OKI SEMICONDUCTOR

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ML2213

Speech Synthesizer & Melody LSI with On-Chip 1.5-Mbit Mask ROM

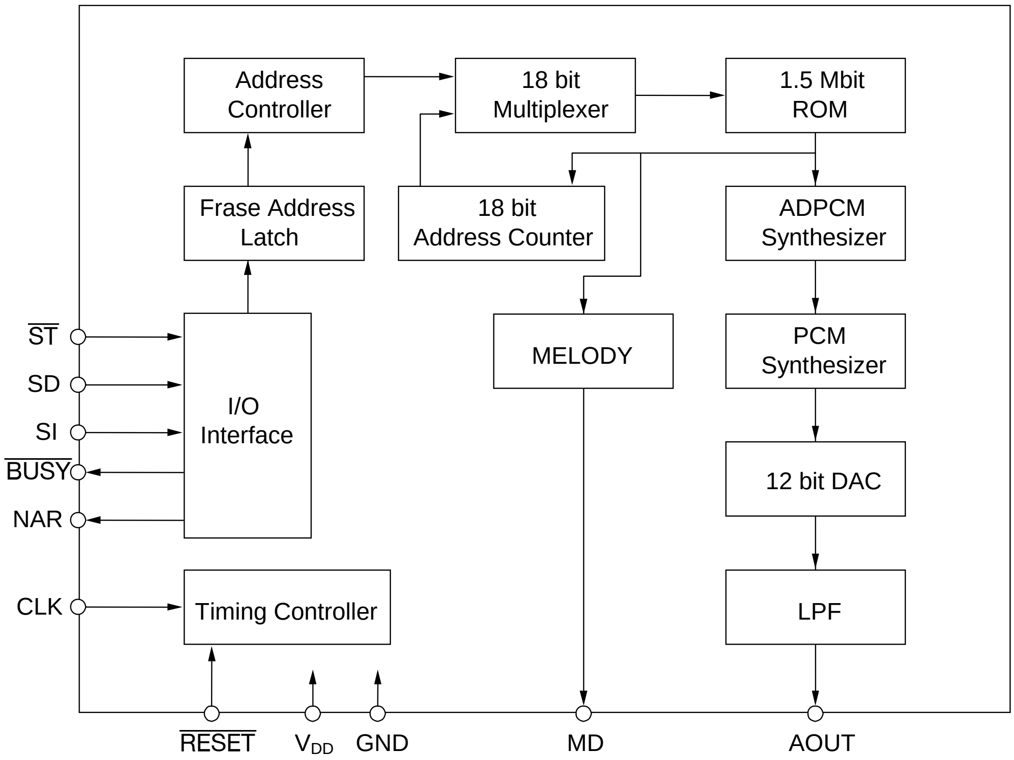
GENERAL DESCRIPTION

The ML2213 is an ADPCM-based Speech Synthesizer LSI with on-chip 1.5-Mbit Mask ROM for storing multiple speech data. In addition, the LSI has a built-in Melody Generator circuit that can generate melodies by automatically acquiring user-defined musical notes data from the ROM. The ML2213 has a 12-bit D/A Converter and Low Pass Filter, and enables a user to readily build a message and music playback sub-system by simply adding an external speaker and driving amplifier.

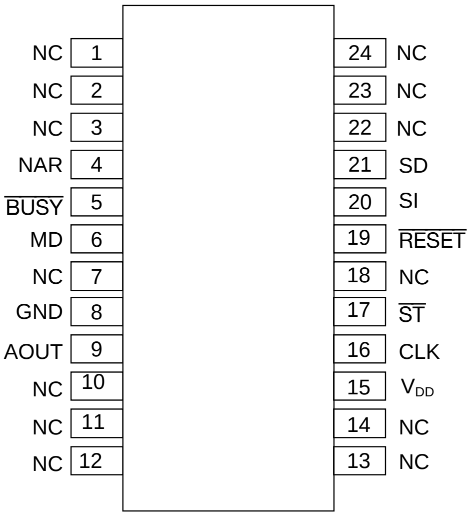
FEATURES

- On-Chip 1.5-Mbit Mask ROM
- Serial Interface: User-selectable Mask options for 2-pin or 3-pin interfacing
- 3 Speech Synthesis Algorithms for user selection
  4-bit ADPCM/8-bit OKI Non-Linear PCM/8-bit PCM/Melody
- Sampling Frequency (At 4.096 MHz External Clock)
  4.0 kHz, 5.3 kHz, 6.4 kHz, 8.0 kHz, 10.7 kHz, 12.8 kHz, 16.0 kHz
- Built-in Melody Generator function
  User-definable 31 musical scales, 60 musical notes, and 30 tempos
- User-defined Phrases up to 247 phrases, including melodies.
- Built-in 12-bit D/A Converter
- Built-in Low Pass Filter
- Driver for piezo-speaker (MD pin)
- External Clock: Frequency can be selected as Mask option
  4.096 MHz, 8.192 MHz, 16.384 MHz
- Power Supply Voltage: 2.4 to 5.5 V
- Package: 24-pin plastic SOP (SOP24-P-430-1.27-K) (Product name: ML2213-xxxMA)
  14-pin plastic SSOP (SSOP14-P-44-0.65-K) (Product name: ML2213-xxxMB)

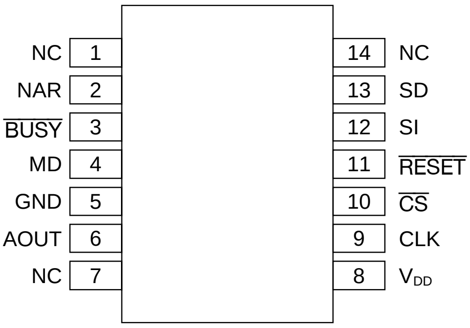
BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)



24-Pin Plastic SOP



14-Pin Plastic SSOP

NC: No connection

Leave the NC pins open.

Note : If the 14-Pin Plastic SSOP is used, contact your nearest Oki sales office for availability and specifications.

PIN DESCRIPTIONS

Pin	Symbol	Type	Description
11 (19)	$\overline{\text{RESET}}$	I	“L” input to this pin turns the LSI into standby mode. At this point, output from the AOUT pin rises up to V_{DD} level, having the LSI initialized internally. By “H” input to the pin the AOUT output returns to 1/2 V_{DD} level.
2 (4)	NAR	O	This pin outputs a signal showing empty/full status of the Phase Address Latch Register. “H” level indicates the register is empty, and thus the LSI is ready to accept serial data input. At powering up, the pin outputs “H level”.
3 (5)	$\overline{\text{BUSY}}$	O	Outputs “L” level while output signal is present either at the AOUT or MD pin. At powering up, the pin outputs “H” level.
4 (6)	MD	O	Melody output pin. Leave this pin open when not using melody output.
6 (9)	AOUT	O	Analog output pin. V_{DD} is output from this pin while the $\overline{\text{RESET}}$ pin is at “L” (during standby mode). 1/2 V_{DD} is output except during playback after this LSI is activated.
5 (8)	GND	—	Ground pin
9 (16)	CLK	I	External clock input pin
12 (20)	SI	I	Serial clock input pin
13 (21)	SD	I	Serial data input pin. Input a phrase code corresponding to a phrase address through this pin.
10 (17)	$\overline{\text{ST}}$	I	Chip select signal pin. Mask option allows a user to choose either 2-pin (SD and SI) interfacing or 3-pin (SD, SI and $\overline{\text{ST}}$) interfacing. When 3-pin inter-facing is selected, input to the SD and SI pins is valid while the $\overline{\text{ST}}$ pin being held “L”. When 2-pin interfacing is selected, pull this pin down to the GND.
8 (15)	V_{DD}	—	Power supply pin. Insert 0.1 µF or larger bypass capacitor between this pin and the GND pin.

* 14-pin plastic SSOP (24-pin plastic SOP)

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	V_{DD}	Ta = 25°C	–0.3 to +7.0	V
Input Voltage	V_{IN}		–0.3 to V_{DD}+0.3	V
Storage Temperature	T_{STG}	—	–55 to +150	°C

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Range			Unit
Power Supply Voltage	V_{DD}	—	2.4 to 5.5			V
Operating Temperature	T_{OP}	—	–40 to +85			°C
External Clock Frequency	f_{EXTCK}	Selected as Mask options	Min	Typ.	Max	MHz
			3.5	4.096	4.5	
			7.5	8.192	9.0	
			14.5	16.384	18.0	

ELECTRICAL CHARACTERISTICS

DC Characteristics (3 V Version)

(V_{DD} = 2.4 to 3.6 V, GND = 0 V, Ta = –40 to +85°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
“H” Input Voltage	V_{IH}	—	0.87 × V_{DD}	—	—	V
“L” Input Voltage	V_{IL}	—	—	—	0.13 × V_{DD}	V
“H” Output Voltage	V_{OH}	I_{OH} = –500 μA	V_{DD}–0.3	—	—	V
“L” Output Voltage	V_{OL}	I_{OL} = 1 mA	—	—	0.4	V
“H” Input Current	I_{IH}	V_{IH} = V_{DD}	—	—	10	μA
“L” Input Current	I_{IL}	V_{IL} = GND	–10	—	—	μA
Operating Supply Current	I_{DD}	—	—	1	4	mA
Standby Supply Current	I_{DS}	Ta = –40 to +85°C	—	—	10	μA
DA Output Relative Error	$\lvert V_{DAE} \rvert$	—	—	—	40	mV

DC Characteristics (5 V Version)

(V_{DD} = 3.7 to 5.5 V, GND = 0 V, Ta = –40 to +85°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" Input Voltage	V_{IH}	—	0.85 × V_{DD}	—	—	V
"L" Input Voltage	V_{IL}	—	—	—	0.15 × V_{DD}	V
"H" Output Voltage	V_{OH}	I_{OH} = –500 µA	V_{DD}–0.3	—	—	V
"L" Output Voltage	V_{OL}	I_{OL} = 1 mA	—	—	0.4	V
"H" Input Current	I_{IH}	V_{IH} = V_{DD}	—	—	10	µA
"L" Input Current	I_{IL}	V_{IL} = GND	–10	—	—	µA
Operating Power Consumption	I_{DD}	—	—	2	4	mA
Standby Power Consumption	I_{DS}	Ta = –40 to +85°C	—	—	10	µA
DA Output Relative Error	$\|V_{DAE}\|$	—	—	—	40	mV

Analog Characteristics

(V_{DD} = 2.4 to 5.5 V, GND = 0 V, Ta = –40 to +85°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
AOUT Output Voltage	V_{AO}	—	V_{DD}/4	—	V_{DD}	V
AOUT Pull-up Resistor Value	R_{AO}	—	1.5	2.5	4.5	kΩ

Note that the maximum amplitude voltage output from the AOUT pin is about 80% of V_{DD}.

FUNCTIONAL DESCRIPTION

1. Specifying a user-defined phrase code for playback

The LSI allows a user to define up to 247 phrases. To playback a user-defined phrase, input a phrase code (phrase address) in serial order, starting with the MSB, through the SD pin.

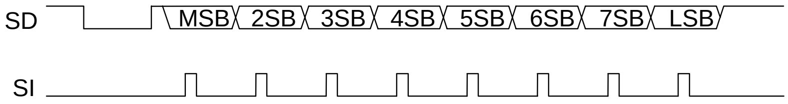


Figure 1.1 Timing for Phrase Code Input

When more than 8 SI clocks are input, the first 8-clock data is taken as valid data. Table 1.1 shows phrase codes for user-defined phrases.

Table 1.1 Phrase Code for User-Defined Phrase

MSB to LSB	Code Description
00000000	Stop Code
00000001 • • 11110111	User-defined Phrase Codes
11111000 • • 11111111	Test Codes*

Note: * No test codes could be used to represent a user-defined phrase.

2. Use-Prohibited Area in on-chip Mask ROM

As shown in the Table 2.1, the last 3 bytes of on-chip Mask ROM are use-prohibited. Be sure not to use the last 3 bytes when you prepare ROM data using an analyzing tool.

Table 2.1 shows addresses that are prohibited to use, and Figure 2.1 shows the address map of on-chip Mask ROM.

Table 2.1 User's Data Area and Use-Prohibited Area in On-Chip Mask ROM

User's Data Area	Use-Prohibited Area
007C8 to 2FFFC	2FFFD, 2FFFE, 2FFFF

00000H 007C7H	Phrase Control Table Area
007C8H 2FFFCH	User's Date Area
2FFFDH 2FFFFH	Test Date Area

Figure 2.1 Mask ROM Address Map

3. Mask Options

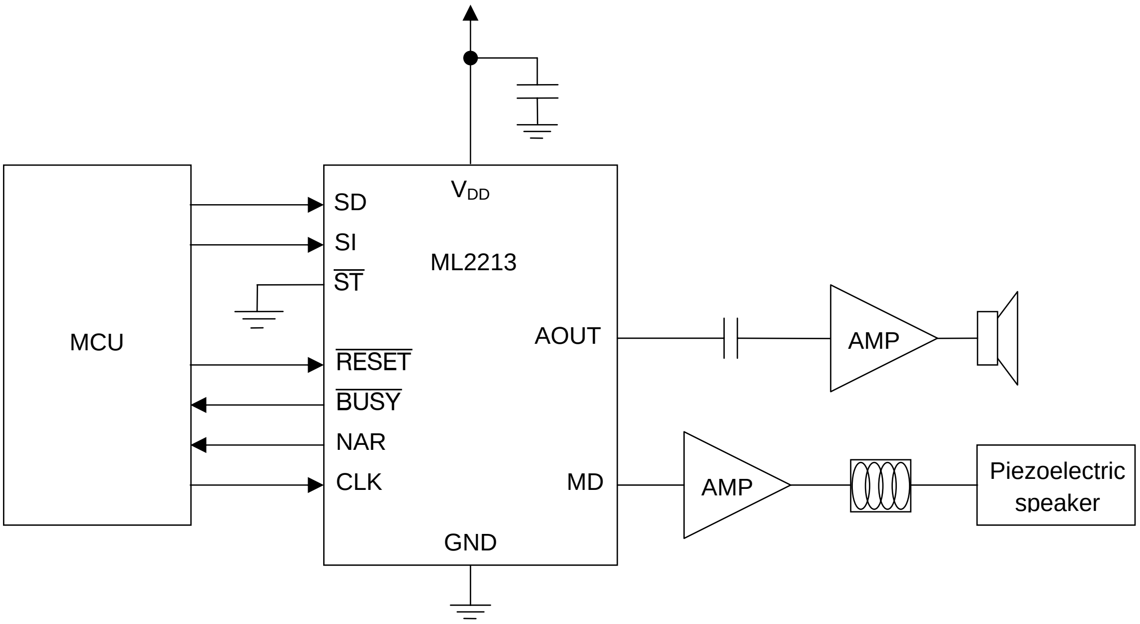
The following mask options are available to choose an interfacing type and an external clock frequency, as shown in Table 3.1.

Table 3.1 Mask Options

Option	Interfacing Type	External Clock Frequency
A	3-pin Interfacing	4.096 MHz
B	3-pin Interfacing	8.192 MHz
C	3-pin Interfacing	16.384 MHz
D	2-pin Interfacing	4.096 MHz
E	2-pin Interfacing	8.192 MHz
F	2-pin Interfacing	16.384 MHz

APPLICATION CIRCUITS

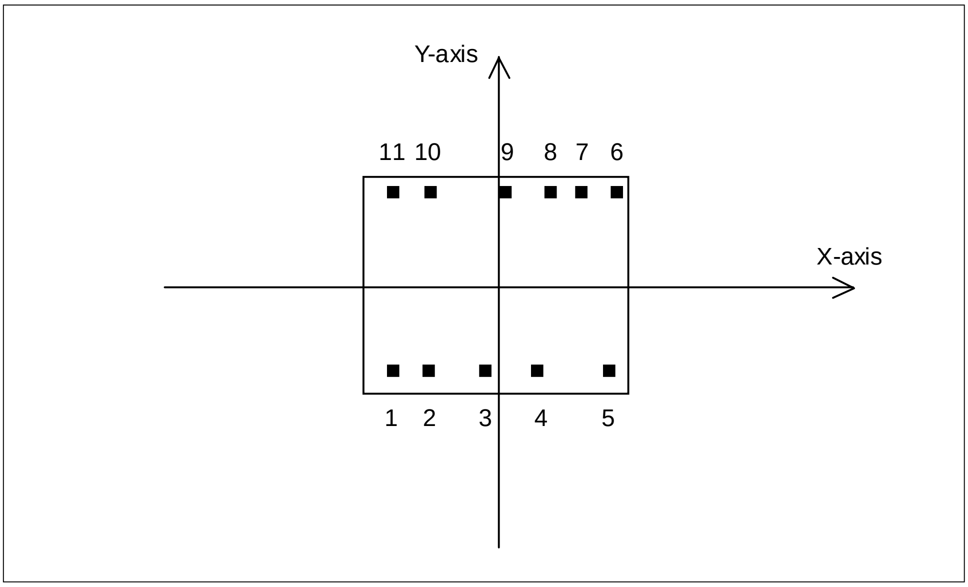
When 2-pin interfacing is selected
(Fix the $\overline{\text{ST}}$ pin to GND.)



PAD CONFIGURATION

Chip size X = 2.808 mm Y = 2.496 mm

1. Chip and Pad Numbers



2. Pad Coordinates
(Chip center is located at X = 0 and Y = 0)

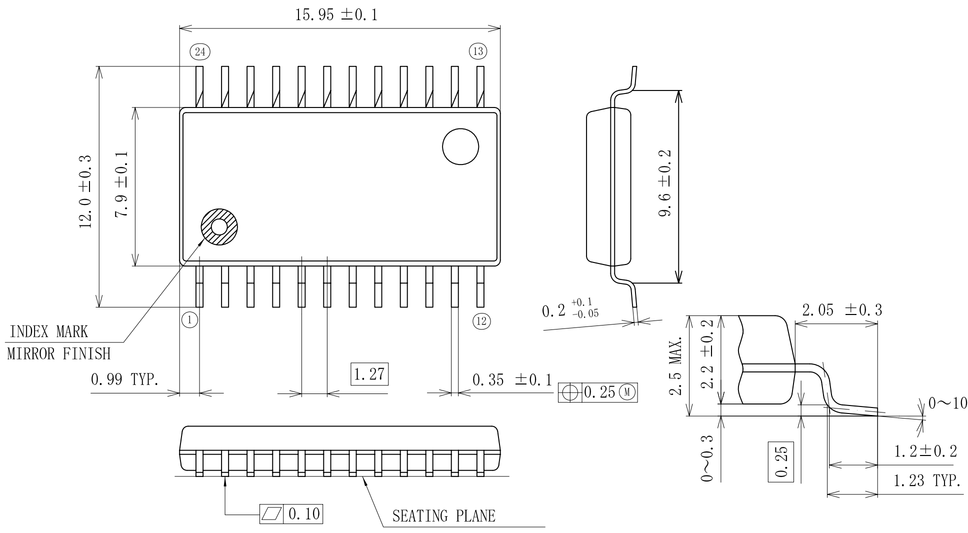
(Unit: µm)

PAD No.	PAD Name	X-axis	Y-axis
1	NAR	–1066	–1098.5
2	$\overline{\text{BUSY}}$	–689	–1098.5
3	MD	–182	–1098.5
4	GND	247	–1098.5
5	AOUT	1105	–1098.5
6	VDD	1248	1098.5
7	CLK	819	1098.5
8	$\overline{\text{ST}}$	390	1098.5
9	$\overline{\text{RESET}}$	13	1098.5
10	SI	–689	1098.5
11	SD	–1066	1098.5

PACKAGE DIMENSIONS

SOP24-P-430-1.27-K

(Unit : mm)



Oki Electric Industry Co., Ltd.

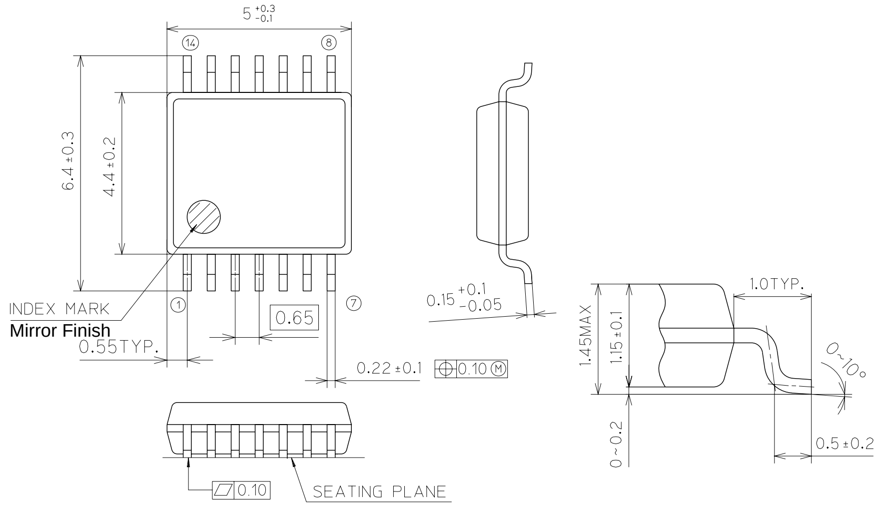
Package material	Epoxy resin
Lead frame material	42 alloy
Lead finish	Sn/Pb=70/30 to 95/5
Pin treatment	Solder plating (≥5μm)
Package weight (g)	0.58 TYP.
Rev. No./Last Revised	7/Jul. 30, 2004

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

(Unit: mm)

SSOP14-P-44-0.65-K



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating (≥5μm)
Package weight (g)	0.066 TYP.
Rev. No./Last Revised	1/Sept. 18, 1998

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