



# ML22361/362/363/364/Q364

# Preliminary

## OKI ADPCM Speech Synthesis LSI

### GENERAL DESCRIPTION

The ML22360 family, which include mask ROM and Flash memory for storing speech data, respectively, are speech synthesis LSIs which can controll speech playback utilizing an event input system. It includes 16bit DA Converter and low-pass filter, so it is possible to have high quality sound and solution for playback.

### FEATURES

- Playback Time

Product Name	Capacitance of ROM(bit)	Maximum Playback time(s) (Fsam=8.0kHz)	
		4bitADPCM2	16bitPCM
ML22361	128K	4	1
ML22362	256K	8	2
ML22363	384K	12	3
ML22364/Q364	640K	20	5

- Speech synthesis system: 4-bit ADPCM2  
8-bit/16-bit straight PCM system  
8-bit nonlinear PCM system  
(can be specified for each phrase)
- Speech ROM capacity ML22361: 128-Kbit Mask ROM (TBD)  
ML22362: 256-Kbit Mask ROM (TBD)  
ML22363: 384-Kbit Mask ROM (TBD)  
ML22364: 640-Kbit Mask ROM (TBD)  
ML22Q364: 640-Kbit Flash (TBD)
- Sampling frequency: 8.0/16.0 /32.0kHz, 6.4/12.8/25.6 kHz/, 10.7/21.3 kHz  
(fsam can be specified in units of phrase)
- Analog output: Built-in 16-bit DA converter
- Interface: Event input system (built-in noise elimination function)
- Maximum event count: 30 events
- Input pin setting: High-impedance input (CMOS input), pull-down input, or pull-up input is selectable based on ROM data
- Source oscillation frequency: 4.096 MHz (Typ.)
- Power supply voltage: 2.3V to 5.5V
- Flash memory rewrite cycles: 80 times (ML22Q364)
- Operating temperature range: -40°C to +85°C
- Package: 30-pin plastic SSOP (SSOP30-56-0.65-Z6K)  
16-pin plastic TSSOP (P-TSSOP16-0225-0.65-K3)
- Product name: ML22361-xxxMB (30pinSSOP) , ML22361-xxxMP (16pinTSSOP)  
ML22362-xxxMB (30pinSSOP) , ML22362-xxxMP (16pinTSSOP)  
ML22363-xxxMB (30pinSSOP) , ML22363-xxxMP (16pinTSSOP)  
ML22364-xxxMB (30pinSSOP) , ML22364-xxxMP (16pinTSSOP)  
ML22Q364-NNNMB/ML22Q364-xxxMB (30pinSSOP)  
ML22Q364-NNNMP/ML22Q364-xxxMP (16pinTSSOP)

\* xxx: ROM code number

## DESCRIPTION OF FUNCTIONS

### Event Activation

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

### Edit Phrase

Two or more voice phrases are joined and it can be played continuously. Moreover, the silent section can be inserted between voice phrases.

### Setting of Mask Option

The following table shows the items which can be set by using the Mask option (ROM data):

Parameter	Setting value
EVIN0-4 pin input setting	High-impedance input (CMOS input), pull-up input, or pull-down input selectable (EVIN0 pin can specify only high-impedance input and pull-up input )
Speech synthesis system	4-bit ADPCM2 / 8-bit/16-bit straight PCM system / 8bit nonlinear PCM
Sampling frequency	8.0/16.0 /32.0kHz, 6.4/12.8/25.6 kHz/, 10.7/21.3 kHz
Event execution mode	Play once mode, scheduled play mode and change immediately mode can be selected for each execution event.
Transfer time for pop noise elimination, play start, and power down: WS1 ~ WS4	0 to 1020 ms ((00h~FFh)×4ms) selectable
Delay time / Pulse width of SEQ output pattern: $t_{\text{SEQD}}/t_{\text{SEQW}}$	4 to 1024 ms ((00h~FFh)×4ms+4ms) selectable

And volume setting is as follows.

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

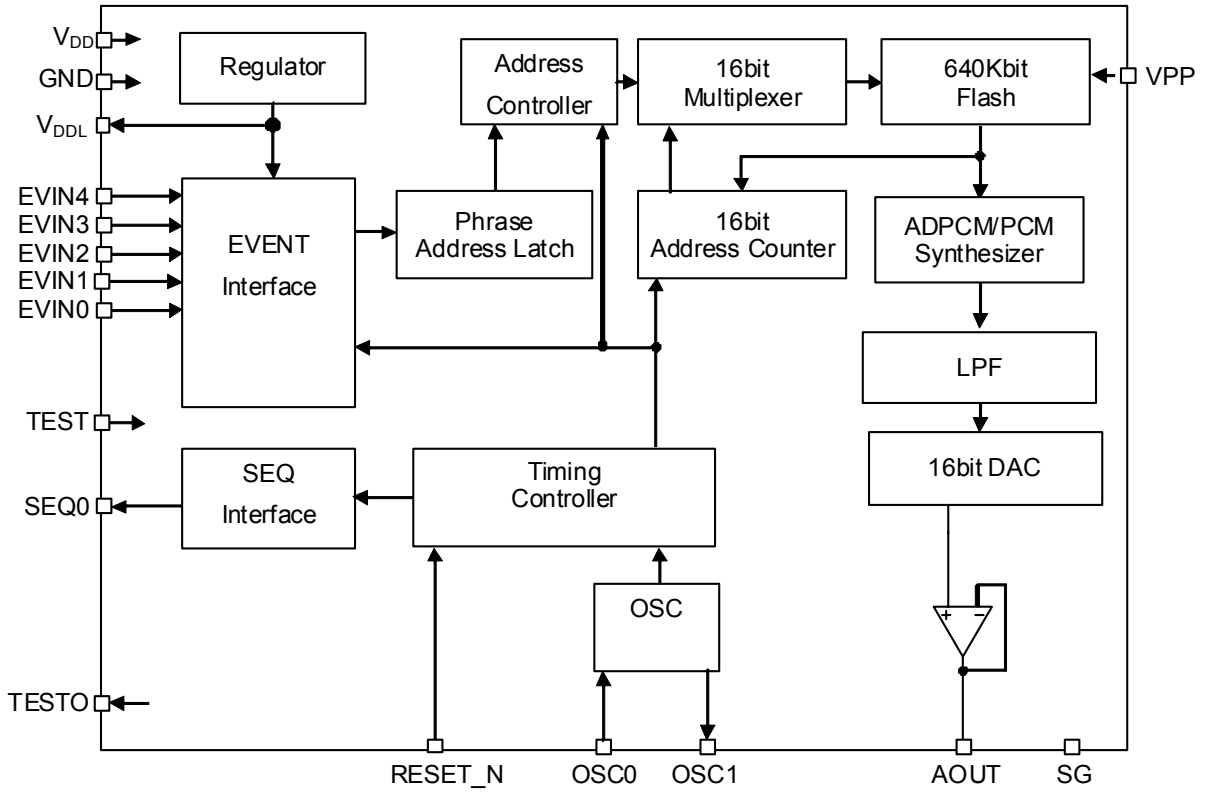
**Event contents**

There are two kinds of event contents, Stop (00h) and Play (02h~1Fh), as follows.

EVENT No.	Input pattern					Contents
	EVIN4	EVIN3	EVIN2	EVIN1	EVIN0	
00h	L	L	L	L	L	Stop
01h	L	L	L	L	H	None
02h	L	L	L	H	L	Play
03h	L	L	L	H	H	↑
04h	L	L	H	L	L	↑
05h	L	L	H	L	H	↑
06h	L	L	H	H	L	↑
07h	L	L	H	H	H	↑
:	:	:	:	:	:	:
:	:	:	:	:	:	:
18h	H	H	L	L	L	↑
19h	H	H	L	L	H	↑
1Ah	H	H	L	H	L	↑
1Bh	H	H	L	H	H	↑
1Ch	H	H	H	L	L	↑
1Dh	H	H	H	L	H	↑
1Eh	H	H	H	H	L	↑
1Fh	H	H	H	H	H	↑

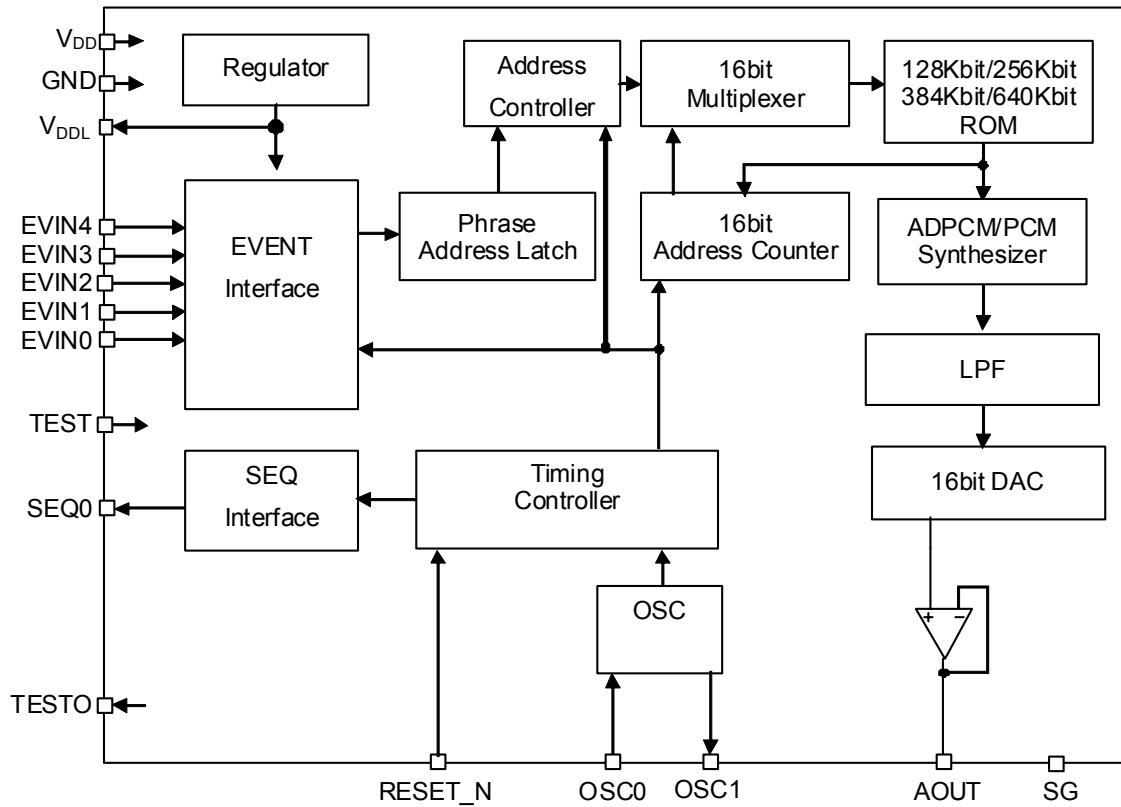
**BLOCK DIAGRAM**

ML22Q364-NNN



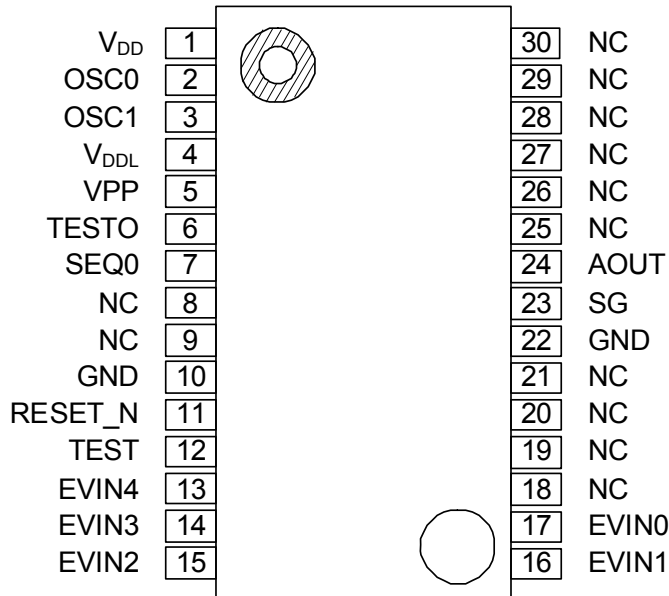
**BLOCK DIAGRAM**

ML22361-xxx/ML22362-xxx/ML22363-xxx/ML22364-xxx



**PIN CONFIGURATION (TOP VIEW)**

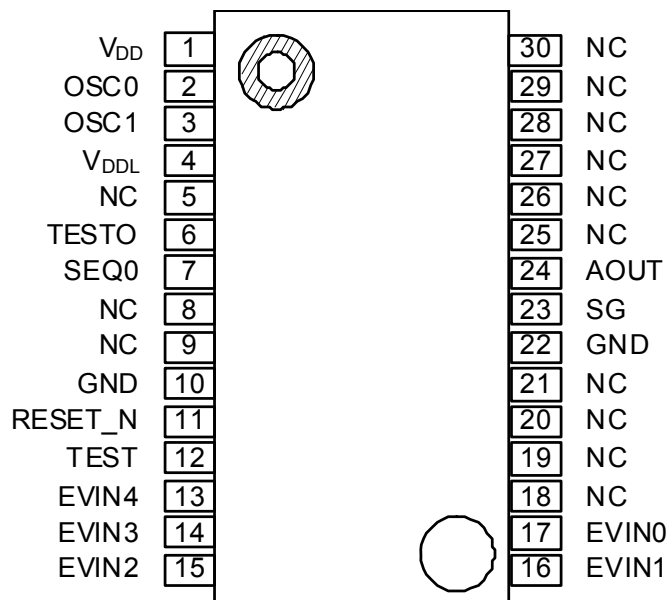
ML22Q364-NNNMB



NC:Unused pin

**30-pin Plastic SSOP**

ML22361-xxxMB/ML22362-xxxMB/ML22363-xxxMB/ML22364-xxxMB

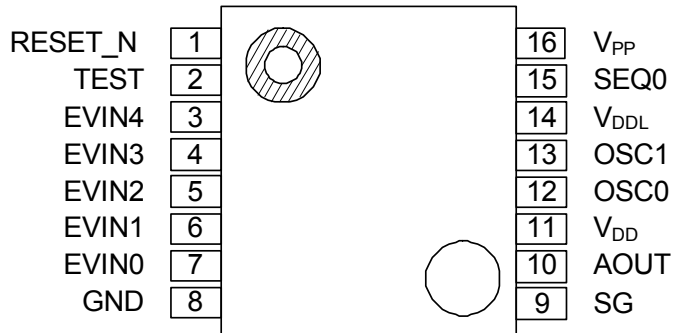


NC:Unused pin

**30-pin Plastic SSOP**

**PIN CONFIGURATION (TOP VIEW)**

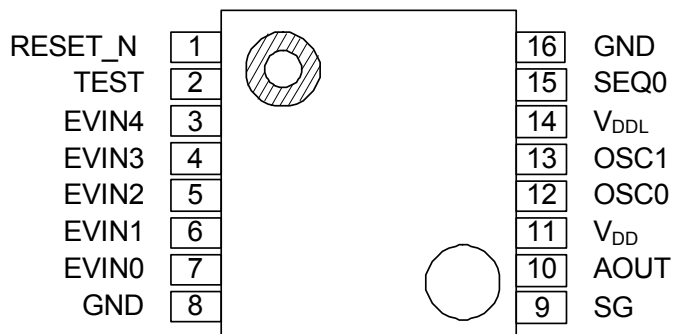
ML22Q364-NNNMP



NC: Unused pin

**16-pin Plastic TSSOP**

ML22361-xxxMP/ML22362-xxxMP/ML22363-xxxMP/ML22364-xxxMP



NC: Unused pin

**16-pin Plastic SSOP**

**PIN DESCRIPTIONS**

30SSOP Pin	16TSSOP Pin	symbol	I/O	Description
11	1	RESET_N	I	Place this pin at a "L" level when powered on. After the supply voltage is settled, place this pin at a "H" level.
17 16 15 14 13	7 6 5 4 3	EVIN0 EVIN1 EVIN2 EVIN3 EVIN4	I	Event specifying input pins. Event execution or stop can be performed by changes in the input signals to the activation pins set by the EVIN0 pin or Mask option Set the unused pins to be pulled up or pulled down.
12	2	TEST	I	Input pin for testing. Fix this pin at a "L" level (GND level).
2	12	OSC0	I	Pin for connecting a crystal or a ceramic vibrator. A feed back resistor (about 1 MΩ) is included between OSC0 and OSC1 pins. When a vibrator is used, place it as close to the LSI as possible.
3	13	OSC1	O	Pin for connecting a crystal or a ceramic vibrator. When a vibrator is used, place it as close to the LSI as possible.
6	-	TESTO	O	Output pin for testing. Keep this pin open.
7	15	SEQ0	O	Sequencer output pins.
8-9,18-21, 25-30	-	NC	O	Unused pins.
24	10	AOUT	O	Playback signal output pin.
5	16	VPP *Note 1	—	Power supply pin for rewriting Flash memory. Fix this pin to GND except when rewriting Flash memory.
1	11	V <sub>DD</sub>	—	Digital power supply pin. Connect a capacitor of 0.1 μF or more between this pin and GND.
4	14	V <sub>DDL</sub>	—	Output pin of the regulator for the internal logic power supply. Connect a electrolytic capacitor of 10 uF or more and a ceramic capacitor of 0.1 μF or more between the V <sub>DDL</sub> and GND pins.
10,22	8	GND	—	Digital ground pin.
23	9	SG	O	Built-in line amplifier's reference voltage output pin. Connect a capacitor of 0.1 μF or more between this pin and GND.

Notes: 1. Applies to ML22Q364-NNN.

**ABSOLUTE MAXIMUM RATINGS**

(GND = 0 V)

Parameter	Symbol	Condition	Rating	Unit
Digital power supply voltage	V <sub>DD</sub>	Ta = 25 °C	-0.3 to +7.0	V
Internal logic power supply voltage	V <sub>DDL</sub>		-0.3 to +3.6	V
Flash power supply voltage (Note 1)	V <sub>PP</sub>		-0.3 to +9.5	V
Input voltage	V <sub>IN</sub>	Ta = 25 °C When JEDEC 2-layer board is mounted	-0.3 to V <sub>DD</sub> +0.3	V
Power dissipation	P <sub>D</sub>	Ta = 25 °C	800	mW
Output short current	I <sub>SC1</sub>	Ta = 25 °C	-12 to +11	mA
Storage temperature	T <sub>STG</sub>	—	-55 to +150	°C

Note 1: Applies to the ML22Q364-NNN.

**RECOMMENDED OPERATING CONDITIONS**

(GND = 0 V)

Parameter	Symbol	Condition	Range			Unit
Digital power supply voltage	V <sub>DD</sub>	—	2.3 to 5.5			V
		ML22Q364 read	2.3 to 5.5			
		ML22Q364 write	2.7 to 5.5			
Flash power supply voltage	V <sub>PP</sub>	ML22Q364 write	7.7 to 8.3			V
Flash memory rewrite cycles	N	ML22Q364	80			—
Operating temperature	T <sub>OP1</sub>	ML22364	-40 to +85			°C
	T <sub>OP2</sub>	ML22Q364 read	-40 to +85			
	T <sub>OP3</sub>	ML22Q364 write	0 to +40			
Source oscillation frequency	f <sub>OSC</sub>	—	Min.	Typ.	Max.	MHz
			3.5	4.096	4.5	

**ELECTRICAL CHARACTERISTICS**

**DC Characteristics**

$V_{DD} = 2.3 \text{ to } 5.5 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $T_a = -40 \text{ to } +85^\circ\text{C}$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" input voltage	$V_{IH}$	—	$0.7 \times V_{DD}$	—	$V_{DD}$	V
"L" voltage	$V_{IL}$	—	0	—	$0.3 \times V_{DD}$	V
"H" output voltage 1	$V_{OH1}$	$I_{OH} = -0.5 \text{ mA}$ CMOS output, Pch open drain selected	$V_{DD} - 0.5$	—	—	V
"H" output voltage 2	$V_{OH2}$	$I_{OH} = -100 \mu\text{A}$ OSC1 pin	$V_{DD} - 0.5$	—	—	V
"L" output voltage 1	$V_{OL1}$	$I_{OL} = 0.5 \text{ mA}$ CMOS output, Nch open drain selected	—	—	0.5	V
"L" output voltage 2	$V_{OL2}$	$I_{OL} = 100 \mu\text{A}$ OSC1 pin	—	—	0.5	V
"H" input current 1	$I_{IH1}$	$V_{IH} = V_{DD}$ High-impedance input selected	—	—	1	$\mu\text{A}$
"H" input current 2	$I_{IH2}$	$V_{IH} = V_{DD}$ TEST pin	0.02	0.3	1.5	mA
"H" input current 3	$I_{IH3}$	$V_{IH} = V_{DD}$ Pull-down input selected	2	30	250	$\mu\text{A}$
"L" input current 1	$I_{IL1}$	$V_{IL1} = GND$ High-impedance input selected	-1	—	—	$\mu\text{A}$
"L" input current 2	$I_{IL2}$	$V_{IL} = GND$ RESET_N pin	-1.5	-0.3	-0.02	mA
"L" input current 3	$I_{IL3}$	$V_{IH} = V_{DD}$ Pull-up input selected	-250	-30	-2	$\mu\text{A}$
Supply current during operate	$I_{DD1}$	Non-loaded output $V_{DD} = 3.0\text{V}$	—	2.5	12	mA
	$I_{DD2}$	Non-loaded output $V_{DD} = 5.0\text{V}$	—	8	12	
Supply current during power down	$I_{DDS1}$	$T_a \leq 40^\circ\text{C}$	—	0.5	2.0	$\mu\text{A}$
	$I_{DDS2}$	$T_a \leq 85^\circ\text{C}$	—	0.5	8.0	

**Analog Characteristics**

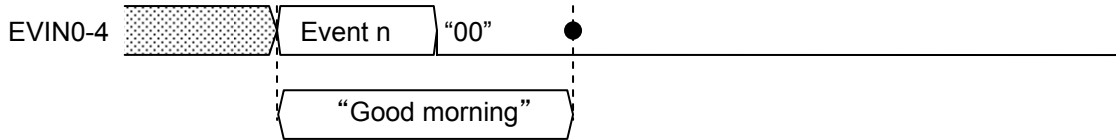
$V_{DD} = 2.3 \text{ to } 5.5 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $T_a = -40 \text{ to } +85^\circ\text{C}$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
AOUT output load resistance	$R_{LAO}$	During $1/2 DV_{DD}$ output	10	—	—	$k\Omega$
AOUT output voltage range	$V_{AOUT}$	No output load	$1/6 \times V_{DD}$	—	$5/6 \times V_{DD}$	V
SG output voltage	$V_{SG}$	—	$0.95 \times V_{DD}/2$	$V_{DD}/2$	$1.05 \times V_{DD}/2$	V
SG output resistance	$R_{SG}$	—	57	96	135	$k\Omega$

**Event Control example**

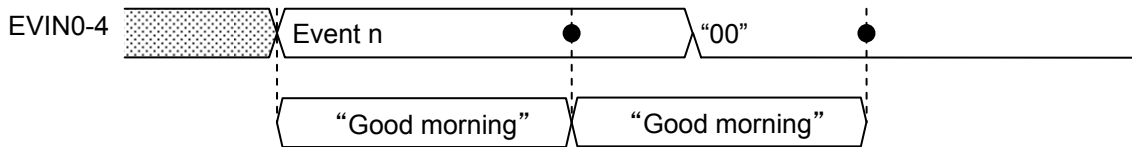
○ Event Control example 1 (Only one playback in Play once mode)

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



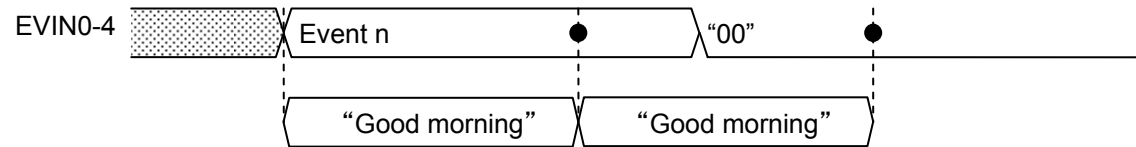
○ Event Control example 2 (Only one playback in Scheduled play mode)

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



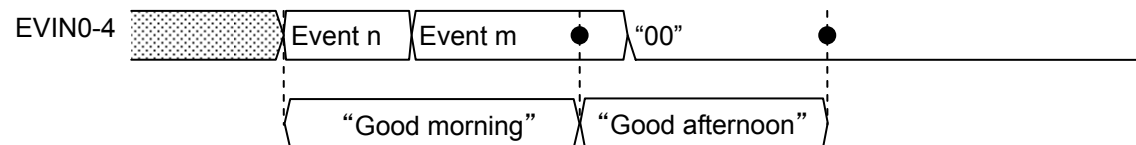
○ Event Control example 3 (Repetitive playback in Scheduled play mode)

Operation: While the EVIN0-4 pin states are held, the event execution is repeated.  
In the case of the event execution stop, the event execution is terminated.  
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, hold the EVIN0-4 pin states. When desired to stop event execution, input all "0s" to the EVIN0-4 pins.



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

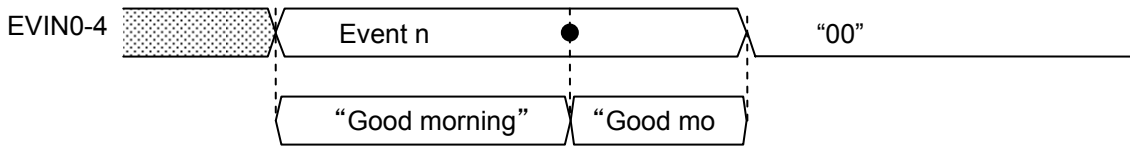
Operation: The event execution specified first is ended and newly specified event execution is started.  
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, input the event number to be executed next to the EVIN0-4 pins and hold the EVIN0-4 pin states until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



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

Operation: Event execution is performed until the EVIN0-4 pin states are changed. The event execution stops when the EVIN0-4 pin states are changed.

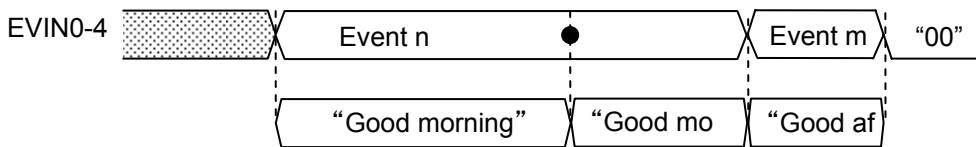
Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, hold the EVIN0-4 pin states while the event execution is to be performed. When desired to stop event execution, input all "0s" to the EVIN0-4 pins



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

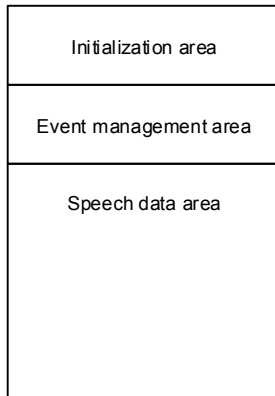
Operation: The event execution specified first is ended and newly specified event execution is started.

Control method: Input the event number to be executed to the EVIN0-4 pins. After event activation, input the event number to be executed next to the EVIN0-4 pins



## Configuration of Built-in ROM

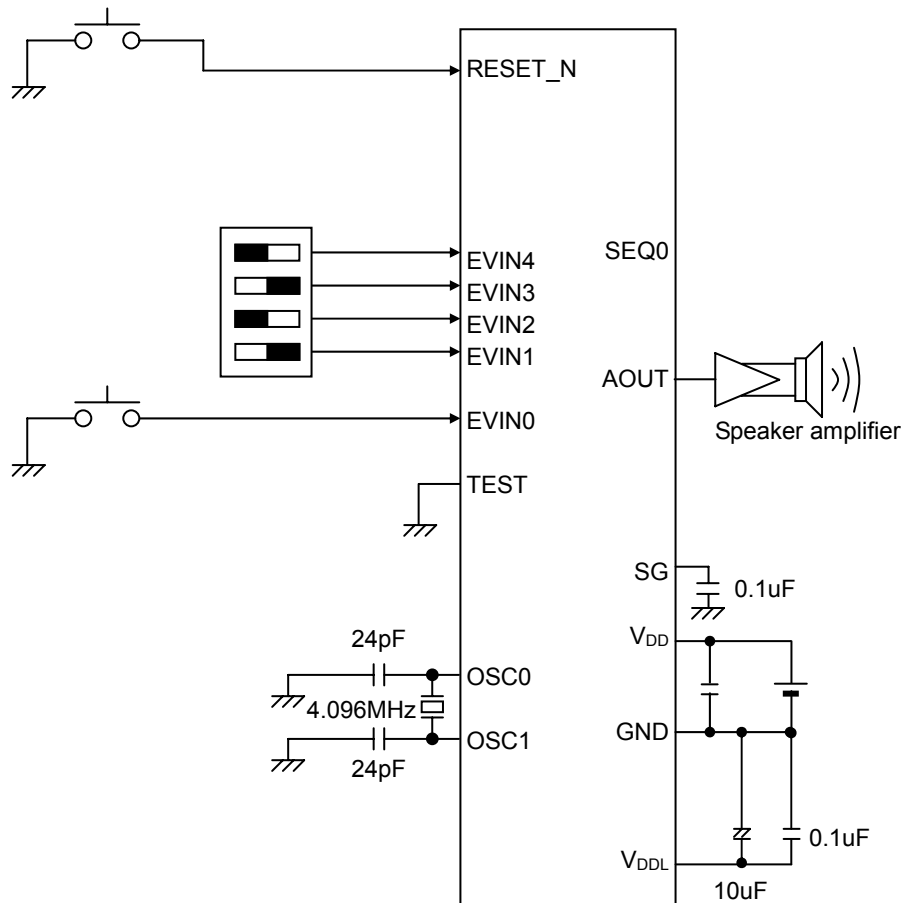
The built-in ROM consists of the initialization, event management, and speech data areas.



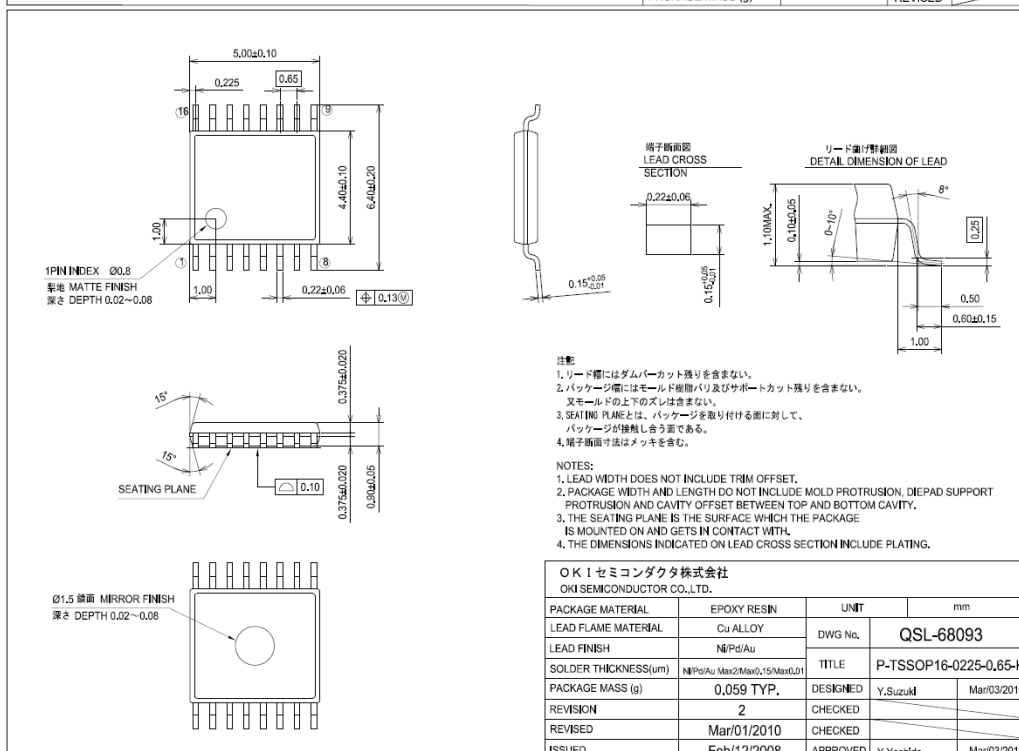
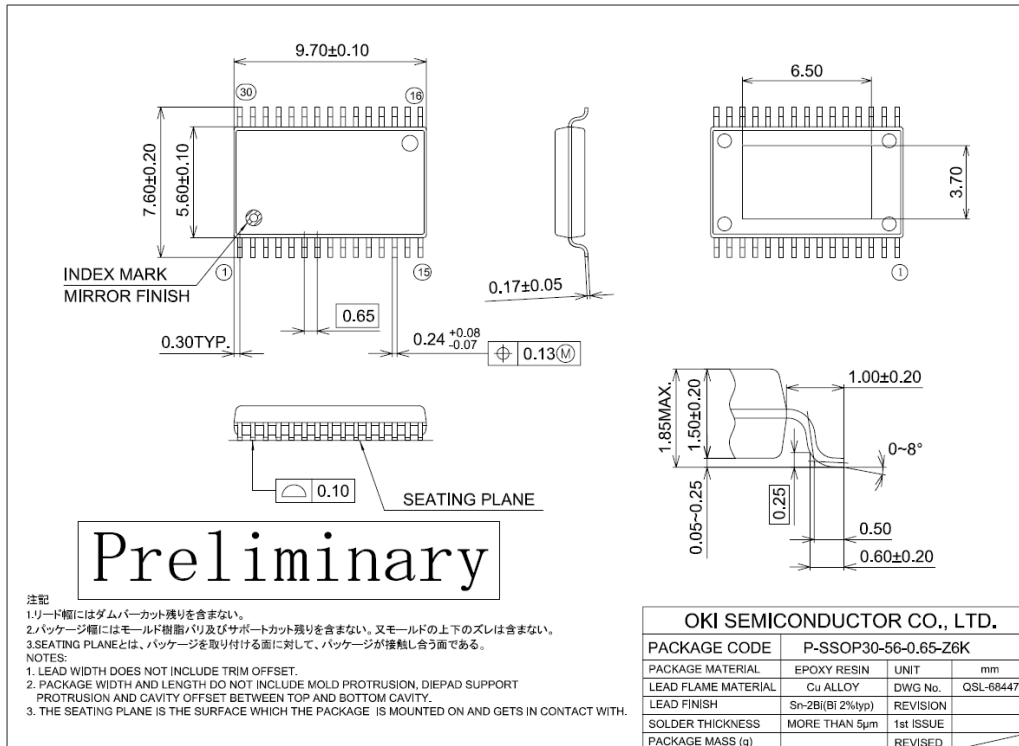
Built-in ROM configuration

Notes: Since the data which exceeds 64 K bytes in one phrase cannot be played, please divide the voice phrase to be set to each below 64 K bytes, and join those data by the edit phrase function.

EXAMPLE OF APPLICATION CIRCUIT



**PACKAGE DIMENSIONS**



**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 OKI SEMICONDUCTOR's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

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