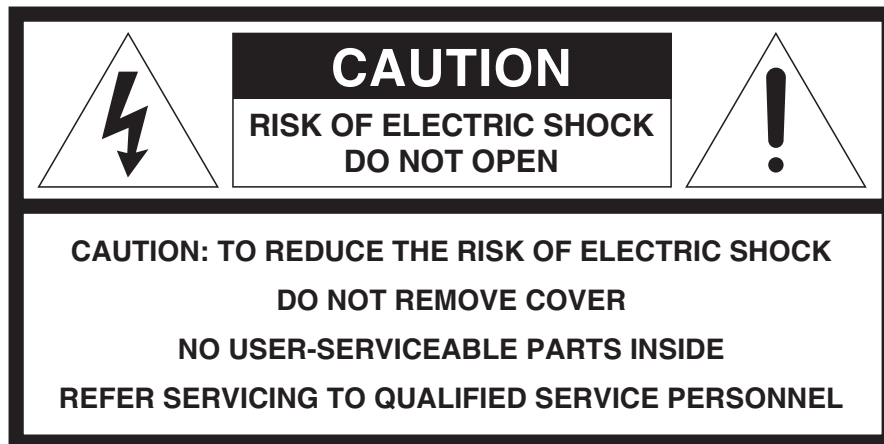




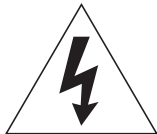
# HD1600-V2 User Guide

HDMI Matrix Switches





### Important Safety Instructions



The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated “dangerous voltage” within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons. Read these instructions.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer’s instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.

11. Only use attachments/accessories specified by the manufacturer.
12. Unplug this apparatus during lightning storms or when unused for long periods of time unless plugged into a UL rated battery backup and/or surge protection device.
13. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

**WARNING:** To Reduce The Risk Of Fire Or Electric Shock, Do Not Expose This Apparatus To Rain Or Moisture!

This apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases shall be placed on the apparatus.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### Version History

Version 1.0 05-28-2013

- Initial release.

Version 1.1 06-07-2013

- Added HDMI description.
- Added definitions for the EDLO and KSIZI commands.
- Spelling corrections.

Version 1.2 09-11-2013

- Added EDID description.
- Added the ESet menu option.
- Added the 'ESET' serial command.
- Fixed the 'KSIZI' serial command definition.

Version 1.3 09-12-2013

- Added a description of the Audio menu options.

Version 1.4

- Clarified the use of the IR-IN jack.

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## What's Inside

### Thank you for your purchase!

Thank you for your purchase of the HD1600V2 HDMI Matrix switch.

Every care has been taken to assure you of a successful installation and the subsequent operation of your new HD1600V2 video switch, however should something go wrong, and warranty repair work is needed, we request that you hold on to the original packaging materials.

Please take this time to verify the contents of the HD1600V2 box.

The following should be included:

- HD1600V2 HDMI Matrix Switch
- Power Cord
- USB Drive
- Quick Start User Guide

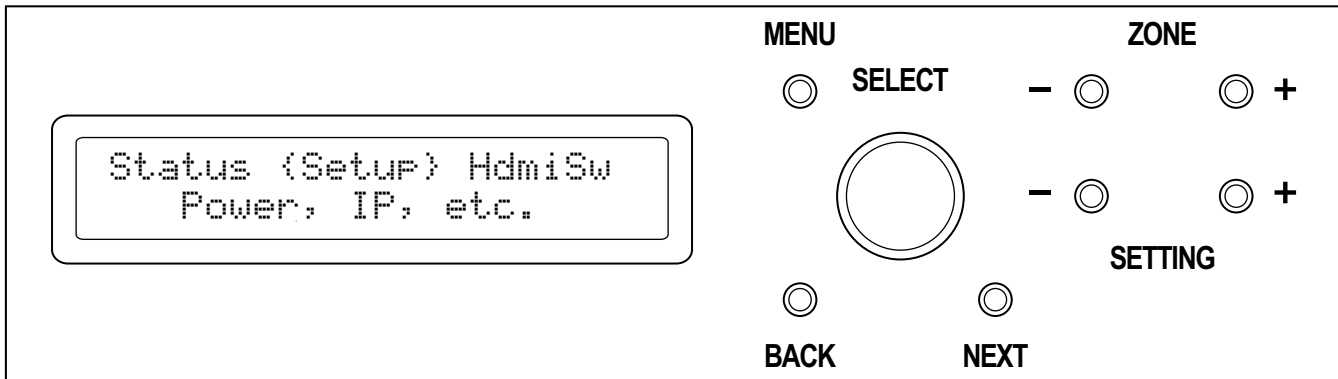
If anything is missing please get in touch with us as soon as possible so that we can correct the situation.

### Features

- 8x8 active matrix HDMI video switch.
- Serial, TCP/IP control.
- All discrete codes available including on, off, and codes for mapping any input to any output.
- Made in U.S.A.
- Three year warranty.

## Overview

### Front Panel Controls



#### Key definitions:

**MENU** - Pressing this button will bring you back to the main menu.

**ZONE** - Anytime a zone is being displayed, these buttons provide a shortcut to switch quickly between zones.

**SETTING** - Provide shortcuts to changing a setting. These buttons change their function, depending upon the screen selected. For instance when one of the source/zone switching display is being used, these buttons will allow switching between the sources.

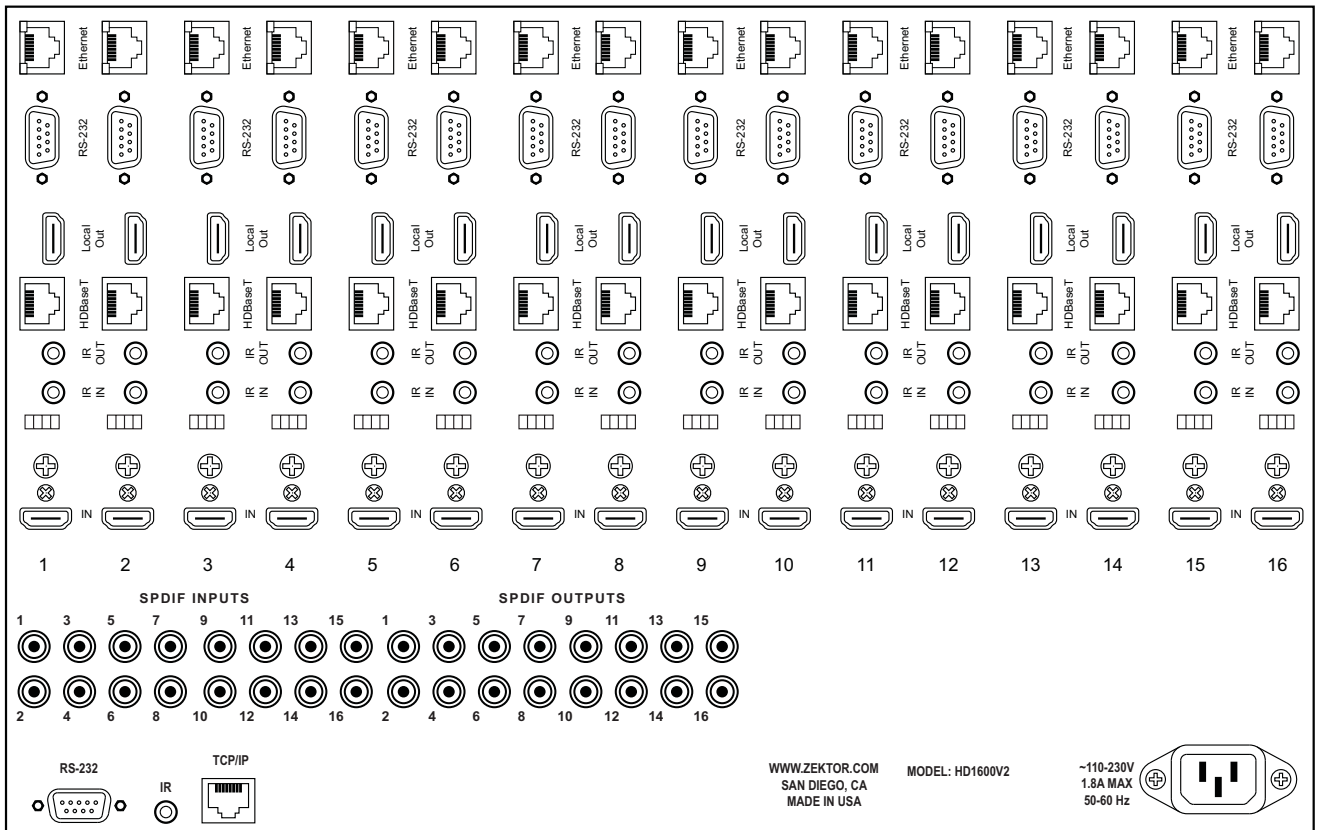
**BACK** and **NEXT** - Screen dependent buttons.

**SELECT** - This is a multifunction button. Twisting the knob allows scrolling between menu options, or the changing of a parameter, depending upon the current selection state.

Pressing the **SELECT** knob will either select a menu option, or toggle between the select-mode, and the update-mode.



## Rear Panel Connections to the HD1600V2



### Back panel connections defined

IN-1 through IN-16 -- HDMI inputs.

OUT-1 through OUT-16:

- IR-IN -- These inputs are used to send IR to the HDBaseT receivers. An IR controller can plug directly into these inputs. They are a mono-jacks, polarity insensitive (it doesn't matter how you connect the two wires to the tip and sleeve of the connector), and they accept any voltage between 3.5V and 15V. *This input is for controllers only. You cannot use a standard IR receiver, it won't hurt anything, it just won't work.*
- IR-OUT These outputs are the return IR channels from the HDBaseT. They will drive a controller or a standard 5V IR emitter/flasher. These outputs use a mono jack. The sleeve is ground and the tip is +5V.
- HDBaseT -- These are the HDBaseT outputs and will drive up to 330ft of Cat5/6 cable to the HDBaseT receivers. Power is also sent over the Cat5/6 cable and the HDBaseT receiver does not need a separate power supply.
- Local Out -- These are local HDMI outputs. They are not mirrored outputs, plugging in an HDMI monitor to one of these outputs will disable the HDBaseT receiver.
- RS-232 -- These allow two way RS-232 signals to be sent to the HDBaseT receiver. These are straight through connections. They are the same pinout as the main RS-232 control port . The baudrates can be up to 115K.

- Ethernet -- Each HDBaseT can have an Ethernet channel sent to it. These are 100Mbps full duplex channels. There are no internal connections between the outputs, to send the Ethernet down all 8 zones, you will need some type of 8 port Ethernet switch.

SPDIF Inputs -- Digital audio coax inputs.

SPDIF Outputs -- Digital audio coax outputs.

RS-232, TCP/IP -- The switch's control ports.

## Using the Front Panel

### Using the Menu System

Use the SELECT knob to scroll to a menu option. Press the knob to select the option.

Most menu options are self explanatory. As you scroll through menu options, the bottom line of the display shows a short description of each option's function.

For instance to turn off the HD1600V2:

- Scroll to SETUP, press SELECT
- Scroll to OFF, press SELECT

The switch will turn off.

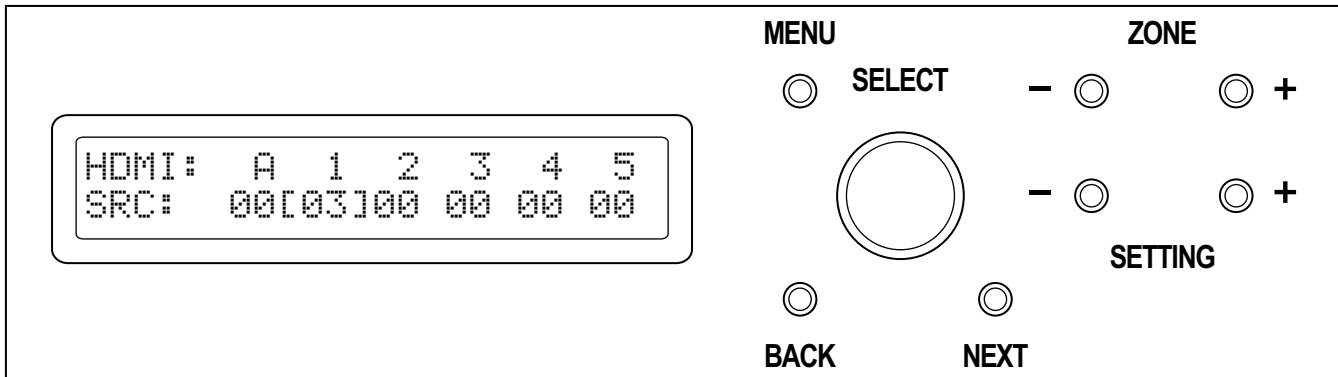
Through out the manual the above sequence would be shortened to: Setup > Off

Pressing the SELECT knob performs two functions. The first is to select a menu option as shown by the OFF example given above. The second is to switch between the selection-mode, and the update-mode.

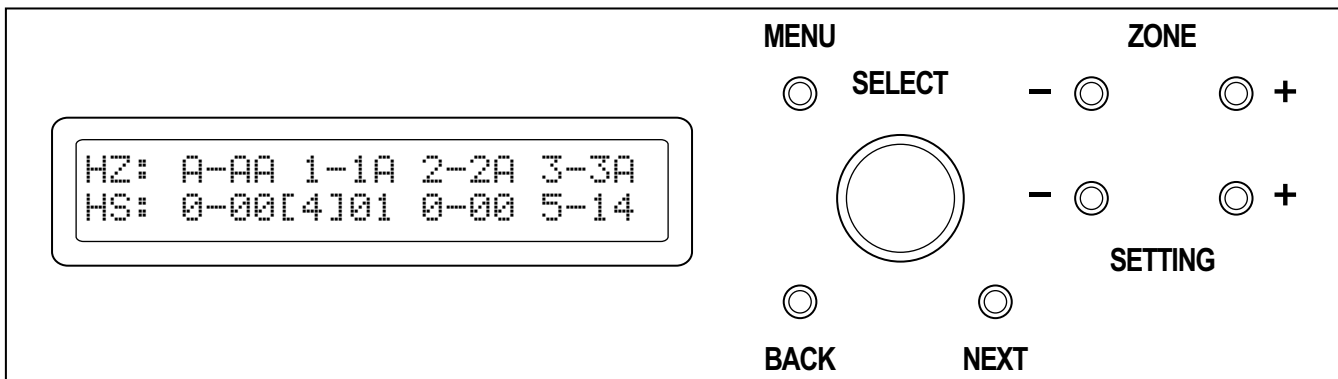
The selection-mode is indicated by the left/right arrow characters { }. Whenever the { } are displayed, twisting the knob to the right (CW), will select the option to the right of the current option. Twisting to the left (CCW) will select the option to the left.

The update-mode is indicated by the bracket characters [ ]. Whenever the [ ] are displayed, twisting the knob will change the parameter inside the brackets.

### Mapping an input to an output zone



### Mapping an input to an output zone with breakaway options



To map any source (input) to any zone (output):

If the LCD display is not at showing the main menu press the MENU button.

To change the Coax Output mappings:

Use the SELECT knob to select the “Map Audio Input /Output” option: CoaxSw

The CoaxSw screen is used to point a Coax output at an HDMI source. When a Coax output point to an HDMI source, all audio on that source will be extracted and sent to the Coax output.

To change the HDMI mappings:

Use the SELECT knob to select the “Map HDMI Input /Output” option: HdmiSw

To change the HDMI mappings with audio/video breakaway:

While in the HdmiSw screen, press the BACK button.

The BACK button is used to flip between the normal HDMI switching screen, and the HDMI with audio/video breakaway screen.

When using the HdmiSw with breakaway screen, the 1st (single digit) source is the HDMI video channel. The 2nd (two digit) source is the HDMI audio channel. For instance in the above display HDMI zone 3’s video channel is set to source 5, the audio channel is set to source 14.

Use the **SELECT** knob to scroll to the zone you wish to change. The zones are numbered on the top line. In the above example we're updating the source of zone 1.

Press the **SELECT** knob to switch from the selection-mode to the update-mode. The cursor will change from the left and right arrow characters to the bracket characters to indicate that we are now in the update-mode.

Use the **SELECT** knob to change to the desired source. Press the **SELECT** knob to use the new source. The switch will switch the given zone to the new source, and the mode will change back to the selection-mode.

Zone '**A**' represents the "ALL" zone. Setting zone '**A**' to a source will set all the zones to the given source.

Setting a source to '**0**', disconnects it from all sources (no audio, blanked video).

### Shortcuts:

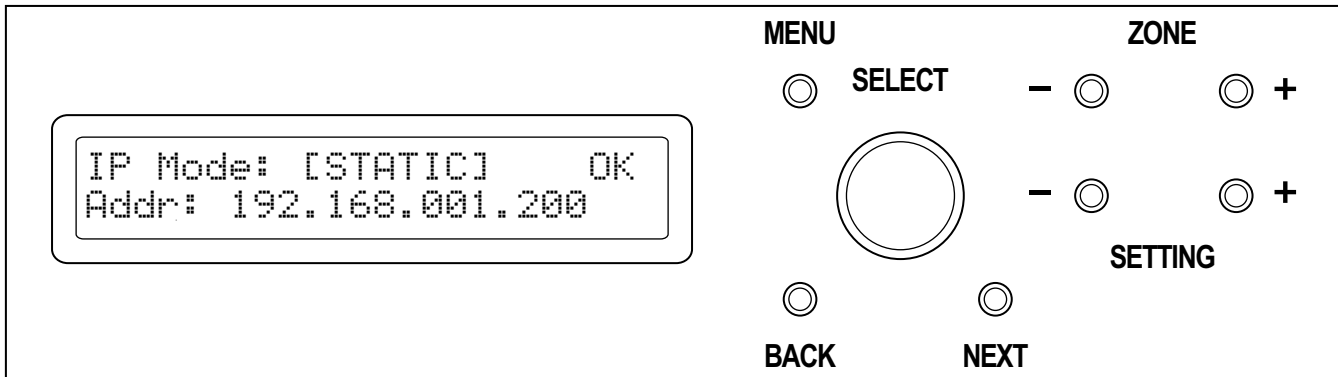
The **ZONE** buttons will move between the zones and set the update-mode, to allow easy use of the **SELECT** knob to update the sources.

The **SETTING** buttons will increment/decrement through the sources and set the select-mode, to allow easy use of the **SELECT** knob to scroll through the zones.

The **BACK** button is used to jump between the **HdmiSw** and the **HdmiSw** with breakaway screens.

Anytime the main menu is being displayed, you can quickly jump to the **HdmiSw** screen by pressing either of the **ZONE** buttons.

### Changing the IP Address



By default the switch uses DHCP to acquire an IP address, to change this to static:

If the LCD display is not at showing the main menu press the MENU button.

Use the SELECT knob to select the “IP Setup” option: Setup > IPSetup

Press the SELECT knob to select the DHCP setting, then use the knob to change this to STATIC. Press the SELECT knob again to switch to the static mode.

Use the SELECT knob to scroll to the [Addr:] option, press the SELECT to enter the update-mode.

The SELECT knob can now be used to scroll between the [Addr:], [Mask:] and [Gate:] options, allowing you to change the static IP address, the IP mask and the IP gateway parameters.

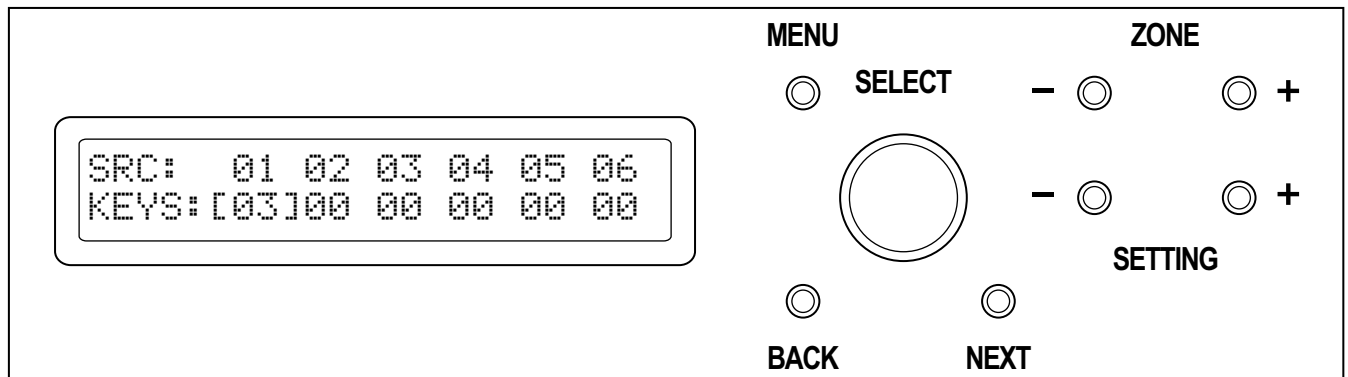
To change any of the parameters, select the parameter you want to change (address, mask, or gateway), and press the SELECT knob. Scroll to the octect you want to change, select it, and change it.

Hint: The selection knob uses acceleration to allow faster updating of values. To make large changes in the values, spin the knob quickly. For precise changes, spin the knob slowly.

The IP address changes are not made until you scroll to [OK], and select it. You can ignore any of the changes you’ve made by pressing the MENU button before selecting [OK].

Once you select [OK], the IP address changes will be made and they will be saved in EEPROM so that they will be retained through a power failure.

## Adjusting HDCP key counts



Normally these settings can just be left alone, but if you run into a source that does not have enough HDCP keys to distribute to all your zones, you can use this menu to compensate. When the number of HDCP keys is set to 0, this indicates the “Normal” mode of operation. The switch will simply let the source issue keys as needed.

To determine if you have an HDCP problem, refer to the section: “*HDCP Keys*” on page 19.

To adjust the number of keys used by a source:

If the LCD display is not at showing the main menu press the MENU button.

Use the SELECT knob to select the “HDCP key counts” option: Setup > HDCP

Use the SELECT knob to scroll to the problem zone, then set the number of keys the source makes available.

If you don’t know the number of keys, just set it to 1.

Once all changes are made, pressing the MENU button will cause them to go into effect.

When the number of HDCP keys is set to a value less than the number of monitors, the switch still needs to authenticate the source to each monitor. Since there are more monitors than keys, this must be done using smaller groups of keys.

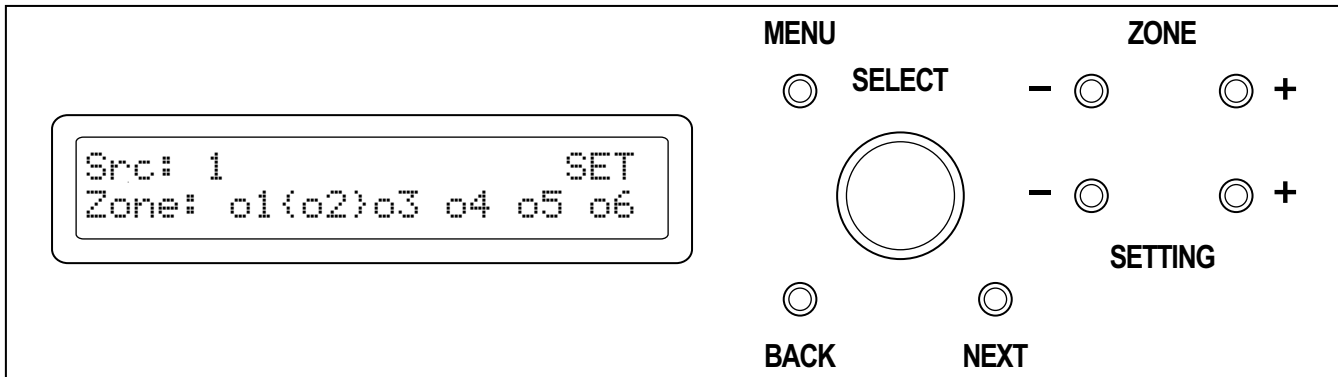
If the source is capable of issuing 3 keys, then the switch will authenticate 3 monitors at a time. So the only real effect of indicating that a source has only 1 keys, is that the authentication will take longer.

Once the authentication is done, the keys will be cached. Once the keys are cached the switch will operate at full switching speeds with no flickering. However if anything is changed (a new source or monitor plugged in, or removed) everything will need to be re-authenticated. So using a low key count will cause longer delays each time a new device is attached or removed from the switch. But once the authentication is done, switching will return to full speed.

**Note: All these changes will be lost when power is turned off, unless they are backed up into EEPROM!**

Once all HDCP settings have been set, and verified using the verification process (See: “*Validating the installation of the HD1600V2*” on page 22), you should save the HDMI settings into EEPROM, to prevent them from being lost at the next power cycle. (See: “*Saving the EDID/HDCP settings*” on page 18)

### Assigning Zones to Source EDIDs



By default an EDID that uses the lowest common features of all zones is given to each source. This screen allows you to override the EDID of an individual source by combing the EDIDs of all the assigned zones, and using it as the new EDID of the source.

For more information on EDID settings refer to the section: “*EDID*” on page 20.

To assign zones to a source:

If the LCD display is not at showing the main menu press the **MENU** button.

Use the **SELECT** knob to select the “Assign EDID zones” option: **Setup > ESet**

Use the **ZONE** buttons to switch between sources.

Use the **SELECT** knob to scroll to a zone, and the press the **SELECT** to assign or unassigned a zone.

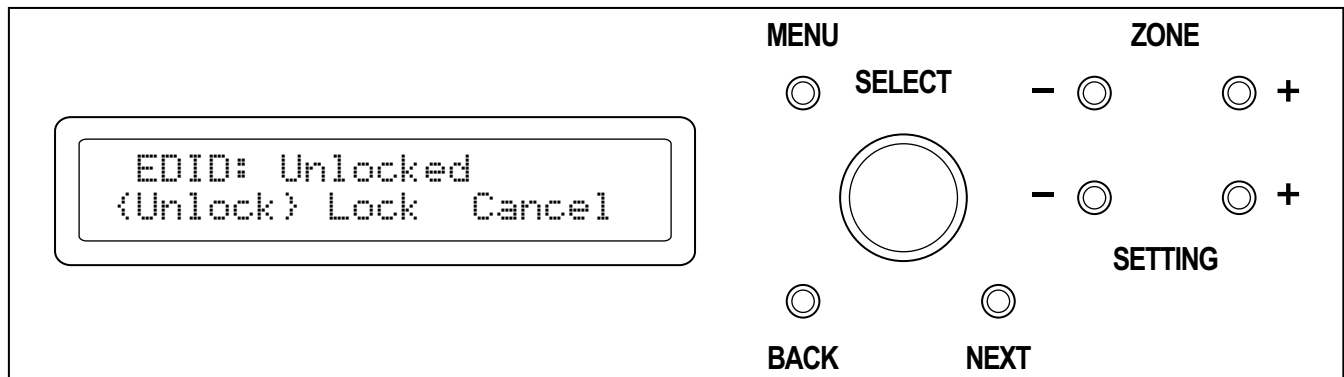
A zone is assigned when the small square to the left of the zone number is filled in.

A source that has no zones assigned is the same as a source that has all of it’s zones assigned, in both cases the default EDID is used for that source.

Once all changes are made, pressing the **MENU**, or either of the **ZONE** buttons, or scrolling to the **SET** option will cause the new EDID to be sent to the source.



## Locking the EDID settings



Locking the EDID will prevent EDID changes from registering with the switch. When the EDID is locked, all changes to the sources and zones will be ignored.

Audio Video Receivers can sometimes change their EDID settings when power is cycled.

When an A/V receiver is on, it will supply its own EDID indicating what type of audio it can play and what kind of video it can display, or pass through to a monitor. When the receiver's power is turned off, some receivers can act like they've been unplugged (removing the EDID completely), others will pass the EDID of the monitor attached to its output. To the switch, either of these occurrences is indistinguishable from a zone that's either had the receiver unplugged, or replaced by a monitor.

Anytime a zone's EDID changes, the zone must be authenticated with the attached sources. The authentication process will cause the zones to blank as the EDID keys are read, and the HDCP keys are negotiated.

To prevent display blanking each time a receiver is turn on or off, the EDID settings should be locked. Once locked, all EDID settings will be ignored, and displays will not flicker when an A/V receiver is powered cycled.

**Note:** When the EDID settings are locked, any EDID changes will be ignored, this includes the addition of any new equipment. If any equipment is to be added or removed from the current setup, you must first unlock the EDID settings, or the changes will not be registered.

The A/V receivers should be in their powered on state when the EDID is locked. Before locking, you should verify the installation (See: "**Validating the installation of the HD1600V2**" on page 22), this will cause all EDIDs and HDCP keys to be cached. Once this is done you can lock the EDID settings.

To lock/unlock the EDID settings:

If the LCD display is not at showing the main menu press the MENU button.

Use the SELECT knob to select the "EDID Lock" option: Setup > ELock

Use the EDID Lock menu to either verify the current settings, or to lock or unlock the EDID settings.

**Note:** After locking the EDID settings you should save all EDID/HDCP settings so that they will be retained after a power cycle (See: "**Saving the EDID/HDCP settings**" on page 18). If the settings are not saved they will be lost the next time the switch is powered off.

### Saving the EDID/HDCP settings

Each time the HD1600V2 is power on, it must read the EDIDs of each zone, and negotiate the HDCP keys between sources and zones. Once these EDIDs are read and the HDCP keys negotiated, they will be cached until the next time the switch is powered down.

When viewing a source on one zone, and another zone is switched to the same source, the HDCP keys must be read and negotiated with the new zone. To do this, the HDCP protocol requires the video to be blank while the new encryption keys are shared. This will cause video blanking and flickering on monitors sharing the same source.

Once the EDIDs and HDCP keys are read, they will be cached by the HD1600V2. When a zone, that has previously been authenticated with a source are connected, the keys will not be read from the source, but instead from the cache, and any shared monitors will not flicker.

When the switch is powered off, all the EDIDs and HDCP caches will be lost. To prevent this, the values can be saved in internal EEPROM and read back in each time the switch is powered on. This will prevent the initial flickering after powering on.

The following settings are saved in the internal memory:

- All EDIDs currently read into cache.
- All HDCP keys currently read into cache.
- The HDCP count settings.
- The EDID lock setting.

To save the EDID/HDCP settings:

If the LCD display is not at showing the main menu press the **MENU** button.

Use the **SELECT** knob to select the “EDID Save” option: **Setup > ESave**

The settings will be saved when you select the **ESave** menu selection.

If you add or removing any equipment from the switch, you should re-save the EDID/HDCP settings.

It's best to make sure all EDIDs and HDCP keys have been read before saving the EDID settings, this is done using the installation verification procedure, See: “**Validating the installation of the HD1600V2**” on page 22.

### Clearing the EDID/HDCP settings

Each time the switch is powered on, the previously saved EDID and HDCP key settings will be read, and used as the starting point.

If you make changes to the switch's configuration, the saved EDID and HDCP key settings will no longer match the connected equipment.

If the switch is to be used in a different location, or a new project (all the equipment and connections are going to change) you should clear all the saved EDID and HDCP settings to keep from wasting cache on EDID and HDCP keys that are no longer part of the project.

To clear the EDID/HDCP settings:

If the LCD display is not at showing the main menu press the **MENU** button.

Use the **SELECT** knob to select the “EDID Clear” option: **Setup > EClear**

Use the **EClear** menu to clear the EDID and HDCP keys and settings.

## Using The HD1600V2

### Functional Overview

The HD1600V2 is functionally divided into two switches, an HDMI switch and a SPDIF Digital Audio switch. These two switches function as two separate switches.

The HDMI switch, is a full featured HDMI switch with audio breakaway capabilities. It caches EDID settings and HDCP keys. The audio breakaway options allows the displaying of video from one HDMI source, while playing audio from another HDMI source, or from the AUDIO switch.

The SPDIF Digital Audio switch allows the extraction of audio from any HDMI input.

### The HDMI Switch

HDMI has many issues associated with its distribution. It was originally designed to connect a DVD player to a TV, with a few tweaks to the specification to allow for limited distribution.

#### HDCP Keys

HDMI allows for encrypted audio/video streams to be sent over the HDMI cables. To do this, each receiving TV or monitor must be issued its own decryption key. This forces each HDMI cable to send a different stream of encrypted data, even if it's the same program being sent to two different monitors.

This prevents a simple splitter from working, since a simple splitter would send the same stream to two different monitors.

This also allows the source (DVD player, Cable Box, etc) to determine the number of simultaneous monitors allowed to view it's content. Some cable box manufacturers only supplied a single HDCP key, while some Blu-ray players supplied a very limit number (like 3). Even today there are manufacturers that limit the number of HDCP keys, in their Blu-ray players to 9.

To work around this problem, the HD1600V2 will cache keys from sources and generate keys when needed, to supply up to 24 HDCP keys.

When a source runs out of HDCP keys (there are more monitors attempting to view a source than there are keys), it can do a number of undefined things. Video can go blank, or it can flash on and off, or in some cases the source could even lock up and need to be power cycled.

If you suspect an HDCP problem, you can verify this by:

- Turning off the HD1600V2
- Turn off all TVs and monitors connected to the HD1600V2
- Turn on the HD1600V2 and set all zones to point to the source with the suspected HDCP problem.
- Now start turning on zones. If the display starts flickering or blanking after you turn on a zone, then the source most likely has one less HDCP key that the number of zones you have turned on.
- To remedy the HDCP problems, see the section on setting the number of HDCP keys. (*See: "Adjusting HDCP key counts" on page 15*).

For the most part there are fewer and fewer HDCP key issues with the newer HDMI products, and usually nothing needs to be done for the switch to work out of the box.

## EDID

EDID is simple in concept. Each monitor or receiver contains a small data block that indicates what the monitor's or receiver's capabilities are. When a source connects to a monitor, the monitor's EDID is read, and using this information, the source adjusts its output to match the capabilities of the monitor. If a monitor can display 1080p and the source can output 1080p, then 1080p will be used. The same is true for audio formats. The EDID will contain multiple resolutions that the monitor can display, and if it can decode multiple audio formats, these formats will also be included in the EDID. The source will compare the capabilities of the monitor, and its own capabilities, and choose the best video and audio solution to send over the HDMI link.

This works well when a single source is connected to a single monitor. A matrix switch complicates this a bit. What happens when two monitors are connected to the same source? Which EDID is used to indicate what the monitors are capable of displaying? What if the monitors have different capabilities?

Traditionally this has been handled in a number of different ways. Some switches will use predefined EDIDs that force certain modes, like 1080p, 1080i or 720p and Dolby5.1 or PCM stereo audio, and then assume all monitors can handle this.

Other solutions involve reading a single monitor's EDID and sending it to all sources. Or a pass through mode, where a single EDID is sent to a single source (in some switches this will prevent the viewing of this source by any other zones).

There have been solutions that depend upon the order of switching, where the 1st zone to switch to a source determines the EDID that is used. This is ideal if only one zone is switched to a source at a time. A shared source can have a different EDID, depending upon switching order. This can lead to confusion "Why does Dolby5.1 only work sometimes?", and requires the user to disconnect all zones from a source and reconnect them in a different order, depending upon what EDID features they want. This can be disruptive to all viewers of a source, as well as hard to explain to the end user why this is necessary. Or alternatively it requires custom driver programming at each install.

Our solution is to allow any combination of EDIDs to be combined and sent to any source. This allows the flexibility of setting a source EDID to the capabilities of any single monitor / receiver, or any combination of monitors / receivers. Each source can be sent a different combination of zone EDIDs. The EDIDs sent to the source, are not switching order dependent, and since the EDIDs are based on zone EDIDs, they are always valid.

By default, all the EDIDs of all zones (monitors and receivers) are read, and the lowest common features of all the zones are combined into a single EDID, that is sent to all the sources. For instance, if all the zones can receive Dolby5.1 audio, then the EDID will indicate that Dolby5.1 can be sent. If however even a single TV can only decode PCM stereo, the combined EDID will indicate to all the sources that only PCM stereo can be sent to any zone.

You can now use the ESet screen to combine the EDIDs of similar devices and send the combined EDID to a source that will be associated with the devices. For instance all receivers can be combined and sent to a Blu-ray or Cable box that will be used mostly for those receivers. This allows you to enable Dolby5.1, or Dolby TrueHD, or any other features the receivers are capable of decoding.

Here are some common examples:

### Scenario 1

You have a dedicated Blu-ray player to be used by a single hometheater receiver. You would use the ESet screen to set the EDID of the Blu-ray's source to include only the zone of the hometheater receiver. In this case, the EDID of the hometheater will be sent directly to the Blu-ray player and all audio modes of the hometheater receiver will be available to the Blu-ray player. This will not prevent any other zones from switching to the Blu-ray player, but there can be issues if another zone does not support the same audio formats that the hometheater does. Leave all the other EDIDs to their default values, and all other sources will be viewable by all zones.

## *Scenario 2*

You have a dedicated Blu-ray player, but 3 hometheater receivers at different zones. The receivers have slightly different features, but you only need the audio features that all three support. Use the ESet screen to set the EDID of the Blu-ray's source to include the three zones used by the hometheater receivers. Once this is done, the Blu-ray player will always output video and audio that will be playable by all three receivers. Any of the receivers will be able to view and listen to anything played on the Blu-ray player. Other zones may or may not be able to, depending upon their capabilities.

## *Scenario 3*

You have two 3D displays and one Blu-ray player dedicated to 3D video. The two displays may support different 3D formats, but they will most likely share formats. By setting the EDID to include both 3D TVs, the Blu-ray player will only send a 3D image that is viewable by both displays.

## **The SPDIF Audio Switch**

### **The SPDIF Audio Switch's Sources**

The SPDIF Audio switch has 16 possible sources of audio:

- 1-16 These are the HDMI inputs labeled on the back of the switch. When a Coax output is switched to an HDMI input, the digital audio from the HDMI input will be extracted and sent to the coax output.

## Validating the installation of the HD1600V2

After all sources and zones are connected, you should perform the following series of steps to verify everything is working ok, and to lock in the HDCP and EDID changes. These steps should only be done *after* using the ESet screen to make any EDID source changes.

- Be sure the EDID is unlocked. (See: “**Locking the EDID settings**” on page 17.)
- Turn on all sources, all TV / Monitors, and all receivers. Set the sources to “protected” content if possible. (Play a Hollywood DVD -- not a copy. Set the cable boxes to a premium channel like HBO. Etc.)
- Using the ‘A’ zone, sequentially switch all the zones to each of the sources. (See: “**Mapping an input to an output zone**” on page 12.)
- Wait for all pictures to stabilize on each source change, verify that a picture can be seen on all zones. There can be a lot of video blanking and flickering at this point, and if you have sources that have manual HDCP key count settings, this could take a while. Verify that all sources can be seen on all zones.
- You should now be able to switch a single zone between different sources without causing flickering on any of the other zones.
- If you have a receiver attached to any of the output zones, you should lock the EDID. (See: “**Locking the EDID settings**” on page 17.)
- After locking the EDID settings, you should be able to turn off an on receivers without causing flickering on any of the zones.
- You should now save the EDID settings in EEPROM so that all the HDCP keys and EDIDs cached will not be lost when power is turned off. (See: “**Saving the EDID/HDCP settings**” on page 18.)
- Before adding or removing any sources or zones, be sure to unlock the EDID. When the EDID is locked, the switch will ignore all new devices or changes, so it must be unlocked to register any changes.

## RS-232 / TCP/IP Port Hardware

### TCP/IP Overview

The Serial and TCP/IP port share the same protocol.

The TCP/IP connection is a very simple socket, sometimes referred to as Raw TCP/IP socket, similar to Telnet, but without the Telnet protocol overhead. Most telnet clients will allow you to telnet into the HD1600V2 without error.

We use the open source package PuTTY to do our testing. It has a convenient “Raw” mode that works great with the HD1600V2, and is available in Windows and Linux (with a Mac O/S version in the works). (*We are not associated with PuTTY in anyway, but do find it a useful tool when communicating over TCP/IP and Serial port connections*)

Website: <http://www.chiark.greenend.org.uk/~sgtatham/putty>

By default, the HD1600V2 uses DHCP to acquire an IP address. The TCP/IP socket’s is fixed to 50005.

Once a connection is made it will remain open until closed by the client, or after 10 minutes of retries at attempting to talk to the client.

After connecting to the TCP/IP port, all commands are identical to those of the Serial port. All strings coming from the HD1600V2 will be sent to both the TCP/IP sockets and Serial ports.

The HD1600V2 will accept commands from both Serial ports and TCP/IP simultaneously, each port’s commands will be buffered until the ending ‘\$’ is read, at which time the commands will be executed in the order received. All responses will be sent to both Serial ports and TCP/IP connections.

### Setting a static IP address vs DHCP

By default, the HD1600V2 will use DHCP to retrieve a IP address, an IP mask, and the address of the router (gateway). The IP address can be set using the front panel, or you can issue serial commands.

When using serial commands, setting an IP address is a two step process. You must first set the static values to be used for the IP address, the IP mask, and the router address, then place the HD1600V2 into the Static IP address mode.

The commands to set the static IP address, mask and router are: IPA, IPM and IPG respectively. (*See: “‘IPA’ Set / View the static IP Address” on page 42.*)

The command to change the IP address mode is: IPSET. (*See: “‘IPSET’ Set the IP operation mode, DHCP or STATIC” on page 41.*)

The command to save these changes in EEPROM so that they are used after a power failure is: ‘^SS 32\$’. (*See: “‘SS’ Save Default Power On Settings” on page 39.*)

As an example, to set a static address of 192.168.1.200, a mask of 255.255.255.0 and a router address of 192.168.1.1, and save this in EEPROM, the following commands would be executed:

<code>^IPA 192,168,1,200\$</code>	- Set the static IP address
<code>^IPM 255,255,255,0\$</code>	- Set the static IP mask
<code>^IPG 192,168,1,1\$</code>	- Set the gateway address
<code>^IPSET 0\$</code>	- Set the TCP/IP mode to “Static”
<code>^SS 32\$</code>	- Save the new settings in EEPROM in case of power failure

### TCP/IP settings used by the HD1600V2

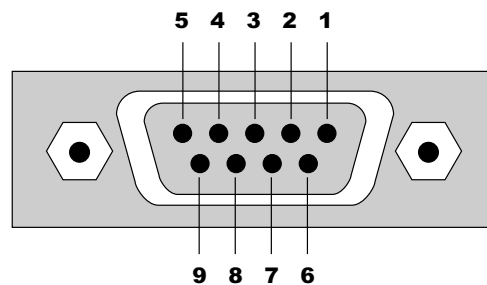
Default IP Address:	DHCP
Port Number:	50005
Duplex:	Full
Speed:	10/100 Mbps

### RS-232 Pinout and Baudrate Settings

The RS-232 port on the HD1600V2 is the same format, and pinout, as a PC modem, and uses the same type of cable as a standard serial modem would, which is a standard straight through cable. Do not use a cable that is marked as a “Null Modem” cable.

The HD1600V2 can also be used with USB to RS-232 conversion cables, these are all typically straight through cables. *(Be sure to install any drivers that come with the USB to RS-232 cable you are using.)*

The RS-232 port is a female type DE-9 connector (sometimes mistakenly referred to as a DB-9 connector) with the following pinout:



### Pin definitions

1 - No Connect	6 - No Connect
2 - TX	7 - No Connect
3 - RX	8 - No Connect
4 - No Connect	9 - No Connect
5 - GND	

### Port settings used by the HD1600V2

Baudrate:	19200
Data Bits:	8
Stop Bits:	1
Parity:	NONE

### Timing information (unless specified otherwise by a command's description)

Min character to character time:	0ms
Min line to line time:	0ms
Min time between commands:	0ms
Max time to respond to a request:	100ms



## Command Syntax

### Command Syntax

The HD1600V2 serial command set uses an ASCII based protocol and a terminal emulator can be used to test the serial port of the HD1600V2.

Each serial command is formatted as:

```
^CMD param1,param2,...$
```

Where:

^ = All commands and responses start with the '^' character.  
CMD = The name of the command.  
param = Any number of parameters can follow a command.  
\$ = All commands and responses end with the '\$' character.

For instance the name of the command to turn power on / off is 'P' (must be capitalized) therefore, to turn on the HD1600V2 send:

```
^P 1$          -> Command sent to the A/V switch
^+$           <- Acknowledgment indicating valid command
^=P 1$        <- Response from the A/Vswitch for new setting
```

to turn off the HD1600V2 send:

```
^P 0$          -> Command sent to the A/V switch
^+$           <- Acknowledgment indicating valid command
^=P 0$        <- Response from the A/V switch for new setting
```

**NOTE:** Only the characters between '^' and '\$' are valid, any characters sent before the '^' or after the '\$' will be ignored.

**NOTE:** By default, the HD1600V2 adds a carriage return and a line feed to the end of its responses, after the '\$'. This makes testing with terminal software easier. Since they are outside the '^' and '\$' characters, they should be ignored by software drivers. If desired, this behavior can be disabled. (See: "XS' Control Settings" on page 37)

## Command Responses

### Type of Responses and Timing Information

There are three different types of responses: Acknowledgements, Errors and Query Strings.

By default, the HD1600V2 will always respond to a command, there are no "time-out" modes, if you send a command and don't get a response within 100ms, something's wrong with the connection.

### The Acknowledgement Response

Every command will be followed by an acknowledgement or error response.

Anytime you issue a command and there are no errors, you will receive the acknowledgement response. Which is:

```
^+$
```

## The Error Response

Every command will be followed by an acknowledgement or error response.

If something is wrong with the command, you will get an error response. Which is

`^!<error_number>$`

which is the ‘!’ followed by an error number (in ASCII), followed the ‘\$’ character.

For instance ‘2’ is not allowed as a parameter in the ‘P’ (power) command, so:

`^P 2$`

-> Command sent to A/V switch

`^!2$`

<- Error response to an out of range parameter

which indicates there was an out of range parameter.

The following are the Error Response codes that can be returned by the HD1600V2:

- 1 - Unrecognized command.
- 2 - A parameter was out of range.
- 3 - Syntax error, or a badly formed command.
- 4 - Reserved.
- 5 - Too many or too few parameters.
- 6 - Device busy, cannot process command.
- 7 - Buffer overflow.
- 8 - Command not valid if device is not powered on.
- 2xx - Error initializing the HDMI subsystem.

And some more detailed descriptions of their meanings:

**Error 1** - The command given was not recognized as a HD1600V2 command. Commands are case sensitive and in the HD1600V2, all commands are upper case.

**Error 2** - One of the parameters given was too large, or too small, the command will be ignored.

**Error 3** - Something was wrong with the command's syntax. There was possibly extra data at the end of the line, or non-decimal data as part of a parameter.

**Error 4** - Reserved.

**Error 5** - The number of parameters given does not match the number allowed by this command.

**Error 6** - To prevent conflicts between the front panel Setup Mode and the serial port settings, when the HD1600V2 is in the Setup Mode, many parameters become read only and any attempt at writing them will return Error 6.

**Error 7** - An internal buffer has overflowed, for instance more than 16 key codes were sent as part of the “Key Emulation” command.

**Error 8** - Power to the device must be ‘ON’ before this command is allowed.

**Error 2xx** - An error occurred while initializing the HDMI sub-section.

## The Query Response

The query response is sent by the HD1600V2 to indicate a setting has changed, or as a response to a query command. The query response string consists of the ‘=’ character followed by the command string of the command being queried.

For instance, in the case of the power command:

`^P ?$`

-> Send a power request command to the A/V switch

^+ $\$$

<- Acknowledgement (the command has no errors)

^=P 1 $\$$

<- Query response indicating the power is on.

## Using Bitmapped Parameters

### Reading / Writing Bitmapped Parameters

Some commands accept “Bitmapped” parameters. These are decimal values that represent a series of flags, or bits, that control, enable and/or disable different device operations.

Binary arithmetic is used to represent bitmapped parameters, it is assumed the reader has some familiarity with binary arithmetic.

An example of a command that uses a bitmapped parameter is the “XS settings” command, which is defined as:

`^XS settings $\$$`

Where ‘settings’ is a bitmapped parameter defined as:

Value	32768	16384	8192	4069	2048	1024	512	256	128	64	32	16	8	4	2	1
Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	AMU	VMU	12V	AON	IRJ	IRS	IRE	KYE	CHG	SET	CSE	CRE	CHN	ECO	ACK	ASY
Default:	1	0	0	1	1	1	0	0	1	1	0	1	0	1	1	1

*For information on what each bit of the XS command does, see: “XS’ Control Settings” on page 37.*

The “Value” row, in the table’s header, refers to the values, that when added together, create the decimal parameter used by the command. For instances if you want the bits ‘ASY’ and ‘IRS’ to be set to 1, and the rest of the bits set to zero, the parameter’s value would be calculated as: 1+1024, making the parameter value: 1025.

The command to set those two bits to ones, and reset all the others would be:

`^XS 1025 $\$$`

Individual bits of a bitmapped parameter can be set or reset without affecting the other bits, by prefixing the bitmapped parameter with a ‘+’ to set individual bits, or a ‘-’ to reset individual bits.

For instance in the above example the bitmapped value has been set to 1025. If we would now like to enable the IR jack, by setting the ‘IRJ’ bit, the following command can be issued:

`^XS +2048 $\$$`

This will set the ‘IRJ’ bit, and have no effect on the others, and the new “XS” value would be: 3073

If we’d like to now disable the IR jack and the IR sensor, by clearing the ‘IRJ’ and ‘IRS’ bits, we’d use the value “2048+1024, or 3072 and issue the command:

`^XS -3072 $\$$`

leaving the new “XS” value to be: 1.

## Basic Control

### Reference for Basic Control Commands

These commands are all that are needed for basic control of the HD1600V2 and includes power on/off, remapping sources to zones. This section also includes some helpful control options for changing the way serial commands behave.

#### Definitions

The following terms are used through out this manual.

#### *Zone*

An output. The HD1600V2 has sixteen (16) outputs, known as zones. A single zone consists of the combination of a HDMI video channel, and an HDMI audio channel. For most commands, zones are indicated by using a '@' prefix character.

#### *Input*

An input, or source. The HD1600V2 has sixteen (16) HDMI inputs, each consists of the combination of an HDMI video channel and an HDMI audio channel. For commands that mix inputs with zones, 'inputs' are indicated by numbers without a '@' prefix.

#### *Channel*

A channel is an HDMI video path, or an HDMI audio path. Channels are used to control breakaway features.

The following channels are supported by the HD1600V2:

- 1** - HDMI video channel.
- 4** - Digital Audio channel.
- 8** - HDMI audio channel.

---

## Basic Command Definitions

---

### 'P' Power Control

Turn on / off, or toggle the power state of the HD1600V2:

<b>^P 0\$</b>	Turn off power if power is not locked on.
<b>^P 1\$</b>	Turn on power.
<b>^P 2\$</b>	Turn off power regardless of "locked" state.
<b>^P 3\$</b>	Turn on power and lock it on -- only a "P 2" command can turn off power.
<b>^P +\$</b>	Toggle power
<b>^P ?\$</b>	Query for current setting

Response String:

**^=P n\$**

Where:

n = Current power status, 0=Off, 1=On, 3=Locked On. (A value of '2' is never returned.)

The power lock and unlock can be used to keep a controller from turning off the HD1600V2.

Drivers should be written to only use the "P 0" and "P 1" commands to turn on and off the HD1600V2. This allows users to override the driver's logic by manually issuing the "P 2" and "P 3" commands.

By issuing a "P 3" command (lock power on), the HD1600V2 will be turned on, and locked. Only a subsequent "P 2" command will turn off the HD1600V2, The "P 0" and "P 1" commands will be ignored.

---

### 'SZ' Set Zone(s) -- SPDIF Audio Switch

This is the command used to map sources to any number of zones on the audio switch.

Its different forms are:

<b>^SZ @zone,@zone,in\$</b>	Map all channels of an source, to a zone or zones.
<b>^SZ.ch @zone,in\$</b>	Map only the selected channels of sources to zones.
<b>^SZ.ch @zone,+\$</b>	Sequence zones forward through sources.
<b>^SZ.ch @zone,-\$</b>	Sequence zones in reverse through sources.
<b>^SZ ?\$</b>	In polled mode, reads current settings of all logged changes.
<b>^SZ @zone,?\$</b>	Read current settings of given zones.
<b>^SZ.ch @zone,?\$</b>	Read current settings of the selected channels of zones.

Response Strings:

**^=SZ @zone,in\$**                      or,  
**^=SZ.ch @zone,in\$**

Where:

@zone = One (or more) zones to be mapped.  
in = Source to map to given zone(s).  
ch = Channel bitmap.

### 'SZ' Examples

The 'SZ' command in its simplest form:

**^SZ @1,@3,2\$**

maps the input '2' to the zones '1' and '3'. You can also map multiple zones and inputs using a single command. For instance:

```
^SZ @1,2,@3,@5,7$
```

maps the input '2' to zone '1', and also maps the input '7' to zones '3' and '5'.

By appending a '.' and a channel bitmap to the 'SZ' command, the command can also be used to breakaway the different channels:

```
^SZ.4 @1,3
```

maps only the HDMI audio from input '3' to zone '1'. The HDMI video and digital audio channels, on zone 1, remain unchanged.

The channel (the '.4' in the above example) is a bitmapped number that indicates which channel or channels are to be affected by the command.

The channels are mapped as:

```
4 = Digital audio
```

Currently, the only channel used by the audio switch is the Digital Audio channel, so there are no breakaway options for the 'SZ' command.

## 'SZ' Query Examples

To make parsing the response strings easier, only one response string is sent per zone. Or, in the case of channel breakaways, only one response string per channel is returned. The response string is sent as a fixed length string using leading zeroes.

You can request the mapping of multiple zones, with one command, and still only one response string per zone will be returned, for instance:

```
^SZ @1,@3,@4,?
```

could return:

^+\$	<- Indicates no errors in the command
^=SZ @001,002\$	<- Input '2' mapped to zone '1'
^=SZ @003,007\$	<- Input '7' mapped to zone '3'
^=SZ @004,003\$	<- Input '3' mapped to zone '4'

---

## 'HSZ' Set Zone(s) -- HDMI Switch

This is the command used to map sources to any number of zones on the audio switch.

Its different forms are:

^HSZ @zone,@zone,in\$	Map all channels of an source, to a zone or zones.
^HSZ.ch @zone,in\$	Map only the selected channels of sources to zones.
^HSZ.ch @zone,+\$	Sequence zones forward through sources.
^HSZ.ch @zone,-\$	Sequence zones in reverse through sources.
^HSZ ?\$	In polled mode, reads current settings of all logged changes.
^HSZ @zone,?\$	Read current settings of given zones.
^HSZ.ch @zone,?\$	Read current settings of the selected channels of zones.

Response Strings:

```
^=HSZ @zone,in$      or,  
^=HSZ.ch @zone,in$
```

Where:

@zone = One (or more) zones to be mapped.  
in = Source to map to given zone(s).  
ch = Channel bitmap.

**'HSZ' Examples**

The 'HSZ' command in its simplest form:

```
^HSZ @1,@3,2$
```

maps the input '2' to the zones '1' and '3'. You can also map multiple zones and inputs using a single command. For instance:

```
^HSZ @1,2,@3,@5,7$
```

maps the input '2' to zone '1', and also maps the input '7' to zones '3' and '5'.

By appending a '.' and a channel bitmap to the 'HSZ' command, the command can also be used to breakaway the different channels:

```
^HSZ.8 @1,3
```

maps only the HDMI audio from input '3' to zone '1'. The HDMI video on zone 1, remains unchanged.

The channel (the '.8' in the above example) is a bitmapped number that indicates which channel or channels are to be affected by the command.

The channels are mapped as:

1 = HDMI video  
8 = HDMI audio

By adding together the above numbers, you can switch any combination of channels without affecting the unselected channels.

For instance:

```
^HSZ.1 @3,4$
```

would map only the HDMI video from input '4' to zone '3'.

To map both the video and audio channels, add the HDMI video and HDMI audio channel numbers together:  $9 = 8 + 1$ , and use that as the channel number:

```
^HSZ.9 @2,@3,4$
```

This would map the HDMI video and HDMI audio channels from input '4' to zones '2' and '3'.

There are two forms of the query response string, depending upon whether any channel breakaway options are in affect.

If HDMI video and HDMI audio, from input '3' are all mapped to zone '1', then:

```
^HSZ @1,?$ -> Query request sent to the A/V switch
```

would respond with:

```
^+$ -<- Indicates no errors in the command  
^=HSZ @001,003 -<- Video and audio channels are all mapped to input 3
```

If instead, zone '1' had HDMI video from input '3' mapped to it, but had digital and HDMI audio from input '4' mapped to it, the response would have been:

```
^=HSZ.1 @001,003 -<- HDMI from input '3' mapped to zone 1  
^=HSZ.9 @001,004 -<- HDMI S/PDIF audio from input '4' mapped to zone '1'
```

**'HSZ' Query Examples**

To make parsing the response strings easier, only one response string is sent per zone. Or, in the case of channel breakaways, only one response string per channel is returned. The response string is sent as a fixed length string using leading zeroes.

You can request the mapping of multiple zones, with one command, and still only one response string per zone will be returned, for instance:

```
^HSZ @1,@3,@4,?
```

could return:

```
^+ $          <- Indicates no errors in the command
^=HSZ @001,002 $ <- All channels of input '2' mapped to zone '1'
^=HSZ @003,001 $ <- All channels of input '1' mapped to zone '3'
^=HSZ.1 @004,007 $ <- Video from input '7' mapped to zone '4'
^=HSZ.8 @004,005 $ <- HDMI audio from input '5' mapped to zone '4'
```

You can also request the mapping of channels, for instance:

```
^HSZ.1 @2,?
```

could return:

```
^HSZ.1 @002,006 <- Video from input '6' mapped to zone 2
```

only the video channel's status is returned.

If you plan on using breakaway options consistently you, you can have the HD1600V2 always send the channel with the response string. This keeps you from having to parse two different types of strings.

Using the 'XS' command to set the 'CHN' bit, will cause the HD1600V2 to always include the channel number. The following example demonstrates this:

```
^XS +4 $      -> Set the CHN bit
^+ $          <- Acknowledge 'XS' command
^=XS nnnnn $ <- Indicates the new 'XS' settings
^HSZ @1,? $   -> Request mappings for zone 1
^+ $          <- Acknowledge 'SZ' command
^=HSZ.9 @1,4 <- All channels of input '4' mapped to zone '1'
```

By setting the 'CHN', even though all channels on zone '1' are the same, the full channel bitmap is still returned.

In the polled mode (See: **"XS' Control Settings"** on page 37.), any zone selections changes are logged. You can retrieve all the logged changes by issuing the 'HSZ ?' command. This command returns any pending changes, followed by a termination record to indicate there are no more pending changes.

For instance, assume Zone 1 and 3 have changed since the last time read:

```
^HSZ ? $      -> Request pending changes
^+ $          <- Acknowledge 'SZ' command
^=HSZ @001,002 $ <- Input '2' mapped to zone '1'
^=HSZ @003,001 $ <- Input '1' mapped to zone '3'
^=HSZ @000,000 $ <- Termination record, there are no more pending changes.
```

---

**'MZ' Mute (Disconnect) Zone(s) -- SPDIF Audio Switch**



This is the command used to mute, or disconnect a zone from any source. When audio is muted, the sound is turned off. When video is muted, video is turned off, leaving a black screen. (Or possibly blue screen, depending upon how your receiver acts when video has been turned off.)

The different forms of the MZ command are:

<code>^MZ @zone,@zone,mute\$</code>	Mute all channels of a zone or zones.
<code>^MZ.ch @zone,mute\$</code>	Mute only the selected channels of zones.
<code>^MZ.ch @zone,+\$</code>	Toggle the mute setting of zones.
<code>^MZ ?\$</code>	In polled mode, reads current settings of all logged changes.
<code>^MZ @zone,?\$</code>	Read current settings of given zones.
<code>^MZ.ch @zone,?\$</code>	Read current settings of the selected channels of zones.

Response Strings:

`^=MZ @zone,mute$` or,  
`^=MZ.ch @zone,mute$`

Where:

@zone = One (or more) zones to be mapped.  
mute = Mute setting (0=Unmuted, 1=Muted).  
ch = Channel bitmap (Range 1-3).

### 'MZ' Examples

The 'MZ' command in its simplest form:

```
^MZ @1,@3,1$
```

mutes all channels of the zones '1' and '3'. You can also mute/unmute multiple zones using a single command. For instance:

```
^MZ @1,1,@3,@5,0$
```

mutes zone '1', and unmutes zones '3' and '5'.

By appending a '.' and a channel bitmap to the 'MZ' command, the command can also be used to mute individual channels.

Currently the only channel available to the Audio switch is channel '4'.

### 'MZ' Query Examples

To make parsing the response strings easier, only one response string is sent per zone. Or, in the case of channel breakaways, only one response string per channel is returned. The response string is sent as a fixed length string using leading zeroes.

You can request the settings of multiple zones, with one command, and only one response string per zone will be returned, for instance:

```
^MZ @1,@3,@4,?
```

could return:

<code>^+\$</code>	<- Indicates no errors in the command
<code>^=MZ @001,1\$</code>	<- All channels of zone '1' are muted
<code>^=MZ @003,0\$</code>	<- All channels of zone '3' are not muted
<code>^=MZ.004 @004,1\$</code>	<- Digital Audio on zone '4' is muted

If you plan on using breakaway options consistently you, you can have the HD1600V2 always send the channel with the response string. This keeps you from having to parse two different types of strings.

## 'MZ' Query Examples

Using the 'XS' command to set the 'CHN' bit, will cause the HD1600V2 to always include the channel number. The following example demonstrates this:

<code>^XS +4\$</code>	-> Set the CHN bit
<code>^+\$</code>	<- Acknowledge 'XS' command
<code>^=XS nnnnn\$</code>	<- Indicates the new 'XS' settings
<code>^MZ @1,?\$</code>	-> Request mute settings for zone 1
<code>^+\$</code>	<- Acknowledge 'MZ' command
<code>^=MZ.4 @1,0</code>	<- Audio of zone '1' is not muted

By setting the 'CHN', even though all channels on zone '1' are the same, the full channel bitmap is still returned.

---

## 'HMZ' Mute (Disconnect) Zone(s) -- HDMI Switch

This is the command used to mute, or disconnect a zone from any source. When audio is muted, the sound is turned off. When video is muted, video is turned off, leaving a black screen. (Or possibly blue screen, depending upon how your receiver acts when video has been turned off.)

The different forms of the MZ command are:

<code>^HMZ @zone,@zone,mute\$</code>	Mute all channels of a zone or zones.
<code>^HMZ.ch @zone,mute\$</code>	Mute only the selected channels of zones.
<code>^HMZ.ch @zone,+\$</code>	Toggle the mute setting of zones.
<code>^HMZ ?\$</code>	In polled mode, reads current settings of all logged changes.
<code>^HMZ @zone,?\$</code>	Read current settings of given zones.
<code>^HMZ.ch @zone,?\$</code>	Read current settings of the selected channels of zones.

Response Strings:

<code>^=HMZ @zone,mute\$</code>	or,
<code>^=HMZ.ch @zone,mute\$</code>	

Where:

@zone	= One (or more) zones to be mapped.
mute	= Mute setting (0=Unmuted, 1=Muted).
ch	= Channel bitmap.

## 'HMZ' Examples

The 'HMZ' command in its simplest form:

```
^HMZ @1,@3,1$
```

mutes all channels of the zones '1' and '3'. You can also mute/unmute multiple zones using a single command. For instance:

```
^HMZ @1,1,@3,@5,0$
```

mutes zone '1', and unmutes zones '3' and '5'.

By appending a '.' and a channel bitmap to the 'HMZ' command, the command can also be used to mute individual channels. This is the proper way to mute an audio channel while allowing video to pass unobstructed. For instance to mute the HDMI audio sound, while leaving the video alone:

```
^HMZ.8 @1,1
```

mutes the digital and analog audio on zone '1'. The HDMI video remains unchanged.

The channel (the '.8' in the above example) is a bitmapped number that indicates which channel or channels are to be affected by the command.

The channels are mapped as:

1 = HDMI video

8 = HDMI audio

By adding together the above numbers, you can switch any combination of channels without affecting the unselected channels.

For instance:

```
^HMZ.1 @3,1$
```

would mute (blank) only the HDMI video on zone '3'.

To mute both the HDMI video and HDMI audio channels, add the channel numbers together:  $9 = 1 + 2$ , and use that as the channel number:

```
^HMZ.9 @2,@3,1$
```

This would mute the HDMI video and HDMI audio channels on zones '2' and '3'.

### 'HMZ' Query Examples

There are two forms of the query response string, depending upon whether any channel breakaway options are in effect.

For instance if HDMI video, digital audio, and HDMI audio, are all muted on zone '1', then:

```
^HMZ @1,?$
```

>- Query request sent to the A/V switch

would respond with:

```
^+$
```

<- Indicates no errors in the command

```
^=HMZ @001,1
```

<- Video and all audio channels are muted on zone '3'

If instead, zone '1' had HDMI audio muted, but HDMI video was not muted, then the response would have been:

```
^=HMZ.1 @001,0
```

<- Video not muted on zone '1'

```
^=HMZ.8 @001,1
```

<- Audio muted on zone '1'

To make parsing the response strings easier, only one response string is sent per zone. Or, in the case of channel breakaways, only one response string per channel is returned. The response string is sent as a fixed length string using leading zeroes.

You can request the settings of multiple zones, with one command, and only one response string per zone will be returned, for instance:

```
^HMZ @1,@3,@4,?
```

could return:

```
^+$
```

<- Indicates no errors in the command

```
^=HMZ @001,1$
```

<- All channels of zone '1' are muted

```
^=HMZ @003,0$
```

<- All channels of zone '3' are not muted

```
^=HMZ.1 @004,0$      <- Video on zone '4' is not muted
^=HMZ.8 @004,1$      <- Audio on zone '4' is muted
```

You can also request the mapping of channels, for instance:

```
^HMZ.2 @4,?
```

could return:

```
^HMZ.2 @004,1      <- HDMI audio on zone '4' is muted
```

only the HDMI audio channel's status is returned.

If you plan on using breakaway options consistently you, you can have the HD1600V2 always send the channel with the response string. This keeps you from having to parse two different types of strings.

### 'HMZ' Query Examples

Using the 'XS' command to set the 'CHN' bit, will cause the HD1600V2 to always include the channel number. The following example demonstrates this:

```
^XS +4$              -> Set the CHN bit
^+$                  <- Acknowledge 'XS' command
^=XS nnnnn$         <- Indicates the new 'XS' settings
^HMZ @1,?$          -> Request mute settings for zone 1
^+$                  <- Acknowledge 'MZ' command
^=HMZ.9 @1,0        <- Audio and video of zone '1' is not muted
```

By setting the 'CHN', even though all channels on zone '1' are the same, the full channel bitmap is still returned.

## Advanced Control

### Reference for Advanced Control Commands

These commands are for more advanced control over the HD1600V2, including front panel light intensities, changes to serial port behavior, etc.

### Advanced Command Definitions

#### '!' Resend Error Code

This special purpose command is used to request that the HD1600V2 resend the last error code sent. This can be useful if the last error code sent had a checksum appended to it that did not match.

`^!$` Request that the last error code sent, be resent

#### 'V' Version

Returns the current firmware version of the HD1600V2.

`^V ?$`

Response String:

`^=V "HD800(V2)",1.0a,30B2S12345678$`

Where:

`"HD800(V2)"` = Model  
`1.0a` = Firmware version  
`30B2S12345678` = Serial number

#### 'XS' Control Settings

Turn on and off operational modes of the HD1600V2.

The format of the command is:

`^XS settings1,settings2$` Set the control bits to 'settings1' and 'settings2'  
`^XS +settings1,+settings2$` Set bits indicated in 'settings1' and 'settings2' to 1  
`^XS -settings1,+settings2$` Reset bits indicated in 'settings1' and 'settings2' to 0  
`^XS ?$` Query for current settings

Response String:

`^=XS settings1,settings2$`

Where 'settings1' is a bitmapped parameter defined as:

Value	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	0	0	0	KYD	IRJ	IRS	0	0	CHS	SET	0	CRE	CHM	ECO	ACK	ASY
Default:	0	0	0	0	1	1	0	0	1	1	0	1	0	1	1	1

ASY - 0=Polled mode. 1=Asynchronous Mode.  
ACK - 0=Don't acknowledge cmds with "^+\$" 1=Acknowledge error free commands with a "^+\$"  
ECO - 0=Do not send a response strings for each cmd. 1=Always send response string when a serial command is issued  
CHM - 0=Only send a ".ch" when needed. 1=Always append a ".ch" channel mask to a zone response cmd  
CRE - 0=Don't send CRs/LFs at end of responses 1=End all responses with a carriage return and a line feed.

0 - Reserved.

Where ‘settings2’ is a bitmapped parameter defined as:

Value	32768	16384	8192	4069	2048	1024	512	256	128	64	32	16	8	4	2	1
Bit Position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Name	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Default:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0 - Reserved.

This command uses a bitmapped parameter. Each bit can set or reset without affecting the other bits. (See: “**Using Bitmapped Parameters**” on page 27, for more information on using bitmapped parameters.)

Both parameters do not have to be present on the command line, if a parameter is left out the command, it will be left unchanged:

`^xS settings1$` Only ‘settings1’ is changed

Since ‘settings2’ was not present on the command line, it will not be affected.

A comma can be used to indicate a missing parameter:

`^xS ,settings2$` Only ‘settings2’ is changed

Since ‘settings1’ was not present on the command line, it will not be affected.

The following paragraphs define each option in more detail:

### *‘ASY’ Set the Polled or Asynchronous Mode*

With this bit set, the HD1600V2 is in the asynchronous mode, which simply means each time a state changes, like the power being toggled, the HD1600V2 will send a response string immediately out the serial and TCP/IP ports.

In polled mode, a response is only sent when requested.

### *‘ACK’ Enable / Disable Acknowledgements*

Each time a command is sent to the HD1600V2, the HD1600V2 responds with either an error message, if there was a problem with the command, or an acknowledgement string of “^+ $\$$ ”. This behavior can be changed by setting this bit to ‘0’. If the bit is reset, the “^+ $\$$ ” string will not be sent.

### *‘ECO’ Enable / Disable the ‘Parameter Changed’ Strings*

Each command that makes a change to a parameter, will be echoed with a response string that indicates the new values of the parameters changed. The response strings are only issued after the changes have taken affect, and reflect the new state of the HD1600V2.

With this bit set to ‘0’, these response strings will not be sent. To verify the new settings, the controller must read the new values manually.

### *‘CHM’ Enable / Disable always sending “.ch” masks on zone commands*

On commands that change zone settings (‘SZ’, ‘MZ’, ‘DZ’), the “.ch” channel mask is only sent when needed to indicate a difference in settings between channel. With this bit set, the “.ch” mask will always be sent, regardless of any differences between channel settings.

If you plan on using the HD1600V2's breakaway functions, setting this bit can make parsing the response strings easier, since only one type of response string will be returned.

### 'CRE' Enable / Disable trailing Carriage Returns Line Feeds

A carriage return and line feed can be appended to all responses coming from the HD1600V2. This is useful when using terminal software to test command strings.

Since the carriage returns and line feeds are sent outside of the normal string (they are sent after the ending '\$'), they should be ignored by the controller. But if there are problems with this behavior, they can be turned off by setting this bit to a '0'.

### 'SS' Save Default Power On Settings

When all power is lost to the HD1600V2 (for instance the power cord is unplugged), the current settings will be lost. When power is restored all settings will be set to their initial values. This command allows you to change those initial values.

To use this command, the HD1600V2 should be set to the values that are to be used as the initial values.

Once the current settings are in place, this command is issued to save the current settings as the initial values.

This command uses a bitmapped parameter to indicate which values are to be saved. A bit set to '1' indicates the associated setting should be saved, a bit set to '0' indicates the setting should not be saved and the previously saved setting will remain unchanged.

Command formats:

^ss settings\$ Set the enable bits to 'settings'

Response String:

*There is no response string to the SS command, this command is write only.*

Where 'settings' is a bitmapped parameter defined as:

Value	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

- Bit-0 - Save zone input/output mappings, and power state
- Bit-1 - Save switching delay times
- Bit-2 - Save LED levels and mode
- Bit-3 - Save control settings (the XS command settings)
- Bit-5 - Save IP parameters
- Bit-15 - Save HDMI settings: EDID and HDCP caches, HDCP key counts, and the EDID lock state.

Note: The HD1600V2 must be powered on before sending the "Save HDMI settings" (Bit-15).

All other bits are reserved and should be set to 0 when issuing this command.

### 'FS' Reset to Factory Settings

This command will reset selected parameters of the HD1600V2 to their factory default settings.

This command uses a bitmapped parameter to indicate which values are to be reset. A bit set to '1' indicates the associated setting should be reset, a bit set to '0' indicates the setting should not be reset and the previous setting will remain unchanged.

Command formats:

**^FS settings\$**

Reset the parameters indicated by 'settings'

Response String:

*There is no response string to the FS command, this command is write only.*

Where 'settings' is a bitmapped parameter defined as:

Value	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

- Bit-0 - Reset zone input/output mappings, and power state
- Bit-1 - Reset switching delay times
- Bit-2 - Reset LED levels and mode
- Bit-3 - Reset control settings (the XS command settings)
- Bit-5 - Reset IP parameters
- Bit-15 - Reset HDMI settings: Clear EDID and HDCP caches, clear HDCP key counts and the EDID lock state.

Note: The HD1600V2 must be turned on before sending the "Reset HDMI settings" (Bit-15), and the switch must be power cycled (using the 'P 0' and 'P 1' commands) before the cleared settings take affect.

All other bits are reserved and should be set to 0 when issuing this command.

## 'LI' Lighting Mode and Intensities

This command uses a bitmapped parameter. Each bit can set or reset without affecting the other bits. (See: "Using Bitmapped Parameters" on page 27, for more information on using bitmapped parameters.)

Allows changing the behavior of the front panel LEDs, and adjusting their intensities.

**^LI mode , dim , bright , off\$**                      Set mode and intensities  
**^LI ?\$**    Query for current settings

Response String:

**^=LI mode , dim , bright , off\$**                      Set mode and intensities

Where:

- mode                      = Lighting mode (Settings: 0=Off, 1=Dim, 2=Bright, 3=Auto-dim)
- dim                        = Intensity of dimmed LEDs (Range: 0-100)
- bright                    = Intensity of brightened LEDs (Range: 0-100)
- off                        = Intensity of the standby power LED (Range: 0-100)

Response Example:

**^=LI 3,020,090,010\$**                                      Mode=Auto, dim=20%, bright=90%, off=10%

The mode settings allow you to set the front panel LEDs to always be: 0 - off, 1 - Always at the 'dim' intensity, 2 - always at the 'bright' intensity, or 3 - auto-dim from 'bright' to 'dim' when the front panel is not in use.

The intensities range for 0, which of off, to 100, which is full intensity.

When setting parameters, not all parameter have to be present, if a parameter is not present, it will be left unchanged. For instance to change just the 'bright' value to 50%:

**^LI , , 50\$**    -> Set the 'bright' intensity to 50%

Only the 'bright' intensity is affected.



## TCP/IP Control

The HD1600V2 can use DHCP to negotiate an address with a router, or it can be programmed to use a static IP address.

The 'IPSET' command is used to switch between the two modes. 'IPSET 0' indicates a static address, and 'IPSET 1' indicates a DHCP negotiated address.

To set a new static IP address, first issue the 'IPA', 'IPM' and 'IPG', commands to setup the IP address, IP mask, and IP gateway, respectively. Then issue the 'IPSET 0' command.

---

### 'IPSET' Set the IP operation mode, DHCP or STATIC

This command is used to set the TCP/IP operating mode of the HD1600V2. It allows you to choose between DHCP and Static IP address operations.

When set to the DHCP, the HD1600V2 will negotiate an IP address, IP mask, and gateway address (the address of the router), using DHCP.

When set to Static mode, the IP address, IP mask, and gateway address, given by the 'IPA', 'IPM' and 'IPG' commands will be used.

You can easily switch between the two modes without losing the static address setting. In other words when switching to DHCP new IP address values will be obtained from the router, but the static IP address values of the 'IPA', 'IPM' and 'IPG' commands are not lost, and when returning to static mode, these settings do not need to be resent.

The command format is:

<code>^IPSET mode\$</code>	Set new TCP/IP operating mode
<code>^IPSET ?\$</code>	Read the current TCP/IP operating mode

Response String:

`^=IPSET mode$`

Where:

mode = Current operating mode. 0=Static, 1=DHCP.

To change the static IP address the 'IPSET 0' form of this command must be issued. This is true even if you are already operating in the static mode. For instance if your static address is 192.168.1.200 and you wish to change it to 192.168.1.201, you must first issue a 'IPA' command and then reissue the 'IPSET 0' command:

<code>^IPA 192,168,1,201\$</code>	Set the new static address
<code>^IPSET 0\$</code>	Tell the HD1600V2 to use the new static address

## 'IPA' Set / View the static IP Address

This command does not immediately change the TCP/IP address. It sets up the static IP address that will be used the next time the 'IPSET 0' command is issued.

The command format is:

<code>^IPA xxx,xxx,xxx,xxx\$</code>	Set new TCP/IP address
<code>^IPA ?\$</code>	Read the current TCP/IP address

Response String:

`^=IPA xxx,xxx,xxx,xxx$`

Where:

`xxx,xxx,xxx,xxx` = IP address in standard form (Ex: 192,168,001,200)

The response string of the 'IPA' command is not the current IP address of the HD1600V2, but the IP address that will be used the next time the 'IPSET 0' command is issued. To retrieve the current IP address of the HD1600V2, use the read only command 'IPAX' (See: "**'IPAX' Retrieve the current IP address in use**" on page 43.)

---

## 'IPM' Set / View the static IP Mask

This command does not immediately change the TCP/IP mask. It sets up the static mask that will be used the next time the 'IPSET 0' command is issued..

The command format is:

<code>^IPM xxx,xxx,xxx,xxx\$</code>	Set new TCP/IP mask
<code>^IPM ?\$</code>	Read the current TCP/IP mask

Response String:

`^=IPM xxx,xxx,xxx,xxx$`

Where:

`xxx,xxx,xxx,xxx` = IP mask in standard form (Ex: 255,255,255,000)

The response string of the 'IPA' command is not the current IP mask of the HD1600V2, but the IP mask that will be used the next time the 'IPSET 0' command is issued. To retrieve the current IP mask of the HD1600V2, use the read only command 'IPMX' (See: "**'IPMX' Retrieve the current IP mask in use**" on page 43.)

---

## 'IPG' Set / View the static IP gateway address

This command does not immediately change the TCP/IP gateway. It sets up the TCP/IP gateway address that will be used the next time the 'IPSET 0' command is issued.

The command format is:

<code>^IPG xxx,xxx,xxx,xxx\$</code>	Set new TCP/IP router address
<code>^IPG ?\$</code>	Read the current TCP/IP router address

Response String:

`^=IPG xxx,xxx,xxx,xxx$`

Where:

`xxx,xxx,xxx,xxx` = Gateway address in standard form (Ex: 192,168,001,001)

The response string of the 'IPG' command is not the current gateway address of the HD1600V2, but the gateway address that will be used the next time the 'IPSET 0' command is issued. To retrieve the current IP address of the HD1600V2, use the read only command 'IPGX' (See: "**IPGX** Retrieve the current IP gateway address in use" on page 43.)

---

## 'IPAX' Retrieve the current IP address in use

This is read only and will return the IP address being used by the HD1600V2. If DHCP is being used, this will return the address given to the HD1600V2 by the router. If static mode is being used, this will return the static address currently in use by the HD1600V2.

The command format is:

**^IPAX ?\$** Read the current IP address

Response String:

**^=IPAX xxx,xxx,xxx,xxx\$**

Where:

**xxx,xxx,xxx,xxx** = IP address in standard form (Ex: 192,168,001,200)

---

## 'IPMX' Retrieve the current IP mask in use

This command is read only and will return the IP mask being used by the HD1600V2. If DHCP is being used, this will return the mask given to the HD1600V2 by the router. If static mode is being used, this will return the static mask currently in use by the HD1600V2.

The command format is:

**^IPGX ?\$** Read the current IP mask

Response String:

**^=IPGX xxx,xxx,xxx,xxx\$**

Where:

**xxx,xxx,xxx,xxx** = IP mask in standard form (Ex: 255,255,255,000)

---

## 'IPGX' Retrieve the current IP gateway address in use

This command is read only and will the gateway address being used by the HD1600V2. If DHCP is being used, this will return the address given to the HD1600V2 by the router. If static mode is being used, this will return the static address currently in use by the HD1600V2.

The command format is:

**^IPGX ?\$** Read the current TCP/IP router address

Response String:

**^=IPGX xxx,xxx,xxx,xxx\$**

Where:

**xxx,xxx,xxx,xxx** = Gateway address in standard form (Ex: 192,168,001,001)

## HDMI Control Settings

HDMI control settings.

These settings are saved using the 'FS' command. (See: “‘SS’ Save Default Power On Settings” on page 39)

---

### 'EDLO' EDID Lock

Locking the EDID will keep the HDMI switch from registering any EDID changes. Any new devices added to the switch, or any devices removed from the switch will be ignored.

This command is useful in keep receiver from causing the switch to re-read EDIDs and HDCP keys each time the receiver is power cycled.

Most receivers will change their EDID settings when the power state is changed. They will change the EDID to indicate their own built in capabilities when turned on. When turned off they will either remove the EDID completely or pass through the EDID of the monitor plugged into the receiver's output.

The switch sees this change in EDIDs as a change in devices, which forces it to re-negotiate the new devices with the sources HDCP keys. This will cause a temporarily loss of video on zones sharing the source that's having it's HDCP keys read.

To prevent display flickering each time a receiver is turned on or off, you should perform the “**Validating the installation of the HD1600V2**” on page 22.

Once your system is validated, you should lock the EDID, and then save the new HDMI settings in EEPROM so that they won't be lost when power is cycled. (See: “‘SS’ Save Default Power On Settings” on page 39)

To turn on / off, or the EDID lock state of the HD1600V2:

<code>^EDLO 0\$</code>	Unlock EDID, sets the switch to the normal mode of operating.
<code>^EDLO 1\$</code>	Lock EDID, all device changes will be ignored.
<code>^EDLO ?\$</code>	Query for current setting

Response String:

`^=EDLO n$`

Where:

n = Current lock state, 0=Unlocked, 1=Locked.

---

### 'ESET' Assign zones to an input source

By default, all the EDIDs of all zones (monitors and receivers) are read, and the lowest common features of all the zones are combined into a single EDID, that is sent to all the sources. For instance, if all the zones can receive Dolby5.1 audio, then the EDID will indicate that Dolby5.1 can be sent. If however even a single TV can only decode PCM stereo, the combined EDID will indicate to the all the sources that only PCM stereo can be sent to any zone.

You can now use the 'ESET' command to combine the EDIDs of similar devices and send the combined EDID to a source that will be associated with the devices. For instance all receivers can be combined and sent to a Blu-ray or Cable box that will be used mostly for those receivers. This allows you to enable Dolby5.1, or Dolby TrueHD, or any other features the receivers are capable of decoding.

To assign zone EDIDs to a source:

- `^ESET @src,0$` Use the default EDID for this source.
- `^ESET @src,zmsk$` Assign zone EDIDs to the source based on the bits in the setting.
- `^ESET @src,?$` Query for current setting

Response String:

`^=ESET @src,zmsk$`

Where:

src = The source number.

zmsk = The zone assignment mask. If Bit-0 is set, then Zone1 will be assigned to the source, if Bit-1 is set, the assign Zone2.

### Example:

To assign zones 1 & 3 to source 4:

`^ESET @4,5$` Bit0=Zone1, Bit2=Zone3. Setting bits '0' and '2' = '5'.

---

### 'KSIZI' Set the number of HDCP keys of a source

For HDMI to work properly, each monitor connected to the switch must be issued a key by each source connected to the switch.

By default the switch simply assumes each source has enough keys to drive all the monitors attached to the switch. But this is not always the case.

Some manufacturers supply a limit number of keys, sometime as small as 1 key. If a source has only 1 HDCP key, then only one monitor can negotiate an HDCP connection with the source. When a second monitor is switch to the source, it will be unable to connect. In most cases, this will also break the video connection to the working monitor as well.

This command allows you to specify the number of keys a source has. The HD1600V2 will then limit the number of HDCP negotiations to the given number. All the monitors will still need to be authenticated with the source, to allow proper HDCP operations, but the switch will limit the number of simultaneous negotiations to the number given by this command.

Once all the connected monitors are authenticated to the source, the HD1600V2 will generate the missing keys.

If you believe you are having a problem with HDCP keys, perform the steps outlined at: "**HDCP Keys**" on page 19. If it appears you have a source with a limited amount of keys, use this command to limit the number of keys sent to the source.

To set the number of keys of a source:

- `^KSIZI @src,0$` Sets the switch to the normal mode, where key limits are not checked.
- `^KSIZI @src,n$` Sets the HDCP key limit to 'n' (n = 1 - 23).
- `^KSIZI @src,?$` Query for current setting

Response String:

`^=KSIZI @src,n$`

Where:

src = The source number.

n = Number of keys available in source. 0 = Key limits are not checked, 1-23 = Limit the number of HDCP keys to 'n'.

This setting is lost when power is cycled on the HD1600V2. To save this settings through a power cycle, backup the HDMI settings using the 'SS' command. (See "*SS' Save Default Power On Settings*" on page 39.)