◇**Structure** **Silicon Monolithic integrated circuit**
◇**Product name** **USB host +CD-ROM decoder + WAV/AAC/WMA/MP3 Decoder LSI**
◇**Type** **BU94605KV**
◇**Applications** **Audio products, etc.**
◇**Functions** **BU94605KV is WAV/AAC/WMA/MP3 decoder IC which contains program download function from external serial Flash ROM and contains USB host, SD card I/F, CD-ROM 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 format I/F 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)
WAV format file playing function contained.
Sample Rate Converter contained.
System Controller contained.
FAT analysis function contained.
CD-ROM I/F function and CD-ROM decode function contained.
Browsing function of other File Names, Folder Names on music playing contained.
ID3TAG and WMATAG and AACTAG Analysis.
Fast forward playing and fast backward playing function contained.
External processor can control.
Resume function contained.
Audio DAC contained. Sound Effect function contained.
Digital Audio Out(I^2S, EIAJ, S/PDIF) function contained.
Program download function from external serial Flash ROM contained.
Regulator for internal CORE power supply contained.
VQFP80pin(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	900	mW	

*1：In the case of use at Ta=25℃ or more, 9mW 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

◇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	-	60	90	mA	*1 When USB memory is played.
Circuit current (VDD1 SD1)	IDD1SD1	-	35	60	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
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	20.0	24.8	kΩ	*8
<Audio DAC>						
Distortion rate	THD	―	0.005	―	%	1kHz, 0dB, sine, *9
Dynamic range	DR	―	90	―	dB	1kHz, -60dB, sine, *9
S/N ratio	S/N	―	95	―	dB	*9
Max output level	VSMAX	―	0.67	―	Vrms	1kHz, 0dB, sine, *9

*1 3.3V system I/O, Analog Power supply(VDD1), 1kHz, 0dB, sine-wave playing

*3 1, 3, 4-9, 14-23, 29, 31-32, 34-35, 61-63, 71-76 pin

*4 9, 11-12, 14-15, 18-20, 30, 36, 58-60, 61-67, 69-70 pin

*5 2, 3, 17 pin

*6 24-26, 28, 29 pin

*7 49 pin

*8 41, 42 pin

*9 53, 55 pin

◇Description of Terminals

No.	Name	I/O	Description of terminals
1	RESETX	I	System reset terminal
2	TEST15	O	[TEST15]Pull-up at 2.2k ohm to VDD1 system power supply terminal(TEST PIN)
3	TEST16	O	[TEST16]Pull-up at 2.2k ohm to VDD1 system power supply terminal(TEST PIN)
4	SEL_SLAVE	I	Slave mode selection（H：Stand Alone mode, L：Slave mode）
5	SEL_MP3/INREQI	I	[SEL_MP3]MPEG Audio Layer selection（H：Only MP3, L：MP1, MP2 and MP3 can be playback）, [INREQI]Input data valid
6	SEL_DOUT/LRCKI	I	[SEL_DOUT]Digital Audio out selection（H：Disable、L：Enable）, [LRCKI]Digital Audio channel clock input terminal
7	SEL_VOL/BCKI	I	[SEL_VOL] Volume operation selection（H：Volume+- Effective, L：VOL+-Inavalidity）, [BCKI]Digital Audio bit clock input terminal
8	SEL_APLAY/SDATAI	I	[SEL_APLAY] At device(USB,SD) connection, Auto Play mode selection(H:It stop, L:It playback), [SDATAI]Digital Audio data input terminal
9	SEL_UTPKT/BFULLO	I/O	[SEL_UTPKT] USB test packet output selection（H：Normal、L：Test packet）,[BFULLO]Input buffer FULL flag output terminal
10	DVSS	—	GND terminal
11	IRPTO	O	To HOST interruption output terminal
12	SEARCH	O	Search flag terminal
13	DVDDIO	—	IO Power supply(VDD1) terminal
14	KEY_ROW1/MCHNG	I/O	[KEY_ROW1]KEY Matrix terminal, [MCHNG]Music change flag terminal
15	KEY_ROW2/BUSY	I/O	[KEY_ROW2]KEY Matrix terminal, [BUSY]Busy flag terminal
16	KEY_ROW3/SCL	I	[KEY_ROW3]KEY Matrix terminal, [SCL]I^2C slave clock I/F input terminal
17	KEY_ROW4/SDA	I/O	[KEY_ROW4]KEY Matrix terminal, [SDA]I^2C slave data I/F terminal
18	KEY_COL1/A0	O/I	[KEY_COL1]KEY Matrix terminal, [A0]I^2C slave address selection
19	KEY_COL2/A1	O/I	[KEY_COL2]KEY Matrix terminal, [A1]I^2C slave address selection
20	KEY_COL3/SEL_I2C	O/I	[KEY_COL3]KEY Matrix terminal, [SEL_I2C]Pull-up to VDD1 system power supply terminal
21	SD_WP	I	SD card Write Protect terminal
22	SD_CON	I	SD card Connect terminal
23	SD_DO	I	SD card Data In terminal
24	SD_CLK	O	SD card Clock terminal
25	SD_DI	O	SD card Data Out terminal
26	SD_CS	O	SD card Chip select terminal
27	DVSS	—	GND terminal
28	FL_CS	O	Serial FLASH ROM Chip select terminal
29	TEST/CLK12MO	I/O	[TEST] Pull-up to VDD1 system power supply terminal(TEST PIN), [CLK12MO]12MHz clock output terminal
30	TEST5	O	[TEST5]OPEN (TEST PIN)
31	TEST6	I	[TEST6]Pull-up to VDD1 system power supply terminal(TEST PIN)
32	TEST7	I	[TEST7]Pull-up to VDD1 system power supply terminal(TEST PIN)
33	DVDDIO	—	IO Power supply(VDD1) terminal
34	TEST8	I	[TEST8]Pull-up to VDD1 system power supply terminal(TEST PIN)
35	TEST9	I	[TEST9]Pull-up to VDD1 system power supply terminal(TEST PIN)
36	TEST10	O	OPEN (TEST PIN, IPL ERROR Flag output)
37	DVSS	—	GND terminal
38	DVDD_M2	—	CORE Power supply(VDD2) monitor terminal. Connect to DVDD_M1 pin.
39	ATEST1	O	USB TEST terminal(TEST PIN), OPEN
40	AVDDC	—	USB Power supply(VDD1)terminal
41	USB_DM	I/O	USB D－I/O terminal
42	USB_DP	I/O	USB D+ I/Oterminal
43	AVSSC	—	USB GND terminal
44	REXTI	O	USB bias resistor(12kΩ) connecting terminal
45	VOREFI	O	USB TEST terminal(TEST PIN), OPEN
46	VSS_PLL	—	PLL GND terminal
47	TEST_PLL1	I	PLL TEST terminal(TEST PIN), OPEN
48	XIN_PLL	I	X'tal(16.9344MHz) connecting input terminal
49	XOUT_PLL	O	X'tal(16.9344MHz) connecting output terminal
50	TEST_PLL2	O	PLL TEST terminal(TEST PIN), Pull-up to VDD1 system power supply terminal
51	VDD_PLL	—	PLL Power supply(VDD1) terminal
52	DAVSS	—	Audio DAC GND terminal
53	RDACO	O	Audio DAC Rch Line output terminal
54	VCDACO	O	Audio DAC Reference voltage output teminal
55	LDACO	O	Audio DAC Lch Line output terminal
56	DAVDD	—	Audio DAC Power supply(VDD1) terminal
57	DVSS	—	GND terminal
58	AMUTE	O	Audio Mute output terminal（H：MUTE OFF, L：MUTE ON）
59	TEST11	O	OPEN (TEST PIN)

60	TEST12/MCLK	O	[TEST12] OPEN (TEST PIN), [MCLK] Digital Audio master clock (16.9344MHz) output terminal
61	LED_ERROR/ SS_CS	O/I	[LED]Lighting output terminal at ERROR, [SS_CS] Slave SIO Chip select In terminal
62	LED_PLAY/SS_DI	O/I	[LED]Lighting output terminal at PLAY, [SS_DI] Slave SIO Data In terminal
63	LED_PSD/SS_CLK	O/I	[LED]Lighting output terminal at PLAY for SD card, [SS_CLK] Slave SIO Clock In terminal
64	LED_PUSB/SS_DO	O	[LED]Lighting output terminal at PLAY for USB memory, [SS_DO] Slave SIO Data Out terminal
65	LED_ACCESS/LRCKO	O	[LED]Lighting output terminal when memory is being accessed,[LRCKO]Digital Audio channel clock or SPDIF output terminal
66	LED_RANDOM/BCKO	O	[LED]Lighting output terminal at PLAY for RANDOM, [BCKO]Digital Audio bit clock output terminal
67	LED_REPEAT/SDATAO	O	[LED]Lighting output terminal at PLAY for REPEAT, [SDATAO]Digital Audio data output terminal
68	DVDDIO	—	IO Power supply(VDD1) terminal
69	TEST13	O	OPEN (TEST PIN)
70	TEST14	O	OPEN (TEST PIN)
71	SEL_USB	I	At device(USB,SD) connection, 1st device detection selection(H:USB, L:SD)
72	TEST4	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
73	TEST3	I	Pull-up to VDD1 system power supply terminal(TEST PIN, L: IPL WRITE MODE1)
74	TEST2	I	Pull-up to VDD1 system power supply terminal(TEST PIN, L: IPL WRITE MODE2)
75	TEST1	I	Pull-up to VDD1 system power supply terminal(TEST PIN)
76	TMODE	I	Connect to GND(TEST PIN)
77	DVSS	—	GND terminal
78	DVDD_M1	—	CORE Power supply(VDD2) monitor terminal, Connect to bypass condenser
79	DVDDIO	—	IO Power supply(VDD1) terminal
80	TEST0	I	Connect to GND(TEST PIN)

◇External dimensions・Block diagram

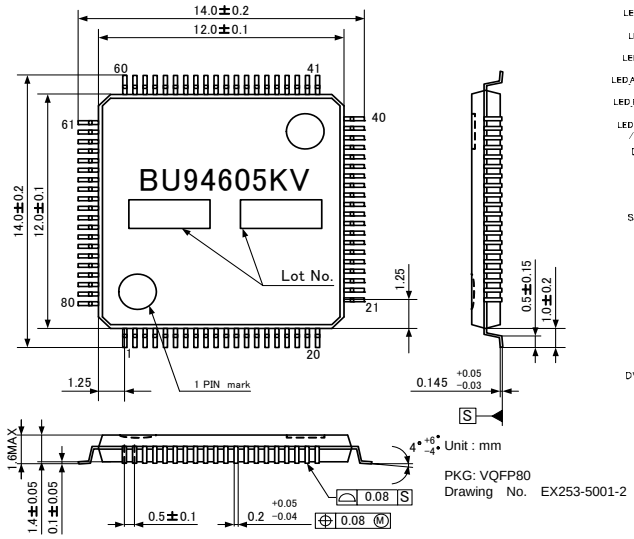


Figure 1. External dimention

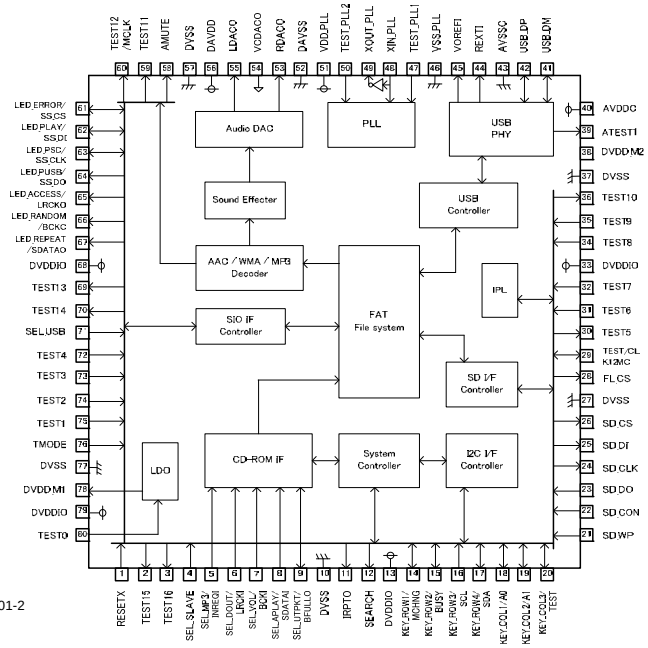


Figure 2. Block diagram

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 100us after the oscillation of the system clock is steady. Moreover, please make the terminal RESETX Low level during 100us 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.

(9) Power off or memory disconnection under memory writing

The sudden power off or memory disconnection during file write operation to a memory may break the data in a memory.

(10) Browsing operation

With a memory with slow access speed, Browsing operation during music playing may generate skipping.

(11) CD-ROM playing

CD-ROM playing operation is premised on data being inputted so that an internal data buffer may not become empty.
When an input does not meet the deadline and internal data buffers become empty, skipping occurs.

(12) Playing time of MP3 file

The playing time of an MP3 file may shift when fast forward playing, rewinding playing, and VBR playing.

(13) Write-in operation exceeding memory size

When memory size is exceeded, IC will stop writing to a file and will be in an error condition.

(14) Write-in operation of the file size exceeding FAT specification

When file size is exceeded, IC will stop writing to a file and will be in an error condition.

(15) About WMA

Windows Media Audio is the music compression technology which Microsoft Corp. developed.
Windows Media is the registered trademark of U.S. Microsoft Corporation in the U.S., and other countries.

(16) About I^2C format I/F

Although this LSI has adopted the I^2C format, the level shifter circuit is not built in.
For this reason, level shifter is needed for connection with the device besides the range of operating power supply voltage of this LSI.

Notes

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