

HDMI repeaters with audio extract/insert - Product Summary -

MDS, known for its innovative audio and video products, has created a line of off the shelf products that can meet the requirements for sophisticated HDMI interfaces for modern consumer electronics applications.

MDS' range of HDMI repeater products removes the need for audio system developers to become experts with the complications (and expense) of designing in HDMI/HDCP.

MDS' HSR-5 and HSR-8-3D offers 4 or 8 channels of HDMI input, or with an optional daughter card, 12 channels of input on the HSR-8-3D. Dual outputs are supported on the HSR-8-3D. MDS' HSR-5 and HSR-7 support HDMI 1.4 3D video formats as well as OSD (On Screen Display). The HSR-8-3D supports HDMI 1.4 3D video formats and provides an upgrade path from the HSR-8 product; the HSR-5 similarly offers an upgrade for HSR-4 customers.

CEC support ensures compatibility with a growing range of consumer products, and the newest products offer optional support for ARC (Audio Return Channel) defined in the HDMI 1.4 specification.

With MDS modules manufacturers can have solutions ready for markets with minimal development. Manufacturers can focus on the user experience and "front panel" and "rear panel" design and avoid the headaches of the high speed design and the complex software for HDMI processing.

Product Details

The following table summarizes the HDMI repeater products available from MDS. Also available is MDS' VPROC-3D, which provides both HDMI and analog video switching, processing, and supports complex OSD creation using Sigma Design's broadcast quality VXP processor. Please see the MDS website for more information on the VPROC-3D.

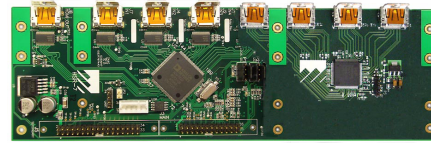
All inputs feature adaptive cable EQ that supports (typical, for good quality source and cable) 20m at the highest supported data rate.

Model	Inputs	Outputs	3D	OSD	Audio Loop	DSD	ARC	CEC
HSR-8-3D	8/12	2	Yes	No	Yes	Opt.	Opt.	Opt.
HSR-5	4	1	Yes	Yes	Yes	No	Opt.	Opt.
HSR-7	7	1	Yes	Yes	Yes	No	Opt.	Opt.

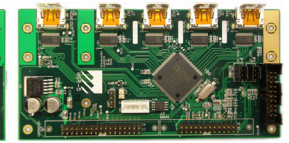
Notes: ARC requires CEC. Models with 12 inputs require optional HIB-4.



HSR-8-3D



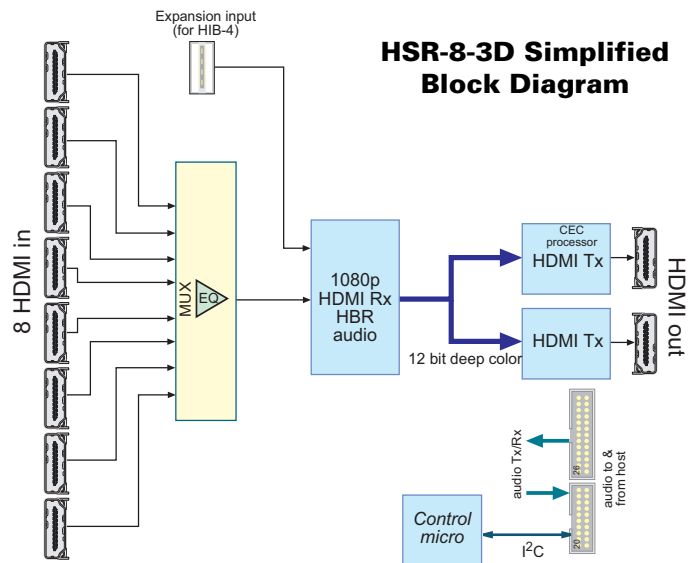
HSR-7



HSR-5

The HDMI inputs and outputs support the mandatory video features found in the HDMI 1.4 specification, and the Deep Color (12 bits) at up to 1080p resolution. Color Gamut Meta-data is supported to allow the use of xvYCC color spaces (HDMI 1.4 x.v.Color).

All use high quality Tyco HDMI connectors to ensure reliable connector operation over the life of the product.



Audio extract/insert

All MDS HDMI repeater products extract the audio (as four I²S lines along with a SPDIF line) for local processing. The audio decoder can then provide a downmixed stereo PCM signal for the HDMI transmitter. Except for the HSR-4, HDMI audio input can be looped directly through to the output, if desired.

The HSR-5, 7, and 8-3D support ARC (Audio Return Channel) as defined in HDMI 1.4; use of this also requires use of the (optional) CEC features.

Other products

MDS' HDMI experts are available to help create custom products as well as work with your own engineering team to support your own product development.

MDS also offer large HDMI matrix cross-bars such as our HXBAR-88, 8 in, 8 out any to any switcher/repeater.

HDMI switcher/repeater modules

Introduction to HDMI capabilities

HDMI signals (1080p 12 bit deep color) can have data rates up to 2.25 GBit/sec and require special high speed design techniques for PCB layout. Certification requires meeting timing tolerances measured in 10's of picoseconds, versus typical digital audio (I2S) where margin is measured in nanoseconds.

The design of HDCP (the encryption scheme that prevents using the encoded data) prevents a product from just extracting audio; the HDMI signal with audio and video must be received, decoded, decrypted, the audio extracted, and then at the transmitter device re-encrypted, encoded, and transmitted. This type of device is defined as a HDCP *repeater* or just repeater for short.

In comparison an HDMI switch functions somewhat like a mechanical source selector in the days of analog signals - except with HDMI active components are needed to switch the multi-GHz bandwidth signals without degrading them. An HDMI switch does not need to decrypt/encrypt the data.

A device with two or more outputs must also be a HDCP *repeater*. A simple splitter/buffer like was done with analog signals will not work as the HDCP encryption scheme only supports point to point connections. This means the repeater device must not only decrypt the input and then reencrypt each output, it must also execute complicated HDCP protocols to authorize everything that is connected to the repeater outputs.

1080p 12 bit 4:4:4 support

With the advent of Deep Color in the HDMI 1.3 specification, determining exact capability is tricky. All MDS HSR series can handle resolutions up to 1080p with 12 bit Deep Color, i.e. 4:4:4 sampling vs. the 4:2:2 mode of pre HDMI 1.3 specifications. As source content from digital TV and DVD/Blu Ray are limited to 8 bit, the 12 bit capability ensures future compatibility with new devices/technologies yet to be invented.

Cable EQ

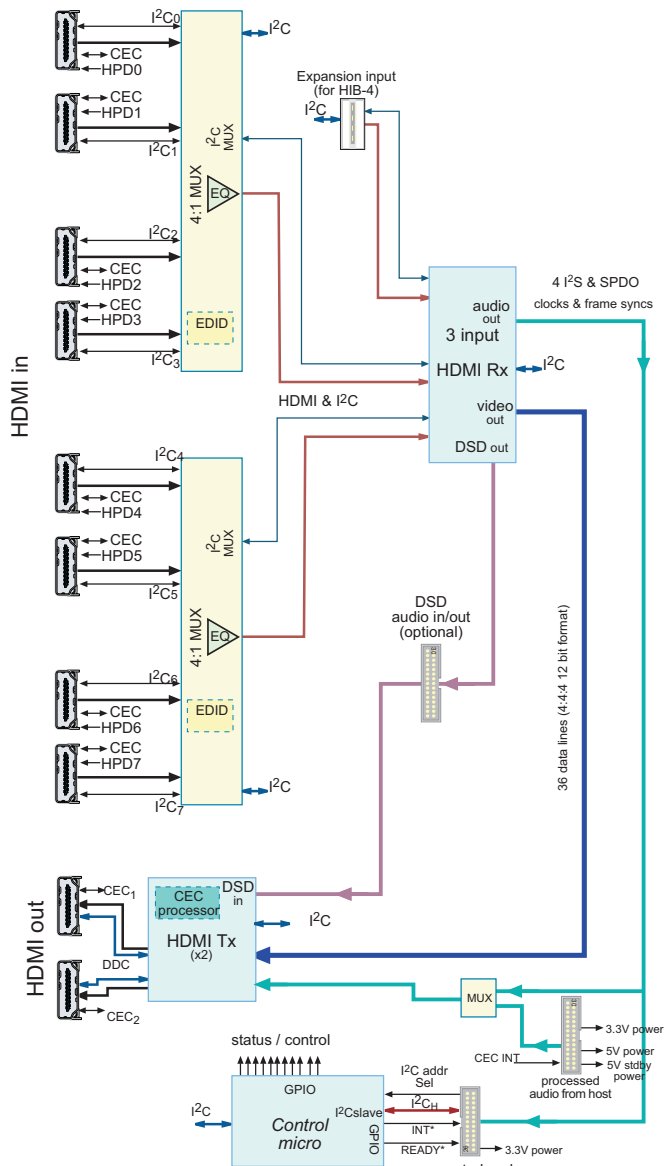
All HDMI inputs on the module include automatic cable equalization to support up to (typically) 20 meters of input cable with 1080p sources. Full ESD protection is implemented on all HDMI connectors. While the boards can be operated on a total automatic setting, host controlled overrides can be enabled to help rectify problematic situations.

CEC handling

The modules provide support for Consumer Electronics Control (CEC) as defined in the HDMI specifications. A dedicated microprocessor on the card manages (the bit banging for) receiving and sending CEC messages. The CEC Switch and Amplifier logical units are supported but full implementation of these logical units is dependent on the user's system host processor to make decisions on CEC action requests. A high level interface is provided to make it convenient for the user to implement this support.

If implemented, CEC must remain operational when the device is in standby (for similar reasons IR remotes must still work to turn the unit on, though CEC does quite a bit more when "off"), therefore use of CEC requires power to be supplied at all times. When commanded by the host the modules can enter a low power state (HDMI shut off).

When in standby and the module decodes a CEC message that needs host intervention it will activate the interrupt line. Assuming the host is asleep it must then wake up to determine what the next action will be; it may actually be quite common that the host will take no action and just go back to sleep.



HSR-8-3D Detailed Block Diagram

HDMI switcher/repeater modules

Option for DSD support

Some SACD players provide HDMI output in DSD format and while it's considered a legacy format, it is possible to support. The HSR-8/-3D can be used to extract DSD audio (or pass it from input to output). This requires ordering a special version as DSD signals are implemented differently than I2S lines so a separate connector is used.

Flexible output control

An HDMI device with 2 outputs may not function well in the real world if it simply assumed the two connected HDMI sink devices support the same capability. For example, an HDMI source might need to route to an audio system and a projector. The projector might only support stereo PCM audio.

If the repeater blindly took the lowest common format among the connected sink devices, the audio system would always be fed 2 channel PCM data by the source instead of surround sound (compressed) data.

The HSR-8-3D, with its dual outputs, can be told to assign input audio formats from different sink device capabilities to determine what the HDMI source should send (as determined when the source device reads the EDID).

OSD

The HSR-5 and HSR-7 can overlay a basic "ASCII text" OSD on 2D video. MDS provides two factory default high level OSD functions, one to display arbitrary text near the top of the screen (typically for showing input source) and the other for a volume control type bar indicator.

More complex OSDs with icons and menus can be created by directly using the features of the ADV7623, either via the standard I2C interface and the on board SPI EEPROM or dynamically through the optional higher speed SPI connection. MDS offers consulting services to assist with creation of custom host created OSDs.

Four input, single output repeaters

MDS offers a four input, one output switcher/repeater modules, the HSR-5.

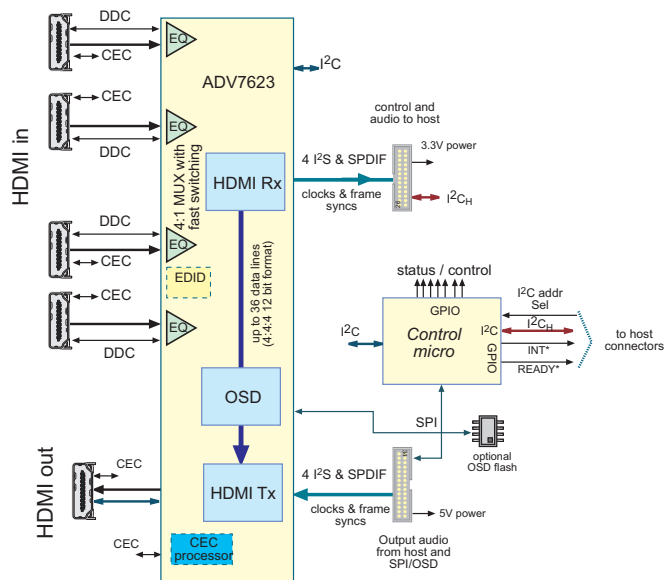
The HSR-5 can loop audio from input to output. However for AV Receiver applications the general mode of operation is that the decoder would be fed the (Dolby/DTS) encoded input and supply a stereo (PCM) downmix for the sink device.

Mechanically the HSR-5 can mount into the same set of holes as the HSR-8-3D, simplifying chassis designs when two different configurations may be desired.

The HSR-5 supports pass through of the mandatory 3D formats defined in the HDMI 1.4a specification. The ARC feature is supported but requires a full CEC implementation of the Audio System logical device as defined in the HDMI 1.4a specification.

The HSR-5 can create a simple OSD (On Screen Display) using the capabilities of the Analog Devices ADV7623.

Note also that the ADV7623 provides a fast switching implementation that can help reduce the latency associated with HDCP authentication when switching input sources.



HSR-5 Block Diagram

Seven input, single output repeater

The HSR-7 is based on the HSR-5 design, adding a four input HDMI multiplexer to the basic design to provide a total of 7 inputs. The same features described for the HSR-5 apply to the HSR-7.

One difference from the HSR-5 is that the faster switching speeds (reduced HDCP latency) are not available on the 4 inputs connected to the multiplexer. However as newer sources are faster at authenticating the difference in inputs may go unnoticed by most consumers. Alternately the consumer can be directed to use the 3 inputs connected to the ADV7623 for the most common sources. Lastly, the fast switching feature can be disabled, making all input appear equal.

Eight input, dual output repeater

Many AV applications require sending video to one location and audio to another; alternately the need may be to send video to two different locations, for example a main screen in the home theater and a second TV in the kitchen area. The HSR-8-3D provides dual outputs to remove the need for an external HDMI splitter/repeater.

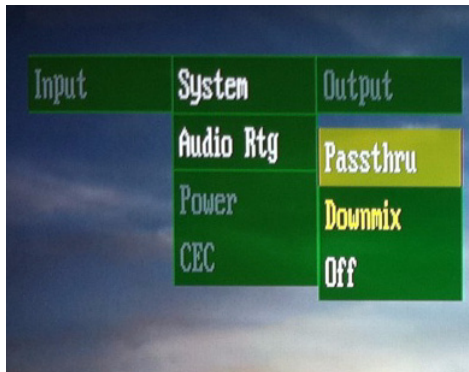
HDMI switcher/repeater modules

The HSR-8-3D has the same capabilities as the older HSR-8 and adds support for the mandatory HDMI 1.4a 3D video formats as well as supporting the ARC feature (full CEC required). Note that CEC and ARC are only supported on the primary output, the CEC specification does not support multi-output repeaters.

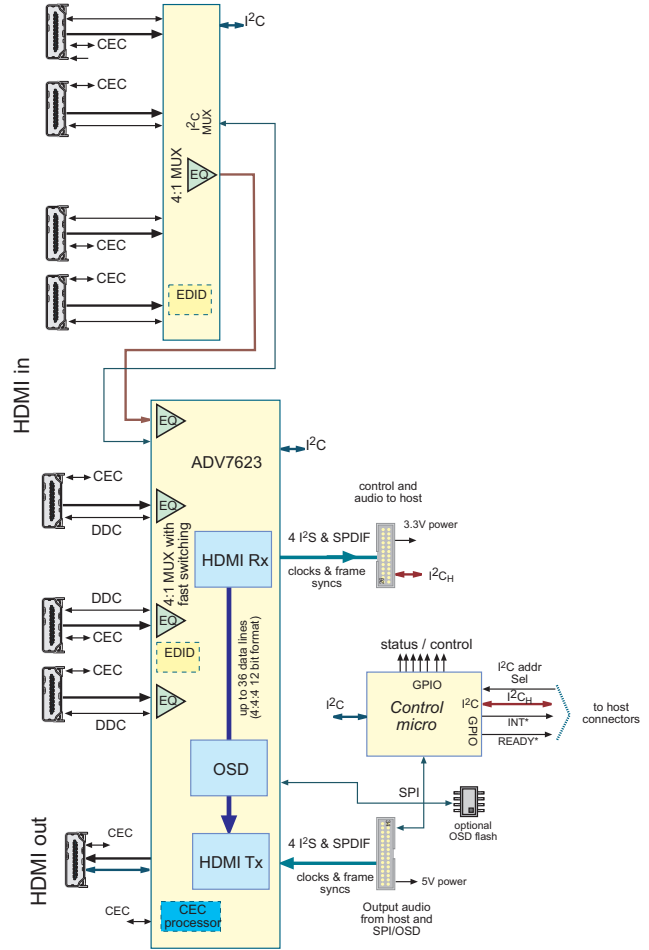
Since the HSR-8-3D has audio loop through capability they can be used as a standalone HDMI switcher repeater. Only a power supply and a small microprocessor for a front panel and/or external control interface are needed to make a complete system.

HIB-4 (expander for HSR-8 & HSR-8-3D)

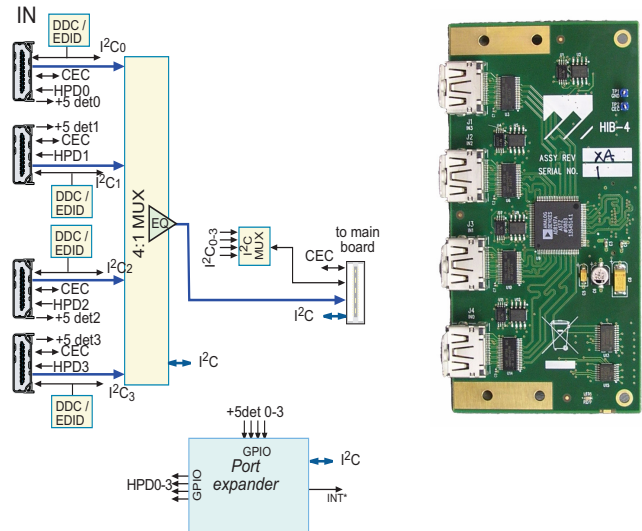
This optional module provides 4 additional HDMI input connections for the HSR-8. The HSR-8 & HSR-8-3D must be ordered with the HIB-4 as the expansion connector is normally not included.



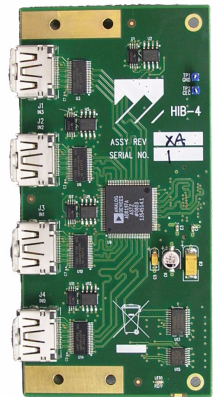
OSD Example



HSR-7 module



HIB-4 expansion module for use with HSR-8 and HSR-8-3D to provide 12 inputs total



HDMI switcher/repeater modules

Developing with MDS HDMI modules

MDS offers an evaluation kit that provide everything needed to evaluate the modules and start code development on your host processor.

The kit include the module (mounted to a base), interconnect cables, power supply, a (generic) host side API library, and a Windows based demonstration program to simplify experimentation.

Users integrating with MDS Digital Audio product should purchase the appropriate development platform as it includes more comprehensive system level examples.

Host connectors

A 26 pin IDC (.1") connector carries primary 3.3V power, the I²C control signals, and the audio signals received by the card.

Note that the audio data may be invalid due to the source creating bad data or things like cable disconnects. Users of the audio data should check status to mute during recognized invalid data periods and be prepared to handle audio clock discontinuities.

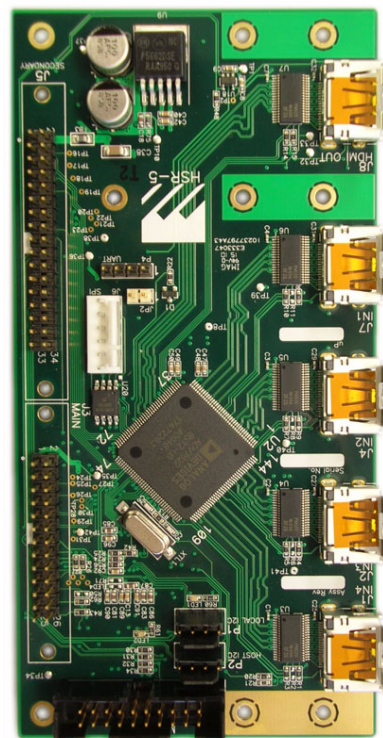
A 30 pin (HSR-8-3D) or 34 pin (HSR-5/7) IDC connector is used to provide access to the audio output signals and power. For the HSR-5 and 7 the larger 34 pin connector adds SPI lines for optional direct control/loading of the OSD interface.

Depending on the needs of the application all OSD loading can be done over the I²C interface so that the host does not need to interface with the HSR-5/7's SPI port.

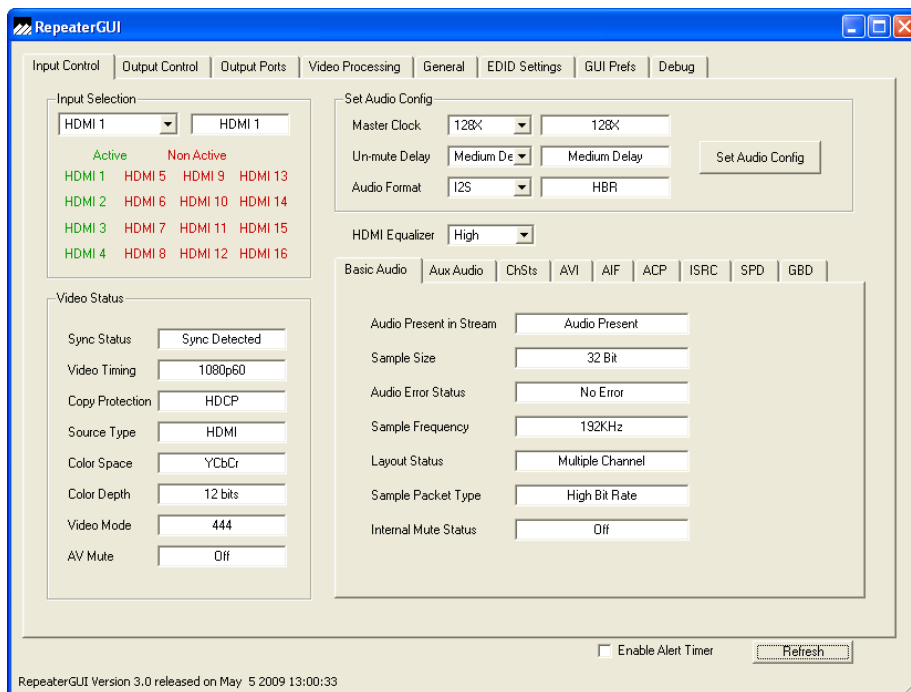
The 34 pin connector of the HSR-5/7 is backwards compatible with the 30 pin connector of the HSR-4, providing a reasonably straightforward upgrade path for HSR-4 users.

MDS Alpha messaging control protocol

All products uses the same I²C based messaging protocol used on other MDS OEM products. Users of those products will find the HDMI modules easy to control; users new to the MDS alpha messaging protocol can start with supplied C++ based examples that can be recompiled to run on typical embedded 32 bit microcontrollers.



HSR-5 HDMI switcher/repeater



**Windows Repeater GUI software included
with evaluation kit**

HDMI switcher/repeater modules

Evaluation kit

To gain experience with integrating MDS HDMI products into your system design, MDS offers an evaluation kit that includes the selected HDMI repeater board and the adapter board shown in the figure below.

(Customers of MDS DAE AV Receiver modules can purchase the ADP system instead as it offers a fully integrated platform for AV Receiver development.)

Using this board and the provided Windows software the HSR can be controlled and configured without the need to have your own host application code running yet.

Pass through connectors allow connecting to your audio subsystem but still use the MDS provided GUI software for control and status monitoring. Alternately the EVM board can be setup for loopback of received HDMI audio to the output.

An audio DAC is connected to the primary I2S input line to allow playback of 2 channel stereo PCM without need to connect external devices. Likewise a SPDIF in and out allows for easy experimentation before connecting into a more complex system.

Board integration

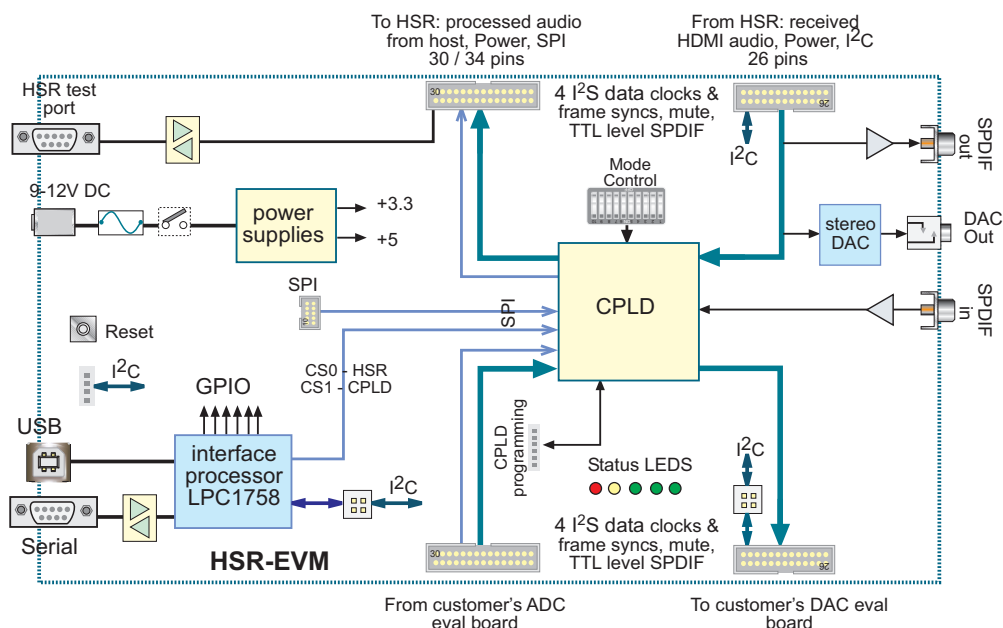
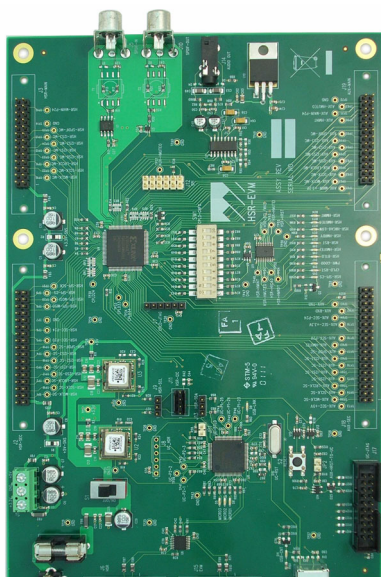
The boards require 3.3 and 5V power, if CEC is used these supplies must be provided when the system is in standby (depending on the model, standby mode power draw is less than 350 mW).

In addition to the I2S related signals, connection to I2C clock/data, and the (board to host) interrupt line are needed. The board's reset input should only be released once the supplies are stable and the host is ready to start interacting with the board. For full details the relevant hardware manual should be consulted.

MDS HDMI testing of a final unit

MDS must be supplied with a final unit to run a range of mandatory HDMI tests to ensure conformance with the HDMI licensing rules. Customers with their own HDMI license can do their own family product self certifications.

Two levels of testing are possible, a basic test for cases where CEC is not being used, and a combined basic plus CEC test for units that will use CEC (use of ARC requires CEC). Typical test periods run from 1 to 3 days, unless problems are found, which is unlikely in the basic tests but possible in the CEC test as the host software must process and respond to a range of possible CEC messages.



Eval kit adapter board

HDMI switcher/repeater modules

Ordering information

Minimum order quantity of standard OEM boards is 50 pieces. HSR-8-3D with the optional DSD support and/or optional input expansion (HIB-4) have a 100 piece minimum order.

HSR-8-3D: 8 input, dual output HDMI switcher/repeater.

- HDMI 1.4a mandatory 3D formats
- Up to 1080p 60 Hz pixel rates
- Up to 12 bit Deep Color
- Color Gamut Metadata (xvYCC color space) supported
- Audio extraction/injection (I2S standard) and loop through
- Order with -DSD for optional DSD support, 100 piece minimum
- Optional CEC switch and Audio System device support
- Optional ARC (requires CEC support)

HIB-4: 4 input expansion module for HSR-8-3D

- Provides 4 HDMI inputs for 12 total
- Must be ordered with HSR-8-3D, not field upgradeable

HSR-5: 4 input HDMI switcher/repeater.

- HDMI 1.4a mandatory 3D formats
- HDMI 1.4a mandatory 3D formats
- Up to 1080p 60 Hz pixel rates
- Up to 12 bit Deep Color input
- Color Gamut Metadata (xvYCC color space) supported
- Audio extraction/injection (I2S standard) and loop through
- Fast switching (HDCP authentication) on all inputs
- Optional CEC switch and Audio System device support
- Optional ARC
- Textual OSD capability

HSR-7: 7 input HDMI switcher/repeater.

- Same feature set as HSR-5 except with 7 inputs, fast switching on 3 inputs only (can be disabled to make all inputs act the same)

Note that the actual allowed input format is determined by the sink device(s) connected to the unit, the above descriptions define the maximum available capability.

Trademarks:

Dolby is trademark of Dolby Laboratories, Inc.

DTS is a trademark of Digital Theater Systems, Inc.

HDMI, the HDMI logo and High-Definition Multimedia Interface are trademarks or registered trademarks of HDMI Licensing LLC.

HDCP is a trademark of Digital Content Protection, LLC.

x.v.Color is a trademark of Sony

DAE and DAE-6D are trademarks of MDS.

Related products

#-EVM-KIT: Add this suffix to the above for the developer/eval kit

- Selected board
- IDC cables
- Eval adapter board with USB port to I²C feature to allow control from a PC (new firmware version to be released 2Q 2011 for this)
- PC control program (new version to be released 2Q 2011)
- Control API documentation
- Example code
- Connector, power, and mechanical information
- Power supply (110/220 universal input brick)

HTEST-BASIC: HDMI product family self certification test

HTEST-CEC: For HDMI product using CEC (or ARC), verification of proper CEC handling

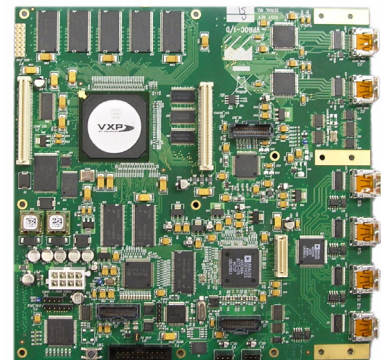
System developers may also want to consider platforms based on MDS' DAE modules.

ADP:

- Complete audio development system for MDS DAE-6D surround sound decoder module
- Supported formats include PCM, Dolby Digital, DTS, Dolby Plus, Dolby HD, DTS HD/Master Audio

Licensing

These products use licensed technologies and are only available for sale to authorized audio / video companies. Please contact MDS for more information.



VPROC-3D video processor module

For applications needing a complete video system with support for analog video, deinterlacing, scaling, and On Screen Display (OSD) please see the VPROC-3D datasheet.