
# The M&K Sound Technology Handbook

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www.mksound.com

# Contents

# The Legend Lives On

Aimed at music recording, post production and broadcast applications, M&K Sound Professional loudspeaker systems have been used by the world's leading recording engineers, mixers, sound designers, editors and music composers for more than 35 years.

M&K Sound Professional speakers are designed as essential creative tools for mixing engineers and artists to let them do their job easier, faster and better with no unpleasant surprises along the way to a perfect mix that will translate seamlessly between studio, cinema and home.

Created for state-of-the-art recording/mixing studios, M&K Sound Professional Systems are ideal for a wide range of demanding and critical audio applications, including near-field music composition, recording and mixing, sound design, broadcast monitoring, voice-over booths and quality control.

Throughout our storied history, M&K Sound's uncompromising products have consistently broken down barriers between pro and consumer audio with loudspeakers that shed clear, natural daylight on any recording, regardless of source (analog or digital), format (two-channel or multi-channel), playback environment (studio or domestic) or application (movies or music).

M&K Sound Professional monitors capture subtle detail, while maintaining a firm grasp of the big picture.  They mercilessly lay bare the technical quality of the source, while effortlessly conveying the underlying emotion and artistic intent.

Equally active and respected among cutting edge recording studio personnel  and discerning high end home audiophiles, M&K Sound Professional has unique experience in both arenas and a unique perspective on exactly what is required to get things right in sound recording, mixing and playback, whether for music or movies, stereo or surround.

M&K Professional Systems share proprietary driver elements, utilized in various single and multiple driver configurations, developed, assembled and rigorously tested to our exacting standards exclusively for our loudspeakers.

This is why M&K Sound Professional monitors are used with pride by audio professionals who seek the unblemished, unadorned truth. Here are just a few of the famous names that have made M&K Sound the Choice of Professionals:

20th Century Fox
Dolby Laboratories
DreamWorks
DTS
HBO Studio Productions
Lucasfilm
Paramount Studios
Sony Music
Sony Pictures
Skywalker Sound
Universal Studios
Walt Disney Pictures
Warner Bros.

# M&K Sound – The Vision and the Mission

At M&K Sound, we design loudspeakers to sound inherently *right*, making them universal tools, equally adept with any style of music or movie soundtrack, in stereo or surround.

The inherent *rightness* of our products – call it accuracy, precision, naturalness, realism –breaks down the barriers that otherwise exist between professional and consumer audio, as we create loudspeakers free from the analytical brutality of typical studio monitors that make listening feel like work and equally free from the euphonic colorations of typical domestic speakers that introduce a boring sameyness to recorded sound.

Our philosophy is that the only truly worthwhile listening experience is one that transports you to the site of the original acoustic event with absolutely minimal loss, addition or distortion. This is why our speakers are designed as a conduit to allow you to hear exactly what the performers and recording engineers heard, no more and no less.

As a company founded on audiophile recording and High End loudspeaker design, the basis for all M&K design work throughout three and a half decades has always been that a good loudspeaker must accurately and realistically reproduce the original acoustic event, whether the source is a human voice, a musical instrument, an explosion or a gentle breeze caressing the leaves of a tree. Naturally, this must include the acoustical ambience of the space in which the source was recorded.

**A Commitment to Excellence**

For more than three decades, M&K Sound has been the standard bearer in speakers for music and motion picture sound in the studio and in the home. Because our emphasis has always been exclusively on accurate reproduction that maintains the full integrity of the original recorded signal, M&K Sound has developed a fiercely loyal following both among professional users and music and cinema enthusiasts.

Under the M&K Sound banner, veteran members of the M&K Professional team joined forces in 2007 to keep the legend alive with a clear and focused vision to maintain and improve the high standard of the products and their presence in the global marketplace. Along with newly recruited expertise, the M&K Sound team includes Individuals closely associated with the brand for many years, to ensure continuity and consistency as we strive to enhance the distinct identity and high profile of the brand.

Our product development and listening panel includes representatives from one of the world's leading microphone manufacturers, from major US and European post-production facilities, as well as innovative transducer designers.

We are all dedicated audiophiles with a passion for the art and science of high quality sound reproduction. With staff on three continents, M&K Sound represents a serious investment in and commitment to research and development and quality assurance.

***Believe everything you hear, but only if you're hearing it on M&K Sound loudspeakers.***

# M&K In The Professional Audio World

Here's a trivia question. Who were M&K's first customers? None other than Walter Becker and Donald Fagen of *Steely Dan,* who in 1973 ordered a custom designed monitoring system for the *Pretzel Logic* mixdown sessions.

Shortly thereafter, the first M&K SatelliteSubwoofer system was designed (and used by a number of prominent recording engineers) as a portable reference recording monitor system. For over 35 years, sound professionals have been using M&K in both their studio and home systems.

In the early '90s, pro use of M&K speakers really heated up, led by Dolby Labs. During the development of the Dolby Digital discrete 5.1 channel surround system, several of Dolby's key technical people heard the M&K 5000THX system at Lucasfilm's Skywalker Ranch, during the HDTV Grand Alliance listening tests.

This led to Dolby acquiring a 5000 system, which they used as their reference speaker for the development of Dolby Digital. Dolby's San Francisco labs and listening rooms have used M&K since then, and the 150 system has become a fixture in Dolby's Los Angeles and New York reference rooms.

M&K speakers were also used for all of the industry demonstrations of Dolby Digital prior to the introduction of actual processors by individual manufacturers. The FCC Advanced Television Standards Committee (High Definition TV) uses M&K in their laboratory and in a system that they use in overseas presentations to demonstrate the superiority of the American HD standard to countries that have not yet selected an HDTV standard.

And Dolby is not the only multichannel advocate using M&K. Multi-channel music pioneer DTS employed multiple M&K systems for their groundbreaking re-mixes. In fact, if there's one thing that Dolby, DTS, and THX can agree upon, it is that they all use M&K speakers!

The Hollywood postproduction community has embraced the M&K system as the 5.1 channel standard. As more professionals have an opportunity to hear it, the number of studios installing it increases. Well over 100 professional recording and mastering studio rooms in the music, film, and video fields are using M&K systems as their reference.

Pro audio's EQ magazine reviewed the 150 system, and the reviewer loved it, concluding "For a professional surround sound system, I think the M&K MPS-150THX is the one to beat." After using M&K for the score of the blockbuster *Armageddon*, composer Trevor Rabin commented "the bottom line is M&K's MPS line of 5.1 monitors and powered subwoofers are the best speakers I've ever heard."

# The M&K Sound Advantage

M&K Sound Professional loudspeakers define the standard for high-performance monitors, continually satisfying the world's most demanding audio professionals. These talented professionals choose M&K Sound for one reason. Trust. Every day they make hundreds of decisions based upon what they hear on their speakers. The trust they have in M&K Sound allows them to work quickly and effectively as they create the most breath-taking sound tracks and music ever put to film or disc.

The same level of quality that these professionals enjoy is also available to the home theater enthusiast. M&K Sound offers a full line of home theater speakers, all of which provide the listener with the same superb sound quality that audio professionals have come to expect from M&K.

Developed to work in the most demanding multichannel surround environments, you'll find both the tonal and spatial characteristics of M&K Sound speakers to be extraordinary either in stereo or in multichannel.

As we like to say, ***"If you want the same experience at home that the people who made the movies enjoyed, just take home M&K Sound!"***

**Expanding the Sweet Spot**

Designed to reproduce the surround channels of multichannel digital formats (Dolby Digital, DTS, DVD Audio, SACD etc.), M&K Sound's exclusive Tripole surround speakers provide a very high level of performance in a variety of room conditions producing superb reproduction of any and all surround material.

The Tripole operates as if it is two speakers: first a near-ideal point source direct radiator (on its front baffle), with an M&K Sound Phase-Focused crossover feeding its woofer and soft-dome tweeter. The second is a dipole speaker using two unique paper cone mid-tweeters that are treated with a special damping compound. These drivers achieve a very smooth and transparent sound from 300 Hz through the critical midrange and above, due in part to the fact that they operate without any midrange crossover (meaning optimum phase and sonic coherency).

As you walk around a room where M&K Sound Tripoles are operating, you'll find the quality of the surround channels remains remarkably consistent, with good imaging and spatiality in virtually any room location. Here's why: when your ears move off of the direct axis of sound produced by the closest speaker baffle, they move into the direct sound field of one of the other baffles. When the directional and timbre characteristics of the speaker are virtually the same in various room locations, this means excellent coverage for listeners regardless of where they sit in the room.

The Tripole's imaging coherency is optimized for placement ranging up to two feet above or two feet below the listener's ears (0° to +24°), with the front tweeter always closer to the listener than the front woofer.

Therefore, if the speaker is placed above the listeners, the front tweeter should be at the bottom of the front baffle. If the speaker is below the listeners, the tweeter should be at the top.

**M&K Sound Exclusive Phase-Focused Crossover**

M&K Sound's exclusive Phase-Focused crossover is a computer-designed system that provides an extremely coherent response over a wide and controlled listening window (including in the vertical plane, which is critical when surround speakers are located above listeners heads). This very complex and unique crossover has been critically tuned through both psychoacoustic analysis and complex computer time-domain analysis to achieve a uniform timbre balance throughout the listening room.

This exclusive design gives a very smooth response over a wide horizontal and vertical listening window. While other crossover designers consider just frequency response on one axis (the sweet spot), M&K Sound considers the speaker's response in both the time and frequency domains, at a very wide range of angles in both the vertical and horizontal planes, thus optimizing the speaker's three-dimensional response. In virtually any location in the room, listeners will hear superior imaging and sound quality, with remarkable clarity both on and off axis.

**Timbre Matching**

One of the most important factors in achieving excellent Home Theatre performance is timbre matching. On film soundtracks, specific sounds are often moved from left to right or from front to back in the room. When the speakers reproducing these sounds have dissimilar characteristics, there will be an audible discontinuity when the sound shifts from one speaker to another.

Timbre-matched speakers have very similar tonal characteristics and sound, which come from three critical elements*: similar or identical drivers; similar or identical crossovers; and similar or identical frequency response.* In full M&K Sound systems, these elements have been addressed. You can be assured that your M&K Sound speaker system can achieve the full potential of multichannel sound reproduction.

The Center channel speaker in a multichannel system is the most important speaker in the system. It often produces more output than the left and right speakers combined. This speaker should be of the highest possible quality, and as similar as possible in response and radiation pattern to the left and right speakers. Three identical speakers are best for the L, C, and R positions.

It is also important to have as much amplifier power as possible for the Center channel. As a minimum, the three front channels should be identical in power output, but it is better if the Center channel has more. If you have less power in the Center channel, this will be the limiting factor in the total output capability of the system.

**M&K Sound Deep Bass**

Perhaps no other element in the surround sound system is more exciting than the subwoofer. Capable of reproducing astounding and detailed low-end impact, the subwoofer is that loudspeaker that truly makes us believe that we are at the cinema. Having invented the subwoofer over 30 years ago, M&K Sound is uniquely qualified to present its latest lineup of superb low-end reproducers. All M&K Sound subwoofers employ M&K Sound's Deep Bass Concept - a feature made possible by careful matching of the drivers with the amplifiers, M&K Sound's exclusive Headroom Maximizer circuit and our sealed cabinet designs.

M&K's Headroom Maximizer Circuit TM, allows the full-uncompressed dynamics of the audio signal to be heard up to the subwoofer's full capacity - while preventing amplifier clipping and distortion. M&K subwoofers also feature M&K's Deep Bass TM sealed-box design, which produces significant low-frequency output, with an in-room response flat to frequencies well below 20 Hz. Unlike subwoofers with ported cabinets, which have an extremely sharp roll off (24dB per octave or more) below the lower limit of their "flat" response (this is also referred to as the port's cut-off frequency), M&K subwoofers reproduce bass frequencies below 20Hz with excellent transient response, accuracy and an authority that other subwoofers cannot match.

Whether in the studio or at home, with M&K Sound you will be assured of the highest quality in sound reproduction.

***That's the M&K Sound advantage.***

# M&K Sound History

Founded in 1974, M&K Sound is the only manufacturer with over three decades of experience in designing and manufacturing subwoofers and other high-end loudspeakers, *as well as* extensive audiophile recording experience.

The original vision of company founders Ken Kreisel, Dr. Lester Field, and D. Jonas Miller is realized in today's extensive line of innovative speaker products at the leading edge of technology, advancing the state-ofthe-art in both the recording and reproduction of music and film sound for more than 35 years.

Anticipating home theater by more than a decade, M&K is recognized as the pioneer in the design concept of Powered Subwoofers and Satellite speakers, now copied by virtually every speaker manufacturer in their own surround systems.

Ongoing research continues to provide significant improvements to the M&K line, with innovations such as the Phase-Focused crossover, Headroom Maximizer circuit, and Push-Pull Dual Driver subwoofers.

In 1974, the brand-new company combined interest in live music recording and loudspeaker design experience with the research and acoustics background of Dr. Field, who retired as Chief Scientist and vice president of research at Hughes Aircraft Company, after being a full professor at both Caltech and Stanford Universities and prior work at Bell Telephone Research Laboratories after obtaining his Ph.D. at Stanford.

By combining creativity, critical listening and experience in live sound recording with scientific methodology and experience, M&K's foundation was set.

In 1973, Walter Becker of Steely Dan asked Kreisel for a studio reference subwoofer and monitoring system for the *Pretzel Logic* mixdown sessions. M&K's speaker business was born with the balanced dual-driver subwoofer designed for the sessions. M&K RealTime's acclaimed direct-to disc recordings soon followed.

By the end of the '70s, M&K led the way again, being among the first to make commercial recordings digitally, using an M&K-modified Sony 16-bit digital recorder. In fact, **M&K was the first U.S. company to release Compact Discs!**

With experience in Home Theater dating back to Hollywood screening room design and installation in the '70s, M&K has long been at the leading edge of music and film sound technology.

This is why M&K was among the very first companies to join Lucasfilm in the Home THX program, and why M&K speakers are considered to be the best at reproducing both music and film soundtracks. Numerous awards and number one rankings in product reviews and shootouts document this fact.

And in 1997, M&K finally made its formal entry into the world of professional audio, even though M&K has been at home in recording studios from day one.

In 2007, key M&K staff members took over full responsibility for the brand's future development and continue to offer innovative loudspeakers designed to be an open window onto the original sonic event.

# The M&K Sound Satellite-Subwoofer Concept

**Unrivalled Sat/Sub Experience**

M&K is the only speaker manufacturer that has produced only Satellite and Subwoofer systems since 1974. M&K makes Satellite-Subwoofer systems because we believe this is the optimum configuration for reproducing music and film sound. Here is why:

**Bass Frequencies and Large Boxes**

Basic laws of physics dictate that speakers reproducing true Deep Bass (down to 20 Hz and below) must be large. Therefore, M&K Powered Subwoofers, come in fairly large enclosures

**Mid and High Frequencies and Small Enclosures**

But large enclosures, with their large front baffles, are not good for reproducing the rest of the audible spectrum. Midrange and high freuencies produced from cabinets with large front baffles have a distinctive coloration known as baffle diffraction distortion. The small baffles of M&K Satellites minimize this coloration, resulting in an open, natural three-dimensional sound.

**M&K Sound Optimized Powered Subwoofers**

M&K subwoofers are designed as complete systems. Each model's performance is even better than you would expect from the high quality of its driver, cabinet, and amplifier—because these elements are optimized to work with each other in that specific product.

M&K's design allows the user to set the bass level anywhere from flat to grossly exaggerated. Built-in adjustable low-pass filters allow users to fine-tune the transition between the Satellite and Subwoofer speakers without a separate crossover. For use with surround processors, most models have a low-pass filter bypass to eliminate any phase problems associated with dual filters.

**Incompatible Placement Demands**

When speakers are set up in a room, they are usually located to produce the best imaging at the main listening position. In virtually all rooms, though, that location does not give the deepest and smoothest bass response. It usually means that the speaker's bass response will be disappointing, because the speaker will not meet its bass specs in that room! This compromise is inherent for all speakers without a separate subwoofer.

With an M&K system, you simply locate the Satellites for imaging and the Subwoofer(s) for the best bass. Listening rooms have an enormous effect on sound quality, and only Satellite-Subwoofer systems provide this superior flexibility for achieving the best possible sound in any room.

**Ideal Compact M&K Sound Satellites**

The compact size of M&K Satellites has been appreciated by music lovers for many years, because of the great placement flexibility and unobtrusiveness. With the advent of home theater and music systems requiring 5.1, 6.1, 7.1 channels, and even more this advantage is appreciated even more!

# M&K Sound Satellite Advantages

Because M&K Satellites do not have to reproduce deep bass (thanks to the M&K powered subwoofers), those Satellites are optimized to reproduce midrange and highs without size compromises. Each cabinet's front baffle is about the minimum size that will accommodate its drivers, with cabinets optimized in shape to eliminate midbass and midrange problems found in virtually all other speakers.

**Best Location for optimum Imaging**

Very few loudspeakers are capable of reproducing fundamental frequencies below 50 Hz. This is made even worse when the speakers are placed in a room, because they are usually set up for the best imaging.

The location with the best imaging is virtually always different from the one that gives the deepest and smoothest bass response. This means that a speaker in that location will not meet its bass specifications, either for low frequency extension or for flatness of response.

With M&K Satellite speakers, no compromise is necessary, as the Satellites can be located for optimum imaging, with the Subwoofer located for optimum bass.

**M&K Sound Satellite Attributes**

Our strengths are in our quality of construction and appearance, our long-term reliability, and our sound quality. M&K speakers are engineered for excellent transient performance, which we have always considered essential for the accurate reproduction of music. Our superiority in this area becomes even more apparent in home theater, where the overly polite and compressed sound of many speakers will suck the life out of an exciting soundtrack.

M&K Satellite speakers produce a very natural, lifelike three-dimensional sound, thanks to their compact cabinet sizes and the transient accuracy of their crossovers. In addition to producing a startlingly real sound with good recordings, this means excellent soundstaging and accurate (unexaggerated) depth.

**Advanced Low-Distortion Drivers**

The drivers used in M&K Satellite speakers have extremely low distortion thanks in great part to their development using a speaker driver measurement technique known as the "two-tone distortion test."

This severe test measures the distortion produced when a driver is fed with a swept signal consisting of two closely-spaced tones. This test has very close correlation to the perception of experienced audiophiles listening to music. It is a breakthrough tool in improving the sound quality of high-performance loudspeakers.

This technique made it possible for M&K to develop drivers that go beyond conventional distortion measurements to accomplish truly superior audible reproduction of musical signals.

# M&K Sound Satellite Crossovers

**Phase-Focused Crossovers**

M&K Phase-Focused crossovers deliver razor-sharp stereo imaging by combining three important elements of crossover design: Time Domain Analysis, Frequency Domain Analysis and what we call Point-In-Space Analysis (a three dimensional analysis of the speaker's response in the room).

Other crossover designs consider just frequency response on one axis by designing the crossover for a "sweet spot" listening position. The Phase-Focused crossover is designed by measuring and optimizing both its phase and amplitude response at dozens of points (angles) each in both the vertical and horizontal planes.

This means that we consider its response at various angles in both the vertical and horizontal planes, optimizing its three-dimensional response. Our uniquely sophisticated crossovers are critically tuned through both psychoacoustic listening analysis and complex computer analysis—giving you much more than just good on-axis response. You hear a very smooth response over a wide listening window (very important for home theater), and you also hear a more focused and coherent sound on axis!

Take an M&K crossover out of a cabinet and compare it to other crossovers. Only high quality components are used, including large-trace circuit boards, distortionless air-core inductors and high quality resistors and capacitors. Combine this with our designed-in performance and extraordinary user flexibility and it means that M&K crossovers deliver better sound quality.

Compare the sharp transient response, razor-sharp imaging, and accurate soundstaging of M&K Satellites to an ordinary speaker's "smeared" sound. The crossover is a major reason the M&K produces a much more lifelike and detailed three-dimensional sound.

**Satellite Crossover Controls**

Through multiple inputs or back-panel switches, M&K Satellites can be fine tuned for a listener's room, equipment, personal taste, etc. to achieve a flat response at the listener's ear. They also provide the unique ability to most closely realize a timbre match with non-M&K speakers in multichannel systems.

These switches can be used to optimize response for room conditions or personal preference, but in normal room locations, known as 4 pi space (NORMAL position); when the speaker is on the floor or directly against a wall, known as 2 pi space, (SPECIAL position); or when tuning a system with third-octave equalization.

Additional positions provide a psychoacoustic LOW or MID EFFICIENCY for use in live and bright-sounding rooms; any time the Satellite is used without a subwoofer or when the listener prefers it.

A separate Treble Contour switch (or Hi/Lo Tweeter inputs) provide flat and increased/decreased high frequencies in specially designed contours. These are not simple tweeter level controls and are useful for tuning the speaker to the room or the system.

# M&K Sound Satellite Cabinets

**Sharper Imaging and Reduced Coloration**

Midrange and high frequencies sound best when the speakers producing them are mounted on the smallest possible baffle (as long as the backward sound radiated from the driver is contained and absorbed, as in an acoustically stuffed sealed box). For this reason, M&K Satellites have just about the minimum baffle necessary to mount their drivers. This helps to provide the sharp detail and clarity M&K Satellites are famous for.

On a large baffle, signals from the tweeter and woofer drivers travel on its surface until they reach a cabinet edge. There they radiate into the room, but time delayed in comparison to the direct signal coming from the drivers. When these time-delayed signals reach your ear, the sound becomes jumbled, with a loss of clarity and imaging, leading to the “canned” unnatural sound of conventional speakers.

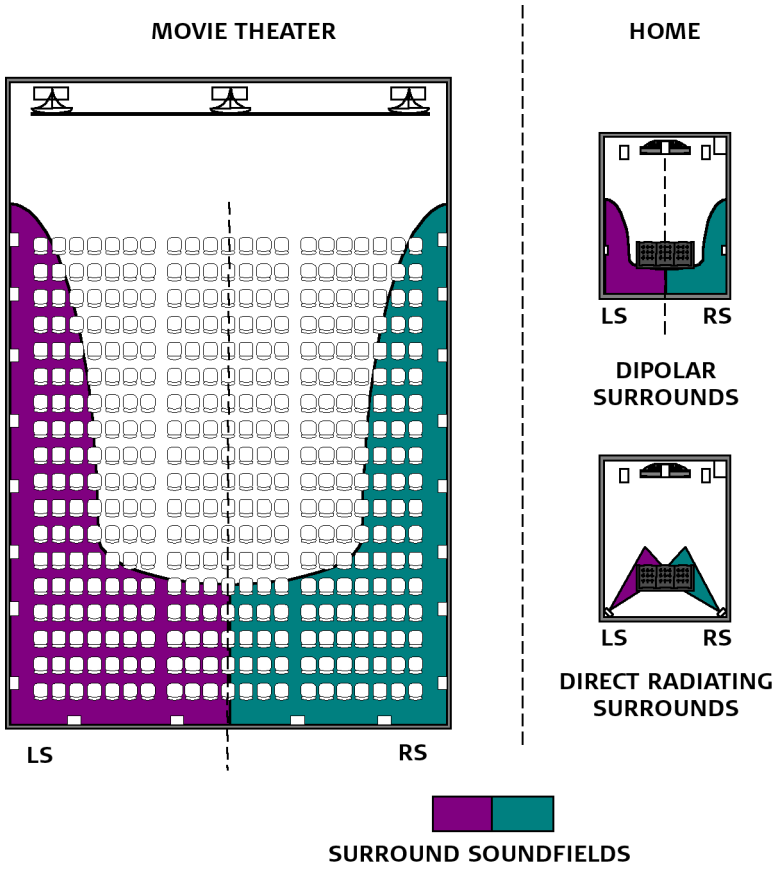
With diffraction distortion reduced or eliminated, M&K Satellites have much sharper imaging (which some have described as “holographic”) and detail.

# M&K Sound Exclusive Tripole Surrounds

*The debate continues to rage: What is the best type of surround speaker for multi-channel applications?*

Monopole, Dipole or Tripole?

*Here is an overview of many of the factors involved.*

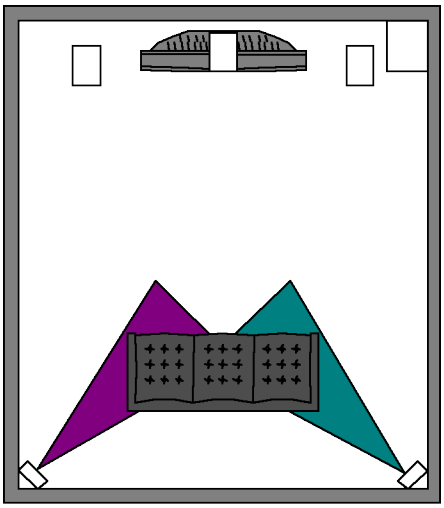



The first issue that should be considered is the environment and sound system used for playback. The two main types of playback environments that typically will be dealt with are commercial cinemas and consumer homes.

Figure 1 shows the acoustic signatures of the surround channel in these two environments. The commercial cinema environment typically uses an array of surrounds that provides an enveloping and diffuse surround field to the listeners, while also providing broad directional cues. Consumers can, depending on the acoustics of the room, recreate this type of acoustic signature by using a pair of dipole surround speakers. The second surround field that is commonly found in consumer playback systems is one that is created using two monopoles (also referred to as direct radiators).

Once the end user's playback system and environment have been identified, it is time to start examining the various surround speaker technologies. The type of surround speaker that best suits your surround mixing needs, should also translate accurately into the end-user's playback environment/system. So when analyzing the advantages and disadvantages of the different types of speakers, always keep in mind what is practical for the end-user and their playback system.

# Monopole Surround Speakers




**Monopole Surrounds**

Monopole surround speakers are probably the most common type of surround speakers found in consumer multi-channel audio systems. Most consumers using this type of speaker made no specific decision to use monopole surround speakers, but are using them because they already had an existing pair of speakers that they assumed were suitable for this surround application.

This does not mean that a certain segment of consumers are not going out and making an informed decision when purchasing monopoles. There are certainly a significant amount of consumers purchasing monopoles because they believe it yields an accurate and favorable result.

Additionally, there are many recording professionals and companies, such as DTS, which are advocating monopoles for multi-channel music applications.

However, when mixing for cinema applications, using monopoles can result in some translation errors that characteristically manifest as a perceived level discrepancy between the studio and the cinema. Typically the surround channels in the cinema are perceived as lower in level than how they were perceived when mixed in the recording studio.

Using multiple pairs of monopoles in an array is a possible solution; however, because most control rooms and home cvinemas are relatively small, there tend to be audible comb-filtering effects that can only be resolved by using digital delays for each surround speaker. This solution tends to be less cost effective than using dipole surround speakers. However, there are some disadvantages in using dipoles as well, please see the “Dipole Surround Speaker” section.

***The Advantages of Monopoles***

1. Monopole surrounds are extremely directional and can provide excellent stereo imaging.
2. Monopole surrounds can be identical to the front speakers and therefore more closely match the front speakers in timbre.
3. A large number of consumers use monopole speakers as surrounds.

***The Disadvantages of Monopoles***

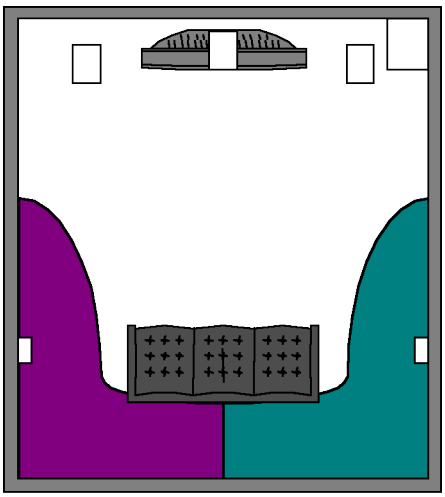
1. Because monopoles are extremely directional, they are also extremely localizable, which has been found to be distracting when listening to certain types of program material.
2. Monopole surround speakers are extremely sensitive to where the listener is in relationship to the speakers. A listener must sit directly between the speakers, in a very small sweet spot, in order to experience the mix accurately and with the proper stereo imaging. This can be a challenging problem to deal with when mixing on a large format console.

# Dipole Surround Speakers

Dipole surround speakers have become popular largely because THX has mandated their use as part of its consumer THX Ultra standard. Many dipole models are currently available, including lower priced non-THX certified products.

Dipole surrounds, unlike monopole surrounds, generate a majority of the sound that reaches the listener's ears by reflecting energy off the side, back and front walls. The two sides of the dipole cabinet are 180 degrees out of phase, which generates a large null. The null of the speaker cabinet is placed to the side of the listener and approximately 2 or more feet (60 or more cm) above the seated ear height. When installed in a room with relatively reflective side and back walls, a surround soundfield that mimics an array of surround speakers is created.

Unfortunately, because dipole surround speakers rely largely on acoustic reflections from the walls within the room, they are not compatible with environments that have large amounts of absorptive material on the walls. As with any monitoring system, it is important to design an acoustic environment that optimizes the performance of these types of speakers.




**Dipole Surrounds**

Dipole surround speakers are the second most popular type of surround speaker currently being used in consumer homes. A majority of these types of surround speakers are sold to home theater enthusiasts attempting to most accurately recreate the cinema experience in the home.

Although viewed by the music world as a less than ideal surround source, many consumers and industry professionals are reporting favorable playback results. A key reason for this is because although they are more diffuse than monopoles, they still provide a reasonable amount of directional acuity. Additionally, because the sound is more diffuse, the sweet spot is much larger than that provided by a standard set of monopoles.

Recording professionals in both the post-production and film scoring community are using this type of surround speaker because of its superb translation to the cinema. There are also a few music-recording professionals that have chosen this type of surround speaker.

***The Advantages of Dipoles***

1. Dipole surrounds are very diffuse and produce an enveloping surround field that closely matches a movie theater.

2. Dipole surrounds offer a wide listening window that does not require the listener to sit directly between the speakers.

3. A large number of consumer use dipoles as surrounds

***The Disadvantages of Dipoles***

1. Dipole surrounds are very diffuse and might not produce the imaging specificity required.
2. Compared to the front speakers, dipole surrounds tend to have a slightly different spectral character that does not typically match the front speakers.

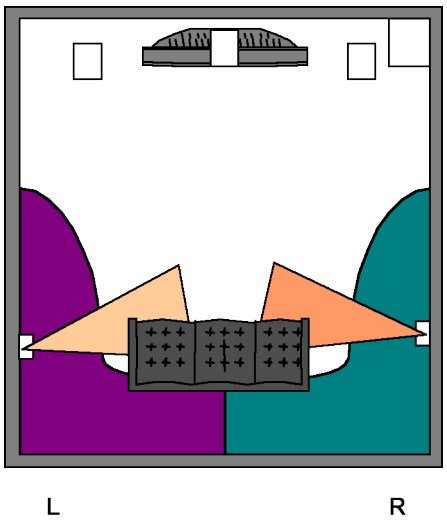
# Tripole™ Surround Speakers

Exclusively manufactured and designed by M&K Sound, the Tripole™ design was envisioned as the perfect tool for mixing and playing multi-channel audio material, regardless of the application or end-user playback environment.

Using a hybrid speaker design, the Tripole incorporates both Monopole and Dipole elements into a single enclosure. A Tripole™ speaker simultaneously operates as a dipole (from its left and right side baffles), and a monopole (from its front baffle), combining the diffused, spacious sound of a dipole speaker with the imaging specificity of a direct radiator.

This almost perfect compromise between direct and reflected sound has been found to translate seamlessly into both consumer and cinema playback environments.

As with any almost "perfect solution", there is always at least one caveat: Because this surround design is basically two types of speakers in one enclosure, experimentation with placement is critical in optimizing the performance for your environment and preferences.




Tripole™ Surrounds

**The Advantages of Tripoles™**

1. Combines the best Monopole and Dipole speaker characteristics.
2. Infinitely compatible with most acoustic environments.
3. Because of the timbre-matched direct radiating monopole element, performance can be identical in timbre to M&K Sound front loudspeakers.

**The Disadvantages of Tripoles™**

1. Because the Tripole design is basically two speakers in one enclosure, the placement of the speaker can be more critical.

# M&K Sound MX Subwoofer Technology

M&K Sound MX subwoofers employ dual, ultra high performance, long-throw 12" drivers and discrete Class A/B amplification for extremely high output with superb articulation, clarity and authority.

**Balanced Push-Pull Dual Drive Configuration**
Eliminates even-order harmonic distortion and doubles the sound power per watt of amplifier power, for 6 dB of additional output! Delivers major improvements in bass detail, articulation, authority and impact.

**Sealed Enclosure**
Sealed design delivers the best transient response and is the only design capable of producing true deep bass with in-room response flat to well below 20 Hz for lifelike power and authority. MX-250 is far superior to vented, bass reflex designs that roll off rapidly below the port tuning frequency with poor transient response, resulting in blurred, muddy sound with limited pitch definition.

**Superior Drivers**
For reduced distortion and improved definition, MX250 bass drivers have an undercut core, an asymmetrical voice coil mounting and an extremely linear magnetic motor design.

**Linear Phase Lowpass Filter**
Optimizes system performance and simplifies set-up by creating a perfect, seamless transition between the upper range of the subwoofer and the lower range of the satellite speakers.

**Discrete Class A/B Amplifier Power**
Offers extremely clean sound and extraordinary articulation far superior to cheap digital amplifiers. MX-250 provides massive power with enormous output and incredible dynamic range.

**Tightly Controlled System Q**
is achieved because every element of the MX-250 subwoofer, from the driver to the enclosure and the amplifier is very tightly damped (low Q), so that they in combination deliver extremely tight and articulate musical bass.

**Honest Measurements**
M&K Sound publishes only reliable, confirmed measured specifications for power output, frequency response, distortion, etc., not fictive numbers from an over-active marketing department.

**Proprietary Headroom Maximizer IV circuitry**
Prevents amplifier clipping for enhanced deep bass resolution with reduced distortion

**Heavily Braced Cabinet**
Provides the most stable platform for the drivers and eliminates resonances, buzzes and rattles that are common in flimsy, unbraced cabinets.

# Sealed Box vs. Vented Subwoofers

All M&K Subwoofers (and Satellites) are sealed-box designs, tightly packed with highly efficient sound absorbing material. This configuration delivers the best transient response, and is the only design capable of producing true Deep Bass.

Good transient response means that the speaker responds quickly to input signals, with a quick start and (especially) a quick stop. Speakers with poor transient response have a blurred, muddy sound with little pitch definition. Deep Bass refers to the ability of the speaker to produce significant output to very low frequencies below 20 Hz, which is needed to produce the "startle factor."

M&K cabinets are very heavily braced to provide the most stable platform for the drivers and to avoid the resonances, buzzes and rattles that are surprisingly common in competitive subwoofers. Flimsy, unbraced cabinets produce an easily recognized sound. They sound cheap!

**Weaknesses of Vented (Ported and Passive Radiator) Designs**
Many subwoofers are vented designs, using ports or passive radiators. These designs have inherently poor transient response, producing that all too familiar boomy, uncontrolled sound you are familiar with. They may play fairly loud, but their sound is boomy and muddy, and that sound becomes fatiguing to listeners very quickly. Most produce a very audible air turbulence noise from their ports when producing certain frequencies. This noise can draw your attention to the subwoofer and make it easy to hear its location. Most of these subwoofers respond poorly or not at all to very rapid impulses, such as flamenco dancers' foot stomps on a wooden floor.

Like a bottle filled with water that produces one particular frequency when you whistle across its opening, the sole purpose of a port or passive radiator is to make a cabinet resonate at or near the tuned frequency of the port. This generates added output (3 to 6 dB) at that frequency, but there is a price to pay for that poorly damped extra output, because with this design internal damping material cannot be used.

Remember that a speaker driver is radiating as much sound inside the cabinet as it is filling the room. This is why all M&K subs are tightly stuffed with highly efficient absorbing material to absorb much or all of the sound inside the cabinet. When a cabinet does not have this absorbing material, the sound in the room becomes muddy. In a ported speaker, stuffing cannot be used.

The other fatal weakness of vented designs is their extremely rapid roll-off below their tuned resonance frequency (usually well above 30 Hz). Below that frequency, the woofer's response drops off so quickly it essentially disappears, making it unable to reproduce subsonic transients. Vented boxes roll off at twice the rate of sealed box speakers (24 dB per octave), and their active driver and vent are actually out of phase with each other, so they cannot produce Deep Bass

# Push-Pull Deep Bass

**Push-Pull Dual-Driver Configuration**
M&K's innovative Push-Pull Dual Driver configuration delivers a major improvement in subwoofer detail and clarity by virtually eliminating even-order harmonic distortion, which produces a boomy and poorly defined bass sound.

In these subwoofers, one driver is mounted conventionally on the cabinet's front baffle. The second driver, however, is mounted inverted. The front of its cone faces the inside of the cabinet, with the rear of the cone, magnet, and frame facing the outside.

Although both drivers fire into the room in pressure phase (one with the front side of its cone and the other with the rear), they operate mechanically out of phase relative to each other's magnetic structure. (They are driven electrically out of phase). Therefore, regardless of position, each cone is always in the exact opposite position from the other in its travel, relative to its own magnet.

The even-order (second, fourth, etc.) harmonic distortion products of each driver cancel acoustically, because the even-order harmonics of each driver are both virtually equal and exactly opposite in time phase to each other. Even-order harmonic distortion is caused by different non-linearities in the cone's motion when the voice coil is moving deep into its magnet compared with when it is moving away from its magnet.

As important as the distortion cancellation, push-pull also doubles efficiency in comparison to a single 12" driver subwoofer (the same as doubling the amplifier power), as well as allowing twice the amplifier power to be used because of the power dissipation of two drivers. The total output improvement is four times! (6 dB).

M&K Push-Pull Dual Driver designs deliver deep bass with very low musical distortion and tremendous articulation to produce a very natural and powerful bass reproduction.

**M&K Sound Deep Bass**
Since 1974, M&K has invited listeners to "Discover Deep Bass." Deep Bass specifically refers to a subwoofer's ability to produce usable steady-state and transient output below 20 Hz. M&K's Deep Bass design produces significant deep bass output in some models down to frequencies below 10 Hz. This output makes a major difference in subwoofer performance, producing what some have described as the "startle factor," or "awesome" bass.

Most conventional subwoofer designs (especially units with passive radiators and vented cabinets) have an extremely sharp roll-off (24 dB/octave) below the lower limit of their "flat" response. But M&K subwoofers have a much shallower roll-off below their -3 dB anechoic response frequency. By reproducing bass frequencies well below 20 Hz, M&K subwoofers have a lifelike power and authority that other subwoofers cannot match.

**Ease of service**
All M&K amplifiers and crossovers utilize printed circuit boards for maximum reliability, quality control testing and easy of service. Unlike M&K Sound, many speaker crossovers are simply glued to a mounting panel or to the cabinet itself and they cannot be easily removed or tested.

M&K amplifiers are modular in design, meaning they can be easily removed from the cabinet and returned for service.  M&K Satellite crossovers are similarly designed and can be removed and replaced quite easily in the unlikely event of major damage.

M&K subwoofer cabinets use heavy-duty T-Nut type fasteners to secure the speaker drivers. These make driver removal and reinstallation a snap, without the worry of stripping the wood.

**M&K Sound V12**

THX SELECT2

**M&K Sound V8**

**M&K Sound V10**

# No Servo Feedback in M&K Sound Subwoofers

**Servo and Other Types of Feedback**
Many customers ask about negative feedback in powered subwoofers. M&K does not currently manufacture subwoofers using servo feedback, although the original Volkswoofer did have a servo circuit. Here is some discussion on the subject.

Feedback uses a sensor mounted on the speaker that detects the movement of the cone. The signal generated by this movement is sent from the speaker voice coil area back to the electrical input of the power amplifier and compared to the subwoofer's input signal. Any difference between the two represents distortion. The feedback circuit takes that difference (distortion) signal, inverts its phase, and applies it back to the amplifier's input, *theoretically* canceling the distortion.

When an input signal is steady-state, like a sine wave, feedback can measure extremely well. Unfortunately, music is always changing. And if a musical signal has changed by the time the "correction" signal has been applied, the sound is not improved—it is actually made worse!

**This is why designers of High End amplifiers strive for minimum feedback.** Even though greater feedback produces lower measured distortion, excessive feedback produces poorer sound due to a phenomenon known as Transient Intermodulation Distortion.

In loudspeakers, the same principle applies, but to a much greater degree, because the delay in applying the correction signal is due to the motion of the speaker, instead of the speed of electrons moving through an amplifier (at nearly the speed of light).

In speakers, feedback also affects transient performance and dynamic range. **Feedback systems can become unstable with sharp transients and high output levels, so designers must put limiting circuitry on the amplifier**. This changes the sound quality by dulling transients and compressing dynamics.

It is M&K's philosophy is to strive for excellent reproduction of transients, not sine waves. Compare the sound of an M&K Powered Subwoofer to any subwoofer using servo feedback. The dynamic and transient performance of the M&K will result in an audibly cleaner and more detailed musical sound.

# Installing M&K Sound Subwoofers

Ultimately, the amount and quality of bass you get in a room are dependent on the room itself and the location of the subwoofer in that room. Low frequency bass sounds are affected most by the size of the room and the method of construction used to build it. All rooms are different when it comes to reproducing bass, and the quantity and quality of that bass is highly dependent on the subwoofer's location.

A simple rule to remember is that you get more bass when you move a subwoofer towards any wall or corner. Moving it away from a wall or corner gives you less bass. Remember that the floor also loads the subwoofer and that maximum bass is found with the woofer on the floor in a corner.

**Our experience in measuring subwoofer performance (in hundreds of rooms) shows that in the majority of cases the best location is either directly in or very close to a corner.**

All our measurements were taken using the MLSSA system's Adaptive Window technique, the only room measurement technique that correlates well to the time and frequency domain characteristics of the human ear-brain system. Third-octave techniques do not provide sufficient frequency resolution or time-domain selectivity needed for accurately determining ideal subwoofer placement.

Placing the subwoofer near or in a corner provides good loading to the room, and is the best place to start when experimenting. Placing the subwoofer in a corner maximizes bass output, but in some rooms it may negatively affect the quality of the bass. In these cases, placement away from the corner is indicated.

One room position will exhibit the flattest response, with no peaks and dips, and the highest output (room gain). Typically this is the corner closest to the listening position. If the seating is in the rear half of the room, this is a rear corner.

Virtually every room has a set of frequencies that are either overemphasized (response peaks) or lacking (response dips) because of the room's dimensions. When this happens, the sound is "boomy" and unclear - not just at those frequencies but overall. The goal is to achieve a smooth sound quality, with the entire bass spectrum equally prominent.

**Subwoofer Placement for Optimal Performance**
M&K Sound subwoofers deliver excellent performance located virtually anywhere in your room. M&K Sound subwoofers are designed so that their output is not localizable when used with proper bass-management electronics. Therefore, there is no need to place your subwoofer either between your main speakers or in any specific location, other than the one that offers the best spectral response. Determining which location works best for your particular application should be done according to the following guidelines.

The low frequency response and efficiency of a subwoofer are heavily influenced by the acoustics of the playback environment. More specifically, the response is influence by the room's dimensional ratios, type of construction and location of the subwoofer within that environment. You can significantly improve the subwoofer's in-room response and efficiency by experimenting with various room placements until you find an optimum location.

*When placing the subwoofer, there are several general guidelines that should be kept in mind, these include:*

1. *Every acoustic space is unique and experimentation is an important key in finding the best possible location in your particular environment.*
2. *A subwoofer becomes more acoustically efficient (has greater output) as you move it closer to a room surface (e.g. wall or floor).*
3. *A subwoofer will give maximum output and maximum acoustic excitement when it is located in a corner.*
4. *Under certain acoustic conditions corner locations are optimum; in others they can excite multiple "room modes", producing "muddy" or "boomy" sound.*

Place the subwoofer where your main **listening** position will be, connected to your system. Play some music through the system, and then walk around the room, stopping to listening to the sound quality of the bass in potential room locations for the subwoofer.

The location where you hear the best combination of smooth response, exciting deep bass, with impact and sock, and the least "boominess" is likely to be the best place to locate the subwoofer.

Move the subwoofer to that location, and continue your listening tests from the main listening position. If the sound quality is good, leave the subwoofer where it is. If it is not, continue experimenting.

The other technique is to use a sound level meter and a series of low-frequency test tones (100 Hz and below), such as those found on a test CD/DVD. Move the subwoofer to each possible location in the room, taking measurements at the listening position for each location. Measure the sound level for each frequency and plot it on a sheet of graph paper. The location that has the smoothest overall response is the best location for the subwoofer.

# Deep Bass Subwoofer Drivers and Amplifiers

### M&K Sound Proprietary High-Performance Subwoofer Drivers

All M&K subwoofer drivers are designed by and manufactured exclusively for M&K. Our designers take full advantage of the fact that these drivers are used to reproduce only the lowest bass frequencies, thereby allowing the drivers to be optimized for the best low frequency transient response and lowest distortion.

For reduced distortion and improved definition, all of these drivers have an undercut core, an asymmetrical voice coil mounting, and an extremely linear magnetic motor design. Voice coil and magnet sizes are matched to the sensitivity and power handling requirements for each model's amplifier and cabinet.

### Integrated system with amplifier, driver and cabinet

The amplifier found in each M&K Powered Subwoofer is specifically designed for that model's cabinet and driver. It is designed to drive the specific load of the driver(s) used and to provide the desired response for that driver in its cabinet. By designing the subwoofer and its amplifier and driver components as a complete integrated system, we achieve extremely flat frequency response, optimized transient response, very deep bass response for the cabinet's size, maximum amplifier efficiency by optimizing the amplifier to its driver's impedance and control of the system "Q" to deliver tight, musical bass.

### No Load on Main Amplifier

M&K Deep Bass amplifiers electronically combine both inputs. Their low-level "FROM PREAMP" inputs have a 15 KOhm impedance and their speaker-level "FROM AMPLIFIER" inputs have a 200 Ohm impedance. This means that the subwoofer will present virtually no load to the amplifier driving the customer's main speakers. Paralleled with a Satellite speaker's 4 or 8 Ohm impedance, 200 Ohms is invisible to that amplifier.

### Extreme Deep Bass from Modest Cabinets

When we design a subwoofer, we start with a driver design optimized for excellent transient characteristics, with low distortion and high output capability. Once it is mounted in its cabinet, we can then tailor the response of its amplifier to make the system's response perfectly flat to any frequency we desire, typically well below 20 Hz, even in small cabinet enclosures. With a standard external amplifier, this would not be possible.

### Maximum Efficiency Optimized for Driver Impedance

M&K power amplifiers are optimized for the load presented by the specific driver(s) used for that model. The amplifier is simply designed for maximum performance when driving the load it sees from those driver(s).

# M&K Sound Subwoofer Q and Low-Pass Filters

**Control of System "Q" for Tight, Musical Bass**

"Q" is a measure of quality that involves the speaker's transient performance, with a low "Q" being better. Subwoofers with passive radiators, vented boxes (bass reflex) or bandpass designs use air in a chamber or port as a high Q resonator, much as a bottle filled with water whistles at only one frequency when you blow across its opening. The vent "tunes" the speaker to a given frequency, which then becomes essentially its low frequency limit.

The purpose of these ports or passive radiators is to resonate the cabinet at some frequency, which, if done properly, can increase the speaker's output by 3 to 6 dB at that frequency.

But these high Q systems have an unavoidable tendency to resonate (or "ring"), much as a tuning fork continues to sound long after it is struck. M&K sealed-box low Q sealed box designs, tightly stuffed with special sound-absorbing material (which cannot be used with a vented speaker), produce a solid output without ringing, down to frequencies below 20 Hz.

Every element of an M&K subwoofer, from the driver to the enclosure and the amplifier is very tightly damped (low Q), so the combination achieves extremely tight and articulate musical bass.

**True Non-Directional Bass Dispersion**

The M&K low-pass filter is an important element in the sound quality of M&K Subwoofers. Our 36 dB/octave filters have a sufficiently sharp roll-off to truly eliminate the reproduction of frequencies above 125 Hz, where subwoofer output is unwanted.

Virtually all competitive subwoofers have a shallower filter slope, meaning they reproduce audible information such as voices at 200 Hz and above. This degrades the system's overall sound quality and means that listeners may be able to identify the location of the subwoofer.

When listeners say they can locate a subwoofer in a room, it is because of this higher frequency reproduction. M&K subwoofers are truly non-directional.

There are actually two filters in the circuit. The first is user-adjustable through the FILTER knob on the amplifier back panel. This lets the user set the "knee" of the rolloff curve (3 dB down point) anywhere between 50 and 125 Hz. This first filter rolls off the woofer at a rate of 12 dB/octave. The second filter comes into play at 125 Hz to produce a total roll-off of 36 dB/octave.

# Using Multiple Subwoofers

**Advantages of Multiple Subwoofers**

Whenever possible, we recommend using two (or more) subwoofers in any system. A second subwoofer significantly improves a system's total bass output, dynamic range and headroom. The second unit doubles the amount of driver radiating area, which, depending on room placement, increases efficiency by as much as 3 dB (the same as doubling amplifier power). The second subwoofer then doubles available amplifier power for another 3 dB of output **for a total increase of 6 dB!**

The addition of a second woofer means that both woofers have to work up to 6 dB less hard (25% of the work) for a given output level, making for lower distortion (due to less cone motion) at all but the highest playback levels (which are much higher with the second woofer).

You'll remember that the bass quality and peaks and dips in the frequency response of a subwoofer in a given room are dependent on the location of the subwoofer. If you can find and use the optimum location for a subwoofer in a room, two subwoofers at that single location is best!

If the optimum location cannot be used, two subwoofers in different locations can complement each other. From two locations, different room modes are "driven", which can produce smoother response in the room. Listening and measurement tests can help determine the best dual subwoofer placement. The use of stereo subwoofers is controlled by the same conditions.

**Multiple Subs and the LFE channel**

Some questions arise regarding the use of multiple subwoofers with discrete surround formats with a dedicated LFE channel. Some users implement one subwoofer for the LFE signal and another for the bass from all other channels. Instead, we recommend that all subwoofers in a system should reproduce all the bass from all channels.

Surround controllers and receivers include what is called Bass Management. This allows the user to route the bass content of each channel either to the main speaker reproducing that channel or to the subwoofer(s).

This means that a single subwoofer can reproduce the output of all 5.1 channels (just as a single subwoofer in a stereo system reproduces the bass content of the left and right channels). Whether a system has two channels or five, six or seven channels, the Satellite-Subwoofer concept means that one subwoofer can always handle the bass output of all channels. Of course, multiple subwoofers are always better.

**We strongly recommend that the bass content of all channels be fed to all subwoofers in a system.** Never send just the LFE channel to a subwoofer.

# M&K Sound Home Theater Set-Up

### Connecting a Subwoofer

The preferred connection from a surround amp/receiver or controller is from the subwoofer output. This may be called SUB OUT, MONO, LOW PASS, CENTER WOOFER, etc. This connection usually insures that a full bass signal is fed to the subwoofer. Never use the CENTER CHANNEL OUTPUT.

If your component has no subwoofer output, connect the Subwoofer to the front Left and Right channel speaker outputs with speaker wires. VERY IMPORTANT: When the Subwoofer is connected with speaker wires and the controller is in Pro-Logic mode, the Center channel WIDE/NORMAL switch MUST be set to the NORMAL mode. If the switch is set to the WIDE mode, the bass content of the Center channel will not be fed to the Subwoofer, and you will lose a significant amount of bass.

With 5.1 or more channels, make certain that the bass from ALL channels is fed to the subwoofer(s). Set all speakers to the SMALL or Normal setting. Be sure that you do not send only the LFE (Low Frequency Effects channel) to the subwoofer. This channel contains only special bass effects, not the normal bass content of the other channels.

### Timbre Matching

A critical factor in achieving excellent multi-channel sound is timbre-matching. On film soundtracks, specific sounds are often moved from left to right or from front to back. When speakers reproducing these sounds have dissimilar characteristics, there is an audible discontinuity when the sound shifts from one speaker to another.

Timbre-matched speakers have very similar tonal characteristics and sound, which come from three critical elements: similar or identical drivers; similar or identical crossovers; and similar or identical frequency response. In full M&K systems, these elements have all been thoroughly addressed. You can be assured that the system can achieve the full potential of your Home Theater.

### Channel Balancing

The other factor crucial to achieving excellent surround performance is level-matching of the front and surround channels. This is even more important than timbre-matching.

We strongly recommend that you purchase a Sound Level Meter (preferably analog meter, not a digital one and use it to measure the output of the speakers by pointing the unit's microphone at each speaker, at the same distance, when playing the test tones generated by your processor or receiver. **DO NOT CALIBRATE LEVELS BY EAR!**

If you get different readings from different channels, when using identical front speakers and amplifiers with speakers at about equal distance, don't automatically set the channels to different levels. These different readings are probably the result of limitations of that type of meter measurement technique. Identical speakers with identical amplifiers at identical distances should be set to the same level, at least within 1 or 2 dB.

**Speaker Placement**

When M&K Satellites are being used in a Home Theatre system, placement becomes extremely important, as you will be balancing five or more speakers (not counting the subwoofer) rather than two. The flowing guidelines apply to a 5.1 channel speaker system. For 6.1 or 7.1 systems, see the instructions that accompany the surround speakers or your surround processor.

**Center Channel**

The Center channel speaker is far and away the most important speaker in the system. This speaker often produces more output than the left and right speakers combined. This speaker should be of the highest possible quality and as similar as possible in response and radiation pattern to the front left and right speakers. Three identical speakers are best.

It is also important to have as much amplifier power as possible for the Center channel. As a minimum, the three front channels should be equal in power output, but it is better if the Center channel has more. If you have less power in the Center channel, this will be the limiting factor in the total output capability of the system.

M&K Satellites, with their compact size and adjustable tonal balances, are ideal for Center channel use. Because of their adjustable tonal balances, they will blend with a wide range of speakers and can be acoustically balanced to provide a smooth front channel soundfield.

The Center channel speaker should be located as close as physically possible to the television or projection screen. It should be just above or just below the screen. If that is not possible, then just to the left or the right of the screen may still be acceptable.

If the television is not in the center of the room (or not centered between the Left and Right speakers), the Center channel speaker should still be as close as possible to the screen—even if it is outside the left and right speakers (such as a TV located in a corner of the room outside the stereo spread of the left and right speakers). Good results can be achieved in unusual configurations when the Center speaker is as close as possible to the screen.

**Front Channels**

The Left and Right front channel speakers in a Home Theater system should be placed the same as the left and right speakers in a stereo setup. Some listeners, however, may prefer to reduce the distance between the left and right speakers to bring the size of the acoustic image closer to the size of the screen image.

For example, with a 32" direct-view television, you would want the speakers closer together than you would with a 100" projection screen. One recommendation is to separate the speakers by 1.5 times the diagonal screen size; another is to place the left and right speakers to create a 45 degree angle with the main listening position.

There is a great deal of latitude in this area, as it is one of personal preference (especially if you also plan to listen to music without video).

It is also preferred that the speakers be equidistant from the listening position. Equidistant usually means that when the center speaker is flush with the screen, the left and right speakers will be slightly forward of of the screen (they will be farther from the wall behind the TV than the center speaker). Ideally, the speakers should be at the same height as the screen, but it is much more important that all three speakers be as close to each other's height as possible. If the center is much higher or lower than the other speakers, the effect can be distracting. Angling, or toeing-in the left and right speakers, to aim at the listening position often improves imaging.

When using a Center channel speaker, you have extra flexibility in placing the left and right speakers, as the Center channel speaker will tie most dialog and effects directly to the screen.

**Surround Channels**

The Surround channel speakers can be placed in a wide variety of locations in the room to give good performance. In general, the surround speakers should be either adjacent to or behind the main listening position and located higher than the listener's heads. They can be mounted on either the side walls or on the back wall, flush to the wall, on shelves, on ceiling brackets, floor stands, etc.

The goal is to achieve an enveloping sound. The surround channels should seem to come from all around you, rather than seeming to come from behind you only or directly from a speaker.

This section discusses non-THX surround speakers. THX system requirements call for dipolar surround speakers mounted to the sides of the listening position above the listeners' heads. See the M&K instruction manual that accompanies our Tripole surround speakers.

For non-THX surrounds, try starting with speakers on the side walls of the room, two to three feet above the listeners' heads, directly adjacent to the listening position or behind it. You can aim the speakers to fire towards each other (across the listening area), or you can aim them to fire towards the back wall at an angle. When possible, the surround speakers should not be in front of the main listening position.

If you mount the surrounds on the side wall behind the listening position, they can be aimed towards each other or angled towards the back wall or the side wall surface directly behind them. By reflecting sound behind the listening position, you may increase the sense of envelopment in the sound.

If you want or need to mount speakers on the back wall of the room, there are several options. You can aim them so that they fire towards each other (so they fire along the back wall); you can aim them towards the front wall of the room; or you can angle them so they fire toward the side walls. Symmetrical arrangements work best.

The speakers should be a minimum of a few feet away from the nearest listener. If the speaker is located too close to a listener, its sound will become too directional and may distract that listener. Ideally, the surround speakers should not call attention to themselves and should not be audible as separate sources of sound.

If the surrounds must be located close to the listeners, aiming them at the room walls or even the ceiling can help to reduce any directional effect. As described above, this can produce a desirable result even in rooms where the surround speakers are an adequate distance from the listeners' heads.

If the surrounds cannot be placed on a wall, try placement on tables or the floor to the sides of the main listening position, firing up towards the ceiling. This can work very well in environments that do not allow permanent attachment of speakers to the walls.

For a 6.1 or 7.1 channel system, the main surround speakers should be positioned to the sides of the listening area as described above. A single center rear surround speaker (6.1 channels) should be placed behind the central listening position. A pair of center rear surround speakers (7.1 channels) should be placed behind the central listening position symmetrically to both sides of the central listening position.

The surround channels can be installed in a wide variety of locations, but because they are usually mounted on the walls of the room, they can be a challenge to install successfully and attractively. If you have further questions, please contact your local authorized M&K Sound specialist.

*"We've been using M&K THX speaker systems on the Star Wars films in both the sound design and picture editing suites. The M&K THX speakers' accuracy and imaging qualities let us hear all the nuances of dialogue, music and sound effects at every stage of the creative process.*

*This gives us the ability to create the powerful, yet subtle and persuasive soundtracks that are the hallmark of the Star Wars films."*

— Rick McCallum, Producer, Star Wars Episodes I, II, and III