# Celestion System 6000 loudspeaker system

*Martin Colloms, February, 1987*

In the audio field, the British have traditionally thought "small," scoring hits both with their compact loudspeakers and with medium-priced amplifiers. The continued growth of the audiophile speaker market in the US, however, which favors larger loudspeakers, has at the same time stimulated the research and design of more powerful, excellent quality amplifiers. In their turn, these have placed increased demands on the speakers they drive.

Until 1986, nearly all UK speaker companies shied away from competing head-on with the bigger US loudspeakers, but two models launched last year appear to take up the challenge: the KEF R107 and Celestion System 6000. Roughly comparable in price in the USA, $3900 and $4930 (including SL600 "satellites") respectively, both are flagship designs intended to make a serious bid for the upper-middle sector of the audiophile market.

Both are decently sized three-way systems using moving-coil drive-units. The similarities are extraordinary, though their appearance and operating principles could hardly be more divergent.

To cover the common ground first, both are floor-standing models employing tandem bass units with pulp-cone diaphragms operating over an electronically extended low-frequency range, crossing over at relatively low frequencies, 200 and 100Hz respectively, to the upper-frequency sub-enclosure. Acoustically speaking, the low-frequency cabinet structures are singularly rigid and nonresonant.

Both have mid and treble drivers fitted in compact, demountable sub-enclosures: 8-12 litre boxes with the tweeter positioned vertically above the mid driver. The latter measure 5 and 6.5 inches, with flared plastic-cone diaphragms. High-loss synthetic surround terminations are fitted; intrinsically, these units have an extended frequency range of better than 80Hz to 5kHz, which represents a span of some five octaves. The upper crossover of both designs is set in the 2-3kHz range, while the tweeters are small dome units, measuring 27mm and 32mm in nominal diameter.

The mid/treble sub-enclosures are constructed in very different ways, yet with equal success in producing cabinets with very low intrinsic coloration. These smaller head enclosures endow both speakers with the equivalent cabinet width of a stand-mounted miniature, with the same high standard of stereo focus. Both speakers may be keyed into the floor by means of carpet-piercing floor spikes (not suitable for antique carpets or parquet flooring!) which give an absolute rigid stance, one highly conducive to sharp stereo focus, as well as a clean, dynamic bass.

The System 6000 has clearly grown out of Celestion's highly respected but costly miniature, the SL600. Indeed, the mid and treble sections of the 6000 are identical to those of the '600, and SL600 owners may buy a separate pair of subwoofers with crossover for $3300. (Given this fundamental system compatibility, the 6000 sensitivity is predetermined at the low level originally defined by the need for the miniature SL600 to have wide-bandwidth operation.)

The correct operating height for the SL600 is when a seated listener can just see over the top of the enclosure. The System 6000 replicates that height, in addition to providing a massive nonresonant support for the '600, while at the same time giving a new measure of bass performance.

Conceptually, the SL600 was designed to have a fast time signature, especially with regard to its remarkable enclosure, which was engineered for low energy storage. The introduction of this enclosure was a major step forward in reducing the box coloration restraining the performance of so many other systems. In continuation of this concept, System 6000 lacks any cabinet or enclosure for the bass. By omitting the enclosure, the bass section has been engineered to a standard compatible with the SL600 in terms of energy storage or, as in this case, the lack of it.

Within the strangely shaped bass section are two 12" bass units, mounted "front-to-front" and spaced by an open air gap. There is no box or baffle as such, just the reinforced panels on which the drivers are actually mounted. The woofers are long-throw, low-resonance units with high stiffness, flared, pulp-composition diaphragms.

With the cones moving in the same acoustic phase, the 6000 bass section constitutes a bidirectional push-pull radiating element, or dipole, little different from an open panel loudspeaker. (The pair act as a virtual drive-unit located at a point midway between them.) A dipole has an output concentrated in the fore and aft directions, while the output at the sides falls to zero. This directional property is exploited in aerials to improve the signal recovery, and adding a second element makes the array performance still more directional, increasing the sensitivity or power gain in the desired axial directions. The second bass-driver, placed close behind the first in the 6000, constitutes just such a second element, resulting in a simple array equivalent to a two-element FM aerial. In addition, the excursion required for a given low-frequency sound level will be reduced, with the workload shared between two drivers.

Celestion's designer Graham Bank has therefore produced a subwoofer which operates as a boxless, minimum-baffle area, double dipole with a bass output beamed in its operating frequency range (25-100Hz). Fundamental questions must be raised, however, concerning the relationship of a dipole to room loading. Extensive computer-modeled tests on rooms and positions indicate that directional bass will be an advantage since the bass beam or lobe may be directed toward the listener, thereby giving a much higher proportion of direct sound. Conventional box bass is omnidirectional, attaches itself to those local boundaries local to the speaker, and is then driven down the room, exciting a high proportion of the low-frequency standing wave modes. This leads to extensive unevenness in the response.

A directional bass-dispersion pattern avoids the ceiling and sidewall reflections, thus reducing such room excitation. In low-mass electrostatic-diaphragm panel dipoles, the back-wave reflection dominates the acoustic impedance or reflected air load on the panel, destructively nulling the output over a range of bass frequencies. The Celestion woofers are high mass, however, and are thus indifferent to the back-wave returning from the rear wall; this eventually arrives delayed and partially diffused at the listening position. The intrinsic response of the enclosureless subwoofer is a gentle 6dB/octave rolloff below its turnover point. With simple first-order equalization and variable bass-unit angling with respect to the room, the optimum combination of balance and extension can thus be realized.

With the electronic crossover—which connects either in the preamplifier tape loop or between pre- and power amplifiers—set to 100Hz, the bass section can be adjusted for absolute level and the best extension in the nominal 20-70Hz range, with a constant Q of approximately 0.4. The 24dB/octave, 4th-order Butterworth crossover slopes are complementary, being obtained by substitution; *ie*, the low-pass output is obtained by subtracting the high-pass output from the input, and the crossover is DC-coupled throughout, this (unusually) including the high-pass section, which has no series capacitors. The crossover/controller is well constructed, self-powered, and employs selected integrated circuits of well-defined audio performance.

The woofer section provides a massive inert platform on which to place the SL600 speaker. For those unfamiliar with the '600, this established high-tech design uses a one-piece, pure piston, copper-dome tweeter, and a well-terminated, 6.5", synthetic flared-cone woofer. Built on cast metal frames, these drivers are mounted in a compact, low-mass enclosure of exceptional stiffness. This costly construction is fabricated of Aerolam, a low-mass aircraft structural material. No grille is supplied, as it impairs the stereo performance.

**Sound Quality**
I must put on record at the outset that I am an SL600 fan. I have found it to be, virtually since its inception, a consistently useful reviewing and musical tool. I know it is rather expensive in the US for its small size and limited low-frequency extension, but its fundamental performance is sufficiently high to make it a creditable, if modest, audiophile speaker.

To some degree, it was the demand for a subwoofer for the SL600 which resulted in the System 6000. When set up and properly adjusted, my first observation was that the 6000 sounded extraordinarily like a naked '600. Leaving aside for the moment matters of dynamic range and bass extension, the low-frequency sections of this speaker were remarkably unobtrusive. Since I reckon the SL600 to be most accurate, within its limits, below 1kHz, it was significant to find that the '600 sound was not particularly modified by the addition of the subwoofers. So many subwoofers immediately draw attention to themselves, almost in a manner designed to prove to the listener that they are, in fact, working!

As a complete three-way system, the 6000 sounded completely coherent, with all three driver outputs skillfully integrated, forming a uniform, wide-range, and well-balanced whole. The inherently "rich," but in the main desirable, balance of the '600 was unaffected.

Well, what does the System 6000 do that the SL600 cannot? Put on some wide-range material at decent levels and the answers will be immediately apparent. The 6000 then sounds like a louder, clearer, more articulate and more extended SL600. On powerful material, the reduction in midrange intermodulation and the resulting gain in the resolution of complex instrumental scoring is very worthwhile. The dry, extended bass provided a solid foundation for a sense of scale and place, underpinning the entire performance. SL600 bass is one of the least colored in the business, and the 6000 bass proved to be still less so. As with other extended-bass systems, the extension removes some subjective "heaviness" from the midbass, while the midrange sounds more natural.

As a system, the 6000 played to respectably high music sound levels, but not to disco intensity in large rooms. Amplifiers capable of delivering 100-200W/channel into 8 ohms are required to exploit it to the full.

Fine results were obtained with a baseline system consisting of the English Audiolab separates—two 8000 stereo power amplifiers partnered by the 8000C preamplifier.

System 6000 continued to show improvements in tonality, resolution and speed when partnered with more costly electronics. Although I don't offer this as a specific recommendation, System 6000 benefited from a trial with a Krell KSA100 driving the bass, partnered by an Audio Research M100 for the upper range, both amps driven by an Audio Research SP-11 preamplifier with a Cambridge Audio CD1 player and a Linn/SME V/van den Hul One vinyl disc source.

Comparisons were possible with a number of mid-price audiophile speakers. I was fortunate to have temporary loan pairs of Apogee Duetta II, MartinLogan CLS, and Magnepan MGIIIa speakers to hand (see Vol.10 No.1); when properly driven, the System 6000 landed squarely in their performance category. All the aforementioned speakers have good fundamental performances coupled with specific areas of greatness. The System 6000 is not outstanding in any one

respect, save the consistent balance of its performance. One could argue over the merits of the speed and transparency of the CLS in the mid, or the airy, extended treble of the MGIIIA, or the low coloration and free-space "slam" of the Duetta II. The Celestion, however, fights back, without fuss or drama, to deliver a classically balanced performance: dry, controlled, and coherent.

On absolutes, the 6000 consistently satisfied over longer time periods, drawing less attention to itself and more to the program. Stereo images were a little restricted in height, but threw a considerable depth downstage. This was allied to exceptional positional focus, coupled with remarkable perspective layering. On appropriate material, the stereo width comfortably extended beyond the breadth of the speaker enclosures.

Subjectively, the frequency response stretched from 25Hz to 15kHz, lacking some upper treble sparkle; compared with most big speakers, it was a little too dry in the final bass octave (just as the KEF seemed a little too rich in the same region).

Coloration levels were low, with no perceptible box effects, and just a mild, cone-type, "nasal" thickening in the upper mid. A hint of "sibilance" was also present in the treble. Taken overall, however, the treble was very fine, with high resolution, transparency, and neutrality, free from grain or "zizz." Only if the subwoofer level were set too high—to make an excessively weighty low end, for example—would some lower-mid muddling occur, this due to excessive driver overlap in the 100Hz region. With levels correctly set, the bass possessed a natural, fast, and open "slam," with good tune-playing ability. The bass controller was deleted to check its effect on the mid and treble. It was possible, when using the most costly supporting electronics, to fault the controller very slightly on treble purity and transparency, as well as demonstrating a small impairment in stereo depth. The latter loss was more than restored by the System 6000, due to the reduced SL600 workload, this resulting from diverting the large bass excursions required to the subwoofer.

Interestingly, the Quad ESL-63 would be a potential alternative to the SL600 for use with the 6000 woofer (footnote 1). A pair of '63s were tested, and the Celestion's dipole bass matched that of the Quad very well, providing a powerfully clean low end, improved mid clarity, and allowing the Quad to play several dB louder on wide-band program. Moreover, the Quad '63 sounded good at the increased height conferred by the 6000 platform, resulting in a generously "tall" speaker effect.

**Conclusions**
These two remarkable speakers represent a challenge to the increasing performance standards being set by large panel speakers, matching the best of them in terms of both bass power and extension, while at the same time conceding little in terms of coloration levels. In fact, both the KEF and the Celestion beat a number of the panel models in such fundamental areas as tonal balance and response uniformity.

The 6000 system and the R107 are refined systems, with no obvious flaws or rough edges. In no way do they represent "first prototypes"—their designers are not going to have second thoughts during the next six or twelve months!

With its distinctive—if not downright odd—appearance, the System 6000 offers a more costly solution to the same problem, one with additional refinements in terms of room bass alignment, transparency, and treble subtlety, but with a substantial reduction in maximum sound level attainable. If genuinely high sound levels are required, then it must be said that the 6000 will not suit rooms of greater than 120m$^3$ volume. In my room, however, with its near ideal proportions and moderate 80m$^3$ dimensions, the 6000 fit like a glove, delivering the best big-speaker bass yet, and with a clear enhancement of the SL600 performance.

The System 6000 has suffered from greater compromises in engineering than the KEF, this partly due to the incorporation of the low-sensitivity SL600. Conversely, this is also one of its major strengths: when powered up in this three-way system, the '600 easily stretches beyond its previously known limits to generate a satisfyingly dynamic and balanced sound. Competitive though the R107 is, the Celestion 6000 also scores a hit, but on a different target, this one significantly nearer the heart of the high-end market.

Given the 6000's performance, it seems apparent that Celestion has also produced one of the finest, least colored subwoofers around. Tests with the Quad ESL-63 were most encouraging; it is also a natural partner for other high-quality dipole systems of limited bass power. It will also work well with smaller and cheaper systems, but its $3300 cost does not really justify such partnerships.

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Footnote 1: Quad's Peter Walker always used to decry efforts to marry his loudspeakers to moving-coil subwoofers on the grounds that the overlap between an omnidirectional subwoofer and a dipole loudspeaker was inherently unsatisfactory.—**John Atkinson**

**Sidebar 1: Specifications**

**Celestion SL600:** two-way, sealed-box loudspeaker with Aerolam (aluminum-honeycomb) enclosure. Drive-units: 1.25" copper-dome tweeter, 6.5" Kobex-cone (PVC) woofer. Crossover frequency: 2.3kHz, second-order, 12dB/octave slopes. Frequency response: 60Hz-20kHz ±3dB, low-end, -6dB at 60Hz in free-space conditions. Sensitivity: 82dB/W/m. Nominal impedance: 8 ohms. Amplifier requirements: up to 120W on program.
**Dimensions:** 14.5" (368mm) H by 7.75" (197mm) W by 9.25" (235mm) D. Enclosure volume: 12 litres (0.4 cubic feet).

**Weight:** 11.25 lbs (5.1kg) each.
**Serial numbers of units tested:** Not noted.
**Price:** $1630/pair (1986); $1995/pair (1989-1992); no longer available (2003).

**Celestion 6000:** Dipolar subwoofer with two 12" paper-cone woofers and electronic line-level crossover. Crossover slopes: 24dB/octave, 4th-order, Butterworth.
**Dimensions:** Not noted.
**Serial numbers of units tested:** Not noted.
**Price:** $3300/pair (1987); no longer available (2003).

**Common to both:** Approximate number of dealers: 240.
**Manufacturer:** Celestion Consumer Division, Eccleston Road, Tovil, Maidstone, Kent ME15 6QP, England. Tel: +44 (0) 1622 687442. Fax: +44 (0) 1622 687981. US Distributor: Celestion Industries Inc., Holliston, MA (1992); www.celestion.com (2003).

**Sidebar 2: Measurements**

A lab check on the controller (fig.1) provided proof of the somewhat different view that Celestion's designers have taken of system equalization. Taking the upper range or high-pass filter first, this shows a perfectly flat response with a crossover point at 100Hz, -6dB, falling almost precisely at a 24dB/octave rate, a 4th-order Butterworth. With no additional programmed extension, the lowest "70Hz" bass response setting is plotted lower in level than the high-frequency section, due to the high intrinsic sensitivity of the bass driver section, typically 88dB/W. This level offset gives a less than ideal graphical picture of the 100Hz crossover overlap. At -6dB, 100Hz, and in accordance with theory, the bass system also shows a rolloff approaching 24dB/octave, its rapidity beneficially muting the big cones in the midrange, where they might otherwise add coloration.

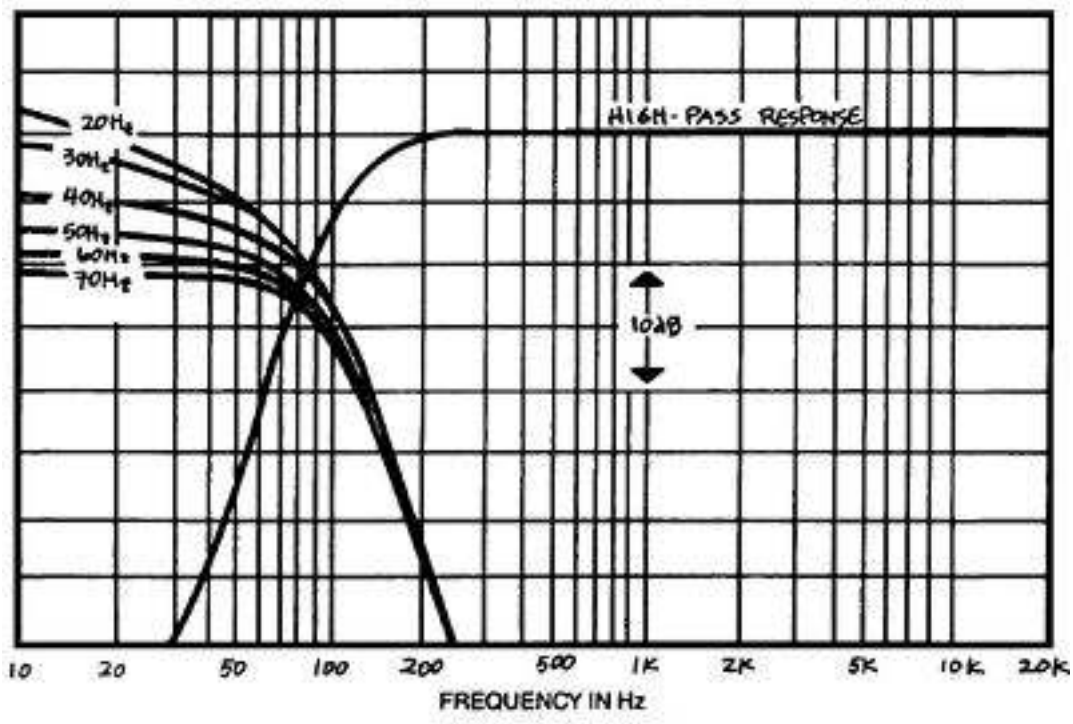


Fig.1 Celestion System 6000, high- and low-pass crossover responses, effect of extension control with level control set to "5" (5dB/vertical div.).

Note that no bass lift has been applied at all for the 70Hz limit. Indeed, given the -6dB level requirement to match the bass to the SL600, the subwoofer is, in fact, well under-driven, giving it a tremendous headroom on this and other similar settings down to 40Hz.

At extension settings below 70Hz, the bass boost begins to build. In the context of the 82dB/W SL600 sensitivity, this boost reaches +3dB at 20Hz for a 30Hz extension, and +4.5dB at 20Hz for a "20Hz" extension.

These are comparatively modest boost levels, allowing the use of a realistically sized bass amplifier. With lowering bass-cutoff frequency, the equalization slope approaches a maximum of 6dB/octave, while in theory the turnover point at nominally 100Hz should step back a little with each increment in extension. Fig.2 shows the range offered by both the bass-level and extension controls. For example, (a) corresponds to a full bass-level at 20Hz extension. The matching

curve (b) for 70Hz indicates that the system will accommodate an upper-range unit with up to 10dB more sensitivity, or cope with similar sensitivity variations between the power amplifiers.

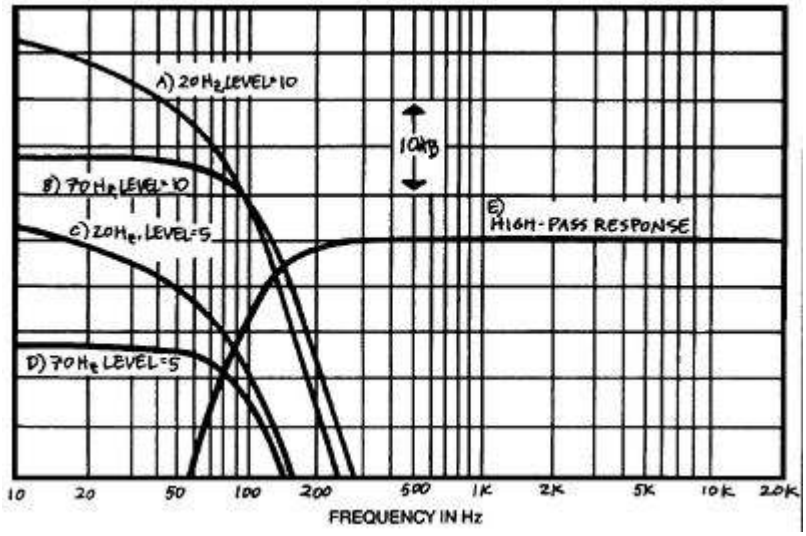


Fig.2 Celestion System 6000, high- and low-pass crossover responses, effect of level control with extension set to "20" and "70" (5dB/vertical div.).

Though the level control will go to zero, the "5" position was chosen to generate the second set of graphs. In fact, the level control range is, in my view, excessive, leading to cramped adjustment above "7." I would like to see a more open range—say from -12dB relative to the SL600 setting up to +6dB; thus catering for even the most unlikely amplifier/speaker combinations.

Distortion results for the controller lay in the -90dB region (0.003%), and at an 8V peak-peak output, HF intermodulation measured -99dB, almost 0.001%! The controller provides a voltage gain of 6dB with a 100k-ohm input impedance, and a low 10-ohm output impedance. A CD player with a volume control could be fed directly into the 6000 controller, without the need for a preamp at all. Electrical noise levels were very low; for example, -111dBA referenced to a IHF 0.5V output. Hum levels were better than 85dB down.

The Celestion forward responses at 1 meter (fig.3) relate to the axial responses shown in fig.4. As with the KEF, which has essentially similar dimensions and head geometry, the forward group of on- and off-axis responses is excellent. The well-behaved group of curves is, in large measure, responsible for the excellent stereo and neutral balance shown by both systems.

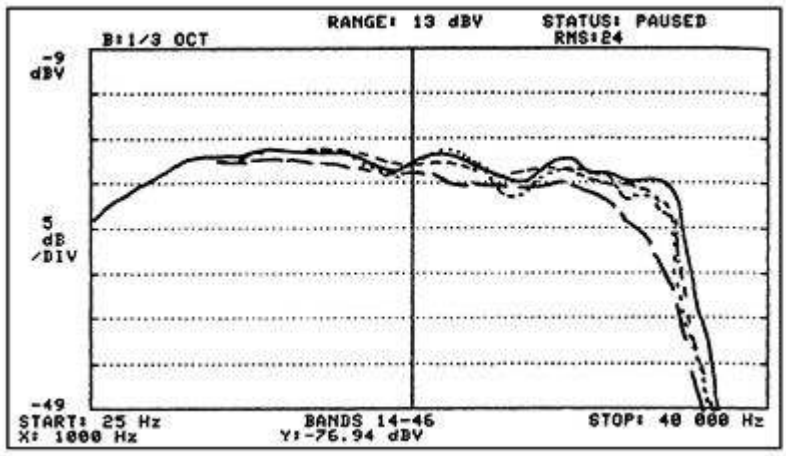


Fig.3 Celestion System 6000, responses on- and off-HF axis at 1m (5dB/vertical div.).

Fig.4 shows the third-octave axial response, noting the tapered room-matched bass rolloff, with good extension to 25Hz; the "rich," mildly downtilted response, and the slight lift in the treble around 5kHz (the "sibilance region"), are also apparent. Even under acoustically difficult semi-anechoic room conditions, a fine ±2.5dB was achieved in third-octave averaged mode from 40Hz to 16kHz.

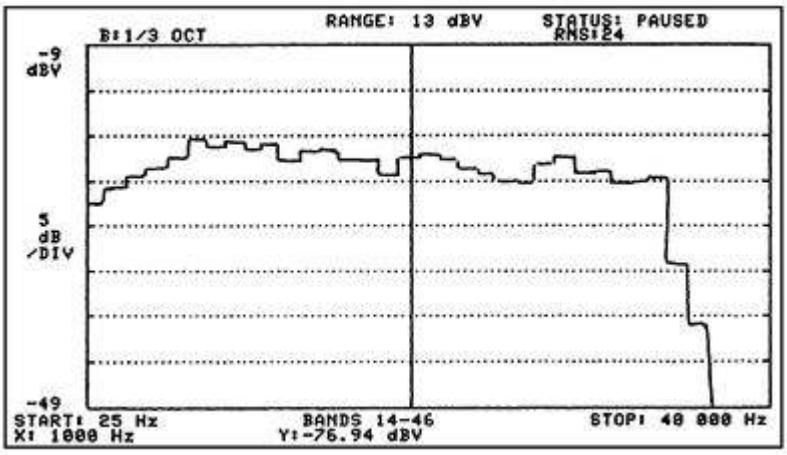


Fig.4 Celestion System 6000, 1/3-octave response on HF axis at 1m (5dB/vertical div.).

Computer-averaged in-room, the directional woofer was tried in the straight-ahead position (fig.5), with full extension and a little bass cut, (*ie*, "level" set 1dB too low). The curve demonstrates good extension, but was muted, especially around 100Hz. Lifting the bass-level, however, was found to impair the upper-bass definition.

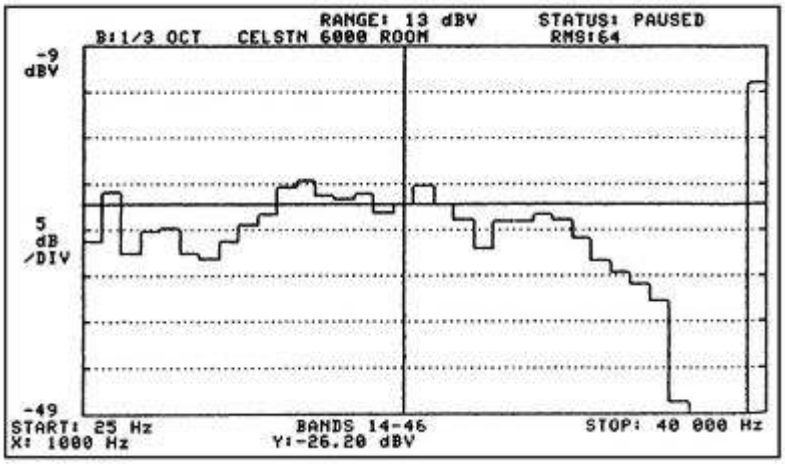


Fig.5 Celestion System 6000, spatially averaged, 1/3-octave, in-room response with woofer straight ahead, extension set to 20Hz, and level set to -1dB (5dB/vertical div.).

Celestion recommends a position with the 600 angled in by 30 degrees and the woofer axes angled in by 15 degrees. A setting of 7.1 was determined for the controller level. This resulted in the curve shown in fig.6, a trace with an extraordinarily even low-frequency response, and a subjective sound to match. At times I preferred a touch more bass "weight," achieved finally in fig.7 by increasing the bass level to 7.25.

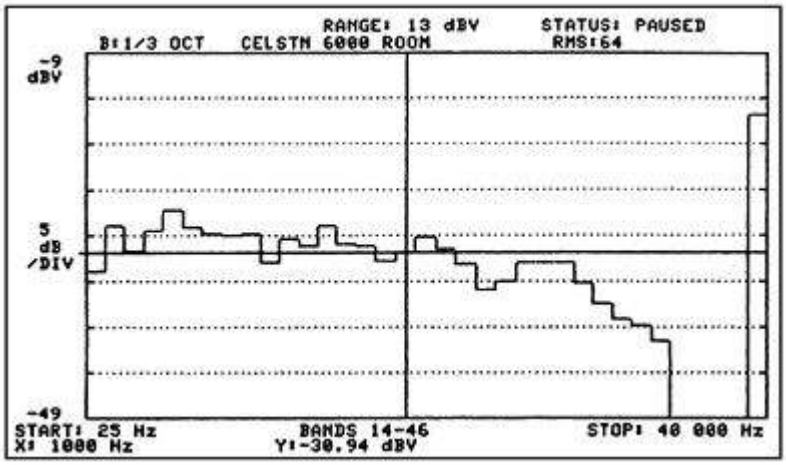

Fig.6 Celestion System 6000, spatially averaged, 1/3-octave, in-room response with woofer angled in by 15 degrees, extension set to 20Hz, and level set to 7.1dB (5dB/vertical div.).

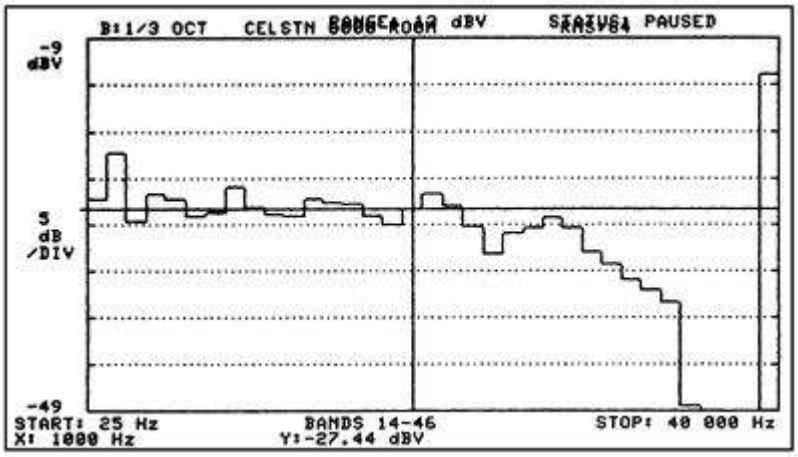


Fig.7 Celestion System 6000, spatially averaged, 1/3-octave, in-room response with woofer angled in by 15 degrees, extension set to 20Hz, and level set to 7.25dB (5dB/vertical div.).

As these curves show, the 6000 integrates very well with my room acoustic. The directional bass response does seem to produce a uniform, clean, transient quality, in my listening area at least. In terms of room matching, this speaker was one of the best I have tested at my location. I look forward with interest to the results from other reviewers in different rooms.

Concerning the other test parameters, the System 6000 does have a low system sensitivity of 82.5dB/W, but this represents quite a uniform and fairly kind 8-ohm load impedance, both for the woofer and head sections. The only warning concerns the SL600 load impedance at near ultrasonic frequencies, where it becomes predominantly capacitative at around 4.5 ohms. One or two amplifiers with a poor stability margin might be uncomfortable with it.

With a 200W peak program as an acceptable maximum input and 75W as a sensible minimum, the 6000 will deliver maximum sound levels of 101dBA in typical rooms measuring 80m$^3$—comfortable (3.5dB louder than the Duetta II), but neither deafening nor earthshaking.—**Martin Colloms**

**Dick Olsher wrote about the System 6000 in January 1989 (Vol.12 No.1):**

The System 6000 was previously reviewed in *Stereophile*, by Martin Colloms in Vol.10 No.2 (February 1987). What follows is simply meant as a quickie followup to that in-depth review.

Someone was bound to ask how Celestion's dipole subwoofer system ($2699/pair complete with electronic crossover) compared with the products surveyed herein, especially in view of the liberal use I've made of the Celestion SL600. So I endeavored to obtain a sample, which arrived just in time for a couple days' listening.

Here is a product designed to mate specifically with the SL600. Not surprisingly, therefore, the overall integration was very smooth—except for an annoying room mode at 60Hz which I couldn't eliminate. The improvements wrought by the introduction of the subwoofer were dramatic. Bass extension and dynamic headroom were much improved. Bass detail and pitch definition wee as good as ever. The range handled by the SL600s was much more effortless, with much reduced congestion on loud peaks, better detail, and, believe it or not, imaging stability was up a notch. The imaging was stable before, but now it's solid as a rock. The measured nearfield response of the subwoofer was well extended, with a –3dB point of 25Hz. However, there's not much dynamic headroom below 30Hz. An excellent subwoofer system, nonetheless.

Early on, I was bothered by grain and veiling in the upper midrange. It seemed reasonable to attribute this to the high-pass filter section of the line-level Controller, because the problem went away when the SL600s were operated fullrange. I'm surprised that MC did not comment on this in his review. After about a 48-hour warmup, the upper mids smoothed out quite a bit. But the problem was not adequately addressed until I replaced the Levinson amplifier with the Cochran Delta Modes as satellite amps. Is it possible that the tubed front-end of the Delta Modes filters most of the dirt generated by the Controller? I'm left with a nagging suspicion that perhaps the Controller could benefit from a discrete no-holds-barred design. Let's see, if I could talk Threshold into rebuilding the Celestion Controller...

Subwoofing makes good sense only if you're buying a sure thing, like upgrading to a Celestion System 6000, or if you are a risk-taker who can afford the cost of experimentation. If you decide to experiment, then the best strategy is to bi-amp using steep filter sections and a nominal 100Hz crossover point.—**Dick Olsher**