AKD5704-B
AK5704 Evaluation Board Rev.0

GENERAL DESCRIPTION
The AKD5704-B is an evaluation board for the AK5704, 4 channel 32bit ADC with built-in PLL and Mic Amplifier. The AKD5704-B also has the digital audio interface and can achieve the interface with digital audio systems via opt-co nector or USB.

Ordering Guide
AKD5704-B --- AK5704 Evaluation Board
(Control software is included in this package.)

FUNCTION
- Mini jack for analog input
- Digital audio Interface
  - DIT with optical output connector
  - USB audio interface with USB connector
- USB port for serial control interface

Figure 1. AKD5704-B Block Diagram
■ Power supply setting

(1) In case of using each power supply connectors (J1, J2) <Default>

Jumper pins setting

![Jumper pins setting diagram]

Power supply connection

Table 1. Power supply setting

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Color</th>
<th>Name</th>
<th>Supply voltage</th>
<th>Used by</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Red</td>
<td>VDD5V</td>
<td>+5V</td>
<td>Regulator</td>
</tr>
<tr>
<td>J2</td>
<td>Black</td>
<td>GND</td>
<td>0V</td>
<td>Ground</td>
</tr>
</tbody>
</table>

(2) In case of using each power supply connectors

Jumper pins setting

![Jumper pins setting diagram]

Power supply connection

Table 2. Power supply setting

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Color</th>
<th>Name</th>
<th>Supply voltage</th>
<th>Used by</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Red</td>
<td>VDD5V</td>
<td>Open</td>
<td>Regulator</td>
</tr>
<tr>
<td>J2</td>
<td>Black</td>
<td>GND</td>
<td>Open</td>
<td>Ground</td>
</tr>
</tbody>
</table>
Evaluation mode

1. Input setting
   (1) MEMS microphone input setting

AKD5704 can evaluate using microphones with MIC board. Please do not connect anything to 3, J4, J5, J6.

Connecting the board

Figure 2. AKD5704-B-SUB-MIC board connection diagram

Table 3. Correspondence table between MEMS microphone and AK5704 input pin

<table>
<thead>
<tr>
<th>MEMS microphone</th>
<th>AK5704 input pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>U101</td>
<td>AIN2B+//-</td>
</tr>
<tr>
<td>U102</td>
<td>AIN2A+//-</td>
</tr>
<tr>
<td>U103</td>
<td>AIN1B+//-</td>
</tr>
<tr>
<td>U104</td>
<td>AIN1A+//-</td>
</tr>
</tbody>
</table>
(2) **Analog input setting**

MEMS-MIC board should be removed in this evaluation mode.

(1-1) **When using mini jack (single-ended input)**

(1-2) **When using mini jack (differential input)**

(3) **Digital microphone input setting**

MEMS-MIC board should be removed in this evaluation mode. Please connect a digital microphone to the following test pin.

<table>
<thead>
<tr>
<th>Test Pin</th>
<th>Name</th>
<th>Corresponding ADC</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMDAT1</td>
<td>AIN1A+/DMDAT1</td>
<td>ADC1</td>
</tr>
<tr>
<td>DMCLK1</td>
<td>AIN1B+/DMCLK1</td>
<td>ADC1</td>
</tr>
<tr>
<td>DMDAT2</td>
<td>AIN2A+/DMDAT2</td>
<td>ADC2</td>
</tr>
<tr>
<td>DMCLK2</td>
<td>AIN2B+/DMCLK2</td>
<td>ADC2</td>
</tr>
</tbody>
</table>
2. Output setting

(1) When using S/PDIF optical output (OPT-OUT [PORT1])

Please connect an optical digital cable to PORT1.
System clock of AK5704 should be set to EXT Master Mode and BCLK=64fs.

A crystal of 24.576MHz is mounted on X1.
This setting is recommended for fs = 48kHz and MCLK = 256fs. When fs = 96 kHz and MCLK = 256 fs or fs = 192 kHz and MCLK = 128 fs, JP11 is set to “24.576”. When fs = 24 kHz and MCLK = 256 fs, JP11 is set to “6.144”. When fs = 12 kHz and MCLK = 256 fs, JP11 is set to “3.072”.

(2) When using USB digital output (USB-AUDIO [PORT2])

PORT2 is connected to the PC using USB cable, AK5373 is recognized by PC.
The sampling frequency must be set on the PC. Open the Microphone (AK5373) Properties, and select the sample rate from Default format on Advanced tab. USB audio supports 2ch, 16bit, 8kHz / 11.025kHz / 16kHz / 22.05kHz / 32kHz / 44.1kHz / 48kHz.
System clock of AK5704 should be set to EXT Slave Mode.

(3) Switch setting

S1(5373-PDN): Power down of AK5373
Fixed to “H” side.

S2(ROM-WR): Unused
Fixed to Left side.

S3(RESET): Power down of AK5704 and AK4104
Fixed to “H” side.
(4) **Other default setting**

**CL1(CAD):** Setting of AK5704 CAD pin
- **Open:** I2C Chip Address = 0 (default)
- **Short:** I2C Chip Address = 1

**CL2(MCLK-OFF):** Output enable/disable for crystal generator (X1)
- **Open:** Output Enable (default)
- **Short:** Output Disable
Control Software Manual

Evaluation Board and Control Software Settings

1. Set the evaluation board according to each evaluation mode and turn on the power supply.
2. Connect the evaluation board PORT3 (CONTROL) to the PC with a USB cable.
3. The USB controller is recognized as HID (Human Interface Device) on the PC.
4. Please launch the control software (AK5704.exe).
   If "AKDUSBIF - B" is not displayed at the bottom left and "No Port" is displayed, reconnect the PC and the USB cable and press the [InitPort] button.
5. Press the [PDN: L] button and confirm that the display changes to [PDN: H]. The reset of AK5704 and AK4104 is released.

Figure 3. Window of Control Soft
**Operation Overview**

Function and Register map are controlled by this control software. These controls may be selected by the upper tabs.

Frequently used Buttons, such as the register initializing button “Write Default”, are located outside of the switching window.

1. [InitPort]: Reset the USB port on the main board. Please click this button when connected the PC and the USB controller after software start.

2. [CAD0/CAD1]: Control the CAD pin of AK5704.
   (To control CAD pin with control software, switch JP48 setting to "PIC")

3. [Write Default]: AK5704 register initialization.

4. [All Read]: Executes read commands for all AK5704 registers displayed.

5. [All Write]: Executes write commands for all AK5704 registers displayed.

6. [Script Save]: Save the script with the current setting.

7. [Read]: It reads the current register and displays "Address: Read value" in the display field at the bottom of "Address: Data". Unlike the [All Read] button, only hexadecimal display is performed and it is not reflected in the register map.

8. [Init Board]: Reset the AK5704 and initialize the AK5704 register.

9. [PDN:H]: Control the PDN pin of AK5704 and AK4118A.
   (PDN:H → PDN pin = “H”, PDN:L → PDN pin = “L”)

10. [Close]: Exit the control software.
Tab functions

(1) [MainFunc] Tab: Function Control

Pressing each block in the window opens the setting window for that block. The displayed selector can be selected directly. With the three function buttons at the top of the window, execute the sequence processing of the function described on the button.

Figure 4. [MainFunc] Window

1: AVDD operation mode setting
2: Analog input/Digital Microphone input select (AIN1, AIN2)
3: Single-ended input/ Full-Differential input select (AIN1A, AIN1B, AIN2A, AIN2B)
4: Stereo/Mono select
5: SDTO2 output, TDMIN input select
6: Slave/Master select
7: PLL Clock Source (MCKI/BCLK) select
8: MCKI frequency select
9: BCLK output frequency select (Only Master Mode)
10: Sampling frequency select
11: Master Clock Rate select
12: Master Clock output select
13: Pull-down resistance of each pin Enable/Disable (BCLK, LRCK, TDMIN/SDTO2, MCKO, SDTO1)
14: Power Management of each block (PMAD1A, PMAD1B, PMAD2A, PMAD2B, PMPFIL1, PMPFIL2, PMVAD, PMPLL)
(1-1) ADC, MIC Gain Setting

On the [MainFunc] screen, pressing the MicGain block opens the [ADC, MIC Gain Setting] screen. Power up / down of MIC Gain, ADC, Digital MIC and related settings are controlled.

AVDD internal operation mode on the [MainFunc] screen should be set before power up of the ADC.

![Image of ADC, MIC Gain Setting](image)

Figure 5. [ADC, MIC Gain Setting] Window
(1-2) Digital Function Setting


Figure 6. [Digital Function Setting] Window
(1-3) Mixer, HPF, LPF Setting

On the [MainFunc] screen, pressing the MIX1, MIX2, HPF1/LPF1 or HPF2/LPF2 block opens the [Mixer, HPF, LPF Setting] screen. Mixer, power up/down of Programmable Filter (HPF, LPF) and various settings are controlled.

PFTHR1/2 and PFSDO1/2 bits can be switched directly from the [MainFunc] screen.

Figure 7. [Mixer, HPF, LPF Setting] Window
(1-4) ALC Setting

On the [MainFunc] screen, pressing the ALC1 or ALC2 block opens the [ALC Setting] screen. Power up/down of Programmable Filter and ALC settings are controlled.

Figure 8. [ALC Setting] Window
(1-5) VAD Setting

On the [MainFunc] screen, pressing the VAD or VAD Delay block opens the [VAD Setting] screen. Power up/down of VAD and related settings are controlled.

VADSEL, VAS/VBS and VADOE bits can be switched directly from the [MainFunc] screen.
(1-6) Audio I/F Setting

On the [MainFunc] screen, pressing the Audio I/F block opens the [Audio I/F] screen. Audio I/F settings are controlled.

![Audio I/F Setting Window](image)

Figure 10. [Audio I/F Setting] Window
(2) [Script] Tab: Function Control

This is the tab for executing the script file. If the [Refer] button is pressed and the script file is selected, the program is executed automatically. By pressing the [Repeat] button, the selected script file will be executed once again.

![Figure 11. [Script] Window]

<table>
<thead>
<tr>
<th>Command</th>
<th>Notation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SCRIPT]</td>
<td>-</td>
<td>Header of script file. A data error will be detected without this header.</td>
</tr>
<tr>
<td>; Comment</td>
<td>-</td>
<td>The line following to &quot;;&quot; is recognized as comment and ignored.</td>
</tr>
<tr>
<td>RI:H or RI:L</td>
<td>H or L</td>
<td>Control the PDN pin. RI:H: Reset release (PDN pin = “H”) RI:L: Reset (PDN pin = “L”)</td>
</tr>
<tr>
<td>T, &lt;wait&gt; ex) T, 50ms</td>
<td>base 10 (DN)</td>
<td>Set a waiting time. 50msec wait.</td>
</tr>
<tr>
<td>W:&lt;address&gt;, &lt;data&gt;</td>
<td>base 16 (HEX)</td>
<td>Register write is executed. Address: 1 byte Date: 1 byte</td>
</tr>
</tbody>
</table>
(3) [RegMap] Tab: Register Map

This tab is for register read and write.

Each bit of the register map is a push button, and the register is updated at the time of pressing.

“1”: Indicate in red letters.
“0”: Indicate in blue letters.

The register which are not defined in the datasheet are indicated "- -".

![Register Setting](image)

Figure 12. [RegMap] Window

n0H-nFH (n = 0 ~ 4): Moves to the address map in the displayed range.
Write: Select the [Write] button located on the right of the each corresponding address when changing two or more bits on the same address simultaneously.
Read: Click the [Read] button located on the right of the each corresponding address to execute a register read. The current register value will be displayed in the register map.
Measurement Results

[Measurement Condition]
- Measurement unit: Audio Precision, SYS-2722
- Master Clock: 256fs (12.288MHz@48kHz, 24.576MHz@96kHz), 128fs (24.576MHz@192kHz)
- Sampling Frequency: 48kHz, 96kHz, 192kHz
- Resolution: 24bit
- Measurement Mode: External Master mode
- Power Supply: AVDD=3.3V (Regulator), TVDD=1.8V (Regulator)
- Input Signal: 1kHz (Sine wave)
- Measurement Frequency: 20 ~ 20kHz@48kHz, 20 ~ 40kHz@96kHz, 20 ~ 40kHz@192kHz
- Temperature: Room

[Measurement Results]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result</th>
<th>Unit</th>
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<tr>
<td>ADC Analog Input Characteristics: AIN1A+/AIN1A- pins (Single-ended Input) → ADC1 → SDTO1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGAIN = 0dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THD+N (-1dBFS)</td>
<td>fs=48kHz, BW=20kHz</td>
<td>-97.8</td>
</tr>
<tr>
<td></td>
<td>fs=96kHz, BW=40kHz</td>
<td>-95.7</td>
</tr>
<tr>
<td></td>
<td>fs=192kHz, BW=40kHz</td>
<td>-95.7</td>
</tr>
<tr>
<td>Dynamic Range (-60dBFS, A-Weighted)</td>
<td>104.5</td>
<td>104.5 dB</td>
</tr>
<tr>
<td>S/N (A-weighted)</td>
<td>104.5</td>
<td>104.5 dB</td>
</tr>
<tr>
<td>MGAIN = +18dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THD+N (-1dBFS)</td>
<td>fs=48kHz, BW=20kHz</td>
<td>-90.9</td>
</tr>
<tr>
<td></td>
<td>fs=96kHz, BW=40kHz</td>
<td>-89.6</td>
</tr>
<tr>
<td></td>
<td>fs=192kHz, BW=40kHz</td>
<td>-89.6</td>
</tr>
<tr>
<td>Dynamic Range (-60dBFS, A-Weighted)</td>
<td>-96.0</td>
<td>-95.9 dB</td>
</tr>
<tr>
<td>S/N (A-weighted)</td>
<td>-96.0</td>
<td>-95.9 dB</td>
</tr>
</tbody>
</table>
[Plot Data]

1. ADC1 (AIN1A+/AIN1B+ \rightarrow \text{ADC1} \rightarrow \text{SDTO1}) (0dB)

1-1. fs=48kHz

Figure 13. FFT (Input level= -1dBFS)

Figure 14. FFT (Input level= -60dBFS)

Figure 15. FFT (No Signal)
Figure 16. THD+N vs. Input Level

Figure 17. THD+N vs. Input Frequency

Figure 18. Linearity
Figure 19. Frequency Response

Figure 20. Crosstalk
1-2. $fs=96kHz$

Figure 21. FFT (Input level= -1dBFS)

Figure 22. FFT (Input level= -60dBFS)

Figure 23. FFT (No Signal)
Figure 24. THD+N vs. Input Level

Figure 25. THD+N vs. Input Frequency

Figure 26. Linearity
Figure 27. Frequency Response

Figure 28. Crosstalk
1-3. fs=192kHz

Figure 29. FFT (Input level= -1dBFS)

Figure 30. FFT (Input level= -60dBFS)

Figure 31. FFT (No Signal)
Figure 32. THD+N vs. Input Level

Figure 33. THD+N vs. Input Frequency

Figure 34. Linearity
Figure 35. Frequency Response

Figure 36. Crosstalk
2. ADC1 (AIN1A+/AIN1B+ → ADC1 → SDTO1) (+18dB)

2-1. fs=48kHz

Figure 37. FFT (Input level=-1dBFS)

Figure 38. FFT (Input level=-60dBFS)

Figure 39. FFT (No Signal)
Figure 40. THD+N vs. Input Level

Figure 41. THD+N vs. Input Frequency

Figure 42. Linearity
Figure 43. Frequency Response

Figure 44. Crosstalk
2-2. fs=96kHz

Figure 45. FFT (Input level= -1dBFS)

Figure 46. FFT (Input level= -60dBFS)

Figure 47. FFT (No Signal)
Figure 48. THD+N vs. Input Level

Figure 49. THD+N vs. Input Frequency

Figure 50. Linearity
Figure 51. Frequency Response

Figure 52. Crosstalk
2-3. fs=192kHz

Figure 53. FFT (Input level= -1dBFS)

Figure 54. FFT (Input level= -60dBFS)

Figure 55. FFT (No Signal)
Figure 56. THD+N vs. Input Level

Figure 57. THD+N vs. Input Frequency

Figure 58. Linearity
Figure 59. Frequency Response

Figure 60. Crosstalk
### Revision History

<table>
<thead>
<tr>
<th>Date (yy/mm/dd)</th>
<th>Manual Revision</th>
<th>Board Revision</th>
<th>Reason</th>
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