

A green dot is located at the top of a thin green vertical line that extends down the left side of the page.

White Paper

Understanding IT/AV and HDBaseT Control Systems

Bill Lauby

Senior Product Manager for Leviton Network Solutions

Table of Contents

Control Signals - Why We Need Them.....	3
Control Signal Options and Examples.....	4
Relays and Contact Closures (Switches).....	4
RS-232.....	5
USB.....	6
Ethernet - TCP/IP Protocol Suite.....	6
Infrared (IR).....	6
Radio Frequency (RF).....	7
HDBaseT™ Control Capabilities.....	8
HDBaseT 1.0.....	8
HDBaseT 2.0.....	8
Control Over HDBaseT.....	8
Simple Room Control Example Using HDBaseT.....	9
Conclusion.....	9

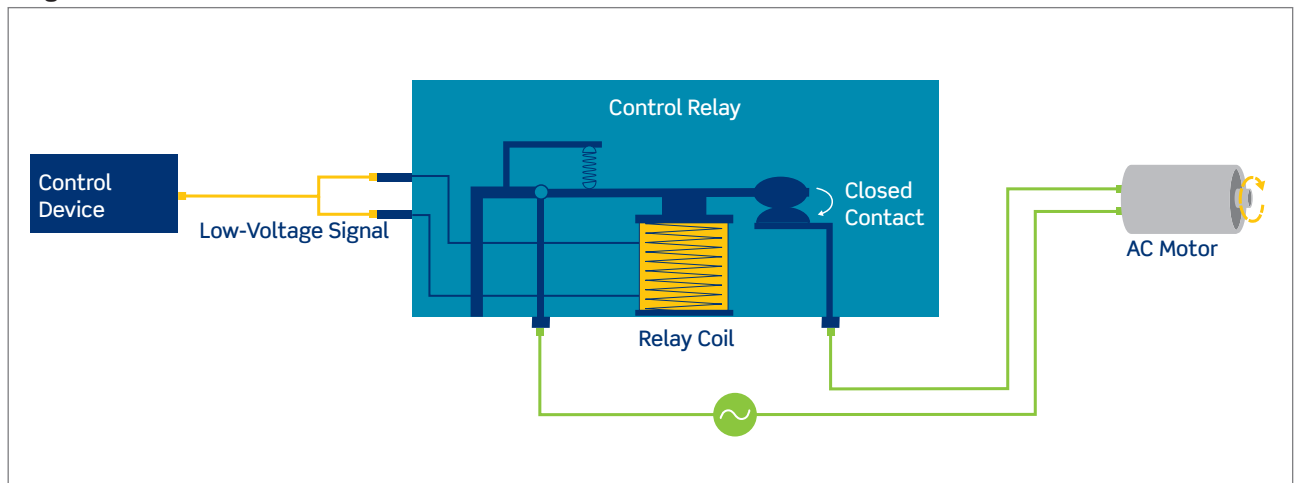
Control Signal Options and Examples

Signal control options rely on either wired or wireless signals. Wired signals include relays and contact closures (low-voltage on/off), RS-232 serial, USB, and Ethernet. Wireless signals and protocols include IR (infrared) and RF (radio), which includes Wi-Fi, Bluetooth, Z-Wave, ZigBee, and Thread.

Relays and Contact Closures (Switches)

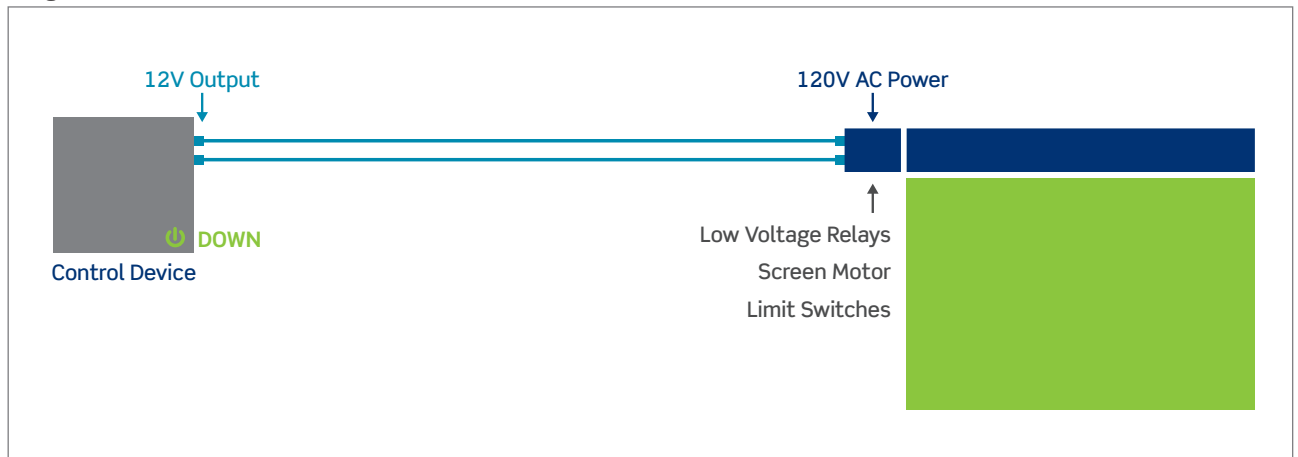
Diagram 2 illustrates the function of a relay and contact closure. A low-voltage signal from a control device energizes the relay coil so the coil becomes a magnet to close a contact, completing the circuit and energizing the motor.

Diagram 2



One typical application of relays is controlling a motorized projector screen. Diagram 3 illustrates how a low-voltage 12-volt signal can be used to activate a relay to energize the screen motor. In addition, relays are used in conjunction with limit switches to stop the motor when the screen is fully extended, and then to reverse direction and stop the motor when it is fully retracted.

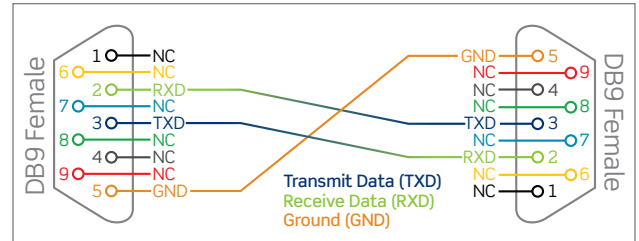
Diagram 3



RS-232

A common method for serial bi-directional communication, the three-wire RS-232 connection (diagram 4) typically supports a maximum distance of 15 meters or 50 feet, depending on the data rate. It uses a variation of voltage to provide logic 1 (mark) asserted at -3V to -15V and logic 0 (space) asserted at +3V to +15V, delivering a digital signal. Each manufacturer's device has its own protocol and command set with logic determined by the manufacturer.

Diagram 4



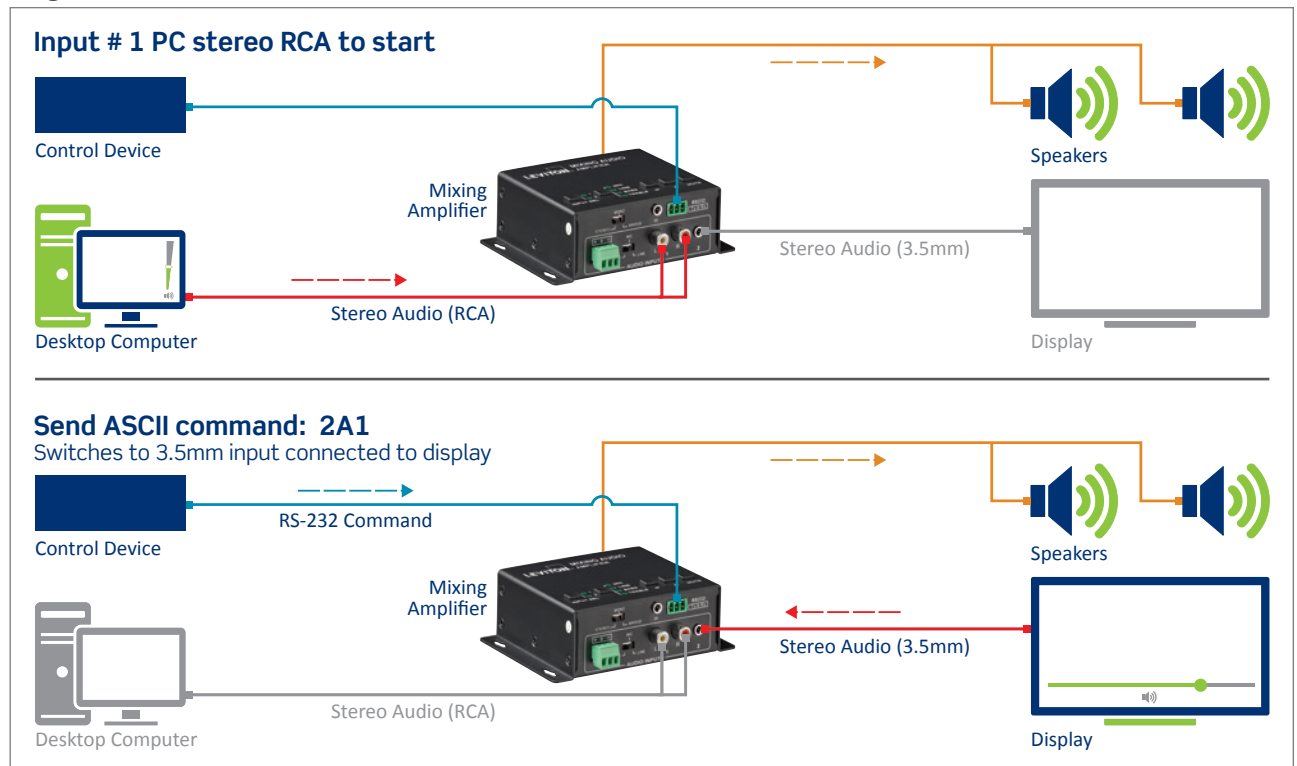
RS-232 is typically used with an AV controller with an RS-232 output. Direct communication is also an option, using a PC terminal emulation to send discrete ASCII or hexadecimal commands.



A serial command example includes switching inputs of an audio amplifier with RS-232 control capability (figure 1). First the protocol needs to be established (9600 Baud rate, 8 data bits 1 stop bit, and no parity). Once setup with an emulation program or command set, an ASCII command can be sent to switch from input 1 (stereo RCA) to input 2 (3.5mm stereo).

In diagram 5, the desktop computer is connected to the mixing amplifier via input 1 (RCA). The display is connected via input 2 (3.5mm). The control device can send RS-232 commands to the mixing amplifier to switch audio between sources and adjust or mute volume.

Diagram 5



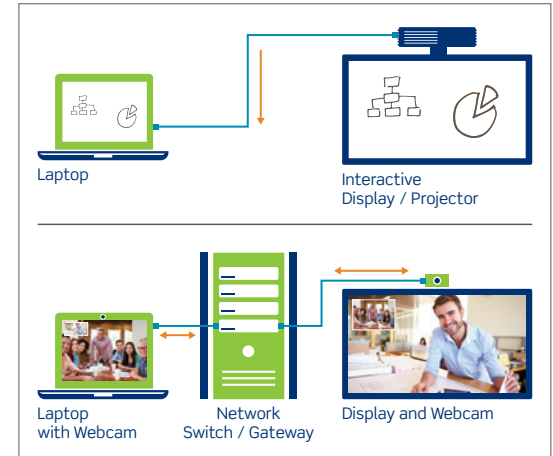
USB

The USB (universal serial bus) is a bus connection between computers and electronic devices. The computer talks to the end points in a device via streaming or messaging over logical channels, sometimes referred to as pipes. A keyboard or mouse is a good example of a message signal, sending messages back and forth to the computer. Composite devices, like webcams, instead use streaming to consistently send and receive signals from the host controller.

Common usage, as shown in diagram 6, includes:

1. A laptop connected to an interactive display or projector in a classroom, via a USB 2.0 connection, sending information back and forth between devices, or
2. A webcam connected to a PC or laptop in a conference room

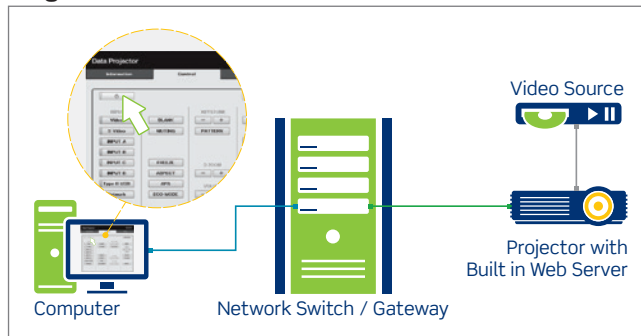
Diagram 6



Ethernet - TCP/IP Protocol Suite

Ethernet is a computer network communication that sends bi-directional, serial packet-based transmission of data. The signal is sent over category-rated cable, fiber optic, or Wi-Fi. Transmission control protocol (TCP) provides host-to-host connectivity. The Internet protocol (IP) is responsible for addressing hosts and routing packets across individual devices on the network.

Diagram 7



IP commands are created within a control software application or control server interface, and are unique to the AV device. They are typically sent between a computer or AV controller and a device on the network. This provides greater flexibility and a more scalable method of control.

In diagram 7, the computer connected to the network via Ethernet can control a projector with a built-in web server.

Infrared (IR)

IR is a modulated, one-way infrared light transmission from a transmitter to a receiver. The light pulse code, unique for each function, is converted to electrical signal pulses at the receiver.

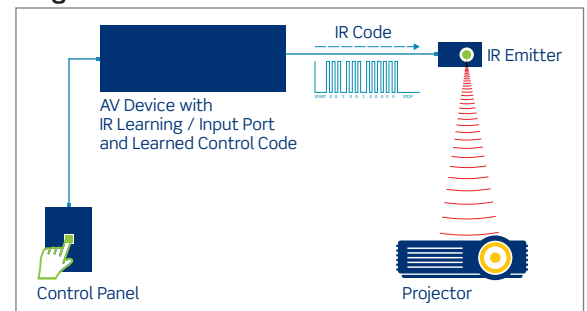
IR is short ranged (10 meters or 30 feet), requires line of sight, and can be affected by bright ambient light. However, it is a cost-effective, simple means of control. Additionally, IR control is included in nearly all consumer electronics products and in many professional AV devices. These devices often include the ability to record and send IR codes, called learning.

IR learning converts the IR pulse light from a hand-held remote control into an electrical signal that can be stored in an AV device. The signal can then be remotely sent upon command to an IR emitter directed at the AV device to be controlled.

Diagram 8 illustrates one example of controlling a projector via the learned IR code stored in the AV device.

An on/off command, for example, is sent from the control panel to the AV device. The AV device sends out a binary code to the IR emitter, which converts the electrical pulse into light and activates the projector. This function also works with an amplifier, display, or other AV devices for complete audio control.

Diagram 8

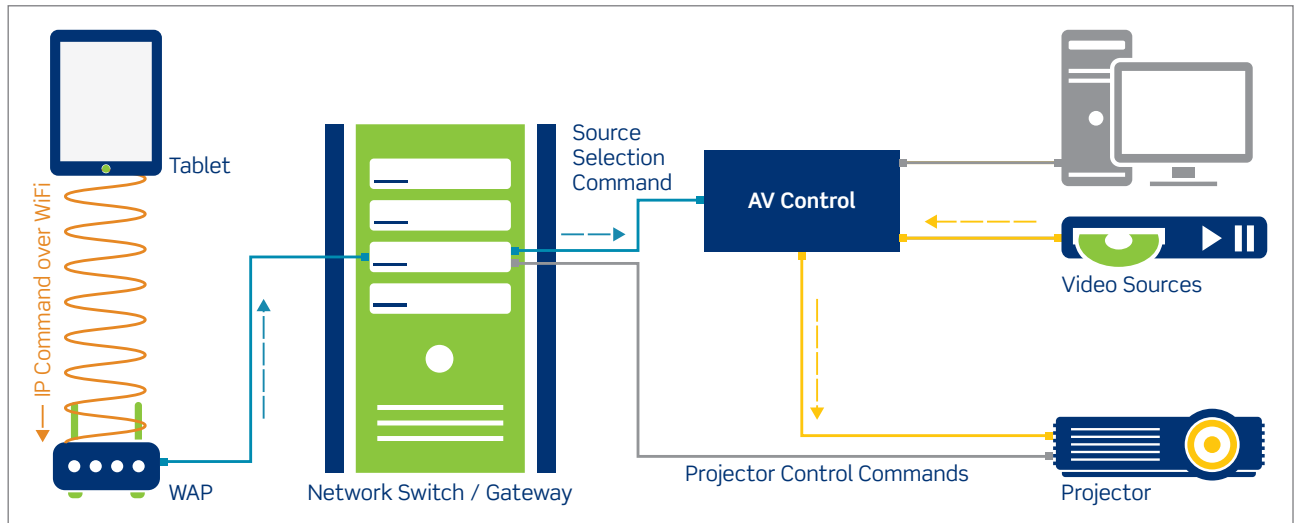


Radio Frequency (RF)

RF transmits omnidirectionally from a transmitter to a receiver. The short-range radios typically used for AV control indoors include Wi-Fi (2.4GHz and 5GHz) with a 100-meter distance capability and Bluetooth with a typical range of less than 10 meters. While RF is relatively inexpensive and easily accessible, RF signals can be diminished by walls and ceilings, require encryption to ensure security, and implementation often demands coordination with facility IT managers.

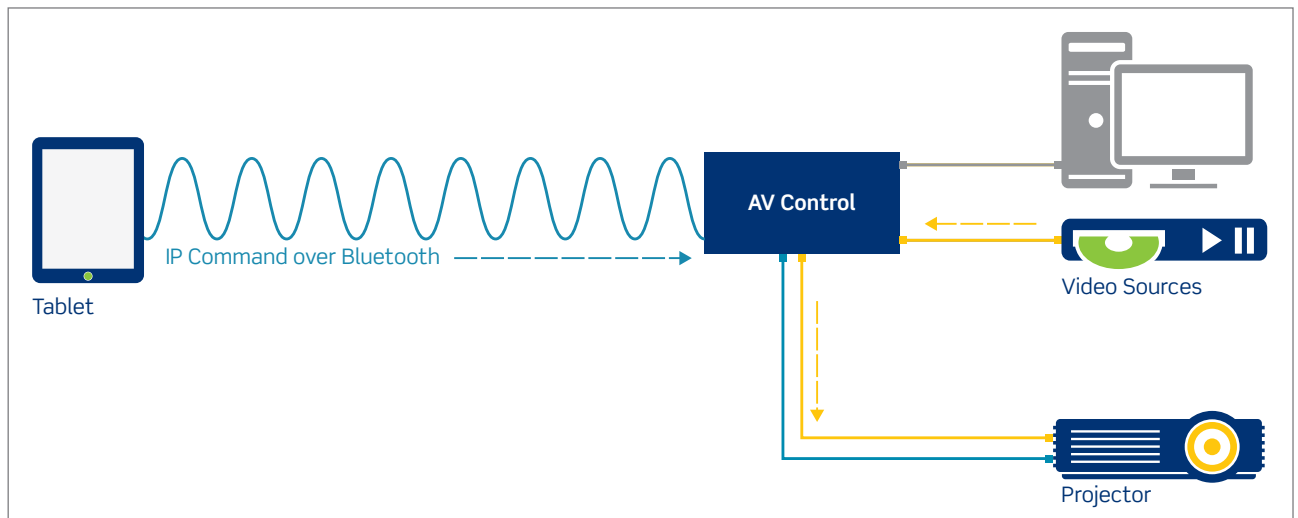
Diagram 9 illustrates a projector controlled via an RF signal. From a mobile device, such as a tablet, an IP command can be issued to a wireless access point (WAP) via Wi-Fi. The command is then transmitted through the network to the AV controller or projector. This supports remote control of projector activation and source selection.

Diagram 9



With Bluetooth, device activation and source selection can also be remote controlled. As shown in diagram 10, a mobile device, like a tablet or smart phone, an IP command transmits over Bluetooth, which is received by an AV controller to activate a projector or switch between sources.

Diagram 10



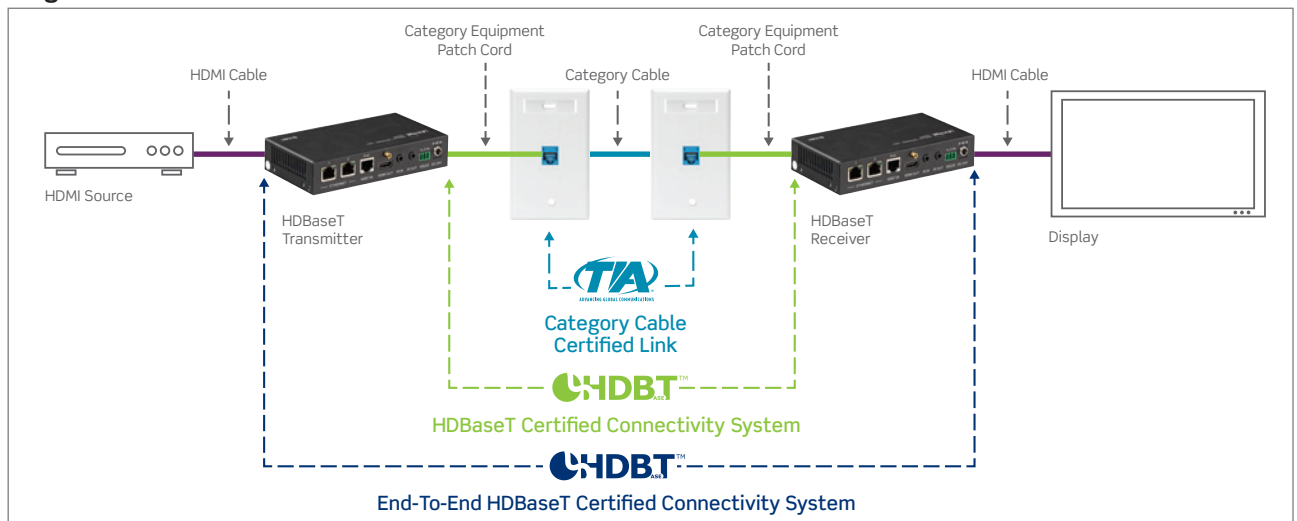
HDBaseT™ Control Capabilities

HDBaseT extends an HDMI® signal over category-rated cable, typically up to 100 meters. The HDBaseT Alliance certifies devices that incorporate this technology to ensure a reliable, plug-and-play extension of HDMI signals, and the technology is standardized by IEEE and is recognized as IEEE 1911.1.

HDBaseT 1.0

For end-to-end reliable performance, HDBaseT™ supports extension of full digital audio, HDMI uncompressed video, 100Mb Ethernet, power, and RS-232 and IR control signals over a single certified category-rated cable channel. Diagram 11 illustrates the HDBaseT channel link.

Diagram 11



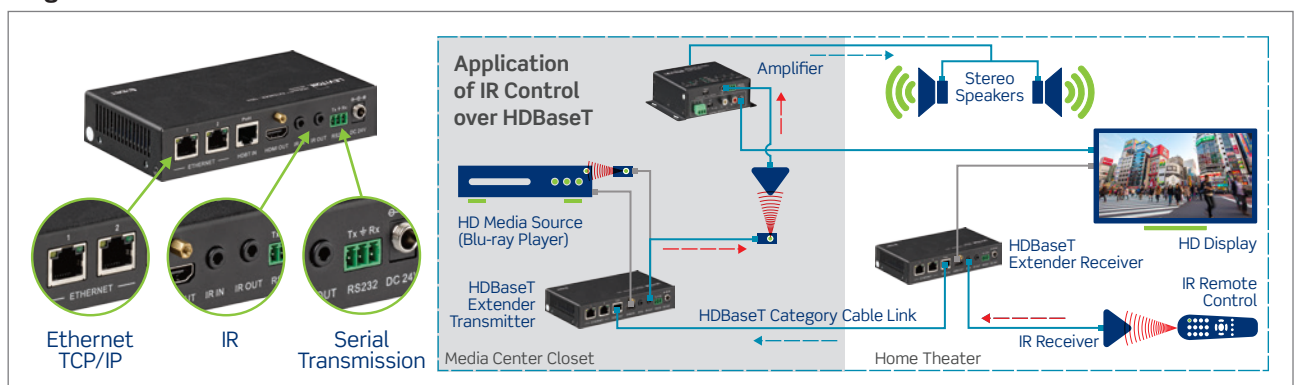
HDBaseT 2.0

HDBaseT 2.0 adds USB capability to the link, simultaneously transmitting full digital audio, HDMI uncompressed video, 100Mb Ethernet, power, RS-232 and IR control, and USB over a single certified category-rated cable channel.

Control Over HDBaseT

Since it's connected via a wired connection, a typical HDBaseT transmitter provides RS-232, IR, Ethernet (IP), and USB command capability up to 100 meters. Diagram 12 illustrates a typical HDBaseT application for IR control, demonstrating control of a complex audiovisual system over remote distances.

Diagram 12

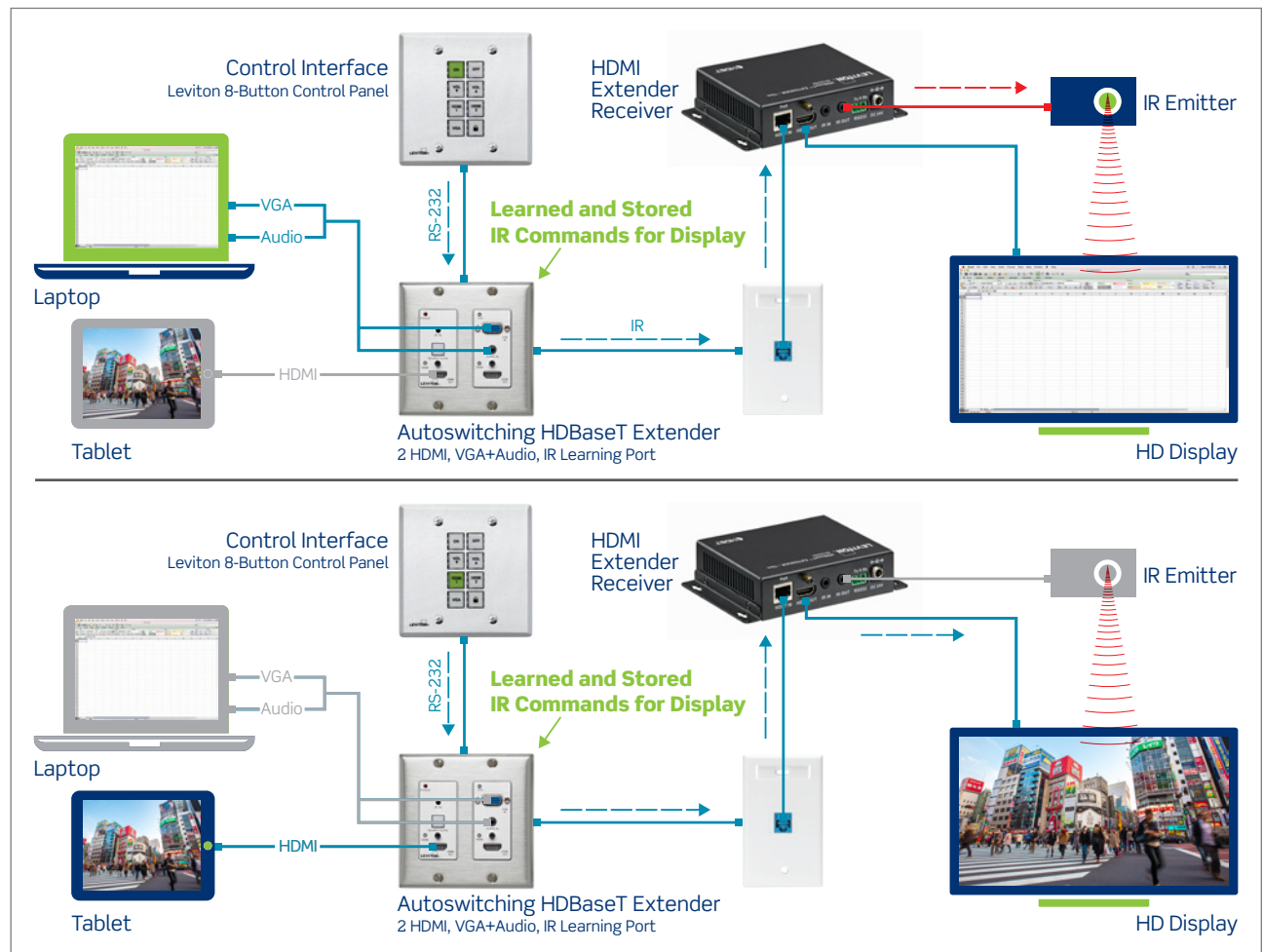


Simple Room Control Example Using HDBaseT™

HDBaseT also supports simple room control with innovative devices like the Autoswitching Wallplate, which acts as an HDBaseT transmitter and can switch between one VGA and two HDMI® sources. For enhanced room control, the Autoswitching Wallplate is designed to work in tandem with an 8-Button Room Control Panel, and can store learned IR commands to control devices anywhere in the room.

Diagram 13 shows an example of an HDBaseT room-control application. The 8-Button Control Panel transmits an RS-232 command to the Autoswitching Wallplate which transmits a learned IR command over the category cable link to an IR emitter to activate the HD display. The 8-Button Control Panel can also be used to switch sources from the laptop to the tablet.

Diagram 13



Conclusion

IT/AV control systems are the next step in HDBaseT signal extension and will further solidify low-voltage contractors as the next-generation of AV experts. 40% of contractors already deploy HDBaseT, and that number is expected to increase in the coming years.

With IT/AV room control becoming a standard feature in newer education facilities, it's easy to see the importance of becoming familiar with this technology. Gaining a better understanding of audiovisual control now will open new opportunities for revenue growth while establishing knowledgeable contractors as experts in the industry.

THE SMART CHOICE FOR A BETTER NETWORK

High-performance connectivity backed by the industry's best service and support

We invent the industry's best technologies. We build them to last. And we stand behind every product and every installation – delivering industry-leading performance and unbeatable service and support – throughout the life of your structured cabling system. Add in the peace of mind that comes from working with a stable, century-old supplier, and you get far and away the highest return on infrastructure investment.

Leviton Network Solutions Division Headquarters leviton.com/networksolutions

2222-222nd Street S.E., Bothell, WA 98021 USA

Inside Sales

T 800.722.2082

E insidesales@leviton.com

Technical Support

T 800.824.3005 / +1.425.486.2222

E appeng@leviton.com

International Inside Sales

T +1.425.486.2222

E intl@leviton.com

Leviton Network Solutions European Headquarters brand-rex.com

Viewfield Industrial Estate, Glenrothes, Fife KY6 2RS, UK

Customer Service

T +44.0.1592.772124

E customerservice@brand-rex.com

Leviton Corporate Headquarters leviton.com

201 N. Service Road, Melville, NY 11747 USA

Customer Service

T 800.323.8920 / +1.631.812.6000

E customerservice@leviton.com

Leviton International Offices

Asia / Pacific

T +1.631.812.6228

E infoasean@leviton.com

India / SAARC

T +971.4.886.4722

E infoindia@leviton.com

Canada

T +1.514.954.1840

E pcservice@leviton.com

Latin America

T +52.55.5082.1040

E lsamarketing@leviton.com

Caribbean

T +1.954.593.1896

E infocaribbean@leviton.com

Mexico

T +52.55.5082.1040

E lsamarketing@leviton.com

China

T +852.2774.9876

E infochina@leviton.com

Middle East & Africa

T +971.4.886.4722

E lmeinfo@leviton.com

Colombia

T +57.1.743.6045

E infocolombia@leviton.com

South Korea

T +82.2.3273.9963

E infokorea@leviton.com

All Other International Inquiries

E international@leviton.com

