixer, audio

mixer, MCR)

- Beltpack with earpieces



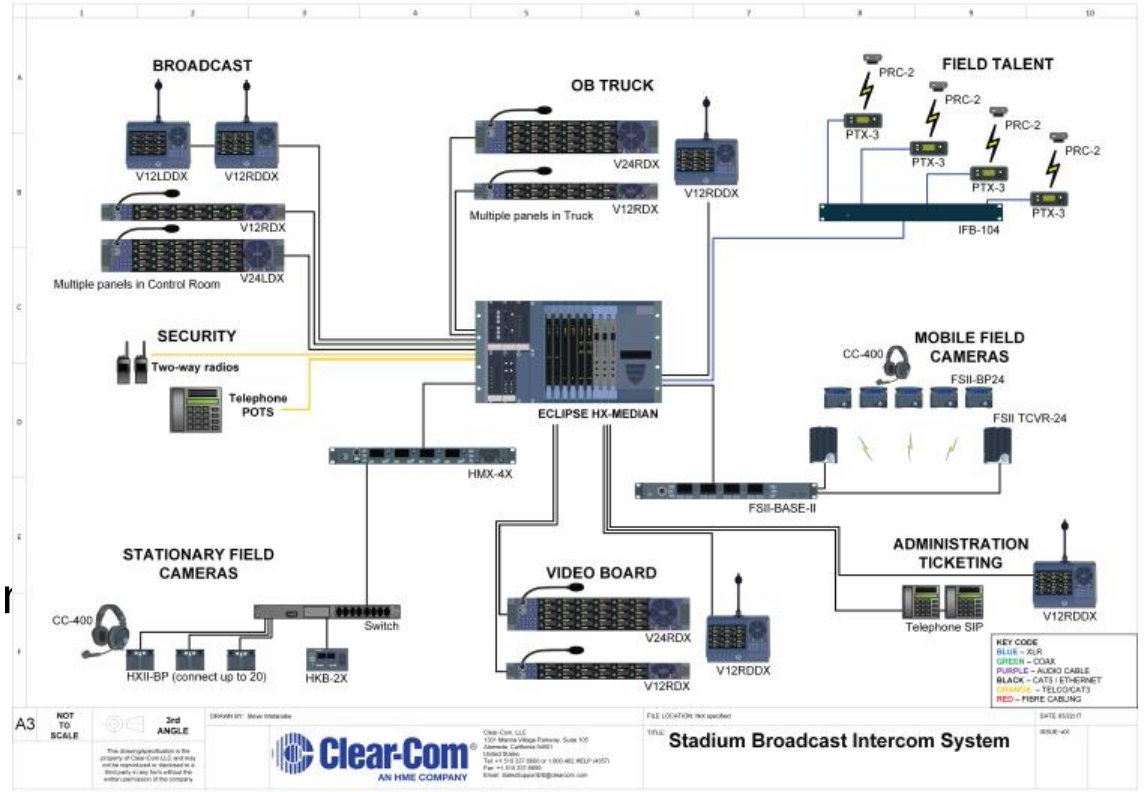


Equipment - Intercom system

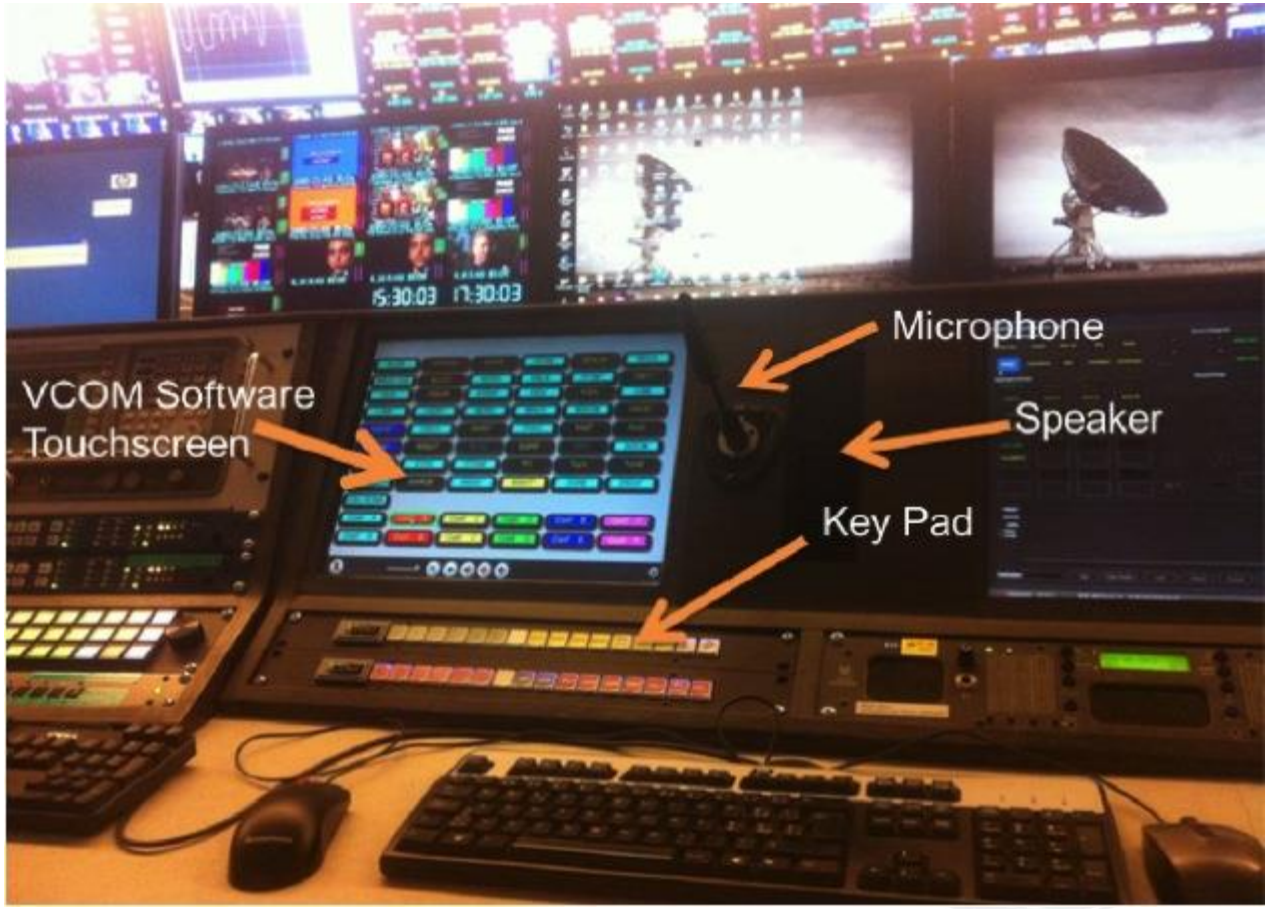
1. **Wired intercom systems (Party-Line / Two-Wire):**
   - All users are connected to the same line
   - Listen and speak at the same time (full-duplex)
   - Suitable for small and medium studios and local TV stations
   - Simple installation and lower costs

2. **Network / matrix intercom systems:**
   - Each user has a dedicated channel
   - Director can address individuals or groups
   - Scalable systems for large TV stations and productior
   - Easy integration with IP networks

3. **Wireless intercom systems:**
   - Mobility for camera operators and field crews
   - Often combined with wired systems
   - Requires radio frequency planning to avoid interference

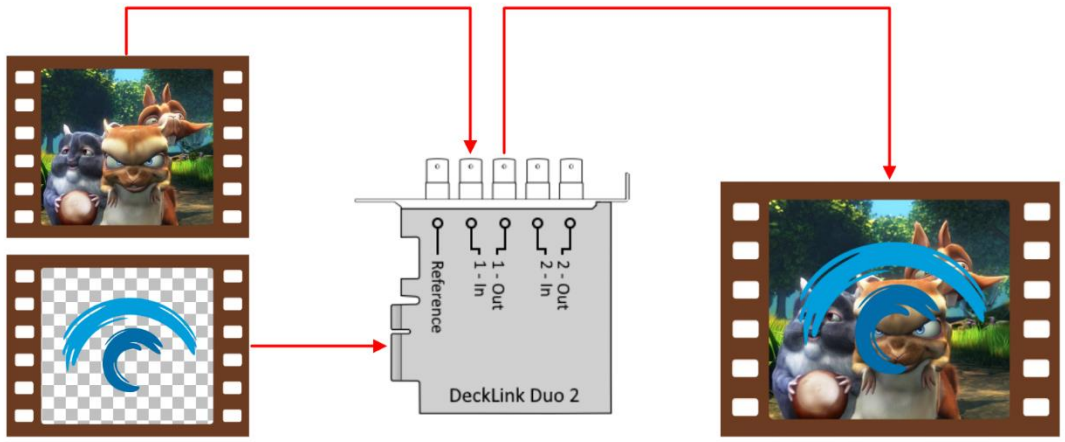


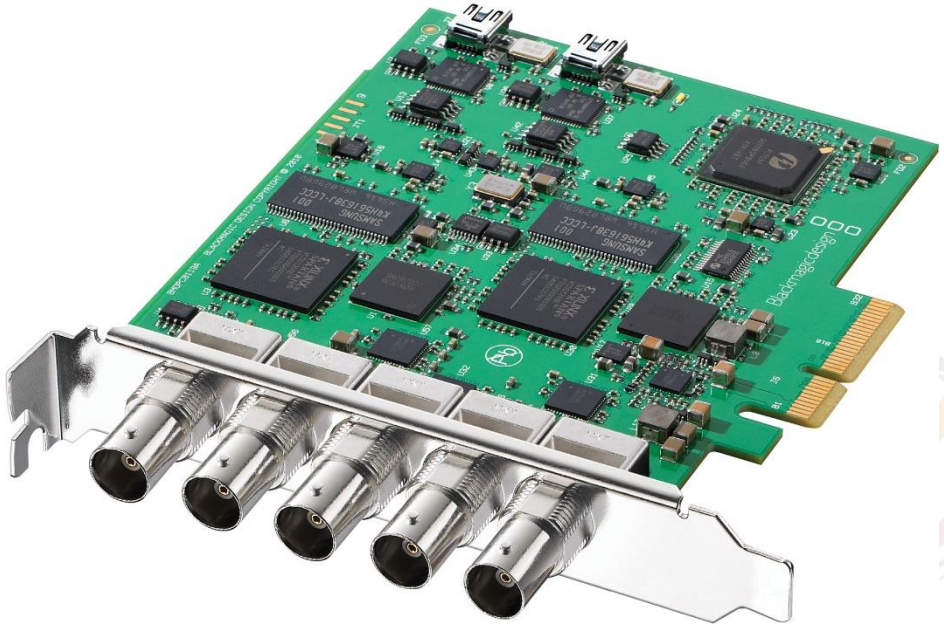
Equipment – Intercom system



Equipment – CGI and character generator

- Displaying graphics during live shows or recording
- Subtitles, logos, animations, crawls, etc.
- Software control and system integration via SDI, NDI, or IP protocols
- Compatible with newsroom workstations
- Integration with the video mixer – key/fill signals



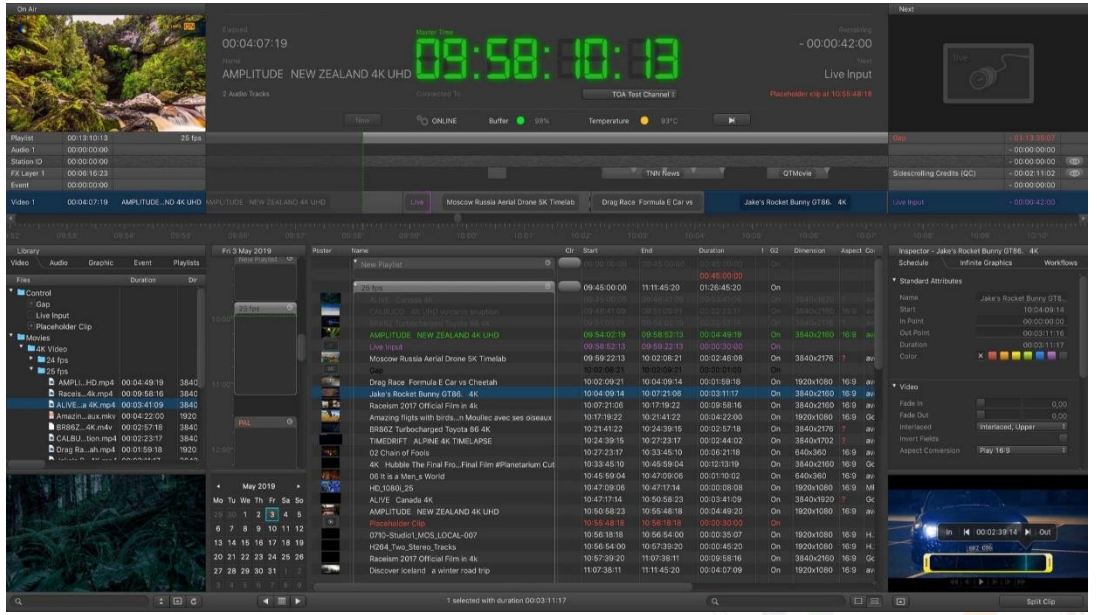


Equipment – Virtual sets

- **Hardware keyers:**
  - Built into professional video mixers
  - Real-time processing with no delay
- **Software keyers:**
  - Adobe After Effects, vMix, OBS Studio
  - Flexible for post-production and live streaming
- **CGI software for virtual sets:**
  - Vizrt, Unreal Engine, Ross XPression
  - Generates 3D graphics and dynamic elements
- **DeckLink cards:**
  - Input/output for SDI video signals
  - Used with virtual studios and keying systems

Equipment - Playout

- The playout system is the center for automatic playback and management of TV content.
- Software “queues” the program schedule, often using PCIe cards like DeckLink, but it can be standalone or integrated with a server
- The program schedule is loaded in advance
- Automatic broadcasting according to the planned timing
- Manages the entire broadcast schedule: shows, segments, commercials, promotional materials
- Also called AirBox and often connected to a capture box



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Equipment - Lighting

- **Fresnel spotlights** – precise control of directed light
- **LED panels** – energy-efficient, adjustable color temperature
- **Soft light** – even, diffused lighting for faces and green screens
- **PAR lights** – effects and background illumination
- **Moving head lights** – special effects and dynamic scenes
- **Follow spotlights** – track the host or guest in motion

- 50W to 600W, CRI>95, 3000–7000K

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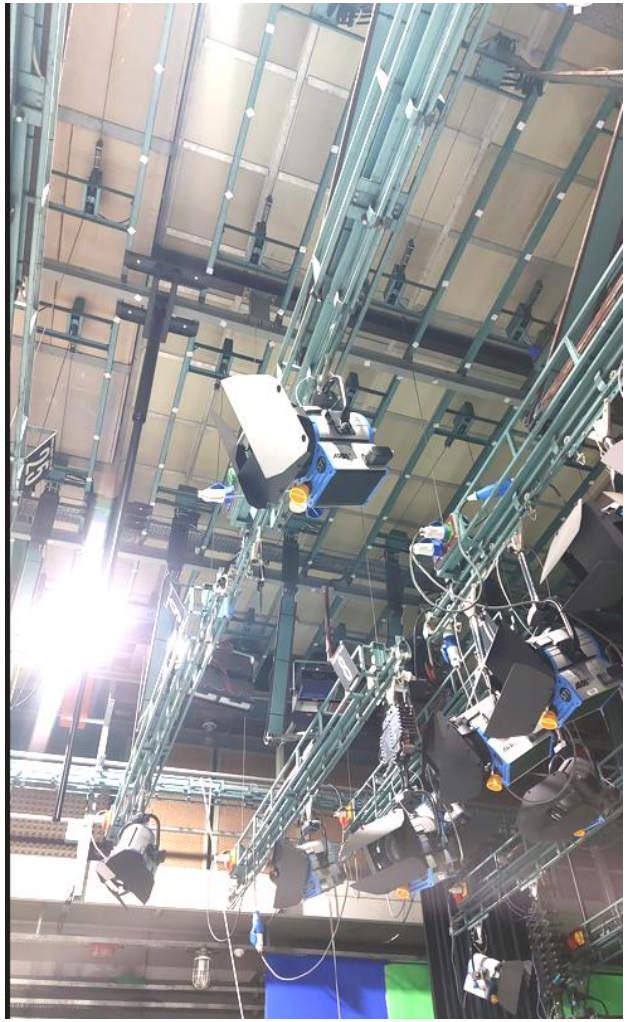
Equipment – Lighting



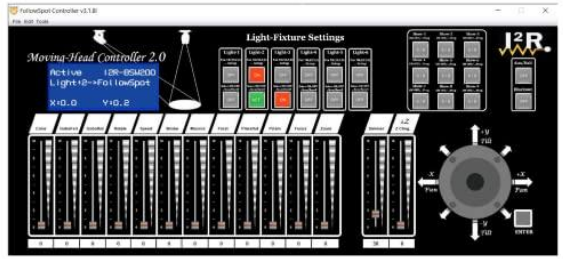
Equipment – Lighting

- **Grid:**
  - Installation of spotlights above the studio
  - Security Systems & Cabling

- **DMX Control System:**
  - Controlling the lights from the control room
  - Scene and Transition Programming

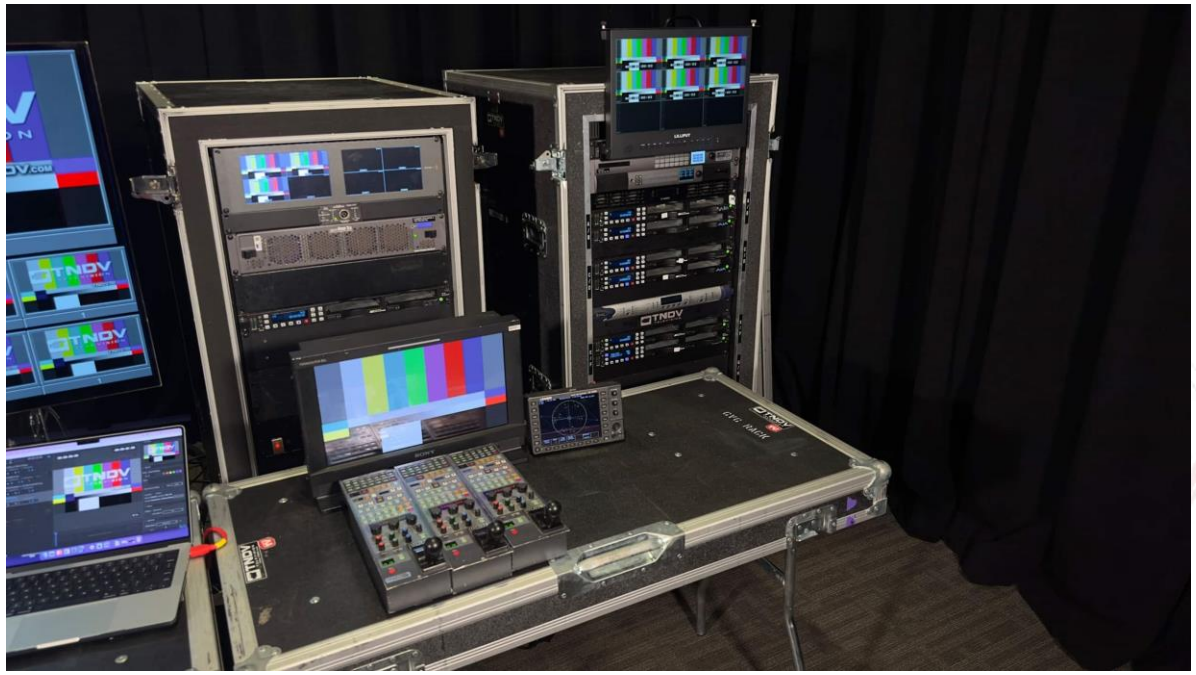
- **Dimmers and LED drivers:**
  - Regulation of intensity and effects

- **Measuring devices:**
  - Lux meters for measuring light intensity
  - Colorimeters for color temperature



Equipment – Measuring equipment

- Provides a stable and high-quality signal for production and broadcasting
- Real-time measurement of video and audio parameters
- Identifying and Solving Technical Problems
- Ensures compliance with standards (SMPTE, EBU, ITU)
- Indispensable in directing, car room and broadcasting



Equipment – Measuring equipment

- **Waveform monitor:**
  - Displays the brightness and color levels in the video signa
  - Exposure and Color Balance Control

- **Vectorscope:**
  - Measurement of chrominance and color saturation

- **Audio meters:**
  - VU and Peak Meters for Volume Control
  - Loudness Meters for Standards Compliance

- **BER and MER analyzer:**
  - Checking the quality of the digital transport stream (DVB-T2/S

- **Network Monitors:**
  - Monitoring of IP production systems(SMPTE 2110)

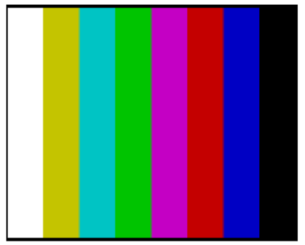
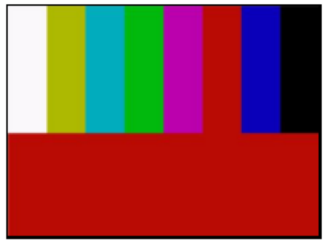
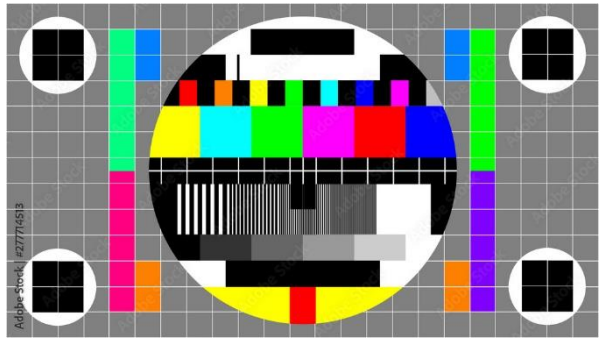
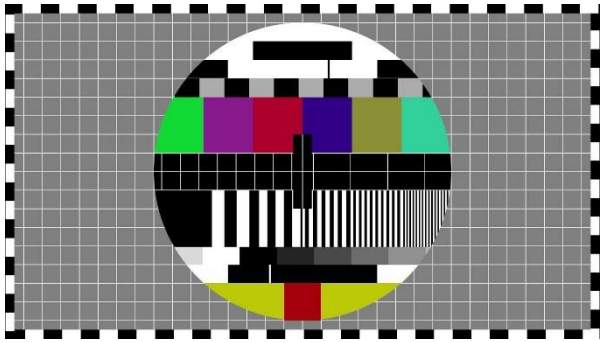
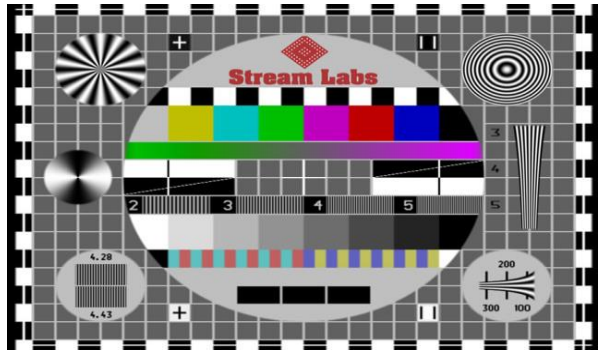
Equipment – Test Signals

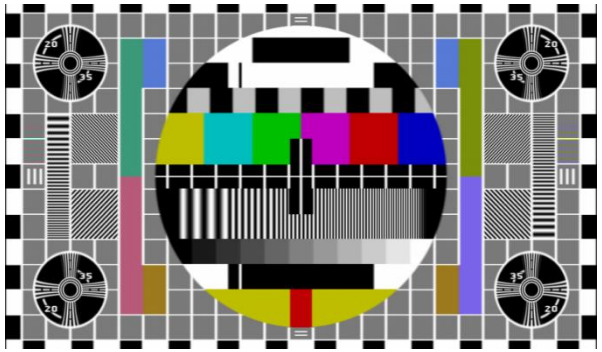
- They are used to set up and check the system

- **Video test signals:**
  - SMPTE color bars (colors)
  - Blue background for color balancing
  - Black and white levels for brightness calibration

- **Audio test signals:**
  - 1 kHz tone for calibrating the audio system
  - Pink noise to control the frequency response.

- **Digital Transport Test Signals:**
  - TS Generator For DVB System
  - Checking multiplexers and encoders



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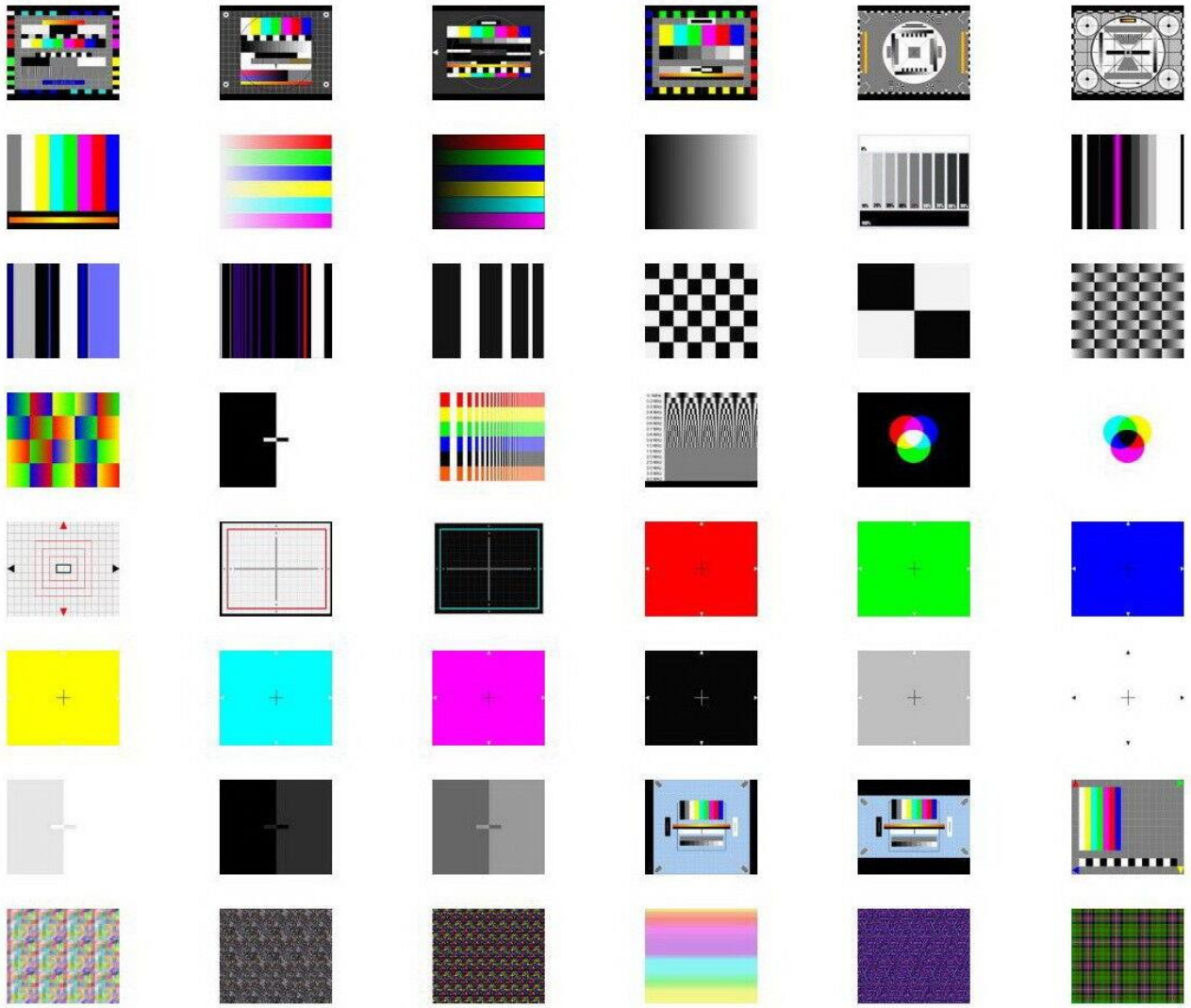
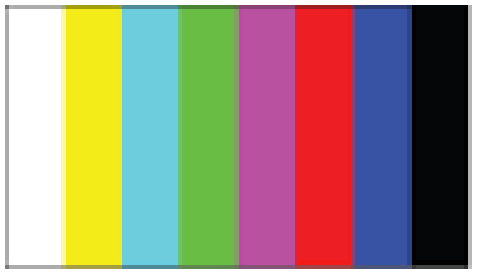
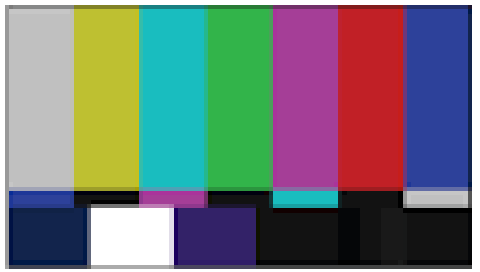
Equipment – Test Signals

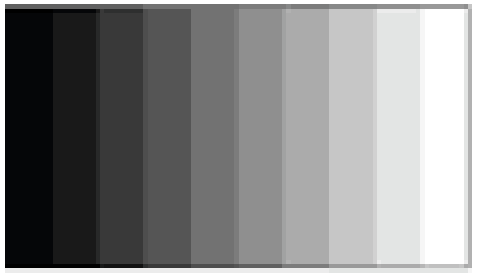




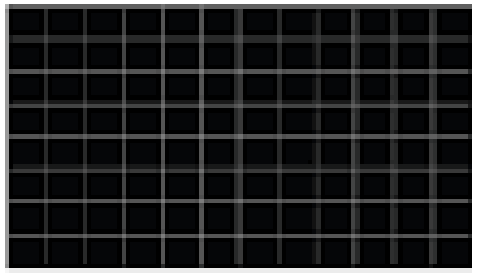
Full field color bar



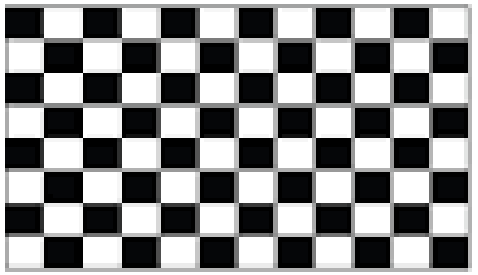
SMPTE color bar



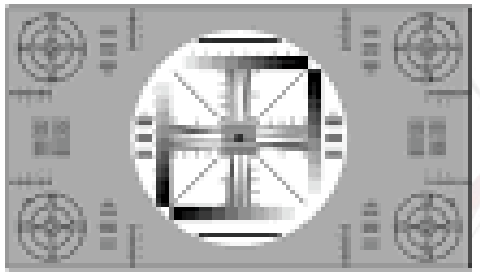
Grayscale chart



Crosshatch pattern



Checkerboard pattern



Monochrome Test Pattern

Oprema - Konverteri

• Svi uređaji su smešteni rek ormanima koji su uglavnom smešteni u mašinskoj sobi

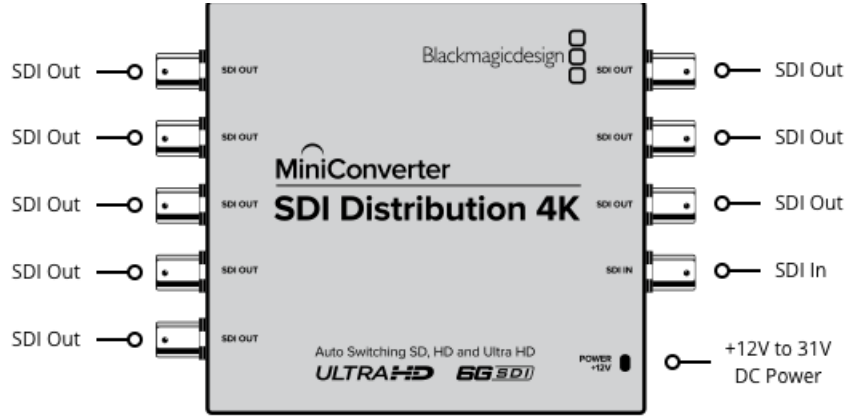
• Primer BlackMagic konvertera u manjem TV studiju:
- SDI distribucija
- Analog to SDI (AD konverzija)
- SDI to Analog (DA konverzija)
- HDMI to SDI i SDI to HDMI
- Audio to SDI (embeder)
- SDI to Audio (deembeder)
- Sync generator
- GPI and Tally interface
- Ostali HDMI spliteri i extenderi

Equipment – Converters – SDI distribution

•It is necessary to convert and distribute signals between different standards and devices.

•Distributing a single video signal to multiple devices at the same time.

•:SDI standards
- •SD-SDI (Standard Definition)
- •HD-SDI (High Definition)
- •3G-SDI (Full HD 1080p)
- •6G-SDI (4K)

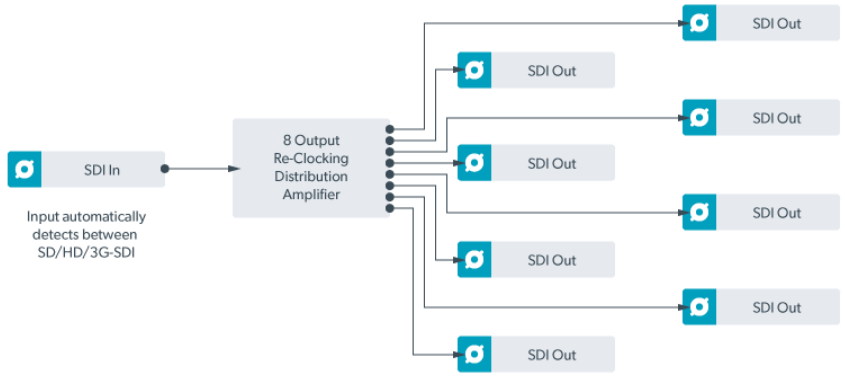


•Used for:
- •Connecting Multiple Monitors
- •Parallel work with multiple systems (monitoring, playout, etc.)
- •Transfer speed: up to 3 Gb/s.

Equipment – Converters - SDI distribution

- 8 Independent SDI outputs (1x8 system)
- Automatic resolution recognition
- Supports ASI, embedded audio and auxiliary data

- The maximum length of the cables.:
  - HD-SDI do 100m
  - 3G-SDI do 70m
  - 6G-SDI do 50m
- Connectors: **BNC 75 Ohm**



Standards

SD Video Standards
525i59.94 NTSC, 625i50 PAL

HD Video Standards
720p50, 720p59.94, 720p60, 1080i50, 1080i59.94, 1080i60, 1080p23.98, 1080PsF23.98, 1080p24, 1080PsF24, 1080p25, 1080PsF25, 1080p29.97, 1080PsF29.97, 1080p30, 1080PsF30, 1080p50, 1080p59.94, 1080p60

2K Video Standards
2K DCI 23.98p, 2K DCI 24p, 2K DCI 25p, 2K DCI 23.98PsF, 2K DCI 24PsF, 2K DCI 25PsF

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4K DCI 23.98p, 4K DCI 24p, 4K DCI 25p

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition and high definition.

SDI Video Sampling
4:2:2 and 4:4:4

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2 and 4:4:4

SDI Color Space
YUV and RGB

SDI Auto Switching
Automatically detects SD, HD or 6G-SDI.

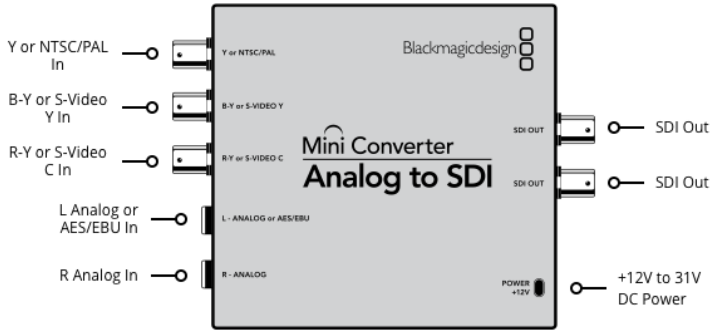
ASI Support
Yes

Equipment – Converters – Analog to SDI

- Converts an analog video signal to an SDI digital signal.
- Used for older equipment:
  - VHS, Betacam SP
  - Set top box Devices
- Supports balanced AES/EBU audio and analog inputs
- Setting can be changed using a mini switch
- It's very simple, from setup to application
- Automatic format recognition:
  - NTSC, PAL, 720p, 1080i, 1080p, 2k, 4k

Equipment – Converters– Analog to SDI

- Inputs:
  - Composite and Component Video
  - AES/EBU audio
- Outputs:
  - SDI video
  - Embedded audio



- Transfer speed: up to 3 Gb/s
- Connecting with fiber optic cables for long distances
- USB port for software upgrades

Connections

SDI Video Outputs
2 x SDI Video Outputs.

Analog Video Inputs
NTSC, PAL, S-Video and Component SD/HD input.

Analog Audio Inputs
2 channels of balanced analog audio.

Digital Audio Inputs
2 channels of balanced AES/EBU audio.

Multi Rate Support
Auto detection of SD or HD.

Updates and Configuration
Via USB 2.0 high speed. (480 Mb/s)

Reclocking
Yes

Standards

SD Video Standards
525i59.94 NTSC, 625i50 PAL

HD Video Standards
720p50, 720p59.94, 720p60
1080i50, 1080i59.94, 1080i60

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, ITU-R BT.656 and ITU-R BT.601.

SDI Video Sampling
4:2:2

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2

SDI Color Space
YUV

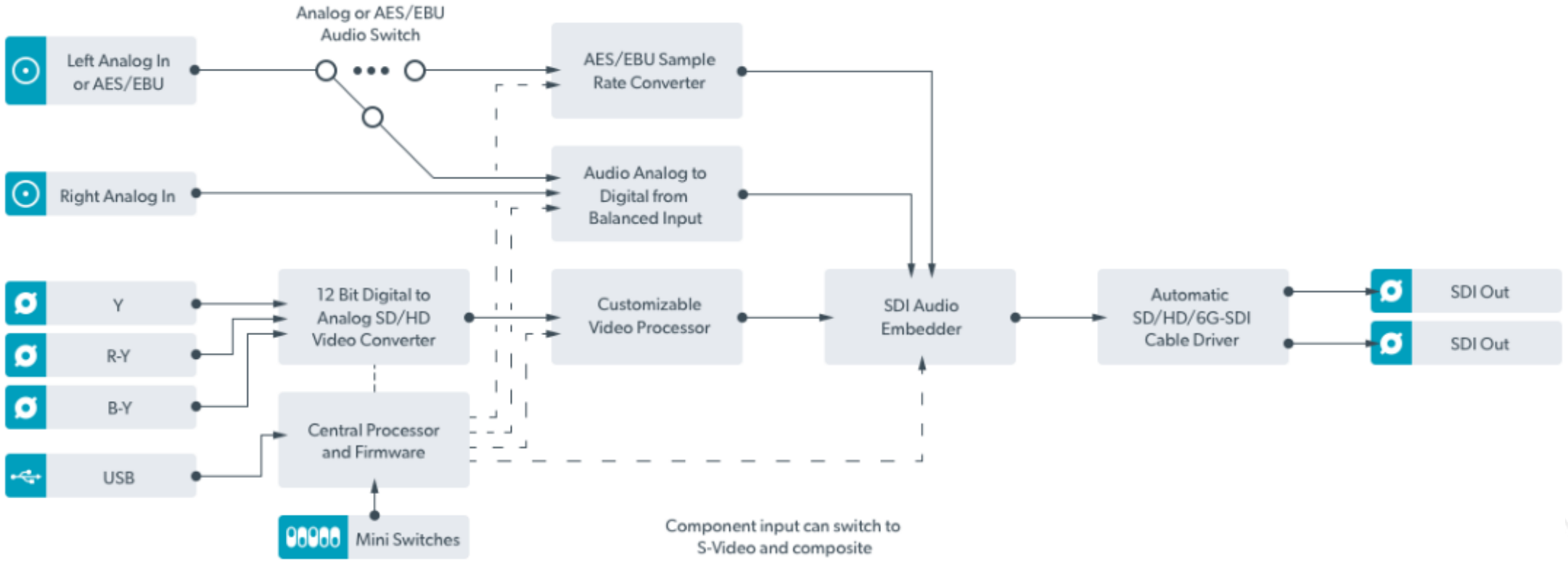
SDI Auto Switching
Automatically follows format of analog input.

Analog Color Space
YUV

Analog Color Precision
4:2:2

Co-funded by the European Union

Equipment – Converters – Analog to SDI



Equipment – Converters – SDI to Analog

- Converts SDI signal to analog video signal.
- Used for:
  - Older monitors and recorders
  - VHS and Betacam devices.
- Supports:
  - Component Video (Y, R-Y, B-Y)
  - S-Video and Composite Signal
- Supports balanced AES/EBU audio output.

Connections

SDI Video Inputs
1 x SD, HD or 6G-SDI. 1 x ALT SDI Input for automatic switch over if main input fails.

SDI Video Outputs
1 x SDI Video Loop Output.

Analog Video Outputs
NTSC, PAL, S-Video and component SD/HD from 6G-SDI input.

Analog Audio Outputs
2 channels of professional balanced analog audio with standard 1/4 inch jack connections.

Digital Audio Outputs
2 channels of professional balanced digital with standard 1/4 inch jack connections.

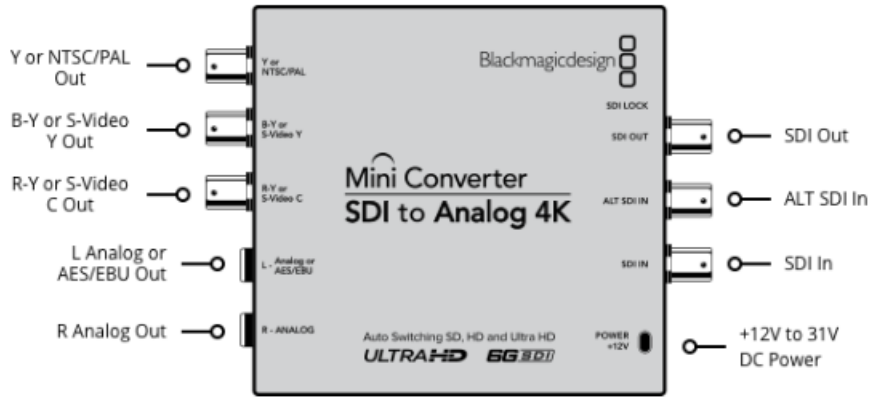
SDI Redundant Input
Automatically switches over if main SDI input is lost.

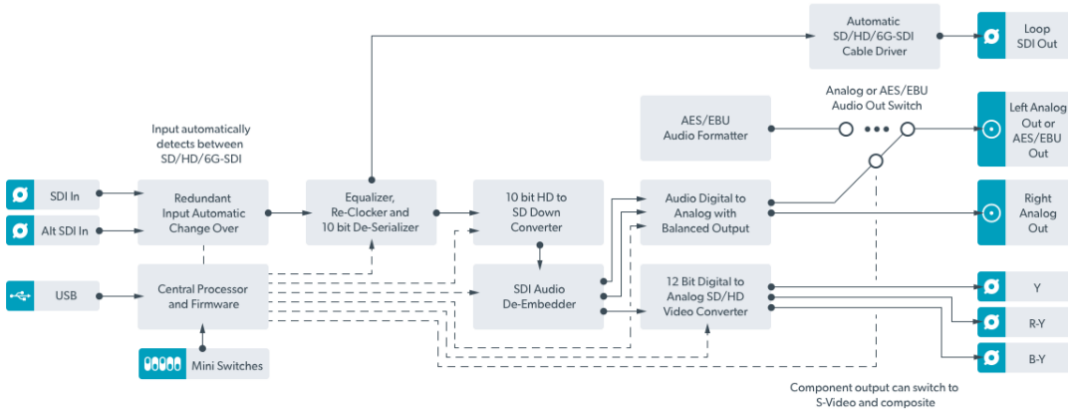
Multi Rate Support
Auto detection of SD, HD or 6G-SDI.

Updates and Configuration
USB

Reclocking
Yes

Equipment – Converters – SDI to Analog





Standards

SD Video Standards
525i59.94 NTSC, 625i50 PAL

HD Video Standards
720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080PsF23.98, 1080PsF24, 1080PsF25, 1080PsF29.97, 1080PsF30, 1080i50, 1080i59.94, 1080i60

2K Video Standards
2K DCI 23.98p, 2K DCI 24p, 2K DCI 25p, 2K DCI 23.98PsF, 2K DCI 24PsF, 2K DCI 25PsF

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4K DCI 23.98p, 4K DCI 24p, 4K DCI 25p

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition and high definition.

SDI Video Sampling
4:2:2

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2

SDI Color Space
YUV

SDI Auto Switching
Automatically detects SD and HD.

Analog Format Support
525i59.94 NTSC, 625i50 PAL, 720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080i50, 1080i59.94, 1080i60

Analog Color Space
YUV

Analog Color Precision
4:2:2

Equipment – Converters – HDMI to SDI

- Converts HDMI signal to SDI standard.
- Automatically detects the type of input signal.
- It supports resolutions.:
  - 720p, 1080i, 1080p, 2K, 4K
- Used for:
  - Connecting PCs, cameras, monitors.

Connections

SDI Video Outputs
2 x SDI Video Outputs. Automatically matches the SD, HD and 6G-SDI HDMI video input.

HDMI Video Inputs
HDMI type A in

Analog Audio Inputs
2 channels of professional balanced analog audio with standard 1/4 inch jack connections.

Digital Audio Inputs
2 channels of AES/EBU digital audio.

Multi Rate Support
Auto detection of SD, HD or 6G-SDI.

Updates and Configuration
USB

Reclocking
Yes

Equipment - Converters - HDMI to SDI

Standards

SD Video Standards
625i50 PAL, 525i29.97 NTSC

HD Video Standards
720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080i50, 1080i59.94, 1080i60

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4K DCI 23.98p, 4K DCI 24p, 4K DCI 25p

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE 424M, SMPTE 425M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition, high definition, 3G-SDI and 6G-SDI. HDMI to SDI 6G supports level B only on 3G-SDI output.

SDI Video Sampling
4:2:2

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2

SDI Color Space
YUV

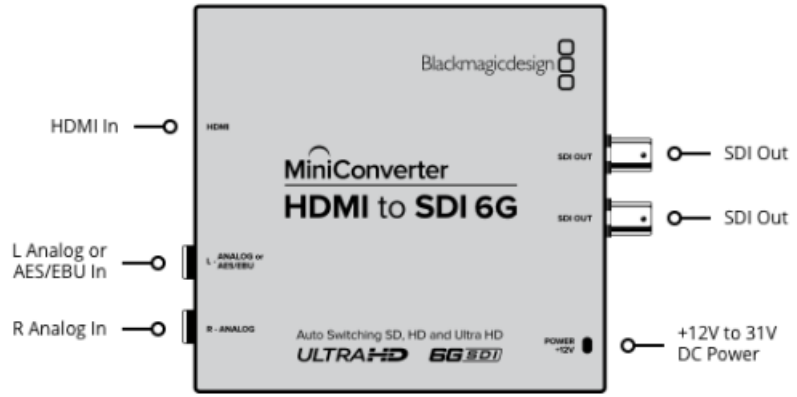
SDI Auto Switching
Automatically detects SD, HD or 6G-SDI.

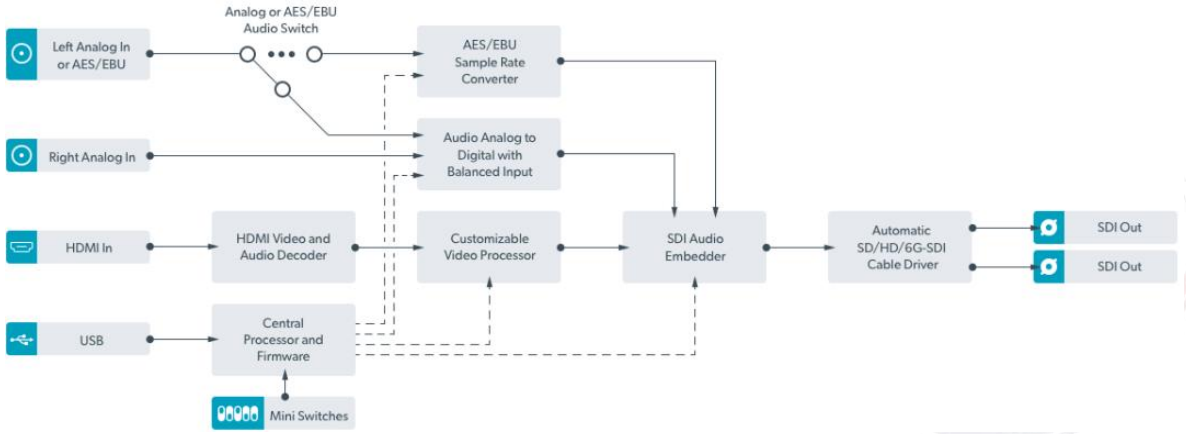
HDMI Video Standards
625i50 PAL, 525i29.97 NTSC, 720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080i50, 1080i59.94, 1080i60, 2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

HDMI Color Space
YUV and RGB

HDMI Color Precision
4:2:2 and 4:4:4

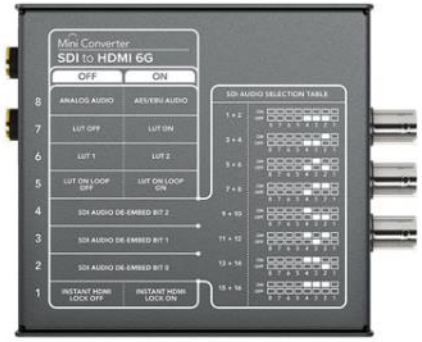
Copy Protection
HDMI input is unable to capture from copy protected HDMI sources. Always confirm copyright ownership before capture or distribution of content.





Equipment – Converters – SDI to HDMI

- Converts SDI signal to HDMI.
- Used for:
  - Monitors, primitive TVs, projectors.
- Also available in a version with optical connectors for long distances.
- Supports AES/EBU audio transmission..



Connections

SDI Video Inputs
1 x SD, HD or 6G-SDI. 1 x ALT SDI Input for automatic switch over if main input fails.

SDI Video Outputs
1 x SDI Video Loop Output.

HDMI Video Outputs
HDMI type A out.

Analog Audio Outputs
2 channels of balanced analog audio.

Digital Audio Outputs
2 channels of AES/EBU digital audio

SDI Redundant Input
Automatically switches over if main SDI input is lost.

Multi Rate Support
Auto detection of SD, HD or 6G-SDI.

Updates and Configuration
USB

Reclocking
Yes

Equipment - Converters - SDI to HDMI

Standards

SD Video Standards
625i50 PAL, 525i59.94 NTSC

HD Video Standards
720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080PsF23.98, 1080PsF24, 1080PsF25, 1080PsF29.97, 1080PsF30, 1080i50, 1080i59.94, 1080i60

2K Video Standards
2K DCI 23.98p, 2K DCI 24p, 2K DCI 25p
2K DCI 23.98PsF, 2K DCI 24PsF, 2K DCI 25PsF

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4K DCI 23.98p, 4K DCI 24p, 4K DCI 25p

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition and high definition.

SDI Video Sampling
4:2:2 and 4:4:4

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2 and 4:4:4

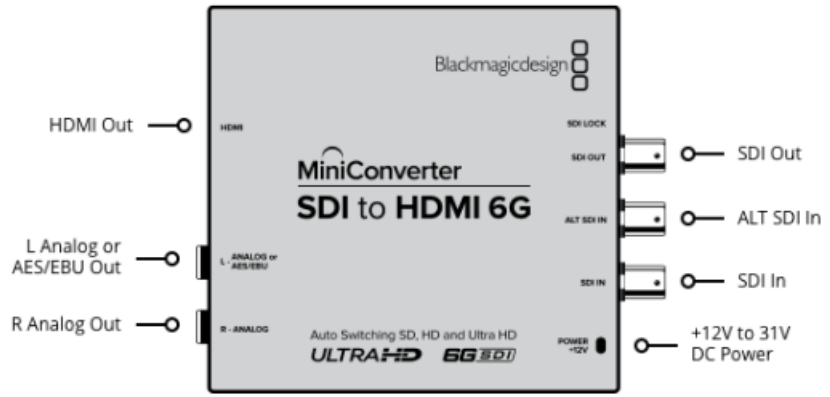
SDI Color Space
YUV and RGB

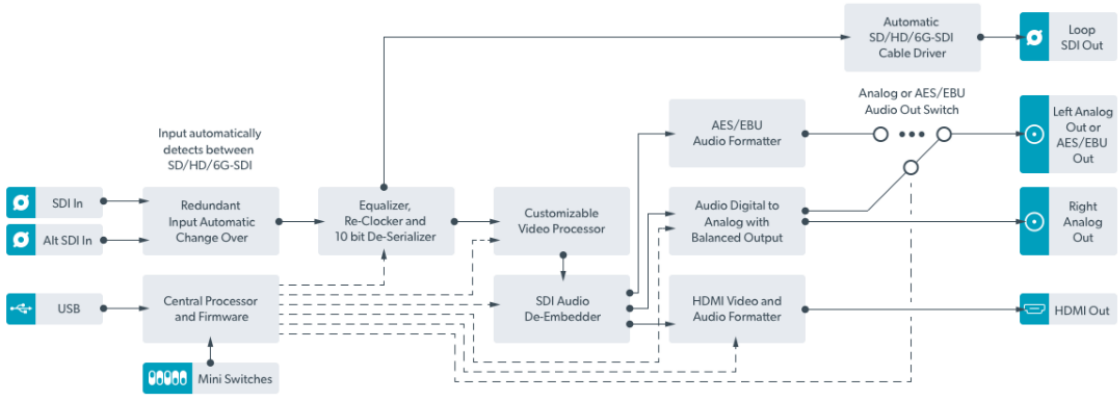
SDI Auto Switching
Automatically detects SD, HD or 6G-SDI.

HDMI Video Standards
625i50 PAL, 525i59.94 NTSC, 720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080i50, 1080i59.94, 1080i60, 2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

HDMI Color Space
YUV and RGB

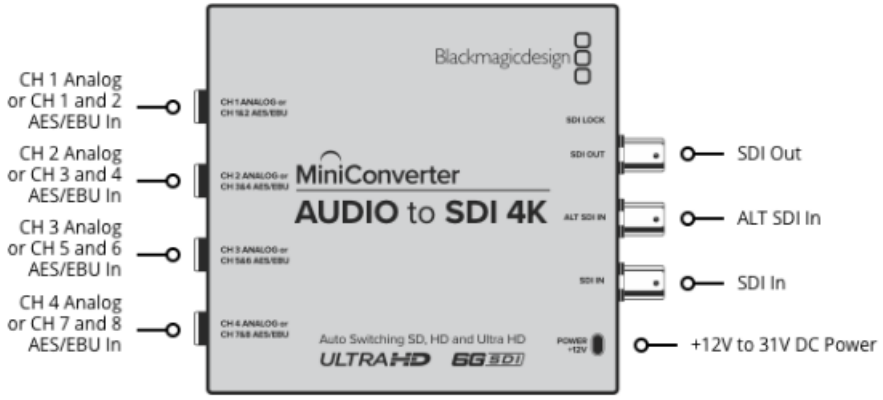
HDMI Color Precision
4:2:2 and 4:4:4





Equipment – Converters – Audio to SDI

- Adds (embeds) an audio signal to an SDI video signa
- Support:
  - 4 Analog Audio Channels
  - 8 AES/EBU digital audio channels
- It is used to integrate multiple audio sources into a single video stream.



Connections

SDI Video Inputs
1 x SD, HD or 6G-SDI. 1 x ALT SDI Input for automatic switch over if main input fails.

SDI Video Outputs
1 x Embedded SDI Output.

Analog Audio Inputs
4 channels of professional balanced analog audio with standard 1/4 inch jack connections.

Digital Audio Inputs
8 channels of professional balanced digital with standard 1/4 inch jack connections.

SDI Redundant Input
Automatically switches over if main SDI input is lost.

Multi Rate Support
Auto detection SD, HD or 6G-SDI.

Updates and Configuration
Via USB 2.0 high speed. (480 Mb/s)

Reclocking
Yes

Equipment - Converters - Audio to SDI

Standards

SD Video Standards
525i59.94 NTSC, 625i50 PAL

HD Video Standards
720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p47.95, 1080p48, 1080p50, 1080p59.94, 1080p60, 1080PsF23.98, 1080PsF24, 1080PsF25, 1080PsF29.97, 1080PsF30, 1080i50, 1080i59.94, 1080i60

2K Video Standards
2Kp23.98 DCI, 2Kp24 DCI, 2Kp25 DCI, 2Kp29.97 DCI, 2Kp30 DCI, 2Kp47.95 DCI, 2Kp48 DCI, 2Kp50 DCI, 2Kp59.94 DCI, 2Kp60 DCI, 2KPsF23.98 DCI, 2KPsF24 DCI, 2KPsF25 DCI, 2KPsF29.97 DCI, 2KPsF30 DCI

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4Kp23.98 DCI, 4Kp24 DCI, 4Kp25 DCI, 4Kp29.97 DCI, 4Kp30 DCI

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition and high definition.

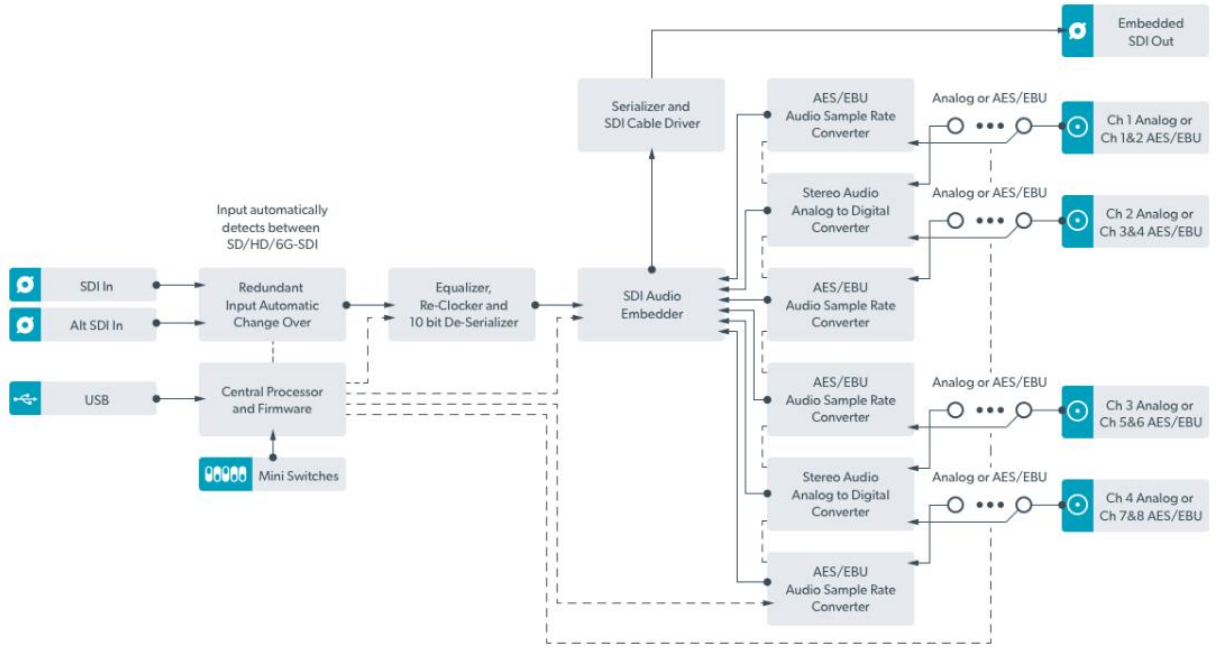
SDI Video Sampling
4:2:2, 4:4:4

SDI Audio Sampling
Television standard sample rate of 48kHz and 24-bit.

SDI Color Precision
4:2:2, 4:4:4

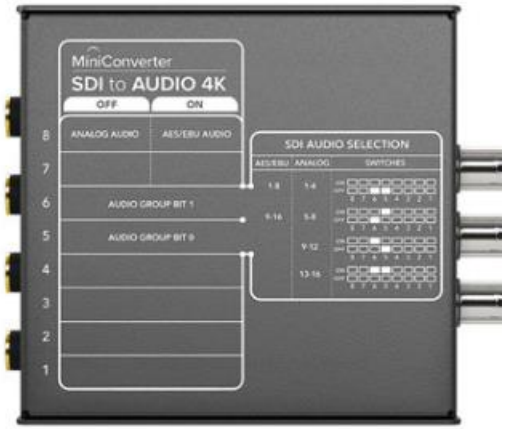
SDI Color Space
YUV, RGB

SDI Auto Switching
Automatically selects between SD, HD, 3G and 6G-SDI.



Equipment – Converters – SDI to Audio

- Extracts (de-embeds) audio from SDI signals.
- At the output:
  - 4 analog audio channels
  - 8 AES/EBU digital audio channels
- Allows for separate sound processing.



Connections

SDI Video Inputs
1 x SD, HD or 6G-SDI. 1 x ALT SDI Input for automatic switch over if main input fails.

SDI Video Outputs
1 x SDI Video Loop Output.

SDI Redundant Inputs
Automatically switches over if main SDI input is lost.

Analog Audio Outputs
4 channels of professional balanced analog audio with standard 1/4 inch jack connections.

Digital Audio Outputs
8 channels of professional balanced digital with standard 1/4 inch jack connections.

Multi Rate Support
Auto detection SD, HD or 6G-SDI.

Updates and Configuration
USB

Reclocking
Yes

Equipment - Converters - SDI to Audio

Standards

SD Video Standards
525i59.94 NTSC, 625i50 PAL

HD Video Standards
720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080PsF23.98, 1080PsF24, 1080PsF25, 1080PsF29.97, 1080PsF30, 1080i50, 1080i59.94, 1080i60

2K Video Standards
2K DCI 23.98p, 2K DCI 24p, 2K DCI 25p, 2K DCI 23.98PsF, 2K DCI 24PsF, 2K DCI 25PsF

Ultra HD Video Standards
2160p23.98, 2160p24, 2160p25, 2160p29.97, 2160p30

4K Video Standards
4K DCI 23.98p, 4K DCI 24p, 4K DCI 25p

SDI Compliance
SMPTE 259M, SMPTE 292M, SMPTE 296M, SMPTE 372M, SMPTE ST-2081, ITU-R BT.656 and ITU-R BT.601

SDI Video Rates
SDI video inputs are automatically detected between standard definition and high definition.

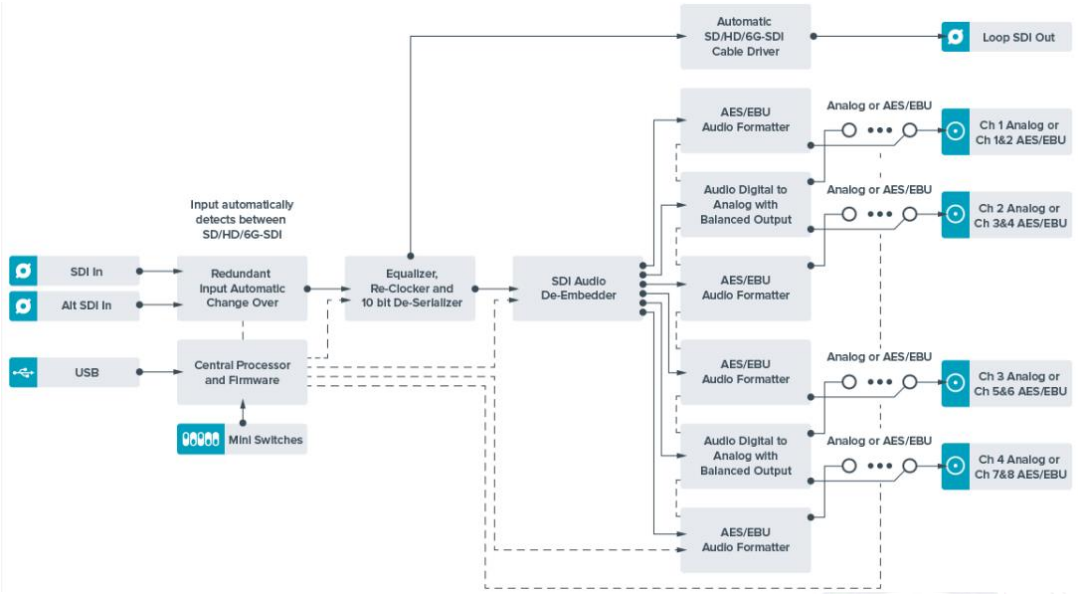
SDI Video Sampling
4:2:2, 4:4:4

SDI Audio Sampling
Television standard sample rate of 48 kHz and 24 bit.

SDI Color Precision
4:2:2, 4:4:4

SDI Color Space
YUV, RGB

SDI Auto Switching
Automatically selects between SD, HD, 3G and 6G-SDI.



Equipment – Converters – Sync Generator

- Synchronizes all the video devices in the studio..
- A must for multiple cameras and complex systems..
- Outputs:
  - Tri-level sync signal
  - Blackburst signal
- 6 Independent outputs for studio equipment.

Standards

Analog Format Support
525i29.97 NTSC, 625i50 PAL, 720p50, 720p59.94, 720p60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080PsF23.98, 1080PsF24, 1080i50, 1080i59.94, 1080i60

Connections

Analog Video Outputs
6 x common Blackburst or Tri Level reference outputs.

Multi Rate Support
Via mini switches

SDI Rates
270Mb, 1.5G.

Updates and Configuration
USB

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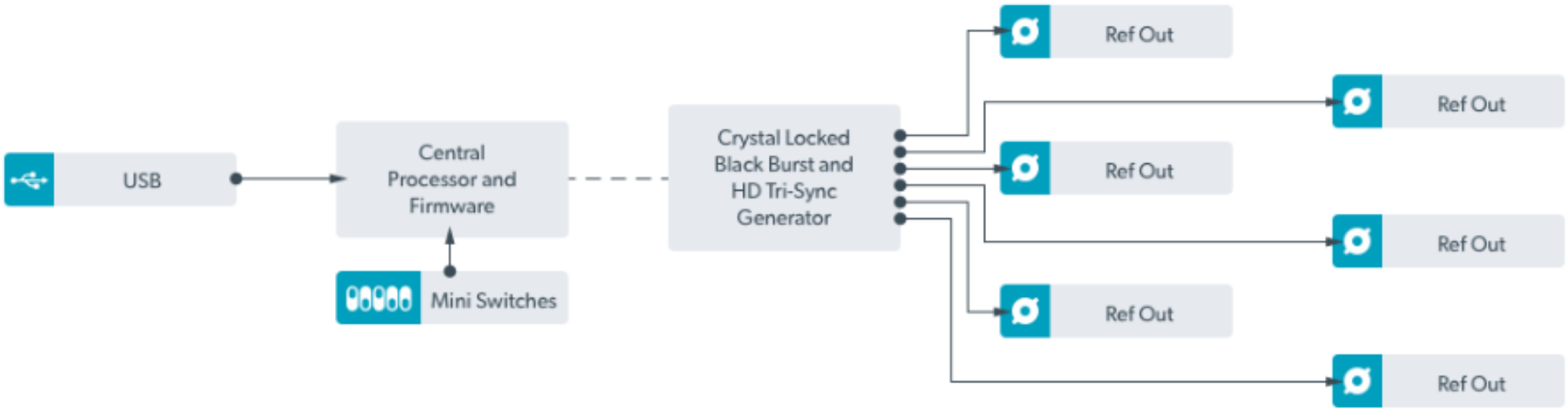
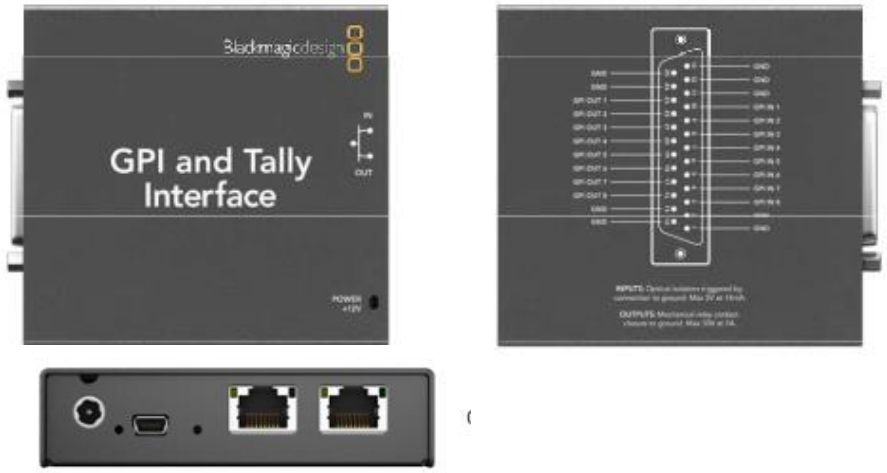
Equipment – Converters – Sync Generator



Equipment – Converters – GPI and Tally Interface

- GPI/Tally is used to signal the status of the cameras:
  - „On-Air“
  - „Preview“
- Connects to video mixer and cameras.
- DB25 connector for connecting to cameras.



Connections

Contact Closure
25 pin D-type connector providing 8 opto isolated inputs and 8 relay contact closure outputs.

Outputs
Mechanical relay contact closure to ground. Max 30V at 1A.

Computer Interface
1 x USB 2.0 high speed interface for configuration and firmware updates.

Ethernet
10/100 BaseT with loop through for connecting to other ethernet enabled equipment.

Inputs
Optical isolators triggered by connection to ground. Max 5V at 14mA.

Equipment - Converters - HDMI

Pros:

- High-resolution transmission up to 10K
- Easy to use
- Frequent as an interface on devices
- Supports HDR and 120Hz
- Transmission of audio and video signals
- Price

Cons:

- Maximum length up to 10m
- For lengths of more than 10 m, optics are recommen
- Unprofessional because of the interface
- More Stadnard
- It's not easy to break up

HDMI Version	Max Resolution	Max 4k Frame Rate	HDR	Wide Color Gamut	Hybid Log Gamma
1.4	4k	30Hz	✗	✗	✗
2.0	4k	60Hz	✗	✗	✗
2.0A	4k	60Hz	✓	✓	✗
2.0B	4k	60Hz	✓	✓	✓
2.1	10k	120Hz	✓	✓	✓

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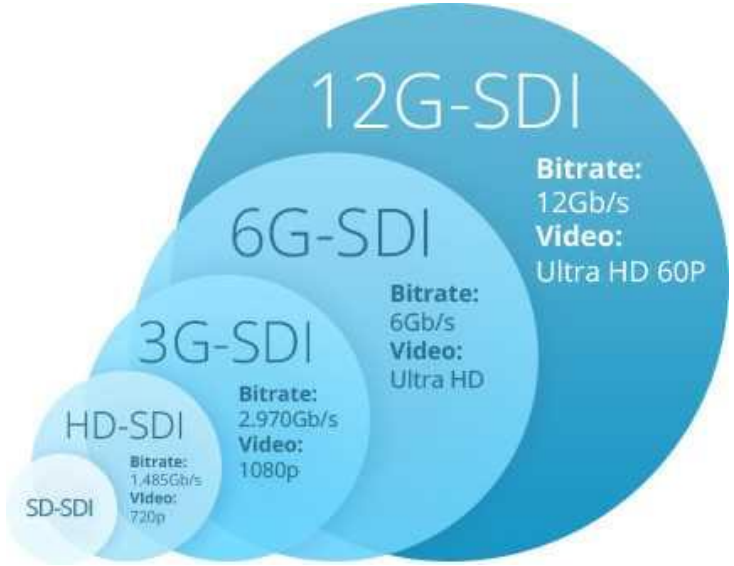
Equipment – Converters -SDI

Pros:

- High reliability
- Low latency
- Transmission over longer lengths of 30m (100m+)
- Easy to use and professional
- Can carry up to 16 audio channels

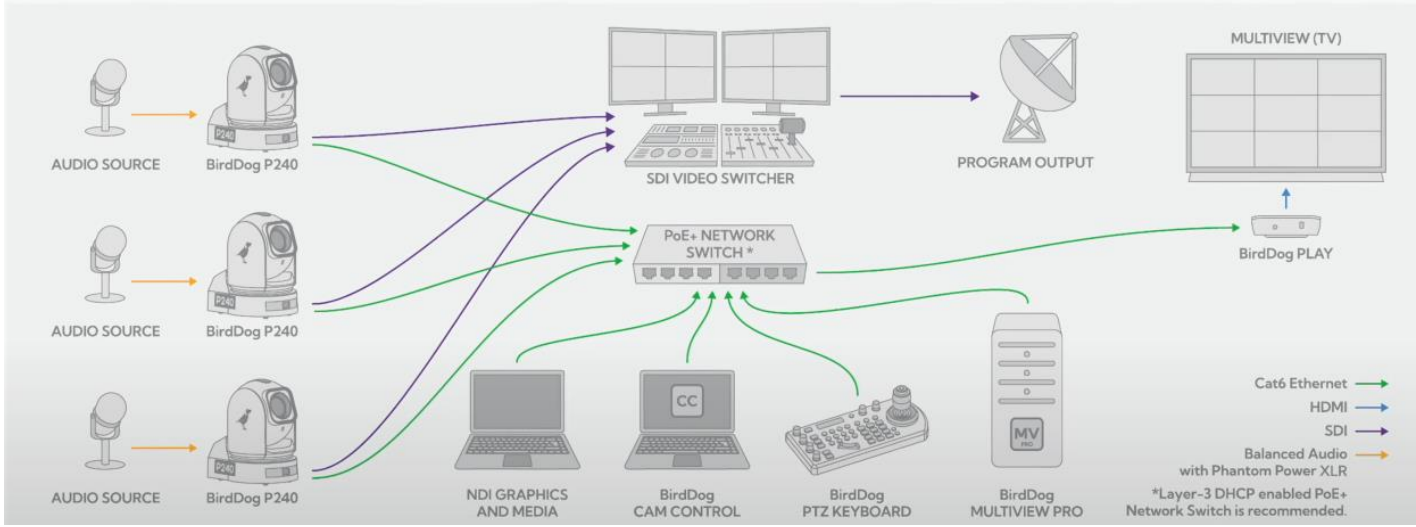
Cons:

- Limit the number of channels (1)
- Less flexibility
- Maximum Resolution and Refresh Rate.



Oprema - Converters -NDI

- Easy installation
- Reduced costs
- Flexibility and remote access
- Easy distribution
- Can transmit 4K (usually Full HD)
- For full HD recommended 100 Mbps
- Low latency (less than 1 frame) – 8 lines
- Compression?

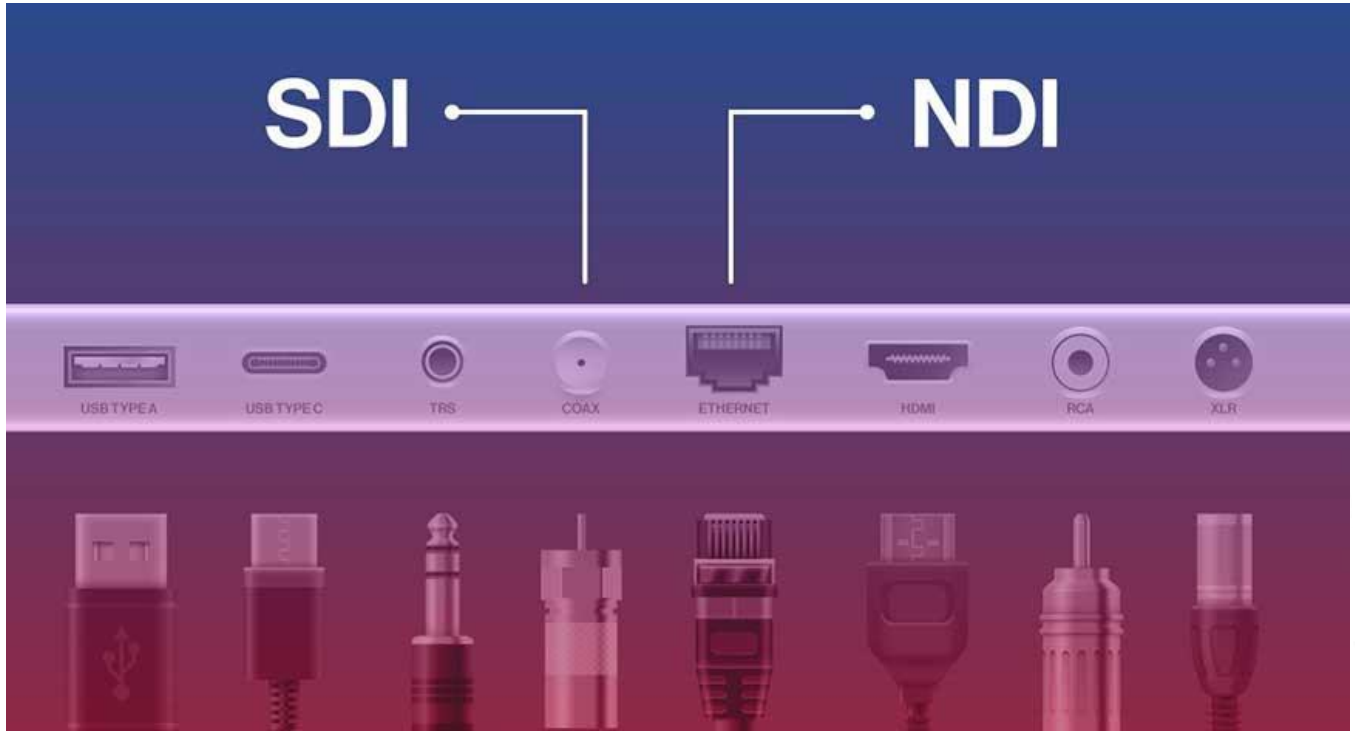


Oprema - Converters -NDI mane

- Compatibility and different versions
- Obsolescence and dependency of infrastructure
- Security risks
- Poor synchronization (delay of more than 8 lines?)
- Loss of quality due to transmission
- Everything goes through one cable
- Each stream through the network takes at least 100 Mb

What to choose?

NDI, SDI, HDMI or all?



Equipment – Broadcasting

• The final output of the program goes through the MCR (Master Control Room) and then to the distribution networks:
  - **Terrestrial broadcasting (DVB-T/T2)**
  - **Cable & IPTV Networks**
  - **Satellite broadcasting (DVB-S/S2)**
  - **Streaming services and OTT platforms**

The main functions of broadcasting:

- Image and sound quality control prior to public broadcasting
- Monitor all output feeds in real-time
- Switching to a backup signal in the event of a failure (redunda
- Advertising Block Management and Program Schedule

Required equipment:

- Video router for distribution of output signals
- Audio/video processors for final control
- Multiview systems for monitoring all channels
- UPS and backup power supply for 24/7 operation

Equipment – Broadcasting

- **Enkoder (Encoder):**
  - Converts uncompressed video to compressed MPEG-TS
  - Supported codecs: H.264/AVC, H.265/HEVC
  - Resolution: up to 1080p/60 or 4K (in modern devices)

- **Modulator:**
  - Signal modulation for DVB-T2, DVB-S2, DVB-C
  - Supported modulations: QPSK, 16-QAM, 64-QAM, 256-QAM
  - Input Signal: ASI, IP (UDP/RTP)
  - 470–862 MHz frequency range, precise control of MER and BER

- **Multiplexer:**
  - Combines multiple TV channels into a single transport stream
  - Inputs/Outputs: 16×ASI or IP (Gigabit Ethernet)
  - Functions: PSI/SI tabular generator, remultiplexing
  - Redundant connectors and hot-swappable modules

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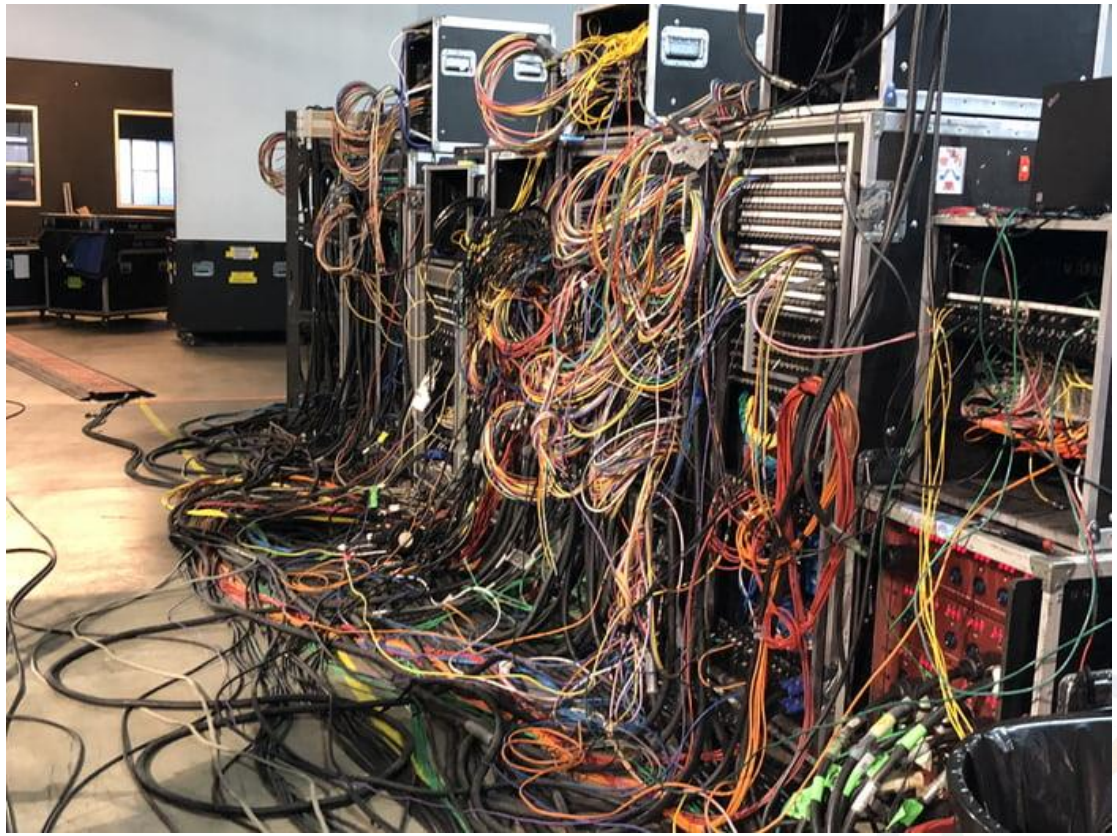
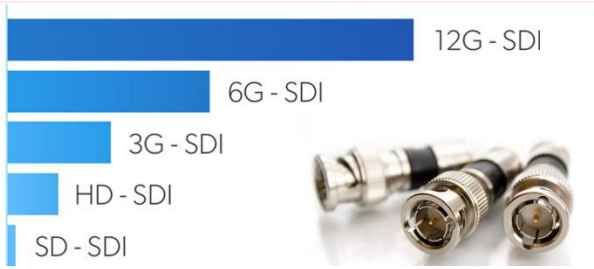
Equipment - Cables

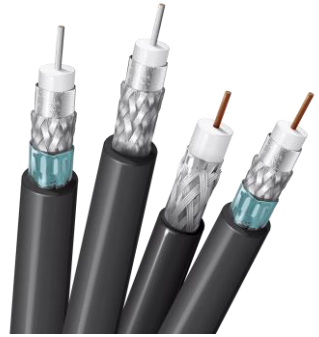
- Video cables (SDI, HDMI, optical)
- Audio cables (balanced and unbalanced)
- Network cables (Ethernet, Dante, NDI, IP)
- Control cables (DMX, DALI, intercom)
- Power cables (power and UPS systems)



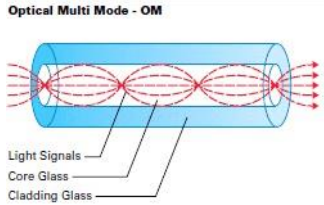
Equipment – Cables

- **SDI Cables (Serial Digital Interface):**
  - HD-SDI, 3G-SDI, 12G-SDI
  - BNC Connectors
  - Professional standard for studios, 75 Ω impedance

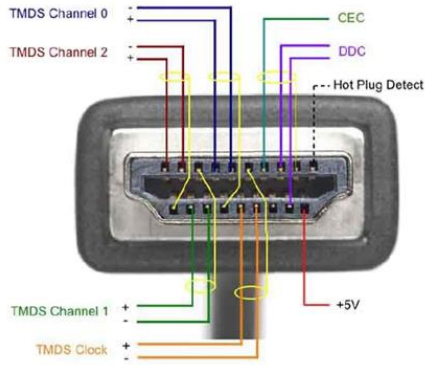


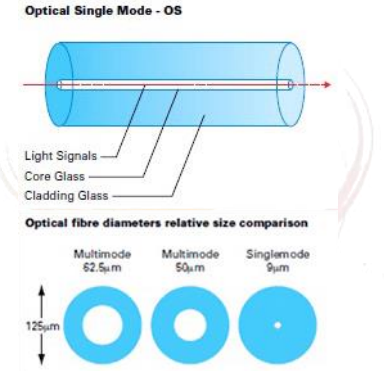


- **Fiber Optic Cables:**
  - Transmission over long distances without loss of quality
  - SC/LC Connectors
  - They are used for 4K and 8K production.



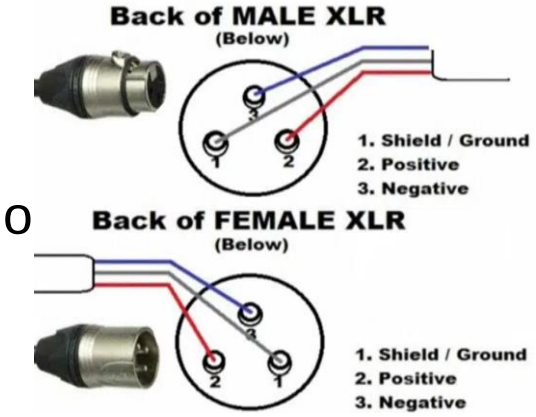
- **HDMI Cables:**
  - Only for auxiliary monitors and non-primary signals
  - Limited length up to 5-10m

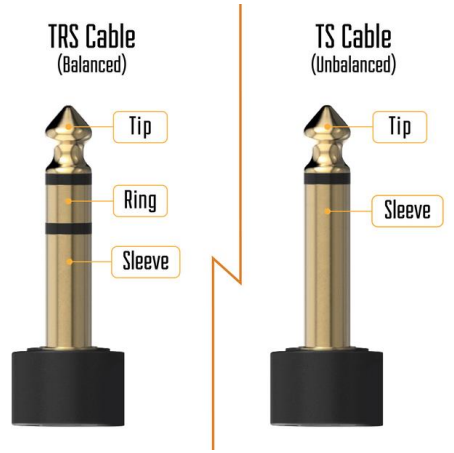


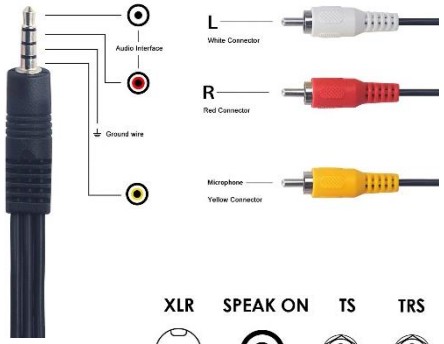


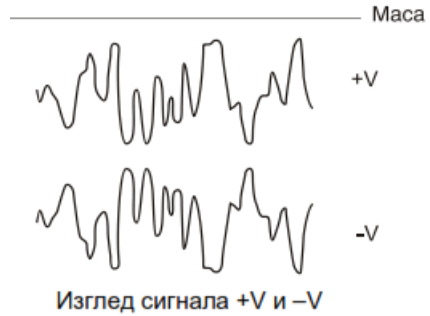
Equipment - Cables

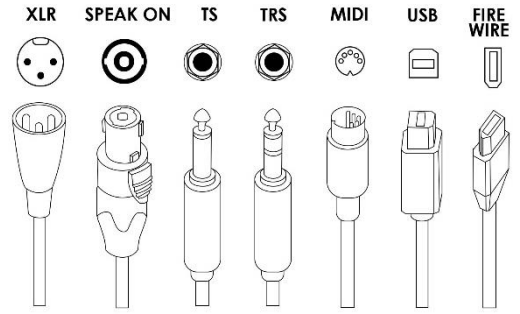
- **Balanced Audio Cables:**
  - XLR/TRS connectors
  - The Professional Standard for Microphones and Audio
  - Immunity to interference
- **Unbalanced Audio Cables:**
  - TS/RCA Connectors
  - They are used for smaller appliances or consumer equipn
- **Digital Audio Cables:**
  - AES/EBU (XLR)
  - Dante or AVB over network cables (Ethernet Cat6/7)

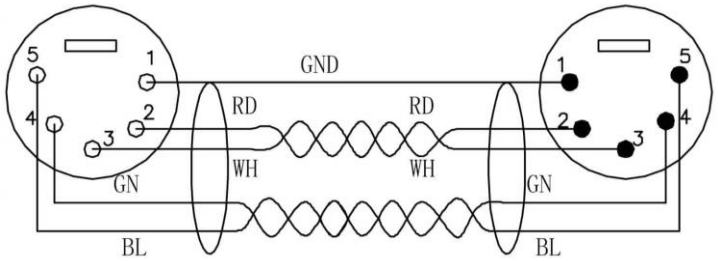








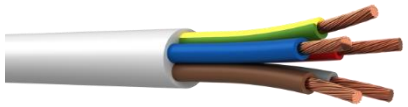




Equipment – Cables

- **DMX Cables:**
  - Standard for control of lighting in the studio
  - 3-pin or 5-pin XLR connectors

- **DALI Cables:**
  - Digital Addressable Lighting Interface
  - It is used in advanced lighting systems



- **triax Cables:**
  - How to connect studio cameras to the CCU (Camera Control Unit)
  - Transmission of image, power and control signals through a single cable
  - Central conductor for video signal (usually HD-SDI)
  - Up to 300 m for standard HD signal, depending on cable quality

Equipment - Cables

- **Standard power cables:**
  - Power supply for cameras, mixers, lighting and other equipme
  - IEC Connectors for Studio Equipment

- **UPS System:**
  - Special power cables and battery backup

- **Power distribution:**
  - Power distribution rack with labeled circuits
  - Redundant power supplies (A/B lines)

Equipment - Cables

- Marking cables with colors or markings
- Patch panels for organization and quick configuration change
- Safety standards:
  - Avoiding "spaghetti" cables
  - Fixing cables to prevent trips and damage
  - Regular testing and maintenance of cables.

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Where to start?

Where to start?

- It's a project solution!
- Cables, cables, cables...
- Study height 5m and more
- Floor studjia (flat, antistatic, matte dark color, floating to not transmit vibration, physically separated from the walls)
- Noise, windows
- Antistatic double floor

Kompjuterski pod

Kanali

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Required installations

- Electrical installation (power supply)
- Installation of technological equipment
- Installation of ducts (in the wall or floor, covers at 1 or 2 m)
- Installation of a computer network.
- Installation of antenna connectors
- Connection of the system to KDS, broadcasting system, satellite, IPTV, Internet, to the public telecommunications network (encoder...)
- Installation of fire protection
- Installing the phone (IP)

Laying cables

•Cables for audio and video signals should be routed separately from the power cables.
And when it is impossible for them to be completely separated, they should be crossed at an angle of **90°**
with a distance of **10mm** between each other, or an insulating insert is placed between **3mm**.

•The parallel horizontal distance between power and telecommunications cables should be a minimum distance of **20 cm.**

•When audio and video cables are parallel to power cables, interference can be induced.

•Cables should be laid in a straight line vertically and horizontally.

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Laying cables

•It is forbidden to carry out the continuation and branching of conductors in ducts, but only in the appropriate **BOXES**.

•The free length of cables at the outlets of the junction boxes should be approx**. 0.5 m**,
And in the middle of the **3m** in the headquarters.

•For unit microphone and modulation lines, **LiYCY 2x0.25mm²** shielded cables are used,
for group microphone and modulation lines shielded multikore cables,
for low-impedance speaker lines PP**/J cable 3X1.5mm**.

•For video lines **75 ohms**.

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Power supply

- General **Consumption Installation**
- Installation of lighting in the studio
  - With cables that are resistant to temperature.
  - **warm + Cold**,
  - 60%:40% ratio in favor of warm
  - When the light is dimmed, there should be no change in temperature

- Installation for technological devices (for grounding it is done with a fork or star-shaped, not in a loop because then the system can behave like an antenna, sockets of different colors)
- UPS, for 2-3 hours of autonomy, depending on the amount of equipment
- Generator
- Installation of panic lighting
- The first installed power of technological equipment in the machine room is about 120KW, when the air conditioning stops working, the room heats up in 45 minutes about 40°C.

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Power supply

•If possible, the lighting fixtures and general consumers should be powered from a different phase than the A/V equipment.
•It is good that all A/V equipment is powered from the same phase.
•Each circuit should have a separate fuse.
•All sockets should be marked with different colors (technological, general consumption, aggregate, phases R, S, T)
•There should be a panic light in all technological rooms.

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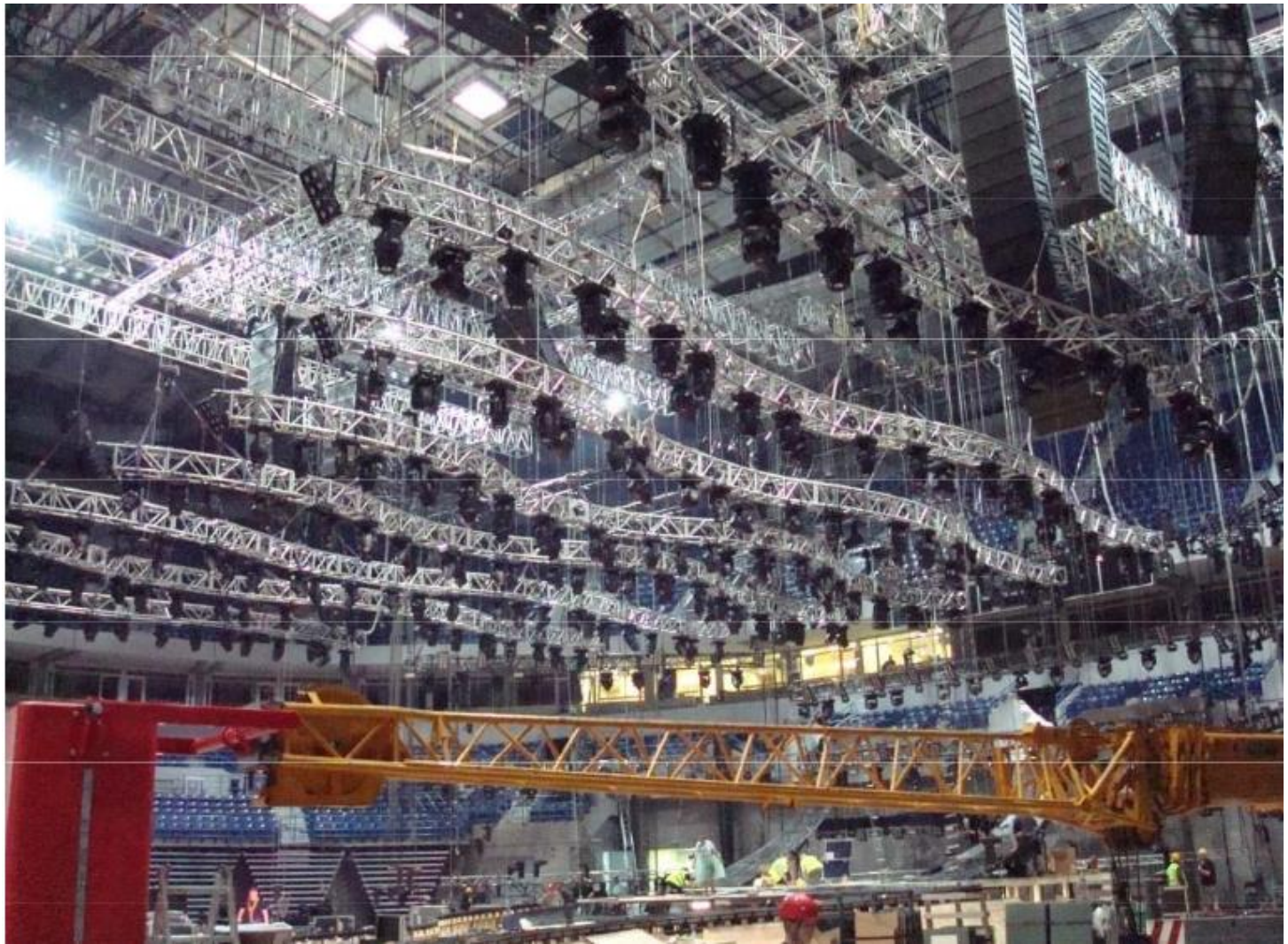
Grid



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Acoustics and the current state

- The nature of the object, the size and shape of the object
- Existing condition of the building
- Acoustics, reverberation vermen measurement, room materials
- After measurement, acoustic processing

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Akustika i zatečeno stanje

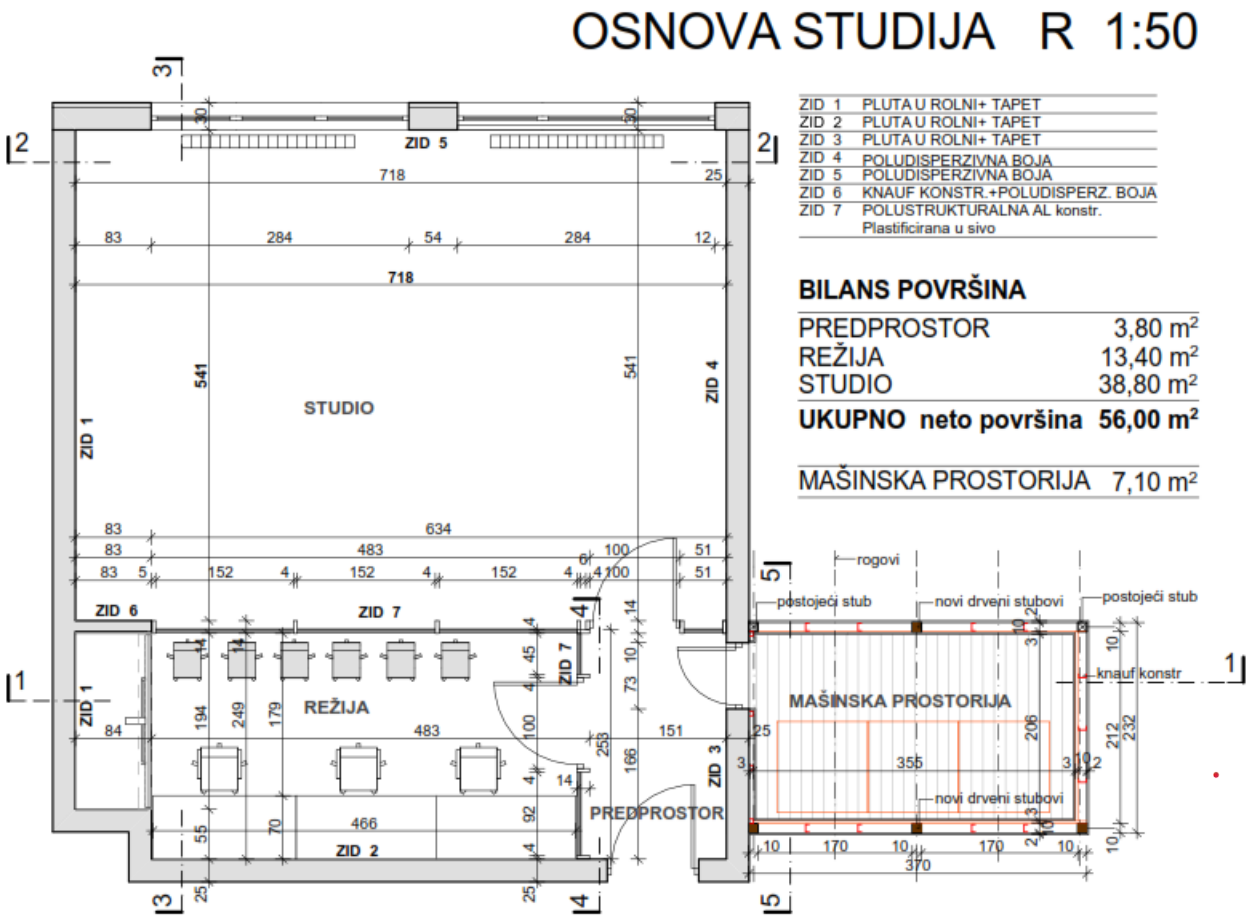
•**Na plafonu se isto postavljaju RIGITON ploče**

•Moguće je koristiti dvostruke rigips ploče (staklena vuna + vazduh) između,
tu je dobra akustička i toplotna izolacija.

•Rigips ploče 60x60 ili gipsane ploče, ako može, treba ih postaviti pod nekim uglom *(cik-cak ili pod uglom)*.

•Kod staklenih pregrada između režije i TV studija, ako se pregrada koristi za slikanje kamerom, staklo treba da je pod uglom od oko **15 stepeni** zbog refleksije.

What should the TV look like?



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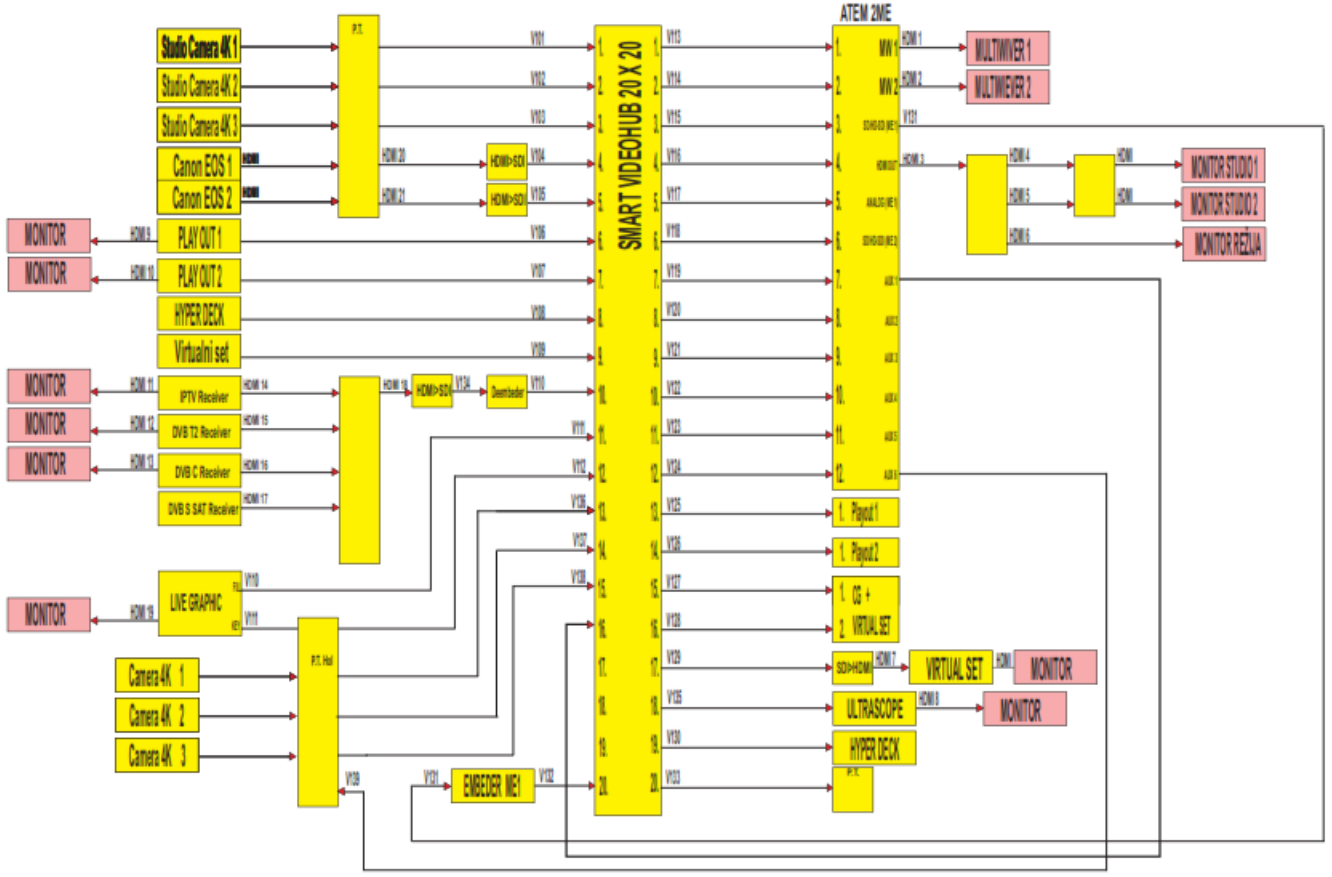

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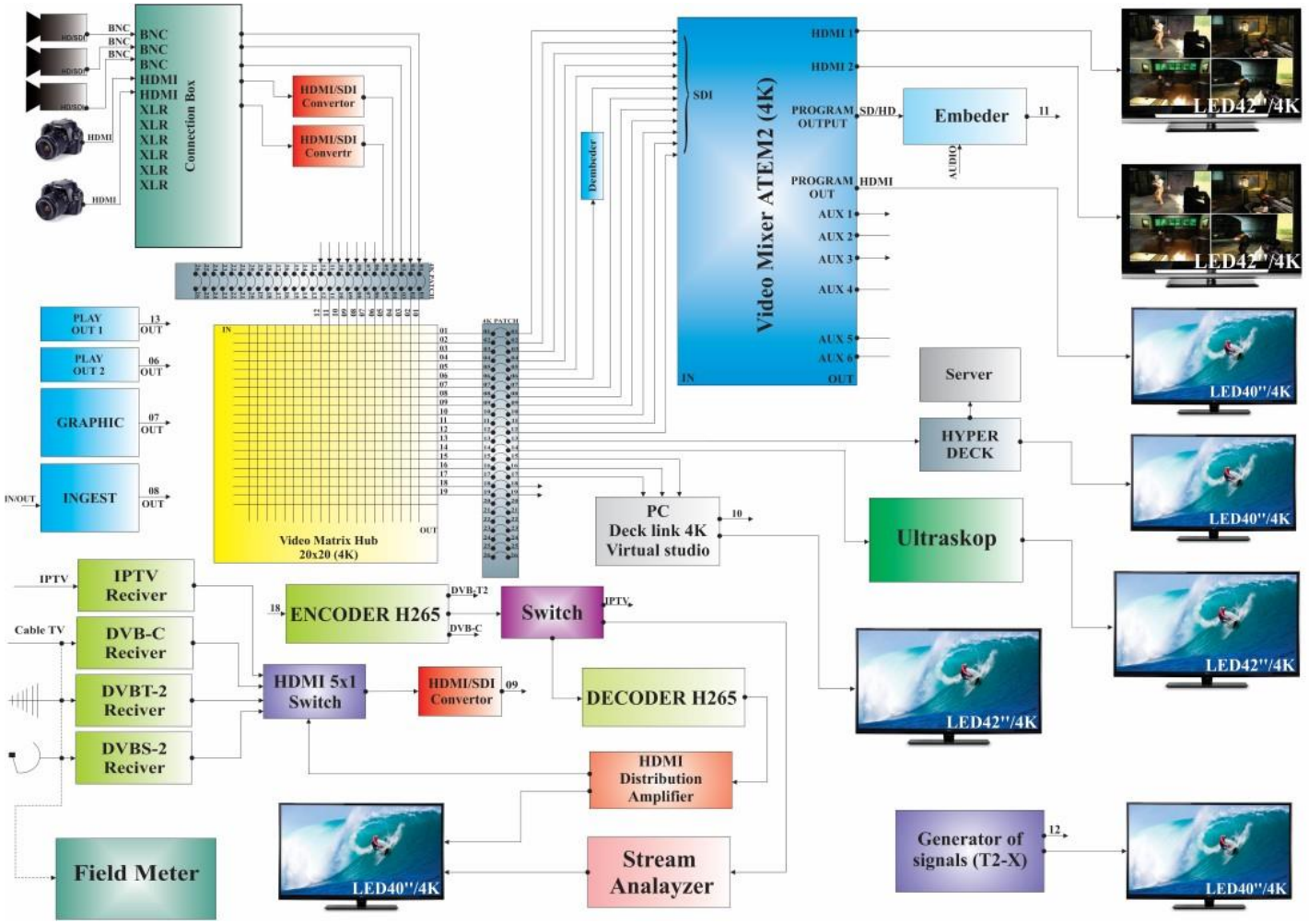

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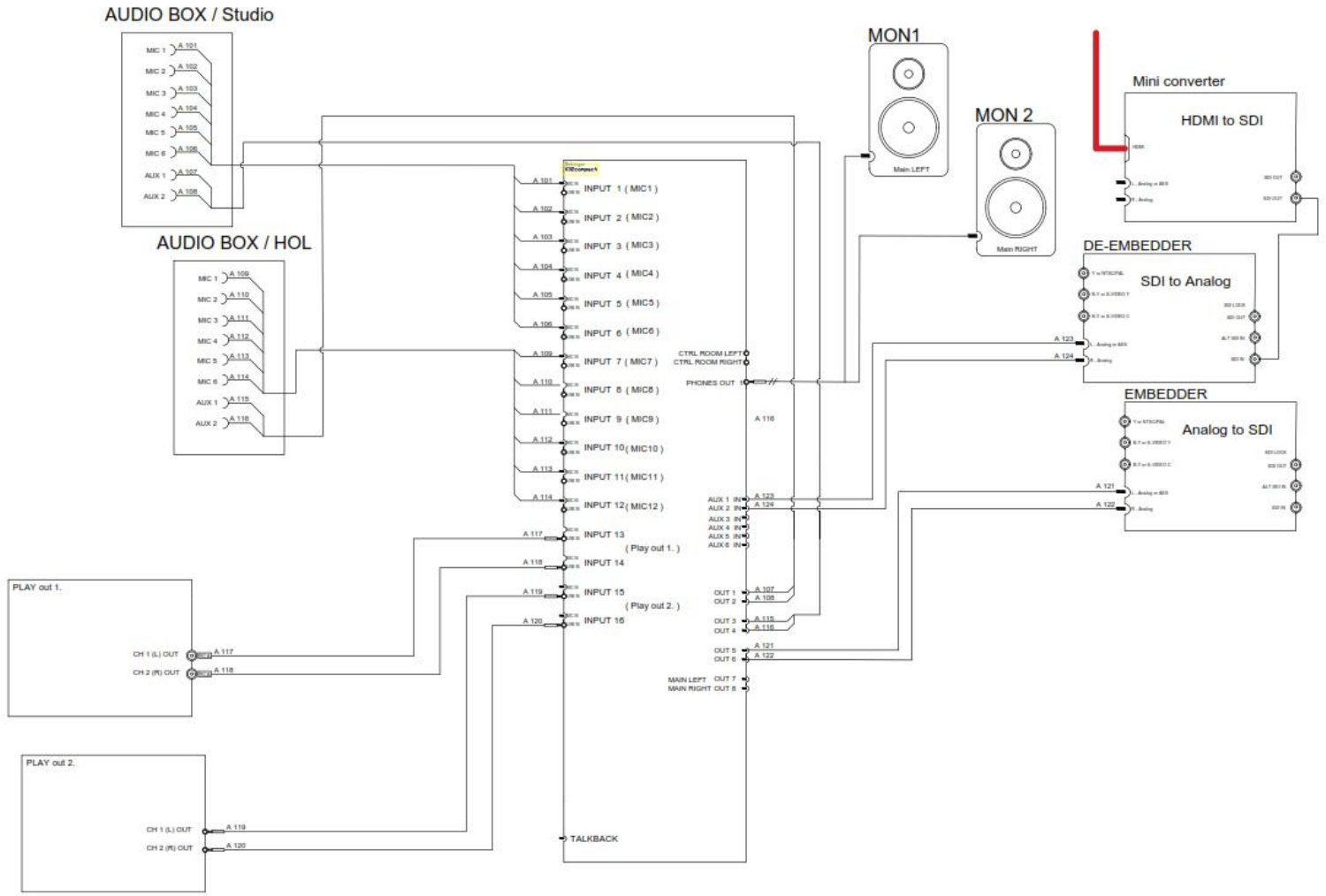

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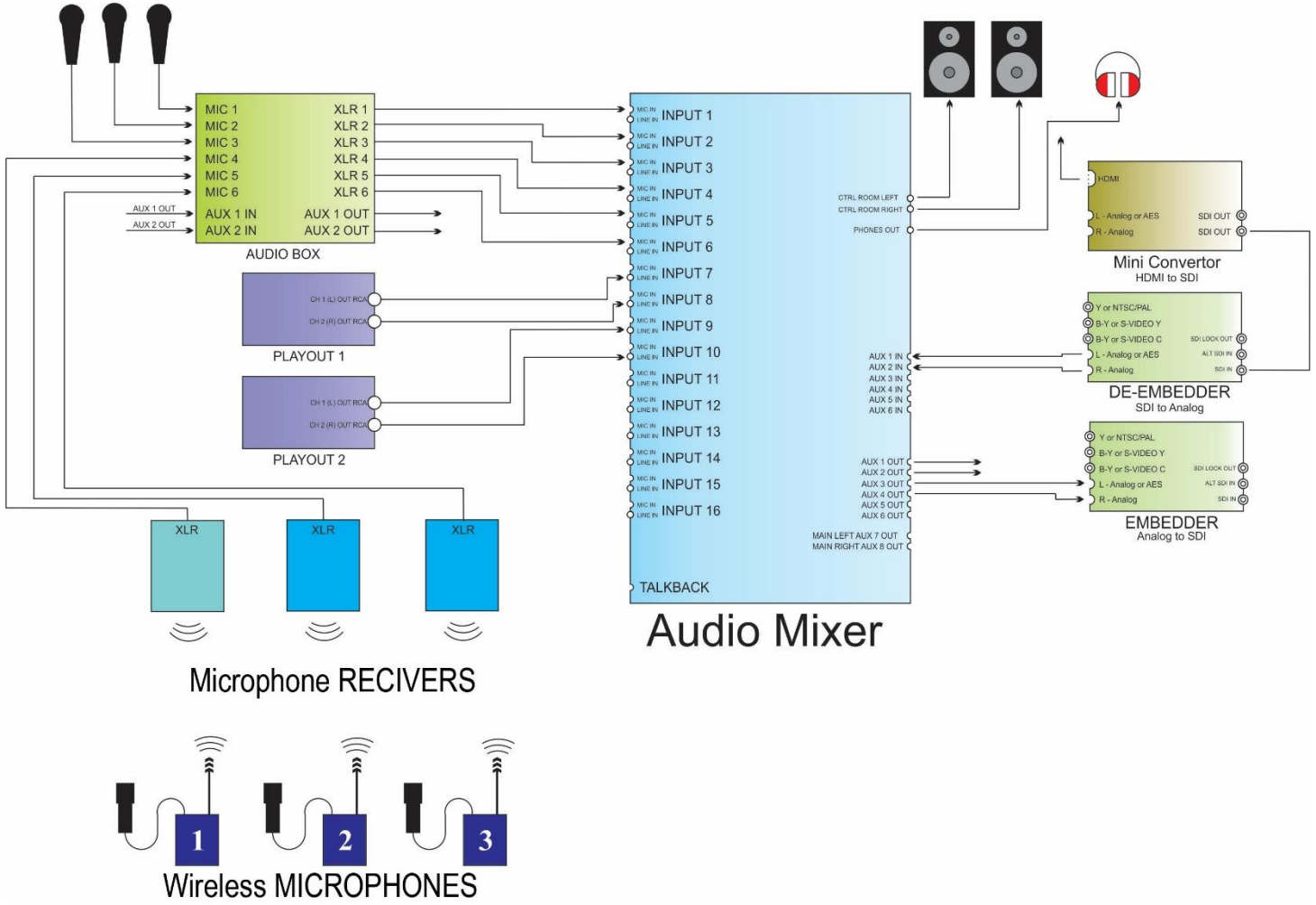

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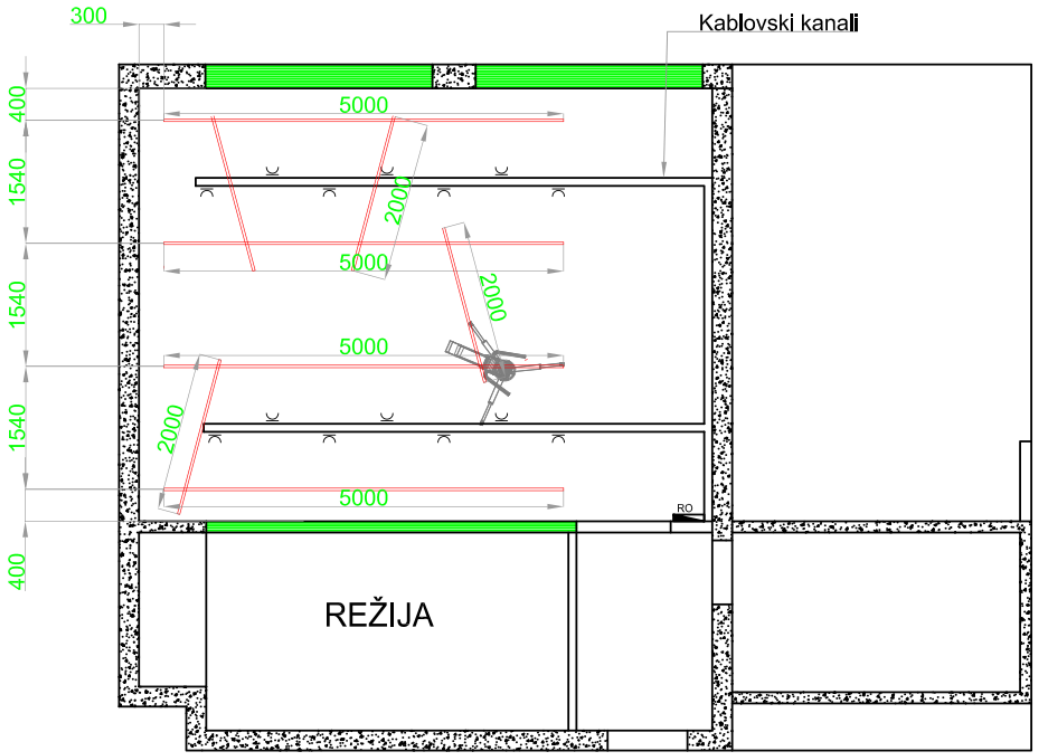
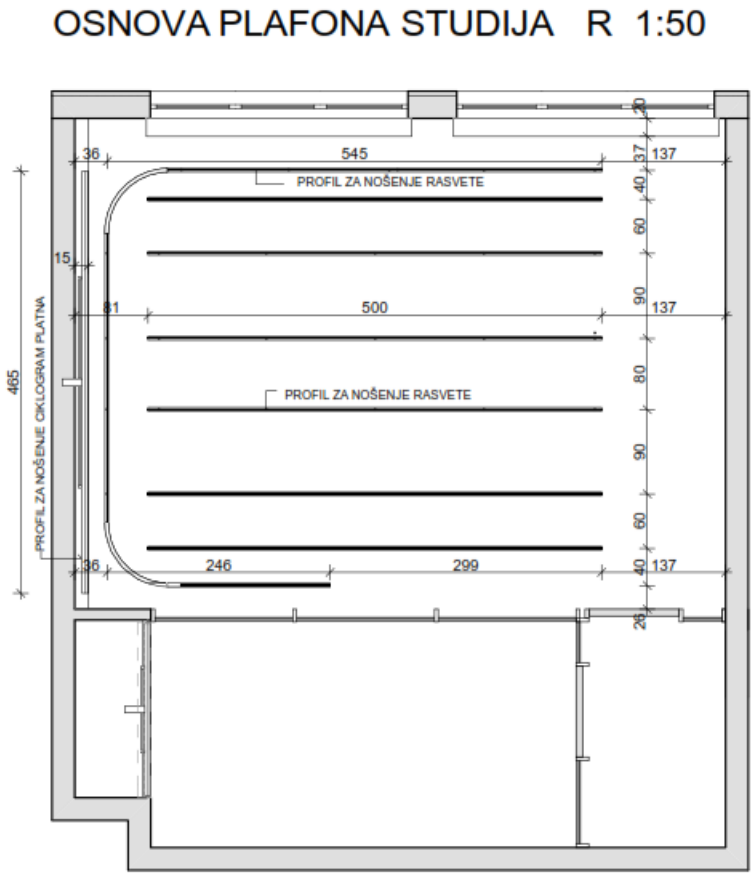


POZ.	NAZIV	KOM.	DIMENZIJE	MATERIJAL	S
	Datum	Ime	Potpis		
Konstruisao					
Crtao		Branko Jovanović			
Odobrio					
Razmera: 1:50	Naziv dela: Rešenje 2 TV studija				
	Visoka elektrotehnička škola Beograd				



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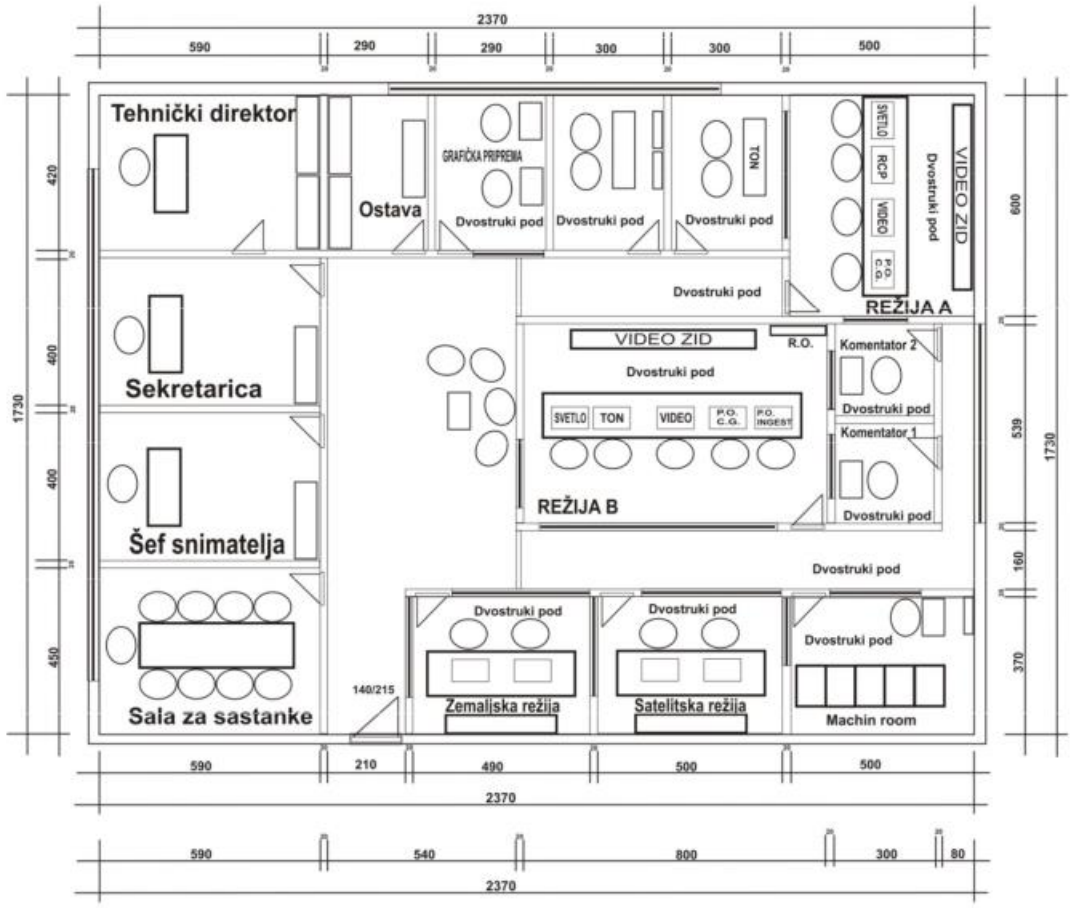
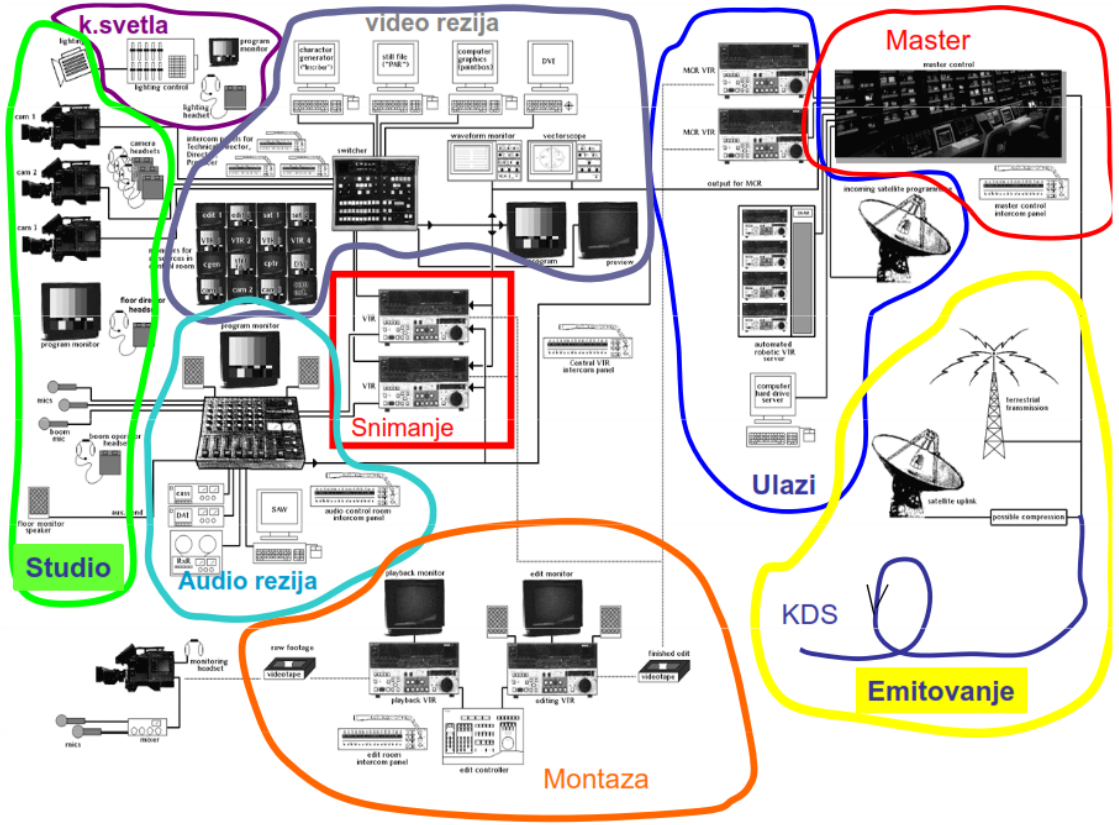
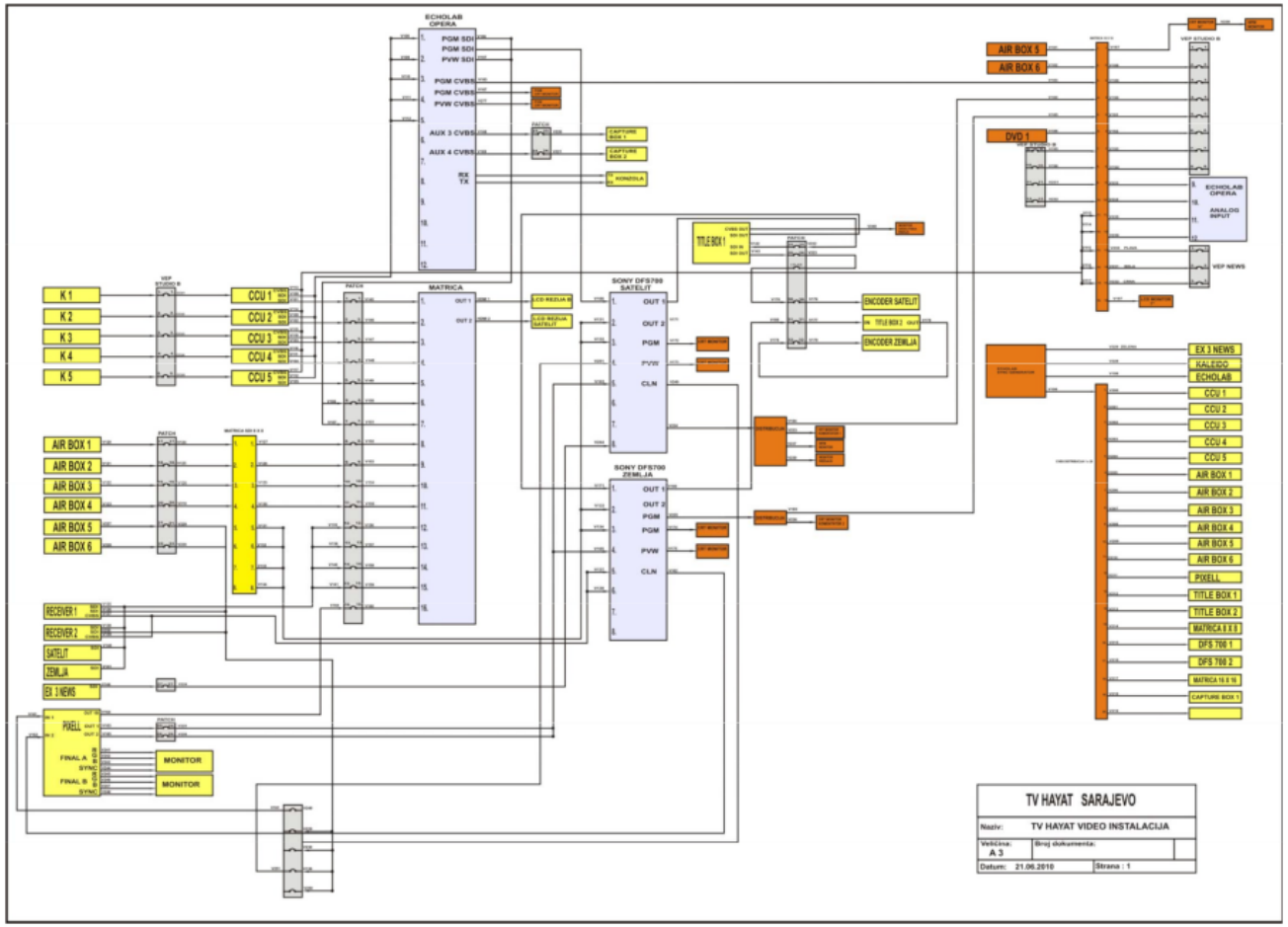
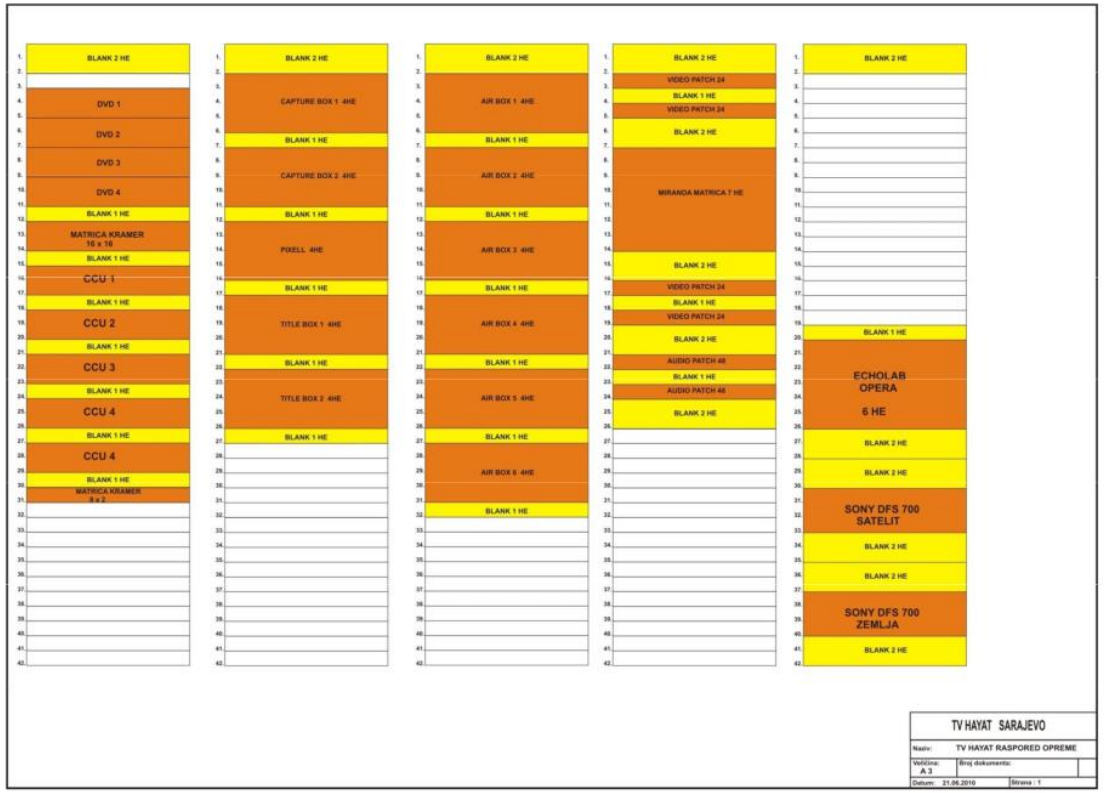




TV HAYAT SARAJEVO		
Naziv:	TV HAYAT RASPORED PROSTORIJA	
Veličina: A 3	Broj dokumenta:	
Datum: 21.06.2010	Strana :	

What should the TV look like?





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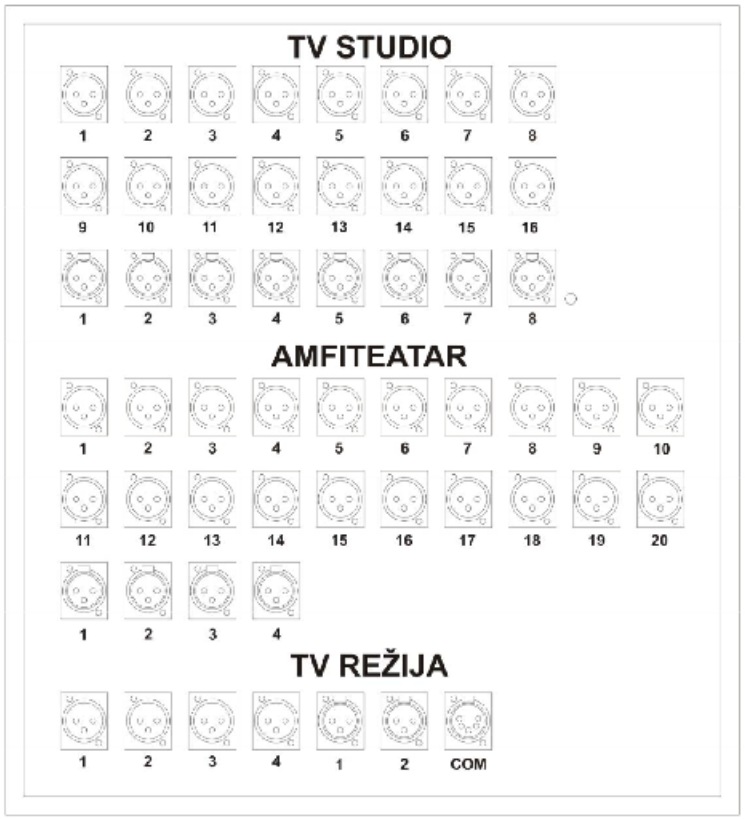
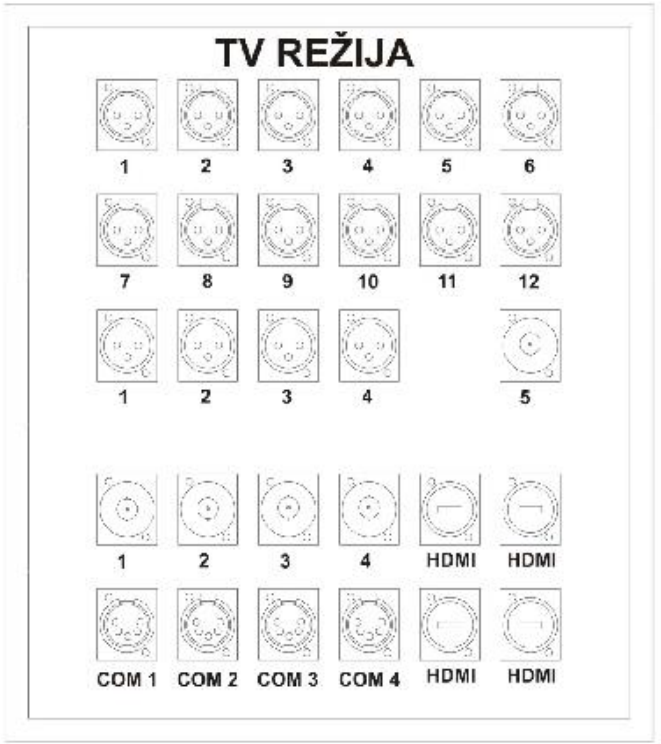
What should the TV look like?

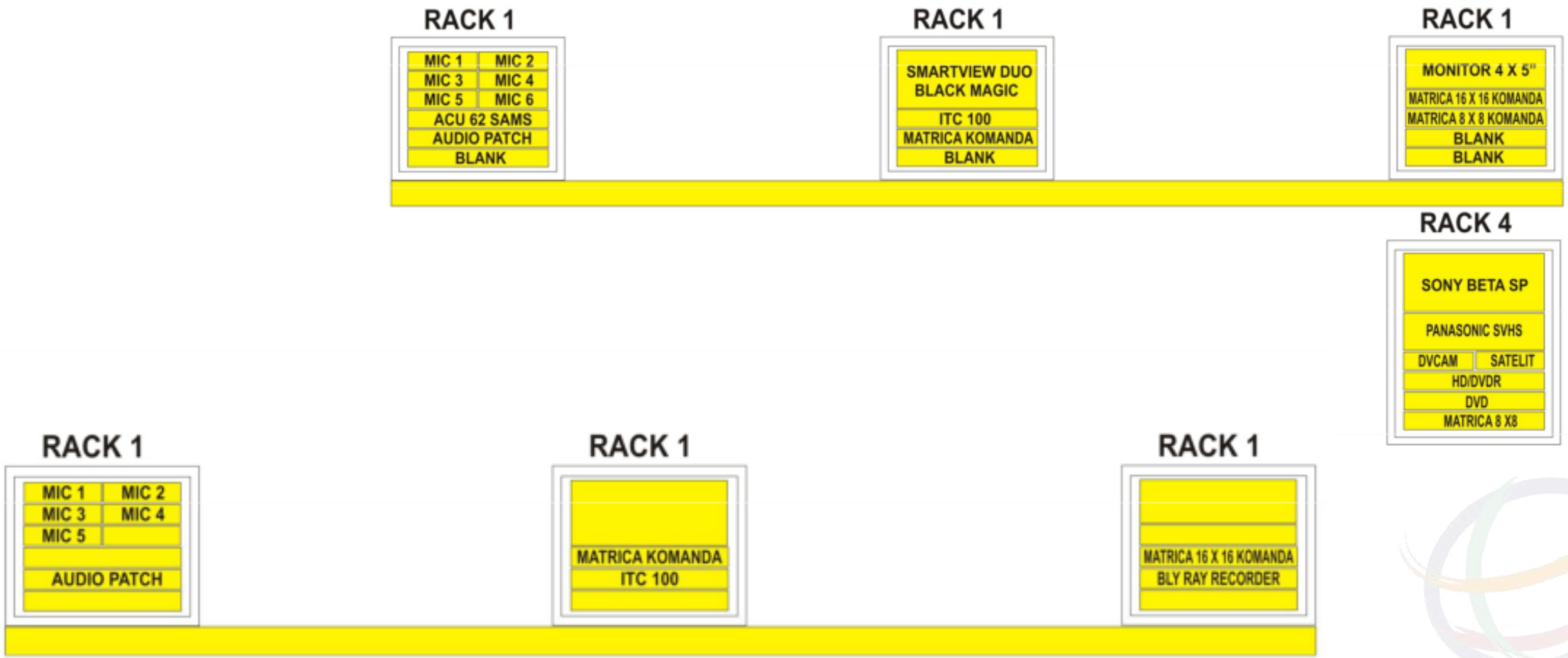
PK 3 5.1 REŽIJA



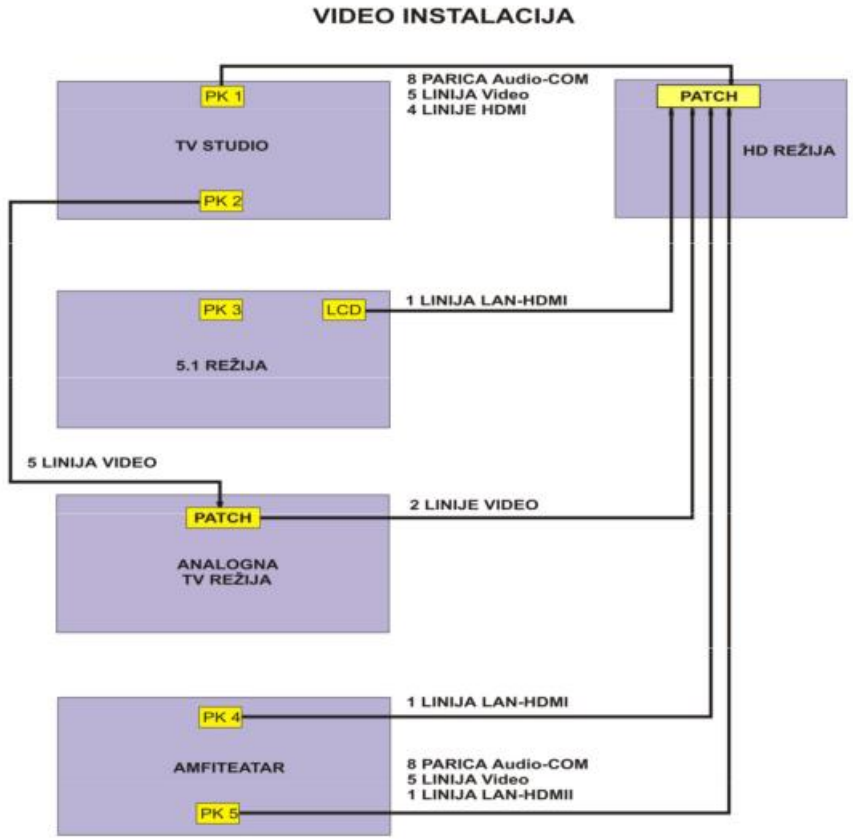
PK 1 TV STUDIO



What should the TV look like?



What should the TV look like?



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Questions & Answers

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