AKD4381
Evaluation board Rev.A for AK4381

GENERAL DESCRIPTION

The AKD4381 is an evaluation board for the AK4381, the 24bit, 192kHz D/A converter for DVD and AC-3 amp. The AKD4381 has the interface with AKM's wave generator using ROM data and with AKM's A/D converter evaluation boards. Therefore, it is easy to evaluate the AK4381. The AKD4381 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector or BNC connector.

■ Ordering guide

AKD4381 --- Evaluation board for AK4381
(Cable for connecting with printer port of IBM-AT compatible PC and control software are packed with this.)

FUNCTION

- **On-board 2nd order LPF**
- **Compatible with 2 types of interface**
  - **Direct interface with AKM's A/D converter evaluation boards**
  - **On-board AK4112B as DIR which accepts optical or BNC input**
- **10pin header for serial control interface**

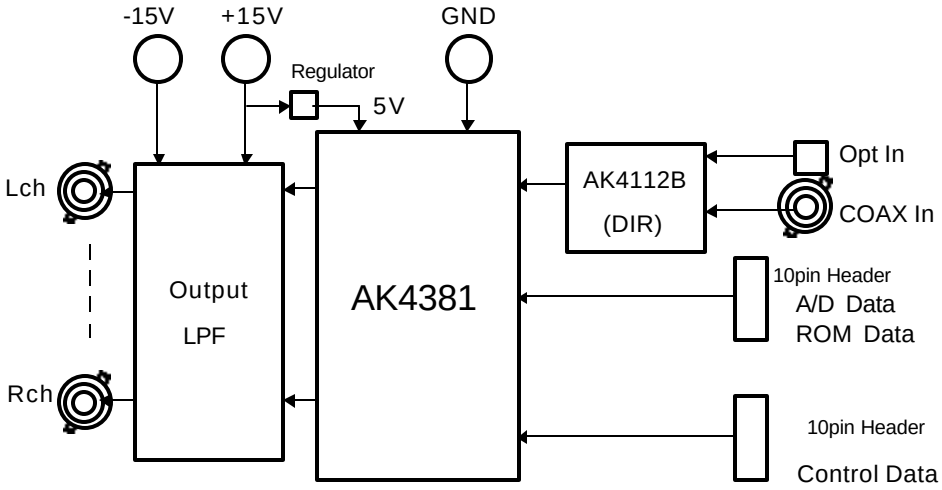


Figure 1. AKD4381 Block Diagram

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

■ External analog circuit

The 2nd order LPF (fc=93.2kHz, Q=0.712) which adds differential outputs of the AK4381 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 AK4381 is 5.5Vpp@5V.

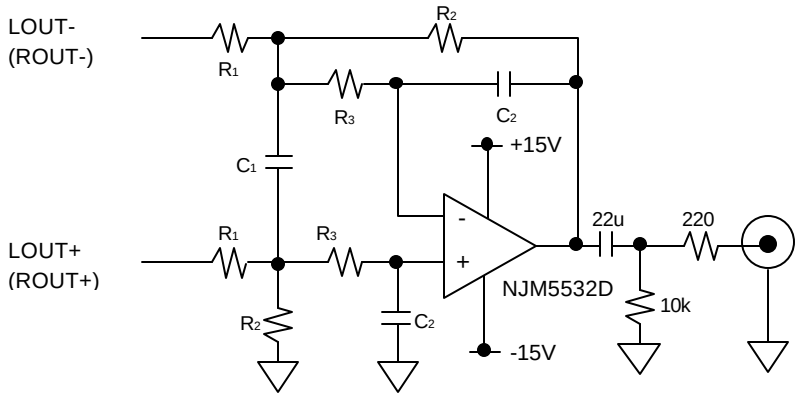


Figure 2. On-board analog filter

R_1	R_2	R_3	C_1	C_2
4.7k	4.7k	200	3300p	470p

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

fin	20kHz	40kHz	80kHz
Frequency Response	-0.003dB	-0.122dB	-1.821dB

Table 2. Frequency Response of LPF

<Calculation>

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

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

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

$$\omega_0=\frac{1}{\sqrt{2C_1C_2R_2R_3}},$$

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

■ Operation sequence

1) Set up the power supply lines.

[+15V]	(orange)	= +12 ~ +15V
[-15V]	(blue)	= -12 ~ -15V
[4382_VDD]	(red)	= 4.75 ~ 5.25V (Note 2)
[AGND]	(black)	= 0V
[DGND]	(black)	= 0V

Note: 1. Each supply line should be distributed from the power supply unit.
2. JP3(REG) should be shorted and "4382_VDD" jack should be open if VDD of the AK4381 is supplied from the regulator.

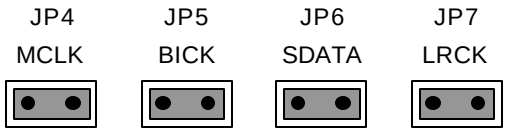
2) Set-up the evaluation modes, jumper pins and DIP switches (See the followings.)

3) Power on.
The AK4381 should be reset once bringing SW1(PDN) "L" upon power-up.

■ Evaluation mode

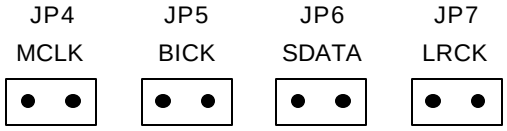
Applicable evaluation modes
1) DIR (Optical Link or BNC) (default)
2) Using AKM's evaluation board for ADC
3) Feeding all signals from external

1) DIR (Optical Link or BNC) <default>
The AK4112B(DIR) generates MCLK, BICK, LRCK and SDATA from the received data through PORT1(TORX176: optical link) or J1(BNC). Used for the evaluation using CD test disk. Nothing should be connected to PORT2(EXT). In case of using optical connector (TORX176), JP1(TORX/BNC) should be selected to "TORX". In case of using BNC connector, select "BNC".



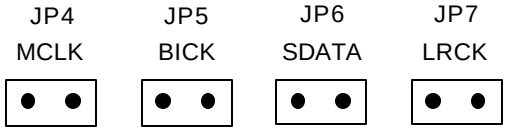
2) Using AKM's evaluation board for ADC

To evaluate the AK4381 with analog input, the AKM 's evaluation board for ADC can be used. MCLK, BICK and LRCK and A/D converted data are sent to the AKD4381 through PORT2(EXT) via 10 pin flat cable.



3) Feeding all signals from external

Under the following set-up, all external signals can be fed through POTR2(EXT).



■ DIP switch(S1) set up

S1 sets the mode of the AK4112B. Set-up is needed only for the evaluation mode 1 and 2. ON is "H" and OFF is "L".

No.	Pin	Default	Introduction
1	CM0	OFF	Clock mode set-up (Refer to the table 4.)
2	CM1	OFF	
3	OCKS1	OFF	MCLK frequency set-up (Refer to the table 5.)
4	OCKS0	OFF	

Table 3. S1 set-up

CM1 (S1-2)	CM0 (S1-1)	MCKO	SDTO	
OFF	OFF	TORX or BNC	TORX or BNC	<default>
OFF	ON	X'tal	"0" data	

Table 4. AK4112B clock mode set-up

OCKS1 (S1-3)	OCKS0 (S1-4)	MCLK	LRCK		
			Normal	Double	
OFF	OFF	256fs	Yes	Yes	
ON	OFF	512fs	Yes	No	<default>

Table 5. AK4112B MCLK frequency set-up

■ Jumpers set up

[JP1](TORX/BNC): The source of the biphase signal input to the AK4112B
TORX: PORT1(TORX176: optical link) <default>
BNC: J1(BNC)

[JP2](GND): AGND and DGND
Open: AGND and DGND are disconnected. <default>
Short: AGND and DGND are connected. ("DGND" jack can be open.)

[JP3](REG): VDD of the AK4381
Short: VDD is supplied from the regulator ("4382_VDD" jack should be open). <default>
Open: VDD is supplied from "4382_VDD" jack.

[JP4](MCLK): MCLK of the AK4381
Short: MCLK is fed from the AK4112B. <default>
Open : MCLK is fed from the external circuit via PORT2(EXT).

[JP5](BICK): BICK of the AK4381
Short: BICK is fed from the AK4112B. <default>
Open : BICK is fed from the external circuit via PORT2(EXT).

[JP6](SDATA): SDTI of the AK4381
Short: SDATA is fed from the AK4112B. <default>
Open : SDATA is fed from the external circuit via PORT2(EXT).

[JP7](LRCK): LRCK of the AK4381
Short: LRCK is fed from the AK4112B. <default>
Open : LRCK is fed from the external circuit via PORT2(EXT).

■ The function of the toggle SW

[SW1] (PDN): Resets the AK4381 and the AK4112B. Keep "H" during normal operation.

■ The indication content for LED

[LE1] (ERF) : Unlock and parity error output of the AK4112B.
[LE2] (FS96) : 96kHz sampling detect of the AK4112B.
[LE3] (AUTO) : Non-PCM data (AC-3, MPEG etc.) detects of the AK4112B.
[LE4] (V) : Validity detect of the AK4112B.

■ Serial control

The AKD4381 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT3(uP-I/F) with PC by 10-wire flat cable packed with the AKD4381.

Take care of the direction of connector. There is a mark at 1pin.
The pin layout of PORT3 is as Figure 4.

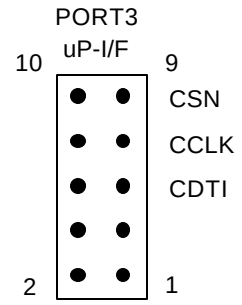


Figure 4. PORT3 pin layout

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 : 10Hz~20kHz (fs=44.1kHz), 10Hz~40kHz (fs=96kHz), 10Hz~40kHz (fs=192kHz)
- Bit : 24bit
- Power Supply : VDD=5V
- Interface : DIR AK4112B(44.1kHz), AK4114(192kHz)
- Temperature : Room

fs=44.1kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	20kLPF	95.0dB	95.6dB
DR	1kHz, -60dB	20kLPF	103.7dB	103.5dB
		22kLPF, A-weighted	106.2dB	106.0dB
S/N	no signal	20kLPF	103.5dB	103.5dB
		22kLPF, A-weighted	106.0dB	105.9dB

fs=96kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	94.0dB	94.9dB
DR	1kHz, -60dB	40kLPF	101.8dB	101.7dB
		22kLPF, A-weighted	107.3dB	107.3dB
S/N	no signal	40kLPF	102.9dB	102.9dB
		22kLPF, A-weighted	108.6dB	108.6dB

fs=192kHz

Parameter	Input signal	Measurement filter	Lch	Rch
S/(N+D)	1kHz, 0dB	40kLPF	91.9dB	92.0dB
DR	1kHz, -60dB	40kLPF	100.5dB	100.5dB
		22kLPF, A-weighted	105.7dB	105.7dB
S/N	no signal	40kLPF	102.6dB	102.4dB
		22kLPF, A-weighted	108.4dB	108.1dB

■ Plots

[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 : 10Hz~20kHz (fs=44.1kHz), 10Hz~40kHz (fs=96kHz), 10Hz~40kHz (fs=192kHz)
- Bit : 24bit
- Power Supply : VDD=5V
- Interface : DIR AK4112B(44.1kHz, 96kHz), AK4114(192kHz)
- Temperature : Room

fs=44.1kHz

Figure 6. FFT (1kHz, 0dBFS input)
Figure 7. FFT (1kHz, -60dBFS input)
Figure 8 . FFT (noise floor)
Figure 9 . FFT (out-of-band noise)
Figure10. THD+N vs Input Level (fin=1kHz)
Figure11. THD+N vs fin (Input level=0dBFS)
Figure12. Linearity (fin=1kHz)
Figure13. Frequency Response (Input level=0dBFS)
Figure14. Cross-talk (Input level=0dBFS)

fs=96kHz

Figure15. FFT (1kHz, 0dBFS input, Notch=OFF)
Figure16. FFT (1kHz, 0dBFS input, Notch=ON)
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Figure20. THD+N vs Input Level (fin=1kHz)
Figure21. THD+N vs fin (Input level=0dBFS)
Figure22. Linearity (fin=1kHz)
Figure23. Frequency Response (Input level=0dBFS)
Figure24. Cross-talk (Input level=0dBFS)

fs=192kHz

Figure25. FFT (1kHz, 0dBFS input, Notch=OFF)
Figure26. FFT (1kHz, 0dBFS input, Notch=ON)
Figure27. FFT (1kHz, -60dBFS input)
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Figure29. FFT (outband noise)
Figure30. THD+N vs Input Level (fin=1kHz)
Figure31. THD+N vs fin (Input level=0dBFS)
Figure32. Linearity (fin=1kHz)
Figure33. Frequency Response (Input level=0dBFS)
Figure34. Cross-talk (Input level=0dBFS)

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

(fs=44.1kHz)

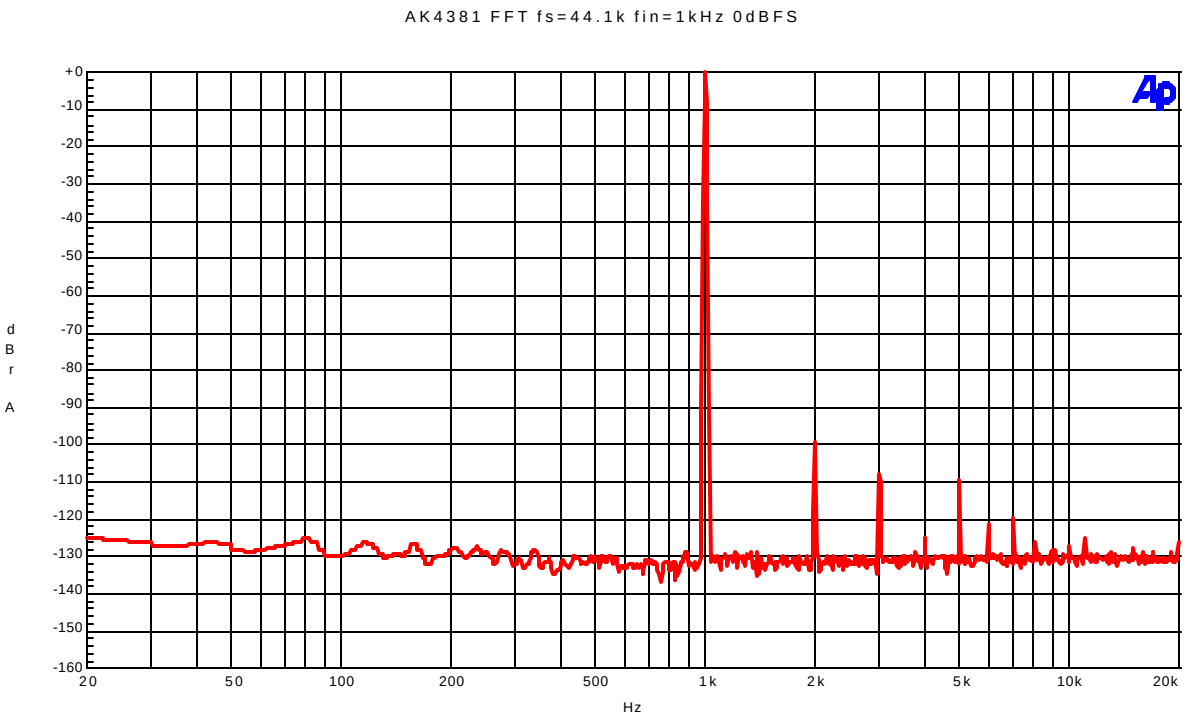


Figure 6 . FFT (1kHz, 0dBFS input)

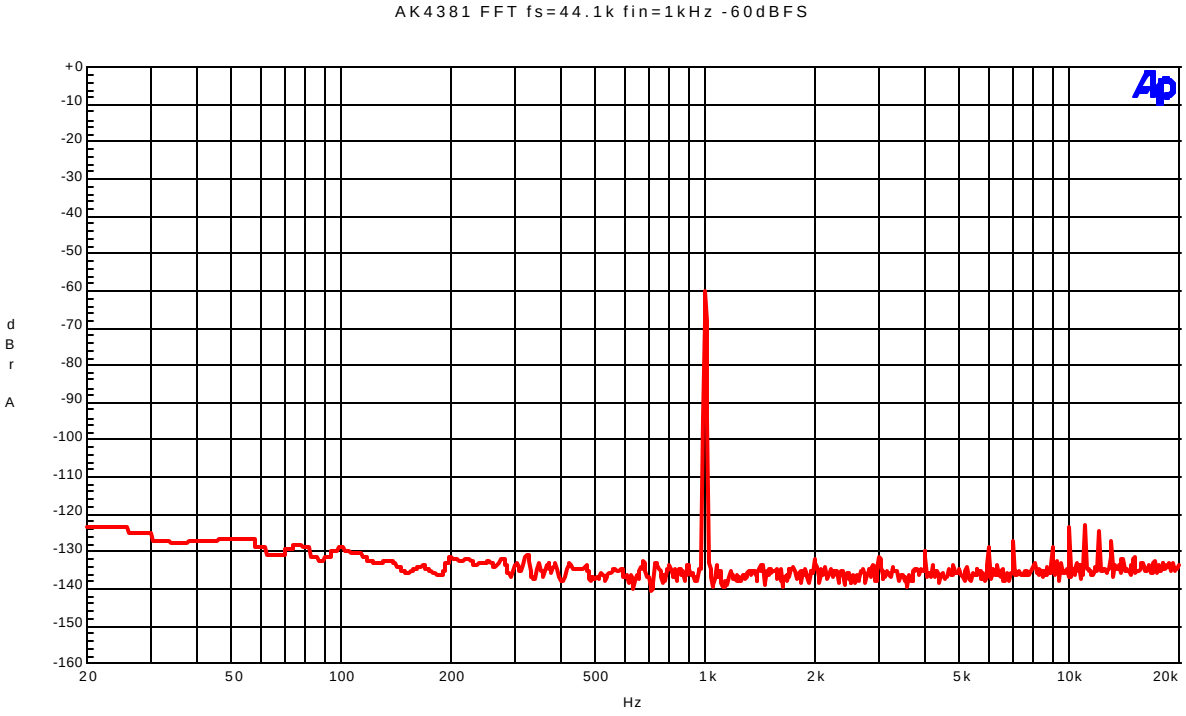


Figure 7 . FFT (1kHz, -60dBFS input)

(fs=44.1kHz)

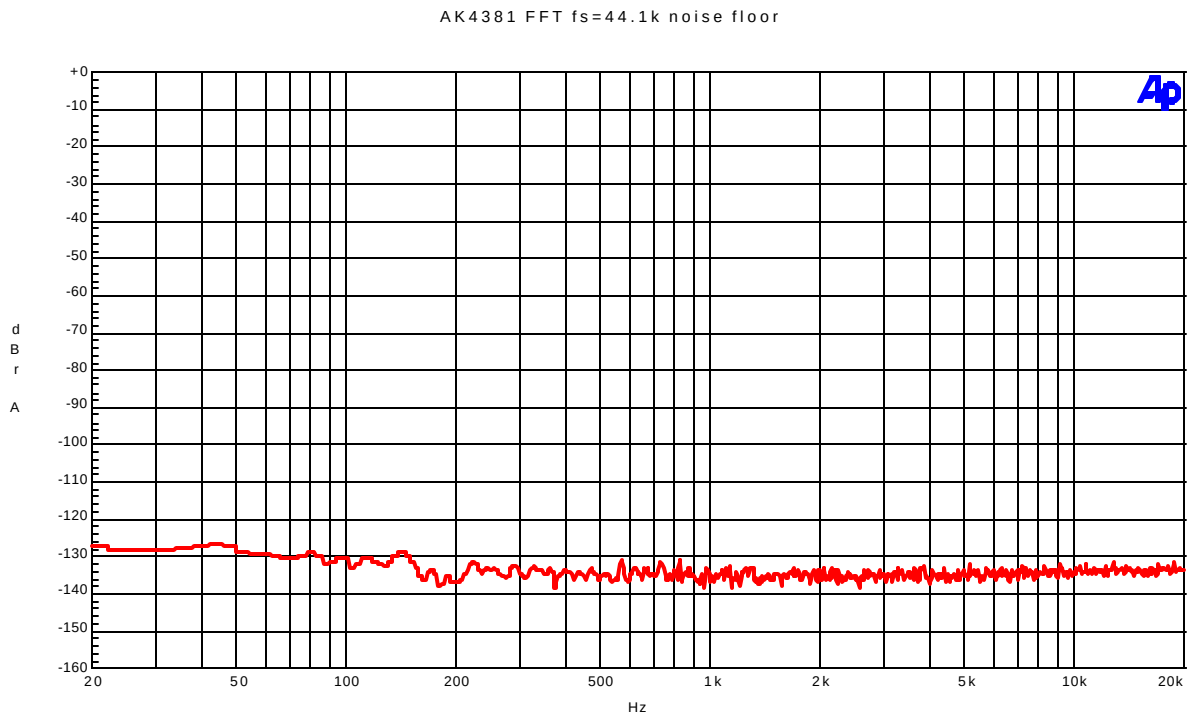


Figure 8 . FFT (noise floor)

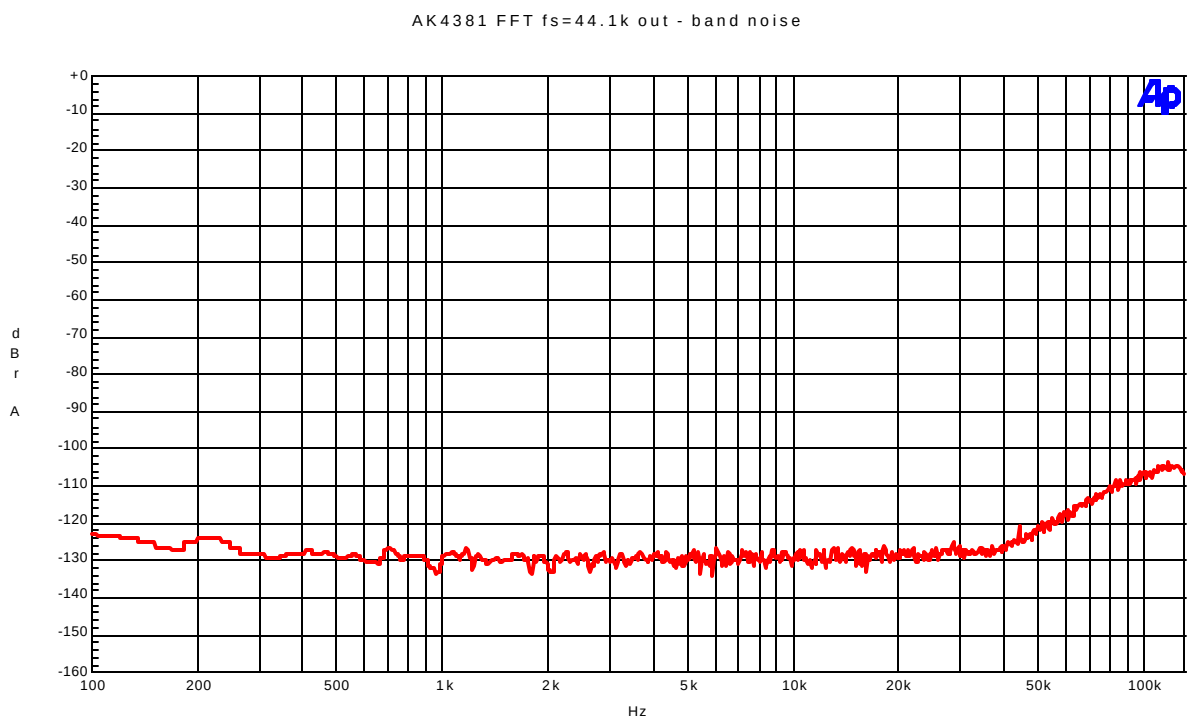


Figure 9 . FFT (out-of-band noise)

(fs=44.1kHz)

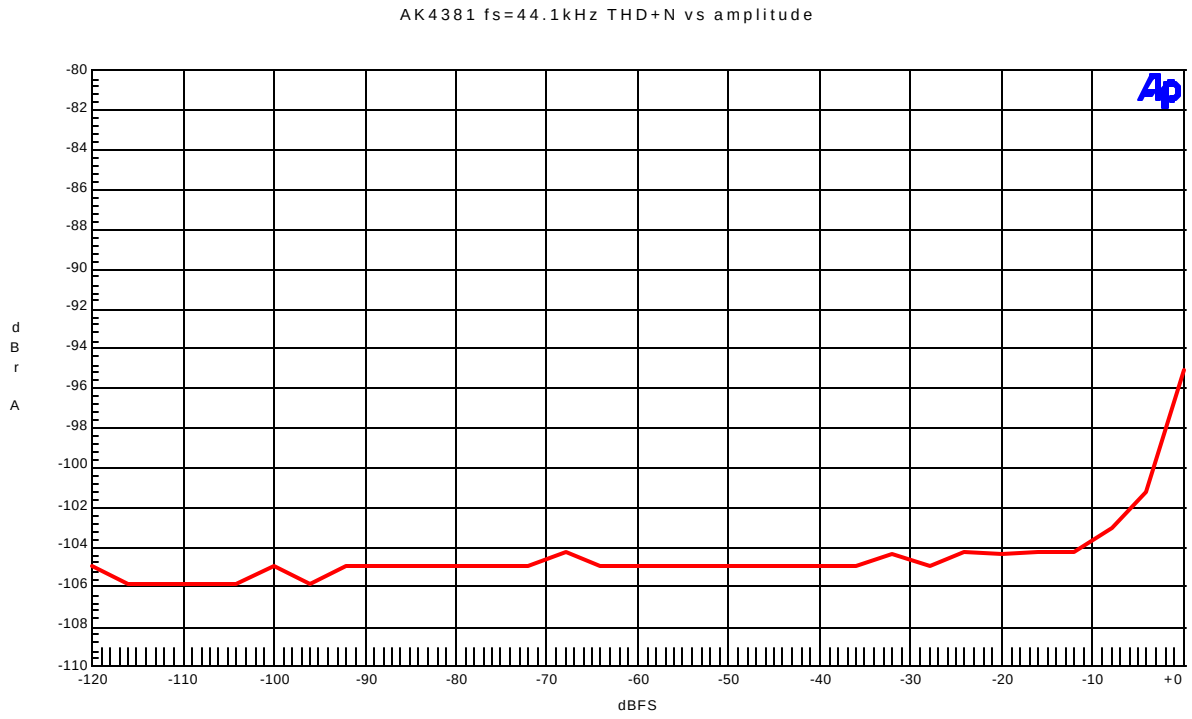


Figure10. THD+N vs Input Level (fin=1kHz)

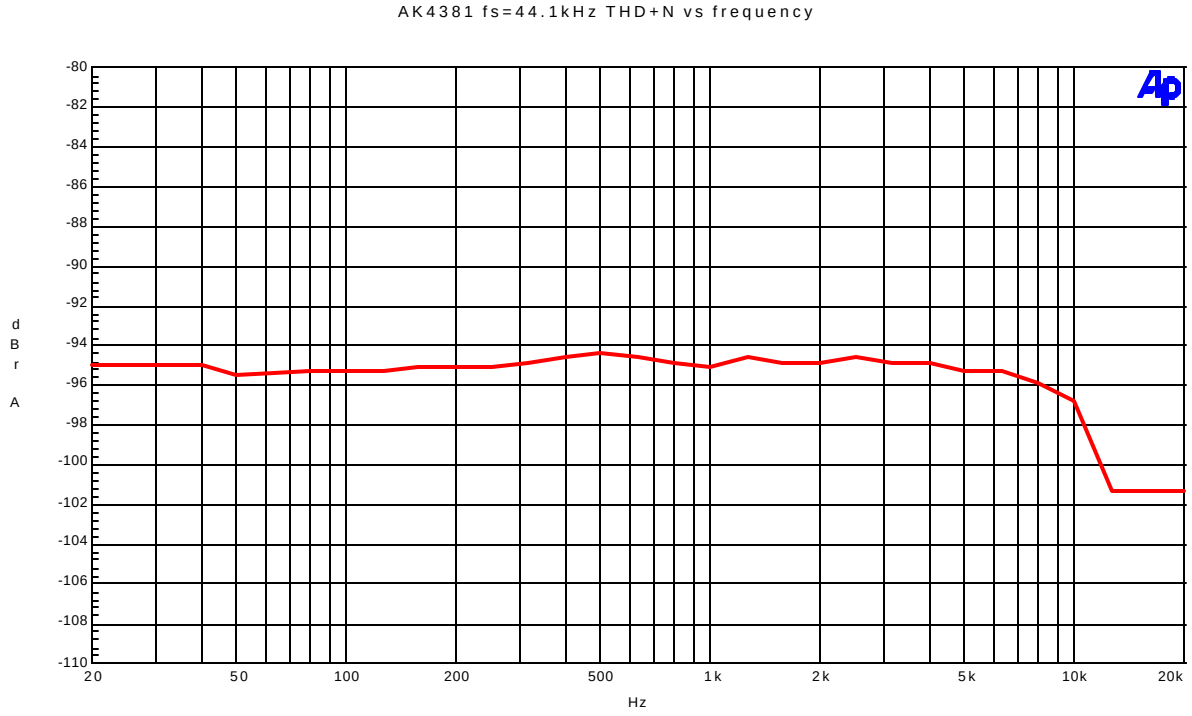


Figure11. THD+N vs fin (Input level=0dBFS)

(fs=44.1kHz)

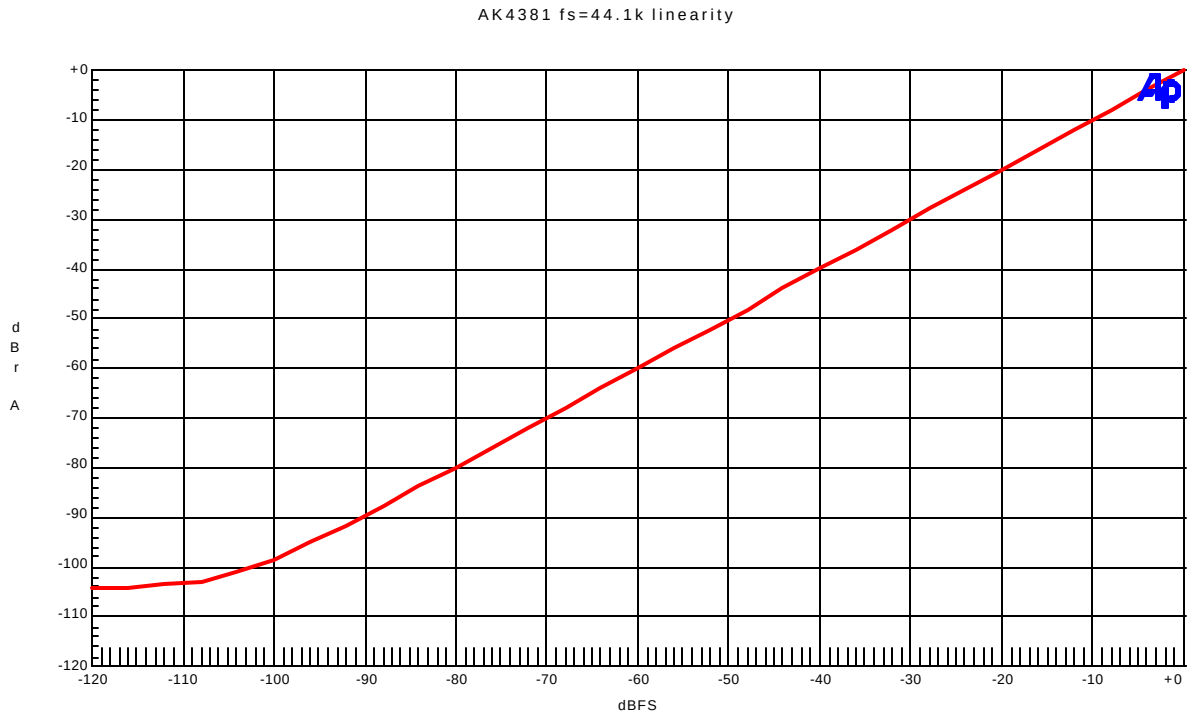


Figure12. Linearity (fin=1kHz)

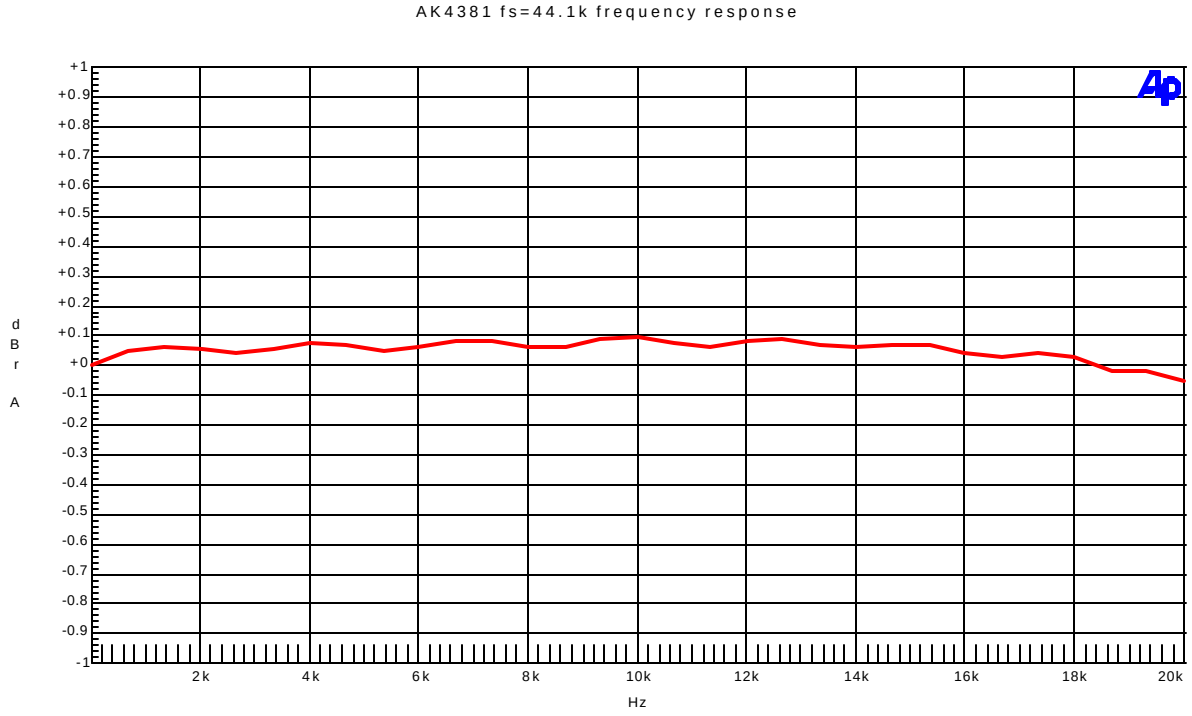


Figure13. Frequency Response (Input level=0dBFS)

(fs=44.1kHz)

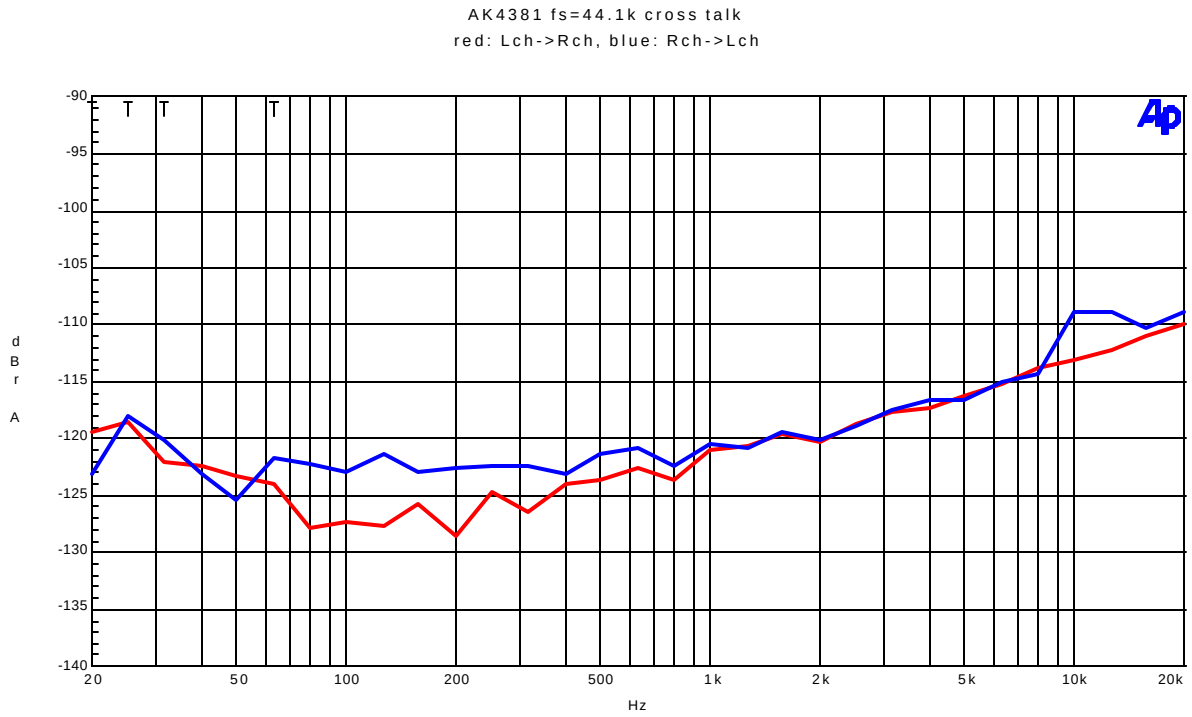


Figure14. Cross-talk (Input level=0dBFS)

(fs=96kHz)

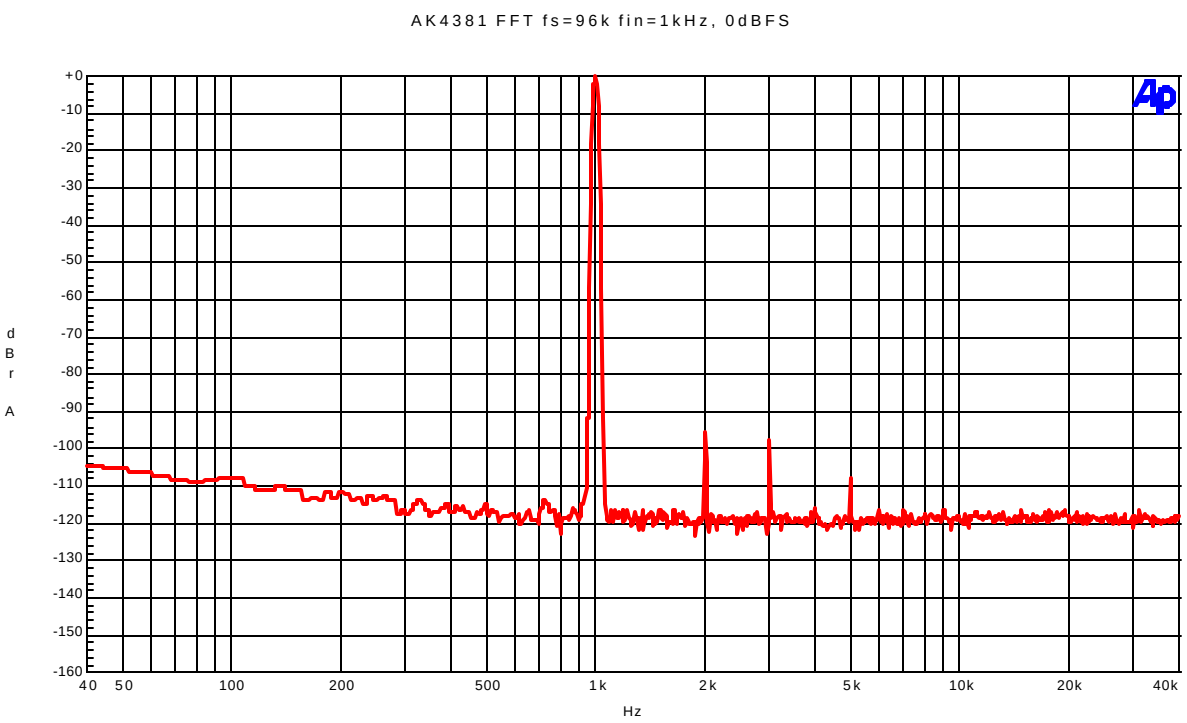


Figure15. FFT (1kHz, 0dBFS input, Notch=OFF)

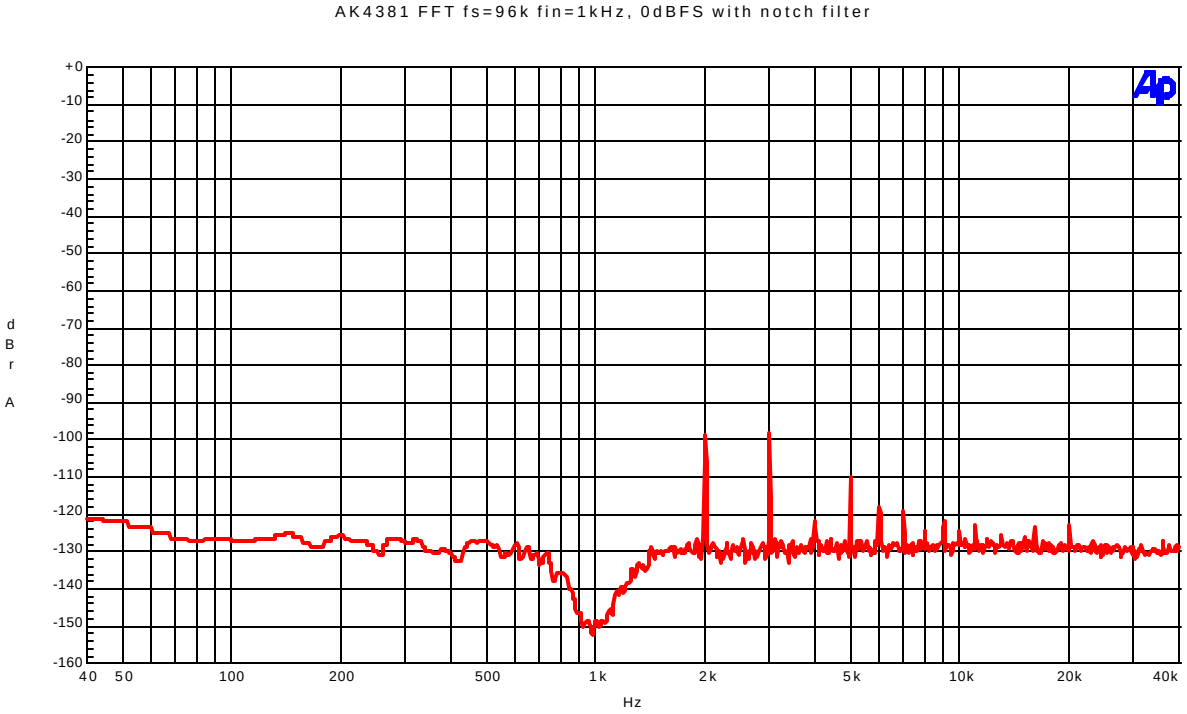


Figure16. FFT (1kHz, 0dBFS input, Notch=ON)

(fs=96kHz)

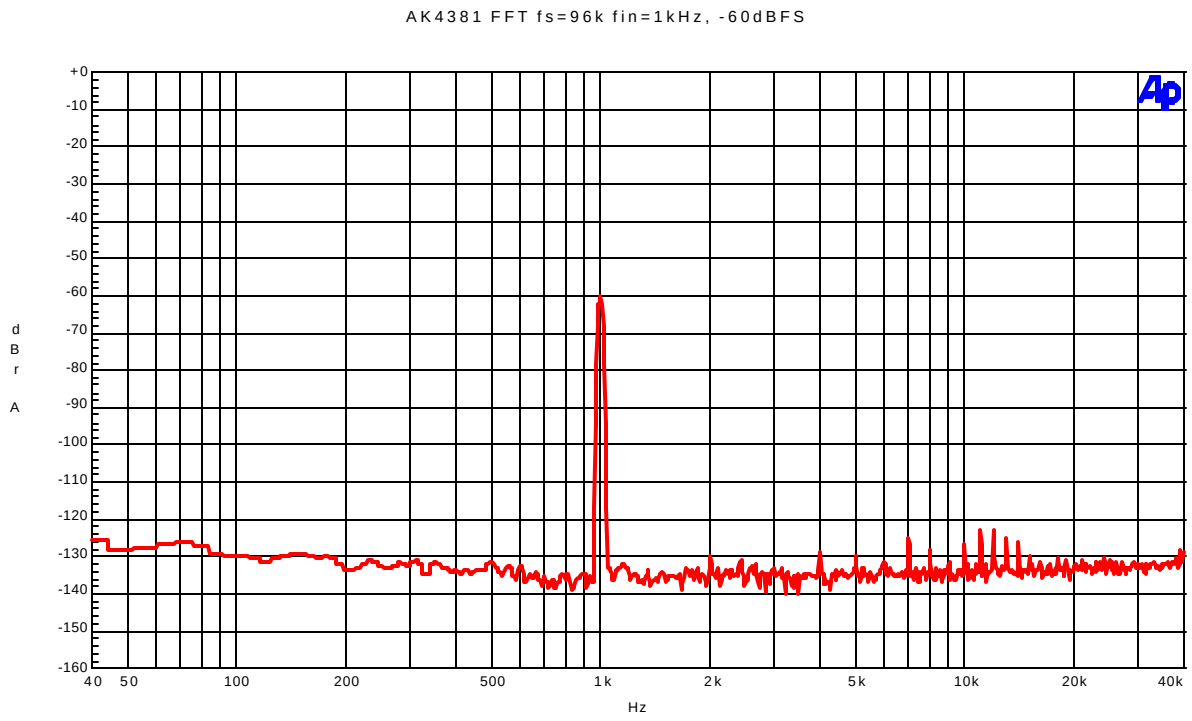


Figure17. FFT (1kHz, -60dBFS input)

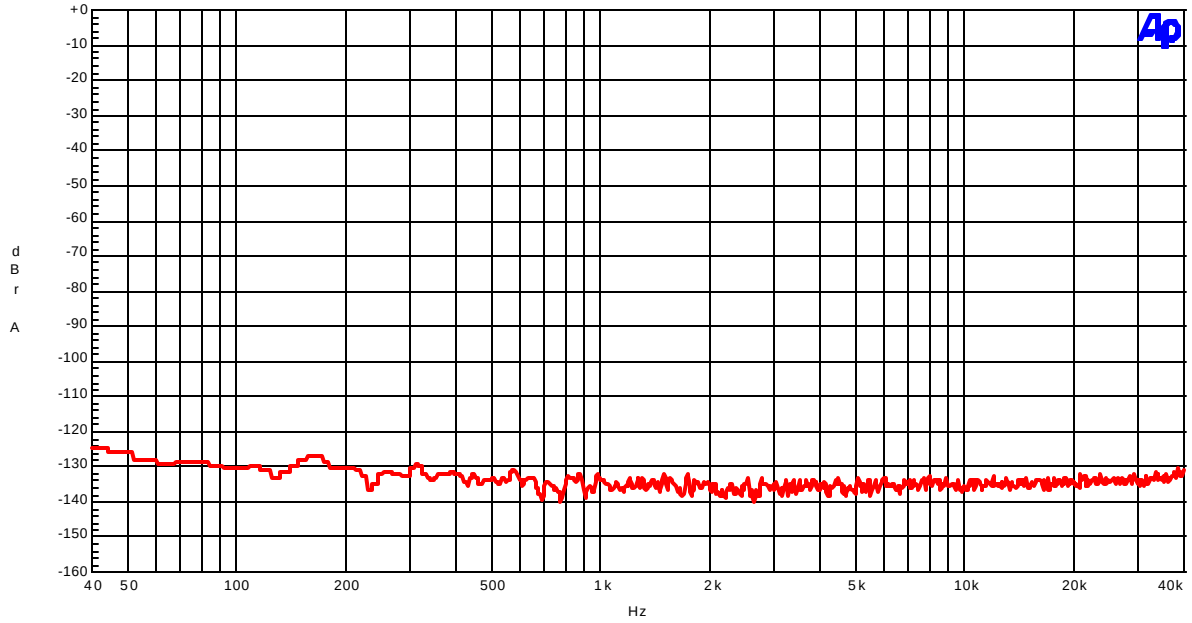


Figure18. FFT (noise floor)

(fs=96kHz)

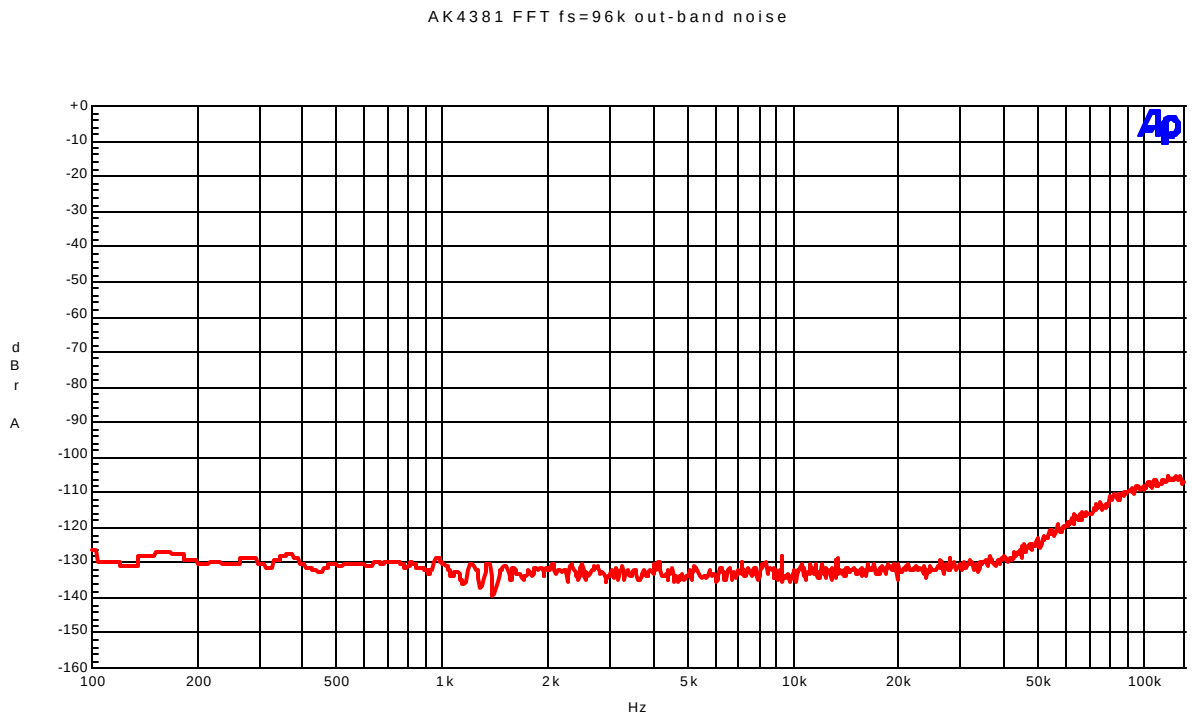


Figure19. FFT (out-of-band noise)

(fs=96kHz)

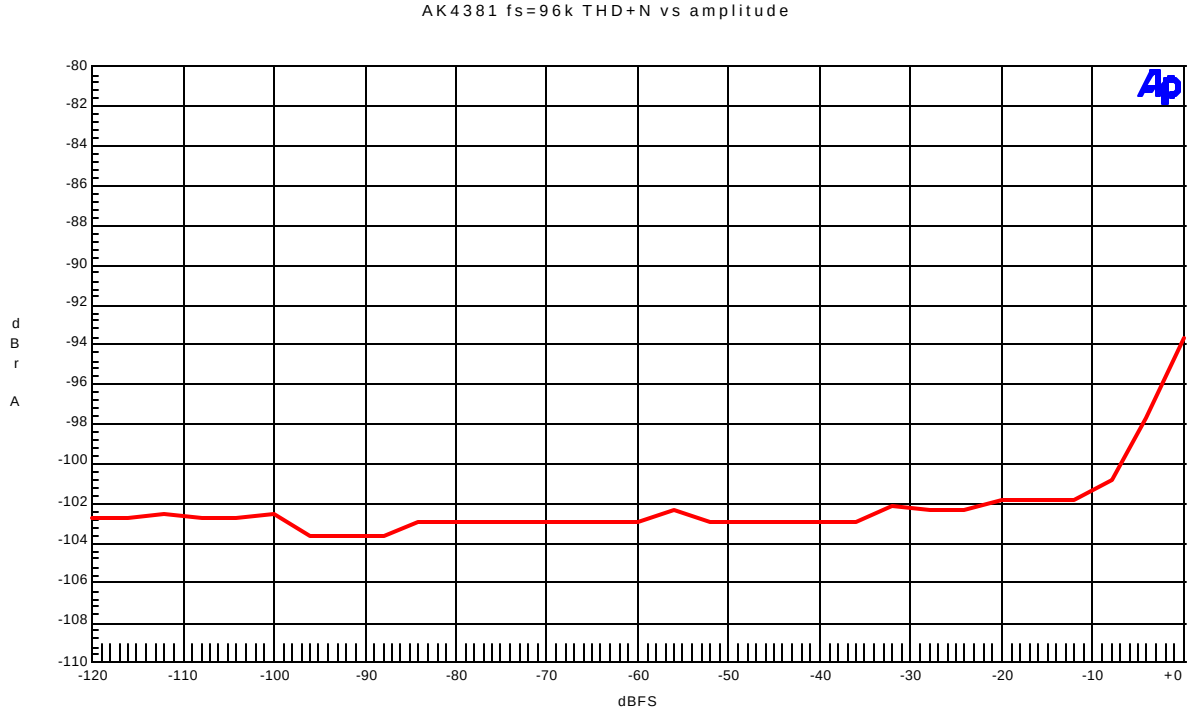


Figure20. THD+N vs Input Level (fin=1kHz)

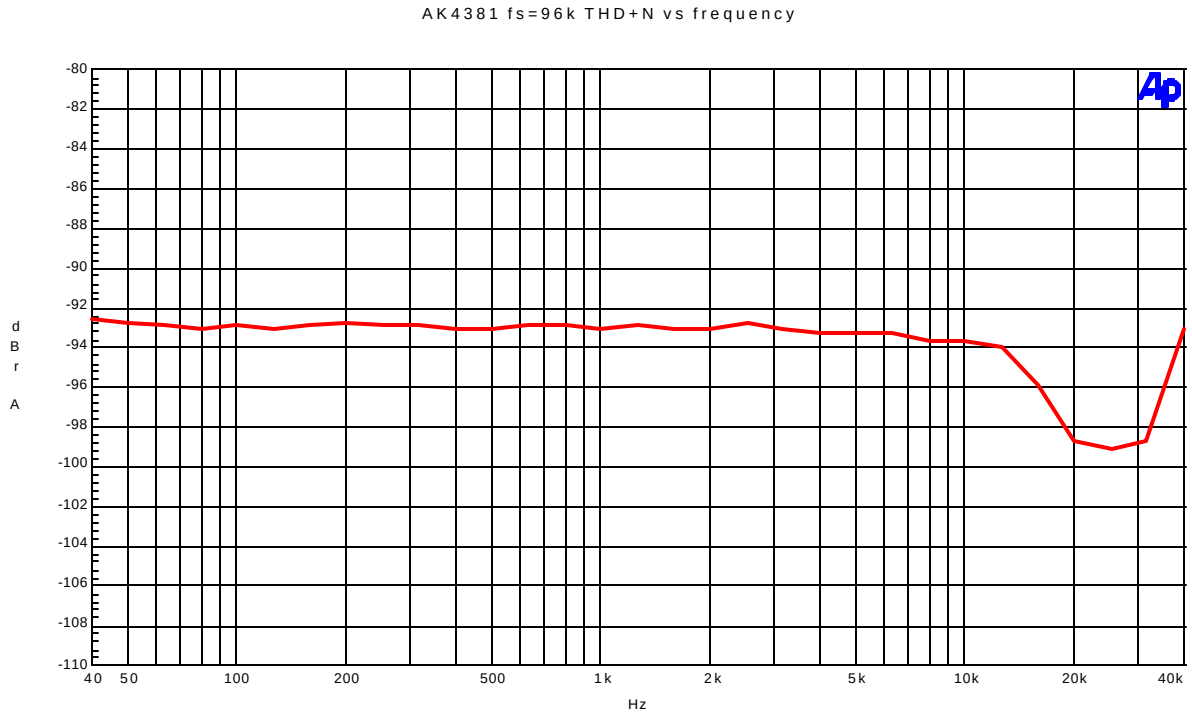


Figure21. THD+N vs fin (Input level=0dBFS)

(fs=96kHz)

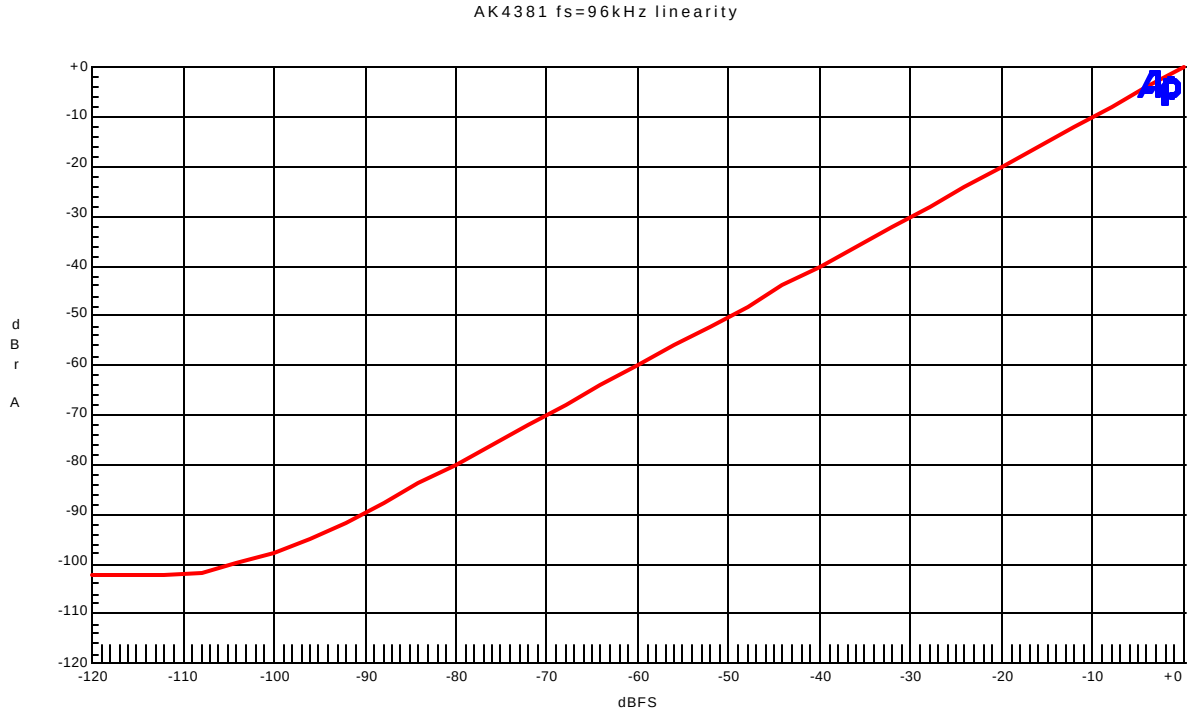


Figure22. Linearity (fin=1kHz)

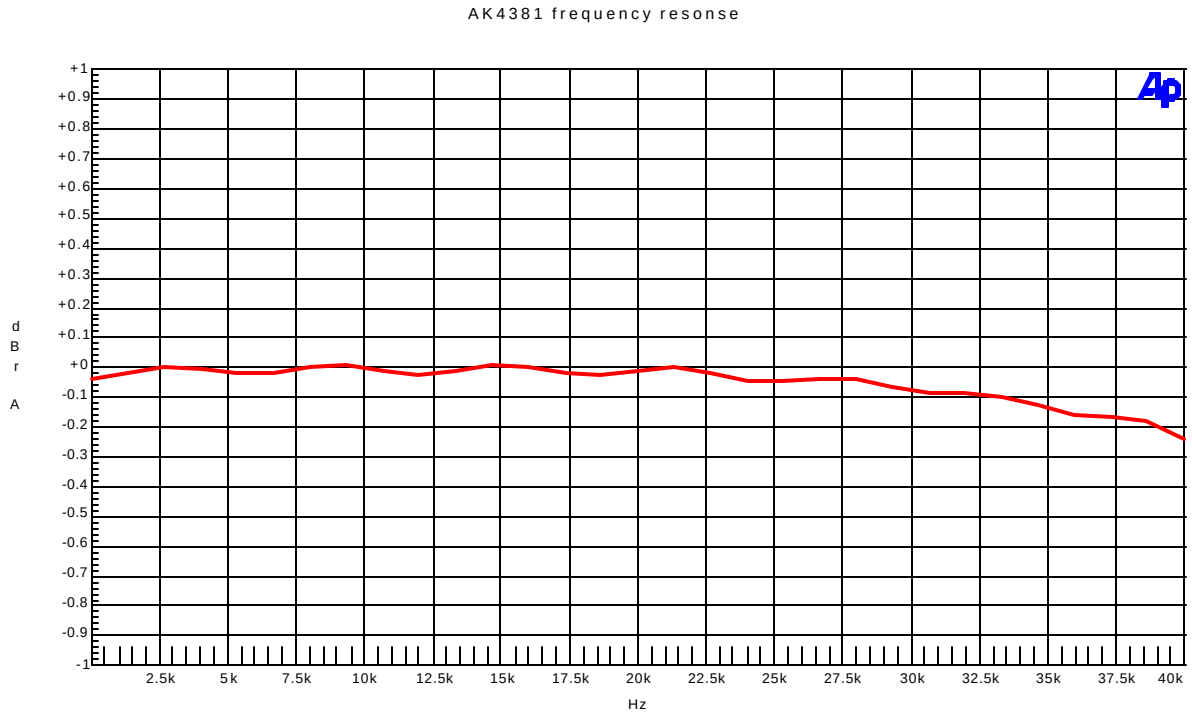


Figure23. Frequency Response (Input level=0dBFS)
(Including external LPF)

(fs=96kHz)

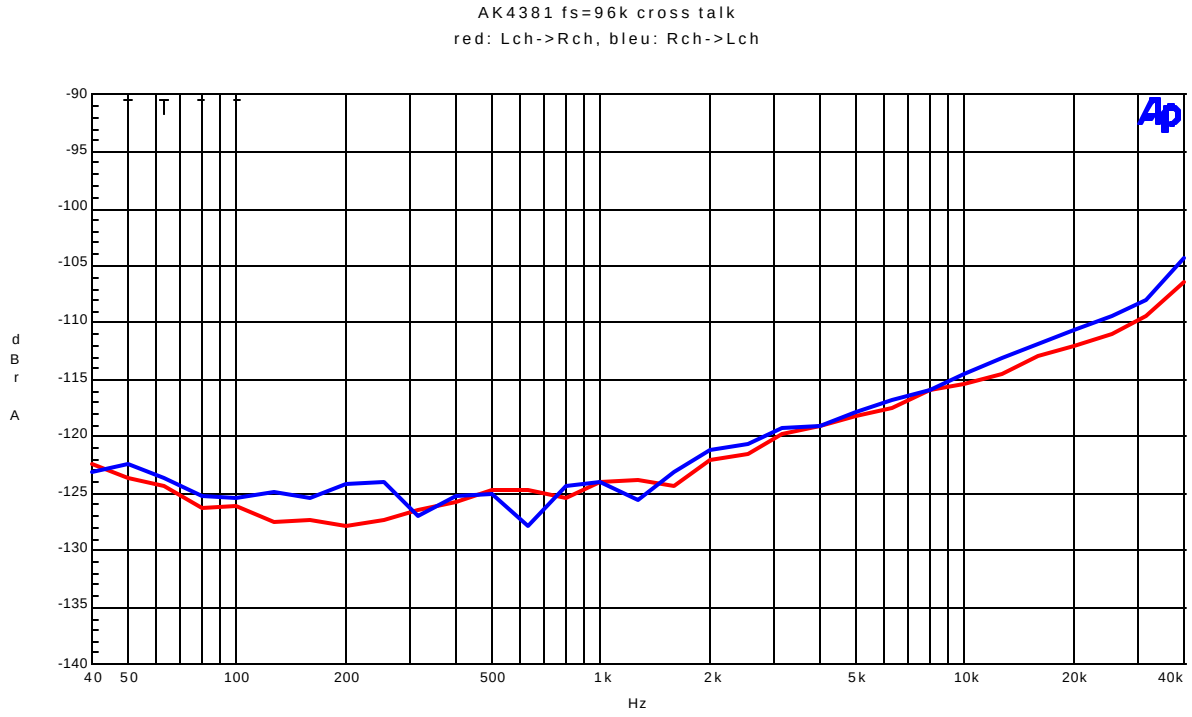


Figure24. Cross-talk (Input level=0dBFS)

(fs=192kHz)

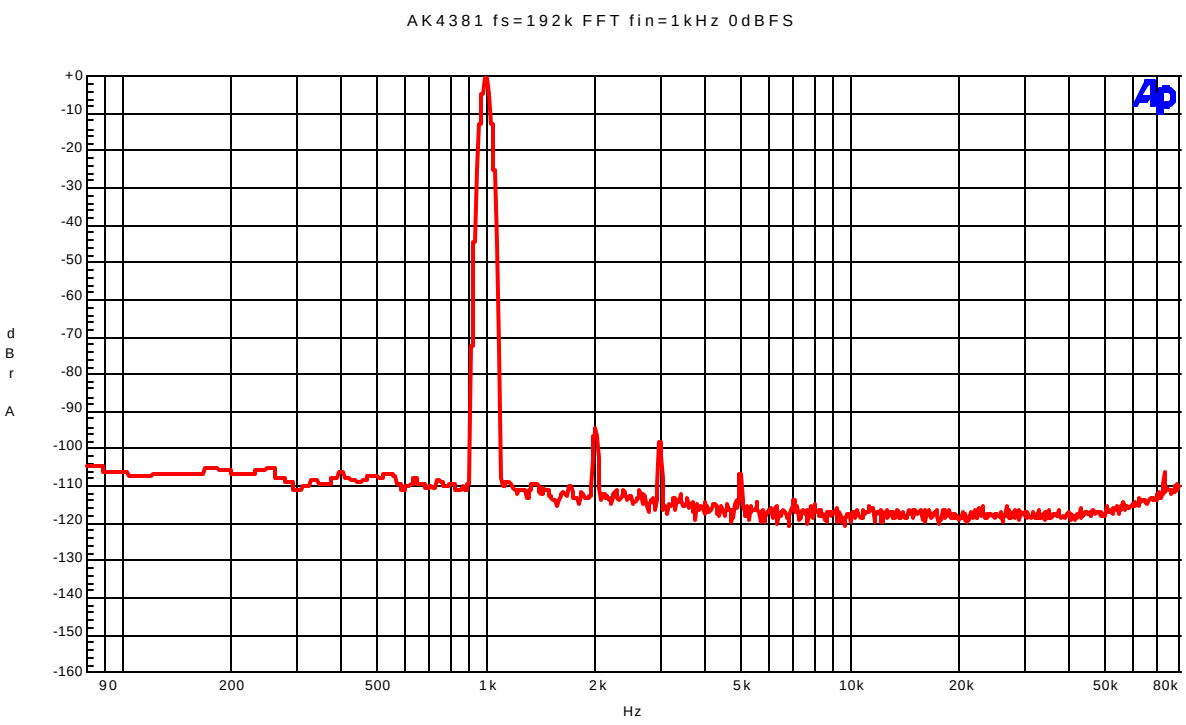


Figure25. FFT (1kHz, 0dBFS input, Notch=OFF)

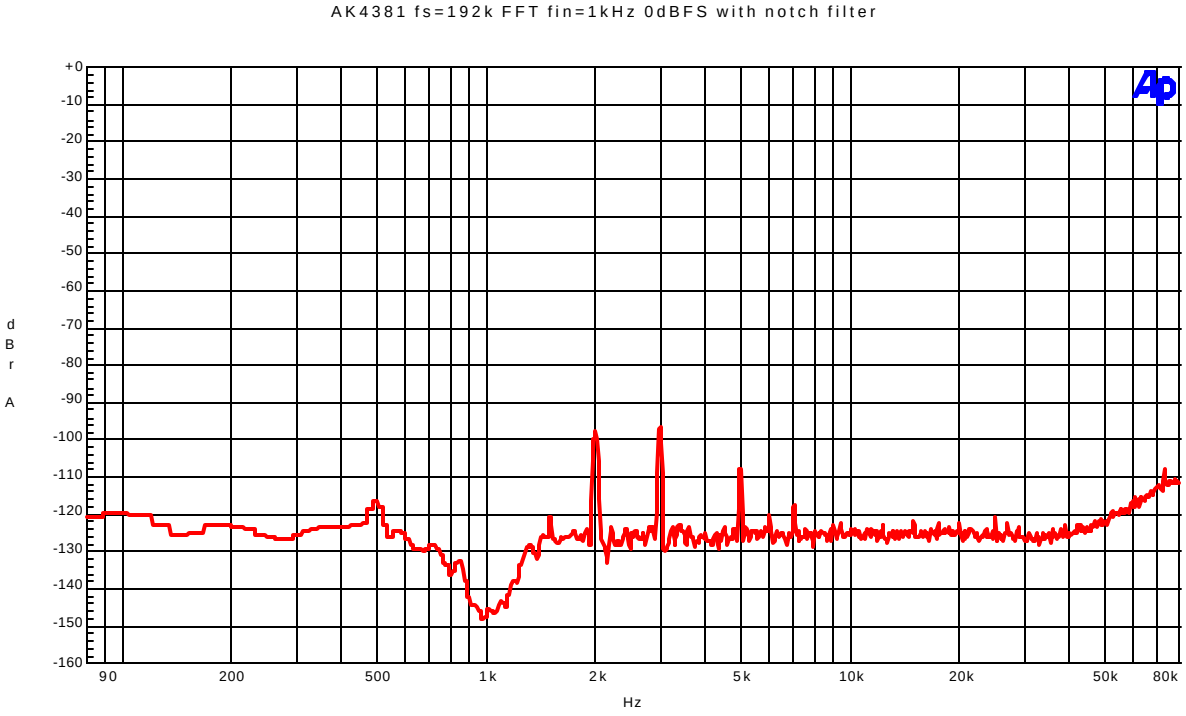


Figure26. FFT (1kHz, 0dBFS input, Notch=ON)

(fs=192kHz)

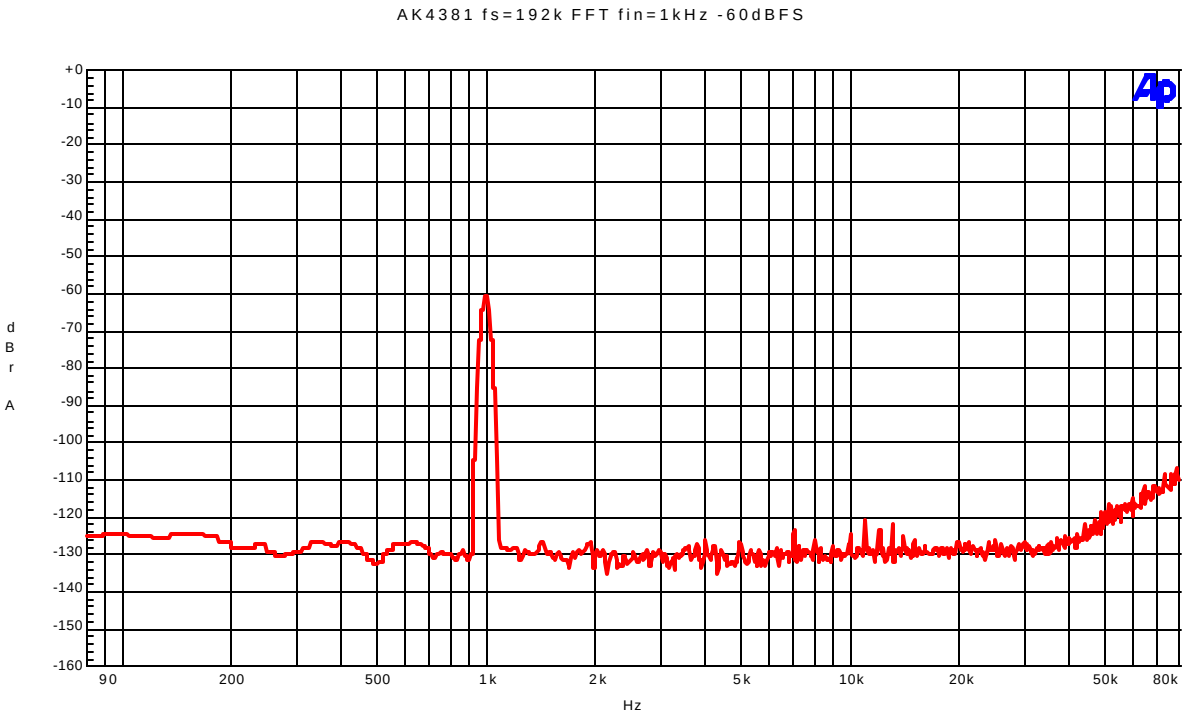


Figure27. FFT (1kHz, -60dBFS input)

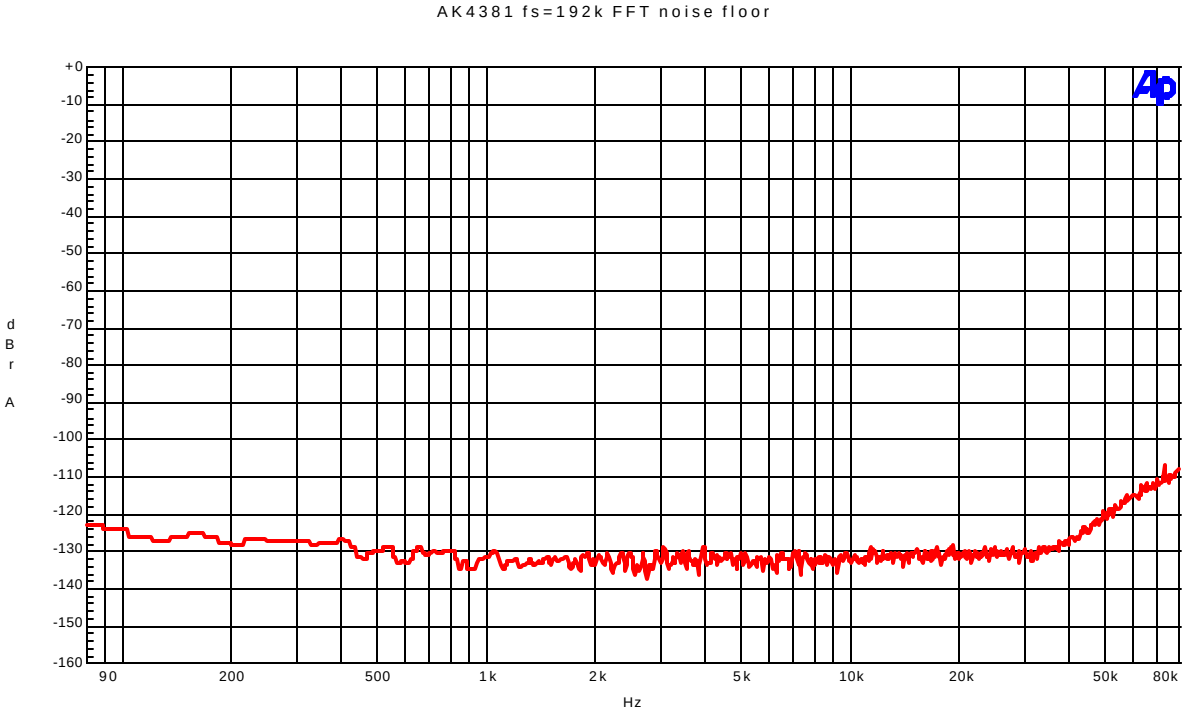


Figure28. FFT (noise floor)

(fs=192kHz)

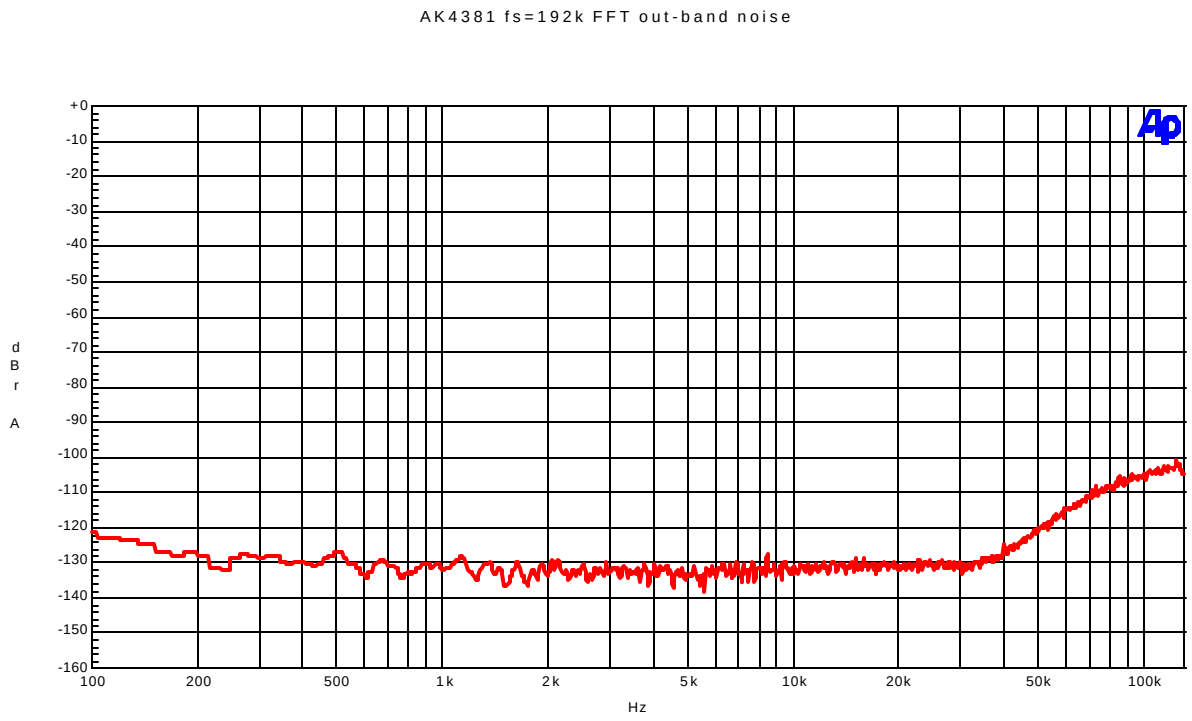


Figure29. FFT (out-of-band noise)

(fs=192kHz)

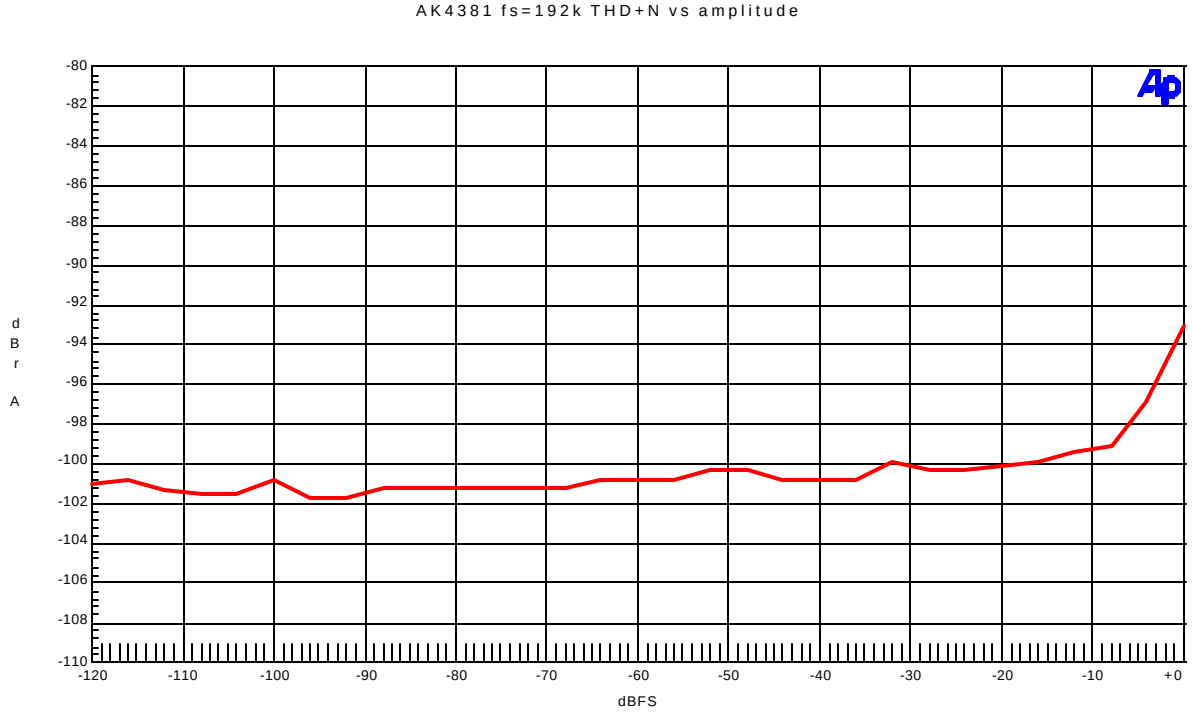


Figure30. THD+N vs Input Level (fin=1kHz)

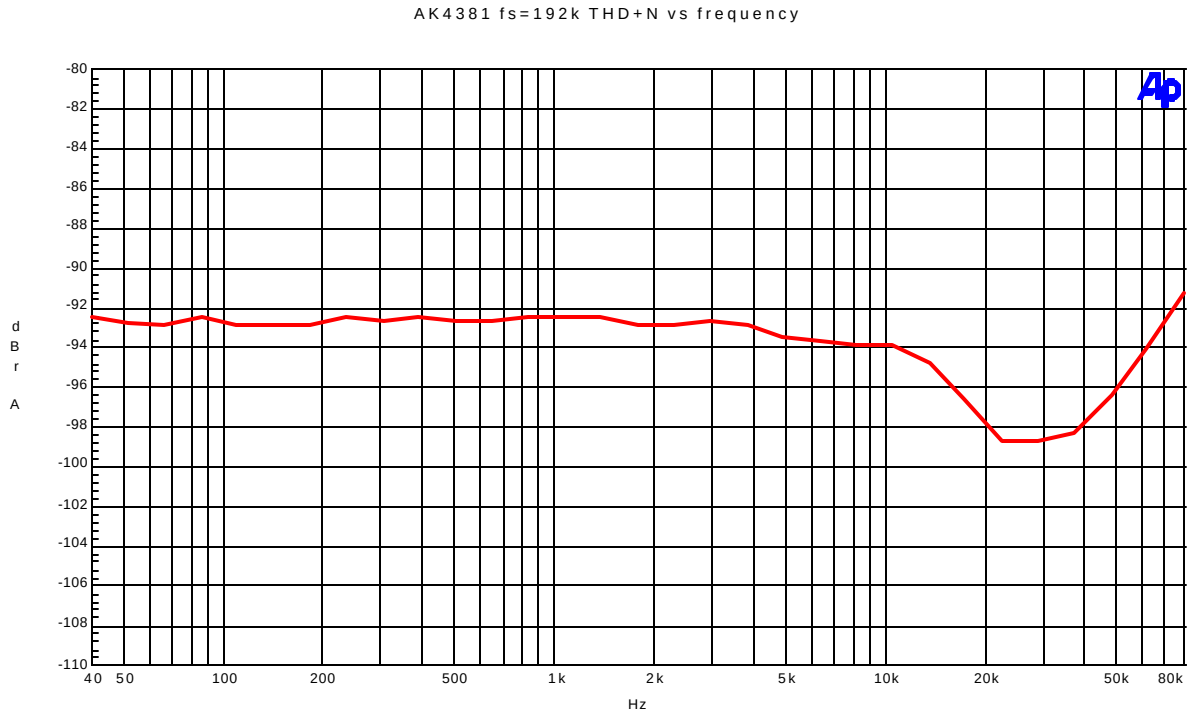


Figure31. THD+N vs fin (Input level=0dBFS)

(fs=192kHz)

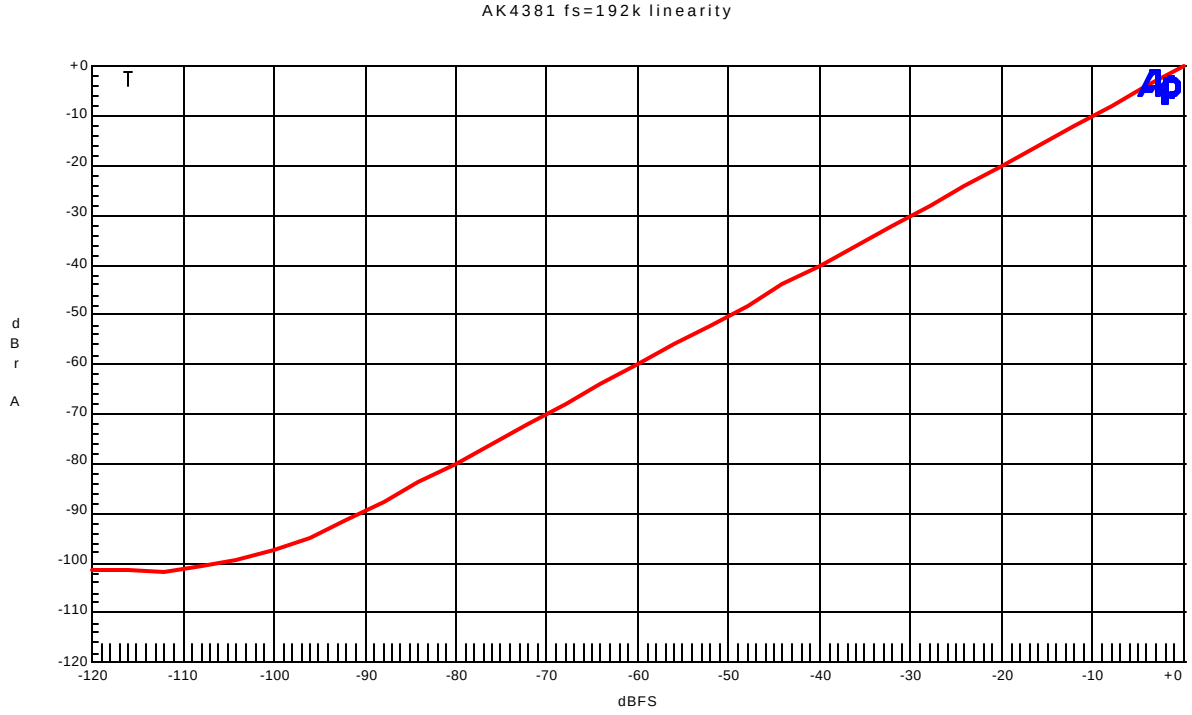


Figure32. Linearity (fin=1kHz)

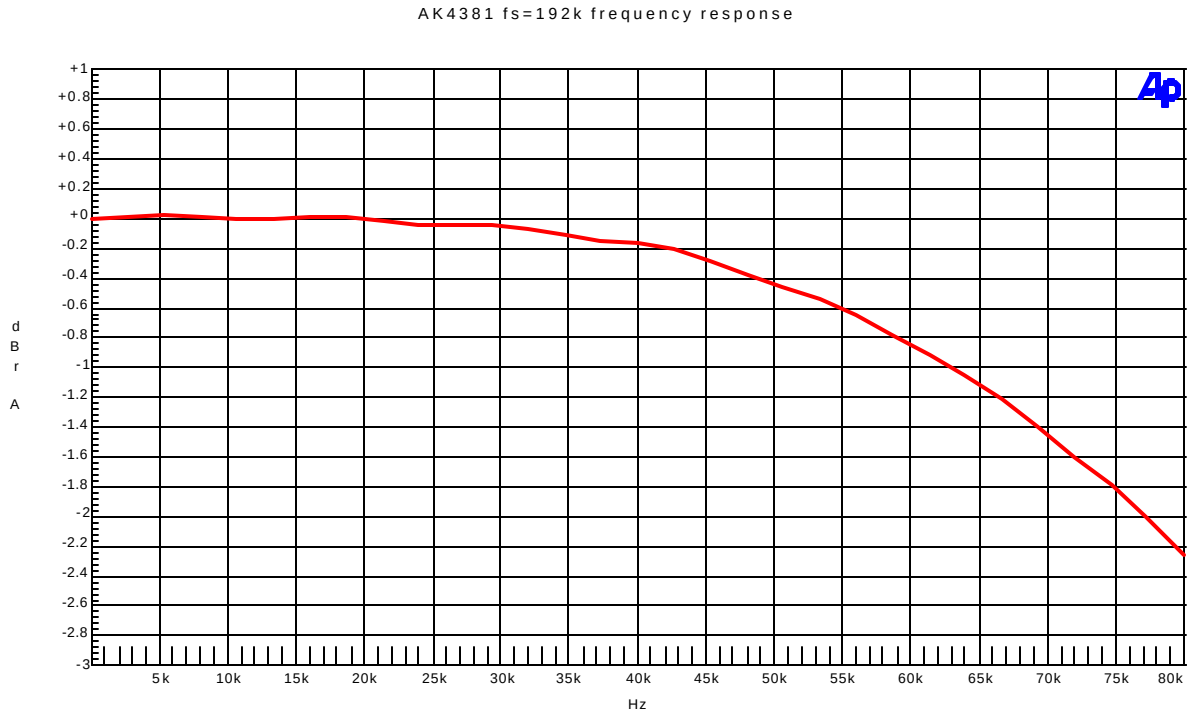


Figure33. Frequency Response (Input level=0dBFS)
(Including external LPF)

(fs=192kHz)

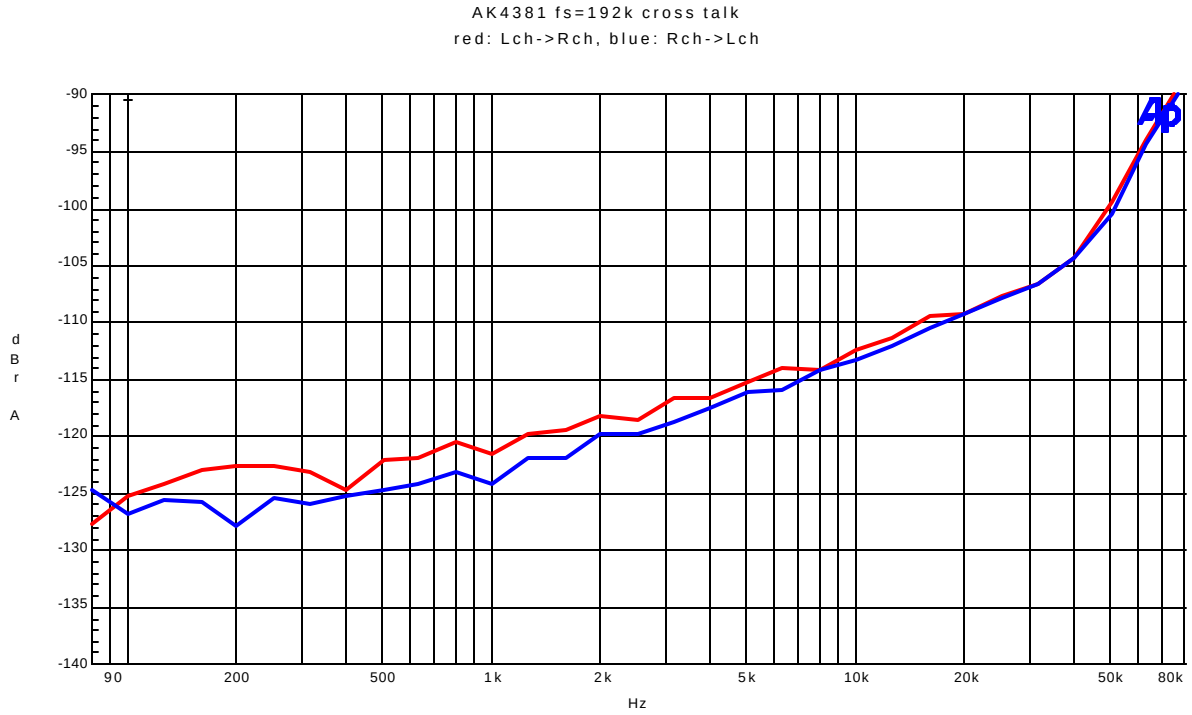


Figure34. Cross-talk (Input level=0dBFS)

AKD4381 Control Program ver 1.0 operation manual

■ Set-up of evaluation board and control software

1. Set up the AKD4381 according to previous term.

2. Connect IBM -AT compatible PC with AKD4381 by 10-line type flat cable (packed with AKD4381). Take care of the direction of 10pin header. (This control software does not operate on Windows NT/2000/XP, therefore please operate it on Windows95/98/ME.)

3. Insert the floppy-disk labeled "AKD4381 Control Program ver 1.0" into the floppy-disk drive.

4. Access the floppy-disk drive and double-click the icon of "AKD4381.exe" to set up the control program.

5. Then please evaluate according to the follows.

■ Explanation of each buttons

1. [Port Setup] : set up the printer port.
2. [Write default] : initialize the register of AK4381.
3. [Function1] : set up the dialog which can be written by keyboard operation.
4. [Function2] : set up the dialog which can be written by keyboard operation.
5. [Write] : set up the dialog corresponding to each register which can be written by mouse operation.

■ 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 AK4381, click "OK" button. If not, click "Cancel" button.

2. [Function2 Dialog] : Dialog to evaluate DATT

This dialog corresponds to only addr=03H and 04H

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 AK4381 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 AK4381, 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 AK4381, click "OK" button. If not, click "Cancel" button.

■ Operation flow

Keep the following flow surely.

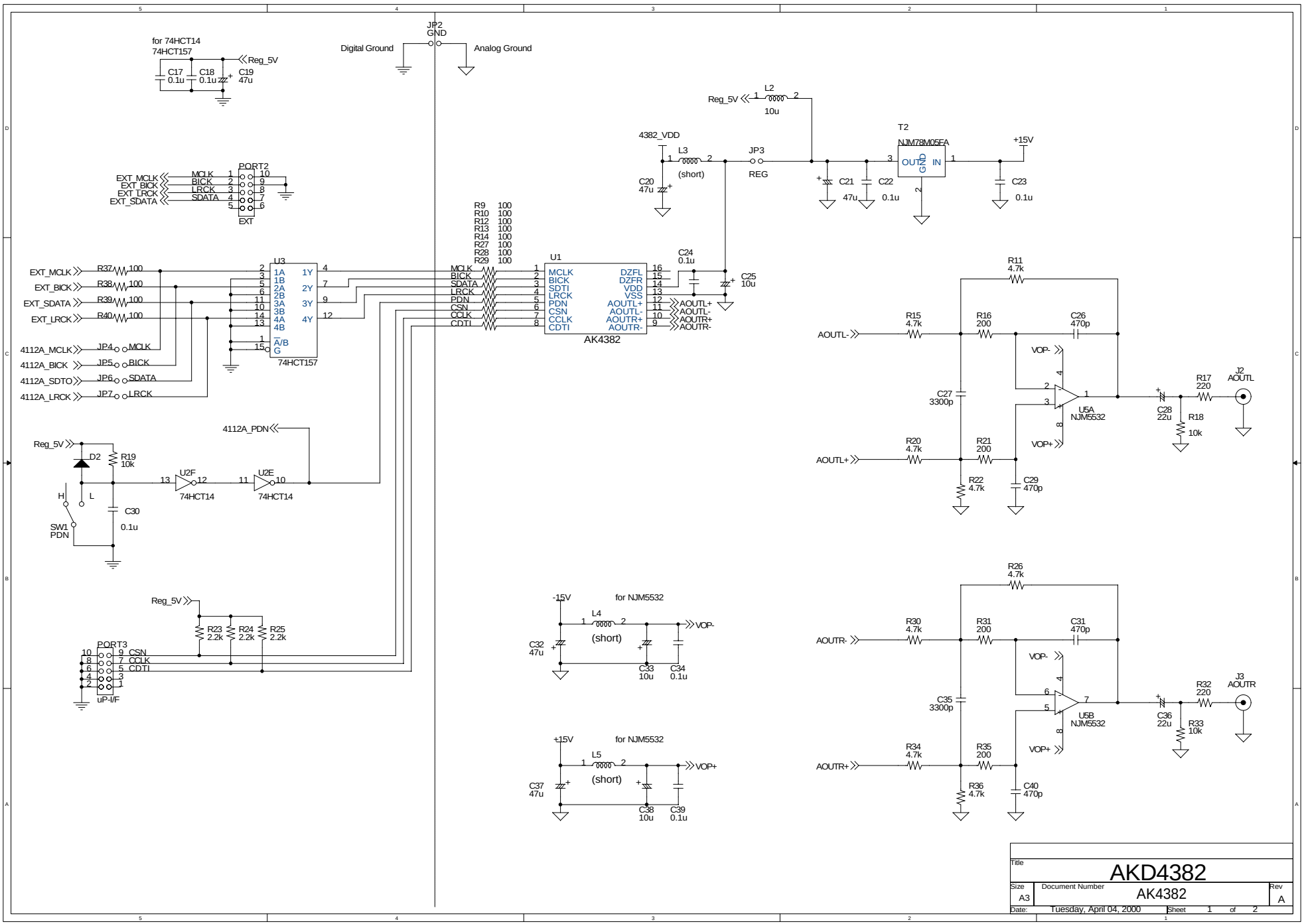
1. Set up the control program according to explanation above.
2. Click "Port Setup" button.
3. Click "Write default" button.
4. Then set up the dialog and input data.

■ 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 diabg, 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 operation does not need if you click "Cancel" button or check the check box.



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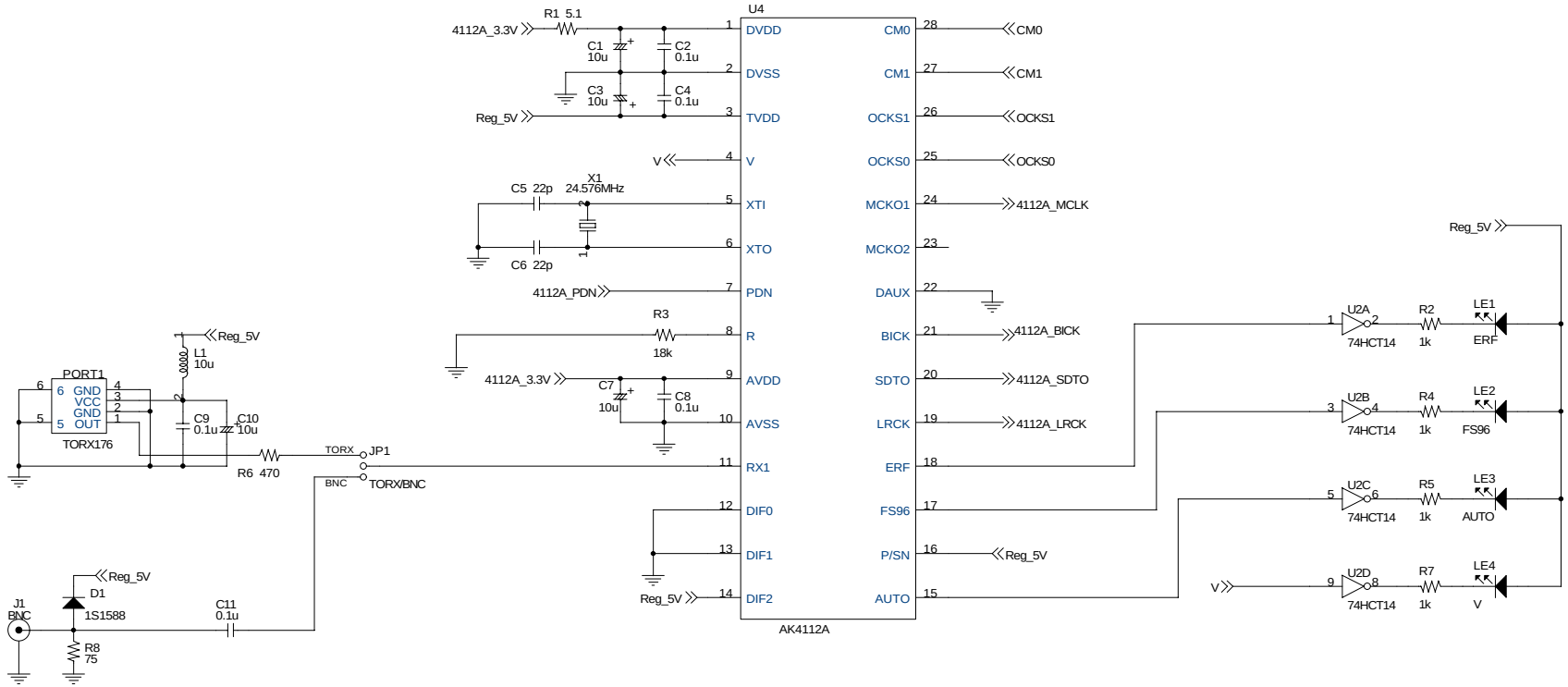
Size: A3	Document Number: AK4382	Rev: A
Date: Tuesday, April 04, 2000	Sheet 1 of 2	



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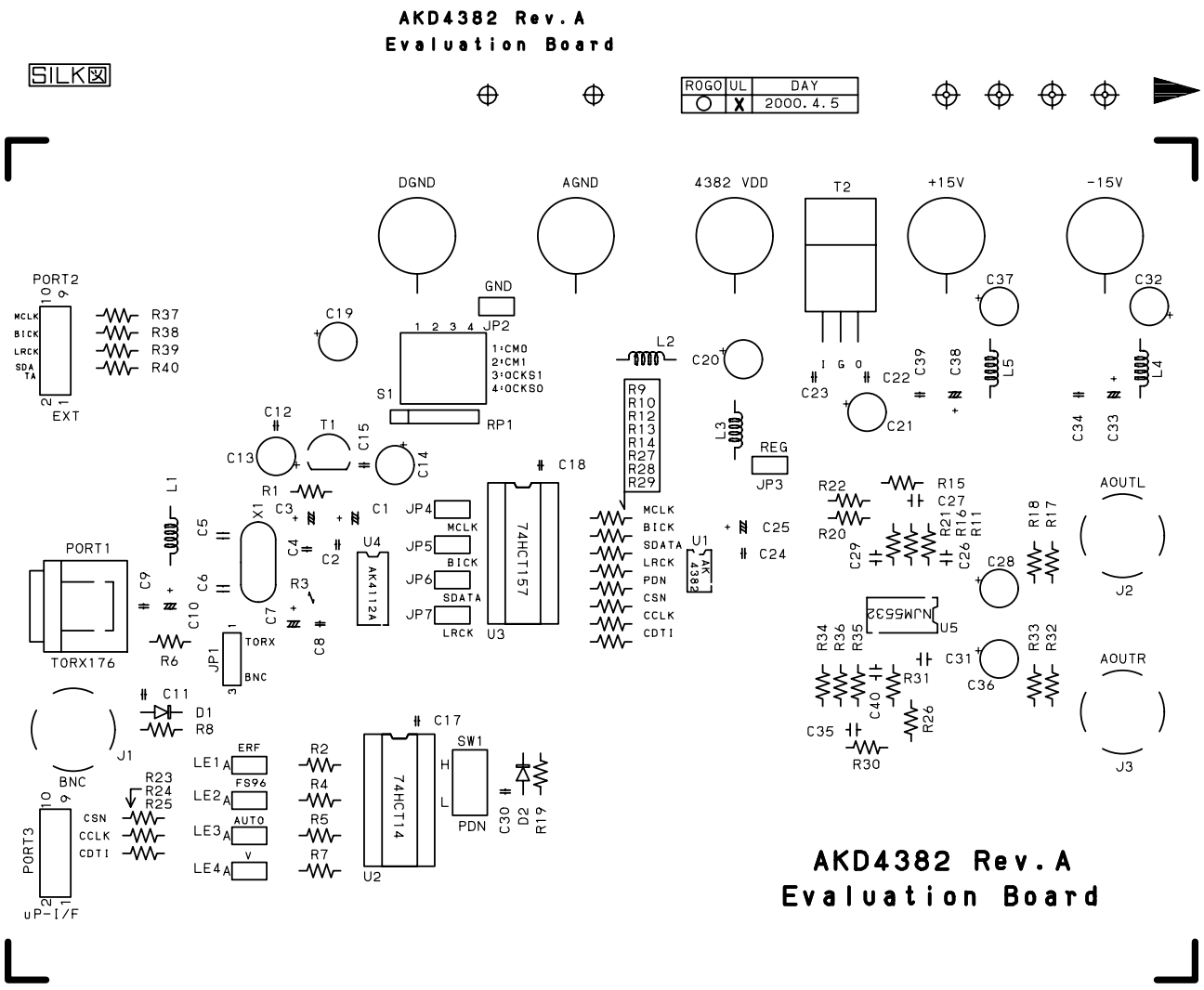
Size A3	Document Number AK4112A	Rev A
Date: Tuesday, April 04, 2000	Sheet 2 of 2	


AKD4382 Rev.A
Evaluation Board
SILK図
ROGO
UL
DAY
2000.4.5
DGND
AGND
4382 VDD
T2
+15V
-15V
PORT2
EXT
R37
R38
R39
R40
GND
JP2
S1
RP1
C19
L2
C20
C12
C13
T1
C15
C14
C18
R1
X1
C3
C1
JP4
JP5
JP6
JP7
MCLK
BICK
SDATA
LRCK
U4
AK4124
74HCT157
U3
R9
R10
R12
R13
R14
R27
R28
R29
U1
4382
C25
C24
L3
REG
JP3
C23
C22
C21
C39
C38
L5
C37
C32
L4
C34
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R22
R20
R15
C27
C29
C26
R21
R16
R11
R18
R17
C28
AOUTL
J2
NJM5532
U5
C31
C36
R34
R36
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C9
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C6
C5
C4
C2
C7
C8
R3
R6
JP1
TORX
BNC
L1
C11
D1
R8
J1
BNC
R23
R24
R25
PORT3
CSN
CCLK
CDTI
uP-I/F
LE1
LE2
LE3
LE4
ERF
FS96
AUTO
V
R2
R4
R5
R7
C17
74HCT14
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Evaluation Board

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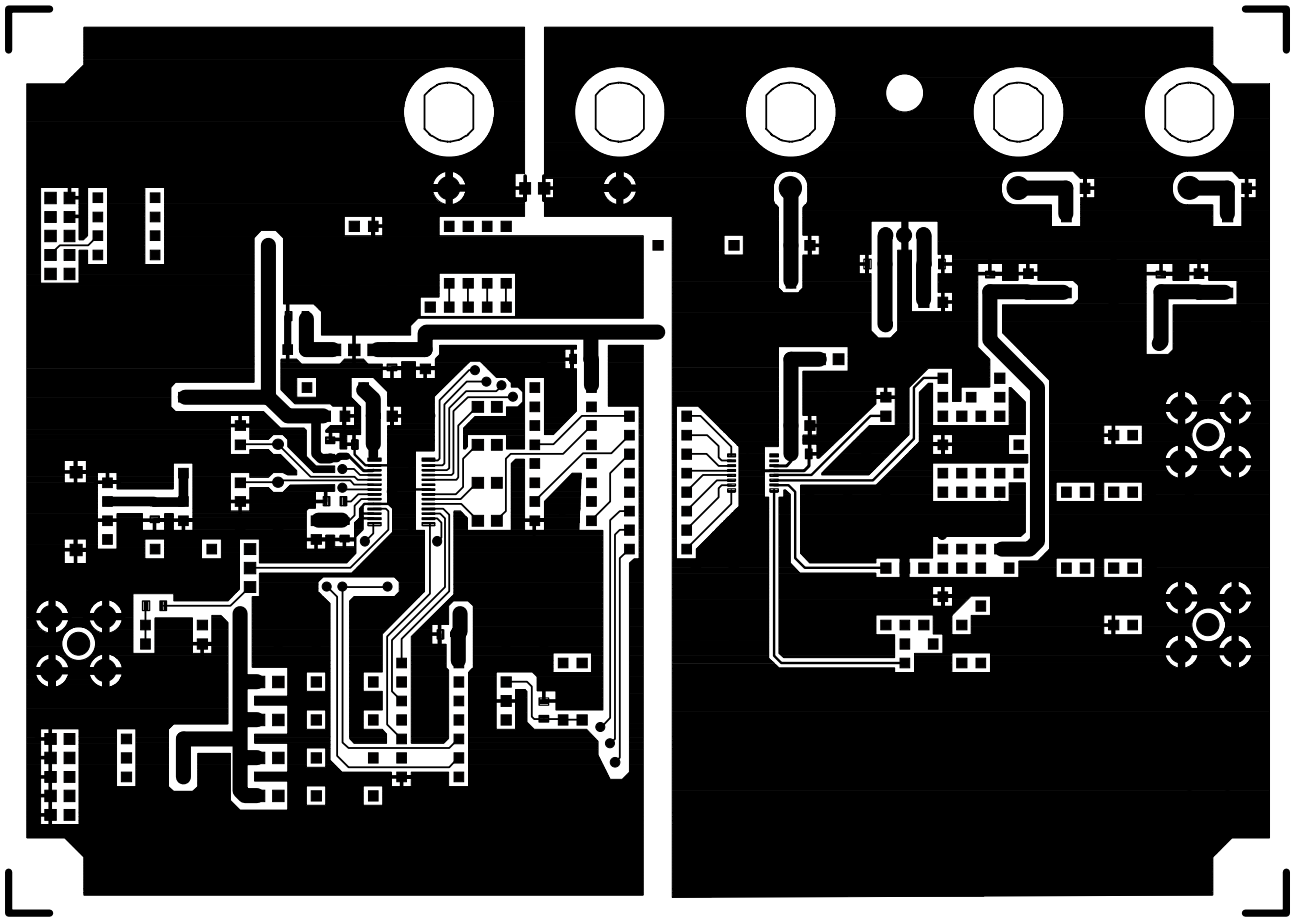

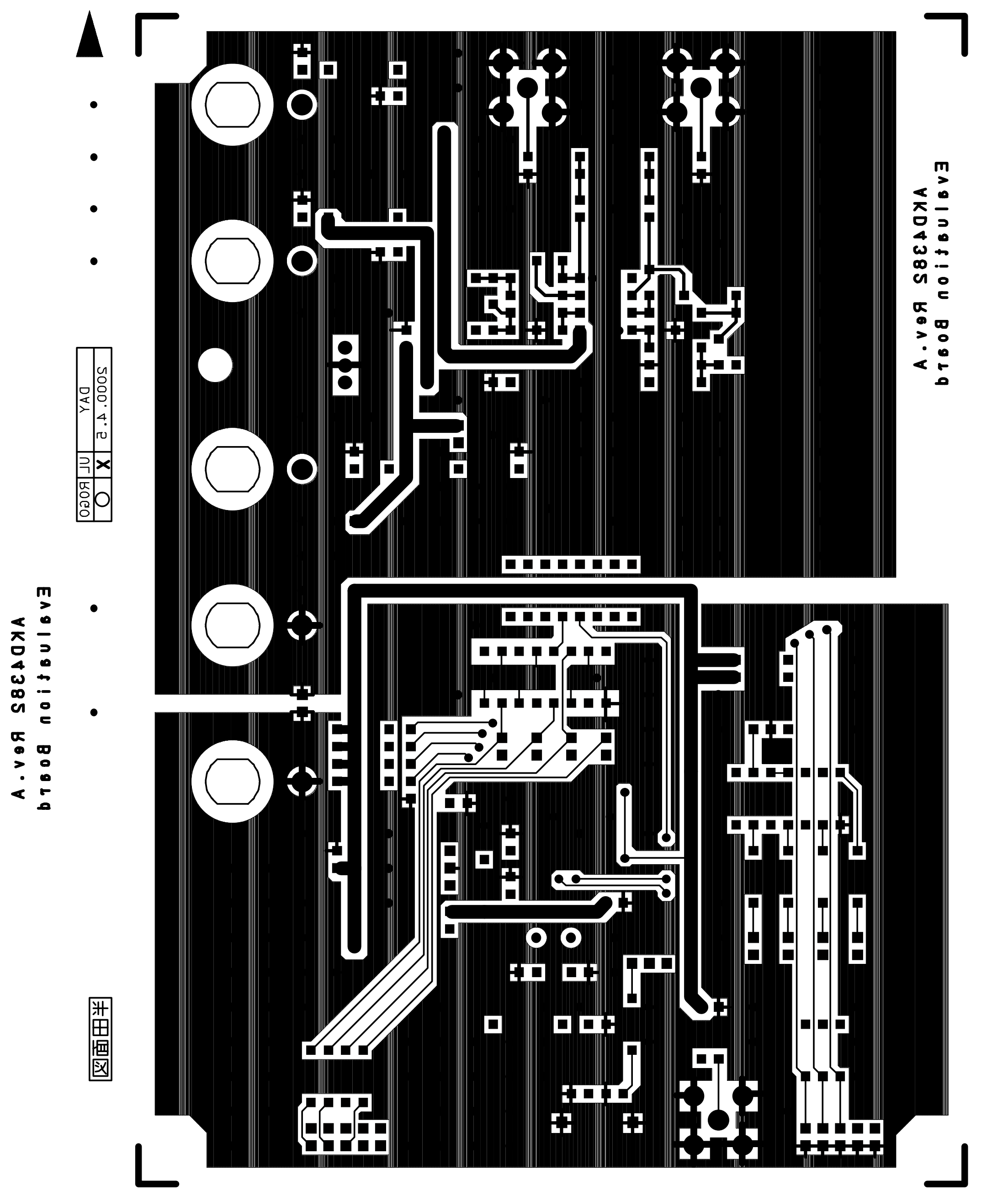
AKD4382 Rev.A
Evaluation Board
2000.4.5
DAY

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