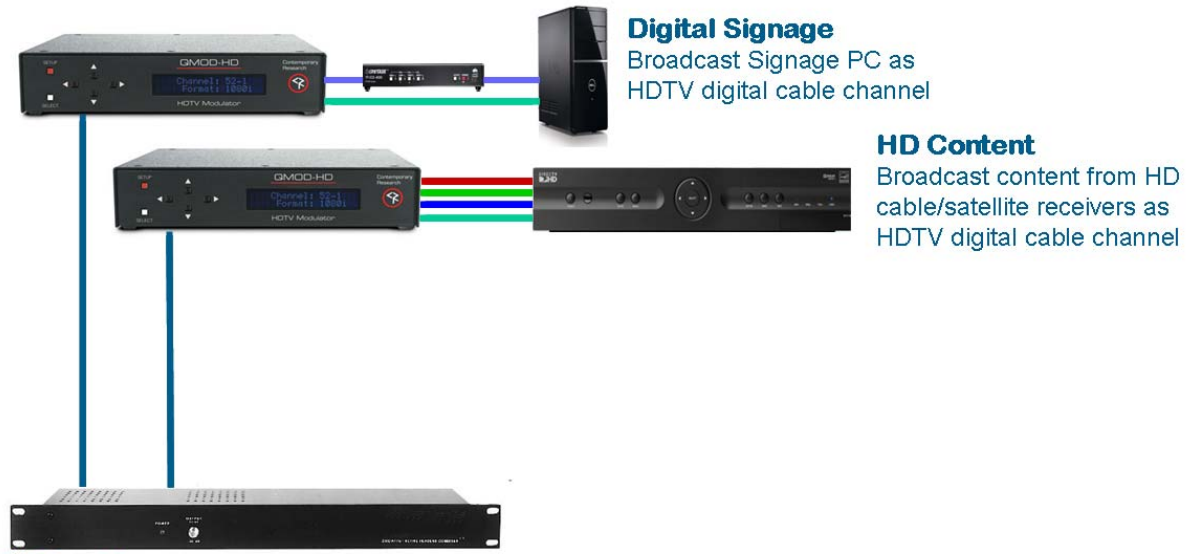
Intro to QMOD-HD Integration

November 6, 2009



Digital Signage
Broadcast Signage PC as
HDTV digital cable channel

HD Content
Broadcast content from HD
cable/satellite receivers as
HDTV digital cable channel

RF Combiner
Combine channels for distribution over broadband

Table of Contents

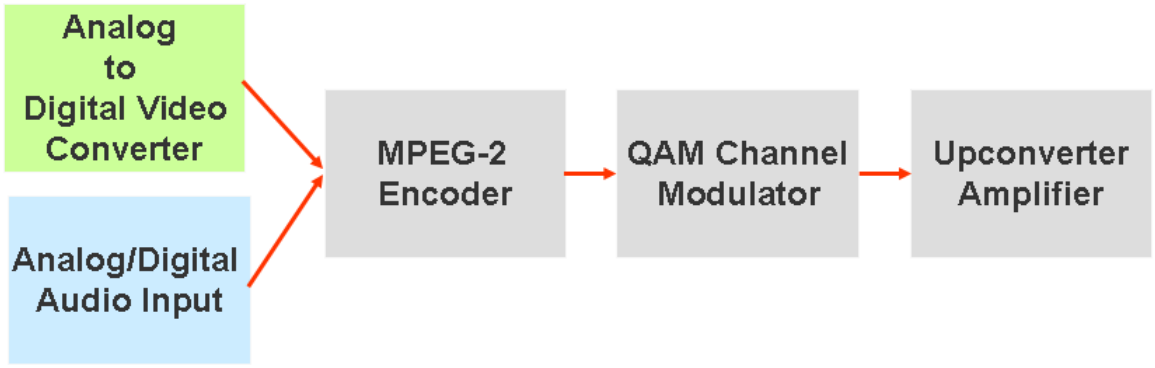
Overview

Thanks to new innovation, broadband RF over coax isn't just for TV anymore. The broadband network that exists in many sports, commercial, education, and civic facilities can be re-tasked for distribution of in-house high-definition video and audio from HD satellite and cable receivers, IP and microwave driven media – and digital signage.

A few years ago, this type of technology required a $30,000 investment per channel, down to $15,000 a year later, and is now a practical, commercial solution for less than $2500 a channel. At that cost, a wide range of new distribution and integration opportunities are possible.

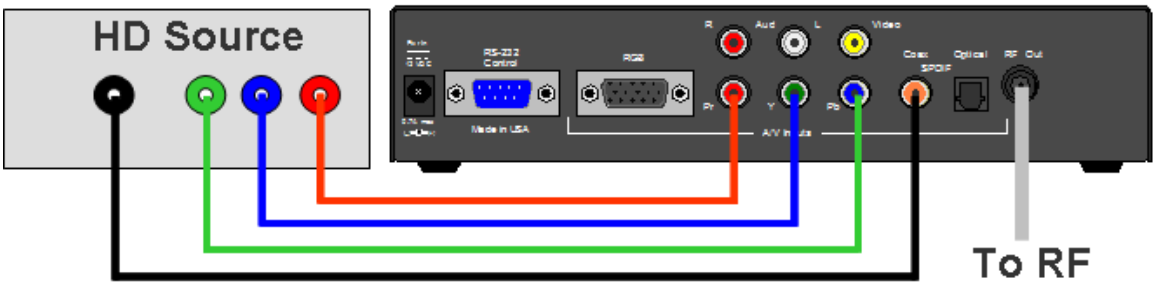
How Does it Work?

While the technology is pretty amazing, the chips and codecs that make the magic work are now available at a practical price. Older technology involved a number of separate, expensive components. In the QMOD-HD, the entire solution is integrated into one HDTV Modulator:



- **Analog to Digital Converter** scans the selected video input and converts to digital packets
- **MPEG-2 Encoder** - the video stream and audio input are merged together into a DVB MPEG-2 transport stream, 1080i/720p/480p/480i
- **QAM Channel Modulator** formats the stream into a 64 or 256 QAM digital cable channel
- **Upconverter / Amplifier** sets the channel to a specific number, then amplifies for distribution through the RF system, typically up to 30 dBmV

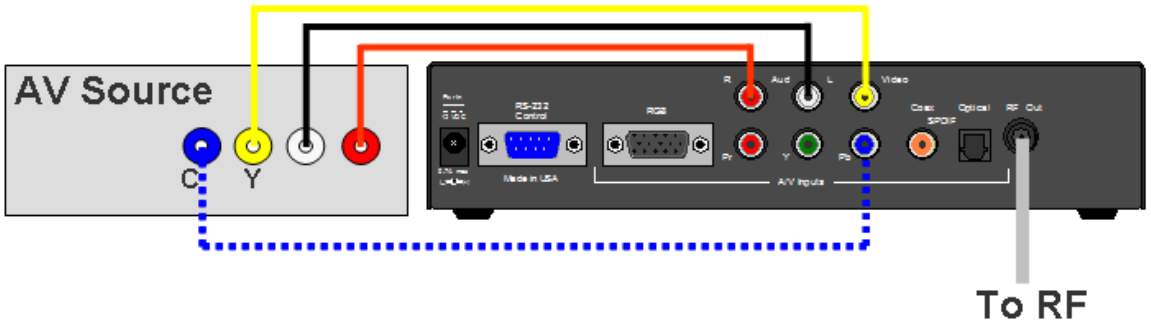
HD Component Source



The most common application for QMOD technology is to distribute the output of an HD satellite receiver or cable box.

- Connect the Component video between the two units, then either TosLink optical, coax digital or stereo audio outputs to the QMOD.
- Set the receiver to 720p or 1080i (or SD 480p)
- Configure the QMOD inputs using the Setup, Arrow, and Select buttons on the front – the LCD text will display the various menus and options
    - Select the Component input
    - Select the Audio input
    - Select the resolution to match the output of the source
    - Select the planned channel for the RF system (2-1 to 135-1)
- Connect the RF Out to a nearby display, tune to the selected channel to preview

AV Video Source



The QMOD can also handle SD video on the S-Video or composite video input at 480i. For S-Video, use the Video input for the Y, the blue Pb input for C.

Connect the source to the Video and Audio inputs, configure the QMOD to suit.

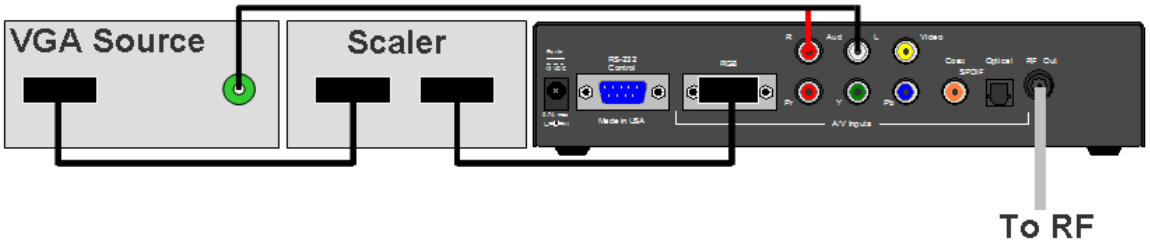
VGA Source

VGA output is handled differently, for several reasons. Similar to video projection, using a Scaler allows you to format the video exactly how you want it to be seen, instead of off to the left, right, up, down, chopped off, too small or not at all.

- VGA 1920 x 1080 and 1280 x 720 are very different standards than 1080i or 720p
- Some digital signage PCs are fixed at other resolutions, and some are 4:3 instead of 16:9
- The frequency of the signal is rarely accurate, needs to be 59.94 Hz
- The graphics of the signage presentation may run to the edges, and need to be under-scanned to fit the graphics for use with HDTV displays

For that reason, almost all PCs require a VGA Scaler that can output 1080i/720p HD at 59.94 Hz.

For the QMOD-HD, the best practice is to use a commercial Scaler such as the TV One 1T-C2-400 to condition the VGA video to HDTV standards.



Otherwise, integration for VGA is similar to Component.

- Connect the VGA output to the Scaler
- Set the Scaler for 1080i or 720p output
- Connect the Scaler VGA to the QMOD VGA input
- Connect the stereo output of the PC to the QMOD, or digital audio if available
- Configure the QMOD inputs using the Setup, Arrow, and Select buttons on the front – the LCD text will display the various menus and options
    - Select the VGA input
    - Select the Audio input
    - Select the resolution to match the output of the source
    - Select the planned channel for the RF system (2-1 to 135-1)
- Connect the RF Out to a nearby display, tune to the selected channel to preview
- Use the external Scaler or QMOD-HDS menus to position, resize, or underscan as needed.

Use of 64 and 256 QAM

The QMOD supports 64 or 256 QAM standards. While 256 sounds like it's 4 times better, it's also more susceptible to RF noise. When you're only sending one program within a channel, 64 QAM can be more noise-friendly with no change in quality. In general, start with 64, then try 256.

RF Integration

In this section, we will discuss the basics of RF distribution. We encourage integrators to learn more about RF systems, Blonder-Tongue is one company that offers many resources and seminars. In addition, providers such as Toner Cable can offer design assistance, RF distribution components, and testing tools.

Channel Architecture

In baseband video, such as video cable or Cat5 systems, one cable can carry only one signal. To deliver multiple sources or channels of media there must be a video switcher, with an input for every possible source, and an output for every possible destination.

In broadband video, or RF (Radio Frequency) systems – such as off-air TV or cable; video and audio are modulated, changed to be easily broadcast within a 6 MHz channel.

As shown above, each channel starts at a different frequency. When you change your TV tuner to Channel 5, you're selecting a different frequency. That's how TV and cable can support so many channels on a single cable. A typical in-house cable system will use about 115 channels, also called a 750 MHz system. A really well-designed system can top out at 870 MHz, older systems and coax cable types will carry less channels.

The key benefit of broadband RF is that one cable can carry all the channels, and all you need to receive them is a standard TV tuner. In the analog era, there were many trade-offs in the quality of the signal, but with HDTV, RF coax can carry HD media with much less loss from the original.

The other benefit is distance; RF coax can be driven for hundreds of feet, many miles using optical fiber. Cable providers carry channel over entire cities, so engineering an RF delivery system for homes, companies, and college campuses is not challenging.

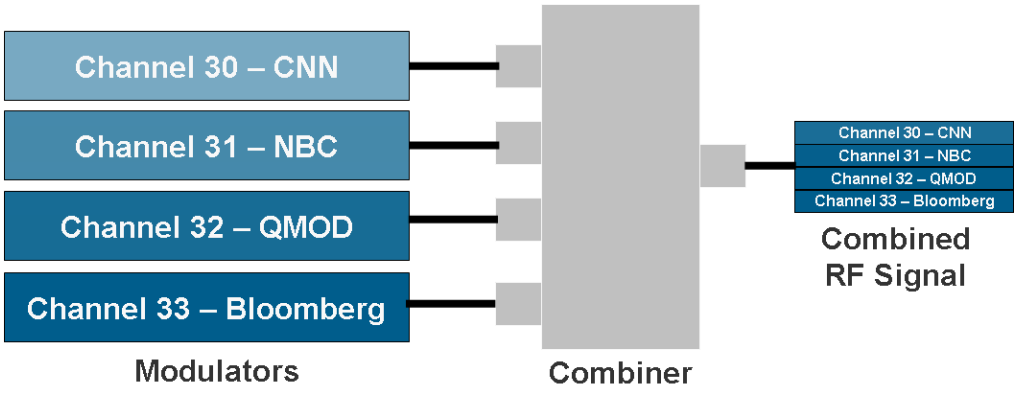
Broadband is more flexible than other AV carriers, able to combine analog, SD digital, and HD digital media.

System economy is fully scalable. You can originate a mix of analog/SD/HD modulators where appropriate. Broadband coax is easy to expand through branching – new home run wiring is not needed. Tune into channels using standard HDTV tuners. And you can manage displays and channels over the same coax using our Display Express through-the-RF control system.

Wherever you need to send a mix of channels to many destinations in one facility, allow for easy expansion, and a pathway for centralized control, broadband RF can offer a viable solution over Cat5 baseband video and IPTV.

Combining channels

Somewhere at the cable company head end, the company combined all the different cable channel modulators in to one RF delivery system.

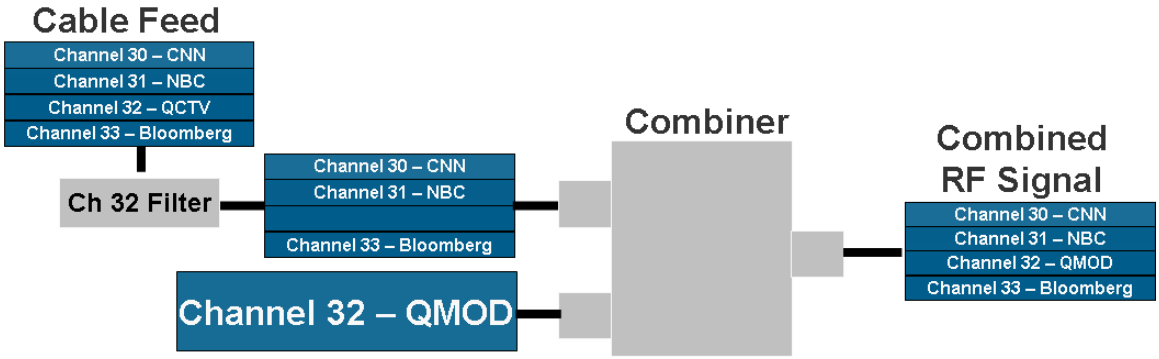


A **Modulator** receives an analog or digital video signal on one end, and converts it to single channel on the other. Each modulator can be set to a different channel.

Remember those little TV splitters you've used to drive one to four TV sets from the same antenna or cable feed? A **combiner** is the same idea – you just use it the other way. The four channels go into the four inputs on the combiner, sent out as one cable at the other end. The four channels can mix together because they are set to different frequencies, so they don't interfere with each other. Your RF equipment supplier can suggest a number of commercial combiners to use for your application.

Inserting Channels

Inserting a QMOD HD channel into the system above is a simple matter. Use a Channel Filter to block out QCTV (which nobody watches in our company) and insert the QMOD on the same frequency.



There are several variations on this design. If a cable feed has a mix of analog and digital channels, you want to block the analog channels – a digital channel can carry 12 programs, so you usually don't want to block those.

Many cable feeds don't go over channel 100, so it's often easier to go to 105 or where the cutoff is. Note that some in-house cable systems can't handle higher channels, so the right answer depends on several factors. We'll discuss those options more on the Measuring RF section.

Using and Measuring RF Output Levels

One important fact to understand is that, when combining modulators with other modulators or an incoming cable feed, the amplitude levels of all the sources must be at least roughly the same. That means you need to know what those levels are.

If the only sources are multiple QMOD units, just set them all the same level.

When combining with cable, you will want to know the level, measured in dBmV. In most applications the incoming cable goes into a main amplifier that drives the main RF system. You'll want to combine with the incoming feed with the QMOD, then feed the combined RF to the amplifier.

Very often, the end user may not know the level, or if there are clear channels on the top of the RF frequencies. To know for sure, the most practical tool is a modern RF meter. Costing between $800 and $1400 meters like the Sadelco DisplayMax 800CLI and Sencore SLM-1476 can test all sorts of things, including the signal strength of one or more channels, analog and digital channels, performance, and other tests. You can find where the cable channels end, and if there is any noise that you need to filter out.

If you have an older meter that only measures analog channels, there's a rough rule of thumb you can apply if you're mixing QMOD with cable. Measure the average strength of the analog channels. Set the QMOD to be about 6 Db down from that level. In most cases, that should do the trick.

Modulators that attempt to auto-adjust output relative RF signal strength don't work in commercial applications. Most modulators have 4-5 steps of attenuation, so auto-adjustment is not precise, anyhow. An RF meter is the only tool that can tell you exactly what the levels are in the feeds you are combining with the QMOD, the level coming out of the combiner, the level out of the primary amplifier, and what you're actually getting at taps and rooms.

You also need the meter before the proposal, so you can test the performance of the customer's existing RF system. Like any integration application, you need real tools to measure real performance in the real world.

RF Output Levels and Combiners

Note, that when you combine RF channels, there is some loss, called insertion loss. A simple 2-input combiner might drop the output a few dB. Larger 8- or more input combiners can drop much more, in the range of -12 to 18 dB. There are also a few active, multi-port commercial combiners that average less loss than similar passive combiners. Your RF supplier can supply insertion loss information for their products.

So when we say the QMOD can output about 30 Db, that power can be cut in half or more in the combining process. Also, when you're combining the QMOD with cable, you'll lower the power to match or be bit less than the analog cable channels.

Launch Amp

In classic RF design, therefore, after all the filtering and combining is done at a site's "head end" – where the system originates the RF to the building. For typical commercial applications, a "launch amp" is added after the processing gear to amplify the signal to all rooms. How much power you need depends on the design of the entire RF system.

Distribution and Attenuation

Cable

You lose power over the coax over each 100 feet. How much loss is determined by how many channels you're planning for and what kind of cable you are using. Get the free **Broadband Reference Guide** from Blonder-Tongue for full charts and other handy information.

Here's a short summary:

Cable Loss – dB per 100 feet

MHz	Channels	RG59	RG6	RG11
500	70	5.5	4.51	3.61
750	115	6.96	6.09	4.87
870	135	7.54	6.09	4.87

For practical design, use of RG11 should be limited to trunk feeds to branches where distance is a factor and you need conserve loss. RG11 has the least loss, but is harder and stiffer to work with, and most tools and connectors are made for RG6 cable.

Taps and Splitters

Every tap and splitter you add in the system adds a loss factor. How much usually depends on how many outputs are on each, the highest frequency going through, and the tap's design.

- **Splitter** – distributes input power equally to output ports, typically around 3.5 dB loss each port, usually located in a room where you split to multiple TVs or tuners.
- **Rack-Mount Splitter** – good for connecting main trunk or home-rum feeds, usually feature 24 to 36 taps, low loss.
- **Directional Tap** – In/Out ports pass on RF with little loss, 1-8 taps drop power down to connect to displays. For example, a 30 dB tap would accept a 40 dB input, deliver a 10 dB output to TVs.

A directional tap is used to extend branches, tapping off a lower-power leg while passing the bulk of the power to other areas. Consult your supplier for the best specs for your application.

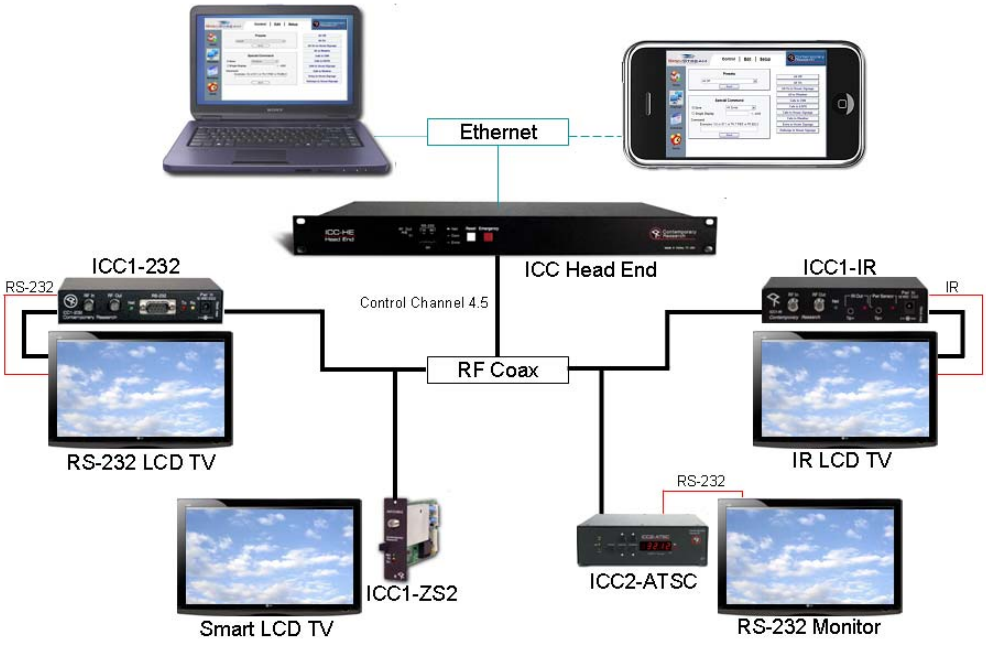
Destinations

The aim of your RF design is to deliver at least 0 dBmV for digital, 10 dB for analog to each TV. If you achieve a bit less, you have headroom. Technically, a digital tuner can tune down to -20 dBmV - in a perfect world. Any noise or reflections can stop tuning at that low signal level.

Resources

In review, there are several key resources integrators will need to effective in providing HDTV solutions.

- **RF Meter** – should be able to test both analog and digital channels, up to 870 MHz
- **Education** – The Blonder Tongue **Broadband Reference Guide** is a must-have "bible" for RF applications, available from Blonder or your RF supplier. Blonder also sponsors basic and advanced seminars for RF design – go to www.blondertongue.com to order lit and research seminars – sessions qualify for InfoComm education credits.
- **RF Component Suppliers** – a number of companies, such as Toner Cable and NSC Communications, market a variety of RF components to integrators and offer quality assistance for design and application.



Now that you've created an HD delivery system for RF, you can also integrate the displays over the same RF cable using Display Express. In IT terms, Display Express is the control layer of broadband RF. The system inserts a small control signal between channels 4 and 5, combined and carried throughout the system with the rest of the TV channels. The technology will not interfere with other TV channels, and can be carried to thousands of displays via coax cable and fiber.

Design and Install Using Three Components

The system architecture is simple, employing three types of system components.

- **Display Express Software** - delivers Web browser-based control pages that can be accessed anywhere over your network. Compatible with IE, Firefox, Opera, and Safari browsers, Web control is available from iPhones or other Internet-enabled phones.
    - Display Express PC - rack-mount PC that resides in the RF Head End
    - User PC - with installed Display Express software
    - Windows Server - software operates from network Windows server
- ICC-HE or ICE-HE Head End. Inserts RS-232 commands from Display Express into the RF system at 74.7 MHz, in between channels 4 and 5. The ICE-HE Ethernet Head End can communicate with Display Express over IP, required when Display Express is installed on a server.
- RF Controllers. Only Display Express offers open-architecture control for a wide variety of makes and models. Typical controllers include:
    - ICC1-232 RS-232 Display Controller. Use with RS-232 controlled displays with integral HDTV tuners, including LG, Revolution HD, NEC Museo, and others.
    - ICC1-IR IR Display Controller. While RS-232 control is the best solution, this controller can integrate existing TVs, and consumer IR-driven displays. Displays without discrete power commands will need an optional power current sensor.
    - ICC1-ZS2 LG/Zenith Smart Card. Inserts into LG Smart Displays.
    - ICC2-ATSC HDTV Tuner/Controller. Use with flat-panel monitors and video projectors. Provides integrated RS-232 control and HDMI/Component/RGB HD video and audio.