Dear customer

ROHM Co., Ltd. ("ROHM"), on the 1st day of April, 2024,
has absorbed into merger with 100%-owned subsidiary of LAPIS Technology Co., Ltd.

Therefore, all references to "LAPIS Technology Co., Ltd.", "LAPIS Technology"
and/or "LAPIS" in this document shall be replaced with "ROHM Co., Ltd."
Furthermore, there are no changes to the documents relating to our products other than
the company name, the company trademark, logo, etc.

Thank you for your understanding.

ROHM Co., Ltd.
April 1, 2024

ML22Q284

ADPCM Speech Synthesis LSI for Automotive

■ GENERAL DESCRIPTION

ML22Q284 is a speech synthesis LSI supporting an in-vehicle quality that incorporates Flash for storing voice code data, and can be controlled with a standalone interface.
By integrating all the functions required for voice output into a single chip, this LSI can be more easily incorporated in compact portable devices.

- Playback time

Product name	Flash capacity (bit)	Maximum playback time (sec) (at fs = 6.4 kHz)	
		4-bit ADPCM2	16-bit PCM
ML22Q284	692K	27.6	6.9

Notes: Flash capacity shows the numerical value of only a voice area

- Speech synthesis method: 4-bit ADPCM2
  8-bit Nonlinear PCM
  8-bit PCM , 16-bit PCM
  (Method can be specified for each phrase)
- Flash capacity: 692 Kbit
- Sampling frequency (Fs): 8.0/16.0/32.0 kHz, 6.4/12.8/25.6 kHz, 10.7/21.3 kHz
  (Can be specified for each phrase)
- Speaker driving amplifier: D-class amplifier (driven by 8 Ω)
- CPU command interface: Standalone interface (built-in noise removal function)
- Maximum number of phrases: 30 phrases
- Disconnection detection function /Speaker pin short detection function
- Source oscillation frequency: 4.096 MHz (Typ) (internal)
- Power supply voltage: 2.0 to 5.5 V
- Flash memory rewritable time: 80 times
- Operating temperature range: –40 °C to +105 °C
- AEC-Q100: Compliant

■ Applications

● Automotive equipment (e.g., AVAS(Acoustic Vehicle Alerting System), Meter cluster, Various warning sounds) .
● Consumer and Industrial equipment (e.g., Household appliances, Housing equipment, Office equipment, Measurement instrumentation, etc.).

【NOTE】
This product cannot be applicable for automatic train control systems, and railway safety systems. Please contact ROHM sales office in advance if contemplating the integration of this product into applications that requires high reliability, such as transportation equipment for ships and railways, communication equipment for trunk lines, traffic signal equip.

■ Table format

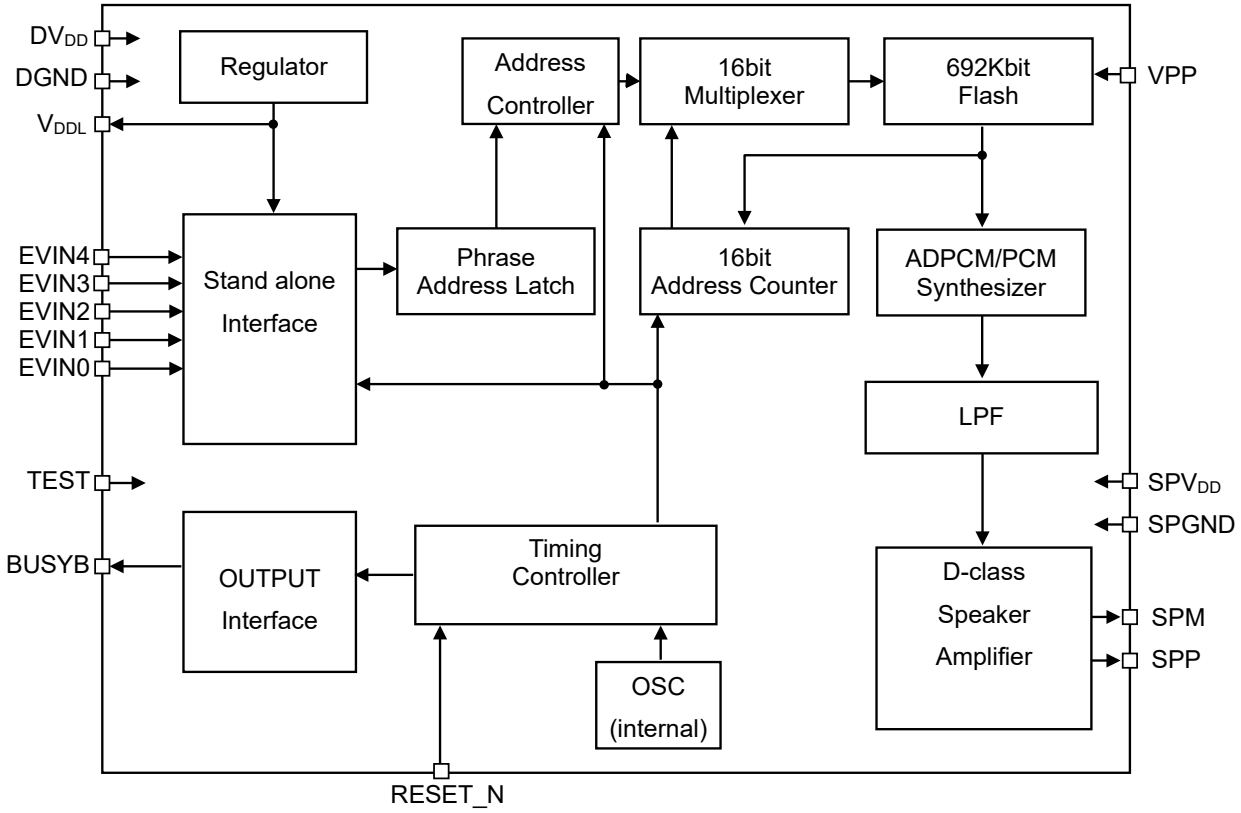
Package	Body size (including lead) [mm × mm]	Pin pitch [mm]	Packing form and Product name*1	
			Tray	Tape & Reel
20 pin plastic TSSOP	6.5 × 4.4 (6.5 × 6.4)	0.65	ML22Q284-NNNTDZ0ARL ML22Q284-xxxTDZ0ARL	ML22Q284-NNNTDZ0ATL ML22Q284-xxxTDZ0ATL

*1 “NNN” is a blank product. “xxx” denotes ROM code number.

The following table shows the differences from ML22Q274, ML22Q294.

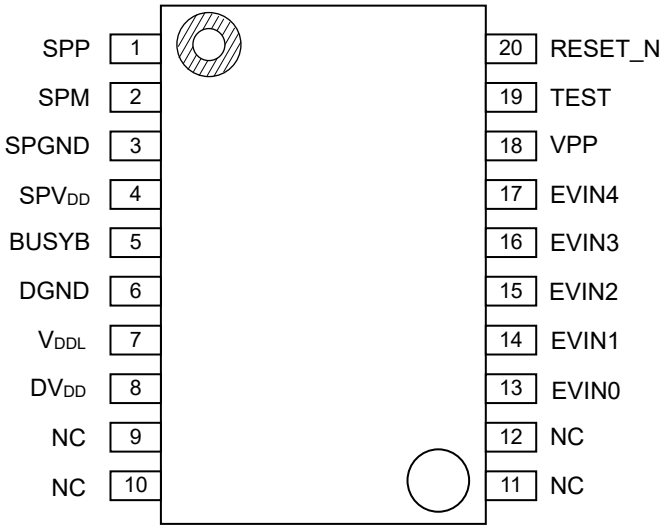
Parameter	ML22Q284	ML22Q274	ML22Q294
MCU interface	Standalone	Clock synchronization Serial	I2C
Flash capacity	692 Kbit	692 Kbit (when 30 phrases are selected) 688 Kbit (when 62 phrases are selected)	←
Playback method	4-bit ADPCM2 8-bit Nonlinear PCM 8-bit PCM 16-bit PCM	←	←
Maximum number of phrases:	30	30/62	←
Sampling frequency (kHz)	6.4/8.0/10.7/12.8/ 16.0/21.3/25.6/32.0	←	←
Clock frequency	4.096 MHz (internal oscillation)	←	←
Low-pass filter	FIR interpolation filter	←	←
Speaker driving amplifier	D-class amplifier	←	←
Speaker driving amplifier output load	8Ω	←	←
Speaker driving amplifier output voltage	1 W (Ta = -40 to +85°C) 0.8 W (Ta = -40 to +105°C)	←	←
Edit ROM function	Yes	←	←
Volume control	32 levels	←	←
Silence insertion	4 ms to 1024 ms (4 ms/step)	←	←
Repeat function	Yes	←	←
Power supply voltage	2.0 to 5.5 V	←	←
Operating temperature range	-40 to +105°C	←	←
Package	20-pin TSSOP	←	←

■ BLOCK DIAGRAMS



■ PIN CONFIGURATIONS (TOP VIEW)

20-Pin Plastic TSSOP



NC : Unused pin

■ PIN DESCRIPTION

Pin	Symbol	I/O	Initial value (At the RESET_N Input)	Initial value (At standby)	Description
1	SPP	O	Hi-Z	Hi-Z	Positive (+) output pin of the speaker amplifier built-in
2	SPM	O	Hi-Z	Hi-Z	Negative (-) output pin of the speaker amplifier built-in.
3	SPGND	-	-	-	Ground pin for the speaker amplifier.
4	SPV_{DD}	-	-	-	Power supply pin for the speaker amplifier Connect a bypass capacitor of 0.1 μF or more between this pin and SPGND pin.
5	BUSYB	O	Hi-Z	1	BUSY output pin. When BUSYB use mode is set, the "L" level is outputted during playback. When disconnection is detected with disconnection detection function, the "L" level is outputted. BUSYB unused mode and logic inversion can be set with Speech LSI Utility.
6	DGND	-	-	-	Digital ground pin.
7	V_{DDL}	-	-	-	Regulator output pin for internal logic circuitry. Connect a capacitor of 10 μF or more between this pin and DGND pin
8	DV_{DD}	-	-	-	Digital power supply pin. Connect a capacitor of 0.1 μF or more between this pin and DGND pin.
13	EVIN0	I	0	0	Command input pin. Voice can be played back and stopped based on a change in a signal input to EVIN4-0 pin. The pin state can be set with Code Option Setting when a voice code is generated. EVIN0 pin: select pull-up input or high impedance input EVIN4-1 pin: select pull-down input, pull-up input, or high impedance input
14	EVIN1	I			
15	EVIN2	I			
16	EVIN3	I			
17	EVIN4	I			
18	VPP	-	-	-	Power supply pin for rewriting Flash memory. Fix this pin to GND except when rewriting Flash memory
19	TEST	I	0	0	Test pin. Fix this pin to DGND.
20	RESET_N	I	0	1	Reset pin. Input “L” level for initialization, when power is turned on, or when voltage falls below recommended operation power supply voltage range. After the power supply voltage is stable, drive this pin to “H” level.
9 10 11 12	N.C.	-	-	-	Unused pin. Leave this pin open.

■ ABSOLUTE MAXIMUM RATINGS

(DGND = 0 V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	DV_{DD} SPV_{DD}	Ta = 25 °C	-0.3 to + 7.0	V
Internal logic power supply voltage	V_{DDL}		-0.3 to +3.6	V
Flash power supply voltage	VPP		-0.3 to +9.5	V
Input voltage	V_{IN}		-0.3 to V_{DD} +0.3	V
Power dissipation	P_D		1	W
Output short-circuit current	I_{SC1}	Applied to pin other than SPP or SPM	-12 to +11	mA
	I_{SC2}	SPP pin, SPM pin	600	mA
Storage temperature	T_{STG}	-	-55 to +150	°C

■ RECOMMENDED OPERATING CONDITIONS

(DGND = 0 V)

Parameter	Symbol	Condition	Range	Unit
Power supply voltage	DV_{DD} SPV_{DD}	-	2.0 to 5.5	V
		Flash memory write	2.7 to 5.5	
Flash power supply voltage	VPP	Flash memory write	7.7 to 8.3	V
Flash memory rewrite cycles	N	-	80	times
Operating temperature range	T_{OP1}	-	-40 to +105	°C
	T_{OP2}	Flash memory write	0 to +40	

■ ELECTRICAL CHARACTERISTICS

● DC Characteristics

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +105°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" input voltage	V_{IH}	-	0.7 × DV_{DD}	-	DV_{DD}	V
"L" input voltage	V_{IL}	-	0	-	0.3 × DV_{DD}	V
"H" output voltage 1	V_{OH1}	I_{OH} = −0.5 mA	DV_{DD}−0.5	-	-	V
"L" output voltage 1	V_{OL1}	I_{OL} = 0.5mA	-	-	0.5	V
"H" input current 1	I_{IH1}	V_{IH} = DV_{DD}	-	-	1	µA
"H" input current 2	I_{IH2}	V_{IH} = DV_{DD} TEST pin	0.02	0.3	1.5	mA
"H" input current 3	I_{IH3}	V_{IH} = DV_{DD} EVIN4-1 terminal pull-up input is set	0.02	0.3	1.5	mA
"L" input current 1	I_{IL1}	V_{IL} = DGND	-1	-	-	µA
"L" input current 2	I_{IL2}	V_{IL} = DGND RESET_N pin	-1.5	-0.3	-0.02	mA
"L" input current 3	I_{IL3}	V_{IL} = DGND EVIN4-0 terminal pull-up input is set	-1.5	-0.3	-0.02	mA
"H" output current 1	I_{OOH1}	VOH= DV_{DD}= SPV_{DD} (High impedance) BUSYB, SPP, SPM pin	-	-	1	µA
"H" output current 2	I_{OOH2}	VOH= DV_{DD} (Nch Open drain) BUSYB pin	-	-	1	µA
"L" output current 1	I_{OOL1}	VOL=DGND=SPGND (High impedance) BUSYB, SPP, SPM pin	-1	-	-	µA
"L" output current 2	I_{OOL2}	VOL=DGND (Pch Open drain) BUSYB pin	-1	-	-	µA
Supply current during playback	I_{DD1}	No output load DV_{DD}= SPV_{DD}=3.0 V	-	4.0	6.0	mA
	I_{DD2}	No output load DV_{DD}= SPV_{DD}=5.0 V	-	6.0	10	
Supply current during stabilizing chattering	I_{DDC1}	DV_{DD}=SPV_{DD}=5.0 V	-	3.0	5.0	mA
Standby supply current	I_{DDS1}	Ta ≤ 40°C	-	0.5	3.0	µA
	I_{DDS2}	Ta ≤ 85°C	-	0.5	8.0	
	I_{DDS3}	Ta ≤ 105°C	-	0.5	16.0	
Source oscillation frequency	f_{OSC}	-10 to +50°C	4.034	4.096	4.158	MHz
		-40 to +105°C	3.973	4.096	4.219	

● Characteristics of Analog Circuitry

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +105°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
SPM, SPP output load resistance	R_{LSP}	-	8	-	-	Ω
Speaker amplifier output voltage	P_{SPO}	SPV_{DD} = 5.0 V, Sin wave f = 1 kHz R_{LSP} = 8 Ω, THD ≥ 10% Ta = -40 to +85°C	-	1.0	-	W
		SPV_{DD} = 5.0 V, Sin wave f = 1 kHz R_{LSP} = 8Ω, THD ≥ 10% Ta = -40 to +105°C	-	0.8	-	W

- AC Characteristics

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +105°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
RESET_N input pulse width	t_{RST}	-	100	-	-	µs
Start time SPV_{DD} after starting DV_{DD}	t_{VDD}	-	0	-	-	ns
Initialization time after reset release	t_{INIT}	-	-	-	65	ms
Oscillation stable time	t_{PUP1}	-	-	1	2	ms
Playback time	t_{VCYC}	-	20	-	-	ms
Chattering removal time[*1]	t_{SP}	Initial value (08 h)	Typ.-2	16	Typ.+2	ms
Command processing time	t_{B1}	-	-	-	400	µs
Oscillation stop time, after playback	t_{OSST}	-	-	-	500	µs
Next command transmit time□ In the case of the playback	t_{NCM}	-	-	-	10	ms
Next command transmit time after shifting to a standby state	t_{CMS}	-	50	-	-	ns
Disconnection judging by the DISCONNECT command start time	t_{DCDS}	-	1.5	-	-	ms
Disconnection judging by the DISCONNECT command end time	t_{DCDE}	-	-	-	1	s
BUSYB change time from "L" to "H", after over-current detection of a speaker amplifier	t_{SD}	-	-	-	80	µs
Processing time before playback start	t_{PLBF}	-	0.3	-	2.1	ms
Processing time after playback start	t_{PLAF}	-	0.15	-	1.2	ms
Fade-out time at Change Immediately mode or Change Immediately Once mode	t_{FDO}	-	-	22	-	ms

Note 1 : Can be set within a range from 0 ms to 62 ms with Speech LSI Utility.
Note : Output pin load capacitance = 45 pF (max.)

■ FUNCTIONAL DESCRIPTION

● Standalone interface

Standby is canceled by a change in a signal input to the EVIN4-0 pin, and after the chattering removing period, an operation corresponding to a command indicated by the EVIN4-0 pin starts.

The pin status of the EVIN0 pin can be selected between high-impedance input (Hi-Z) and pull-up input (PullUp). The pin status of the EVIN4-1 can be selected among high-impedance input (Hi-Z), pull-down input (PullDown), and pull-up input (PullUp).

The pin status of the EVIN4-0 pin is selected using Speech LSI Utility.
Please refer to a "Code Option Setting Item" for details.

● Chattering removal time

Chattering removal time can be set for preventing erroneous operation due to chattering when the EVIN4-0 pin changes. The time can be set from 2 ms to 62 ms (setting value: 01h to 1Fh) in increments of 2 ms. The initial value is 16 ms (08h).

Chattering removal time = (2^4*bit4+2^3*bit3+2^2*bit2+2^1*bit1+2^0*bit0)*2 ms

Set a setting value 10h to set the time to be 32 ms.

Chattering removal time = 2^4*1+2^3*0+2^2*0+2^1*0+2^0*0)*4 ms = 8*2 ms = 32 ms

The chattering removal time is selected using Speech LSI Utility.
Please refer to a "Code Option Setting Item" for details.

● Speech synthesis method

Supporting four types of speech synthesis methods, which are 4bit ADPCM2, 8-bit nonlinear PCM, 8-bit PCM, and 16-bit PCM. Any of these can be selected based on the characteristics of the voice to be played back.

Speech synthesis method	Compression rate*1	Suitable waveform	Characteristics
4-bit ADPCM2	1/4	Normal voice sound wave	Unique scheme which is a refined version of 4bit ADPCM Offers higher sound quality with better waveform followability.
8-bit Nonlinear PCM	1/2	Sound including high frequency components (such as sound effects)	A part around the center of the waveform is played back with a sound quality equivalent to 10 bits.
8-bit PCM	1/2		Normal 8-bit PCM.
16-bit PCM	1		Normal 16-bit PCM.

Note 1: When the same sampling frequency is used.

- Memory Allocation and Creating Voice Data

The voice code data consists of a voice management area, a voice data area, and an edit ROM area.
The voice control area manages voice data for 30 phrases.
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 only available when the edit ROM is used.

The ROM data is created using Speech LSI Utility.

Please refer to a "Code Option Setting Item" for details.

Voice code data configuration

0x00000 0x001FF	Voice control area
0x00200 0x159FF	Voice data area / Edit ROM area*1

*1: Edit ROM area depends on creation of the data

- Playback Time and Flash 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.

$$\text{Playback time [sec]} = \frac{1.024 \times (\text{Voice data area/Edit ROM area})\,(\text{Kbit})}{\text{Sampling frequency [kHz]} \times \text{Bit length}}$$

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

In the case that the sampling frequency is 8 kHz, algorithm is 4-bit ADPCM2, the playback time is approx. 22.1 seconds.

$$\text{Playback time} = \frac{1.024 \times 692\,(\text{Kbit})}{8\,(\text{kHz}) \times 4(\text{bit})} \approx 22.1\ [\text{sec}])$$

Make the playback time of one phrase more than 20 msec.

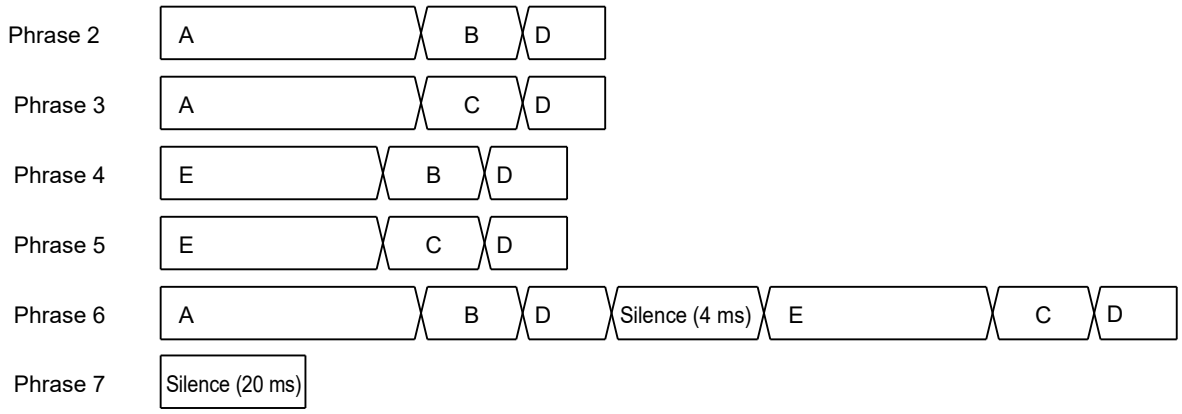
- Edit ROM function

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

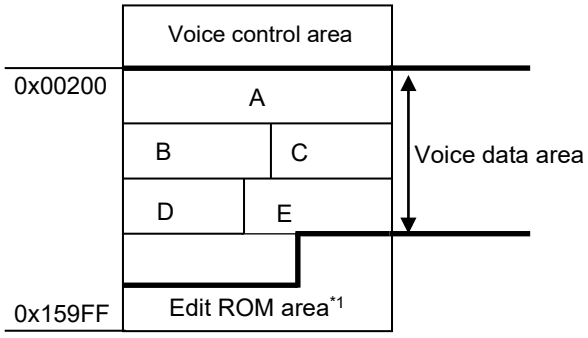
- Continuous playback: There is no limit to set the number of times of the continuous playback. It depends on the Flash capacity only.
- Silence insertion function: 4 ms to 1,024 ms
  *Note: Silent insertion time varies for ±1 ms depends on the sampling frequency.
  An independent phrase generated by edit ROM shall be 20 ms or longer.

It is possible to use voice ROM effectively to use the edit ROM function.
An example of the ROM structure, in a case of using the edit ROM function is as follows.

Example 1) Phrases using the Edit ROM Function



Example 2) Structure of the ROM storing contents of Example 1



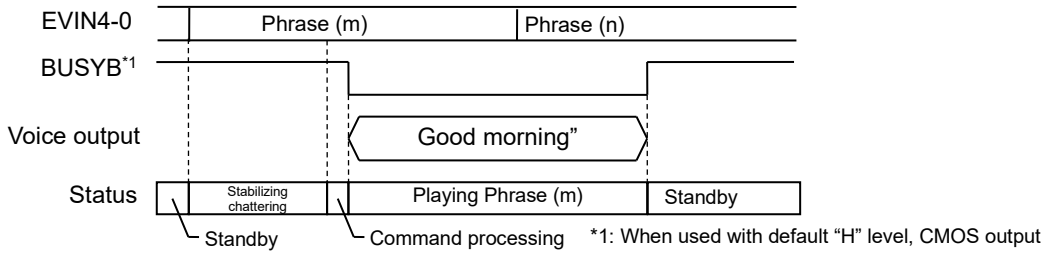
*1 : Information on phrases 2 to 7 stored

- Playback mode setup

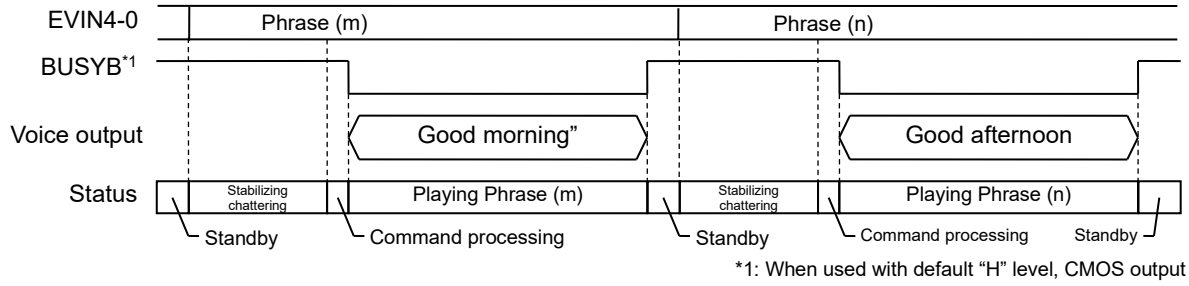
  Five playback modes are available. Can be set up for every phrase.
  Set when the voice code data is generated.

◆ Play Once mode

This mode is playback once.
All the commands become invalid during playback.

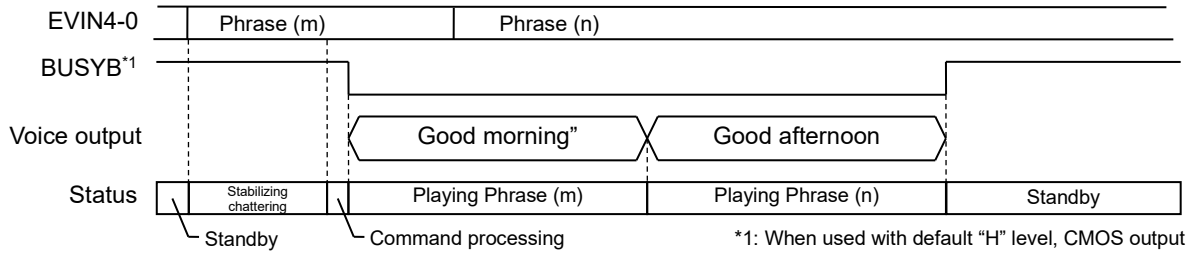


Next command must be input in the standby state after the playback ends.

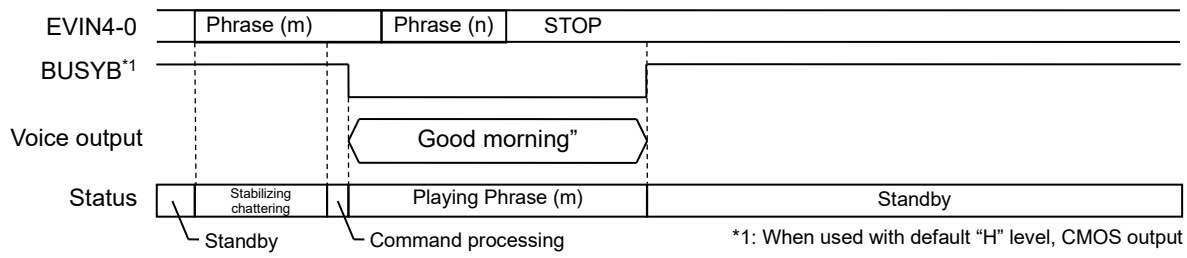


◆ Scheduled Play Once mode

This mode is playback once.
When the next phrase is inputted during playback, after playback of the present phrase ends, playback of the next phrase starts.When the following phrase is inputted into playback, after playback of the present phrase is completed, playback of th following phrase starts.

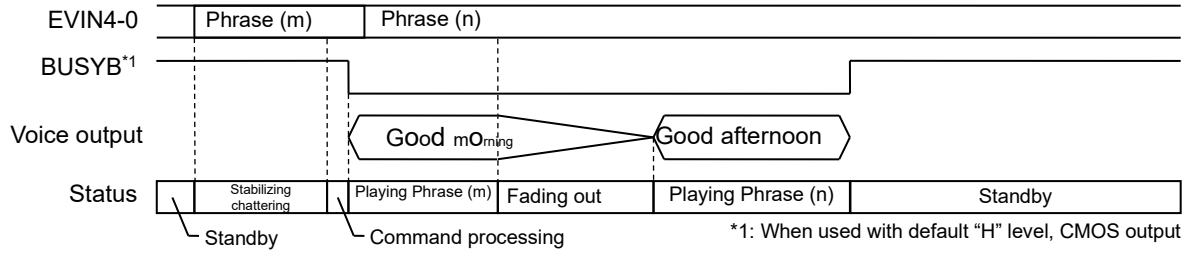


When a plurality of commands are input, the last command input at the end of the phrase is valid.
In the following case, the phrase (n) is not played back because the last command is STOP command.

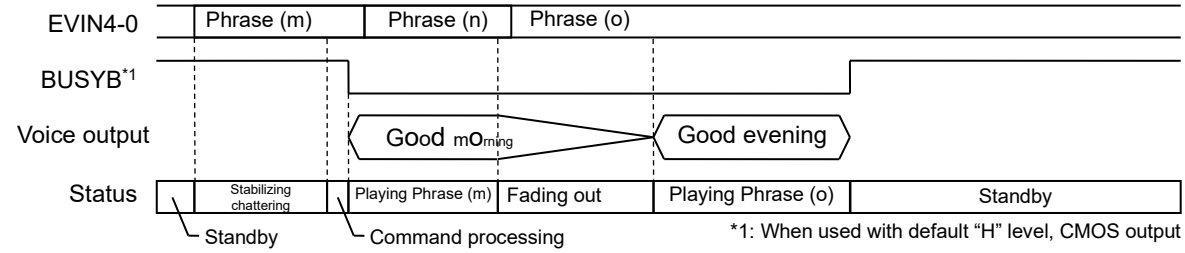


◆ Change Immediately Once mode

This mode is for playing back once.
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.

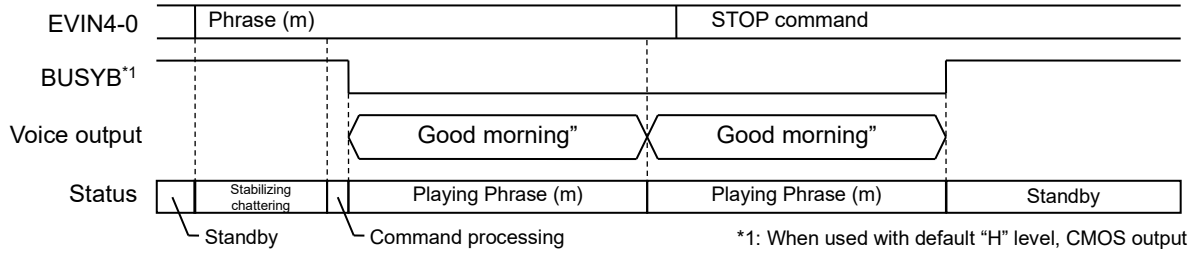


When a plurality of commands are input, the last command input at the end of the phrase is valid.
In the following case, the last input phrase (o) is played back.



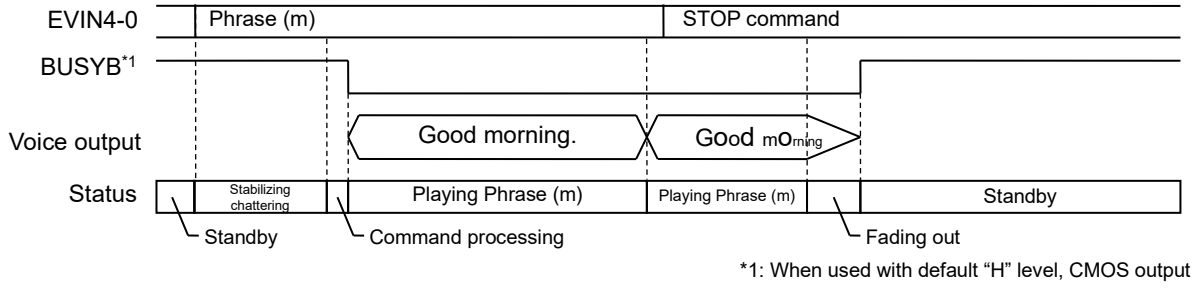
◆ Scheduled Play mode

Once the playback starts, it is repeated until the next command is input.
The next command input during the playback is executed after the playback ends.
When a plurality of commands are input, the last command input at the end of the phrase is valid, as in Scheduled Play Once.



◆ Change Immediately mode

Once the playback starts, it is repeated until the next command is input.
When the next command is input, the phrase being played back is terminated, and the next command is executed.When the following command is inputted into playback, playback of the present phrase is ended on the way, and playback of the following command starts.
When a plurality of commands are input, the last command input at the end of the phrase is valid, as in Change Immediately Once.



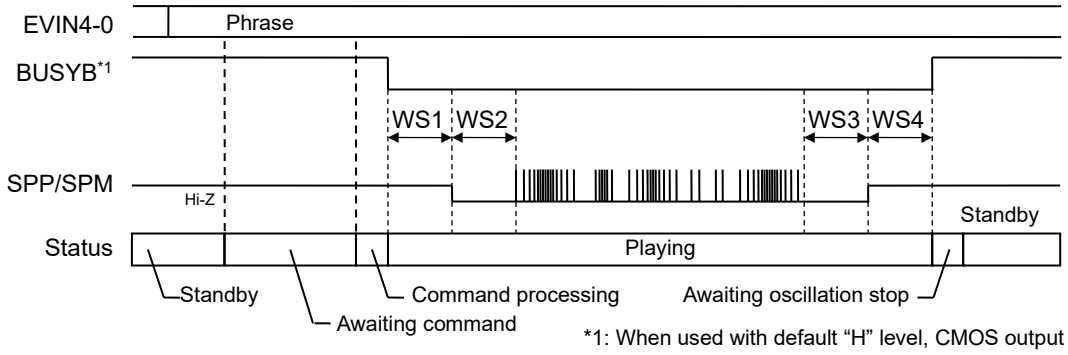
- Volume setup function

Each phrase can set up the volume setup.
Set when the voice code data is generated.

Value	Volume [dB]	Value	Volume [dB]	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

- Function of setting wait time before and after playback (WS1, WS2, WS3, WS4)

Wait time before playback (WS1, WS2) and after playback (WS3, WS4) can be set for each phrase.
Set when the voice code data is generated.

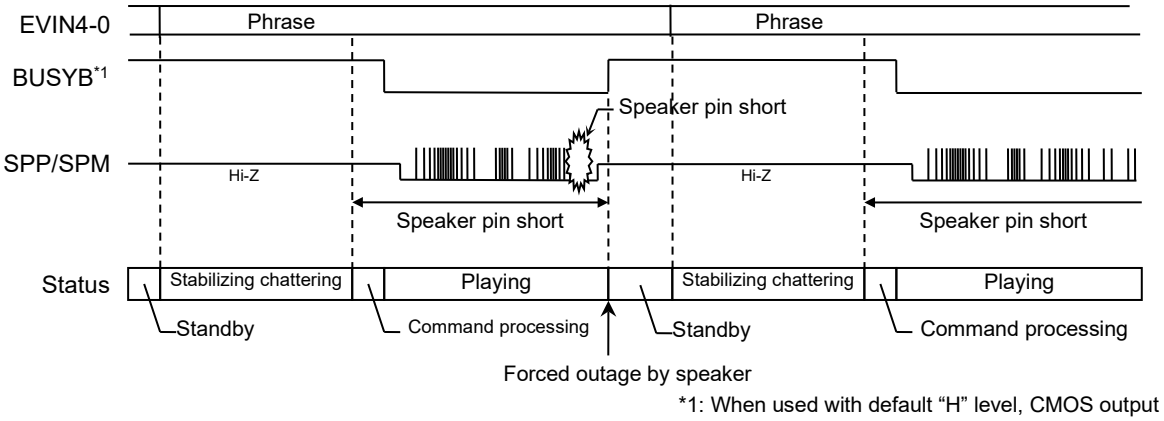


WS1: Time after inputting a phrase address, until SPP/SPM pins are enabled.
WS2: Time after SPP/SPM pins are enabled, until playback is started.
WS3: Time after playback is completed, until SPP/SPM pins are disabled.
WS4: Time after SPP/SPM pins are disabled, until it will be in a standby state.

WS1-WS4 can be arbitrarily set up between 0 to1020 ms (4 ms unit).

- Speaker Pin Short Detection Function

The speaker pin short detection function detect the short-circuit between SPP pin and SPM pin, or between SPP/SPM pin and GND during playback.
When short-circuit of a speaker pin is detected, the playback will be stopped automatically, BUSYB pin will become "H" level, and LSI will become in a standby state.
Speaker short detection prevents IC destruction, but the detection circuit is effective to prevent destruction caused by sudden accidents, and is not intended for use in the condition like short detection occurs continuously.
This function can be set up with the option screen of Speech Utility.
Please refer to a "Code Option Setting Item" for details.



*1: When used with default “H” level, CMOS output

■ Commands

The following commands are used for the LSI.After setting the voice code data in the flash memory of this LSI, be sure to use the voice playback command.

Command	Description
STOP	Stop command. The STOP command becomes effective for phrase other than those in Play Once mode and Scheduled Play Once mode.
DISCONNECT	Disconnection detection command. Speaker disconnection is detected. The STOP command must be input after using the DISCONNECT command.
PHRASE	Playback command. Playback phrase is selected from 30 phrases.

● Command configuration

Command is of 1 byte, and any bit sequence can be set for STOP command and DISCONNECT command.
PHRASE command is allocated with a bit sequence other than the set values for STOP command and DISCONNECT command.

These are set when the voice code data is generated.
Please refer to a "Code Option Setting Item" for details.

The command configuration when the initial value (STOP command is set to be 00000b and DISCONNECT command is set to be 00001b) is set is as follows.

Command	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
STOP	0	0	0	0	0
DISCONNECT	0	0	0	0	1
PHRASE	0	0	0	1	0
	:				
	1	1	1	1	1

Example where STOP command is set to 11111b and DISCONNECT command is set to 00001b is described.
When STOP command is changed from the initial value, the number of phrase available decreases by one.

Command	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
-*1	0	0	0	0	0
DISCONNECT	0	0	0	0	1
PHRASE	0	0	0	1	0
	:				
	1	1	1	1	0
STOP	1	1	1	1	1

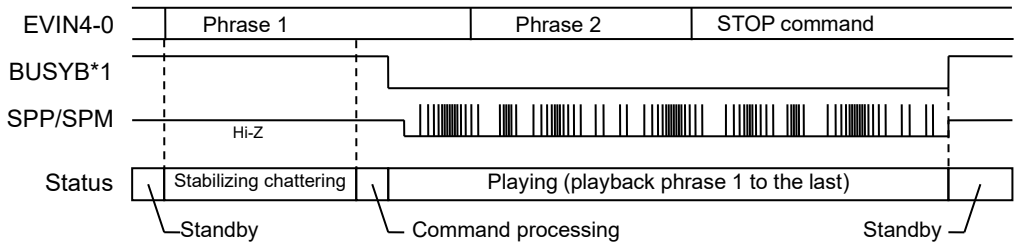
Note 1: 00000b cannot be set to PHRASE command. 29 phrases from 00010b to 11110b can be set to PHRASE command.

- STOP command

EVIN4-0 pin	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
Initial value	0	0	0	0	0

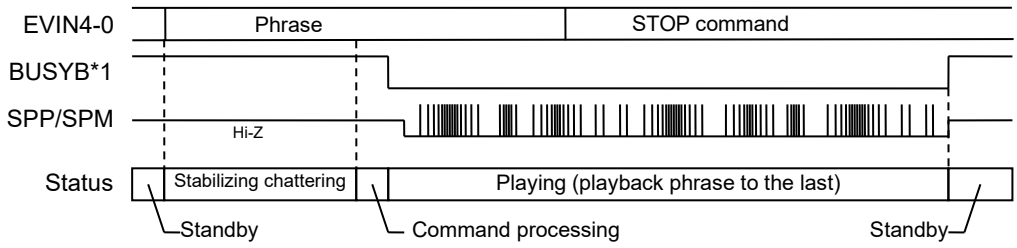
The STOP command is used to stop the playback. BUSYB pin will become “H”, if the playback is stopped.
The STOP command becomes effective for the phrase waiting to be played in Scheduled Play Once mode, and in Scheduled Play modem, Change Immediately Once mode, and Change Immediately mode.
STOP command used for phrases played back in Play Once mode or Scheduled Play Once mode, the STOP is ignored.
When STOP command is input in Scheduled Play mode, the playback stops after the phrase is played back to the end.
When STOP command is input in Change Immediately Once mode or Change Immediately mode, the voice fades out, and the playback stops.
Input a phrase playback request (PHRASEn command) after the STOP command, after confirming the end of the phrase being played (BUSYB="H"), and after $t_{OSST}+t_{CMS}$ has elapsed.
Operations where STOP command is effective are described below.

◆ STOP command operation in the case of Scheduled Play Once mode



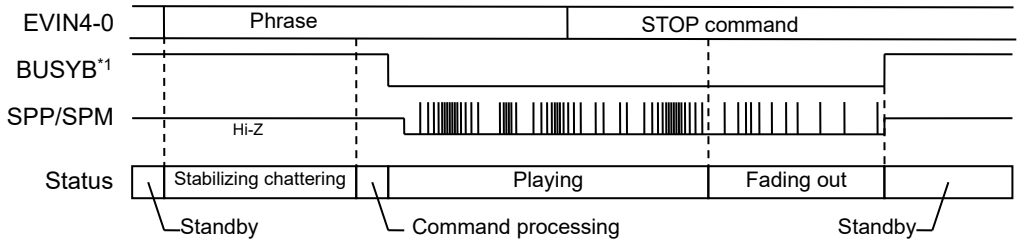
*1: When used with default “H” level, CMOS output

◆ STOP command operation in the case of Scheduled Play mode



*1: When used with default “H” level, CMOS output

◆ STOP command operation in the case of Change Immediately Once mode or Change Immediately mode

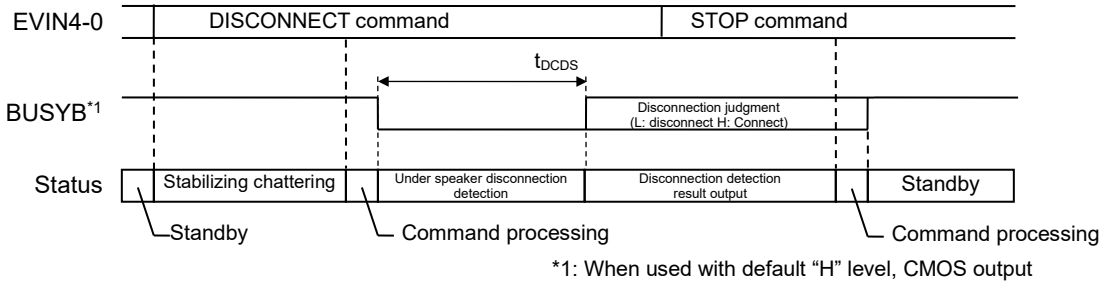


*1: When used with default “H” level, CMOS output

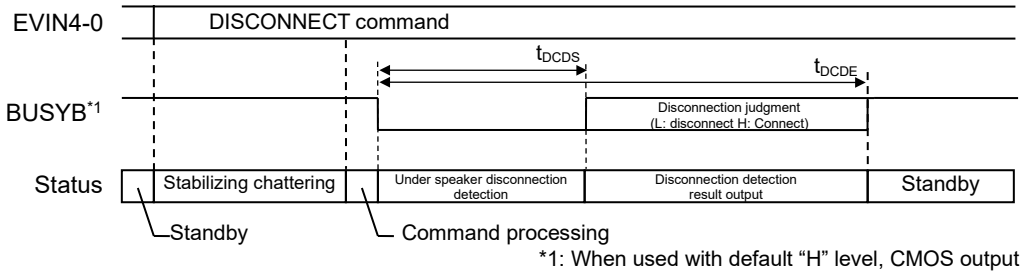
- DISCONNECT command

EVIN4-0 pin	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
Initial value	0	0	0	0	1

The DISCONNECT command is used to diagnose whether the speaker is disconnected or not.
The command cannot be used during voice playback. The command shall be used during standby (no playback).
Disconnection detection result is output to BYSYB pin. "L" is output when the speaker is disconnected, and outputs "H" when the speaker is not disconnected. Please input the STOP command to transition to standby state, after you use the DISCONNECT command.



When no STOP command is input after the execution of DISCONNECT command, the disconnection detection automatically stops in one second, and transition to standby occurs.

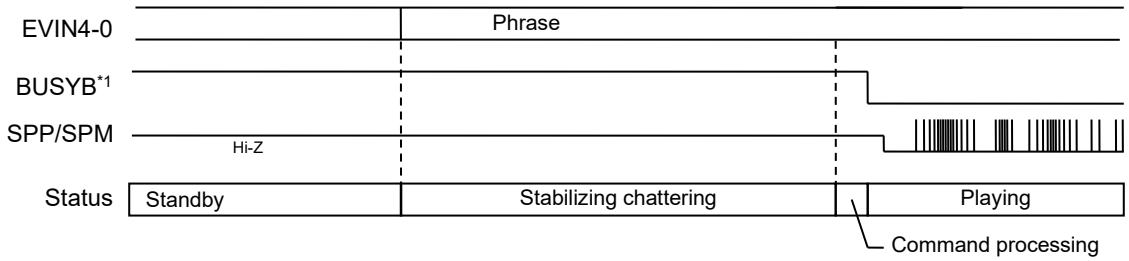


- PHRASE command

EVIN4-0 pin	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
	0	0	0	1	0
Initial value	:				
	1	1	1	1	1

PHRASE command is playback command. Specifies an address of a phrase to be played back.
Command that is not set to be STOP command or DISCONNECT command is set to be PHRASE command.
An address of phrase to be played back is set when voice code data is generated with Speech LSI Utility.

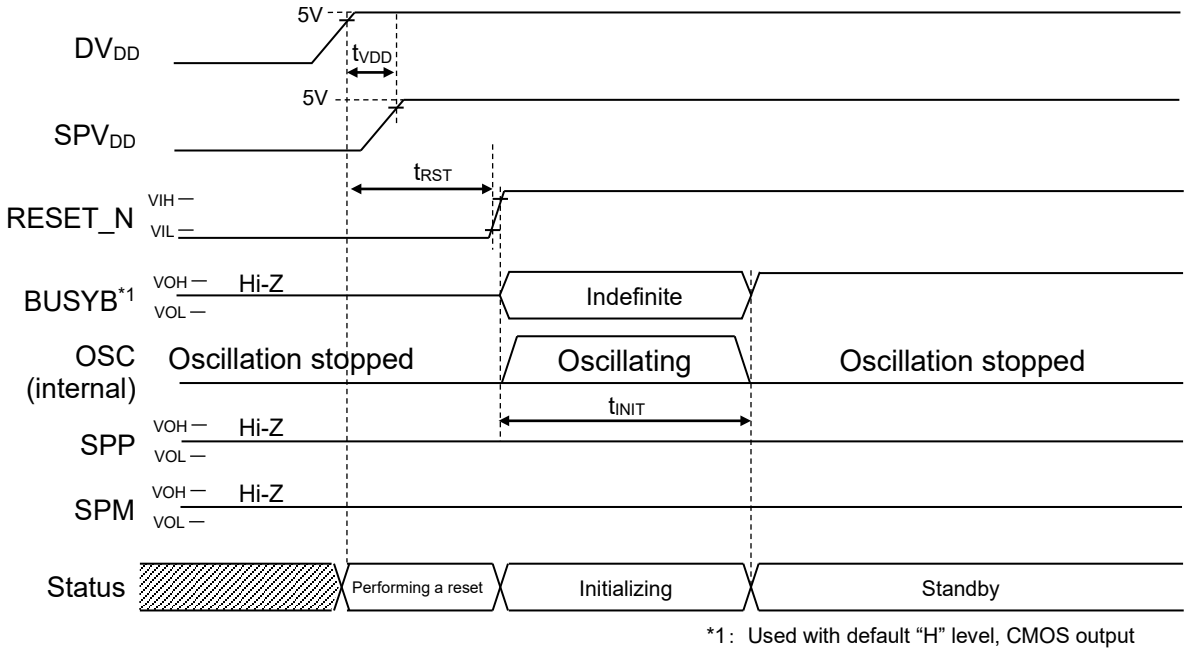
Timings of PHRASE command are shown below.



*1: When used with default “H” level, CMOS output

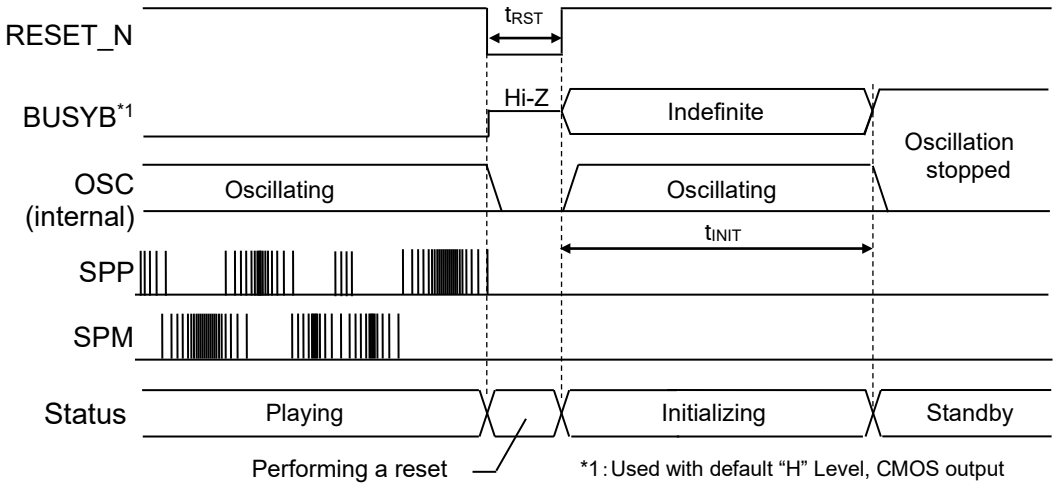
■ TIMING DIAGRAMS

- Power-On Timing



Turn on DVDD and SPVDD simultaneously, or turn on SPVDD after turning on DVDD.
Turn on DVDD and SPVDD simultaneously, or turn on SPVDD after turning on DVDD.
When DV_{DD} or SPV_{DD} falls below recommended operation power supply voltage range, “L” level must be input to RESET_N pin.

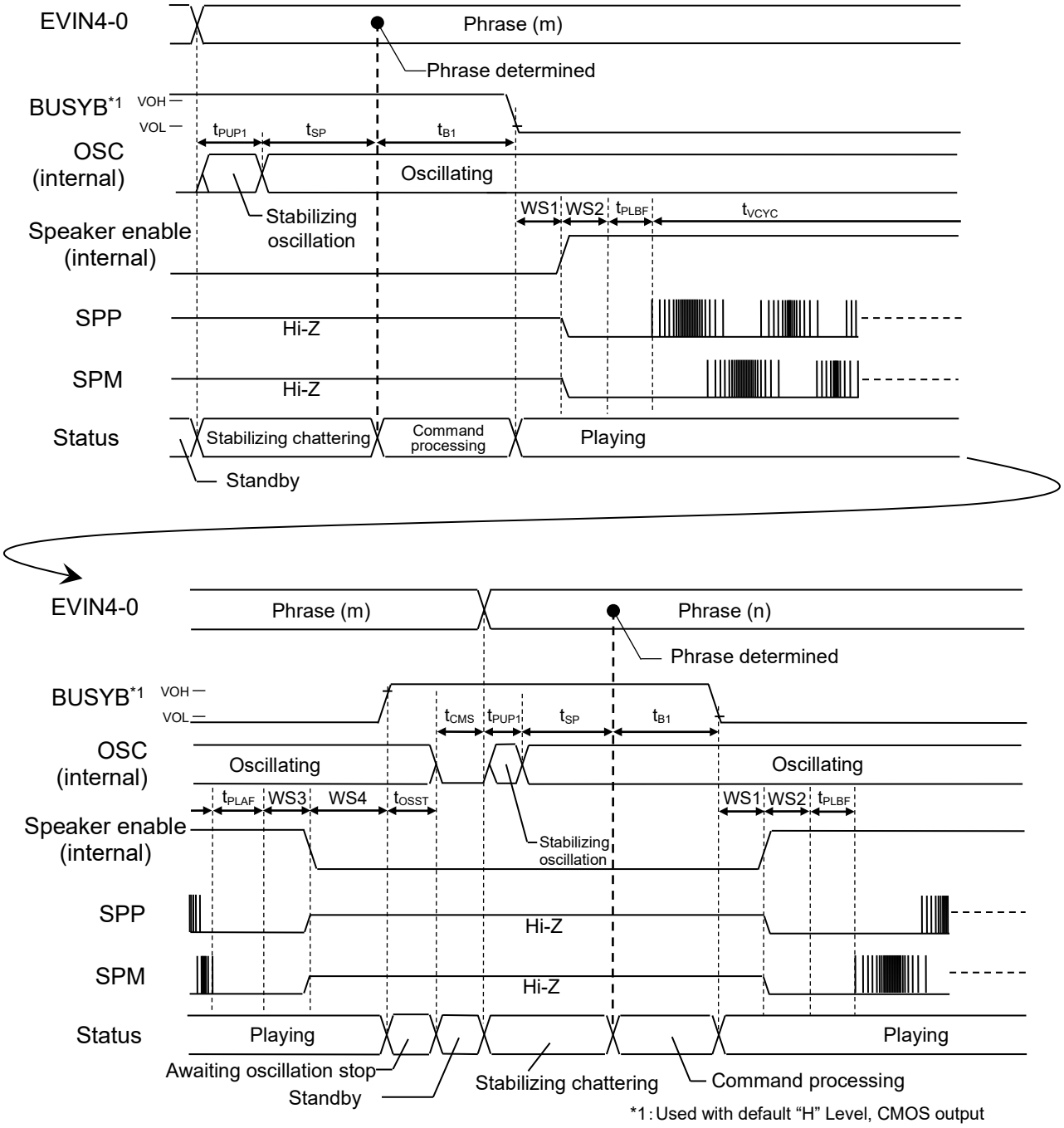
- Power down timing (RESET_N pin)



When DV_{DD} or SPV_{DD} falls below recommended operation power supply voltage range, “L” level must be input to RESET_N pin.

- Play Oncemode/Scheduled Play Once/Change Immediately Once timing

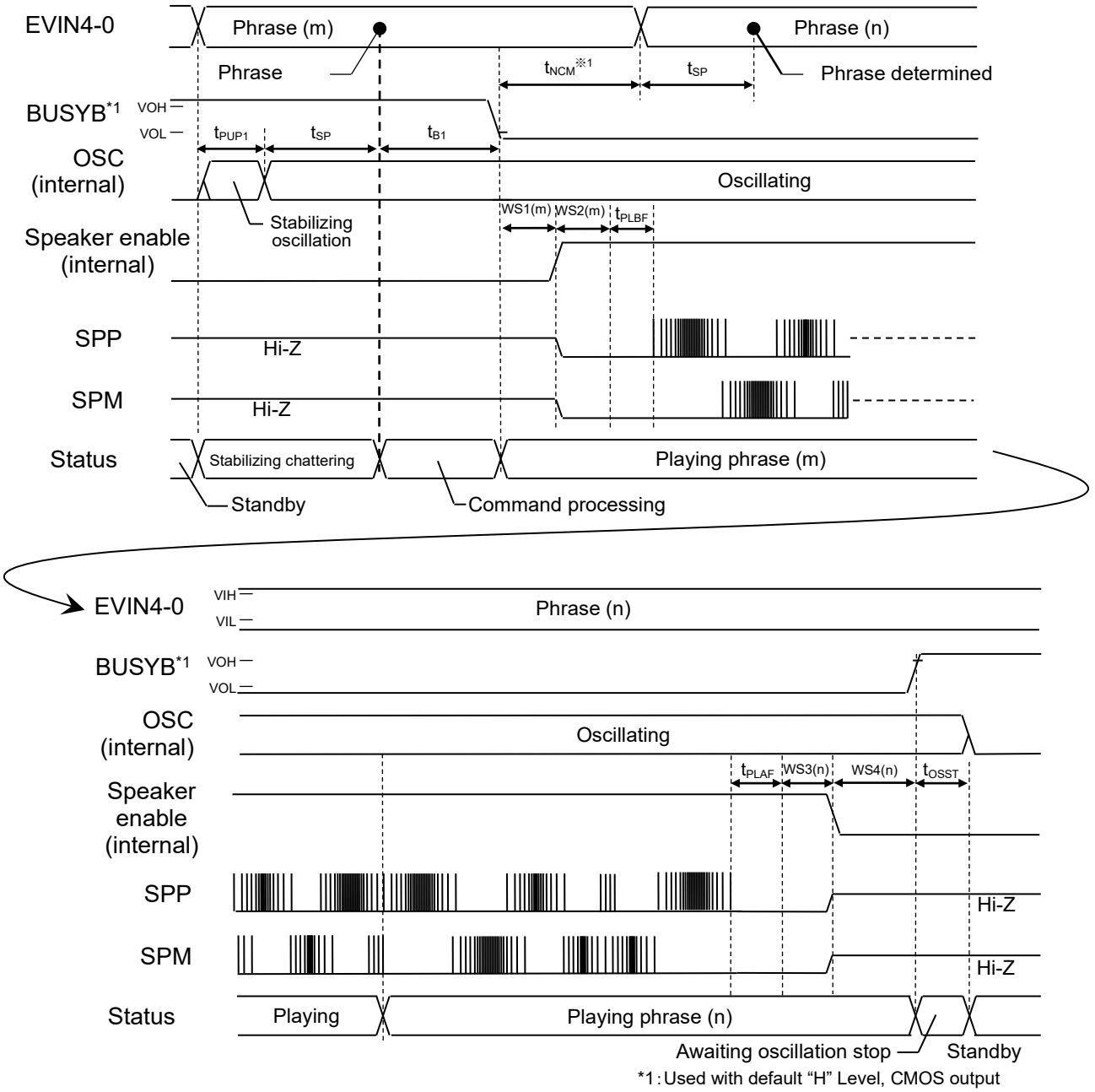
After playback of phrase (m) ends, playback request for next phrase (n) is accepted and the phrase (n) is played back.
All the commands become invalid during playback of phrase (m).
After BUSYB has shifted to "H" level, input the PHRASE command after t_{OSST}+t_{CMS} has elapsed.



*1 : Used with default “H” Level, CMOS output

- Scheduled Play Once mode and Scheduled Play mode Timing (Continuous Play)

  In response to playback request for the next phrase (n), the phrase (m) is played back to the end, and then playback of the phrase (n) starts.

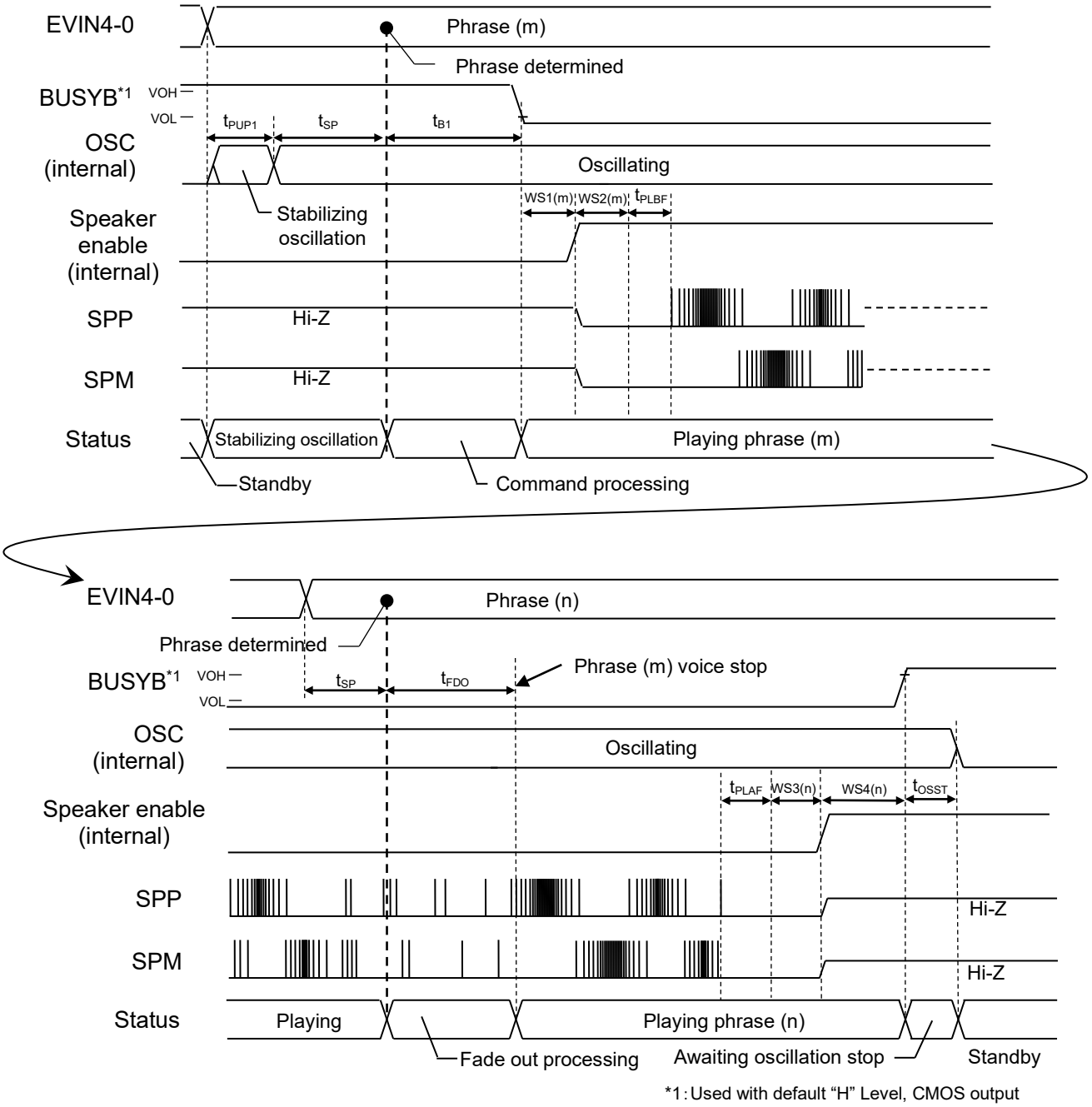


*Under Scheduled Play mode, playback is stopped by STOP command.

Note 1: In Scheduled Play Once mode, the phrase (n) is played back immediately after the end of the playback of the phrase (m), in response to an input of a playback request (PHRASE command) for the next phrase (phrase (n)) within t_{NCM}.

- Change Immediately Once mode and Change Immediately mode Timing (Continuous Play)

  In response to playback request for the next phrase (n), the phrase (m) is played back to the last, and then playback of the phrase (n) starts.

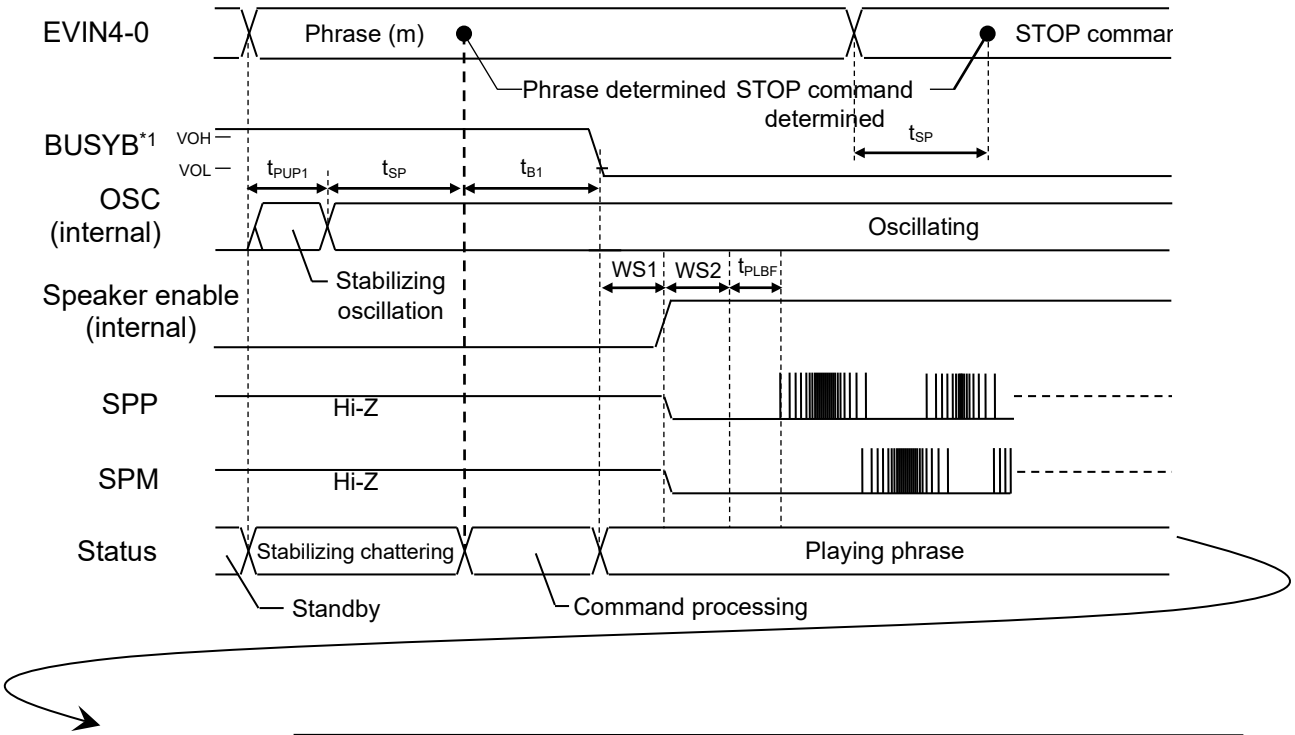


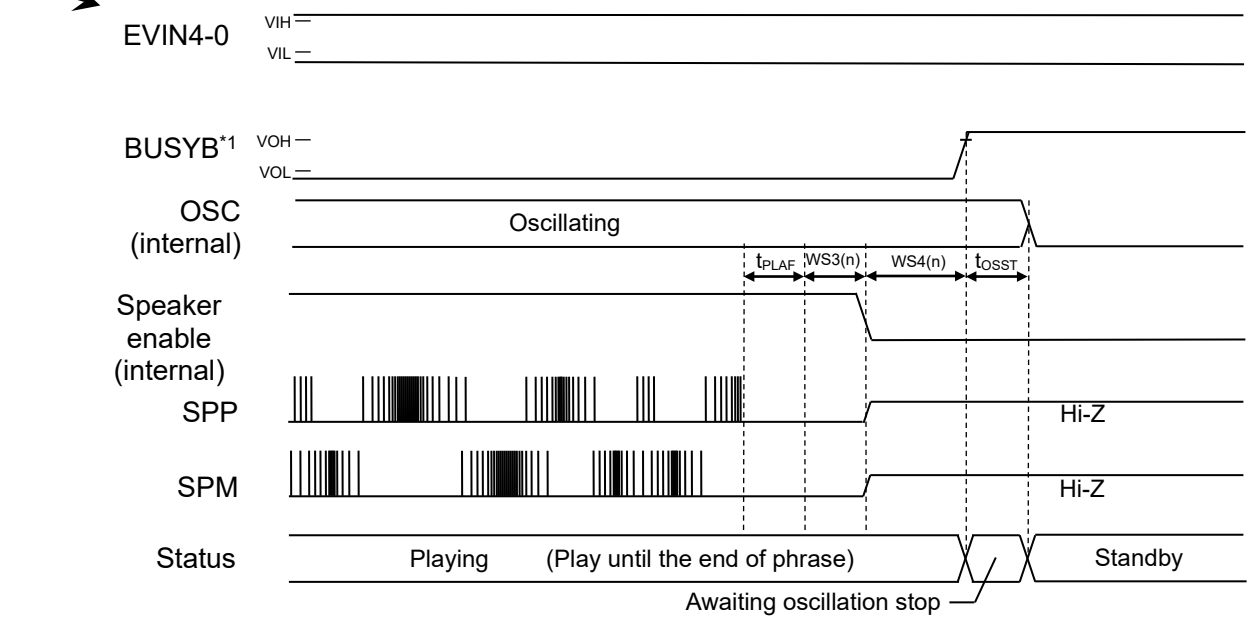
*1 : Used with default "H" Level, CMOS output

・Under Change Immediately mode, playback is stopped by STOP command.

- Scheduled Play Once mode and Scheduled Play mode Timing voice stop timing

After STOP command is input, the phrase is played back until the end, and the playback stops.

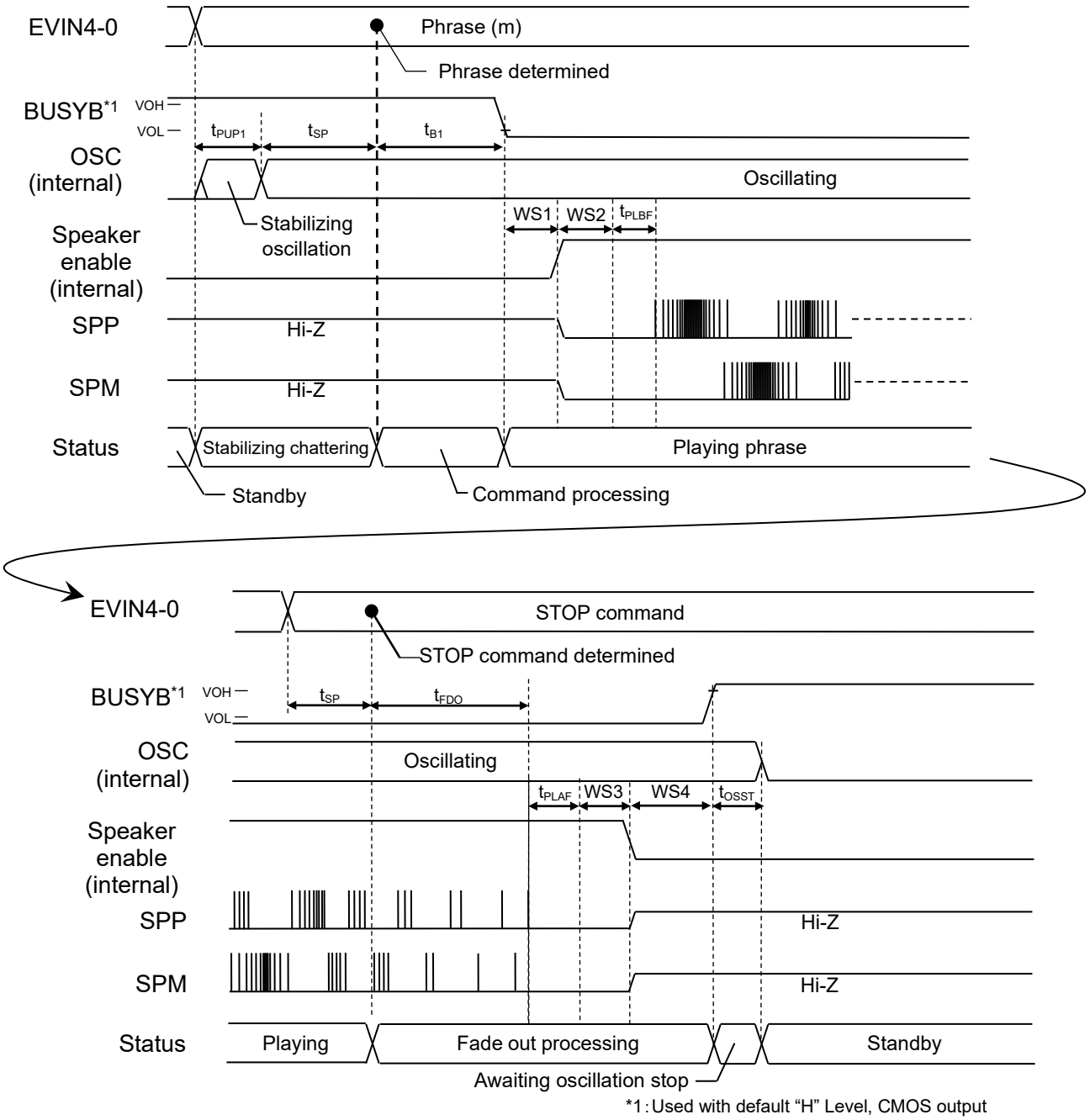




*1 : Used with default “H” Level, CMOS output

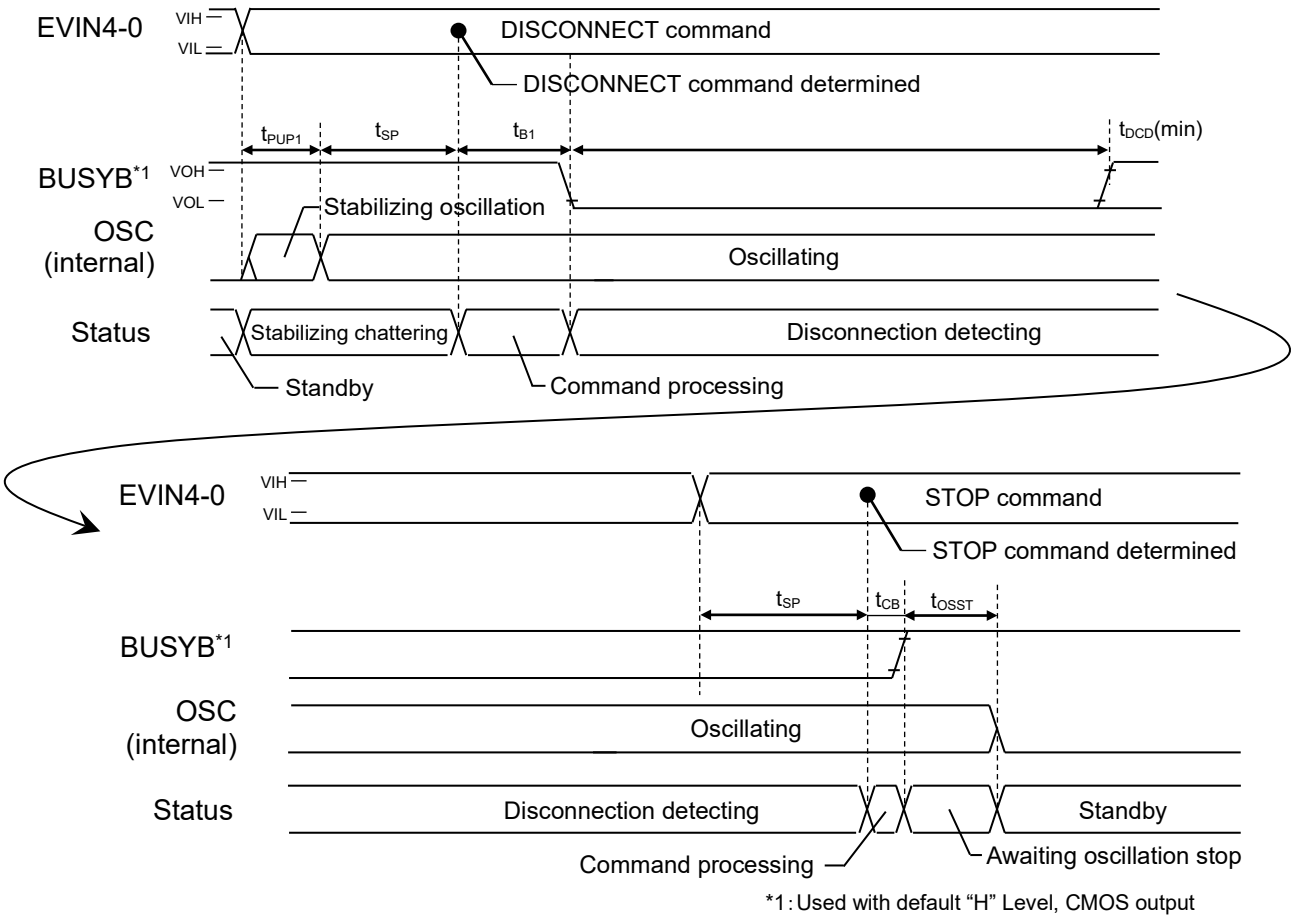
- Change Immediately Once mode and Change Immediately mode voice stop timing

After STOP command is input, the voice fades out, and the playback stops.



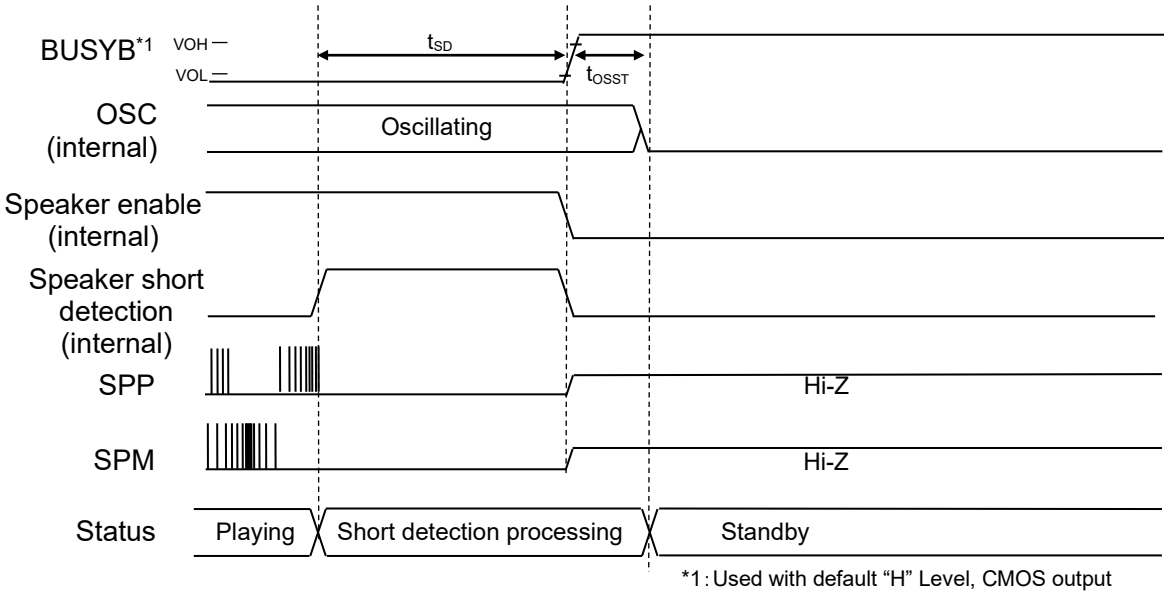
*1 : Used with default “H” Level, CMOS output

- Disconnection detection timing



*1 : Used with default “H” Level, CMOS output

- Speaker short detection timing



*1 : Used with default “H” Level, CMOS output

■ Code Option Setting Item

Items set on Code Option Setting screen for Speech LSI Utility are as follows.

・Speaker pin short detection function setting

Use of speaker pin short detection function	☐ (Not used)
	☐ (Used)

・Command setting

Command type	○1 byte (communicate with 1-byte command)
	○~~2byte~~ (cannot be set)

STOP/DISCONNECT Command	Command bit sequence	
○ Standard	STOP command	Use 0_0000b
	DISCONNECT command	Use 0_0001b
○Custom	STOP command	Set any bit sequence
	DISCONNECT command	Set any bit sequence (Set value different from STOP command)

・BUSYB Pins Setting

Use of BUSYB	Initial State	Condition	BUSYB pin status
☐ (Not used)	○L level Output	*	Fixed to “L” output
	○H level Output	*	Fixed to “H” output
☐ (Used)	○L level Output	○CMOS	Output initial value “L” with CMOS output
		○Nch Open Drain	Output initial value “L” with Nch open drain output
		○Pch Open Drain	Output initial value HiZ with Pch open drain output
		○Hi-Z	Hiz output
	○H level Output	○CMOS	Output initial value “H” with CMOS output
		○Nch Open Drain	Output initial value HiZ with Nch open drain output
		○Pch Open Drain	Output initial value “H” with Pch open drain output
		○Hi-Z	Hiz output

*: Setting value invalid

・EVIN4 to EVIN0 Pins Setting

EVIN4-1	○Hi-Z	Used with high impedance input
	○ Pull Down	Used with pull-down input
	○Pull-up	Used with pull-up input
EVIN0	○Hi-Z	Used with high impedance input
	○~~Pull Down~~	Used with pull-down input (cannot be set)
	○Pull-up	Used with pull-up input

・Chattering removal time setting

Chattering removal time	Set chattering removal time within a range of 2 ms to 62 ms (initial value is 16 ms))

■ Event Setting Item

Items set on Event Setting screen for Speech LSI Utility are as follows.

・Playback mode
Set playback mode suitable for target playback, with reference to “Playback mode” in FUNCTIONAL DESCRIPTION.

・Volume setup
Set playback mode suitable for target playback, with reference to “Volume setup function” in FUNCTIONAL DESCRIPTION.

・Setting Wait time before and after volume playback
Set desired Wait time with reference to “Function of setting wait time before and after playback (WS1, WS2, WS3, WS4)”.

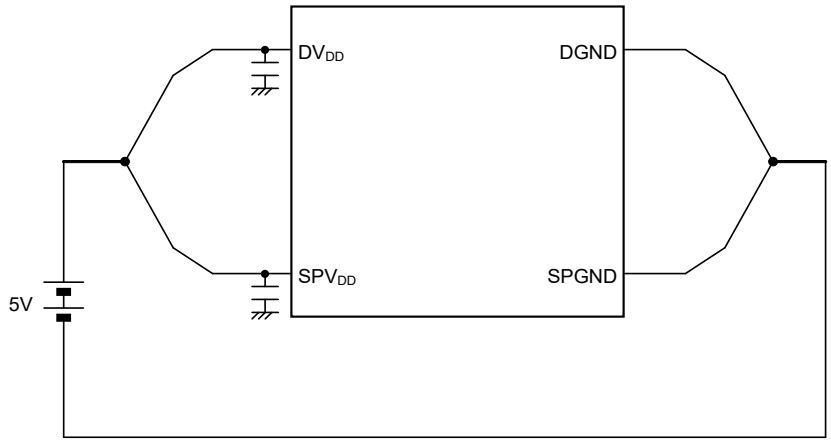
■ TERMINATION OF THE V_{DDL} PIN

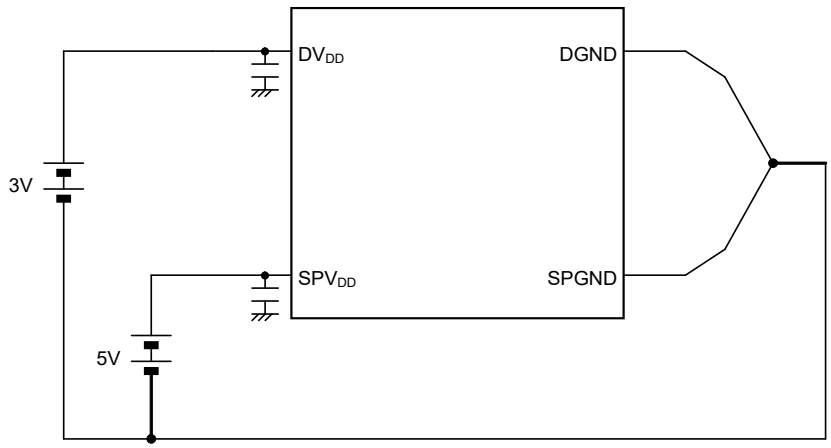
The VDDL pin is the regulator output that is power supply pin for the internal logic circuits. Connect a capacitor between this pin and the ground in order to prevent noise generation and power fluctuation.
The recommended capacitance value is shown below. However, it is important to evaluate and decide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

Pin	Recommended capacitance value	Remarks
VDDL	10 μF ±20%	The larger the connection capacitance, the longer the settling time.

■ POWER SUPPLY WIRING

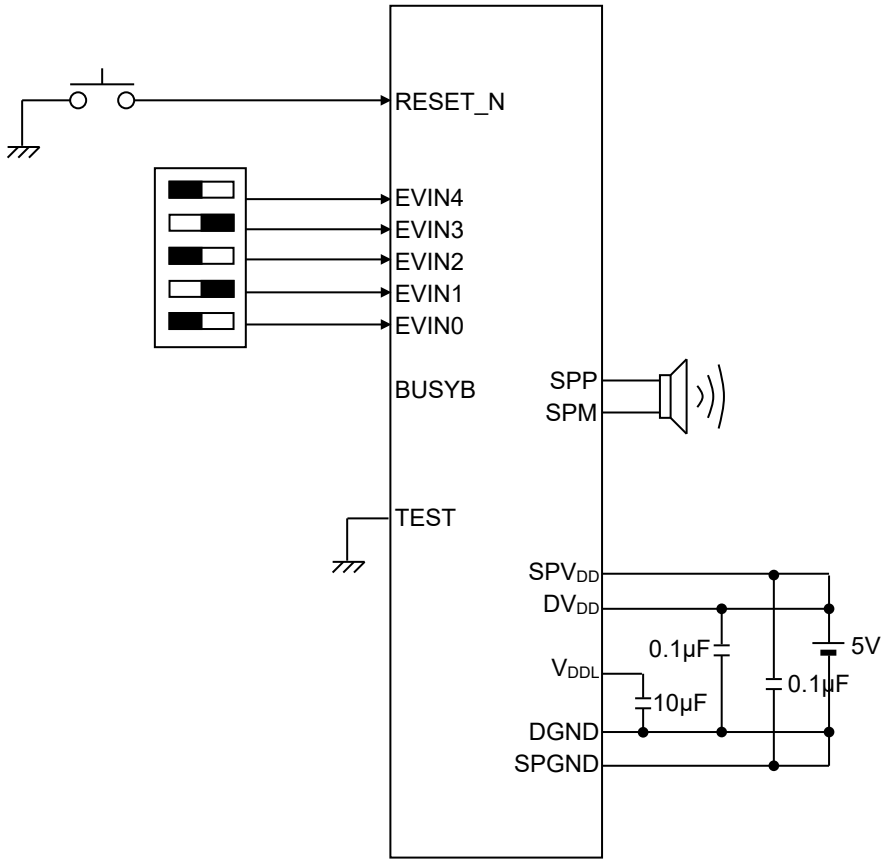
The power supplies of this LSI are divided into the following two:
· Power supply for logic circuitry (: DVDD)
· Power supply for speaker amplifier (: SPVDD)
The example of power connection is shown below



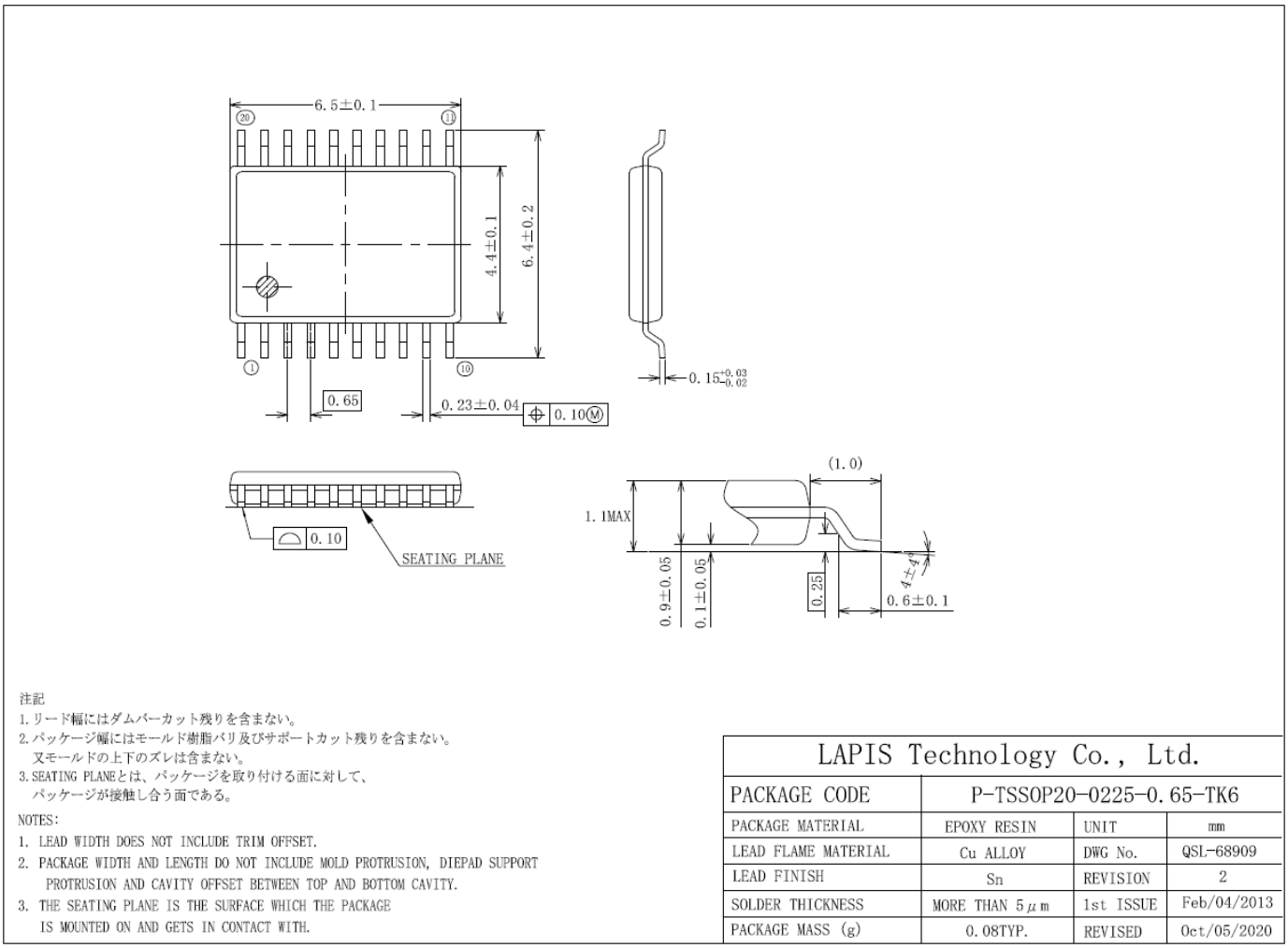


- Turn on DVDD and SPVDD simultaneously, or turn on SPVDD after turning on DVDD.
- Turn off DVDD and SPVDD simultaneously, or turn off DVDD after turning on SPVDD.

■ APPLICATION CIRCUIT



■ PACKAGE DIMENSIONS



注記
1. リード幅にはダムバーカット残りを含まない。
2. パッケージ幅にはモールド樹脂バリ及びサポートカット残りを含まない。
又モールドの上下のズレは含まない。
3. SEATING PLANEとは、パッケージを取り付ける面に対して、
パッケージが接触し合う面である。

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.

LAPIS Technology Co., Ltd.			
PACKAGE CODE	P-TSSOP20-0225-0.65-TK6		
PACKAGE MATERIAL	EPOXY RESIN	UNIT	mm
LEAD FLAME MATERIAL	Cu ALLOY	DWG No.	QSL-68909
LEAD FINISH	Sn	REVISION	2
SOLDER THICKNESS	MORE THAN 5μm	1st ISSUE	Feb/04/2013
PACKAGE MASS (g)	0.08TYP.	REVISED	Oct/05/2020

Notes for Mounting the Surface Mount Type Package

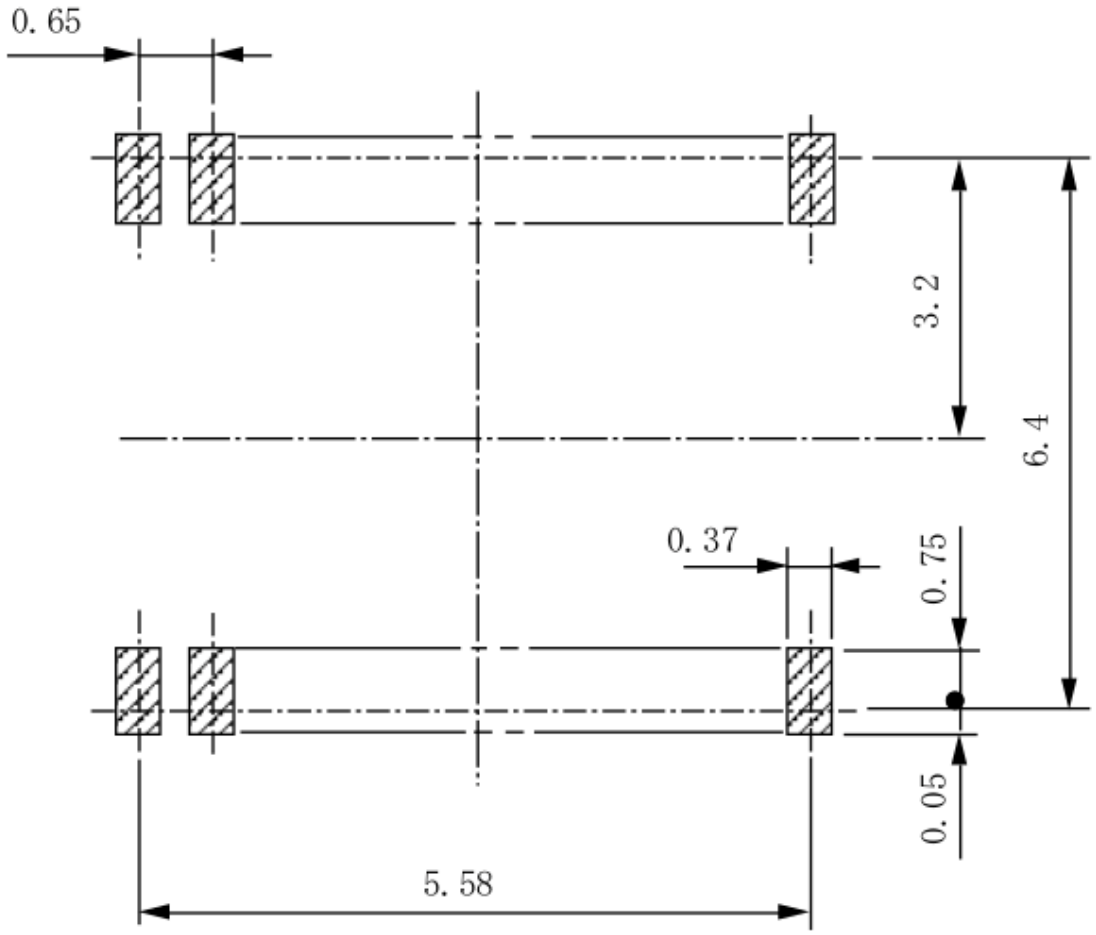
The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact a ROHM sales office for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature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

PCB Layer	JEDEC 4layers	JEDEC 2layers
PCB	(W/L/t= 76.2 / 114.3 / 1.6 (mm))	
Air cooling conditions	Calm(0m/sec)	
Heat resistance (θ ja)	63.7[°C /W]	69.4[°C /W]
Heat resistance (θ jc)	0.46[℃/W]	0.48[°C /W]
Maximum power consumption of LSI (PMax) At 1W into 8Ω playback	0.28[W]	

TjMax of this LSI is 125 °C. TjMax is expressed with the following formulas.
TjMax=TaMax+ θ ja×PMax

半田付け部端子存在範囲図

Mounting area for package lead soldering to PC boards



［単位/Unit:mm］

実装基板のフットパターンの設計の際には、実装の容易さ、接続の信頼性、配線の引き回し、半田ブリッジ発生のないことなどを十分考慮してください。

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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, wiring,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 the mounting area that the package leads are allowable for soldering to PC boards.

■ REVISION HISTORY

Document No	Date	Page		Description
		Previous Edition	Current Edition	
FEDL22Q284-01	Mar 5, 2021	—	—	Formal 1st edition.
FEDL22Q284-02	Mar 30, 2021	6	6	SPP, SPM terminal output short-circuit current value change. (Before change) 300mA (After change) 600mA
FEDL22Q284-03	Oct 4, 2021	15	15	Speaker short-circuit detection warning added.
		16	16	Added a note on using commands.
		17	17	Added a note on phrase playback after the STOP command.
		21	21	Added a note for phrase playback after transitioning to BUSYB "H" level.
		31	31	Describe the thermal resistance information of the package.
		-	32	Added "Mounting area for package lead soldering to PC boards".
FEDL22Q284-04	Jun 29, 2022	31	31	Removed "(SSOP16)" notation for PACKAGE DIMENSIONS.
FEDL22Q284-05	Feb 9, 2024	-	2	Added application information.
		1	2	Changed shipping form to table format.
		34	35	Revised the Note.

Notes

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