

AKD4550

Evaluation board Rev.C for AK4550

GENERAL DESCRIPTION

AKD4550 is an evaluation board for the portable digital audio 16bit A/D and D/A converter, AK4550. The AKD4550 can evaluate A/D converter and D/A converter separately in addition to loopback mode (A/D → D/A). The A/D section can be evaluated by interfacing with AKM's DAC evaluation boards directly. The AKD4550 has the interface with AKM's wave generator using ROM data and AKM's ADC evaluation boards. Therefore, it's easy to evaluate the D/A section. The AKD4550 also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector.

■ **Ordering guide**

AKD4550 --- Evaluation board for AK4550

FUNCTION

- **Compatible with 2 types of interface**
 - Direct interface with AKM's A/D & D/A converter evaluation boards
 - DIT/DIR with optical input/output
- **BNC connector for an external clock input**

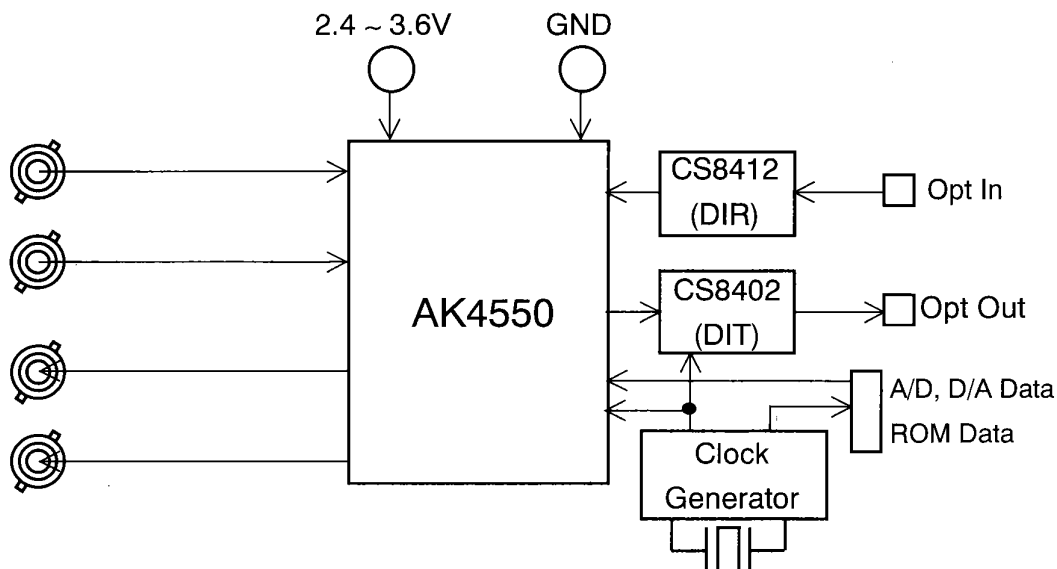


Figure 1. AKD4550 Block Diagram

■ Input Circuit

External analog signal fed through the BNC connector is terminated by a resistor of 560 ohms. The resistor value should be properly selected in order to meet the output impedance of the signal source.

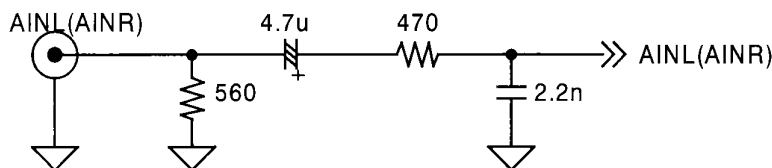


Figure 2. Input buffer circuit on board

* AKM assumes no responsibility for the trouble when using the circuit examples.

■ Analog Output Circuit

The AK4550 includes a combination of switched-capacitor filter (SCF) and continuous-time filter (CTF), so any external filters are not required.

■ Grounding and Power Supply Decoupling

To minimize the coupling by digital noise, VDD pin should be supplied from analog power supply in system. Decoupling capacitors should be connected to AK4550 as near as possible. Especially, the capacitor between VDD and VSS pins should be connected nearest.

■ Operation sequence

1) Set up the power supply lines.

| | | |
|----------------|--------------|---|
| [VA] (orange) | = 2.4 ~ 3.6V | : for VDD of AK4550 |
| [VP] (orange) | = 2.4 ~ 3.6V | : for VP of 74HC4050 |
| [VD] (red) | = 3.6 ~ 5.0V | : for logic |
| [AGND] (black) | = 0V | : for analog ground (including VSS of AK4550) |
| [DGND] (black) | = 0V | : for logic ground |

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

VP and VA must be same voltage level.

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

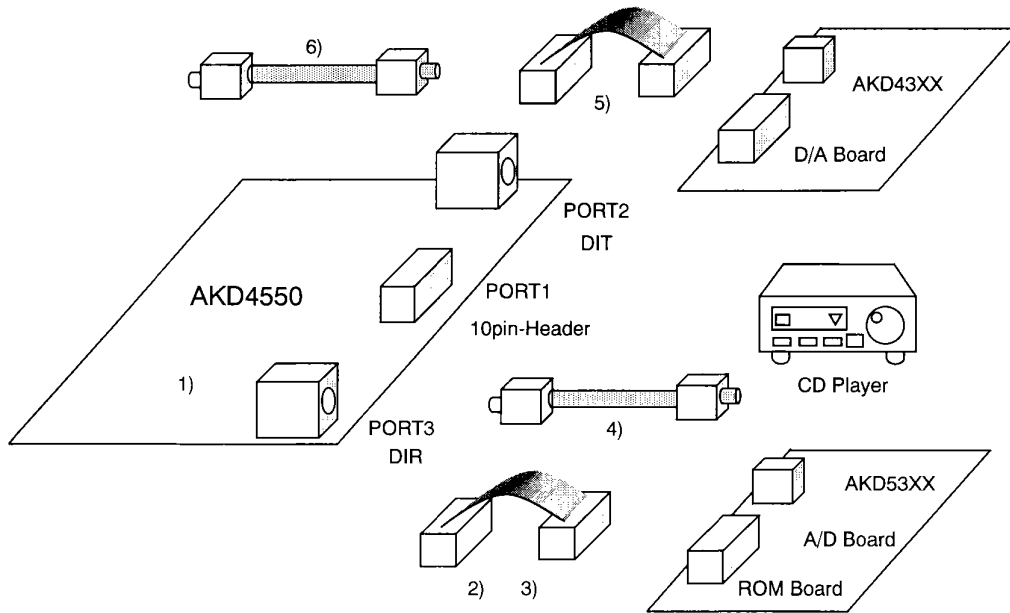
3) Power on.

The AK4550 should be reset once bringing SW1,2 ($\overline{\text{PWAD}}$, $\overline{\text{PWDA}}$) “OFF” upon power-up.

■ Evaluation mode

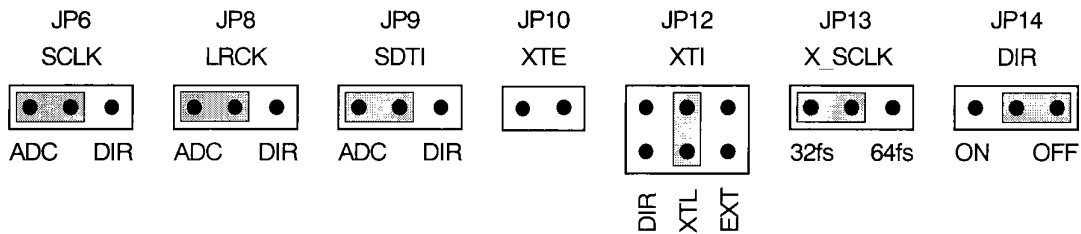
Applicable Evaluation Mode

- 1) Evaluation of loopback mode (default)
- 2) Evaluation of D/A using ideal sin wave generated by ROM data
- 3) Evaluation of D/A using A/D converted data
- 4) Evaluation of D/A using DIR (Optical Link)
- 5) Evaluation of A/D using D/A converted data
- 6) Evaluation of A/D using DIT (Optical Link)
- 7) All interface signals including master clock are fed externally.



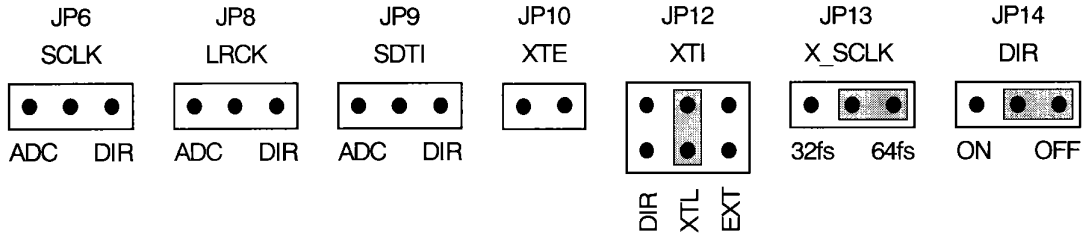
1) Evaluation of loopback mode. (default)

Nothing should be connected to PORT1/PORT3. In case of using external clock through a BNC connector (J5), select EXT on JP12 (XTI) and short JP10 (XTE). This mode corresponds to only JP13 (X_SCLK) 32fs.



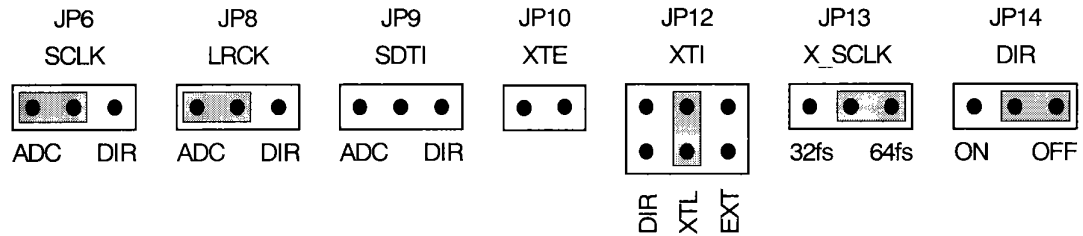
2) Evaluation of D/A using A/D converted data from ideal sine wave generated by ROM data.

Digital signals generated by AKD43XX are used. PORT1 is used for the interface with AKD43XX. Master clock is sent from AKD4550 to AKD43XX and SCLK, LRCK, SDTI are sent from AKD43XX to AKD4550. Nothing should be connected to PORT3. In case of using external clock through a BNC connector (J5), select EXT on JP12 (XTI) and short JP10 (XTE).



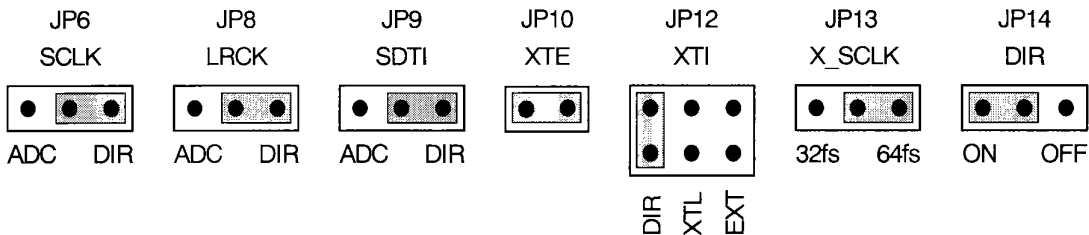
3) Evaluation of D/A using A/D converted data.

It is possible to make evaluation in the form of analog inputs and analog outputs by interfacing with various AKM's A/D evaluation boards with PORT1. Nothing should be connected to PORT3. In case of using external clock through a BNC connector (J5), select EXT on JP12 (XTI) and short JP10 (XTE).



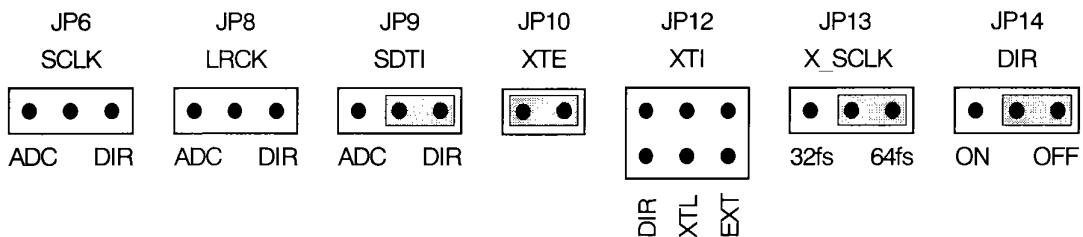
4) Evaluation of D/A using DIR. (Optical link)

PORT3 (TORX176) is used. DIR generates MCLK, SCLK, LRCK and SDATA from the received data through optical connector (TORX176). Used for the evaluation using CD test disk. Nothing should be connected to PORT1/PORT2.



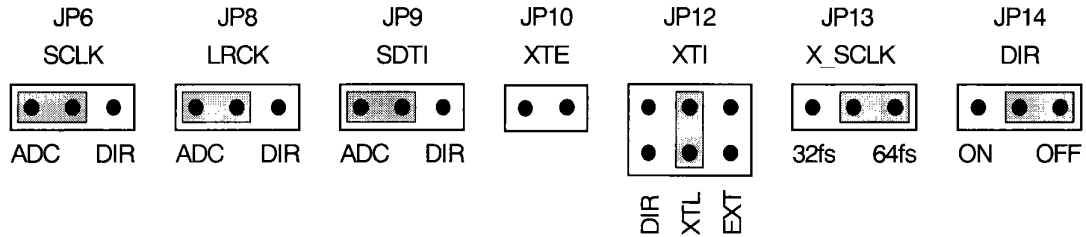
5) Evaluation of A/D using D/A converted data.

It is possible to make evaluation in the form of analog inputs and analog outputs by interfacing with various AKM's D/A evaluation boards with PORT1. Nothing should be connected to PORT3.



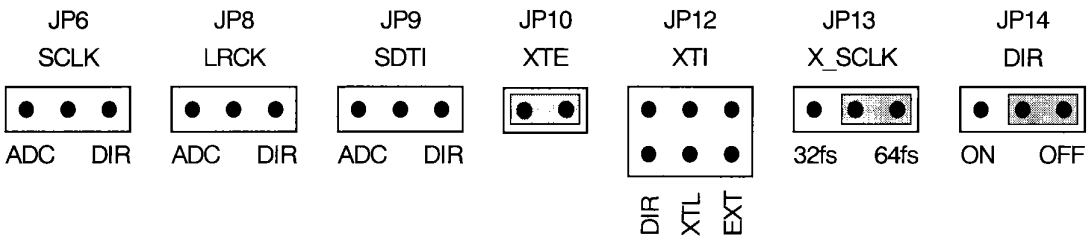
6) Evaluation of A/D using DIT. (Optical link)

PORT2 (TOTX176) is used. DIT generates audio bi-phase signal from received data and which is output through optical connector (TOTX176). It is possible to connect AKM's D/A converter evaluation boards on the digital-amplifier which equips DIR input. In case of using external clock through a BNC connector (J5), select EXT on JP12 (XTI) and short JP10 (XTE).



7) All interfacing signals (MCLK, SCLK, LRCK) are fed from the external circuit through PORT1.

Under the following set-up, all external signals needed for the AK4550 to operate could be fed through PORT1. In case of interfacing external sources to D/A converter, JP9 (SDTI) should be open. And in case of using A/D data to externally, JP9 (SDTI) is set ADC side. When JP9 (SDTI) is open, the A/D data can be output from the SDTO pin of PORT1 at the same time if JP7 (SDTO) is short.



■ DIP switch set up

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

[SW3]: Sets the C-bit of CS8402. (Default is the consumer mode.)

This set up does not affect the evaluation of the AK4550. In case of using DIT, need to set it up correctly. For more detailed configurations, please refer to the CS8402 data sheet.

| Switch | OFF=0, ON=1 | Contents |
|--------|-------------|--|
| 8 | PRO = 0 | Professional mode, C0=1 |
| 7, 6 | C6, C7 | C6,C7 – Sampling frequency |
| | 11 | 00 – Not indicated. Receiver default to 48kHz. |
| | 10 | 01 – 48kHz |
| | 01 | 10 – 44.1kHz |
| | 00 | 11 – 32kHz |
| 5 | C9 | C8,C9,C10,C11 – 1bit of channel mode |
| | 1 | 0000 – Mode not indicated. Receiver default to 2-channel mode. |
| | 0 | 0100 – Stereophonic. |
| 4 | C1 | C1 – Audio mode |
| | 1 | 0 – Normal audio |
| | 0 | 1 – Non-audio |
| 3 | TRNPT | Transparent mode *CS8402 is CRE |
| | 0 | Normal mode |
| | 1 | Transparent mode |
| 2, 1 | EM1, EM0 | C2,C3,C4 – Encoded audio signal emphasis |
| | 11 | 000 – Emphasis not indicated. Receiver defaults to no emphasis with manual override enabled. |
| | 10 | 100 – None |
| | 01 | 110 – 50/15usec |
| | 00 | 111 – CCITT J.17 |

Table 1. DIP switch set-up of CS8402 (Professional mode)

| Switch | OFF=0, ON=1 | Contents |
|---------|-------------|--------------------------------------|
| 8 | PRO = 1 | Consumer mode, C0=1 <Default> |
| 7 | C2 | C2 – Copy |
| | 1 | 0 – Copy inhibited |
| Default | 0 | 1 – Copy permitted |
| 6 | C3 | C3,C4,C5 – Pre-emphasis |
| Default | 1 | 000 – None |
| | 0 | 100 – 50/15usec |
| 5 | C15 | C15 – General Status |
| | 1 | 0 – See the standard |
| Default | 0 | 1 – See the standard |
| 4, 3 | FC1,FC0 | C24,C25,C26,C27 – Sampling frequency |
| | 00 | 0000 – 44.1kHz |
| | 01 | 0100 – 48kHz |
| Default | 10 | 1100 – 32kHz |
| | 11 | 0000 – 44.1kHz, CD mode |
| 2, 1 | C8, C9 | C8-C14 – Category code |
| Default | 11 | 0000000 – General |
| | 10 | 0100000 – PCM encoder/decoder |
| | 01 | 1000000 – CD |
| | 00 | 1100000 – DAT |

Table 2. DIP switch set-up of CS8402 (Consumer mode; default)

■ Other jumper pins set up

[JP1] (GND): Analog ground and digital ground
 open: separated <default>
 AGND and DGND are connected near to AK4550 on the board.

[JP2] (VP-VD): VP and VD
 open: separated <default>
 short: common (The connector “VP” can be open.)

[JP3, 4] (DEM0, DEM1): Set up the de-emphasis of AK4550

| DEM1 (JP3) | DEM0 (JP4) | Mode |
|------------|------------|---------|
| open | open | 44.1kHz |
| open | short | OFF |
| short | open | 48kHz |
| short | short | 32kHz |

Table 3. Set up the de-emphasis of AK4550

[JP5] (SCLK2): Phase of SCLK
 THR: SCLK is coincides with AK4550. <default>
 INV: SCLK is inverted.

[JP7] (SDTO): SDTO of AK4550
 Always open. It is possible to short for evaluation mode 7.

[JP11] (SPEED): Select of MCLK
 NORMAL: 256fs <default>
 DOUBLE: 512fs

■ The function of the toggle SW.

Upper-side is “ON” and lower-side is “OFF”.

- [SW1] ($\overline{\text{PWDA}}$): Resets the D/A of AK4550. Keep “ON” during normal operation.
- [SW2] ($\overline{\text{PWAD}}$): Resets the A/D of AK4550. Keep “ON” during normal operation.
- [SW4] (DIT_RST): Resets the CS8402. “OFF” resets the internal counter of CS8402, then Bi-phase signal is not output. Keep “ON” during normal operation.

■ Indication for LED

- [LED1]: Indicate whether the input data of CS8412 is pre-emphasized or not.
- [LED2] (VERF): Monitor VERF pin of the CS8412. LED turns on when some error has occurred to CS8412.

MEASUREMENT RESULTS

[Measurement condition]

- Measurement unit: Audio Precision, System two
- MCLK : 256fs
- SCLK : 32fs (ADC), 64fs (ADC, DAC)
- fs : 32kHz, 44.1kHz, 48kHz
- Bit : 16bit
- Power Supply : VDD = VP = 2.5V, VD = 5V
- Interface : DIT/DIR
- Temperature : Room

1. ADC

(1) SCLK = 32fs

| VDD | Parameter | Measured Filter | fs = 32kHz | fs = 44.1kHz | fs = 48kHz |
|------|--------------------|---------------------|------------|--------------|------------|
| 2.5V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 84.8 dB | 78.9 dB | 79.1 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 88.6 dB | 89.6 dB | 89.6 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 88.5 dB | 89.6 dB | 89.6 dB |
| 3.0V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 83.3 dB | 78.7 dB | 78.6 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 89.8 dB | 90.7 dB | 90.8 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 89.7 dB | 90.5 dB | 90.2 dB |
| 3.6V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 81.2 dB | 78.5 dB | 78.0 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 91.0 dB | 91.9 dB | 91.9 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 91.0 dB | 90.8 dB | 90.2 dB |

(2) SCLK = 64fs

| VDD | Parameter | Measured Filter | fs = 32kHz | fs = 44.1kHz | fs = 48kHz |
|------|--------------------|---------------------|------------|--------------|------------|
| 2.5V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 81.2 dB | 81.6 dB | 81.7 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 88.6 dB | 89.7 dB | 89.8 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 88.6 dB | 89.7 dB | 89.9 dB |
| 3.0V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 80.3 dB | 80.7 dB | 80.8 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 89.9 dB | 90.9 dB | 91.1 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 89.9 dB | 90.9 dB | 91.1 dB |
| 3.6V | S/(N+D) (-0.5dBFS) | 20kHz LPF | 79.2 dB | 79.6 dB | 79.7 dB |
| | D-Range (-60dBFS) | 20kLPF + A-weighted | 91.0 dB | 92.0 dB | 92.3 dB |
| | S/N (0 data) | 20kLPF + A-weighted | 91.0 dB | 92.0 dB | 92.3 dB |

2. DAC

(1) SCLK = 64fs

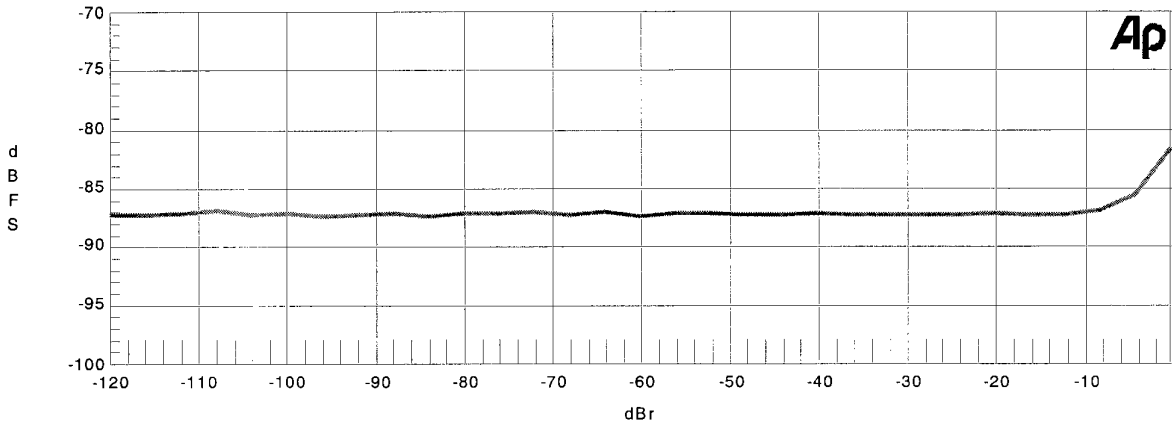
| VDD | Parameter | Measured Filter | fs = 32kHz | fs = 44.1kHz | fs = 48kHz |
|------|-------------------|---------------------|------------|--------------|------------|
| 2.5V | S/(N+D) (0dBFS) | 20kHz LPF | 88.3 dB | 87.5 dB | 87.4 dB |
| | D-Range (-60dBFS) | 22kLPF + A-weighted | 92.1 dB | 92.5 dB | 92.8 dB |
| | S/N (0 data) | 22kLPF + A-weighted | 92.8 dB | 93.2 dB | 93.4 dB |
| 3.0V | S/(N+D) (0dBFS) | 20kHz LPF | 89.7 dB | 89.6 dB | 89.4 dB |
| | D-Range (-60dBFS) | 22kLPF + A-weighted | 93.5 dB | 93.8 dB | 94.1 dB |
| | S/N (0 data) | 22kLPF + A-weighted | 94.7 dB | 94.9 dB | 95.0 dB |
| 3.6V | S/(N+D) (0dBFS) | 20kHz LPF | 91.0 dB | 91.3 dB | 91.3 dB |
| | D-Range (-60dBFS) | 22kLPF + A-weighted | 94.8 dB | 95.2 dB | 95.3 dB |
| | S/N (0 data) | 22kLPF + A-weighted | 96.3 dB | 96.6 dB | 96.6 dB |

3.Graph

(1) ADC

AKM

AK4550 Rev.B ADC THD+N vs Input Level
VDD=2.5V, SCLK=64fs, fs=44.1 kHz

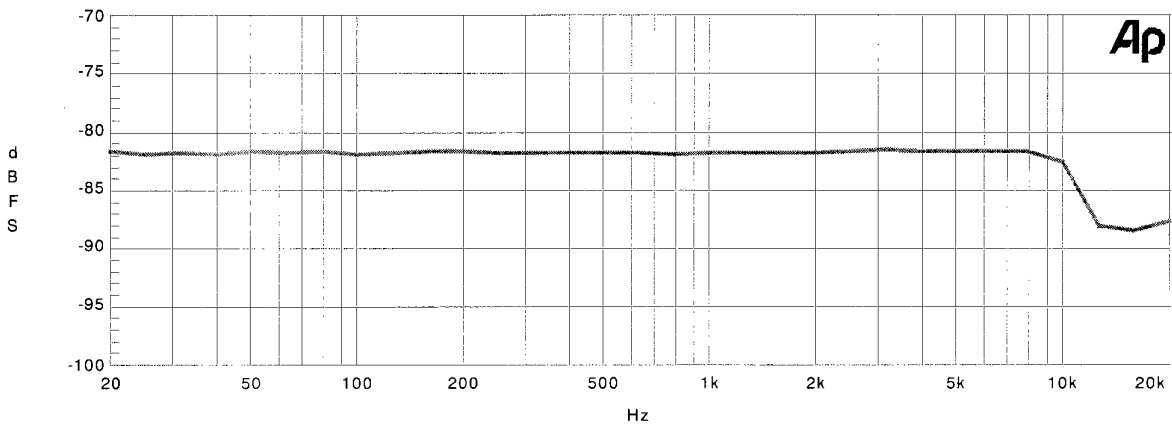


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|----------------------------|------|
| Red | Solid | 3 | DSP Audio Anlr.TH+D+N Ampl | Left |

last.at2

AKM

AK4550 Rev.B ADC THD+N vs Input Frequency
VDD=2.5V, SCLK=64fs, fs=44.1 kHz

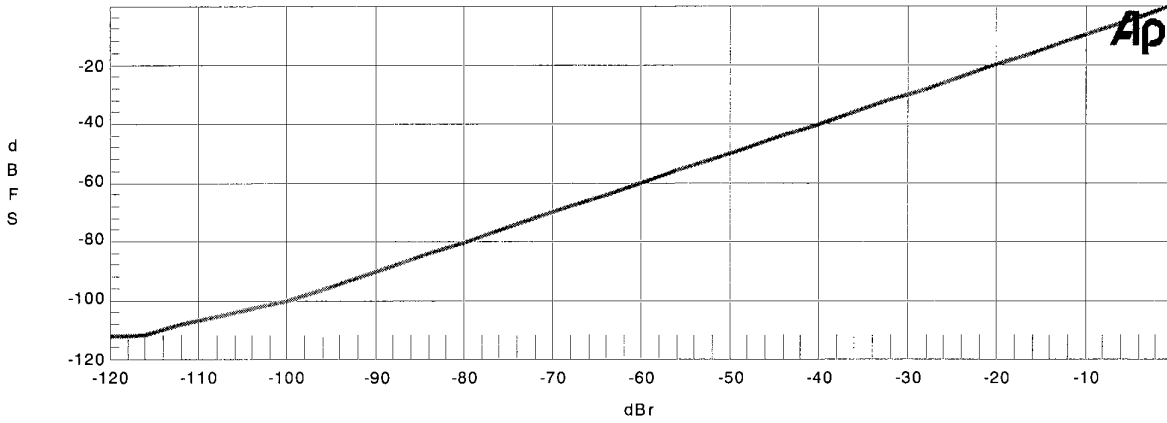


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|----------------------------|------|
| Red | Solid | 3 | DSP Audio Anlr.TH+D+N Ampl | Left |

last.at2

AKM

AK4550 Rev.B ADC Linearity
 VDD=2.5V, SCLK=64fs, fs=44.1 kHz

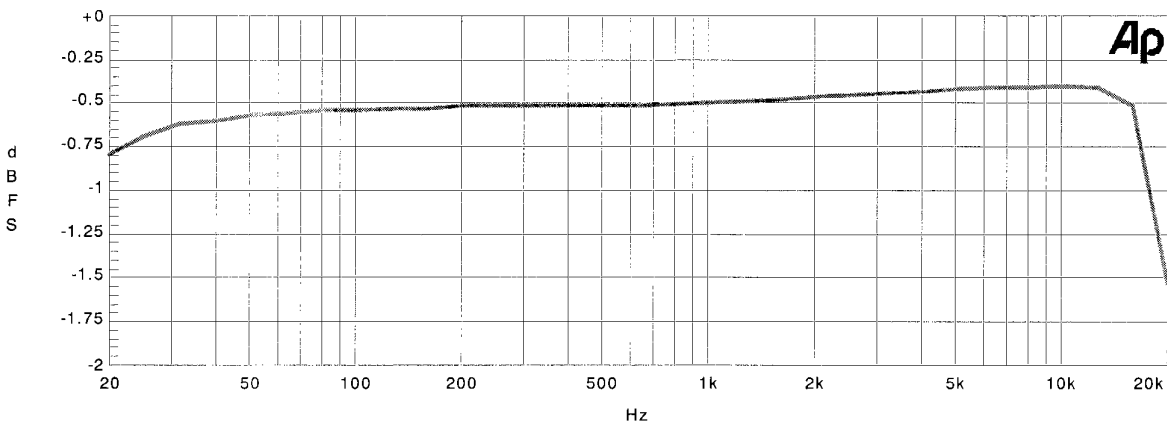


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|-------------------------|------|
| Red | Solid | 3 | DSP Audio Anlr.Bandpass | Left |

last.at2

AKM

AK4550 Rev.B ADC Frequency Response
 VDD=2.5V, SCLK=64fs, fs=44.1 kHz, Input=-0.5dBr

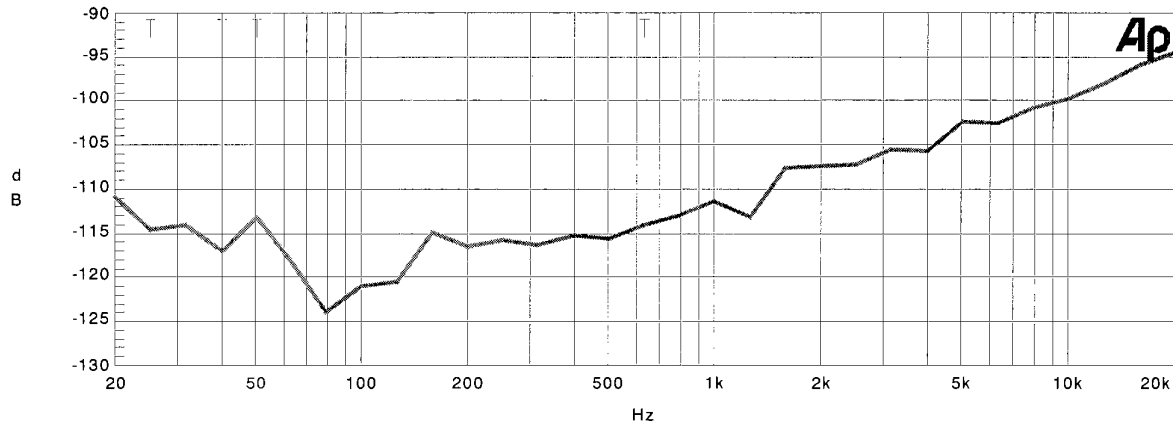


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|-------------------------|------|
| Red | Solid | 3 | DSP Audio Anlr.Bandpass | Left |

last.at2

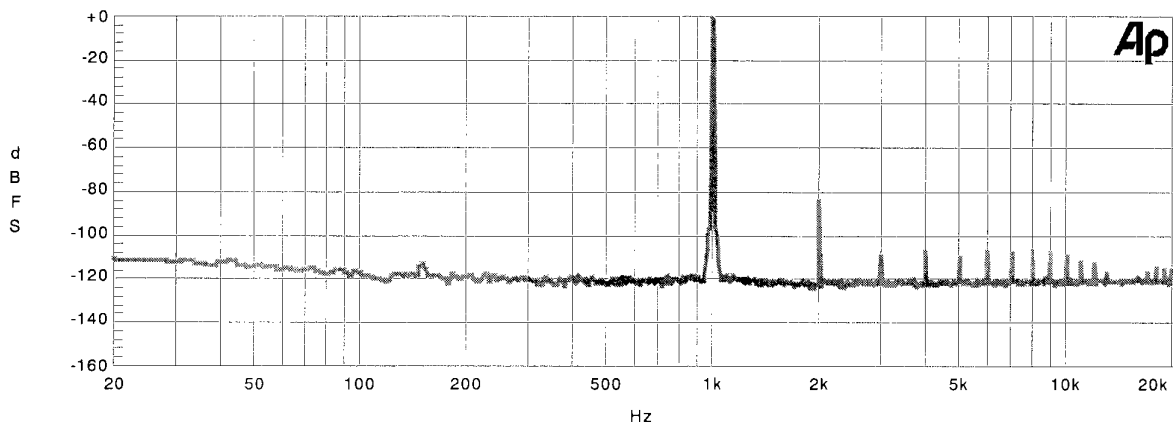
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AK4550 Rev.B ADC Crosstalk
VDD=2.5V, SCLK=64fs, fs=44.1kHz



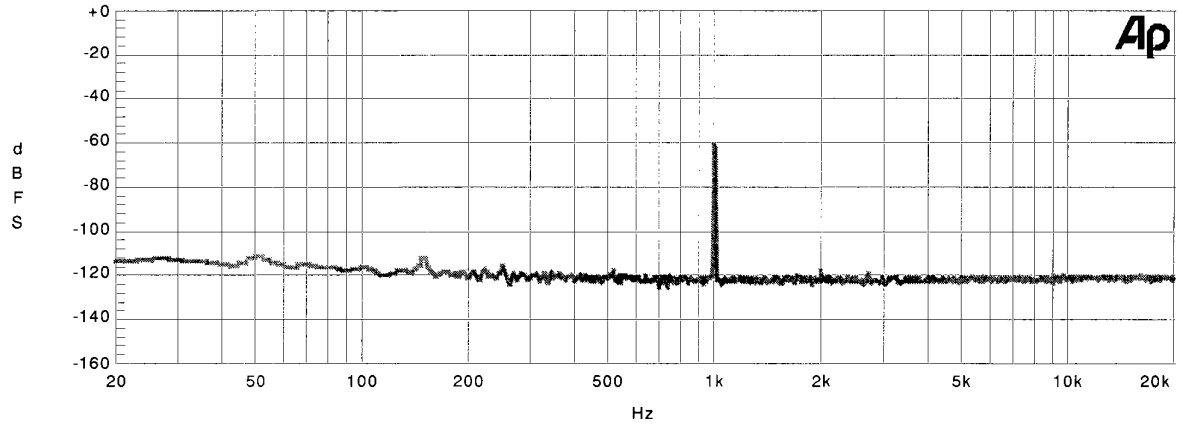
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AK4550 Rev.B ADC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=-0.5dB



AKM

AK4550 Rev.B ADC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=-60dB

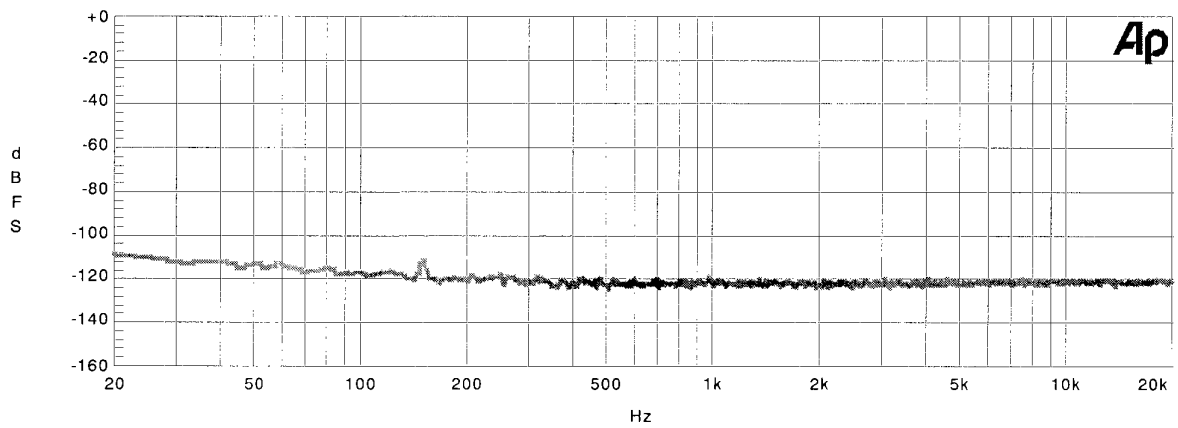


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Fft.Ch.1 Ampl | Left |

last.at2

AKM

AK4550 Rev.B ADC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=None



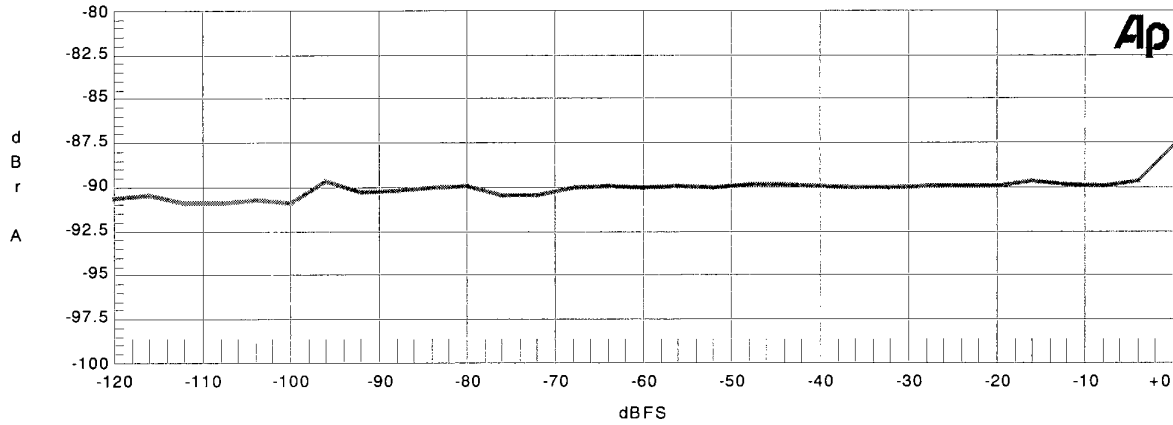
| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Fft.Ch.1 Ampl | Left |

last.at2

(2) DAC

AKM

AK4550 Rev.B DAC THD+N vs Input Level
VDD=2.5V, SCLK=64fs, fs=44.1 kHz

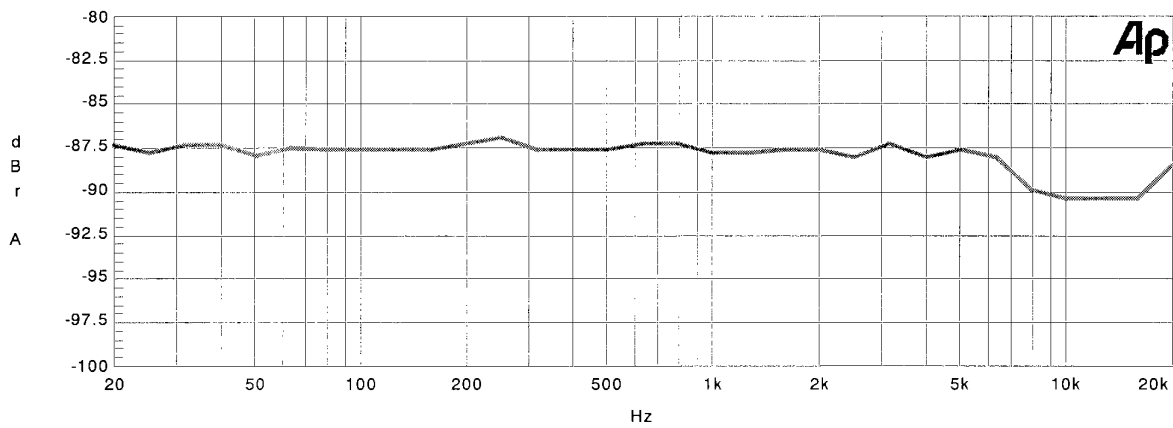


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|-----------------|------|
| Red | Solid | 3 | AnIr.THd+N Ampl | Left |

last.at2

AKM

AK4550 Rev.B DAC THD+N vs Input Frequency
VDD=2.5V, SCLK=64fs, fs=44.1 kHz

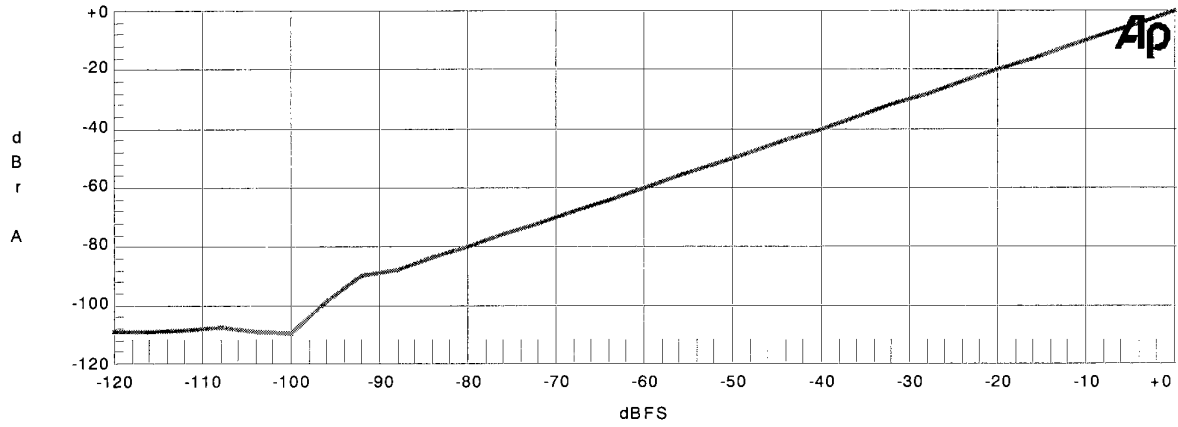


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|-----------------|------|
| Red | Solid | 3 | AnIr.THd+N Ampl | Left |

last.at2

AKM

AK4550 Rev.B DAC Linearity
VDD=2.5V, SCLK=64fs, fs=44.1kHz

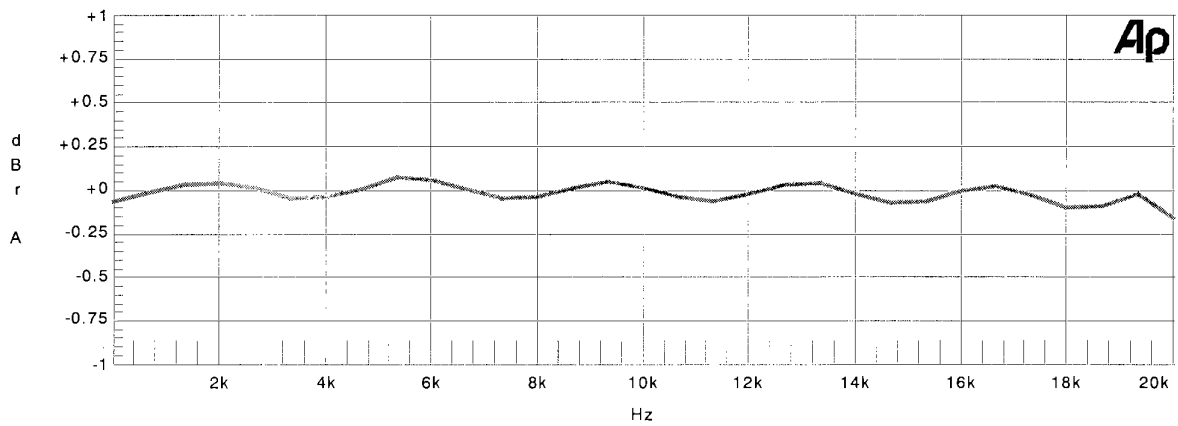


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Anlr.Bandpass | Left |

last.at2

AKM

AK4550 Rev.B DAC Frequency Response
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=0dBFS

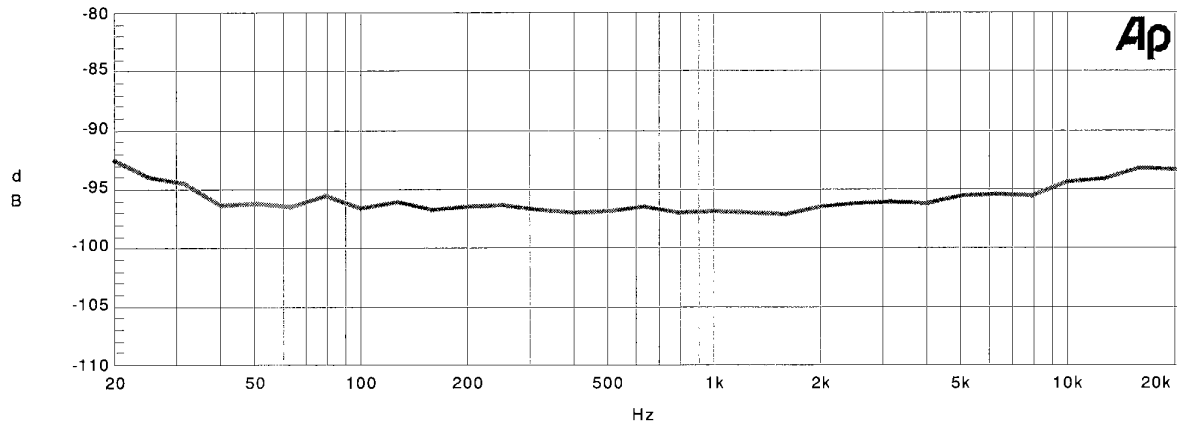


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Anlr.Bandpass | Left |

last.at2

AKM

AK4550 Rev.B DAC Crosstalk
VDD=2.5V, SCLK=64fs, fs=44.1kHz

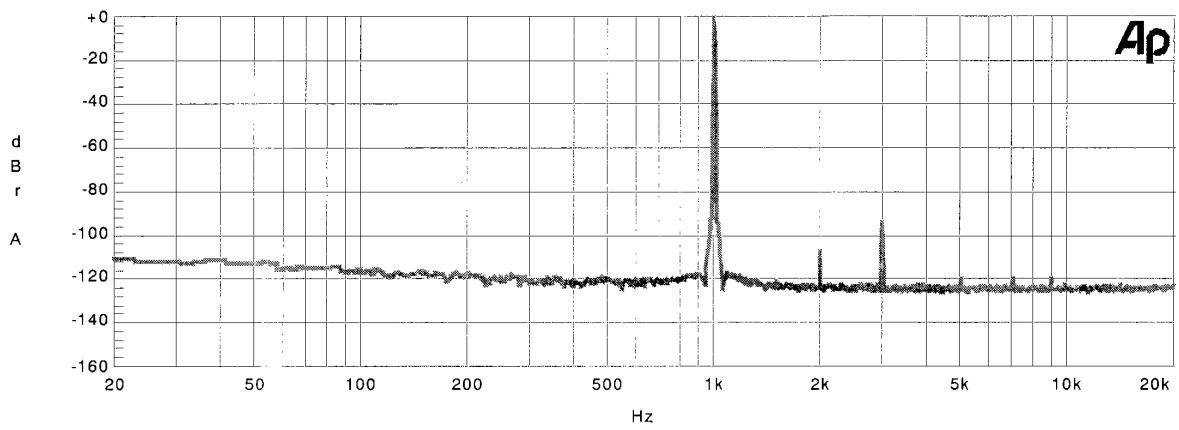


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|----------------|------|
| Red | Solid | 3 | Anlr.Crosstalk | Left |

last.at2

AKM

AK4550 Rev.B DAC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=0dBFS

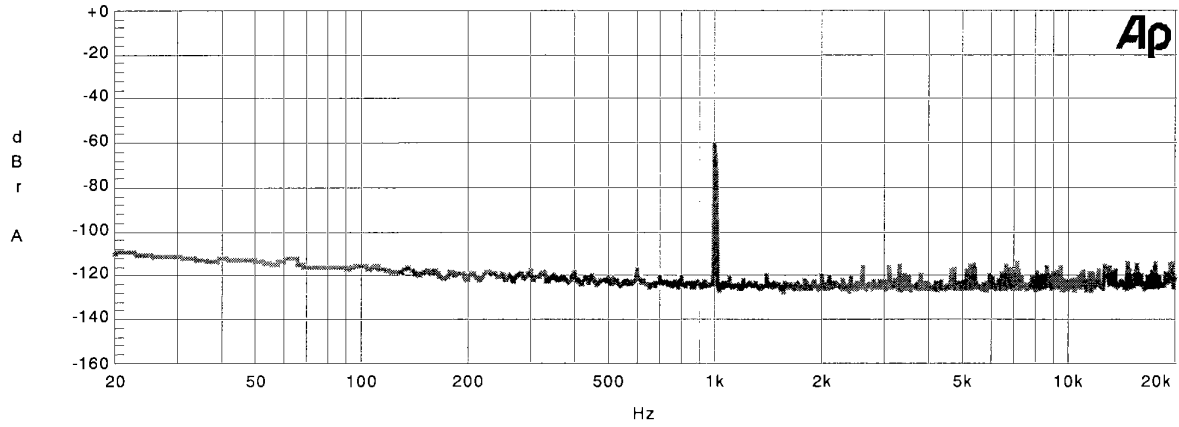


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Fft.Ch.1 Ampl | Left |

last.at2

AKM

AK4550 Rev.B DAC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=-60dBFS

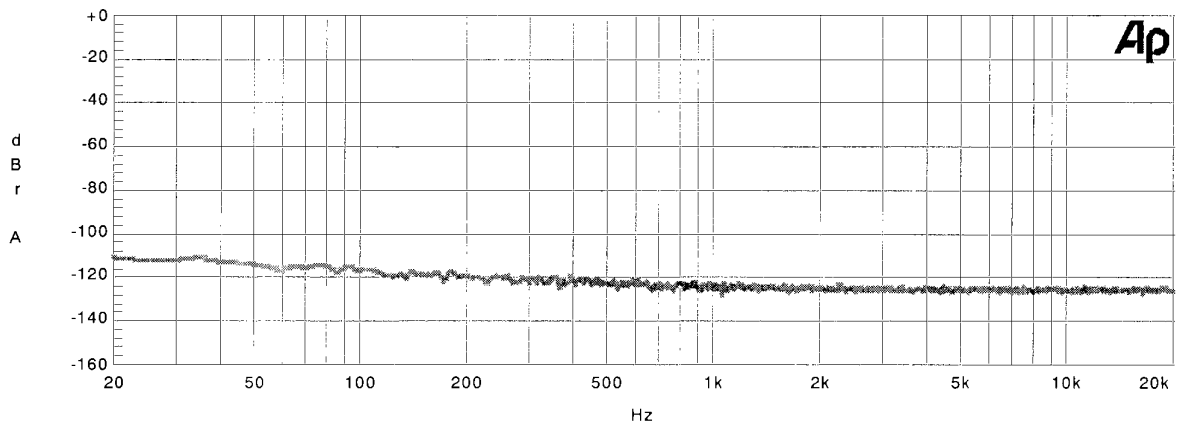


| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Fft.Ch.1 Ampl | Left |

last.at2

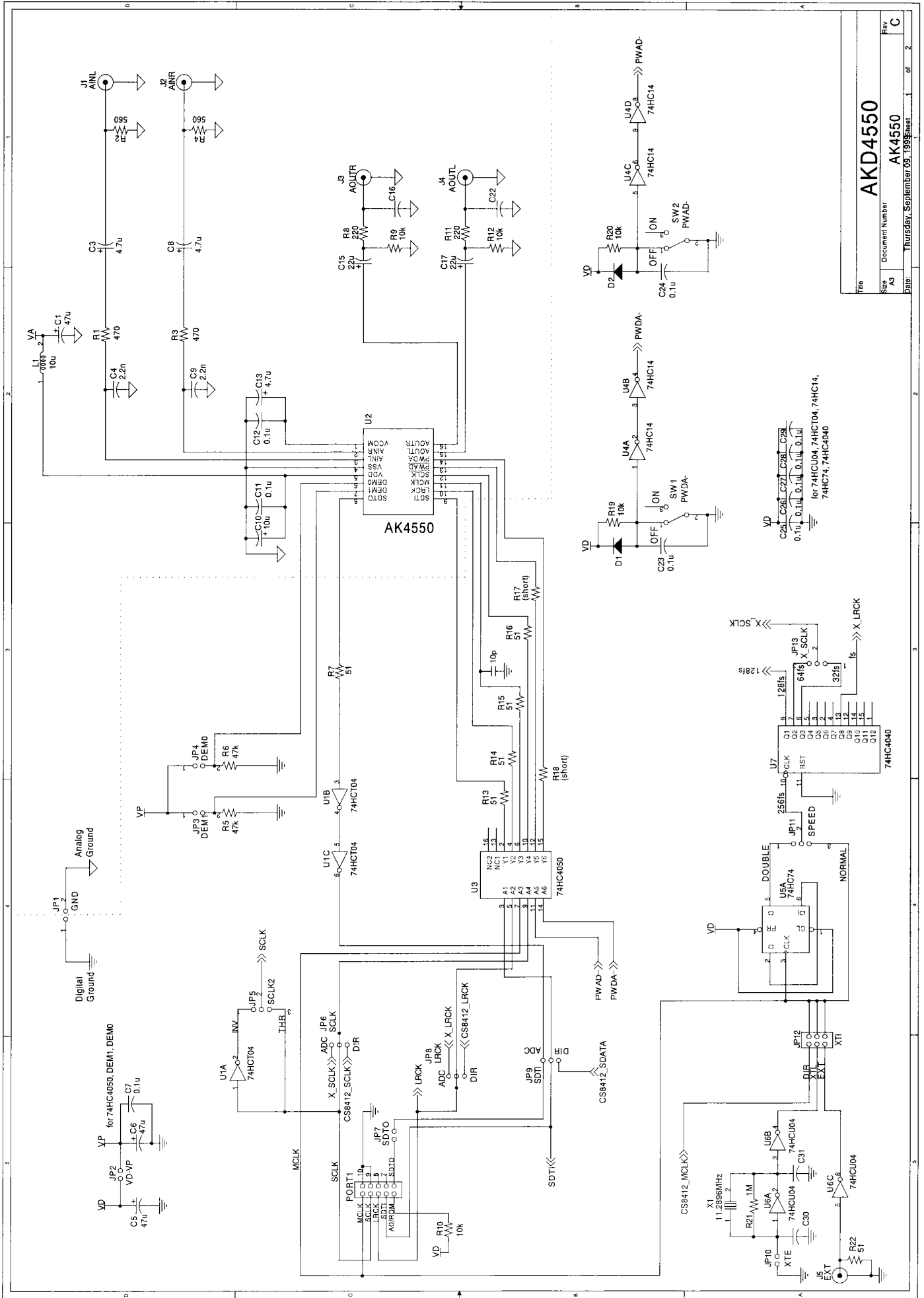
AKM

AK4550 Rev.B DAC FFT Plot
VDD=2.5V, SCLK=64fs, fs=44.1kHz, Input=None



| Color | Line Style | Thick | Data | Axis |
|-------|------------|-------|---------------|------|
| Red | Solid | 3 | Fft.Ch.1 Ampl | Left |

last.at2



AKD4550

Document Number
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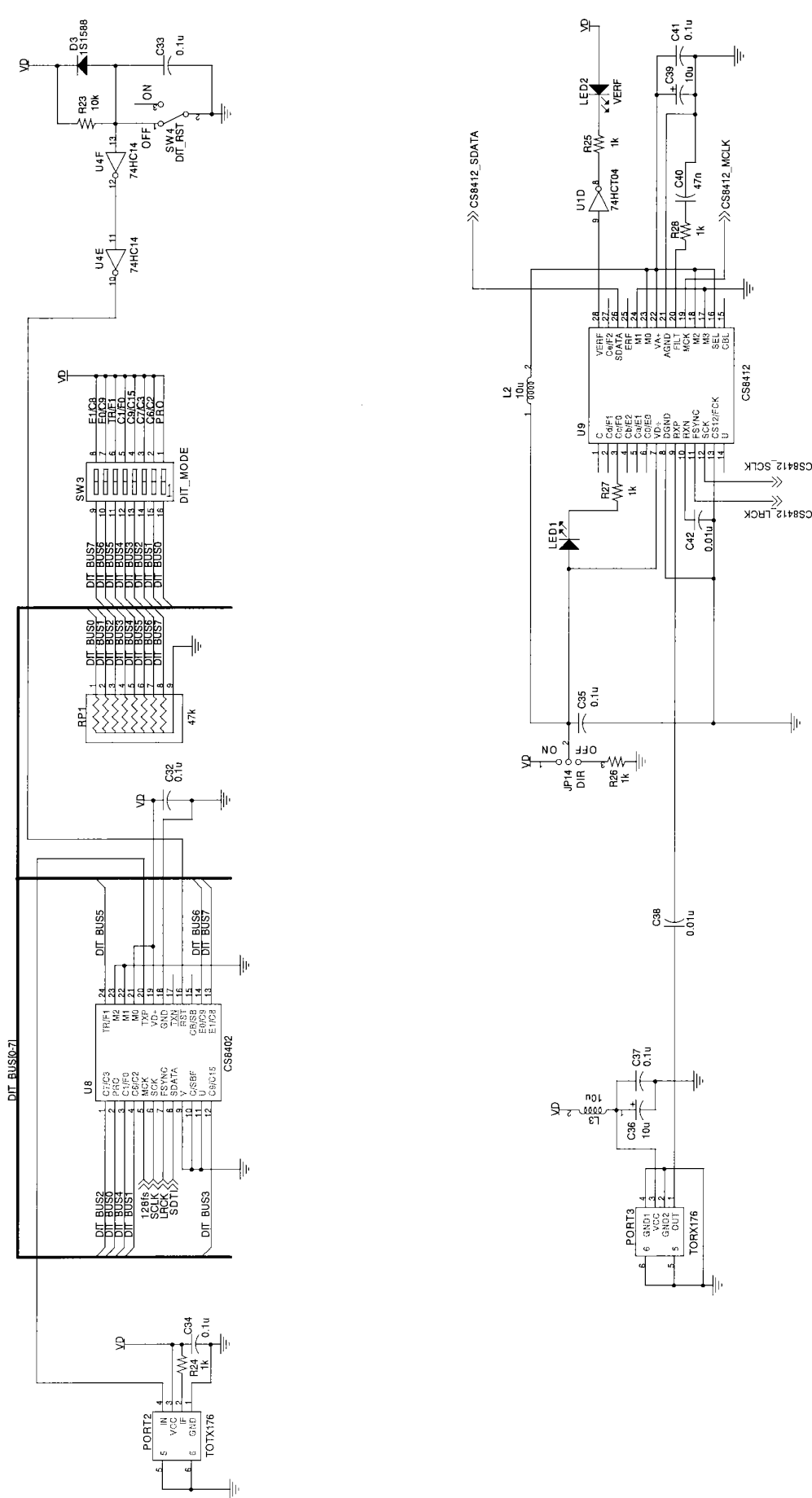
Thursday, September 09, 1998

File Size A3

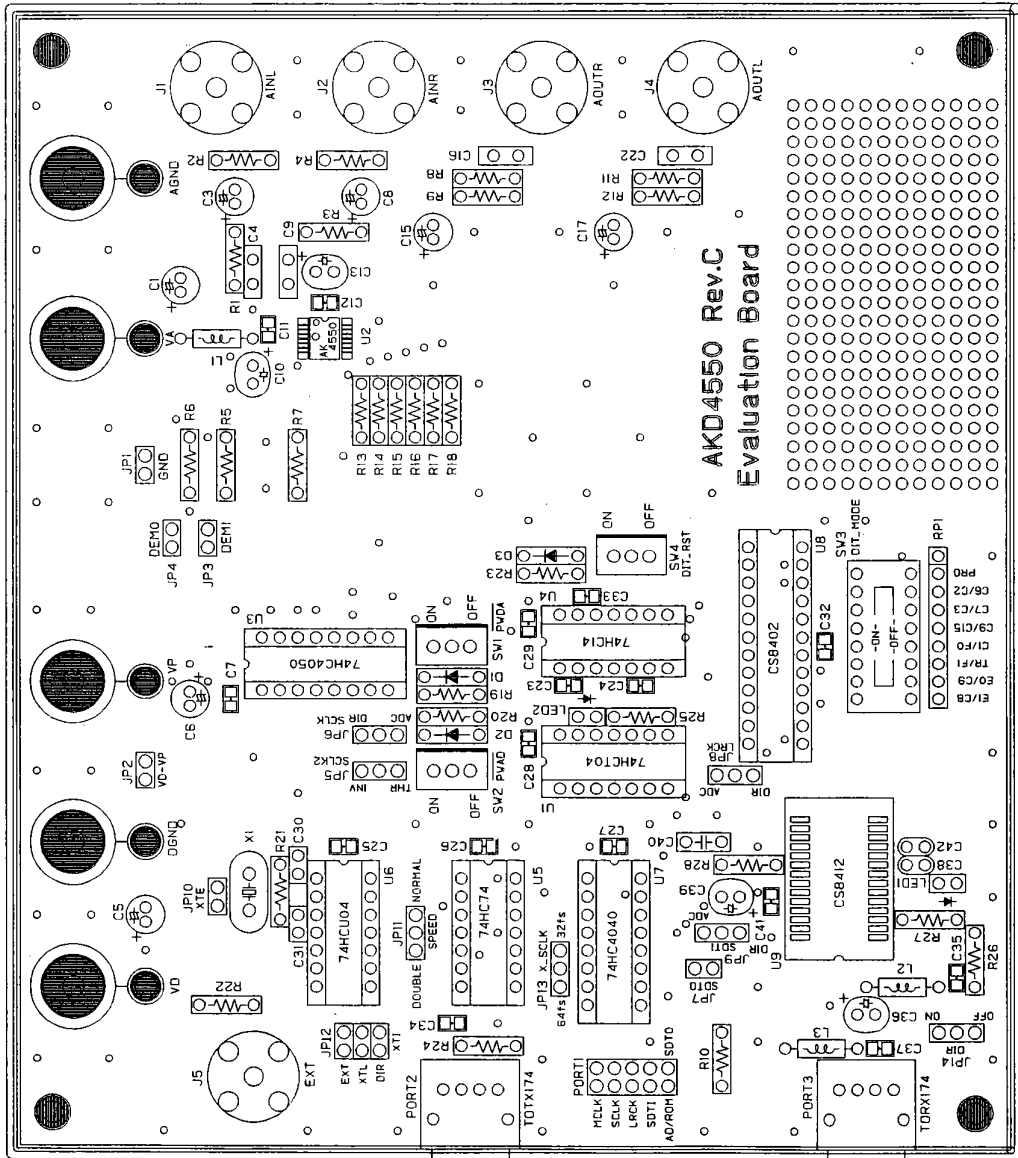
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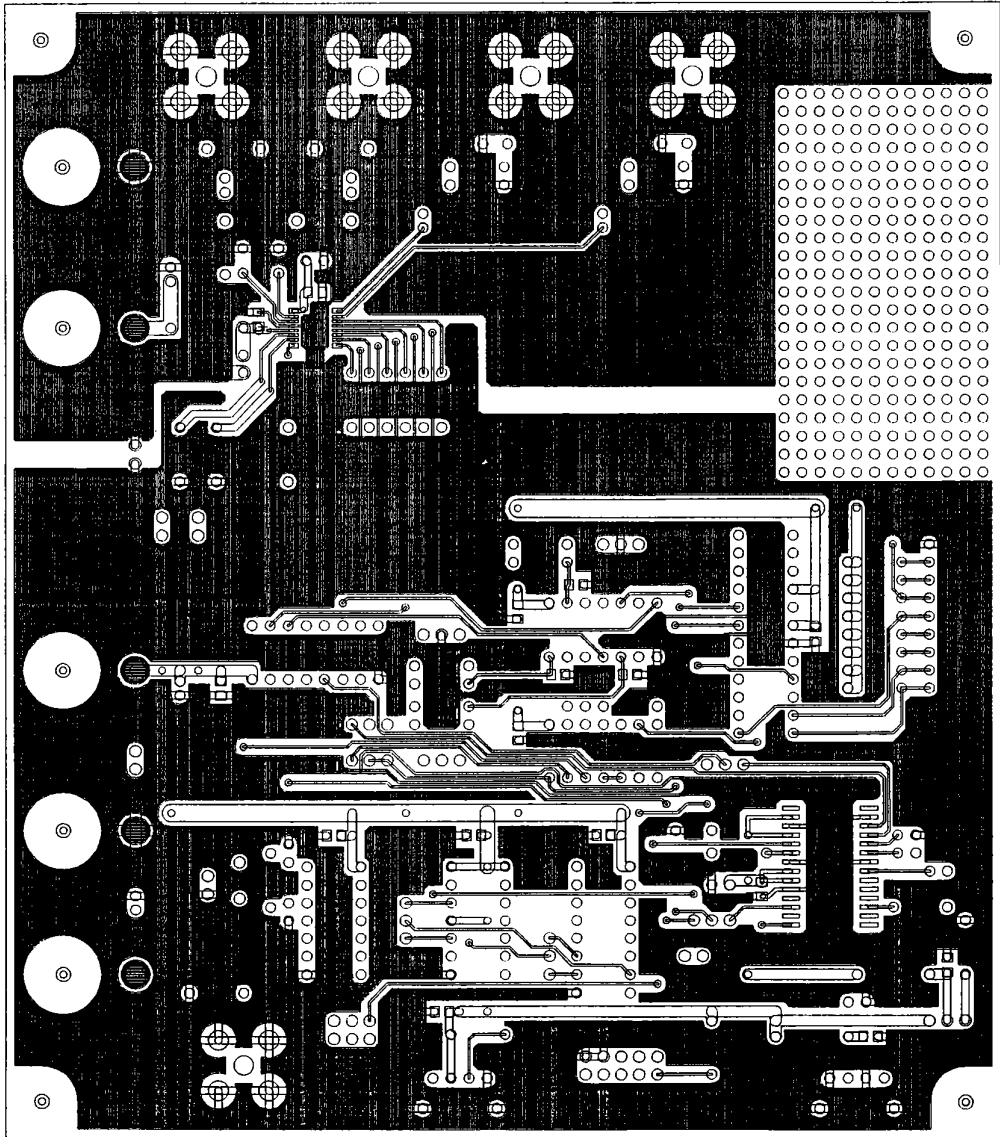
Rev C



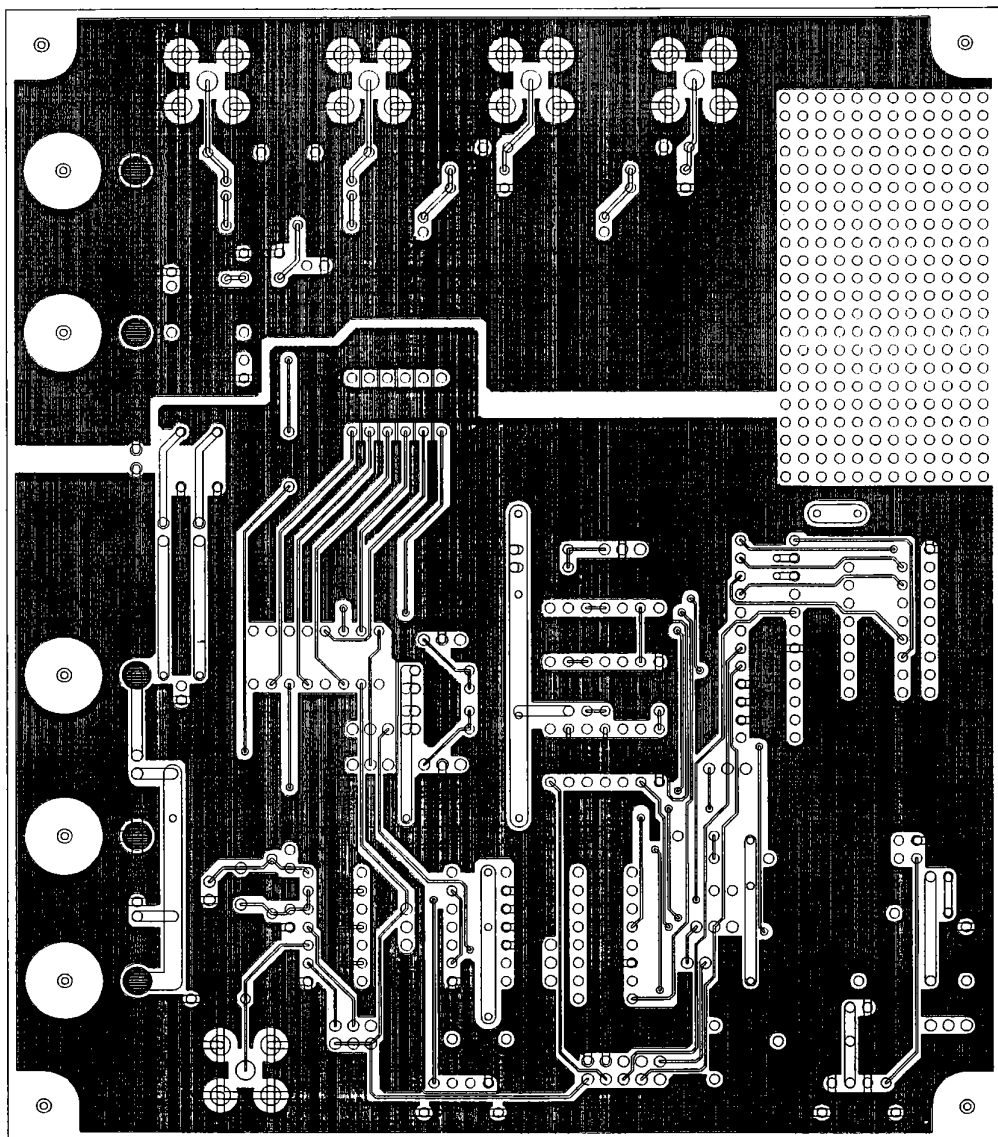
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| Date | Thursday, June 24, 1999 | Rev | C |



**AKD4550 Rev.C
Evaluation Board**



L1 部品面 AKD4550 RevC



FS 井田 画 VKD7220 R6AC

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