

Amplifying a Wide Range of Acoustic and Electric Guitar
Sounds Across the Stage and Throughout the Audience
with Little Change in Tone or Level

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Summary

Amplified guitars are the source of some truly remarkable musical instrument sounds. At the same time, we found they are the source of acoustical problems that often prevent musicians and members of the audience from hearing the guitar as intended.

We traced the most serious problems to how electric guitar amplifiers radiate sound into the performance environment. The sound level from a guitar amplifier decreases rapidly with distance, and as a consequence, it is impossible to set a level that is consistent for all listeners. Thus for many, the guitar sound is either too loud or too soft. Guitar speakers are also acutely directional – exhibiting unpleasant, often uncomfortably loud and harsh sound in a narrow sound beam projecting out from the front of the amplifier. Musicians and members of the audience who are caught in this beam are often subjected to painfully harsh guitar sound. Listeners located to the side of the beam report hearing only a dull, distant version of the tone so carefully constructed by the guitarist.

Acoustic guitar players using amplification also experience problems, and are forced to choose between two inadequate options. Microphones provide only a small amount of amplification before tone coloration and then feedback set in. Piezoelectric pickups allow more amplification, but sound thin and tinny and do not faithfully reproduce the dynamic range of the instrument.

To solve these problems, Line 6 & Bose engineers combined flagship technology from each company into a single, integrated solution for guitarists and their audiences. We submit that the result is a level of performance from amplified electric and acoustic guitar that has not been possible before. Digital circuitry in Line 6 guitars translates vibrations from the strings into the sound of various popular guitars, and additional Line 6 products recreate the sound of popular electric guitar amplifiers and electric guitar effects. A new Line 6 guitar looks, feels, and plays like an acoustic guitar but achieves electric guitar volume levels without coloration or feedback. Special circuitry then precisely matches the Line 6 devices to an entirely new and novel Bose loudspeaker capable of projecting sound across the stage and throughout the audience with little change in tone or level.

Tests of this new system for guitar show that it is now possible to produce a wide range of authentic, powerful, electric and acoustic guitar sounds faithfully and consistently across the stage and throughout the audience – all from an integrated, optimized, and compact system.

Introduction

THE guitar has had, and continues to have, a phenomenal influence on music. The acoustic guitar is perhaps the single most important instrument in European and American folk music, and it is likely that more songs are performed with the guitar as accompaniment than with any other instrument. Beginning in the middle part of the twentieth century, electric guitar began its explosive influence on music. Today, in most popular styles of music, the electric guitar is a dominant instrument, powering the sound of countless compositions, musical groups, artists, and recordings. In amplified music and in the styles that evolved with and because of amplification, the guitar is almost synonymous with the music itself.

Guitars are also a major commercial force. According to the International Music Products Association, guitars are the biggest single segment in the musical instrument and musical instrument equipment market. Amplification equipment is a close second in this market with guitar amplifiers alone representing the sixth largest segment. Many would agree that the guitar is the commercial locomotive of amplified music.



The “guitar wall” in a contemporary music store.

The means for amplifying guitars have existed for nearly a century. The motivation for amplification has changed, however, from the need to make the acoustic guitar louder, to the extreme tones and volume levels of the electric guitar in the popular styles of the latter half of the twentieth century.

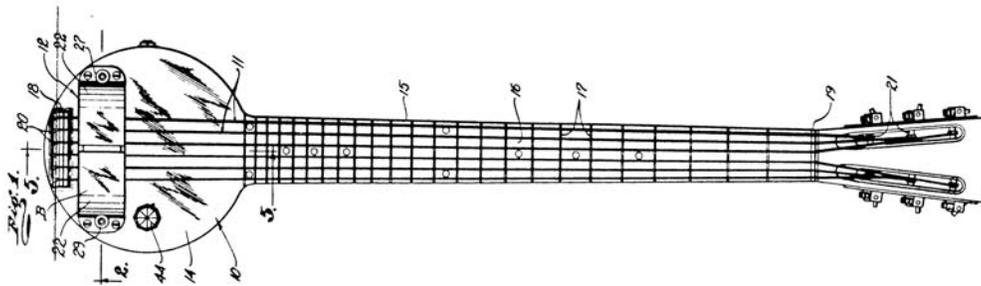
Brief History of Electric Guitar Systems:

TODAY, the guitar holds a dominant position in many of the most popular styles of music. In order to understand the goals and challenges facing today's guitarist, it is helpful to review the history and evolution of the instrument and its associated electronics from its beginnings.

Electric guitars

Early in the twentieth century, experimentation began to fit acoustic instruments with electronic pickups, which converted string vibrations to electrical signals that could then be electronically amplified. Without amplification, a stringed instrument – including the guitars used in many of the popular styles of the time – could not be heard above the other instruments in bands of increasing size playing to larger and noisier audiences.

Before long, new instruments were invented that *only* worked when amplified. The Hawaiian lap steel guitar became popular, and as an instrument was especially hard to hear in an ensemble. To address this problem, George Beauchamp and Adolph Rickenbacker introduced what is considered to be the first commercially available all-electric guitar in the early 1930s, and other companies quickly followed suit.



A 1932 patent drawing from what is considered the first commercially available all-electric guitar, nicknamed the “frying pan”, is shown.

The inventions of Les Paul, Leo Fender, and many others found their way into the hands of musicians worldwide in the following decades. By the middle of the twentieth century, musical styles were emerging and evolving *because* of amplified electric guitars. No longer important only as a tool to increase the level of certain instruments being played within existing musical styles, amplified guitars were actually catalyzing the evolution of new musical styles. Thousands of different electric guitar designs emerged through the years, offering the guitarist a wide range of instrument tones through the many variations in magnetic pickups, types of wood, body construction, and guitar circuitry.

Electric guitar amplifiers

The electric guitar's contribution to this musical evolution was only half of the story, since without amplification, the guitar alone had no purpose. The guitar amplifier's role in this tonal evolution was equally significant.

From the simple original goal of using amplification to make traditional guitars louder came a vast array of unintentional, yet very musical, tonal variations. At the start of the amplified revolution, the only method of amplification was with vacuum tubes. With the help of RCA's radio handbook, many engineers and hobbyists built amplifiers based on vacuum tubes for the newly invented electric guitar. These amplifier designs set out to provide linear amplification of the guitar signal, or in other words, to simply make the guitar louder. But as the amplifier gain was increased, the signal would begin to distort. Guitarists quickly began to use this distortion as a musical tool to add a new dimension to their sound. Playing style and volume could be used to control the character of the distortion, and new musical styles evolved from this tone. First with the blues, and then in rock and roll, the sound of popular music was forever changed by the accidental discovery of amplifier distortion.

Throughout the second half of the twentieth century, many manufacturers developed tube guitar amplifiers. Brands like Fender, Marshall, and Vox, and many others, each developed their own signature sound, using the variations in circuitry, tubes, and speakers. Different musical styles, as well as different artists, favored specific sounds. For example, country and blues were often linked with Fender, and rock and metal with Marshall. A group's sound could even become associated with a particular amp, as with early Beatles music and Vox amps.



Powerful guitar amplifiers became popular in the 1960's, producing new sounds often at very high volume levels.

By the end of the twentieth century, many of these classic amplifiers had become sought-after collectables, due to the relatively low number of units produced, and for their unique tonal characteristics. Component tolerance variation, plus the ever-changing parts suppliers used by the early manufacturers meant it was rare if ever that two of the same amplifier models sounded exactly alike. Tone connoisseurs were known to test multiple amplifiers of the same make and model in order to find the one that had ‘perfect tone’.



A collection of vintage and modern guitar amplifiers is shown.

Modern guitar amplifiers have evolved in design from these origins, but they still use the same basic vacuum tube technology.¹ Circuit variations in how the tubes are used, as well as variations in tone and power supply circuitry have created new tonal colors that have added to the guitarist’s range of sonic choices.

¹ Although the invention of the transistor led to several solid state guitar amplifier designs starting in the 1960s, these have been generally considered inferior in tone to tube amps due to the different manner in which transistors distort the audio signal. Tube-based designs remain the preferred method of amplification for most guitarists.

Guitar effects

Starting in the 1960s, guitar effects appeared as a tool for exploring new sounds. Distortion boxes, tremolo, chorus, phase shifters, flangers, and many other effects became commonplace. Guitarists often collected dozens of them and spent countless hours adjusting and rearranging their order to explore new sounds. By the 1980s, rack-mounted studio effects such as delay, reverb, and pitch shifting added still more sounds to the guitarist's tone palette.



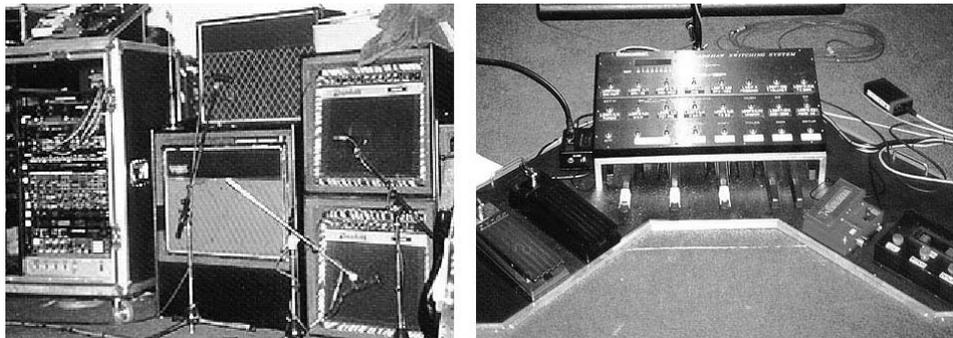
A collection of vintage guitar effects (top) and a guitarist's pedal board (bottom) are shown.

Guitar speaker cabinets

The final stage in guitar amplification is the actual loudspeaker, typically one or more 12-inch speaker cones. As with the tonal differences that exist between different amplifiers, each speaker type, as well as each speaker cabinet type, provides a unique sonic signature. In their quest for tone, guitarists have often replaced speakers in amplifiers, or mixed and matched different brands of amplifiers and speaker cabinets to get a desired result. More than just a means for projecting the guitar's sound, to a guitarist the speaker is often considered an integral part of his or her own unique sound.

The traditional guitar rig

The range of tones available to today's guitarist is vast. The traditional solution for a guitarist seeking to use a wide range of tones is to purchase multiple guitar amplifiers, guitars, and effects, and develop a complex system to switch between the various devices.



An example electric guitar rig with multiple guitar amplifiers, effects, speakers, and switch pedal boards is shown.

A number of difficulties arise, however, when assembling a traditional guitar rig:

- Complex switching systems are required in order to make practical use out of multiple amplifier setups.
- Many older tube amplifiers only achieve their desired tone at a specific (usually higher) volume, making it often difficult to manage stage volume and dynamics.
- It is difficult to maintain the settings of the many knobs from one session to another. If a knob moves between sessions, the sound changes.
- Set up and maintenance is often complicated and time consuming, requiring dozens of cables, power supplies (or batteries) for pedals, plus the required care and replacement of vacuum tubes. Weight and bulk make transport and setup a burden for many.
- A significant investment is required if tonal flexibility is needed. As a result, only guitarists with big budgets are able to fully develop their sound.

Digital Modeling of Electric Guitar Systems

By the mid 1990s, Digital Signal Processing (DSP) technology became sophisticated and affordable enough to be applied to the problems of the traditional guitar rig. The name ‘digital modeling’ is given to the process of replicating the sonic characteristics of traditional analog circuitry using DSP algorithms. In this approach, as with the traditional guitar rig, the instrument is treated independently from the amplifier and the effects.

Digital modeling of amplifiers, effects, speakers, and microphones

Digital modeling of a guitar rig begins with the careful analysis and measurement of the tone and distortion characteristics of analog amplifiers and guitar effects selected for their sonic quality and popularity. In digital modeling, mathematical software algorithms that run on digital signal processing hardware recreate the tone-shaping characteristics of the circuits in the original amplifiers and effects.

In order to capture the sonic contribution of the guitar speaker, acoustic as well as electronic elements are modeled. Since a guitar speaker is highly directional, a specific listening location is selected that represents the desired tonality. This is typically the same place that a recording engineer would place a microphone in order to record the guitar. The frequency response and other sonic characteristics of speakers, as well as various microphones and their placement, can all be digitally modeled.

Once represented digitally, hundreds of different pieces of tone-shaping equipment can be instantly recalled. This presents a number of new sonic and creative opportunities for the guitarist:

- A single device can replicate the tone of a huge collection of gear, including amplifiers, speaker cabinets, stomp boxes, rack effects, and microphones.
- Specific desirable amplifier tones can be achieved at any volume.
- Programmability provides instant recall of settings.
- Different configurations of the various tone shaping elements can be created and instantly recalled, including combinations that never existed before. For example, a certain speaker cabinet model from one classic amp can be combined with the amplifier section model of another amp to create an entirely new sound.
- The sound is no longer dependent on component age, temperature, or humidity.
- Equipment setup time is vastly reduced.
- Bulk and weight is reduced.
- Reliability is increased with far fewer devices and far fewer points of failure.
- Equipment costs are reduced. Players on modest budgets can access the tone palette in the past available only to the player with a big budget.

Line 6's POD_{XT} family of digital modeling products provide models of many popular amplifiers, speakers, effects, and microphones in order to deliver a complete set of sonic tools within one device. It is optimized for providing a complete tonal solution for recording without the need for any other equipment, and has become an industry standard in this application. It also provides the musician with a library of preset tones so that the guitarist can quickly select an acceptable tone and focus mainly on the musical performance.



The Line 6 POD_{XT} contains digital models of many sought after amplifiers and guitar effects in a single, programmable, cost-effective device.

Digital modeling has become increasingly sophisticated. Today, for example, even the sonic nuances that result from the sagging power supplies and aging filter caps in certain coveted guitar amplifiers can be accurately represented. While to the layperson these kinds of details may seem esoteric, to many guitarists they are critical to delivering a musically satisfying experience.

Digital modeling of electric guitars

Many of the physical characteristics of traditional electric guitars contribute to their sound. For example, the sound of a hollow body electric is the result of its body resonance, and different pickup types and pickup positions are also important contributors to a guitar's tone. By creating detailed digital models of these and other tonal elements, a single instrument can produce the sound of many different instruments. Fundamentally, digital modeling means that physical design is no longer the determining factor in creating an instrument's sound.

In digital guitar modeling, the vibrations of each string are converted to a digital signal, and then processed through models that represent a guitar body, pickup, and guitar electronics. Unlike a guitar synthesizer or MIDI guitar, the nuances of the guitarist's playing are retained since all of the natural string vibrations of the guitar are captured and passed through the models.



The Line 6 Variax 700 electric guitar has the construction of a fine solidbody guitar, but with the sounds from over two dozen sought after instruments.

By providing a collection of guitar sounds in one instrument, digital modeling of guitars opens many new possibilities for the musician:

- Dozens of guitar sounds can be instantly recalled from one instrument.
- Since there are no actual magnetic pickups (only analog-to-digital converters for the string vibrations) no hum or noise is picked up from light dimmers, displays, or other electromagnetic interference.
- A guitarist can switch between any two guitar sounds within a song while still playing one instrument.
- The sounds of other instruments, such as 12-string guitars, acoustic guitars, resonator guitars – even bango and sitar – can now be played from one instrument.
- Different configurations of the various tone shaping elements can be created and instantly recalled – including combinations that never existed before. A certain guitar body can be combined with a certain pickup to create an entirely new sound.

The combination of a Variax and a POD_{XT} provides the guitarist with an almost infinite combination of guitar tonalities by choosing from the library of guitar, amp, effects, speaker, and microphone models. All of the key elements of the traditional guitar rig are present, except for the final amplification and output of the sound.

Digital modeling of acoustic guitars

Digital modeling technology can also be applied to capturing the tone of acoustic guitars. In this application, the acoustic resonance properties of an instrument, along with its string decay characteristics and other distinguishing sonic elements are captured and stored as digital models. Since the actual strings are still the sound source, the guitarist's style and nuances are all retained as they pass through the selected digital models.

Moreover, modeling can be used to replicate the sonic characteristics of a fine recording microphone located at an ideal position in a world-class recording studio, thereby eliminating the need for a microphone or a studio. If constructed similarly in scale and feel to a standard acoustic guitar, but with a solidbody design, a digital acoustic guitar can furthermore be made impervious to ambient noise or feedback.



The Line 6 Variax acoustic uses a solidbody design but looks, feels, and plays like a fine acoustic. It contains the sounds of dozens of famous acoustic guitars and plays at electric guitar levels with no coloration or feedback.

The digital acoustic guitar offers a number of important benefits for the guitarist:

- A large collection of different instruments can be instantly selected from one guitar, including several different sized acoustics, 12 string guitars, resonators, sitar, and banjo.
- The tonal quality of a properly recorded acoustic guitar can be included in the model, allowing the guitarist to record without a studio or studio microphone, or play live with the tonal quality of a fine recording.
- Since the microphone is eliminated, ambient noise from computer fans, people talking, or air conditioners don't interfere in any way with the recording process.
- The model of the microphone's position, along with a model of a studio compressor, can be adjusted by the user to suit their tastes.
- The guitar's tone can be amplified to electric guitar levels without feedback.
- Alternate tuning of the strings can be stored and recalled, eliminating performance delays required for re-tuning, or the need for multiple instruments to be available to accommodate different tunings.

The Challenges of Live Guitar Amplification:

MANY guitarists and studio engineers know where to place certain microphones relative to a guitar amp to capture its tone on a recording. Techniques for recording acoustic guitar are also well known: the guitar producing the desired tone is recorded in a professional and acoustically designed studio through one or more high-quality studio microphones. And recently, digital modeling technology has simplified recording for acoustic and electric guitar since no microphone or acoustically designed studio is required. With modeling technology, the signal from the guitar is developed tonally in the digital models, and then sent directly to the audio recorder.

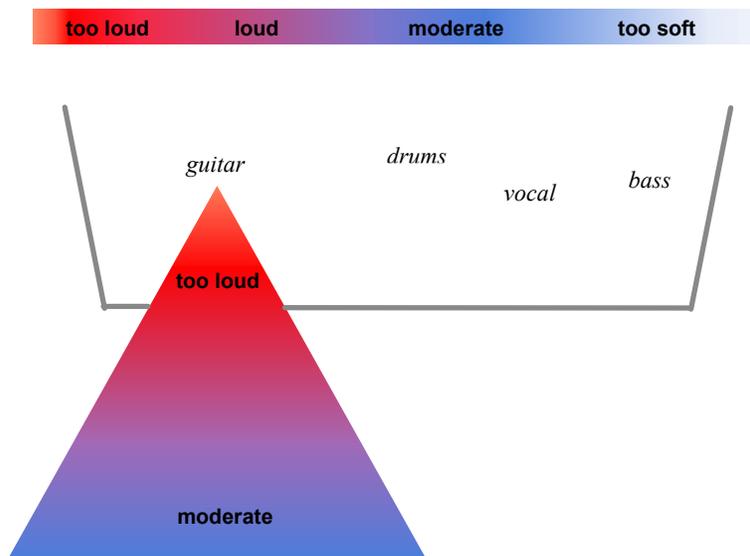
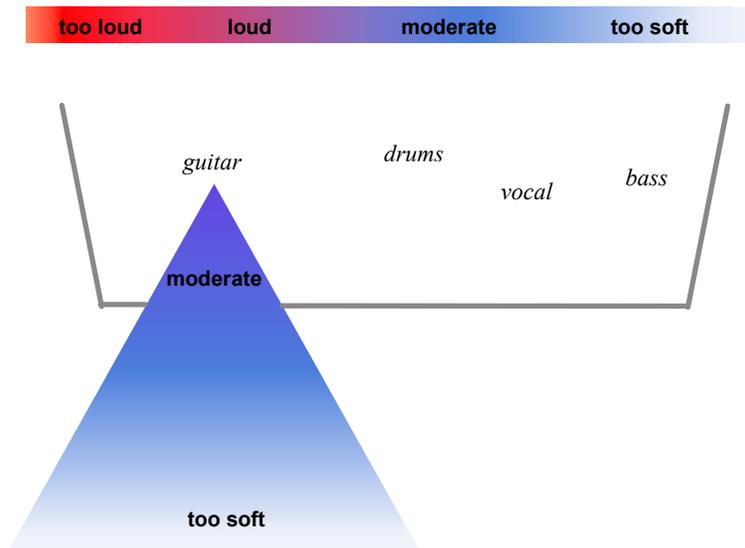
While guitars are now recorded routinely with highly satisfying results, we found that in live performances serious problems still exist – problems that affect the musicians on stage as well as the people in the audience. In this section, these problems are explored for both the electric and acoustic guitar.

Too loud, too soft, rarely just right

The sound level from a guitar amplifier, as from any conventional loudspeaker, decreases rapidly with distance. As a consequence, it is impossible to set a level that is consistent for all listeners. For many, therefore, the guitar sound is either too loud or too soft.

The problem of filling a performance venue using a conventional loudspeaker such as a guitar speaker can be traced to a fundamental property of the loudspeakers used to amplify guitar and other instruments. Namely, conventional loudspeakers are very loud at close range, but they decrease rapidly in level with distance.² We found that if the desired level is set on stage, it is not loud enough in much of the audience area, and conversely, setting the desired level in the audience means exposing the musicians to painful sound levels on stage. In other words, regardless of what volume level is used, most listeners hear sound that is either too loud or too soft compared to what's intended.

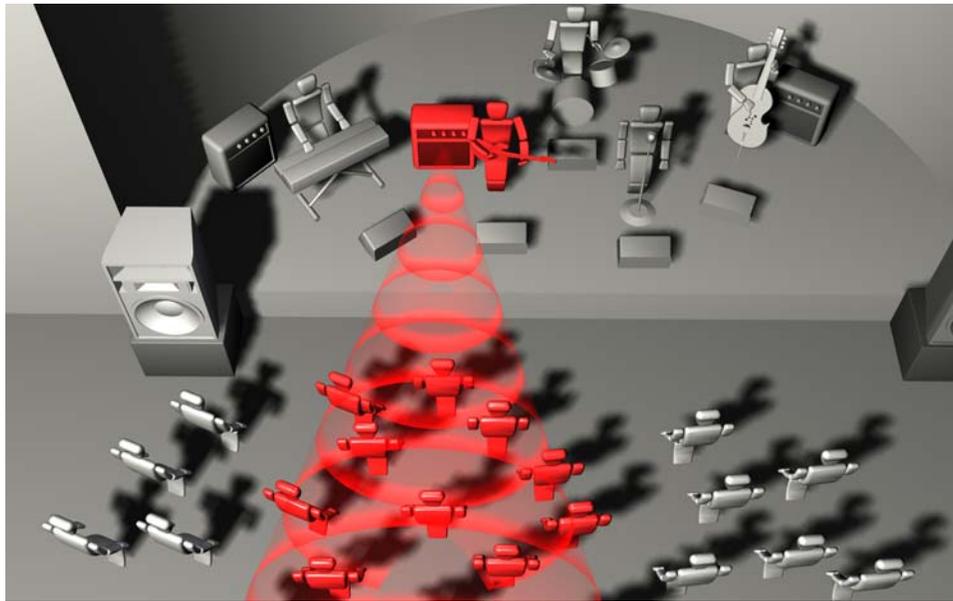
² In the field of physical acoustics, this is known as the *inverse square law*, whereby sound intensity drops by a factor of four with each doubling of distance from the source.



Conventional loudspeakers, including guitar amplifiers, decrease rapidly in level with distance from the stage. If a moderate level is set on stage, the sound in the audience is too soft (top). Conversely, increasing the level of the speaker in the audience to a moderate level means excessive levels on stage and squealing from microphones and instrument pickups (bottom).

Acute directionality of guitar amplifiers

Guitar speakers are also acutely directional – exhibiting unpleasant, often uncomfortably loud and harsh sound in a narrow sound beam projecting out from the front of the amplifier. To compensate for this, the guitarist almost always stands to one side or the other to avoid the beam. Other musicians and members of the audience who are caught directly on axis, however, are often subjected to painfully harsh guitar sound. Conversely, audience members located off to the side and away from the guitar speakers hear only a dull, distant version of the tone so carefully crafted by the guitarist.



Conventional guitar amplifiers are acutely directional. The guitarist usually stands to the side of this harsh beam of sound. But audience members and other musicians are often unable to move out of the way.

Musicians told us they experience the same effect. If they are on axis of the guitar beam – for example when guitarists aim their amps across the stage – the sound is brash, loud, and dominating. If they are off axis they hear a dull version of the instrument – a version that guitar players say is unrepresentative of the tone they have so carefully created. We have concluded therefore that the only person who is getting the right guitar sound is the guitarist: in other words, good tone, but only in one place.³

³ Readers are encouraged to hear the effects of this acute directionality and its associated problems for themselves by rotating a guitar amplifier while a guitarist plays. Most who have tried this easily hear and recognize the harsh sound within the beam, the dull sound away from the beam, and the relatively small angle where the guitar tone is balanced.

Acoustic guitars live

The process traditionally used for recording the acoustic guitar is unfortunately poorly suited to live performance. Ambient noise, the sound of other instruments, and erroneous room reflections are all picked up by the guitar microphone. Moreover, because the amplified signal must be dispersed through the same acoustic environment as the microphone, feedback usually occurs long before an adequate amount of amplification is achieved, especially when the guitar must compete with other instruments in an ensemble. Finally, the live performance venue is rarely of an acoustical quality that would allow the full tonal quality of the acoustic guitar to develop.

Because of these problems, acoustic guitarists have often turned to built-in piezoelectric pickups in order to perform at higher volumes. These pickup devices capture the vibrations of the instrument by being acoustically coupled to the bridge or body, but the signal output is vastly inferior to what is achieved when using a high-quality microphone in an acoustically-tuned studio. Guitarists told us that feedback problems are reduced, but the tone no longer accurately resembles the sound of the instrument.

Acoustic guitarists are thus faced with choosing between two unsatisfying options: reasonable tone with inadequate amplification – which means getting buried in the mix when playing with others – or unnatural tone and poor dynamics if a pickup is used to achieve more amplification.

The digital modeling acoustic guitar can solve these problems by providing the sonic output that is desired and achieved in recording studios, but it still needs a suitable amplification system that can deliver that tone properly to other musicians on stage and to members of the audience.

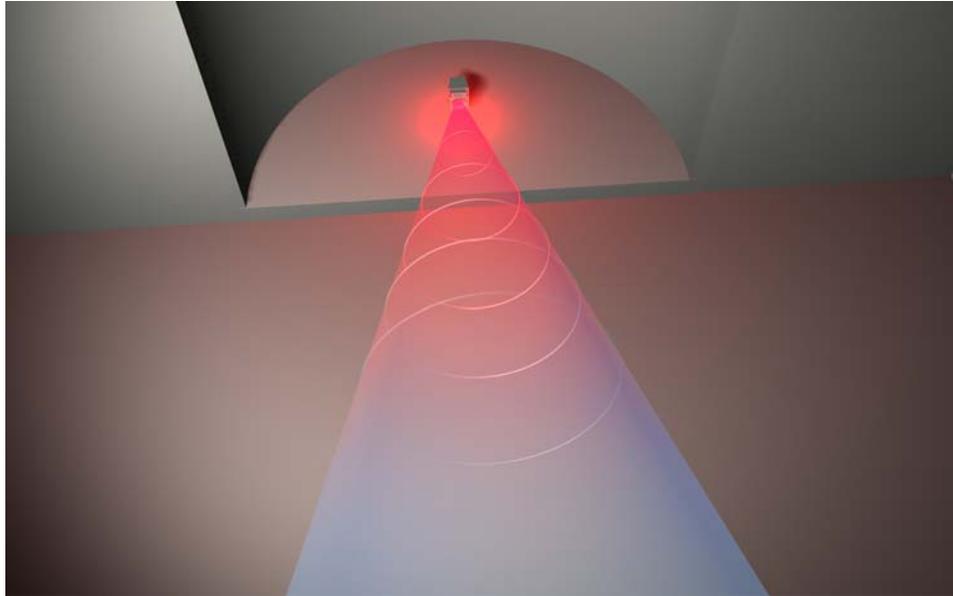
A Completely New Approach to Live Guitar Amplification

LINE 6 & Bose engineers initiated their work together because of their mutual interest in solving the longstanding problems and limitations inherent in live guitar amplification. Line 6 had already solved the problems associated with guitar amplifiers, effects, and guitars described above. And Bose had recently introduced its new Cylindrical Radiator loudspeaker which unlike any conventional speaker delivers consistent tone and level across the stage and throughout an audience of several hundred.

Work began at laboratories and performance venues in Agoura Hills CA, and Framingham MA, to marry the critically acclaimed technologies from each company into a single integrated system for guitarists. The goal was to create the first system that allows guitarists to develop tone from a huge palette of sounds, and then deliver that tone to everyone in a live performance environment.

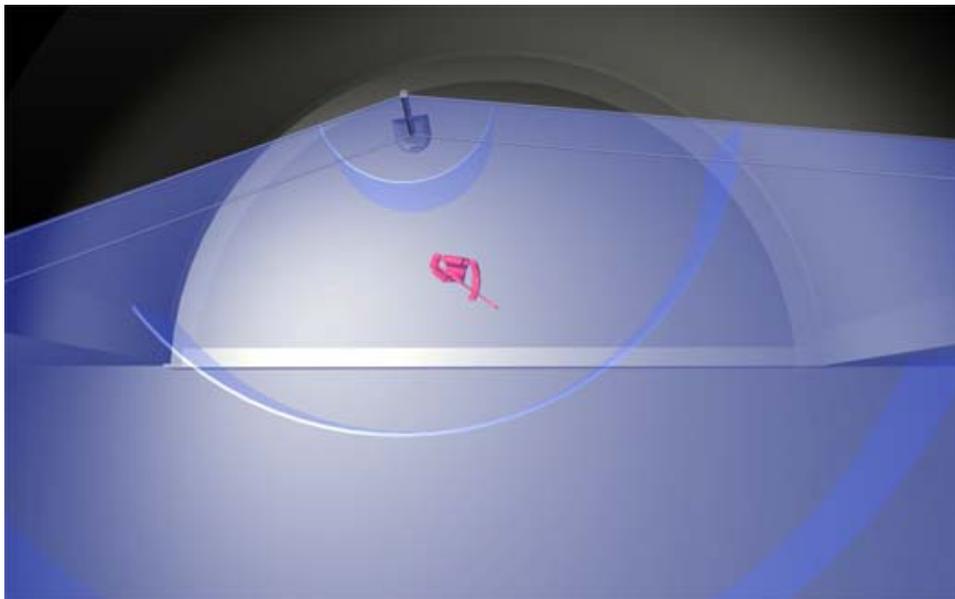
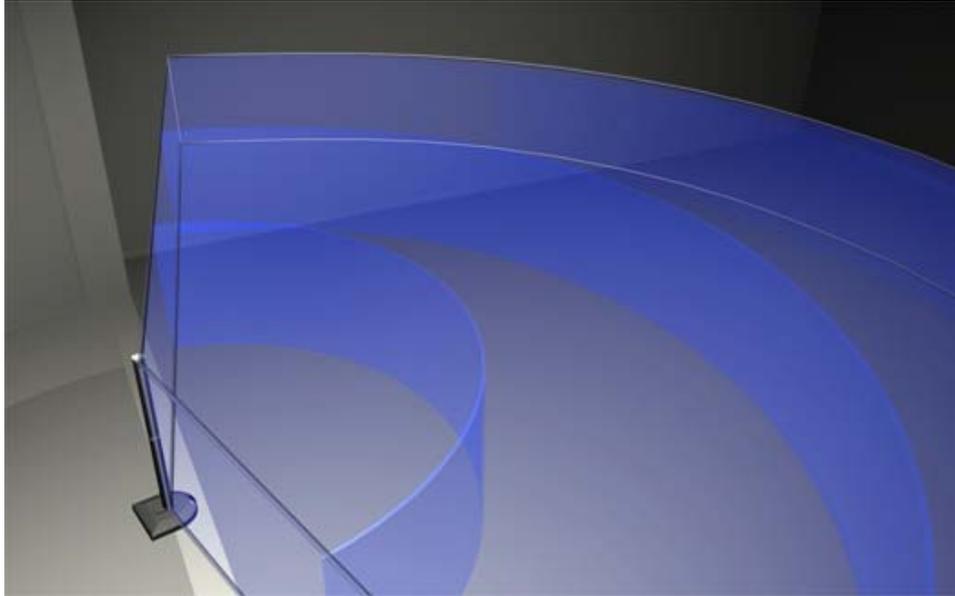
Cylindrical Radiator loudspeakers

To understand the insight that led to the new Cylindrical Radiator loudspeaker, recall that a conventional loudspeaker radiates sound in three dimensions: out, left and right, and up and down. It is well known that such a source retains only one-fourth of its sound intensity with each doubling of distance from the source. We hear this as a rapid reduction in sound level with distance.



The problem is that if a comfortable level is set on stage for the musicians, the sound is often not loud enough in the audience area. Conversely, if a comfortable volume level is set in the audience, it is uncomfortably loud on stage. It is this fundamental property that makes conventional loudspeakers unsuitable for the challenge of creating sound for both the musician and the audience at the same time without being too loud or soft for either.

In contrast, a Cylindrical Radiator loudspeaker radiates sound predominantly in two dimensions: out and to the sides, but very little up and down. Confining the sound energy to two dimensions versus three means that the sound level diminishes only modestly with distance from the source.⁴



⁴ See the paper *Applying the Benefits of Unamplified Acoustic Music to Performances with Amplification* for an extensive description of the Cylindrical Radiator loudspeaker. The paper can be downloaded from www.bose.com/musicians.

In fact, if a Cylindrical Radiator loudspeaker and conventional speaker are both set to the same volume level at 3 feet, then at 30 feet, the conventional loudspeaker will be less than one-tenth the intensity and less than half the volume. It is this property that allows the Cylindrical Radiator loudspeaker to be placed behind the guitarist and result in consistent tone and level across the stage and throughout an audience of several hundred.

Optimization

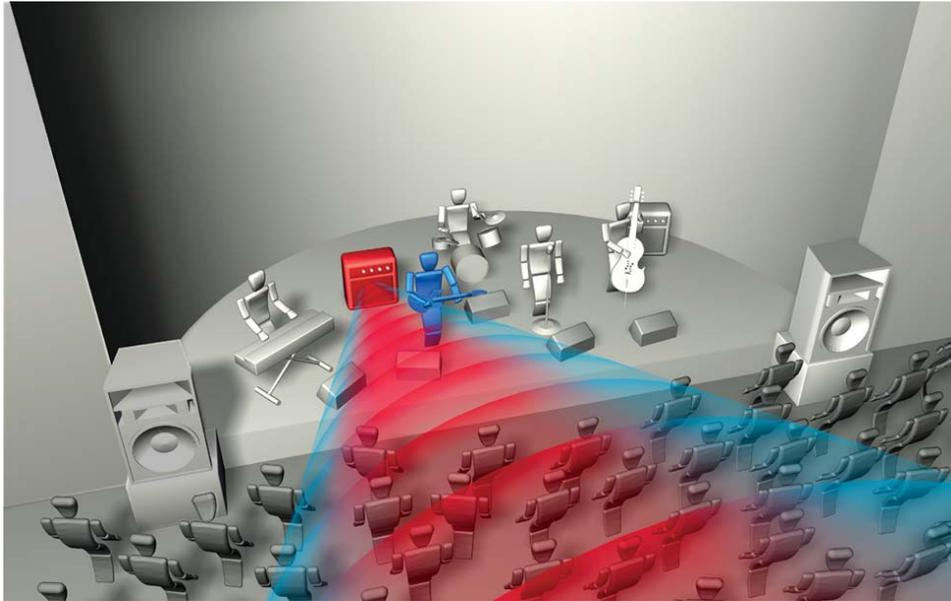
Engineers at both companies knew that the best possible guitar tone could only be achieved through the development of a complete, integrated system. Full optimization of the sound was possible in this case because the signal path from guitar, to guitar electronics, speaker amplification, and speaker were all included in the integrated solution.

The benefits of optimization are significant. One of the most serious limitations in any component-based approach is the fact that the inventors of the component have no way of knowing what other components will be used with theirs to complete a system. The best the inventor can do under these circumstances is optimize for an average of the components likely to be used. This is the essence of a component-based approach: mix and match flexibility, but at the expense of performance.

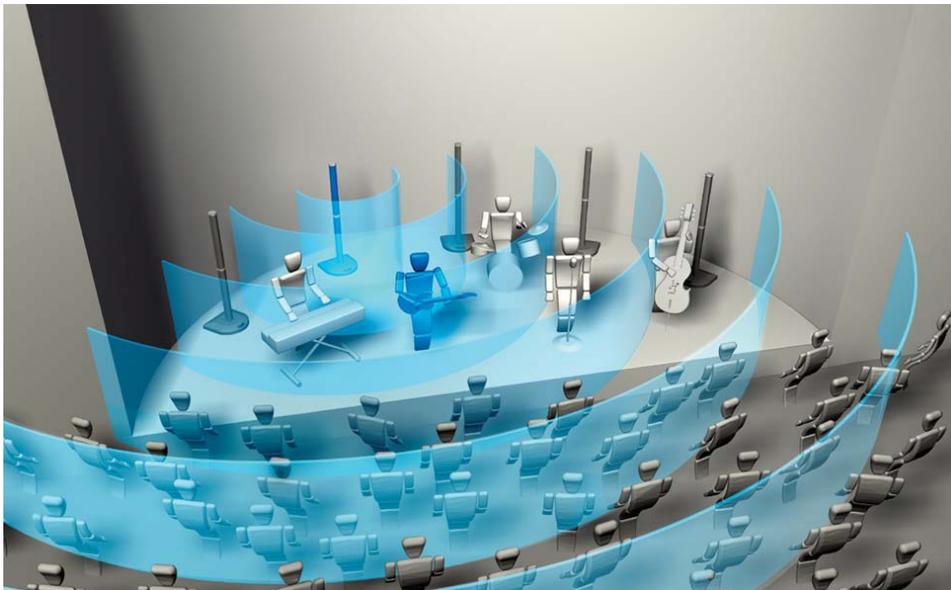
In contrast, when all of the elements in a system are included, it is well known in the field of system engineering that superior performance can always be achieved (assuming other variables are held constant.) In the case of creating an integrated amplified guitar solution, significantly better performance can be achieved when, for example, Line 6 engineers know exactly what power amplifier and loudspeaker will be used with their POD_{XT}. Instead of guessing what kind of speaker will be used, or instead of designing their device to sound good for an average of devices, the sound of the combined devices can be fully optimized.

In addition, by optimizing the system around the Cylindrical Radiator loudspeaker, the result is not limited to one listening location, as would be the case with a traditional guitar speaker. The resulting performance is therefore superior to anything that could be achieved otherwise, and because of the radiating properties of the Cylindrical Radiator loudspeaker, is superior in covering the stage and audience areas with consistent sound when compared to any conventional guitar amplifier.

Such optimization has been performed by Line 6 & Bose engineers, and resides as a user-selectable mode within an updated version of POD_{XT} firmware. The optimization is included with all current POD_{XT} family products for use in this system, and is being made available as a software download for existing owners.



Traditional guitar amplifiers make it impossible for all but one person (the guitarist) to hear the desired tone and level.



An entirely new approach to live guitar amplification allows the guitar tone to be created from a huge palette of sounds using Line 6 digital modeling technology, and then for that tone to be delivered across the stage and throughout an audience of several hundred by means of the new Bose Cylindrical Radiator loudspeaker.

Fundamental Advantages of the New Approach

1. The guitarist's tone – everywhere
Before this system was developed, optimized tone was confined to an extraordinarily limited area – essentially to the position of the guitarist. It is now possible for guitarists to create their ideal tone, and then radiate it across the stage and throughout an audience of several hundred with little change in tone or level.
2. Huge palette of sounds
In the past, the guitarist using amplification was limited to the tonal characteristics of the specific instrument amplifier and effects chosen. It is now possible to choose from an enormous palette of instrument, amplifier, and effect sounds without changing equipment. Classic and new sounds can be created easily and inexpensively.
3. Acoustic guitar sound at high gain, with no coloration or feedback
From the moment amplification was used with acoustic guitars, feedback and tone coloration forced guitarists into compromises and limitations as musical artists. It is now possible to enjoy the sound of the acoustic guitar at the sound levels previously only possible with electric guitar, with no coloration and no feedback. In an ensemble, the acoustic guitarist can play confidently without concern about being lost in the sound of the other instruments.
4. Consistency of tone
The tone-generating elements of this new system from Line 6, and the loudspeaker technology supplied by Bose are all stable electronic systems. If the guitarist creates a desired tone at home or in the studio, they can be assured of hearing the same tone at a later time at the touch of a button. The problems of tone changing with changing temperature, humidity, and electronics age are made a thing of the past.
5. One system for electric & acoustic guitar
For the first time, the same system that can dominate a stage like a powerful traditional guitar amplifier can also provide precision, detail, and clarity in reproducing the subtleties of an excellent acoustic guitar. This same amplification system is optimized for a vocal microphone as well, making it ideal for solo performers or singing guitarists in a band. Thus the same amplification system can be used for electric guitar, acoustic guitar, and vocals. This is accomplished without compromise, since the system is independently optimized specifically for each of these signals.

Conclusion

FOR almost a century, amplified guitar has played a central role in live music performances. Many technological advancements have been made over the years – advances that have vastly increased the range of sounds possible, and more recently advances in the form of digital modeling that allow virtually all guitarists easy access to a huge palette of sounds. Modern technologies also permit the guitar to be recorded satisfactorily and routinely at minimal cost and with much less specialized knowledge than in the past.

And yet in all these years of technological improvement, one area – live guitar amplification – has remained a source of serious problems for musicians and audiences. Essentially, a guitarist's carefully crafted tone was wasted on all but the guitarist because of severe limitations in the way guitar amplifiers radiate sound into the performance environment. At the same time, acoustic guitarists have been forced to choose between the insufficient amplification and feedback problems associated with microphones, or the poor tonal quality associated with piezoelectric pickups.

There now exists an entirely new approach to live guitar amplification, one that offers acoustic and electric players a vast palette of sounds *and* a means to deliver that sound throughout the performance environment. According to all who have heard this solution, it is now possible to produce a wide range of authentic, powerful, electric and acoustic guitar sounds faithfully and consistently across the stage and throughout the audience – all from an integrated, optimized, and compact system.

First Edition

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Early guitar amplification system.
(Frank Driggs Collection)