AKD4645-B
AK4645 Evaluation board Rev.0

GENERAL DESCRIPTION

AKD4645-B is an evaluation board for the AK4645, Stereo CODEC with built-in MIC/HP amplifier. The AKD4645-B can evaluate A/D converter and D/A converter separately in addition to loop-back mode (A/D → D/A). The AKD4645-B also has the digital audio interface and can achieve the interface with digital audio systems via opt-connector.

■ Ordering guide

AKD4645-B --- Evaluation board for AK4645
(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

- **DIT/DIR with optical input/output**
- **10pin Header for serial control mode**
- **On-board Stereo Class-D Speaker Amplifier (AK7830)**

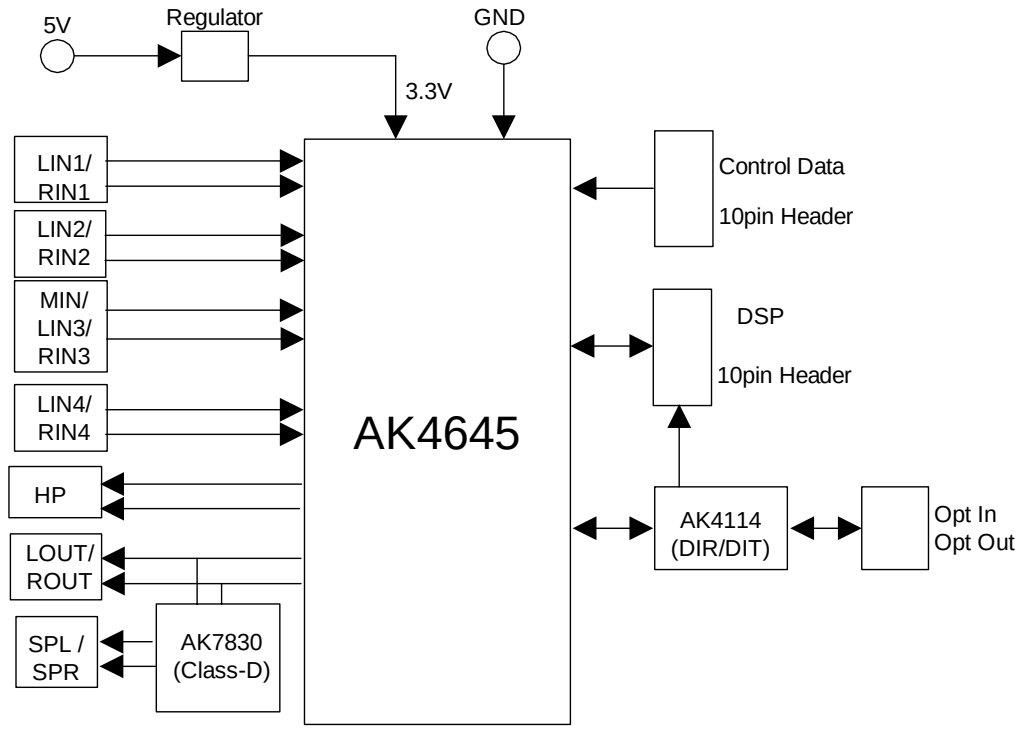


Figure 1. AKD4645-B Block Diagram

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

Evaluation Board Manual

■ Operation sequence

1) Install the control software (Refer to page 9).

2) Set up the power supply lines.
[VCC] (red) = 5.0V (or 3.3V)
[TVDD] (orange) = 1.6 ~ 3.6V : for TVDD of AK4645 (typ. 3.3V:≤DVDD)
[AGND] (black) = 0V
[DGND] (black) = 0V

Each supply line should be distributed from the power supply unit.
When the power is supplied to the AK4645 via the regulator, JP2 should be set to "REG" side and VCC should be 5.0V.<default> (When the power is supplied from VCC jack to the AK4645 directly, JP2 should be set to "VCC" side and VCC should be 3.3V.)

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

4) Power on.
The AK4645 and AK4114 should be reset once bringing SW2 "L" upon power-up.
And the AK7830 should be reset once bringing SW1 (SPK_PDN) "L" upon power-up.

■ Evaluation mode

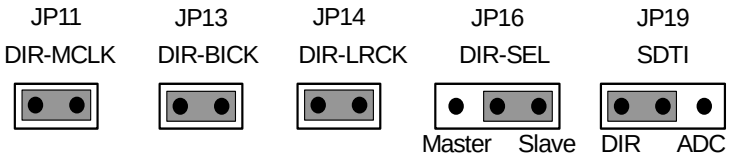
(1) Slave mode

(1-1) Evaluation of Recording block (MIC, ADC) using DIT of AK4114
(1-2) Evaluation of Playback block (HP, LINEOUT) using DIR of AK4114
(1-3) Evaluation of Loop-back using AK4114 <Default>
(1-4) All interface signals including master clock are fed externally.

The AK4114's audio interface format is fixed to LJ compatible.

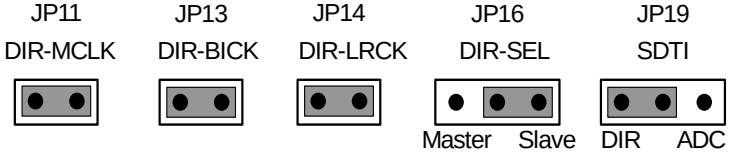
(1-1) Evaluation of Recording block using DIT of AK4114

PORT2 (DIT) and X1 (X'tal) are used. DIT generates audio bi-phase signal from received data and which is output through optical connector (TOTX141). Nothing should be connected to PORT1 (DIR) and PORT3 (DSP).



(1-2) Evaluation of Playback block using DIR of AK4114

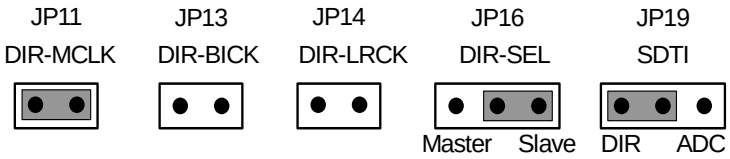
PORT1 (DIR) is used. Nothing should be connected to PORT3 (DSP).



The AK4114 operates at fs of 32kHz or more. If the fs is slower than 32kHz, any other evaluation mode without using DIR should be used.

(1-3) Evaluation of Loop-back using AK4114 <Default>

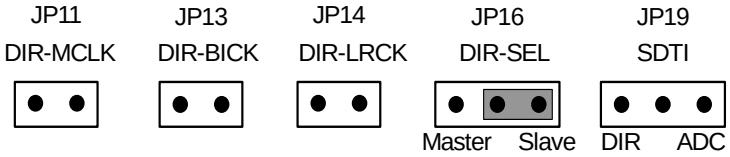
X'tal oscillator (X1) is used. Nothing should be connected to PORT1 (DIR) and PORT3 (DSP).



The AK4114 operates at fs of 32kHz or more. If the fs is slower than 32kHz, any other evaluation mode without using DIR should be used.

(1-4) All interface signals including master clock are fed externally.

PORT3 (DSP) is used. Nothing should be connected to PORT1 (DIR).

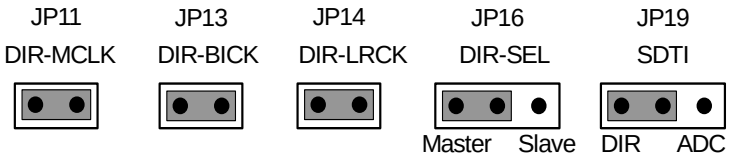


(2) Master mode

(2-1) Evaluation of Recording block using MCLK of AK4114
(2-2) Master clock is fed externally

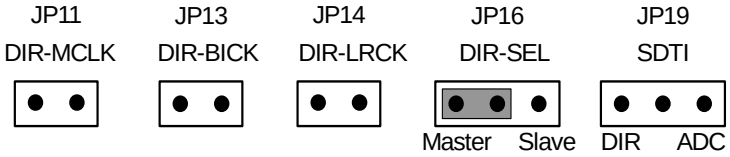
(2-1) Evaluation of Loop-back using MCLK of AK4114

X'tal oscillator (X1) is used. Nothing should be connected to PORT1 (DIR) and PORT3 (DSP). It can be evaluated at internal loop-back mode (LOOP bit = "1"). It is possible to evaluate at various sampling frequencies using built-in AK4645's PLL.



(2-2) Master clock is fed externally

PORT3 (DSP) is used and MCLK is fed from PORT3. Nothing should be connected to PORT1 (DIR). It can be evaluated at internal loop-back mode (LOOP bit = "1"). It is possible to evaluate at various sampling frequencies using built-in AK4645's PLL.



■ Other jumper pins set up

[JP1] (GND) : Connection between AGND and DGND.
OPEN : Both grounds are separated on board.
SHORT : Both grounds are connected on board. <Default>

[JP9, JP10] : Connection of mic power.
OPEN: Mic power is not connected.
SHORT : Mic power is connected. <Default>

[JP4, JP8]: Select Pin #5, 28

Pin #5	Pin #28	JP4	JP8	AIN3 bit	
VCOC	MIN	VCOC	Open	0	<Default>
RIN3	LIN3	RIN3	Short	1	

[JP7] : Select the Power Booster of AK7830.
VCC : Power Booster ON
GND: Power Booster Off<Default>

[JP15] : Select Output Signal Voltage of 74AVC8T245
TVDD: TVDD = D3V <Default>
D3V : TVDD < D3V

[JP18] (SDTO-IN): Presence of external device connection via PORT3(DSP)
SHORT : connection <default>
OPEN : non-connection

■ The function of the toggle SW

[SW1] (SPK_PDN): Power down of AK7830. Keep “H” during normal operation.
[SW2] (PDN): Power down of AK4645 and AK4114. Keep “H” during normal operation.

■ Indication for LED

[LED1] (ERF): Monitor INT0 pin of the AK4114. LED turns on when some error has occurred to AK4114.

■ Serial Control

The AK4645 can be controlled via the printer port (parallel port) of IBM-AT compatible PC. Connect PORT4 (CTRL) with PC by 10 wire flat cable packed with the AKD4645. When I^2C bus mode is used, PORT4 should be directly connected to the I^2C bus on the system. JP3, 17 and 12 should be set to I^2C bus mode to control the AK7830.

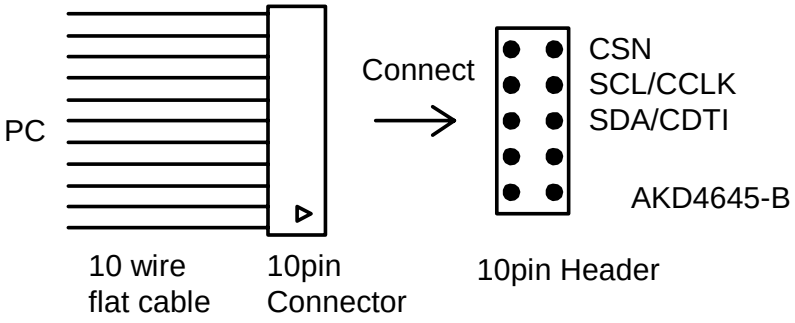
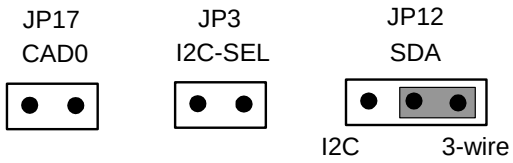


Figure 2. Connect of 10 wire flat cable

(1) 3-wire Serial Control Mode <Default>

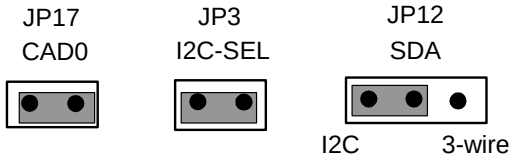


The jumper pins should be set to the following.

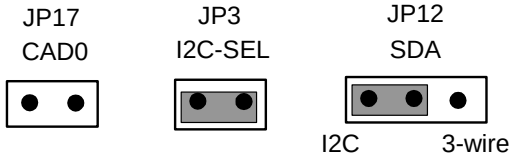
(2) I^2C-bus Control Mode

The jumper pins should be set to the following.

(2-1) In case of using CAD0=0 (device address bits).



(2-2) In case of using CAD0=1 (device address bits).



■ Analog Input/Output Circuits

(1) Input Circuits

1. MIN/LIN3/RIN3 Input Circuit

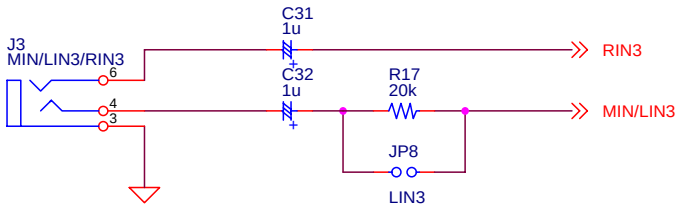


Figure 3. MIN/LIN3/RIN3 Input Circuit

2. LINE1 Input Circuit

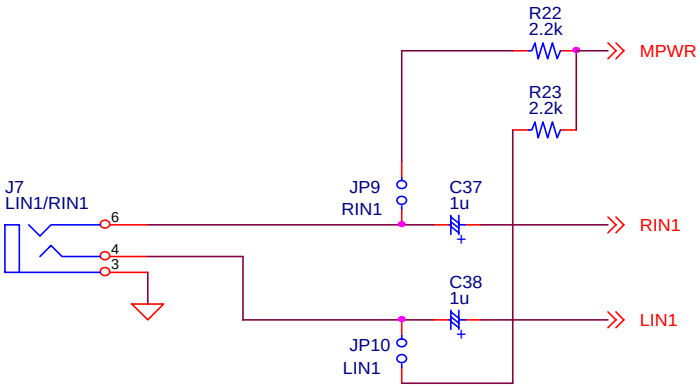


Figure 4. LIN1/RIN1 Input Circuit

3. LINE2 Input Circuit

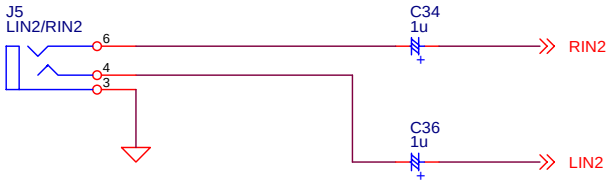


Figure 5. LIN2/RIN2 Input Circuit

4. LINE4 Input Circuit

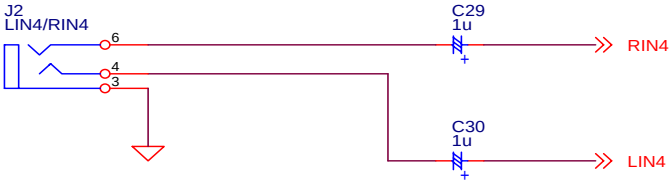


Figure 6. LIN4/RIN4 Input Circuit

(2) Output Circuits

1. Headphone-amp Output Circuit

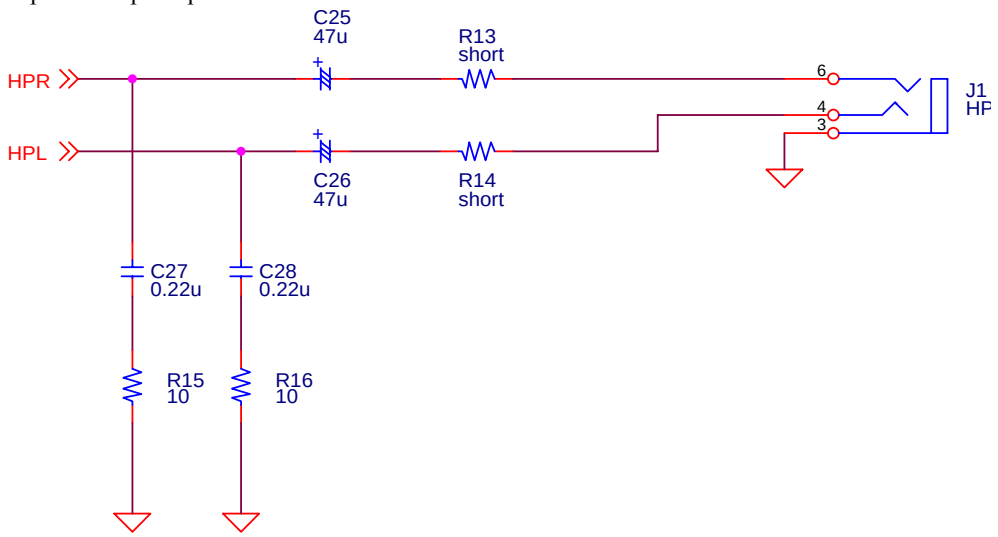


Figure 6. Headphone-amp Output Circuit

2. LINE Output Circuit

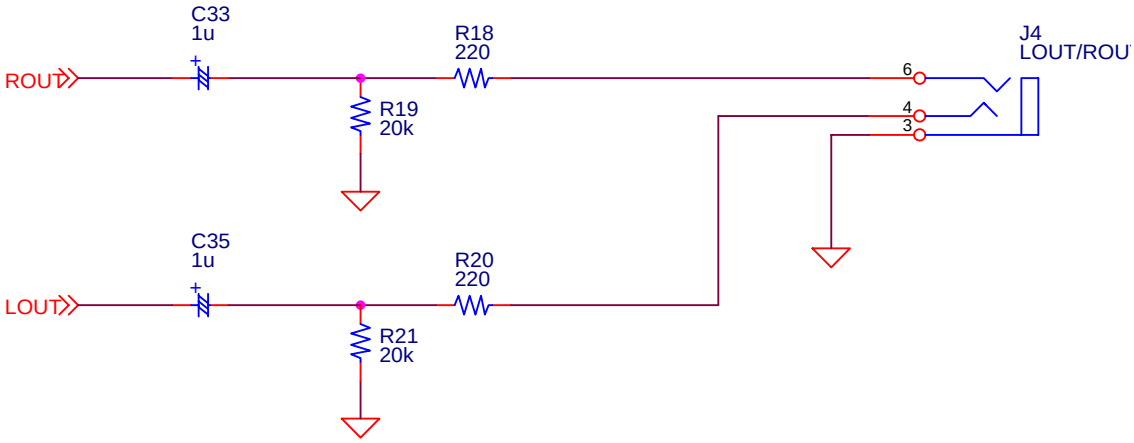


Figure 7. LINE Output Circuit

4. External SPEAKER-Amp(AK7830) Output Circuit

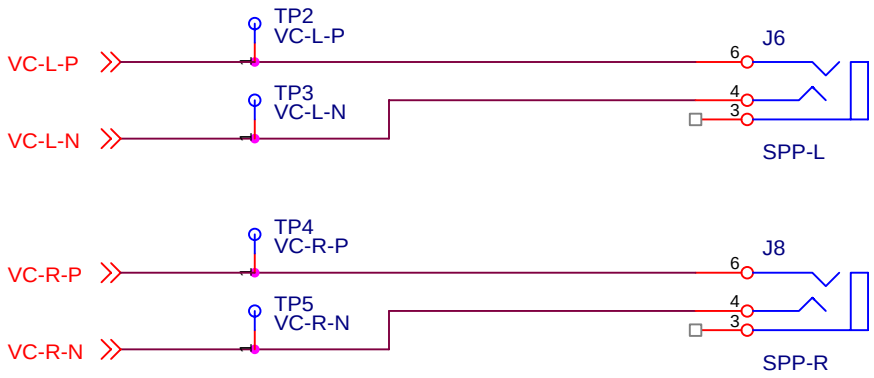


Figure 8. External SPEAKER-Amp(AK7830) Output Circuit

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

Control Software Manual

■ Set-up of evaluation board and control software

1. Connect IBM-AT compatible PC with AKD4645-B by 10-line type flat cable (packed with AKD4645-B). 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.)

2. Insert the CD-ROM labeled "AKD4645-B Evaluation Kit" into the CD-ROM drive.

3. Access the CD-ROM drive and double-click the icon of "akd4645.exe" to set up the control program. When control the AK7830 with the serial mode, double-click the icon of "akd7830.exe" to set up the control program.

4. 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.
3. Click "Write default" button

■ Explanation of each buttons

[Port Reset] : Set up the USB interface board (AKDUSBIF-A) .
[Write default] : Initialize the register of AK4645.
[All Write] : Write all registers that is currently displayed.
[Function1] : Dialog to write data by keyboard operation.
[Function2] : Dialog to write data by keyboard operation.
[Function3] : The sequence of register setting can be set and executed.
[Function4] : The sequence that is created on [Function3] can be assigned to buttons and executed.
[Function5]: The register setting that is created by [SAVE] function on main window can be assigned to buttons and executed.
[SAVE] : Save the current register setting.
[OPEN] : Write the saved values to all register.
[Write] : Dialog to write data by mouse operation.
[Filter] : Set Programmable Filter (FIL1, FIL3, EQ) of AK4645 easily.

■ 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 the AK4645, 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 the AK4645, click [OK] button. If not, click [Cancel] button.

3. [Function2 Dialog] : Dialog to evaluate DATT

There are dialogs corresponding to register of 09h, 0Ah, 0Ch, and 0Dh.

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 the AK4645 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 the AK4645, click [OK] button. If not, click [Cancel] button.

4. [SAVE] and [OPEN]

4-1. [SAVE]

All of current register setting values displayed on the main window are saved to the file. The extension of file name is "akr".

<Operation flow>
(1) Click [SAVE] Button.
(2) Set the file name and click [SAVE] Button. The extension of file name is "akr".

4-2. [OPEN]

The register setting values saved by [SAVE] are written to the AK4645. 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”.

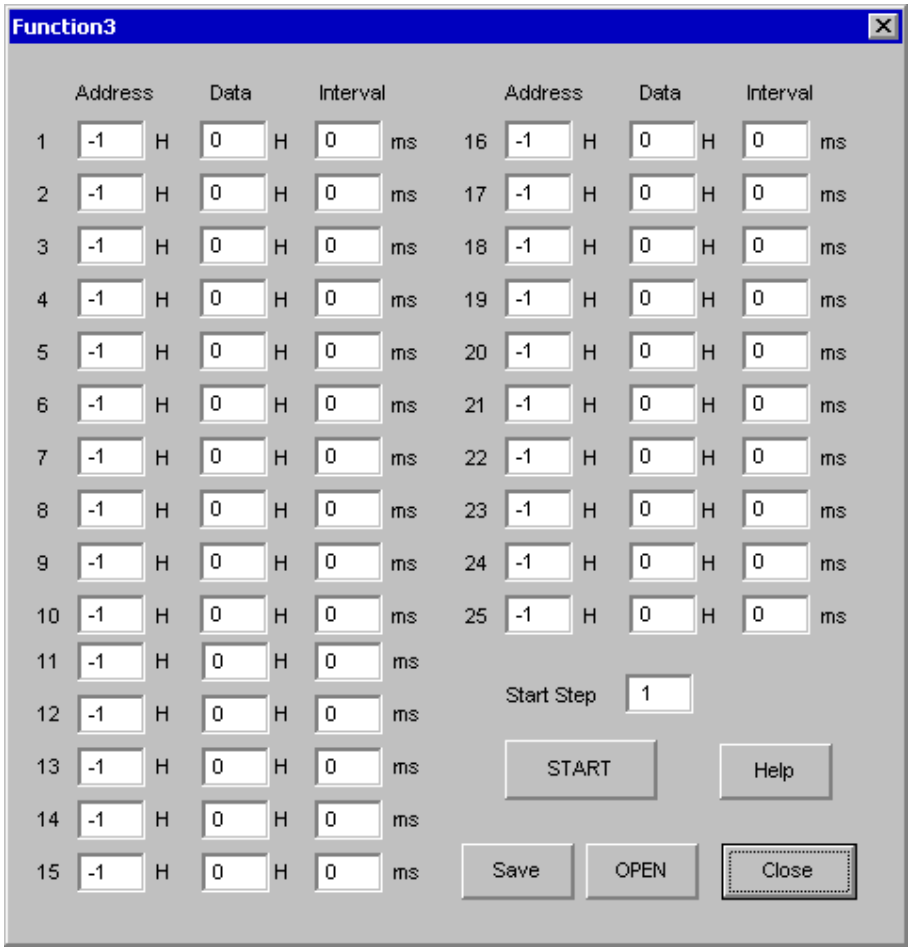


Figure 9. Window of [F3]

6. [Function4 Dialog]

The sequence file (*.aks) saved by [Function3] can be listed up to 10 files, assigned to buttons and then executed. When [F4] button is clicked, the window as shown in Figure 10 opens.

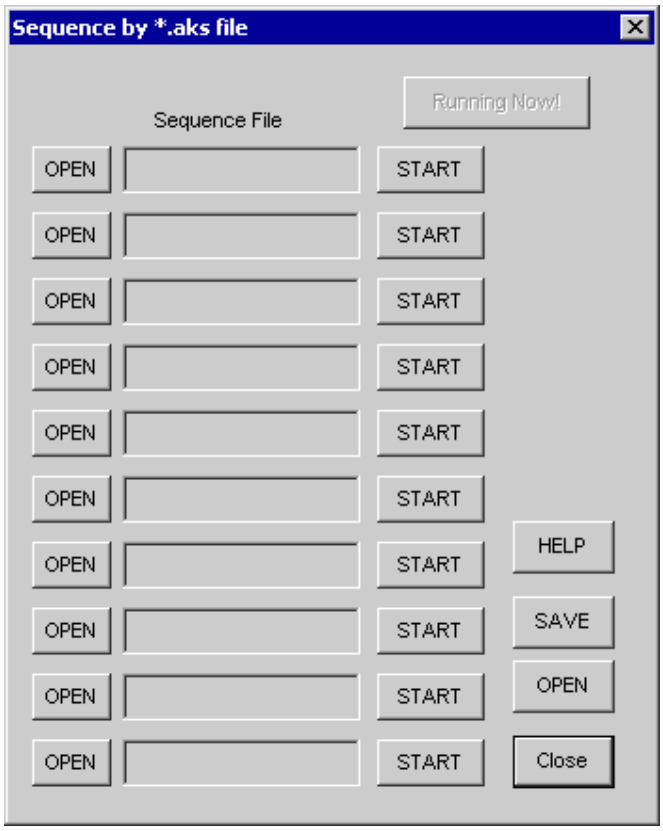


Figure 10. [F4] window

6-1. [OPEN] buttons on left side and [START] buttons

(1) Click [OPEN] button and select the sequence file (*.aks) saved by [Function3].

The sequence file name is displayed as shown in Figure 11. (In case that the selected sequence file name is "DAC_Stereo_ON.aks")

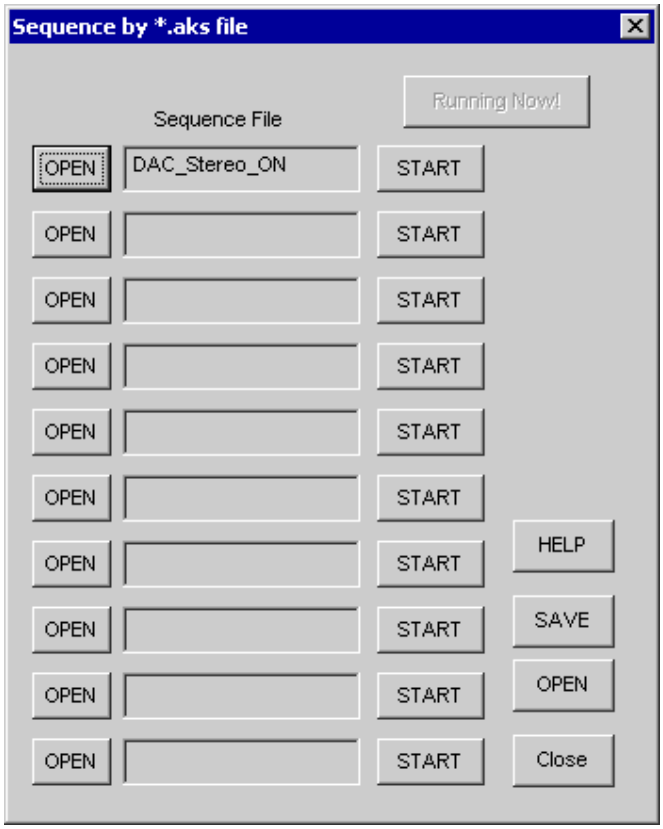


Figure 11. [F4] window(2)

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

6-2. [SAVE] and [OPEN] buttons on right side

[SAVE] : The name assign of sequence file displayed on [Function4] window can be saved to the file. The file name is "*.ak4".

[OPEN] : The name assign of sequence file(*.ak4) saved by [SAVE] is loaded.

6-3. Note

(1) This function doesn't support the pause function of sequence function.

(2) All files used by [SAVE] and [OPEN] function on right side need to be in the same folder.

(3) When the sequence is changed in [Function3], the sequence file (*.aks) should be loaded again in order to reflect the change.

7. [Function5 Dialog]

The register setting file(*.akr) saved by [SAVE] function on main window can be listed up to 10 files, assigned to buttons and then executed. When [F5] button is clicked, the window as shown in Figure 12 opens.

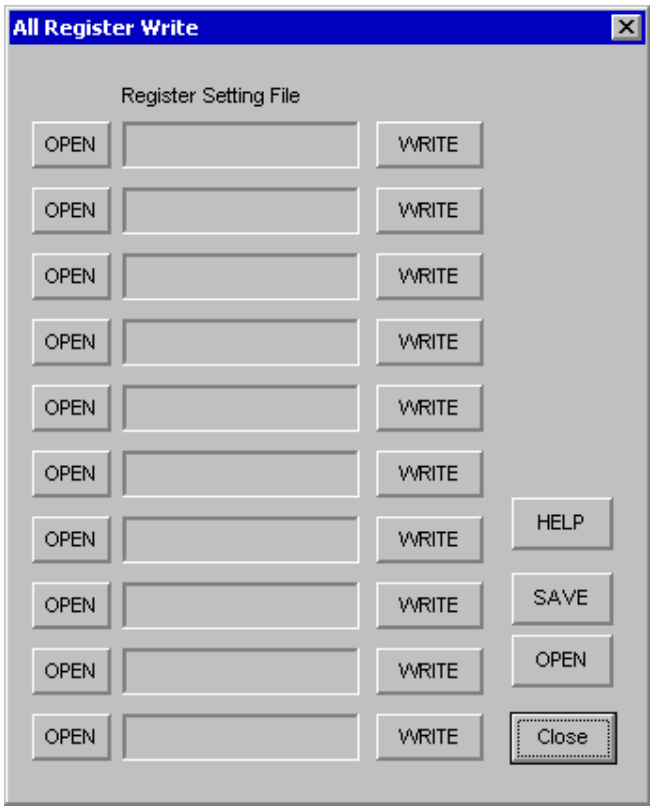


Figure 12. [F5] window

7-1. [OPEN] buttons on left side and [WRITE] button

(1) Click [OPEN] button and select the register setting file (*.akr).

The register setting file name is displayed as shown in Figure 13. (In case that the selected file name is "DAC_Output.akr")

(2) Click [WRITE] button, then the register setting is executed.

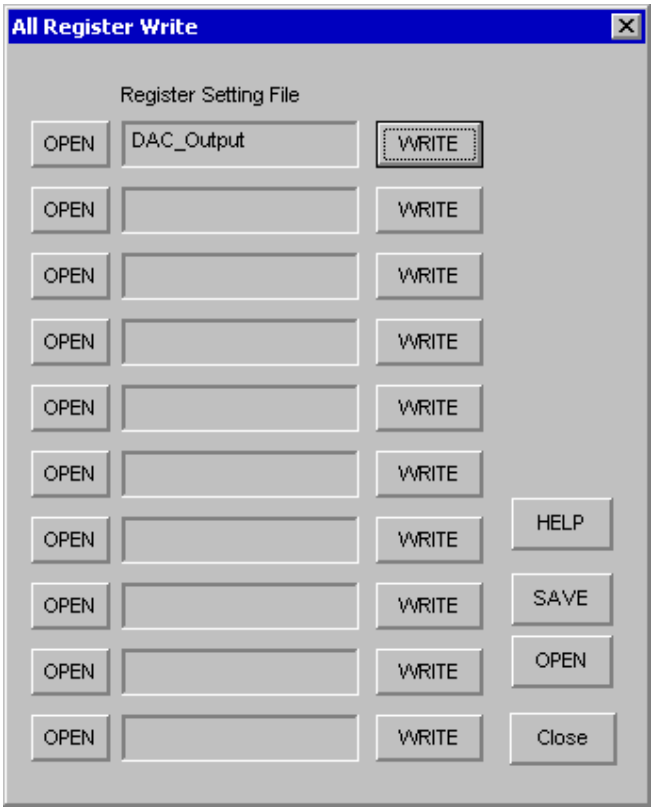


Figure 13. [F5] windows(2)

7-2. [SAVE] and [OPEN] buttons on right side

[SAVE] : The name assign of register setting file displayed on [Function5] window can be saved to the file. The file name is "*.ak5".
[OPEN] : The name assign of register setting file(*.ak5) saved by [SAVE] is loaded.

7-3. Note

(1) All files used by [SAVE] and [OPEN] function on right side need to be in the same folder.

(2) When the register setting is changed by [SAVE] Button on the main window, the register setting file (*.akr) should be loaded again in order to reflect the change.

8. [Filter Dialog]

This dialog can easily set the AK4645's programmable filter.

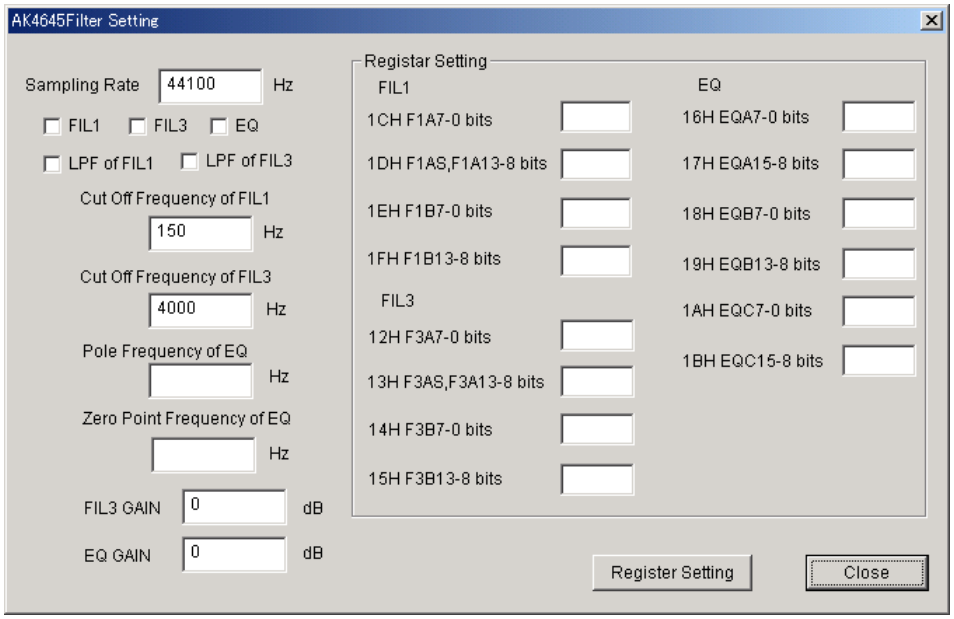


Figure 6. [Filter] window

8-1. Value input columns on left side

[Sampling Rate] → Input value of sampling frequency [unit : Hz] <default : 44100>
[Cut Off Frequency of FIL1] → Input value of cut off frequency of FIL1 [unit : Hz] <default : 150>
[Cut Off Frequency of FIL3] → Input value of cut off frequency of FIL3 [unit : Hz] <default : 4000>
[Pole Frequency of EQ] → Input value of pole frequency of EQ [unit : Hz]
[Zero Frequency of EQ] → Input value of zero frequency of EQ [unit : Hz]
[FIL3 GAIN] → Input value of gain of FIL3 (0~−10dB) [unit : dB]
[EQ GAIN] → Input value of gain of EQ (+12~0dB) [unit : dB]

8-2. Check box on left side

Check Box	Check	Check off
FIL1	FIL1 bit ="1"	FIL1 bit ="0"
FIL3	FIL3 bit ="1"	FIL3 bit ="0"
EQ	EQ bit ="1"	EQ bit ="0"
LPF of FIL1	F1AS bit ="1"(LPF)	F1AS bit ="0"(HPF)
LPF of FIL3	F3AS bit ="1"(LPF)	F3AS bit ="0"(HPF)

8-2. [Register Setting] panel and [Register Setting] button on right side

Click [Register setting] button, then filter coefficient set by 8-1 and 8-2 is written on [Register setting] panel. (It is also written to the actual control register of the AK4645.)

MEASUREMENT RESULTS

1. EXT mode (slave mode)

[Measurement condition]

- Measurement unit: Audio Precision, System two Cascade
- EXT Slave Mode
- MCLK: 256fs
- BICK: 64fs
- Bit: 16bit
- Measurement Frequency: 20Hz ~ 20kHz
- Power Supply: AVDD=DVDD=HVDD=TVDD=3.3V
- Temperature: Room
- Input Frequency: 1kHz
- Sampling Frequency: 44.1kHz

[Measurement Results]

ADC (LIN2/RIN2) characteristics (IVOL=0dB, ALC1 = OFF, LIN2/RIN2 → ADC → IVOL)

		L[dB]		R[dB]	
MIC-Amp Gain		0dB	+20dB	0dB	+20dB
S/(N+D)	20kHzLPF (–1dB)	88.7	83.6	88.5	83.5
DR	20kHzLPF + A-weighted	95.6	87.1	95.6	87.1
S/N	20kHzLPF + A-weighted	95.6	87.1	95.6	87.1

DAC (LOUT/ROUT) characteristics (R_L=20kΩ, DAC → LOUT/ROUT)

		L[dB]	R[dB]
S/(N+D)	20kHzLPF (–3dB)	88.3	88.1
S/N	20kHzLPF + A-weighted	94.4	94.4

2. PLOT DATA

2-1 ADC (LIN2/RIN2 → ADC) (+20dB)

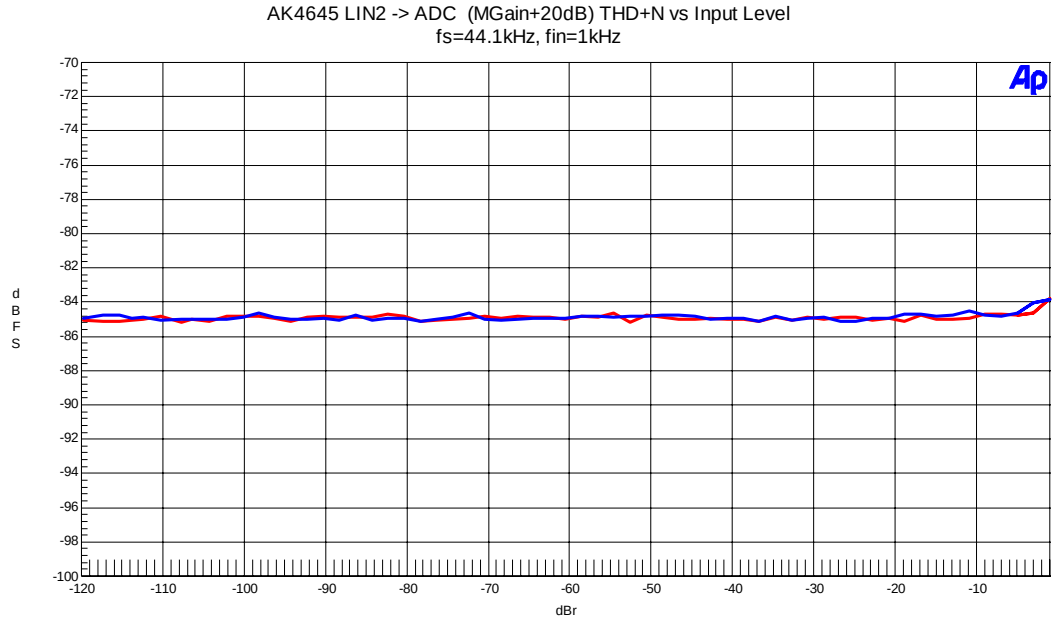


Figure 15. THD+N vs. Input Level

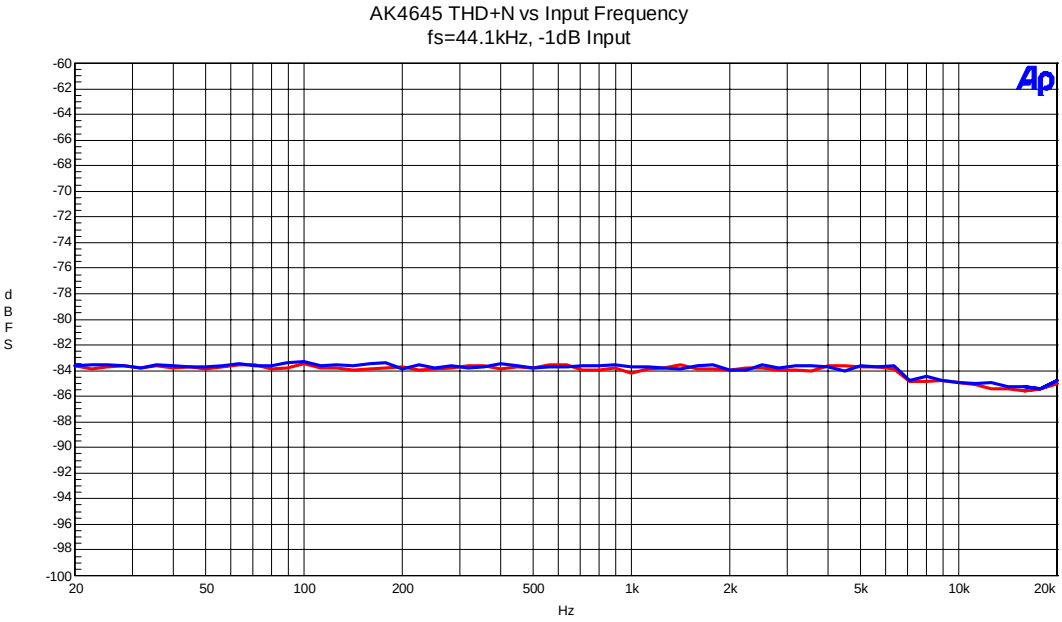


Figure 16. THD+N vs. Input Frequency

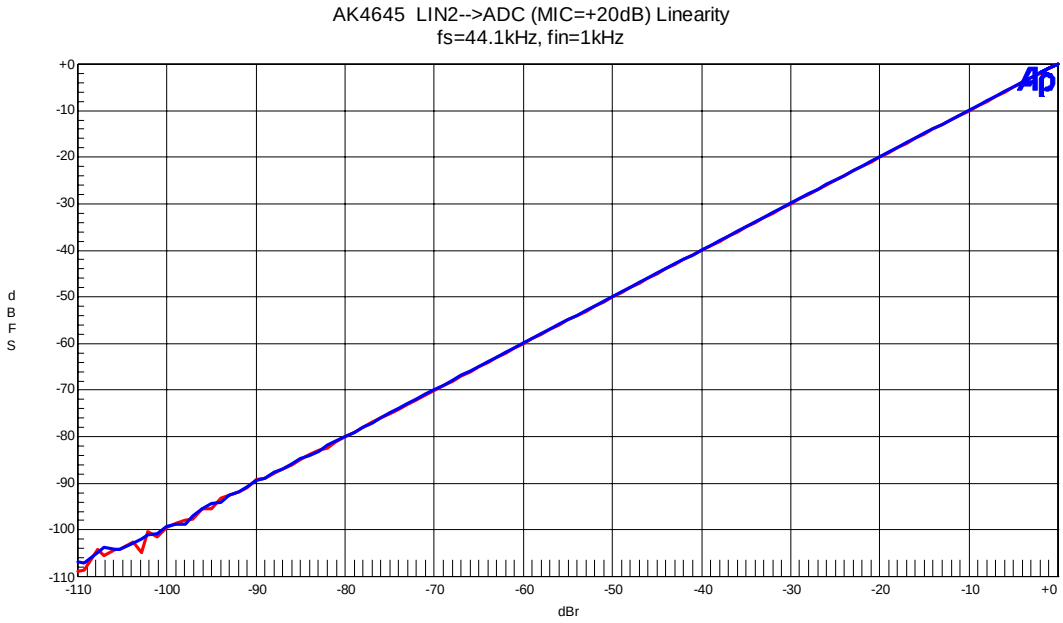


Figure 17. Linearity

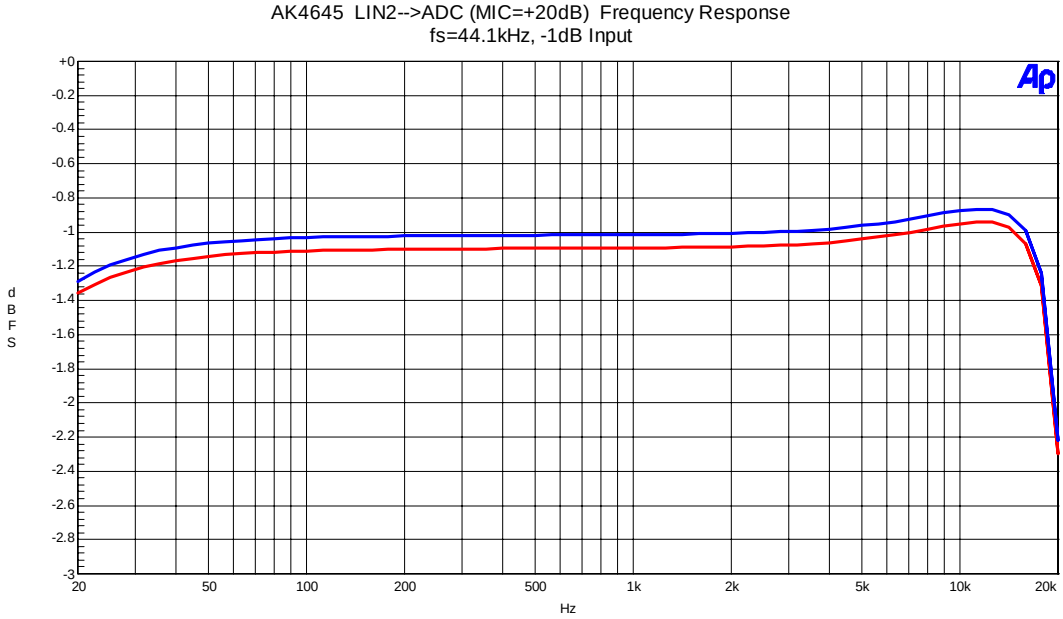


Figure 18. Frequency Response

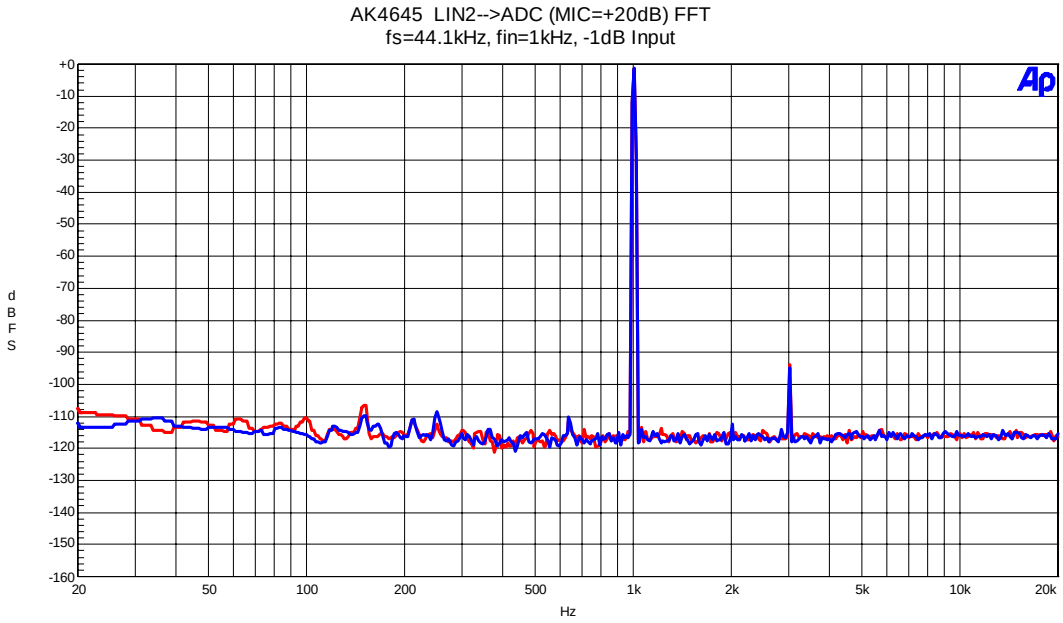


Figure 19. FFT Plot (Input level= -1dBFs)

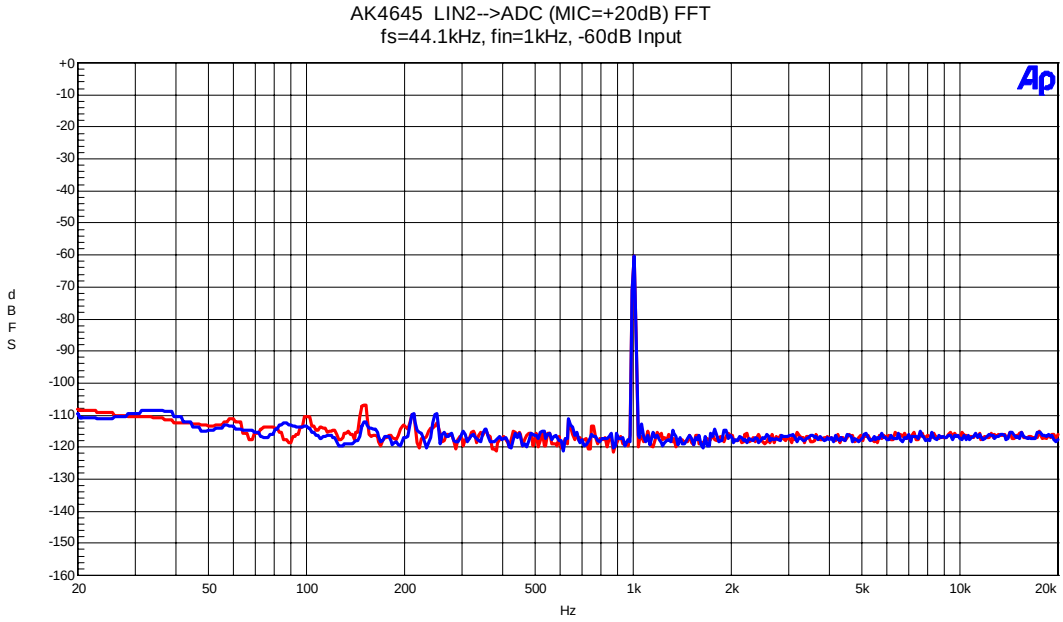


Figure 20. FFT Plot (Input level= -60dBFs)

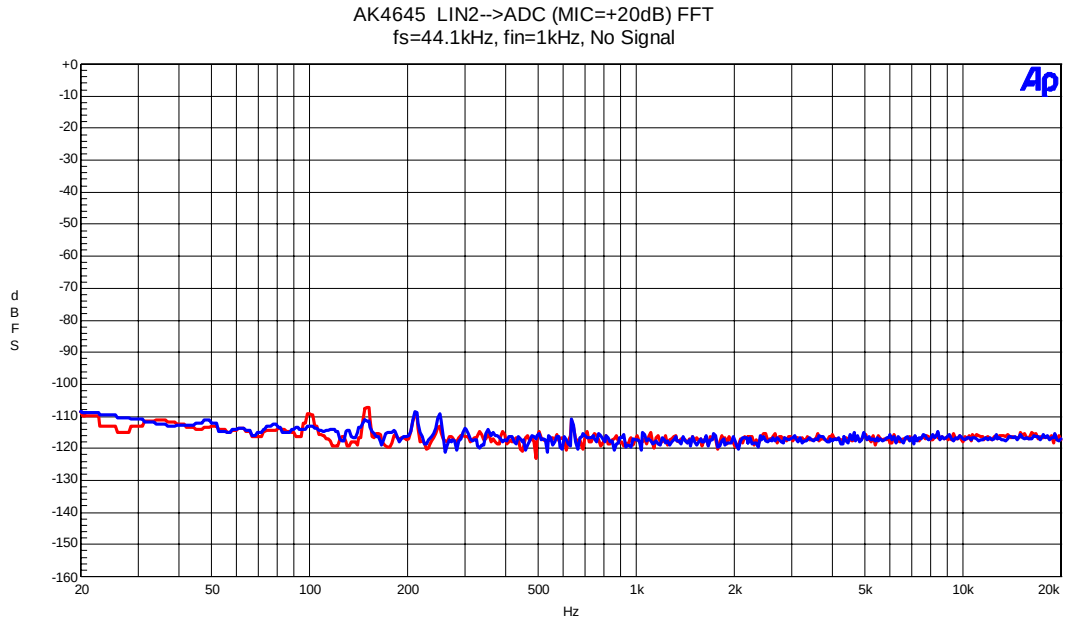


Figure 21. FFT Plot (No signal)

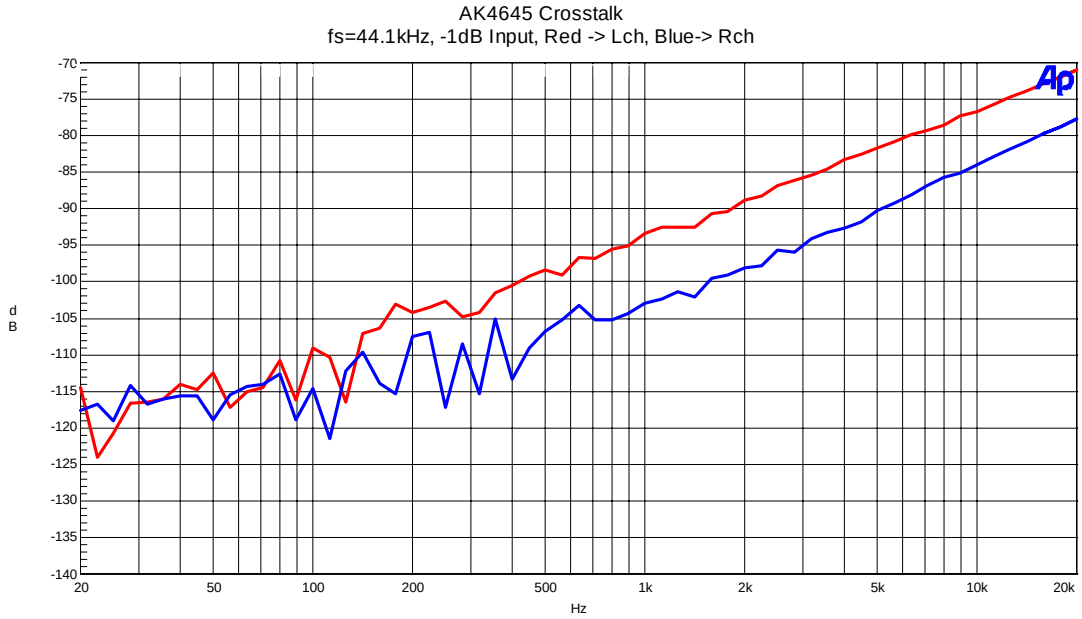


Figure 22. Crosstalk Plot

2-2 ADC (LIN2/RIN2 → ADC) (0dB)

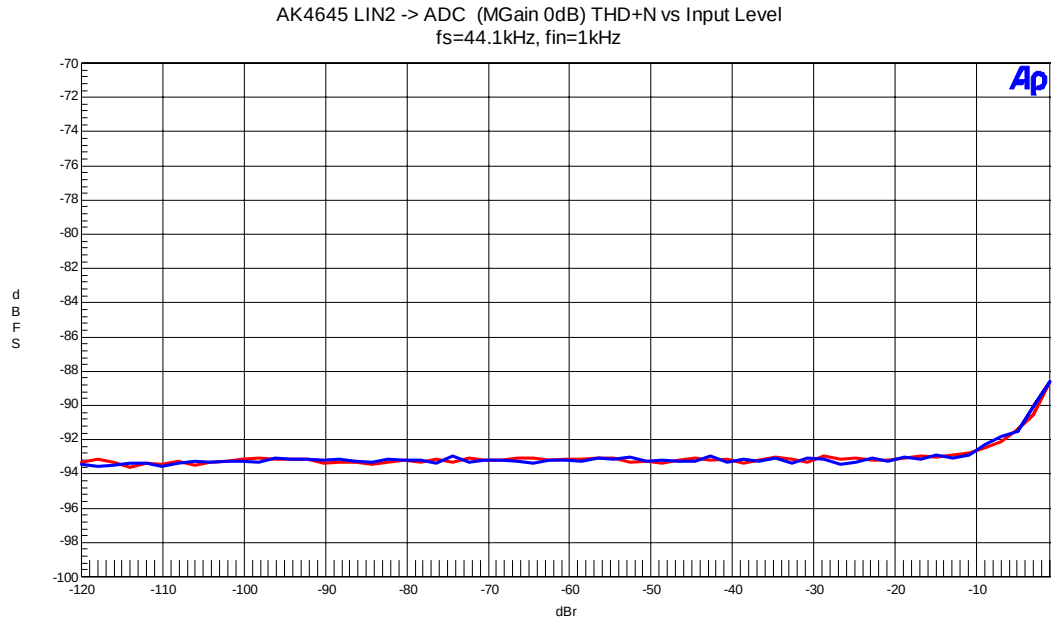


Figure 23. THD+N vs. Input Level

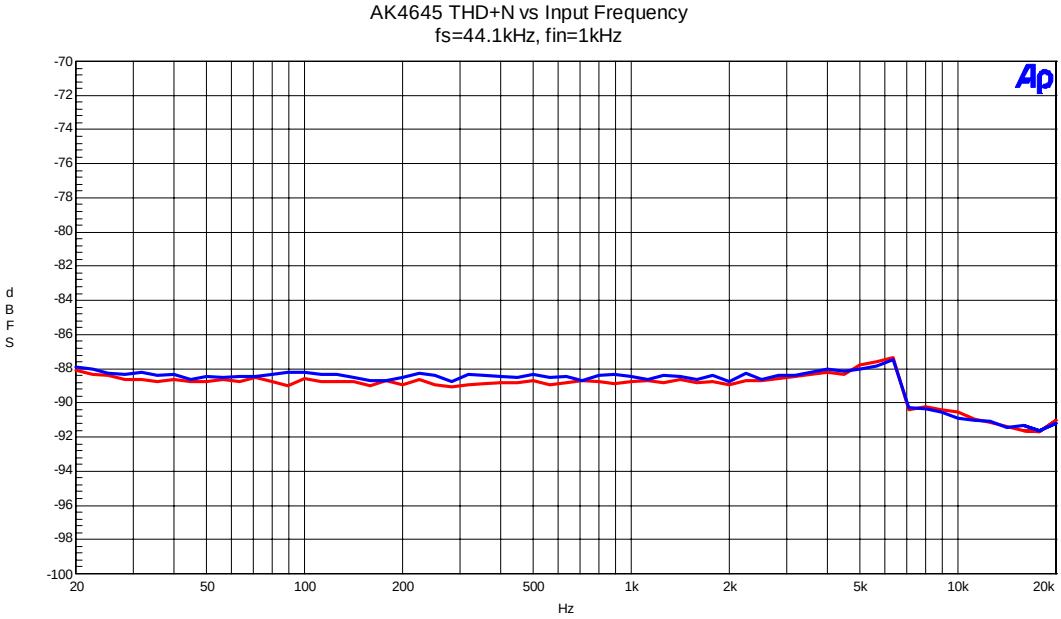


Figure 24. THD+N vs. Input Frequency

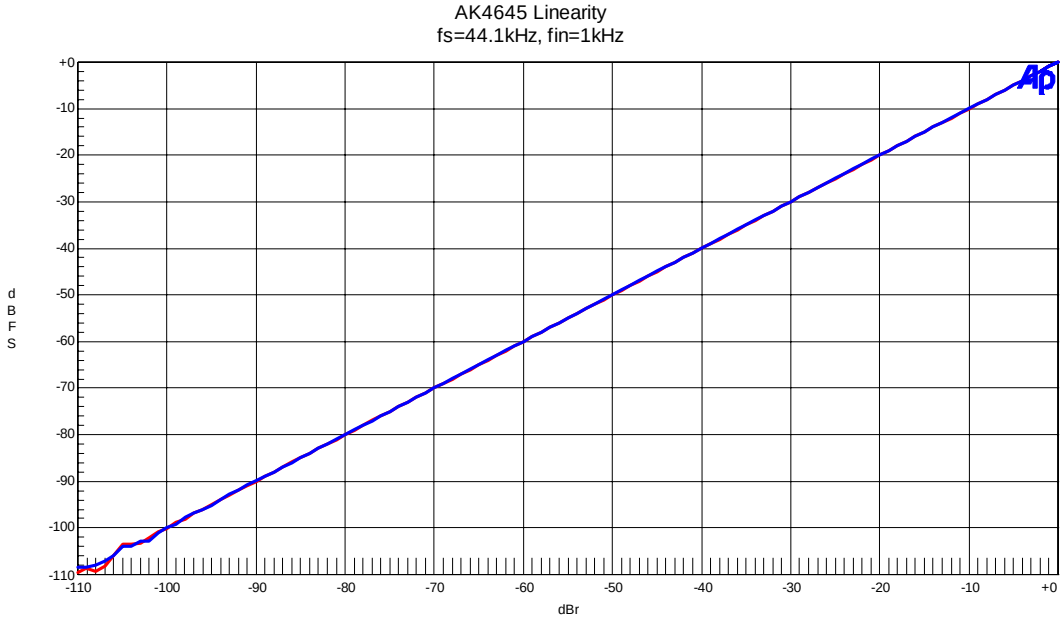


Figure 25. Linearity

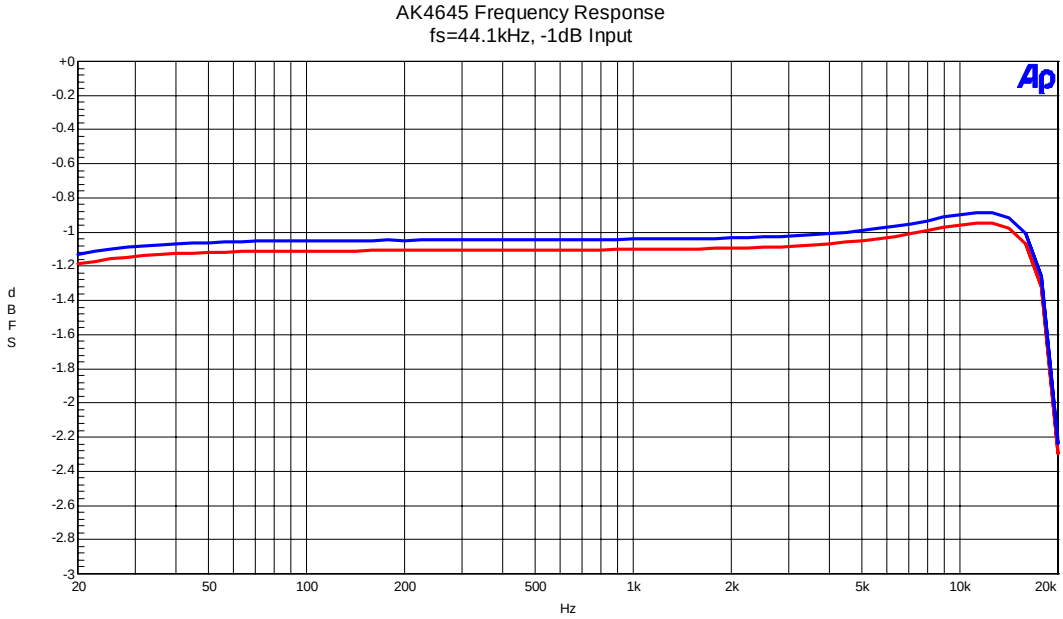


Figure 26. Frequency Response

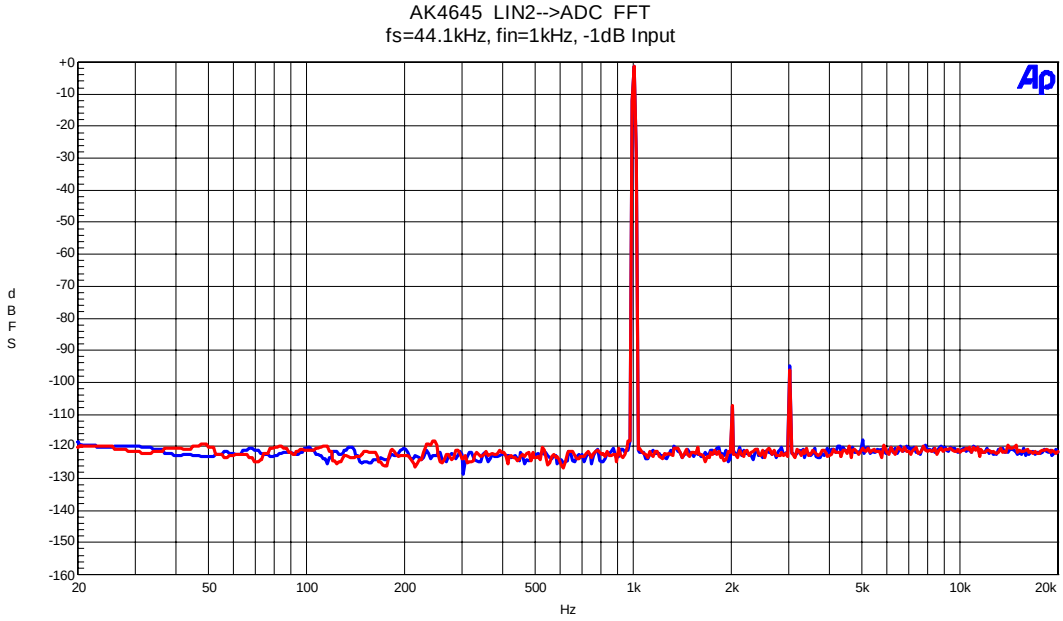


Figure 27. FFT Plot (Input level= -1dBFs)

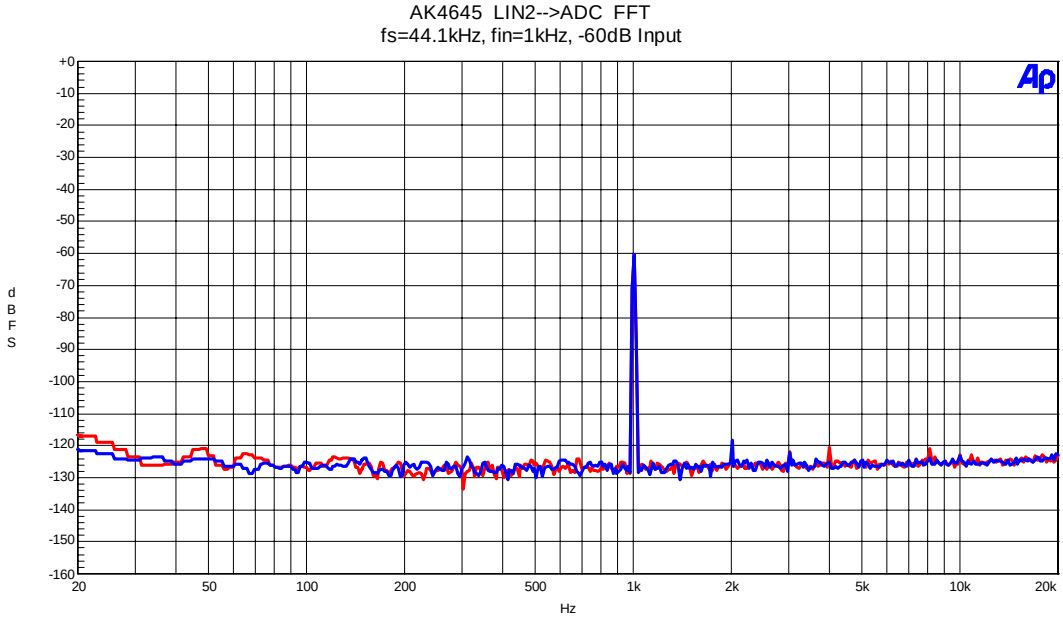


Figure 28. FFT Plot (Input level = -60dBFs)

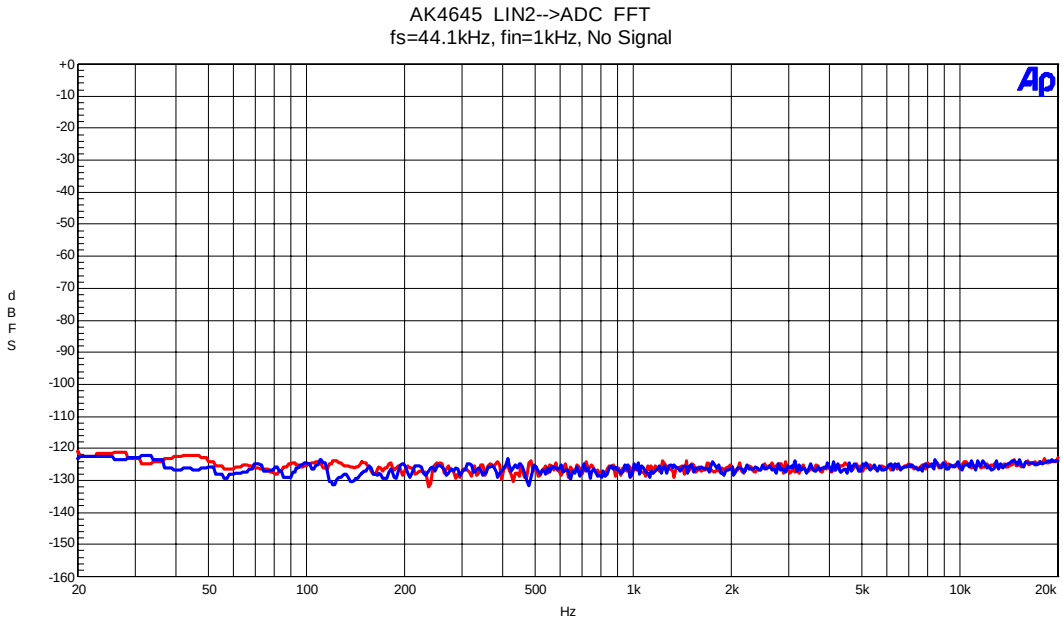


Figure 29. FFT Plot (No signal)

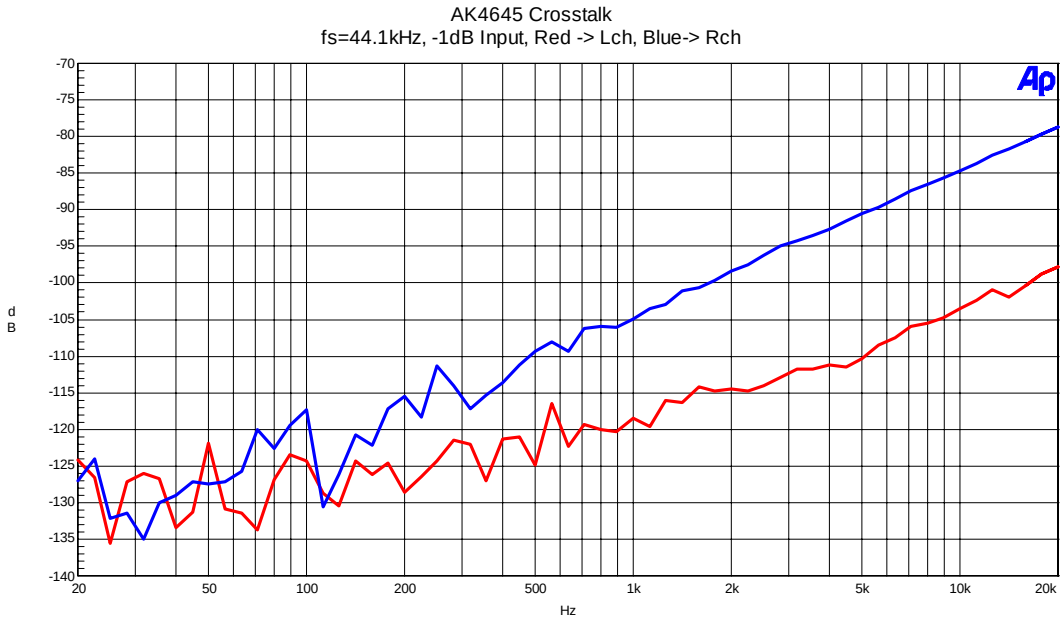


Figure 30. Crosstalk Plot

2-3 DAC (DAC→ LOUT/ROUT)
Vin = 0dB

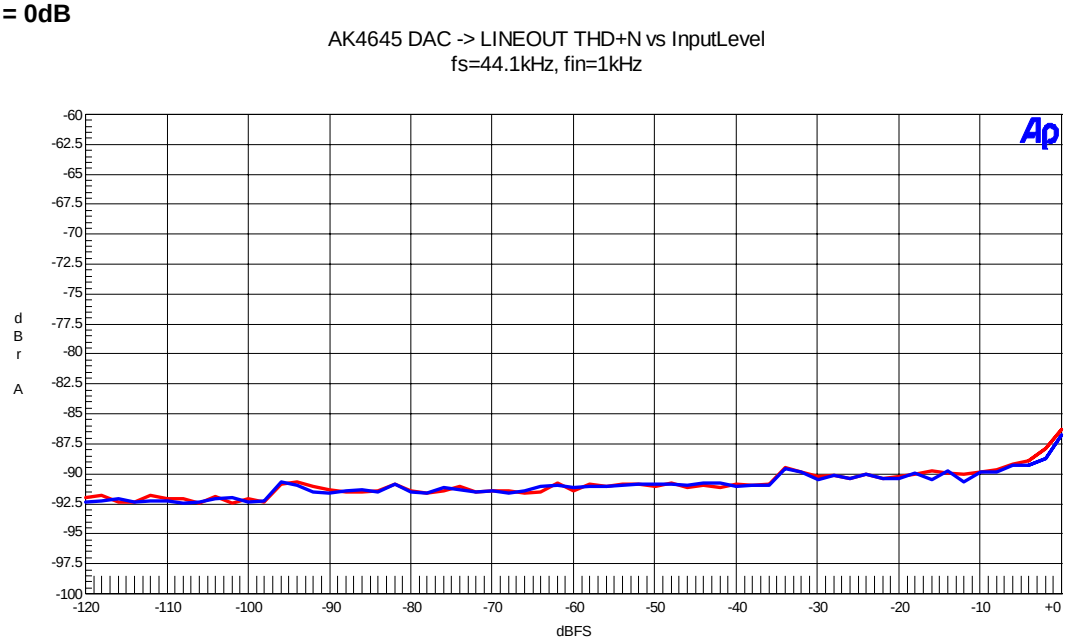


Figure 31. THD+N vs. Input Level

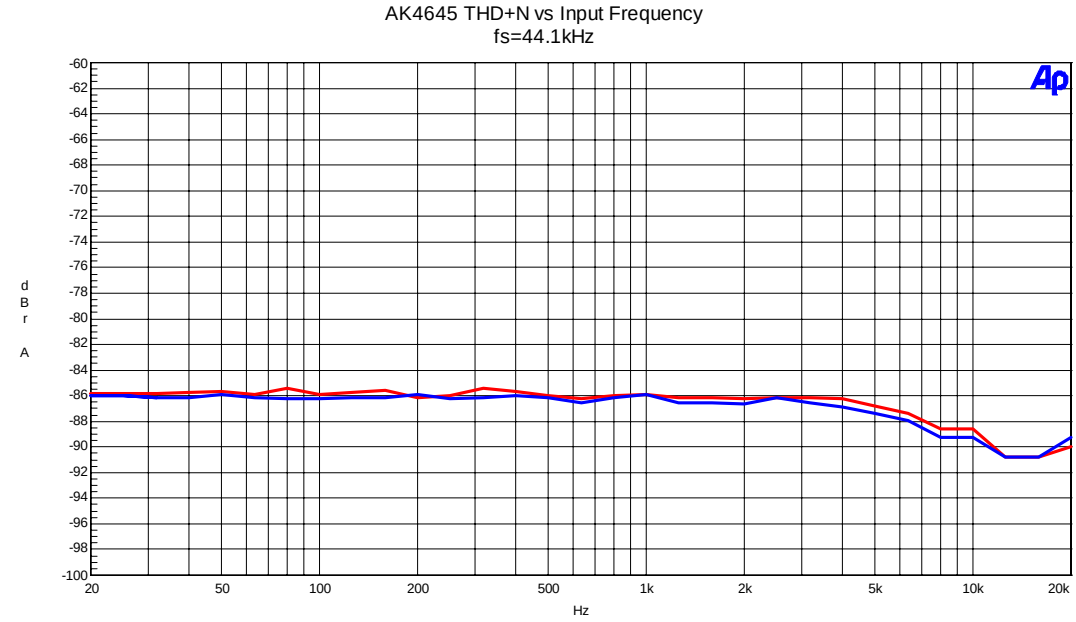


Figure 32.THD+N vs. Input Frequency (Input Level = 0dBFS)

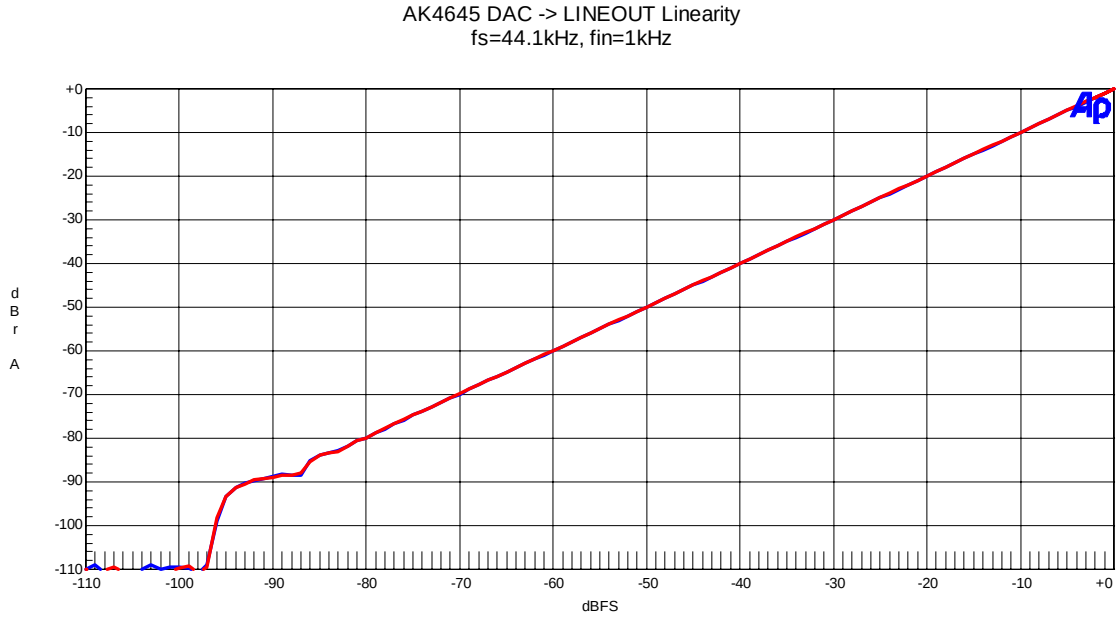


Figure 33. Linearity

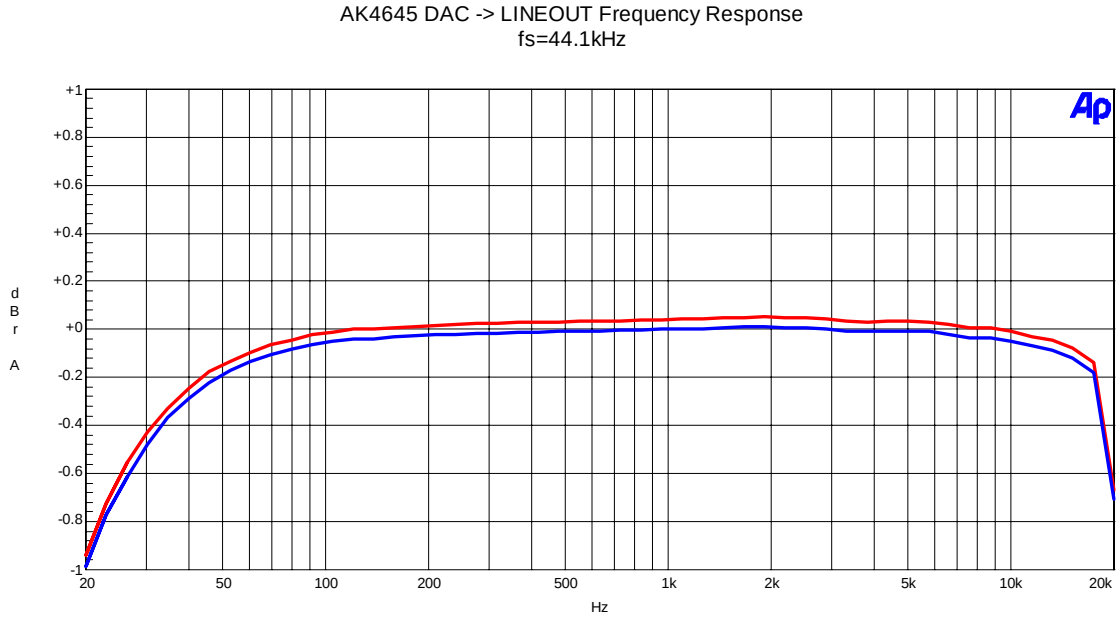


Figure 34. Frequency Response

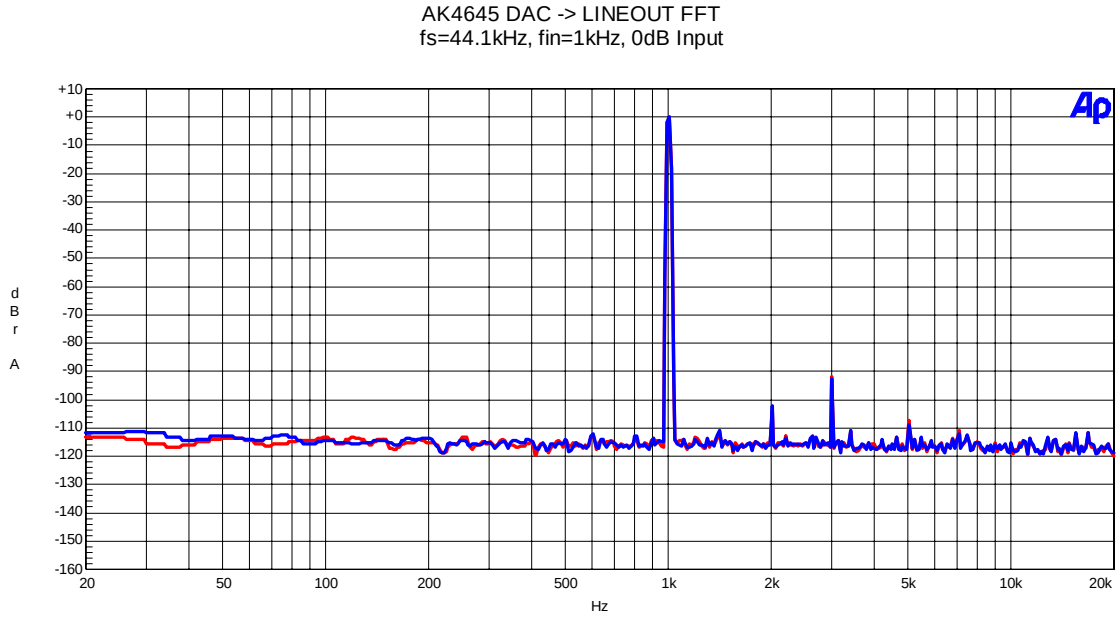


Figure 35. FFT Plot (Input level= 0dBFs)

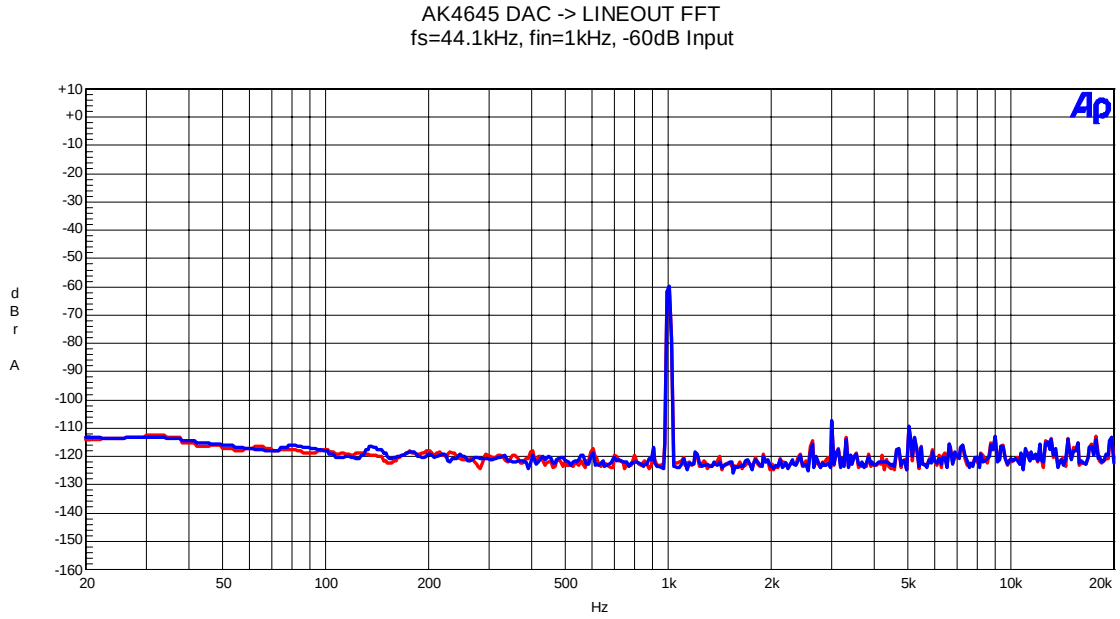


Figure 36. FFT Plot (Input level = -60dBFs)

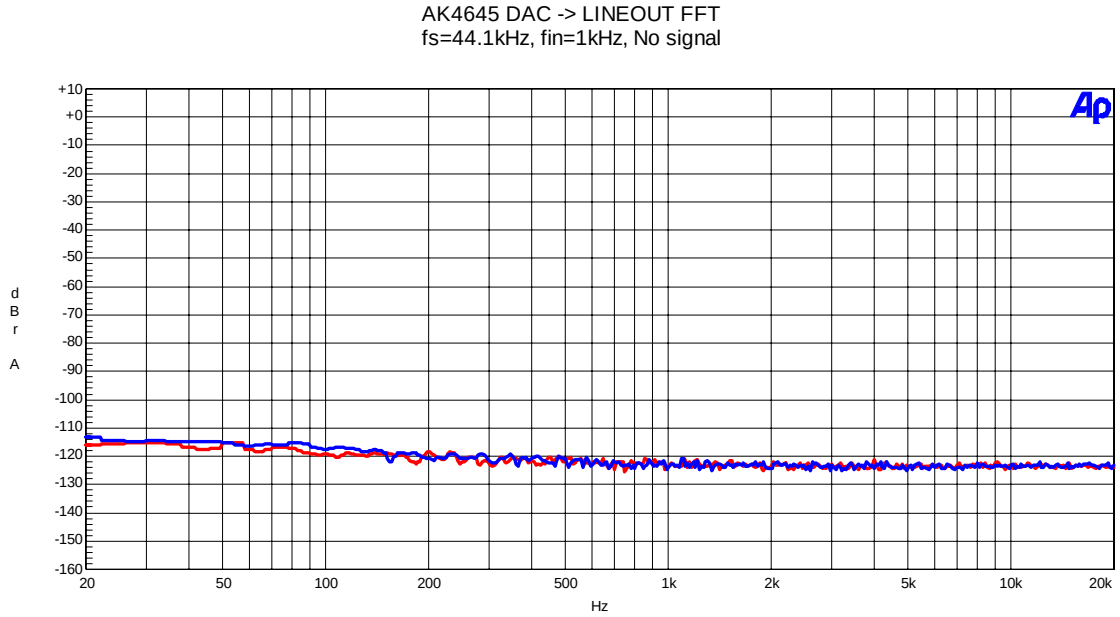


Figure 37. FFT Plot (No signal)

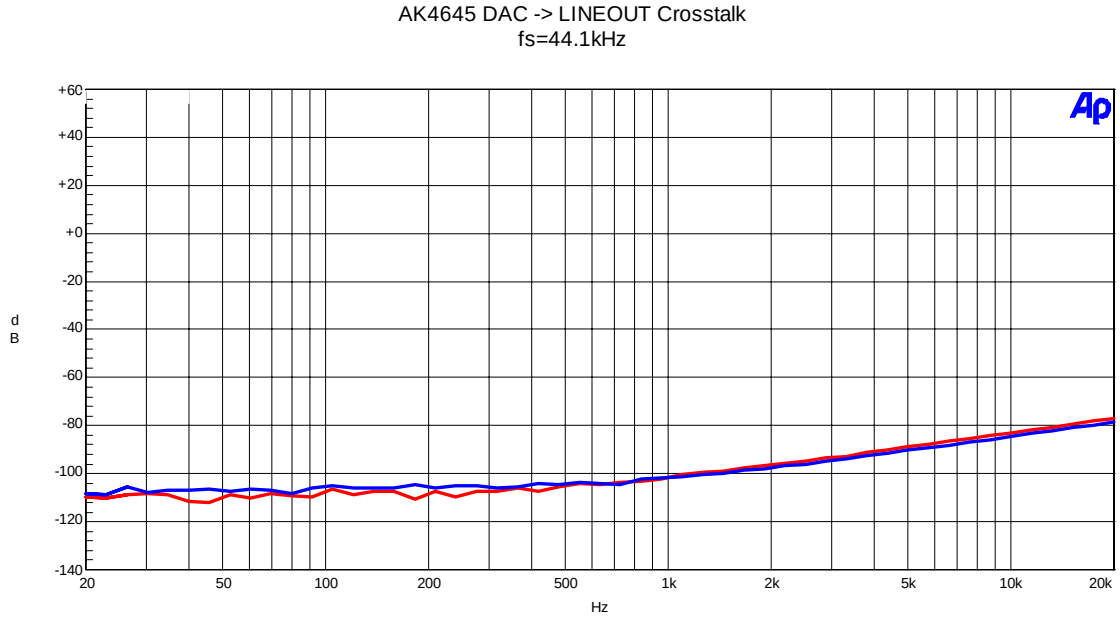


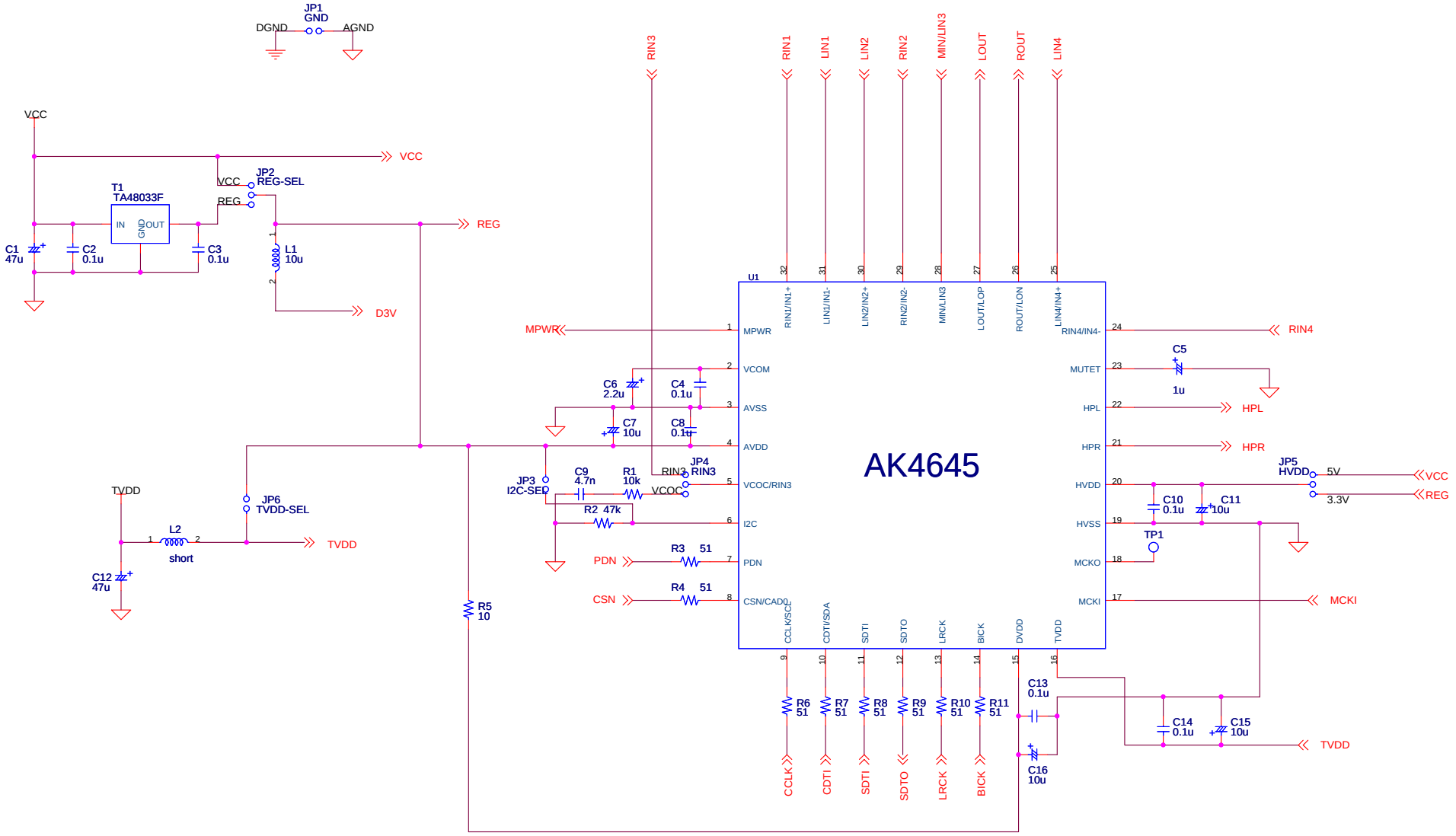
Figure 38. Crosstalk Plot

Revision History

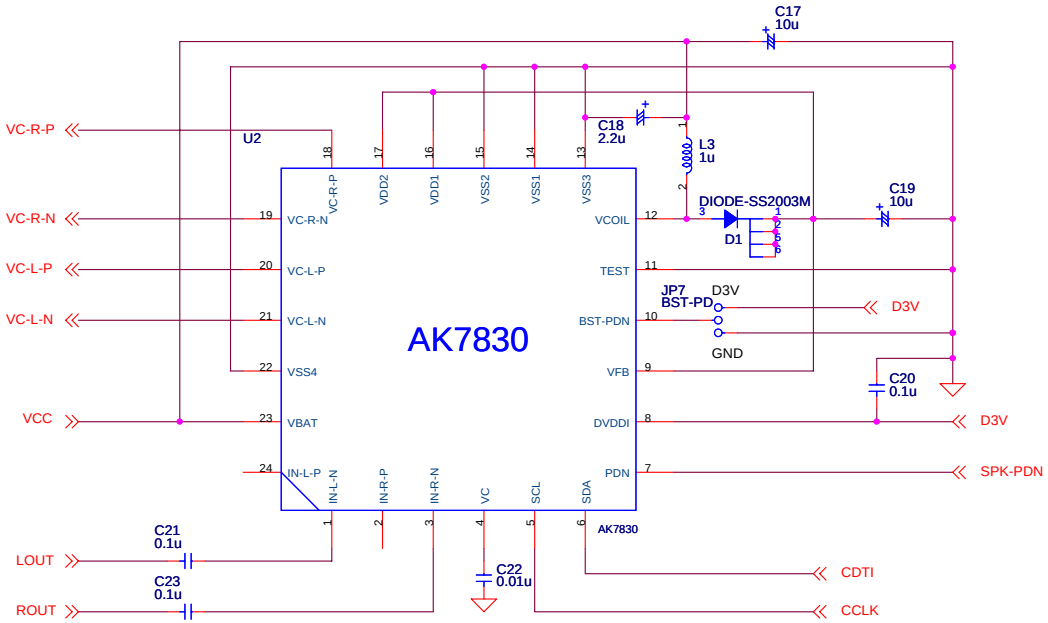
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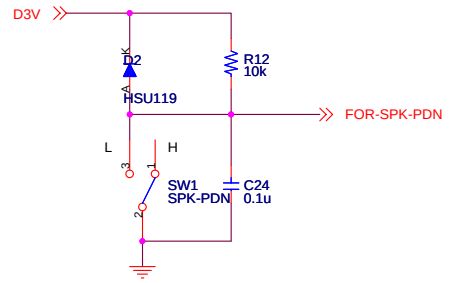
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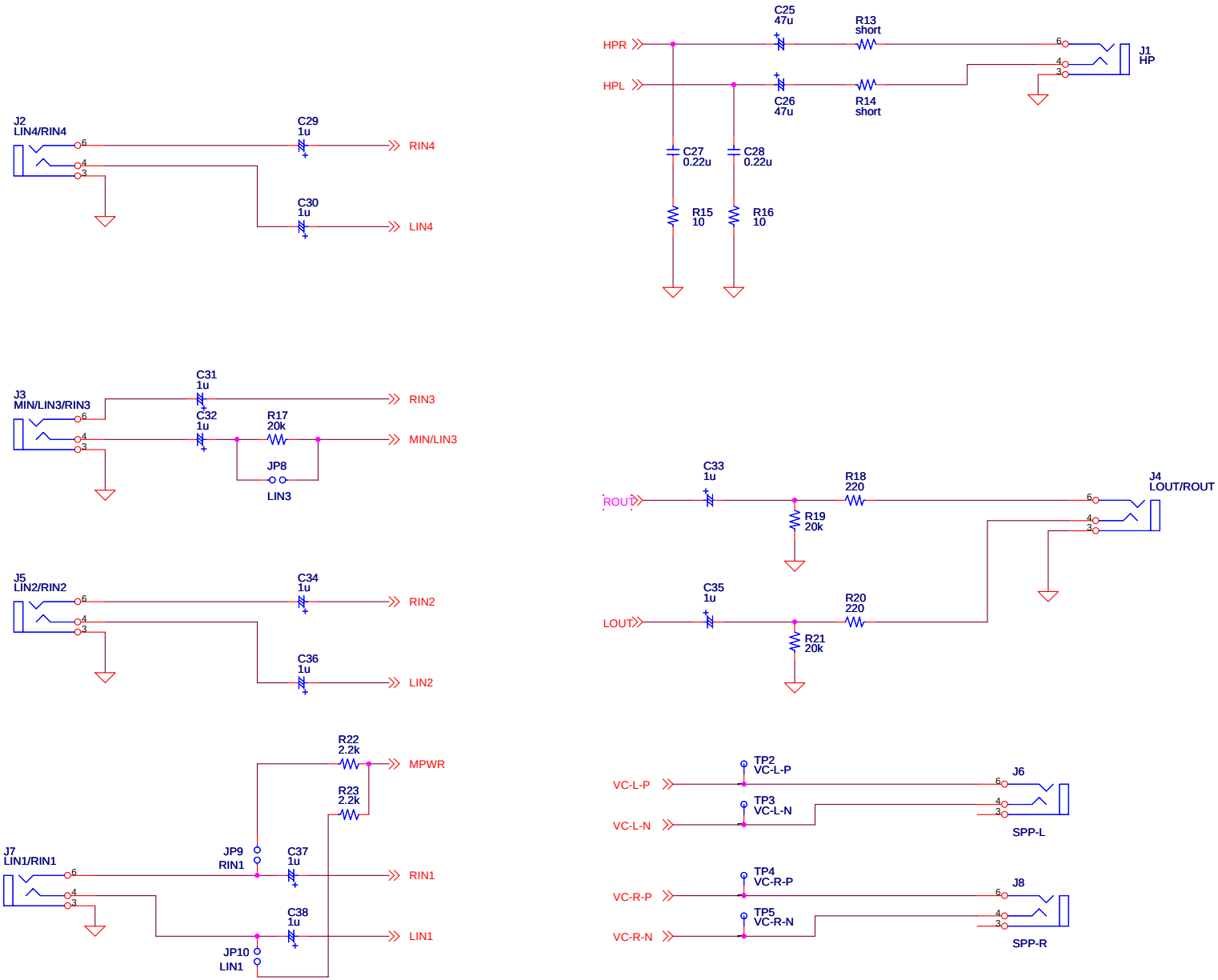


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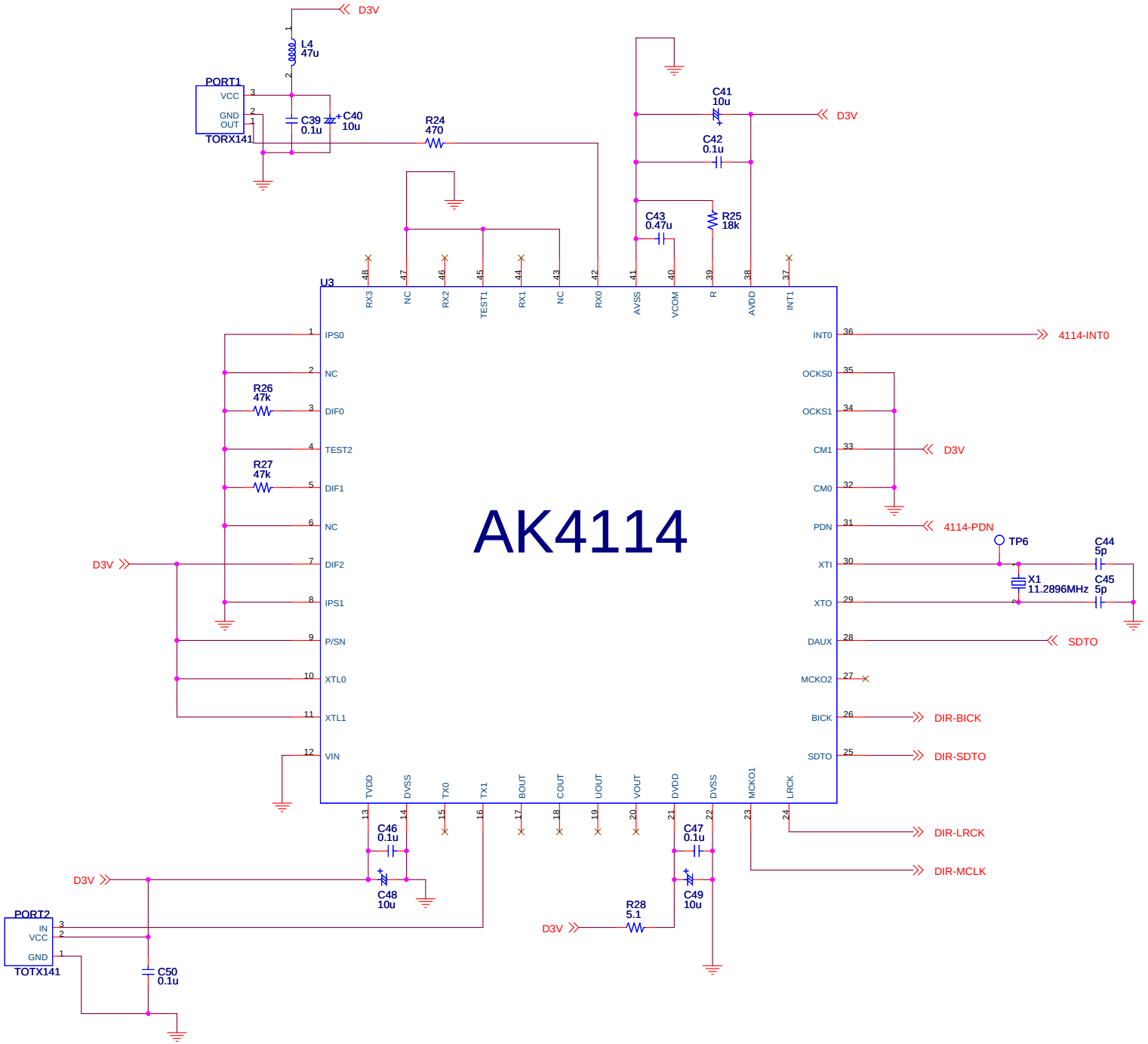




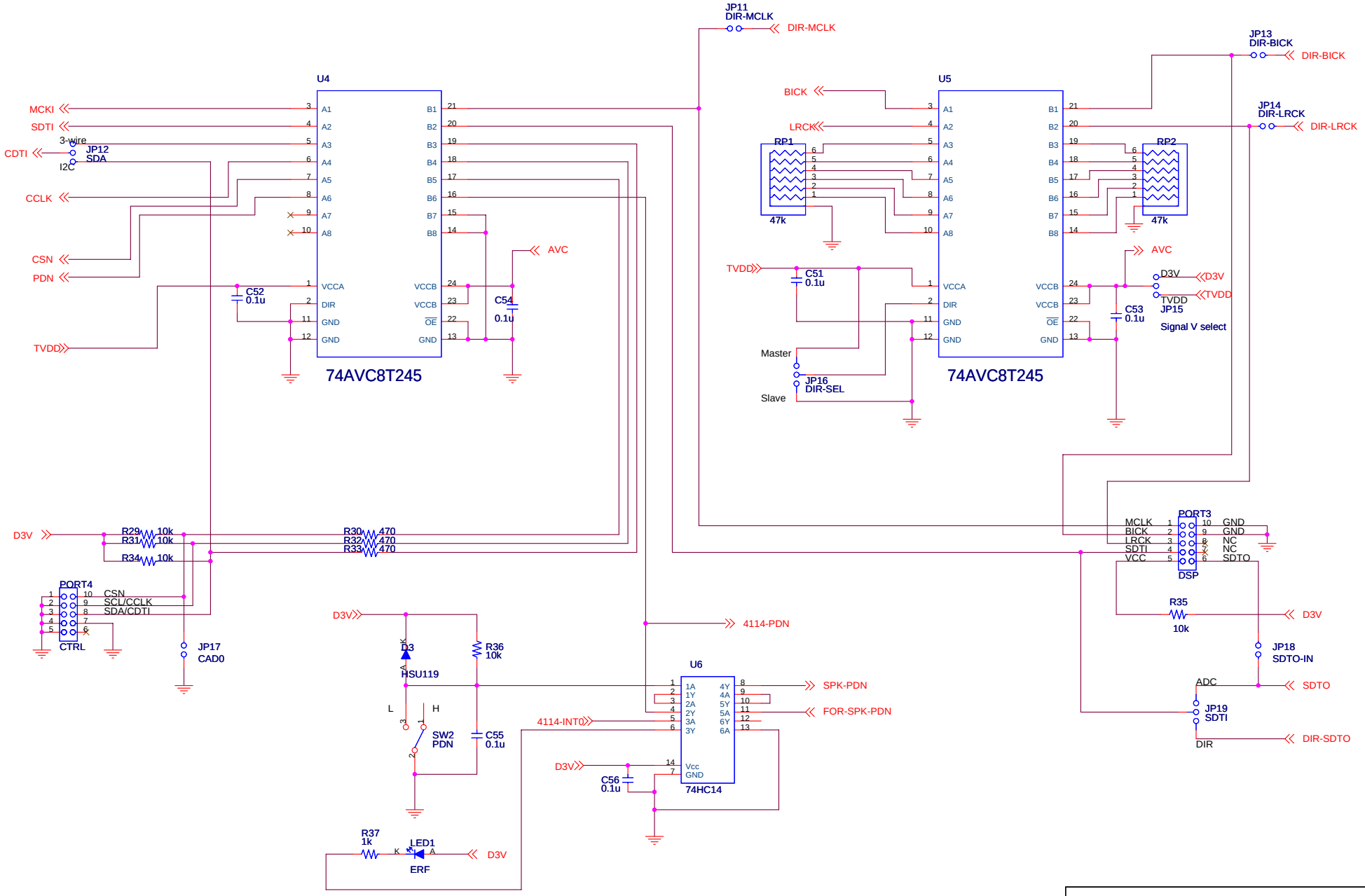
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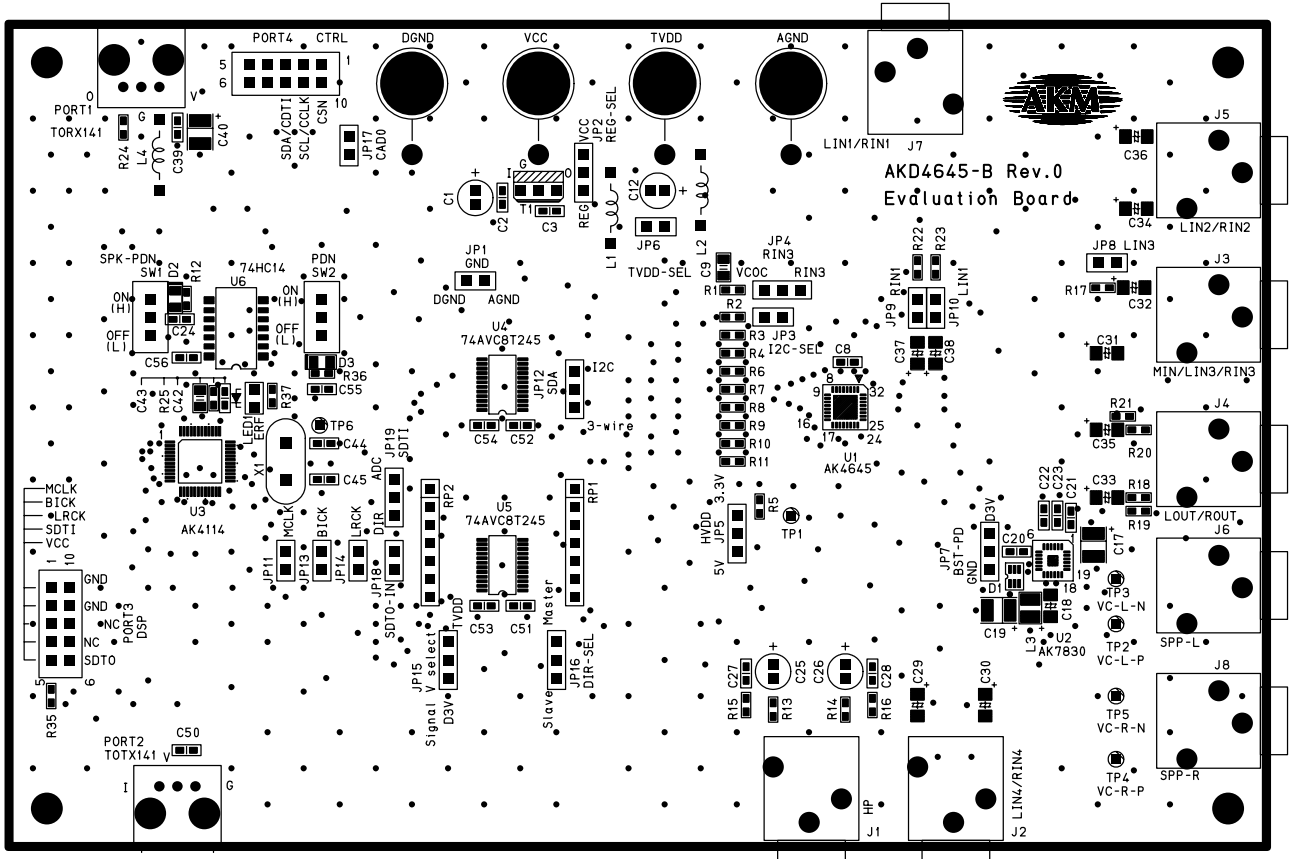
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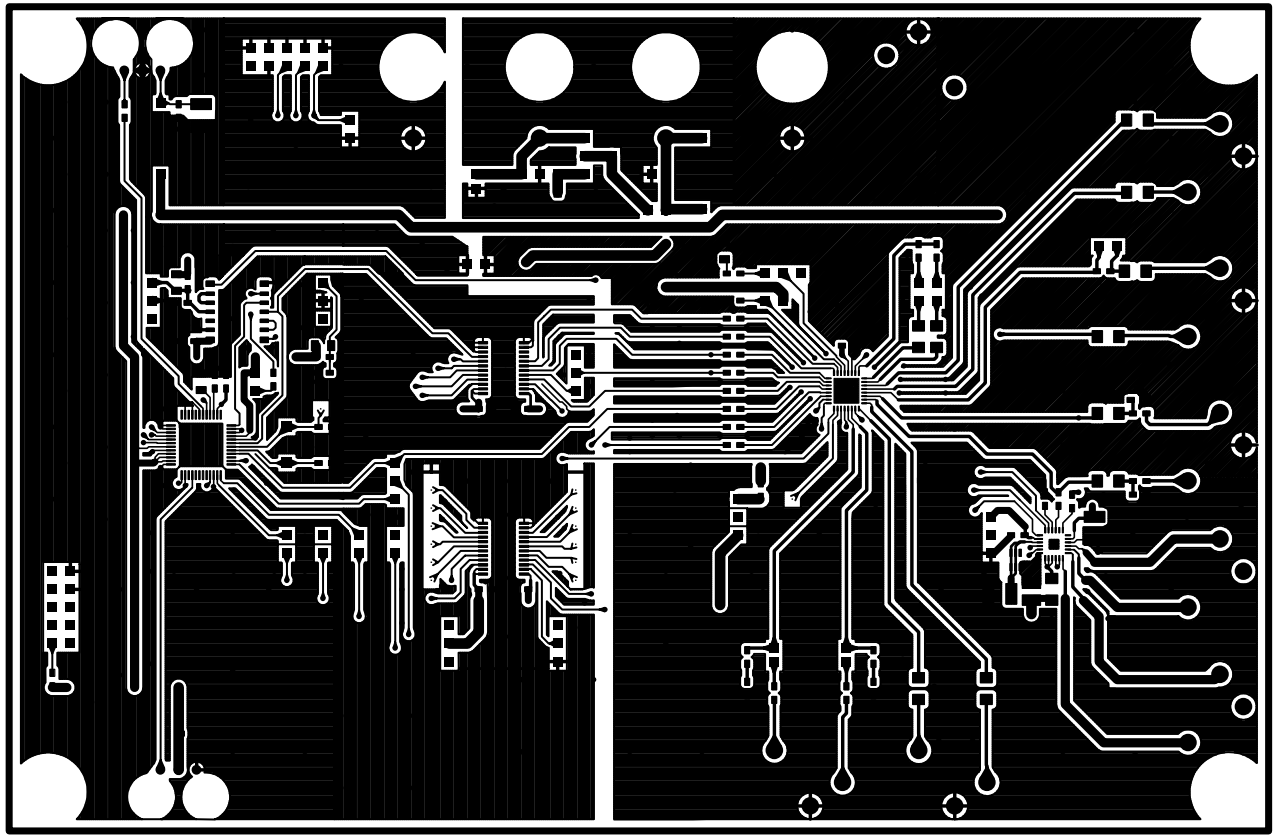


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