



# AKD4370-B

## Evaluation Board Rev.0 for AK4370

### GENERAL DESCRIPTION

The AKD4370 is an evaluation board for 24bit DAC with Headphone Amplifier, AK4370. The AKD 4370 has the interface with AKM's ADC evaluation boards. Therefore, it's easy to evaluate the AK4370. The ADK4370 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector.

■ **Ordering guide**

AKD4370-B --- Evaluation board for AK4370  
 (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

- **Compatible with 2 types of interface**
  - Direct interface with AKM's A/D converter evaluation boards
  - On-board AK4116 as DIR which accepts optical input
- **10pin header for serial control interface**
- **Mini-jack for external Stereo Speaker**
- **On-board Class-D Speaker Amplifier (AK7832)**

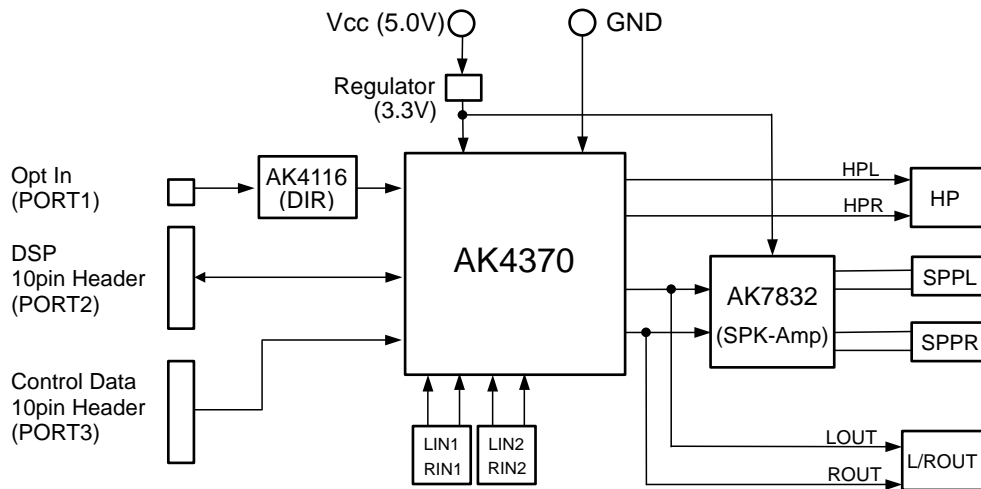


Figure 1. AKD4370 Block Diagram

\* Circuit diagram and PCB layout are attached at the end of this manual.

## Evaluation Board Manual

### ■ Operation sequence

1) Set up the power supply lines.

- [VCC] (red) = 5.0V : for Regulator
- [AGND] (black) = 0V : for analog ground
- [DGND] (black) = 0V : for logic ground

Each supply line should be distributed from the power supply unit.  
3.3V is supplied to via the regulator.

2) Set up the evaluation mode, jumper pins. (See the followings.)

3) Power on.

The AK4370 and AK4116 should be resets once bringing SW1 (DAC/DIR\_PDN) “L” upon power-up.  
And the AK7832 should be resets once bringing SW2 (SPK\_PDN) “L” upon power-up.

### ■ Evaluation mode

**When evaluating the AK4370 using the PORT1(AK4116), it is possible to use the initial setting of the audio interface format (24bit MSB justified). The AK4116 operates at fs of 32kHz or more. If the fs is slower than 32kHz, any other evaluation mode should be used.**

**When inputting the data from the PORT2, the AK4370's audio interface format should be set to correspond the input data's audio interface format. Refer to the AK4370's datasheet.**

#### Applicable Evaluation Mode

- (1) External Slave Mode
  - (1-1) Evaluation using DIR (Optical Link) of AK4116
  - (1-2) Evaluation connecting AKD4370 with external DSP
- (2) Master Mode

**(1) Slave Mode**

The AK4370's register should be set to Slave Mode. MCKI frequency should be set to the same as the specification of DSP or DIR. About the AK4370's register definitions, refer to datasheet of the AK4370.

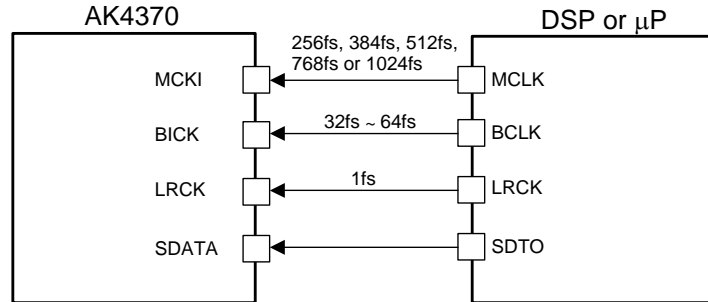


Figure 2. Slave Mode

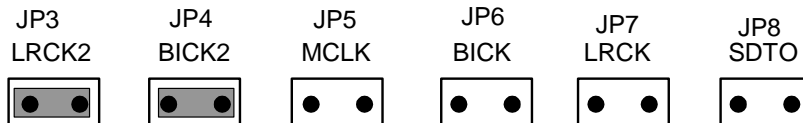
**(1-1) Evaluation using DIR (Optical Link) of AK4116**

PORT1 (DIR) is used. Nothing should be connected to PORT2 (DSP). Set up the jumper pins.



**(1-2) Evaluation connecting AKD4370 with external DSP**

PORT2 (DSP) is used. Nothing should be connected to PORT1 (DIR). MCLK, SDTI, BICK, LRCK of PORT2 should be connected to MCLK, SDTO, BICK, LRCK for DSP. Set up the jumper pins.



**(2) Master Mode**

The AK4370's register should be set to Master Mode. MCKI frequency should be set to the same as DSP's specification. About the AK4370's register definitions, refer to datasheet of the AK4370.

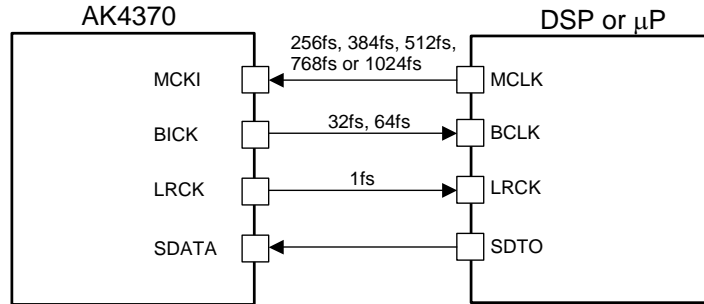
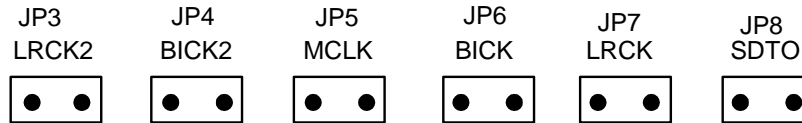


Figure 3. Master Mode

PORT2 (DSP) is used. Nothing should be connected to PORT1 (DIR). The system clock should be connected to MCLK of PORT2. SDTI of PORT2 should be connected to SDTO of DSP. The JP4(LRCK2) and JP3(BICK2)'s right side should be connected to LRCK and BICK of DSP. Set up the jumper pins.



**■ Other jumper pins set up**

JP1 (GND) : Analog ground and Digital ground.

OPEN : Separated.

SHORT : Common. <default>

JP11 (INLN) : Setting of AK7832 Input pin "INLN"

OPEN : When SW2 (SPK\_PDN) is "L".

SHORT : When SW2 (SPK\_PDN) is "H". <default>

JP12 (INRN) : Setting of AK7832 Input pin "INRN"

OPEN : When SW2 (SPK\_PDN) is "L".

SHORT : When SW2 (SPK\_PDN) is "H". <default>

JP13 (DVDD\_REG) : Setting of Power Supply "DVDD"

OPEN : It supplies "DVDD" from the outside.

SHORT : It supplies "DVDD" from the Regulator (3.3V).<default>

**■ The function of the toggle SW**

Upper-side is "H" and lower-side is "L".

[SW1] (DAC/DIR\_PDN): Power down of AK4370 and AK4116. Keep "H" during normal operation.

[SW2] (SPK\_PDN): Power down of AK7832. Keep "H" during normal operation.

**■ Indication for LED**

[LED1] (ERF): Monitor INT0 pin of the AK4116. LED turns on when some error has occurred to AK4116.

■ **Serial Control**

The AK4370 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT3 (uP -IF) with PC by 10 wire flat cable packed with the AKD4370.

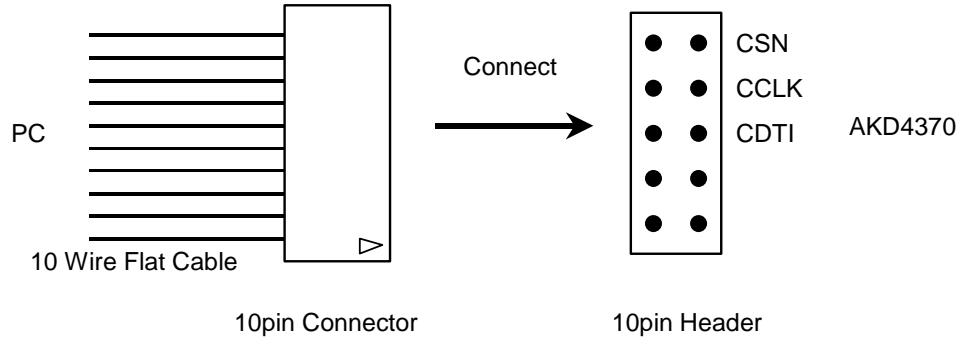
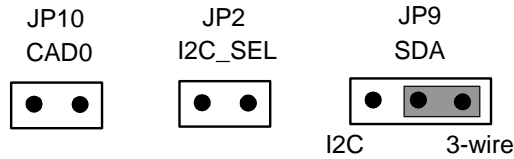


Figure 4. Connect of 10 wire flat cable

**(1) 3-wire Serial Control Mode <Default>**

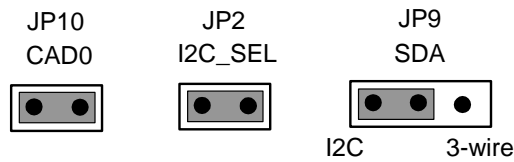
The jumper pins should be set to the followings.



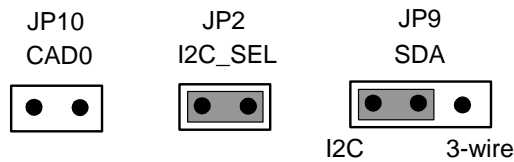
**(2) I<sup>2</sup>C-bus Control Mode**

The jumper pins should be set to the followings.

(2-1) In case of using CAD0=0 (device address bits).



(2-2) In case of using CAD0=1 (device address bits).



■ Input / Output circuit

(1) Input Circuit

LIN1/RIN1, LIN2/RIN2 Input circuits

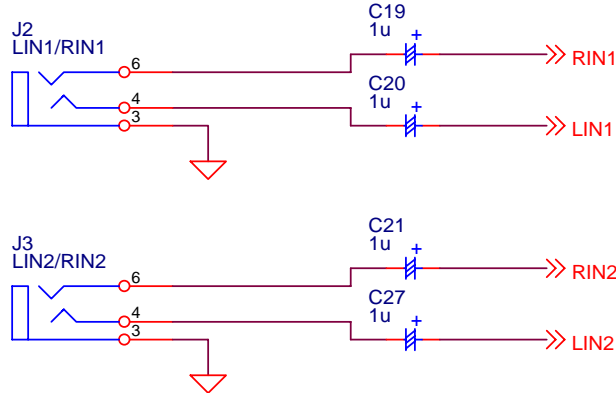


Figure 5. LIN1/RIN1,LIN2/RIN2 Input circuits

(2) Output Circuit

1) HPL/HPR Output Circuit

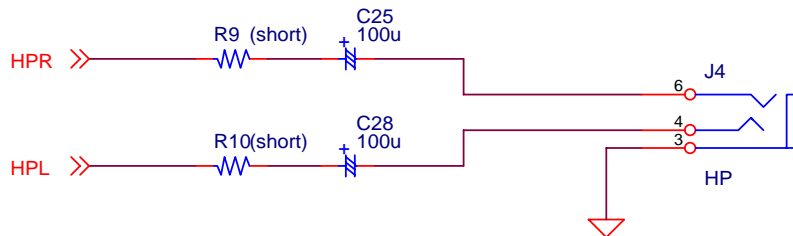


Figure 6. HPL/HPR Output Circuit

2) LOUT/ROUT Output Circuit

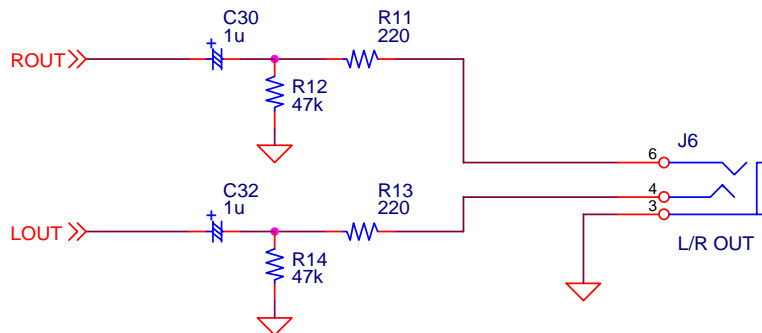


Figure 7. LOUT/ROUT Output Circuit

### 3) Speaker Output Circuit

Evaluation using AK7832's Speaker , the jumper pins should be set to the followings.

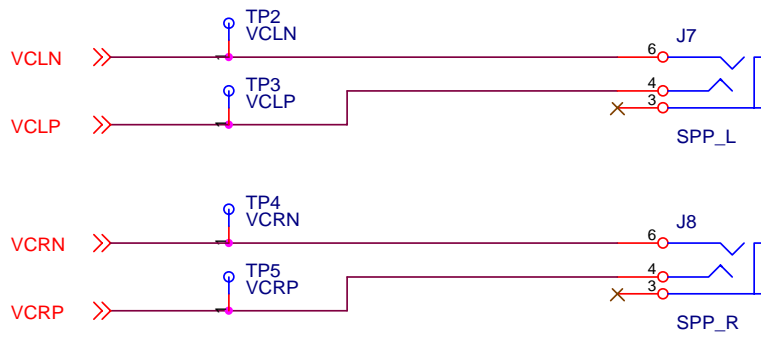
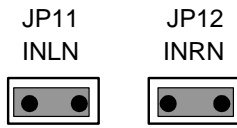


Figure 8. SPK-Amp Output Circuit

\* AKM assumes no responsibility for the trouble when using the above circuit examples.



## Control Software Manual

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

1. Set up the AKD4370 according to previous term.
2. Connect IBM-AT compatible PC with AKD4370 by 10-line type flat cable (packed with AKD4370). 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 “AK4370 Evaluation Kit” into the CD-ROM drive.
4. Access the CD-ROM drive and double-click the icon of “akd4370.exe” to set up the control program.
5. Then please 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.
3. Click “Write default” button

### ■ Explanation of each buttons

1. [Port Reset] : Set up the USB interface board (AKDUSBIF-A) when using the board.
2. [Write default] : Initialize the register of AK4370.
3. [All Write] : Write all registers 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”.

If you want to write the input data to AK4370, 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.

If you want to write the input data to AK4370, click [OK] button. If not, click [Cancel] button.

### 3. [Function2 Dialog] : Dialog to evaluate DATT

There are dialogs corresponding to register of 05h, 06h, 09h and 0Eh.

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 AK4370 by this interval.

Step Box: Data changes by this step.

Mode Select Box:

If you check 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

If you do not check 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

If you want to write the input data to AK4370, click [OK] button. If not, click [Cancel] button.

#### 4. [SAVE] and [OPEN]

##### 4-1. [SAVE]

All of current register setting values displayed on the main window are saved to the file. The extension of file name is “akr”.

<Operation flow>

- (1) Click [SAVE] Button.
- (2) Set the file name and click [SAVE] Button. The extension of file name is “akr”.

##### 4-2. [OPEN]

The register setting values saved by [SAVE] are written to the AK4370. The file type is the same as [SAVE].

<Operation flow>

- (1) Click [OPEN] Button.
- (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. The default setting sequence DAC->HP(3D=OFF) is displayed. Jump to (3) below if the default setting sequence is used. Go to (2) if the other setting sequence is required.
- (2) 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".

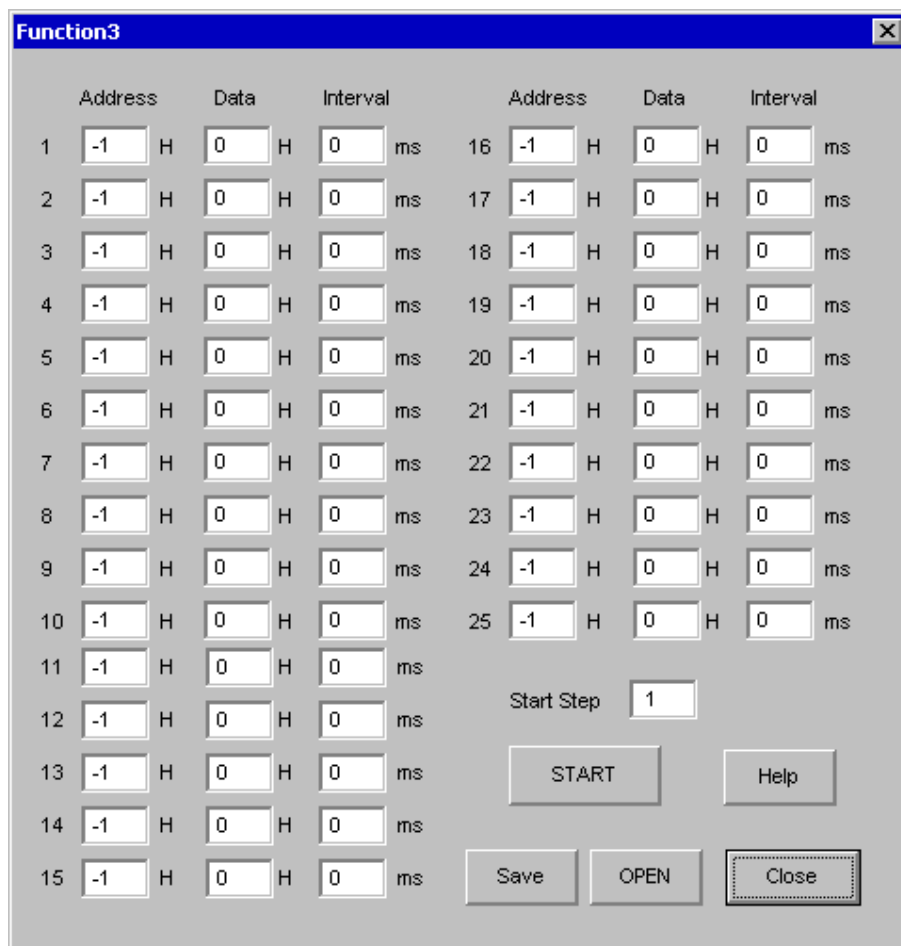


Figure 9. Window of [F3]

### 6. [Function4 Dialog]

The sequence file (\*.aks) saved by [Function3] can be listed up to 10 files, assigned to buttons and then executed. When [F4] button is clicked, the window as shown in Figure 9 opens.

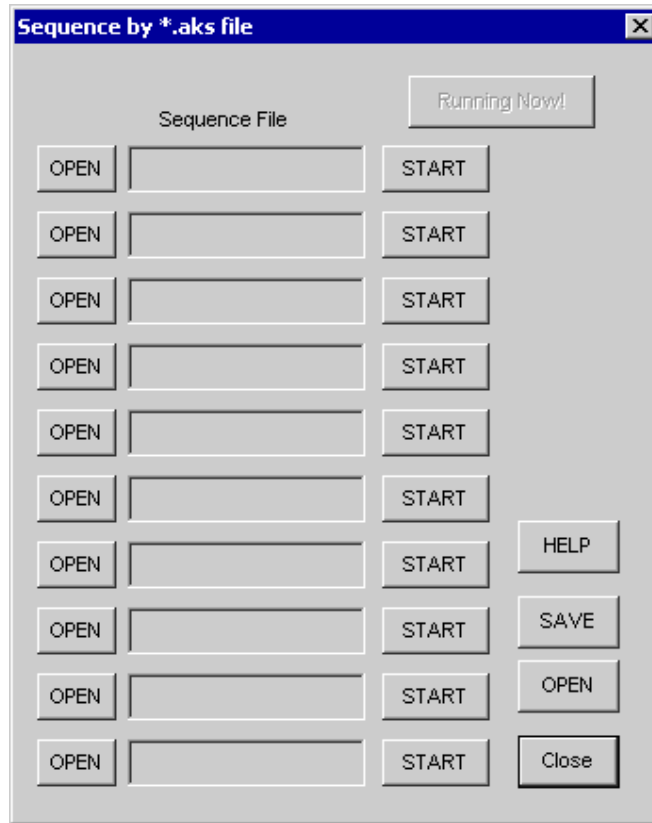


Figure 10. [F4] window

## 6-1. [OPEN] buttons on left side and [START] buttons

(1) Click [OPEN] button and select the sequence file (\*.aks) saved by [Function3].

The sequence file name is displayed as shown in Figure 10. ( In case that the selected sequence file name is “DAC\_Stereo\_ON.aks”)

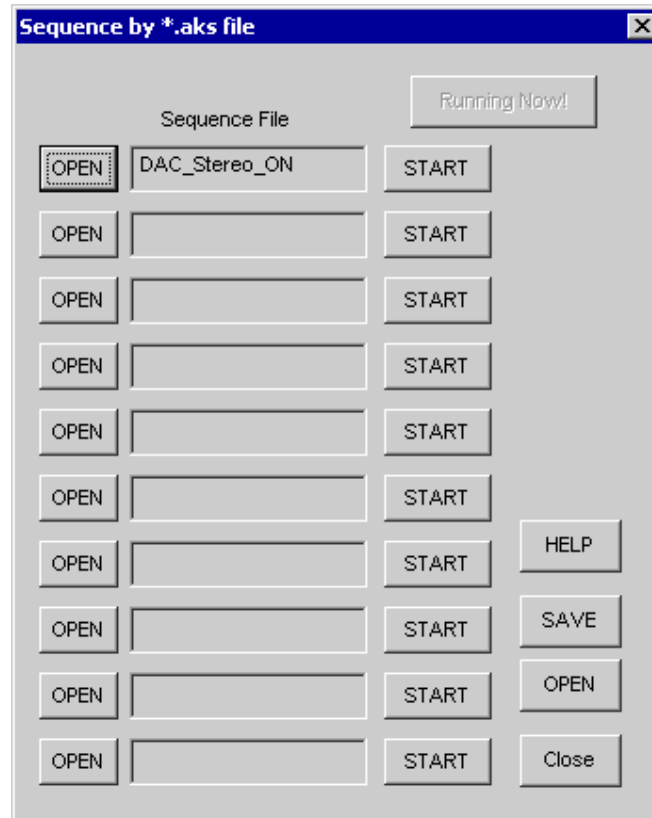


Figure 11. [F4] window (2)

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

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

[SAVE] : The name assign of sequence file displayed on [Function4] window can be saved to the file. The file name is “\*.ak4”.

[OPEN] : The name assign of sequence file(\*.ak4) saved by [SAVE] is loaded.

## 6-3. Note

- (1) This function doesn't support the pause function of sequence function.
- (2) All files used by [SAVE] and [OPEN] function on right side need to be in the same folder.
- (3) When the sequence is changed in [Function3], the sequence file (\*.aks) should be loaded again in order to reflect the change.

## 7. [Function5 Dialog]

The register setting file(\*.akr) saved by [SAVE] function on main window can be listed up to 10 files, assigned to buttons and then executed. When [F5] button is clicked, the window as shown in Figure 11 opens.

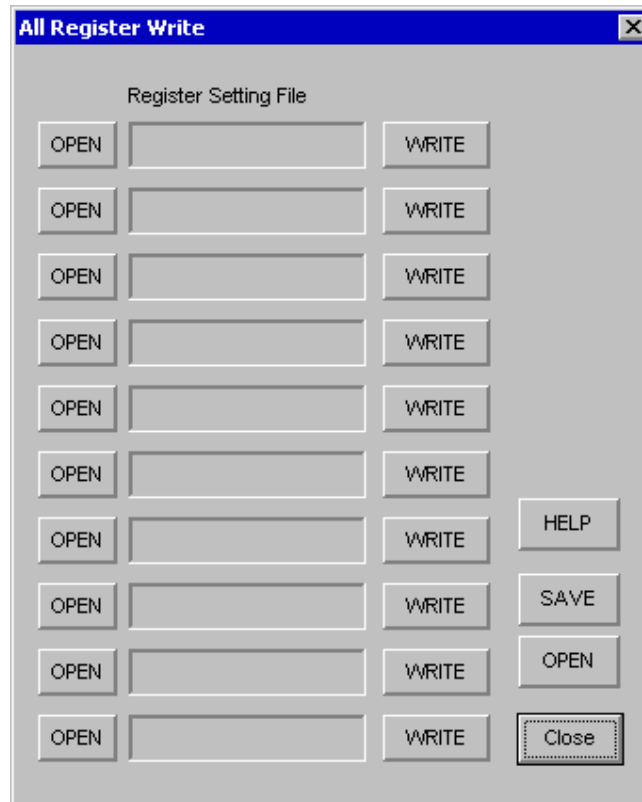


Figure 12. [F5] window

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

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

The register setting file name is displayed as shown in Figure 12. (In case that the selected file name is "DAC\_Output.akr")

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

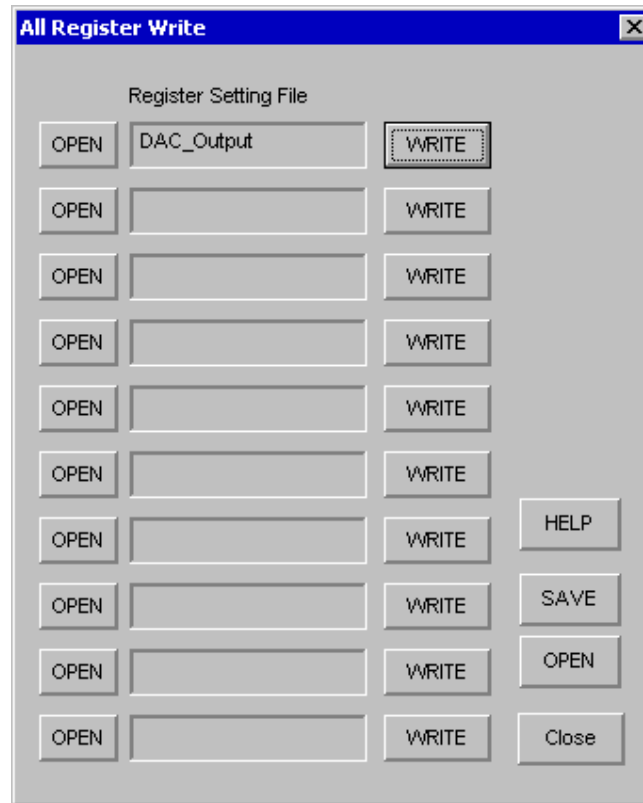


Figure 13. [F5] window (2)

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

[SAVE] : The name assign of register setting file displayed on [Function5] window can be saved to the file. The file name is “\*.ak5”.

[OPEN] : The name assign of register setting file(\*.ak5) saved by [SAVE] is loaded.

#### 7-3. Note

- (1) All files used by [SAVE] and [OPEN] function on right side need to be in the same folder.
- (2) When the register setting is changed by [SAVE] Button on the main window, the register setting file (\*.akr) should be loaded again in order to reflect the change.



**MEASUREMENT RESULTS**

[Measurement condition]

- Measurement unit : Audio Precession System Two Cascade
- MCLK : 11.2896MHz
- BICK : 64fs
- fs : 44.1kHz
- Bit : 24bit
- Measurement Mode : Slave Mode
- Power Supply : AVDD = HVDD = DVDD = PVDD = 3.3V
- Measurement Filter : 22Hz ~ 20kHz
- Temperature : Room

| Parameter DAC Analog Output Characteristics                 | Result (Lch / Rch) | Unit |
|-------------------------------------------------------------|--------------------|------|
| <b>DAC -&gt; HP AMP <math>R_L=16\Omega</math></b>           |                    |      |
| THD+N (0dBFS Output)                                        | 54.1 / 54.2        | dB   |
| D-Range (-60dB Output, A-weighted)                          | 92.7 / 92.7        | dB   |
| S/N (A-weighted)                                            | 93.2 / 93.2        | dB   |
| <b>DAC -&gt; LOU<sub>T</sub> <math>R_L=47k\Omega</math></b> |                    |      |
| THD+N (0dBFS Output)                                        | 59.8 / 60.0        | dB   |
| D-Range (-60dB Output, A-weighted)                          | 90.2 / 90.2        | dB   |
| S/N (A-weighted)                                            | 90.4 / 90.2        | dB   |

[Plot of Headphone Amp]

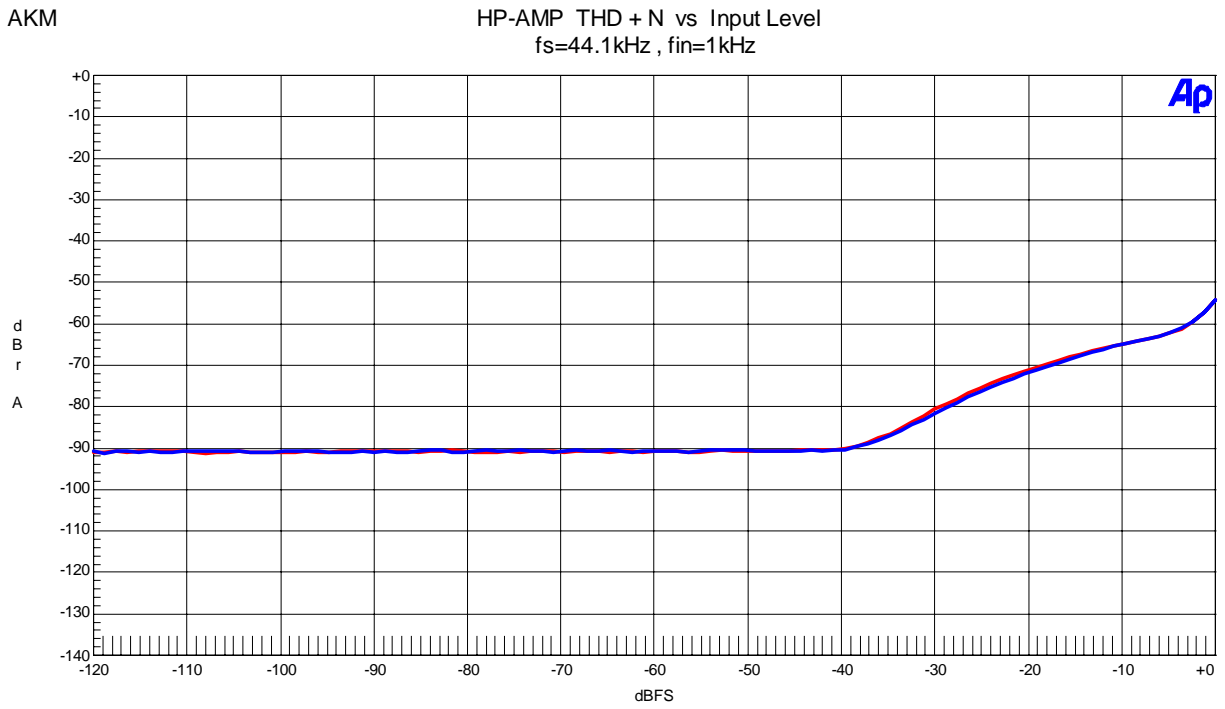


Figure 14. THD+N vs. Input Level

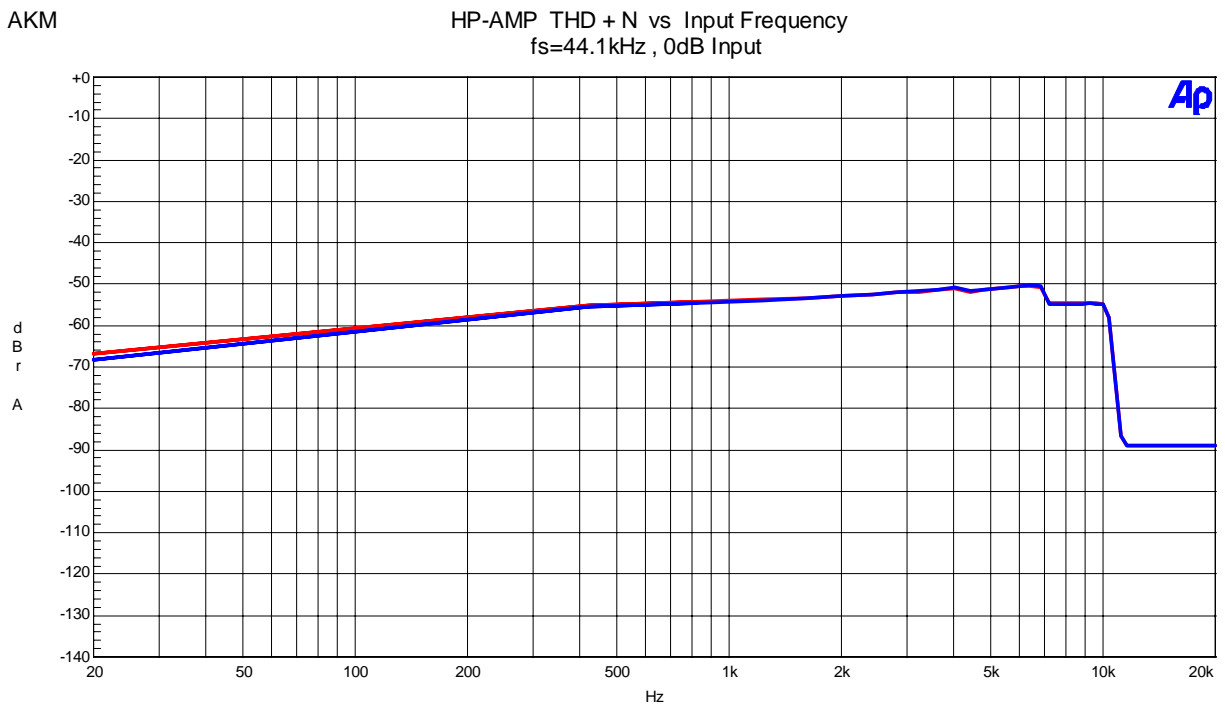


Figure 15. THD+N vs. Input Frequency

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HP-AMP THD + N vs Linearity  
fs=44.1kHz , fin=1kHz

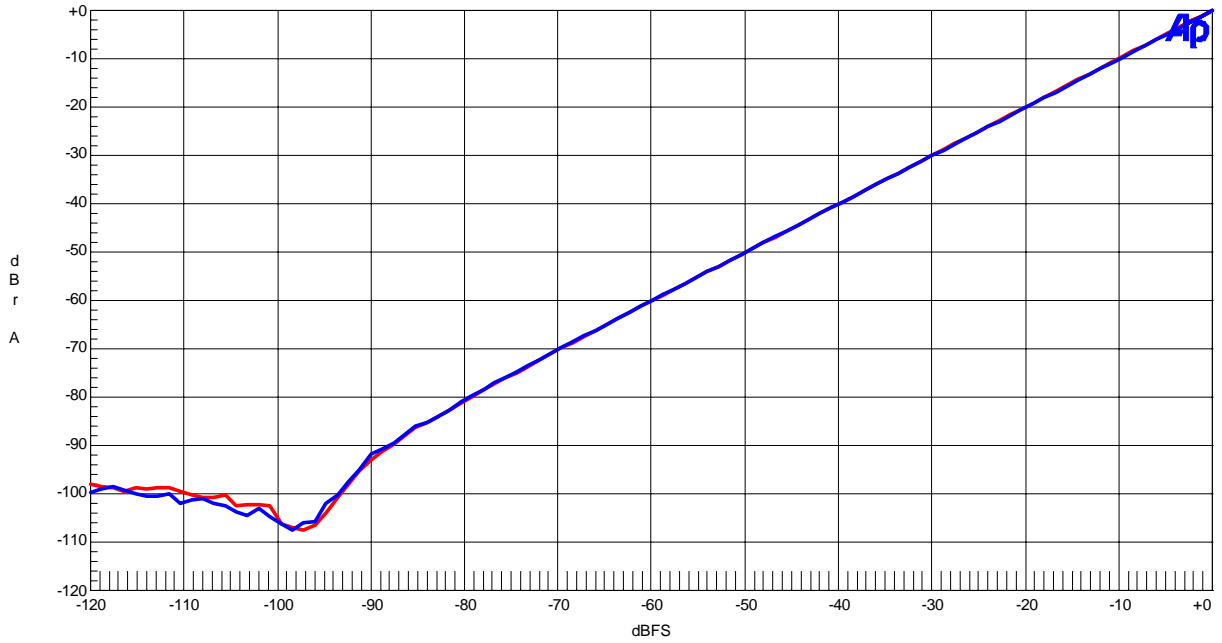


Figure 16. Linearity

AKM

HP-AMP Frequency Response  
fs=44.1kHz , 0dB Input

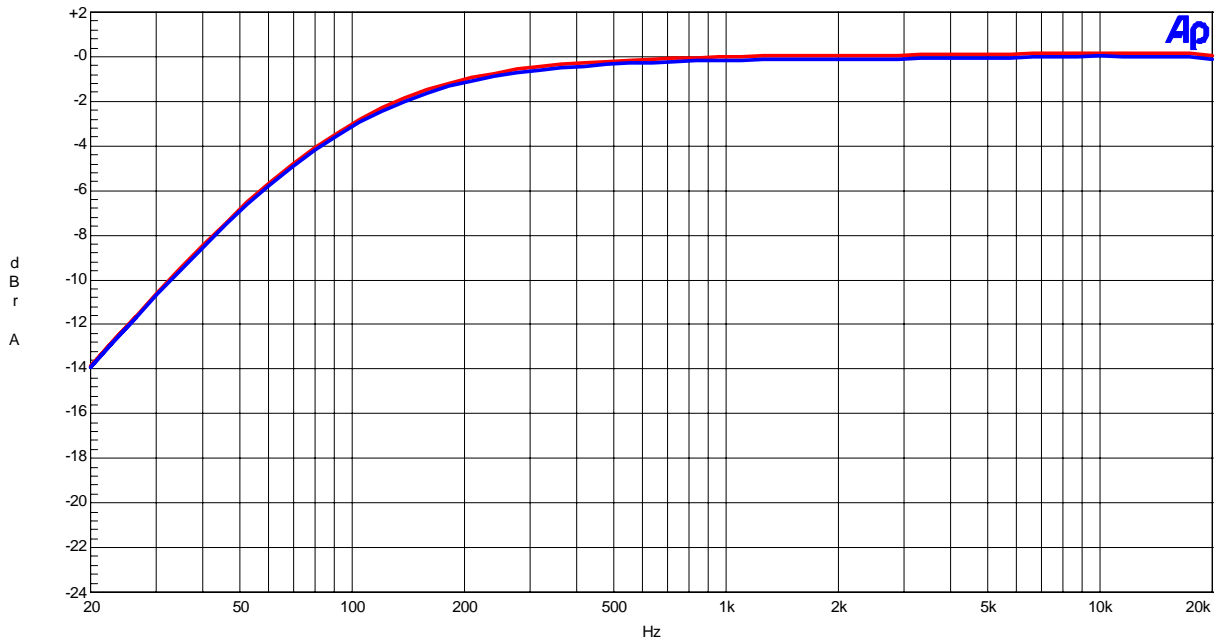


Figure 17. Frequency Response  
(including external HPF)

AKM

HP-AMP FFT  
fs=44.1kHz , 0dB Input

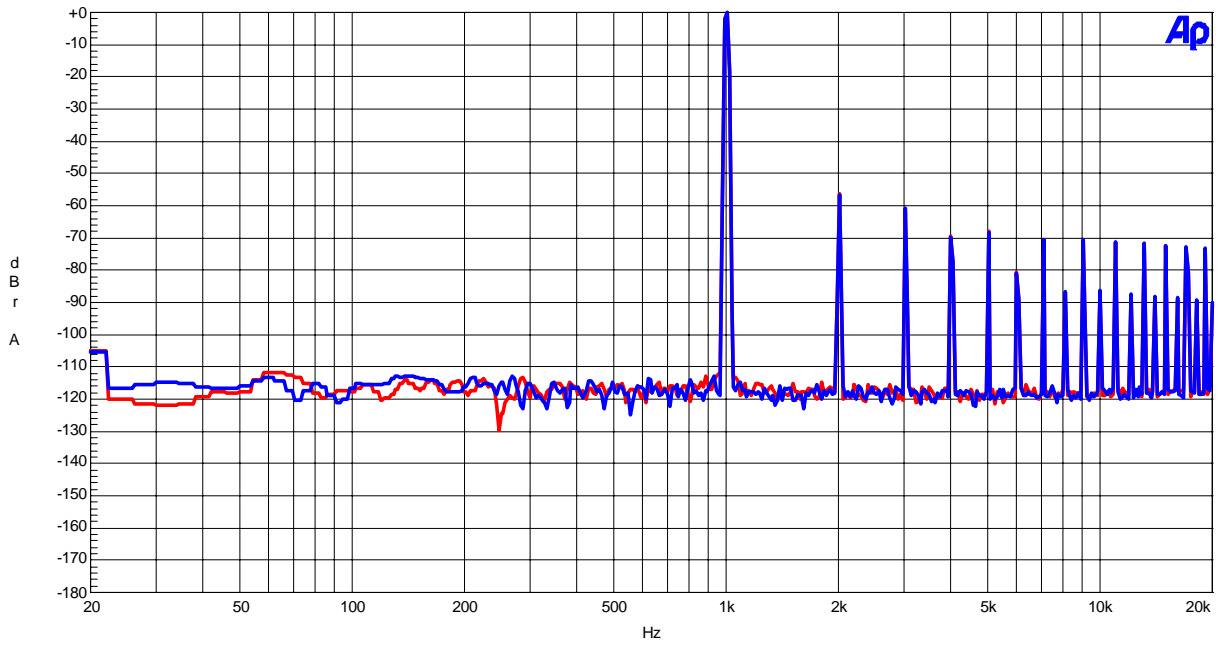


Figure 18. FFT Plot(1kHz,0dB)

AKM

HP-AMP FFT  
fs=44.1kHz , -60dB Input

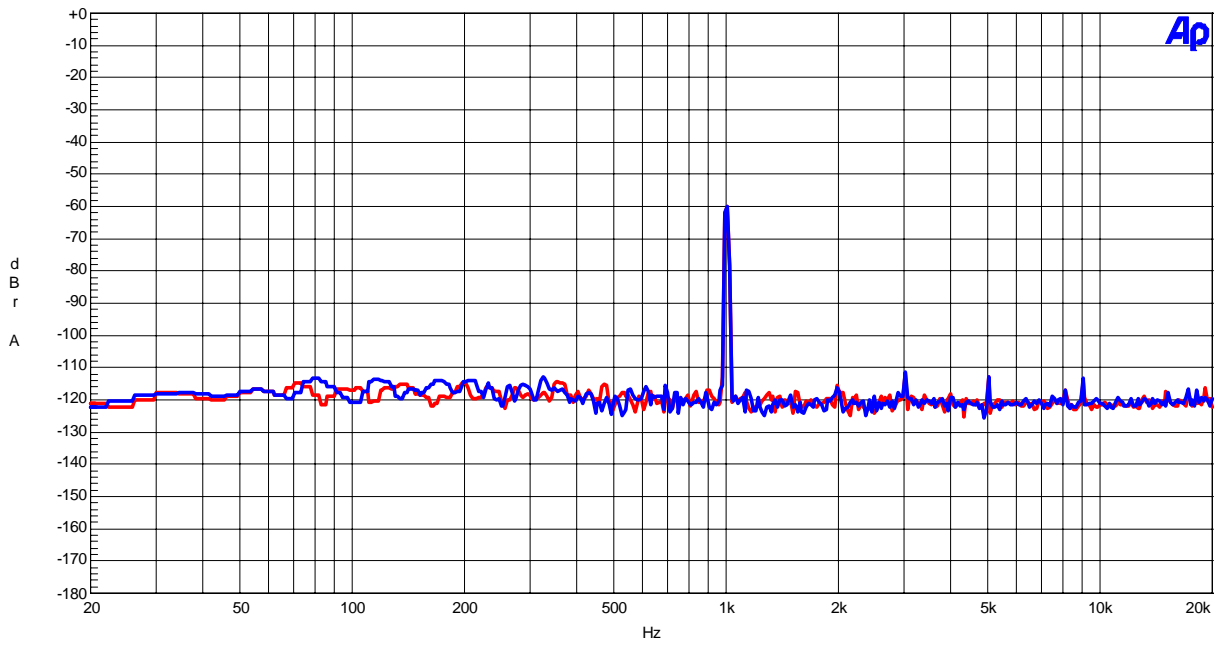


Figure 19. FFT Plot(1kHz,-60dB)

AKM

HP-AMP FFT  
fs=44.1kHz , No Signal

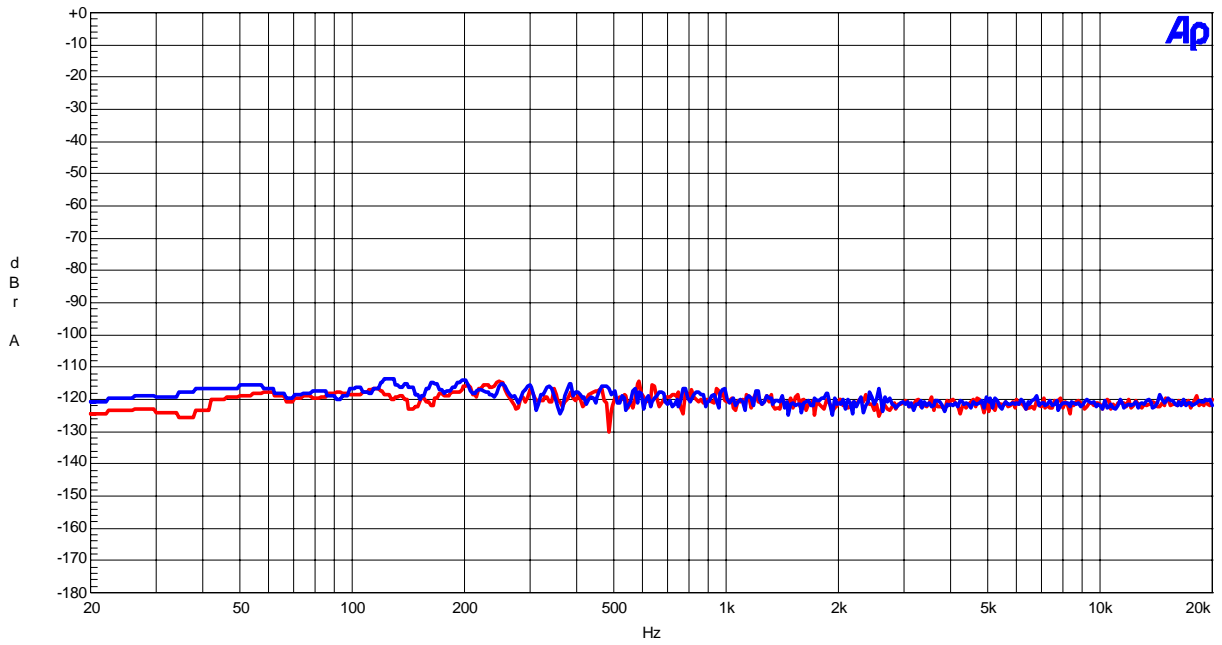


Figure 20. FFT Plot(Noise Floor)

AKM

HP-AMP FFT  
fs=44.1kHz , Outband Noise

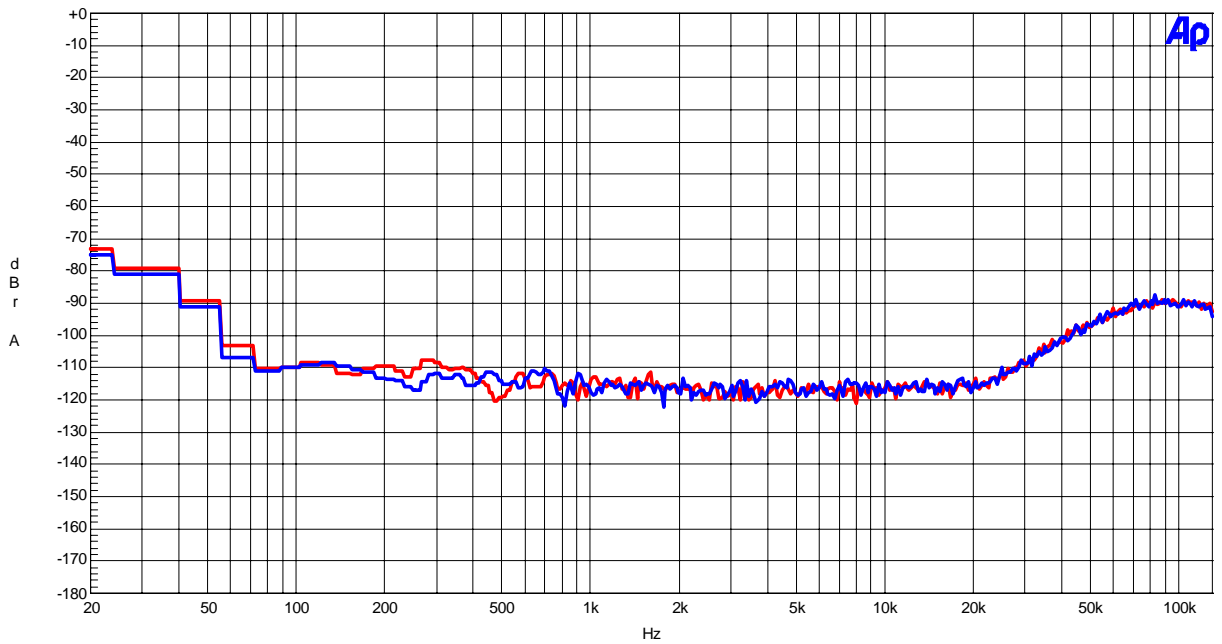


Figure 21. Out-band Noise

AKM

HP-AMP Crosstalk  
fs=44.1kHz, 0dB Input

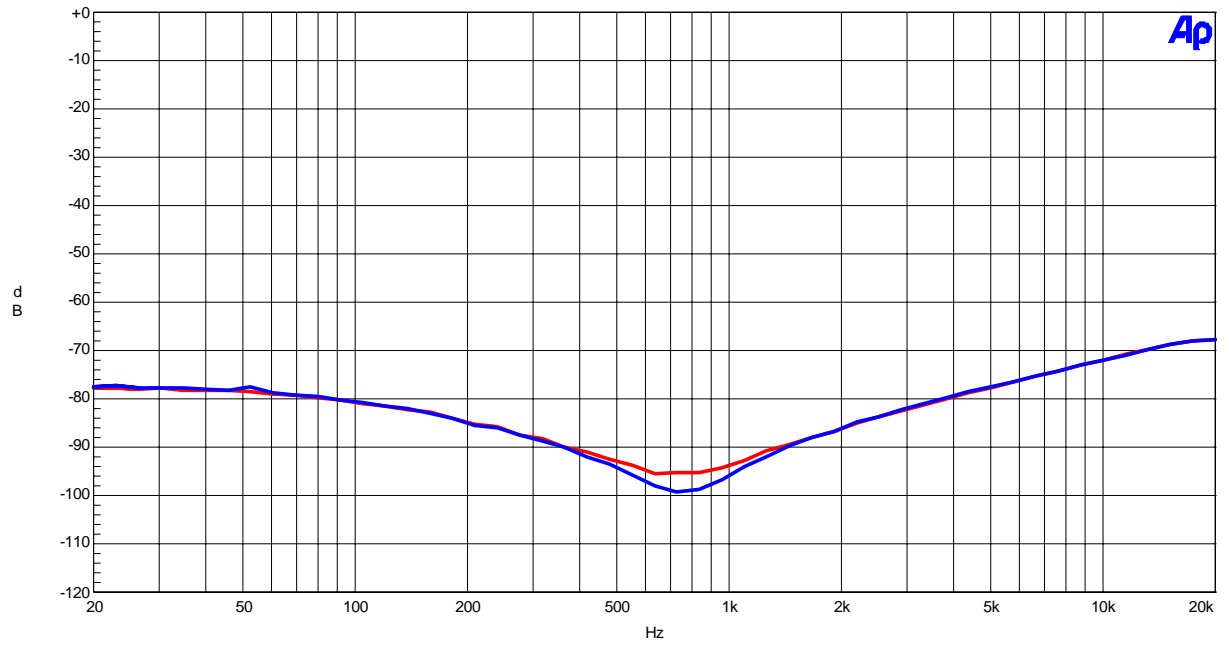


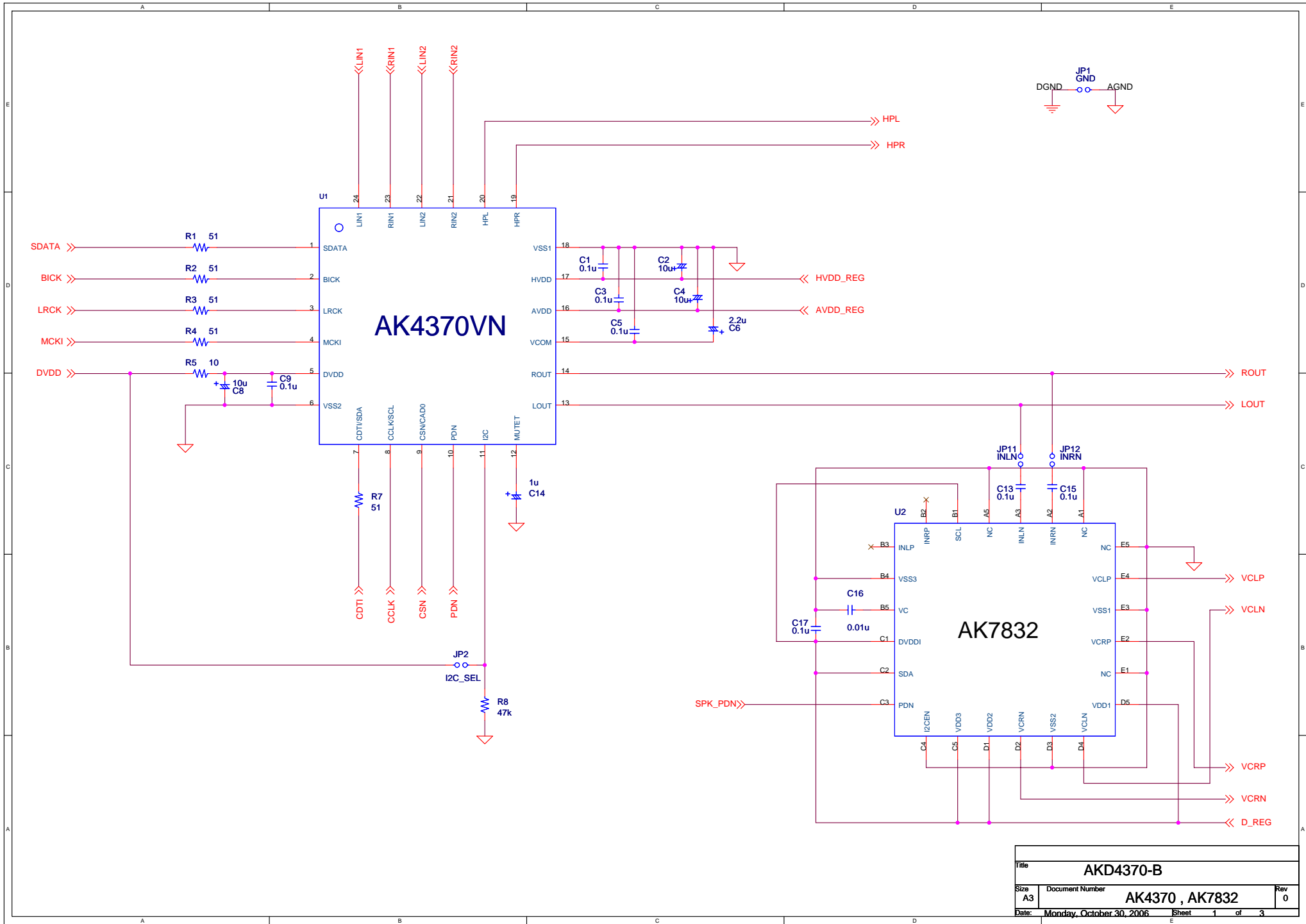
Figure 22. Crosstalk

**Revision History**

| Date<br>(YY/MM/DD) | Manual<br>Revision | Board<br>Revision | Reason        | Contents |
|--------------------|--------------------|-------------------|---------------|----------|
| 06/12/12           | KM086300           | 0                 | First edition |          |

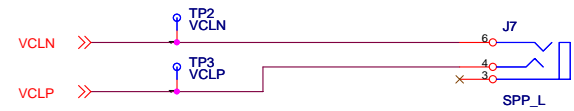
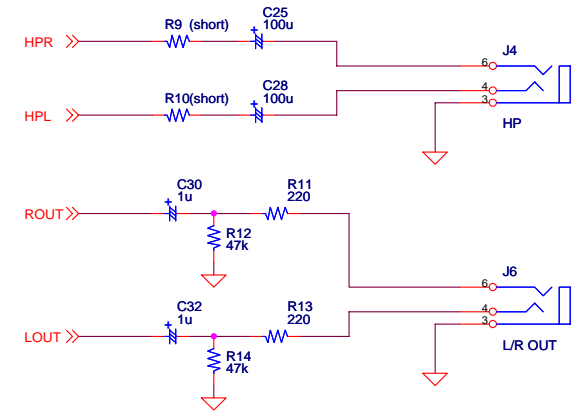
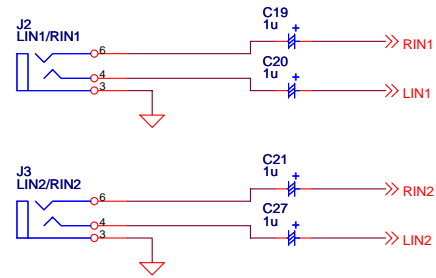
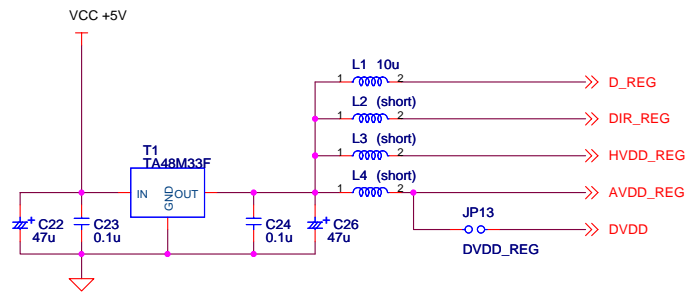
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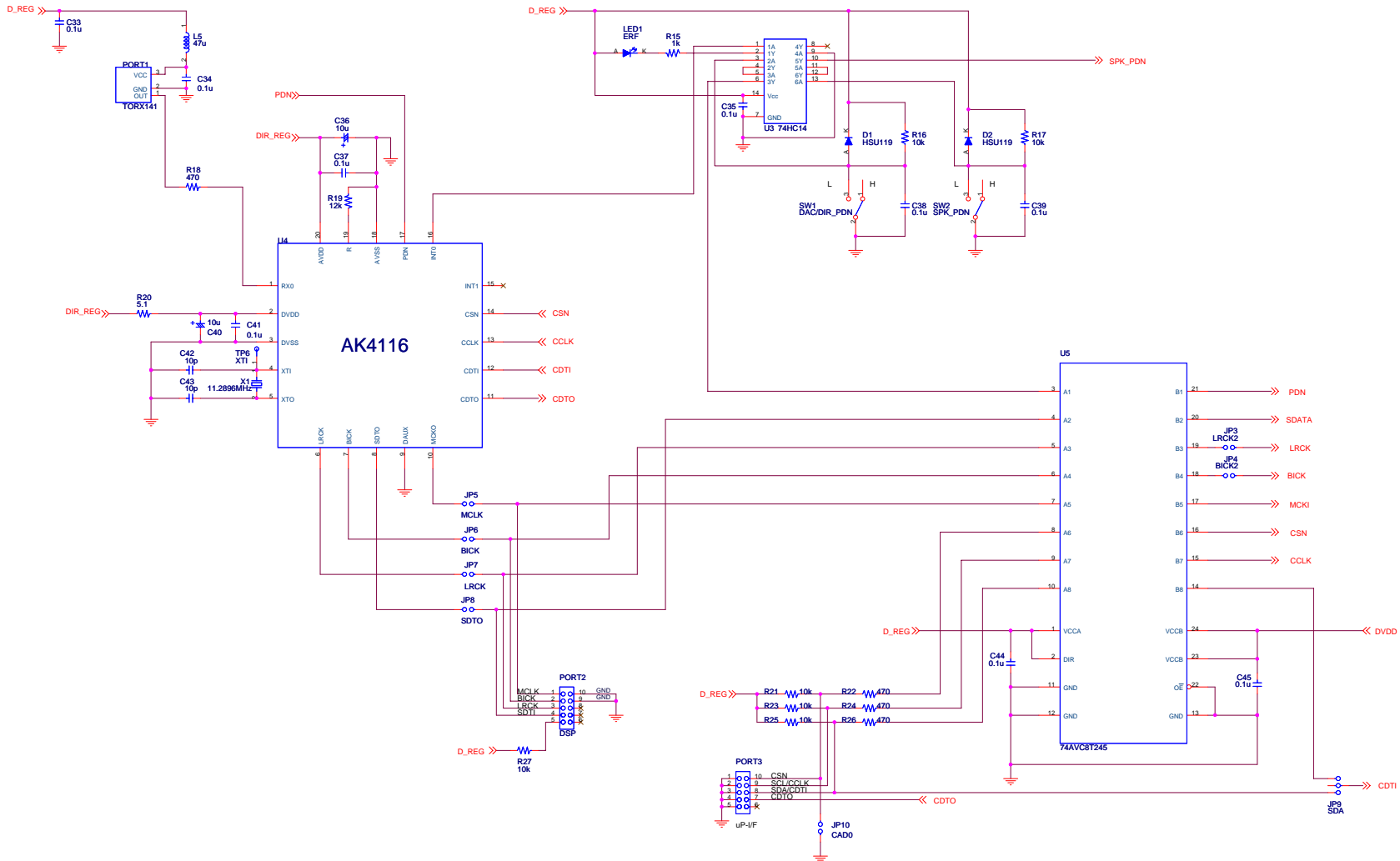


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| Title |                          |                 | AKD4370-B |    |     |
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| A3    |                          |                 |           |    | 0   |
| Date: | Monday, October 30, 2006 | Sheet           | 1         | of | 3   |





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| Size | Document Number             | Rev          |
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| Date | Thursday, November 16, 2006 | Sheet 3 of 3 |

