Why is ATC different?

Britain built a reputation for excellence in the design, development and production of high fidelity loudspeakers from the 1950's through the 1970's. This was period of craftsmanship in research, build quality and product performance advancements. In recent years the trend has been toward commodity manufacturing to supply fewer yet larger speaker retailers, measuring success by increased sales rather than better performance. Speaker manufacturing has ceased to be a small engineering driven business and has become a cost critical larger scale manufacturing business.

While the basic design criteria for a high quality loudspeaker haven't changed, new materials and new designs have opened the door to possible advancements in performance. ATC is one company that is acutely aware of the advancements that re-engineering can deliver and has invested heavily in developing such technologies. Billy Woodman, owner and chief engineer at ATC, places design and materials research at the top of his personal list of "things I must do today". Over the past number of years, ATC has quietly moved ahead of its competitors by actively developing and implementing key ideas that radically improve performance.

Woodman and his team have approached the design of ATC loudspeakers by studying the differences and the common tradeoffs between hi-fi and studio monitor speakers, and incorporating the characteristics of both in a single speaker system. The best hi-fi speakers have brilliant sound quality – wide and smooth frequency response and low distortion, but typically have limited dynamic range. In the home listening environment, this is a reasonable compromise since the majority of commercially available music that we listen to for enjoyment has already been processed to restrict dynamic range.

On the other hand, studio monitors must be capable of accurately reproducing not only the finished audio product, but also raw, unprocessed sound straight from the microphones which can have a wide frequency range and a huge dynamic range as well. A studio monitor must be capable of revealing details of what's wrong with the sound, however it must still sound pleasant enough so the engineer isn't fatigued after a long day of listening. The aim of ATC is to equal or better the acoustic performance of the best high fidelity speakers combined with the wide dynamic range of large horn-loaded studio monitors.

Another area which ATC addresses in their design philosophy is the tradeoff between wide horizontal dispersion and smooth off-axis frequency response. A narrow “beamy” speaker can sound good over a small listening area, but this does little to provide a realistic reverberant sound field in the listening room. A carefully designed loudspeaker system can provide even frequency response over a wide horizontal area so that the reverberant sound resulting from reflections off the walls has the same smooth quality as the direct sound.

To build a great loudspeaker system, you must start with great drivers. ATC’s low and mid-frequency drivers are manufactured in house to exacting tolerances and have many design innovations. Hand-wound, short voice coils are edge wound from flat OFC (oxygen free copper) wire and operate in a precision long magnetic gap. Front and rear venting of the magnet assembly not only reduces airflow noise and heat, it increases power handling and increases long term reliability. The unique “Soft Dome” technology originally developed by ATC in 1976, which reduces high frequency resonance anomalies and improves midrange dispersion, is featured in the SCM 50, 100, 150, 200 and 300.

Smooth and even frequency response has long been the primary measure of a loudspeaker’s performance. While it’s common for modern powered speaker systems to correct amplitude response irregularities with factory-tuned built-in equalization, it is simpler and more elegant to use properly designed drivers that require no amplitude equalization.

High linearity drivers allow the use of a linear phase crossover network. This substantially reduces irregularities in off-axis frequency response and changes in dispersion through the frequency crossover points of a multi-driver system. Each driver is powered by an integral power amplifier operating substantially in Class A. Since the designer knows the performance parameters of all system components, he can optimize power distribution, phase correction, and damping to maintain a consistent sound character across the full product line from the smallest to the largest speaker, with differences being only in bass extension and maximum acoustic output level.

Let’s take a look at the important characteristics of a high quality loudspeaker and ATC’s approach to the design and engineering necessary to optimize performance in these areas:

Frequency Response and Non-Linearity

There are three principal sources of non-linearity in a loudspeaker system, all related to the drivers. First is the geometry of the motor assembly (voice coil and magnet) and uniformity of the lines of magnetic force within the active portion of the gap. ATC’s magnet design employs a short coil in a long gap with an undercut center core. This design keeps the voice coil in the portion of the magnetic field where the lines of force are most uniform. A beneficial side effect of this geometry is that heat dissipation is improved, maintaining a relatively constant voice coil temperature, which results in less variation of its electrical and magnetic characteristics over the full power range of the loudspeaker.

Another source of distortion in long excursion low frequency, high power drivers is the cone suspension. The spider, the flexible part of the driver assembly that keeps the voice coil centered in the magnet assembly, represents a number of tricky design compromises. Since the gap clearance is small and the linear excursion is large, the spider must be quite a precise and stable mechanical device to prevent the voice coil from being pulled off-center at the ends of its travel. In addition to restraining the voice coil excursion to prevent physical damage, the spider is also a critical part of the damping system.

A third source for distortion has to do with the non-linear magnetic characteristics of the metal parts the magnet assembly. Current flowing in the driver's voice coil induces eddy currents which modify the magnetic field of the carefully designed magnet assembly. These induced currents tend to buck the voice coil's magnetic field, reducing efficiency in a non-linear manner. To minimize this effect, ATC's "SL" series bass and low-mid drivers use a new material called Super Linear Magnetic Material (SLMM) which has the characteristics of high magnetic permeability and saturation, as well as low electrical conductivity. SLMM construction suppresses the eddy currents, resulting in a 12-15 dB reduction in third harmonic distortion.

Phase Response

An ideal speaker system should have phase response linear with frequency, which in simple terms means that all frequencies produced by the driver reach the listener's ear at the same time. This eliminates partial cancellation of certain frequencies due to their arrival at the listening point out of phase. Phase shift is a result of resonances in the drivers, as well as a consequence of the design of crossover network filters.

Careful driver design assures an amplitude response free from any broadband (low Q) resonance. Conventional design wisdom tells us that a stiff speaker cone is ideal for wide on-axis frequency response. However, poor off-axis frequency response and multiple resonances that color the sound make a non-flexible cone less than optimum. The conventional approach to resolving this problem is to highly damp the motion of the cone, but this dramatically reduces the efficiency of the speaker.

One of ATC's approaches to eliminating resonant peaks in the driver is to use a heavily damped fabric cone with sufficient structural integrity to sustain high power levels. Constrained Layer Damping (CLD), an ATC innovation, uses a “sandwich” cone construction, with a damping layer molded between two lightweight fabric cones. As the cone assembly flexes, the damping material absorbs the shear energy between the two layers, offering dramatically more efficient damping than conventional methods. This design reduces harmonic distortion, minimizes resonances that affect on- and off-axis frequency response, and, since it offers less loss than standard damping techniques, dynamic headroom is improved.

The combination of mechanical damping and electrical damping from the power amplifier keeps the system tightly controlled, providing well defined bass and midrange detail.

Dispersion and Directivity

In a normal listening environment, we hear both the direct (on-axis) sound and the off-axis sound which bounces off the walls, floor, and ceiling before it reaches our ears. The relationship between direct and reverberant sound is very important to simultaneously achieve accurate stereo imaging and a wide effective listening area. While no loudspeaker design can replace a poor listening environment, the better the acoustic environment, the better a high quality loudspeaker will sound.

The direct on-axis sound, which is first to arrive at our ears, gives us most of the phase related directional cues as well as low level details. These are quickly lost in the reverberant field, which gives us the sense of space and depth. Since a loudspeaker “illuminates” the room in more than a single direction, not only must the on-axis frequency response be accurate and linear, but the off-axis radiation must have no large peaks or dips in frequency response. To achieve consistency between direct and reverberant fields, ATC’s design goal is to maintain frequency response flat within 6 dB up to 10 kHz anywhere between ±80 degrees of the speaker centerline horizontally and ±10 degrees vertically.

Poor midrange dispersion tends to lead the mix engineer to overly equalize the upper midrange in an attempt to compensate for the apparent lack of energy in that region. Many popular recordings, particularly those mixed in personal studios, demonstrate this characteristic - a hard strident upper midrange and masking of high frequencies, making vocals sound weak while accentuating the bass.

ATC’s wide dispersion Soft Dome technology is featured in all models across the board. Regardless of which size speaker system best fits your room and your budget, you’ll have the same even direct-to-reverberant response and an unusually wide effective listening area.

Dynamic Range

Dynamic range is a complex issue. The dynamic range of a driver is primarily a function of the voice coil operating temperature and total magnetic flux. As the voice coil temperature rises, its electrical resistance increases, requiring more power to maintain a given sound pressure level. This effectively compresses the dynamics of the music, often leading to a blurred or undefined sound as the speaker heats up. This is an insidious form of distortion because it isn't initially present and it increases slowly as the driver heats up. At the same time our hearing is constantly changing throughout the workday, so it's difficult to know just how much power compression is present. Many loudspeakers exhibit a significant amount of Power Compression, and it's demonstrable. Just ask the producer who's been off on a half day coffee break to listen to a mix that you worked on with him earlier in the day. If he asks "What did you change?" he's probably hearing the effect of power compression. ATC SL drivers address this issue at the design stage so that there will be minimal driver heating, and hence minimal power compression.

Equally important to a speaker's dynamic range is the mechanical integrity of the frame, magnet, diaphragm, and suspension structure. Finally, the amplifier driving the loudspeaker must deliver sufficient power over the full dynamic range of the program material to sustain the required sound level.

Electronics

By integrating electronics (power amplifier and crossover) with the loudspeaker, the system designer can assure that the drivers will have sufficient power to deliver their rated sound level with no sacrifice of dynamic range. All of ATC's electronics are built in house to their exact requirements and share a common grounded source MOSFET power stage design scaled for the particular frequency range and power requirements of a driver. The ATC-built Class AB amplifier operates in Class A up to approximately 66% of rated power, with Class B operation taking over above that point to provide ample headroom.

ATC uses completely independent amplifiers, including power supplies, for each driver; two amplifiers in a two way speaker and three or four (for models with dual low frequency drivers) in a three way speaker. ATC power amplifiers are passively cooled and are installed on the rear of each speaker cabinet in all models except the 200 and 300. These two models use the external ATC P4 amplifier assembly which integrates all crossovers, limiters and eight power amplifiers into a single 5-space rack mounted, fan cooled package.

ATC amplifiers are thermally protected and include a super fast acting FET limiter for each band to protect the drivers in the event of an unexpected peak. Because these limiters are designed specifically for driver protection, they do not leave a big audio footprint and are far less intrusive in operation than conventional limiter designs.

Speaker Cabinets and Enclosures

A well designed set of drivers needs a well designed enclosure in which to operate in order to achieve full performance. ATC uses two different cabinet types. The two smallest active models, the 20ASL and 16A, are housed in cast aluminum cabinets, completely sealed, and heavily damped for zero resonance. All other speaker cabinets, built by German cabinet makers, are constructed from composite MDF (medium density fiberboard) materials and are massively braced to eliminate resonance and mechanical instability. The wooden cabinets are ported. This is not a resonant port designed to increase bass extension below the driver's free field resonance, but rather, to provide the low frequency driver with loading equivalent to that of a sealed cabinet.

Not only do the cabinets support all the components solidly, but they look great as well. ATC cabinets can be custom ordered in a variety of veneered woods. Veneer is applied inside as well as outside to prevent bowing or distorting of cabinet walls over time.

ATC makes two cabinet configurations for its standard professional product line: conventional free standing and in-wall mounted. In-wall models110, 200 and 300 are proportioned for approximately the same internal volume as the standard mounting cabinets, however they are taller and wider, but much shallower than a standard loudspeaker.

Free standing cabinets, intended primarily for mid-field applications when mounted on stands or above the console meter bridge, are smaller in height and width but are deeper than in-wall versions. Standard cabinets can be converted for in wall mounting by removing the built in amplifier packs and mounting them remotely. Contact us for the special parts you will need to make this work.

ATC 50, 100 and 150 models accommodate either vertical or horizontal mounting of the cabinet by providing an additional cutout and blank plate, allowing the tweeter to be mounted above the midrange driver in either orientation. This assures the same coverage and dispersion characteristics for both vertical and horizontal mounting should the speakers need to be relocated in the future. Not all models offer convertible orientation, so inquire about this when you place your order.

ATC professional versions normally are built without grilles, but can be custom ordered at the time of manufacturing with grilles. The cabinet is built with an edge to allow the grille and it's frame to pressure fit within the cabinet for a flush look.

In addition to the stock models, ATC custom builds cabinets to fit a customer's specific size, shape or space requirements. This unique capability is geared solely to the professional user with unique requirements that must be addressed outside the standard speaker dimensions or designs. Please contact us to discuss this in detail. Options such as suspended "flying" hardware, different shapes, inverted versions or special additions like wood trim rings for wall mounted cabinets can be addressed.

It's important to understand that although ATC offers several different sizes of loudspeaker systems, an important design criteria is maintaining uniform sound characteristics across the entire product line. The only difference between large and small cabinets, in addition to the way they're mounted, is the bass extension and maximum loudness. With ATC, a bigger speaker does not automatically equate to better sound. You can choose the speaker based on the space you have available, how you plan to install it, and how much sound level you'll need to fill the studio space, remaining confident that you aren't compromising sound quality if a smaller speaker is what fits the space and the budget.