

# KHAV - SL Studio KH HD

## Cabling Diagrams & Specifications

Standard Installation using analog cameras (Sony EVI-D70, Sony EVI-D80)

- Adjusted analog video infrastructure to be as simple as possible. Now analog to SDI-HD converters are used in conjunction with BlackMagic Decklink Mini Recorder boards to go SDI-HD as early as possible and make most infrastructure SDI-HD only. This allows future upgrading of cameras to native SDI-HD cameras without major infrastructure changes.
- Small corrections on parts lists.

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# Introduction

This document contains a template for Kingdom Hall Audio / Video system for combined use by both hearing and sign language congregations. It leverages the same infrastructure so all audiences (including sign language) can benefit from HD video presentations and a modern distribution architecture.

SL Studio KH HD is a modernized version of the SL Studio KH version that uses the recently released branch proposed SDI-HD infrastructure to distribute the video signal instead of using composite video. It also uses a professional studio grade HDMI/SDI-HD video mixer to provide cross faded switching between camera feeds and media. All media stays digital delivering the quality that is available for download from [jw.org](http://jw.org) without degradation.

SL Studio KH HD is a single application with the following integrated features:

- Seamless semi automatic switching between camera feeds for stage and audience and media using cross fading
- Support for controlling studio grade PTZ cameras. Perfectly framed audience participants can be switched on screen in less than 4 seconds using seating overlay view presets and nose pointing technology.
- Automatic blackout for fast movements to presets of cameras that are currently on screen
- Automatic selection of stage camera after media finishes playing
- One button update and synchronization of over 300 GB media set for sign language clips (by using companion SL Media Updater app)
- Simple selection of media by just typing in the desired scripture(s), ranges of scriptures, song numbers, publications (book abbreviation, chapter, paragraph), magazine (article, paragraph(s), question).
- Drag & drop capability for all of media, including pictures and all other media types supported (JPG, PNG, GIF, PDF files, etc.)
- Create playlists by adding currently selected media to the list (one button add), or drag & drop media onto the playlist to enter it. Playlists can be saved and used at a later time on all SL Studio systems in KHs and AHs and even other KHAudio systems.
- Import text file list of needed media into playlists for ultra fast and light weight meeting part setup
- Full scrolling capability through selected media. Select chapters within a media file from scrollable list (media chapters can be verses in a bible chapter, or paragraphs in a publication). Single step frames. Set frame accurate In/Out points of media for playback (allows you to play portions of a verse or any point that is not on a media chapter boundary).
- Step through playlist for presentation. Skip over or backup any entry in the playlist. Select different media in addition to the playlist entries and then simply continue with the rest of the playlist. Allows for dynamic changes if needed.
- All equipment controlled, configured and switched on/off automatically using a single click by the operator upon activation (assuming controllable devices are used of course).

KHAudio/Video is a single application with the following completely integrated features:

- microphone signal mixing (up to 16 channels)
- song-, background music and external track playback
- recording to date/time stamped MP3 files
- internet based conferencing for shut-ins (eliminating old style telephone lines)
- video, slides and streaming media playback
- playlist handling for more complex presentations (compatible with KHAV Playlist Editor, SL Studio Personal/Group/KH/AH and Cobalt Sound System for AHs)
- direct digital audio connections to KHs on same network (double KHs) or over internet for overflow situations or special programs
- fully configurable audio processing including dyn. voice compression, parametric filtering, equalization, bandpass filtering, tel. compression, FM compression, delays, etc.
- optional auto gating and auto mixing (avoiding unnecessary feedback)
- specific features for KH use like Auto Mute Roving Mics, Auto Recording & Splitting, Auto Conf Connection, etc.
- KHConf and MetroConf real-time callers list and count
- fast setup and configuration with built-in spectrum analyzer
- full integration with SL Studio KH, leveraging video equipment already present in KHs with sign language congregations
- optional integration with the KH Control System, automatic shutdown of equipment, lighting controls for media presentations

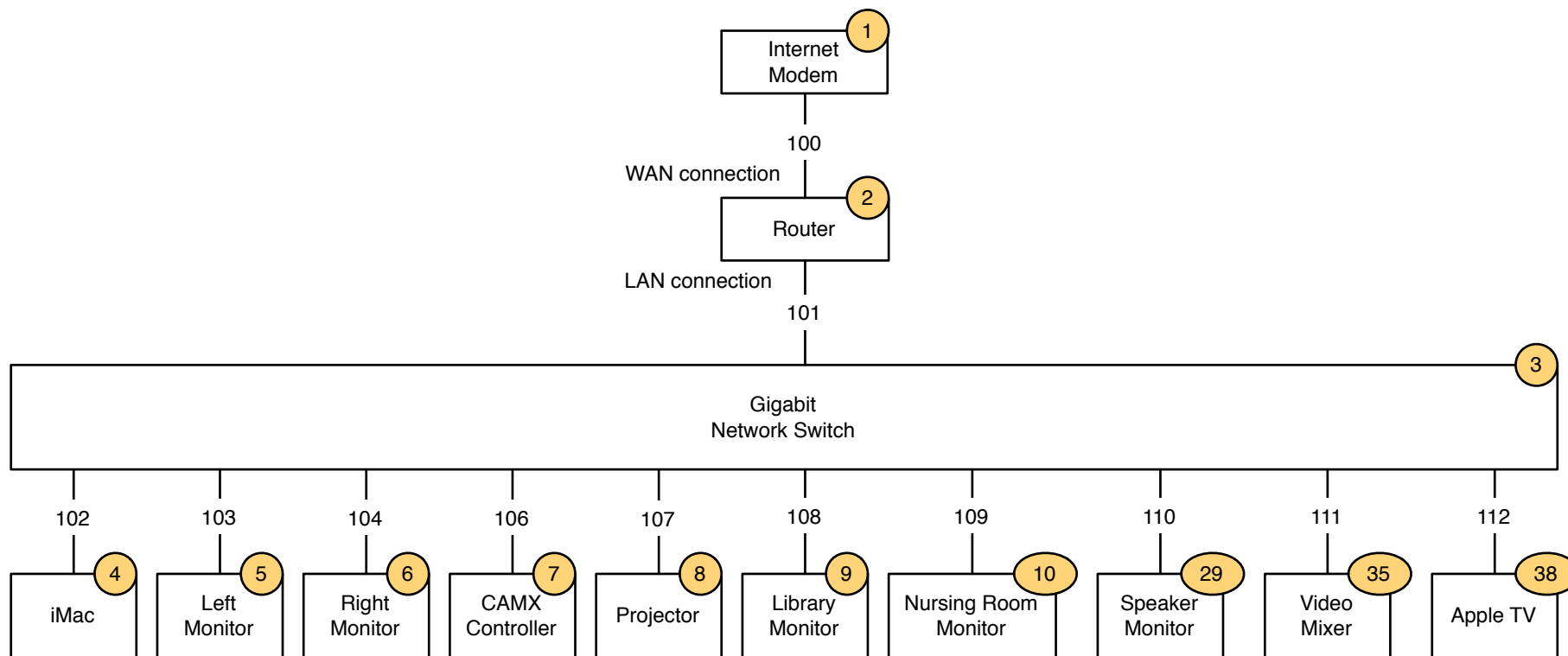
In this doc you will find all the necessary schematics (following branch proposed video infrastructure) for a completely integrated system along with routing schemes, components lists, cable lists, etc. Budgeting can be derived easily from those lists by researching the given part numbers or other specs. Many components can be viewed as optional (dashed outlines) and you can obviously mix and match your specific configuration to your needs. If your KH happens to have an SL Studio KH system and/or a KH Control system, then KHAudio can be configured to integrate with those systems leveraging the already installed infrastructure. This can be useful for automatically switching off lights that interfere with certain presentations, switching certain equipment or sharing video equipment. In such cases all equipment can be controlled from within the KHAudio application. No running around with IR remotes etc.

# Network Cabling Infrastructure

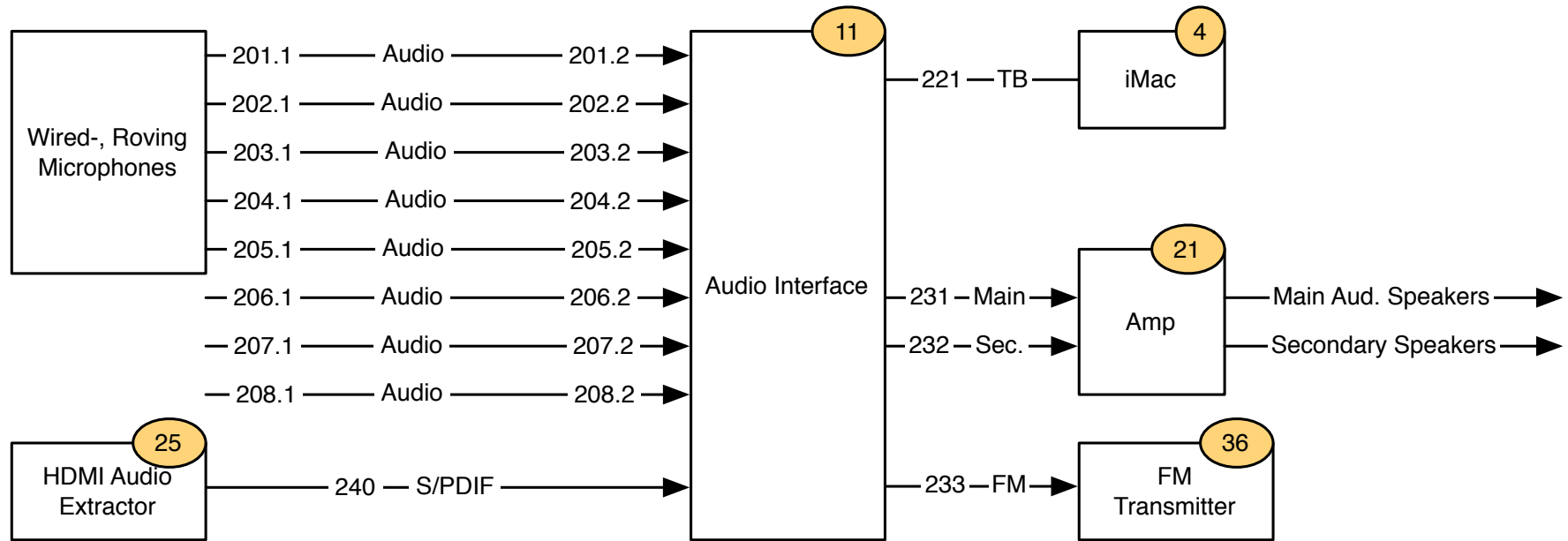
The system uses an Ethernet network to allow for fast pre-meeting media downloads, presentation control from the KHAV Player app (see Apple App Store), and integration with SL Studio KH, the KH Control System and/or other equipment controllers and devices. IP protocol controllable monitors can be turned on and properly configured by KHAudio if such protocols are publicly available (coming soon). For equipment that is controllable over serial connections, KHAudio will use the CAMX Controller to control such equipment. Any KHs that have SL Studio KH, already have such controller (or the older model that can also be used).

The network connections are also leveraged for Voice over IP (VOIP) based telephone connections to conferencing systems like KHConf or MetroConf.

All network cabling and components to be installed for 1 Gb infrastructure

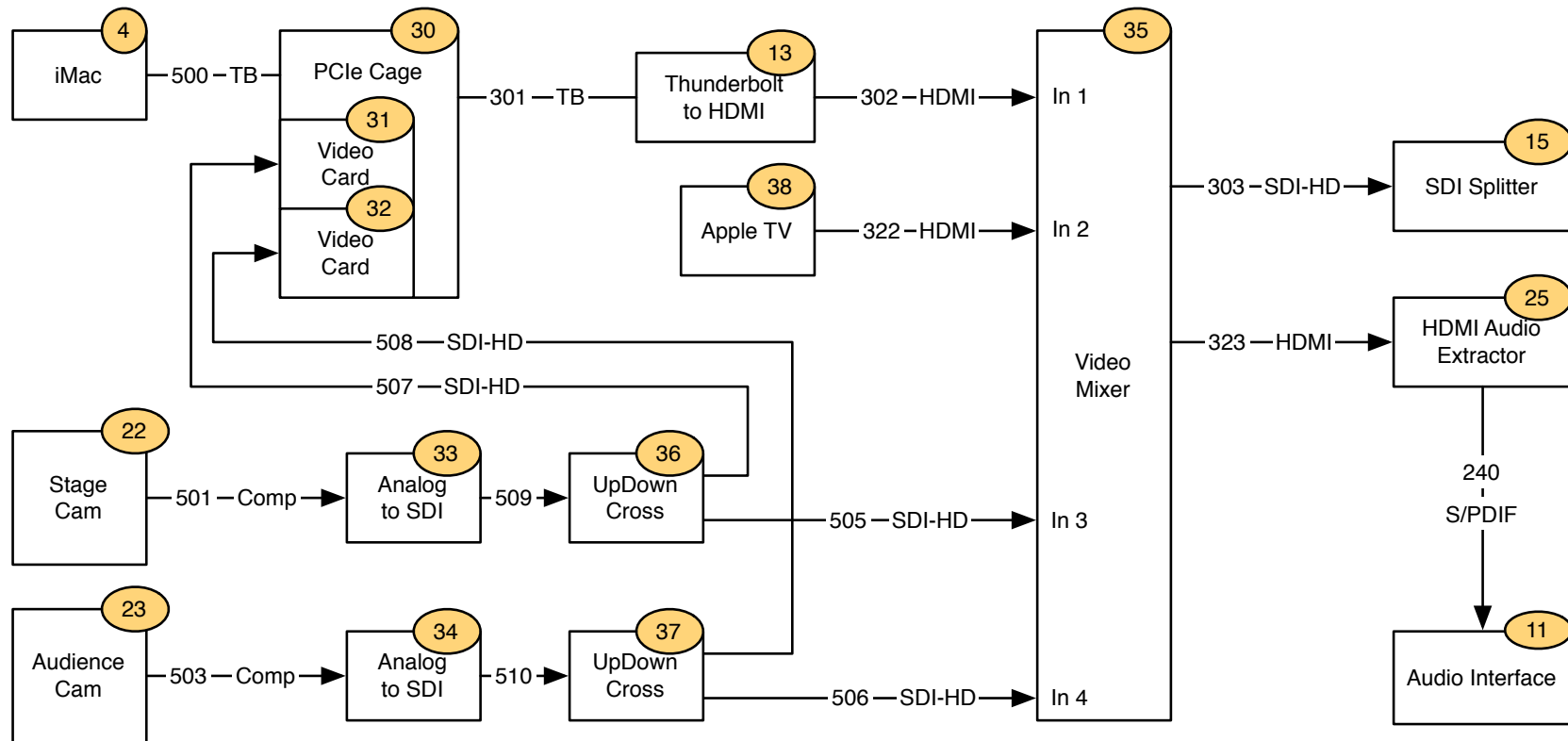


# Audio Cabling Infrastructure



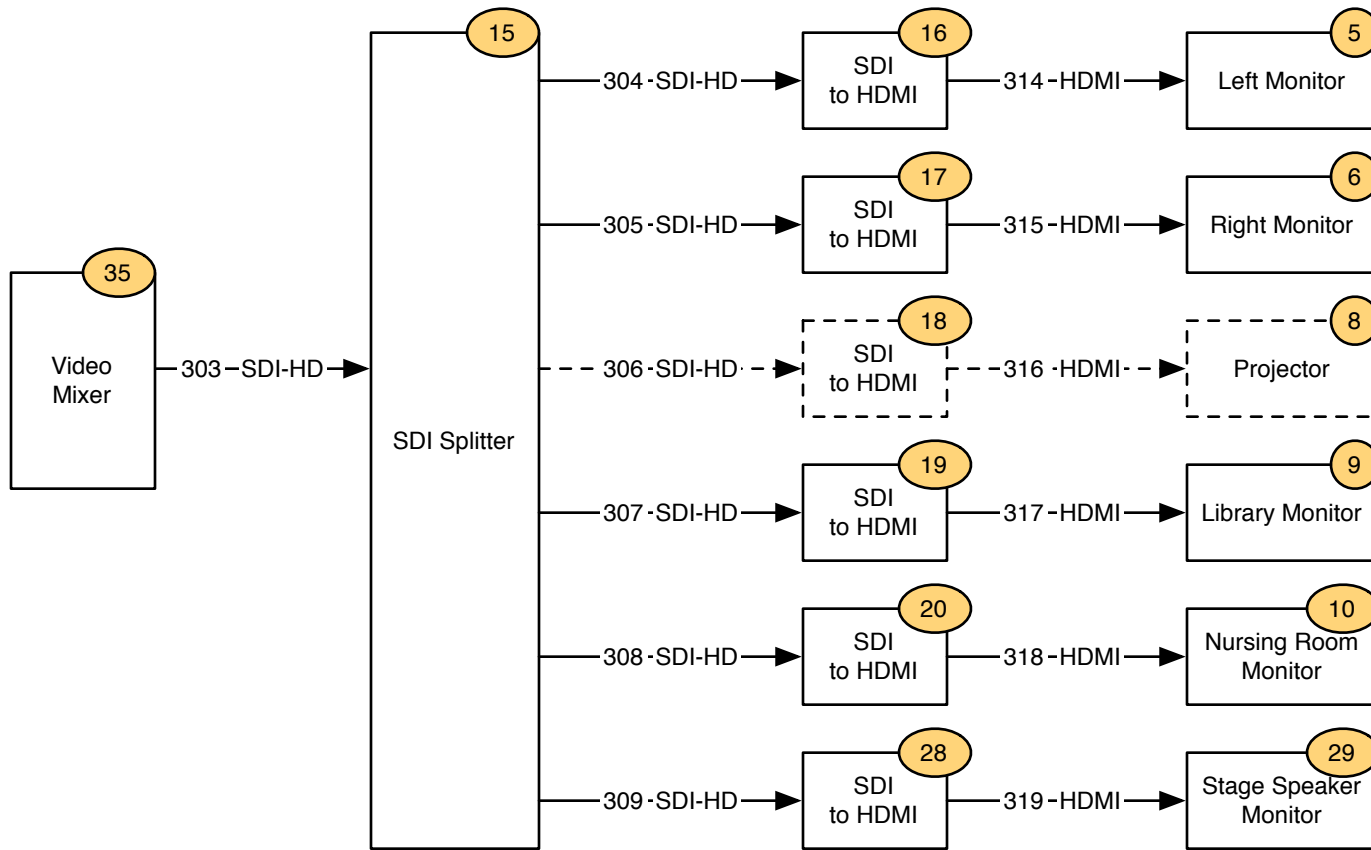
- Conferencing connections to services like KHConf and MetroConf are all established using internet connections. No need for telephone interfaces.
- Recording is handled in software. No need for recording equipment.
- Playback of songs, background music in multiple languages and external tracks is handled in software. No need for playback equipment.
- All mixing, sound processing, filtering, etc is done in software. No need for external mixers or sound processing equipment other than an interface and an amp.
- Very straightforward microphone to interface wiring and interface to amplifier and FM transmitter wiring (virtually the only analog wiring).
- Very simple configuration. Templates can be copied from KH to KH. Backup of a complete KH setup can be saved in seconds.

# Video Cabling Infrastructure



## Video System Diagram

- All presentation of video tracks, still pictures, year texts, lyrics, external audio tracks and streaming content is handled in KHAudio or SL Studio KH HD. No need for other software or equipment.
- See cabling specs in tables below.
- All HDMI cables facilitate short connections inside the A/V console (so short cables).
- All projection devices have their own SDI-HD feed reducing the possibility of a single point of failure.
- Audio embedded in video tracks will be routed from HDMI audio extractor to audio interface input typed Media.

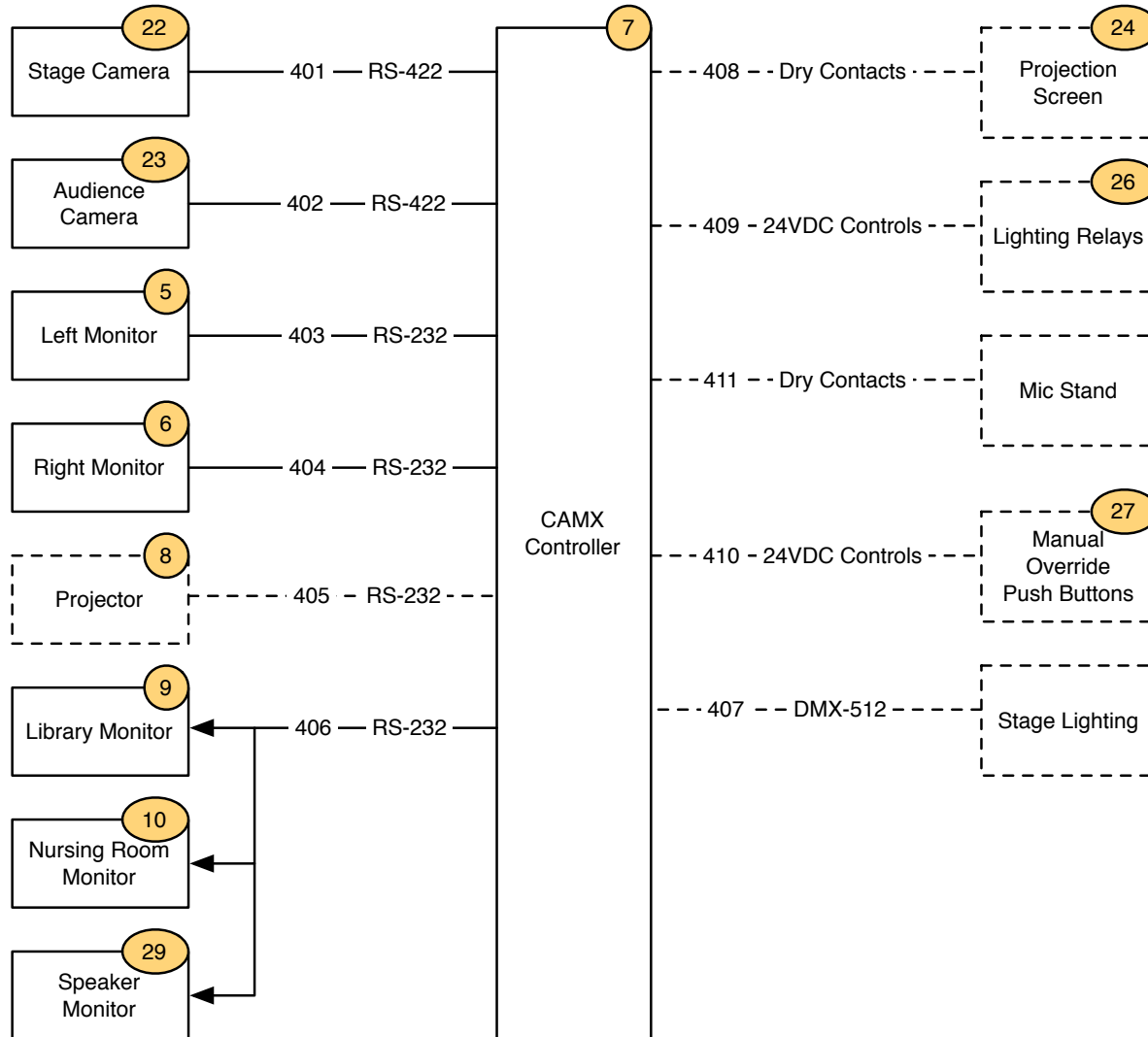


### Video Distribution Diagram

- Splitter at A/V operator console, SDI-HD cabling using spec'd cables to monitor/projector destinations. See cable routing diagrams.
- All HDMI cables facilitate connection from SDI to HDMI converter to projector and/or monitors only (they should be very short).  
Control Cabling Infrastructure



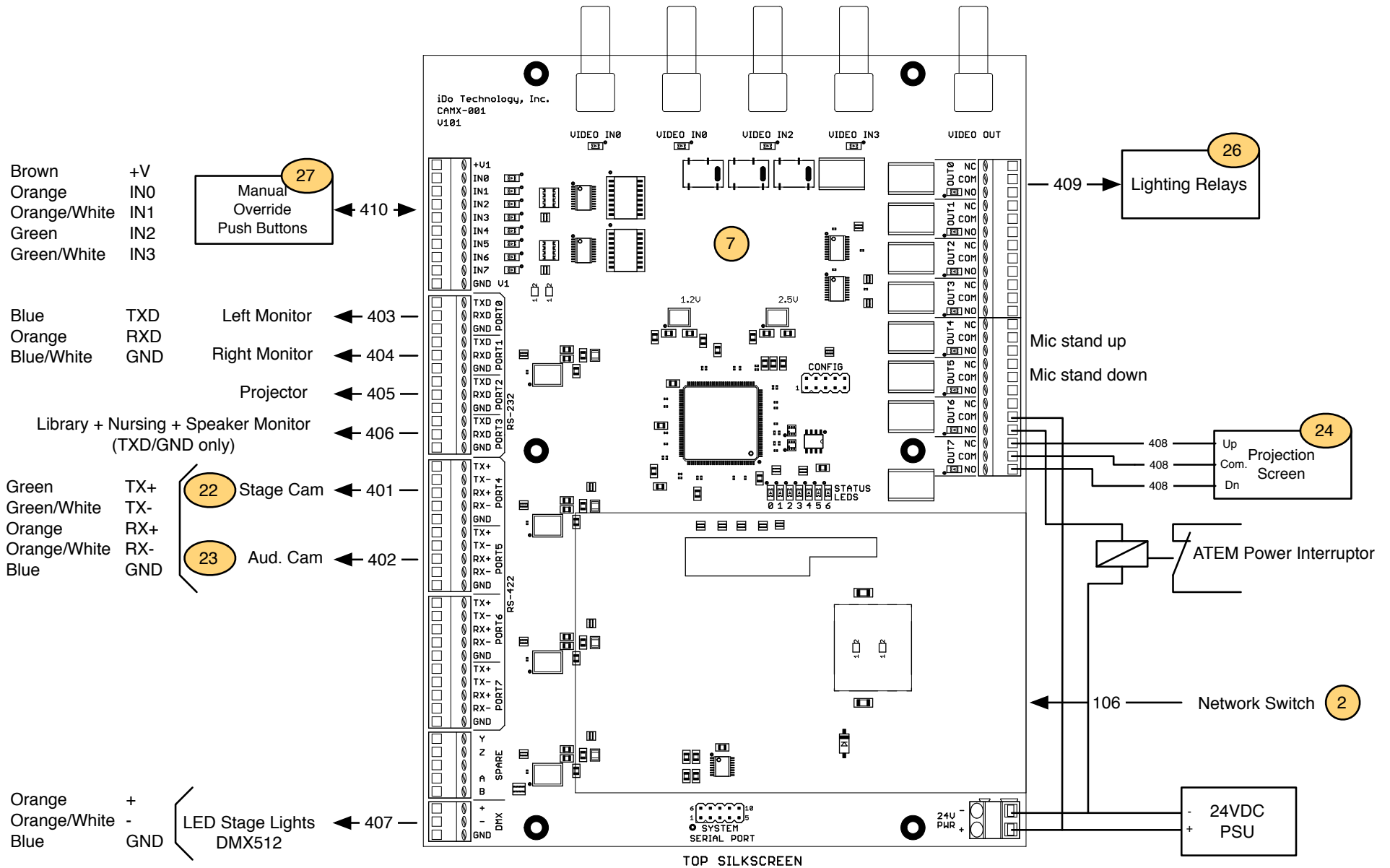
# CAMX Controller Wiring



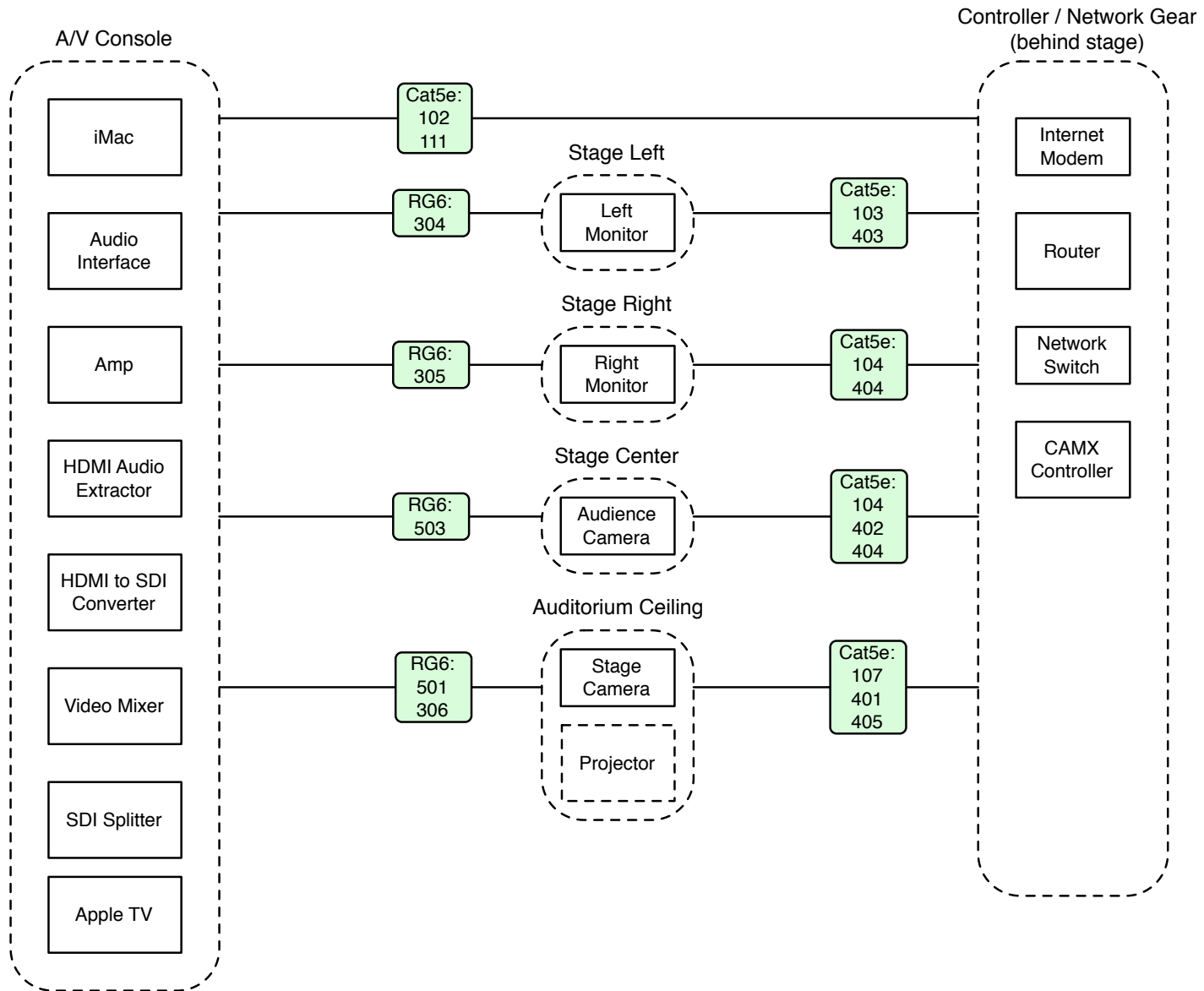
## **Control System Diagram**

- During or before the meeting all equipment can be turned on with a single click on the Equipment On button. Monitors/projector will come on with the proper video input, resolution, aspect ratio, etc selected.
- When done, a click on Equipment Off will pull up the screen, turn on the stage lights, turn monitors and projectors off.
- During the meetings, no commercials will appear as KHA/V or SL Studio will keep the monitors/projectors in blackout until actual media is presented. After a video track has ended or the speaker proceeds from a still picture, the screens will fade to black.
- When enabled the Year Text in the selected language for the meeting will appear after a configurable time when no media is being shown.
- When enabled Lyrics will show up automatically in the selected language for the meeting in sync with the song being played. As the lyrics file format is lightweight rich text document (RTF) based, it can be easily extended for any language.
- Mic stand controls with up/down controls from the main panel of KHA are supported on output 4 (up) and output 5 (down).
- Alternatively equipment and lighting can be controlled directly from push buttons behind the stage wall (optional install). This allows for extra redundancy.

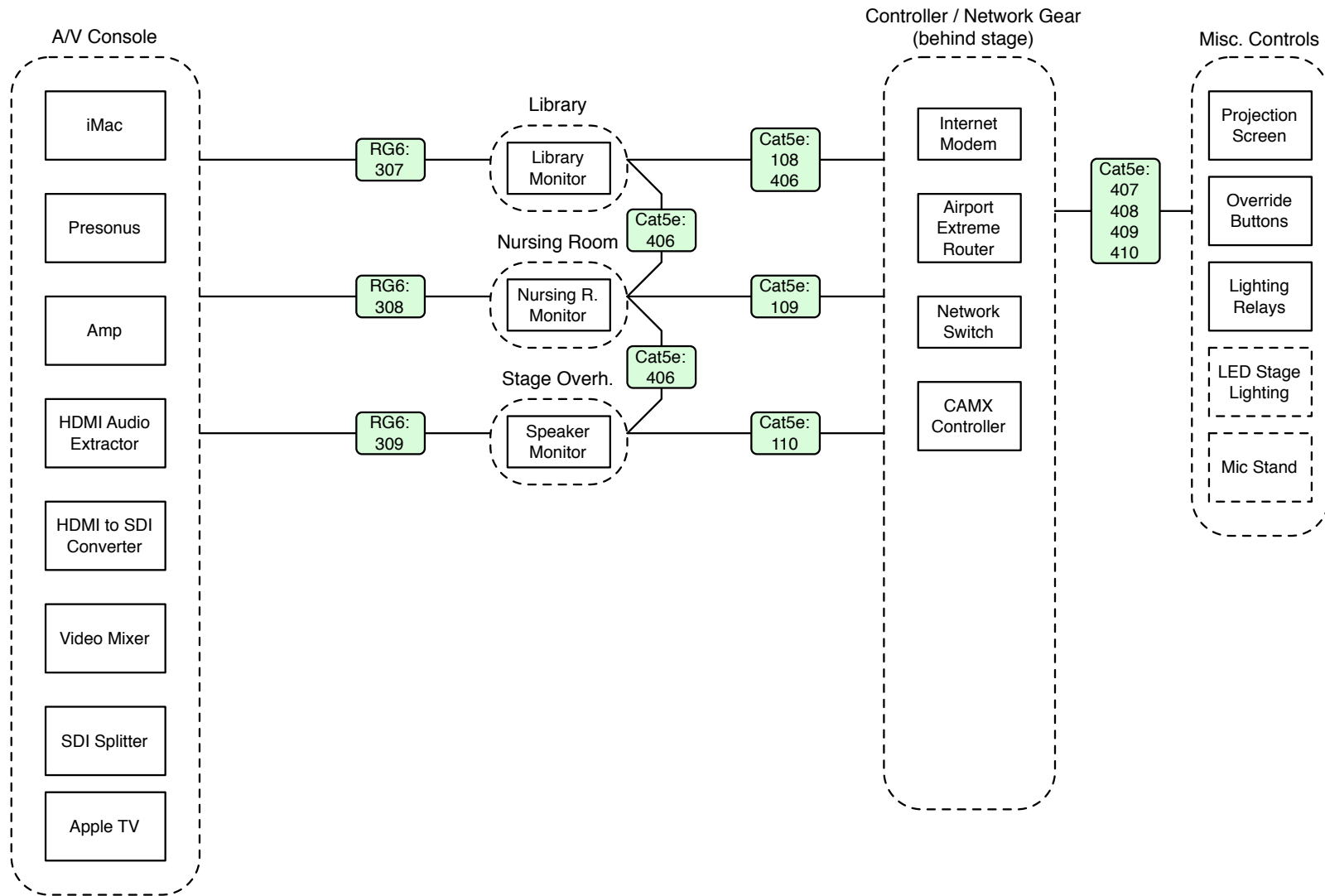
# KHAV-SL Studio KH HD using Analog Cameras - Cabling Diagrams & Specifications



# A/V System Locations & Cable Routing



KHAV-SL Studio KH HD using Analog Cameras - Cabling Diagrams & Specifications



# Components List

## AV System Components

| Item Numbers | Description   | Manufacturer  | Man. Part Nr            | Supplier       | Min. Amount |
|--------------|---|---------------|-------------------------|----------------|-------------|
|              | <b>Network components</b>   |               |                         |                |             |
| 1            | Internet modem (delivered by provider but might need to be replaced with a real modem. Don't accept routers unless configured to be modems) |               |                         |                |             |
| 2            | Router  | Synology      | RT1900AC                |                | 1           |
| 3            | 16 port 1 Gb network switch   | Netgear       |                         | Amazon         | 1           |
|              | Cat5e Cable   | Belden        | Belden 1213             |                |             |
|              | <b>OR:</b> Cat5e Cable  | Belden        | Belden 1583A            |                |             |
|              | RJ45 Connectors - RJ45 CAT-5E   |               |                         |                | 20          |
|              | <b>Audio/Video components</b>   |               |                         |                |             |
| 11           | Digital Audio Workstation Interface   | Zoom          | TAC-8                   |                | 1           |
| 21           | Amplifier   |               |                         |                |             |
| 36           | FM Transmitter  |               |                         |                |             |
| 25           | HDMI to S/PDIF (RCA Coax) Audio Extractor   | My Cable Mart | HA-HH51AU4 (or similar) | Amazon         | 1           |
| 22,23        | Stage + Audience Camera   | Sony          | EVI-D80                 |                | 2           |
| 30           | Thunderbolt PCIe Cage   | Sonnet        | ECHO-EXP-SE2            |                | 1           |
| 31,32        | Decklink Mini Recorder  | BlackMagic    | BDLKMINIREC             | B&H PhotoVideo | 2           |
| 500, 301     | Thunderbolt cable   | Apple         |                         |                | 2           |
| 13           | MiniDisplayPort to HDMI adapter   | Belkin        | F2CD021EB (or similar)  | Amazon         | 1           |
| 33,34        | Analog to SDI converter   | BlackMagic    | CONVMAAS2               | B&H PhotoVideo | 2           |
| 36,37        | UpDownCross converter   | BlackMagic    | CONVMUDC                | B&H PhotoVideo | 2           |

KHAV-SL Studio KH HD using Analog Cameras - Cabling Diagrams & Specifications

| Item Numbers  | Description  | Manufacturer    | Man. Part Nr                         | Supplier       | Min. Amount |
|---|--|-----------------|--------------------------------------|----------------|-------------|
| 35  | ATEM Television Studio   | BlackMagic      | SWATEMTVSTU                          | B&H PhotoVideo | 1           |
| 15  | SDI Splitter   | Monoprice       | 10323                                | Monoprice      | 1           |
| 16,17,18,19,<br>20,28   | SDI to HDMI converter  | Monoprice       | 10318                                | Monoprice      | 5           |
| 302, 314, 315,<br>316, 317, 318,<br>319, 322, 323,<br>505, 506                      | HDMI Cable 8 ft (shorter possible if SDI to HDMI converters planned close or behind equipment) |                 |                                      |                | 11          |
| 5,6   | LCD/LED Flatscreen Monitor (70"), preferably RS232 controllable with published protocols       |                 |                                      |                | 2           |
| 9,10  | LCD/LED Flatscreen Monitor (42"), preferably RS232 controllable with published protocols       |                 |                                      |                | 2           |
| 29  | LCD/LED Flatscreen Monitor (22"), preferably RS232 controllable with published protocols       |                 |                                      |                | 1           |
| 501,503,<br>509,510,<br>505,506,<br>507,508,<br>303,304,305,<br>306,307,308,<br>309 | RG6 Cable - Belden 1694A (non plenum) or 1695A (plenum)  | Belden          | 1694A/1695A                          | Belden         | as needed   |
|   | BNC Connectors   | Belden          | FSNS6BNCU (1694A) or FS6BNCU (1695A) |                | 30+         |
| 240   | RCA to RCA S/PDIF cable  |                 |                                      | Amazon         | 1           |
|   | <b>CAMX Controller components</b>  |                 |                                      |                |             |
| 7   | A/V Equipment Controller   | iDo Technology  | CAMX                                 | iDo Technology | 1           |
|   | Power Supply 24 V (for Cam Controller)   | Meanwell        | DR-60-24                             |                | 1           |
|   | DB9 Male (see what you need for your monitor serial connections)                               | TE Connectivity | 5-747904-5                           | DigiKey        | 6?          |

KHAV-SL Studio KH HD using Analog Cameras - Cabling Diagrams & Specifications

| Item Numbers | Description   | Manufacturer    | Man. Part Nr             | Supplier    | Min. Amount |
|--------------|---|-----------------|--------------------------|-------------|-------------|
|              | DB9 Female (see what you need for your monitor serial connections)  | TE Connectivity | A102040-ND               | DigiKey     | 6?          |
|              | DB9 connector enclosures  | AMPLIMITE       | 5749914-1 / 5749914-1-ND | Digikey     | 6?          |
|              |   |                 |                          |             |             |
|              | <b>Stage lighting components</b>  |                 |                          |             |             |
|              | LED wash light, controllable color and intensity  | Chauvet         | Slim PAR Pro VW          |             | 2           |
|              | XLR 3 pin male  |                 |                          |             | 2           |
|              | XLR 3 pin female  |                 |                          |             | 2           |
|              | 120 Ohm 1/4W Carbon Resistor  |                 |                          |             | 2           |
|              |   |                 |                          |             |             |
|              | <b>Computer components</b>  |                 |                          |             |             |
| 4            | <b>KHAudio + SL Studio KH HD:</b><br>27-inch iMac Retina 5K display,<br>3.2GHz quad-core Intel Core i5<br>16GB 1867MHz DDR3 SDRAM<br>1 TB Fusion Drive<br>Magic Mouse 2<br>Apple Keyboard <b>with Numeric Keypad</b><br>(English) | Apple           |                          | Apple Store | 1           |
| 38           | Apple TV  | Apple           |                          | Apple Store | 1           |
|              |   |                 |                          |             |             |



# Specifications Cat5e Cabling

| CableID | Type     | Signal      | .1 Device (From)       | .1 Connector | .2 Device (To)                              | .2 Connector  |
|---------|----------|-------------|------------------------|--------------|---|---------------|
| 100     | Cat5e    | 1G Ethernet | House Network Switch   | RJ45         | Airport Extreme Router                      | RJ45          |
| 101     | Cat5e    | 1G Ethernet | Airport Extreme Router | RJ45         | Network Switch                              | RJ45          |
| 102     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | iMac at A/V Console                         | RJ45          |
| 103     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Left Monitor                                | RJ45          |
| 104     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Right Monitor                               | RJ45          |
| 106     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | CAMX Controller                             | RJ45          |
| 107     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Projector                                   | RJ45          |
| 108     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Library Monitor                             | RJ45          |
| 109     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Nursing Room Monitor                        | RJ45          |
| 110     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | Speaker Monitor                             | RJ45          |
| 111     | Cat5e    | 1G Ethernet | Network Switch         | RJ45         | ATEM Television Studio                      | RJ45          |
| 112     | Cat5e    | 1G Ethernet | Network Switch         | RJ46         | Apple TV                                    | RJ46          |
| 401     | Cat5e    | RS422       | CAMX Controller        |              | Stage Camera                                | Phoenix 9 pin |
| 402     | Cat5e    | RS422       | CAMX Controller        |              | Audience Camera                             | Phoenix 9 pin |
| 403     | Cat5e    | RS232       | CAMX Controller        |              | Left Monitor                                |               |
| 404     | Cat5e    | RS232       | CAMX Controller        |              | Right Monitor                               |               |
| 405     | Cat5e    | RS232       | CAMX Controller        |              | Projector                                   |               |
| 406     | Cat5e    | RS232       | CAMX Controller        |              | Library + Nursing + Speaker (daisy chained) |               |
| 407     | Cat5e    | DMX512      | CAMX Controller        |              | First LED Stage Light                       | Male XLR      |
| 408     | Cat5e    | Controls    | CAMX Controller        |              | Projection Screen                           |               |
| 409     | Cat5e    | Controls    | CAMX Controller        |              | Lighting Relays                             |               |
| 410     | Cat5e    | Controls    | CAMX Controller        |              | Manual Override Push Buttons                |               |
| 411     | 4x18 AWG | Controls    | CAMX Controller        |              | Mic Stand Up/Down                           |               |

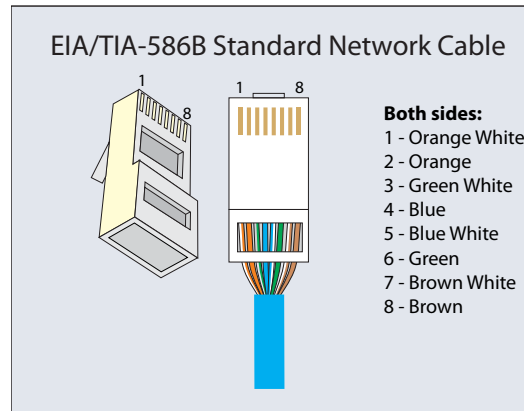
# Specifications RG6/S-Video/HDMI Cabling

| CableID | Type   | Signal    | Part Number  | Approx Length (ft) | .1 Device (From)                 | .1 Connector | .2 Device (To)                   | .2 Connector | Notes |
|---------|--------|-----------|--------------|--------------------|----------------------------------|--------------|----------------------------------|--------------|-------|
| 501     | RG6    | Composite | Belden 1694A | 3                  | Stage Cam (22)                   | BNC          | Analog to SDI Converter (33)     | BNC          |       |
| 509     | RG6    | SDI       | Belden 1694A | ??                 | Analog to SDI Converter (33)     | BNC          | UpDownCross Converter (36)       | BNC          |       |
| 505     | RG6    | SDI-HD    | Belden 1694A | 3                  | UpDownCross Converter (36)       | BNC          | Video Mixer (35)                 | BNC          |       |
| 507     | RG6    | SDI-HD    | Belden 1694A | 3                  | UpDownCross Converter (36)       | BNC          | Decklink Mini Recorder Card (31) | BNC          |       |
| 503     | RG6    | Composite | Belden 1694A | ??                 | Audience Cam (23)                | BNC          | Analog to SDI Converter (34)     | BNC          |       |
| 510     | RG6    | SDI       | Belden 1694A | 3                  | Analog to SDI Converter (34)     | BNC          | UpDownCross Converter (37)       | BNC          |       |
| 506     | RG6    | SDI-HD    | Belden 1694A | 3                  | UpDownCross Converter (37)       | BNC          | Video Mixer (35)                 | BNC          |       |
| 508     | RG6    | SDI-HD    | Belden 1694A | 3                  | UpDownCross Converter (37)       | BNC          | Decklink Mini Recorder Card (32) | BNC          |       |
| 303     | RG6    | SDI-HD    | Belden 1694A | 3                  | ATEM Television Studio (35)      | BNC          | SDI Spitter (15)                 | BNC          |       |
| 304     | RG6    | SDI-HD    | Belden 1694A | ??                 | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (16)       | BNC          |       |
| 305     | RG6    | SDI-HD    | Belden 1694A | ??                 | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (17)       | BNC          |       |
| 306     | RG6    | SDI-HD    | Belden 1694A | ??                 | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (18)       | BNC          |       |
| 307     | RG6    | SDI-HD    | Belden 1694A | ??                 | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (19)       | BNC          |       |
| 308     | RG6    | SDI-HD    | Belden 1694A | ??                 | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (20)       | BNC          |       |
| 309     | RG6    | SDI-HD    | Belden 1694A | 6                  | SDI Spitter (15)                 | BNC          | SDI to HDMI Converter (28)       | BNC          |       |
| 302     | HDMI   | HDMI      |              | 3                  | MiniDisplay to HDMI Adapter (13) | HDMI         | Video Mixer (35)                 | HDMI         |       |
| 322     | HDMI   | HDMI      |              | 3                  | Apple TV (38)                    | HDMI         | Video Mixer (35)                 | HDMI         |       |
| 323     | HDMI   | HDMI      |              | 3                  | Video Mixer (35)                 | HDMI         | HDMI Audio Extractor (25)        | HDMI         |       |
| 314     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (16)       | HDMI         | Left Monitor (5)                 | HDMI         |       |
| 315     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (17)       | HDMI         | Left Monitor (6)                 | HDMI         |       |
| 316     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (18)       | HDMI         | Projector (8)                    | HDMI         |       |
| 317     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (19)       | HDMI         | Library Monitor (9)              | HDMI         |       |
| 318     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (20)       | HDMI         | Nursing Monitor (10)             | HDMI         |       |
| 319     | HDMI   | HDMI      |              | 3                  | SDI to HDMI Converter (28)       | HDMI         | Speaker Monitor (29)             | HDMI         |       |
| 240     | S/PDIF | S/PDIF    |              | 3                  | HDMI Audio Extractor (25)        | RCA          | Audio Interface (11)             | RCA          |       |

# Cable Termination

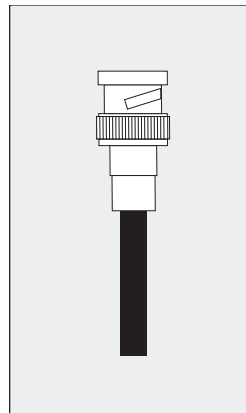
## Cat5e Cable Terminations

Each end an RJ45 connector:

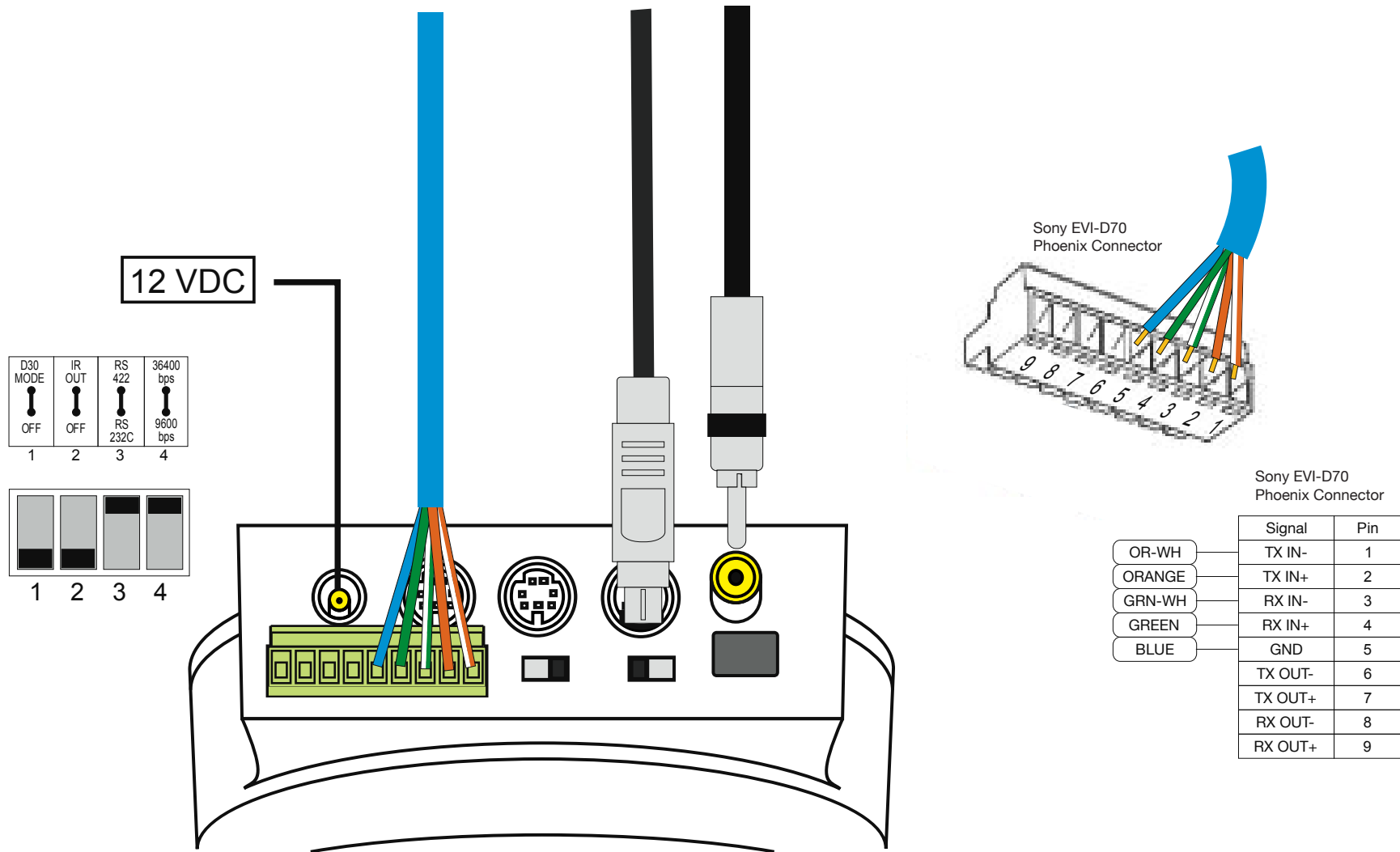


## RG6 Video Cable Terminations

Each end a BNC connector:



## Sony EVI-D80 Camera Connections



## ATEM Television Studio (35)

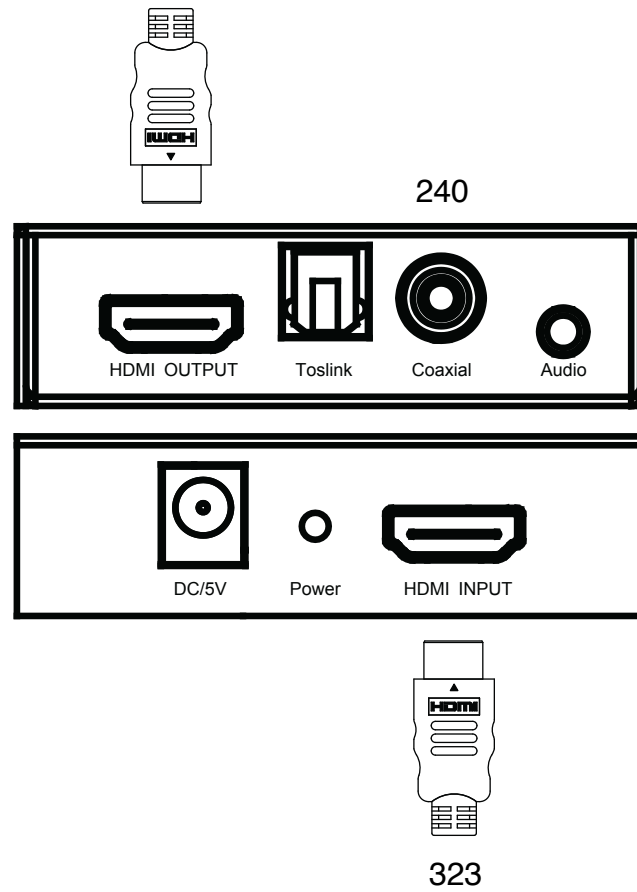


### ATEM Inputs

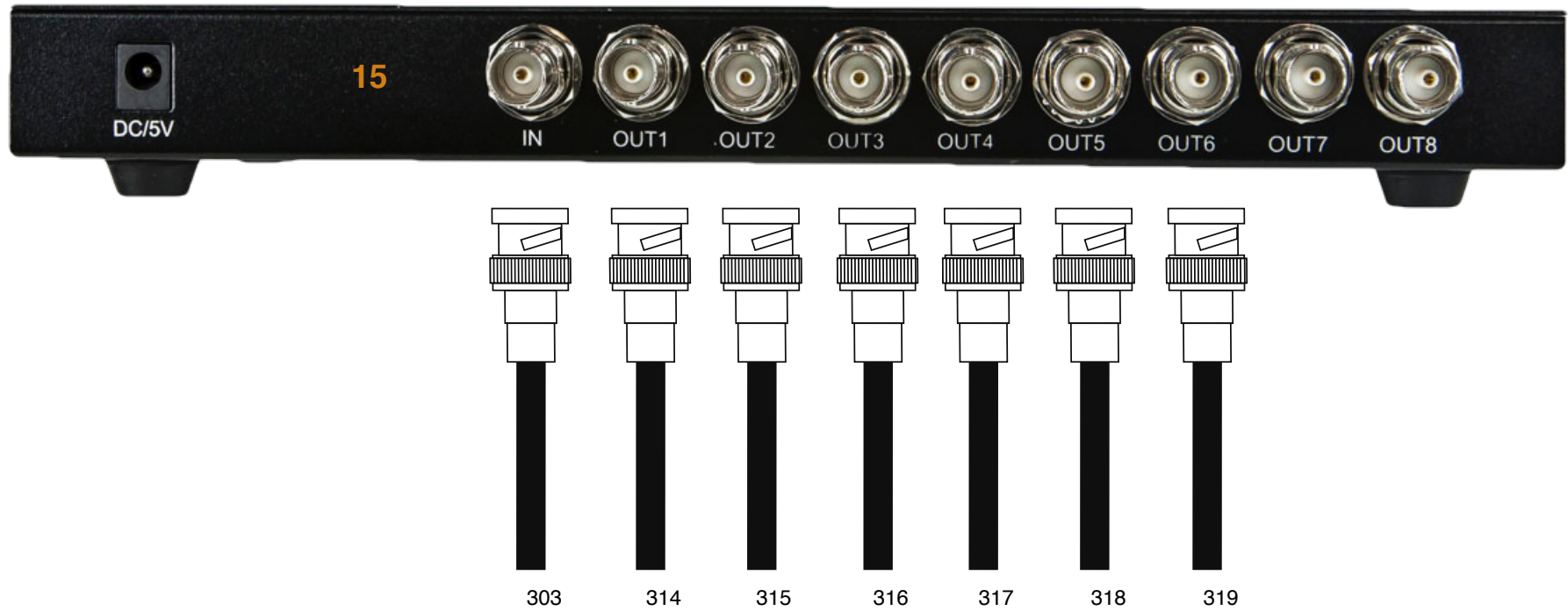
1. iMac Media HDMI feed (cable 302)
2. Apple TV / External HDMI feed (cable 322)
3. Stage Camera HDMI feed (cable 505)
4. Audience Camera HDMI feed (cable 506)

SDI-HD Program Output to be connected to SDI-HD Splitter (15) using cable 303  
HDMI Program Output to be connected to HDMI Audio Extractor (25) using cable 323

## SDI Audio Extractor (25)



## SDI Splitter Connections (15)



## Converter Settings and Connections

### Blackmagic Mini Converter: Analog to SDI





Blackmagic Mini Converter: UpDownCross

