



AKD4359

Evaluation board Rev.B for AK4359

GENERAL DESCRIPTION

The AKD4359 is an evaluation board for AK4539, the 24bit 8ch D/A converter. The AKD4359 also has the digital audio interface and can achieve the interface with digital audio systems via opt-conector or BNC connector.

■ Ordering guide

AKD4359 --- Evaluation board for AK4359
(Cable for connecting with printer port of IBM-AT compatible PC and control software are packed with this. This control software does not operate on Windows NT)

FUNCTION

- ☐ **Compatible with 2 types of interface**
DIR with optical input and BNC input
Direct interface with AC3 decoder by 10pin header
- ☐ **10pin header for serial control interface**

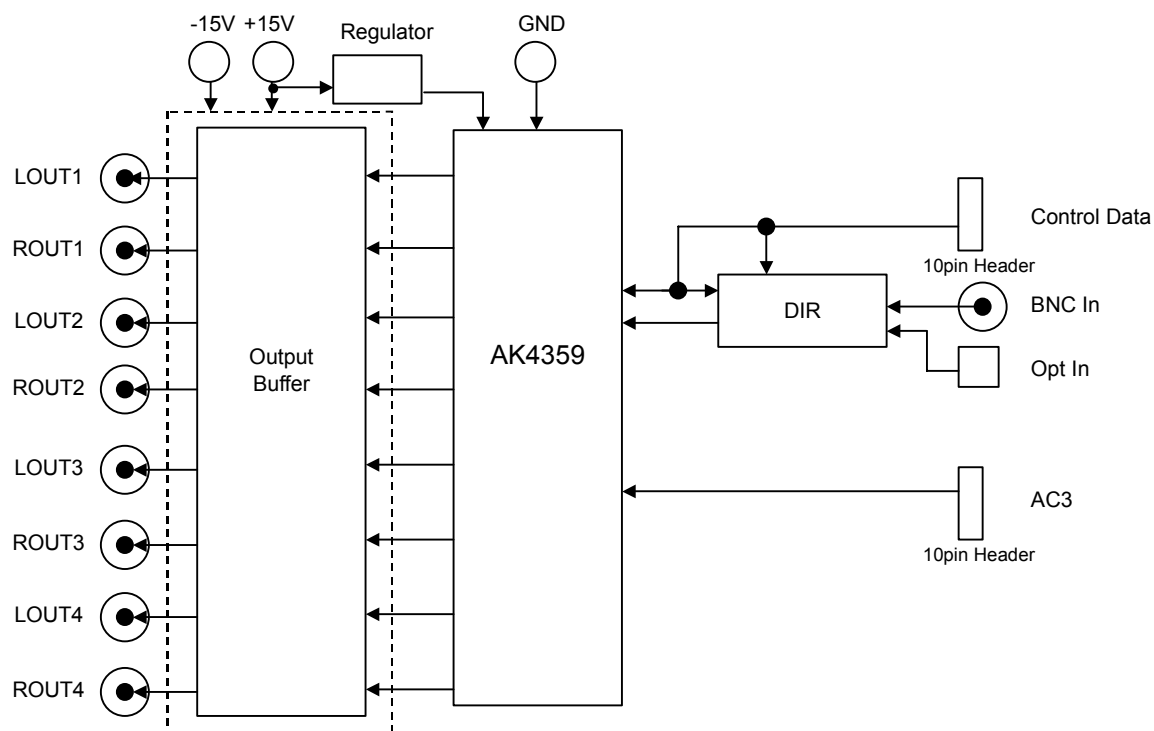


Figure 1. AKD4359 Block Diagram

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

1. Evaluation Board Manual

■ Operation sequence

1) Set up the jumper for power supply.

- [JP1(VD)] Select a power supply voltage source which is supplied to DVDD pin of the AK4359.
 REG: The power supply voltage is supplied from a regulator (Default)
 Nothing should be connected to an 4359_VD terminal when using the regulator.
 4395_VD: AVDD pin of the AK4359 is supplied from an 4359_VD terminal.

2) Set up the power supply lines.

- [+15V] (orange) = +12 ~ +15V
 [-15V] (blue) = -12 ~ -15V
 [4359_VD] (red) = +5V: Supplied to DVDD pin of the AK4359.
 [AGND] (black) = 0V
 [DGND] (black) = 0V

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

±15V are supplied to analog interface.

+15V is regulated to +5V by a regulator (T1).

+5V is supplied to AVDD and DVDD pins of the AK4359.

3) Set up the evaluation mode and jumper pins. (See the followings.)

4) Power on

The AK4359 should be reset once bringing SW1 “L” upon power-up.

5) Set up serial control

Serial control can be controlled via the printer port (PORT3 is used).

The AKD4359 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT3 (μP-I/F) with PC by 10-line flat cable packed with the AKD4359.

Take note of the direction of connector. There is a mark at pin #1.

The PORT3 pin layout is shown in Figure 2.

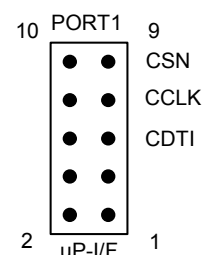


Figure 2. PORT3 pin layout

■ Evaluation Mode (Refer to Table 1)

1) Evaluation of DAC

TORX or BNC is used. JP6, JP7, JP8 and JP9 should select “DIR”. (Default)

2) Evaluation of DAC using DSP.

A 10 pin header (PORT1) is used. It is EXT about JP6, 7, 8, and 9. Please set JP2, 3, 4, and 5 to Open.

Evaluation Mode	JP32, JP35, JP38, JP42	Interface
DAC	DIR	TORX176 or BNC
DSP is used	Open	PORT1 (10pin header)

Default

Table 1. Evaluation Mode

■ DIP switch (S1) set up

No.	Pin	出荷時	説明
1	CM0	OFF	AK4114 Clock mode set-up (Refer to the table 3)
2	OCKS1	OFF	MCLK frequency set-up (Refer to the table 4.)
3	OCKS0	OFF	
4	P/S	OFF	AK4359 P/S pin set-up (Refer to the table 5.)
5	ACKS	OFF	ACKS/CCLK pin set-up (Refer to the table 6.)
6	SMUTE	OFF	SMUTE pin set-up (Refer to the table 7.)

Table 2. S1 set-up

CM0 (S-1)	MCKO	SDTO
OFF	TORX or BNC	TORX or BNC
ON	X'tal	"0" data

Table 3. AK4114 Clock mode set-up

OCKS1 (SW3-3)	OCKS0 (SW3-4)	MCLK	LRCK		
			Normal	Double	Quad
OFF	OFF	256fs	Yes	Yes	No
ON	OFF	512fs	Yes	No	No
ON	ON	128fs	No	Yes	Yes

Table 4. MCLK frequency set-up

P/S	Control mode	Default
ON	Serial mode	
OFF	Parallel mode	

Table 5. AK4359 P/S pin set-up

ACKS	MCLK setting	Default
ON	Auto setting	
OFF	Manual setting	

Table 6. ACKS/CCLK pin set-up

SMUTE	MUTE	Default
ON	Enable	
OFF	Disable	

Table 7. SMUTE pin set-up

■ Other jumper set up

[JP1](VD)	: VD supply selection for the AK4359
REG	: VD is supplied from the regulator. <default>
4359_VD	: VD is supplied from “4359_VD” jack.
[JP2-5](SDTI1-4)	: SDTI1-4 selection for the AK4359
Open	: Input “0” data
Short	: Input data <default>
[JP6](DAC_SDIT)	: SDTI pins data selection for the AK4359
EXT	: External port supplies data to the AK4359
DIR	: DIR (AK4114) supplies data to AK4359. <default>
[JP7](DAC_MCLK)	: MCLK clock selection for the AK4359
EXT	: External port supplies MCLK to AK4359
DIR	: DIR (AK4114) supplies MCLK to AK4359. <default>
[JP8](DAC_BICK)	: BICK clock selection for the AK4359
EXT	: External port supplies BICK to AK4359
DIR	: DIR (AK4114) supplies BICK to AK4359. <default>
[JP9](DAC_LRCK)	: LRCK clock selection for the AK4359
EXT	: External port supplies LRCK to AK4359
DIR	: DIR (AK4114) supplies LRCK to AK4359. <default>
[JP10](TORX/BNC)	: The source of the biphasic signal input to AK4114
TORX	: PORT4(TORX176: optical link) <default>
BNC	: J9(BNC)
[JP9] (GND)	: Digital GND and Analog GND
Open	: Digital GND and Analog GND are disconnected. <default>
Short	: Digital GND and Analog GND are connected.

■ The function of the toggle SW

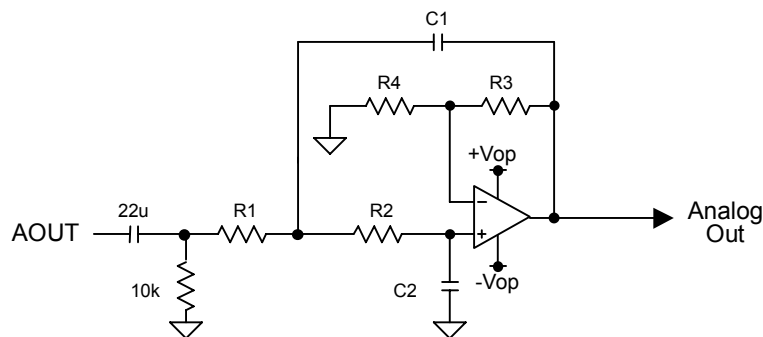
[SW1]	: Reset the AK4359. Keep “H” during normal operation.
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■ The indication content for LED

[LE1] (UNLOCK/PAR)	: Unlock and parity error output of the AK4114.
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■ External analog circuit

The 2nd order LPF ($f_c=111.8\text{kHz}$, $Q=0.714$) which adds differential outputs of the AK4359 is implemented on the board. When the further attenuation of the out-band noise is needed, some additional LPF is required. Analog signal is output through BNC connectors on the board. And the output level of the AK4359 is $5.68\text{Vpp}@5\text{V}$.



$f_c=111.8\text{kHz}$, $Q=0.714$, $g=-0.04\text{dB}$ at 40kHz

Figure 3. On-board analog filter

R_1	R_2	R_3	R_4	C_1	C_2
1.5k	1.8k	2.2k	3.3k	820p	820p

Table 1. The value of R,C on this board

f_{in}	20kHz	40kHz	80kHz
Frequency Response	0.00dB	-0.04dB	-0.76dB

Table 2. Frequency Response of LPF

<Calculation>

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

$$K = \frac{R_3 + R_4}{R_4},$$

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

$$\omega_0 = \frac{1}{\sqrt{2C_1C_2R_1R_2}},$$

$$Q = 2\pi f_c \frac{1}{\frac{1}{C_1R_1} + \frac{1}{C_1R_2} + \frac{1-k}{C_2R_2}}$$

2. Control Software Manual

■ Set-up of evaluation board and control software

1. Set up the AKD4359 according to previous term.
2. Connect IBM-AT compatible PC with AKD4359 by 10-line type flat cable (packed with AKD4359). Take care of the direction of 10pin header. (Please install the driver in 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 Windows 95/98ME, this installation is not needed. This control software does not operate on Windows NT.)
3. Insert the CD-ROM labeled "AK4359 Evaluation Kit " into the CD-ROM drive.
4. Access the CD-ROM drive and double-click the icon of "AKD4359.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 "Write default" button.
3. Then set up the dialog and input data.

■ Explanation of each buttons

1. [Write default]: Initialize the register of the AK4359.
2. [Function1] : Dialog to write data by keyboard operation.
3. [Function2] : Dialog to write data by keyboard operation.
4. [Write] : Dialog to write data by mouse operation.
5. [Interface]: By pressing this button, you can select between I2C and 3-wire interface mode. I2C interface mode is default. Make sure this mode matches the mode set on S1 of this board. Please confirm "S1" switch on the board whether this mode select.

■ Explanation of each dialog

1. [Function1 Dialog]: Dialog to write data by keyboard operation

- Address Box: Input register address in 2 figures of hexadecimal.
- Data Box: Input register data in 2 figures of hexadecimal.

If you want to write the input data to AK4359, click “WRITE” button. If not, click “Cancel” button.

2. [Function2 Dialog]: Dialog to evaluate DATT

This dialog corresponds to only addr= 03H ~ 0AH.

- Address Box: Input register address in 2 figures of hexadecimal.
- Start Data Box: Input start data in 2 figures of hexadecimal.
- End Data Box: Input end data in 2 figures of hexadecimal.
- Interval Box: Data is written to AK4359 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 AK4359, click “OK” button. If not, click “Cancel” button.

3. [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 AK4359, click “OK” button. If not, click “Cancel” button.

■ 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.

■ Attention on the operation

If you set up Function1 or Function2 dialog, input data to all boxes. Attention dialog is indicated if you input data or address that is not specified in the datasheet or you click “OK” button before you input data. In that case set up the dialog and input data once more again. These operations does not need if you click “Cancel” button or check the check box.

MEASUREMENT RESULTS

[Measurement condition]

- Measurement unit: Audio Precision, System two, Cascade
- MCLK : 256fs
- BICK : 64fs
- fs : 44.1kHz, 96kHz, 192kHz
- BW : 10Hz~20kHz (fs=44.1kHz), 10Hz~40kHz (fs=96kHz), 10Hz~40kHz (fs=192kHz)
- Bit : 24bit
- Power Supply : VDD=5V
- Interface : DIR(AK4114)
- Temperature : Room

fs=44.1kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	20kLPF	98.5dB	98.9dB
DR	1kHz, -60dB	20kLPF	103.0dB	103.2dB
		22kLPF, A-weighted	106.0dB	106.0dB
S/N	no signal	20kLPF	103.2dB	103.3dB
		22kLPF, A-weighted	106.2dB	106.2dB

fs=96kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	98.4dB	98.9dB
DR	1kHz, -60dB	40kLPF	102.7dB	102.8dB
		22kLPF, A-weighted	105.9dB	106.0dB
S/N	no signal	40kLPF	103.0dB	103.2dB
		22kLPF, A-weighted	106.0dB	106.2dB

fs=192kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	97.3dB	97.5dB
DR	1kHz, -60dB	40kLPF	102.8dB	102.8dB
		22kLPF, A-weighted	105.9dB	106.1dB
S/N	no signal	40kLPF	102.8dB	102.9dB
		22kLPF, A-weighted	106.1dB	106.2dB

■ プロット図

[Measurement condition]

- Measurement unit: Audio Precision, System two, Cascade
- MCLK : 256fs
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- fs : 44.1kHz, 96kHz, 192kHz
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- Bit : 24bit
- Power Supply : VDD=5V
- Interface : DIR(AK4114)
- Temperature : Room

fs=44.1kHz

- Figure 4. FFT (1kHz, 0dBFS input)
- Figure 5. FFT (1kHz, -60dBFS input)
- Figure 6. FFT (noise floor)
- Figure 7. FFT (out-of-band noise)
- Figure 8. THD+N vs Input Level (fin=1kHz)
- Figure 9. THD+N vs fin (Input level=0dBFS)
- Figure 10. Linearity (fin=1kHz)
- Figure 11. Frequency Response (Input level=0dBFS)
- Figure 12. Cross-talk (Input level=0dBFS)

fs=96kHz

- Figure13. FFT (1kHz, 0dBFS input)
- Figure14. FFT (1kHz, -60dBFS input)
- Figure15. FFT (noise floor)
- Figure16. FFT (outband noise)
- Figure17. THD+N vs Input Level (fin=1kHz)
- Figure18. THD+N vs fin (Input level=0dBFS)
- Figure19. Linearity (fin=1kHz)
- Figure20. Frequency Response (Input level=0dBFS)
- Figure21. Cross-talk (Input level=0dBFS)

fs=192kHz

- Figure22. FFT (1kHz, 0dBFS input)
- Figure23. FFT (1kHz, -60dBFS input)
- Figure24. FFT (noise floor)
- Figure25. FFT (outband noise)
- Figure26. THD+N vs Input Level (fin=1kHz)
- Figure27. THD+N vs fin (Input level=0dBFS)
- Figure28. Linearity (fin=1kHz)
- Figure29. Frequency Response (Input level=0dBFS)
- Figure30. Cross-talk (Input level=0dBFS)

FFT point=16384, Avg=8, Window=Equiripple

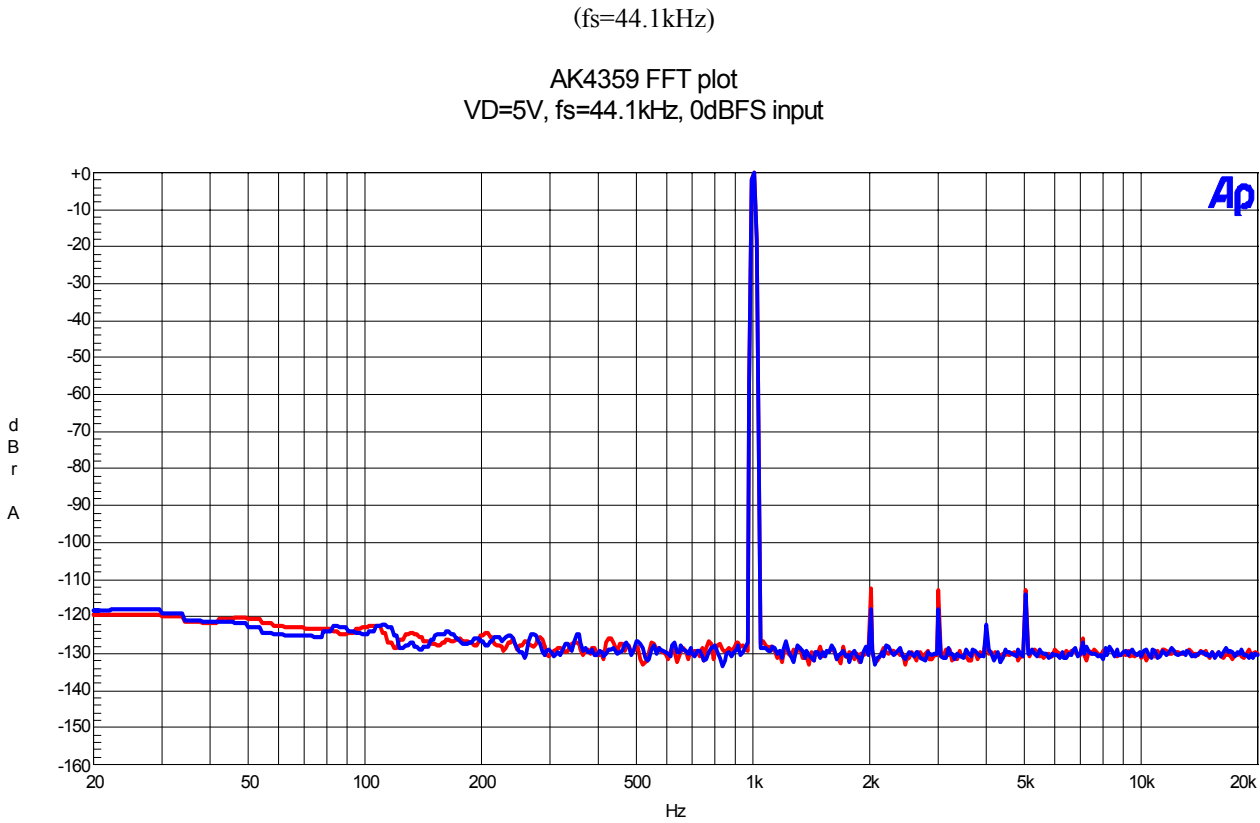


Figure 4. FFT (1kHz, 0dBFS input)

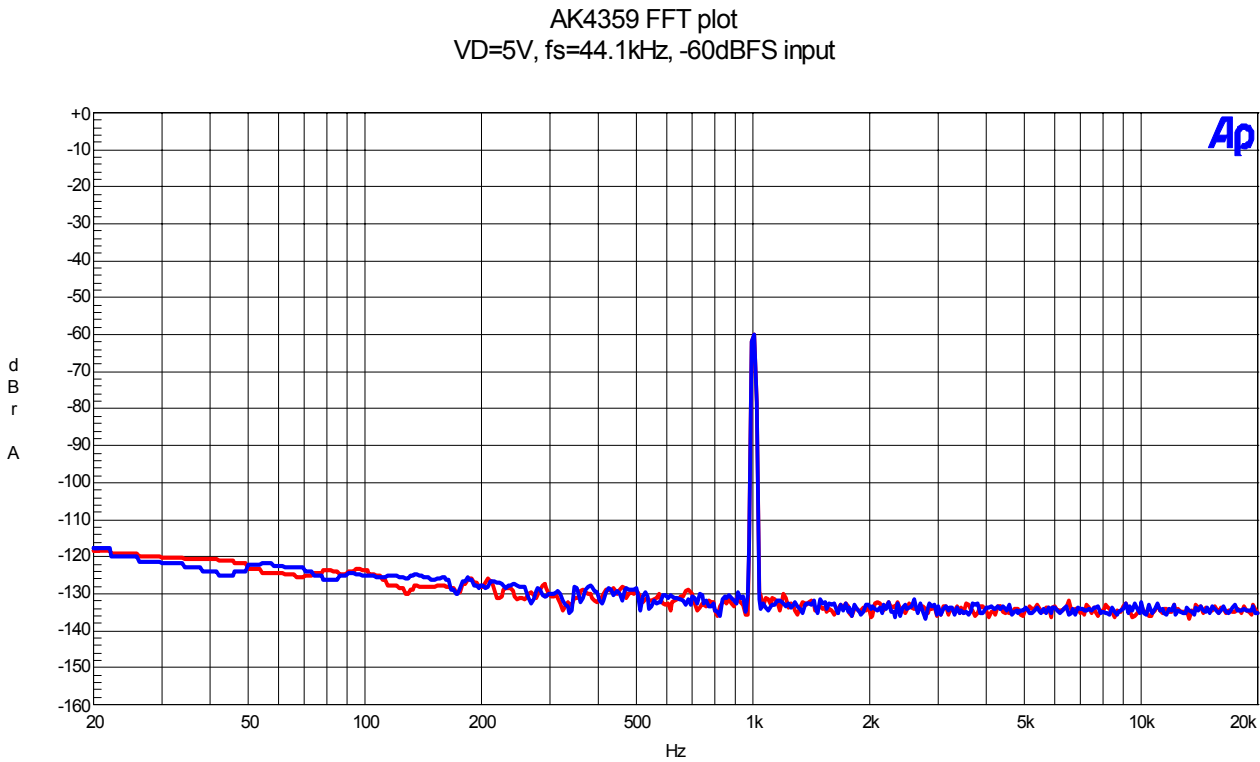


Figure 5. FFT (1kHz, -60dBFS input)

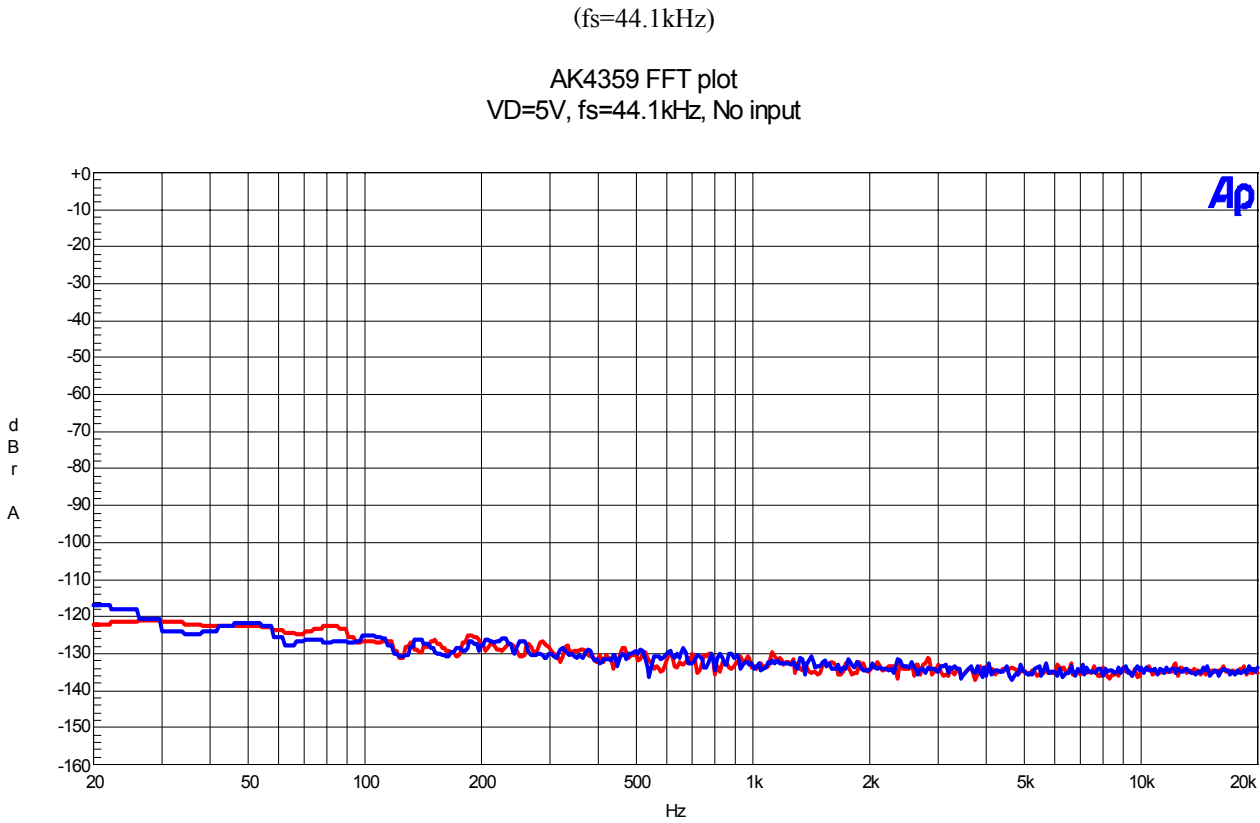


Figure 6. FFT (noise floor)

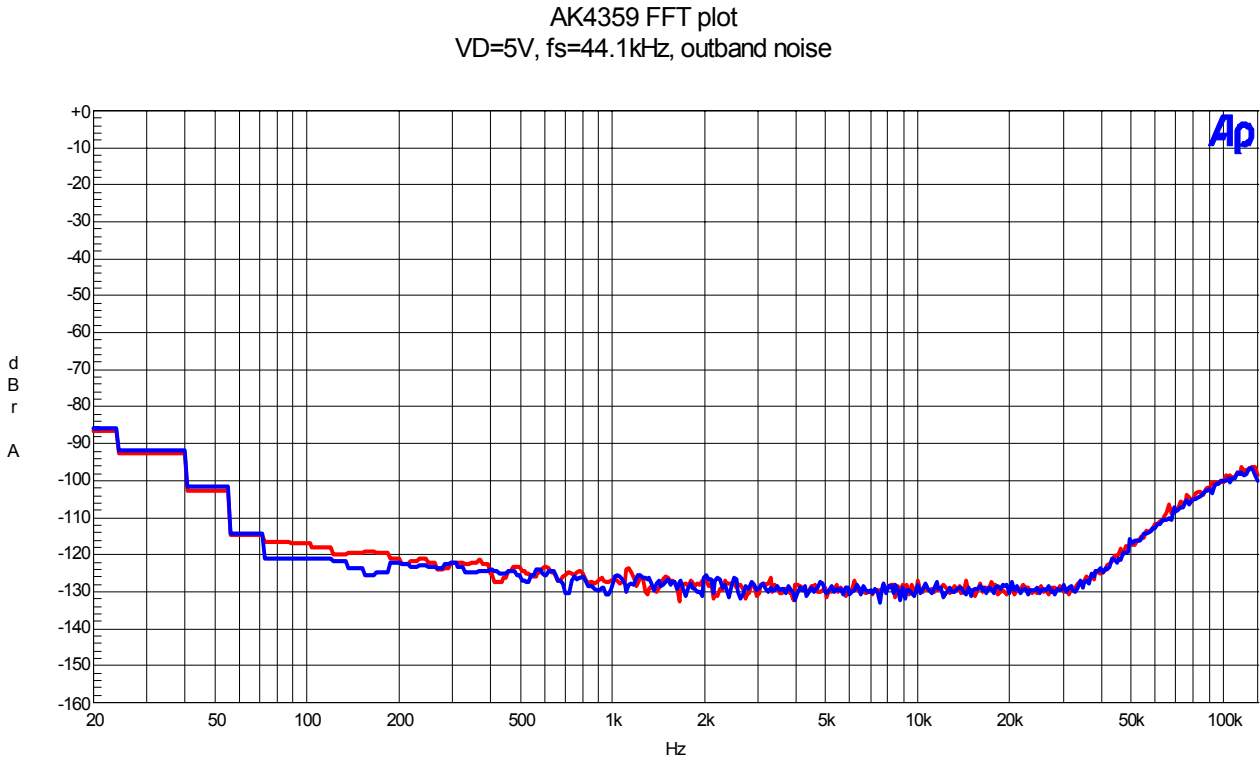


Figure 7. FFT (out-of-band noise)

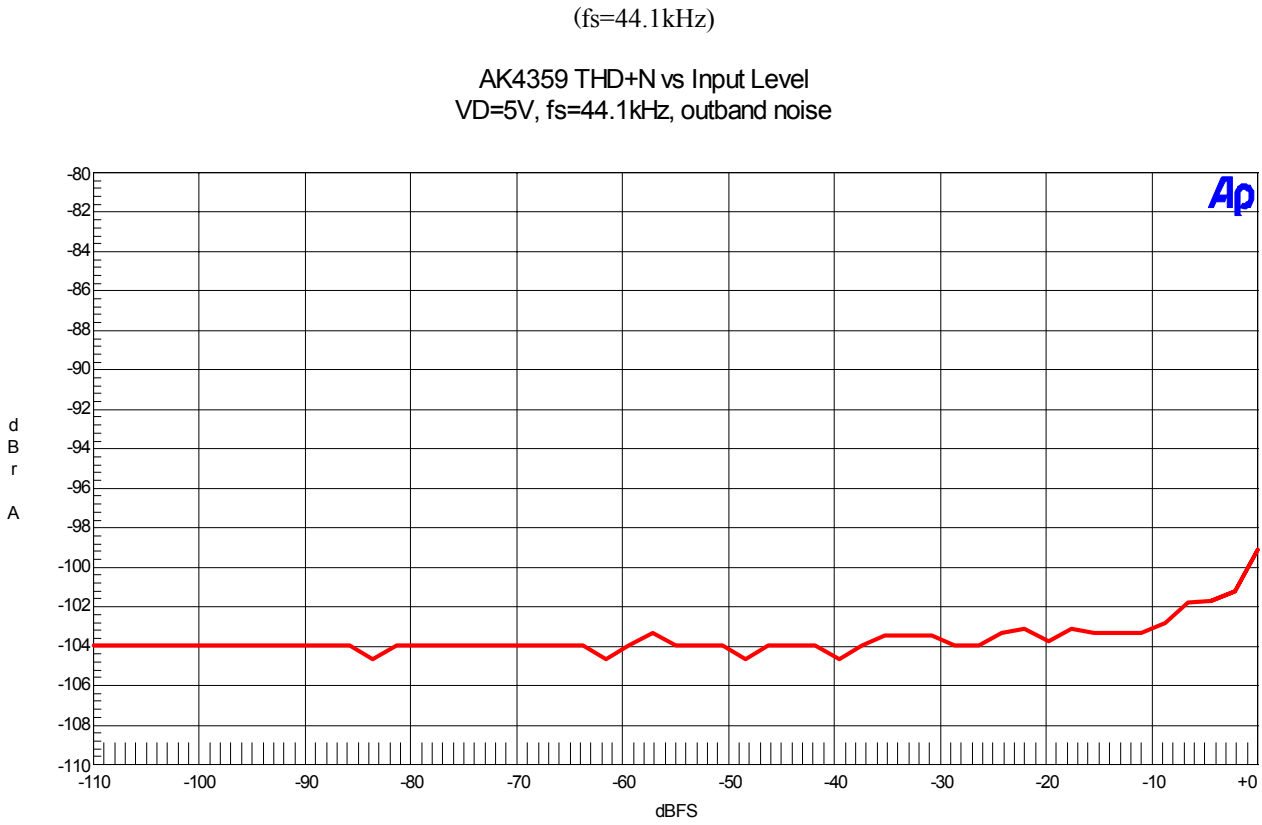


Figure 8. THD+N vs Input Level (fin=1kHz)

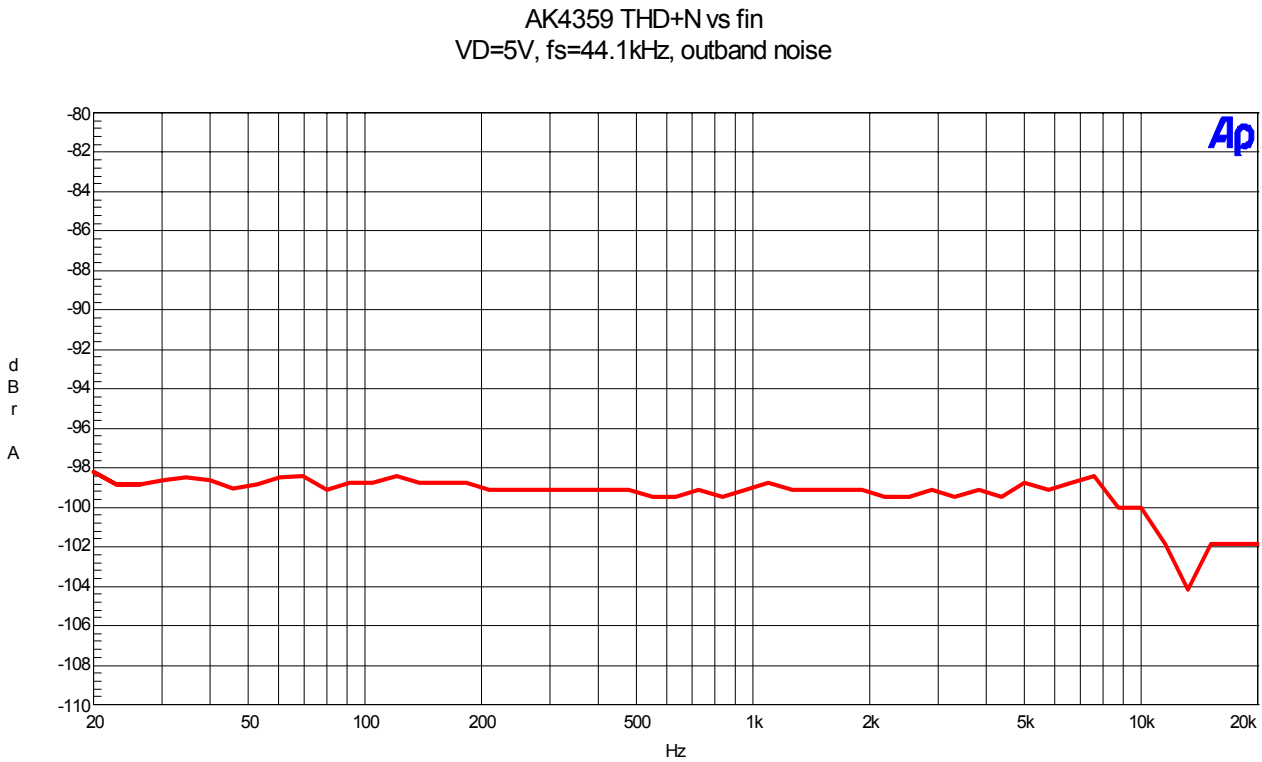


Figure 9 . THD+N vs fin (Input level=0dBFS)

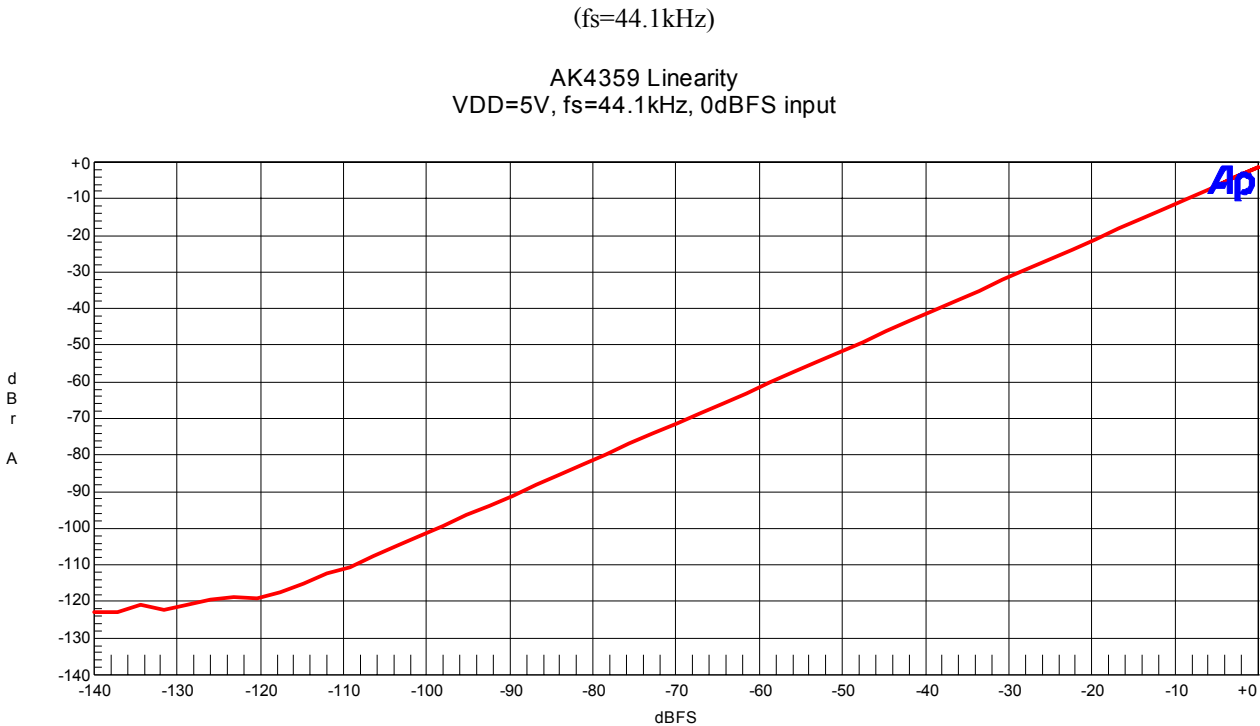


Figure 10. Linearity (fin=1kHz)

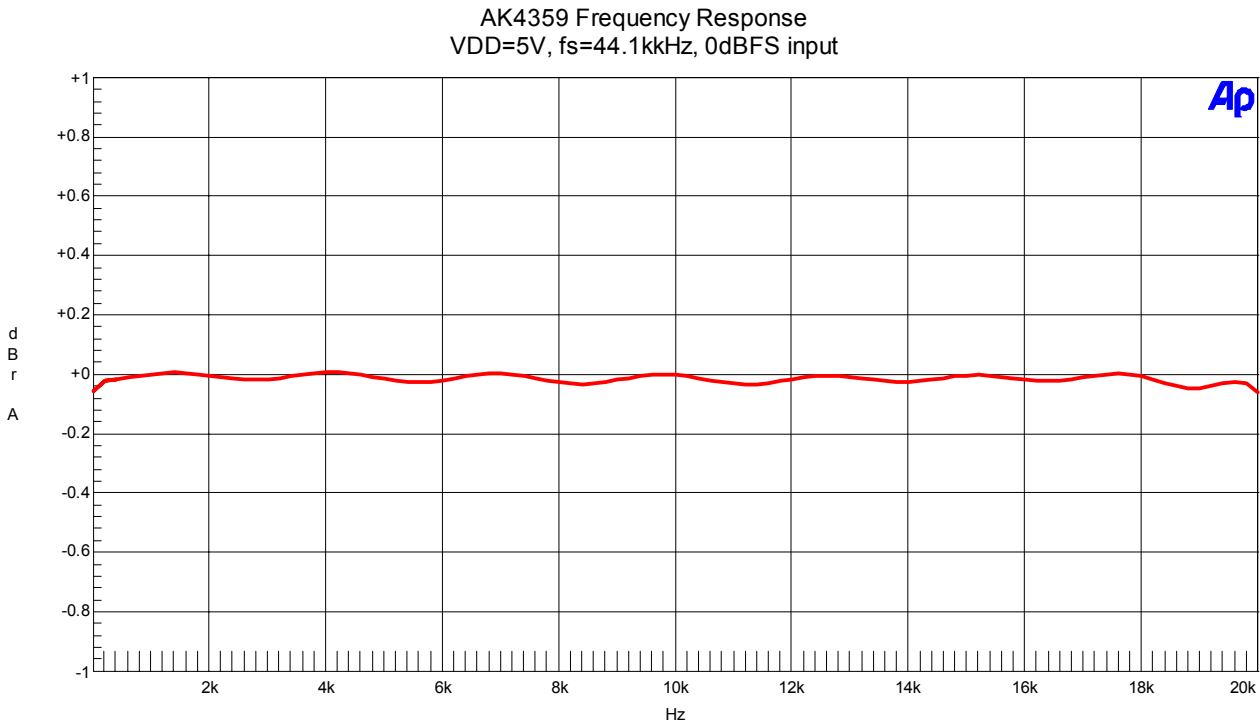


Figure 11. Frequency Response (Input level=0dBFS)

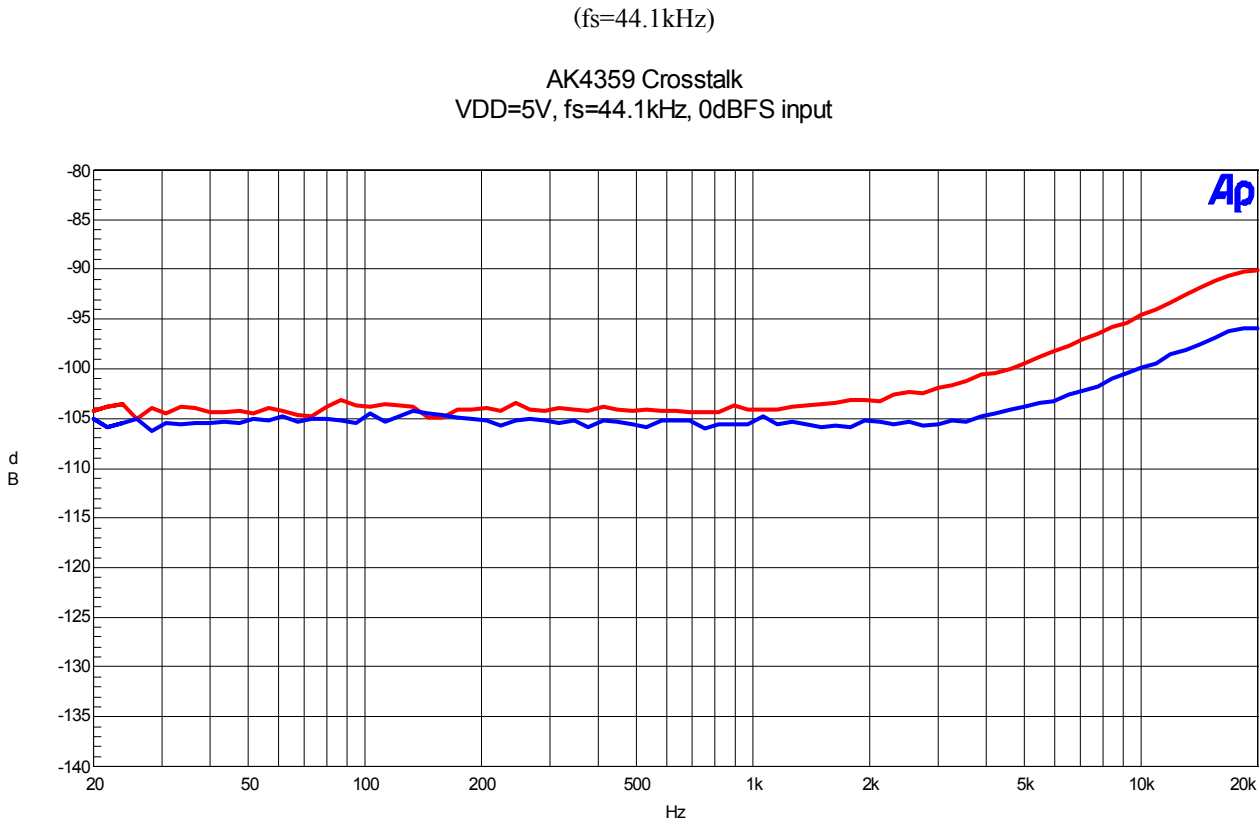


Figure 12. Cross-talk (Input level=0dBFS)

(fs=96kHz)

AK4359 FFT plot
VDD=5V, fs=96kHz, 0dBFS input

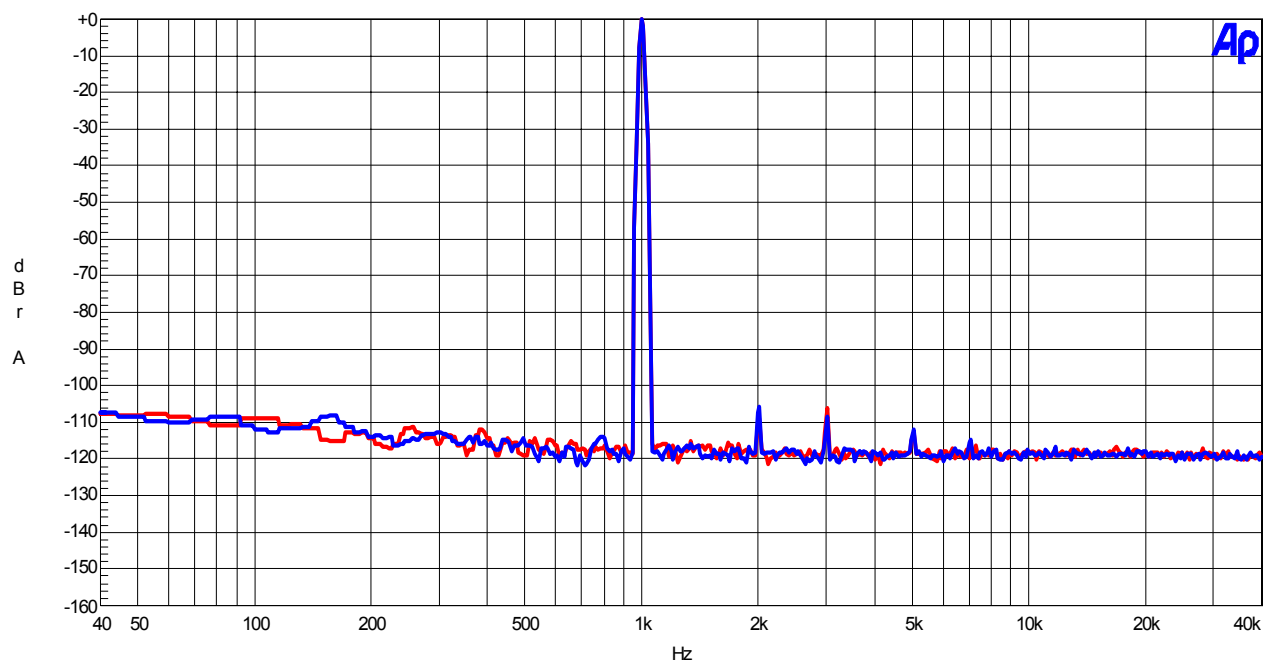


Figure13. FFT (1kHz, 0dBFS input)

AK4359 FFT plot
VDD=5V, fs=96kHz, -60dBFS input

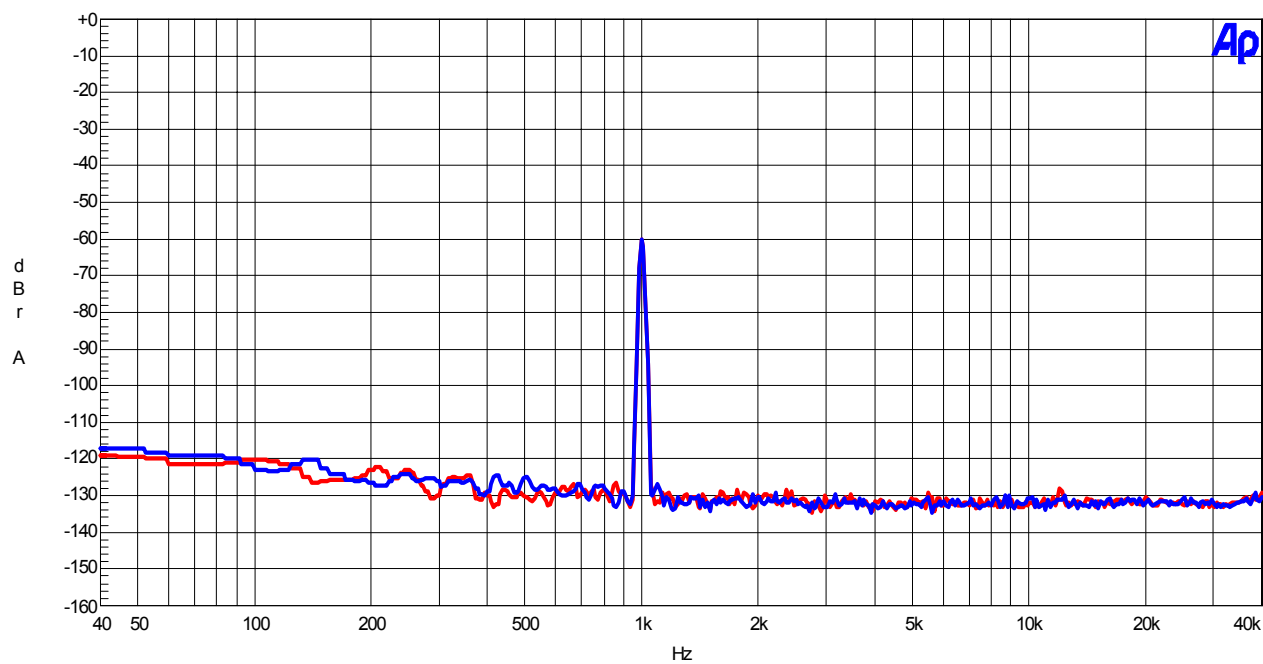


Figure14. FFT (1kHz, -60dBFS input)

(fs=96kHz)

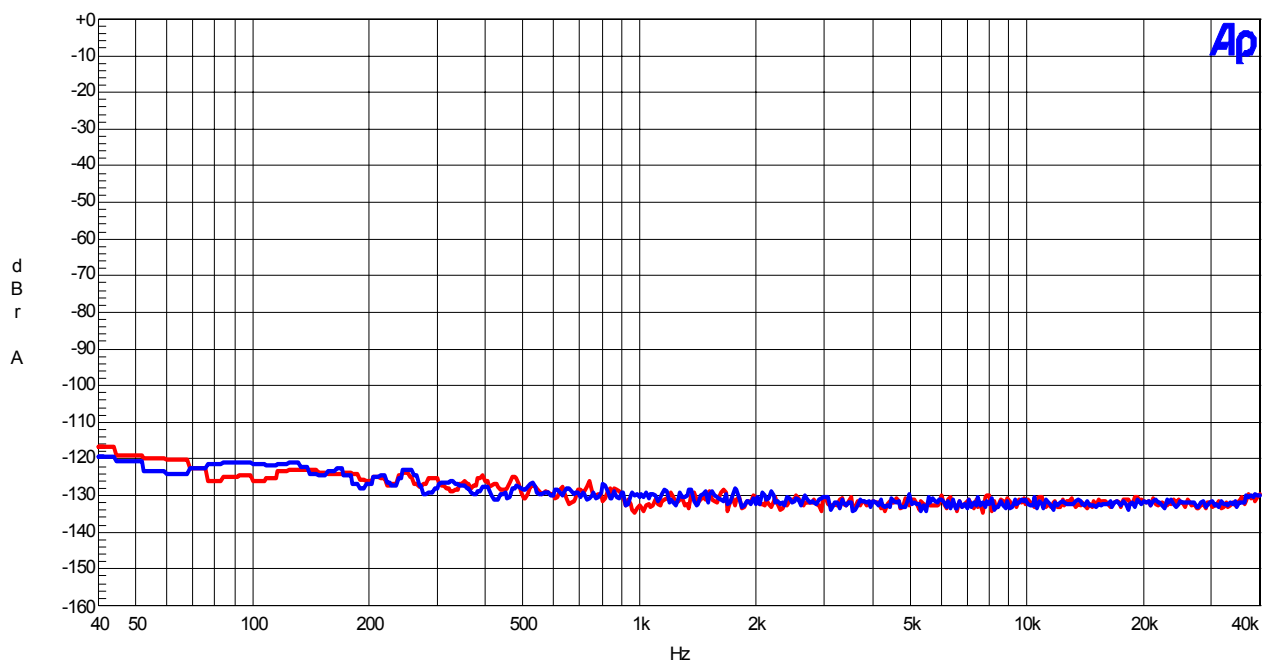
AK4359 FFT plot
VDD=5V, fs=96kHz, No input

Figure15. FFT (noise floor)

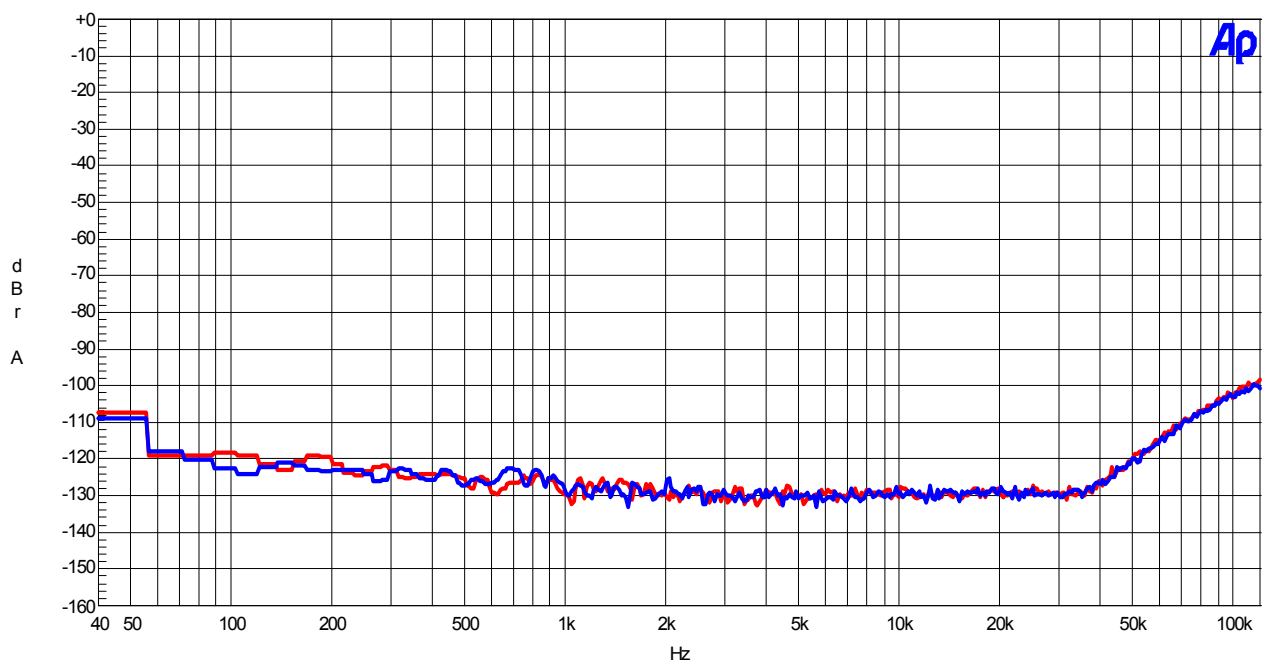
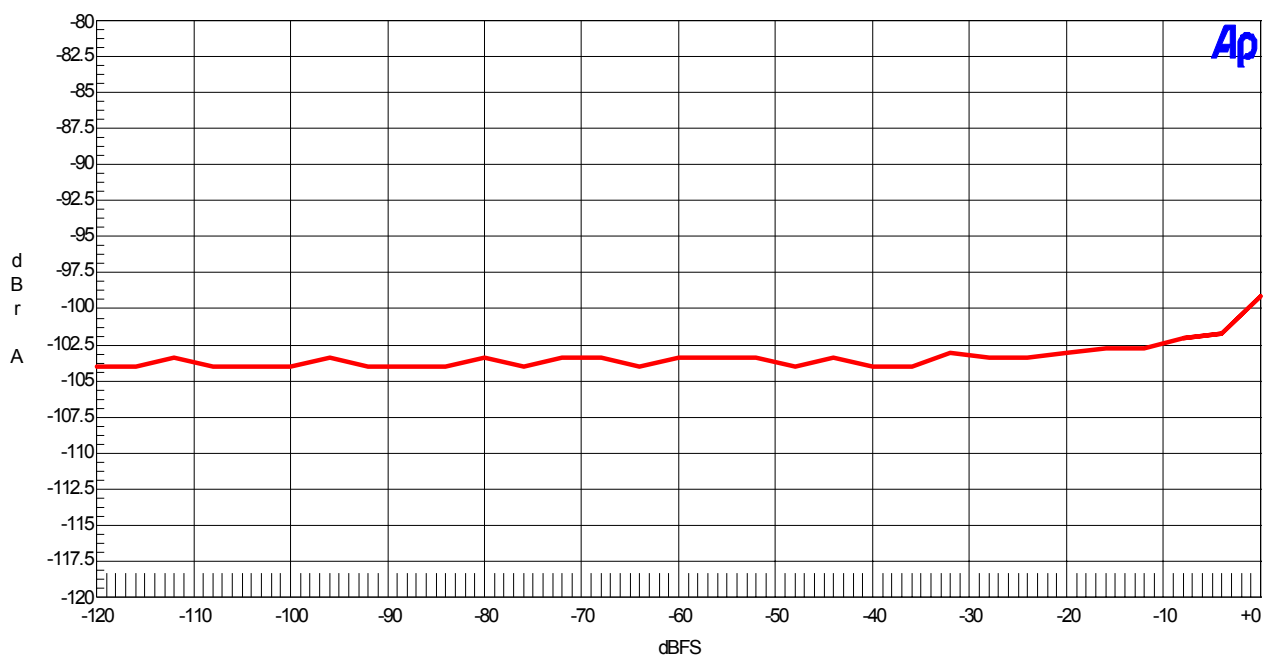
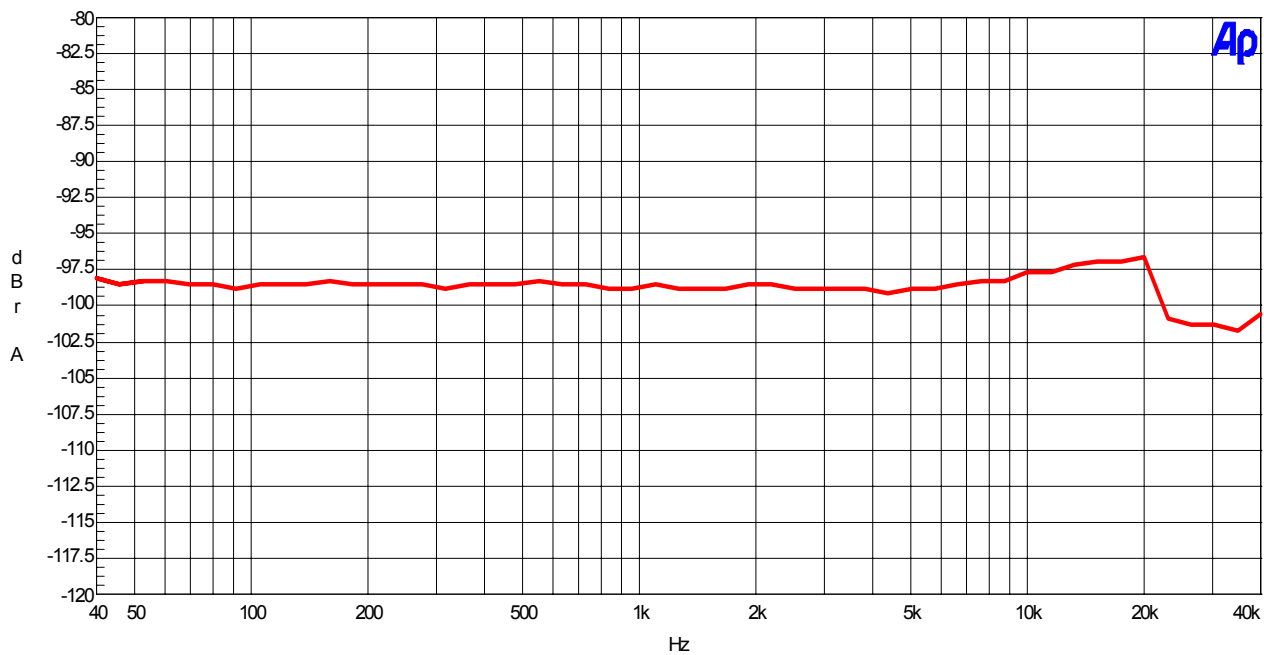
AK4359 FFT plot
VDD=5V, fs=96kHz, Outband Noise

Figure16. FFT (outband noise)

(fs=96kHz)

AK4359 THD+N vs Input Level
VDD=5V, fs=96kHz, 0dBFS inputFigure17. THD+N vs Input Level (f_{in}=1kHz)AK4359 THD+N vs Input Level
VDD=5V, fs=96kHz, 0dBFS inputFigure18. THD+N vs f_{in} (Input level=0dBFS)

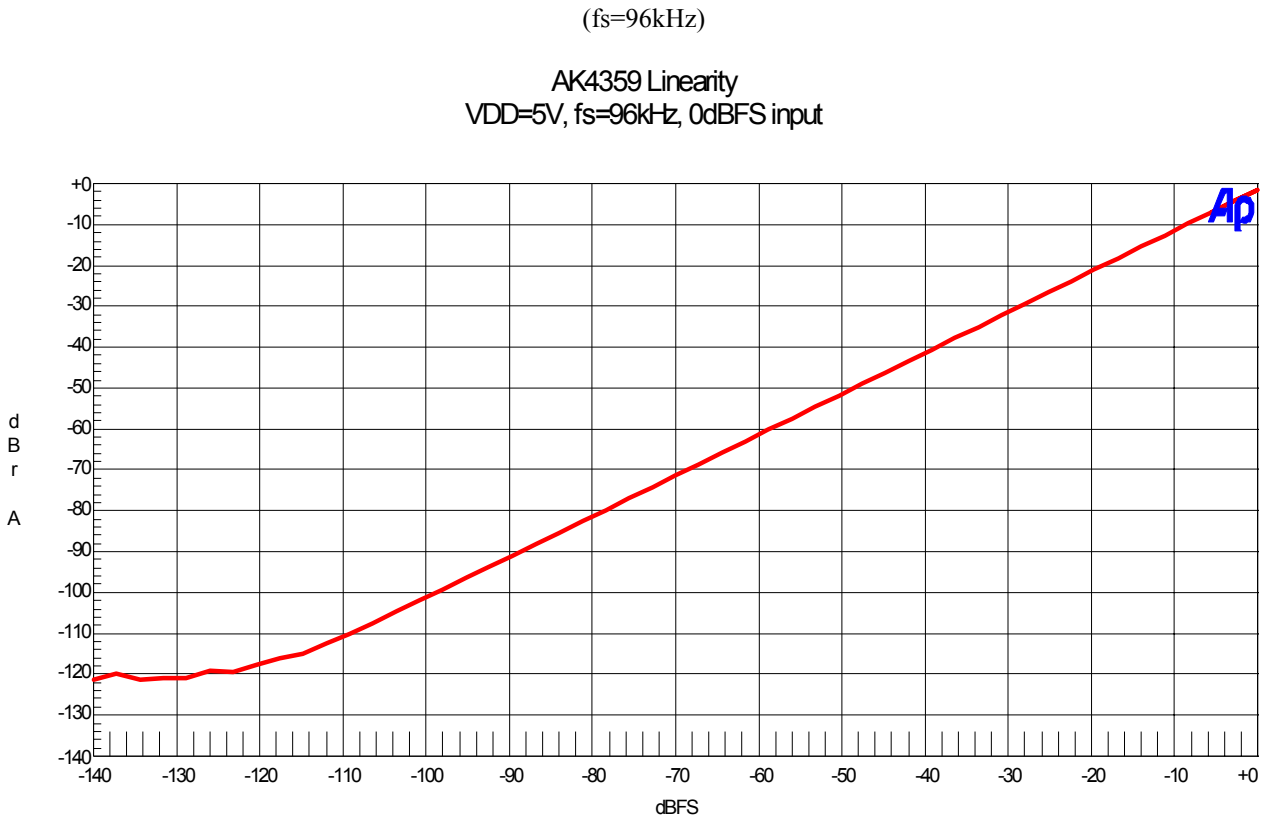


Figure19. Linearity (fin=1kHz)

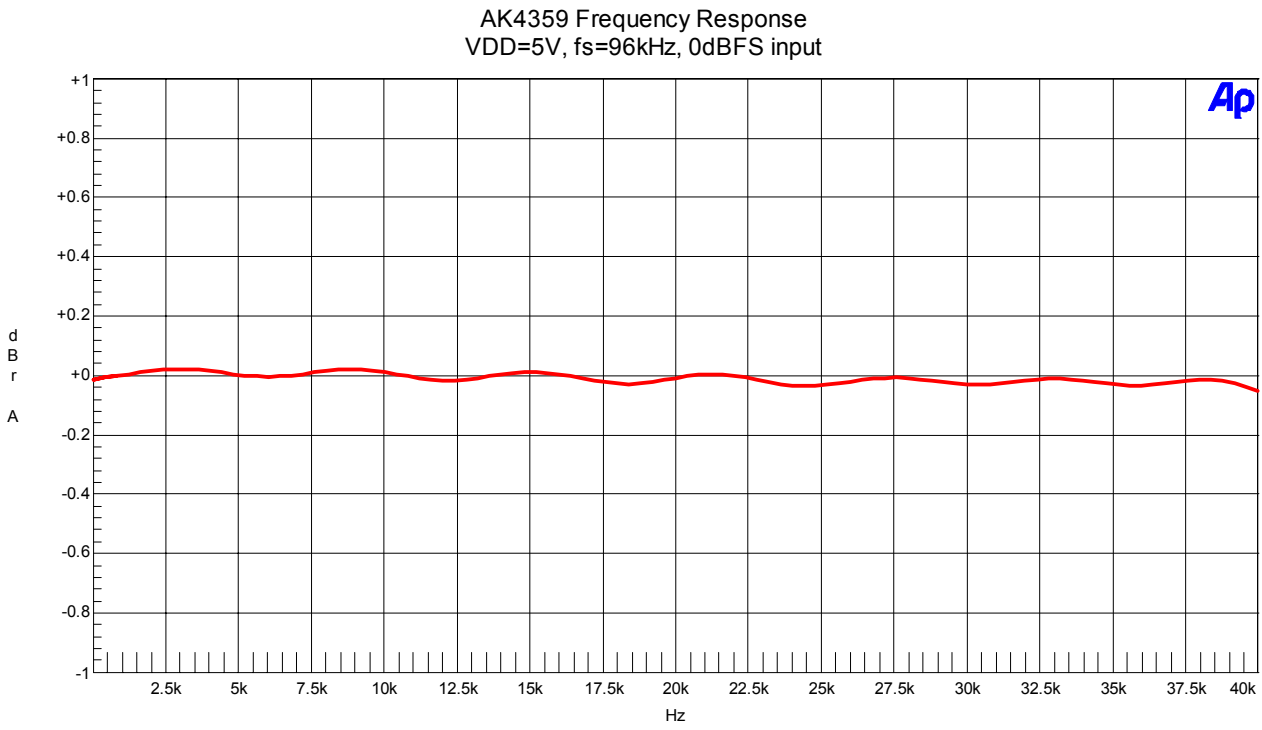


Figure20. Frequency Response (Input level=0dBFS)

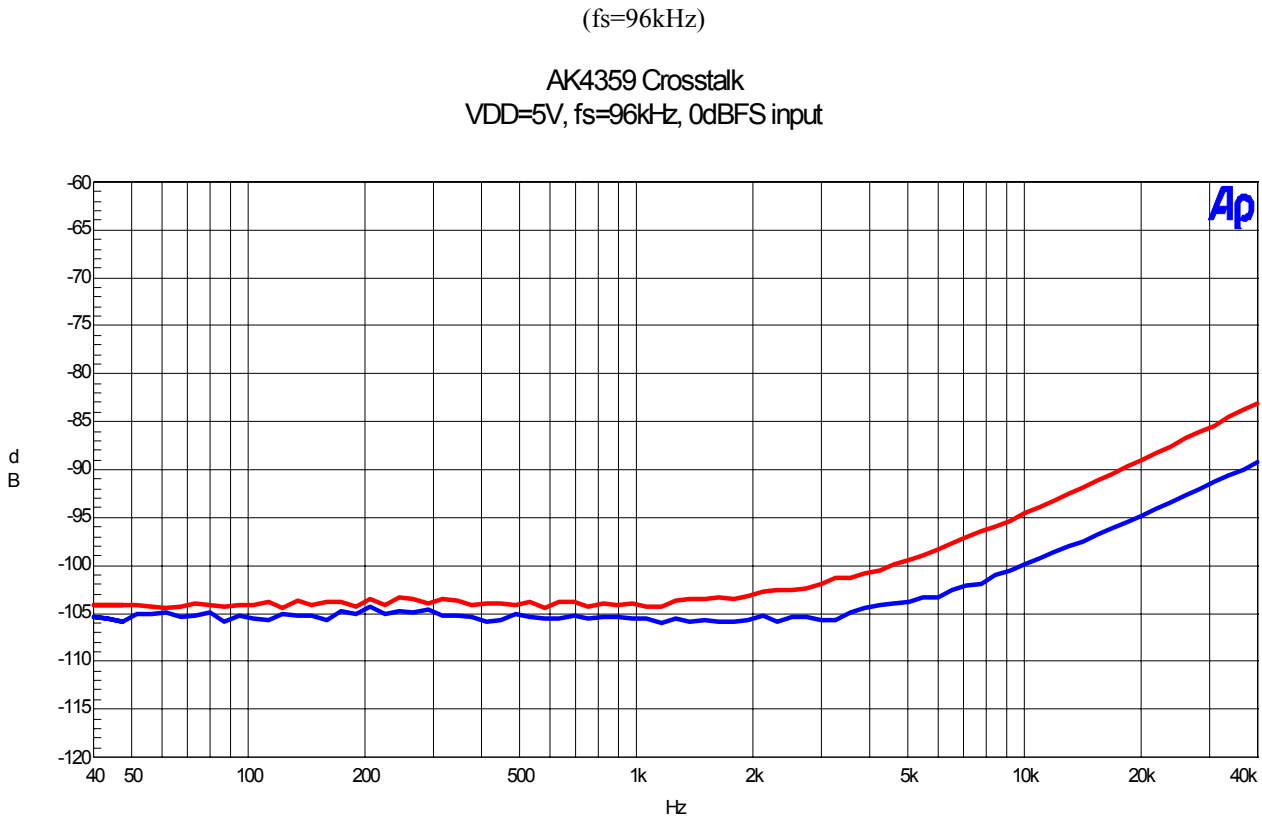


Figure21. Cross-talk (Input level=0dBFS)

(fs=192kHz)

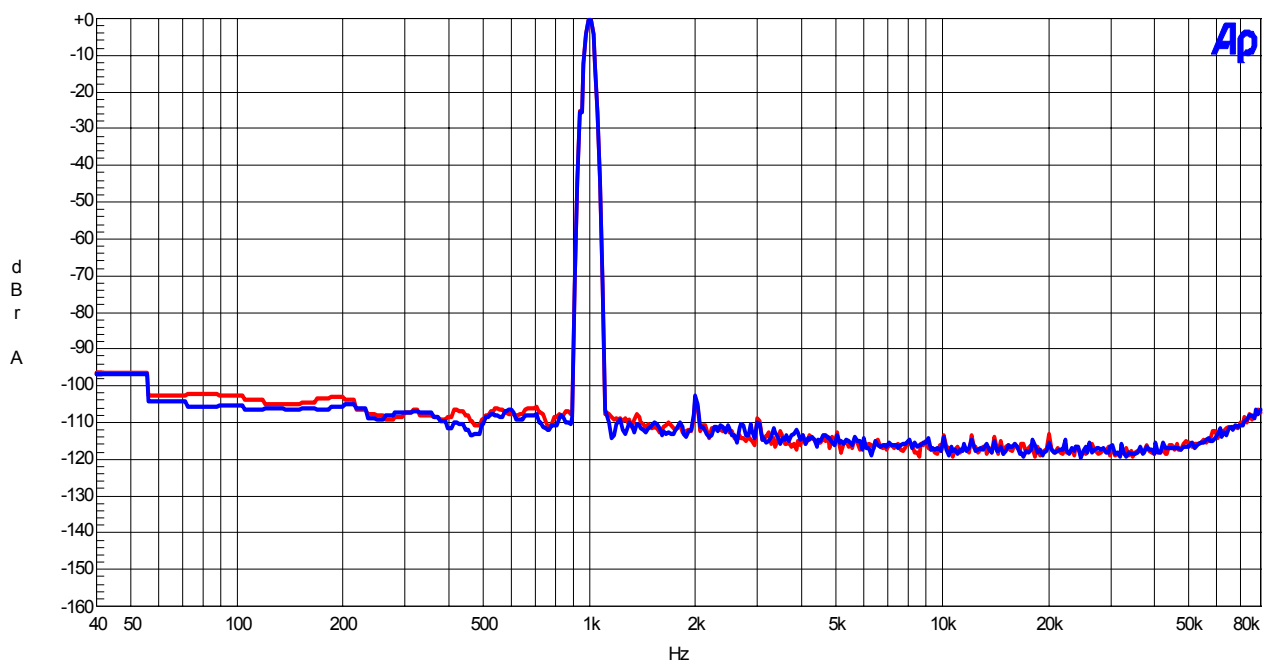
AK4359 FFT plot
VDD=5V, fs=192kHz, 0dBFS input

Figure22. FFT (1kHz, 0dBFS input)

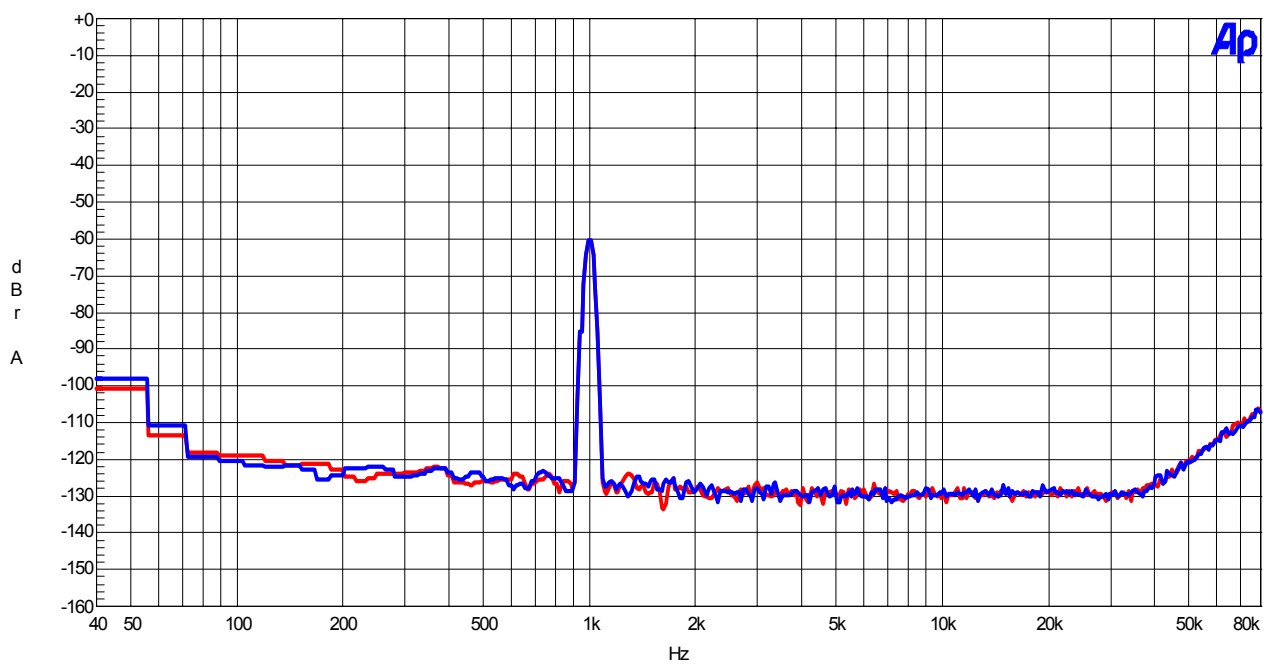
AK4359 FFT plot
VDD=5V, fs=192kHz, -60dBFS input

Figure23. FFT (1kHz, -60dBFS input)

(fs=96kHz)

AK4359 FFT plot
VDD=5V, fs=192kHz, No input

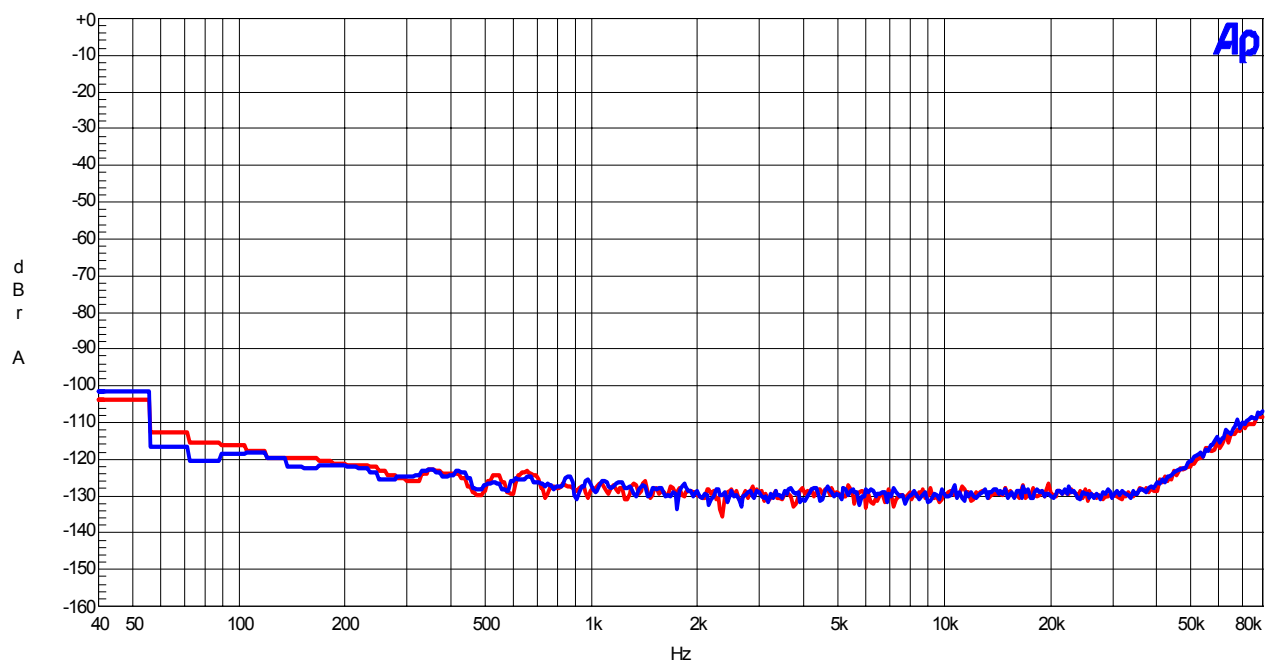


Figure24. FFT (noise floor)

AK4359 FFT plot
VDD=5V, fs=192kHz, Outband Noise

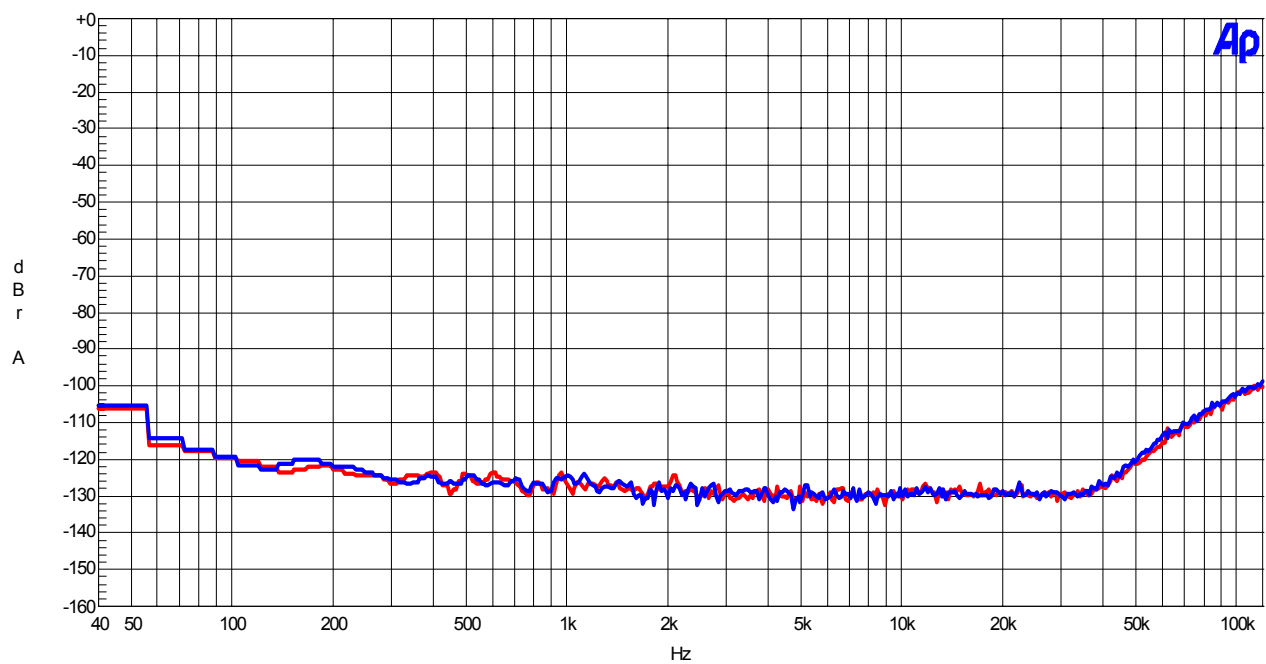


Figure25. FFT (outband noise)

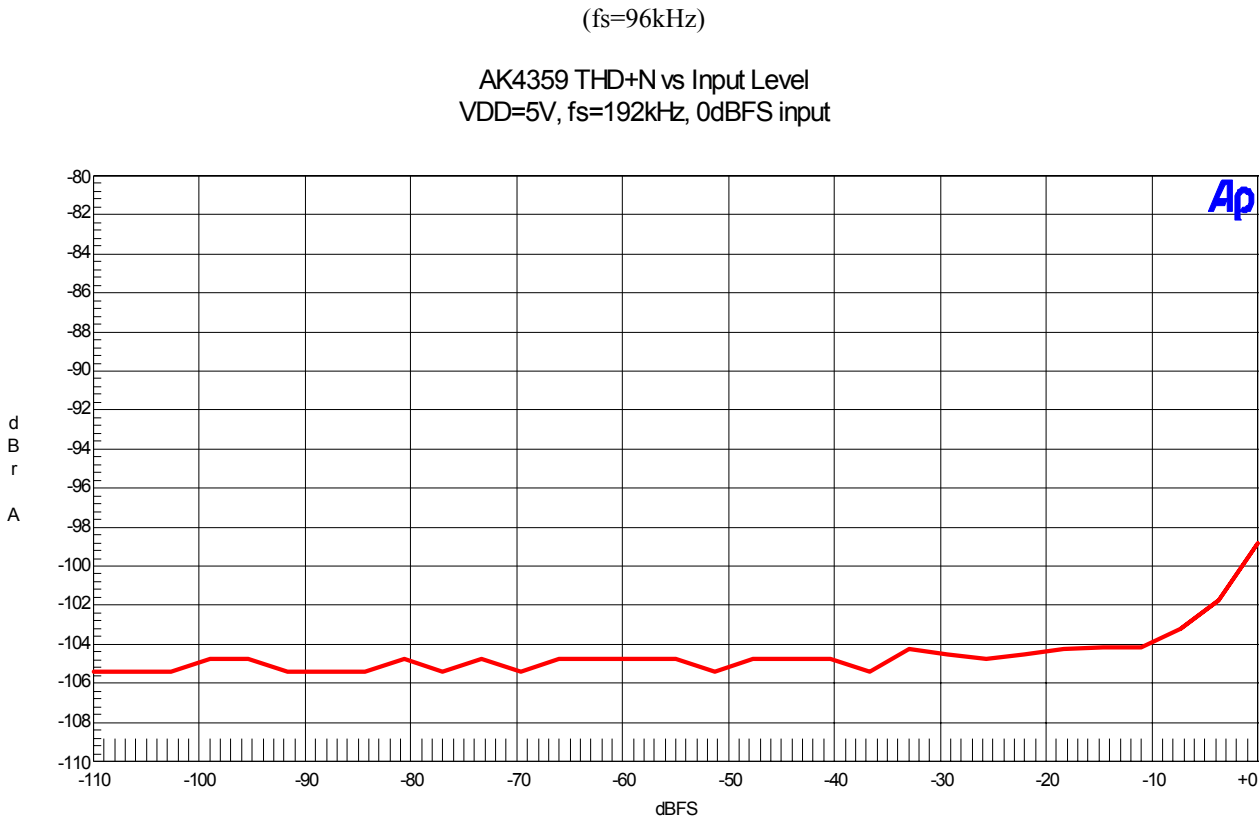


Figure26. THD+N vs Input Level (fin=1kHz)

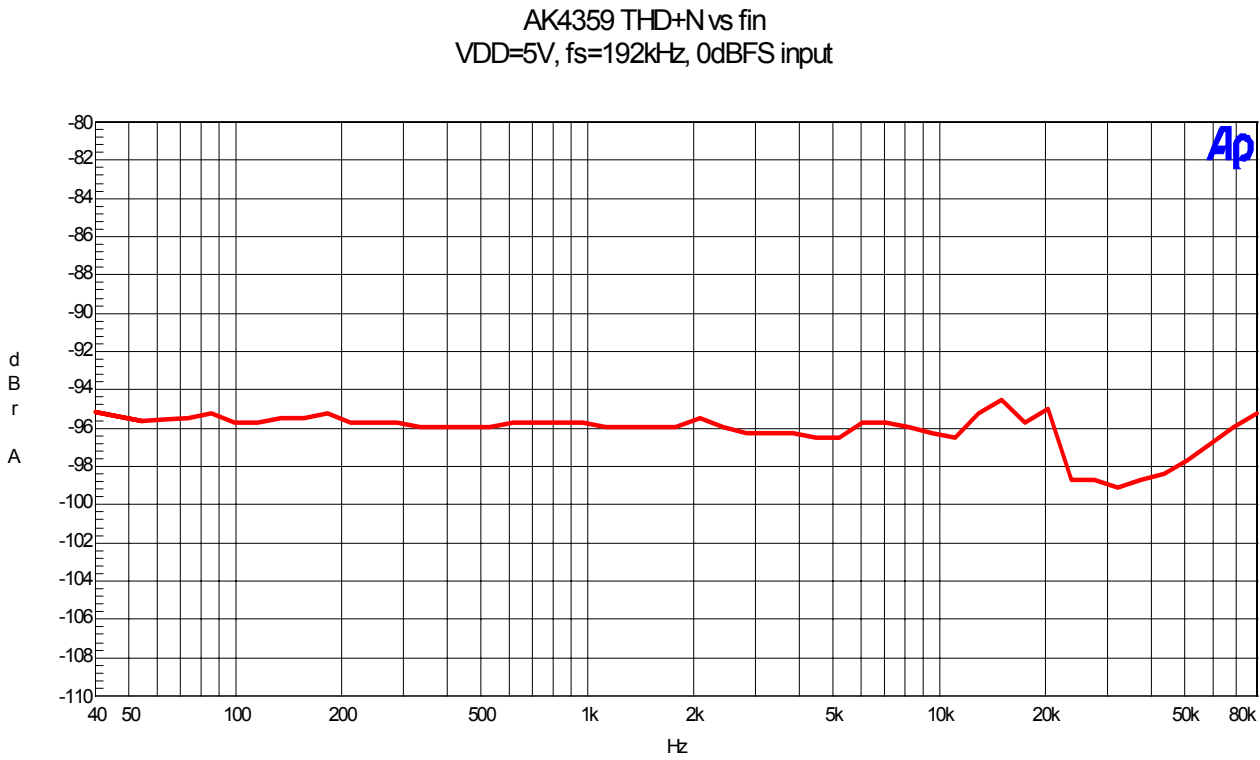


Figure27. THD+N vs fin (Input level=0dBFS)

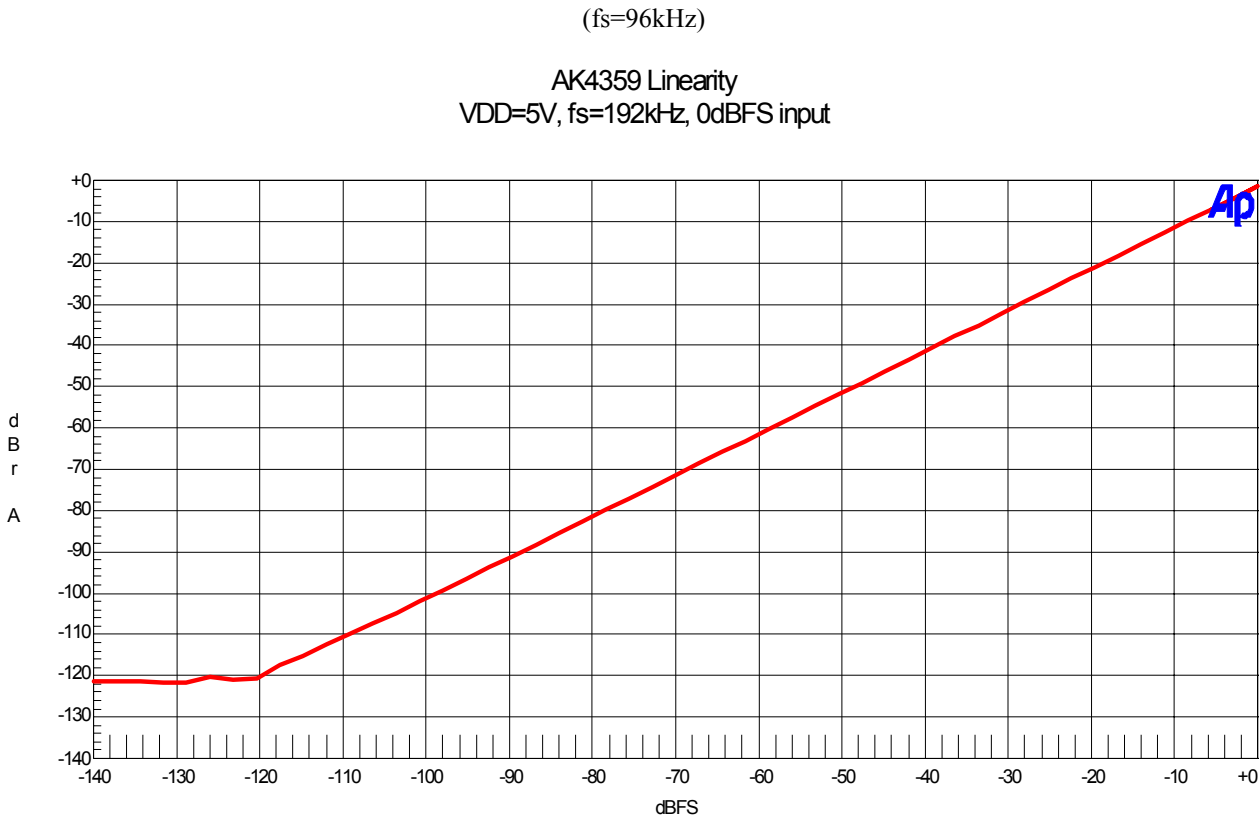


Figure28. Linearity (fin=1kHz)

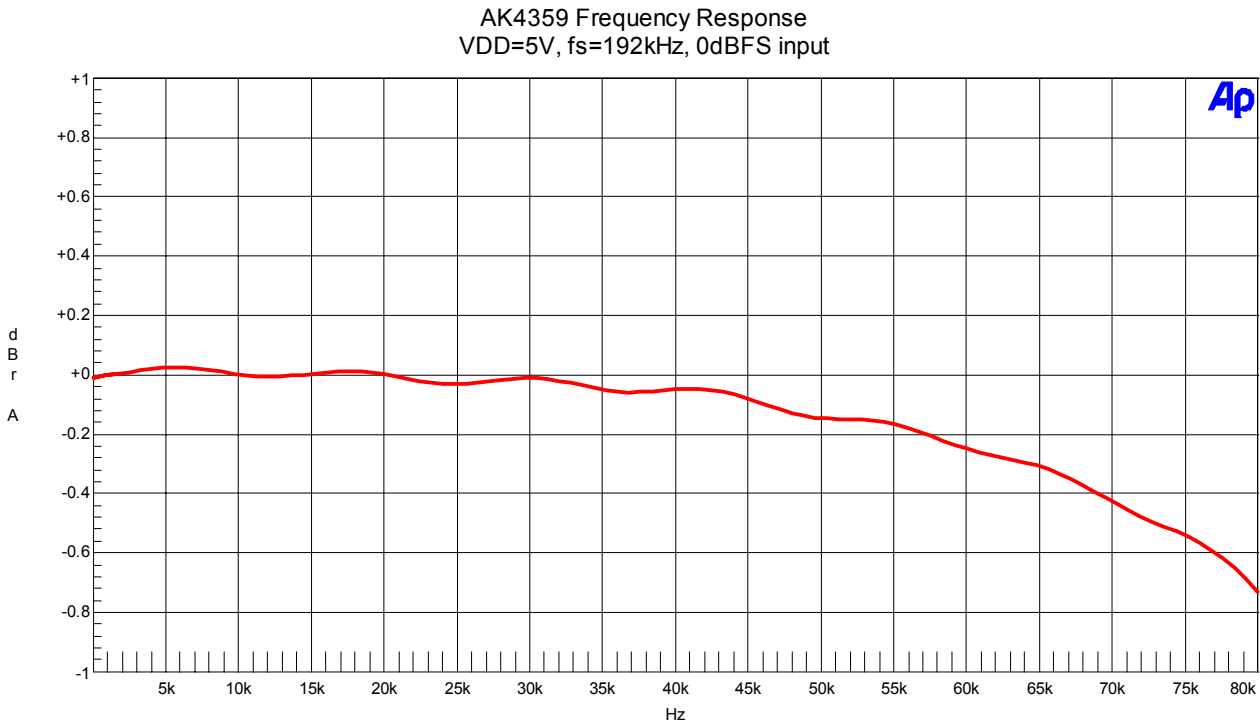


Figure29. Frequency Response (Input level=0dBFS)

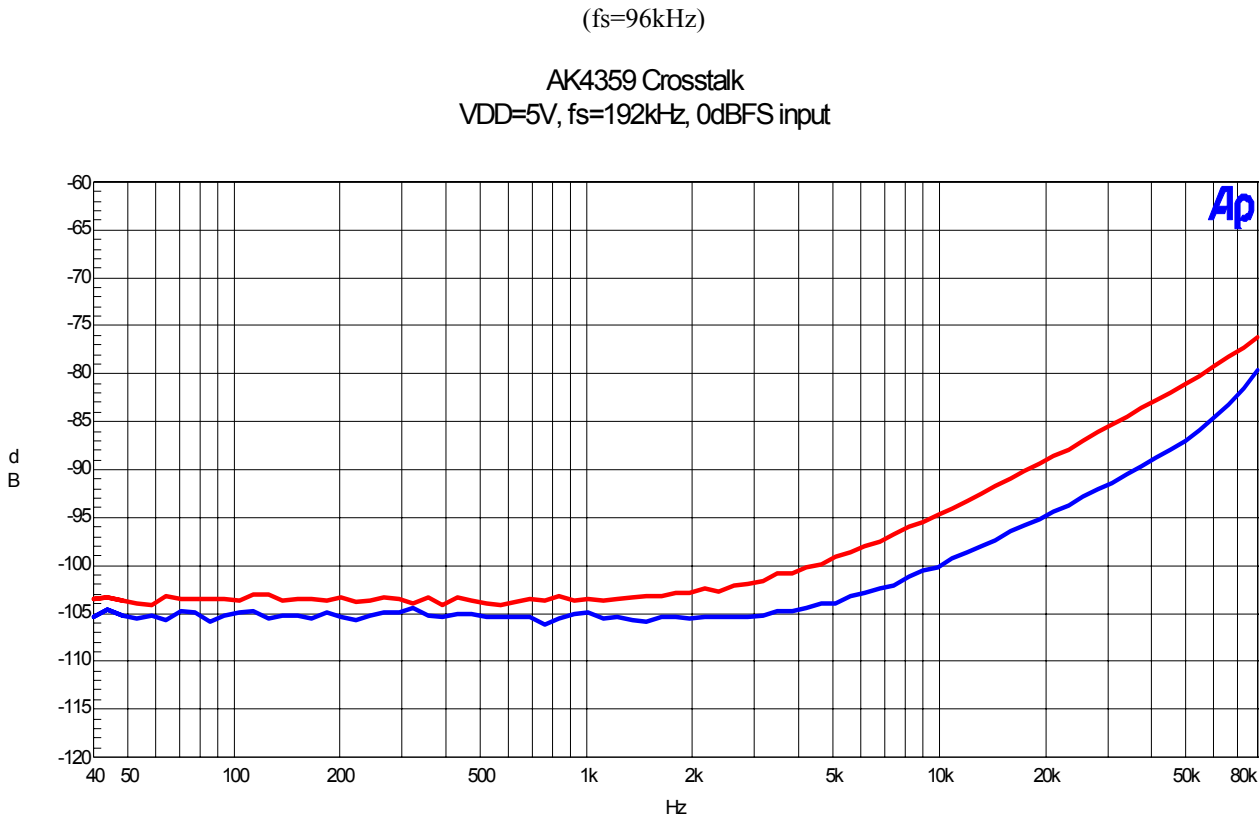
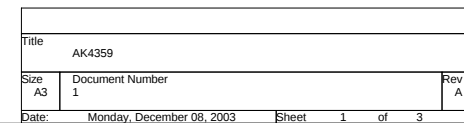
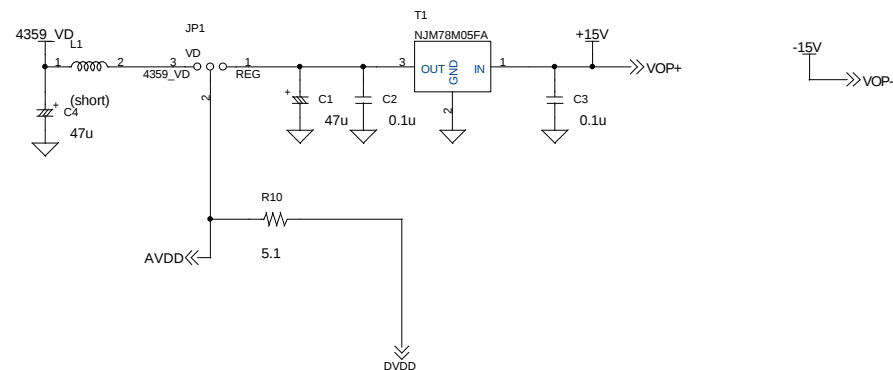
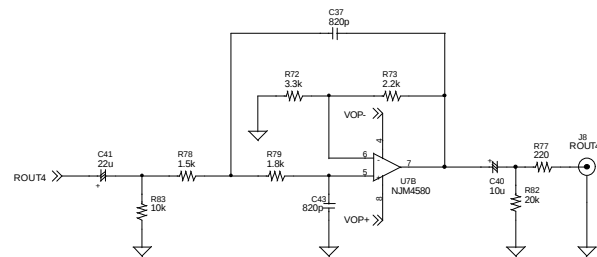
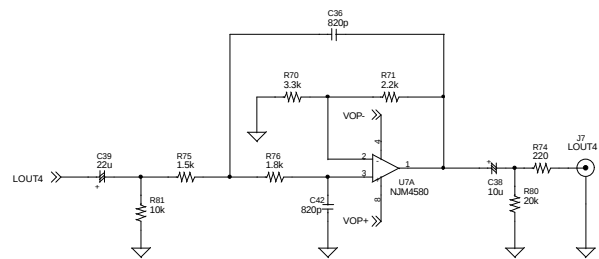
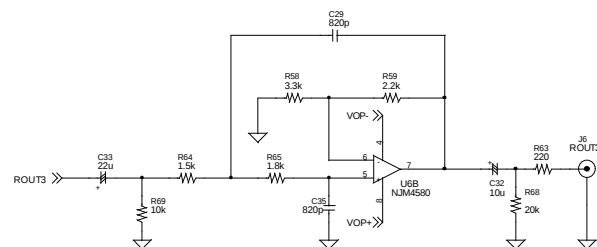
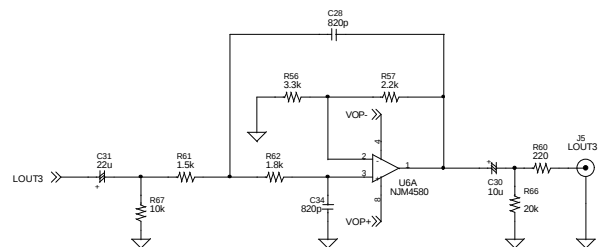
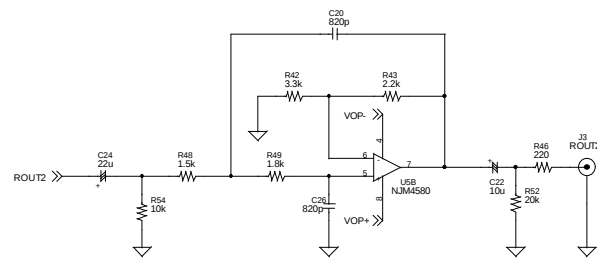
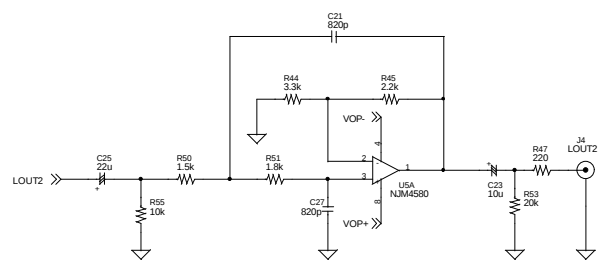
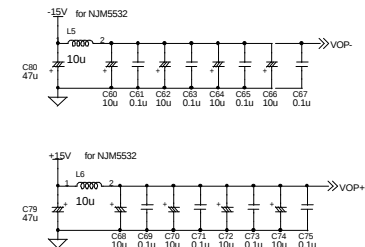
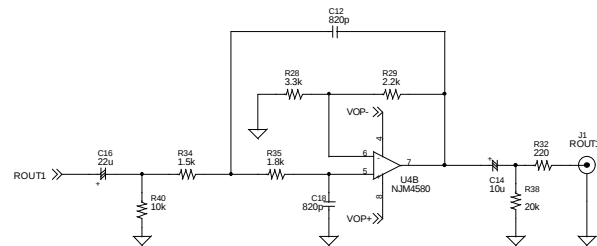
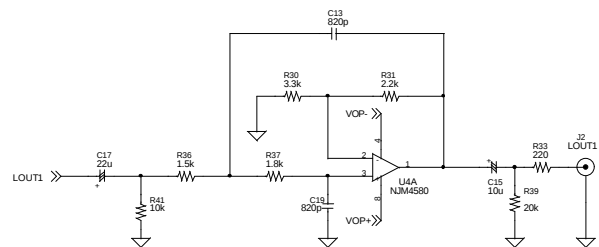


Figure30. Cross-talk (Input level=0dBFS)

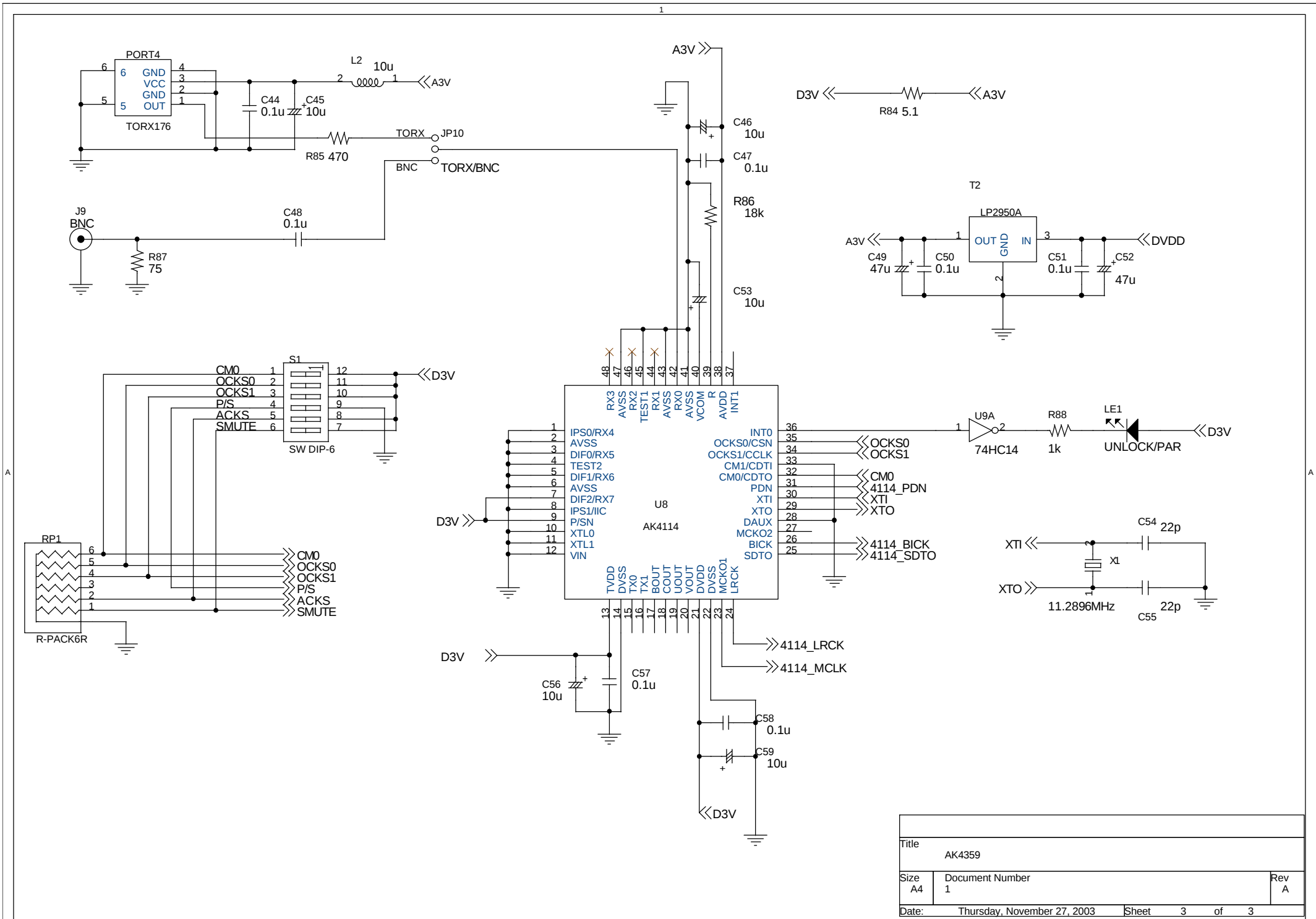
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