

Theta Digital Casablanca III HD and Casablanca IV

The Casablanca platform traditionally had a number of proprietary features that made it unique. Some of them have been replaced. What's gone? What's replaced it? And Why?

1. There are two huge improvements in the Casablanca IV: bandwidth and room correction. And two areas that could be called omissions: bass management and center channel management. Let's look at the "omissions" first:
 - a. The Casablanca platform up to and including the Casablanca 3 HD offered what was probably the most flexible bass management choices of any unit in the industry. It was capable of 3 topologies including Phase Perfect, Butterworth and Linkwitz-Riley and independent choices of high-pass and low-pass filter slopes from 1st to 4th order and a choice of 8 crossover frequencies with choices based on 1/3 octave spacing from 40 Hz to 160 Hz.
 - i. However, the unit had no way to measure frequency response and thus, no tools that would allow the user to make the correct filter choices.
 - ii. While the Casablanca III HD allowed independent crossover choices for the Center, Left/Right and Surround Channels, the Surround and Surround Back channels were tied together and were forced to have the same bass management even if it was wrong for one of the pairs.
 - iii. Thus, bass management on the Casablanca III HD gave the hobbyist ample ways to pass the time experimenting with what could be hundreds of filter choices but with no means to assess the accuracy of any other than "Doing it by Ear".
 - b. With the Casablanca IV, bass management choices have been reduced dramatically. Users may choose Linkwitz-Riley filters, only, with 2nd or 4th order low-pass filters and 2nd order high-pass filters.

The significant advantage of Linkwitz-Riley filters over all other filter types is that Linkwitz-Riley filters exhibit zero phase difference between the high-pass and low-pass filters at all frequencies. *They always match.*

In addition, the choice of crossover frequencies has been expanded to include the range from 40 Hz to 220 Hz in 10 Hz increments.

Further, crossovers may be set independently based on *all* channel pairs. Unlike the earlier Casablanca's, the Surround and Surround Back channels are now completely independent and can have separate and independent crossovers.

Finally, the biggest advantage of bass management in the Casablanca IV comes from the inclusion of Dirac Live® Digital Room Correction and Optimization.

Each Casablanca IV ships with an individually calibrated measurement microphone. Using Dirac Live and the supplied microphone, Casablanca owners (or their installers) can measure the exact response of their speakers in their room, view the results and can choose the optimum crossover point based on the actual in-room measurements.

Combining the optimum crossover topology (Linkwitz-Riley) with expanded crossover frequency choices, independent for all channels and guided by accurate measurements of their system's actual response, allows systems using the Casablanca IV to have vastly superior bass (and system) response to any based on earlier versions of the Casablanca.

2. The Casablanca III HD had a feature called Center Spread. Center Spread allowed the user to divert some of the center channel signal to the left and right main speakers. The Center Spread settings varied from having no signal to the center with all center channel information fed to the left and right speakers (essentially duplicating "Phantom Mode") to allowing increasing amounts fed to the Center Speaker until it was the same as the full L/C/R mode.
 - a. The genesis of the Center Spread feature dates back to the earliest days of home theater. Laserdiscs were the oft-used source material and center channel speakers were often not matched to the sound of the L/R speakers nor were they of the same quality. Users found that the standard "Phantom Mode" wherein all center channel sounds were sent equally to the L/R speakers worked perfectly as long as there was a single centered listener. Identical timbre was maintained as the 'dialogue channel' was reproduced by the same speakers as the L/R channel material.

Phantom Mode failed whenever there was a non-centered listener. Due to the Haas or Precedence effect, dialogue moved from being centered between the speakers to the left or right speaker, whichever was closer, destroying the illusion of an on-screen centered actor speaking from the center of the video display.

Attempts to add a non-identical or inexpensive center speaker also failed. Dialogue remained anchored to the screen, but sounds were not timbre-matched to the left and right speaker and the experience simply didn't sound good.

- i. Adding Theta Digital's Center Spread to the playback choices allowed some of the dialogue to remain in the high-quality left and right speakers with some sent to the poor-quality center speaker in an attempt to anchor the dialogue.
 - b. With the Casablanca IV, Center Spread is no longer necessary.**
 - i. The Phantom Mode allows for a single, centered listener to get the best of home theater even without a center channel speaker.
 - ii. Second, the idea of timbre-matching is now common place. Poor quality center channel speakers are rarely matched with high-performance left/right main speakers.
 1. And even if they were, *Dirac Live® and appropriate bass management (guided by the actual speaker response measured using Dirac Live®) offers accurate timbre-matching for any home theater system using the Casablanca IV.*

3. Rear Center Speakers

- a. The history of surround sound shows a steady progression: first with 4 matrixed channels as in Dolby Pro Logic, moving to 5 discrete channels and then to a matrixed center rear channel used in Dolby Surround EX and DTS-ES.
 - i. The Casablanca processors kept pace and added the provision for a rear-center speaker to properly reproduce Surround EX and DTS-ES sources.
- b. When home theater progressed to discrete 7-channel sources, the Casablanca processors were ready. They already had provisions for 4 surround speakers. However, a little understood quirk of the early Casablanca preamp/processors, including the Casablanca 3 HD, is that the surround speakers (back surround speakers) and the side surround speakers were clones. Both received the same signal.
 - i. Adding a phase-derived Center Surround speaker was the only way to add depth to the surround presentation.
 - ii. Without the uniquely signaled Center Surround, users could hear the side surrounds or the back surrounds but not both as they carried identical signals.
- c. The Casablanca IV supports full 7-channel surround sound. The Surround (now side surround speakers) and the Back Surround speakers are now completely independent. Since each pair reproduces unique material, users can now hear all 4 channels. Rear channel depth no longer requires a center surround speaker.
 - i. And since no formal surround mode requires a center-rear speaker (there are no 8.1 channel sources), the rear center speaker was dropped from the Casablanca IV.

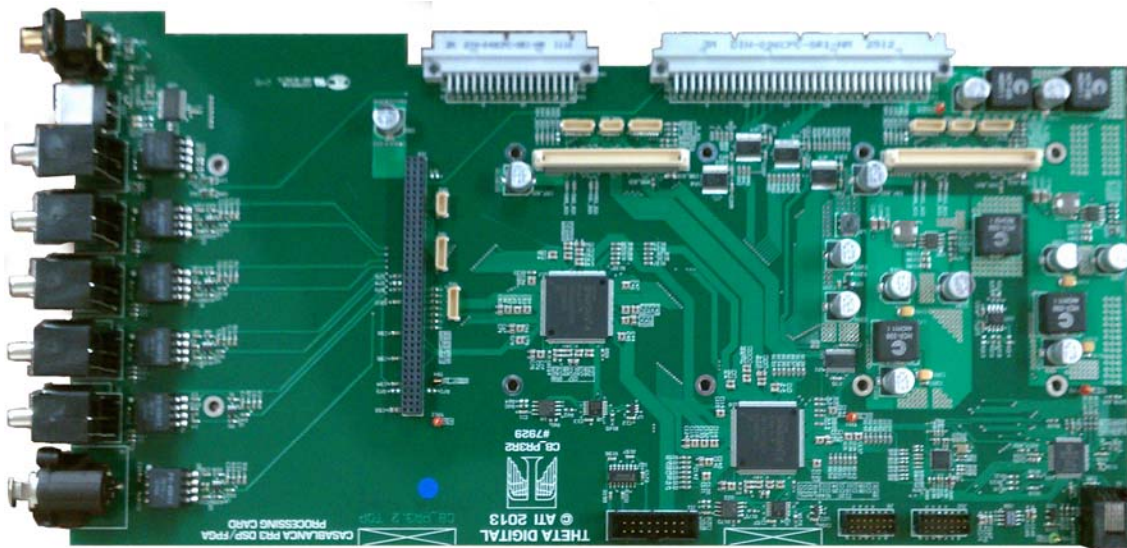
With the Casablanca IV, Dirac Live's ability to match the timbre of the L/R speakers with any center channel speaker allows the advantages of a hard center channel with none of the disadvantages of mismatched speakers. In addition, independent surround and back surround speakers eliminate the need for a rear-center speaker to create depth.

4. Improved bandwidth

When the Casablanca 3 was introduced, the hardware and software engineers who developed the platform went beyond industry standards to create channels and subwoofers that did not exist in the original source so systems using Theta Digital exceeded industry norms. Their tool of choice was a DSP chip from Freescale (formerly Motorola): the DSP56362. It processed 24-bits of data and was capable of 120 MIPS (Millions of Instructions Per Second.) Using multiple DSP56362 chips and custom software written in-house, Theta Digital expanded the Casablanca preamp processors to 12 output channels with a bandwidth of 48 kHz.

But the industry moved on. CD's have data at 44.1 kHz. DVD's are 48 kHz. But advanced downloads and Blu-ray discs were available at 88.2, 96, 176.4 and even at 192 kHz. Using advanced sample rate conversion algorithms, recordings with even these expanded data rates played back perfectly on the Casablanca. But only at 48 kHz.

- a. Theta Digital's development engineers set out on a quest to maintain the channel flexibility of the Casablanca 3 and 3 HD but with bandwidth up to and including 192 kHz. In late 2013 the new PR-3 post processing card was complete and the Casablanca IV was born.



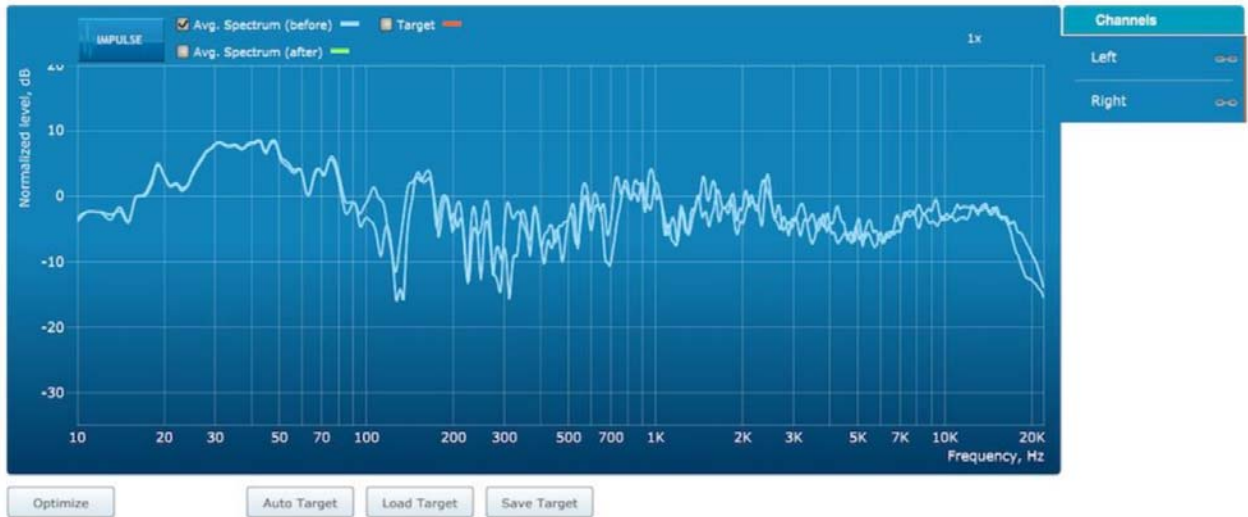
(The PR-3 expandable post processing card. It can be configured with multiple 300 MIPS DSP chips.)

5. Dirac Live® Digital Room Correction and Optimization

In a 2002 article in *The Audio Critic*, Dr. Floyd Toole, then Vice President, Engineering for Harman Industries wrote: "The room is the final audio component. Rooms audibly modify many aspects of sound quality. All rooms are different." Dr. Toole went on to say, "*Accurate high-resolution in-room measurements along with acoustical corrections and equalization are necessary to deliver truly good sound to listener's ears in homes and in studios.*"

We agree completely and now include Dirac Live® Digital Room Correction and Optimization with every Casablanca IV. Using the calibrated measurement microphone (supplied with the Casablanca IV) and a laptop computer with a latter day Microsoft operating system, users or their installers can complete accurate in-room measurements and generate correctional filters downloaded into the Casablanca IV that deliver music and home theater so good it verges onto the incredible.

Dirac Live begins with a screen to guide the measurement process. Pictorial diagrams are shown to guide system measurements for a chair, a couch or an auditorium. They show the number of measurements recommended (typically 9) and where to position the mic.

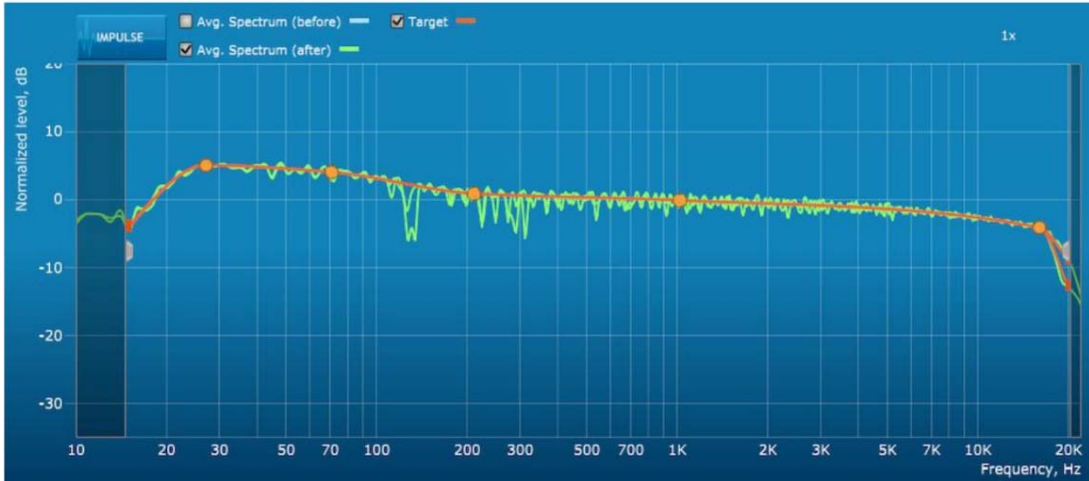


The results for a two channel system. This is the actual in-room response.

After completing the data acquisition phase of the measurements, along with the actual in-room response, the Dirac Live measurement screen shows a recommended target curve. This is only the starting point, the calibrator has complete freedom to alter the target curve should his experience suggest a better alternative.



The initial recommended target curve is shown in orange.



After Optimization shown in green. (Note the initial recommended target curve was slightly modified by the calibrator.)

After calibration, the filters are downloaded into the Casablanca IV. As with virtually every Casablanca feature, the Dirac filters are stored and available by input.

The Theta Digital Casablanca Music and Cinema Controllers have been continuously upgradeable since their inception in 1996. Over time features and capabilities change. As with any changes, some may initially prefer the previous version—the status quo—and some prefer the changes. We are confident that the Casablanca IV represents a significant advancement in every area over previous versions and hope this position paper serves as a reasonable explanation for the changes.