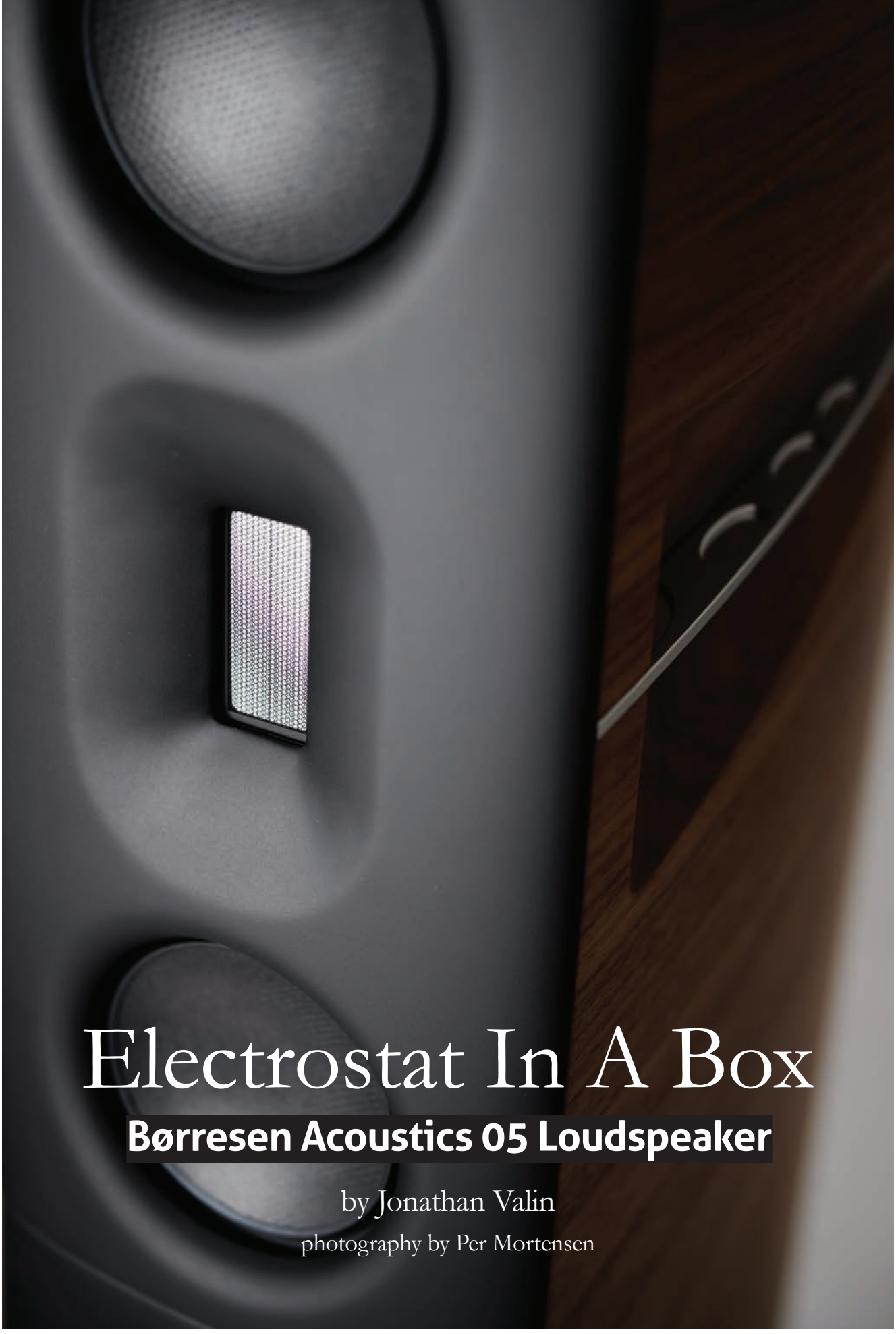
ULTIMATE LOUDSPEAKER ISSUE!

the absolute sound

Børresen Acoustics 05

High Resolution!

ELECTRONICALLY REPRINTED FROM OCTOBER 2020



Electrostat In A Box

Børresen Acoustics 05 Loudspeaker

by Jonathan Valin

photography by Per Mortensen

Børresen Acoustics 05 Loudspeaker

IT'S COMMONPLACE for an equipment reviewer to praise a multiway dynamic loudspeaker by favorably comparing it to a boxless single-driver electrostat (which kinda makes you wonder why the reviewer's listening to a bunch of cones in the first place). What may not be quite as common is for that reviewer to compare a dynamic loudspeaker to a *specific* electrostat—indeed, an electrostat that was only on the market for a couple of years before it was replaced by a "new and improved" model, which, as it turned out, was not entirely an improvement. And yet the first time I heard the five-foot-tall, one-foot-wide, seven-driver, two-and-a-halfway, ribbon/cone Børresen 05 floorstander—the current flagship of the Danish loudspeaker company Børresen Acoustics, founded by former Raidho mainstays Michael Børresen and Lars Kristensen—I immediately thought of the original MartinLogan CLS. Indeed, the 05 so *precisely* reminded me of the CLS (a speaker I lived with in various iterations for almost a decade) that it was uncanny, especially since the two speakers didn't really sound alike in the bottom octaves or the treble, where the 05 was markedly fuller, flatter, and more extended. But in the midrange…well, sonic memories of the MartinLogans just kept popping into my head.

Before I get to the reasons why this was the case, I should note that what also surprised me at the very start of the review period was how *little* the Børresen 05 sonically resembled Michael's previous projects—the superb Raidho C-1, D-1, C-5, D-5, etc. Oh, the 05 had the same outstanding resolution as Michael's Raidhos (Børresen transducers have always been standard-setters when it comes to the recovery of detail). And, on a less salubrious note, there was also a familiar and unwelcome bit of the Raidho profile in the 05's in-room rise in the 70–100Hz range, which, depending on recording, could mess with pitch definition in a narrow but, alas, musically populous segment of the midbass—particularly on sustained notes from standup or electronic bass and synth (less so, or not at all, on those from piano and low-pitched brass and winds).

It was elevation of the midbass and lower mids—coupled to a suckout in the upper midrange, which I'll come to, and a roll in the very top treble—that gave Børresen's Raidhos their characteristically dark, powerful, "bottom-up" sound signature. On most recordings this heavy accentuation of the power range could be extremely thrilling and lifelike. For example, on "I've Got You Under My Skin" from *Sinatra at the Sands* [MoFi], I have to this day never heard the recorded brasses and winds of a large band (in this case, Count Basie's, conducted by Quincy Jones) sound as awesome as they did through the Raidho D-5s, which delivered that host of trumpets, trombones, and saxophones with the kind of avalanche power, weight, and impact that I've only before experienced with actual big bands at jazz clubs. (Sinatra does warn the Sands audience to "run for cover" before Basie's men, Harry "Sweets" Edison and Eddie "Lockjaw" Davis among them, launch into their break.) However, the D-5's massive power-range sock could also be dismaying when it set the room ringing, as it did mine on certain notes from Norman Keenan's standup bass at very loud playback levels on "Come Fly with Me" and other cuts from that same Sinatra album.

Let's be frank: Unless your listening room is custom-designed to ameliorate the problem, as my pal Robert Harley's is, or you're using DSP in the bottom octaves, as I am with the MBL 101 X-tremes' subwoofer stack, some 70–100Hz boom is almost inevitable with ported speakers like Raidhos and Børresens. However, because of their huge elevation of the midbass, the larger Raidhos went way beyond "some amount" on a handful of discs. The Børresens, as you will soon read, do not. (These remarks *only* apply to Michael's Raidho designs; they do not apply to the current iterations of Raidho's loudspeakers, such as the TD3.8 reviewed by AHC in this issue, which have been redesigned by Benno Baun Meldgaard.)

As I noted a paragraph or two ago, the Raidho's bottom-up sound was also reinforced by suckout in the upper midrange, precisely where Børresen's otherwise remarkable single-ended ribbon tweeter crossed over to his cone midrange. A broad, designed-in Gundry dip in the 2–4kHz range, intended to mask the breakup modes and dispersion mismatches of the vapor-de-

It was the Børresen 05's lack of a color cast coupled with its phenomenal resolution and near-boxless openness that put me in mind of the original CLS.

posited diamond/carbonite midrange drivers and the single-ended ribbon tweeter, gave the Raidhos a slightly recessed sound, pushing some instrumentals and vocals back a bit in the soundstage and (in combination with the tweeter's gentle roll at the very top) further darkening overall timbre. The plus side of this bottom-up balance was simply gorgeous midrange/treble tone color, with not a hint of added edginess, brightness, or sibilance. Very few speakers in my experience have been as purely and consistently beautiful-sounding and dynamically electrifying as Børresen's Raidhos, large and small.

So, imagine my surprise when the Børresen 05s didn't sound dark or particularly voluptuous at all. Indeed, it was their lack of a color cast (dark or bright, plain or glamorous), coupled with their phenomenal resolution and near-boxless openness, that put me in mind of the original CLSes (still, in the midband, the most colorlessly neutral and transparent loudspeakers I've ever heard). What in the world of Børresen had changed?

Well, a lot it turns out. (For more detail on the innovations in the Børresen 05, see Michael's comments in the sidebar appended below.)

To begin at the top, Børresen's wonderful ribbon tweeter—alongside the equally fabulous MBL HF Radialstrahler, *the* best tweet in high-end audio, IMO—has been audibly improved. According to Michael, "much of this improvement is due to new, thinner, lighter, and more heat-resilient membrane materials driven by an FEMM (Finite Element Methods Magnetics)-optimized, stronger, and more linear magnetic motor." The result of better materials and better magnetics is that Børresen's new ribbon is said to handle a lot more power, cross over at a lower frequency, and extend a full octave higher than his Raidho ribbon. Those of you who know the sound of Børresen Raidhos will hear the differences immediately—the darkness and recessiveness are gone, replaced by the colorless neutrality and minute resolution of previously-undisclosed detail that you heard from the CLS (hence, part of my nostalgia), except that Børresen's tweet is more extended and more linear in the high frequencies than the CLS's panel was.

What is true of the tweeter is equally true of Børresen's mid/bass and bass drivers, which now use carbon/Nomex-honeycomb sandwich membranes rather than the vapor-deposited-over-ceramic diamond/carbonite ones in Michael's Raidho designs. The 05 has two 5" carbon/Nomex mid/bass drivers and four 8" carbon/Nomex woofers in a quasi-D'Appolito array on its extremely narrow front panel, with individual ports at the rear of the cabinet—three for the woofers and one for both mid/woofs—along with ingenious flow-vents inside and on the outside of the box. (More on these things in a moment.) According to Michael, the membranes of his dynamic mid/woofs and woofers make for drivers with "absolutely the best weight-to-stiffness ratio and best internal damping we currently know of."

But Michael's new membranes are only half—and maybe not even the most important half—of what has changed in his cone drivers. He has also spent a great deal of time and money on improving the motors that power these cones. By using neodymium magnets (in artfully opposed sets) exclusively and by replacing the iron in the pole pieces with pure copper (see the sidebar below), Michael claims to have eliminated variations in the flux that drives the voice coil, which, unaddressed, changes unevenly with the direction of the current in the coil. The result of eliminating iron and iron distortion from his drivers is a 90% reduction in voice-coil inductance, and with that lowering of inductance comes a lowering of reactance, "meaning that the driver will not spike up the impedance where the system has its resonance nearly as much as normal iron-based drivers, and thus will produce much more linear bass output in rooms."

Though Børresen is quick to add that speaker placement is still essential to minimizing room pressure and distance nodes (a caveat to which I can attest), it is a fact (to which I can also attest) that when properly situated—and we're talking some work here, as millimeters make a difference—the 05s induce markedly less boom in the midbass, have greater pitch definition, and extend more deeply and linearly, with gen-u-ine floor-shaking power, into the bottom octaves than Michael's Raidhos and than most other pricey, ported dynamic loudspeakers. As with the tweeter, the net result is a colorlessly neutral presentation, with the selfsame resolution of previously undisclosed detail.

The overall result of all these changes to membranes, voice coils, enclosures, and crossovers is the closet thing I've yet heard to an electrostat in a box.

If you're looking to hear (and very nearly see) what's on your best records with a neutrality and completeness rarely matched by other speakers, the Børresen 05s are must-auditions.

Of course, a significant goal of improving individual drivers is to make their overall blend with the other drivers more seamless by extending linear bandwidth, lowering distortion, and reducing the audibility of out-of-bandwidth breakup modes. And with help from its crossover and its ingenious enclosure, that is the case with the 05. The speaker would not have put me in mind of the CLS had it not sounded more like a freestanding membrane driver than a collection of cones in a box.

Let's consider that box, which is pint-size in dimensions. In front, all seven drivers are mounted in waveguide-like circular indentations CNC-milled into three, thick, slightly bowed, extremely narrow, damped-composite panels—a mere foot in width—which are stacked near-seamlessly atop each other. There is very little "margin" on either side of the mid/woof and woofer cones. The ribbon tweeter is deeply inset in an actual waveguide to focus its output and better match its dispersion pattern at the bottom of its range to that of the mid/woofs at the top of theirs.

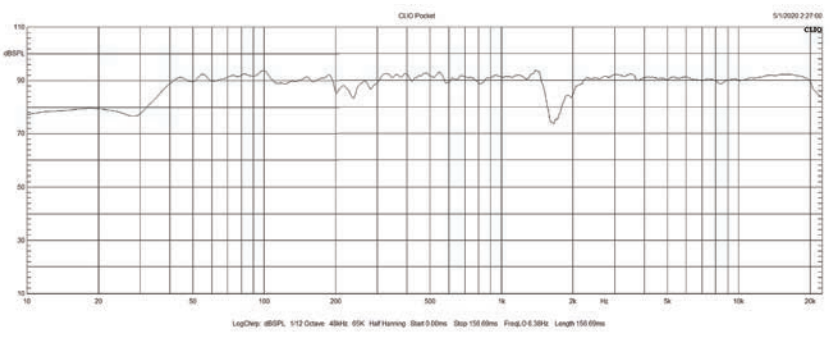
The trio of faceplates are edgelessly attached to a bowed, two-foot-long HDF-and-solid-wood enclosure (with real-wood veneer on all exposed sides) that gradually tapers to less than three inches at the rear. The woofer and mid/woof ports are situated in a long, narrow, U-shaped channel at the back. As Michael notes, the odd-looking, tubular ports (or flow vents) have what he calls "fins" set into their narrow tubes "to generate micro-turbulence, so the air doesn't stall in big first-order turbulences." (As Børresen says in the sidebar, the idea came from Formula 1 fins and airfoils.) Clearly, the thing has been aerodynamically streamlined to minimize diffraction. And for the most part it works.

With extremely neutral, high-resolution, low-distortion drivers and next to no box to radiate off, there is zero sense of enclosure. Outside of that small, source-dependent, room-induced trouble spot in the midbass, it's as if the drivers were free-standing and of a single piece. Which, of course, is another large reason why I kept thinking "CLS."

Part of the 05's seamlessness is also owed to its two-and-a-halfway crossover, which, as Michael explains below, allows the twin midrange drivers to "extend (without crossover) all the way to the bottom [of their range], and only limits their transient excursion via an internal flow vent." Interestingly, the Børresen 05's crossovers use active charging to remove the zero-crossing from the XO's tweeter caps. (You connect a supplied wall-wart cable from a jack on the speaker to your AC or, if you wanna go fancy, to a Børresen Acoustics box specifically designed to power the caps.) As Michael notes, Børresen also uses in-house-designed coils made from heavy-gauge copper foils.

The overall result of all these changes to membranes, voice coils, enclosures, and crossovers is the closest thing I've yet heard to an electrostat in a box—and not just to any 'stat but to the most colorless, highest-resolution one I've owned.

In case my descriptions and analogies haven't impressed you sufficiently, take a look (to your right) at the quasi-anechoic frequency response of the Børresen 05 (before my room takes hold).



Although I'm not a true believer in loudspeaker measurements—since microphones don't hear the way ear/brains do (they don't have a built-in ISO226:2003 equal-loudness contour for one thing and their response is absurdly dependent on placement for another)—I do perform them occasionally, when I am puzzled or impressed. In this case, I was both. And in this case, the test just confirmed what I already knew from listening—that this is one *very* neutral transducer. (In case you're wondering about that narrow, anomalous dip between 1.5kHz and 2.25kHz, it is caused by the tweeter being wired out-of-phase—and is simply inaudible in playback.)

So what does an incredibly neutral, impressively low distortion electrostat-in-a-box sound like? Since I've talked, repeatedly, about the crucial role that neutrality (the absence of artificial emphases in timbre, intensity, pitch, and duration) and completeness (the full recovery of recorded information) play in triggering that gestalt shift which turns well-recorded parts into lifelike wholes, you ought to be able to guess.

Or, if you don't want to guess, just put on a really good recording, like Julie London's "Cry Me A River" from the Analogue Productions LP *The Wonderful Sounds of Female Vocals*, and hear for yourself.

This is a mono cut taken from the 1955 album *Julie Is Her Name* on Liberty Records. The Bobby Troup (then London's husband) arrangement couldn't be simpler: Just London closely mic'd front and center, with guitarist Barney Kessell and bassist Ray Leatherwood backing her up. In all likelihood the microphone used for London's vocal was a Neumann/Telefunken U-47—the famous, near-ubiquitous, triode-powered condenser

with a big, warm, spacious sound that, because of a rise from 2kHz to 10kHz, also added presence, brilliance, texture, and (sometimes) a hint of nasality to vocals (think Sinatra on Capitol, who swore by the U-47).

London once said of her singing, "It's only a thimbleful of a voice, and I have to use it close to a microphone. But it is a kind of oversmoked voice, and it automatically sounds intimate." Through the 05s, London's contralto has seldom sounded more wry, languid, and intimate; the singer is so realistically "there"—so spookily present—you can almost see the trail of smoke from her stubbed-out cigarettes.

It has been my long experience that when recorded vocalists and instrumentalists seem to be "there," as Ms. London certainly does through the 05s, there is *always* a synesthetic component to the illusion. When the stars align, we don't just hear voices and instrumentals *sounding* more real; we also seemingly *see* the artists and their instruments right there in front of us—as if the sounds they make have suddenly coalesced into physical presences. This synesthesia is a large reason why we are always pleasantly surprised when something recorded sounds real: It's not just that the heightening of the illusion is rare and unexpected; it's also that it's magical—to suddenly seem to see what you're perforce only listening to.

What triggers synesthetic visual impressions is what I'm calling "completeness"—the full and impartial reproduction of musical, instrumental, performance, venue, and engineering details. With the addition of such completeness, a piano, for instance, acquires individual keys, felt-covered hammers, dampers, strings, soundboards, and pedals—all being expressively manipulated by the performer sitting at the keyboard. You "see" that instrument and instrumentalist because your stereo system is creating a more complete picture of the music he is playing, the instrument he is playing it on, the technique he is playing it with, the room he is playing it in, and the ways and means by which all these critical things have been recorded.

Like the CLS—except on a much broader sonic canvas—the Børresen 05 consistently delivers this "completeness." With such a panoply of expressive detail, visualization becomes the norm rather than the exception on the best LPs. And that can change how you hear your music.

For instance, though widely esteemed, the RCA LP of the Prokofiev Third Piano Concerto with pianist Van Cliburn and the Chicago Symphony Orchestra under Walter Hendl has never been one of my favorite performances of this piece. (I prefer the fiery Janis on Mercury and the fleet, idiosyncratic Argerich on DG.) And yet through the 05s on the Analogue Productions reissue, I developed a new respect for Cliburn's playing. Thanks to the Børresens' more neutral and complete presentation, I could hear into (i.e., more nearly see) how Cliburn was handling the challenges of this fiendishly difficult music. How he did poetic justice to the wintry fourth variation in the second movement, with its thirds falling like snow on a grey afternoon. (Has anyone ever conjured the blue chill of winter better than Prokofiev?) And how he sailed through (or maybe a bit above) the famously challenging double-note arpeggios (which require the performer to straddle two adjacent keys with each finger and do so with spirit [*brioso*]) in the coda of the third movement. He may not have been Janis or Argerich here (and Hendl falls well short of the driving Kondrashin or the March Hare Abbado), but through the 05s he was—at last and admirably—his own precocious, gifted, rather aloofly romantic self.

Ditto in terms of neutrality, completeness, and synesthetic presence on the excellent MoFi reissue of *The Band* (which could, just as fittingly if not as memorably, have been called *America*, had Robertson and Helm had their druthers), where important musical and performance details—like the sweet lilt of Richard Manuel's falsetto, the old-fashioned rattle and snap of Levon Helm's vintage snare drum (with hardwood hoops, calf heads, and gut snares), the ropelike bass lines of Rick Danko's Ampeg fretless, the dishpan clatter of Manuel's upright, Garth Hudson overdubbed comping on soprano, tenor, baritone sax, and trombone (most folks seem to think that brass-and-wind comps didn't show up on Band recordings until Allen Toussaint's arrangements on *Cahoots* and *Rock of Ages*, but listen to *The Band* and be enlightened)—are "made visible" and brought fully to life.

As you can see from the photos on *The Band*'s foldout cover, the set was recorded in a "studio" that The Band put together in the backyard pool house of a scenic Hollywood Hills mansion once owned by Sammy Davis Jr. The songs were taped on an 8-track recorder, mostly, I believe, via the highly directional Electro-Voice RE15 dynamic mics the boys used on *Big Pink* and other equipment loaned to the group by Capitol Records. The kind of old-timey, noncommercial sound that was achieved in this impromptu setting, where vocal and instrumental lines are both separated and mixed together as if in friendly, overlapping conversation, fitted the

Børresen Acoustics 05 Loudspeaker

Specs & Pricing

Type: Two-and-a-halfway, ported floorstanding loudspeaker
Frequency response: 25Hz–50kHz
Sensitivity: 90dB
Impedance: >5 ohms
Recommended amplifier: >50W
Dimensions: 12.0" x 61.0" x 22.8"
Weight: 165.35 lbs. each
Price: $120,000

BØRRESEN ACOUSTICS ApS
Rebslagervej 4
9000 Aalborg
Denmark
borresen-acoustics.com

JV's Reference System
Loudspeakers: MBL 101 X-treme, Magico M3, Børresen Acoustics 05, Voxativ 9.87, Avantgarde Zero 1, MartinLogan CLX, Magnepan 1.7 and 30.7
Subwoofers: JL Audio Gotham (pair), Magico QSub 15 (pair)
Linestage preamps: MBL 6010 D, Soulution 725, Constellation Audio Altair II, Siltech SAGA System C1, Air Tight ATE-2001 Reference
Phonostage preamps: Soulution 755, Clearaudio Absolute Phono, Walker Proscenium V, Constellation Audio Perseus
Power amplifiers: MBL 9008 A, Soulution 711, Constellation Audio Hercules II Stereo, Air Tight 3211, Air Tight ATM-2001, Zanden Audio Systems Model 9600, Siltech SAGA System V1/P1, Odyssey Audio Stratos, Voxativ Integrated 805
Analog source: Clearaudio Master Innovation, Acoustic Signature Invictus Jr./T-9000, Walker Audio Proscenium Black Diamond Mk V, TW Acustic Black Knight/TW Raven 10.5, AMG Viella 12
Tape deck: United Home Audio Ultimate 4 OPS
Phono cartridges: Clearaudio Goldfinger Statement, Air Tight Opus 1, Ortofon MC Anna, Ortofon MC A90
Digital source: MSB Reference DAC, Soulution 760, Berkeley Alpha DAC 2
Cable and interconnect: Crystal Cable Ultimate Dream, Synergistic Research Galileo UEF and Foundation, Ansuz Acoustics D-TC
Power cords: Crystal Cable Ultimate Dream, Synergistic Research Galileo UEF and Foundation, Ansuz Acoustics D-TC
Power conditioner: AudioQuest Niagara 5000, Synergistic Research Galileo UEF, Ansuz Acoustics D-TC
Support systems: Critical Mass Systems MAXXUM and QXK equipment racks and amp stands,Symposium Isis and Ultra equipment platforms
Room treatment: Stein Music H2 Harmonizer system, Synergistic Research UEF Acoustic Panels/ Atmosphere XL4/UEF Acoustic Dot system, Synergistic Research ART system, Shakti Hallographs (6), Zanden Acoustic panels, A/V Room Services Metu acoustic panels and traps, ASC Tube Traps
Accessories: Symposium Rollerblocks and Fat Padz, Walker Prologue Reference equipment and amp stands, Walker Valid Points and Resonance Control discs, Clearaudio Double Matrix Professional Sonic record cleaner, Synergistic Research RED Quantum fuses

group's songs and spirit perfectly (though Capitol did The Band no favors when it originally engineered the mix). With the MoFi reissue, you hear (and recover) both sound and sprit through the 05s.

When it comes to soundstaging, the Børresen 05s are their own rather interesting thing (just as the Raidhos were). If you are used to cones-in-a-box that seem to constantly image well "outside" their enclosures, the Børresens are going to surprise (and perhaps disappoint) you a bit. Oh, they will do the wall-to-wall thing on recordings that are made with widely spaced omni mics (such as the Neumann M50s used on many orchestral recordings from Decca and RCA), but for the most part their staging and imaging is tighter than, say, that from a Magico M3 (or an MBL 101 X-treme, *par excellence*).

Our Robert E. Greene noted in last issue's "Point/Counterpoint" that "the correctness of stereo is essentially completely embodied in the tight focus of images from mono signals." Though I do not agree with the rest of his supporting argument, it is an interesting point. And for what it's worth, on a mono recordings such as the Julie London cut I mentioned earlier or any of the mono vocals or instrumentals on *Chet Baker Sings*, I'm not sure I have ever before heard clearer, tighter mono focus than that delivered by the Børresen 05s. I'm not talking about vertically "slit-like" imaging here, as if the vocalist has been turned into a narrow slice of peach pie. London's voice, for example, is life-sized, rounded, and quasi-dimensional—not slightly one-dimensional as she would be through most cones-in-a-box or as fully 3-D as she is through the MBLs—but it is also unusually "fixed," solid, and stable, and centered right between the speakers.

That this stability and solidity add to "visualization" of the artists and their instruments on mono recordings is undeniable. That they can also rob two-channel LPs of a bit of lifelike ambience, expansiveness, and pure stereophonic fun is also true. I used to wonder why Michael and Lars always widely spaced their speakers (nearly wall-to-wall) at shows, and then toed them in dramatically. (The folks at Audio Physic used to do this same thing.) But it is clear to me now that, because of their speakers' more focused, phase-coherent release of energy and their low-reflection, low-diffusion enclosures, Borresen and Kristensen were using the space between the speakers to "imply" greater stage width.

Michael Børresen on the Børresen 05

WHEN DESIGNING EQUIPMENT for the reproduction of recorded music, you only have one objective: to remove yourself from the proceedings as completely as possible. This is also why making hi-fi equipment is very different from making equipment for performing artists. Artists select their products for a certain sound and then make that sound a part of their art. Our job is to create products that are true to the intent of the artist. We have to get out of the way and let the performance shine. When it comes to speakers, this means we have to focus on all sources of noise and resonance, while recognizing that any choices we make will influence the end result and that installment and usage will also have a great impact on a speaker's final ability to convey the intent of the recording artists.

In all my loudspeaker design work I have always striven to lower noise. I did this at the start when I was working on my own and throughout my work with Raidho, and it is a quest that I will continue to pursue as long as I set the course and direction of loudspeaker design.

As we build every part of our speakers in-house, we naturally focus a great deal on drivers and their performance. My experience is that the drivers are ultimately the chief limiting factor in loudspeaker design. Nothing can be created that supersedes the drivers used. System concepts are only able to extract more or less of the potential of the driver complement.

In the Børresen 05—if we start at the top octave—the tweeter is a direct development of the work I did very early on with ribbon high-frequency drivers. The 05's ribbon is fundamentally based on the magnet structure that was developed in the early 80s by Philips, and similar to the system I made use of in my FF75 and later employed in the Raidho speakers.

As with anything more than 20 years old, materials and possibilities change. So the latest Børresen tweeter is more efficient, can handle a lot more power, and crosses over at a lower frequency while extending a full octave higher. Much of this improvement is due to new, thinner, lighter, and more heat-resilient membrane materials driven by an FEMM (Finite Element Methods Magnetics)-optimized, stronger, and more linear magnetic motor.

Objectively, the foil membrane can withstand twice the heat, weighs only half as much (0.01g), and boasts a very high efficiency of 94dB for 1W. This lower mass simply leads to lower noise, as there is next to no mass to resonate—and next to no mass to cause a movement delay from the signal. Since a dome weighs 40–100 times more than a ribbon driver, it's easy to understand why the Børresen tweeter is very low in noise and imposes very little of its own signature on the performance. It simply delivers the treble as recorded.

The Børresen 05 has two 5" mid/bass driver and four 8" bass drivers. They all share the same ironless motor system and the same type of carbon/Nomex honeycomb sandwich membranes.

I have always been puzzled by why dynamic loudspeaker drivers have had the same basic structure since the day they were invented about a hundred years ago. In a way it seems like it's a *given* structure, maybe because (in broad terms) there's a split between those who manufacture drivers and those who build speakers. As a result, a magnet system has always been a magnet and some iron to guide the flux into a narrow gap where the voice coil is situated and drive the cone with the signal. But, while iron is a good conductor of magnetic flux it has also some very severe, and noisy, drawbacks.

To understand the function of each element in a driver requires some explanation. The force on the membrane follows a simple principle: Electric current in magnetic flux develops a mechanical force—the F=B×L product of the driver (with F being force, L being the length of the voice-coil wire in the magnet gap, and B being the magnitude of the flux). This is the fundamental formula for all drivers.

Now B is the *summed* flux of the driver—the conducted magnetic DC flux from the permanent magnet summed with the electromagnetic flux stemming from the current flow through the voice coil. (The voice coil acts as an electromagnet.) Here it's quite easy to understand why iron has a negative effect on performance. As the DC flux from the permanent magnet loads the iron close to magnetic saturation, the magnetic contribution from the VC (voice coil) has a hard time increasing flux but a very easy time relaxing it. The magnetic flux that drives the voice coil simply varies unevenly with the direction of the current in the coil. This is the mechanism of iron distortion.

If we look at the Børresen patented magnet system without iron, the nonlinearities of magnetic flux summation (B) are 100% removed, as the system is 100% symmetric for motion in both directions. Instead of having polepieces of iron, we have polepieces of pure copper. We achieve the desired flux of 1.1 Tesla by compression of two opposed sets of neodymium magnets, with the two copper polepieces acting as an effective magnetic DC block, so the electro-magnetic changes from the voice coil's electromagnetism are largely blocked. This we see as a great reduction in voice-coil inductance, more than 90% lower than a normal iron-based driver. (The actual number is 0.04mH on a 6-ohm driver voice coil, where typical iron-based driver numbers are about 0.5mH.)

The low induction of the system has further advantages. Because inductance is lowered, reactance is also very low, meaning that the driver will not spike up the impedance (where the system has it resonance) nearly as much as normal iron-based drivers, and thus will produce much more linear bass output in rooms. No, this will not remove the need to find a position where the speaker works with the room and does not excite room pressure and distance nodes, but it will allow the driving amplifier to have far greater control in the lower operating range.

The membranes of the dynamic drivers are made from two very thin, non-woven plies of carbon over a 4.5mm-thick Nomex honeycomb. This gives a very stiff, very strong, and very well damped membrane. Throughout my quest to design the best drivers, I have always worked with stiff membranes, the main caveats being the undamped resonances you tend to get with stiffer membranes and the heavier weights that stiff membranes also have. This design (stolen from the front wings of F1 race cars) addresses both these issues, with the absolutely best weight-to-stiffness ratio and best internal damping we currently know of.

The Børresen 05 is configured as a 2.5-way system, where we let the two midrange drivers extend (without crossover) all the way to the bottom and only limit their transient excursion via an internal flow-vent design. This way of de-

signing eliminates the typical three-way issues, where you may have measurable SPL output but can't feel the energy due to the big phase shifts of three-way crossovers. The speaker is crossed over at 2.5kHz (second-order), and we roll-off the four bass drivers gently from 120Hz up. The crossover filter uses charged capacitors (from external supplies) to remove the zero-crossing from the tweeter caps. We also use in-house-designed coils made from heavy-gauge copper foils, with porous paper separating the layers of the coil. After winding we impregnate the assembly with natural resins under vacuum. Where current flows, coils and capacitors tend to vibrate. This vibration causes them to generate their own signal, which is then layered into the signal driving the loudspeaker. The impregnated resins significantly reduce this microphonic effect, making for greater clarity.

The cabinet is made from a combination of veneered HDF, solid wood, and aluminum. Sides are machined and vary in thickness, so the bracings are joined to sections of greater width. You can always argue that cabinet material plays a role in the overall result. In my opinion woods are the best materials. While not the most expensive, they have the most ear-friendly resonance patterns. Just knock on a piece of wood and compare that sound to the loud tinny resonance you get from a similar piece of aluminum—or most other material for that matter.

Behind each driver are the internal bracings and the flow-vents that Lars [Kristensen] brought to us from his first speaker ventures with Russel Kauffmann. These vents control the airflow behind the drivers in a very intriguing way. At low transient levels the drivers see the full size of the cabinet with hardly any air flowing through the vents, but when there's a huge transient, airflow through the vents increases as more pressure builds behind the driver, controlling the excursion and improving the transient response, so you don't get the overshoot that is typical of vented designs.

Three of the ports in the back of the speaker are for the bass drivers and one is for the two mid/basses. The fins in the ports are there to generate micro-turbulence, so the air doesn't stall in big first-order turbulences. This is much the same idea that Formula 1 teams use when they put serrated edges on fins and airfoils.

The tweeters have air reliefs through the two side cuts. (Treble improves a lot with the vents, though the airflow through them is next to nothing.) We put two layers of titanium decoupling in the base of the speakers and use adjustable feet to accommodate uneven floors.

It occurs to me that I may be leaving the impression that these superb 'stat-like Børresens are strictly "fidelity to source" loudspeakers—that they don't have the color and drama of Michael's Raidhos. While there's a little bit of truth to this, there's also a whole lot that is misleading. Yes, the Raidho D-5s, for example, were the quintessence of musicality-first transducers, but they were also flawed in ways that the Børresen 05s are not. True, the D-5s were very high in resolution, but they were also (by design) anything but neutral in timbre, pitch, intensity, and duration. And without that neutrality they didn't conjure up the living presence of Julie London or Van Cliburn or The Band with the near-visible completeness that the 05s do; they didn't present the timbre of London's voice or Cliburn's Steinway grand or The Band's variety of instruments, new and vintage, with the truthfulness that the 05s do; they didn't report back on how and where the recordings were made with the fidelity that the Børresens do. All of which is to say that the 05s are, IMO, considerably higher-fidelity loudspeakers.

It also occurs to me that I may be leaving the impression that the 05s' bass decades are screwed up because of that recording-dependent in-room peak in the midbass. This is simply not the case. This is a very powerful, deep-reaching loudspeaker that will, believe me, shake the floors on orchestral tuttis and hard rock—and do so while simultaneously telling you exactly what's doing the shaking. All you have to do is put on something with truly powerful low end—like Robbie Robertson's "I Hear You Paint Houses" from *Sinematic* with Pino Palladino on Fender Precision Bass or Hans Theessink's "Storm Warning" from *Hans Theessink 70th Birthday Bash* with Jon Sass on jazz tuba—to hear just how colorless, extended, precisely defined, and gut-thumping the 05s are in the bottom octaves. Unlike the ML CLSes they resemble so uncannily in the midband, they do not suck out the power range—and deracinate timbre. They are as full and hard-hitting as the music and the recording tell them to be, but they aren't the all-purpose sledgehammers that the Raidho D-5s were.

At $120,000, the Børresen 05s certainly have competition—from Magico, Wilson, MBL, Kharma, Rockport, Tidal, Raidho, Focal, the single-driver Voxativs (minus the touch of horn shoutiness in the upper mids and the roll in the top treble, the box speakers they most closely resemble sonically), etc. So you're going to have to give them a long listen with a variety of your music. Be aware that they will not give you the *sui generis* body, dimensionality, density of timbre, dynamic impact, and wall-to-wall-to-wall soundstaging of my reference MBL 101 X-tremes—no speakers in a box (or speakers without one) will. But the Xes are better than twice the dough of 05s, are gigantically large, heavy, and complex, and require entirely different, more elaborate, and far more expensive amplification. (For the record, my listening with the 05s was done entirely with Børresen-designed Aavik Acoustics electronics—M-300 mono amplifiers and a C-300 full-function preamplifier—and Ansuz Acoustics Speakz D-TC cables, Signalz D-TC interconnects, and Mainz8 D-TC power conditioner. The neutrality and completeness of the sound I'm reporting on clearly owes a considerable debt to all of these Børresen products).

If you're looking for an electrostat in a box—looking to hear (and very nearly see) what's on your best records, discs, and streams with a neutrality and completeness that are rarely matched by other dynamic loudspeakers, in a package that is both demure for all that is on offer and quite attractive for cones—then the Børresen 05s are a must-audition. Shoe-ins for one of our annual Product of the Year Award nominations, they are, obviously, most highly, warmly, and enthusiastically recommended. **tas**