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The Challenges of DIY Home Theater

By Ken Wacks

In the Winter 2007 issue of *iHomes & Buildings* I explained how to optimize the home theater experience. Since then I have been helping a colleague convert a family room into a media room. This has been quite a lesson in solving practical problems that I will highlight in this article. The good news is that the home theater experience is great! However, I encountered technical challenges that could discourage do-it-yourself (DIY) installations. Many of these technical issues are the result of confusing product designs and a plethora of connection options for audio/video (A/V) components.

The home theater setup

The room for the home theater is about 10 x 20 feet with the arrangement shown in Figure 1. Equipment from two existing stereo systems was combined with new purchases to create a surround-sound system. Video was provided by a front-projection television and wall-mounted screen. The components of the audio/video system are listed in Table 1. I am omitting the brand names so I can present objective commentary.

As noted in Table 1, the DVD player, VCR, CD player, and turntable were salvaged from two stereo systems. The owner has a large standard-definition DVD collection, so opted not to buy a high-definition DVD (Blu-ray) player now. However, he did splurge on a 1080p high definition projector (1080 progressive-scan lines). I searched for a model that was rated especially good at rendering standard-definition images. Most projectors include circuitry to up-scale lower resolution inputs (480 lines for standard definition) to the native high-definition

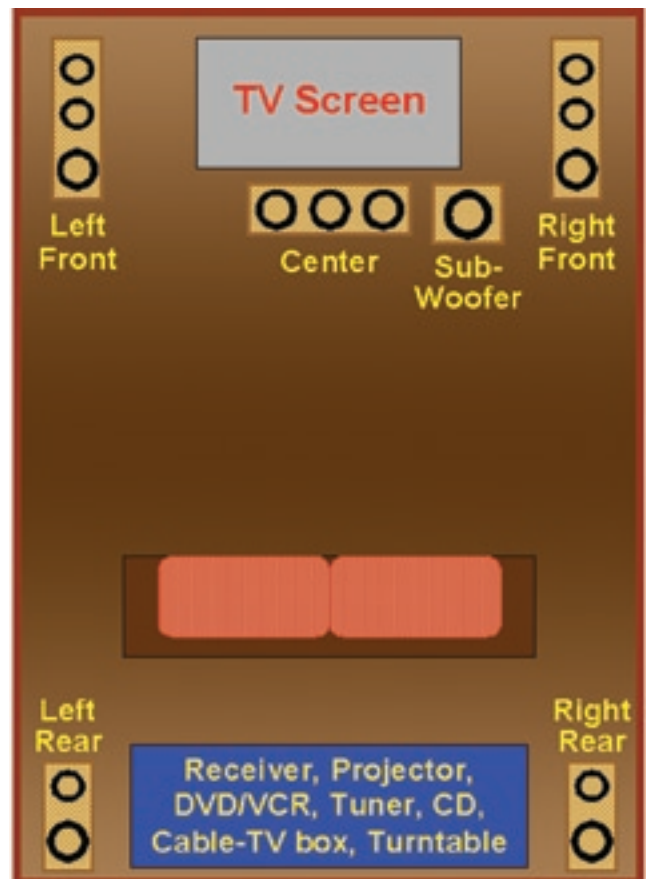


Figure 1: Home Theater Room Arrangement

progressive scan (non-interlaced) display mode. However, I found that the picture improved when I switched the DVD player to progressive scan output rather than depending on the projector to de-interlace the image.

About half the area of one wall was devoted to a 92-inch 16:9 screen (measured diagonally). There are two

Components	x = new purchase
Receiver (with AM/FM radio)	X
Front projector (16:9, 1080p)	X
Wall-mounted screen (16:9, 92")	X
DVD/VCR combination unit	
TV tuner (PC plug-in)	X
Cable-TV box	
CD player with carousel	
Audio cassette player/recorder	
Turntable	
UPS (battery + surge suppressor)	
Front stereo speakers	
Center speaker	X
Subwoofer	X
Rear stereo speakers	

Table 1 – Home Theater Equipment

sources of TV signals: a digital cable box and an HDTV (high-definition TV) tuner. The owner had recently purchased a personal computer plug-in card that tunes analog (NTSC) and digital (ATSC) broadcast signals off the air with an antenna. The ATSC tuner was able to receive all the digital TV (DTV) stations of the network affiliates in the local area. The computer includes software that implements PVR (Personal Video Recorder) functions so TV shows can be recorded onto the hard disk via remote control.

HDTV (High Definition Television) is being broadcast primarily for evening prime-time shows, network and some local news, and the late-night talk shows. The stage sets of the talk shows were stunning on the large screen; the hosts and some guests showed their age very clearly in HD! Also, the surround sound carried in HD signals via ATSC broadcast was a noticeable improvement over stereo TV sound.

All standard-definition DVD players produce images encoded in the 4:3 shape of analog TV, as do many DTV programs that are not HD. The projector controls include an option to expand the image to fill more of the

screen. As I explained last year, matching the shape of a movie to a 16:9 screen almost always leaves black bars because movies before 1952 and analog TV programs are narrower (4:3) and most movies after 1952 are wider than 16:9. Please note that I do not prefer the option available on some TVs to stretch the image to fill the screen because it distorts shapes such as actors' faces.

I am now investigating the space requirements and cost to replace the 16:9 screen with a 2.35:1 shape. This would accommodate many Cinemascope movies. Movies in 1.85:1, DTV (16:9), and NTSC (4:3) will all project with bars (so-called "pillars") on the side. Thus the aspect ratio of the screen is a compromise.

Confusing connectors

One of the major new purchases was the A/V receiver. The new generation of receivers is far different from the stereo receiver I bought in college. Not only does it support the six surround-sound speakers shown in Figure 1, it includes a selector to switch both the audio and video from the tuner and various players to the speakers and projector. Figure 2 shows the layout on the back of the receiver from the manual, while Figure 3 is photo of the actual installation.

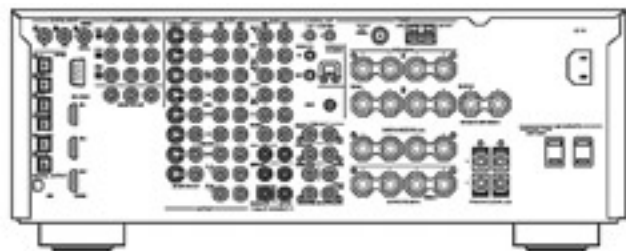


Figure 2 – Receiver Connectors



Figure 3 – Receiver Wiring

I devoted more time to determining which plugs (male connector) and jacks (female connector) to use than solving any other installation problem. In the Fall 2005 issue of *iHomes & Buildings* I wrote about this in an article entitled, "DTV: Confusing our Customers." I can testify that the confusion is real, and an incorrect choice

may work, but may degrade the image. It takes time, some experimentation, and experience to make the right choices. Therefore, I am sure that many installations have not used the best connections available, resulting in sub-optimum performance.

The picture definitely improves by upgrading the connection between the player and the receiver from composite video to S-video to component video to HDMI (High-Definition Multimedia Interface). The sound is better through the “digital coax” that carries the surround sound stream than through the stereo wires.

HDMI problems

The HDMI cable and connector were introduced to carry a high-speed digital video and audio stream between a player and a receiver and between the receiver and a TV or projector. HDMI supports uncompressed HD video, eight channels of audio with a data rate up to 10 billion bits per second (10.2 Gbps for HDMI version 1.3), and a control channel (Consumer Electronic Control – CEC). When the HDMI link works, the picture is great. But there are problems, some of them intractable.

The HDMI cables are quad-shielded with metal and plastic coatings making them heavy. A 15-foot cable weighs about three pounds. The HDMI connectors look like a large version of a computer USB connector. However, the connector does not include much friction to hold it in the jack. The cable needs to be supported so the weight does not pull the plug out of the jack. I am amazed that this practical issue had not been solved. Colleagues in the consumer electronics industry told me they encountered the same problem. Some manufacturers have introduced modified HDMI plugs and jacks that screw the plug into the jack.

The TV tuner card in the computer includes a DVI output (Digital Video Interface – a predecessor to the HDMI connector) plus a digital audio coax output. The digital audio connection to the receiver delivered excellent surround sound; the video link did not work. I converted the DVI to HDMI and plugged the cable into the receiver. The receiver was connected to the projector with another HDMI cable and properly displayed the DVD, but not the tuner signal.

I consulted three HDMI experts and got three different opinions. The projector manufacturer told me the problem is likely a design flaw in the receiver. The HDMI control signal includes handshaking that is probably not carried through the receiver properly. All the

experts agreed that the HDMI specification is complex and prone to misinterpretation by consumer electronics manufacturers. My work-around was to run the HDMI cable from the tuner directly to the projector, bypassing the receiver. However, this requires the user to change settings both on the projector and on the receiver to use the TV tuner – not a great solution.

Too many remotes!



Figure 4 – Remote Control Units for Home Theater

Figure 4 is photo of the remote controls needed to operate the home theater (from left to right in the photo):

1. The receiver remote control
2. The projector remote control
3. The tuner remote control
4. The cable box remote control
5. The DVD/VCR remote control
6. The CD remote control

The remote controls for the receiver, projector, and cable box can be programmed with some, but not all, of the functions of the other remotes.

Since the early 1980s, the Consumer Electronics Association (and the predecessor organization, the Electronics Industry Association) have been writing standards for home automation. I was told that the original goal from 1984 was to rationalize conflicting infrared codes embedded in remote control units. The manufacturers refused to cooperate, resulting in the confusion I encountered. There are some companies that make single remote control units that could accommodate many, but not all, of the features of the six remote control units needed for this home theater.

Future extensions

The home theater installation produces impressive pictures and sound. Technically, though, the installation is

not complete. The following are on my to-do list (at a low priority level):

- Calibrate the surround sound system to balance the six speaker outputs.
- Adjust the color temperature and spectrum for optimum reproduction using features included in the projector.
- Reduce the number of remote control units by combining functions where possible.
- Install an infrared repeater so the remote control units can be aimed at the screen and reach the equipment in the back of the room.
- Add some home automation in the form of remote controlled room lighting for automatic dimming when a video starts.

Advice and recommendations

Installation of a home theater using discrete components is not for the inexperienced. I recommend allocating some budget to hire an installer, or to bribe a knowledgeable friend with a good dinner. Please note that some installations may require hiding speaker

wires in the wall or behind moldings. Thus, a good installer should be familiar with the electronics, the cabling, the speaker wires, the remote control units, plus have some knowledge of carpentry and an appreciation for neatness.

In addition to setting up the electronics, the installer can recommend useful peripheral equipment such as an antenna, remote control repeater, and links into home automation for lighting and drapery operation. Retailers should recognize the business opportunity of bundling the sale of home theater equipment with professional installation. **H**

Dr. Kenneth Wacks has been a pioneer in establishing the home systems industry. He advises manufacturers and utilities worldwide on business opportunities, network alternatives, and product development in home and building systems. For further information, please contact Dr. Wacks at 781.662.6211; kenn@alum.mit.edu; www.kenwacks.com.