

KALMAN RUBINSON

# Bel Canto Design e.One REF600M

## MONOBLOCK POWER AMPLIFIER

**H**as it really been more than seven years since I reviewed Bel Canto's REF1000M monoblock?<sup>1</sup> According to the Bel Canto website, that model, based on Bang & Olufsen's ICEpower class-D modules, is no longer made. But now, like so many manufacturers, Bel Canto has adopted for its new models the NCore class-D module from Hypex—although the REF600M monoblock (\$4990/pair) is not Bel Canto's first product to use it . . .

Last year, Michael Fremer reviewed Bel Canto's nearly all-digital Black amplification system,<sup>2</sup> which comprises one ASC1 Asynchronous Stream Controller (essentially a Master Clock/preamplifier) and a pair of MPS1 Mono PowerStreams (monoblock DAC/power amps with digital and analog inputs, connected to the ASC1 via ST-optical links). The MPS1 is based on an NCore amplifier module and Hypex SMPS power supply board, supplemented by Bel Canto's own AC power pre-conditioning circuitry. The sound of this \$50,000 system



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(\$20,000 for the ASC1, \$15,000 for each MPS1) impressed the fastidious Fremer, and John Atkinson's measurements (and comments) were highly complimentary. After spending an unseemly amount of time with it at the 2015 Consumer

1 See "Music in the Round," March 2009: [www.stereophile.com/solidpower-amps/bel\\_canto\\_ref1000m\\_monoblock\\_power\\_amplifier/](http://www.stereophile.com/solidpower-amps/bel_canto_ref1000m_monoblock_power_amplifier/).

2 See the July 2015 issue: [www.stereophile.com/content/bel-canto-design-black-amplification-system](http://www.stereophile.com/content/bel-canto-design-black-amplification-system).

## SPECIFICATIONS

**Description** Solid-state, class-D monoblock power amplifier. Input: single-ended RCA or balanced XLR. Output: one pair WBT NextGen five-way binding posts. Power output: 300W into 8 ohms (24.8dBW), 600W into 4 ohms (24.8dBW). Peak output current: 27A.

Minimum load: 2 ohms. Voltage gain: 27dB (single-ended or balanced input). Frequency response: 0Hz–50kHz,  $\pm 3$ dB, all loads. THD+N: 0.003%, 1W, 1kHz, 4 ohms. IMD (CCIF): 0.0003%, 1W, 14/15kHz, 4 ohms. Input impedance: 100k ohms (RCA), 200k ohms (XLR). Input

voltage for max output: 2.3V RMS. Output noise (RMS, A-weighted): 35 $\times$ V, 10Hz–20kHz. Damping factor: >1000. Output impedance at 100Hz: <8 milliohms. **Dimensions** 8.5" (216mm) W by 3.5" (88mm) H by 12" (305mm) D. Weight: 15.4 lbs (7kg).

**Serial numbers of units reviewed** R6M-132, R6M-133. **Price** \$4990/pair. Approximate number of dealers: 40. **Manufacturer** Bel Canto Design, 221 N. First Street, Minneapolis, MN 55401. Tel: (612) 317-4550. Fax: (612) 359-9358. Web: [www.belcantodesign.com](http://www.belcantodesign.com).

Electronics Show, I, too, was impressed with the Black system.

I couldn't help noticing that the power-output specs of the REF600M monoblock—300W into 8 ohms, 600W into 4 ohms—are identical to those of the MPS1, suggesting that they share similar NCore and power-supply components. So, even taking into account the fact that a basic power amp such as the REF600M has no need for the MPS1's digital inputs and DAC, the new amp's price is eye-opening low. Yes, there are cheaper NCore monoblocks out there (and Hypex modules are available to DIY-ers), but this amp comes with a pedigree. I had to have a pair.

### Déjà vu

When the REF600Ms arrived, I felt as if I were in the movie *Groundhog Day*: Everything seemed the same, but not quite. The REF600Ms' shipping cartons, outer and inner, were the same as were used for the REF1000M and REF1000M Mk.II. The User's Guide was spare but adequate. The amp itself is similar in appearance to Bel Canto's previous little brick, and 3.1 lbs lighter. The REF600M, however, is finished with smoother corners and edges—and, in all black, it's quite reminiscent of the Black system. The only thing on the front panel is a single green power-on LED at dead center, but the rear panel is all business: IEC power inlet and switch, two sturdy WBT NextGen five-way binding posts, RCA and XLR input jacks with pushbutton selector, and a 5V/12V trigger input. Just like its predecessors.

Inside are three circuit boards: a Hypex NC500 amplifier, a Hypex SMPS1200 power supply, and Bel Canto's input conditioning board with their Impedance Optimized Input Stage, for balanced, high common-mode rejection and to provide a low output impedance to the input of the amplifier board. The active element on the board is an LME49720 Dual High-Performance Audio op-amp in what appears to be a low-pass filter configuration. I was interested to note

that Bel Canto has chosen not to include their own power supply, as they did with the ICEpower-based REF1000M—which probably accounts for the REF600M's lighter weight. Note, too, that while the power specs of the REF600M and Black are similar, the REF1000M was capable of much higher current (45A vs 27A).

Installation of the REF600M was trivially easy. I pulled the left and right XLR interconnects and speaker cables from my Parasound Halo A 31 power amplifier and inserted them in the Bel Cantos, which I plugged into the wall with Kubala-Sosna Emotion AC cords. I flipped on the REF600Ms' power switches, the green LEDs lit up, and off we went.

### Potent Little Bricks

Like other NCore-based amps I've tried—specifically, NAD's Masters Series M27 and M22, and Theta Digital's Dreadnaught D—the REF600Ms sounded smooth, powerful, and without significant faults. Their sound was detailed without being notably bright, they provided full bass extension and excellent imaging between the speakers, and were capable of driving even somewhat difficult speakers—the only kind I have—without breaking a sweat. Still, despite their common genealogy, each of the NCore implementations has unique characteristics, and the REF600M was no exception.

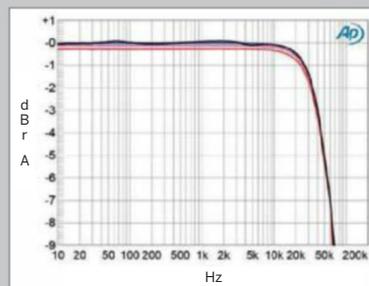
Despite its small size, the REF600M is a powerhouse, outputting 600W into 4 ohms, which is the approximate impedance of my B&W 802 D3s in the most demanding part of the audioband. It never ran out of steam with any sort of music at any listening level, and remained absolutely consistent in tonal balance and clarity. In "Mars," from Dean Peer's *Think . . . It's All Good* (CD, Turtle 8713606599008), electric-bass virtuoso Peer and percussionist Ty Burhoe produce lots of energy from about 100Hz down, yet their individual contributions remained unobscured through the

## MEASUREMENTS

I performed a full set of measurements on the Bel Canto Design e.One REF600M, using my Audio Precision SYS2722 system (see the January 2008 "As We See It," [www.stereophile.com/content/measurements-maps-precision](http://www.stereophile.com/content/measurements-maps-precision)). As the REF600M uses a class-D output stage, ahead of the analyzer I used Audio Precision's auxiliary AUX-0025 passive low-pass filter, which eliminates noise above 200kHz that might otherwise overload the SYS2722's input circuitry.

The Bel Canto's voltage gain into 8 ohms measured 26.9dB from both its unbalanced and balanced inputs, though the latter result was obtained with the Audio Precision's balanced output floating with respect to ground. Grounding the XLR's pin-1 connection reduced the gain by almost 5dB and increased the noise level, so I floated the balanced ground for all the tests.

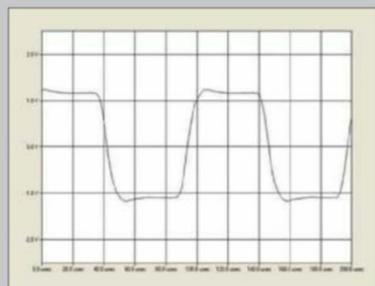
Both balanced and unbalanced inputs preserved absolute polarity (ie, were non-inverting). The unbalanced input impedance measured close to the specified 100k ohms at low and middle frequencies, dropping to a still-high 58k ohms at 20kHz. The balanced input impedance was 77k ohms.



**Fig.1** Bel Canto e.One REF600M, balanced frequency response at 2.83V into: simulated loudspeaker load (gray), 8 ohms (blue), 4 ohms (magenta), 2 ohms (red) (1dB/vertical div.).

The REF600M's output impedance, including 6' of cable, was low, at 0.1 ohm from 20Hz to 20kHz. As a result, there was very little variation of its response with our standard simulated loudspeaker<sup>1</sup> (fig.1, gray trace). This

<sup>1</sup> See [www.stereophile.com/content/real-life-measurements-page-2](http://www.stereophile.com/content/real-life-measurements-page-2).



**Fig.2** Bel Canto e.One REF600M, small-signal, 10kHz squarewave into 8 ohms.

Bel Cantos, whether I played this track for my own musical enjoyment or pumped it up to annoy the neighbors. Inspired—or, rather, provoked—by this, I popped on Yello's *One Second* (CD, Mercury 832 675-2) and let rip. "Oh Yeah"—Ferris Bueller would have loved how the REF600Ms delivered the big thrills.

This is not to say that the REF600Ms lacked subtlety. Every participant in the fairly complex combinations of instruments, solo voices, and choruses of *Le Jardin de Monsieur Rameau*, a collection of 17th- and 18th-century French music performed by William Christie and Les Arts Florissants (CD, Les Arts Florissants AF002), was exquisitely discernible within an ensemble setting that was believably arrayed across the soundstage. I had thought this recording just a bit too lively, but the Bel Cantos tamed its edginess to reveal a well-balanced sound—an ability that did not diminish with scale. I was particularly taken with a recent and surprisingly effective recording of Stravinsky's *The Rite of Spring*, with David Bernard conducting the Park Avenue Chamber Symphony (CD, Recursive Classics RC2057001; download from ClassicsOnline.com). The PACS bulked up to 100 players to record this in a relatively small space at the DiMenna Center for Classical Music, in Manhattan. While the bass in this acoustic is a little ripe and the perspective is,



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of necessity, somewhat close, the recording provides an opportunity to hear *into* this icon of 20th-century music. The REF600Ms made sure no detail was lost, and Bernard leads this semiprofessional band in an affecting performance. Local

guys make really good.

Solo voices and instruments had satisfying presence and warmth through the REF600Ms. In Gerald Finzi's "Come Away, Death," Marianne Beate Kielland's mezzo-soprano was nicely balanced and of appropriate depth, while the sound of Sergei Osadchuk's piano was full but a bit lacking in *ping*—as if its lid were closed (24-bit/192kHz PCM, free stereo download from SACD/CD, 2L 2L-064-SACD). Robert Silverman's brilliant pianism in Rachmaninoff's Piano Sonatas 1 and 2 (CD, Stereophile STPH019-2), was less subject to that lack, which was not apparent with solo guitar, whether electric (as in Dean Peer's *Think . . . It's All Good*) or acoustic, as in Francisco Tarrega's *Capricho árabe*, from classical guitarist Stefano Grondona's *La Guitarra de*

#### measurements, continued

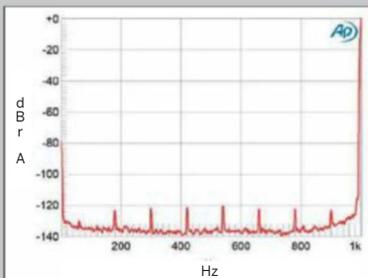
graph was taken with a balanced input; the unbalanced behavior was identical. Despite KR's conjecture, the amplifier's response is flat in the audioband, rolling off above 20kHz to reach -3dB at 40kHz. A 10kHz squarewave was reproduced with a very slight overshoot but no ringing (fig.2).

Although its class-D output stage produces 381mV of ultrasonic switching noise with a center frequency of

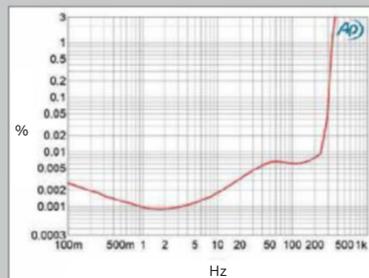
442kHz with no audio signal present, the Bel Canto was otherwise an extremely quiet amplifier. With the Audio Precision low-pass filter removing the switching noise, the unweighted, wideband signal/noise ratio (ref. 2.83V into 8 ohms with the input shorted to ground) was an extraordinary 109.9dB, which improved to 113dB when A-weighted. Spectral analysis of the amplifier's low-frequency noise floor while

it reproduced a 1kHz tone into 8 ohms (fig.3) indicated that the only spurious present were at 60Hz and its odd-order harmonics, though these all lie below -120dB and are thus negligible.

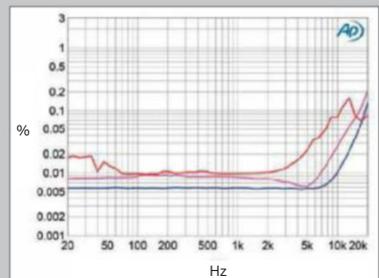
Fig.4 plots the percentage of THD+noise against power into 8 ohms. Distortion is extremely low up to 10W or so, and the REF600M clips (defined as 1% THD+N) at 340W (25.3dBW), exceeding the specified power of



**Fig.3** Bel Canto e.One REF600M, spectrum of 1kHz sine wave, DC-1kHz, at 1W into 8 ohms (linear frequency scale).



**Fig.4** Bel Canto e.One REF600M, distortion (%) vs 1kHz continuous output power into 8 ohms.



**Fig.5** Bel Canto e.One REF600M, THD+N (%) vs frequency at 9V into: 8 ohms (blue), 4 ohms (magenta), 2 ohms (red).

Torres (CD, Divox CDX-29701).

The lack of *ping* was elusive with bowed strings, perhaps because the performer is constantly shifting the position of the instrument with respect to the microphone and, thus, the listener. Overall, I suspect that it has to do with the different overtone structures of various instruments, but it led me to suspect that the attractiveness of the REF600M's warm sound might be due to some rolloff of the very high treble. That might also have contributed to the inky "blackness" of the backgrounds, as well as the Bel Canto amp's kind treatment of less than tip-top recordings. Moreover, there was none of the somewhat parched treble that bothered me with earlier ICEpower amplifier technology.

That the REF600M didn't sound identical to some other amps was neither surprising nor a criticism of any of them. Of three recent amps of my experience, the REF600M was the warmest, the NAD Masters Series M22 the most detailed, and the Theta Dreadnaught D somewhere in between. Why should various amps based on circuit boards of the same technology (NCore) and made by the same company (Hypex) sound different? I don't know, but the amplifier boards aside, I could see physical differences inside these three amps. The big Theta uses a big linear power supply or two, while the more compact Bel Canto and NAD use a Hypex SMPS. Theta and NAD use the input circuit on the NCore amp board, while Bel Canto supplements it with a proprietary circuit. These differences must affect the sound quality, but to link them with what I heard will take testing procedures that control more variables than I can.

### Conclusions

Bel Canto Design's REF600M has the power to impress. It never ran out of watts, and, with recording after record-

## ASSOCIATED EQUIPMENT

**Digital Sources** Oppo Digital BDP-105 universal BD player, Baetis XR2 PC-based music server, exaSound e28 multi-channel D/A processor, QNAP TS569L NAS.

**Preamplifiers** Audio Research MP1, Parasound Halo P 7.

**Power Amplifiers** McIntosh Laboratory MC303, NAD Masters Series M22, Parasound Halo A 31.

**Loudspeakers** Bowers & Wilkins 802 D3.

**Cables** Analog Interconnect: AudioQuest Earth/DBS balanced, Kubala-Sosna Anticipation (RCA/XLR). Digital Interconnect: AudioQuest Vodka (HDMI) & Carbon (USB). Speaker: AudioQuest Oak/DBS biwire. AC: AudioQuest NRG-10, JPS Aluminata, Kubala-Sosna Emotion.

**Accessories** Environmental Potentials EP-2450 power conditioner, CyberPower 850PFCLCD AC filter (supplied with Baetis server).

**Listening Room** 24' L by 14' W by 8' H, with two MSR Acoustics Dimension4 SpringTraps in front corners, two Ready Acoustics Chameleon Super Sub Bass Traps at sides, and moderately sound-absorbing furniture. Front wall has large windows partly covered by fabric drapes and 4' by 2' by 3" OC 705 panels. Rear of room opens into 10' by 7' foyer and 12' by 8' dining area.—*Kalman Rubinson*

ing, its sound was musically satisfying—so satisfying that it encouraged, even demanded, listening with complete engagement. During those listening sessions, the REF600M never gave me any reason to question its performance, even with the recordings mentioned above. As they used to say in the British press, the Bel Canto REF600M could not be caught out. ■

### measurements, continued

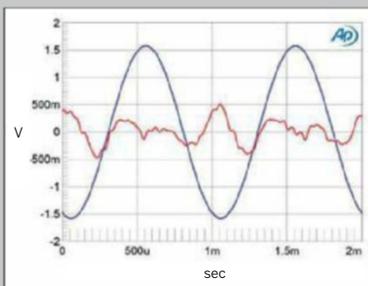
300W into this load (24.8dB). The amplifier clipped at the specified 600W into 4 ohms (24.8dBW).

How the Bel Canto's THD+N percentage varied with frequency at a level, 9V, where I could be sure I was examining actual distortion rather than noise, is shown in fig.5. Below 3kHz, the THD varies little with either frequency or load impedance, but does increase

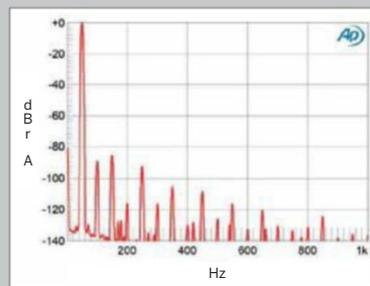
in the top octave. The 2 ohm trace (red) is a little irregular, apparently due to a slight history effect with the amplifier driving this very low impedance; that is, the measured percentage took a few seconds to stabilize. The distortion signature at this voltage into 8 ohms primarily consisted of low-order harmonics (fig.6), and the second and third harmonics were still predomi-

nant at high powers (fig.7). Even so, the third harmonic lay at just -86dB (0.005%). Intermodulation distortion was similarly very low in level, even at high power into 4 ohms (fig.8)

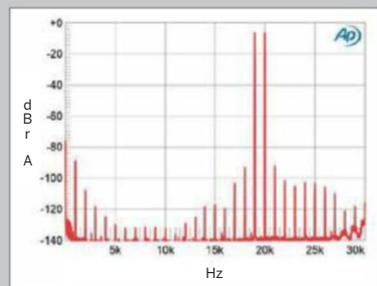
Bel Canto Design's e.One REF600M amplifier packs a huge amount of power into a small package, and offers impressively low levels of distortion and noise.—*John Atkinson*



**Fig.6** Bel Canto e.One REF600M, 1kHz waveform at 10W into 8 ohms, 0.0049% THD+N (blue); distortion and noise waveform with fundamental notched out (red, not to scale).



**Fig.7** Bel Canto e.One REF600M, spectrum of 50Hz sinewave, DC-1kHz, at 100W into 8 ohms (linear frequency scale).



**Fig.8** Bel Canto e.One REF600M, HF intermodulation spectrum, DC-24kHz, 19+20kHz at 200W peak into 4 ohms (linear frequency scale).