

## 8-CHANNEL HIGH\_QUALITY LOW-POWER AUDIO CODEC FOR PORTABLE APPLICATIONS

Check for Samples: [TWL6040](#)

### FEATURES

- Four audio digital-to-analog (DAC) channels
  - Stereo capless headphone drivers:
    - Up to 104-dB DR
    - Power tune for performance/power consumption tradeoff
  - Stereo 8  $\Omega$ , 1.5 W per channel speaker drivers
  - Differential earpiece driver
  - Stereo line-out
  - Two audio analog-to-digital (ADC) channels:
    - 96-dBA SNR
  - Four audio inputs:
    - Three differential microphone inputs
    - Stereo line-in/FM input
  - Two vibrator/haptics feedback channels:
    - Differential H-bridge drivers
  - Two low-noise analog microphone bias outputs
  - Two digital microphone bias outputs
  - Analog low-power loop from line-in to headphone/speaker outputs
  - Dual phase-locked loops (PLLs) for flexible clock support:
    - 32-kHz sleep clock input for system low-power playback mode
    - 12-/19.2-/26-/38.4-MHz system clock input
- Accessory plug/unplug detection, accessory button press detection
  - Integrated power supplies:
    - Negative charge pump for capless headphone driver
    - Two low dropout voltage regulators (LDOs) for high power supply rejection ratio (PSRR)
  - I<sup>2</sup>C control
  - Thermal protection:
    - Host interrupt
  - Power supplies:
    - Analog: 2.1 V
    - Digital I/O: 1.8 V
    - Battery 2.3 to 5.5 V
  - Package 6-mm × 6-mm 120-pin PBGA

### APPLICATIONS

- Mobile and smart phones
- MP3 players
- Handheld devices

PRODUCT PREVIEW



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## DESCRIPTION

The TWL6040 device is an audio coder/decoder (codec) with a high level of integration providing analog audio codec functions for portable applications, as shown in [Figure 1](#). It contains multiple audio analog inputs and outputs, as well as microphone biases and accessory detection. It is connected to the OMAP4™ host processor through a proprietary PDM interface for audio data communication enabling partitioning with optimized power consumption and performance. Multichannel audio data is multiplexed to a single wire for downlink (PDML) and uplink (PDMUL).

The OMAP4 device provides the TWL6040 device with five PDM audio-input channels (DL0–DL4). Channels DL0–DL3 are connected to four parallel DAC channels multiplexed to stereo headphone (HSL, HSR), stereo speaker (HFL, HFR), and earpiece (EAR) or stereo line outputs (AUXL, AUXR).

The stereo headphone path has a low-power (LP) mode operating from a 32-kHz sleep clock to enable more than 100 hours of MP3 playback time. Very-high dynamic range of 104 dBA is achieved when using the system clock input and DAC path high-performance (HP) mode. Class-AB headphone drivers provide a  $1\text{-}V_{\text{rms}}$  output and are ground centered for capless connection to headphone, thus enabling system size and cost reduction. The earpiece driver is a differential class-AB driver with  $2\text{-}V_{\text{rms}}$  capability to a typical 32- $\Omega$  load or  $1.4\text{-}V_{\text{rms}}$  to a typical 16- $\Omega$  load.

Stereo speaker path has filterless class-D outputs with 1.5-W capability per channel. For output power maximization supply connection to an external boost is supported. Speaker drivers also support also hearing aid coil loads. For vibrator and haptic feedback support, the TWL6040 has two PWM channels with independent input signals from DL4 or inter-integrated circuit (I<sup>2</sup>C™).

Vibrator drivers are differential H-bridge outputs, enabling fast acceleration and deceleration of vibrator motor. An external driver for a hearing aid coil or a piezo speaker requiring high voltage can be connected to line outputs.

The TWL6040 supports three differential microphone inputs (MMIC, HMIC, SMIC) and a stereo line-input (AFML, AFMR) multiplexed to two parallel ADCs. The PDM output from the ADCs is transmitted to the OMAP4 processor through UL0 and UL1. AFML, AFMR inputs can also be looped to analog outputs (LB0, LB1).

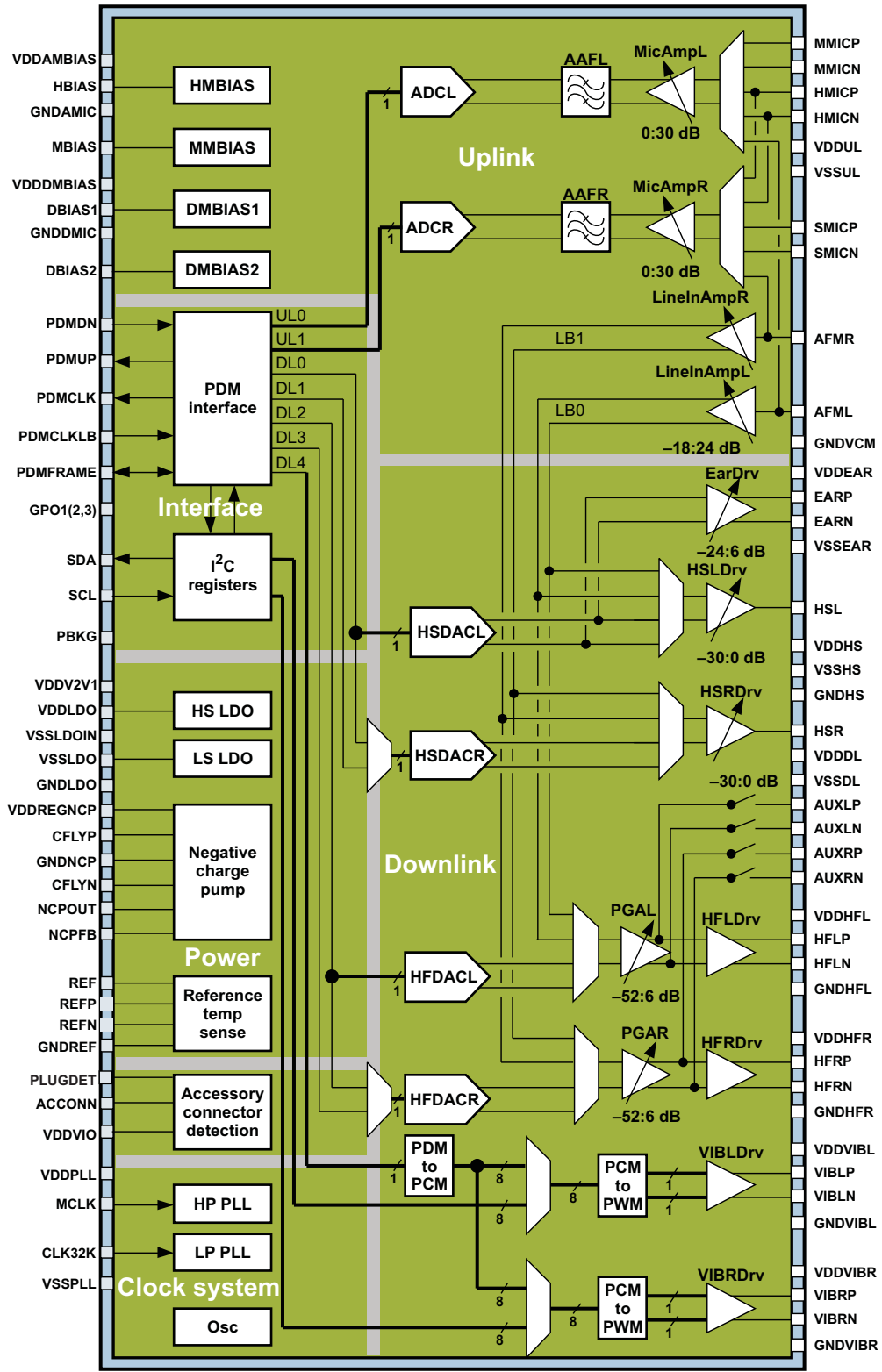
Two LDOs provide a voltage of 2.1 V to bias analog microphones (MBIAS and HBIAS). The maximum output current is 2 mA for each analog bias, allowing up to two microphones on one bias. Two LDOs provide a voltage of 1.8 V/1.85 V to bias digital microphones (DBIAS1 and DBIAS2). One bias generator can bias up several digital microphones at the same time, with a total maximum output current of 10 mA.

The TWL6040 has an integrated negative charge pump (NCP) and two LDOs (HS LDO and LS LDO) for high PSRR. The only external supply needed is 2.1 V, which is available from the 2.1-V DC-DC of the TWL6030 power management IC (PMIC) in the OMAP4 system. By powering audio from low-noise 2.1-V DC-DC of low power consumption, high dynamic range and high output swing at headset output are achieved. All other supply inputs can be directly connected to battery or system 1.8-V I/O.

Two integrated PLLs enable operation from a 12/19.2/26/38.4-MHz system clock (MCLK) or, in LP playback mode, from a 32-kHz sleep clock (CLK32K). The frequency plan is based on a 48-kS/s audio data rate for all channels, and host processor uses sample-rate converters to interface with different sample rates (for example, 44.1 kHz). In the specific case of low-power audio playback, the 44.1-kS/s and 48-kS/s rates are supported by the TWL6040. Transitions between sample rates or input clocks are seamless.

Accessory plug and unplug detections are supported (PLUGDET). Some headsets have a manual switch for submitting send/end signal to the terminal through the microphone input pin. This feature is supported by a periodic accessory button press detection to minimize current consumption in sleep mode. Detection cycle properties can be programmed according to system requirements.

[Figure 1](#) shows a simplified block diagram of the device.



SWCS044-001

Figure 1. Simplified Block Diagram

PRODUCT PREVIEW

**For the complete TWL60xx data sheet, contact your TI sales representative. The document is internally available for download on ESP under the corresponding TWL60xx product folders and can be shared with customers.**

**PRODUCT PREVIEW**

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Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TWL6040A2ZQZ	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	
TWL6040A2ZQZR	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	
TWL6040A3SRSZQZ	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	
TWL6040A3SRSZQZR	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	
TWL6040A3ZQZ	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	
TWL6040A3ZQZR	ACTIVE	BGA MICROSTAR JUNIOR	ZQZ	120	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	

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**TBD:** The Pb-Free/Green conversion plan has not been defined.

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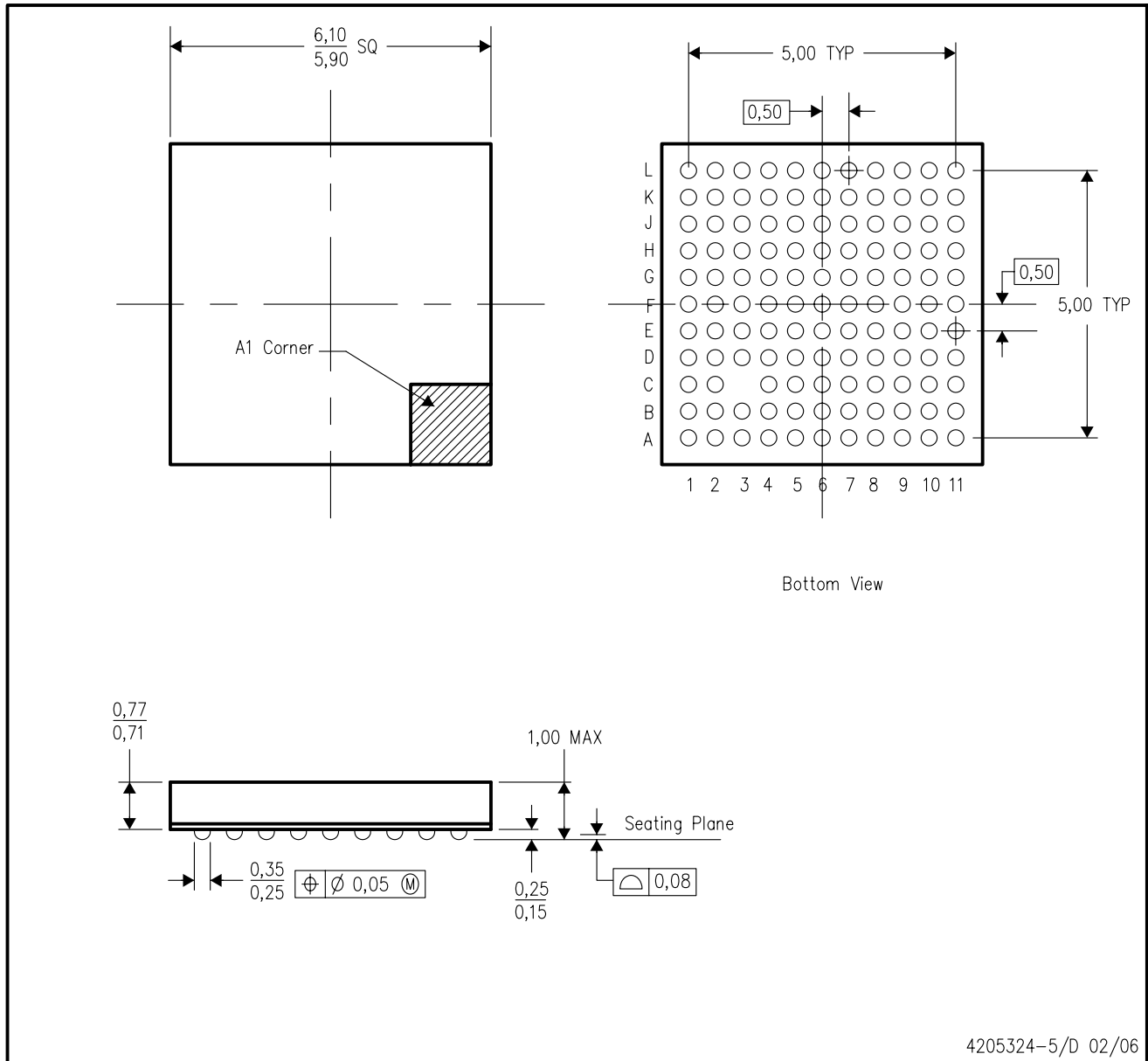
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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ZQZ (S-PBGA-N120)

PLASTIC BALL GRID ARRAY



- NOTES:
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  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225
  - D. This package is lead-free.



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Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
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Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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