AsahiKASEI
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AKD4371-B

AK4371 Evaluation Board Rev.1

GENERAL DESCRIPTION

The AKD4371 is an evaluation board for 24bit DAC with Headphone Amplifier, AK4371. The AKD4371 has the interface with AKM's ADC evaluation boards. Therefore, it's easy to evaluate the AK4371. The ADK4370 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector.

■ Ordering guide

AKD4371-B --- Evaluation board for AK4371
(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)**

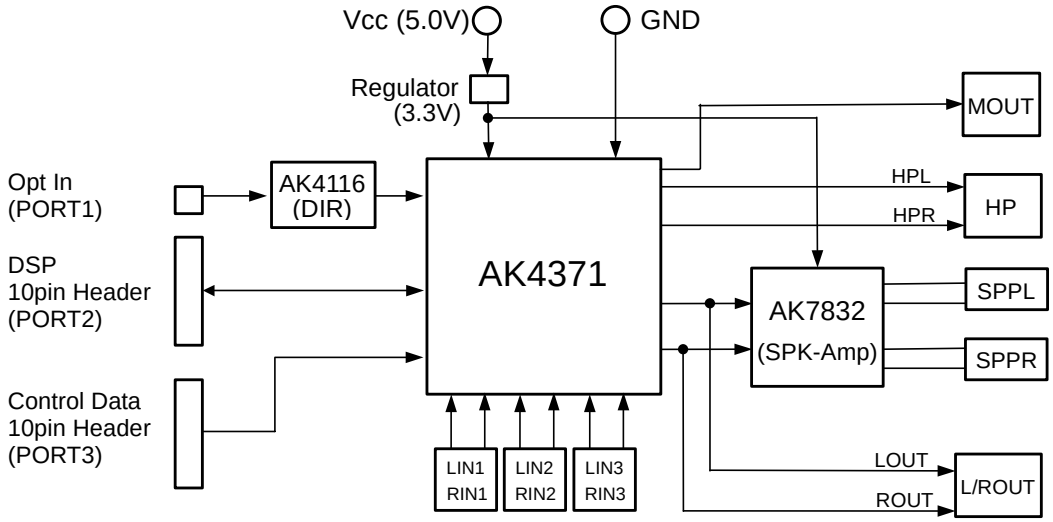


Figure 1. AKD4371 Block Diagram

* 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 AK4371 via the regulator.

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

3) Power on.
   The AK4371 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 AK4371 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 AK4371's audio interface format should be set to correspond the input data's audio interface format. Refer to the AK4371's datasheet.

Applicable Evaluation Mode

(1) PLL Master Mode
(2) PLL Slave Mode
    (2-1) PLL Reference Clock : MCKI pin
    (2-2) PLL Reference Clock : BICK or LRCK pin
(3) External Slave Mode
    (3-1) Evaluation using DIR (Optical Link) of AK4116 <default>
    (3-2) Evaluation connecting AKD4371 with external DSP
(4) External Master Mode

(1) PLL Master Mode

PORT2 (DSP) is used. Nothing should be connected to PORT1(DIR). BICK and LRCK are supplied from PORT2.It is possible to evaluate at various sampling frequencies using built-in the AK4371's PLL.

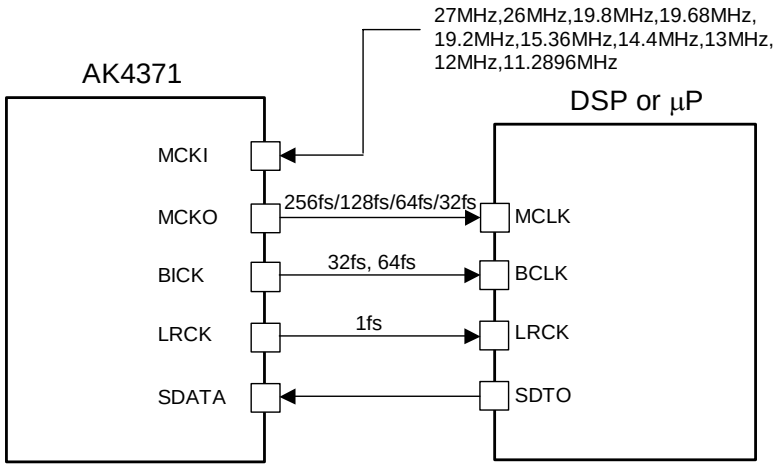
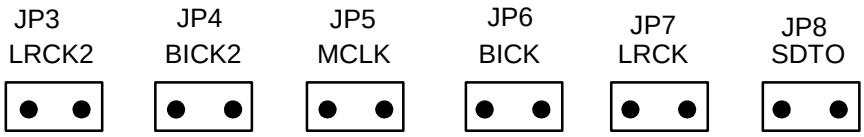


Figure 2. PLL Master Mode

The system clock should be connected to MCLK of PORT2. SDTI of PORT2 should be connected to SDTO of DSP. The JP3(LRCK2) and JP4(BICK2)'s right side should be connected to LRCK and BICK of DSP.
In case of supplying MCKO to DSP, the test pin(MCKO) should be connected to MCLK of DSP.
Set up the jumper pins.



(2) PLL Slave Mode

(2-1) PLL Reference Clock : MCKI pin

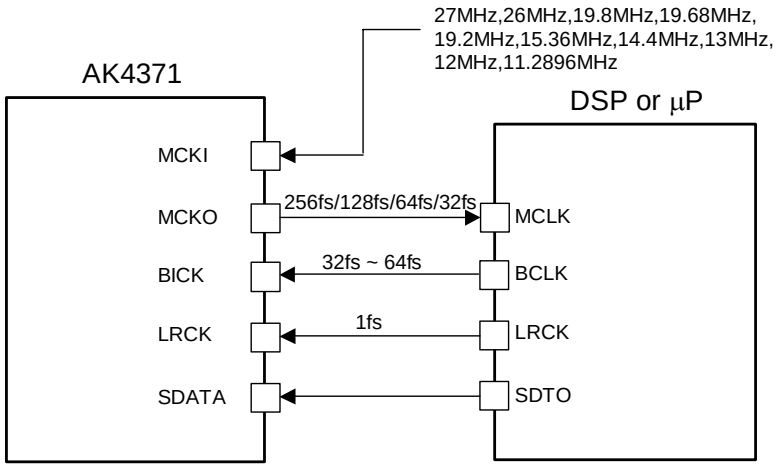
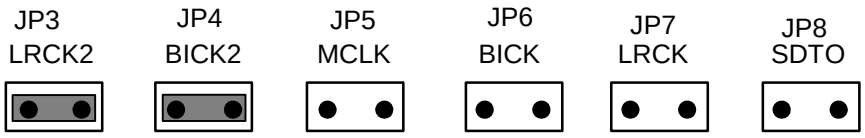


Figure 3. PLL Master Mode (PLL Reference Clock : MCKI pin)

PORT2 (DSP) is used. Nothing should be connected to PORT1(DIR).
MCKO is needed for a synchronous signal of BICK and LRCK.
MCLK,BICK,LRCK and SDATA are supplied from PORT2. The test pin(MCKO) should be connected to MCLK of DSP.
Set up the jumper pins.



(2-2) PLL Reference Clock : BICK or LRCK pin

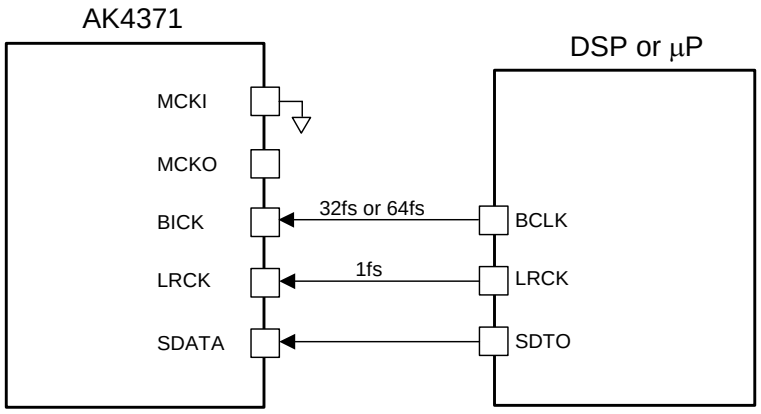
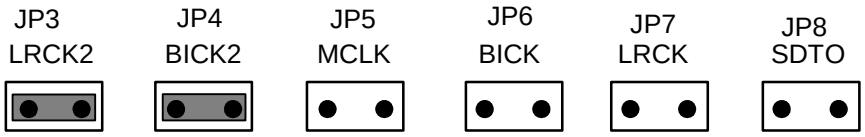


Figure 4. PLL Master Mode (PLL Reference Clock : BICK or LRCK pin)

PORT2 (DSP) is used. Nothing should be connected to PORT1(DIR).
BICK,LRCK and SDATA are supplied from PORT2.
Set up the jumper pins.



(3) External Slave Mode

The AK4371's register should be set to EXT Slave Mode. MCKI frequency should be set to the same as the specification of DSP or DIR. About the AK4371's register definitions, refer to datasheet of the AK4371.

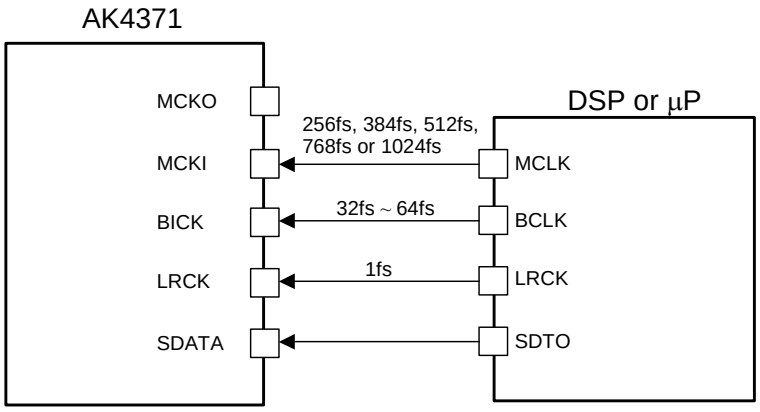
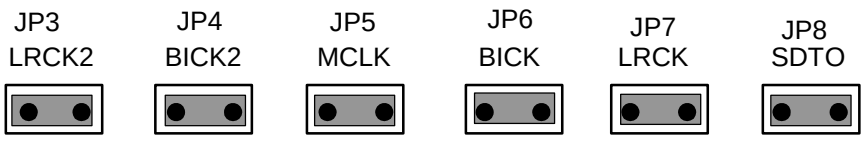


Figure 5. External Slave Mode

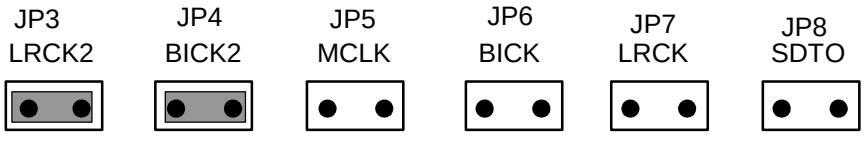
(3-1) Evaluation using DIR (Optical Link) of AK4116 <default>

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



(3-2) Evaluation connecting AKD4371 with external DSP

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



(4) External Master Mode

The AK4371's register should be set to EXT Master Mode. MCKI frequency should be set to the same as DSP's specification. About the AK4371's register definitions, refer to datasheet of the AK4371.

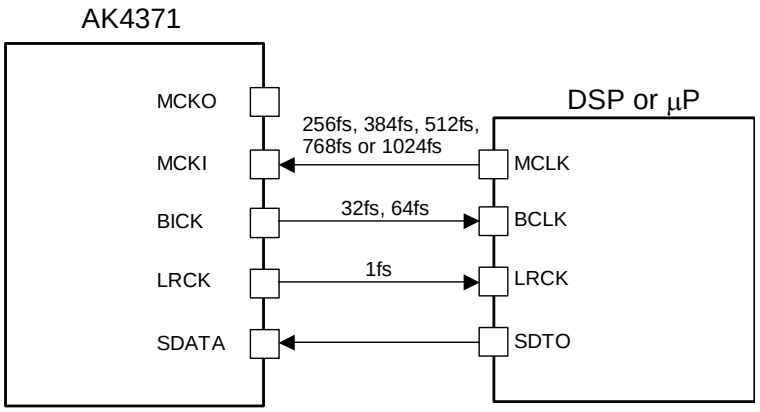
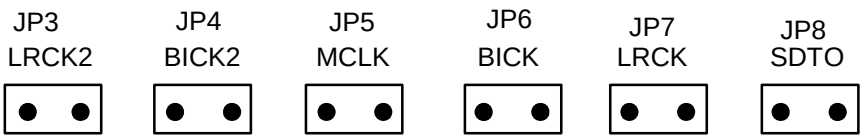


Figure 6. EXT Master Mode

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 AK4371 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 AK4371 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 AKD4371.

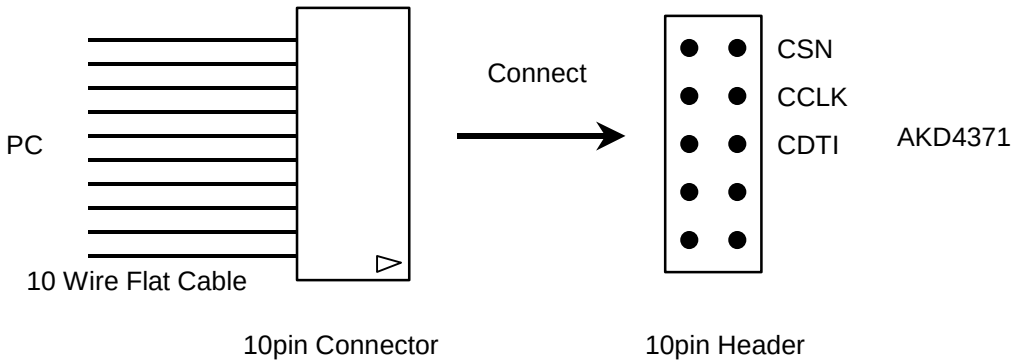
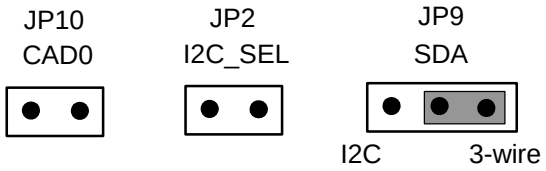


Figure 7. Connect of 10 wire flat cable

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

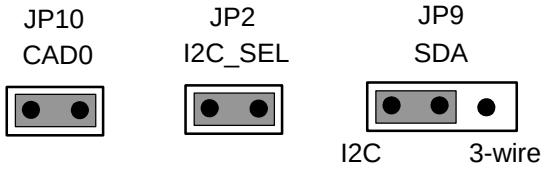
The jumper pins should be set to the followings.



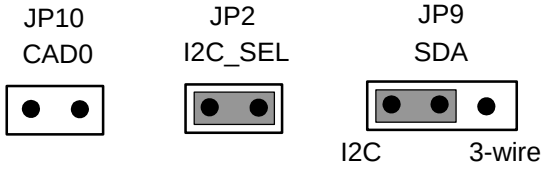
(2) I²C-bus Control Mode

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, LIN3/RIN3 Input circuits

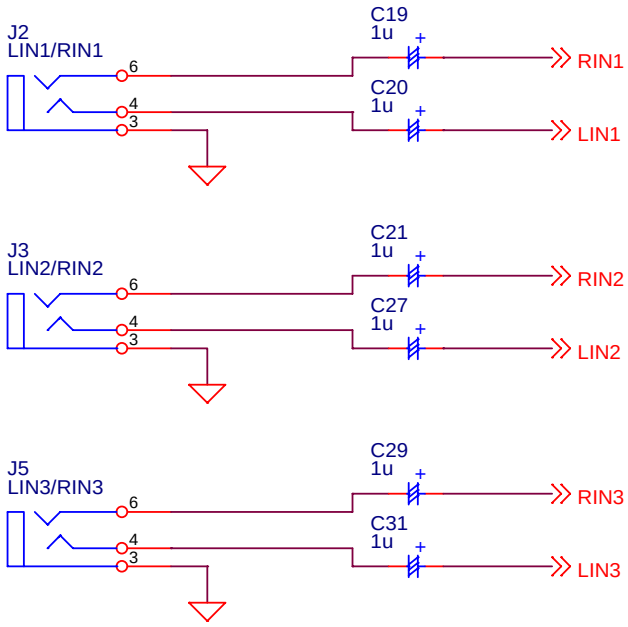


Figure 8. LIN1/RIN1,LIN2/RIN2,LIN3/RIN3 Input circuits

(2) Output Circuit

1) HPL/HPR Output Circuit

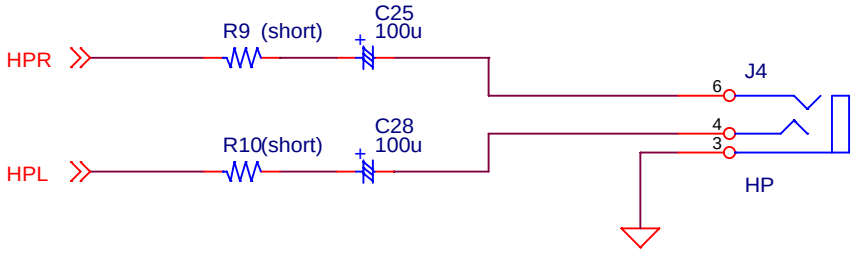


Figure 9. HPL/HPR Output Circuit

2) MOUT Output Circuit



Figure 10. MOUT Output Circuit

3) LOUT/ROUT Output Circuit

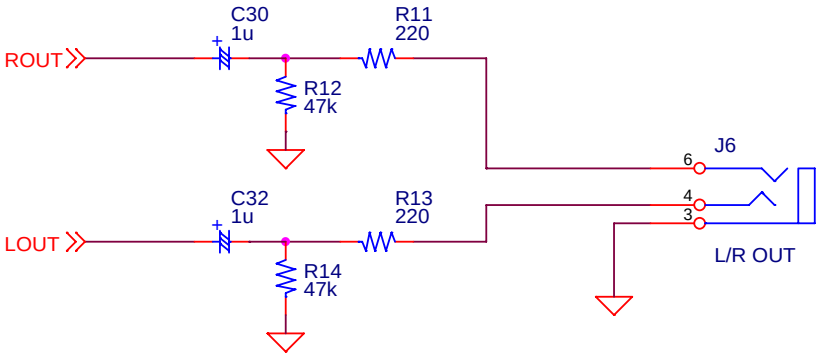
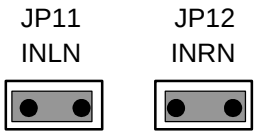


Figure 11. LOUT/ROUT Output Circuit

4) Speaker Output Circuit

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



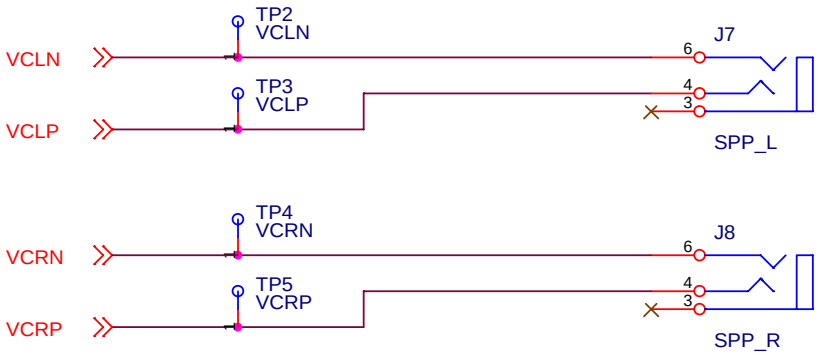


Figure 12. SPK-Amp Output Circuit

∗ 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 AKD4371 according to previous term.

2. Connect IBM-AT compatible PC with AKD4371 by 10-line type flat cable (packed with AKD4371). 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 "AK4371 Evaluation Kit" into the CD-ROM drive.

4. Access the CD-ROM drive and double-click the icon of "AKD4371.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 AK4371.
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 AK4371, 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 AK4371, 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 , 0Eh and 13h.

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 AK4371 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 AK4371, 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 AK4371. 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".

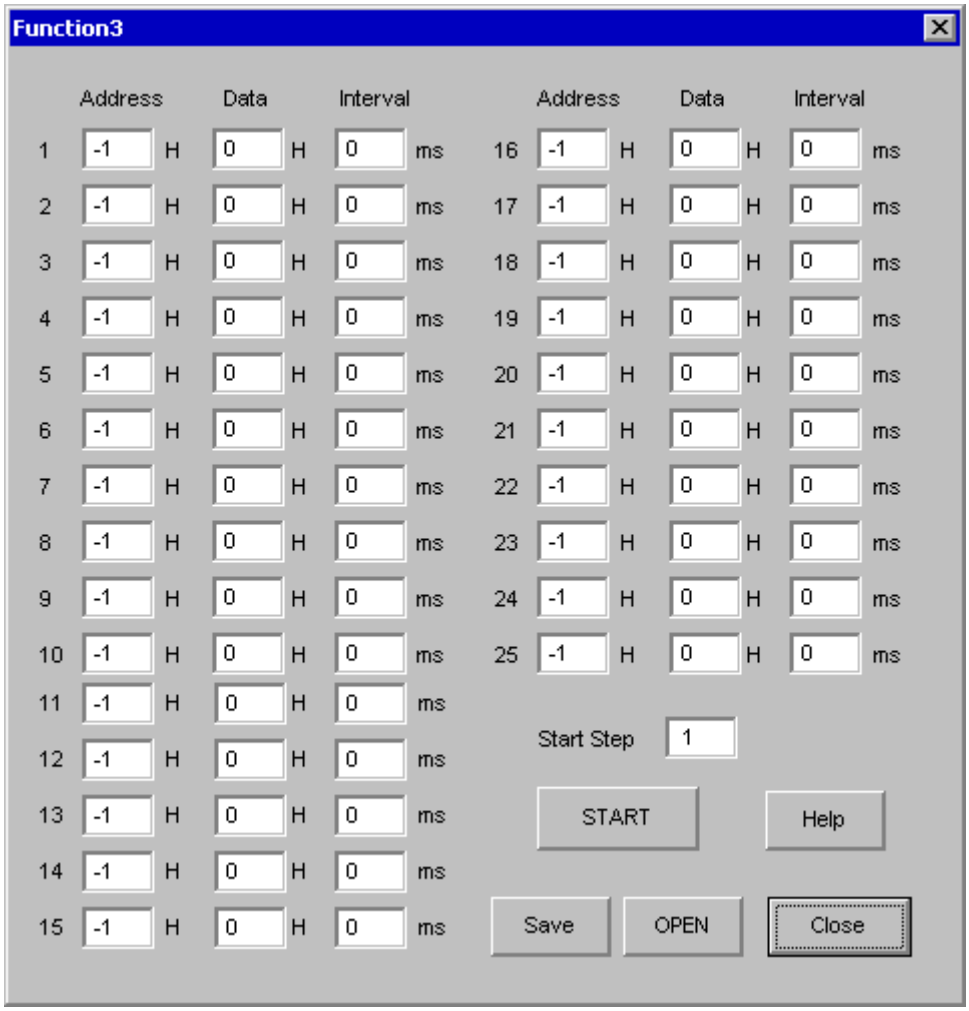


Figure 13. Window of [F3]

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.

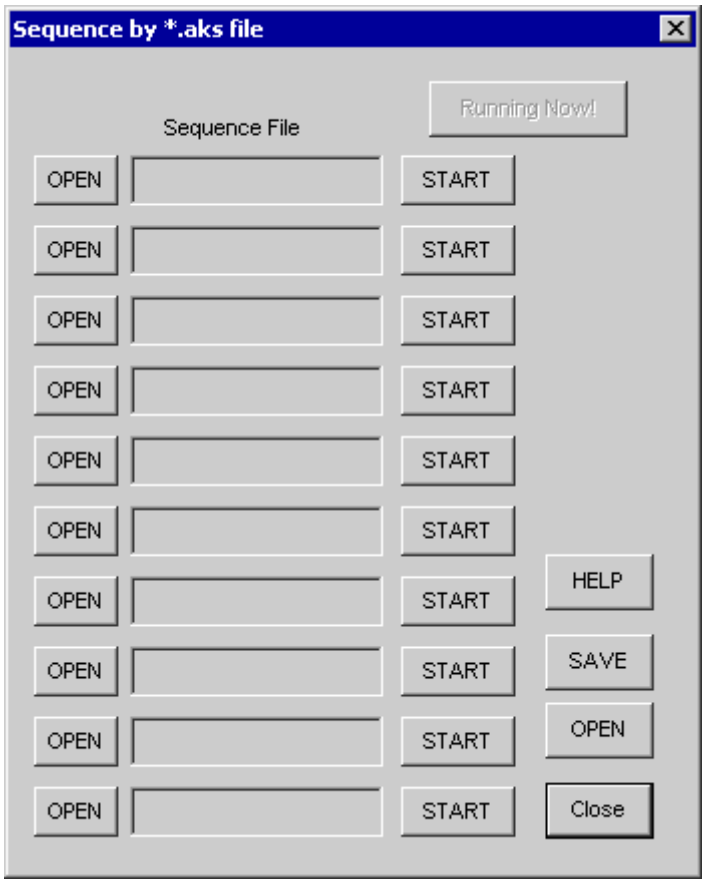


Figure 14. [F4] window

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")

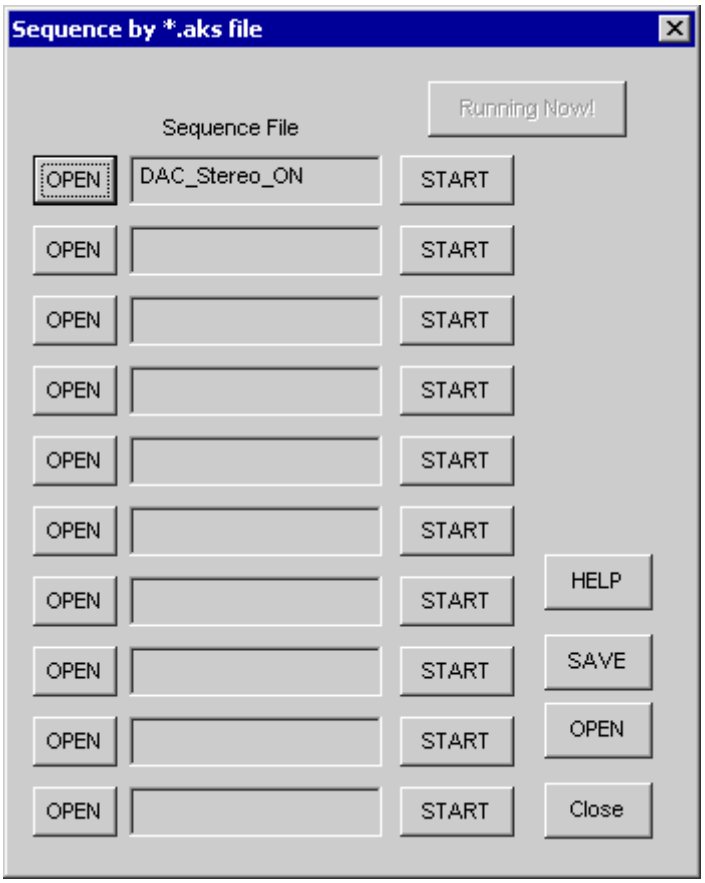


Figure 15. [F4] window (2)

(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.

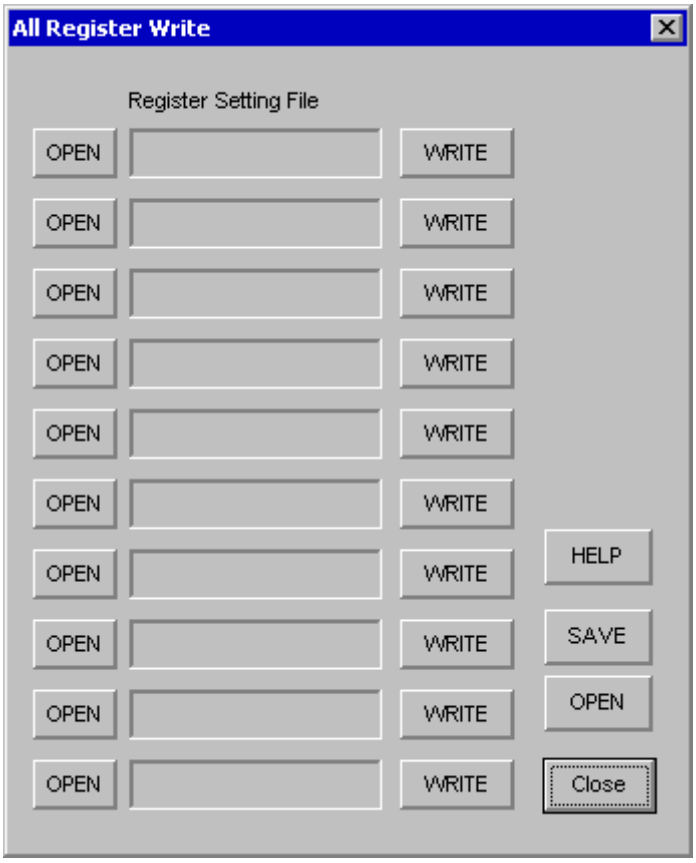


Figure 16. [F5] window

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.

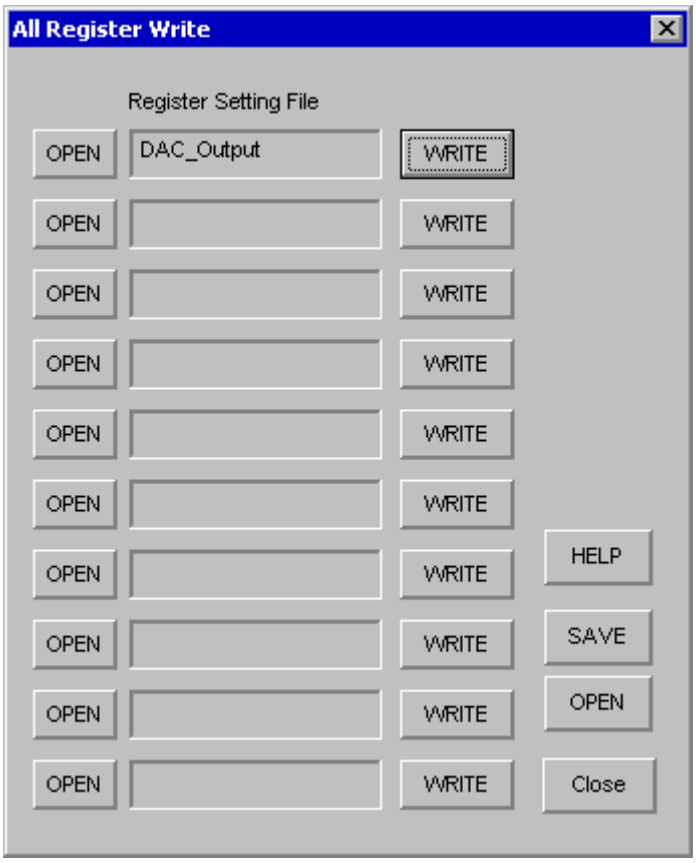


Figure 17. [F5] window (2)

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 : EXT 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 / 54.1	dB
D-Range	(-60dB Output, A-weighted)	92.7 / 92.7	dB
S/N	(A-weighted)	93.0 / 93.0	dB
DAC -> LOUT (R_L=47kΩ)			
THD+N	(0dBFS Output)	59.8 / 60.0	dB
D-Range	(-60dB Output, A-weighted)	90.2 / 90.3	dB
S/N	(A-weighted)	90.2 / 90.3	dB

[Plot of Headphone Amp]

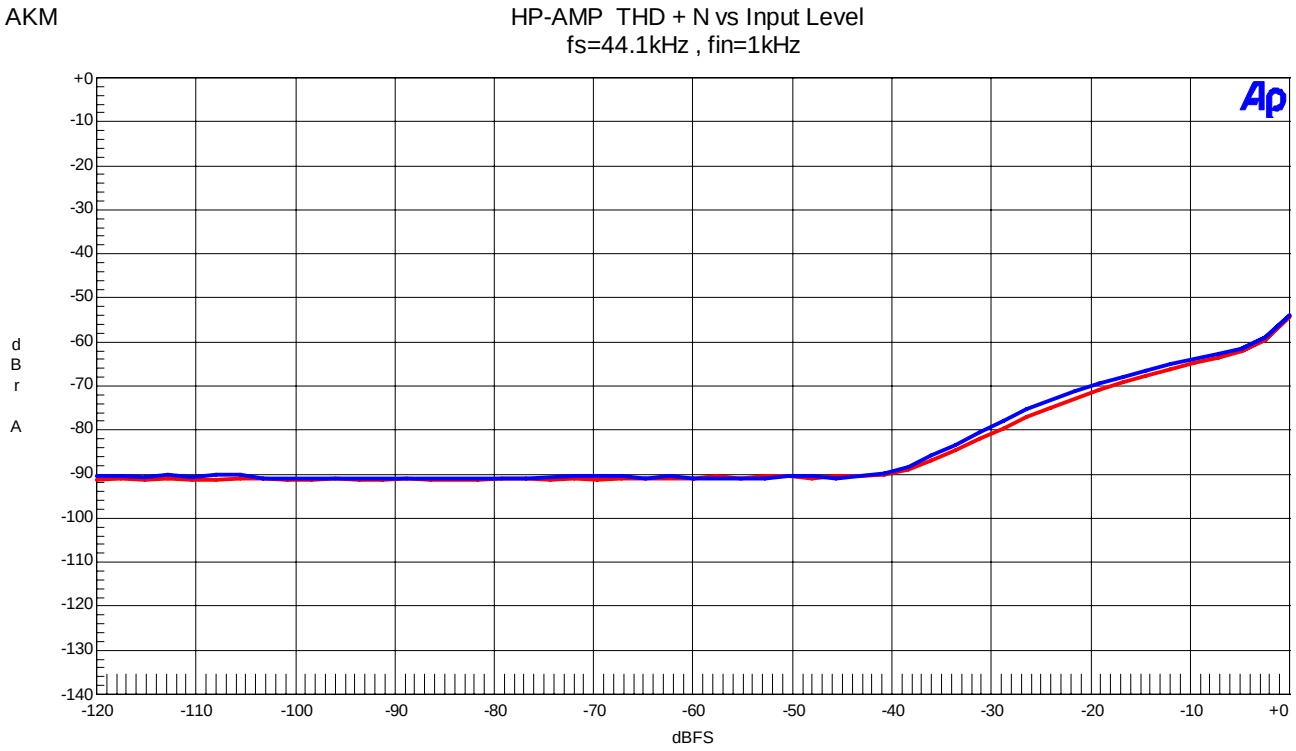


Figure 18. THD+N vs. Input Level

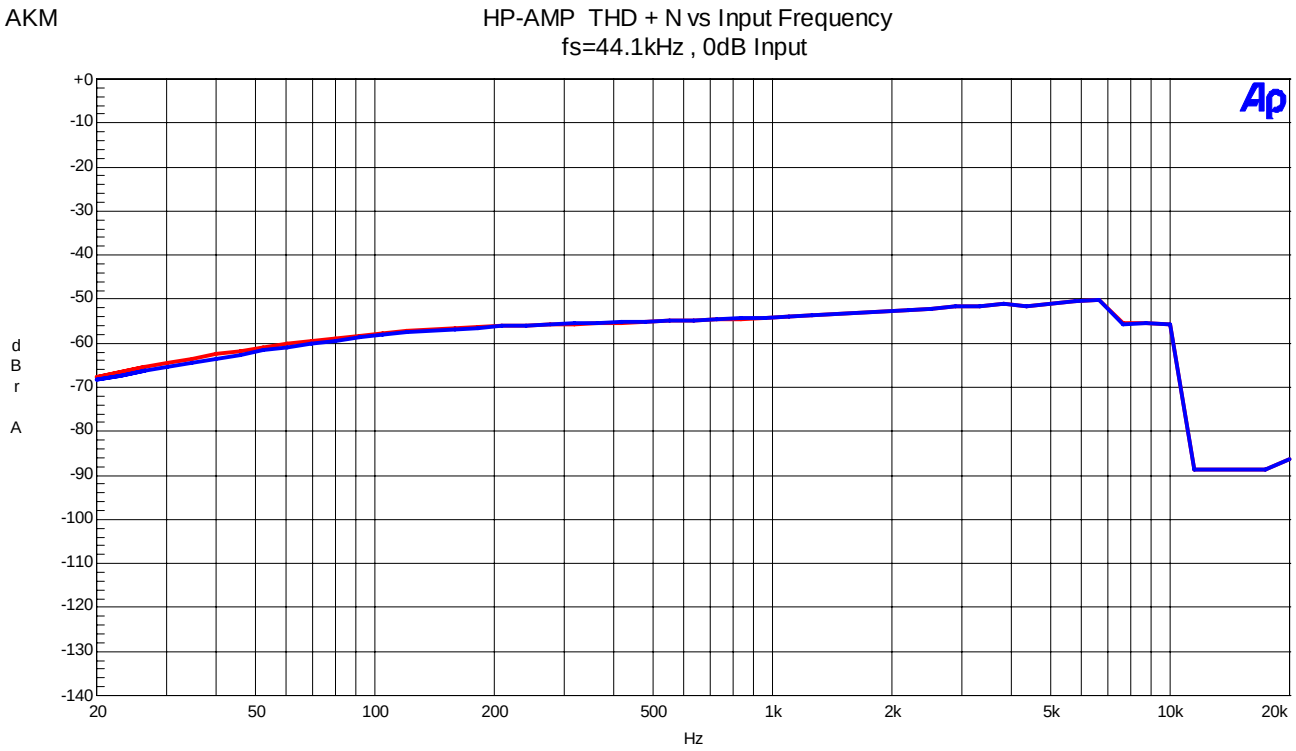


Figure 19. THD+N vs. Input Frequency

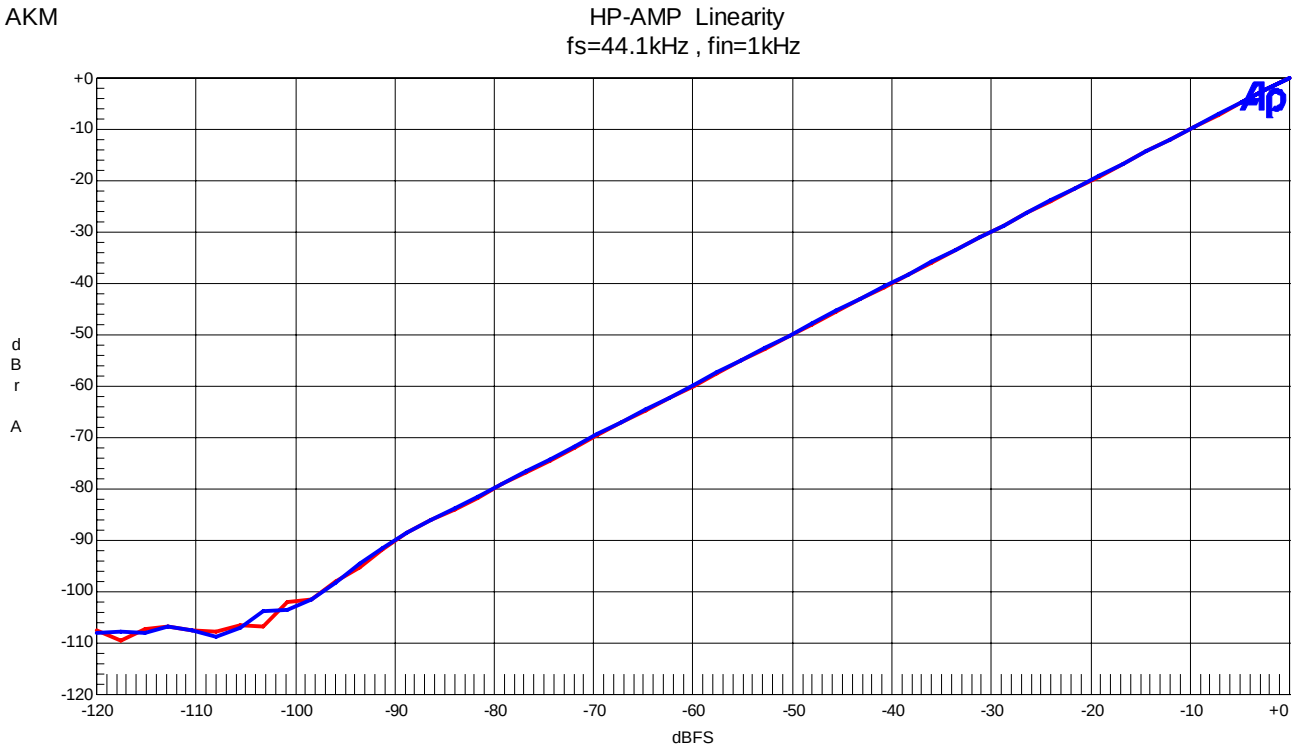


Figure 20. Linearity

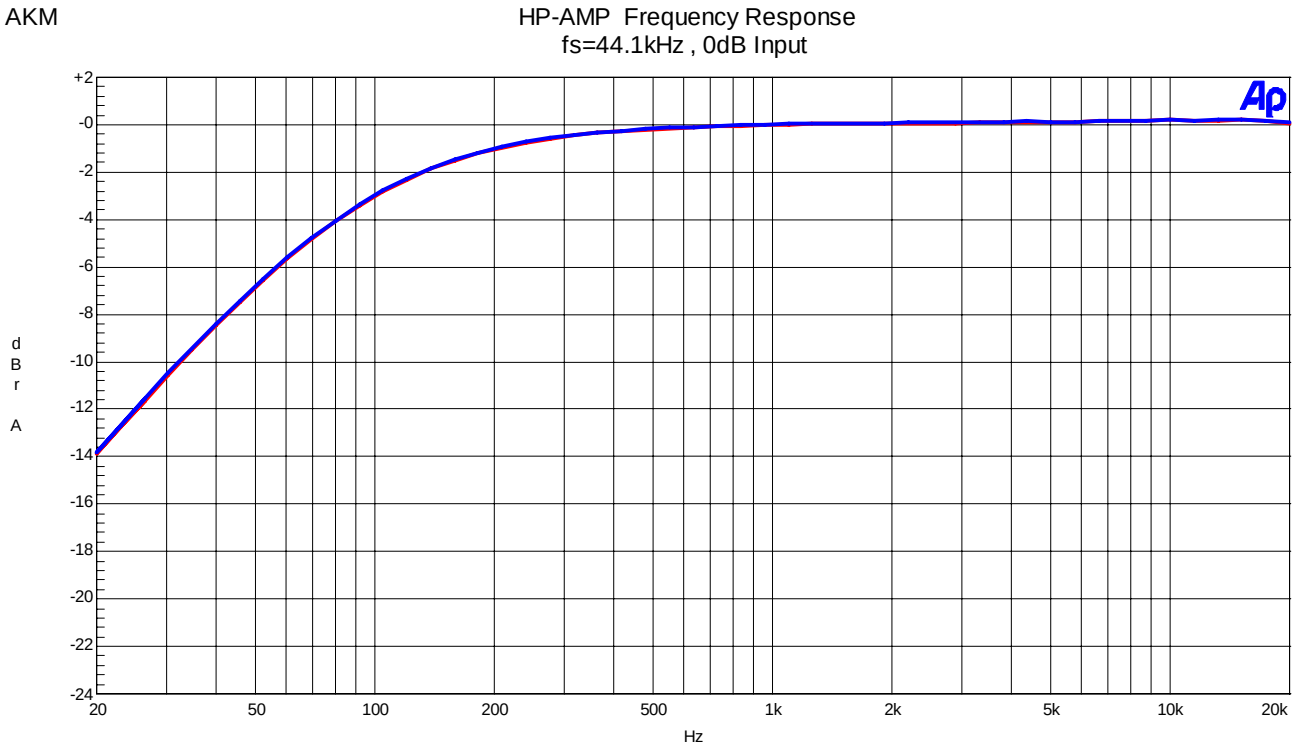


Figure 21. Frequency Response
(including external HPF)

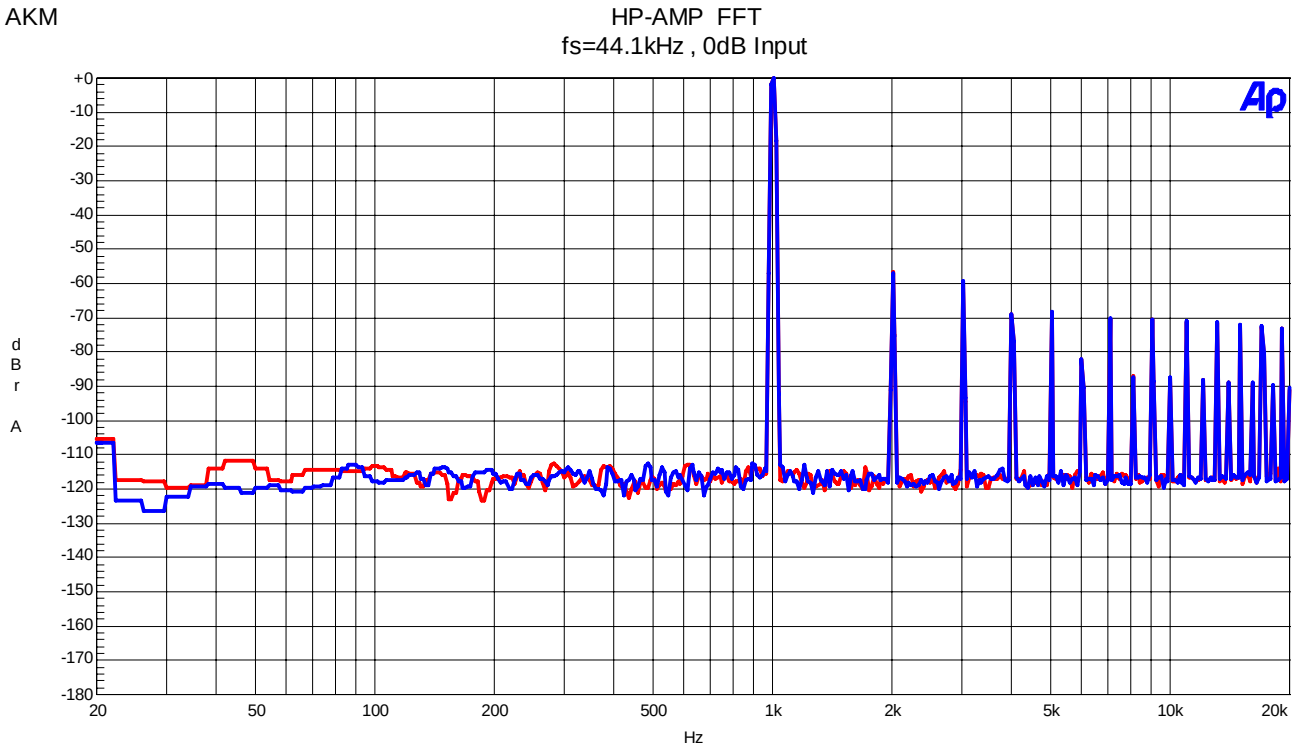


Figure 22. FFT Plot(1kHz,0dB)

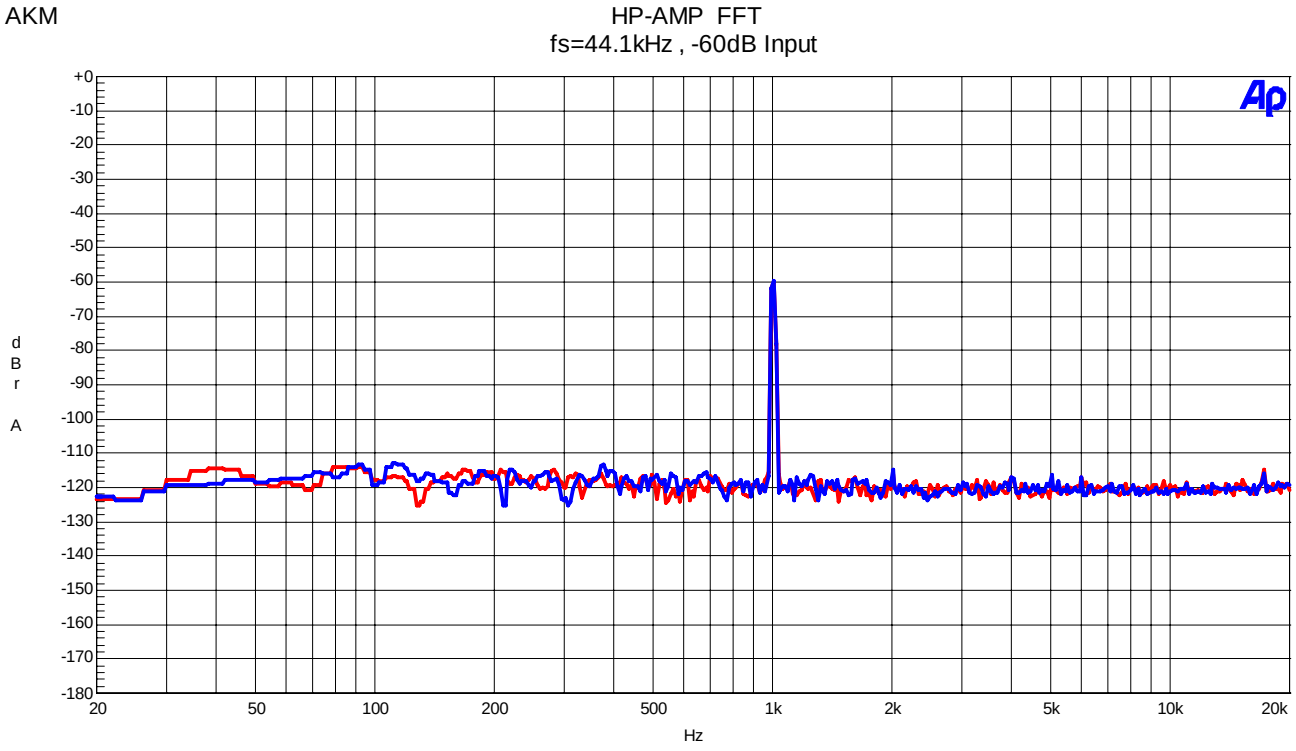


Figure 23. FFT Plot(1kHz,-60dB)

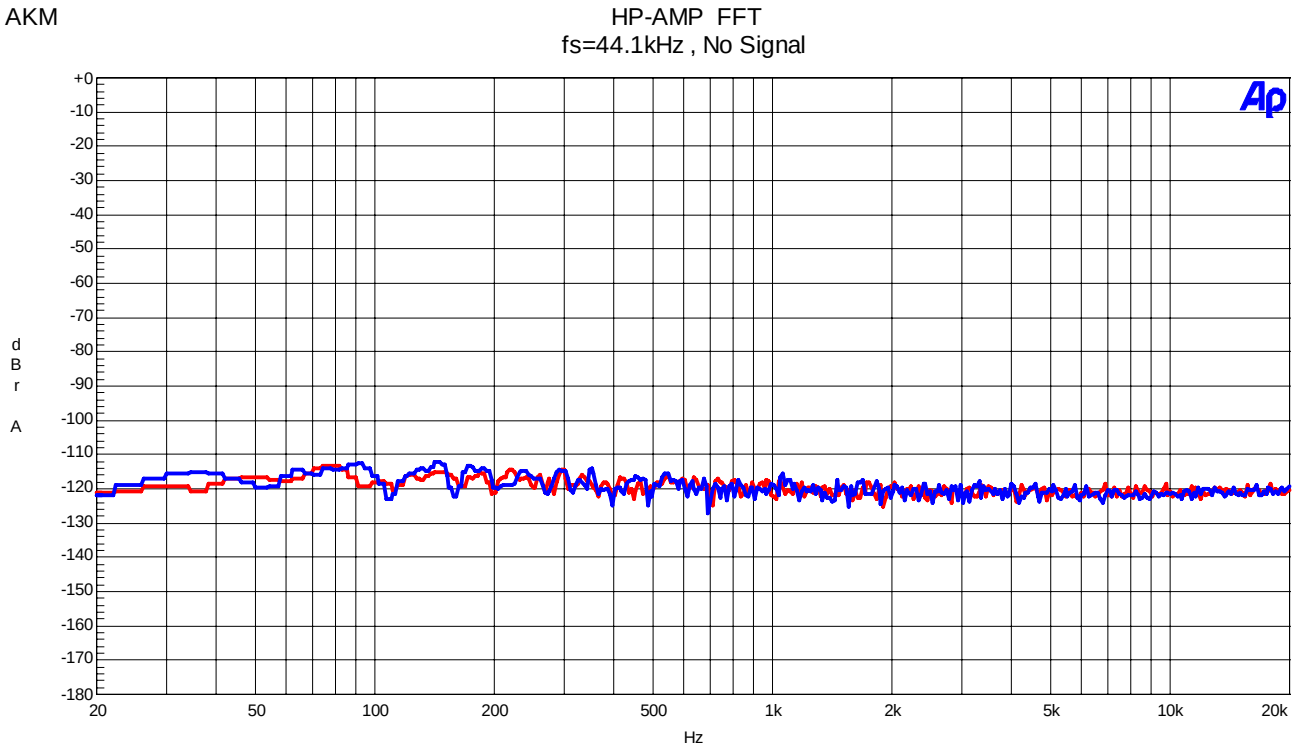


Figure 24. FFT Plot(Noise Floor)

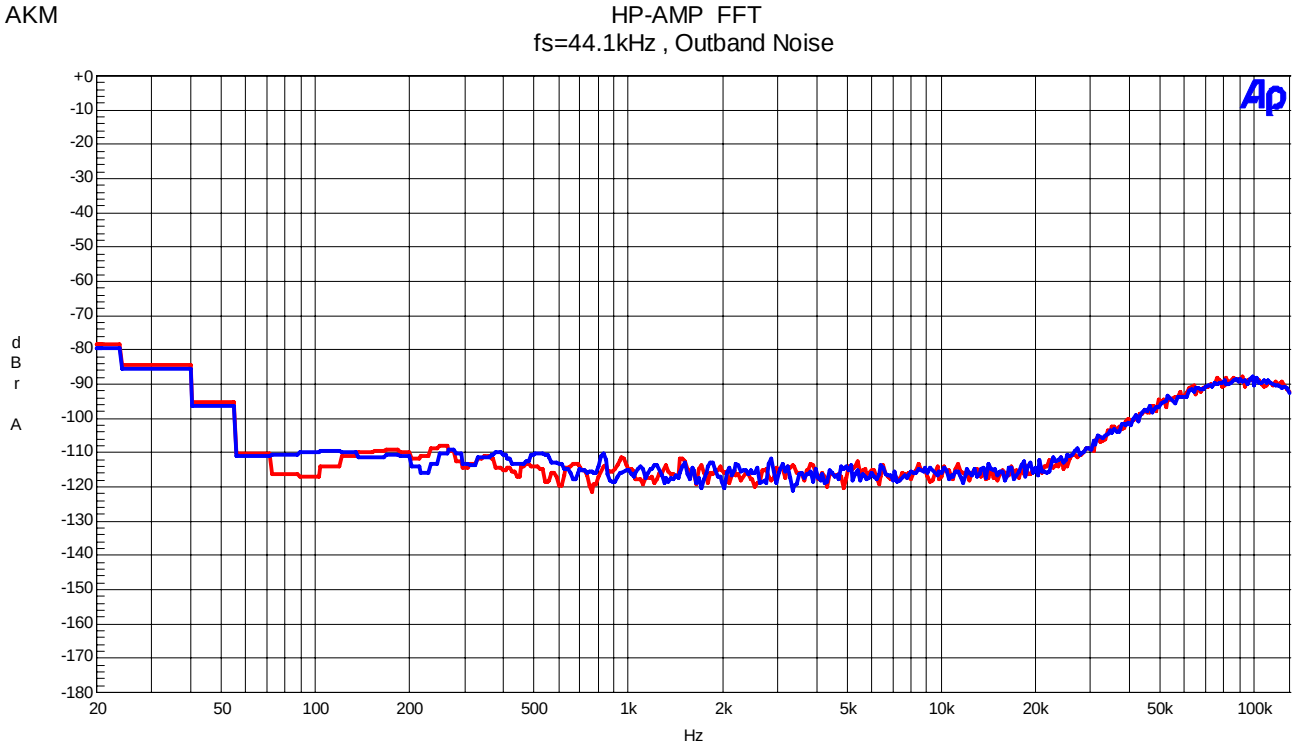


Figure 25. Out-band Noise

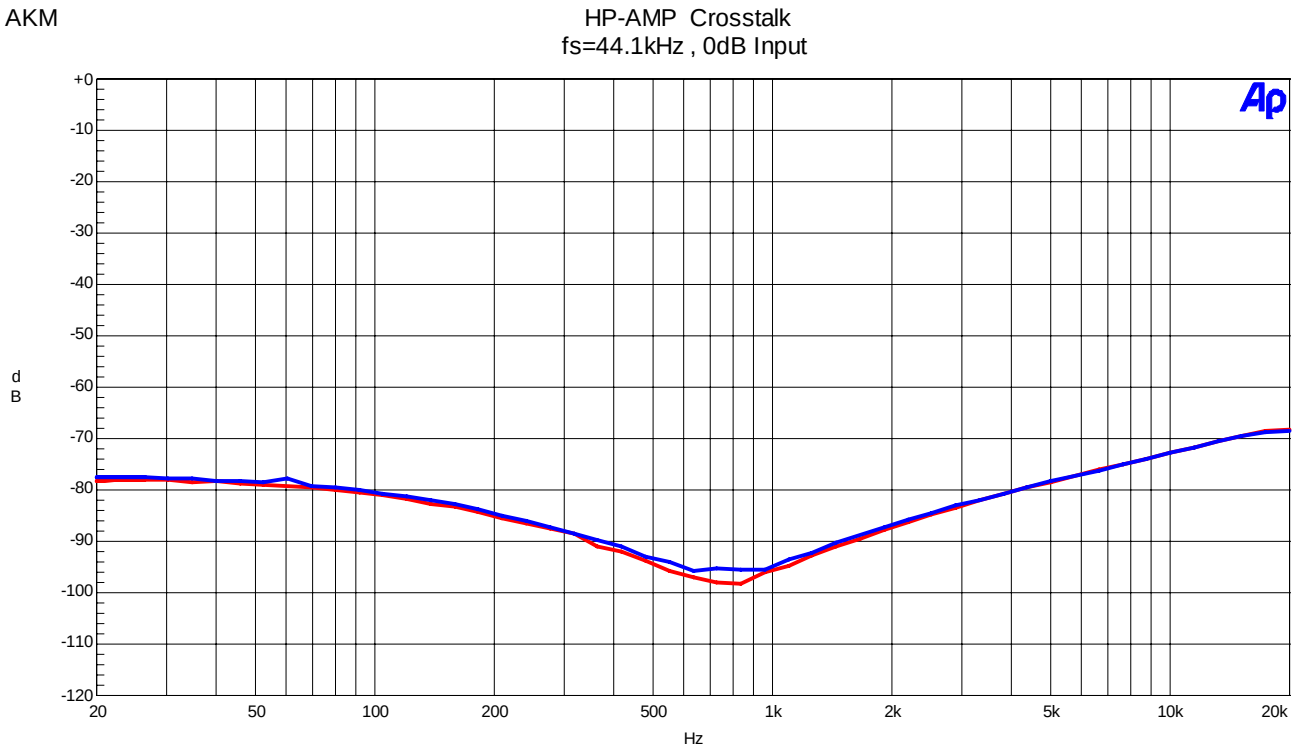


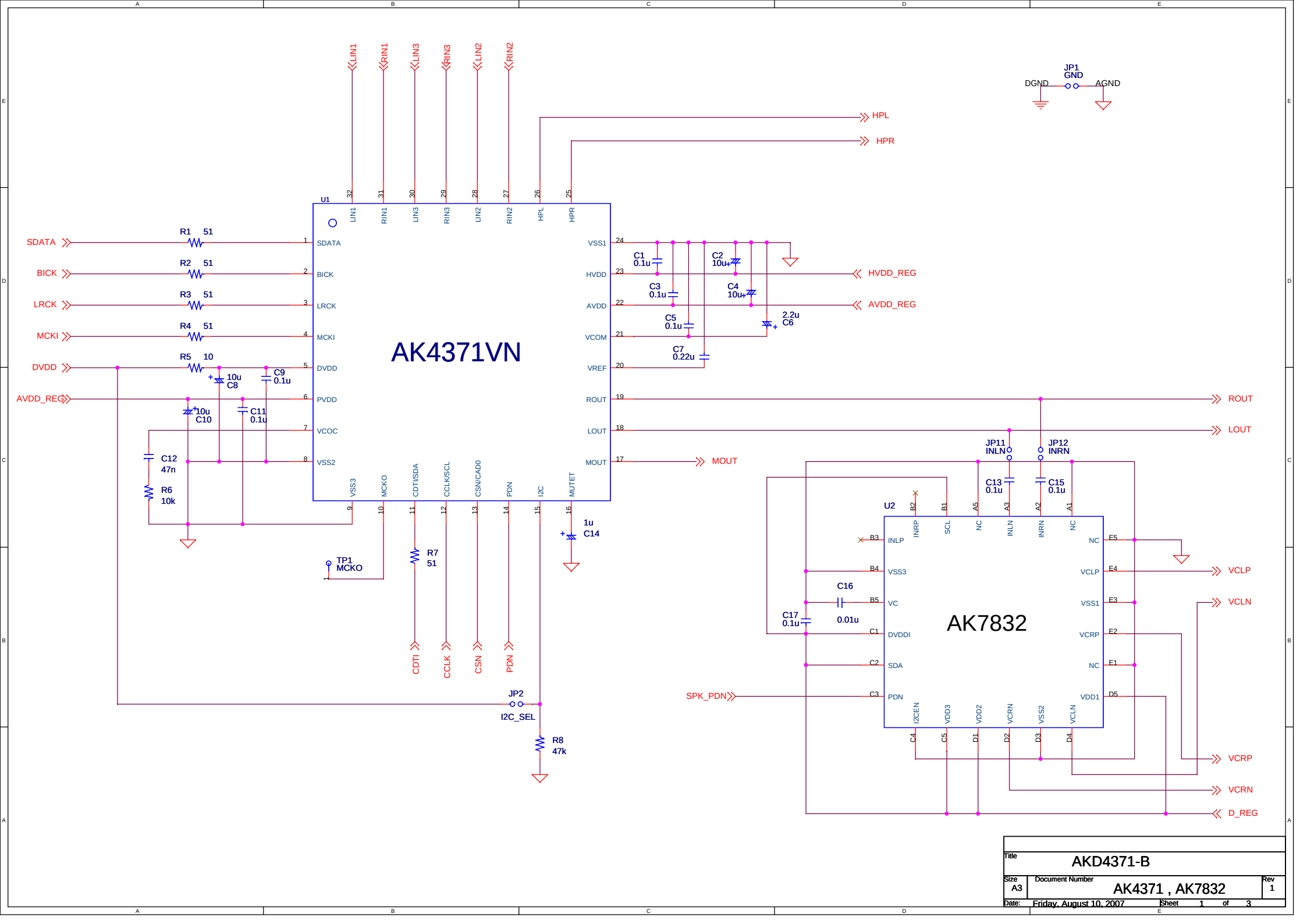
Figure 26. Crosstalk

REVISION HISTORY

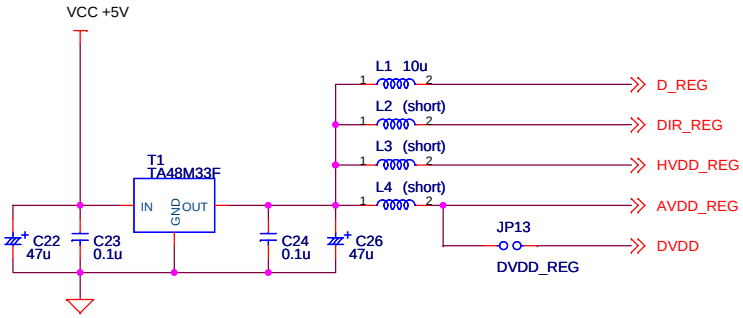
Date (yy/mm/dd)	Manual Revision	Board Revision	Reason	Page	Contents
06/12/12	KM086200	0	First Edition		
07/07/24	KM086201	1	Change	27	C12 4.7nF → 47nF
			Change		Device revision was changed. Rev. A → Rev. B

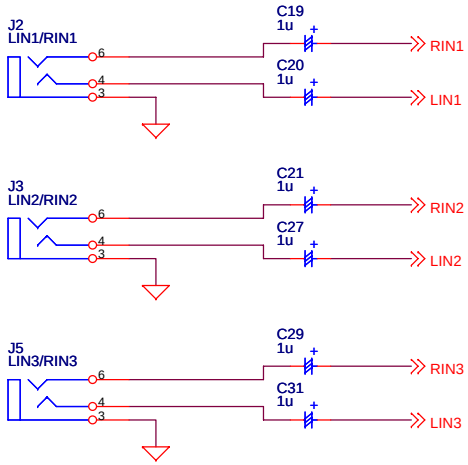
IMPORTANT NOTICE

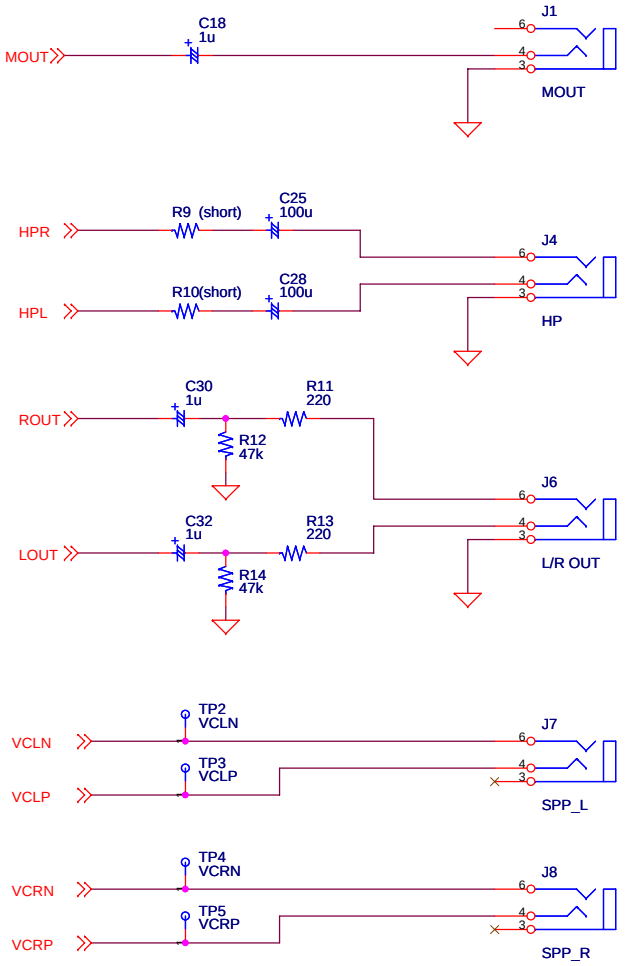
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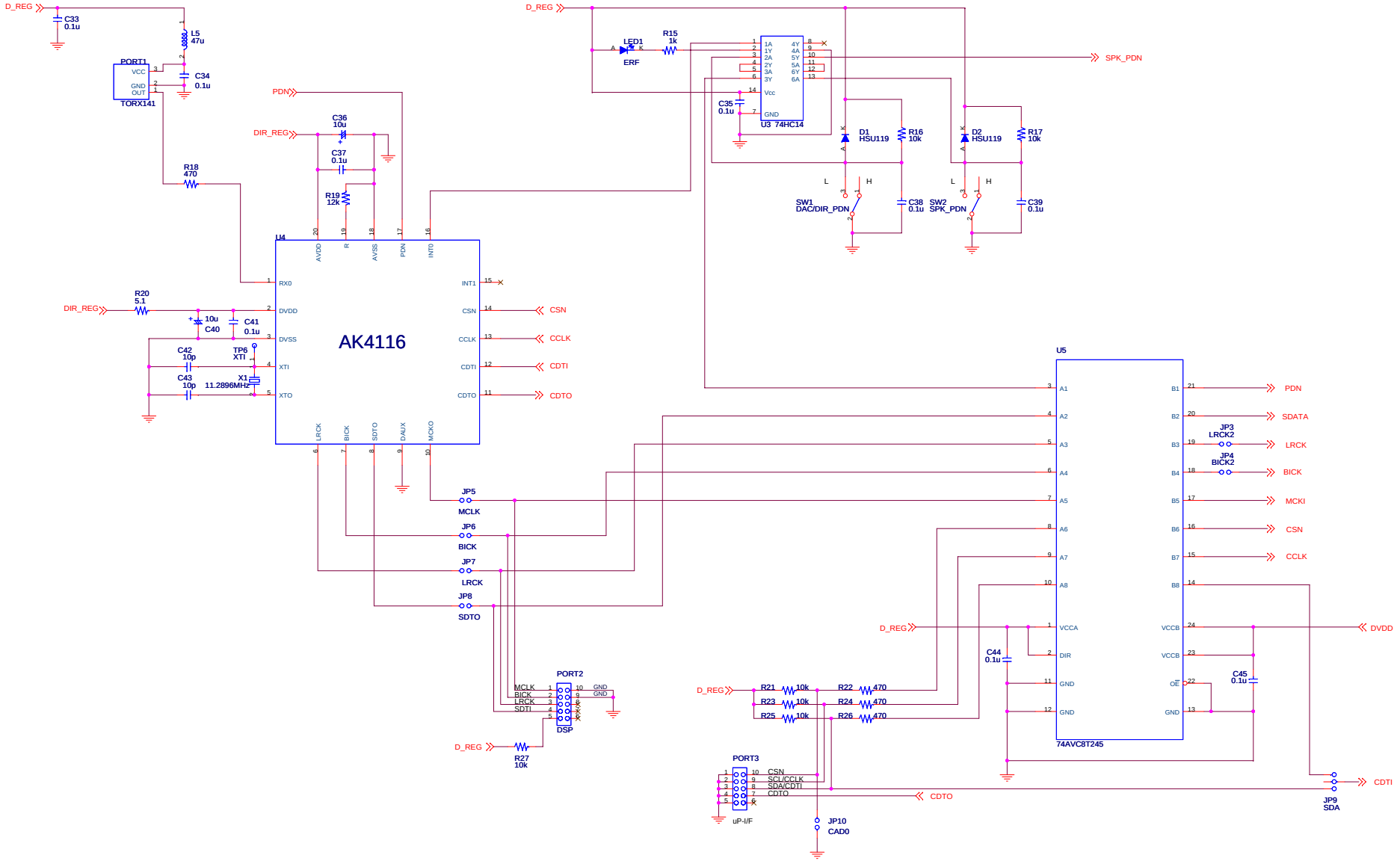
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Size	A3
Document Number	AK4371 , AK7832
Rev	1
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Sheet	1 of 3



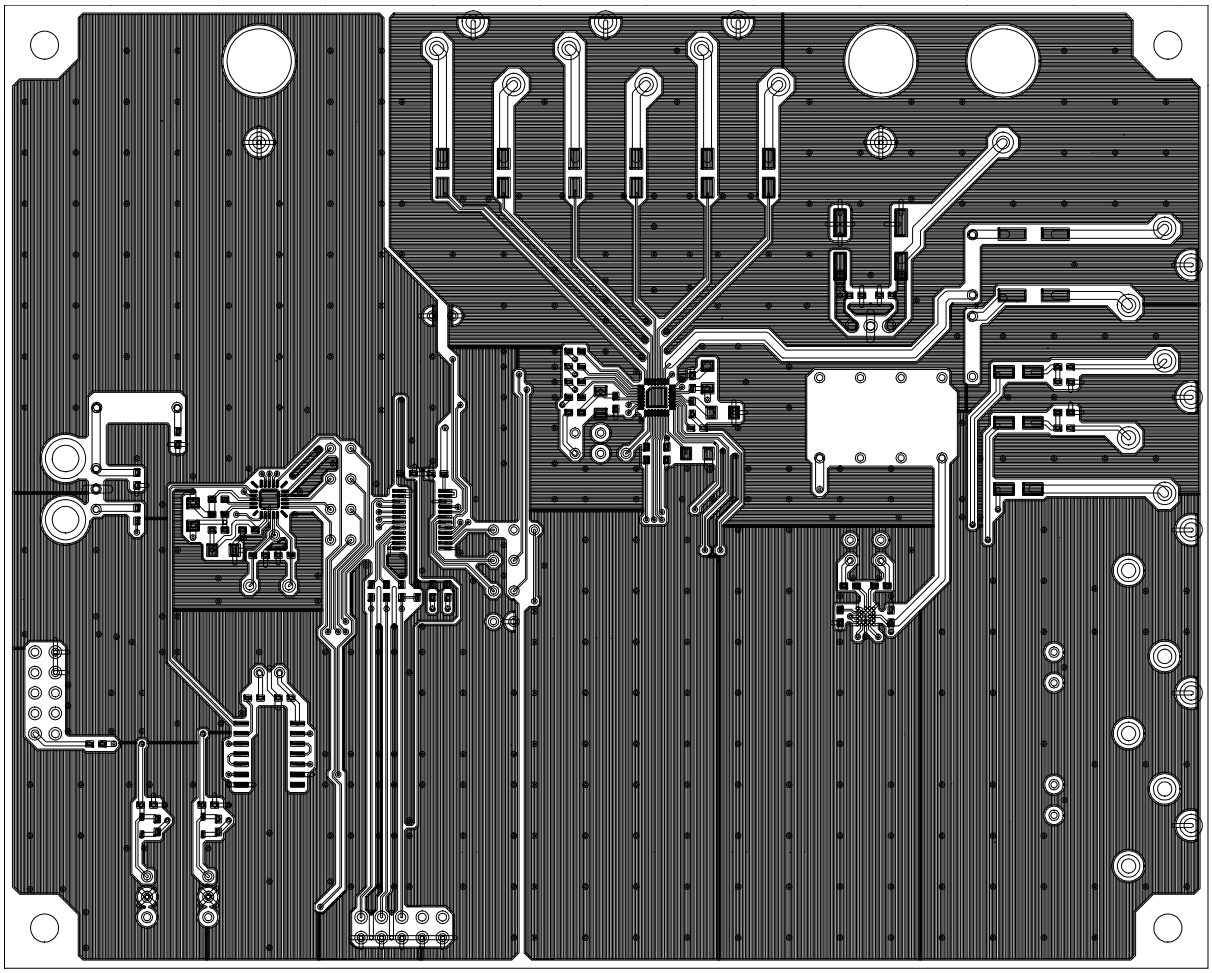


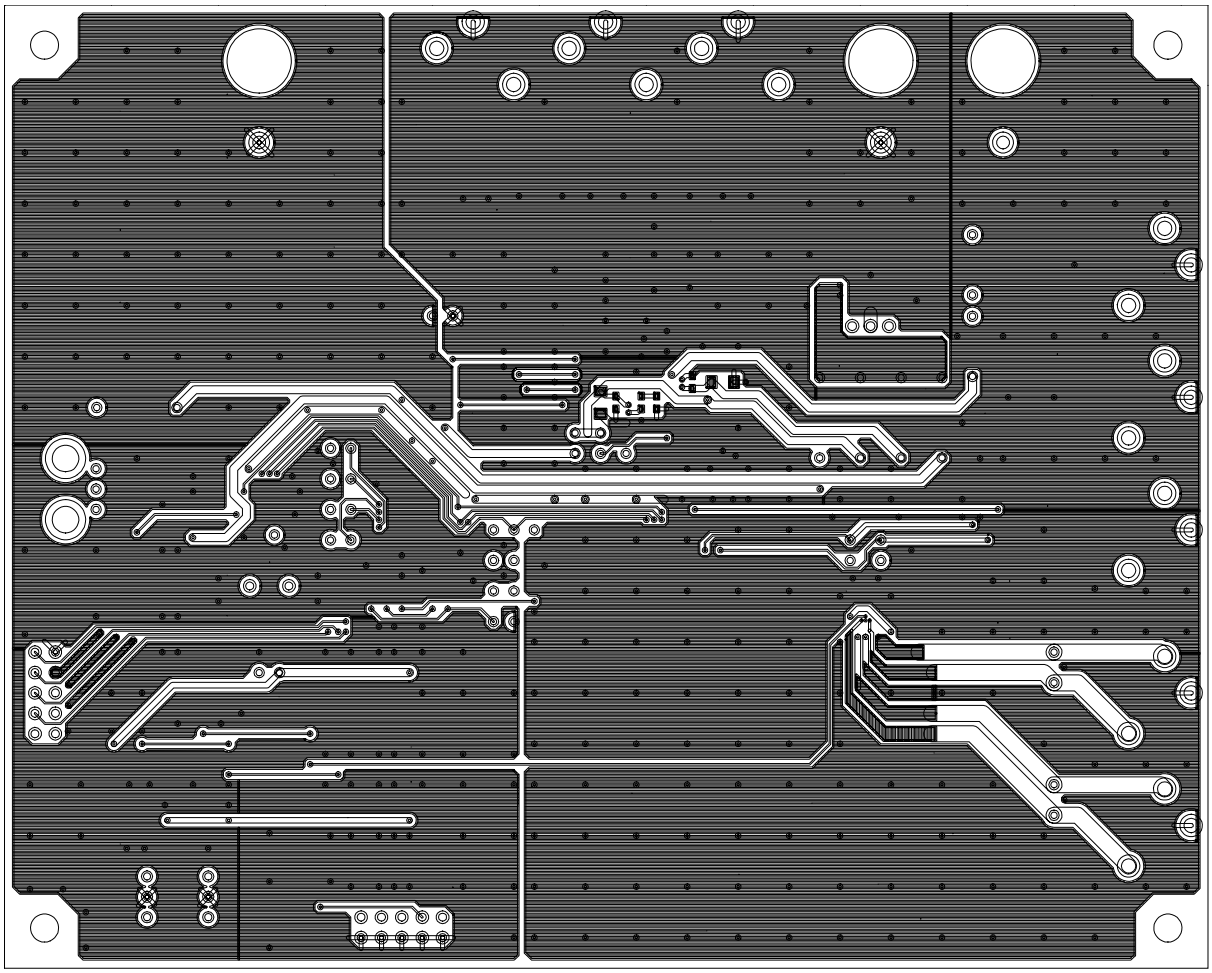


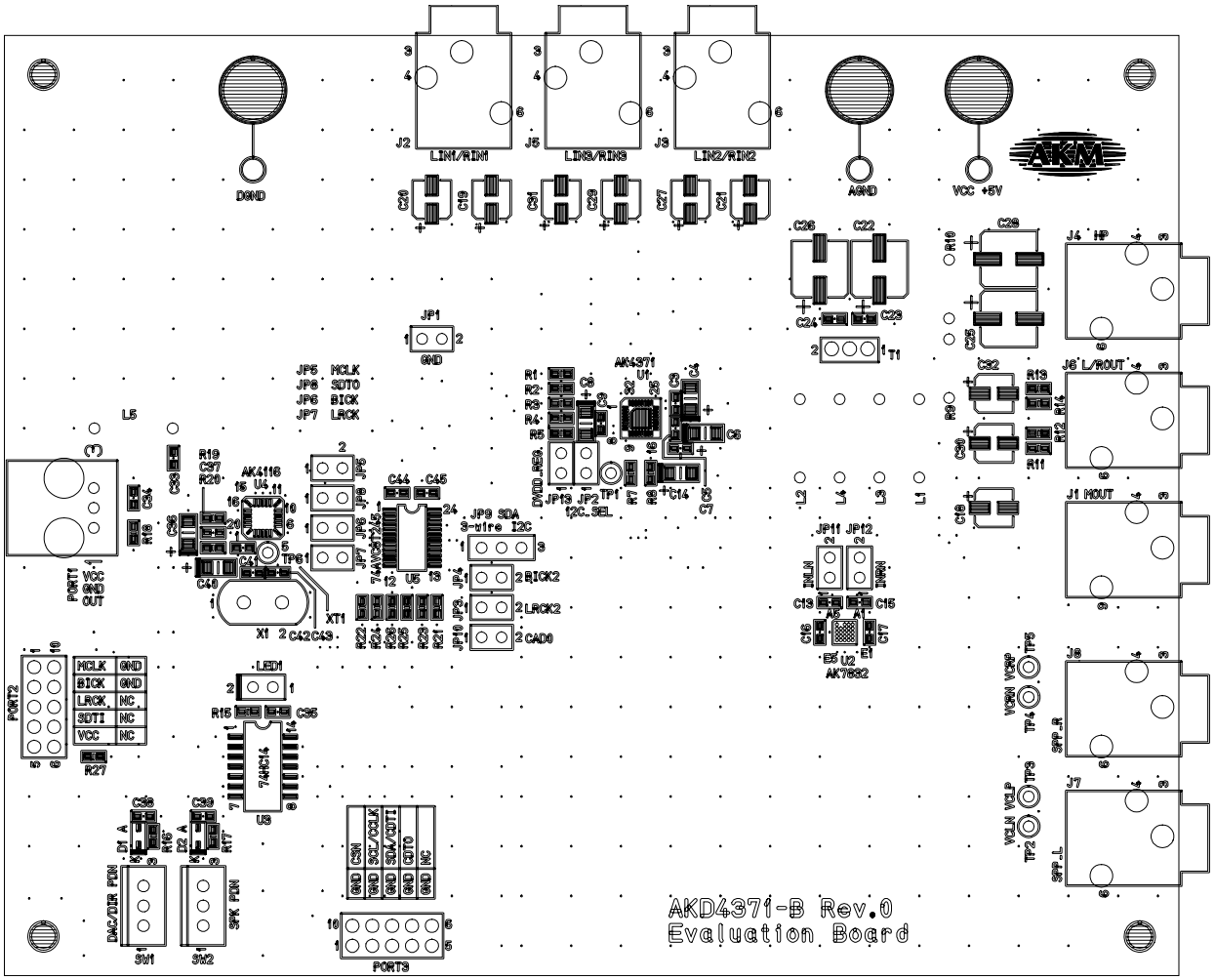
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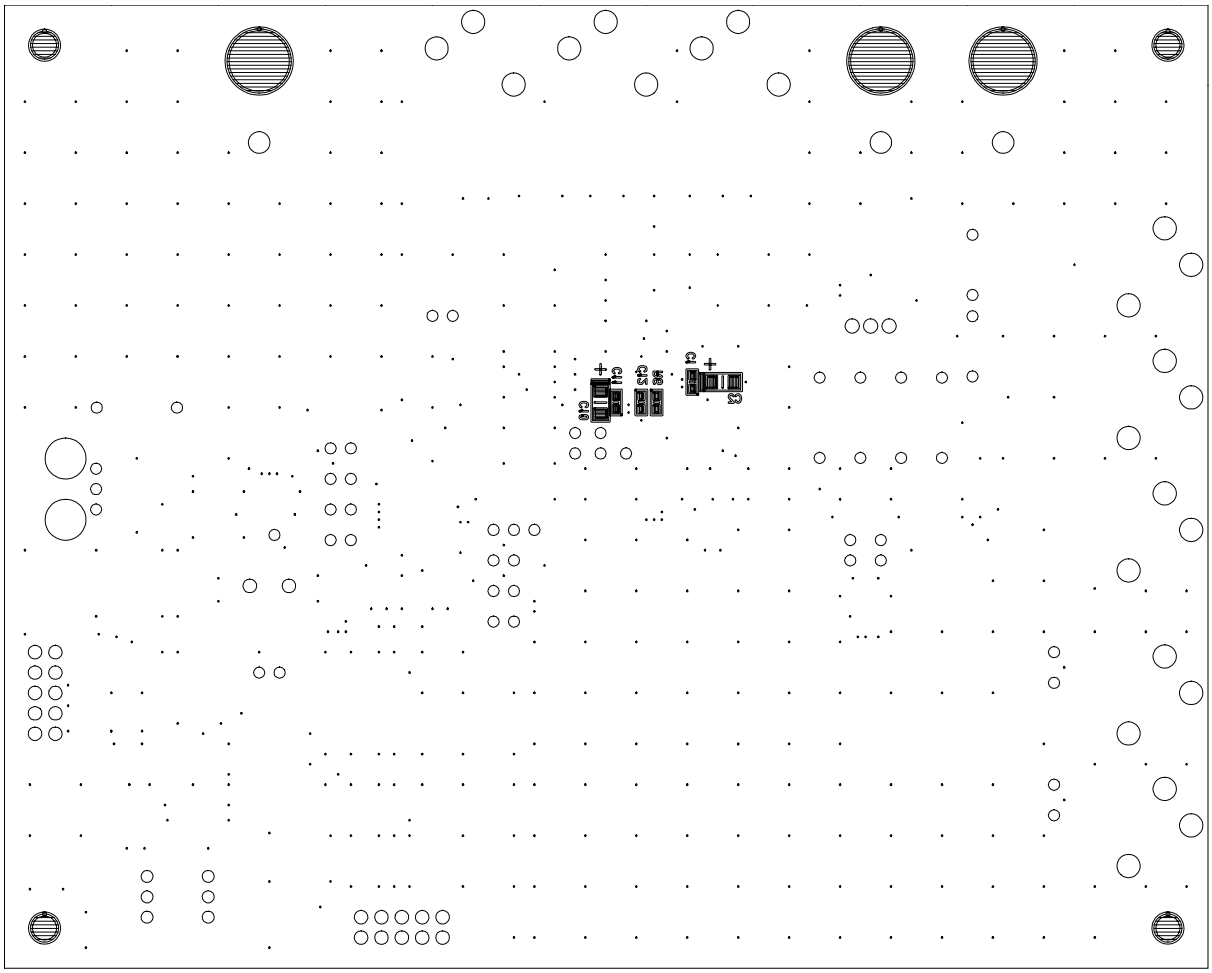


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Size A2	Document Number CLOCK	Rev 1
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AKD4371-B Rev.0
Evaluation Board
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LIN3/RIN3
LIN2/RIN2
DGND
AGND
VCC +5V
J4 HP
J6 L/ROUT
J1 MOUT
J8 SPP_R
J7 SPP_L
AK4371
AK4116
74VHC74
74HC14
AK7632
PORT1
PORT2
PORT3
SW1
SW2
3-wire I2C
I2C_SEL
DAC/DIR PDN
SPK PDN


C2
C3
C12
C13
C14