Lifting the Veil:
The Science Behind the SSL Sound

Solid State Logic
OXFORD · ENGLAND

When you hear an SSL, you hear the world with the veil lifted. This is no accident. In both the analogue and digital domains, we accept no compromise. This is why you shouldn't either...

Solid State Logic has been a leader in console and audio tools for creative music production for 40 years. Over that time the company has gained a reputation for innovation, excellence, and service, and our products are held up as benchmarks for professional audio technology.

Our philosophy is simple. We spare nothing in designing and manufacturing the best precision music tools available anywhere. There is no single magic stage in any SSL product. Everything from the pre-amps to the conversion, digital processing, FX algorithms, and output stages plays its part.

In the analogue world we have unrivalled experience, knowhow, and legacy. Our SuperAnalogue technology is the practical, no compromise application of all those things, either in complete products, or the analogue stages of our digital consoles and interfaces.

In the digital world, SSL has over three decades of development behind it for the music, live, and broadcast sound industries, and now the Tempest platform gives our designers a new freedom to continually innovate and evolve superior algorithms and architectures with the same commitment to distinction as we have in all aspects of our work.

Solid State Logic - Excellence in Music, Live, and Broadcast.

Live: Blink 182

"Other live consoles seem to mimic what's happening on stage... The SSL gives you what's really happening."

Jason Decter, FOH

SuperAnalogue™

SSL's SuperAnalogue technology is not an accident, nor is it magic, mythology, or 'smoke and mirrors'. It is the sum of an applied design philosophy, constant invention, and dedication to optimising every detail of our precision audio products. There are many contributing aspects, including our bespoke circuits, ground-breaking low-noise gain control, servo-coupled amplifier stages, and so on. Here are some of the main features:

Wide Band Audio
We design and test our analogue circuits for a bandwidth way beyond 20kHz, which many other manufacturers consider to be 'good enough'.

A lucky few people can identify frequencies beyond 20kHz. However, there is a secondary hearing mechanism, directly related to 'rise-time' (the transient performance of components) and evidence to show that even though the basic frequency spectrum of human hearing degrades over time, our sensitivity to rise-times does not. In addition, Transient Intermodulation Distortion (TIM) is a real - if difficult to measure - issue that brings high-frequency 'waste' to bear on the audible spectrum in poor or bandwidth-limited designs through feedback paths in amplifier circuits, for example.

For fast, accurate rise times, and low Transient Intermodulation Distortion, SSL implements precision, high-frequency analogue technologies and tests everything to better than 80kHz.

Stable, Low Noise Gain Control
Most manufacturers use VCA (Voltage Controlled Amplifiers) and 'fixed-reference' DACs for controlling attenuation or gain - either for convenience, or lower cost, or simplicity. SSL has pioneered the use of M-DACs (Multiplying Digital-to-Analogue Converters) in SuperAnalogue technology, enabling ultra-low noise and precise tracking, even with variable temperatures.

No Electrolytic Capacitors
The physical construction of an electrolytic capacitor means that its performance is imprecise, it is vulnerable to electro-magnetic interference, and even expensive 'high-quality' electrolytics do not meet our standards. In addition, over time and with temperature variations, electrolytic capacitors degrade and become 'leaky' - resulting in significant noise issues, altered characteristics, and a shortened product life.

SSL avoids using electrolytic capacitors for de-coupling between analogue stages wherever possible. Instead we use advanced DC servo coupling techniques for low noise, high precision DC offset control.

Broadcast: Zen Broadcast

"System T is by far the best sounding broadcast console I have ever mixed on... It's a game changer..."

Kevin Duff, Sound Supervisor

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Low Noise Design

Analogue design is a juggling act that must always balance the power / noise / heat triangle. That is, if you want low power and low heat, you get high noise. If you want low noise, you cannot have low power. While advances in component and power supplies inevitably bring greater efficiencies (a legacy 48-channel SSL 9k console drew nearly 4.5kW while a modern 48-channel Duality console draws about 1.5kW), specifically designing for low power consumption will always result in compromise.

SSL designs precision, low noise music circuits.

Discrete Design

Many modern analogue audio products are the result of the 'cookbook' approach - where off-the-shelf blocks are strung together to fulfil a practical brief, but lack the additional details that take them from functional to fantastic. To do that, you have to understand how to augment commercially available components with discrete elements, do original research, and sometimes even design your own components.

The VHD Pre

The VHD (Variable Harmonic Drive) mic pre is now a common fixture in many Solid State Logic products, offering the user an all-analogue variable mic pre characteristic from the clean SuperAnalogue path through a blended range of 2nd and 3rd-order harmonics. At lower gain settings, VHD adds gentle valve-style warmth or a touch of transistor edge. As the gain is increased, so does the distortion, until at high gain settings it delivers fierce, trashy transistoresque grunge.

The VHD circuit is actually derived from an early SSL experimental mic-pre project that was shelved at the time because the distortion was too high! Unusually though it produced 2nd harmonic distortion rather than the 3rd harmonic distortion normally associated with solid state technology. This is why it was re-visited later on when SSL engineers were looking for a musical way to add distortion back into our SuperAnalogue designs. The core circuit was patented, and we added the mix pot to balance 2nd and 3rd order harmonics for even more flexibility.

Studio: Nicky Romero

"With the AWS, no quality is lost; and when you play the mix live, no other song will stand out more than the one that's mixed on an SSL..."

Nicky Romero, Producer, DJ

SSL does not do 'datasheet design' and continues to optimise and improve upon datasheet specifications and 'serving suggestions' - we have even licensed our advances back to semiconductor manufacturers. We have built up over 40 years of experience and expertise in improving the canon of analogue music electronics to continually exceed and progress our own high standards.

Audio Switching

Audio switching is extremely common in analogue audio circuits - for everything from switching processing stages in and out to routing, soloing, muting, and so on. SSL uses both relays and an active JFET design with optimised dual-device topology for exceptional distortion-free switching performance.

Transformerless Design

Transformers are an effective component for low audio levels and for bringing character to particular processes, but at line level they introduce low frequency distortion and high frequency roll-off - unless they are physically large enough, which makes them heavy, costly, and space-hungry. SSL uses its own output driver configuration that emulates the floating characteristics of a transformer-coupled output but without the distortion.

Our philosophy is simple. We spare nothing in designing and manufacturing the best precision music tools available anywhere. There is no single magic stage in any SSL product. Everything from the pre-amps, through the line level electronics, conversion, digital processing, FX algorithms, and output stages plays its part.

Live: Depeche Mode

"You want something that will work every day, sound good, and travel on the truck... So SSL is the only choice."

Antony King, FOH.

DIGITAL

There is no fundamental, direct link between the quality of a digital audio algorithm and the underlying technology choice - whether that system is floating point or not, whether it is based on DSP, FPGA, or CPU, and so on. Any fit-for-purpose root platform, with enough processing power and careful implementation, can be 'good enough'.

However, there are many facets of digital technology choices that enable excellence - that give designers the freedom to develop systems and algorithms free from the traditional constraints that can prevent other platforms from reaching their full potential.

Solid State Logic designs without compromise, so we created a platform where channel count is no longer an issue, where latencies are measured in single samples, and where the power, speed, and flexibility of the foundation allows us to devise algorithms and dynamic architectures free from the limits that other manufacturers have to combat every day. The SSL Tempest audio engine with Optimal Core Processing (OCP), together with our Solid Clock technology, give us that freedom.

Audio Insight

Multiplexed displays and LEDs in SSL digital products are refreshed at a rate that is a multiple of- and locked to the current operational sample rate. If the console is running at 96kHz, the refresh rate is 384kHz - over 3000 times the refresh rate of an average domestic TV. Any undesirable aliasing imposed on the audio as a result of the display electronics is always reduced to DC... That is, it disappears!

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SolidClock™

Jitter is variation in a clock signal that can cause distortion and noise in a digital audio system through a form of frequency modulation. It is a very specific kind of noise, often confused in measurements with harmonic distortion and results in a degree of 'unease' in a listener.

To address this, SSL developed SolidClock, an ultra-low jitter clocking technology that guarantees clock deviation of just a few pico-seconds and an accuracy of better than one part per million - exceeding all current standards by a wide margin.

Live: Imagine Dragons

"It was great to be able to bring up channels that sounded good right out of the box"

Scott Eisenberg, FOH

Tempest – A CPU Audio Engine

The Tempest Engine is an SSL CPU-based design that uses two multicore processors - one dedicated to control and display; the other running a Real Time Operating System (RTOS) with our patented Optimal Core processing (OCP). OCP's main task is to guarantee deterministic, real-time performance even with heavy memory exchange loads. This enables us to execute multiple complex, high resolution algorithms at very low latency without relying on additional FPGA bus-summing or any extensive external routing hardware. Multiple processing cores are seen as a single processor, which eliminates the 'farm' latencies seen in multiprocessor systems. Others often have to sacrifice latency for algorithm quality. There are no such limits for SSL.

Ultra-low Latency Processing

Latency in digital audio is an inevitable consequence of processing large amounts of data. On many systems, such as DAW-based plug-in platforms, and DSP and FPGA farms, it is often a variable and significant issue.

In the SSL Tempest Engine, almost all processing blocks have a latency of a single sample. That is true however big the block is, and whatever the sample rate of the system is. For example, every FX algorithm in the FX rack (except linear phase processes and algorithms that, by definition, introduce delay) has one sample latency; every movable processing block in a processed path has one sample of latency. If those blocks were not movable and we treated a channel as a single block - that too could have one sample latency. One sample latency at 96kHz equates to 0.01ms of delay.

Two Hearts

SSL's latest digital consoles for live sound and broadcast actually have two hearts – both analogue and digital. The Live consoles – L200, L300, and L500 – and our new broadcast audio production environment – System T – both have Tempest cores, though they built, from the ground up, for their own applications. Both also have SuperAnalogue I/O, available either locally (in the case of the Live products) and through SSL's Network I/O stageboxes – all of which use SuperAnalogue or mic-pres and output stages.

Broadcast: Canal+

"The sound quality of the whole system is regularly complimented by our operators, and they love the SSL user interface and processing - its high capacity and sonic performance is amazing."

Jean Marc Delage, Technical Executive

Compare that to the range of latencies at various sample rates in typical computer / plug-in-based environments. Single plug-in latencies of 300 samples (about 3mS at 96kHz, or 300 SSL processing blocks!) are not unusual, and can be much higher. A single DAW-based native EQ plug-in that uses over 5000 samples at 96kHz carries 50mS of delay!

Dynamic Bit Depth

Inside the Tempest Audio Engine bit depth is allocated depending on the needs of the process. There are virtually no limits to digital headroom or precision anywhere in the system and processes are given the resources they need, as they need it.

Runtime Variable Architectures

For the users, the ability to design their own console architecture for any given project is a boon to any production, and a direct result of our multi-core OCP technology. New inputs, outputs, channels, busses, and routings can be created without interrupting audio, and the processed path processing blocks can be moved around in a simple drag-and-drop interface without re-setting the console or muting other channels.

Studio: University of York

"Listening to that kind of quality, you know you've heard what is possible... I think that's important, because you can continue to strive for that in your own work."

Ben Eyes, Studio Manager / Sound Engineer, Trevor Jones Studio.

EXCEPTIONAL SSL

Solid State Logic treats every aspect of its technology research and product design with equal importance. We are constantly finding new ways to improve both the sound, and the experience.

We understand that professional music and audio production tools have to be creative, precise, and efficient in order to make the grade. We also understand how to make that happen, with meticulous research and sophisticated design workflows.

That is why SSL is such a respected force in music studios, broadcast facilities, and live venues worldwide - and will continue to be so.

More Information

For more information on our studio, broadcast, and live products, both digital and SuperAnalogue, visit the **SSL website here**.