

One step

beyond

*The exploration
of digital audio
innovations in*

*guitar effects
pedals is one
small step for*

*man, one giant
'kerrang' for*

mankind! By

Mike Richardson.

No other instrument has come close to reshaping musical development in the way the electric guitar has. Musicians like Hendrix, Page and Townshend have helped transform the guitar by developing a 'body in contact' freedom of expression far beyond musical artistry to the point where the guitar has transcended instrument status to becoming an extension of the player.

These rock legends have struck a chord with an entire generation of young people, with their onstage antics spawning an army of air guitarists pretending to play guitar solos.

During the 1950s, the development of the electric guitar saw Fender and Gibson introduce their first solid body models. Meanwhile, a number of effects boxes were also launched to enable further manipulation of tone colours and effects. Perhaps the most popular effects pedal is the wah wah, which

alters the tone of the signal to create a distinctive effect intended to mimic the human voice.

Today's leading audio designers are bringing harmony to a new generation of guitarists by offering

more functionality in an array of sonic tools at affordable prices. Harnessing the power of mixed signal 'system on chip' (SoC) designs, the latest guitar multi effects foot pedals are helping today's bedroom studio guitar wannabe to become tomorrow's professional rock star.

One example of wah wah, wowing the musical equipment market is Source Audio's Hot Hand motion controlled effects, which has seen the company change from a minor to major key player. Hot Hand is said to be the only effects system allowing musicians to use hand and body motion to control key functions such as speed and depth.

At the core of the Hot Hand motion sensing system is Analog Devices' dual axis iMEMS accelerometer, whilst a customised version of Analog Devices' SigmaDSP audio processor – the Sound Audio SA601 SoC – provides a 56bit audio processor with 24bit a/d and d/a converters.

"The original idea for Hot Hand began when our





vice president of engineering, Jesse Remignanti, had been experimenting with a version of SigmaDSP," explained Source Audio's president, Roger K Smith. "I suggested it would make a terrific effects product, so we combined it with Analog Devices' accelerometer to provide an innovative method of combining audio effects processing with gestured control."

Remignanti first mounted the sensor onto the guitar, but the prototype was disappointing because it restricted the player's movement.

"However, moving the sensor to the guitarist's hand in the form of a ring opened huge possibilities," Smith continued. "Jesse is a competent guitarist and understood the implications of wearing a ring and how it would feel for a performer. As the architect of the user interface and the look and feel of the ring, it was absolutely essential that Jesse had a musical background in order to design products that would appeal to other guitarists."

Freedom of expression

Smith says that one Hot Hand user – Eric Krasno of SouLive – uses subtle hand and finger motions to create sounds that you just can't get from bending a note or using an effects pedal. In contrast, Dragonforce's Herman Li uses Hot Hand in an extremely visual fashion by running around the stage. Prior to Hot Hand, he needed effects pedal 'stations' in different positions around the stage.

"Li's music is featured on Guitar Hero III and, as a result, he's become quite famous," Smith continued. "Hot Hand gives him the freedom to use dramatic hand motions and create an intense visual experience. We've housed a blue led in the ring to create a cool connection between the sound and the visual experience, taking artistic expression to a new level."

Source Audio is set to announce a new distortion product called MultiWave. "We've had our most 'picky' guitarists – those who've never touched anything but analogue pedals – admit they've been blown away," chimed Smith. "I'm sure the purists will never want to touch a digital pedal. Would they ever be satisfied? Would they pass a blind taste test? MultiWave splits the input signal into 10 different frequency bands, distorts each one separately and recombines them. Play a chord through distortion and you create a complicated sound that turns into 'mush'. This is a common problem; you can play high or low notes separately, but you can't combine them. MultiWave is one of the first products where complicated chords can be played and the multiple notes come through clearly and cleanly. This would be extremely difficult to implement with analogue effects."

Source Audio has a number of products under development connected with Hot Hand generating

MIDI control signals to a host of devices that accept MIDI as a control interface.

"A performer could have a Hot Hand ring on each hand and use hand gestures to control various lighting parameters or instruments – the possibilities are endless," predicted Smith. "We've also created a modified ring connected to a guitar pick containing a pressure sensor. By squeezing the pick, you create an alternative way of controlling the guitar effect!"

Making music

In an age where the internet has brought a virtual recording studio into the home, it is no surprise that companies are stepping up this trend by developing downloadable tone expansion software for effects units online. Digital modelling specialist Line 6's customers can freely download drivers and upgrades, or simply purchase add on patches to expand their existing effects settings.

The company's collaboration with Freescale enables third party audio designers to create custom sounds using Line 6's new ToneCore dsp developer kit reference platform to fast track the development of audio effects. The kit enables audio dsp developers with little or no electronic design experience to quickly and easily program audio effects modules for Line 6's ToneCore guitar pedals. All it takes is a pc and the kit.

The kit contains a Line 6 Developer ToneCore Dock, which in addition to containing the Freescale Symphony audio dsp, audio circuitry and ToneCore module docking slot, can be connected directly to a pc. The ToneCore programmable module is customisable and stores dsp code in the flash memory of the on board Freescale microcontroller. Code development is performed on pc and then a programming tool is used to flash the mcu with the new code through the Developer ToneCore Dock.

"Designers can plug in processing algorithms on the fly in any way they want," explained Freescale's multimedia division product marketing manager Jim Bridgewater. "Line 6 has taken advantage of this demand by providing a toolset for customers to create patches which can then be slotted into the dsp. We live in the

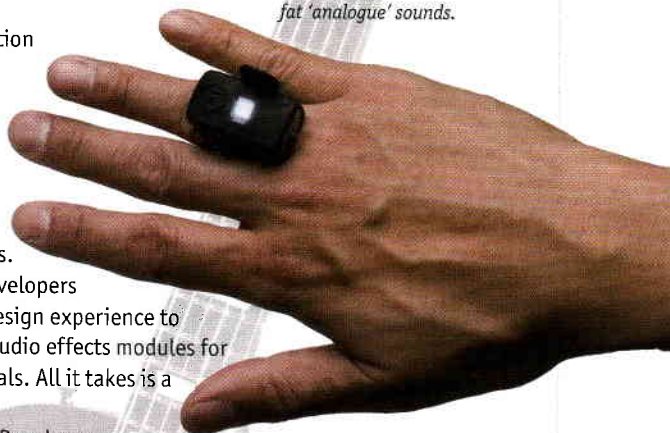


Far left:

I've got a fuzzbox and I'm going to use it! Dragonforce's Herman Li puts pedal to the heavy metal using Hot Hand.

Above:

Line 6's ToneCore guitar pedals employ Freescale's Symphony audio dsp's to provide warm, fat 'analogue' sounds.

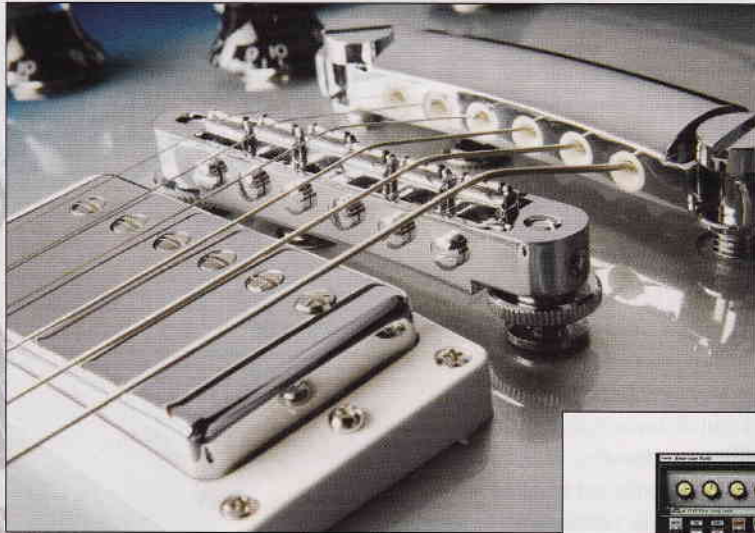


Below and far left:

Lord of the ring. With a ring mounted sensor, Source Audio's Hot Hand motion controlled effects system offers musicians more freedom of expression by using hand and body motion.



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**Right:**

Want to turn your bedroom into a professional recording studio? Line 6's software lets you control an entire arsenal of amps, stompboxes and studio effects - from your desktop pc.

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internet age where everyone wants to share patches online."

Bridgewater points to the rapid growth of what he terms the 'prosumer' market of 'bedroom' musicians with a basic studio, plus the fact that the semiconductor industry is always pushing down the price of processing power. This allows companies like Freescale to offer enough Mips for this to be done at a reasonable price.

"The music industry is quite conservative and most people would rather buy a vintage guitar than a modern one for good reasons, because of the level of craftsmanship," he noted. "The same is true with digital processing. Emulating traditional analogue effects has to be done at high sample rates and with a wide dynamic range, otherwise you get the 'hard' metallic digital sound that musicians dislike. Guitarists want a warm analogue sound and the last thing they want is for their effects to sound digital."

I, robot guitar

First appearances would indicate that there is nothing 'digital' about Gibson's new Robot Guitar. It may look like any other classic Les Paul, but closer inspection reveals innovations that, Gibson claims, will change the guitar world forever.

Said to be the world's first automatic self-tuning guitar, the user simply pulls out the traditional volume pot - which also functions as the selector for a range of tuning options - to activate minute servomotors in the neck which then tune the strings. Tuning frequencies are monitored against each setting's ideal by piezoelectric sensors in the bridge, which feed back the

appropriate tuning action to the neck.

Robot Guitar employs Tronical's Powertune modular system, which can be retrofitted to virtually any guitar make or model without destructive retrofitting. At the touch of a button, Robot Guitar tunes itself in less than 2s to accuracies beyond those of manual tuning. What's more, its memory accounts for the musician's personal preferences by allowing pre-programmed or individually saved presets, such as open tuning, special grunge or slide settings to be recalled immediately.

At the heart of Powertune is dsp based tuning analysis software located in the controller electronics to calculate the actual tuning and necessary correction. This provided a huge design challenge of integrating electronics in packages that were small, yet robust enough to do the job without affecting the guitar's traditional physical design.

"We couldn't use FFT algorithms because they

require large processors that consume too much power," began Tronical's ceo and chairman Chris Adams. "We needed algorithms offering fast and reliable frequency detection and we now have a stable frequency detection in 0.1s, with an accuracy of two thousandths of a semitone."

When old meets new

Combining state of the art, high accuracy technology with the relatively low accuracy of a vintage guitar - without changing its existing construction - meant another challenge for Adams.

"The feedback from some of the leading guitarists is that Powertune is a happy marriage of old meets new," he confirmed. "Our aim is to ensure the guitar remains in its original condition and that Powertune doesn't spoil the original tone and feel. The future is about combining the best from the past with what will be happening in the future. You don't need to remove the heart and soul of a guitar to make it more practical."

Certainly, audio designers are giving their heart, soul - and sole - to stay one step ahead of consumer demand for more foot pedal fanciness. Whilst a final guitar design is surely way off in the future, affordable digital audio technology has seen effects pedals undergo a renaissance.

This has inspired guitarists to experiment with new sounds and guarantee that, for now at least, the electric guitar continues to enjoy the kind of popularity its inventors could never have dreamed of! ■

**Above and right:**

Using Tronical's Powertune system, Gibson's new Robot Guitar tunes itself in less than 2s to accuracies beyond those of manual tuning.

