AKD4432-SA

AK4432 Sound Quality Evaluation Board Rev.2

GENERAL DESCRIPTION

The AKD4432-SA is an evaluation board for the AK4432 (32-bit 2ch DAC) that supports DVD-Audios, Car-Audio Systems, allowing quick evaluation with digital audio interface.

■ **Ordering guide**

AKD4432-SA --- Evaluation board for AK4432
（Control software is packed with this board）

FUNCTION

☐ **3 type digital audio interface**
- **Optical input**
- **COAX input**
- **External input**

☐ **2ch Analog outputs**

☐ **USB Port for Serial control**

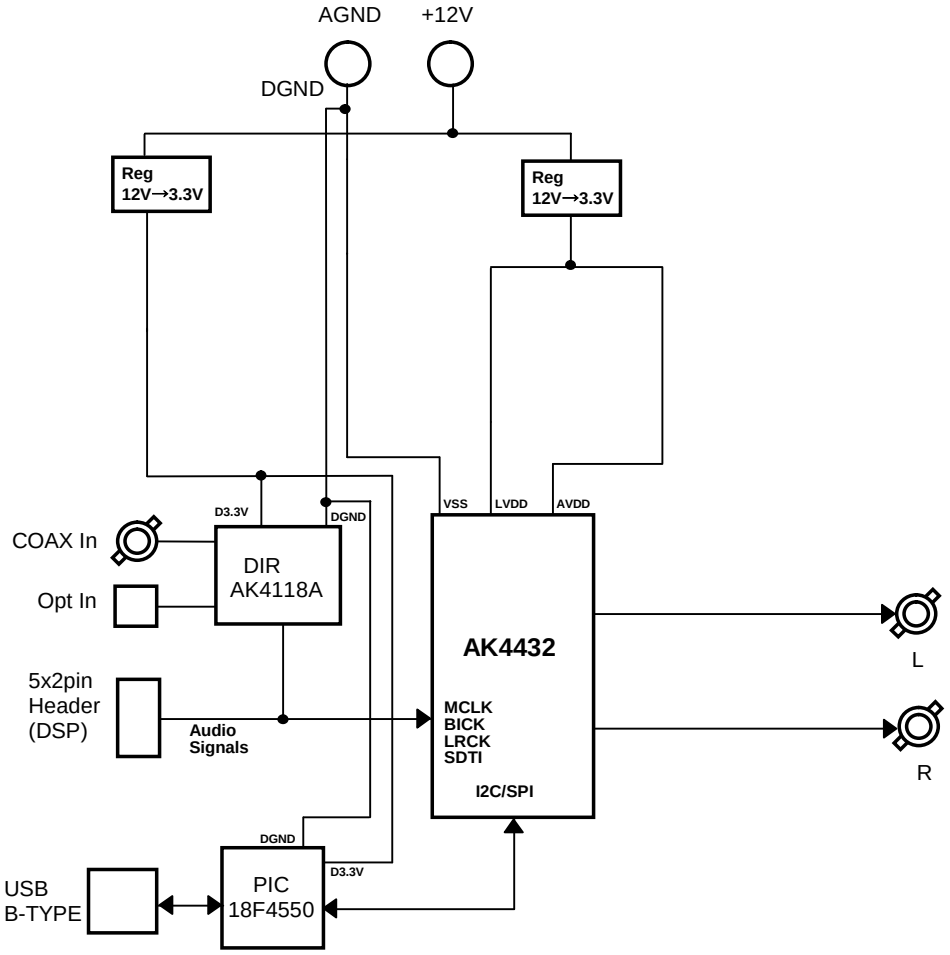


Figure 1. AKD4432-SA Block Diagram

Board Diagram

■ Board Diagram

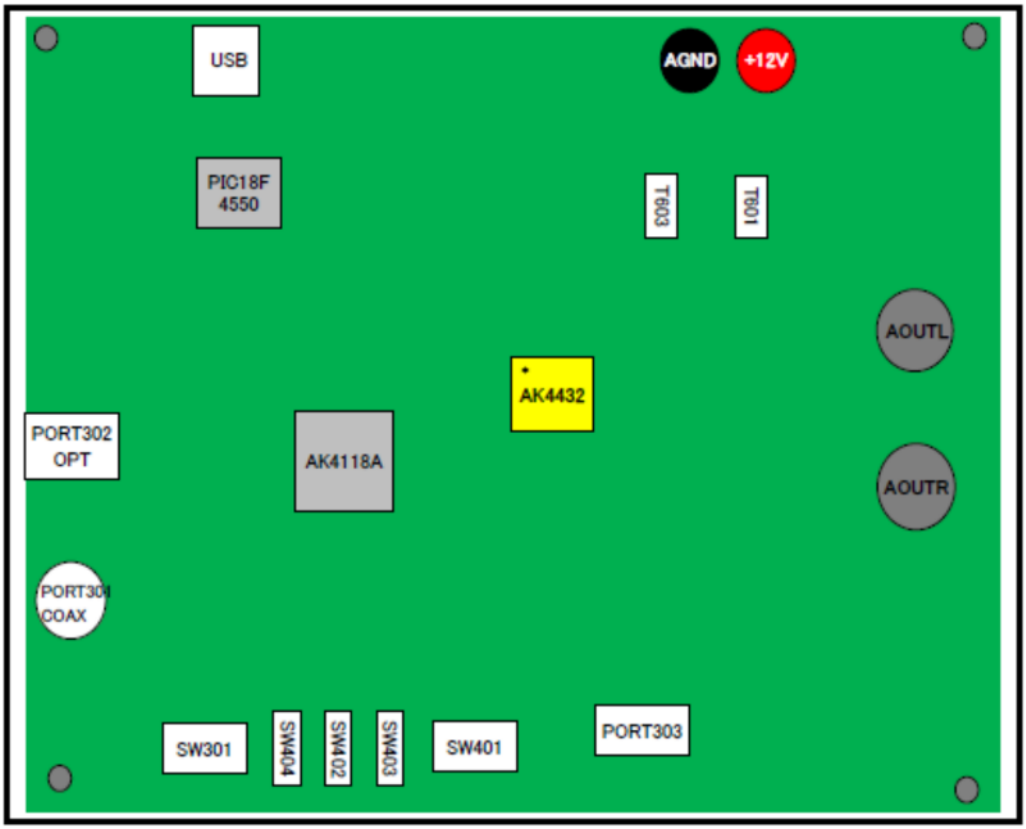


Figure 2. AKD4432-SA Board Diagram

■ Description

(1) Connector for Power supply
+12V、AGND
Terminals for power supply. Refer to table1.

(2) AOUTL、AOUTR
RCA Jack 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 AK4432 as DIR.

(5) PORT303
External digital data inputs to AK4432.
MCLK、BICK、LRCK、SDTI
When using the PORT303：R310=R311=R312=R313= 51Ω
R314= R315= R316=R317=Open

When using the AK4118A：R310=R311=R312=R313=Open (Default)
R314= R315= R316=R317=51Ω (Default)

(6) USB
USB Port. It is possible to set up the registers of AK4432 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 AK4432.Upside is “Hi”, downside is “Lo”
Refer to Table5.SW401 setting.

(10) SW402
Power down switch for AK4432.Upside is “Hi (on)”, downside is “Lo (off)”

(11) SW403
Mute switch for AK4432.
Push：AK4432 is mute
Release：AK4432 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	DAUX	SDTO	LRCK		BICK		
							I/O		I/O	
0	0	0	0	24bit, Left justified	16bit, Right justified	H/L	O	64fs	O	
1	0	0	1	24bit, Left justified	18bit, Right justified	H/L	O	64fs	O	
2	0	1	0	24bit, Left justified	20bit, Right justified	H/L	O	64fs	O	
3	0	1	1	24bit, Left justified	24bit, Right justified	H/L	O	64fs	O	
4	1	0	0	24bit, Left justified	24bit, Left justified	H/L	O	64fs	O	default
5	1	0	1	24bit, I^2S	24bit, I^2S	L/H	O	64fs	O	
6	1	1	0	24bit, Left justified	24bit, Left justified	H/L	I	64-128fs	I	
7	1	1	1	24bit, I^2S	24bit, I^2S	L/H	I	64-128fs	I	

Table 3. AK4118A Audio interface format

OCKS1 pin	OCKS0 pin	(X'tal)	MCKO1	MCKO2	fs (max)	
0	0	256fs	256fs	256fs	96 kHz	
0	1	256fs	256fs	128fs	96 kHz	
1	0	512fs	512fs	256fs	48 kHz	default
1	1	128fs	128fs	64fs	192 kHz	

Table 4. AK4118A MCLK setting

(2) SW401 setting

No.	Switch Name	Function	default
1	I2C	I2C pin of AK4432 H: I2C mode L: SPI mode	Hi
2	PS	PS pin of AK4432 H: Parallel mode L: Serial mode	Hi
3	I2CFIL	I2CFIL pin of AK4432 H: Fast Mode Plus(1MHz) L: Fast Mode(400kHz)	Lo
4	ACKS	ACKS pin of AK4432 H: Auto Setting Mode L: Manual Setting Mode	Hi
5	DIF	DIF pin of AK4432 (Parallel mode only) H: 32bit I2S compatible L: 32bit LSB justified	Lo
6	Open	-	-

Table 5. SW401 setting

(3) SW402/SW403/SW404 setting

SW402	AK4432-PDN	Power down switch for AK4432 Hi: Power up Lo: Power down ※Should be "Hi" during operation AK4432.
SW403	MUTE	Mute switch for AK4432 (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.

Table6. 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 AK4432 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

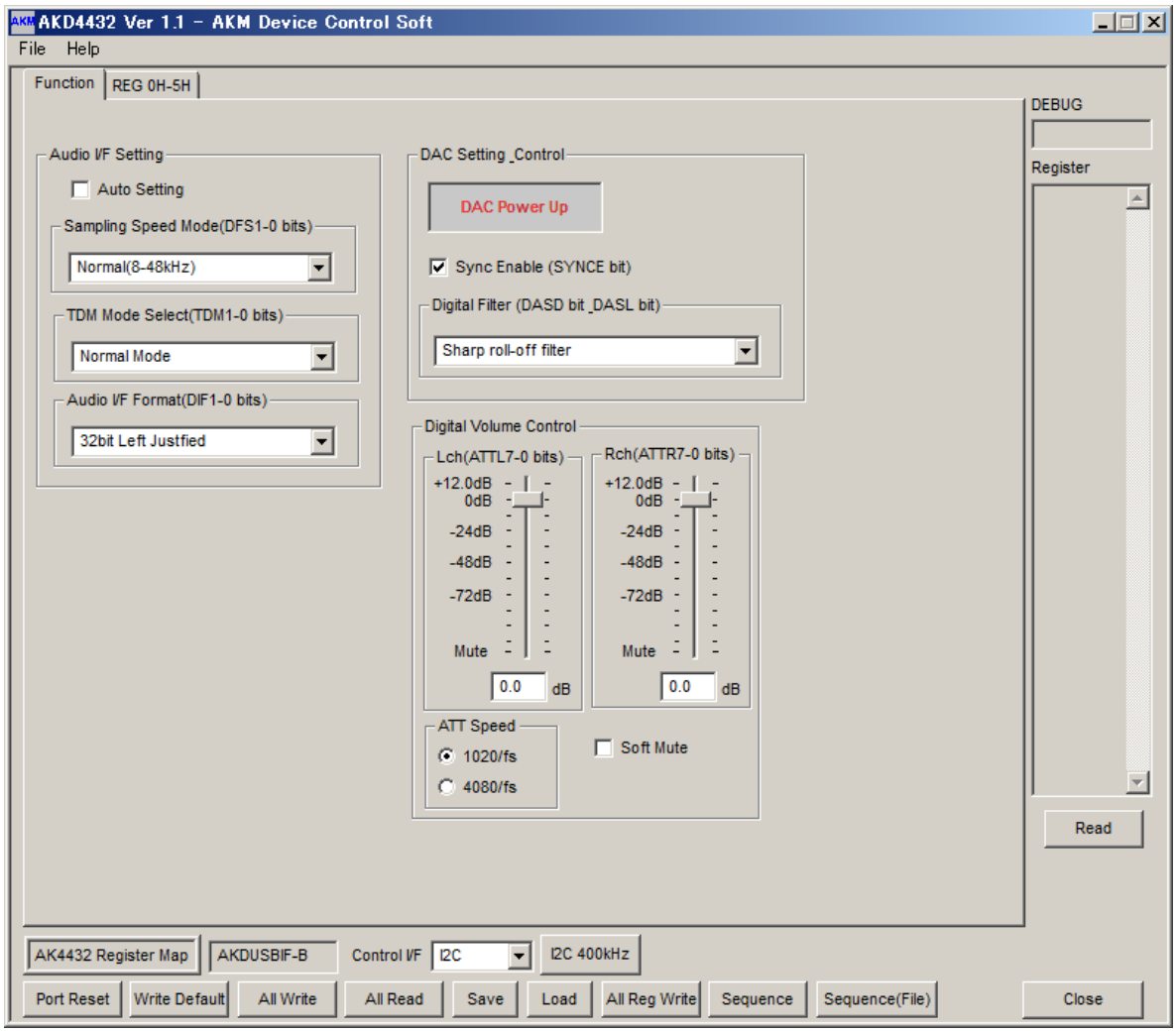


Figure 3. Control Software Window

■ 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.

Function Tab

1. [Function]: Function Map

This tab is for a function and volume setting.
Each operation is executed by [Function] buttons on the left side of the screen.

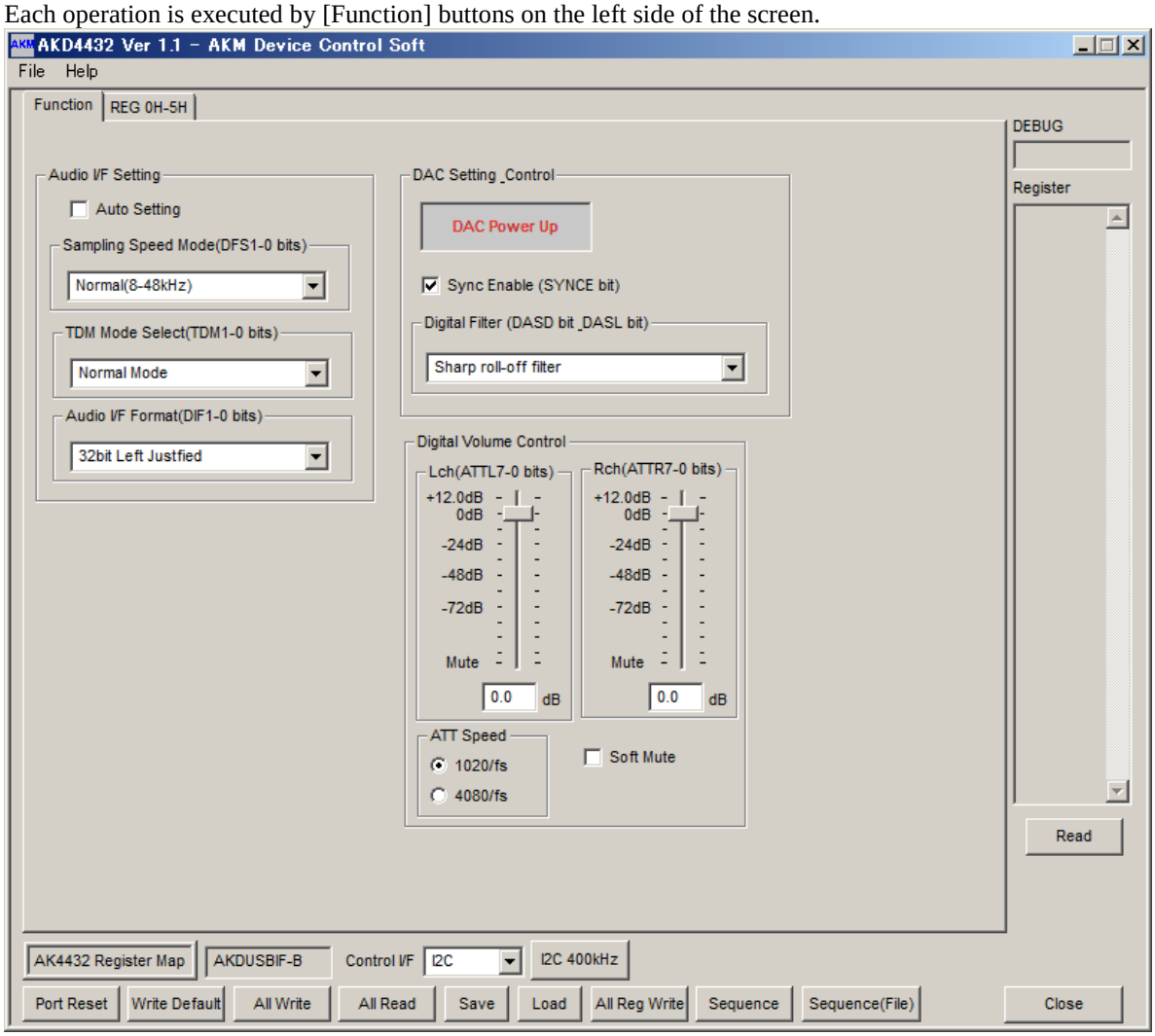


Figure 4. Window of [Function]

[Function] Tab

- Audio I/F Setting: Audio interface function setting.
- DAC Setting Control: DAC function setting.
- Digital Volume Control: Digital volume function setting.

1-1.[Audio I/F Setting]

1. [Auto Setting]: ACKS mode select.
   No check: ACKS is invalid, Manual Setting Mode (default)
   Checked: ACKS is valid, Auto Setting Mode

2. [Sampling Speed Mode(DFS1-0 bits)]: Sampling speed mode setting.(when ACKS invalid)
   Normal Speed Mode 32kHz~48kHz
   Double Speed Mode 64kHz~96kHz
   Quad Speed Mode 128kHz~192kHz

3. [TDM Mode Select(TDM1-0 bits)]: TDM fomat select.
   Normal mode (default)
   TDM128 mode (Quad Speed Mode)
   TDM256 mode (Double Speed Mode)

4. [Audio I/F Format(DIF1-0 bits)]: Audio interface format select.
   16bit, Right justified
   20bit, Right justified
   24bit, Left justified
   24bit, I²S
   24bit, Right justified
   32bit, Right justified
   32bit, Left justified (default)
   32bit, I²S

1-2.[DAC Setting Control]

1. [DAC Power Up/Down]: DAC power management function setting by push down of a button.
   DAC Power Up: RMDA invalid, normal operation(default)
   DAC Power Down: RMDA valid, power down

2. [Sync Enable(SYNCE bit)]: Clock sync function select by the check patterns.
   No checked: Clock sync invalid
   Check: Clock sync valid (default)

3. [Digital Filter(DASD bit_DASL bit)]: Digital filter function setting.
   Sharp roll-off filter (default)
   Slow roll-off filter
   Short delay Sharp roll-off filter
   Short delay Slow roll-off filter

1-3.[Digital Volume Control]

1. [Lch(ATTL7-0 bits)]: Volume setting of Lch by the slide button.
   +12.0dB,
   0dB (default)
   ～-115dB,
   Mute

2. [Rch(ATTR7-0 bits)]: Volume setting of Rch by the slide button.
   +12.0dB,
   0dB (default)
   ～-115dB,
   Mute

3. [ATT Speed]: Digital volume transfer time setting.
   1020/fs (default)
   4080/fs
4. [Soft Mute]: Soft mute function setting by the check patterns.
   No checked : Mute off , Normal (default)
   Checked : Mute on

Tab Functions

2. [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 “---”.

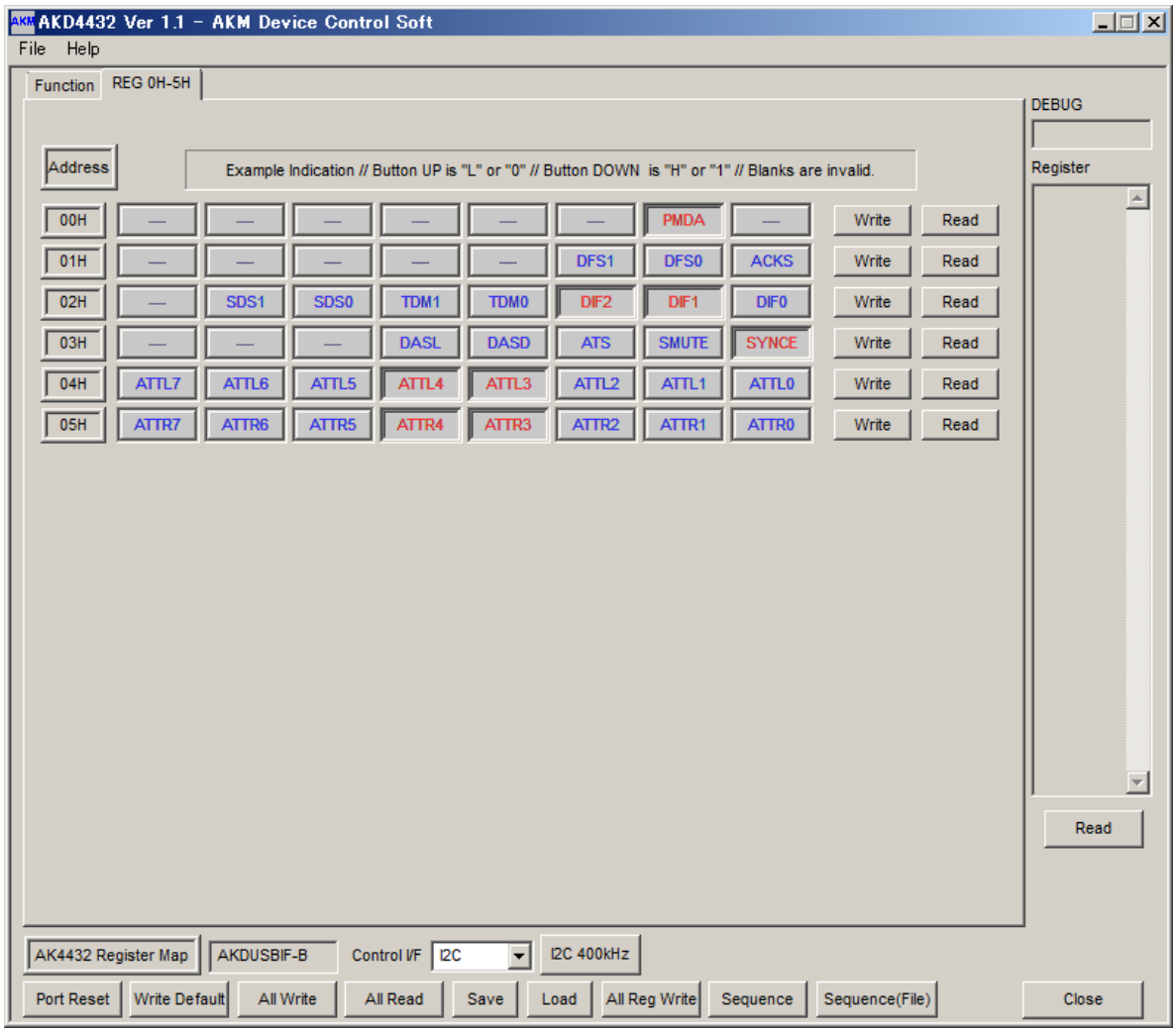


Figure 5. Window of [REG]

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 wil 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.

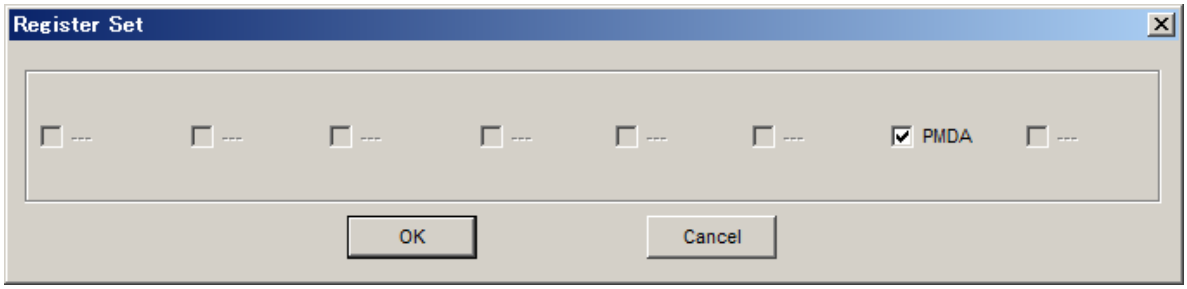


Figure 6. Window of [Register Set]

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.

■ 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.

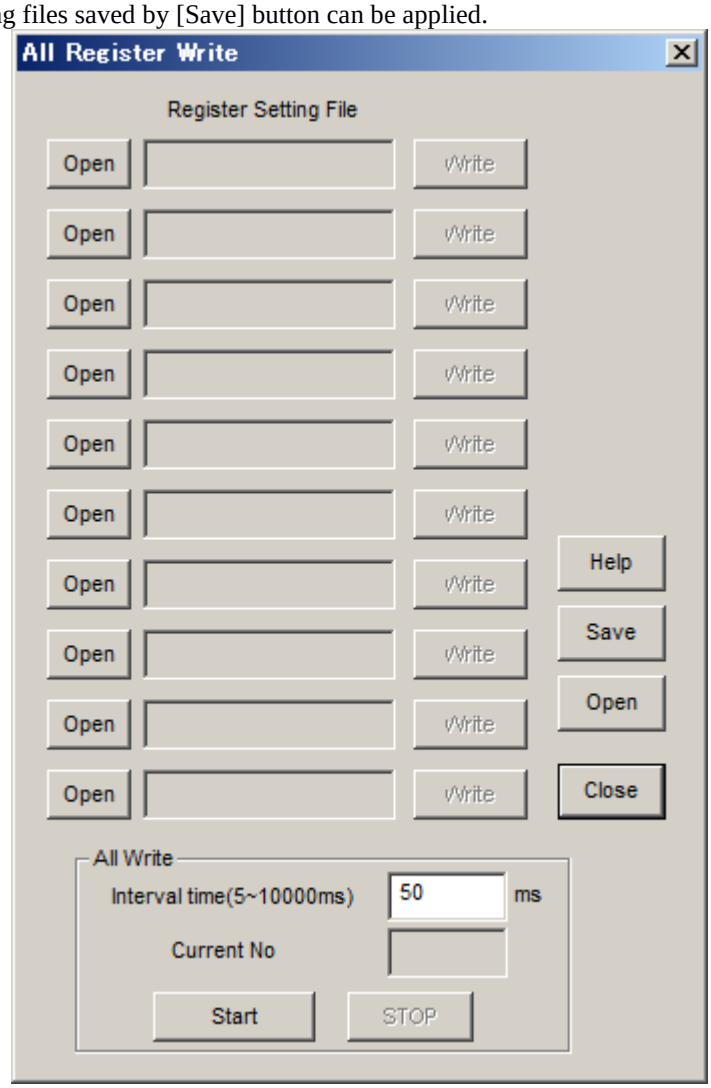


Figure 7. Window of [All Reg Write]

[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.
[All Write]: A chosen register setting file is written in together.
Execution order of the choice file will be the order of the bottom from the window top.
[Start]: Register writing in of all files is carried out from the upper side.
[Stop]: Register writing in is canceled.
[Interval time]: The waiting time until writing in of the next register setting file is begun is designated.
(5msec ～ 10,000msec)
[Current No] : The file number which is being written in is indicated.

~ 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. [Sequence]: Sequence Dialog Box

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

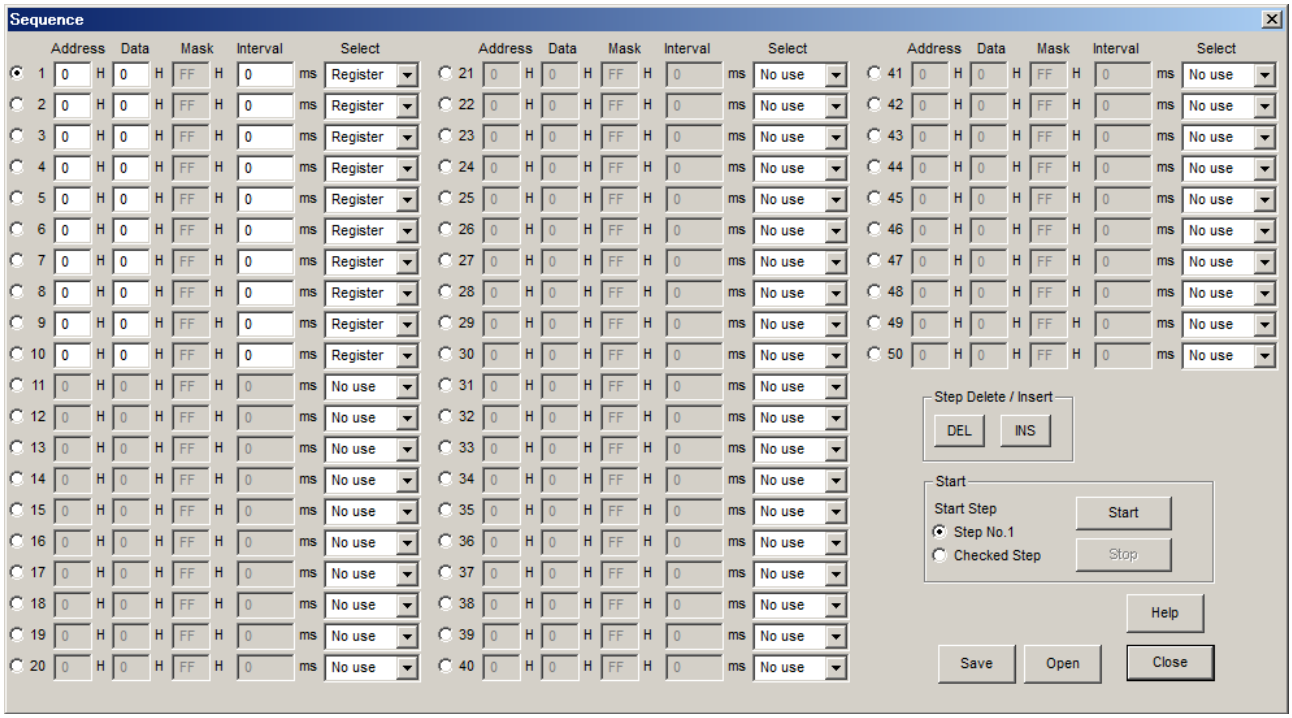


Figure 8. Window of [Sequence]

~ 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.

[DEL]:Step with a check is deleted.
[INS]: Insert the one step that was last deleted step with a check.
[Start Step]: Select Start Step.
No.1 Step: Start from No.1 step.
Checked Step: Start from step with a check.
[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.

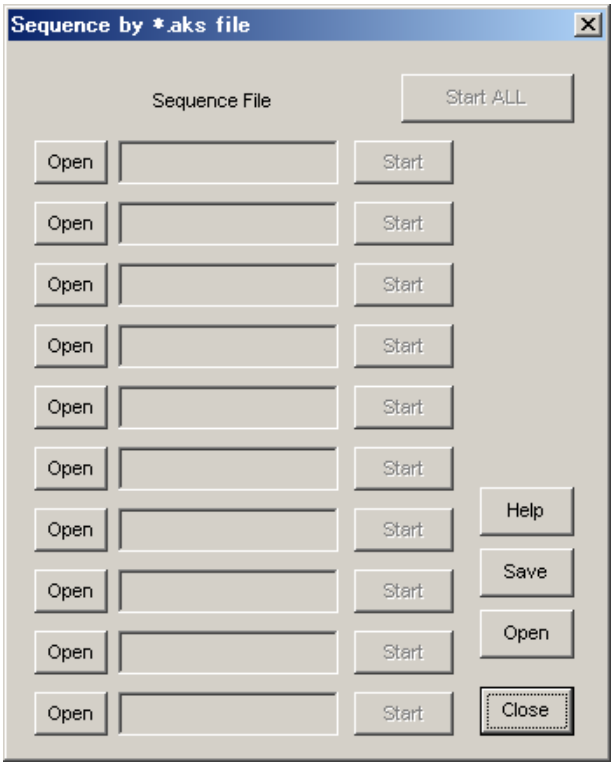


Figure 9. Window of [Sequence(File)]

[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 10. 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
- Bit : 24bit
- Input Frequency : 1kHz
- Power Supply :＋12V, GND
  AVDD=LVDD=3.3V (Regulator)
- Pass : COAX→AK4118A(DIR) → AK4432 → AOUT
- Temperature : Room
- Board Setting : Parallel Mode

[Measurement Results]

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

		Result		Unit
		Lch	Rch	
DAC : SDTI => DAC => L/ROUT				
S/(N+D)	fs = 48kHz (0dBFS, 20kHz LPF)	90.0	89.8	dB
DR	fs = 48kHz (-60dBFS, A-Weighted)	108.0	108.0	dB
S/N	fs = 48kHz (No Inputs, A-Weighted)	108.0	108.0	dB

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

		Result		Unit
		Lch	Rch	
DAC : SDTI => DAC => L/ROUT				
S/(N+D)	fs = 96kHz (0dBFS, 40kHz LPF)	89.7	89.6	dB
DR	fs = 96kHz (-60dBFS, 40kHz LPF)	102.8	102.8	dB
S/N	fs = 96kHz (No Input, 40kHz LPF)	102.8	102.8	dB

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

		Result		Unit
		Lch	Rch	
DAC : SDTI => DAC => L/ROUT				
S/(N+D)	fs = 192kHz (0dBFS, 40kHz LPF)	89.6	89.6	dB
DR	fs = 192kHz (-60dBFS, 40kHz LPF)	102.8	102.8	dB
S/N	fs = 192kHz (No Inputs, 40kHz LPF)	102.8	102.8	dB

[Plot Data]

1. fs=48kHz, MCLK=512fs, BICK=64fs
   DAC : SDTI => DAC => AOUTL/AOUTR

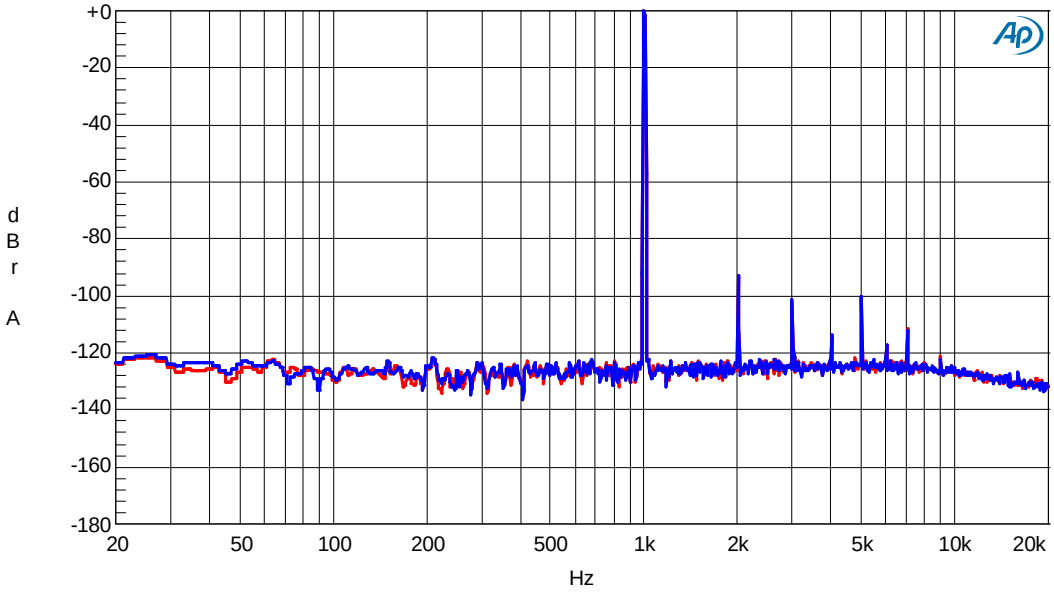


Figure 11. FFT (0dBFS) [fs = 48kHz]

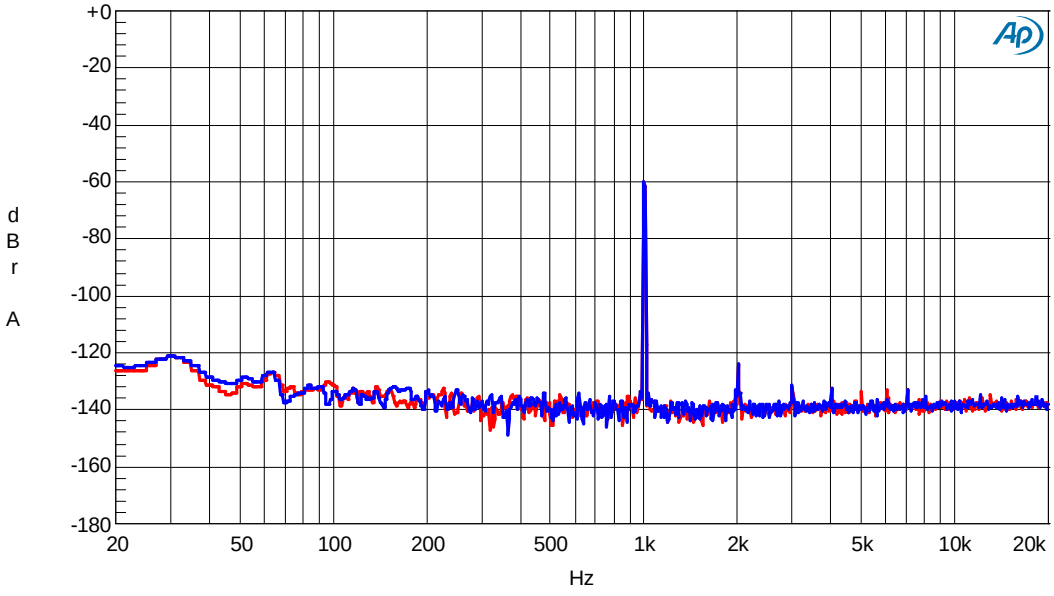


Figure 12. FFT (-60dBFS) [fs = 48kHz]

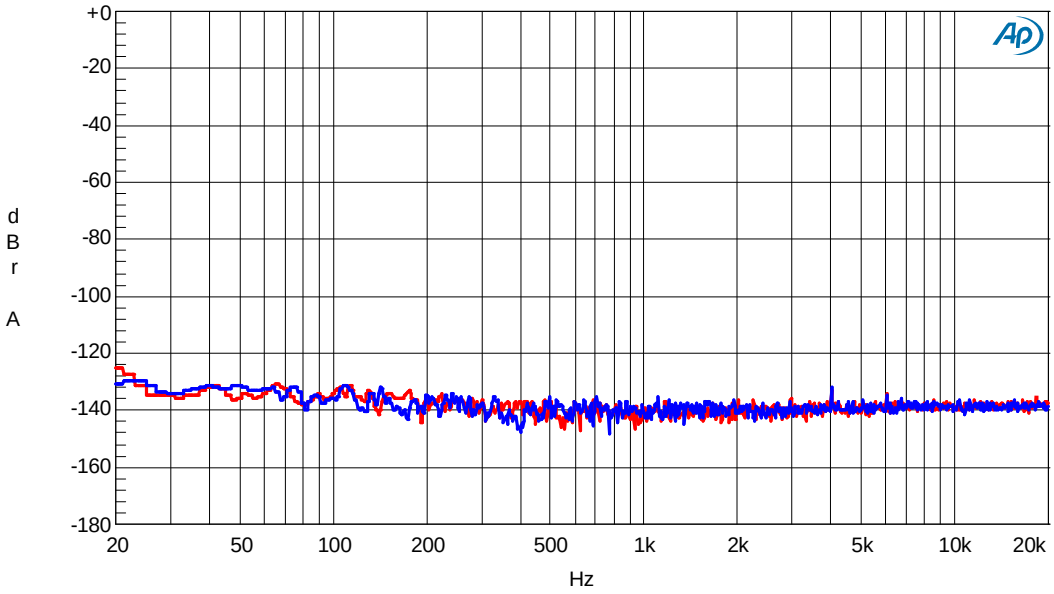


Figure 13. FFT (No Inputs fs=48kHz]

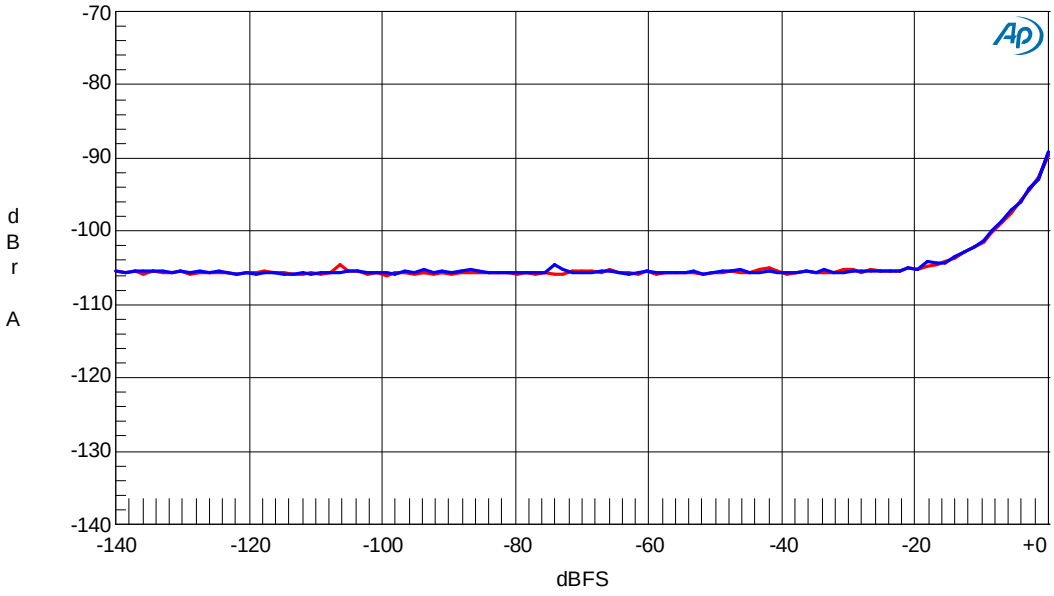


Figure 14. THD+N vs. Amplitude (Input Level) [fs = 48kHz]

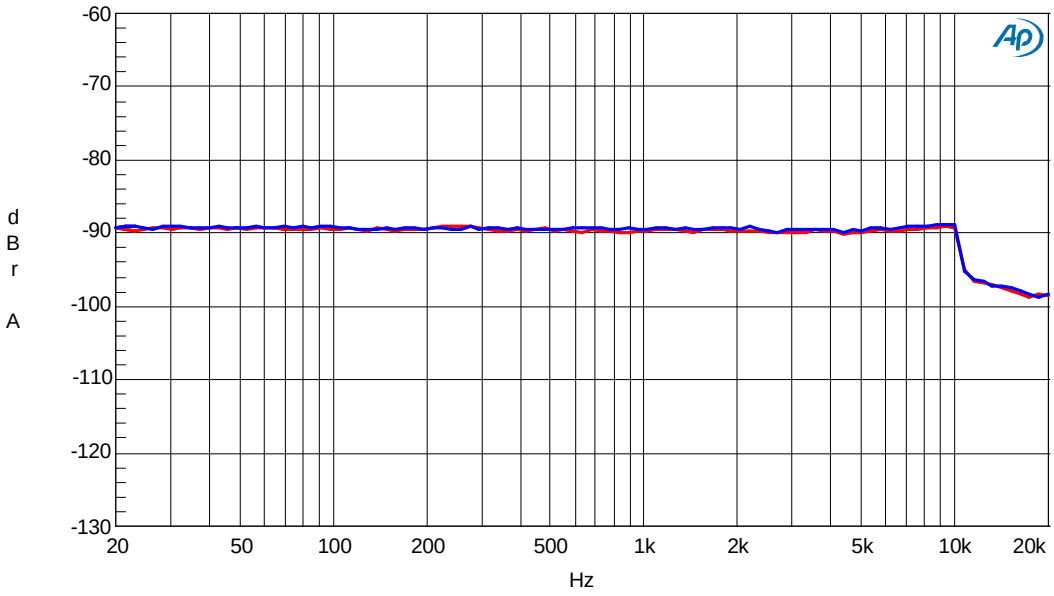


Figure 15. THD+N vs. Input Frequency [fs = 48kHz, 0dBFS Inputs]

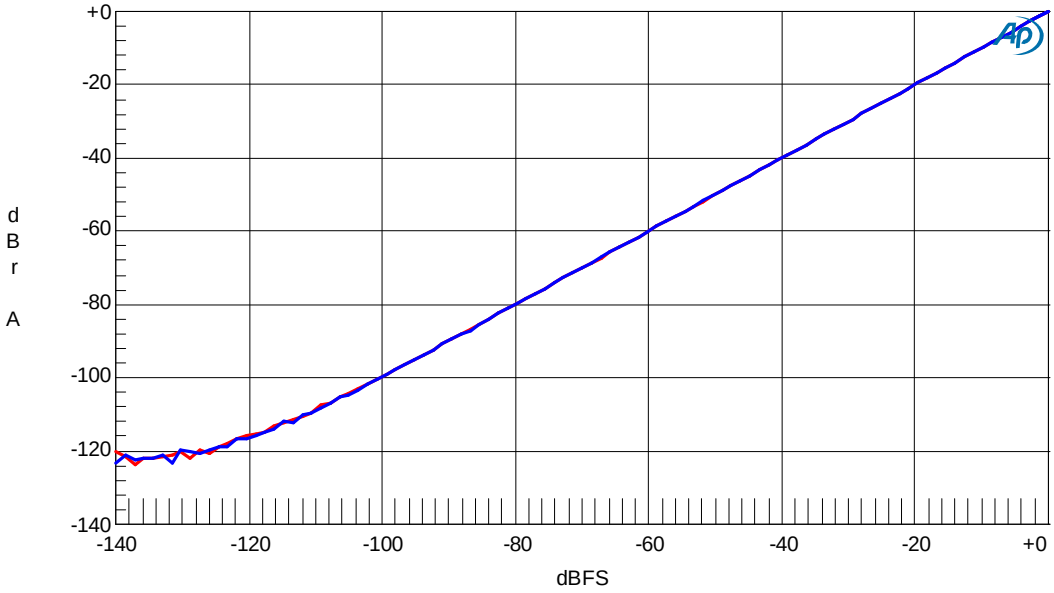


Figure 16. Linearity [fs = 48kHz]

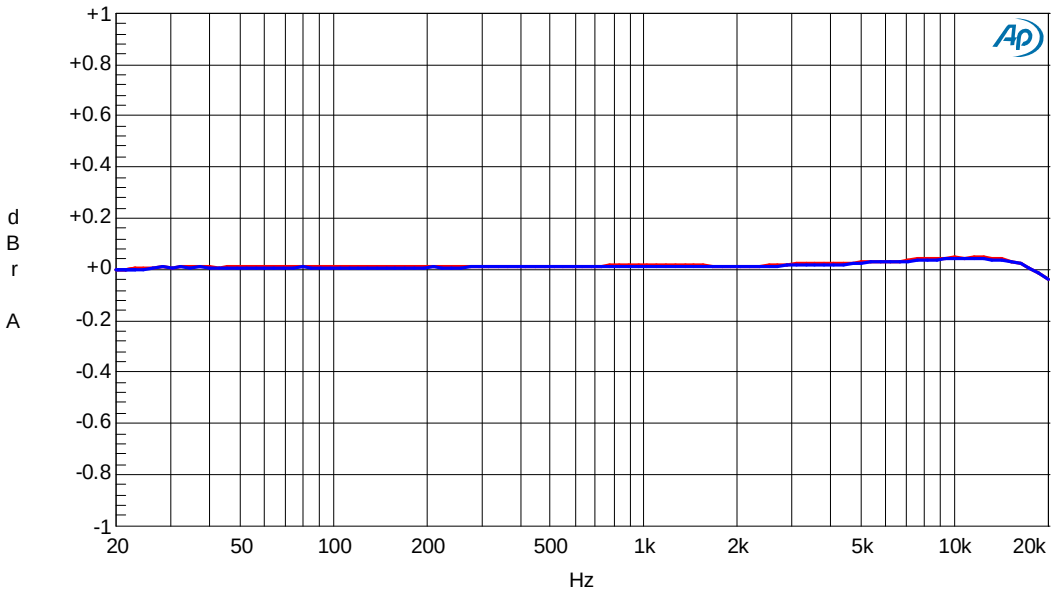


Figure 17. Frequency Response [fs = 48kHz]

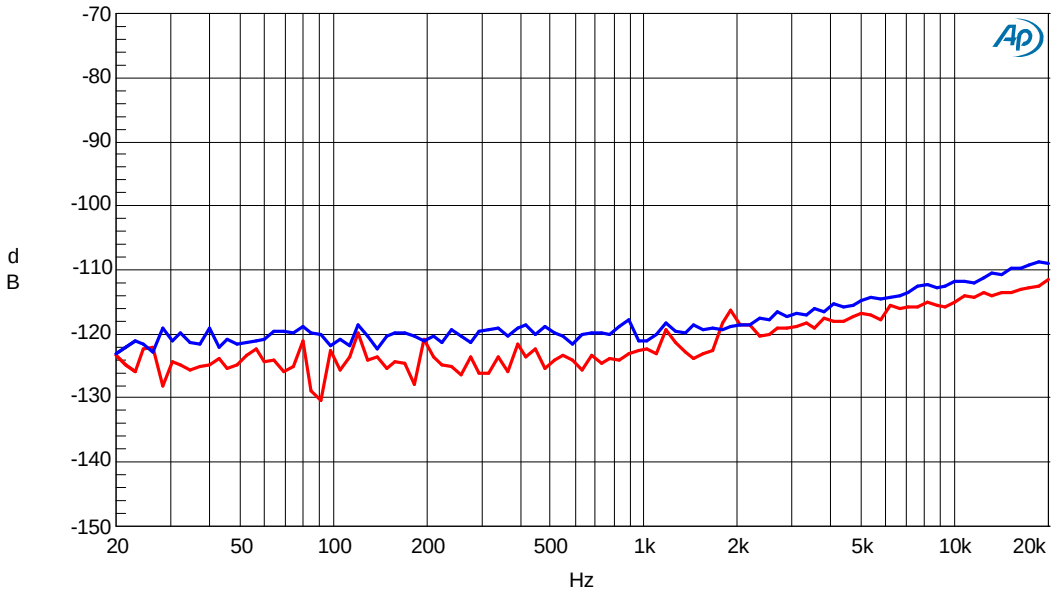


Figure 18. Crosstalk [fs = 48kHz]

[Plot Data]

2. fs=96kHz, MCLK=256fs, BICK=64fs
   DAC : SDTI => DAC => AOUTL/AOUTR

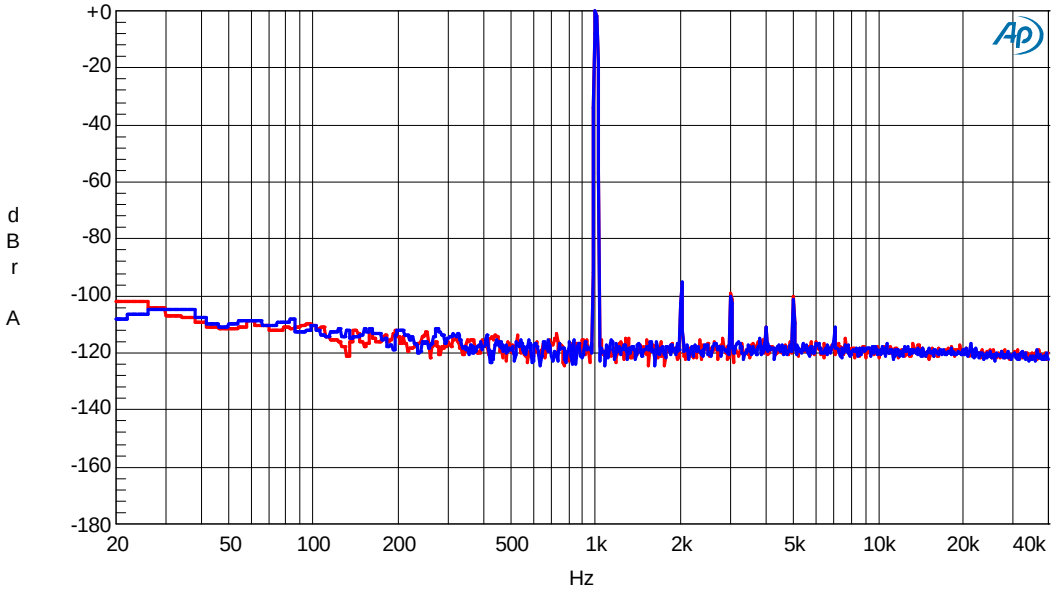


Figure 19. FFT (0dBFS) [fs = 96kHz]

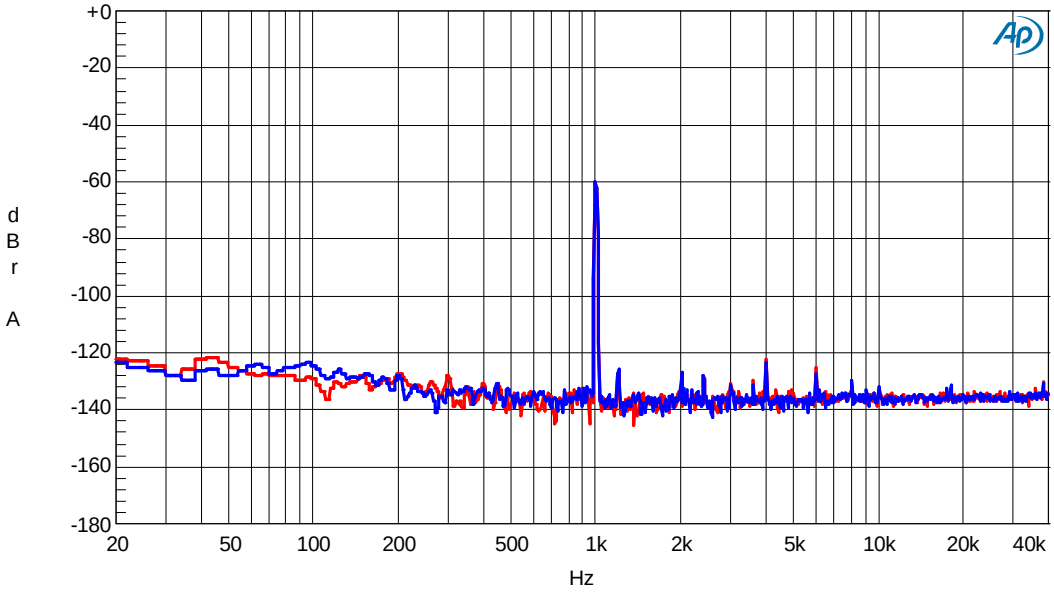


Figure 20. FFT (-60dBFS) [fs = 96kHz]

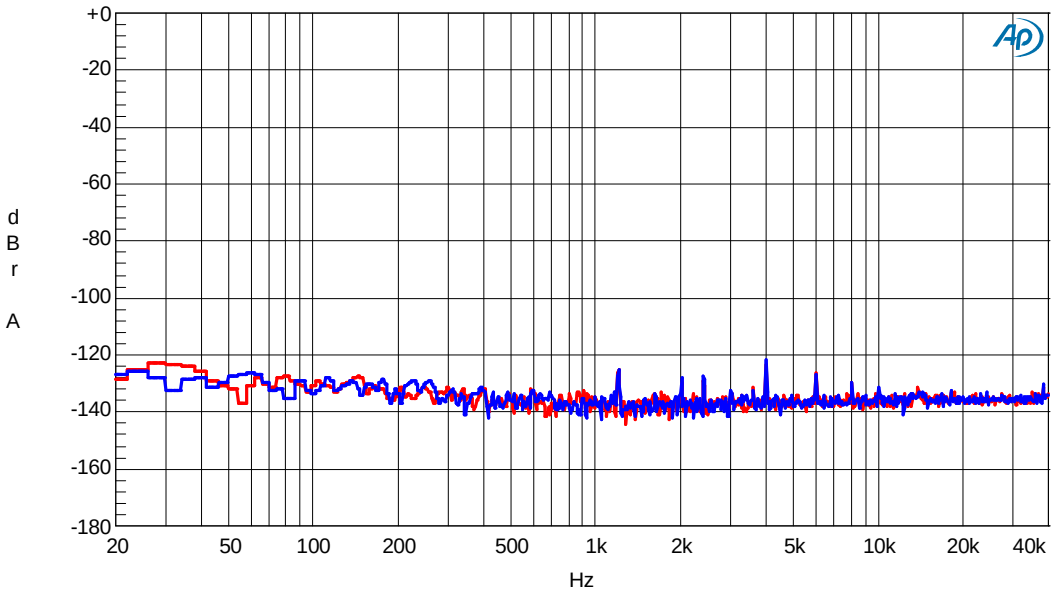


Figure 21. FFT (No Inputs fs=96kHz]

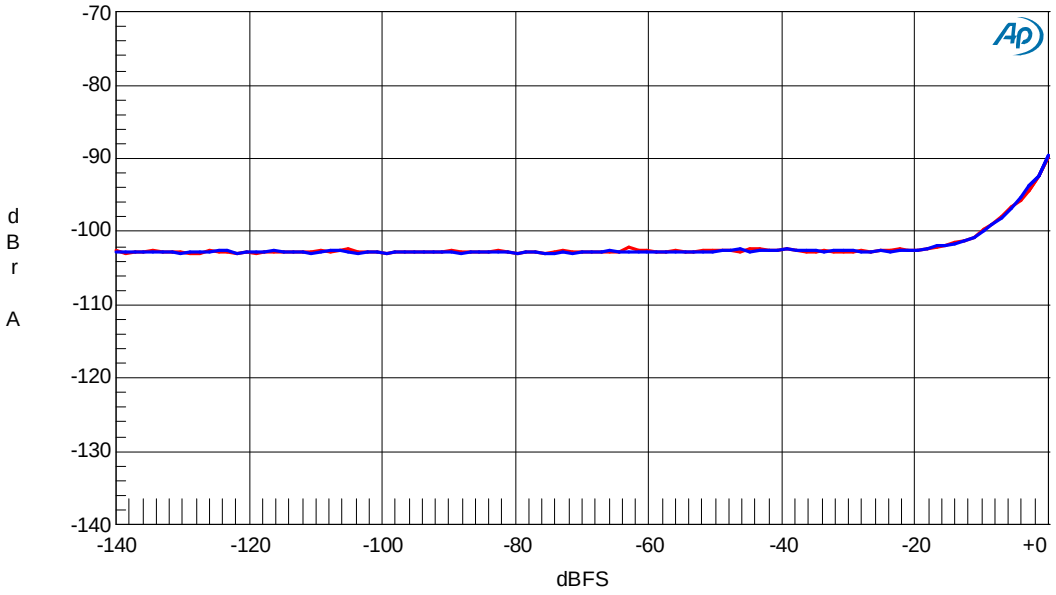


Figure 22. THD+N vs. Amplitude (Input Level) [fs = 96kHz]

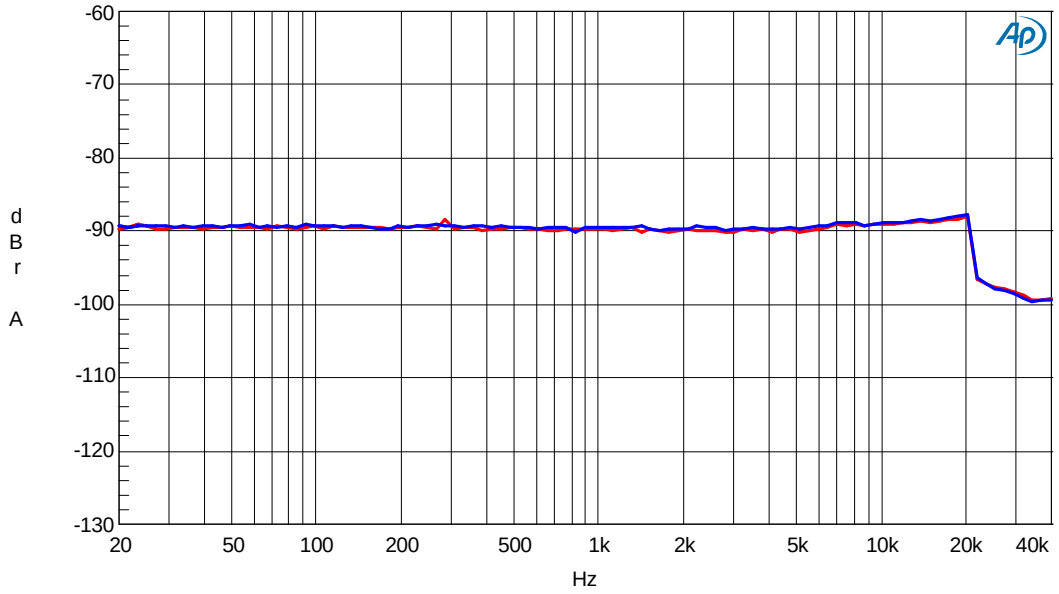


Figure 23. THD+N vs. Input Frequency [fs = 96kHz, 0dBFS Inputs]

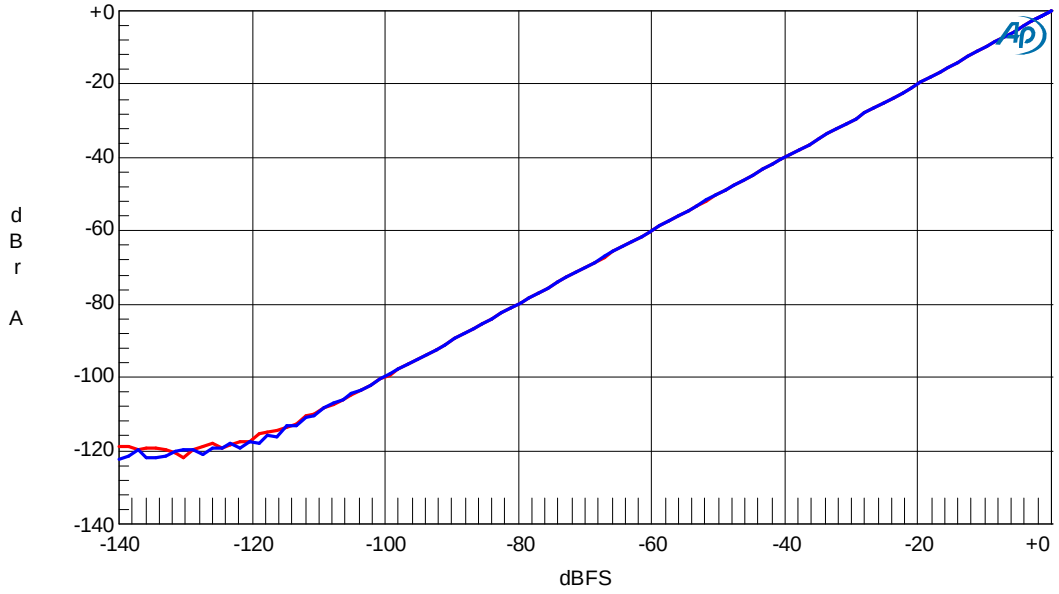


Figure 24. Linearity [fs = 96kHz]

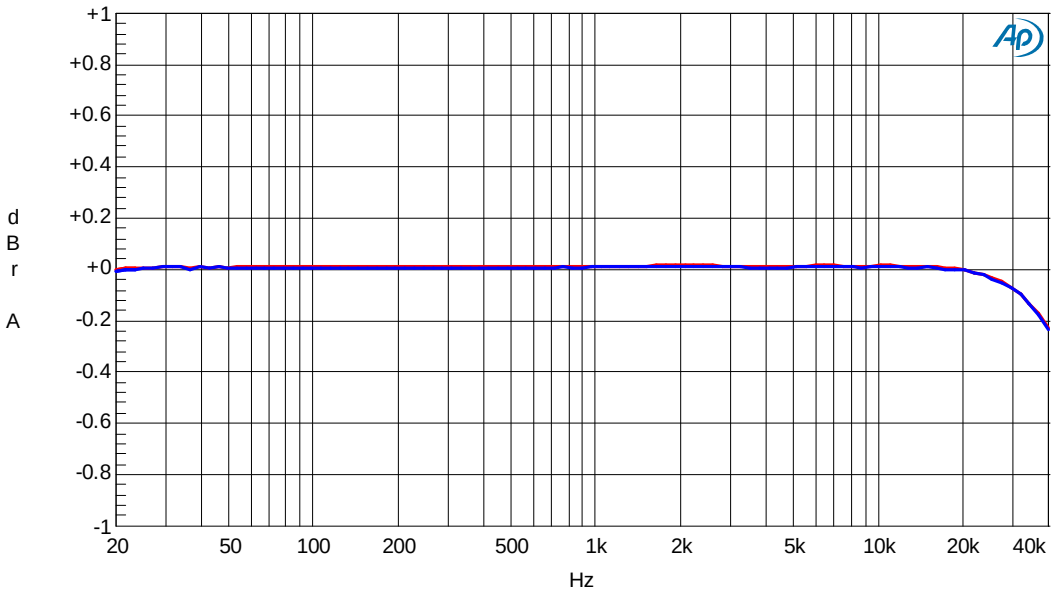


Figure 25. Frequency Response [fs = 96kHz]

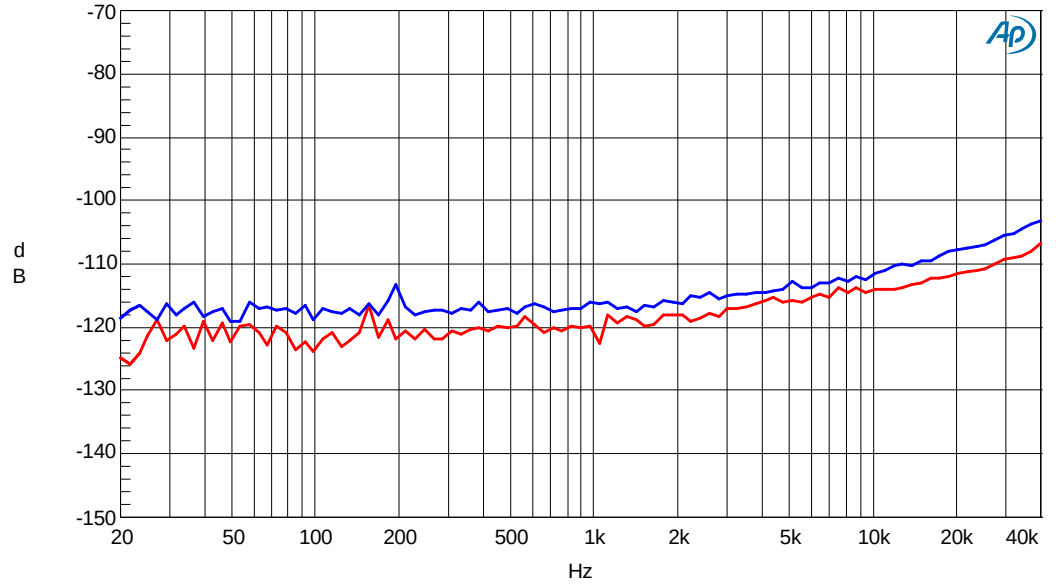
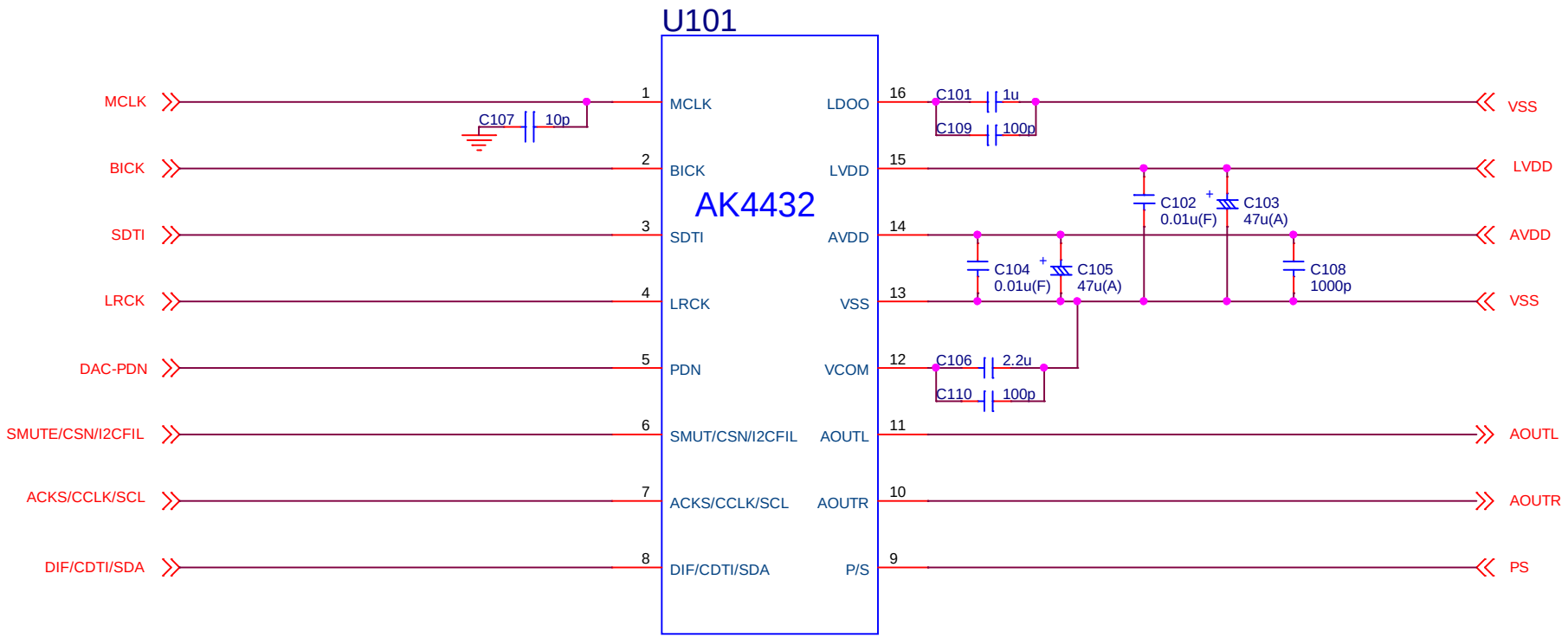


Figure 26. Crosstalk [fs = 96kHz]

REVISION HISTORY

Date (yy/mm/dd)	Manual Revision	Board Revision	Reason	Page	Contents
15/01/09	KM119000	0	First edition		
16/03/23	KM119001	1	Modification		Schematic Changed Add Measurement Results
17/03/15	KM119002	2	Modification		Parts replacement Update Control Soft Update Measurement Results
20/05/18	KM119003	2	Modification		Schematic Changed



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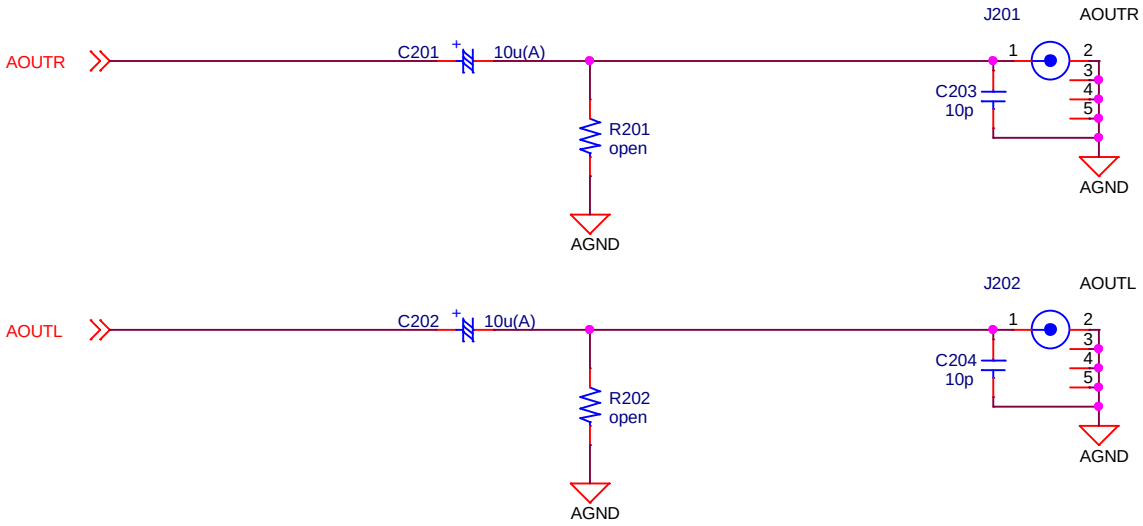

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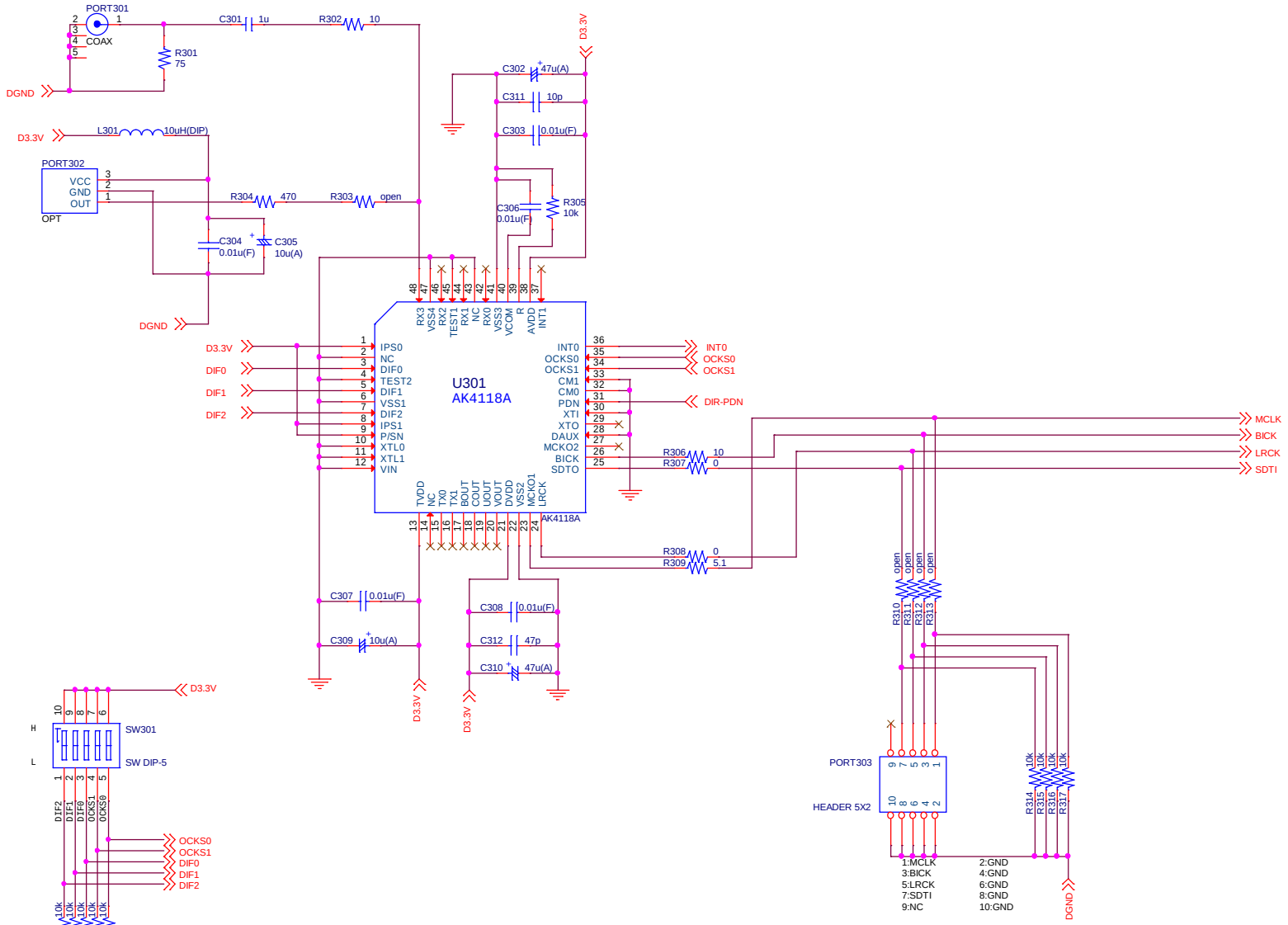

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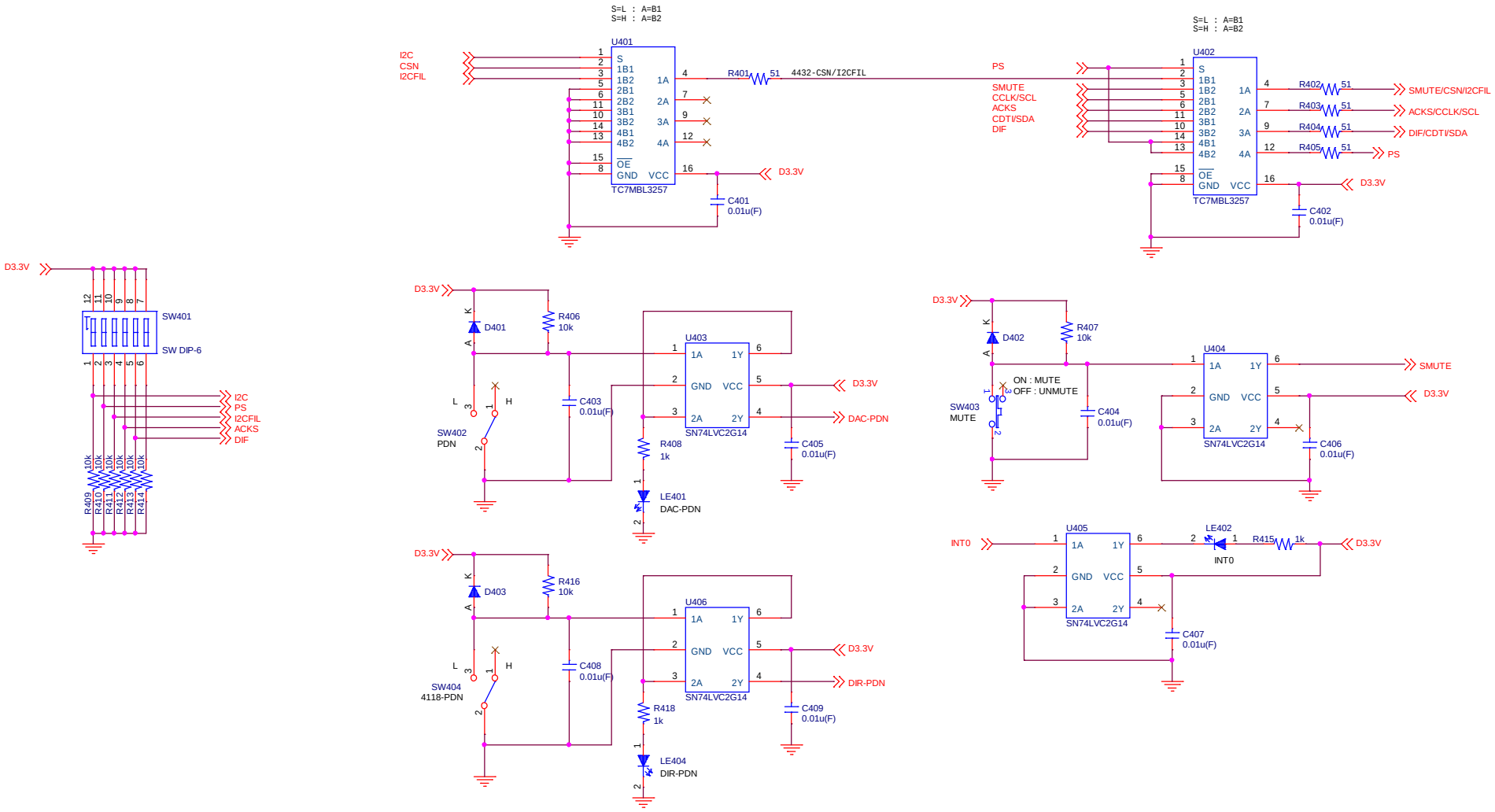

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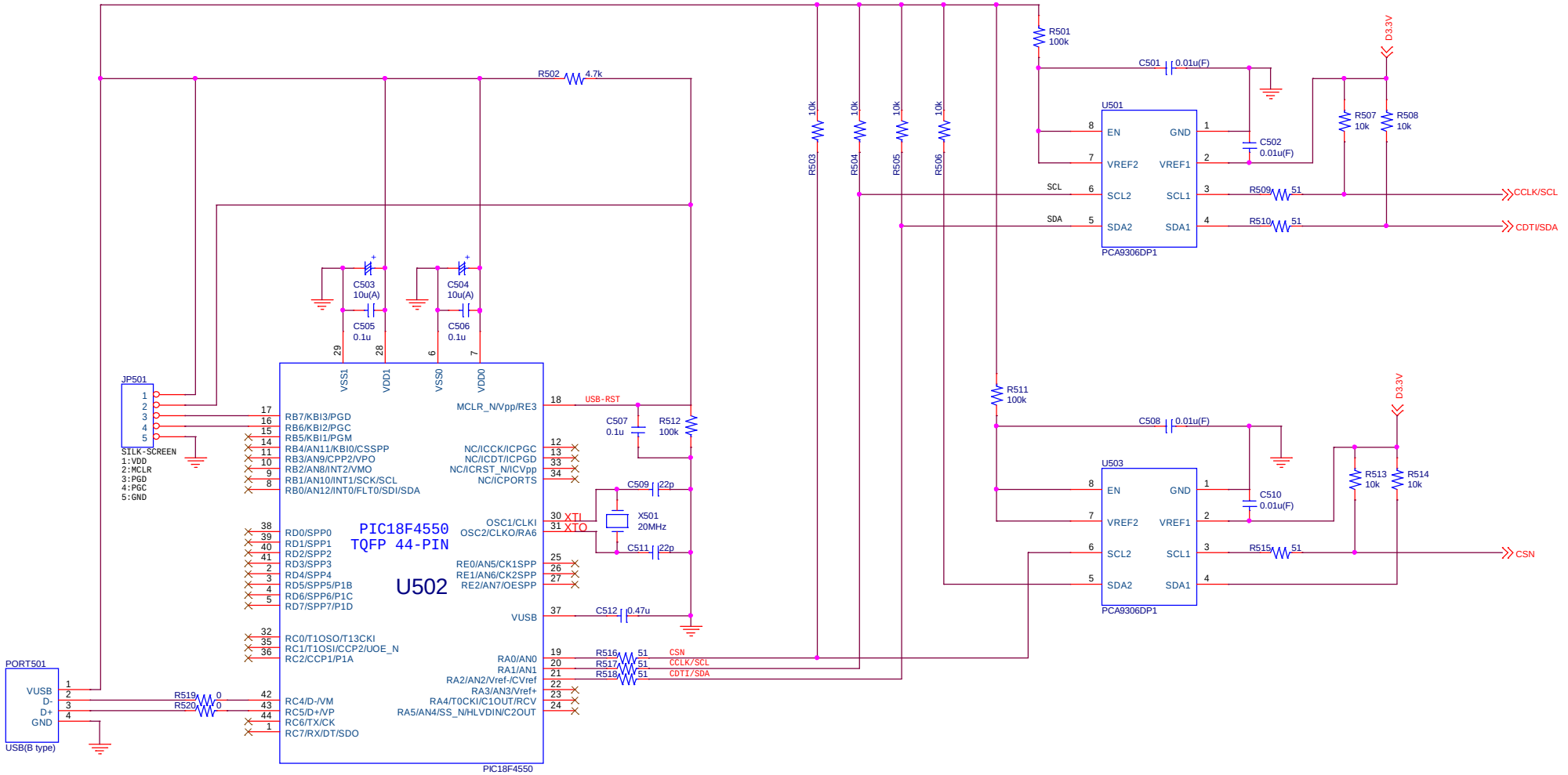

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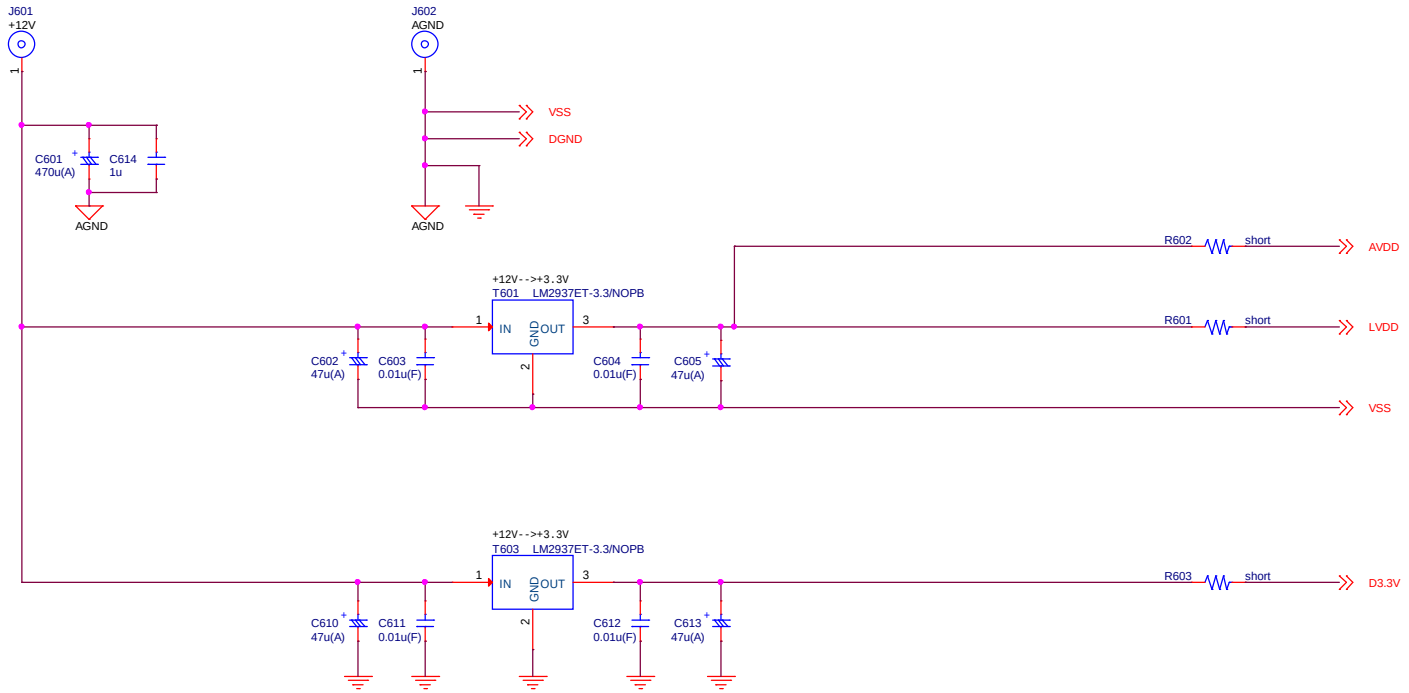

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Size A3	Document Number Power	Rev 2
Date: Monday, June 05, 2017	Sheet 6 of 6	