BU9458KV Application Note

Rev. Target 0.02

ROHM System Audio Team.

Contents

I. Introduction

This application note explains how to implement an audio player which is designed to play AAC/WMA/MP3 data written to a USB memory or SD memory card, using BU9458KV in addition to a normal CD audio play set.

BU9458KV incorporates the following three operation modes: Standalone Mode (hereinafter referred to as MODE1) which enables standalone operations such as “play” and “forward” using a KEY input function, Auto Slave Mode (hereinafter referred to as MODE2) which is driven by sending a command, equivalent to a KEY input, from the master micro controller, and Manual Slave Mode (hereinafter referred to as MODE3) which enables BU9458KV to send the position of AAC/WMA/MP3 file within the memory device to the master micro controller using a I2C serial interface and then, enables the master micro controller to directly specify the position of AAC/WMA/MP3 file to be played to BU9458KV based on the received information. These modes allow BU9458KV to optimize functions fit to each audio system.

It is preferable to refer to this application note to understand the operations and system of BU9458KV having the above-mentioned functions and enhance functions of the audio set.

[Important]

The contents and software of this application note are given as examples of using the USB host AAC/WMA/MP3 decoder LSI. It is not given to guarantee the application itself.

Although the application note contains the command specifications, etc. possibly required at development of the above system, make sure to read the BU9458KV function specifications for details.

II. Internal Block Diagram

Figure II.1 shows the BU9458KV internal block diagram.

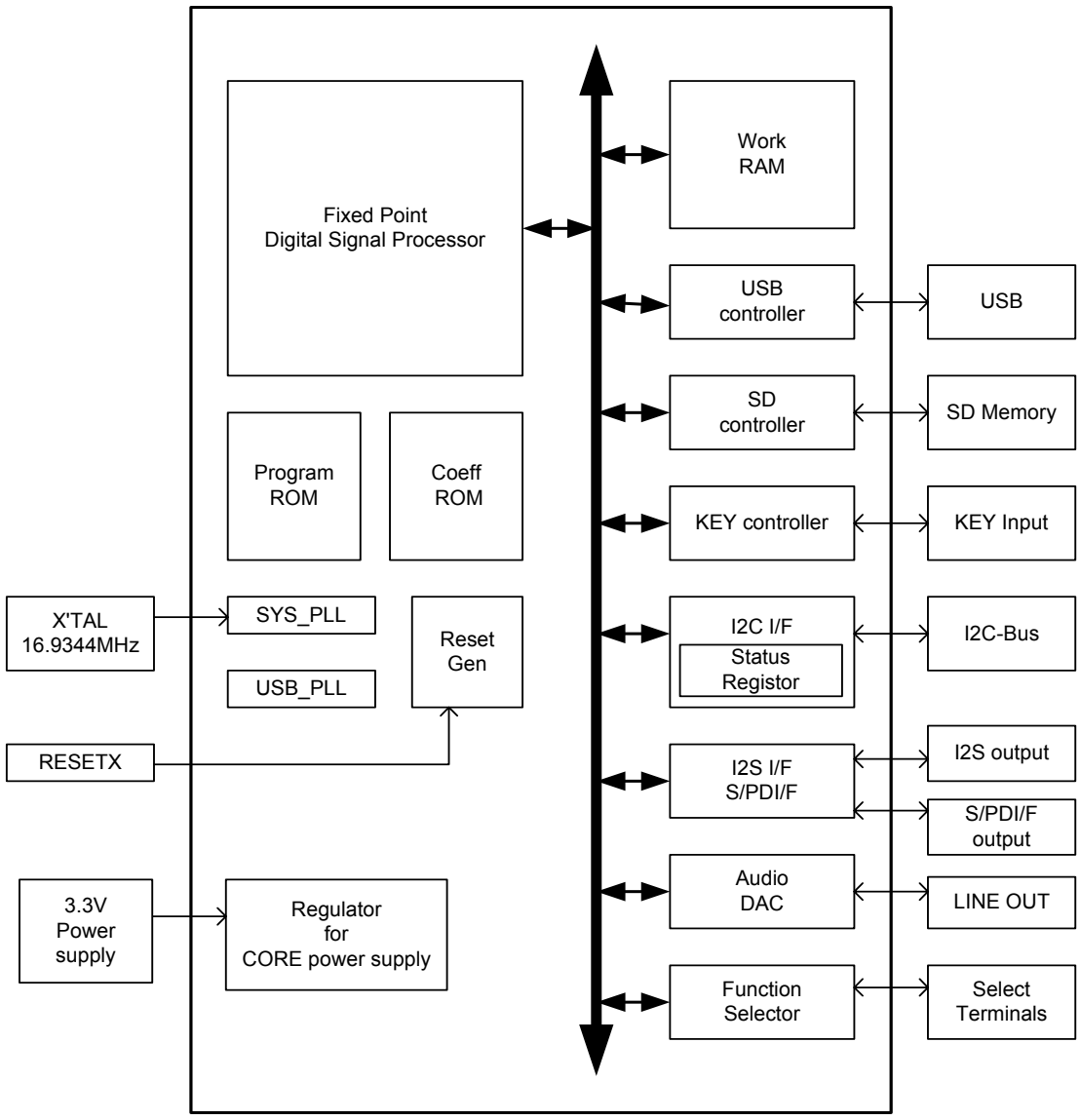


Figure II.1 Internal Block Diagram

Input from KEY is controlled by KEY Input Controller, and commands from the master micro controller are controlled by I2C interface. The mode switching terminal port determines which block becomes enabled. A command received by KEY or I2C interface is analyzed and executed by DSP.

III. Terminal Port Layout

III.1 Terminal Port Layout Diagram

Figure III.1 shows the BU9458KV terminal port layout.

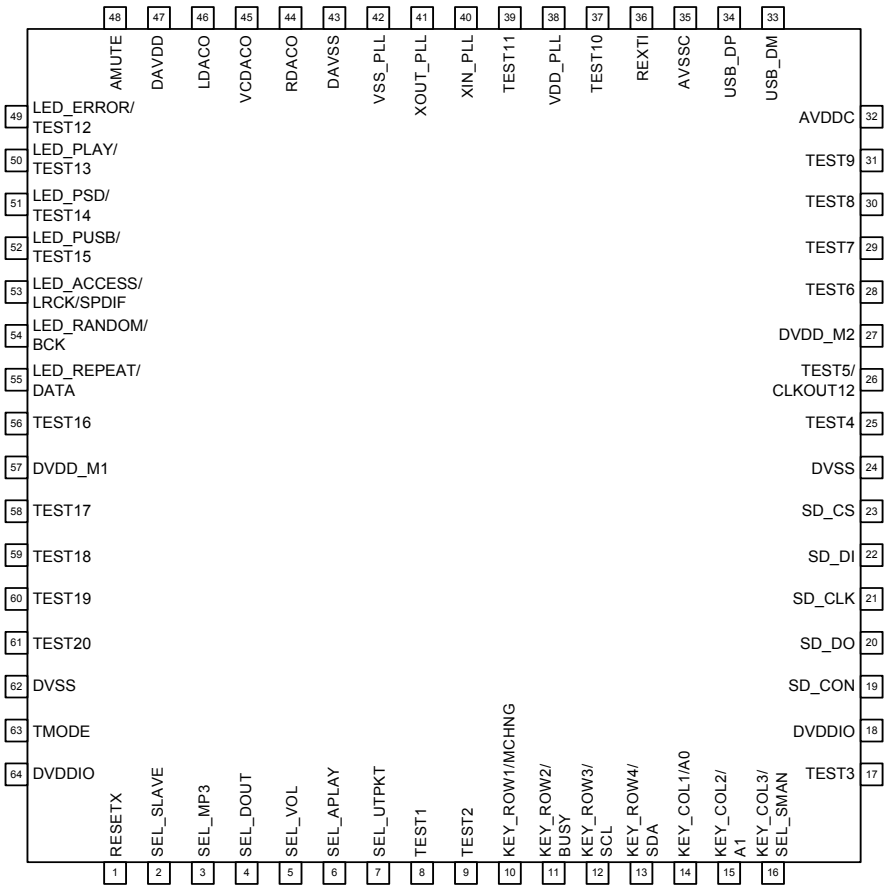


Figure III.1 Terminal Port Layout Diagram

IV. Connection Diagram

This section shows examples of connection diagrams in each mode.

This LSI is build in regulator for internal CORE power supply.

DVDD terminal of 27PIN and 57PIN connect to bypass condenser. DVDD terminal of 27PIN and 57PIN don't connect to power supply.

Please confirm the optimal oscillation circuit parameters applicable to your systems or products with the oscillator manufacturer in advance.

IV.1 MODE1

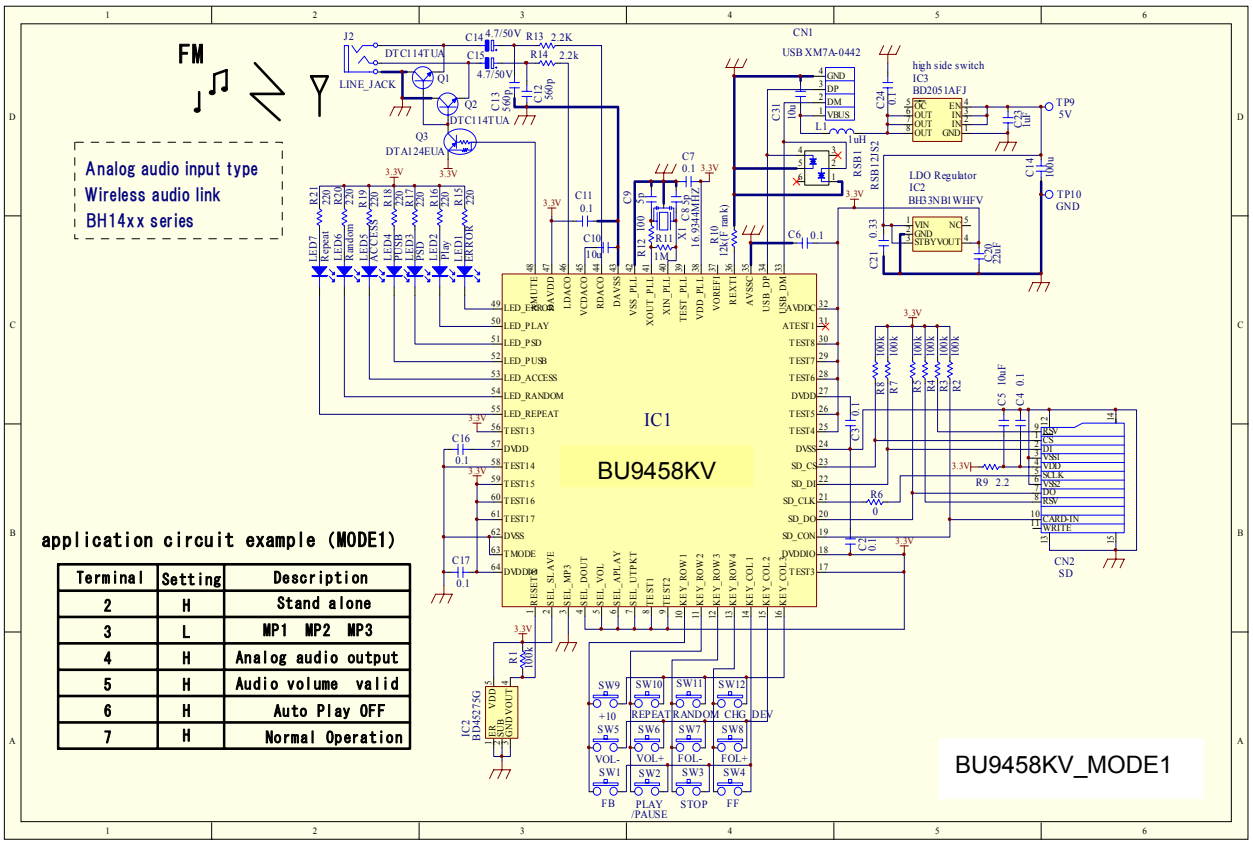
Figure IV.1 shows an example of connection circuit application in MODE1.

IV.2 MODE2

Figure IV.2 shows an example of connection circuit application in MODE2.

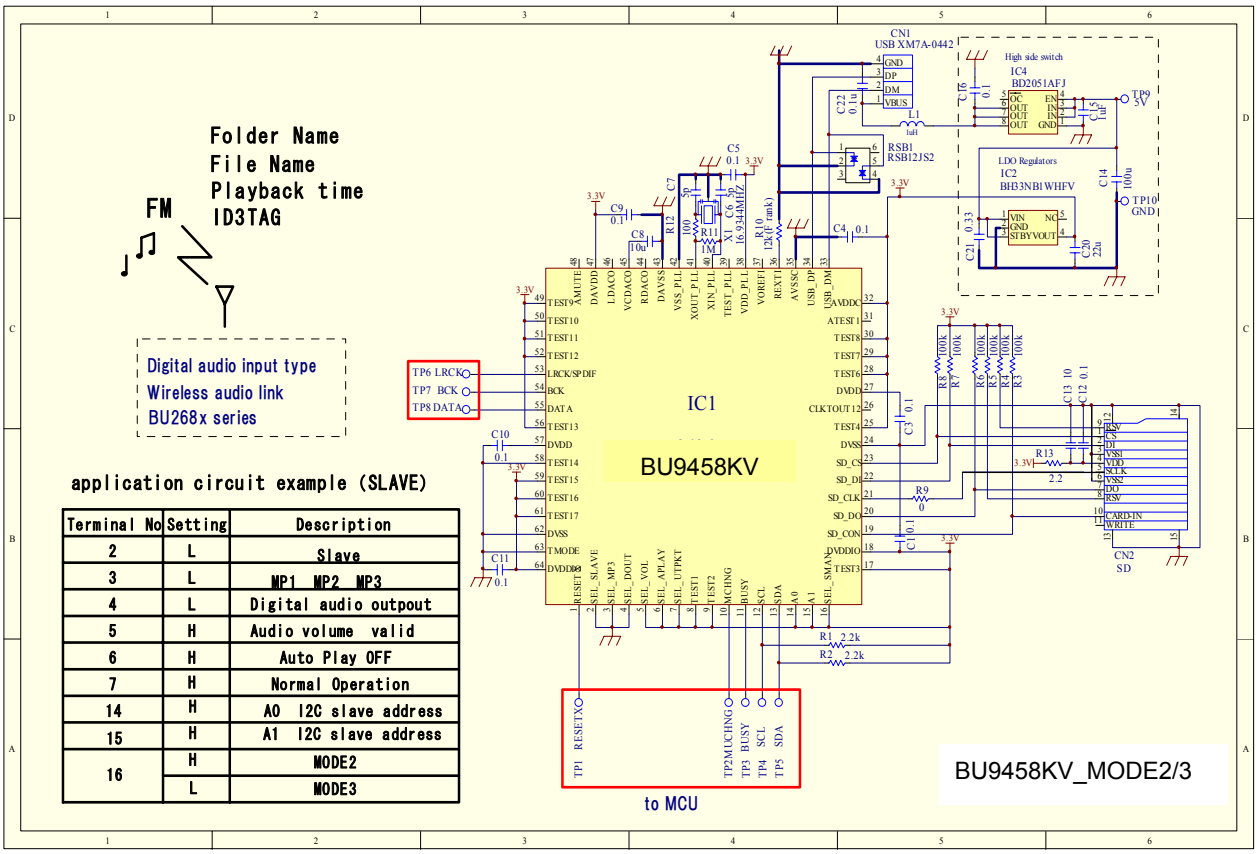
IV.3 MODE3

The connection circuit application in MODE3 is almost similar to MODE2. However, please connect pin16 SEL_SMAN with GND.



Terminal	Setting	Description
2	H	Stand alone
3	L	MP1 MP2 MP3
4	H	Analog audio output
5	H	Audio volume valid
6	H	Auto Play OFF
7	H	Normal Operation

Figure IV.1 an example of connection circuit application in MODE1.



Terminal No	Setting	Description
2	L	Slave
3	L	MP1 MP2 MP3
4	L	Digital audio outpout
5	H	Audio volume valid
6	H	Auto Play OFF
7	H	Normal Operation
14	H	A0 I2C slave address
15	H	A1 I2C slave address
16	H	MODE2
	L	MODE3

Figure IV.2 an example of connection circuit application in MODE2/MODE3.

Though all application circuit examples can be recommended in faith, confirm them fully before using them.
To use external devices beyond a predetermined quantity, make decision with an adequate allowance, considering differences between the external devices and our ICs including the transient properties as well as static properties.

IV.4 Oscillator circuit

The reference circuit and reference circuit parameters for crystal oscillator are shown below.
The circuit parameters introduced to below is not taking into consideration the environment in customer's systems or set ‘s board. Therefore, ROHM is not guaranteed this contents in any circuits.
Please check the optimal circuit parameter in customer's actual systems or products with the oscillator manufacturer
The circuit parameters are as a result of the test performed by the oscillator manufacturer under specific conditions.

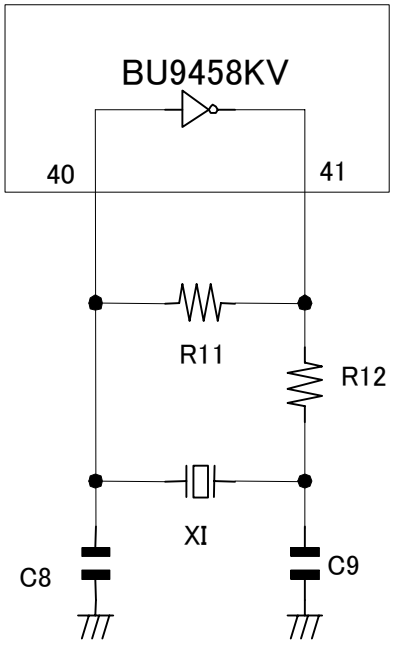


Figure IV.3 Oscillator circuit

crystal resonator

Maker	Daisihinku Corp.	Daisihinku Corp.	Kyocera
Type	DSX840GA	DSX530GA	CX-8045G
Frequency (MHz)	16.9344	16.9344	16.9344
R11 (Ω)	1.0 M	1.0 M	1.0 M
R12 (Ω)	100	100	220
C8 (pF)	5	5	15
C9 (pF)	5	5	15
Negative Resistance (Ω)	-680	-680	-391
Drive Level (uW)	51	69	109
Frequency Deviation (ppm)	11	8	17

The example of the measurement result by DSX840GA (DAISHINKU) and the evaluation board of our company is shown below.

Specification of a crystal resonator

Loading Capacitance : 8 pF
Equivalent resistance : 50 ohms MAX / CL=series (General standard)
Frequency Tolerance : +/- 50 ppm at 25deg.C +/- 3deg.C (General standard)
Temperature Drift : +/- 50 ppm / -40deg.C to 85deg.C (General standard)
Mode of oscillation : Fundamental

Circuit conditions

Negative Resistance : More than 10 times of Equivalent series resistance
Drive Level : 300 micro Watts MAX
Circuit parameters : R11=1.0MΩ, R12=100Ω, C8=5pF, C9=5pF

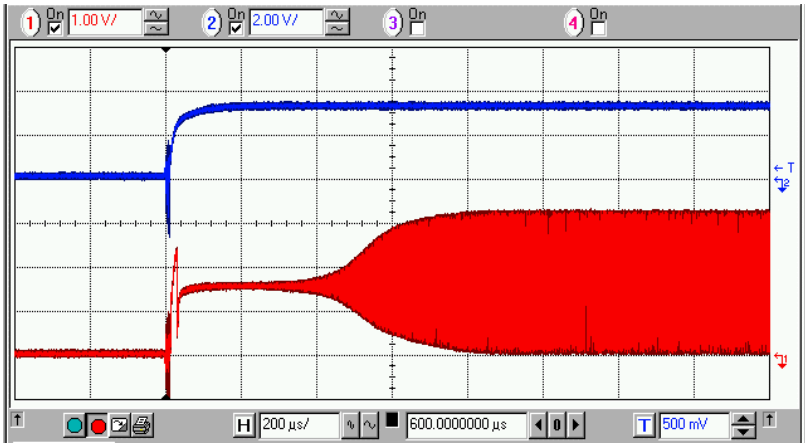


Figure IV.4 Oscillation beginning waveform (Between at beginning oscillation = 0.8 ms)

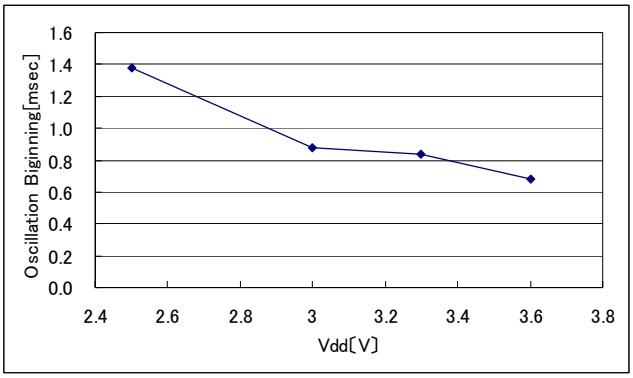


Figure IV.5 Impressed Voltage – Oscillation Beginning

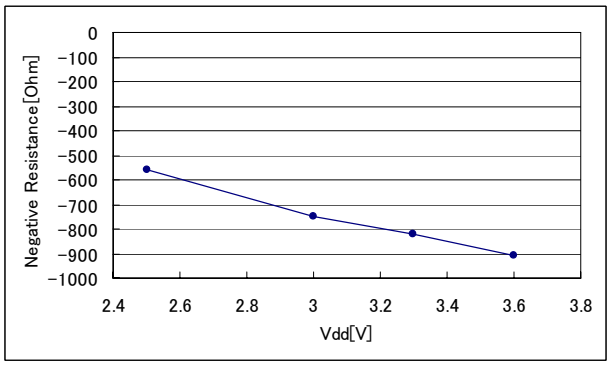


Figure IV.6 Impressed Voltage – Negative Resistance

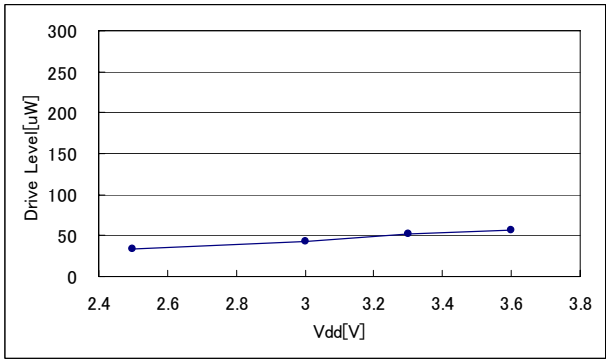


Figure IV.7 Impressed Voltage – Drive Level

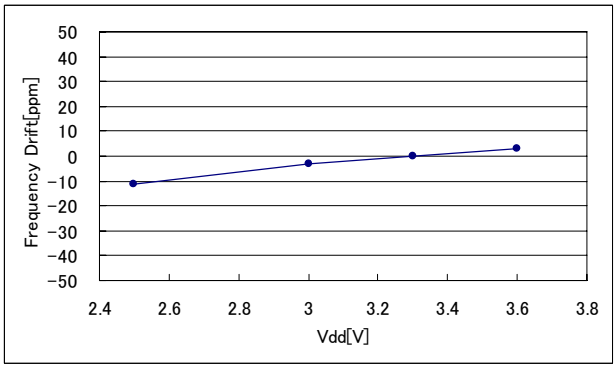


Figure IV.8 Impressed Voltage – Frequency drift

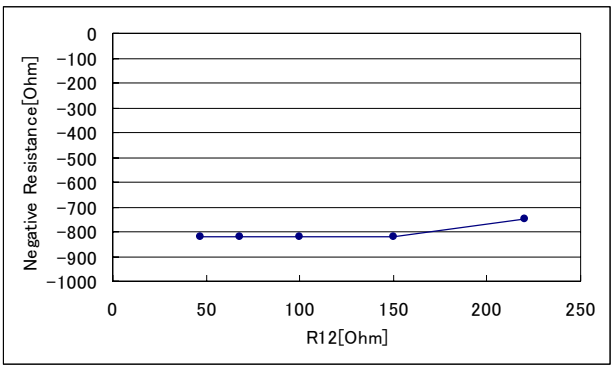


Figure IV.9 Dumping resistance – Negative Resistance

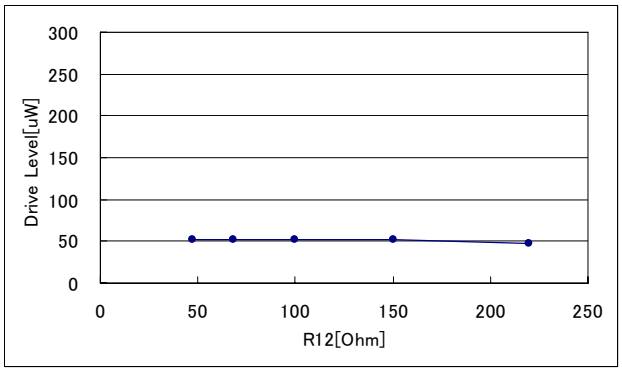


Figure IV.10 Dumping resistance – Drive Level

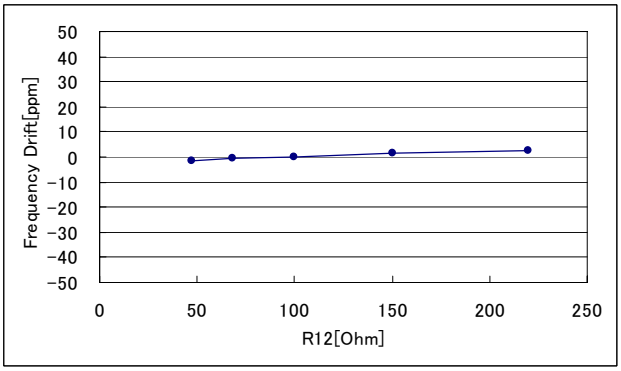


Figure IV.11 Dumping resistance – Frequency drift

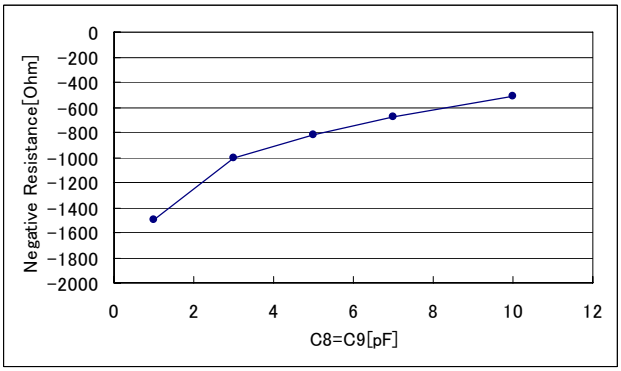


Figure IV.12 Capacitor – Negative Resistance

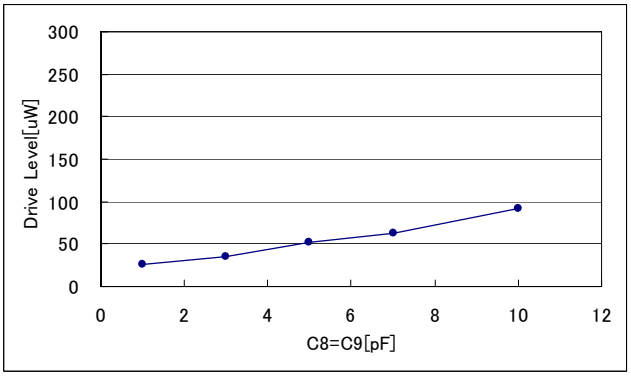


Figure IV.13 Capacitor – Drive Level

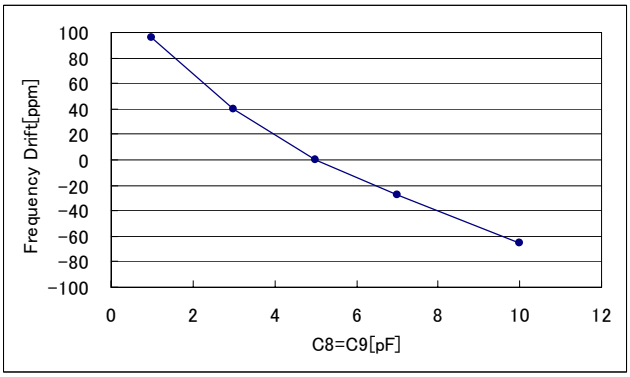


Figure IV.14 Capacitor resistance – Frequency drift

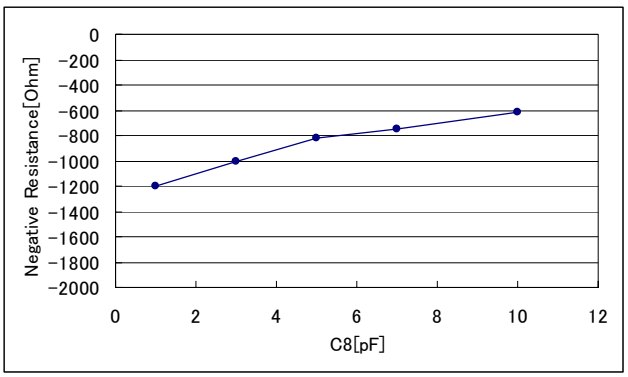


Figure IV.15 Capacitor – Negative Resistance (C9=5pF)

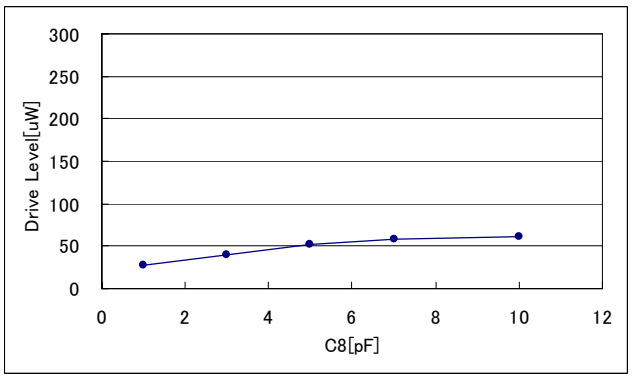


Figure IV.16 Capacitor – Drive Level (C9=5pF)

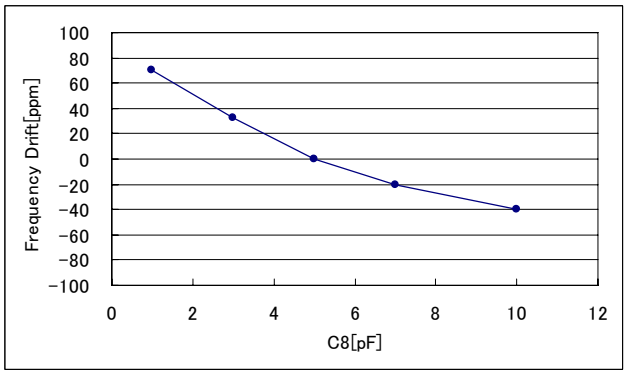


Figure IV.17 Capacitor resistance – Frequency drift (C9=5pF)

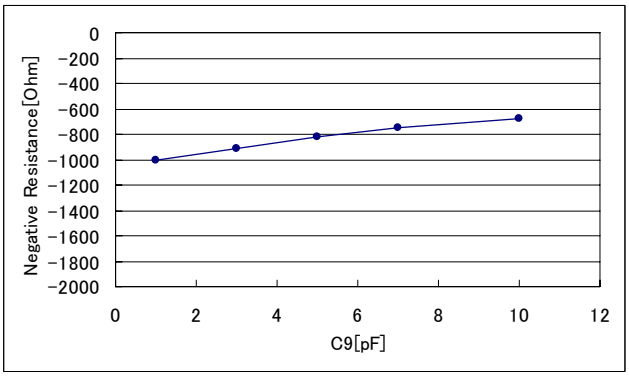


Figure IV.18 Capacitor – Negative Resistance (C8=5pF)

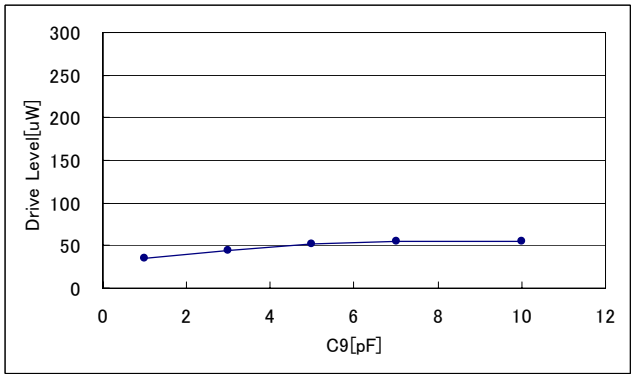


Figure IV.19 Capacitor – Drive Level (C8=5pF)

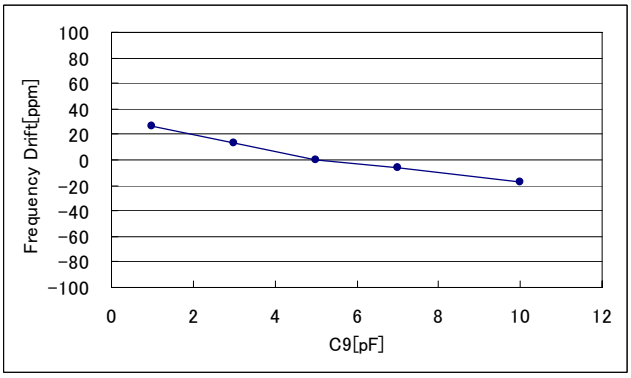


Figure IV.20 Capacitor resistance – Frequency drift (C8=5pF)

Oscillation start time is from the point of time when the impressed voltage reaches 90%, up to when the oscillation amplitude reaches 90%.

Negative resistance of graph is as a result of measurement. at normal temperature.

Negative resistance of the board has been tested under various temperatures.

Oscillation frequency deviation was measured at a load capacitance of 8.0pF.

Oscillation frequency deviation are not contained in Frequency tolerance and Temperature drift of a crystal resonators.

Inquiries: DAISHINKU Corp.

http://www.kds.info/

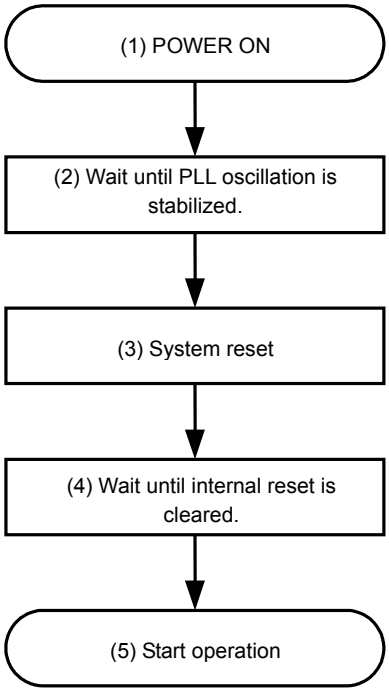
V. Sequence Control

This chapter sets an example of sequence control techniques required when using BU9458KV. Details differ depending on the application. This means that the sequence introduced in this chapter is not always the most effective technique. You should also keep in mind that the given example will not guarantee the perfect operation.

V.1 MODE1

MODE1 is a standalone mode which enables standalone operations of “play”, “forward”, etc. using the KEY input function of LSI.

V.1.1 Power ON Sequence



(1) POWER ON
Turn ON the power switch.

(2) Wait until PLL oscillation is stabilized
Input clock to XIN_PLL and wait until the internal PLL oscillation is stabled.

(3) System reset
Input L for RESETX input for more than 5 μs and then input H.

(4) Wait until internal reset is cleared
Wait for more than 10 ms until the internal reset is cleared after system reset is cleared.

(5) Start operation

Figure V.1.1 Power ON Sequence

V.1.2 State Transition Diagram

The following describes how the state transits from operation start.

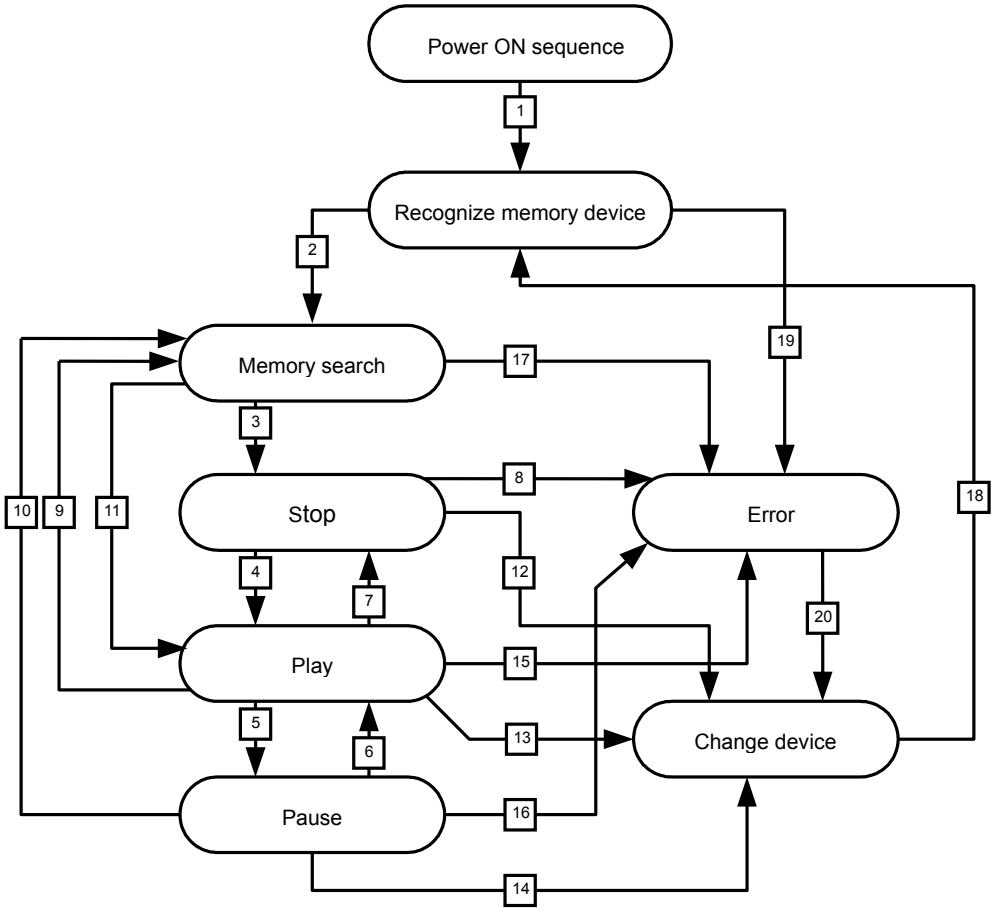


Figure V.1.2 MODE 1 State Transition Diagram

1. When a memory device (USB memory or SD memory card) is inserted after the power ON sequence is completed, the LSI starts recognizing the memory device automatically.
2. The LSI recognizes the memory device. When the currently selected memory device properly corresponds to the LSI, it automatically searches files within the memory.
3. The LSI searches playable files within the memory device. When a playable file is searched and H is input to the SEL_APLAY terminal port, the LSI stops. Or, STOP KEY interrupts the search operation and the LSI stops.
4. In the “stop” state, input of PLAY/PAUSE KEY enables the LSI to play the first sorted file within the memory device.
5. In the “play” state, input of PLAY/PAUSE KEY pauses the play operation.
6. In the “pause” state, input of PLAY/PAUSE KEY enables the LSI to play files.
7. In the “play” state, input of STOP KEY stops the LSI.
8. When the selected memory device is removed in the “stop” state, an error occurs.
9. In the “play” state, input of SELECT FILE TO PLAY KEY enables the LSI to search files in response to the given KEY operation.
10. In the “pause” state, input of SELECT FILE TO PLAY KEY enables the LSI to search files in response to the given KEY operation.
11. When files in the memory have been searched except during memory device recognition, the LSI automatically plays searched files. During memory device recognition, the LSI automatically plays searched files only when L is input to the SEL_APLY terminal port.
12. If another memory exists for the currently selected device in the “stop” state, input of CHNG_DEV KEY moves the control to this memory.
13. If another memory exists for the currently selected device in the “play” state, input of CHNG_DEV KEY moves the control to this memory.
14. If another memory exists for the currently selected device in the “pause” state, input of CHNG_DEV KEY moves the control to this memory.

15. When the currently selected memory device is removed in the “play” state, or when an error occurs on memory communications, the LSI is put in error.
16. When the selected memory device is removed in the “pause” state, the LSI is put in error.
17. When there is no playable file during search in memory device, when a communication error to the memory device continues for 5 seconds or longer, or when the device is removed, the LSI is put in error.
18. After CHNG_DEV KEY is input, the LSI automatically recognizes the device.
19. Memory device recognition continues for 30 seconds at maximum. If the memory is not able to correspond, the LSI is put in error.
20. If another memory exists for the currently selected memory device in the “error” state, input of CHNG_DEV KEY moves the control to this memory. If only one device is used, input of CHNG_DEV KEY becomes invalid.

V.2 MODE2

MODE2 is an auto slave mode which runs through command operations, equivalent to KEY input in MODE1, from the master micro controller using the built-in I2C interface.

V.2.1 MODE2 entire sequence

Figure V.2.1 shows an example of the entire operation flow control when using the LSI in MODE2.

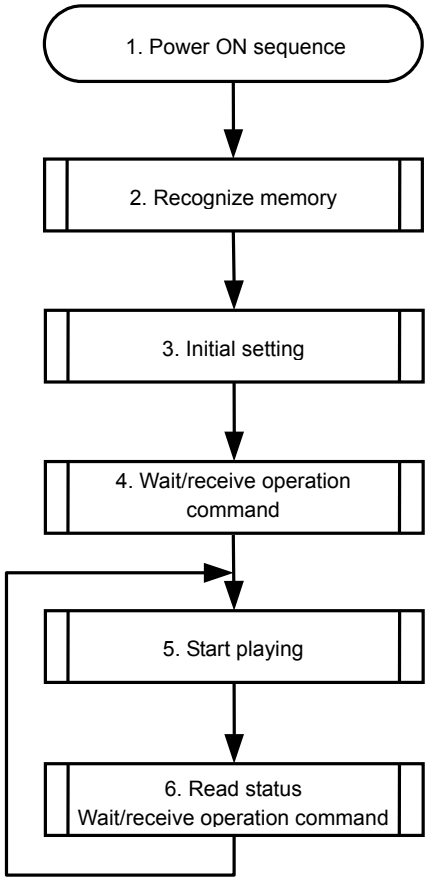


Figure V.2.1 MODE2 Entire Sequence

1. Power ON sequence

The Power ON sequence in MODE2 is the same as in MODE1.

After waiting PLL oscillation to be stabilized, input L for system reset for more than 5 μs to clear system reset.

2. Recognize memory

After the power ON sequence is completed, the LSI recognizes the inserted memory automatically. The inserted memory recognizes the USB memory with the first priority.

3. Initial setting

When a playable memory exists after memory recognition is completed, perform initial setting. In this step, set volume, audio output, format and Tag analysis.

4. Wait/receive operation command

After initial setting is completed, the audio set automatically waits for operation commands. Control the operation command reception on the set.

Obtain the information on the files and Tag.

5. Start playing

6. Read status/wait/receive operation command

After the LSI starts playing, read the status such as information on play time.

The LSI automatically waits to receive the set operation commands.

V.2.2 Power ON sequence

Control the power ON sequence in the same manner as in MODE1.(See V.1.1)

V.2.3 Recognize memory

V.2.3.1 Memory recognition operation flow

Figure V.2.2 shows the operation flow to recognize memory.

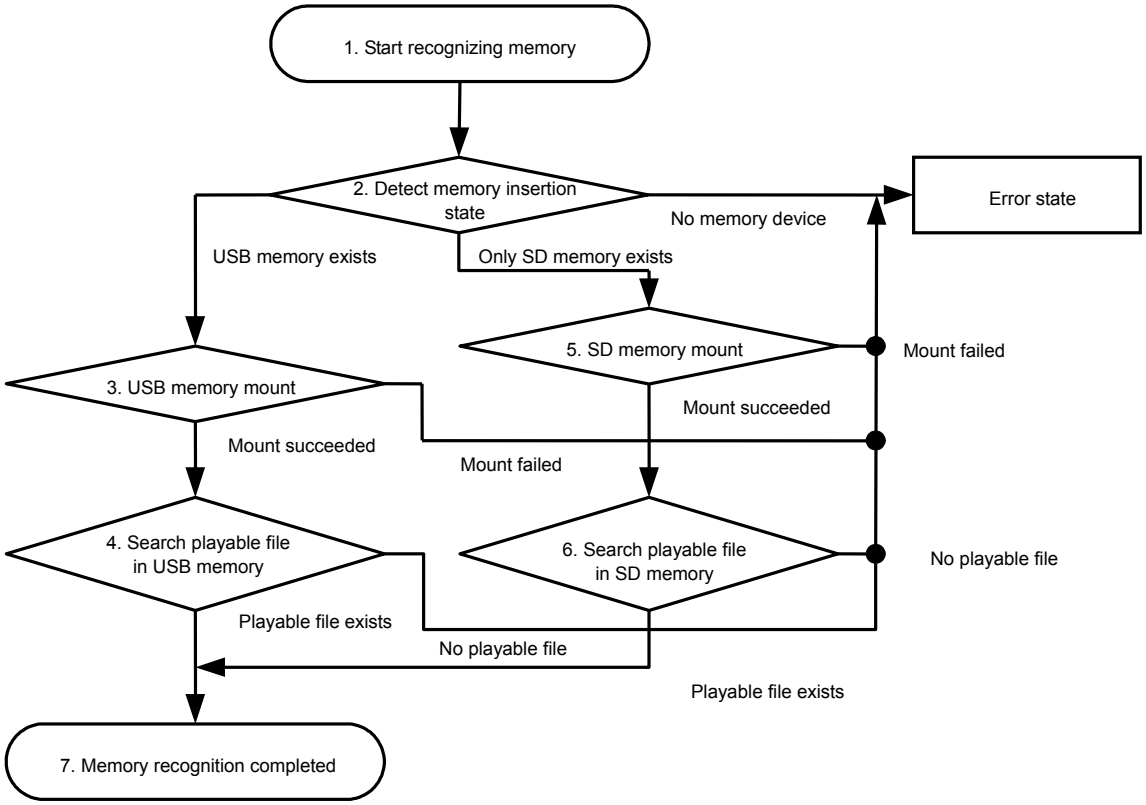


Figure V.2.2 Memory Recognition Operation Flow

V.2.3.2 Start recognizing memory

After the power ON sequence is normally completed, the LSI automatically starts recognizing memory.

V.2.3.3 Detect memory insertion state

The LSI detects the insertion state of the memory device only.

The LSI does this for both USB memory and SD memory. If there is no SD memory, an error occurs.

First, the LSI recognizes whether the USB device is inserted (for about 3 seconds, during which the LSI also recognizes whether SD is inserted).

If the LSI cannot confirm insertion of the USB device but finds SD, it moves to the SD memory mount operation in 3 seconds.

V.2.3.4 USB memory mount

After detecting insertion of USB memory, the LSI recognizes whether it is a connectable USB memory.
The LSI recognizes USB memory for 30 seconds at maximum. After 30 seconds have passed, an error occurs.
If the LSI fails to mount, an error occurs. Then, it goes to the command waiting state. If this happens, control software allows the LSI to automatically send the CHNG_DEV command to the SD memory and move to recognition of the SD memory.

V.2.3.5 Search USB memory playable file

When succeeding in mounting the USB memory, the LSI automatically searches playable files within the USB memory. Playable files should follow the setting of the SEL_AAC/WMA/MP3 terminal port.
If there is no playable file, an error occurs. Then, the LSI is put in the command waiting state. If this happens, control software allows the LSI to automatically send the CHNG_DEV command to the SD memory and move to recognition of the SD memory.

CHNG_DEV command

CHNG_DEV	1st Byte	2nd Byte
	0x50	0x08

V.2.3.6 SD memory mount

After detecting insertion of the SD memory, the LSI recognizes whether the SD memory is connectable.
As is the case for the USB memory, the LSI recognizes the SD memory for 30 seconds at maximum. After 30 seconds have passed, an error occurs.
If the LSI fails to mount, an error occurs. Then, the LSI is put in the command waiting state.

V.2.3.7 Search SD memory playable file

When succeeding in mounting the SD memory, the LSI automatically searches playable files within the SD memory. Playable files should follow the setting of the SEL_AAC/WMA/MP3 terminal port.
If there is no playable file, an error occurs. Then, the LSI is put in the command waiting state.

V.2.3.8 Memory recognition completed

When a playable file exists either in the USB memory or SD memory, the LSI terminates memory recognition and is put in the command waiting state.

V. 2.3.9 Memory recognition status

The status when the LSI recognizes memory can be read using the MODE2 status resister map “STATUS2”.

Figure V.2.3. shows the status timing chart at memory recognition. Figure V.2.4 shows the status timing chart at memory dismount.

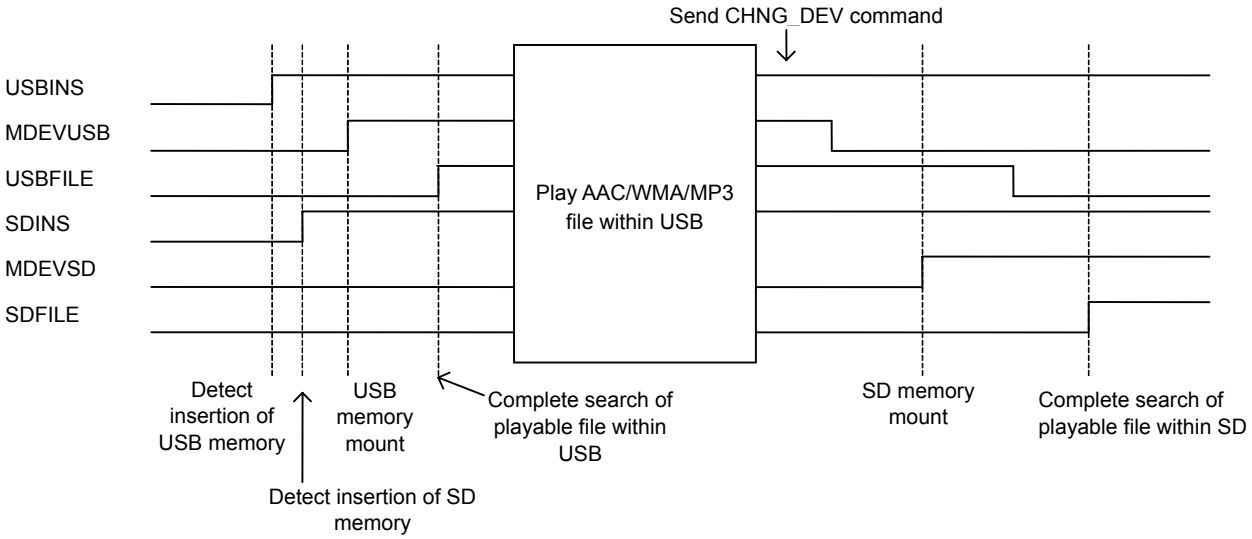


Figure V.2.3 Memory Recognition Status Timing Chart at Insertion of USB Memory/SD Memory

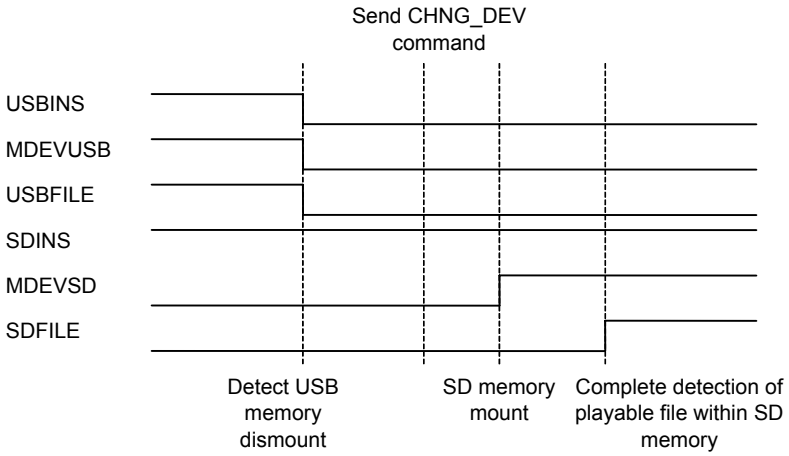


Figure V.2.4 Status Timing Chart at USB Memory Dismount

V.2.4 Initial setting

Upon completion of memory recognition, perform initial setting including search of TOC (Table of Contents: total number of folders/files within memory), volume and audio output before the LSI starts playing a AAC/WMA/MP3 file. Figure V.2.5 shows the initial setting operation flow.

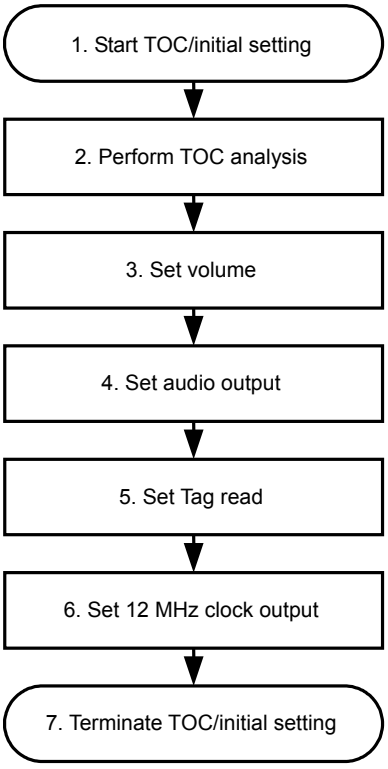


Figure V.2.5 Initial Setting Operation Flow

If the above initial setting is required, set the following parameters.

V.2.4.1 Perform TOC Analysis

The LSI searches the total number of folders/files within the selected memory. Send the SEL_TOC command. If you do not need TOC analysis, you can omit it. Figure V.2.6 shows the TOC analysis operation flow.

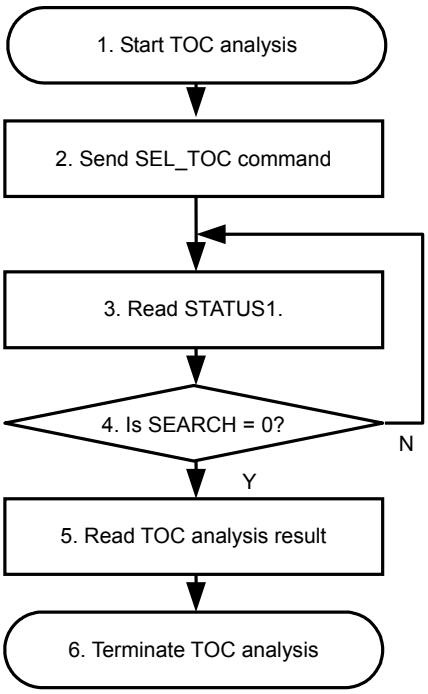


Figure V.2.6 TOC Analysis Operation Flow

SEL_TOC command

SEL_TOC	1st Byte	2nd Byte
	0x57	0x01

STATUS1 read command

READ_BUFF	1st Byte	2nd Byte	1Byte Read
	0x5E	0x00	

Read TOC analysis result when USB memory is selected

READ_BUFF	1st Byte	2nd Byte	6 Byte Read
	0x5E	0x10	

Read TOC analysis result when SD memory is selected

READ_BUFF	1st Byte	2nd Byte	6 Byte Read
	0x5E	0x16	

When sending SEL_TOC command, the LSI searches the total number of folders and files within the selected memory device. During search, the results are output to the STATUS1: SEARCH register. Therefore, before the LSI starts reading the total number of folders and files after the SEL_TOC command is sent, be sure to read the STATUS: SEARCH register and confirm that analysis has been completed.
Upon completion of TOC analysis, read the analysis results to the selected memory device.
When the SEL_TOC status is ON, the LSI always starts obtaining the total number of folders and files first in response to insertion of the device and occurrence of the CHNG_DEV command. Even during play, if SEL_TOC is turned from OFF to ON, the LSI interrupts playing and starts obtaining the total number of folders/files.

V.2.4.2 Set volume

When the LSI can change the volume using the SEL_VOL terminal port, set the volume initial value. The LSI allows you to change the volume by 32 steps from 0x00 to 0x1F. Set the volume at the second byte of the SET_VOL command.

Volume setting command

	1st Byte	2nd Byte
SET_VOL	0x53	Setting value

V2.4.3 Set audio output

When the digital audio output is selected by the SEL_DOUT terminal port, you can select the digital audio output format (I2S output/SPDIF output) using the SET_DOUT command. When digital audio output is selected, the initial setting value is output in the I2S 32fs format.

Digital audio output format selection command

	1st Byte	2nd Byte	3rd Byte	4th Byte
SET_DOUT	0x51	0x20	Select output format	

When the line output is selected by the SEL_DOUT terminal port, you can perform the equalizer effect in the line output using the SET_EQ command. This will be disabled in the digital audio output format.

Equalizer output selection command

	1st Byte	2nd Byte
SET_EQ	0x52	Select

V.2.4.4 Set Tag read

This setting selects whether information analysis of Tag added to AAC/WMA/MP3 file is performed.

By default, Tag analysis is not performed.

Tag information analysis setting command

	1st Byte	2nd Byte
SEL_ID3	0x56	Selection

V.2.4.5 Set 12 MHz clock output

You should set this parameter if 12 MHz clock output from the CLK12MOUT terminal port is required.

By default, 12 MHz clock output is not performed.

12 MHz clock output setting command

	1st Byte	2nd Byte
SEL_12MOUT	0x58	0x01

V.2.5 Wait/Receive Operation Command

After recognizing the memory device and completing the initial setting, the LSI is put in the state to wait for operation commands.

The master micro controller receives operation input from the configured set. Send the received command to the LSI. The LSI allows you to implement a wide range of set operationability as listed below, from the master micro controller commands in this state.

(1) To obtain and display all the folder/file names within the currently selected folder and select a tune to play explicitly.

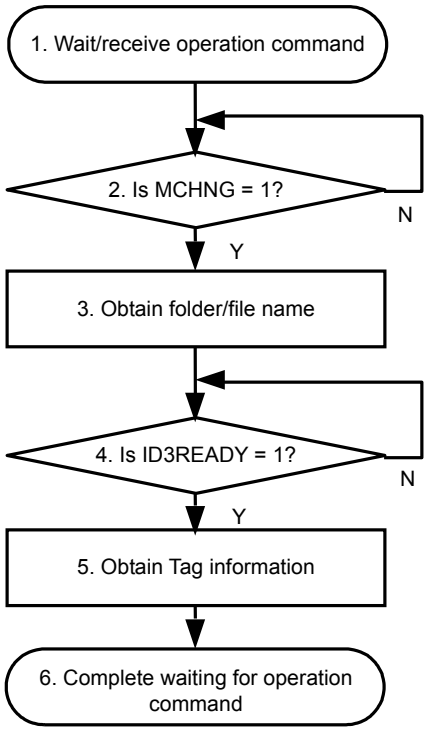
(2) To select a tune only, display the file name and Tag information of the selected AAC/WMA/MP3 file, stop, and then start playing the file by the PLAY command from the set.

(3) To display the file name and Tag information of the selected AAC/WMA/MP3 file and, concurrently, play the file.

(1) and (2) are implemented by scanning the AAC/WMA/MP3 file using a command to select a tune only (FF, FB, +10, -10, etc.) and fetching the information of the file name, etc. by reading the status. (3) is implemented by starting playing the file using a select & play command (FF&PLAY, FB&PLAY, +10&PLAY, -10&PLAY, etc.) and, concurrently, fetching the file information by status.

Since these methods use almost the same operation flows, this chapter takes (2) as an example.

Figure V.2.7 shows the operation flow right before starting playing in the case of (2).



Read MCHNG/ID3READY status command

READ_BUFF	1st Byte	2nd Byte	1Byte Read
	0x5E	0x02	

Obtain folder name command

READ_FOLDER_ NAME	1st Byte	2nd Byte	64 Byte Read at maximum
	0x5F	0x08	

Obtain file name command

READ_FILE_ NAME	1st Byte	2nd Byte	64 Byte Read at maximum
	0x5F	0x07	

Obtain Tag command

READ_ID3_ TITLE/ ARTIST/ ALBUM	1st Byte	2nd Byte	64 Byte Read at maximum
	0x5F	0x04/ 0x05/ 0x06	

Figure V.2.7 Operation Flow before Starting Playing

When receiving a command to select a tune, the LSI searches the AAC/WMA/MP3 file fit to the selected command. When starting searching the AAC/WMA/MP3 file, the LSI sets STATUS1: SEARCH=1.

After completing search of the AAC/WMA/MP3 file, the LSI sets STATUS3: MCHNG=1.

The status register MCHNG is output as it is to the MCHNG terminal port of the LSI. Therefore, it is recommended that the MCHNG terminal port be connected to the interrupt port of the master micro controller and be fetched at a rising edge.

Reference

Status when obtaining Tag

The following shows a status timing chart when the LSI is performing the Tag analysis.

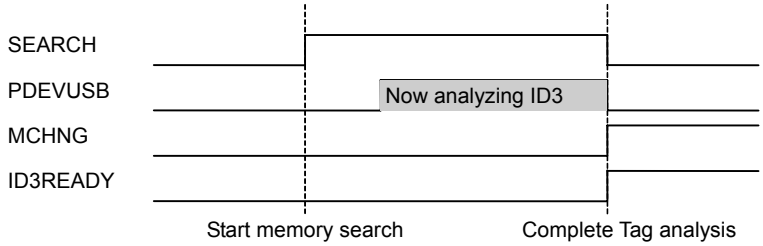


Figure Tag Analysis Timing Chart

The timing chart in the figure shows waveforms while sending a command to select tune, such as FF or FB, in the stop state when selecting the USB memory. After sending the command, the LSI searches through the memory device and then starts Tag analysis.

Upon completion of Tag, MCHNG=H is set. If Tag exists, ID3READY=H is set. If not, ID3READY=L is set. When Tag analysis takes long time (SEARCH=H and PDEVUSB=H), the ABORT command allows you to terminate the Tag analysis forcedly. If this happens, ID3READY=L is set in the above timing chart.

V.2.6 Start Playing

After receiving the operation command and obtaining the file name and the Tag information of the selected AAC/WMA/MP3 file, the LSI starts playing the file.

Figure V.2.8 shows the operation flow at start of play.

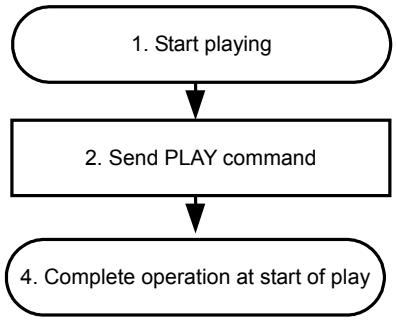


Figure V.2.8 Operation Flow at Start of Play

V.2.6.1 Send PLAY command

The LSI sends the PLAY command in the start-of-play state.

PLAY command

	1st Byte	2nd Byte
PLAY	0x50	0x01

V.2.7 Read Status/Wait/Receive Operation Command

During play, read the status of the play time information and error. Read the play time information at an interval of 100 ms or so.

The LSI waits for the operation command during play. Before sending the command, be sure to read the STATUS1: SEARCH status. Make sure that the LSI is in the search stop state and then send the command.

Read play time information command

	1st Byte	2nd Byte	
READ_BUFF	0x5E	0x0E	2 Byte Read

Read STATUS1: SEARCH status command

	1st Byte	2nd Byte	
READ_BUFF	0x5E	0x00	1 Byte Read

V.2.8 Resume Play Method

By sending the resume information obtained from the READ_RESUME_INFO status to the LSI using the SET_RESUME_INFO command, it automatically searches the AAC/WMA/MP3 file written to the READ_RESUME_INFO status within the memory device and starts playing the file from the time of read READ_RESUME_INFO status.

Figure V.2.9 shows the operation flow at obtain resume data.

Figure V.2.10 shows the operation flow at resume play.

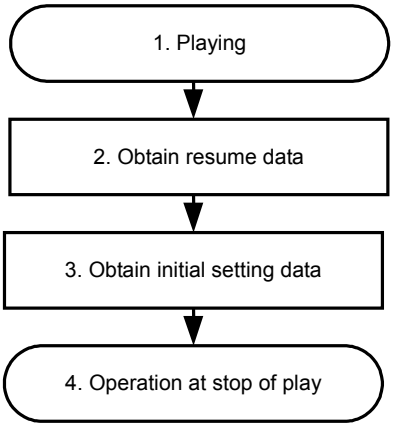


Figure V.2.9 operation flow at obtain resume data.

V.2.8.1 Obtain resume data

The LSI checks the MDEVUSB and MDEVSD statuses and obtains the device selected.

The LSI checks that play of the file has been started in the PLAY status and obtains the resume file data.

READ_RESUME_INFO command

READ_RESUME_INFO	1st Byte	2nd Byte	42 Byte Read
	0x5F	0x09	

After obtaining the resume file data, the LSI reads the settings of the current volume and audio output and obtains the initial setting data at resume play.

Read initial setting data command

READ_BUFF	1st Byte	2nd Byte	6 Byte Read
	0x5E	0x03	

The read initial setting data command allows the LSI to obtain the following statuses.

Initial setting data	1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte	6th Byte
	Repeat/ random setting	12 MHz output setting	Volume setting	EQ setting	Digital audio output setting 1	Digital audio output setting 2

For details on each status output, see the functional specifications.

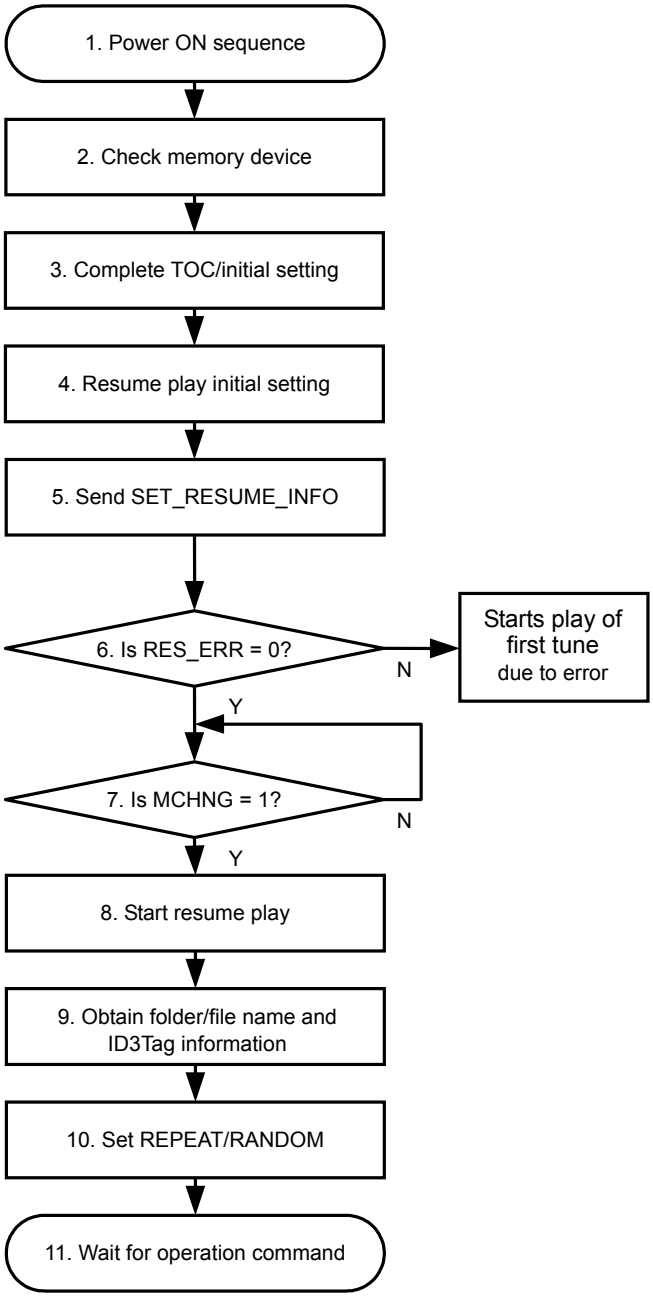


Figure V.2.10 Resume Play Operation Flow

V.2.8.2 Power ON sequence

The operations from power ON to TOC/initial setting during execution of resume play have the completely same flow as for normal play.

V.2.8.3 Check memory device

The LSI checks whether the inserted and recognized memory device is the same one when obtaining the resume data. After the power ON sequence is completed, the LSI reads the status and checks whether the device is the same.

READ_BUFF	1st Byte	2nd Byte	1 Byte Read
	0x5E	0x01	

Check the MDEVUSB status and MDEVSD status

If the selected memory device is the other one, send the CHMG_DEV command to change the device.

CHNG_DEV	1st Byte	2nd Byte
	0x50	0x08

V.2.8.4 TOC/initial setting

The TOC/initial setting operation has the same flow as for normal play.

V.2.8.5 Resume play initial setting

During resume play, set the resume initial settings such as volume setting for resume play and audio output format in the completed initial setting condition. Use the statuses read in V.2.8.1 for the resume initial setting.

Perform the following initial setting only and do not execute REPEAT/RANDOM play settings.

(1) Volume setting

SET_VOL	1st Byte	2nd Byte
	0x53	Setting value

(2) EQ setting (only when the line output is selected for audio output)

SET_EQ	1st Byte	2nd Byte
	0x52	Select

(3) Digital audio output setting (only when digital audio output is selected for audio output)

SET_DOUT	1st Byte	2nd Byte	3rd Byte	4th Byte
	0x51	0x20	Select output format	

V.2.8.6 Send SET_RESUME_INFO command and start resume play

Send 42-Byte resume data obtained from the read status command, READ_RESUME_INFO, by every 6 Bytes.

SET_RESUME_INFO command

SET_RESUME _INFOX	1st Byte	2nd Byte	6 Byte Write
	0x51	0x4X	

To transfer 42-Byte data by every 6 Bytes, the SET_RESUME_INFO command is executed 7 times in all.

After 42-Byte SET_RESUME INFO commands have been sent, and the last one, SET_RESUME_INFO7 command has been sent, the LSI automatically searches resume files.

During search, if the LSI cannot search a MP3 file for resume play because of change or no insertion of the memory device, it issues an error occurrence in the STATUS5:RES_ERR status. Therefore, when sending a SET_RESUME_INFO command, be sure to read the STATUS5:RES_ERR status and check for errors. If an error occurs, the LSI automatically plays the first tune in the memory device. A resume error may possibly arise in the following cases:

(1) When the file number or folder number does not match

(2) When the folder hierarchy does not match
(3) When the FAT entry index does not match

When searching a resume file, a AAC/WMA/MP3 file play start status is output to the STATUS3: MCHNG status or MCHNG terminal port. Then, the LSI automatically starts playing the file from time of resume.

V.2.8.7 Obtain folder name, file name and Tag information

After starting resume play, be sure to obtain the folder/file name and Tag information. To do this, see V.2.5 for details.

V.2.8.8 Set REPEAT/RANDOM

To reproduce the state before resume, the volume and audio output have already been set in V.2.8.5. Set REPEAT and RANDOM play in this stage.

REPRAND	1st Byte	2nd Byte
	0x54	Setting

Set REPEAT/RANDOM command

V.2.8.9 Wait for operation command

In this stage, resume play has been already started. The subsequent operation flow is the same as the normal operation flow.

V.2.9 Fast Forward(Backward) Play

Figure V.2.11 shows the Fast Forward(Backward) Play operation flow.

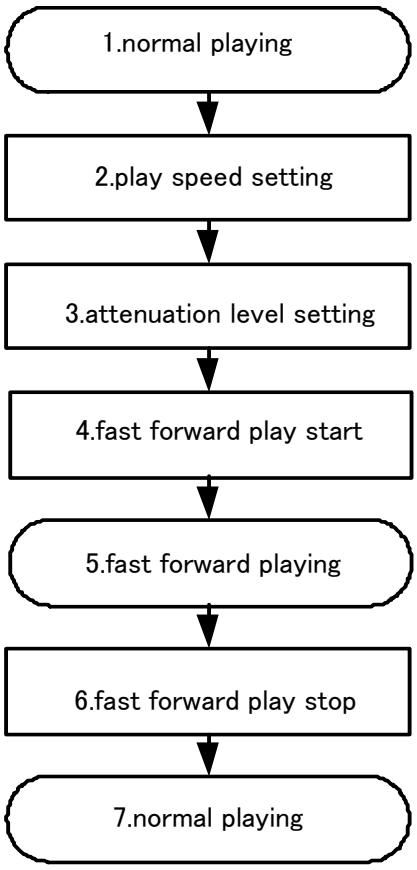


Figure V.2.11 Fast Forward(Backward) Play operation flow

V.2.9.1 Fast Forward(Backward) Play speed setting

SET_RPM command set up playtime and skiptime for fast forward playing and fast backward playing.
Fast forward and fast backward playing repeat this cycle by making {playtime(M) + skiptime(N) +error(O)} into 1 cycle.
With an error, it depends on the cajoled error between the minimum decoding unit and playtime, and the real time which searchs skiptime. Errors differ by every file and every composition in memory.
This command set up that playtime is M[15:0]=[4th byte, 3rd byte] and skiptime are N[15:0]=[6th byte and 5th byte].
Initial value set playtime is 300 mili second=M[15:0]=[4 th byte=x01, 3rd byte=x2C] and
skiptime is 2100 mili second=N[15:0]=[6 th byte=x08, 5 th byte=x34].
When command set up to 0x0, setting value is initial value.
The playtime should set up 300ms or more, and skiptime should set up below (playtime x16).

SET_RPM command

SET_RPM	1st Byte	2nd Byte	4 Byte Write
	0x5B	0x00	

V.2.9.2 Fast Forward(Backward) Play attenuation setting

This command set up the attenuation level under fast forward and backward playing.

A attenuation level serves as (-6dB X [3rd byte]).

A setup can be specified from 0x00 to 0x10.As for an initial value, 0x02=-12dB is set up. It becomes equivalent to MUTE by setup of 0x10.

SET_RPM command

SET_RPM	1st Byte	2nd Byte	4 Byte Write
	0x5B	0x01	

3rd byte=setting, 4th=5th=6th=0x00

V.2.9.3 Fast Forward(Backward) Play start

This command

A fast forward (backward) play start command "FFP_ON" ("FBP_ON") is transmitted during playing.

After command transmission, fast forward (backward) play is started.

FFP_ON command

FFP_ON	1st Byte	2nd Byte	3rd Byte	4th Byte
	0x55	0x01	0x02	0x00

FBP_ON command

FBP_ON	1st Byte	2nd Byte	3rd Byte	4th Byte
	0x55	0x02	0x02	0x00

V.2.9.4 Fast Forward(Backward) Play stop

A fast forward (backward) play finish command "FFP_OFF" ("FBP_OFF") is transmitted during fast forward (backward) playing.

After command transmission, the normal play is started.

FFP_OFF command

FFP_OFF	1st Byte	2nd Byte	3rd Byte	4th Byte
	0x55	0x01	0x03	0x00

FBP_OFF command

FBP_OFF	1st Byte	2nd Byte	3rd Byte	4th Byte
	0x55	0x02	0x03	0x00

V.3 MODE3

MODE3 is a manual slave mode in which the LSI sends the position of AAC/WMA/MP3 file within the memory device to the master micro controller using the I2C serial interface, and then the master micro controller directly specifies the position of AAC/WMA/MP3 file to be played within the memory device to the LSI based on the received information.

V.3.1 MODE 3 Entire Sequence

Figure V.3.1 shows the entire operation flow control chart when using the LSI in MODE3.

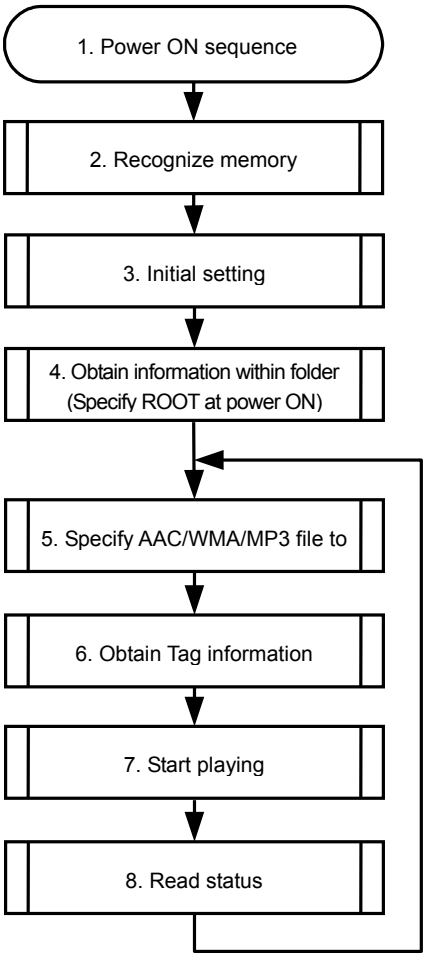


Figure V.3.1 MODE3 Entire Operation Flow

1. Power ON sequence
   In MODE3, the same power ON sequence is used as in MODE1.
   After waiting until oscillation stabilization, input L for system reset for more than 5 μs to clear system reset.
2. Recognize memory
   In MODE3, the same memory recognition sequence is used as in MODE2. See V.2.3.
3. Initial setting
   As in MODE2, perform initial settings for volume and EQ.
4. Obtain information within folder
   The LSI obtains the folder/file information such as name of folder and files contained in the specified folder. The folder/file information has a set of access data assigned to each memory device. In MODE3, the master micro controller sends this data to the LSI to specify AAC/WMA/MP3 file play or folder analysis. At power ON, specify the root folder.
5. Specify AAC/WMA/MP3 file to be played
   The LSI specifies the AAC/WMA/MP3 file access data based on the obtained information within the folder.
6. Obtain Tag information
   The LSI obtains the Tag information on the specified AAC/WMA/MP3 file.

7. Start playing
   Upon completion of preparation of play, the LSI starts playing the AAC/WMA/MP3 file specified by the PLAY_DIRECT command.
8. Read status
   After starting playing the AAC/WMA/MP3 file, read the play time information status at an interval of 100 ms or so to obtain the play time.

The following explains each of the flows.

V.3.2 Power ON Sequence, Recognize Memory

In MODE3, power ON sequence is the same as in MODE1 and MODE2. See the explanation in the section of MODE1 power ON sequence.

V.3.3 Initial setting

In MODE3, the initial setting is the same as in MODE2 except for SEL_ID3 command. Because the SEL_ID3 command is invalid in MODE3, use the GET_ID3 command to obtain the Tag information.

V.3.4 Obtain information within folder

The LSI obtains the folder/file information contained in the folder. This information also contains the access data to the folders/files written to the memory device, and folder/file names. For details on folder/file information, see the functional specifications.

Figure V.3.2 shows the operation flow to obtain information within the folder.

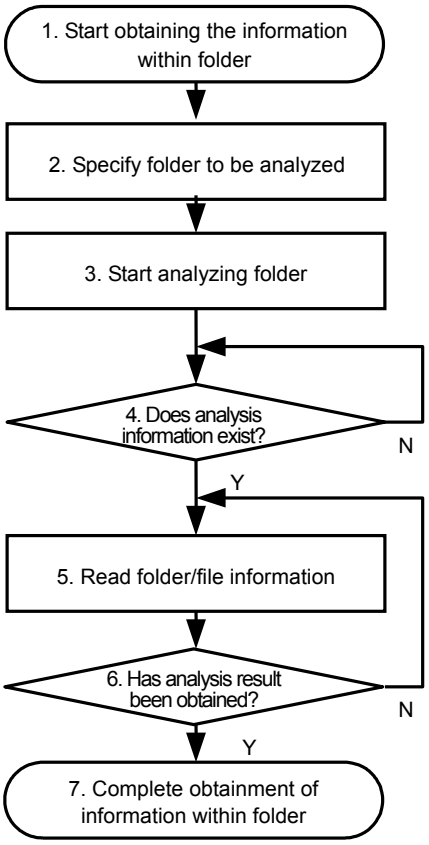


Figure V.3.2 Operation Flow to Obtain Information within Folder

1. Start obtaining information within folder
   To analyze the folder newly or upon completion of initial setting, the LSI starts analyzing information within the folder at this point.
2. Specify folder to be analyzed
   Specify the folder to be analyzed. Give 6-Byte access data to the argument. At power ON, be sure to specify the root folder and specify “0” to the access data.
3. Start analyzing folder
   The LSI starts obtaining the folder/file information on the specified folder.
4. Does analysis information exist?
   After starting analyzing the folder, the LSI tells the master micro controller that the folder analysis data can be read.
5. Read folder/file information
   After the LSI completes with preparation of reading the analysis information within the folder, start reading the folder/file information.
6. Has analysis result been obtained?
   Check that all the folder/file information has been read from the specified folder.
7. Complete obtainment of information within folder
   After obtaining all the folder/file information on the specified folder to be analyzed, obtainment of the information within the folder is completed.

The following explains each of the flows.

V.3.4.1 Specify folder to be analyzed

Send a SET_DIREST command using the access data of the folder to be analyzed as an argument and specify the folder to be analyzed.
At power ON, specify the root folder. The access data of the root folder must be “0”.

SET_DIRECT command

SET_DIRECT	1st Byte	2nd Byte	3th-8th Byte
	0x59	0x00	Access data

V.3.4.2 Start analyzing folder

The LSI starts analyzing the folder/file information on the specified folder.

GET_DIRECT command

GET_DIRECT	1st Byte	2nd Byte
	0x50	0x09

V.3.4.3 Does analysis information exist?

After starting analyzing the folder, the LSI writes the analysis result to its internal buffer. When the written result is folder information, the LSI outputs status to STATUS4: FOLINF, and when it is file information, the LSI outputs status to STATUS4: FILEINF. Read STATUS4: FOLINF and STATUS4: FILEINF and check that folder/file information is ready to be output.

Read status command

READ_BUFF	1st Byte	2nd Byte	1 Byte Read
	0x5E	0x03	

V.3.4.4 Read folder/file information

After checking that folder/file information is ready to be output in LSI, read the information from the LSI buffer area. Both folder information and file information are 76 Byte long.

Read folder information command

READ_FOLDER_ INFO	1st Byte	2nd Byte	76 Byte Read
	0x5F	0x0D	

Read file information command

READ_FILE_ INFO	1st Byte	2nd Byte	76 Byte Read
	0x5F	0x0E	

V.3.4.5 Has analysis result been obtained?

After the master micro controller has read all the analysis results of the folder/file information within the specified folder, “completion of analysis” is indicated to STATUS4: ANAEND. When analyzing the folder using the GET_DIRECT command, be sure to check that analysis has been completed by reading STATUS4: ANAEND.

Read status command

READ_BUFF	1st Byte	2nd Byte	1 Byte Read
	0x5E	0x03	

The analysis results of the folder are once written to the LSI internal buffer. Therefore, when the internal buffer becomes full, no more data can be written there until the data is read out by READ_FOLDER_INFO or READ_FILE_INFO from the internal buffer. You can check how full the buffer by reading the STATUS4: FOLFULL or STATUS4: FILEFULL status.
To judge completion of folder analysis, the following two conditions must be met:

(1) STATUS4: ANAEND = 1

(2) STATUS4: FOLINF= STATUS4: FILEINF = 0

Read the folder/file information until the above two conditions are met.
During execution of folder analysis, it may take long time to analyze a folder depending on how a AAC/WMA/MP3 file has been written. In this case, you can interrupt analysis using the ABORT command. After sending the ABORT command, the LSI is put in the stop state before obtaining the folder analysis results.

ABORT command

ABORT	1st Byte	2nd Byte
	0x50	0x0C

V.3.5 Specify AAC/WMA/MP3 file to be played

After analysis within the folder has been completed, the master micro controller determines the AAC/WMA/MP3 file to be played based on the file information and sends the access data of the AAC/WMA/MP3 file to be played, using the SET_DIRECT command.

V.3.6 Obtain Tag information

If you need to obtain the Tag information, send the GET_ID3 command. If not, you do not have to do this.
Figure V.3.3 shows the operation flow to obtain the Tag information.

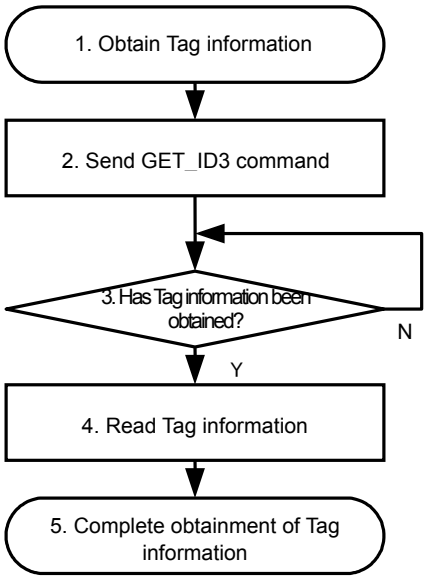


Figure V.3.3 Operation Flow to Obtain Tag Information

V.3.6.1 Send GET_ID3 command

If you need to obtain the Tag information, send the GET_ID3 command using the SET_DIRECT command in which the AAC/WMA/MP3 file is specified.

GET_ID3 command

GET_ID3	1st Byte	2nd Byte
	0x50	0x0B

V.3.6.2 Has Tag information been obtained?

The status timing at completion of Tag obtainment is the same as reference (on status when obtaining Tag).
As MCHNG = H is a condition to terminate, check the ID3READY status at this point and obtain Tag.

V.3.6.3 Read Tag information

After checking status which shows completion of obtaining the Tag information, read the Tag information from the LSI, using READ_ID3_TITLE, READ_ID3_ARTIST and READ_ID3_ALBUM.

READ_ID3_TITLE command

READ_ID3_ TITLE	1st Byte	2nd Byte	64Byte Read
	0x5F	0x04	

READ_ID3_ARTIST command

READ_ID3_ARTIST	1st Byte	2nd Byte	64 Byte Read
	0x5F	0x05	

READ_ID3_ALBUM command

READ_ID3_ALBUM	1st Byte	2nd Byte	64 Byte Read
	0x5F	0x06	

To interrupt Tag analysis using the ABORT command and then execute Tag analysis again, send the STOP command once and then send GET_ID3 command again. Also, to select a different AAC/WMA/MP3 file after analysis, send the STOP command once.

V.3.6.4 The notes when GET_ID3 command execution

Where AAC/WMA / MP3 file is specified by the SET_DIRECT command after reset, TAG analysis may not be performed at the time of the first GET_ID3 command execution.

Please perform the following processing before the first GET_ID3 command sending.

In the state where AAC/WMA / MP3 file was specified by the SET_DIRECT command.

(1) Send the PLAY_DIRECT command.

(2) It is WAIT (about 1-2msec) until BUSY PIN Falls to L, since BUSY PIN is set to H after Command Reception.

(3) If BUSY PIN Falls to L, send the STOP command immediately.

Then, GET_ID3 command sending is performed.

After performing the above-mentioned processing once, TAG analysis by the GET_ID3 command is performed normally.

If the STOP command is immediately (Less than about 10msec) executed after BUSY PIN falling, IC does not output sound by the decoding processing time of IC by the case of gapless files, either.

V.3.7 Start Playing

Specify the AAC/WMA/MP3 file to be played in the SET_DIRECT and send the PLAY_DIRECT command. The LSI starts playing the specified file.

PLAY_DIRECT command

PLAY_DIRECT	1st Byte	2nd Byte
	0x50	0x0D

To stop playing, send the STOP command.

STOP command

STOP	1st Byte	2nd Byte
	0x50	0x03

V.3.8 Read Status

During play, read the statuses of play time and error condition in the same manner as in MODE2. Read the play time information at an interval of 100 ms or so.

After playing the AAC/WMA/MP3 file, the status of the MCHNG terminal port or STATUS3: MCHNG turns “0”.

Upon completion of play of AAC/WMA/MP3 file, specify the access data of the AAC/WMA/MP3 file to be played in the same manner.

Reference

When specifying the number of folders/files to be obtained

You can specify the number of folders or files to be analyzed, using the SET_NUMBER command.
Specify the access data of the obtained folder using the SET_DIRECT command. Before sending the GET_DIRECT command, specify the number of folders/files to be obtained using the SET_NUMBER command.

SET_NUMBER command

	1st Byte	2nd Byte	3th-6th Byte
SET_NUMBER	0x51	0x21	Number of folders [2Byte] + Number of files [2Byte]

Reference

When obtaining the number of folders/files contained in the specified folder

Specify the access data of the folder for which you want to obtain the number of folders/files, using the SET_DIRECT command, and send the GET_NUMBER command.

GET_NUMBER command

	1st Byte	2nd Byte
GET_NUMBER	0x50	0x0A

When using the GET_NUMBER command, check that analysis has been completed by reading the STATUS4: ANAEND status and then read the number of folders/files using the READ_NUMBER command, in the same manner when using the GET_DIRECT command.

READ_NUMBER command

	1st Byte	2nd Byte	
READ_NUMBER	0x5F	0x0A	4 Byte Read

Ⅴ.4 File Read Function

Reading a specified file data is possible from USB memory. Host CPU SW can be updated by this function. Only a file that exists in root folder and has a file name of 8.3 forms corresponds.

This chapter explains the operation flow that achieves the File Read function.

Ⅴ.4.1 The flow of the File Read function

Fig.Ⅴ.4.1 shows about operation flow of File Read function.

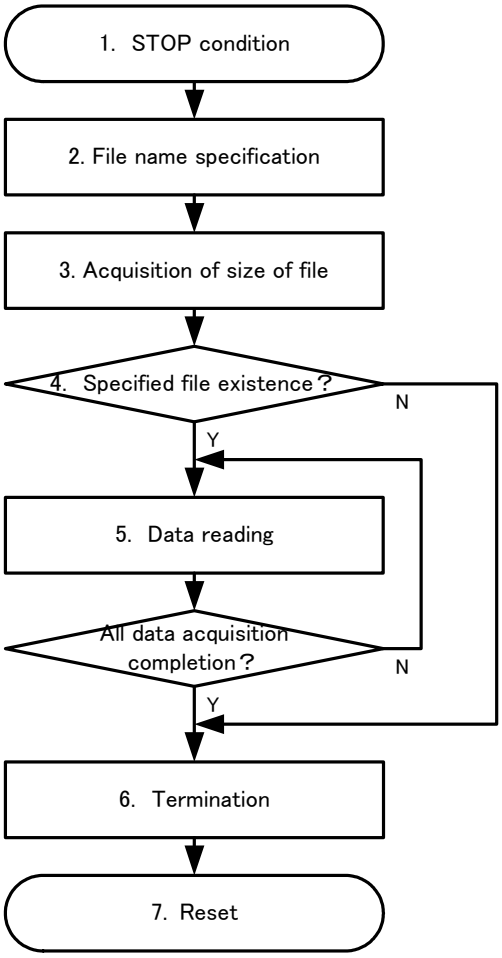


Fig. Ⅴ.4.1 Operation flow of File Read function

Ⅴ.4.1.1 Stop condition

Operate the File Read function from the stop condition.

Ⅴ.4.1.2 File name specification

Specify the file read by using SET_UPLOAD_FILE1 and SET_UPLOAD_FILE2 command.

The file that can be specified exists in the root folder, and becomes a file of the file name of 8.3 forms.

When the file is specified, the wild-card cannot be used.

SET_UPLOAD_FILE1 command

	1st Byte	2nd Byte	
SET_UPLOAD_FILE1	0x51	0x51	NAME[0:5] 6 Byte Write

SET_UPLOAD_FILE2 command

SET_UPLOAD_FILE2	1st Byte	2nd Byte	NAME[6:7] EXTENSION[0:2] 6 Byte Write
	0x51	0x52	

Bury it with 0x20 when the file name doesn't come up to eight bytes.

Bury it with 0x00 when the extension doesn't come up to three bytes.

When the file names are compared, it doesn't assume after 0x00 of the end to be correspondence of the comparison.

(Example)

For the file name "UPDATE.BIN"

SET_UPLOAD_FILE1 : [0x51、0x51、0x55、0x50、0x44、0x41、0x54、0x45]

SET_UPLOAD_FILE2 : [0x51、0x52、0x20、0x20、0x42、0x49、0x4E、0x00]

Ⅴ.4.1.3 Acquisition of size of file

The size of the specified file is acquired.

READ_FILE_SIZE command

READ_FILE_SIZE	1st Byte	2nd Byte	4 Byte Read
	0x5F	0x11	

The size of the file is output by four bytes. Acquire it with Little Endian.

When the file doesn't exist, 0xFF, 0xFF, 0xFF, and 0xFF are output to the size of the file.

Ⅴ.4.1.4 Specified file existence

End the file reading, if the file is not existence after the size of the specified file is acquired.

Ⅴ.4.1.5 Data reading

Read the data for the size of the file by the READ_FILE_DATA command.

READ_FILE_DATA command

READ_FILE_DATA	1st Byte	2nd Byte	96 Byte Read
	0x5F	0x12	

Read the file data by reading every 96 bytes. Four head bytes of each data become file offsets, and substance becomes 92 bytes' worth of the following data. Therefore, the file offset does the count improvement in 92.

(Example)

1st Reading [0x00、0x00、0x00、0x00、92byte data]

2nd Reading [0x5C、0x00、0x00、0x00、92byte data]

....

13419th Reading [0x74、0cD6、0x12、0x00、92byte data]

Execute it from the SET_UPLOAD_FILE command when you interrupt reading on the way.

The data read when the file terminal is exceeded and up-loaded is irregular. Disregard data other than the size of the file.

Ⅴ.4.1.6 Termination

End the File Read function by the "UPLOAD_END" command when completed reading of the data of the specified file.

UPLOAD_END command

UPLOAD_END	1st Byte	2nd Byte
	0x51	0x53

Ⅴ.4.1.7 Reset

Reset the system when you end File Read.

VI. Revision History

Revision No.	Date	Revised by	Revising points
Target 0.01	2009/02/02	H.K.	Newly created
Target 0.02	2009/05/28	H.K.	The explanation addition of resume and fast forward playing and fast backward playing. File Read functional explanation addition.