USB Audio Decoder ICs

AAC/WMA/MP3 +SD Memory Card+CD-ROM

BU94605AKV

No.12080EAT04

●Description

BU94605AKV is WAV/AAC/WMA/MP3 decoder IC which contains program download function from external serial Flash ROM and contains USB host, SD card I/F, CD-ROM I/F, audio DAC, system controller, regulator for internal CORE power supply.

●Features

1) USB2.0 Full Speed host I/F function contained.
2) SD card I/F function contained.
3) I^2C format I/F function contained.
4) MP3 decode function contained. (available for MPEG1, 2 and 2.5, Layer 1, 2 and 3)
5) WMA decode function contained. (available for WMA9 standard and not available for DRM)
6) AAC decode function contained. (available for MPEG4 AAC-LC and not available for DRM)
7) WAV format file playing function contained.
8) Sample Rate Converter contained.
9) System Controller contained.
10) FAT analysis function contained.
11) CD-ROM I/F function and CD-ROM decode function contained.
12) Browsing function of other File Names, Folder Names on music playing contained.
13) ID3TAG and WMATAG and AACTAG Analysis.
14) Fast forward playing and fast backward playing function contained.
15) KEY function can control. (STAND ALONE MODE)
16) External processor can control. (SLAVE MODE)
17) Resume function contained.
18) Audio DAC contained.
19) Sound Effect function contained.
20) Digital Audio Out(I^2S, EIAJ, S/PDIF) function contained.
21) Program download function from external serial Flash ROM contained.
22) Regulator for internal CORE power supply contained.
23) VQFP80pin(0.5mm pitch)

●Applications

Audio products, etc

●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit	Comment
Supply voltage(Analog, I/O)	VDD1MAX	-0.3～4.5	V	DVDDIO, VDD_PLL, DAVDD, AVDDC
Input voltage	VIN	-0.3 ～ VDD1 + 0.3	V	
Storage temperature range	TSTG	-55～125	℃	
Operating temperature range	TOPR	-40～85	℃	
Power dissipation *1	PD	900	mW	

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

●Operating conditions (Ta = 25℃)

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

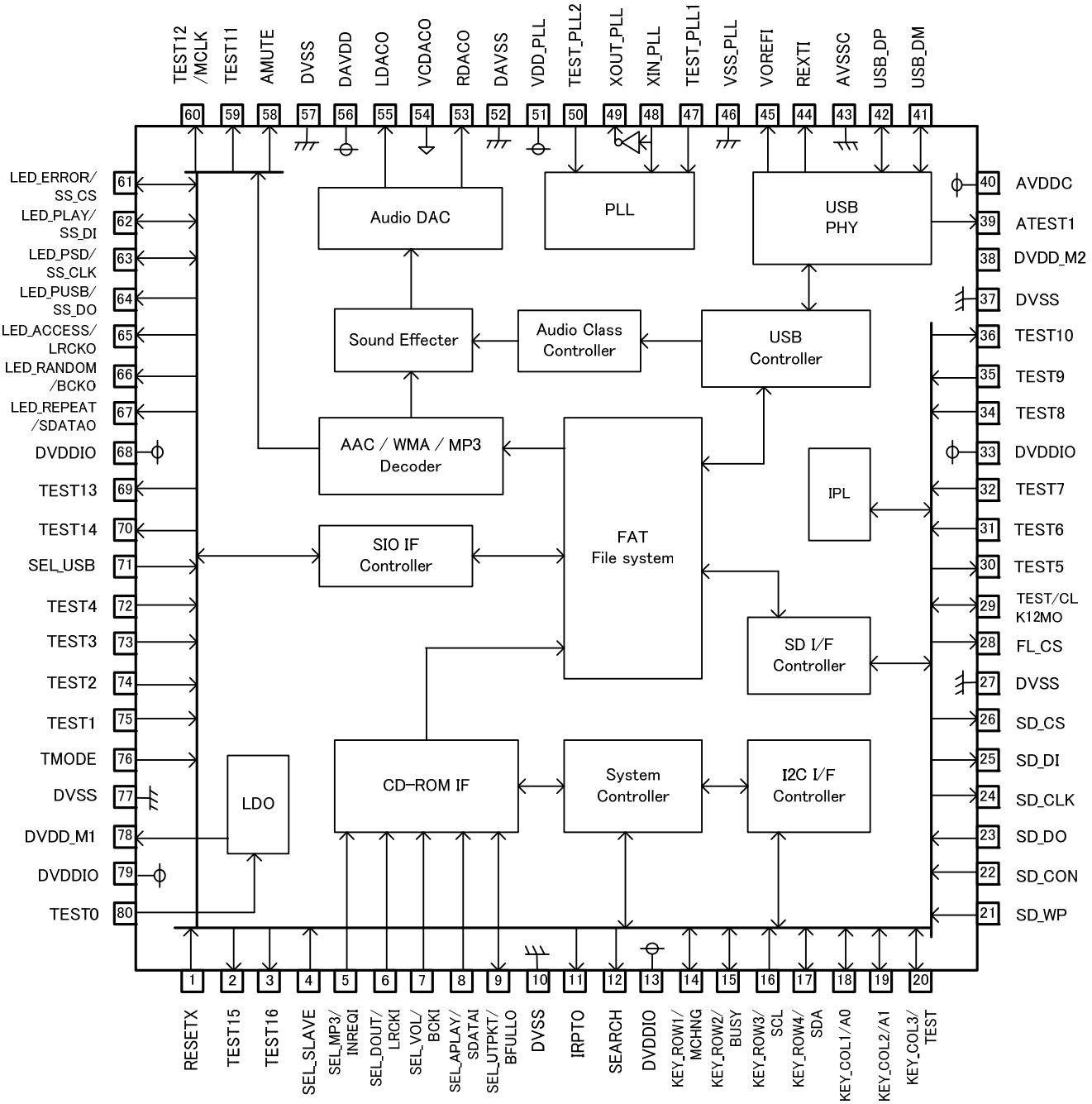
1. Electrical characteristics

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

Parameter	Symbol	Limits			Unit	Condition
		MIN.	TYP.	MAX.		
<Total >						
Circuit current (VDD1 USB1)	IDD1USB1	-	60	90	mA	*1 When USB memory is played.
Circuit current (VDD1 SD1)	IDD1SD1	-	35	60	mA	*1 When SD card is played.
<Digital block>						
H-Level input voltage	VIH	VDD1*0.7	—	VDD1	V	*3
L-Level input voltage	VIL	DVSS	—	VDD1*0.3	V	*3
H-Level output voltage1	VOH1	VDD1-0.4	—	VDD1	V	IOH=-1.6mA, *4
L-Level output voltage1	VOL1	0	—	0.4	V	IOL=1.6mA. *4
L-Level output voltage2	VOL2	0	—	0.4	V	IOL=3.6mA, *5
H-Level output voltage3	VOH3	VDD1-0.4	—	VDD1	V	IOH=-0.6mA, *6
L-Level output voltage3	VOL3	0	—	0.4	V	IOL=0.6mA, *6
H-Level output voltage4	VOH4	VDD1-1.0	—	VDD1	V	IOH=-0.6mA, *7
L-Level output voltage4	VOL4	0	—	1.0	V	IOL=0.6mA, *7
<USB-HOST >						
H-Level input voltage	VIHUSB	VDD1*0.6	—	VDD1	V	*8
L-Level input voltage	VILUSB	AVSSC	—	VDD1*0.3	V	*8
Output impedance(H)	ZOH	22.0	45.0	60.0	Ω	*8
Output impedance(L)	ZOL	22.0	45.0	60.0	Ω	*8
H-Level output voltage	VOHUSB	VDD1-0.5	—	VDD1	V	*8
L-Level output voltage	VOLUSB	0	—	0.3	V	*8
Rise/Fall time	Tr/Tf	—	11	—	ns	*8, Output capacity 50pF
Voltage of crossing point	VCRS	—	VDD1/2	—	V	*8, Output capacity 50pF
Range of differential input	VDIFF	0.8	—	2.5	V	*8
Differential input sensitivity	VSENS	0.2	—	—	V	*8
Pull-down resistance	RPD	14.25	20.0	24.8	kΩ	*8
<Audio DAC>						
Distortion rate	THD	—	0.005	—	%	1kHz, 0dB, sine, *9
Dynamic range	DR	—	90	—	dB	1kHz, -60dB, sine, *9
S/N ratio	S/N	—	95	—	dB	*9
Max output level	VSMAX	—	0.67	—	Vrms	1kHz, 0dB, sine, *9

*1 3.3V system I/O, Analog Power supply(VDD1), 1kHz, 0dB, sine-wave playing
*3 1, 3, 4-9, 14-23, 29, 31-32, 34-35, 61-63, 71-76 pin
*4 9, 11-12, 14-15, 18-20, 30, 36, 58-60, 61-67, 69-70 pin
*5 2, 3, 17 pin
*6 24-26, 28, 29 pin
*7 49 pin
*8 41, 42 pin
*9 53, 55 pin

2. Block diagram



Block diagram

3. Description of Terminals

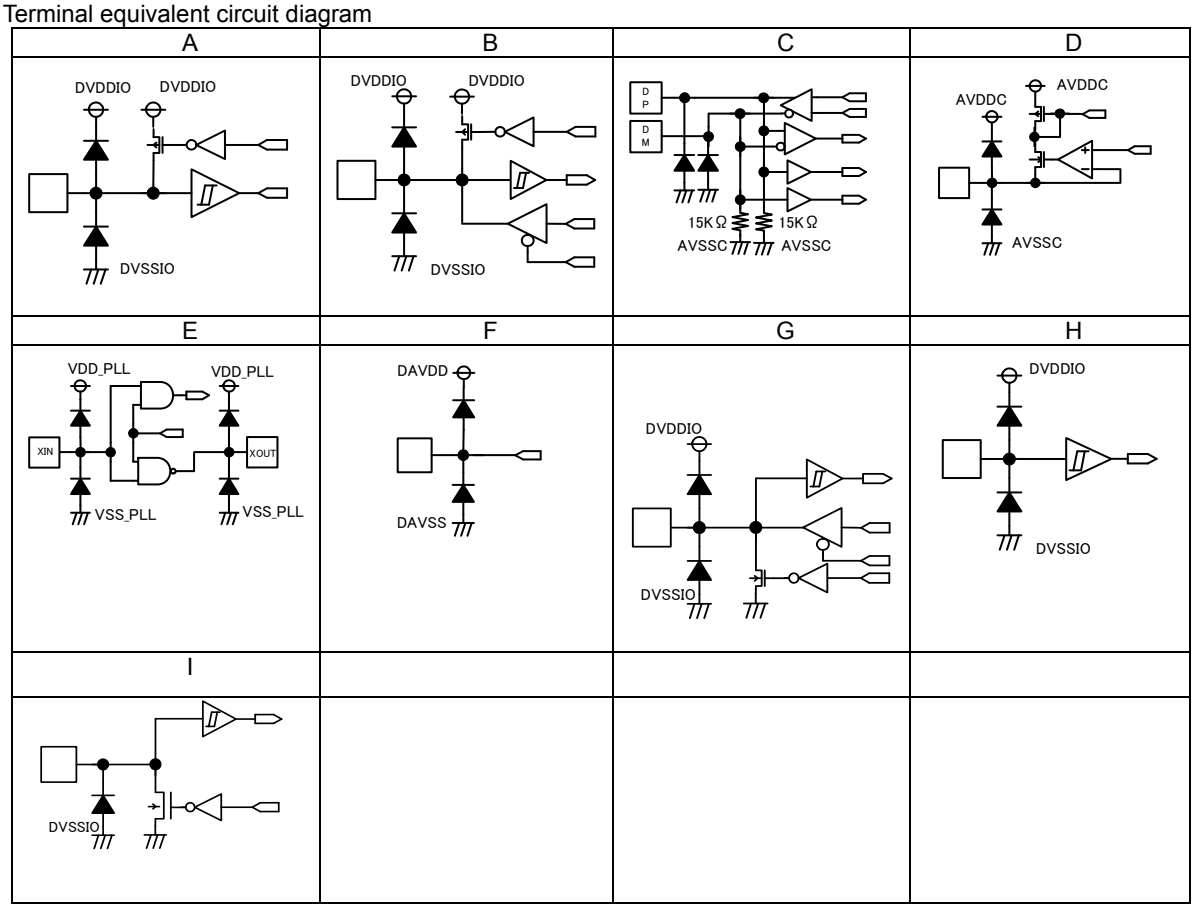
			STAND ALONE MODE (MODE1)			SLAVE MODE (MODE2)		
No	Pin Name	IO Cir	IO	PU	Function	IO	PU	Function
1	RESETX	A	I	PU	H: Release RESET, L: RESET	←	←	←
2	TEST15	I	O	*3	Test mode terminal Pull it up at VDD1 power.	O	*3	←
3	TEST16	I	I/O	*3	Test mode terminal Pull it up at VDD1 power.	I/O	*3	←
4	SEL_SLAVE	B	I	PU *1	H: STAND ALONE, L:SLAVE	←	←	←
5	SEL_MP3/ INREQI	B	I	PU *1	H: PLAY MP3 ONLY, L: PLAY MP1,MP2 and MP3	I	-	Input data valid terminal
6	SEL_DOUT/ LRCKI	B	I	PU *1	H: ANALOG DAC Output, L: Digital Output	I	-	Digital Audio channel clock input terminal
7	SEL_VOL/ BCKI	B	I	PU *1	H: Volume controll valid, L: Volume control invalid	I	-	Digital Audio bit clock input terminal
8	SEL_APLAY/ SDATAI	B	I	PU *1	H: Auto Play OFF , L: Auto Play	I	-	Digital Audio channel data input terminal
9	SEL_UTPKT/ BFULLO	B	I	PU *1	H: Normal Operation L: USB Test Packet Output	O	-	Input buffer full flag output terminal
10	DVSS	-	-	-	GND terminal	-	-	GND terminal
11	IRPTO	B	O	-	OPEN	O	-	Connection interrupt output terminal
12	SEARCH	B	O	-	OPEN	O	-	Search flag output terminal
13	DVDDIO	-	-		IO power (VDD1) terminal	-	-	IO power (VDD1) terminal
14	KEY_ROW1/ MCHNG	B	I	PU	KEY ROW1 key command input	O	-	File play end flag output terminal
15	KEY_ROW2/ BUSY	B	I	PU	KEY ROW2 key command input	O	-	Command analysis BUSY output temrinal
16	KEY_ROW3/ SCL	I	I	*3	KEY ROW3 key command input	I	*3	I^2C slave clock input terminal
17	KEY_ROW4/ SDA	I	I	*3	KEY ROW4 key command input	I/O	*3	I^2C slave data I/O terminal
18	KEY_COL1/ A0	B	O	-	KEY COLUMN1 Key command output	I	-	I^2C slave address setting terminal
19	KEY_COL2/ A1	B	O	-	KEY COLUMN2 Key command output	I	-	I^2C slave address setting terminal
20	KEY_COL3/ SEL_I2C	B	O	-	KEY COLUMN3 Key command output	I	-	Test mode terminal. Pull it up at VDD1 power.
21	SD_WP	B	I	PU	SD card I/F WP detection terminal	←	←	←
22	SD_CON	B	I	PU	SD card I/F connection detection terminal	←	←	←
23	SD_DO	B	I	-	SD card I/F data input terminal	←	←	←
24	SD_CLK	B	O	-	SD card I/F clock output terminal	←	←	←
25	SD_DI	B	O	-	SD card I/F data output terminal	←	←	←
26	SD_CS	B	O	-	SD card I/F chip select output terminal	←	←	←
27	DVSS	-	-	-	GND terminal	-	-	GND terminal
28	FL_CS	B	O	-	Serial Flash ROM chip select output terminal	←	←	←
29	TEST/ CLK12MO	B	I	PU	Test mode terminal. Pull it up at VDD1 power.	O	-	12MHz CLK Output.
30	TEST5	B	O	-	Test mode terminal. Use it as OPEN.	←	←	←
31	TEST6	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
32	TEST7	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
33	DVDDIO	-	-	-	IO power (VDD1) terminal	-	-	IO power (VDD1) terminal

34	TEST8	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
35	TEST9	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
36	TEST10	B	O	-	Test mode terminal (IPL ERROR status). Use it as OPEN.	←	←	←
37	DVSS	-	-	-	GND terminal	-	-	GND terminal
38	DVDD_M2	-	-	-	CORE power (VDD2) monitor terminal Short-circuit to DVDD_M1. Connect bypass capacitor.	-	-	CORE power (VDD2) monitor terminal Short-circuit to DVDD_M1. Connect bypass capacitor.
39	ATEST1	-	O	-	USB test terminal (OPEN)	←	←	←
40	AVDDC	-	-	-	USB power (VDD1) terminal	←	←	←
41	USB_DM	C	I/O	-	USB D-I/O terminal	←	←	←
42	USB_DP	C	I/O	-	USB D+ I/O terminal	←	←	←
43	AVSSC	-	-	-	USB GND terminal	←	←	←
44	REXTI	D	O	-	USB reference voltage output terminal Connect to AVSSC terminal using USB bias resistor (12kΩ).	←	←	←
45	VOREFI	-	O	-	USB test terminal (OPEN)	←	←	←
46	VSS_PLL	-	-	-	PLL GND terminal.	←	←	←
47	TEST_PLL1	-	I	-	PLL test terminal. (OPEN)	←	←	←
48	XIN_PLL	E	I	-	X'tal (16.9344MHz) connection input terminal.	←	←	←
49	XOUT_PLL	E	O	-	X'tal (16.9344MHz) connection output terminal.	←	←	←
50	TEST_PLL2	-	I	-	PLL test terminal. Pull it up at VDD1 power.	←	←	←
51	VDD_PLL	-	-	-	PLL power (VDD1) terminal.	←	←	←
52	DAVSS	-	-	-	Audio DAC GND terminal	←	←	←
53	RDACO	F	O	-	Audio DAC Rch line output terminal	←	←	←
54	VCDACO	F	O	-	Audio DAC reference voltage output terminal	←	←	←
55	LDACO	F	O	-	Audio DAC Lch line output terminal	←	←	←
56	DAVDD	-	-	-	Audio DAC power (VDD1) terminal	←	←	←
57	DVSS	-	-	-	GND terminal	-	-	GND terminal
58	AMUTE	G	O	-	Audio mute output (H: Mute OFF, L: Mute ON) terminal	←	←	←
59	TEST11	B	O	-	Test mode terminal. Use it as OPEN.	←	←	←
60	TEST12	B	O	-	Test mode terminal. Use it as OPEN.	←	←	←/Master Clock output(16.9344MHz)
61	LED_ERROR/ SS_CS	B	O	-	[LED] Error LED ON output	I	PU	SIO Slave CS input terminal
62	LED_PLAY/ SS_DI	B	O	-	[LED] Play LED ON output	I	-	SIO Slave DATA input terminal
63	LED_PSD/ SS_CLK	B	O	-	[LED] SD device select LED ON output	I	-	SIO Slave clock input terminal
64	LED_PUSB/ SS_DO	B	O	-	[LED] USB device select LED ON output	O	-	SIO Slave DATA output terminal
65	LED_ACCESS/ LRCKO	B	O	-	[LED] Device access LED blink output	O	-	[LRCKO] Digital Audio channel clock output, SPDIF output
66	LED_RANDO M/BCKO	B	O	-	[LED] Randum play LED ON output	O	-	[BCKO] Digital Audio bit clock output
67	LED_REPEAT/ SDARAO	B	O	-	[LED] Repeat LED ON output	O	-	[DATAO] Digital Audio data output
68	DVDDIO	-	-	-	IO power (VDD1) terminal	-	-	I/O power (VDD1) terminal
69	TEST13	B	O	-	Test mode terminal Use it as OPEN.	←	←	←
70	TEST14	B	O	-	Test mode terminal Use it as OPEN.	←	←	←
71	SEL_USB	B	I	PU	Preference detection device select	←	←	←

				*1	(H: USB, L: SD)			
72	TEST4	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
73	TEST3	H	I	-	Test mode terminal (IPL WRITE MODE1) Pull it up at VDD1 power.	←	←	←
74	TEST2	H	I	-	Test mode terminal (IPL WRITE MODE2) Pull it up at VDD1 power.	←	←	←
75	TEST1	H	I	-	Test mode terminal Pull it up at VDD1 power.	←	←	←
76	TMODE	H	I	-	Test mode terminal Connect it to GND.	←	←	←
77	DVSS	-	-	-	GND terminal	-	-	GND terminal
78	DVDD_M1	-	-	-	CORE power (VDD2) monitor terminal Connect it to bypass capacitor.	←	←	←
79	DVDDIO	-	-	-	IO power (VDD1) terminal	-	-	IO power (VDD1) terminal
80	TEST0	-	I	-	Test mode terminal Connect it to GND.	←	←	←

*1 Pull-Up turns OFF when L is input.
*2 In STAND ALONE MODE (MODE1):
It turns OFF when ANALOG DAC output is selected (SEL_DOUT=H).
It performs I2S format audio output when Digital output is selected (SEL_DOUT=L).
*3 An external pull-up resistor is required because of Open Drain IO.

4. Terminal equivalent circuit diagram



I/O terminal equivalent circuit diagram

5. I/O Signal Specifications

5.1 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 5.1.)

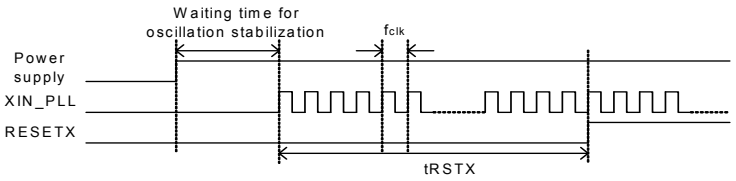


Figure 5.1 Reset Timing

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	

5.2 SEL_SLAVE

MODE1/MODE2 selection input signal

Signal name	I/O	Function	Remarks
SEL_SLAVE	I	Selection between MODE1 and MODE2	H: MODE1, L: MODE2

SEL_SLAVE allows you to select MODE1 (Stand-alone Mode) or MODE2 (Slave Mode).
SEL_SLAVE is set only at power ON. Note that selection change will be ignored after power ON.

5.3 SEL_MP3

MPEG Audio Layer 1, 2 and 3 play selection signal

Signal name	I/O	Function	Remarks
SEL_MP3	I	MPEG Audio Layer selection	H: Only MP3 is playable. L: MP1,MP2 and MP3 are playable.

SEL_MP3 allows you to select the layer of MPEG audio to be played. It is available in MODE1 only.
Enter L to make all the files having file extensions of mp1, mp2 and mp3 playable.
Enter H to play mp3 file only.
SEL_MP3 is set only at power ON. Note that selection change will be ignored after power ON.

5.4 SEL_DOUT

Audio output selection signal

Signal name	I/O	Function	Remarks
SEL_DOUT	I	Audio output selection	H: Line output, L: I2S three-line serial output

SEL_DOUT selects the audio output signal. It is available in MODE1 only.
Audio outputs in each MODE are shown in Table 5.4.1 “Audio Output”.
Output formats used in each MODE are shown in Table 5.4.2 “I2S_fs”.
See Chapter 6 for commands.
Because TEST terminal is an output terminal, use it as OPEN.

Table 5.4.1 Audio Output

Pin.	MODE1		MODE2		
	SEL_DOUT=H	SEL_DOUT=L	ANALOG	DIGTAL	
				SPDIF OFF	SPDIF ON
53	Line Out Rch	HiZ	Line Out Rch	HiZ	HiZ
55	Line Out Lch	HiZ	Line Out Lch	HiZ	HiZ
65	LED_ACCESS	I2S LR CLOCK	TEST terminal	LR CLOCK	SPDIF
66	LED_RANDOM	I2S BIT CLOCK	TEST terminal	BIT CLOCK	TEST terminal
67	LED_REPEAT	I2S LRDATA	TEST terminal	LRDATA	TEST terminal

Table 5.4.2 I2S_fs

MODE1	32fs I2S
MODE2	Selectable by commands

SEL_DOUT is set only at power ON. Note that selection change will be ignored after power ON.

5.5 SEL_VOL

Volume control selection signal

Signal name	I/O	Function	Remarks
SEL_VOL	I	Volume control selection	H: Volume control ON, L: Volume control OFF

SEL_VOL allows you to select volume control ON/OFF. It is available in MODE1 only.
When SEL_VOL=H, volume control becomes enabled.
The initial value is –25.6dB at power ON.
When SEL_VOL=L, volume control becomes disabled. Audio output is fixed to 0 dB.
Figure 5.5 shows the relationship between audio outputs and volume steps.
SEL_VOL is set only at power ON. Note that selection change will be ignored after power ON.

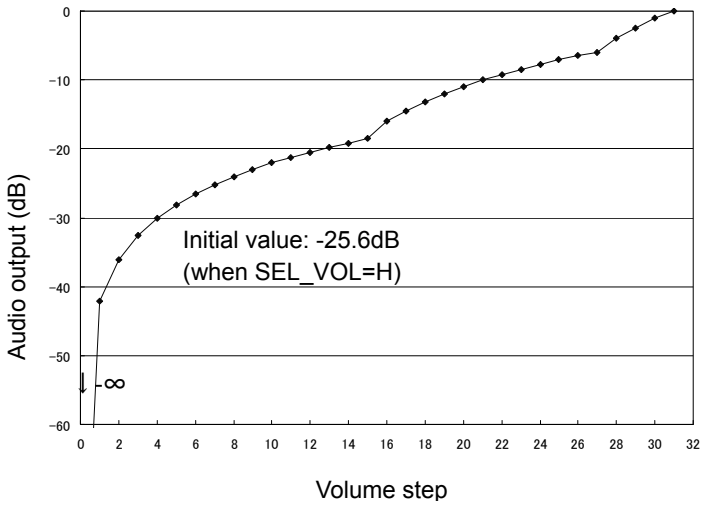


Figure 5.5 Volume Step Function

5.6 SEL_APLAY

Auto play selection signal at power ON and at device recognition

Signal name	I/O	Function	Remarks
SEL_APLAY	I	Auto play selection at device recognition	H: Stop after device recognition, L: Play after device recognition

SEL_APLAY selects whether the audio data in the memory is to be automatically played when a memory device (USB memory or SD card) is inserted at power ON or when the system recognizes the memory device inserted. SEL_APLAY is selectable in MODE1 only.
In MODE2, the operation stops after device recognition. Use a command to select the operation.

5.7 SEL_UTPKT

USB test packet

Signal name	I/O	Function	Remarks
SEL_UTPKT	I	USB test packet send	H: Invalid, L: USB test packet send

When L is input in SEL_UTPKT at power ON, test packet signals are output from USB_DP and USB_DM terminals. SEL_UTPKT is available in MODE1 only.
Test packet signals are continuously output until the power is turned OFF. You can use this signal to evaluate the USB terminal. In other cases, you can use it with Pull-up.

5.8 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.

5.9 SD I/F

SD memory card SPI interface

Signal name	I/O	Function	Remarks
FL_CS	O	Serial flash ROM chip select	-
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
SD_WP	I	SD card write-protect detection terminal	H: SD write-protect valid, L: SD write-protect invalid

This interface connects to the SD memory card slot to communicate with the SD memory device.
Since the SD memory card slot needs to detect the insertion status of the SD memory device and the write-protect status, be sure to use the slot having the SD memory card insertion status detection terminal and the WP terminal and connect it to the terminals. The SD_CON terminal is pulled up within the device and detects “SD card connect” when L is input. The SD_WP terminal is pulled up within the device and detects “SD card no-write-protect” when L is input.
SD I/F is also used as an external serial flash ROM I/F.

5.10 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.

In MODE1, the output turns ON when SEL_DOUT terminal is selected. In MODE2, it turns ON when line output is selected by a command.

5.11 MUTE control output

Audio MUTE

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

This control terminal is used to mute audio output when power is ON or in the silence mode such as FF or FB.
It outputs H at audio output and L at mute.
Figure 5.11 shows the operation waveforms.

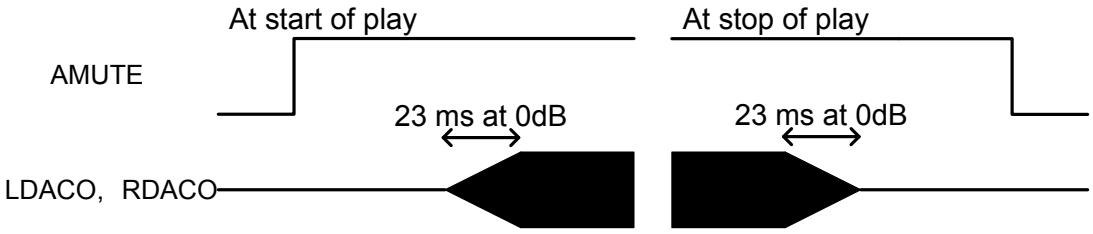


Figure 5.11 Waveform at Audio Mute

5.12 Serial audio output

Three-line serial audio interface

Signal name	I/O	Function	Remarks
LRCK	O	LR clock output (fs=44.1kHz)	-
BCK	O	Bit clock output	-
DATA	O	Data output	-

This is a serial audio output interface terminal. In MODE1, it becomes enabled by inputting L to SEL_DOUT terminal. In MODE2, it becomes enabled by using the appropriate command.
When serial audio output is selected, the data is output in I2S format of 32fs in MODE1. In MODE2, the output format can be selected from the EIAJ format or I2S format of 32fs, 48fs or 64fs.
Figures 5.12.1, 5.12.2, 5.12.3, 5.12.4, 5.12.5 and 5.12.6 show the output formats.

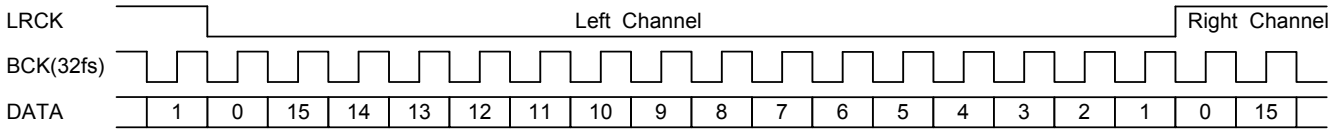


Figure 5.12.1 I2S Output Timing (32fs)

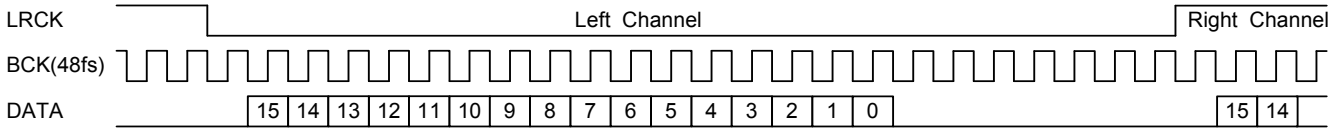


Figure 5.12.2 I2S Output Timing (48fs)

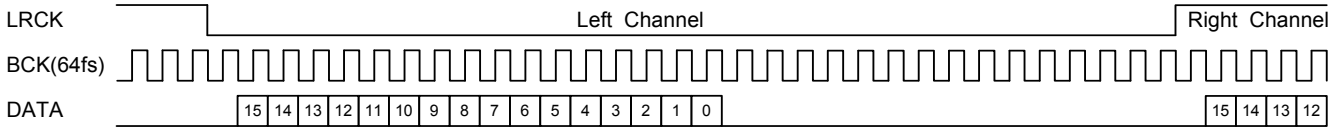


Figure 5.12.3 I2S Output Timing (64fs)

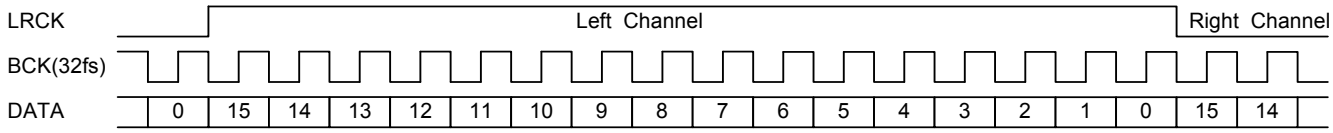


Figure 5.12.4 EIAJ Output Timing (32fs)

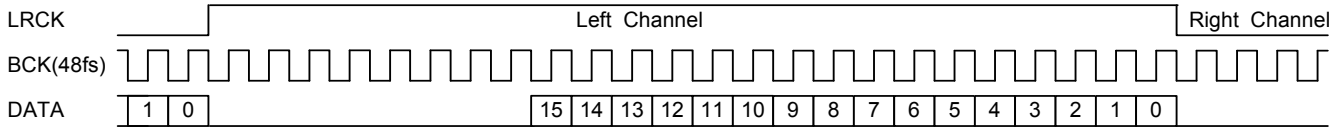


Figure 5.12.5 EIAJ Output Timing (48fs)

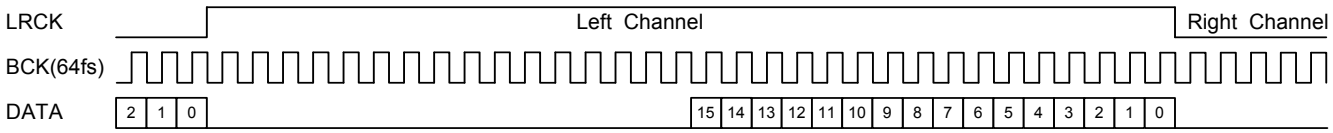


Figure 5.12.6 EIAJ Output Timing (64fs)

5.13 SPDIF output

Digital audio interface

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

SPDIF output become enabled by setting it in MODE2 using the appropriate command.
Figure 5.13 shows the digital audio signal output format.

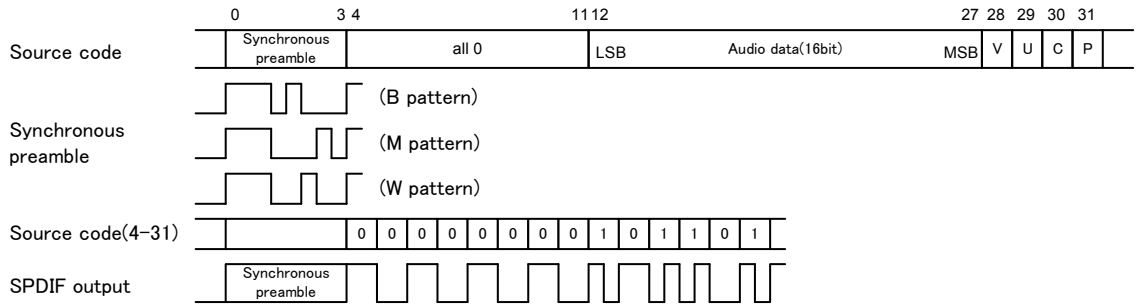


Figure 5.13 SPDIF Output Format

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 5.13.1 and 5.13.2. V bit is fixed to L. U bit uses 98 frames (≈13.3 ms) for one cycle.

Table 5.13.1 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 5.13.2 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 5.13.3 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.

5.14 KEY input I/F

3x4 matrix command I/O

Signal name	I/O	Function	Remarks
KEY_ROW1	I	KEY matrix I/O signals	-
KEY_ROW2	I		-
KEY_ROW3	I		External pull-up resistor is required.
KEY_ROW4	I		External pull-up resistor is required.
KEY_COL1	O		-
KEY_COL2	O		-
KEY_COL3	O		-

Configure the circuit of the matrix signal terminal for KEY commands as shown in Application Circuit Diagram in Figure 5.14.
The interface performs the operations for KEY pressed in this circuit.
Chapter 6 in this document details each operation.

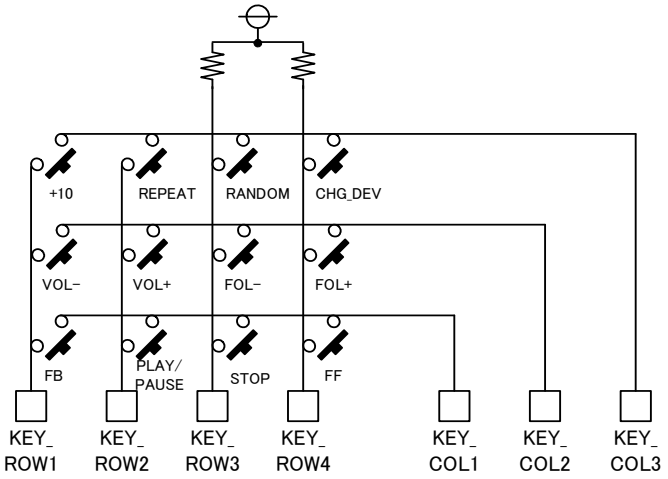


Figure 5.14 KEY Matrix Application Circuit Diagram

5.15 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.
A0	I	Slave address selection terminal	Slave address [0] bit setting terminal
A1	I	Slave address selection terminal	Slave address [1] bit setting terminal

This is an I2C serial interface terminal to communicate with the microcomputer (master).
The interface becomes enabled by inputting L in SEL_SLAVE terminal (in MODE2).
It supports slave I2C operations.

5.15.1 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 5.15.1 shows Start condition, Stop condition of I2C.

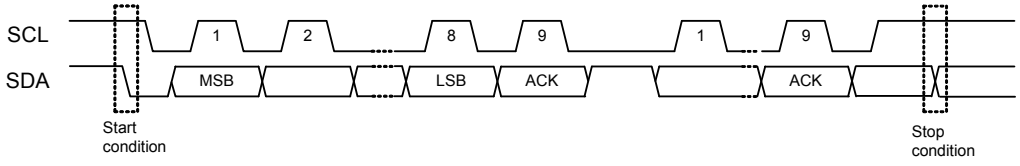


Figure 5.15.1 I2C Start, Stop Conditions

5.15.2 Slave address

I2C bus slave addresses support the 7-bit addressing mode. By inputting to terminals A0 and A1, the bus slave address can be selected as shown in Table 5.15.2. Figure 5.15.2 shows the slave address transfer format.

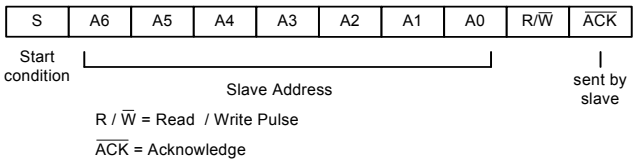


Figure 5.15.2 Slave Address Transfer Format

Table 5.15.2 Settable Slave Addresses

MSB A6	A5	A4	A3	A2	A1 terminal	LSB A0 terminal
1	0	0	0	0	0	0
1	0	0	0	0	0	1
1	0	0	0	0	1	0
1	0	0	0	0	1	1

5.15.3 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 5.15.3. For details on each command, see Chapter 6.

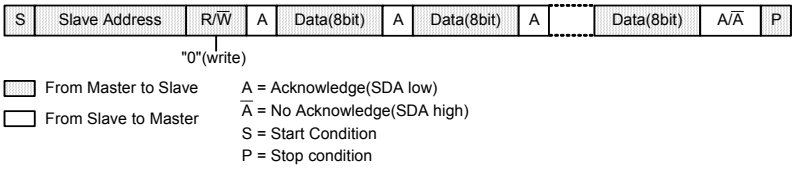


Figure 5.15.3 Command Send Protocol

5.15.4 Protocol to read to the master

When sending the received data from the slave to the master using the I2C bus, be sure to conform to the transfer protocol shown in Figure 5.15.4.1. 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 I2C 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 even without sending the status read command (step1). In addition, internal statuses other than BUSY shown in Table 5.15.4 can be read.

Figure 5.15.4.2 shows the relationship between the transferred data and BUSY.
* For details on BUSY, see 5.16.

Table 5.15.4 BUSY Byte Structure

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

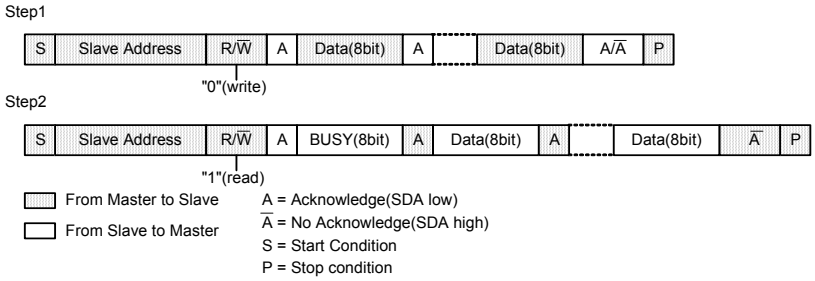


Figure 5.15.4.1 Status Reception Protocol

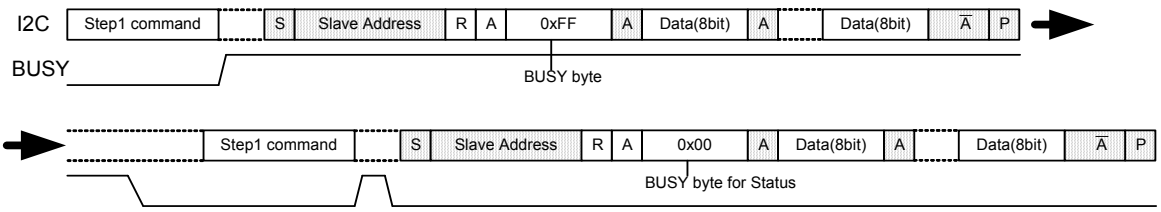


Figure 5.15.4.2 Relationship between Transferred Data and BUSY

5.15.5 I2C Bus line timing

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

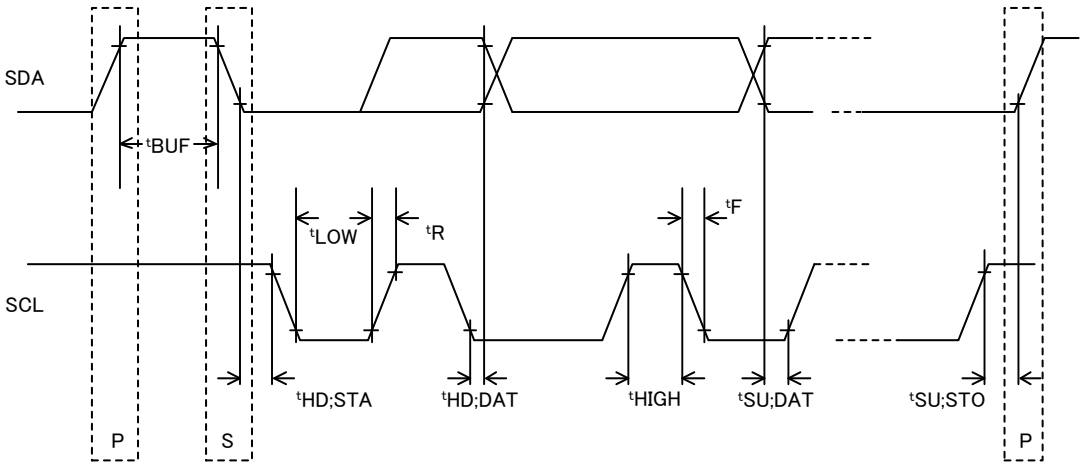
Parameter		Code	Min.	Max.	Unit
1	SDA, SCL H input voltage	VIH	VDD*0.7	VDD	V
2	SDA, SCL L input voltage	VIL	DVSS	VDD*0.3	V
3	SDA H output voltage	VOH	VDD-0.4	VDD	V
4	SDA L output voltage	VOL	0	0.4	V
5	SCL clock frequency	fSCL	0	400	kHz
6	Bus-free-time between "Stop" condition and "Start" condition	tBUF	1.3	—	us
7	Hold time for "Start" condition After this, the first clock pulse is generated.	tHD;STA	0.6	—	us
8	LOW status hold-time of SCL clock	tLOW	1.3	—	us
9	HIGH status hold-time of SCL clock	tHIGH	0.6	—	us
10	Data-hold-time	tHD;DAT	0*	—	us
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	—	us
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.



5.16 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 untill analyzing a command from the master and starting the command operation.
This LSI ignores command input during BUSY.

5.17 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.

5.18 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.
The LSI ignores command input during SEARCH. However, it can accept only ABORT, STOP and staus read commands even during SEARCH and can execute them command.

5.19 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.

5.21 CD INPUT interface

Three-line serial audio input interface

Signal name	I/O	Function	Remarks
LRCKI	I	LR clock input	-
BCKI	I	BIT clock input	-
SDATAI	I	Data input	-
INREQI	I	Input data valid	H: Input data valid, L: Input data invalid
BFULLO	O	Internal buffer FULL output	H: Internal buffer FULL, L: Not FULL

This is a three-line serial audio input interface terminal from a CD.
The interface is available in MODE2.
4X max input speed supports.

5.21.1 Input format

You can select the input format from the EIAJ format and I2S format of 16 bits.
You can select the BIT clock from 32fs, 48fs and 64fs.
You can select the input sampling frequency from 32 kHz, 44.1 kHz and 48 kHz.
Perform the required settings using commands before inputting data.

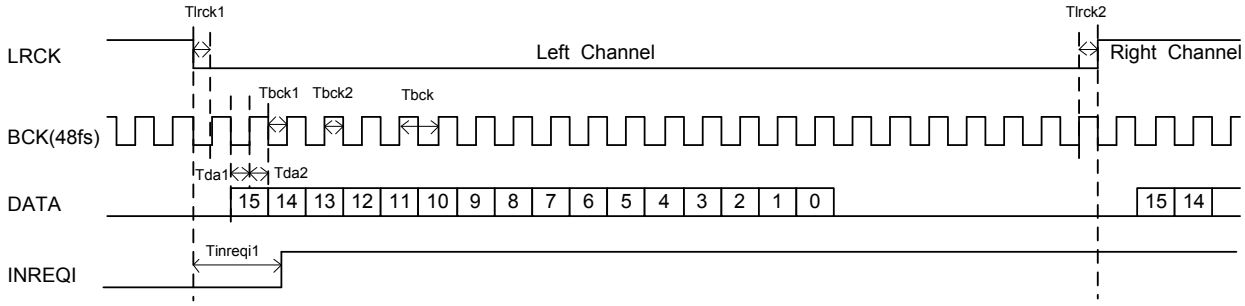


Figure 5.21.1.1 I2S Input Timing (48fs)

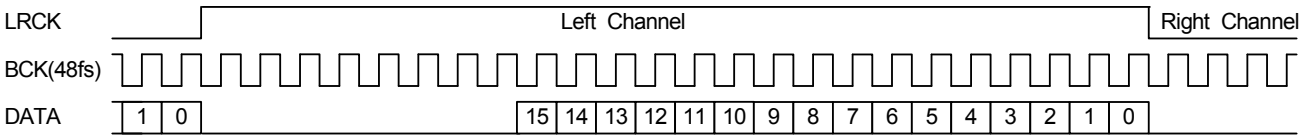


Figure 5.21.1.2 EIAJ Input Timing (48fs)

			timing(ns)			
	Item	sign	MIN	TYP	MAX	
LRCKI	setup	Tlrck1	41	Tbck/2	-	
	hold	Tlrck2	41	Tbck/2	-	
BCKI	L section	Tbck1	41	Tbck/2	-	
	H section	Tbck2	41	Tbck/2	-	
SDATAI	setup	Tda1	41	Tbck/2	-	
	hold	Tda2	41	Tbck/2	-	
INREQI	setup	Tinreqi1	200	-	-	

CD I/F input timing regulation

5.21.2 INREQI

INREQI inputs H from the microcomputer when the input data is valid.
When INREQI＝H and BFULLO＝L, the IC fetches the input data to the internal buffer.

5.21.3 BFULLO

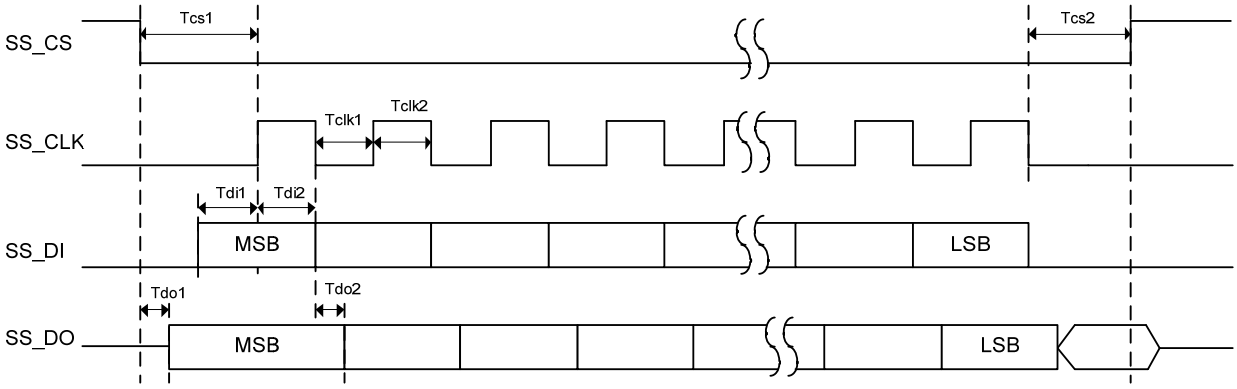
BFULLO outputs H when the internal buffer becomes FULL because the data input speed is too fast to manage the internal decoding.
When BFULLO=H, the microcomputer set to INREQI=L.
When INREQI＝H and BFULLO＝L, the IC fetches the input data to the internal buffer.

5.22 Serial interface

Slave SPI serial interface

Signal name	I/O	Function	Remarks
SS_CS	I	Slave SPI chip select input	-
SS_CLK	I	Slave SPI clock input	-
SS_DI	I	Slave SPI data input	-
SS_DO	O	Slave SPI data output	-

This is a slave serial SPI interface terminal.
The interface is available in MODE2. It supports the SPI format (MODE0,1,2 and 3).
You can select the data width from 8, 16 and 32 bit.
An input clock is 2MHz at the maximum.
The interface is available to read and write the specific file data from/to the memory.



8 or 16 or 32bit − SPI MODE0 Serial Format (SCPH=0)
SS_CLK rise edge; data capture , fall edge; data shift
SPI MODE2 is opposite in the clock polarity in SPI MODE0.

Figure 5.22.1 SPI MODE0 Serial Timing

			timing(ns)		
	Item	sign	MIN	TYP	MAX
SS_CS	setup	Tcs1	500	−	−
	hold	Tcs2	250	−	−
	H section	Tcsh	0	−	−
SS_CLK	L section	Tclk1	250	−	−
	H section	Tclk2	250	−	−
	pulse width controlled	−	−	−	100
SS_DI	setup	Tdi1	100	−	−
	hold	Tdi2	100	−	−
SS_DO	output delay	Tdo1	−	150	−
	output delay	Tdo2	−	150	−

SPI I/F input timing regulation

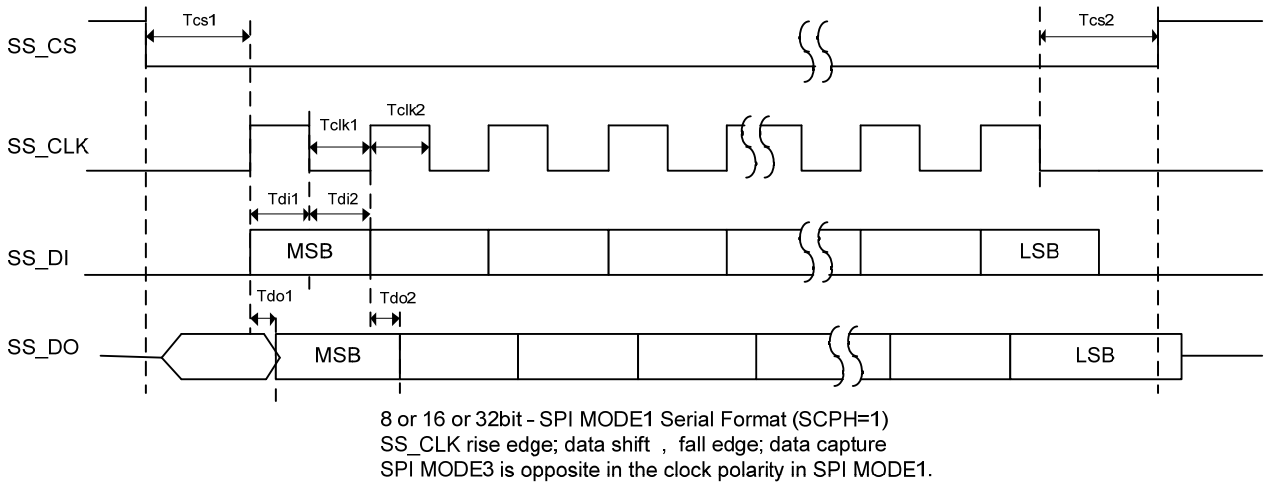


Figure 5.22.2 SPI MODE1 Serial Timing

5.23 SEL_USB

Preference device detection selection signal

Signal name	I/O	Function	Remarks
SEL_USB	I	Preference device detection selection signal	H: USB, L: SD

The signal selects which device should be detected with the highest priority at power ON.
When SEL_USB=H, the microcomputer detects the preference device from USB. When SEL_USB=L, it detects the preference device from SD.
SEL_USB is set only at power ON only. Note that selection change will be ignored after power ON.

6. Functions and Operations

6.1 File search

6.1.1 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.

Table6.1.1 Maximum Playable Files per Folder

	Root folder	Sub folder
FAT12	512	65534
FAT16	512	65534
FAT32	65536	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 100 files in the order of FAT within each folder are sorted according to UNICODE. More than 100 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. In MODE2, a sorting function can be selected valid or invalid with a command. In MODE1, a sorting function is always effective.
- The folder hierarchies up to 16 hierarchies whose full path including the file name is within 260 characters can be searched.

6.1.2 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

[1] SEL_MP3: For details, see SEL_MP3.
[2] Attribute: Files with hidden attributes are also playable. Files with system attributes cannot be played.
[3] File name: The file name, including its size, does not depend on playability.
[4] File size: A file with file size "0" is not recognized as a playable file.

6.1.3 File playing sequence

The file playing sequence depends on the following rules when sort function valid. See Figure 6.1.3.

[1] Files of 1 to 100, in the order written to FAT (FAT order) in each folder, are sorted in the order of UNICODE (see 6.1.4). Files more than 100 are played in the FAT order. The same rule is applied when sorting sub-folders.
MP3 files are sorted for MP3 which conforms to SEL_MP3. All the folders including null ones and those to which no playable file is written are sorted. If over 100 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.

6.1.4 Folder/File sort

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

[1] Obtain up to 100 sub-folders and files each in the order written to FAT within selected folder.

[2] Compare the obtained folder/file names for 14 characters (28 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 treat these 2 bytes as one character.

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

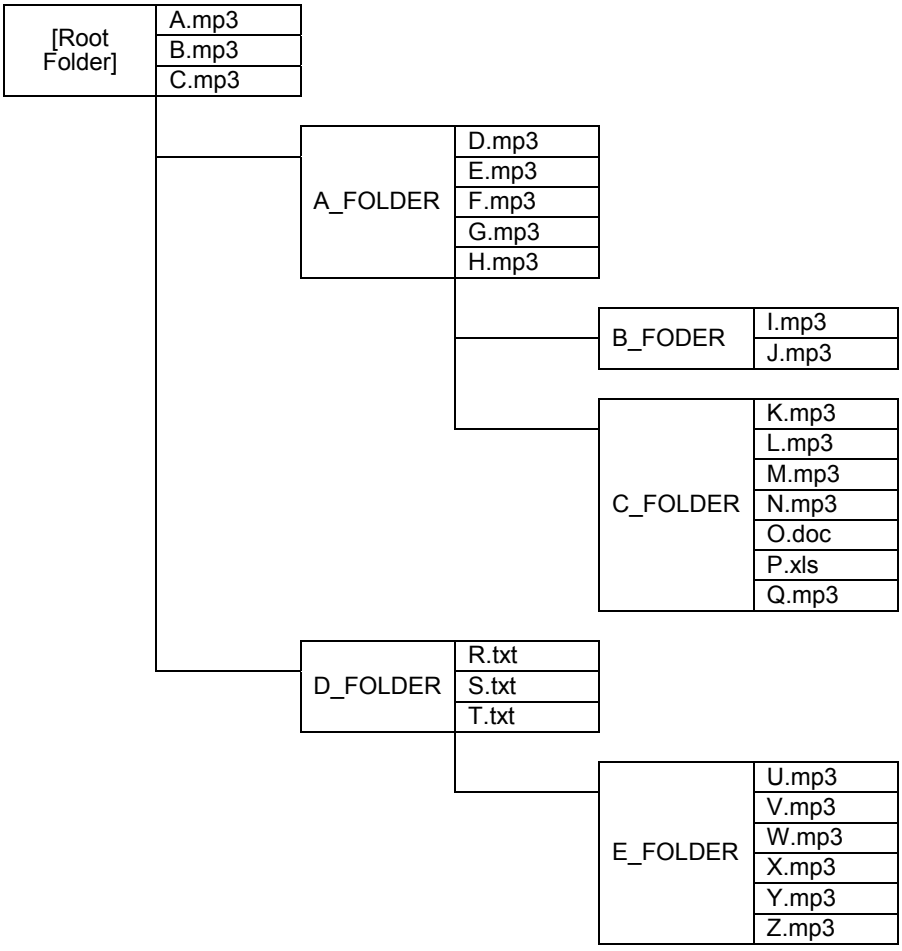


Figure 6.1.3 Example of Folder/File Structure within the Memory Device

Table 6.1.3 File Play Sequence for Folder/File Structure in Figure 6.1.3

Play order	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	

6.1.5 Search within multi-drive and multi-partition

If a device is a multi-drive type, the LSI recognizes the drive having the smaller LUN (Logical Unit Number) for the supporting FAT.

Only one drive is recognized and the other drive is not.

For the multi-partition, the LSI recognizes only the first read FAT-supported partition.

Files in other partitions cannot be read.

6.1.6 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.

6.2 Playing files

6.2.1 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.

6.2.2 Playable file formats

6.2.2.1 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).

6.2.2.2 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, 12 kHz, 24 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.

6.2.2.3 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.

6.2.2.4 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.

6.2.3 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.

6.2.4 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

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

[2] REPEAT_FOL: Repeats playing tunes within the folder in process.

[3] REPEAT_TUN: Repeats playing the tune in process.

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

[5] 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.
In MODE1, the Next playing mode is fixed to [1] and you cannot select others.
In MODE1, you cannot select the repeat mode [5].

	REPEAT_ALL	REPEAT_FOL	REPEAT_TUN	RANDOM_ALL	RANDOM_FOL
PLAY_NEXT	○	○	○	○	○
PLAY_ALL_STOP	○	×	×	×	×
PLAY_FOL_STOP	○	○	×	×	×
PLAY_TUN_STOP	○	○	○	○	○

6.2.5 resume playing function

The LSI can read the resume information to the microcomputer in MODE2, the resume playing will be enabled using this information.
The resume information includes the playing time when it has been read. Thus, in MODE2, the LSI resumes from previous playing time of the tune.
Resume playing is not supported in MODE1.

6.3 MODE1

6.3.1 KEY command operation

6.3.1.1 KEY SCAN (signal mode)

KEY SCAN operates in the following sequence on the circuit configuration as shown in Figure 5.14.

[1] KEY_COL1 to 3 output waveforms at timing as shown in Figure 6.3.1.

[2] By pressing the KEY switch, KEY_ROW 1 to 4 are set to L at timing when KEY_COL 1 to 3 are L.

[3] When detecting L input from KEY_ROW 1 to 4 three times, the master judges that KEY has been pressed. Then, the master starts the KEY operation.

Figure 6.3.2 shows the waveforms when PLAY KEY has been pressed.

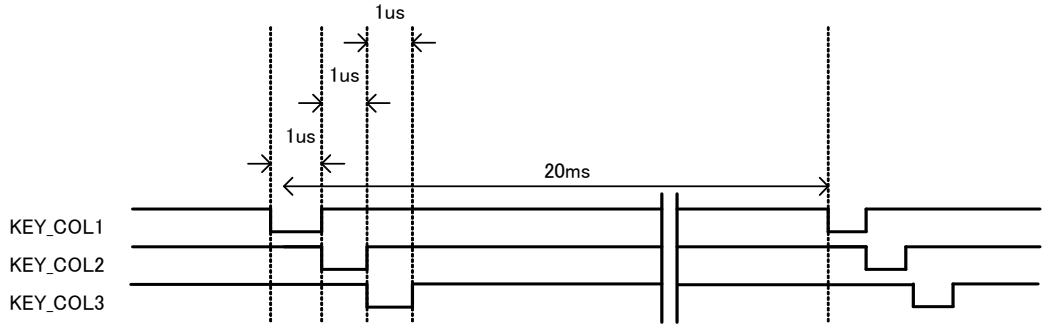


Figure 6.3.1 KEY SCAN Waveforms

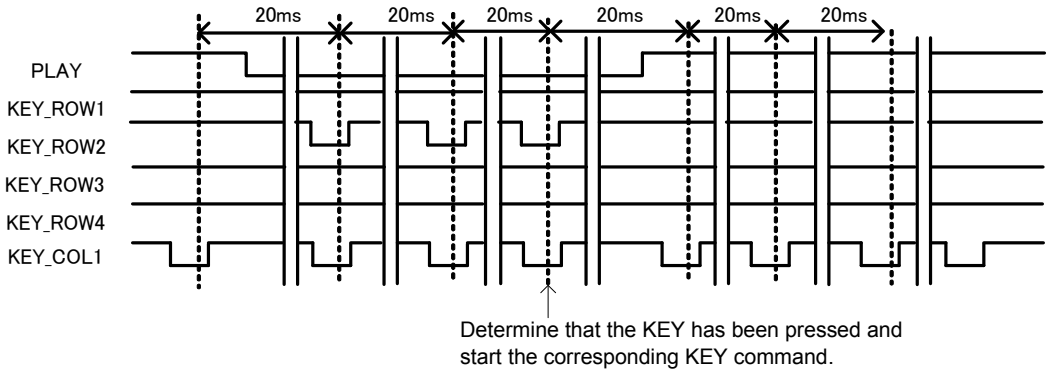


Figure 6.3.2 Operation Waveforms when KEY is Pressed

6.3.1.2 KEY SCAN (Hold Mode)

KEY SCAN operates in the following sequence on the circuit configuration as shown in Figure 5.14.

[1] KEY_COL1 to 3 output waveforms at timing as shown in Figure 6.3.1.

[2] By pressing KEY switch, KEY_ROW 1 to 4 are set to L at timing when KEY_COL 1 to 3 are L.

[3] When detecting L input from KEY_ROW 1 to 4 three times, the master judges that KEY has been pressed. Then, the master starts judging status of holded KEY.

[4] When pressed KEY's decision (L input from KEY_ROW 1 to 4 three times) is detected consecutive 15 times, the master judges that KEY Mode is Hold Mode.

[5] When KEY release is detected in judging status of holded KEY, the master judges that KEY Mode is Single Mode. Then, the master starts the KEY operation.

[6] When Hold Mode is detected, the master starts the KEY operation in Hold Mode. When KEY release is detected in Hold Mode, the master finish the KEY operation.

KEYS corresponding to Hold Down operations are FF, FB, VOL+ and VOL-.

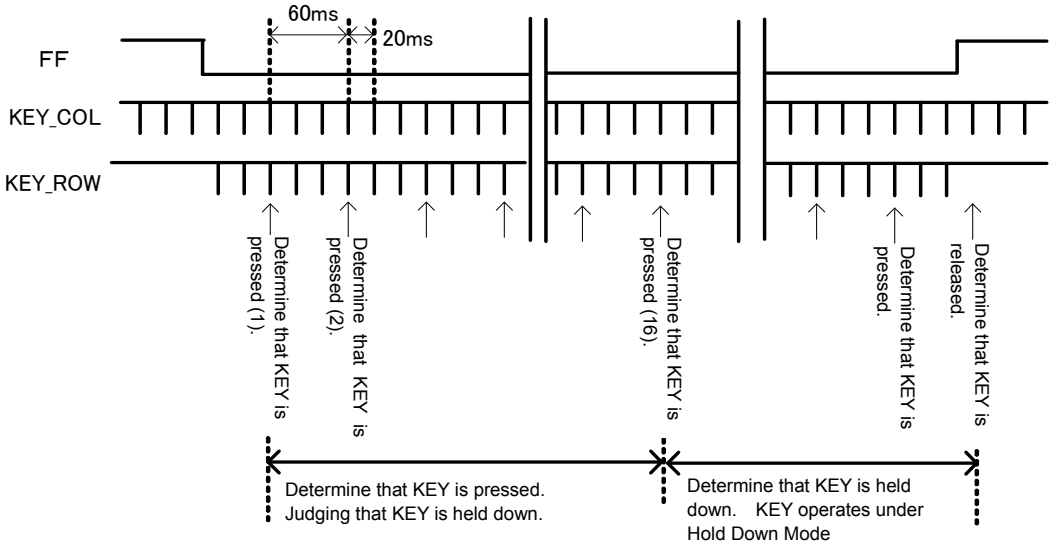


Figure 6.3.3 Operation Waveforms when KEY Is Held

Note 1: Based on the above sequence, the master determines that KEY is pressed and starts the operation of the pressed KEY, pressing multiple KEYs at the same time will produce different operations depending on the KEY combinations. Therefore, you cannot regulate the operation sequence correctly even simultaneously pressing multiple KEYs will not cause any problems. In Hold Mode, Other pressed KEY is disregarded.

Note 2: Because the KEY input does not have a buffering function, KEY inputs other than those described below are ignored.

6.3.1.3 KEY commands

Table 6.3.1.3.1 shows the types and operations of KEY commands.

Table 6.3.1.3.2 shows valid and invalid statuses of KEY commands.

Table 6.3.1.3.1 KEY Commands and Operations

KEY COMMAND	Operations
PLAY/PAUSE	-When receiving PLAY/PAUSE KEY during stop, the LSI starts playing the top file sorted for the recognized device. -When receiving PLAY/PAUSE KEY during play, the LSI pauses playing the file. When receiving PLAY/PAUSE KEY again, it restarts playing.
STOP	-When receiving STOP KEY during play, pause or file search, the LSI stops playing, pausing or searching a file.
FF	-When receiving FF KEY (single) during play or pause, the LSI searches the next playable file in the sort order of files being played or paused. Upon completion of search, it starts playing. -During play of the final file, the LSI returns to the top file in the sort order and starts playing. -When repeat or random mode is set up, LSI searches the next file following to setup in this mode. However, when one music repeat is set up, LSI searches the next file following to setup in memory repeat mode within a memory. -When receiving FF KEY (Hold Down) during play or pause, the LSI starts fast forward operations from the position being played. When detecting FF KEY release, the LSI returns to normal play. -When a tune ends during FF KEY (Hold Down), the LSI starts fast forward operations from the top of the next tune in the sort order. However, if repeat is preset, the LSI follows the setting and starts fast forward operations from the top of the next tune. When detecting FF KEY release, it returns to normal play.
FB	-When receiving FB KEY (single) during play or pause, the LSI searches the previous AAC/WMA/MP3 file in the sort order of files being played or paused. Upon completion of search, it starts playing. -During play of the top file, the LSI plays the last file sorted. -When repeat or random mode is set up, LSI searches the next file following to setup in this mode. However, when one music repeat is set up, LSI searches the next file following to setup in memory repeat mode within a memory. -When receiving FB KEY (single) in 1 seconds after start of play, the LSI plays the previous tune sorted. When receiving FB KEY after 1 second pasts, the LSI returns to the top of the file being played and restarts playing. -When receiving FB KEY (Hold Down) during play or pause, the LSI rewinds the file from the present position of the tune being played. When detecting FB KEY release, it returns to normal play. When a tune ends during FB KEY (Hold Down), the LSI starts rewinding the previous tune sorted from its end. However, if repeat is preset, the LSI follows the setting and starts rewinding the previous tune from its end. When detecting FB KEY release, it returns to normal play.
FOL+	-When receiving FOL+ KEY during play or pause, the LSI searches files in the next folder in the sort order, where the files being played or paused exits. Upon completion of search, the LSI plays the file. -While playing a file in the last folder in the sort order, the LSI plays the top file in the sort order.
FOL-	-When receiving FOL-KEY during play or pause, the LSI search files in the previous folder in the order of sort of the folder where the files being played or paused exits. Upon completion of search, the LSI plays the file. -While playing files in the top folder in the sort order, the LSI plays the top file in the last folder in the sort order.
+10	-When receiving +10 KEY during play or pause, the LSI searches the file 10 files ahead of the current one in the sort order of the files being played or paused. Upon completion of search, the LSI starts playing the file. -When the remaining number of files to be played in the sort order becomes less than 10, the LSI plays the top file. -When repeat or random mode is set up, LSI searches the next file following to setup in this mode. However, when one music repeat is set up, LSI searches the next file following to setup in memory repeat mode within a memory.

VOL+/VOL-	-When receiving VOL+/VOL- KEY with SEL_VOL terminal set to H, the LSI controls the sound volume. -The volume is controlled in 32 steps between -∞ (minimum volume) to 0 dB (maximum volume). -VOL+/VOL- KEY turns UP/DOWN the volume by one step at the timing when the KEY is pressed (single). When Hold Downing KEY for more than 1 second, the LSI judges the operation as a Hold Down and then continuously turns UP/DOWN the volume while the KEY is held down. Thus, VOL_KEY can be held down.
CHNG_DEV	-The master selects the device between USB memory and SD memory card. To do this, both devices should be connected or one device should correspond to the other (USB to SD or SD to USB). Otherwise, this key operation is ignored. -Stop after selecting the device at the top tune of the device. -REPEAT and RANDOM settings return to the initial values. -When inserting both USB Memory and SD Memory card, or neither USB Memory and SD Memory card, the master precedes USB Memory.
REPEAT	-REPEAT KEY changes the repeat play mode. -By pressing REPEAT KEY, the LSI toggles “Repeat all tunes within the memory“→ “Repeat one tune” → “Repeat within folder”. -”Repeat within folder” repeats files within the folder being played. “Repeat all tunes within the memory” is set by default
RANDOM	-RANDOM KEY plays in the range of ±128 files in the sort order at random. -RANDOM KEY can change the mode only during play, pause or stop.

Table 6.3.1.3.2 KEY Operation Valid/Invalid

	After recognized device (Stop after searching)		During playing device		STOP	During search	Error condition	
	recognized either USB or SD	recognized both USB and SD	recognized either USB or SD	recognized both USB and SD			recognized either USB or SD	recognized both USB and SD
PLAY/ PAUSE	○	○	○	○	○	×	×	×
STOP	×	×	○	○	×	○	×	×
FF	×	×	○	○	×	×	×	×
FB	×	×	○	○	×	×	×	×
FOLDER+	×	×	○	○	×	×	×	×
FOLDER-	×	×	○	○	×	×	×	×
VOL+	○	○	○	○	○	×	○	○
VOL-	○	○	○	○	○	×	○	○
＋１０	×	×	○	○	×	×	×	×
CHNG_DEV	×	○	×	○	○	×	×	○
REPEAT	○	○	○	○	○	×	×	×
RANDOM	○	○	○	○	○	×	×	×

○ = Valid, × = Invalid

6.3.2 LED operations

To display the LSI operation status, 7 types of LED controls are provided. The type of LEDs and their statuses are shown in Figure 6.3.2.

Table 6.3.2 Types and Operations of LEDs

Type of LEDs	Operations
LED_ERROR	-The LED lights when an error occurs. The following cases cause errors. [1] Neither USB memory nor SD memory is connected, or there is no playable file even if the memory is connected. [2] Communication error in the memory being played, or communication disconnection. -The LED blinks when USB HUB or un-supported device. [1] USB HUB; Blink in a cycle of 500ms after 30sec from insertion. [2] un-supported device; Blink in a cycle of 200ms.
LED_PLAY	The LED lights during play. It blinks during pause.

LED_PSD	The LED lights when the SD memory card is connected and it is being played. The LED blinks when the SD memory card is connected but it is not selected. The LED goes off when the SD memory card is not connected.
LED_PUSB	The LED lights when the USB memory is connected and it is being played. The LED blinks when the USB memory is connected but it is not selected. The LED goes off when the USB memory is not connected.
LED_ACCESS	The LED lights during access to the USB memory or SD memory card.
LED_RANDOM	The LED lights during random play.
LED_REPEAT	The LED lights while repeating a folder. The LED blinks while repeating one tune. The LED goes off while repeating all tunes.

6.4 MODE2

6.4.1 Command operations

The LSI allows command operations from an external microcomputer via a slave I2C serial interface.
This is enabled by inputting L to SEL_SLAVE to set MODE2. The command length to be sent varies depending on the command.
Table 6.4.1.1 shows the command specifications.
Table 6.4.1.2 shows enabled/disabled state of each command.

Table 6.4.1.1 Command Operations

Command name	Command	Command				Explanation of operation
		1st	2nd	3rd	4th	
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. N= 0x00 ; CONFIG Mode N= 0x01 ; PLAYER Mode N= 0x02 ; FILE RW Mode N= 0x03 ; PLAY LIST Mode N= 0x05 ; CD-ROM Mode N= 0x07 ; IPL WRITE 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	N	0x00	・This command suspends the current analysis such as TAG analysis and folder analysis. ・The LSI suspends analysis only and continues playing the file when receiving the ABORT command. ・Select N at the 3rd byte from the following. Any other settings are considered to specify N=0x01. Specify the operation to be suspended at N. N=0x00: Suspends TAG analysis before playing. The LSI continues playing the file. N=0x01: Suspends folder analysis. Since this sets the unanalyzed status after suspension, be sure to send the ANALYZE_ROOT command to redo analysis before obtaining the file contents.

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.
SET_12MOUT	4	0x60	0x07	N	M	・Set up CLKOUT12 terminal and a TEST12 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 16.9344 MHz clock output from the TEST12 terminal. M=0x01: Enables 16.9344 MHz clock output from the TEST12 terminal. ・The 16.9344 MHz clock is a clock which buffers the input from the XIN_PLL terminal. ・initial setting is N= 0x00 and M= 0x00. Output is invalid.
SET_LANG	4	0x60	0x08	N	M	・Set up a NATIVE language. ・Select N and M at the 3rd and 4th bytes from the following. Any other setting is considered to specify {M,N}={0x00,0x00}: ASCII. { M, N }= { 0x03, 0xA4 }: SHIFT-JIS(CP932) { M, N }= { 0x03, 0x52 }: OEM_850 ・Initial setting is {M , N} = {0x03, 0xA4} ; SHIFT JIS(CP932).
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_BROWSE_NUM	4	0x60	0x0A	N	0x00	・Specify the number of entries (a file or folder) when enabling a browsing function which carries out prediction analysis. ・Specify N at the 3rd byte within the range from 0x00 to 0x14(20). Any other settings will not accept the command. ・The LSI analyzes entries in the number specified by N. ・Since even (0-N) can specify with the parameter of 'READ_BROWSE_INFO', N+1 entry information can be acquired at the maximum. ・Initial setting is N=0x0A=10 entry prediction analysis.
SET_PLAYINFO_NUM	4	0x60	0x0B	N	0x00	・Specify the number of files predicted by the READ_PFILE_NAME command. ・A READ_PFILE_NAME command can be predicted only within the same folder. ・Specify N at the 3rd byte within the range from 0x00 to 0x5. Any other settings will not accept the command. The LSI looks ahead files in the number specified by N.

						・Since READ_PFILE_NAME allows you to specify in a range of 0 to N, you can obtain the information of up to N+1 files. ・Initial setting is N=0x03 file prediction analysis.
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_IPL_UNIT	4	0x60	0x0E	N	0x00	・Set up the unit which rewrites FLASH ROM when IPLWrite. ・Select N at the 3rd byte from the following. Any setting other than N=0x00 is considered to specify N=0x01. N=0x00: Writes to FLASH by page. N=0x01: Writes to FLASH by byte. ・Initial value is N= 0x00. It is page unit writing.
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_LANG2	4	0x60	0x11	0x00	N	・Set up the character encoding conversion mode inside a file system. ・Please choose N from the following values.The other setup is not received. N= 0x00 : Character encoding conversion is performed inside a file system. N= 0x01 : Character encoding conversion is not performed inside a file system. ・When N= 0x01 is set up, an action changes as follows. the path information which Read(s) -- the data in media -- it becomes binary data as it is The other delimiter and reservation character of path information turns into a character of UTF-16 encoding. ・After a receptionist, when this command performs changes in system mode, it becomes effective. ・An initial value is N= 0x00.
SET_OUTLANG	4	0x60	0x12	0x00	N	・Set up whether UTF8/UTF16 conversion is performed when the character string status output of a file and a folder name. ・Please choose N from the following values.The other setup is not received. N= 0x00 : With a setup of SET_LANG, it outputs without changing. N= 0x01 : It changes and outputs to UTF-8 at the time of an output. N= 0x02 : It changes and outputs to UTF-16 at the time of an output. ・An initial value is N= 0x00.
SET_TOUT_TUR	4	0x60	0x18	0x01	N	・Set up the wait time after Test Unit Ready command transmission at the time of USB memory recognition. ・When the response to Test Unit Ready is failure, re-try of Test Unit Ready is performed after the setting value Nx2 (msec). ・Re-try is performed to 375 times. ・A timeout occurs after the setting value Nx750 (msec). ・An initial value is 191sec (setting value N=0xFF).

SET_IDL_TIME	6	0x60	0x18	0x02	0x00	・Set up the idle time after USB memory bus reset. ・Set a setup as the 5 - 6th byte with a little endian. ・Setting value {6 th=M, 5 th=N} x0.167 (usec) becomes wait time. ・As for an initial value, 220usec (setting value N=1325= {M=x05, N=x2D}) is set up. ・Please set a setting value as the range of 300 (50usec)-9000 (1.5msec).
SET_TUR_PASS	4	0x60	0x18	0x0B	N	・Operation after timeout generating with the Test Unit Ready command is set up at the time of USB memory recognition. ・Please choose 4th byte N from the following. A setup of those other than the following operates as that to which 0x01 was set. N= 0x00: It is referred to as ERROR as memory recognition failure after a timeout. N= 0x01: When the number of effective LUN is one, after a timeout, the response of Test Unit Ready is disregarded and the next memory recognition processing is performed. ・An initial value is N= 0x00.
SET_THR1	12	0x6F	0x00	0x00	0x00	・Setup which performs the through output to I2S output from I2S input. ・Please set up 8 bytes from the 5th byte of following. 0x00 0x00 0x30 0xD0 0x1E 0x00 0x00 0x00 ・When you perform a through output, please set up SET_THR1, SET_THR2, and SET_THR3.
SET_THR2	12	0x6F	0x00	0x00	0x00	・Setup which performs the through output to I2S output from I2S input. ・Please set up 8 bytes from the 5th byte of following. Through output invalidity; 0x00 0x00 0xB0 0xD0 0x01 0x00 0x00 0x00 Through output effective; 0x00 0x00 0xB0 0xD0 0x05 0x00 0x00 0x00 ・When you perform a through output, please set up SET_THR1, SET_THR2, and SET_THR3.
SET_THR3	12	0x6F	0x00	0x00	0x00	・Setup which performs the through output to I2S output from I2S input. ・Please set up 8 bytes from the 5th byte of following. EIAJ input; 0x00 0x00 0x40 0xE0 0x00 0x00 0x00 0x00 I2S input; 0x00 0x00 0x40 0xE0 0x30 0x00 0x00 0x00 ・When you perform a through output, please set up SET_THR1, SET_THR2, and SET_THR3.
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. ・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 “repeat 1 tune” is set, the LSI searches the next file in accordance with the repeat setting within the memory. ・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.
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 “repeat one tune” is set, the LSI searches files in accordance with the “repeat within the memory” 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 folder in a status where “repeat within the memory” 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 folder in the status where “repeat within the memory” 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	0x00	・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. ・After writing the command, the LSI starts resume play. ・If the resume target cannot be searched, the LSI searches the first tune of in the device and plays.
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 analog line. N=0x01: Outputs using the digital audio interface (SPDIF). N=0x02: Outputs in I2S(32fs) format. N=0x03: Outputs in I2S(48fs) format. N=0x04: Outputs in I2S(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: "Analog 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. ・When system operation mode is PLAYLIST mode, operation in a folder of N= 0x02 setup becomes invalid, and does not receive a

						command.
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 whenFF and FB command. N=0x03: REPEAT_TUN: Repeats one tune Repeats the tune being played. A setup of the repeat in the memory is followed whenFF 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. ・When system operation mode is PLAYLIST mode, operation in a folder of N= 0x01 and 0x05 setup becomes invalid, and does not receive a command.
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 command. ・After TOC analysis is completed, the LSI writes the result 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. ・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 the entries (files or subfolders) set by the SET_BROWSE_NUM command. ・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.
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.
GET_PATH_CURSOR	4	0x62	0x01	0x03	0x00	・This command analyzes the full path (within the memory) of the entry pointed by the memory browsing cursor.
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 entries specified by the SET_BROWSE_NUM command, 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 entries specified by the SET_BROWSE_NUM command, 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 5^{th}-10^{th} bytes. ・Select the operation after moving with N in the 4^{th} 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.
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 4^{th} byte from the following. Any other settings will not accept the command. N=0x00: Playable file N=0x01: Play list 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.
PLAYLIST						
SET_PLAYLIST	260	0x62	0x10	0x00	N	This command selects the play list file by full path and file name. ・The full path is 256 bytes at maximum (including drive letter (A:\), file name and extension). Set this at the 5^{th}-260^{th} 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.) ・The setting for MUSIC/playllist/playlist.m3u will be: x4D 55 53 49 43 5C 70 6C 61 79 6C 69 73 74 5C 70 6C 61 79 6C 69 73 74 2E 6D 33 75 00. ・The operation after search conforms to the setting of 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: Searches the first tune and then stops. N=0x01: Searches the first tune and then starts playing it. ・After executing this command, the position of the play list browsing cursor is reset to the top.
SET_PLAYLIST_DIRECT	10	0x62	0x11	0x00	N	・This command selects a play list file by access data. ・The LSI does nothing if the access data is other than play list file. ・Set the access data at the 5th-10th bytes. ・The operation after search conforms to the setting of 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: Searches the first tune and then stops. N=0x01: Searches the first tune and then starts playing it. ・After executing this command, the position of the play list browsing cursor is reset to the top.
SET_PLAYLIST_CURSOR	4	0x62	0x12	0x00	N	・This command specifies the entry pointed by the play list browsing cursor as play list. ・The LSI does nothing if a file other than the play list is specified. ・The operation after search conforms to the setting of 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: Searches the first tune and then stops. N=0x01: Searches the first tune and then starts playing it. ・After executing this command, the position of the play list browsing cursor is reset to the top.
PLST_PLAY_CURSOR	4	0x62	0x13	0x00	0x00	・This command plays the file pointed by the play list browsing cursor. ・If any play list is not selected, the command will not be accepted.
PLST_GET_TAG_CURSOR	4	0x62	0x13	0x01	0x00	・This command starts TAG analysis for the file pointed by the play list browsing cursor. ・If any play list is not selected, the command will not be accepted.
PLST_MOV_NEXT	4	0x62	0x14	0x00	N	・This command moves the play list browsing cursor to the position N ahead from the current position. ・The LSI analyzes the information as much as the files (or folders) set by the SET_BROWSE_NUM command. After analysis, the LSI writes the result to the status register. ・If any play list is not selected, the command will not be accepted.
PLST_MOV_PREV	4	0x62	0x14	0x01	N	・This command moves the play list browsing cursor to the position N backward from the current position. ・The LSI analyzes the information as much as the files (or folders) set by the SET_BROWSE_NUM command. After analysis, the LSI writes the result to the status register. ・If any play list is not selected, the command will not be accepted.
PLST_MOV_HOME	4	0x62	0x14	0x02	0x00	・This command moves the play list browsing cursor to the top. ・The LSI analyzes the information as much as the files (or folders) set by the SET_BROWSE_NUM command. After analysis, the LSI writes the result to the status register. ・If any play list is not selected, the command will not be accepted.
PLST_MOV_PLAYING	4	0x62	0x14	0x03	0x00	・This command moves the play list browsing cursor to the tune being played. ・The LSI analyzes the information as much as the files (or folders) set by the SET_BROWSE_NUM command. After analysis, the LSI writes the result to the status register. ・If any play list is not selected, the command will not be accepted.
FILE RW						

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.
FOPEN_W	266	0x63	0x02	0x00	0x00	・This command specifies the full path, name, and update date information of the file to be written to the memory using the File Write function. ・After receiving the command, open the specified file. ・You can set the update date information in terms of year, month, day and time. ・Set the update date information at the 5th-10th bytes in BCD format in the order of year (upper), year (lower), month, day, hour, and minute. If all the data of the update date information is set to 0x00, the LSI considers that 0x20, 0x09, 0x01,0x01, 0x12, and 0x00 are specified when processing the data. ・The full path is 256 bytes at maximum (including drive letter (A:\), file name and extension). Set this at the 11th-266th 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.) ・If the specified file does not exist, it should be created. ・A file with the same name that already exists will be deleted. ・After creating a file, the structure of the file creation folder (including the intermediate folders) is changed. Thus, when using the browsing function, you should start over browsing analysis.
FCLOSE	4	0x63	0x03	0x00	0x00	・This command closes the file. ・After the File Read/Write function is completed, CLOSE the file.
SET_FRW_BUS	4	0x63	0x04	N	M	・This command selects the BUS to be used with the File Read/Write function. When selecting the I2C bus, data of up to 256 bytes can be read/written at one transfer. When selecting the SPI bus, data up to 4 Kbytes can be read/written at one transfer. ・Set the BUS type to be used with N at the 3rd byte. Select N from the following. Any other settings will not accept the command. N=0x00: Uses the I2C bus. N=0x01: Uses the 8-bit SPI bus. N=0x02: Uses the 16-bit SPI bus. N=0x03: Uses the 32-bit SPI bus. ・Set a SPI mode with M at the 4th byte. Select M at the 4th byte from the following. If any other setting is specified, the LSI does nothing. If N=0x00, the following M values will become disabled. M=0x00: Uses SPI mode 0. M=0x01: Uses SPI mode 1. M=0x02: Uses SPI mode 2. M=0x03: Uses SPI mode 3.

						・By default, N=0x00: "Uses the I2C bus" is set (M=0x00).
FWRITE_DAT	4/260	0x63	0x05	N	N	・This command specifies data size to be written and the data itself. ・At 0xN(16bit) in the 3rd and 4th bytes, specify the data size to be written at one transfer in Little Endian format. ・When using the I2C bus, set the data at the 5th-260th bytes. Data of up to 256 bytes can be sent at one time. ・When using the SPI bus, the LSI waits until the FWRREADY bit turns 1 after this command is sent, and then starts transferring the data through that bus. When the transferred data reaches the data size specified by SPI transfer, the LSI starts writing the data to the memory. Data of up to 4096 bytes can be sent at one time. ・If the specified data size does not match the data size actually sent, this command is assumed to be an error.
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 I2C 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.
FDEL	260	0x63	0x07	0x00	0x00	・This command deletes the file or folder specified by the full path. ・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.) ・The command deletes a folder only when there is no file (or folder) in it. ・After deleting a file or folder, the structure of the folder where the deleted file (or folder) existed is changed. Thus, when using the browsing function, you should start over browsing analysis.
FDEL_CURSOR	4	0x63	0x07	0x01	0x00	・This function deletes the file or folder being pointed by the memory browsing cursor. ・The command deletes a folder only when there is no file in it. ・After deletion, the cursor positions at the top of the folder where the deleted file or folder existed. Then, the LSI analyzes the folder.
CD-ROM						

START_CDROM	4	0x65	0x00	N	M	・This command enables CD-ROM input. ・Set the ECC retry count with N at the 3rd byte. Specify N within the range from 0x00 to 0x0F. Any other settings will not accept the command. ・When N=0x00, error correction is performed only for EDC. When N=0x01 to 0x0F, the LSI executes EDC and then executes ECC as many times as specified (retry specification). ・Set the format of the input from CD with M at the 4th byte. Select M from the following. Any other settings will not accept the command. M=0x00: Inputs in I2S (32fs) format. M=0x01: Inputs in I2S (48fs) format. M=0x02: Inputs in I2S (64fs) format. M=0x04: Inputs in EIAJ (32fs) format. M=0x05: Inputs in EIAJ (48fs) format. M=0x06: Inputs in EIAJ (64fs) format. ・By default, N=0x03: "ECC retry count 3" and M=0x05: "Inputs in EIAJ (48fs) format" are set. ・By default, CD-ROM input is disabled.
STOP_CDROM	4	0x65	0x01	0x01	0x00	・This command disables CD-ROM input. ・The command cancels the SEEK request (necessary LBN request). ・When the LSI is analyzing the CD-ROM file system, the command stops analysis. ・When the LSI is playing or copying a CD-ROM file, the command forcibly stop the operation.
START_CDANA	4 or8	0x65	0x01	0x02	0x00	・This command starts analyzing the CD-ROM file system. ・After receiving the command, the LSI requests the necessary LBN. ・When the necessary LBN data is input, the LSI analyzes the data. After analysis, it outputs the analyzed result to the status register. ・If the command length is less than 8 bytes, the LSI searches the CD-ROM file system information starting from LBN=0. ・To analyze the file system information after the 2nd session on the multi-session disk, you must specify the starting LBN. In this case, specify the LBN in which the file system information resides (after the start position of this session) at the 5th-8th bytes in Little Endian format. ・Reset the acquisition state of a file/folder information.
STOP_CDANA	4	0x65	0x01	0x03	0x00	・This command stops or suspends analysis of the CD-ROM file system. ・If the file system analysis is not completed, you can restart it.
CD_SET_VD	4	0x65	0x02	0x00	N	・This command set Volume Descriptor, which is preferred during the CD-ROM file system analysis, at the 4th byte. ・Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x00: PVD preferred N=0x01: SVD preferred ・By default, N=0x00: "PVD preferred" is set.
CD_SET_LBN	12-	0x65	0x03	0x00	N	・This command sets the information on the file to be played (first LBN, file size, file name and file kind). ・Select N at the 4th byte from the following. Any other settings will not accept the command. N=0x01:MP3 , N=0x02:WMA, N=0x03:AAC , N=0x04:WAV Please specify the value read by the READ_CD_FILE command as it is. ・Set the LBN data at the 5th-8th bytes in Little Endian format. ・Set the size data at the 9th-12th bytes in Little Endian format. ・Set the file name at the 13th and following bytes with NUL (0x00) at the end. If the command length is less than 14 bytes, do not set the file name. In this case, the file name is obtained as a null character string with some commands such as READ_PFILE_NAME. ・After receiving the command, the LSI requests necessary LBN. When the valid data is input, the LSI starts decoding the data.

Table 6.4.1.2 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 RW	PLAYLIST	IPL WRITE	CD-ROM	STOP	PLAY	SEARCH (mode)	SEARCH (file)	Analyze	Write	ERROR
CONFIG													
CHG_SYSTEM_MODE	○	○	○	○	○	○	○	○	×	×	×	×	○
STOP	○	○	○	○	○	○	○	○	○	○	○	○	○
ABORT	○	○	○	○	○	○	○	○	○	○	○	×	x
CHG_DEV	○	○	○	○	○	○	○	○	×	×	×	×	○
DIS_WDT	○	○	○	○	○	○	○	×	×	×	×	×	×
SET_WDT	○	○	○	○	○	○	○	×	×	×	×	×	○
SET_SORT	○	○	○	○	○	○	○	×	×	×	×	×	×
SET_12MOUT	○	○	○	○	○	○	○	×	×	×	×	×	○
SET_LANG	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_MP3	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_BROWSE_NUM	○	○	○	○	○	○	○	×	×	×	×	×	×
SET_PLAYINFO_NUM	○	○	○	○	○	○	○	×	×	×	×	×	×
SET_LBIT	○	○	○	○	○	○	○	×	×	×	×	×	○
SET_IPL_UNIT	○	○	○	○	○	○	○	×	○	○	×	×	○
SET_UTPKT	○	×	×	×	×	×	○	×	×	×	×	×	×
GET_DEV_FREE	○	○	○	○	○	○	○	×	×	×	×	×	×
SET_LANG2	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_OUTLANG	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_TOUT_TUR	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_IDL_TIME	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_TUR_PASS	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_THR1	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_THR2	○	×	×	×	×	×	○	×	×	×	×	×	×
SET_THR3	○	×	×	×	×	×	○	×	×	×	×	×	×
PLAY control													
PLAY	○	○	×	○	×	○	○	○	×	×	×	×	×
PAUSE	×	○	×	○	×	○	○	○	×	×	×	×	×
HOME	×	○	×	○	×	×	○	○	×	×	×	×	×
PLAYMODE	×	○	×	○	×	○	○	○	×	×	×	×	×
VOL+	○	○	○	○	○	○	○	○	×	×	×	×	○
VOL-	○	○	○	○	○	○	○	○	×	×	×	×	○
REPEAT	×	○	×	○	×	○	○	○	×	×	×	×	×
RANDOM	×	○	×	○	×	○	○	○	×	×	×	×	×
FF	×	○	×	○	×	○	○	○	×	×	×	×	×
FB	×	○	×	○	×	○	○	○	×	×	×	×	×
FOL+	×	○	×	×	×	○	○	○	×	×	×	×	×
FOL-	×	○	×	×	×	○	○	○	×	×	×	×	×
PLAY_RESUME	×	○	×	○	×	×	○	○	×	×	×	×	×
PLAY Setting													
SET_DOUT	○	○	○	○	○	○	○	○	×	×	×	×	○
SET_EQ	○	○	○	○	○	○	○	○	×	×	×	×	○
SET_VOL	○	○	○	○	○	○	○	○	×	×	×	×	○
SET_NEXT	×	○	×	○	×	○	○	○	×	×	×	×	×
SET_REPRAND	×	○	×	○	×	○	○	○	×	×	×	×	×
SET_TAG	×	○	×	○	×	○	○	○	×	×	×	×	×
SET_TOC	×	○	×	×	×	○	○	○	×	×	×	×	×
SET_PRM	×	○	×	○	×	○	○	○	×	×	×	×	×

BROWSING													
ANALYZE_ROOT	×	○	○	○	×	×	○	○	x	○	×	×	×
PLAY_CURSOR	×	○	×	×	×	×	○	○	x	x	×	×	×
GET_TAG_CURSOR	×	○	×	×	×	×	○	○	x	○	×	×	×
GET_PATH_CURSOR	×	○	○	○	×	×	○	○	x	○	×	×	×
PLAY_DIRECT	×	○	×	×	×	×	○	○	x	x	×	×	×
MOV_NEXT	×	○	○	○	×	×	○	○	x	○	×	×	×
MOV_PREV	×	○	○	○	×	×	○	○	x	○	×	×	×
MOV_UP	×	○	○	○	×	×	○	○	x	○	×	×	×
MOV_DOWN	×	○	○	○	×	×	○	○	x	○	×	×	×
MOV_HOME	×	○	○	○	×	×	○	○	x	○	×	×	×
MOV_PLAYING	×	○	×	×	×	×	×	○	x	×	×	×	×
MOV_DIRECT	×	○	×	○	×	×	○	○	x	○	×	×	×
SET_EXTENSION	×	○	○	○	×	○	○	○	○	○	×	×	×
PLAYLIST													
SET_PLAYLIST	×	×	×	○	×	×	○	○	×	×	×	×	×
SET_PLAYLIST_DIRECT	×	×	×	○	×	×	○	○	×	×	×	×	×
SET_PLAYLIST_CURSOR	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_PLAY_CURSOR	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_GET_TAG_CURSOR	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_MOV_NEXT	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_MOV_PREV	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_MOV_HOME	×	×	×	○	×	×	○	○	×	×	×	×	×
PLST_MOV_PLAYING	×	×	×	○	×	×	○	○	×	×	×	×	×
FILE RW													
FOPEN_R	×	×	○	×	×	×	○	×	×	×	×	×	×
FOPEN_R_CURSOR	×	×	○	×	×	×	○	×	×	×	×	×	×
FOPEN_R_DIRECT	×	×	○	×	×	×	○	×	×	×	×	×	×
FOPEN_W	×	×	○	×	×	×	○	×	×	×	×	×	×
FCLOSE	×	×	○	×	×	×	○	×	×	×	×	×	×
SET_FRW_BUS	×	×	○	×	×	×	○	×	×	×	×	×	×
FWRITE_DAT	×	×	○	×	×	×	○	×	×	×	×	×	×
FREAD_DAT	×	×	○	×	×	×	○	×	×	×	×	×	×
FDEL	×	×	○	×	×	×	○	×	×	×	×	×	×
FDEL_CURSOR	×	×	○	×	×	×	○	×	×	×	×	×	×
CD-ROM													
START_CDROM	×	×	×	×	×	○	○	×	×	×	×	×	×
STOP_CDROM	×	×	×	×	×	○	○	○	○	○	○	×	×
START_CDANA	×	×	×	×	×	○	○	○	×	×	×	×	×
STOP_CDANA	×	×	×	×	×	○	○	○	×	×	×	×	×
CD_SET_VD	×	×	×	×	×	○	○	×	×	×	×	×	×
CD_SET_LBN	×	×	×	×	×	○	○	○	×	×	×	×	×

○=enable×=disable

6.4.2 Status output

The operation information, such as internal statuses, play time, folders, files and Tags, is output using a I2C interface.
The statuses shown in Table 6.4.2.1 MODE2 Status Register Map are output.
When reading status via I2C, the OFFSET position is automatically incremented after reading byte data. However, by issuing the I2C 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 6.4.2.2 shows the status output commands.
Byte data, when reading via I2C, 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.

Table 6.4.2.1 MODE2 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		INIT_END	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	SEL_USBSD	FBP	FFP	PLAYFILE			
0x05	STATUS6	PRECOMSTAT							
0x06	VOLINF	0	0	0	VOLINF				
0x07	DOUTINF	EQINF				DOUTINF			
0x08	PMODEINF	REPEATINF				SETNEXTINF			
0x09	SEL_MP3	0	0	0	0	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	BROWSESTA	ANA_ERR	0	GET_PAT	GET_TAG	GET_TAG_ID			ANA_CUR

	T			H_END	_END				
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	PLISTPLAY	PLIST_GTAG_END	PLIST_TAG_EXIST	PLIST_BR_ERR	PLIST_BR_BSY	PLISTERR	0	PLISTOPEN	PLISTPLAY
0x2F	FIOSTAT	FIOERR	0	FIORW	FIOOPEN	FRDREADY	FWRREADY	FIOSEARCH	FIOMODE
0x30	FIOSET	FIOBUS		FIOSPIMD		FIOOPE			
0x31	IPLWMODE	0	IPLWUNIT	IPLWMODEACT	IPLWMODEEND	IPLWEERR	IPLWEXIST	IPLSERCH	IPLWMODE
0x32	ENCON	0	0	0	0	0	0	0	0
0x33	COMPON	0	0	0	0	0	0	0 1	0
0x34	ENC_PLAY	0				0			
0x35	ENC_BITRATE	0				0			
0x36	CDROMON	BUFFULL	0	SEEK	CDROMAERR	CDROMAEND		CDROMABUSY	CDROMON
0x37	MEMINFO	MEMINFO				0	0	IRPTOINT	IRPTODEVICE
0x38 - 0x13F	COMAREA	COMAREA							

OFFSET	Status	bit	NAME	Contents
0x00	STATUS1	7	ERROR	ERROR situation 0 ; Nothing error, 1 ; Error
		6:5	SEARCH	SEARCH situation 0: Search stop, 1: Under a search (file search) , 2: Under a search (under device recognition)
		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 the RPT_OFF function
		3	INIT_END	The completion situation of initialization 0: Incomplete 1: When a program is normally loaded from FLASH completed and (set to 1 at the time of either of the followings) connected and a program is normally downloaded from the host who has connected
		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 analisis 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	SEL_USBSD	Device recognition priority situation 0:SD>USB 1:USB>SD
		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. 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	0	0
		6	0	0
		5	0	0
		4	0	0
		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]
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	TFILEMEML L	7:0	TFILEMEMLL	The number of total files in memory. [15:0] low-rank byte [7:0]
0x1F	TFILEMEML H	7:0	TFILEMEMLH	The number of total files in memory. [15:0] higher-rank [15:8]
0x20	TFILEMEMH L	7:0	TFILEMEMHL	The number of total files in memory. [31:16] low-rank byte [23:16]
0x21	TFILEMEMH H	7:0	TFILEMEMHH	The number of total files in memory. [31:16] higher-rank byte [31:24]
0x22	BROWSEST AT	7	ANA_ERR	browsing analysis Error 0: With no error 1: Error-generate in analysis.
		6	0	-
		5	GET_PATH_E ND	Cursor position folder path analysis situation 0;Under folder path un-analyzing/analysis, 1;Finishing of folder path analysis
		4	GET_TAG_EN D	Cursor position TAG analysis situation 0: Under TAG un-analyzing/analysis, 1: Finishing of TAG analysis
		3:1	GET_TAG_ID	Existence TAG kind 0:ID 3V1, 1:ID 3V2, 2;With WMA, 3;AAC, 4:WAV, and 7: no TAG information
		0	ANA_CUR	Cursor position entry analysis. 0;Analysis stop, 1;Under analysis
0x23	NUMANAFO LLL	7:0	NUMANAFOL LL	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	NUMANAFO LLH	7:0	NUMANAFOL LH	Cursor position number in a cursor existence folder [15:0] Higher rank byte [15:8]
0x25	NUMANAFO LHL	7:0	NUMANAFOL HL	Cursor position number in a cursor existence folder [31:16] Low rank byte [23:16]
0x26	NUMANAFO LHH	7:0	NUMANAFOL HH	Cursor position number in a cursor existence folder [31:16] Higher rank byte [31:24]
0x27	TFILEANAF OLLL	7:0	TFILEANAFOL LL	The number of files total in a cursor existence folder [15:0] Low rank byte [7:0]
0x28	TFILEANAF OLLH	7:0	TFILEANAFOL LH	The number of files total in a cursor existence folder [15:0] Higher rank byte [15:8]
0x29	TFILEANAF OLHL	7:0	TFILEANAFOL HL	The number of files total in a cursor existence folder [31:16] Low rank byte [23:16]
0x2A	TFILEANAF OLHH	7:0	TFILEANAFOL HH	The number of files total in a cursor existence folder [31:16] Higher rank byte [31:24]
0x2B	TFOLANAF OLL	7:0	TFOLANAFOL L	The number of subfolders total in a cursor existence folder [15:0] Low rank byte [7:0]
0x2C	TFOLANAF OLH	7:0	TFOLANAFOL H	The number of subfolders total in a cursor existence folder [15:0] Higher rank byte [15:8]
0x2D	TFOLANAH EIRL	7:0	TFOLANAHEI RL	The classes number of cursor existence folder [7:0] A ROOT class is set to 1.
0x2E	PLISTPLAY	7	PLIST_GTAG_ END	TAG analysis situation on Browsing cursor position in Play LIST 0: Under TAG un-analyzing / analysis , 1:End of TAG analysis

		6	PLIST_TAG_EXIST	TAG existence situation on Browsing cursor position in Play LIST 0: With no TAG, 1: with TAG
		5	PLIST_BR_ERR	Browsing error situation in Play LIST. 0: Normal end 1: Error
		4	PLIST_BR_BSY	Browsing BUSY situation in Play LIST 0:Not-BUSY, 1:BUSY (under analysis)
		3	PLISTERR	Situation support to Play LIST. 0: With no error, 1: format Error.
		2	0	0
		1	PLISTOPEN	PLAY LIST file setting situation. 0;Un-setting up, 1;Play List setuped
		0	PLISTPLAY	PLAY LIST MODE effective/invalid. 0: invalid, 1 :P LAY LIST MODE is effective
0x2F	FIOSTAT	7	FIOERR	FILE IO Error situation 0: With no Error, 1:Error
		6	0	0
		5	FIORW	FILE IO Read/Write mode 0:Read mode, 1:Write mode
		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	FWRREADY	Write-in FIFO preparation situation 0:Under preparation, 1:Preparation O.K. (it is used only at the time of SPI bus use)
		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	FIOBUS	FILE IO use BUS kind setup. 0:I2C, 1:SPI (8 bits), 2:SPI (16 bits), 2:SPI (32 bits)
		5:4	FIOSPIMD	FILE IO SPI mode setup. 0:SPI MODE0, 1:SPI MODE1, 2:SPI MODE2, 3:SPI MODE3
		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	IPLWMODE	7	0	0
		6	IPLWUNIT	IPL FLASH ROM rewriting unit setup. 0;Page unit, 1;Byte unit
		5	IPLWMODEACT	IPL FLASH ROM rewriting operation situation. 0;Stop, 1;Under operation
		4	IPLWMODEEND	IPL FLASH ROM rewriting processing end situation. 0;during operation, 1;End
		3	IPLWEERR	IPL FLASH ROM Write Error Situation. 0;With no Error, 1;Write Error
		2	IPLWEXIST	File existence situation for rewriting in a memory. 0;With no file, 1;with a file
		1	IPLSERCH	File search situation for rewriting in a memory. 0;Search stop, 1;Under search
		0	IPLWMODE	IPL FLASH ROM rewriting mode effective/invalid 0;invalid, 1,effective
0x32	ENCON	7:4	ENCERR	Encode Error situation 0;With no Error , 1;Error
		3:0	ENCON	Encoding mode effective/invalid 0;invalid , 1; effective
0x33	COMPON	7:4	TAGW	0
		3:0	COMPON	0
0x34	ENC_PLAY	7:4	ENC_INFORM	0
		3:0	ENC_PLAY	0
0x35	ENC_BITRATE	7:4	ENC_INSR	0
		3:0	ENC_BITRATE	0
0x36	CDROMON	7	BUFFULL	Inside buffer state of CD input 0;not FULL, 1;FULL
		6	0	0
		5	SEEK	CD-ROM function SEEK demand situation. 0;Nothing, 1:SEEK request
		4	CDROMANAERR	CD-ROM file analysis error situation 0;no Error, 1: with Error
		3:2	CDROMANAEND	CD-ROM file analysis end situation 0;Un-analyzing , 2: Analysis end
		1	CDROMANABUSY	CD-ROM file analysis situation 0;Stop, 1;Under analysis
		0	CDROMON	CD-ROM mode effective/invalid 0;invalid , 1;effective
0x37	MEMINFO	7:4	MEMINFO	Memory device information chosen now
		3	0	0
		2	0	0
		1	IRPTOINT	0
		0	IRPTODEVICE	0
0x38	COMAREA	7:0	COMAREA	Data common area The contents change with status read-out commands.

- 0x13F				(When read-out exceeding OFFSET=0x140 is performed, OFFSET does not return to 0x00, but the value read becomes unfixed)

Table 6.4.2.2 MODE2 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 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 0x04. 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 preposed data ID (2 bytes). See 6.4.6 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 preposed 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 6.4.6 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 Descripter value when the USB memory is inserted and chosen.
READ_CONDESC	4	0x6D	0x00	0x08	0x01	32	・Output a Configration Descripter value when the USB memory has been recognized.
READ_INQUIRY	4	0x6D	0x00	0x08	0x02	36	・Output a MSC Inquiry value when the USB memory has been recognized.
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 0x13. ・See 6.4.7 for the output format.
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 preposed data ID (2 bytes). See 6.4.6 for the output format.
READ_BROWSE_PATH	4	0x6D	0x01	0x04	0x00	258	・Outputs the full path (including drive letter (A:\)) of the entry pointed by the cursor analyzed by the GET_PATH_CURSOR command. ・The drive letter is "A:\" for USB and "B:\" for SD. ・Output data has the preposed data ID (2 bytes). See 6.4.6 for the output format.
READ_PLIST_STATUS	4	0x6D	0x02	0x00	0x00	1	・Output about play list mode status. ・Output about OFFSET 0 x2E-x31 of a status buffer.
READ_PLIST_TAG	4	0x6D	0x02	0x01	N	130	・Outputs the TAG analysis results of the file analyzed by the PLST_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 preposed data ID (2 bytes). See 6.4.6 for the output format.
READ_PLIST_PATH	4	0x6D	0x02	0x02	N	258	・Outputs the full path (including drive letter (A:\)) of the Nth entry ahead from the one pointed by the play list browsing cursor. ・The drive letter is "A:\" for USB and "B:\" for SD. ・Output data has the preposed data ID (2 bytes). See 6.4.6 for the output format. ・Specify N at the 4th byte. Specify N in the range from 0x00 to 0x13 ("0x00" indicates the current entry).
READ_PLIST_NAME	4	0x6D	0x02	0x03	N	130	・Outputs the name of the Nth file ahead from the entry pointed by the play list browsing cursor. ・Output data has the preposed data ID (2 bytes). See 6.4.6 for the output format. ・Specify N at the 4th byte. Specify N in the range from 0x00 to 0x13 ("0x00" indicates the current entry).
READ_PLIST_PLAY_PATH	4	0x6D	0x02	0x04	N	258	・Outputs the full path (including drive letter (A:\)) of the Nth entry ahead from the one being played. ・The drive letter is "A:\" for USB and "B:\" for SD. ・Output data has the preposed data ID (2 bytes). See 6.4.6 for the output format. ・Specify N at the 4th byte. Specify N in the range from 0x00 to 0x04 (0x00 indicates the current entry).
READ_PLIST_PLAY_NAME	4	0x6D	0x02	0x05	N	130	・Outputs the name of the Nth file ahead from the entry being played. ・Output data has the preposed data ID (2 bytes). See 6.4.6 for the output format. ・Specify N at the 4th byte. Specify N in the range from 0x00 to 0x04 (0x00 indicates the current entry).
READ_PLIST_TNUM	4	0x6D	0x02	0x06	0x00	4	・Outputs the currently set number of files within the play list.
READ_PLIST_PNUM	4	0x6D	0x02	0x07	0x00	4	・Outputs the currently set cursor position within the play list.
READ_FR_STATUS	4	0x6D	0x03	0x00	0x00	2	・Output about a file read and file write 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 LittleEndian.
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_IPL_STATUS	4	0x6D	0x05	0x00	0x00	1	・Output about IPL Write status. ・Output about OFFSET 0x31-x34 of a status buffer.
READ_CD_STATUS	4	0x6D	0x07	0x00	0x00	1	・Output about CD-ROM mode status. ・Output about OFFSET 0x36 of a status buffer.
READ_CD_SLBN	4	0x6D	0x07	0x01	0x00	4	・Output about the LBN number demanded by SEEK request. ・Output by LittleEndian.
READ_CD_PLBN	4	0x6D	0x07	0x01	0x01	4	・Output about the LBN number of the present input data. ・Output by LittleEndian.
READ_CD_FINUM	4	0x6D	0x07	0x01	0x02	6	・Outputs the number of files in the file system analysis result. ・Outputs the value in Little Endian format. ・1st-2nd byte : the file information acquirable number of a file system analysis result (n). The file information to this number can be read at 'READ_CD_FILE'. ・3rd-4th byte : The file number (m) of the head which can carry out information acquisition is outputted. ・5th-6th byte :The total file number of a file system analysis result is outputted.When analysis is not completed, the number of files which analysis has ended is outputted.
READ_CD_FONUM	4	0x6D	0x07	0x01	0x03	6	・Outputs the number of folders in the file system analysis result. ・Outputs the value in Little Endian format. ・1st-2nd byte : the folder information acquirable number of a file system analysis result (n). The folder information to this number can be read at 'READ_CD_FOL'. ・3rd-4th byte : The folder number (n) of the head which can carry out information acquisition is outputted. ・5th-6th byte :The total folder number of a file system analysis result is outputted. When analysis is not completed, the number of folders which analysis has ended is outputted.
READ_CD_FILE	4	0x6D	0x08	N	M	64	・Outputs information of the L[15:0]={M, N}th file in the file system analysis result. (For L, Please set up L between file information acquirable numbers [1st-2nd byte of 'REDA_CD_FINUM'] from 1.) ・The information is output in Little Endian format. ・When file system analysis is not completed, the maximum of specified L is recorded as information read-out completion. The acquired information may become invalid when analysis is resumed.
READ_CD_FOL	4	0x6D	0x09	N	M	64	・Outputs information of the L[15:0]={M, N}th folder in the file system analysis result. (For L, Please set up L between file information acquirable numbers [1st-2nd byte of 'REDA_CD_FONUM'] from 1.) ・The information is output in Little Endian format. ・If L=0 is specified, the command outputs the information on CD volume. ・When file system analysis is not completed, the maximum of specified L is recorded as information read-out completion. The acquired information may become invalid when analysis is resumed.
READ_SYSMODE	4	0x6D	0x0A	0x00	0x00	1	・Output about the present system operation mode.
READ_MEMINFO	4	0x6D	0x0A	0x02	0x00	1	・Output about the present memory information. ・Output about OFFSET 0x37 of a status buffer.
READ_CKSUM	4	0x6D	0x0A	0x03	0x00	5	・Output the CHECK SUM calculation result when IPL download. ・Output a 1st byte= comparison result. When the 1st byte is 0x0, it show that comparison result is coincidence. When the 1st byte is 0x1, it show that comparison result is disagreement. ・Output a 2nd-3th byte are calculation result and 3th-5th byte are the value currently written in FLASH ROM.
READ_MOUNT_ERROR	4	0x6D	0x0A	0x04	0x00	14	・Output the information on which stage of media mount went wrong when ERROR generating. ・1st byte:The state whenUSB enumeration is outputted. ・2nd byte:The state when SD initialization is outputted.

							・10th byte:The state when file system analysis is outputted. ・Other bytes should be disregarded. ・Please read this value only when ERROR=1. ・Also at the time, although a value is read, it is usually the information on ERROR=0 for which the value was performed at the end. ・Please refer to process information about the details of a read-out value at the time of a back clause media mount error.
READ_FW_VER	4	0x6D	0xFF	0x00	0x00	4	・Output about a firmware version.
READ_IPL_VER	4	0x6D	0xFF	0x01	0x00	12	・Output about the image version in Flash. ・1st-2nd byte= model number "W0" =0x57 0x30, 3th-4th= year (lower 2 figures), 5th-8th= manufacture days and months, and 9th-12th="FLAS"=0x46 0x4C0x41 0x53 is outputted.

Table 6.4.2.3 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 RW	PLAYLIST	IPL WRITE	CD-ROM	STOP	PLAY	SEARCH (device)	SEARCH (FILE)	Analyze	Write	ERROR
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_INQUIRY	○	○	○	○	○	○	○	×	×	×	×	×	×
READ_BROWSE_STATUS	×	○	○	○	○	○	○	○	○	○	○	○	○
READ_BROWSE_PNUM	×	○	○	○	×	×	○	○	×	×	×	×	×
READ_BORWSE_TNUM	×	○	○	○	×	×	○	○	×	×	×	×	×
READ_BROWSE_FOL_INFO	×	○	○	○	×	×	○	○	×	×	×	×	×
READ_BROWSE_ENTRY_INFO	×	○	○	○	×	×	○	○	×	×	×	×	×
READ_BROWSE_TAG	×	○	○	×	×	×	○	○	×	×	×	×	×
READ_BROWSE_PATH	×	○	○	○	×	×	○	○	×	×	×	×	×

READ_PLIST_STATUS	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_PLIST_TAG	×	×	×	○	×	×	○	○	×	×	×	×	×
READ_PLIST_PATH	×	×	×	○	×	×	○	○	×	×	×	×	×
READ_PLIST_NAME	×	×	×	○	×	×	○	○	×	×	×	×	×
READ_PLIST_PLAY_PATH	×	×	×	○	×	×	×	○	×	×	×	×	×
READ_PLIST_PLAY_NAME	×	×	×	○	×	×	×	○	×	×	×	×	×
READ_PLIST_TNUM	×	×	×	○	×	×	○	○	×	×	×	×	×
READ_PLIST_PNUM	×	×	×	○	×	×	○	○	×	×	×	×	×
READ_FR_STATUS	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_FR_SIZE	×	×	○	×	×	×	○	×	×	×	×	×	×
READ_FR_DATA	×	×	○	×	×	×	○	×	×	×	×	×	×
READ_IPL_STATUS	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_CD_STATUS	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_CD_SLBN	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_CD_PLBN	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_CD_FINUM	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_CD_FONUM	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_CD_FILE	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_CD_FOL	×	×	×	×	×	○	○	○	×	×	×	×	×
READ_SYSMODE	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_MEMINFO	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_CKSUM	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_MOUNT_ERROR	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_FW_VER	○	○	○	○	○	○	○	○	○	○	○	○	○
READ_IPL_VER	○	○	○	○	○	○	○	○	○	○	○	○	○

○=enable×=disable

6.4.3 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.
The changes state in System Operation MODE is shown in Fig. 6.4.3.1.

Command CHG_SYSTEM_MODE

N=0x00 ; CONFIG MODE
It is in the state which changes after a power supply and download of the program by IPL.
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 RW MODE
It is the mode which Reading/Writing 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.

N=0x03 ; PLAY LIST MODE
It is the mode which play according to the specific playlist file in a memory.

N=0x05 ; CD-ROM Decode MODE
It is the mode which analyzes and play(decoding) the input from CD-ROM.

N=0x07 ; IPL WRITE MODE
It is the mode which upload to outside serial Flash ROM from the specific data in a memory.
A data file is offered from ROHM.
The reset to the LSI is required for after data rewriting.

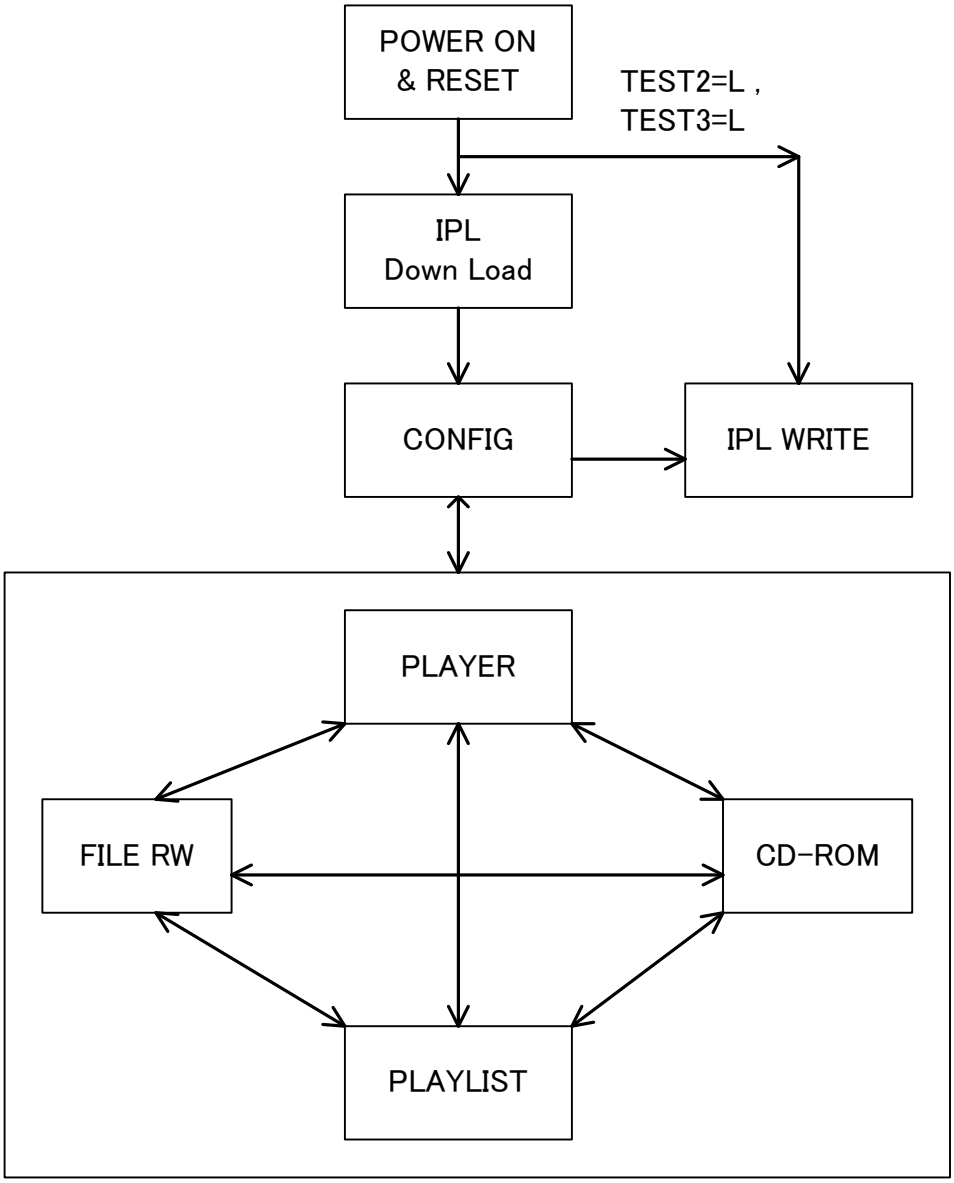


Fig. 6.4.3.1. The changes state in System Operation MODE

6.4.4 Equalizers

You can select audio line output from 5 types of equalizers and 2 types of bus boosts, using commands. (See Table 6.4.1.1.) 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.

Figures 6.4.4.1 to 6.4.4.6 show frequency characteristics of each filter.

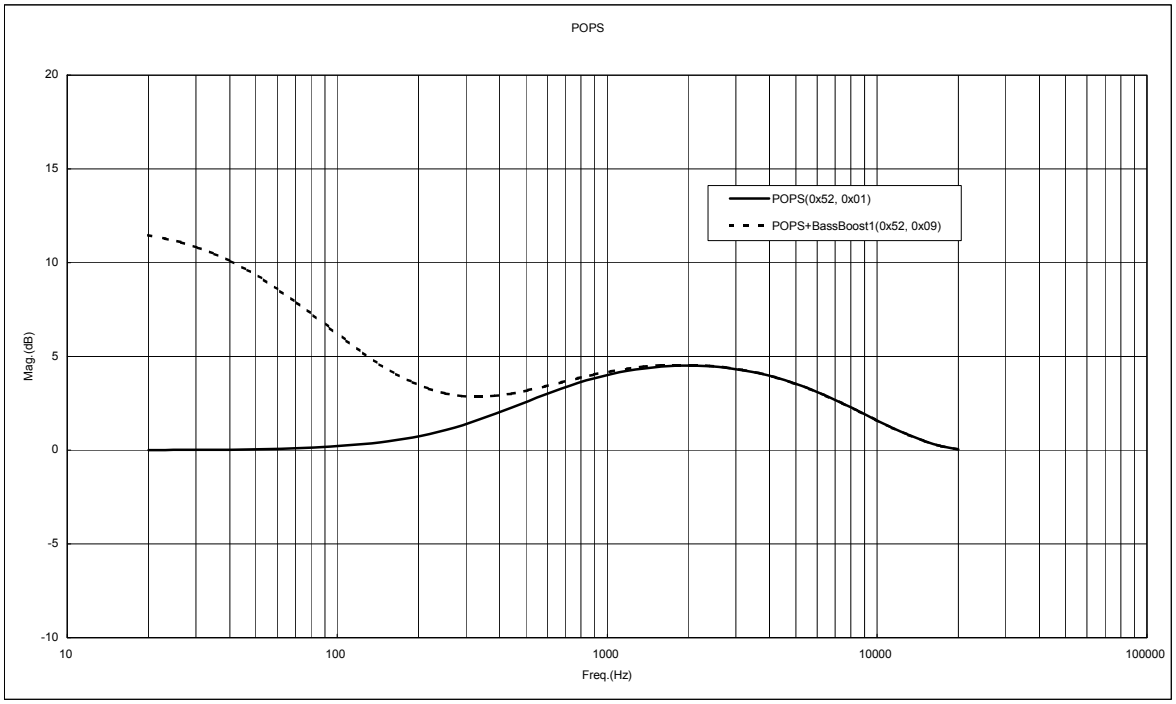


Figure 6.4.4.1 POPS Frequency Characteristics

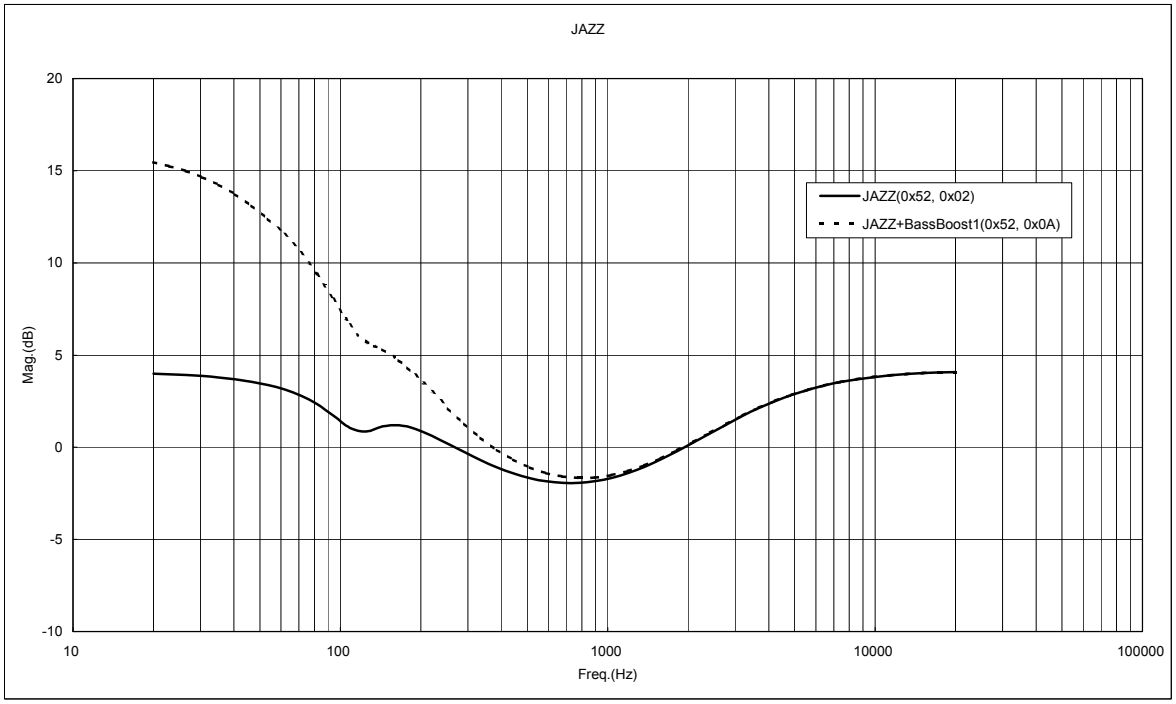


Figure 6.4.4.2 JAZZ Frequency Characteristics

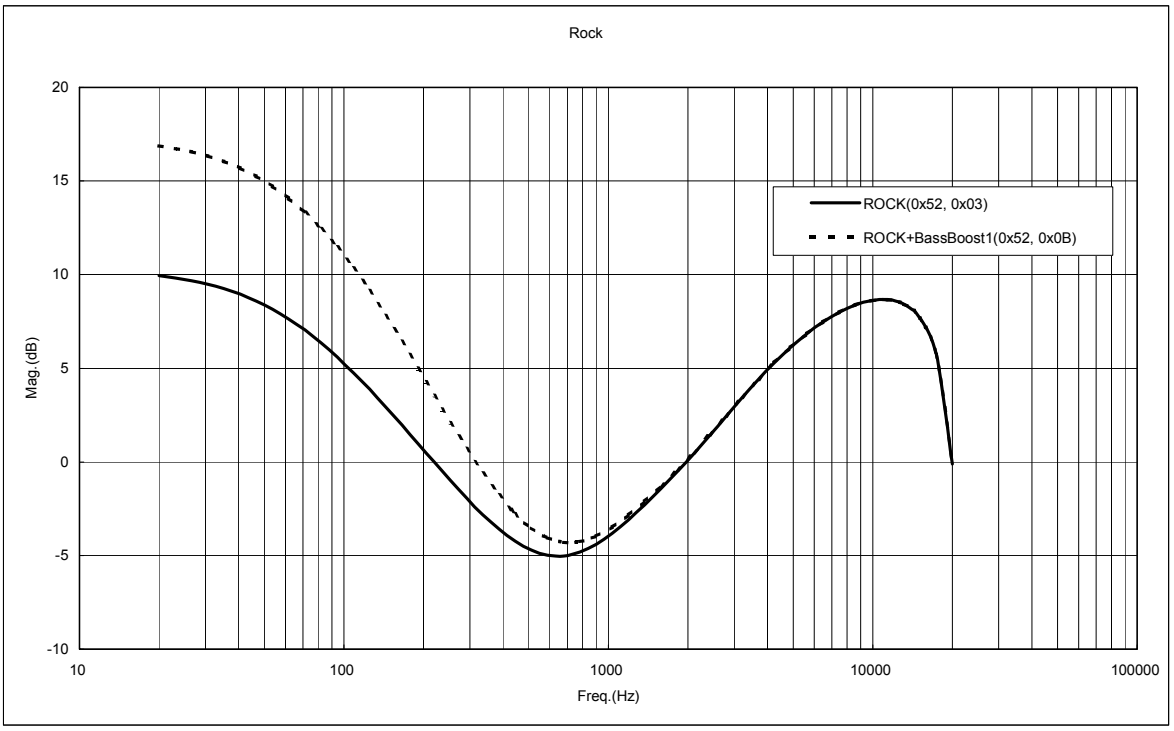


Figure 6.4.4.3 ROCK Frequency Characteristics

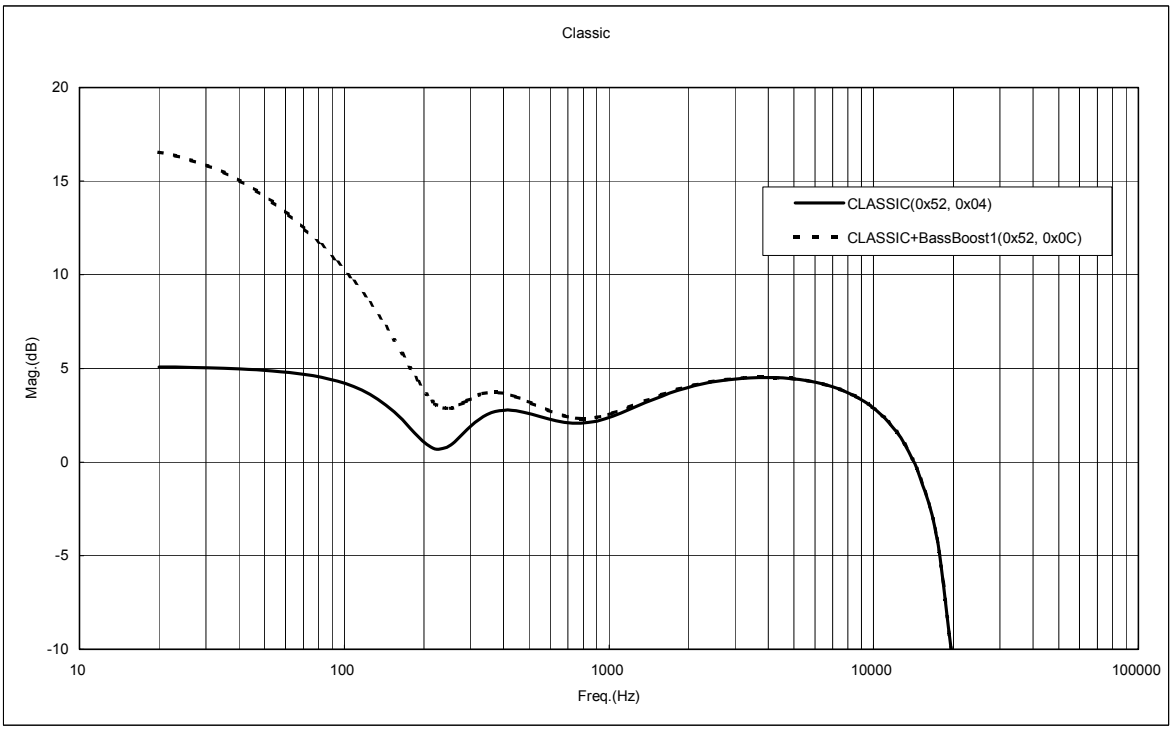


Figure 6.4.4.4 CLASSIC Frequency Characteristics

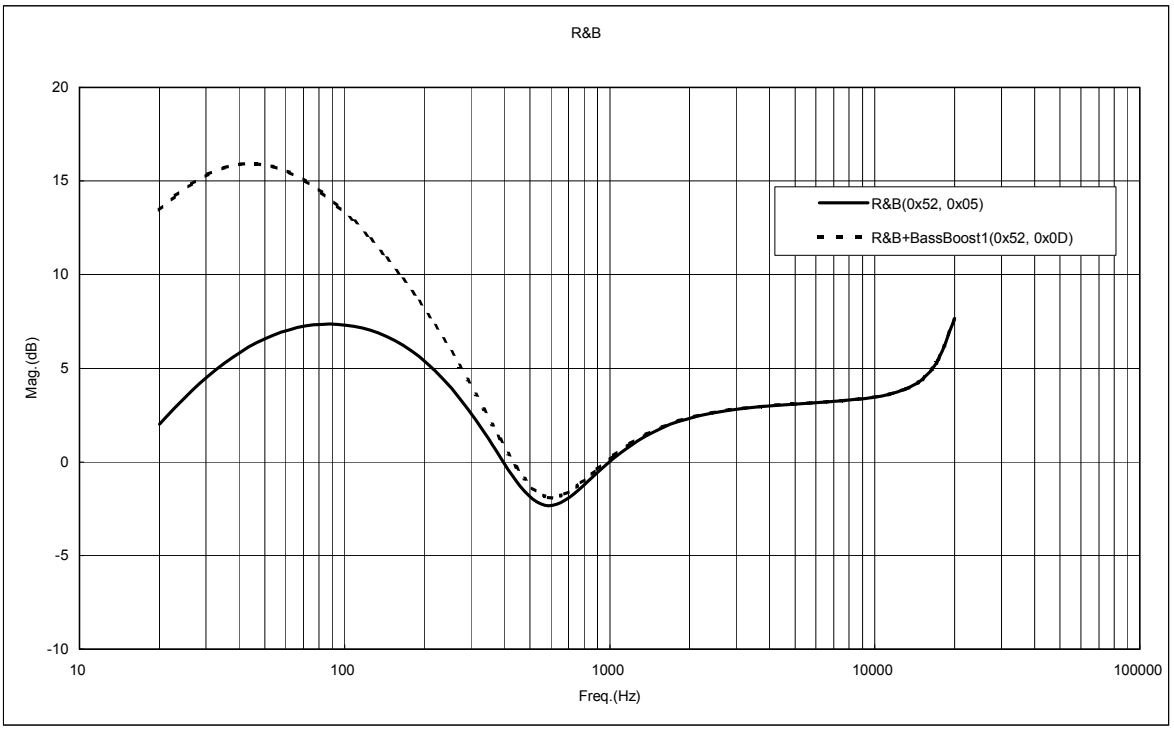


Figure 6.4.4.5 R&B

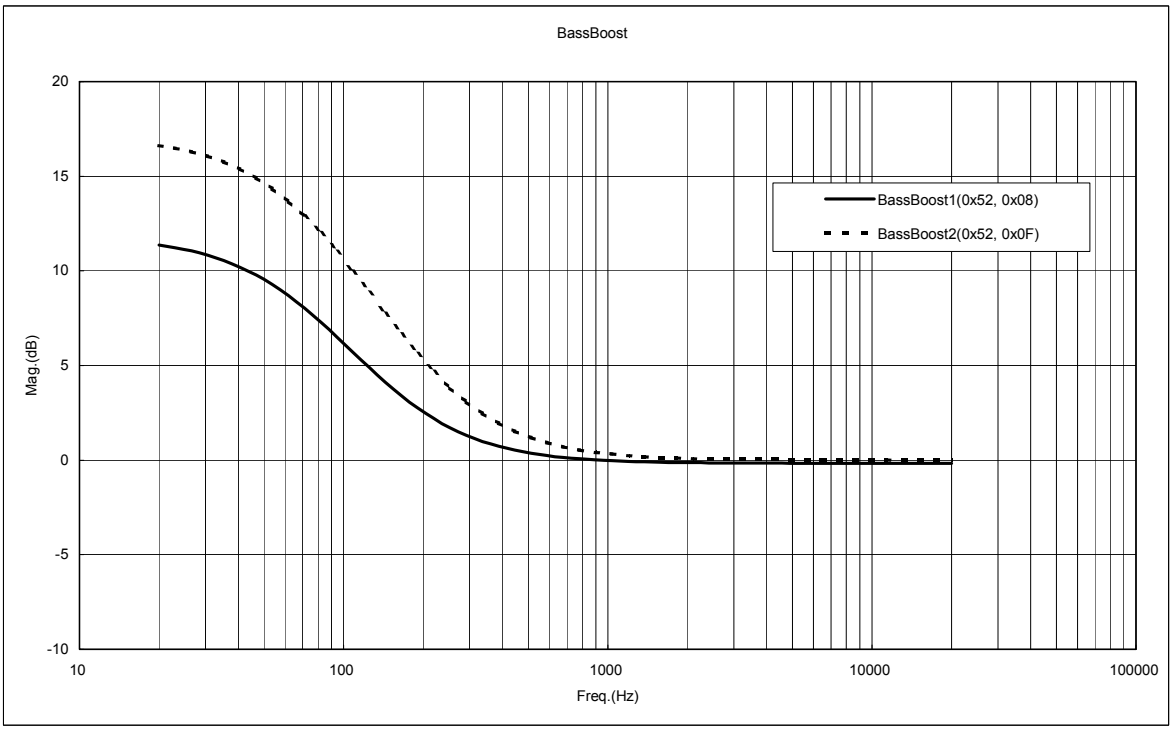


Figure 6.4.4.6 Bass Boost

6.4.5 resume information

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

Table 6.4.5.1 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 file and plays it.

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 playing the first tune.

6.4.6 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 6.4.6.1.

Table 6.4.6.1 File (folder, TAG) information register 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.

The full path within the memory to which a file exists is outputted to a status register.
File path information status register structure is shown in Table 6.4.6.2.

Table 6.4.6.2 File path information register 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-0x139	256	File path	A file path is outputted. The delimiter between folder layers is ”\” (0x5C). Up to 256 bytes can be output. If the data is less than 256 bytes, it terminates with 0x00. For USB, the data starts with ”A:\”; for SD, with ”B:\”.

The character code information on TAG information is outputted to a status register.
Character code information status register structure is shown in Table 6.4.6.3.

Table 6.4.6.3 Character code information register 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)

6.4.7 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 number of entries can be changed by the setting of SET_BROWSE_NUM.)

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.

The file information status register structure which can be read by the file browsing function in a memory is shown in Table 6.4.7.1.

Table 6.4.7.1 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 are 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 become the following cases. 0x1=MP3, 0x2=WMA, 0x3=AAC, 0x4=WAV , 0x5=PLAY LIST, 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 are 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 plaing, music skipping may occur by the memory with a slow access speed.

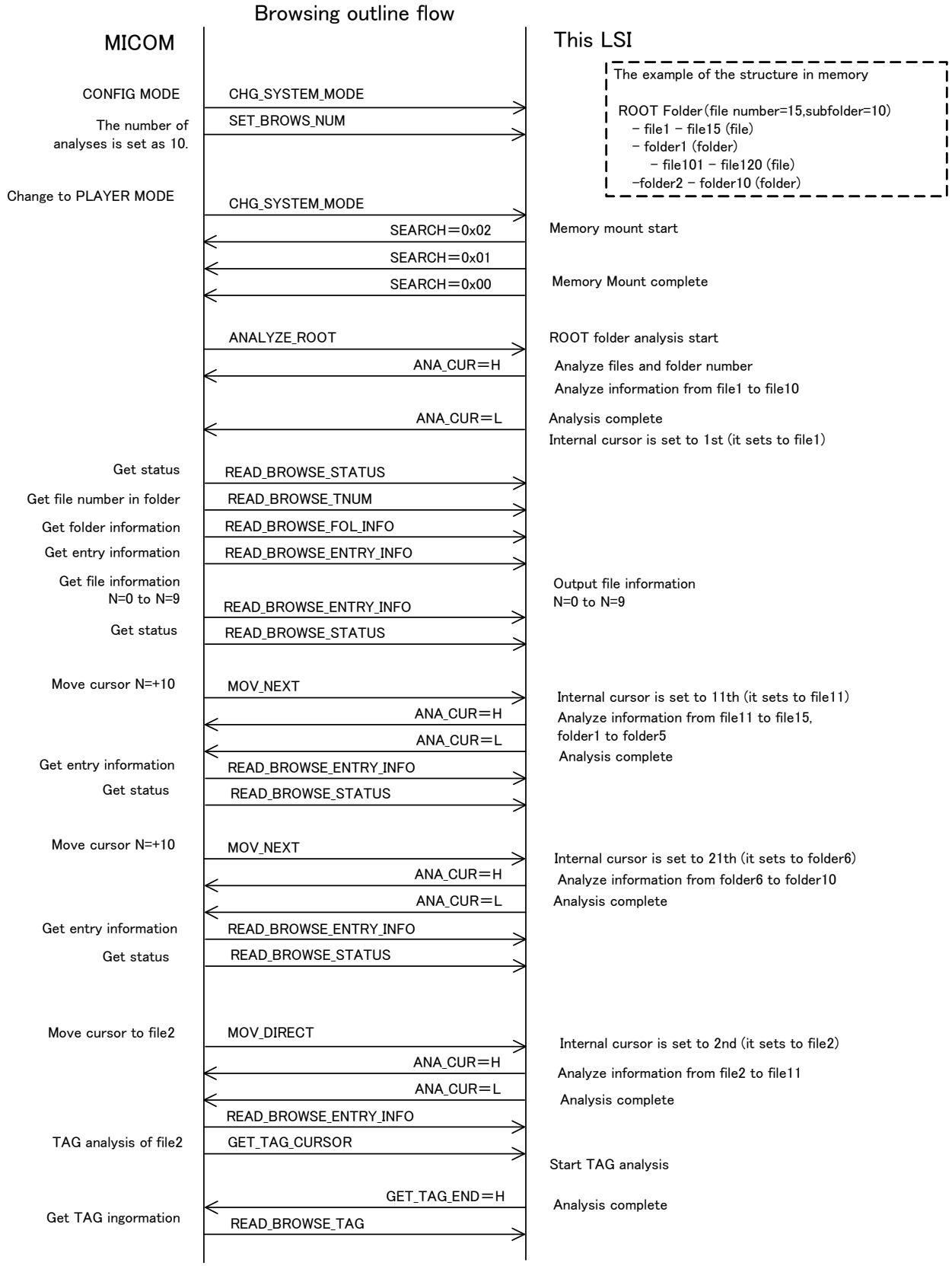


Figure 6.4.7.1 File browsing outline flow (analyze root folder)

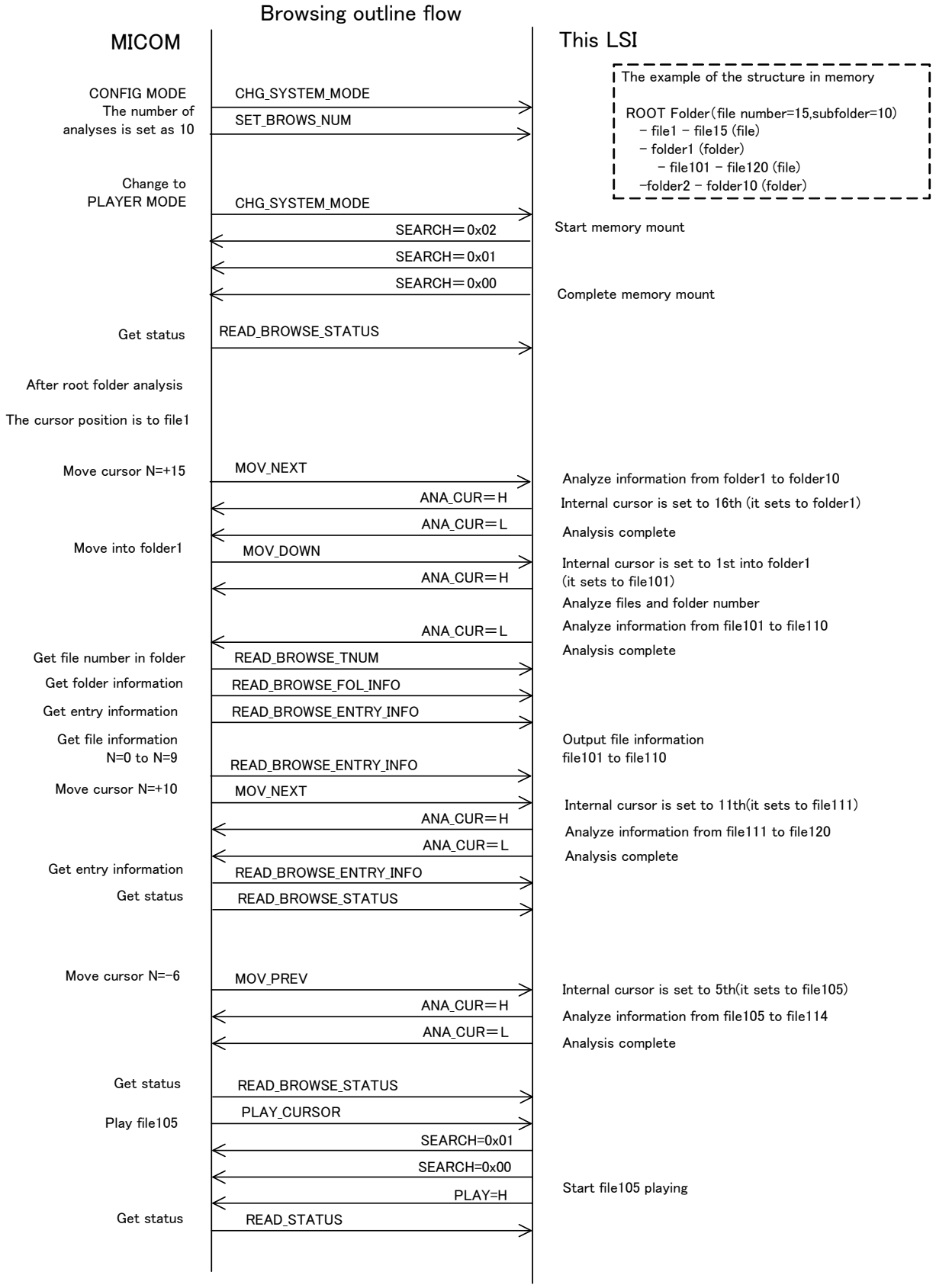
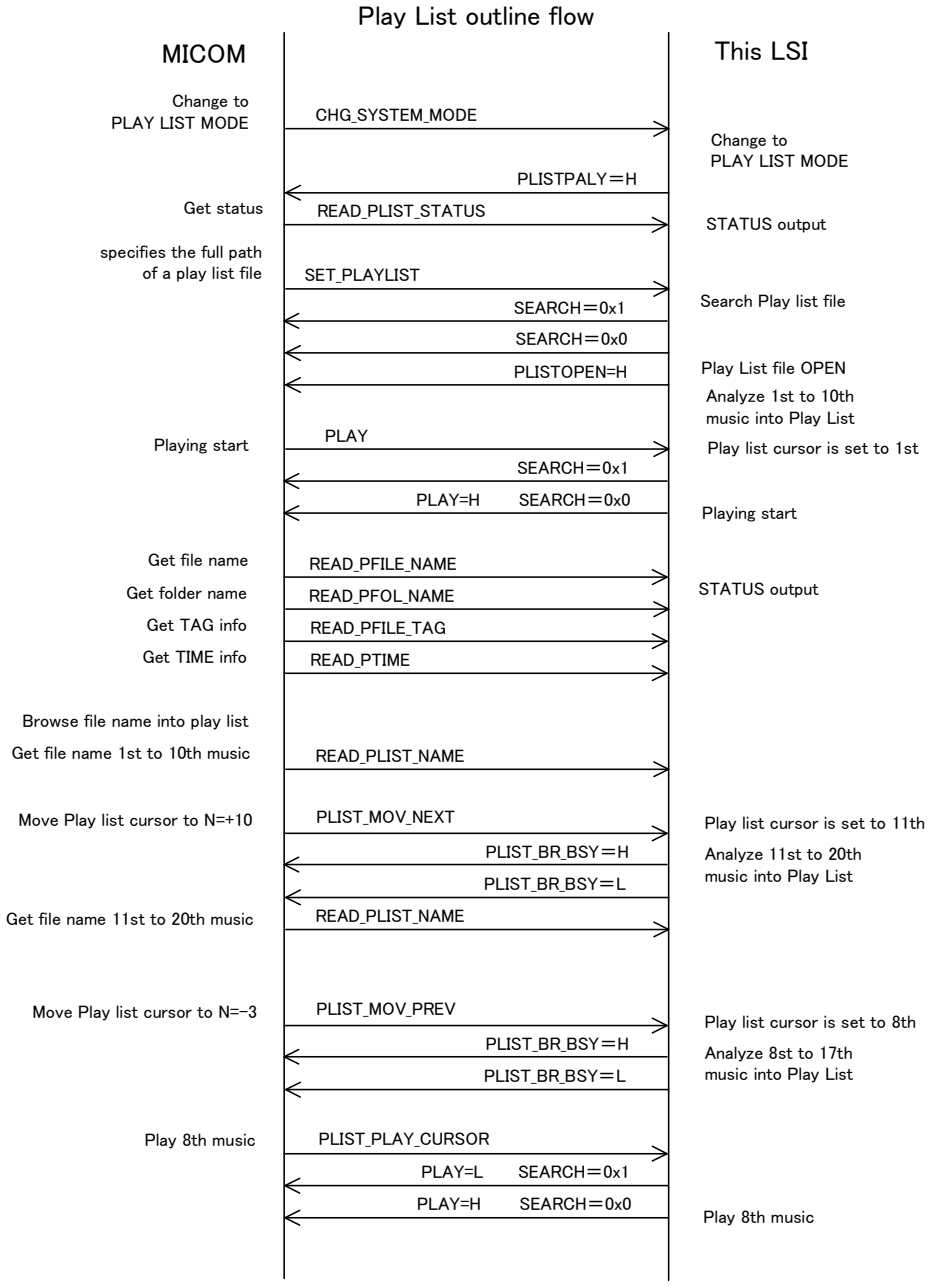


Figure 6.4.7.2 File browsing outline flow (analyze folder1)

6.4.8 Play list play

The LSI can search the play list in the specified folder within the memory and output the play list information.
When the microcomputer selects the play list, the LSI plays the selected tunes in the order written to the play list.
Also, the LSI can output the file information in the selected play list.
Available playlist file should have an extension of M3U or PLS and be described in full path using ASCII or SHIFT-JIS.
The full path of a file described in the playlist should be within 256 bytes and within 16 hierarchies.
If the play list format is other than the above or the path does not match, the LSI skip playing tunes.
While playing the tunes in the playlist, PLAY, STOP, PAUSE, FF and FB commands can be used to control the list.
The music file described during the play list is treated as what exists in the flat of one class (only root folder) within a memory irrespective of the place (path) where the file exists really. For this reason, it becomes invalid a folder repeat and a folder random command, and it becomes effective the repeat in a memory, an one music repeat, and random in a memory setting up a repeat setup by the SET_REPRAND command.

Figure 6.4.8.1 Play List playing outline flow



6.4.9 File data write and File data read

It is possible to read the contents of data of the specification file in a memory.
It is possible to create a data file in a memory.
Specification of a file name is specified by the full path (less than 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.
A full path is acquirable with browsing operation.
Deletion of a file is possible at the time of browsing operation.
The above-operation can be performed when system operation mode is FILE RW mode.

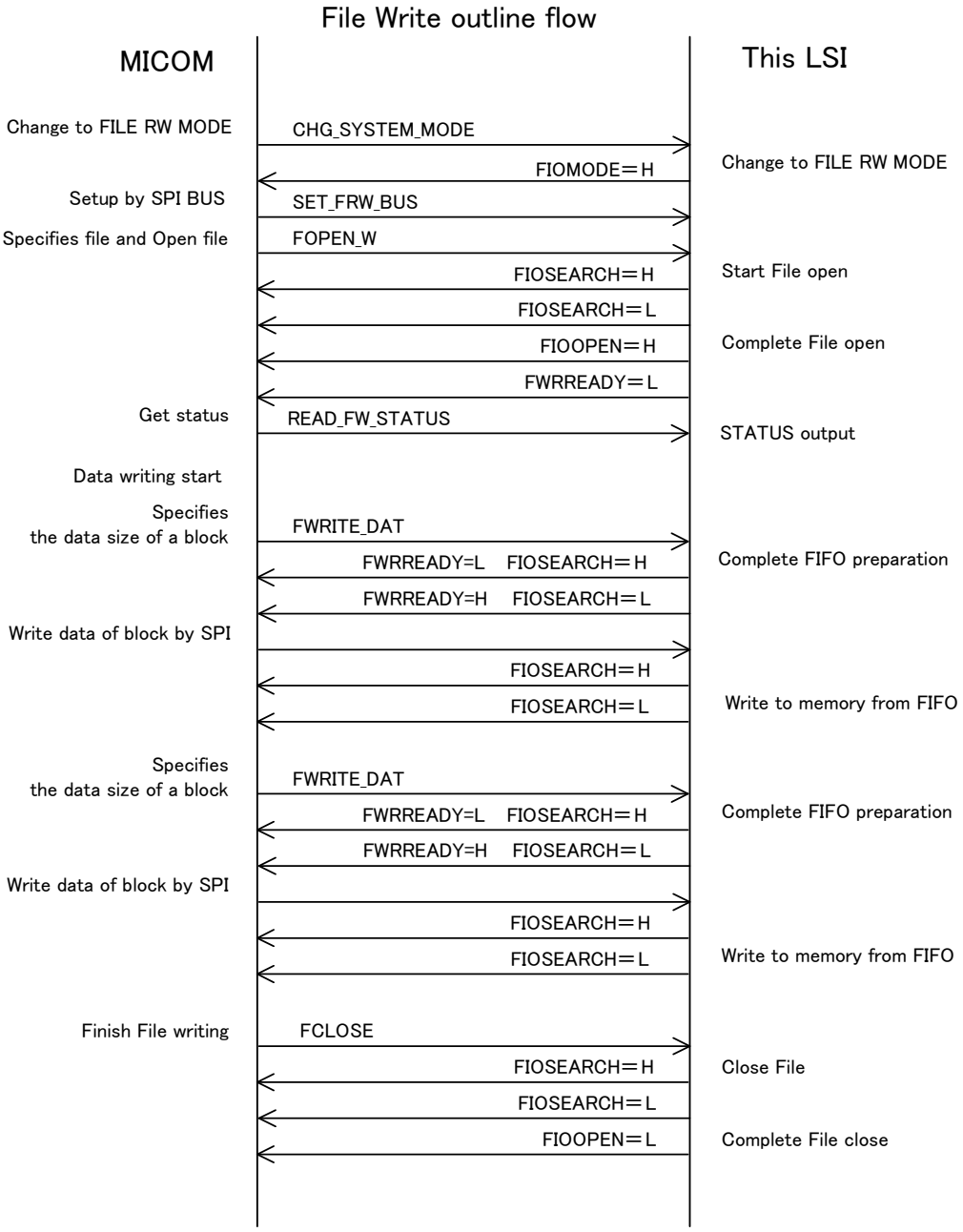


Figure 6.4.9.1 File write function outline flow

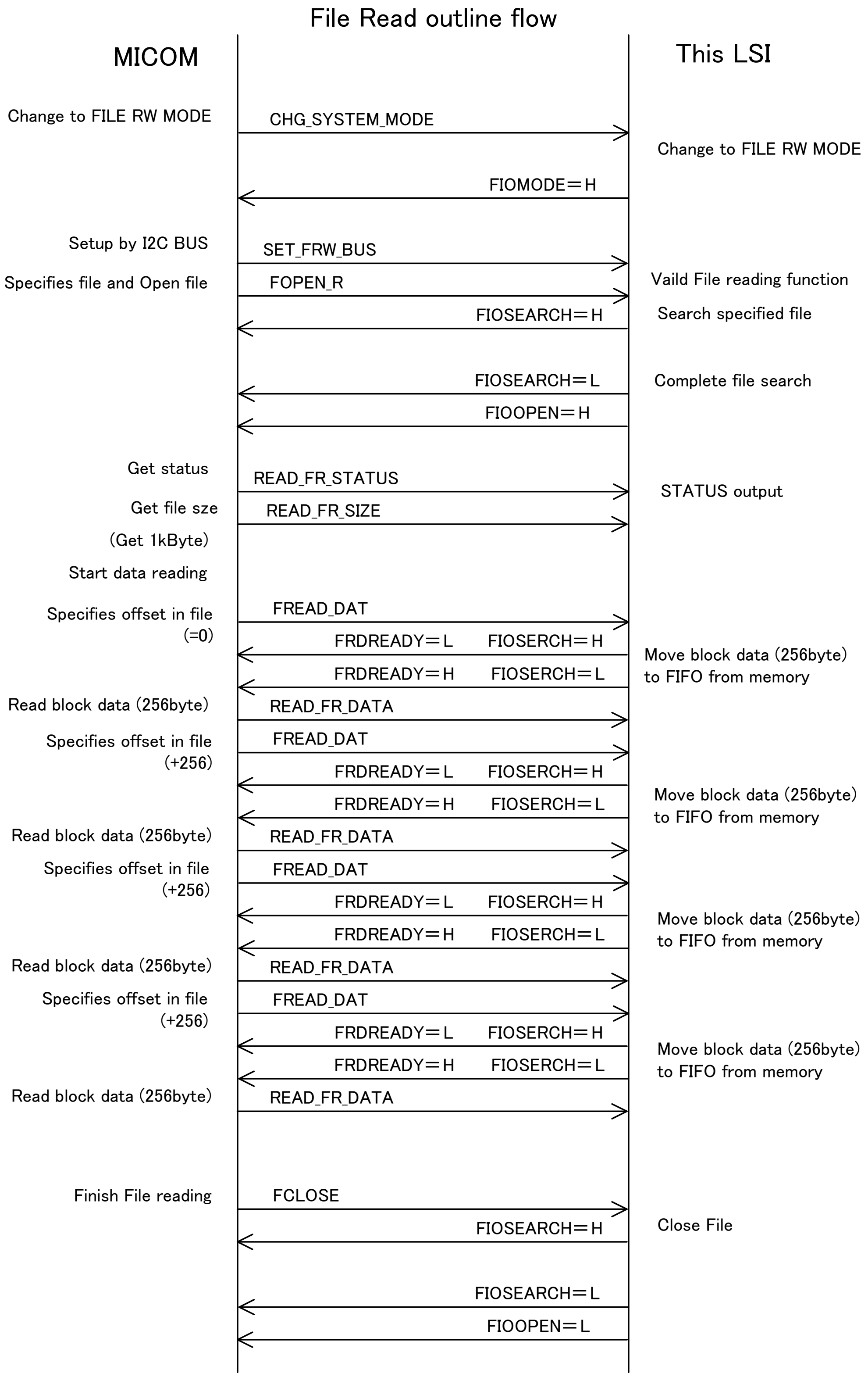


Figure 6.4.9.2 File read function outline flow

6.4.10 CD-ROM Decoder

File system analysis and decoding of data are performed to 3 line serial input data from CD-ROM format.
The result of file system analysis holds the maximum about 350 entry (folders+ files) grade to an internal buffer, when a file name or a folder name consists of 48 bytes as a standard. When 32 bytes or less are constituted, an analysis result holds the maximum about 450 entry grade to an internal buffer. An analysis result is outputted to status.
The entry which was not able to be held to the buffer domain for analysis cannot be played after file system analysis.
Moreover, since analysis is performed from the class of a higher rank, when the buffer domain for analysis is set to FULL before the analysis of a playable file by the reasons of a higher rank class having many folders, it may be unable to play depending on the structure in CD-ROM. The number of entries which can be held to the buffer for analysis changes depending on the contents of composition of each CD-ROM.
The input data buffer of about 100 kB is built in. (A file system analysis result is also included.)
CD-ROM ECC and the EDC function are supported.
Refer to the CD data ripping for CD input data format and input terminal specification.

6.4.10.1 Support File System

CD-ROM Mode1, Mode2 form1, and Mode2 form2 are supported.
The file system supports ISO9660 level 1 and 2.
Remeo and Joliet extension are supported.
The folder class which can be searched support by 8 classes.
A folder name and a file name are acquirable to 48 bytes.

6.4.10.2 SEEK request

The status of the LBN of required data is outputted when a file analysis start and file selection.
Furthermore, SEEK request interruption is outputted from an IRPTO terminal to a microcomputer at this time.
When a SEEK request occurs, a microcomputer should perform playing from at least 1 sector before from requested LBN.
If a request sector is inputted, it will be automatic, connection operation will be performed and subsequent data will be processed.

6.4.10.3 File, Folder, CD Volume Information

The status of the CD file system analysis result is outputted by READ_CD_FOL and a READ_CD_FILE command.
If the 0th is specified by the READ_CD_FOL command, the volume information on CD will be outputted.
A file, a folder, and volume information status register structure are shown below.

Table 6.4.10.3.1 CD file information register structure

Status OFFSET	The number of bytes	NAME	Contents
0x38-0x39	2	Parent folder number	A parent folder number is outputted. A route becomes No. 1.
0x3A-0x3B	2	File number	A file number is outputted.
0x3C-0x3F	4	File size	File size is outputted.
0x40-0x43	4	File LBN	LBN of the file head is outputted.
0x44	1	Extension type	An extension (file kind) is outputted. 0x01 : MP 3 0x02 : WMA 0x03 : AAC 0x04 : WAV 0x05 : Play list file 0x06-0x0E : Reserved 0x00 and 0x0F : Other files
0x45	1	Identifier length	The identifier length (byte) recorded on DISC is outputted.
0x46	1	-	0x01
0x47	1	Data length	Data length is outputted.
0x48-0x77	48	File name	A file name is outputted by left fitted. Up to 48 bytes can be output. A data type is outputted as BYTE.

Table 6.4.10.3.2 CD folder information register structure

Status OFFSET	The number of bytes	NAME	Contents
0x38-0x39	2	The number of subfolders	The number of subfolders is outputted.
0x3A-0x3B	2	The number of playable files	The number of playable files is outputted.
0x3C-0x3D	2	Parent folder number	A parent folder number is outputted. A route becomes No. 1.
0x3E-0x3F	2	Folder number	The present folder number is outputted.
0x40-0x43	4	Folder LBN	LBN of the folder head is outputted.
0x44	1	-	reserve
0x45	1	Identifier length	The identifier length (byte) recorded on DISC is outputted.
0x46	1	-	0x01
0x47	1	Data length	Data length is outputted.
0x48-0x77	48	Folder name	A folder name is outputted by left stuffing. Up to 48 bytes can be output. A data type is outputted as BYTE.

Table 6.4.10.3.3 CD volume information register structure

Status OFFSET	The number of bytes	NAME	Contents
0x38?0x39	2	The number of total folders	The number of total folders is outputted.
0x3A-0x3B	2	The number of total playable files	The number of total playable files is outputted.
0x3C-0x3F	4	Path table LBN	LBN of the path table (L type) currently recorded on effective VD is outputted
0x40-0x43	4	Root folder LBN	LBN of the root folder head is outputted.
0x44	1	VD type	VD type is outputted. 0x00 : PVD 0x01 : SVD
0x45	1	Identifier length	The identifier length (byte) recorded on DISC is outputted.
0x46	1	-	0x01
0x47	1	Data length	Data length is outputted.
0x48-0x67	32	Volume name	A volume name is outputted by left stuffing. Up to 32bytes can be output. A data type is outputted as BYTE.

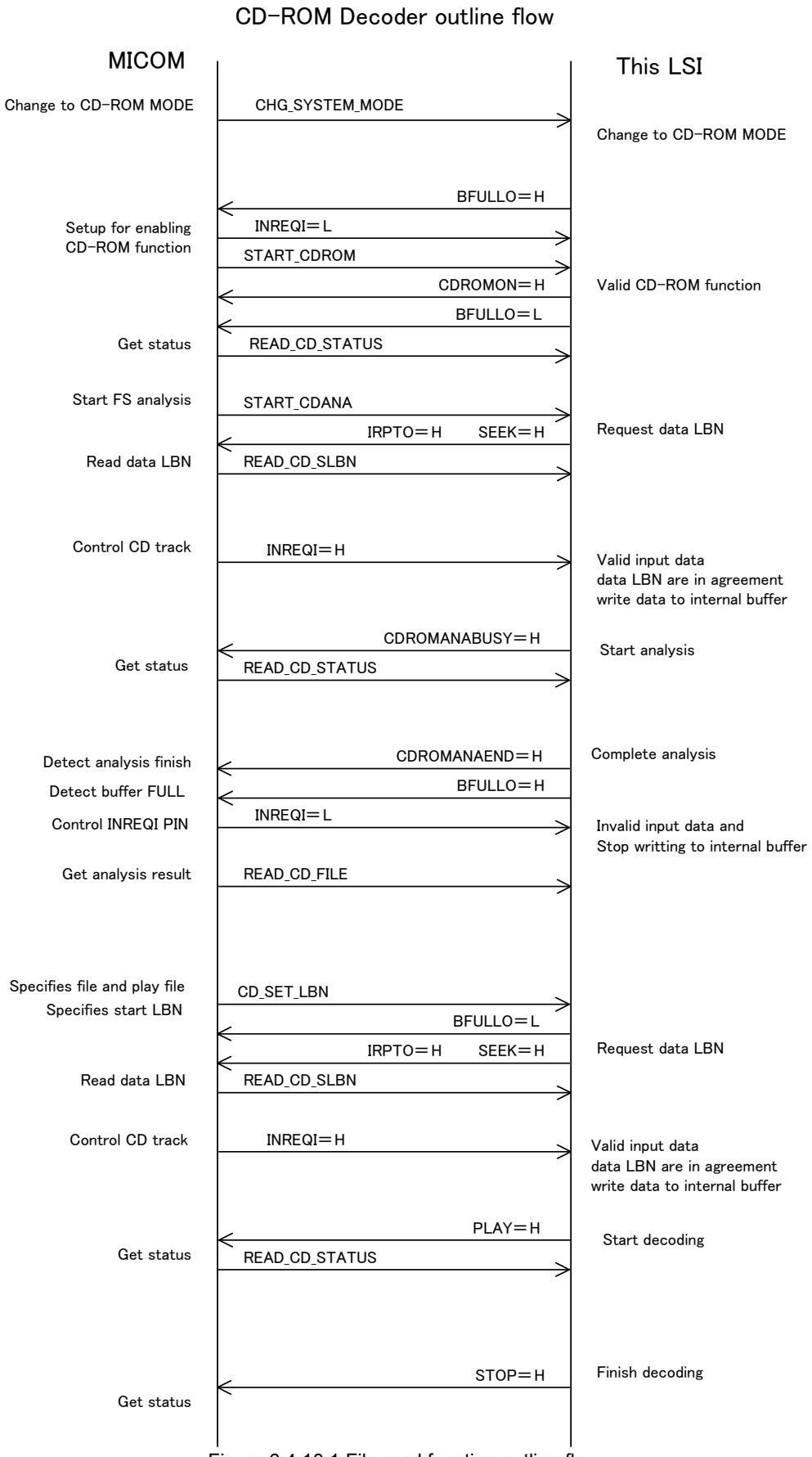


Figure 6.4.10.1 File read function outline flow

6.4.11 Interruption IRPTO Terminal to Microcomputer

An IRPTO terminal generates an interrupt request to a microcomputer.
Interruption becomes active by H.
The contents of interruption change with the states where it is operating mode. The contents are shown below.
We encourage detecting a standup in the interruption port of a microcomputer.

State	Interruption	Contents
PLAYER MODE	ERROR	An interrupt occurs when memory connection error or communication error. Clear conditions; interruption is cleared by extraction and insertion of a memory.
FILE RW MODE File read	FRDREADY	An interrupt occurs when a specification file is searched and read-out is ready. Clear conditions; interruption is cleared by data are read (block unit).
FILE RW MODE File write	FWRREADY	An interrupt occurs when read-in is ready with memory. Clear conditions; interruption is cleared by data are write (block unit).
PLAY LIST MODE	ERROR	An interrupt occurs when memory connection error or communication error. Clear conditions; interruption is cleared by extraction and insertion of a memory.
CD-ROM MODE	SEEK	An interrupt occurs when requiring necessary data (LBN). Clear conditions; interruption is cleared by required data are inputted.
IPL WRITE MODE	IPLMODEEND	An interrupt occurs when FLASH ROM rewriting end. Clear conditions; interruption is cleared by reset.

6.4.12 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.
0x11	WRITE PROTECTED	The device is write-protected.
0x13	DISK FULL	The memory has no free space.
0x15	DEVICE ERROR	Device error

6.4.13 Selected memory information

The kind and information on a device which are selected now are outputted by the READ_MEMINFO command. 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	USB device which cannot be recognized
0x5	-
0x6	-
0x7	SD Card
0x8-0xF	It means that there is HUB, when Bit7 is H.

6.4.14 Process information when a media mount error

The information on in which stage of media mount it failed with the READ_MOUNT_ERROR command is outputted. After being set to ERROR=1, by reading this command shows in detail whether the error has occurred during which process execution.

For example, when ERROR=1 and 1st byte=0x08 or 0x09 of READ_MOUNT_ERROR command, since a response mistake is made from the device in the process of TEST UNIT READY or REQUEST SENSE, it becomes a mount error.

The details of an output value are shown below.

1st byte (offset=0) of a read value outputs the process state at the time of USB mount.

Read value	Process state		Read value	Process state
0x00	Before a start of operation		0x10	GET_DEVSTATUS
0x01	Device descriptor		0x11	Sector read command send
0x02	SET_ADDRESS		0x12	Sector read command recive
0x03	Configuration descriptor		0x13	Sector read status recive
0x04	End Point connect		0x14	Sector write command send
0x05	SET_Configuration		0x15	Sector write command recive
0x06	GET MAX LUN		0x16	Sector write status recive
0x07	CLEAR_FEATURE		0x17	Not-supported Device Subclass
0x08	INQUARY		0x18	HUB only
0x09	TEST UNIT READY		0x19	LOW DEVICE detect
0x0A	REQUEST SENSE		-	-
0x0B	READ_CAPACITY		-	-
0x0C	CLEAR_PORT_FEATURE		-	-
0x0D	GET_PORT_STATUS		-	-
0x0E	SET_PORT_FEATURE		-	-
0x0F	HUB descriptor		-	-

2nd byte (offset=1) of a read-out value outputs the process state at the time of SD initialization.

Read value	Process state
0x00	Before a start of operation
0x01	CMD0 Response
0x02	CMD8 Response
0x04	CMD55 Response
0x08	CMD41 Response
0x10	CMD58 Response
0x20	CMD1 Response

10th byte (offset=9) of a read-out value outputs the process state at the time of FAT filesystem analysis.

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

6.5 Watch Dog Timer

The LSI incorporates Watch Dog Timer, which monitors the system hang-up and resets whenever it occurs.

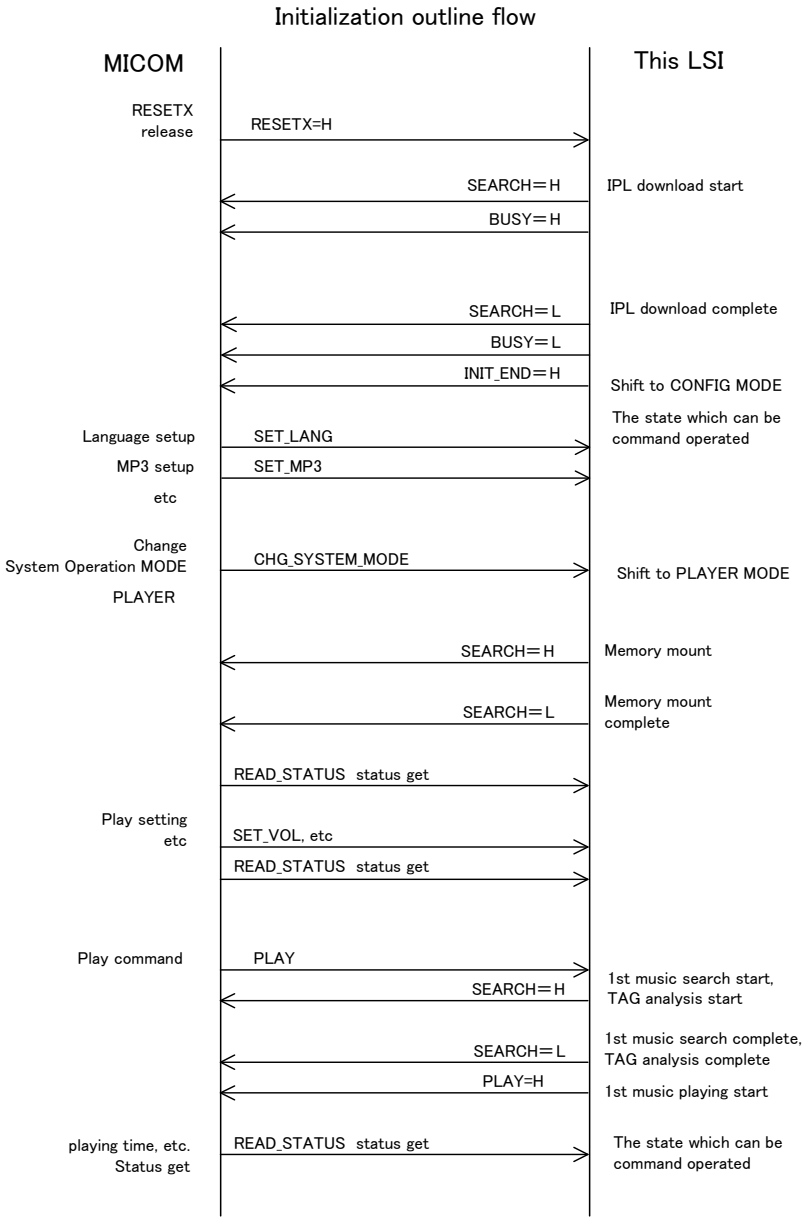
After resetting hang-up, WDT (Watch Dog Timer) becomes available in either MODE1 or MODE2. In MODE1, WDT keeps valid all the time. In MODE2, you can disable WDT using DIS_WDT command. Once WDT is disabled, it cannot be enabled until reset is input.

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.

6.6 IPL support to external serial FLASH ROM

Once reset, the LSI needs to download the program to a part of the internal program area from the external serial FLASH ROM.
However, it is also possible to write in data from a microcomputer without connecting external serial FLASH ROM.
The download function from the external serial FLASH ROM enables to add and change the system functions simply by rewriting the external serial FLASH ROM.
The program is downloaded automatically after reset. After download is completed, it shifts to CONFIG mode.



This LSI supports to serial FLASH ROM to 8 bit-Command, 24 bit-ADDRESS, and clock MIN=15MHz by minimum size 2Mbit. This LSI supports to serial FLASH ROM to Write Status Register cycle time MAX.= 500msec, Page Program cycle time MAX.= 500msec, and Chip Erase cycle time MAX.= 180sec.
The download time of the program from serial FLASH ROM is about 0.6 secs. This time changes with contents of the program writed in serial FLASH ROM.

The LSI supports a mode which enables to write the program data written to the memory (USB or SD) to the external serial FLASH ROM. By executing the command to enable the FLASH ROM write mode, the LSI searches in the memory and rewrites the external serial FLASH ROM. After rewriting the FLASH ROM, you should reset the LSI.

●Notes for use

1) Power on Reset
Please keep the terminal RESETX at the Low level when the power supply starts. After completely starting up 3.3V system power supply , afterwards, please make the terminal RESETX High level after 100us after the oscillation of the system clock is steady. Moreover, please make the terminal RESETX Low level during 100us or more when resetting it while operating..

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

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

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

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

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

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

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

9) Power off or memory disconnection under memory writing
The sudden power off or memory disconnection during recording or file write operation to a memory may break the data in a memory.

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

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

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

13) Write-in operation exceeding memory size
When memory size is exceeded, IC will stop writing to a file and will be in an error condition.

14) Write-in operation of the file size exceeding FAT specification
When file size is exceeded, IC will stop writing to a file and will be in an error condition.

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

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

●Ordering part number

B	U	9	4	6	0	5	A	K	V	-	E	2

Part No. (B U)

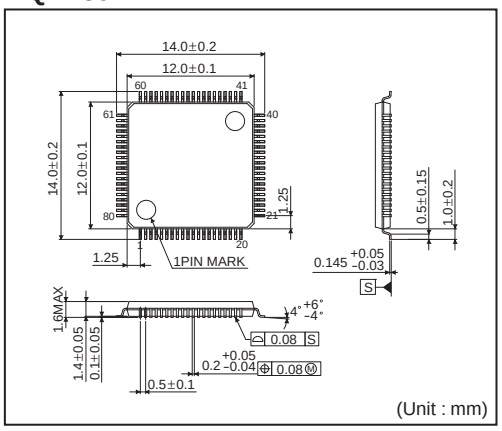
Part No. (9 4 6 0 5 A)

Package
KV:
VQFP80

Packaging and forming specification
E2: Embossed tape and reel
None: Tray, Tube

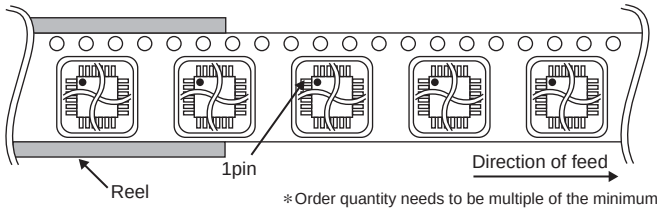
●Physical Dimension Tape and Reel Information

VQFP80



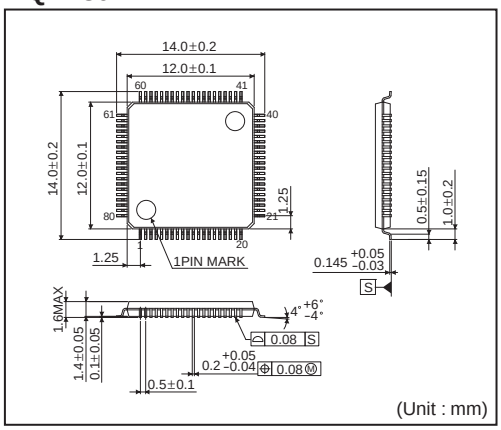
<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	1000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



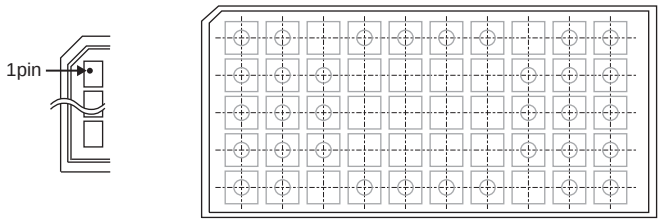
∗Order quantity needs to be multiple of the minimum quantity.

VQFP80



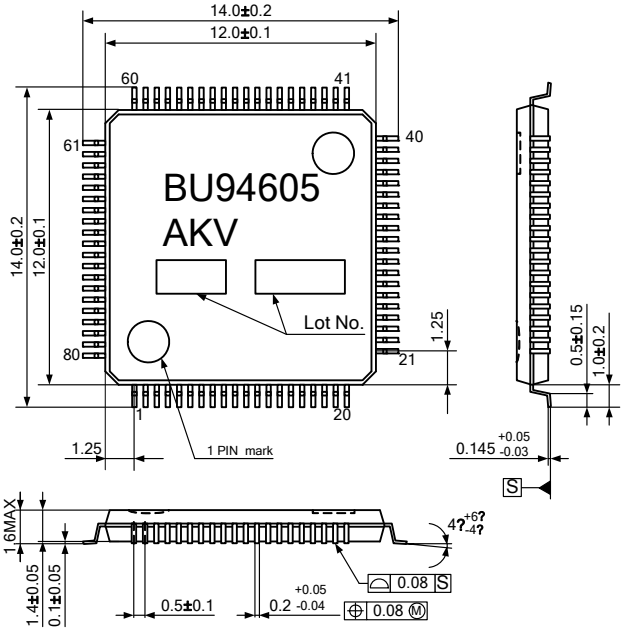
<Tape and Reel information>

Container	Tray (with dry pack)
Quantity	1000pcs
Direction of feed	Direction of product is fixed in a tray



∗Order quantity needs to be multiple of the minimum quantity.

●External dimension



●Revision history

Date	Revision	Changes
01.Apr.2012	A	New Release

Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM Co.,Ltd.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products specified in this document are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.

ROHM SEMICONDUCTOR

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

http://www.rohm.com/contact/

Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM Co.,Ltd.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products specified in this document are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.

ROHM SEMICONDUCTOR

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

http://www.rohm.com/contact/