AKD4456-SA

AK4456 Sound Quality Evaluation Board Rev.1

GENERAL DESCRIPTION

The AKD4456-SA is an evaluation board for the AK4456 (32-bit 6ch DAC) that supports AV-Receiver, DVD-Audios, Car-Audio Systems. It integrates differential output low pass filters, allowing quick evaluation with digital audio interface.

■ Ordering guide

AKD4456-SA --- Evaluation board for AK4456
（Control software is packed with this board）

FUNCTION

- ☐ **3 type digital audio interface**
  - **- Optical input**
  - **- COAX input**
  - **- External input**
- ☐ **Low Pass Filters (LPF) for Pre-amplifier Outputs**
- ☐ **6ch Analog outputs**
- ☐ **USB Port for Serial control**

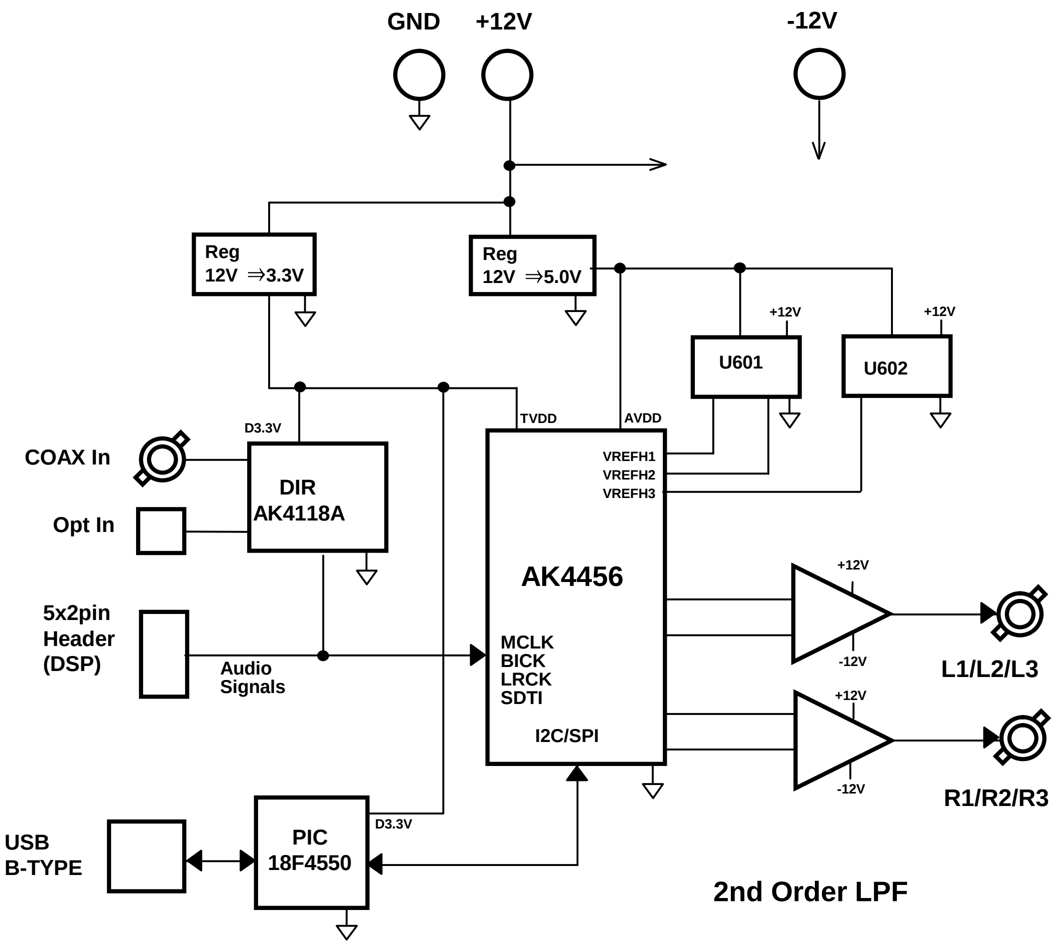


Figure 1.AKD4456-SA Block Diagram

Board Diagram

■ Board Diagram

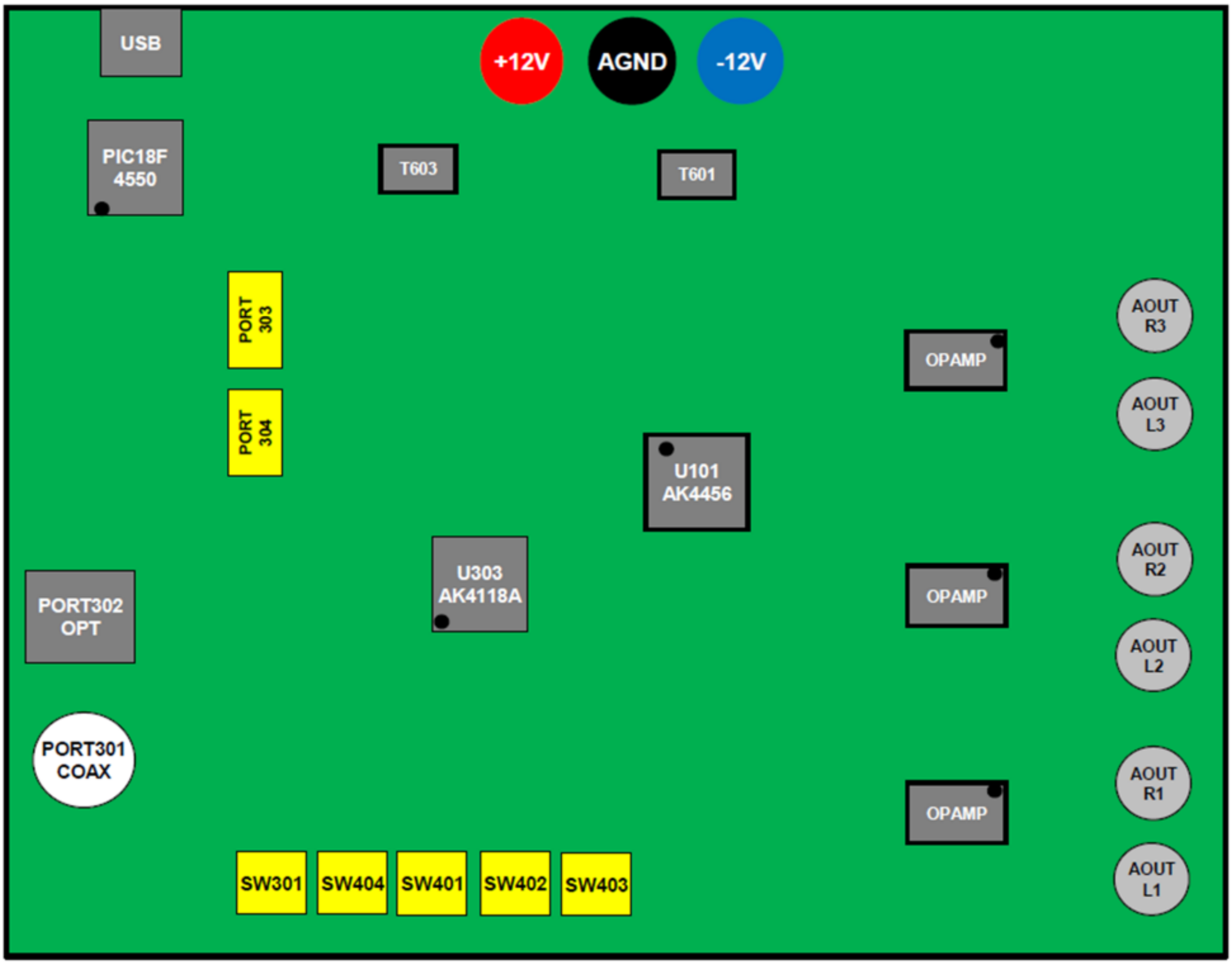


Figure 2.AKD4456-SA Board Diagram

■ **Description**

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

(2) AOUTL1~AOUTL3、AOUTR1~AOUTR3
RCA Jack for analog outputs.

(3) COAX、OPT
Input SPDIF signal to AK4118A.
When using the COAX：R305=0Ω、R306=Open (Default)
When using the OPT：R305=Open、R306=0Ω

(4) AK4118A
AK4118A outputs digital data to AK4456 as DIR.

(5) PORT303
External digital data inputs to AK4456.
MCLK、BICK/DLCLK、LRCK/DSDL1、SDTI1/DSDR1、SDTI2/DSDL2
When using the PORT303：R328=R329=R330=R331=R332=51Ω
R316=R317=320=R321=R349=Open

When using the AK4118A：R328=R329=R330=R331=R332=Open (Default)
R316=R317=320=R321=R349=51Ω (Default)

(6) PORT304
External digital data inputs to AK4456.
SDTI3/DSDR2、SDTI4/DSDL3、DSDR3、DSDL4、DSDR4
When using the PORT304： R326=R327=51Ω
R350=R351=Open
When using the AK4118A：R326=R327=Open (Default)
R350=R351=51Ω (Default)

(7) USB
USB Port. It is possible to set up the registers of AK4456 from PC via the USB port.

(8) PIC18F4550
USB control IC

(9) SW301
Setting switch for AK4118A.Upside is “Hi”, downside is “Lo”.
Refer to Table2.SW301 setting.

(10) SW401
Setting switch for AK4456.Upside is “Hi”, downside is “Lo”
Refer to Table5.SW401 setting.

(11) SW402
Power down switch for AK4456.Upside is “Hi (on)”, downside is “Lo (off)”

(12) SW403
Mute switch for AK4456.
Push ：AK4456 is mute
Release：AK4456 is unmute

(13) 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 ・OP Amp	Should always be connected.
-12V	Blue	-12V	・OP-Amp	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^{2}S	24bit, I^{2}S	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^{2}S	24bit, I^{2}S	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 AK4456 H：I2C mode L：SPI mode	Hi
2	PS	PS pin of AK4456 H：Parallel mode L：Serial mode	Lo
3	DCHAIN	DCHAIN pin of AK4456（Parallel mode only） H：DCHAIN mode L：Normal mode	Lo
4	TDM0	TDM0 pin of AK4456（Parallel mode only）	Lo
5	TDM1	TDM1 pin of AK4456（Parallel mode only）	Lo
6	DIF	DIF pin of AK4456（Parallel mode only） H：32bit I2S compatible L：32bit LSB justified	Lo
7	CAD0-I2C	CAD0 pin of AK4456（I2C mode only）	Lo
8	CAD0-SPI	CAD0 pin of AK4456（SPI mode only）	Lo
9	CAD1	CAD1 pin of AK4456（Serial mode only）	Lo

Table 5.SW401 setting

(3) SW402/SW403/SW404 setting

SW402	AK4456-PDN	Power down switch for AK4456 Hi：Power up Lo：Power down ※Should be “Hi” during operation AK4456.
SW403	MUTE	Mute switch for AK4456（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 AK4456 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 up the evaluation board as needed, according to the previous terms.
2. Connect the evaluation board to a PC with USB cable.
3. The USB control 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 “AKDUSBIF-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

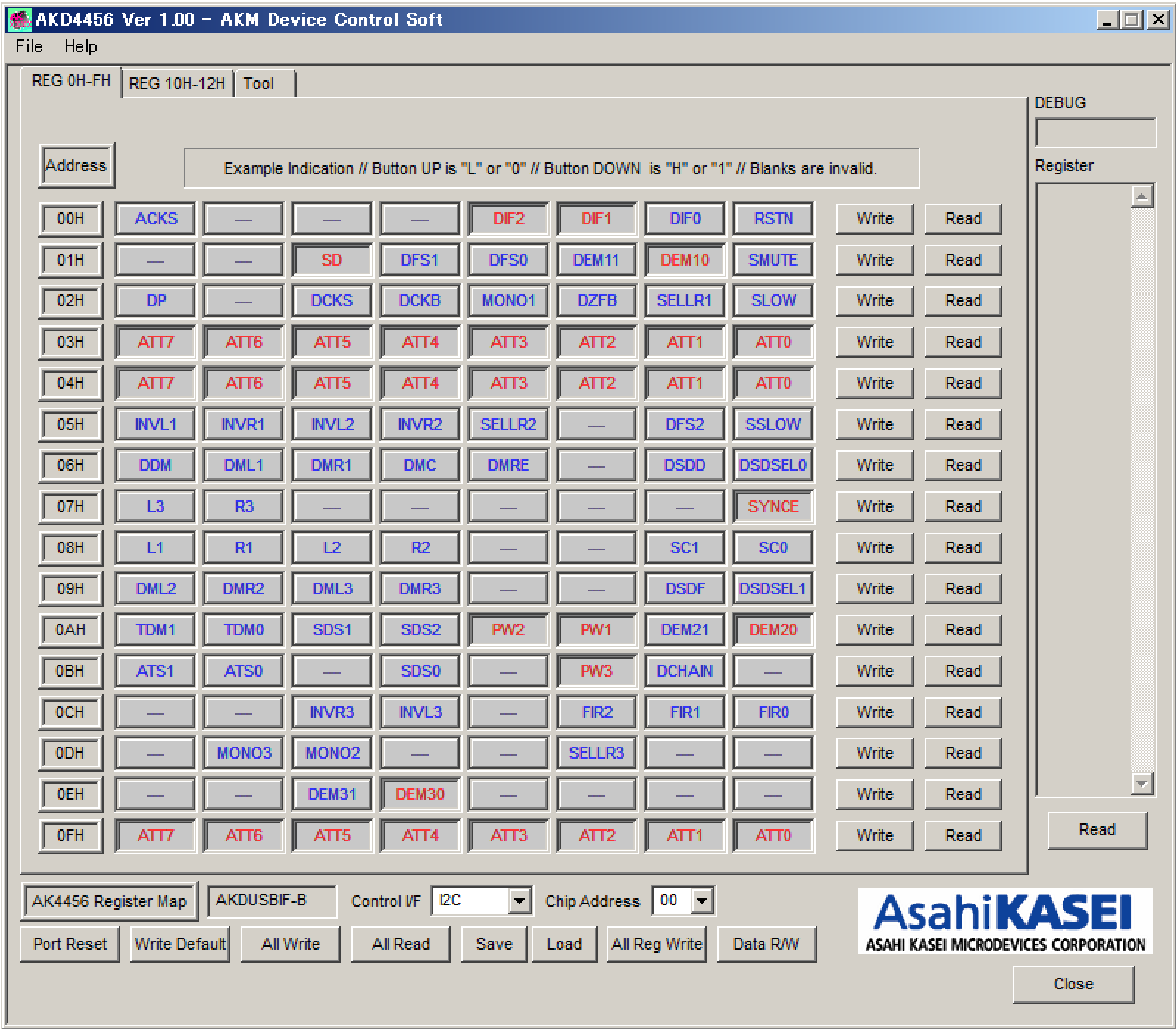


Figure3.Control Software Window

■ 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 "---".

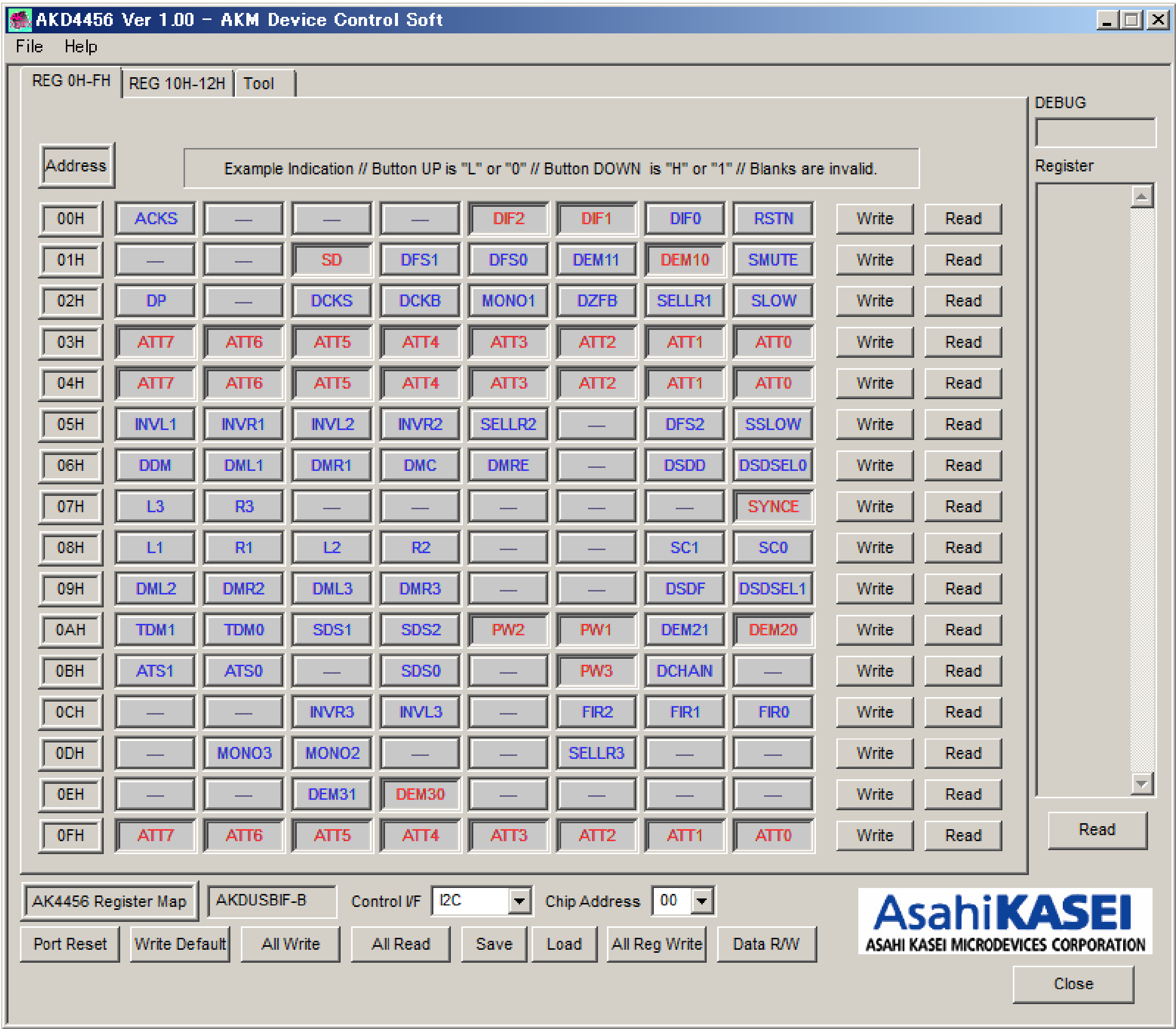


Figure4.Window of [REG]

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.

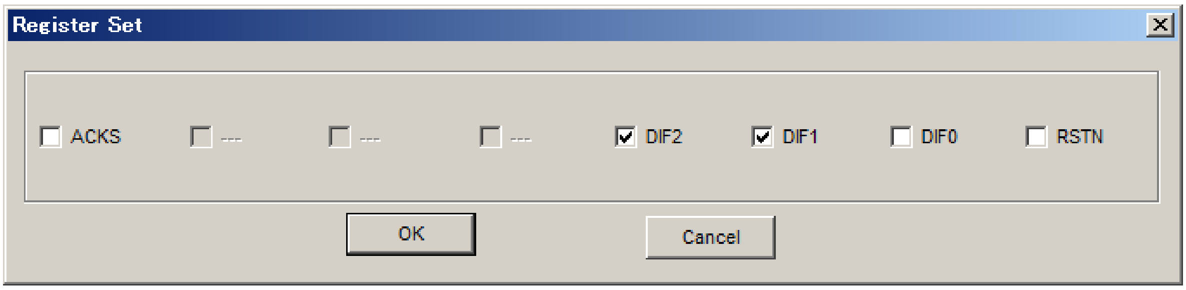


Figure5.Window of [Register Set]

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.

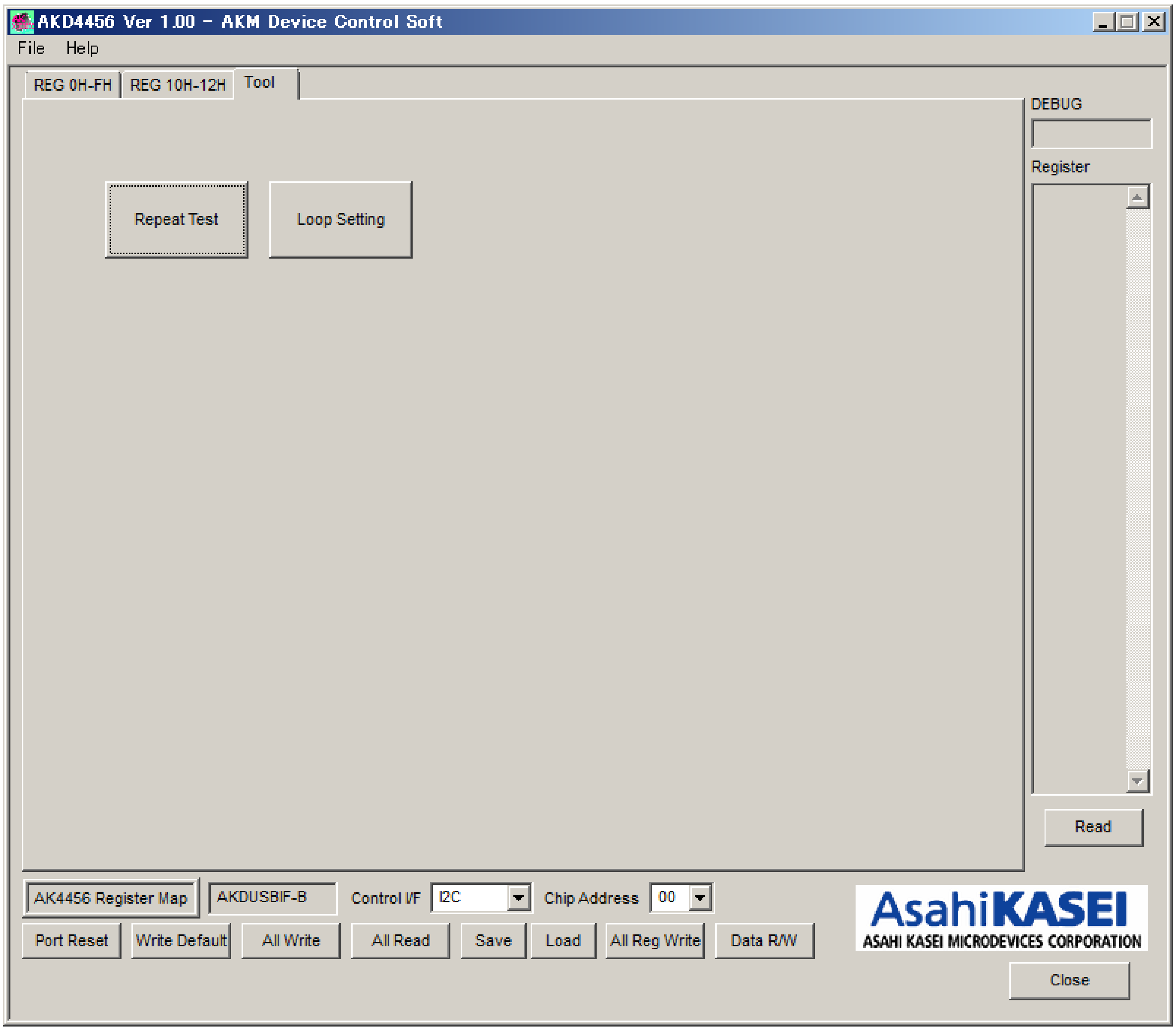


Figure 6.Window of [Tool]

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.

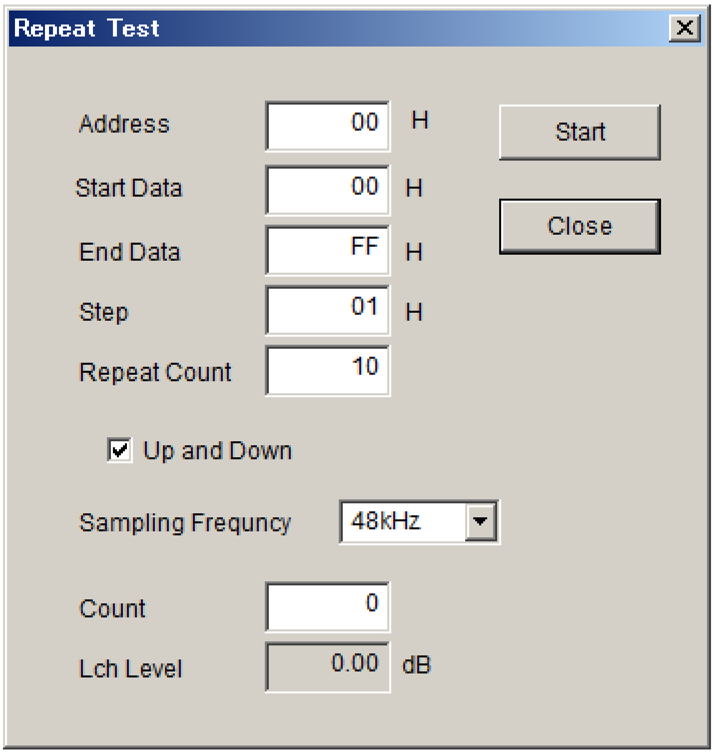


Figure 7.Window of [Repeat Test]

[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.

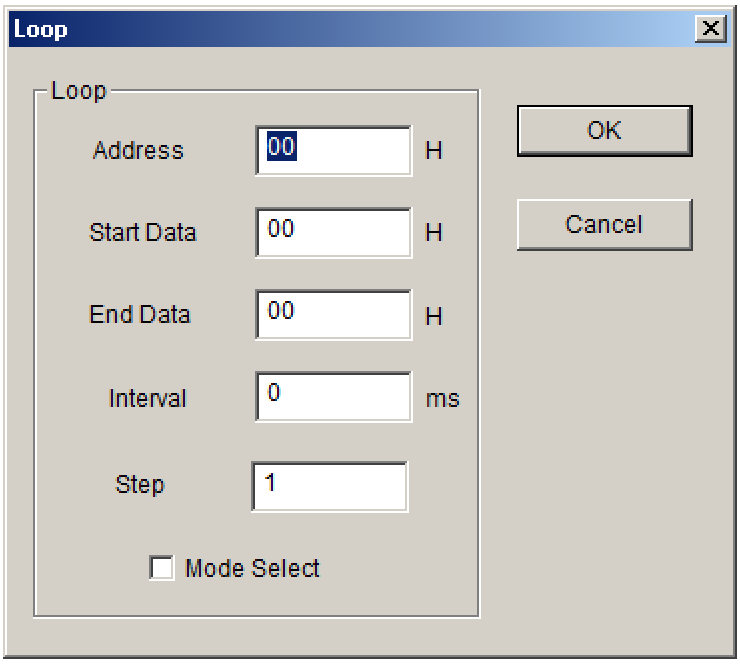


Figure 8.Window of [Loop]

[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.

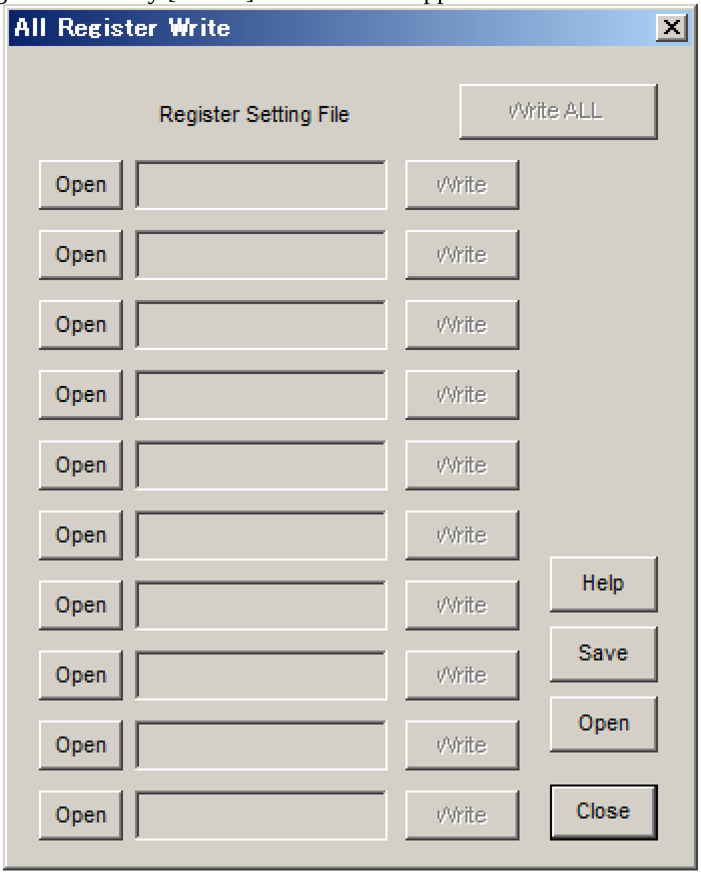


Figure9.Window of [All Reg Write]

[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.

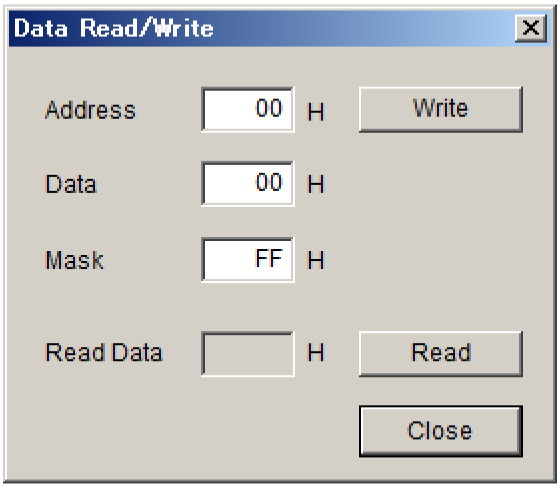


Figure 10. Window of [Data R/W]

[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]: Writs 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.

Measurement Results

- Measurement unit : Audio Precision, SYS-2722 (No.00103)
- MCKI : 512fs 、256fs、128fs
- BICK : 64fs
- fs : 44.1kHz、96kHz、192kHz
- Bit : 24bit
- Input Frequency : 1kHz
- Power Supply : ±12V, GND
  AVDD=VREHH=5.0V (Regulator)、TVDD=3.3V (Regulator)
- Pass : COAX→AK4118A(DIR) → AK4456 → AOUTL/R
- Temperature : Room
- Board Setting : Parallel Mode
- External OP-AMP : NJM2043D

[Measurement Results]

1. fs=44.1kHz, MCLK=512fs, BICK=64fs

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 44.1kHz (0dBFS)	106.9	106.7	dB
DR	fs = 44.1kHz (-60dBFS, A-Weighted)	114.5	114.5	dB
S/N	fs = 44.1kHz (No Inputs, A-weighted)	114.6	114.8	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 44.1kHz (0dBFS)	104.7	105.0	dB
DR	fs = 44.1kHz (-60dBFS, A-Weighted)	114.7	114.9	dB
S/N	fs = 44.1kHz (No Inputs, A-weighted)	114.8	114.8	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 44.1kHz (0dBFS)	105.2	105.3	dB
DR	fs = 44.1kHz (-60dBFS, A-Weighted)	114.7	114.8	dB
S/N	fs = 44.1kHz (No Inputs, A-weighted)	114.8	114.7	dB

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

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 96kHz (0dBFS)	104.0	103.9	dB
DR	fs = 96kHz (-60dBFS, A-Weighted)	114.2	114.7	dB
S/N	fs = 96kHz (No Inputs, A-weighted)	114.3	114.7	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 96kHz (0dBFS)	103.0	102.4	dB
DR	fs = 96kHz (-60dBFS, A-Weighted)	114.6	114.7	dB
S/N	fs = 96kHz (No Inputs, A-weighted)	114.8	114.7	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 96kHz (0dBFS)	102.3	102.4	dB
DR	fs = 96kHz (-60dBFS, A-Weighted)	114.7	114.4	dB
S/N	fs = 96kHz (No Inputs, A-weighted)	114.6	114.5	dB

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

		Result		Unit
		Lch	Rch	
DAC1 : SDTI1 => DAC1 => L/ROUT1				
S/(N+D)	fs = 192kHz (0dBFS)	104.6	104.3	dB
DR	fs = 192kHz (-60dBFS, A-Weighted)	114.5	114.5	dB
S/N	fs = 192kHz (No Inputs, A-weighted)	114.6	114.8	dB
DAC2 : SDTI2 => DAC2 => L/ROUT2				
S/(N+D)	fs = 192kHz (0dBFS)	102.2	102.3	dB
DR	fs = 192kHz (-60dBFS, A-Weighted)	114.5	114.6	dB
S/N	fs = 192kHz (No Inputs, A-weighted)	114.7	114.7	dB
DAC3 : SDTI3 => DAC3 => L/ROUT3				
S/(N+D)	fs = 192kHz (0dBFS)	102.7	102.9	dB
DR	fs = 192kHz (-60dBFS, A-Weighted)	114.5	114.5	dB
S/N	fs = 192kHz (No Inputs, A-weighted)	114.7	114.7	dB

[Plot Data]

1. fs=44.1kHz, MCLK=512fs, BICK=64fs
   DAC1 : SDTI1 => DAC1 => L/ROUT1

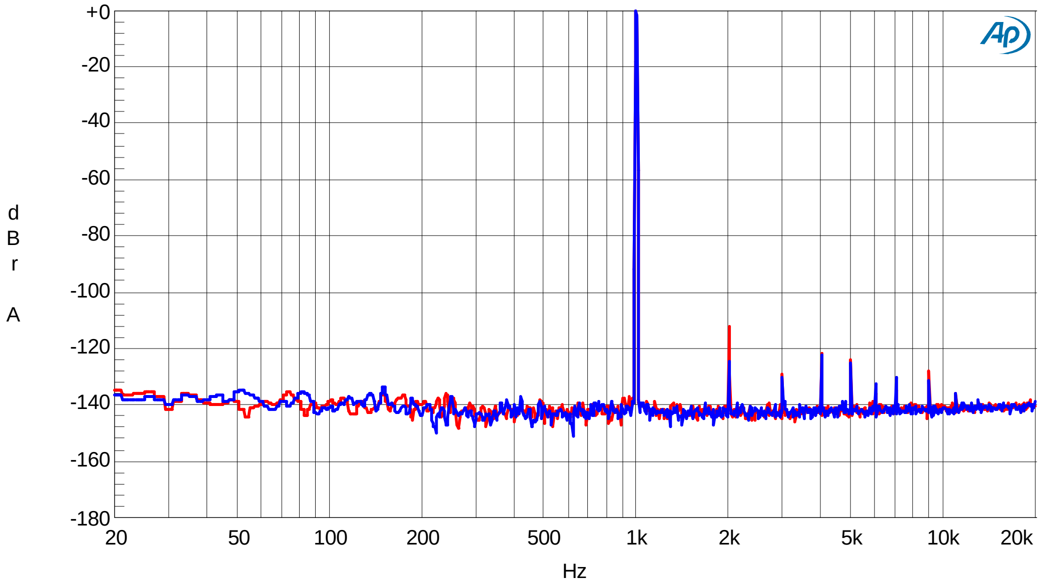


Figure 11.FFT (0dBFS) [fs = 44.1kHz]

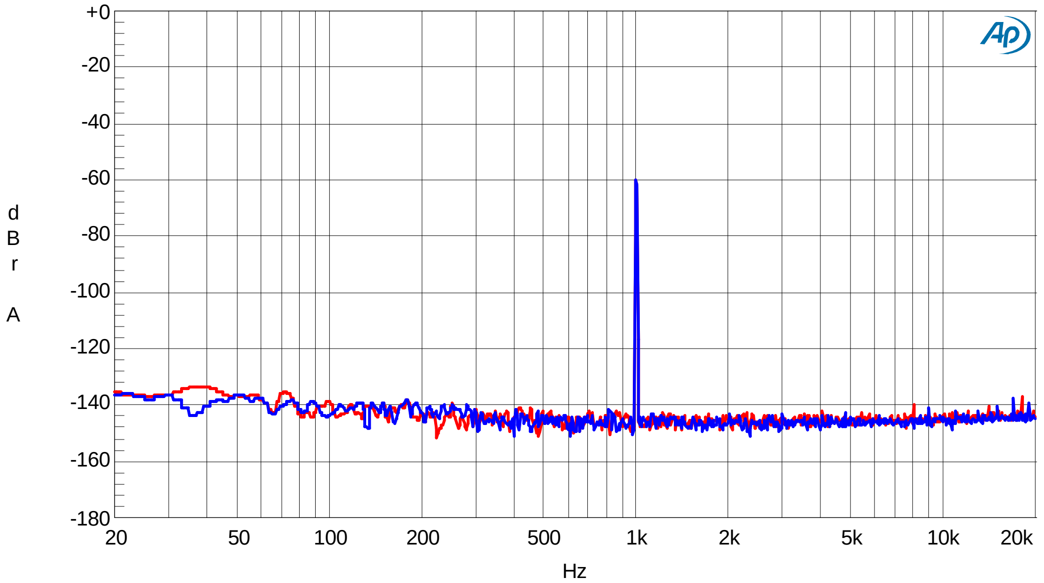


Figure 12.FFT (-60dBFS) [fs = 44.1kHz]

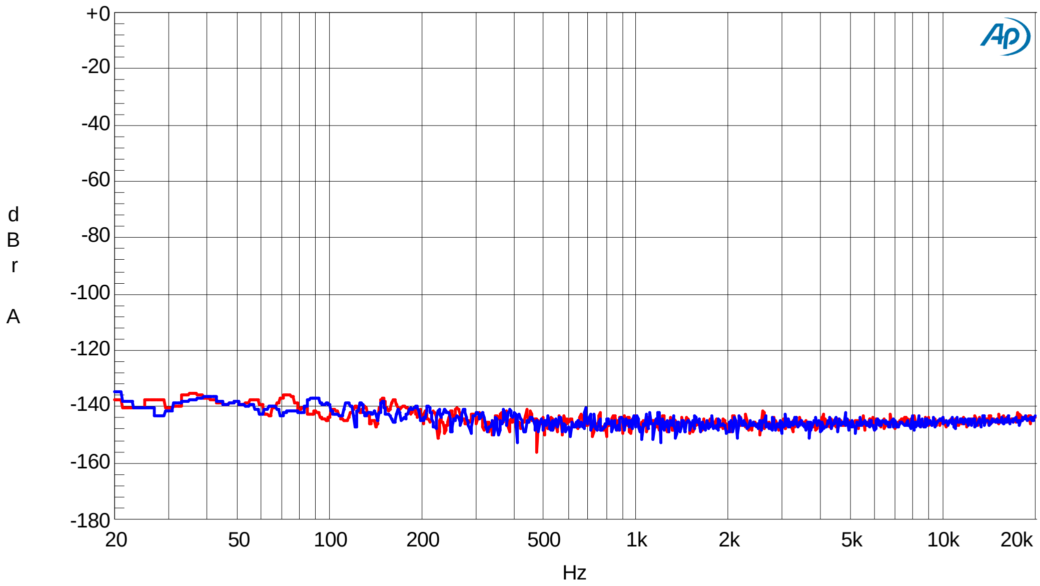


Figure 13.FFT (No Inputs fs=44.1kHz]

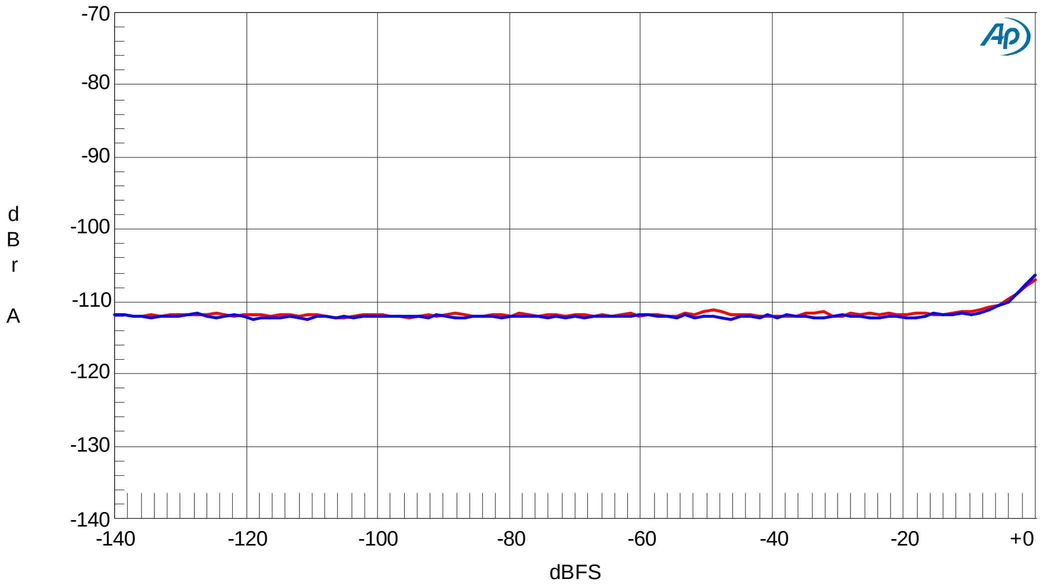


Figure 14.THD+N vs. Amplitude (Input Level) [fs = 44.1kHz]

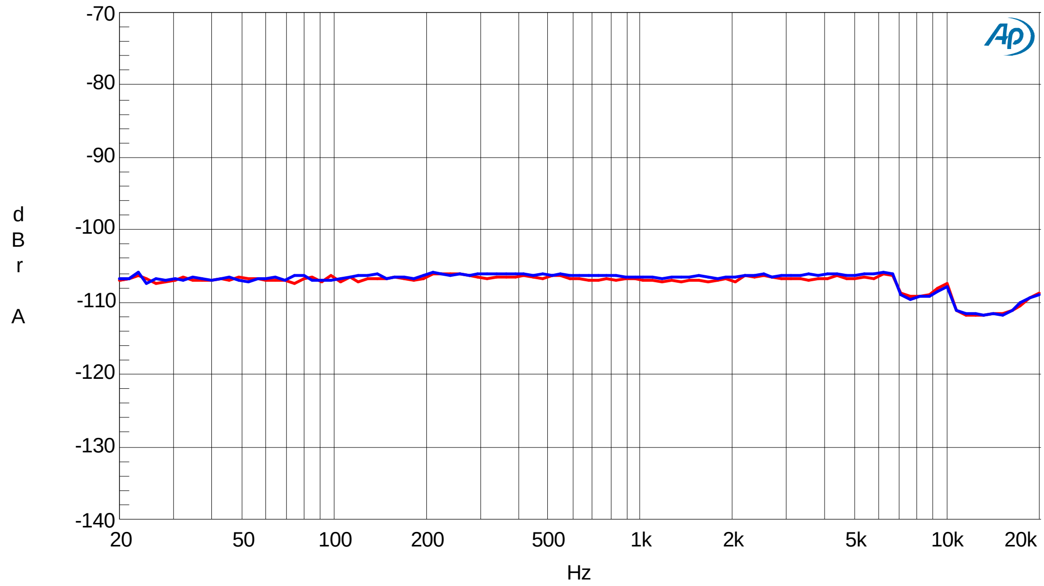


Figure 15.THD+N vs. Input Frequency [fs = 44.1kHz, 0dBFS Inputs]

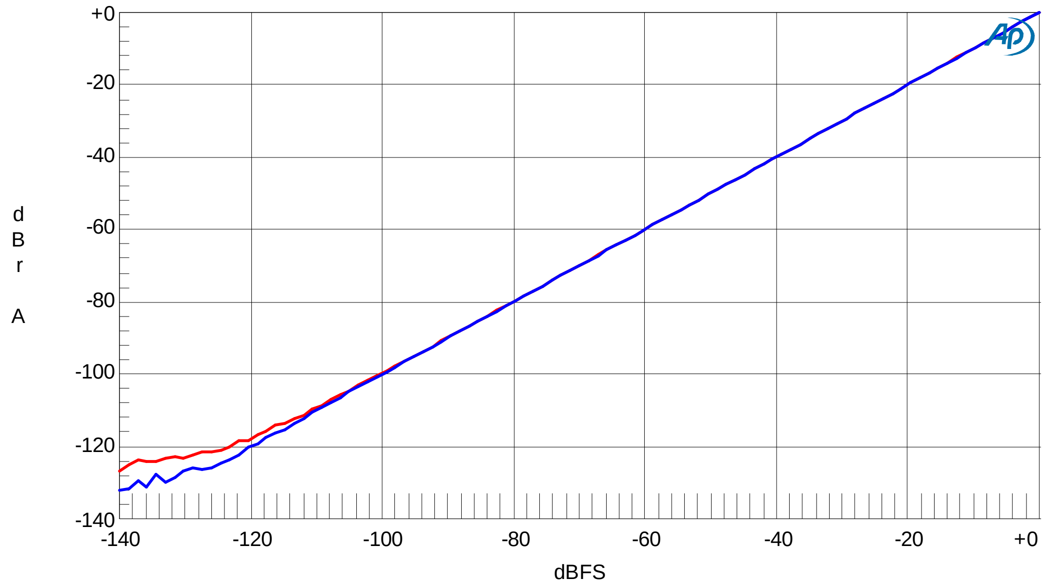


Figure 16.Linearity [fs = 44.1kHz]

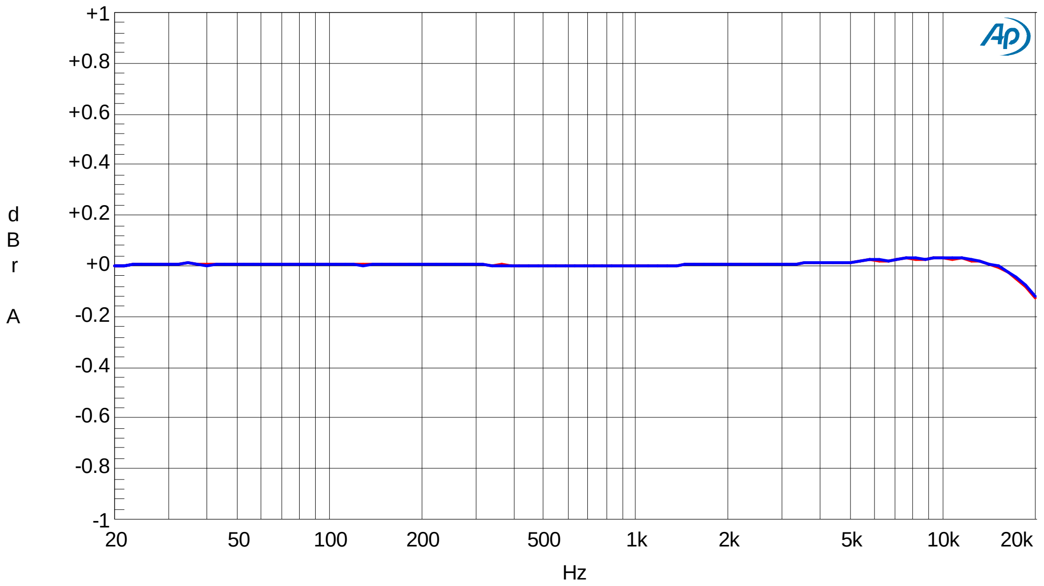


Figure 17.Frequency Response [fs = 44.1kHz]

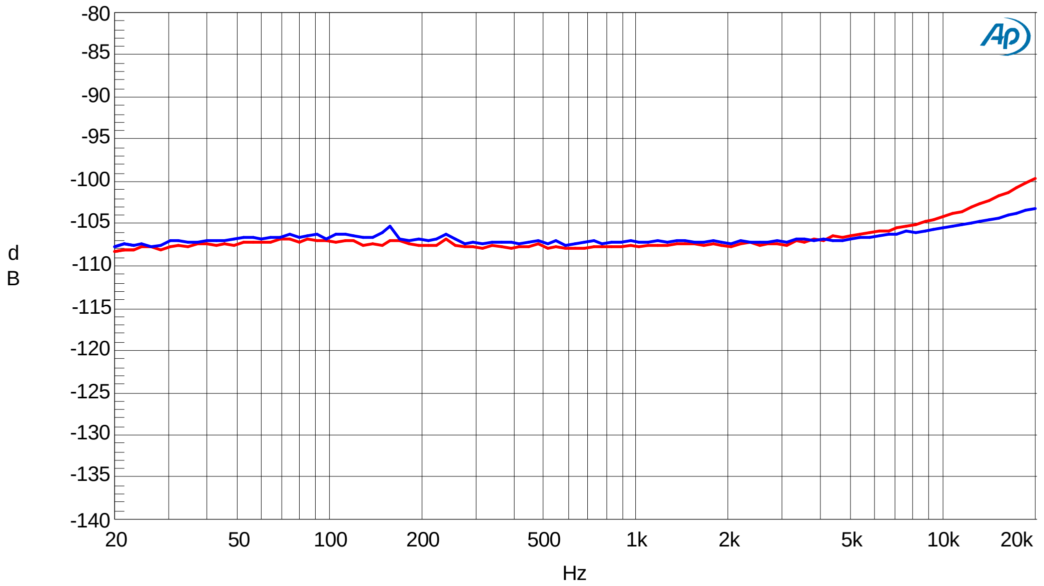


Figure 18.Crosstalk [fs = 44.1kHz]

[Plot Data]

2. fs=96kHz, MCLK=256fs, BICK=64fs
   DAC1 : SDTI1 => DAC1 => L/ROUT1

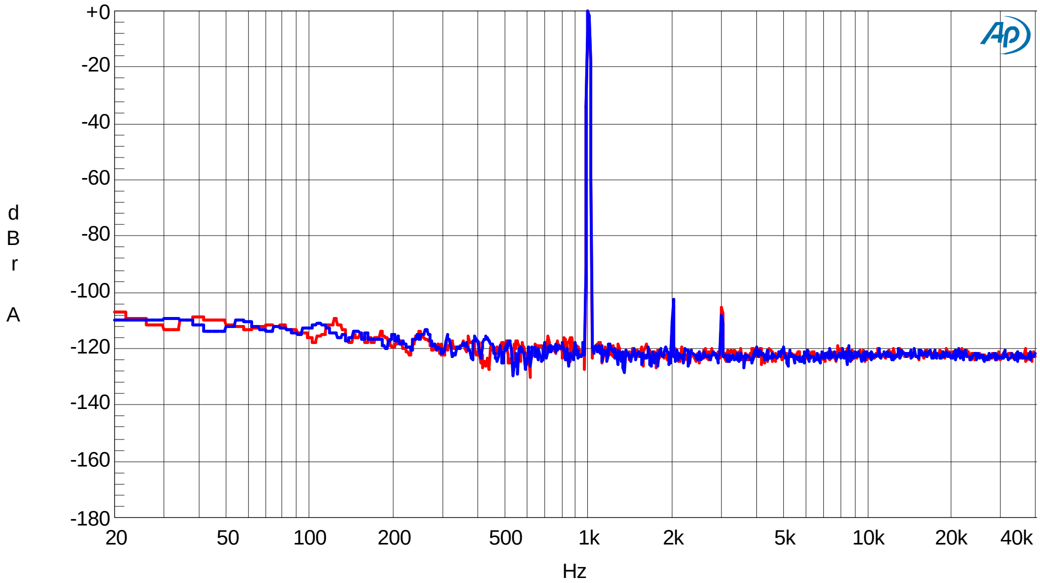


Figure 19.FFT (0dBFS) [fs = 96kHz]

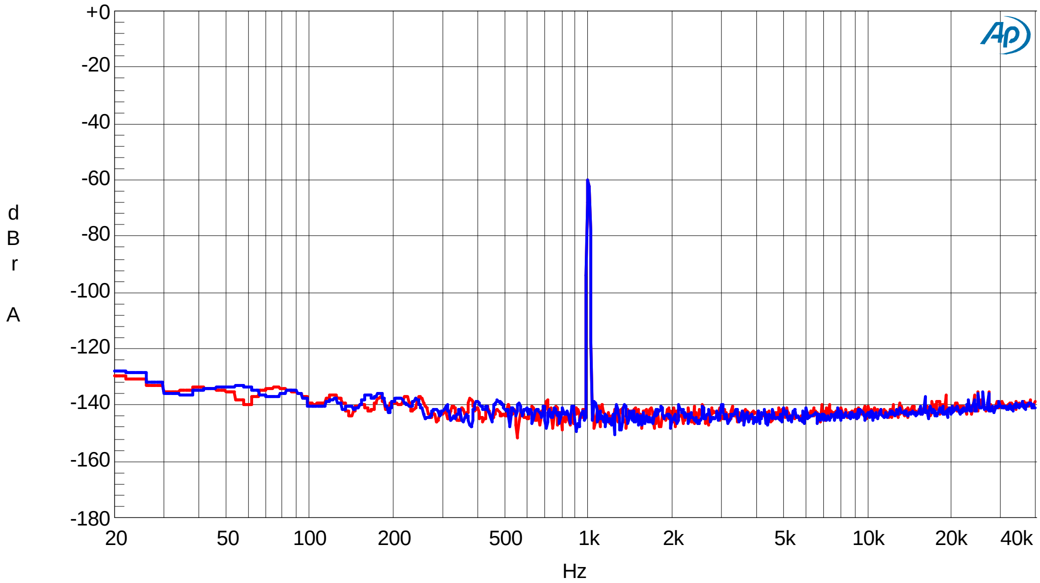


Figure 20.FFT (-60dBFS) [fs = 96kHz]

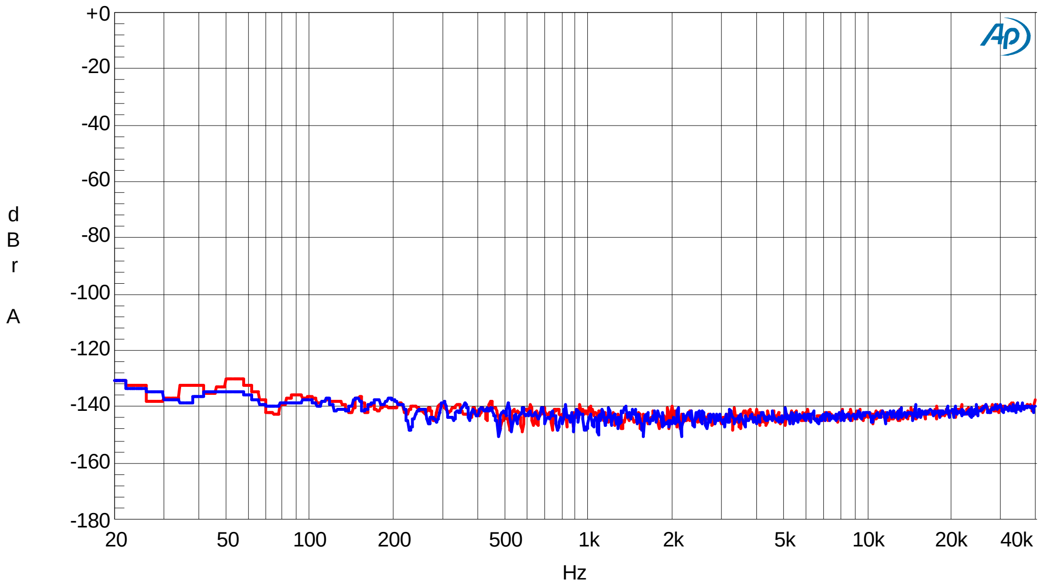


Figure 21.FFT (No Inputs fs=96kHz]

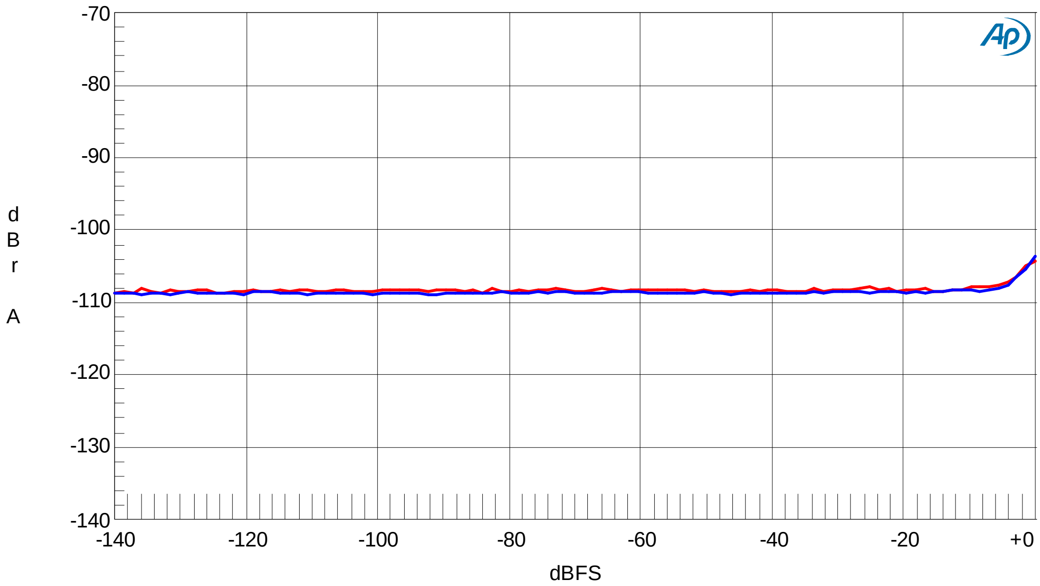


Figure 22.THD+N vs. Amplitude (Input Level) [fs = 96kHz]

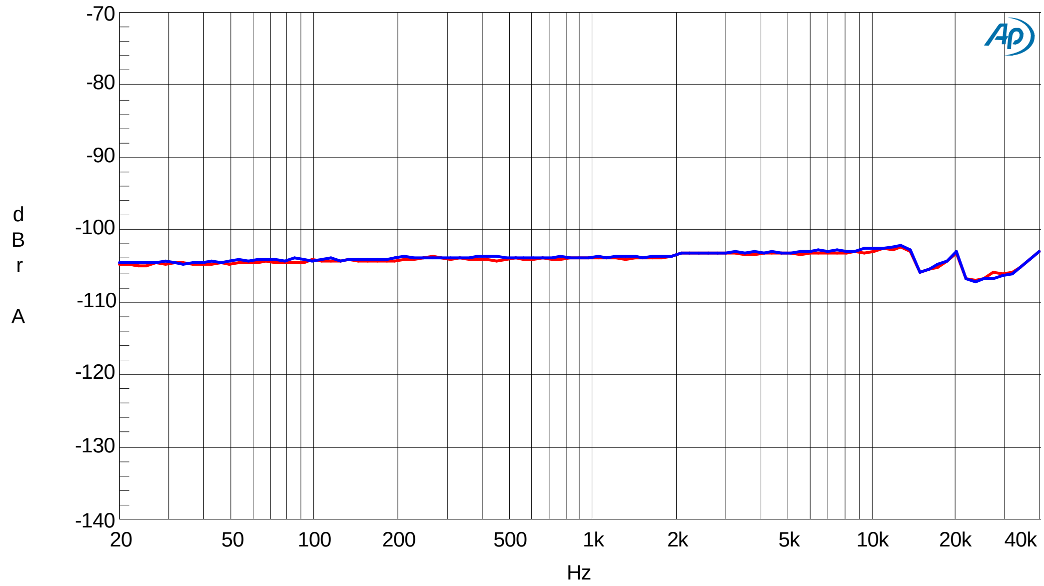


Figure 23.THD+N vs. Input Frequency [fs = 96kHz, 0dBFS Inputs]

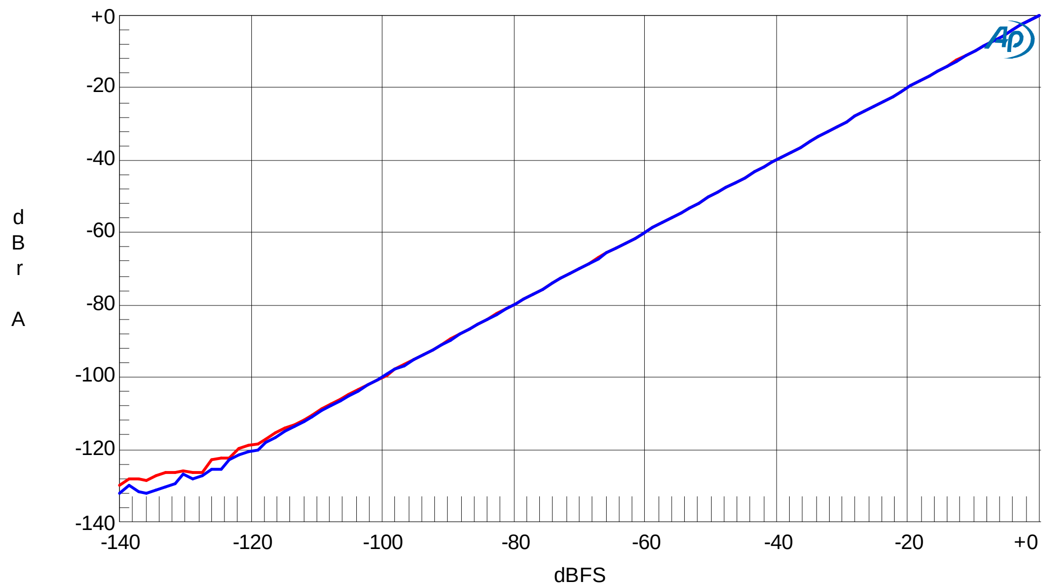


Figure 24.Linearity [fs = 96kHz]

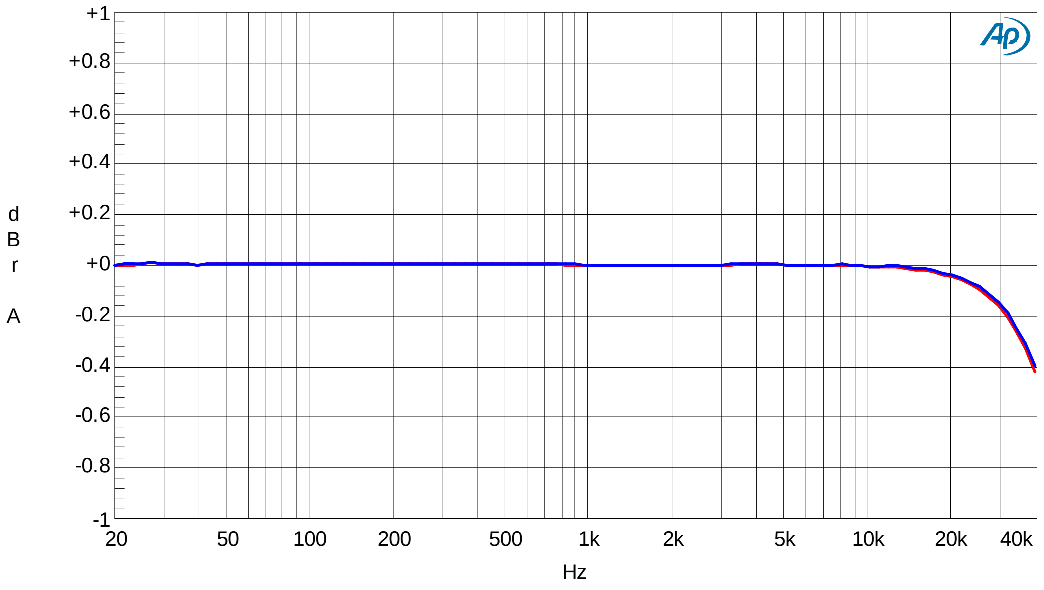


Figure 25.Frequency Response [fs = 96kHz]

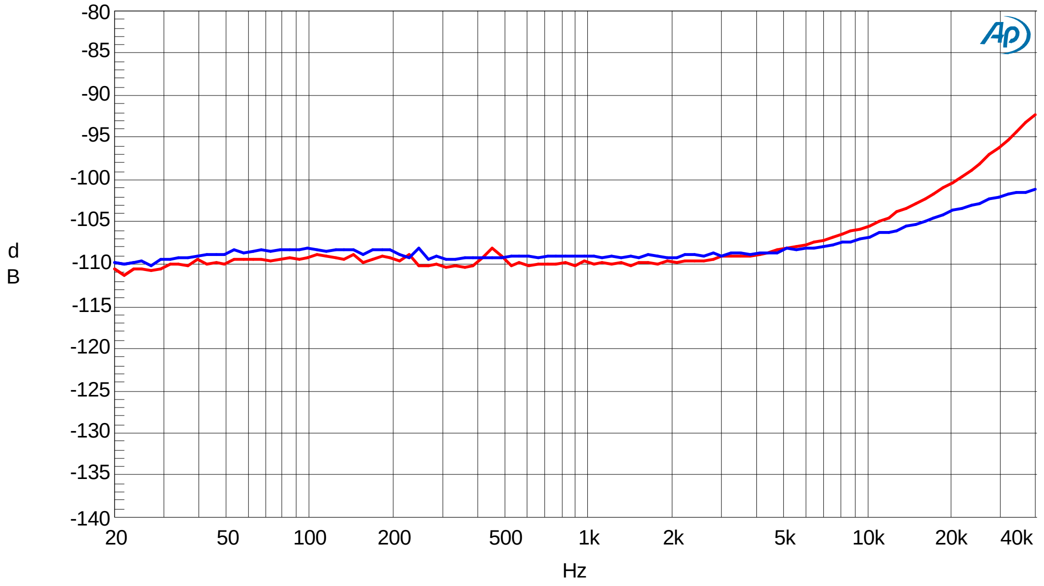


Figure 26.Crosstalk [fs = 96kHz]

[Plot Data]

3. fs=192kHz, MCLK=128fs, BICK=64fs
DAC1 : SDTI1 => DAC1 => L/ROUT1

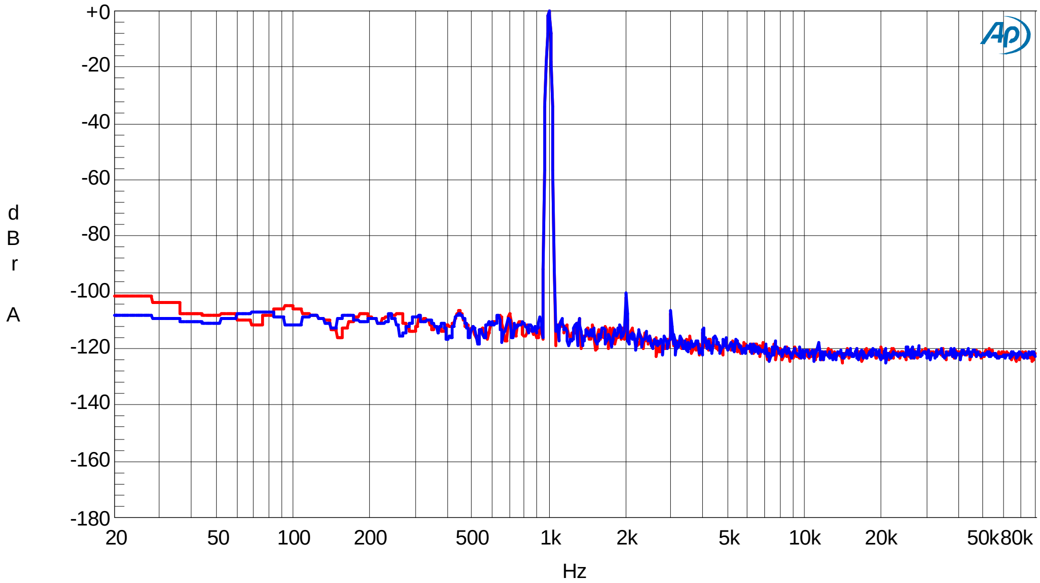


Figure 27.FFT (0dBFS) [fs = 192kHz]

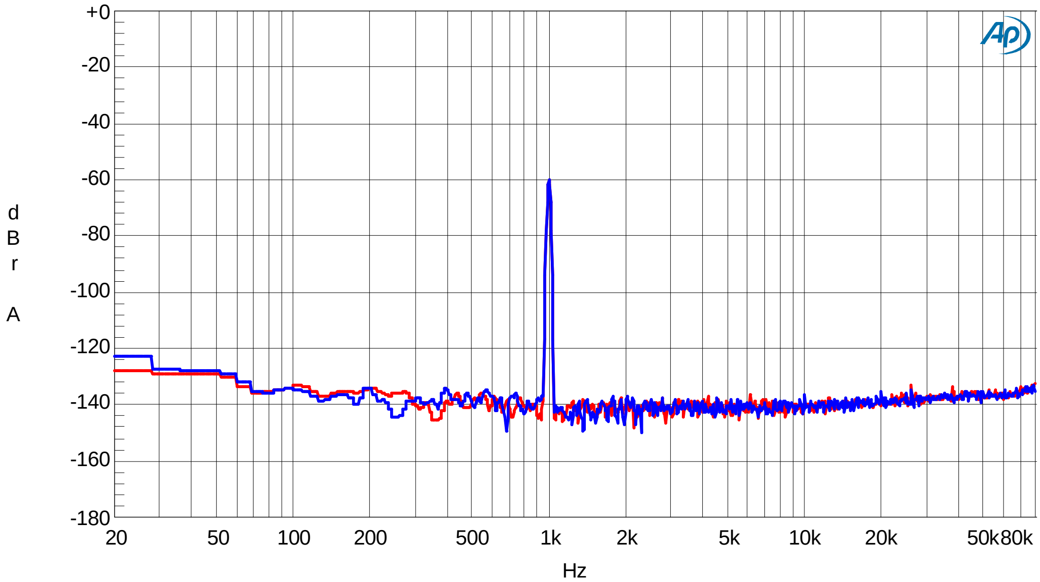


Figure 28.FFT (-60dBFS) [fs = 192kHz]

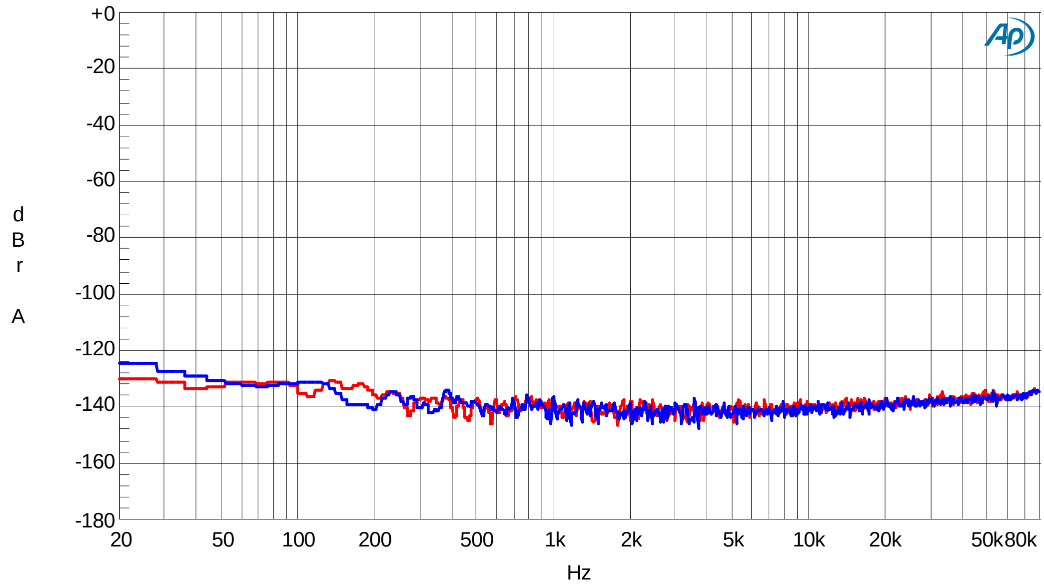


Figure 29.FFT (No Inputs fs=192kHz]

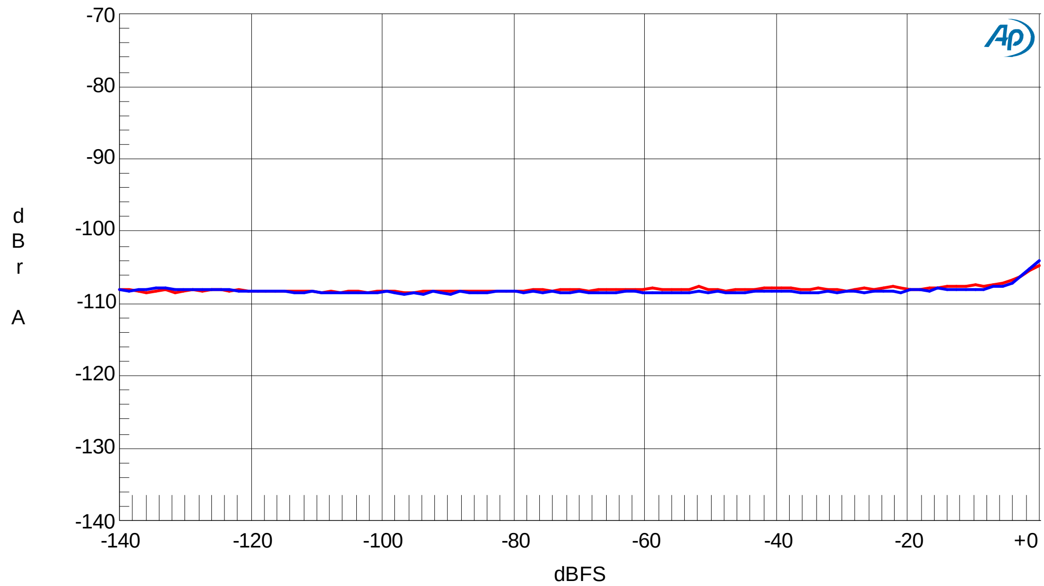


Figure 30.THD+N vs. Amplitude (Input Level) [fs = 192kHz]

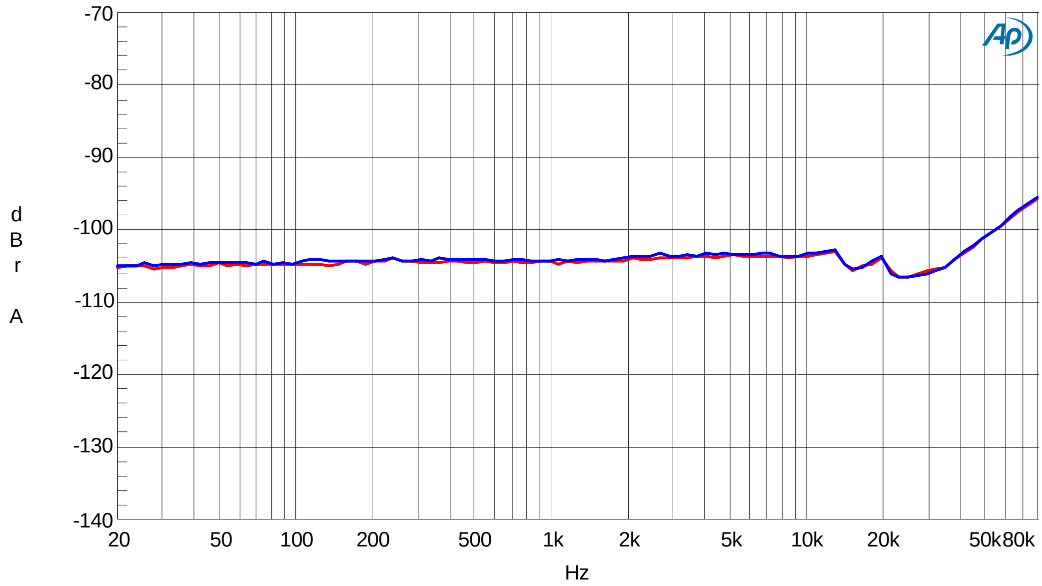


Figure 31.THD+N vs. Input Frequency [fs = 192kHz, 0dBFS Inputs]

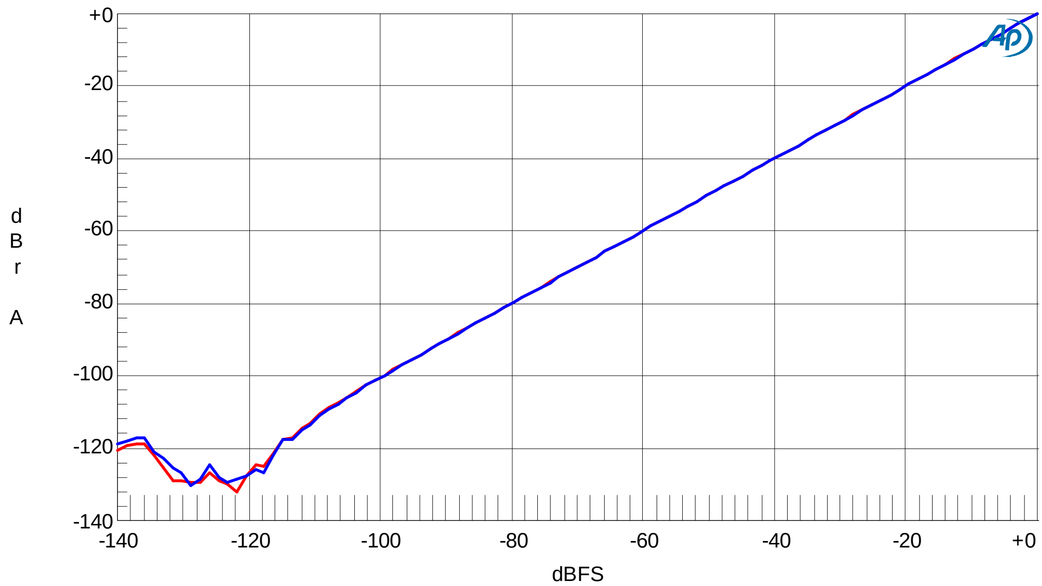


Figure 32.Linearity [fs = 192kHz]

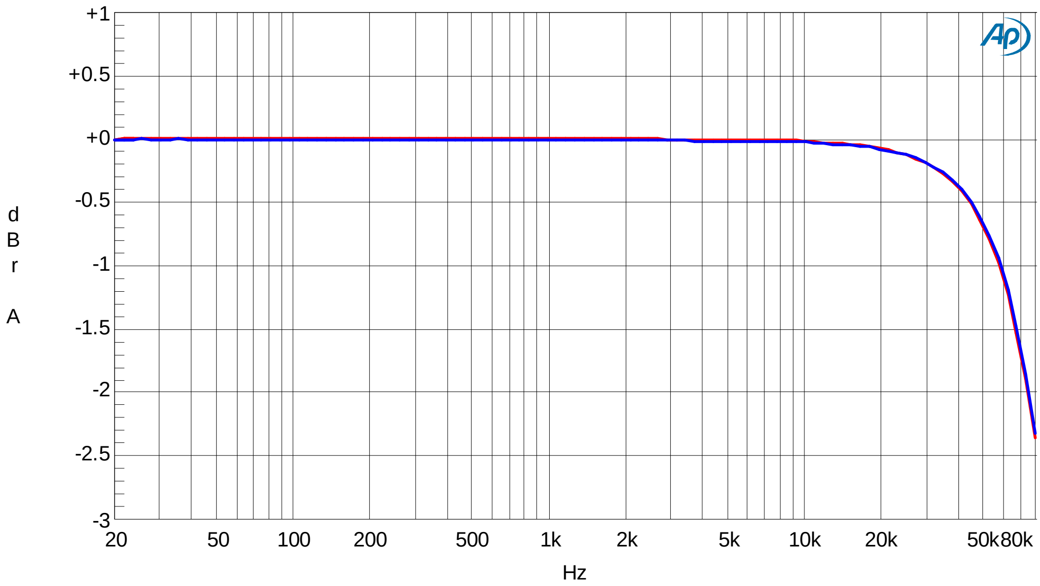


Figure 33.Frequency Response [fs = 192kHz]

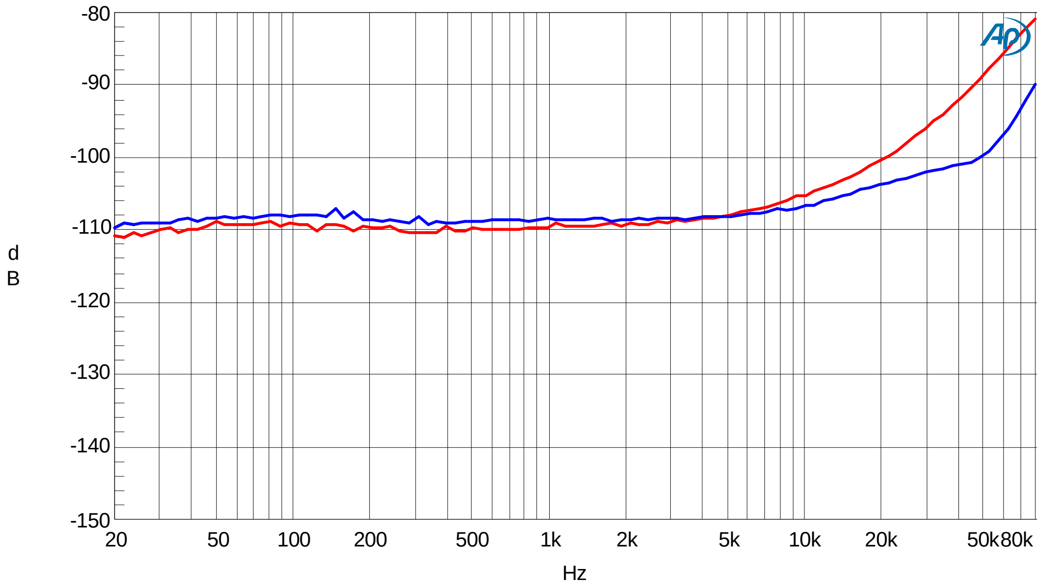
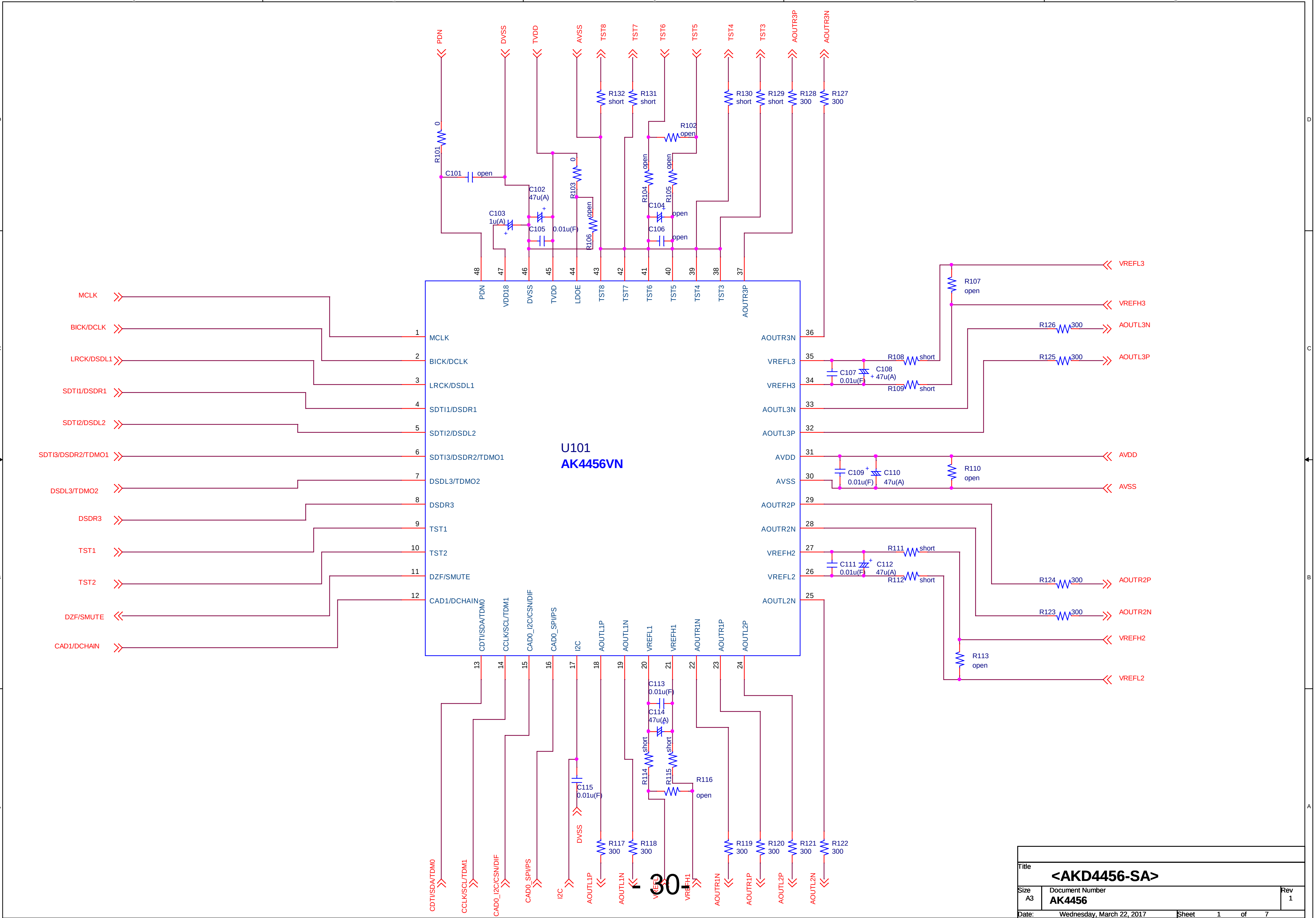


Figure 34.Crosstalk [fs = 192kHz]

REVISION HISTORY

Date (yy/mm/dd)	Manual Revision	Board Revision	Reason	Page	Contents
15/05/28	KM118600	0	First edition		
17/03/22	KM118601	1	Modification		Schematic changed Update Measurement Data



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Size	Document Number	Rev
A3	AK4456	1

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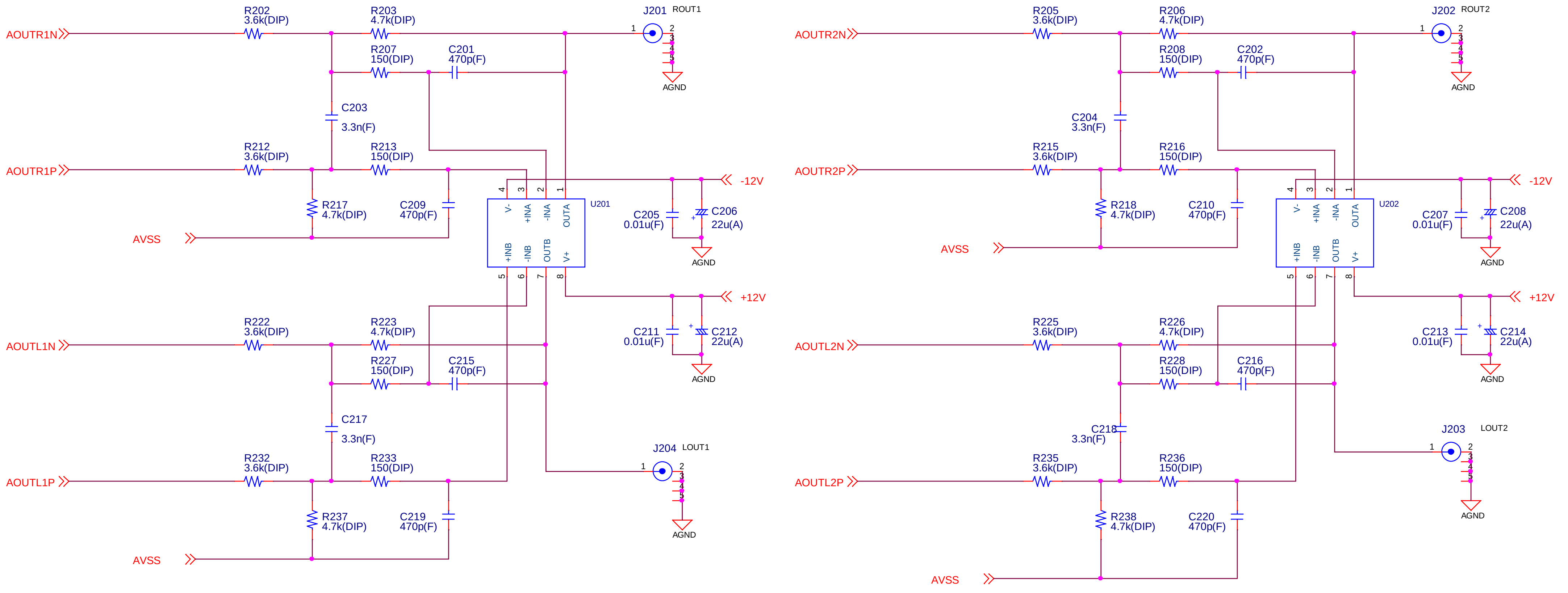

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Size A3	Document Number: Analog Out1	Rev 1
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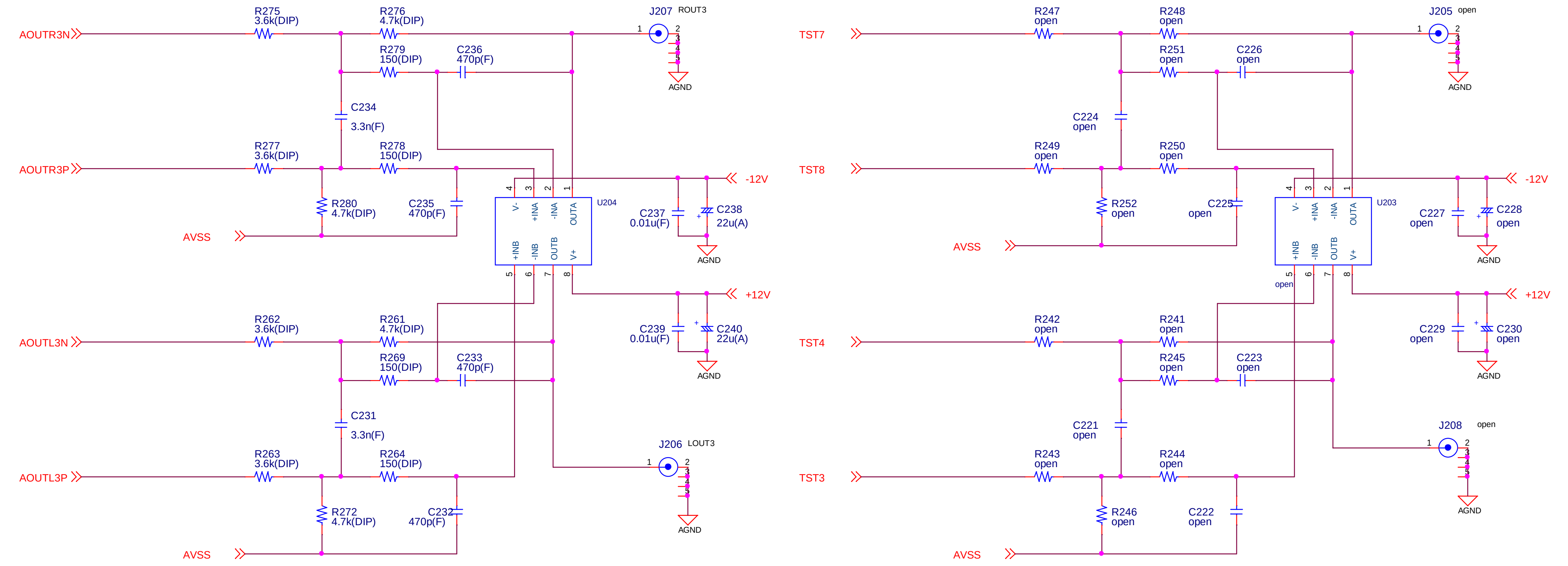

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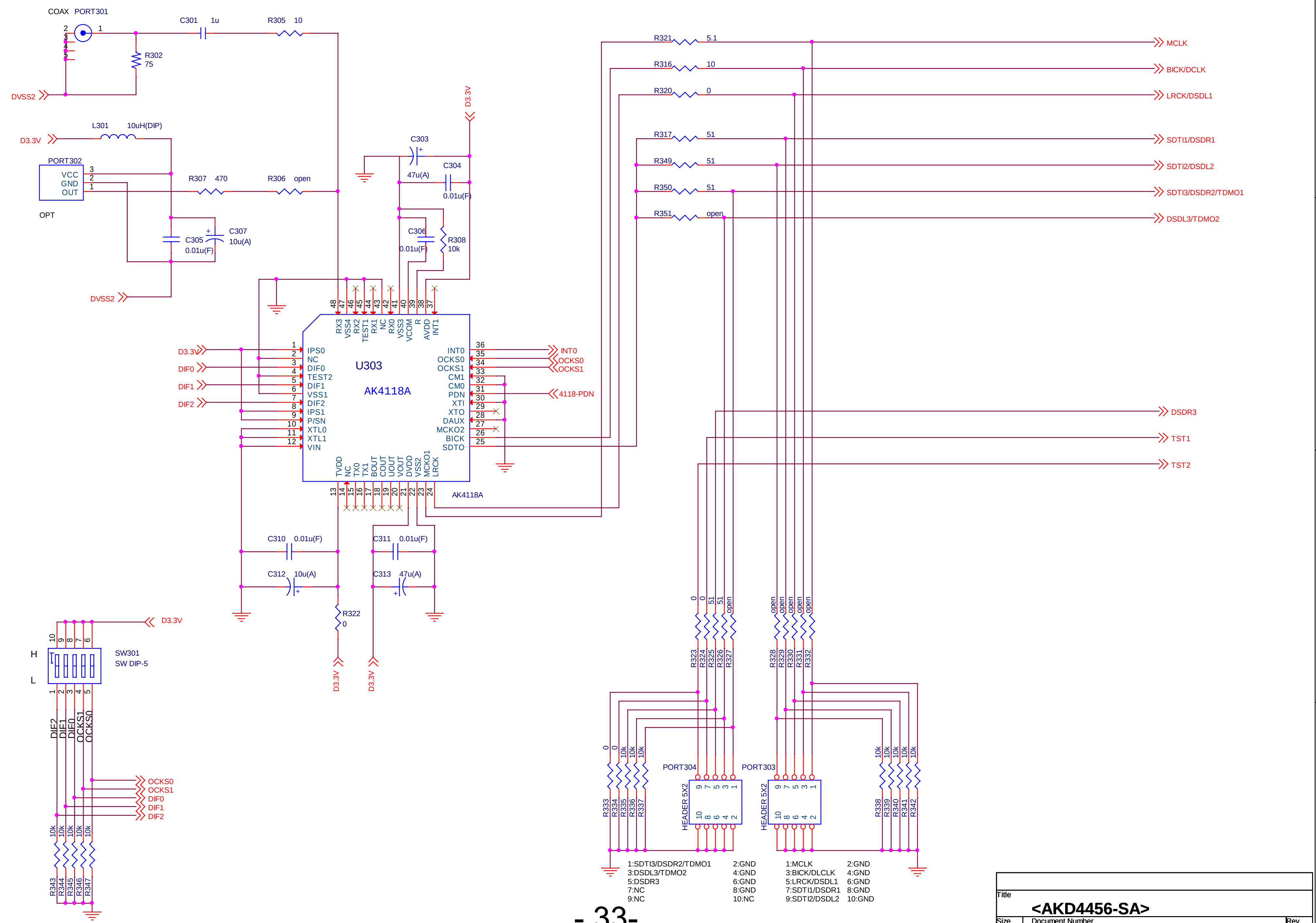
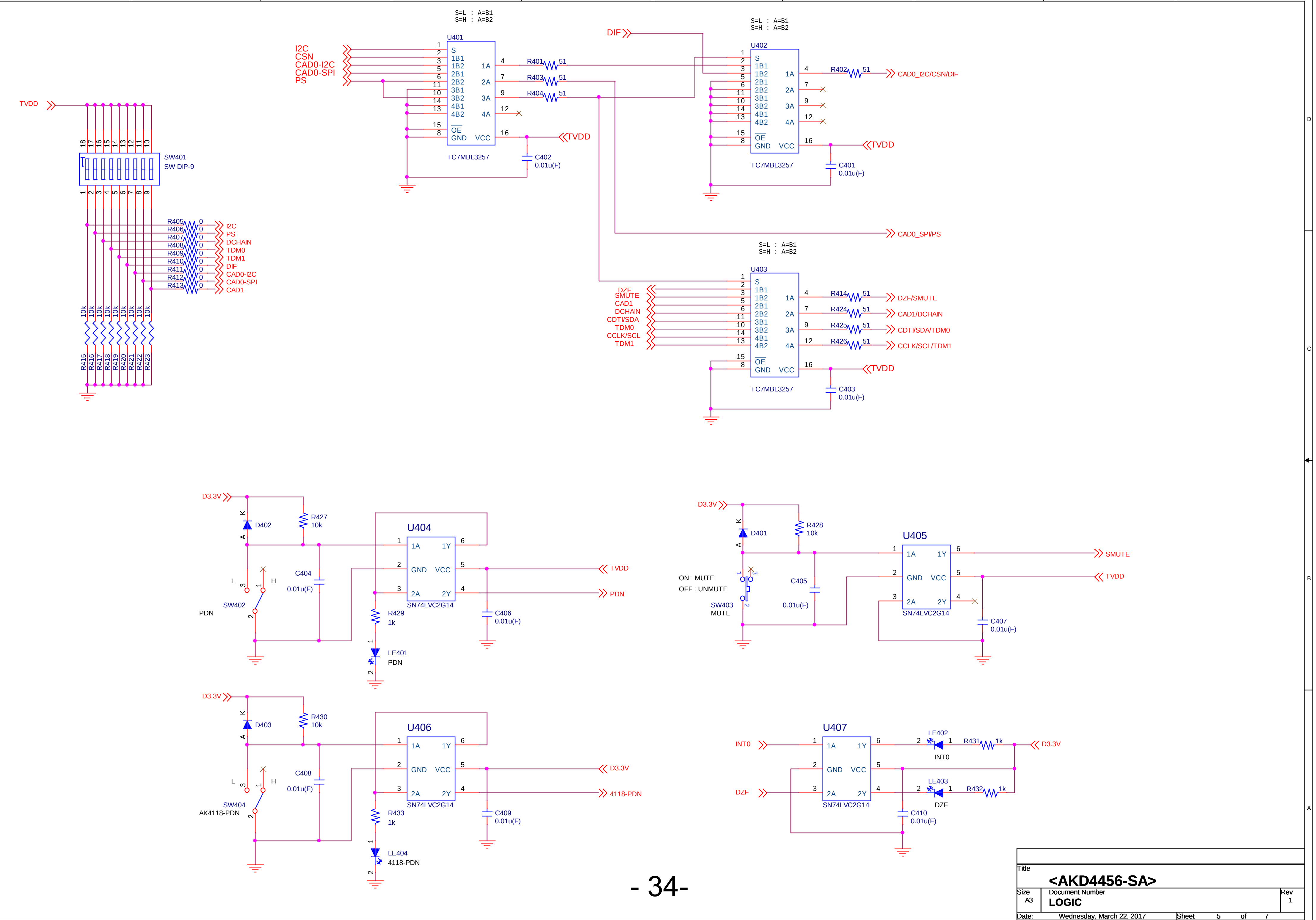
Size A3	Document Number: Analog Out2 — Rev 1
Date: Wednesday, March 22, 2017	Sheet 3 of 7



Title	<AKD4456-SA>	
Size A3	Document Number DIR	Rev 1
Date: Wednesday, March 22, 2017	Sheet 4 of 7	



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Size	Document Number	Rev
A3	LOGIC	1

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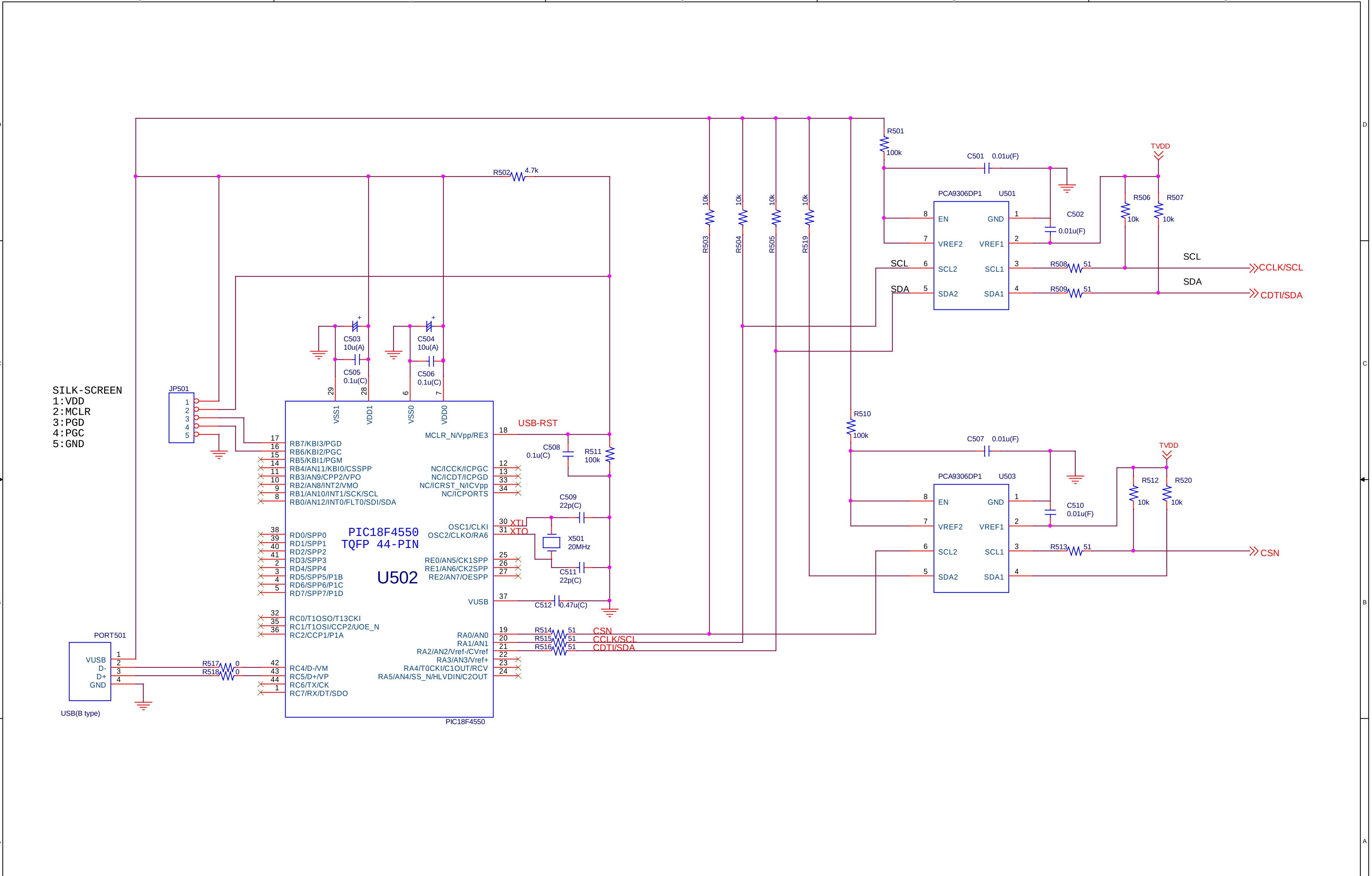

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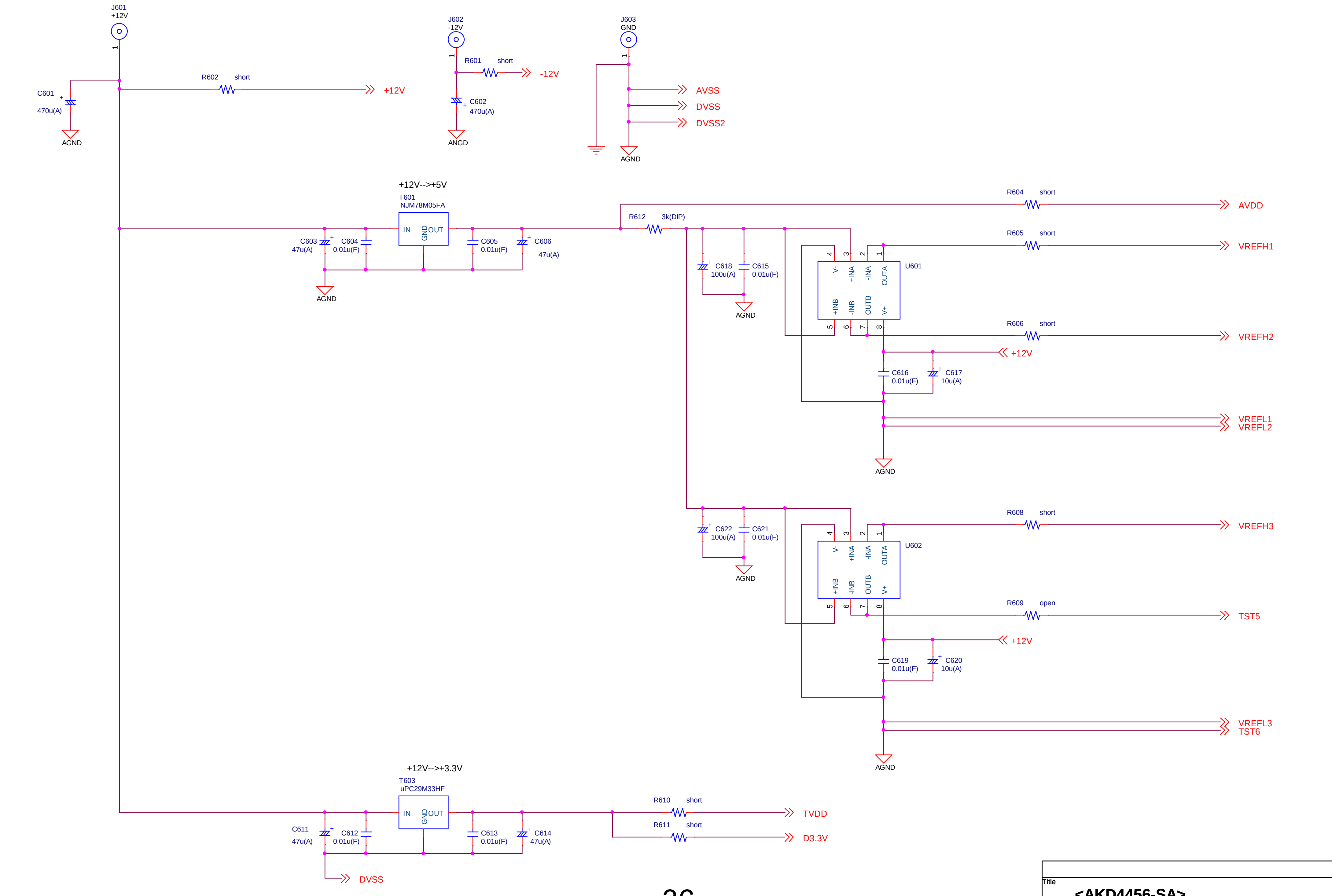
Size	A3
Document Number	PC-IF
Rev	1
Date:	Wednesday, March 22, 2017
Sheet	6 of 7



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Size A3	Document Number POWER	Rev 1
Date: Wednesday, March 22, 2017	Sheet 7 of 7	