GENERAL DESCRIPTION

The AKD4528 is an evaluation board for the AK4528, the 24Bit A/D & D/A converter. The AKD4528 can evaluate A/D converter and D/A converter separately in addition to Loopback mode (A/D→D/A). The AKD4528 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector.

Ordering guide

AKD4528 --- AK4528 Evaluation Board
(Cable for connecting with printer port of IBM-AT compatible PC and control software are packed with this. This Control software does not operate on Windows NT.)

FUNCTION

- Digital interface
  - DIT (AK4353), DIR (AK4112B) with optical output/input.
- 10pin header for serial control interface

Figure 1. AKD4528 Block Diagram

* Circuit diagram and PCB layout are attached at the end of this manual.
1. Analog Input Buffer Circuit

The ADC inputs are full differential and the input resistance is 27kΩ (typ. @fs=44.1kHz). The input signal range scales with the VREF voltage and nominally 0.56 x VREF Vpp. It is recommended that the input DC bias voltage is 2.9V(The bias is a voltage divided by resistors (3.3k and 4.7k) from VA in figure 2. The ADC output data format is 2’s complement. The DC offset including ADC own DC offset removed by the internal HPF (fc=0.9Hz@fs=44.1kHz).

The AK4528 samples the analog inputs at 64fs. The digital filter rejects noise above the stopband except for multiples of 64fs. A simple RC filter may be used to attenuate any noise around 64fs though most audio signals do not have significant energy at 64fs. Figure 2 is an example of differential input circuit.

![Figure 2. Differential Input Buffer Example](image)

2. Analog Output Buffer Circuit

The 2nd-order LPF (fc=93.2kHz, Q=0.712) which adds differential output of AK4528 is implemented on the board.

When the further attenuation of the out-band noise is needed, some additional LPF is required. NJM5532D is used for op-amp. Analog signal is output through BNC connectors (AOUTL, AOUTR) on board, and the output level of AK4528 is about 5.4Vp-p.

![Figure 3. External 2nd order LPF Example (using dual supply op-amp)](image)
1. Evaluation Board Manual

■ Operation sequence

1) Set up the power supply line
   [+15V] (Orange) = +15V
   [-15V] (Green) = -15V
   [AGND] (Black) = 0V
   [DGND] (Black) = 0V

   Note: Power should be supplied after jumpers are set-ups properly.
   Each supply line should be distributed from the power supply unit.

2) Set up the evaluation modes, jumper pins and DIP switch. (See the followings.)

3) Power on
   The AK4528, AK4112B and AK4353 should be reset once bringing SW3 (PDN) “L” upon power-up.

■ Evaluation modes

Applicable evaluation modes
(1) Loopback mode (Default)
(2) Evaluation of ADC
(3) Evaluation of DAC

(1) Loopback mode (Default)
   Clock mode of the AK4112B should be set to X’tal mode.

(2) Evaluation of ADC
   TOTX176 is used for digital output. Clock mode of the AK4112B should be set to X’tal mode.

(3) Evaluation of DAC
   TORX176 or COAX is used for digital input. Clock mode of the AK4112B should be set to PLL mode.
Set-up SW2

[SW2]: Set-up AK4112B. Upper is “ON” (“H”), Lower is “OFF” (“L”)  
(For further details, refer to the datasheet.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Default</th>
<th>OFF</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OCKS0</td>
<td>OFF</td>
<td>Set-up the master clock frequency (Default: 256fs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Refer to the datasheet.)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>OCKS1</td>
<td>OFF</td>
<td>Set-up the clock source (Default: X’tal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Refer to the datasheet.)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CM0</td>
<td>ON</td>
<td>Set-up the audio format (Default: 24bit, I’S )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Refer to the datasheet.)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CM1</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DIF0</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>DIF1</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DIF2</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Set up SW2

1. Set-up Master clock frequency

This master clock is generated by the AK4112B, and is supplied from MCK01 pin of the AK4112B.

<table>
<thead>
<tr>
<th>OCKS1 pin (SW2-2)</th>
<th>OCKS0 pin (SW2-1)</th>
<th>MCK01</th>
<th>fs (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>256fs</td>
<td>32, 44.1, 48, 96 (Default)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>256fs</td>
<td>32, 44.1, 48, 96</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>512fs</td>
<td>32, 44.1, 48</td>
</tr>
</tbody>
</table>

Table 2. Set up Master clock frequency

2. Set-up Clock source

<table>
<thead>
<tr>
<th>CM1 pin (SW2-4)</th>
<th>CM0 pin (SW2-3)</th>
<th>PLL</th>
<th>X’tal</th>
<th>Clock source</th>
<th>Input data of DAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>ON</td>
<td>OFF</td>
<td>PLL</td>
<td>Optical</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>X’tal</td>
<td>Output of ADC</td>
</tr>
</tbody>
</table>

Table 3. Set up Clock source  
(Note) ON: Oscillation (Power-up), OFF: STOP (Power-down)

3. Set-up Audio interface format

<table>
<thead>
<tr>
<th>DIF2 pin (SW2-7)</th>
<th>DIF1 pin (SW2-6)</th>
<th>DIF0 pin (SW2-5)</th>
<th>ADC format at Loopback</th>
<th>Input format of DAC</th>
<th>LRCK</th>
<th>BICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24bit, Left justified</td>
<td>16bit, Right justified</td>
<td>H/L</td>
<td>64fs</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>24bit, Left justified</td>
<td>18bit, Right justified</td>
<td>H/L</td>
<td>64fs</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>24bit, Left justified</td>
<td>20bit, Right justified</td>
<td>H/L</td>
<td>64fs</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>24bit, Left justified</td>
<td>24bit, Right justified</td>
<td>H/L</td>
<td>64fs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>24bit, Left justified</td>
<td>24bit, Left justified</td>
<td>H/L</td>
<td>64fs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>24bit, Left justified</td>
<td>24bit, I’S</td>
<td>L/H</td>
<td>64fs</td>
</tr>
</tbody>
</table>

Table 4. Set up Audio interface format
### Set-up SW1

[SW1]: Set-up AK4528. Upper is “ON” (“H”), Lower is “OFF” (“L”).
(For further details, refer to the datasheet.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Default</th>
<th>OFF</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P/S</td>
<td>ON</td>
<td>Serial mode</td>
<td>Parallel mode (Default)</td>
</tr>
<tr>
<td>2</td>
<td>DEM1</td>
<td>OFF</td>
<td>Set up de-emphasis (Default: OFF)</td>
<td>Refer to the datasheet.</td>
</tr>
<tr>
<td>3</td>
<td>DEM0</td>
<td>ON</td>
<td>(Refer to the datasheet.)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>DFS</td>
<td>OFF</td>
<td>Normal speed (Default)</td>
<td>Double speed</td>
</tr>
<tr>
<td>5</td>
<td>DIF</td>
<td>ON</td>
<td>MSB justified</td>
<td>IFS (Default)</td>
</tr>
<tr>
<td>6</td>
<td>CKS1</td>
<td>OFF</td>
<td>Set up Master clock frequency in case of the parallel mode</td>
<td>(Default: 256fs)</td>
</tr>
<tr>
<td>7</td>
<td>CKS0</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Set up SW1

### Set up Registers and Device pins of AK4528

The register setting uses the control software. (For further details, refer to the datasheet.)

1. **Set up Parallel/Serial mode control**

When P/S = “H”, the AK4528 becomes to the parallel mode. DIF pin selects the audio interface format, and DFS, CKS1, and CKS0 pins select the master clock frequency.

When P/S = “L”, the AK4528 becomes to the serial mode. The CKS1, CKS0 and DIF pins are changed to CDTI, CCLK and CSN pins respectively. The DEM1, DEM0 and DFS are ORed between pins and register respectively, so those are able to control by pins even in serial mode. When all the functions are controlled by register, DEM1, DEM0 and DFS pins should be set to “L”.

2. **Set up Master clock frequency**

   (a) **In case of serial mode**

<table>
<thead>
<tr>
<th>CMODE bit</th>
<th>CKS1 bit</th>
<th>CKS0 bit</th>
<th>MCLK Normal Speed (DFS bit = “0”)</th>
<th>MCLK Double Speed (DFS bit = “1”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>256fs</td>
<td>N/A</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>512fs</td>
<td>256fs</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1024fs</td>
<td>512fs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>384fs</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>768fs</td>
<td>384fs</td>
</tr>
</tbody>
</table>

Table 6. Set up Master clock frequency in case of serial mode

   (b) **In case of parallel mode**

<table>
<thead>
<tr>
<th>CKS1 Pin (SW1-6)</th>
<th>CKS0 Pin (SW1-7)</th>
<th>MCLK Normal Speed (DFS pin = “L”)</th>
<th>MCLK Double Speed (DFS pin = “H”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>256fs</td>
<td>N/A</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>512fs</td>
<td>256fs</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>384fs</td>
<td>N/A</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>1024fs</td>
<td>512fs</td>
</tr>
</tbody>
</table>

Table 7. Set up Master clock frequency in case of parallel mode
3. Set up Audio interface format

(a) In case of the serial mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>DIF2 bit</th>
<th>DIF1 bit</th>
<th>DIF0 bit</th>
<th>SDTO</th>
<th>SDTI</th>
<th>LRCK</th>
<th>BICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24bit, MSB justified</td>
<td>16bit, LSB justified</td>
<td>H/L</td>
<td>≥ 32fs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>24bit, MSB justified</td>
<td>20bit, LSB justified</td>
<td>H/L</td>
<td>≥ 40fs</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>24bit, MSB justified</td>
<td>24bit, MSB justified</td>
<td>H/L</td>
<td>≥ 48fs</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>24bit, I&lt;S&gt;</td>
<td>24bit, I&lt;S&gt;</td>
<td>L/H</td>
<td>≥ 48fs</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>24bit, MSB justified</td>
<td>24bit, LSB justified</td>
<td>H/L</td>
<td>≥ 48fs</td>
</tr>
</tbody>
</table>

Table 8. Set up Audio interface format in case of serial mode

(b) In case of parallel mode

<table>
<thead>
<tr>
<th>Mode</th>
<th>DIF Pin (SW1-5)</th>
<th>SDTO</th>
<th>SDTI</th>
<th>LRCK</th>
<th>BICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>24bit, MSB justified</td>
<td>24bit, MSB justified</td>
<td>H/L</td>
<td>≥ 48fs</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>24bit, I&lt;S&gt;</td>
<td>24bit, I&lt;S&gt;</td>
<td>L/H</td>
<td>≥ 48fs</td>
</tr>
</tbody>
</table>

Table 9. Set up Audio interface format in case of parallel mode

Set up Registers of AK4353 (DIT).

The register setting uses the control software. (For further details, refer to the datasheet)

1. Set up Master clock frequency

<table>
<thead>
<tr>
<th>CKS2 bit</th>
<th>CKS1 bit</th>
<th>CKS0 bit</th>
<th>DIF1, DIF0 bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>“1”, “1”</td>
<td>“0”, “0”</td>
<td>“0”, “1”</td>
<td>“0”, “1”</td>
</tr>
<tr>
<td>“1”</td>
<td>“1”</td>
<td>512fs</td>
<td>256fs, 128fs</td>
</tr>
<tr>
<td>“0”</td>
<td>“1”</td>
<td>256fs</td>
<td>256fs</td>
</tr>
<tr>
<td>“0”</td>
<td>“0”</td>
<td>768fs</td>
<td>384fs, 192fs</td>
</tr>
<tr>
<td>“0”</td>
<td>“1”</td>
<td>384fs</td>
<td>384fs</td>
</tr>
<tr>
<td>“1”</td>
<td>“0”</td>
<td>1024fs</td>
<td>512fs, 256fs</td>
</tr>
<tr>
<td>“1”</td>
<td>“1”</td>
<td>512fs</td>
<td>512fs, N/A</td>
</tr>
<tr>
<td>“1”</td>
<td>“0”</td>
<td>1536fs</td>
<td>768fs, 384fs</td>
</tr>
<tr>
<td>“1”</td>
<td>“1”</td>
<td>768fs</td>
<td>768fs, N/A</td>
</tr>
</tbody>
</table>

Table 10. Set up Master clock frequency

(Note) DFS1, DFS0=“1”, “0”: Reserved (Not defined)
2. Set up Audio interface format

<table>
<thead>
<tr>
<th>Mode</th>
<th>DIF2 bit</th>
<th>DIF1 bit</th>
<th>DIF0 bit</th>
<th>SDTI</th>
<th>L/R</th>
<th>BICK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16bit, LSB justified</td>
<td>H/L</td>
<td>≥32fs</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>18bit, LSB justified</td>
<td>H/L</td>
<td>≥36fs</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>20bit, LSB justified</td>
<td>H/L</td>
<td>≥40fs</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>24bit, LSB justified</td>
<td>H/L</td>
<td>≥48fs</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>24bit, MSB justified</td>
<td>H/L</td>
<td>≥48fs</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>FS</td>
<td>L/H</td>
<td>≥48fs</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 11. Set up Audio interface format

■ Set up Jumper pins

JP1 (RX): Selection of Optical connector or BNC connector
  TORX176 (Default): Biphase signal is supplied to AK4112B by optical connector.
  COAX            : Biphase signal is supplied to AK4112B by BNC connector.

JP2 (GND): Separate/Connect AGND and DGND
  Open     : Separate AGND and DGND.
  Short (Default) : Connect AGND and DGND.

■ The indication content for LED

[LE1] (ERF) : AK4112B unlock and parity error output.
[LE2] (FS96) : AK4112B 96kHz sampling detect.
[LE4] (V)    : Validity.

■ The function of the toggle SW

[SW3]: Resets the AK4528, AK4112B and AK4353. Keep “H” during normal operation.

■ Serial control mode

The AK4528 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT2 (CR-I/F) with PC by 10-wire flat cable packed with the AKD4528.

Take care of the direction of connector. There is a mark at pin#1.
The pin layout of PORT1 is as Figure 4.

*AKM assumes no responsibility for the trouble when using the circuit examples.
Control Software Manual

### Set-up of evaluation board and control software

1. Set up the AKD4528 according to previous term.

2. Connect IBM-AT compatible PC with AKD4528 by 10-line type flat cable (packed with AKD4528). Take care of the direction of 10pin header. (Please install the driver in the CD-ROM when this control software is used on Windows 2000/XP. Please refer “Installation Manual of Control Software Driver by AKM device control software”. In case of Windows95/98/ME, this installation is not needed. This control software does not operate on Windows NT.)

3. Insert the CD-ROM labeled “AKD4528 Evaluation Kit” into the CD-ROM drive.

4. Access the CD-ROM drive, and double-click the icon of “akd4528.exe” and “akd4528_dit.exe”, and set up the control program.
   - `akd4528.exe`: AK4528 control program
   - `akd4528_dit.exe`: AK4353 (DIT) control program

5. Then evaluate according to the follows.

### Operation flow

Keep the following flow.

1. Set up the control program according to explanation above.
2. Click “Port Reset” button.

### Explanation of each buttons

1. [Port Reset]: Set up the USB interface board (AKDUSBIF-A).
2. [Write default]: Initialize the registers.
3. [All Write]: Write all registers data that is currently displayed.
4. [Function1]: Dialog to write data by keyboard operation.
5. [Function2]: Dialog to write data by keyboard operation.
6. [Function3]: The sequence of register setting can be set and executed.
7. [Function4]: The sequence that is created on [Function3] can be assigned to buttons and executed.
8. [Function5]: The register setting that is created by [SAVE] function on main window can be assigned to buttons and executed.
9. [SAVE]: Save the current register setting.
10. [OPEN]: Write the saved values to all register.
11. [Write]: Dialog to write data by mouse operation.

### Indication of data

Input data is indicated on the register map. Red letter indicates “H” or “1” and blue one indicates “L” or “0”. Blank is the part that is not defined in the datasheet.
Explanation of each dialog

1. **[Write Dialog]: Dialog to write data by mouse operation**

   There are dialogs corresponding to each register.

   Click the [Write] button corresponding to each register to set up the dialog. If you check the check box, data becomes “H” or “1”. If not, “L” or “0”.

   When writing the input data to register, click [OK] button. If not, click [Cancel] button.

2. **[Function1 Dialog]: Dialog to write data by keyboard operation**

   Address Box: Input registers address in 2 figures of hexadecimal.
   Data Box: Input registers data in 2 figures of hexadecimal.

   When writing the input data to register, click [OK] button. If not, click [Cancel] button.

3. **[Function2 Dialog]: Dialog to evaluate ATT**

   This is a dialog corresponding to address: 04H, 05H of AK4528, and address: 03H, 04H of AK4353.

   Address Box: Input registers address in 2 figures of hexadecimal.
   Start Data Box: Input starts data in 2 figures of hexadecimal.
   End Data Box: Input end data in 2 figures of hexadecimal.
   Interval Box: Data is written to register by this interval.
   Step Box: Data changes by this step.
   Mode Select Box: With checking this check box, data reaches end data, and returns to start data.

   **[Example]**
   Start Data = 00, End Data = 09
   Data flow: 00 01 02 03 04 05 06 07 08 09 09 08 07 06 05 04 03 02 01 00

   Without checking this check box, data reaches end data, but does not return to start data.

   **[Example]**
   Start Data = 00, End Data = 09
   Data flow: 00 01 02 03 04 05 06 07 08 09

   When writing the input data to register, click [OK] button. If not, click [Cancel] button.
4. [Save] and [Open]

4-1. [Save]

Save the current register setting data to the file. The extension of file name is “akr”.

(Operation flow)
1. Click [Save] Button.
2. Set the file name and push [Save] Button. The extension of file name is “akr”.

4-2. [Open]

The register setting data saved to the file by [Save] is written to register. The file type is the same as [Save].

(Operation flow)
2. Select the file (*.akr) and Click [Open] Button.
5. **[Function3 Dialog]**

The sequence of register setting can be set and executed.

(1) Click [F3] Button.

Set the control sequence.

Set the address, Data and Interval time. Set “-1” to the address of the step where the sequence should be paused.

(3) Click [Start] button. Then this sequence is executed.

The sequence is paused at the step of Interval="-1". Click [START] button, the sequence restarts from the paused step. This sequence can be saved and opened by [Save] and [Open] button on the [Function3] window. The extension of file name is “aks”.

![Figure 1. Window of [F3]](image-url)
6. [Function4 Dialog]

The sequence that is created on [Function3] can be assigned to buttons and executed. When [F4] button is clicked, the window as shown in Figure 2 opens.

![Figure 2. [F4] window](image-url)
6-1. [OPEN] buttons on left side and [START] buttons

(1) Click [OPEN] button and select the sequence file (*.aks).

The sequence file name is displayed as shown in Figure 3.

![Sequence by *.aks file](image)

Figure 3. [F4] window(2)

(2) Click [START] button, then the sequence is executed.

6-2. [SAVE] and [OPEN] buttons on right side

[SAVE]: The sequence file names can be saved. The file name is *.ak4.

[OPEN]: The sequence file names that are saved in *.ak4 are loaded.
6-3. Note

(1) [Function4] doesn't support the pause function of sequence function.

(2) All files need to be in same folder used by [SAVE] and [OPEN] function on right side.

(3) When the sequence is changed in [Function3], the file should be loaded again in order to reflect the change.
7. [Function5 Dialog]

The register setting that is created by [SAVE] function on main window can be assigned to buttons and executed. When [F5] button is clicked, the following window as shown in Figure 4 opens.

![Figure 4. [F5] window](image)

7-1. [OPEN] buttons on left side and [WRITE] button

(1) Click [OPEN] button and select the register setting file (*.akr).

(2) Click [WRITE] button, then the register setting is executed.

7-2. [SAVE] and [OPEN] buttons on right side

[SAVE]: The register setting file names assign can be saved. The file name is *.ak5.

[OPEN]: The register setting file names assign that are saved in *.ak5 are loaded.
7-3. Note

(1) All files need to be in same folder used by [SAVE] and [OPEN] function on right side.

(2) When the register setting is changed by [Save] Button in main window, the file should be loaded again in order to reflect the change.
### AK4528 Measurement Results

**Conditions:**
- Measurement unit: Audio Precision System Two Cascade
- MCLK: 256fs
- BICK: 64fs
- LRCK: 44.1kHz(DIR or DIT), or 96kHz(DIR or DIT)
- Power supply: VA=VD=VT=5.0V
- Interface: DIT or DIR
- Temperature: Room Temp.

1. **ADC**

   1-1. $fs = 44.1$kHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Input signal</th>
<th>BW, filter</th>
<th>Results</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S/(N+D)$</td>
<td>1kHz, -0.5dB</td>
<td>20kHz</td>
<td>98.4</td>
<td>98.2 dB</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>1kHz, -60dB</td>
<td>20kHz</td>
<td>102.6</td>
<td>102.6 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20kHz, A-weighted</td>
<td>107.4</td>
<td>107.5 dB</td>
</tr>
<tr>
<td>$S/N$</td>
<td>off</td>
<td>20kHz</td>
<td>102.8</td>
<td>102.8 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20kHz, A-weighted</td>
<td>107.5</td>
<td>107.5 dB</td>
</tr>
</tbody>
</table>

   1-2. $fs = 96$kHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Input signal</th>
<th>BW, filter</th>
<th>Results</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S/(N+D)$</td>
<td>1kHz, -0.5dB</td>
<td>fs/2</td>
<td>91.4</td>
<td>92.8 dB</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>1kHz, -60dB</td>
<td>fs/2</td>
<td>99.8</td>
<td>99.9 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fs/2, A-weighted</td>
<td>108.3</td>
<td>108.5 dB</td>
</tr>
<tr>
<td>$S/N$</td>
<td>off</td>
<td>fs/2</td>
<td>100.0</td>
<td>100.8 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fs/2, A-weighted</td>
<td>108.9</td>
<td>109.0 dB</td>
</tr>
</tbody>
</table>
## DAC

### 2-1. fs=44.1kHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Input signal</th>
<th>BW, filter</th>
<th>Results</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/(D+N)</td>
<td>1kHz, 0dBFS</td>
<td>20kHz</td>
<td>93.7</td>
<td>94.5 dB</td>
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<tr>
<td>Dynamic range</td>
<td>1kHz, -60dBFS</td>
<td>20kHz</td>
<td>108.0</td>
<td>108.0 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22kHz, A-weighted</td>
<td>110.7</td>
<td>110.6 dB</td>
</tr>
<tr>
<td>S/N</td>
<td>&quot;0&quot; data</td>
<td>20kHz</td>
<td>108.2</td>
<td>108.0 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22kHz, A-weighted</td>
<td>110.9</td>
<td>110.7 dB</td>
</tr>
</tbody>
</table>

### 2-2. fs=96kHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Input signal</th>
<th>BW, filter</th>
<th>Results</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/(N+D)</td>
<td>1kHz, 0dBFS</td>
<td>40kHz</td>
<td>91.2</td>
<td>91.8 dB</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>1kHz, -60dBFS</td>
<td>40kHz</td>
<td>104.8</td>
<td>104.9 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80kHz, A-weighted</td>
<td>110.0</td>
<td>110.0 dB</td>
</tr>
<tr>
<td>S/N</td>
<td>&quot;0&quot; data</td>
<td>40kHz</td>
<td>104.9</td>
<td>104.8 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80kHz, A-weighted</td>
<td>110.2</td>
<td>109.9 dB</td>
</tr>
</tbody>
</table>
1. ADC

(fs=44.1kHz)

AKM

AK4528 ADC FFT (Input Level=-0.5dBFS, fin=1kHz)

FFT (Input Level = -0.5dBFS, fin=1kHz)

AKM

AK4528 ADC FFT (Input Level=-60dBFS, fin=1kHz)

FFT (Input Level = -60dBFS, fin=1kHz)
AKM AK4528 ADC FFT (noise floor)

FFT (noise floor)
(fs=44.1kHz)

**THD + N vs Amplitude (fin=1kHz)**

**THD + N vs Input Frequency (Input Level=0dBFS)**

**THD + N vs Input Frequency (Input Level = -0.5dBFS)**
(fs=44.1kHz)

AKM

AK4528 ADC Linearity

Linearity (fin=1kHz)

AKM

AK4528 ADC Crosstalk

Frequency Response (Input Level=1kHz)
AKM
AK4528 ADC Crosstalk

Crosstalk

(fs=44.1kHz)
(fs=96kHz)

AKM
AK4528 ADC FFT (Input Level = -0.5dBFS, fin=1kHz)

FFT (Input Level = -0.5dBFS, fin=1kHz)

AKM
AK4528 ADC FFT (Input Level = -60dBFS, fin=1kHz)

FFT (Input Level = -60dBFS, fin=1kHz)
(fs=96kHz)

AKM

AK4528 ADC FFT (noise floor)

FFT (noise floor)
AKM

AK4528 ADC THD + N vs Amplitude (fin=1kHz)

THD + N vs Amplitude (fin=1kHz)

AKM

AK4528 ADC THD + N vs Input Frequency (Input Level=-0.5dBFS)

THD + N vs Input Frequency (input Level=-0.5dBFS)
AKM AK4528 ADC Linearity

(linear behavior)

(\text{Linearity (fin=1kHz)})

AKM AK4528 ADC Frequency Response

(frequency response)

(Frequency Response (Input Level=\pm0.5\text{dBFS})
AKM
AK4528 ADC Crosstalk (Upper=Lch, Lower=Rch)

Crosstalk

(\text{fs}=96\text{kHz})
2. DAC

(fs=44.1kHz)

AKM

AK4528 DAC FFT (Input Level=0dBFS, fin=1kHz)

FFT (Input Level=-60dBFS, fin=1kHz)
(fs=44.1kHz)

AKM

AK4528 DAC FFT (Input=0data)

FFT (Input = “0”data)

AKM

AK4528 DAC FFT (Out-of-band noise)

FFT (out-of-band noise)
(fs=44.1kHz)

AKM

AK4528 DAC THD + N vs Amplitude (fin=1kHz)

THD + N vs Amplitude (fin=1kHz)

AKM

AK4528 DAC THD + N vs Input Frequency (Input Level=0dBFS)

THD + N vs Input Frequency (Input Level=0dBFS)
AKM AK4528 DAC Linearity

Linearity (fin=1kHz)

AKM AK4528 DAC Frequency Response

Frequency Response (Input Level = 0dBFS)
(fs=44.1kHz)

AKM

AK4528 DAC Crosstalk(Upper=Rch, Lower=Lch)
(fs=96kHz)

AKM

AK4528 DAC FFT (Input Level=0dBFS, fin=1kHz, notch ON)

FFT (Input Level=0dBFS, fin=1kHz)

AKM

AK4528 DAC FFT (Input Level=-60dBFS, fin=1kHz)

FFT (Input Level=-60dBFS, fin=1kHz)
(fs=96kHz)

AKM

AK4528 DAC FFT (Input 0data)

FFT (Input = "0"data)
(fs=96kHz)

AKM

AK4528 DAC THD + N vs Amplitude (fin=1kHz)

THD + N vs Amplitude (fin=1kHz)

AKM

AK4528 DAC THD + N vs Input Frequency (Input Level=0dBFS)

THD + N vs Input Frequency (Input Level=0dBFS)
AKM

AK4528 DAC Linearity

(fs=96kHz)

Linearity (fin=1kHz)

AKM

AK4528 DAC Frequency Response

Frequency Response (Input Level=0dBFS)

<KM063101>
AKM AK4528 DAC Crosstalk

(fs=96kHz)

Crosstalk
## Revision History

<table>
<thead>
<tr>
<th>Date (YY/MM/DD)</th>
<th>Manual Revision</th>
<th>Board Revision</th>
<th>Reason</th>
<th>Contents</th>
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<tr>
<td>00/06/01</td>
<td>KM063100</td>
<td>0</td>
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<tr>
<td>05/11/01</td>
<td>KM063101</td>
<td>1</td>
<td>Circuit Change</td>
<td>(1) AK4112A → AK4112B</td>
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<tr>
<td></td>
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<td></td>
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<td>(2) C6, C7: 22pF → 5pF</td>
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<td>(3) C36, C37, C47, C48 → Delete</td>
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<tr>
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<td></td>
<td></td>
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<td>(4) L2: short → Resistance: 5.1 Ohm</td>
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<td></td>
<td>Manual Change</td>
<td>(1) Change DOS base program to Windows base program.</td>
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<tr>
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<td>(2) Change the description about control program.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3) Add register / pin settings of AK4528 and AK4353.</td>
</tr>
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</table>

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