HDMI information notes

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This document is intended to help you from the early stage of your project with everything related to using HDMI with Trinnov's Altitude[16] and Altitude[32] processors.

We noticed that a lot of issues related to HDMI were in fact due to various misunderstandings of how things work. We hope this document will clarify the process.

For advanced and effective support, please help us by filling out this troubleshooting form.

Summary

Things to know

What is EDID?

EDID is the acronym of "Extended Display Identification Data". Basically, it a set of information sent by one device to another to announce what its video and audio capabilities are. For example, if a 4k-capable source receives the EDID from an HD TV, it will know that it can not handle 4k and will downgrade the signal to HD to ensure the content is displayed correctly on screen.

It is important to understand that EDID information always moves upstream, basically from display to source. In a standard Altitude setup with source -> Altitude -> display, the display will first send its EDID to the Altitude, the Altitude will combine this EDID with its own and send the result to the source. In this way, the source should be able to generate a stream compatible with the announced (by EDID) capabilities.

An EDID that is not properly built or refreshed by the source can easily lead to both video and audio errors.

What is HDCP?

HDCP is the acronym for High-Bandwidth Digital Content Protection. It is digital protection system intended to prevent copying of protected content. Since its introduction, the process has evolved and is now in version 2.2, usually found in UHD Blu Ray disc for instance and in most streaming device able to do 4k. (Note that HDCP is not mandatory to display a 4K image; it is the choice of the content maker to use it or not.)

HDCP is based on a key exchange. If the devices have problems communicating (because the cable is not of good quality for instance), then you can experience video noise (snow) on the screen, or a black screen, or an image that is displayed alternatively with black screen (as a result of the Source and the Display trying to set HDCP again and again).

If your display does not support HDCP, or only an older version of HDCP to the one required by the content, then you can have either a black screen or a degraded version of the content, typically a SD video for HD content and a HD video for UHD content.

HDMI 1.4 and HDMI 2.0 board differences

Note that all Altitude[32] and Altitude[16] can receive HDMI board upgrades.
- Altitude[32] #1 to #112 were delivered with the HDMI 1.4 HSR82 board
- Altitude[32] #113 to #593 were delivered with the HDMI 1.4 / HSR82P
- Altitude[32] #594 and above were delivered with the HDMI 2.0 / HSR72Q board
- Altitude[16] have all been delivered with the HDMI 2.0 / HSR72Q board

HDMI 1.4 boards

The HDMI 1.4 board exists in 2 revisions:
- The first one, HSR82, is HDCP 1.4 compatible
- The second one, HSR82P, is HDCP 2.2 compatible (but <u>only</u> when using input 1 and output 2)

Both boards have 8 inputs and 2 outputs and can do 4k resolution at 60Hz in 4:2:0 video mode (speed is limited to 300MHz, so 10Gbps is the maximum bandwidth available). But HSR82 won't be able to display it if it is content protected by HDCP 2.2, so typically you may not be able to display content at 4k resolution played from a UHD Bluray that require HDCP 2.2 compatibility (image will be downgraded to HD).

The HSR82P board is compatible with HDCP 2.2 encryption (on Input 1 and Output 2), so it can display 4k content from a UHD disc. However, it is not compatible with the HDR metadata (usually, the image will be toned mapped to standard dynamic range by the source).

Note that some of our competitors branded the HSR82P as being an HDMI 2.0 board, something we refused to do as it is *not* able to do HDR and 600MHz speed, the two major features of HDMI 2.0.

HDMI 2.0 board

The HDMI 2.0 board (HSR72Q) brings HDR compatibility and up to 600MHz bandwidth speed (18Gbps) and has 7 inputs and 2 outputs, configured as follows:
- Inputs are all compatible with HDCP 2.2 and HDMI 2.0.
- However, by default, inputs 1 to 3 are declared as HDMI 1.4. This software-based limitation is intended to help with some older sources that do not correctly recognize HDMI 2.0 hardware, and to improve reliability with hardware that does not support high speed bandwidth (over 300MHz). Despite this limitation, these inputs can still support HDCP 2.2 content and HDR signals and any other feature of the other inputs. Said otherwise, as long as you are using a signal that is under the 300MHz/10 Gbps limit they are identical to other inputs.
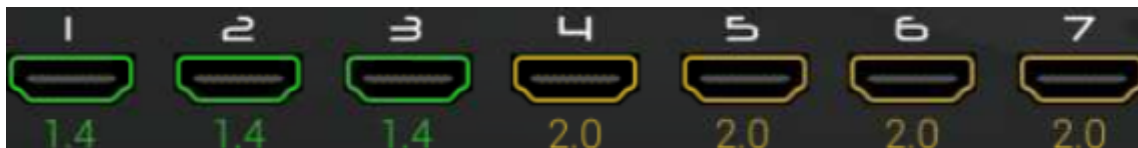
Default HDMI input configuration on HSR72Q

Please note that this limitation is software only, and a future software release will allow to set any input or output to be set as HDMI 1.4 or HDMI 2.0.

Also, inputs 5 to 7 pass through only one HDMI chipset instead of two (in the case of inputs 1 to 4). In some cases, we have seen that some associated equipment seems to work more reliably with the slightly-reduced timing issues that result from using only one chipset. (Some gear have tiny time windows in which they respond to EDID changes.)

- Output 2 is HDCP 2.2 and HDMI 2.0 with 18Gbps (600MHz) capability, output 1 is HDMI 1.4 and HDCP 1.4 only. This is a hardware limitation that cannot be removed. See the next paragraph for more information on what to expect

Video mode/features supported

The HSR72Q supports:
- HDR10 (SMPTE 2084)
- Dolby Vision (this implementation has not been tested by Dolby and they or we do not provide support for it. But it seems to work just fine.)
- HLG
- HDR10+ is not supported, it is not known yet if it's technically doable.

ARC is not supported, its feasibility is being studied.

All major resolutions, bit depths, color spaces and chroma samplings are supported as long as the combination fits into the 18Gbps limit.

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HSR72Q: Using both outputs simultaneously

As Output 2 is HDCP 2.2 and output 1 is HDCP 1.4, there will obviously be some limitations when both are used simultaneously. Here are some details on how this works.

EDID reconstruction

When two displays are used, an EDID is built to better match both outputs capability so, basically, if a feature is available to both displays it is added to the combined EDID.

However, in order to maintain as many of the capabilities of the display on output 2 as possible, the "High Value" features like 4K, HDR, BT2020 or 3D are added to the combined EDID *even if the display on output port 1 does not support them*. Depending of the source and content you may have various results.

With HDCP at HDMI 1.4 speed

When a content speed-compatible with HDMI 1.4 is played, the source is notified that a HDCP 1.4 device is in use, so it will be up to the source to decide to send a signal compatible with it or not. If yes, then both devices will display an image, if not only the device on output 2 will work and output 1 will be blank. It is important to notice that **this is source dependent** and thus not easily predictable.

One possible scenario for example:
1. Display on outport 2 is 4k/HDR compatible but not the one on output 1.
2. The source will be notified that 4k/HDR is possible (as 4k/HDR is a "high value" prioritized feature, see EDID reconstruction above) and that a HDCP 1.4 device is in use.
3. The source can then either choose to send the 4k/HDR content, and then output 1 will be blank, or downgrade the signal to make it compatible with both outputs.

With HDCP at HDMI 2.0 speed

When the speed of the content is not compatible with HDMI 1.4 speed (over 10Gbps), output 1 is removed from the handshake with the source and will deliver a blank image. The same thing happens if HDCP 2.2 is sent by the source (even if the display does support HDCP 2.2, as this is a hardware limitation of the output 1 port).

With some sources, if content temporarily switches to HDCP 1.4, then the player can decide when content is back to HDCP2.2 to then downgrade it to HDCP 1.4.

So, being able to see full quality picture or picture on both outputs depends not only on the source's own preference settings but also in which order the content is played. For example: some disc menus are HDMI 1.4 while the content is HDMI 2.0. The source component alone decides how to respond to these changes.

Recommendations

We think it is best to avoid using both HDMI outputs if you intend to use output 2 to its maximum capacity and without enduring (almost) randomly blank images on output 1.

Nethertheless if you still wish to use both outputs turn off (preferably electrically) the display on output 1 (and/or remove the hdmi cable) when it is not in use to have the best quality on output 2.

If two full-time HDCP 2.2/HDMI2.0 display outputs are a requirement you will have to rely on an external hdmi switcher.

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Version HDMI recquise sur un appareil en fonction du type de vidéos UHD/4K en 2D

Vidéos 2D	8 bits	10 bits	12 bits
UHD/4K@24p	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4
UHD/4K@25p	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4
UHD/4K@30p	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4
UHD/4K@50p	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4
UHD/4K@60p	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4	4:2:0 4:2:2 4:4:4

Prise HDMI 1,4 recquise (10 Gbits)
Prise HDMI 2,0 full requis (18 Gbits)
Prise HDMI 2,1 requise (> 18Gbits)

Table extract from http://www.hdfever.fr/forum/viewtopic.php?f=9&t=6304

What bandwidth do I really need ?

Video on UHD discs (and on streaming services) is recorded mostly on 4k resolution, 10-bit color depth and in 4:2:0 chroma sampling.

These parameters fit into the 10Gbps allowed by the default configuration of all inputs for the HSR72Q board, as shown above.

HDR metadata are light and have virtually no impact on bandwidth. To pass the high majority of content actually available on discs, you don't need to go over 4:2:0, even for 60 frames per second content!

Lower bandwidth proves to be more reliable than higher bandwidth, whatever the issue is. So you have to really think about the benefits of setting your source to output more color and use more bandwidth and ask yourself this question: is the internal chroma upsampling of my source really better than the one into my projector? Remember: the content is almost always natively 4:2:0; whether it is upsampled in the player or the display depends only on which might do the better job of upsampling. Typically, there is more money in the display. You do the math.

The other important thing we can see in this table: 4:4:4 is only possible at 60Hz in 8-bits color; going to 10 or 12 bits in 4:4:4 with a 50/60Hz is not possible with HDMI 2.0's 18 Gbps limit, so don't try to force it.

Recommendation: don't use chroma upsampling or increase of color bit depth (10 ->12 bits) just for the sake of a "bigger number." Be sure the improvement with your source/display is real because you may be trading reliability for a pseudo improvement.

The importance of cables

With HDMI 2.0 and content in excess of 10Gbps, the cable quality is of major importance. It impacts not only video (glitches like flickering and drops) but also the HDCP handshake.

We estimate that around 80% of the HDMI issues are, in fact, related to cables.

Cable length is also important, as we have often observed that in the same brand the shorter cable may be compliant when the longer is not, and it's a common practice to use active cables when the length is over 9 meters (about 30 feet). It is also better to avoid passive extenders, as they have proved to be unreliable.

Surprisingly, cables under a meter are not recommended, they have been reported as overloading inputs on some devices.

The price of the cable does not correlate with performance and shouldn't be the only thing to look at when choosing one.

In theory the HDMI 2.0 logo on the box should be enough but it's not bulletproof.

The best thing to be sure is first to test them with an HDMI analyzer (Astro 1844A, Murideo Fox & Hound or Six-G/Six-A, Quantum 780D and potentially others). If the cable fails to pass *any* item of the cable test then it must not be used for 18Gbps signal.

The second test is a field test with hardware you know well. Not every source or display has the same sensitivity to cable quality, so check with as many combinations as possible. Don't forget to use a video mode that pushes the bandwidth to the maximum (for instance 4:4:4 8-bits 60Hz or 4:2:2 12-bits 60Hz).

Obviously, there is absolutely no guarantee that a perfectly fine working cable for 10Gbps bandwidth signal will be able to transmit 18Gbps correctly.

Active cables are of various varieties (copper, optical, both, powered by the HDMI port or by an external supply, etc.). Unlike passive cables, active cables' maximum capabilities are dependant of the chip used to convert (for example) the electric signal to optical signal. Thus, it is *impossible* for a 10Gbps optical/fibre cable to transmit 18Gbps signals. Be sure to check the limit before buying the cable; manufacturers may have different ranges with one or the other type.

Also, according to our HDMI board manufacturer, it's better to avoid cables that mix optic fiber and copper as usually the copper transmits auxiliary signals, among them HDCP which is very sensitive.

It is also good practice to plug-unplug-replug connectors several times, it usually helps to have better connection quality.

Finally: Don't test your cable on site the day of the installation, be sure to leave office with a working set! We have seen sets of cable from the same brand work perfectly fine and then, the next batch of the same cable does not meet the 18Gbps standard anymore!

Power consumption of active cables

HDMI specified that a maximum of 50mA can be drawn from an HDMI output. This 50mA can be used to power (for instance) an active cable. Any cable demanding more than 50mA is out of specification and should not be used (or is then expected to come with an external power supply).

All our HDMI boards are able to handle 200mA on each HDMI output, which is over specification and should provide some headroom, but it has been reported than some cables are consuming way more than that. Again, they should not be used.

You have two ways of checking the cable consumption is (potentially) an issue:

- Most HDMI analyzers are able to display the cable consumption.
- In the HDMI interface of the Altitude the "Over Current" field in the Video tab is set to true if the cable is drawing more than what the board is able to provide.

List of working cables

Please note that we don't endorse any brand of HDMI cables. The purpose of this list is only to share the cables that we know have been successfully used in the field:

Cables from 2m to 3m: (Do not use 1m or shorter cables, as they can overload many HDMI inputs.)
- Tributaries UHDP
- Monoprice Certified Premium High Speed HDMI Cable, 4K @ 60Hz, HDR, 18Gbps, 28AWG, YUV 4:4:4, 6 or 10 feet

Longer cables (Typically to projectors):
- RUIPRO HDMI Fiber Cable 4K60HZ HDR Light Speed HDMI2.0b Cable, Supports 18.2Gbps, ARC, HDR10, HDCP2.2, 4:4:4, Ultra Slim and Flexible HDMI Optic Cable with Optic Technology
- Monoprice SlimRun AV HDR High Speed Cable for HDMI-Enabled Devices - 4K @ 60Hz, HDR, 18Gbps, Fiber Optic, AOC, YUV 4:4:4
- Chromis fiberoptics GigaPOF Salus 4K Series

Best Practice

Powering-on devices in the correct order

As the EDID is going upstream (see the What is EDID chapter) it is important to power on the display first and then power-up units continuously from device to device until the source is reached, and that should be the last.

Note that the Altitude boots with a default EDID that does not have every audio format descriptor declared; it is only used while the software is loading. It is better to turn on the source only when the GUI interface (on the front panel or in VNC) is available.

We have observed that some sources are very bad at refreshing their EDID, among them Windows PC and XBox consoles. So if you start them before Altitude's full EDID is ready, they will catch the default EDID of the board and not catch the EDID change with all the audio data it comes with.

Get the right tools

HDMI analyzers are hugely important to debug delicate issues. Most of them also have calibration screens and test signals, among them the cable test, that could be useful with any projector.

Here is a list of analyzers that we know work well:
- Astro 1844A
- Murideo Fox & Hound
- Murideo Six-G/Six-A
- Quantum 780D

Use the right inputs/outputs

- No 18 Gbps signal ? Verify you are not using inputs 1 to 3.
- Using inputs 4 to 7 but getting a blank screen? Verify that you are using output 2.
- You have some instabilities on input 1 to 4? Please use inputs 5 to 7 that only go through one HDMI chipset and are more stable.
- You have trouble with a source willing to send 18Gbps when your display is not stable with it? Use inputs 1 to 3. Or force your source to something less bandwidth-consuming (4:2:0…)
- Don't use if possible output 1 or 1 & 2 simultaneously if you want consistent results.

Know your hardware

Some projectors, even when handling 4k and HDR, do not support more than 10Gbps or 13.5Gbps (for example, some Sony projectors). So don't expect them to accept a 18Gbps signal on their inputs.

Isolate the issue

If your HDMI chain is not working, it's important to proceed methodically when trying to find the origin of the issue.

First rule and most important rule would be: only change one element at a time! If you change two you won't be able to determine which one is indeed provoking the issue.

This applies as much as for hardware than software: before doing any hardware change, think about how their software is configured, for instance: is the video setting handled by the projector?

Once everything is checked, remember to use the correct set of inputs/outputs on the Altitude to match your video settings.

If you are swapping devices, again change only one at a time: does it work with another source? If yes, have you tried to use source having an issue on the same input ? With the same video settings ? etc.

Also use your past experience: if you have already used a similar working setup try to identify what could be the differences between them and change that element. It could be a cable model for instance, in that case try if possible the setup with the same cable used in the previously known working configuration.

If you know working configurations, please contribute to our database by filling out this form.

Issues frequently met

1. **Bizarre color-space misbehavior:** the screen goes all magenta and cyan due to YCbCr being decoded as though it was RGB. This is more likely to happen on a video mode change, from HDR or Dolby vision to SDR for example, when the display does not get the new color space used (he thinks still being in BT2020 when YCbCR709 is sent). Forcing another video change should solve the issue
2. **Digital Snow:** Due to a problem in HDCP between sources, Altitude and display. To limit the frequency of this issue you have to limit the speed of the connection (going for 4:2:0, for 8-bits, etc.) and/or set your source to avoid video mode changes or set it to a fixed video mode.
3. **Thin green line:**. Observed on some Sony's projectors. Not reproduced during our tests.
4. **Bitstream being "decoded" as though it was PCM**. Full-Scale digital noise. This happened when booting up to an active source. To avoid the issue boot your source after the Altitude.

Interoperability Notes

Kaleidescape Strato

The secondary output only sends PCM or Dolby Digital content

Solution: correctly setup the secondary output to get bitstream audio on it. The Kaleidescape can only output a bitstream on one output and, by default, the primary output is selected.

From the user manual:
About Lossless Audio Strato supports advanced, lossless audio formats including Dolby TrueHD, DTS-HD MA, Dolby Atmos, and DTS:X. Strato sends these formats as a bitstream over HDMI to a compatible audio processor. In order to enjoy lossless audio output from your Strato, you must enable bitstream audio output in the player's Browser Interface Settings page. Go to the system's Browser Interface, and click on the Settings tab. You should see the Components page. In the section for your Strato, click the Settings button: In the window that opens, click the Audio tab, then select Bitstream passthrough. Click OK to save the setting. Bitstream audio can be output from one HDMI port at a time. Strato sends the bitstream audio to the DIGITAL AUDIO HDMI port if it detects a connection on that port. Otherwise, it sends the bitstream audio to the VIDEO HDMI port.

EDID issue kept even if everything is rebooted

The Strato still shares its EDIDs when switched off. If there is an EDID problem or similar, the only way to fix it would be to disconnect the Strato from the main AC during a few seconds and then reboot everything.

> Example: *The Altitude is receiving 2.0 PCM audio even if the Strato is configured to send Bitstream. It can be because the projector is also connected on the Strato and interfering with the EDIDs. Then, unplug the Strato from the main is the only solution.*

Strato doesn't play audio if the sink is off

For an unknown reason, if the display is off, the Strato doesn't play audio.

Misc.

It has been observed that the Strato is much more stable when speed is limited in its options. Full 18Gbps signal may be an issue if cables do not match HDMI 2.0 requirements, 10Gbps or 13.5Gbps can be enough to match the content and display capabilities while assuring better reliability and wider cable compatibility.

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Xbox 1

Xbox 1 is among the devices that do not detect EDID change easily. Be sure to turn it on after the Altitude has booted completely.

AppleTV

Usually runs fine, but some flickers can be experienced in the menu when it is set to the higher video modes (eg:4K HDR 4:2:2 60Hz). Seems to be very cable quality dependant. Occasionally may need to have its power cycled to eliminate digital snow (HDCP problem)..

Samsung BDJ7500 / UBD-K8500

When starting a new track/movie we get no sound. Occurs randomly. Apparently a problem from the player, and the data we are receiving on our side is only partially complete, thus can't be decoded.

To solve that issue you have to press the "prev chapter" button on the remote control, the sound should then should be correctly decoded.

Roku 4

Netflix App works but there is an HDCP error on the Youtube app with 4K content.
The message "HDCP Unauthorized" is displayed on screen.

Apparently, it would be caused by the Roku not always sending the correct HDCP2.2 flag.
Solutions are to:
- Doing an input change on Altitude to force another HDCP exchange
- Use the restart option of the Roku (Main->Settings->System->System Restart->Restart)
- Switching resolution from 4K -> HD ->4K may help.
- Be sure to set display resolution of Roku after it has been connected to the Altitude with the display itself connected to the altitude and running.

Sony Projectors

The Input 2 works slightly better on Sony projectors, especially on projectors that accept HDCP 2.2 on both inputs.

Sony UBP-X1000ES BluRay player

Two audio settings are required to output a bitstream:

Digital Audio Output must be set to **Auto** (as opposed to PCM), AND

BD Audio MIX setting must be **Off** or else everything is decoded to PCM in the player in order to mix the primary and secondary audio streams.

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