

# ML2500

## Analog-Storage Single-chip Record/Playback LSI with 1M Bit-Cell Flash Memory

This document contains minimum specifications. For full specifications, please contact your nearest Oki office or representative.

### GENERAL DESCRIPTION

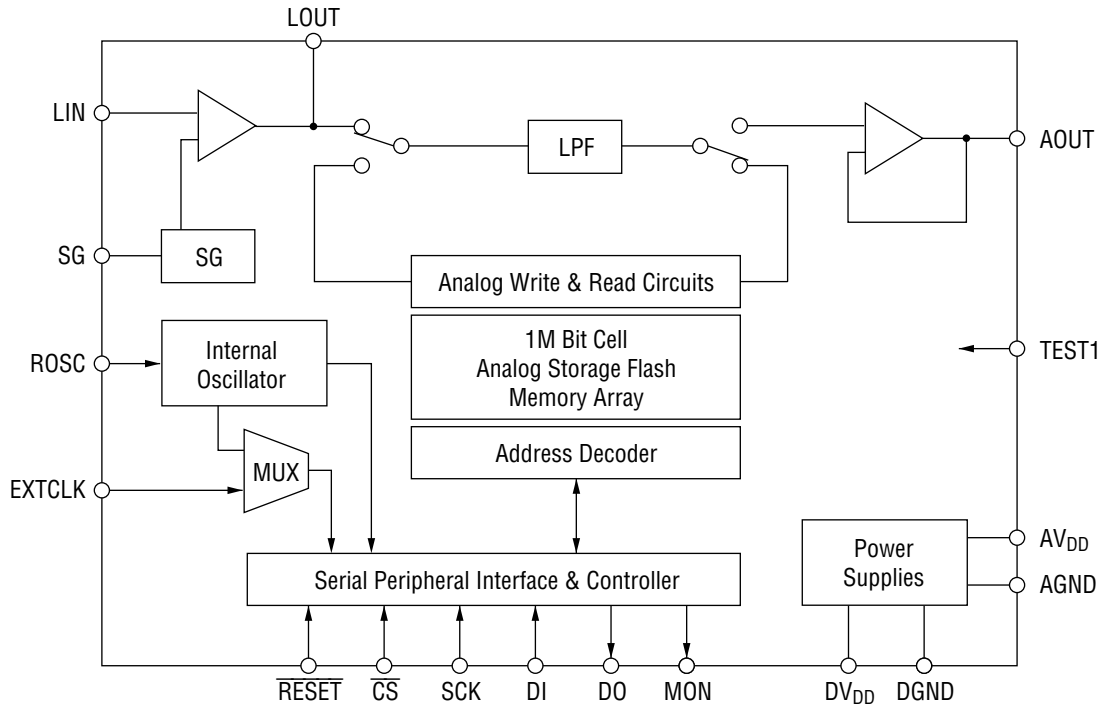
Thanks to newly developed Analog Multi-Level Storage technology, ML2500 stores non-compressed analog source signal directly into on-chip 1M Bit-Cell Flash memory. The result is superb sound quality without noise and distortions introduced through coding/decoding, and impressive long-time record/playback capability up to 256 sec. ML2500 is fully controllable by an external MCU via the industry's standard Serial Peripheral Interface.

In addition, no backup requirement and low operating voltage (2.7 to 3.3 V) make the LSI an ideal choice for compact, handy and portable terminals. ML2500 is a true shingle-chip solution to record/playback subsystem for use with today's size-critical electronic products.

### FEATURES

- On-chip non-volatile 1M bit-cell Flash memory
  - Program/Erase Cycles : 10,000 cycles
  - Data Retention : 10 years
- MCU Interface
  - Serial Peripheral Interface (SPI; Mode 0)
- Record/Playback Time Length (With the int. Osc. or ext. clock at 8.192 MHz)
  - ap. 160 sec (At fsam = 6.4 kHz)
  - ap. 190 sec (At fsam = 5.3 kHz)
  - ap. 256 sec (At fsam = 4.0 kHz)
- Selectable Sampling Frequencies
  - 4.0 kHz, 5.3 kHz, 6.4 kHz
- Maximum number of recording phrases: 320 phrases
- Phrase Control
  - Fully controllable with user-definable Start, Stop addresses
- Built-in LPF/Smoothing Filter (LPF attenuation -40dB/oct)
- Built-in Oscillation Circuit (8.192 MHz), No oscillator required
  - Optional external clock input (Clock Frequency 4.0 MHz to 8.192 MHz)
- Power Supply : 2.7 to 3.3 V
- Operating Temperature:
  - 10 to +70°C (guaranteed for both function and voice quality)
  - 40 to +85°C (guaranteed for function only) \*Notice
- \*Notice
  - The voice quality can deteriorate at temperatures beyond the range of -10 to +70°C.
  - DC and AC characteristics in this data sheet are specified for -10 to +70°C operating temperature range.
- Package:
  - 32-pin Plastic TSOP (TSOPI32-P-814-0.50-1K) (Product name: ML2500TA)

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



NC: No connection. Keep NC pins open.

**32-Pin Plastic TSOP (Type I)**

## PIN DESCRIPTIONS

Pin	Symbol	Type	Description
5	DI	I	Serial input pin for command data.
6	DO	O	Serial output pin for status data.
4	SCK	I	Shift clock input pin for the DI and the DO pins.
3	$\overline{CS}$	I	Chip select pin. "L" level input enables data input/output through the serial interface.
2	$\overline{RESET}$	I	RESET input pin, resetting the serial interface circuit only. "L" level input to this pin initializes the serial interface. Must input "L" pulse after each power-on.
15	ROSC	I	Insert a 30 k $\Omega$ resistor (Precision within $\pm 1\%$ ) between this pin and the DGND pin. The same resistor should also be inserted if an external clock is used. The resistor value determines the frequency of the clock for control in this device.
8	EXTCLK	I	External clock input pin. Allowable clock frequency range is 4.0 MHz to 8.192 MHz. When external clock is unused and internal oscillation clock is used, connect this pin to the DGND.
7	MON	O	Output "H" level during recording/playback operation.
26	SG	O	Analog reference voltage (Signal Ground Voltage) output pin. It is recommendable to insert a capacitor smaller than 3300 pF between this pin and the AGND pin. Loads except for capacitors should not be connected to this pin.
31	LIN	I	Inverting input pin for the internal OP amplifier. Non-inverting input pin is internally connected to SG voltage.
30	LOUT	O	Output pin from the internal OP amplifier.
27	AOUT	O	Analog waveform output. Connect to an amplifier to drive a SP.
11, 13, 18, 20, 22, 28, 29	TEST2	O	Pins for testing the LSI. Must be held "OPEN".
24	TEST1	I	LSI's testing pin. Must be connected to DGND.
1	DV <sub>DD</sub>	—	Digital power supply pin. Insert a 0.1 $\mu$ F or larger by-pass capacitor between this pin and the DGND pin.
16	DGND	—	Digital Ground pin.
32	AV <sub>DD</sub>	—	Analog power supply pin. Insert a 0.1 $\mu$ F or larger by-pass capacitor between this pin and the AGND pin.
17	AGND	—	Analog Ground pin.

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	$V_{DD}$	$T_a = 25^\circ\text{C}$	-0.3 to +5.0	V
Input Voltage	$V_{IN}$		-0.3 to $V_{DD}+0.3$	V
Storage Temperature	$T_{STG}$	—	-55 to +150	$^\circ\text{C}$

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Range			Unit
Power Supply Voltage	$V_{DD}$	DGND = AGND = 0V	2.7 to 3.3			V
Operating Temperature	$T_{op}$	—	-10 to +70			$^\circ\text{C}$
			<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	
External Clock Frequency 1	*1 $f_{EXTCLK1}$	—	3.85	4.096	4.34	MHz
External Clock Frequency 2	*1 $f_{EXTCLK2}$	—	7.70	8.192	8.68	MHz

\*1: Applicable only with external clock

## ELECTRICAL CHARACTERISTICS

### DC Characteristics

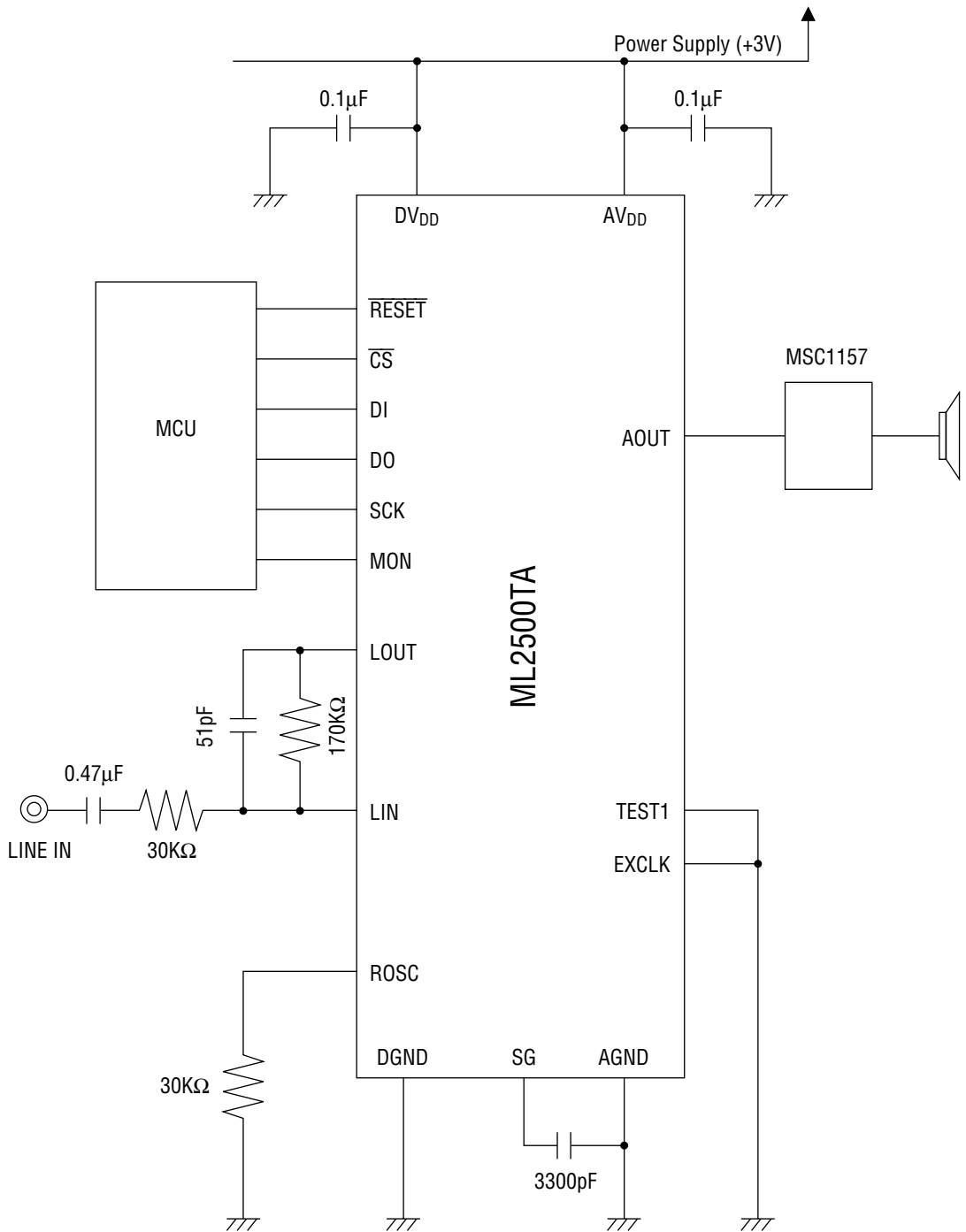
$DV_{DD} = AV_{DD} = 2.7\text{ V to }3.3\text{ V}$ , DGND = AGND = 0 V,  $T_a = -10\text{ to }+70^\circ\text{C}$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
"H" Input Voltage	*1 $V_{IH}$	DGND = AGND = 0V	$0.8 \times V_{DD}$	—	—	V
"L" Input Voltage	*1 $V_{IL}$	—	—	—	$0.2 \times V_{DD}$	V
"H" Output Voltage	*2 $V_{OH}$	$I_{OH} = -40\mu\text{A}$	$V_{DD} - 0.3$	—	—	V
"L" Output Voltage	*2 $V_{OL}$	$I_{OL} = 2\text{mA}$	—	—	0.45	V
"H" Input Current	*1 $I_{IH}$	$V_{IH} = V_{DD}$	—	—	10	$\mu\text{A}$
"L" Input Current	*1 $I_{IL}$	$V_{IL} = 0\text{V}$	-10	—	—	$\mu\text{A}$
Operating Current Consumption 1	$I_{DD1}$	In Recording Operation	—	30	45	mA
Operating Current Consumption 2	$I_{DD2}$	In Playback Operation	—	20	30	mA
Operating Current Consumption 3	$I_{DD3}$	In Command-Wait State	—	5	10	mA
Powerdown Current Consumption	$I_{DD5}$	—	—	—	10	$\mu\text{A}$

\*1: Applied to logic input pins (DI, SCK,  $\overline{\text{CS}}$ ,  $\overline{\text{RESET}}$  and EXTCLK) except ROSC and TEST1 pins.

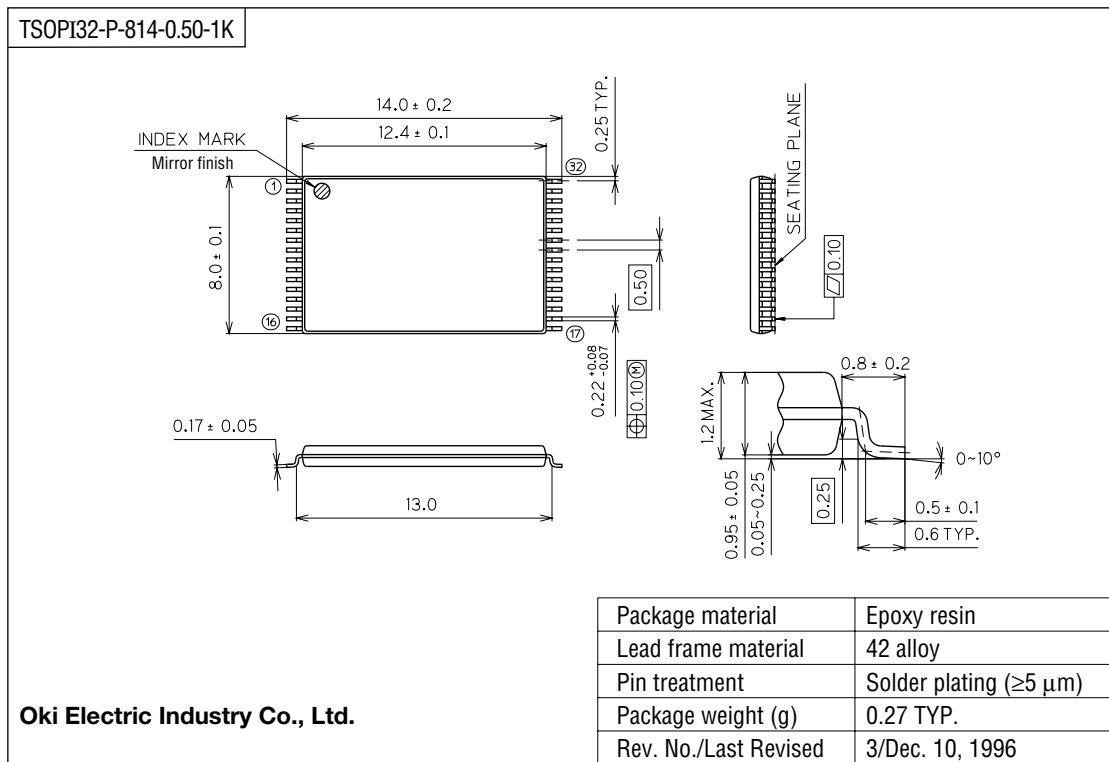
\*2: Applied to logic output pins (DO and MON) except TEST2 pin.

APPLICATION CIRCUITS



PACKAGE DIMENSIONS

(Unit : mm)



Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which 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).

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