

Model HR-733 Fiber optic Video Extender

Extend HDMI™ / DVI or VGA / YPbPr
together with Full-Duplex RS-232 over a
Single Fiber Optic Cable



UMA1183 Rev A

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1.0 General

Thank you for purchasing the Hall Research HR-733 fiber-optic video Extender. The HR733 is a 3 input multi-format HD video extender with bi-directional RS-232 extension and control.

The device can select among 2 HDMI (or DVI) inputs and 1 VGA (or YPbPr) input and extend the selected source as an uncompressed digital signal over a single multi-mode fiber to a remote receiver. The device supports embedded audio on the HDMI inputs, and provides separate R/L analog or SPDIF (TOSLINK) digital audio inputs for the VGA input.

The HR-733 can also extend a bi-directional data channel (CEC, or RS-232 Serial) over a single multi-mode (OM2 or OM3) fiber optic cable spanning distances of up to 1000m (3280ft).

The compact remote unit provides an HDMI output (with embedded audio) for simple AV connectivity to any display.

The RS-232 port can be used as an extension, or at the same time it can be used to control the Sender (e.g. to select inputs). A user-friendly front panel with high-contrast alphanumeric LCD enables the user to easily set up and control the system.

Advanced features include: automatic scaling of the analog video input to match the native resolution of the remote display, diagnostic messages on the front panel LCD (e.g. RS-232 strings sent or received), audio delay of the analog input to correct lip-sync, support for CEC data channel of HDMI (choice of RS-232 or CEC extension), and 3D deep-color HDMI 1.4 support (without ARC or Ethernet extension).

The Sender unit is designed as a ½ wide 1RU with threaded holes so that two can be mounted side by side on a tray (Model RMS-1U-1A), or a single unit can be rack mounted using supplied brackets (pair of F10375).



Figure 1 – Model HR-733 Sender and Receiver

2.0 Features

- ✓ 3 video inputs (2 HDMI and 1 VGA/YPbPr with Audio)
- ✓ Transmits uncompressed HDMI video along with RS-232 to 1000m
- ✓ Supports Deep-color (HDMI 1.3 or 1.4) and 3D
- ✓ Compatible with DVI video (with DVI to HDMI input cable)
- ✓ Converts PC VGA or component video and audio to HDMI at any resolution
- ✓ Automatically detects VGA/YPbPr input and timing parameters
- ✓ Front panel LCD readout for easy setup and control
- ✓ Status indication of fiber-optic link, remote LCD (hot-plug), and Source video
- ✓ Bi-directional RS-232 data transmission between the sender and the receiver
- ✓ RS-232 control of the input source selection and setup
- ✓ 1RU high Sender includes rack-mount brackets, and Receiver has surface mounting provisions
- ✓ Safety interlock does not turn on high-power fiber LED drivers unless fiber-optic cable is plugged in at both ends
- ✓ Front panel button functions can be locked through serial port
- ✓ Locking HDMI connectors
- ✓ Green design, turns off parts of circuit when they are not in use
- ✓ Compact, Rugged, Reliable, and Economical
- ✓ Made in USA

3.0 Precautions



This device is a Class 3R Laser device (per IEC 60825-1:2007) and can cause damage to eye sight if used improperly. Refer to ANSI Z136 for proper handling and usage of Class 3R devices.



This device is sensitive to Electrostatic Discharge (ESD). Prior to touching the unit (especially the connectors), touch a grounded object, and make sure the devices that will be plugged in to the HR-733 are properly grounded.



4.0 Theory of Operation

The Sender provides both digital (HDMI/DVI), and analog (VGA/YPbPr + audio) inputs. However, in the fiber video is transmitted as digital regardless of the selected input, and always comes out as HDMI on the receiver with audio embedded in the video on the same connector. When the analog input is selected, its video and audio are digitized and scaled to match the native resolution of the remotely connected LCD.

The video data is transmitted on only one multi-mode fiber. The reason multi-mode cable is needed is because the TMDS data are transmitted over a range of optical wavelengths to reduce bandwidth requirement at any particular wavelength. The TMDS signals use LED lasers to drive the cable. However, for safety reasons, these lasers are not turned on if no fiber optic cable is plugged in at both the Sender and Receiver.

Additional (non-video) DVI or HDMI signals are also seamlessly connected between the source and the sink device. These include:

- DDC Channel (SDAT and SCLK) for EDID and HDCP
- Hot Plug Detect (to detect remote monitor connection)
- Source Active +5vDDC (to indicate to sink there is a source)

In addition, the fiber-optic link provides a general purpose bi-directional data lane that can be assigned by the user to be used as RS-232 pass-through between sender and receiver, or to extend the CEC standard of the HDMI. Currently CEC is seldom used in pro-AV installations, and its implementation varies from one TV manufacturer to another, so as default the HR-733 uses the data lane for RS-232 communication and control. However, the CEC can be selected by the user, in which case the RS-232 port on the remote unit will not serve any function (the RS-232 port on the Sender can still be used for source selection).

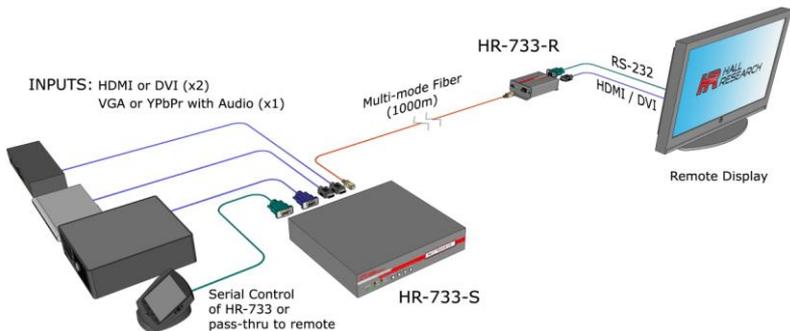


Figure 2 - Connection Block Diagram

5.0 Installation

5.1 Required Cables

- 1 or 2 HDMI cables to connect up to 2 HDMI sources to the HR-733-S
- HDMI cable to connect the HR-733-R to the HDMI display
- HD-15 male-to-male VGA cable to connect a PC analog video or an HD-15 to 3-RCA for component YPbPr DVD video connection to the HR-733-S
- 3.5mm stereo audio cable or optical (TOSLINK) audio cable to connect associated audio of VGA/YPbPr source to the sender
- RS-232 DB9 male-to-female (pin to pin) cable to connect the HR-733-S's serial port to a PC
- Multi-mode (MM) fiber-optic cable to connect the HR-733-S and HR-733-R

5.2 Inputs & Outputs

The HR-733-S has 2 HDMI inputs, 1 VGA/YPbPr input with audio, and a bi-directional RS232 port. The audio source of the VGA/YPbPr input can be either 3.5mm L/R stereo or optical.

The HR-733-R has 1 HDMI output and 1 bi-directional RS232 port.

5.3 Fiber Optic Cable Requirements

Each end of the HR-733 uses a single SC connector and requires a multi-mode fiber-optic cable. Unlike some other fiber-optic equipment that may work with either single-mode or multi-mode cables, the HR-733 is not compatible with single-mode cables. Multi-mode cables are generally available in OM1, OM2, or OM3 constructions. The OM3 cables are best suited for max transmission lengths and are recommended for this product.



Figure 3
SC Fiber Connector

Data Rate	OM1 (62.5/125 μm)	OM2 (50/125 μm)	OM3 (50/125 μm)
1.65 Gb/s (HDMI 1.2a)	250 m (820 ft)	500 m (1640 ft)	1000 m (3280 ft)
3.4 Gb/s (HDMI 1.3, 1.4)	150 m (500 ft)	250 m (820 ft)	500 m (1640 ft)

The above table shows the maximum possible cable lengths based on data rates for 1080p resolution with normal 8-bit color per HDMI 1.2a, as well as deep color per HDMI 1.3 or 1.4, versus different cable constructions. The max specified distances disregard inter-pair skew. A maximum inter-pair skew of $0.6 * T_{\text{pixel}}$ (as required by HDMI specifications) would limit the max distance to 600 meters regardless of cable construction at 1080p resolution. However, most HDMI equipment can tolerate skews larger than that.

5.4 Status of LED Indicators

- PWR:** Solid GREEN –Unit is in operation.
OFF – Unit is off or not operational.
- LINK:** Solid RED – Optical link has been established between the sender and the receiver.
OFF – Optical link has not been established between the sender and the receiver.
- SOURCE:** Solid GREEN – Source detected on the sender.
OFF – No source detected on the sender.
(Note that for Source #3 VGA input, due to the built-in Converter, the source LED will be lit regardless of connection of VGA input)
- HPD:** Solid RED – Hot plug detect is active (there is a monitor plugged to the remote unit and/or it is turned on).
OFF – No hot plug detect is present (there is no LCD connected to the remote, or it is off).
- VIDEO:** Solid GREEN – There is TMDS clock (digital video is coming from Source)
OFF – Source is not outputting digital video.
(Note that for Source #3 VGA input, due to the built-in Converter, the source LED will be lit regardless of connection of VGA input)

6.0 Operation

The HR-733-S has 4 buttons and an LCD display on the front panel which allows users to easily navigate through the menu and change the settings.

6.1 Front Panel Buttons

The 4 buttons are used to do the following tasks:

- The **UP** and **DOWN** buttons indicated by ▲ and ▼ can be used to navigate through the menu and to adjust the setting.
- The **ENTER** button when pressed will go into the selected menu. It is also used to save the setting when you exit.
- The **MENU** is used to exit to the previous menu without saving the setting.

NOTE

- ▶ *Symbol on the LCD is used to indicate the currently selected option*

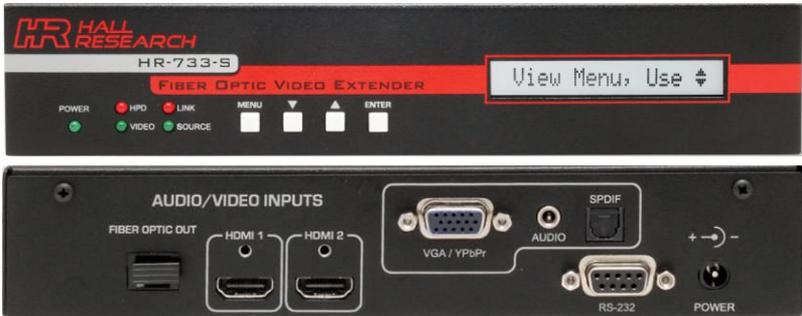


Figure 4 – HR-733-S Front and Rear Views



Figure 5 – HR-733-R Front and Rear Views

6.2 HR-733-S LCD Menu System

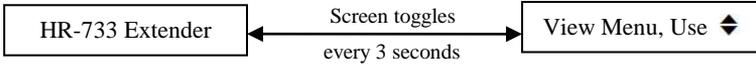


Figure 6 - Idle Menu

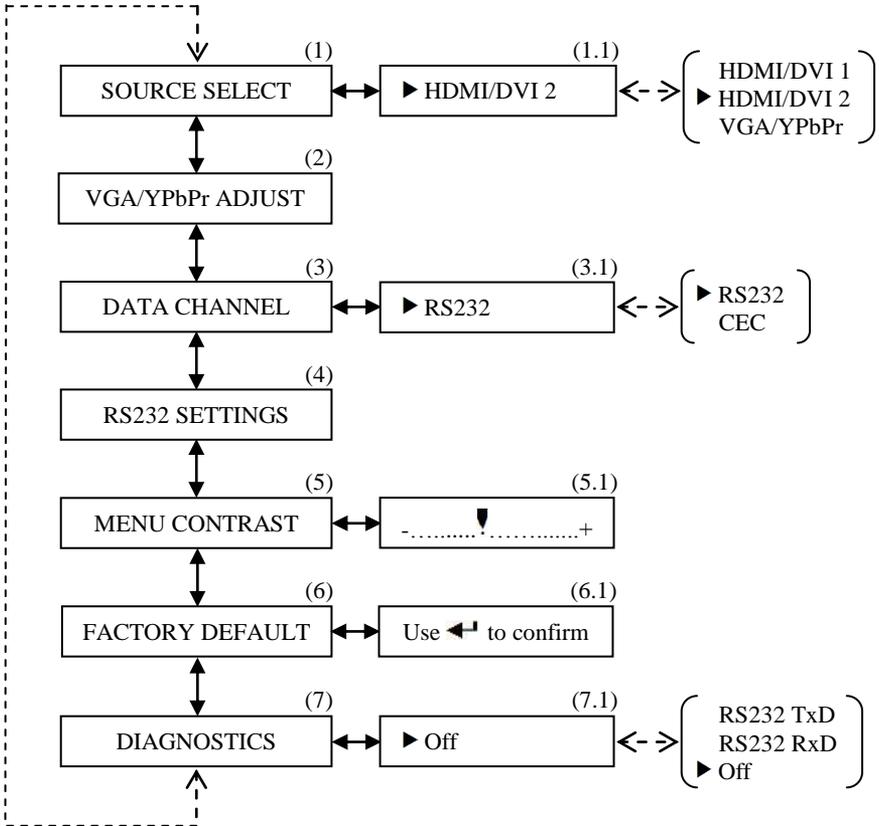


Figure 7 - Top Level Menu

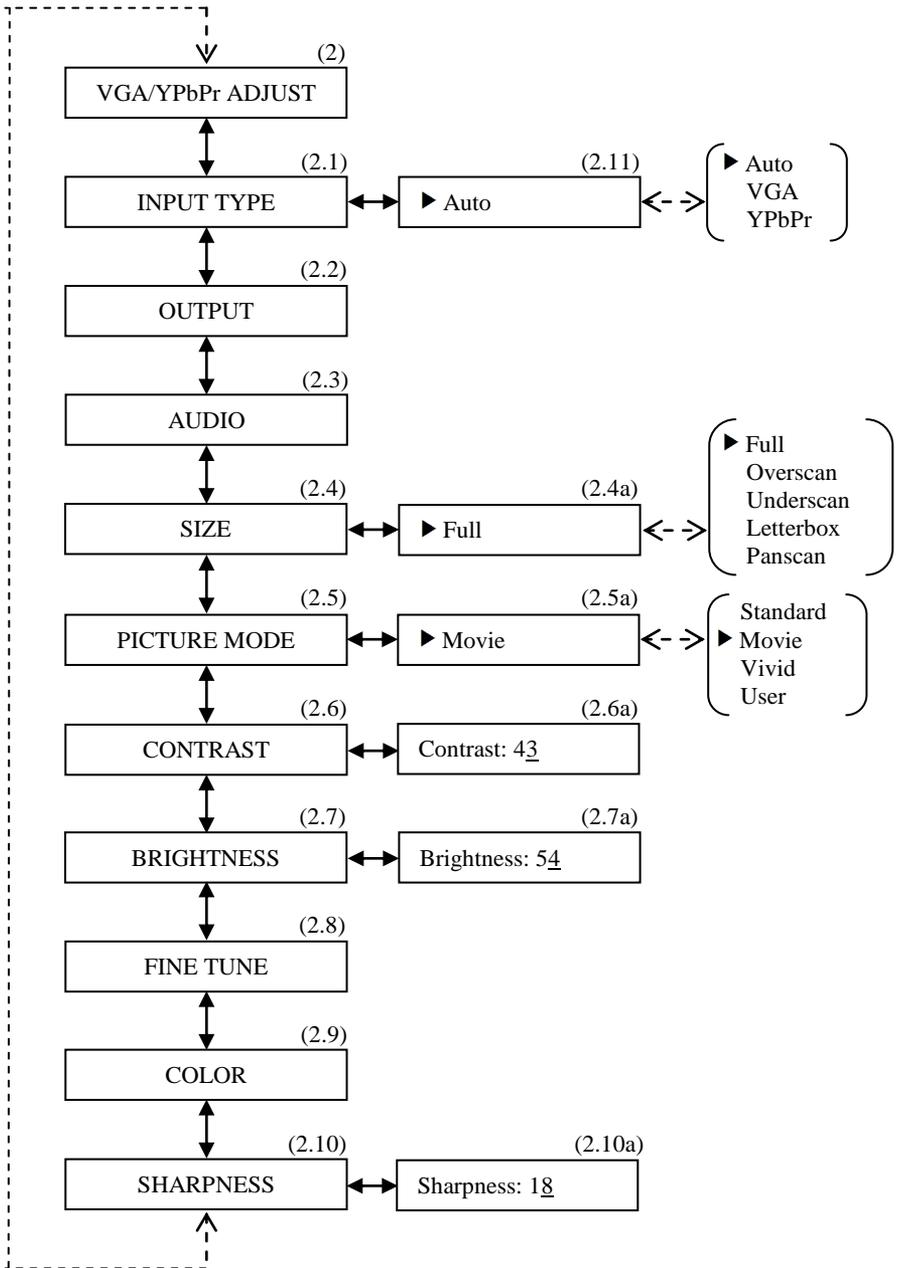


Figure 8 - VGA/YPbPr Menu

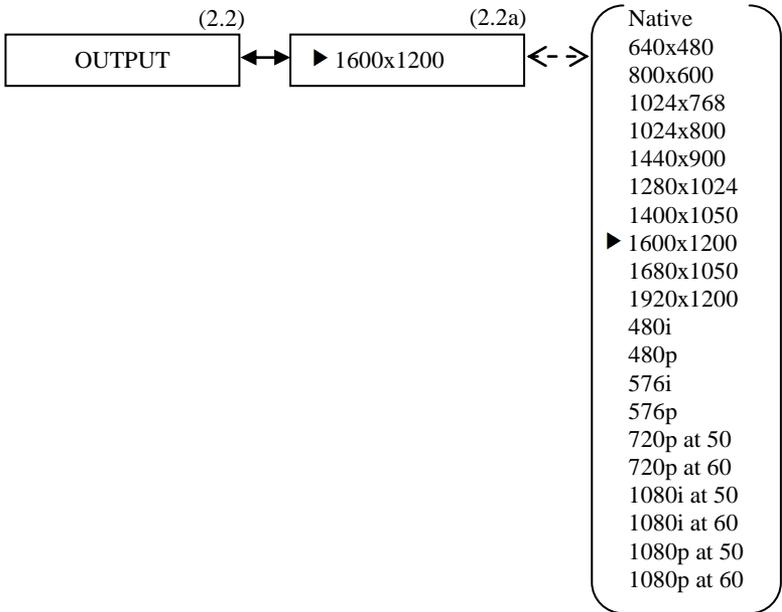


Figure 9 - VGA/YPbPr Output Resolution Menu

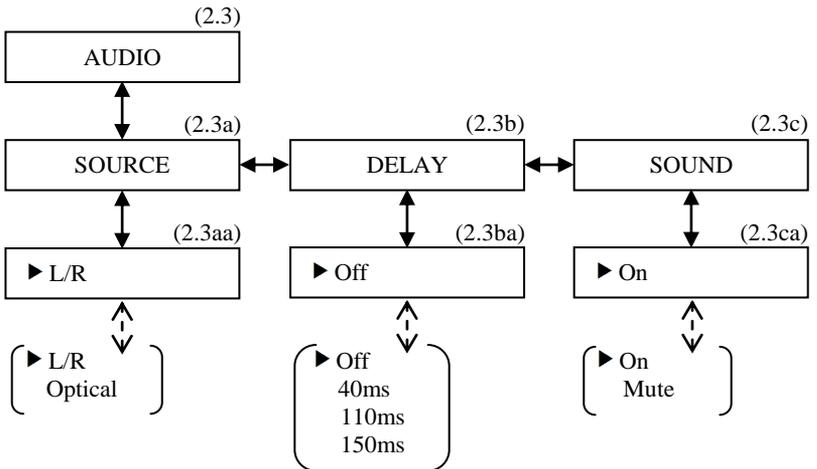


Figure 10 - VGA/YPbPr Audio Menu

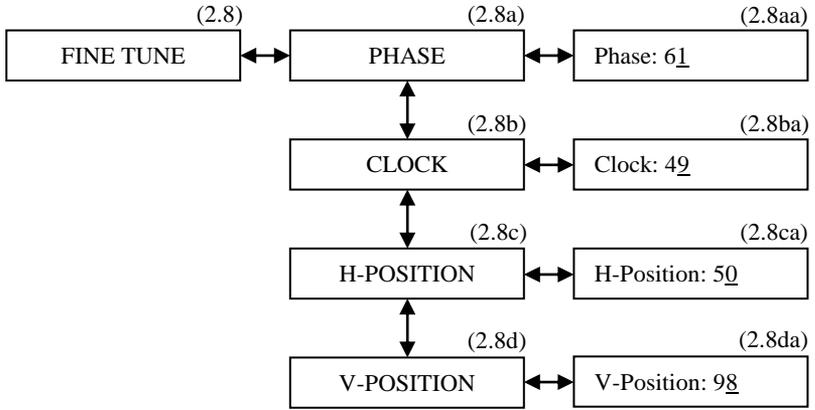


Figure 11 - VGA/YPbPr Fine Tune Menu

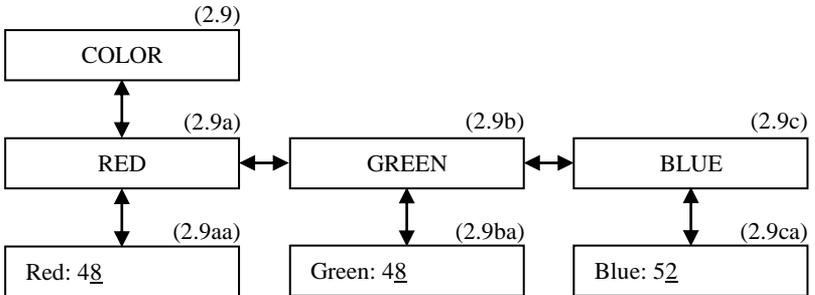


Figure 12 - VGA/YPbPr Color Menu

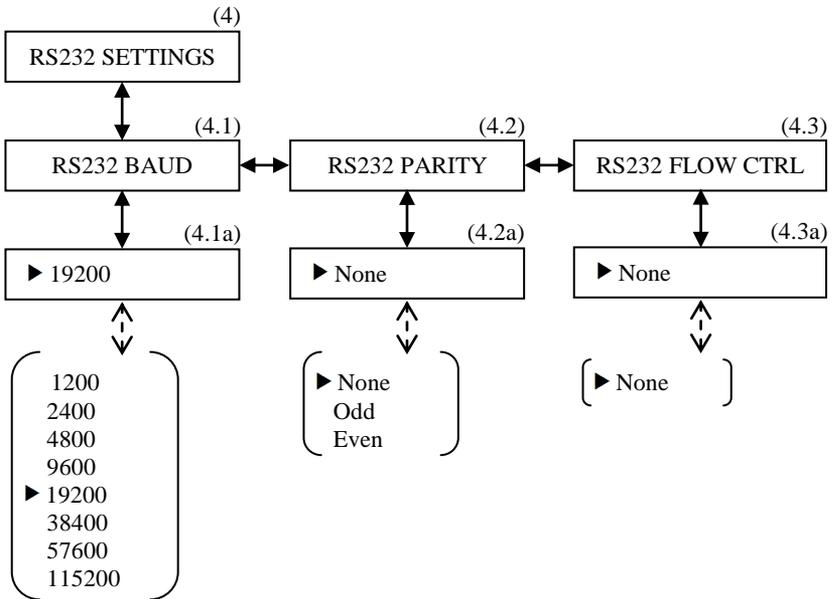


Figure 13 – RS-232 Settings Menu

NOTE

If there is no user activity for 1 minute, the idle menu will be shown and LCD backlight will be off. Pressing any button will take the user back to the previous menu.

6.3 LCD Menu Detailed Descriptions

The following paragraphs explain in further detail the function of each menu choice. The numbers in parenthesis () refer to the corresponding menu level in figures 6 through 13 in the previous section.

(1) **SOURCE SELECT** – This menu allows the user to select one of the three input sources: **HDMI/DVI #1**, **HDMI/DVI #2**, or **VGA/YPbPr**.

(2) **VGA/YPbPr ADJUST** – This menu gives the user the ability to fine-tune the way input #3 (VGA or component YPbPr) is converted into an HDMI or DVI signal. The unit can embed an associated audio in to the video. The audio can be either L/R analog on 3.5mm mini stereo or digital SPDIF on TOSLINK connector.

(2.1) **INPUT TYPE** – This is used to specify the type of analog video that is going to be fed to the unit. Select either a PC analog VGA or

component YPbPr input as the source. It can also be set to **Auto**. In auto mode the unit will try to determine if the input is VGA or YPbPr. This is the default setting.

(2.2) OUTPUT – This allows the user to select the output resolution from a large selection of possible settings. The output setting is independent of the input timing and resolution. The output resolution setting can automatically match the native resolution of the display that the receiver HR-733-R is connected to, or may be specified by the user.

(2.3) AUDIO – The audio source of VGA/YPbPr can be either a line level analog as **L/R** or optical digital as **Optical**. The audio source can be set to **40ms**, **110ms**, or **150ms** delay for audio/video synchronization/timing alignment. If needed, the audio source can be set to **Mute**.

(2.4) SIZE – The video image of VGA/YPbPr source can be set to various sizes such as **Full**, **Overscan**, **Underscan**, **Letterbox**, and **Panscan** to enable users to adjust displayable area of some displays if needed.

(2.5) PICTURE MODE – This is used to adjust color and picture settings of the VGA/YPbPr input source to one of the options such as **Standard**, **Movie**, **Vivid**, and **User**. You can change the picture mode to get the best picture from different sources in different environments.

(2.6) CONTRAST – This is used to set difference between light and dark areas.

(2.7) BRIGHTNESS – This is used to brighten or darken the picture of the VGA/YPbPr input source.

(2.8) FINE TUNE – This menu can be used to fine tune to picture of the input source such as **PHASE**, **CLOCK**, **Horizontal**, and **Vertical Position**.

(2.9) COLOR – This menu enables the user to use advanced settings to adjust the color of the picture including **RED**, **GREEN**, and **BLUE**.

(2.10) SHARPNESS – This is used to sharpen or soften the picture.

(3) DATA CHANNEL – This menu gives the user an ability to choose the data path between the sender and the receiver as either **RS232** channel or **CEC** (Consumer Electronic Control) channel. When RS232 channel is selected, serial data can be transmitted in both directions between the sender and the receiver. If the CEC channel is selected, the CEC is used for basic automatic control between HDMI input source from the sender and HDMI output source from the receiver.

The RS-232 connection to the sender always operates at fixed 9600 baud, whereas the receiver baud rate and parity can be set to match the device (projector or other display) that it is connected to.

The reason the sender baud rate is fixed, is because the RS-232 can also be used to specifically control the sender functions (such as selecting input source channel, please see sections 5.4 through 5.6).

(4) RS232 SETTINGS – This menu allows users to set a specific baud rate and parity for the receiver to control a projector or other serially controlled device. Remember the baud rate of the Sender is fixed at 9600

(5) MENU CONTRAST – This is used to adjust the front panel LCD contrast.

(6) FACTORY DEFAULT – This is used to set all settings of both the sender and the receiver back to factory defaults. Once you get in this menu, the **ENTER**  button can be pressed to set the HR-733 to factory defaults.

(7) DIAGNOSTICS – The diagnostic feature can be turned on to display the serial data transmitted or received at the RS-232 port of the sender. This feature is turned off by default.

6.4 More on RS-232

The RS-232 pin-out on the Sender and Receiver are shown below.

DB9-Female on HR-733-S	
Pin	Function
2	TX (output)
3	RX (input)
5	Ground

DB9-Male on HR-733-R	
Pin	Function
2	RX (input)
3	TX (output)
5	Ground

The HR-733 provides users the ability to control some of the features of the Sender (such as input source selection), and if the data channel link to the remote Receiver is set for RS-232 rather than CEC (in menu 3.1), then the RS-232 port can also transmit or receive any serial data between the sender and the receiver.

Note on RS-232 port availability on your PC

Most PCs and notebooks do not have a serial port. So to program the Switch you may need a USB to RS-232 Serial converter. These are available from Hall Research (Model USB-RS232-1).



In a typical application the remote receiver is connected to a display or a video projector. In this case the RS-232 pass-through feature is used to control the remote display (such as turning it on or off). Depending on the specification of the remote display, the baud rate of the remote unit can vary. Through the OSD menu of the HR-733 or the serial port in command

mode, you can specify the remote unit's serial parameters (baud-rate and parity). However, please note that the Sender's baud rate is fixed at 9600. In this way the PC or other serial device (such as touch-screen control system) uses 9600 baud rate to communicate with HR-733-S. The system takes care of baud-rate changes that are needed at the remote end, and using FIFO buffers ensures no data is lost.

The RS-232 port on the sender can also control the sender in command mode. This is done by appending a special set of characters to the serial data that is sent to the HR-733-S.

6.5 Using the HR-733-S in Command Mode

If the data received at the serial port contains ==> (equal, equal, greater than), then the Sender will interpret it as start of a command sequence. In this mode you can specify one of the commands described in the following section. The unit will stay in command mode until it gets a Carriage Return <cr>. Once a command is executed, the unit will go back to Serial pass-through mode (if data channel is configured that way). The ==> and command sequence are not transmitted to the HR-733-R remote unit.

Most commands (such as input channel selection), can be issued to the HR-733-S regardless of how its data channel is configured (CEC or RS-232 pass through). There are a few commands that cannot be executed in CEC mode as noted below.

6.6 RS-232 Control Commands

All commands are prefixed with ==>

All commands and responses are followed with a carriage return <CR>

Wrong commands will get a response of ERR1

Command: SCn stands for input Source Channel where n=(0-3,?). (0 = Blank, 1 = HDMI#1, 2 = HDMI#2, 3 =VGA/YPbPr, ? = query input)
Response: SCn

Command: PLn stands for front Panel Lock where n=(0-1,?). (0 = unlocked, 1 = locked, ? = query lock status)
Response: PLn

Command: SBn stands for Set Baud of remote unit where n=(0-7,?). (0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200, ? = query baud rate)
Response: SBn
Condition: This command can only be executed when the fiber-optic data channel is configured for RS-232. If this command is issued in CEC mode the front panel will show a notice to change to RS-232 mode, and the serial port response will be ERR2

Command: SPn stands for Set Parity of remote unit where n=(0-2,?). (0 = none, 1 = odd, 2 = even, ? = query Parity)
Response: SPn
Condition: This command can only be executed when the fiber-optic data channel is configured for RS-232. If this command is issued in CEC mode the front panel will show a notice to change to RS-232 mode, and the serial port response will be ERR2

Command: DCn stands for Data Channel configuration where n=(0,1,?). (0 = RS-232, 1 = CEC, ? = query Parity)
Response: SPn

Command: FD stands for Factory Default –factory default settings will be restored. This may take as long as 7 seconds
Response: FD

Command: FW? stands for Firmware Version query
Response: FW Version #

7.0 Troubleshooting

Make sure that all of the connections to the units are solid, and check the state of the LED's on the front of the unit. Do not open or try to repair the unit yourself. There is no customer repairable item in the unit and you will void your warranty.

Contact HR Support at 714-641-6607 or via email or web. If you need to ship your unit for repair, make sure to get a Return Material Authorization (RMA) number first.

8.0 Specifications

Video Inputs 2x HDMI or DVI, 1x VGA or YPbPr

Supported Resolutions PC from VGA to WUXGA, HDTV from 480i to 1080p

Audio Inputs 3.5mm stereo, TOSLINK optical for VGA/YPbPr

Optical Wavelength 780 nm to 980 nm

Optical Cable Simplex (only 1 fiber) Multi-Mode. OM2 or OM3

Temperature Operating: 32 to 122°F (0 to 50°C);
Storage: -40 to +185°F (-40 to +85°C)

Enclosure HR-733-S: Steel, HR-733-R: Steel & Aluminum

MTBF 90,000 hours (calculated estimate)

Power 5V DC, 2.6A

Size Sender: 1.66 H x 8.2 W x 7.826 D (4.2x20.8x19.8 cm)
Receiver: 1.25 H x 2.75" W x 4.28" D (3.2x7.0x10.9 cm)

Weight Sender: 2.7 pounds (1.22 kg)
Receiver: 0.4 pounds (0.18 kg)



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