

**Model HR-731-S
Fiber optic Video Sender**

**Extend HDMI™ or DVI
and RS-232 over a Single Fiber Optic Cable**



UMA1208 Rev 2

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This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer’s instructions, may cause interference to radio communication. It has been designed to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are intended to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at their own expense will be required to take whatever measures may be necessary to correct the interference. Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.



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1.0 General

Thank you for purchasing the Hall Research HR-731-S fiber-optic video Sender (transmitter). The Sender is normally sold as a kit together with a compatible receiver under Model # HR-733. The HR-731 extends HD video along with bi-directional RS-232 (for control).

The HR-731-S extends the HDMI video with no compression on one multi-mode fiber to a remote receiver up to 1,000 meters away. It supports embedded audio on the HDMI, and all single-link DVI and HDMI resolutions to including 1080p and beyond. Deep color and 3D formats are also supported.

Higher resolution and video with non-standard resolution can also be extended, however for resolutions above 1080p@60 the maximum cable length is reduced. For example 4K@30 (UHD) video can be extended to 300 meters on OM3 (50 micron) fiber, and 2560x1600 @ 60 can be extended to 400 meters on OM3 (50 micron) fiber, 200 meters on OM2 (50 micron), or 100 meters on OM1 (62.5 micron) fiber.

The HR-731 also extends a bi-directional data channel for device control. This data channel is user selectable to be either CEC (Consumer Electronics Control) or RS-232 (mutually exclusive). As shipped the device is configured to extend RS-232, however the user can set the mode for CEC. An LED on the Sender indicates the operating mode.

The RS-232 port on the Sender operates at a fixed 9600 baud. The sender's baud rate cannot be changed. As shipped the Receiver's baud rate is set at 19200, however the receiver side's baud rate is user settable and can be set to any standard rate in the range of 1200 to 115,200. Both sides incorporate data FIFOs to accommodate the differing data rates at each end.

The RS-232 port on the sender can also be used to make configuration changes (e.g. select data channel mode or change the Receiver's baud rate). Since normally all control data that is received by the RS-232 port of the sender is automatically extended and transmitted to the remote Receiver, a special sequence of characters is used to identify the sequence is a configuration command (which will not be extended). When using the configuration commands, both ends need to be connected and linked.



Figure 1 – Model HR-731-S Sender Front and Rear

2.0 Features

- ✓ 1 HDMI input
- ✓ 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)
- ✓ Status indication of fiber-optic link, Source video, RS232 or CEC extension
- ✓ Bi-directional RS-232 data transmission between the sender and the receiver
- ✓ RS-232 control of the data channel selection and setup
- ✓ Safety interlock does not turn on high-power fiber LED drivers unless fiber-optic cable is plugged in at both ends
- ✓ 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-731-S and HR-733-R are properly grounded.



4.0 Theory of Operation

The Sender HR-731-S provides an HDMI input with audio embedded in the video on the same connector.

The video data is transmitted on only one multi-mode fiber. A multi-mode fiber (rather than single mode) is required since the TMDS video data is 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. For safety reasons, these lasers are not turned on if no cable is plugged in at both the Sender and Receiver.

Additional (non-video) hand-shake 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 designated by the user to be either RS-232 pass-through or CEC as defined by HDMI specifications. By default the HR-731 uses the data lane for RS-232 control. Note that in CEC mode, the RS-232 connector on the Remote does not serve any function but the RS-232 port on the Sender can still be used for configuration changes.

5.0 Installation

HR-731 kit is comprised of a HR-731-S sender and a HR-733-R receiver.

The following block diagram depicts an HR-733-S as a sender. The HR-731-S only has one video input. The receiver is the same for both senders.

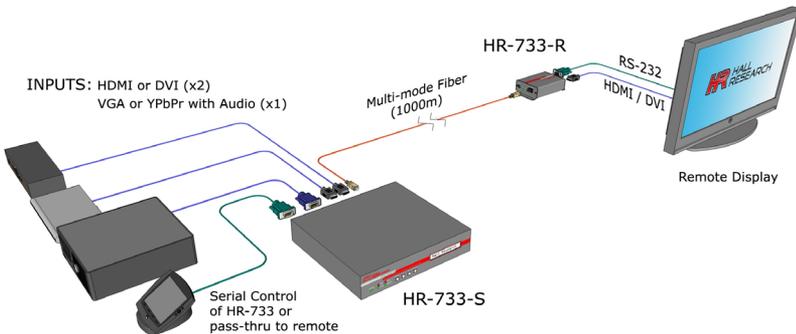


Figure 2 – Block Diagram (HR-731-S only has one HDMI video input)

5.1 Required Cables

- 1 HDMI cable to connect an HDMI source to the HR-731-S
- HDMI cable to connect the HR-733-R to the HDMI display
- RS-232 DB9 male-to-female (straight-through) cable to connect the HR-731-S's serial port to a PC
- Multi-mode (OM2 or OM3) fiber-optic cable

5.2 Fiber Optic Cable Requirements

Both the Sender HR-731-S and the Receiver HR-733-R use a single SC connector and require a multi-mode fiber-optic cable. The extender 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, as well as 16 bit deep color per HDMI 1.3 or 1.4, for different cable constructions.

5.3 Status of LED Indicators

- LINK: ON – Optical link has been established between the sender and the receiver.
OFF – Optical link has not been established between the sender and the receiver.
- VIDEO: ON – There is TMDS clock (digital video is coming from Source)
OFF – Source is not outputting digital video.
- CEC: ON – CEC mode is on. OFF – Not in CEC mode.
- RS232: ON – RS-232 mode is on. OFF – Not in RS-232 mode.

6.0 Operation

The HR-731-S operates with a +5V power supply.

The HR-731-S has an input for HDMI source connection and a RS-232 port for bi-directional data transmission between the Sender and the Receiver.

A fiber optic output connector is used to extend the HDMI signal to the Receiver HR-733-R via a fiber optic cable up to 1000m.

The LINK LED will be on when there is an optic link between the Sender HR-731-S and the Receiver HR-733-R. If no link is established between them, it will be off.

The VIDEO LED will be on when there is a video source displayed on the sink LCD.

The CEC and RS-232 LEDs are used to indicate the mode the data channel is set to. By default they are in RS-232 mode. However, they can be switched to either mode by sending a serial command **==>DCn<CR>** to the Sender (see section 6.2).



Figure 4 – HR-731-S Front and Rear Views



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

6.1 More on RS-232

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

DB9-Female on HR-731-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-731-S provides users the ability to set the mode of the data channel, recall factory defaults, or change the remote receiver's serial baud rate (and parity).

The RS-232 port on the Sender operates at a fixed 9600 baud. The sender's baud rate cannot be changed. As shipped the Receiver's baud rate is set at 19200, however the receiver side's baud rate is user settable and can be set to any standard rate in the range of 1200 to 115,200. Both sides incorporate data FIFOs to accommodate the differing data rates at each end.

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 serial port in command mode, you can specify the remote unit's serial parameters (baud-rate and parity).

NOTICE

It is important to note that when sending configuration commands to the Sender, the receiver must be connected and communicating.

6.2 Using the HR-731-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.

Some commands can be issued to the HR-731-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.

6.3 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

Not-allowed commands in CEC mode will get a response of ERR2

Command:	SBn	<i>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)</i>
Response:	SBn	
Condition:		<i>This command can only valid when the data channel is set to RS-232. If this command is issued in CEC mode, the HR-731-S responds with ERR2</i>

Command:	SPn	<i>stands for Set Parity of remote unit where n=(0-2,?) (0 = none, 1 = odd, 2 = even, ? = query Parity)</i>
Response:	SPn	
Condition:		<i>This command can only valid when the data channel is set to RS-232. If this command is issued in CEC mode, the HR-731-S responds with ERR2</i>

Command:	STn	<i>stands for Set Terminating byte/character where n=(0-255,?) (0 = none (default), 1-255 = Terminating character (or byte) has a decimal value of n, ? = query Terminating byte)</i>
Response:	STn	
Condition:		<i>This command is only valid when the data channel is set to RS-232. If this command is issued in CEC mode, the HR-731-S responds with ERR2</i>
Comments:		<i>Normally in RS-232 mode, every character received is immediately transmitted to the opposite side. By specifying a Terminating character, the device will keep all the data received in a buffer and transmit the entire string at once upon receiving the terminating character (including the terminating character). For example: to wait for a Carriage Return before sending the string, use n=13 (since CR=0D Hex, or 13 Decimal).</i>

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

Command:	FD	<i>stands for Factory Default Factory default settings will be restored</i>
Response:	FD	

Command:	FW?	<i>stands for Firmware Version query</i>
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 1x HDMI or DVI

Supported Resolutions HDTV from 480i to 1080p at any color depth, 4K30 8-bit
PC from VGA to WUXGA, 2560x1600@60 8bit color

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 Steel & Aluminum

MTBF 90,000 hours (calculated estimate)

Power 5V DC, 2.6A

Size (each) 1.25''H x 2.75''W x 4.28''D (3.2x7.0x10.9 cm)

Weight (each) 0.4 pounds (0.18 kg)



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