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

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ML22Q244

ADPCM Speech Synthesis LSI

■ GENERAL DESCRIPTION

ML22Q244 is a speech synthesis LSI that incorporates Flash for storing sound code data, and can be controlled with a standalone interface.
By integrating D-class speaker amplifier, solution required for sound output is made possible with single chip.

- Playback time

Product name	Flash capacity (bit)	Maximum playback time (sec) (at fs*1 = 6.4 kHz)	
		HQ-ADPCM	16-bit Straight PCM
ML22Q244	692K (when 30 phrases are selected)	34.6	6.92
	688K (when 62 phrases are selected)	34.4	6.88

Notes: Flash capacity shows the numerical value of only a sound area
*1: Sampling frequency

- Speech synthesis algorithm: HQ-ADPCM
  4-bit ADPCM2
  8-bit Nonlinear PCM
  8-bit / 16-bit Straight PCM
  (Can be specified for each phrase)
- Flash capacity: 692 Kbit (30 phrases selection), 688Kbit (62 phrases selection)
- Sampling frequency (Fs): 6.4kHz, 8.0kHz, 10.7kHz, 12.8kHz, 16.0kHz, 21.3kHz, 25.6kHz, 32.0kHz
  (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 or 62 phrases
- Disconnection detection function
- Speaker pin short detection function
- Source oscillation frequency: 8.192MHz (Typ) (internal)
- Power supply voltage: 2.0 to 5.5 V
- Flash memory rewritable time: 100 times
- Operating temperature range: –40 °C to +85 °C

*1 Ky's Technology HQ-ADPCM is a high sound quality audio compression technology of "Ky's". "Ky's" is a Registered trademark of National Universities corporate Kyushu Institute of Technology

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■ Applications

● Consumer and Industrial equipment (e.g., Household appliances, Housing equipment, Office equipment, Measurement instrumentation, etc.).

【NOTE】
This product cannot be applicable for automotive use, 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	ML22Q244-NNNTDZWARL ML22Q244-xxxTDZWARL	ML22Q244-NNNTDZWATL ML22Q244-xxxTDZWATL

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

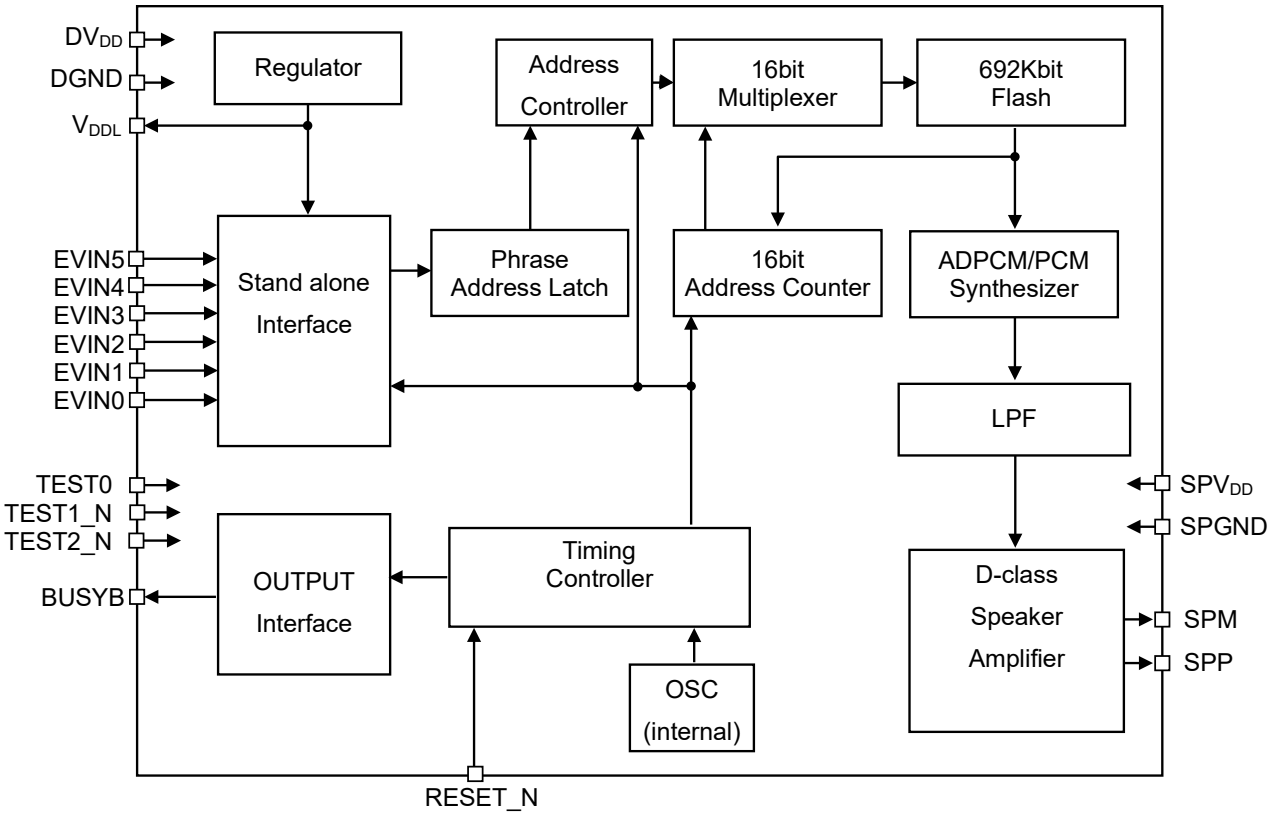
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The following table shows the differences from ML22Q234, ML22Q254.

Parameter	ML22Q244 (This product)	ML22Q234	ML22Q254
MCU interface	Standalone	Clock synchronization Serial	I^2C
Flash capacity	692 Kbit (when 30 phrases are selected) 688 Kbit (when 62 phrases are selected)	676 Kbit (when 30 phrases are selected) 672 Kbit (when 62 phrases are selected)	←
Speech synthesis algorithm	HQ-ADPCM 4-bit ADPCM2 8-bit Nonlinear PCM 8-bit Straight PCM 16-bit Straight PCM	←	←
Maximum number of phrases:	30/62	←	←
Sampling frequency (kHz)	6.4/8.0/10.7/12.8/ 16.0/21.3/25.6/32.0	←	←
Clock frequency	8.192 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	←	←
Edit ROM function	Yes	←	←
Volume control	Code setting : 32 levels (Including Mute)	Code setting : 32 levels (Including Mute) Command setting : 31 levels	←
Silence insertion	4 ms to 1024 ms (4 ms/step)	←	←
Repeat function	Yes	←	←
Flash memory access function by MCU	No	Yes	←
Power supply voltage	2.0 to 5.5 V	←	←
Operating temperature range	-40 to +85°C	←	←
Package	20-pin TSSOP	←	←

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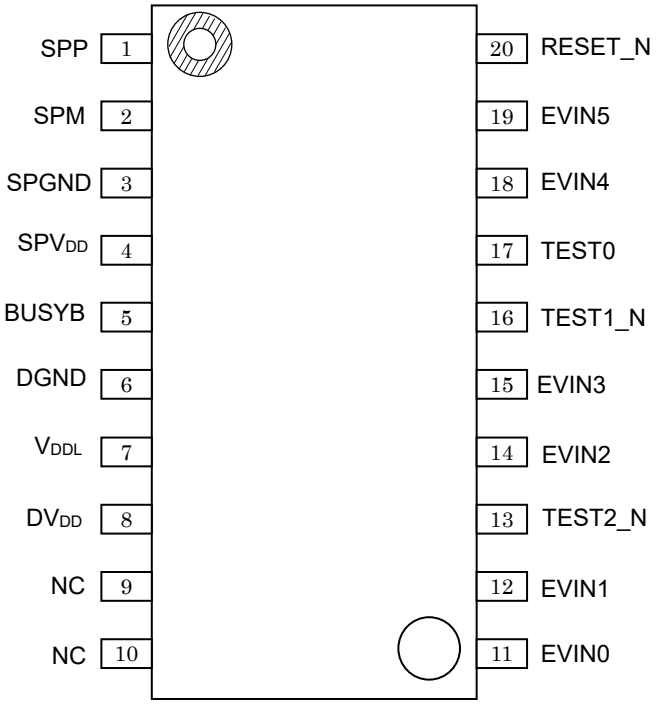
■ BLOCK DIAGRAMS



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■ PIN CONFIGURATIONS (TOP VIEW)

20-Pin Plastic TSSOP



NC : Unused pin

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■ 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 1 µF ±30% 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 1 µF ±30% between this pin and DGND pin
8	DV_{DD}	-	-	-	Digital power supply pin. Connect a capacitor of 1 µF ±30% or more between this pin and DGND pin.
11	EVIN0	I	*1	*1	Command input pin. Sound can be played back and stopped based on a change in a signal input to EVIN5-0 pin. The pin state can be set with Speech LSI Utility. Select pull-down input, pull-up input, or high impedance input
12	EVIN1	I			
14	EVIN2	I			
15	EVIN3	I			
18	EVIN4	I			
19	EVIN5	I			
13	TEST2_N	I	1	1	Input pin for testing. This pin has a pull-up resistor built in. Fix this pin to DV_{DD}.
16	TEST1_N	I	1	1	Input pin for testing. This pin has a pull-up resistor built in. Fix this pin to DV_{DD}.
17	TEST0	I/O	0	0	Input/output pin for testing. Non connection.
20	RESET_N	I	0	1	Reset input pin. This pin has a pull-up resistor built in. 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	N.C.	-	-	-	Unused pin. Leave this pin open.

*1: This value depends on Speech LSI Utility setting. Please refer to a "Code Option Setting Item" for details.

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■ ABSOLUTE MAXIMUM RATINGS

(DGND = SPGND = 0 V)

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	DV_{DD} SPV_{DD}	Ta = 25 °C	-0.3 to + 6.5	V
Internal logic power supply voltage	V_{DDL}		-0.3 to +2.0	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 = SPGND = 0 V)

Parameter	Symbol	Condition	Range	Unit
Power supply voltage	DV_{DD} SPV_{DD}	-	2.0 to 5.5	V
		Flash memory write	2.2 to 5.5	
Flash memory rewrite cycles *1	N	-	100	times
Operating temperature range	T_{OP1}	-	-40 to +85	°C
	T_{OP2}	Flash memory write	0 to +40	
Capacitor externally connected to DV_{DD} pin	C_V	-	1±30% or more	µF
Capacitor externally connected to SPV_{DD} pin	C_{SV}	-	1±30% or more	µF
Capacitor externally connected to V_{DDL} pin	C_L	-	1±30%	µF
FLASH Memory write cycle	Y_{DR}	-	15	years

*1: It means one erase and one program. Even when erasing is interrupted, it counts as one time.

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■ ELECTRICAL CHARACTERISTICS

● DC Characteristics

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +85°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} TEST0 pin	0.02	0.3	1.5	mA
"H" input current 3	I_{IH3}	V_{IH} = DV_{DD} EVIN5-0 pin pull-down input is set	2	30	250	µA
"L" input current 1	I_{IL1}	V_{IL} = DGND	-1	-	-	µA
"L" input current 2	I_{IL2}	V_{IL} = DGND RESET_N pin, TEST1_N	-1.5	-0.3	-0.02	mA
"L" input current 3	I_{IL3}	V_{IL} = DGND TEST2_N EVIN5-0 pin pull-up input is set	-250	-30	-2	µA
"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	-	3.0	6.0	mA
	I_{DD2}	No output load DV_{DD}= SPV_{DD}=5.0 V	-	5.0	9.0	
Supply current during stabilizing chattering	I_{DDC1}	DV_{DD}= SPV_{DD}=5.0 V	-	2.0	3.5	mA
Standby supply current	I_{DDS1}	Ta ≤ 50°C	-	0.5	3.0	µA
	I_{DDS2}	Ta ≤ 85°C	-	0.5	8.0	
Source oscillation frequency	f_{OSC}	-10 to +50°C	8.069	8.192	8.315	MHz
		-40 to +85°C	7.946	8.192	8.438	

● Characteristics of Analog Circuitry

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +85°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%	-	1.0	-	W

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- Power-on/Shutdown Sequence

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +85°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
RESET_N input pulse width at Power on	t_{RSTR}	-	100	-	-	µs
RESET_N input pulse width at shut down	t_{RSTF}	-	0	-	-	µs

- AC Characteristics

DV_{DD} = SPV_{DD} = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = -40 to +85°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Initialization time after reset release	t_{INIT}	-	-	-	65	ms
Oscillation stabilization 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}	-	-	-	160	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

*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.)

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■ PLAYBACK FUNCTION

● Standalone interface

Standby is canceled by a change in a signal input to the EVIN5-0 pin, and after the chattering removing period, an operation corresponding to a command indicated by the EVIN5-0 pin starts.

The pin status of the EVIN5-0 can be selected among high-impedance input (Hi-Z), pull-down input (PullDown), and pull-up input (PullUp).

The pin status of the EVIN5-0 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 EVIN5-0 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 algorithm

Supporting four types of Speech Synthesis algorithms, which are HQ-ADPCM, 4bit ADPCM2, 8-bit nonlinear PCM, 8-bit Straight PCM, and 16-bit Straight PCM. Any of these can be selected based on the characteristics of the sound to be played back.

Speech Synthesis method	Compression rate*1	Suitable waveform	Characteristics
HQ-ADPCM	1/5	Sound including high frequency components (such as sound effects)	4bit ADPCM2 algorithm is improved. Adopting variable bit length enables high sound quality and high data compression.
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 Straight PCM	1/2		Normal 8-bit Straight PCM.
16-bit Straight PCM	1		Normal 16-bit Straight PCM.

*1: When the same sampling frequency is used.

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- Memory Allocation and Creating Sound Code Data

The sound code data consists of a sound management area, a sound data area, and an edit ROM area.
The sound control area manages setting information for 30 phrases or 62phrases.
The sound area contains actual waveform data.
The edit ROM area contains data for effective use of sound 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.

Sound code data configuration
(when 30 phrases are selected)

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

Sound code data configuration
(when 62 phrases are selected)

0x00000 0x003FF	Sound control area
0x00400 0x159FF	Sound data area / Edit ROM area*1

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

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- 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 3.2 at the HQ-ADPCM, 4 at the 4-bit ADPCM2 and 8/16 at the PCM.)

In the case that the sampling frequency is 8 kHz, algorithm is HQ-ADPCM, the playback time is as follows.

When 30 phrases are selected

$$\text{Playback time} = \frac{1.024 \times 692\,(\text{Kbit})}{8\,(\text{kHz}) \times 3.2(\text{bit})} \approx 27.6\ [\text{sec}]$$

When 62 phrases are selected

$$\text{Playback time} = \frac{1.024 \times 688\,(\text{Kbit})}{8\,(\text{kHz}) \times 3.2(\text{bit})} \approx 27.5\ [\text{sec}]$$

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

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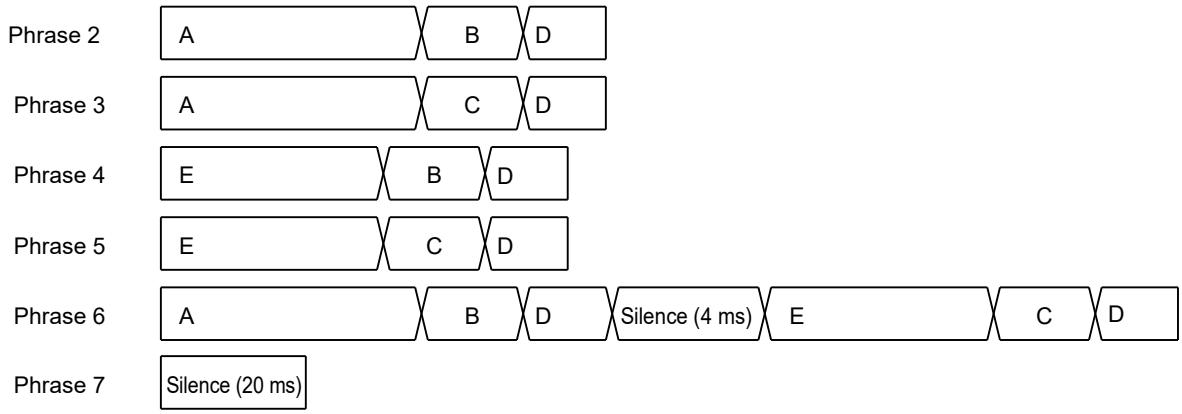
- Edit ROM function

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

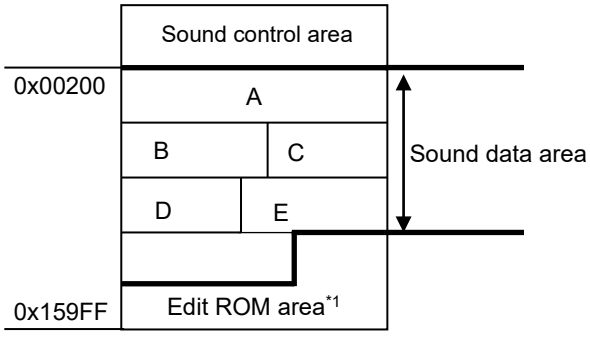
- Continuous playback: There is no limit to set the number of times of the continuous playback. It depends on the Flash capacity only.
- Silence insertion function: 4 ms to 1,024 ms
  *Note: Silent insertion time varies for ±1 ms depends on the sampling frequency.
  An independent phrase generated by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

It is possible to use sound 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 (When 30 phrases are selected)



*1 : Information on phrases 2 to 7 stored

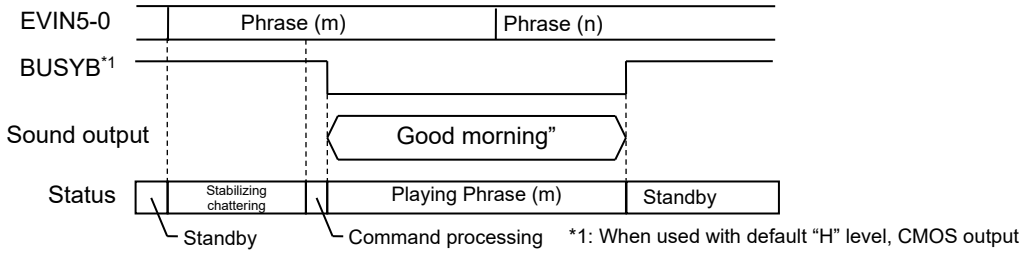
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- Playback mode setup

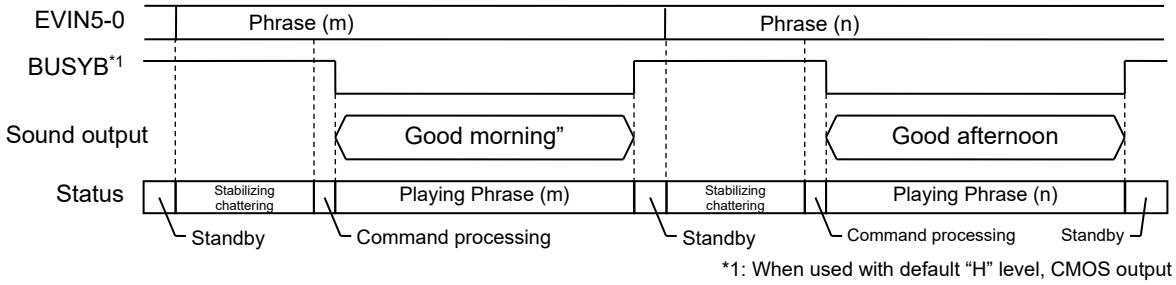
  Five playback modes are available. Can be set up for every phrase.
  Set when the sound code data is generated.

◆ Play Once mode

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

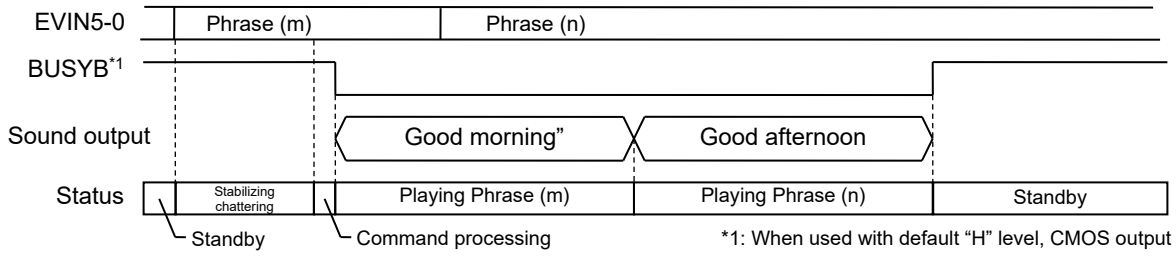


Next command must be input in the standby state after the playback ends.

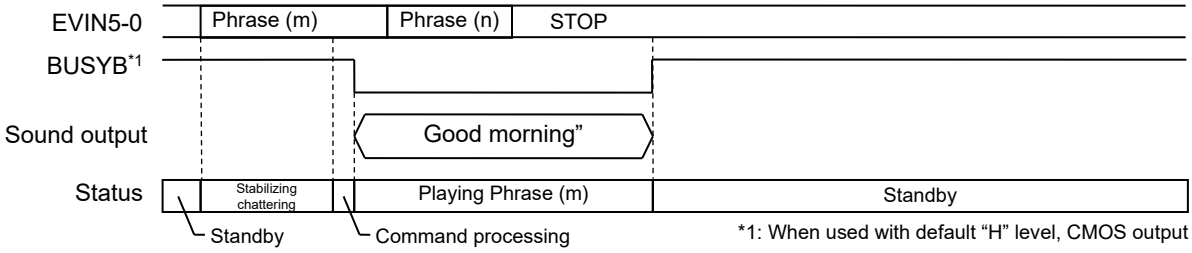


◆ Scheduled Play Once mode

This mode is playback once.
When the next command is inputted during playback, after playback of the present phrase ends, playback of the next command starts.



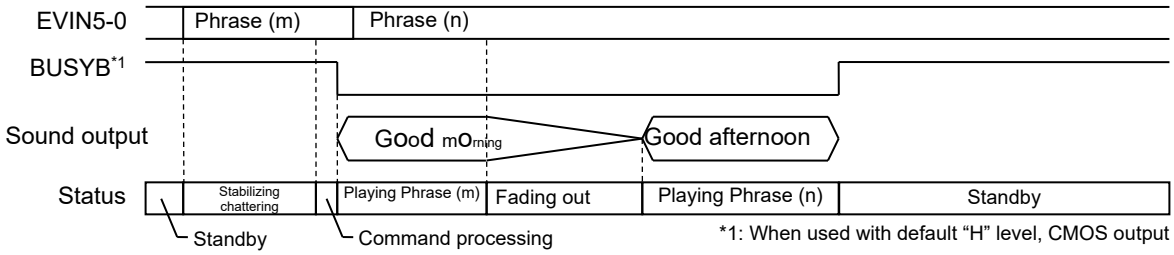
When a plurality of commands are inputted, the last command input at the end of the phrase is valid.
In the following case, the phrase (n) is not played back because the last command is STOP command.



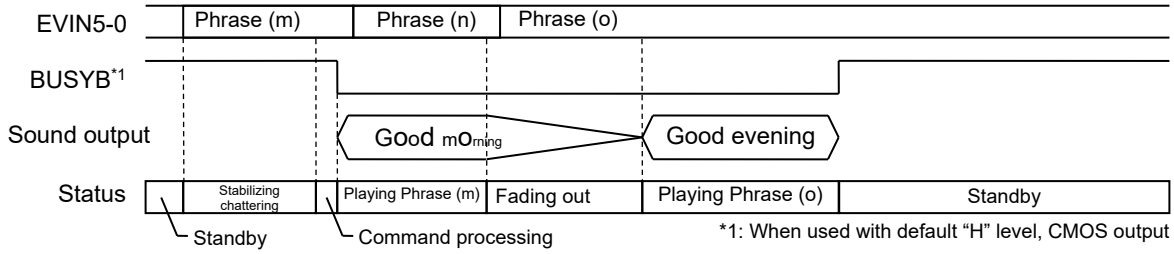
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◆ Change Immediately Once mode

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.

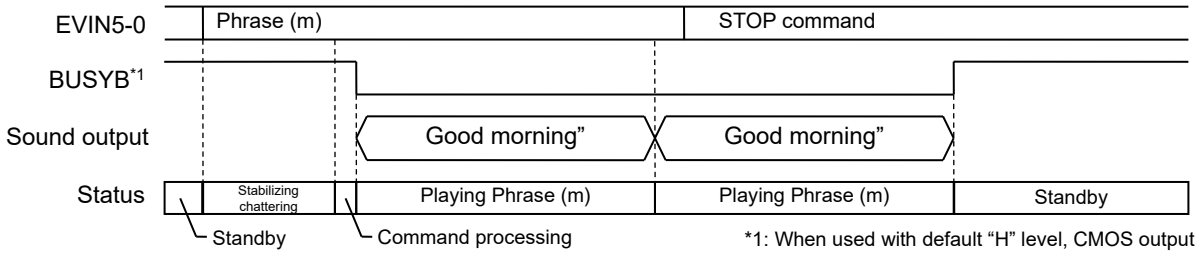


When a plurality of commands are inputted, the last command input at the end of the phrase is valid.
In the following case, the last input phrase (o) is played back.



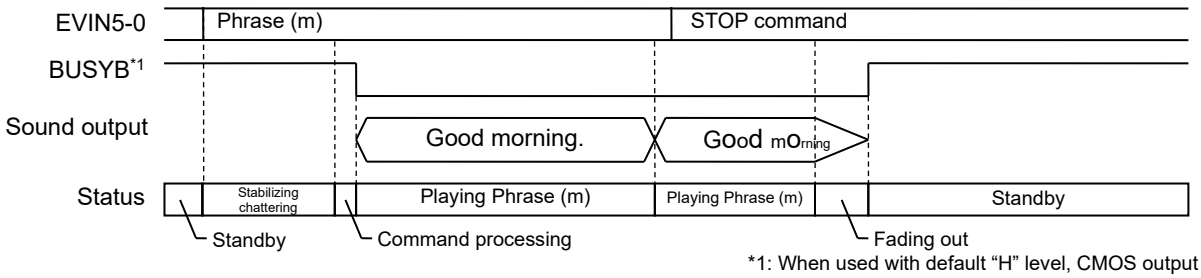
◆ Scheduled Play mode

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 inputted, 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 inputted, the phrase being played back is terminated, and the next command is executed.
When a plurality of commands are inputted, the last command input at the end of the phrase is valid, as in Change Immediately Once.



- Volume setup function

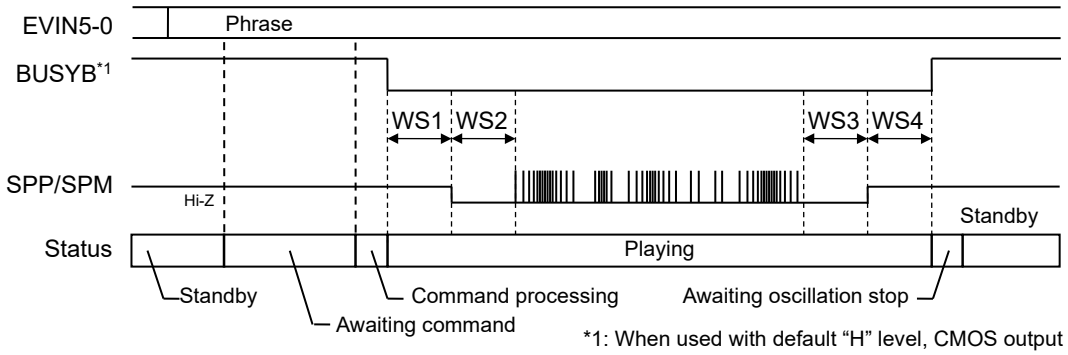
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Each phrase can set up the volume setup.
Set when the sound code data is generated.

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 sound code data is generated.



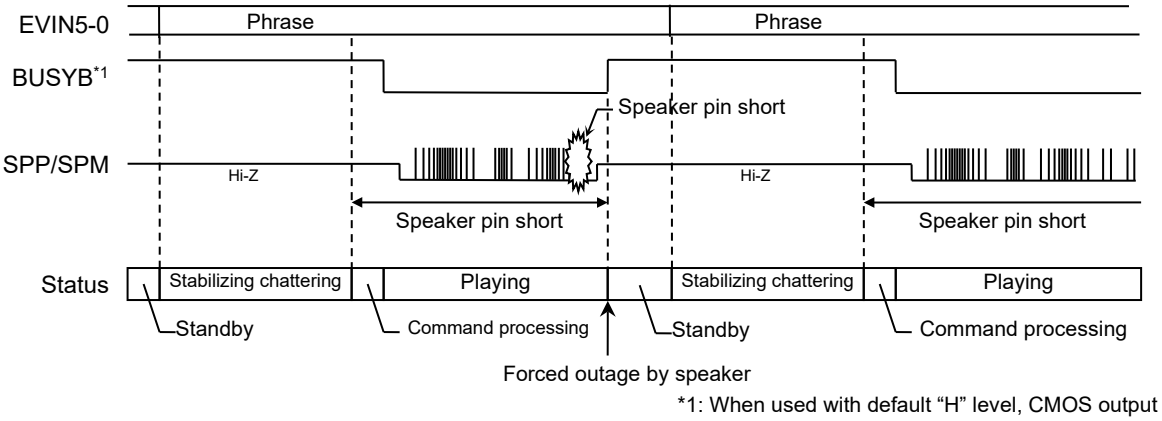
WS1: Time after inputting a phrase address, until SPP/SPM pins are enabled.
WS2: Time after SPP/SPM pins are enabled, until playback is started.
WS3: Time after playback is completed, until SPP/SPM pins are disabled.
WS4: Time after SPP/SPM pins are disabled, until it will be in a standby state.

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

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- 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

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■ PLAYBACK COMMANDS

● Playback commands list

The following playback commands are used for the LSI. Use the playback commands in the condition ensuring that the sound code data is set on the flash memory of this LSI.

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 or 62phrases..

● Playback commands configuration

Control by EVIN4-0 and control by EVIN5-0 can be selected.
When the control by EVIN5-0 is selected, the number of phrases can be expanded to 62 phrases.
PHRASE command is allocated with a bit sequence other than the set values for STOP command and DISCONNECT command.

These are set when the sound 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 00h and DISCONNECT command is set to be 01h) is set is as follows.

(1) Control by EVIN4-0 (30 phrases)

Command	EVIN5	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

*: EVIN5 input is disabled.

(2) Control by EVIN5-0 (62 phrases)

Command	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
STOP	0	0	0	0	0	0
DISCONNECT	0	0	0	0	0	1
PHRASE	0	0	0	0	1	0
	:					
	1	1	1	1	1	1

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Any bit sequence can be set for STOP command and DISCONNECT command.

The following shows examples of a case where a non-initial value is set.
When STOP command is changed from the initial value, the number of phrase available decreases by one.

(1) Control by EVIN4-0 (when STOP command is set to be 1Fh and DISCONNECT command is set to be 01h)

Command	EVIN5	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

*: EVIN5 input is disabled.

*1: 00h cannot be set to PHRASE command. 29 phrases from02h to 1Eh can be set to PHRASE command.

(2) Control by EVIN5-0 (when STOP command is set to be 3Eh and DISCONNECT command is set to be 02h)

Command	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
-*1	0	0	0	0	0	0
PHRASE	0	0	0	0	0	1
DISCONNECT	0	0	0	0	1	0
PHRASE	0	0	0	0	1	1
	:					
	1	1	1	1	0	1
STOP	1	1	1	1	1	0
PHRASE	1	1	1	1	1	1

*1: 00h cannot be set to PHRASE command. 61 phrases of 01h, 3Fh and from 03h to 3Dh can be set to PHRASE command.

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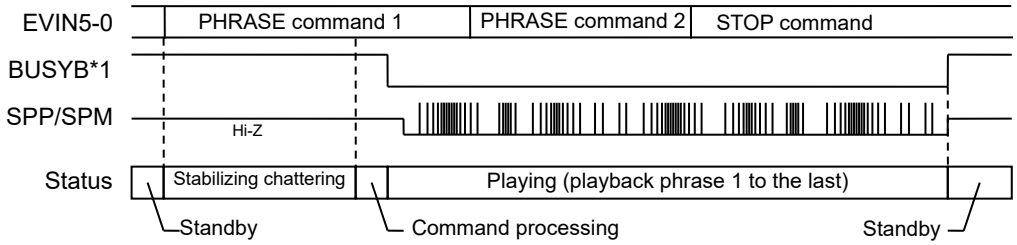
- STOP command

EVIN5-0 pin	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
Initial value	0	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 sound fades out, and the playback stops.

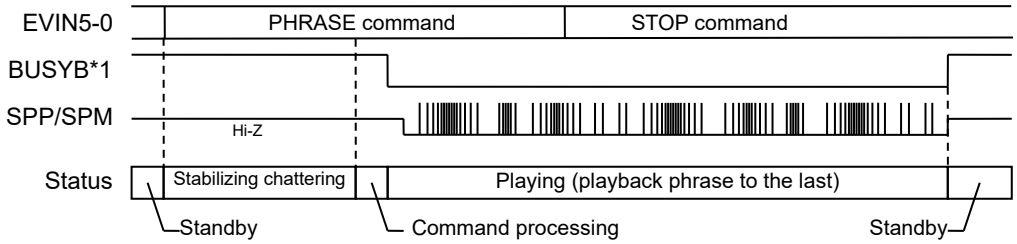
Operations where STOP command is effective are described below.

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



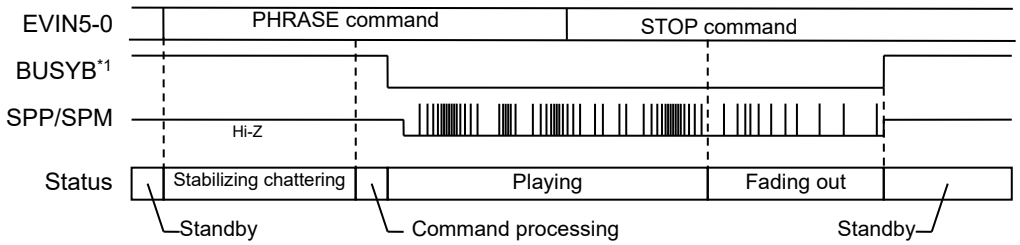
*1: When used with default “H” level, CMOS output

◆ 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



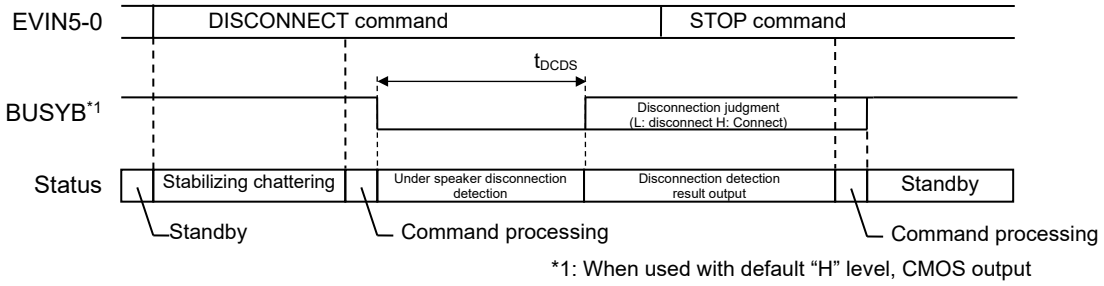
*1: When used with default “H” level, CMOS output

Downloaded from Arrow.com.

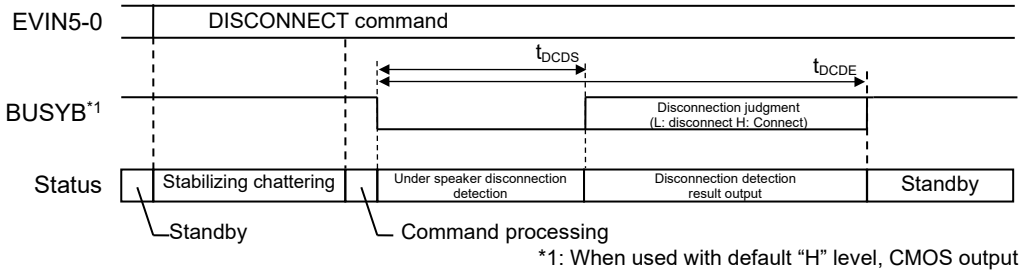
- DISCONNECT command

EVIN5-0 pin	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
Initial value	0	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 sound 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.



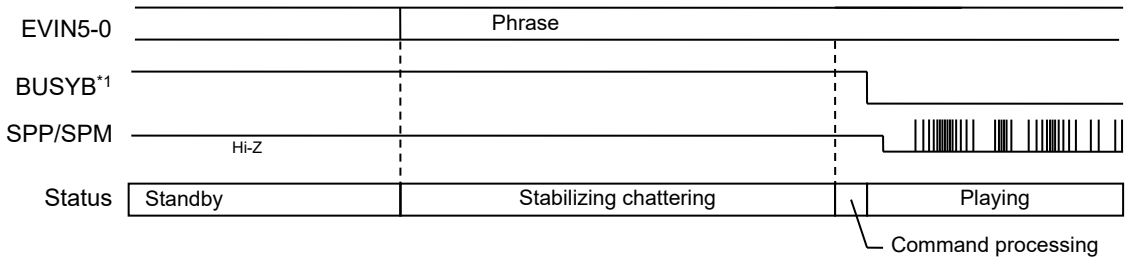
Downloaded from Arrow.com.

- PHRASE command

EVIN5-0 pin	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0
	0	0	0	0	1	0
Initial value	:					
	1	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 sound code data is generated with Speech LSI Utility.

Timings of PHRASE command are shown below.



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

Set the playback Phrase with EVIN4-EVIN0 or EVIN5-EVIN0.

(1) 1-byte command selection

No.	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0	Playing Phrase
1	*	0	0	0	1	0	Phrase 2
:	*	:					:
30	*	1	1	1	1	1	Phrase 1F

*: EVIN5 input is disabled.

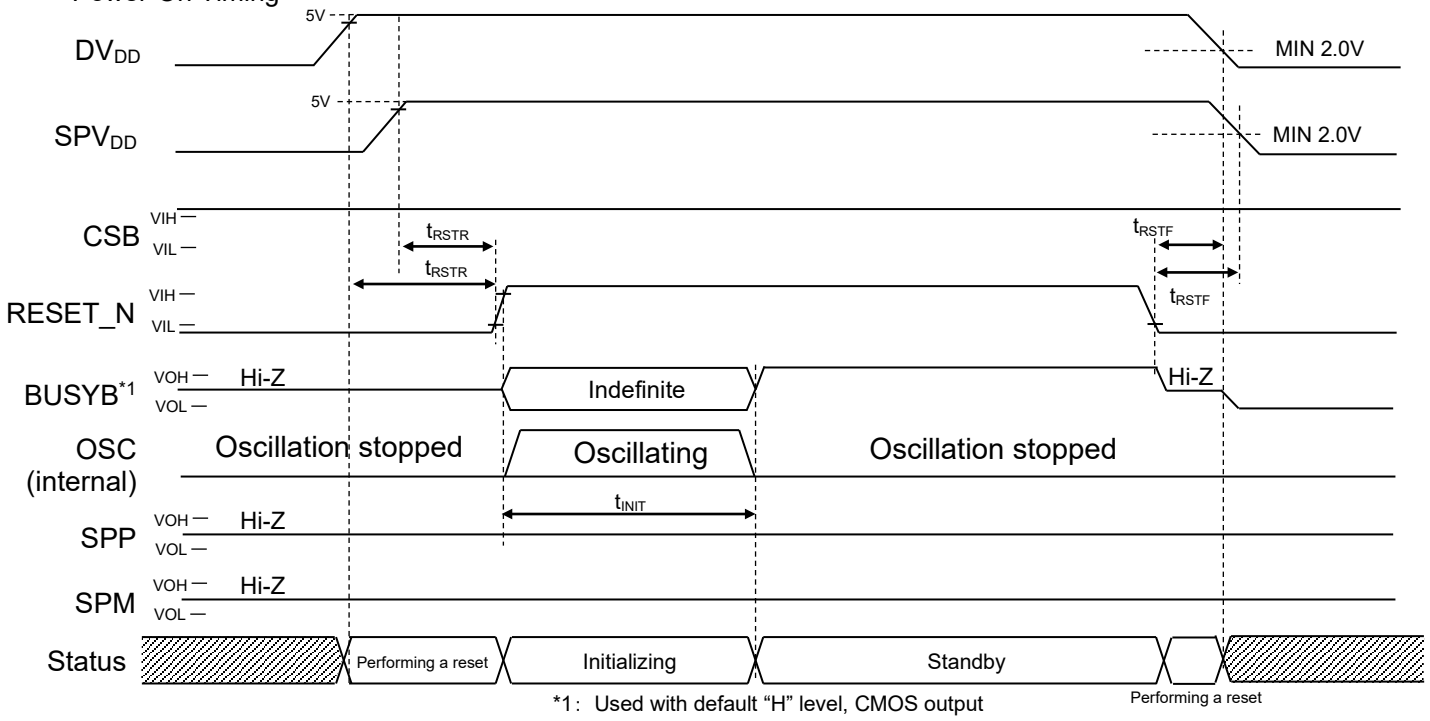
(2) 2-byte command selection

No.	EVIN5	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0	Playing Phrase
1	0	0	0	0	1	0	Phrase 2
:	:						:
62	1	1	1	1	1	1	Phrase 3F

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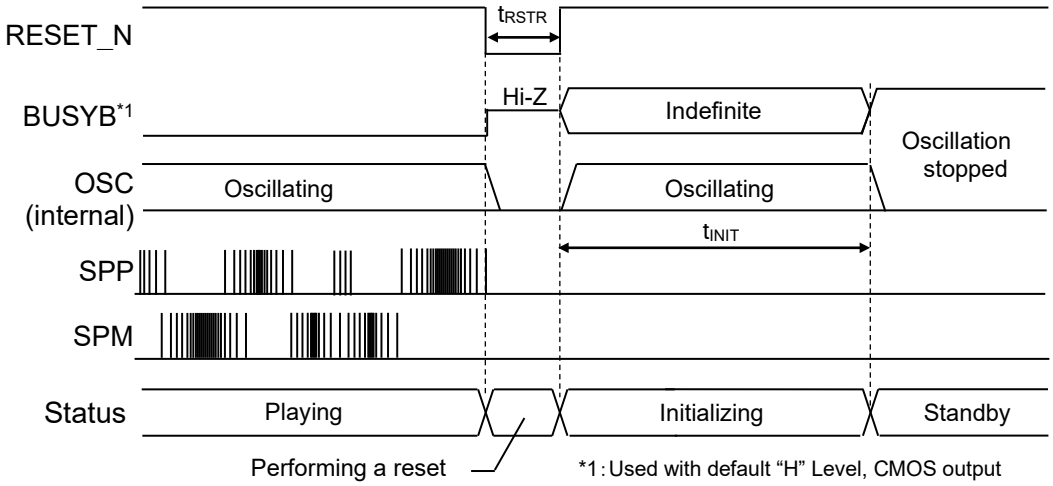
■ TIMING DIAGRAMS

- Power-On Timing



When the power is turned on and off, there is no restriction on the order of turning on DV_{DD} and SPV_{DD}. 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)

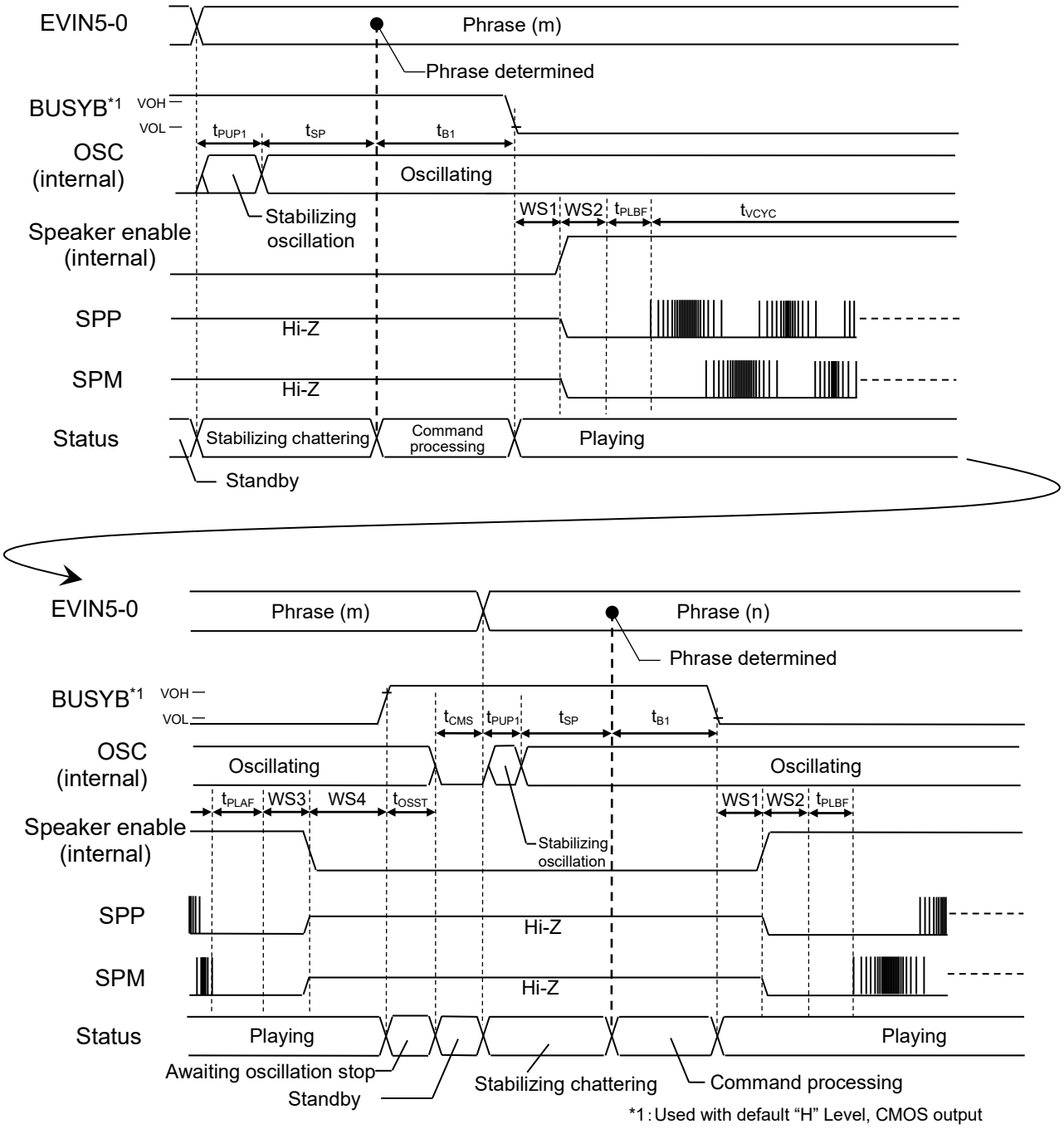


When DV_{DD} or SPV_{DD} falls below recommended operation power supply voltage range, "L" level must be input to RESET_N pin.

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

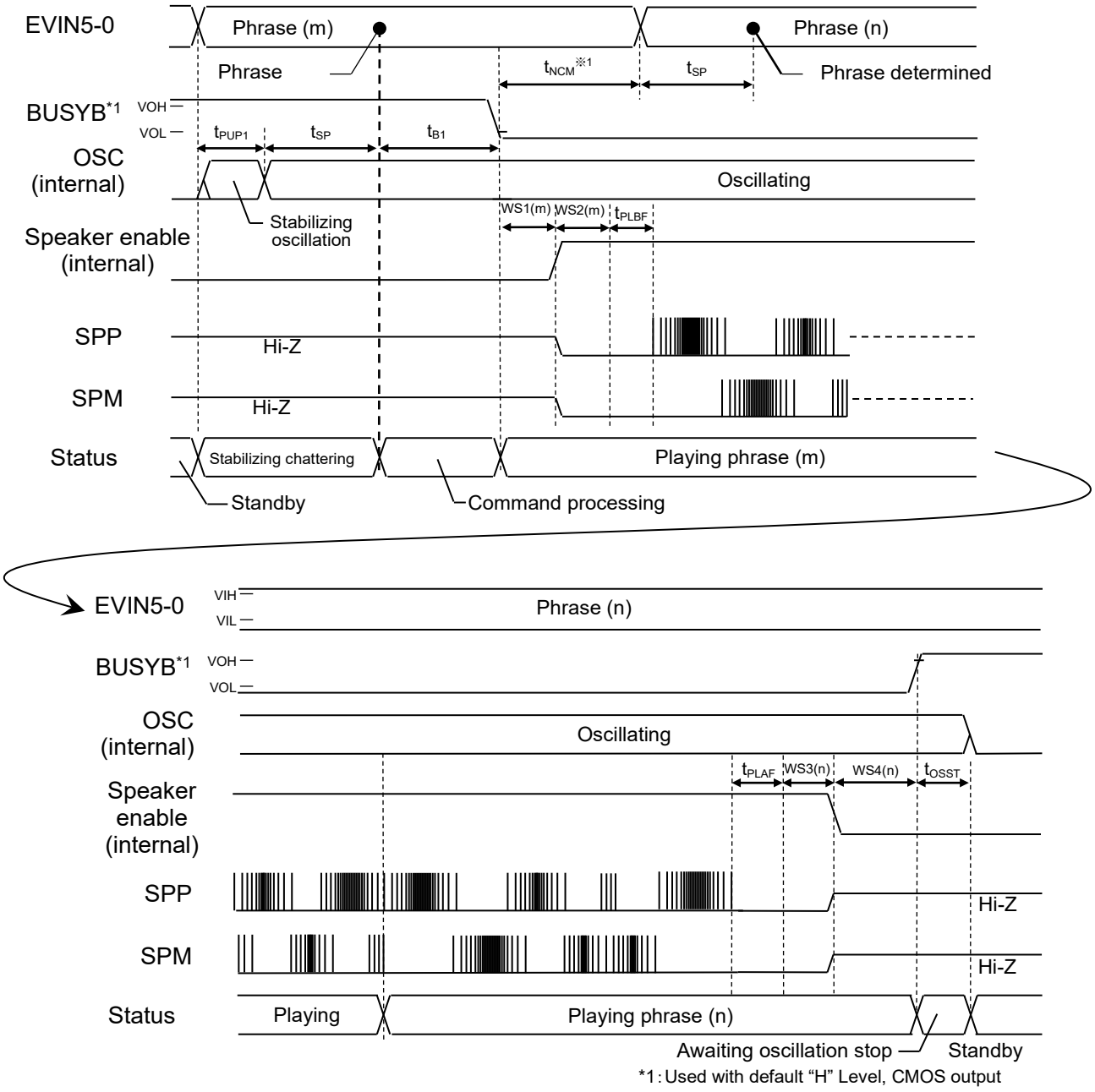
After playback of phrase (m) ends, playback request for next phrase (n) is accepted and the phrase (n) is played back. All the commands become invalid during playback of phrase (m).



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- 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.



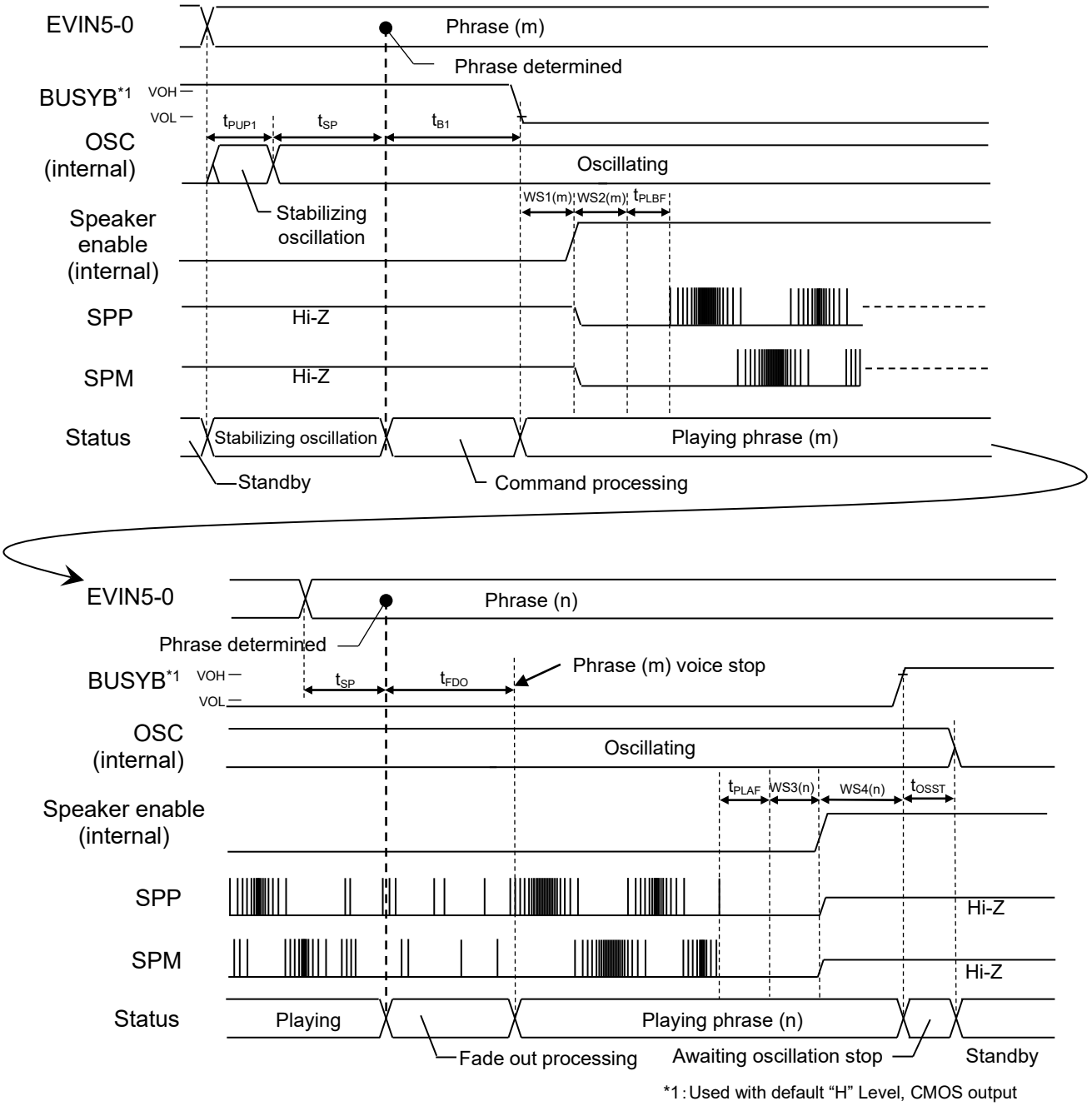
*Under Scheduled Play mode, playback is stopped by STOP command.

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}.

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- 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.



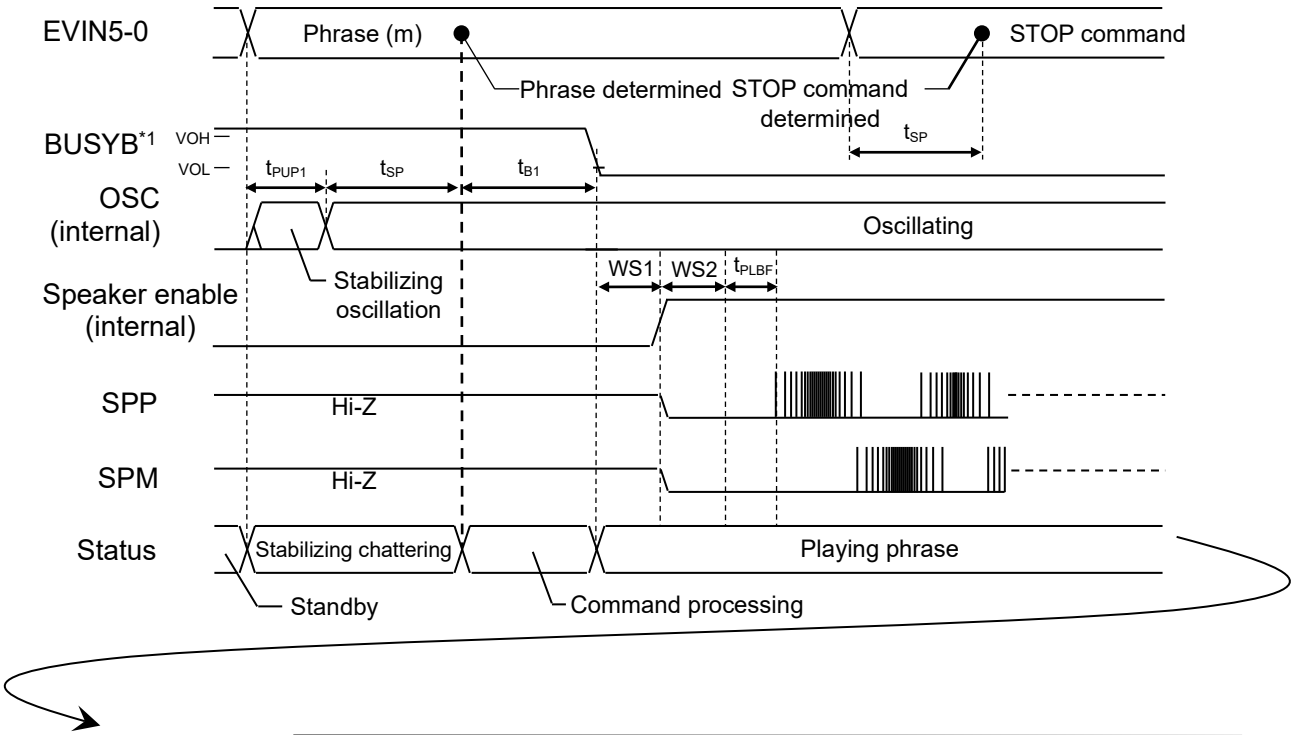
*1 : Used with default "H" Level, CMOS output

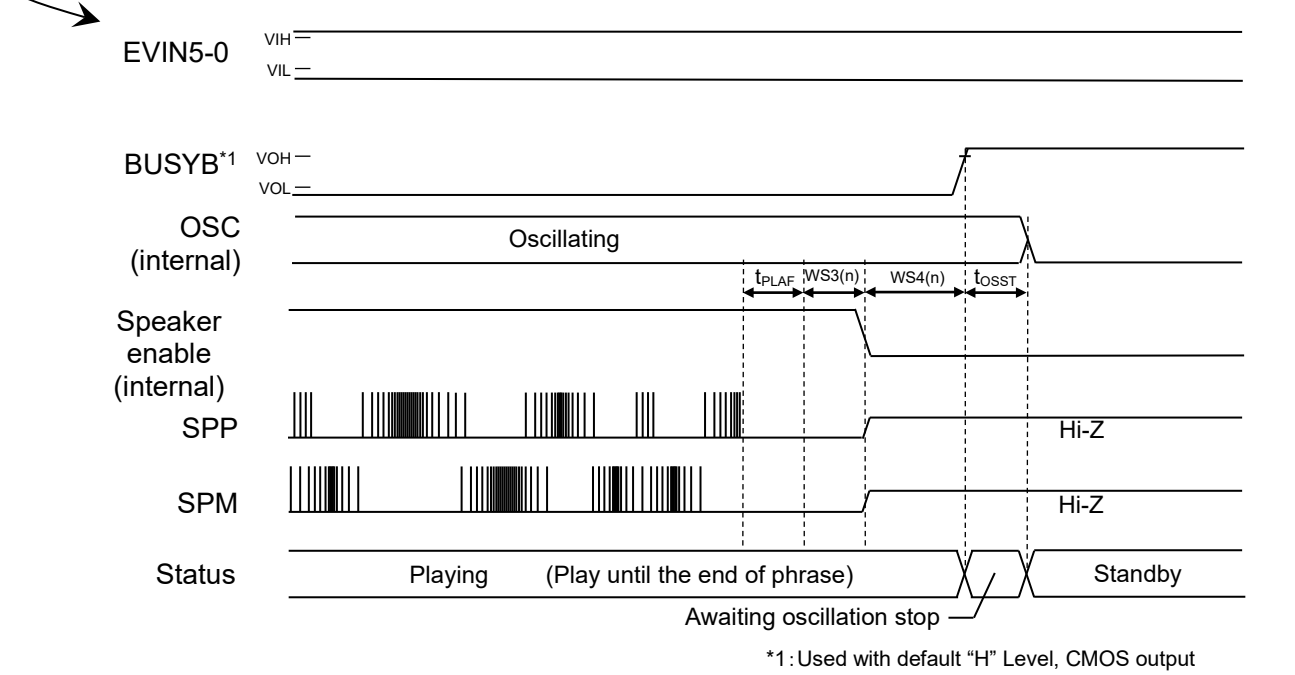
・Under Change Immediately mode, playback is stopped by STOP command.

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

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



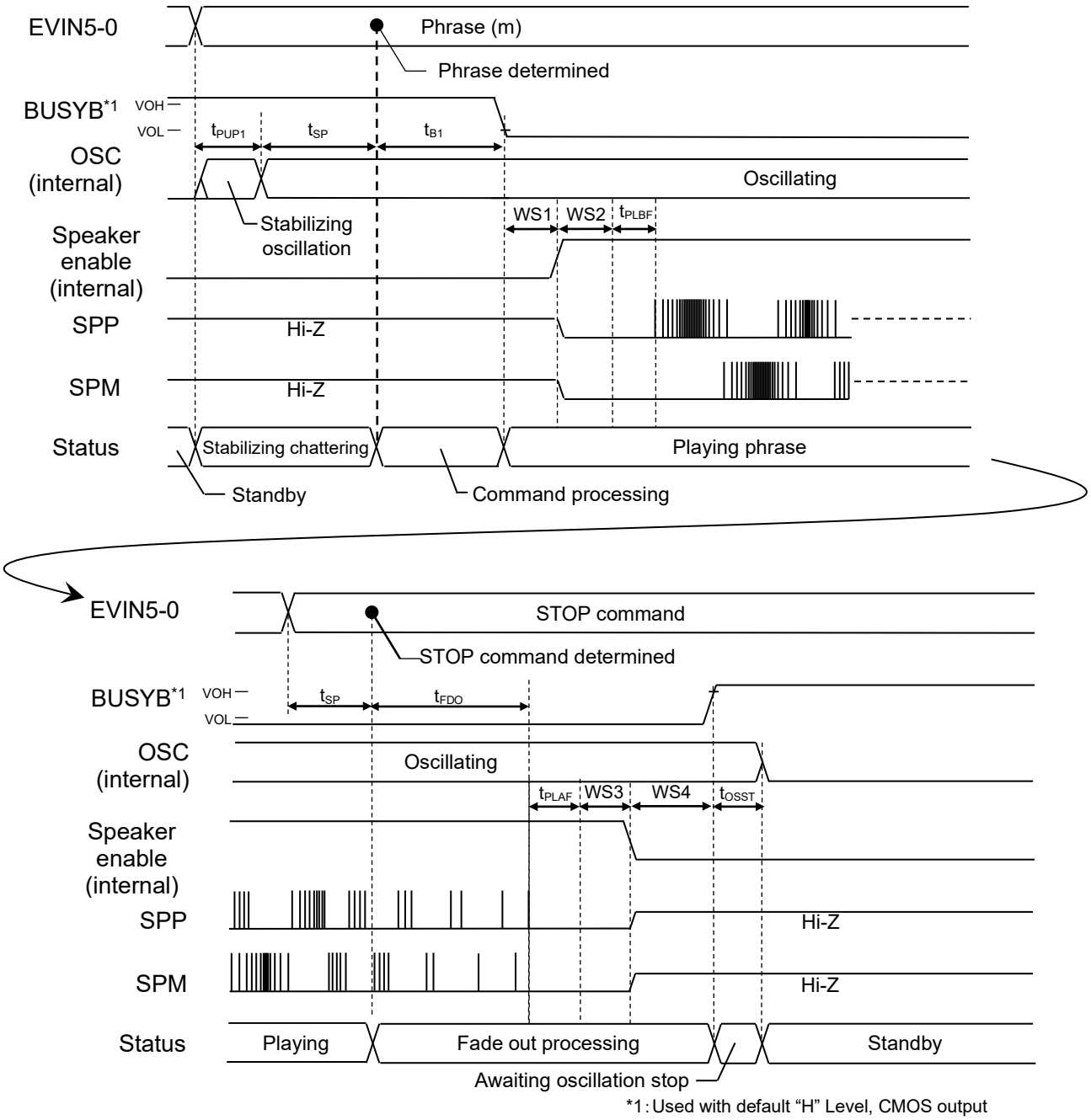


*1 : Used with default “H” Level, CMOS output

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

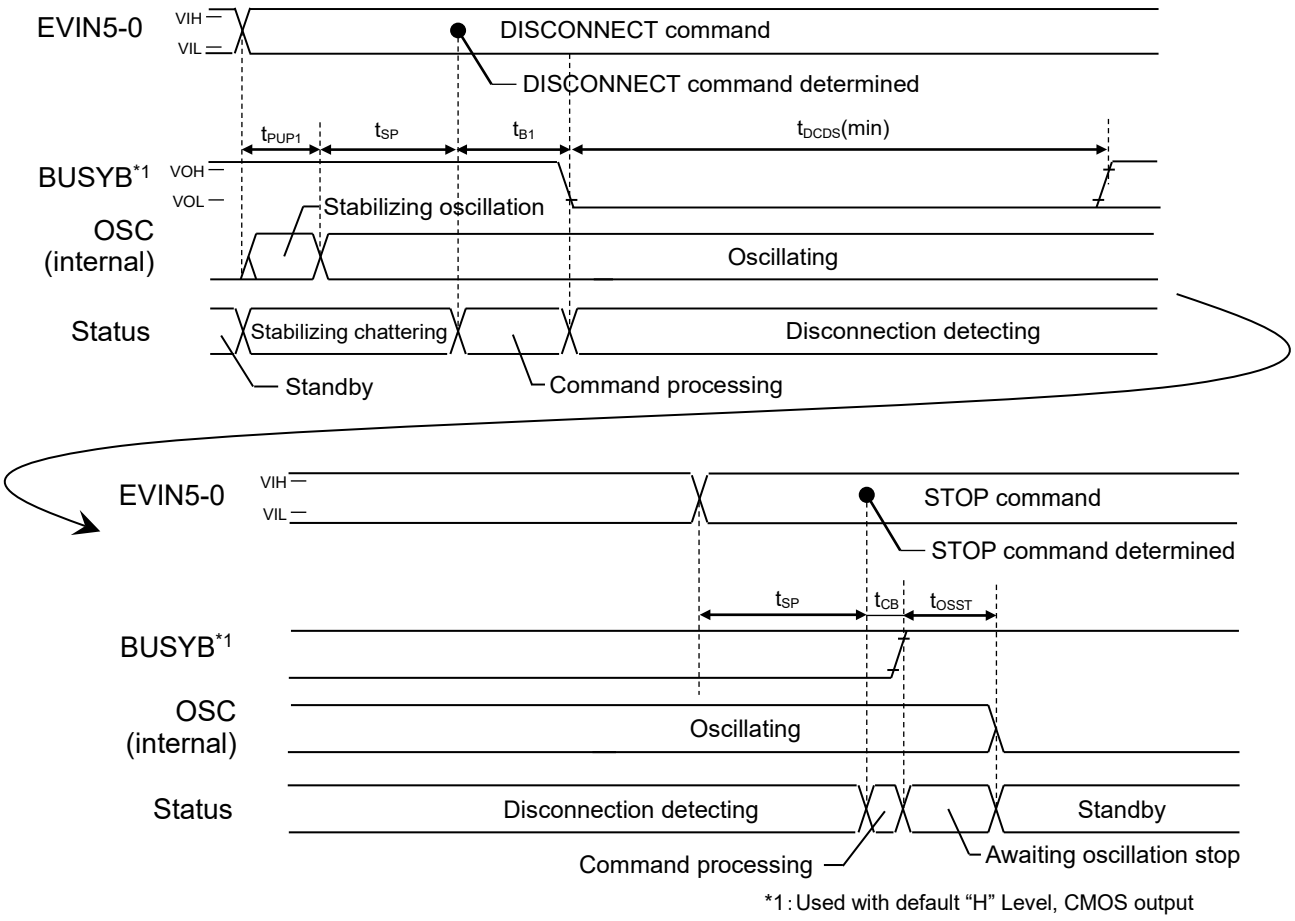
After STOP command is input, the sound fades out, and the playback stops.



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

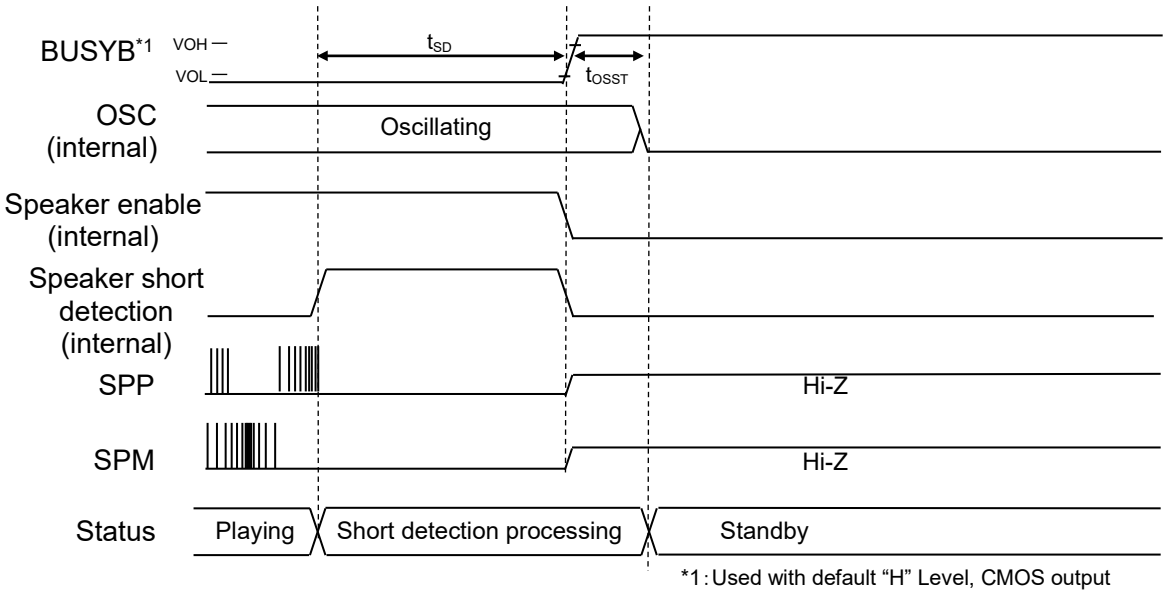
Downloaded from Arrow.com.

- Disconnection detection timing



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

- Speaker short detection timing



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

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■ Code Option Setting Item

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

・Speaker pin short detection function

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

・Num of Phrases and Command type setting

Num of Phrases / Command type	○30 phrases / EVIN4-0 (30 phrases can be played and communicate with EVIN4-0 pins)
	○62 phrases / EVIN5-0 (62 phrases can be played and communicate with EVIN5-0 pins)

STOP/DISCONNECT Command	Command bit sequence	
○Standard	STOP command	Set 00h
	DISCONNECT command	Set 01h
○Custom	STOP command	Set any bit sequence
	DISCONNECT command	Set any bit sequence (Set value different from STOP command)

・BUSYB Pin 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

・EVIN5 to EVIN0 Pins Setting

EVIN5-0	○Hi-Z	Used with high impedance input
	○Pull Down	Used with pull-down input
	○Pull-up	Used with pull-up input

When 30 phrases / EVIN4-0 is selected, EVIN5 input is disabled.

・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)

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■ Phrase information Setting Item

The items to be set on the phrase info setting screen of Speech LSI Utility are as follows.

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

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■ 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.

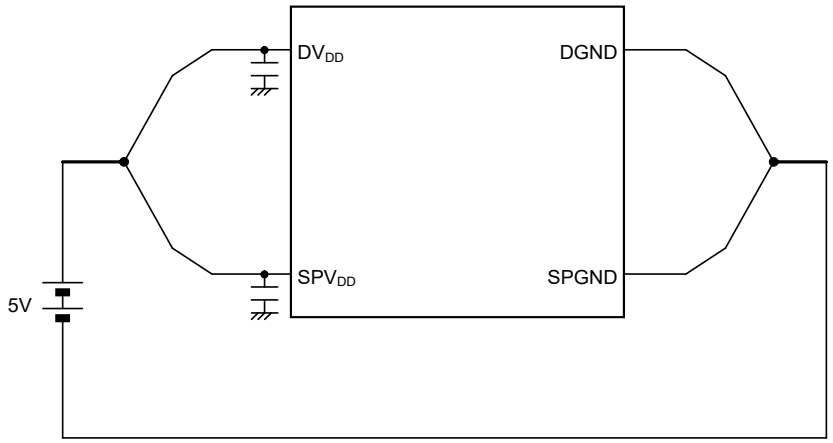
Pin	Recommended capacitance value	Remarks
V_{DDL}	1 µF ±30%	The larger the connection capacitance, the longer the settling time.

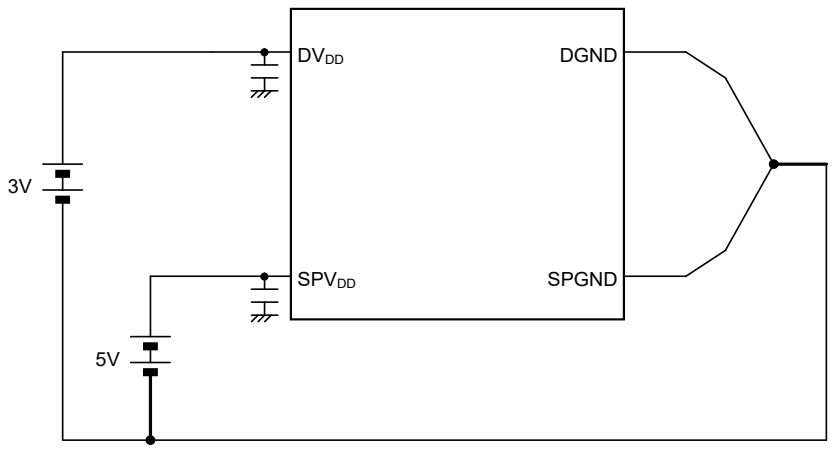
■ POWER SUPPLY WIRING

The power supplies of this LSI are divided into the following two:

- Power supply for logic circuitry (: DV_{DD})
- Power supply for speaker amplifier (: SPV_{DD})

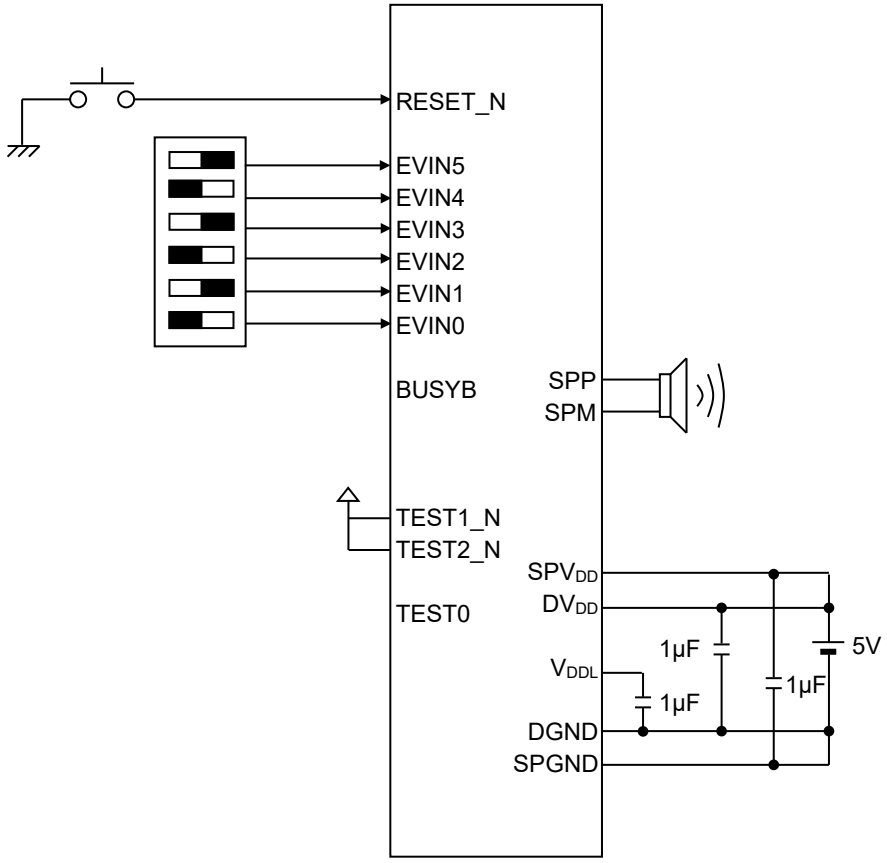
The example of power connection is shown below





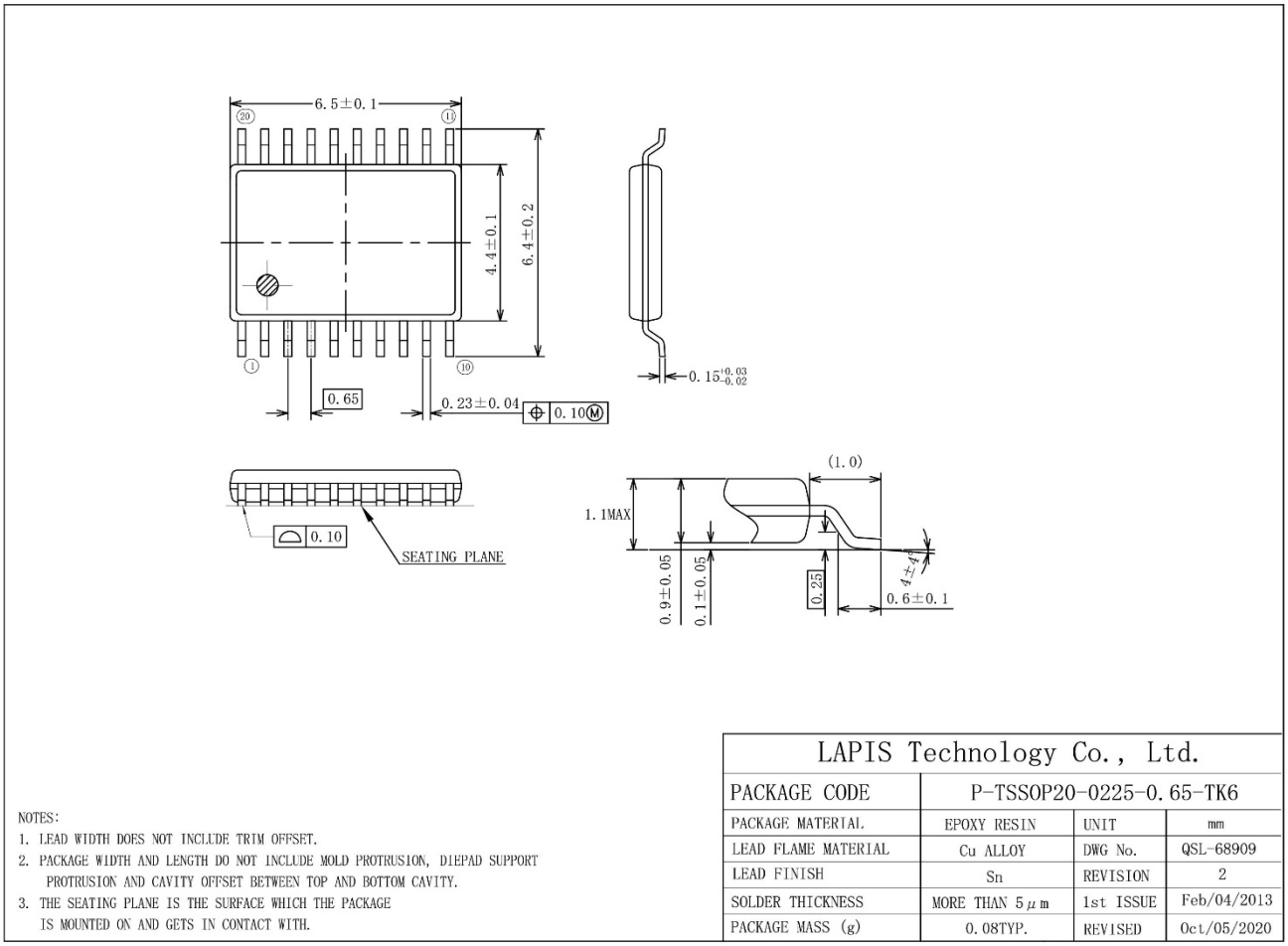
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■ APPLICATION CIRCUIT



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■ PACKAGE DIMENSIONS



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 condition	Calm(0m/sec)	
Heat resistance(θ ja)	68.48[ºC/W]	74.00[ºC/W]
Heat resistance(θ jc)	0.61[ºC/W]	0.61[ºC/W]
Maximum power consumption of LSI (PMax) during 8Ω/1W speaker amp. output	0.3[W]	

TjMax of this LSI is 110 ºC. TjMax is expressed with the following formulas.
TjMax = TaMax + θJa × PMax

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■ REVISION HISTORY

Document No	Date	Page		Description
		Previous Edition	Current Edition	
FEDL22Q244-01	Jun. 15, 2021	—	—	Formal 1st edition.
FEDL22Q244-02	Jun. 20, 2022	8	8	Removed start time SPV_{DD} after starting DV_{DD} (t_{VDD})
		8	8	Added Oscillation stabilization time, t_{PUP1} in AC Characteristics
		17	17	Added the note when using the playback commands
		29	29	Revised the description of STOP/DISCONNECT command
		33	33	Described heat resistance and TjMax of this LSI
		—	35	Added “Notes for product usage”
FEDL22Q244-03	Feb. 9, 2024	-	2	Added application information.
		1	2	Changed shipping form to table format.
		36	37	Revised the Note.
FEDL22Q244-04	Oct. 25, 2024	9	9	Changed BUSYB change time from "L" to "H", after over-current detection of a speaker amplifier (Before change) 80µs (After change) 160µs
FEDL22Q244-05	Jun. 9, 2026	8	8	Corrected a typo in the IIH3 condition
		37-38	37-39	Revised the Note.

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Notes for product usage

1. HANDLING OF UNUSED INPUT PINS
   Fix the unused input pins to the power pin or GND to prevent to cause the device performing wrong operation or increasing the current consumption due to noise, etc. If the handlings for the unused pins are described in the chapters, follow the instruction.

2. STATE AT POWER ON
   At the power on, the internal setting and output of the ports are undefined until the power supply voltage reaches to the recommended operating condition and "L" level is input to the reset pin.
   Be careful to design the application system does not work incorrectly due to the undefined data of internal setting and output of the ports.

3. CHARACTERISTICS DIFFERENCE BETWEEN THE PRODUCTS
   Electrical characteristics, noise tolerance, noise radiation amount, and the other characteristics are different from each product.
   When replacing from other product to LAPIS Technology products, please evaluate enough the apparatus/system which implemented LAPIS Technology products.

4. USE ENVIRONMENT
   When using LAPIS Technology products in a high humidity environment and an environment where dew condensation, take moisture-proof measures.

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Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application examples, their constants, software, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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