AKD4358-SC
AK4358 Evaluation board Rev.0

GENERAL DESCRIPTION

The AKD4358-SC is an evaluation board for the AK4358. The AK4358 accepts up to192kHz PCM data and 1-Bit DSD data making it ideal for a wide range of applications including DVD-Audio and SACD. The AKD4358-SC has a digital audio interface that can interface with digital audio systems via opt-connector or RCA connector. The AKD4358-SC also has several ports allowing you to interface the AK4358 to external devices such as a DSP, DSD processor or AC3 decoder.

■ Ordering Guide

AKD4358-SC --- AK4358 Sound quality Evaluation board
(Cable for connecting the board with printer port of an IBM-AT compatible PC and control software is packed with this. This control software does not operate on Windows NT.)

FUNCTION

- **On-board 2nd order LPF**
- **On-board clock generator (AK4113)**
- **Compatible with 3 types of interface**
  - **Direct interface with AKM's A/D converter evaluation boards and direct interface**
  - **On-board AK4113 (DIR) that accepts optical or BNC Input.**
  - **Direct interface with DSD Decoder via 10pin header**
- **10pin header for serial control interface**
  - **Supports I2C and 3-wire control interface**

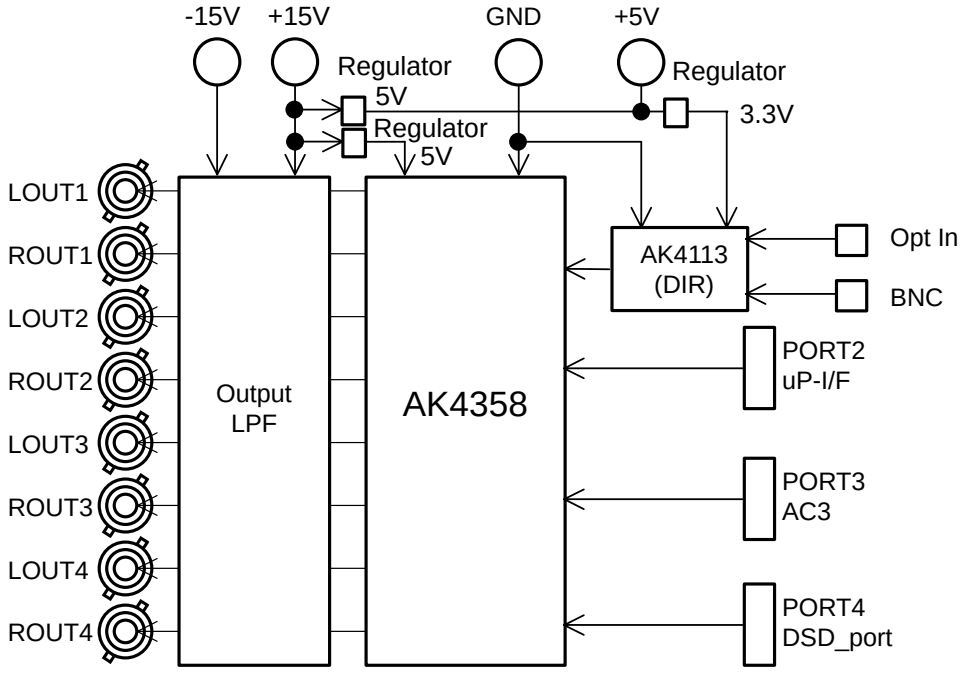


Figure 1. AKD4358-SC Block Diagram
*Circuit diagram and PCB layout are attached at the end of this manual.

■ Operation Sequence

1) Set power supply voltages in the fallowing ranges.

Name	Color	Voltage	Comments	Attention
+15V	green	+12~+15V	For regulator and op-amps.	This jack should be always connected to power supply.
-15V	Blue	-12~-15V	For op-amps.	This jack should be always connected to power supply.
+5V	Red	+4.75~+5.25V	For AK4358	No connect
GND	Black	0V	GND	This jack should be always connected to power supply.

Table 1. Set up of power supply lines

Each supply line should be distributed from the power supply unit.

2) Set-up jumper pins and DIP switches for desired mode. (See Evaluation Mode Setup.)

3) Power on.
The AK4358 should be reset once by bringing SW1(PDN) "L" upon power-up.

■ Evaluation Mode Setup

Only PCM Mode is supported.

1. DIR (COAX) (Default)
It is possible to evaluate the AK4385 by using CD disk. The DIR generates MCLK, BICK, LRCK and SDATA from the received data through BNC connector (J1). Setting of jumper is shown below.

COAX is recommended for an evaluation of the Sound quality.

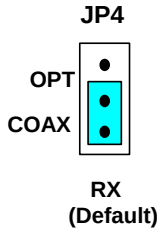


Figure 2. Jumper setting, when using DIR

2.DIR (Optical Link)
It is possible to evaluate the AK4385 by using CD disk. The DIR generates MCLK, BICK, LRCK and SDATA from the received data through optical connector (PORT3: TORX176). Setting of jumper is shown below.

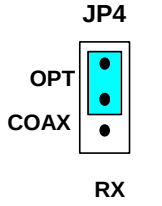


Figure 3. Jumper setting, when using DIR

■ DIP Switch Setup

[SW2]: AK4113 setting

No.	Pin	OFF	ON	Default
1	OCKS1	AK4113 Master Clock setting Refer to Table4		ON
2	OCKS0			OFF

Table 1. SW2 setting

The frequency of the master clock output is set by OCKS0 and OCKS1 as shown in Table 4.

OCKS1	OCKS0	MCLK Frequency	
OFF	OFF	256fs @fs=88.2/96kHz	
ON	OFF	512fs @32/44.1/48kHz	Default
ON	ON	128fs @176.4/192kHz	

Table 2. MCLK Clock

AK4358 is setup using DIP switch S1.
*ON is “H” and OFF is “L”.

[S1]: AK4358 setting

No.	Pin	Default	Description
1	CAD0	OFF	Chip address setup
2	CAD1	OFF	Chip address setup (I^2C only)
3	I2C	OFF	I2C pin select OFF: 3wire, ON I^2C
4	DIF0	OFF	DIF0pin select
5	ACKSN	ON	ACKSN pin select

Table 3. S1 setting

■ Jumpers Descriptions

[JP4](OPT/COAX) : The source of the biphase signal input to AK4113
OPT : PORT1(TORX173: optical link) <Default>
COAX : J1(BNC)

■ Toggle SW Function

[SW1] (PDN) : Resets the AK4113 and AK4358. Keep “H” during normal operation.

■ Serial control

The AKD4358-SC can be controlled via the printer port (parallel port) of an IBM-AT compatible PC. Connect PORT2(uP-I/F) to the PC with the 10-wire flat ribbon cable packed with the AKD4358-SC.

The pin layout of PORT2 is shown in Figure 4. Proper connection makes the flat ribbon cable going away from the board.

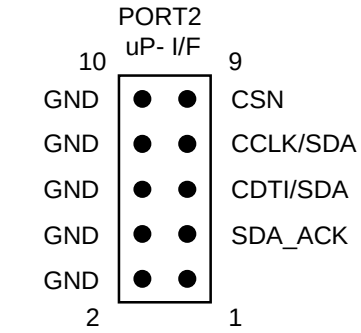


Figure 4. Control port pin layout

■ Interface with AC3 decoder

PORT3(AC3) is used for interface with an AC3 decoder. MCLK, BICK, LRCK and 4-line serial data can be input from the decoder via PORT3.

Pin layout of PORT3 is shown in Figure5.

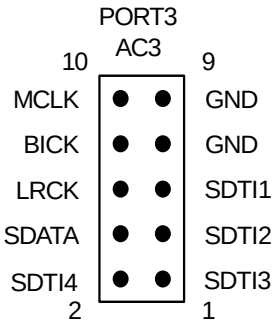


Figure 5. AC3 port pin layout

■ External analog circuit

The 2nd order LPF is implemented on the board in order to sum the differential outputs of the AK4358 and attenuate out of band noise.

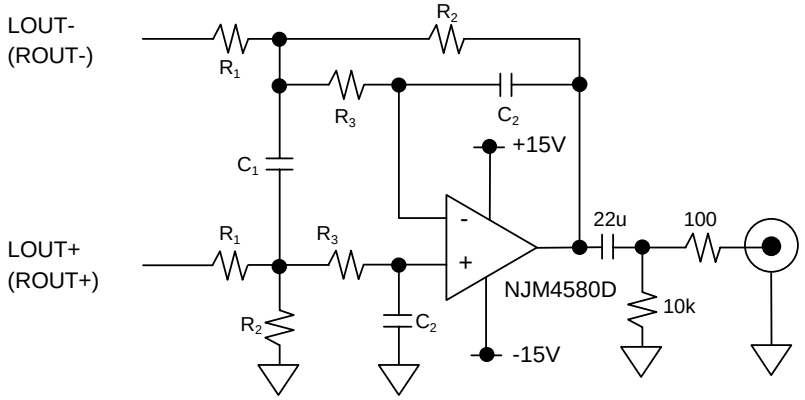


Figure 6. On-board analog filter

R_1	R_2	R_3	C_1	C_2
3.9k	4.7k	180	3900p	470p

Table 4. The value of R, C on this board

fin	20kHz	40kHz	80kHz
Frequency Response	-0.021dB	-0.039dB	-1.752dB

Table 5. Frequency Response of LPF

<Calculation>

$$\text{Amplitude} = 20 \log \frac{K}{\sqrt{[1-(f/fc)^2]^2+[(1/Q)(f/fc)]^2}} \text{ [dB]},$$

$$K = \frac{R_2}{R_1},$$

$$fc = \frac{\omega_0}{2\pi},$$

$$\omega_0 = \frac{1}{\sqrt{C_1 C_2 R_2 R_3}},$$

$$Q = \frac{2C_1\omega_0}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}}.$$

Control Software Manual

■ Set-up of evaluation board and control software

1. Set up the AKD4358-SC according to previous term.

2. Connect IBM-AT compatible PC with AKD4358-SC by 10-line type flat cable (packed with AKD4358-SC). 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 “AKD4358-SC Evaluation Kit” into the CD-ROM drive.

4. Access the CD-ROM drive and double-click the icon of “AKD4358-SC.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.

■ Explanation of each buttons

1. [Port Reset] : Set up the USB interface board (AKDUSBIF-A) in case using the board.
2. [Write default] : Initialize the register of AKD4358-SC.
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 andexecuted.
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 AK4358, 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 AK4358-B, click [OK] button. If not, click [Cancel] button.

3. [Function2 Dialog] : Dialog to evaluate ATT

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 AK4642 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 AK4358, click [OK] button. If not, click [Cancel] button.

4. [Save] and [Open]

4-1. [Save]

Save the current register setting data. The extension of file name is “akr”.

(Operation flow)
(1) Click [Save] Button.
(2) Set the file name and push [Save] Button. The extension of file name is “akr”.

4-2. [Open]

The register setting data saved by [Save] is written to AK4358. The file type is the same as [Save].

(Operation flow)
(1) Click [Open] Button.
(3) 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.

(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”.

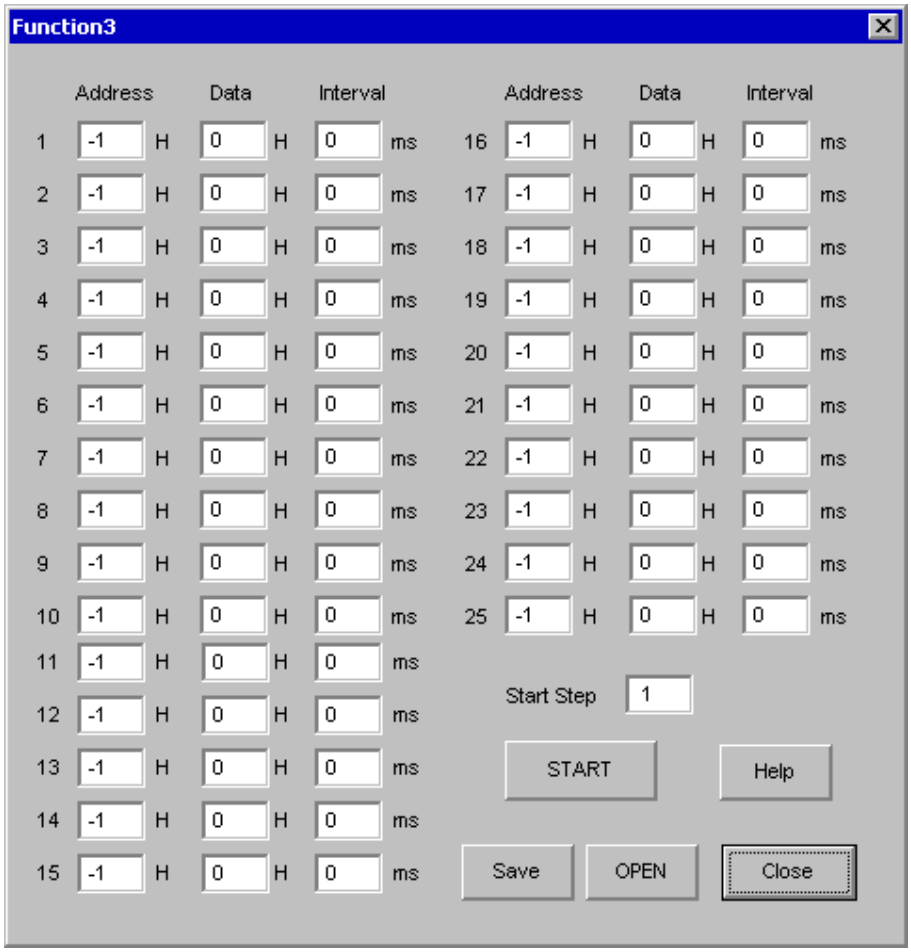


Figure 1. Window of [F3]

6. [Function4 Dialog]

The sequence that is created on [Function3] can be assigned to buttons and executed. When [F4] button is clicked, the window as shown in Figure opens.

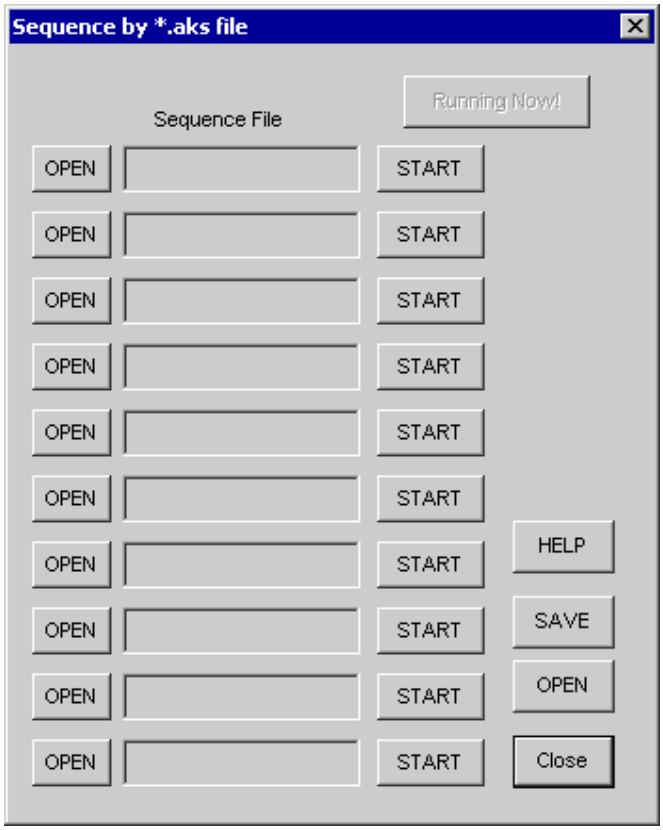


Figure 2. [F4] window

6-1. [OPEN] buttons on left side and [START] buttons

(1) Click [OPEN] button and select the sequence file (*.aks).

The sequence file name is displayed as shown in Figure .

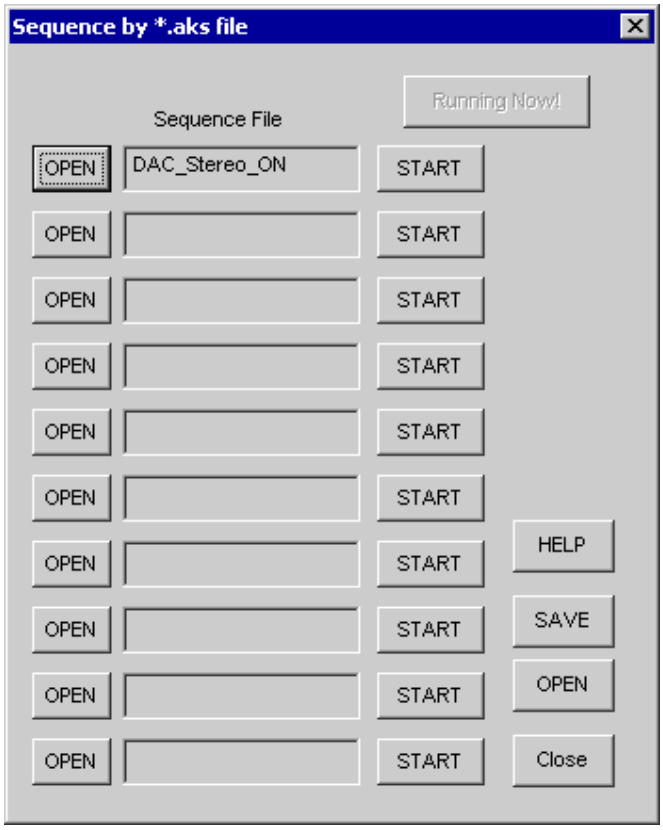


Figure 3. [F4] window(2)

(2) Click [START] button, then the sequence is executed.

6-2. [SAVE] and [OPEN] buttons on right side

[SAVE] : The sequence file names can assign be saved. The file name is *.ak4.

[OPEN] : The sequence file names assign that are saved in *.ak4 are loaded.

6-3. Note

(1) This function doesn't support the pause function of sequence function.

(2) All files need to be in same folder used by [SAVE] and [OPEN] function on right side.

(3) When the sequence is changed in [Function3], the file should be loaded again in order to reflect the change.

7. [Function5 Dialog]

The register setting that is created by [SAVE] function on main window can be assigned to buttons and executed. When [F5] button is clicked, the following window as shown in Figure opens.

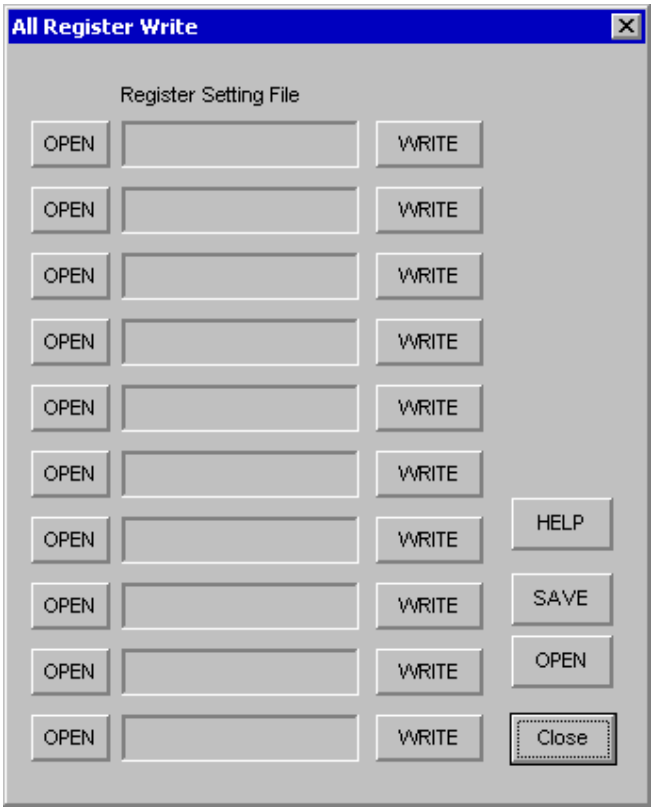


Figure 4. [F5] window

7-1. [OPEN] buttons on left side and [WRITE] button

(1) Click [OPEN] button and select the register setting file (*.akr).

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

7-2. [SAVE] and [OPEN] buttons on right side

[SAVE] : The register setting file names assign can be saved. The file name is *.ak5.

[OPEN] : The register setting file names assign that are saved in *.ak5 are loaded.

7-3. Note

(1) All files need to be in same folder used by [SAVE] and [OPEN] function on right side.

(2) When the register setting is changed by [Save] Button in main window, the file should be loaded again in order to reflect the change.

MEASUREMENT RESULTS

[Measurement condition]

- Measurement unit : Audio Precision System two Cascade
- MCLK : 512fs(44.1kHz),256fs(96kHz),128fs(192kHz)
- BICK : 64fs
- fs : 44.1kHz,96kHz,192kHz
- BW : 20Hz~20kHz(fs=44.1kHz),40Hz~40kHz(fs=96kHz,192kHz)
- Bit : 24bit
- Power Supply : VDD=5V
- Interface : DIR(44.1kHz,96kHz), Cascade Dual BNC(fs=192kHz)
- Temperature : Room
- Board : AKD4358-SC Rev.0
- DIR : AK4113

PCM mode

fs=44.1kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	20kLPF	91.2dB	91.4dB
DR	1kHz, -60dB	22kLPF, A-weighted	111.7dB	111.7dB
S/N	“0”data	22kLPF, A-weighted	111.7dB	111.7dB

fs=96kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	90.7dB	90.8dB
	1kHz, -60dB		47.8dB	47.8dB
DR	1kHz, -60dB	22kLPF, A-weighted	111.3dB	111.3dB
S/N	“0”data	40kLPF	108.0dB	108.0dB
	“0”data	22kLPF, A-weighted	111.3dB	111.3dB

fs=192kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	87.8dB	87.8dB
	1kHz, -60dB		42.6dB	42.4dB
DR	1kHz, -60dB	22kLPF, A-weighted	105.3dB	105.6dB
S/N	“0”data	40kLPF	107.8dB	108.0dB
	“0”data	22kLPF, A-weighted	111.1dB	111.1dB

■ Plot

[Measurement condition]

- Measurement unit : Audio Precision System two Cascade (fs=44.1kHz, 96kHz)
- MCLK : 512fs(44.1kHz), 256fs(96kHz), 128fs(192kHz)
- BICK : 64fs
- fs : 44.1kHz, 96kHz, 192kHz
- BW : 20Hz~20kHz(fs=44.1kHz), 40Hz~40kHz(fs=96kHz, 192kHz)
- Bit : 24bit
- Power Supply : VDD=5V
- Interface : Internal DIR (44.1kHz, 96kHz, 192kHz)
- temperature : room

1. PCM mode

fs=44.1kHz

Figure 1. FFT (1kHz, 0dBFS input)
Figure 2. FFT (1kHz, -60dBFS input)
Figure 3. FFT (Noise floor)
Figure 4. FFT (Out-of-band noise)
Figure 5. THD+N vs Input Level (fin=1kHz)
Figure 6. THD+N vs Input Frequency (0dBFS input)
Figure 7. Linearity (fin=1kHz)
Figure 8. Frequency Response (0dBFS input)
Figure 9. Cross-talk (0dBFS input)

fs=96kHz

Figure 10. FFT (1kHz, 0dBFS input)
Figure 11. FFT (1kHz, -60dBFS input)
Figure 12. FFT (Noise floor)
Figure 13. FFT (Out-of-band noise)
Figure 14. THD+N vs Input Level (fin=1kHz)
Figure 15. THD+N vs Input Frequency (0dBFS input)
Figure 16. Linearity (fin=1kHz)
Figure 17. Frequency Response (0dBFS input)
Figure 18. Cross-talk (0dBFS input)

fs=192kHz

1 PCM mode

(fs=44.1kHz)

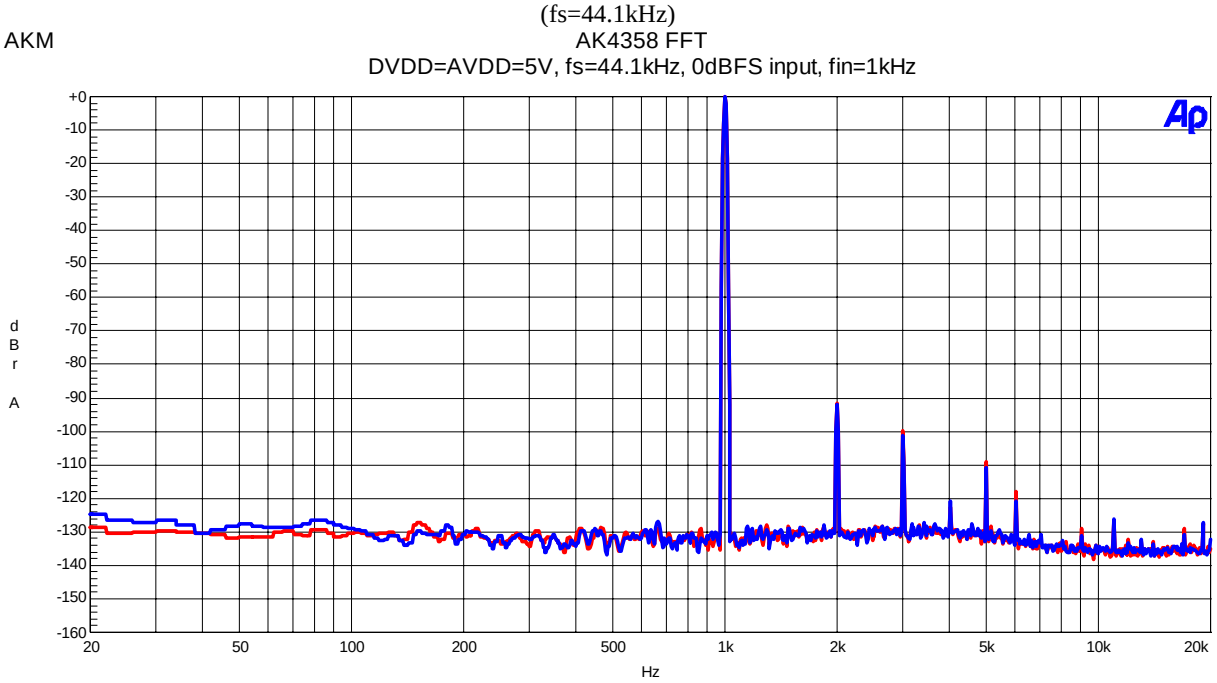


Figure 1. FFT (fin=1kHz, 0dBFS input)

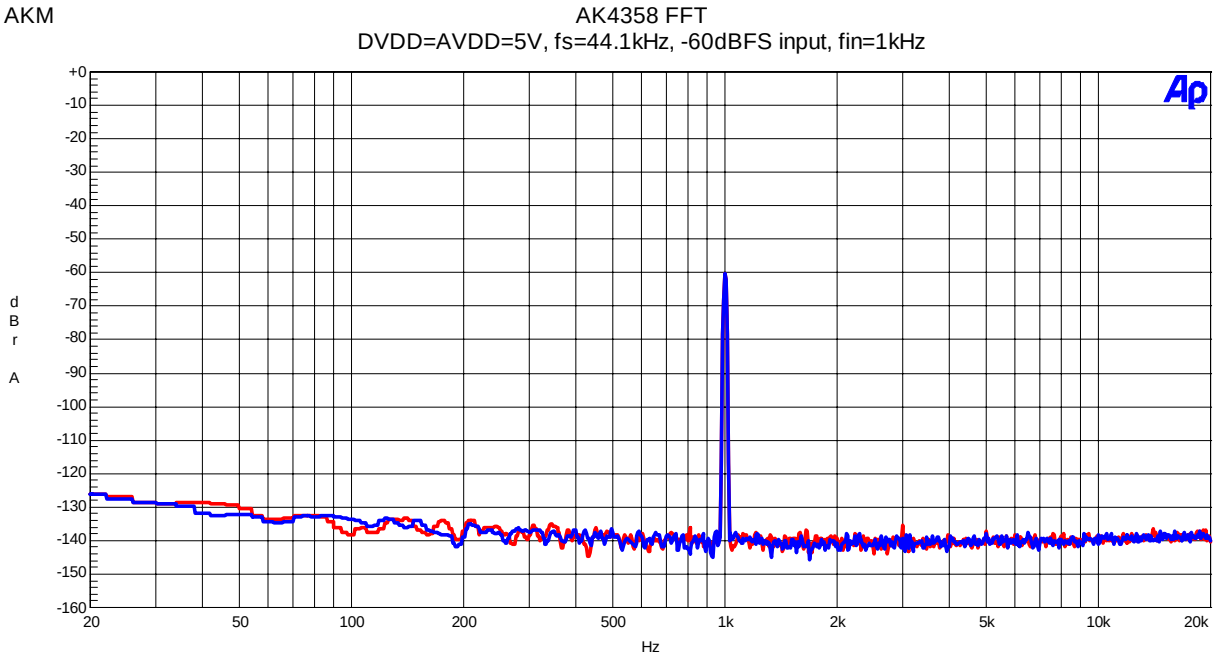


Figure 2. FFT (fin=1kHz, -60dBFS input)

(fs=44.1kHz)

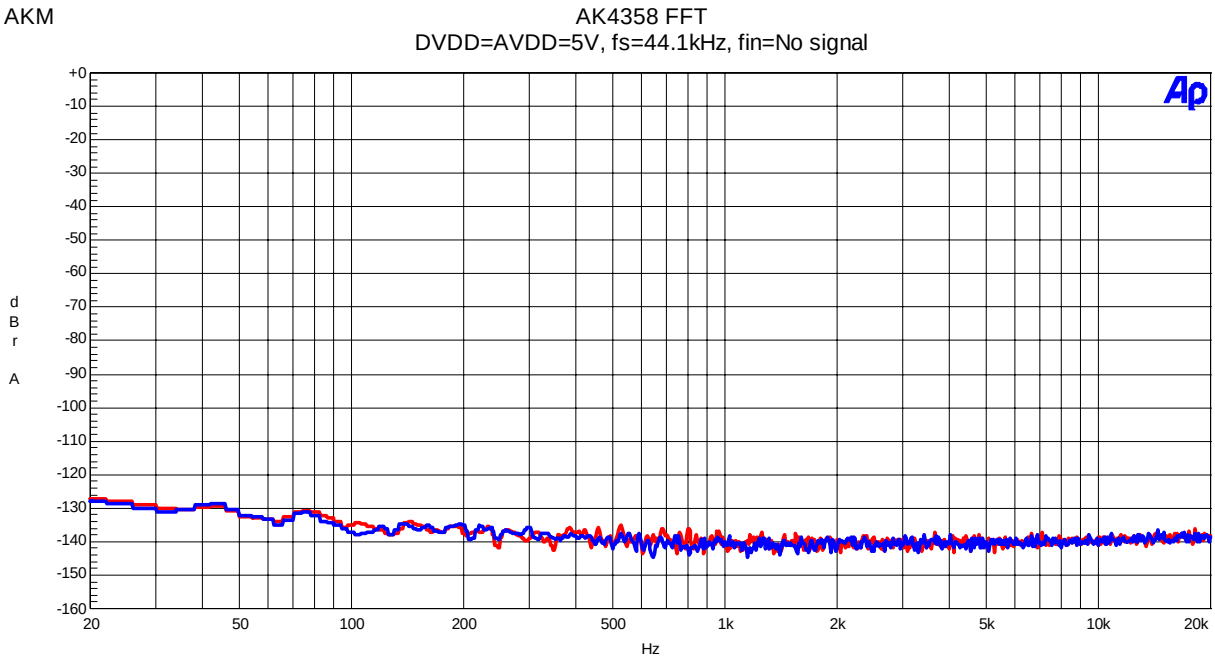


Figure 3. FFT (Noise floor)

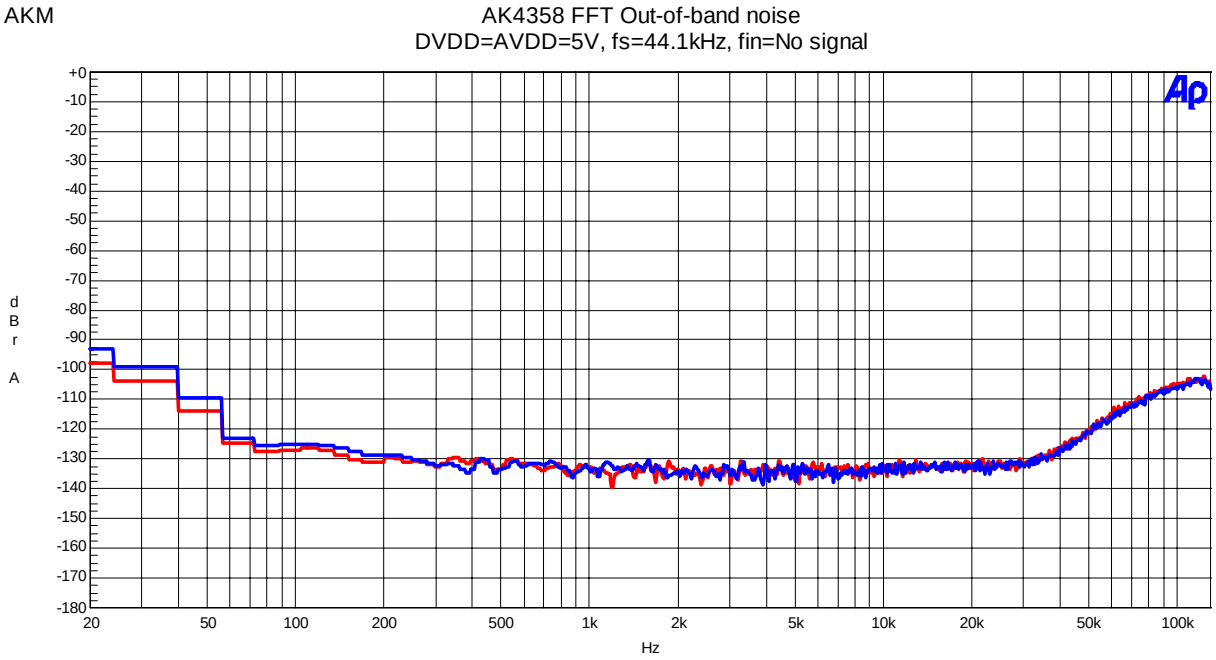


Figure 4. FFT (Out-of-band noise)

(fs=44.1kHz)

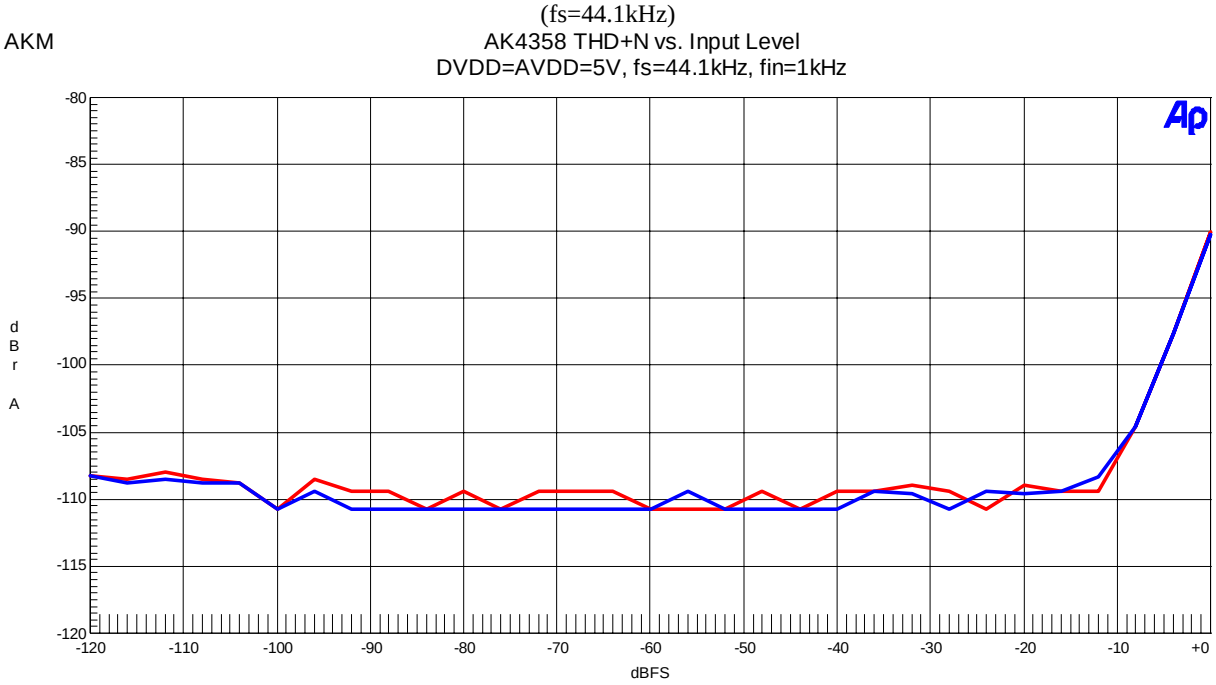


Figure 5. THD+N vs Input Level (fin=1kHz)

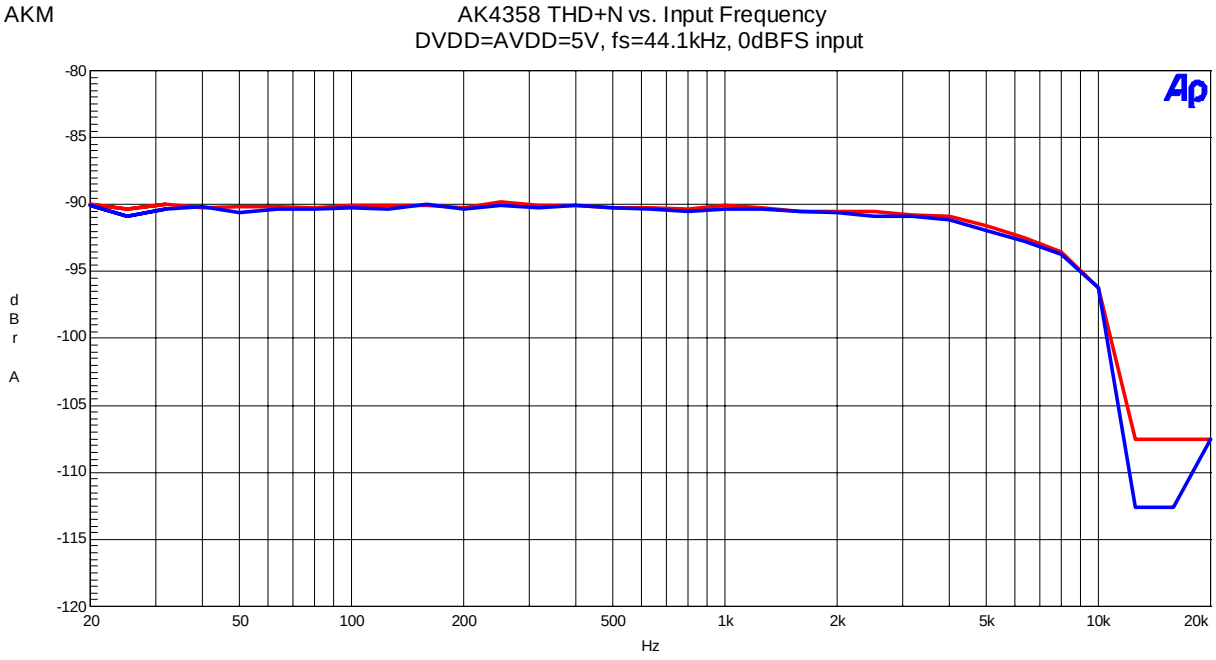


Figure 6. THD+N vs fin (0dBFS input)

(fs=44.1kHz)

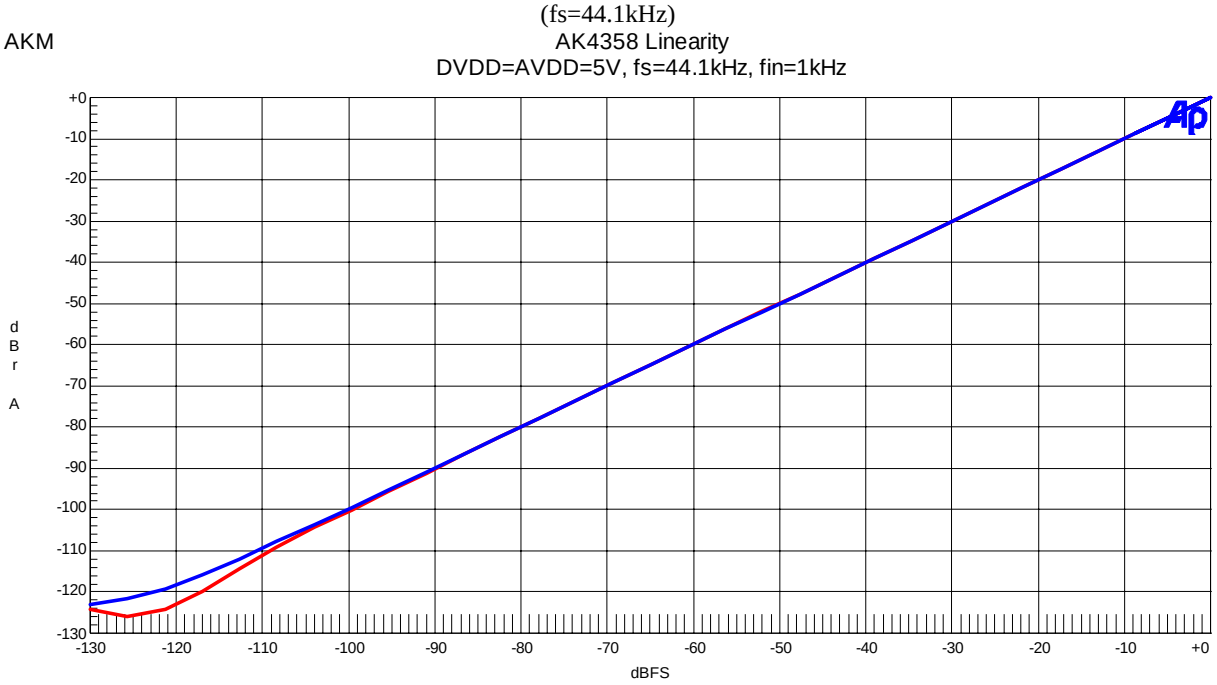


Figure 7. Linearity (fin=1kHz)

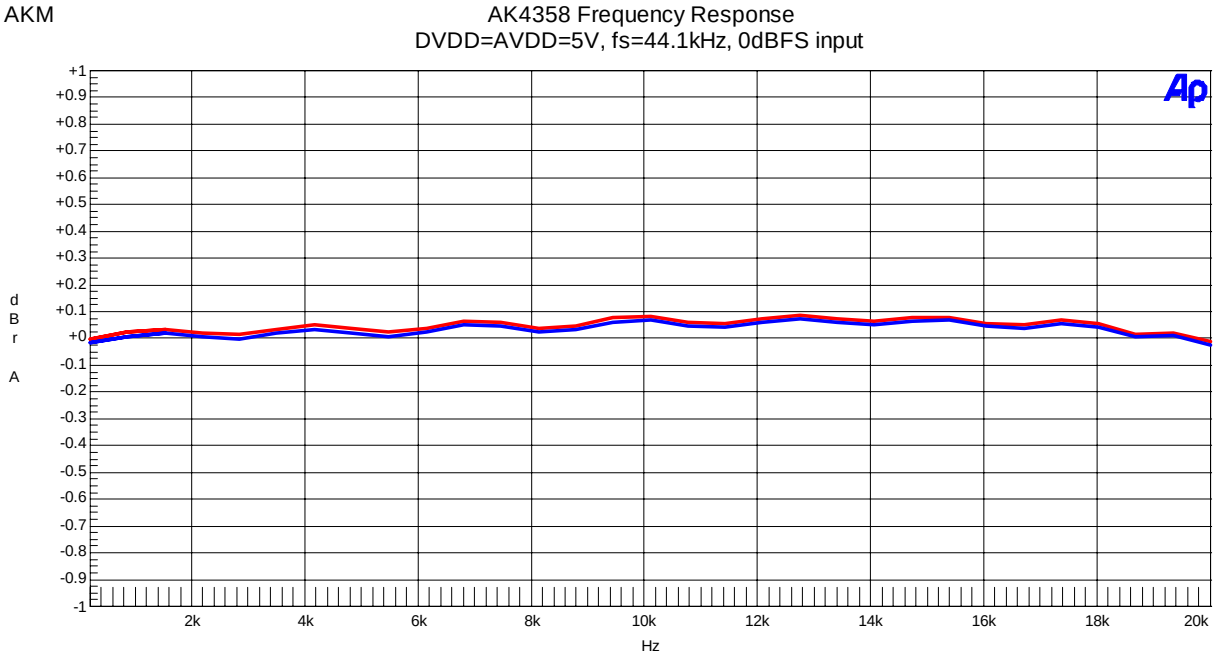


Figure 8. Frequency Response (0dBFS input)

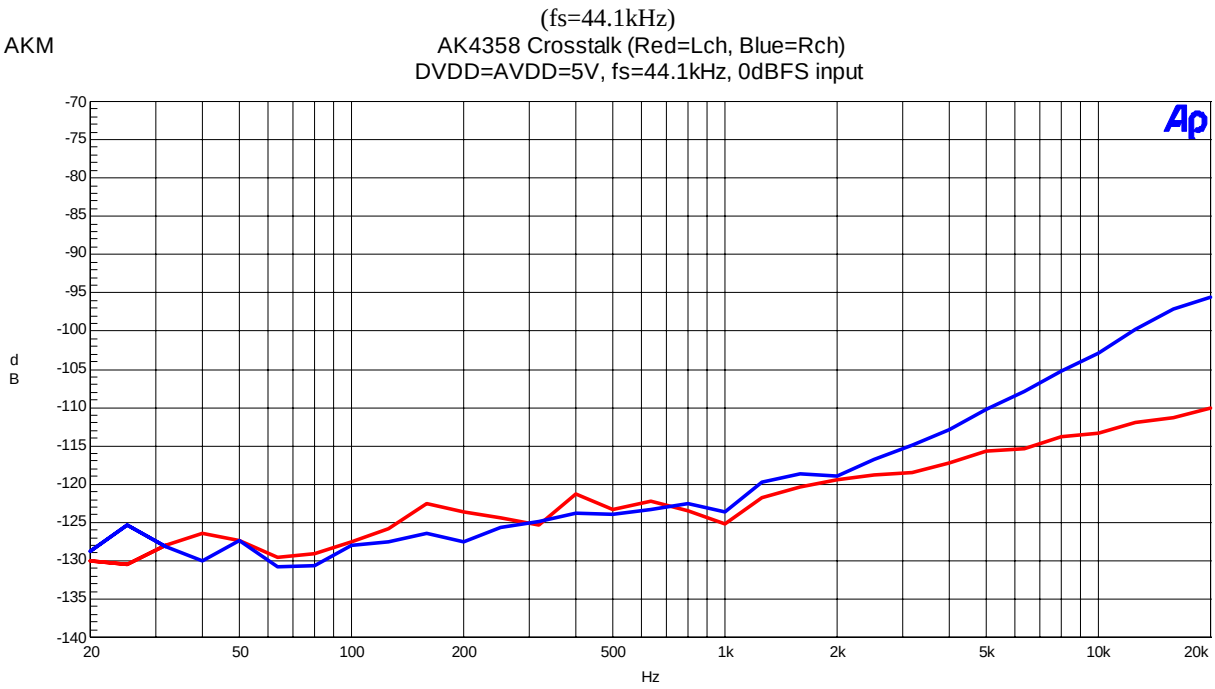


Figure 9. Cross-talk (0dBFS input)

(fs=96kHz)

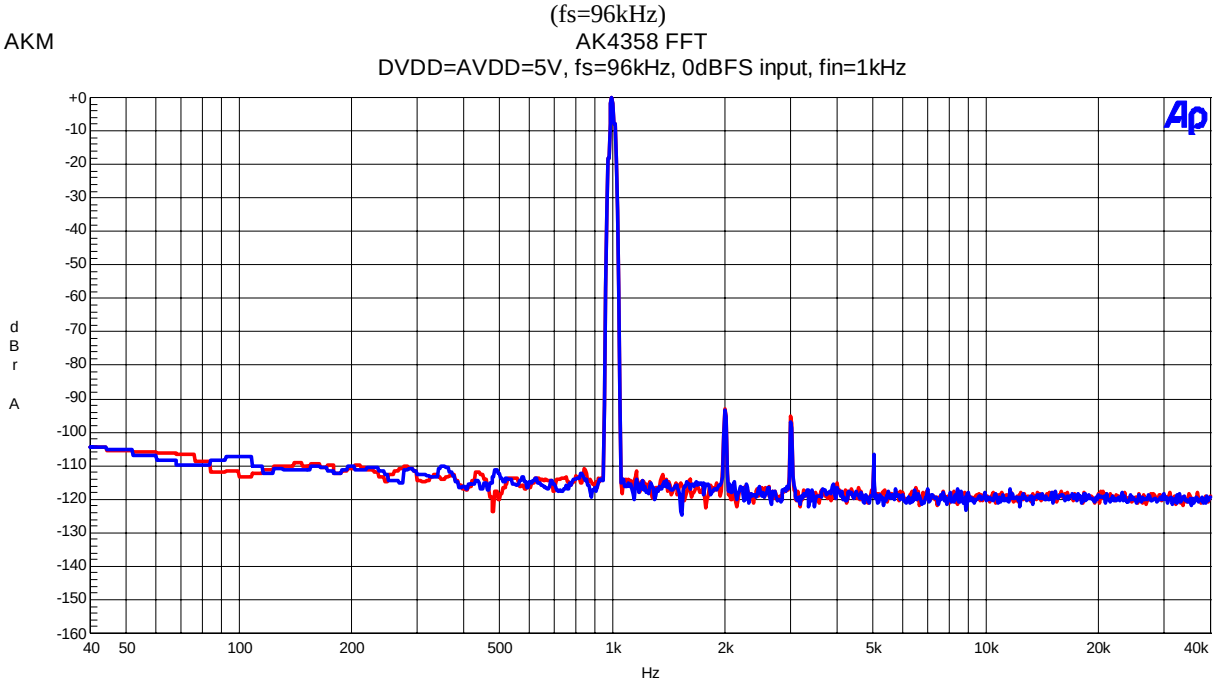


Figure 10. FFT (fin=1kHz, 0dBFS input)

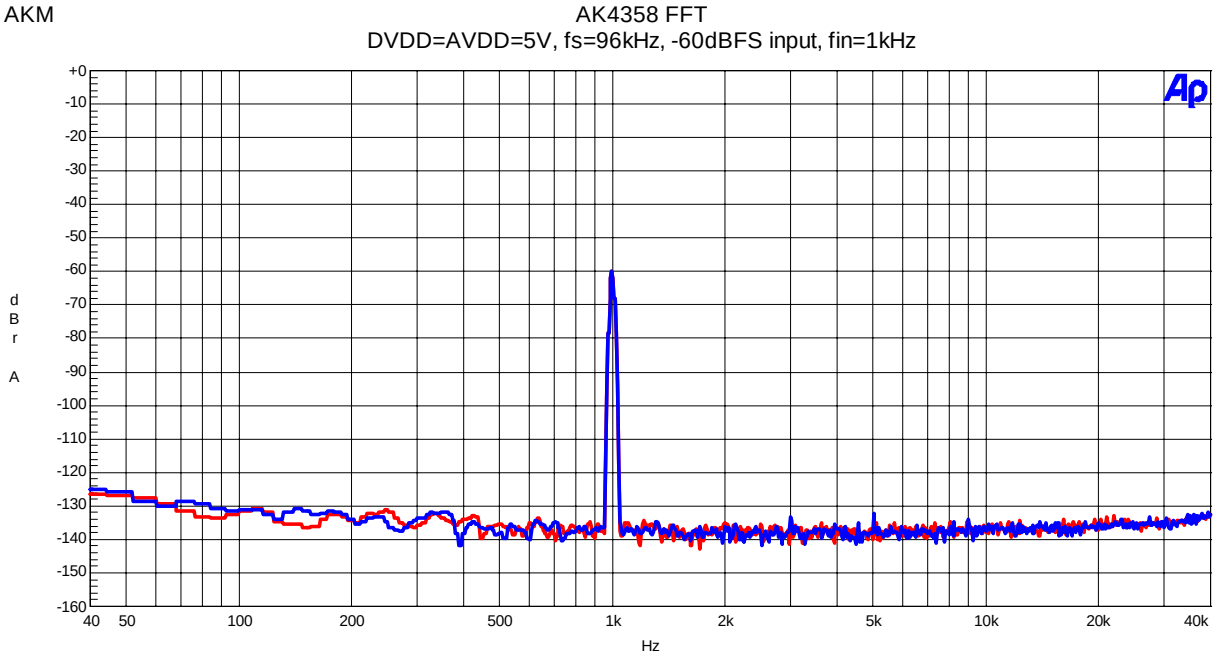


Figure 11. FFT (fin=1kHz, -60dBFS input)

(fs=96kHz)

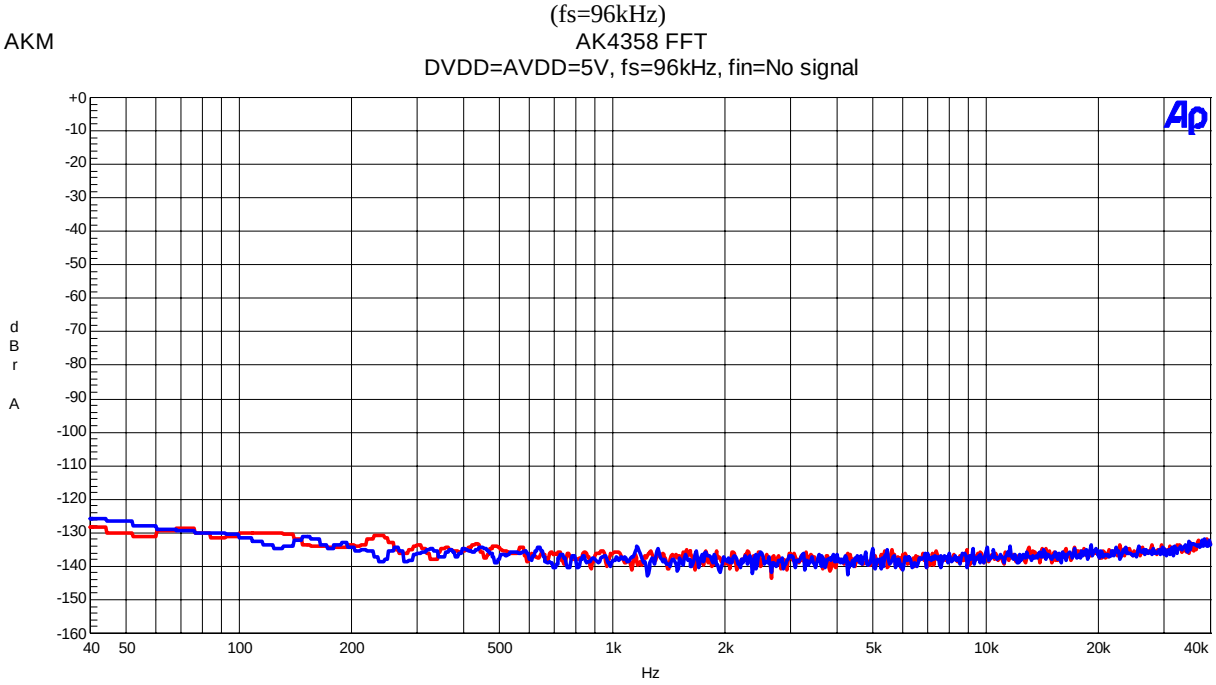


Figure 12. FFT (Noise floor)

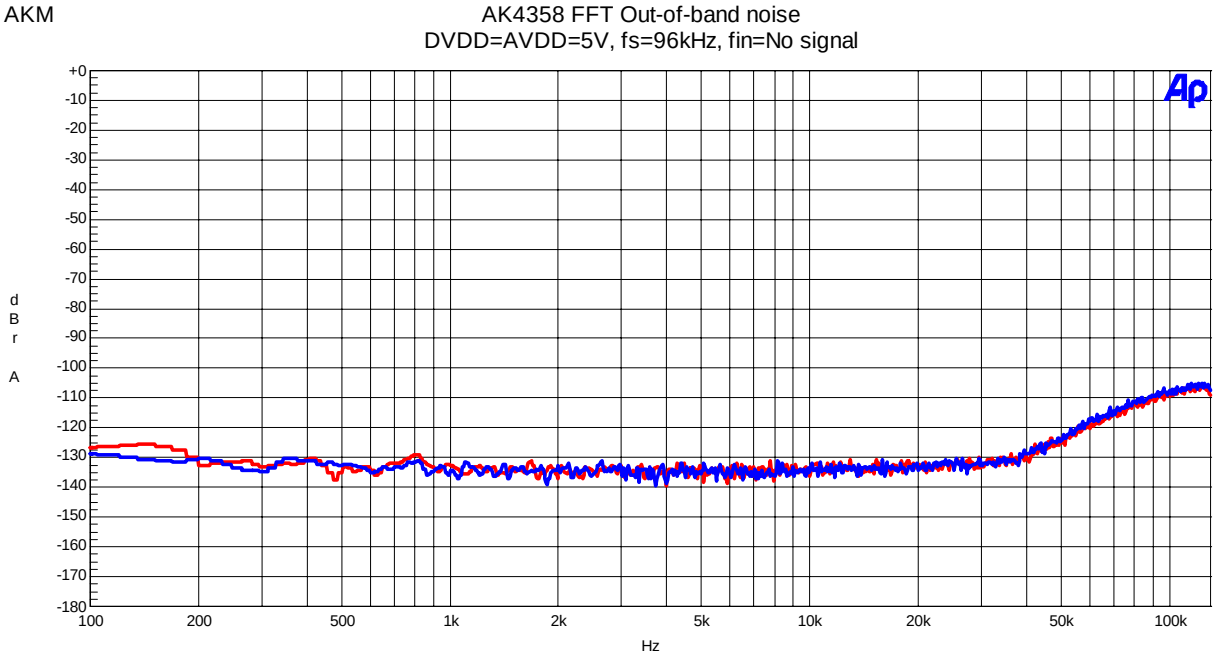


Figure 13. FFT (Out-of-band noise)

(fs=96kHz)

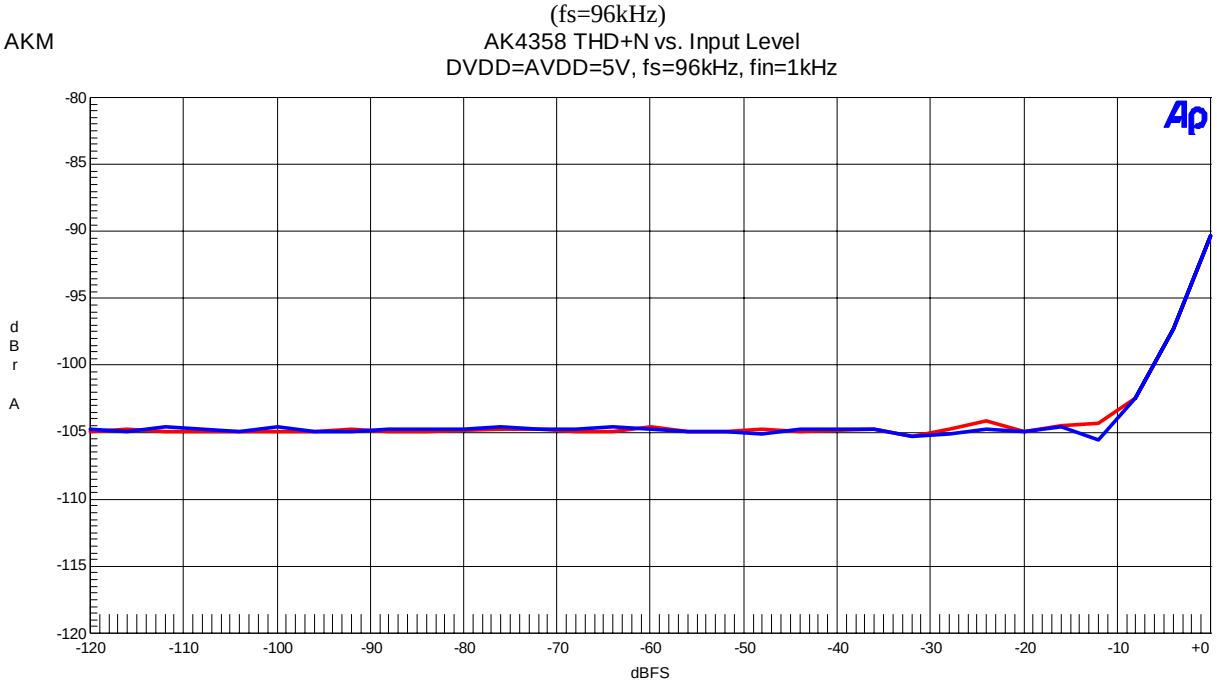


Figure 14. THD+N vs Input Level (fin=1kHz)

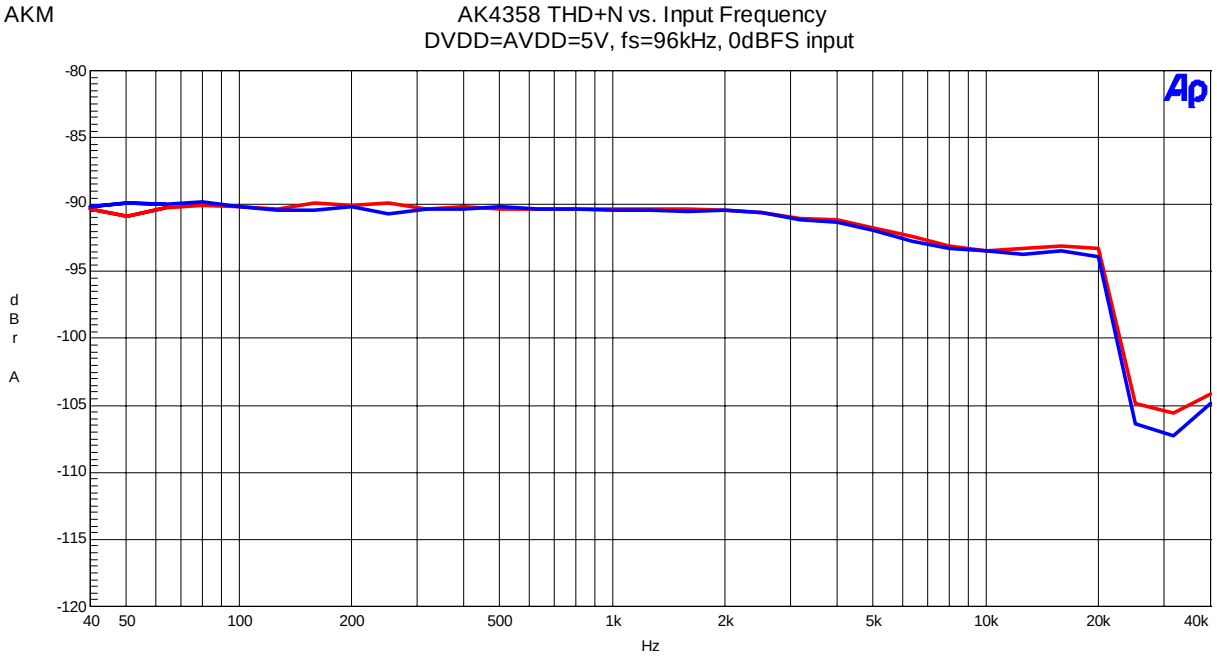


Figure 15. THD+N vs fin (0dBFS input)

(fs=96kHz)

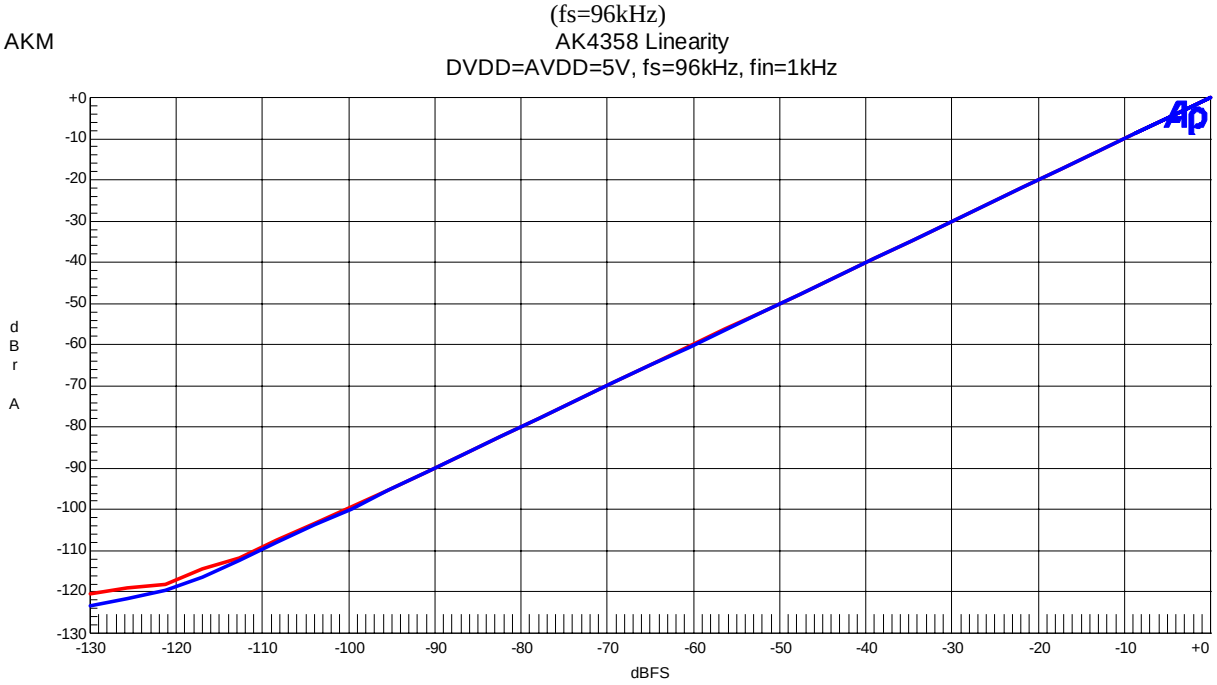


Figure 16. Linearity (fin=1kHz)

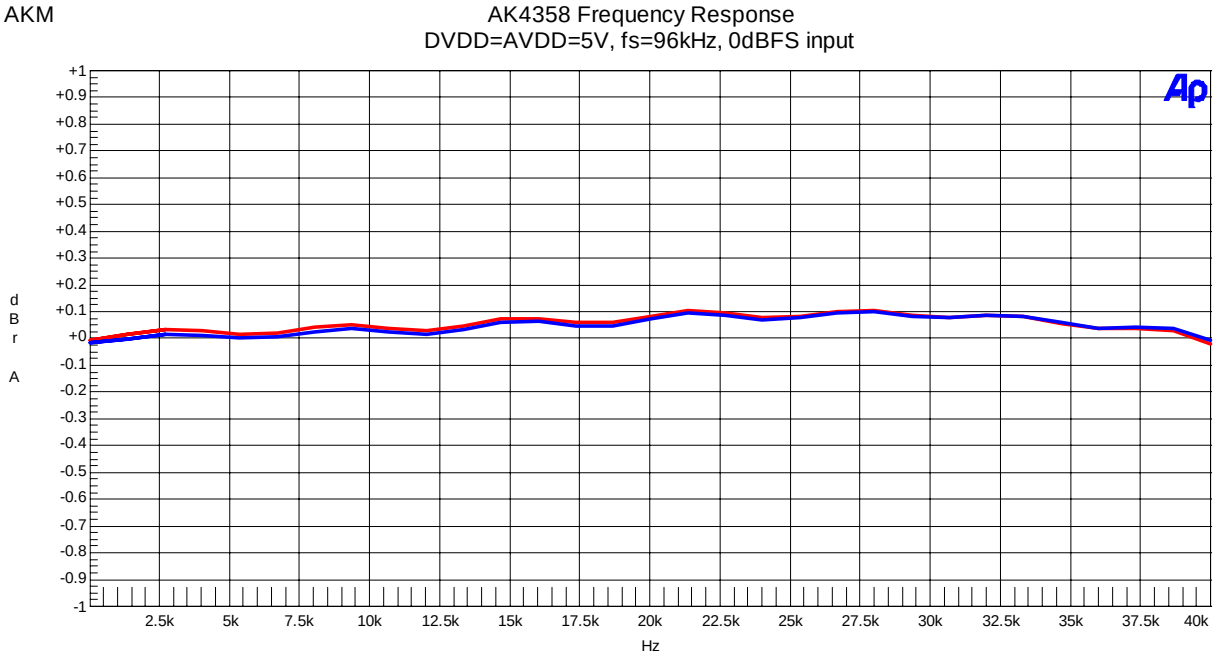


Figure 17. Frequency Response (0dBFS input)

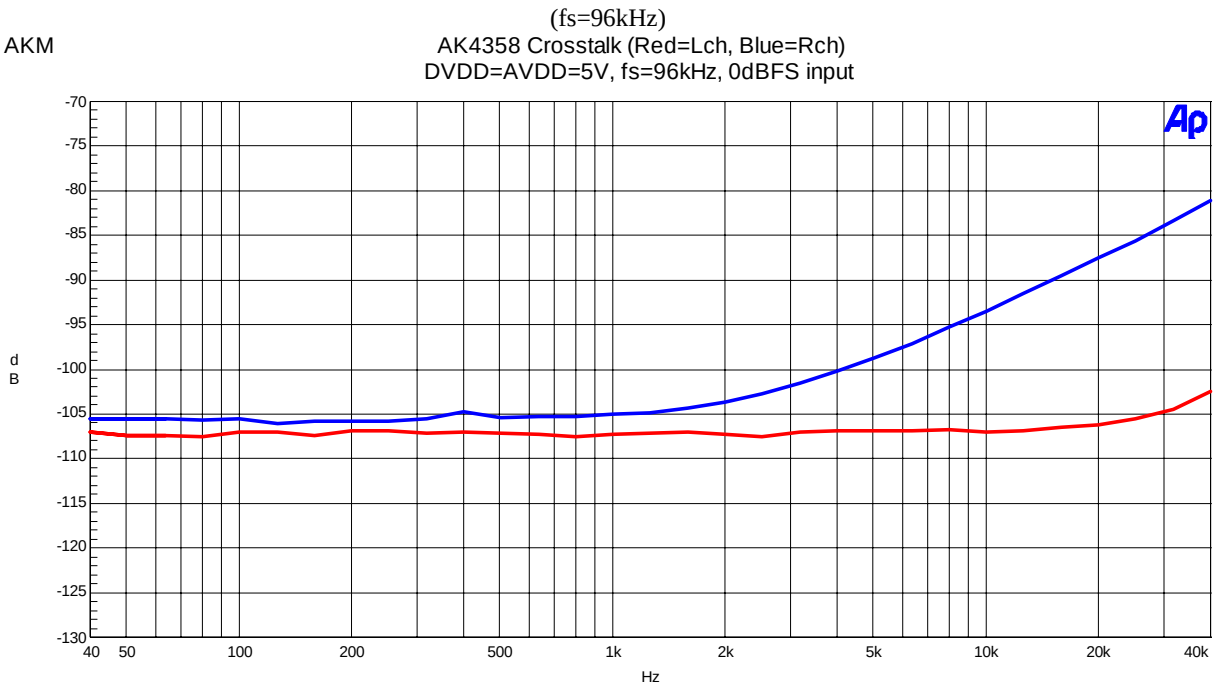


Figure 18. Cross-talk (0dBFS input)

(fs=192kHz)

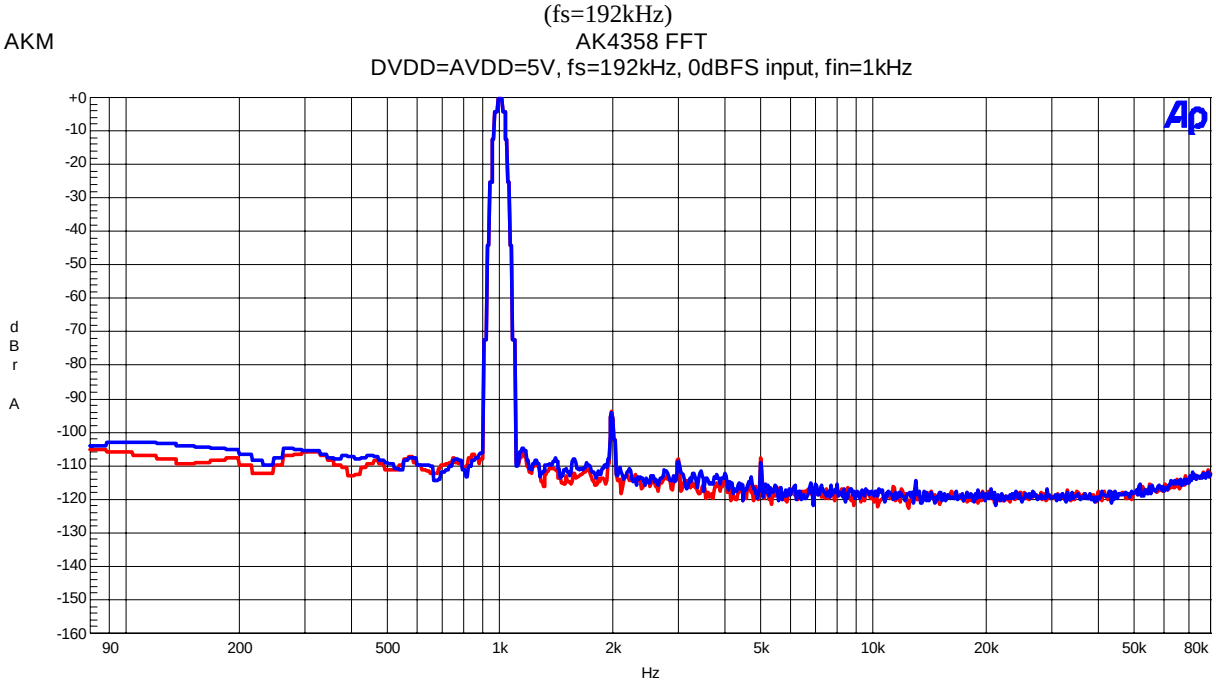


Figure 19. FFT (fin=1kHz, 0dBFS input)

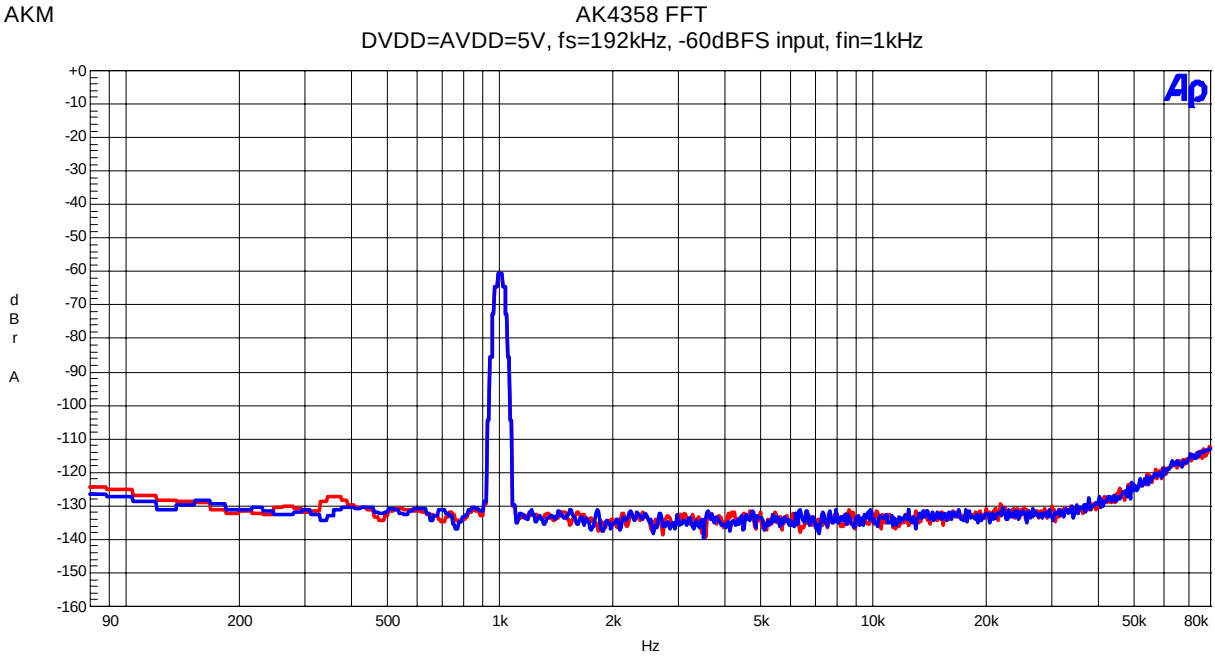


Figure 20. FFT (1kHz, -60dBFS input)

(fs=192kHz)

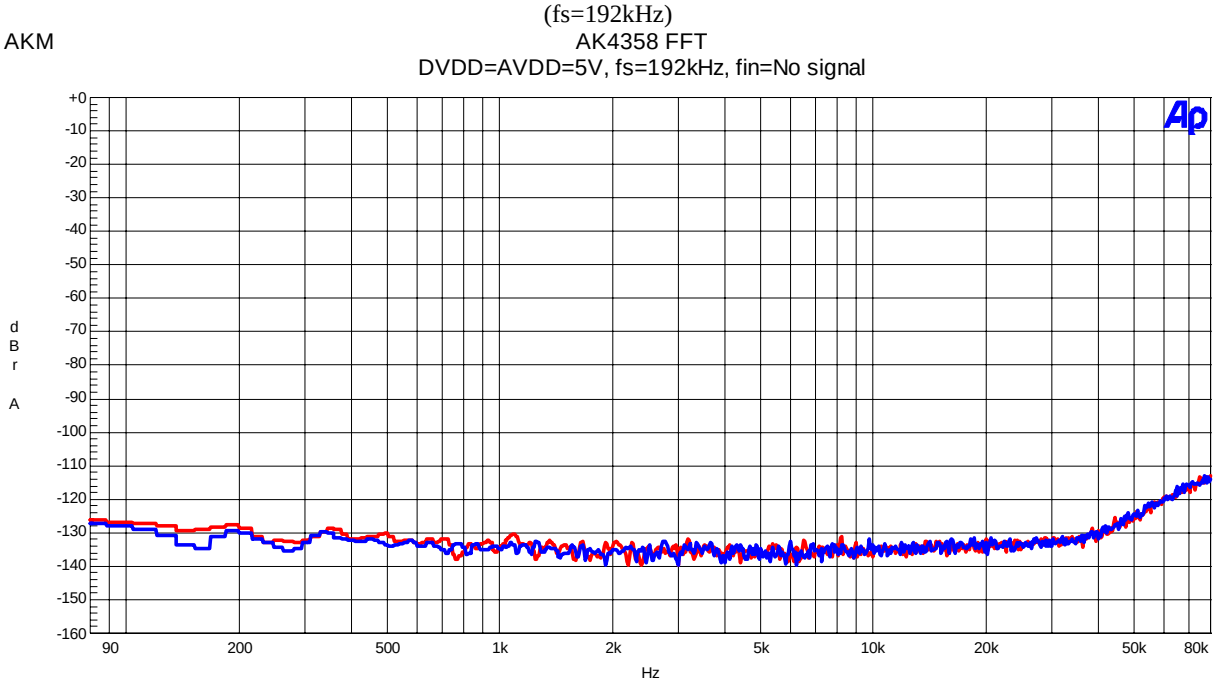


Figure 21. FFT (Noise floor)

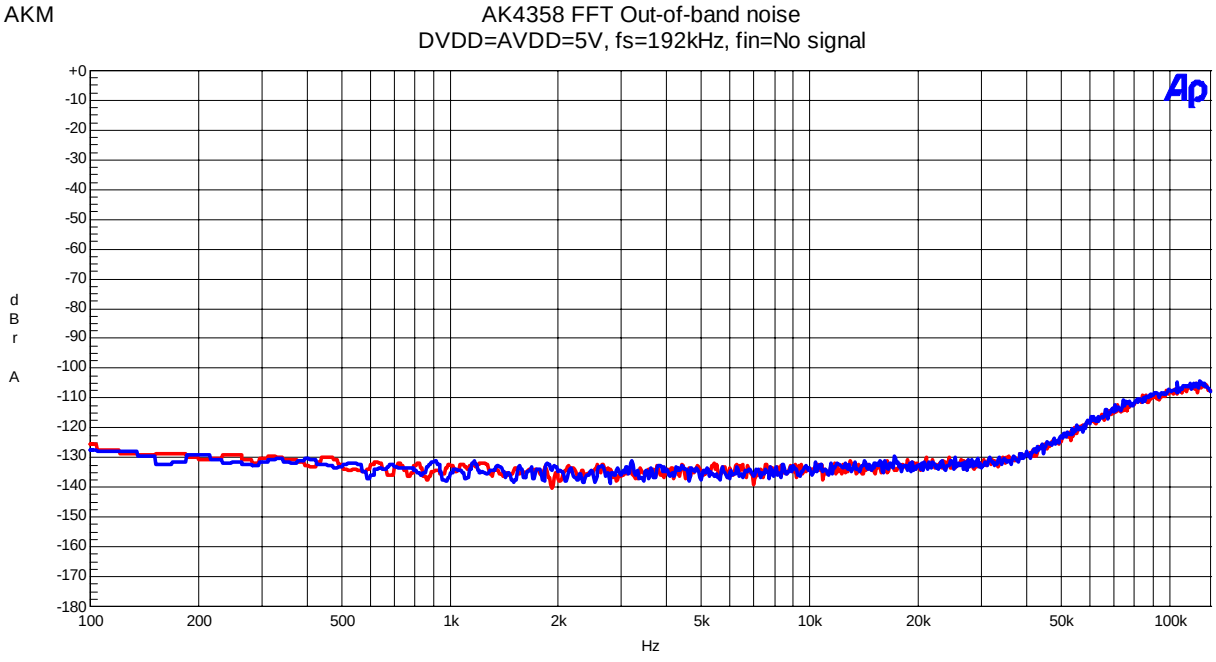


Figure 22. FFT (Out-of-band noise)

(fs=192kHz)

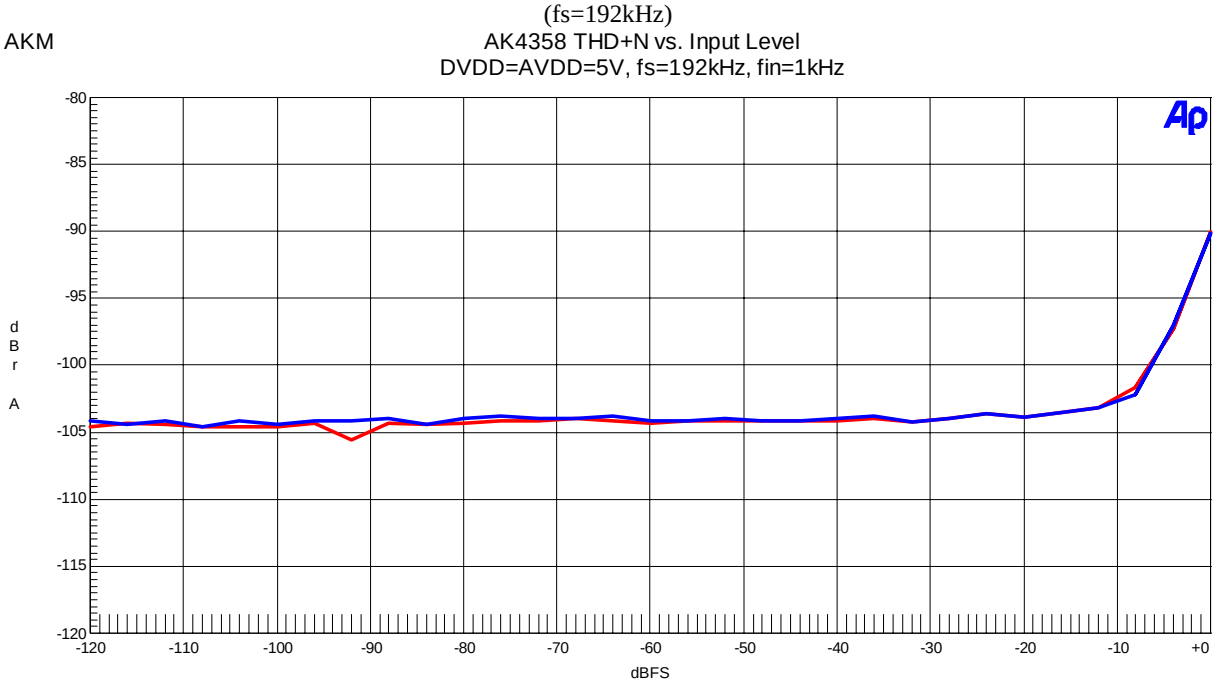


Figure 23. THD+N vs Input Level (fin=1kHz)

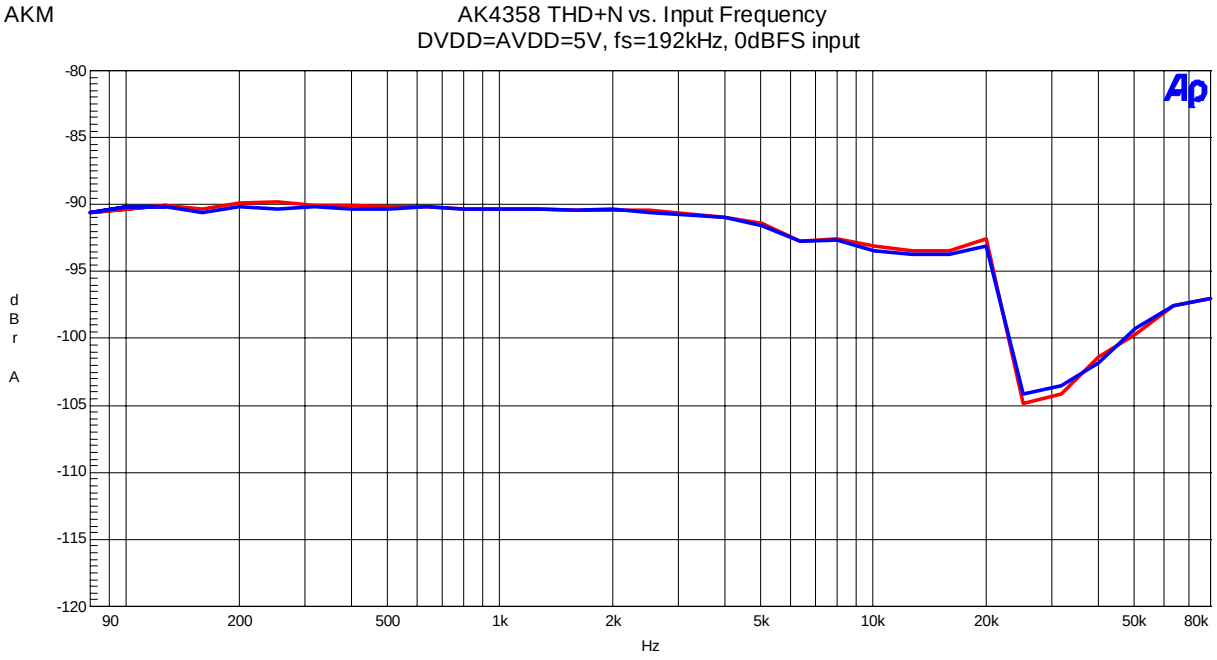


Figure 24. THD+N vs fin (0dBFS input)

(fs=192kHz)

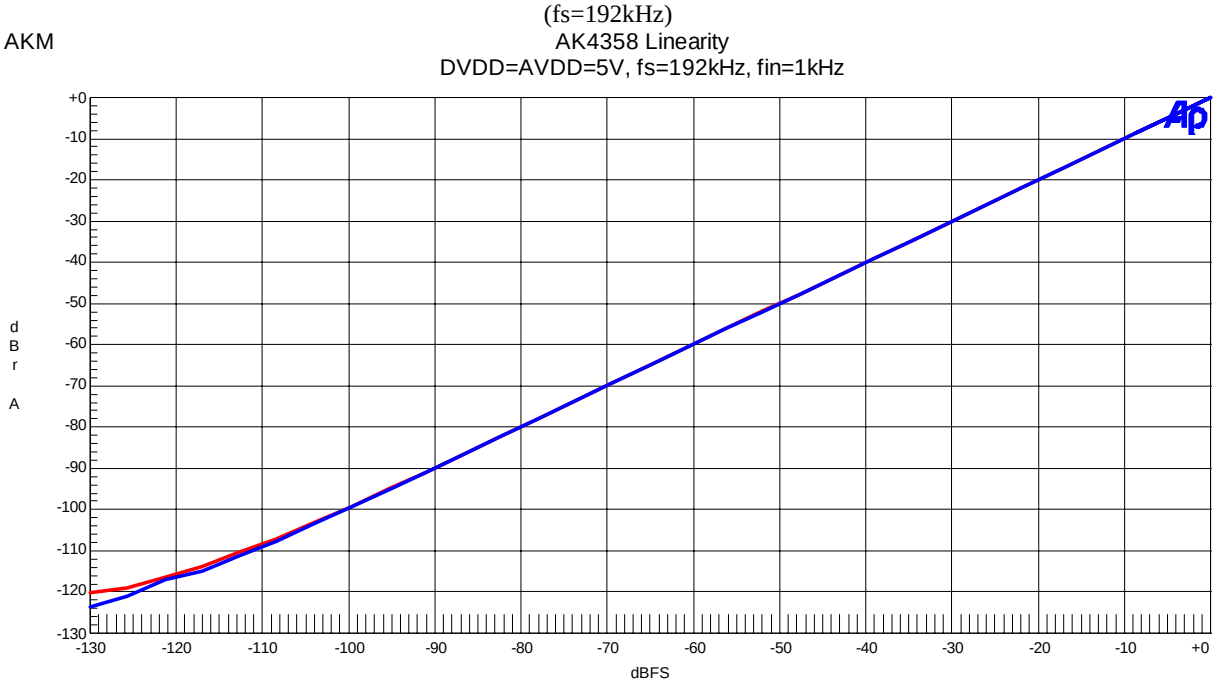


Figure 25. Linearity (fin=1kHz)

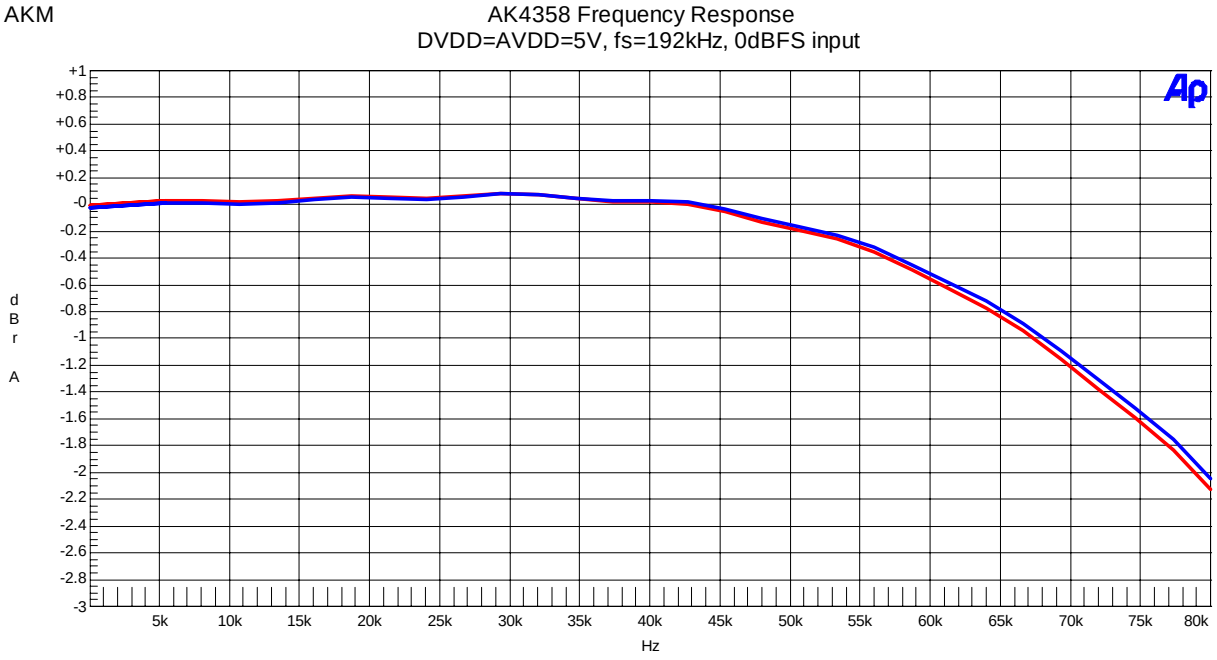


Figure 26. Frequency Response (0dBFS input)

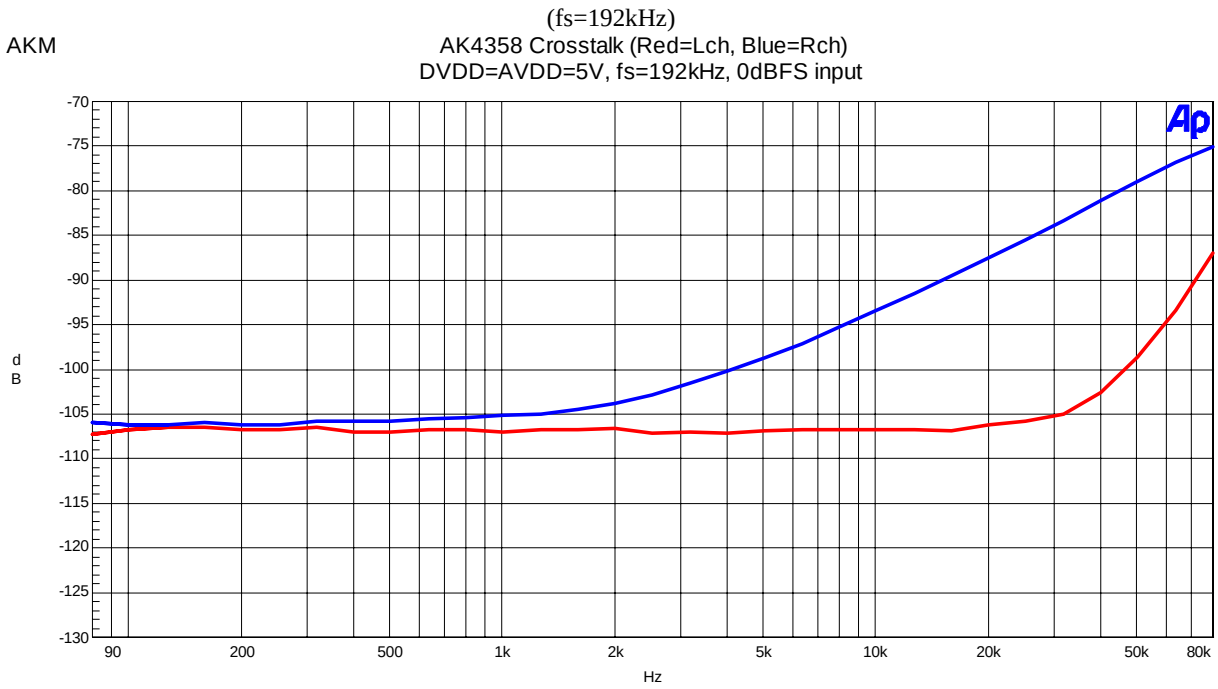
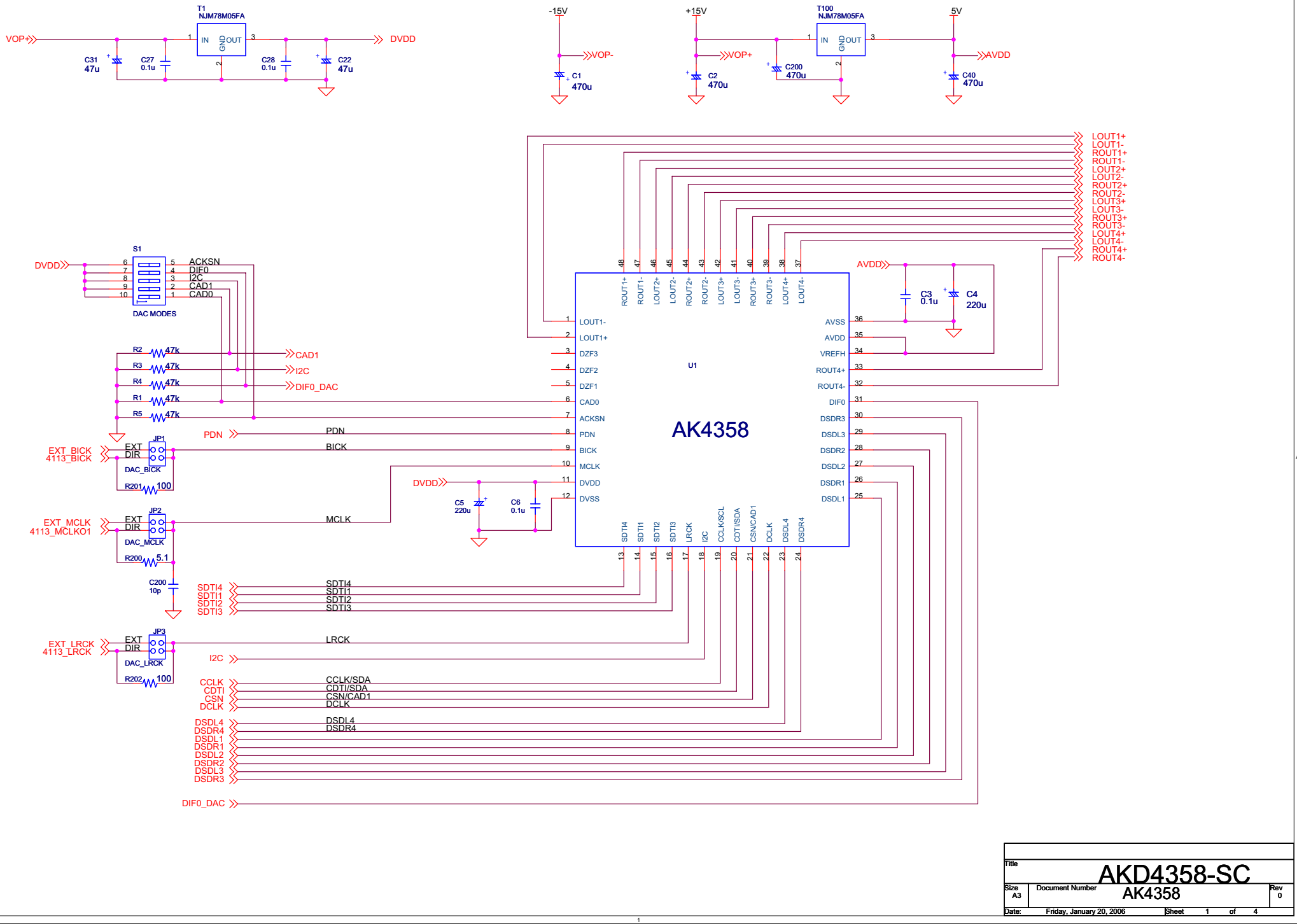


Figure 27. Cross-talk (0dBFS input)

Revision History

Date (YY/MM/DD)	Manual Revision	Board Revision	Reason	Contents
06/03/08	KM080700		First Edition	



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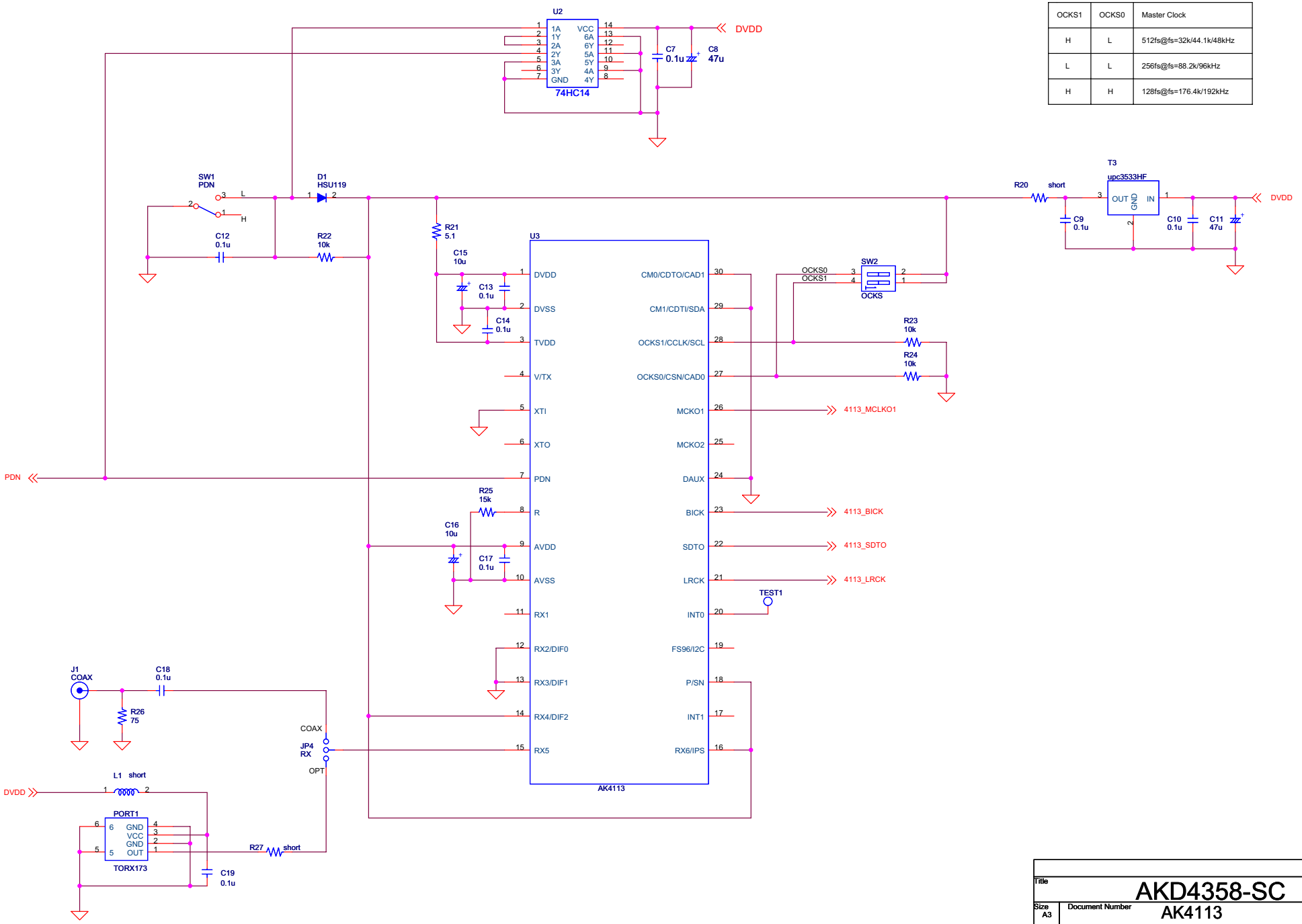

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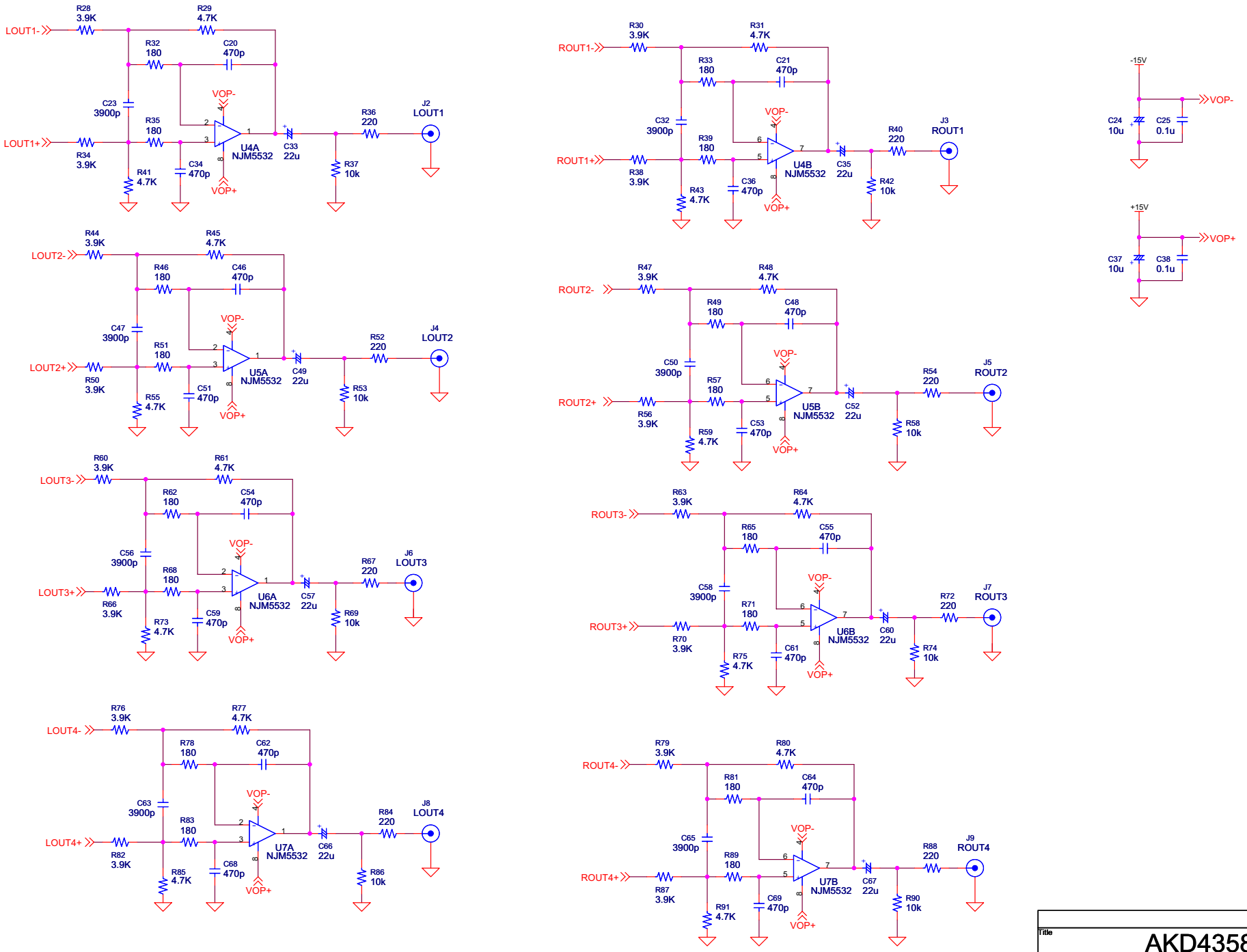
Size A3	Document Number AK4113		Rev 0
Date: Friday, January 20, 2006	Sheet 2 of 4		



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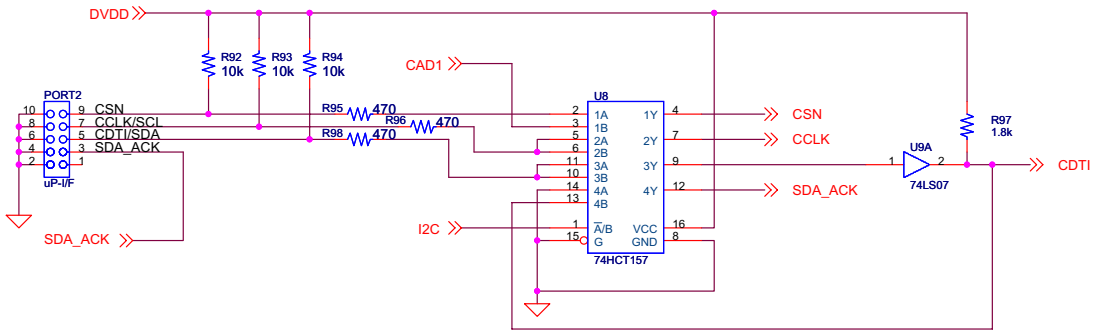

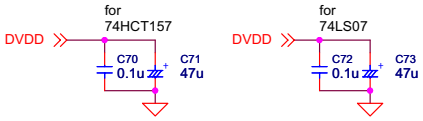

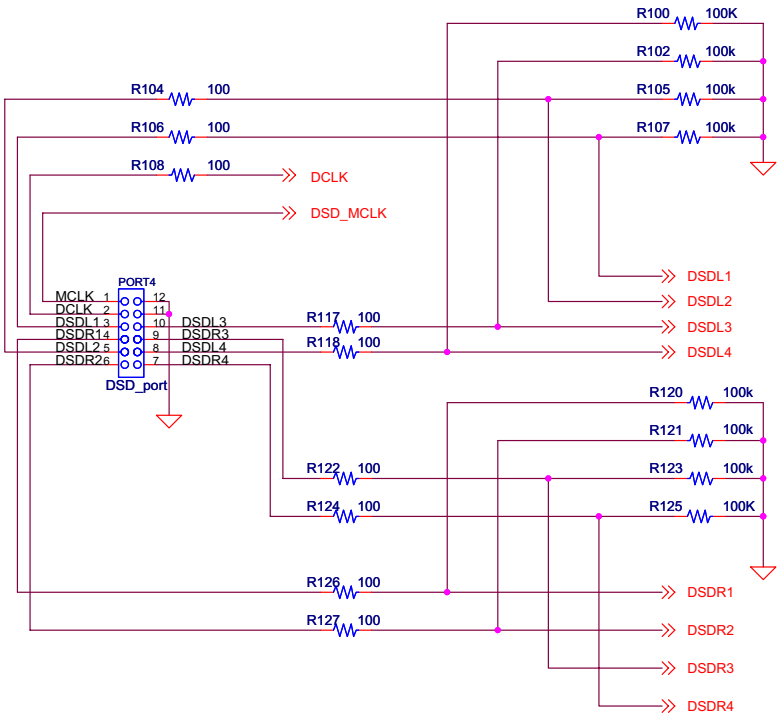

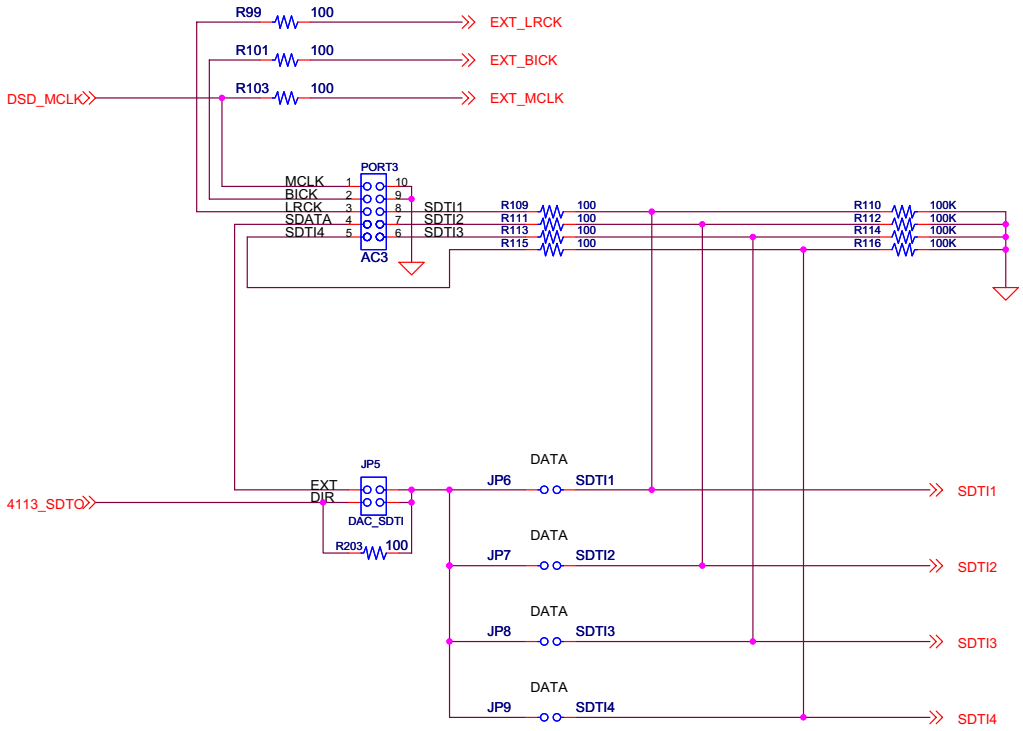

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