◇Structure Silicon Monolithic integrated circuit
◇Product name USB host AAC+WMA+MP3 Decoder LSI
◇Type BU9438KV
◇Applications Audio products, etc.
◇Functions BU9438KV is AAC+WMA+MP3 decoder IC which contains USB host and SD card I/F, audio DAC, system controller, regulator for internal CORE power supply.

- USB2.0 Full Speed host I/F function contained.
- SD card I/F function contained.
- I^2C I/F function contained.
- FAT analysis function contained.
- MP3 decode function contained. (available for MPEG1, 2 and 2.5, Layer 1, 2 and 3)
- WMA decode function contained. (available for WMA9 standard and not available for DRM)
- AAC decode function contained. (available for MPEG4 AAC-LC and not available for DRM)
- Sample Rate Converter contained.
- System Controller contained.
- LED Controller contained.
- KEY matrix Controller contained.
- Stand Alone mode contained.
- External processor can control.
- Audio DAC contained.
- Sound Effect function contained.
- Digital Audio Out(I^2S, S/PDIF) function contained.
- File Name, Folder Name Sorting.
- ID3TAG and WMATAG and AACTAG Analysis.
- Regulator for internal CORE power supply contained.
- VQFP64pin(0.5mm pitch)

◇Absolute maximum ratings (Ta = 25・C)

Parameter	Symbol	Limits	Unit	Comment
Supply voltage(Analog, I/O)	VDD1MAX	-0.3〜4.5	V	DVDDIO, VDD_PLL, DAVDD, AVDDC
Input voltage	VIN	-0.3 〜 VDD1 + 0.3	V	
Storage temperature range	TSTG	-55〜125	℃	
Operating temperature range	TOPR	-40〜85	℃	
Power dissipation *1	PD	750	mW	

*1：In the case of use at Ta=25℃ or more, 7.5mW should be reduced per 1℃.
Radiation resistance design is not arranged.

◇Operating conditions (Ta = 25℃)

Parameter	Symbol	Limits	Unit	Comment
Supply voltage(Analog, I/O)	VDD1	3.0〜3.6	V	DVDDIO,VDD_PLL, DAVDD, AVDDC

MPEG Layer-3 audio decoding technology licensed from Fraunhofer IIS and Thomson.

Status of this document
The Japanese version of this document is the formal specification. A customer may use this translation version only for a reference to help reading the formal version. If there are any differences in translation version of this document, formal version takes priority.

◇Electrical characteristics

(Unless specified, Ta=25℃, VDD1=3.3V, DVSS=AVSSC=VSS_PLL=DAVSS=0V, XIN_PLL=16.9344MHz)

Parameter	Symbol	Limits			Unit	Condition
		MIN.	TYP.	MAX.		
<Total >						
Circuit current (VDD1 USB1)	IDD1USB1	-	65	80	mA	*1 When USB memory is played.
Circuit current (VDD1 SD1)	IDD1SD1	-	35	50	mA	*1 When SD card is played.
<Digital block>						
H-Level input voltage	VIH	VDD1*0.7	–	VDD1	V	*3
L-Level input voltage	VIL	DVSS	–	VDD1*0.3	V	*3
H-Level output voltage1	VOH1	VDD1-0.4	–	VDD1	V	IOH=-1.6mA, *4
L-Level output voltage1	VOL1	0	–	0.4	V	IOL=1.6mA. *4
H-Level output voltage2	VOH2	VDD1-0.4	–	VDD1	V	IOH=-3.6mA, *5
L-Level output voltage2	VOL2	0	–	0.4	V	IOL=3.6mA, *5
H-Level output voltage3	VOH3	VDD1-0.4	–	VDD1	V	IOH=-0.6mA, *6
L-Level output voltage3	VOL3	0	–	0.4	V	IOL=0.6mA, *6
H-Level output voltage4	VOH4	VDD1-1.0	–	VDD1	V	IOH=-0.6mA, *7
L-Level output voltage4	VOL4	0	–	1.0	V	IOL=0.6mA, *7
<USB-HOST >						
H-Level input voltage	VIHUSB	VDD1*0.6	–	VDD1	V	*8
L-Level input voltage	VILUSB	AVSSC	–	VDD1*0.3	V	*8
Output impedance(H)	ZOH	22.0	45.0	60.0	Ω	*8
Output impedance(L)	ZOL	22.0	45.0	60.0	Ω	*8
H-Level output voltage	VOHUSB	VDD1-0.5	–	VDD1	V	*8
L-Level output voltage	VOLUSB	0	–	0.3	V	*8
Rise/Fall time	Tr/Tf	–	11	–	ns	*8, Output capacity 50pF
Voltage of crossing point	VCRS	–	VDD1/2	–	V	*8, Output capacity 50pF
Range of differential input	VDIFF	0.8	–	2.5	V	*8
Differential input sensitivity	VSENS	0.2	–	–	V	*8
Pull-down resistance	RPD	14.25	15.0	24.8	kΩ	*8
<Audio DAC>						
Distortion rate	THD	–	0.02	–	%	1kHz, 0dB, sine, *9
Dynamic range	DR	–	88	–	dB	1kHz, -60dB, sine, *9
S/N ratio	S/N	–	96	–	dB	*9
Max output level	VSMAX	–	0.92	–	Vrms	1kHz, 0dB, sine, *9

*1 3.3V system I/O, Analog Power supply(VDD1), 1kHz, 0dB, sine-wave playing
*3 1-17, 19-20, 25-26, 40, 49-52, 56, 58-61, 63 pin
*4 10-11, 14-16, 48-55 pin
*5 13 pin
*6 21-23, 26 pin
*7 41 pin
*8 33, 34 pin
*9 44, 46 pin

◇Description of Terminals

No.	Name	I/O	Description of terminals
1	RESETX	I	System reset terminal
2	SEL_SLAVE	I	Slave mode selection (H:Stand Alone mode, L:Slave mode)
3	SEL_MP3	I	MPEG Audio Layer selection (H:Only MP3 is playback, L:MP1, MP2 and MP3 can be playback)
4	SEL_DOUT	I	Digital Audio out selection (H:Disable、L:Enable)
5	SEL_VOL	I	Volume operation selection (H:Volume+- Effective, L:VOL+-Inavalidity)
6	SEL_APLAY	I	At device(USB,SD) connection, Auto Play mode selection(H:It stop, L:It playback)
7	SEL_UTPKT	I	USB test packet output selection (H:Normal operation、L:Test packet output)
8	TEST1	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
9	TEST2	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
10	KEY_ROW1/MCHNG	I/O	[KEY_ROW1]KEY Matrix terminal, [MCHNG]Music change flag terminal
11	KEY_ROW2/BUSY	I/O	[KEY_ROW2]KEY Matrix terminal, [BUSY]Busy flag terminal
12	KEY_ROW3/SCL	I	[KEY_ROW3]KEY Matrix terminal, [SCL]I^2C I/F clock terminal
13	KEY_ROW4/SDA	I/O	[KEY_ROW4]KEY Matrix terminal, [SDA]I^2C I/F data terminal
14	KEY_COL1/A0	I/O	[KEY_COL1]KEY Matrix terminal, [A0]I^2C Slave address selection
15	KEY_COL2/A1	I/O	[KEY_COL2]KEY Matrix terminal, [A1]I^2C Slave address selection
16	KEY_COL3/SEL_SMAN	I/O	[KEY_COL3] KEY Matrix terminal, [SEL_SMAN]Manual mode selection (H:Auto, L:Manual)
17	TEST3	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
18	DVDDIO	−	IO Power supply(VDD1) terminal
19	SD_CON	I	SD card Connect terminal
20	SD_DO	I	SD card Data In terminal
21	SD_CLK	O	SD card Clock terminal
22	SD_DI	O	SD card Data Out terminal
23	SD_CS	O	SD card Chip select terminal
24	DVSS	−	GND terminal
25	TEST4	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
26	TEST5/CLKTOU12	O	[TEST5]Pull-up to VDD1 system power supply terminal(TEST PIN), [CLKOUT12]12MHz clock output terminal
27	DVDD_M2	−	CORE Power supply(VDD2) monitor terminal. Connect to 57PIN.
28	TEST6	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
29	TEST7	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
30	TEST8	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
31	ATEST1	O	USB TEST terminal(TEST PIN)
32	AVDDC	−	USB Power supply(VDD1)terminal
33	USB_DM	I/O	USB D−I/O terminal
34	USB_DP	I/O	USB D+ I/Oterminal
35	AVSSC	−	USB GND terminal
36	REXTI	O	USB bias resistor(12kΩ) connecting terminal
37	VOREFI	O	USB TEST terminal(TEST PIN)
38	VDD_PLL	−	PLL Power supply(VDD1) terminal
39	TEST_PLL	I	PLL TEST terminal(TEST PIN)
40	XIN_PLL	I	X'tal(16.9344MHz) connecting input terminal
41	XOUT_PLL	O	X'tal(16.9344MHz) connecting outpu terminal
42	VSS_PLL	−	PLL GND terminal
43	DAVSS	−	Audio DAC GND terminal
44	RDACO	O	Audio DAC Rch Line output terminal
45	VCDACO	O	Audio DAC Reference voltage output teminal
46	LDACO	O	Audio DAC Lch Line output terminal
47	DAVDD	−	Audio DAC Power supply(VDD1) terminal
48	AMUTE	O	Audio Mute output terminal (H:MUTE OFF, L:MUTE ON)
49	LED_ERROR/TEST9	O	[LED]Lighting output terminal at ERROR, [TEST9]Pull-up to VDD1 system power supply terminal(TEST PIN)
50	LED_PLAY/TEST10	O	[LED]Lighting output terminal at PLAY, [TEST10]Pull-up to VDD1 system power supply terminal(TEST PIN)
51	LED_PSD/TEST11	O	[LED]Lighting output terminal at PLAY for SD card, [TEST11]Pull-up to VDD1 system power supply terminal(TEST PIN)
52	LED_PUSB/TEST12	O	[LED]Lighting output terminal at PLAY for USB memory, [TEST12] Pull-up to VDD1 system power supply terminal(TEST PIN)
53	LED_ACCESS	O	[LED]Lighting output terminal when memory is being accessed, [LRCK]Digital Audio channel clock or SPDIF output terminal
54	LED_RANDOM	O	[LED]Lighting output terminal at PLAY for RANDOM, [BCK]Digital Audio bit clock output terminal
55	LED_REPEAT	O	[LED]Lighting output terminal at PLAY for REPEAT, [DATA]Digital Audio data output terminal
56	TEST13	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
57	DVDD_M1	−	CORE Power supply(VDD2) monitor terminal, Connect to bypass condenser
58	TEST14	I	Connect to GND(TEST PIN)
59	TEST15	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
60	TEST16	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
61	TEST17	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
62	DVSS	−	GND terminal
63	TMODE	I	Connect to GND(TEST PIN)
64	DVDDIO	−	IO Power supply(VDD1) terminal

◇External dimensions・Block diagram

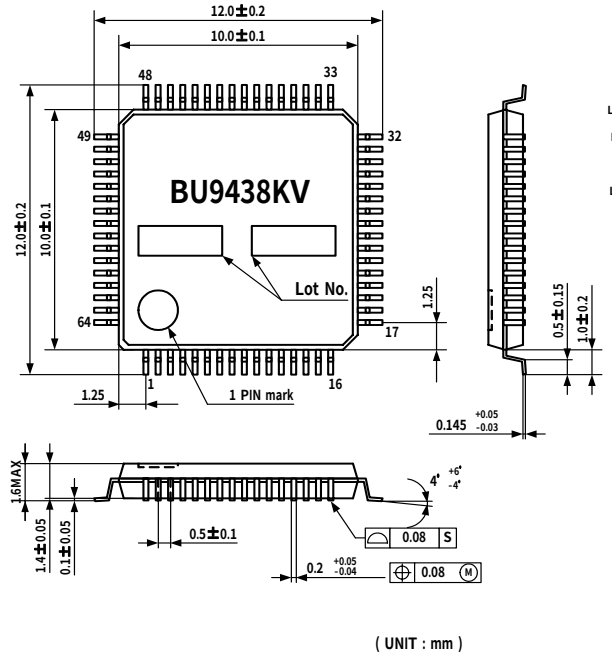

Figure 1. External dimention

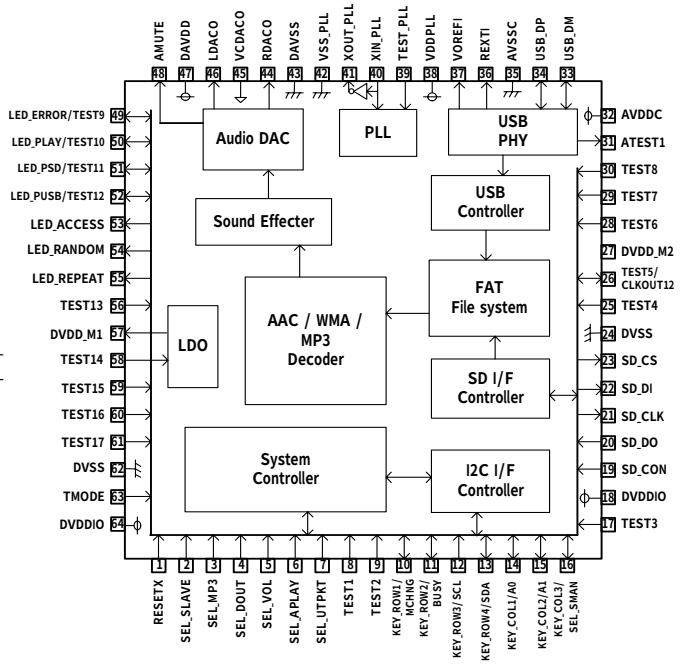

Figure 2. Block diagram

◇Caution

(1) Power on Reset
Please keep the terminal RESETX at the Low level when the power supply starts. After completely starting up 3.3V system power supply , afterwards, please make the terminal RESETX High level after 5us after the oscillation of the system clock is steady. Moreover, please make the terminal RESETX Low level during 5us or more when resetting it while operating..

(2) About compatibility in USB memory device and SD memory card
According to the file structure and communication speed of an USB memory, SD memory card, this LSI might not play back correctly.

(3) About turning on the power supply
Current rush might flow momentarily by the order of turning on the power supply and the delay in IC with two or more power supplies, and note the capacity of the power supply coupling, the power supply, and width and drawing the GND pattern wiring.

(4) About absolute maximum rating
When the absolute maximum rating such as the applied voltage and the ranges of the operating temperature is exceeded, LSI might be destroyed. Please apply neither voltage nor the temperature that exceeds the absolute maximum rating. Please execute physical measures for safety such as fuse when it is thought to exceed the absolute maximum rating, and examine it so that the condition to exceed the absolute maximum rating is not applied to LSI.

(5) About GND Voltage
In any state of operation must be the lowest voltage about the voltage of the terminal GND. Please actually confirm the voltage of each terminal is not a voltage that is lower than the terminal GND including excessive phenomenon.

(6) About design of overheating malfunction preventive circuit
Please design overheating malfunction preventive circuit with an enough margin in consideration of a permissible loss in the state of using actually.

(7) About the short between terminals and the mounting by mistake
Please note the direction and the gap of position of LSI enough about LSI when you mount on the substrate. LSI might be destroyed when mounting by mistake and energizing. Moreover, LSI might be destroyed when short-circuited by entering of the foreign substances between the terminal and GND, between terminals, between the terminal and the power supply of LSI.

(8) About operation in strong electromagnetic field
Use in strong electromagnetic field has the possibility of malfunctioning and evaluate it enough, please.