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# Application Guide

## DCIO-H Digital Cinema I/O

Processing Multi-Channel Audio from HDMI and from Stereo Analog Sources



# THE DCIO-H CAN BOTH PROCESS HDMI DIGITAL AUDIO AND UPMIX STEREO ANALOG AUDIO.

Blu-ray/media players, satellite/cable boxes, and other AV sources typically provide multi-channel audio in a compressed digital format such as DTS-HD® or Dolby Audio™. The HDMI section of the DCIO-H Digital Cinema I/O automatically identifies the audio formats present in the content and de-compresses the data.

Some cinema sources have only analog stereo audio outputs, and the DCIO-H can handle these as well, including upmixing them to produce a full surround audio sound field.

The DCIO-H presents the channels as streaming audio data on the Q-LAN audio network within the Q-SYS Ecosystem, where it can benefit from the full power and flexibility of Q-SYS processing, control, and routing.

This application guide describes how the DCIO-H HDMI processing handles these different compressed digital audio formats and also how it can be used to upmix analog stereo audio into a full surround system. This versatility is useful for presenting alternate content from sources other than a Digital Cinema Package (DCP) in cinema auditoriums or other presentation venues with surround speaker systems.

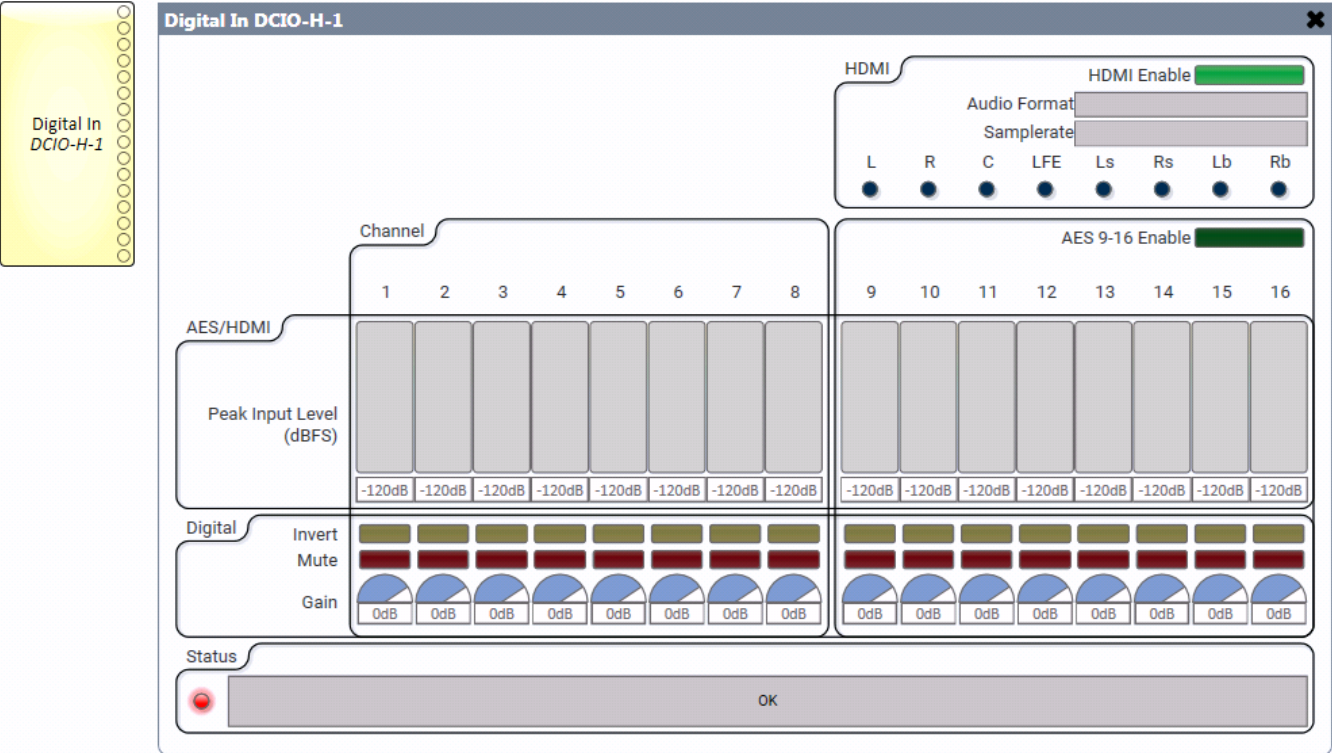


Figure 1 — When enabled, the eight available HDMI audio channels replace AES3 channels 9 through 16.

# 1. CONNECTIONS

Connect an HDMI cable from a media source—a Blu-ray disc player, media player, satellite or cable converter box, et al—to the HDMI IN port of the DCIO-H. Connect the HDMI OUT port to an HDMI input on the digital cinema projector or on a QSC NV-32-H Network Video Endpoint.

The DCIO-H can decode the most common formats of compressed multi-channel digital audio: DTS-HD® (common in Blu-ray and many other media players) and Dolby Audio™ (common in satellite and cable TV transmission), which includes Dolby Digital Plus™ and Dolby® Surround 7.1. See Table 1 for a complete list of supported formats as well as those that are passed through.

Table 1 — Supported formats	
Format	Decoding support
Dolby Digital 5.1 AC-3	Yes
Dolby Digital Plus™	Yes
Dolby Surround 7.1	Yes
DTS® 5.1	Yes
DTS-HD	Yes
DTS-HD MA	Yes
DTS:X	Pass-thru only
Dolby Atmos®	Pass-thru only

# 2. SETUP IN Q-SYS DESIGNER SOFTWARE

To use the HDMI input of the DCIO-H you must enable it in the Q-SYS design. The HDMI Enable button is in the control box of the Digital In block of the DCIO-H (Figure 1).

Enabling the HDMI input replaces AES3 channels 9 through 16 with the eight channels available in the HDMI, which are assigned in the order shown in Table 2. Outputs 1 through 8 always contain AES3 channels 1 through 8.

The HDMI / AES9–16 selection button can be set up on a User Control Interface (UCI) for use on a touchscreen panel. See Section 4 for tips.

Table 2 — HDMI channel assignment	
DCIO-H Digital In	HDMI Channel
9	Left
10	Right
11	Center
12	LFE (Subwoofer)
13	Left surround
14	Right surround
15	Left back
16	Right back

# 3. AUDIO UPMIXING

The digital audio conveyed via HDMI will accommodate up to a 7.1 surround system. The number of channels required may vary among installations, and similarly, some program material may support only a subset of these channels.

Table 3 — Upmix options in DCIO-H			
Format of input audio	Upmix Control Selection		
	None	5.1	7.1
Stereo	Stereo	5.0	7.0
Lt/Rt (Surround-encoded stereo)	5.0 / 7.0	5.0 / 7.0	5.0 / 7.0
5.1	5.1	5.1	7.1
7.1	7.1	7.1	7.1

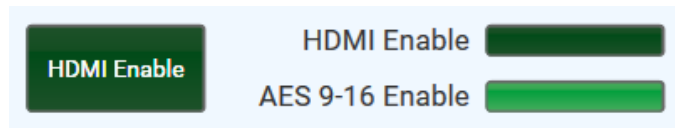
In Q-SYS release 8.4 and later, any HDMI stereo audio content can be upmixed to synthesize a center channel as well as side and rear surround channels. The amount of upmixing is selectable in the HDMI settings (Table 3).

## 4. CREATING A UCI FOR HDMI SELECTION

Selecting the HDMI inputs or the AES3 inputs is an ideal function to put on the UCI of a touchscreen panel that can be installed in a projection booth, control room, etc.

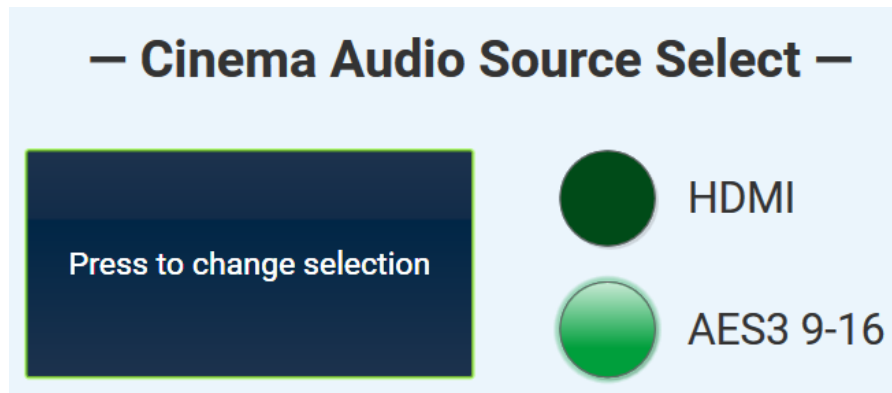
First, open the **Digital In** control box of the DCIO-H, as in Figure 1. Copy the **HDMI Enable** and **AES 9–16 Enable** buttons to the design page. Make another copy of the **HDMI Enable** button and make sure its **Push Action** is set to **Toggle** (Figure 2).

For the two buttons **HDMI Enable** and **AES 9–16 Enable**, change their **Presentation** to **LED**. Copy all of them into the UCI.



**Figure 2 — The copied HDMI Enable and AES 9–16 Enable buttons plus an additional copy of the HDMI Enable button.**

Customize the UCI as desired by resizing and arranging the controls as desired and modifying their properties as needed. Add any suitable text. You can even add graphics to the UCI if you wish, including a background. Figure 3 shows a basic idea of the UCI for a TSC-7w touchscreen. Touch the Press to change selection button to switch between the HDMI and AES3 inputs. The LEDs indicate which set of inputs are currently enabled.



**Figure 3 — Buttons copied into UCI, reshaped and with added text.**

## 5. CREATING SURROUND AUDIO CHANNELS FROM A STEREO SOURCE

Some AV content might have only two channels of audio with no center screen channel. Stereo sound that uses only the left and right front loudspeakers may sound hollow and inadequate in a cinema or other large auditorium that has a multi-channel surround audio playback system. A common technique to create audio for a phantom center channel is to mix the left and right channels into a mono signal and feed it into the center channel. The stereo channels can also be used to synthesize side surround channels.

You can do this automatically in your Q-SYS design (Figure 4). The Active Matrix Surround Decoder is an audio component in the cinema library of Q-SYS Designer Software (to enable the cinema library, right-click on the **Q-SYS Designer Software** shortcut and append **/cinema** to the **Target**). It will convert stereo audio into a multi-channel sound field by creating an artificial center channel and a surround channel. Adding a stereo crossover and summing the low-frequency outputs lets you create an LFE channel. Used together, these components will greatly improve the audio quality in a cinema auditorium when the source has only stereo audio.

In this example, the stereo audio channels are from an analog source. The high-frequency outputs of the stereo crossover feed the Active Matrix Surround Decoder, which produces the center channel with filtered audio content that is common to the left and right channels. The left and right channel outputs are the left and right channels with the center channel content removed. The surround channel output feeds the Surround Mixer, which creates the left and right surround channels in a 5.1 audio field but can also be configured to produce the left, right, left back, and right back surround channels in a 7.1 audio field.

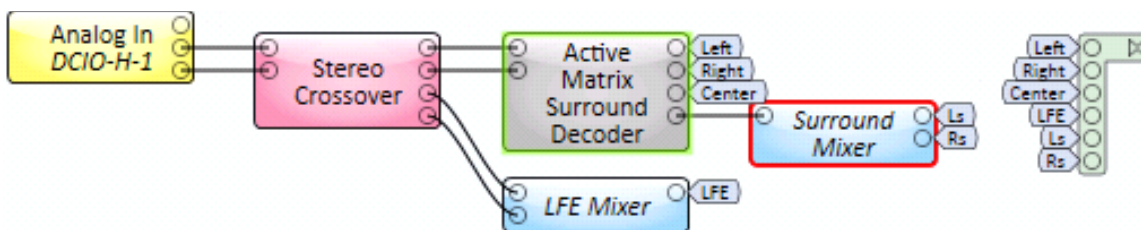


Figure 4 — Using a Q-SYS Active Matrix Surround Decoder.



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(800) 854-4079 or +1 (714) 957-7100  
Outside the U.S. +1 (714) 754-6175  
Fax: +1 (714) 754-6174

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QSC, LLC  
1675 MacArthur Boulevard  
Costa Mesa, CA 92626 USA