- Structure   :Silicon monolithic integrated circuit
- Product name   :Voice synthesis IC
- Shape name   :BU6922KV
- External dimensional drawing   :Figure 2-1
- Pin layout   :Table 3-1
- Block diagram: Figure 5-1

- Absolute maximum rating(Ta=25)

Item	Symbol	Ratings	Unit
Power dissipation	Pd	750 *	mW
Applied voltage	V_{DD}	-0.2 4.5	V
	V_{DDCORE}	-0.2 2.5	V
Input voltage	V_{IN}	-0.2 VDD+0.3	V
Operating temperature range	T_{OPR}	-20 +75	
Storage temperature range	TSTG	-50 125	

     * Over Ta=25 , reduce 7.5mW per .

- Not designed for radiation resistance.

This product has not been checked for service (design, manufacture, and technology) defined in the Foreign Exchange and Foreign Trade Control Low of Japan so that a verification work is required before exporting it.

DESIGN	CHECK	APPROVAL	DATE: 2006/06/13	SPECIFICATION No.: Target specifications
			REV. 0.5	ROHM CO., LTD.

1.Functional overview

   BU6922KV is a voice synthesis IC which retrieves voice synthesis data from external ROM
   along with various modes set by the serial interface, and decodes and playbacks
   high-efficiency voice compression data. The main functions are described below.

   High compression rate
   Support maximum 128Mbits external ROM
   Sampling rate is 32KHz
   Built-in 16bits DAC
   System clock is 16.384MHz. Build in oscillation circuit
   Serial interface is supported for host interface.
   Various play modes
       - decodable 4 tracks simultaneously
       - adjustable volume at each track independently.
       - enable to decode tunes which are registered in the sequencer list. Order of tunes are
       randomly selected.
       - For each track, enable to playback a selected tune or to playback tunes in the sequencer list
       with/without loop.
       - fade-in and fade-out functions are supported.

2.External dimensional drawing

BU6922KV

12.0 ± 0.2

10.0 ± 0.1

12.0 ± 0.2

10.0 ± 0.1

48 33

49 32

64 17

1 16

1.25

$1PIN\tau-\jmath$

LOT No.

1.25

0.5 ± 0.15

1.0 ± 0.2

$0.145\,^{+0.05}_{-0.03}$

$1.6MAX$

1.4 ± 0.05

0.1 ± 0.05

0.5 ± 0.1

$0.2\,^{+0.05}_{-0.04}$

$4^{\cdot}\,^{+6^{\cdot}}_{-4^{\cdot}}$

| � | 0.08 | S |

| ⊕ | 0.08 Ⓜ |
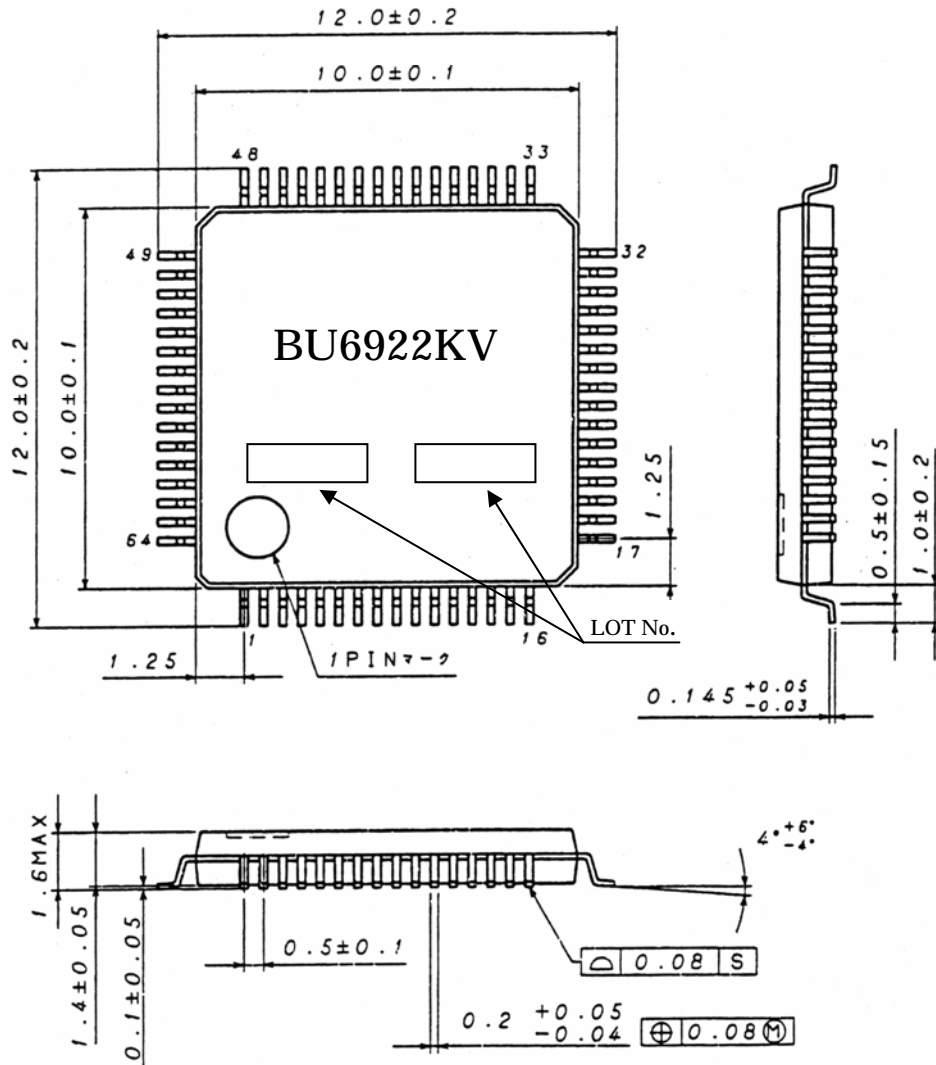
(UNIT:mm)

3.Pin layout

Table 3-1 shows pin layout.

Table 3-1 Pin table - Refer to page 25/25 for I/O circuit form.

PIN NO.	Pin name	I/O	I/O circuit form	Function
1	TEST1	I	-B	("L" fixation)
2	REFOUT	O	-B	DAC reference voltage output
3	DACOUT	O	-B	DAC output
4	VDD1	-	-	Power supply 1 (IO and analog) (3V)
5	ROMA21	O	-A	External ROM address 21
6	ROMA22	O	-A	External ROM address 22
7	ROMCS_BAR	O	-A	External ROM chip select
8	ROMA0	O	-A	External ROM address 0
9	ROMA1	O	-A	External ROM address 1
10	ROMA2	O	-A	External ROM address 2
11	ROMA3	O	-A	External ROM address 3
12	ROMA4	O	-A	External ROM address 4
13	GND	-	-	GND
14	ROMA5	O	-A	External ROM address 5
15	ROMA6	O	-A	External ROM address 6
16	RESET_BAR	I	-A	Reset input ("L" active)
17	INROM_BAR	I	-A	("H" fixation)
18	ROMA7	O	-A	External ROM address 7
19	ROMA8	O	-A	External ROM address 8
20	ROMA9	O	-A	External ROM address 9
21	VDD2	-	-	Power supply 2 (core) (1.8V)
22	ROMA10	O	-A	External ROM address 10
23	ROMA11	O	-A	External ROM address 11
24	ROMA12	O	-A	External ROM address 12
25	ROMA13	O	-A	External ROM address 13
26	ROMA14	O	-A	External ROM address 14
27	ROMA15	O	-A	External ROM address 15
28	GND	-	-	GND
29	ROMA16	O	-A	External ROM address 16
30	TEST	I	-A	("L" fixation)
31	ROMA17	O	-A	External ROM address 17
32	TXD	O	-A	Serial interface transmit data

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PIN NO.	Pin name	I/O	I/O circuit form	Function
33	RXD	I	-A	Serial interface receive data
34	RXC_BAR	I	-A	Serial interface clock
35	ROMA18	O	-A	External ROM address 18
36	ROMA19	O	-A	External ROM address 19
37	ROMA20	O	-A	External ROM address 20
38	ROMD15	I	-A	External ROM data 15
39	STBY	I	-A	Standby ("H" oscillation stop, DAC OFF) "L" normal
40	ROMD14	I	-A	External ROM data 14
41	SYNC_REQ	O	-A	Synchronous character request (Synchronization error "H")
42	ROMD13	I	-A	External ROM data 13
43	TSEVENT	O	-A	Play, stop flag("H": play, "L" stop)
44	ROMD12	I	-A	External ROM data 12
45	VDD2	-	-	Power supply 2 (core) (1.8V)
46	ROMD11	I	-A	External ROM data 11
47	ROMD10	I	-A	External ROM data 10
48	GND	-	-	GND
49	OSC1	I		Oscillation cell input (16.384MHz)
50	OSC2	O		Oscillation cell output (16.384MHz)
51	VDD1	-	-	Power supply 1 (IO, analog) (3V)
52	ROMD9	I	-A	External ROM data 9
53	ROMD8	I	-A	External ROM data 8
54	ROMD7	I	-A	External ROM data 7
55	ROMD6	I	-A	External ROM data 6
56	ROMD5	I	-A	External ROM data 5
57	ROMD4	I	-A	External ROM data 4
58	ROMD3	I	-A	External ROM data 3
59	ROMD2	I	-A	External ROM data 2
60	ROMD1	I	-A	External ROM data 1
61	ROMD0	I	-A	External ROM data 0
62	GND	-	-	GND
63		O	-B	(OPEN)
64	TEST2	I	-B	("H" fixation)

Note) Set the following specified pins as shown in the table below.

Pin No.	Pin name	Fixed value
1	TEST1	L
17	INROM_BAR	H
30	TEST	L
64	TEST2	H

Operation at other than above-described pin setting is not guaranteed.

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4.Electric characteristic

- Operating conditions (Ta=-20　+75　unless otherwise specified.)

Item	Symbol	Specified value			Unit	Condition	Circuit form	Measurement Circuit
		Min	Typ	Max				
Operating power-supply voltage(I/O power supply)	V_{DD}	2.7	3.0	3.6	V	-	-	-
Operating power-supply voltage(Core power supply)	V_{DDcore}	1.62	1.8	1.98	V	-	-	-

- DC characteristic (Ta=+25　V_{DD}=3.0V　V_{DDcore}=1.8V unless otherwise specified.)

Item	Symbol	Standard value			Unit	Condition	Circuit form	Measurement Circuit
		Min	Typ	Max				
"H" input voltage	V_{IH}	$0.7V_{DD}$	-	-	V	-	I	1
"L" input voltage	V_{IL}	-	-	$0.3V_{DD}$	V	-	I	1
"H" output voltage	V_{OH}	V_{DD}-0.4	-	-	V	Io=1.8mA		2
"L" output voltage	V_{OL}	-	-	0.4	V	Io=1.8mA		2
"H" input current	I_{IH}	-	-	10	μA	$V_{IH}=V_{DD}$	I	1
"L" input current	I_{IL}	-	-	-10	μA	$V_{IL}=GND$	I	1
Static consumption current	I_{ST}	-	-	10	μA	$V_i=V_{DD}orGND$	-	3

- OSC, RESET_BAR, and command interface timing

1. OSC
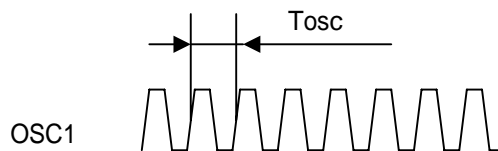
Figure 4-1   OSC1 timing

Table 4-1   OSC1 timing

Item	Symbol	Min	Typ	Max	Unit
Clock frequency	fosc	-	16.384	-	MHz
Clock cycle	Tosc	-	61.0	-	ns

2. RESET_BAR
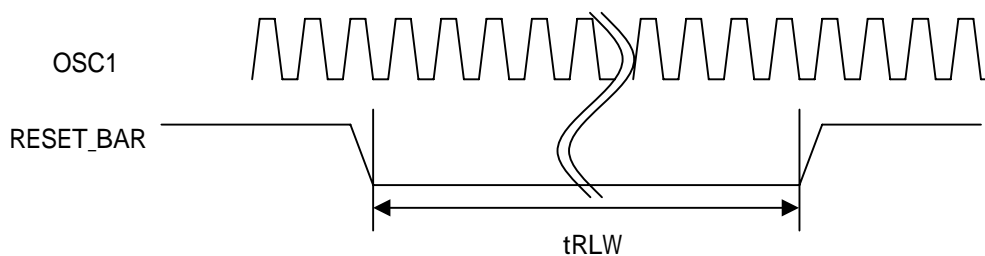
Figure 4-2   Reset timing

Table 4-2   Reset timing

Item	Symbol	Min	Typ	Max	Unit
Reset "L" pulse width	tRLW	17	-	-	CLK

3. RXC_BAR, RXD, and TXD serial interface
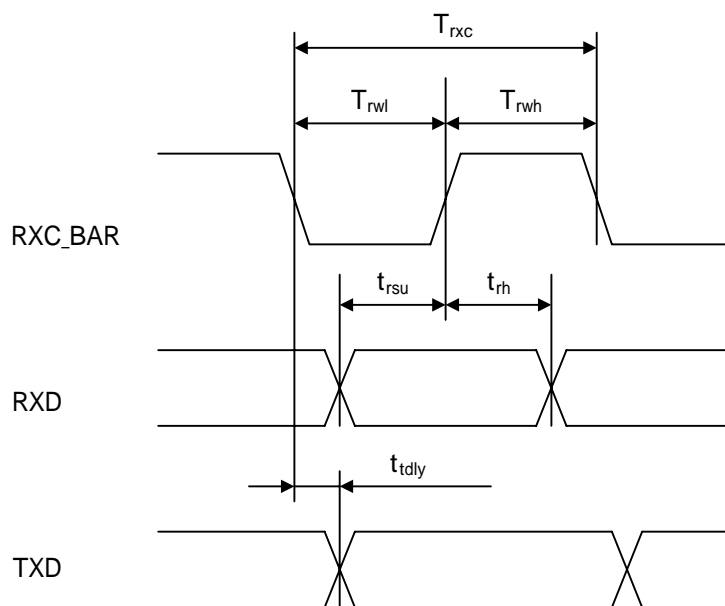
Figure 4-3   Serial interface timing

Table 4-3   Serial interface timing

Item	Symbol	Min	Typ	Max	Unit
RXC cycle	Trxc	10*Tosc	-	-	ns
RXC Lo cycle	Trwl	4*Tosc	-	-	ns
RXC Hi cycle	Trwh	4*Tosc	-	-	ns
RXD setup time	trsu	2*Tosc	-	-	ns
RXD hold time	trh	2*Tosc	-	-	ns
TXD output delay	ttdly	-	-	4*Tosc	ns

4. External ROM interface
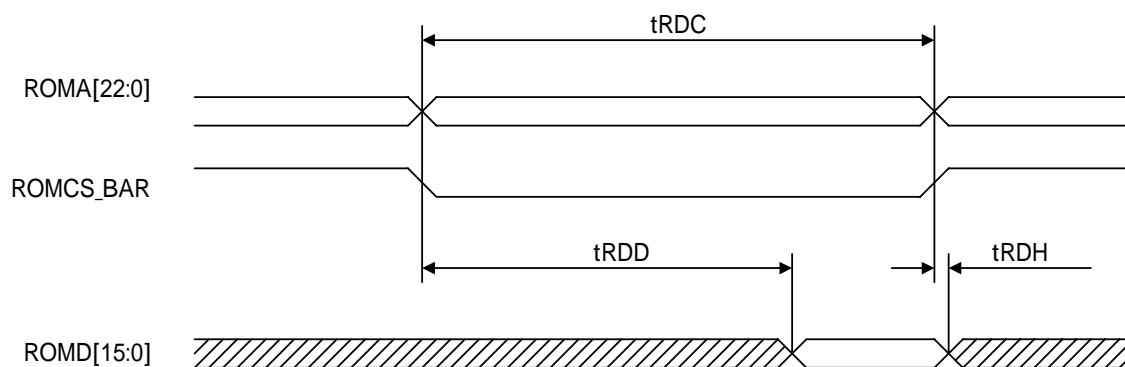
Figure 4-4   External ROM interface timing

.

Table 4-4   External ROM interface timing

Item	Symbol	Min	Typ	Max	Unit
Read cycle time	tRDC	-	5	-	CLK(Tosc)
Read data delay time	tRDD	-	-	4	CLK(Tosc)
Data hold time	tRDH	0	-	-	ns

5. Block Diagram

SIO

BU6922KV

Command I/F (Serial I/F)	Main processor Control part	Output I/F

| Pre-processor
Control part | Calculating part
Reverse quantization
Sub band synthesis | DAC |

ROM I/F	Work RAM

output

Coefficient ROM
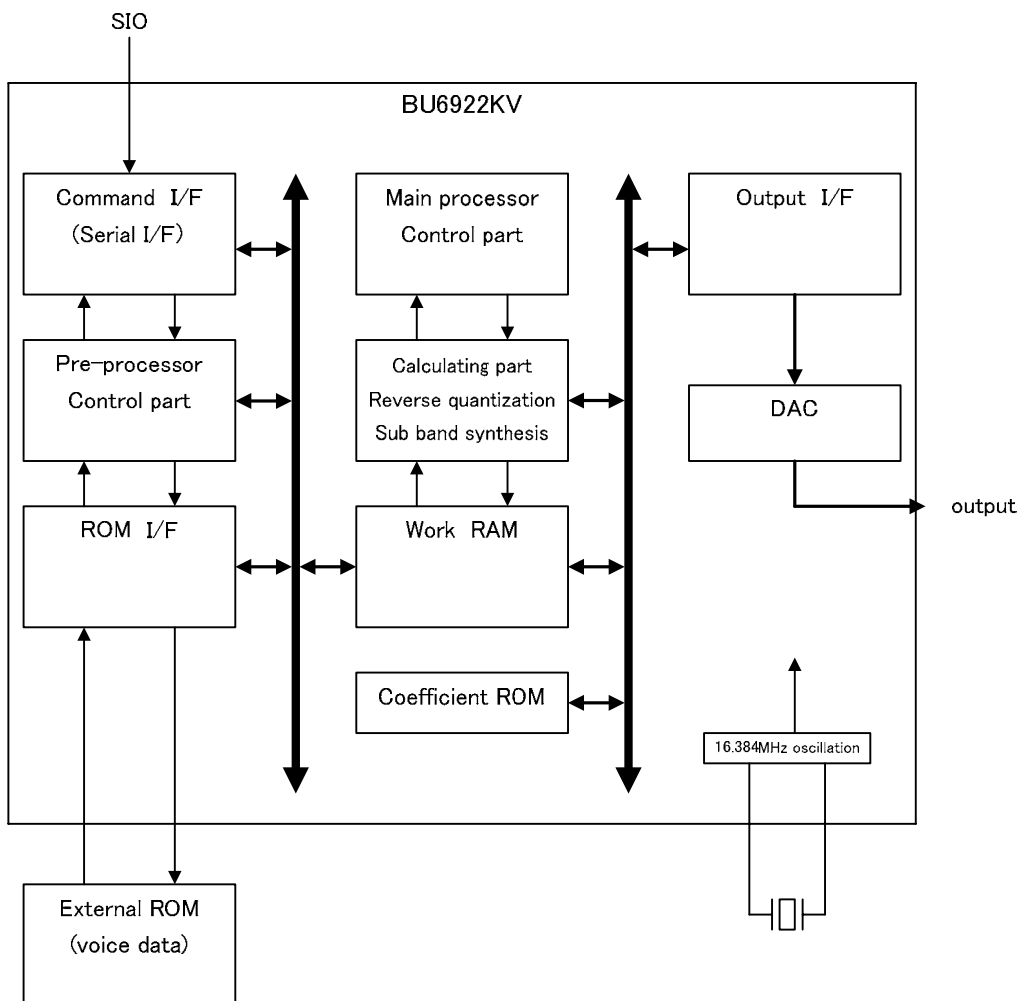
16.384MHz oscillation

External ROM
(voice data)

Figure 5-1　BU6922KV block diagram

6. Command interface

Command interface is a serial interface receiving 8 or 16 bits command data synchronized with input clock, non parity, and sync-code (8 bits).   Sync-code is a fixed value, BF(h).

The order of received data is   LSB FAST.

6.1.1.   Command communication

The command is communicated with clocks and the data   as follows;

(1) Serial data transfer clock input (RXC_BAR); retrieves data by rising edge.

Frequency shall be equal to or less than   1MHz.

(2) Serial data input (RXD); 8 bits or 16 bits serial data(LSB FAST)

(3) Sync-code request output (SYNC_REQ); when this signal is "H", sync-code should be sent followed by the commands

6.1.2.   Monitoring TSTATUS (TXD)

It outputs status of accepting play and stop command at   each track.

("H" shows accepting play command, "L" shows accepting stop command)

Also, it outputs OR of 4 tracks status(play or stop) to TSEVENT terminal.

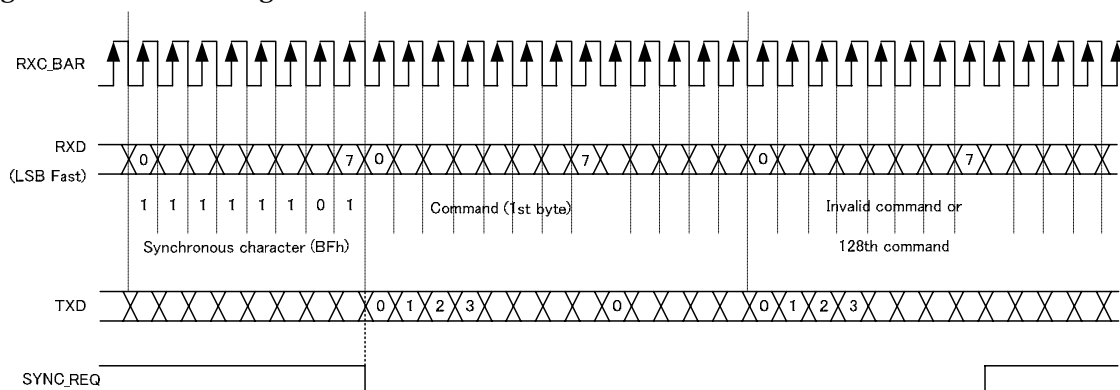Figure 6-1 shows timing chart of communication.

Figure 6-1   Serial interface timing chart

At Fig.6-1, sync-code(more than 1 byte) is input before sending command. The maximum chunk of consecutive commands is 128 bytes. Noted that , if sync-code   is input after command transfer, 128 bytes of consecutive command after sync-code   are accepted.

If more than 129 bytes of command are conseutively input, 129th byte or later is ignored. Noted that, if 128th byte is the first byte of 2 byte command, 129th byte (2nd byte of 2 byte command) can be accepted.

If 128th byte is sync-code, it   is   ignored. In this case, SYNC_REQ   becomes   "H" and its status becomes   "waiting for sync-code".

After command transfer is completed, interface shall be one of the following states until next command transfer.

1.   continue to   input sync-code

2.   input nothing (stops clock RXC_BAR.)

The status(play/stop)of each track is output   to TXD   during synchronization. The bit order of TXD is Track0,1,2,3.

6.2. Status signal

BU6922KV outputs the following status signals.

1. SYNC_REQ

SYNC_REQ is a sync-code request signal. "L" shows the state of synchronization, and "H" shows the state of "waiting for sync-code", or synchronization error.
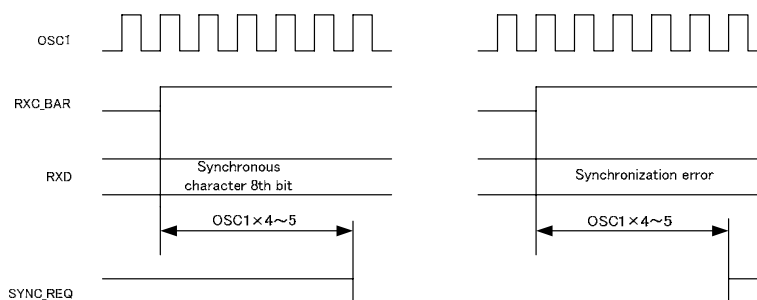
Timing chart is described below.

Figure 6-2-1 SYNC_REQ timing

2. TSEVENT

TSEVENT signal becomes "H" when any of the track receives play command.

The timing chart is described in a figure below.
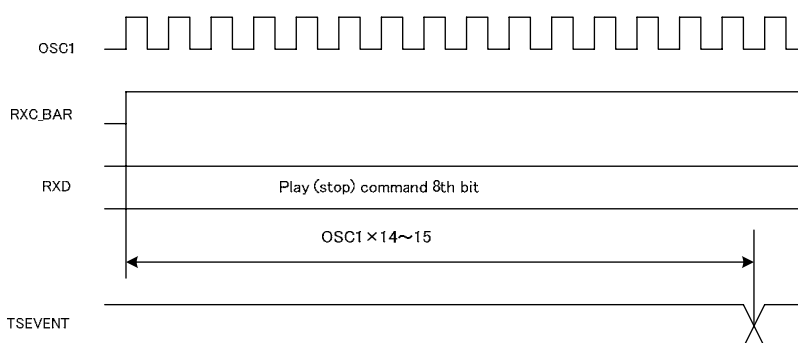

Figure 6-2-2 TSEVENT timing

Noted that outputting sound has several ms delay after accepting play command. When stop commands are issued and accepted to all tracks, TSEVENT signal becomes "L". Noted also that there is several ms delay until the sound stops.
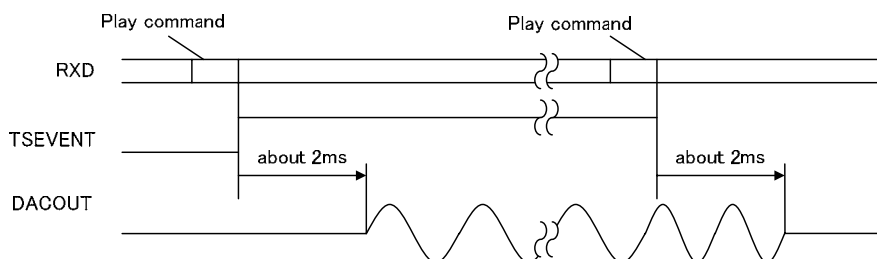

Figure 6-2-3 TSEVENT and DACOUT timing

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6.3. Command details

6.3.1. Command list

All commands are 1 byte or 2 bytes command.

Table 6.3-1 shows the command list. Also, details of each command are described from the later page.

Table 6.3-1　command list

Content of command	Bit allocation(CMD 7:0)							
	7	6	5	4	3	2	1	0
System setting	0	0	0	0	0	1	0	MODE
LOOP setting	0	1	0	0	1	Loop	TRSel	
Pause	0	1	0	0	0	1	TRSel	
Play	0	0	1	0	Mode	Loop	TRSel	
Stop	0	1	0	0	0	0	TRSel	
Sequence clear	0	1	0	1	1	0	TRSel	
Selection	1	1	0	1	0	Mode	TRSel	
	Tune							
Volume	1	0	0	1	Fade	Maste	TRSel	
				Vol				
Fade volume initial value	1	0	1	0	0	0	TRSel	
				Vol				
Fade interval time	1	0	1	0	0	1	TRSel	
	Time							

6.3.2. Details of each command

(1) System setting command(1byte command)

Set track mode.

Content of	Bit allocation(CMD[7:0])							
command	7	6	5	4	3	2	1	0
System setting	0	0	0	0	0	1	0	Mode

Item	Number of bits	Initial value	1	
Mode	1	0b	The system mode is set.	
			Set value	Function
			0b	NOP mode
			1b	4 track mode

(2) Play command(1byte command)

Play tunes at a selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Play	0	0	1	0	Mode	Loop	TRsel	

Item	Number of bits	Initial value	Explanation	
Mode	1	0b	Play mode is set.	
			Set value	Function
			0b	Normal play
			1b	Sequencer is executed.
Loop	1	0b	Loop control of the track is set.	
			Set value	Function
			0b	Loop disable
			1b	Loop enable
TRSel	2	00b	Re-controlled track is selected.	
			Set value	Function
			00b	Track 0
			01b	Track 1
			10b	Track 2
			11b	Track 3

(3) Stop command(1byte command)

Stop tunes at a selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Stop	0	1	0	0	0	0	TRSel	

Item	Number of bits	Initial value	Explanation	
TRSel	2	00b	Track to stop is selected.	
			Set value	Function
			00b	Track 0
			01b	Track 1
			10b	Track 2
			11b	Track 3

(4) Pause command(1byte command)

pause or resume at　selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Pause/ resume	0	1	0	0	0	1	TRSel	

(5) LOOP command(1byte command)

set LOOP at selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
LOOP setting	0	1	0	0	1	Loop	TRSel	

Item	Number of bits	Initial value	Explanation		
Loop	1	0b	Set Loop control		
			Set value	Function	
			0b	Invalid loop	
			1b	Valid loop	
TRSel	2	00b	Select track for looping.		
			Set value	Function	
			00b	Track 0	
			01b	Track 1	
			10b	Track 2	
			11b	Track 3	

The usage of this command is to disable loop mode during playing with loop mode. The command is also valid for sequencer mode. When disabling loop during playing tunes at sequencer mode, sequencer stops at the end of the tune in the sequencer list. For example, when five songs are set for looping, it　stops to playback at the end of　5th song when "disable loop" command is issued.

(6) Sequence clear command(1byte command)

Clear sequence list

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
LOOP setting	0	1	0	1	1	0	TRSel	

(7) Tune-selection command(2bytes command)

Set tune number at the selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Selection	1	1	0	1	0	Mode	TRSel	
	Tune							

Item	Number of bits	Initial value	Explanation		
Mode	1	0b	Set tune-selection mode		
			value	Function	Number of command bytes
			0b	select a tune	2 bytes
			1b	Add tune to sequence	2 bytes
TRSel	2	00b	Select a track		
			value	Function	
			00b	Track 0	
			01b	Track 1	
			10b	Track 2	
			11b	Track 3	
Tune	8	00h	Select a tune number.		

(8) Volume command(2bytes command)

Control volume at the selected track.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Volume	1	0	0	1	Fade	Master	TRSel	
					Vol			

Item	Number of bits	Initial value	Explanation
Fade	1	0b	Set Fade in/out. It fades from the initial value to volume value specified by this command. <table><tr><td>Set value</td><td>Function</td></tr><tr><td>0b</td><td>Disable</td></tr><tr><td>1b</td><td>Enable</td></tr></table>
Master	1	0b	Set validity of volume value. When fade0-in/fade-out mode, Set "0" at each track. <table><tr><td>Set value</td><td>Function</td></tr><tr><td>0b</td><td>Disable</td></tr><tr><td>1b</td><td>Enable</td></tr></table>
TRSel	2	00b	Track which sets the volume is selected. <table><tr><td>Set value</td><td>Function</td></tr><tr><td>00b</td><td>Track 0</td></tr><tr><td>01b</td><td>Track 1</td></tr><tr><td>10b</td><td>Track 2</td></tr><tr><td>11b</td><td>Track 3</td></tr></table>
Vol	5	1Fh	Set volume value. 0 = mute, 31 = maximum volume

(9) volume initial value for fade in/out command(2bytes command)

al Set initial value for executing fade in/out.

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Fade volume initial value	1	0	1	0	0	0	TRSel	
					Vol			

Item	Number of bits	Initial value	Explanation		
TRSel	2	00b	Select track		
			Set value	Function	
			00b	Track 0	
			01b	Track 1	
			10b	Track 2	
			11b	Track 3	
Vol	5	1Fh	Set volume value 0 = mute, 31 = maximum volume		

(10) Fade interval time set command(2bytes command)

Set interval time value for fade in/out .

command	Bit allocation(CMD[7:0])							
	7	6	5	4	3	2	1	0
Fade interval time	1	0	1	0	0	1	TRSel	
					Time			

Item	Number of bits	Initial value	Explanation	
TRSel	2	00b	Select track	
			Set value	Function
			00b	Track 0
			01b	Track 1
			10b	Track 2
			11b	Track 3
Time	8	00h	Interval time at fading is set. The unit is 1ms.	

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7. Sequencer

Control of sequencer and addition/clear of tune are done by play command and tune-selection command respectively. Each track has a sequencer independently. The maximum numbers of tune registered to sequencer are 8.   The example of sequencer is shown below;
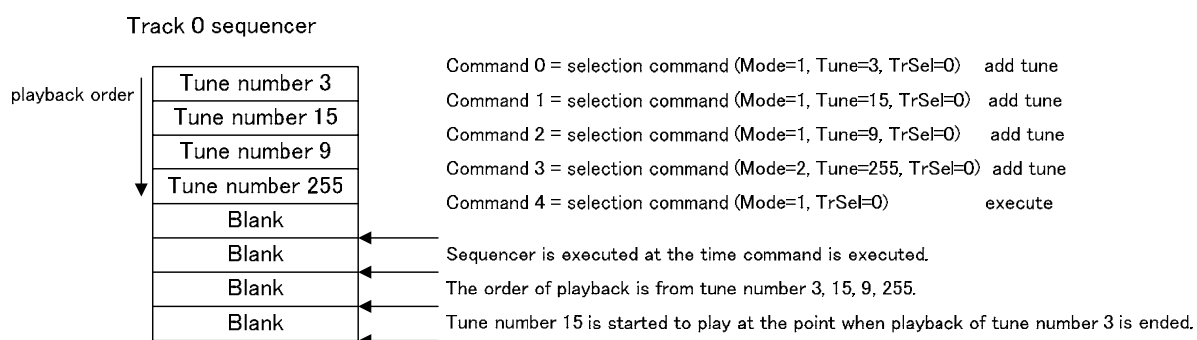
Track 0 sequencer

Figure 7-1 Sequencer

- Addition of a tune to sequencer

It is done by selection command (Mode=1).

When sequencer is stopped by stop command while sequencer is running, or when additional command is issued after execution of sequencer is finished, a tune is added at the end of sequencer list.

- Sequencer clear

Clear of sequencer is done by tune-selection command (Mode=2). When sequencer clear is issued, all tunes in the list are cleared shown in figure 7-1. For changing the order of tunes, it is necessary to clear sequencer once, and add tune by tune-selection command.

Clear command   during sequencer is running is ignored.

- tune-selection command issued when 8 tunes are already in the sequencer list

The command is ignored.

8. playback using Loop command

The order of playback when sequencer is running with LOOP mode is from tune number 3 15 9
255 3 15 9   as described in Figure 8-1

Also, when disabling LOOP command is issued while LOOP is on, sequencer is stopped at the end of next tune of the tune currently running.
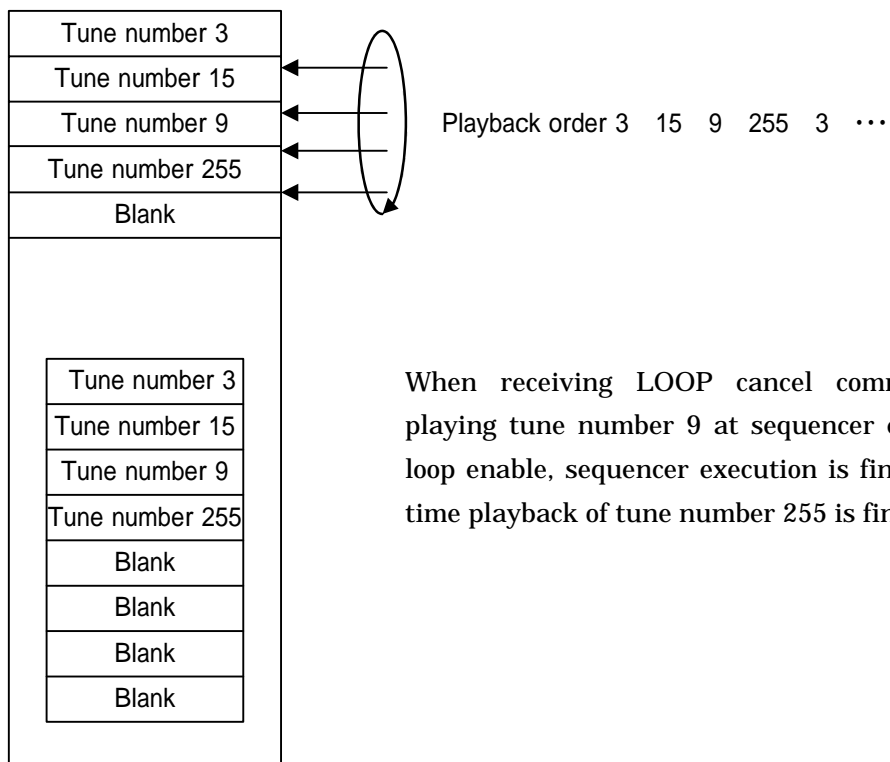

Figure 8-1 playback using Loop command

9. Fade

BI6922KV supports the function of fade in/out.

The example of fade in is described below.

1.Fade volume initial value command (TrSel=0,Vol=0)

2.Fade interval time command (TrSel=0,Time=10)

3.Volume command (Fade=1,Master=0,TrSel=0,Vol=31)---Fade in is executed when this command is issued.
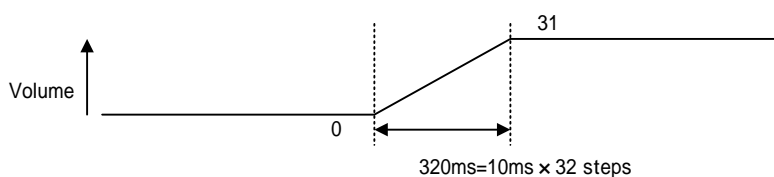
Figure 9-1 Fade

In this example, volume increases from 0 by one step and becomes 31 after 320ms.

In the case that volume value of initial value command is bigger than the volume set by volume command, fade out is executed.

10. Example of system block diagram using BU6922KV and example of command setting
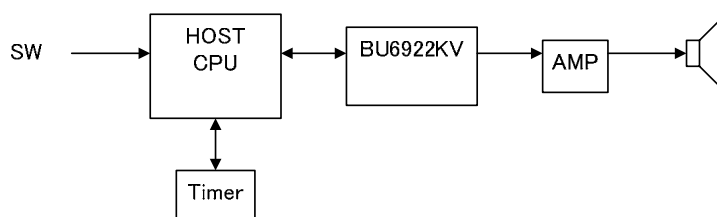

Figure 10-1   example of system block diagram using BU6922KV

Example of command setting

The example shows the case when playing 2 tracks simultaneously and executing fade out at the end of the sequence. For the tune number to play, track 0 loop from   0th   to   5th tune, and track 1 repeats 10th tune.

Table 10-1   Command setting example

Proce- dure	Operation	Command setting value		Content
		1st byte	2nd byte	
1	system setting command issue	05h		changes from NOP to 4 track mode.
2	selection command issue	D0h	00h	Tune 0 is added to track 0.
		D4h	05h	Tune 5 is added to track 0
		D1h	0Ah	Tune 10 is added to track 1.
3	volume command setting	90h	0Fh	The volume of track 0 is set to 15.
		91h	0Fh	The volume of track 1 is set to 15.
4	Fade volume initial setting	A0h	0Fh	Initial value of track 0 is set to 15.
		A1h	0Fh	Initial value of track 1 is set to 15.
5	Fade time setting	A4h	80h	Track 0 is set at 128ms intervals.
		A5h	80h	Track 1 is set at 128ms intervals.
6	Play	2Ch		Track 0 is played with sequencer, and loop. (0 5 0 5------)
		25h		Track 1 is played without sequencer and with loop. (10 10 10 10------)
7	Volume command setting	98h 99h	00h 00h	Volume of track 0 is set to "0". Start fade out for track 0. Volume of track 1 is set to "0". Start fade out for track 1.
8	Stop command	40h		Track 0 stop
		41h		Track 1 stop

ROHM CO., LTD.   REV.   0.5   SPECIFICATION No. : target specifications
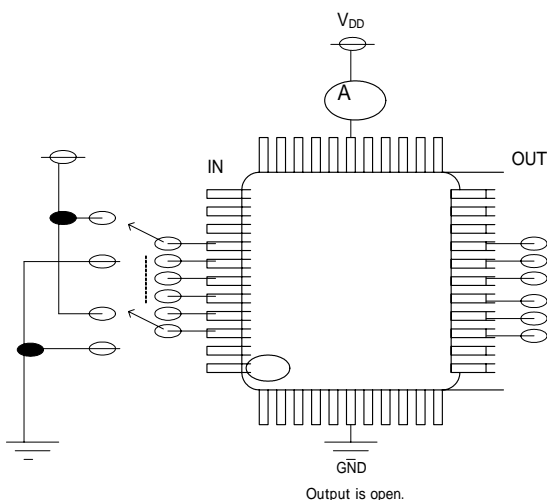
- Measurement circuit
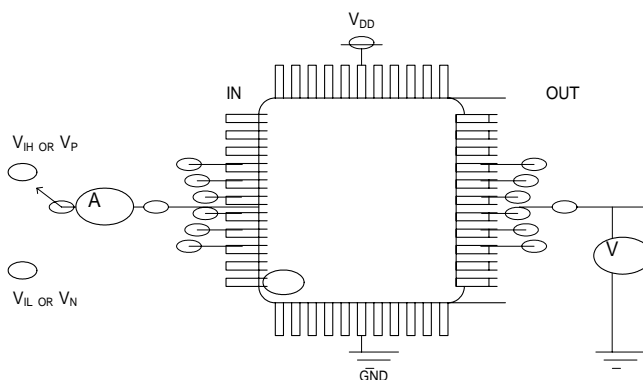
Measurement circuit - 1   Input voltage current measurement circuit
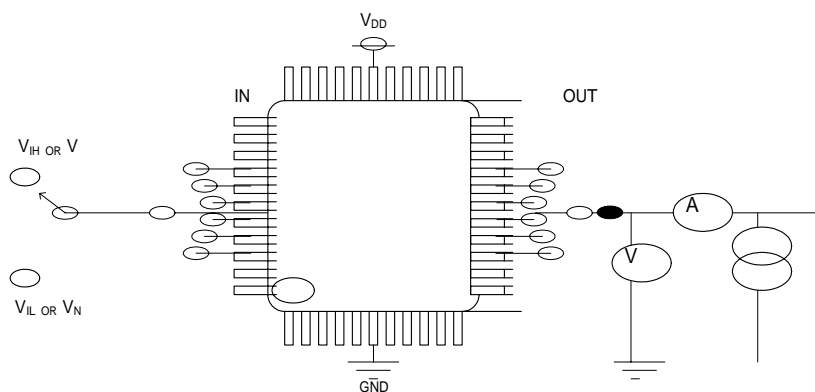
Measurement circuit - 2   Output voltage current measurement circuit

Output is open.

Measurement circuit – 3   Static consumption current measurement circuit