The room and the monitor

JBL's LSR6300 Series studio monitors employ a variety of technologies that aim to address the limitations of real-world control room environments and to offer consistent and optimised performance at the listening position. JBL Professional's PETER CHAIKIN talks us through the thinking and the implementation.

THE LAST 15 YEARS have seen dramatic changes in production — not just in equipment but also in the environment itself. The objective is still the same: the facility must ensure that product produced in its control room translates to a range of systems in the outside world. Using proper construction and drawing on the expertise of a qualified acoustician, a professional commercial production facility may pay a good deal of attention to providing accuracy at the mix position, the place where the operator makes critical creative decisions. However, the availability of affordable high performance production systems has meant much of the work is done in less-than-perfect acoustic environments.

The project studio owner may not have the resources or the physical space to accommodate the acoustic treatment required to optimise the performance of their production space. It takes more than a 'flat' monitor system to have accuracy in the control room. Once a monitor is placed in a room, the monitor and the room work as a system, which, for better or worse, is the reference point for your creative decisions. If the room has problems, mix balances suffer. A move from stereo towards multichannel surround production and the lack of space for the optimum placement of all those extra speakers, further exacerbates the situation.

JBL Professional has been developing speaker systems that aim to provide greater accuracy at the mix position even in difficult acoustic environments. To achieve greater accuracy in the room, you must take into account a number of realities. At the mix position, the operator hears as much as 60% reflected sound. This means it is not enough for a speaker to be simply accurate on axis. The sound that the speaker sends to the walls, ceiling and floor, arriving at the mix position must also be neutral and uncoloured. The speaker's proximity to boundaries — walls, corners and work surfaces — will affect response. Standing waves, or room modes, can produce low frequency muddiness — or conversely — a lack of bass at the mix position can fool the operator into thinking they have the right amount of low frequency in the mix. All these issues affect the operator's perception and ultimately the balances of their mix.

So the objective is to create a system — a combination of the speaker and the room — that provides an accurate representation of the program's spectral content heard in the mixer's chair. With the release of the LSR6300 Linear Spatial Reference monitor system, JBL has applied technologies to address the realities of the modern production space and to provide greater accuracy in a wider range of environments. Linear Spatial Reference design means the loudspeaker is optimised to provide Linear sonic response Reference in the actual working Space. The resulting combination of speaker and work space produces a neutral reference the operator can trust in making creative decisions.

When JBL began designing its modern versions of cinema systems about 25 years ago, the concept of flat power response was very much in the minds of us all. The older hardware had given yeoman service to the movie industry for nearly five decades, but it simply could not keep up with the developing performance demands of uniform coverage and low distortion. The result was the model 4675, a two-way system with dual 15-inch low-frequency drivers and a constant-directivity high-frequency horn. This became the THX standard of the day and, ultimately, the industry standard, winning scientific and engineering awards from the Motion Picture Academy. The success of the design is due largely to its 'power response' — the attribute that allows the audience to hear uncoloured response regardless of the position in the room.

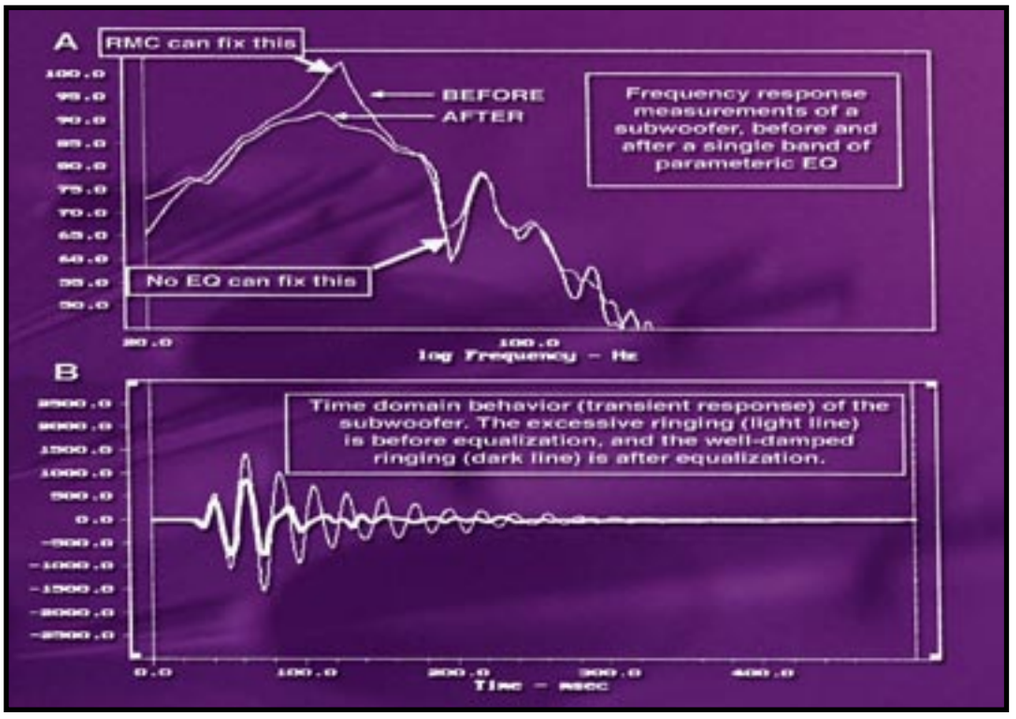
Power Response (or 'total radiated power response') is the sum of all acoustic power radiated in all directions through a sphere encompassing the loudspeaker. Power response provides an indication of the spectrum of the reverberant field. The reverberant field combines with the reflected sound field and the direct sound to provide a neutral, uncoloured response at the listening position. This is only possible if the off-axis response of the speaker is very smooth, otherwise you will hear 'holes' in the frequency response.

While uncoloured response is desirable in the live playback environment, it is essential in the recording and mixing environment. A speaker may measure 'flat' on axis, but in the room it may no longer sound accurate. This is due to poor power response. It is said that you can tell a speaker with good power response by standing outside the room and listening to the speaker through an open doorway. If the speaker has good power response, the sound coming through the doorway will be balanced.

In the LSR6300 series smooth power response was a primary objective. Modern designers of small project studios and large dubbing theatres opt for an acoustic character in which the balance of direct and initial reflected sound is about equal. In these spaces, we believe LSR products excel. The uniformity of off-axis frequency response excites an equally uniform pattern of first reflections, and the frequency balance in the room is uniform. As a result, better mix balances are achieved, and artists, producers and engineers don't have to sit in a precisely confined 'sweet spot' any longer.

Smooth power response is achieved through careful attention to the baffle design, the layout of transducers, and the exacting dimensions of waveguides and edge contours. Optimised crossover networks are used. The off-axis response is confirmed by taking 72 measurements, spanning 360 degrees around the speaker system. After much refinement and careful auditioning with critical users, JBL attained the degree of phase response shown in the diagram. An added benefit of the power response signature of the LSR6300 system is sonic compatibility with the large JBL cinema systems used in dubbing theatres. Product produced on the LSR6300 system translates perfectly to the stage.

With an unlimited budget, it is possible to design a monitoring space that is uniformly absorptive over the entire frequency range. When finished, you will have built-in bass traps that damp out the resonance caused by low frequency standing waves. But if you're outfitting a spare room at home you probably won't have the budget or the room for effective bass traps.



The curves in A represent the response of a system exciting a strong room axial mode at a frequency of about 40Hz, with and without a single section of parametric equalisation via Room Mode Correction (RMC). Figure B shows the before and after EQ effect on the time domain response of the loudspeaker/room system.

Normal room furnishings, drapery, carpeting, and a handful of diffusing elements will usually 'tame' the room to about 100Hz or 125Hz. Below that, there is not enough acoustical absorption to smooth out low frequency resonance caused by room modes.

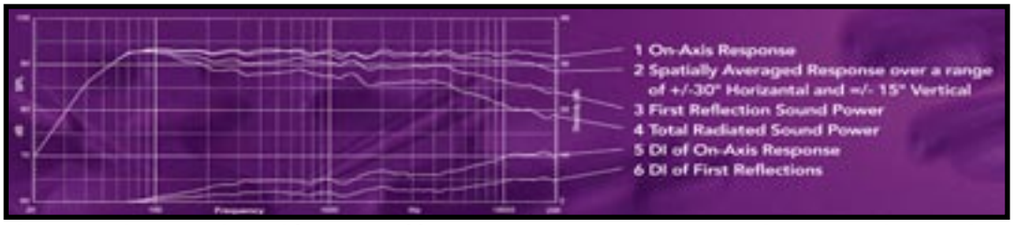
In about 95% of monitoring spaces, particularly smaller spaces without special LF damping, there is a troublesome dominant first-order axial mode, usually in the range between 25Hz and about 90Hz. The response peak due to that mode may be anywhere from 3 or 4dB up to 10 or 12dB, depending on the inherent damping of the room's structural elements. When left untreated, standing waves, or room modes can give a false impression of low frequency content at the mix position. Low-frequency peaks caused by room modes can cloud the mix and mislead the mix engineer, causing him to misapply EQ, compression and miss the mark on overall balances. The problem is not the program material, it is a problem in the room. The same program material played in another room would sound quite different in the low frequency area.

By matching the frequency, degree of damping (Q), and amount of response rise (dB), it is possible to equalise out a peak caused by a standing wave with a single-section of parametric equalisation. To address the effect of room modes, JBL integrated a system into two LSR6300 models called RMC, or Room Mode Correction. The RMC system is comprised of an application-specific parametric equaliser in the speaker and a calibration kit that allows the user to take measurements at the mix position and dial-in filter settings to minimise the presence of low frequency resonance. The equaliser has 18 frequency centres between 96Hz and 24Hz, variable Q from 1/2 octave to 1/20th octave wide and provides up to 14dB of attenuation. It is important that the corrective equalisation be minimum phase, inasmuch as the filtering effect of the mode itself is minimum phase. You can see how amplitude and time domain behaviour have been 'tamed' by the complementary filtering in the other diagram.

The settings are normally made once for a given loudspeaker set-up, and the time involved in making the adjustments is normally no more than a few minutes per speaker. An analysis kit, including a sound level meter and test CD, comes with each powered LSR6312SP subwoofer and each pair of LSR6328P monitors. The smaller 2-Way LSR6325P and the 3-way non-powered LSR6332 enjoy Room Mode Correction when the LSR6312SP subwoofer with RMC is incorporated into the system.

All LSR products are designed to produce a nominally flat response when operated in a freestanding mode. The placement of loudspeakers on stands is the preferred method of setting up a surround system. Loudspeakers mounted on stands at least 4-5 feet from a wall require no boundary compensation. For various positions in close proximity to a wall or corner there will be a general rise in LF below 200Hz, and it is desirable to reduce the system's output in that range to avoid low-frequency 'thickness' in the sound. The LSR6300 series has integrated mounting points that provide more options for placement, but mounting puts the speaker close to the boundary. The powered LSR6300 models incorporate switchable equalisation to compensate for placement near boundaries. Like RMC, this is a one-time setting for a given location.

The LSR6300 monitors also benefit from ongoing developments in materials and magnetics. The application of JBL's Differential Drive technology provides lightweight, high excursion capability in the woofers. The systems achieve unusual sound pressure levels, low distortion and low power compression to ensure the monitors sound the same at all playback levels.



The Curves shown are derived from a set of frequency response measurements taken every 5 degrees along two great circles (vertical and horizontal) about the loudspeaker. The off-axis data is processed to give simulated performance of a loudspeaker located at the centre of the IEC standard listening room.

For a monitor to be called accurate, it must not merely measure as accurate — it must be accurate in the room. It is JBL's objective to produce systems that take the room into account and make mixing easier. We believe the LSR6300 goes 'beyond accurate' to deal with the realities of today's workspace and give the mixer a clear window at the mix position in a less-than perfect environment. ■