

# AKD4356

## Evaluation board Rev.B for AK4356

### GENERAL DESCRIPTION

The AKD4356 is an evaluation board for AK4356, the 24bit 6ch D/A converter for DVD-audio. The AKD4356 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 AK4356. The AKD4356 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector or RCA connector.

■ **Ordering guide**

AKD4356 --- Evaluation board for AK4356  
 (Cable for connecting with printer port of IBM-AT compatible PC and control software are packed with this.)

### FUNCTION

- On-board 2nd order LPF
- On-board clock generator
- Compatible with 3 types of interface
  - Direct interface with AKM's A/D converter evaluation boards and direct interface with AKM's signal generator(AKD43XX) by 10pin header
  - On-board CS8414 as DIR which accepts optical input
  - Direct interface with AC3 decoder by 10pin header
- BNC connector for an external clock input
- 10pin header for serial control interface

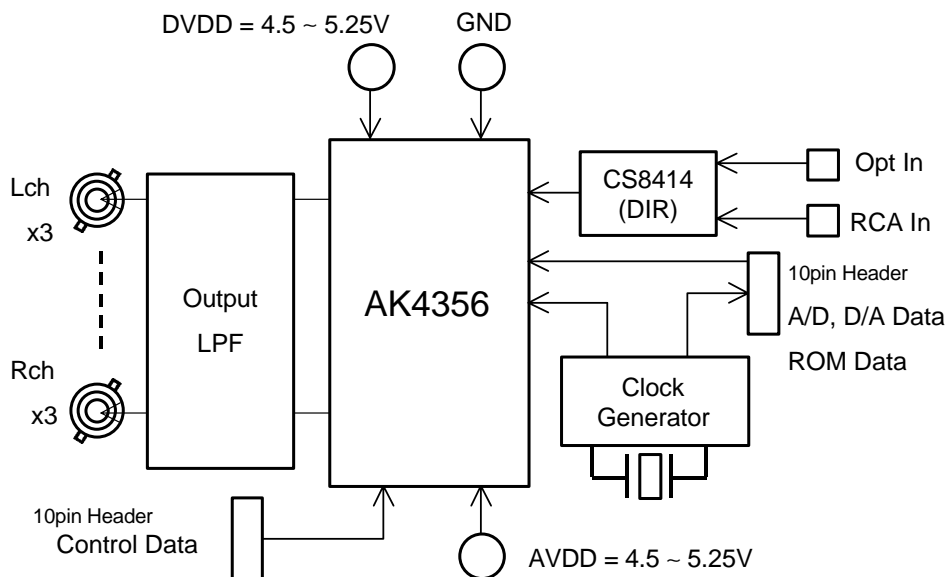


Figure 1. AKD4356 Block Diagram

\* 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 AK4356 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 AK4356 is 5.5Vpp@5V. The AK4356 detects input signal “zero” conditions and assert high on DZFL/DZFR pins. As shown on Figure 2, analog output is muted externally with this signal.

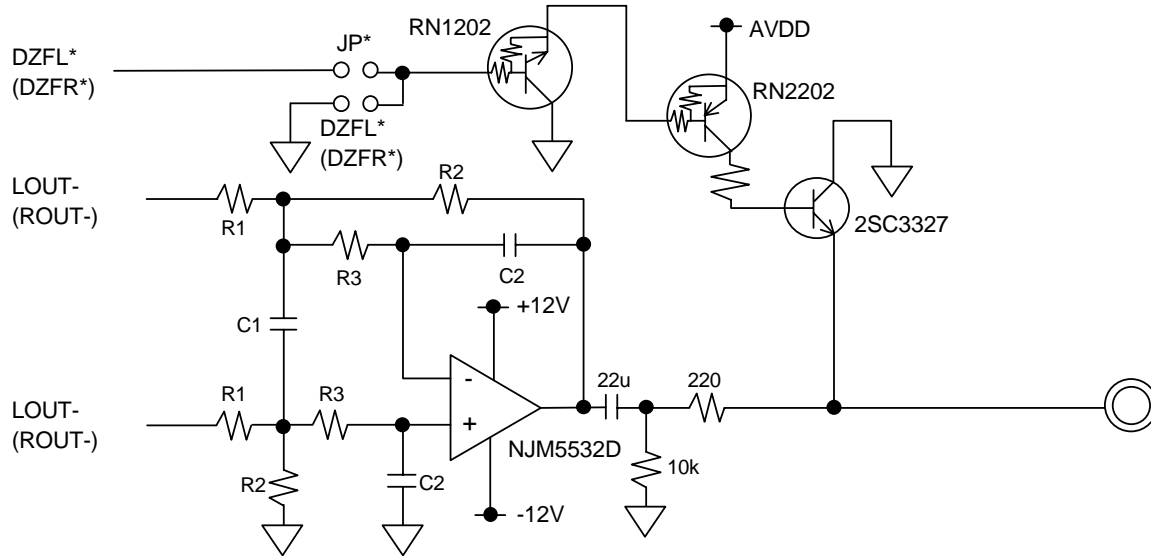


Figure 2. On-board analog filter

R1	R2	R3	C1	C2
4.7k	4.7k	200	3300p	470p

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

fin	20kHz	40kHz	80kHz
Frequency Response	-0.004dB	-0.123dB	-1.823dB

Table 2. Frequency Response of LPF

<Calculation>

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

$$\omega_0 = \frac{1}{\sqrt{2 \cdot C1 \cdot C2 \cdot R2 \cdot R3}}$$

$$Q = \frac{2 \cdot C1 \cdot \omega_0}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$

■ Operation sequence

- 1) Set up the power supply lines.
  - [AVDD] (orange) = 4.5~5.25V
  - [DVDD] (orange) = 4.5~5.25V
  - [VD] (red) = 3.4~5.0V
  - [VP+] (green) = +12V~-+15V
  - [VP-] (blue) = -12V~-12V
  - [AGND] (black) = 0V
  - [DGND] (black) = 0V

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

- 2) Set-up the evaluation modes, jumper pins and DIP switches (See the followings.)
- 3) Power on.
  - The AK4356 should be reset once bringing SW1(-PD) “L” upon power-up.

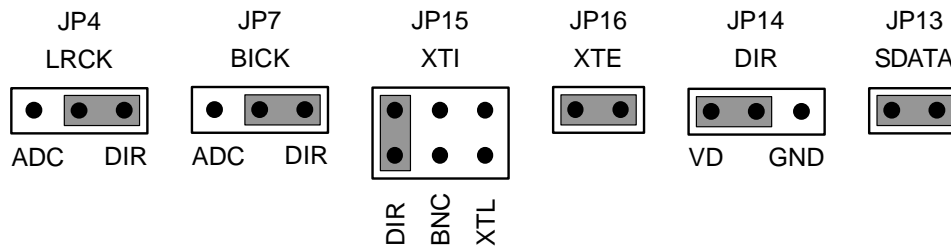
■ Evaluation mode

Applicable evaluation modes

- 1) DIR (Optical Link and RCA) (default)
- 2) Using ROM data (AK43XX)
- 3) Using AKM's evaluation board for ADC
- 4) Feeding all signals from external

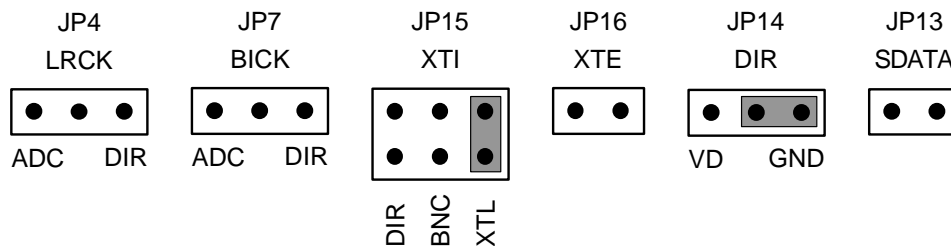
1) DIR (Optical Link and RCA) <default>

PORT4(TORX174) or J1(RCA) is used. All clock are supplied from CS8414(DIR). DIR generates MCLK, BICK, LRCK and SDATA from the received data through optical connector (TORX174) or RCA connector. Used for the evaluation using CD test disk. Nothing should be connected to PORT2,3. In case of using optical connector (TORX174), select “OPT” on JP17(RCA/OPT). In case of using RCA connector, select “RCA”.



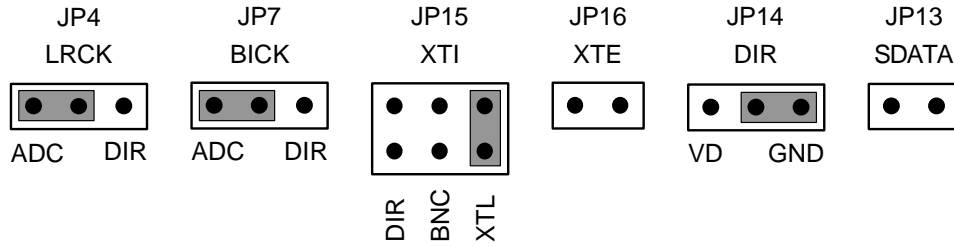
2) Ideal sine wave generated by ROM data

Connect the AKD43XX with PORT3(AD/ROM). AKD4356 sends MCLK to AKD43XX, and receives LRCK, BICK and SDATA. In case of using external master clock through a BNC connector, select “BNC” on JP15(XTI) and short JP16(XTE).



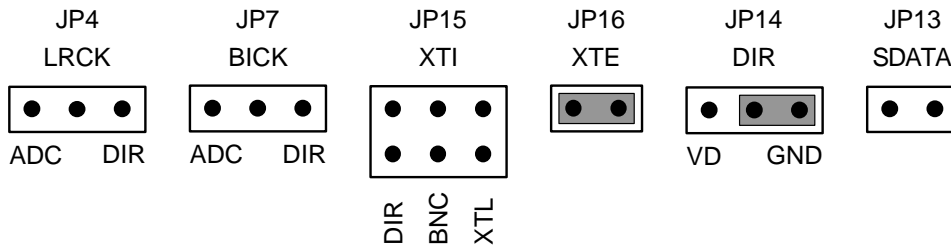
3) Using AKM's evaluation board for ADC

To evaluate AK4356 with analog input, the AKM's evaluation board for ADC can be used. MCLK, BICK and LRCK are supplied from clock generator on the AKD4356, and analog signal is A/D converted and send to AKD4356 through PORT3(AD/ROM). In case of using external master clock through a BNC connector, select "BNC" on JP15(XTI) and short JP16(XTE).



4) Feeding all signals from external

Under the following set-up, all external signals can be fed through POTR3.



■ BICK frequency

[JP9]: When BICK is fed from 74HC4040 on board, it's frequency is selected with JP9.

- 128fs: BICK = 128fs
- 64fs: BICK = 64fs (Figure 3)
- 32fs: BICK = 32fs

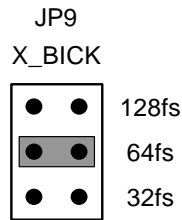


Figure 3. BICK frequency

### ■ DIP switch set up

Upper side is “ON”(“H”), lower side is “OFF”(“L”).

[SW3](MODE1): No.1 to 5 set the mode of AK4356 and No.6 to 8 set the mode of CS8412.

No.	Pin	OFF	ON
1	CAD1	Chip address (2bit) <default="00">	
2	CAD0		
3	DIF0	Digital interface format of AK4356 (See table 2.)	
4	DIF1		
5	DIF2		
6	M2	Digital interface format of CS8414 (See table 2.) (Note)	
7	M1		
8	M0		

Table 3. SW3 set-up

(Note: M2-0 should be selected at only evaluation mode 1.  
In other mode, these should be “OFF”.)

Mode	Format	3	4	5	6	7	8	JP6
		DIF0	DIF1	DIF2	M2	M1	M0	BICK2
0	16bit, LSB justified	0	0	0	1	0	1	THR
1	20bit, LSB justified	1	0	0	-	-	-	-
2	24bit, MSB justified	0	1	0	0	0	0	INV
3	I2S	1	1	0	0	1	0	THR
4	24bit, LSB justified	0	0	1	-	-	-	-

default

Table 4. Digital interface format set-up (1=ON, 0=OFF)  
(CS8414 does not correspond to 20/24bit LSB justified format.)

[SW4](MODE2): Set the mode of AK4356.

No.	Pin	OFF <default>	ON
1	DFS0	Normal speed	Double speed
2	DZFE	Zero detect disable	Zero detect enable
3	CKS2	Clock select (See the datasheet of AK4356. JP5 and 8 should be selected as table 4.)	
4	CKS1		
5	CKS0		

Table 5. SW4 set-up

[JP5, 8]: Set the dividing rate corresponding to CKS2-0. This set up is needed only for the evaluation mode 3.

Mode	JP5	JP8
	FS2	FS1
128fs	x1/2	x1
256fs	x1	x1
512fs	x1	x2

Table 6. JP5 and 8 set up  
(For 192fs/384fs/768fs mode, use the external divider.)

## ■ Other jumpers set up

[JP1](GND): Analog ground and digital ground

Open: Separated <default>

Short: Common (The connector “DGND” can be open.)

[JP2](DVDD): DVDD of AK4356

DVDD: Independent of AVDD <default>

AVDD: Same as AVDD (The connector “DVDD” can be open.)

[JP3](REG): AVDD of AK4356

Open: Supplied from “AVDD” connector

Short: Supplied from the regulator (The connector “AVDD” should be open.)

[JP10-12](SDTI1-3): SDTI of AK4356

DATA: Serial data <default>

GND: “0” data

## ■ The function of the toggle SW

Upper-side is “H” and lower-side is “L”.

[SW1](-PD): Resets the AK4356. Keep “H” during normal operation.

[SW2](SMUTE): Soft mute of AK4356. Bring “H” when using soft mute.

## ■ The indication content for LED

[D2] (VERF): Monitors VERF pin of the CS8414. LED turns on when some error has occurred to CS8414.

[D3] (PREM): Indicates whether the input data is pre-emphasized or not. LED turns on when the data is pre-emphasized.

## ■ Serial control mode

The AK4356 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT1(CR-I/F) with PC by 10-line flat cable packed with the AKD4356.

Chip address can be selected by SW3(MODE1)-No.1(CAD1) and No.2(CAD0).

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

The pin layout of PORT1 is as Figure 4.

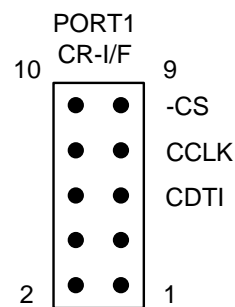


Figure 4. PORT1 pin layout

## ■ Interface with AC3 decoder

PORT2(AC3) is used for interface with AC3 decoder.

MCLK, BICK, LRCK and 3-line serial data can be input from the decoder via PORT2.

Pin layout of PORT2 is as Figure5.

In this case, JP4(LRCK), JP7(BICK), JP15(XTI), JP16(XTE), JP14(DIR) and JP13(SDATA) should be set up as evaluation mode 4.

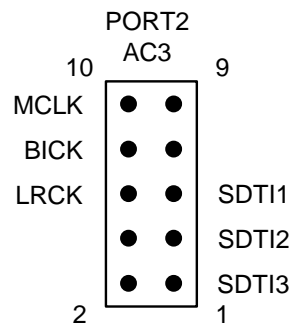


Figure 5. PORT2 pin layout

<b>MEASUREMENT RESULTS</b>
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## [Measurement condition]

- Measurement unit : ROHDE & SCHWARZ, UPD04
- MCLK : 256fs
- BICK : 64fs
- fs : 44.1kHz, 96kHz, 192kHz
- BW : 20Hz~20kHz (fs=44.1kHz), 20Hz~40kHz (fs=96kHz), 20Hz~80kHz (fs=192kHz)
- Bit : 24bit
- Power Supply : AVDD=DVDD=5V
- Interface : DIR (fs=44.1kHz), Serial Multiplex (fs=96kHz, 192kHz)
- Temperature : Room

Parameter	Input signal	Measurement filter	fs=44.1kHz
S/(N+D)	1kHz, 0dB	20kLPF	97.5dB
DR	1kHz, -60dB	20kLPF	110.0dB
		20kLPF, A-weighted	113.2dB
S/N	no signal	20kLPF	110.1dB
		20kLPF, A-weighted	113.5dB

Parameter	Input signal	Measurement filter	fs=96kHz
S/(N+D)	1kHz, 0dB	40kLPF	94.4dB
DR	1kHz, -60dB	40kLPF	106.2dB
		20kLPF, A-weighted	112.3dB
S/N	no signal	40kLPF	106.4dB
		20kLPF, A-weighted	112.8dB

Parameter	Input signal	Measurement filter	fs=192kHz
S/(N+D)	1kHz, 0dB	80kLPF	90.0dB
DR	1kHz, -60dB	80kLPF	92.6dB
		20kLPF, A-weighted	112.8dB
S/N	no signal	80kLPF	93.3dB
		20kLPF, A-weighted	112.8dB

## [Measurement condition]

- Measurement unit : Audio Precision, System two, Cascade
- MCLK : 256fs
- BICK : 64fs
- fs : 44.1kHz
- BW : 20Hz~20kHz
- Bit : 24bit
- Power Supply : AVDD=DVDD=5V
- Interface : DIR
- Temperature : Room

Parameter	Input signal	Measurement filter	Results
S/(N+D)	1kHz, 0dB	20kLPF	98.8dB
DR	1kHz, -60dB	22kLPF, A-weighted	112.2dB
S/N	no signal	22kLPF, A-weighted	112.6dB

## ■ Plots

### [Measurement condition]

- Measurement unit : Audio Precision, System two, Cascade (fs=48kHz),  
ROHDE & SCHWARZ, UPD04 (fs=96kHz)
- MCLK : 256fs
- BICK : 64fs
- fs : 44.1kHz, 96kHz, 192kHz
- BW : 20Hz~20kHz (fs=44.1kHz), 20Hz~40kHz (fs=96kHz), 20Hz~80kHz (fs=192kHz)
- Bit : 24bit
- Power Supply : VA=VD=5V
- Interface : DIR (fs=48kHz, 96kHz), Serial Multiplex (fs=192kHz)
- Temperature : Room

### fs=44.1kHz

- Figure 6. THD+N vs Input Level (fin=1kHz)
- Figure 7. THD+N vs fin (0dBFS input)
- Figure 8. Linearity (fin=1kHz)
- Figure 9. Frequency Response (0dBFS input)
- Figure 10. Cross-talk (0dBFS input)
- Figure 11. FFT (1kHz, 0dBFS input)
- Figure 12. FFT (1kHz, -60dBFS input)
- Figure 13. FFT (noise floor)
- Figure 14. FFT (outband noise)

### fs=96kHz

- Figure 15. THD+N vs Input Level (fin=1kHz)
- Figure 16. THD+N vs fin (0dBFS input)
- Figure 17. Linearity (fin=1kHz)
- Figure 18. Frequency Response (0dBFS input)

### fs=192kHz

- Figure 19. THD+N vs Input Level (fin=1kHz)
- Figure 20. THD+N vs fin (0dBFS input)
- Figure 21. Linearity (fin=1kHz)
- Figure 22. Frequency Response (0dBFS input)



AKM

AK4356 THD+N vs Input Level (fs=44.1kHz, fin=1kHz)

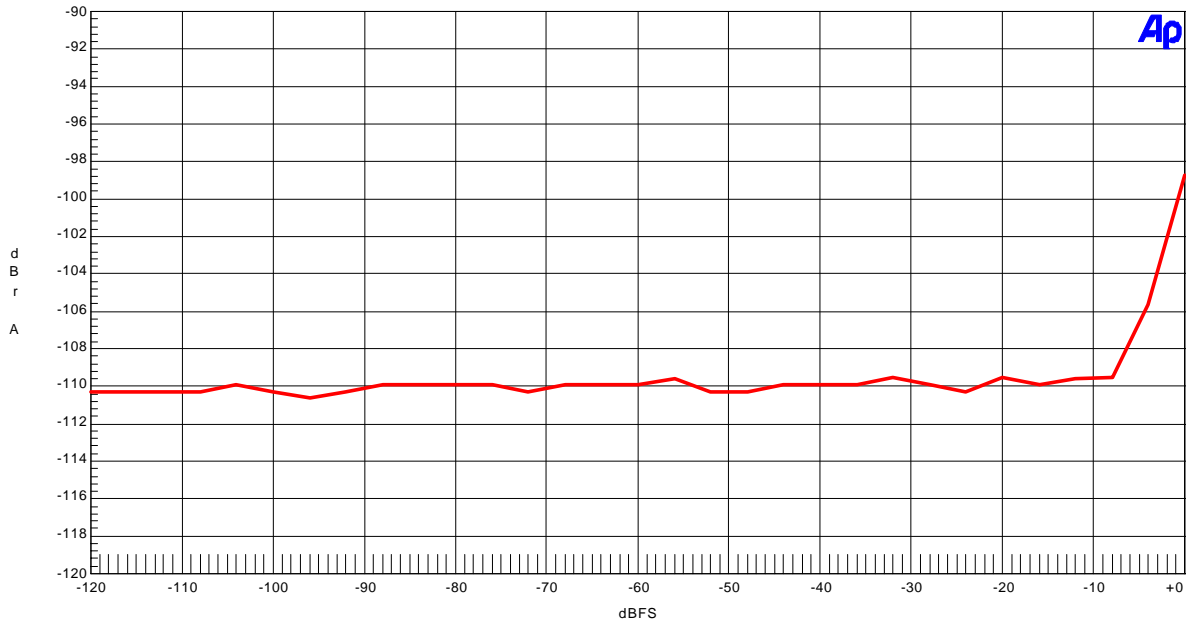


Figure 6. THD+N vs Input Level (fs=44.1kHz; fin=1kHz)

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AK4356 THD+N vs fin (fs=44.1kHz, 0dBFS input)

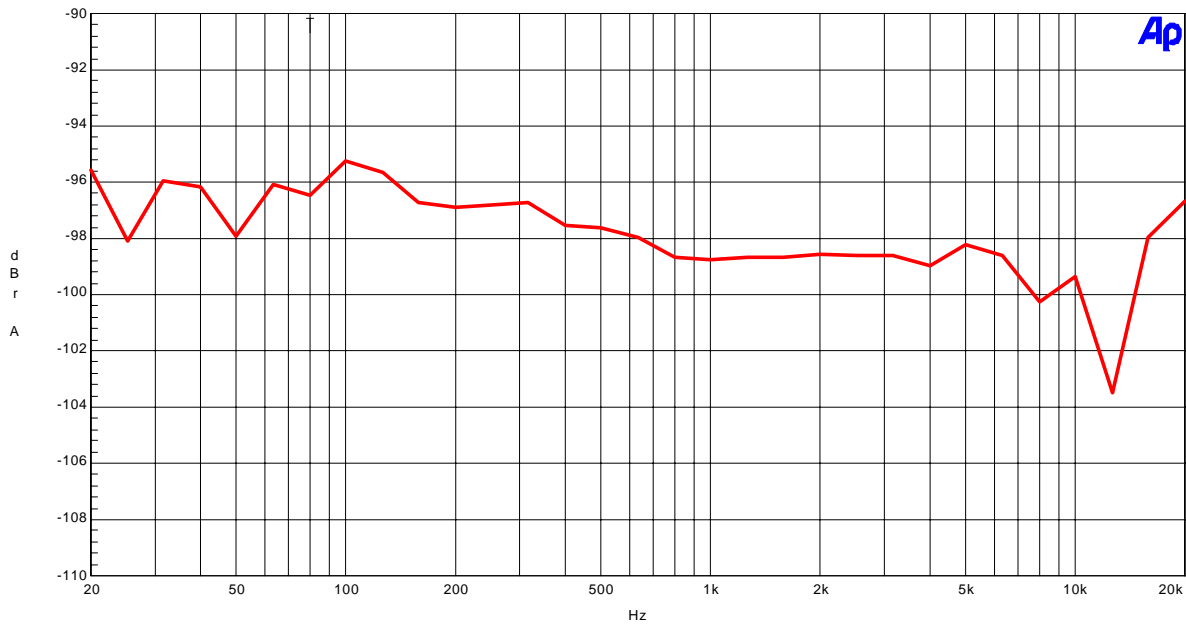


Figure 7. THD+N vs fin (fs=44.1kHz; 0dBFS input)

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AK4356 Linearity (fs=44.1kHz, fin=1kHz)

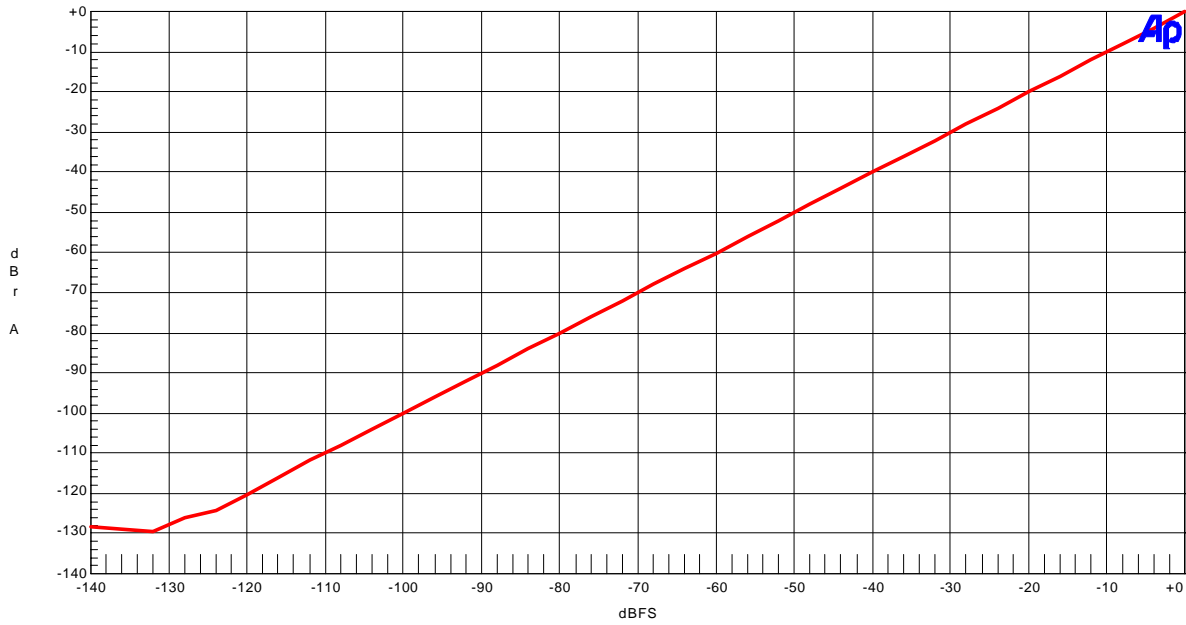


Figure 8. Linearity (fs=44.1kHz; fin=1kHz)

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AK4356 Frequency Response (fs=44.1kHz, 0dBFS input)

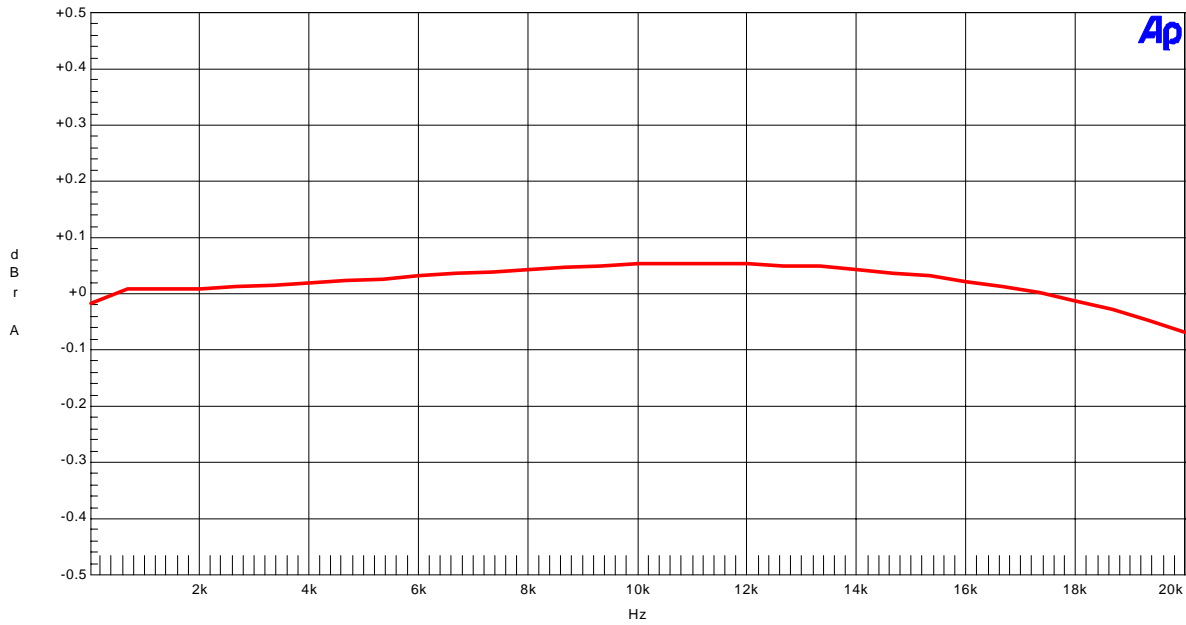


Figure 9. Frequency Response (fs=44.1kHz; 0dBFS input)  
\* including output 2nd order LPF Response

AKM

AK4356 Cross-talk (fs=44.1kHz, 0dBFS input)

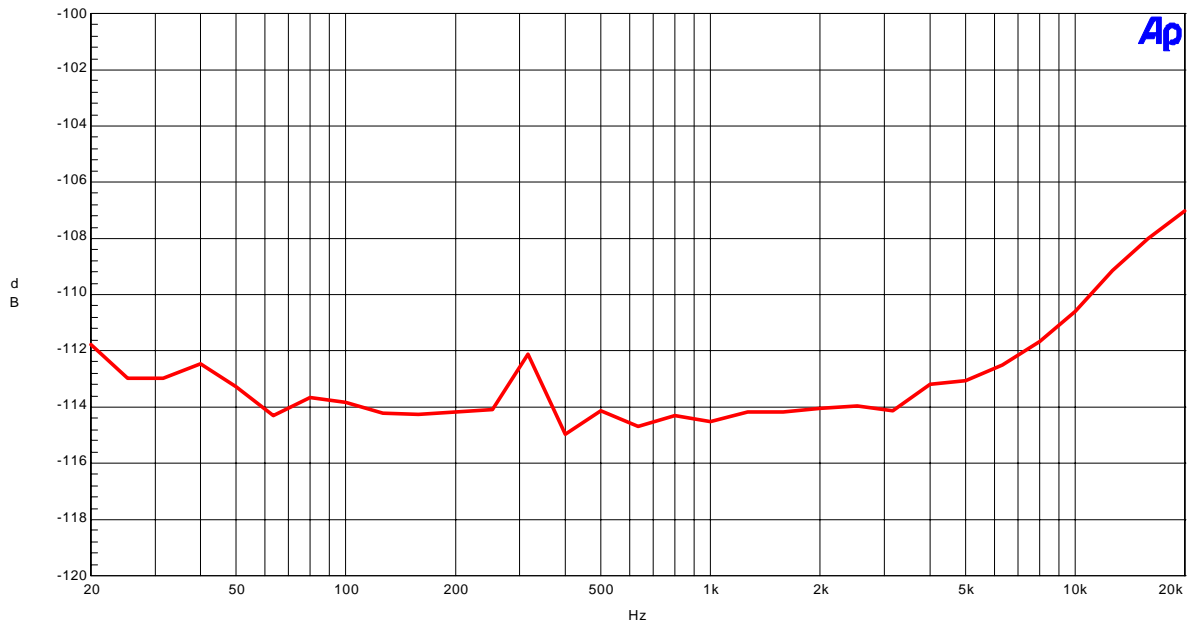


Figure 10. Cross-talk (fs=44.1kHz; 0dBFS input)

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AK4356 FFT (fs=44.1kHz; 1kHz, 0dBFS input)

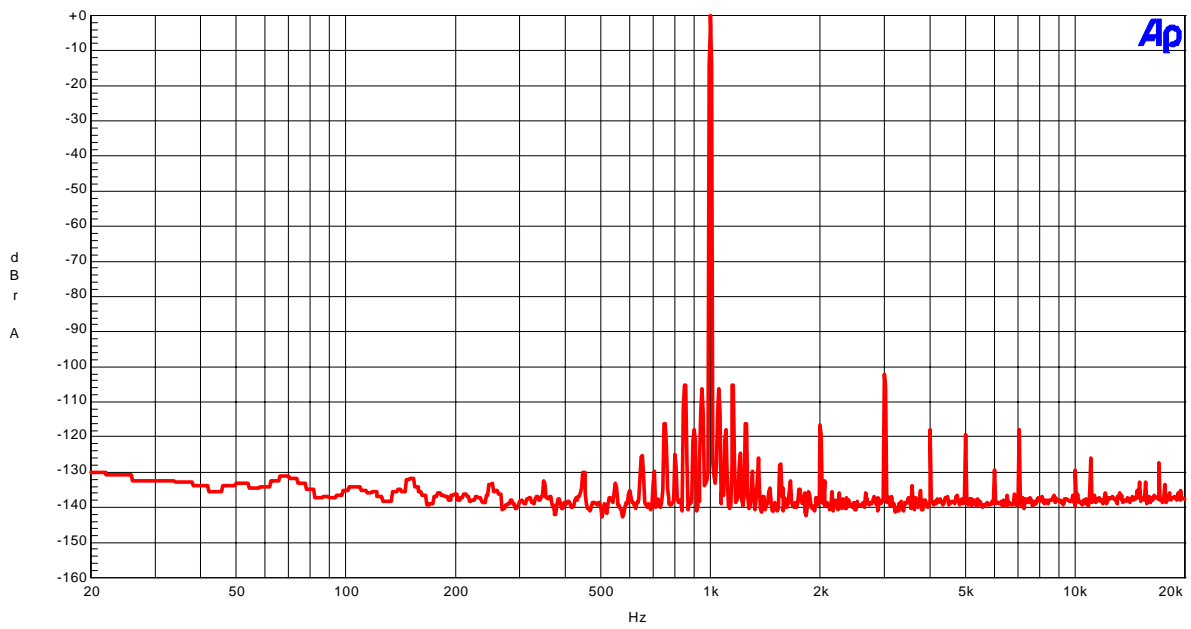


Figure 11. FFT (fs=44.1kHz; 1kHz, 0dBFS input)  
FFT point=16384, Avg=8

AKM

AK4356 FFT (fs=44.1kHz; 1kHz, -60dBFS input)

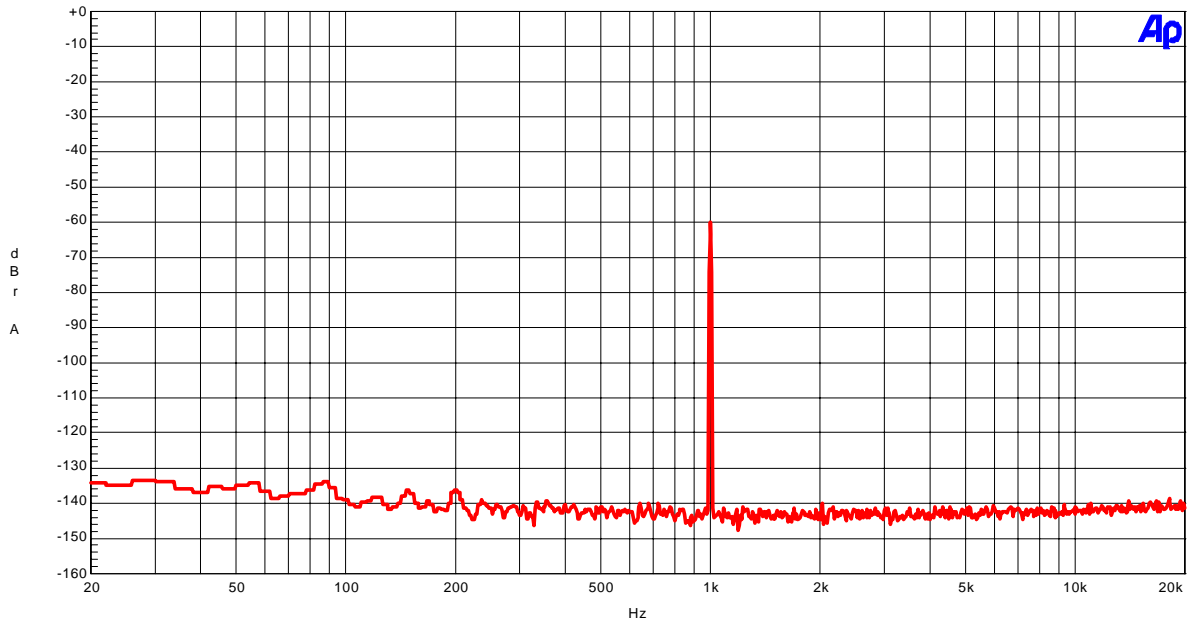


Figure 12. FFT (fs=44.1kHz; 1kHz, -60dBFS input)  
FFT point=16384, Avg=8

AKM

AK4356 FFT (noise floor; fs=44.1kHz, no signal input)

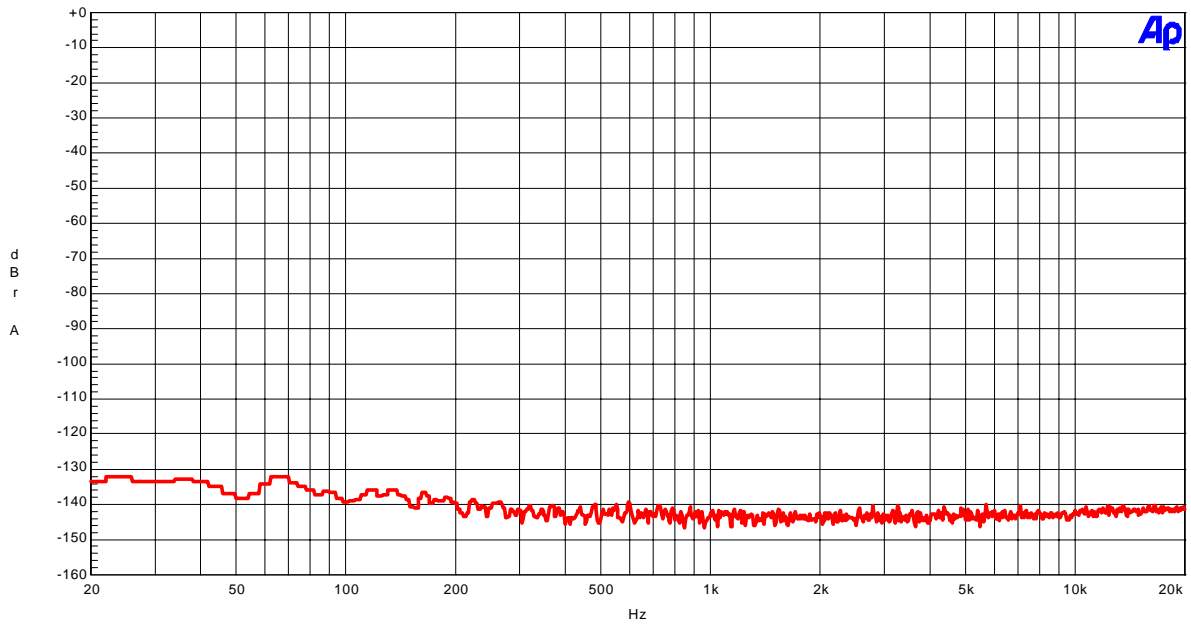


Figure 13. FFT (noise floor: fs=44.1kHz; no signal input)  
FFT point=16384, Avg=8

AKM

AK4356 FFT (outband noise: ~130kHz; fs=44.1kHz, no signal input)

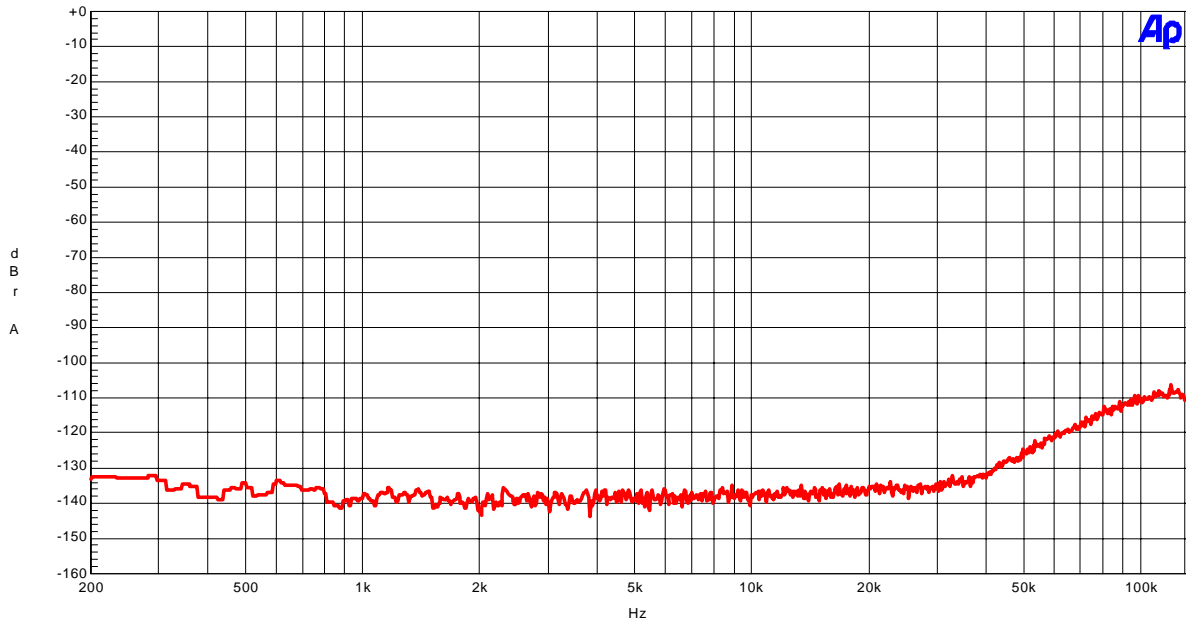


Figure 14. FFT (outband noise: fs=44.1kHz; no signal input)  
FFT point=16384, Avg=8

AKM

AK4356 THD+N vs Input Level (fs=96kHz, fin=1kHz)

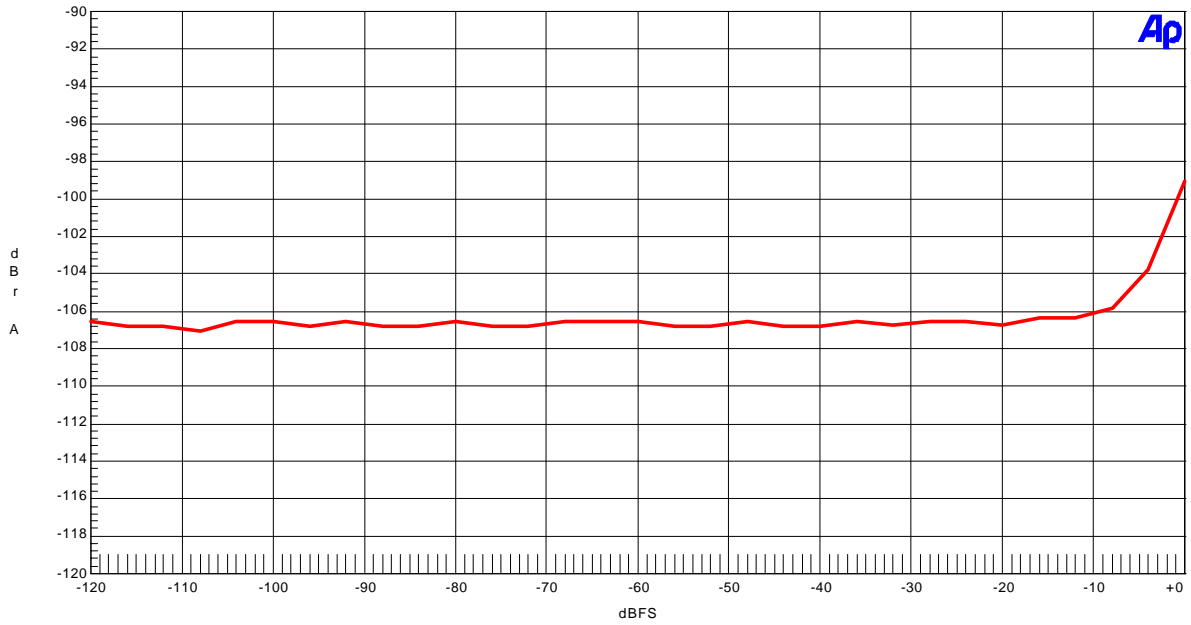


Figure 15. THD+N vs Input Level (fs=96kHz; fin=1kHz)

AKM

AK4356 THD+N vs fin (fs=96kHz, 0dBFS input)

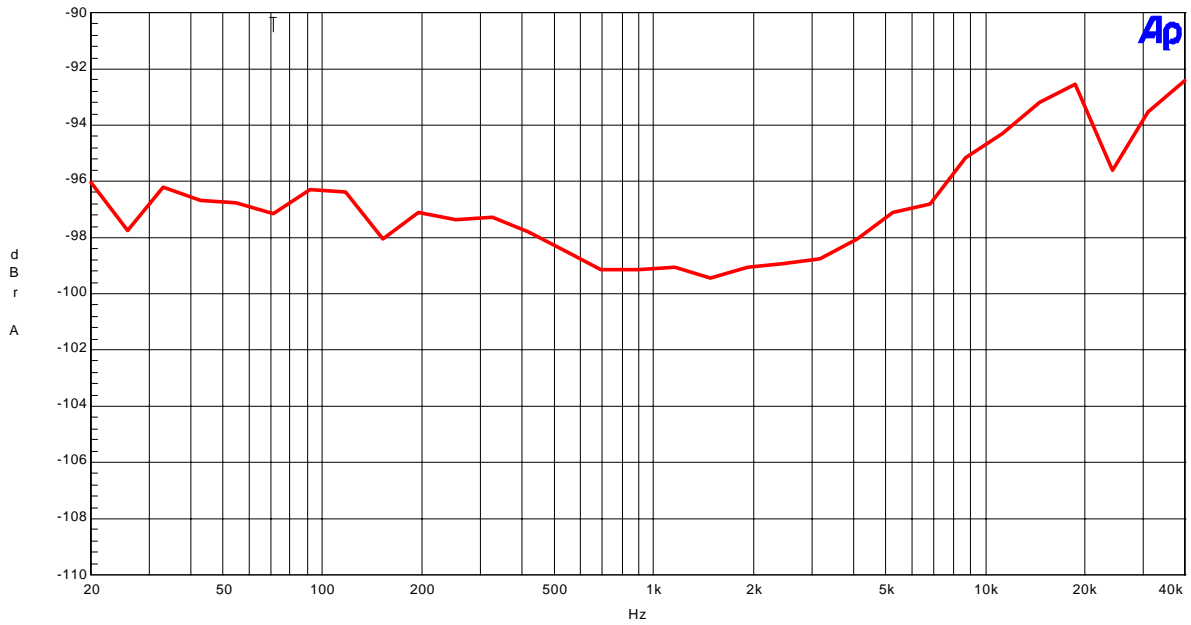


Figure 16. THD+N vs fin (fs=96kHz; 0dBFS input)

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AK4356 Linearity (fs=96kHz, fin=1kHz)

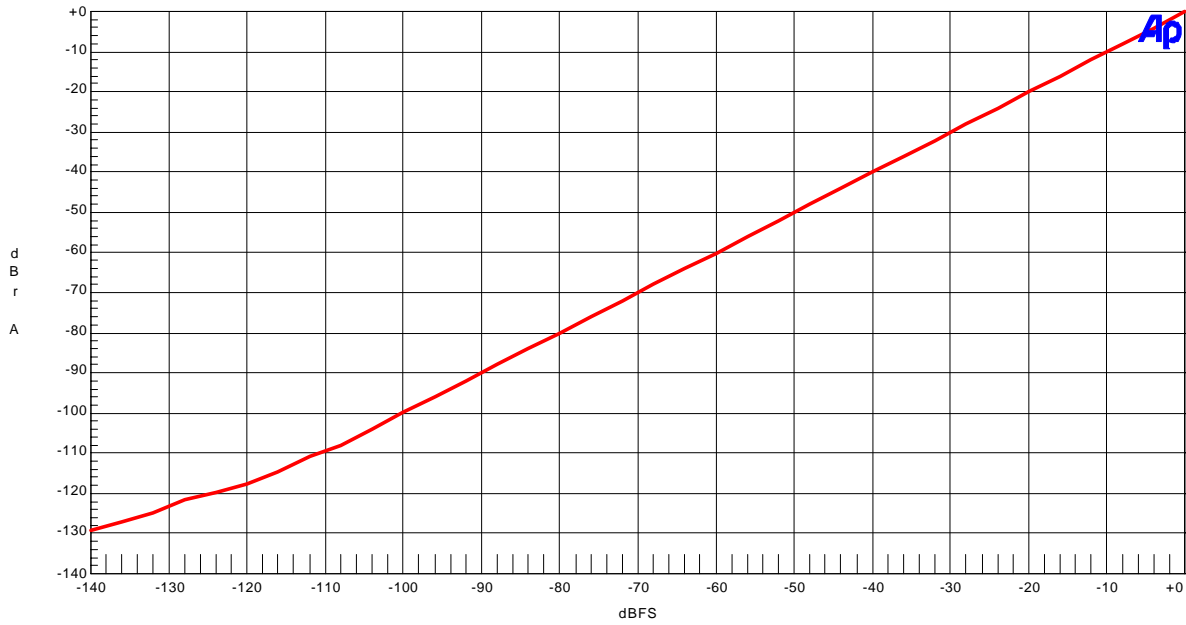


Figure 17. Linearity (fs=96kHz; fin=1kHz)

AKM

AK4356 Frequency Response (fs=96kHz, 0dBFS input)

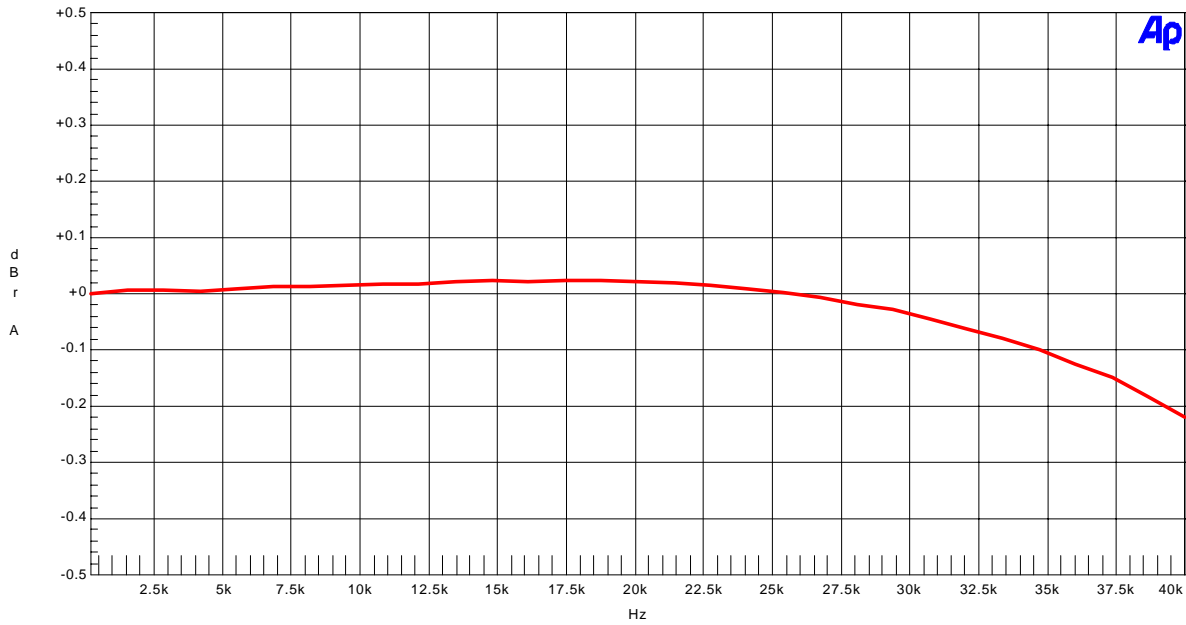


Figure 18. Frequency Response (fs=96kHz; 0dBFS input) including external 2nd order LPF response

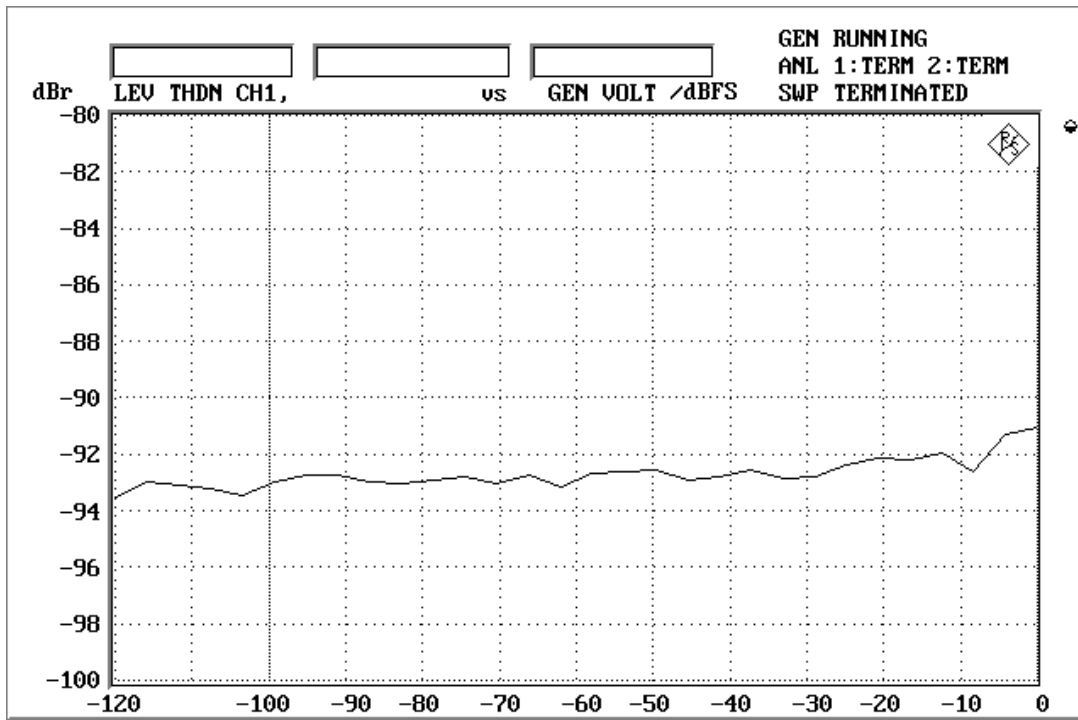


Figure 19. THD+N vs Input Level (fs=192kHz; fin=1kHz)

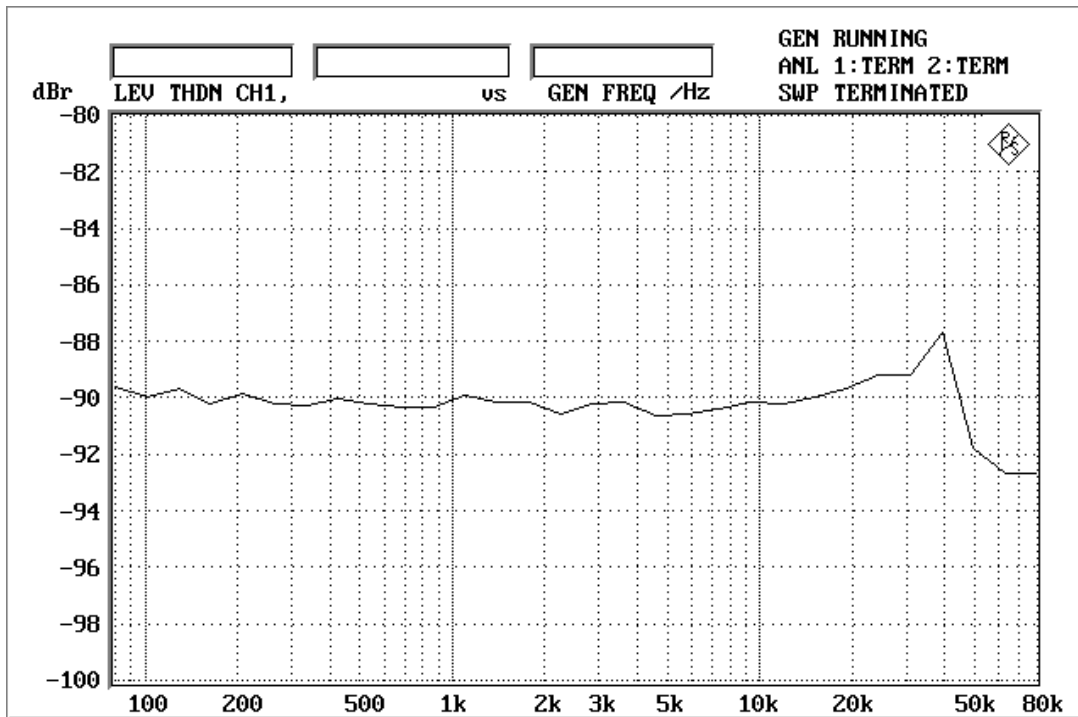


Figure 20. THD+N vs fin (fs=192kHz; 0dBFS input)



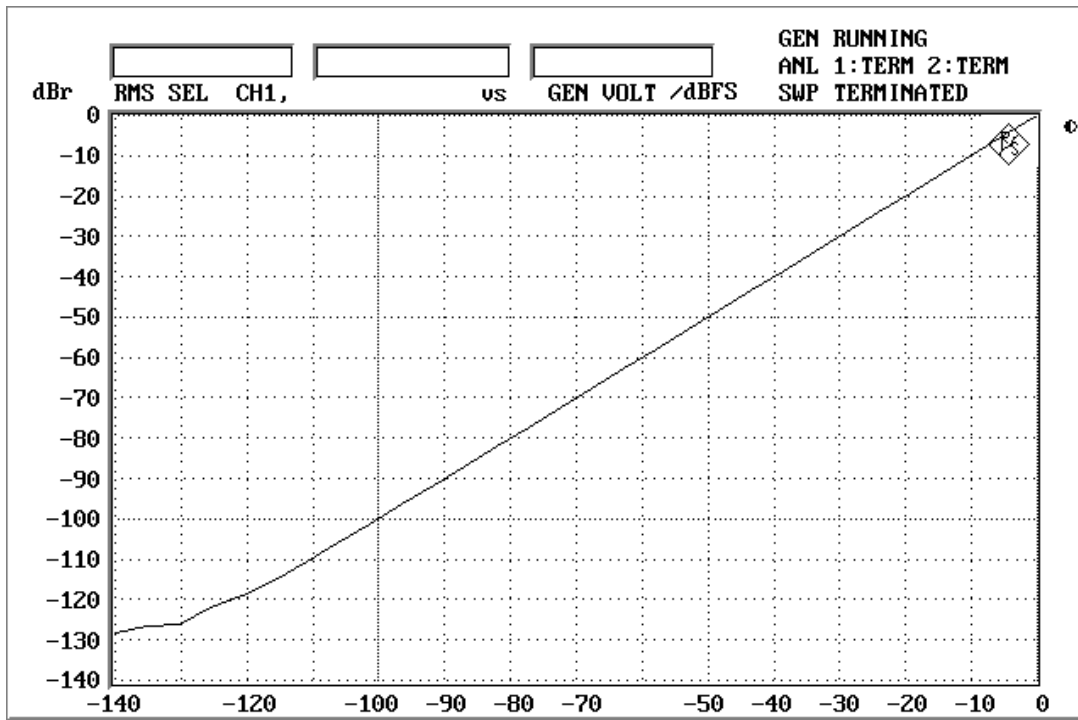


Figure 21. Linearity (fs=192kHz; fin=1kHz)

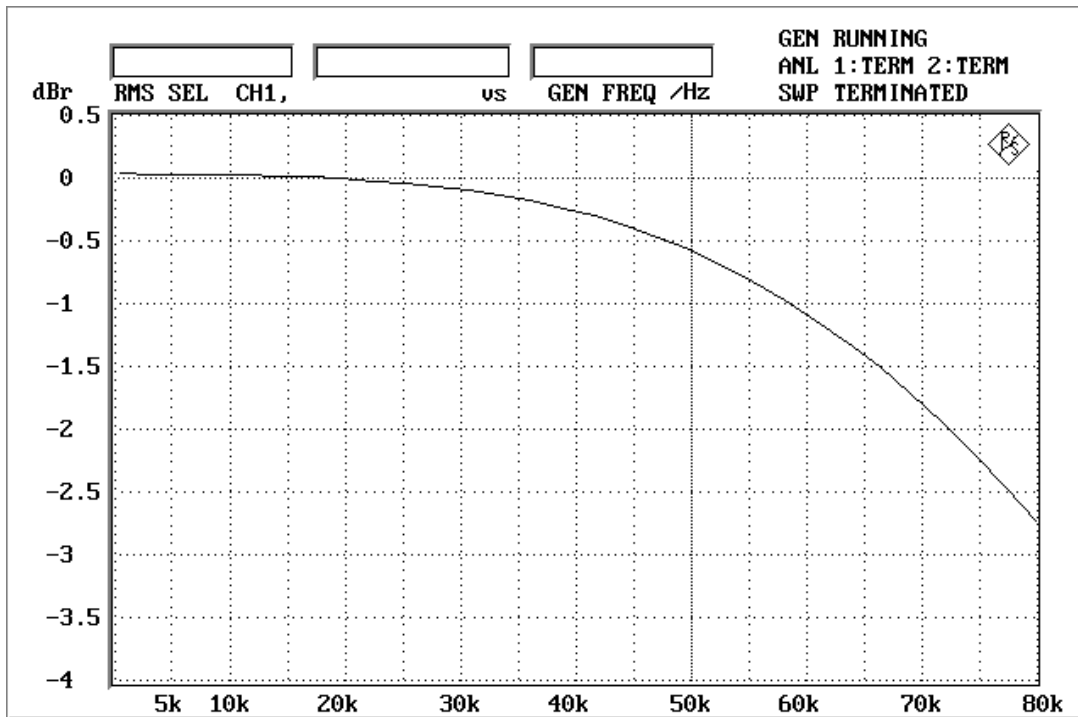


Figure 22. Frequency Response (fs=192kHz; 0dBFS input)  
\* including external 2nd order LPF response

**AKD4356 Control Program ver 1.0 operation manual**

1. Connect IBM-AT compatible PC with AKD4356 by 10-line type flat cable (packed with AKD4356).  
Take care of the direction of 10pin Header (Refer to manual of AKD4356).
2. Start up "WINDOWS 95" or "WINDOWS 98".
3. Insert the floppy-disk labeled "AKD4356 Control Program ver 1.0" into the floppy-disk drive.
4. Set up "MS-DOS" from start menu.
5. Change directory to the floppy-disk drive(ex.a:) at MS-DOS prompt.
6. Type "ak4356".
7. Then follow the displayed comment (See the following).

```

===== <<Operating flow>> =====
Input Chip Address (2bit)
Write data/ Display register map/ Reset etc.  loop
=====
    
```

At first the following message is displayed:

```
***** AK4356 Control Program ver 1.0 , '99/3 *****
copyright(c) 1999, Asahi Kasei Microsystems co.,ltd.
All rights reserved.

Input Chip Address(CAD1,CAD0) (2 figure, binary) =
```

Input chip address in 2 figures of binary.

Set CAD1 and CAD0 before the AKD4356 is powered up.

When hanging CAD1 and CAD0, set SW1(-PD) "L", then "H" after that.

After chip address is defined, the following default register map is displayed (Loop starts from here):

```
CAD1-0=00 -----
ADDR = 00 : 01 <Control 1> ( 0 SLOW DZFM DZFE DIF2 DIF1 DIF0 RSTN )
ADDR = 01 : 01 <Control 2> ( 0 0 0 CKS2 CKS1 CKS0 SMUTE RSTN )
ADDR = 02 : 0F <Speed & PD> ( 0 0 DFS1 DFS0 PW3 PW2 PW1 RSTN )
ADDR = 03 : 15 <DEM control>( 0 0 DEMC1 DEMC0 DEMB1 DEMB0 DEMA1 DEMA0)
ADDR = 04 : FF <LOUT1 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 05 : FF <ROUT1 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 06 : FF <LOUT2 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 07 : FF <ROUT2 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 08 : FF <LOUT3 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 09 : FF <ROUT3 ATT> ( ATT7 ATT6 ATT5 ATT4 ATT3 ATT2 ATT1 ATT0 )
ADDR = 0A : 00 <Test> ( TEST7 TEST6 TEST5 TEST4 TEST3 TEST2 TEST1 TEST0 )

Input 1(Write), R(Reset), T(Table), I(Increment), D(Decrement) or S(Stop) :
```

1) If you input "1", you can write data to AK4356.

```
You can write data to AK4356
Input Register Address (2 figure, hex) (00-0A) =
```

Input register address in 2 figures of hexadecimal.

Then current data of this address is displayed:

```
ADDR = 00 : 01 <Control 1> ( 0 SLOW DZFM DZFE DIF2 DIF1 DIF0 RSTN )
                          0 0 0 0 0 0 0 1
Input Register Data (2 figure, hex) (00-FF) =
```

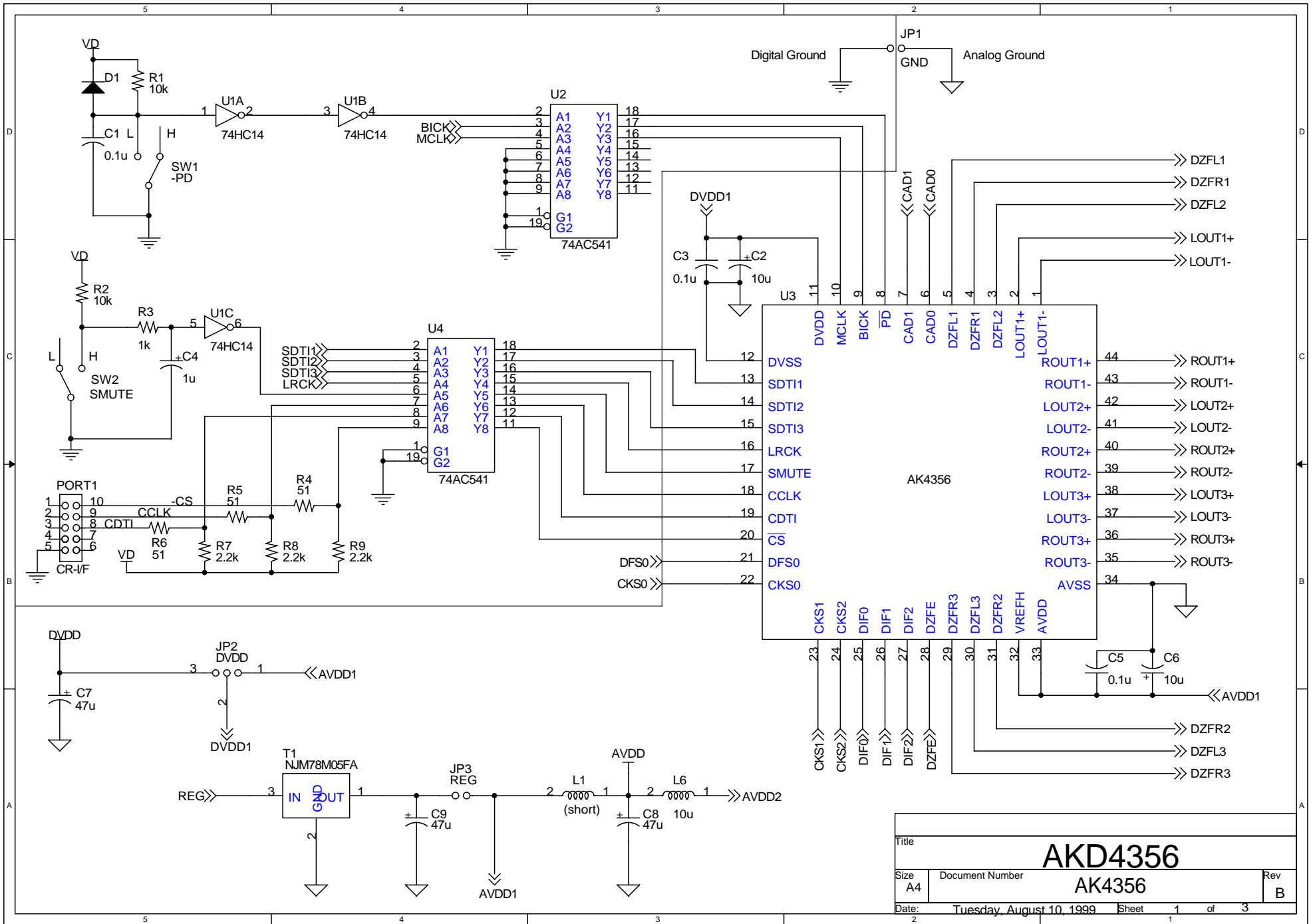
You can write control data to this address. Input control data in 2 figures of hexadecimal.

Refer to datasheet of AK4356.

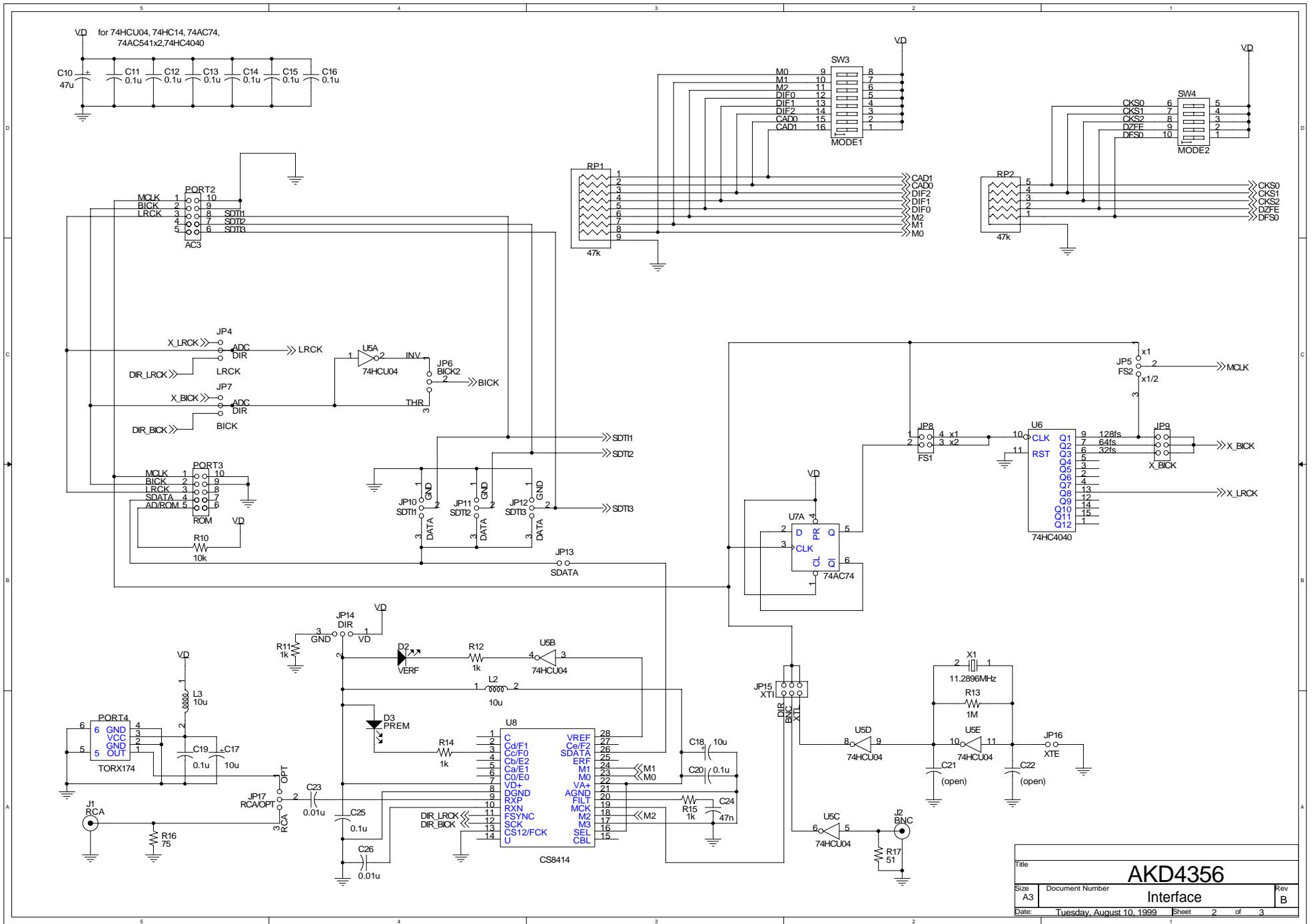
Then the data written to this address is displayed:

```
ADDR = 00 : 07 <Control 1> ( 0 SLOW DZFM DZFE DIF2 DIF1 DIF0 RSTN )
                          0 0 0 0 0 1 1 1
```

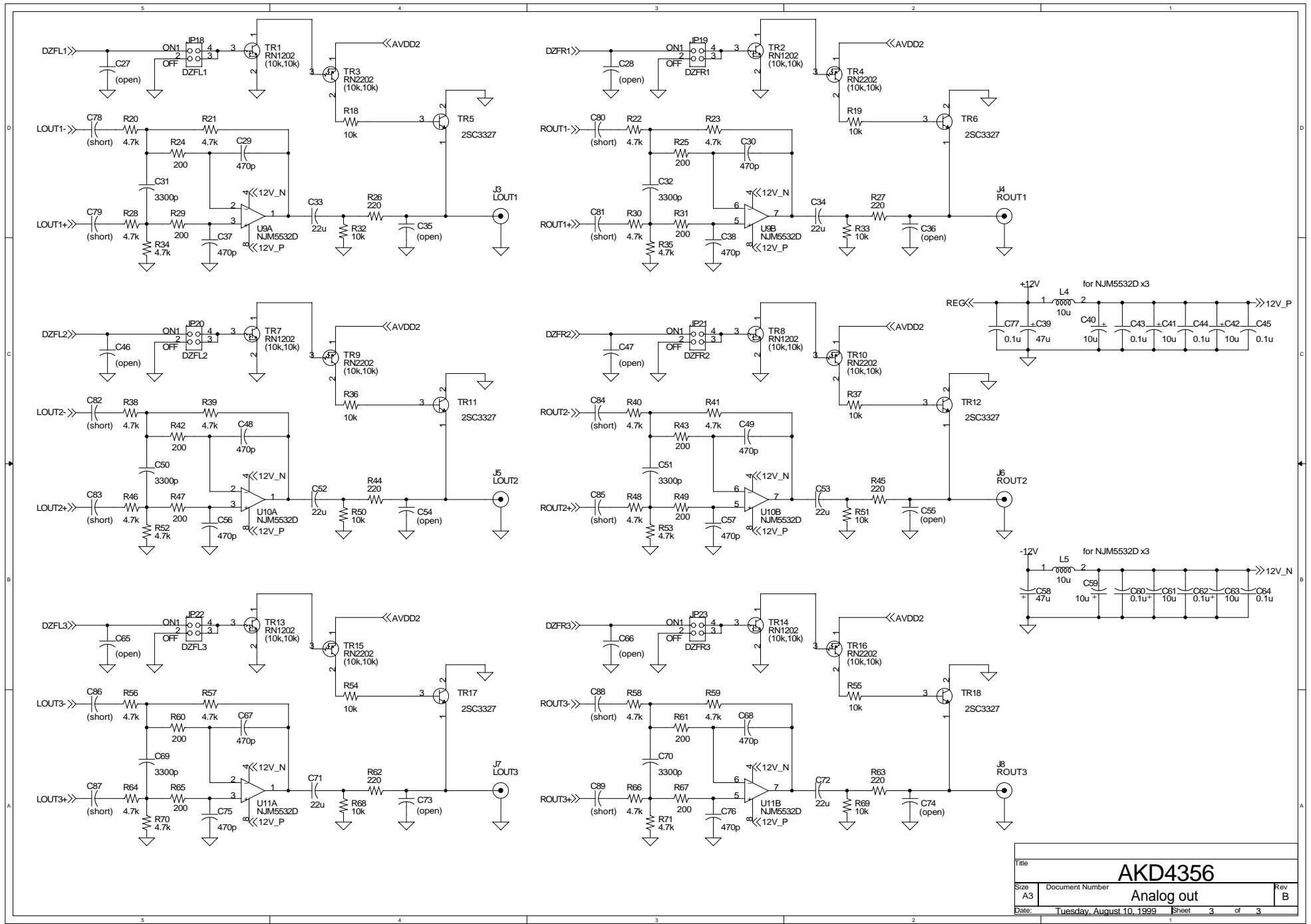
- 2) If you input "R" or "r", this program writes default data to all register addresses.
- 3) If you input "T" or "t", current register map is displayed.
- 4) If you input "I" or "i", this program increment data of current address by 1 (only for addr=04H to 09H).  
You can increment ATT value by 1step.
- 5) If you input "D" or "d", this program decrement data of current address by 1 (only for addr=04H to 09H).  
You can decrement ATT value by 1step.
- 6) If you input "S" or "s", this program is terminated.



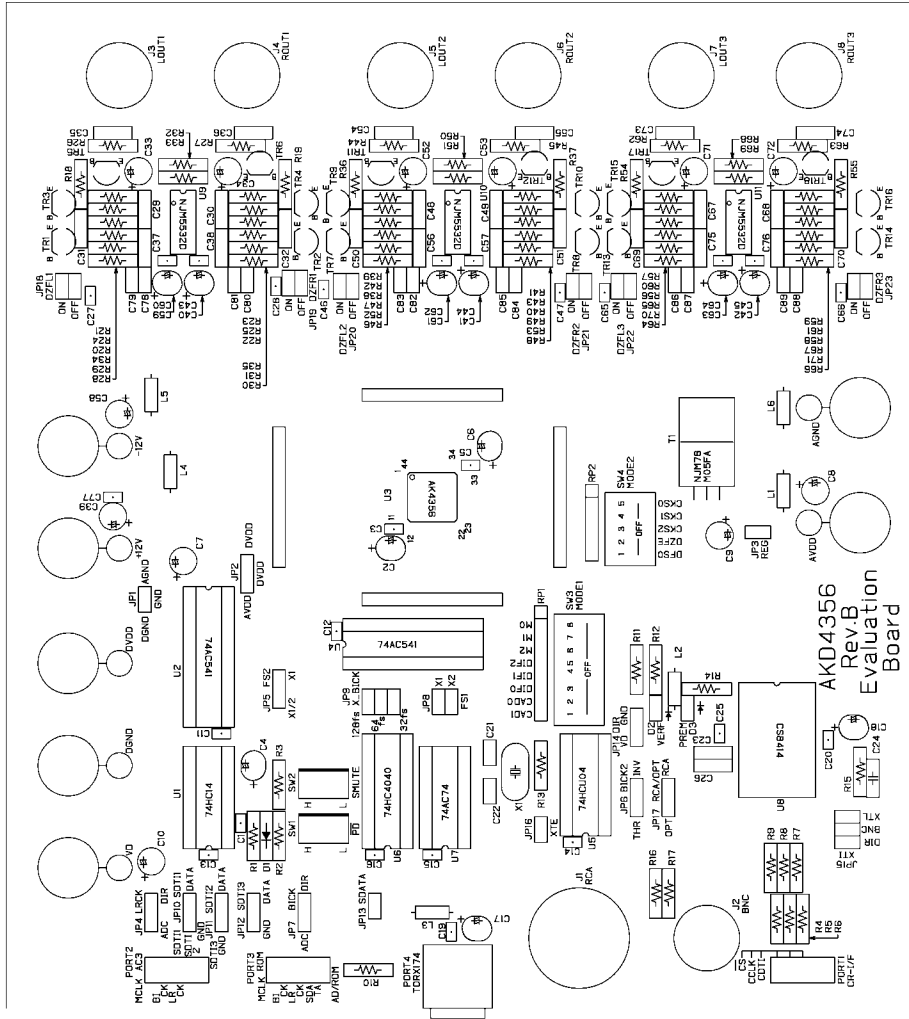
Title			<b>AKD4356</b>		
Size	Document Number		AK4356		Rev
A4					B
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Title			<b>AKD4356</b>		
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A3					B
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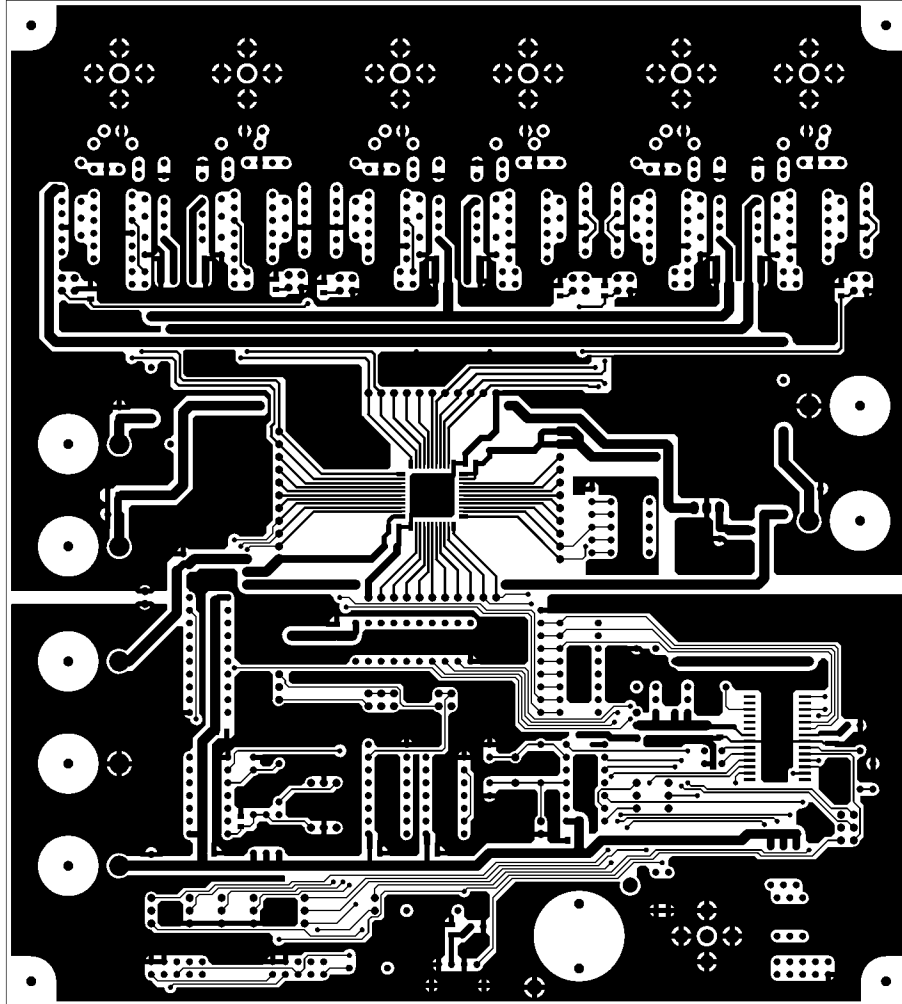


Title			
<b>AKD4356</b>			
Size	Document Number	Rev	
A3	Analog out	B	
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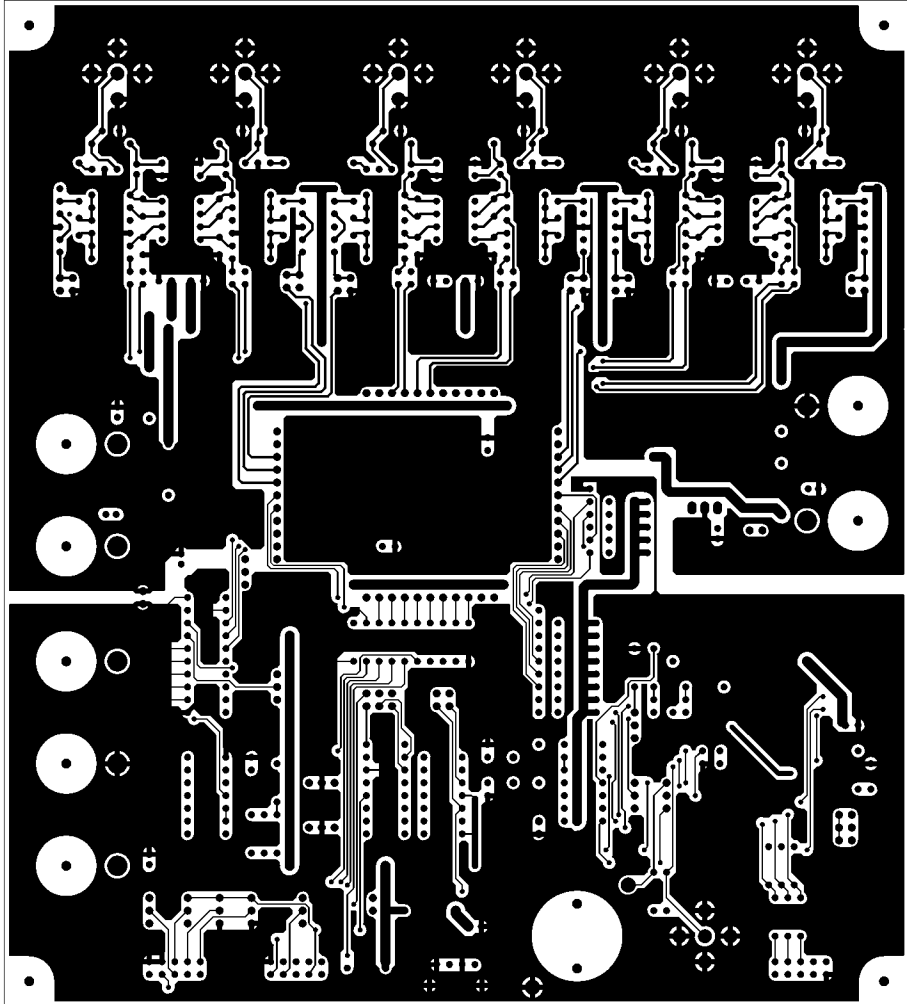


L1 部品面 シ/17 AKD4356 Rev.B





L1 基板面 / 1/4-y  
AKD4356 Rev.B



JS 板图 1A-1

RevB 82620A

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