

**AsahiKASEI**  
ASAHI KASEI EMD

**AKD4368-B**

**AK4368 Evaluation Board Rev.2**

### GENERAL DESCRIPTION

The AKD4368 is an evaluation board for 24bit DAC with integrated Headphone Amplifier, AK4368. The AKD4368 has the interface with AKM's ADC evaluation boards. Therefore, it's easy to evaluate the AK4368. The AKD4368 also has the digital audio interface and can achieve the interface with digital audio systems via opt-conector.

### ■ Ordering guide

AKD4368-B --- Evaluation board for AK4368  
(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 (AK7830)**

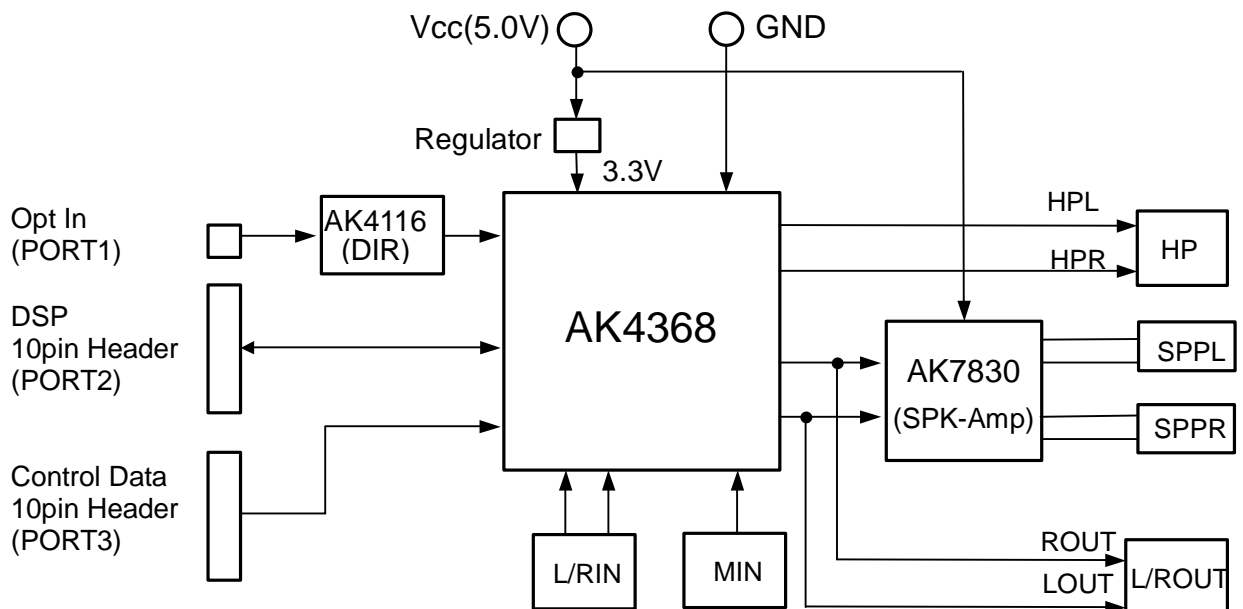


Figure 1. AKD4368 Block Diagram

\* 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 SPK-Amp (typ. 5.0V)
  - [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 AK4368 and AK4116 via the regulator.

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

- 3) Power on.

The AK4368 and AK4116 should be resets once bringing SW1(DAC/DIR\_PDN) "L" upon power-up.  
And the AK7830 should be resets once bringing SW2(SPK\_PDN) "L" upon power-up.

### ■ Evaluation mode

When evaluating the AK4368 using the PORT1(AK4116), it is possible to use the initial setting of the audio interface format (24bit MSB justified). When inputting the data from the PORT2, the AK4368's audio interface format should be set to correspond the input data's audio interface format. Refer to the AK4368's datasheet.

#### Applicable Evaluation Mode

- (1) PLL Master Mode
- (2) PLL Slave Mode
- (3) EXT Slave Mode
  - (3-1) In case of using DIR (Optical Link) <default>
  - (3-2) In case of connecting AK4368 with a external DSP

#### (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 AK4368's PLL.

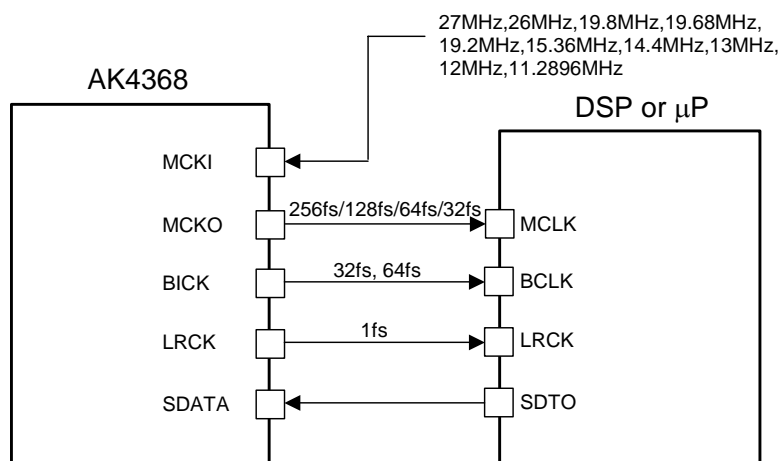
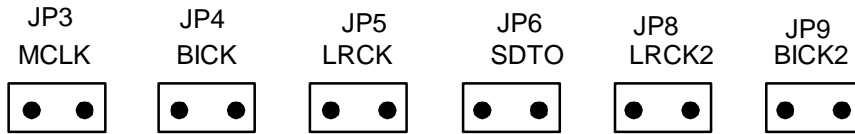


Figure 2. PLL Master Mode

JP3(MCLK), JP4(BICK), JP5(LRCK) and JP6(SDTO) should be open.  
JP8(LRCK2) and JP9(BICK2) should also be open.

The system clock should be connected to MCLK of PORT2. SDTI of PORT2 should be connected to SDTO of

DSP. The JP8(LRCK2) and JP9(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.



## (2) PLL Slave Mode

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

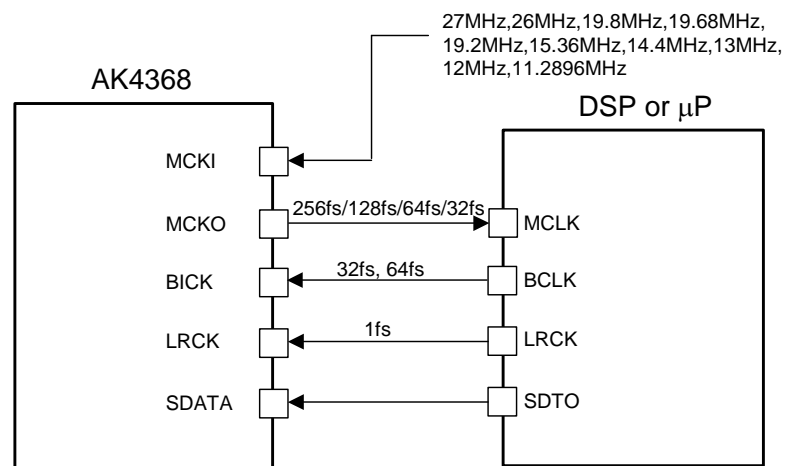
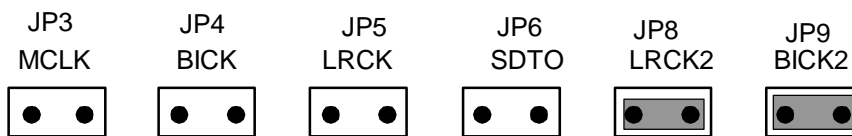


Figure 3. PLL Slave Mode

JP8(LRCK2) and JP9(BICK2) should be short.  
JP3(MCLK),JP4(BICK),JP5(LRCK) and JP6(SDTO) should be open.





**(3) EXT Slave Mode**

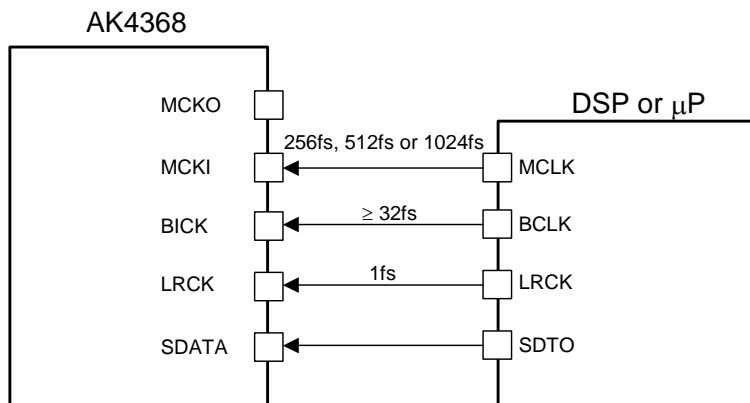
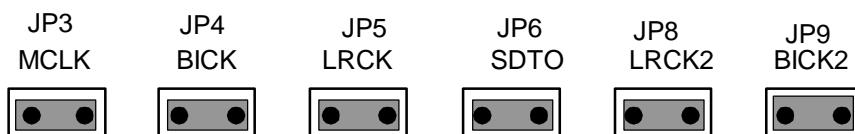


Figure 4. EXT Slave Mode

**(3-1) In case of using DIR (Optical Link) <default>**

PORT1 (DIR) is used. DIR generates MCLK, BICK, LRCK and SDATA from the received data through optical connector (TORX141). Nothing should be connected to PORT2(DSP).

JP3(MCLK),JP4(BICK),JP5(LRCK) and JP6(SDTO) should be shorted.  
JP8(LRCK2) and JP9(BICK2) should also be short.

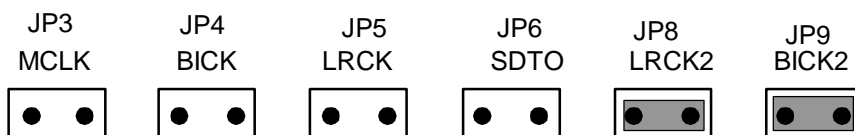


The AK4116 operates at fs of 32kHz or more. If the fs is slower than 32kHz, any other evaluation mode without using DIR should be used.

**(3-2) In case of connecting AK4368 with external DSP**

PORT2 (DSP) is used. MCLK, BICK, LRCK and SDATA are supplied from PORT2. Nothing should be connected to PORT1 (DIR).

JP3(MCLK),JP4(BICK),JP5(LRCK) and JP6(SDTO) should be open.  
JP8(LRCK2) and JP9(BICK2) should be short.



**■ Other jumper pins set up**

- JP1 (GND) : Analog ground and Digital ground
- OPEN : Separated. <default>
- SHORT: Common. (The connector “DGND” can be open.)



■ **The function of the toggle SW**

Upper-side is “H” and lower-side is “L”.

[SW1] (DAC/DIR\_PDN): Power down of AK4368 and AK4116. Keep “H” during normal operation.

[SW2] (SPK\_PDN): Power down of AK7830. 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 AK4368 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 AKD4368.

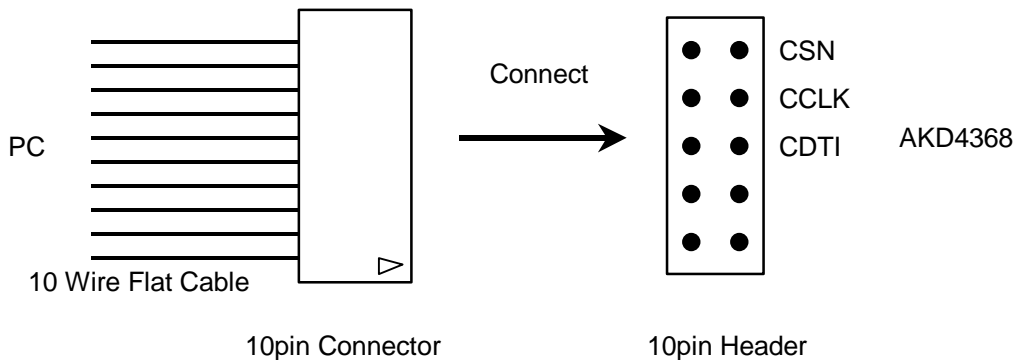
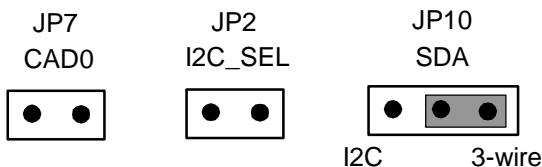


Figure 5. Connect of 10 wire flat cable

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

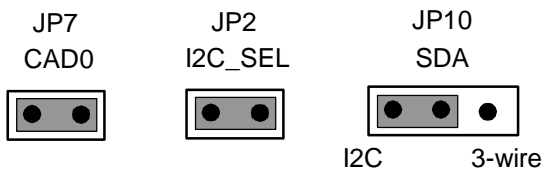
The jumper pins should be set to the followings.



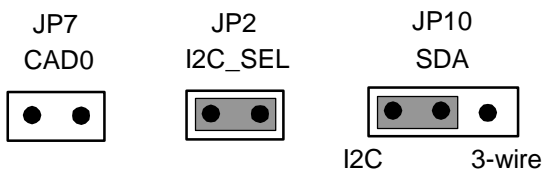
(2) I<sup>2</sup>C-bus Control Mode

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 & Set-up jumper pin for Input / Output circuits

(1) Input Circuit

LIN, RIN and MIN Input circuits

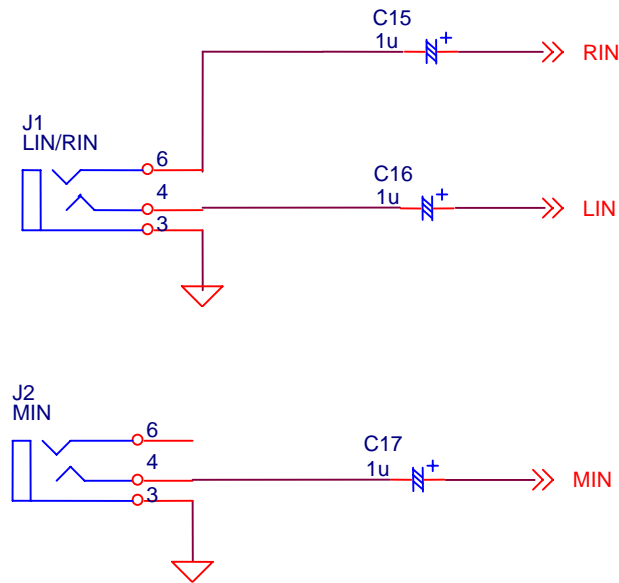


Figure 6. MIN, LIN, RIN Input circuits

(2) Output Circuit

1) HPL, HPR Output Circuit

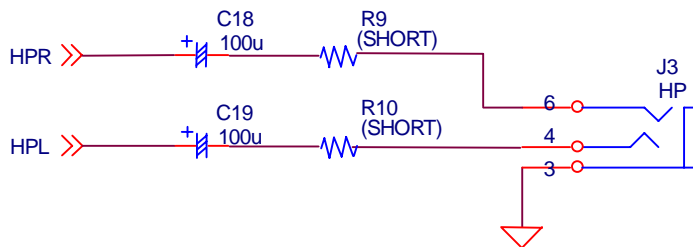


Figure 7. HPL,HPR Output Circuit

2) LOU, ROUT Output Circuit

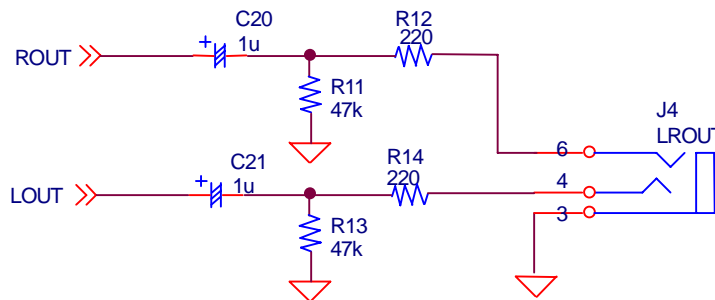


Figure 8. LOU, ROUT Output Circuit



3) SPEAKER Output Circuit

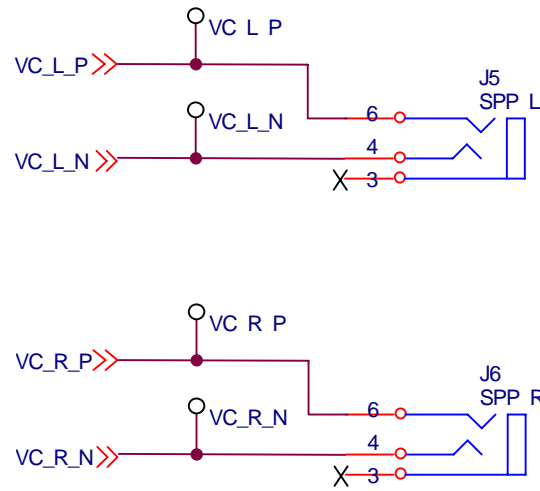


Figure 9. SPK-Amp Output Circuit

\* 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 AKD4368 according to previous term.
2. Connect IBM-AT compatible PC with AKD4368 by 10-line type flat cable (packed with AKD4368). 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 “AK4368 Evaluation Kit” into the CD-ROM drive.
4. Access the CD-ROM drive and double-click the icon of “akd4368.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 AK4368.
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 AK4368, 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 AK4368, click [OK] button. If not, click [Cancel] button.

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

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

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 AK4368 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 AK4368, 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 AK4368. 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".

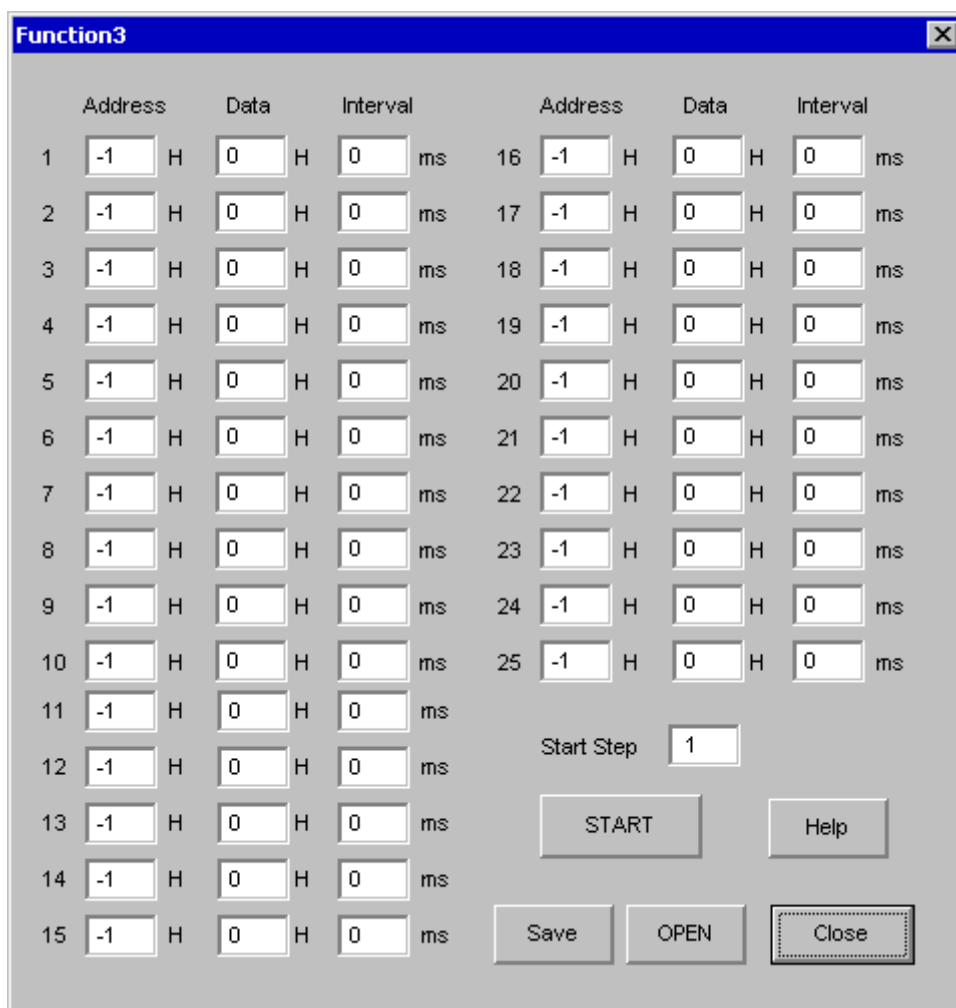


Figure 10. Window of [F3]



### 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 10 opens.

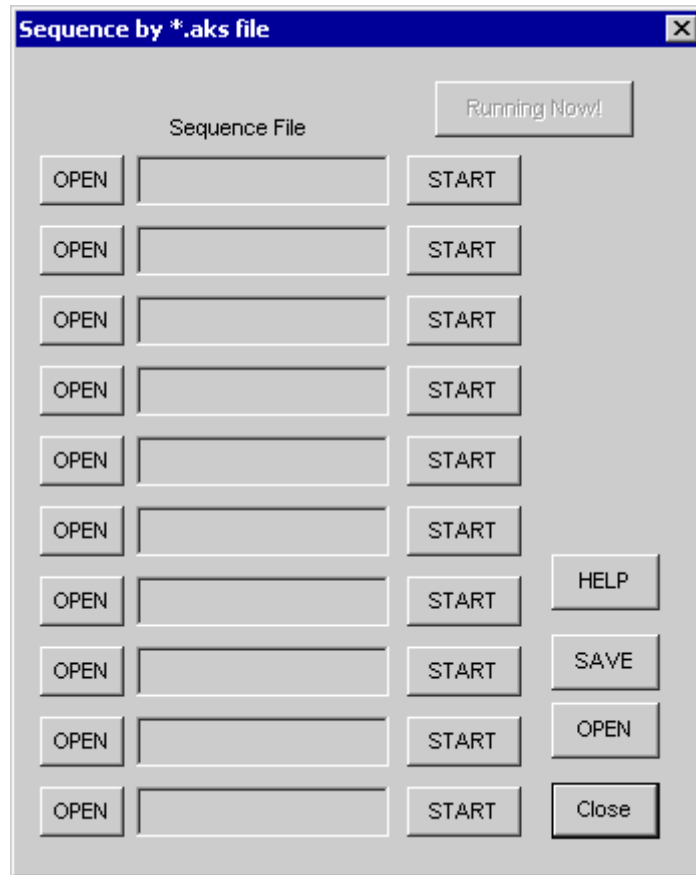


Figure 11. [F4] window



### 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 11. ( In case that the selected sequence file name is “DAC\_Stereo\_ON.aks”)

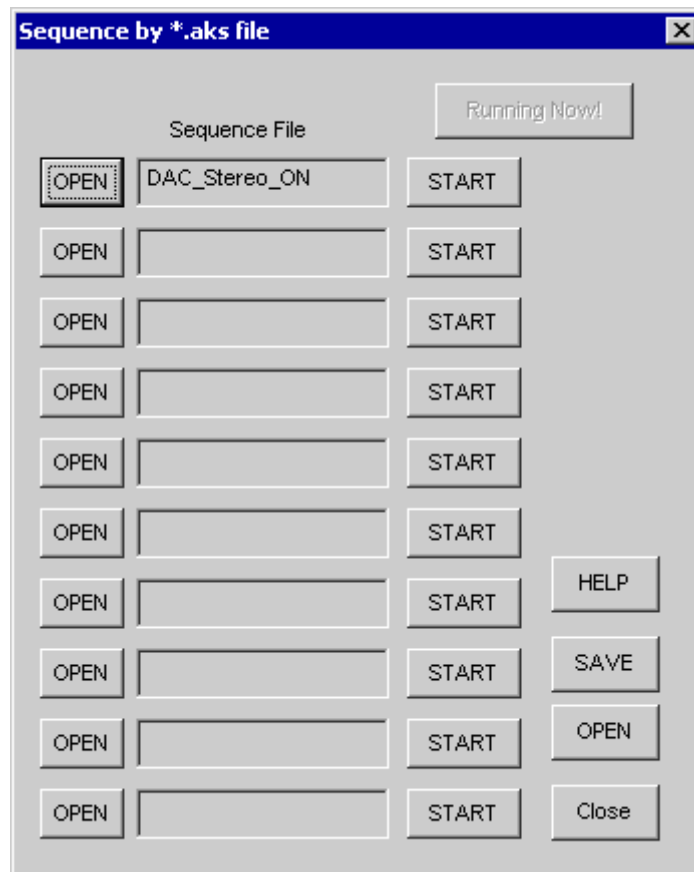


Figure 12. [F4] window(2)

(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 12 opens.

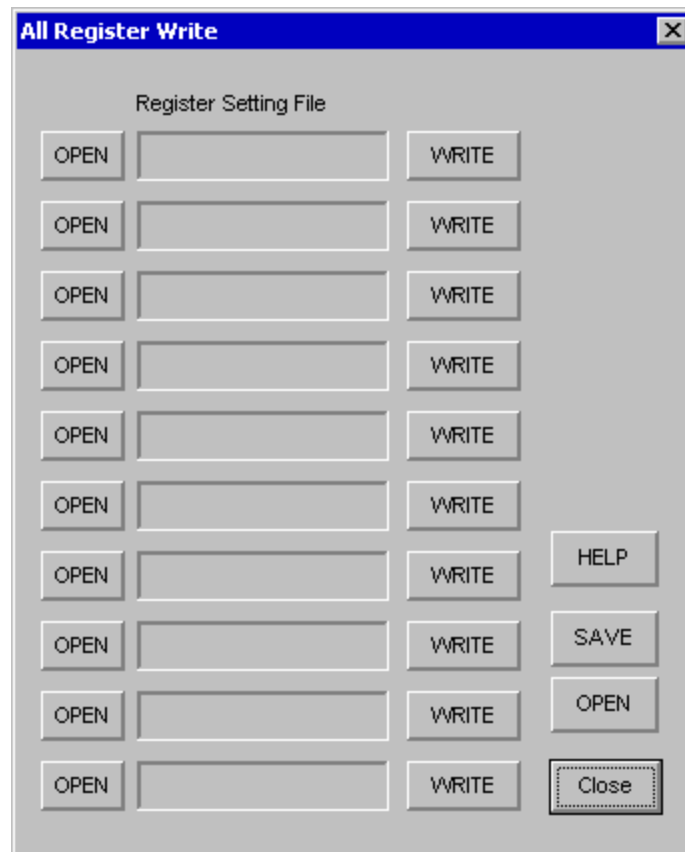


Figure 13. [F5] window

### 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 14. (In case that the selected file name is "DAC\_Output.akr")

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

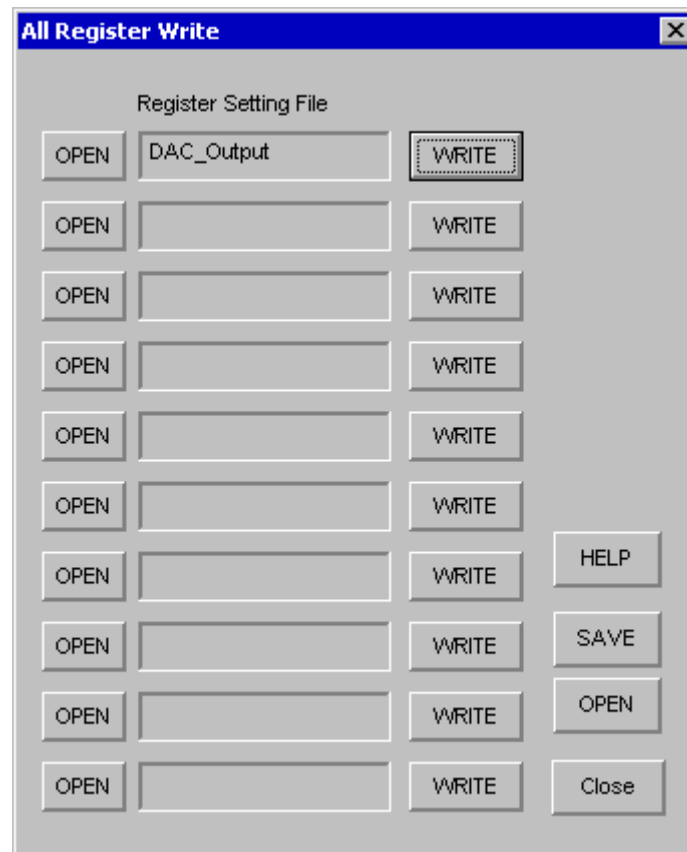


Figure 14. [F5] windows(2)

#### 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.



<b>MEASUREMENT RESULTS</b>
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## [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 : VDD = 5.0V(AVDD = HVDD = DVDD = PVDD = 3.3V)
- Measurement Filter : 22Hz ~ 20kHz
- Temperature : Room

Parameter DAC Analog Output Characteristics	Result (Lch / Rch)	Unit
<b>DAC -&gt; HPAMP</b>		
THD+N (-3dBFS Output)	-57.6 / -57.7	dB
D-Range (-60dB Output, A-weighted)	92.6 / 92.7	dB
S/N (A-weighted)	92.9 / 93.1	dB
<b>DAC -&gt; LOUT</b>		
THD+N (0dBFS Output)	-62.4 / -61.6	dB
D-Range (-60dB Output, A-weighted)	90.5 / 90.0	dB
S/N (A-weighted)	90.7 / 90.3	dB



[Plot of Headphone Amp]

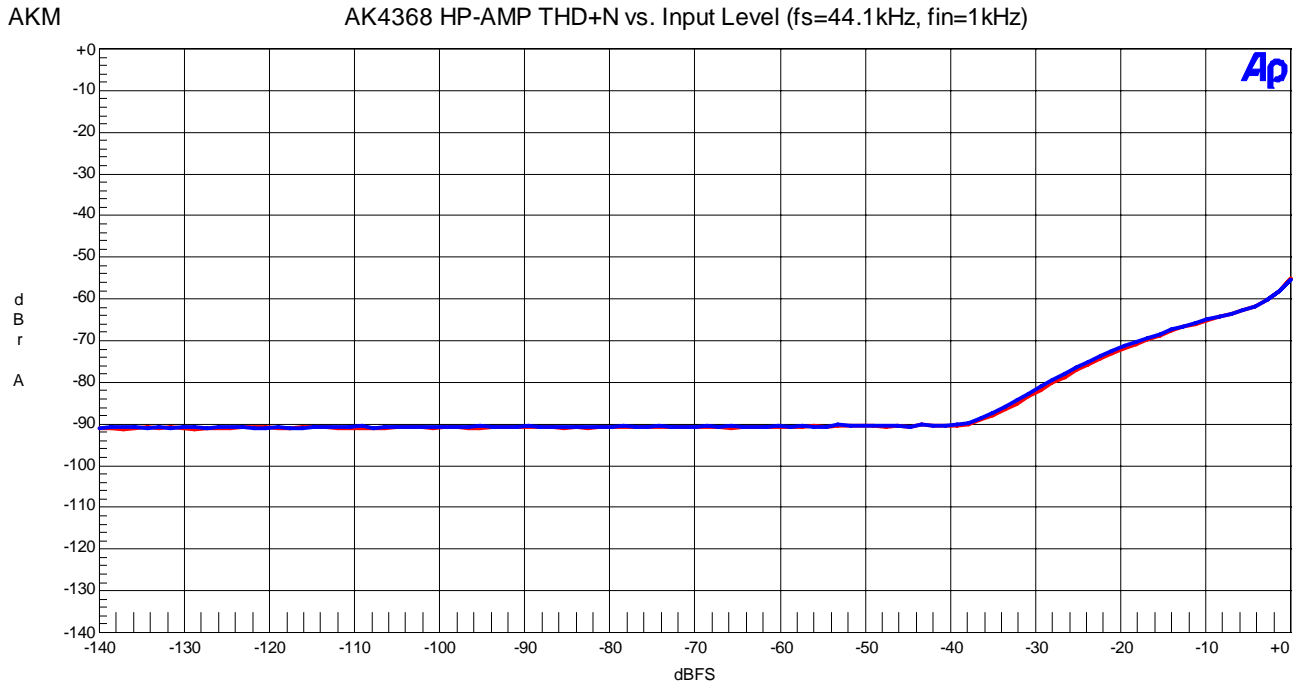


Figure 15. THD+N vs. Input Level

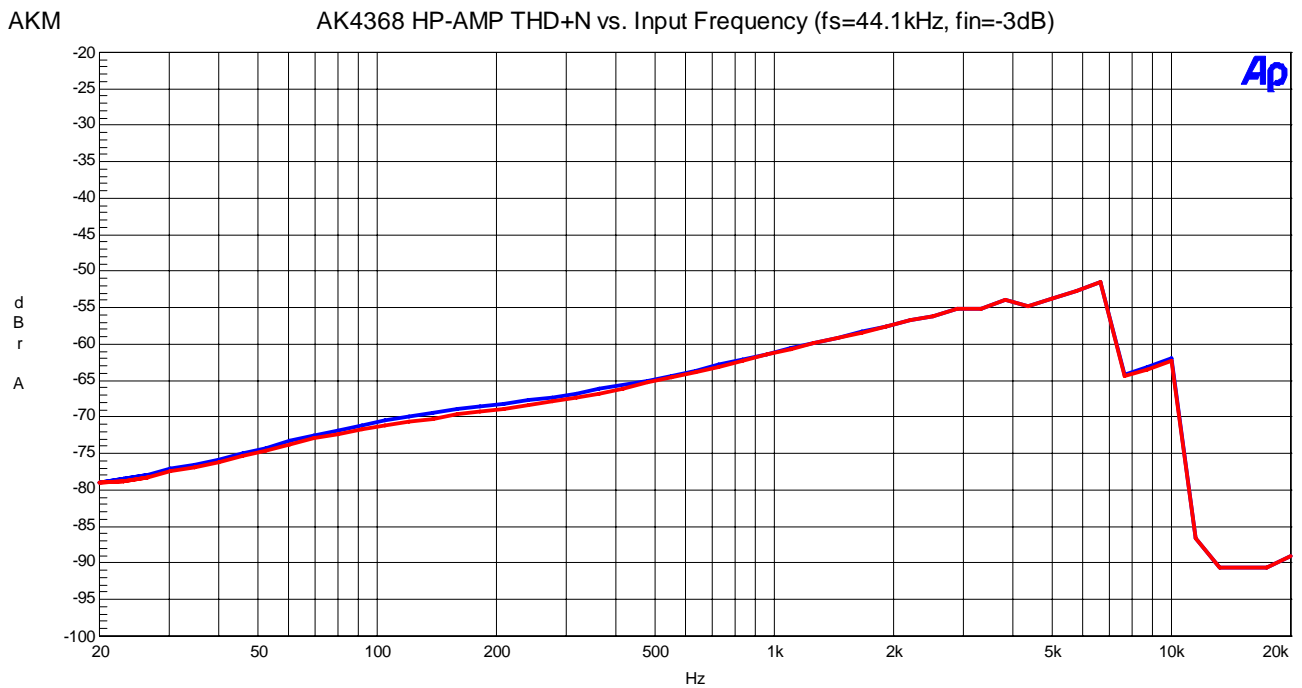


Figure 16. THD+N vs. Input Frequency

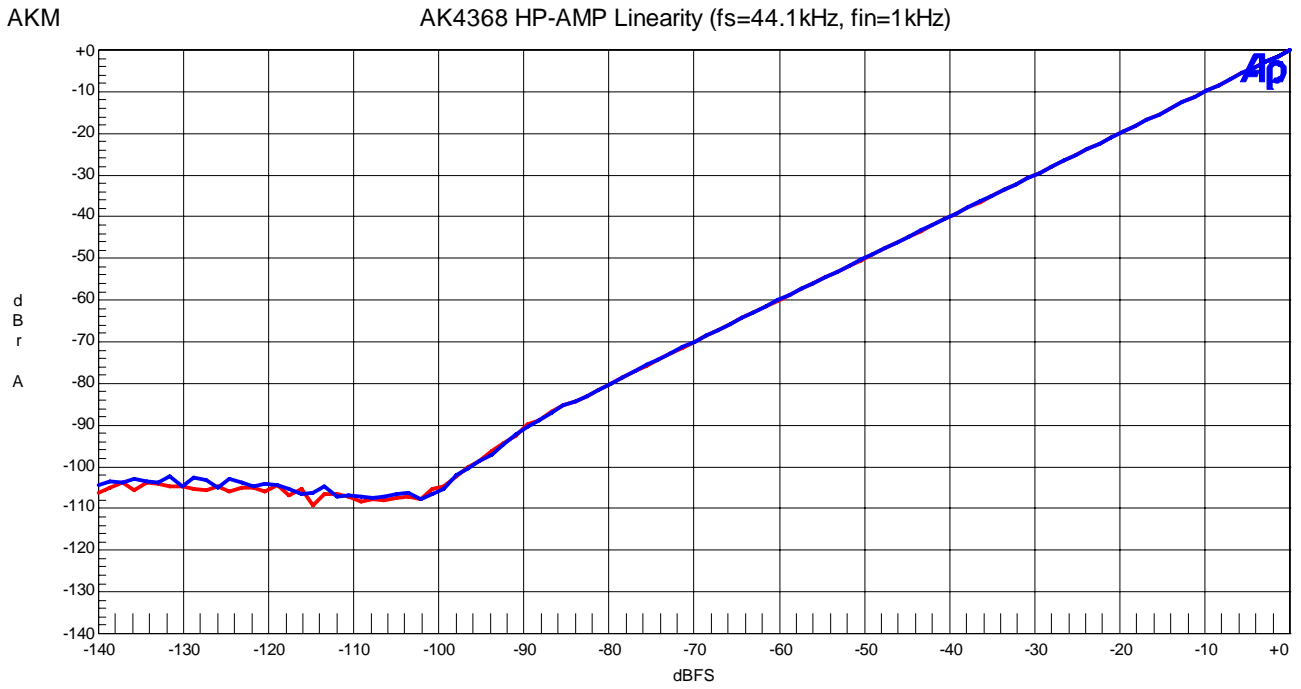


Figure 17. Linearity

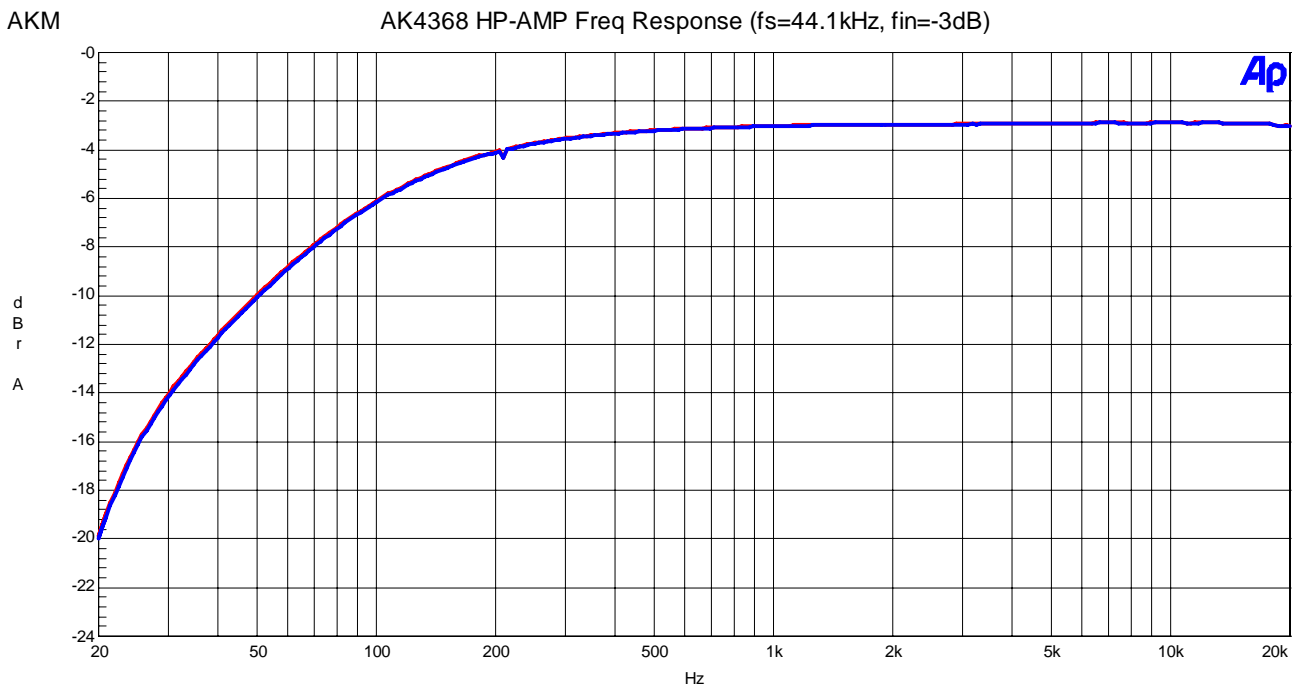


Figure 18. Frequency Response (Boost off)  
(including external HPF)



AKM

AK4368 HP-AMP FFT (fs=44.1kHz, fin=-3dB)

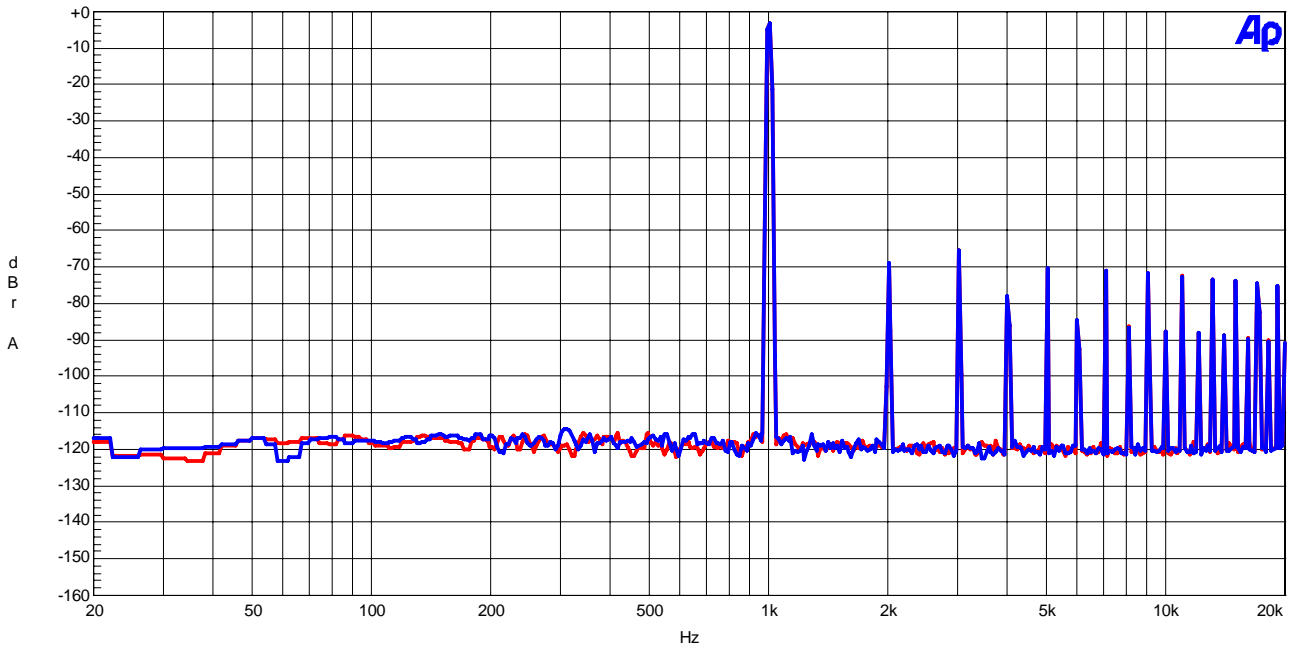


Figure 19. FFT Plot(1kHz,-3dB)

AKM

AK4368 HP-AMP FFT (fs=44.1kHz, fin=-60dB)

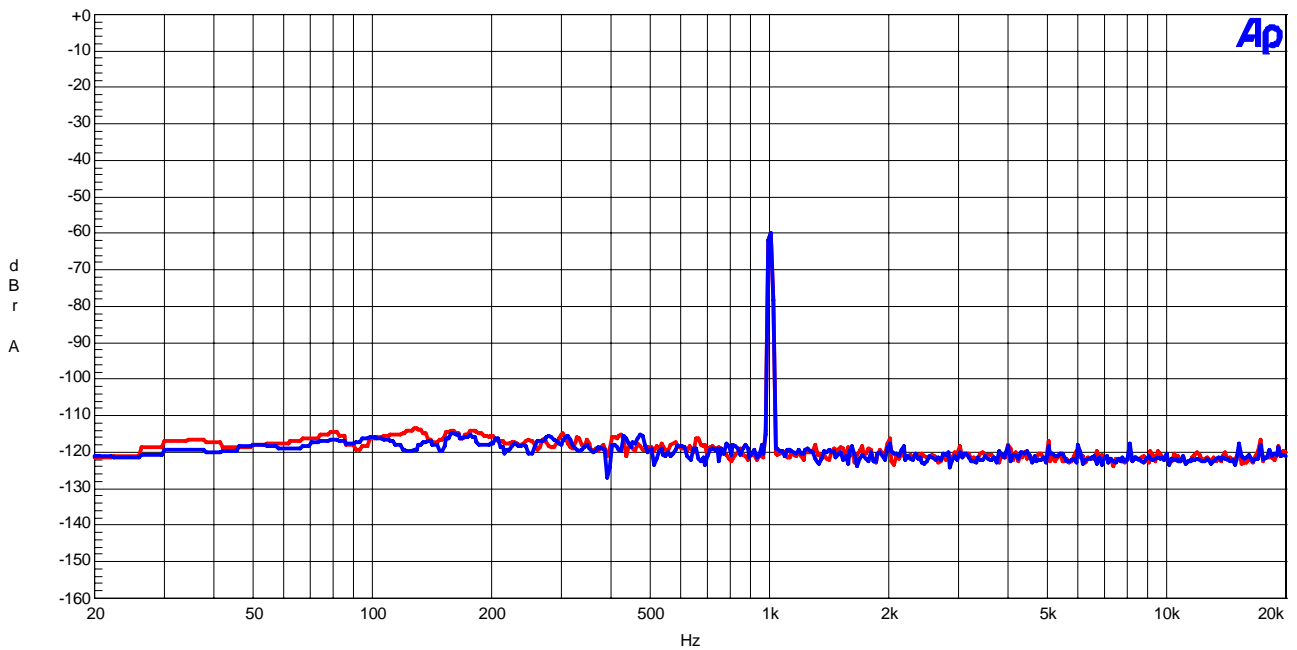


Figure 20. FFT Plot(1kHz,-3dB)



AKM

AK4368 HP-AMP FFT (Noise Floor)

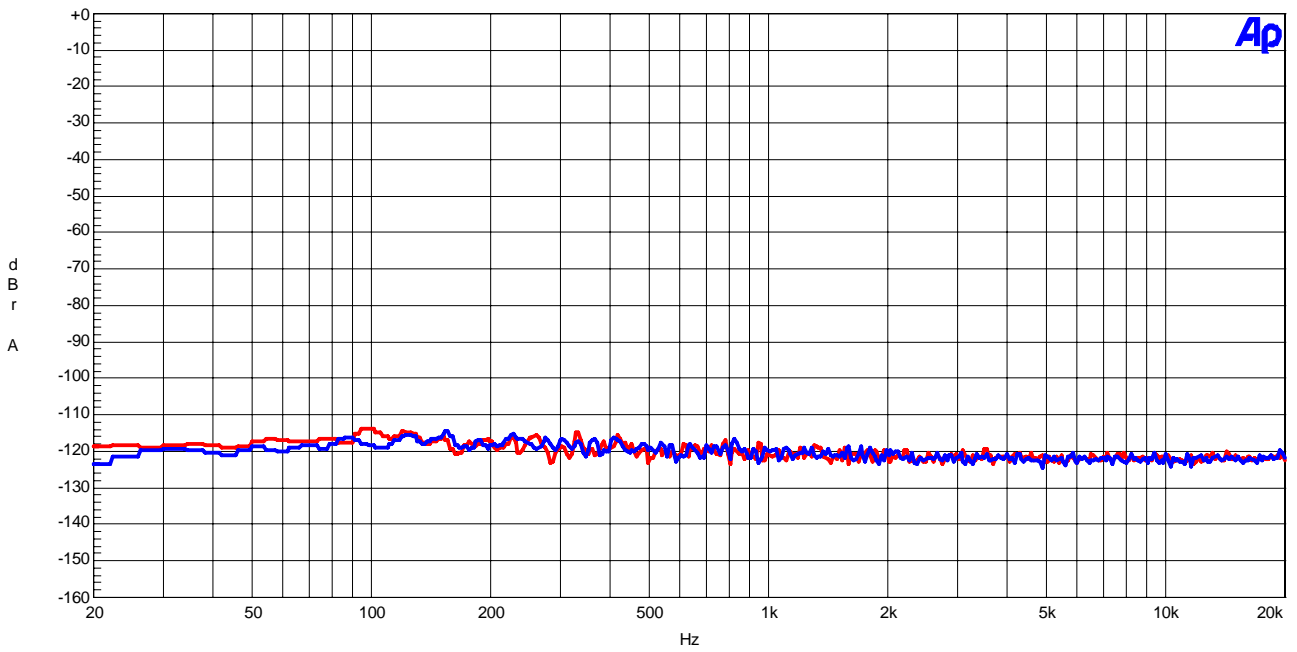


Figure 21. FFT Plot(Noise Floor)

AKM

AK4368 HP-AMP FFT Out-band Noise

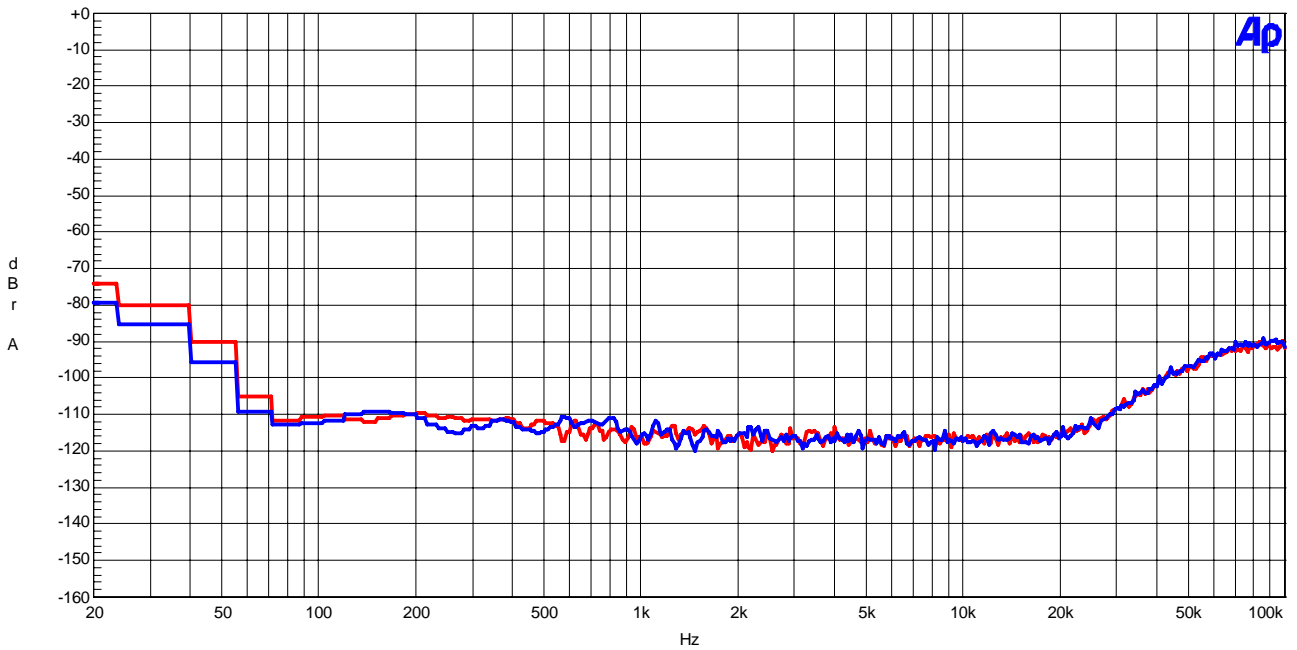


Figure 22. Out-band Noise



AKM

AK4368 HP-AMP Crosstalk (fs=44.1kHz, fin=-3dB)

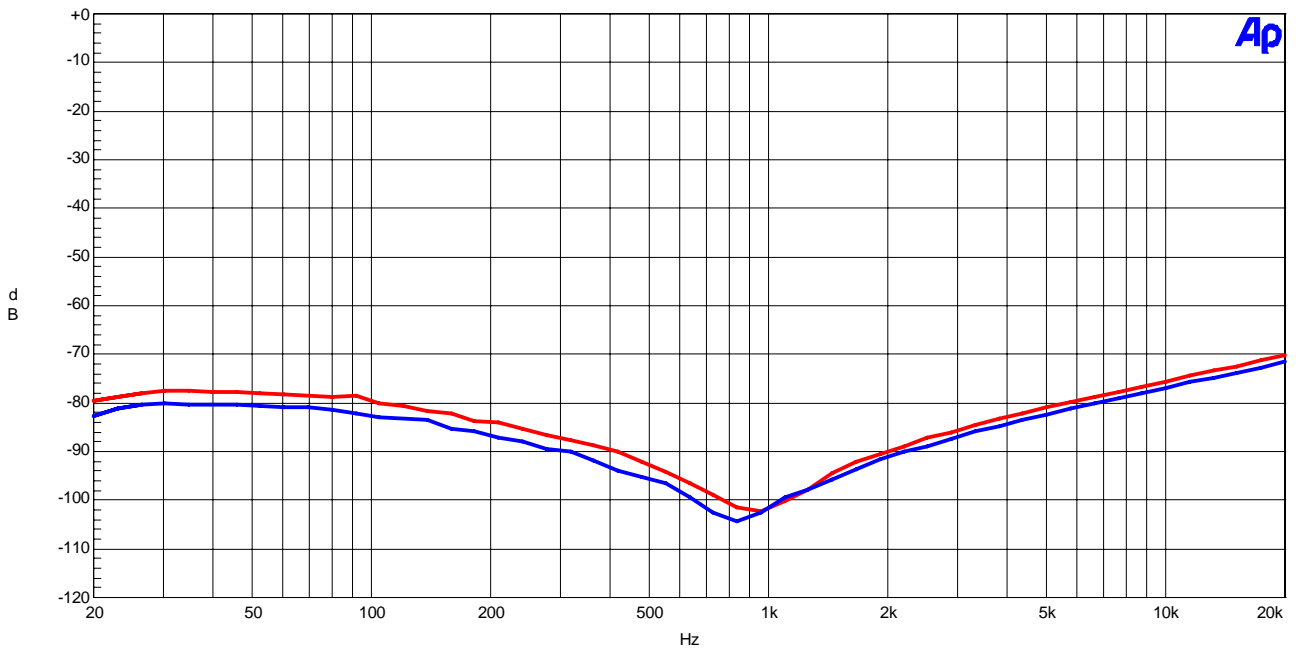


Figure 23. Crosstalk

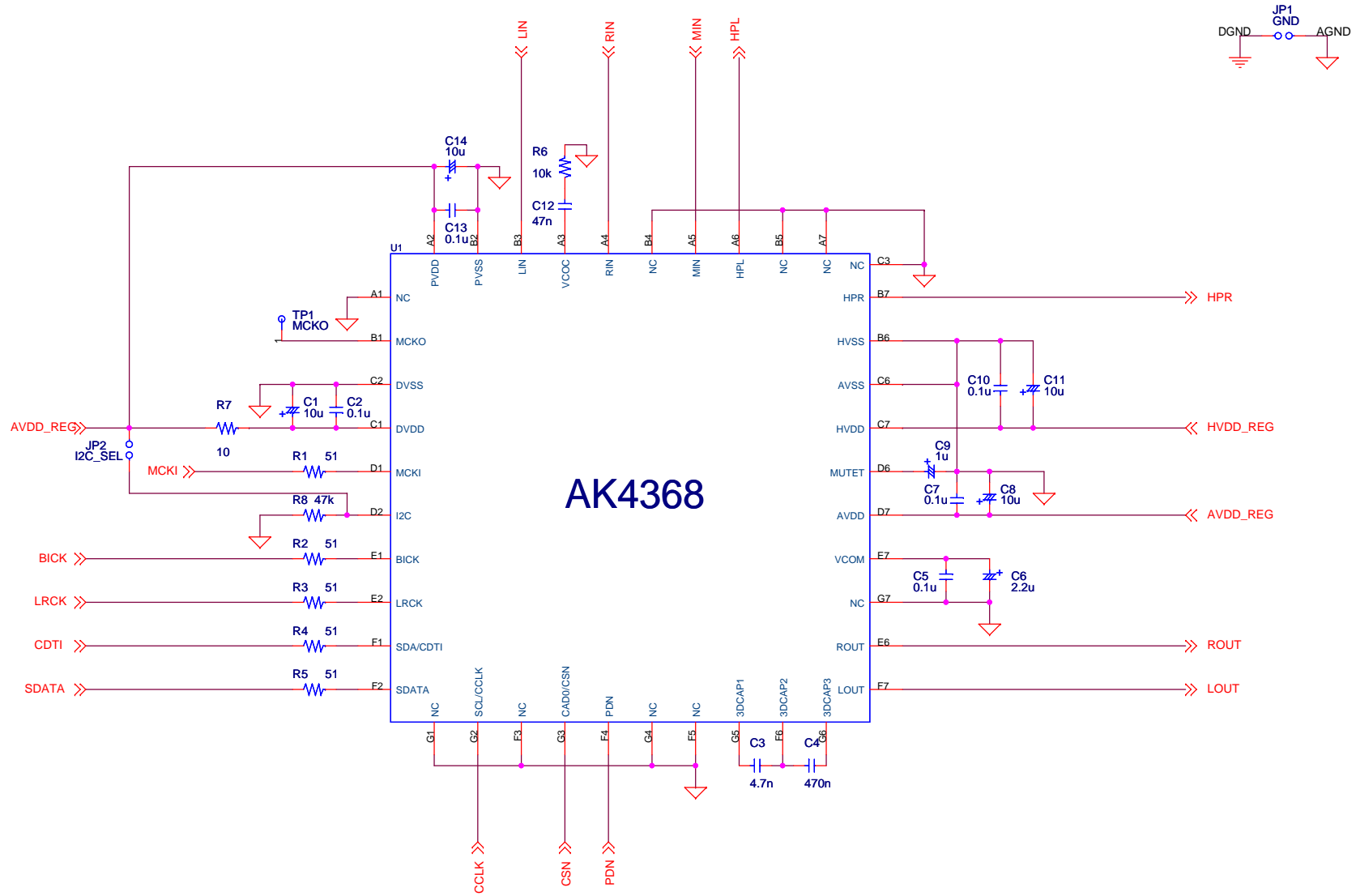


<b>REVISION HISTORY</b>
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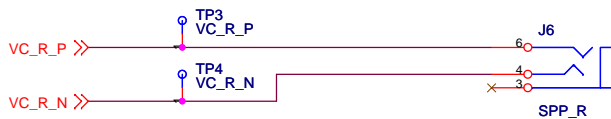
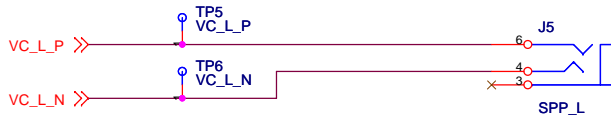
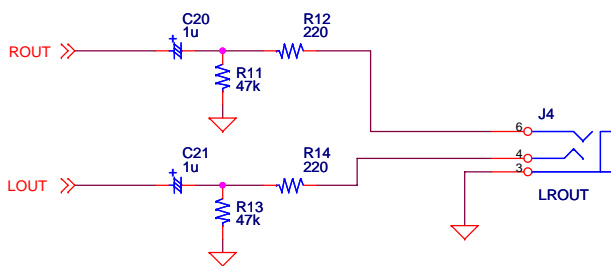
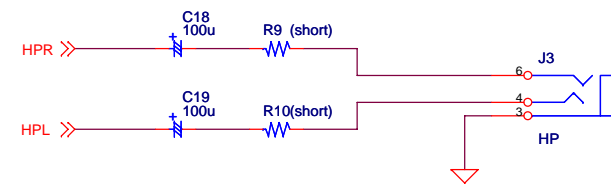
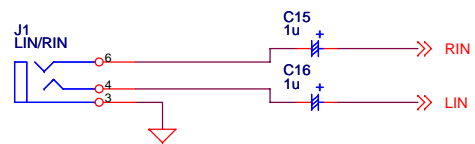
Date (yy/mm/dd)	Manual Revision	Board Revision	Reason	Page	Contents
05/10/31	KM081300	0	First Edition		
06/02/10	KM081301	1	Change Circuit		The connection between GND and the pin3 of Mini-jack J5 and J6 were cut.
07/08/01	KM081302	2	Change	24	C12 4.7nF → 47nF

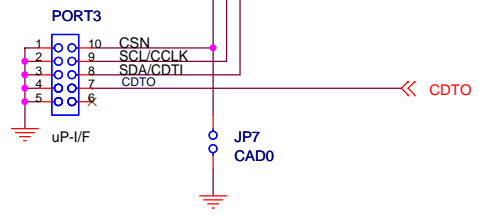
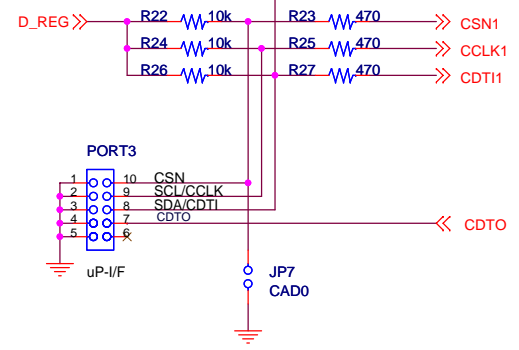
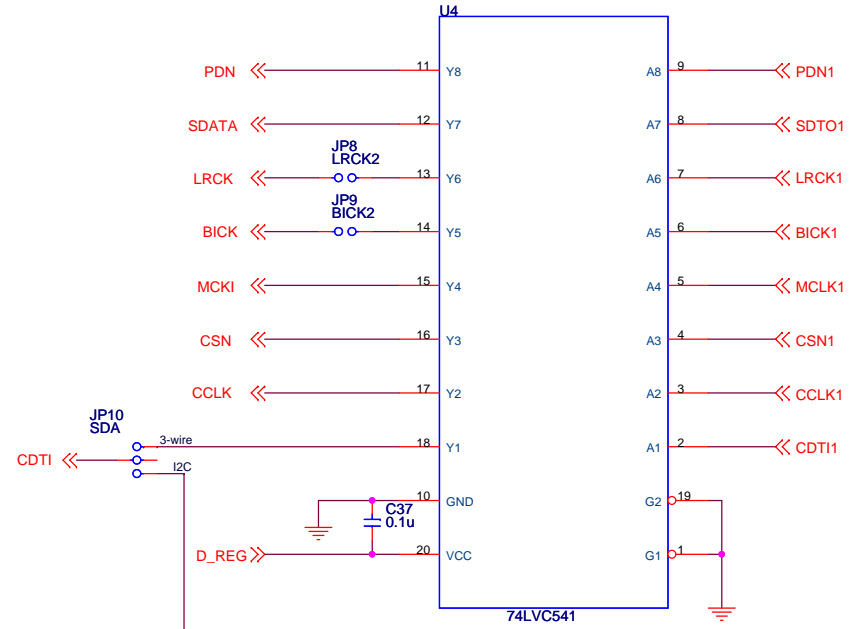
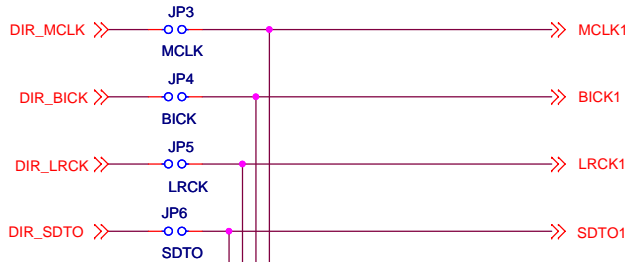
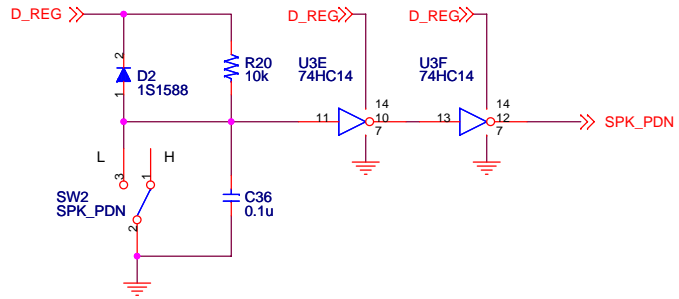
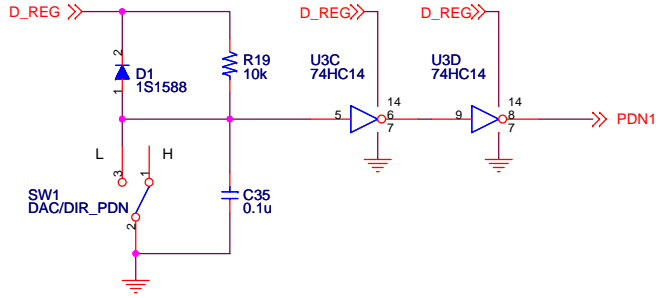
IMPORTANT NOTICE

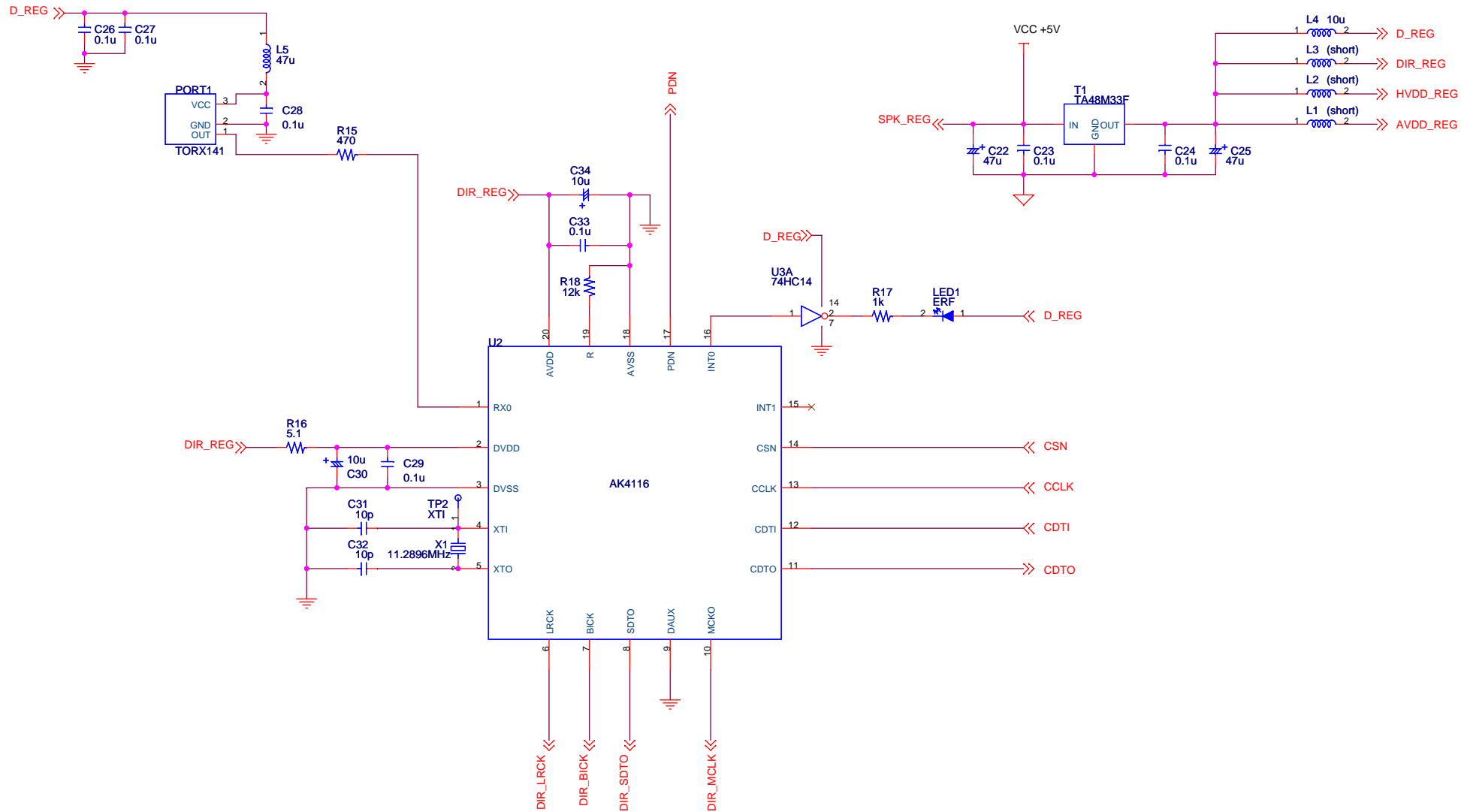
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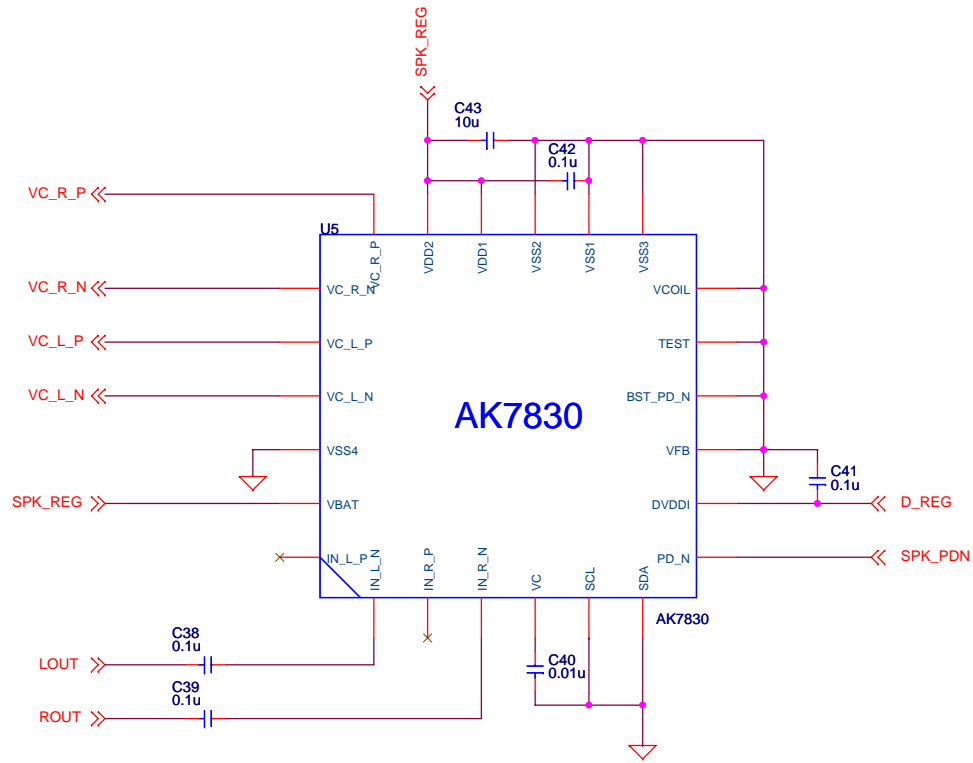
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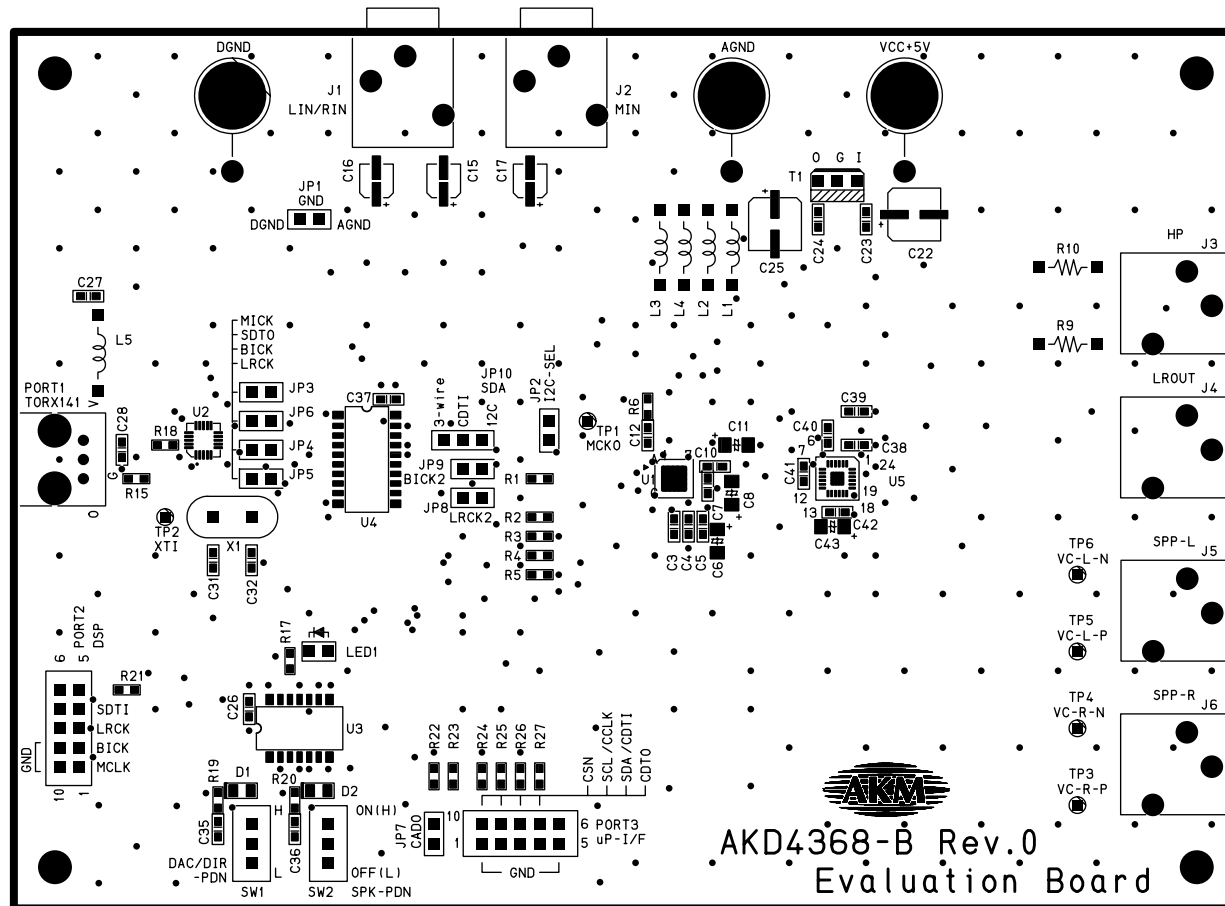




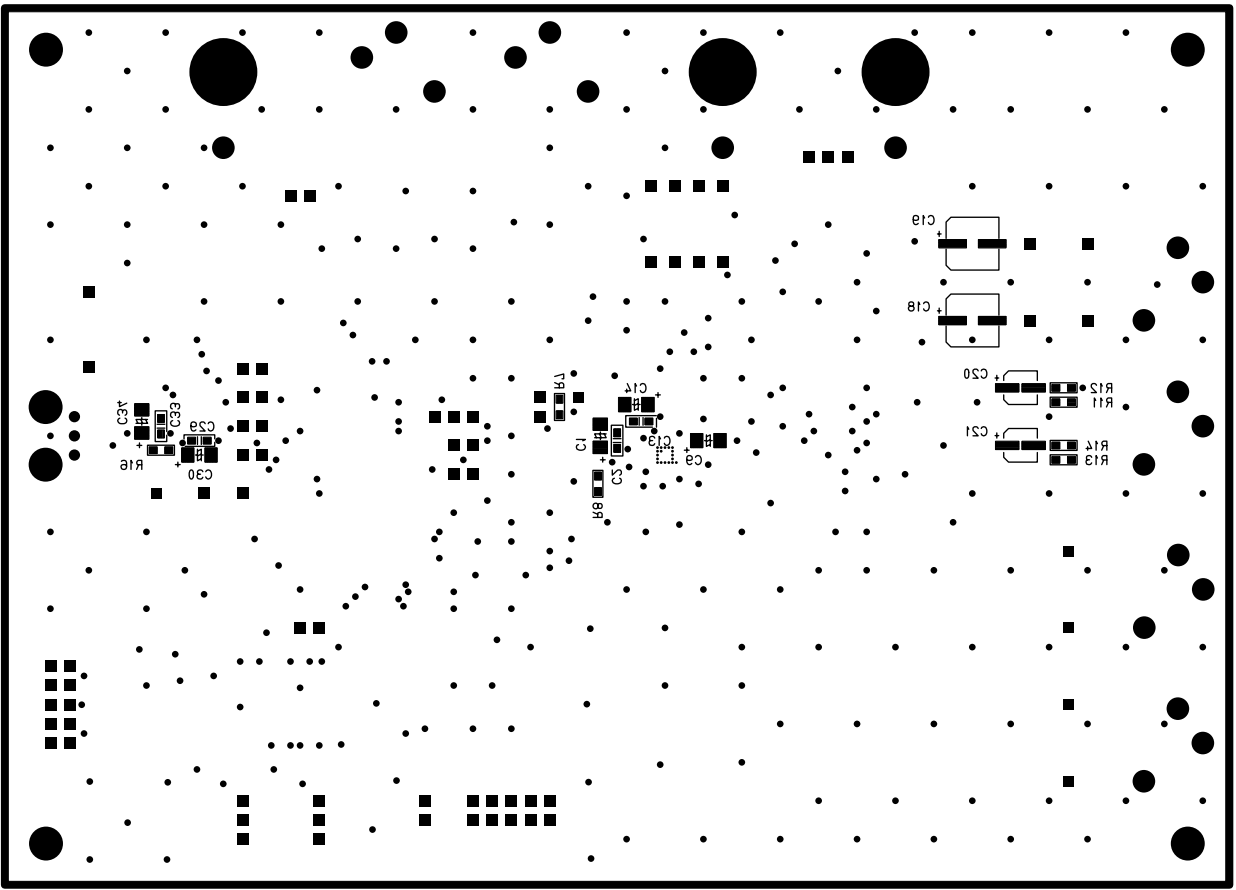
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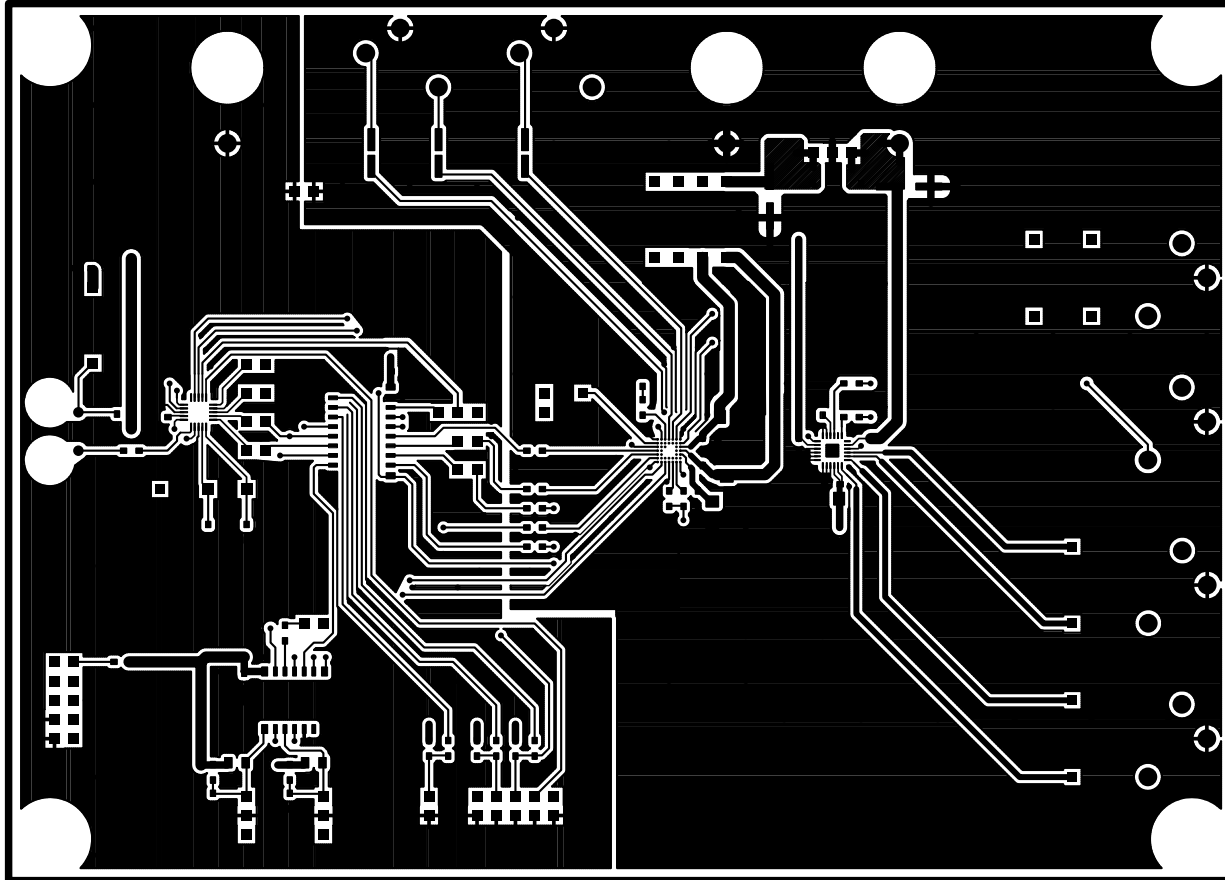
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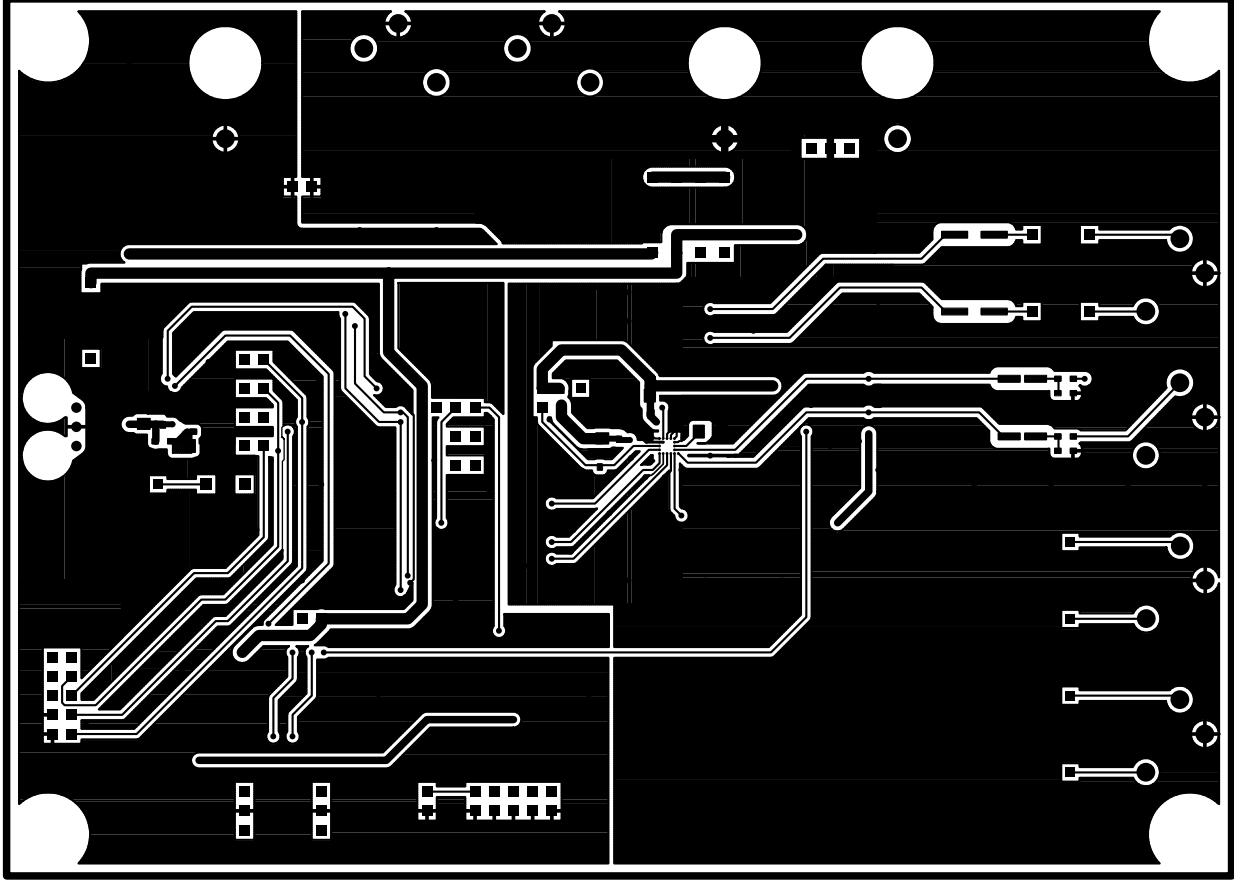
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AKD4368-B L1



AKD4368-B FS