USB Audio Decoder LSI Series

AAC/WMA/MP3 +SD Memory Card + iPod

BU9450xAxxx Series

●Description

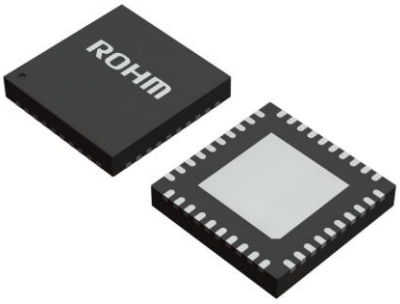
BU9450xAxxx series are WAV/AAC/WMA/MP3 decoder LSI which contains USB host, SD card I/F, audio DAC, system controller, regulator for internal CORE power supply.

●Features

- USB2.0 Full Speed host I/F function contained.
- SD card I/F function contained.
- I^2C format I/F function contained.
- Protocol conversion from I^2C to USB HID or from USB HID to I^2C. (BU94502AMUV and BU94502AKS2 only)
- 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.
- Browsing function of File Names, Folder Names on music playing contained.
- ID3TAG and WMATAG and AACTAG Analysis.
- Fast forward playing and fast backward playing function contained.
- Resume function contained.
- Reading a specified file data is possible from connected memory.
- LUN is selectable.
- Sound Effect function contained.
- Digital Audio Out function contained. (I^2S, EIAJ, S/PDIF)
- Audio DAC contained.
- Regulator for internal CORE power supply contained.

●Package

W(Typ.) x D(Typ.) x H(Max.)



VQFN040V6060
6.00mm x 6.00mm x 1.00mm

SQFP-T52
12.00mm x 12.00mm x 1.50mm

●Applications

Audio products, etc

●Line up

Part number	iPod	Package		Ordering part number
BU94501AMUV	Not supported	VQFN040V6060	Reel of 2000	BU94501AMUV-E2
BU94501AKS2		SQFP-T52	Tray of 1000	BU94501AKS2
BU94502AMUV	Supported	VQFN040V6060	Reel of 2000	BU94502AMUV-E2
BU94502AKS2		SQFP-T52	Tray of 1000	BU94502AKS2

○Product structure : Silicon Monolithic integrated circuit ○Radiation resistance design is not arranged

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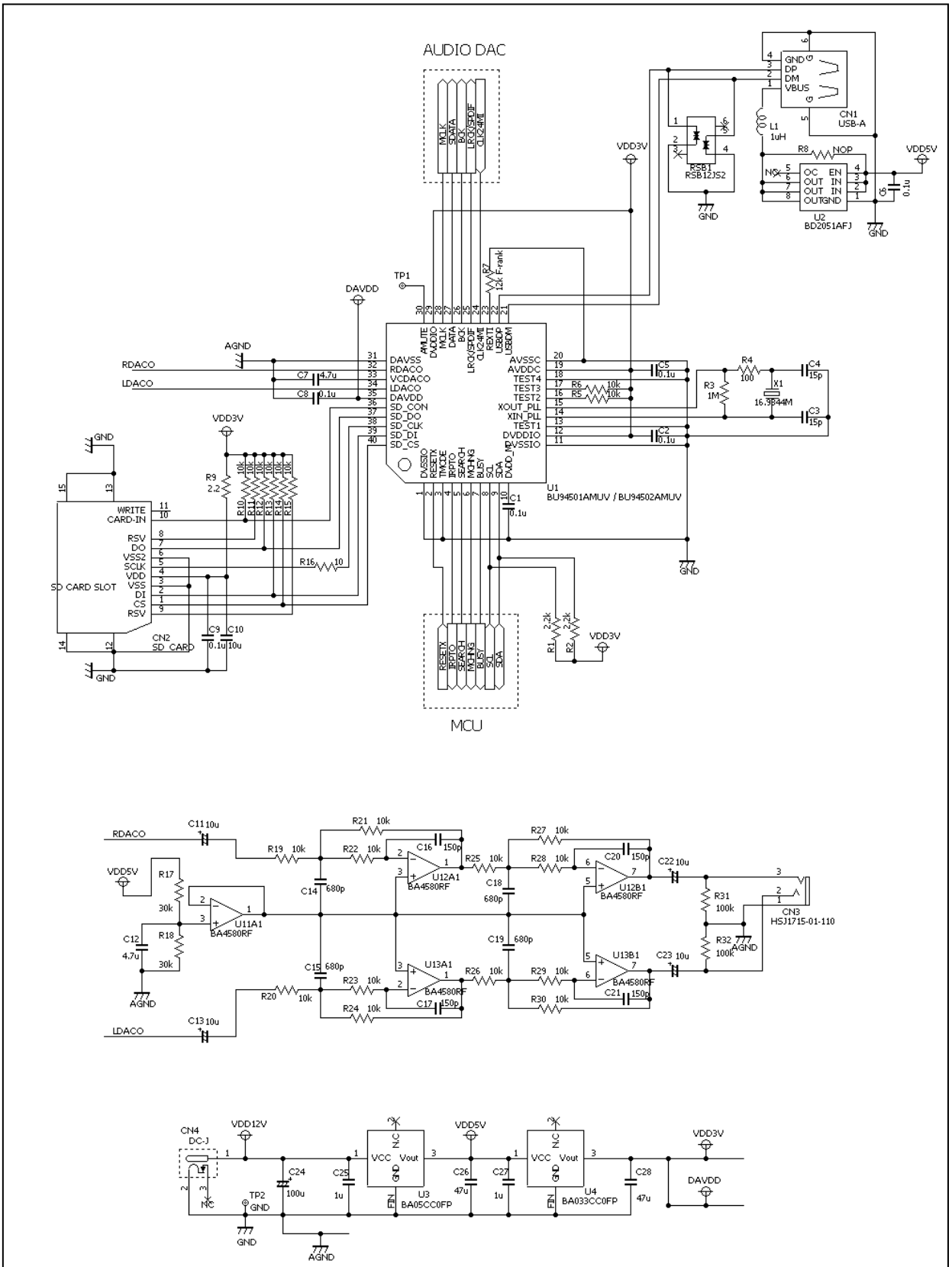
●**Basic circuit application diagram -part1**



This LSI builds in regulator for internal CORE power supply (1.5V).
DVDD_M terminal of 10PIN connect to bypass condenser and don't connect to power supply (3.3V)
Please confirm the optimal oscillation circuit parameters applicable to your systems or products with the oscillator manufacturer in advance.
VQFN040V6060 package exposes its frame of the backside of package. Note that this part is assumed to use after providing heat dissipation treatment to improve heat dissipation efficiency. Try to occupy as wide as possible with heat dissipation pattern not only on the board surface but also the backside.

Figure 1. an example of connection circuit application（BU9450xAMUV）

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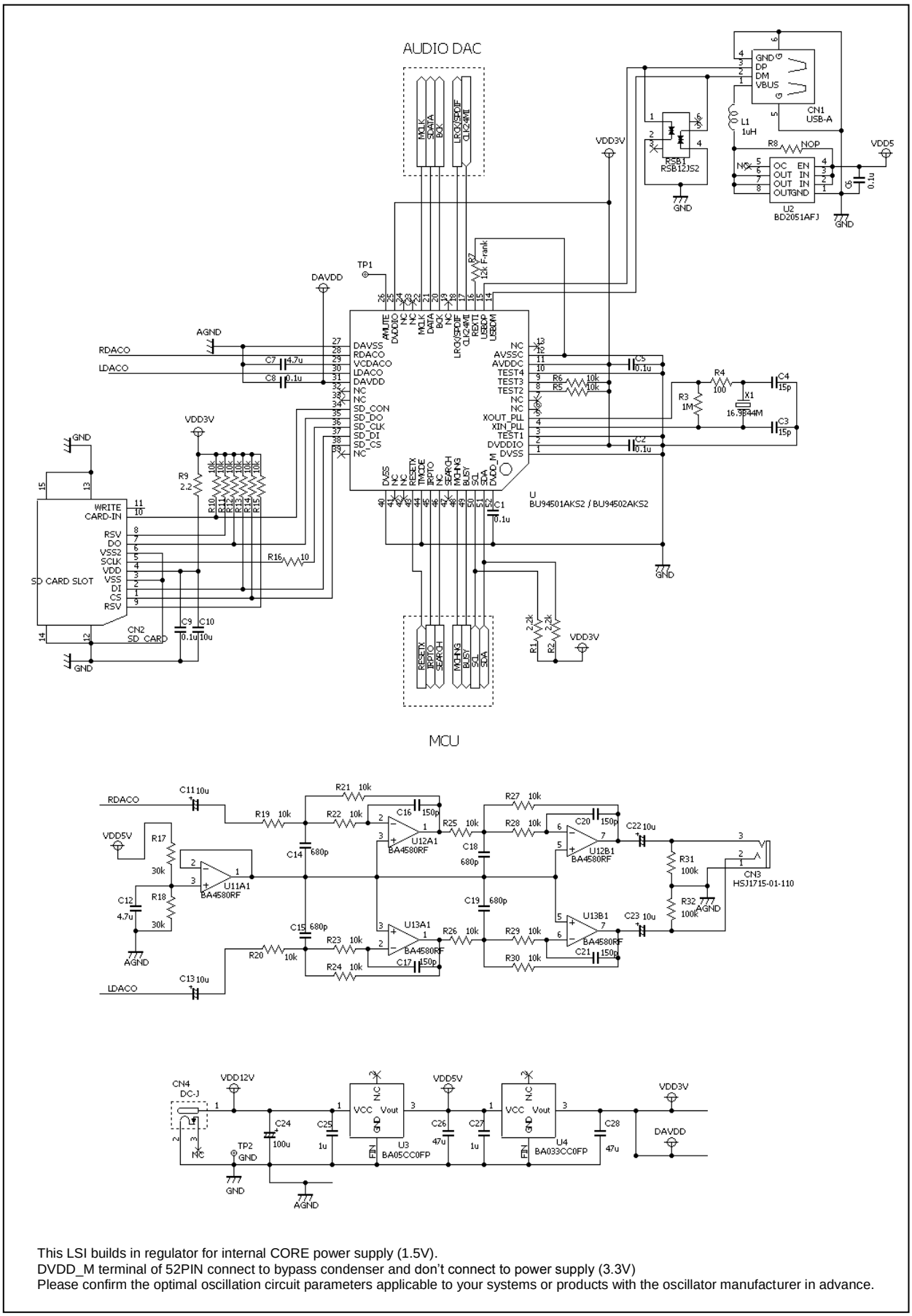
●**Basic circuit application diagram -part2**



This LSI builds in regulator for internal CORE power supply (1.5V).
DVDD_M terminal of 52PIN connect to bypass condenser and don't connect to power supply (3.3V)
Please confirm the optimal oscillation circuit parameters applicable to your systems or products with the oscillator manufacturer in advance.

Figure 2. an example of connection circuit application（BU9450xAKS2）

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●**Difference of BU9450XA Series features**

Item	BU94502AMUV	BU94501AMUV	BU94502AKS2	BU94501AKS2
Package	VQFN040V6060		SQFP-T52	
Number of pins	40pin		52pin	
Power supply	3.3V (inner 1.5V regulator)		3.3V (inner 1.5V regulator)	
USB Host I/F	USB Full speed(12Mbps), USB mass storage class		USB Full speed(12Mbps), USB mass storage class	
SD card I/F	SPI mode SD, SDHC, MMC, mini-SDcard		SPI mode SD, SDHC, MC, mini-SDcard	
iPod	Supported	Not supported *1	Supported	Not supported *1
iPod automatic enumeration	Supported	Not supported *1	Supported	Not supported *1
I^2C command I/F （Slave）	Supported		Supported	
Patch cord download	Supported		Supported	
Change the Setting of timeout and retry mode in USB memory or SD card mount operation	Supported		Supported	
Audio line output	Supported		Supported	
Digital audio output	I^2S, EIAJ, SPDIF		I^2S, EIAJ, SPDIF	
Sample rate convertor	Supported		Supported	
clock	16.9344MHz (*1)		16.9344MHz (*1)	
Playable MP3 files	*.mp3, *.mp2, *.mp1		*.mp3, *.mp2, *.mp1	
Playable WMA files	*.asf, *.wma		*.asf, *.wma	
Playable AAC files	*.m4a, *.3gp, *.mp4		*.m4a, *.3gp, *.mp4	
Playable WAV files	*.wav		*.wav	
Browsing function	Supported		Supported	

*1 For using of BU94502AMUV and BU94502AKS2, It is necessary to become a licensee of Apple Inc. regarding "Made for iPod/iPhone/iPad License".

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●**Block diagram**

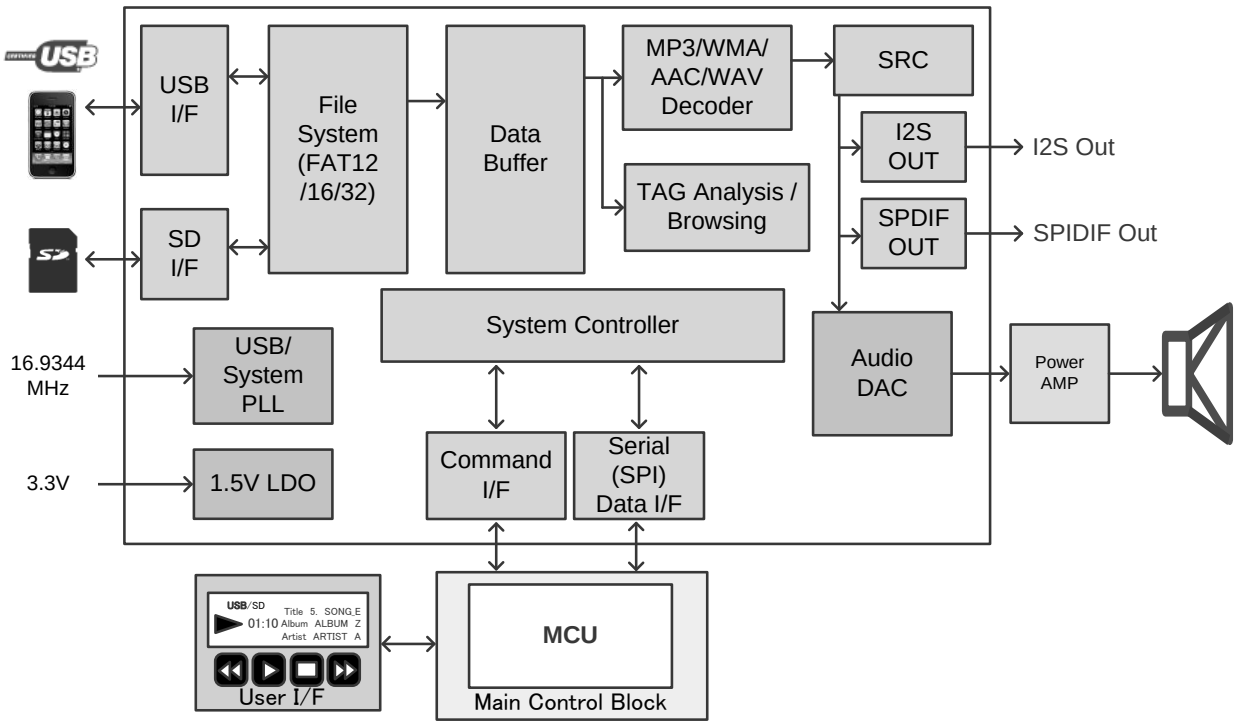

Figure 3. Block diagram

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●Arrangement of Terminals

BU94501AMUV / BU94502AMUV

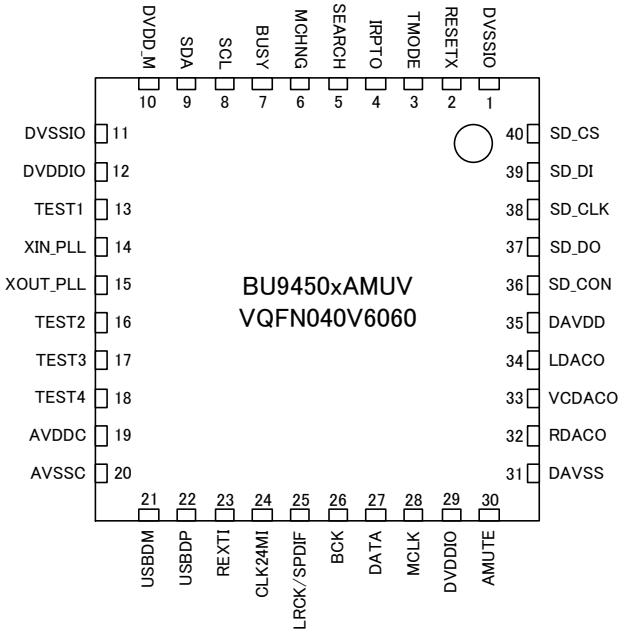

Figure 4. Arrangement of Terminals (BU9450xAMUV)

BU94501AKS2 / BU94502AKS2

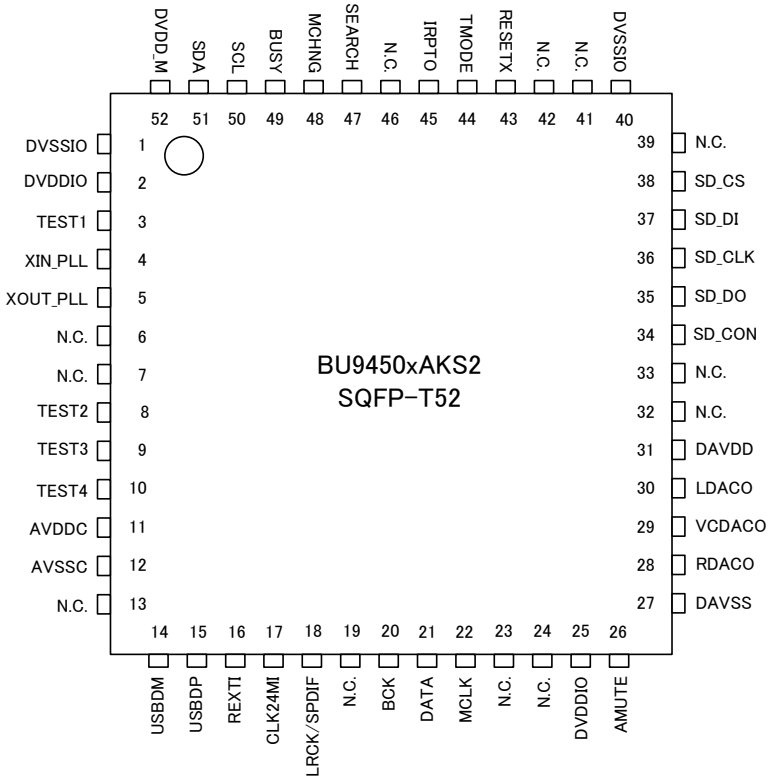

Figure 5. Arrangement of Terminals (BU9450xAKS2)

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●**Description of Terminals -part1**

BU94501AMUV / BU94502AMUV

No	Pin Name	IO Cir	IO	PU	Function
1	DVSSIO	—	—	—	GND terminal
2	RESETX	A	I	PU*3	H: Release RESET, L: RESET
3	TMODE	H	I	—	Test mode terminal. Connect it to GND.
4	IRPTO	B	O	—	Connection interrupt output terminal
5	SEARC	B	O	—	Search flag output terminal
6	MCHNG	B	O	—	File play end flag output terminal
7	BUSY	B	O	—	Command analysis BUSY output temrinal
8	SCL	I	I	*2	I^2C slave clock input terminal
9	SDA	I	I/O	*2	I^2C slave data I/O terminal
10	DVDD_M	—	—	—	CORE power (VDD2) monitor terminal. Connect it to bypass capacitor.
11	DVSSIO	—	—	—	GND terminal
12	DVDDIO	—	—	—	IO power (VDD1) terminal
13	TEST1	—	I	—	Test mode terminal. Connect it to GND.
14	XIN_PLL	E	I	—	X'tal (16.9344MHz) connection input terminal.
15	XOUT_PLL	E	O	—	X'tal (16.9344MHz) connection output terminal.
16	TEST2	H	I	PU	Pull it up at VDD1 power.
17	TEST3	H	I	PU	Pull it up at VDD1 power.
18	TEST4	H	I	PU *1*3	Test mode terminal. Connect it to GND.
19	AVDDC	—	—	—	USB Power supply (VDD1) terminal
20	AVSSC	—	—	—	USB GND terminal
21	USB_DM	C	I/O	—	USB D－I/O terminal
22	USB_DP	C	I/O	—	USB D+ I/O terminal
23	REXTI	D	O	—	USB bias resistor (12kΩ) connecting terminal Arrange the resistance of 12kΩ near PIN, and wiring on the PIN side doesn't cross with other signal lines.
24	CLK24MI	B	I/O	PU*3	24MHz clock input terminal at SRC through mode
25	LRCK/SPDIF	B	O	—	Digital Audio channel clock or SPDIF output terminal
26	BCK	B	O	—	Digital Audio bit clock output terminal
27	DATA	B	O	—	Digital Audio data output terminal
28	MCLK	B	O	—	Audio Master clock (12.288MHz/16.9344MHz) output terminal
29	DVDDIO	—	—	—	IO Power supply (VDD1) terminal
30	AMUTE	G	O	—	Audio Mute output terminal (H：MUTE OFF, L：MUTE ON)
31	DAVSS	—	—	—	Audio DAC GND terminal
32	RDACO	F	O	—	Audio DAC Rch Line output terminal
33	VCDACO	J	O	—	Audio DAC Reference voltage output terminal
34	LDACO	F	O	—	Audio DAC Lch Line output terminal
35	DAVDD	B	—	—	Audio DAC Power supply (VDD1) terminal
36	SD_CON	B	I	PU*3	SD card Connect terminal
37	SD_DO	B	I	—	SD card Data In terminal
38	SD_CLK	B	O	—	SD card Clock terminal
39	SD_DI	B	O	—	SD card Data Out terminal
40	SD_CS	B	O	—	SD card Chip select terminal

*1 Pull-Up turns OFF when L is input.
*2 An external pull-up resistor is required because of Open Drain IO
*3 please input L level directly without resistance when you input L to the terminal with Pull-Up (about 33 kΩ)

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●**Description of Terminals -part2**

BU94501AKS2 / BU94502AKS2

No	Pin Name	IO Cir	IO	PU	Function
1	DVSSIO	ー	ー	ー	GND terminal
2	DVDDIO	ー	ー	ー	IO power (VDD1) terminal
3	TEST1	ー	I	ー	Test mode terminal. Connect it to GND.
4	XIN_PLL	E	I	ー	X'tal (16.9344MHz) connection input terminal.
5	XOUT_PLL	E	O	ー	X'tal (16.9344MHz) connection output terminal.
6	N.C.	ー	ー	ー	Non Connection
7	N.C.	ー	ー	ー	Non Connection
8	TEST2	H	I	PU	Pull it up at VDD1 power.
9	TEST3	H	I	PU	Pull it up at VDD1 power.
10	TEST4	H	I	PU *1*3	Test mode terminal. Connect it to GND.
11	AVDDC	ー	ー	ー	USB Power supply (VDD1) terminal
12	AVSSC	ー	ー	ー	USB GND terminal
13	N.C.	ー	ー	ー	Non Connection
14	USB_DM	C	I/O	ー	USB D－I/O terminal
15	USB_DP	C	I/O	ー	USB D+ I/O terminal
16	REXTI	D	O	ー	USB bias resistor (12kΩ) connecting terminal Arrange the resistance of 12kΩ near PIN, and wiring on the PIN side doesn't to cross with other signal lines.
17	CLK24MI	B	I	PU*3	24MHz clock input terminal at SRC through mode
18	LRCK/SPDIF	B	O	ー	Digital Audio channel clock or SPDIF output terminal
19	N.C.	ー	ー	ー	Non Connection
20	BCK	B	O	ー	Digital Audio bit clock output terminal
21	DATA	B	O	ー	Digital Audio data output terminal
22	MCLK	B	O	ー	Audio Master clock (12.288MHz/16.9344MHz) output terminal
23	N.C.	ー	ー	ー	Non Connection
24	N.C.	ー	ー	ー	Non Connection
25	DVDDIO	ー	ー	ー	IO Power supply (VDD1) terminal
26	AMUTE	G	O	ー	Audio Mute output terminal (H：MUTE OFF, L：MUTE ON)
27	DAVSS	ー	ー	ー	Audio DAC GND terminal
28	RDACO	F	O	ー	Audio DAC Rch Line output terminal
29	VCDACO	J	O	ー	Audio DAC Reference voltage output terminal
30	LDACO	F	O	ー	Audio DAC Lch Line output terminal
31	DAVDD	B	ー	ー	Audio DAC Power supply (VDD1) terminal
32	N.C.	ー	ー	ー	Non Connection
33	N.C.	ー	ー	ー	Non Connection
34	SD_CON	B	I	PU*3	SD card Connect terminal
35	SD_DO	B	I	ー	SD card Data In terminal
36	SD_CLK	B	O	ー	SD card Clock terminal
37	SD_DI	B	O	ー	SD card Data Out terminal
38	SD_CS	B	O	ー	SD card Chip select terminal
39	N.C.	ー	ー	ー	Non Connection
40	DVSSIO	ー	ー	ー	GND terminal
41	N.C.	ー	ー	ー	Non Connection
42	N.C.	ー	ー	ー	Non Connection
43	RESETX	A	I	PU*3	H: Release RESET, L: RESET
44	TMODE	H	I	ー	Test mode terminal. Connect it to GND.
45	IRPTO	B	O	ー	Connection interrupt output terminal
46	N.C.	ー	ー	ー	Non Connection
47	SEARCH	B	O	ー	Search flag output terminal
48	MCHNG	B	O	ー	File play end flag output terminal
49	BUSY	B	O	ー	Command analysis BUSY output terminal
50	SCL	I	I	*2	I^2C slave clock input terminal
51	SDA	I	I/O	*2	I^2C slave data I/O terminal
52	DVDD_M	ー	ー	ー	CORE power (VDD2) monitor terminal Connect it to bypass capacitor.

*1 Pull-Up turns OFF when L is input.
*2 An external pull-up resistor is required because of Open Drain IO
*3 please input L level directly without resistance when you input L to the terminal with Pull-Up (about 33 kΩ)

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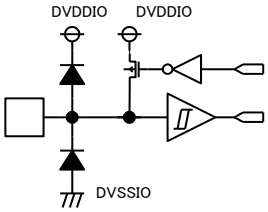
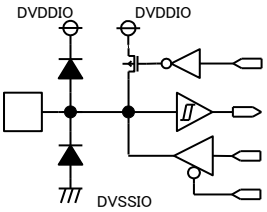
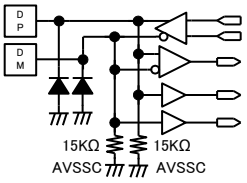
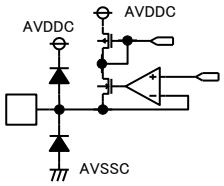
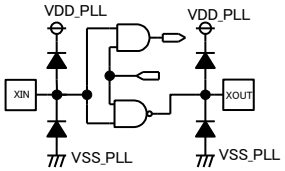
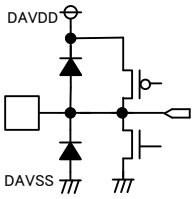
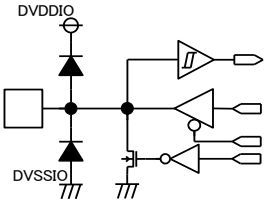
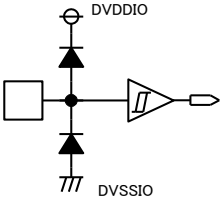
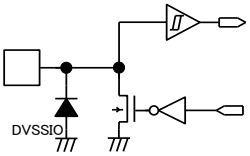
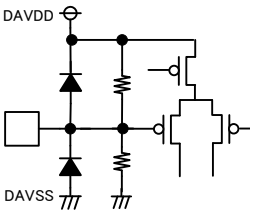
●**Terminal equivalent circuit diagram**

A	B	C	D
			
E	**F**	**G**	**H**
			
I	**J**		
			

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●Description of each block's movement -part1

1. USB host interface

- Builds in the USB Full speed (12Mbps) HOST control function.
- Supports the USB mass storage class.
- Supports changeover of LUN (Logical Unit Number) and possible that Test Unit Ready of other LUN is confirmed during the playback.
- Converts the protocol from I^2C to USB (HID) or vice versa during communications with the master microcomputer.*
- Builds in isochronous transmission functions up to 192byte/Frame. *
- Builds in the interrupt IN transfer function. *
- Doesn't support external HUB.
- Doesn't support MTP.

*These functions are available for a device having two or more configurations.

2. SD card interface

- Supports the SPI mode.
- Supports SDHC memory cards.
- Supports MMC, mini-SD and micro-SD cards.
- Does not support CPRM.

3. I^2C command interface (Slave I/F)

- Communicates with the master microcomputer using the I^2C interface format.
- Operates as I^2C slave I/F.
- Supports the standard mode (100kbps) and the fast mode (400kbps).
- Supports 7-bit addresses.

4. Audio output

- Supports audio line outputs from built-in 1bit-DAC.
- Builds in the digital soft mute function. *
- Supports digital audio outputs of the I^2S format, the EIAJ format and those and the digital audio interface (SPDIF).
- Builds in sound effects including POPS, JAZZ, ROCK, CLASSIC, R&B and Bass Boost. *

*This is available for audio line outputs only.

5. Sample rate converter

- Converts all support sample rates to 44.1 kHz based on the polyphase calculation.
- Selection of sample rate converter ON / OFF is possible by the command configuration.

* Supports only digital audio outputs of the I^2S and EIAJ format and

- When sample rate converter is used in off, enter the clock of 24.576 MHz synchronizing with the clock of 16.9344 MHz (enter XIN_PLL terminal) to the CLK24MI terminal.

6. System controller

- Control all operations including interface control to the master microcomputer, USB device access, SD card access, FAT analysis, sort function, decoding, encoding and audio output.

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●**Description of each block's movement -part2**

7. FAT analysis

Supports FAT32, FAT16 and FAT12 file system.
Supports VFAT (long file name).
Supports multi-partition up to 1 partition.
Supports multi-drive up to 1 drive.
Supports playable folder hierarchies up to 16 hierarchies whose full path including the file name is within 260 characters.
Supports playable file extension of *.wav for WAV files.
Supports playable file extensions of *.m4a, *.3gp and *.mp4 for AAC files.
Supports playable file extensions of *.asf and *.wma for WMA files.
Supports playable file extensions of *.mp3, *.mp2 and*.mp1 for MP3 files. For *.mp2 and *.mp1, the function allows you to select whether to play. Does not extinguish between upper case letters and lower case letters of file extensions.
Up to 256 folders and 256 files can be sorted and played in the order of UNICODE when sorting functional effective.
Can obtain 5 file names ahead from current music file.
Can obtain a folder name or file name within 128 bytes.
Supports 512, 1024, 2048 and 4096 bytes per sector.
Playable file size up to 2G-1 byte. A file over 2Gbyte is recognized as a playable file, too. But, it is for 2Gbyte -1byte that it can play.
Supports the device size up to FAT specification (2T byte).

8. Control from master microcomputer (little endian order)

Can control from the master microcomputer using the I^2C interface.

Controllable using commands of play, pause, stop, tune skip, tune forward, folder move, device change, volume setting, repeat change, random play, digital audio output setting, sound effect setting and direct tune selection and etc.

Can read information on internal status during play or stop, folder number, file number within the folder, play time, total number of folders, total number of files, name of folder being played, name of file being played and TAG (title, artist, album, genre), and etc.

9. MP3 decoder

- Supports MPEG audio 1, 2 and 2.5.
- Supports Layer1, 2 and 3.
- Supports sample rate of 8 k, 16 k, 32 k, 11.025 k, 22.05 k, 44.1 k, 12 k, 24 k and 48 kHz.
- Supports bit rate of 8 to 320 kbps and VBR (Variable Bit Rate). *Excluding the free format
- Supports ID3TAG V1.0, V.1, 1, V2.2, V2.3 and V2.4.
  (Up to 128 bytes can obtain for album, artist, title and genre, respectively.)

10. WMA decoder

- Supports Windows Media Audio 9 standard.
- Not supports DRM files.
- Supports sample rate of 8 k, 16 k, 32 k, 11.025 k, 22.05 k, 44.1 k and 48 kHz.
- Supports bit rate of 5 to 384 kbps and VBR (Variable Bit Rate).
- Supports WMA-TAG.
  - (Up to 128 bytes can obtain for album, artist, title and genre, respectively.)

11. AAC decoder

- Supports MPEG4 AAC-LC (Audio stream).
- Based on 3GPP TS 26.244 and iTunes.
- Supports File Type of m4a, mp4 and 3gpX. (X stands for any numeric value.)
- Not supports DRM files.
- Supports sample rate of 8 k, 16 k, 32 k, 11.025 k, 22.05 k, 44.1 k, 12 k, 24 k and 48 kHz.
- Supports bit rate of 8 to 320kbps and VBR (Variable Bit Rate).
- Supports AACTAG (iTunes Meta-data and 3GP Meta-data).
  (Up to 128 bytes can obtain for album, artist, title and genre, respectively.)
  *For files other than those encoded by iTunes, sound interruption may occur when skipping or forwarding to the next tune if streams such as gaps and video data are contained in the file.

12. WAV play

- Supports WAV format.
- Supports sample rate of 8 k, 16 k, 32 k, 11.025 k, 22.05 k, 44.1 k, 12 k, 24 k and 48 kHz.

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- Supports 16-bit PCM data.
- Supports RIFF TAG.
  (Up to 128 bytes can obtain for album, artist, title and genre, respectively.)

13. Browsing and direct tune selection

- Can analyzes and read other file name in memory while playing the current music.
- Up to 64 bytes can obtain for file name, folder name respectively.
- Supports direct music selection using the analysis data.

14. Repeat and random play

- Supports repeat within the memory, repeat within folder and repeat with single tune.
- Supports random play within the area of ±128 files.
- Can select auto-play of next music or stop playing at the end of current music playing.

15. Read from files within memory

- Can read the data from specified file stored in the specified folder within the memory.

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●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit	Comment
Supply voltage(Analog, I/O)	VDD1MAX	-0.3 to 4.5	V	DVDDIO, DAVDD, AVDDC
Input voltage	VIN	-0.3 to VDD1 + 0.3	V	
Storage temperature range	TSTG	-55 to 125	˚C	
Operating temperature range	TOPR	-40 to 85	˚C	
VQFN040V6060 Package Power dissipation *1	PD1	800	mW	BU94501AMUV BU94502AMUV
SQFP-T52 Package Power dissipation *1	PD2	850	mW	BU94501AKS2 BU94502AKS2

*1：74.2mm × 74.2mm × 1.6mm, FR4, 1-layer glass epoxy board (Copper area 23.69mm2)
In the case of use at Ta=25℃ or more, 8mW should be reduced per 1℃.
*2：In the case of use at Ta=25℃ or more, 8.5mW should be reduced per 1℃.

●Operating conditions (Ta = 25℃)

Parameter	Symbol	Limits	Unit	Comment
Supply voltage(Analog, I/O)	VDD1	3.0 to 3.6	V	DVDDIO, 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	-	51.0	75.0	mA	*1 When USB memory is played.
Circuit current (VDD1 SD1)	IDD1SD1	-	26.0	45.0	mA	*1 When SD card is played.
<Digital block>						
H-Level input voltage	VIH	VDD1*0.7	—	VDD1	V	*2
L-Level input voltage	VIL	DVSS	—	VDD1*0.3	V	*2
H-Level output voltage1	VOH1	VDD1-0.4	—	VDD1	V	IOH=-1.6mA, *3
L-Level output voltage1	VOL1	0	—	0.4	V	IOL=1.6mA. *3
L-Level output voltage2	VOL2	0	—	0.4	V	IOL=3.6mA, *4
H-Level output voltage3	VOH3	VDD1-0.4	—	VDD1	V	IOH=-0.6mA, *5
L-Level output voltage3	VOL3	0	—	0.4	V	IOL=0.6mA, *5
H-Level output voltage4	VOH4	VDD1-1.0	—	VDD1	V	IOH=-1.6mA, *6
L-Level output voltage4	VOL4	0	—	1.0	V	IOL=1.6mA, *6
<USB-HOST >						
H-Level input voltage	VIHUSB	VDD1*0.6	—	VDD1	V	*7
L-Level input voltage	VILUSB	AVSSC	—	VDD1*0.3	V	*7
Output impedance(H)	ZOH	22.0	45.0	60.0	Ω	*7
Output impedance(L)	ZOL	22.0	45.0	60.0	Ω	*7
H-Level output voltage	VOHUSB	VDD1-0.5	—	VDD1	V	*7
L-Level output voltage	VOLUSB	0	—	0.3	V	*7
Rise/Fall time	Tr/Tf	—	11	—	ns	*7, Output capacity 50pF
Voltage of crossing point	VCRS	—	VDD1/2	—	V	*7, Output capacity 50pF
Range of differential input	VDIFF	0.8	—	2.5	V	*7
Differential input sensitivity	VSENS	0.2	—	—	V	*7
Pull-down resistance	RPD	14.25	20.0	24.8	kΩ	*7
<Audio DAC>						
Distortion rate	THD	—	0.005	0.05	%	1kHz, 0dB, sine, *8
Dynamic range	DR	—	90	—	dB	1kHz, -60dB, sine, *8
S/N ratio	S/N	66	96	—	dB	1kHz, 0dB, A-weighted, *8
Max output level	VSMAX	0.60	0.75	—	Vrms	1kHz, 0dB, sine, *8

BU94501AMUV / BU94502AMUV

*1 3.3V system I/O, Analog Power supply(VDD1), 1kHz, 0dB, sine-wave playing
*2 2, 3, 7-9, 13, 14, 16-18, 24, 36, 37 pin
*3 4-7, 24-28, 30 pin
*4 9 pin
*5 38-40 pin
*6 15 pin
*7 21, 22 pin
*8 32, 34 pin output no-load

BU94501AKS2 / BU94502AKS2

*1 3.3V system I/O, Analog Power supply(VDD1), 1kHz, 0dB, sine-wave playing
*2 3, 4, 8-10, 17, 34, 35, 43, 44, 49-51 pin
*3 45,47-49,17,18,20-22,26 pin
*4 51 pin
*5 36-38 pin
*6 5 pin
*7 14, 15 pin
*8 28, 30 pin output no-load

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●Application Information

1. Clock and Reset

Clock

Clock name	I/O	Function	Remarks
XIN_PLL	I	X'tal (16.9344MHz) connection input terminal	-
XOUT_PLL	O	X'tal (16.9344MHz) connection terminal	-

Reset

Signal name	I/O	Function	Remarks
RESETX	I	System reset input terminal	-

Please release the reset signal continue L input for more than 100 us after clock input from the oscillation I/O terminal becomes stable. (See Figure 6.)

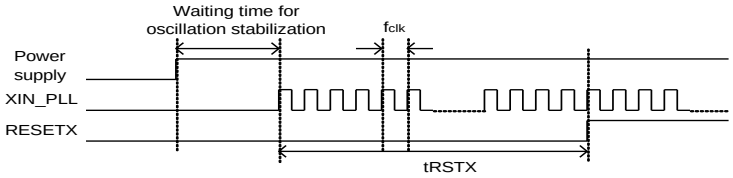

Figure 6. Reset Timing

Item	Code	Rating			Unit	Remarks
		min	typ	max		
Clock frequency	f_{CLK}	16.9302	16.9344	16.9386	MHz	-
Reset L interval	t_{RSTX}	100	-	-	us	-

2. USB I/F

USB I/O interface

Signal name	I/O	Function	Remarks
USB_DP	I/O	USB D+ I/O terminal	-
USB_DM	I/O	USB D- I/O terminal	-
REXTI	O	USB bias resistor connection terminal	Connect a resistor of 12 kΩ±1% to GND.

This interface communicates with the USB device using USB_DP and USB_DM differential signals.
REXTI terminal is used to connect to the bias resistor in the USB-PHY block.

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3. SD I/F

SD memory card SPI interface

Signal name	I/O	Function	Remarks
SD_CS	O	SD chip select	-
SD_CLK	O	SPI clock	-
SD_DI	O	SPI data input	-
SD_DO	I	SPI data output	-
SD_CON	I	SD card connect detection terminal	H: Do not detect SD card connect, L: Detect SD card connect

This interface connects to the SD memory card slot to communicate with the SD memory device.
Supports the SPI mode.
Supports SD, SDHC memory cards and MMC, mini-SD and micro-SD cards.
Does not supports CPRM.
Since the SD memory card slot needs to detect the insertion status of the SD memory device, be sure to use the slot having the SD memory card insertion status detection terminal. The SD_CON terminal is pulled up within the device and detects “SD card connect” when L is input.
The SD_CON terminal is pulled up within the device and detects “SD card connect” when L is input.

3.1 Timing

（Unless specified, Ta=25℃, VDD1=3.3V, Load=20pF, 10kΩ）

Item	Symbol	Rating			Unit	Remarks
		min	typ	max		
SD_CS Setup time	Tcss	-	5	-	us	
SD_CS Hold time	Tcsh	-	15	-	us	
SD_CLK Clock Frequency	Tclk	-	13.5	-	MHz	
SD_DI Output delay	Tod	-20	-	20	ns	
SD_DO Data in Setup time	Tds	18	-	-	ns	
SD_DO Data in Hold time	Tdh	5	-	-	ns	
Output High Voltage	Voh	0.625*VDD1	-	-	V	
Output Low Voltage	Vol	-	-	0.25*VDD1	V	

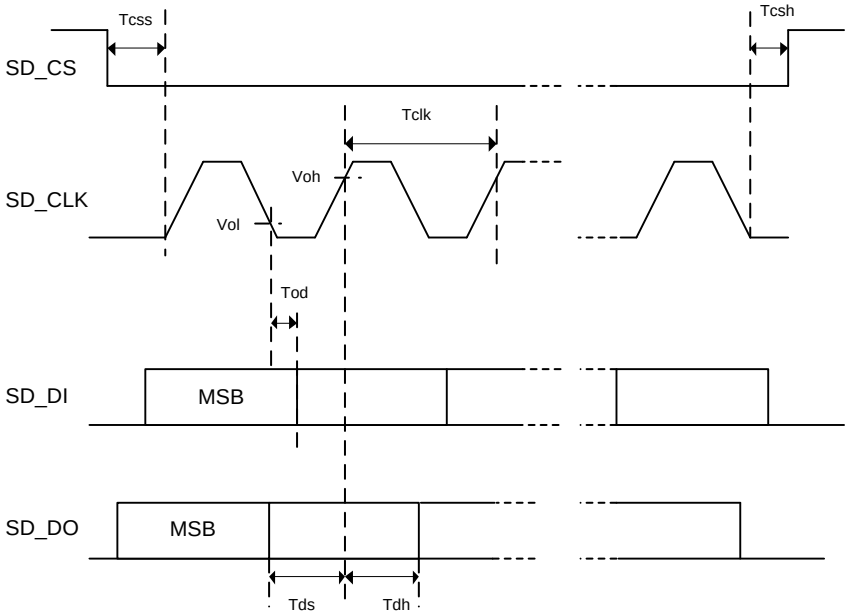

Figure 7. SPI I/F Timing

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4. Audio line output

Audio line output

Signal name	I/O	Function	Remarks
LDACO	O	Lch audio line output	-
RDACO	O	Rch audio line output	-

This is a line output of decoded music data.
When a sample rate converter is used in on, data on the sample rate 48kHz, 32kHz are changed into 44.1kHz and outputted.
It turns ON when line output is selected by a command.
Figure 8. shows the relationship between audio outputs and volume steps.
The initial value is –24.1dB at power ON.

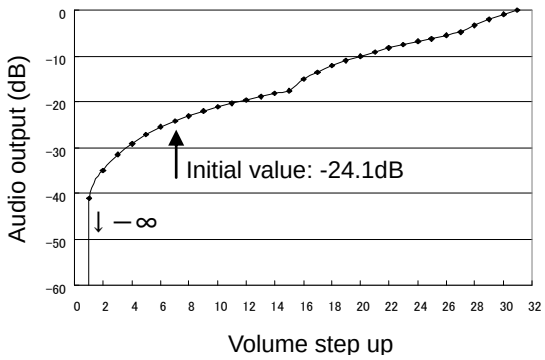

Figure 8. Volume Step Function

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5. Equalizers

Selectable audio line output from 5 types of equalizers and 2 types of bus boosts, using commands.
You can use a combination of an equalizer and bus boost 1.
Even when line output is not selected, the equalizer setting is valid. However, for digital output, the equalizer cannot change the sound quality.
Figure 9. - Figure 14.show frequency characteristics of each filter.
Clipping may occur by the combination of volume and equalizer setting.

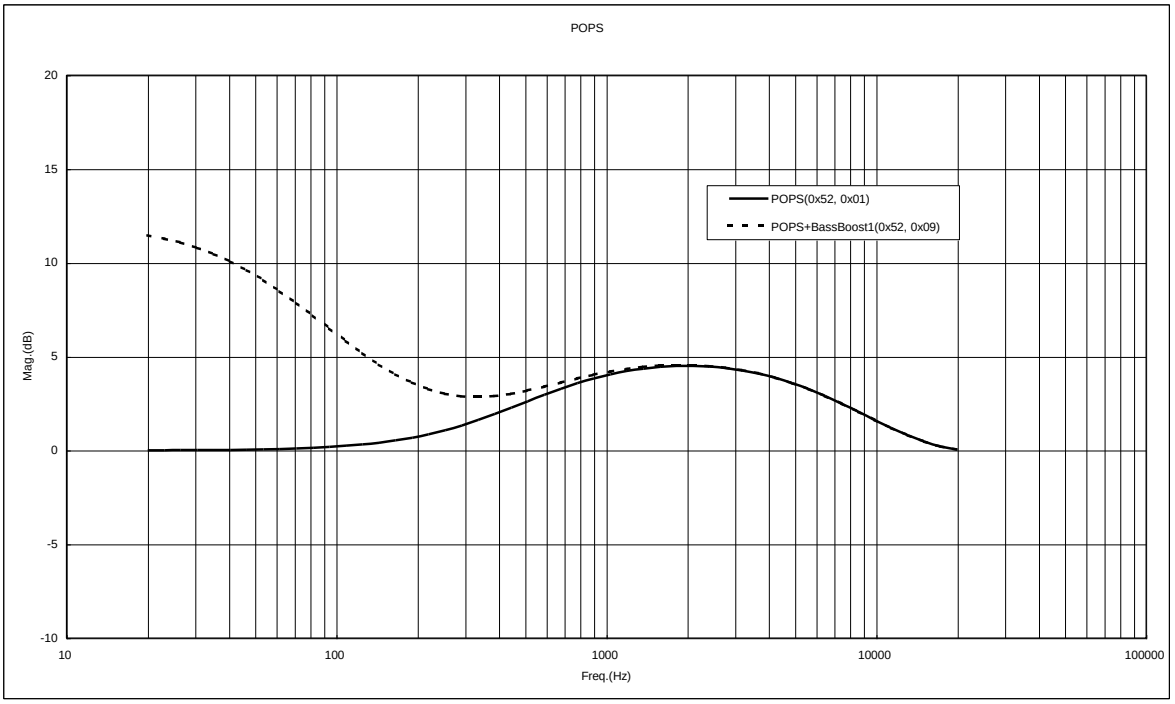

Figure 9. POPS Frequency Characteristics

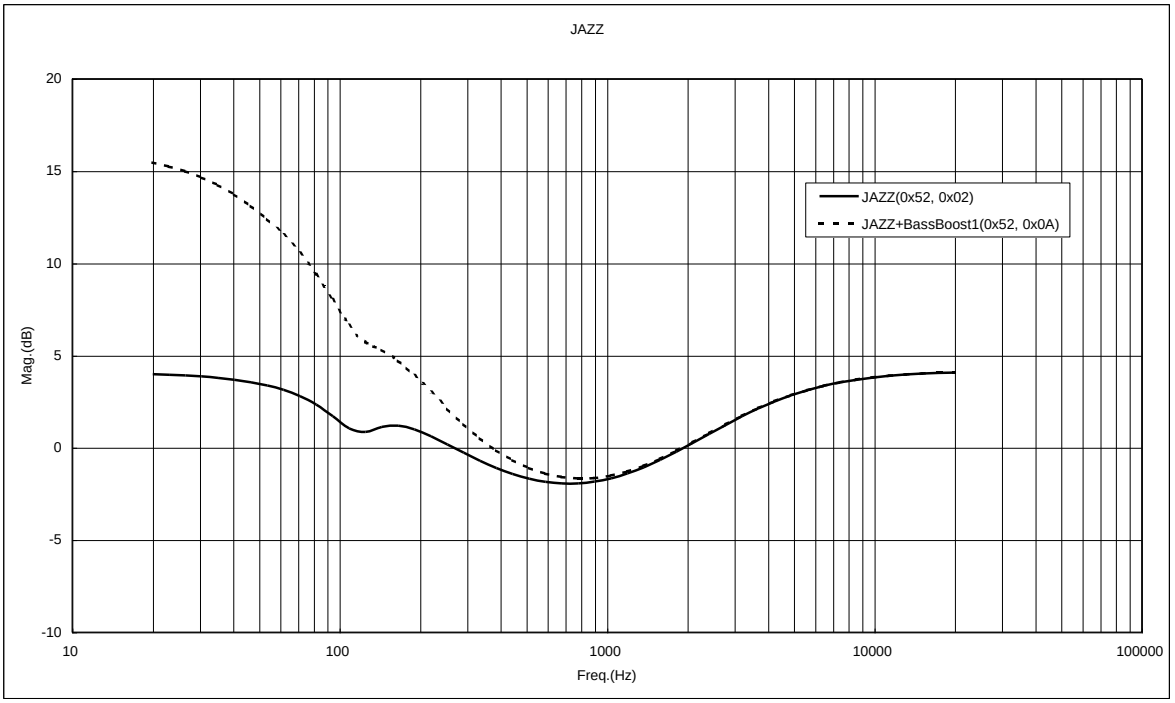

Figure 10. JAZZ Frequency Characteristics

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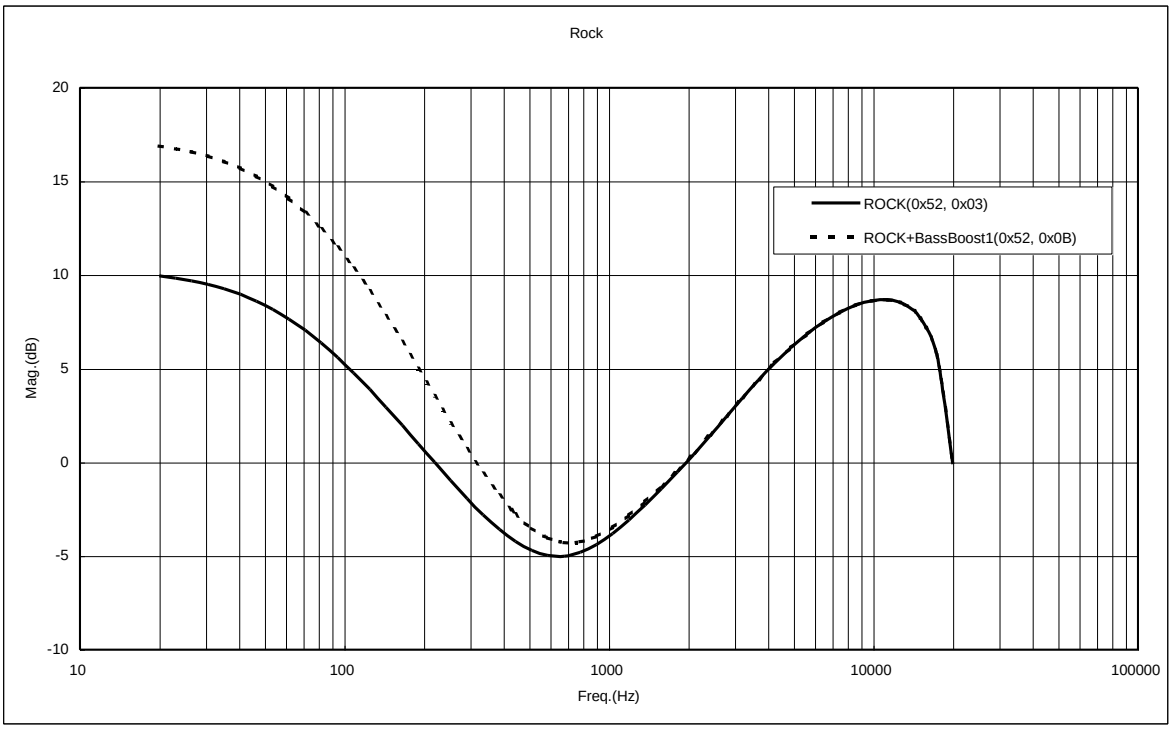

Figure 11. ROCK Frequency Characteristics

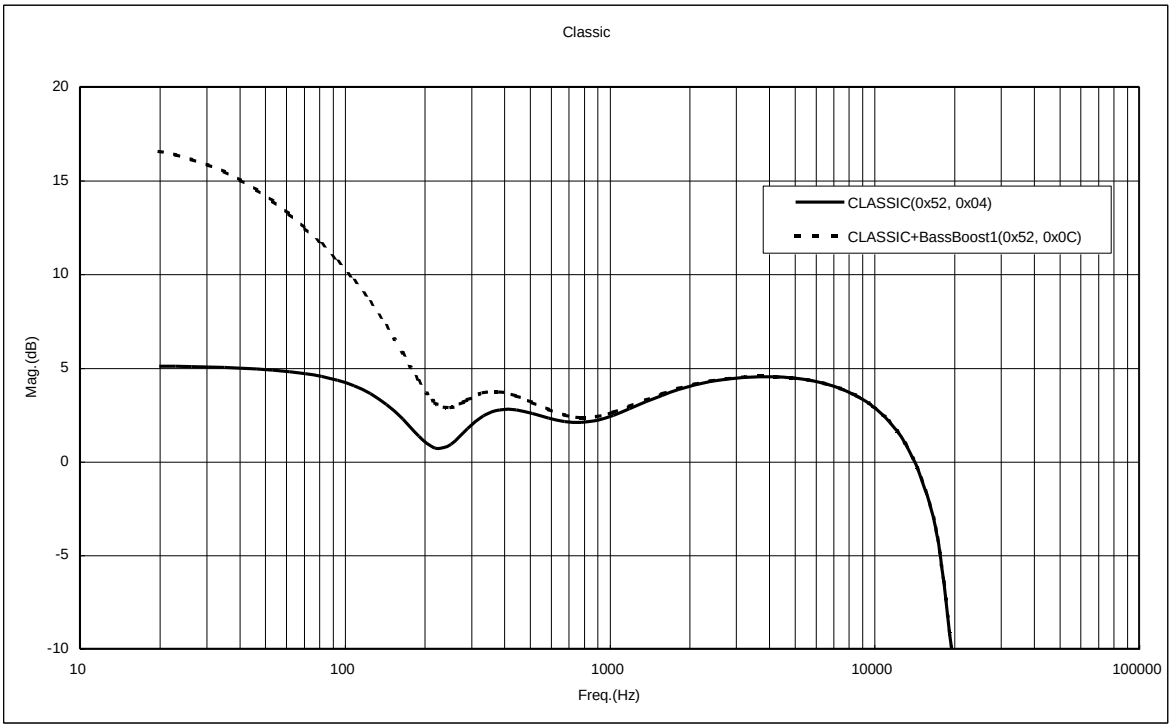

Figure 12. CLASSIC Frequency Characteristics

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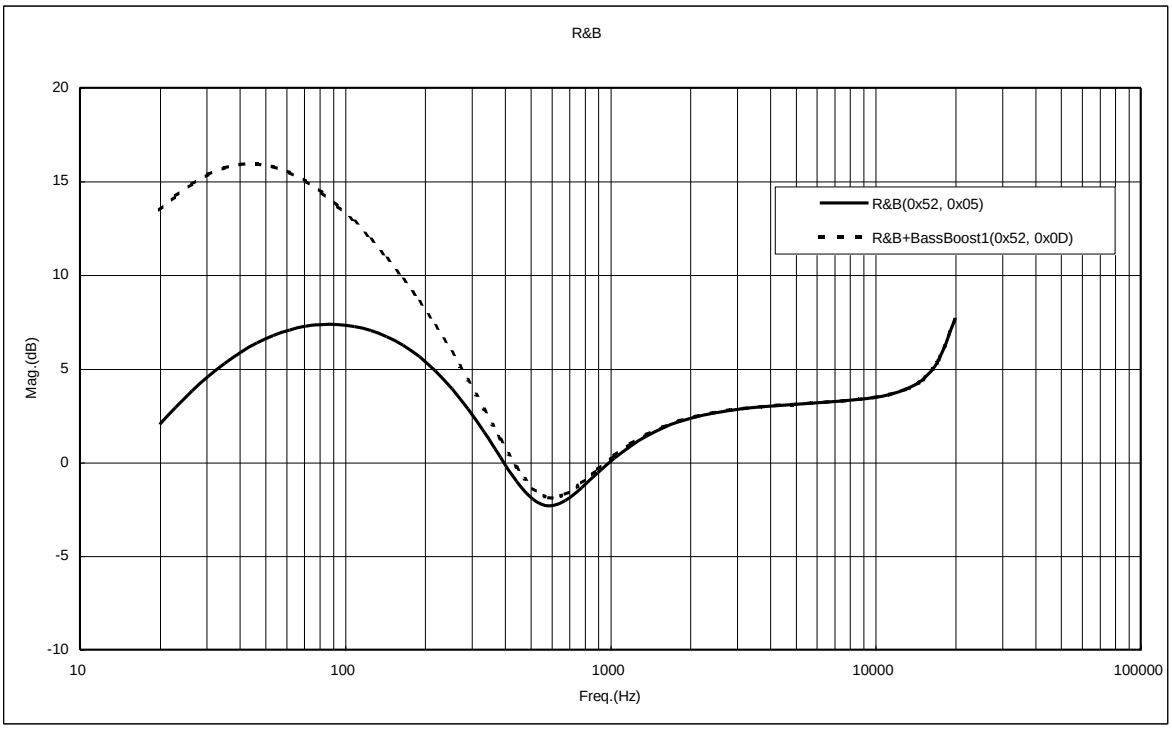

Figure 13. R&B

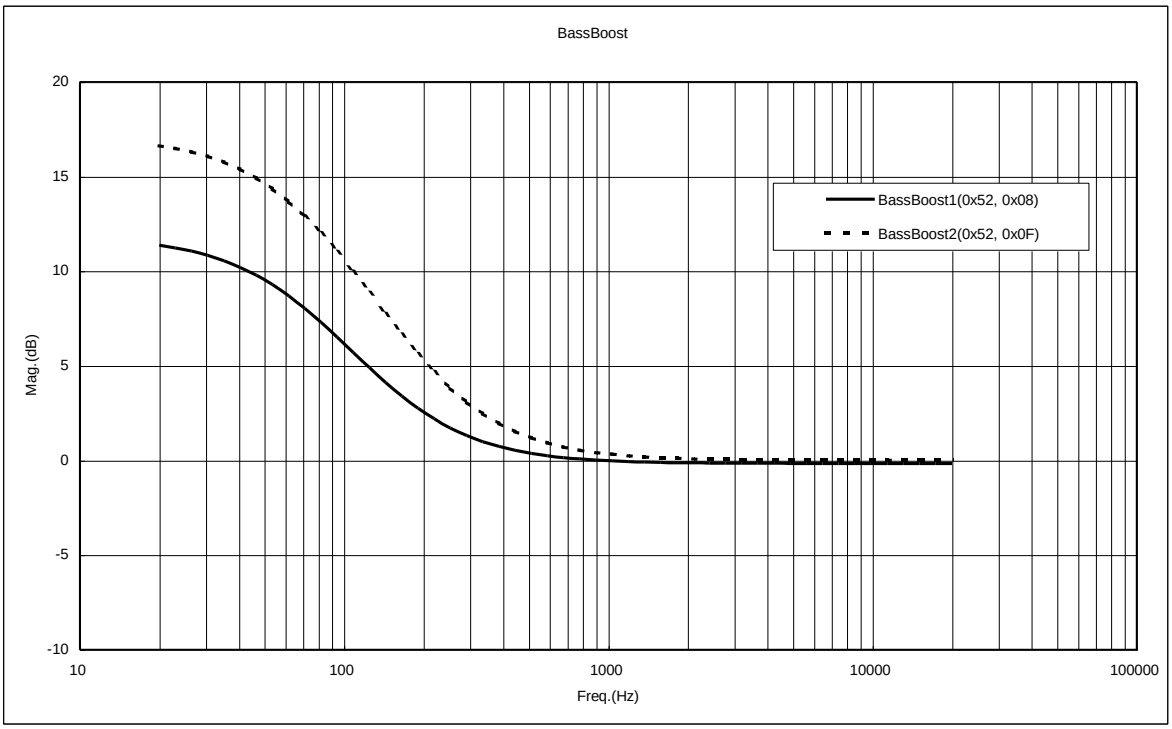

Figure 14. Bass Boost

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6. MUTE control output

Audio MUTE

Signal name	I/O	Function	Remarks
AMUTE	O	Audio mute control terminal	H: At audio output , L: At mute

It outputs H at audio output and L at mute.
When power is ON or in the silence mode such as FF or FB, This control terminal is used to mute audio output
It can be used for the flag to do mute with the amplifier of the rear step and so on.
Figure 15. shows the operation waveforms.

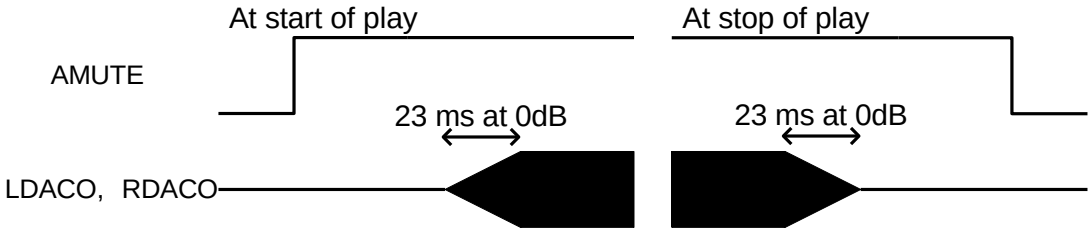

Figure 15. Waveform at Audio Mute

7. Digital audio output (I^2S, EIAJ)

Audio outputs are shown in Table 1. “Audio Output”.
Because TEST terminal is an output terminal, use it as OPEN.

Table 1. Audio Output

PIN	ANALOG output mode	DIGTAL output mode	
		SPDIF OFF	SPDIF ON
RDACO	Line Out Rch	HiZ	HiZ
LDACO	Line Out Lch	HiZ	HiZ
LRCK	TEST terminal	LR CLOCK	SPDIF
BCK	TEST terminal	BIT CLOCK	TEST terminal
DATA	TEST terminal	LR DATA	TEST terminal
MCLK	TEST terminal	MASTER CLOCK	TEST terminal

Digital audio interface (I^2S, EIAJ)

Signal name	I/O	Function	Remarks
LRCK	O	LR clock output (fs=44.1kHz)	-
BCK	O	Bit clock output	-
DATA	O	Data output	-
MCLK	O	Masterxlock output	At fs=32kHz 12.288MHz (384fs) At fs=44.1kHz 16.9344MHz (384fs) At fs=48kHz 12.288MHz (256fs)

This is a digital audio output interface terminal.
It becomes enabled by using the appropriate command.
When serial audio output is selected, The output format can be selected from the EIAJ format or I^2S format of 32fs, 48fs or 64fs .
Selectable With the mode that the sample rate of the playback tune is outputted and the mode fixed on 44.1 kHz by sample rate converter.
Figure 16. - Figure 21. show the output formats.

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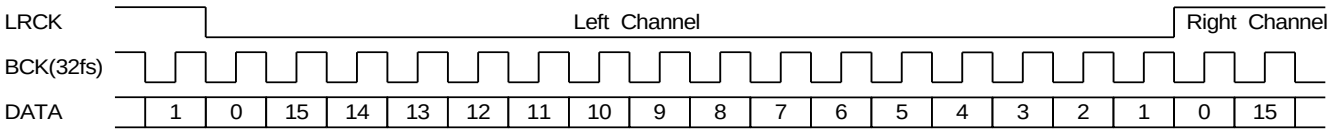

Figure 16. I^{2}S Output Timing (32fs)

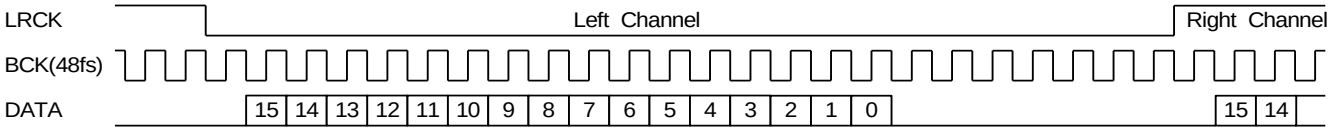

Figure 17. I^{2}S Output Timing (48fs)

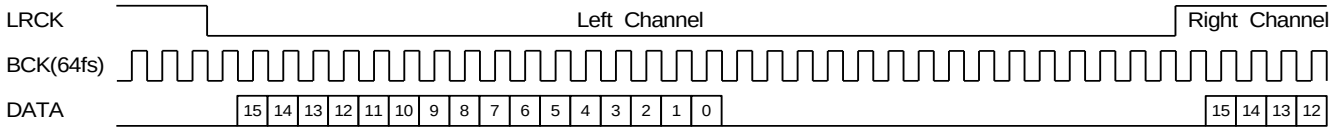

Figure 18. I^{2}S Output Timing (64fs)

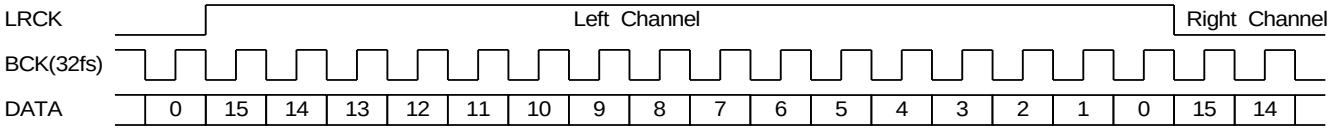

Figure 19. EIAJ Output Timing (32fs)

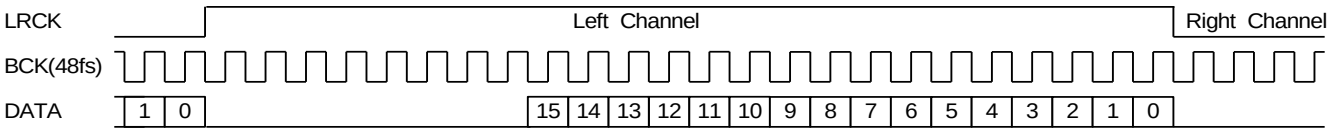

Figure 20. EIAJ Output Timing (48fs)

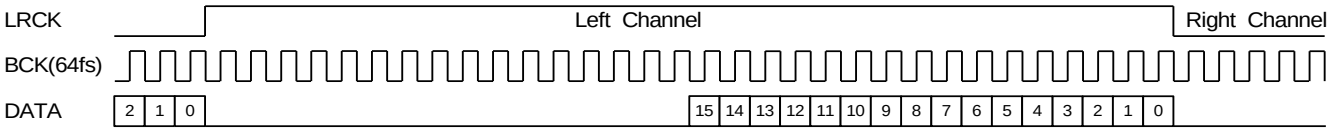

Figure 21. EIAJ Output Timing (64fs)

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7.1 I^2S, EIAJ Output Timing

48fs I^2S format（Unless specified, Ta=25℃, VDD1=3.3V, Load=20pF）

Item	Symbol	Rating			Unit	Remarks
		min	typ	max		
BCK Clock Frequency	Tbck	-	472.4	-	ns	
BCK Low time	Tbck1	216	236	-	ns	
BCK High time	Tbck2	216	236	-	ns	
LRCK Clock Frequency	Tlrck	-	44.1	-	kHz	
LRCK Output delay	Tlrck1	-20	0	20	ns	
DATA Output delay	Tda1	-20	0	20	ns	
Output High Voltage	Toh	VDD1-0.4	-	-	V	
Output Low Voltage	Vol	-	-	0.4	V	

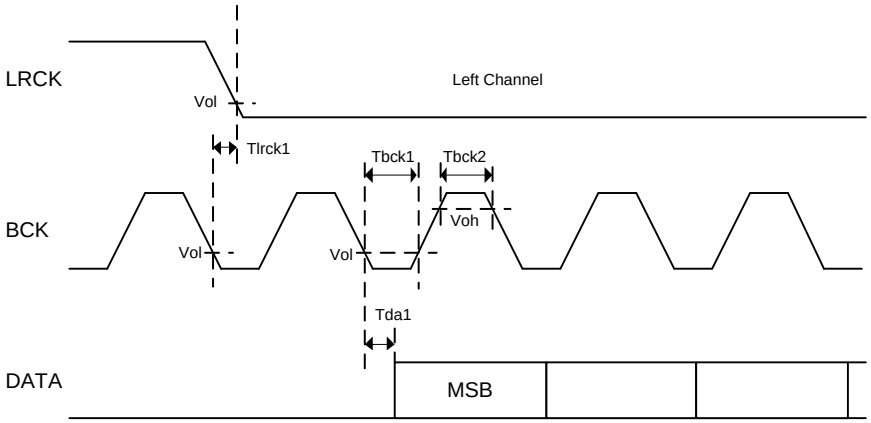

Figure 22. I^2S, EIAJ Output Timing

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8. Digital audio output (SPDIF)

Digital audio interface

Signal Name	I/O	Function	Remarks
SPDIF	O	SPDIF output	-

SPDIF output become enabled by setting it using the appropriate command.
Figure 23. shows the digital audio signal output format.

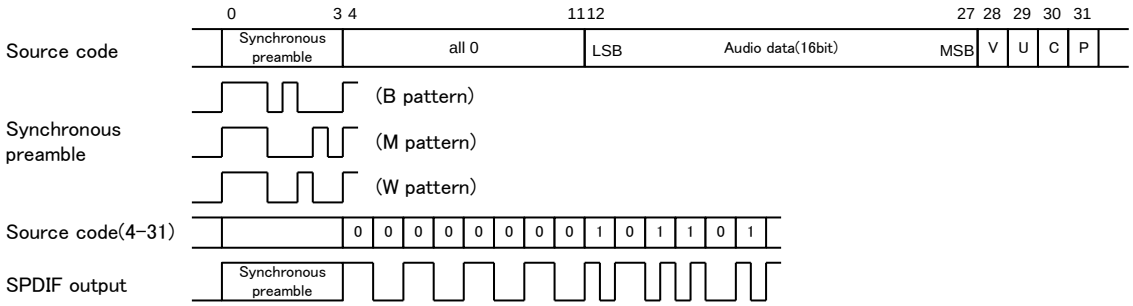

Figure 23. SPDIF Output Format

One sub frame of SPDIF consists of synchronous preambles, 16-bit audio data, V bit (validity flag), U bit (user data), C bit (channel status) and P bit (parity bit).
Output rate is fixed to 1X speed.
SPDIF outputs synchronous preambles (source code 0-3) as they are, and other elements (source code 4-31) as the biphase output. While the operation stops, L output is enabled.
Synchronous preambles and C bit use 32 frames (≈4.4 ms) for one cycle. The data formats are shown in Tables.2 and 3 V bit is fixed to L. U bit uses 98 frames (≈13.3 ms) for one cycle

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Table 2. Synchronous Preamble Pattern

	L0	R0	L1	R1	L2	R2	L3	R3	L4	R4	L5	R5
0	B	W	M	W	M	W	M	W	M	W	M	W
1	M	W	M	W	M	W	M	W	M	W	M	W
:	:	:	:	:	:	:	:	:	:	:	:	:
31	M	W	M	W	M	W	M	W	M	W	M	W

Table 3. C Bit Format

	L0	R0	L1	R1	L2	R2	L3	R3	L4	R4	L5	R5
0	0		0		Copy		0		0		0	
1	0		0		1		0		0		0	
2	0		0		0		Lbit		0		0	
3	0		0		1	0	0	1	0		0	
4	0		0		0		0		0		0	
5	0		0		0		0		0		0	
:	:		:		:		:		:		:	
31	0		0		0		0		0		0	

Table 4. U Bit Format

	L0	R0	L1	R1	L2	R2	L3	R3	L4	R4	L5	R5
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	0	0
:	:	:	:	:	:	:	:	:	:	:	:	:
97	1	0	0	0	0	0	0	0	0	0	0	0

P bit is set to 1 if the number of “1” contained in source codes 4-30 is odd, and set to 0 if the number is even. Therefore, the number of source codes to be set to 1 for one data must be even, SPDIF ends with L output, and preamble output always starts in the same direction.

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8.1 SPDIF Output Timing

（Unless specified, Ta=25℃, VDD1=3.3V, Load=20pF）

Item	Symbol	Rating			Unit	Remarks
		min	typ	max		
SPDIF Clock Frequency	Tck	-	2.822	-	MHz	
SPDIF Clock High time	Tck1	157	177	-	ns	
SPDIF Clock Low time	Tck2	157	177	-	ns	
Output High Voltage	Voh	VDD1-0.4	-	-	V	
Output Low Voltage	Vol	-	-	0.4	V	

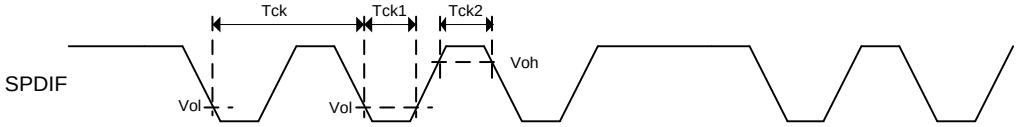

Figure 24. SPDIF Output Timing

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9. I²C command interface

Slave I²C serial interface

Signal name	I/O	Function	Remarks
SCL	I	I²C interface clock input	External pull-up resistor is required.
SDA	I/O	I²C interface data I/O	External pull-up resistor is required.

This is an I²C serial interface terminal to communicate with the microcomputer (master).
It supports slave I²C operations.

9.1 I²C protocol

When the I2C bus is in the IDLE state, SDA and SCL are set to H by the external Pull-up resistor.
To start communications, the master sets SDA to L while SCL set to H (Start condition).
To finish communications, the master sets SDA to H while SCL set to H (Stop condition). During transfer, the master changes SDA only while SCL is L. Figure 25. shows Start condition and Stop condition of I²C.

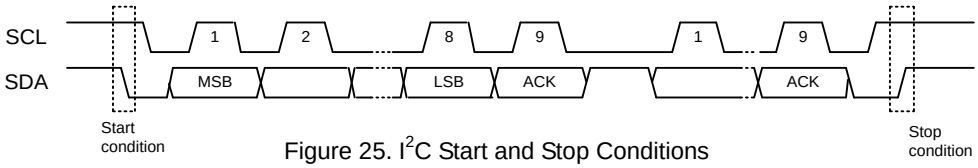

Figure 25. I²C Start and Stop Conditions

9.2 Slave address

I²C bus slave addresses support the 7-bit addressing mode.
Figure 26. shows the slave address transfer format.

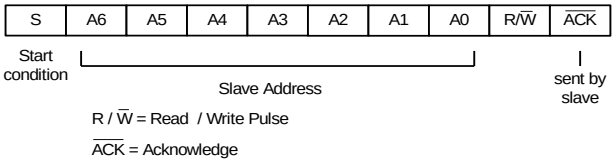

Figure 26. Slave Address Transfer Format

Table 5. Settable Slave Addresses

MSB	A5	A4	A3	A2	A1	LSB A0
1	0	0	0	0	1	1

9.3 Protocol to write from the master

When sending commands from the master using the I²C bus, be sure to conform to the transfer protocol shown in Figure 27.

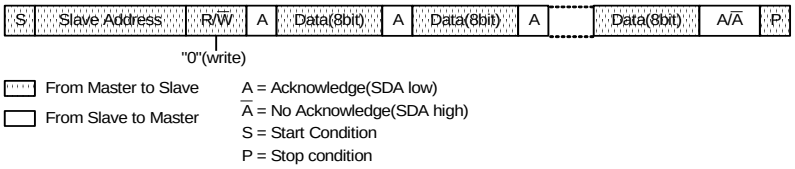

Figure 27. Command Send Protocol

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9.4 Protocol to read to the master

When sending the received data from the slave to the master using the I^2C bus, be sure to conform to the transfer protocol shown in Figure 28. First, transfer the status read command (step1). Then, input SCL clock of required bytes in step2 to read the status.
If the device status is BUSY when receiving the device status or the data within the memory, the I^2C bus may be occupied by the device in BUSY. This LSI transfers the data to the master to avoid such occupation of the bus. However, as the BUSY status still exists internally, the proper data may not be transferred in BUSY. To cope with this situation, the first byte of the transfer data (step2) is used to judge whether the transferred data is valid or invalid. After addressing from the master to the slave, if the 0 bit of the first byte of the transfer data immediately after requiring the data transfer is 0, the data transferred from the slave is valid. If the 0 bit of the first byte is 1, it shows the BUSY status. Thus, judge all the transferred data to be invalid. If this happens, retry Step1 to send commands to read the status.
The first byte of the transferred data (step2) can be readable as the BUSY byte. Please read the status after sending the status read command (step1). In addition, internal statuses other than BUSY shown in Table 6. can be read.
The first byte of the transferred data (step2) can be readable as the BUSY byte. Please read the status after sending the status read command (step1). In addition, internal statuses other than BUSY shown in Table.7 can be read.

Figure 29. shows the relationship between the transferred data and BUSY.

Table 6. BUSY Byte Structure

bit	STATUS
7	0
6	0
5	0
4	PRECOM
3	IRPTO
2	SEARCH
1	MCHNG
0	BUSY

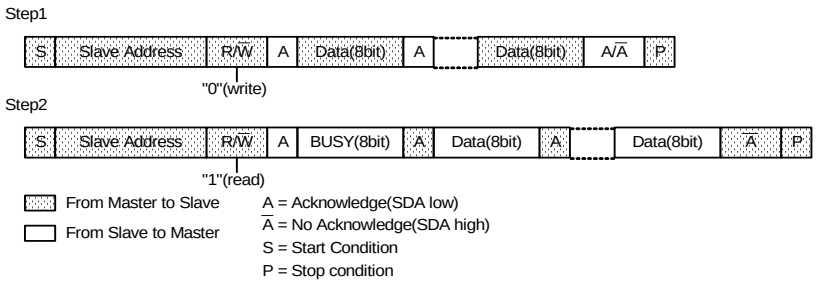

Figure 28. Status Reception Protocol

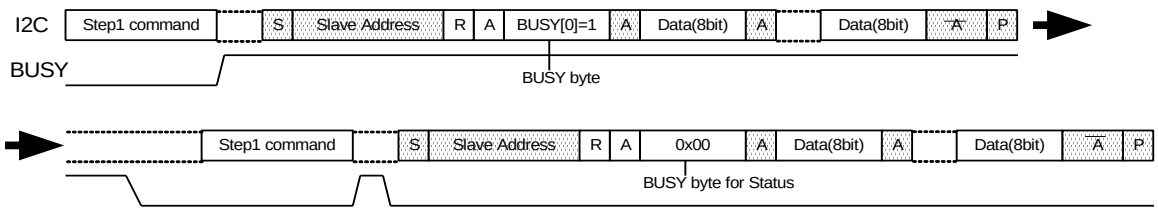

Figure 29. Relationship between Transferred Data and BUSY

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9.5 I^{2}C Bus line timing

Table 7. I^{2}C Bus line timing

SDA and SCL bus-line characteristic (Unless specified, Ta=25℃, Vcc=3.3V)

	Parameter	Code	Min.	Max.	Unit
1	SDA, SCL H input voltage	VIH	VDD*0.7	VDD	V
2	SDA, SCL L input voltage	VIL	DVSS	VDD*0.3	V
3	SDA H output voltage	VOH	VDD-0.4	VDD	V
4	SDA L output voltage	VOL	0	0.4	V
5	SCL clock frequency	fSCL	0	400	kHz
6	Bus-free-time between "Stop" condition and "Start" condition	tBUF	1.3	—	μS
7	Hold time for "Start" condition After this, the first clock pulse is generated.	tHD;STA	0.6	—	μS
8	LOW status hold-time of SCL clock	tLOW	1.3	—	μS
9	HIGH status hold-time of SCL clock	tHIGH	0.6	—	μS
10	Data-hold-time	tHD;DAT	0*	—	μS
11	Date-setup-time	tSU;DAT	100	—	ns
12	Rising time of SDA and SCL signal	tR	20+0.1*Cb	300	ns
13	Fall time of SDA and SCL signal	tF	20+0.1*Cb	300	ns
14	Setup time of "Stop" condition	tSU;STO	0.6	—	μS
15	Capacitive load of each bus-line	Cb	—	400	pF

The above-mentioned numerical values are all the values corresponding to $V_{IH\ min}$ and $V_{IL\ max}$ level.
*To exceed an undefined area on falling edged of SCL, transmission device should internally offer the hold-time of 300ns or more for SDA signal ($V_{IH\ min}$ of SCL signal).
Because the "Repeated Start" condition to send "Start" condition without sending "Stop" condition doesn't correspond, after sending "Start" condition, always send "Stop" condition.
Neither terminal SCL nor terminal SDA correspond to 5V tolerant.

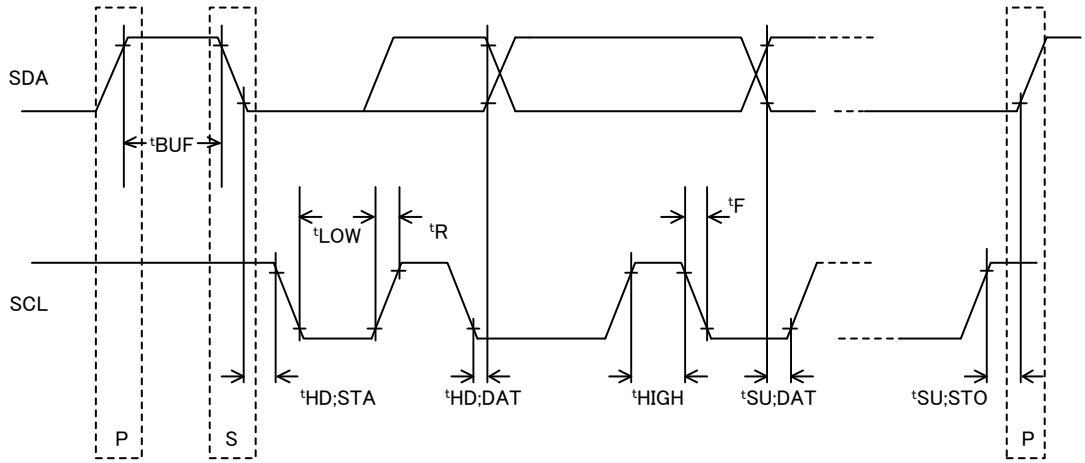

Figure 30. I^{2}C Bus line timing chart

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10. Interrupt Signals to microprocessor

10.1 BUSY

BUSY status detection output

Signal name	I/O	Function	Remarks
BUSY	O	BUSY status detection output signal	H: Busy, L: Not Busy

This is output to indicate that the LSI is in the BUSY status.
A BUSY signal outputs H until analyzing a command from the master and starting the command operation.
The command input to this LSI in BUSY status is unacceptable.
Connect it to the PIO port of the microcomputer.

10.2 MCHNG

Tune number change detection output

Signal name	I/O	Function	Remarks
MCHNG	O	Tune number change detection output signal	H: During playing, L: At the end or stop of tune

This signal outputs the information which tells that the file within the memory is being played or the file to be played is changed.
Precisely, the signal outputs H during the internal decode sequence operation, and L at stop of the operation.
Connect it to the interruption port of the microcomputer.

10.3 SEARCH

SEARCH status detection output

Signal name	I/O	Function	Remarks
SEARCH	O	SEARCH status detection output signal	H: SEARCH, L: Not SEARCH

This is output to indicate that the LSI is in the SEARCH status.
A SEARCH signal becomes H at the time of memory mount, file search, TAG analysis and TOC analysis.
This signal is OR of the 2-bit SEARCH status.
The LSI ignores command input during SEARCH. However, it can accept only ABORT, STOP and status read commands even during SEARCH and can execute them command.
Connect it to the PIO port of the microcomputer.

10.4 IRPTO

Interrupt output to microcomputer

Signal name	I/O	Function	Remarks
IRPTO	O	Interrupt output to microcomputer	H: Interrupt, L: Not Interrupt

This is output to indicate that the LSI is now requiring interruption to the microcomputer.
Change from L to H shows that an interruption has occurred.
When signage is H, it is shown that interrupt occurs.
Connect it to the interruption port of the microcomputer.

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11. File search

11.1 Function

- The file search function supports file system of FAT32, FAT16 and FAT12. (NTFS is not supported.)
- The number of maximum playable files per folder follows the specification of FAT.

Table 8. Maximum Playable Files per Folder

	Root folder	Sub folder
FAT12	512	65534
FAT16	512	65534
FAT32	65535	65534

The number of files described above includes folders and files other than playable files (WAV/AAC/WMA/MP3). Thus, if non-playable files or folders contain in the above folders and the number of total files exceeds the maximum limit, all the playable files may not be played.

- Less than 256 files in the order of FAT within each folder are sorted according to UNICODE. More than 256 files, if any, will be sorted in the FAT order. The same rule is applied when sorting sub-folders. More than 100 sub-folders, if any, will be sorted in the FAT order. Sorting function can be selected valid or invalid with a command. The folder hierarchies up to 16 hierarchies whose full path including the file name is within 260 characters can be searched.

11.2 Playable file

The playable file extension is *.WAV for the WAV file, *.M4A, *.3GP and *.MP4 for the AAC file, *.ASF and *.WMA for the WMA file, and *.MP3, *.MP2 and *.MP1 for the MP3 file. (There is no distinction between upper case letters and lower case letters.) Note that the file operation differs in the following cases

・Codec selection command: For details, please see
SET_MP3 / SET_WMA / SET_AAC / SET_WAV / SET_MP3_PLAY command specifications.
・Attribute: Files with hidden attributes are also playable. Files with system attributes cannot be played.
・File name: The file name, including its size, does not depend on playability.
・File size: A file with file size "0" is not recognized as a playable file.

11.3 File playing sequence

The file playing sequence depends on the following rules when sort function valid. See Figure 28.

[1] Files of 1 to 256, in the order written to FAT (FAT order) in each folder, are sorted in the order of UNICODE.
Files more than 256 are played in the FAT order. The same rule is applied when sorting sub-folders.
All the folders including null ones and those to which no playable file is written are sorted (selectable setting by command). If over 256 playable files or sub-folders are contained in the folder, they are played in the order written to the FAT directory entries.
The writing method of directory entries will not help understand the file play order because the method depends on the OS operation at writing.

[2] When a playable file exists in the root folder (the top hierarchy), the file is to be played first.

[3] After all the playable files within the root folder have been played, playable files in the folder in the lower hierarchy, if any, are played.

[4] If another folder exists in the lower hierarchy, playable files within this folder are played. If not, the LSI searches other folders in the same hierarchy. If another folder exists there, the LSI plays that folder.

[5] After playing all the files, the LSI returns to the root folder as in [2] and play the files starting with the top sorted one.

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11.4 Folder/File sort

The LSI sorts the sub-folders and files in the following sequence:

[1] Obtain up to 256 sub-folders and files each in the order written to FAT within selected folder.

[2] Compare the obtained folder/file names for 8 characters (16 bytes) from the beginning in UNICODE (2-byte character) and sort them in the ascending order. *

[3] If there are files/folders with same character strings: follow the order of MP3, WMA, AAC and WAV when the extension is different; and, otherwise, follow the order written to FAT.

[4] 101 or more files or sub-folders follow the order written to FAT.

* The processing of the file name and the folder name is shown in the following.

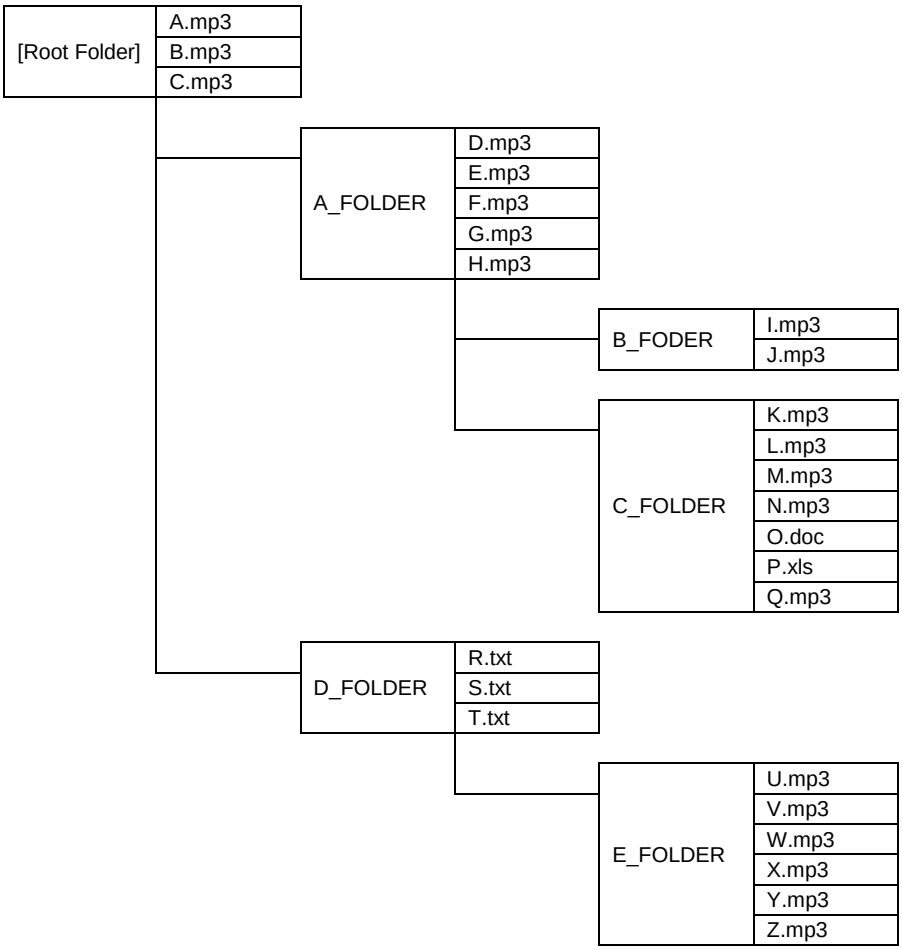
1) When a LFN (long file name) entry exists, 2 bytes are treated as one character.

2) When no LFN entry exists, the SFN(short file name) entry is processed as follows.

2-a) When the first appeared character code is within the range of 0x00-0x7F (US-ASCII), the LSI treats one byte as one character, and adds '0x00' to the upper of the character to expand the entire character to an UNICODE.

2-b) For a case other than 2-a), practically, the LSI treats these 2 bytes as one character.

*For details on LFN and SFN, see the FAT file system specifications.



◊ Figure 31. Example of Folder/File Structure within the Memory Device

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Table 9. File Play Sequence for Folder/File Structure in Figure 28.

Playing sequence	File to be played	Remarks
1	A.mp3	-The LSI first starts playing the playable files in the root folder, if any. -The files are played in the ascending order of UNICODE given to each file name.
2	B.mp3	
3	C.mp3	
4	D.mp3	-After playing all the playable files in the root folder, the LSI searches folders in the lower hierarchy. -The folders are searched in the ascending order of UNICODE given to each folder name.
5	E.mp3	
6	F.mp3	
7	G.mp3	
8	H.mp3	
9	I.mp3	
10	J.mp3	
11	K.mp3	
12	L.mp3	
13	M.mp3	
14	N.mp3	
15	Q.mp3	-Unplayable files are ignored.
16	U.mp3	-After playing all the playable files including those in A_FOLDER and in its lower hierarchy, the LSI moves to the hierarchy in which A FOLDER exists and searches files. -In this case, since no playable file exists in D FOLDER, which is in the same hierarchy of A_FOLDER, the LSI plays the playable files in E FOLDER in the further lower hierarchy.
17	V.mp3	
18	W.mp3	
19	X.mp3	
20	Y.mp3	
21	Z.mp3	

11.5 Search within multi-drive and multi-partition

If a device is a multi-drive type or multi partition type, the LSI can recognize the drive by selecting LUN (Logical Unit Number) for the supporting FAT.

If particular LUN isn't selected, the LSI mounts the device whose LUN detected first. (default)

It is possible that Test Unit Ready of other LUNs is confirmed during the playback.

11.6 External HUB search

When the USB connector is connected to a HUB, and a FAT-supported drive is connected ahead of the HUB at mounting the USB for this LSI, only one drive is recognized.

The LSI does not support external HUBs, it cannot detect plugging/unplugging of the drive ahead of the HUB after the USB is mounted.

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12. Playing files

12.1 Function

For the files judged to be playable through the file search function, the LSI automatically switches the decoder using the file extension and decodes these files.
Fast forward play and rewinding play operations are available.
Also, repeat play and random play are available.

12.2 Playable file formats

12.2.1 MP3 file format

This format supports MPEG Audio 1, 2, 2.5 and Layer 1, 2, 3.
It supports sample rates of 8 kHz, 16 kHz, 32 kHz, 11.025 kHz, 22.05 kHz, 44.1 kHz, 12 kHz, 24 kHz and 48kHz.
It supports bit rates of 8 to 320kbps and VBR (Variable Bit Rate).

12.2.2 WMA file format

This format supports WMA Ver.9 Standard.
It supports sample rates of 8 kHz, 16 kHz, 32 kHz, 11.025 kHz , 22.05 kHz, 44.1 kHz and 48 kHz.
It supports bit rates of 5 to 384kbps and VBR (Variable Bit Rate).
It does not support DRM.
It supports ASF files including audio streams only.

12.2.3 AAC file format

This format supports MPEG4 AAC-LC.
It conforms to ITunes and 3GPP TS 26.244.
It supports file types of m4a, mp42 and 3gpX. (X is an arbitrary numeric value.)
ITunes is validated in the following versions: 4.*, 5.*, 6.* and 7.0-7.5.
It supports sample rates of 8 kHz, 16 kHz, 32 kHz, 11.025 kHz, 22.05 kHz, 44.1 kHz, 12 kHz, 24 kHz and 48 kHz.
It supports bit rates of 8 to 320kbps and VBR (Variable Bit Rate).
It does not support DRM.

12.2.4 WAV file format

This format supports RIFF WAVE.
It supports sample rates of 8 kHz, 16 kHz, 32 kHz, 11.025 kHz, 22.05 kHz, 44.1 kHz, 12 kHz, 24 kHz and 48k Hz.

If you try to play a file created in any format other than above, the LSI immediately terminates decoding it.

12.3 Playing files having damaged data

If the data section of the MP3 file is damaged, the LSI plays the music data in the possible range instead of ceasing to play the entire file. It mutes the unplayable section. However, AMUTE terminal remains H output.
If the data section of the WAV file is damaged, noises are output.
The LSI executes other files within the playable range and stops playing. Then, it skips to the next tune.
If a part of the data header is damaged, the LSI immediately terminates playing and skips to the next tune.

If the file's extension is playable but its file's data does not have a format supporting to the extension, the LSI immediately terminates playing and skips to the next tune.
If the file does not have a file format, the LSI immediately terminates playing and skips to the next tune.
However, when the file data is structured in a format other than MP3 and its file extension is *.MP3, *.MP2 or *.MP1, the LSI plays it in the silence mode basically. However, if the LSI can read any playable data, it plays the file partially.
In this case, the time information which is output as the serial status also becomes unstable. The time information is then partially output but you cannot obtain the correct information.

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12.4 NEXT playing mode and Repeat playing mode

You can select the operation as shown below depending on the next playing mode, repeat mode and random mode.

Next playing mode

[1] PLAY_NEXT: Automatically searches the next tune after the tune being played ends and starts playing the next tune.

[2] PLAY_ALL_STOP: After the last tune being played within the memory ends, stops upon completion of search for the next tune.
Starts playing the next tune by the play command issued subsequently.

[3] PLAY_FOL_STOP: After the last tune being played within the folder ends, stops upon completion of search for the next tune.
Starts playing the next tune by the play command issued subsequently.

[4] PLAY_TUN_STOP: After the tune being played ends, stops upon completion of search for the next tune.
Starts playing the next tune by the play command issued subsequently.

Repeat mode

Ⅰ:REPEAT_ALL: After playing all the tunes within the memory in process, starts playing them from the beginning of the memory.

Ⅱ:REPEAT_FOL: Repeats playing tunes within the folder in process.

Ⅲ:REPEAT_TUN: Repeats playing the tune in process. The operation at the time of FF and FB command reception follows a setup of a SET_REPRAND command.

Ⅳ:RANDOM_ALL: Plays the range of ±128 files from the current tune being played at random within the memory.

Ⅴ:RANDOM_FOL: Plays the range of ±128 files from the current tune being played at random within the folder in process.

Select one operation from next play mode and repeat mode respectively to determine the operation.
When repeat mode is REPEAT_FOL, the PLAY_ALL_STOP becomes invalid, and serves as PLAY_NEXT.
When repeat mode is [3][4][5], the PLAY_ALL_STOP and PLAY_FOL_STOP becomes invalid, and serves as PLAY_NEXT.

	Ⅰ: REPEAT_ALL	Ⅱ: REPEAT_FOL	Ⅲ: REPEAT_TUN	Ⅳ: RANDOM_ALL	Ⅴ: RANDOM_FOL
[1] PLAY_NEXT	○	○	○	○	○
[2] PLAY_ALL_STOP	○	×	×	×	×
[3] PLAY_FOL_STOP	○	○	×	×	×
[4] PLAY_TUN_STOP	○	○	○	○	○

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13. Command operations

13.1 Write command

The LSI allows command operations from an external microcomputer via a slave I^2C serial interface.
The command length to be sent varies depending on the command.
Table 9. shows the command specifications.
Table 10. shows enabled/disabled state of each command.

Table 9. Command Operations

Command name	Command Byte length	Command 1st	2nd	3rd	4th	Explanation of operation
CONFIG						
CHG_SYSTEM_MODE	4	0x60	0x00	N	0x00	・Set up System Operation Mode. ・Please choose 3rd byte N from the following. The other setup does not receive a command. Please be sure to perform the changes to each mode via CONFIG mode. The changes between PLAYER mode and FILEREAD mode cannot be performed directly N= 0x00 ; CONFIG Mode N= 0x01 ; PLAYER Mode N= 0x02 ; FILE RW Mode The initial setting is N= 0x00.
STOP	2	0x60	0x01	-	-	・When receiving the STOP command, end the present processing and shift to the initial state in each system operation mode. ・Playing of a file will be stopped when receiving the STOP command during Playing, a stop, and file search. ・Playing of a file will be stopped when receiving the STOP command during fast forward or fast back Playing. ・After stopping playing the file, the LSI restarts playing it from the tune being stopped. However, if the memory is removed and new one is inserted before restarting, the LSI returns to the top tune of the memory.
ABORT	4	0x60	0x02	0x01	0x00	・Suspends folder analysis. After suspend, the analysis state becomes "not analyzed" and the cursor position becomes invalid. In order to reset this status, it is necessary to transmit an ANALYZE_ROOT command, and it is necessary to make the cursor position valid. After ANALYZE_ROOT command, contents acquisition of a desired folder can be performed. It is not necessary to analyze intermediate folders one by one from a route folder. ・The LSI suspends analysis only and continues playing the file when receiving the ABORT command.
CHG_DEV	2	0x60	0x03	-	-	・This command select device between USB memory and SD memory card. To do this, both devices must be connected or one device is provided against the other (USB memory against SD memory card, and vice versa). Any other cases will be ignored. ・After the device is selected, the system operation mode remains the previous mode (before selecting) and goes to the initial state. ・The setting values of the individual commands remain as they are. However, those of the REPEAT and RANDOM commands return to the initial values.
DIS_WDT	2	0x60	0x04	-	-	・This command disables Watch dog Timer. ・Initial setting is that Watch dog Timer function is effective.
SET_WDT	2	0x60	0x05	-	-	・This command writes “1” to STATUS WDT_RFLG when it is executed.
SET_SORT	4	0x60	0x06	N	0x00	・Set up file sorting operation in a memory. ・Select N at the 3rd byte from the following. Any setting other than N=0x00 is considered to specify N=0x01. N=0x00: Disables sorting of files/folders. Data is read out in the order that is written to FAT. N=0x01: Enables sorting of files/folders. ・Initial setting is N= 0x01. A sorting function is effective.

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SET_12MOUT	4	0x60	0x07	N	M	・Set up CLKOUT12 terminal and a MCLK terminal output. ・Select N at the 3rd byte from the following. Any other settings will not accept the command. N=0x00: Disables 12 MHz clock output from the CLKOUT12 terminal. N=0x01: Enables 12 MHz clock output from the CLKOUT12 terminal. ・Select M at the 4th byte from the following. Any other settings will not accept the command. M=0x00: Disables 12.288MHz/16.9344 MHz clock output from the MCLK terminal. M=0x01: Enables 12.288MHz/16.9344 MHz clock output from the MCLK terminal. ・The 16.9344 MHz clock is a clock which buffers the input from the XIN_PLL terminal. ・The 12.288 MHz clock is divided from CLK24MI terminal input. ・initial setting is N= 0x00 and M= 0x00. Output is invalid.
SET_MP3	4	0x60	0x09	N	0x00	・Select the layer of the MPEG audio to play. ・Select N at the 3rd byte from the following. Any setting other than N=0x00 is considered to specify N=0x01. N=0x00: Plays all the files having extension mp1, mp2, and mp3. N=0x01: Plays the files having extension mp3 only. ・Initial setting is N= 0x00. All the files of mp1, mp2, and mp3 are reproduced.
SET_LBIT	4	0x60	0x0D	N	0x00	・Set up LBIT and a copy bit when SPDIF output. ・Select N at the 3rd byte from the following. Any setting other than N=0x01 is considered to specify N=0x00. N=0x00: SPDIF LBIT=1, copy bit = 0 (copy disabled). N=0x01: SPDIF LBIT=0, copy bit = 1 (copy enabled). ・Initial value is N= 0x00, (ban on a copy).
SET_UTPKT	4	0x60	0x0F	N	0x00	・Set up a USB terminal output. ・Select N at the 3rd byte from the following. Any other setting is considered to specify N=0x01. N=0x00: Normally operating terminal N=0x01: Outputs a test packet from the USB terminal. ・Initial value is N= 0x00.
GET_DEV_FREE	4	0x60	0x10	0x00	0x00	・Analyze the availability of the media selected now. ・The LSI starts analyzing the free space after receiving the command. During analysis, SEARCH=0x1 is set. Upon completion of analysis, SEARCH=0x0 is set. ・After analyzing the free space, you can use the READ_DEV_FREE command to obtain the current free space. ・The LSI does not monitor the free space automatically. Whenever changing the system operation mode or the selected media, you should restart analysis.
SET_TOUT_TUR	4	0x60	0x18	0x01	N	・Specify the wait time after the first-time Test Unit Ready command in USB memory mount operation. ・Setting value [value of SET_TOUT_TUR] x 2 x [value of SET_RETVAL] becomes the wait time. ・Initial setting is N=0x4 (4 x 2 x 375 = 3,000msec). ・Specify N within the range from 0x00 to 0xFF.
SET_IDL_TIME	8	0x60	0x18	0x02	0x00	・Specify the idle time after USB memory bus reset. ・Specify the setting value to the 5 - 6th byte with a little endian. ・Setting value {6 th=M, 5 th=N} x0.167 (usec) becomes wait time. ・Initial setting is 220usec (setting value =1325= {M=x05, N=x2D}) . ・Specify setting value within the range from300 (50usec) to 9000 (1.5msec).
SET_USB_R_WAIT	6	0x60	0x18	0x03	0x00	The wait time after bus reset is set up at the time of USB memory recognition ・Specify the setting value to the 5 - 6th byte with a little endian. ・Setting value {6 th=M, 5 th=N} x200 (msec) is wait time. An initial value is 600 msec (N,M=0x0300), and maximum value is 13107 sec (N,M=0xFFFF).
SET_TOUT_M	4	0x60	0x18	0x04	0x00	The ACK timeout of the command under memory mount is set up. The set point x100 (msec) is timeout. At the time, 5th byte is upper byte and 6th byte is lower byte. An initial value is 30 sec (5th byte =0x2C, 6th byte =0x01), and maximum value is 60 sec (5th byte =0x58, 6th byte =0x02).If set point is over the maximum value, this command is ignored. Mount ERROR will be carried out if a timeout occur.
SET_TOUT_C	4	0x60	0x18	0x05	0x00	The ACK timeout of the commands at the time of PLAY or STOP or PAUSE and sector read under memory mount is set up. The set point x100 (msec) is timeout. At the time, 5th byte is upper byte and 6th byte is lower byte. An initial value is 5 sec (5th byte =0x32, 6th byte =0x00), and maximum value is 60 sec (5th byte =0x58, 6th byte =0x02). If set point is over the maximum value, this command is ignored. Communication ERROR will be carried out if a timeout occur.

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SET_USB_GETDEV_F	6	0x60	0x18	0x06	0x00	・Specify the timeout value for device descriptor acquisition in the head of USB memory mount operation. ・Specify the setting value to the 5 - 6th byte with a little endian. ・Setting value {6 th=M, 5 th=N} x100 (msec)becomes timeout value. ・Communication ERROR will be carried out if a timeout occur. ・Initial setting is N=100 (10sec). ・Specify N within the range from 0x1 to 0xFFFF.
SET_TESTU_MODE	4	0x60	0x18	0x07	N	・Specify the operation for the first-time Test Unit Ready command in USB memory mount operation. ・Select N from the following. Any other settings will not accept the command. N= 0x00 : Retry is performed according to the setting value of a SET_RETVAL command. N= 0x01 : Retry is performed infinitely. N= 0x02 : Cancels infinite retry of N=0x01 setting. ・Initial setting is N= 0x00 (Retry is performed according to the setting value of a SET_RETVAL command.)
SET_USBCMD_CAN	8	0x60	0x18	0x08	0x00	・Specify the initialization procedure performed in USB memory mount operation. ・Specify the mask of the initialization procedure with a little endian. ・The following bit values should be used for an initialization procedure mask. When a bit is 0, an applicable initialization procedure is performed. When a bit is 1, an applicable initialization procedure is not performed. 0x0001 : GET_DEVICE_STATUS 0x0002 : CLEAR_FEATURE 0x0004 : SET_ADDRESS 0x0008 : GET_DESCRIPTOR 0x0010 : GET_CONFIG 0x0020 : SET_CONFIG 0x0040 : GET_LUN 0x0080 : CLEAR_PORT_FEATURE 0x0100 : GET_PORT_STATUS 0x0200 : SET_PORT_FEATURE 0x0400 : GET_HUB_DESCRIPTOR 0x0800 : INQUIRY 0x1000 : TEST_UNIT_READY 0x2000 : REQUEST_SENSE 0x4000 : READ_CAPACITY ・Initial setting is0x0000 . ・Please specify 0 to 7th-8th byte.
SET_RETVAL	6or8	0x60	0x18	0x09	N	・Specify the retry operation performed in USB memory mount operation. ・Specify the setting value from the 5th byte with a little endian. ・The length of a setting value changes with values of N. ・Select N from the following. Any other settings will not accept the command. N = 0x00: Specify the number of times of execution of sector read at 2 bytes. Setting value+1 becomes the number of times of execution. Initial setting is 3. Specify N within the range from 0x0 to 0xFFFF. N = 0x01: Specify the times of retry for first-time device descriptor acquisition at 2 bytes. Initial setting is 3. Specify N within the range from 0x1 to 0xFFFF. N = 0x02: Specify the number of times of execution of the first-time Test Unit Ready command at 2 bytes. Initial setting is 375. Specify N within the range from 0x0 to 0xFFFF. N = 0x05: Specify the timeout setting in the HUB port scan at 4 bytes. Initial setting is 30000. Specify N within the range from 0x1 to 0xFFFF_FFFF. N = 0x06: Specify the number of times of execution of the second-time Test Unit Ready command at 2 bytes. Initial setting is 375. Specify N within the range from 0x0 to 0xFFFF.
SET_RETRYMODE	6	0x60	0x18	0x0A	N	・Specify the operation for the each processing in USB memory mount operation. ・Select 5th byte from the following. 0x00 : Retry is performed according to the preset value or specified value by command. 0x01 : Retry is performed infinitely. 0x02 : Cancels infinite retry setting (0x01). ・Select N from the following. Any other settings will not accept the command. N= 0x01: Specify the operation of sector read. N= 0x02: Specify the operation of first-time device descriptor acquisition N= 0x03: Specify the operation of HUB port scan. N= 0x04: Specify the operation of the waiting for the ACK response for other command request. N= 0x05: Specify the operation of wait after first-time bus reset.
SET_TUR_PASS	4	0x60	0x18	0x0B	N	・Specify the operation after Test Unit Ready timeout in USB memory mount operation. ・Select N from the following. Any other setting is considered to specify N=0x01. N=0x00: TestUnitReady timeout is considered as mount failure. N=0x01: If the number of effective LUN is one, continues mount operation. ・Initial value is N= 0x00.

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SET_TESTU_MODE2	4	0x60	0x18	0x0C	N	・Specify the operation for the second-time Test Unit Ready command in USB memory mount operation. ・Select N from the following. Any other settings will not accept the command. N= 0x00 : Retry is performed according to the setting value of a SET_RETVAL command. N= 0x01 : Retry is performed infinitely. N= 0x02 : Cancels infinite retry of N=0x01 setting. ・Initial setting is N= 0x00 (Retry is performed according to the setting value of a SET_RETVAL command.)
SET_TOUT_TUR2	6	0x60	0x18	0x0D	0x00	・Specify the wait time after the second-time Test Unit Ready command in USB memory mount operation. ・Setting value [value of SET_TOUT_TUR2] x 2 x [value of SET_RETVAL] becomes the wait time. ・Specify the setting value to the 5 - 6th byte with a little endian. ・Initial setting is N=0xFF (255 x 2 x 375 =191,250msec). ・Specify N within the range from 0x00 to 0xFFFF
SET_EMP_DIR	4	0x60	0x1A	N	0x00	・At the time of the FAT analysis, A number isn't given to folders which the file which can reproduce is not in through. ・Select N at the 3rd byte from the following. Any other setting is considered to specify N=0x01. N=0x00 ; A number is assigned in folders as well which the file which can reproduce is not in through. N=0x01 ; A number isn't assigned in folders as well which the file which can reproduce is not in through. ・Initial value is N= 0x00.
SEL_IRPTO	4	0x60	0x1B	N	0x00	・Specify the mode of IRPTO signal output condition. ・In variable interruption mode, IRPTO is unified output by two or more status change. Master microcomputer can select the status. ・In fixed interruption mode, IRPTO is output by single status change according to system mode. ・Select N from the following. Any other setting is considered to specify N=0x00. N=0x00: Variable interruption mode N=0x01: Fixed interruption mode ・Initial value is N= 0x00(Variable interruption mode)
SET_MASK_IRPTO_00	4	0x60	0x1C	0x00	N	・MASK is done from the movement of IRPTO toward each bit of the status register STATUS1 (Offset : 0x0000). MASK is done with bit which 'H' was set up to from the interruption factor of IRPTO Initial value is 0x7A. ・Refer to 6.4.12 for the details of the movement.
SET_MASK_IRPTO_02	4	0x60	0x1C	0x02	N	・MASK is done from the movement of IRPTO toward each bit of the status register STATUS1 (Offset : 0x0002). MASK is done with bit which 'H' was set up to from the interruption factor of IRPTO Initial value is 0x3F. ・Refer to 6.4.12 for the details of the movement.
SET_MASK_IRPTO_22	4	0x60	0x1C	0x22	N	・MASK is done from the movement of IRPTO toward each bit of the status register STATUS1 (Offset : 0x0022). MASK is done with bit which 'H' was set up to from the interruption factor of IRPTO Initial value is 0x4E. ・Refer to 6.4.12 for the details of the movement.
SET_MASK_IRPTO_2F	4	0x60	0x1C	0x2F	N	・MASK is done from the movement of IRPTO toward each bit of the status register STATUS1 (Offset : 0x002F). MASK is done with bit which 'H' was set up to from the interruption factor of IRPTO Initial value is 0x75. ・Refer to 6.4.12 for the details of the movement.
SET_MASK_IRPTO_37	4	0x60	0x1C	0x37	N	・MASK is done from the movement of IRPTO toward each bit of the status register STATUS1 (Offset : 0x0037). MASK is done with bit which 'H' was set up to from the interruption factor of IRPTO Initial value is 0xF8. ・Refer to 6.4.12 for the details of the movement.
SET_NODIFF	4	0x60	0x21	0x00	N	・When folder and file are sorted. It is configured whether it cases sensitivity of the alphabet. When it was configured without a distinction. It becomes only alphabet ("a" - "z" and "A" - "Z") that it is equated. ・Select N at the 4rd byte from the following. Any other setting is considered to specify N=0x01. N=0x00 ; Alphabet doesn't case sensitivity. N=0x01 ; Alphabet cases sensitivity. ・Initial value is N= 0x00.

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SET_IGNORE	12	0x60	0x22	0x00	N	・Specify the character string disregarded at the time of sorting files and folders. ・The specified character string is compared with the head of the name. ・Specify 4byte ASCII character string to 5-8th byte. ・If the ASCII character is less than 4byte, fill with 0x00 data. ・Select N from the following. N=0x00 ; Normal sort. Specified character is not disregarded. N=0x01-0x04 ; Specified character is disregarded. Specify character length to N. ・Initial value is N= 0x00.(Normal sort)
SET_SRC_OFF	4	0x60	0x23	0x00	0x01	・sample rate converter is used in off ・sample rate converter can't be turned on by the command. Turned on it by the IC reset.
SET_SD	4	0x60	0x24	N	M	・Specify the use of a serial bus. ・Select N from the following. N=0x00:No effective-I/F N=0x01:SD I/F ・Initial setting is N=0x00(No effective-I/F). ・Select M from the following. M=0x00: Initialization processing is carried out after detecting SD connection. M=0x01: Initialization processing is not carried out after detecting SD connection. ・Initial setting is M=0x00(Initialization processing is carried out). ・When select M=0x01, send SET_SD_INFO command in advance.
AUTO_RECOG_LUN	4	0x60	0x25	N	0x00	・When multiple LUN device is connected, the auto polling of the Test Unit Ready to each LUN is enabled. ・The result of the polling is saved to LUN_READY status. Then, LUN_READY_RENEW status notifies the updating. ・Select N from the following. Any other setting is considered to specify N=0x01. N=0x00 ; The auto polling of the Test Unit Ready is disabled. N=0x01 ; The auto polling of the Test Unit Ready is enabled. ・Initial setting is N=0x00(The auto polling of the Test Unit Ready is disabled).
SET_RECOG_TIM	4	0x60	0x26	0x00	N	・Cycles to do the auto polling of AUTO_RECOG_LUN is configured. ・Set value x200 (msec) becomes the cycle of the polling performance. ・Initial value is 1sec.
RECOG_LUN	4	0x60	0x27	0x00	0x00	・Check Test Unit Ready of each LUN , and update LUN_READY status only once.
SET_WMA	4	0x60	0x28	0x00	0x00	・The file of the extension "WMA', "ASF" is removed from the playback object. ・The configuration of this command can't do exemption by the command. Exempt it by the IC reset.
SET_AAC	4	0x60	0x29	0x00	0x00	・The file of the extension"MP4', "M4A", "3GP" is removed from the playback object. ・The configuration of this command can't do exemption by the command. Exempt it by the IC reset.
SET_LUN	4	0x60	0x31	0x00	N	LUN, which USB memory mounts, is specified. LUN specified at the time of USB connection mounts. When another LUN is already mounted, Re-mounts By FORCE_DISCON_USB command and FORCE_CON_USB command, When not specifying LUN, effective LUN becomes an AUTO setup and LUN detected first is mounted at the time of USB memory connection. (Initial value)
RESET_LUN	4	0x60	0x32	0x00	0x00	Effective LUN is set to AUTO and LUN detected first comes to be mounted at the time of USB memory connection.
FORCE_DISCON_USB	4	0x60	0x33	0x00	0x00	Force USB memory to be disconnected.
FORCE_CON_USB	4	0x60	0x34	0x00	0x00	Mount USB memory again,.

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FORCE_DISCON_SD	4	0x60	0x36	0x00	0x00	Force SD card to be disconnected
FORCE_CON_SD	4	0x60	0x37	0x00	0x00	Mount SD card again.
SET_SD_TMOUT	8	0x60	0x38	0x01	N	・Specify the timeout value for SD cad mount operation. ・Specify the setting value to the 5 - 8th byte with a little endian. ・Setting value (msec) becomes timeout value. ・If Setting value is 0 , Retry is performed infinitely until it is cancelled by SET_SD_ABORT command. ・Select N from the following. Any other settings will not accept the command. N=0x00: Specify timeout of the whole SD mount operation. Initial setting is 30000. N=0x01: Specify timeout of the first-time CMD8 response. Initial setting is 500. N=0x02: Specify timeout of the second-time CMD8 response. Initial setting is 1000. N=0x03: Specify timeout of the sector reading. Initial setting is 5000.
SET_SD_ABORT	4	0x60	0x38	0x00	0x00	・Cancels infinite retry of SD mount operation by SET_SD_TMOUT command. ・SD mount operation is failed.
SET_WAV	4	0x60	0x39	0x00	0x00	・Remove the file of extension "WAV" for reproduction. ・A setup of this command cannot be canceled. Please reset the LSI.
SET_MP3_PLAY	4	0x60	0x3A	0x00	0x00	・Remove the file of extension "MP3", "MP1", and "MP2" for reproduction. ・A setup of this command cannot be canceled. Please reset the LSI.
SET_USB_SUBC	4	0x60	0x3B	0x00	M	・Specifies valid subclass code for USB mount operation. ・Specify the combination of the following bits to M 0x01 : The subclass 0x01 is valid. 0x02 : The subclass 0x02 is valid. 0x04 : The subclass 0x03 is valid. 0x08 : The subclass 0x04 is valid. 0x10 : The subclass 0x05 is valid. 0x20 : The subclass 0x06 is valid. ・Initial setting is M=0x30 (the subclass 0x05 and 0x06 is valid).
ENABLE_MEDIADRV	4	0x60	0x3C	0x00	0x00	・Enables USB memory/SD card mount operation. ・USB memory/SD card mount operation is disabled until this command is received.
SET_SD_INFO	10	0x60	0x3D	N	N	・Specify the inside information of SD driver. ・When you select M= 0x01 (Initialization processing is not carried out) for SET_SD command, send SET_SD_INFO command in advance. ・Specify 8 bytes data acquired by the READ_SD_STATUS command to the 3rd - 10th byte.
SET_PATCH_CODE	4	0x6F	0x03	0x00	0x00	・Download a patch image packet to this LSI. ・Specify the start offset of the patch image packet to the 5-6th byte with a little endian. ・Specify the length of the patch image packet to the 7-8th byte with a little endian. ・Specify the patch image packet after the 9th byte. ・The maximum length of the patch image packet is 502 bytes. ・Specify 2 bytes CRC16 after the patch image packet with a little endian. ・When CRC16 is not right, the command is not accepted and PRECOM status becomes H.
SET_PATCH_CRC	4	0x6F	0x03	0x01	0x00	・Validate the patch image. ・Specify the CRC16 of the whole patch image to the 5-6th byte with a little endian. ・Specify the length of the whole patch image to the 7-8th byte with a little endian. ・When CRC16 or length is not right, the command is not accepted and PRECOM status becomes H.

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PLAY control						
PLAY	2	0x61	0x01	-	-	・When receiving the PLAY command during stop, the LSI starts playing the file currently selected. ・When receiving the PLAY command during pause, the LSI starts playing the file at the paused time. ・When receiving the PLAY command in the CONFIG mode, the LSI automatically goes to the PLAYER mode and plays the first tune in the sort order.
PAUSE	2	0x61	0x02	-	-	・When receiving the PAUSE command during play, the LSI pauses playing of the file
HOME	4	0x61	0x03	N	0x00	・When receiving the HOME command, the LSI searches files of the first tune within the memory. ・TAG analysis, if it is enabled, is performed. ・It is not the first tune in the memory at the time of the random setup, but it is moved for the tune chosen at random. ・Select N at the 3rd byte from the following. Any setting other than N=0x00 is considered to specify N=0x01. N=0x00: Stops after search is completed. N=0x01: Starts playing after search is completed.
PLAYMODE	4	0x61	0x04	N	0x00	・When receiving the PLAYMODE command, the LSI changes play mode in accordance with the setting of N in the 3rd byte. ・During play, the play mode is immediately changed. During stop, this command cannot start playing the file. ・Select N at the 3rd byte from the following. Any other settings will not accept the command. N=0x00: Changes to normal play. N=0x01: Changes to fast forward. N=0x02: Changes to rewind. ・Initial setting is N= 0x00. It is normal Playing.
VOL+	4	0x61	0x06	0x01	0x00	・When receiving the VOL+ command, the LSI controls the sound volume step by incrementing by 1. ・The sound volume is controlled in 32 steps from -∞ (minimum volume) to 0 dB (maximum volume).
VOL-	4	0x61	0x06	0x02	0x00	・When receiving the VOL- command, the LSI controls the volume step by decrementing by 1. ・The sound volume is controlled in 32 steps from -∞ (minimum volume) to 0 dB (maximum volume).
REPEAT	4	0x61	0x06	0x03	0x00	・This command changes the mode for repeat. ・REPEAT command toggles as: memory repeat ->1 music repeat -> folder repeat. ・For the settings of the REPEAT, RANDOM, and SET_REPRAND commands, the one finally set becomes enabled. ・Initial setting is the all-songs repeat in a memory.
RANDOM	4	0x61	0x06	0x04	0x00	・This command changes the mode for random play. ・If random play is enabled, the LSI plays the currently-played file at random in the area of ±128 files in the sort order. ・The RANDOM command toggles as: Normal play→Repeat all the tunes within the memory. ・For the settings of the REPEAT, RANDOM and SET_REPRAND commands, the one finally set becomes enabled.
FF	4	0x61	0x07	M	N	・When receiving the FF command during play, pause, or stop, the LSI searches the file N tunes ahead from the file being played or paused in the sort order. ・If the number of remaining files is less than N in the sort order, the LSI searches back to the first file. ・If N=0, the LSI searches the current file. ・If REPEAT or RANDOM is set, the LSI searches the next file in accordance with the setting. However, if “Repeats one tune” is set, the LSI searches the next file in accordance with the SET_REPRAND command setting. ・If TAG analysis is enabled, the LSI also performs that analysis. ・After searching, the LSI operates in accordance with the setting in the 3rd byte. Select M at the 3rd byte from the following. Any setting other than M=0x00 is considered to specify M=0x01. M=0x00: Stops after search is completed. M=0x01: Starts playing after search is completed. ・The number of tunes to be searched depends on the setting of N in the 4th byte.

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FB	4	0x61	0x08	M	N	・When receiving the FB command during play, pause, or stop, the LSI searches the file, N tunes back from the file being played, paused or stopped, in the sort order. ・When the LSI play is playing a tune in less than N files from the top in the sort order, it searches the first tune. However, only when the file to be searched is the first tune within the memory in the "repeat within the memory" setting, the LSI searches the file across the last tune within the memory to the first one. If the file to be searched is the first file within the folder in the "repeat within the folder" setting, the LSI searches the file within the same folder. ・If N=0, the LSI searches the top of the current file. However if it receives the FB command with N=0 when the play time is within 1 second, the LSI searches the top of the previous tune. ・If REPEAT or RANDOM is set, the LSI searches files in accordance with the setting. However, if "Repeats one tune" is set, the LSI searches the next file in accordance with the SET_REPRAND command setting. ・If TAG analysis is enabled, the LSI also performs that analysis. ・After searching, the LSI operates in accordance with the setting in the 3rd byte. Select M at the 3rd byte from the following. Any setting other than M=0x00 is considered to specify M=0x01. M=0x00: Stops after search is completed. M=0x01: Starts playing after search is completed. ・The number of tunes to be searched depends on the setting of N in the 4th byte.
FOL+	4	0x61	0x09	M	N	・When receiving the FOL+ command during play, pause, or stop, the LSI searches the folder N tunes ahead from the one having the file being played, paused or stopped in the sort order. ・If the remaining folders are less than N in the sort order, the LSI returns to the first folder. ・Even if REPEAT or RANDOM is set, the LSI searches the file in the status where repeat mode is set. ・Search the file chosen at random when RANDOM is set. ・If N=0, the LSI searches the top of the current folder. ・If TAG analysis is enabled, the LSI also performs that analysis. ・After searching, the LSI operates in accordance with the setting in the 3rd byte. Select M at the 3rd byte from the following. Any setting other than M=0x00 is considered to specify M=0x01. M=0x00: Stops after search is completed. M=0x01: Starts playing after search is completed. ・The number of tunes to be searched depends on the setting of N in the 4th byte.
FOL-	4	0x61	0x0A	M	N	・When receiving the FOL- command during play, pause, or stop, the LSI searches the folder N tunes back from the one having the file being played or paused in the sort order. ・When playing a tune less than N folders from the top in the sort order, the LSI returns to the first folder. However, when playing a file within the first folder, the LSI searches the folder across the last tune within the memory. ・Even if REPEAT or RANDOM is set, the LSI searches the file in the status where repeat mode is set. ・Search the file chosen at random when RANDOM is set. ・If N=0, the LSI searches the top of the current folder. ・If TAG analysis is enabled, the LSI also performs that analysis. ・After searching, the LSI operates in accordance with the setting in the 3rd byte. Select M at the 3rd byte from the following. Any setting other than M=0x00 is considered to specify M=0x01. M=0x00: Stops after search is completed. M=0x01: Starts playing after search is completed. ・The number of folders to be searched depends on the setting of N in the 4th byte.
PLAY_RESUME	46	0x61	0x0B	0x00	N	・This command sets 42-byte data obtained by the READ_RESUME_INFO command to 5th-46th bytes. ・Set the data in ascending order of the offsets obtained by the READ_RESUME_INFO command. ・Select N at the 4rd byte from the following. Any other setting is considered to specify N=0x01. N=0x00 ; Playback is started in the time when「READ_RESUME_INFO」command was forwarded. N=0x01 ; Stop (Pause) in the time when「READ_RESUME_INFO」command was forwarded. N=0x02 ; Playback is started from the front of the tune when「READ_RESUME_INFO」command was forwarded. N=0x03 ; Stop (Pause) the front of the tune when「READ_RESUME_INFO」command was forwarded. ・If the resume target cannot be searched, the LSI searches the first tune of in the device and plays or stop (Pause).

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PLAY Setting						
SET_DOUT	4	0x61	0x10	0x00	N	・This command sets audio output. ・Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: Outputs via audio line. N=0x01: Outputs using the digital audio interface (SPDIF). N=0x02: Outputs in I^2S(32fs) format. N=0x03: Outputs in I^2S(48fs) format. N=0x04: Outputs in I^2S(64fs) format. N=0x05: Outputs in EIAJ(32fs) format. N=0x06: Outputs in EIAJ (48fs) format. N=0x07: Outputs in EIAJ (64fs) format. ・By default, N=0x00: "audio line output" is set.
SET_EQ	4	0x61	0x10	0x01	N	・This command sets the equalizer. ・Set N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: EQ OFF N=0x01: POPS N=0x02: JAZZ N=0x03: ROCK N=0x04: CLASSIC N=0x05: R&B N=0x07: EQ OFF N=0x08: BASS BOOST1 N=0x09: POPS + BASS BOOST1 N=0x0A: JAZZ + BASS BOOST1 N=0x0B: ROCK + BASS BOOST1 N=0x0C: CLASSIC + BASS BOOST1 N=0x0D: R&B + BASS BOOST1 N=0x0F: BASS BOOST2 ・By default, N=0x00: EQ OFF is set.
SET_VOL	4	0x61	0x10	0x02	N	・This command sets the sound volume with the value of N at the 4th byte in 32 steps from 0x00 to 0x1F. ・Setting range outside 0x00 to 0x1F will not accept the command. ・By default, N=0x06 is set.
SET_NEXT	4	0x61	0x10	0x03	N	・This command sets next tune play mode. ・Select N at the 4th byte from the following. Any settings other than N=0x04 will not accept the command. N=0x00: PLAY_NEXT: After the tune being played is completed, the LSI automatically searches the next tune and starts playing it. N=0x01: PLAY_ALL_STOP: After the last tune within the memory being played is completed, the LSI reaches the next tune and stops. When the play command is issued again, the LSI starts playing the next tune. N=0x02: PLAY_FOL_STOP: After the last tune within the folder being played is completed, the LSI searches the next tune and stops. When the play command is issued again, the LSI starts playing the next tune. N=0x03: PLAY_TUN_STOP: After the tune being played is completed, the LSI searches the next tune and stops. When the play command is issued again, the LSI starts playing the next tune. ・By default, N=0x00 is set. ・If the repeat mode is set to “repeat within folder”, operation setting N=0x01 will become disabled. The LSI searches the next tune and then starts playing it. ・If the repeat mode is set to “repeat one tune”, operation settings N=0x01 and 0x02 will become disabled. The LSI searches the next tune and then starts playing it. ・If the repeat mode is set to “random within memory” or “random within folder”, the operation settings N=0x01 and 0x02 will become disabled. The LSI searches the next tune and then starts playing it.
SET_REPRAND	4	0x61	0x10	0x04	N	・This command sets repeat mode. ・Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: REPEAT_ALL: Repeats within the memory Repeats all the tunes within the memory being played. N=0x01: REPEAT_FOL: Repeats within the folder Repeats the tunes within the folder being played. N=0x02: REPEAT_TUN: Repeats one tune Repeats the tune being played. A setup of the repeat in the memory is followed when FF and FB command. N=0x03: REPEAT_TUN: Repeats one tune Repeats the tune being played.

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						A setup of the repeat in the memory is followed when FF and FB command. N=0x04: RANDOM_ALL: Random within the memory Plays tunes at random starting from the one being played, in a range 128 tunes ahead and back of the tune. N=0x05: RANDOM_FOL: Random within the folder Plays tunes at random within the folder starting from the one being played, in a range 128 tunes ahead and back of the tune. ・By default, N=0x00 is set. ・For the settings of the REPEAT, RANDOM and SET_REPRAND commands, the one finally set becomes enabled.
SET_TAG	4	0x61	0x10	0x05	N	・This command sets TAG analysis mode. ・Select N at the 4th byte from the following. Any settings other than N=0x00 will be considered to specify N=0x01. N=0x00: Does not perform TAG analysis. N=0x01: Performs TAG analysis. ・TAG analysis is performed immediately before the LSI starts playing a tune, and started from the file to be searched after the setting is enabled. ・After TAG analysis is completed, the LSI writes the result to the status register. ・By default, N=0x01: "Performs TAG analysis" is set.
SET_TOC	4	0x61	0x10	0x06	N	・This command sets TOC analysis mode. ・Select N at the 4th byte from the following. Any setting other than N=0x00 will be considered to specify N=0x01. N=0x00: Does not perform TOC analysis. N=0x01: Performs TOC analysis. ・When receiving the command, inserting or changing the device, the LSI analyzes the total number of folders within the device (all the folders including root folders) and the total number of playable files. When receiving a command, TOC analysis is performed only at change from OFF to ON. ・The total number of files conforms to the SEL_MP3, SET_WMA, SET_AAC, SET_WAV, SET_MP3_PLAY command. ・The total number of folders conforms to the SET_EMP_DIR command. ・After TOC analysis is completed, the LSI writes the number of total folder and total playable file to the status register, and stops at the first tune in the device. ・By default, N=0x00: "Does not perform TOC analysis" is set.
SET_PRM	8	0x61	0x10	0x07	L	・This command sets play time (M) and skip time (N) for fast forward and rewind. ・Play time is a period of time to make sound. Skip time is a period of time to skip during search. ・For fast forward and rewind, a cycle of {play time (M) + skip time (N) + error (O)} is repeated. The error is determined by the difference between the minimum decode unit and the rounding error between the play time and the real time requiring to search the skip time. The error varies depending on the file and memory structure. ・Play time is set to M[15:0]= [6th byte, 5th byte], and skip time to N[15:0]= [8th byte, 7th byte]. The unit is msec. By default, play time is 300ms=M[15:0]= [6th byte=x01,5th byte=x2C], and skip time is 2100ms=N[15:0]= [8th byte=x08,7th byte=x34]. Specifying 0x0 sets the default. Set play time to 300ms or more, and skip time to (play time×16) or less. When it is moved by the fast rewind play in the front to the tune, the regenerated time of the first period may become shorter than setup time. ・0xL in the 4th byte sets the attenuation level during fast forward and rewind. The allowable level is -6dB X[4th byte]. Allowable setting range is from 0x00 to 0x10. By default, 0x02=-12dB is set. Setting of 0x10 is equivalent to MUTE.
BROWSING						
ANALYZE_ROOT	4	0x62	0x00	0x00	0x00	・The LSI starts analyzing the root folder immediately after receiving the command. ・The analysis is performed for the information of 10 entries (files or subfolders) ・Upon completion of analysis, the cursor position for browsing within the memory is set to the first entry (file or subfolder) within the root folder.
PLAY_CURSOR	4	0x62	0x01	0x00	0x00	・This command selects the file being pointed by the memory browsing cursor. ・If a playable file is selected, the LSI starts playing it. ・If a folder or unplayable file is selected, this command will not be accepted. ・Don't use PLAY_CURSOR in the PLAYER mode when use SET_EXTENSION command by the setup except for N=0x00 (Playable file). Get access data of present cursor position by READ_BROWSE_ENTRY_INFO command, and start play by PLAY_DIRECT command.
GET_TAG_CURSOR	4	0x62	0x01	0x01	0x00	・This command performs TAG analysis for the file being pointed by the memory browsing cursor. ・When a file is pointed by the memory browsing cursor, the LSI immediately starts TAG analysis through the file. Upon completion of analysis, the LSI writes the result to the status register. ・When a folder is pointed by the memory browsing cursor, this command will not be accepted.

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PLAY_DIRECT	10	0x62	0x01	0x04	0x00	・This command starts playing the file specified by the access data. ・If the access data does not specify a playable file, the LSI searches the first tune in the device and stops. ・The position of the memory browsing cursor does not change. ・Set the access data at the 5th-10th bytes.
MOV_NEXT	4	0x62	0x02	0x01	N	・This command moves the memory browsing cursor from the current position to the position N ahead in the sort order. ・The analysis is performed for the information of the 10 entries specified, starting from the move destination. After the analysis is completed, the LSI writes the result to the status register. ・If there are less than N files after the current memory browsing cursor position in the folder, the cursor position goes to the end of the folder. ・If the sort function (SET_SORT) is OFF, the cursor moves in the FAT order.
MOV_PREV	4	0x62	0x02	0x02	N	・This command moves the memory browsing cursor from the current position to the position N backward in the sort order. ・The analysis is performed for the information of the 10 entries specified, starting from the move destination. After the analysis is completed, the LSI writes the result to the status register. ・If there are less than N files from the top of the folder to the current memory browsing cursor position, the cursor position goes to the top of the folder. ・If the sort function (SET_SORT) is OFF, the cursor moves in the FAT order.
MOV_UP	4	0x62	0x02	0x03	0x00	・This command moves the memory browsing cursor to a higher-level folder. ・After moving, the LSI analyzes the folder. ・If the cursor is in the highest layer (root), nothing will be done.
MOV_DOWN	4	0x62	0x02	0x04	0x00	・This command selects the lower-level holder pointed by the memory browsing cursor to move. After moving, the LSI analyzes the folder. ・When a folder is selected, the LSI starts analyzing it. ・When a file is selected, the LSI does not accept the command. ・If the cursor selects the folder in the lowest layer, nothing will be done.
MOV_HOME	4	0x62	0x02	0x05	0x00	・This command moves the memory browsing cursor to the top of the root folder. ・After moving, the LSI analyzes the folder.
MOV_PLAYING	4	0x62	0x02	0x06	0x00	・This command moves the memory browsing cursor to the tune being played. ・After moving, the LSI analyzes the folder. ・During stop or search, the LSI does not accept the command.
MOV_DIRECT	10	0x62	0x02	0x07	N	・This command moves the memory browsing cursor to the position specified by the access data. ・After moving, the LSI starts analyzing at this position. ・Set the access data at the 5th-10th bytes. ・Select the operation after moving with N in the 4th byte. Select N from the following. Any setting other than N=0x00 will be considered to specify N=0x01. N=0x00: Only moves the cursor and analyzes. N=0x01: If moving to a file, starts playing it. ・Don't use MOV_DIRECT command with N=0x01 (a setup with the starts playing) in the PLAYER mode when use SET_EXTENSION command by the setup except for N=0x00 (the file which can reproduce). The movement of the browsing cursor is to use a MOV_DIRECT command (There is no N=0x00; Playable file.) Play start is to use PLAY_DIRECT command.
SET_EXTENSION	4	0x62	0x04	0x00	N	・This command sets the type of file to be output to the status register when browsing within the memory (analyzing the folder). ・Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: Playable file N=0x02: All files N=0x03: Folder only (Does not browsing files.) ・The initial value depends on the mode. In PLAYER mode: N=0x00: Playable file In PLAYLIST mode: N=0x01: Play list file In FILE RW: N=0x02: All files In other cases: N=0x00: Playable file ・The setting of this command is reflected only when the ANALYZE_ROOT command is executed. After setting the command again, be sure to execute the ANALYZE_ROOT command. ・Don't use MOV_DIRECT command (There is N=0x01; starts playing.) and a PLAY_CURSOR command in the PLAYER mode when use it by the setup except for N=0x00 (Playable file).

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FILE READ						
FOPEN_R	260	0x63	0x01	0x00	0x00	・This command specifies the full path and name of the file to be read from the memory using the File Read function. ・If a file exists after receiving the command, open the specified file. ・The full path is 256 bytes at maximum (including drive letter (A:\), file name and extension). Set this at the 5th-260th bytes. If the length is less than 256 bytes, insert 0x00 at the end. Insert "\"(0x5C) for the delimiter between folder layers. ・The drive letter is "A:\" for USB and "B:\" for SD. ・You can also specify the path in a format without drive letter. In this case, the length is 253 bytes at maximum. ・If the full path has a drive letter different from the one for the memory being selected, an error occurs. (For example, "B:\" is set for the full path when USB is selected.)
FOPEN_R_CURSOR	4	0x63	0x01	0x01	0x00	・This command specifies the file pointed by the memory browsing cursor for the one to be read from the memory using the File Read function. ・If a file exists after receiving the command, open the specified file.
FOPEN_R_DIRECT	10	0x63	0x01	0x02	0x00	・This command specifies the access data of the file to be read from the memory using the File Read function. ・The access data is 6 bytes. Set it at the 5th-10th bytes. ・If a file exists after receiving the command, open the specified file.
FCLOSE	4	0x63	0x03	0x00	0x00	・This command closes the file. ・After the File Read function is completed, CLOSE the file.
FREAD_DAT	6	0x63	0x06	N	N	・This command specifies the position of data to be read from the file at File Read. ・Specify the data position to be read in the 3rd to 6th bytes in Little Endian format. ・When using the I^2C bus, send this command and then check that the FRDREADY bit turns 1. Then, send the READ_FR_DATA command. Data of up to 256 bytes can be read at one time. ・When using the SPI bus, send this command and then check that the FRDREADYA bit turns 1. Then, read the data from the SPI bus. Data of up to 4096 bytes can be read at one time.

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Table 10. Command enable/disable in each system operation mode

Command	Command enable/disable in each system operation mode			Command enable/disable in each status					
	CONFIG	PLAYER	FILE READ	STOP	PLAY	SEARCH (mode)	SEARCH (file)	Analyze	Write
CONFIG									
CHG_SYSTEM_MODE	○	○	○	○	○	×	×	×	○
STOP	○	○	○	○	○	○	○	○	○
ABORT	○	○	○	○	○	○	○	○	×
CHG_DEV	○	○	○	○	○	×	×	×	○
DIS_WDT	○	○	○	○	×	×	×	×	×
SET_WDT	○	○	○	○	×	×	×	×	○
SET_SORT	○	○	○	○	×	×	×	×	×
SET_12MOUT	○	○	○	○	×	×	×	×	○
SET_MP3	○	×	×	○	×	×	×	×	×
SET_LBIT	○	○	○	○	×	×	×	×	○
SET_UTPKT	○	×	×	○	×	×	×	×	×
GET_DEV_FREE	○	○	○	○	×	×	×	×	×
SET_TOUT_TUR	○	×	×	○	×	×	×	×	×
SET_IDL_TIME	○	×	×	○	×	×	×	×	×
SET_USB_R_WAIT	○	○	○	○	○	×	×	×	○
SET_TOUT_M	○	○	○	○	○	×	×	×	○
SET_TOUT_C	○	○	○	○	○	×	×	×	○
SET_USB_GETDEV_F	○	○	○	○	×	×	×	×	×
SET_TESTU_MODE	○	○	○	○	×	×	×	×	×
SET_USBCMD_CAN	○	○	○	○	×	×	×	×	×
SET_RETVAL	○	○	○	○	×	×	×	×	×
SET_RETRYMODE	○	○	○	○	×	×	×	×	×
SET_TESTU_PASS	○	○	○	○	×	×	×	×	×
SET_TESTU_MODE2	○	○	○	○	×	×	×	×	×
SET_TOUT_TUR2	○	×	×	○	×	×	×	×	×
SET_EMP_DIR	○	×	×	○	×	×	×	×	×
SEL_IRPTO	○	○	○	○	○	○	○	○	○
SET_IRPTO_MASK_00	○	○	○	○	○	○	○	○	○
SET_IRPTO_MASK_02	○	○	○	○	○	○	○	○	○
SET_IRPTO_MASK_22	○	○	○	○	○	○	○	○	○
SET_IRPTO_MASK_2F	○	○	○	○	○	○	○	○	○
SET_IRPTO_MASK_37	○	○	○	○	○	○	○	○	○
SET_NODIFF	○	○	○	○	○	○	○	○	○
SET_IGNORE	○	○	○	○	○	○	○	○	○

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SET_SRC_OFF	○	○	○	○	○	○	○	○	○
SET_SD	○	○	○	○	○	○	○	○	○
AUTO_RECOG_LUN	○	○	○	○	○	○	○	○	○
SET_RECOG_TIM	○	○	○	○	○	○	○	○	○
RECOG_LUN	○	○	○	○	○	○	○	○	○
SET_WMA	○	×	×	○	×	×	×	×	×
SET_AAC	○	×	×	○	×	×	×	×	×
SET_LUN	○	○	○	○	○	×	×	×	○
RESET_LUN	○	○	○	○	○	×	×	×	○
FORCE_DISCON_USB	○	○	○	○	○	×	×	×	○
FORCE_CON_USB	○	○	○	○	○	×	×	×	○
FORCE_DISCON_SD	○	○	○	○	○	×	×	×	○
FORCE_CON_SD	○	○	○	○	○	×	×	×	○
SET_SD_TMOUT	○	○	○	○	×	×	×	×	×
SET_SD_ABORT	○	○	○	○	×	×	×	×	×
SET_WAV	○	×	×	○	×	×	×	×	×
SET_MP3_PLAY	○	×	×	○	×	×	×	×	×
ENABLE_MEDIADRV	○	×	×	×	×	×	×	×	×
SET_SD_INFO	○	×	×	○	×	×	×	×	×
SET_PATCH_CODE	○	×	×	○	×	×	×	×	×
SET_PATH_CRC	○	×	×	○	×	×	×	×	×
PLAY control									
PLAY	○	○	×	○	○	×	×	×	×
PAUSE	×	○	×	○	○	×	×	×	×
HOME	×	○	×	○	○	×	×	×	×
PLAYMODE	×	○	×	○	○	×	×	×	×
VOL+	○	○	○	○	○	×	×	×	○
VOL-	○	○	○	○	○	×	×	×	○
REPEAT	×	○	×	○	○	×	×	×	×
RANDOM	×	○	×	○	○	×	×	×	×
FF	×	○	×	○	○	×	×	×	×
FB	×	○	×	○	○	×	×	×	×
FOL+	×	○	×	○	○	×	×	×	×
FOL-	×	○	×	○	○	×	×	×	×
PLAY_RESUME	×	○	×	○	○	×	×	×	×
PLAY Setting									
SET_DOUT	○	○	○	○	○	×	×	×	○
SET_EQ	○	○	○	○	○	×	×	×	○
SET_VOL	○	○	○	○	○	×	×	×	○

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SET_NEXT	×	○	×	○	○	×	×	×	×
SET_REPRAND	×	○	×	○	○	×	×	×	×
SET_TAG	×	○	×	○	○	×	×	×	×
SET_TOC	×	○	×	○	○	×	×	×	×
SET_PRM	×	○	×	○	○	×	×	×	×
BROWSING									
ANALYZE_ROOT	×	○	○	○	○	×	○	×	×
PLAY_CURSOR	×	○	×	○	○	×	x	×	×
GET_TAG_CURSOR	×	○	×	○	○	×	○	×	×
PLAY_DIRECT	×	○	×	○	○	×	x	×	×
MOV_NEXT	×	○	○	○	○	×	○	×	×
MOV_PREV	×	○	○	○	○	×	○	×	×
MOV_UP	×	○	○	○	○	×	○	×	×
MOV_DOWN	×	○	○	○	○	×	○	×	×
MOV_HOME	×	○	○	○	○	×	○	×	×
MOV_PLAYING	×	○	×	×	○	×	×	×	×
MOV_DIRECT	×	○	×	○	○	×	○	×	×
SET_EXTENSION	×	○	○	○	○	○	○	×	×
FILE READ									
FOPEN_R	×	×	○	○	×	×	×	×	×
FOPEN_R_CURSOR	×	×	○	○	×	×	×	×	×
FOPEN_R_DIRECT	×	×	○	○	×	×	×	×	×
FCLOSE	×	×	○	○	×	×	×	×	×
FREAD_DAT	×	×	○	○	×	×	×	×	×

○=enable ×=disable

13.2 Status output

The operation information, such as internal statuses, play time, folders, files and Tags, is output using an I^2C interface. The statuses shown in Table 11. Status Register Map is output.

When reading status via I^2C, the OFFSET position is automatically incremented after reading byte data. However, by issuing the I^2C start condition, the OFFSET position is reset to OFFSET specified by the previous command.

To read statuses, two methods are available: to specify OFFSET of the status register map and read any bytes continuously from the OFFSET position; and to read byte data by a command without specifying the OFFSET position. Table 12. shows the status output commands.

Byte data, when reading via I^2C, is output in Little Endian format.

When read over OFFSET=0x140, OFFSET does not return to 0x00, therefore the read value turns into an unfixed value.

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Table 11. Status Register Map

OFFSET	Status	bit7 (MSB)	bit6	bit5	bit4	bit3	bit2	bit1	bit0 (LSB)
0x00	STATUS1	ERROR	SEARCH		BUSY	MCHNG	STOP	PAUSE	PLAY
0x01	STATUS2	IRPTO	0	STOP_INFO		0	PRECOM	RES_ERR	DEC_ERR
0x02	STATUS3	USBINS	SDINS	USBFILE	SDFILE	MDEVUSB	MDEVSD	PDEVUSB	PDEVSD
0x03	STATUS4	SEL_TOC	TINFUSB	TINFSD	SET_TAG	ANA_TAG	TAGINFO		
0x04	STATUS5	0	SET_SD	FBP	FFP	PLAYFILE			
0x05	STATUS6	PRECOMSTAT							
0x06	VOLINF	0	0	0	VOLINF				
0x07	DOUTINF	EQINF				DOUTINF			
0x08	PMODEINF	REPEATINF				SETNEXTINF			
0x09	SEL_MP3	AUTO_LUN	SET_SRC	SET_AAC	SET_WMA	WDT_RFLG	12MOUT	SET_SORT	SET_MP3
0x0A	PSEC	PSECH				PSECL			
0x0B	PMINL	PMINLH				PMINLL			
0x0C	PMINH	PMIHH				PMINHL			
0x0D	TSEC	TSECH				TSECL			
0x0E	TMINL	TMINLH				TMINLL			
0x0F	TMINH	TMINHH				TMINHL			
0x10	LANGL	LANGL							
0x11	LANGH	LANGH							
0x12	PFOLNL	PFOLNL							
0x13	PFOLNH	PFOLNH							
0x14	PFILENFLL	PFILENLL							
0x15	PFILENFLH	PFILENLH							
0x16	PFILENFHL	PFILENHL							
0x17	PFILENFHH	PFILENHH							
0x18	PFILENMLL	PFILENLL							
0x19	PFILENMLH	PFILENLH							
0x1A	PFILENMHL	PFILENHL							
0x1B	PFILENMHH	PFILENHH							
0x1C	TFOLMEML	TFOLMEML							
0x1D	TFOLMEMH	TFOLMEMH							
0x1E	TFILEMEMLL	TFILEMEMLL							
0x1F	TFILEMEMLH	TFILEMEMLH							
0x20	TFILEMEMHL	TFILEMEMHL							
0x21	TFILEMEMHH	TFILEMEMHH							
0x22	BROWSESTAT	ANA_ERR	0	0	GET_TAG_END	GET_TAG_ID			ANA_CUR
0x23	NUMANAFOLLL	NUMANAFOLLL							
0x24	NUMANAFOLLH	NUMANAFOLLH							
0x25	NUMANAFOLHL	NUMANAFOLHL							
0x26	NUMANAFOLHH	NUMANAFOLHH							
0x27	TFILEANAFOLLL	TFILEANAFOLLL							
0x28	TFILEANAFOLLH	TFILEANAFOLLH							
0x29	TFILEANAFOLHL	TFILEANAFOLHL							
0x2A	TFILEANAFOLHH	TFILEANAFOLHH							
0x2B	TFOLANAFOLL	TFOLANAFOLL							
0x2C	TFOLANAFOLH	TFOLANAFOLH							
0x2D	TFOLANAHEIRL	TFOLANAFOLL							
0x2E	SORTOPTION	SET_NODIFF	SET_IGNORE	SET_EMP_DIR	0	0	0	0	0
0x2F	FIOSTAT	FIOERR	0	0	FIOOPEN	FRDREADY	0	FIOSEARCH	FIOMODE
0x30	FIOSET	0	0	0	0	0	0	FIOOPE	
0x35	LUN_READY_L	LUN_READY_L							
0x36	LUN_READY_H	LUN_READY_H							
0x37	MEMINFO	MEMINFO				LUN_BUSY	LUN_READY_RENEW	reseve	reseve
0x38 - 0x13F	COMAREA	COMAREA							

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OFFSET	Status	bit	NAME	Contents
0x00	STATUS1	7	ERROR	ERROR situation 0 ; Nothing error, 1 ; Error * ERROR=0 in Config mode.
		6:5	SEARCH	SEARCH situation bit6:device recognition 0: Search stop 1: Under a search bit5:file search 0: Search stop 1: Under a search
		4	BUSY	BUSY situation 0: non-BUSY , 1:BUSY
		3	MCHNG	Music change detection 0: Under a music end / stop, 1: Stop after search/ Playing.
		2	STOP	STOP state 0: not stopped, 1: Under a stop
		1	PAUSE	PAUSE state 0: not stopped, 1: Under a stop
		0	PLAY	Playing state 0: not reproducing, 1: Under Playing
0x01	STATUS2	7	IRPTO	IRPTO interruption state 0: Nothing interruption, 1;interruption
		6	0	0
		5:4	STOP_INFO	Stop state detailed information 0: It is except during the stop/stop after device mount, 1: Stop pulled [music] out the head, 2: Error stop, 3: Stop by SET_NEXT Command setting
		3	0	0
		2	PRECOM	The last command situation 0;Normal receptionist, 1;Abnormalities (un-receiving)
		1	RES_ERR	Resume error 0: With no error, 1: Error
		0	DEC_ERR	Decoding error 0: With no error, 1: Error
0x02	STATUS3	7	USBINS	USB connection detection 0:USB un-connecting, 1:USB connection detection
		6	SDINS	SD connection detection 0:SD un-connecting, 1:SD connection detection
		5	USBFILE	Playable file existence in a USB memory 0;Nothing, 1;existence
		4	SDFILE	Playable file existence in a SD memory 0;Nothing, 1;existence
		3	MDEVUSB	USB memory recognition situation 0: Un-recognizing, 1: Recognition
		2	MDEVSD	SD memory recognition situation 0: Un-recognizing, 1: Recognition
		1	PDEVUSB	USB memory situation 0: Under a stop, 1: Under Playing/TAG analysis
		0	PDEVSD	SD memory situation 0: Under a stop, 1: Under Playing/TAG analysis
0x03	STATUS4	7	SEL_TOC	TOC analysis setup 0:TOC analysis OFF , 1:TOC analysis ON
		6	TINFUSB	Acquisition of total file/folder number in a USB memory. 0: Un-acquiring, 1: Finishing acquisition
		5	TINFSD	Acquisition of total file/folder number in a SD memory. 0: Un-acquiring, 1: Finishing acquisition
		4	SET_TAG	TAG analysis setup 0:TAG analysis OFF, 1:TAG analysis ON
		3	ANA_TAG	TAG analysis situation 0;TAG analysis stop, 1;Under TAG analysis
		2:0	TAGINFO	Existence TAG kind 0:ID 3V1, 1:ID 3V2, 2;With WMA, 3;AAC, 4:WAV, and 7: no TAG information
0x04	STATUS5	7	0	0
		6	SET_SD	SD I/F effective 0:OFF , 1:ON
		5	FBP	Fast back Playing situation 0: normal Playing, 1:fast-back Playing
		4	FFP	Fast forward Playing situation 0: normal Playing, 1:fast-forward Playing
		3:0	PLAYFILE	Playing file information 1:MP3, 2:WMA, 3:AAC, 4:WAV
0x05	STATUS6	7:0	PRECOMSTAT	The last command receptionist situation detailed information ; The last command outputs whether it received normally. Refer to 6.4.13 for the contents A state is held to the following command. A state is not cleared by the lead command. The 0th bit is the same as that of PRECOM status. They are the contents at the time of abnormalities except it.
0x06	VOLINF	7:5	0	0
		4:0	VOLINF	Volume setting information. The value set up by SET_VOL [4:0] is outputted.
0x07	DOUTINF	7:4	EQINF	EQ setting information. The value set up by SET_EQ [3:0] is outputted.
		3:0	DOUTINF	Audio output setting information. The value set up by SET_DOUT [3:0] is outputted.
0x08	PMODEINF	7:4	REPEATINF	REPEAT MODE setting information. The value set up by SET_REPRAND [3:0] is outputted.
		3:0	SETNEXTINF	PLAY NEXT MODE setting information. The value set up by SET_NEXT [3:0] is outputted.
0x09	SEL_MP3	7	AUTO_LUN	Test Unit Ready auto polling condition 0: Auto polling , 1: not polling
		6	SET_SRC	SRC effective 0:ON , 1:OFF
		5	SET_AAC	AAC file playback configuration 0:AAC play , 1:AAC not play
		4	SET_WMA	WMA file playback configuration 0:WMA play, 1:WMA not play
		3	WDT_RFLG	Monitor register for WDT 0:after RESET
		2	12MOUT	12MHz clock output 0:OFF, 1:ON
		1	SET_SORT	file sorting functional setup 0;SORT function OFF, 1;SORT function effective
		0	SET_MP3	MP3 file Playing setup 0;Extensions mp1 and mp2, mp3 Playing, 1;Reproduce only extension mp3.
0x0A	PSEC	7:4	PSECH	Playing time second information [7:4] x 10 seconds
		3:0	PSECL	Playing time second information [3:0] x 1 second
0x0B	PMINL	7:4	PMINLH	Playing time minutes information [7:4] x 10 minutes
		3:0	PMINLL	Playing time minutes information [3:0] x 1 minute
0x0C	PMINH	7:4	PMINHH	Playing time minutes information [7:4] x 1000 minutes
		3:0	PMINHL	Playing time minutes information [3:0] x 100 minutes
0x0D	TSEC	7:4	TSECH	1 track time second information [7:4] x 10 seconds
		3:0	TSECL	1 track time second information [3:0] x 1 second
0x0E	TMINL	7:4	TMINLH	1 track time minutes information [7:4] x 10 minutes
		3:0	TMINLL	1 track time minutes information [3:0] x 1 minute
0x0F	TMINH	7:4	TMINHH	1 track time minutes information [7:4] x 1000 minutes
		3:0	TMINHL	1 track time minutes information [3:0] x 100 minutes
0x10	LANGL	7:0	LANGL	TAG character code information lower byte [7:0]
0x11	LANGH	7:0	LANGH	TAG character code information higher byte [15:8]
0x12	PFOLNL	7:0	PFOLNL	Playing folder number in memory. Lower byte [7:0] ROOT becomes No.1. A number is shaken in order of sorting.
0x13	PFOLNH	7:0	PFOLNH	Playing folder number in memory. Higher rank byte [15:8]
0x14	PFILENFLL	7:0	PFILENLL	Playing file number in the present folder. [15:0], lower byte [7:0], a number is shaken from No.1 in order of sorting.
0x15	PFILENFLH	7:0	PFILENLH	Playing file number in the present folder. [15:0], Higher rank byte [15:8]
0x16	PFILENFHL	7:0	PFILENHL	Playing file number in the present folder. [31:16], Low rank byte [23:16]

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0x17	PFILENFHH	7:0	PFILENHH	Playing file number in the present folder. [31:16], Higher rank byte [31:24]
0x18	PFILENMLL	7:0	PFILENLL	Playing file number in the memory. [15:0] Low rank byte [7:0]
0x19	PFILENMLH	7:0	PFILENLH	Playing file number in the memory. [15:0] Higher rank byte [15:8]
0x1A	PFILENMHL	7:0	PFILENHL	Playing file number in the memory. [31:16] Low rank byte [23:16]
0x1B	PFILENMHH	7:0	PFILENHH	Playing file number in the memory. [31:16] Higher rank byte [31:24]
0x1C	TFOLMEML	7:0	TFOLMEML	The number of total folders in a memory. low rank byte [7:0]
0x1D	TFOLMEMH	7:0	TFOLMEMH	The number of total folders in a memory. higher rank byte [15:8]
0x1E	TFILEMEMLL	7:0	TFILEMEMLL	The number of total files in memory. [15:0] low-rank byte [7:0]
0x1F	TFILEMEMLH	7:0	TFILEMEMLH	The number of total files in memory. [15:0] higher-rank [15:8]
0x20	TFILEMEMHL	7:0	TFILEMEMHL	The number of total files in memory. [31:16] low-rank byte [23:16]
0x21	TFILEMEMHH	7:0	TFILEMEMHH	The number of total files in memory. [31:16] higher-rank byte [31:24]
0x22	BROWSESTAT	7	ANA_ERR	browsing analysis Error 0: With no error 1: Error-generate in analysis.
		6	0	-
		5	0	-
		4	GET_TAG_END	Cursor position TAG analysis situation 0: Under TAG un-analyzing/analysis, 1: Finishing of TAG analysis
		3:1	GET_TAG_ID	Cursor position TAG kind 0:ID3V1, 1:ID3V2, 2:WMA, 3:AAC, 4:WAV, 7: no TAG information
		0	ANA_CUR	Cursor position entry analysis. 0;Analysis stop, 1;Under analysis
0x23	NUMANAFOLLL	7:0	NUMANAFOLLL	Cursor position number in a cursor existence folder [15:0] The entry number which the cursor within the folder in which low rank byte [7:0] cursor exists has pointed out is outputted. A number is shaken from No.1 in order of sorting in a folder.
0x24	NUMANAFOLLH	7:0	NUMANAFOLLH	Cursor position number in a cursor existence folder [15:0] Higher rank byte [15:8]
0x25	NUMANAFOLHL	7:0	NUMANAFOLHL	Cursor position number in a cursor existence folder [31:16] Low rank byte [23:16]
0x26	NUMANAFOLHH	7:0	NUMANAFOLHH	Cursor position number in a cursor existence folder [31:16] Higher rank byte [31:24]
0x27	TFILEANAFOLLL	7:0	TFILEANAFOLLL	The number of files total in a cursor existence folder [15:0] Low rank byte [7:0]
0x28	TFILEANAFOLLH	7:0	TFILEANAFOLLH	The number of files total in a cursor existence folder [15:0] Higher rank byte [15:8]
0x29	TFILEANAFOLHL	7:0	TFILEANAFOLHL	The number of files total in a cursor existence folder [31:16] Low rank byte [23:16]
0x2A	TFILEANAFOLHH	7:0	TFILEANAFOLHH	The number of files total in a cursor existence folder [31:16] Higher rank byte [31:24]
0x2B	TFOLANAFOLL	7:0	TFOLANAFOLL	The number of subfolders total in a cursor existence folder [15:0] Low rank byte [7:0]
0x2C	TFOLANAFOLH	7:0	TFOLANAFOLH	The number of subfolders total in a cursor existence folder [15:0] Higher rank byte [15:8]
0x2D	TFOLANAHEIRL	7:0	TFOLANAHEIRL	The class's number of cursor existence folder [7:0] A ROOT class is set to 1.
0x2E	SORTOPTION	7	SET_NODIFF	Cases sensitivity of the alphabet 0: Cases sensitivity , 1: Not cases sensitivity
		6	SET_IGNORE	Set characters is ignored 0:Not ignored , 1:ignored
		5	SET_EMP_DIR	A number isn't given to empty folders 0: number given , 1:number not given
		1:4	0	0
0x2F	FIOSTAT	7	FIOERR	FILE IO Error situation 0: With no Error, 1:Error
		6	0	0
		5	0	0
		4	FIOOPEN	FILE OPEN state 0: Un-open 1;during file open
		3	FRDREADY	Read-out FIFO preparation situation 0:Under preparation, 1:Preparation O.K.
		2	0	0
		1	FIOSEARCH	FILE IO processing situation 0:Processing stop, 1:Under processing
		0	FIOMODE	FILE IO mode effective/invalid 0;invalid 1; effective
0x30	FIOSET	7:6	0	0
		5:4	0	0
		3:0	FIOOPE	The contents situation of FILE IO processing 0;With no processing , 1;OPEN, 2;Read, 3;Write, 4;Close, 5;Delete
0x31	LUN_READY_L	7:0	LUN_READY_L	The condition of Test Unit Ready of each LUN [7:0] 0: NG , 1: OK
0x32	LUN_READY_H	7:0	LUN_READY_H	The condition of Test Unit Ready of each LUN [15:8] 0: NG , 1: OK
0x37	MEMINFO	7:4	MEMINFO	Memory device information chosen now
		3	LUN_BUSY	Test Unit Ready condition identification flag 0:not identification , 1: identification
		2	LUN_READY_RENEW	The change of state flag of Test Unit Ready 0:Changed , 1:Not changed (It is cleared by 0 by a READ_LUN_READY command read.
		1	reserve	-
		0	reserve	-
0x38 - 0x13F	COMAREA	7:0	COMAREA	Data common area The contents change with status read-out commands. (When read-out exceeding OFFSET=0x140 is performed, OFFSET does not return to 0x00, but the value read becomes unfixed)

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Table 12. Status Output Commands

Command name	Command Byte length	Command 1st	2nd	3rd	4th	Status The number of output bytes	STATUS
READ_BUFF	4	0x6C	0x00	N	M	Arbitrary	・Output the arbitrary number data of bytes from the OFFSET position where the status register map was specified. ・OFFSET is 3rd and 4th byte. It is specified as a byte by Little Endian (M, N= 0x00, 0x00 to 0x01, 0xFF).
READ_STATUS	4	0x6D	0x00	0x00	0x00	6	・Output about internal status. ・Output about OFFSET 0x00-0x05 of a status buffer.
READ_PSET	4	0x6D	0x00	0x01	0x00	4	・Output about setting information. ・Output about OFFSET 0x06-0x09 of a status buffer.
READ_PTIME	4	0x6D	0x00	0x02	0x00	6	・Output about Playing time information. ・Output about OFFSET 0x0A-0x0F of a status buffer.
READ_LANG	4	0x6D	0x00	0x02	0x01	2	・Output about TAG character code information. ・Output about OFFSET 0x10-0x11 of a status buffer.
READ_PNUM	4	0x6D	0x00	0x02	0x02	10	・Output about the number under Playing. ・Output about OFFSET 0x12-0x1B of a status buffer. ・An exact value of the number of total files and folders in memory cannot be acquired when music is specified by cursor and access data, such as a PLAY_CURSOR command.
READ_TNUM	4	0x6D	0x00	0x02	0x03	6	・Output about the file in a memory, and the number of folders. ・Output about OFFSET 0x1C-0x21 of a status buffer.
READ_FNUM	4	0x6D	0x00	0x02	0x04	4	・Output the number of files which is in a folder during the present Playing.
READ_PFILE_NAME	4	0x6D	0x00	0x03	N	130	・Output the file name of the file of the +Nth file during the present Playing. Specify N from 0x00 to 0x03. N=0x00 is the present file. Output is enabled only when the Nth file is within the same folder where the one being played resides. If the Nth file is in a different folder, “0” is output ・Output data has the proposed data ID (2 bytes). See 16. File Name, Folder Name, TAG Information for the output format.
READ_PFOL_NAME	4	0x6D	0x00	0x04	0x00	130	・Output the folder name of the file being played. ・Output data has the proposed data ID (2 bytes). See 6.4.6 for the output format.
READ_PFILE_TAG	4	0x6D	0x00	0x05	N	130	・Outputs the data which is written to TAG of the file being played. ・Specify TAG type with 0xN at the 4th bytes. Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: TITLE , N=0x01: ARTIST , N=0x02: ALBUM , N=0x03: GENRE ・Output data has the preposed data ID (2 bytes). See 16. File Name, Folder Name, TAG Information for the output format.
READ_RESUME_INFO	4	0x6D	0x00	0x06	0x00	42	・Outputs the data required to execute resume play. ・The data is output in Little Endian format. ・See 6.4.5 for the output format.
READ_DEV_FREE	4	0x6D	0x00	0x07	N	8	・Outputs the free space analysis results of the file analyzed by the GET_DEV_FREE command. ・Specify the space type to be output with N at the 4th byte. Select N at the 4th byte from the following. Any other settings will be considered to specify N=0x01. N=0x00: Outputs the free space of the selected media by the byte. N=0x01: Outputs the TOTAL space of the selected media by the byte. ・If the GET_DEV_FREE command has not been sent, this command outputs “0”.
READ_DEVDESC	4	0x6D	0x00	0x08	0x00	18	・Output a Device Descriptor value when the USB memory is inserted and chosen. ・Vendor ID and Product ID are the following offset. 0x08：Vendor ID Lower byte 0x09：Vendor ID Upper byte 0x0A：Product ID Lower byte 0x0B：Product ID Upper byte
READ_CONDESC	4	0x6D	0x00	0x08	0x01	32	・Output a Configuration Descriptor value when the USB memory has been recognized. ・32 bytes from the head of top Configuration Descriptor is outputted.
READ_INQIRY	4	0x6D	0x00	0x08	0x02	32	・Output a MSC Inquiry value when the USB memory has been recognized. ・Vender identification (ASCII) and Product identification (ASCII) are the following offset. 0x08-0x0F Vender identification(ASCII)

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							0x10-0x1F Product identification(ASCII)
READ_LUN	4	0x6D	0x00	0x08	0x03	1	·In case of AUTO detection mode of LUN, LUN of mounted USB memory can be read. ·If LUN is specified using the "SET_LUN" command, specified LUN of mounted USB memory can be read. But if failed to mount, 0xFF is read. · Attention) When memory connected to multi-card reader is removed or re-inserted, LUN read by this command is NOT correct until mount of re-inserted media is completed.
READ_LUN_NUM	4	0x6D	0x00	0x08	0x04	1	·Read the total of LUN of the USB memory which is connected now.
READ_SET_LUN	4	0x6D	0x00	0x08	0x05	1	·Read LUN specified by the "SET_LUN" command. In not setting up, 0xFF is read.
READ_IRPTO_FACTOR	4	0x6D	0x00	0x09	0x00	10	・The condition of the status register made the target of the dimension of IRPTO is outputted. 5byte data is outputted in the order STATUS1 (Offset : 0x000)、STATUS3 (Offset : 0x002)、 BROWSESTAT (Offset : 0x022)、FIOSTAT (Offset : 0x02F)、MEMINFO (Offset : 0x037), and 5byte and outputs the flag which shows bit which is the dimension of IRPTO. As for the flag of the interrupted dimension, MASK isn't done by MASK configuration.
READ_LUN_READY	4	0x6D	0x00	0x0A	0x00	2	・The consequence of Test Unit Ready of each confirmed LUN by 「AUTO_RECOG_LUN」or「RECOG_LUN」is read out. ・When Test Unit Ready is OK, output 1. ・When Test Unit Ready is NG, output 0. ・It is outputted about OFFSET 0x31-0x32 of the status buffer. ・LUN_READY_RENEW flag is cleared by the read of this command.
READ_MASK_IRPTO_00	4	0x6D	0x00	0x0B	0x00	1	・MASK configuration from the dimension of IRPTO can be read out each bit of the status register STATUS1 (Offset : 0x00). ‘H' bit is MASK from the IRPTO dimension.
READ_MASK_IRPTO_02	4	0x6D	0x00	0x0B	0x02	1	・MASK configuration from the dimension of IRPTO can be read out each bit of the status register STATUS1 (Offset : 0x02). ‘H' bit is MASK from the IRPTO dimension.
READ_MASK_IRPTO_22	4	0x6D	0x00	0x0B	0x22	1	・MASK configuration from the dimension of IRPTO can be read out each bit of the status register STATUS1 (Offset : 0x22). ‘H' bit is MASK from the IRPTO dimension.
READ_MASK_IRPTO_2F	4	0x6D	0x00	0x0B	0x2F	1	・MASK configuration from the dimension of IRPTO can be read out each bit of the status register STATUS1 (Offset : 0x2F). ‘H' bit is MASK from the IRPTO dimension.
READ_MASK_IRPTO_37	4	0x6D	0x00	0x0B	0x37	1	・MASK configuration from the dimension of IRPTO can be read out each bit of the status register STATUS1 (Offset : 0x37). ‘H' bit is MASK from the IRPTO dimension.
READ_STOP _PROGRESS	4	0x6D	0x00	0x0C	0x00	4	・Output the state of reproduction stop processing. ・When you send command accompanied by reproduction operation after STOP command ,check the completion of stop processing with this command in advance. ・1st byte outputs the state of stop processing. 1st byte=0x00: stop processing is completed. The command accompanied by reproduction operation can be executed. 1st byte=other than 0x00: stop processing or reproduction processing is running . ・2nd-4th byte outputs other internal processing state.
READ_BROWSE _STATUS	4	0x6D	0x01	0x00	0x00	1	・Output about the browsing analysis status in a memory. ・Output about OFFSET 0x22- of a status buffer.
READ_BROWSE _PNUM	4	0x6D	0x01	0x00	0x01	4	・Output about the cursor position number of browsing in a memory. ・Output about OFFSET 0x23-0x26 of a status buffer.
READ_BORWSE_TNUM	4	0x6D	0x01	0x00	0x02	7	・Output about the number of entries in the folder in which the cursor of browsing in a memory exists, and the number of classes. ・Output about OFFSET 0x27-0x2D of a status buffer.
READ_BROWSE_FOL _INFO	4	0x6D	0x01	0x01	0x00	76	・Outputs the information on the folder where the entry being pointed by the memory browsing cursor resides. ・See 6.4.7 for the output format.
READ_BROWSE _ENTRY_INFO	4	0x6D	0x01	0x02	N	76	・Outputs the information on the Nth entry ahead from the one being pointed by the memory browsing cursor. ・Specify N at the 4th byte. Specify N in the range from 0x00 to 0x10. ・See 17. File browsing within memory for the output format.

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READ_BROWSE_TAG	4	0x6D	0x01	0x03	N	130	・Outputs the TAG analysis results of the file analyzed by the GET_TAG_CURSOR command. ・Specify the TAG type with N at the 4th byte. Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: TITLE, N=0x01: ARTIST, N=0x02: ALBUM, N=0x03: GENRE ・Output data has the proposed data ID (2 bytes). See 17. File browsing within memory for the output format
READ_FR_STATUS	4	0x6D	0x03	0x00	0x00	2	・Output about a file read functional status. ・Output about OFFSET 0 x2F-0x30 of a status buffer.
READ_FR_SIZE	4	0x6D	0x03	0x01	0x00	4	・Output the file size of the file specified by the file read function. ・A unit is a byte. It outputs by Little Endian.
READ_FR_DATA	4	0x6D	0x03	0x02	0x00	260	・Reads the data of the file specified by the File Read function. ・Up to 256 bytes of data can be read at one time. ・The leading 4 bytes are file offset. They are output in Little Endian format.
READ_SYSMODE	4	0x6D	0x0A	0x00	0x00	1	・Output about the present system operation mode.
READ_ERROR	4	0x6D	0x0A	0x01	0x00	4	・Output about the contents of the present error. ・An internal error code original with this LSI is outputted.
READ_MEMINFO	4	0x6D	0x0A	0x02	0x00	1	・Output about the present memory information. ・Output about OFFSET 0x37 of a status buffer.
READ_MOUNT_ERROR	4	0x6D	0x0A	0x04	0x00	14	・Output the information on which stage of media mount went wrong when ERROR occurs. ・1st byte: USB enumeration state is outputted. ・2nd byte: SD initialization state is outputted. ・10th byte: file system analysis state is outputted. ・Other bytes should be disregarded. ・See "12.4.15 Process information when a media mount error " for details of content.
READ_SD_STATUS	4	0x6D	0x0C	0x00	0x00	8	・Output the inside information of SD driver. ・The contents are original with this LSI. ・Please use it by a SET_SD_INFO command.
READ_FW_VER	4	0x6D	0xFF	0x00	0x00	4	・Output about a firmware version.

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Table 13. Command enable/disable in each system operation mode

Command	Command enable/disable in each system operation mode			Command enable/disable in each status					
	CONFIG	PLAYER	FILE READ	STOP	PLAY	SEARCH (device)	SEARCH (FILE)	Analyze	Write
READ_BUFF	○	○	○	○	○	○	○	○	○
READ_STATUS	○	○	○	○	○	○	○	○	○
READ_PSET	○	○	○	○	○	○	○	○	○
READ_PTIME	○	○	○	○	○	×	×	×	×
READ_LANG	○	○	○	○	○	×	×	×	×
READ_PNUM	○	○	○	○	○	×	×	×	×
READ_TNUM	○	○	○	○	○	×	×	×	×
READ_FNUM	×	○	×	○	○	×	×	×	×
READ_PFILE_NAME	×	○	×	○	○	×	×	×	×
READ_PFOL_NAME	×	○	×	○	○	×	×	×	×
READ_PFILE_TAG	×	○	×	○	○	×	×	×	×
READ_RESUME_INFO	×	○	×	○	○	×	×	×	×
READ_DEV_FREE	○	○	○	○	×	×	×	×	×
READ_DEVDESC	○	○	○	○	×	×	×	×	×
READ_CONDESC	○	○	○	○	×	×	×	×	×
READ_INQIRY	○	○	○	○	×	×	×	×	×
READ_LUN	×	○	○	○	○	×	×	×	○
READ_LUN_NUM	×	○	○	○	○	×	×	×	○
READ_SET_LUN	×	○	○	○	○	×	×	×	○
READ_IRPTO_FACTOR	○	○	○	○	○	○	○	○	○
READ_LUN_READY	○	○	○	○	○	○	○	○	○
READ_MASK_IRPTO_00	○	○	○	○	○	×	×	×	○
READ_MASK_IRPTO_02	○	○	○	○	○	×	×	×	○
READ_MASK_IRPTO_22	○	○	○	○	○	×	×	×	○
READ_MASK_IRPTO_2F	○	○	○	○	○	×	×	×	○
READ_MASK_IRPTO_37	○	○	○	○	○	×	×	×	○
READ_STOP _PROGRESS	×	○	×	○	○	○	○	○	○
READ_BROWSE _STATUS	×	○	○	○	○	○	○	○	○
READ_BROWSE _PNUM	×	○	○	○	○	×	×	×	×
READ_BORWSE_TNUM	×	○	○	○	○	×	×	×	×
READ_BROWSE_FOL _INFO	×	○	○	○	○	×	×	×	×
READ_BROWSE _ENTRY_INFO	×	○	○	○	○	×	×	×	×
READ_BROWSE_TAG	×	○	○	○	○	×	×	×	×

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READ_FR_STATUS	○	○	○	○	○	○	○	○	○
READ_FR_SIZE	×	×	○	○	×	×	×	×	×
READ_FR_DATA	×	×	○	○	×	×	×	×	×
READ_SYSMODE	○	○	○	○	○	○	○	○	○
READ_ERROR	○	○	○	○	○	○	○	○	○
READ_MEMINFO	○	○	○	○	○	○	○	○	○
READ_MOUNT_ERROR	○	○	○	○	○	○	○	○	○
READ_SD_STATUS	○	○	○	○	○	○	○	○	○
READ_FW_VER	○	○	○	○	○	○	○	○	○

○=enable ×=disable

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14. System Operation MODE

The LSI starts operation by setting up System Operation MODE after download of the program by IPL after a power supply and reset release.
Possible operation changes with each modes of operation.
Only the one mode can set up mode of operation with a command.
The mode which is simultaneously different cannot be set up.
A microcomputer sets up the change in System Operation MODE with a command.
Please be sure to perform the changes to each mode via CONFIG mode.
The changes between PLAYER mode and FILEREAD mode cannot be performed directly.
The settlement of the following command is to do a re-setup because it is returned in the initial value when it passes through the CONFIG mode.
REPEAT, RANDOM, SET_EQ, SET_NEXT, SET_REPRAND, SET_TAG, SET_PRM

Command CHG_SYSTEM_MODE

N=0x00 ; CONFIG MODE
It is in the state which changes after a power supply
It is the mode which performs initial setting of a system.
Please change to the mode of other operation after setting up with an initial-setting command.
In this mode, even if it detects insertion of a memory, mount of a memory is not performed.
The mount of a memory carried out behind each mode changes.

N=0x01 ; PLAYER MODE
It is the mode which performs decoding play of the file in a memory.
File browsing (structural analysis in a memory) can be performed.

N=0x02 ; FILE Read MODE
It is the mode which Reading can perform about the specific file in a memory.
A specific file can be deleted.
File browsing (structural analysis in a memory) can be performed.

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15. Resume information

This LSI outputs the information for resume function, using READ_RESUME_INFO command.

Table 14. Resume information register structure

Status OFFSET	The number of bytes	NAME	Contents
0x38-0x61	42	Resume information data	This data shows the information on the file being played and on the play position. The data has a LSI-unique structure. The resume information data is data of 42 bytes. It outputs with a little endian.

The above resume information has a LSI-unique structure and is used when executing resume play. Therefore, you should use the data contents as they are without rewriting.
The resume function is implemented by writing the resume information read by READ_RESUME_INFO command to PLAY_RESUME command. After writing to PLAY_RESUME, the LSI automatically searches the resume. As for the action of the searches end, selectable from [Playback is started in the time when「READ_RESUME_INFO」command was forwarded], [top (Pause) in the time when「READ_RESUME_INFO」command was forwarded], [Playback is started from the front of the tune when「READ_RESUME_INFO」command was forwarded], [Stop (Pause) the front of the tune when「READ_RESUME_INFO」command was forwarded].

After reading READ_RESUME_INFO command during file play, the LSI resumes the file from the time READ_RESUME_INFO has been read.
The data contents read by READ_RESUME_INFO command cannot assure the operations when executing PLAY_RESUME which has been rewritten due to the positional information within the memory. If the resume information does not match because of change of memory, the LSI starts searches front file of memory.

16. File Name, Folder Name, TAG Information

A file name, a folder name, and TAG information are outputted to a status register.
The first 2 bytes to be output indicate file data ID information.
The target data is outputted from the 3rd byte.
A file name, a folder name, and TAG information status register structure are shown in Table 15.

Table 15.File (folder, TAG) information registers structure

Status OFFSET	The number of bytes	NAME	Contents
0x38	1	Data type	The type of data is outputted. 0x00; TEXT- NUL (0x00) Terminated character string 0x01; BYTE- Unsigned 1 byte integer
0x39	1	Encoding	Encoding of a character string is outputted. 0x00 ; ISO8859-1(Latin1) 0x01 : UTF-16(with BOM) 0x02 : UTF-16BE 0x03 : UTF-8 0x49 : UTF-16LE When a data type is except 0x00:TEXT, data length (byte unit) is outputted.
0x3A-0xB9	128	File name (Folder name, TAG)	A file name (or a folder name, TAG) is outputted by left fitting. Up to 128 bytes can be output. If the data is less than 128 bytes, it terminates with 0x00.

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The character code information on TAG information is outputted to a status register.
Character code information status register structure is shown in Table 16.

Table 16. Character code information registers structure

LANGH OFFSET=0x11	LANGL OFFSET=0x10	Language Code
0x00	0x00	ID3V1 TAG or ISO8859-1(ID3V2 TAG)
0x00	0x01	UTF-16 (ID3V2 TAG)
0x00	0x02	UTF-16BE (ID3V2 TAG
0x00	0x03	UTF-8 (ID3V2 TAG or AAC TAG iTunes Meta-data)
0x00	0x49	UTF-16LE (WMA TAG)

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17. File browsing within memory

The LSI can analyzing and reading of the entry information of files and subfolders within a folder which is different from the one having the current tune while the current tune is being played or stopped. Since the read information contains access data to be used to select tunes, the LSI enables to directly select and play tunes using this data.
File Browsing within the memory will be enabled by: operating the cursor position which can be controlled separately from the position of the tune being played and analyzing the folder to read the information on folders.
When sending the command to move the cursor, the LSI can analyze and read the information of 10 entries (files or folders) from the move destination.
The cursor movement conforms to the sort order determined by the sort function. If the sort function is enabled, the system first reads the files, and then the subfolders, in the sort order. If the sort function is disabled, the LSI reads the files and subfolders in the order that they are written to FAT.
A file browsing function becomes effective after ANALYSE_ROOT command is send, and starts the analysis in a root folder.
When you select music directly by using the access data or cursor position, The following status doesn't return a normal value because it doesn't understand the number in the whole in the memory.
Playing folder number in memory status, Playing file number in the memory status.
The file information status register structure which can be read by the file browsing function in a memory is shown in Table 17.

Table 17. File (folder) information register structure

Status OFFSET	The number of bytes	NAME	Contents
0x38-0x3D	6	Access data	The position in the memory in which a file and folder information is written is shown. Direct song selection is possible from a microcomputer using this data.
0x3E	1	Entry type	The type of file is outputted. 0x0Y= file-native (LFN, SFN), 0x1Y= folder-native (LFN, SFN) 0x8Y= file-UTF16LE (LFN), 0x9Y= folder-UTF16LE (LFN) Y becomes the following cases. 0x1=MP3, 0x2=WMA, 0x3=AAC, 0x4=WAV , 0x6-0xE=reserve, 0xF,0x0=other file
0x3F	1	-	0x00
0x40-0x43	4	Cluster number	The cluster number in the memory in which a file and folder information is written is shown.
0x44-0x84	64	File name (Folder name)	A file name (folder name) is outputted by left fitting.

Cautions)
If browsing operation is frequently performed during music playing, music skipping may occur by the memory with a slow access speed.

18. File data read

It is possible to read the contents of the specified file in a memory.
File name is specified by the full path (within 256 bytes) including a file name and an extension.
A full path including a file name and an extension supports to 16 classes within 256 bytes.
The above-operation can be performed when system operation mode is FILE Read mode.

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19. IRPTO Interruption Terminal to Microcomputer

When some status changes, this LSI notifies interruption to master microcomputer by IRPTO terminal.
When signal is H, it is shown that interrupt occurs.
Please connect IRPTO terminal to the interruption port of level detection.

The mode of IRPTO signal output condition can be selected by SEL_IRPTO command.
・variable interruption mode: IRPTO is unified output by two or more status change. Master microcomputer can select the status.
・fixed interruption mode: IRPTO is output by single status change according to system mode.

19.1 variable interruption mode
INTERRUPT REQUEST is caused from the IRPTO terminal to the microcomputer when either of the hereunder status register changes.
Interruption factor can be selected by SET_MASK_00-SET_MASK_37 command. The initial setting of the interruption factor is shaded status.

Table 18. Status registers for interruption factor

OFFSET	Status	bit7 (MSB)	bit6	bit5	bit4	bit3	bit2	bit1	bit0 (LSB)
0x00	STATUS1	ERROR	SEARCH		BUSY	MCHNG	STOP	PAUSE	PLAY
0x02	STATUS3	USBINS	SDINS	USBFILE	SDFILE	MDEVUSB	MDEVSD	PDEVUSB	PDEVSD
0x22	BROWSESTAT	ANA_ERR	0	0	GET_TAG_END	GET_TAG_ID			ANA_CUR
0x2F	FIOSTAT	FIOERR	0	0	FIOOPEN	FRDREADY	0	FIOSEARCH	FIOMODE
0x37	MEMINFO		MEMINFO			LUN_BUSY	LUN_READY_RENEW	reserve	reserve

IRPTO is returned to L when forego status is read out by using the READ_IRPTO_FACTOR command. Following table shows the contents of the output data by READ_IRPTO_FACTOR command.
The status value and interruption factor is included. When status changes, corresponding bit of interruption factor becomes H.
For example, when only ERROR status changes, Interruption factor 1 becomes 0x80.

Table 19. the contents of the output data by READ_IRPTO_FACTOR

STATUS OFFSET	byte	NAME	content
0x38 + 0x0	1	Status value 1	(Offset : 0x00) STATUS1
0x38 + 0x1	1	Status value 2	(Offset : 0x02) STATUS2
0x38 + 0x2	1	Status value 3	(Offset : 0x22) BROWSESTAT
0x38 + 0x3	1	Status value 4	(Offset : 0x2F) FIOSTAT
0x38 + 0x4	1	Status value 5	(Offset : 0x37) MEMINFO
0x38 + 0x5	1	Interruption factor 1	status change flag for Status value 1
0x38 + 0x6	1	Interruption factor 2	status change flag for Status value 2
0x38 + 0x7	1	Interruption factor 3	status change flag for Status value 3
0x38 + 0x8	1	Interruption factor 4	status change flag for Status value 4
0x38 + 0x9	1	Interruption factor 5	status change flag for Status value 5

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19.2 Fixed interrupt mode
In fixed interruption mode, IRPTO is output by single status change according to system mode.
Following table shows IRPTO signal output condition for each system mode.

State	Interruption	Contents
PLAYER MODE	MEMINFO = 0x3	An interrupt occurs when status register MEMINFO=0x03 (OFFSET=0x37, [7:4]).See 6.4.14. Selected memory information for content. Clear conditions; interruption is cleared by memory disconnection.
FILE READ MODE	FRDREADY	An interrupt occurs when a specified file is searched and read-out is ready. Clear conditions; interruption is cleared by data are read (block unit).

20. Previous Command Processing Situation

The previous command processing situation is outputted as status register STATUS6 (OFFSET=0x05) PRECOMSTAT. Bit0 of STATUS6(OFFSET=0x05) and Bit2 of STATUS2 (OFFSET=0x01) is the same value. When Bit2 of STATUS2 set to "0", the previous command is normally processed. When Bit2 of STATUS2 set to "1", the previous command is not processed.
The following shows the value descriptions.

Value	NAME	Cause of being unprocessed
0x01	UNCLASSIFIED	Non classification error
0x03	UNKNOWN CMD	Undefined command
0x05	SEARCH	Searching now
0x07	INVALID ARG	Invalid parameter is detected.
0x09	WRONG MODE	Invalid command in the current system operation mode
0x0B	NOT READY	Initialization is not completed.
0x0F	NOT IMPLEMENTED	The function is not mounted.
0x15	DEVICE ERROR	Device error

21. Selected memory information

The kind and information on a device which are chosen now are outputted by a READ_MEMINFO command.
An output value is cleared at the memory disconnection or CHG_DEV command reception, and is updated at the completion of mount operation.
The details of an output value are shown below.

Value[7:4]	Contents
0x0	Mounted USB device (playable device)
0x1	NO-Mounted USB device (file system un-support, etc.)
0x2	USB LOW SPEED device
0x3	USB device with two or more DEVICE CONFIGRATION
0x4	The USB device and SD device which cannot be recognized (USB enumeration failure etc.)
0x5	MEMINFO is undecided.
0x6	-
0x7	SD Card
0x8-0xF	It means that there is HUB, when Bit7 is H.

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22. Process information when a media mount error

When media mount failure occurs, READ_MOUNT_ERROR command output the information on the stage of media mount operation.
After being set to ERROR=1, the detailed information about in which process the error occurred can be read with this command.
For example, when ERROR=1 and 1st byte=0x08 or 0x09, it turns out that mount error is caused by device response error for TEST UNIT READY or REQUEST SENSE.
The details of an output value are shown below.

1st byte (offset=0) of a read value outputs the process state of USB mount operation.
A read value corresponds to the processing which went wrong.
A read value is cleared at the start of a USB mount operation.
A read value is updated irrespective of the success or failure of mount operation at the completion of mount operation.

Read value	Process state		Read value	Process state
0x00	Before a start of operation		0x10	GET_DEVSTATUS
0x01	DEVICE_DISCRIPTOR acquisition		0x11	Sector read command send
0x02	SET_ADDRESS		0x12	Sector read command receive
0x03	CONFIG_DESCRIPTOR acquisition		0x13	Sector read status receive
0x04	End Point connect		0x14	-
0x05	SET_CONFIGRATION		0x15	-
0x06	GET MAX LUN		0x16	-
0x07	CLEAR_FEATURE		0x17	Not-supported Device Subclass
0x08	INQUIRY		0x18	Only HUB is connected
0x09	TEST UNIT READY		0x19	LOW DEVICE is detected
0x0A	REQUEST SENSE		-	-
0x0B	READ_CAPACITY		-	-
0x0C	CLEAR_PORT_FEATURE		-	-
0x0D	GET_PORT_STATUS		-	-
0x0E	SET_PORT_FEATURE		-	-
0x0F	HUB_DESCRIPTOR acquisition		-	-

2nd byte (offset=1) of a read value outputs the process state of SD initialization.
bit corresponding to the succeeded process is set to 1.
A read value is cleared at the start of a SD mount operation.
A read value is updated one by one during mount, irrespective of the success or failure of mount operation.
Update is stopped at the completion of mount operation
A read value is 0x00 before a start of operation.

bit	Process state
0	CMD0 response
1	CMD8 response
2	CMD55 response
3	CMD41 response
4	CMD58 response
5	CMD1 response

10th byte (offset=9) of a read value outputs the process state of FAT file system analysis.
A read value corresponds to the processing which went wrong.
A read value is updated one by one during mount, irrespective of the success or failure of mount operation.
Update is stopped at the completion of mount operation

Read value	Process state
0x00	Before a start of operation
0x01	MBR read
0x02	MBR analysis
0x03	BPB analysis
0x04	FAT table check

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23. Patch Code Download

For play ability improvement to peculiar USB memory and SD card, This LSI supports to download a patch cord from a master microcomputer.
In Config mode, a patch is downloadable from a master microcomputer via I^2C.
The whole patch image size sent into BU94502AMUV must be smaller than 8440 Bytes.
Please divide a patch image into packets within 504 bytes, send by SET_PATCH_CODE command.
After downloading all patch image packets , validate the patch image by SET_PATCH_CRC command.

- Generator polynomial uses CRC-CITT (X^16 + X^12+X^ 5+1).
- Initial value is 0xFFFF.
- Output XOR is 0x0000.
- A bit feed is the right feed.

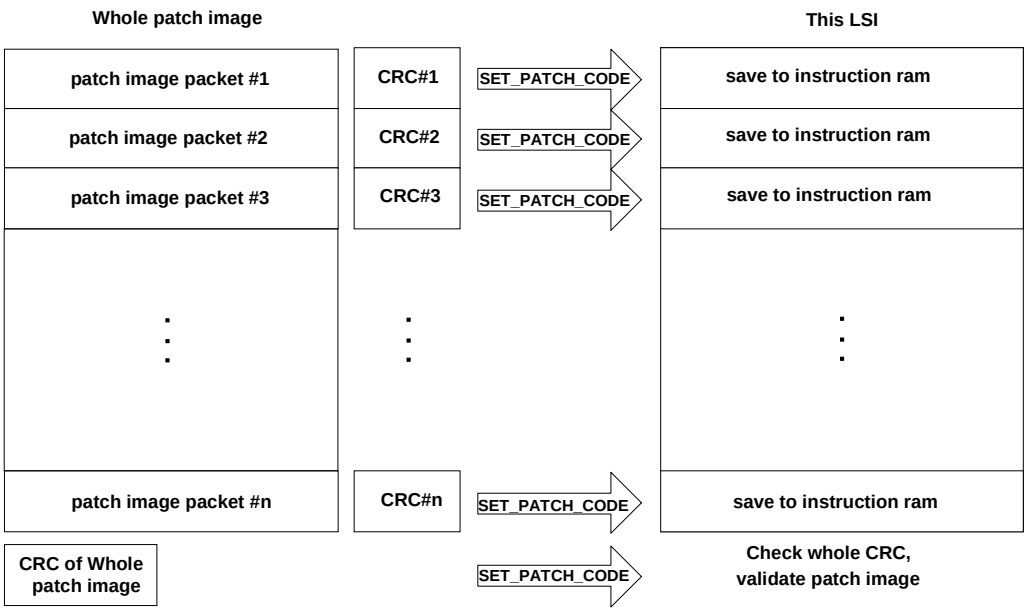

Figure 32. Concept of Patch Code Download

24. Watch Dog Timer

The LSI incorporates Watch Dog Timer, which monitors the system hang-up and resets whenever it occurs.
After resetting hang-up. Can disable WDT using DIS_WDT command. Once WDT is disabled, it cannot be enabled until reset is input.
When WDT, in the valid status, detects a hang-up within the LSI regardless of external situations (on the microcomputer), the LSI resets the system internally.
To monitor whether the LSI is reset by WDT from the master microcomputer (external), use SET_WDT command to write H to STATUS WDT_RFLG and monitor this status. After reset, this status is read as L. This helps you judge that WDT has reset the LSI by reading out L when reading the status regularly after writing H using SET_WDT command.

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●Notes for use

(1)Power on Reset
Please keep the terminal RESETX at the Low level when the power supply starts. Please make the terminal RESETX High level after 100us after 3.3V system power supply and 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.
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions. VQFN040V6060 package（BU94501AMUV / BU94502AMUV）exposes its frame of the backside of package. Note that this part is assumed to use after providing heat dissipation treatment to improve heat dissipation efficiency. Try to occupy as wide as possible with heat dissipation pattern not only on the board surface but also the backside.

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

(10) Playing time of MP3 file
The playing time when it can be acquired at the time of playing the MP3 file, may shift when fast forward playing, rewinding playing, and VBR playing.

(11) 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.

(12) 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.

(13) About " Made for iPod / iPhone / iPad License "
For using of BU94502AMUV / BU94502AKS2, It is necessary to become a licensee of Apple Inc. regarding "Made for iPod/iPhone/iPad License"

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.

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●Information about ordering part number

B	U	9	4	5	0	x	A	x	x	x	-	x	x

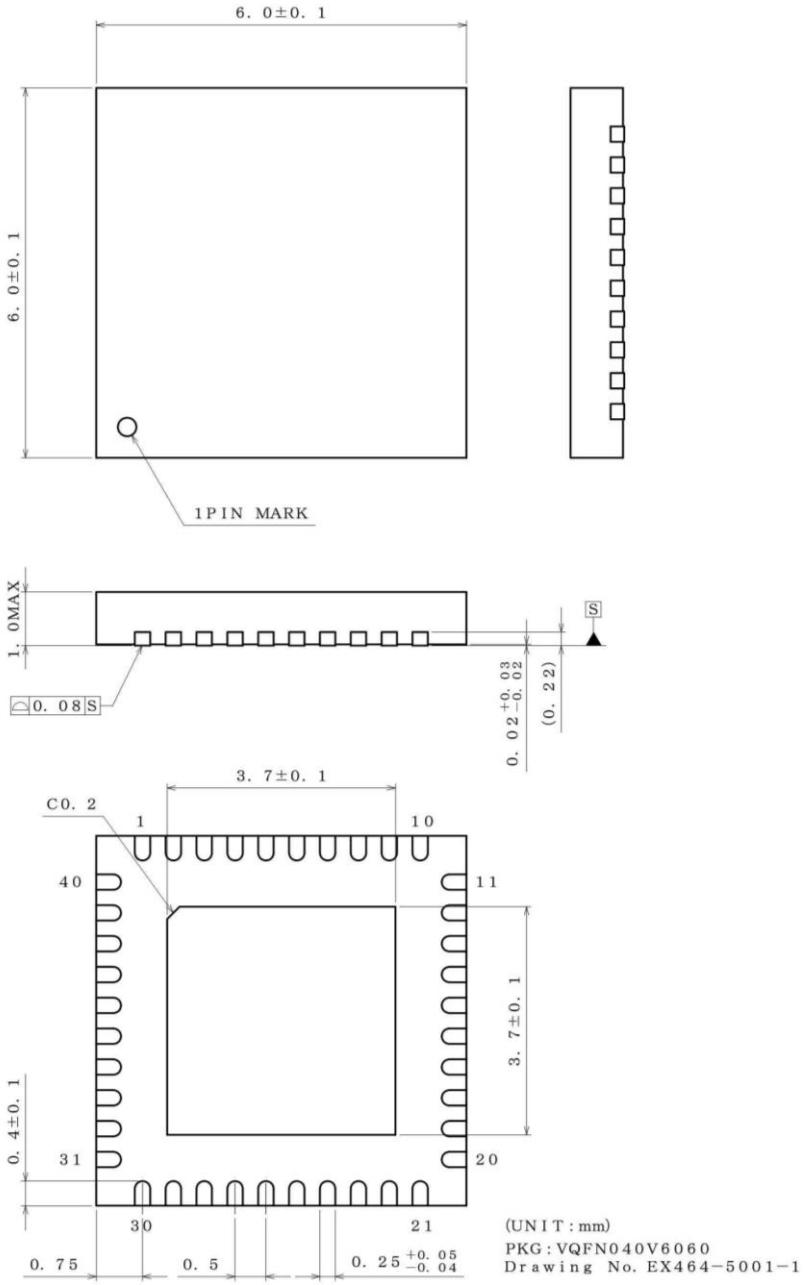
Part Number
BU94502A (iPod support)
BU94501A (iPod not support)

Package
MUV: VQFN040V6060
KS2: SQFP-T52

Packaging and forming specification
E2: Reel-formed emboss taping
None: Tray, Tube
VQFN040V6060 is provided in reel-formed emboss taping
SQFP-T52 is provided in a tray.

●External dimension

BU94501AMUV / BU94502AMUV (VQFN040V6060)



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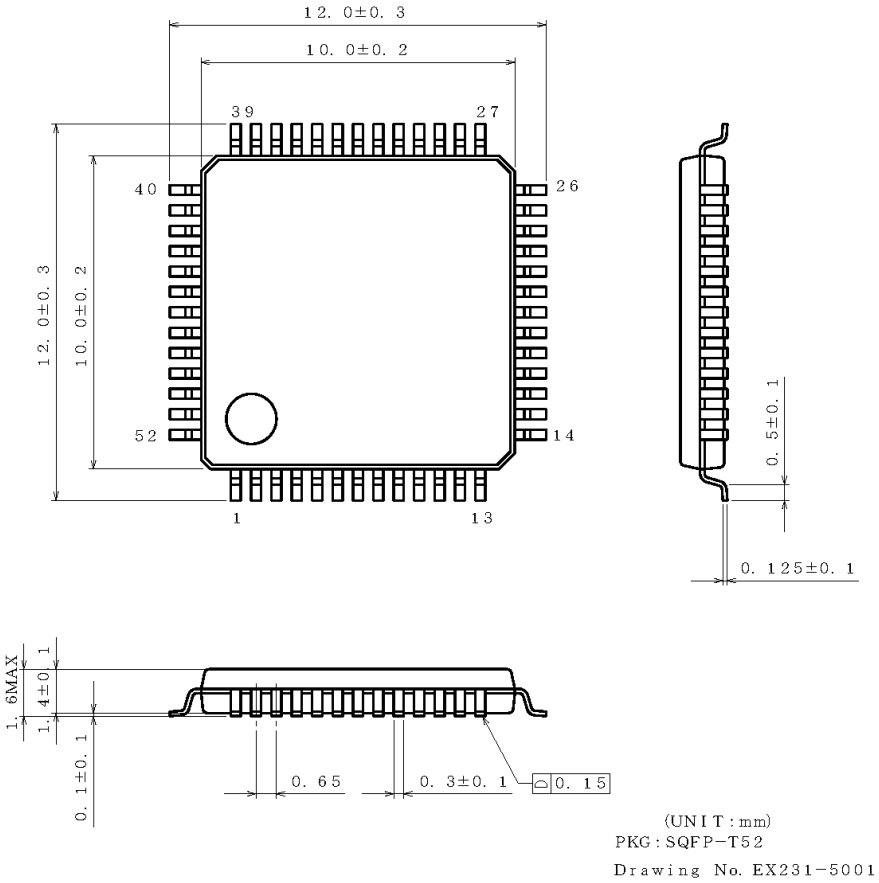
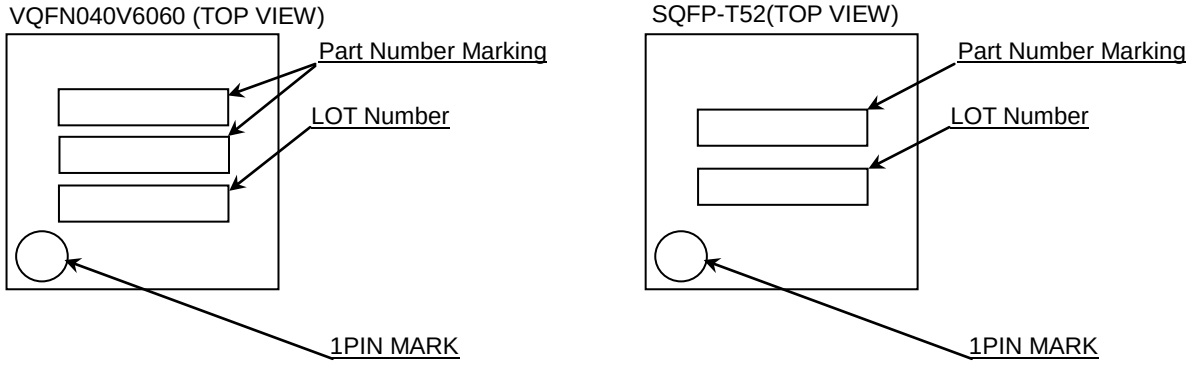
BU94501AKS2 / BU94502AKS2 (SQFP-T52)



●**Mark name image**



Part number	Part Number Marking	Ordering part number
BU94501AMUV	BU94501 AMUV	BU94501AMUV-E2
BU94501AKS2	U94501AKS2	BU94501AKS2
BU94502AMUV	BU94502 AMUV	BU94502AMUV-E2
BU94502AKS2	U94502AKS2	BU94502AKS2

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●**Revision history**

Date	Revision	Changes
02.Jul.2012	001	New Release
13.Jul.2012	002	P.4 : Difference of BU9450XA Series features Playable AAC files *.asf => *.3gp P.2, 3 : Basic circuit application diagram The addition of the precaution P.7, 8 : Description of Terminals The addition of the precaution P.46 : SET_CLRPATH_CUR command specifications addition The addition of other details explanations and indication composition become proper.
10.Dec.2012	003	P.35 : ABOT command option (TAG analysis) is deleted P.44,49 : GET_PATH_CURSOR command is deleted P.46,49 : SET_CLRPATH_CUR command is deleted P.50,52,62 : GET_PATH_END FLAG is deleted P.50,52,35 : DET_HUB, DET_UNSUP, DET_VENDOR FLAG is deleted P.55,56 : READ_BROWSE_PATH command is deleted P.60: Table16. Table 16. File path information register structure is deleted P.41 : Explanation addition of the HOME command in the random setup P.42 : Explanation addition of the FOL+ command in the random setup P.42 : Explanation addition of the FOL- command in the random setup The addition of other details explanations and indication composition become proper.
21.Mar.2017	004	P.1,4,6,13,67 : Change package type “SQFP-T52M” → “SQFP-T52”. P.67,68 : Change External dimension.

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Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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General Precaution

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BU94502AMUV - Web Page

Part Number	BU94502AMUV
Package	VQFN40
Unit Quantity	2000
Minimum Package Quantity	2000
Packing Type	Taping
Constitution Materials List	inquiry
RoHS	Yes