AKM

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.
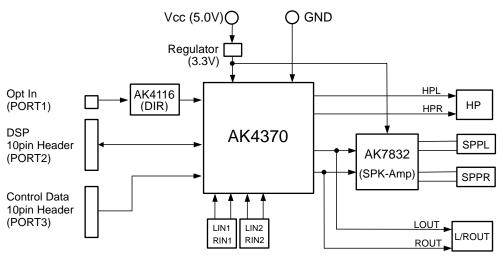
■ **Ordering guide**

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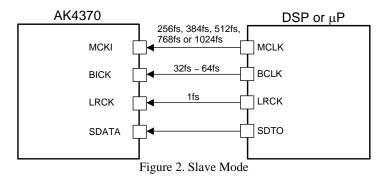**When inputting the data from the PORT2, the AK4370's audio interface format should be set to correspond the input data's audio interface format. Refer to the AK4370's datasheet.**

<u>Applicable Evaluation Mode</u>

       (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.
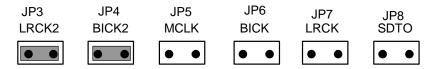

Figure 2. Slave Mode

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

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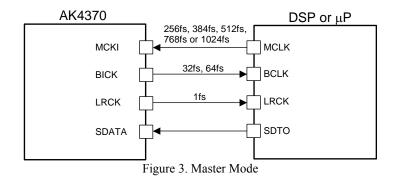Set up the jumper pins.

(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.
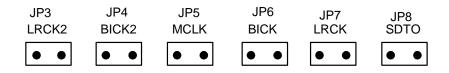Set up the jumper pins.

(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.
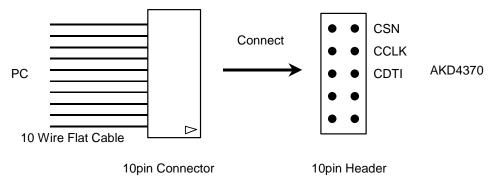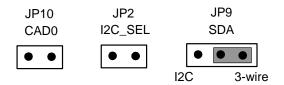

Figure 4. Connect of 10 wire flat cable
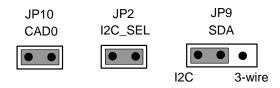
(1) 3-wire Serial Control Mode <Default>
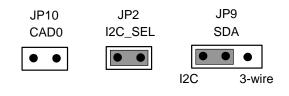
The jumper pins should be set to the followings.

(2) I²C-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**

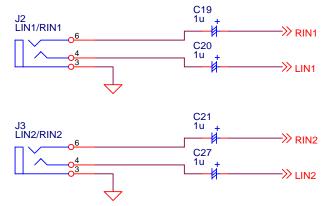**(1) Input Circuit**

LIN1/RIN1, LIN2/RIN2 Input circuits

Figure 5. LIN1/RIN1,LIN2/RIN2 Input circuits
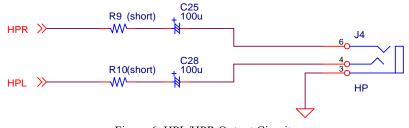
(2) Output Circuit

1) HPL/HPR Output Circuit

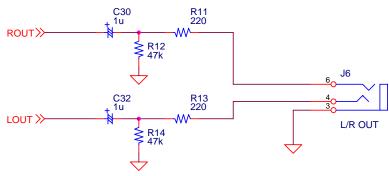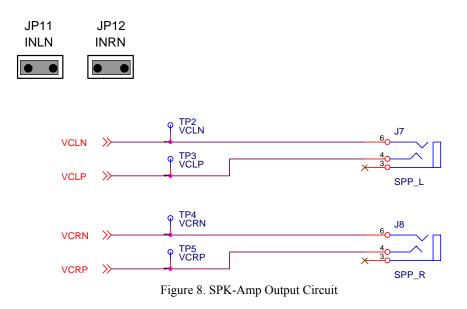Figure 6. HPL/HPR Output Circuit

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.

JP11   JP12
INLN   INRN

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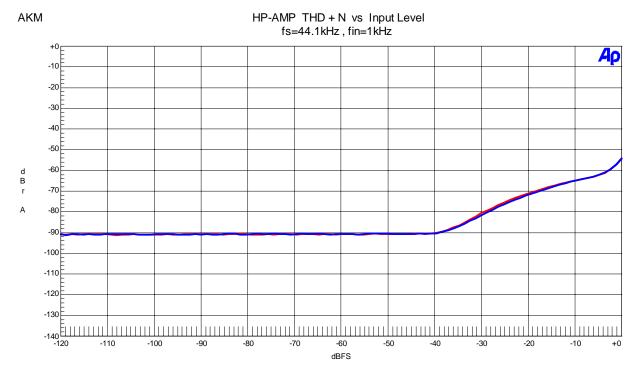
MEASUREMENT RESULTS
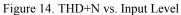
[Measurement condition]
- Measurement unit   : Audio Precession System Two Cascade
- MCLK   : 11.2896MHz
- BICK   : 64fs
- fs   : 44.1kHz
- Bit   : 24bit
- Measurement Mode   : Slave Mode
- Power Supply   : AVDD = HVDD = DVDD = PVDD = 3.3V
- Measurement Filter   : 22Hz ~ 20kHz
- Temperature   : Room

Parameter DAC Analog Output Characteristics	Result (Lch / Rch)	Unit
DAC -> HP AMP R_L=16Ω		
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
DAC -> LOUT R_L=47kΩ		
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]

AKM   HP-AMP THD + N vs Input Level
                                  fs=44.1kHz , fin=1kHz

Figure 14. THD+N vs. Input Level

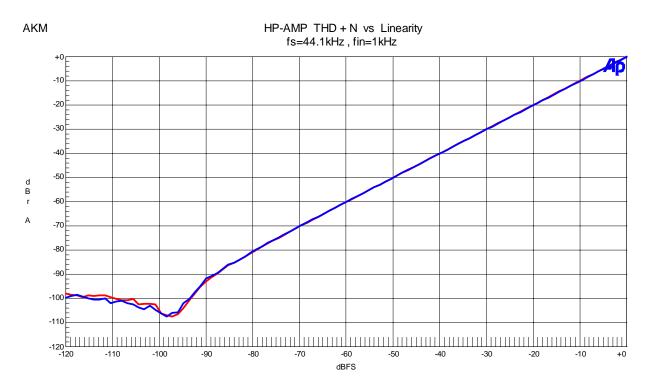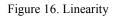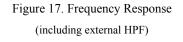AKM   HP-AMP THD + N vs Input Frequency
                                  fs=44.1kHz , 0dB Input
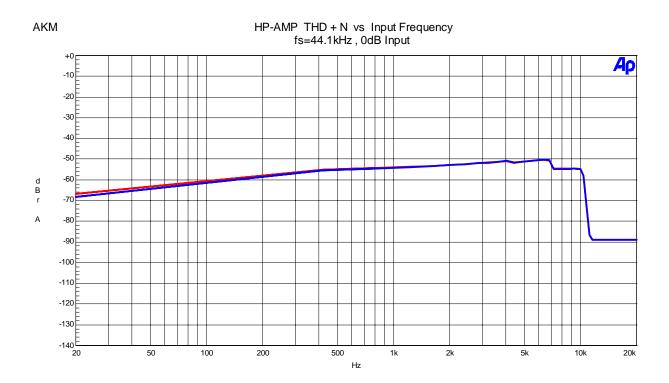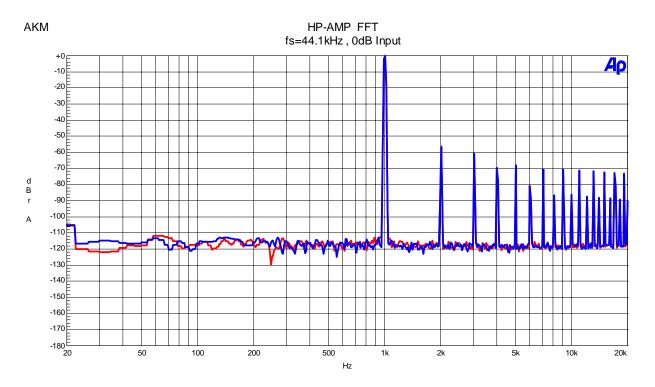
Figure 15. THD+N vs. Input Frequency

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

Figure 16. Linearity
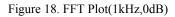
AKM   HP-AMP Frequency Response
                                                    fs=44.1kHz , 0dB Input

Figure 17. Frequency Response

(including external HPF)

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

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

AKM

HP-AMP FFT
fs=44.1kHz , -60dB Input
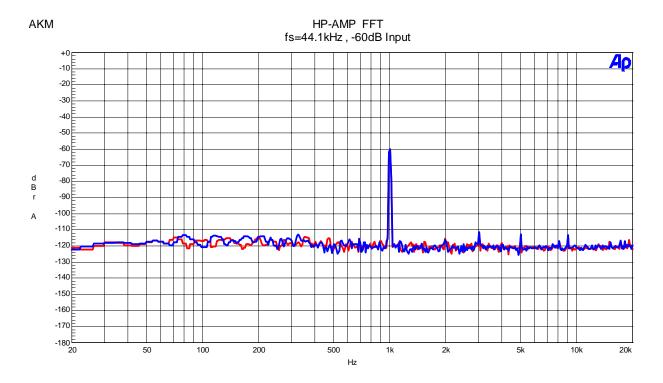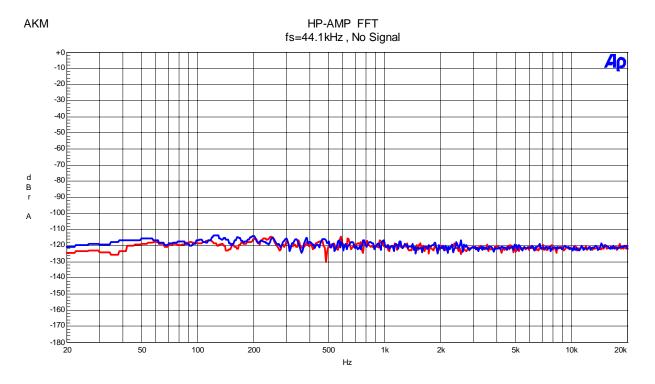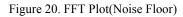
Figure 19. FFT Plot(1kHz,-60dB)

AKM

HP-AMP FFT
fs=44.1kHz , No Signal

Figure 20. FFT Plot(Noise Floor)

AKM

HP-AMP FFT
fs=44.1kHz , Outband Noise
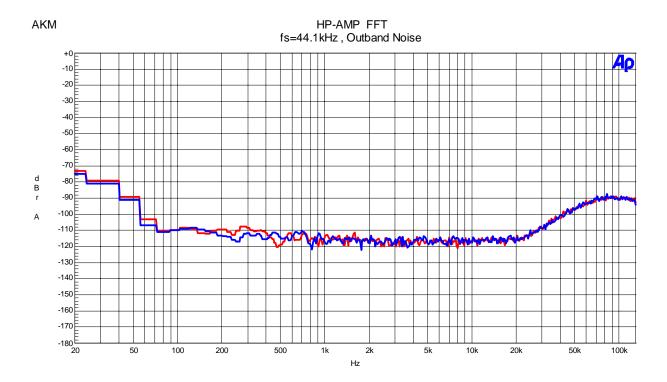
Figure 21. Out-band Noise

AKM   HP-AMP Crosstalk
                                       fs=44.1kHz , 0dB Input
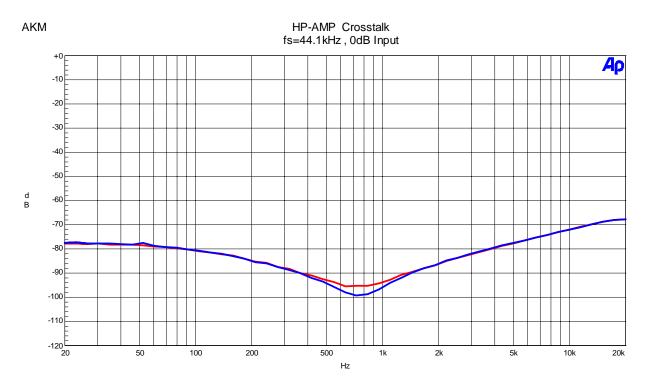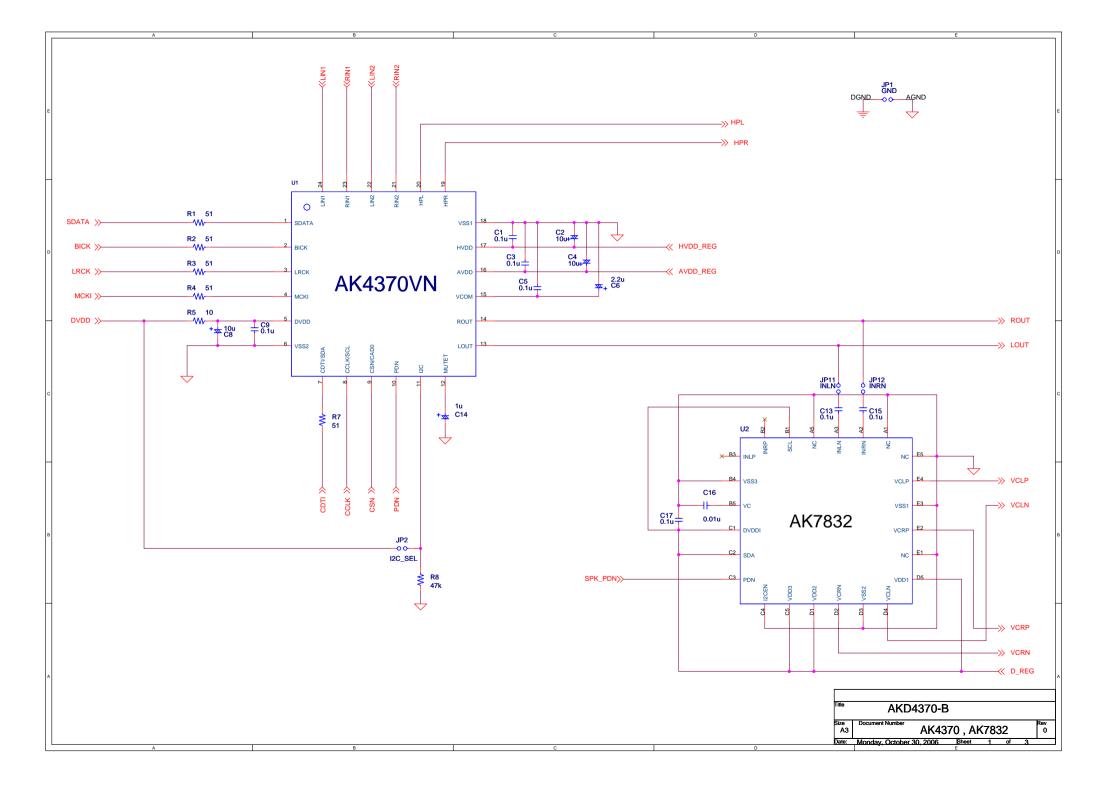
Figure 22. Crosstalk

Revision History				

Date (YY/MM/DD)	Manual Revision	Board Revision	Reason	Contents
06/12/12	KM086300	0	First edition	

AKD4370-B

Size	Document Number		Rev
A3	AK4370 , AK7832		0

Date: Monday, October 30, 2006   Sheet   1   of   3

VCC +5V

T1
TA48M33F
IN
GND
OUT

C22 47u
C23 0.1u
C24 0.1u
C26 47u

L1 10u → D_REG
L2 (short) → DIR_REG
L3 (short) → HVDD_REG
L4 (short) → AVDD_REG
JP13 → DVDD
DVDD_REG

J2
LIN1/RIN1
6
4
3
C19 1u → RIN1
C20 1u → LIN1

J3
LIN2/RIN2
6
4
3
C21 1u → RIN2
C27 1u → LIN2

HPR → R9 (short) — C25 100u
HPL → R10(short) — C28 100u
J4
6
4
3
HP

ROUT → C30 1u — R11 220
R12 47k
LOUT → C32 1u — R13 220
R14 47k
J6
6
4
3
L/R OUT

VCLN → TP2 VCLN
VCLP → TP3 VCLP
J7
6
4
3
SPP_L

VCRN → TP4 VCRN
VCRP → TP5 VCRP
J8
6
4
3
SPP_R

Title: AKD4370-B
Input/Output
Size A3
Rev 0
Document Number
Date: Monday, October 30, 2006
Sheet 2 of 3

AK4116

U4

U5

74AVC8T245

PORT1
TORX141

PORT2
DSP

PORT3
uP-I/F

U3 74HC14

D1 HSU119
D2 HSU119

SW1 DAC/DIR_PDN
SW2 SPK_PDN

LED1 ERF

JP3 LRCK2
JP4 BICK2
JP5 MCLK
JP6 BICK
JP7 LRCK
JP8 SDTO
JP9 SDA
JP10 CAD0

X1 11.2896MHz

D_REG
DIR_REG
SPK_PDN
PDN
SDATA
LRCK
BICK
MCKI
CSN
CCLK
DVDD
CDTI
CDTO

AKD4370-B Rev.0
Evaluation Board

DGND

J2 LIN1/RIN1   J3 LIN2/RIN2

AGND   VCC +5V

C40 C19   C27 C21

C26 C22

C24 C23

AKM

T1

JP1
GND

JP5 MCLK
JP6 SDTO
JP8 BICK
JP7 LRCK

R1
R2
R3
R4
R5
R6

C8

AK4370
U1
24 19

C3
C4

C28

J4 HP

L5

R19
C37
R20

AK4116
U4

DVDD AVDD

C5 C6

C14

C25

JP13 JP2
I2C SEL

R7
R8

R10

L2 L4   L3 L1

C44 C45

JP9 SDA
3-wire I2C

JP11 JP12

J6 L/ROUT

C32 R13
R14

C36 R12
R11

INLN   INRN

C13   C15

C16   C17

A3   A1

U2

AK7832

J8

VCRN VCRP
TP4 TP5

SPP_R

VCLN VCLP
TP2 TP3

SPP_L

J7

R18
C36 C34

POGT1
VCC
GND
OUT

C41
TP61
C40

X1 C42 C43

XT1

R22 R24 R30 R29 R21
R23 R25 R35 R28 R31

74AWC8T245 JP6
U5 13
JP7 JP6
JP4

JP3
JP10

LED1
2   1

R15 C35

POGT2
MCLK GND
BICK GND
LRCK NC
SDTI NC
VCC   NC

R27

74HC14
U3

C38
R16

C39
R77

D1 A   D2 A

DAC/DIR_PDN   SPK_PDN

SW1   SW2

GND CSN
GND SCL/CCLK
GND SDA/CDTI
GND CDTO
GND NC

PORT3

BICK2
LRCK2
CAD0