

GENERAL DESCRIPTION

The AKD4359A-SC is an evaluation board for AK4539, the 24bit 8ch D/A converter. The AKD4359A-SC also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector or BNC connector.

■ **Ordering guide**

AKD4359A-SC --- Evaluation board for AK4359A
(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**

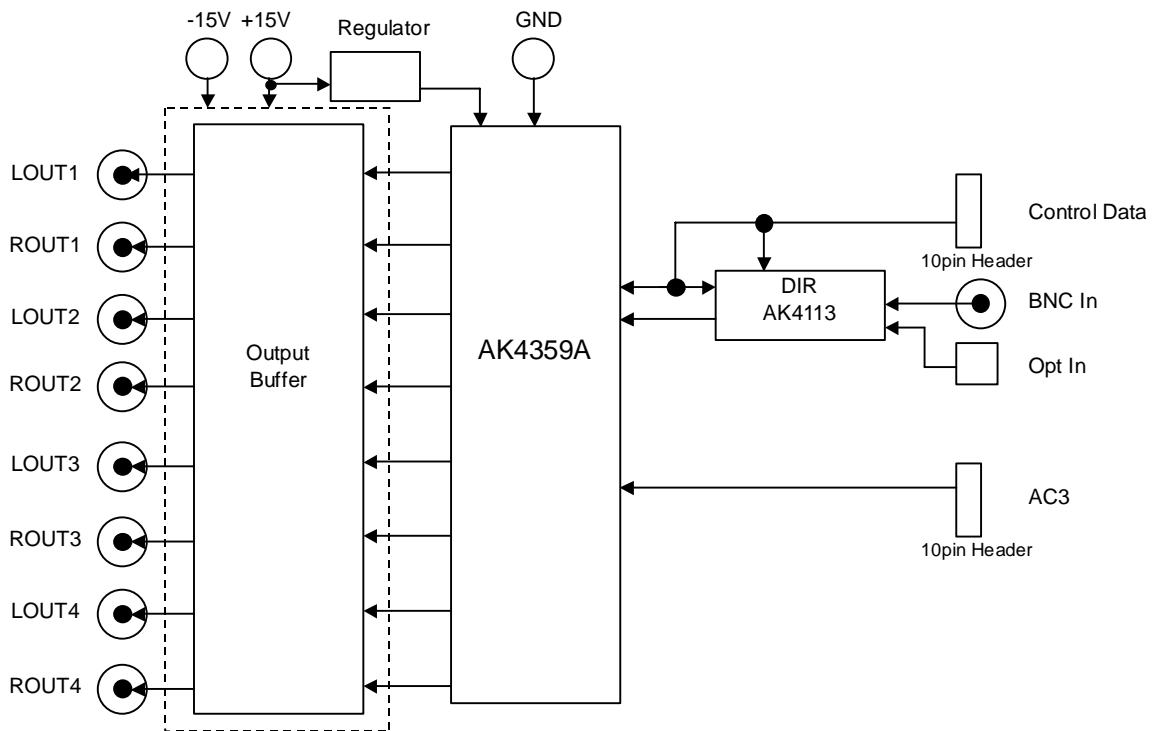


Figure 1. AKD4359A-SC Block Diagram

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

■ Operation sequence

1) Set up the power supply lines. (See “Other jumpers set-up”.)

Name	Color	Voltage	Comments	Attention
+15V	Red	+12~+15V	Regulator, Power supply for Op-amp.	This jack is always needed. Power line
-15V	Blue	-12~-15V	Power supply for Op-amp.	This jack is always needed. Power line
AGND	Black	0V	GND	This jack is always needed.

Table 1. Set up of power supply lines

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

2) Set-up the jumper pins

3) Set-up the DIP switches. (See the followings.)

4) Power on

The AK4359A should be reset once bringing SW1 (PDN) “L” upon power-up.

■ Evaluation mode

1. DIR(COAX) (default)

J1 is used for the evaluation using such as CD test disk. The DIR generates MCLK, BICK and LRCK SDATA from the received data through BNC connector (J9). Setting of jumper is shown below.

COAX is recommended for an evaluation of the Sound quality.

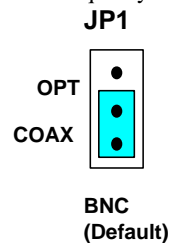


Figure 2. Jumper setting, when using DIR

2. DIR(Optical Link)

PORT1 is used for the evaluation using such as CD test disk. The DIR generates MCLK, BICK and LRCK SDATA from the received data through optical connector (PORT4: TORX176). Setting of jumper is shown below.

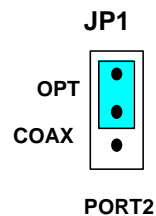


Figure 3. Jumper setting, when using DIR

■ DIP Switch setting

[SW2]: AK4113 setting

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

Table 2. SW2 setting

[SW3]: AK4359A setting

No.	Pin	OFF	ON	Default
1	SMUTE	AK4359A setting		OFF
2	P/S			OFF
3	ACKS			ON

Note : When using the serial mode, R5 and R17 should be removed.

Table 3. SW3 setting

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

OCKS1	OCKS0	MCLK Frequency	Default
0	0	256fs @fs=88.2/96kHz	
1	0	512fs @32/44.1/48kHz	
1	1	128fs @176.4/192kHz	

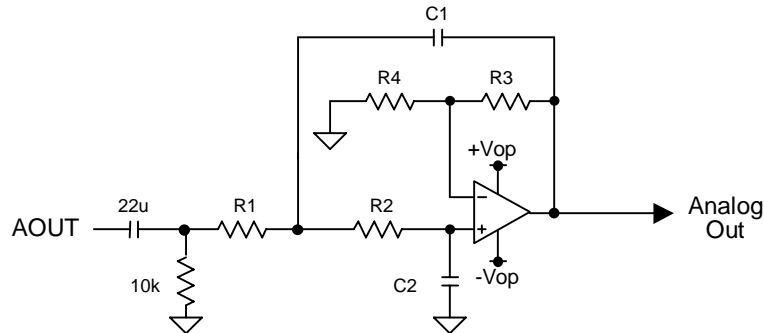
Table 4. MCLK Clock

■ SW1 setting

[SW1](PDN): Reset of AK4359A. Select "H" during operation.

External analog circuit

The 2nd order LPF ($f_c=111.8\text{kHz}$, $Q=0.714$) which adds differential outputs of the AK4359A 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 AK4359A 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 4. 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 5. The value of R,C on this board

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

Table 6. Frequency Response of LPF

<Calculation>

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

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

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

$$\omega_0 = \frac{1}{\sqrt{2C_1 C_2 R_1 R_2}},$$

$$Q = 2\pi f_c \frac{1}{\frac{1}{C_1 R_1} + \frac{1}{C_1 R_2} + \frac{1-k}{C_2 R_2}}$$

Control Software Manual

■ Set-up of evaluation board and control software

1. Set up the AKD4359A-SC according to previous term.
2. Connect IBM-AT compatible PC with AKD4359A-SC by 10-line type flat cable (packed with AKD4359A-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 "AKD4359A-SC Evaluation Kit" into the CD-ROM drive.
4. Access the CD-ROM drive and double-click the icon of "akd4359a-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) .
2. [Write default] : Initialize the register of AK4359A.
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 and executed.
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 AK4359A, 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 AK4359A, 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 AK4359A, 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 AK4359A. The file type is the same as [Save].

(Operation flow)

- (1) Click [Open] Button.
- (2) 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".

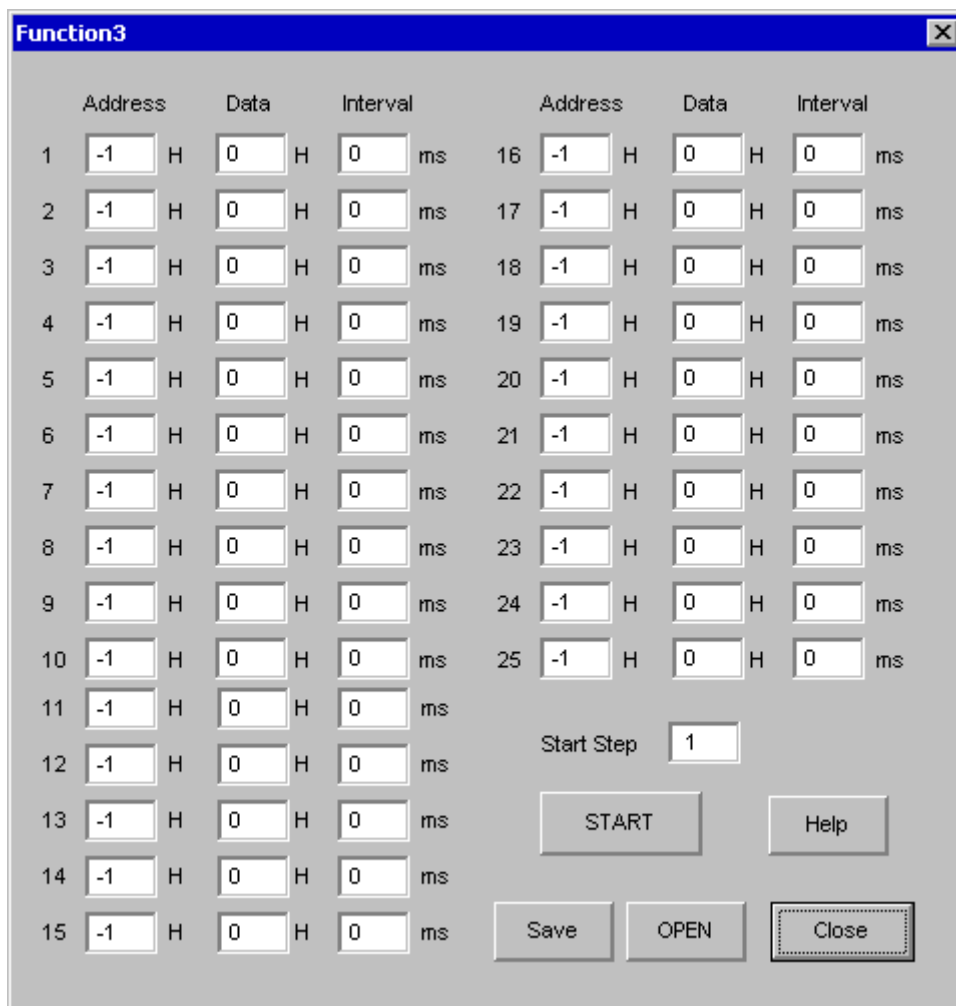


Figure 5. Window of [F3]

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 6 opens.

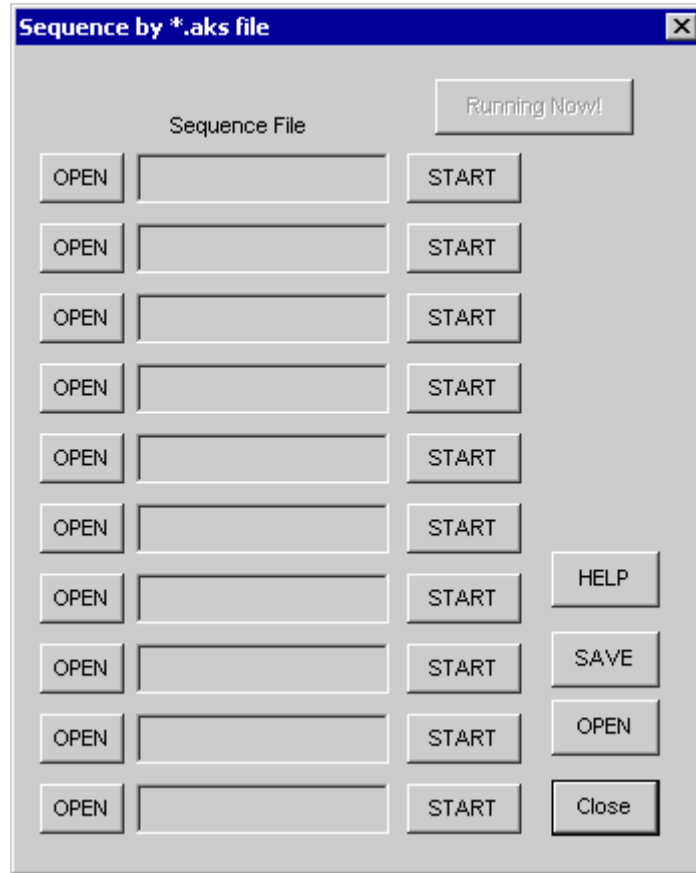


Figure 6. [F4] window

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 7.

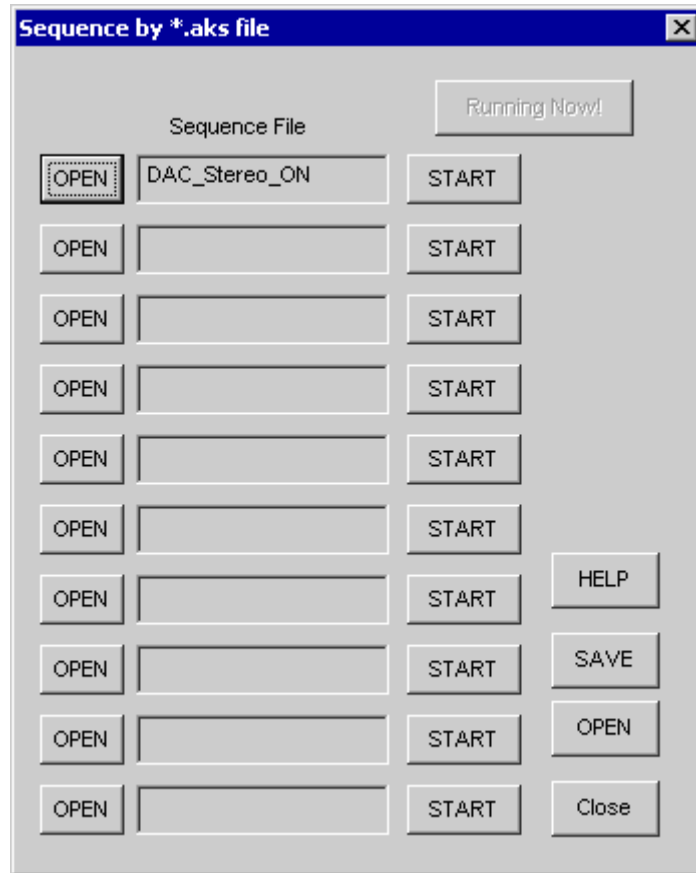


Figure 7. [F4] window(2)

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

3-2. [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.

3-3. 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 8opens.

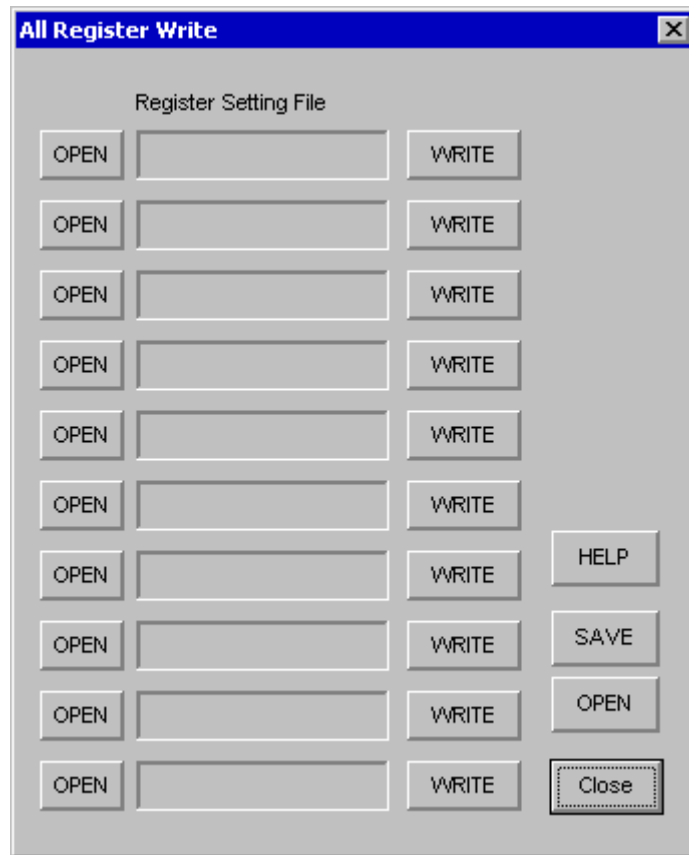


Figure 8. [F5] window

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
- Bit : 24bit
- Power Supply : AVDD=DVDD=5V
- Interface : Internal DIR
- Temperature : Room

fs=44.1kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	20kLPF	99.3 dB	98.9 dB
DR	1kHz, -60dB		104.2 dB	104.5 dB
		22kLPF, A-weighted	107.0 dB	107.2 dB
S/N	no signal	20kLPF	104.4 dB	104.4 dB
		22kLPF, A-weighted	107.0 dB	107.2 dB

fs=96kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	97.2 dB	97.8 dB
DR	1kHz, -60dB		101.7 dB	101.7 dB
		22kLPF, A-weighted	106.3 dB	106.5 dB
S/N	no signal	40kLPF	101.7 dB	101.9 dB
		22kLPF, A-weighted	106.5 dB	106.5 dB

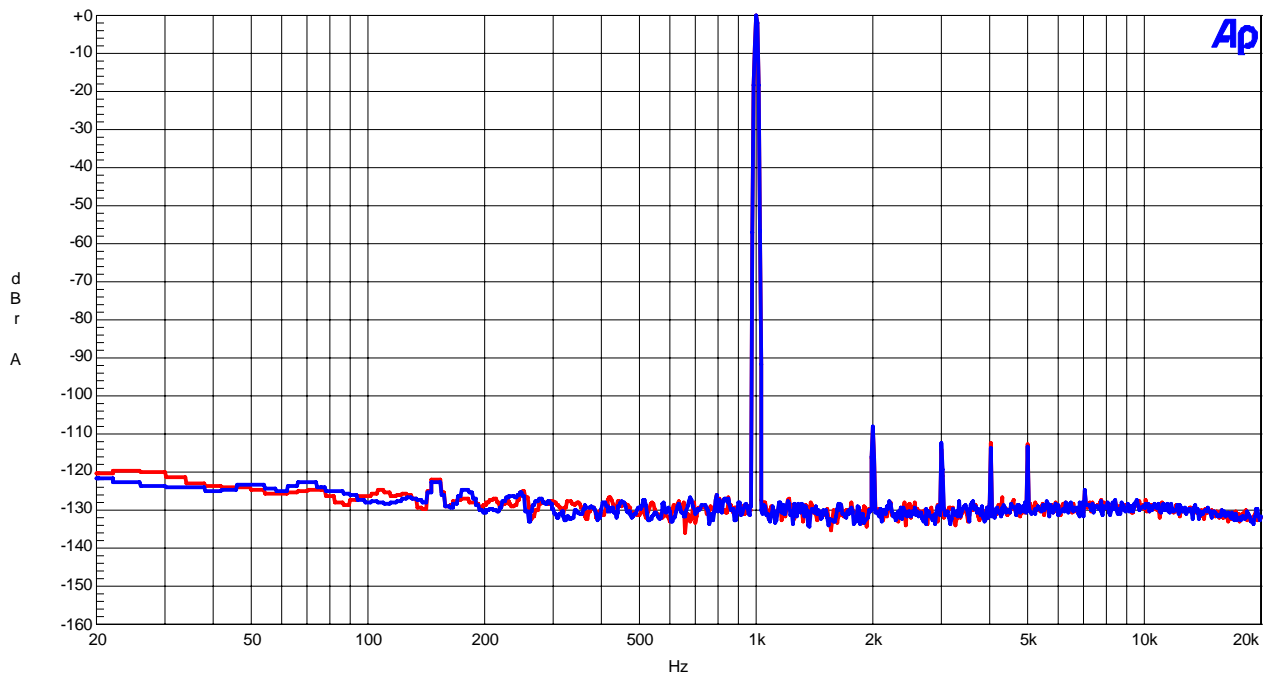
fs=192kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	96.9 dB	97.2 dB
DR	1kHz, -60dB		101.1 dB	101.2 dB
		22kLPF, A-weighted	105.7 dB	105.9 dB
S/N	no signal	40kLPF	101.8 dB	101.7 dB
		22kLPF, A-weighted	106.3 dB	106.5 dB

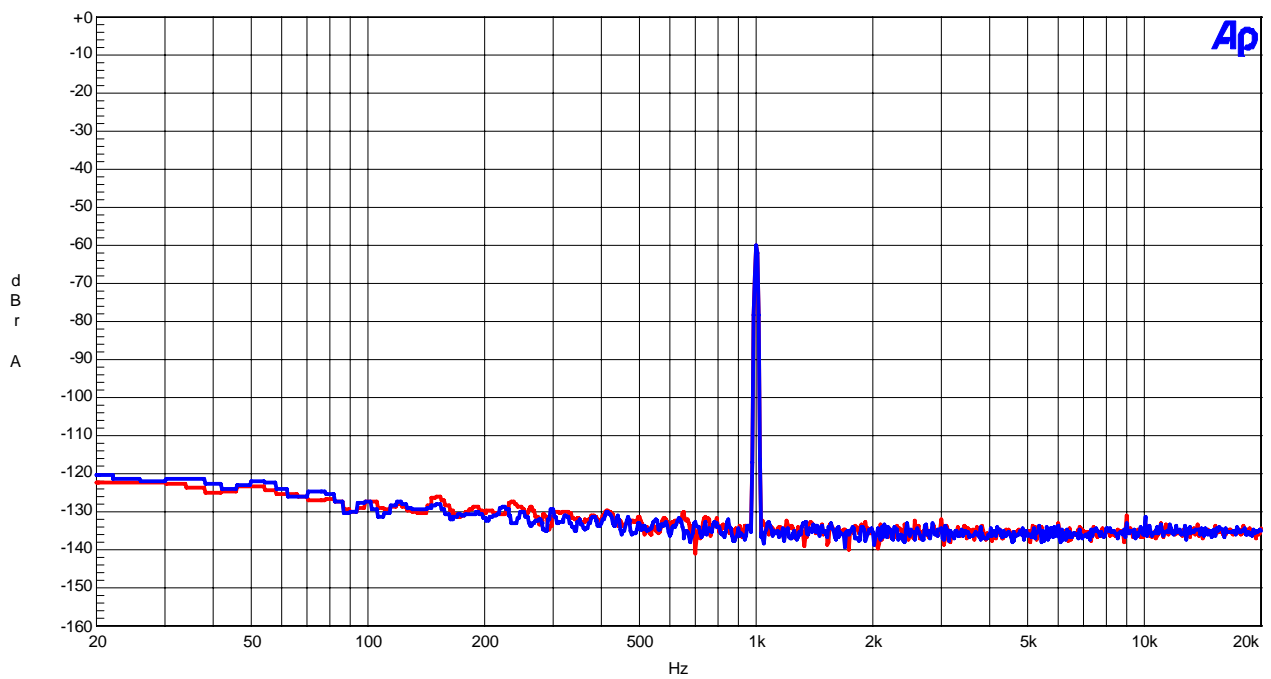
Plots

(fs=44.1kHz)

AKM

AK4359A FFT
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, 0dBFS Input**Figure 9. FFT (1kHz, 0dBFS input)**

AKM

AK4359A FFT
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, -60dBFS Input**Figure 10. FFT (1kHz, -60dBFS input)**

(fs=44.1kHz)

AKM

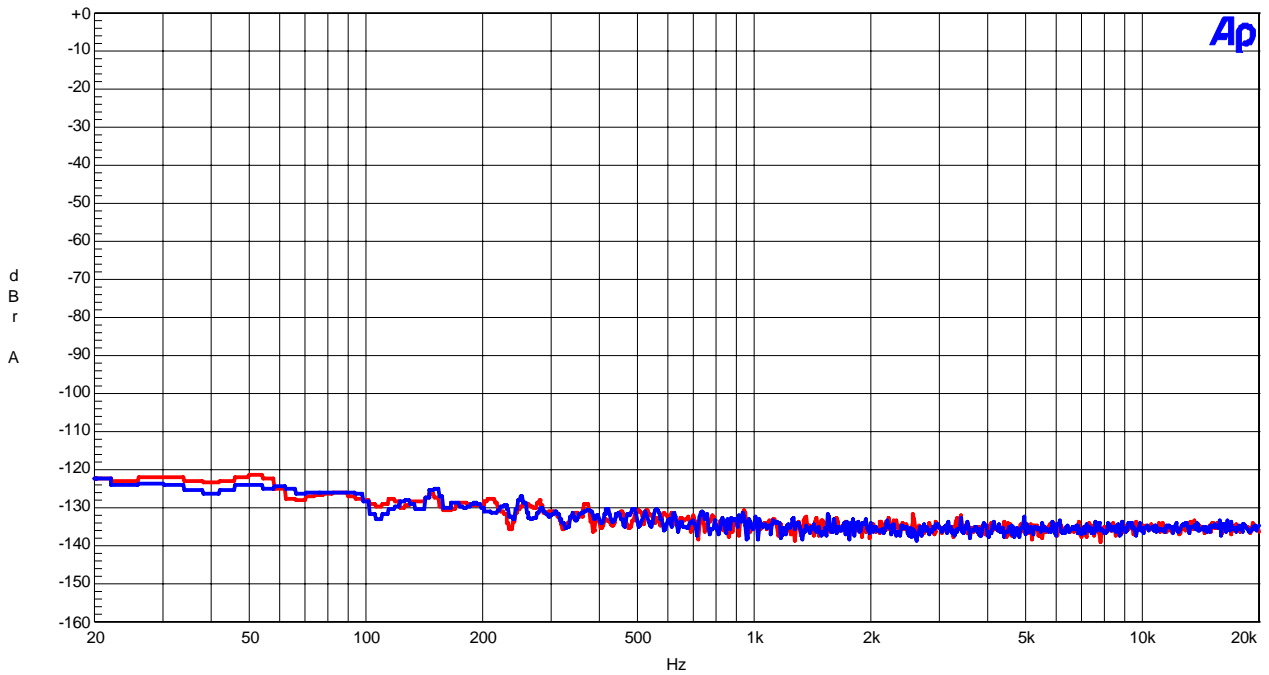
AK4359A FFT
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, No signal Input

Figure 11. FFT (noise floor)

AKM

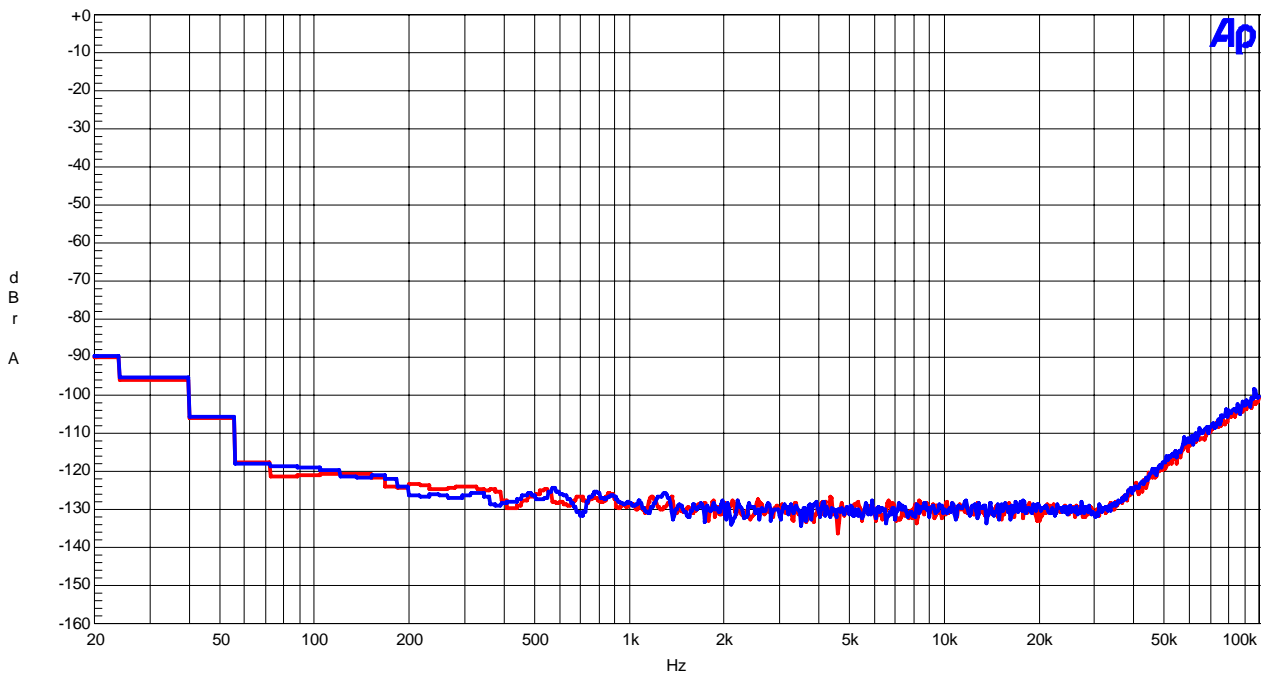
AK4359A FFT Out of Band Noise
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, No signal Input

Figure 12. FFT (out-of-band noise)

(fs=44.1kHz)

AKM

AK4359A THD+N vs. Input Level
 AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, fin=1kHz

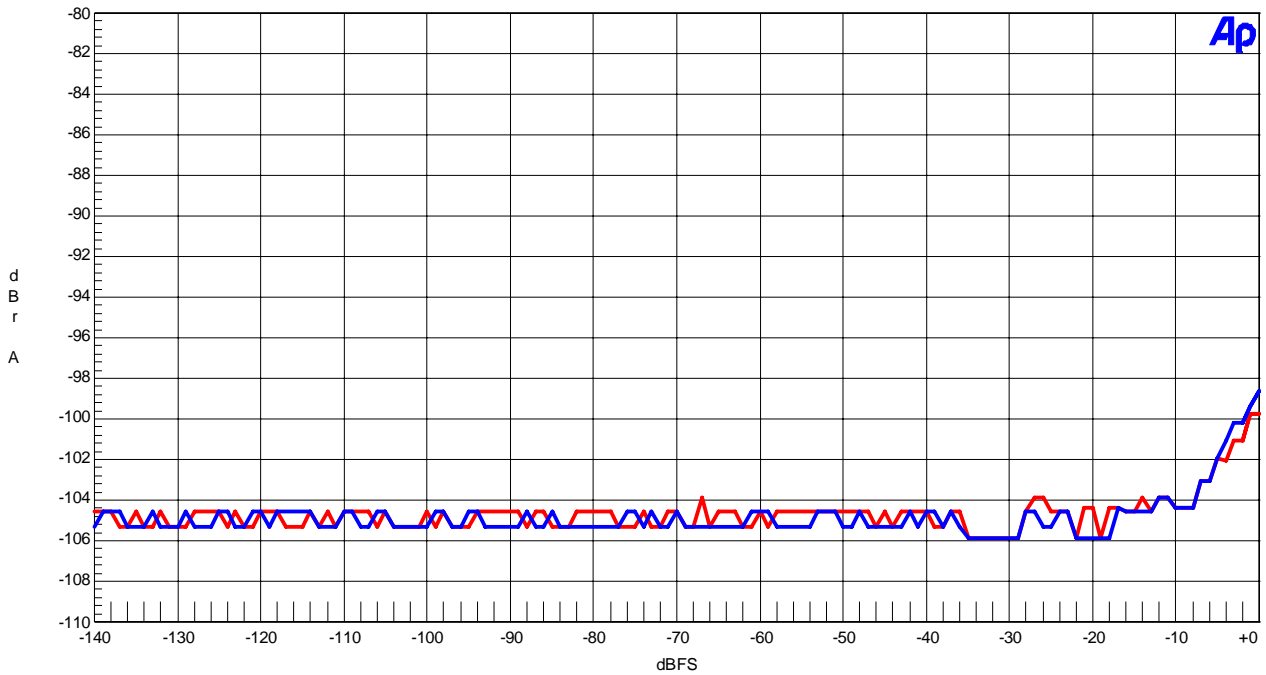


Figure 13. THD+N vs Input Level (fin=1kHz)

AKM

AK4359A THD+N vs. Input Frequency
 AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, 0dBFS Input

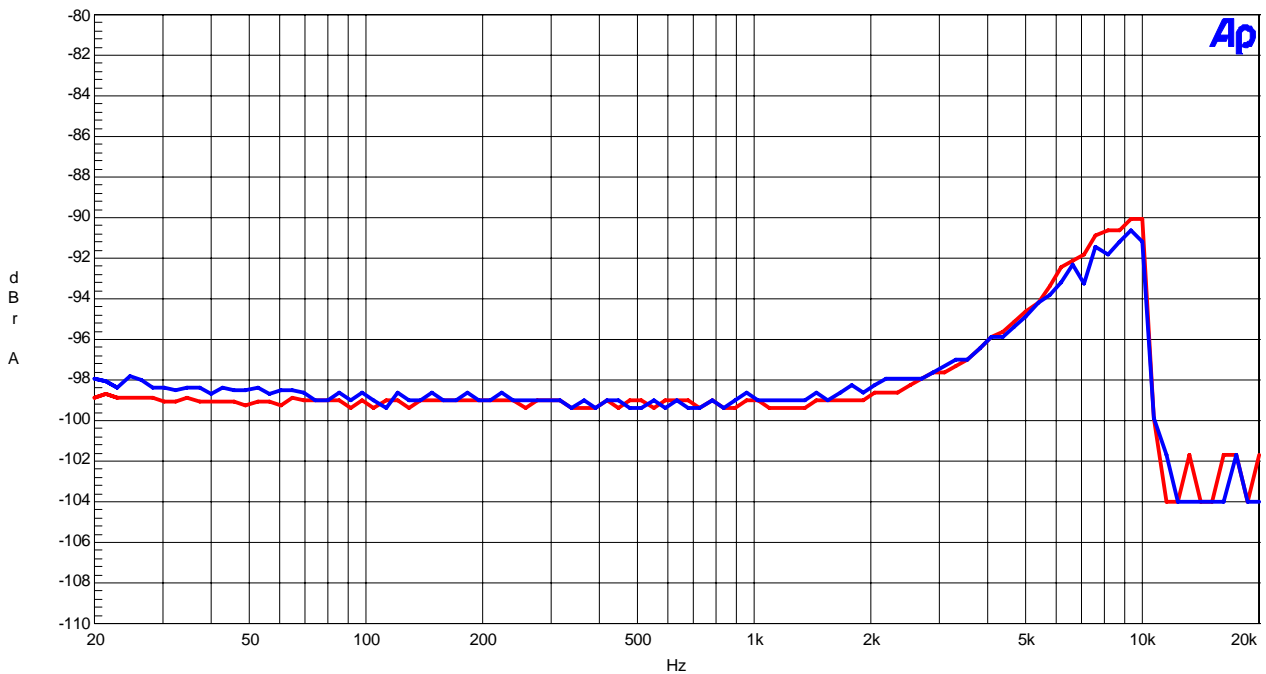


Figure 14. THD+N vs fin (Input level=0dBFS)

(fs=44.1kHz)

AKM

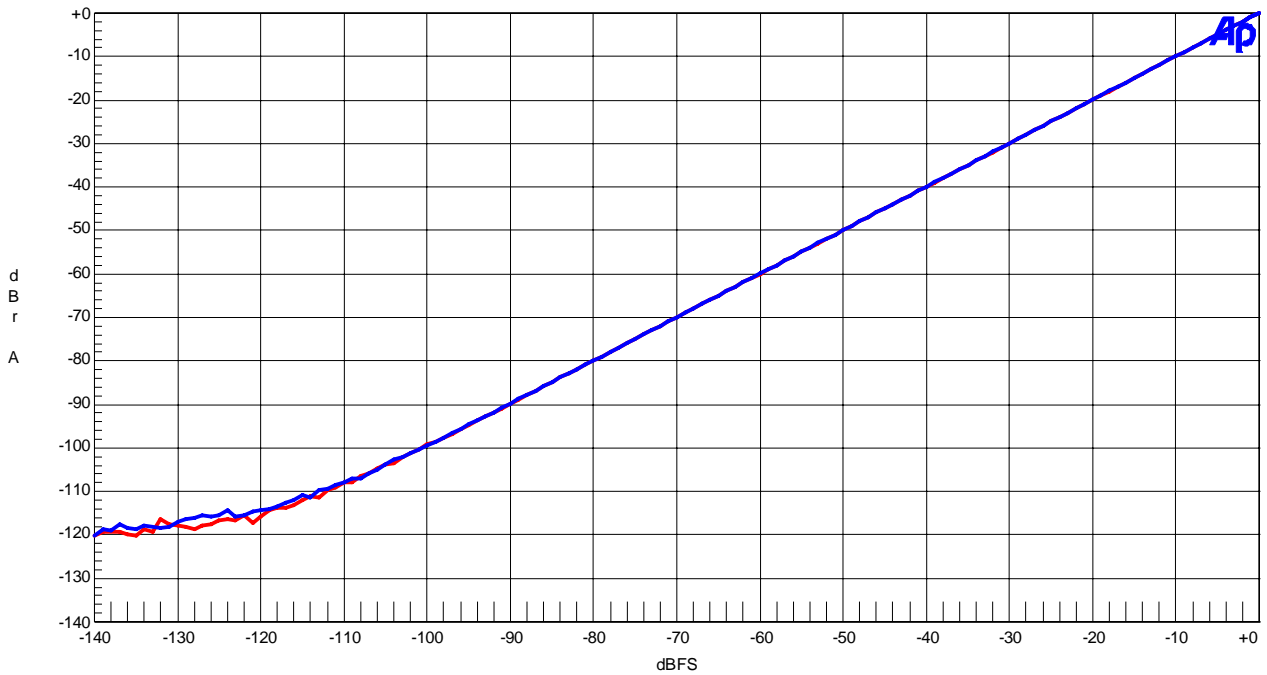
AK4359A Linearity
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, fin=1kHz

Figure 15. Linearity (fin=1kHz)

AKM

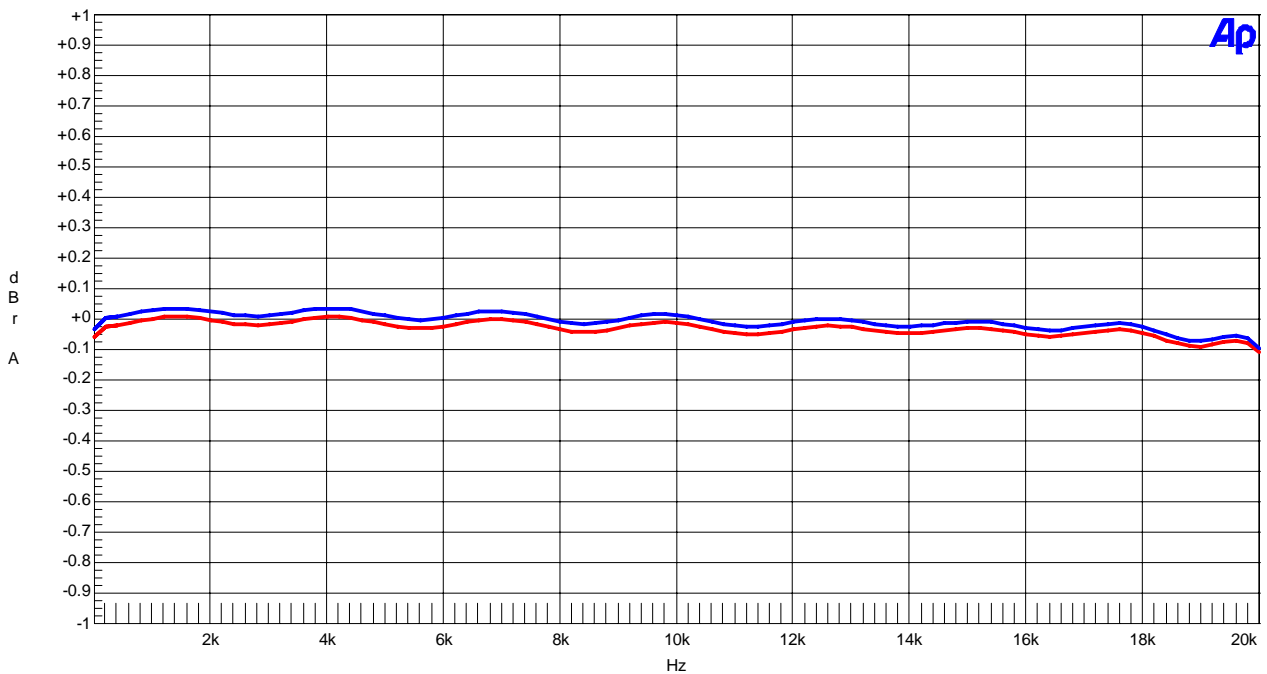
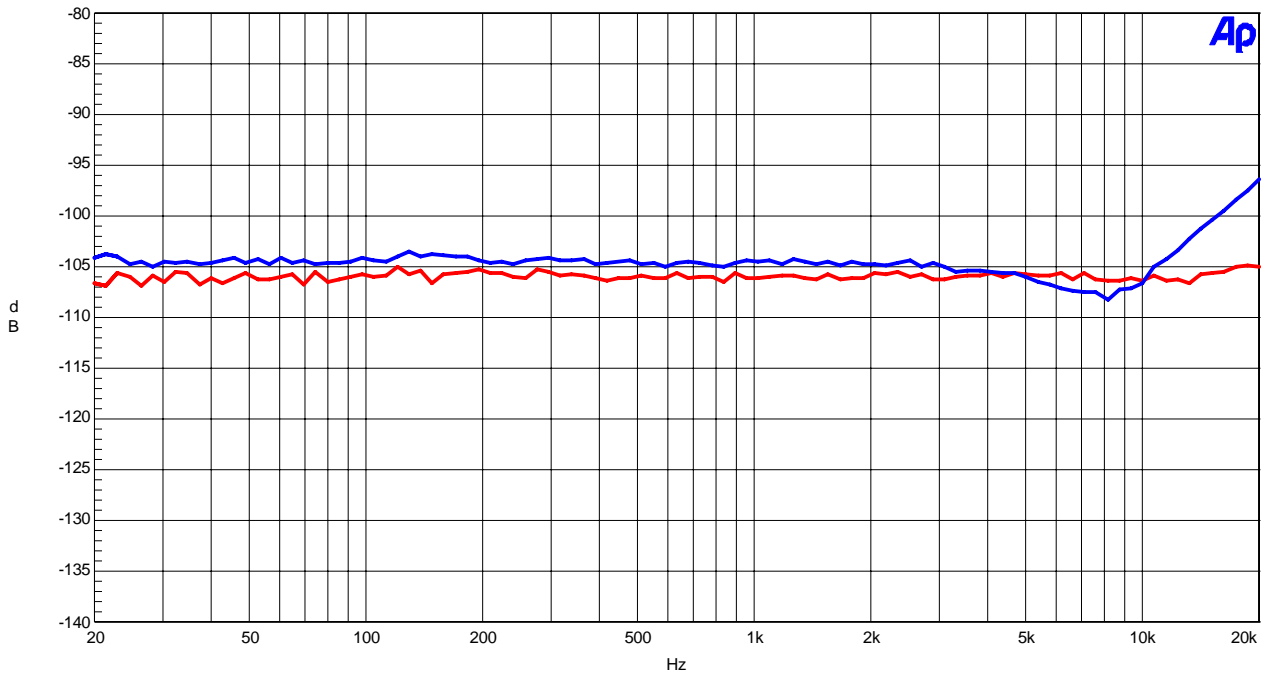
AK4359A Frequency Response
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, 0dBFS Input

Figure 16. Frequency Response (Input level=0dBFS)

(fs=44.1kHz)

AKM

AK4359A Crosstalk
AVDD=DVDD=5V, MCLK=512fs, fs=44.1kHz, 0dBFS Input**Figure 17. Cross-talk (Input level=0dBFS)**

(fs=96kHz)

AKM

AK4359A FFT
 AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, 0dBFS Input

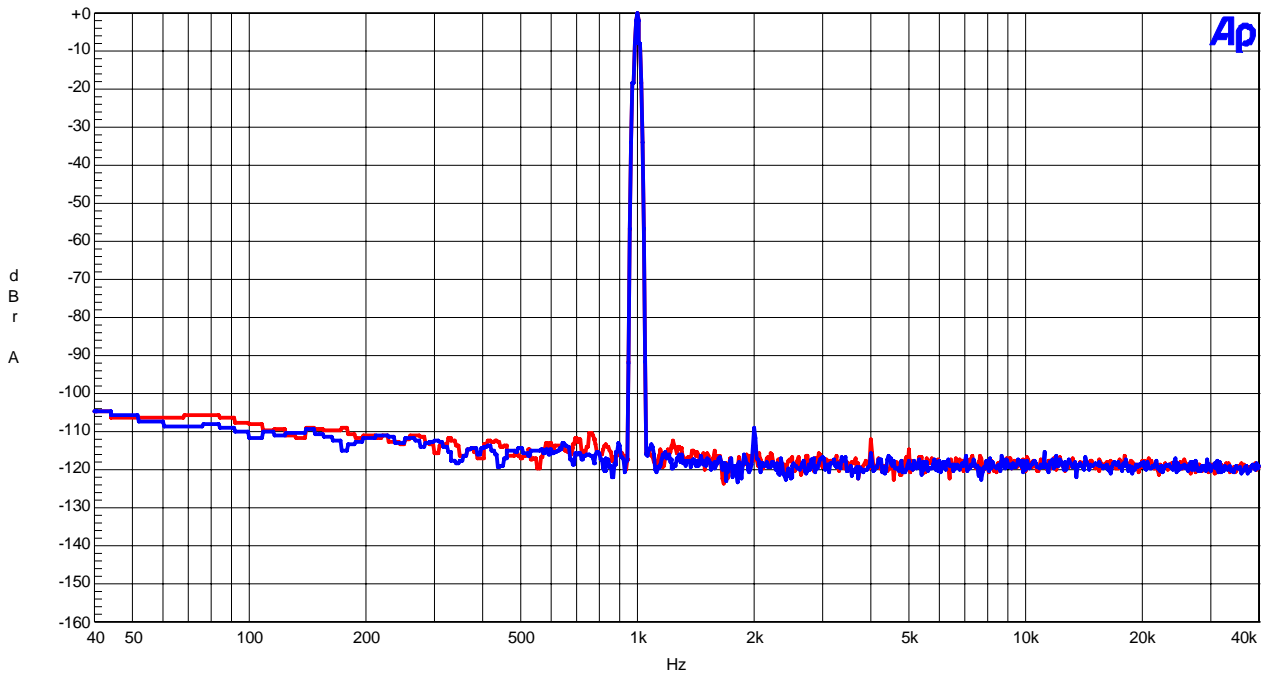


Figure 18. FFT (1kHz, 0dBFS input)

AKM

AK4359A FFT
 AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, -60dBFS Input

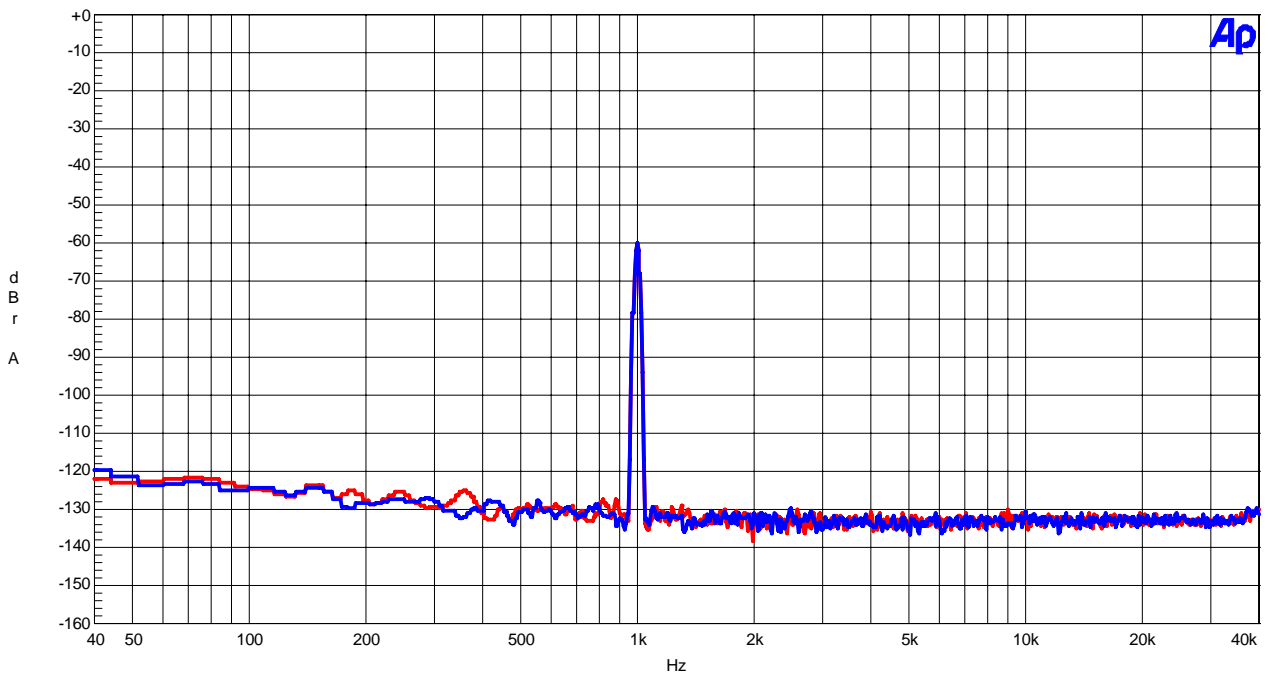


Figure 19. FFT (1kHz, -60dBFS input)

(fs=96kHz)

AKM

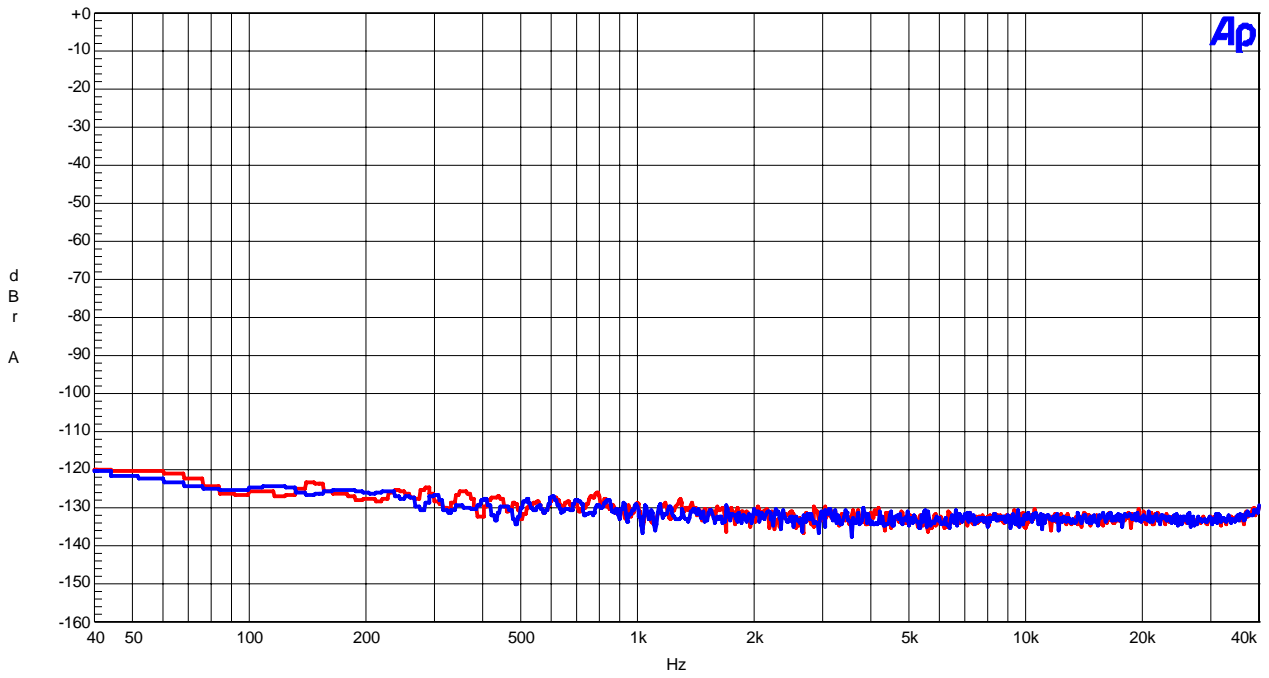
AK4359A FFT
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, No signal Input

Figure 20. FFT (noise floor)

AKM

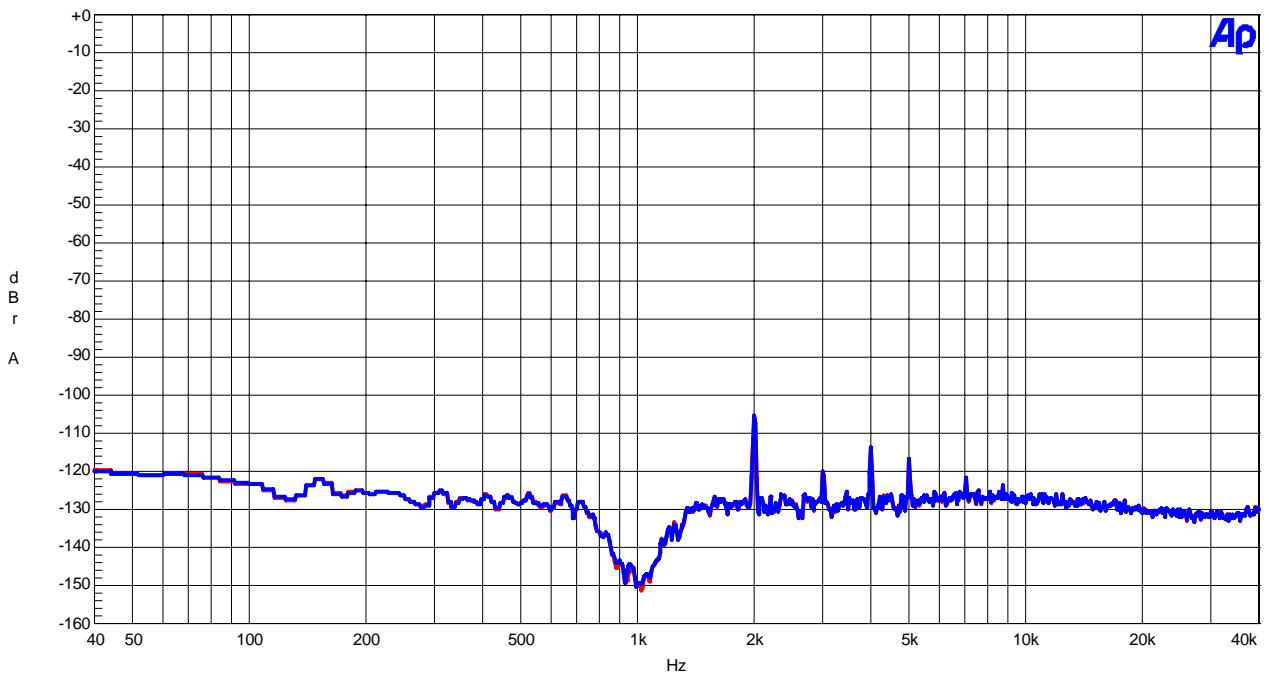
AK4359A FFT Notch
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, 0dBFS Input

Figure 21. FFT (Notch)

(fs=96kHz)

AKM

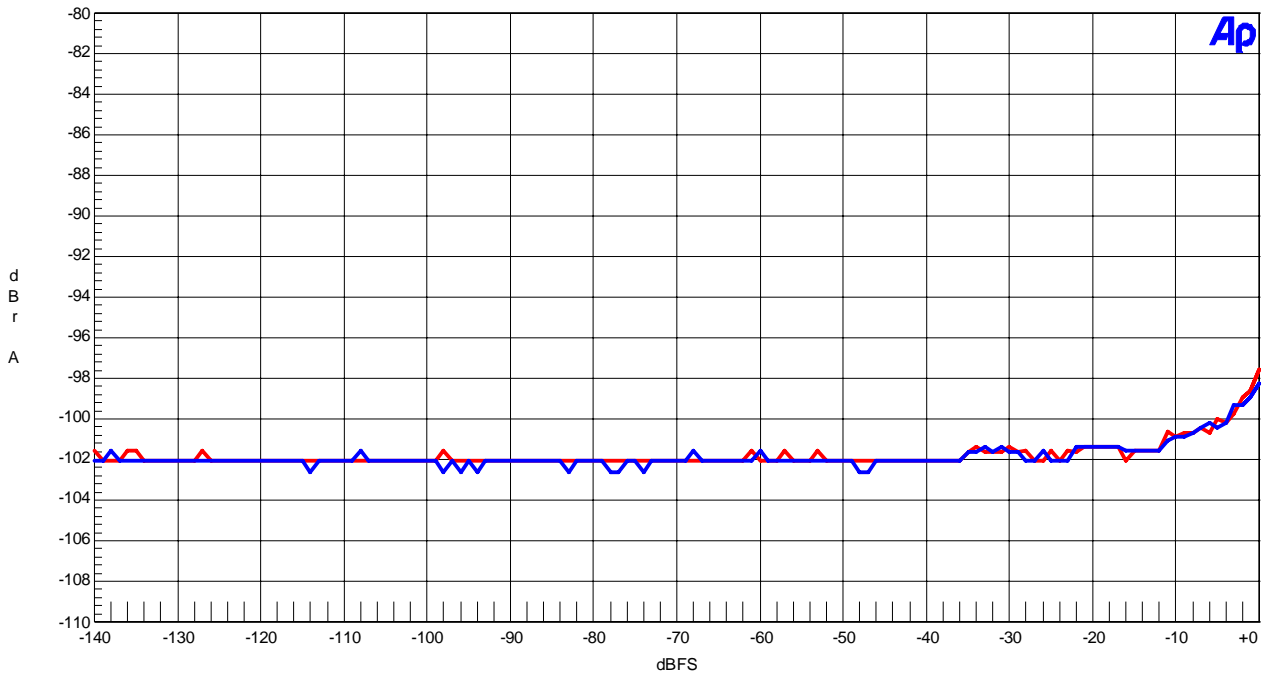
AK4359A THD+N vs. Input Level
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, fin=1kHz

Figure 22. THD+N vs Input Level (fin=1kHz)

AKM

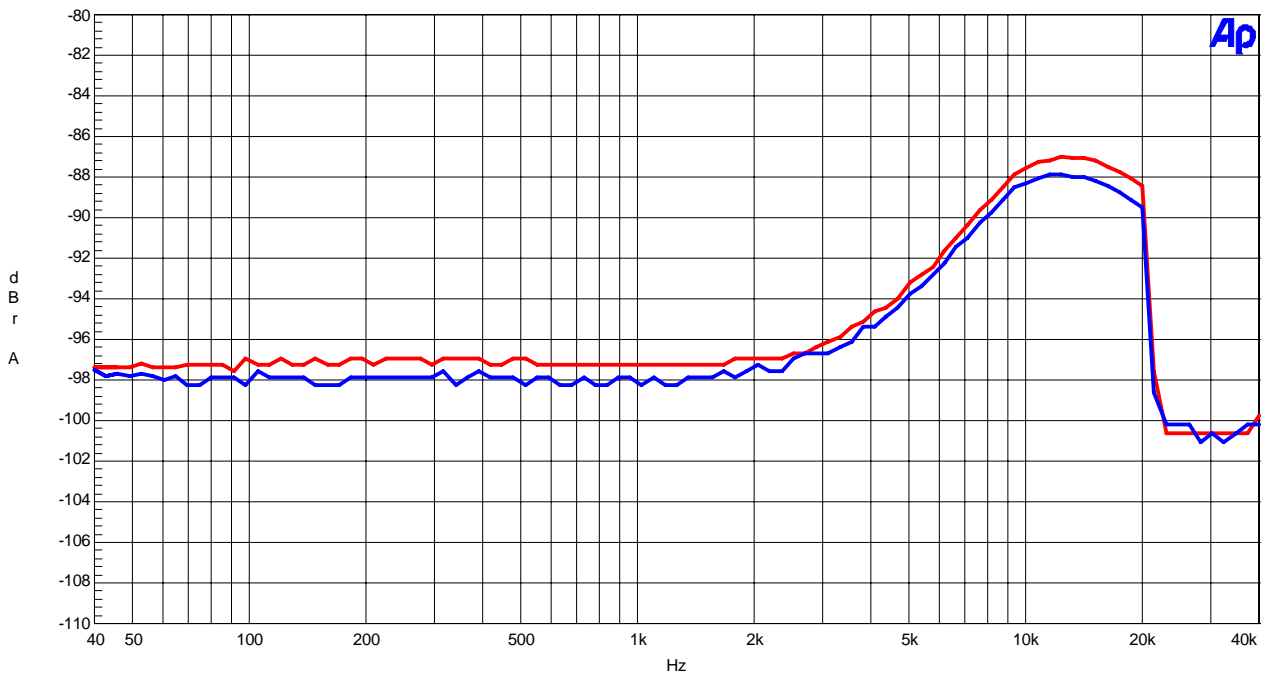
AK4359A THD+N vs. Input Frequency
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, 0dBFS Input

Figure 23. THD+N vs fin (Input level=0dBFS)

(fs=96kHz)

AKM

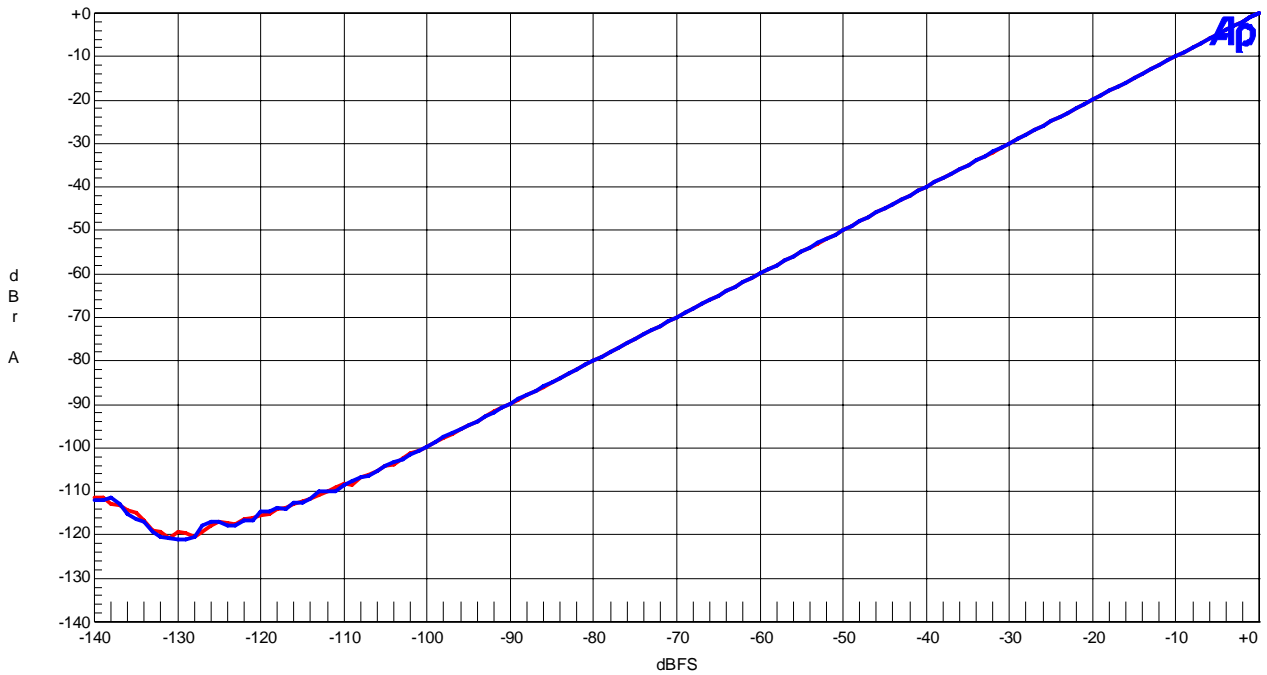
AK4359A Linearity
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, fin=1kHz

Figure 24. Linearity (fin=1kHz)

AKM

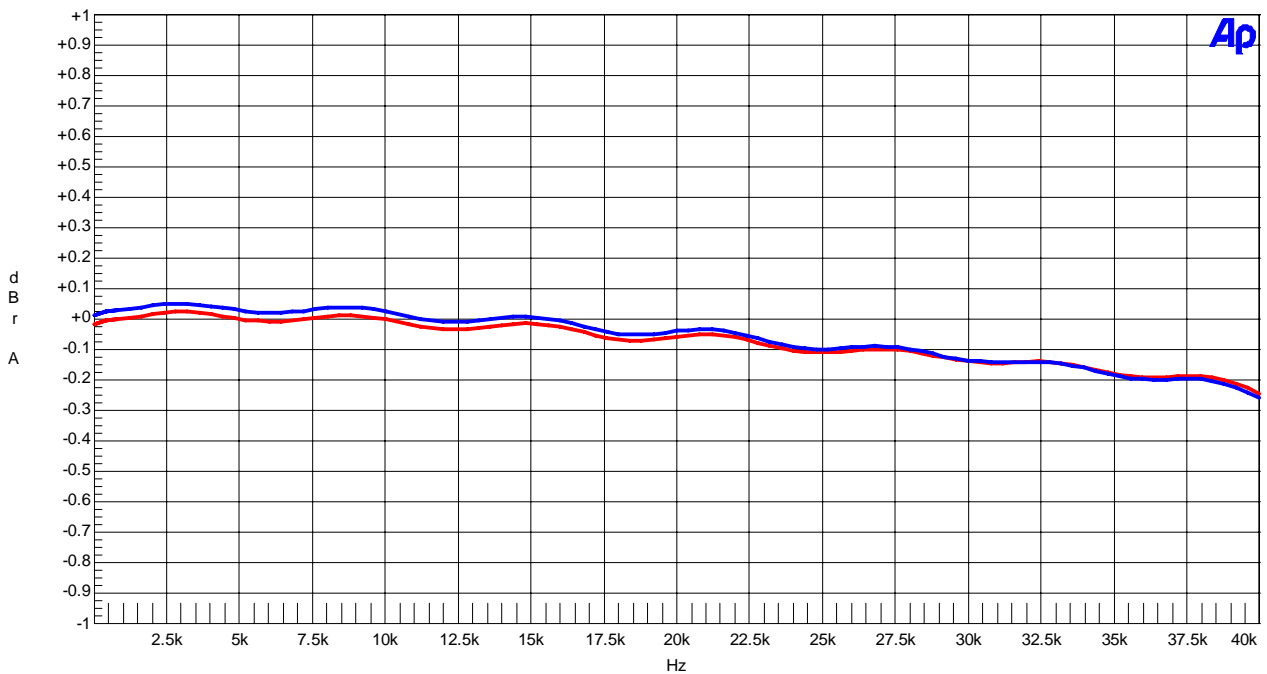
AK4359A Frequency Response
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, 0dBFS Input

Figure 25. Frequency Response (Input level=0dBFS)

(fs=96kHz)

AKM

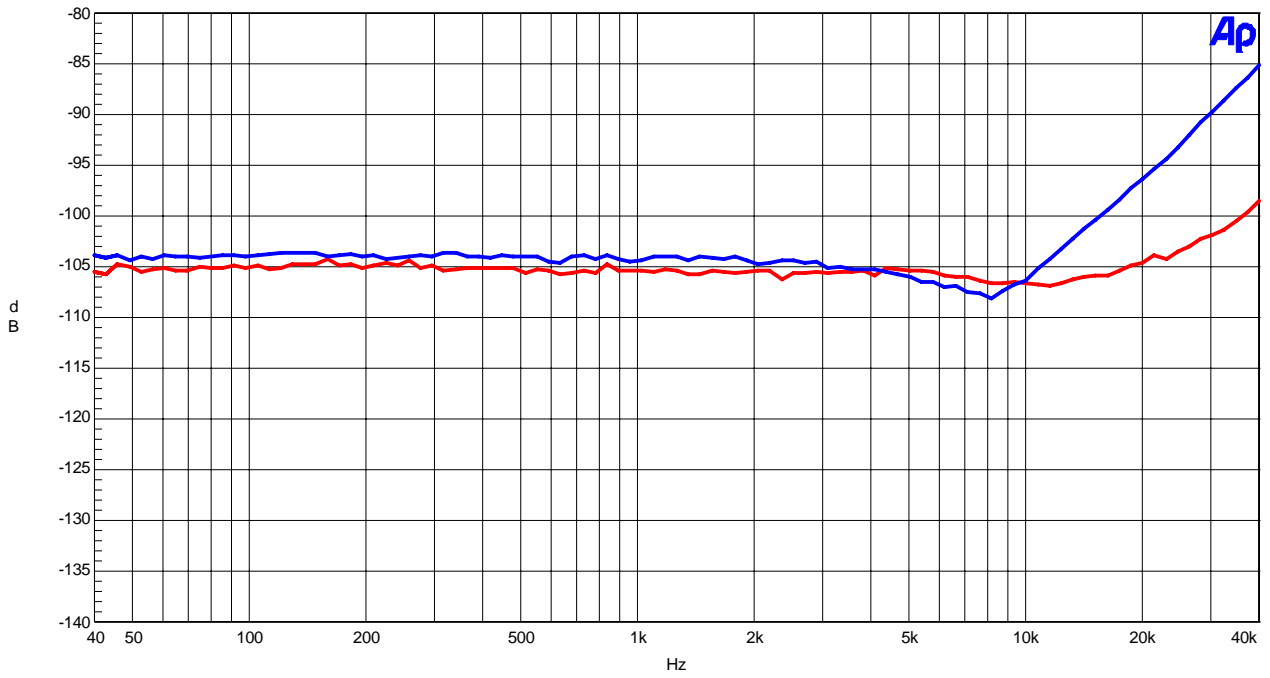
AK4359A Crosstalk
AVDD=DVDD=5V, MCLK=256fs, fs=96kHz, 0dBFS Input

Figure 26. Cross-talk (Input level=0dBFS)

(fs=192kHz)

AKM

AK4359A FFT
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, 0dBFS Input

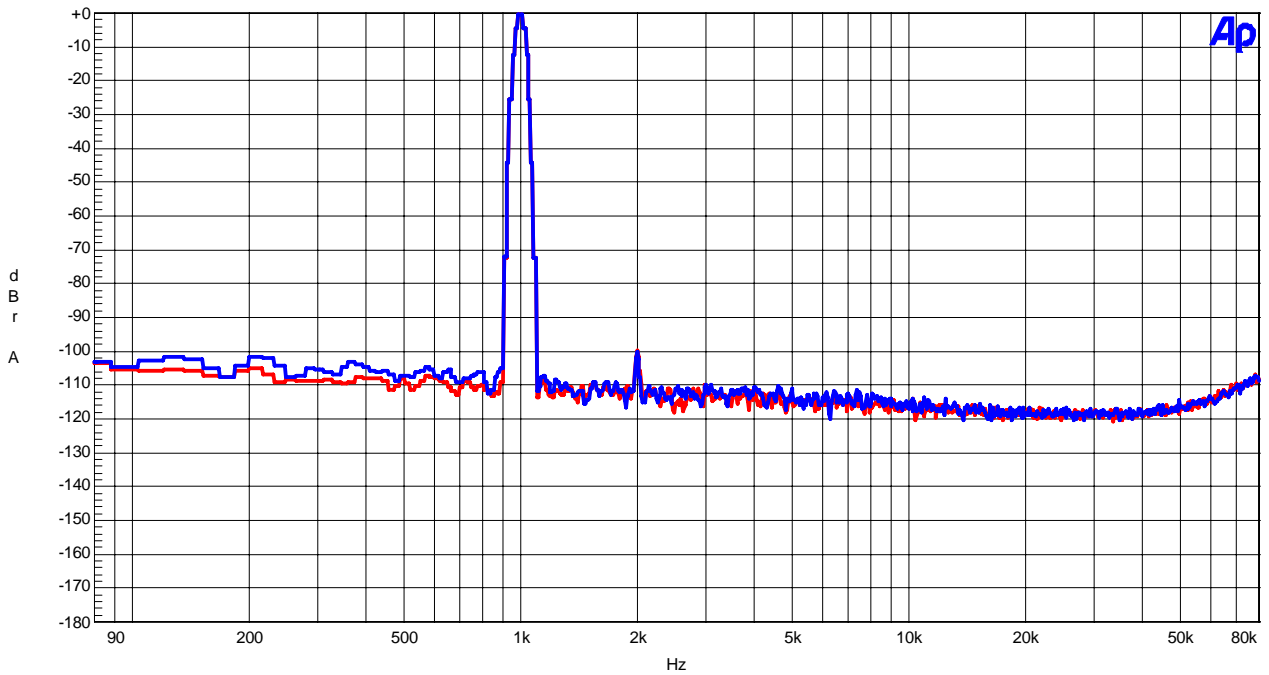


Figure 27. FFT (1kHz, 0dBFS input)

AKM

AK4359A FFT
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, -60dBFS Input

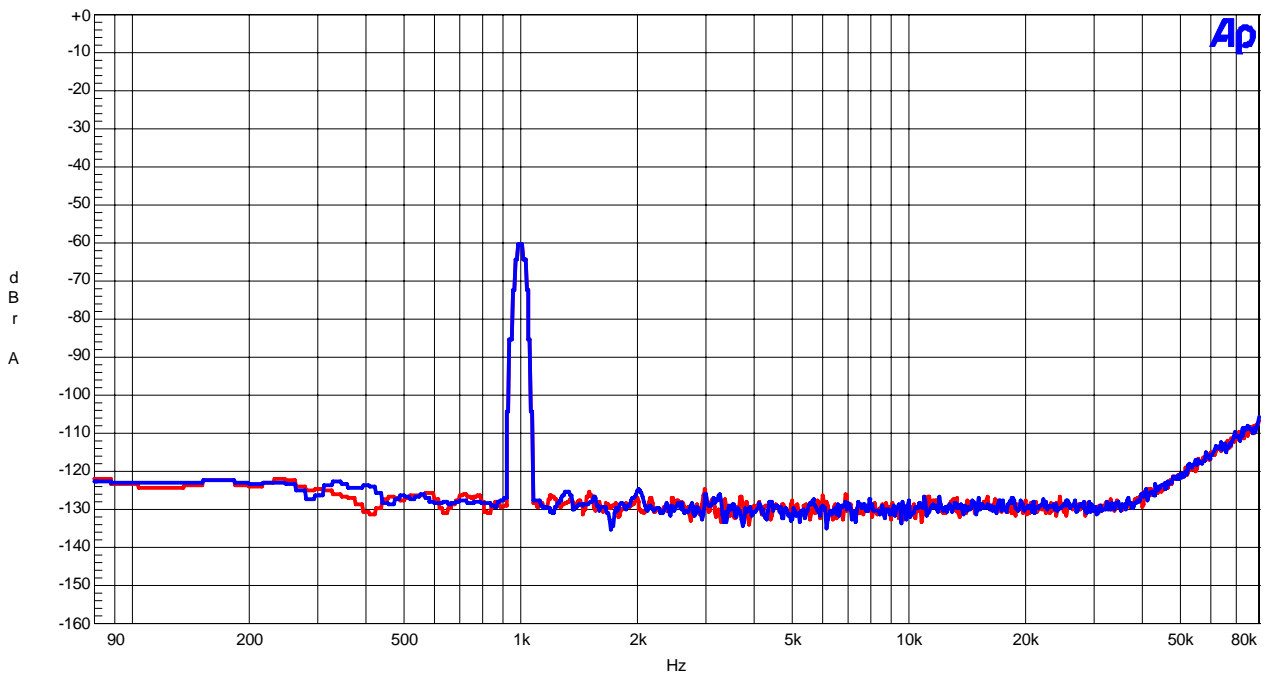


Figure 28. FFT (1kHz, -60dBFS input)

(fs=192kHz)

AKM

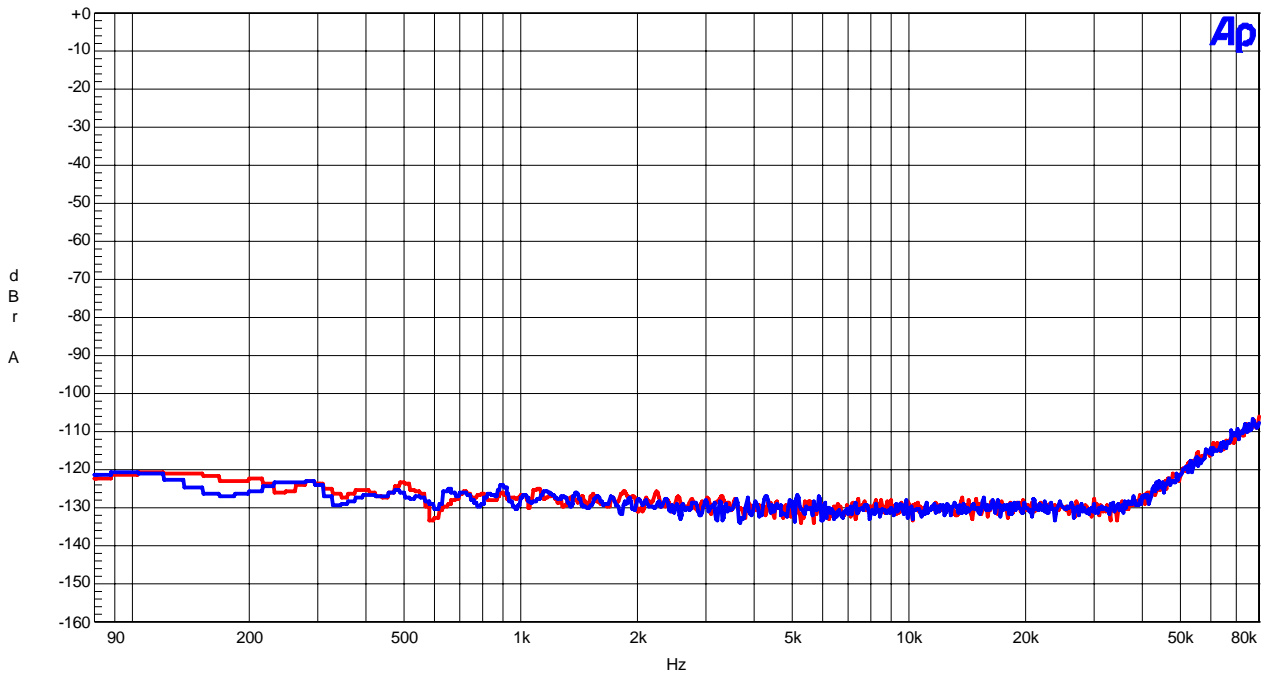
AK4359A FFT
AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, No signal Input

Figure 29. FFT (noise floor)

AKM

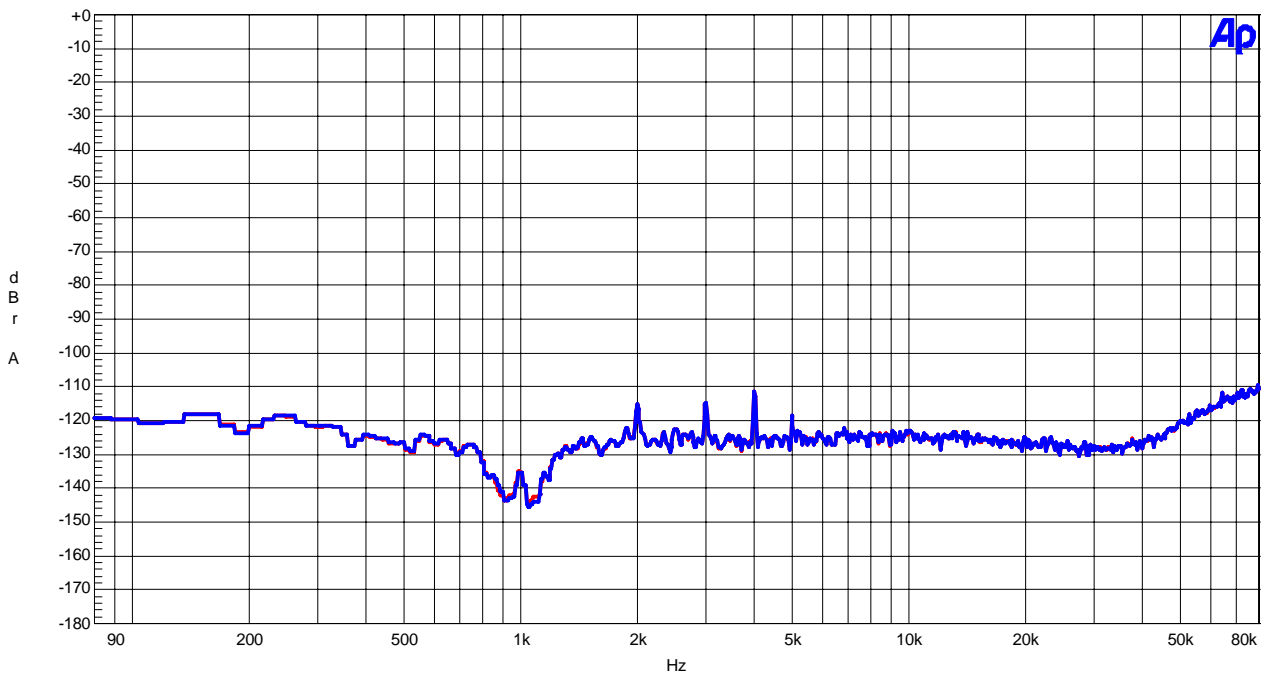
AK4359A FFT Notch
AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, 0dBFS Input

Figure 30. FFT (Notch)

(fs=192kHz)

AKM

AK4359A THD+N vs. Input Level
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, fin=1kHz

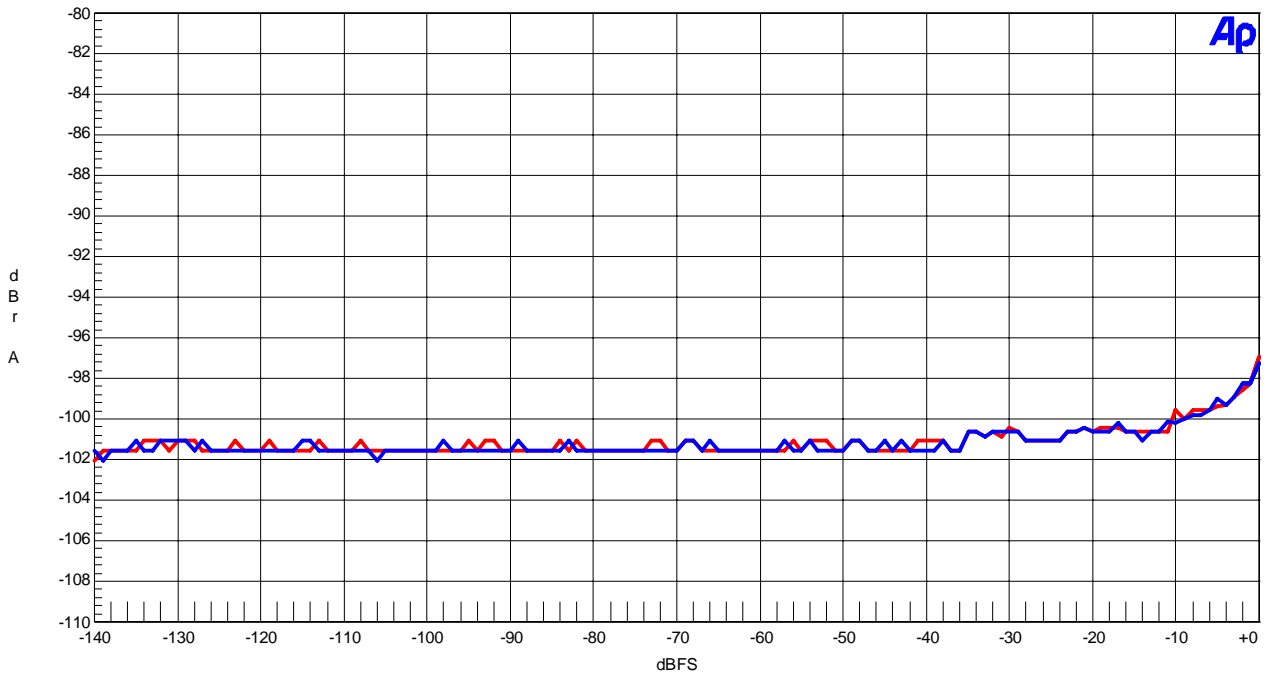


Figure 31. THD+N vs Input Level (fin=1kHz)

AKM

AK4359A THD+N vs. Input Frequency
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, 0dBFS Input

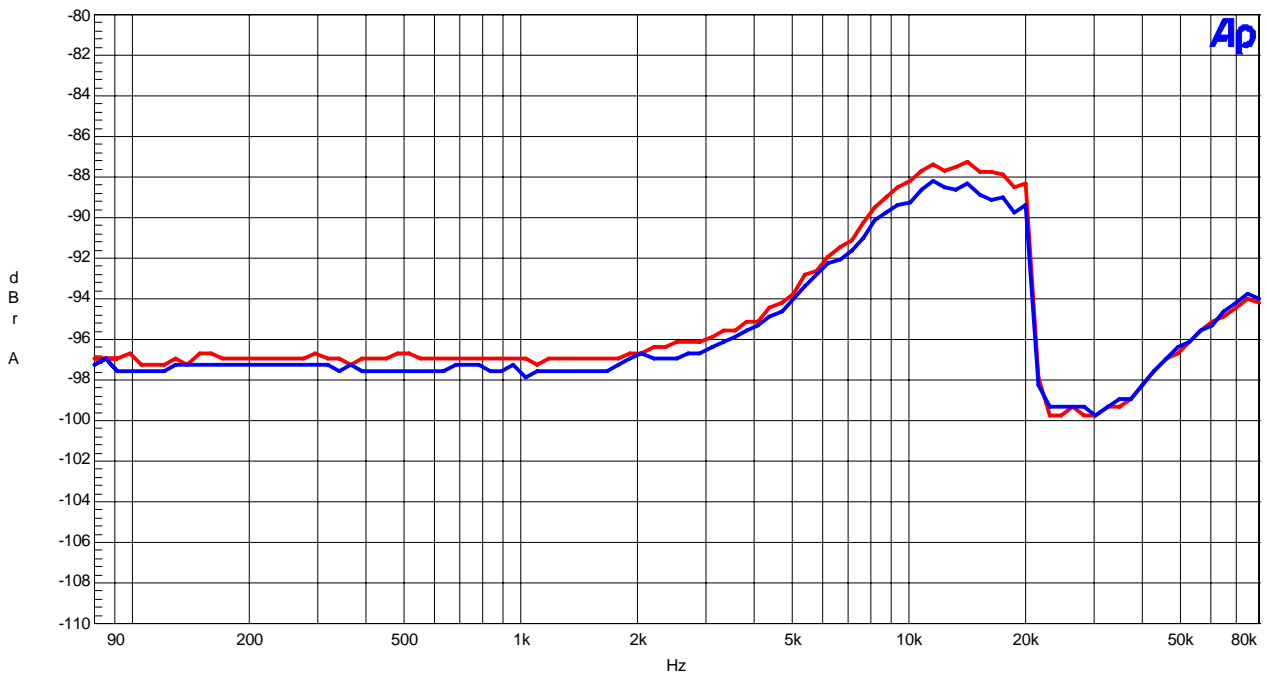


Figure 32. THD+N vs fin (Input level=0dBFS)

(fs=192kHz)

AKM

AK4359A Linearity
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, fin=1kHz

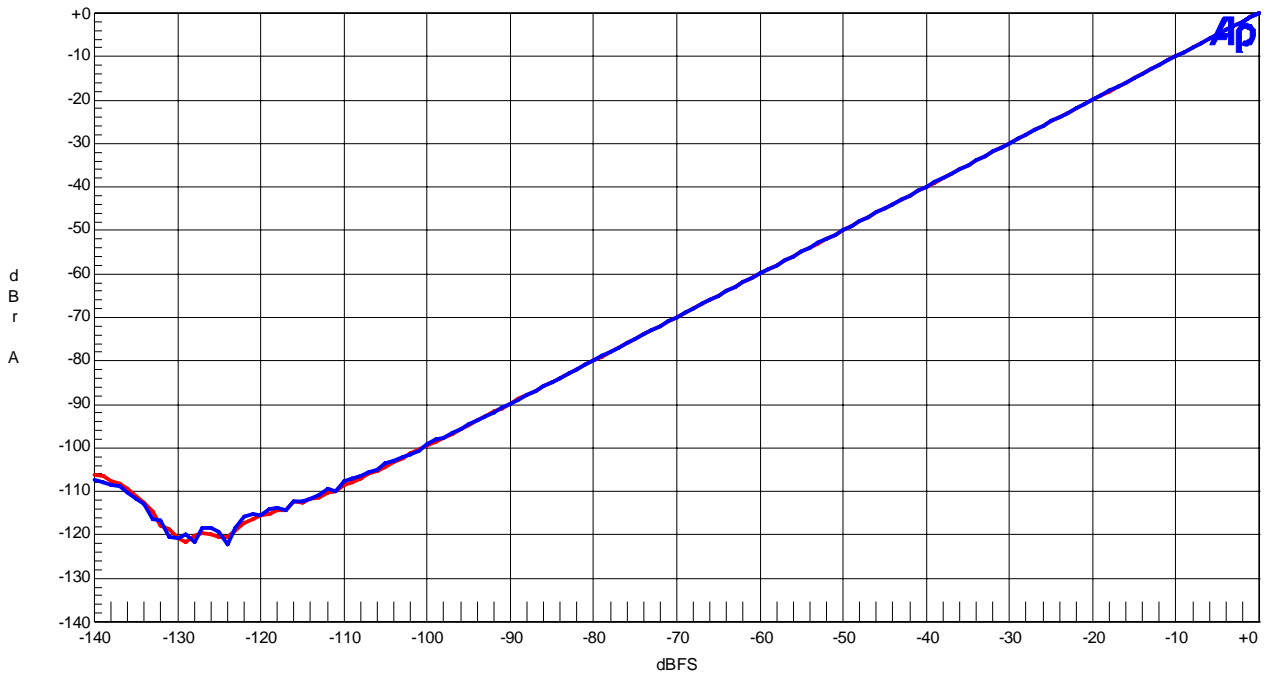


Figure 33. Linearity (fin=1kHz)

AKM

AK4359A Frequency Response
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, 0dBFS Input

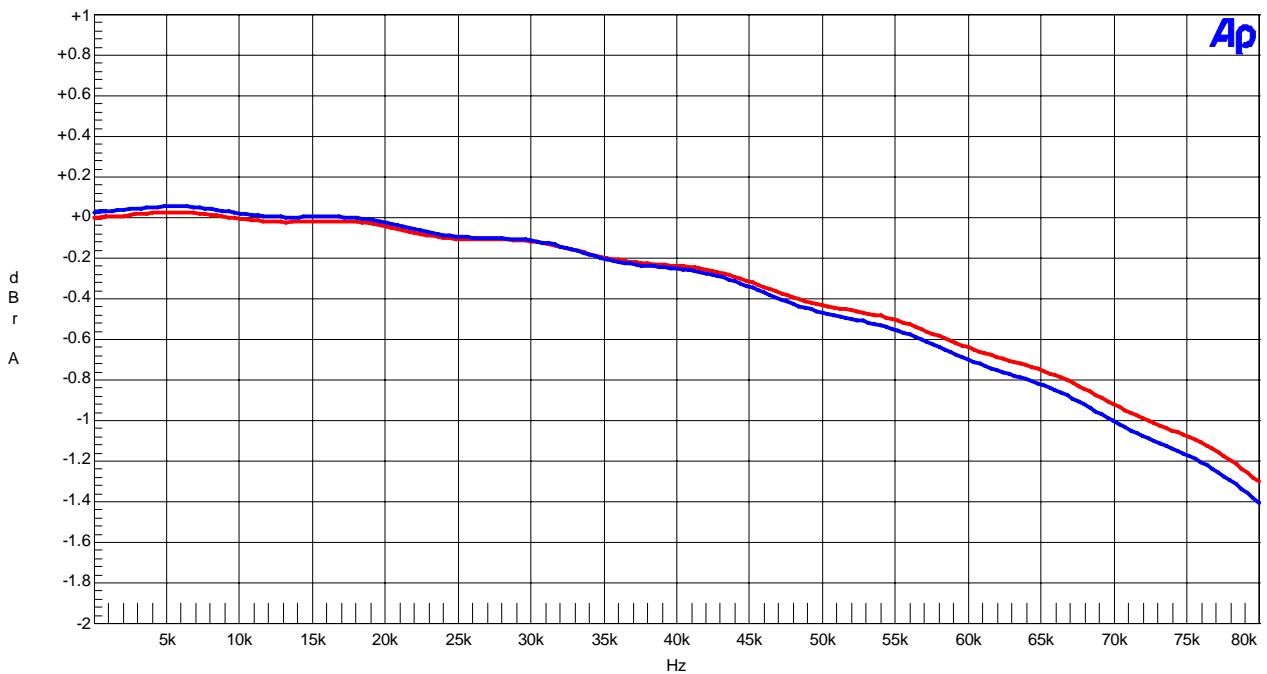


Figure 34. Frequency Response (Input level=0dBFS)

(fs=96kHz)

AKM

AK4359A Crosstalk
 AVDD=DVDD=5V, MCLK=128fs, fs=192kHz, 0dBFS Input

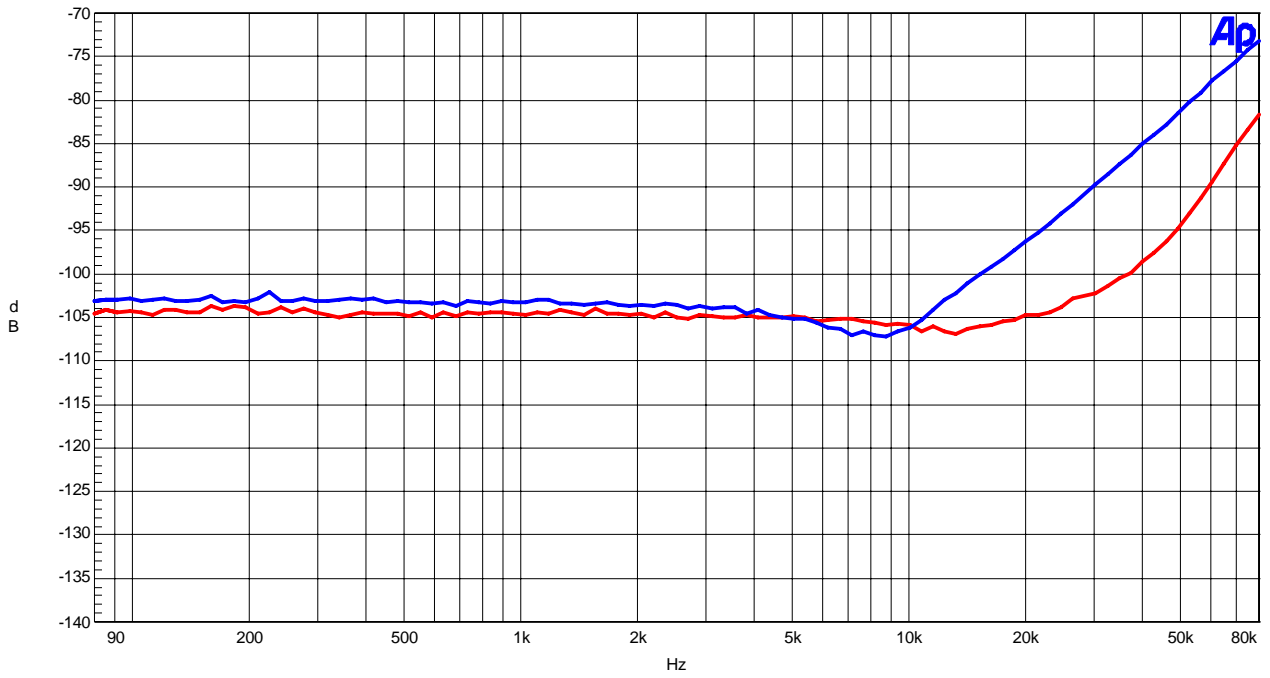


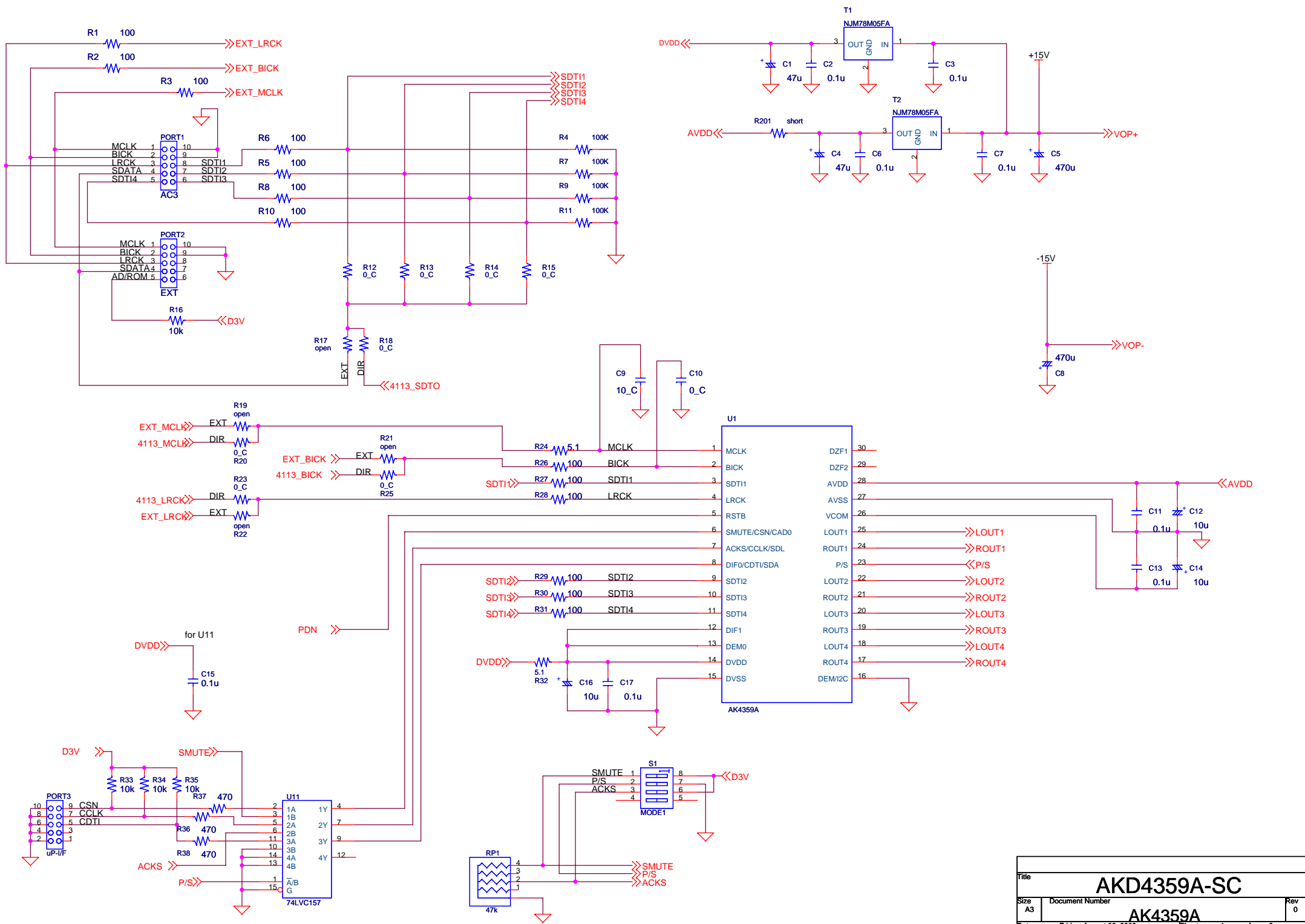
Figure 35. Cross-talk (Input level=0dBFS)

Revision History

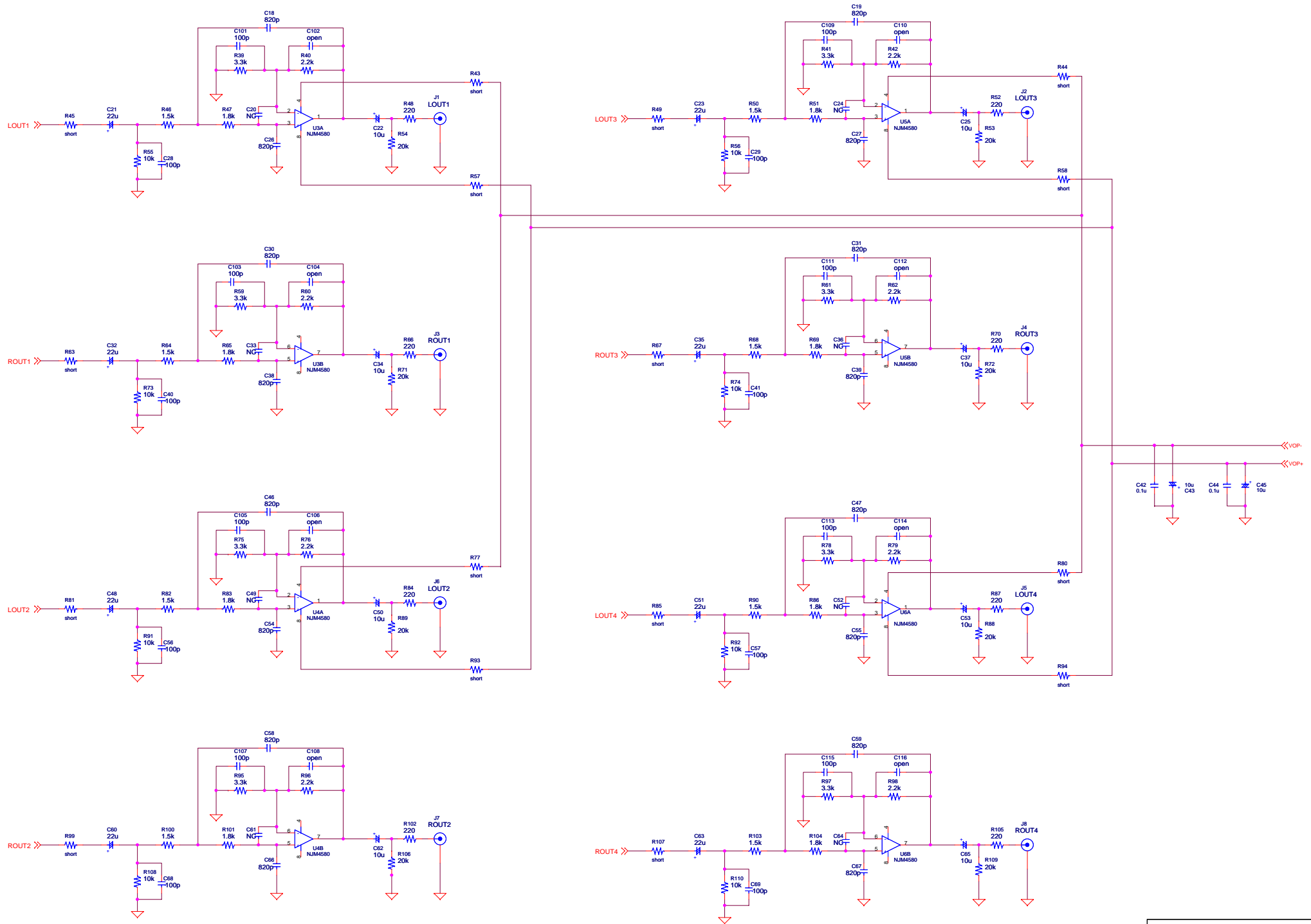
Date (YY/MM/DD)	Manual Revision	Board Revision	Reason	Page	Contents
08/08/05	KM096100	0	First edition		

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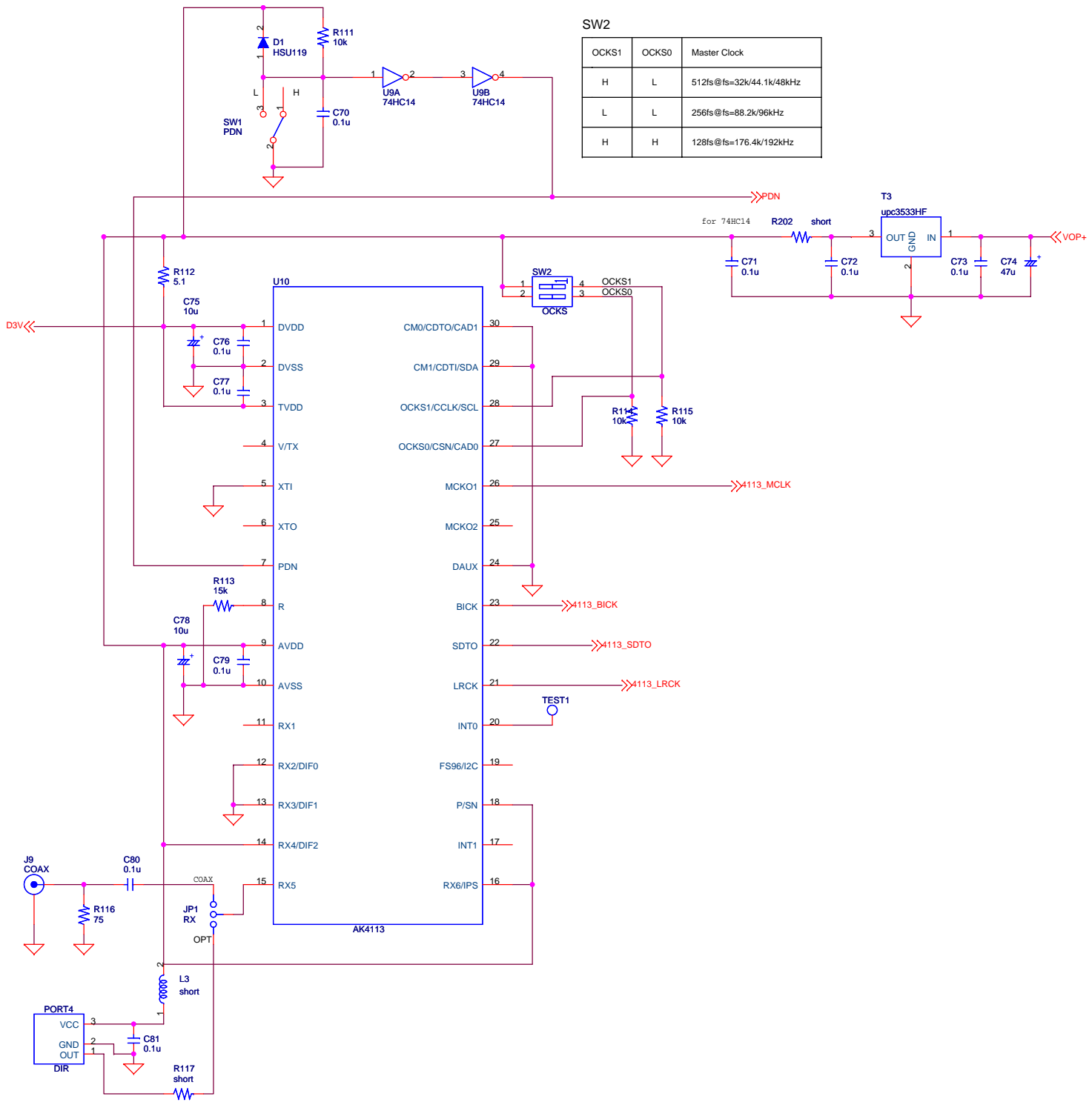
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SW2

OCKS1	OCKS0	Master Clock
H	L	512fs@fs=32k/44.1k/48kHz
L	L	256fs@fs=88.2k/96kHz
H	H	128fs@fs=176.4k/192kHz



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