GENERAL DESCRIPTION

The AKD4462-SA is an evaluation board for the AK4462 (32-bit 2ch Premium DAC) that supports AV- Receivers, Network-Audios, USB-DACs, Car-Audio Systems. It integrates differential output low pass filters, allowing quick evaluation with digital audio interface.

Ordering guide

AKD4462-SA --- Evaluation board for AK4462VN
(Control software is packed with this board)

FUNCTION

- 3 type digital audio interface
  - COAX input
  - Optical input
  - External input
- Low Pass Filters (LPF) for Pre-amplifier Outputs
- 2ch Analog outputs
- USB Port for Serial control

Figure 1. AKD4462-SA Block Diagram
Board Diagram

Description

(1) Connector for Power supply
+12V, -12V, GND
Terminals for power supply. Refer to table1.

(2) LOUT, ROUT
RCA Connector for analog outputs.

(3) LDO : T601～T605
T601:AK1110AEU : AK4462AVDD, VREFH.
T602,T603:AP1158ADS,AP1152ADU40 : AK4462 TVDD.
T604,T605: AP1158ADS,AP1152ADU40 : AK4118A, other logic.

(4) U101
DAC : AK4462VN 32bit-2ch DAC.

(5) U301
AK4118A are Digital Audio I/F Transceivers.
(6) PORT30
   Coaxial input connector of the AK4118A.
   When using the PORT30: R304=0Ω,R302=Open (Default)

(7) PORT302
   Optical input connector of the AK4118A.
   When using the PORT302: R304=Open,R302=0Ω

(8) PORT303
   Pin header for connecting with external interface.
   MCLK,BICK/DLCK,LRCK/DSDL,SDTI/DSDR
   When using the PORT303: R310=R319=R312=R313 =51Ω,R306=R307=R309 =Open

(9) PORT501
   USB I/F port. The AK4462 can be controlled by a PC via USB port.

(10) PIC18F4550
    USB control chip.

(11) SW301
    Power down switch for AK4118A. Upside is “Hi”, downside is “Lo”.
    Refer to Table 2, SW301 setting.

(12) SW401
    Setting switch for AK4462. Upside is “Hi”, downside is “Lo”.
    Refer to Table 5, SW401 setting.

(13) SW402
    Power down switch for AK4462. Upside is “Hi (on)”, downside is “Lo (off)”.

(14) SW403
    Mute switch for AK4462.
    Push: AK4462 is mute
    Release: AK4462 is unmute

(15) SW404
    Power down switch for AK4118A. Upside is “Hi (on)”, downside is “Lo (off)”.

(16) OPAMP
    Differential input to single-ended output amplifier.
Operation sequence

[1] Set up power supplies
The power should be separated from the source of a power supplier.

<table>
<thead>
<tr>
<th>Name of connector</th>
<th>Color of connector</th>
<th>Voltage</th>
<th>Use application</th>
<th>Comment and attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>+12V</td>
<td>Red</td>
<td>+12V</td>
<td>LDO</td>
<td>Should always be connected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OP-Amp</td>
<td></td>
</tr>
<tr>
<td>-12V</td>
<td>Blue</td>
<td>-12V</td>
<td>OP-Amp</td>
<td>Should always be connected.</td>
</tr>
<tr>
<td>GND</td>
<td>Black</td>
<td>0V</td>
<td>GND</td>
<td>Should always be connected.</td>
</tr>
</tbody>
</table>

Table 1. Power supply line setting

[2] Switch setting
It should be set to match the mode.

(1) SW301 setting

<table>
<thead>
<tr>
<th>No.</th>
<th>Switch Name</th>
<th>Function</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DIF2</td>
<td>DIF2-pin of AK4118A.</td>
<td>Hi</td>
</tr>
<tr>
<td>2</td>
<td>DIF1</td>
<td>DIF1-pin of AK4118A.</td>
<td>Lo</td>
</tr>
<tr>
<td>3</td>
<td>DIF0</td>
<td>DIF0-pin of AK4118A.</td>
<td>Lo</td>
</tr>
<tr>
<td>4</td>
<td>OCKS1</td>
<td>OCKS1-pin of AK4118A.</td>
<td>Hi</td>
</tr>
<tr>
<td>5</td>
<td>OCKS0</td>
<td>OCKS0-pin of AK4118A.</td>
<td>Lo</td>
</tr>
</tbody>
</table>

Table 2. SW301 setting

<table>
<thead>
<tr>
<th>Mode</th>
<th>DIF2</th>
<th>DIF1</th>
<th>DIF0</th>
<th>SDTO</th>
<th>LRCK</th>
<th>BICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>H/L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16bit, Right justified</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>H/L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18bit, Right justified</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>H/L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20bit, Right justified</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>H/L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24bit, Right justified</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>H/L</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24bit, Left justified</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>L/H</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24bit, FS</td>
<td>64fs</td>
<td>O</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>H/L</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24bit, Left justified</td>
<td>64-128fs</td>
<td>I</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>L/H</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24bit, FS</td>
<td>64-128fs</td>
<td>I</td>
</tr>
</tbody>
</table>

Table 3. AK4118A Audio interface format

<table>
<thead>
<tr>
<th>OCKS1</th>
<th>OCKS0</th>
<th>MCK01</th>
<th>fs (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>256fs</td>
<td>96 kHz</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>256fs</td>
<td>96 kHz</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>512fs</td>
<td>48 kHz</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>128fs</td>
<td>192 kHz</td>
</tr>
</tbody>
</table>

Table 4. AK4118A MCLK setting
## (2) SW401 setting

<table>
<thead>
<tr>
<th>No.</th>
<th>Switch Name</th>
<th>Function</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I2C</td>
<td>I2C pin of AK4462</td>
<td>Hi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H: I2C mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L: SPI mode</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>PS</td>
<td>PS pin of AK4462</td>
<td>Hi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H: Pin control mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L: Register control mode</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TDM0</td>
<td>TDM0 pin of AK4462 (Pin control mode only)</td>
<td>Lo</td>
</tr>
<tr>
<td>4</td>
<td>TDM1</td>
<td>TDM1 pin of AK4462 (Pin control mode only)</td>
<td>Lo</td>
</tr>
<tr>
<td>5</td>
<td>DIF</td>
<td>DIF pin of AK4462 (Pin control mode only)</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H: 32bit I2S compatible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L: 32bit LSB justified</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CAD0-I2C</td>
<td>CAD0 pin of AK4462 (I2C mode only)</td>
<td>Lo</td>
</tr>
<tr>
<td>7</td>
<td>CAD0-SPI</td>
<td>CAD0 pin of AK4462 (SPI mode only)</td>
<td>Lo</td>
</tr>
<tr>
<td>8</td>
<td>CAD1</td>
<td>CAD1 pin of AK4462 (Register control mode only)</td>
<td>Lo</td>
</tr>
</tbody>
</table>

Table 5. SW401 setting

## (3) SW402/SW403/SW404 setting

<table>
<thead>
<tr>
<th>SW402</th>
<th>DAC-PDN</th>
<th>Power down switch for AK4462</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hi: Power up</td>
<td>Hi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lo: Power down</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>※Should be “Hi” during operation AK4462.</td>
<td></td>
</tr>
<tr>
<td>SW403</td>
<td>MUTE</td>
<td>Mute switch for AK4462 (Pin control mode only)</td>
<td>default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Release: Unmute</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Push: Mute</td>
<td>Lo</td>
</tr>
<tr>
<td>SW404</td>
<td>DIR-PDN</td>
<td>Power down switch for AK4118A</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hi: Power up</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lo: Power down</td>
<td>Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>※Should be “Hi” during operation AK4118A.</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. SW402/SW403/SW404 setting
Evaluation Board and Control Soft Settings

1. Set an evaluation board properly.
2. Connect a PC and an evaluation board the USB cable.
3. The USB control IF is recognized as HID (Human Interface Device) on the PC.
   It is not necessary to install a new driver.
4. Start up the control program.
   When the screen does not display “AKDUSBIF-B” at bottom left, reconnect the PC and the USB cable, and push the [InitPort] button.
5. Proceed evaluation by following the process below.

[Support OS]
Windows 7(32bit) / 10(64bit)

Figure 3. Start Up Window
Operation Overview

Function, register map can be controlled by this control soft.

Figure 4. Control Buttons in Main Window

1. [InitPort]: Reset the USB port.
   Click this button after the control soft starts up when connecting to PC.

2. [SPI / I2C]: Select up interface of the AK4462.
   This setting can be changed when the PDN pin = “L”.

3. [CAD00~CAD11]: Select the CAD pin settings.
   This setting can be changed when the PDN pin = “L”.

4. [Write Default]: Initialize all registers of the AK4462.

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

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

7. [Script Save]: Select a file and save all settings of this software.
   The saved file can be used as a script.

8. [Init Board]: Reset the USB port and the main board.

9. [Close]: Quit the control software.
Tab Functions

1. [MainFunc] Tab : Function

Register settings of the AK4462 can be controlled by this window. The register map will be updated by setting in this window. (Refer to the AK4462 datasheet for register definitions)

Figure 5. Window of [MainFunc]

- [24bit I2S fs=48kHz] button: Setting for I2S 24bit mode (fs=48kHz).
- [DSD 256fs] button: Setting for DSD mode (256fs).
- [DSD] button: Opens “DSD Control” dialog box.
- [DoP] button: Opens “DoP Control” dialog box.
- [Audio I/F] button: Opens “Audio I/F Control” dialog box.
- [Mode] box: The select PCM or DSD or DoP or Auto of AK4462 is controlled.
- [DAC Digital Filter] combo box: The select of Digital Filter. PCM mode only.
- [Sampling Rate] combo box: The select of fs. PCM mode only.
- [DAC Digital Filter Cut Off Frequency] combo box: The select of Digital Filter Cut Off Frequency. DSD mode only.
- [DSD Normal Path] button: The select of DSD Normal path or DSD Volume Bypass.
- [RSTN] button: RSTN of AK4462 is controlled.
- [SMUTE] button: SMUTE of AK4462 is controlled.
- [Volume] button: Opens “Volume Control” dialog box.
- [De-emphasis] button: Opens “De-emphasis Control” dialog box.
- [DAC] button: The power of DAC is controlled.
- [Lch Invert]/[R1 ～ R4ch Invert] combo box: The invert or non-invert select of Output data slot.
- [Address/Data] window: Write or read address and data.
- [Read] button: All registers displayed.
1-1. [DSD] : DSD Control Dialog

This dialog is for DSD Control. (for DSD mode)
Register values can be selected by check boxes and combo boxes.

![DSD Control Dialog](image)

Figure 6. Window of [DSD Control]

1-2. [DoP] : DoP Control Dialog

This dialog is for DoP Control. (for DoP mode)
Register values can be selected by check boxes and combo boxes.

![DoP Control Dialog](image)

Figure 7. Window of [DoP Control]
1-3. [Audio I/F]: Audio I/F Control Dialog

This dialog is for Audio I/F Control. (for PCM mode)
Register values can be selected by check boxes and combo boxes.

![Audio I/F Control Dialog](image)

Figure 8. Audio I/F Control Dialog

1-4. [Volume]: Volume Control Dialog

This dialog is for a ATT of DAC Control.
The volume can be changed by writing a value in a dialog box. The slide bar moves to the value that is written in the dialog box. The Transition Time between set Values of ATTL/R can be controlled.

![Volume Control Dialog](image)

Figure 9. Volume Control Dialog
1-5. [De-em ] : De-emphasis Filter Control Dialog

This dialog is for a De-emphasis Filter of DACs Control. When the checkbox is checked, the data will be selected.

![De-emphasis Filter Control Dialog](image)

Figure 10. De-emphasis Filter Control Dialog

2. [Script] Tab : Script Function

![Window of [Script]](image)

[Refer] : Select a script file. The script written on the file will be executed automatically.
[Repeat] : The selected script file will be executed once again.
3. [ RegMap ] Tab : Register Map Tabs

Register write and read are available in this window. Each tab name shows register address range included in the tab window.

![Register Map Window](image)

Figure 12. Window of [ RegMap ]

Each bit on the register map is a push-button switch. Button Down indicates “1” and the bit name is shown in red. Button Up indicates “0” and the bit name is shown in blue.

Grayed out registers are Read-Only registers. They cannot be controlled. The registers which are not defined on the datasheet, “0” assigned bits and Reserved bits are indicated as “---”.

[Write] and [Read] buttons are shown on the right of the each address if the register is writable and readable.
3-1. [Write]: Data Write Dialog

![Write Window](image)

Select the [Write] button located on the right of the each corresponding address when changing two or more bits on the same address simultaneously.

Click the [Write] button for the register pop-up dialog box shown above.

When the checkbox next to the register is checked, the data will become “1”. When the checkbox is not checked, the data will become “0”.

Click [OK] to write the set values to the registers, or click [Cancel] to cancel this setting.

3-2. [Read]: Data Read

Click the [Read] button located on the right of the each corresponding address to execute a register read. The register map will be updated after executing the [Read] command. (I2C mode only)
# Measurement Results

- Measurement unit: Audio Precision APx555 (No.00754)
- MCKI: 512fs
- BICK: 64fs
- fs: 44.1kHz, 96kHz, 192kHz
- Bit: 24bit
- Input Frequency: 1kHz
- Power Supply: ±12V, GND
  
  AVDD=VREFH=+5.0V (Regulator), TVDD=+3.3V (Regulator)
- Pass: APx(COAX)→AK4118A(DIR)→AK4462→AOUTL/R
- Temperature: Room
- Board Setting: Serial Mode(I2C)

## [Measurement Results]

### 1. fs=44.1kHz, MCKI=512fs, BICK=64fs

<table>
<thead>
<tr>
<th>Result</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="table data" /></td>
<td></td>
</tr>
</tbody>
</table>

### 2. fs=96kHz, MCKI=256fs, BICK=64fs

<table>
<thead>
<tr>
<th>Result</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="table data" /></td>
<td></td>
</tr>
</tbody>
</table>

### 3. fs=192kHz, MCKI=128fs, BICK=64fs

<table>
<thead>
<tr>
<th>Result</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="table data" /></td>
<td></td>
</tr>
</tbody>
</table>
[Plot Data]

■ FFT1 (fin=1 kHz, Input Level=0dBFS)
DAC : SDTI => DAC => L/ROUT

Figure 14. fs=44.1 kHz

Figure 15. fs=96 kHz

Figure 16. fs=192 kHz

■ FFT2 (fin=1 kHz, Input Level=-60dBFS)
DAC : SDTI => DAC => L/ROUT

Figure 17. fs=44.1 kHz

Figure 18. fs=96 kHz

Figure 19. fs=192 kHz
- FFT3 (Noise floor)
  DAC : SDTI => DAC => L/ROUT

Figure 20. fs=44.1 kHz

Figure 21. fs=96 kHz

Figure 22. fs=192 kHz

- THD+N vs Input level
  DAC : SDTI => DAC => L/ROUT

Figure 23. fs=44.1 kHz

Figure 24. fs=96 kHz

Figure 25. fs=192 kHz
- THD+N vs Input Frequency
  DAC : SDTI => DAC => L/ROUT

  **Figure 26.** fs=44.1 kHz

  **Figure 27.** fs=96 kHz

  **Figure 28.** fs=192 kHz

- Linearity
  DAC : SDTI => DAC => L/ROUT

  **Figure 29.** fs=44.1 kHz

  **Figure 30.** fs=96 kHz

  **Figure 31.** fs=192 kHz
### Frequency Response
DAC : SDTI => DAC => L/ROUT

![Figure 32, fs=44.1 kHz](image)

![Figure 33, fs=96 kHz](image)

![Figure 34, fs=192 kHz](image)

### Crosstalk
DAC : SDTI => DAC => L/ROUT

![Figure 35, fs=44.1 kHz](image)

![Figure 36, fs=96 kHz](image)

![Figure 37, fs=192 kHz](image)
<table>
<thead>
<tr>
<th>Date</th>
<th>Manual Revision</th>
<th>Board Revision</th>
<th>Reason</th>
<th>Page</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>19/07/01</td>
<td>KM131900</td>
<td>0</td>
<td>First Edition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20/08/19</td>
<td>KM131901</td>
<td>0</td>
<td>Modification</td>
<td>14</td>
<td>Re-acquired because measurement results differ between Japanese and English manuals.</td>
</tr>
</tbody>
</table>
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