AKD4368-A
Evaluation board Rev.1 for AK4368

GENERAL DESCRIPTION

The AKD4368 is an evaluation board for 24bit DAC with built-in 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-connector.

■ Ordering guide

AKD4368 --- 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 AK4114 as DIR which accepts optical input**
- **10pin header for serial control interface**

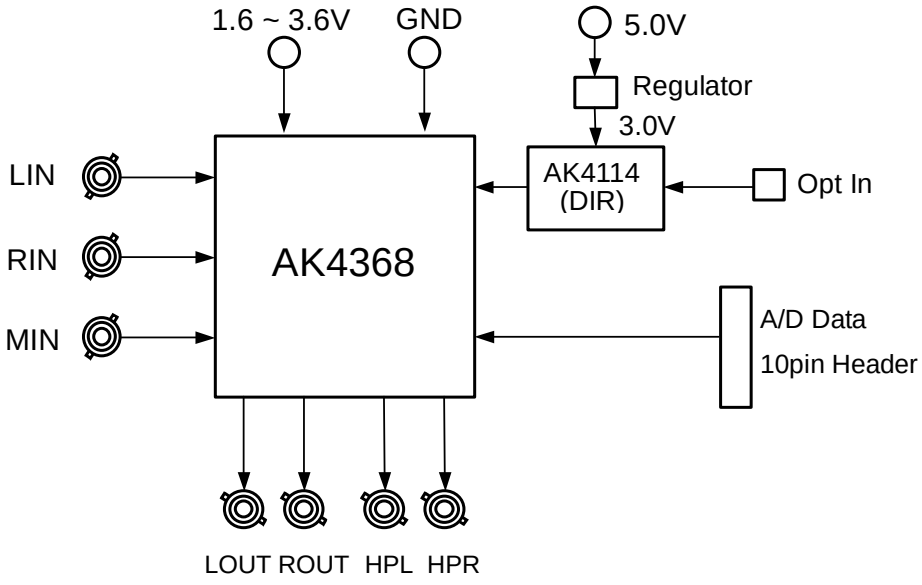


Figure 1. AKD4368 Block Diagram

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

1. Evaluation Board Manual

■ Operation sequence

1) Set up the power supply lines.

[AVDD]	(orange)	= 1.6 ~ 3.6V	: for AVDD, DVDD and PVDD of AK4368 (typ. 2.4V)
[HVDD]	(orange)	= 1.6 ~ 3.6V	: for HVDD of AK4368 (typ. 2.4V)
[D3V]	(orange)	= 1.6 ~ 3.6V	: for 74LVC541 and 74LVC245A (typ. 2.4V)
[VCC]	(red)	= 5.0V	: for logic (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.

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

3) Power on.

The AK4368 and AK4114 should be resets once bringing SW3 (DAC_PDN) and SW2 (DIR_PDN) "L" upon power-up.

■ Evaluation mode

In case of the AK4368 evaluation using the AK4114, it is necessary to correspond to audio interface format for the AK4368 and AK4114. About the AK4368's audio interface format, refer to datasheet of the AK4368. About the AK4114's audio interface format, refer to Table 2 in this manual.

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

PORT3 (ROM) is used. Nothing should be connected to PORT1 (DIR). MCLK, BICK, LRCK and SDATA are supplied from DSP. It is possible to evaluate at various sampling frequencies using built-in the AK4368's PLL.

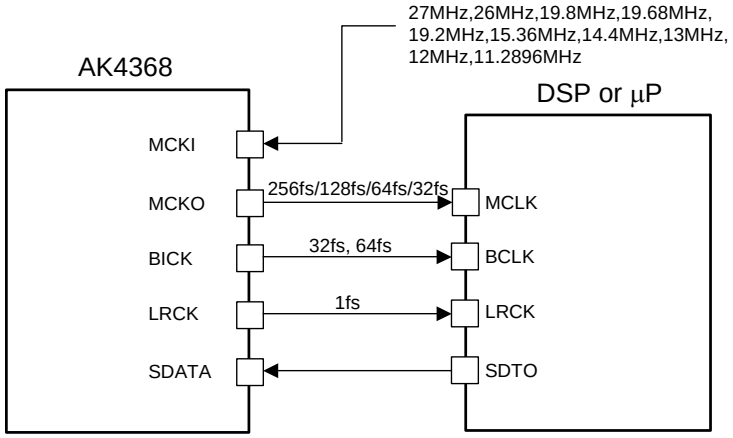
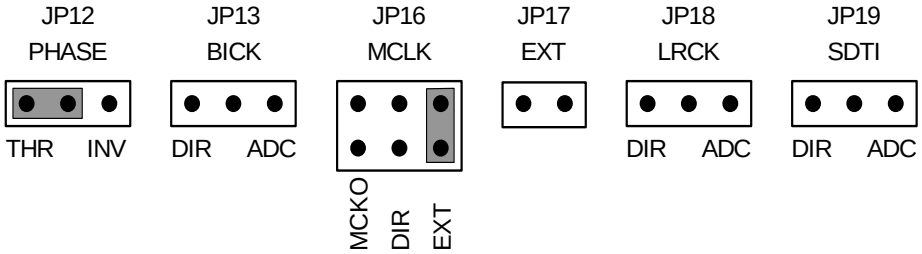


Figure 2. PLL Master Mode

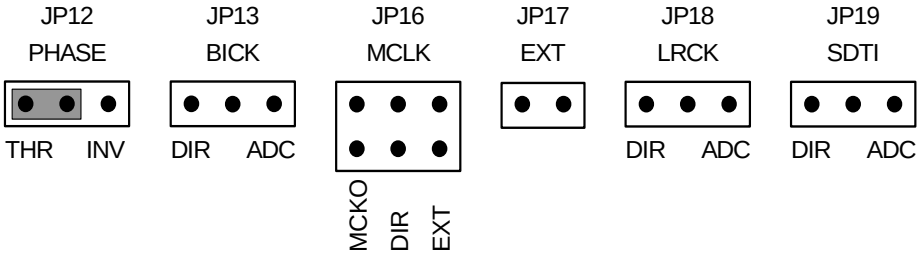
M/S should be set to "H" for SW1. SDTI,LRCK,BICK of PORT3 should be connected to SDTO,LRCK,BICK for DSP. In case of supplying MCKO from DSP, the test pin(MCKO)on sub board should be connected to MCLK of DSP.

The system clock can be supplied by two ways below.

1) Supplied MCKI from J17



2) Supplied MCKI from MCLK(PORT3)



(2) PLL Slave Mode

PORT3 (ROM) is used. BICK,LRCK,SDATA are supplied from DSP. Nothing should be connected to PORT1 (DIR). MCKO is needed for a synchronous singal of BICK and LRCK. M/S should be set to "L" for SW1.

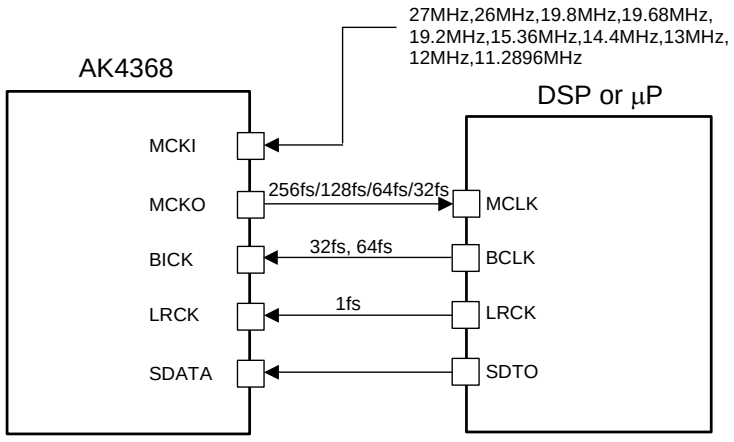


Figure 3. PLL Slave Mode

The test pin (MCKO) on sub board should be connected to MCLK of DSP. System clock MCKI can be supplied from J17 or PORT3. Setup of jumper pins is same as (1)PLL Master Mode.

(3) EXT Slave Mode

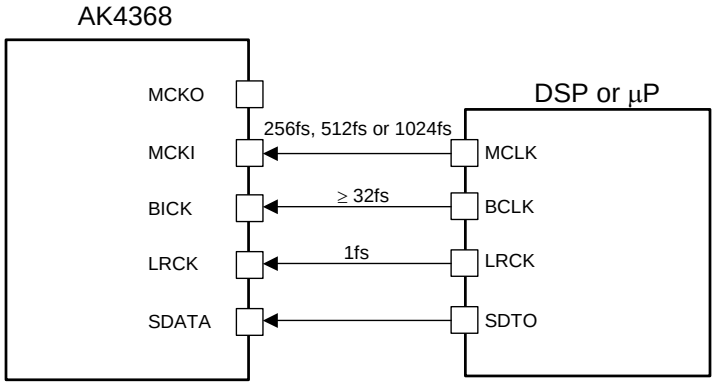
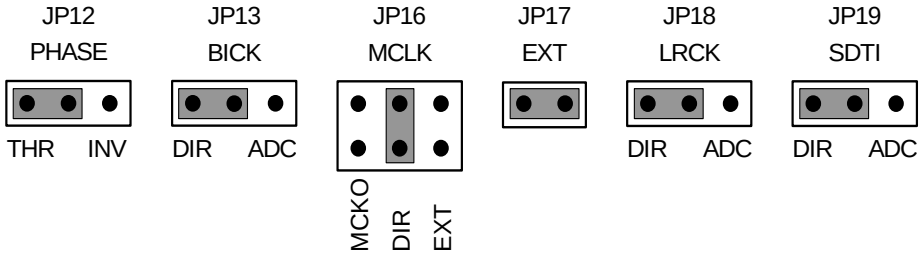


Figure 4. EXT Slave Mode

(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 (TORX176). Nothing should be connected to PORT3 (DSP) and J17. JP17(EXT)should be short. CM0 and M/S should be set to "L" for SW1.

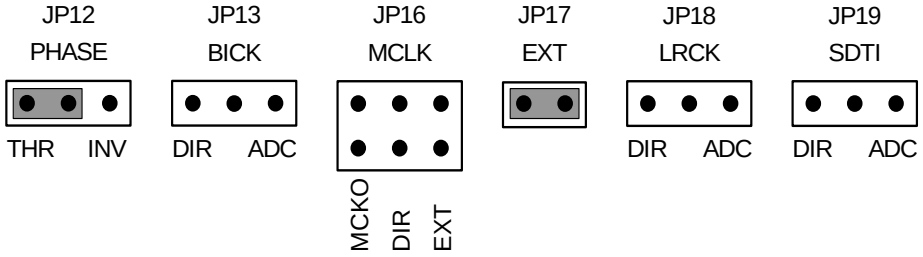


When the AK4114 is used, JP14 (MKFS) and JP15 (BCFS) are not used. Theerfore, JP14 (MKFS) should be set to "x1" and JP15 (BCFS) should be set to "64fs".

The AK4114 does not operate under fs = 32kHz. Therefore, this mode corresponds to fs = 32kHz and over.

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

PORT3 (ROM) is used. MCLK, BICK, LRCK and SDATA are supplied from PORT3. Nothing should be connected to PORT1 (DIR). JP17(EXT) should be short.



When all interface signals are fed externally, JP14 (MKFS) and JP15 (BCFS) are not used. Therefore, JP14 (MKFS) should be set to "x1" and JP15 (BCFS) should be set to "64fs".

JP12 (PHASE) is jumper which decides polarity of BICK, JP12 should be set to "THR" or "INV" according to audio interface format.

■ DIP Switch set up

[SW1] : Mode Setting of AK4368 and AK4114
ON is "H", OFF is "L".

No.	Name	ON ("H")	OFF ("L")
1	DIF0	AK4114 Audio Format Setting See Table 2	
2	DIF2		
3	CM0	AK4114 X'tal Mode	AK4114 PLL Mode
4	CAD0	Fixed to "L"	
5	CAD1		
6	I2C		
7	M/S	Master mode	Slave mode

Note: M/S is set "H" when PLL, Master Mode
Table 1. Mode Setting for AK4368 and AK4114

Mode	DIF2	DIF0	AK4114 SDTO	
0	0	0	16bit, LSB justified	
1	0	1	18bit, LSB justified	
2	1	0	24bit, MSB justified	(default)
	1	1	24bit, I^2S	

Note: DIF1 is fixed to "L" on the board
Table 2. Setting for AK4114 audio interface format

■ Other jumper pins set up

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

2. JP14 (MKFS) : MCLK Frequency
   x1 : 256fs<default>
   x2 : 512fs
   x4 : 1024fs

3. JP15 (BCFS) : BICK Frequency
   32fs : 32fs frequency
   64fs : 64fs frequency<default>

■ The function of the toggle SW

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

[SW2] (DIR): Power down of AK4114. Keep "H" during normal operation.
Keep "L" when the AK4114 is not used.

[SW3] (PDN): Power down of AK4368. Keep "H" during normal operation.

■ Indication for LED

[LED1] (ERF): Monitor INT0 pin of the AK4114. LED turns on when some error has occurred to AK4114.

■ Serial Control

The AK4368 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT4 (CTRL) with PC by 10 wire flat cable packed with the AKD4368.

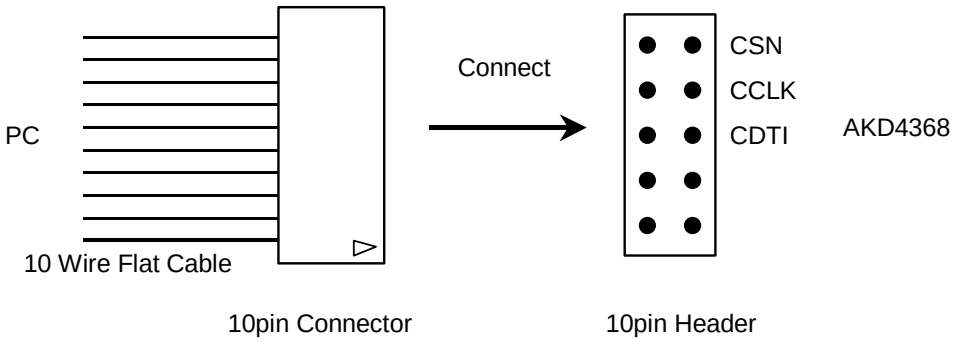


Figure 5. Connect of 10 wire flat cable

■ Input / Output circuit & Set-up jumper pin for Input / Output circuits

(1) Input Circuit

External analog signal is fed through the BNC connector.

MIN, LIN, RIN Input circuits

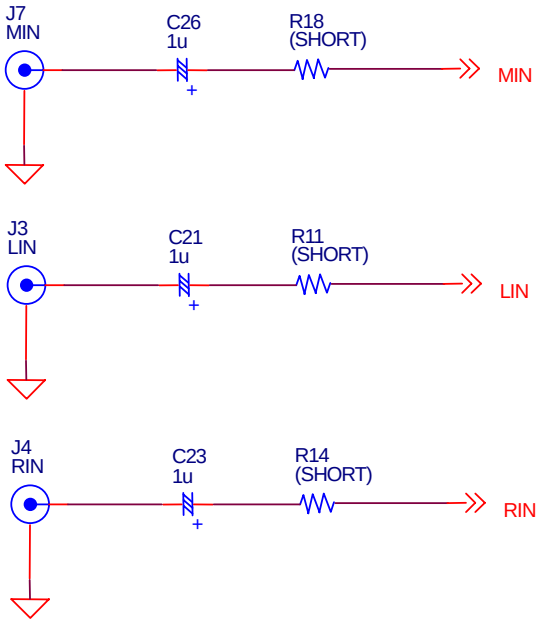


Figure 6. MIN, LIN, RIN Input circuits

(2) Output Circuit

1) LOUT,ROUT Output Circuit

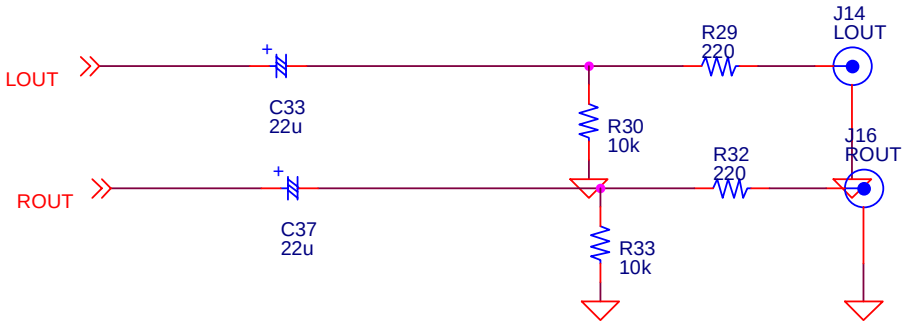


Figure 7. LOUT,RO UT Output Circuit

2) HPL, HPR Output Circuit

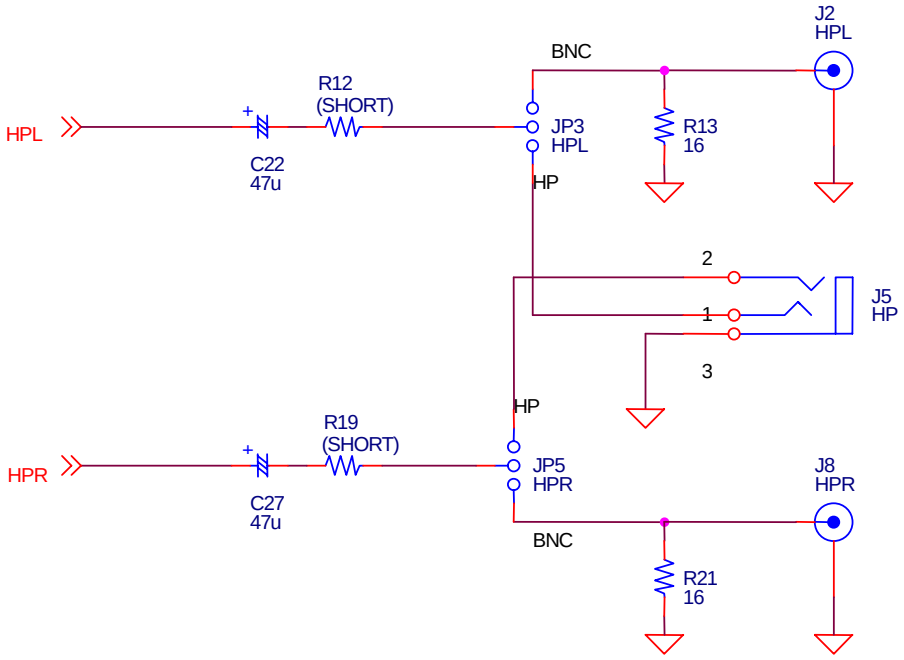
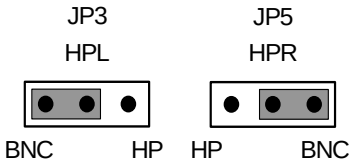
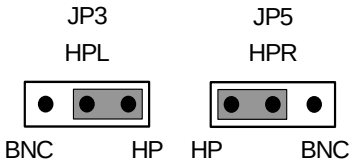


Figure 8. HPL, HPR Output Circuit

2)-1. Outputs of HPL and HPR pins are applied via J2 and J8.



2)-2. Outputs of HPL and HPR pins are applied via J5.



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

2. 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 and 06h.

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".

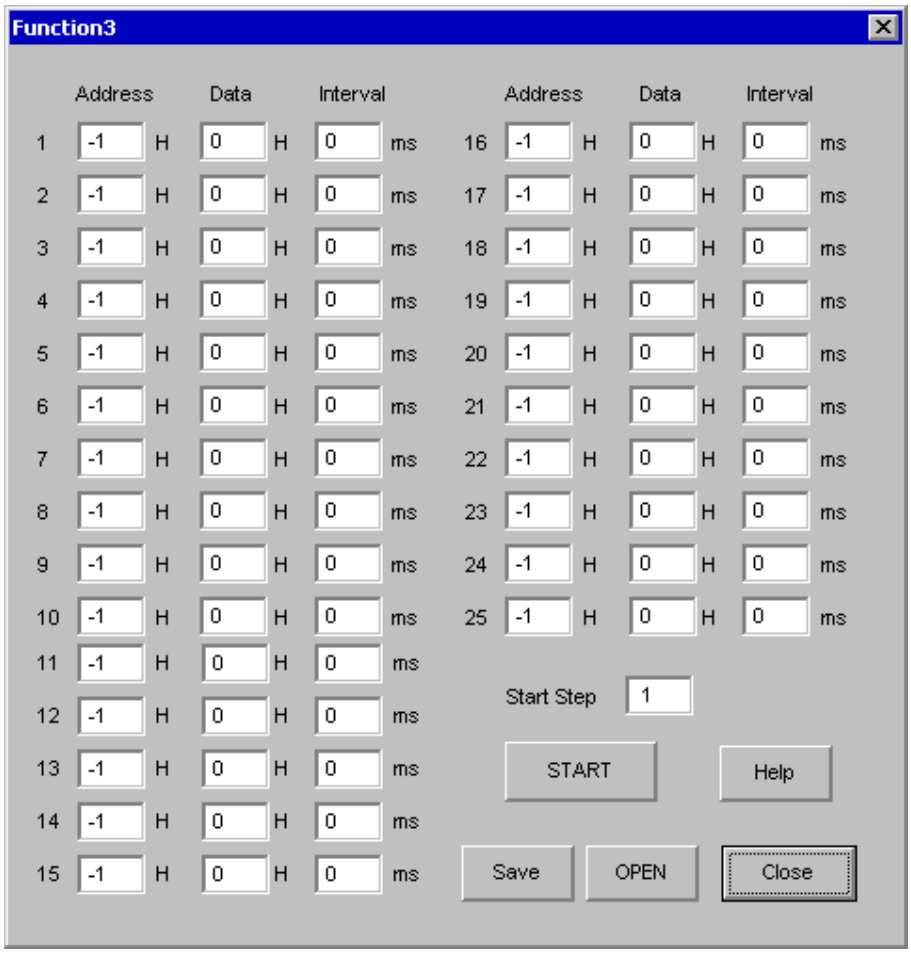


Figure 9. Window of [F3]

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 10 opens.

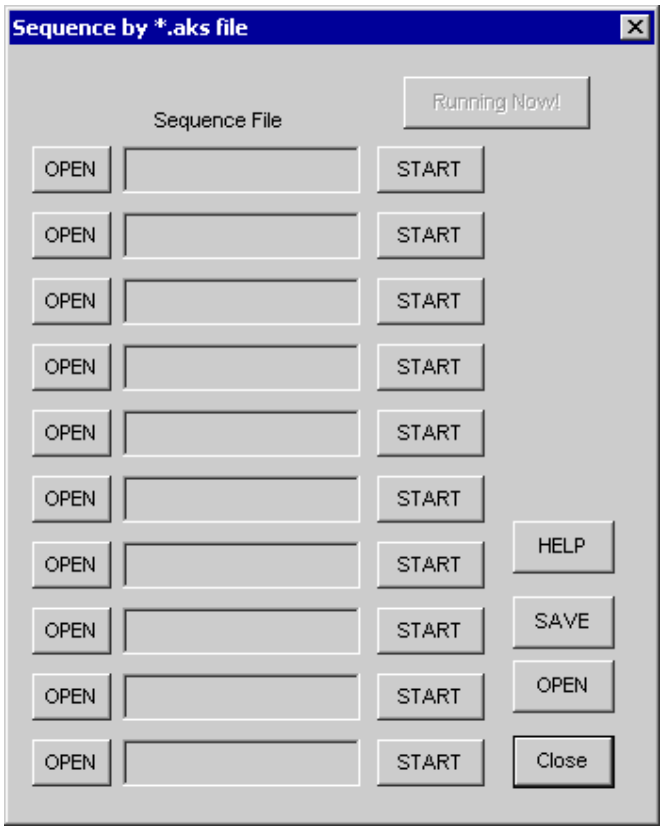


Figure 10. [F4] window

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 11. (In case that the selected sequence file name is "DAC_Stereo_ON.aks")

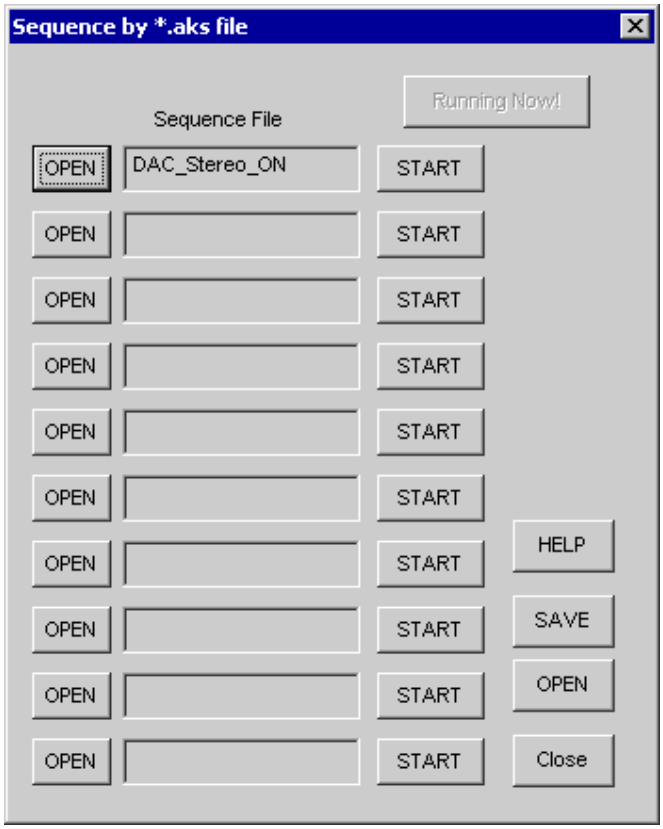


Figure 11. [F4] window(2)

(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 12 opens.

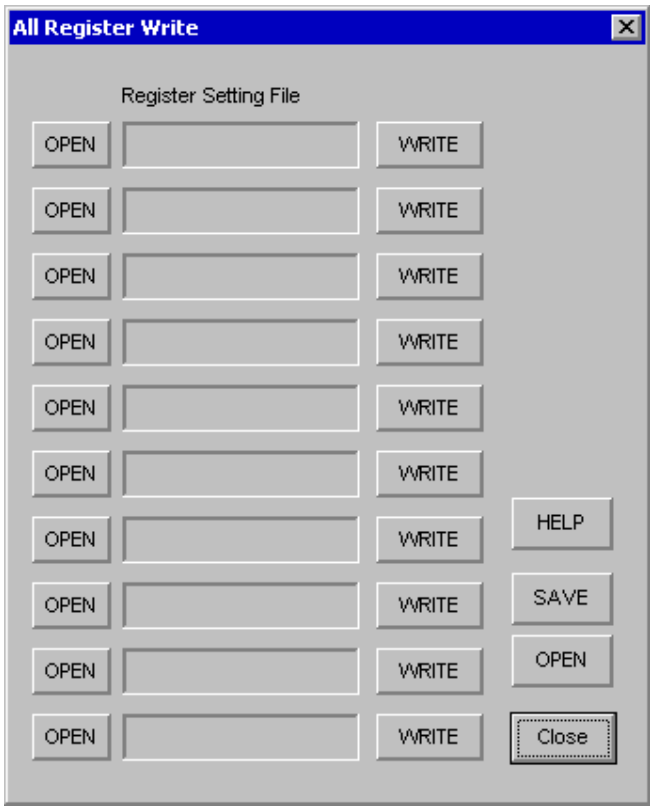


Figure 12. [F5] window

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 13. (In case that the selected file name is "DAC_Output.akr")

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

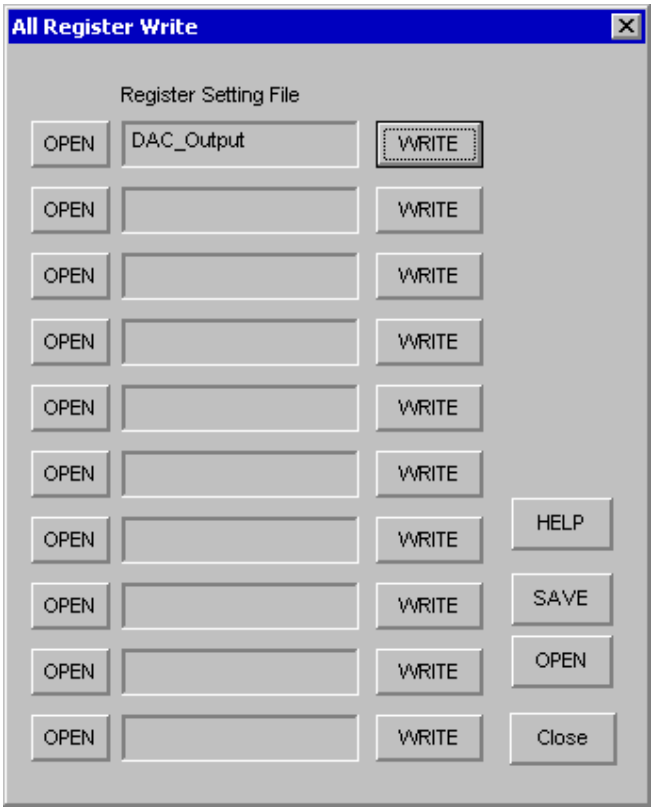


Figure 13. [F5] windows(2)

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.

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 : VDD = HVDD = 3.3V
- Measurement Filter : 10Hz ~ 20kHz
- Temperature : Room

Parameter DAC Analog Output Characteristics		Result (Lch / Rch)	Unit
DAC -> HPAMP			
THD+N	(-3dBFS Output)	-56.5 / -57.0	dB
D-Range	(-60dB Output, A-weighted)	90.7 / 90.7	dB
S/N	(A-weighted)	90.8 / 90.8	dB
DAC -> LOUT			
THD+N	(0dBFS Output)	-75.8 / -75.7	dB
D-Range	(-60dB Output, A-weighted)	88.7 / 88.4	dB
S/N	(A-weighted)	88.7 / 88.4	dB

[Plot of Headphone Amp]

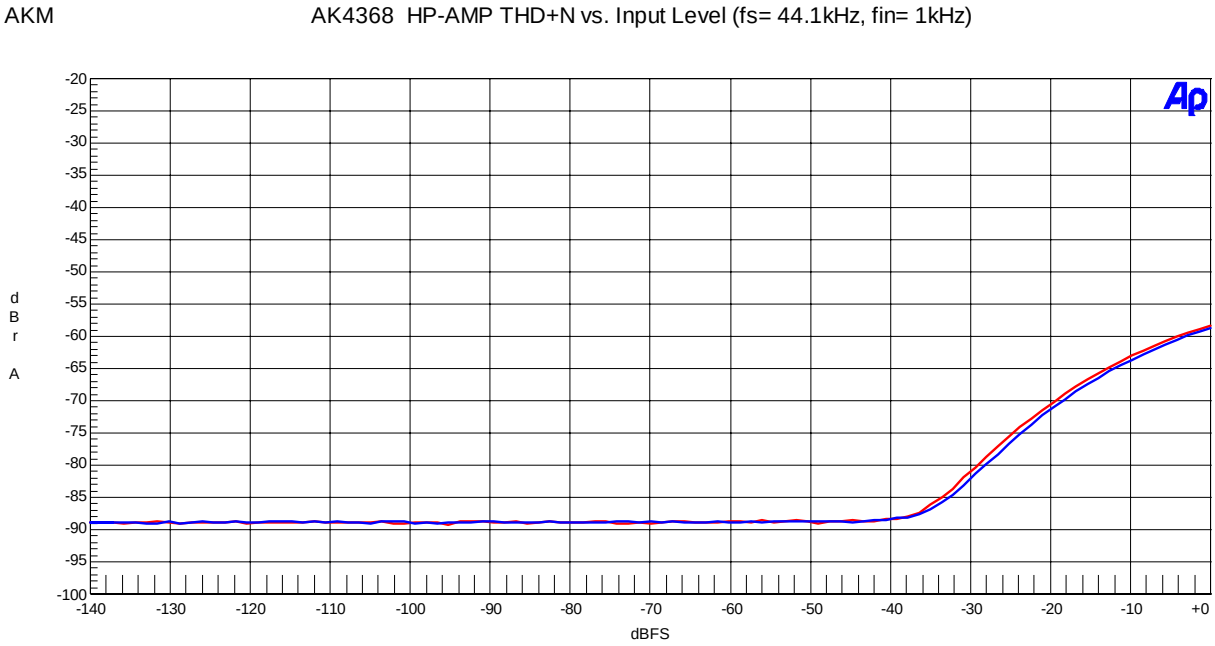


Figure 14. THD+N vs. Input Level

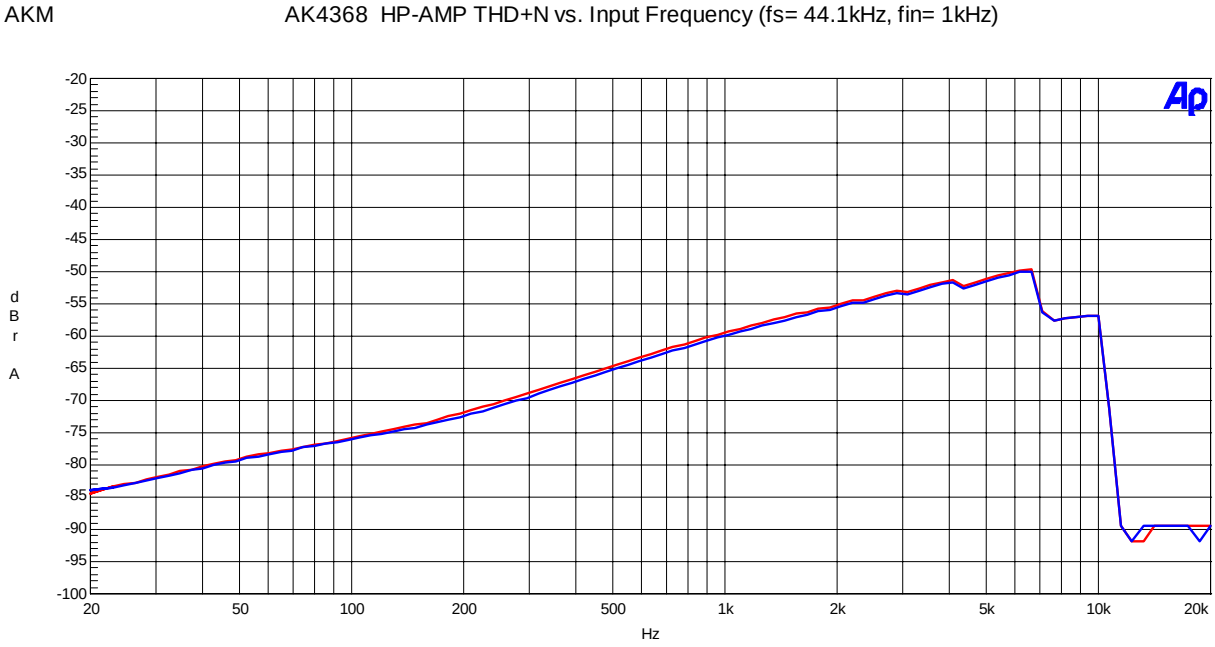


Figure 15. THD+N vs. Input Frequency

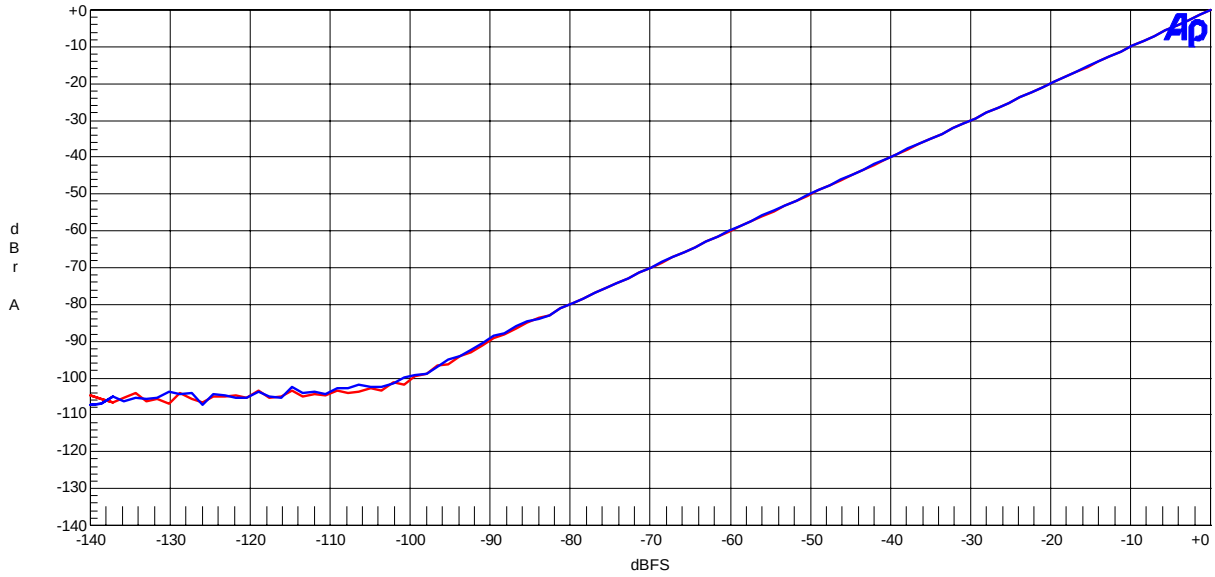


Figure 16. Linearity

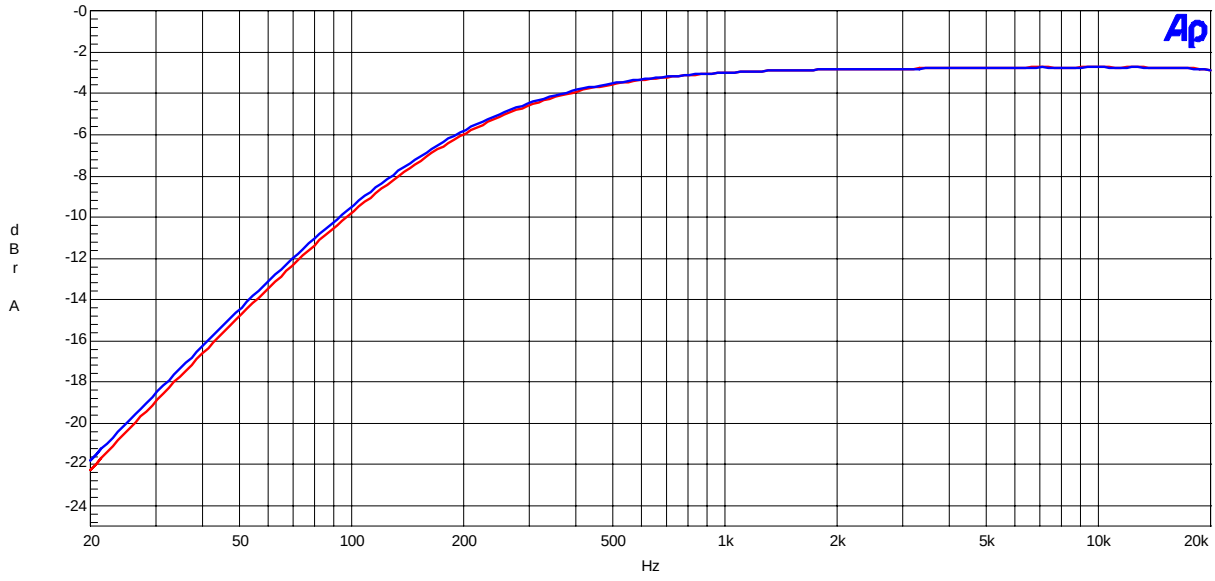


Figure 17. Frequency Response (Boost off)
(including external HPF)

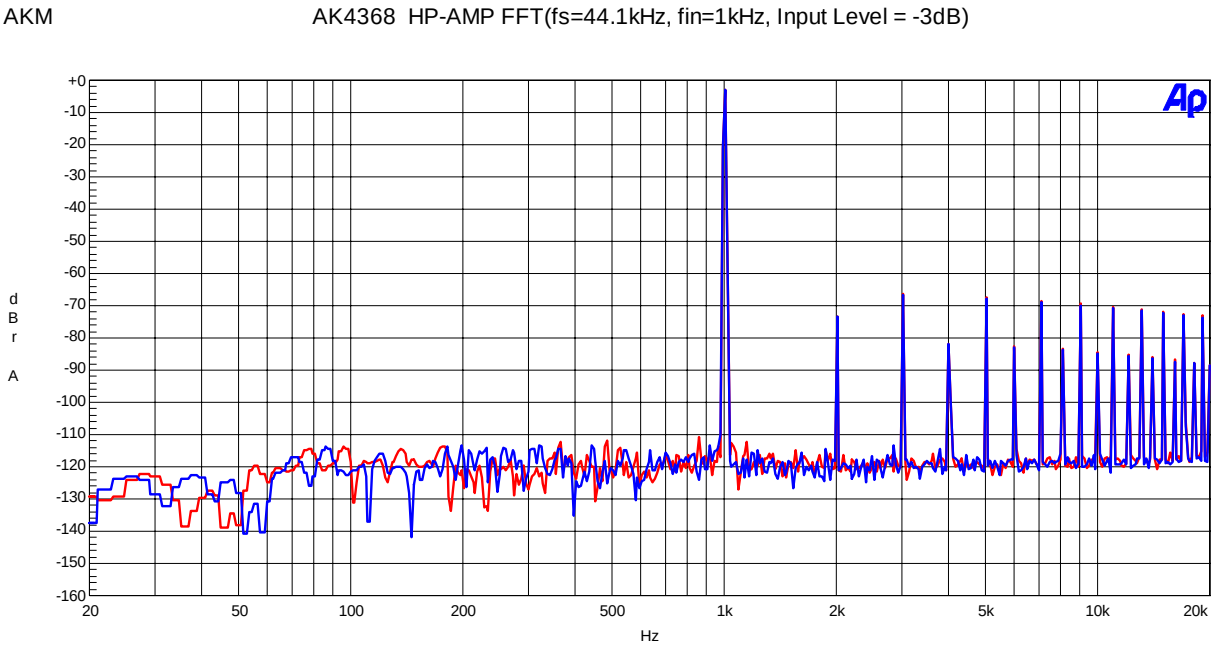


Figure 18. FFT Plot(1kHz,-3dB)

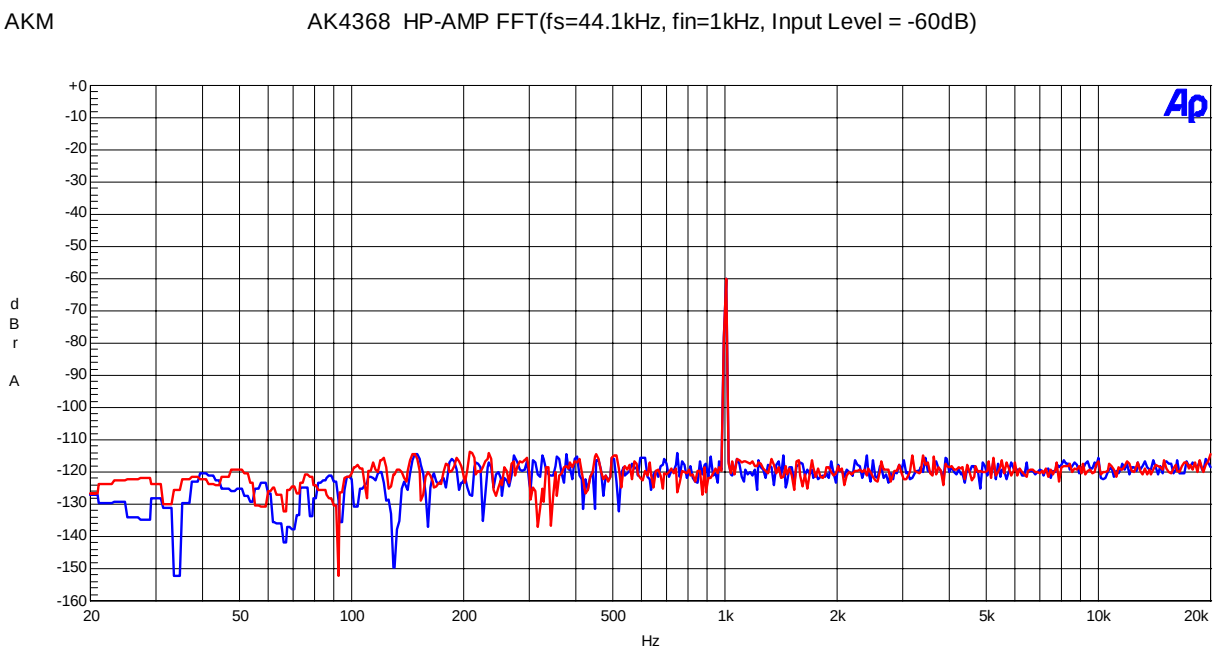


Figure 19. FFT Plot(1kHz,-3dB)

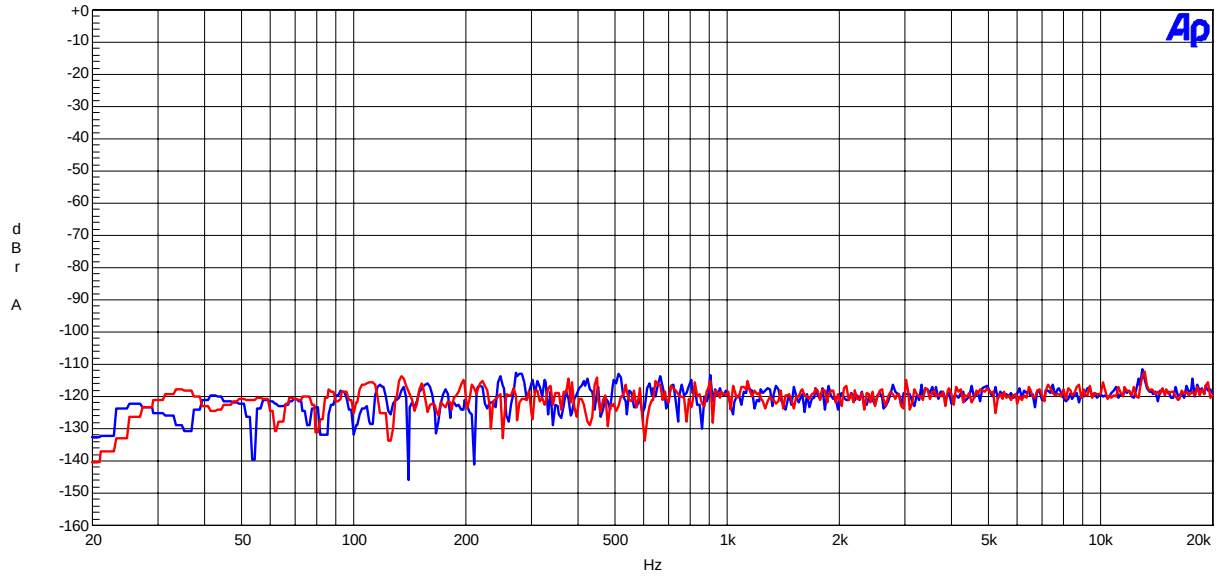


Figure 20. FFT Plot(Noise Floor)

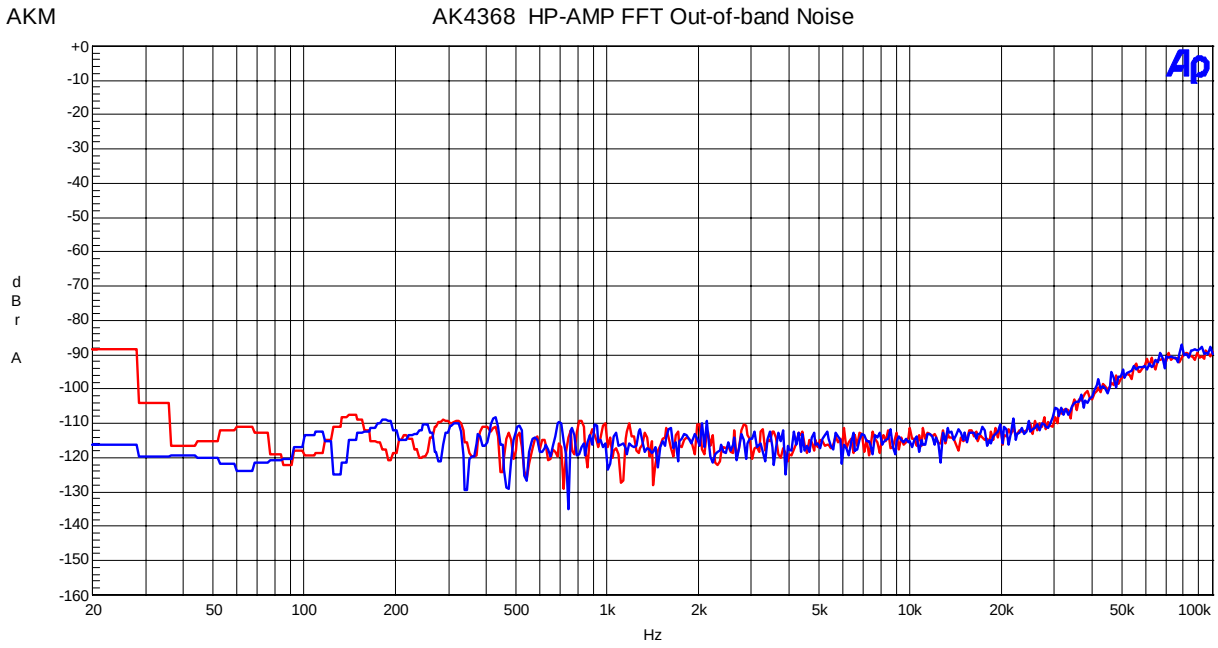


Figure 21. Out-band Noise

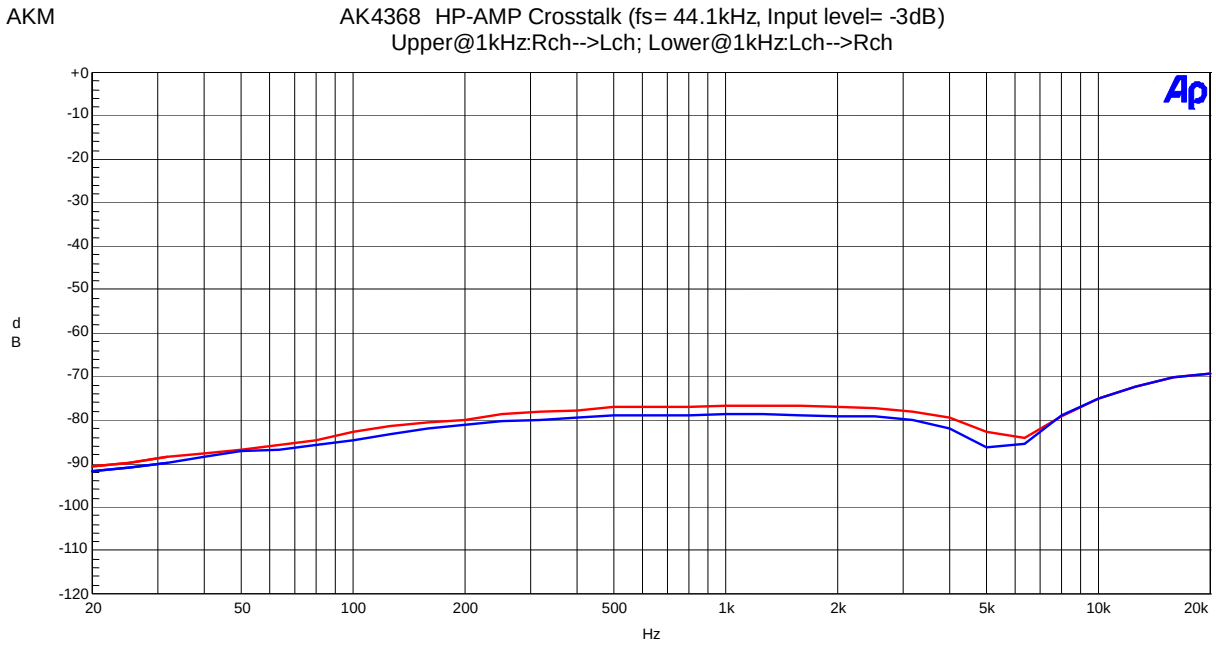


Figure 22. Crosstalk

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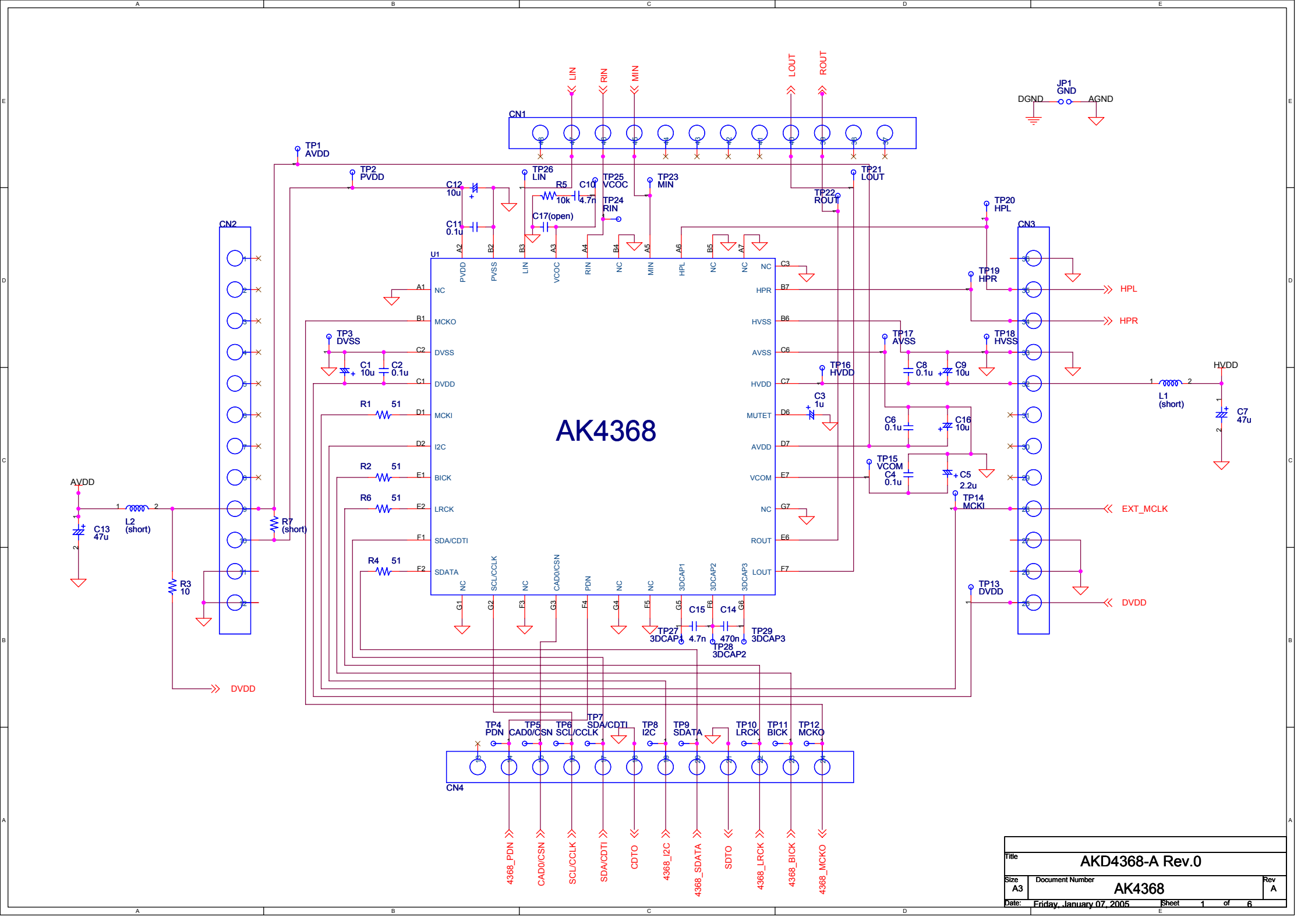

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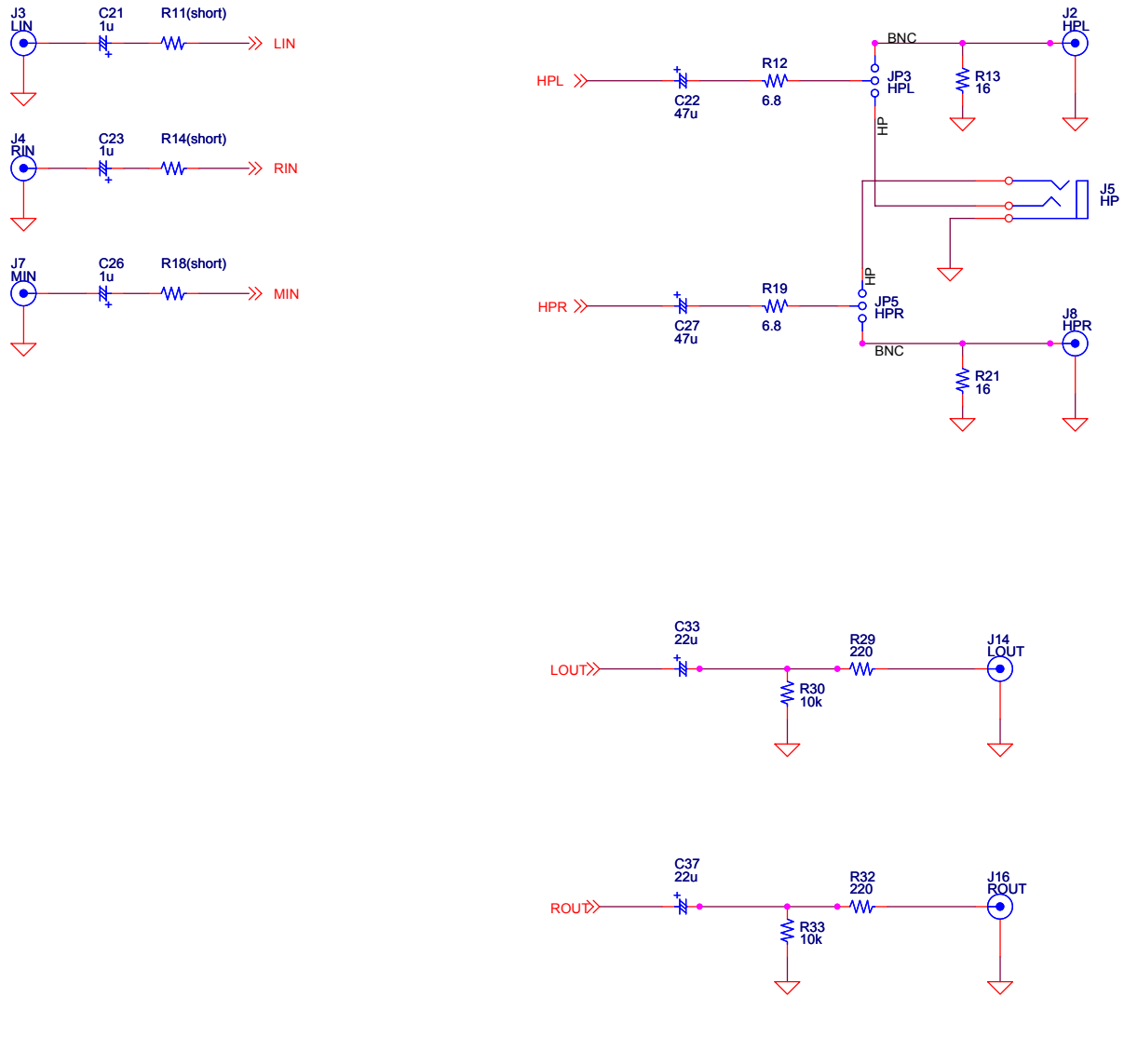

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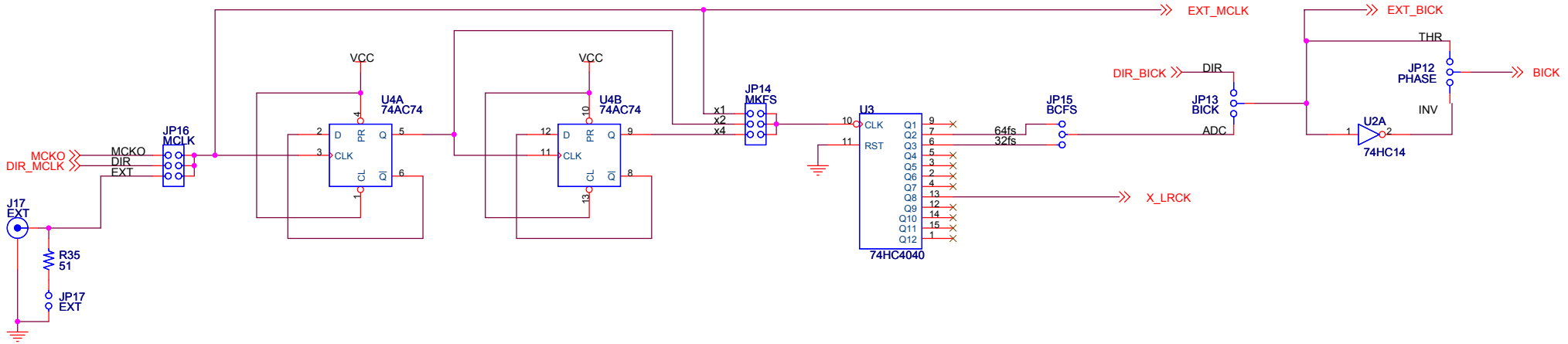

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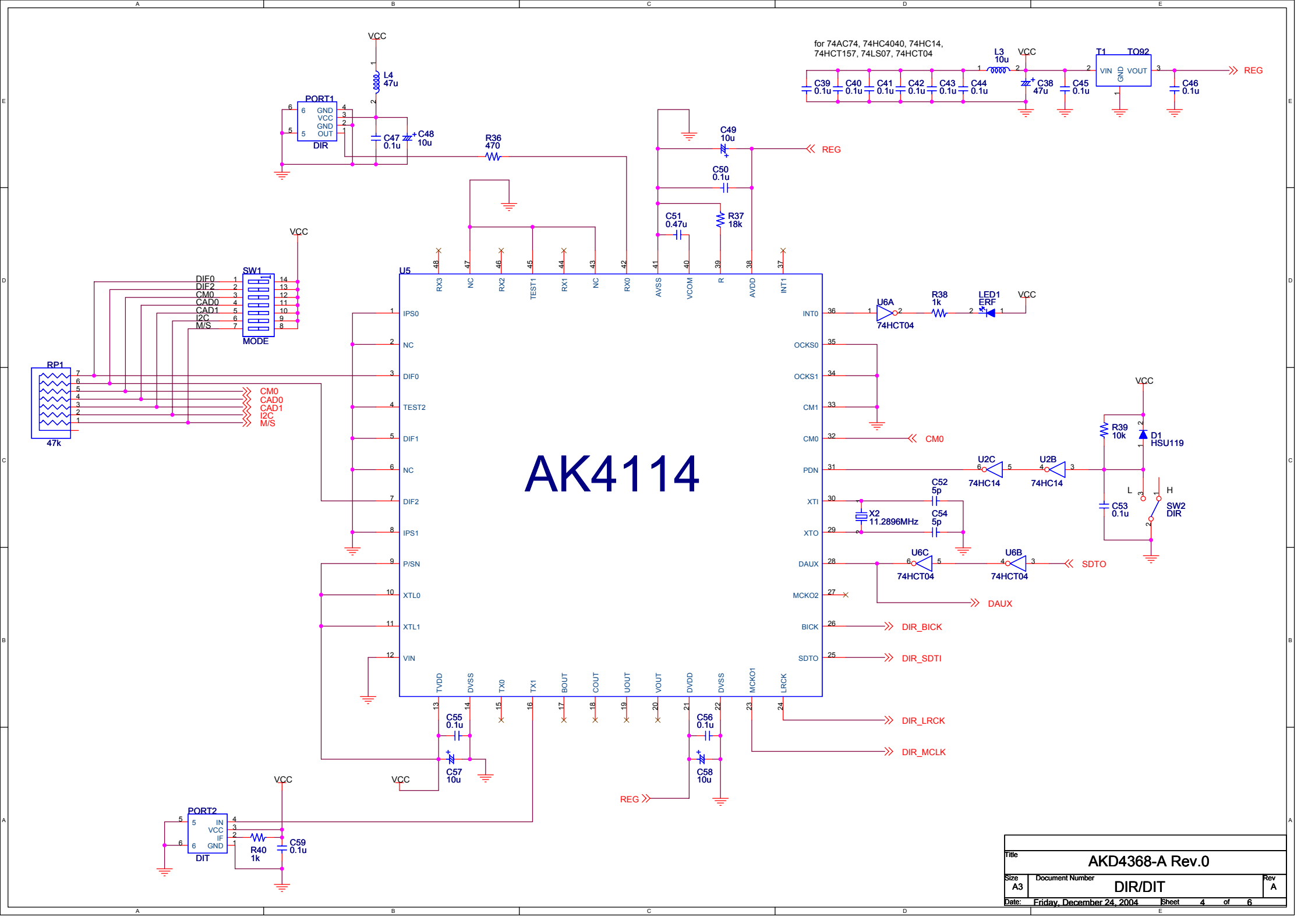

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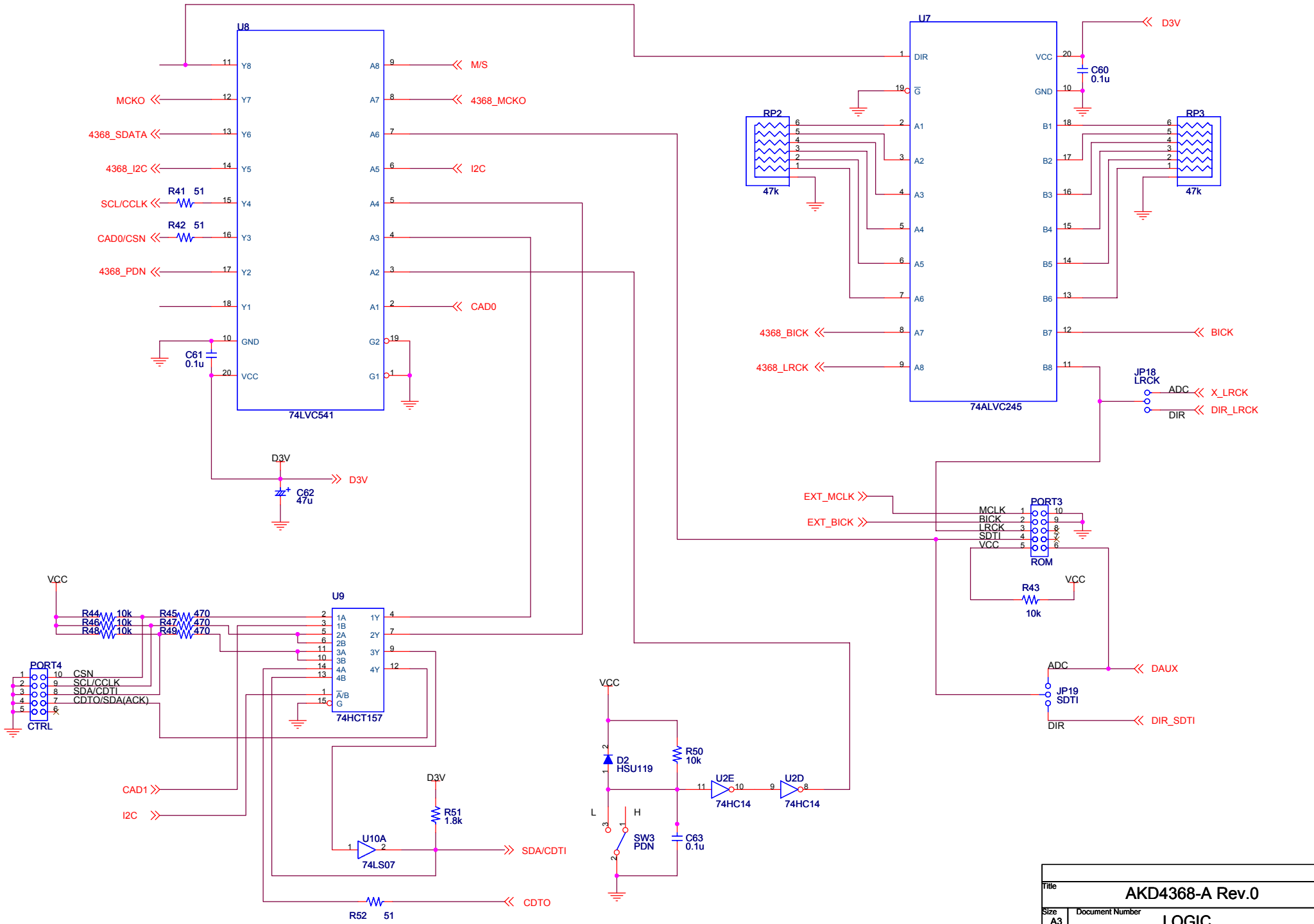

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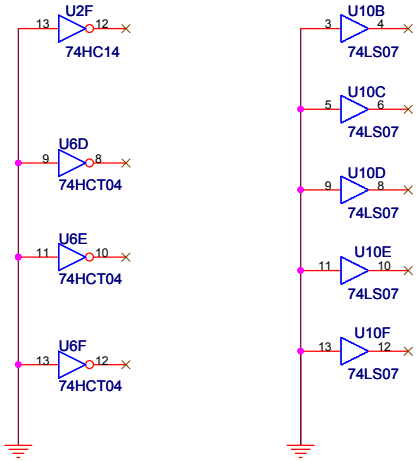

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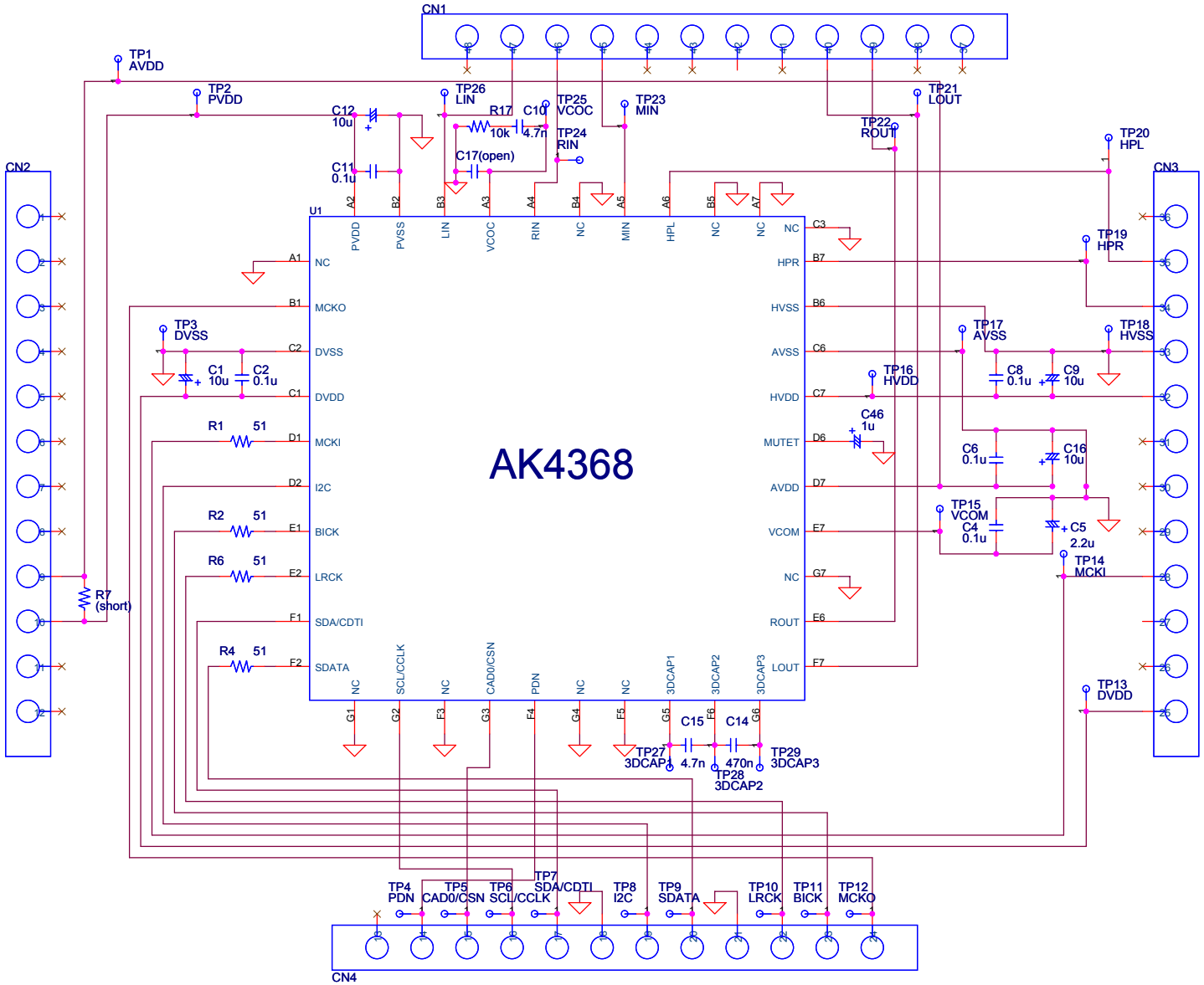

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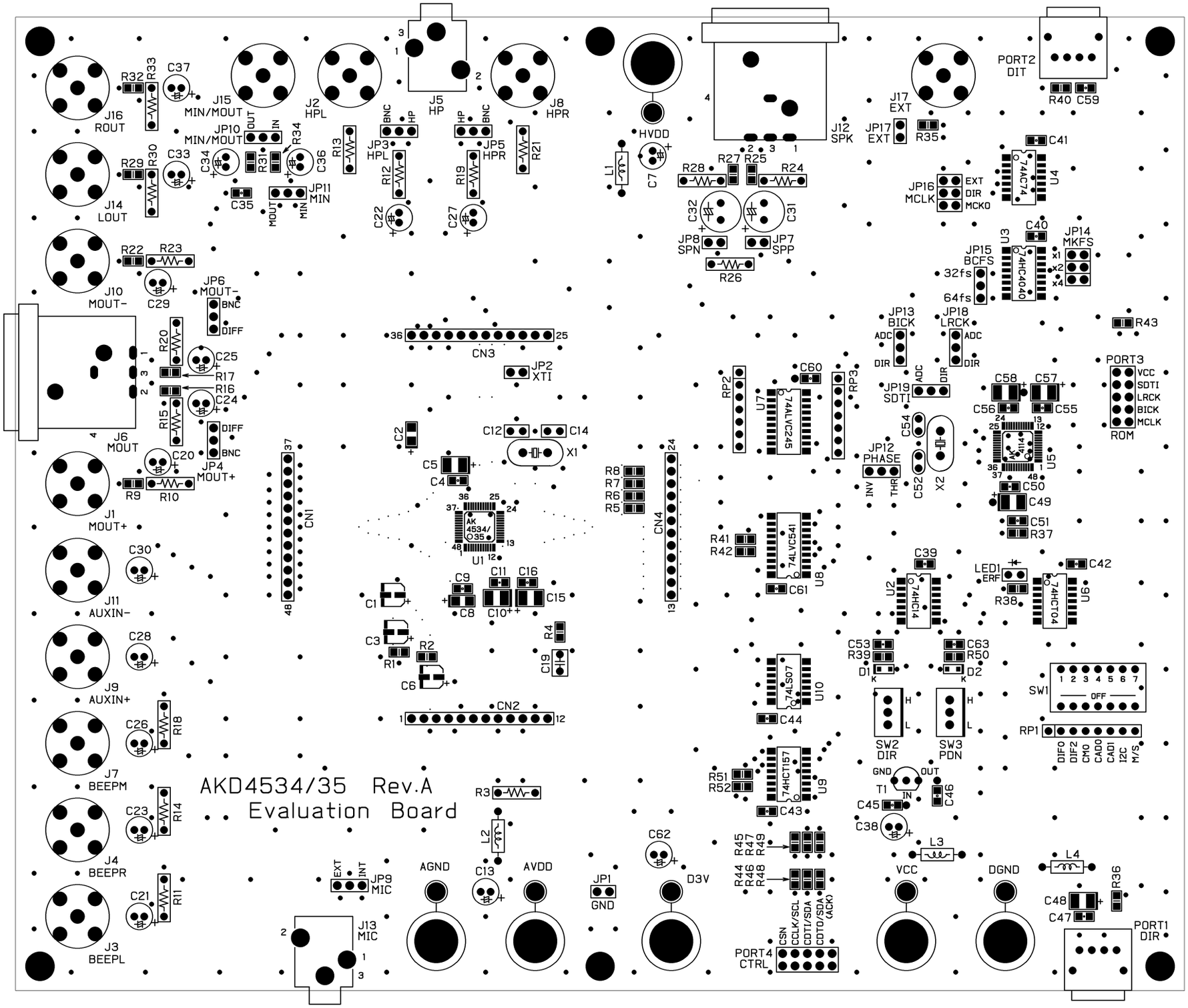

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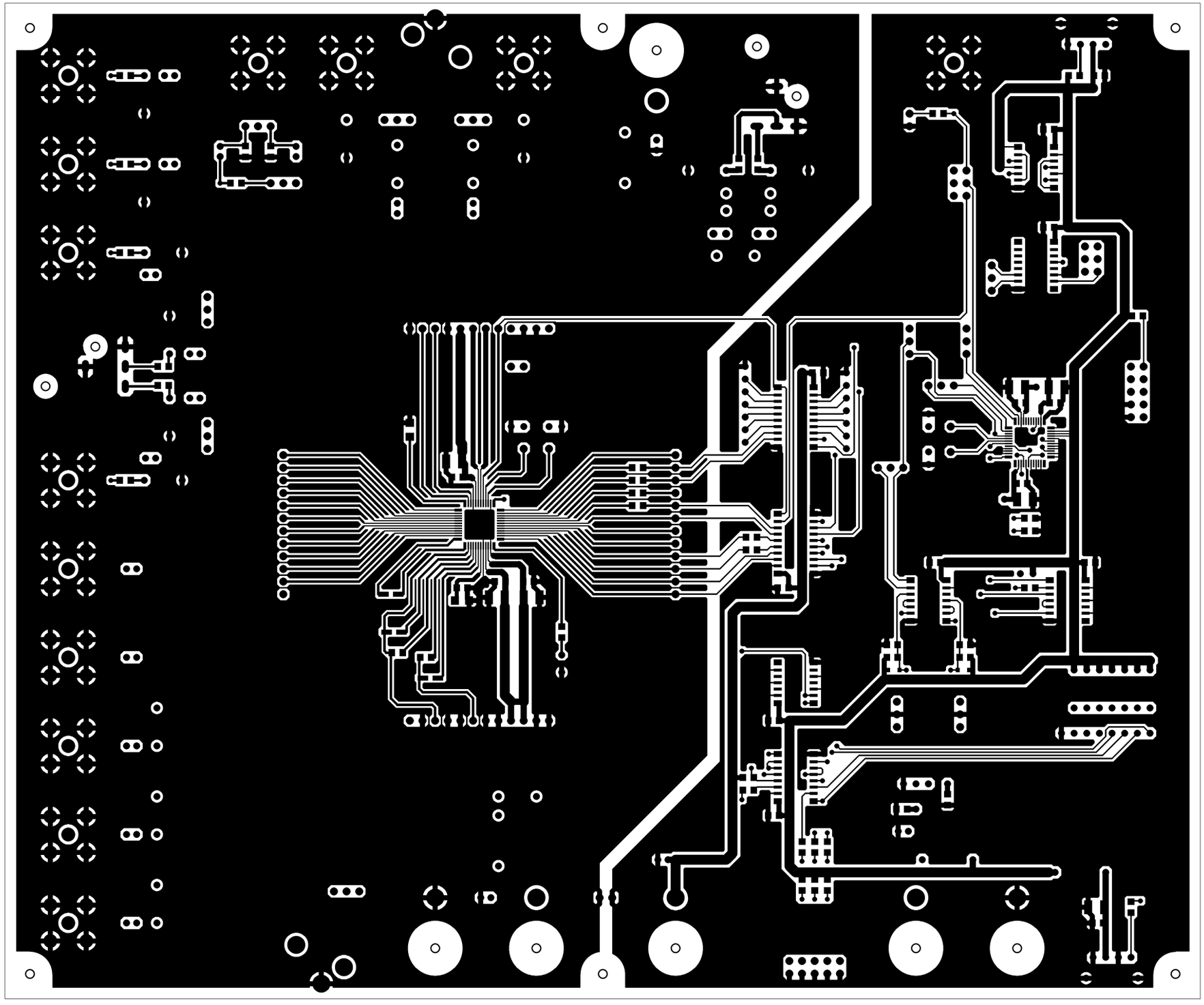

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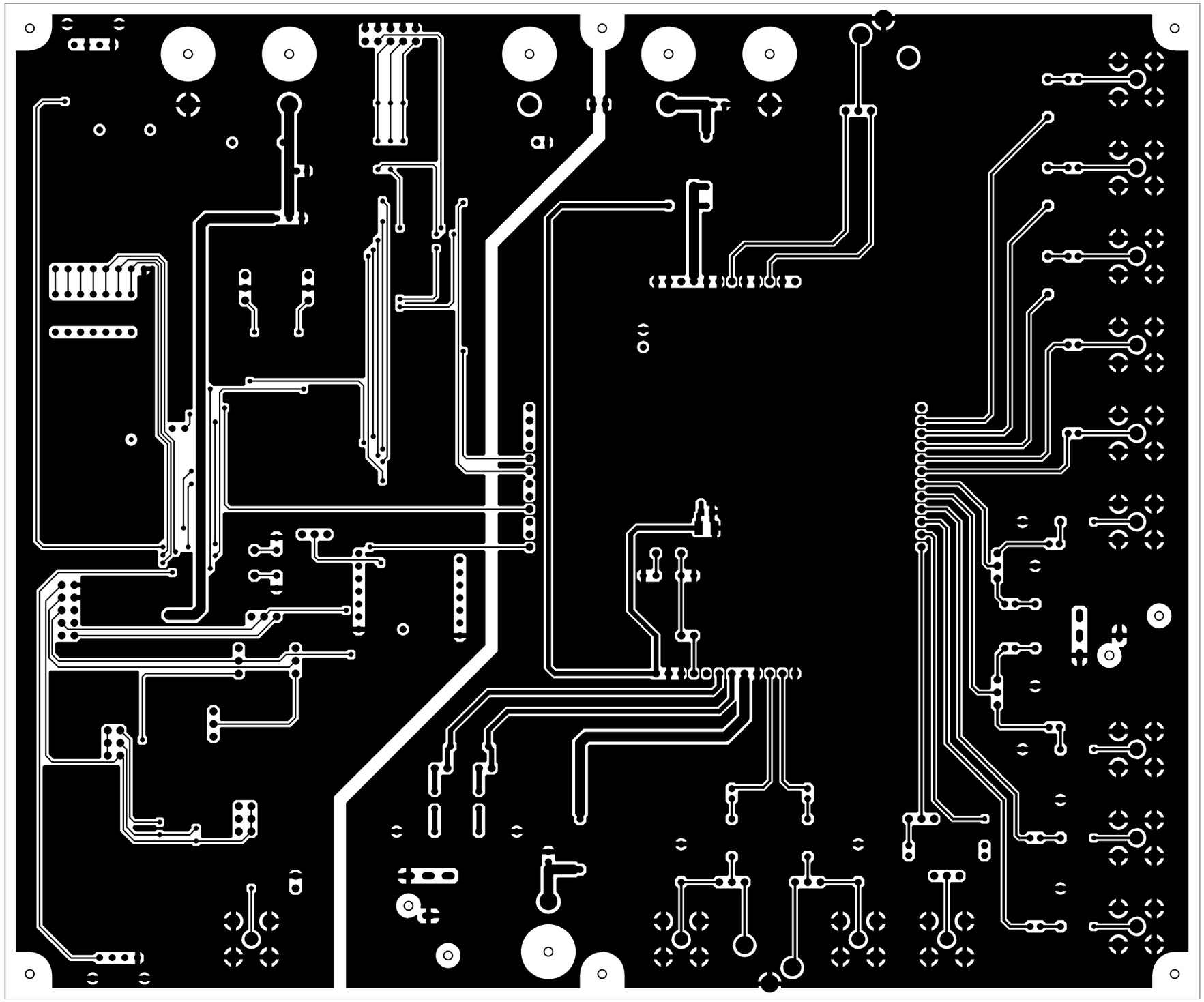
AKD4234\32 Rev.A L2



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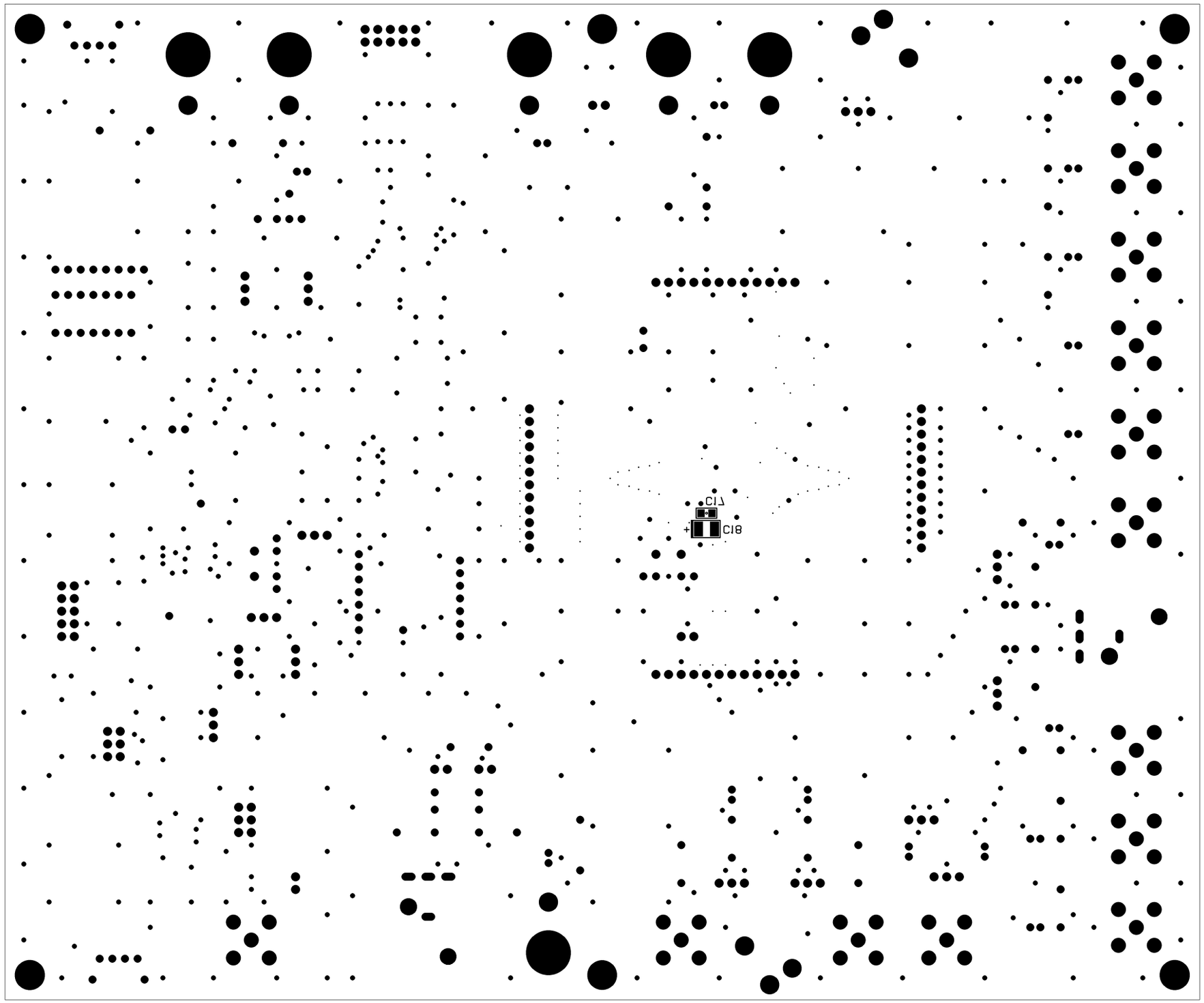

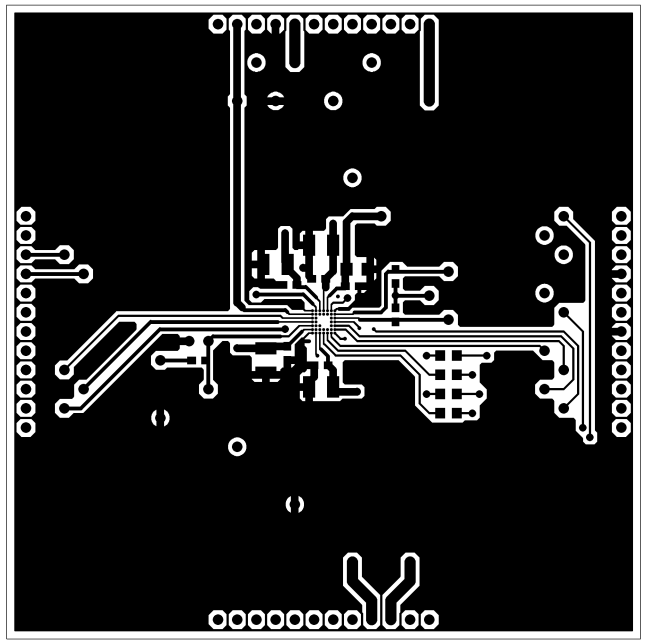

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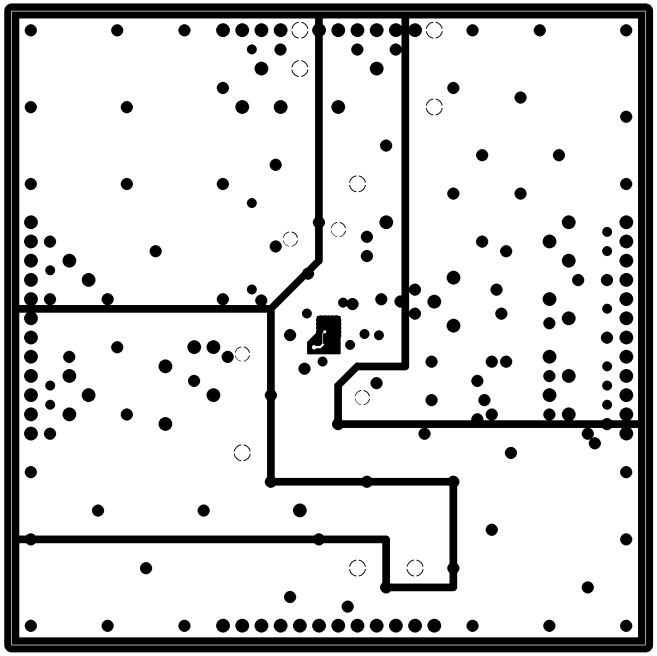

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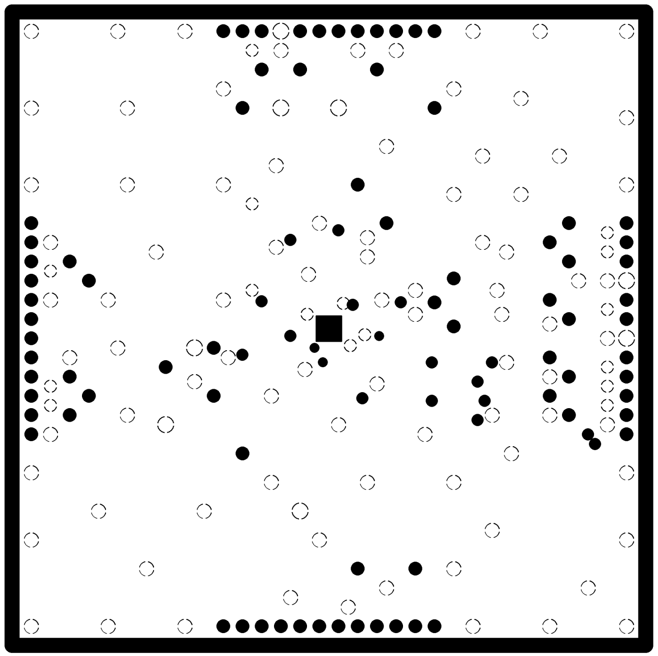

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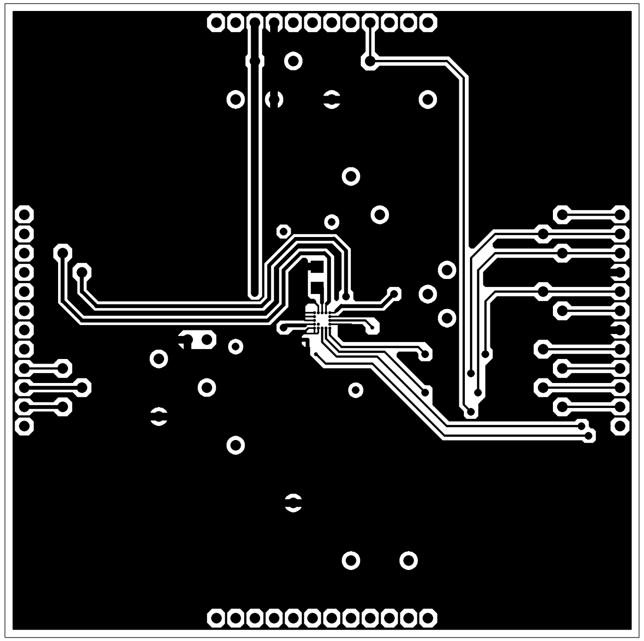

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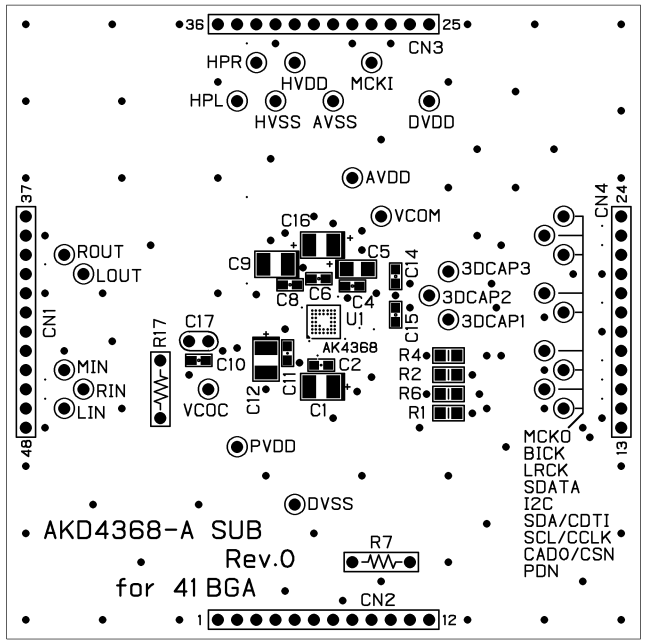

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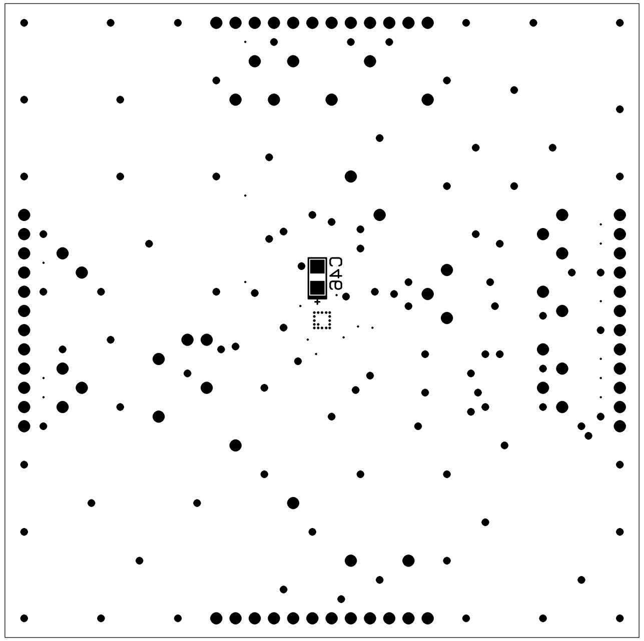

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