

Sound in HD

Likening the performance of its new loudspeakers to high-definition video, Mackie believes that it is about to set a new benchmark for practical PA systems



The men behind the HD Series – technical engineer John Dugan and acoustical lead engineer Dan Boothe

WHEN THE COVERS CAME OFF

Mackie's new HD Series of loudspeakers a couple of months ago, it was with a flourish. Brand product manager Greg Young boldly announced that they had been named the HD Series 'because we want people to react to them in same way that they did when they first saw high-definition video – we want them to be amazed by what they're hearing.' Mr Young was equally clear about their intended users, singling out 'weekend warriors' among the target market. The picture was quickly made clear – we were looking at loudspeakers with a very high standard of reproduction that would be practical, robust and affordable, and not require a training course before they could be put into use.

Taking the physical aspect of the two models that have been released – the HD1521 two-way and HD1531 three-way active loudspeakers – there is no mistaking their practical, roadworthy packaging, indicating that these are speakers to be gigged rather than carefully set up and admired. Yet Mackie has been quick to adopt the 'HD' tag to indicate what it is calling an entirely new category of loudspeaker that it terms 'high-definition live sound'. Can these two objectives be addressed with a single design?

'We have always listened closely to our customers,' Mr Young begins. 'Their demands for powered loudspeakers are simple – in theory. They want huge power, amazing sound quality, a high portability factor and, of course, a good price. Every generation of loudspeakers is subject to these demands. In fact, HD Series speakers offers more power, with measurably higher output, than any other loudspeaker in their class.'

'We believe the only way a manufacturer can continue to meet their customers' needs is by investing in top-notch engineering teams who strive to innovate with every new product,' he continues. 'Thus, our relationship with EAW played a big role when designing the HD Series. Their expertise in cabinet design and sheer acoustical genius allowed us to deliver patented acoustic correction algorithms resulting in an incredible sounding loudspeaker at a great price. And because we're a few generations into class-D amplifier technology and switch-mode power supply design, the HD Series is able to deliver extreme SPL from high power amplifiers in a lightweight and cool running package.'

The class-D amplifiers have also been designed to offer low distortion around clipping and fast recovery from clipping.



HD1531, hung horizontally

'We know a lot of people like to push things until all the lights come on, and this will address the reality of this kind of use, and offer much improved performance,' Mr Young says. 'Class-D amplification is a great example of an enabling technology – these amplifiers are considerably more efficient than older technologies, allowing for class-leading power levels at much lower operating temperatures, virtually eliminating the risk of thermal shutdown. They also are considerably lighter than other amplifier classes, which, when combined with the neodymium woofer magnets and a switching power supply, has led to a substantial reduction in weight. It makes them easier to transport and allows even the larger three-way model to be pole-mounted.'

Where the HD1521 uses a 15-inch neodymium woofer and 1.75-inch heat-treated titanium compression driver, the HD1531 adds a 6-inch midrange driver and Mackie's WaveFront mid/high horn system for wide, consistent dispersion. Housed in wooden boxes – rather than mixed birch plywood and plastic, that can create acoustic anomalies – the speakers draw on the consistency of components that Mackie is able to use and the expertise of the



The HD1531's EQ panel

EAW team to spec the drivers and fine-tune the cabinet design.

'We chose to use all-wood construction because it has a number of benefits, both acoustically and mechanically,' Mr Young explains.

'Any plastic that would be used to make an enclosure this large does not have the stiffness that a high-quality loudspeaker needs, and an enclosure made with overly flexible materials introduces resonances into the system and generally colours the sound of the speaker for the worse,' offers Dan Boothe, HD Series lead engineer at Mackie's Whitinsville base. 'Some amount of EQ can be deployed to help mitigate these symptoms, but its effectiveness goes only so far; the root of the problem remains. The all-wood construction is stiffer by nature, and is further improved by our selection of premium plywood and additional internal bracing. The result is a very robust enclosure that can stand up to the high internal pressures of a PA loudspeaker at max volume without the resonance problems of a plastic box.'

'There is also no substitute for the ruggedness and durability of an all-wood loudspeaker,' Mr Young resumes. 'Moving away from plastic enclosures and plastic end-caps makes the HD able to stand up to a lot of abuse on the road, comparable to much more expensive touring loudspeakers. The rigidity also allows for a large number of mounting options including vertical and horizontal flying in addition to pole and floor mounting. This all adds up to elevate the HD Series loudspeakers to be a truly professional product.'

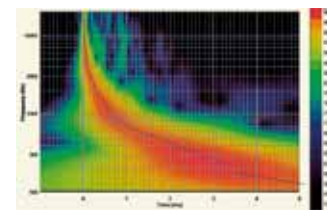
'High horsepower' DSP is also part of the electronics package, providing proprietary acoustic correction processing that counters the inherent physical attributes that compromise passive loudspeaker construction – this

includes the cabinet resonances and horn characteristics already mentioned, all of which can be largely processed out. 'A DSP front-end with sufficient horsepower allowed us to integrate the acoustic correction algorithms into the product,' Mr Boothe agrees. 'The cabinet and horn characteristics are all consistent, known factors because of our low tolerance components and manufacture, so they can be addressed through custom algorithms. Over the past several years, EAW has invested significant time and money refining techniques for correcting acoustic anomalies that are common to all horn-loaded systems. In a tightly integrated system such as this, having the ability to perform finely-tuned optimisations is a great performance boost, and is only made possible with sufficiently powerful digital signal processing in the front-end.'

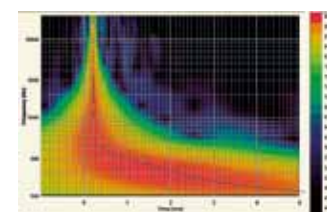
The DSP also provides three-band EQ, with high and low shelves and a sweepable mid, that allows user adjustment of the frequency response curve to suit applications such as voice reinforcement without subwoofers and the loudness (smiley face) curve for low volume use. (The blue operational LED can also be switched off for low visibility applications.)

'The DSP is at the heart of the sound of the HD Series,' Mr Boothe adds. 'Aside from the usual EQ, filtering, and delay used in system alignment and tuning, all the acoustic correction algorithms take place inside the DSP. Limiting, driver protection and thermal monitoring also occur in the DSP.'

The design team began development of the HD Series in earnest around April 2008, and saw the first full prototype in late June. With additional information



A typical loudspeaker spectrogram



HD Series spectrogram



The HD1531 and HD1521 dressed for action with 'weekend warriors'

from this, the design was modified, and the next round of development was completed in mid-August. Since then, the work has focused on diligently refining the voicing and thoroughly testing the design in the field. The final stage was the production ramp-up, to ensure the HD Series is built properly and provides long-term reliable operation.

'From the beginning of the HD Series project, all aspects of the design were focused on acoustic performance, allowing listeners to hear things with more clarity

and accuracy than ever before,' Mr Young says. 'Unquestionably, our patented processing was the key contributor to this moniker. These algorithms provide a level of coherence and accuracy of sound reproduction that is simply not available in any other loudspeaker anywhere close to this price point.'

'But other elements certainly came into play, including woodworking details that break up standing waves in front of the horn that would otherwise be detrimental to the coherence and frequency response of the speaker,' Mr

Boothe goes on. 'The perforation pattern of the grille was carefully selected to be sufficiently open, so as to be acoustically transparent as possible while still remaining sturdy to perform its duty as a protective shield. EAW custom-designed the HD Series' transducers with all other system components in mind to achieve low-frequency extension that is surprising from cabinets of this size.'

'We felt that "HD" best described the difference in sonic quality that sets these loudspeakers apart from all others in this market,' Mr Young says.

But if the HD Series is as groundbreaking as the Mackie team believes, what assurance does it have that it will not be appearing in every other manufacturer's loudspeakers before Mackie can capitalise on it?

'It would be next to impossible to reverse engineer our acoustic correction and DSP techniques,' Mr Young states confidently. 'Such a large portion of our IP [intellectual property] is contained in our design techniques and processes, which cannot be mimicked just by looking closely at the finished product. We have data collection methods and in-house software that is simply not available to our competitors. Our investment in engineering has



Alternative pole-mounting for HD1521

allowed us to develop the acoustic correction algorithms and design methods that are at the core of the HD Series. In other words, the "how" of our design is just as important as the "what".'

With a new generation of loudspeaker design in its hands, where does Mr Young see Mackie's next move? 'At this time we have only announced two speakers in

the HD Series – the HD1521 and the HD1531,' he responds. 'But we are anxious to incorporate HD technology into other products and there are certainly many routes that we could take.'

In the world of R&D, that's about as specific an answer as it's reasonable to expect...

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