

1. General Description

The AK4601 is an Audio HUB CODEC including 5ch ADC, 6ch DAC and digital mixers. The analog input block consists of a 24-bit stereo ADC with MIC gain amplifiers, a 24-bit stereo ADC with input selector and a monaural ADC, and the analog output block consists of 32-bit 6ch DAC. The transfer block for digital signals integrates serial interfaces that support TDM format and a Data BUS, realizing an audio HUB function. It gives scalability to the device for both analog and digital signals.

A car audio system that is capable of processing both sound and voice such as for hands-free function simultaneously can be realized by using the AK4601 with AKM's multi-core DSP, the AK7707. The AK4601 is available in a space saving 48-pin LQFP package.

2. Features

- **ADC1: 24-bit Stereo ADC with MIC Gain Amplifiers**
 - Sampling Frequency: $f_s = 8 \text{ kHz to } 192 \text{ kHz}$
 - Channel Independent Analog Gain Amplifiers
(0 to 18 dB / 2 dB Step, 18 to 36 dB / 3 dB step)
 - Differential Input or Single-ended Input
 - S/N: 106 dB ($f_s = 48 \text{ kHz}$, Differential Input, MIC Gain = 0 dB)
 - Channel Independent Digital Volume Control
(+24 dB to -103 dB / 0.5 dB Step and Mute)
 - Digital HPF for DC Offset Cancelling
 - 2 outputs Low Noise MIC Bias Supply
 - 4 types of Digital Filter for Sound Color Selection
- **ADC2: 24-bit Stereo ADC with Input Selector**
 - Sampling Frequency: $f_s = 8 \text{ kHz to } 192 \text{ kHz}$
 - Analog Input Selector: Differential Input $\times 1$ or Single-ended Input $\times 2$,
Semi-Differential Input $\times 1$
 - S/N: 106 dB ($f_s = 48 \text{ kHz}$, Differential Input)
 - Channel Independent Digital Volume (+24 dB to -103 dB / 0.5 dB Step and Mute)
 - Digital HPF for DC Offset Cancelling
 - 4 types of Selectable Digital Filters for Sound Color
- **ADCM: 24-bit Monaural ADC**
 - Sampling Frequency: $f_s = 8 \text{ kHz to } 192 \text{ kHz}$
 - Differential Input or Single-ended Input
 - S/N: 106 dB ($f_s = 48 \text{ kHz}$, Differential Input)
 - Digital Volume (+24 dB to -103 dB / 0.5 dB Step and Mute)
 - Digital HPF for DC Offset Cancelling
 - 4 types of Selectable Digital Filters for Sound Color
- **DAC1-3: 32-bit Stereo DAC**
 - Sampling Frequency: $f_s = 8 \text{ kHz to } 192 \text{ kHz}$
 - Single-ended Output
 - S/N: 108 dB ($f_s = 48 \text{ kHz}$)
 - Channel Independent Digital Volume Control
(+12 dB to -115 dB / 0.5 dB Step and Mute)
 - 4 types of Selectable Digital Filters for Sound Color

- **Serial IF: Audio Serial Interface:**
 - Support TDM and Stereo
 - Data Input: max 20 ch (16 ch Serial × 1 pin, 2 ch × 2 pins) when TDM
 - Data Output: max 20 ch (16 ch Serial × 1 pin, 2 ch × 2 pins) when TDM
 - LRCK/BICK Input/Output x 2 Lines
 - Data Format: MSB justified, LSB justified, I²S
 - PCM Short / Long Frame Supported
- **Mixer A, B: 2 stereo Input / 1 stereo Output Digital Mixer**
- **Vol1–3: Channel Independent Stereo Digital Volume (+12 dB to –115 dB / 0.5 dB Step and Mute)**
- **μP Interface:**
 - SPI (max. 7 MHz)
 - I²C-bus (max. 1 MHz: Fast Mode Plus, max.400 kHz: Fast mode)
- **Power Supply:**
 - Analog AVDD: 3.0 V to 3.6 V (typ. 3.3 V)
 - Digital Core LVDD: 3.0 V to 3.6 V (typ. 3.3 V) (3.3 V → 1.2 V LDO integrated)
 - Digital I/F TVDD: 1.7 V to 3.6 V (typ. 3.3 V)
- **Operating Temperature Range: –40 °C to 85 °C**
- **Package: 48-pin LQFP (7 mm × 7 mm, 0.5 mm pitch)**

3. Block Diagram and Functions

3.1. Block Diagram

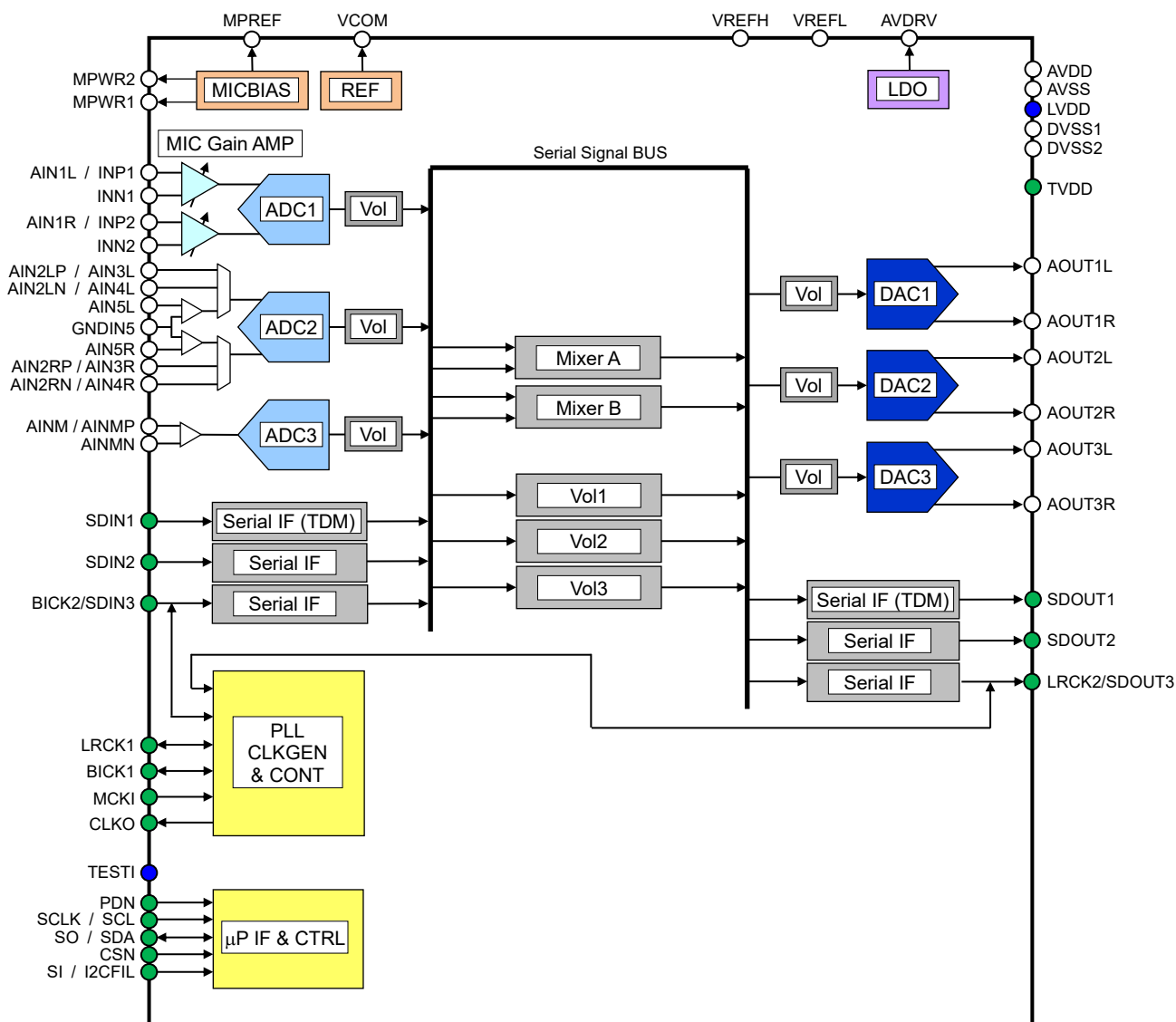


Figure 1. Block Diagram

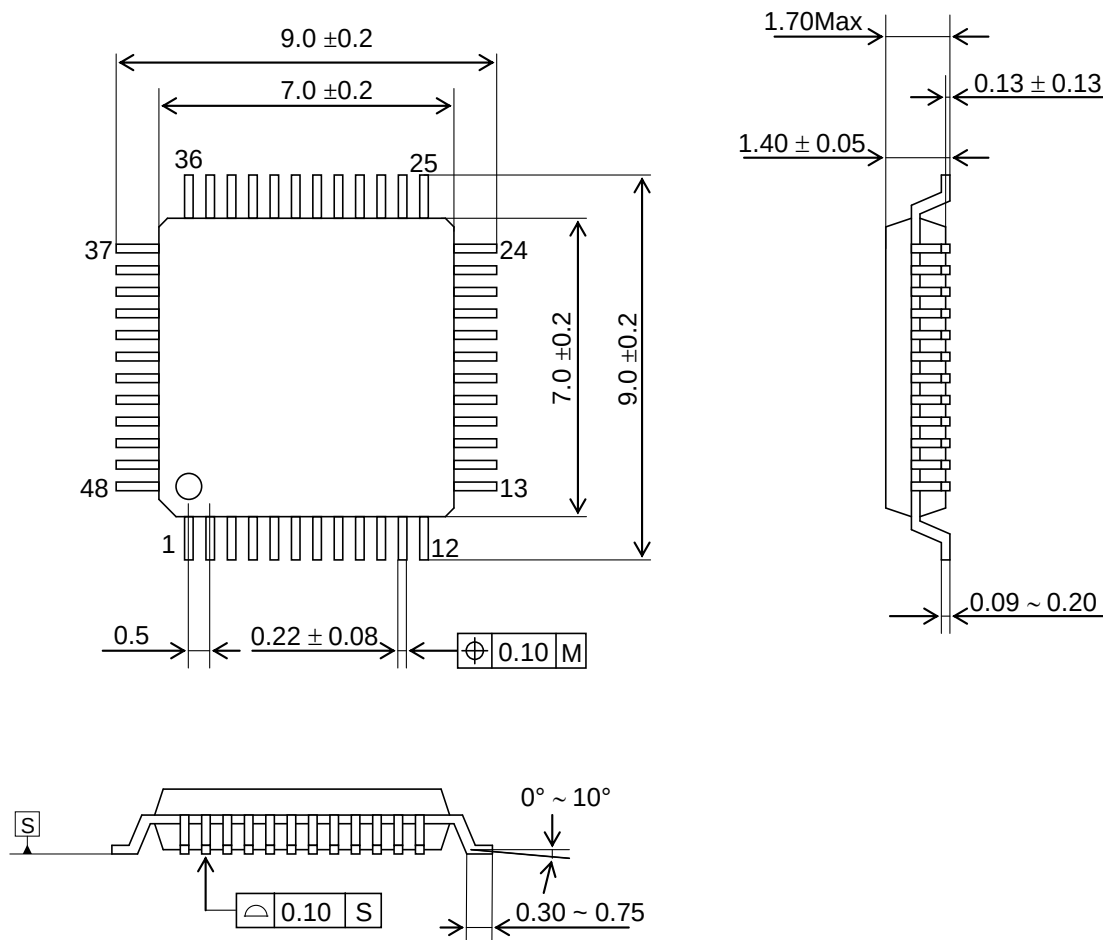
3.2. Functions

Block	Function
REF	Generates internal reference voltage.
MICBIAS	Generates bias voltage for microphone.
MIC Gain AMP	Amplifies analog input signal.
ADC1, ADC2, ADCM	Convert analog signal to digital data.
Vol, Vol1-3	Adjust the level of the digital audio signal.
Mixer A, Mixer B	Mix digital audio signals.
DAC1-3	Convert digital data to analog signal.
LDO	Generates a power supply voltage of 1.2V (typ.) for internal logic circuits.
Serial IF	Communicate digital audio signals with external devices.
PLL, CLKGEN&CONT	Generates an internal operating clock based on the external clock.
μP IF&CTRL	SPI / I ² C interface and control registers.

4. Package

4.1. Outline Dimensions

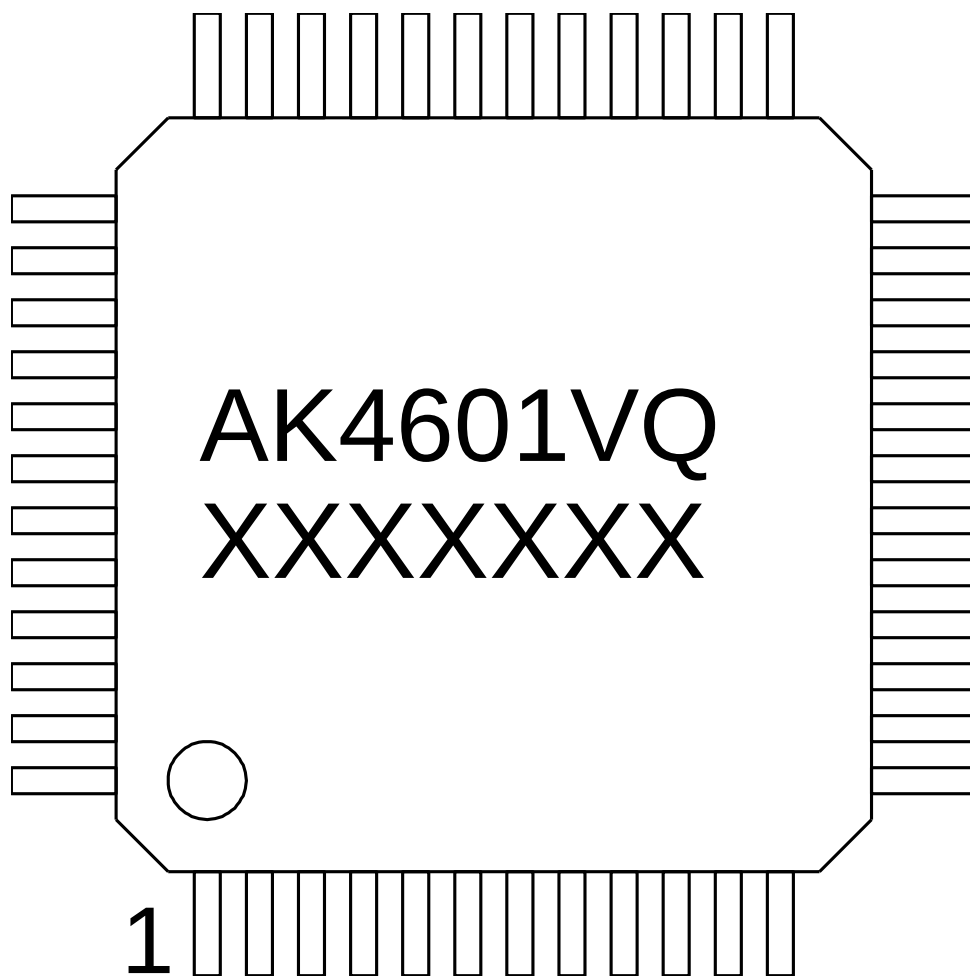
48pin LQFP(Unit: mm)



4.2. Material and Lead Finish

Package: Epoxy
 Lead frame: Copper
 Pin surface treatment: Soldering (Pb free) plate

4.3. Marking



- 1) Pin #1 indication
- 2) Date Code: XXXXXXX (7 digits)
- 3) Marking Code: AK4601VQ
- 4) Asahi Kasei Logo

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