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

**FEDL22Q374-08**
Issue Date: Feb. 9, 2024

# ML22Q374/ML22Q374P

**ADPCM Speech Synthesis LSI**

## ■ GENERAL DESCRIPTION

ML22Q374/ML22Q374P is voice synthesis LSI with built-in Flash memory that stores speech data. This LSI includes edit ROM, ADPCM2 decoder, low pass filter and D-class speaker amplifier. Also, ML22Q374/ML22Q374P support the synchronous serial interface. By integrating all the functions required for voice output into a single chip, this LSI can be more easily incorporated in compact portable devices.

- Built-in memory capacity and maximum playback time:

| Product name | ROM capacity | Maximum playback time (sec) (at $f_s$=8.0kHz) | |
|---|---|---|---|
| | | 4bitADPCM2 | 16bitPCM |
| ML22Q374<br>ML22Q374P | 692 Kbits | 22.1 | 5.5 |

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

- Voice synthesis method: 4-bit ADPCM2
  8-bit Nonlinear PCM
  8-bit PCM , 16-bit PCM
  Can be specified for each phrase.
- Speech ROM capacity ML22Q374/ML22Q374P: 692-Kbit Flash
- Sampling frequency(Fs): 6.4 / 8.0 / 10.7 / 12.8 / 16.0 / 21.3 / 25.6 / 32.0 kHz
  $f_s$ can be specified for each phrase.
- Analog output: Built-in D-class amplifier
- CPU command interface: Synchronous serial interface
- Maximum number of phrases: 30 phrases
- Disconnection detection function /Speaker pin short detection function
- Source oscillation frequency: 4.096 MHz(internal)
- Power supply voltage: 2.0 to 5.5V
- Flash memory rewritable time: 80 times
- Operating temperature range: –40 to +85°C (ML22Q374)
  –40 to +105°C (ML22Q374P)
- AEC-Q100 Compliant

## ■ Applications

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

【NOTE】

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

## ■ Table format

| Package | Body size (including lead) [mm × mm] | Pin pitch [mm] | Packing form and Product name[*1] | |
|---|---|---|---|---|
| | | | Tray | Tape & Reel |
| 16 pin plastic TSSOP | 5.0 × 4.4<br>(5.0 × 6.4) | 0.65 | ML22Q374-NNNTPZ0AJL<br>ML22Q374-xxxTPZ0AJL | ML22Q374-NNNTPZ0ALL<br>ML22Q374-xxxTPZ0ALL |
| 20 pin plastic TSSOP | 6.5 × 4.4<br>(6.5 × 6.4) | 0.65 | ML22Q374-NNNTDZ0ARL<br>ML22Q374-xxxTDZ0ARL<br>ML22Q374P-NNNTDZ0ARL<br>ML22Q374P-xxxTDZ0ARL | ML22Q374-NNNTDZ0ATL<br>ML22Q374-xxxTDZ0ATL<br>ML22Q374P-NNNTDZ0ATL<br>ML22Q374P-xxxTDZ0ATL |

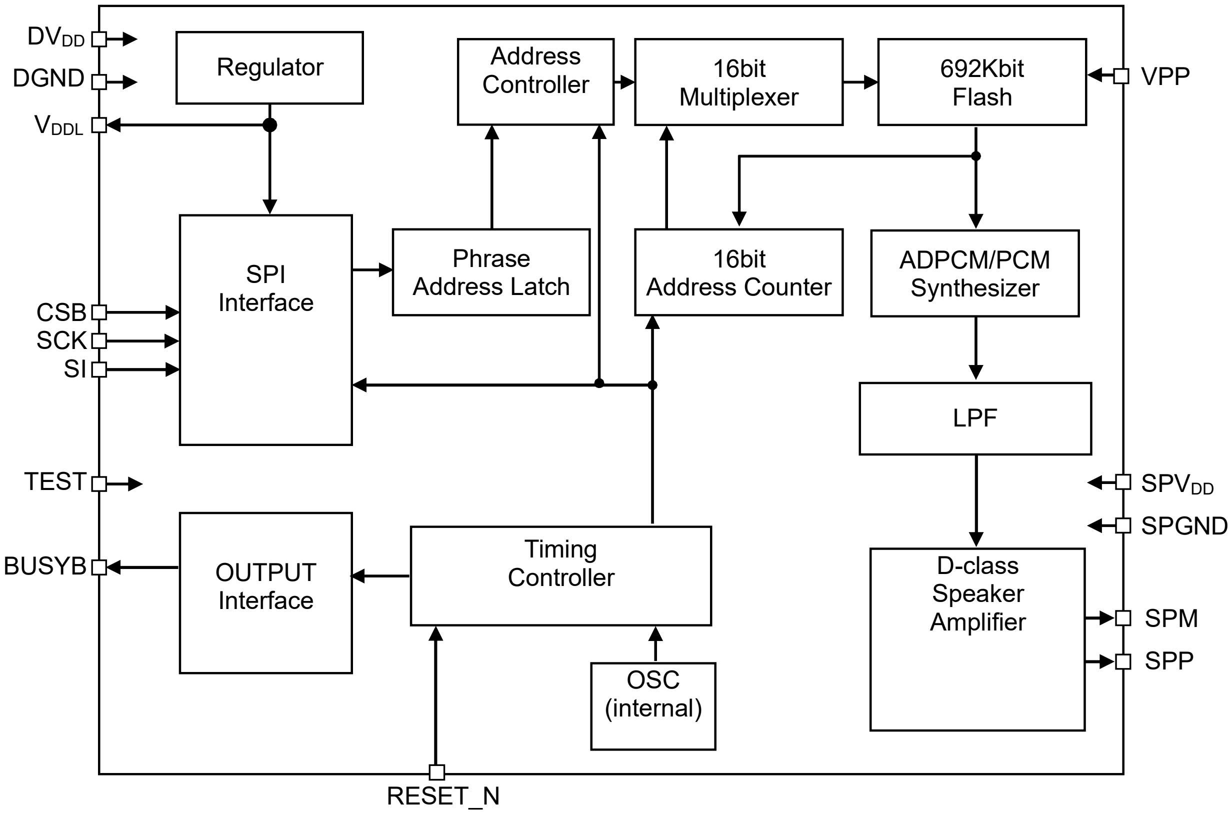
*1 “NNN” is a blank product. “xxx” denotes ROM code number.

The following table shows the differences among the ML22Q394.

| Parameter | ML22Q374 | ML22Q374P | ML22Q394 | ML22Q394P |
|---|---|---|---|---|
| CPU interface | Synchronous serial interface | ← | $I^2C$ | ← |
| Memory capacity | 692Kbit | ← | ← | ← |
| Playback method | 4-bit ADPCM2<br>8-bit nonlinear PCM<br>8-bit straight PCM<br>16-bit straight PCM | ← | ← | ← |
| Maximum number of phrases | 30 | ← | ← | ← |
| Sampling frequency (kHz) | 6.4/12.8/25.6<br>8.0/16.0/32.0<br>10.7/21.3 | ← | ← | ← |
| Clock frequency | 4.096MHz (internal oscillation) | ← | ← | ← |
| Low-pass filter | FIR interpolation filter | ← | ← | ← |
| Speaker driving amplifier | Built-in D-Class<br>1.0W<br>(8Ω, $SPV_{DD}$ = 5 V) | Built-in D-Class<br>0.8W<br>(8Ω, $SPV_{DD}$ = 5 V) | Built-in D-Class<br>1.0W<br>(8Ω, $SPV_{DD}$ = 5 V) | Built-in D-Class<br>0.8W<br>(8Ω, $SPV_{DD}$ = 5 V) |
| Edit ROM function | Yes | ← | ← | ← |
| Volume control | 32 levels | ← | ← | ← |
| Silence insertion | Yes<br>20 ms to 1024 ms<br>(4 ms/step) | ← | ← | ← |
| Repeat function | Yes | ← | ← | ← |
| Power supply voltage | 2.0 V to 5.5 V | ← | ← | ← |
| Operating temperature range | –40 to +85°C | –40 to +105°C | –40 to +85°C | –40 to +105°C |
| Package | 16-pin TSSOP | 20-pin TSSOP | 16-pin TSSOP | 20-pin TSSOP |
|  | 20-pin TSSOP |  | 20-pin TSSOP |  |

## ■ BLOCK DIAGRAMs

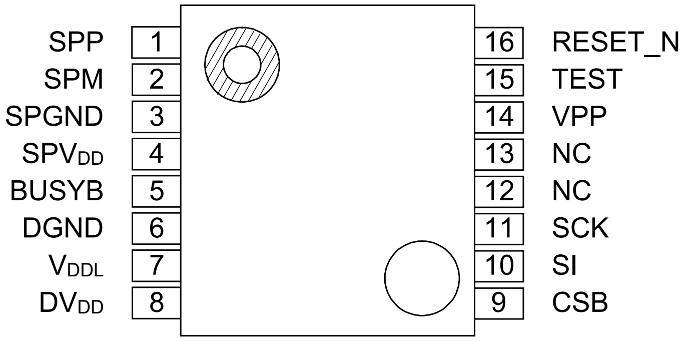
ML22Q374-NNNTP/ML22Q374-xxxTP/ ML22Q374-NNNTD/ML22Q374-xxxTD
ML22Q374P-NNNTD/ML22Q374P-xxxTD


DVDD
DGND
VDDL
Regulator
Address Controller
16bit Multiplexer
692Kbit Flash
VPP
SPI Interface
Phrase Address Latch
16bit Address Counter
ADPCM/PCM Synthesizer
CSB
SCK
SI
LPF
TEST
SPVDD
SPGND
BUSYB
OUTPUT Interface
Timing Controller
D-class Speaker Amplifier
SPM
SPP
OSC (internal)
RESET_N

## ■ PIN CONFIGURATIONs (TOP VIEW)

ML22Q374-NNNTP/ML22Q374-xxxTP

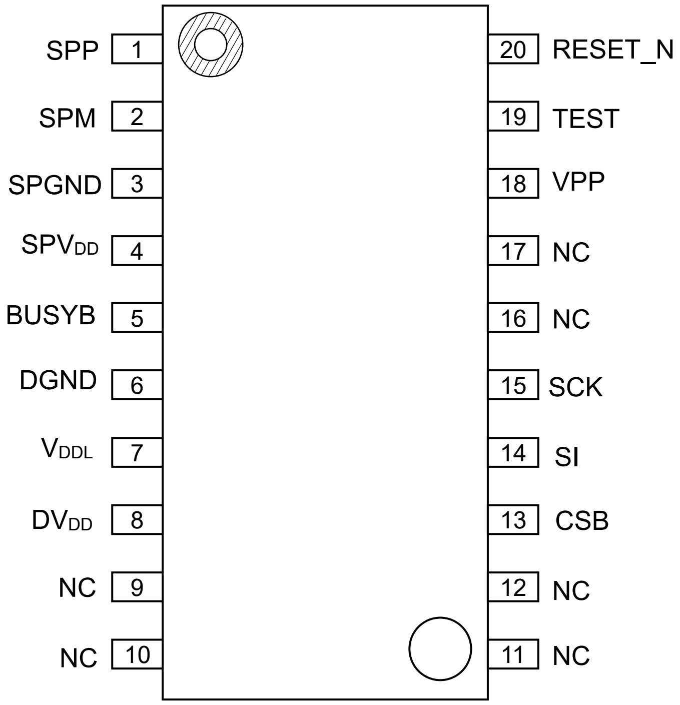
16-Pin Plastic TSSOP


SPP 1
SPM 2
SPGND 3
SPV$_{DD}$ 4
BUSYB 5
DGND 6
V$_{DDL}$ 7
DV$_{DD}$ 8
16 RESET_N
15 TEST
14 VPP
13 NC
12 NC
11 SCK
10 SI
9 CSB

NC : Unused pin

ML22Q374-NNNTD/ML22Q374-xxxTD/ML22Q374P-NNNTD/ML22Q374P-xxxTD

20-Pin Plastic TSSOP


SPP 1
SPM 2
SPGND 3
SPV$_{DD}$ 4
BUSYB 5
DGND 6
V$_{DDL}$ 7
DV$_{DD}$ 8
NC 9
NC 10
20 RESET_N
19 TEST
18 VPP
17 NC
16 NC
15 SCK
14 SI
13 CSB
12 NC
11 NC

NC : Unused pin

## ■ PIN DESCRIPTION

| Pin (20pin TSSOP) | Pin (16pin TSSOP) | Symbol | I/O | Initial value (At the RESET_N Input) | Initial value (At standby) | Description |
|---|---|---|---|---|---|---|
| 1 | 1 | SPP | O | Hi-Z | Hi-Z | Positive(+) output pin of the speaker amplifier built-in |
| 2 | 2 | SPM | O | Hi-Z | Hi-Z | Negative(-) output pin of the speaker amplifier built-in. |
| 3 | 3 | SPGND | — | — | — | Ground pin for the speaker amplifier. |
| 4 | 4 | $SPV_{DD}$ | — | — | — | Power supply pin for the speaker amplifier.<br>Connect a bypass capacitor of 1μF or more between this pin and SPGND pin. |
| 5 | 5 | BUSYB | O | Hi-Z | 1 | BUSY output pin.<br>When BUSYB use mode is set, the "L" level is outputted during playback.<br>At the time of a disconnection detection function,<br>when disconnection is detected, the "L" level is outputted.<br>Logical inversion can be set up with the Mask Option Setting screen of Speech Utility.<br>In addition, when BUSYB use mode is not set, the initial value is outputted. |
| 6 | 6 | DGND | — | — | — | Digital ground pin. |
| 7 | 7 | $V_{DDL}$ | — | — | — | Regulator output pin for internal logic circuitry.<br>Connect a capacitor of 10μF or more between this pin and DGND pin |
| 8 | 8 | $DV_{DD}$ | — | — | — | Power supply pins for logic circuitry.<br>Connect a capacitor of 0.1μF or more between this pin and DGND pin. |
| 13 | 9 | CSB | I | 1 | 1 | Chip select pin, when CSB use mode is set.<br>At the “L” level, data input is available.<br>The pull-up resistor is built in. |
| 14 | 10 | SI | I | 1 | 1 | Input pin for the synchronous serial data. |
| 15 | 11 | SCK | I | 1 | 1 | Clock input pin for the synchronous serial interface. |
| 18 | 14 | VPP | — | — | — | Power supply pin for rewriting Flash memory.<br>Fix this pin to DGND except when rewriting Flash memory. |
| 19 | 15 | TEST | I | 0 | 0 | Test pin. Fix this pin to a DGND level. |
| 20 | 16 | RESET_N | I | 0 | 1 | At the “L” level, the LSI enters initial state.<br>After the power supply voltage is stable, drive this pin to “H” level. |

## ■ ABSOLUTE MAXIMUM RATINGS

(DGND = SPGND = 0 V)

| Parameter | Symbol | Condition | Rating | Unit |
|---|---|---|---|---|
| Power supply voltage | $DV_{DD}$ | Ta=25°C | –0.3 to +7.0 | V |
| Speaker power supply voltage | $SPV_{DD}$ | | –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 $DV_{DD}$+0.3 | V |
| Power dissipation | $P_D$ | | 1 | W |
| Output short-circuit current | $I_{SC1}$ | except SPP pin, SPM pin | -12 to +11 | mA |
| | $I_{SC2}$ | SPP pin, SPM pin | 300 | mA |
| Storage temperature | $T_{STG}$ | — | –55 to +150 | °C |

## ■ RECOMMENDED OPERATING CONDITIONS

(DGND = SPGND = 0 V)

| Parameter | Symbol | Condition | Range | Unit |
|---|---|---|---|---|
| Power supply voltage | $DV_{DD}$ | — | 2.0 to 5.5 | V |
| | | Flash memory write | 2.7 to 5.5 | |
| Speaker power supply voltage | $SPV_{DD}$ | — | 2.0 to 5.5 | V |
| Flash power supply voltage | $V_{PP}$ | Flash memory write | 7.7 to 8.3 | V |
| Flash memory rewrite cycles | N | — | 80 | — |
| Operating temperature | $T_{OP1}$ | ML22Q374 | –40 to +85 | °C |
| | | ML22Q374P | –40 to +105 | |
| | $T_{OP2}$ | Flash memory write | 0 to +40 | |

## ■ ELECTRICAL CHARACTERISTICS

### ● DC Characteristics

$DV_{DD}$ = $SPV_{DD}$ = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = –40 to +85°C (ML22Q374)
Ta = –40 to +105°C (ML22Q374P)

| 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 | $V_{OL1}$ | $I_{OL}$ = 0.5 mA | — | — | 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<br>RESET_N, CSB pin | –1.5 | –0.3 | –0.02 | mA |
| "H" output current 1 | $I_{ooH1}$ | $V_{OH}$ = $DV_{DD}$ = $SPV_{DD}$<br>(High impedance)<br>BUSYB pin, SPP pin, SPM pin | — | — | 1 | μA |
| "H" output current 2 | $I_{ooH2}$ | $V_{OH}$ = $DV_{DD}$<br>(Nch Open drain)<br>BUSYB pin | — | — | 1 | μA |
| "L" output current 1 | $I_{ooL1}$ | $V_{OL}$ = DGND = SPGND<br>(High impedance)<br>BUSYB pin, SPP pin, SPM pin | –1 | — | — | μA |
| "L" output current 1 | $I_{ooL2}$ | $V_{OL}$ = DGND<br>(Pch Open drain)<br>BUSYB pin | –1 | — | — | μA |
| Supply current during playback | $I_{DD1}$ | No output load, $DV_{DD}$ = 3.0V | — | 4.0 | 6.0 | mA |
| | $I_{DD2}$ | No output load, $DV_{DD}$ = 5.0V | — | 6.0 | 10 | |
| Awaiting command supply current | $I_{DDC1}$ | $DV_{DD}$ = $SPV_{DD}$ = 5.0V | — | 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 | $f_{OSC}$ | Ta = –10 to +50°C | 4.034 | 4.096 | 4.158 | MHz |
| | | Ta = –40 to +85°C | 3.973 | 4.096 | 4.219 | |
| | | Ta = –40 to +105°C | 3.973 | 4.096 | 4.219 | |

### ● Characteristics of Analog Circuitry

$DV_{DD}$ = $SPV_{DD}$ = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = –40 to +85°C (ML22Q374)
Ta = –40 to +105°C (ML22Q374P)

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| SPM, SPP output load resistance | $R_{LSP}$ | — | 8 | — | — | Ω |
| Speaker amplifier output power | $P_{SPO}$ | $SPV_{DD}$ = 5.0V, Sin wave f = 1kHz<br>$R_{LSP}$ = 8Ω, THD≥10%<br>(ML22Q374) | — | 1.0 | — | W |
| | | $SPV_{DD}$ = 5.0V, Sin wave f = 1kHz<br>$R_{LSP}$ = 8Ω, THD≥10%<br>(ML22Q374P) | — | 0.8 | — | W |

- AC Characteristics

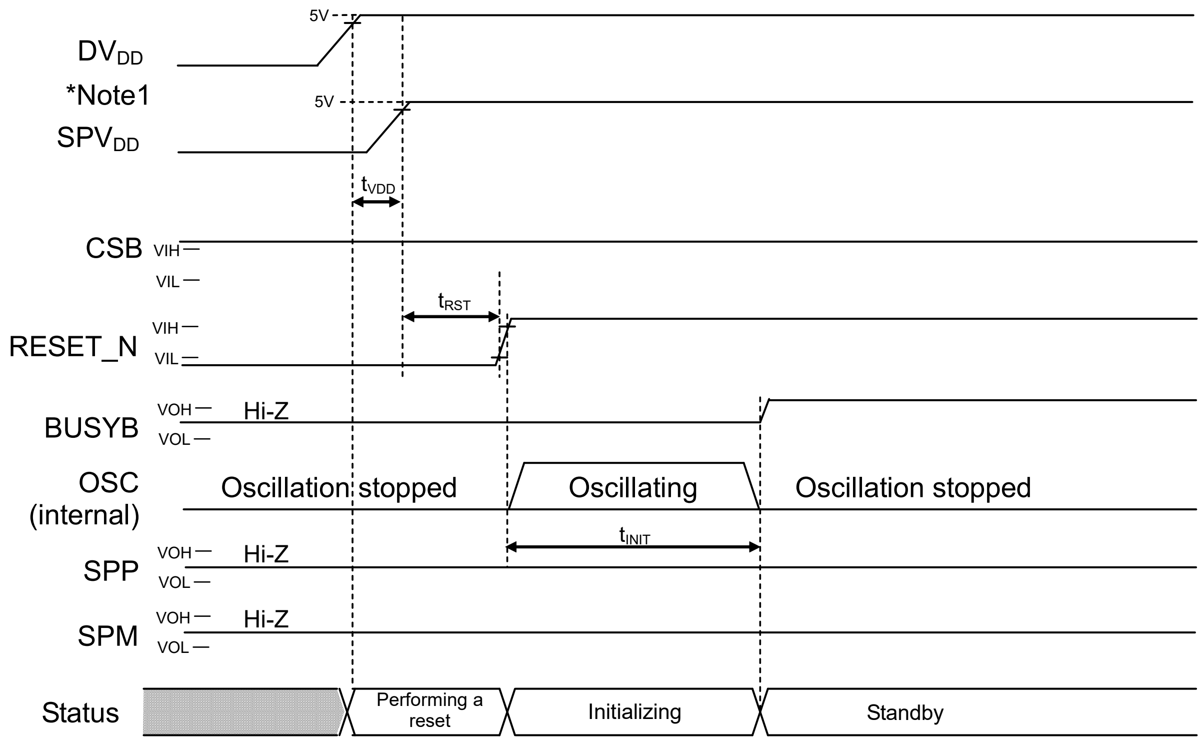
$DV_{DD}$ = $SPV_{DD}$ = 2.0 to 5.5 V, DGND = SPGND = 0 V, Ta = –40 to +85°C (ML22Q374)
Ta = –40 to +105°C (ML22Q374P)

| 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 | $t_{INIT}$ | — | — | — | 20 | ms |
| BUSYB change time to "Hi-Z",after RESET_N fall edge | $t_{BSYR}$ | — | — | — | 500 | ns |
| 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<br>In the case of the playback | $t_{NCM}$ | — | — | — | 10 | ms |
| Disconnection judging time<br>by the DISCONNECT command | $t_{DCD}$ | — | 100 | — | — | ms |
| BUSYB change time from "L" to "H",after Over-current detection of a speaker amplifier | $t_{SD}$ | — | — | — | 80 | μs |
| Processing time before playback start | $t_{PLBF}$ | — | 0.3 | — | 2.1 | ms |
| Processing time after playback start | $t_{PLAF}$ | — | 0.15 | — | 1.2 | ms |
| Fade-out time at Change Immediately mode or Change Immediately Once mode | $t_{FDO}$ | — | — | 22 | — | ms |

Note: Output pin load capacitance = 45 pF

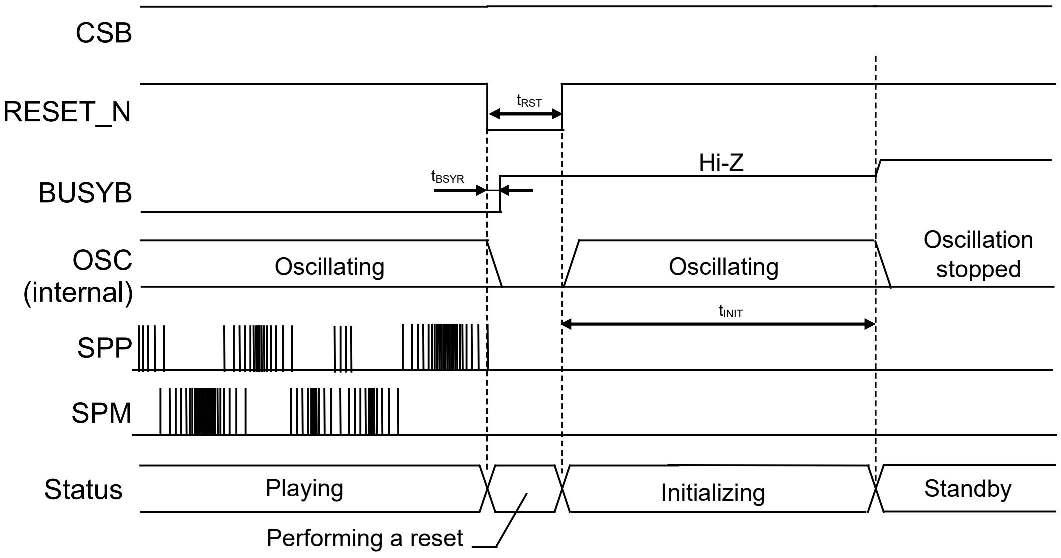
## ■ TIMING DIAGRAMS

- Power-On Timing


DV_DD
*Note1
SPV_DD
5V
5V
t_VDD
CSB
VIH
VIL
t_RST
RESET_N
VIH
VIL
BUSYB
VOH
VOL
Hi-Z
OSC
(internal)
Oscillation stopped
Oscillating
Oscillation stopped
t_INIT
SPP
VOH
VOL
Hi-Z
SPM
VOH
VOL
Hi-Z
Status
Performing a reset
Initializing
Standby

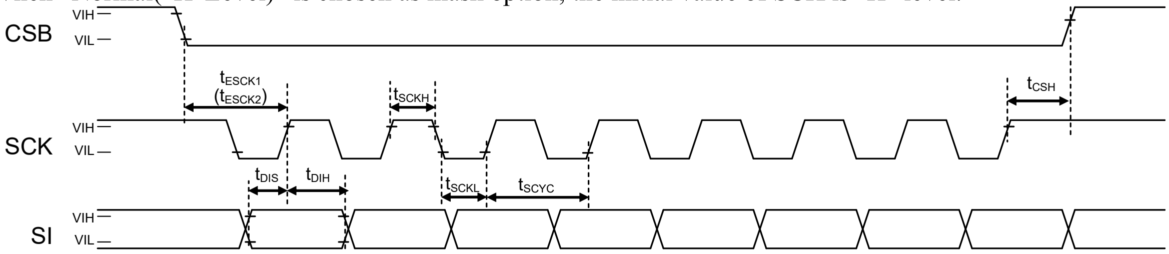
Note 1: Turn on $DV_{DD}$ and $SPV_{DD}$ simultaneously, or turn on $SPV_{DD}$ after turning on $DV_{DD}$.

- Power-Down Timing (At the RESET_N Input)

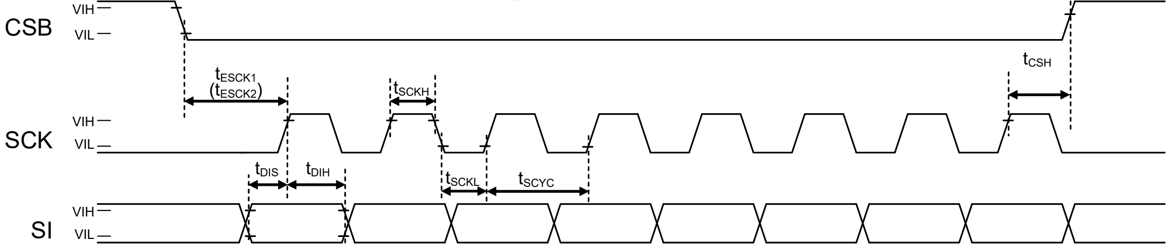

CSB
RESET_N
BUSYB
OSC
(internal)
SPP
SPM
Status
$t_{RST}$
$t_{BSYR}$
Hi-Z
Oscillating
Oscillating
Oscillation
stopped
$t_{INIT}$
Playing
Initializing
Standby
Performing a reset

- Synchronous Serial Interface Timing

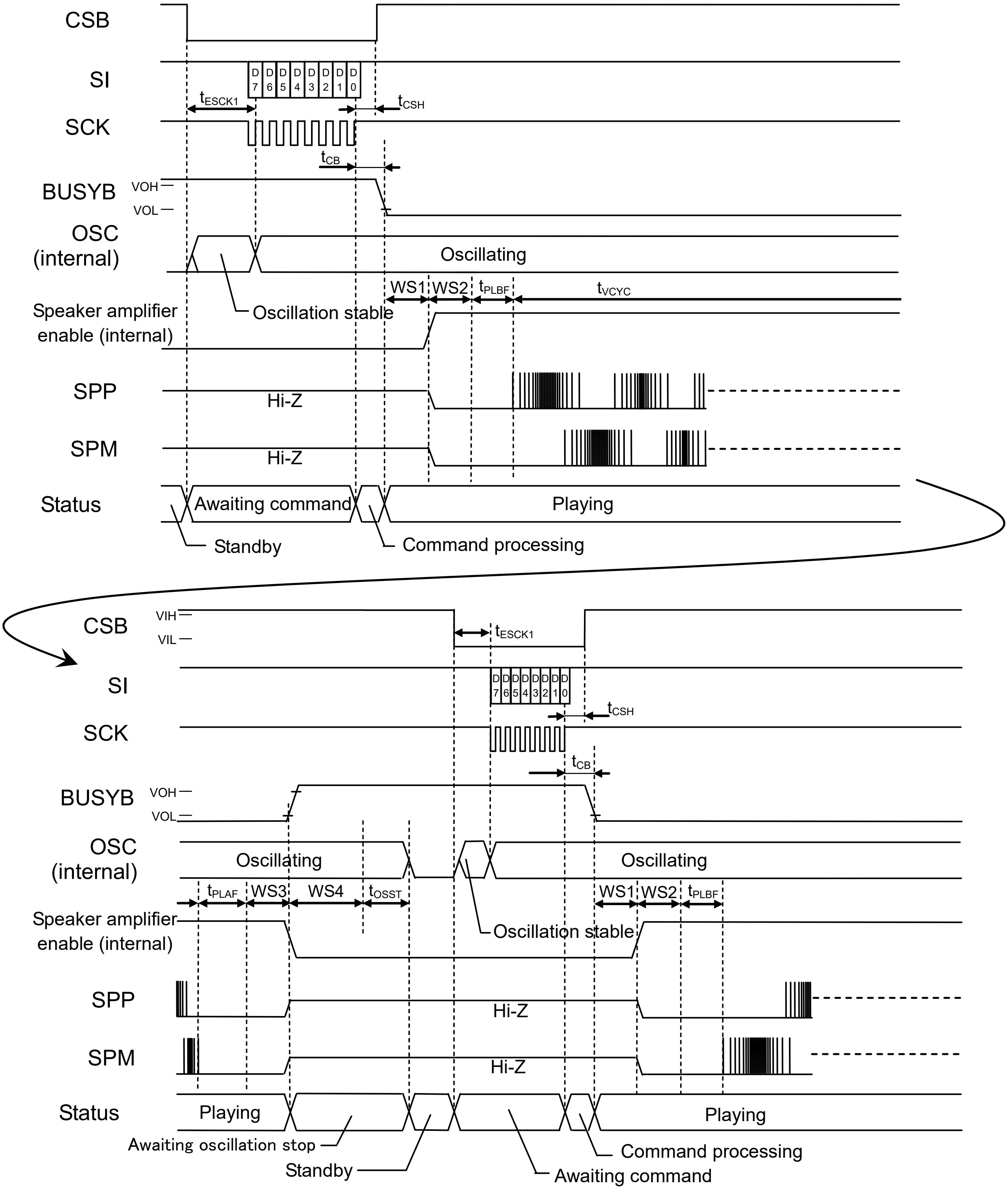
When "Normal("H"Level)" is chosen as mask option, the initial value of SCK is "H" level.


CSB
SCK
SI
VIH
VIL
$t_{ESCK1}$
($t_{ESCK2}$)
$t_{SCKH}$
$t_{CSH}$
$t_{DIS}$
$t_{DIH}$
$t_{SCKL}$
$t_{SCYC}$

When "Reversal("L"Level)" is chosen as mask option, the initial value of SCK is "L" level.


CSB
SCK
SI
VIH
VIL
$t_{ESCK1}$
($t_{ESCK2}$)
$t_{SCKH}$
$t_{CSH}$
$t_{DIS}$
$t_{DIH}$
$t_{SCKL}$
$t_{SCYC}$

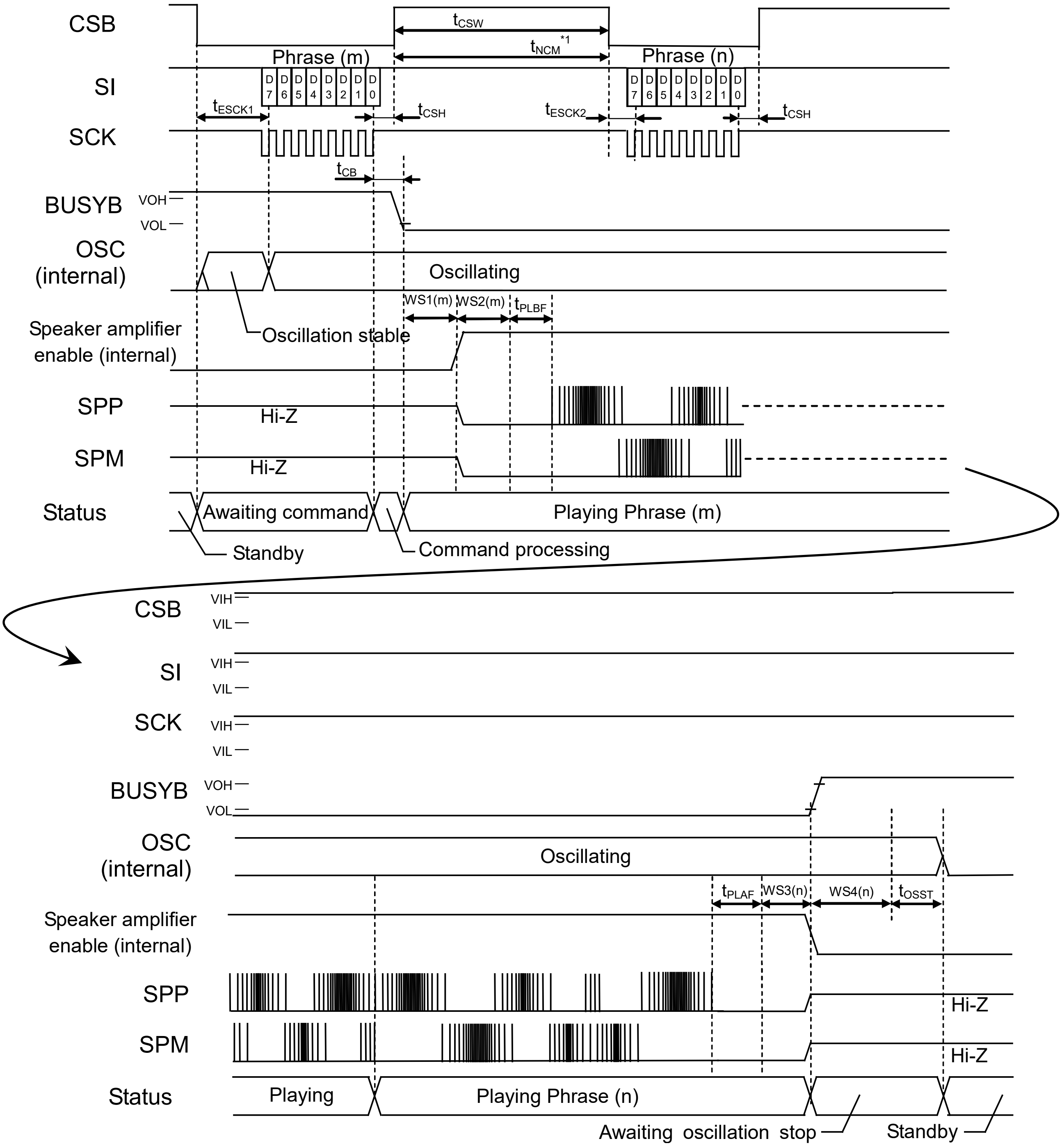
- Play Once mode Timing


CSB
SI
D7 D6 D5 D4 D3 D2 D1 D0
tESCK1
tCSH
SCK
tCB
BUSYB
VOH
VOL
OSC (internal)
Oscillating
Oscillation stable
WS1
WS2
tPLBF
tVCYC
Speaker amplifier enable (internal)
SPP
Hi-Z
SPM
Hi-Z
Status
Awaiting command
Playing
Standby
Command processing
CSB
VIH
VIL
tESCK1
SI
D7 D6 D5 D4 D3 D2 D1 D0
tCSH
SCK
tCB
BUSYB
VOH
VOL
OSC (internal)
Oscillating
Oscillating
tPLAF
WS3
WS4
tOSST
WS1
WS2
tPLBF
Speaker amplifier enable (internal)
Oscillation stable
SPP
Hi-Z
SPM
Hi-Z
Status
Playing
Playing
Awaiting oscillation stop
Standby
Command processing
Awaiting command

- The wait time of WS1, WS2, WS3, and WS4 can be set up for every phrase, when creating sound data using Speech LSI Utility.
- About this function, refer to “3. PHRASEn command” in “Description of Command Functions”

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

After inputting the next PHRASEn command(Phrase(n)), a phrase(Phrase(m)) is played back to the last and thePhrase(n) playback is started.

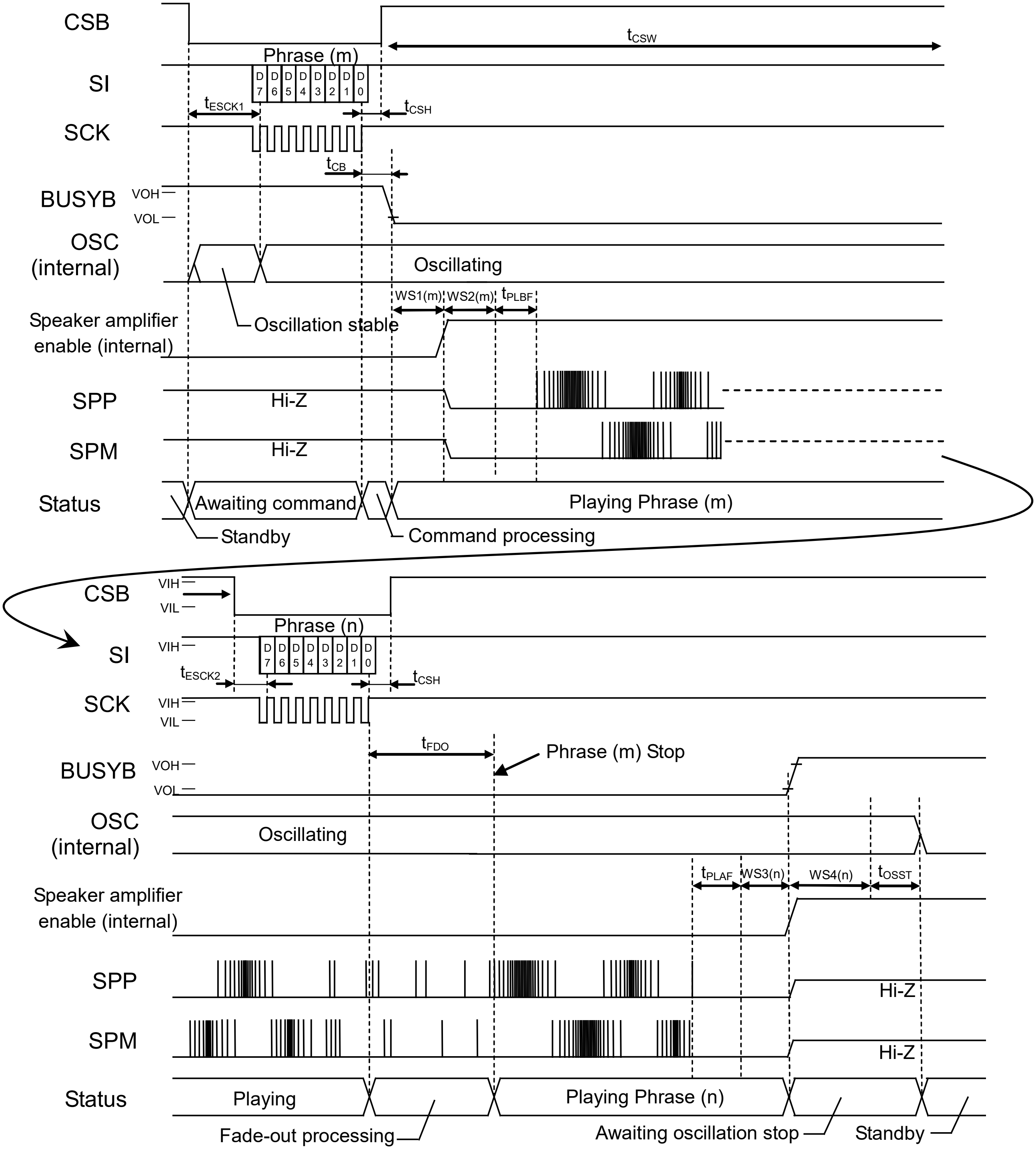

CSB
SI
SCK
BUSYB
OSC (internal)
Speaker amplifier enable (internal)
SPP
SPM
Status
tCSW
tNCM *1
Phrase (m)
Phrase (n)
D7 D6 D5 D4 D3 D2 D1 D0
tESCK1
tCSH
tESCK2
tCB
VOH
VOL
VIH
VIL
Oscillating
Oscillation stable
WS1(m)
WS2(m)
tPLBF
Hi-Z
Awaiting command
Playing Phrase (m)
Standby
Command processing
Playing
Playing Phrase (n)
tPLAF
WS3(n)
WS4(n)
tOSST
Awaiting oscillation stop

- The wait time of WS1, WS2, WS3, and WS4 can be set up for every phrase, when creating sound data using Speech Utility.
- About this function, refer to “3. PHRASEn command” in “Description of Command Functions”

*1: It is applied to the Scheduled Play Once mode. Start the next PHRASEn command within the tNCM. When it can't start, confirm the completion (BUSYB= "H") of the playback. Next, input the next command (PHRASEn command).

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

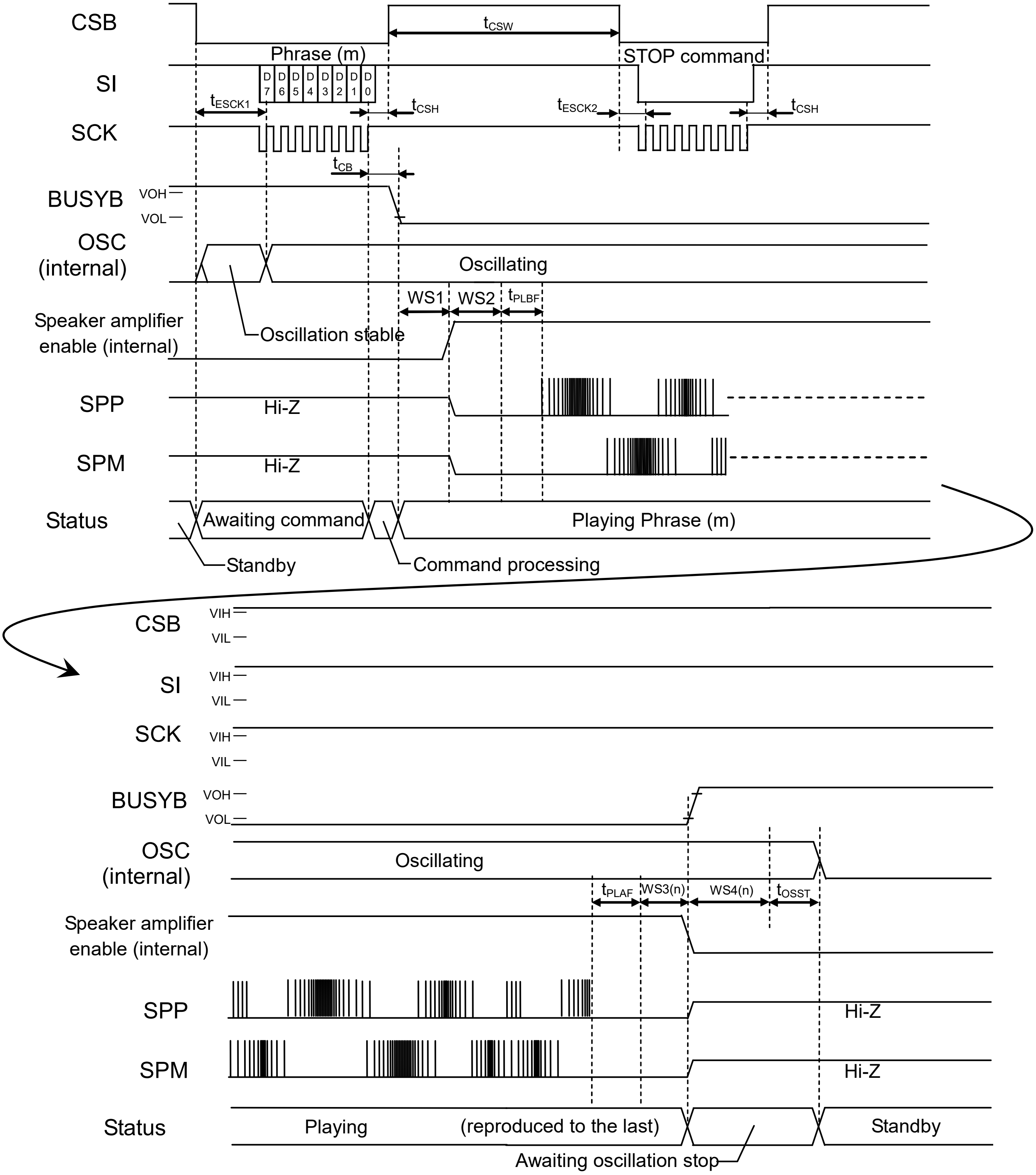
After inputting the next PHRASEn command(Phrase(n)), fade-out of the playback(Phrase(m)) is carried out and thePhrase(n) playback is started.


CSB
SI
SCK
BUSYB
OSC (internal)
Speaker amplifier enable (internal)
SPP
SPM
Status
$t_{CSW}$
Phrase (m)
D7 D6 D5 D4 D3 D2 D1 D0
$t_{ESCK1}$
$t_{CSH}$
$t_{CB}$
VOH
VOL
Oscillating
Oscillation stable
WS1(m)
WS2(m)
$t_{PLBF}$
Hi-Z
Hi-Z
Awaiting command
Playing Phrase (m)
Standby
Command processing
VIH
VIL
Phrase (n)
D7 D6 D5 D4 D3 D2 D1 D0
$t_{ESCK2}$
$t_{CSH}$
$t_{FDO}$
Phrase (m) Stop
Oscillating
$t_{PLAF}$
WS3(n)
WS4(n)
$t_{OSST}$
Hi-Z
Hi-Z
Playing
Playing Phrase (n)
Fade-out processing
Awaiting oscillation stop
Standby

- The wait time of WS1, WS2, WS3, and WS4 can be set up for every phrase, when creating sound data using Speech Utility.
- About this function, refer to “3. PHRASEn command” in “Description of Command Functions”

- Timing which stops the playback in Scheduled Play mode

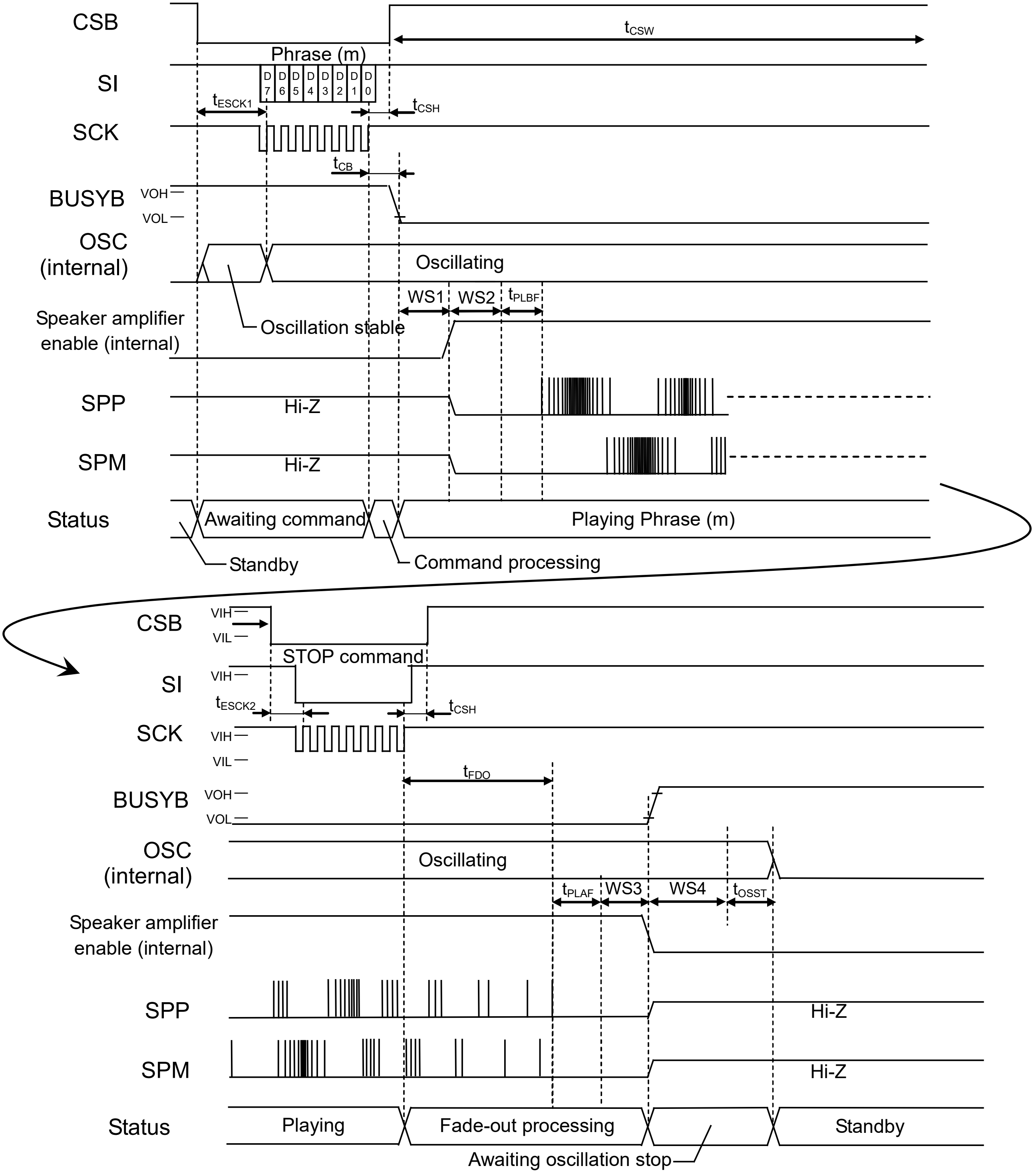
After inputting the STOP command, a phrase is played back to the last and the playback is stopped.


CSB
tCSW
Phrase (m)
STOP command
SI
D7 D6 D5 D4 D3 D2 D1 D0
tESCK1
tCSH
tESCK2
tCSH
SCK
tCB
BUSYB
VOH
VOL
OSC (internal)
Oscillating
Oscillation stable
WS1
WS2
tPLBF
Speaker amplifier enable (internal)
SPP
Hi-Z
SPM
Hi-Z
Status
Awaiting command
Playing Phrase (m)
Standby
Command processing
CSB
VIH
VIL
SI
VIH
VIL
SCK
VIH
VIL
BUSYB
VOH
VOL
OSC (internal)
Oscillating
tPLAF
WS3(n)
WS4(n)
tOSST
Speaker amplifier enable (internal)
SPP
Hi-Z
SPM
Hi-Z
Status
Playing
(reproduced to the last)
Standby
Awaiting oscillation stop

- The wait time of WS1, WS2, WS3, and WS4 can be set up for every phrase, when creating sound data using Speech Utility.
- Confirm the completion (BUSYB= "H") of the playback after input of a STOP command. Next, input the next command (PHRASEn command).
- About this function, refer to “3. PHRASEn command” in “Description of Command Functions”

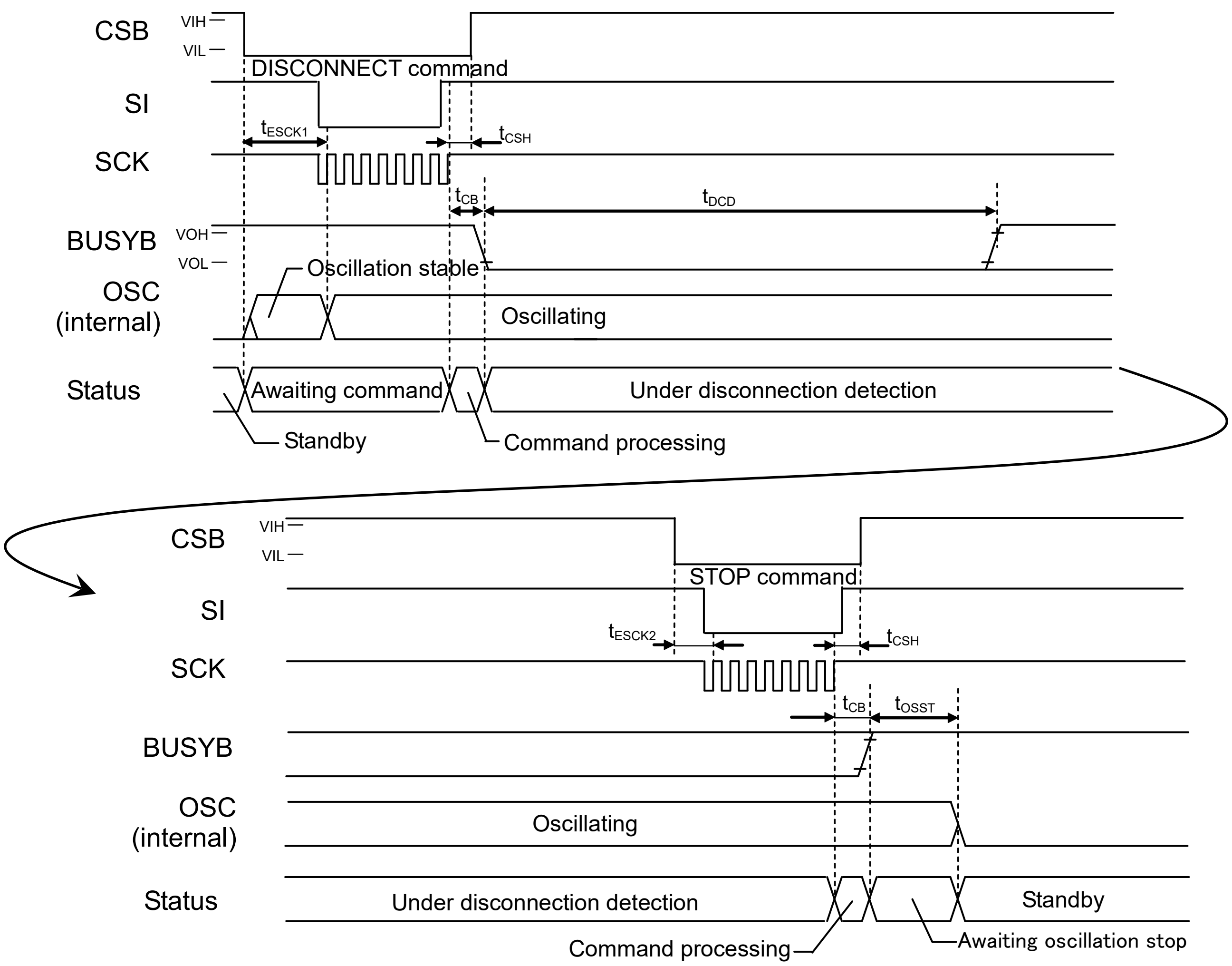
- Timing which stops the playback in Change Immediately mode and Change Immediately Once mode

After inputting the STOP command, fade-out of the playback is carried out and the playback is stopped.

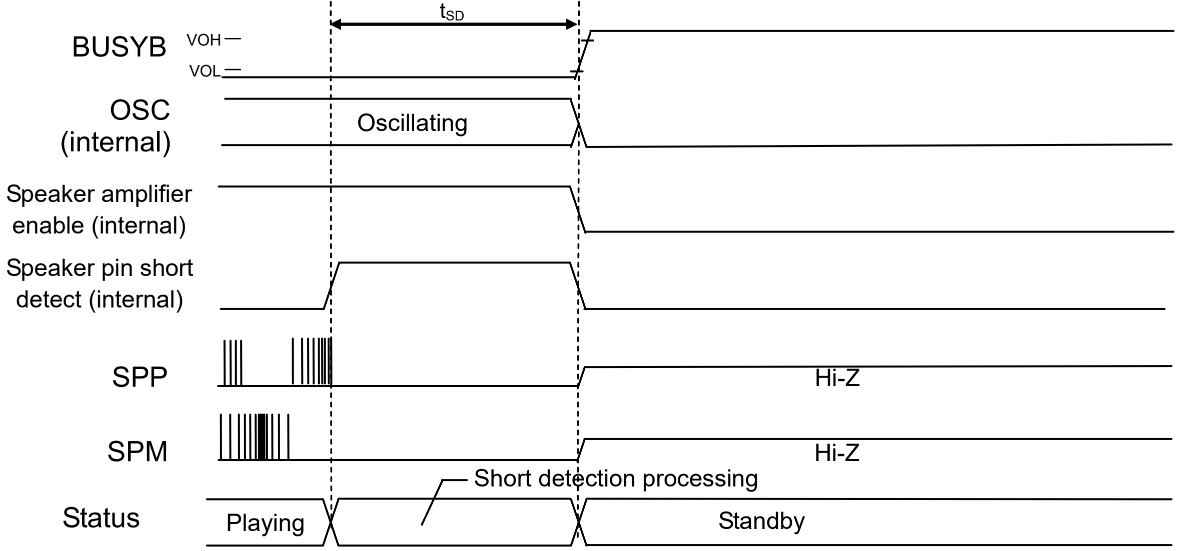

CSB
SI
SCK
BUSYB
VOH
VOL
OSC (internal)
Speaker amplifier enable (internal)
SPP
SPM
Status
Phrase (m)
D7 D6 D5 D4 D3 D2 D1 D0
$t_{CSW}$
$t_{ESCK1}$
$t_{CSH}$
$t_{CB}$
Oscillating
Oscillation stable
WS1
WS2
$t_{PLBF}$
Hi-Z
Hi-Z
Awaiting command
Playing Phrase (m)
Standby
Command processing
CSB
VIH
VIL
STOP command
SI
$t_{ESCK2}$
$t_{CSH}$
SCK
$t_{FDO}$
BUSYB
VOH
VOL
OSC (internal)
Oscillating
$t_{PLAF}$
WS3
WS4
$t_{OSST}$
Speaker amplifier enable (internal)
SPP
SPM
Hi-Z
Hi-Z
Status
Playing
Fade-out processing
Standby
Awaiting oscillation stop

- The wait time of WS1, WS2, WS3, and WS4 can be set up for every phrase, when creating sound data using Speech Utility.
- Confirm the completion (BUSYB= "H") of the playback after input of a STOP command. Next, input the next command (PHRASEn command).
- About this function, refer to “3. PHRASEn command” in “Description of Command Functions”

- Disconnection detection Timing


CSB
VIH
VIL
DISCONNECT command
SI
tESCK1
tCSH
SCK
tCB
tDCD
BUSYB
VOH
VOL
Oscillation stable
OSC (internal)
Oscillating
Status
Awaiting command
Under disconnection detection
Standby
Command processing
CSB
VIH
VIL
STOP command
SI
tESCK2
tCSH
SCK
tCB
tOSST
BUSYB
OSC (internal)
Oscillating
Status
Under disconnection detection
Standby
Command processing
Awaiting oscillation stop

- Speaker pin short detection Timing


tSD
BUSYB
VOH
VOL
OSC (internal)
Oscillating
Speaker amplifier enable (internal)
Speaker pin short detect (internal)
SPP
Hi-Z
SPM
Hi-Z
Short detection processing
Status
Playing
Standby

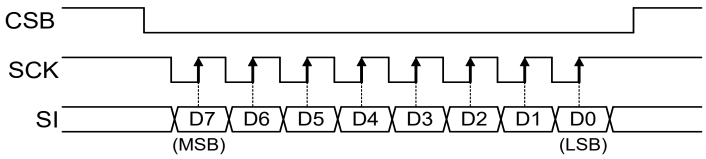
## ■ FUNCTIONAL DESCRIPTION

### ● Synchronous Serial Command Interface

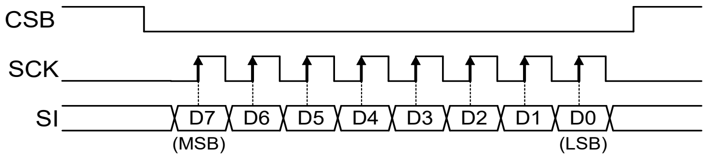
The CSB, SCK, SI pins are used to input the command data. Driving the CSB pin to “L” level enables the serial CPU interface. After the CSB pin is driven to “L” level, the command data are input through the SI pin from the MSB or LSB synchronized with the SCK clock. The command data shifts in through 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.
The initial value of the SCK pin can be chosen by the mask option of Speech Utility. When setting the initial value of the SCK pin as "H" level, please choose “Nomal ("H" Level)” as a mask option. When setting the initial value of the SCK pin as "L" level, please choose “Reversal("L" Level)” as a mask option.
After a command input should return the CSB pin to "H" level.

Data input timing

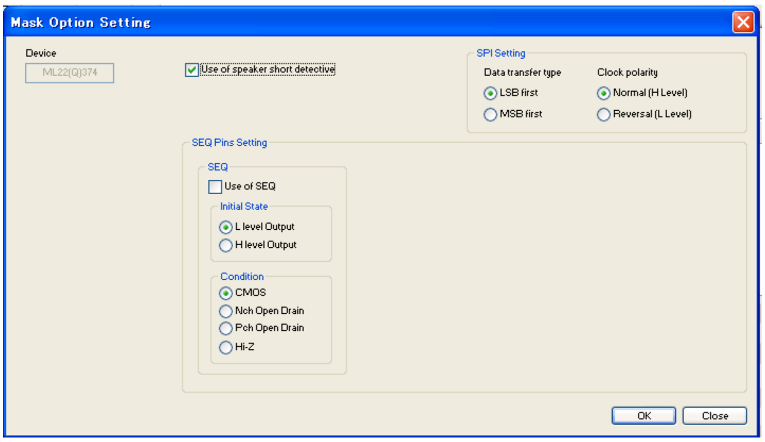
•Nomal(“H” Level)



•Reversal(“L” Level)



The synchronous serial interface option can be set up on the option screen of Speech Utility shown in figure .1.


Mask Option Setting

Device: ML22(Q)374

☑ Use of speaker short detective

SPI Setting
Data transfer type: ● LSB first ○ MSB first
Clock polarity: ● Normal (H Level) ○ Reversal (L Level)

SEQ Pins Setting
SEQ
☐ Use of SEQ
Initial State: ● L level Output ○ H level Output
Condition: ● CMOS ○ Nch Open Drain ○ Pch Open Drain ○ Hi-Z

Figure .1 The option screen of Speech Utility

## ● Command List

Each command is configured by the unit of byte (8-bit).

| Command | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Description |
|---|---|---|---|---|---|---|---|---|---|
| STOP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Stop command.<br>The STOP command becomes effective except the phrase in Play Once mode and Scheduled Play Once mode. |
| DISCONNECT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Disconnection detection command.<br>Please input the STOP command, after you use the DISCONNECT command. |
| PHRASE2 | V2 | V1 | V0 | 0 | 0 | 0 | 1 | 0 | Phrase command |
| PHRASE3 | V2 | V1 | V0 | 0 | 0 | 0 | 1 | 1 | |
| | | | ⋮ | | | | | | |
| PHRASE31 | V2 | V1 | V0 | 1 | 1 | 1 | 1 | 1 | |

## ● Voice Synthesis Algorithm

Four types of voice synthesis algorithm are supported. They are 4-bit ADPCM2, 8-bit non-linear PCM, 8-bit straight PCM and 16-bit straight PCM. Select the best one according to the characteristics of voice.

The following table shows key features of each algorithm.

| Voice synthesis algorithm | Applied waveform | Feature |
|---|---|---|
| 4-bit ADPCM2 | Normal voice waveform | Up version of LAPIS Semiconductor's specific voice synthesis algorithm (: 4-bit ADPCM).<br>Voice quality is improved. |
| 8-bit Nonlinear PCM | Waveform including high frequency signals (sound effect, etc.) | Algorithm, which plays back mid-range of waveform as 10-bit equivalent voice quality. |
| 8-bit straight PCM | | Normal 8-bit PCM algorithm |
| 16-bit straight PCM | | Normal 16-bit PCM algorithm |

- Memory Allocation and Creating Voice Data

The ROM is partitioned into four data areas: voice (i.e., phrase) control area, test area, voice area, and edit ROM area.
The voice control area manages the voice data in the ROM. It contains data for controlling the start/stop addresses of voice data for 1,024 phrases, use/non-use of the edit ROM function and so on.
The test area contains data for testing.
The voice area contains actual waveform data.
The edit ROM area contains data for effective use of voice data. For the details, refer to the section of "Edit ROM Function."
The edit ROM area is not available if the edit ROM is not used.

The ROM data is created using a dedicated tool.

Configuration of ROM data

| | |
|---|---|
| 0x00000<br>0x01FFF | Prohibition of use area<br>(Fixed 64 Kbits) |
| 0x02000<br>max.0x0FBFF | Voice area 2 |
| 0x0FFFF<br>max.0x0FBFF | Edit ROM area<br>Depends on creation<br>of ROM data. |
| 0x0FC00<br>0x0FFFF | Test area |
| 0x10000<br>0x101FF | Voice control area<br>(Fixed 4 Kbits) |
| 0x10200<br>0x17FFF | Voice area 1 |

- Playback Time and Memory Capacity

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

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

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

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

$$\text{Playback time} = \frac{1.024 \times 692\ [\text{Kbits}]}{8\ [\text{kHz}] \times 4\ [\text{bits}]} \cong 22.1\ [\text{sec}]$$

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

- Edit ROM Function

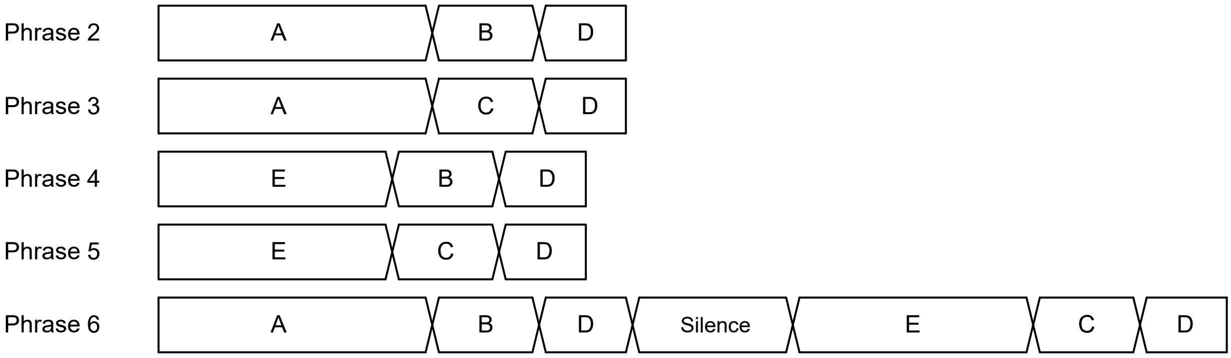
The edit ROM function makes it possible to play back multiple phrases in succession. The following functions are set using the edit ROM function:

| | |
|---|---|
| ・Continuous playback: | There is no limit to set the number of times of the continuous playback. It depends on the memory capacity only. |
| ・Silence insertion function: | 20ms to 1,024 ms |

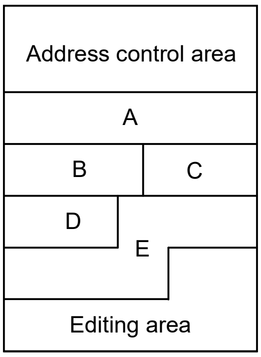
Note: Silent insertion time varies for ±1ms by the sampling frequency

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

Example 1) Phrases using the Edit ROM Function


Phrase 2
A
B
D
Phrase 3
A
C
D
Phrase 4
E
B
D
Phrase 5
E
C
D
Phrase 6
A
B
D
Silence
E
C
D

Example 2) Structure of the ROM that contents of Example 1 are stored

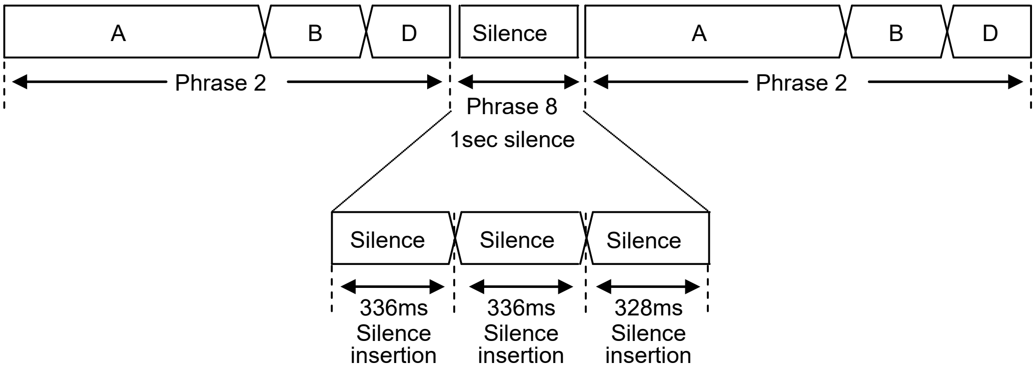

Address control area
A
B
C
D
E
Editing area

- Notice of silence insertion function

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

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

The phrase to playback (The phrase 2 is playbacked twice on both sides of 1 sec silence.)


A
B
D
Silence
A
B
D
Phrase 2
Phrase 8
1sec silence
Phrase 2
Silence
Silence
Silence
336ms
Silence
insertion
336ms
Silence
insertion
328ms
Silence
insertion

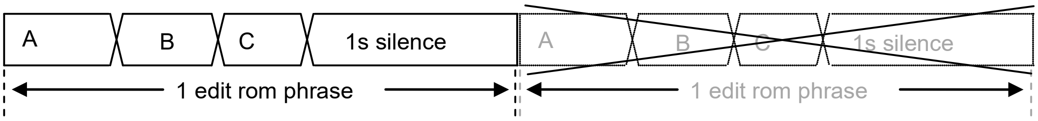
1 sec which is constituted by the three silences is registered as the phrase 8.

- Notice of the silence insertion function, which a "Mute Time" was used for.

When "Mute Time" is used at the end of phrase , the continuous playback of that phrase isn't done.
Modify it to the sound which "Mute Time" was used for and the silence voice data in the case of the continuous playback mode.

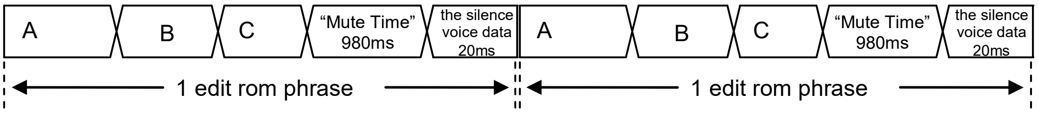
Example 4) Phrase coposition in the case of countinuous playback using silence insertion function

The case of continuous playback using Scheduled play mode.


A
B
C
1s silence
A
B
C
1s silence
1 edit rom phrase
1 edit rom phrase

When "Mute Time"(1s silence) is used at the end of phrase, the continuous playback of that phrase isn't done.

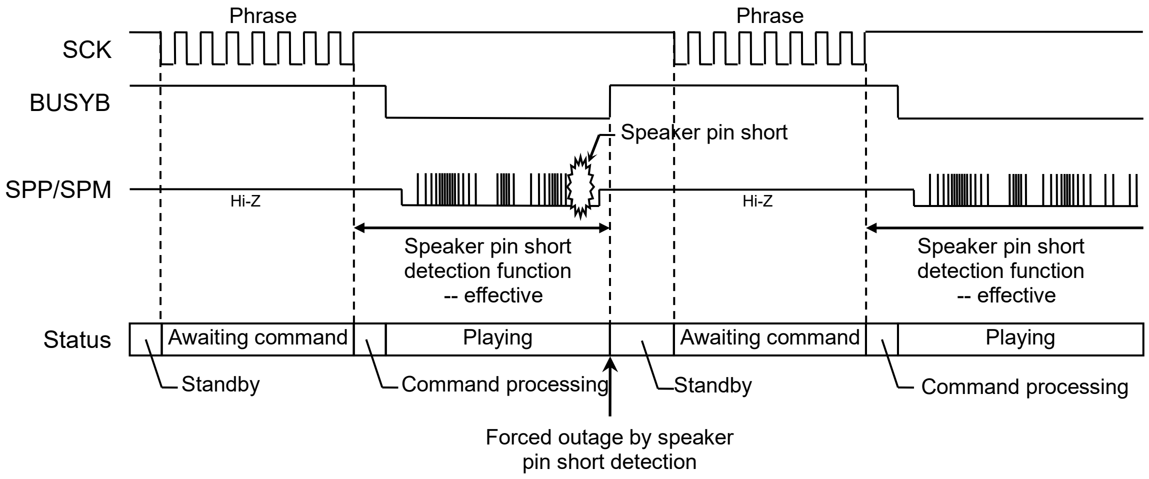
Change "Mute Time"(1s silence) to the combination of " "Mute Time"(980ms silence) and the silence voice data*1 of 20ms".


A
B
C
"Mute Time"
980ms
the silence
voice data
20ms
A
B
C
"Mute Time"
980ms
the silence
voice data
20ms
1 edit rom phrase
1 edit rom phrase

*1：The data that sound-less was made by the voice data are the silence voice data.
In the case of 20ms, it can be realized with 128Byte by choosing sampling frequency 6.4kHz, the 8bit PCM mode.

- 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.
In addition, this function can be set up with the option screen of Speech Utility.
Please refer to a "Mask Option Setting setting item" for the option screen of Speech Utility.


Phrase
Phrase
SCK
BUSYB
Speaker pin short
SPP/SPM
Hi-Z
Hi-Z
Speaker pin short detection function -- effective
Speaker pin short detection function -- effective
Status
Awaiting command
Playing
Awaiting command
Playing
Standby
Command processing
Standby
Command processing
Forced outage by speaker pin short detection

- Description of Command Functions

## 1. STOP command

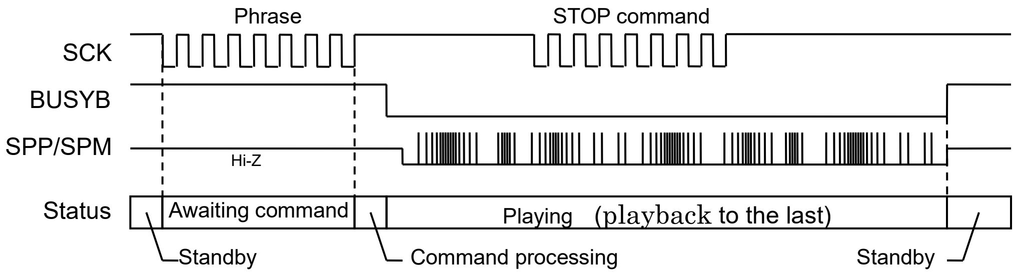
|  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| ・command | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The STOP command is used to stop the playback. BUSYB pin will become "H", if the playback is stopped.
The STOP command becomes effective except the phrase in Play Once mode and Scheduled Play Once mode.
When you use Play Once mode or Scheduled Play Once mode, the STOP command is ignored.

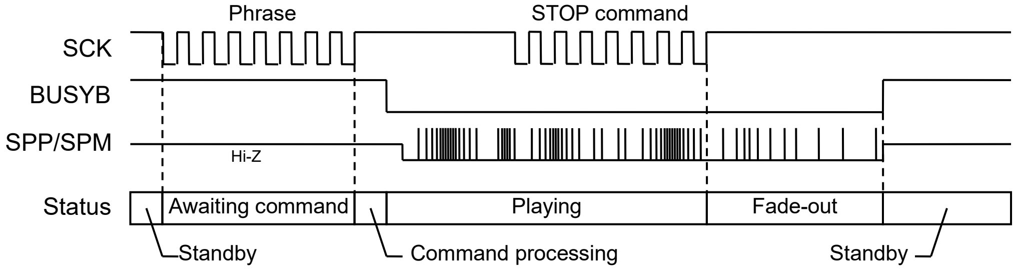
When you use Scheduled Play mode, a phrase is played back to the last and the playback is stopped, after the STOP command is inputted. Furthermore, when you use Change Immediately Once mode or Change Immediately mode, fade-out of the playback is carried out and the playback is stopped, after the STOP command is inputted.

Confirm the completion (BUSYB= "H") of the playback after input of a STOP command. Next, input the next command (PHRASEn command).

・STOP command operation in the case of Scheduled Play mode


Phrase
STOP command
SCK
BUSYB
SPP/SPM
Hi-Z
Status
Awaiting command
Playing (playback to the last)
Standby
Command processing
Standby

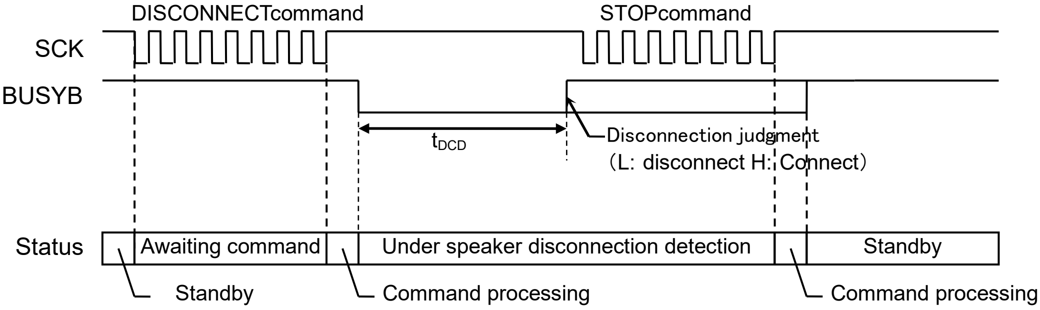
・STOP command operation in the case of Change Immediately Once mode or Change Immediately mode


Phrase
STOP command
SCK
BUSYB
SPP/SPM
Hi-Z
Status
Awaiting command
Playing
Fade-out
Standby
Command processing
Standby

2. DISCONNECT command

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ・command | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

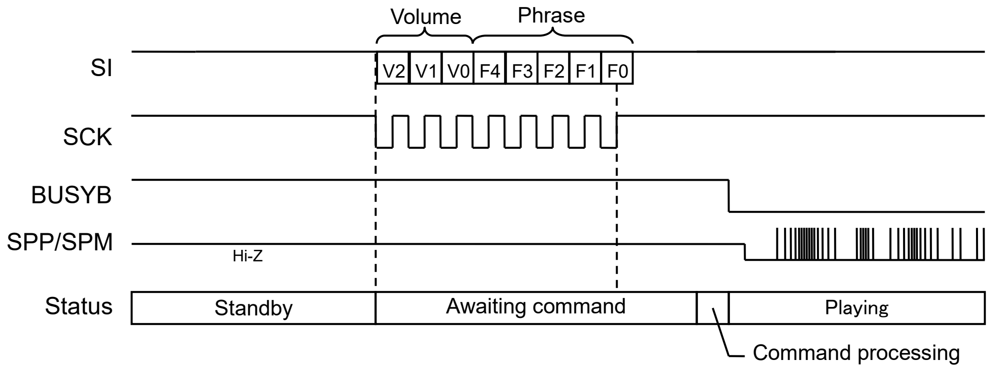
The DISCONNECT command is used to diagnose whether the speaker is disconnected or not. When the speaker is disconnected, BUSYB pin outputs "L". Please input the STOP command, after you use the DISCONNECT command.


DISCONNECTcommand
STOPcommand
SCK
BUSYB
$t_{DCD}$
Disconnection judgment
（L: disconnect H: Connect）
Status
Awaiting command
Under speaker disconnection detection
Standby
Standby
Command processing
Command processing

### 3. PHRASEn (n = 2 to 31) command

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ・command | V2 | V1 | V0 | F4 | F3 | F2 | F1 | F0 |

The PHRASEn (n = 2 to 31) command is used to start playback phrase. When you create the voice data, please set up the phrase address using Speech Utility.
The timing in the case of the playback a phrase address below is shown.

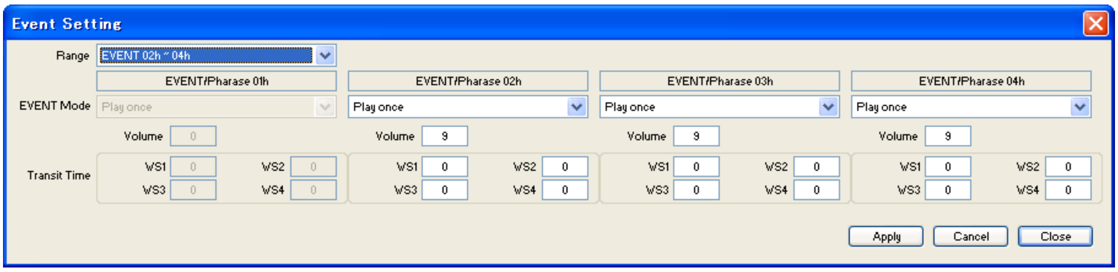

Volume
Phrase
SI
V2
V1
V0
F4
F3
F2
F1
F0
SCK
BUSYB
SPP/SPM
Hi-Z
Status
Standby
Awaiting command
Playing
Command processing

The PHRASEn(n=2 to 31) command can perform a volume setup.
When V2-V0 is “000”, the volume setup of voice cntrol area is used.

| V2 | V1 | V0 | Volume [dB] |
|---|---|---|---|
| 0 | 0 | 0 | The volume setup of voice control area 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

Each phrase can set up the wait time before and after playback, a volume setup, and playback mode using Speech Utility.



Event Setting

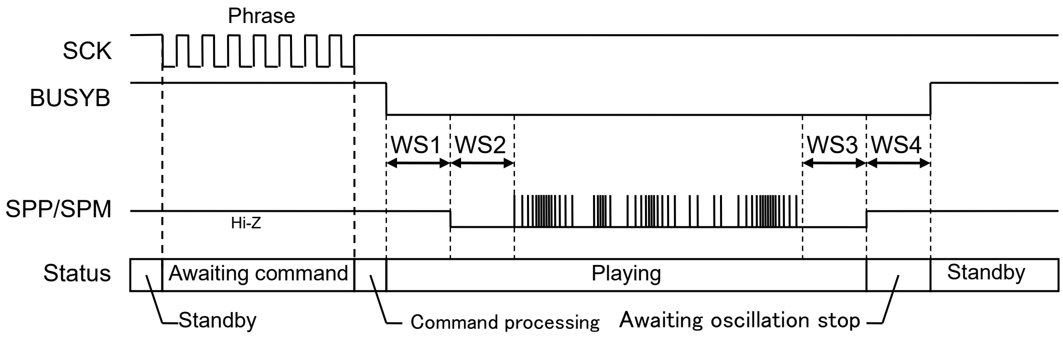
Range: EVENT 02h ~ 04h

| | EVENT/Pharase 01h | EVENT/Pharase 02h | EVENT/Pharase 03h | EVENT/Pharase 04h |
|---|---|---|---|---|
| EVENT Mode | Play once | Play once | Play once | Play once |
| Volume | 0 | 9 | 9 | 9 |
| Transit Time WS1 | 0 | 0 | 0 | 0 |
| Transit Time WS2 | 0 | 0 | 0 | 0 |
| Transit Time WS3 | 0 | 0 | 0 | 0 |
| Transit Time WS4 | 0 | 0 | 0 | 0 |

Figure .2 The option screen for every phrase of Speech Utility

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

Each phrase can set up the wait time before and after playback. Since it is an option setup, change will be impossible once it sets up.



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

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

2) Volume setup (Volume)

Each phrase can set up the volume setup. Since it is an option setup, change will be impossible once it sets up.

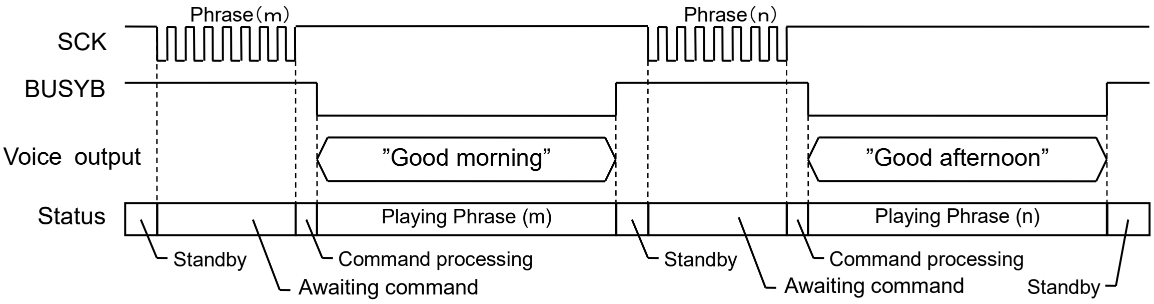
| Value [hex] | Volume [dB] | Value [hex] | Volume [dB] | Value [hex] | Volume [dB] |
|---|---|---|---|---|---|
| 00h | +2.98 | 0Ah | -0.41 | 15h | -6.87 |
| 01h | +2.70 | 0Bh | -0.83 | 16h | -7.79 |
| 02h | +2.40 | 0Ch | -1.28 | 17h | -8.82 |
| 03h | +2.10 | 0Dh | -1.75 | 18h | -9.99 |
| 04h | +1.78 | 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 |

3) Playback mode setup

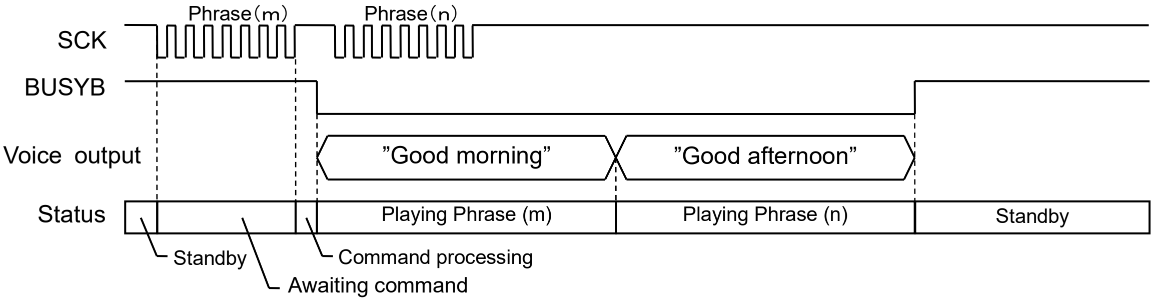
Playback mode can be set up for every phrase. Since it is an option setup, change will be impossible once it sets up.

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

・Play Once mode

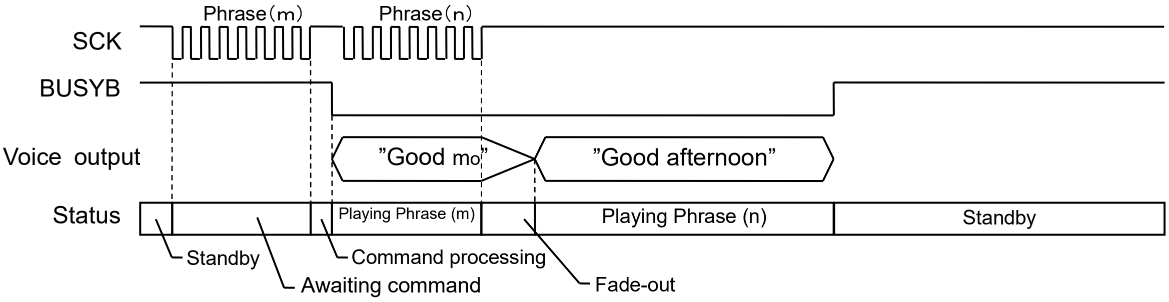

Phrase（m）
Phrase（n）
SCK
BUSYB
Voice output
”Good morning”
”Good afternoon”
Status
Playing Phrase (m)
Playing Phrase (n)
Standby
Command processing
Awaiting command
Standby
Command processing
Awaiting command
Standby

・Scheduled Play Once mode

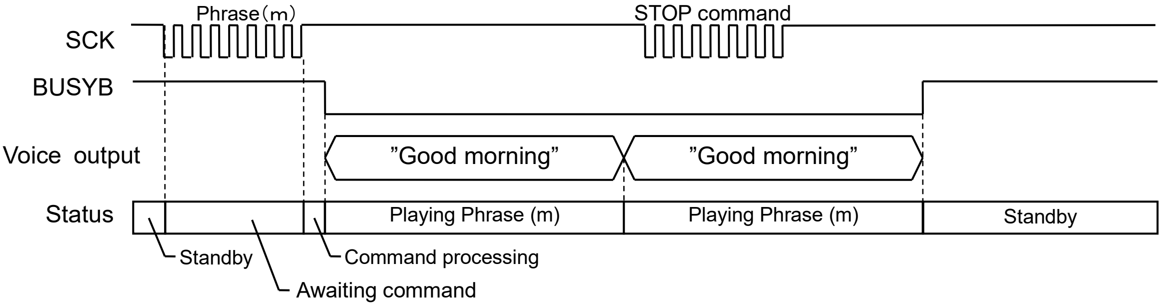

Phrase（m）
Phrase（n）
SCK
BUSYB
Voice output
”Good morning”
”Good afternoon”
Status
Playing Phrase (m)
Playing Phrase (n)
Standby
Standby
Command processing
Awaiting command

Start the next PHRASEn command within the tNCM. When it can't start, confirm the completion (BUSYB= "H") of the playback. Next, input the next command (PHRASEn command).

・Change Immediately Once mode

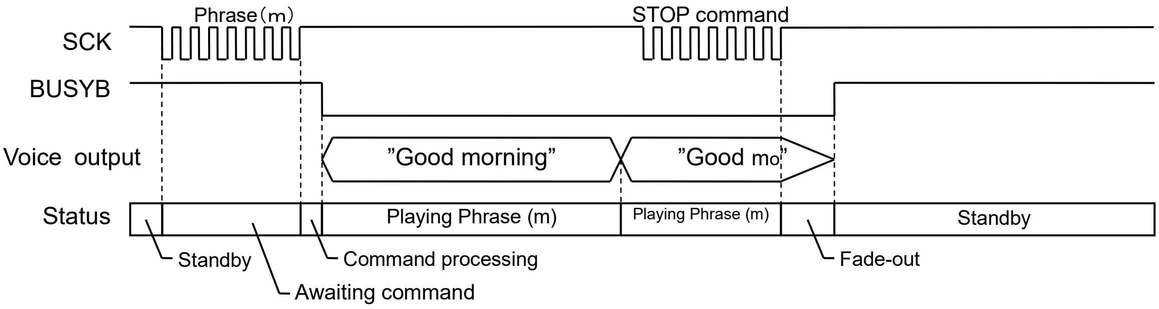

Phrase(m)
Phrase(n)
SCK
BUSYB
Voice output
"Good mo"
"Good afternoon"
Status
Playing Phrase (m)
Playing Phrase (n)
Standby
Standby
Command processing
Awaiting command
Fade-out

・Scheduled Play mode


Phrase(m)
STOP command
SCK
BUSYB
Voice output
"Good morning"
"Good morning"
Status
Playing Phrase (m)
Playing Phrase (m)
Standby
Standby
Command processing
Awaiting command

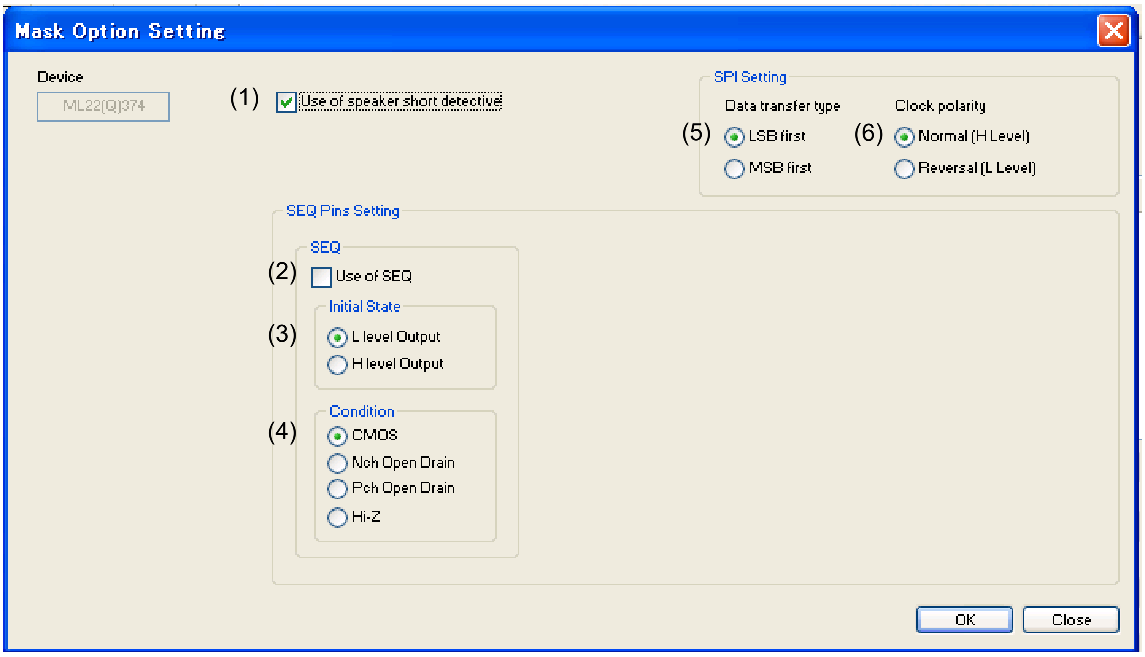
Confirm the completion (BUSYB= "H") of the playback after input of a STOP command. Next, input the next command (PHRASEn command).

・Change Immediately mode


Phrase(m)
STOP command
SCK
BUSYB
Voice output
"Good morning"
"Good mo"
Status
Playing Phrase (m)
Playing Phrase (m)
Standby
Standby
Command processing
Fade-out
Awaiting command

Confirm the completion (BUSYB= "H") of the playback after input of a STOP command. Next, input the next command (PHRASEn command).

- Mask Option Setting



Mask Option Setting

Device: ML22(Q)374

(1) ☑ Use of speaker short detective

SPI Setting

Data transfer type
(5) ● LSB first
○ MSB first

Clock polarity
(6) ● Normal (H Level)
○ Reversal (L Level)

SEQ Pins Setting

SEQ
(2) ☐ Use of SEQ

Initial State
(3) ● L level Output
○ H level Output

Condition
(4) ● CMOS
○ Nch Open Drain
○ Pch Open Drain
○ Hi-Z

Figure .3 The Mask Option Setting screen of Speech Utility

Explanation of each option is shown in the following page.

| Parameter | Function | Explanation |
|---|---|---|
| (1) Use of speaker short detective | ON or OFF selection of a short detection function | If a check box is turned on, a short detection circuit will become effective. |
| SEQ Pins Setting | Interface setup | |
| SEQ | BUSYB setup | |
| (2) Use SEQ | Use or unuse selection of BUSYB | If a check box is turned on, a BUSYB pin can be used. If a check box is turned off, a BUSYB pin does not function but the fixed output of the initial value is carried out. |
| (3) Initial State | Initial output level selection of BUSYB | The initial value of a BUSYB pin at voice stop can be chosen. |
| L Level Output | L Level Output | The "L" level is outputted at voice stop. "H" level is outputted at speech playback. |
| H Level Output | H Level Output | The "H" level is outputted at voice stop. "L" level is outputted at speech playback. |
| (4) Condition | BUSYB condition setup | BUSYB condition can be chosen. |
| CMOS | CMOS output | A BUSYB pin become a CMOS output. Usually, please use this setup. |
| Nch Open Drain | Nch Open Drain output | The "L" level is outputted at the “L” level. High impedance is outputted at the H" level. |
| Pch Open Drain | Pch Open Drain output | The "H" level is outputted at the “H” level. High impedance is outputted at the L" level. |
| Hi-Z | High impedance output | High impedance is always outputted. When BUSYB use mode is set up, please do not use it. |
| SPI Setting | Synchronous Serial Interface | |
| (5) Data transfer type | Data input format | Data input format can be chosen from LSB first or MSB first. |
| LSB first | LSB first | Serial data is inputted at LSB first. |
| MSB first | MSB first | Serial data is inputted at MSB first. |
| (6) Clock polarity | Serial Clock setup | The initial value of the SCK pin can be chosen. |
| Nomal(“H” Level) | An initial value is "H" level. | An initial value of the SCK pin is "H" level. |
| Reversal(“L” Level) | An initial value is "L" level. | An initial value of the SCK pin is "L" level. |

## ■ Termination of the $V_{DDL}$ Pin

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

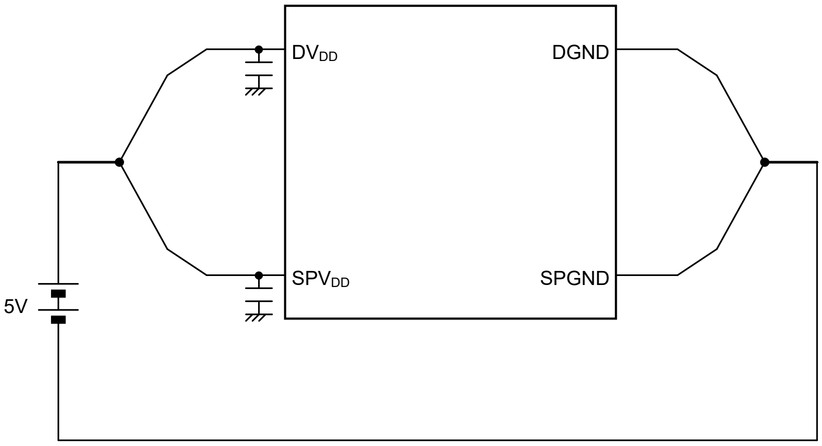
| Pin | Recommended capacitance value | Remarks |
|---|---|---|
| $V_{DDL}$ | 10 μF ±20% | The larger the connection capacitance, the longer the settling time. |

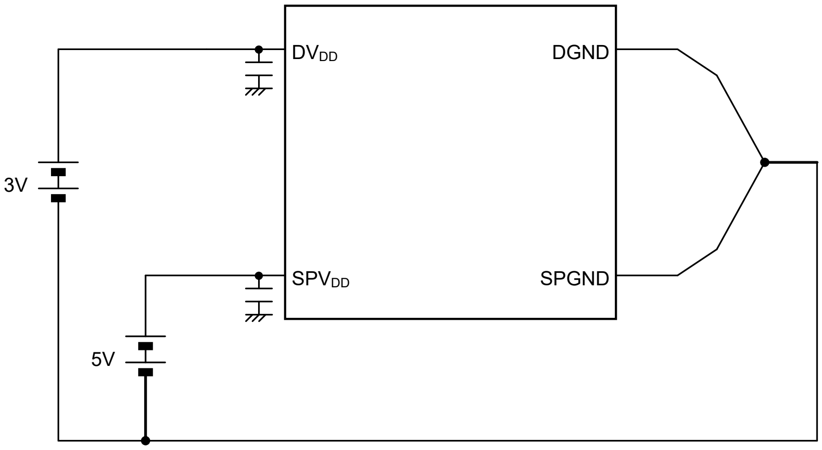
## ■ POWER SUPPLY WIRING

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

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

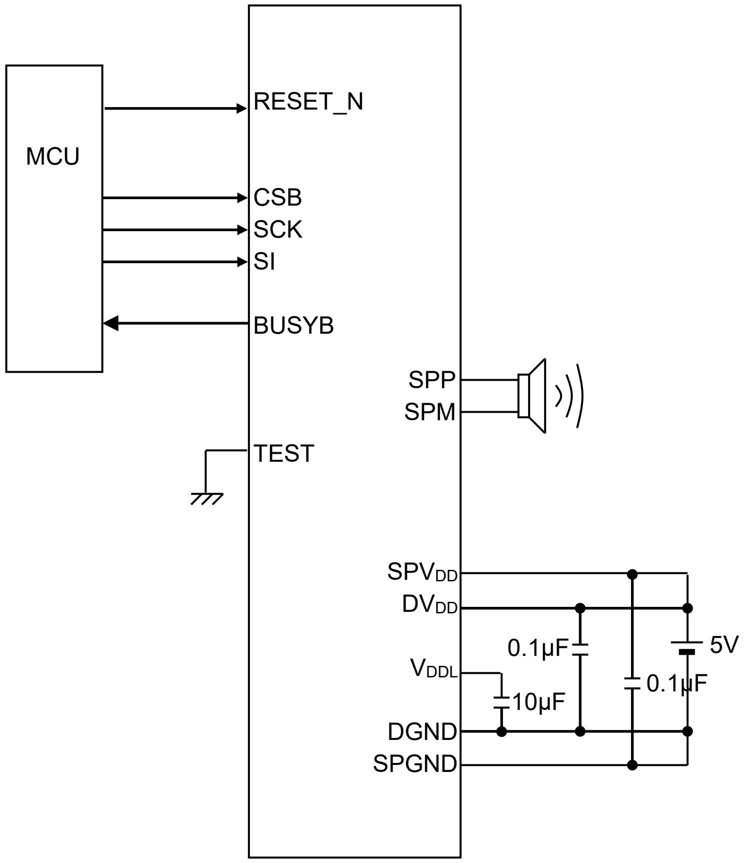
The example of power connection is shown below.





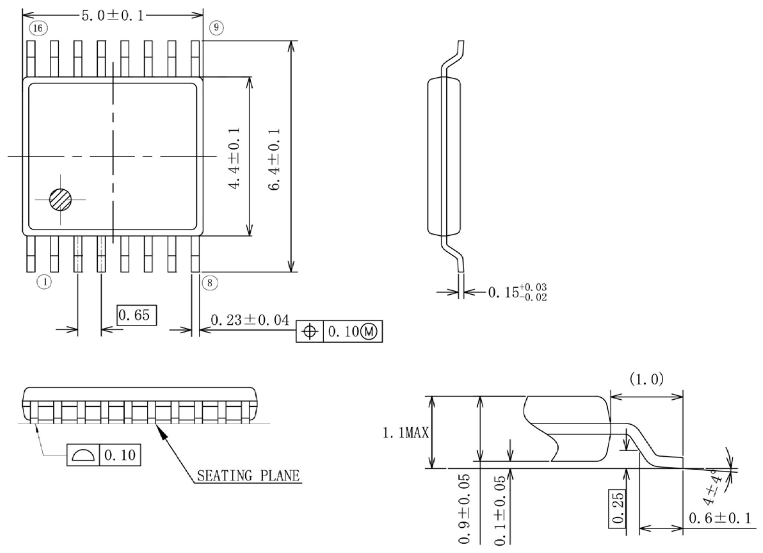
- Turn on $DV_{DD}$ and $SPV_{DD}$ simultaneously, or turn on $SPV_{DD}$ after turning on $DV_{DD}$.
- Turn off $DV_{DD}$ and $SPV_{DD}$ simultaneously, or turn off $DV_{DD}$ after turning on $SPV_{DD}$.

## ■ APPLICATION CIRCUIT


MCU
RESET_N
CSB
SCK
SI
BUSYB
TEST
SPP
SPM
SPVDD
DVDD
VDDL
DGND
SPGND
0.1µF
10µF
0.1µF
5V

## ■ PACKAGE DIMENSIONS (16-pin plastic TSSOP)

(Unit: mm)



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.

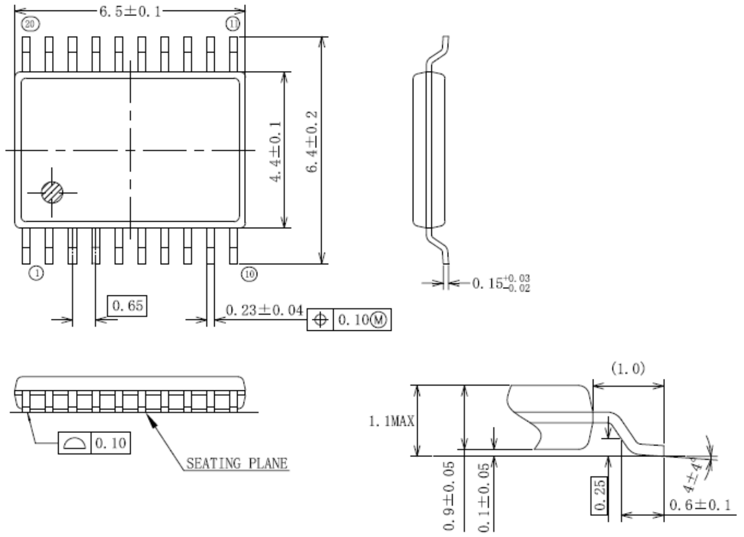
| LAPIS Technology Co., Ltd. | | | |
|---|---|---|---|
| PACKAGE CODE | P-TSSOP16-0225-0.65-TK6 | | |
| PACKAGE MATERIAL | EPOXY RESIN | UNIT | mm |
| LEAD FLAME MATERIAL | Cu ALLOY | DWG No. | QSL-69603 |
| LEAD FINISH | Sn | REVISION | 1 |
| SOLDER THICKNESS | MORE THAN 5μm | 1st ISSUE | Dec/22/2021 |
| PACKAGE MASS (g) | 0.064TYP. | REVISED | |

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).

## ■ PACKAGE DIMENSIONS (20-pin plastic TSSOP)

(Unit: mm)



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).

## ■ Revision History

| Document No. | Date | Page | | Description |
|---|---|---|---|---|
| | | Previous Edition | Current Edition | |
| FEDL22Q374FULL-01 | Oct. 23, 2012 | – | – | Final edition 1 |
| FEDL22Q374-02 | Jun. 06, 2014 | 21 | 21 | Add the Notice of silence insertion function |
| FEDL22Q374-03 | Mar. 16, 2015 | 8 | 8 | Modify the explanation of tNCM. |
| | | 12 | 12 | Add the $t_{CSW}$.<br>Add the notice of the next PHRASEn command input. |
| | | 13 | 13 | Add the $t_{CSW}$. |
| | | 14 | 14 | Add the $t_{CSW}$.<br>Add the notice of the next PHRASEn command input. |
| | | 15 | 15 | Add the $t_{CSW}$.<br>Add the notice of the next PHRASEn command input. |
| | | 19 | 19 | Add the notice of minimam playback time. |
| | | 21 | 21 | Add the notice of the silence insertion function. |
| | | 23 | 23 | Add the notice of the next PHRASEn command input. |
| | | 27-28 | 27-28 | Add the notice of the next PHRASEn command input. |
| FEDL22Q374-04 | Apr. 01, 2016 | 2 | 2 | Deleted ML22330/ML22Q330 and ML22Q384. |
| FEDL22Q374-05 | Oct. 31, 2017 | 2 | 2 | Modify the Sampling frequency. |
| | | 5 | 5 | Modify the BUSYB. |
| | | 30 | 30 | Modify the Initial output level selection of BUSYB. |
| FEDL22Q374-06 | Jul. 31, 2019 | 1 | 1 | Add 20pin TSSOP and ML22Q374-NNN/ML22Q374-xxxTD<br>Add Plan to qualify AEC-Q100 |
| | | 2 | 2 | Add 20pin TSSOP |
| | | 3 | 3 | Add ML22Q374-NNNTD/ML22Q374-xxxTD |
| | | 4 | 4 | Add 20pin TSSOP |
| | | 5 | 5 | Add 20pin assign |
| | | 33 | 33 | Add 16pin SSOP |
| | | 34 | 34 | Add pakage dimensions to 20 PIN TSSOP |
| FEDL22Q374-07 | May. 17, 2021 | 1 | 1 | Add ML22Q374P to Product name<br>Add ML22Q374P to Operating temperature range<br>Modify AEC-Q100 Plan to AEC-Q100 Compliant<br>Add ML22Q374P-NNNTD/ML22Q374P-xxxTD to Product name |
| | | 2 | 2 | Add ML22Q374P, ML22Q394P to a table |
| | | 3 | 3 | Add ML22Q374P-NNNTD/ML22Q374P-xxxTD |
| | | 4 | 4 | Add ML22Q374P-NNNTD/ML22Q374P-xxxTD to 20-Pin Plastic TSSOP |
| | | 6 | 6 | Add ML22Q374P to Operating temperature of RECOMMENDED OPERATING CONDITIONS |
| | | 7 | 7 | Add ML22Q374P to Operating Condition<br>Add Ta ≤ +105°C to Standby supply current, Ta = -40 to +105°C to Source oscillation frequency<br>Add ML22Q374P to Speaker amplifier output power |
| | | 8 | 8 | Add ML22Q374P to Operating Condition |
| | | 25 | 25 | Add the note of the volume |
| | | 33 | 33 | Modify P-SSOP16-0225-0.65-UK to P-SSOP16-0225-0.65-SK |

| Document No. | Date | Page | | Description |
|---|---|---|---|---|
| | | Previous Edition | Current Edition | |
| FEDL22Q374-08 | Feb. 9, 2024 | – | – | Changed 16-Pin SSOP to 16-Pin TSSOP.<br>Format name from ML22Q374-NNNMB/ML22Q374-xxxMB to ML22Q374-NNNTP/ ML22Q374-xxxTP |
| | | – | 2 | Added application information. |
| | | 1 | 2 | Changed shipping form to table format. |
| | | 33 | 34 | Modify P-SSOP16-0225-0.65-SK to P-TSSOP16-0225-0.65-TK6 |
| | | 36 | 38 | Revised the Note. |

Notes

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