
eKA8561A

USB Audio Controller

**Product
Specification**

Doc. VERSION 0.1

ELAN MICROELECTRONICS CORP.


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Contents

1	General Description	1
2	Features	1
3	Applications.....	2
4	Pin Configuration	2
5	Pin Description.....	3
6	Function Description	5
7	Absolute Maximum Rating	5
8	Electrical Characteristic	6
8.1	DC Electrical Characteristic.....	6
8.2	Analog Electrical Characteristic.....	7
9	Application Circuit	8
10	I²S Interface Signal.....	9
11	Package.....	10

PRELIMINARY

Specification Revision History

Doc. Version	Revision Description	Date
0.1	Initial Preliminary Version	2006/04/21

PRELIMINARY

1 General Description

The eKA8561A is a USB digital audio controller with audio data processing that supports 16-bit 2-channel format at 48 kHz sampling rate. The device has an integrated USB transceiver, USB core, DAC, ADC, and I²S Input/Output. It can handle a high-level USB protocol, and manages user interface via HID I/O pins.

2 Features

- USB Specification v1.1 Compliant
- USB Audio and Human Interface Device (HID) Class v1.1 Compliant
- Supports 12 Mb/s Full Speed Serial Data Transmission
- Supports 48K, 44.1kHz, 32kHz, 8kHz sampling rate
- Single oscillator: 6MHz
- Audio buffer size: 192×16 bits × 2
- Total of four Endpoints: Endpoint 0 for control transfer , Endpoint 1 for audio streaming out , Endpoint 2 for streaming in , Endpoint 3 for HID
- Supports stereo/mono playback
- Built-in 2-channel D/A Converter with 10-bit resolution
- Built-in 1-channel A/D converter with 10-bit resolution
- Alternative settings supported by the audio streaming-out interface:
 - ALT-0: (default setting) zero isochronous bandwidth
 - ALT-1: 16-bit PCM 2 channel
- Alternative settings supported by the audio streaming-in interface:
 - ALT-0: (default setting) zero isochronous bandwidth
 - ALT-1: 16-bit PCM stereo
- 2 LED direct sink pins with internal serial resistor
- RC Oscillator with internal RC
- Total of 3 HID control pins (Mute Speaker, Volume Down, Volume Up)
- Wake-up pin in HID control pin
- Package: 48-pin LQFP

3 Applications

- USB Speaker
- USB Microphone
- USB Telephone

4 Pin Configuration

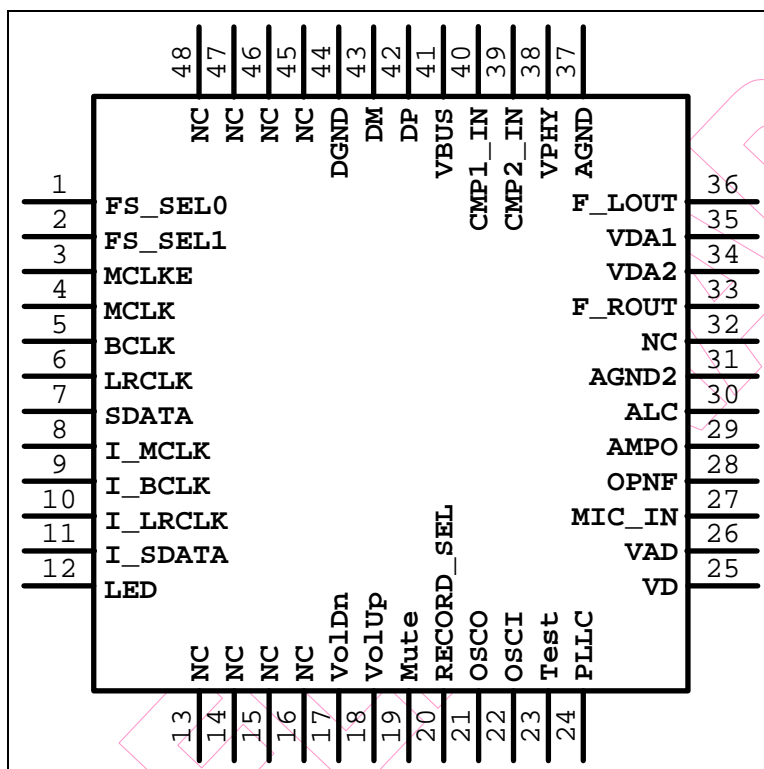


Fig 4-1 48-Pin Configuration of eKA8561A LQFP Type

5 Pin Description

Symbol	Pin No.	I/O	Function															
FS_SEL0 FS_SEL1	1, 2	I	I^2S Sample Frequency. <table border="1"> <thead> <tr> <th></th> <th>Sample Frequency</th> <th>MCLK</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>32kHz</td> <td>8.192MHz</td> </tr> <tr> <td>01</td> <td>8kHz</td> <td>2.048MHz</td> </tr> <tr> <td>10</td> <td>44.1kHz</td> <td>11.2896MHz</td> </tr> <tr> <td>11</td> <td>48kHz</td> <td>12.288MHz</td> </tr> </tbody> </table> Pull-high resistors are connected to VD.		Sample Frequency	MCLK	00	32kHz	8.192MHz	01	8kHz	2.048MHz	10	44.1kHz	11.2896MHz	11	48kHz	12.288MHz
	Sample Frequency	MCLK																
00	32kHz	8.192MHz																
01	8kHz	2.048MHz																
10	44.1kHz	11.2896MHz																
11	48kHz	12.288MHz																
MCLKE	3	I	External MCLK enable pin. 0 : use external MCLK and MCLK pin is input pin 1 : use internal MCLK and MCLK pin is output pin A pull-high resistor is connected to VD.															
MCLK	4	I	Crystal oscillator I/O pin															
BCLK	5	O	BCLK for I^2S interface															
LRCLK	6	O	LRCLK for I^2S interface															
SDATA	7	O	I^2S interface for FL, FR output															
I_MCLK	8	I	MCLK input pin															
I_BCLK	9	I	BCLK for I^2S interface															
I_LRCLK	10	I	LRCLK for I^2S interface															
I_SDATA	11	I	I^2S interface for FL, FR input															
P57 (PlayLED)	12	O	LED output pin Play/Pause: flash LED Stop: LED On															
P56(PowerLED)	13	O	LED output pin Suspend: LED off Power On: LED On															
P55 (RecordLED)	14	O	LED output pin Record: LED On Non-record: LED Off															
P54, P53 (NC)	15-16																	
P52 (VolDn)	17	I	Volume down control pin															
P51 (VolUp)	18	I	Volume up control pin															
P50 (Mute)	19	I	Mute control pin															
RECORD_SEL	20	I	Record select pin 0 : ADC record 1 : I^2S record A pull-low resistor is connected to DGND															



Symbol	Pin No.	I/O	Function
OSCO	21	O	Crystal output
OSCI	22	I	Crystal input
Test	23	I	Test mode select pin Test =0, enter normal mode Test=1, enter test mode A pull-low resistor is connected to DGND.
PLLC	24	I	External capacitor for PLL
VD	25	PWR	5V digital power supply pin
VAD	26	PWR	ADC analog power supply pin
MIC_IN	27	I	Microphone analog input pin
OPNF	28	I	Non-inverting type amplifier. Normally, a feedback resistor connects from AMPO to OPNF and a gain resistor connects to MIC.
AMPO	29	O	Gain amplifier output and negative feedback terminal for MIC
ALC	30	I	Automatic Level Control adjustment pin for MIC
AGND2	31	-	Analog Ground Pin 2
NC	32	-	No connection
F_ROUT	33	O	Front right channel analog audio output pin
VDA2	34	PWR	DAC analog power supply Pin 2
VDA1	35	PWR	DAC analog power supply Pin 1
F_LOUT	36	O	Front left channel analog audio output pin
AGND	37	PWR	Analog ground pin
VPHY	38	PWR	Phy and PLL power supply pin
CMP2_IN	39	I	Comparator 2 Input (FR)
CMP1_IN	40	I	Comparator 1 Input (MIC)
VBUS	41	PWR	USB bus power supply pin
DP	42	I/O	USB plus data line interface
DM	43	I/O	USB minus data line interface
DGND	44	PWR	Digital ground pin
NC	45-48	-	No connection

6 Function Description

The eKA8561A is a USB Audio Controller that transmits/receives audio data stream to/from the host through its Audio Streaming interface. The Audio Data Format supports 16-bit, 2-channel, and 48kHz PCM. It has three interfaces. Interface 1 supports three sampling frequencies. The sampling rate is changed when “Set Endpoint Control Request” is issued. If user plays other format audio data, the application software transforms it to 48kHz data and then transmit to this device. For Interface 2, this device transmits data at a rate that is locked to frame timing. When user use the recording format (ex. 8kHz) to record speech other than 48kHz stereo format, the application software transforms 48kHz data to 8kHz data. Interface 3 is HID pipe which is used to read button status.

The volume and mute control can be activated via host (audio device class requests) or via I/O pins (HID plus audio device class requests). When this function is activated via host, the host manages the audio PCM data directly. The eKA8561A device just playback the audio data. Otherwise, when it is activated via I/O pins, the eKA8561A sends the controlled feature (Volume, Mute) message through HID pipe and signals the host to manage the audio PCM data directly.

7 Absolute Maximum Rating

Symbol	Min	Max	Unit
Temperature under bias	0	70	°C
Storage temperature	-65	150	°C
Input voltage	-0.5	6.0	V
Output voltage	-0.5	6.0	V

8 Electrical Characteristic

8.1 DC Electrical Characteristic

Ta=0°C~70°C, VBus=5V, DGND=0V

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I ² L	Input Leakage Current	VIN = VBus, DGND	-	-	±1	μA
VIH	Input High Voltage	-	2.0	-	-	V
VIL	Input Low Voltage	-	-	-	0.8	V
VIHX	Clock Input High Voltage	OSCI	2.5	-	-	V
VILX	Clock Input Low Voltage	OSCI	-	-	1.0	V
VOH	Output High Voltage (I ² S Interface Pin)	IOH = -10.0mA	2.4	-	-	V
VOL1	Output Low Voltage (I ² S Interface Pin)	IOL = 10.0mA	-	-	0.4	V
VOL2	Output Low Voltage (LED driver)	IOL = 10.0mA VBus = 5V	-10%	1.3	+10%	V
IPH	Pull-high Current (Input and Sel_Vref pin)	Pull-high active, input pin at DGND (PH resistor = 25 KΩ)	-20%	-125	+20%	μA
IPL	Pull-low Current (Test pin)	Test pin at VBus (PL resistor = 25 KΩ)	-20%	125	+20%	μA
ISB1	Power Down Current	All input and I/O pin at VBus, Output pin floating, WDT disabled	-	-	50	μA
ISB2	Power Down Current	All input and I/O pin at VBus, Output pin floating, WDT enabled	-	-	100	μA
ICC	Operating Supply Current	Fosc= 6.0 MHz , output pin floating	-	-	10	mA



8.2 Analog Electrical Characteristic

Parameter	Condition	Min	Typ	Max	Unit
ADC					
ADC Resolution	-	-	10	-	Bits
ADC Sampling Frequency	-	-	48	-	kHz
Internal High Reference Voltage for ADC	-	-	2.55	-	V
Internal Low Reference Voltage for ADC	-	-	0.75	-	V
Pre-Amplifier Spec.					
Pre-Amplifier Voltage Gain	-	19.5	20	20.5	dB
Gain Amplifier Spec.					
Voltage Amplifier Gain	-	49	50	51	dB
Output Voltage Swing	-	-	1.6	-	V _{p-p}
Output Voltage	-	0.85	-	2.45	V
ALC Circuit Spec.					
ALC Detection Level	MIC input = 7.5mV	-40	-	-	dBm
ALC Operating Range	-	36	40	44	dB
LPF Spec					
Pass-Band Ripple	-	-	-	0.5	dB
Pass-Band Cutoff Frequency	-	-	4	-	kHz
Stop-Band Attenuation @ 24kHz	-	70	-	-	dB
Stop-Band Attenuation @ 48kHz	-	90	-	-	dB
DAC					
DAC Resolution	-	-	10	-	Bits
DAC Sampling Frequency	-	-	48	-	kHz
Reference Voltage (Vref)	-	1.45	1.65	1.85	V
Minimum Analog Output Voltage	-	0.99	1.04	1.09	V
Maximum Analog Output Voltage	-	2.15	2.26	2.37	V
Full Scale Voltage Range	VDA=3.3V	-5%	1.2	+5%	V
Analog Output Impedance at Each Output Pin	-	-	-	200	Ω
Analog Output Capacitance at Each Output Pin	-	-	-	20	pF
External Load Impedance	-	-	32	-	Ω
Volume Control Step	-	-	16	-	Step

9 Application Circuit

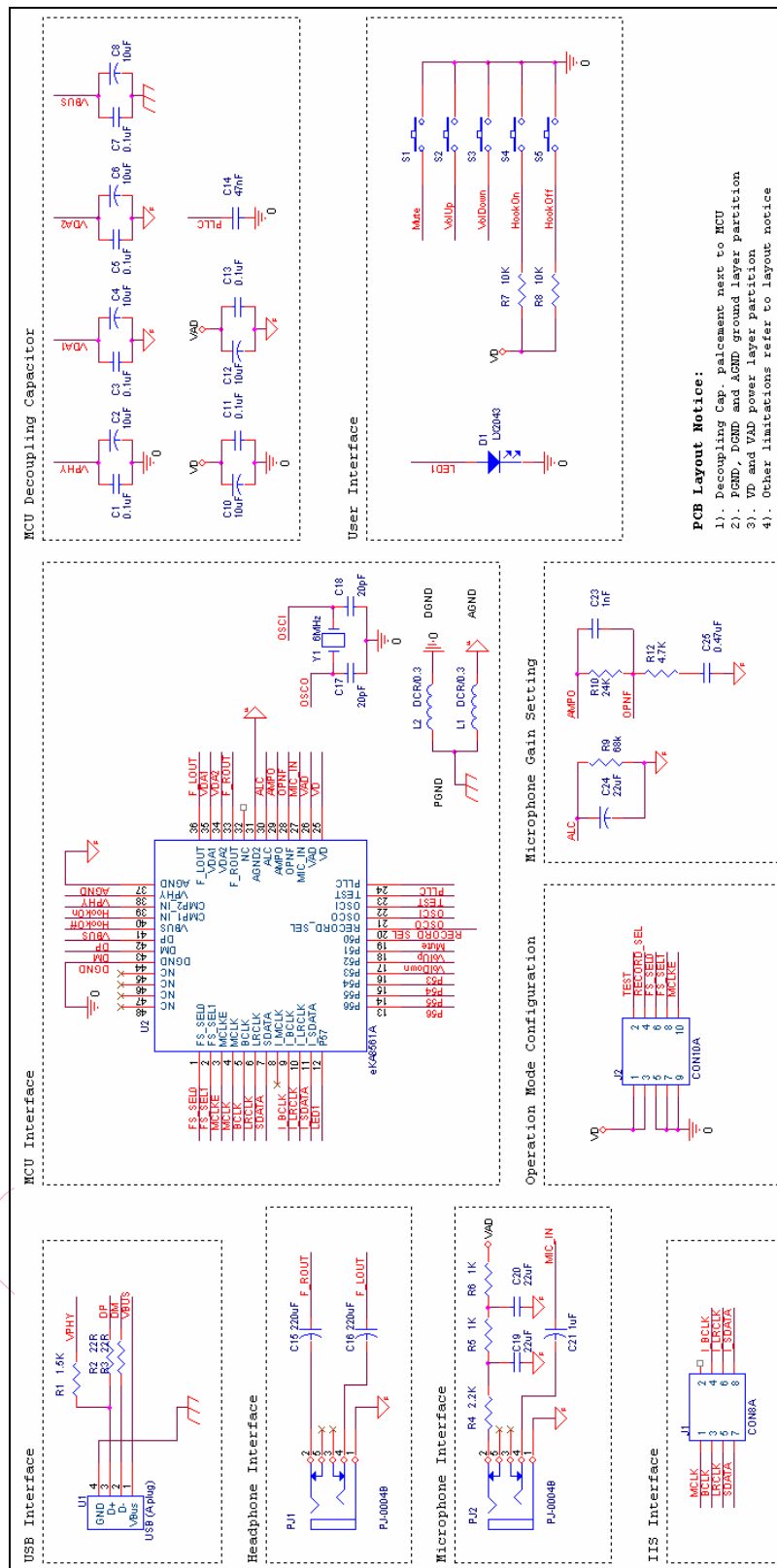


Fig 9-1 eKA8561A 48-pin, Audio Circuit

10 I²S Interface Signal

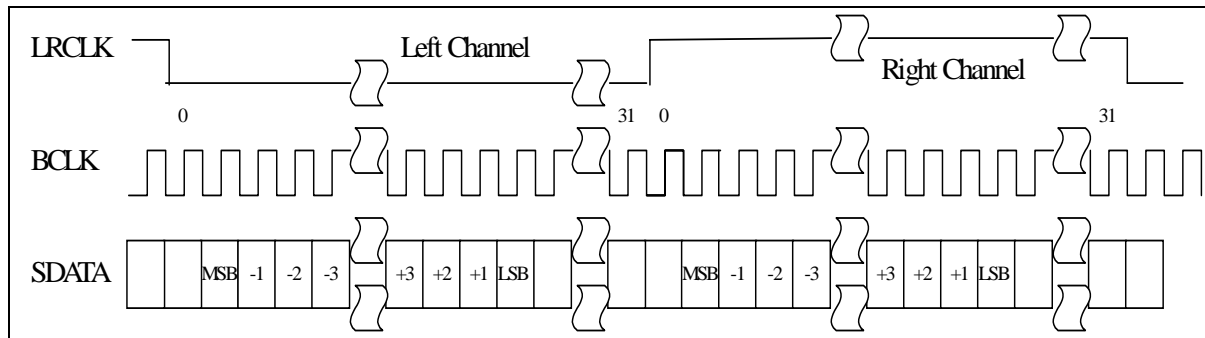


Fig 10-1 I²S Justified Audio Stream Format

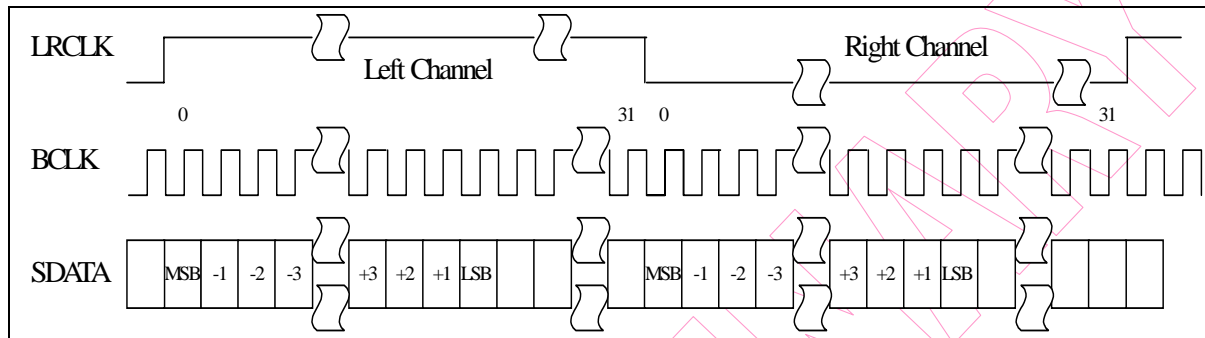


Fig 10-2 Left Justified Audio Stream Format

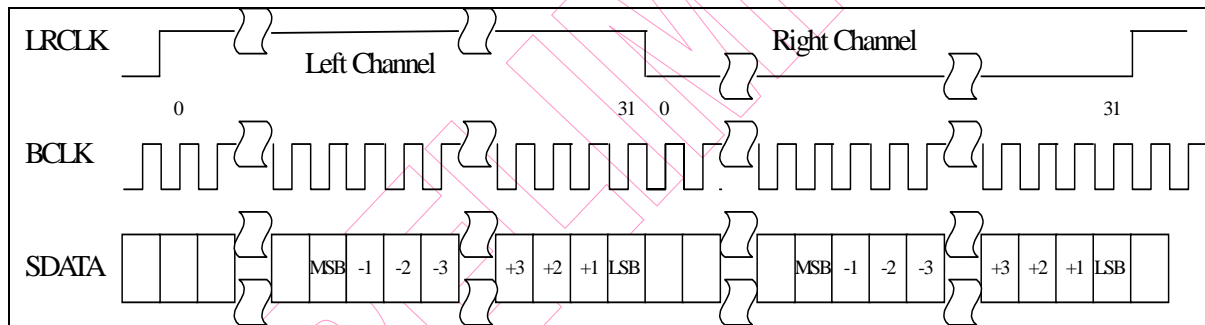


Fig 10-3 Right Justified Audio Stream Format

The LRCLK and BCLK are derived from MCLK.

The frequency ratio is MCLK: LRCLK: BCLK = 256: 1: 64

The frequency of LRCLK equals the sampling rate of 48kHz, 44.1kHz, 32kHz or 8kHz based on FS_SEL0 and FS_SEL1 pins status.

11 Package

Symbol	Min	Normal	Max
A			1.60
A1	0.05		0.15
A2	1.35	1.40	1.45
b	0.17	0.22	0.27
c	0.09		0.20
D1	9.00BCS		
D	7.00BSC		
E1	9.00BSC		
E	7.00BSC		
e	0.50BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
θ	0°	3.5°	7°

義隆電子股份有限公司 ELAN MICROELECTRONICS CORPORATION			TITLE: LQFP-48LQ*7MM FOOTPRINT 2.0mm PACKAGE OUTLINE DIMENSION	
DWG NO: POD-058			File: LQFP48	Edition: A
	Name	Date		Unit: mm
Draw	鍾玉真	92/10/23		Scale: Free
Check	吳進富	92/10/23		Material:
Approved	蔡建文	92/10/23		Sheet: 1 of 1

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