



AKD4438-SA

AK4438 Sound Quality Evaluation Board Rev.2

GENERAL DESCRIPTION

The AKD4438-SA is an evaluation board for the AK4438 (32-bit 8ch DAC) that supports DVD-Audios, Car-Audio Systems, allowing quick evaluation with digital audio interface.

■ Ordering guide

AKD4438-SA --- Evaluation board for AK4438
(Control software is packed with this board)

FUNCTION

- 3 type digital audio interface
 - Optical input
 - COAX input
 - External input
- 8ch Analog outputs
- USB Port for Serial control

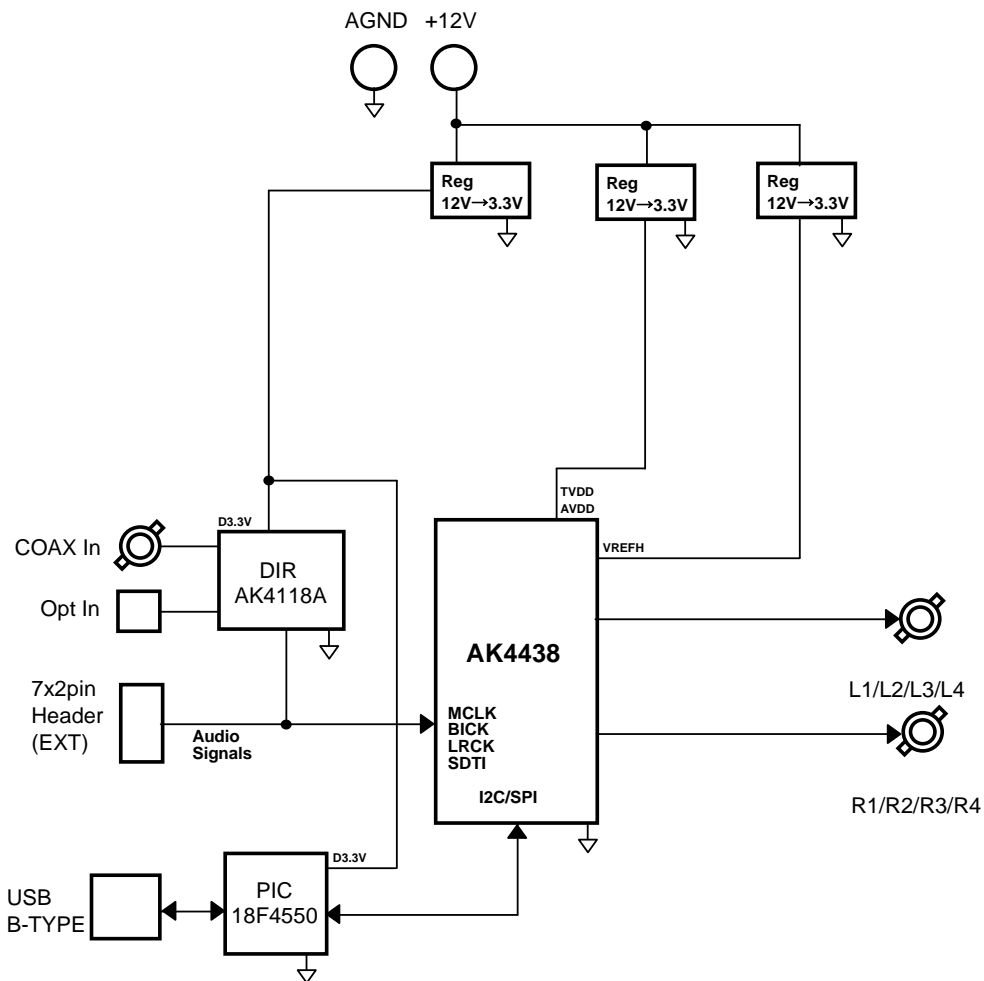


Figure 1. AKD4438-SA Block Diagram

Board Diagram

■ Board Diagram

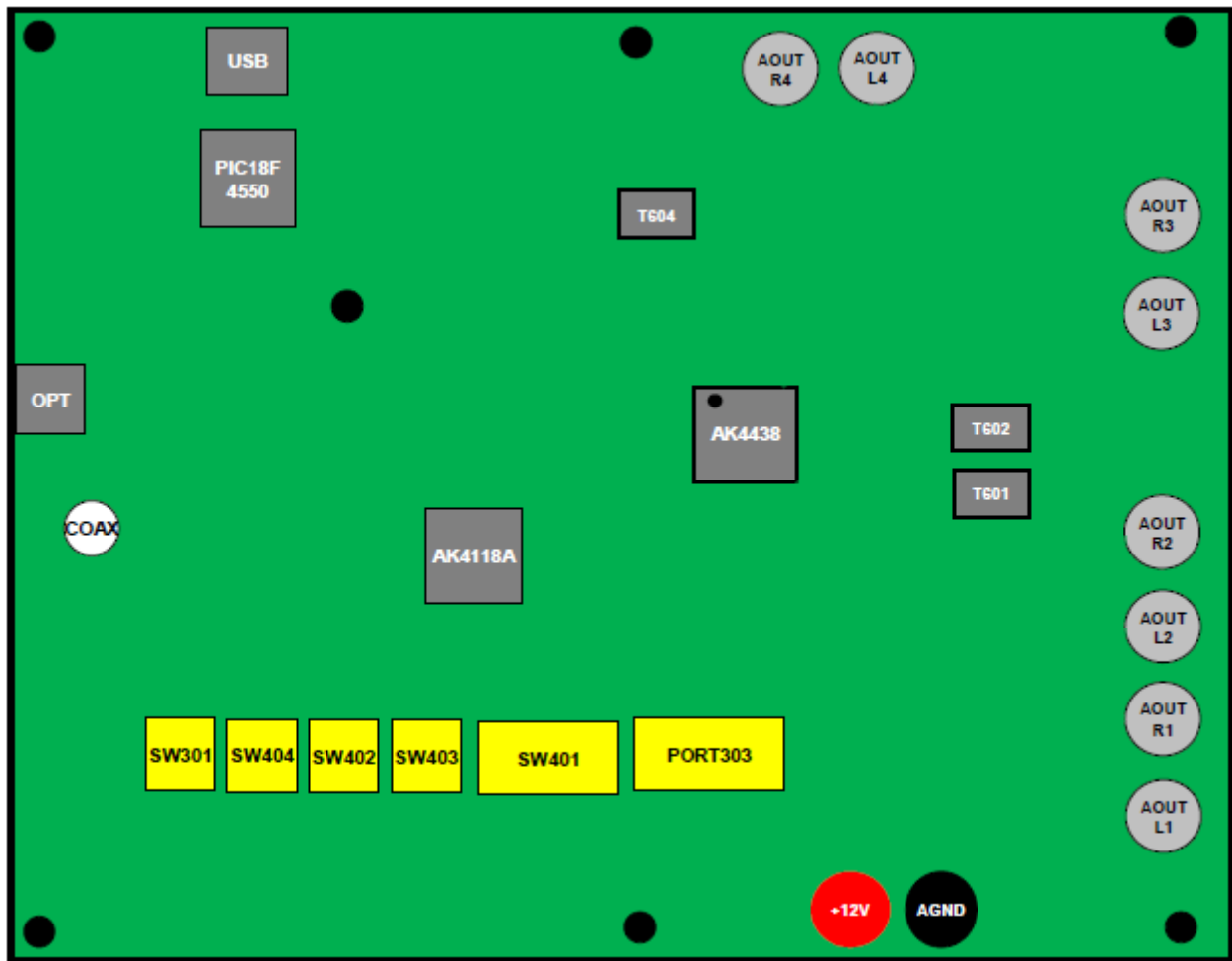


Figure 2.AKD4438-SA Board Diagram

■ Description

- (1) Connector for Power supply
+12V、AGND
Terminals for power supply. Refer to table1.
- (2) AOUT1L~AOUT4L、AOUT1R~AOUT4R
RCA Connector for analog outputs.
- (3) COAX、OPT
Input SPDIF signal to AK4118A.
When using the COAX : R302=0Ω、R303=Open (Default)
When using the OPT : R302=Open、R303=0Ω
- (4) AK4118A
AK4118A outputs digital data to AK4438 as DIR.
- (5) PORT303
External digital data inputs to AK4438.
MCLK、BICK、LRCK、SDTI1、SDTI2、SDTI3、SDTI4
When using the PORT303 : R310=R311=R312=R313=R314= R315= R316=51 Ω
R306=R307=R308=R309=R330 =R331= R332=Open
When using the AK4118A : R310=R311=R312=R313=R314= R315= R316=Open (Default)
R306=R307=R308=R309=R330 =R331= R332=51 Ω
- (6) USB
USB Port. It is possible to set up the registers of AK4438 from PC via the USB port.
- (7) PIC18F4550
USB control IC
- (8) SW301
Setting switch for AK4118A. Upside is “Hi”, downside is “Lo”.
Refer to Table2.SW301 setting.
- (9) SW401
Setting switch for AK4438. Upside is “Hi”, downside is “Lo”
Refer to Table5.SW401 setting.
- (10) SW402
Power down switch for AK4438. Upside is “Hi (on)”, downside is “Lo (off)”
- (11) SW403
Mute switch for AK4438.
Push : AK4438 is mute
Release : AK4438 is unmute
- (12) SW404
Power down switch for AK4118A. Upside is “Hi (on)”, downside is “Lo (off)”

Evaluation Board Manual

■ Operation sequence

[1] Set up power supplies

The power should be separated from the source of a power supplier.

Name of connector	Color of connector	Voltage	Use application	Comment and attention
+12V	Red	+12V	• Regulator	Should always be connected.
GND	Black	0V	• Ground	Should always be connected.

Table 1. Power supply line setting

[2] Switch setting

It should be set to match the mode.

(1) SW301 setting

No.	Switch Name	Function	default
1	DIF2	DIF2-pin of AK4118A	Hi
2	DIF1	DIF1-pin of AK4118A	Lo
3	DIF0	DIF0-pin of AK4118A	Lo
4	OCKS1	OCKS1-pin of AK4118A	Hi
5	OCKS0	OCKS0-pin of AK4118A	Lo

Table 2. SW301 setting

Mode	DIF2 pin	DIF1 pin	DIF0 pin	SDTO	LRCK		BICK		
						I/O		I/O	
0	0	0	0	16bit, Right justified	H/L	O	64fs	O	
1	0	0	1	18bit, Right justified	H/L	O	64fs	O	
2	0	1	0	20bit, Right justified	H/L	O	64fs	O	
3	0	1	1	24bit, Right justified	H/L	O	64fs	O	
4	1	0	0	24bit, Left justified	H/L	O	64fs	O	default
5	1	0	1	24bit, I ² S	L/H	O	64fs	O	
6	1	1	0	24bit, Left justified	H/L	I	64-128fs	I	
7	1	1	1	24bit, I ² S	L/H	I	64-128fs	I	

Table 3. AK4118A Audio interface format

OCKS1 pin	OCKS0 pin	(X'tal)	MCKO1	fs (max)	
0	0	256fs	256fs	96 kHz	
0	1	256fs	256fs	96 kHz	
1	0	512fs	512fs	48 kHz	default
1	1	128fs	128fs	192 kHz	

Table 4. AK4118A MCLK setting

(2) SW401 setting

No.	Switch Name	Function	default
1	I2C	I2C pin of AK4438 H: I2C mode L: SPI mode	Hi
2	PS	PS pin of AK4438 H: Parallel mode L: Serial mode	Hi
3	TDM0	TDM0 pin of AK4438 (Parallel mode only)	Lo
4	TDM1	TDM1 pin of AK4438 (Parallel mode only)	Lo
5	DIF	DIF pin of AK4438 (Parallel mode only) H: 32bit I2S compatible L: 32bit LSB justified	Lo
6	CAD0-I2C	CAD0 pin of AK4438 (I2C mode only)	Lo
7	CAD0-SPI	CAD0 pin of AK4438 (SPI mode only)	Lo
8	CAD1	CAD1 pin of AK4438 (Serial mode only)	Lo

Table 5.SW401 setting

(3) SW402/SW403/SW404 setting

SW402	PDN	Power down switch for AK4438 Hi: Power up Lo: Power down ※Should be “Hi” during operation AK4438.
SW403	MUTE	Mute switch for AK4438 (Parallel mode only) Release: Unmute Push: Mute
SW404	AK4118-PDN	Power down switch for AK4118A Hi: Power up Lo: Power down ※Should be “Hi” during operation AK4118A.

Table 6.SW402/SW403/SW404 setting

[3] USB connect (Serial mode only)

Connect the board to PC with the USB cable.

[4] Power on

Turn on the power to the board. In case of serial mode, startup AK4438 control software.

[5] Setup the control registers (Serial mode only)

Refer to “Control soft manual”.

Control Soft Manual

■ Evaluation Board and Control Soft Settings

1. Set an evaluation board properly.
2. Connect a USB control box (AKUSBIF-B) and an evaluation board.
Pay attention about direction of the 10pin header when connecting to an AKUSBIF-B.
3. Connect a PC (IBM-AT compatible) and the USB control box (AKUSBIF-B).
The USB control box is recognized as HID (Human Interface Device) on the PC.
It is not necessary to install a new driver.
4. Start up the control program.
When the screen does not display “AKUSBIF-B” at bottom left, reconnect the PC and the USB control box, and push the [Port Reset] button.
5. Proceed evaluation by following the process below.

[Support OS]
Windows XP / Vista / 7

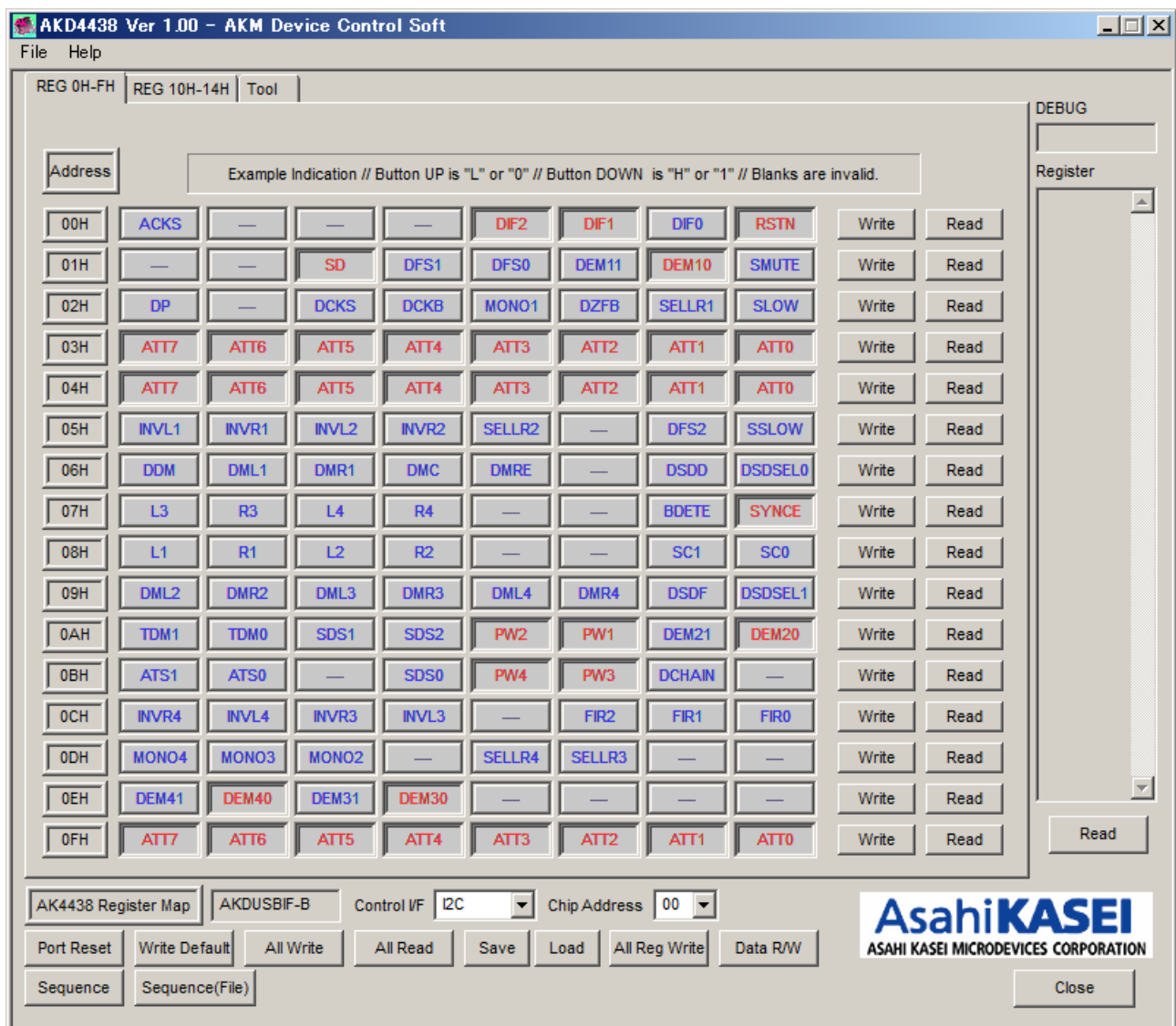


Figure3.Control Software Window

■ Operation Overview

Function, register map and testing tool can be controlled by this control soft. These controls are selected by upper tabs.

Buttons which are frequently used such as register initializing button “Write Default”, are located outside of the switching tab window. Refer to the “■ Dialog Boxes” for details of each dialog box setting.

1. [Port Reset] : For when connecting to PC
Click this button after the control soft starts up when connecting to PC.
2. [Write Default] : Initializes Registers
When the device is reset by a hardware reset, use this button to initialize the registers.
3. [All Write] : Executes write commands for all registers displayed.
4. [All Read] : Executes read commands for all registers displayed.
5. [Save] : Saves current register settings to a file.
6. [Load] : Executes data write from a saved file.
7. [All Req Write] : Opens “All Req Write” dialog box.
8. [Data R/W] : Opens “Data R/W” dialog box
9. [Sequence] : Opens “Sequence” dialog box.
10. [Sequence (File)]: Opens “Sequence(File)” dialog box.
11. [Read] : Reads current register settings and displays on to the register area
(on the right of the main window).
This is different from [All Read] button, it does not reflect to a register map,
only displaying register settings in hexadecimal.

■ Tab Functions

1. [REG]: Register Map

This tab is for a register writing and reading.

Each bit on the register map is a push-button switch.

Button Down indicates “H” or “1” and the bit name is in red (when read only it is in deep red).

Button Up indicates “L” or “0” and the bit name is in blue (when read only it is in gray)

Grayout registers are Read Only registers. They can not be controlled.

The registers which is not defined in the datasheet are indicated as “---”.

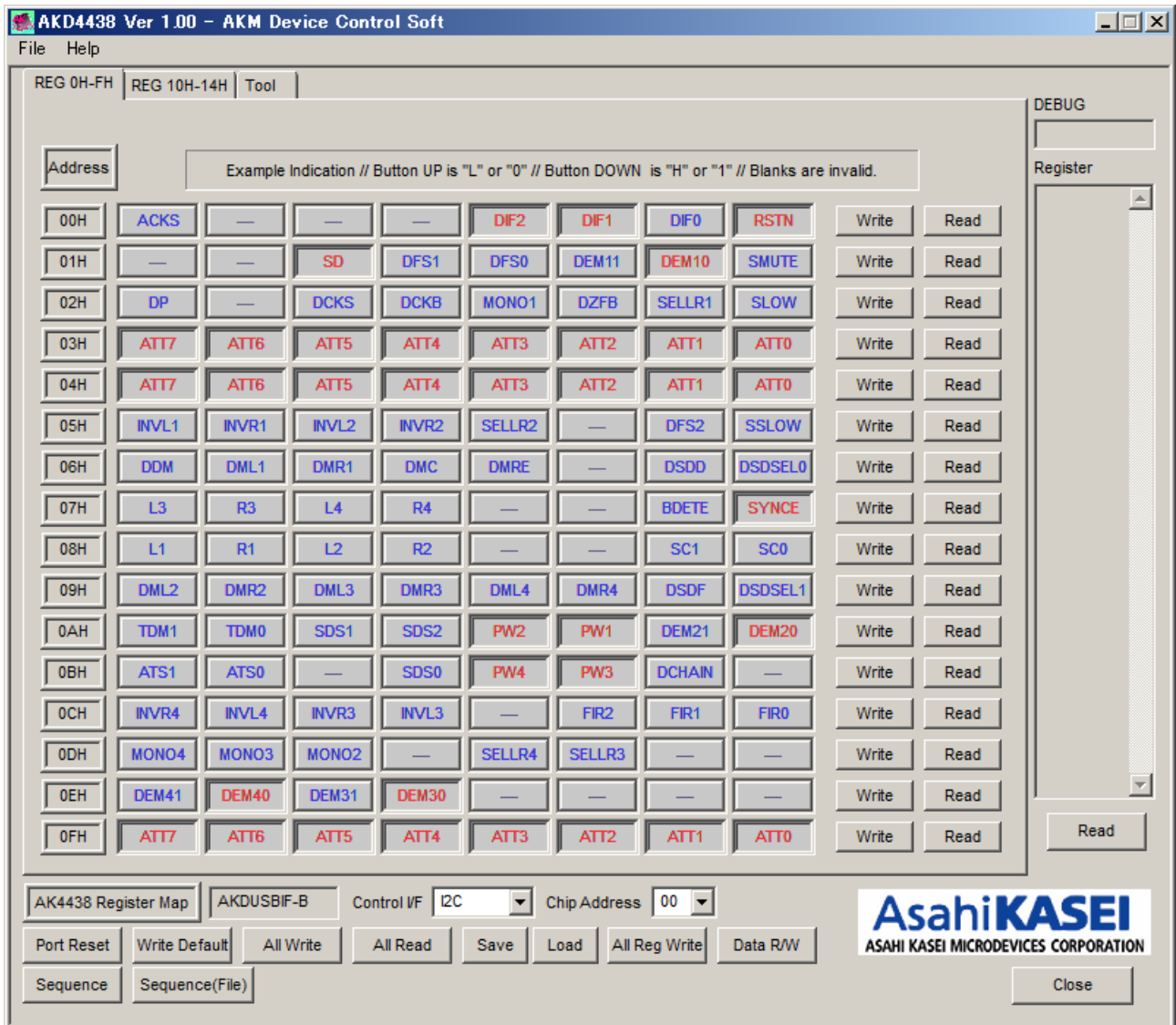


Figure4.Window of [REG]

1-1. [Write]: Data Writing Dialog

It is for when changing two or more bits on the same address at the same time.

Click [Write] button located on the right of the each corresponded address for a pop-up dialog box.

When the checkbox is checked, the data will be “H” or “1”. When the checkbox is not checked, the data will be “L” or “0”. Click [OK] to write setting values to the registers, or click [Cancel] to cancel this setting.

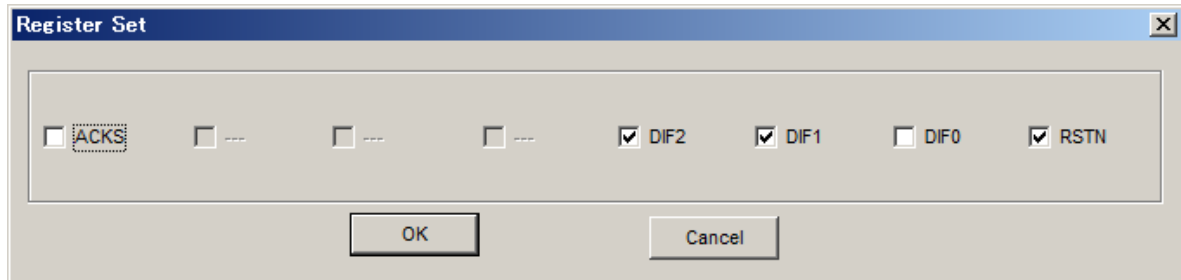


Figure5.Window of [Register Set]

1-2. [Read]: Data Read (I2C mode only)

Click [Read] button located on the right of the each corresponded address to execute a register read.

After register reading, the display will be updated regarding to the register status.

Button Down indicates “H” or “1” and the bit name is in red (when read only it is in deep red).

Button Up indicates “L” or “0” and the bit name is in blue (when read only it is in gray)

Please be aware that button statuses will be changed by a Read command.

2. [Tool]: Testing Tools

Evaluation testing tools are available in this tab.
Click buttons for each testing tool.

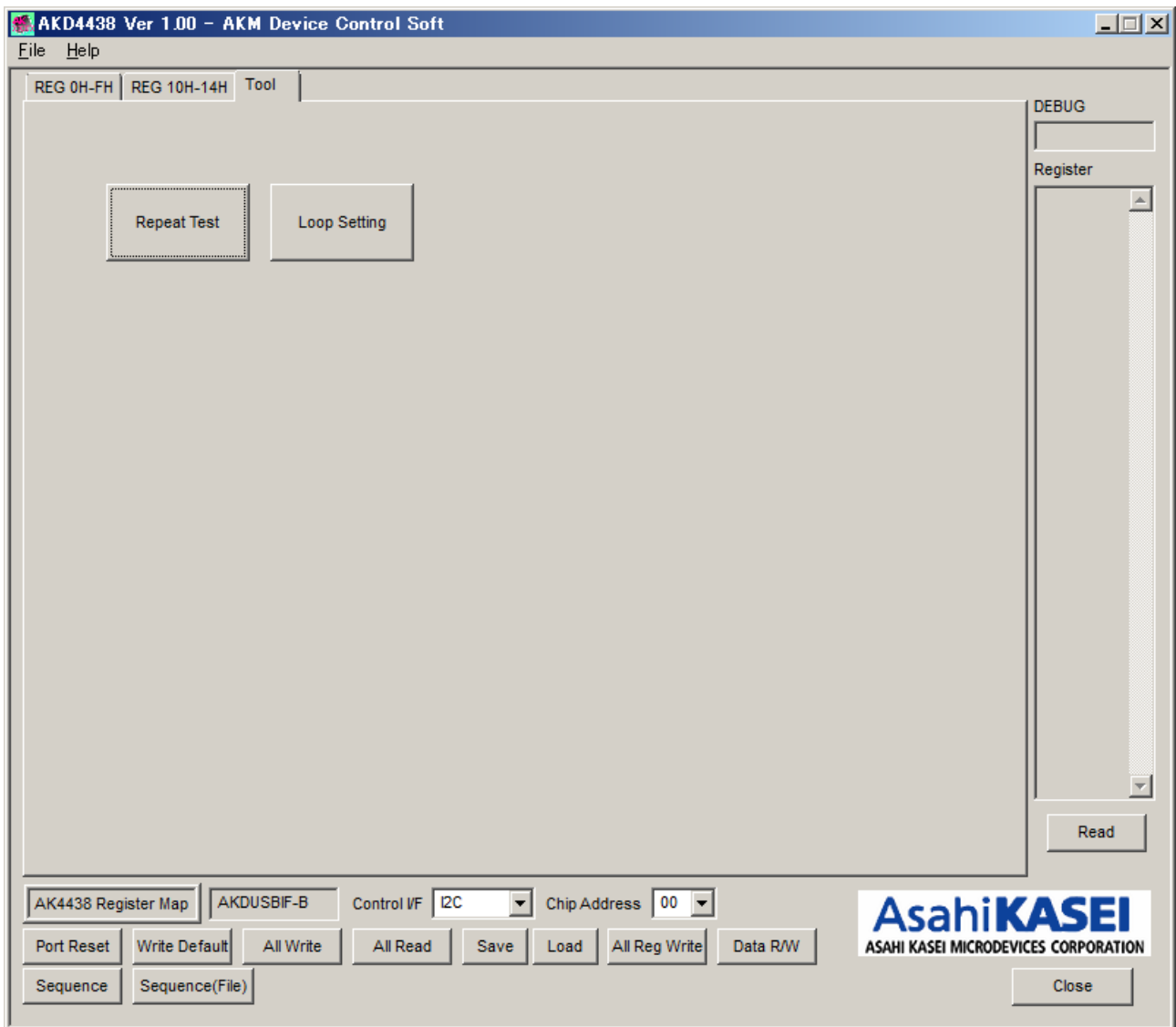


Figure 6. Window of [Tool]

2-1.[Repeat Test] : Repeat Test Dialog

Click [Repeat Test] button in the Test tab to open a repeat test dialog shown below.
Repeat writing test can be executed by this dialog.

Figure 7.Window of [Repeat Test]

[Start] Button : Starts the repeat test.

A dialog for saving a file of the test result will open when clicking this button.

Name the file.

Test will start after specifying a saving file.

[Close] Button : Closes this dialog and finishes the process.

[Address] Box : Data writing address in hexadecimal numbers.

[Start Data] Box : Start data in hexadecimal numbers.

[End Data] Box : End data in hexadecimal numbers.

[Step] Box : Data write step interval.

[Repeat Count] Box : Repeat count of the test writing.

[Up and Down] Box : Data write flow is changed as below.

- Checked: Writes in step interval from the start data to the end data and turn back from the end data to the start data.

[Example] Start Data = 00, End Data = 05, Step = 1, []...for 1 count.

Data flow : [00→01→02→03→04→05→05→04→03→02→01→00] x Repeat Count Number

- Not checked: Writes in step interval from the start data to the end data and finishes writing.

[Example] Start Data = 00, End Data = 05, Step = 1, []...for 1 count.

Data flow : [00→01→02→03→04→05] x Repeat Count Number

[Sampling Frequency] Box: Selects sampling frequency 44.1kHz/48kHz

[Count] Box : Indicates the count number during a repeat test.

[Lch Level] Box : Indicates the Lch Level during a repeat test.

2-2.[Loop Setting] : Loop Dialog

Click [Loop Setting] button in the Tool tab to open loop setting dialog as shown below.
Writing test can be executed.

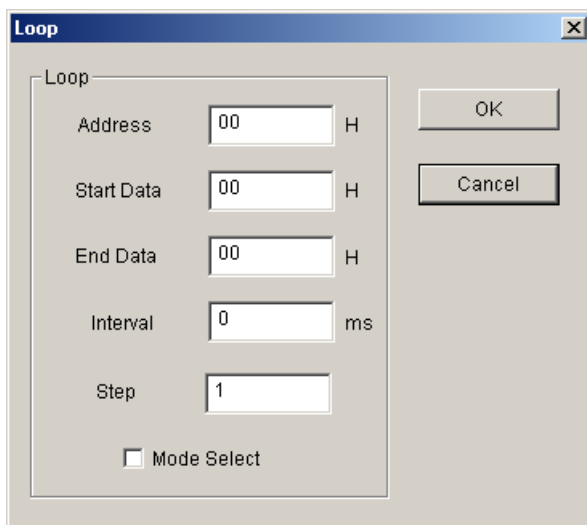


Figure 8.Window of [Loop]

- [OK] Button : Starts the test.
- [Cancel] Button : Closes the dialog and finishes the process.
- [Address] Box : Data writing address in hexadecimal numbers.
- [Start Data] Box : Start data in hexadecimal numbers.
- [End Data] Box : End data in hexadecimal numbers.
- [Interval] Box : Data write interval time.
- [Step] Box : Data write step interval.
- [Mode Select] Box : Mode select check box.

- Checked : Writes in step interval from the start data to the end data and turn back from the end data to the start data.

[Example] Start Data = 00, End Data = 05, Step = 1

Data flow : 00→01→02→03→04→05→05→04→03→02→01→00

- Not Checked : Writes in step interval from the start data to the end data and finishes writing.

[Example] Start Data = 00, End Data = 05, Step = 1

Data flow : 00→01→02→03→04→05

■ Dialog Boxes

1. [All Reg Write]: All Reg Write dialog box

Click [All Reg Write] button in the main window to open register setting files.
Register setting files saved by [Save] button can be applied.

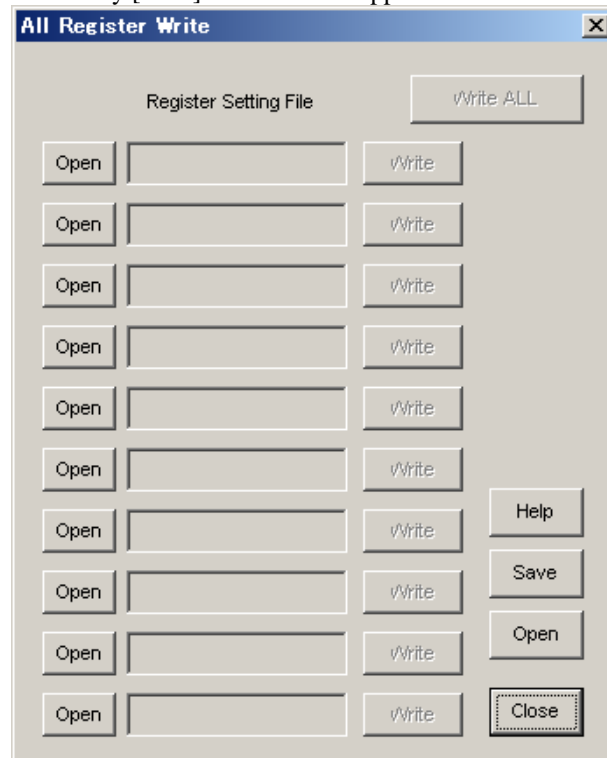


Figure9.Window of [All Reg Write]

[Open (left)] : Selects a register setting file (*.akr).
 [Write] : Executes register writing by the setting of selected file.
 [Write All] : Executes all register writings.
 Selected files are executed in descending order.

[Help] : Opens a help window.
 [Save] : Saves a register setting file assignment. The file name is "*.mar".
 [Open (right)]: Opens a saved register setting file assignment "*. mar".
 [Close] : Closes the dialog box and finish the process.

~ Operating Suggestions ~

1. Those files saved by [Save] button and opened by [Open] button on the right of the dialog "*.mar" should be stored in the same folder.
2. When register settings are changed by [Save] button in the main window, re-read the file to reflect new register settings.

2. [Data R/W]: Data R/W Dialog Box

Click the [Data R/W] button in the main window for data read/write dialog box.
Data write is available to specified address.

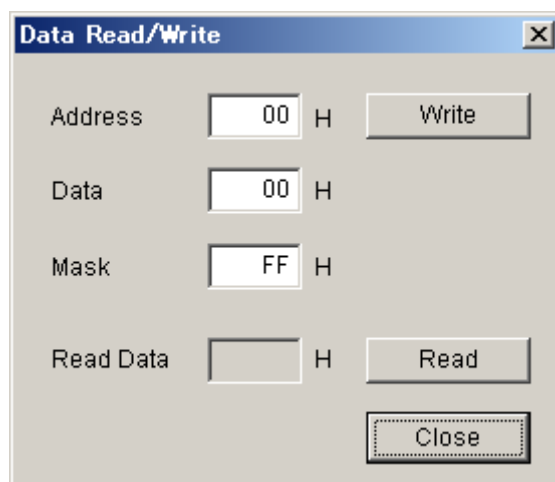


Figure 10. Window of [Data R/W]

[Address] Box : Input data address in hexadecimal numbers for data writing.

[Data] Box : Input data in hexadecimal numbers.

[Mask] Box : Input mask data in hexadecimal numbers.
This is “AND” processed input data.

[Write] : Writes the data generated from Data and Mask values to the address specified by “Address” box.

[Read] : Reads data from the address specified by “Address” box.
The result will be shown in the Read Data Box in hexadecimal numbers.

[Close] : Closes the dialog box and finishes the process.
Data writing can be cancelled by this button instead of executing a write command.

*The register map will be updated after executing [Write] or [Read] commands.

3. [Sequence]: Sequence Dialog Box

Click [Sequence] button to open register sequence setting dialog box.
Register sequence can be set in this dialog box.

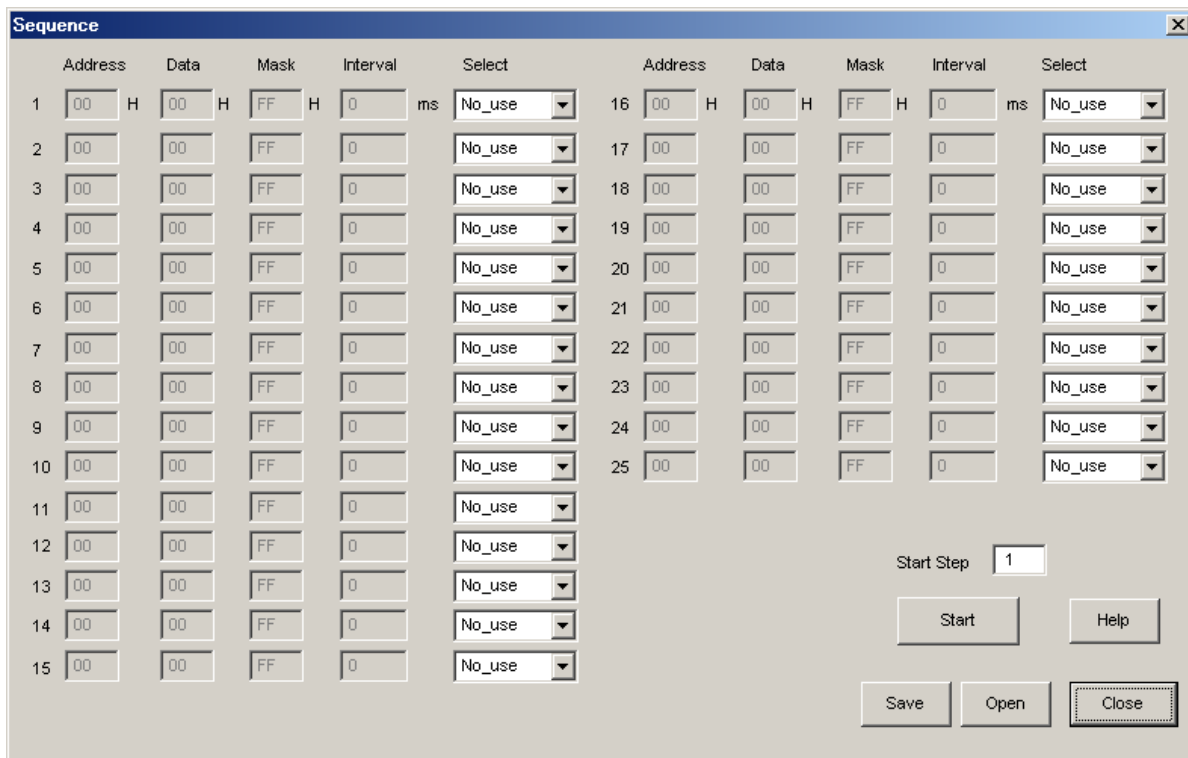


Figure 11. Window of [Sequence]

~ Sequence Setting ~

Set register sequence by following process bellow.

1. Select a command

Use [Select] pull-down box to choose commands.
Corresponding boxes will be valid.

< Select Pull-down menu >

- No_use : Not using this address
- Register : Register writing
- Reg(Mask) : Register writing (Masked)
- Interval : Taking an interval
- Stop : Pausing the sequence
- End : Finishing the sequence

2. Input sequence

[Address] : Data address

[Data] : Writing data

[Mask] : Mask

[Data] box data is ANDed with [Mask] box data. This is the actual writing data.

When Mask = 0x00, current setting is hold.

When Mask = 0xFF, the 8bit data which is set in the [Data] box is written.

When Mask = 0x0F, lower 4bit data which is set in the [Data] box is written.

Upper 4bit is hold to current setting.

[Interval] : Interval time

Valid boxes for each process command are shown bellow.

- No_use : None
- Register : [Address], [Data], [Interval]
- Reg(Mask) : [Address], [Data], [Mask], [Interval]
- Interval : [Interval]
- Stop : None
- End : None

~ Control Buttons~

The function of Control Button is shown bellow.

[Start] : Executes the sequence

[Help] : Opens a help window

[Save] : Saves sequence settings as a file. The file name is "*.aks".

[Open] : Opens a sequence setting file "*.aks".

[Close] : Closes the dialog box and finishes the process.

~ Stop of the sequence~

When "Stop" is selected in the sequence, the process is paused and it starts again when [Start] button is clicked. Restarting step number is shown in the "Start Step" box. When finishing the process at the end of sequence, "Start Step" will return to "1".

The sequence can be started from any step by writing the step number to the "Start Step" box.

Write "1" to the "Start Step" box and click [Start] button, when restarting the process from the beginning.

4. [Sequence(File)]: Sequence Setting File Dialog Box

Click [Sequence(File)] button to open sequence setting file dialog box.
 Those files saved in the “Sequence setting dialog” can be applied in this dialog.

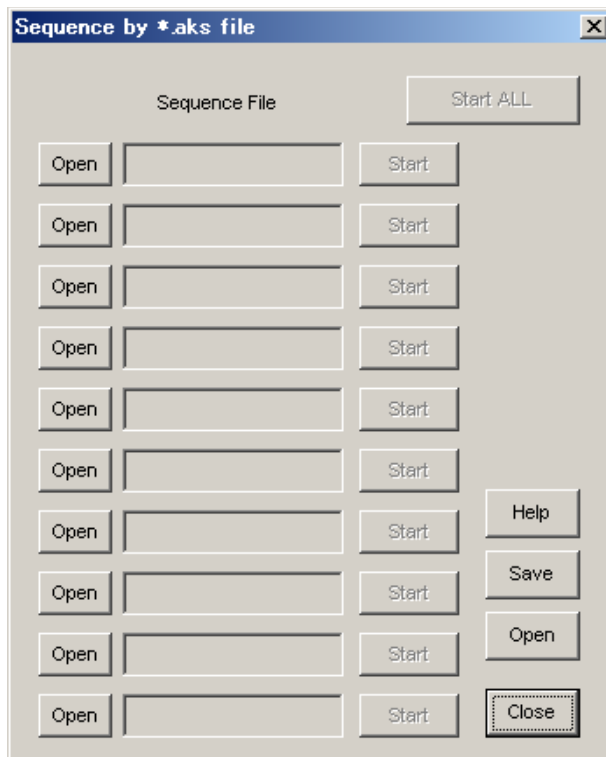


Figure 12. Window of [Sequence(File)]

- [Open (left)] : Opens a sequence setting file (*.aks).
- [Start] : Executes the sequence by the setting of selected file.
- [Start All] : Executing all sequence settings.
 Selected files are executed in descending order.
- [Help] : Opens a help window.
- [Save] : Saves a sequence setting file assignment. The file name is “*.mas”.
- [Open(right)] : Opens a saved sequence setting file assignment “*. mas”.
- [Close] : Closes the dialog box and finishes the process.

~ Operating Suggestions ~

1. Those files saved by [Save] button and opened by [Open] button on the right of the dialog “*.mas” should be stored in the same folder.
2. When “Stop” is selected in the sequence the process will be paused and a pop-up message will appear. Click “OK” to continue the process.



Figure 13. Window of [Sequence Pause]

Measurement Results

[Measurement condition]

- Measurement unit : Audio Precision, SYS -2722 (No.00103)
- MCKI : 512fs、256fs、128fs
- BICK : 64fs
- fs : 48kHz、96kHz、192kHz
- Bit : 24bit
- Input Frequency : 1kHz
- Power Supply : AVDD= TVDD =3.3V (Regulator)、VREFH =3.3V (Regulator)
- Pass : COAX→AK4118A(DIR) → AK4438 → AOUTL/R
- Temperature : Room
- Board Setting : Parallel Mode

[Measurement Results]

1. fs=48kHz, MCLK=512fs, BICK=64fs

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 48kHz (0dBFS, 20kHz LPF)	90.3	90.5	dB
DR	fs = 48kHz (-60dBFS, A-Weighted)	108.0	108.1	dB
S/N	fs = 48kHz (No Inputs, A-Weighted)	108.1	108.1	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 48kHz (0dBFS, 20kHz LPF)	90.6	90.5	dB
DR	fs = 48kHz (-60dBFS, A-Weighted)	107.8	107.8	dB
S/N	fs = 48kHz (No Inputs, A-Weighted)	108.0	107.8	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 48kHz (0dBFS, 20kHz LPF)	90.6	90.6	dB
DR	fs = 48kHz (-60dBFS, A-Weighted)	108.0	107.9	dB
S/N	fs = 48kHz (No Inputs, A-Weighted)	108.1	108.0	dB
DAC4 : SDTI4 => DAC4 => L/ROUT4				
S/(N+D)	fs = 48kHz (0dBFS, 20kHz LPF)	90.8	90.8	dB
DR	fs = 48kHz (-60dBFS, A-Weighted)	108.0	108.9	dB
S/N	fs = 48kHz (No Inputs, A-Weighted)	108.1	108.1	dB

2. fs=96kHz, MCLK=256fs, BICK=64fs

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 96kHz (0dBFS, 40kHz LPF)	90.1	90.0	dB
DR	fs = 96kHz (-60dBFS, 40kHz LPF)	102.7	102.7	dB
S/N	fs = 96kHz (No Input, 40kHz LPF)	102.8	102.8	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 96kHz (0dBFS, 40kHz LPF)	90.1	90.2	dB
DR	fs = 96kHz (-60dBFS, 40kHz LPF)	102.6	102.6	dB
S/N	fs = 96kHz (No Input, 40kHz LPF)	102.7	102.7	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 96kHz (0dBFS, 40kHz LPF)	90.3	90.1	dB
DR	fs = 96kHz (-60dBFS, 40kHz LPF)	102.7	102.6	dB
S/N	fs = 96kHz (No Input, 40kHz LPF)	102.7	102.5	dB
DAC4 : SDTI4 => DAC4 => L/ROUT4				
S/(N+D)	fs = 96kHz (0dBFS, 40kHz LPF)	90.5	90.6	dB
DR	fs = 96kHz (-60dBFS, 40kHz LPF)	102.5	102.5	dB
S/N	fs = 96kHz (No Input, 40kHz LPF)	102.6	102.7	dB

3. fs=192kHz, MCLK=128fs, BICK=64fs

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 192kHz (0dBFS, 40kHz LPF)	90.0	90.0	dB
DR	fs = 192kHz (-60dBFS, 40kHz LPF)	102.7	102.7	dB
S/N	fs = 192kHz (No Inputs, 40kHz LPF)	102.7	102.8	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 192kHz (0dBFS, 40kHz LPF)	90.1	90.2	dB
DR	fs = 192kHz (-60dBFS, 40kHz LPF)	102.6	102.5	dB
S/N	fs = 192kHz (No Inputs, 40kHz LPF)	102.6	102.5	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 192kHz (0dBFS, 40kHz LPF)	90.3	90.3	dB
DR	fs = 192kHz (-60dBFS, 40kHz LPF)	102.6	102.5	dB
S/N	fs = 192kHz (No Inputs, 40kHz LPF)	102.6	102.7	dB
DAC4 : SDTI4 => DAC4 => L/ROUT4				
S/(N+D)	fs = 192kHz (0dBFS, 40kHz LPF)	90.6	90.6	dB
DR	fs = 192kHz (-60dBFS, 40kHz LPF)	102.5	102.5	dB
S/N	fs = 192kHz (No Inputs, 40kHz LPF)	102.7	102.7	dB

4. [Plot Data]

- 1. fs=48kHz, MCLK=512fs, BICK=64fs
DAC1 : SDTI1 => DAC1 => AOUT1L/AOUT1R

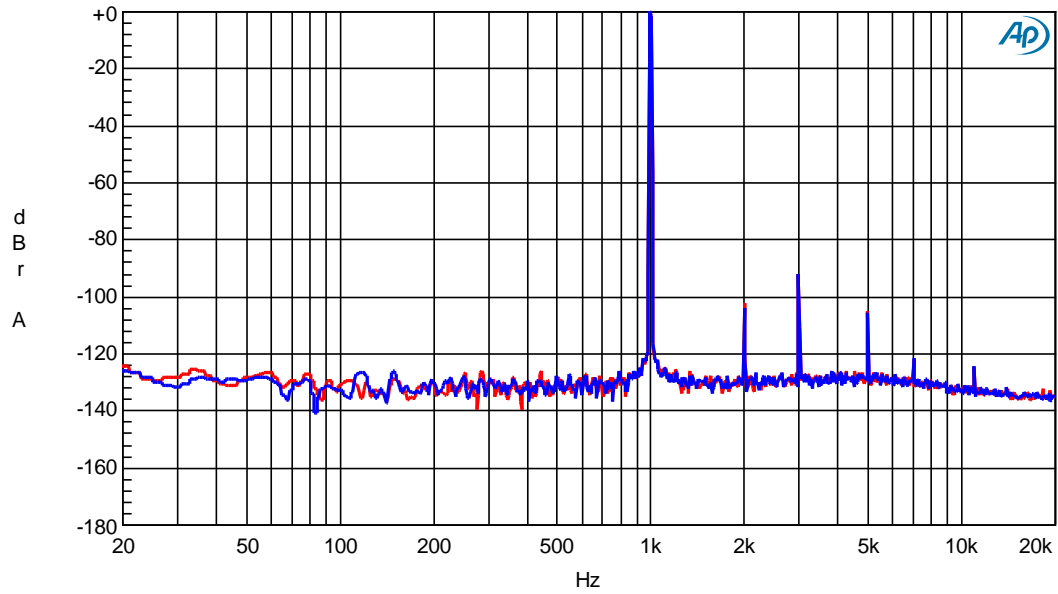


Figure 14.FFT (0dBFS) [fs = 48kHz]

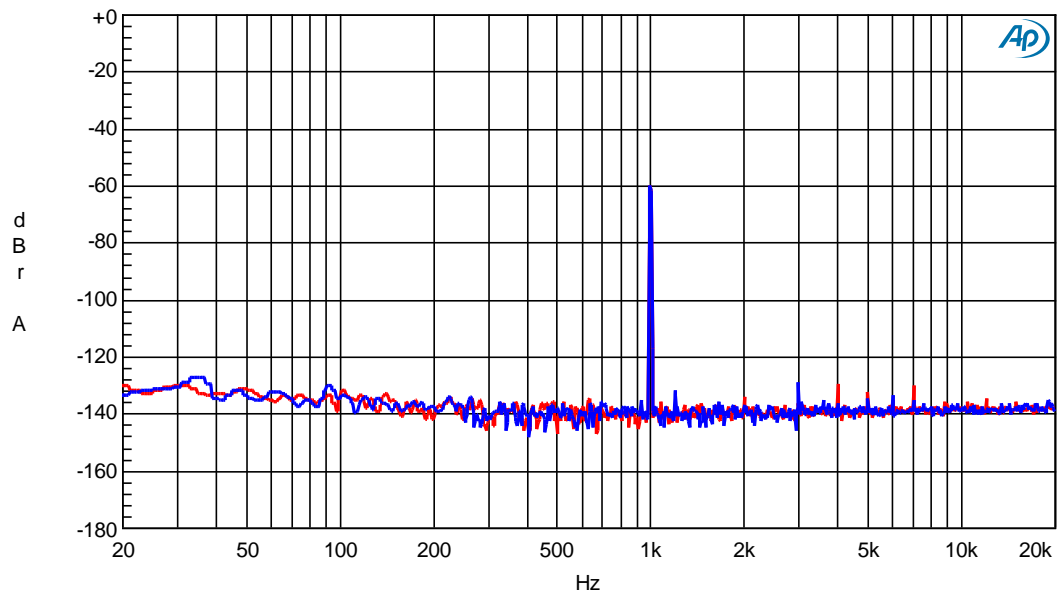


Figure 15.FFT (-60dBFS) [fs = 48kHz]

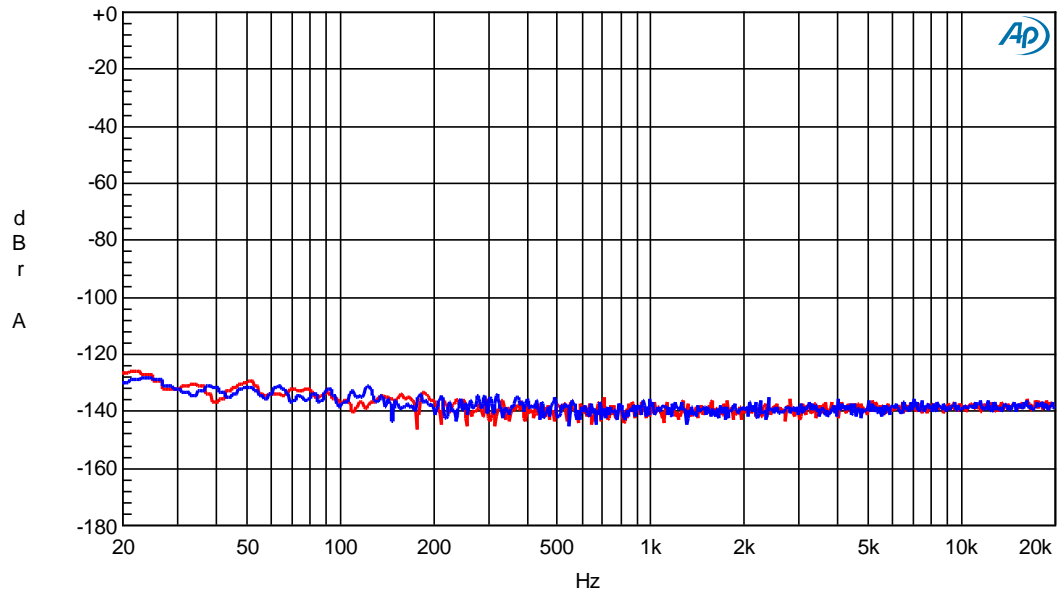


Figure 16.FFT (No Inputs fs=48kHz)

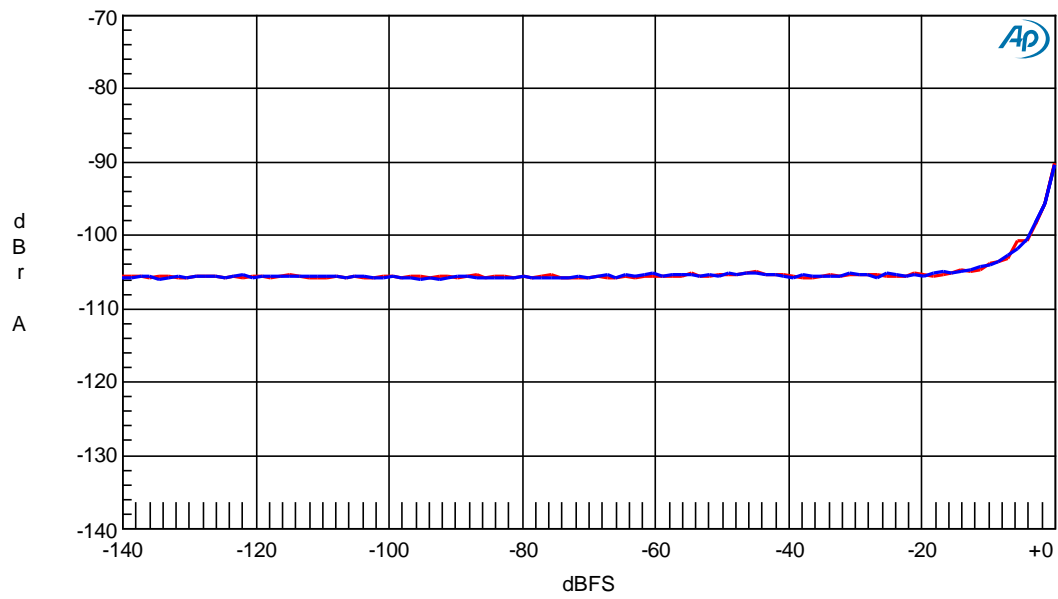


Figure 17.THD+N vs. Amplitude (Input Level) [fs = 48kHz]

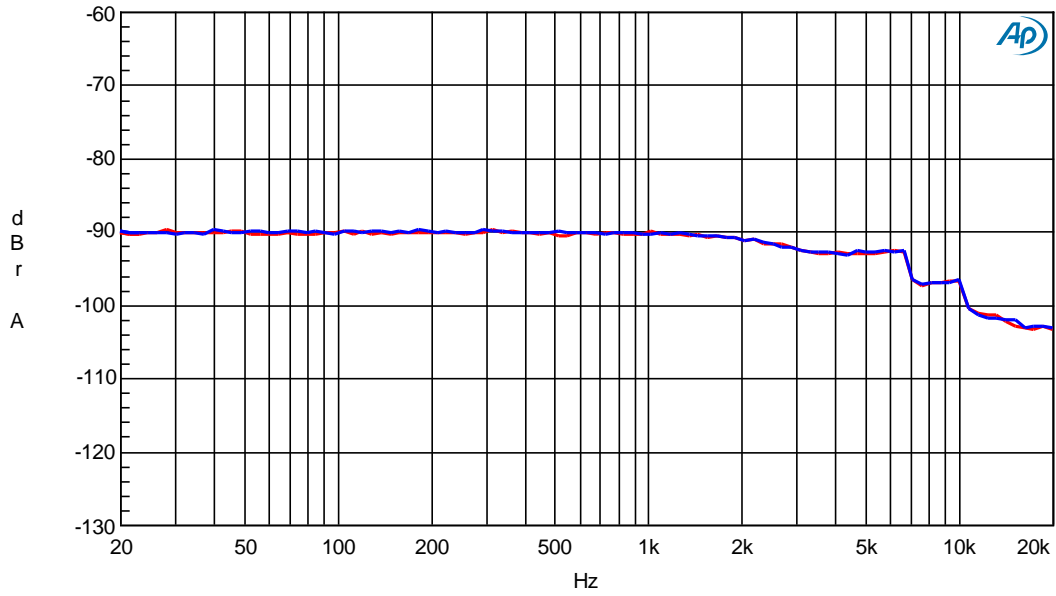


Figure 18. THD+N vs. Input Frequency [fs = 48kHz, 0dBFS Inputs]

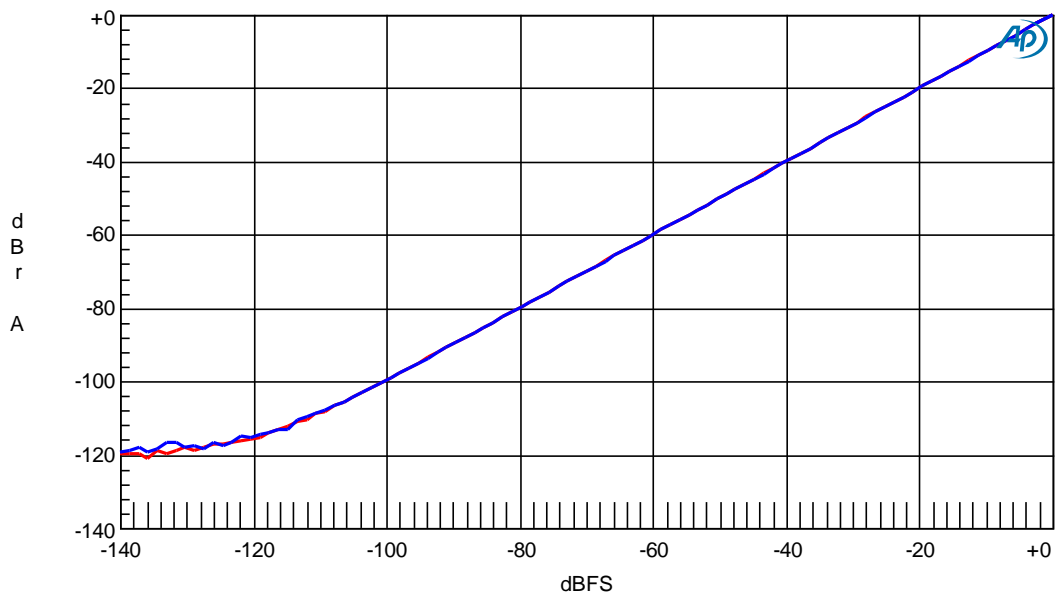


Figure 19. Linearity [fs = 48kHz]

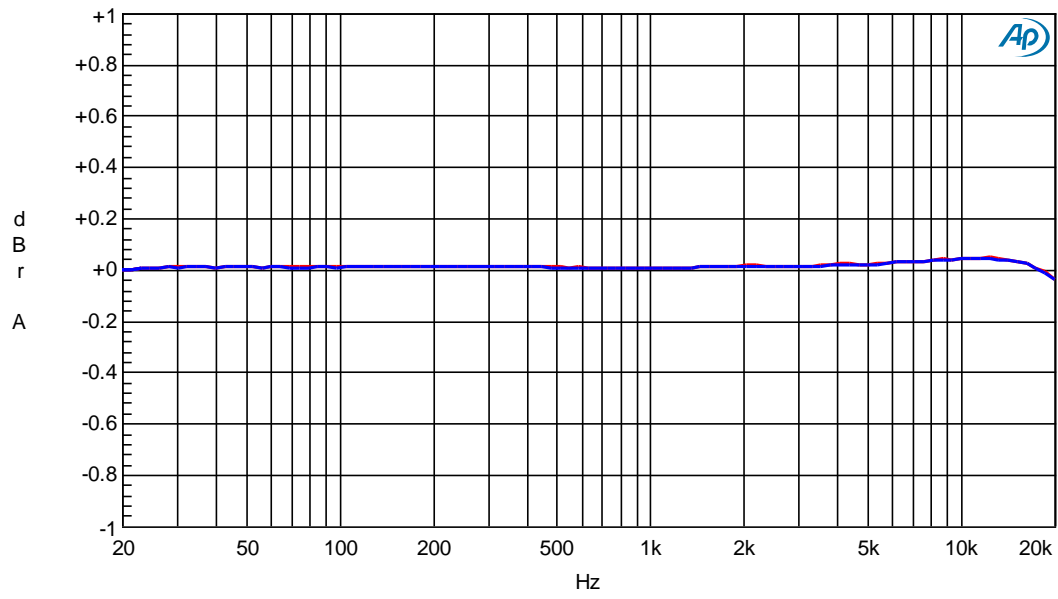


Figure 20.Frequency Response [fs = 48kHz]

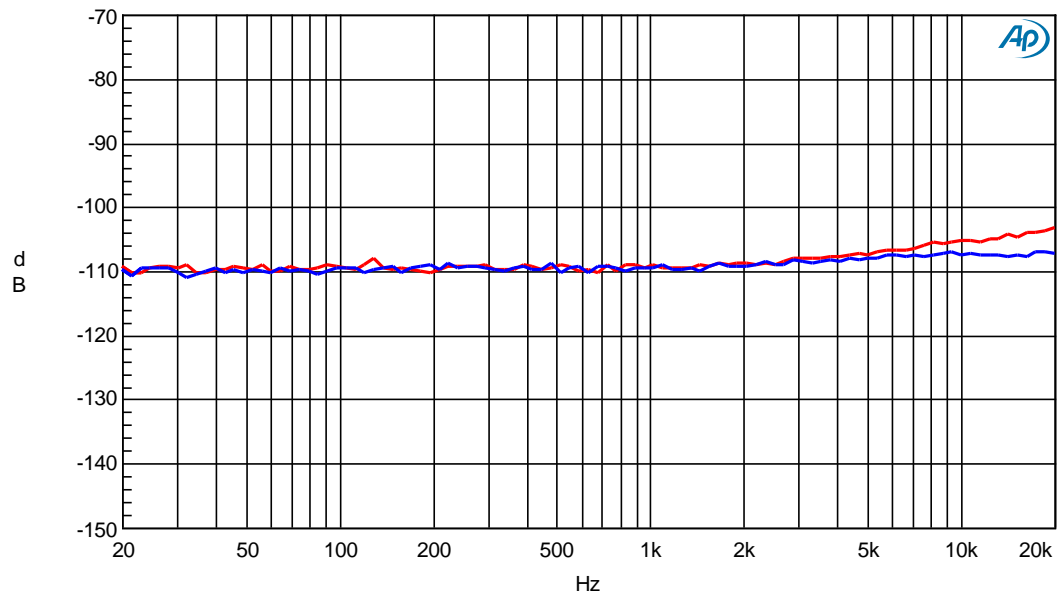


Figure 21.Crosstalk [fs = 48kHz]

[Plot Data]

2. fs=96kHz, MCLK=256fs, BICK=64fs
DAC1 : SDTI1 => DAC1 => AOUT1L/AOUT1R

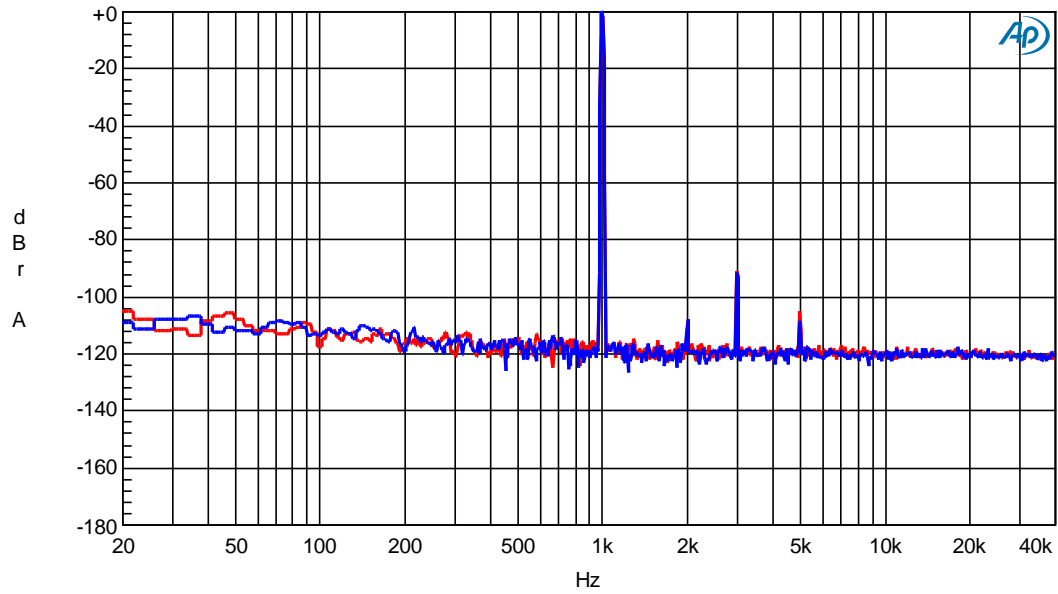


Figure 22.FFT (0dBFS) [fs = 96kHz]

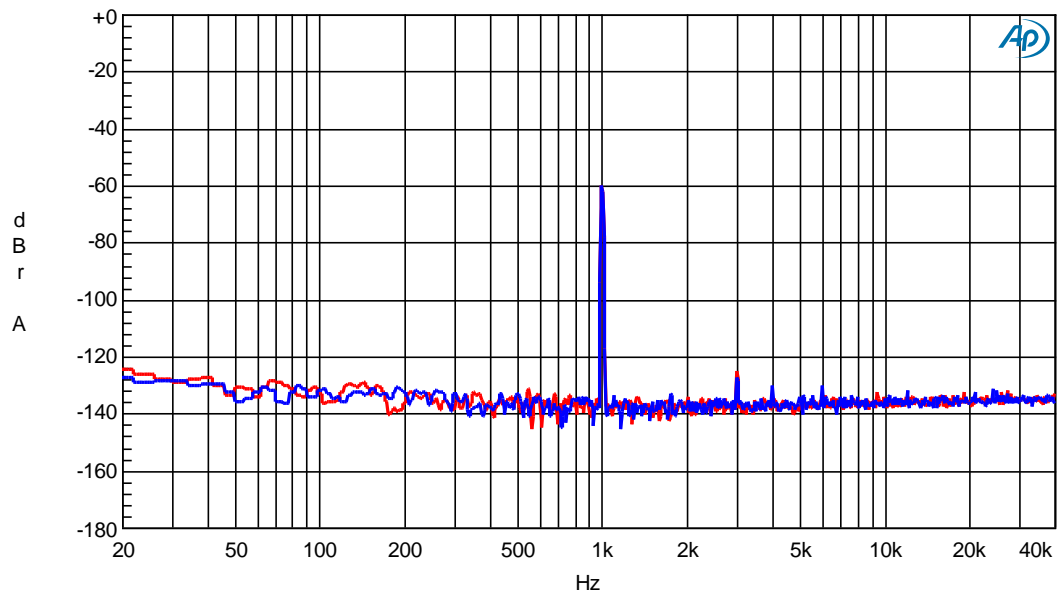


Figure 23.FFT (-60dBFS) [fs = 96kHz]

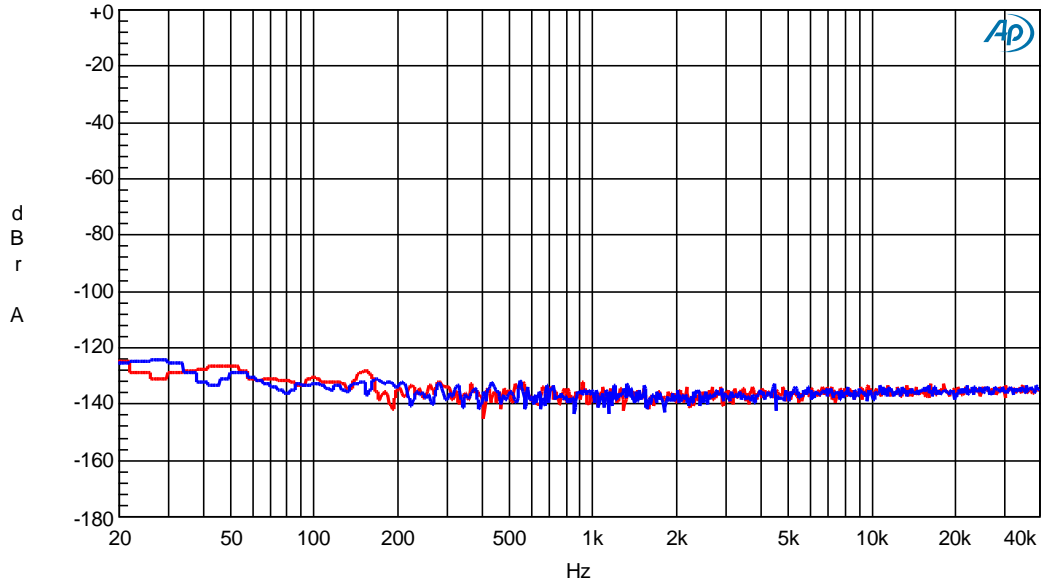


Figure 24.FFT (No Inputs fs=96kHz)

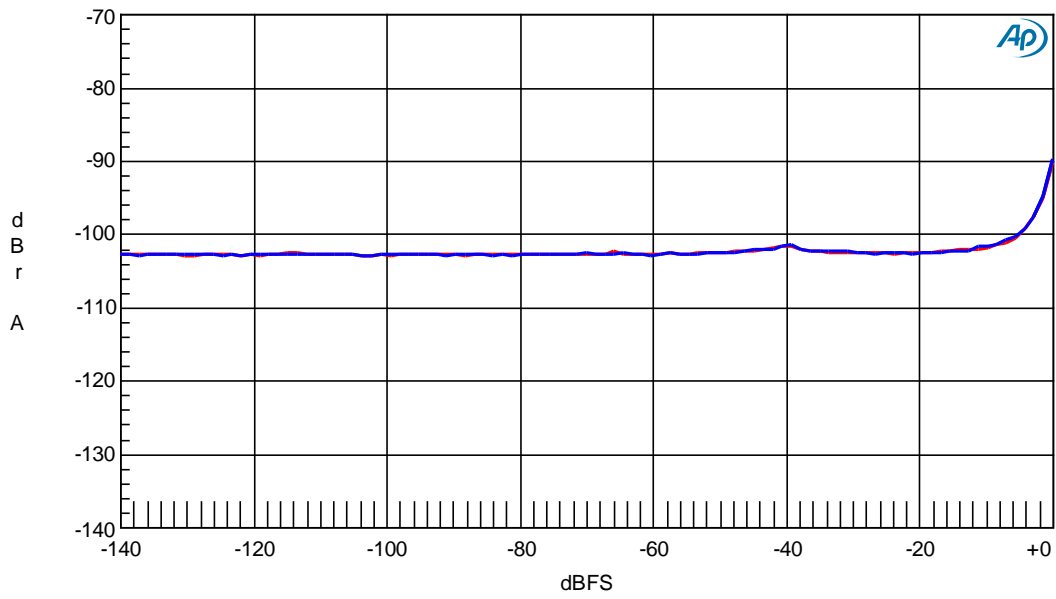


Figure 25.TH+N vs. Amplitude (Input Level) [fs = 96kHz]

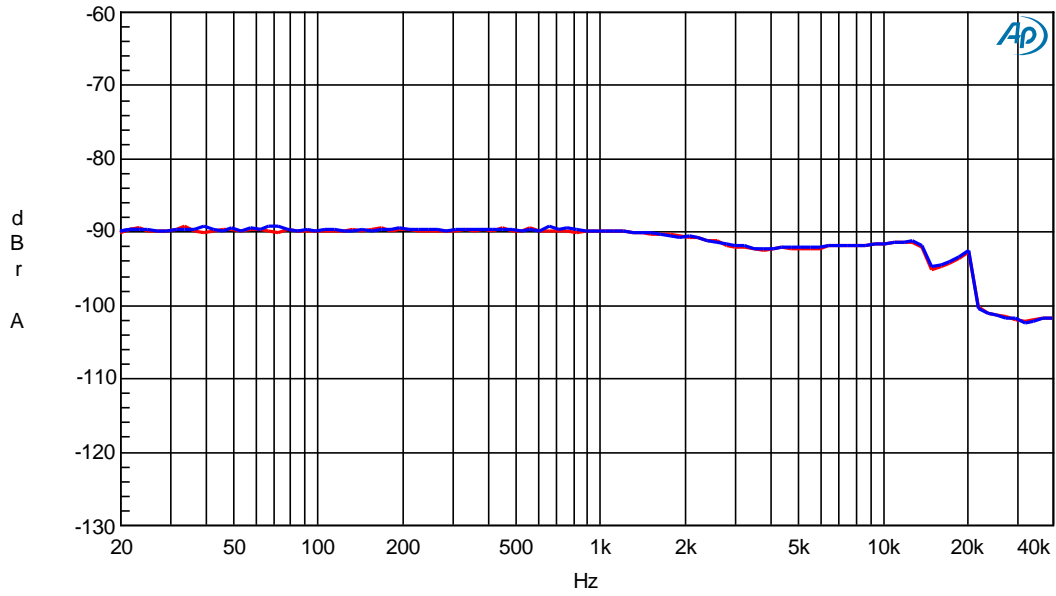


Figure 26. THD+N vs. Input Frequency [fs = 96kHz, 0dBFS Inputs]

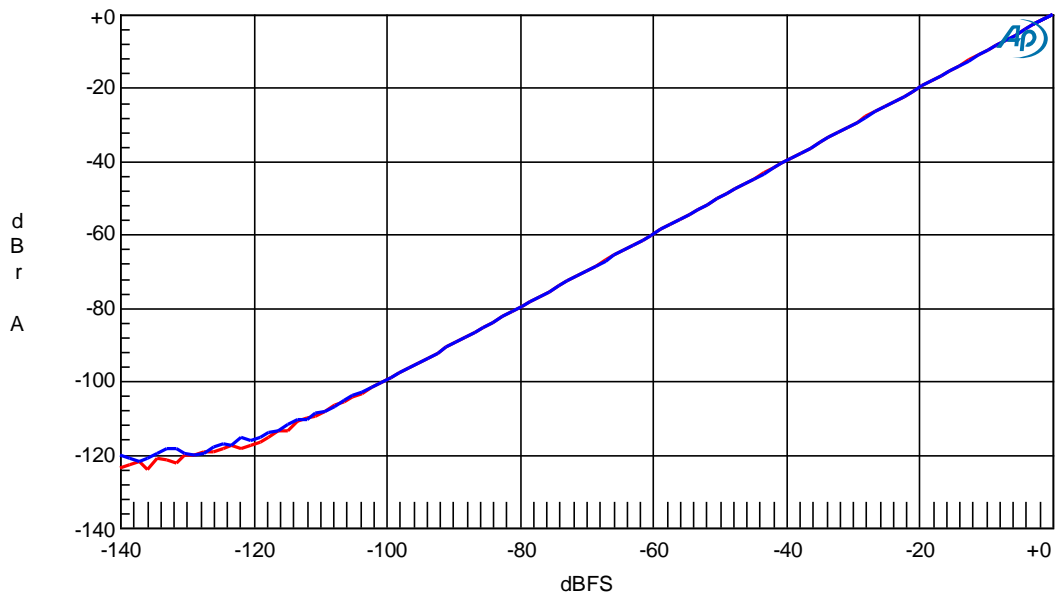


Figure 27. Linearity [fs = 96kHz]

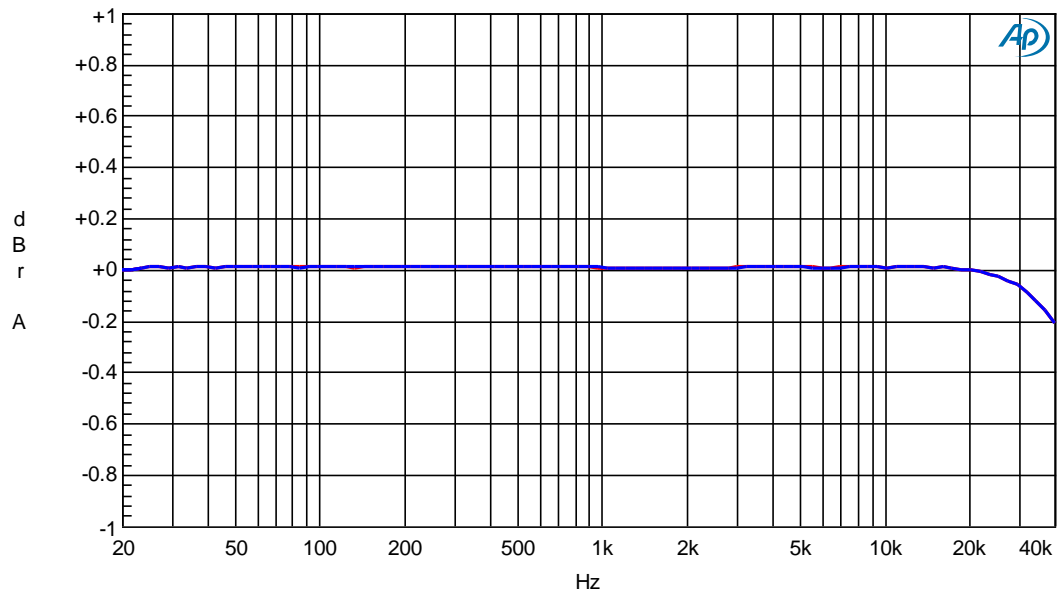


Figure 28.Frequency Response [fs = 96kHz]

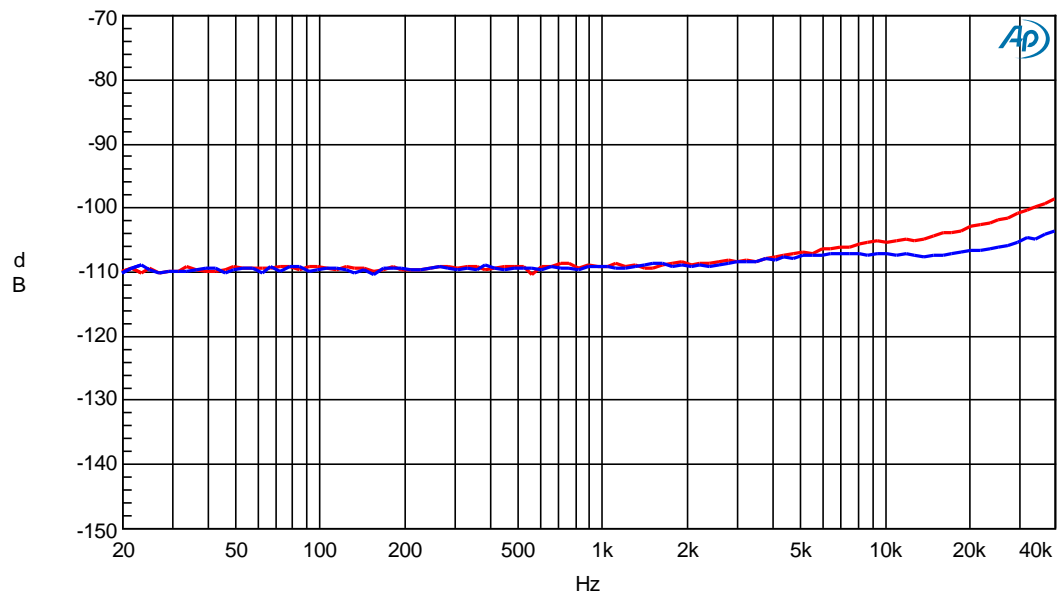


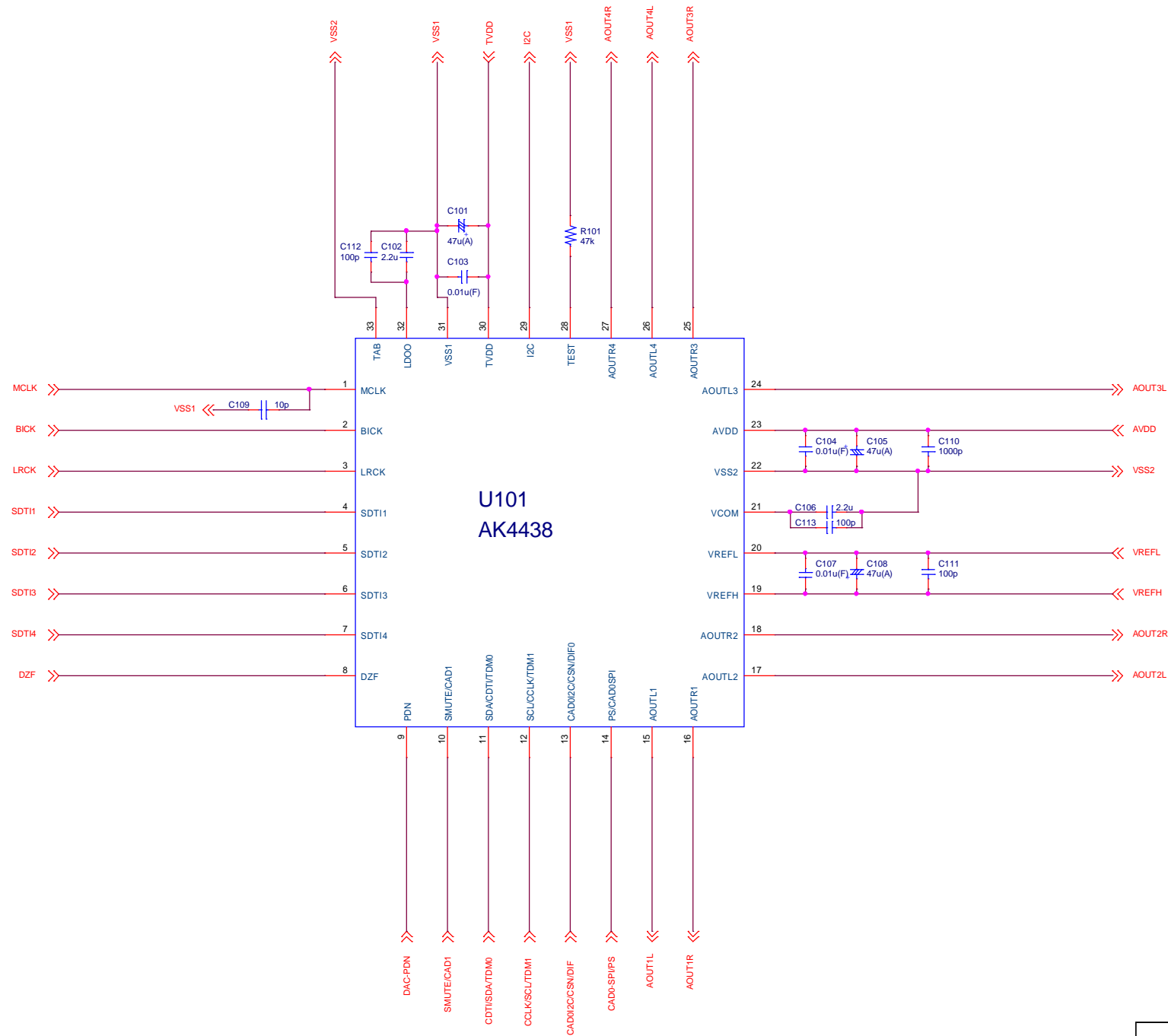
Figure 29.Crosstalk [fs = 96kHz]

REVISION HISTORY

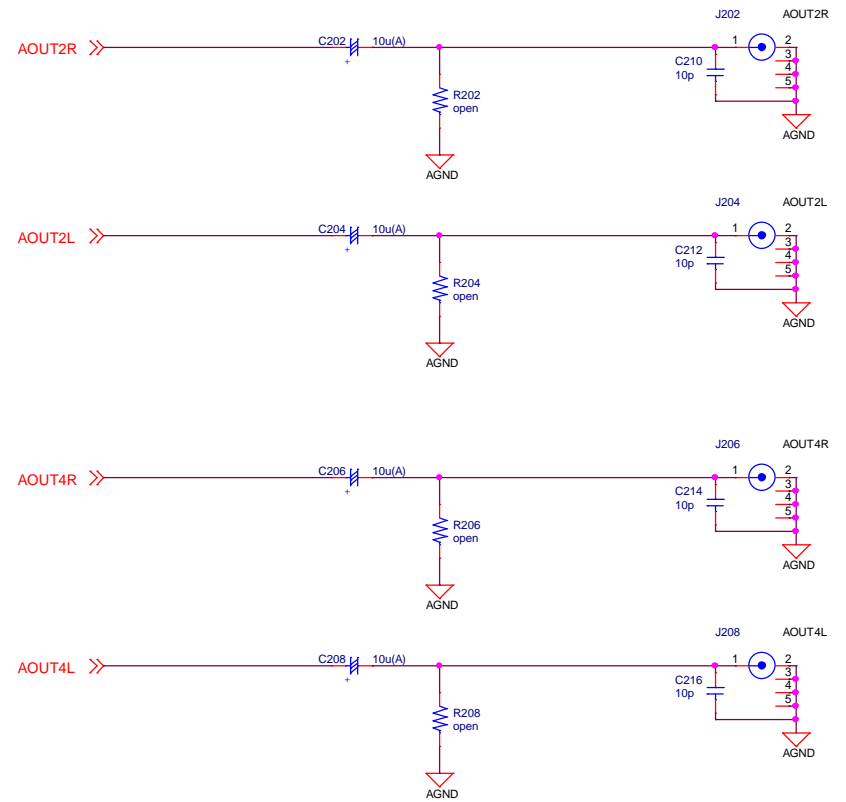
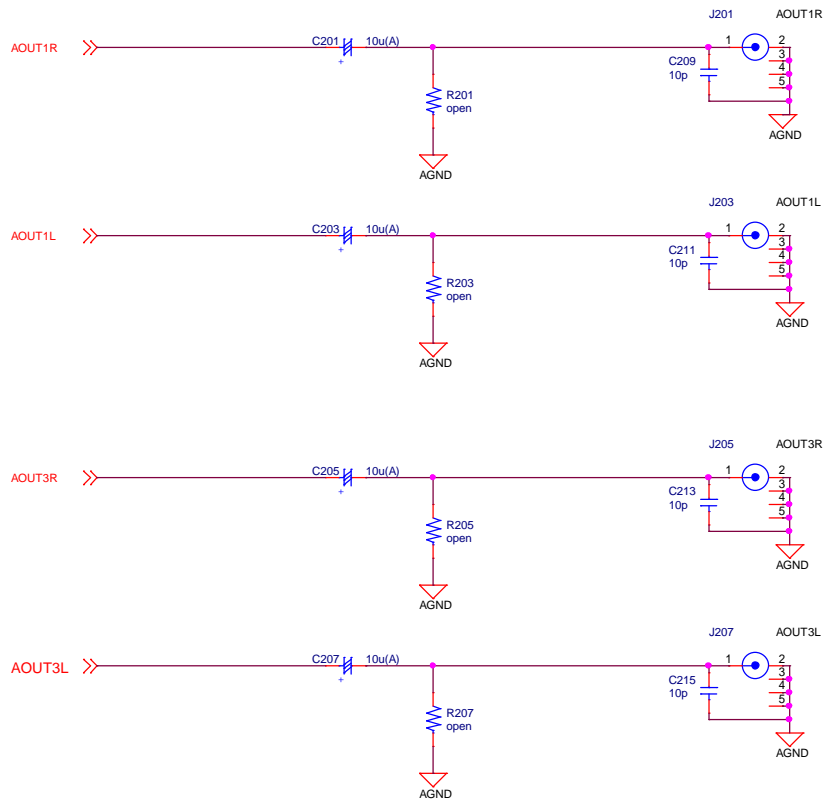
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15/01/09	KM120200	0	First edition		
16/03/23	KM120201	1	Modification		Schematic Changed.
16/03/23	KM120201	1	Modification		Add Measurement Results.
18/07/11	KM120202	2	Modification		Parts replacement(BNC→RCA).
18/07/11	KM120202	2	Modification		Update Measurement Results.

————— IMPORTANT NOTICE —————

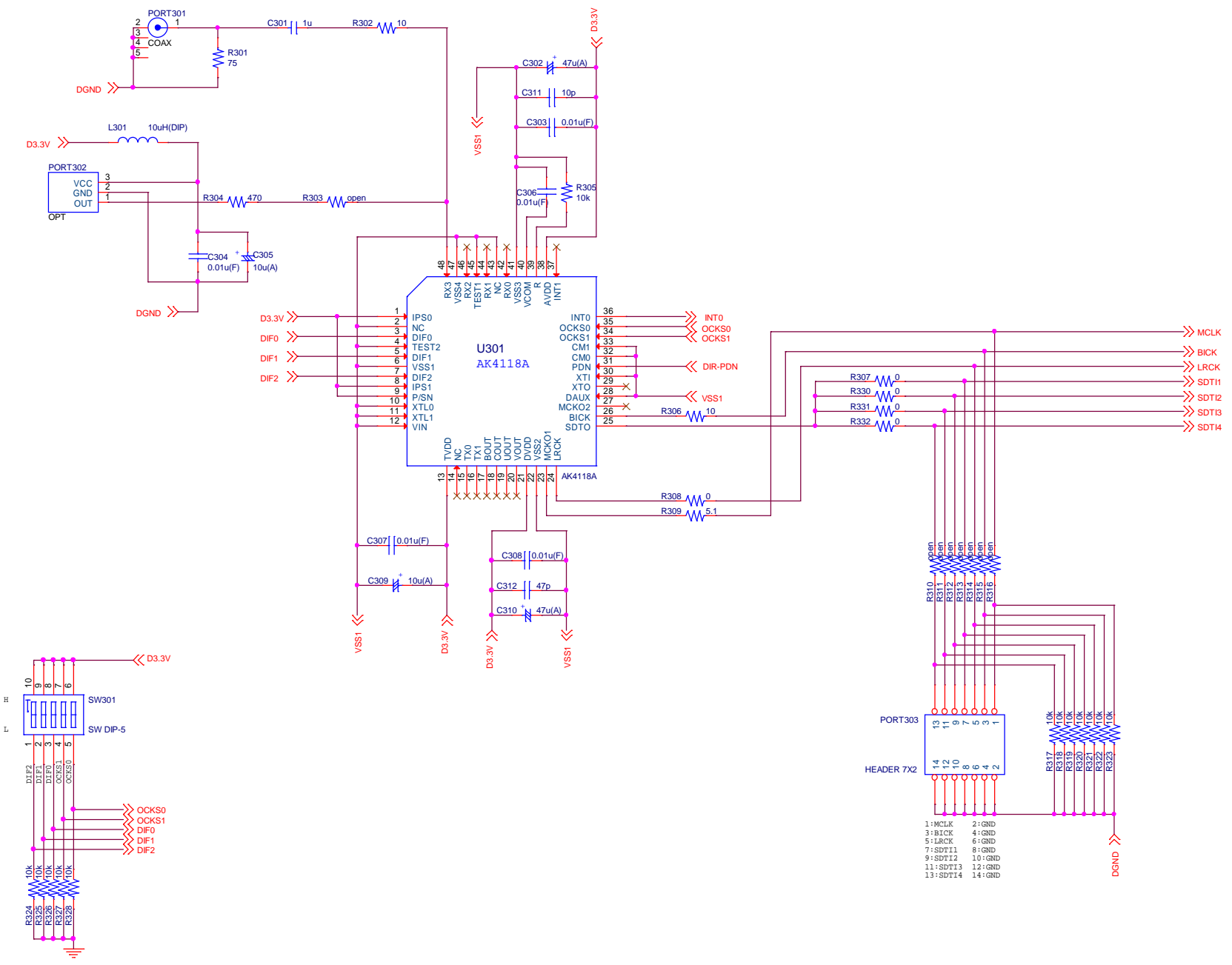
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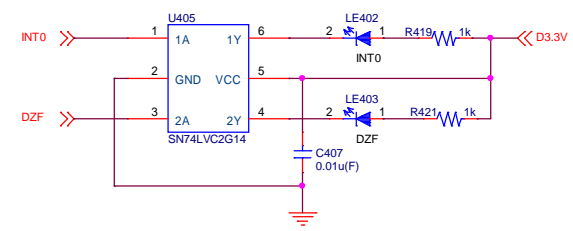
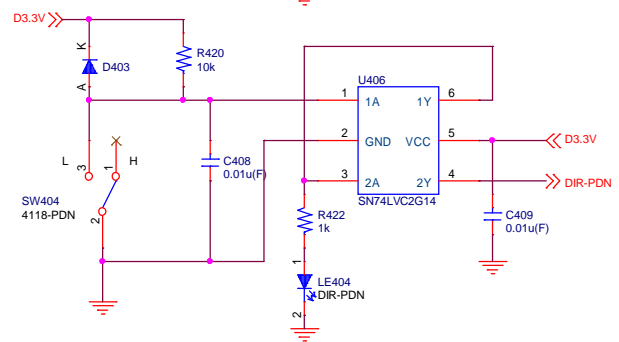
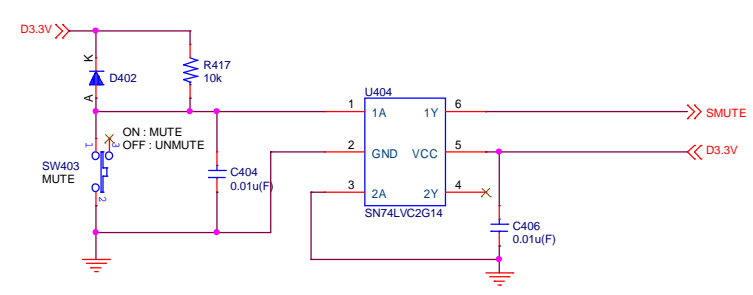
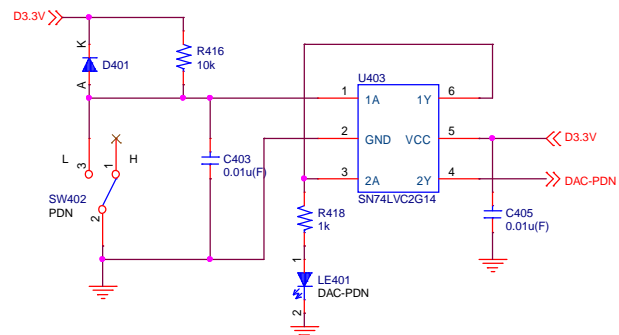
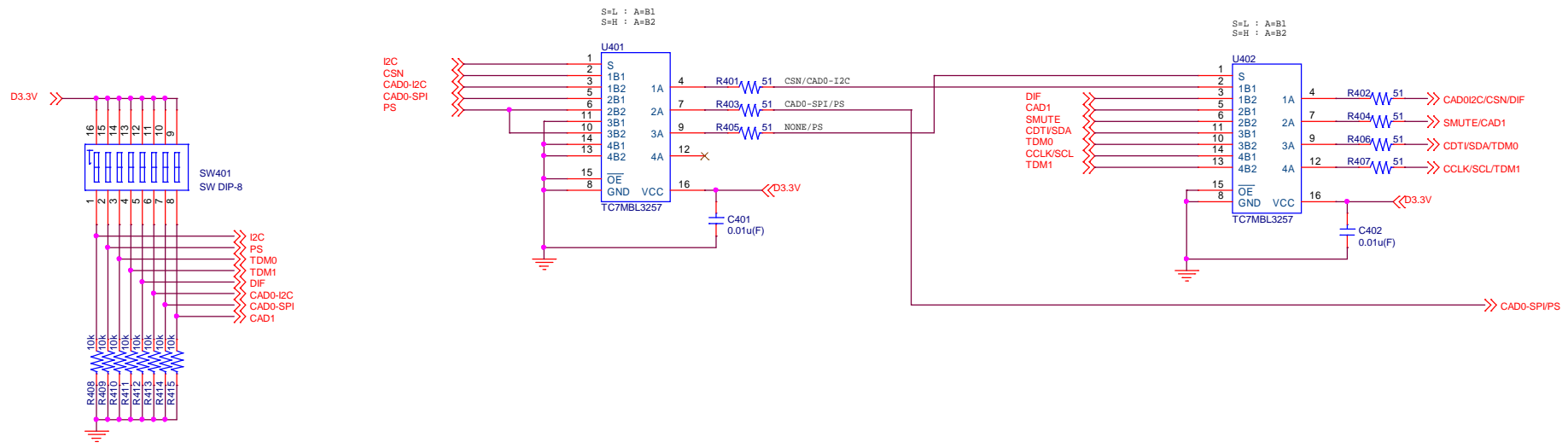
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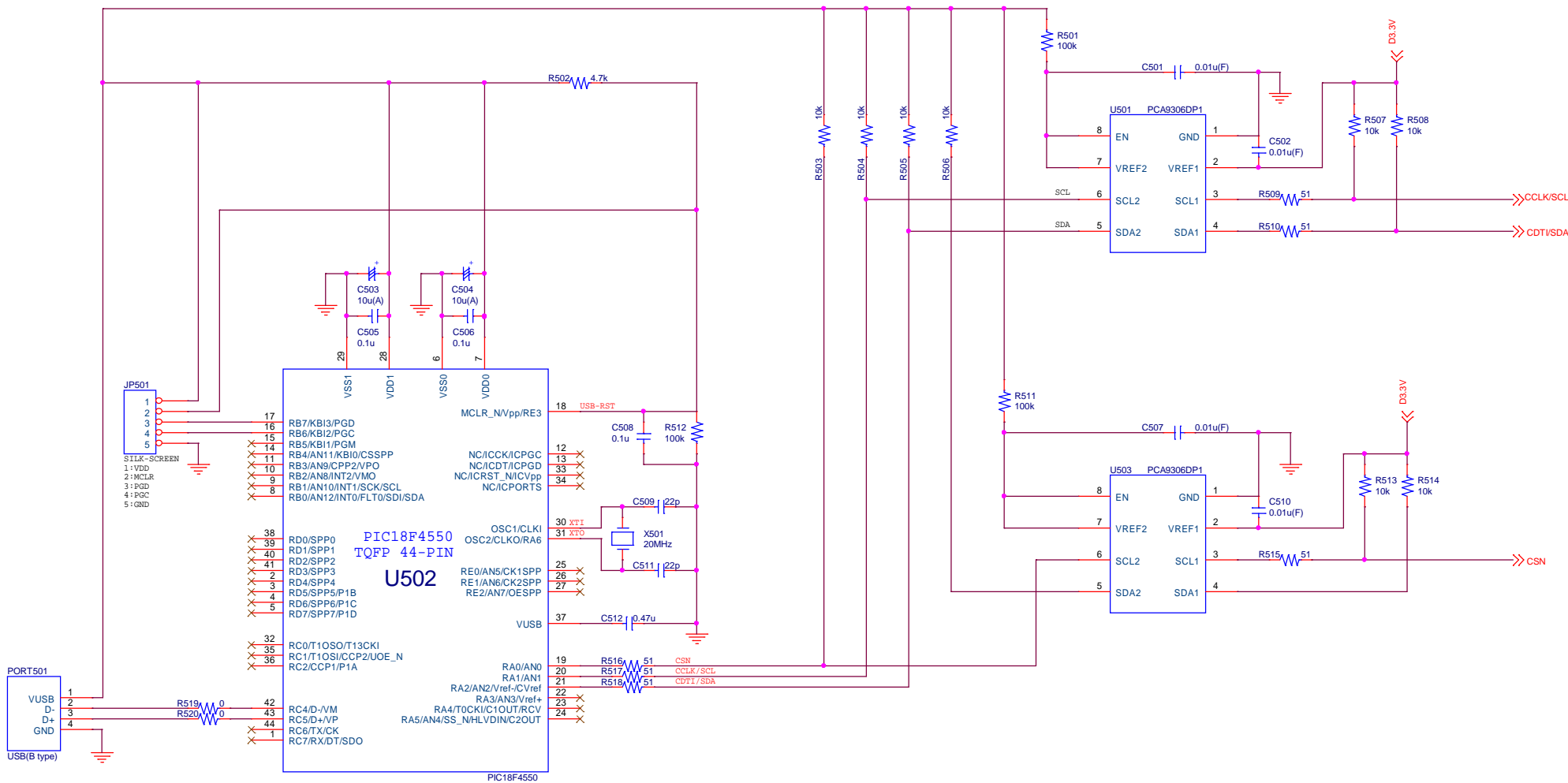
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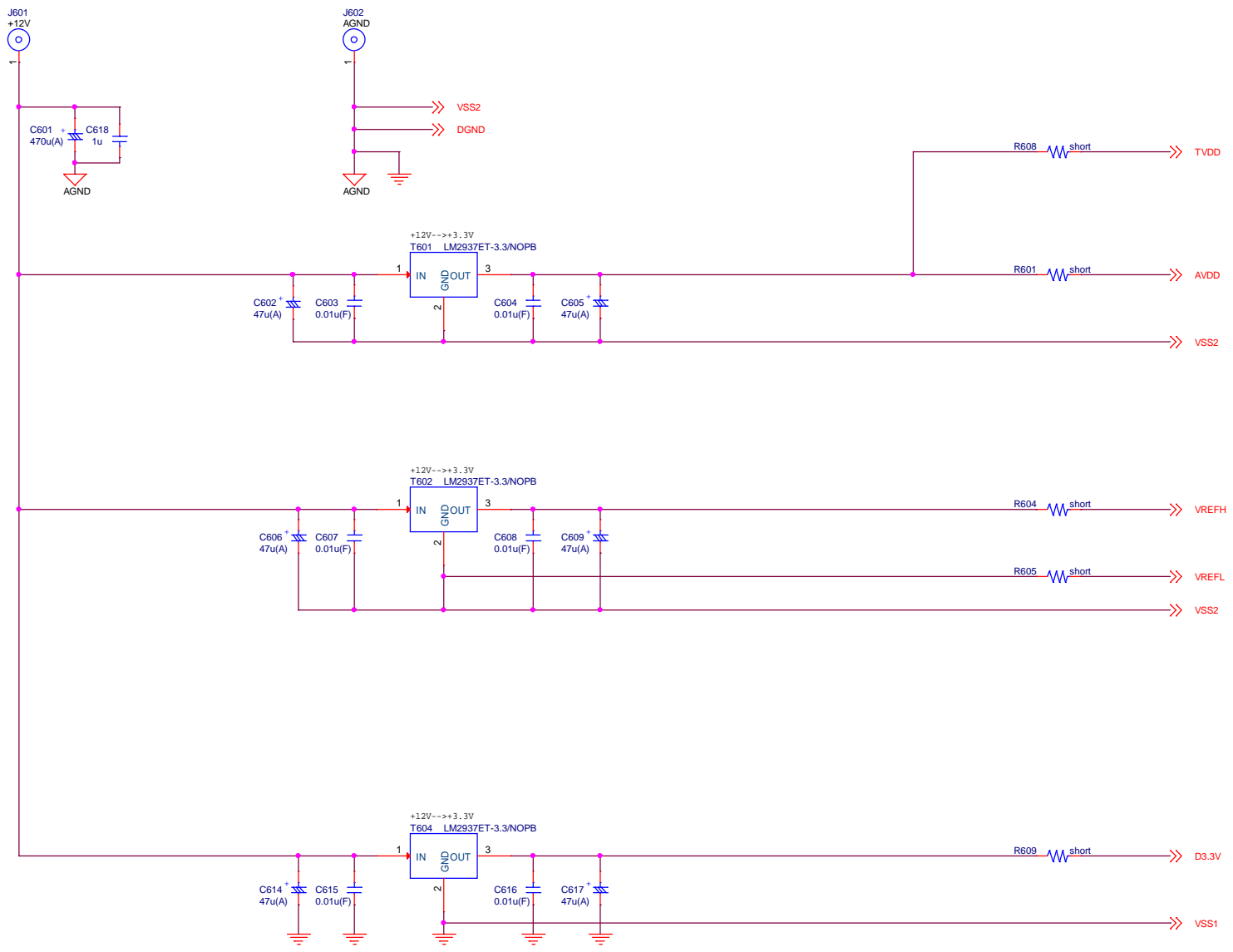
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