

## PORTABLE CONSUMER CODEC LOW-POWER, HIGH-FIDELITY INTEGRATED CODEC

## TSCS25xx

### DESCRIPTION

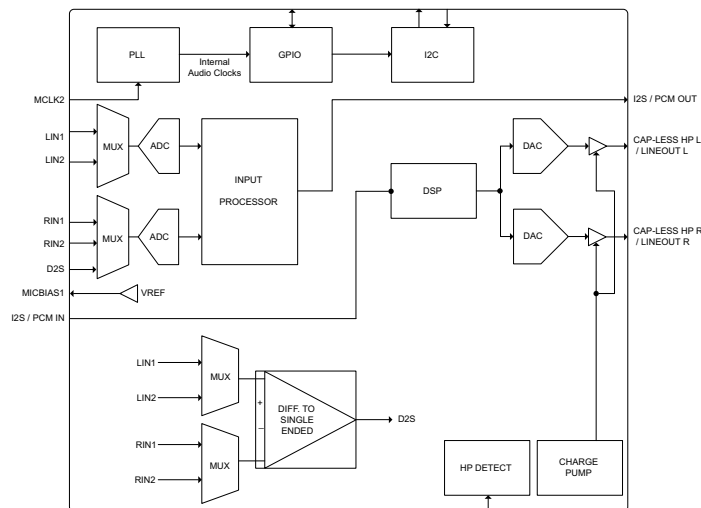
The TSCS25xx is a low-power, high-fidelity integrated CODEC with 32-bit stereo playback stereo record functionality. In addition to a high-fidelity low-power CODEC, the device integrates stereo true cap-less headphone amplifiers.

The digital audio data ports (both input and output) work in both master or slave mode and supports all common digital audio formats for Linear PCM including I2S, Left-Justified, and Right-Justified and as well as direct Bluetooth PCM mode.

Beyond high-fidelity for portable systems, the device offers an enriched “audio presence” through built-in audio output processing (AOP) DSP engine. The AOP supports 12 Bands of EQ, Psychoacoustic Bass and Treble enhancement, 3D stereo enhancement and Wideband Dynamic Range controller to support pro-style Multi-band Compressor / Limiter / Expander capability with independent time and frequency domain parameter adjustability.

### APPLICATIONS

- **Lightning and USB-C to 3.5mm Adapters**
- **Lightning and USB-C Connected Headsets**
- **Wi-Fi / Bluetooth Headsets**
- **VR / AR / MR Headsets**



### FEATURES

- **On-chip true cap-less headphone driver**
  - 35 mW output power (16Ω)
  - Charge-pump allows true, ground-centered outputs
  - SNR (A-Weighted, no active signal) -124dB
  - Headphone detection logic
- **High-fidelity CODEC**
  - 32-bit stereo DAC and 32-bit stereo ADC
  - Sample rates from 8 kHz to 96 kHz
- **Audio Output Processing DSP Engine**
  - 3D stereo enhancement
  - 12-band stereo parametric equalizers
  - Wideband Dynamic Range Controller
  - Multiband Pro-style Dynamic Range Compressor / Limiter / Expander
    - Independent attack / release and gain
  - Psychoacoustic Bass and Treble enhancement processing
- **Microphone / line-in interface**
  - Analog microphone or line-in inputs
  - Automatic level control
- **Low power with built-in power management**
  - 1.7 V CODEC supports 1Vrms
  - Very low standby and no-signal power consumption
  - 1.8V digital / 1.7V analog supply for low power
- **2-wire (I<sup>2</sup>C compatible) control interface**
- **Flexible Digital Audio Data Interface**
  - Supports Bluetooth PCM
    - Adjustable Frame Length
    - Selectable Frame Sync
    - Flexible word lengths (16, 24, 32-bit)
  - Supports Linear PCM
    - Format Support (I2S, Left-Justified, Right-Justified)
    - Flexible word lengths (16, 24, 32-bit)
- **Package**
  - 40-pin, 5x5mm, QFN

### PART NUMBER

TSCS25A3X1NDGXZAX	Analog Microphone
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# TSCS25xx

## Portable Consumer CODECs

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### AUDIO OUTPUTS

The TSCS25xx provides outputs for analog sound. Audio outputs include:

- A line-out / capless stereo headphone port with ground referenced outputs, is capable of driving headphones without requiring any external DC blocking capacitors.
- Constant output power mode maintains output volume even with a dropping battery supply voltage.

Each endpoint features independent volume controls, including a soft-mute capability which can slowly ramp up or down the volume changes to avoid unwanted audio artifacts.

The TSCS25xx output signal paths consist of digital filters, DACs and output drivers. The digital filters and DACs are enabled when the TSCS25xx is in 'playback only' or 'record and playback' mode. The output drivers can be enabled or disabled independently under register control.

The digital filter and audio processing block processes the data to provide volume control and numerous sound enhancement algorithms. Two high performance sigma-delta audio DACs convert the digital data into analog.

The digital audio data is then converted to oversampled bit streams using digital interpolation filters, which then enters the sigma-delta DACs, and become converted to high-quality analog audio signals.

To enhance the sound available from small, low-power speakers typically found in portable devices, the TSCS25xx provides numerous audio enhancement capabilities to help maximize the capabilities of the drivers and enclosure. The TSCS25xx features 24 independently programmable bands of parametric equalization using a variety of available filter types, allowing the system designer to provide an advanced system equalizer to accommodate the specific speakers and enclosure design. A multiband compressor / limiter features programmable attack and release thresholds, enabling the system designer to attenuate loud noise excursions to avoid speaker artifacts, thus allowing the underlying content to be played at a louder volume without distortion. For compressed audio sources, a multiband expander is available to help restore the dynamic range of the original content. A stereo depth "3D" enhancement algorithm allows common left/right content (e.g. dialog) to be attenuated separately from other content, providing a perceived depth separation between background and foreground audio. Psychoacoustic bass enhancement and high-frequency restoration enhancement algorithms help achieve a sound that is rich, full tone with incredible detail even from originally compressed content, using speakers that have a limited frequency response, especially at the low-end.



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