



Application Note

Synaptics Sound Stage Expansion for Headphones

Abstract: This document describes the Synaptics Sound Stage Expansion algorithm for headphones, supported by the Synaptics CAPE DSP engine.

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1. Overview

Synaptics offers a range of playback audio experiences using advanced digital signal processing (DSP) algorithms.

The Synaptics Sound Stage Expansion (3D Spatializer) algorithm enhances the stereophonic headphone listening experience by digitally manipulating the left and right channels of an incoming stereo audio stream to create a 3D-like experience with a wider-than-normal sound stage.



Figure 1. Normal Sound Stage



Figure 2. Synaptics Enhanced Expanded Sound Stage

This algorithm is supported by the Synaptics CAPE DSP engine.

The 3D Spatializer creates the perception that playback audio originates from locations outside the headphones or loudspeakers. It enhances stereo input by digitally processing the original left and right channels.

The module supports two operating modes:

- **Phantom Speaker mode**
- **3D Immersion mode** (reserved mode; unavailable)

If the input audio is monophonic, no processing is applied.

1.1. SPATIAL_CMD_PARAMS

The command data consists of one `SpatialParam` structure containing:

- `int32_t mode` – Operation mode. 0 = Phantom Speaker mode.
- `int32_t delay_phantom` – Delay used by the algorithm, specified in samples. The maximum value is 16; the default is 4.
- `q23_t input_spread` – Controls the spread of the sound field.
- `q23_t gain_phantom` – Controls the gain of the phantom signal mixed into the main signal.

```
golem::sendcmd <APP> <module> SPATIAL_CMD_SET_PARAMS \
                                {<mode>, <delay>, <spread>, <gain>}
golem::sendcmd <APP> <module> SPATIAL_CMD_GET_PARAMS {}
```

The valid range for spread is:

```
[0 .. 0.99]
```

The valid range for gain is:

```
[0 .. 0.99]
```

1.2. Module Control Commands

The following commands to control the Sound Stage Expansion are:

- **Disable:**

```
golem::sendcmd PLBK 2 MODULE_CMD_SET_ACTIVE {0}
```

- **Activate:**

```
golem::sendcmd PLBK 2 MODULE_CMD_SET_ACTIVE {1}
```

1.3. Example Tuning Command

The tuning parameters are set by:

```
golem::sendcmd PLBK 2 SPATIAL_CMD_SET_PARAMS  
{0, 4, (q23_t)0.875, (q23_t)0.58}
```

Using the Synaptics Audio Station (SAS) tool, users can tune these parameters together with the playback equalizer to achieve the desired sound state expansion effect.

Note that the Sound Stage Expansion algorithm modifies the playback frequency response. Therefore, equalizer (EQ) tuning is a necessary step to achieve the desired playback audio performance.

Synaptics Product Applications Engineers are available to assist with tuning and optimization to help ensure project success.

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2. Revision History

Revision	Description
A	Initial release.

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PN: 506-001683-01 Rev A

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