ML22Q340/340/Q341/341

ADPCM Speech Synthesis LSI

GENERAL DESCRIPTION

The ML22340/ML22Q340/ML22341/ML22Q341, which include mask ROM and Flash memory for storing speech data, respectively, are speech synthesis LSIs which can controll speech playback utilizing an event input system.
It includes speaker amplifier and 16bit DA Converter, so it is possible to have high quality sound and solution for playback with 1chip.

- Playback Time

Product Name	Capasitance of ROM(bit)	Maximum Playback time(s) （Fsam=8.0kHz）		
		HQ-ADPCM	4bitADPCM2	16bitPCM
ML22Q340/340	620K	—	19.8	4.9
ML22Q341/341	876K	35.0	28.0	7.0

- Speech sysnthesis system: 4-bit ADPCM2
  8-bit/16-bit straight PCM system
  8-bit nonlinear PCM system
  HQ-ADPCM (*1) (ML22Q341/341)
  (can be specified for each phrase)
- Speech ROM capacity   ML22340:   620-Kbit Mask ROM
  ML22Q340:   620-Kbit Flash
  ML22341:   876-Kbit Mask ROM
  ML22Q341:   876-Kbit Flash
- Sampling frequency: 8.0/16.0 /32.0kHz, 6.4/12.8/25.6 kHz/, 10.7/21.3 kHz
  (fsam can be specified in units of phrase)
- Analog output: Built-in 16-bit DA converter
- Interface: Event input system (built-in noise elimination function)
- Sequencer output function: 16 types
- Maximum event count: 30 events
- Input pin setting: High-impedance input (CMOS input), pull-down input, or pull-up input is selectable based on ROM data
- Output pin setting: High-impedance output, CMOS output, Pch open drain output, Nch open drain output, or LED drive is selectable based on ROM data
- Source oscillation frequency: 4.096 MHz (Typ.)
- Power supply voltage: 2.3V to 5.5V
- Flash memory rewrite cycles   80 times (ML22Q340/Q341)
- Operating temperature range: −40°C to +85°C
- Package: 30-pin plastic SSOP (SSOP30-56-0.65-Z6K9-MC)
- Product name: ML22340-xxxMB (xxx: ROM code number)
  ML22341-xxxMB (xxx: ROM code number)
  ML22Q340-NNNMB/ML22Q340-xxxMB (xxx: ROM code number)
  ML22Q341-NNNMB/ML22Q341-xxxMB (xxx: ROM code number)

(*1) HQ-ADPCM is audio compression technology featuring high-quality sound. It was developed by "Ky's".
"Ky's" is a registered trademark of Kyushu Institute of Technology, one of the national universities in Japan.
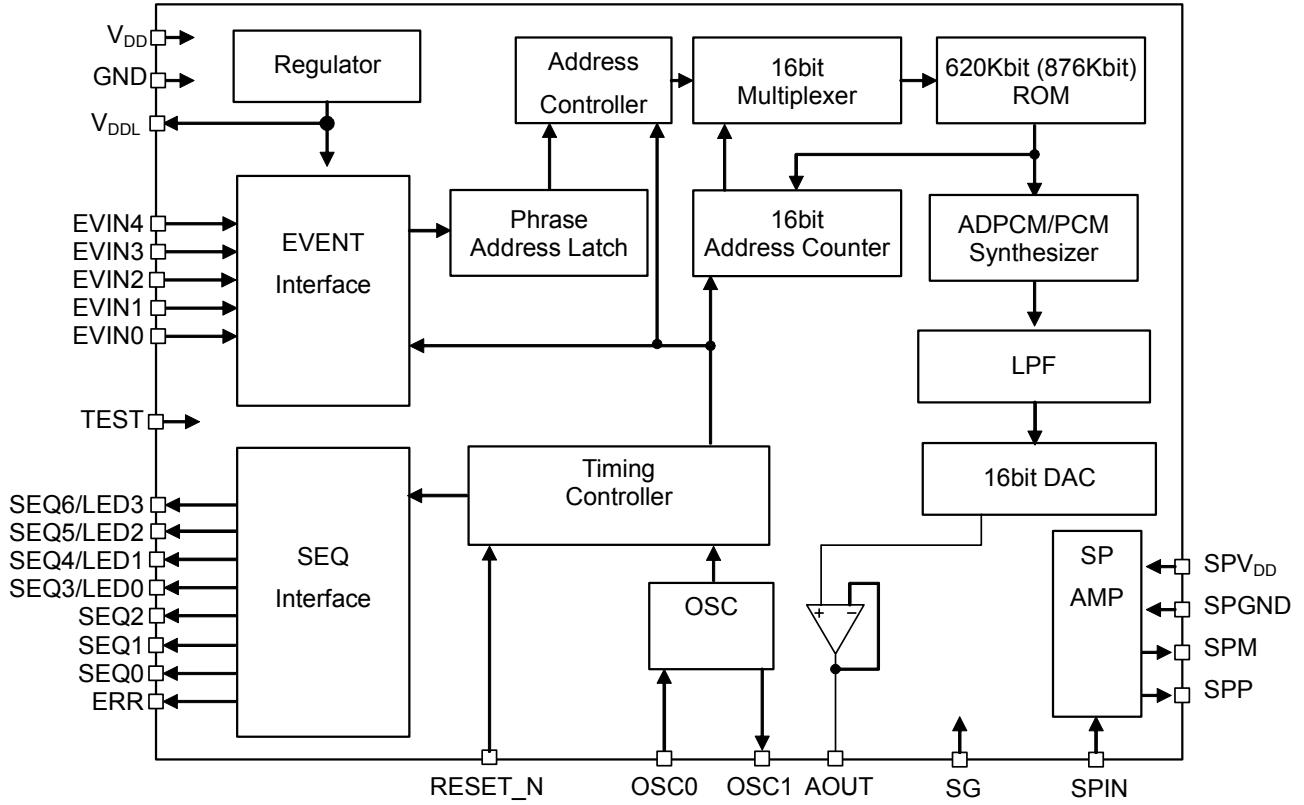
BLOCK DIAGRAM

ML22Q340-NNN/ML22Q341-NNN/ML22Q340-xxx/ML22Q341-xxx
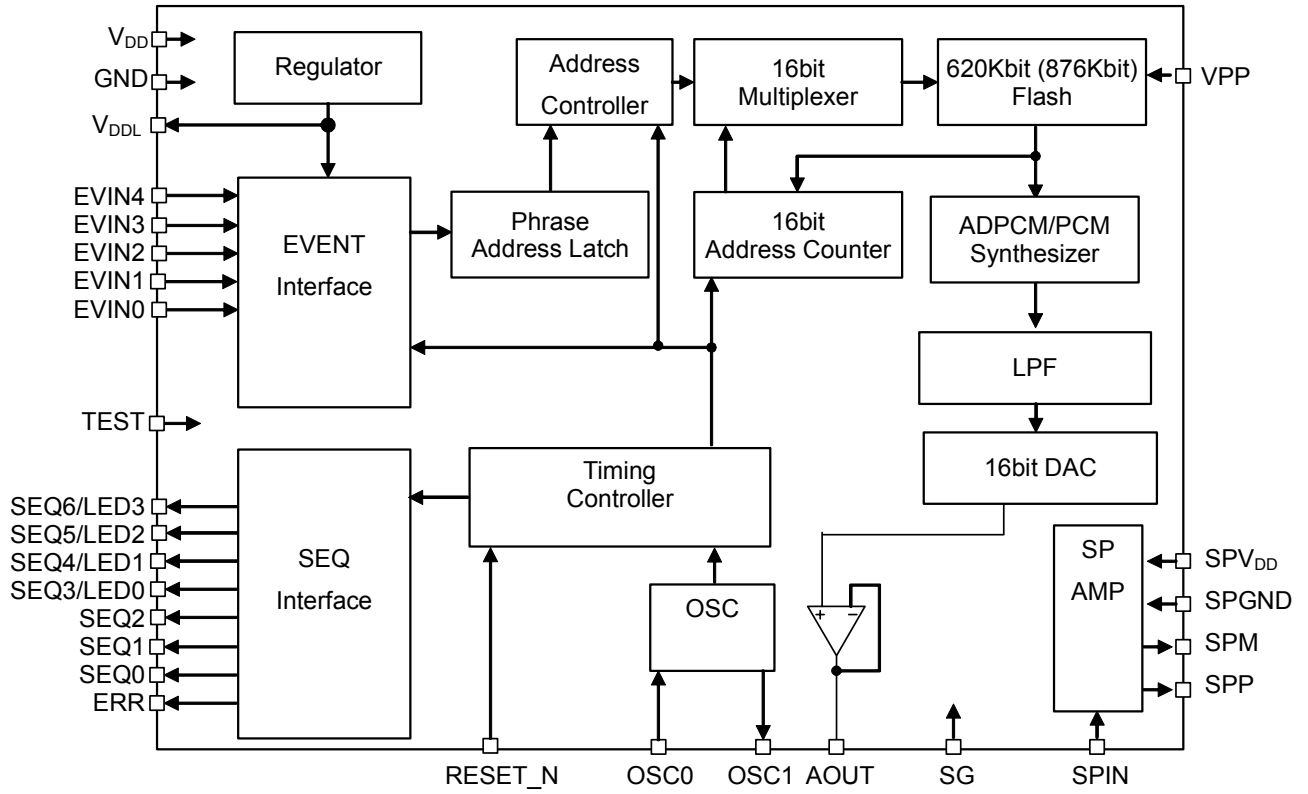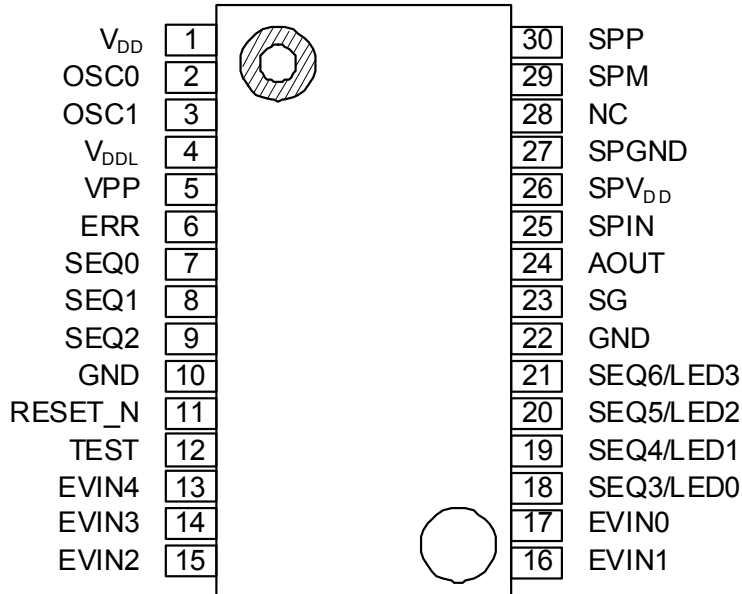

():Applies to ML22Q341

ML22340-xxx/ML22341-xxx

():Applies to ML22341
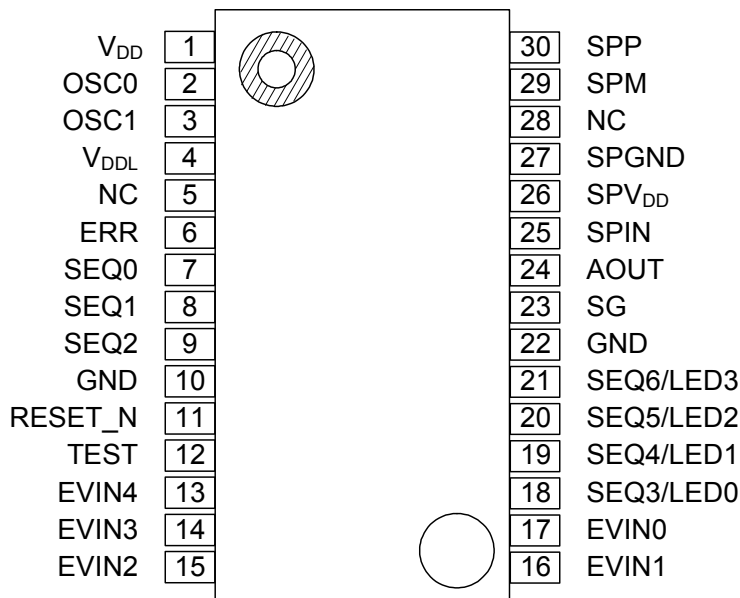
PIN CONFIGURATION (TOP VIEW)

ML22Q340-NNNMB/ML22Q341-NNNMB/ML22Q340-xxxMB/ML22Q341-xxxMB

V_{DD}	1		30	SPP
OSC0	2		29	SPM
OSC1	3		28	NC
V_{DDL}	4		27	SPGND
VPP	5		26	SPV_{DD}
ERR	6		25	SPIN
SEQ0	7		24	AOUT
SEQ1	8		23	SG
SEQ2	9		22	GND
GND	10		21	SEQ6/LED3
RESET_N	11		20	SEQ5/LED2
TEST	12		19	SEQ4/LED1
EVIN4	13		18	SEQ3/LED0
EVIN3	14		17	EVIN0
EVIN2	15		16	EVIN1

NC：Unused pin

30-pin Plastic SSOP

ML22340-xxxMB/ML22341-xxxMB

V_{DD}	1		30	SPP
OSC0	2		29	SPM
OSC1	3		28	NC
V_{DDL}	4		27	SPGND
NC	5		26	SPV_{DD}
ERR	6		25	SPIN
SEQ0	7		24	AOUT
SEQ1	8		23	SG
SEQ2	9		22	GND
GND	10		21	SEQ6/LED3
RESET_N	11		20	SEQ5/LED2
TEST	12		19	SEQ4/LED1
EVIN4	13		18	SEQ3/LED0
EVIN3	14		17	EVIN0
EVIN2	15		16	EVIN1

NC：Unused pin

30-pin Plastic SSOP

PIN DESCRIPTIONS

Pin No.	symbol	I/O	Description
11	RESET_N	I	Place this pin at a "L" level when powered on. After the supply voltage is settled, place this pin at a "H" level.
17 16 15 14 13	EVIN0 EVIN1 EVIN2 EVIN3 EVIN4	I	Event specifying input pins. Event execution or stop can be performed by changes in the input signals to the activation pins set by the EVIN0 pin or Mask option Set the unused pins to be pulled up or pulled down. And the SEQ0 pin can specify only the SEQ pattern 6.
12	TEST	I	Input pin for testing. Fix this pin at a "L" level (GND level).
2	OSC0	I	Pin for connecting a crystal or a ceramic vibrator. A feed back resistor (about 1 MΩ) is included between OSC0 and OSC1 pins. When a vibrator is used, place it as close to the LSI as possible.
3	OSC1	O	Pin for connecting a crystal or a ceramic vibrator. When a vibrator is used, place it as close to the LSI as possible.
6	ERR	O	Error output pin for thermal detection and disconnection detection. If disconnection detection or a higher temperature than the judgment temperature is detected, this pin output "H". Setting event 1 , operate the disconnection detection. And the 100ms "H" pulse is output right after the event start.
7 8 9	SEQ0 SEQ1 SEQ2	O	Sequencer output pins. This pin is output SEQ pattern 01h~10h based on ROM data. The SEQ patterns (01h to 10h) set by Mask option are output. And the SEQ0 pin can specify only the SEQ pattern 6.
18 19 20 21	SEQ3/LED0 SEQ4/LED1 SEQ5/LED2 SEQ6/LED3	O	Sequencer output pins. These pins can drive LED. The patterns set by Mask option are output.
24	AOUT	O	Playback signal output pin. When you use built-in speaker amplifier, connect with the SPIN pin.
5	VPP *Note 1	—	Power supply pin for rewriting Flash memory. Fix this pin to GND except when rewriting Flash memory.
1	V_{DD}	—	Digital power supply pin. Connect a capacitor of 0.1 μF or more between this pin and GND.
4	V_{DDL}	—	Output pin of the regulator for the internal logic power supply. Connect a electrolytic capacitor of 10 uF or more and a ceramic capacitor of 0.1 μF or more between the V_{DDL} and GND pins.
10,22	GND	—	Digital ground pin.
27	SPGND	—	Speaker amplifier ground pin.
26	SPV_{DD}	—	Speaker amplifier power supply pin.
25	SPIN	I	Analog input pin of internal speaker amplifier.
23	SG	O	Built-in speaker amplifier's reference voltage output pin. Connect a capacitor of 0.1 μF or more between this pin and GND.
30	SPP	O	Positive output pin of the built-in speaker amplifier.
29	SPM	O	Negative output pin of the built-in speaker amplifier.

Notes: 1. Applies to ML22Q340-NNN / ML22Q341-NNN.

LAPIS
SEMICONDUCTOR

ABSOLUTE MAXIMUM RATINGS

(GND = SPGND = 0 V)

Parameter	Symbol	Condition	Rating	Unit
Digital power supply voltage	V_{DD}		−0.3 to +7.0	V
Internal logic power supply voltage	V_{DDL}		−0.3 to +3.6	V
Speaker power supply voltage	SPV_{DD}	Ta = 25 °C	−0.3 to +7.0	V
Flash power supply voltage (Note 1)	VPP		−0.3 to +9.5	V
Input voltage	V_{IN}	Ta = 25 °C When JEDEC 2-layer board is mounted	−0.3 to V_{DD}+0.3	V
Power dissipation	P_D	Ta = 25 °C	861	mW
Output short current	I_{SC1}	except LED drive pin, Ta = 25 °C	−12 to +11	mA
	I_{SC2}	LED drive pin, Ta = 25 °C	−12 to +20	mA
Storage temperature	T_{STG}	—	−55 to +150	°C

Note 1: Applies to the ML22Q340-NNN/ML22Q341-NNN.

RECOMMENDED OPERATING CONDITIONS

(GND = SPGND = 0 V)

Parameter	Symbol	Condition	Range			Unit
Digital power supply voltage	V_{DD}	—	2.3 to 5.5			V
		ML22Q340 / ML22Q341 read	2.3 to 5.5			
		ML22Q340 / ML22Q341 write	3.0 to 5.5			
Speaker power supply voltage	SPV_{DD}	—	2.3 to 5.5			V
Flash power supply voltage	VPP	ML22Q340 / ML22Q341 write	7.7 to 8.3			V
Flash memory rewrite cycles	N	ML22Q340 / ML22Q341	80			times
Operating temperature	T_{OP1}	ML22340 / ML22341	−40 to +85			°C
	T_{OP2}	ML22Q340 / ML22Q341 read	−40 to +85			
	T_{OP3}	ML22Q340 / ML22Q341 write	0 to +40			
Source oscillation frequency	f_{OSC}	—	Min.	Typ.	Max.	MHz
			3.5	4.096	4.5	

ELECTRICAL CHARACTERISTICS

DC Characteristics

V_{DD} = SPV_{DD} = 2.3 to 5.5 V, GND = SPGND = 0 V, Ta = −40 to +85°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" input voltage	V_{IH}	—	$0.7 \times V_{DD}$	—	V_{DD}	V
"L" voltage	V_{IL}	—	0	—	$0.3 \times V_{DD}$	V
"H" output voltage 1	V_{OH1}	I_{OH} = −0.5 mA CMOS output, Pch open drain selected	V_{DD}−0.5	—	—	V
"H" output voltage 2	V_{OH2}	I_{OH} = −100 µA OSC1 pin	V_{DD}−0.5	—	—	V
"L" output voltage 1	V_{OL1}	I_{OL} = 0.5 mA CMOS output, Nch open drain selected	—	—	0.5	V
"L" output voltage 2	V_{OL2}	I_{OL} = 100 µA OSC1 pin	—	—	0.5	V
"L" output voltage 4	V_{OL4}	I_{OL} = 8 mA, $V_{DD} \geqq$ 2.3V When the LED drives	—	—	0.5	V
"H" input current 1	I_{IH1}	V_{IH} = V_{DD} High-impedance input selected	—	—	1	µA
"H" input current 2	I_{IH2}	V_{IH} = V_{DD} TEST pin	0.02	0.3	1.5	mA
"H" input current 3	I_{IH3}	V_{IH} = V_{DD} Pull-down input selected	2	30	250	µA
"L" input current 1	I_{IL1}	V_{IL1} = GND High-impedance input selected	−1	—	—	µA
"L" input current 2	I_{IL2}	V_{IL} = GND RESET_N pin	−1.5	−0.3	−0.02	mA
"L" input current 3	I_{IL3}	V_{IL} = GND CSEL pin	−250	−30	−2	µA
Supply current during operate	I_{DD1}	Non-loaded output V_{DD} = SPV_{DD} = 3.0V	—	2.5	12	mA
	I_{DD2}	Non-loaded output V_{DD} = SPV_{DD} = 5.0V	—	8	12	
Supply current during power down	I_{DDS1}	Ta $\leqq$40°C	—	0.5	2.0	µA
	I_{DDS2}	Ta $\leqq$ 85°C	—	0.5	8.0	

Analog Characteristics

V_{DD} = SPV$_{DD}$ = 2.3 to 5.5 V, GND = SPGND = 0 V, Ta = −40 to +85°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
AOUT output load resistance	R_{LA}	During 1/2 V$_{DD}$ output	10	—	—	kΩ
AOUT output voltage range	V_{AO}	No output load	1/6×V$_{DD}$	—	5/6×V$_{DD}$	V
SG output voltage	V_{SG}	—	0.95xV$_{DD}$/2	V$_{DD}$/2	1.05xV$_{DD}$/2	V
SG output resistance	R_{SG}	—	57	96	135	kΩ
SPM, SPP output load resistance	R_{LSP}	—	8	—	—	Ω
Speaker amplifier output power	P_{SPO}	SPV$_{DD}$=5.0V, f=1kHz , R$_{SPO}$=8Ω, THD≧10%	—	1	—	W
Output offset voltage between SPM and SPP with no signal present	V_{OF}	SPIN-SPM gain=0dB 8Ω load	-50	—	50	mV

AC Characteristics

V_{DD} = SPV$_{DD}$ = 2.3 to 5.5 V, GND = SPGND = 0 V, Ta = −40 to +85°C

| Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Duty cycle of source oscillation	f_{duty}	—	40	50	60	%
RESET_N input pulse width	t_{RST}	—	100	—	—	μs
Voltage startup time	t_{PWR}	—	—	—	10	ms
Initialize time	t_{INIT}	f_{OSC} = 4.096 MHz	20	—	22	ms
Oscillation stabilizing time	t_{OSC}	—	—	2	20	ms
Noise elimination time	t_{CHT}	—	14	16	18	ms
SG pin voltage stabilization time (Rising)	t_{SGR}	f_{OSC} = 4.096 MHz	32	—	34	ms
SG pin voltage stabilization time (Falling)	t_{SGF}	f_{OSC} = 4.096 MHz	64	—	66	ms
Pop noise elimination time	t_{POPR} t_{POPF}	f_{OSC} = 4.096 MHz	40	—	42	ms
Disconnection judging time	t_{DCD}	—	100	—	—	ms

Load capacitance of the output pins = 55 pF (max.)
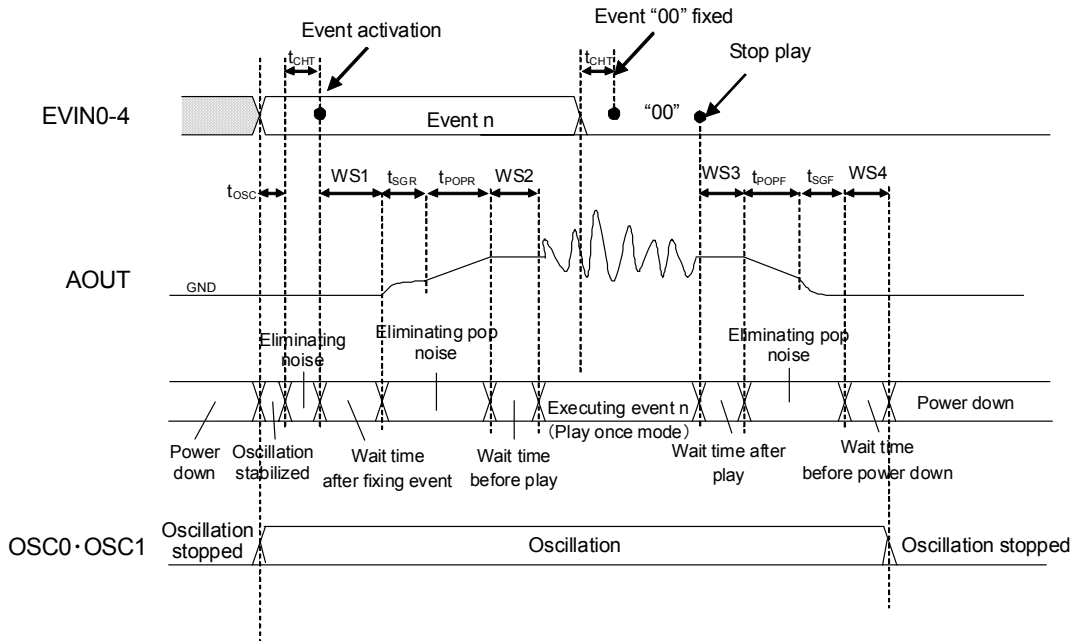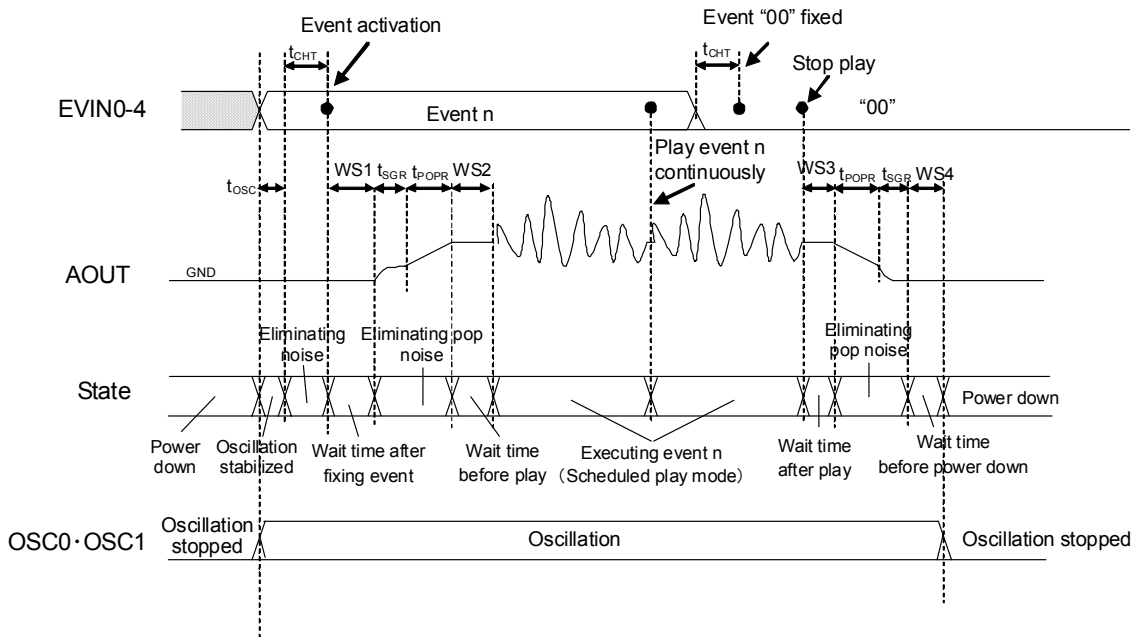
TIMING DIAGRAMS

Power On
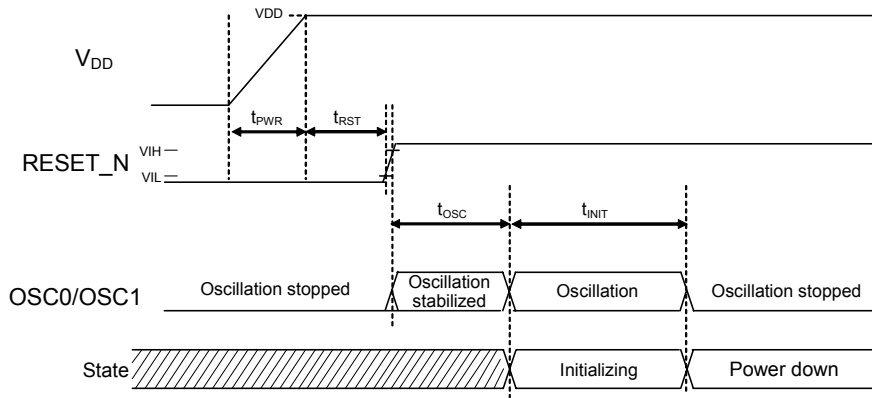
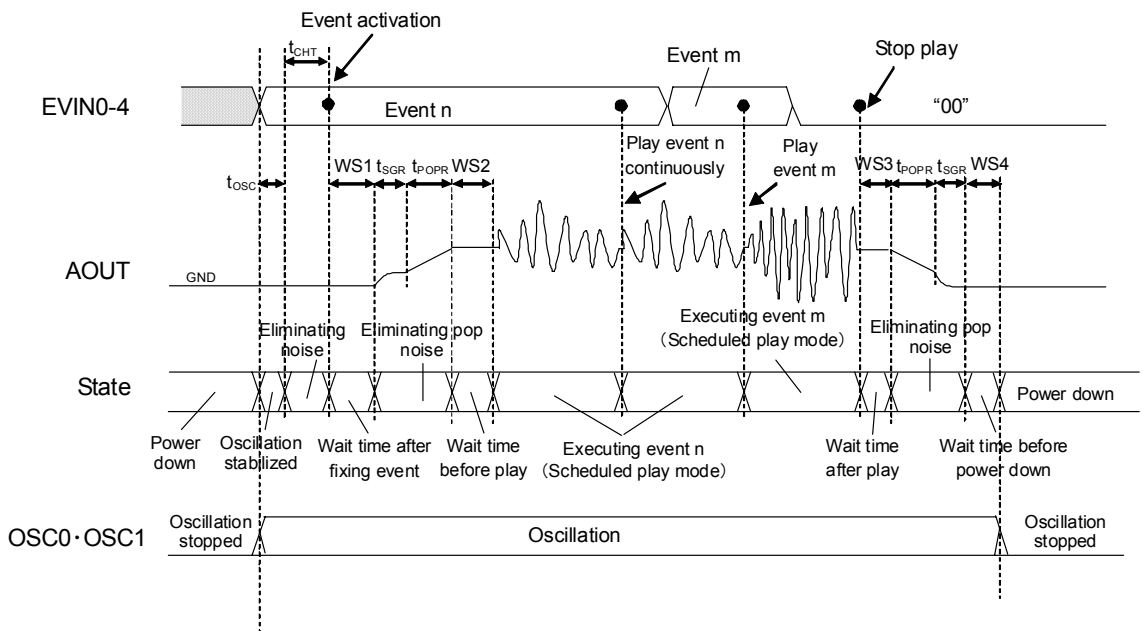**Event Control example 1 (Only one playback in Play once mode)**
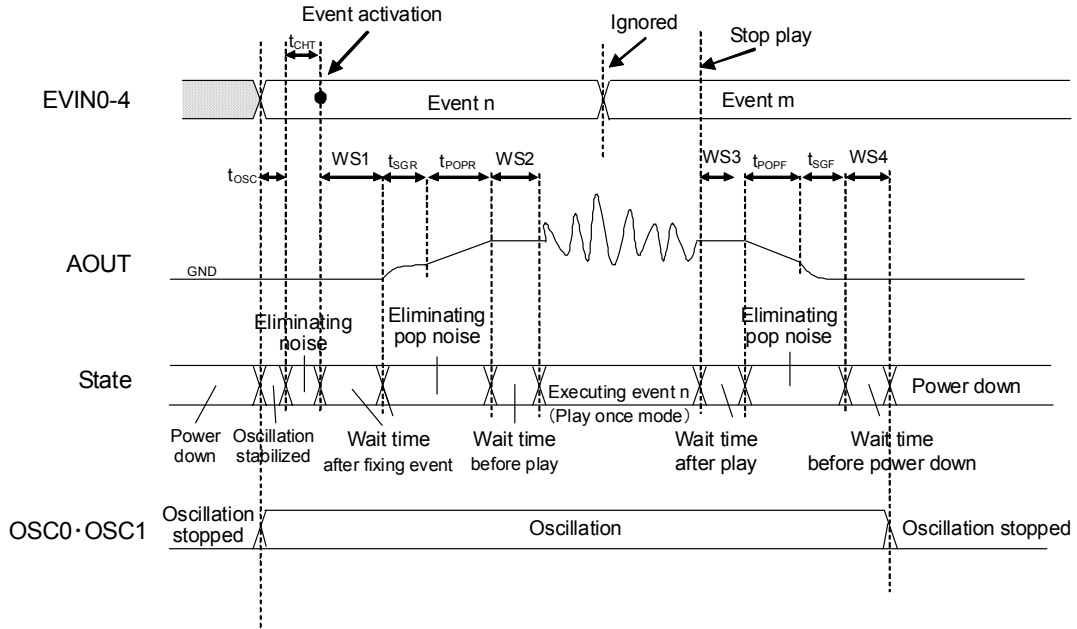
Event Control example 2 (Only one playback in Scheduled play mode)
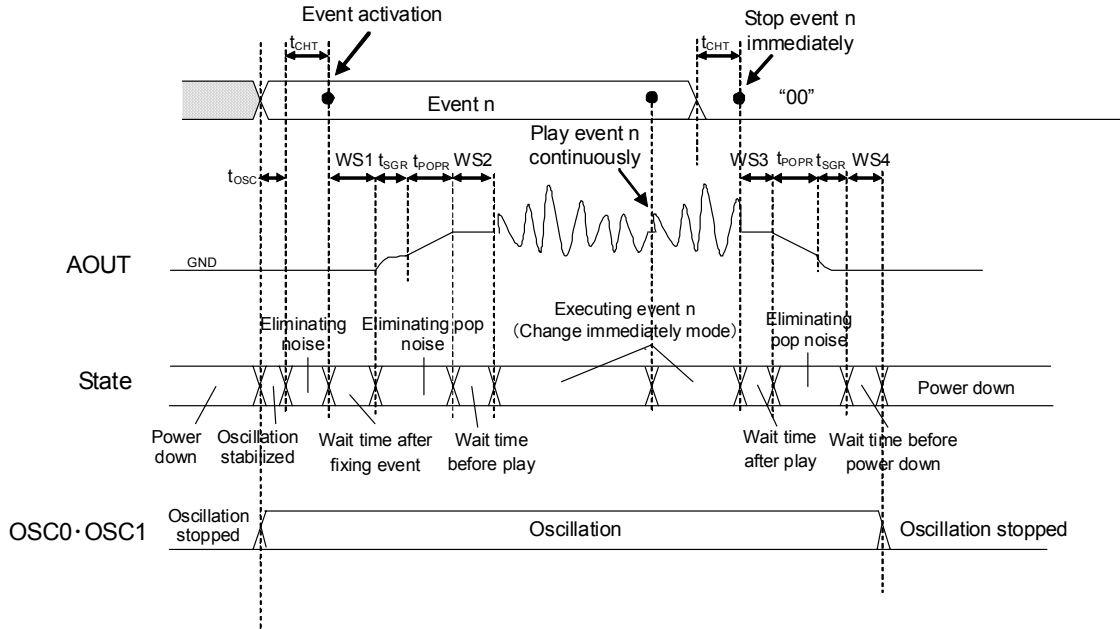
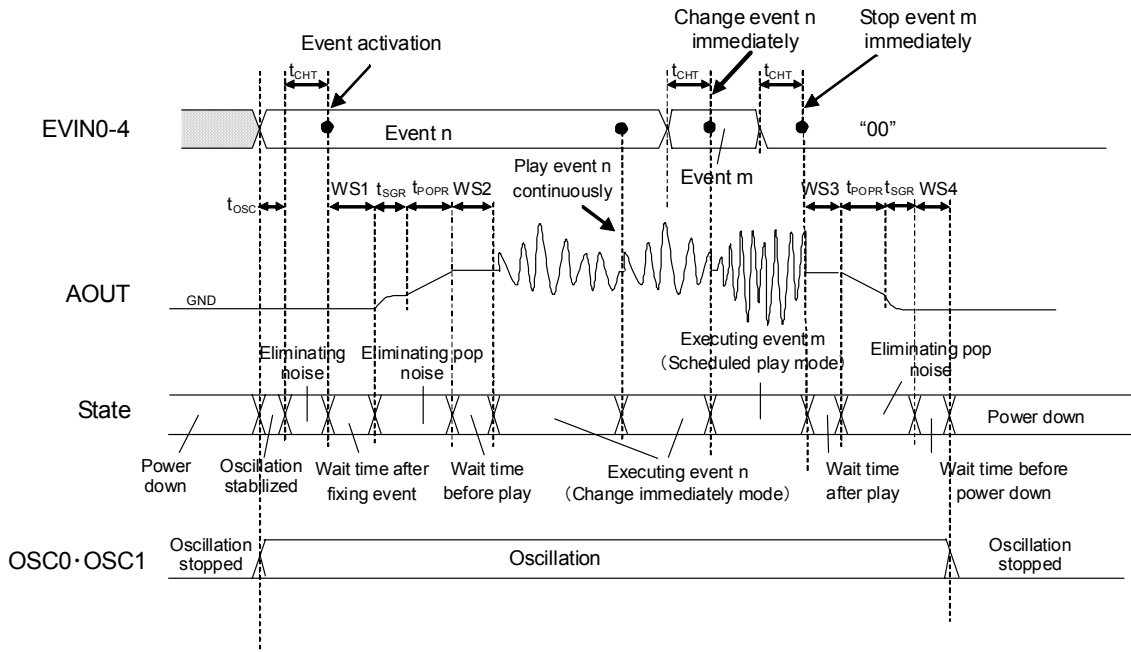**Event Control example 3 (Repetitive playback in Scheduled play mode)**

Event Control example 4 (Change in playback phrase in Scheduled play mode)

Event Control example 5 (Repetitive playback in Change immediately mode)

Event Control example 6 (Different consecutive event execution timing diagram in Change immediately mode)

FUNCTIONAL DESCRIPTION

The "Speech LSI Utility" is used for the setting of an each function and the creating of ROM data.
The Speech LSI Utility is dedicated software.

Event Activation

Power-down is released by the change in the input signal to the EVIN0-4 pins and the event number specified by the EVIN0-4 pins in time t_{CHT} is internally captured and the event execution according to the number is started.

Event contents
There are three kinds of event contents, Stop (00h), Disconnection Detection (01h), and Play (02h~1Fh), as follows.

| EVENT No.	Input pattern					Contents
	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0	
00h	L	L	L	L	L	Stop
01h	L	L	L	L	**H**	Disconnection Detection
02h	L	L	L	**H**	L	Play
03h	L	L	L	**H**	**H**	↑
04h	L	L	**H**	L	L	↑
05h	L	L	**H**	L	**H**	↑
06h	L	L	**H**	**H**	L	↑
07h	L	L	**H**	**H**	**H**	↑
:	:	:	:	:	:	:
:	:	:	:	:	:	:
18h	**H**	**H**	L	L	L	↑
19h	**H**	**H**	L	L	**H**	↑
1Ah	**H**	**H**	L	**H**	L	↑
1Bh	**H**	**H**	L	**H**	**H**	↑
1Ch	**H**	**H**	**H**	L	L	↑
1Dh	**H**	**H**	**H**	L	**H**	↑
1Eh	**H**	**H**	**H**	**H**	L	↑
1Fh	**H**	**H**	**H**	**H**	**H**	↑

Disconnection Detection

Set the event1 (EVIN0="H", EVIN1-4="L") , operate the disconnection detection. If disconnection detection, the "ERR" pin output "H". And the 100ms "H" pulse is output right after the event start.
During the event operating, the disconnention detecction can't be operated.
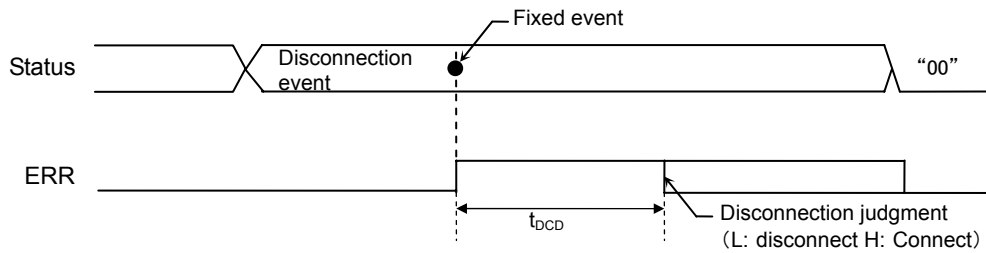
Thermal Detection

In the case of setting the thermal detection mode, if higher temperature than the judgement temperature, the "ERR" pin output "H".
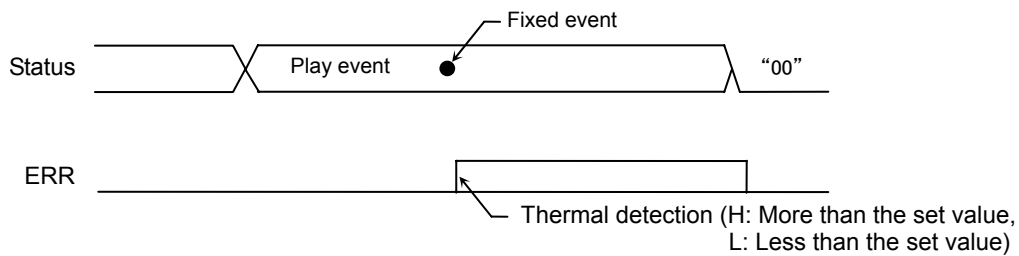
Playback mode setup

Playback mode can be set up for every phrase.
Playback mode is set into the ROM data.
The ROM data is created using a Speech LSI Utility.
The Speech LSI Utility is dedicated software.

Playback mode	Operation
Play Once	This mode is playback once. All the commands become invalid during playback.
Scheduled Play	The playback continues until the following command will be inputted, if playback starts. When the following command is inputted into playback, after playback of the present phrase is completed, the following command is executed.
Change Immediately	The playback continues until the following command will be inputted, if playback starts. When the following phrase is inputted into playback, playback of the present phrase is ended on the way, and playback of the following phrase starts.

The event control example which used each playback mode is as follows.

○ Event Control example 1 (Only one playback in Play once mode)

Operation: Only one event specified is executed after event activation.
Control method: Input the event number to be executed to the EVIN0-4 pins.

EVIN0-4 | Event n | "00" ●
"Good morning"
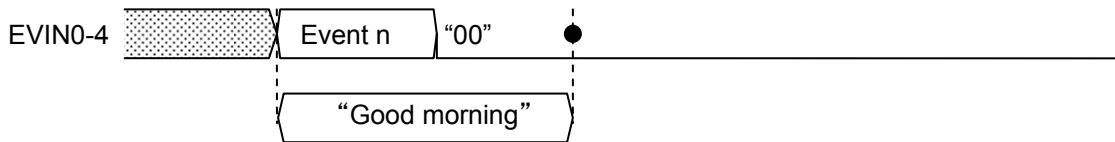
○ Event Control example 2 (Only one playback in Scheduled play mode)

Operation: Only one specification mode is executed
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, input "00" to the
                 EVIN0-4 pins before event execution is ended.

EVIN0-4 | Event n ● | "00" ●
"Good morning" | "Good morning"
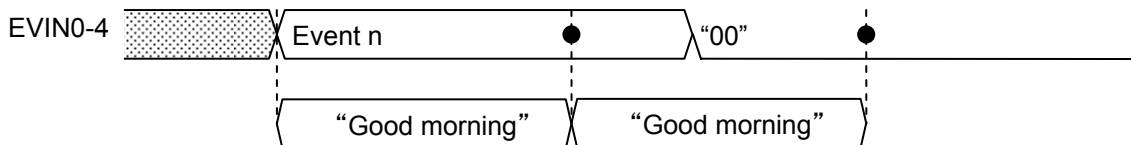
○ Event Control example 3 (Repetitive playback in Scheduled play mode)

Operation: While the EVIN0-4 pin states are held, the event execution is repeated.
                 In the case of the event execution stop, the event execution is terminated.
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, hold the EVIN0-4 pin
                 states. When desired to stop event execution, input all "0s" to the EVIN0-4 pins.
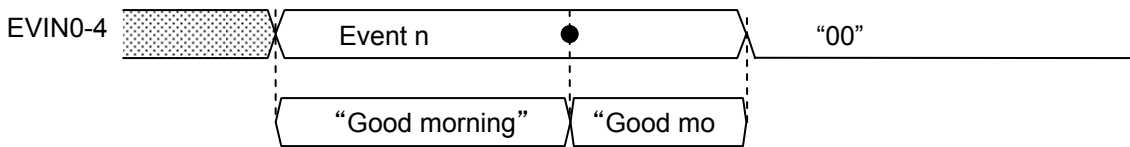
EVIN0-4 | Event n ● | "00" ●
"Good morning" | "Good morning"
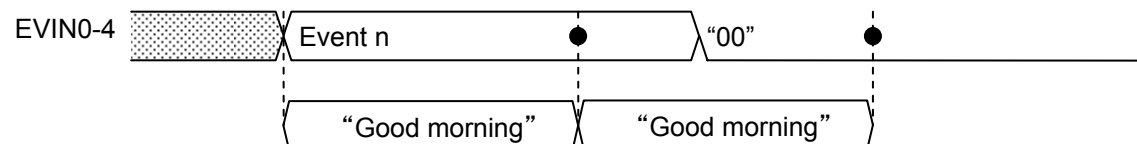
○ Event Control example 4 (Change in playback phrase in Scheduled play mode)

Operation: The event execution specified first is ended and newly specified event execution is started.
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, input the event number to be executed next to the EVIN0-4 pins and hold the EVIN0-4 pin states until the current event execution is ended.
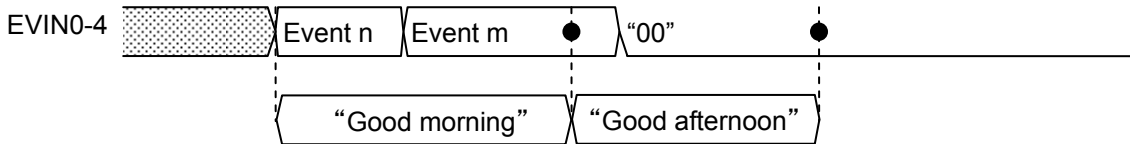

○ Event Control example 5 (Repetitive playback in Change immediately mode)

Operation: Event execution is performed until the EVIN0-4 pin states are changed. The event execution stops when the EVIN0-4 pin states are changed.
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, hold the EVIN0-4 pin states while the event execution is to be performed. When desired to stop event execution, input all "0s" to the EVIN0-4 pins

○ Event Control example 6 (Change in playback phrase in Change immediately mode)

Operation: The event execution specified first is ended and newly specified event execution is started.
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, input the event number to be executed next to the EVIN0-4 pins
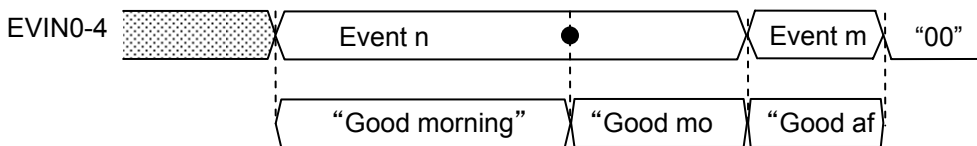
Sequencer Output

The patterns specified to the SEQ0-6 pins are output by specifying the SEQ patterns shown below in the event management area.
When SEQ pattern "00h" is specified, the signals are not output from the SEQ pins.
And the SEQ0 pin can specify only the SEQ pattern 6.
The ROM data is created using a Speech LSI Utility.
The Speech LSI Utility is dedicated software.

LEVEL output
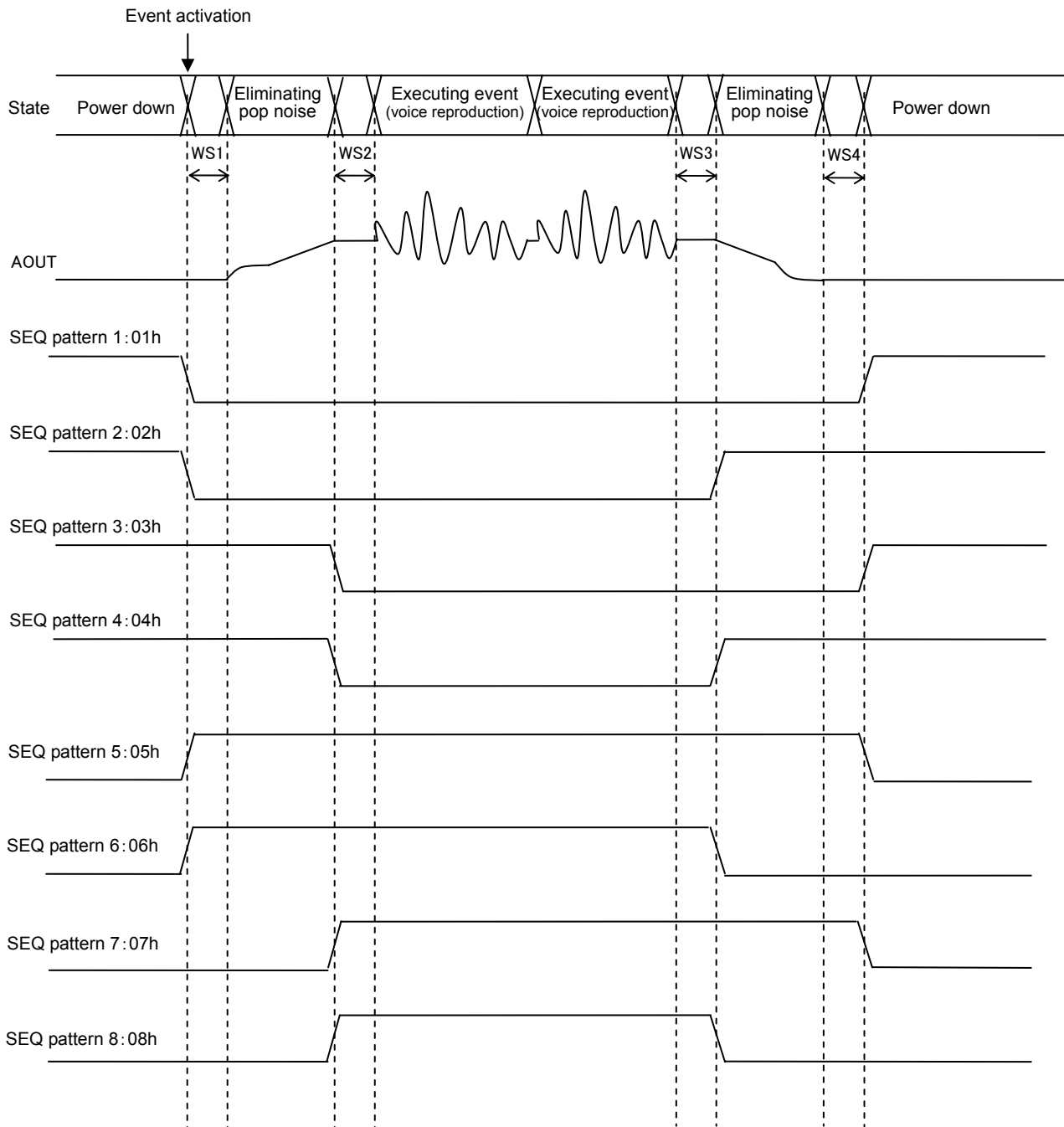
Pulse output
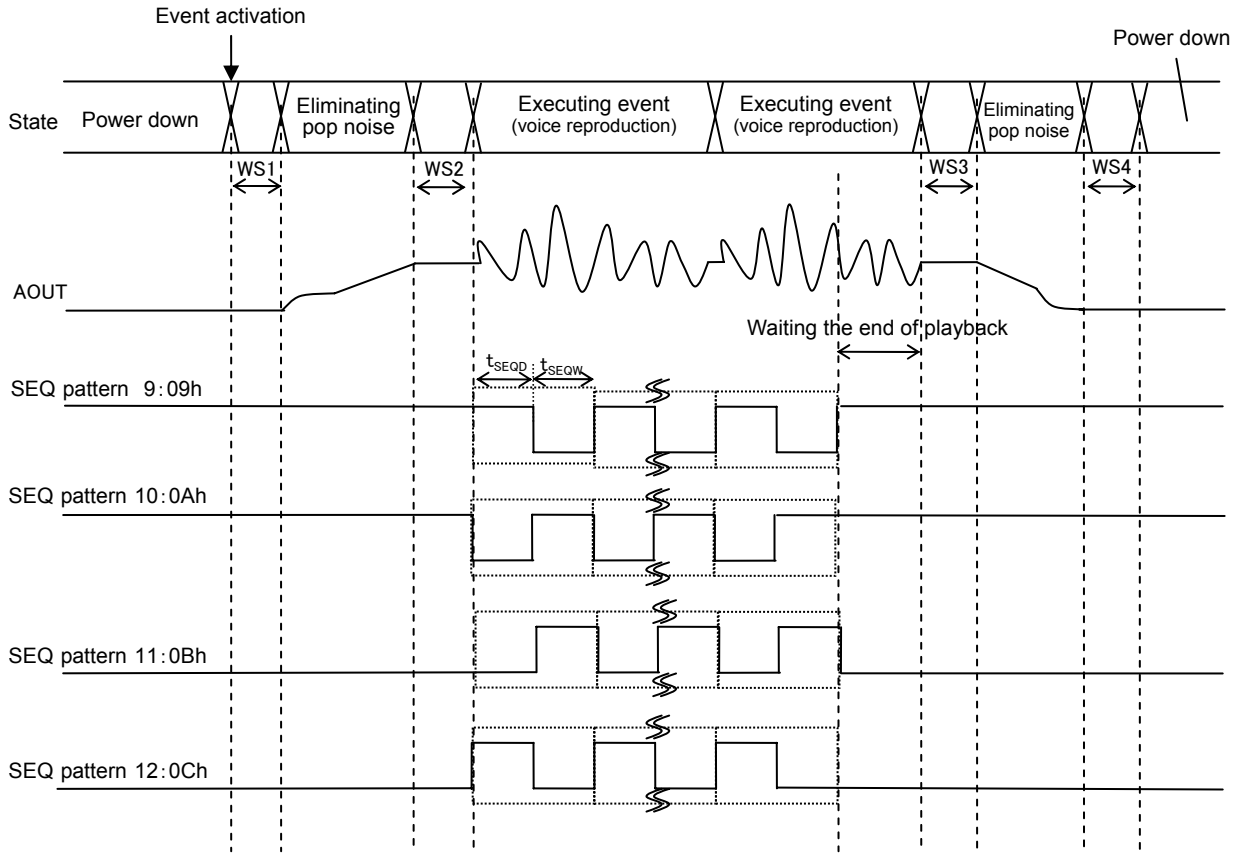
The pulse output is only enaled during playback the sound. If pulse output time is higher than playback sound time, it will be SEQ output initialize level specified by Mask option.

A pulse output is output by the designated pulse width (t_{SEQW}), delay time (t_{SEQD}) and number of times. Speech LSI Utility is used for these setting.

Pulse Wide/Delay Time

Setting value	Pulse Wide/Delay Time [ms]	Setting value	Pulse Wide/Delay Time [ms]	Setting value	Pulse Wide/Delay Time [ms]	Setting value	Pulse Wide/Delay Time [ms]	Setting value	Pulse Wide/Delay Time [ms]	Setting value	Pulse Wide/Delay Time [ms]
00h	4	34h	212	67h	416	9Ah	620	CDh	824		
01h	8	35h	216	68h	420	9Bh	624	CEh	828		
02h	12	36h	220	69h	424	9Ch	628	CFh	832		
03h	16	37h	224	6Ah	428	9Dh	632	D0h	836		
04h	20	38h	228	6Bh	432	9Eh	636	D1h	840		
05h	24	39h	232	6Ch	436	9Fh	640	D2h	844		
06h	28	3Ah	236	6Dh	440	A0h	644	D3h	848		
07h	32	3Bh	240	6Eh	444	A1h	648	D4h	852		
08h	36	3Ch	244	6Fh	448	A2h	652	D5h	856		
09h	40	3Dh	248	70h	452	A3h	656	D6h	860		
0Ah	44	3Eh	252	71h	456	A4h	660	D7h	864		
0Bh	48	3Fh	256	72h	460	A5h	664	D8h	868		
0Ch	52	40h	260	73h	464	A6h	668	D9h	872		
0Dh	56	41h	264	74h	468	A7h	672	DAh	876		
0Eh	60	42h	268	75h	472	A8h	676	DBh	880		
0Fh	64	43h	272	76h	476	A9h	680	DCh	884		
10h	68	44h	276	77h	480	AAh	684	DDh	888		
11h	72	45h	280	78h	484	ABh	688	DEh	892		
12h	76	46h	284	79h	488	ACh	692	DFh	896		
13h	80	47h	288	7Ah	492	ADh	696	E0h	900		
14h	84	48h	292	7Bh	496	AEh	700	E1h	904		
15h	88	49h	296	7Ch	500	AFh	704	E2h	908		
16h	92	4Ah	300	7Dh	504	B0h	708	E3h	912		
17h	96	4Bh	304	7Eh	508	B1h	712	E4h	916		
18h	100	4Ch	308	7Fh	512	B2h	716	E5h	920		
19h	104	4Dh	312	80h	516	B3h	720	E6h	924		
1Ah	108	4Eh	316	81h	520	B4h	724	E7h	928		
1Bh	112	4Fh	320	82h	524	B5h	728	E8h	932		
1Ch	116	50h	324	83h	528	B6h	732	E9h	936		
1Dh	120	51h	328	84h	532	B7h	736	EAh	940		
1Eh	124	52h	332	85h	536	B8h	740	EBh	944		
1Fh	128	53h	336	86h	540	B9h	744	ECh	948		
20h	132	54h	340	87h	544	BAh	748	EDh	952		
21h	136	55h	344	88h	548	BBh	752	EEh	956		
22h	140	56h	348	89h	552	BCh	756	EFh	960		
23h	144	57h	352	8Ah	556	BDh	760	F0h	964		
24h	148	58h	356	8Bh	560	BEh	764	F1h	968		
25h	152	59h	360	8Ch	564	BFh	768	F2h	972		
26h	156	5Ah	364	8Dh	568	C0h	772	F3h	976		
27h	160	5Bh	368	8Eh	572	C1h	776	F4h	980		
28h	164	5Ch	372	8Fh	576	C2h	780	F5h	984		
29h	168	5Dh	376	90h	580	C3h	784	F6h	988		
2Ah	172	5Eh	380	91h	584	C4h	788	F7h	992		
2Bh	176	5Fh	384	92h	588	C5h	792	F8h	996		
2Ch	180	60h	388	93h	592	C6h	796	F9h	1000		
2Dh	184	61h	392	94h	596	C7h	800	FAh	1004		
2Eh	188	62h	396	95h	600	C8h	804	FBh	1008		
2Fh	192	63h	400	96h	604	C9h	808	FCh	1012		
30h	196	64h	404	97h	608	CAh	812	FDh	1016		
31h	200	65h	408	98h	612	CBh	816	FEh	1020		
32h	204	66h	412	99h	616	CCh	820	FFh	1024		
33h	208										

Number of repetition

Setting value	times	Setting value	times	Setting value	times	Setting value	times	Setting value	times	Setting value	times
00h	1	2Bh	44	56h	87	81h	130	ACh	173	D6h	215
01h	2	2Ch	45	57h	88	82h	131	ADh	174	D7h	216
02h	3	2Dh	46	58h	89	83h	132	AEh	175	D8h	217
03h	4	2Eh	47	59h	90	84h	133	AFh	176	D9h	218
04h	5	2Fh	48	5Ah	91	85h	134	B0h	177	DAh	219
05h	6	30h	49	5Bh	92	86h	135	B1h	178	DBh	220
06h	7	31h	50	5Ch	93	87h	136	B2h	179	DCh	221
07h	8	32h	51	5Dh	94	88h	137	B3h	180	DDh	222
08h	9	33h	52	5Eh	95	89h	138	B4h	181	DEh	223
09h	10	34h	53	5Fh	96	8Ah	139	B5h	182	DFh	224
0Ah	11	35h	54	60h	97	8Bh	140	B6h	183	E0h	225
0Bh	12	36h	55	61h	98	8Ch	141	B7h	184	E1h	226
0Ch	13	37h	56	62h	99	8Dh	142	B8h	185	E2h	227
0Dh	14	38h	57	63h	100	8Eh	143	B9h	186	E3h	228
0Eh	15	39h	58	64h	101	8Fh	144	BAh	187	E4h	229
0Fh	16	3Ah	59	65h	102	90h	145	BBh	188	E5h	230
10h	17	3Bh	60	66h	103	91h	146	BCh	189	E6h	231
11h	18	3Ch	61	67h	104	92h	147	BDh	190	E7h	232
12h	19	3Dh	62	68h	105	93h	148	BEh	191	E8h	233
13h	20	3Eh	63	69h	106	94h	149	BFh	192	E9h	234
14h	21	3Fh	64	6Ah	107	95h	150	C0h	193	EAh	235
15h	22	40h	65	6Bh	108	96h	151	C1h	194	EBh	236
16h	23	41h	66	6Ch	109	97h	152	C2h	195	ECh	237
17h	24	42h	67	6Dh	110	98h	153	C3h	196	EDh	238
18h	25	43h	68	6Eh	111	99h	154	C4h	197	EEh	239
19h	26	44h	69	6Fh	112	9Ah	155	C5h	198	EFh	240
1Ah	27	45h	70	70h	113	9Bh	156	C6h	199	F0h	241
1Bh	28	46h	71	71h	114	9Ch	157	C7h	200	F1h	242
1Ch	29	47h	72	72h	115	9Dh	158	C8h	201	F2h	243
1Dh	30	48h	73	73h	116	9Eh	159	C9h	202	F3h	244
1Eh	31	49h	74	74h	117	9Fh	160	CAh	203	F4h	245
1Fh	32	4Ah	75	75h	118	A0h	161	CBh	204	F5h	246
20h	33	4Bh	76	76h	119	A1h	162	CCh	205	F6h	247
21h	34	4Ch	77	77h	120	A2h	163	CDh	206	F7h	248
22h	35	4Dh	78	78h	121	A3h	164	CEh	207	F8h	249
23h	36	4Eh	79	79h	122	A4h	165	CFh	208	F9h	250
24h	37	4Fh	80	7Ah	123	A5h	166	D0h	209	FAh	251
25h	38	50h	81	7Bh	124	A6h	167	D1h	210	FBh	252
26h	39	51h	82	7Ch	125	A7h	168	D2h	211	FCh	253
27h	40	52h	83	7Dh	126	A8h	169	D3h	212	FDh	254
28h	41	53h	84	7Eh	127	A9h	170	D4h	213	FEh	255
29h	42	54h	85	7Fh	128	AAh	171	D5h	214	FFh	256
2Ah	43	55h	86	80h	129	ABh	172				

Edit silent/sound detection output with edit playback
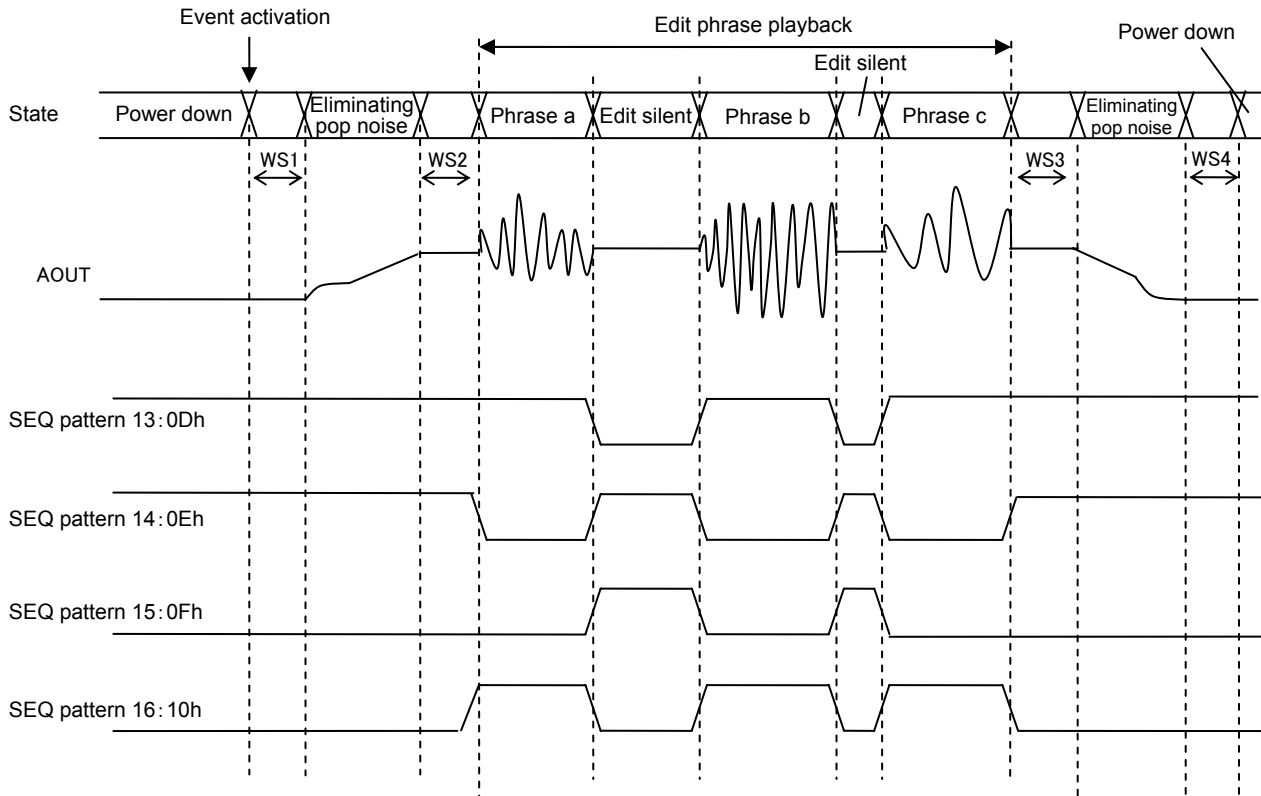
In the edit silent section, a gap as 2.5ms is produced between a setting value and an actual value.

Specific pattern

SEQ pattern 1: 01h
The "L" level is output in time the event activation. In time WS1 after that, and start the POP noise elimination. In time WS2 after that, and play the sound. In time WS3 after that, and start the POP noise elimination. In time WS4 after that, the "H" level is output.

SEQ pattern 2: 02h
The "L" level is output in time the event activation. In time WS1 after that, and start the POP noise elimination. In time WS2 after that, and play the sound. After that, the "H" level is output. In time WS3 after that, and start the POP noise elimination.

SEQ pattern 3: 03h
The "L" level is output after the event activation and POP noise elimination. In time WS2 after that, and play the sound. In time WS3 after that, and start the POP noise elimination. In time WS4 after that, the "H" level is output.

SEQ pattern 4: 04h
The "L" level is output after the event activation and POP noise elimination. In time WS2 after that, and play the sound. After that, the "H" level is output. In time t_{SEQD3} after that, and start the POP noise elimination.

SEQ pattern 5: 05h
The "H" level is output in time the event activation. In time WS1 after that, and start the POP noise elimination. In time WS2 after that, and play the sound. In time WS3 after that, and start the POP noise elimination. In time WS4 after that, the "L" level is output.

SEQ pattern 6: 06h
The "H" level is output in time the event activation. In time WS1 after that, and start the POP noise elimination. In time WS2 after that, and play the sound. After that, the "L" level is output. In time WS3 after that, and start the POP noise elimination.

SEQ pattern 7: 07h
The "H" level is output after the event activation and POP noise elimination. In time WS2 after that, and play the sound. In time WS3 after that, and start the POP noise elimination. In time WS4 after that, the "L" level is output.

SEQ pattern 8: 08h
The "H" level is output after the event activation and POP noise elimination. In time WS2 after that, and play the sound. After that, the "L" level is output. In time t_{SEQD3} after that, and start the POP noise elimination.

SEQ pattern 9 to 12: 09h to 0Ch

    While executing event, the pulses having width tSEQW and period $t_{SEQD} + t_{SEQW}$ are output by the set cycles.

    * If the time of pulses is longer than the time of play sound, and have SEQ output initialize level specified by Mask option after play the sound.

SEQ pattern 13, 16: 0Dh , 0Fh

    The "L" level is output when edited silence is played back and the "H" level is output when edited phrases are played back.

SEQ pattern 14, 15: 0Eh, 10h

    The "H" level is output when edited silence is played back and the "L" level is output when edited phrases are played back.

Wait time setting before and after playback (WS1, WS2, WS3, WS4)

Each phrase can set up the wait time before and after playback.
It is set into the ROM. The ROM data is created using a Speech LSI Utility.
The Speech LSI Utility is dedicated software.
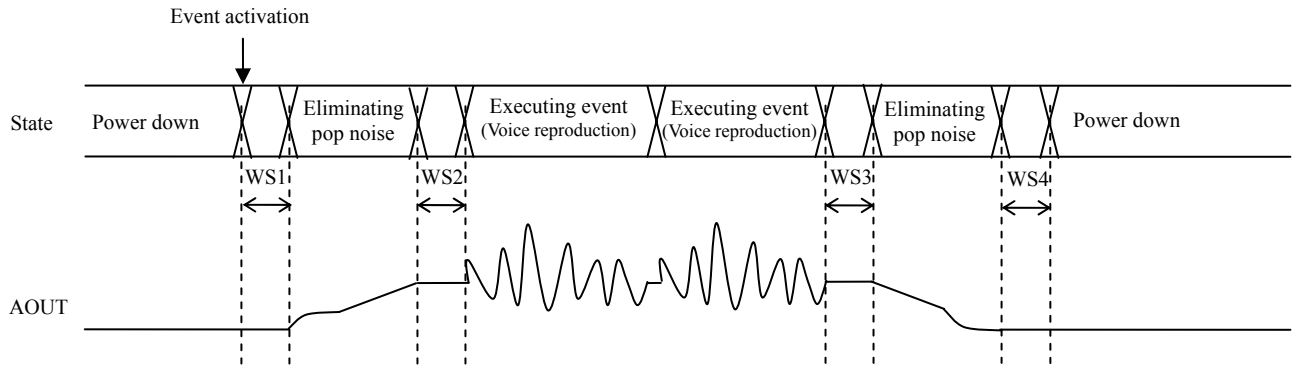
WS1: Time after inputting a phrase address, until SPP/SPM pins are enabled.
WS2: Time after SPP/SPM pins are enabled, until playback is started.
WS3: Time after playback is completed, until SPP/SPM pins are disabled.
WS4: Time after SPP/SPM pins are disabled, until it will be in a standby state.

WS1-WS4 can be arbitrarily set up between 0 to1020ms (4ms unit).

Wait time setting before and after playback (WS1, WS2, WS3, WS4)

Setting value	wait time [ms]	Setting value	wait time [ms]	Setting value	wait time [ms]	Setting value	wait time [ms]	Setting value	wait time [ms]
00h	0	34h	208	67h	412	9Ah	616	CDh	820
01h	4	35h	212	68h	416	9Bh	620	CEh	824
02h	8	36h	216	69h	420	9Ch	624	CFh	828
03h	12	37h	220	6Ah	424	9Dh	628	D0h	832
04h	16	38h	224	6Bh	428	9Eh	632	D1h	836
05h	20	39h	228	6Ch	432	9Fh	636	D2h	840
06h	24	3Ah	232	6Dh	436	A0h	640	D3h	844
07h	28	3Bh	236	6Eh	440	A1h	644	D4h	848
08h	32	3Ch	240	6Fh	444	A2h	648	D5h	852
09h	36	3Dh	244	70h	448	A3h	652	D6h	856
0Ah	40	3Eh	248	71h	452	A4h	656	D7h	860
0Bh	44	3Fh	252	72h	456	A5h	660	D8h	864
0Ch	48	40h	256	73h	460	A6h	664	D9h	868
0Dh	52	41h	260	74h	464	A7h	668	DAh	872
0Eh	56	42h	264	75h	468	A8h	672	DBh	876
0Fh	60	43h	268	76h	472	A9h	676	DCh	880
10h	64	44h	272	77h	476	AAh	680	DDh	884
11h	68	45h	276	78h	480	ABh	684	DEh	888
12h	72	46h	280	79h	484	ACh	688	DFh	892
13h	76	47h	284	7Ah	488	ADh	692	E0h	896
14h	80	48h	288	7Bh	492	AEh	696	E1h	900
15h	84	49h	292	7Ch	496	AFh	700	E2h	904
16h	88	4Ah	296	7Dh	500	B0h	704	E3h	908
17h	92	4Bh	300	7Eh	504	B1h	708	E4h	912
18h	96	4Ch	304	7Fh	508	B2h	712	E5h	916
19h	100	4Dh	308	80h	512	B3h	716	E6h	920
1Ah	104	4Eh	312	81h	516	B4h	720	E7h	924
1Bh	108	4Fh	316	82h	520	B5h	724	E8h	928
1Ch	112	50h	320	83h	524	B6h	728	E9h	932
1Dh	116	51h	324	84h	528	B7h	732	EAh	936
1Eh	120	52h	328	85h	532	B8h	736	EBh	940
1Fh	124	53h	332	86h	536	B9h	740	ECh	944
20h	128	54h	336	87h	540	BAh	744	EDh	948
21h	132	55h	340	88h	544	BBh	748	EEh	952
22h	136	56h	344	89h	548	BCh	752	EFh	956
23h	140	57h	348	8Ah	552	BDh	756	F0h	960
24h	144	58h	352	8Bh	556	BEh	760	F1h	964
25h	148	59h	356	8Ch	560	BFh	764	F2h	968
26h	152	5Ah	360	8Dh	564	C0h	768	F3h	972
27h	156	5Bh	364	8Eh	568	C1h	772	F4h	976
28h	160	5Ch	368	8Fh	572	C2h	776	F5h	980
29h	164	5Dh	372	90h	576	C3h	780	F6h	984
2Ah	168	5Eh	376	91h	580	C4h	784	F7h	988
2Bh	172	5Fh	380	92h	584	C5h	788	F8h	992
2Ch	176	60h	384	93h	588	C6h	792	F9h	996
2Dh	180	61h	388	94h	592	C7h	796	FAh	1000
2Eh	184	62h	392	95h	596	C8h	800	FBh	1004
2Fh	188	63h	396	96h	600	C9h	804	FCh	1008
30h	192	64h	400	97h	604	CAh	808	FDh	1012
31h	196	65h	404	98h	608	CBh	812	FEh	1016
32h	200	66h	408	99h	612	CCh	816	FFh	1020
33h	204								

And volume setting is as follows. (Volume)

Each phrase can set up the volume setup. It is set into the ROM.
The ROM data is created using a Speech LSI Utility.
The Speech LSI Utility is dedicated software.

Setting value	Volume [dB]	Setting value	Volume [dB]	Setting value	Volume [dB]
00h	+2.98	0Ah	-0.41	15h	-6.87
01h	+2.70	0Bh	-0.83	16h	-7.79
02h	+2.40	0Ch	-1.28	17h	-8.82
03h	+2.10	0Dh	-1.75	18h	-9.99
04h	+1.78	0Eh	-2.25	19h	-11.34
05h	+1.45	0Fh	-2.77	1Ah	-12.94
06h	+1.11	10h	-3.34	1Bh	-14.90
07h	+0.76	11h	-3.94	1Ch	-17.44
08h	+0.39	12h	-4.58	1Dh	-21.04
09h	+0.00	13h	-5.28	1Eh	-27.31
		14h	-6.04	1Fh	OFF

Setting of Mask Option

The following table shows the items which can be set by using the Mask option (ROM data):
During initialization processing after power on, mask option data are transferd automatically to each setting.
The ROM data is created using a Speech LSI Utility.
The Speech LSI Utility is dedicated software.

Function	Description	The item of "speech LSI Utility"
Setting of the internal speaker amplifier	Use or unuse of the internal speaker amplifier selectable	Use of Speaker AMP
Setting of thermal detection	Use or unuse of thermal detection selectable	Thermal check ON
Setting of judgement temperature	150°C or 125°C or 100°C selectable	Judgement Temperature 150℃ 125℃ 100℃
Gain setting	+6dB or +12dB selectable	Gain +6dB +12dB
EVIN0-4 pin input setting	High-impedance input (CMOS input), pull-up input, or pull-down input selectable (EVIN0 pin can specify only high-impedance input and pull-up input)	EVIN Pins Setting EVIN0-4 Hi-Z Pull Down Pull Up
Setting of use or unuse of SEQ0-6 pins	Use or unuse of the SEQ output of SEQ0-6 pins selectable (SEQ0 pin can specify only the "use")	SEQ Pins Setting SEQ0-6 Use of SEQ0-6
Setting of the initial value of SEQ0-6 pin output	"L" output, or "H" output state selectable (SEQ0 pin can specify only the "L" output)	SEQ Pins Setting SEQ0-6 Initial State L level Output H level Output
Setting of SEQ0-6 pin output	As for the "CMOS" output setting, the "L" level output becomes "L" level and the "H" level output becomes "H" level output. As for the "Nch open drain" output setting, the "L" level output becomes "L" level and the "H" level output becomes "Hi-Z" output. As for the "Pch open drain" output setting, the "H" level output becomes "H" level and the "L" level output becomes "Hi-Z" output. As for the "Hi-Z" output setting always becomes "Hi-Z". Set when the output is open. (SEQ0 pin can specify only the CMOS output) And SEQ3-6 can be set for the LED drive pins.	SEQ Pins Setting SEQ0-6 Condition CMOS Nch Open Drain Pch Open Drain Hi-Z

Voice Synthesis Algorithm

Five types of voice synthesis algorithm are supported. They are 4-bit ADPCM2, 8-bit non-linear PCM, 8-bit straight PCM and 16-bit straight PCM. Select the best one according to the characteristics of voice.
The following table shows key features of each algorithm.

Voice synthesis algorithm	Feature
HQ- ADPCM	Algorithm that enables high sound quality and high compression, which have been achieved by the improved 4-bit ADPCM that uses variable bit-length coding.
4-bit ADPCM2	Up version of LAPIS Semiconductor's specific voice synthesis algorithm (: 4-bit ADPCM). Voice quality is improved.
8-bit Nonlinear PCM	Algorithm, which plays back mid-range of waveform as 10-bit equivalent voice quality.
8-bit PCM	Normal 8-bit PCM algorithm
16-bit PCM	Normal 16-bit PCM algorithm

Memory Allocation and Creating Voice Data

The ROM is partitioned into four data areas: voice (i.e., phrase) control area, test area, voice area, and edit ROM area.
The voice control area manages the voice data in the ROM. It contains data for controlling the start/stop addresses of voice data for 30 phrases, use/non-use of the edit ROM function and so on.
The test area contains data for testing.
The voice area contains actual waveform data.
The edit ROM area contains data for effective use of voice data. For the details, refer to the section of "Edit ROM Function."
The edit ROM area is not available if the edit ROM is not used.

The ROM data is created using a dedicated tool.

Configuration of ML22(Q)340 ROM data

0x00000 – 0x03FFF	Prohibition of use area (Fixed 128 Kbits)
0x04000 – max. 0x0FBFF	Voice area 2
max. 0x0FBFF	Edit ROM area Depends on creation of ROM data.
0x0FC00 – 0x0FFFF	Test area
0x10000 – 0x105FF	Voice control area (Fixed 12 Kbits)
0x10600 – 0x17FFF	Voice area 1

Configuration of ML22(Q)341 ROM data

0x00000 – 0x03FFF	Prohibition of use area (Fixed 128 Kbits)
0x04000 – max. 0x0FBFF	Voice area 2
max. 0x0FBFF	Edit ROM area Depends on creation of ROM data.
0x0FC00 – 0x0FFFF	Test area
0x10000 – 0x105FF	Voice control area (Fixed 12 Kbits)
0x10600 – 0x1FFFF	Voice area 1

The one phrase must make 50ms or more length.
Since the data which exceeds 64 K bytes in one phrage cannot be played, please devide the voice phrase to be set to
each below 64 K bytes, and join those data by the edit phrase function.

Playback Time and Memory Capacity

The playback time depends on the memory capacity, sampling frequency, and the playback method.
The equation to know the playback time is shown below. But this is not applied if the edit ROM function is used.

$$\text{Playback time [sec]} = \frac{1.024 \times (\text{Voice area 1} + \text{Voice area 2}) \text{ [Kbits]}}{\text{Sampling frequency [kHz]} \times \text{Bit length}}$$

(Bit length is 4 at the 4-bit ADPCM2 and 8/16 at the PCM.)

Example) In the case that the sampling frequency is 8 kHz, algorithm is 4-bit ADPCM2, the playback time is approx. 29.4 seconds, as shown below.

$$\text{Playback time} = \frac{1.024 \times 876 \text{ [Kbits]}}{8 \text{ [kHz]} \times 4 \text{ [bits]}} \cong 28.0 \text{ [sec]}$$

Edit ROM Function

The edit ROM function makes it possible to play back multiple phrases in succession. The following functions are set using the edit ROM function:

- Continuous playback: There is no limit to set the number of times of the continuous playback. It depends on the memory capacity only.
- Silence insertion function: 20ms to 1,024 ms (4ms unit)
  Note: Silent insertion time varies for ±1ms by the sampling frequency
  Note: At the change immediately mode, the silence insertion function cannot use.

It is possible to use voice ROM effectively to use the edit ROM function.
Below is an example of the ROM structure, case of using the edit ROM function.

Example 1) Phrases using the Edit ROM Function

Phrase 2	A	B	D
Phrase 3	A	C	D
Phrase 4	E	B	D
Phrase 5	E	C	D
Phrase 6	A	B	D	Silence	E	C	D
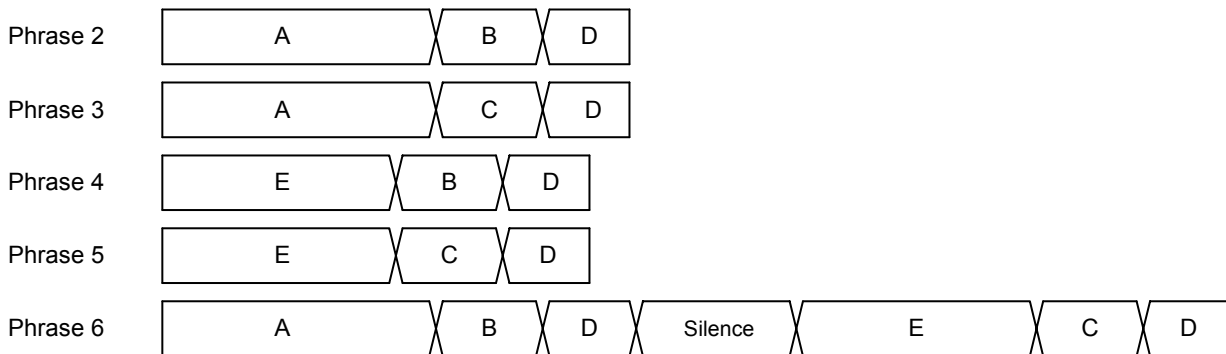
Example 2) Structure of the ROM that contents of Example 1 are stored

| Address control area |
| A |
B	C
D	
	E
Editing area
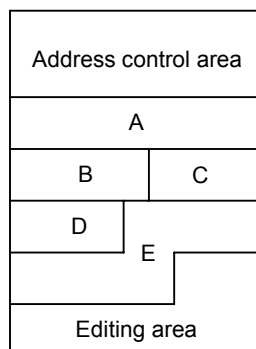
Notice of silence insertion function

If it is only silence phrase registered, please put in order three or more silence phrase.
The phrase which is constituted from one or two of silence phrase does not playback.

Example 3) Phrase composition in the case of using silence insertion function

The phrase to playback (The phrase 2 is playbacked twice on both sides of 1 sec silence.)
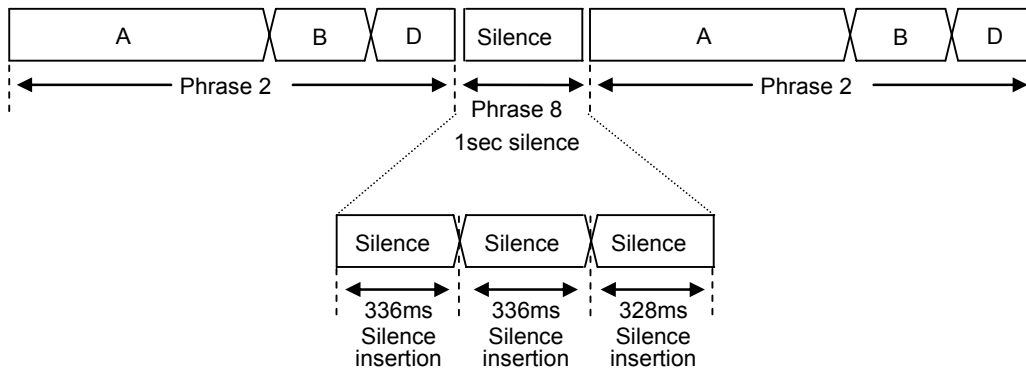
1 sec which is constituted by the three silences is registered as the phrase 8.

The ROM consumption when using the edit ROM function

When playing more than one phrases continuously, the ROM consumption is used 64 bits per 1 phrase.
The silence insertion function is used 16 bits every once.

TERMINATION OF THE V_{DDL} PIN

The V_{DDL} pin is the regulator output that is power supply pin for the internal logic circuits. Connect a capacitor between this pin and the ground in order to prevent noise generation and power fluctuation.
The recommended capacitance value is shown below. However, it is important to evaluate and decide using the own board. Also, start the next operation after each output voltage is stabilized.

Pin	Recommended capacitance value	Remarks
V_{DDL}	10 µF ±20%	The larger the connection capacitance, the longer the settling time.

POWER SUPPLY WIRING

The power supply of this LSI is divided into the following sections:
- Digital power supply (V_{DD})
- Analog power supply (SPV_{DD})

As shown below, supply the same power supply to V_{DD} and SPV_{DD} and separate the analog and digital power supplies by wiring.

Power supply voltage = 3 V

EXAMPLE OF APPLICATION CIRCUIT

PACKAGE DIMENSIONS

LAPIS Semiconductor Co.,Ltd.

PACKAGE CODE	P-SSOP30-56-0.65-Z6K9-MC		
PACKAGE MATERIAL	EPOXY RESIN	UNIT	mm
LEAD FLAME MATERIAL	Cu ALLOY	DWG No.	QSL-68708
LEAD FINISH	Sn-2Bi(Bi 2%typ)	REVISION	2
SOLDER THICKNESS	MORE THAN 5μm	1st ISSUE	Jan11/2012
PACKAGE MASS (g)	0.19TYP.	REVISED	Jan13/2012

NOTES:
1. LEAD WIDTH DOES NOT INCLUDE TRIM OFFSET.
2. PACKAGE WIDTH AND LENGTH DO NOT INCLUDE MOLD PROTRUSION, DIEPAD SUPPORT
   PROTRUSION AND CAVITY OFFSET BETWEEN TOP AND BOTTOM CAVITY.
3. THE SEATING PLANE IS THE SURFACE WHICH THE PACKAGE IS MOUNTED ON AND GETS IN CONTACT WITH.
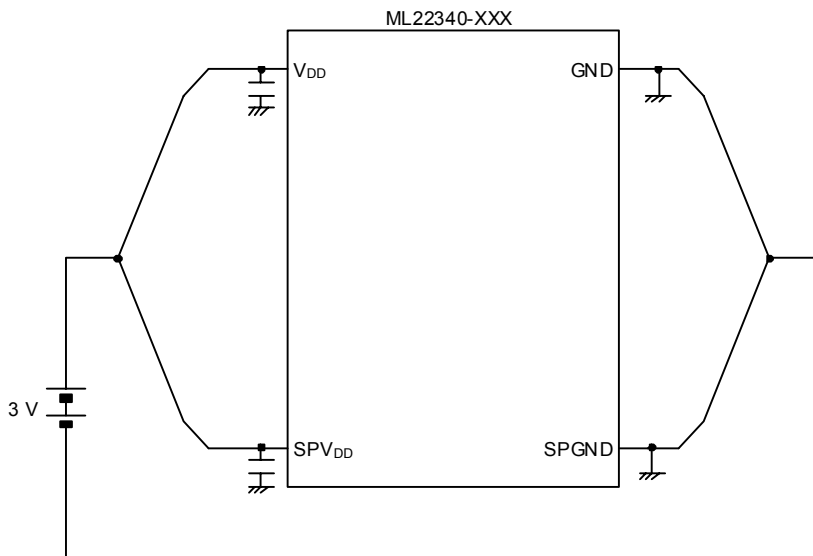
Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact ROHM's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

The heat resistance (example) of this LSI is shown below. Heat resistance (θ Ja) changes with the size and the number of layers of a substrate.

Die pad on the back of a package partial ground contact area	100%
PCB	JEDEC （W/L/t＝76.2/114.5/1.6（mm））
PCB Layer	4L
Air cooling conditions	Calm（0m/sec）
Heat resistance（θJa）	45[℃/W]
Power consumption of Chip PMax at OutputPower 1W (5V)	0.818[W]
Power consumption of Chip PMax at OutputPower 0.5W (3.3V)	0.283[W]

TjMax of this LSI is 125℃. TjMax is expressed with the following formulas.

$$TjMax = TaMax + \theta Ja \times PMax$$

Mounting area for package lead soldering to PCB (reference data) is shown below.
Die pad on the back of a package should connect with the substrate of opening or a GND for heat dissipation.

Mounting area for package lead soldering to PC boards

[unit：mm]
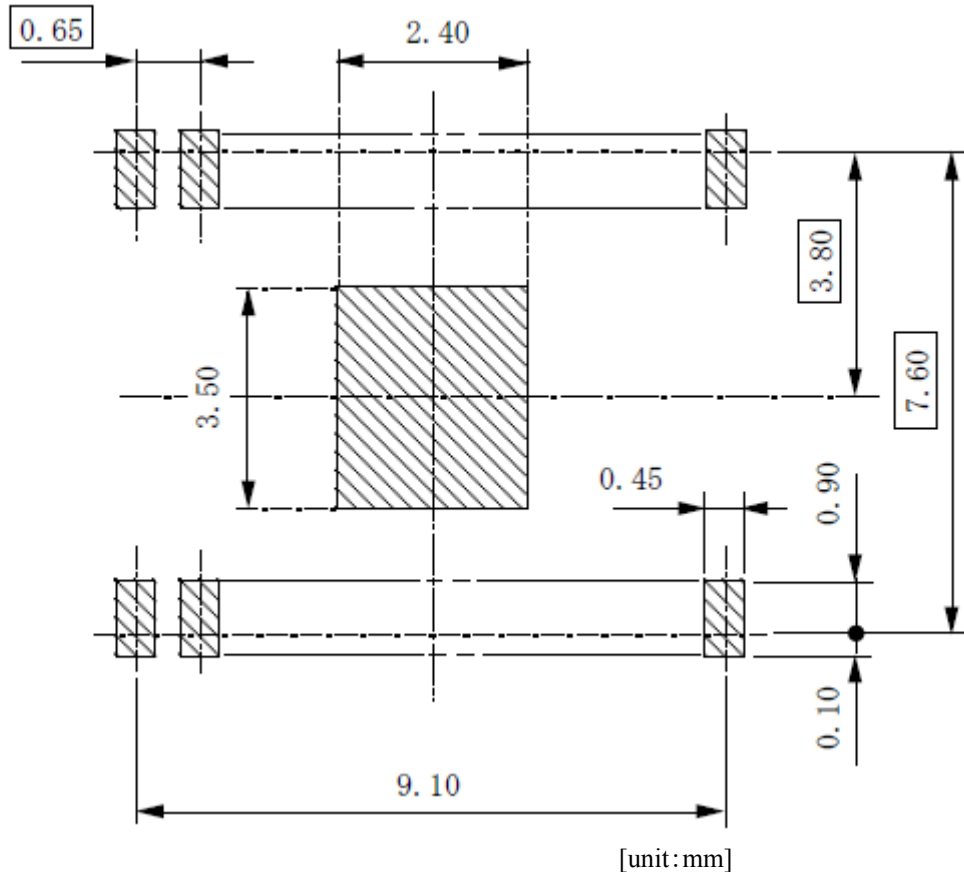
   When laying out PC boards, it is important to design the foot pattern so as to give consideration to ease of mounting, bonding, positioning of parts, reliability, writing, and elimination of solder bridges.
   The optimum design for the foot pattern varies with the materials of the substrate, the sort and thickness of used soldering paste,and the way of soldering. Therefore when laying out the foot pattern on the PC boards, refer to this figure which mean themounting area that the package leads are allowable for soldering to PC boards.

REVISION HISTORY

Document No.	Date	Page Previous Edition	Page Current Edition	Description
FEDL22340-01	Jan. 6, 2011	–	–	Final edition 1
FEDL22340-02	Mar. 23,2015	1,2,3	1,2,3	Change ROM size 640K(896K) -> 620K(876K)
		1	1	Change Playback Time.
		9	6	Digital power supply voltage 2.7 to 5.5 -> 3.0 to 5.5
		9	6	Flash memory rewrite cycles 80 -> 80 times
		10	7	"H" output voltage 2 V_{OH2} OSC2 -> OSC1
		10	7	"L" output voltage 4 V_{OL4} Add the notice of "When the LED drives".
		11	8	AOUT output load resistance R_{LAO} -> R_{LA}
		11	8	AOUT output load resistance During 1/2 DV_{DD} output -> During 1/2 V_{DD} output
		11	8	AOUT output voltage range V_{AOUT} -> V_{AO}
		11	–	Delete the "EVINn input pulse width".
		–	8	Add the notice of "Disconnection judging time".
		14	9	Changes the starting point of "t_{OSC}."
		–	14	Add the Disconnection Detection Timing
		–	14	Add the Thermal Detection Timing.
		–	15	Add the description of "Playback mode setup".
		–	19	Add the table of "Pulse Width and Delay Time".
		–	20	Add the table of "repetition Number".
		–	24	Add the "Wait time setting before and after playback (WS1, WS2, WS3, WS4)"
		–	25	Add the table of "Wait time setting before and after playback (WS1, WS2, WS3, WS4)".
		3	27	Change the "Setting of Mask Option".
		–	28	Add the description of "Voice Synthesis Algorithm".
		–	28	Add the notice of "Memory Allocation and Creating Voice Data".

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
		–	28	Add the description of "minimal playback time".
		–	29	Add the description of "Playback Time and Memory Capacity".
		–	29	Add the description of "Edit ROM Function".
		–	30	Add the notice of the "silence insertion function".
		–	30	Add the notice of "ROM consumption when using the edit ROM function".
		–	31	Add the notice of "TERMINATION OF THE V_{DDL} PIN".
		25	32	EXAMPLE OF APPLICATION CIRCUIT DV_{DD} -> V_{DD}
		26	33	Changes the "package dimensions".
		27	34	The connection between the die pad and the substrate VSS -> GND

NOTES

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