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

Downloaded from Arrow.com.

ML22Q274

ADPCM Speech Synthesis LSI for Automotive

■ GENERAL DESCRIPTION

ML22Q274 is Speech Synthesis LSI with built-in Flash memory that stores speech data. ML22Q274 support the Clock synchronization Serial interface and supports on-vehicle quality.
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 : (Maximum number of phrases 30 When a phrase is selected)

Product name	Flash capacity (bit)	Maximum playback time (sec) (at fs = 6.4 kHz)	
		4bitADPCM2	16bitPCM
ML22Q274	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 (30 phrases selection),688 Kbit (62 phrases selection)
- 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: Synchronous serial interface
- Maximum number of pharases: 30 phrases or 62 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

ROHM SEMICONDUCTOR

Downloaded from Arrow.com.

■ 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	ML22Q274-NNNTDZ0ARL ML22Q274-xxxTDZ0ARL	ML22Q274-NNNTDZ0ATL ML22Q274-xxxTDZ0ATL

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

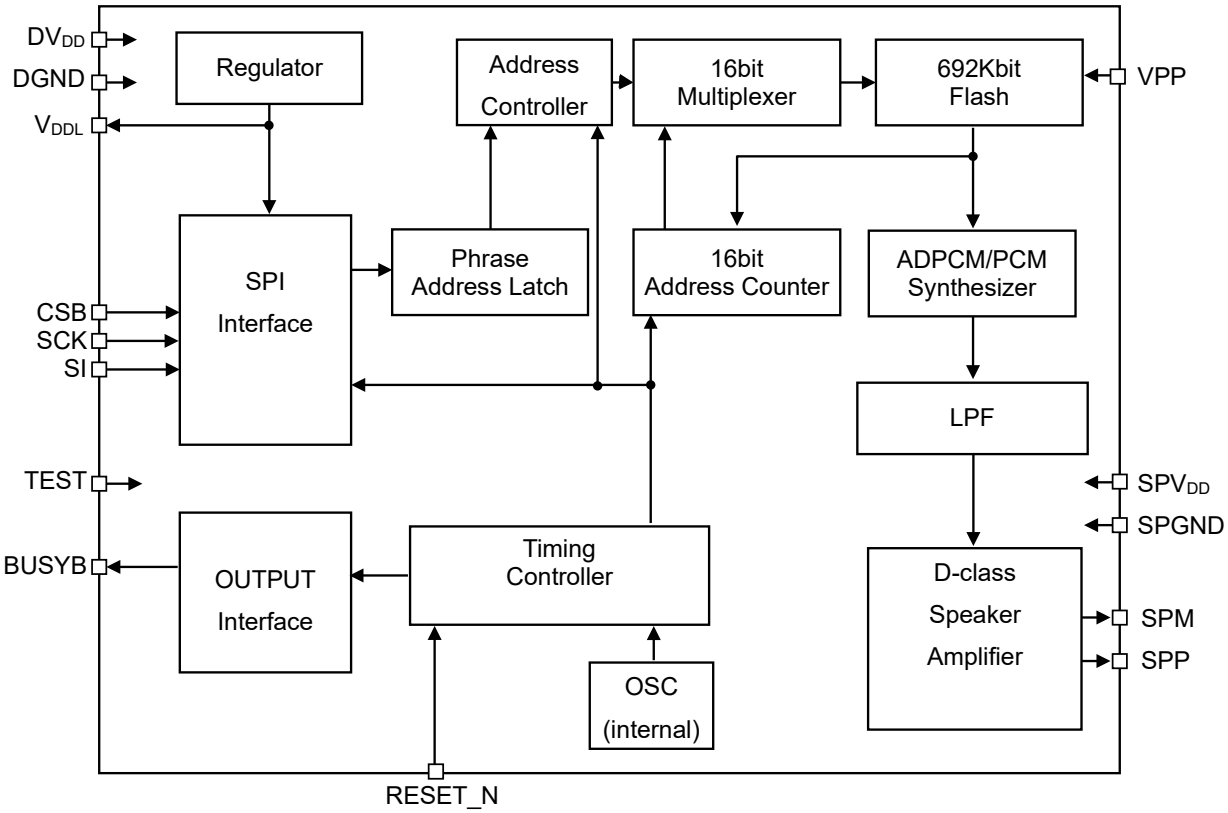
Downloaded from Arrow.com.

The following table shows the differences from ML22Q284, ML22Q294.

Parameter	ML22Q274	ML22Q294	ML22Q284
MCU interface	Clock synchronization Serial	I2C	Standalone
Flash capacity	692 Kbit (when 30 phrases are selected) 688 Kbit (when 62 phrases are selected)	←	692 Kbit
Playback method	4-bit ADPCM2 8-bit Nonlinear PCM 8-bit PCM 16-bit PCM	←	←
Maximum number of phrases:	30/62	←	30
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	←	←

Downloaded from Arrow.com.

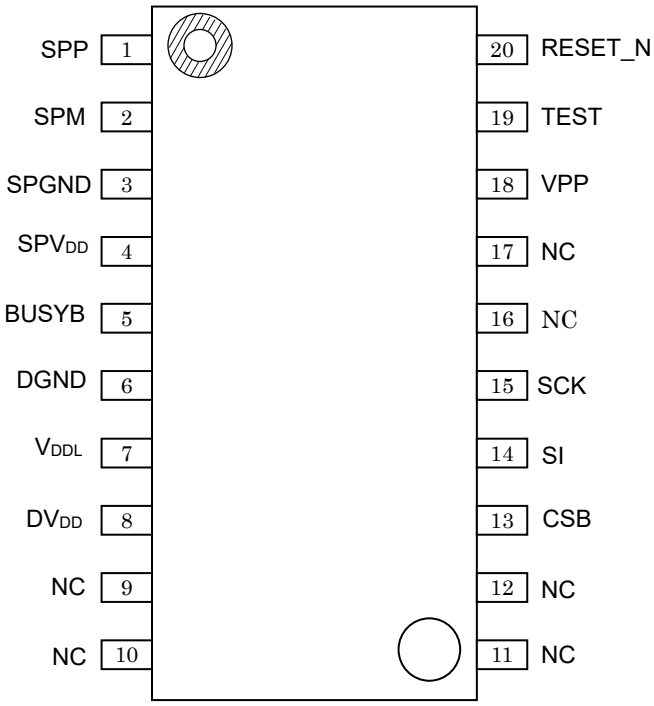
■ BLOCK DIAGRAMS



Downloaded from Arrow.com.

■ PIN CONFIGURATIONS (TOP VIEW)

20-Pin Plastic TSSOP



NC : Unused pin

Downloaded from Arrow.com.

■ 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	CSB	I	1	1	Chip select pin. Internal oscillation starts in response to turning “H” level down to “L” level, and input through Clock synchronization Serial interface becomes available. Pull-up resistor is built in.
14	SI	I	1	1	Input pin for Clock synchronization Serial interface data.
15	SCK	I	1	1	Input pin for Clock synchronization Serial interface clock.
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 16 17	N.C.	-	-	-	Unused pin. Leave this pin open.

Downloaded from Arrow.com.

■ 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	

Downloaded from Arrow.com.

■ 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
"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 CSB pin	-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}=3.0V	-	4.0	6.0	mA
	I_{DD2}	No output load DV_{DD}= SPV_{DD}=5.0 V	-	6.0	10	
Awaiting command supply current	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

DVDD = SPVDD = 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

Downloaded from Arrow.com.

- AC Characteristics

DVDD = SPVDD = 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
SCK input enable time from CSB fall edge	t_{ESCK1}	Oscillation stop	2	-	-	ms
	t_{ESCK2}	Oscillating	10	-	-	µs
SCK hold time from CSB rise edge	t_{CSH}	-	200	-	-	ns
Data setup time from SCK rise edge	t_{DIS}	-	50	-	-	ns
Data hold time from SCK rise edge	t_{DIH}	-	50	-	-	ns
SCK cycle	t_{SCYC}	-	500	-	-	ns
SCK “H” level pulse width	t_{SCKH}	-	200	-	-	ns
SCK “L” level pulse width	t_{SCKL}	-	200	-	-	ns
Playback time	t_{VCYC}	-	20	-	-	ms
BUSYB change time from "H" to "L", after a command is inputted	t_{CB}	-	-	-	400	µs
CSB “H” level pulse width	t_{CSW}	-	1	-	-	ms
Oscillation stop time, after playback	t_{OSST}	-	-	-	500	µs
Next command transmit time in the case of the playback	t_{NCM}	-	-	-	10	ms
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

Note: Output pin load capacitance = 45 pF (max.)

Downloaded from Arrow.com.

■ FUNCTIONAL DESCRIPTION

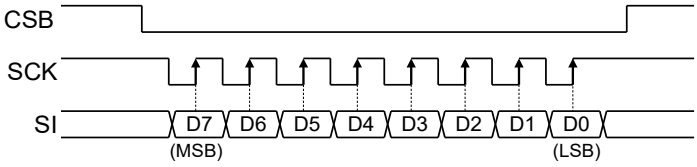
- Clock synchronization Serial interface data.

  The CSB, SCK, SI pins are used to input the command data.
  Driving the CSB pin from “H” to “L” level enables the serial MCU interface.
  After the CSB pin becomes “L” level, the command is input through the SI pin from the MSB or LSB synchronized with the SCK clock. The command shifts in through the SI pin at the rising edge of the SCK clock pulse. Then, a command is executed at the rising edge of the eighth pulse of the SCK clock when 1-byte command is selected and the 16th pulse of the SCK clock when 2-byte command is selected.
  After a command input, should return the CSB pin to "H" level.

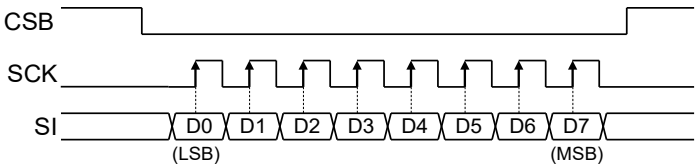
  The initial value of the SCK pin, MSB/LSB of the SI pin data input, and 1-byte command/2-byte command are all chosen with Speech LSI Utility.
  Please refer to a "Code Option Setting Item" for details.

◆ Input timing when 1-byte command is selected

•Normal (“H” Level), MSB fast selected

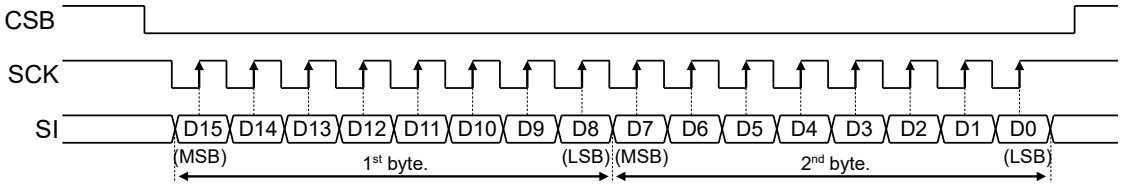


•Reversal (“L” Level), LSB fast selected

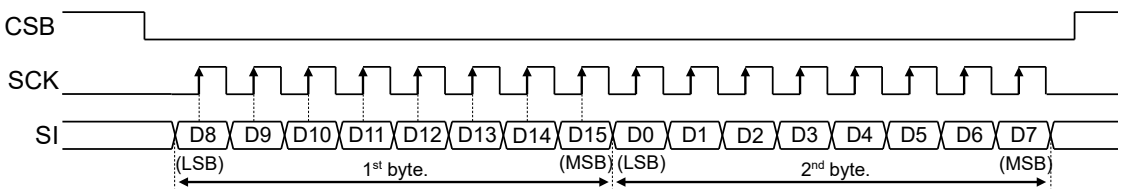


◆ Input timing when 2-byte command is selected

•Normal (“H” Level), MSB fast selected



•Reversal (“L” Level), LSB fast selected



Downloaded from Arrow.com.

- 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 of 30 phrases or 62 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.

The 30 or 62 phrases can be switched using the Speech LSI Utility.
Please refer to a "Code Option Setting Item" for details.

Voice code data configuration(30 phrase selection)

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

Voice code data configuration(62 phrase selection)

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

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

Downloaded from Arrow.com.

- 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.

Downloaded from Arrow.com.

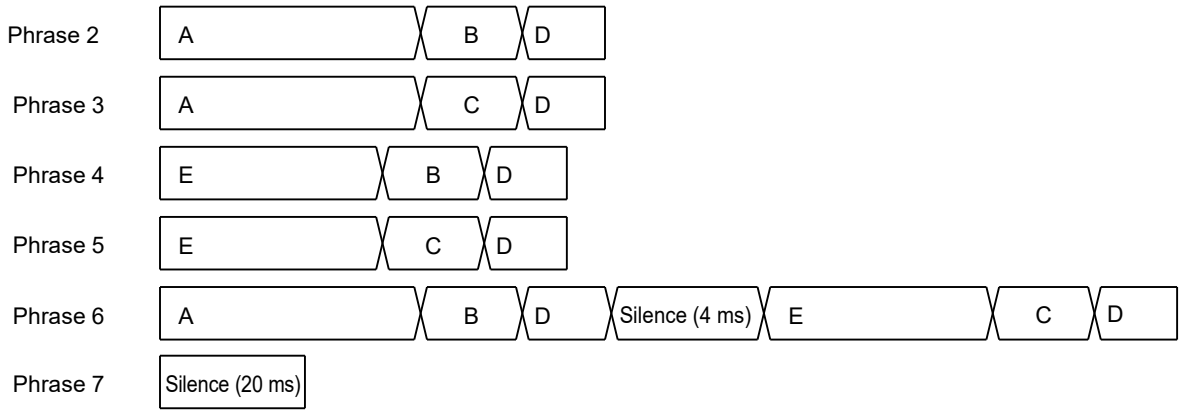
- Edit ROM function

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

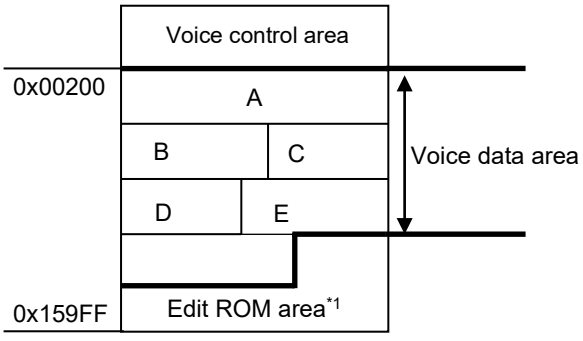
- Continuous playback: There is no limit to set the number of times of the continuous playback. It depends on the Flash capacity only.
- Silence insertion function: 4 ms to 1,024 ms
  *Note: Silent insertion time varies for ±1 ms depends on the sampling frequency.
  An independent phrase generated by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

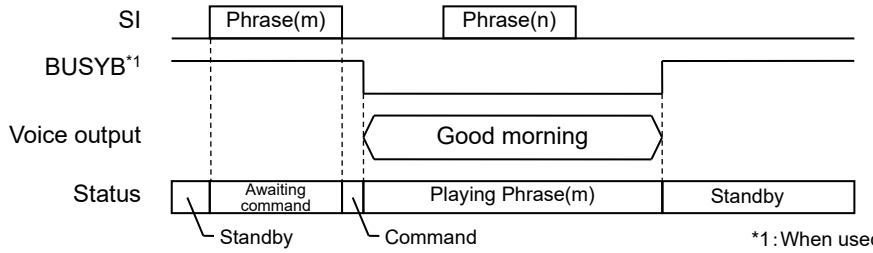
Downloaded from Arrow.com.

- Playback mode setup

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

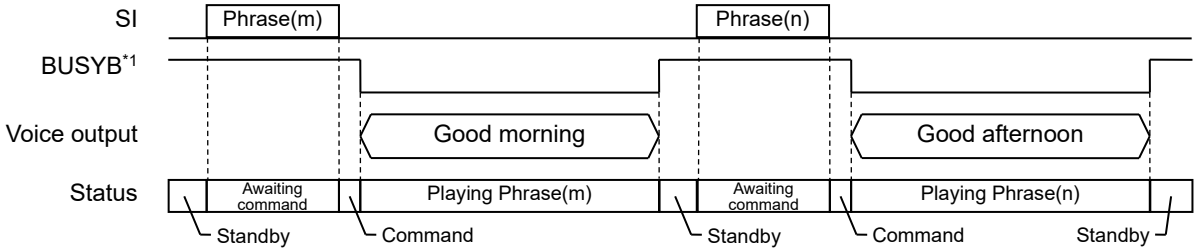
◆ Play Once mode

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



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

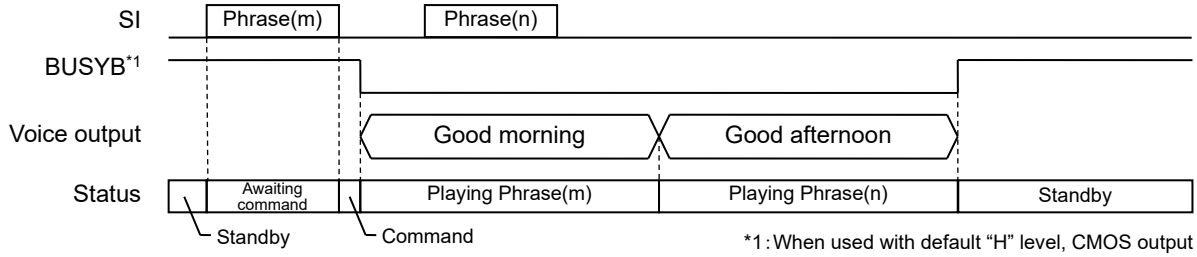
Next command must be input in the standby state after the playback ends.



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

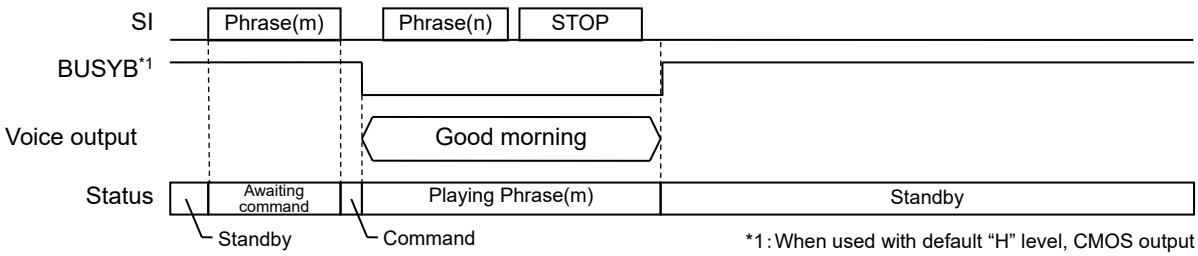
◆ Scheduled Play Once mode

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.



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

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.

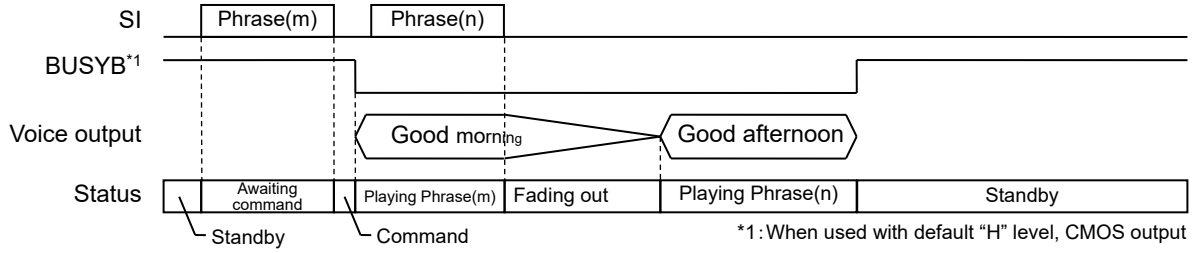


*1 : When used with default “H” level, CMOS output

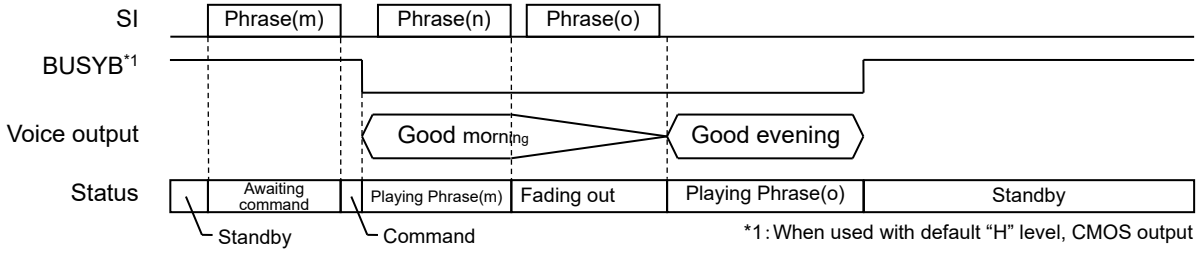
Downloaded from Arrow.com.

◆ 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.

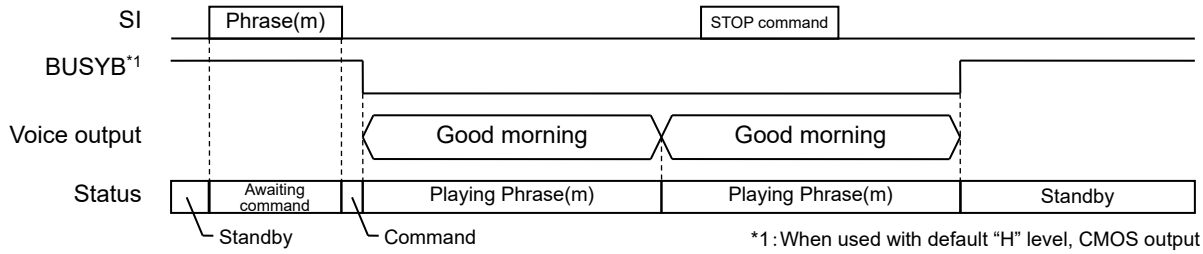


When a plurality of commands are input, the last command input at the end of the phrase is valid.
In the following case, the last input phrase (o) is played back.



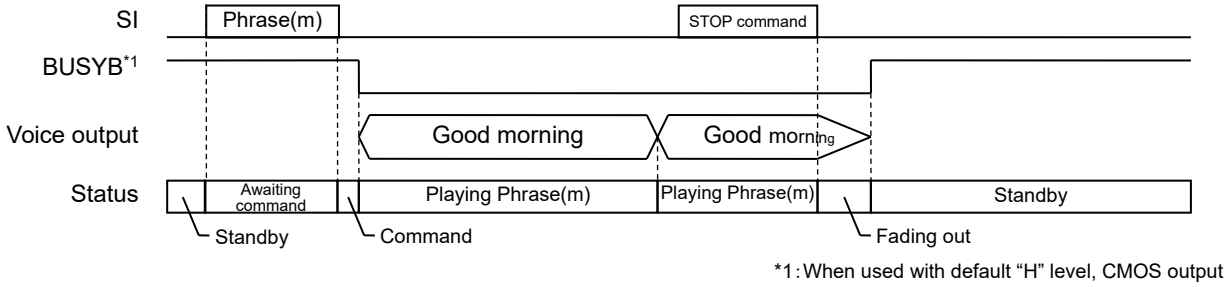
◆ Scheduled Play mode

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.



Downloaded from Arrow.com.

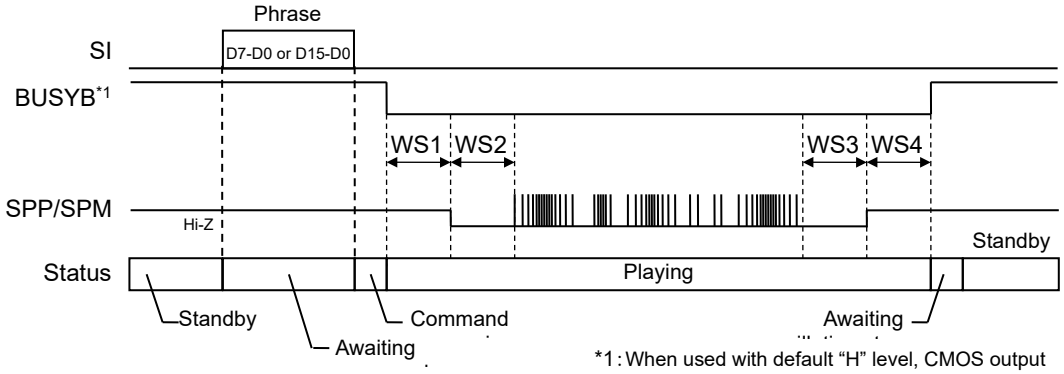
- Volume setup function

Each phrase can set up the volume setup.
The volume is set when voice code data is generated and when PHRASE command is input.
For the setting of volume when PHRASE command is input, refer to “PHRASE command” in Description of Command Functions.
The relationship between the setting and volume at the time of generating voice code data is as follows.

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.



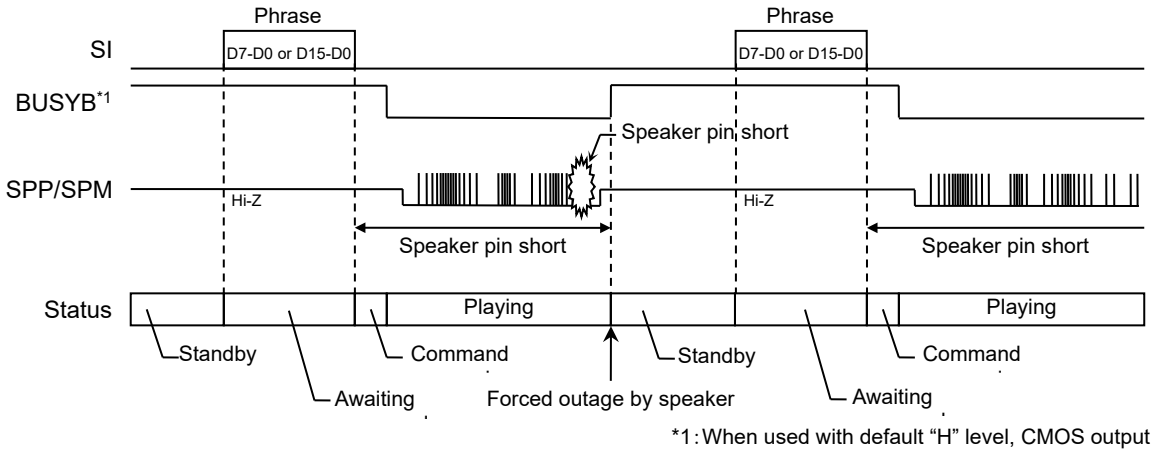
WS1: Time after inputting a phrase address, until SPP/SPM pins are enabled.
WS2: Time after SPP/SPM pins are enabled, until playback is started.
WS3: Time after playback is completed, until SPP/SPM pins are disabled.
WS4: Time after SPP/SPM pins are disabled, until it will be in a standby state.

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

Downloaded from Arrow.com.

- 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.



Downloaded from Arrow.com.

■ 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

1-byte command and 2-byte command can be selected.
When the 2-byte command is selected, the volume can be expanded to 32 levels and 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 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 as follows.

(1) 1-byte command (eight levels of volume and 30 phrases)

Command	First byte							
	D7	D6	D5	D4	D3	D2	D1	D0
STOP	*	*	*	0	0	0	0	0
DISCONNECT	*	*	*	0	0	0	0	1
PHRASE	V2	V1	V0	0	0	0	1	0
	:							
	V2	V1	V0	1	1	1	1	1

(2) 2-byte command (initial value: 32 levels of volume and 62 phrases)

Command	First byte								Second byte							
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
STOP	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	0
DISCONNECT	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	1
PHRASE[*1]	*	*	*	V4	V3	V2	V1	V0	*	*	0	0	0	0	1	0
	:								:							
	*	*	*	V4	V3	V2	V1	V0	*	*	1	1	1	1	1	1

Note: This bit is not used for command identification, so any value can be set.
Note 1: When using a 2-byte command, the combination of 0xff in the 1st byte and 0xff in the 2nd byte is ignored.
For the phrase number 111111b, set the "*" part (arbitrary value) to "0".

Downloaded from Arrow.com.

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) 1-byte command (when STOP command is set to be 11111b and DISCONNECT command is set to be 00001b)

Command	First byte							
	D7	D6	D5	D4	D3	D2	D1	D0
-*1	*	*	*	0	0	0	0	0
DISCONNECT	*	*	*	0	0	0	0	1
PHRASE	V2	V1	V0	0	0	0	1	0
	:							
	V2	V1	V0	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.

(2) 2-byte command (when STOP command is set to be 111110b and DISCONNECT command is set to be 000010b)

Command	First byte								Second byte							
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
-*1	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	0
PHRASE	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	1
DISCONNECT	*	*	*	*	*	*	*	*	*	*	0	0	0	0	1	0
PHRASE	*	*	*	V4	V3	V2	V1	V0	*	*	0	0	0	0	1	1
	*	*	*	V4	V3	V2	V1	V0	*	*	:					
	*	*	*	V4	V3	V2	V1	V0	*	*	1	1	1	1	0	1
STOP	*	*	*	*	*	*	*	*	*	*	1	1	1	1	1	0
PHRASE*2	*	*	*	V4	V3	V2	V1	V0	*	*	1	1	1	1	1	1

Note: This bit is not used for command identification, so any value can be set.
Note 1: 00000b cannot be set to PHRASE command. 29 phrases from 00010b to 11110b can be set to PHRASE command.
Note 2: When using a 2-byte command, the combination of 0xff in the 1st byte and 0xff in the 2nd byte is ignored. For the phrase number 111111b, set the "*" part (arbitrary value) to "0".

Downloaded from Arrow.com.

- STOP command

(1) 1-byte command selection (initial value)

・command

*	*	*	0	0	0	0	0

(2) 2-byte command selection (initial value)

・command

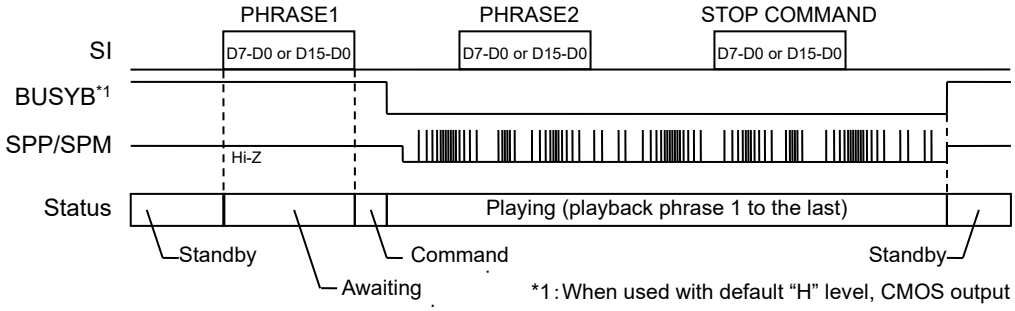
*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	0

*: Since it is a bit that is not used to identify the command, it can be set to any value.

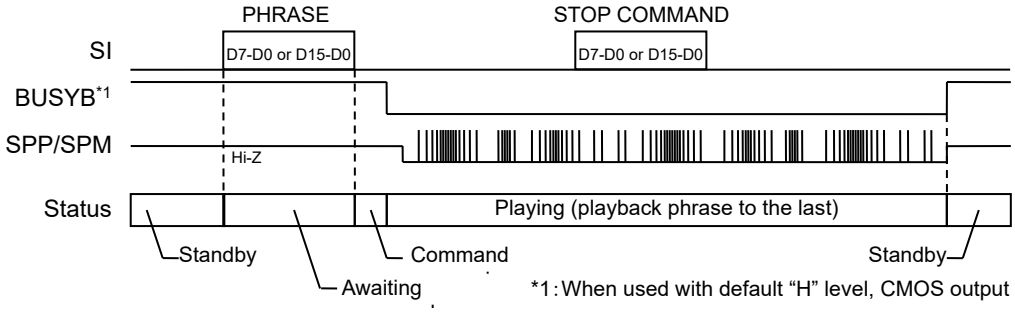
The STOP command is used to stop the playback. BUSYB pin will become "H", if the playback is stopped.
The STOP command becomes effective for the phrase waiting to be played in Scheduled Play Once mode, and in Scheduled Play modem, Change Immediately Once mode, and Change Immediately mode.
STOP command 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.

Operations where STOP command is effective are described below.

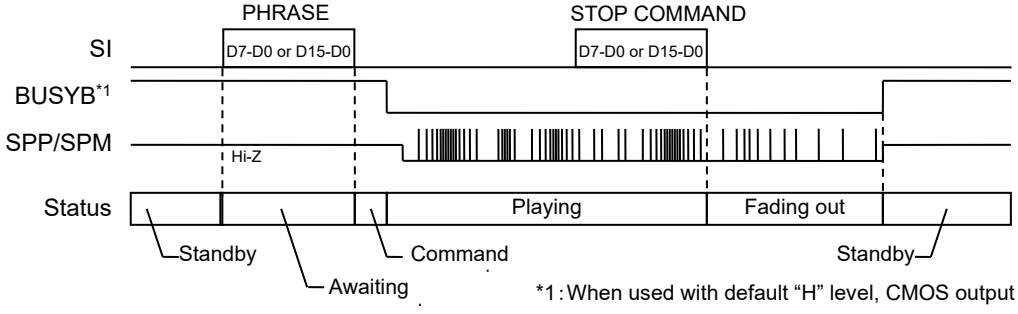
◆ STOP command operation in the case of Scheduled Play Once mode



◆ STOP command operation in the case of Scheduled Play mode



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



Downloaded from Arrow.com.

- DISCONNECT command

(1) 1-byte command selection (initial value)

・command

*	*	*	0	0	0	0	1

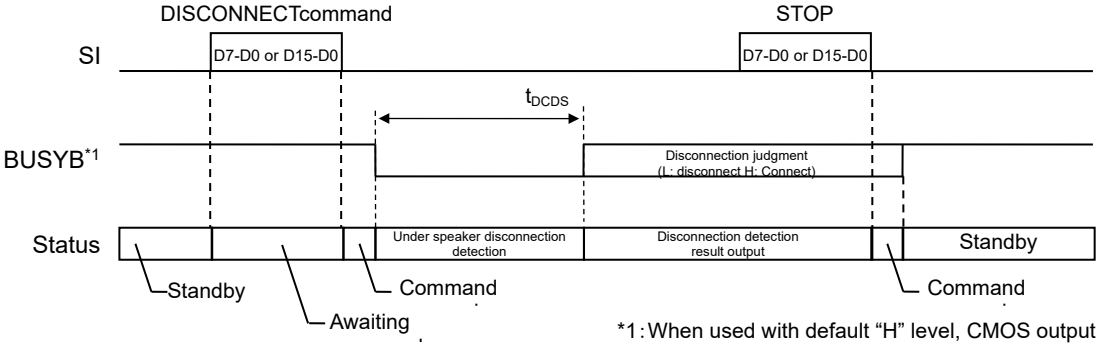
(2) 2-byte command selection (initial value)

・command

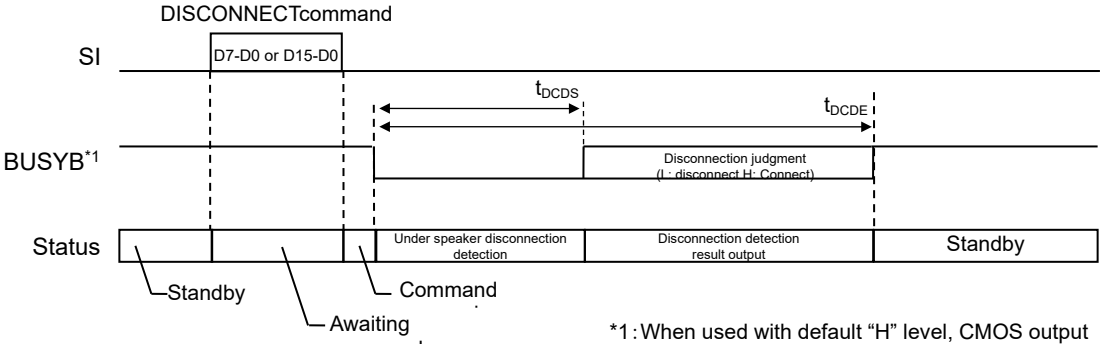
*	*	*	*	*	*	*	*	*	*	0	0	0	0	0	1

*: Since it is a bit that is not used to identify the command, it can be set to any value.

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.



Downloaded from Arrow.com.

- PHRASE command

(1) 1-byte command selection

・command

V2	V1	V0	F4	F3	F2	F1	F0

(2) 2-byte command selection

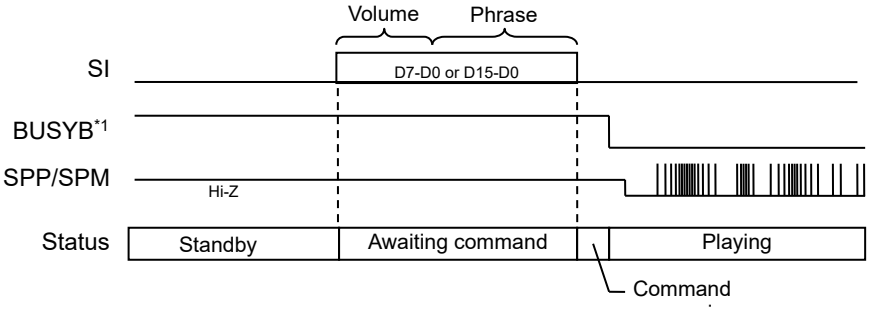
・command

*	*	*	V4	V3	V2	V1	V0	*	*	F5	F4	F3	F2	F1	F0

*: Since it is a bit that is not used to identify the command, it can be set to any value.

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

Set the playback Phrase with F4-F0 or F5-F0.

① 1-byte command selection (initial value)

F4	F3	F2	F1	F0	Playing Phrase
0	0	0	1	0	Phrase0
		:			:
1	1	1	1	1	Phrase29

② 2-byte command selection (initial value)

F5	F4	F3	F2	F1	F0	Playing Phrase
0	0	0	0	1	0	Phrase0
			:			:
1	1	1	1	1	1	Phrase61

Downloaded from Arrow.com.

The volume can be set up with V2-V0 or V4-V0 set.
This is used to playback voice with a volume other than one set when the voice code data is generated.

(1) When 1-byte command is selected.

V2	V1	V0	Volume [dB]
0	0	0	Volume set at the time of generating voice code data is used*1
0	0	1	+2.98
0	1	0	+1.78
0	1	1	0
1	0	0	-2.25
1	0	1	-5.28
1	1	0	-9.99
1	1	1	-21.04

*Note 1: For edited phrase, volume set for each registered phrase is used

(2) When 2-byte command is selected.

V4	V3	V2	V1	V0	Volume [dB]
0	0	0	0	0	+2.98
0	0	0	0	1	+2.70
0	0	0	1	0	+2.40
0	0	0	1	1	+2.10
0	0	1	0	0	+1.78
0	0	1	0	1	+1.45
0	0	1	1	0	+1.11
0	0	1	1	1	+0.76
0	1	0	0	0	+0.39
0	1	0	0	1	+0.00
0	1	0	1	0	-0.41
0	1	0	1	1	-0.83
0	1	1	0	0	-1.28
0	1	1	0	1	-1.75
0	1	1	1	0	-2.25
0	1	1	1	1	-2.77

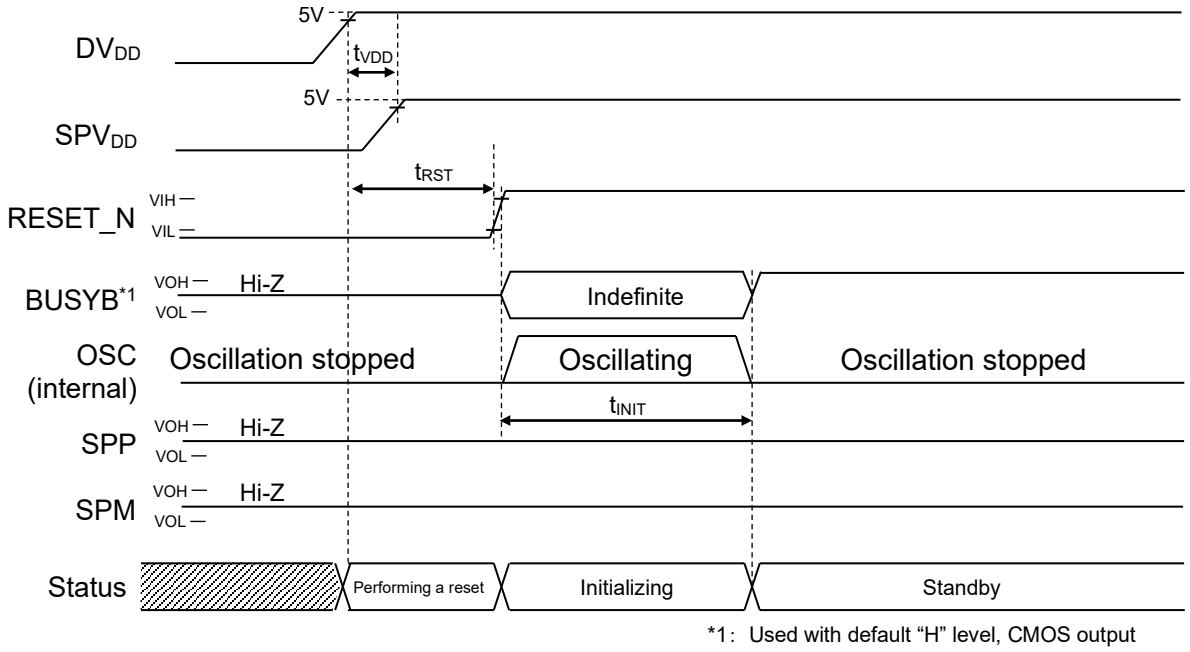
V4	V3	V2	V1	V0	Volume [dB]
1	0	0	0	0	-3.34
1	0	0	0	1	-3.94
1	0	0	1	0	-4.58
1	0	0	1	1	-5.28
1	0	1	0	0	-6.04
1	0	1	0	1	-6.87
1	0	1	1	0	-7.79
1	0	1	1	1	-8.82
1	1	0	0	0	-9.99
1	1	0	0	1	-11.34
1	1	0	1	0	-12.94
1	1	0	1	1	-14.90
1	1	1	0	0	-17.44
1	1	1	0	1	-21.04
1	1	1	1	0	-27.31
1	1	1	1	1	Volume set at the time of generating voice code data is used*1

*Note 1: For edited phrase, volume set for each registered phrase is used

Downloaded from Arrow.com.

■ TIMING DIAGRAMS

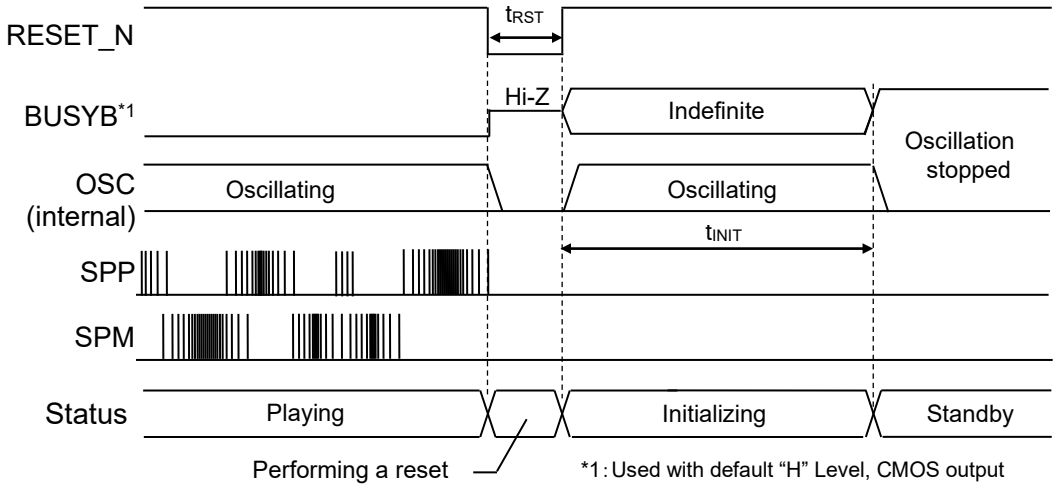
● Power-On Timing



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

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)



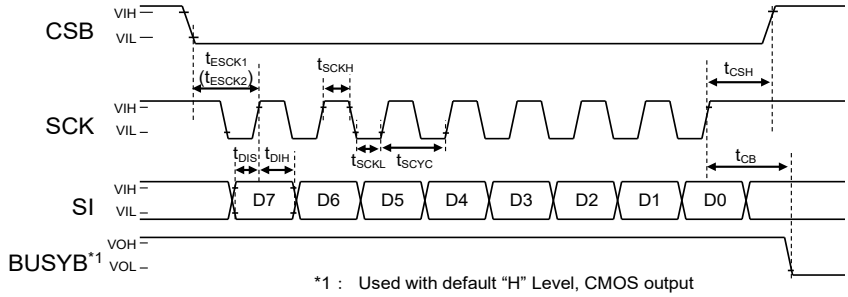
When DV_{DD} or SPV_{DD} falls below recommended operation power supply voltage range, “L” level must be input to RESET_N pin.

Downloaded from Arrow.com.

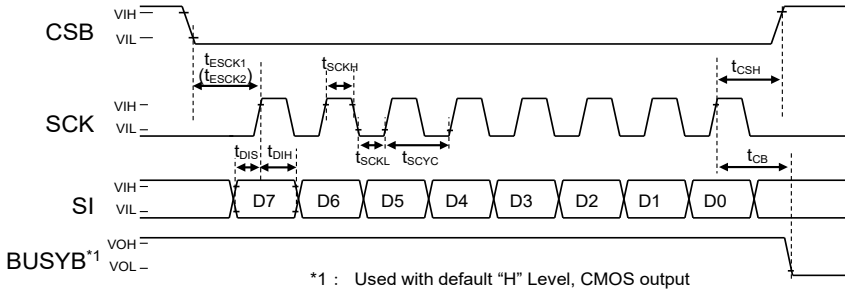
- Clock synchronization Serial interface timing

◆ When 1-byte command is selected.

(When Normal (“H” level) is selected: SCK initial value is “H” level)

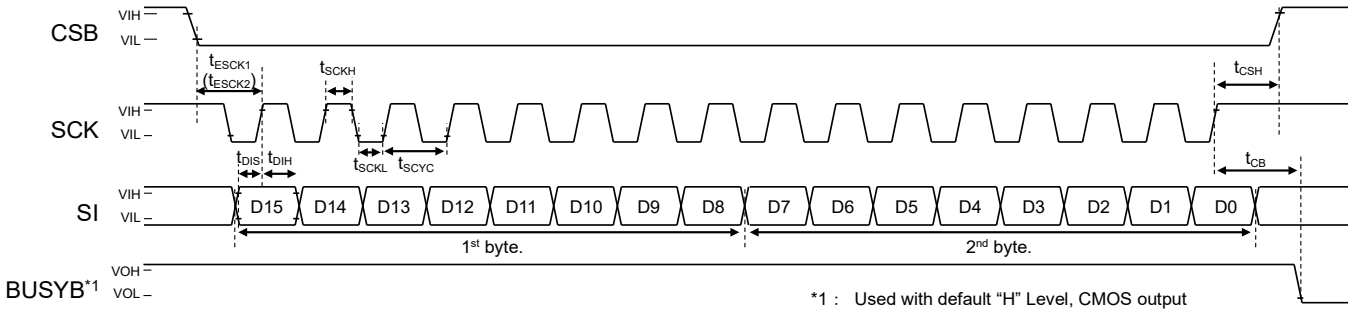


(When Reversal (“L” level) is selected: SCK initial value is “L” level)

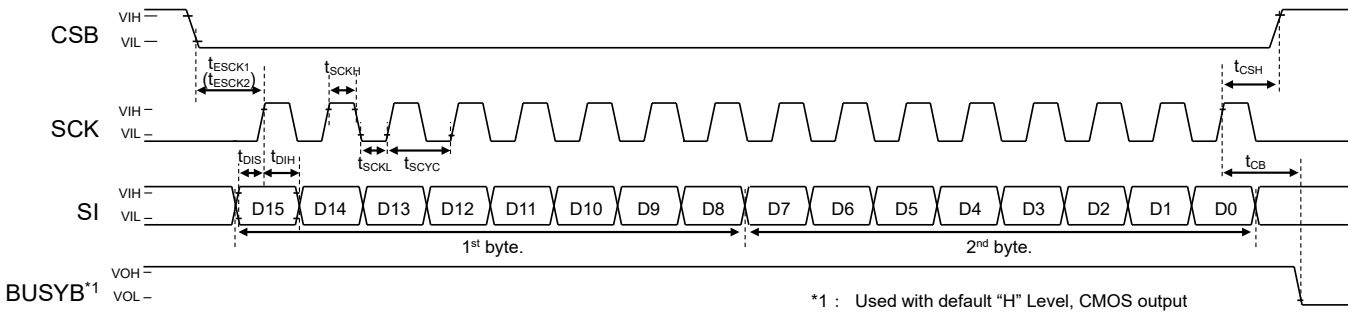


◆ When 2-byte command is selected.

(When Normal (“H” level) is selected: SCK initial value is “H” level)



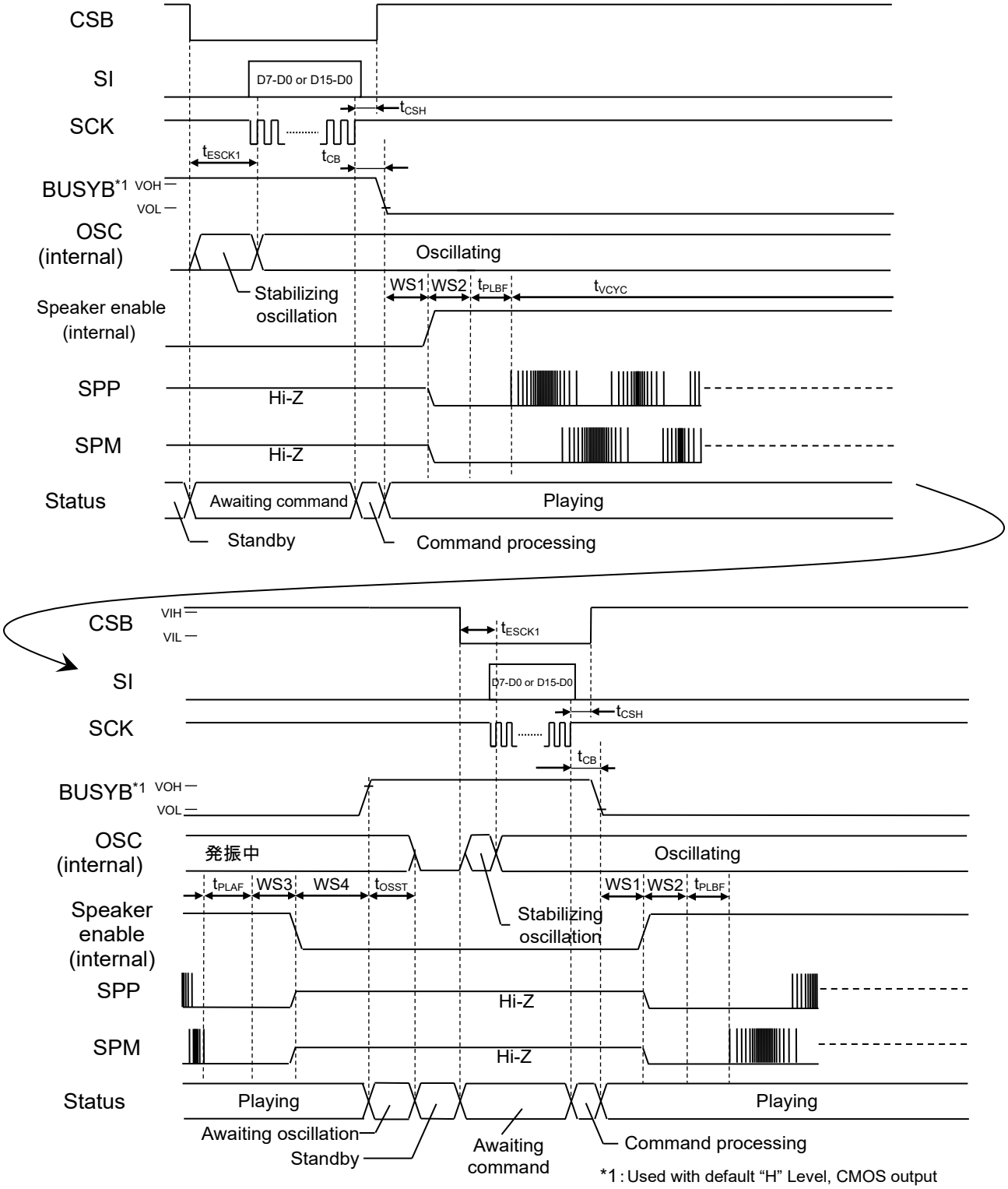
(When Reversal (“L” level) is selected: SCK initial value is “L” level)



Downloaded from Arrow.com.

- Play Oncemode timing

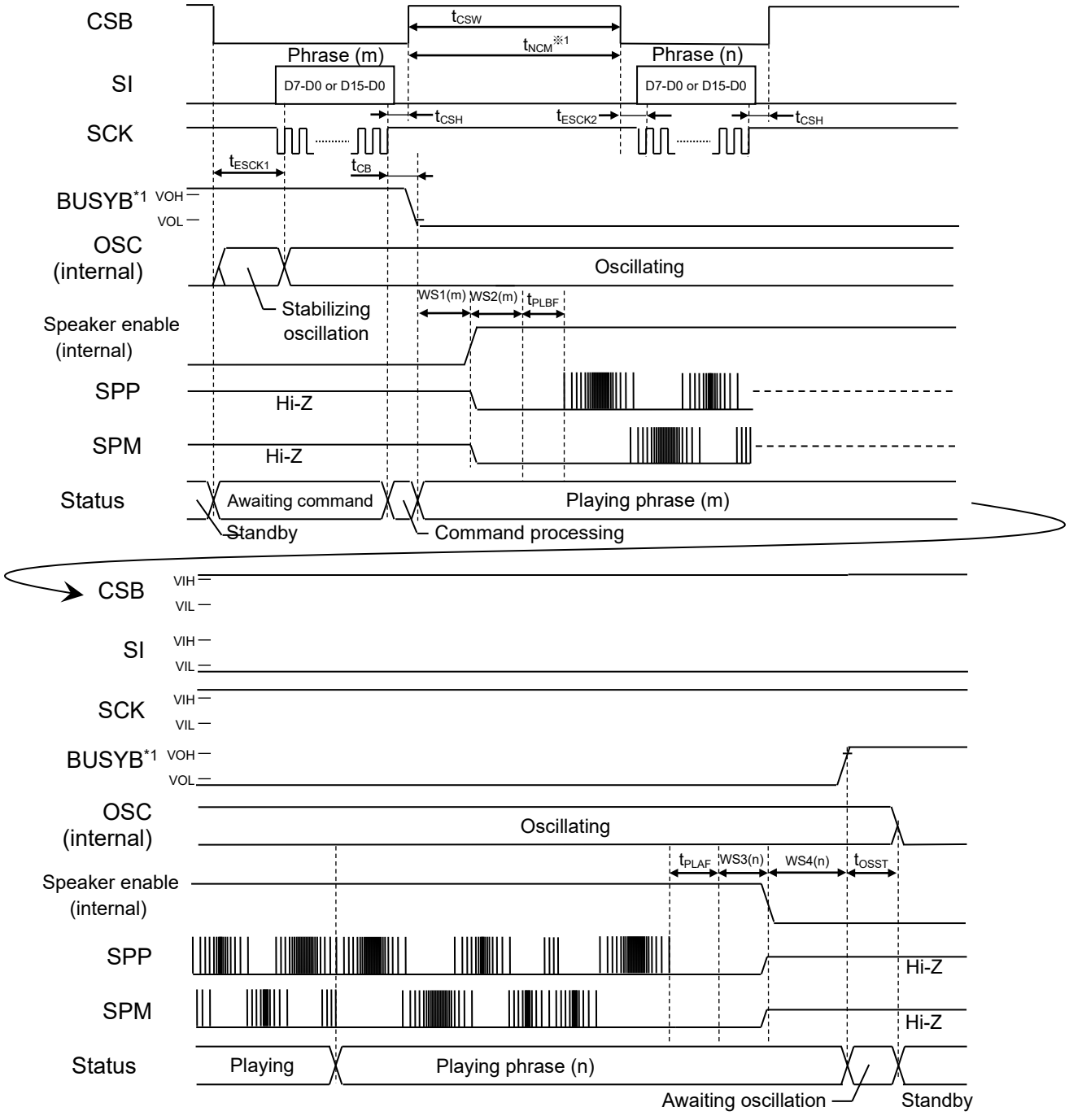
After playback of phrase (m) ends, playback request for next phrase (n) is accepted and the phrase (n) is played back. All the commands become invalid during playback of phrase (m).



Downloaded from Arrow.com.

- 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.



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

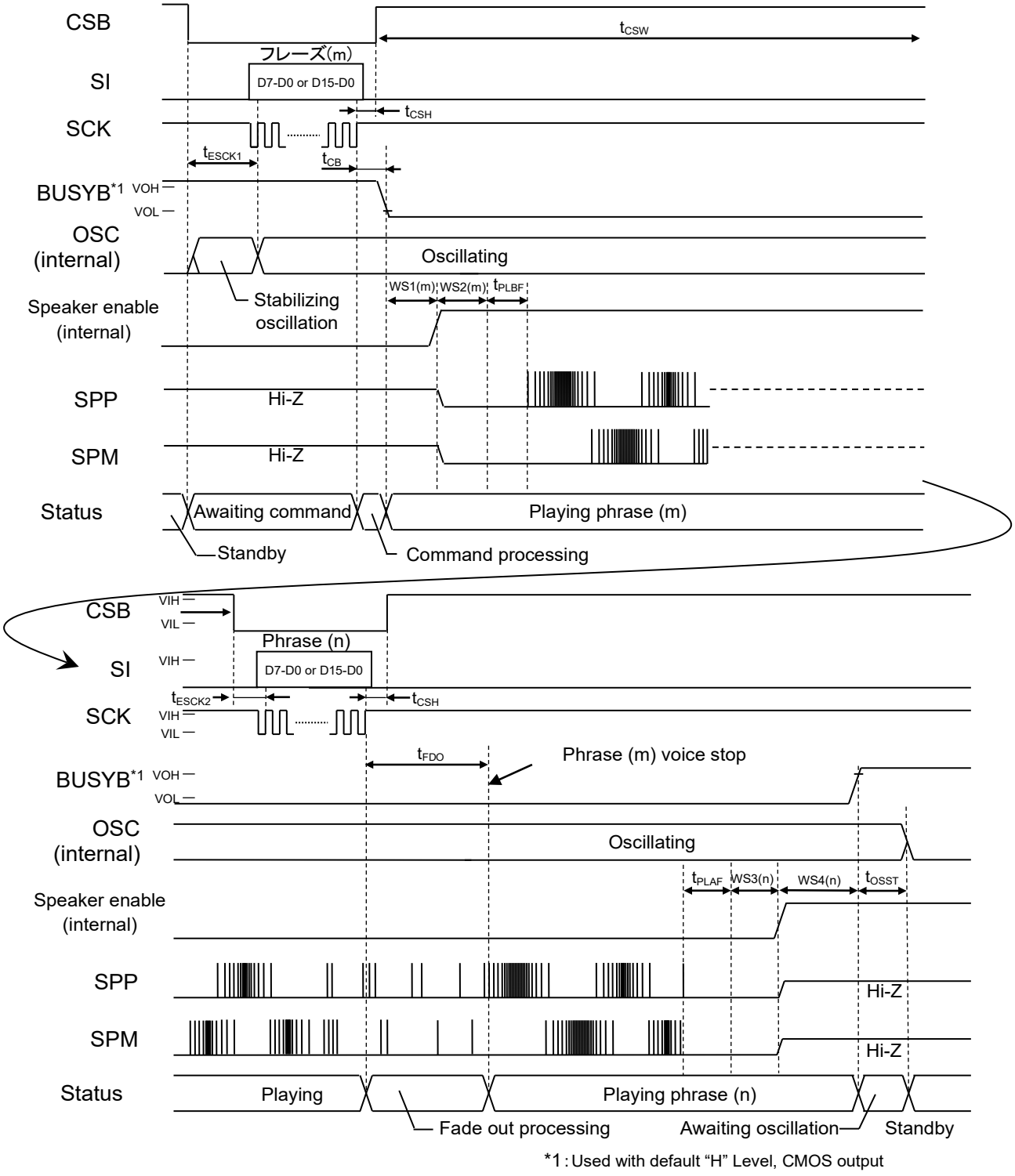
*Under Scheduled Play mode, playback is stopped by STOP command.

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}.

Downloaded from Arrow.com.

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

  After inputting the next PHRASEn command(Phrase(n)), fade-out of the playback(Phrase(m)) is carried out and thePhrase(n) playback is started.



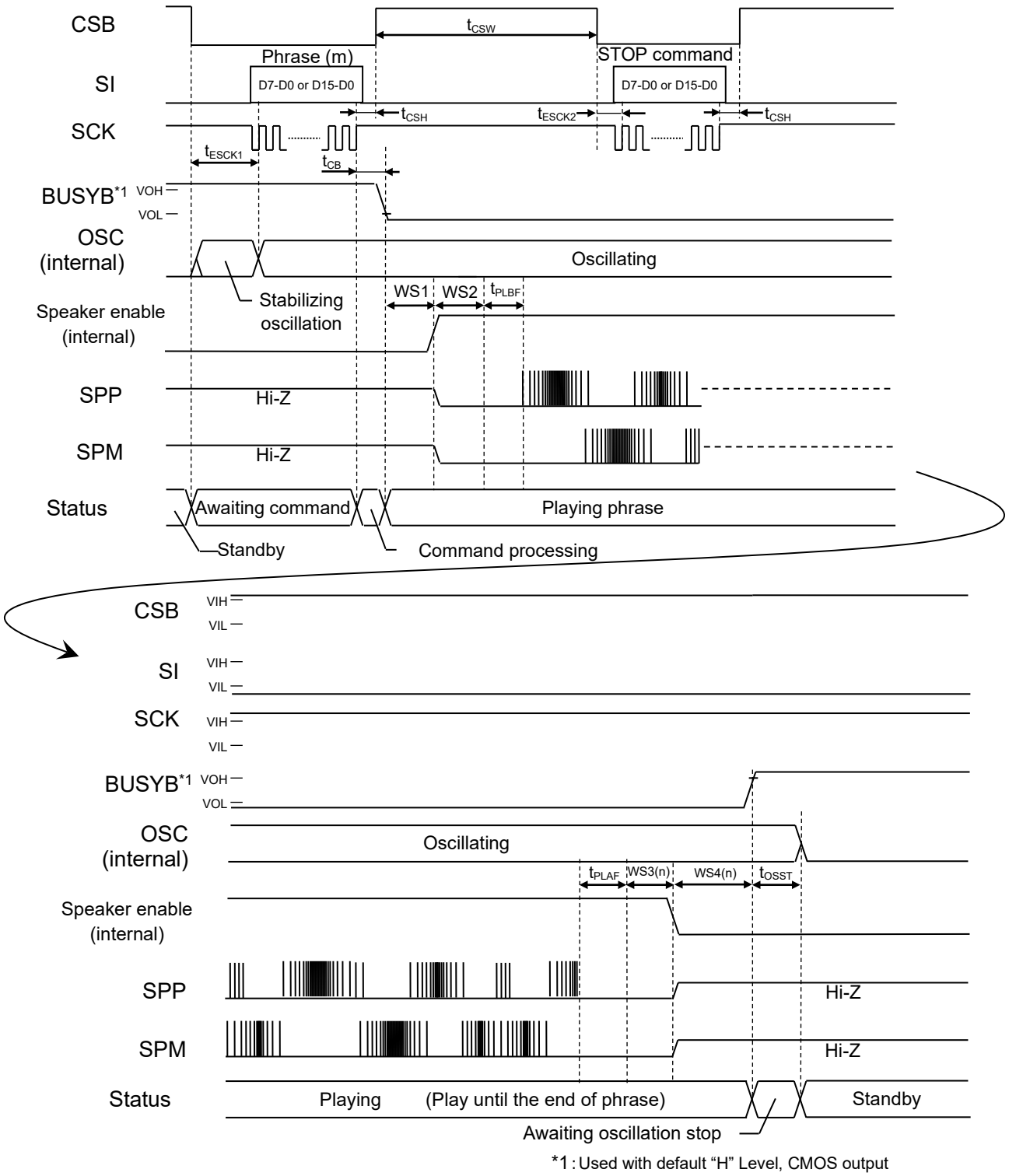
*1 : Used with default "H" Level, CMOS output

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

Downloaded from Arrow.com.

- 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.

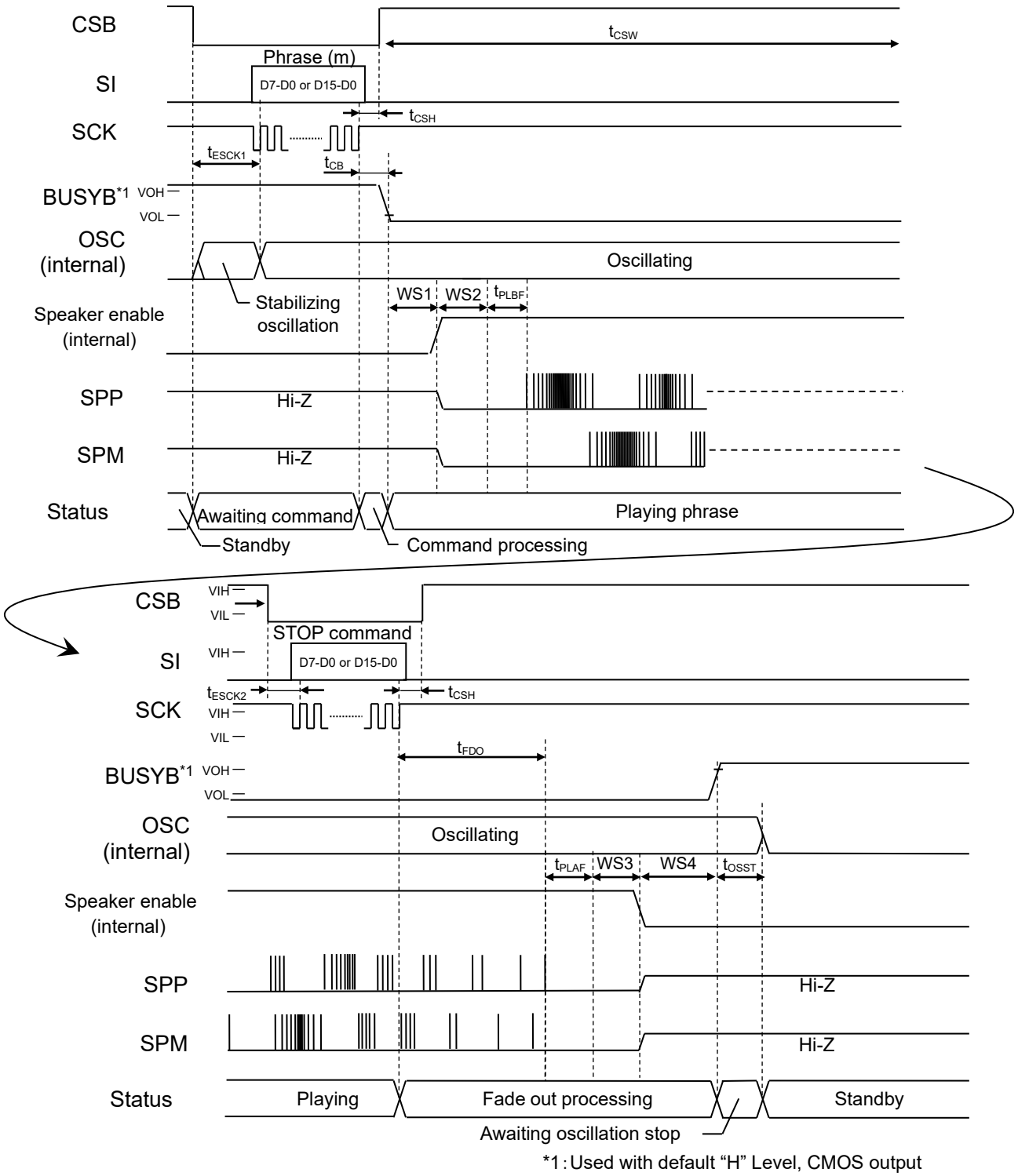


*1 : Used with default “H” Level, CMOS output

Downloaded from Arrow.com.

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

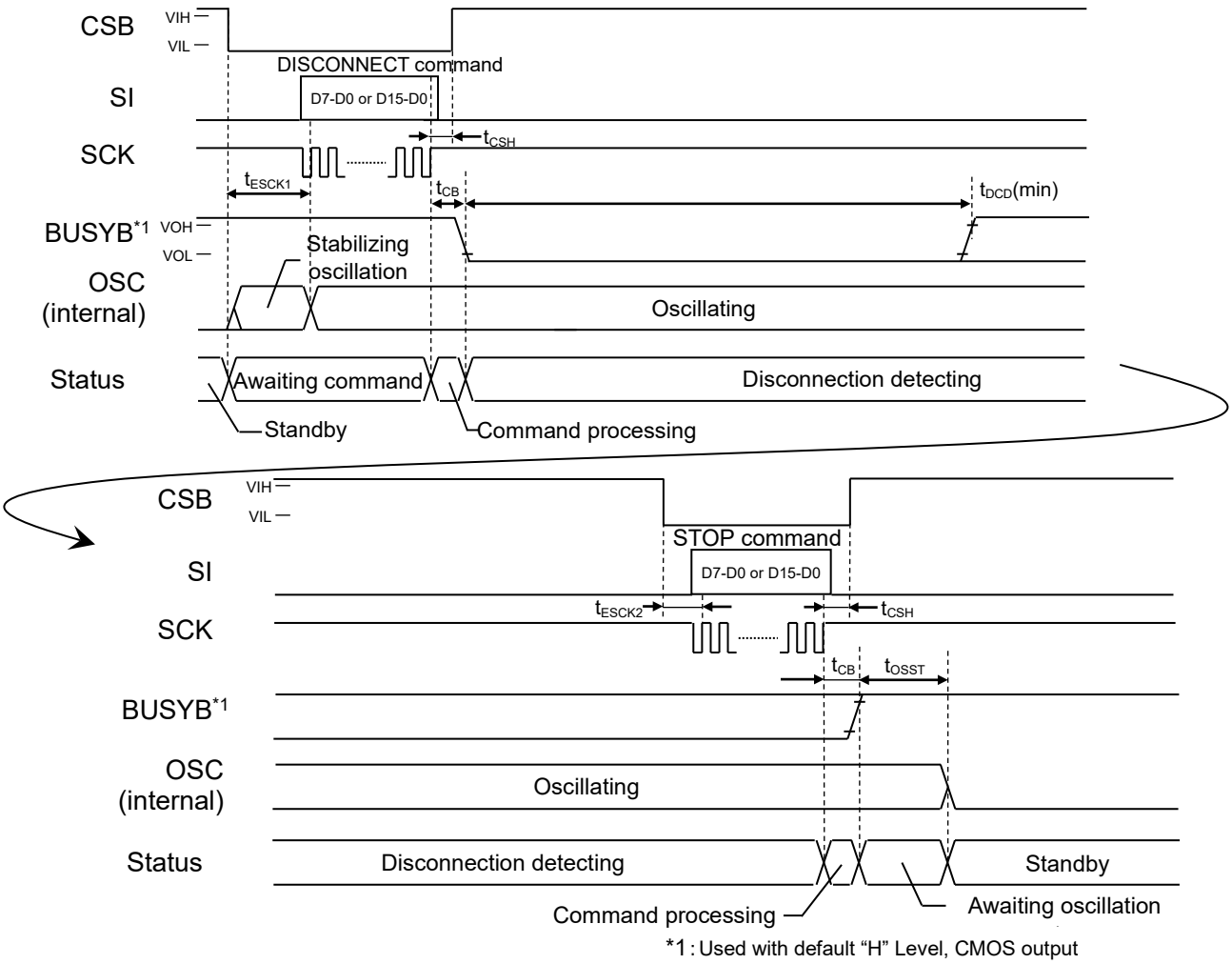
After STOP command is input, the voice fades out, and the playback stops.



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

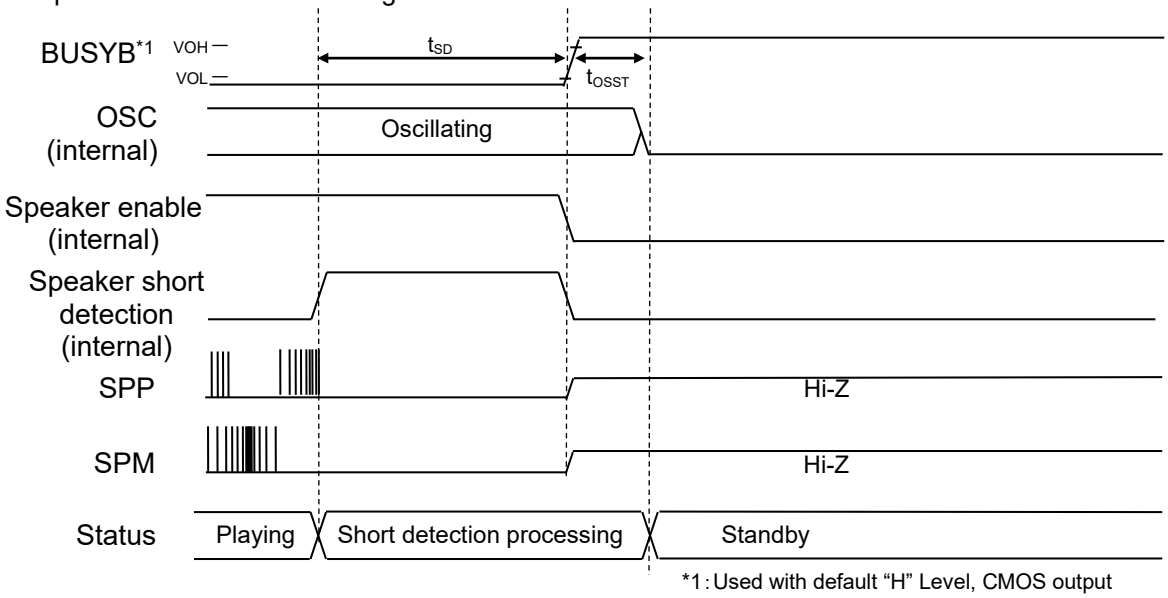
Downloaded from Arrow.com.

- Disconnection detection timing



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

- Speaker short detection timing



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

Downloaded from Arrow.com.

■ 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)

・Command setting

Command type	○1 byte (communicate with 1-byte command)
	○2 byte (communicate with 2-byte command)

STOP/DISCONNECT Command	Command bit sequence	
○Standard	STOP command	Set 0_0000b (1-byte command) Set 00_0000b (2-byte command)
	DISCONNECT command	Set 0_0001b (1-byte command) Set 00_0001b (2-byte command)
○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

・Clock synchronization Serial interface setting (SPI setting)

Data transfer type	○LSB first	Input serial data from LSB
	○MSB first	Input serial data from MSB

Clock polarity	○Normal (H Level)	Use with initial value of SCK pin set to “H” level
	○Normal (L Level)	Use with initial value of SCK pin set to “L” level

Downloaded from Arrow.com.

■ 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)”.

Downloaded from Arrow.com.

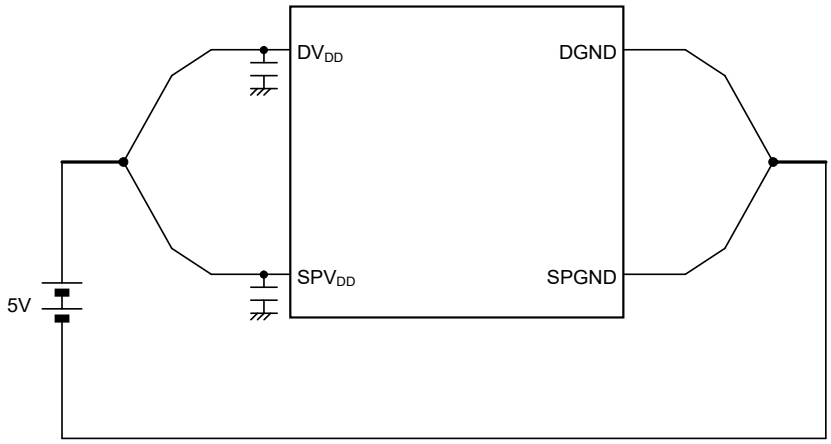
■ TERMINATION OF THE V_{DDL} PIN

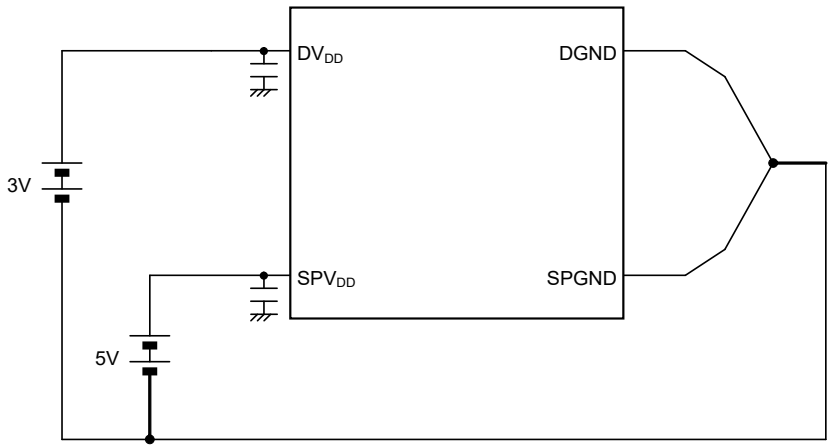
The VDDL pin is the regulator output that is power supply pin for the internal logic circuits. Connect a capacitor between this pin and the ground in order to prevent noise generation and power fluctuation.
The recommended capacitance value is shown below. However, it is important to evaluate and decide 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

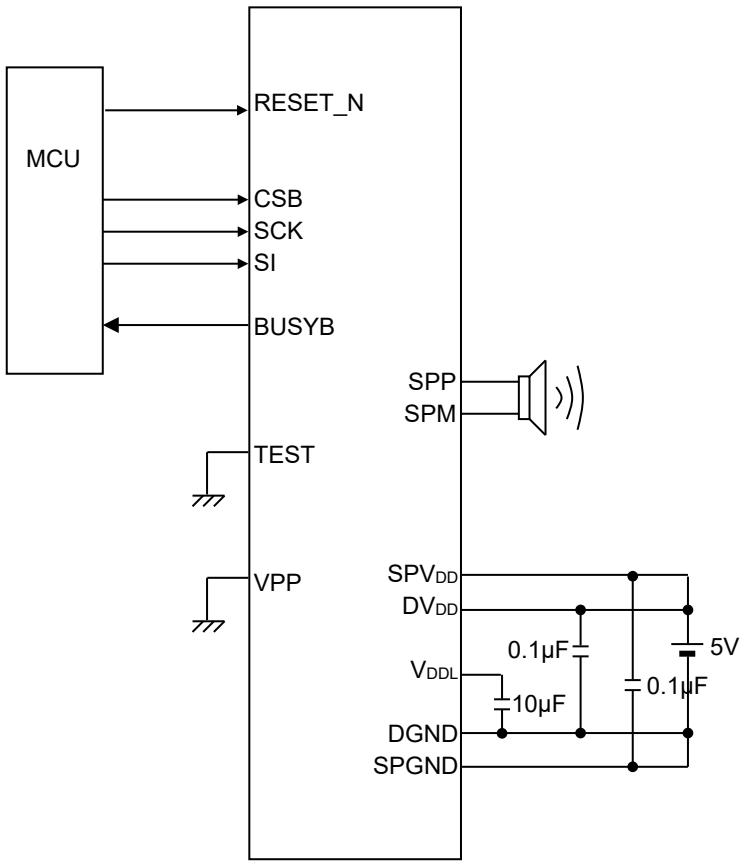




- Turn on DVDD and SPVDD simultaneously, or turn on SPVDD after turning on DVDD.
- Turn off DVDD and SPVDD simultaneously, or turn off DVDD after turning on SPVDD.

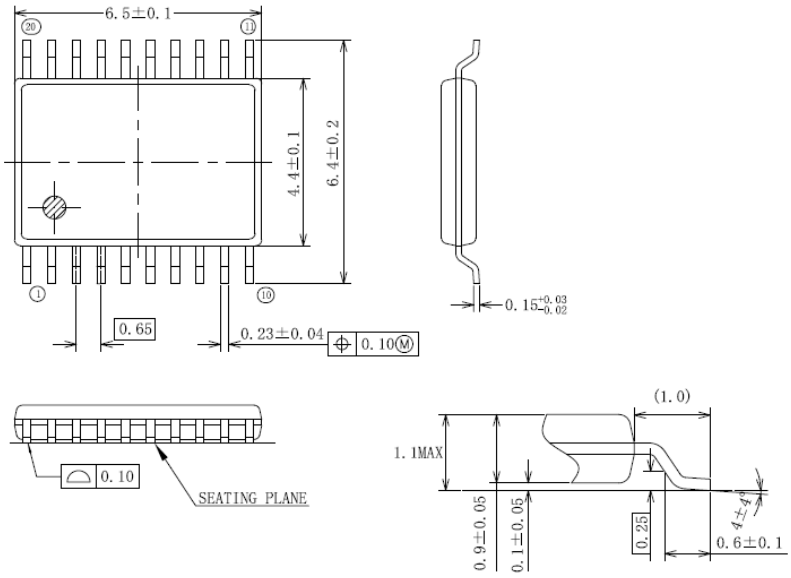
Downloaded from Arrow.com.

■ APPLICATION CIRCUIT



Downloaded from Arrow.com.

■ 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).

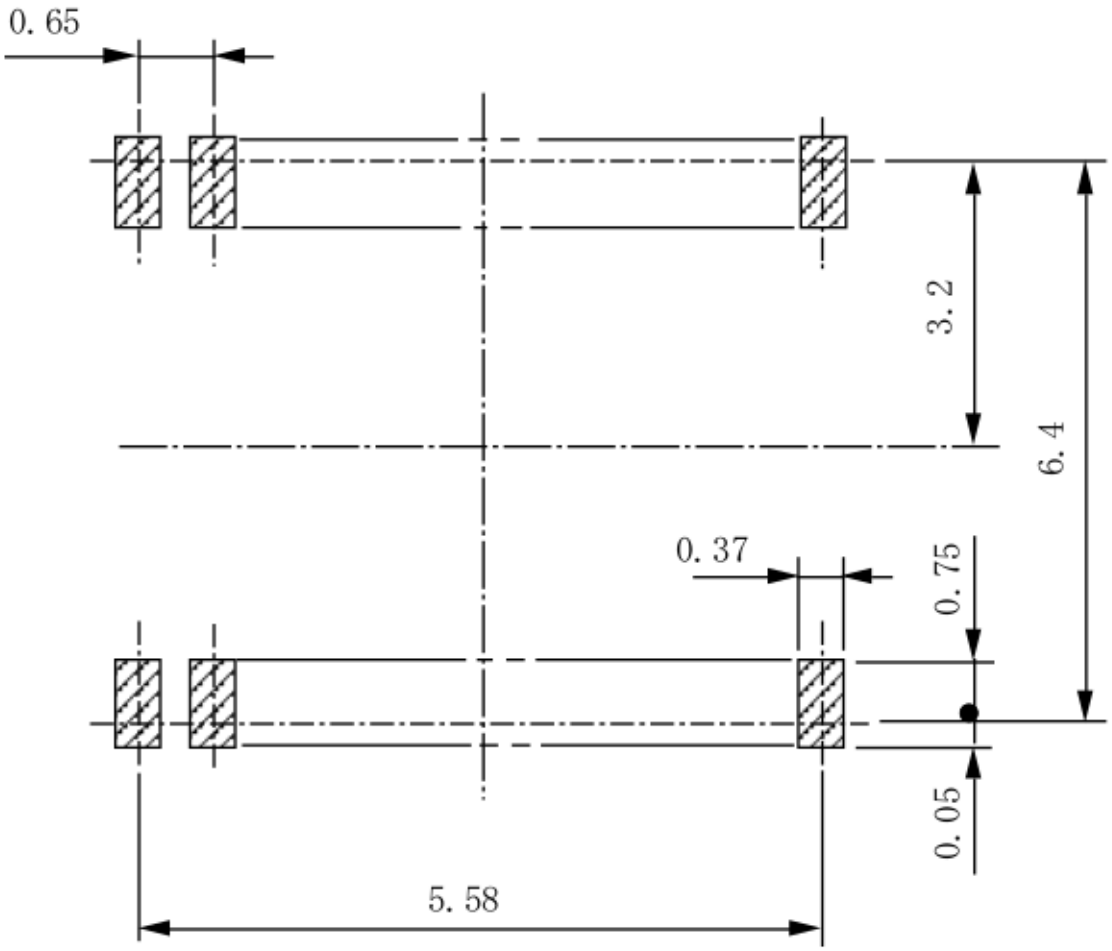
PCB Layer	JEDEC 4layers	JEDEC 2layers
PCB	(W/L/t= 76.2 / 114.3 / 1.6 (mm))	
Air cooling conditions	Calm(0m/sec)	
Heat resistance (θ ja)	63.7[°C /W]	69.4[°C /W]
Heat resistance (θ jc)	0.46[℃/W]	0.48[°C /W]
Maximum power consumption of LSI (PMax) At 1W into 8Ω playback	0.28[W]	

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

Downloaded from Arrow.com.

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。

フットパターンの最適な設計は基板材質、使用する半田ペースト種類、厚み、半田付け方法などによって変わってきます。従って、本パッケージの端子の存在し得る範囲を「半田付け部端子存在範囲図」として示しますので、フットパターン設計の参考資料としてください。

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.

Downloaded from Arrow.com.

■ REVISION HISTORY

Document No	Date	Page		Description
		Previous Edition	Current Edition	
FEDL22Q274-01	Mar 05, 2021	-	-	Formal 1st edition.
FEDL22Q274-02	Mar 30, 2021	6	6	SPP, SPM pin output short-circuit current value change. (Before change) 300mA (After change) 600mA
FEDL22Q274-03	Oct 4, 2021	16	16	Speaker short-circuit detection warning added.
		17	17	Added a note on using commands.
		35	35	Describe the thermal resistance information of the package.
		-	36	Added "Mounting area for package lead soldering to PC boards".
FEDL22Q274-04	Feb 9, 2024	-	2	Added application information.
		1	2	Changed shipping form to table format.
		38	39	Revised the Note.
FEDL22Q274-05	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
FEDL22Q274-06	Jun 9, 2026	8	8	Corrected a typo in IIL2 and added IIL3.
		39-40	39-41	Revised the Note.

Downloaded from Arrow.com.

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

© 2015 ROHM Co., Ltd. All rights reserved.

Downloaded from Arrow.com.

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

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.

2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).

3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

© 2015 ROHM Co., Ltd. All rights reserved.

Downloaded from Arrow.com.

General Precaution

1. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

2. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.

© 2015 ROHM Co., Ltd. All rights reserved.

Downloaded from Arrow.com.