Shakti Technology
White Paper

The Shakti Electromagnetic Stabilizer is a patented Electromagnetic Interference (EMI) absorption and dissipation apparatus. EMI is a general term used to describe the negative interaction of radiated fields with the transfer function of electromagnetic components. Shakti is a three stage passive device that requires no direct electrical connection to the signal path because all interaction takes place through radiated field mutual coupling. The three broad spectrum traps (Microwave, RF and Electric/Magnetic), contained within its portable chassis, absorb and dissipate these parasitic oscillations through inductive coupling. Reducing these fields results in a more accurate signal transfer of the information the host device carries. Specific applications in use at present time are all types of audio/video components and automotive engine computer processors (ECUs) and ignition coils.

EMI in Audio Components

In audio components these spurious fields radiate from several millimeters to several feet around the host component chassis. Left unattenuated, some undesirable portions of this EMF can transgress back into circuits, generating noise artifacts that get amplified along with the music waveform. The result is a noisier, grainier background during moments of inter transient silence and a reduction in dynamic contrasts as signal levels change. In contrast, by reducing these noise sources the overall reproduction of the music becomes more detailed, encompassing greater stage depth, width and clarity.

EMI in Automotive Engines

In the automotive world EMI is a factor in the accuracy of signal information arriving at the Engine Control Module (ECU) of modern vehicles. A variety of sensors located at different vantage points deliver information to the ECU that allow this computer processor to adjust the parameters for ignition timing and electronic fuel injection. The digital chips rf radiation and the inherent close proximity of circuits parts can lead to a contamination of this incoming analog information and interfere with the ECU¹s receiving accurate values. This results in lost horsepower and slower acceleration times. Shakti devices placed near the chips absorb these fields, increasing the precision of the ECU¹s functioning. Ignition coils produce voltage through an expanding and collapsing magnetic field. The collapsing field has an inherent back electro motive force (back EMF) that can interfere with the expanding field. Placement of Shakti devices on the sides of ignition coils absorbs some of the spurious energy of the back EMF, thus speeding up the rise time which improves spark timing.

Origin and Causes of EMI

Falling within the category of EMI are what are identified as parasitic oscillations. These extremely short, tiny bursts of energy are visible on high resolution waveform monitors at certain points along the cycle of a sine wave. Often originating in the RF region, they also have harmonics that reflect up and down into the audio bands and become amplified at high levels along with the music. Sometimes they are external in origin, the circuit stages and traces acting like a giant maze antenna. All metropolitan areas are teeming with RFI that has a spectrum ranging from 30 Hz to 7 gigaHertz, though most often encountered at frequencies below 500mHz. Automotive ignition noise dominates, but can on occasion be superseded by power distribution lines. Other sources of RFI are appliances, electric motors, fluorescent lights, electric garage door openers, industrial equipment, microwave appliances and light dimmers. In audio components , self generated parasitic oscillations are well known to occur in switching power supplies. 120 Hz current spikes, caused by rectifier conduction, emanate in capacitive input design power supplies. Common rectifier diodes, used in a variety of equipment, produce high levels of RFI. Harmonics of these spikes and bursts can be observed in a wide spectrum up into the mgHz region. Radiations of these pulses are conducted to other circuit parts within the amplifier, increasing as a result of being amplified in combination with the music signal. In effect, there are a number of parasitic oscillation transmitters within amplifiers that can produce broad bandwidth, multiple harmonic pulses each second. Printed circuit boards are also sources of unwanted EMI. Several causes are common impedance coupling via power and ground traces, antenna loops formed by ICs and their bypass capacitors and crosstalk between adjoining signal traces of the individual boards or adjacent boards. There is also evidence that things as simple as poor or cold solder connections and dissimilar adjacent metals can be sources of EMI effects.

Conventional Approaches To Reduce EMI Effects

There are a number of traditional approaches to reduce the external RFI that reaches components. Several examples are extensive chassis shielding, ferrite bead type filters at input and output sections and power line conditioners. Engineers generally try and keep signal traces short to minimize stray inductances and capacitances, which can cause signals to ring and to over or undershoot the steady state voltage levels, all of which can be a source of EMI. Several companies are selling ferrite bead devices that are placed around system interconnects to filter RFI that could enter at those points. This is effective at reducing RF that can enter through external wiring. However, it does not attenuate self-generated sources within the component itself, nor can it reduce much higher microwave fields. Also ferrite material filters are only applicable to a situation where they can be placed around a wire to facilitate the impedance shifting effect that is at the heart of the this design. One other device that has been used in audio to absorb some unwanted emanations around power transformers is the VPI brick. Conventional understanding of its topology is that it uses non-torroidial passive transformer laminates to mutually couple with some of the electric and magnetic field energy around active transformers. As noted earlier, there is a good amount of information available that these fields contain undesirable harmonics that can interact with the music waveform in negative ways. To be of any benefit a device such as this must have a resistive element to enhance dissipation. It is not enough to just resonate in harmony with the active field. As a result of the electromagnetic constant, hysteresis, some small dissipation will occur (the definition of hysteresis is that a certain varying percentage of energy will be lost

when an electric field or current moves through a metal conductor). It also is quite probable that the mass of the brick may alter some mechanical chassis resonances, that otherwise could prove harmful in certain situations.

Shakti[1]s Unique Filter Designs

The mechanism that activates the absorption and dissipation circuits in SHAKTI has an electrical equivalent that is analogous to an RF transformer effect. This occurs when a tuned secondary coil (passive) is placed in proximity to an active primary coil. An absorption of energy will take place at predetermined frequencies, as long as the passive unit is properly resistively loaded or damped. The host component represents the active coil and SHAKTI parallels the secondary transformer or coil. The potential drainage of the host transformer is negligible in this application because SHAKTI's circuit design is tuned to absorb the ultra high frequencies of the spurious unwanted fields within the EMF.

SHAKTI differs from past efforts to reduce EMI in several distinct ways. First, there are three specific filter stages to cover a broader source of potential unwanted emanations. Second, new and unique types of absorption components are incorporated, that, even if used with other filter designs (e.g. ferrite types), will compliment rather than duplicate the action, thus producing additional benefits. SHAKTI allows for flexible placement near internal circuit stages that are most prone to self-generated EMI, as well as providing additional noise reduction from external sources. And finally, each stage has not only the inherent hysteresis effect that produces some dissipation, but also a specifically incorporated additional resistive element to enhance the filters' effectiveness.

Stage #1 Microwave Filter Circuit

Utilizing proven laws of wave guide designs, this circuit stage provides absorption and dissipation for frequencies from 1.5 gHz to over 100 gHz. Anyone who wonders if these regions can affect audio quality, should try running a set of preamplifier interconnects near a leaky microwave oven. The essential topology of this stage is comprised of tuned resonant chambers that couple with microwave frequencies. The resistive element is a special conductive internal coating on the chamber walls that dissipates the microwave energy as it moves within the chambers. Full details and mathmatical calculations that outline this circuit are available in the Shakti patent # 5,814,761. This circuit stage is not in the Shakti On-Lines.

Stage #2 RFI Filter Circuit

Through a unique application of quartz oscillators, a broad spectrum of RFI is attenuated. Being a piezeo-electric material, quartz is capable of converting an electric field into mechanical energy. In situations where quartz is employed in active components, the desired goal is to accentuate one resonant frequency to the exclusion of all others. However, within this stage of SHAKTI, quartz is used in a manner to produce the broadest sampling of frequencies to better absorb the some what unpredictable EMI. One of the reasons quartz has

never been used in this type of circuit is because, as effective as it is as a converter of electrical energy, its very high Q means that most of the conversion to mechanical energy swiftly changes back to electrical. To overcome this problem, careful experimentation produced the necessary resistive element that is incorporated to substantially lower the Q. The result is effective dissipation within the first 1/2 cycle. This stage provides absorption/dissipation benefits for both external and self -generated sources of RFI.

Stage #3 Electric and Magnetic Field Filter

This third stage provides filter action for that portion of the host components' EMF that is comprised of an electric or electrostatic field ranging from 50 Hz to 200 kHz. Any magnetic fields that might pass through the chassis would also be dissipated by this stage. The primary element in this stage is the magnetic field that is set up within SHAKTI. Following a fundamental law known as "the right hand rule", (which describes the interaction of electric and magnetic fields), this stage results in absorption/dissipation of the multiple odd harmonics of the ac line frequency (60 cycles), that are known to cause serious EMI problems. A unique part of this stage's circuitry is a component which acts like an antenna to attract some of the spurious field around the active transformer, resulting in greater coupling of unwanted energy into SHAKTI. This circuit stage is not in the Shakti On-Lines.

Shakti's Case

The outer case that encapsulates the internal circuits is comprised of a poured stone concrete material that is not resistive to the host components' EMF. This allows the parasitic fields to easily penetrate through to the absorptive devices as well as providing an excellent and safe medium to release the electrical energy that has been converted to heat. Integral pigmentation throughout the stone material is accomplished by using a proprietary compound that has natural anti-static properties.

Test Procedures Conducted To Date:

€ Electromagnetic Emission Test

At Compatible Electronics Inc., an independent testing lab in Agoura, California, an emissions
test was run to determine Shakti's effects on a known source of parasitic oscillations generated in a shielded room. A comb generator was used to generate the ultra-sonic fields that were then picked up by a log periodic receiving antenna several feet away in the shielded room. This receiving antenna was then connected to a Hewlet Packard spectrum analyzer (HP 8566B) that measured radiated fields both with and without Shakti in place on the comb generator driven unit. Four separate broad spectrum tests were run beginning in the mghz regions and up to 1.6 gHz. In all cases the attenuation was a remarkable 3 to 10 db of reduction when Shakti was in place in the test procedure. These tests clearly show the effectiveness of the RF and Microwave trap circuits within Shakti. In Germany a similar test

was run in a state of the art test center that confirmed these results when looking at the output of a D to A converter. High resolution spectrum analysis of self-generated 30 mghz to 300 mghz frequencies that arose from an input of 1 kHz into the D to A converter were dramatically reduced when Shakti was placed on the component. The spectrum analyzer was directly connected to the output of the D to A converter.

€ Thermodynamic Transfer Of Energy Test

The laws of thermodynamics dictate that if a transfer of energy from the field around an active component takes place through an absorption/dissipation transducer, there must be a measurable increase in mechanical or heat energy in that transducer. At an independent testing lab thermocouplers were attached to an area 1/4" above both a loaded circuit SHAKTI STONE and an unloaded placebo. A very cool running 30 watt receiver was placed in a temperature controlled isolation chamber with the two SHAKTI STONES. Regardless of positioning, the loaded STONE maintained a 1/2 degree Fahrenheit higher reading than the placebo stone. An extreme example was positioning of the placebo directly above the warmest portion of the receiver's chassis (the transformer area), and the loaded SHAKTI several inches in front of the receiver. The higher temperature reading for the loaded SHAKTI STONE is consistent with its conversion of energy properties, because, even at that distance it was still within the host receiver's EMF.

€ 60 Cycle PhaseField View and AC Line Test

At METROLOGY INSTRUMENTS LAB in Simi Valley, California, a phase linearity test was conducted. Each time a SHAKTI STONE was placed near an amplifier's transformer, the waveform analyzer connected to the output of the amplifier, demonstrated a more coherent
60 Hz signal. Another test was conducted at UCLA's HIGH FREQUENCY LAB. This time the amplifier's 60 cycle radiated field was looked at. Once again there was an improvement in coherence with the SHAKTI STONE in place on the component. These results are consistent with expected benefits of EMI reduction. Another test conducted at Metrology Lab was an analysis of the noise on an AC line. It's well known that use of digital gear can contribute to noise artifacts on the AC service they are plugged into. In this procedure a CD player was inserted into an AC line which had one neutral leg fed into an oscilloscope. Turning on the CD player caused ringing at 250 kHz on the AC line. This would have negative effects on all audio gear that shared the same line with this CD player. Placement of a Shakti Stone on

the top of the player's chassis clamped down the ringing significantly. Attempts with mu metal, ferrite beads and other items of significant mass and shielding potential were not able to duplicate the beneficial effects of the Shakti units.

€ Video Image Test

ARCHITECTURAL ELECTRONICS, a home and pro theater installation company in Vancouver, Canada has confirmed that in a variety of situations, use of Shakti products in and around video projectors, VCRs and laser disc players can demonstrably show improvements

in video quality. A revealing objective example is a convergence chart cross hatch test pattern.
The most difficult to resolve areas at the periphery of the picture are more accurately aligned with placement of Shakti Stones under or on top of the video projector. This has been verified in a wide variety of systems ranging from entry level and high end home theaters to commercial board room and studio applications. Other visible areas of improvement included a reduction in hot spots and color noise and an increase in picture depth. The obvious reason for these improvements is a reduction in noise in and around the component.

€ Steady State Audio Test Tones

A number of audio products (e.g. cables) are often cited as examples where subjective empirical listening tests, done with musical information, produce claims of audible benefits, but no correlation can be found on non-musical testing. The explanation from the subjectivist camp for this discrepancy, is that the ear is much more sensitive to the complex and transient nature of music versus the steady state audio of test tones. Even with the enormous sales of exotic cables, the objectivist camp continues to put forward its counter view that they don't really make a difference. In the case of SHAKTI, tests have been conducted that overlap both camps. In addition to musical A/B comparisons that reveal audible benefits, interestingly, a steady state test tone, anywhere in the region between 300 Hz and 1000 Hz, also audibly changes for the better when SHAKTI is placed near a power amplifier's transformer. The parameters for this test are as follows:

1. the listener must sit absolutely still and the tone sent to only one speaker (this is necessary because of the inherent random reflective nature of steady tones and perceived amplitude changes with small changes in ear position.

2. the person facilitating the placement must also keep any body movement to the absolute minimum, just moving his arm to lift the unit on and off the component. The tone is easily perceived as purer and clearer with SHAKTI in place; removal results in a tone with more warble and what sounds like a slightly lower volume. Surprisingly, even when the listener is prevented from seeing the AB, this test is just as consistently successful in identifying the SHAKTI on position. This is in marked contrast to the subjectivist camp's admitted poor test scores when they attempt blind AB testing of most audio gear (for which they have some interesting explanations). Perhaps Shakti, rather than increasing the distance between audio's two rival factions, may instead bring them a bit closer.

Automotive Dynometer Evaluations

In April 2000 testing began to look at Shakti devices effects on automotive Engine Control Units (ECUs). Mike Morgan Motorsports in North Hollywood, California performed the evaluations on their installed dynometer from **Dyno Jet Corporation**. This unit is capable of plus or minus 1 horsepower readings on its inertia type of chassis dyno. Four tests were run with Shakti devices that were all preceded and followed by bone stock runs to certify effects.The first two tests used the Shakti Electromagnetic Stabilizer placed directly on the outside housing of a 2000 Pontiac Trans Am flash card ECU. In both instances the dyno registered between two and three horsepower gains at the rear wheels with the Shakti unit in place and measured returns to stock readings following there removal. The next two tests utilized four and then two Shakti On-Lines in place on the ECU. In both cases results mirrored the two to three hp gains measured with the Stabilizer in place.

Additional tests were conducted on a **Dyno Jet** dynometer at Paragon Tuning in Aurora, Colorado. A 1994 3.0 BMW was measured using Shakti On-Lines and an Electromagnetic Stabilizer on the cars ECU.   In both instances increases of 2 to 3 horsepower were measured at the rear wheels.

In December 2000 testing was done at Passaglia[1]s Automotive in Chicago , Illinois. They have installed a state of the art $100,000 **MUSTANG DYNO** that has resolution of horsepower measurements plus or minus 1/4 horsepower as well as the capability to measure 0 to 60 mph times. The tests conducted were stock runs compared to placement of one Shakti On-Line on each of the 8 ignition coils of a 2000 Chevy Tahoe V 8. In addition to showing horsepower increases of 4 to 5 hp in the critical power range up to 60 mph, the tests measured a significantly faster 0 to 60 mph time. The difference was almost four tenths of a second faster. Technicians at Passaglias said that this degree of change has in the past required $2,000 to $3,000 in engine modifications. Total cost for 8 Shakti On-Lines is $400 retail. In addition to these dyno tests, extensive beta testing on a variety of cars and motrocycles has consistently produced testamonials of discernable improvements in engine smoothness and power at all rpms.

Benjamin Piazza,
Shakti Design Engineer
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