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System T - Immersive Audio

Technology for entertainment programming and events

Solid State Logic

OXFORD • ENGLAND

In media and entertainment (M&E), immersive audio and its application has been a technology topic for the past decade, but we are now seeing it utilised across a growing swell of content. From sports and episodic television, to film, music, and live events, immersive content is being delivered via multiple platforms with specific workflows to ensure the best experience for the end consumer.

The right tool for the job

At Solid State Logic (SSL), we are focused on delivering great immersive audio experiences across our console offering for different markets. In Live sound, SSL Live consoles are frequently used with both L-Acoustics L-ISA and Meyer Sound Spacemap Go loudspeakers systems. Audio objects are controled directly from the console user interface, then processed by immersive loudspeaker systems at the venue. The output is all in real time, channel count is based on the IO the system presents and is physically connected locally, typically MADI or AoIP on a local network.

Within music production, Dolby Atmos is now frequently used and involves providing a renderer with audio beds (up to 7.1.2 format) and objects (up to 118 mono).The render provides a real time monitoring output and importantly creates the output master file. In addition to position, objects and bed channels are given binaural attributes to be used when the file is replayed as a binaural feed on headphones. Currently both analogue and digital SSL consoles including ORIGIN, Duality and System T, can be used to provide the finished mix to the Dolby renderer.

For broadcast audio production for M&E, the immersive audio content is delivered directly to the customer, utilising transmission standardisation such as ATSC 3.0, dependent on geopolitical variations. From an immersive audio standpoint, the dominant approach is multi-audio with height (e.g. 5.1.4). Additional object channels are possible to build out a more complex mix, typically for user selective experiences e.g different commentary and alternate languages. SSL's System T was built from the ground up for broadcast and includes a rich feature set that helps make immersive TV production simple.



System T immersive Tools

System T was developed with immersive audio scenarios at its core. The flexible and agile CPU based processing architecture and multi gesture touch screens provide a platform that can evolve as immersive audio technologies and the creative ideas of those processing content evolve. Features have been added and enhanced to allow mix engineers to work with height channels without compromise, panning and monitoring includes height without complex workarounds involving multiple channels and busses linked together.

The following features detail the tools mixers expect, and some they might not for mixing immersive content, all are included in the System T software as standard. The same software runs on the full range of control surfaces and control interfaces: S500, S500m, S300, TCR & T-SOLSA. The TE1 or TE2 Tempest processing engines provide a range of processing pack options, featuring scalable Pay-As-You-Go licensing capabilities designed to work in harmony with your production requirements. Upgrading capacity for a one-off immersive event beyond your usual DSP capacity is facilitated by renting a software licence. Audio connectivity and routing is via AoIP: Dante, AES67 & ST 2110. SSL have a range of Network IO Interfaces to accompany System T.

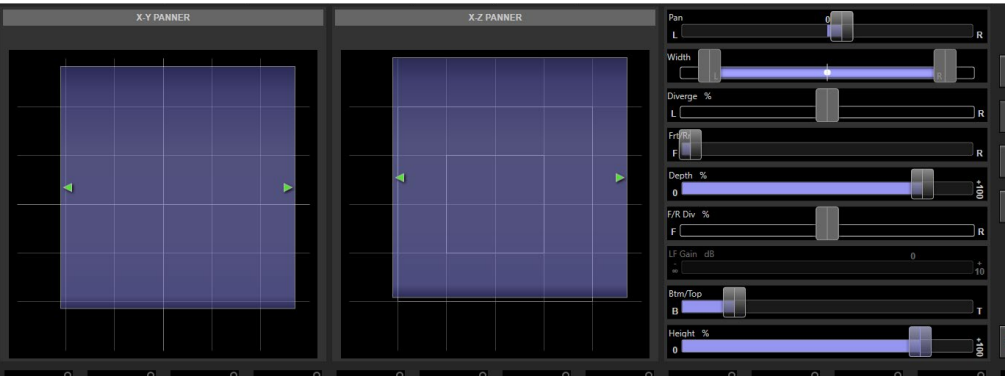
Immersive channels/busses and 3D panning

All System T paths (channels and busses) can be configured in formats up to 7.1.4. When a channel or stem path feeds a bus, the panning parameters for the largest bus being fed become available. All panning is observed to all bus formats, so a channel routed to both a 5.1.4 bus and a stereo bus will pan correctly to both. When bus routing involves downmixing, two foldown options are available per path.

Two panning modes per path are possible, XYZ and ThetaPan. Both panning modes allow point source signals to be positioned in a 3D space, but also incoming or sub mixed multi-channel signals to be manipulated and then positioned. Examples we have seen used include an ORTF 3D mic or Hamazaki square arrangement in venues and stadiums, brought into appropriate format channels, perhaps reducing Width, Depth, and Height (where applicable). This results in being able to use Pan, Front/Rear and Bottom/Top controls to positions the resulting signal.

XYZ Panning

For XYZ panning the traditional XY (e.g. 5.1) Pan LR, width, divergence and depth controls are expanded to include btm/top and height controls in the Z domain.



Pan moves a mono signal left and right. For signals with left and right components, pan is progressively proportional to the width parameter.

Width is available when both the channel and bus have left and right components. The control has a range of 100% to -100% reducing the width of a stereo signal to mono at 0%. As the width becomes negative the image is widened back to full stereo but inverted. For busses with a centre component, as the Width is reduced the mono component is redirected to the centre channel. A reversed image is indicated by the arrows in the display turning red. If Width is 100% or -100% the L/R Pan has no function. As Width is reduced, the L/R Pan acts as an image **offset**

by shifting the narrowed stereo image between the edges of the soundfield. If the Width is 0 (mono), the L/R Pan acts as conventional mono pan pot.

Divergence is available when the bus has left, right and centre components. As Divergence is increased, the centre channel is progressively added to the left and right busses, at the same time reducing the centre channel gain. 100% Divergence provides a true phantom stereo image. When the channel has left and right components, Divergence interacts with Width to determine whether the narrowed stereo image has a phantom or discrete centre component.

Frt/Rr is available when the channel or stem does not have a rear component and is routed to a bus which does. It acts as a surround panner moving the signal forwards and backwards in the soundfield.

Depth is available when both the channel or stem and bus have rear surround components. Depth acts as a differential balance control for the rear channels in relation to the front channels. As the Depth is reduced, the rear channels are proportionally added to the front channels while being attenuated in the rear channels. As with Width, the Frt/Rr pan progressively acts on the reduced soundfield.

F/R divergence is for the side speakers i.e. valid 7.1, 7.1.2 and 7.1.4 formats only, and determines the % of signal sent to the side speakers. 100% divergence is equivalent to 5.1, i.e. no signal is sent to the side speakers when the front/rear position is F50/50R, the signal is distributed 50/50 between the Front and Rear speakers. 0% divergence means that the side speakers receive the full signal at F50/50R position.

LF Gain is available when the bus has an LFE component, it provides a level control for the channel contribution to the LFE bus.

Btm/Top is available when the bus has height components, moving the signal up or down in the 3D sound field provided the channel or stem does not have a height component.

Height is used on channels and stems with a height component that are routed to busses with height components, i.e. the 5.1.2, 5.1.4, 7.1.2, 7.1.4 and 4.0.4 formats. It is equivalent to the Depth parameter that is used to collapse a 5.1 channel in the horizontal plane but Height acts in the vertical plane. As with Depth which collapses the sound field from the rear, the Height initial value is 100% and collapses the sound field from the top as it is reduced, eliminating the height component entirely at 0%. As with Width and Depth, Btm/Top becomes progressively active as the Height is reduced.

LF Only is available on any path with a format that does include an LF channel when routed to a bus with a format that does include an LF channel. Activating LF Only removes all contributions to the other busses leaving the path feeding the LF bus only via the LF Gain parameter. For stereo and above formats, the path legs are summed prior to feeding the LF Gain control.

ThetaPan

For ThetaPan, the user interface switches to rotational controls that elegantly spreads a mono point source across adjacent speakers without requiring complex multiple divergence controls. Additionally, it enables signals to be passed throughout the boundaries of the soundfield in a circular motion.

Angle rotates any signal between –180 and +180 degrees.

Spread is available for mono point sources; it spreads the signal across adjacent speakers around a 360 degree circle.

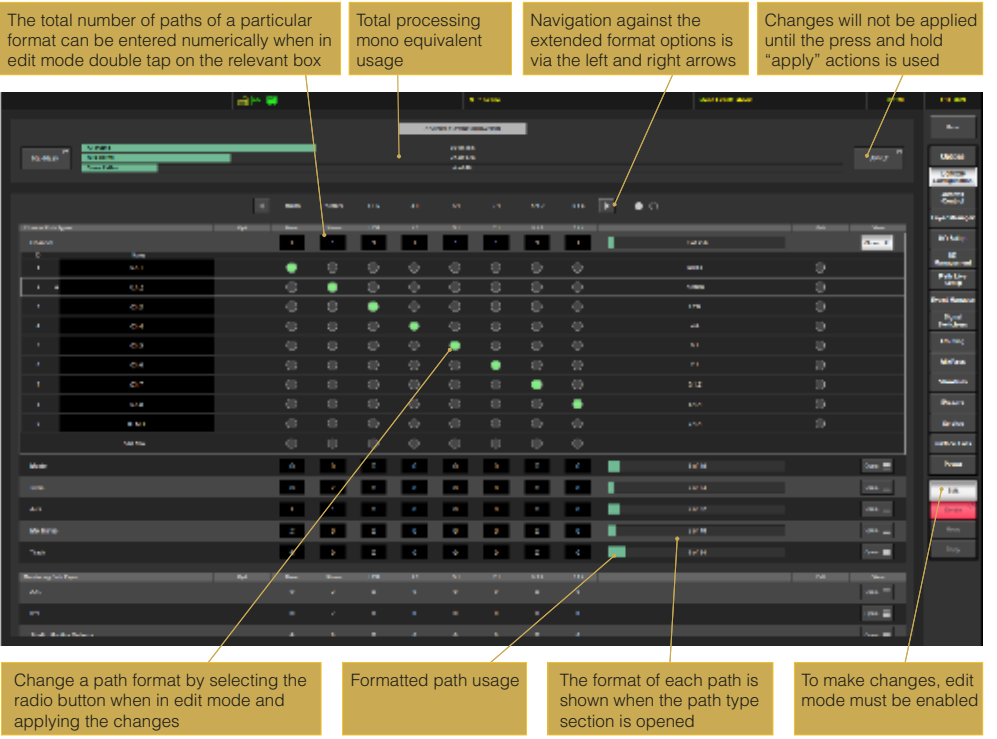
Width is available when the channel has a left and right component. Starting at 100% for 1:1 mapping, width can be reduced to focus signal, or increased to move signal away from the focused angle.

Btm/Top and Height controls in Theta pan have similar functionality to XYZ panning, manipulating the signal vertically within a cylindrical representation.



Console Configuration

The **Menu | Setup | Console Configuration** page allows System T's processing to be completely restructured for each show. At any time, additional path types can be added without interruption to audio currently being processed by the console. The total number of mono equivalent processing paths depends on the Tempest Engine & Processing pack specified (e.g. TE2(P5) - 800 or TE1(P2) - 256). Path formats of mono, stereo, LCR, 4.0, 5.1, 5.1.2, 5.1.4, 7.1, 7.1.2, 7.1.4 and 4.0.4 are available for all channels and bus types. There are total numbers of each bus type, but these are formatted busses, not mono equivalents. For example, eight 5.1.4 master busses would use 8 of the 16 master busses available, 80 of the 192 “bus paths” and 80 of the 800 “all paths” processing (on a TE2 (P5)).



Path Metering



Channel View and S500 meterbridge path meters support all the path formats.

Monitor Section

The System T monitor section shares many functions that will be familiar to SSL users on previous generation audio consoles, but expanded to include support for multiple 12 channel outputs, formatted up to 7.1.4.

Monitor section key features:

- Up to 12 channels to support 7.1, 5.1.2, 5.1.4, 7.1.2, 7.1.4 and 4.0.4 monitor formats.
- 4 sets of monitor speakers: two sets of 12 channel Monitor outputs plus two sets of stereo nearfield outputs
- Additional Stereo PFL Monitor Output
- Dual 12 channel monitor insert points
- 2x 24 external sources selectors + primary input: 49 12 Channel Monitor Inputs
- External Source selector outputs available as routable sources
- Individual level and delay compensation for both main monitor outputs
- Individual level compensation for both alt outputs
- Individual polarity invert on all speaker outputs
- Simultaneous monitoring of two independent program feeds
- Active Solo Insert and Alt Stereo Monitor override
- 7.1.4 to stereo fold down



A **Solo Cancel** feature is included in **Setup | Options | Monitor**. Solo Cancel is primarily for use with immersive audio formats where the outputs of an external monitor format rendering unit will be returned via the insert points. Enabling Solo Cancel ensures the console AFL or PFL bus can be heard directly from the monitors, bypassing any rendering unit. The **Alt Return** monitor option also can also be overridden by an active solo, so that it can be used for monitoring a stereo mix when simultaneous 5.1 and Stereo mixes are being generated via separate master buses.

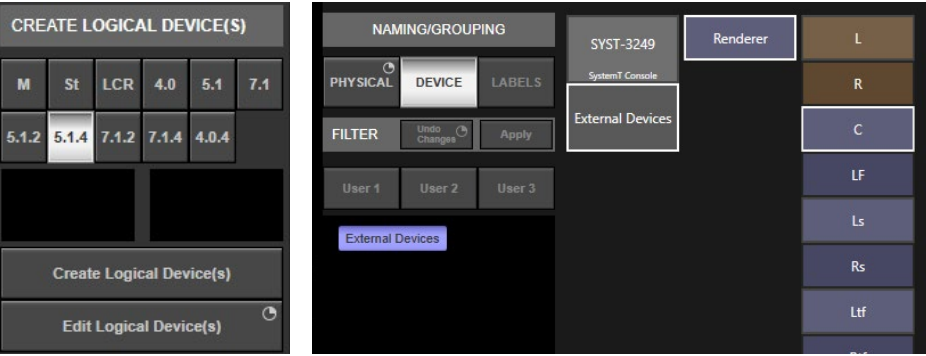
Fold Down



Main and alternate fold down coefficients are available, including controls for the side and top channels mean that standard 5.1, stereo and mono mixes include the precise amount of overhead or side contribution simply by routing the immersive channel or stem to a 5.1, stereo or mono bus. This greatly simplifies the process of simultaneously providing immersive and standard 2D program feeds.

The alternate fold down coefficients can be enabled per path via the Eyeconix Detail view on Channels and Stems, in the Monitor section Misc Pop out, and on the small screen Monitor page. The fold down choice applies to all busses the channel or stem are routed to that have a lower channel format than themselves.

Immersive I/O Management



I/O management, grouping, tagging, and routing of immersive formats is handled in the same way as any other format.

Effect Rack Processing

In addition to all the standard path processing (EQ, Filters, Dynamics 1, Dynamics 2, Delay) including up to 7.1.4 processing, the Effect rack includes immersive format versions of the Bus Compressor, Multiband Compression, Enhancer, Dynamic EQ, G-Flex EQ, All Pass Filter, De-Noiser, Summing Module and others. The Effects rack includes additional tools such as matrix mixers that can be used for additional downmixes, plus loudness and true peak meters.

Ambisonics

The onboard ambisonic 360 transcoder effect unit takes A or B format inputs and renders to a wide range of multichannel outputs from 4.0 to 7.1.4. Included A-B conversion for the Sennheiser AMBEO VR Mic directly outputs the processing-ready B-format for rendering to multichannel, allowing our clients to use the Ambeo VR Mic to add ambient sound quickly and simply for live immersive productions. The transcoder additionally provides decoding for a live VR mix or B format archive recording. Broadcast engineers will be able to record and process immersive content with far greater ease, and without the need for any additional physical equipment.

The input stage provides endfire, invert and rotate tools to accurately decode the signal based on the position and orientation of the microphone.

Zoom and tilt provide creative output tools. Tilt link locks the relative offset (originally 180) between front and rear tilt, until the end stop is reached when the offset is collapsed.

Enable centre channel only applies to output formats with a centre speaker, e.g.5.x (.y) and 7.x(.y), it provides the ability to not have the transcoder feed the centre speaker leaving a spatial gap in the ambient signal for increased intelligibility of dialogue if required.

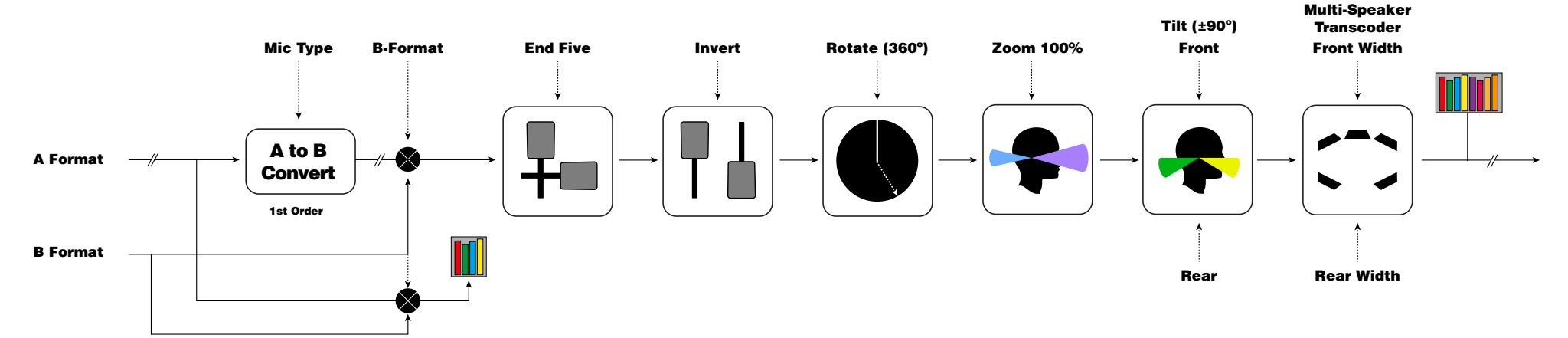
Input signal format selection. The routing key displays Ambisonics channel mapping.

Enables in-phase decoding, allowing the output to be downmixed without phase cancellation.

Speaker positions allow you to move the position of the virtual speakers used in the decoder.

Binaural Tools

The Binaural 3D Encoder effect unit expands System T's immersive and 3D audio toolkit. With input formats from 4.0 to 7.1.4, the binaural encoder provides the ability to monitor immersive beds for Dolby Atmos or MPEG-H via headphones where additional speakers are not available, or provide a stereo binaural feed for streaming purposes. The binaural 3D encoder currently uses the Sadie II HRTF dataset.



Audio Production Platform of Choice

When it comes to developing professional audio solutions our philosophy at Solid State Logic is clear; to create production tools that have the right feature set for the specific task at hand, and System T is testament to that. As broadcast production workflows continue to evolve, the expansive power and flexibility of the System T platform has allowed us to work closely with customers to meet their needs. So as the demand for more engaging and dynamic audio content increases, System T is perfectly placed to meet future immersive audio production requirements.

Find out more with a personalised demonstration on how SSL solutions can help transform your audio production workflow. Please contact our team via our regional offices or head to www.solidstatellogic.com/broadcast for more information.



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