

# OKI Semiconductor

This version: Jan. 1998  
Previous version: May. 1997

## MSM9888L

### Flash-driving Recording and Playback IC

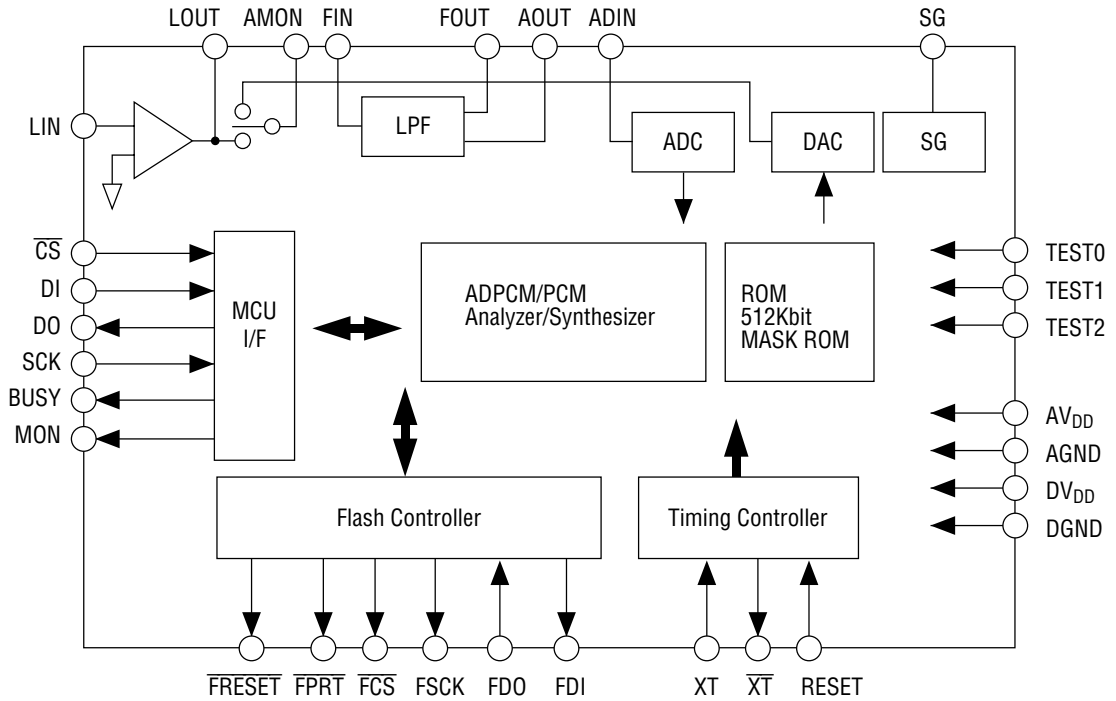
#### GENERAL DESCRIPTION

The MSM9888L is a recording and playback IC that is controlled by the micro-controller in serial mode, compresses voice with the Oki ADPCM system with high tone quality, and directly stores voice data in the serial voice flash memory. This IC can operate in a range of 2.7 to 3.6 V and contains a mask ROM. Since the package is small and backup is not needed, this recording and playback IC is suitable for the voice system such as handy terminals.

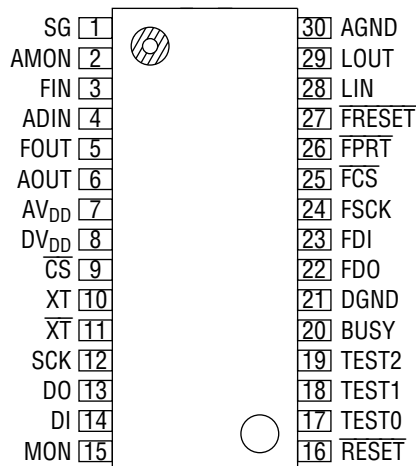
#### FEATURES

- Voice analyzing and synthesizing system
  - : 4-bit OKI ADPCM system
  - : 8-bit OKI non-linear PCM system (for ROM playback only)
- Built-in 12-bit A/D·D/A converter
- Built-in LPF : Attenuation rate -40 dB/oct
- Sampling frequency (for 4.096 MHz of source oscillation frequency)
  - : 2.0 kHz, 2.7 kHz, 3.2kHz, 4.0 kHz, 5.3 kHz, 6.4 kHz, 8 kHz
- External memory for variable message
  - : 1Mb, 2Mb, 4Mb, 8Mb, serial voice flash memory
- Recording time (When the 1Mb serial voice flash is used)
  - : Approximately 32 seconds (Fsam=8.0 kHz)
  - : Approximately 40 seconds (Fsam=6.4 kHz)
  - : Approximately 65 seconds (Fsam=4.0 kHz)
- Built-in 512Kb mask ROM for fixed message
- Playback time for fixed message
  - : Approximately 15 seconds (Fsam=8.0 kHz)
  - : Approximately 20 seconds (Fsam=6.4 kHz)
  - : Approximately 31 seconds (Fsam=4.0 kHz)
- Number of phrases
  - Variable message : 63 phrases
  - Fixed message : 255 phrases
- Any data can be written to and read from a part in the voice flash memory.
- Serial microcontroller interface
- Source oscillation frequency : 4 MHz to 6 MHz
- Supply voltage : 2.7 V to 3.6 V
- Operating temperature : -10°C to 70°C
- Package :  
30-pin plastic SSOP (SSOP30-P-56-0.65-K)(Product name : MSM9888LGS-AK)

**BLOCK DIAGRAM**



**PIN CONFIGURATION (TOP VIEW)**



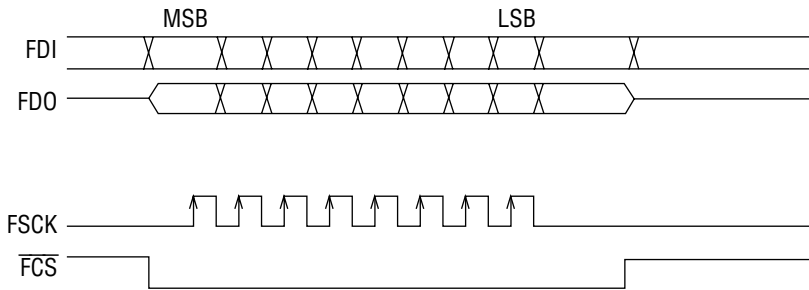
**30-Pin Plastic SSOP**

## PIN DESCRIPTION

Pin	Symbol	I/O	Description
14	DI	I	Inputs the 8-bit command data.
13	DO	O	Outputs the 8-bit status data.
12	SCK	I	Inputs the data transfer clock for the DI and DO pins.
9	$\overline{CS}$	I	Accepts the SCK pulse, when $\overline{CS}$ is "L" level. Does not accept the SCL pulse when $\overline{CS}$ is "H" level.
20	BUSY	O	Indicates "H" level during command execution. When driven high, do not input a command from the external micro-controller.
15	MON	O	Outputs "H" level during recording or playback.
23	FDI	O	1s connected to the DI pin of the serial voice flash memory.
22	FDO	I	1s connected to the DO pin of the serial voice flash memory.
24	FSCK	O	1s connected to the SCK pin of the serial voice flash memory.
25	$\overline{FCS}$	O	1s connected to the $\overline{CS}$ pin of the serial voice flash memory.
26	$\overline{FPRT}$	O	1s connected to the $\overline{PRT}$ pin of the serial voice flash memory.
27	$\overline{FRESET}$	O	1s connected to the $\overline{RESET}$ pin of the serial voice flash memory.
10	XT	I	Oscillator connecting pins. When using an external clock, input the clock from the $\overline{XT}$ pin and keep the XT pin open.
11	$\overline{XT}$	O	
16	$\overline{RESET}$	I	The LSI is reset and starts oscillation when "L" level is input, keep "L" level during oscillation stabilization time. Set to "H" level after oscillation stabilizes.
1	SG	O	Analog reference voltage (Signal Ground) output pin
28	LIN	I	Built-in OP amplifier's invention input pin. The non-invention input pin is internally connected to SG.
29	LOUT	O	Built-in OP amplifier's output pin
4	ADIN	I	Built-in 12-bit AD converter's input signal
2	AMON	O	Connected to the LOUT pin when recording mode, and to the DA converter's output pin when playback mode. Connected to the built-in LPF's input (FIN pin).
3	FIN	I	Built-in LPF's input pin
5	FOUT	O	Built-in LPF's output pin. Connected to the AD converter's input (ADIN pin).
6	AOUT	O	Built-in LPF's output pin. This is the output pin the played back waveform and connected to the speaker driving amplifier.
17-19	TEST0-2	I	LSI testing pins. Fix to "L".
8	DV <sub>DD</sub>	—	Digital power supply pin. Insert a bypass capacitor of 0.1 $\mu$ F or higher between this pin and DGND pin.
21	DGND	—	Digital DGND pin
7	AV <sub>DD</sub>	—	Analog power supply pin. Insert a bypass capacitor of 0.1 $\mu$ F or higher between this pin and AGND pin.
30	AGND	—	Analog GND pin

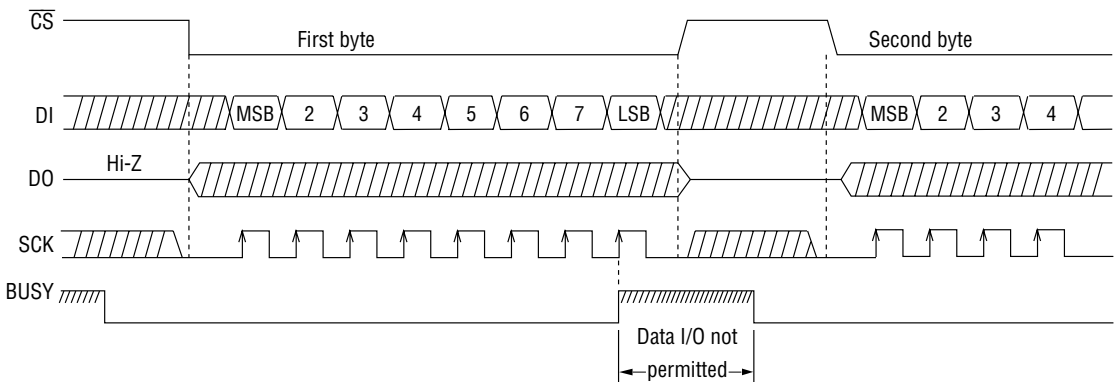
## TIMING DIAGRAM

### Flash driving Timing

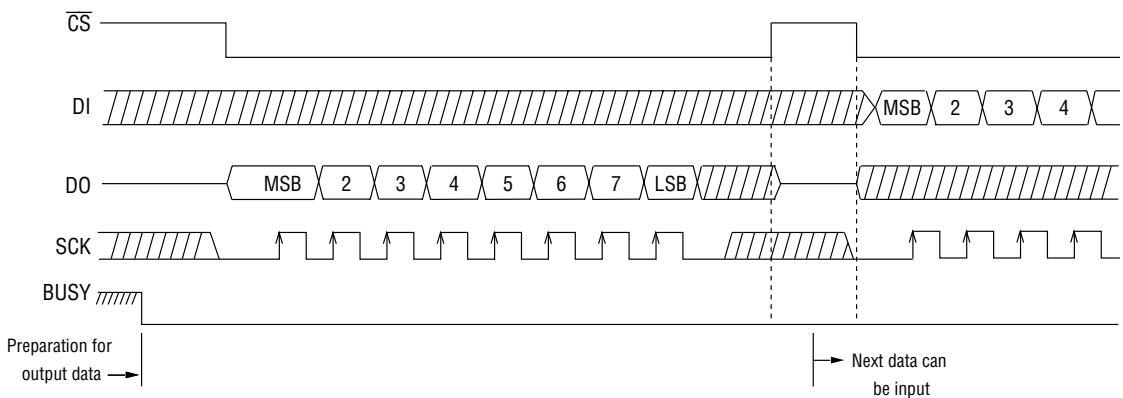


### MCU I/F driving Timing

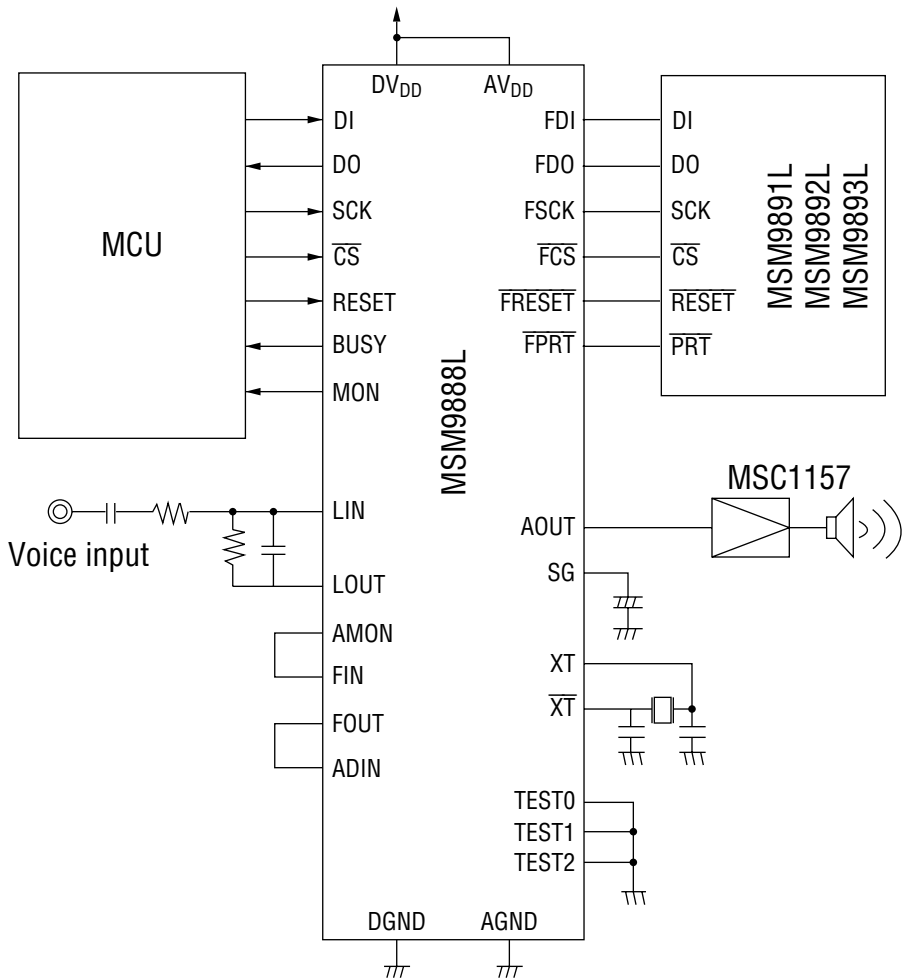
<When data write>



<When data read>



APPLICATION CIRCUITS EXAMPLE



**COMMAND LIST**

Command	D7	D6	D5	D4	D3	D2	D1	D0	Function
NOP	0	0	0	0	0	0	0	0	No function
REC	0	0	0	1	0	S2	S1	S0	Starts recording
	0	0	C5	C4	C3	C2	C1	C0	
PLY	0	0	1	0	0	0	0	M0	Starts playback
	C7	C6	C5	C4	C3	C2	C1	C0	
STOP	0	0	1	1	0	0	0	0	Terminates recording/playback.
PAUSE	0	1	0	0	0	0	0	0	Pauses or resets pause.
BLKRW	0	1	0	1	0	0	0	M1	Sets and reads the recording time.
	D7	D6	D5	D4	D3	D2	D1	D0	
DTRW	0	1	1	0	Pb	Pa	P9	P8	Reads data from or writes data to the flash memory.
	P7	P6	P5	P4	P3	P2	P1	P0	
DEL	0	1	1	1	0	0	0	0	Erases phrases.
	0	0	C5	C4	C3	C2	C1	C0	
PDWN	1	0	0	0	0	0	0	0	Stops the clock to select the power-down mode.
BYTEW	1	0	0	1	0	0	0	B8	Writes the data written with W7-0 to the address indicated by B8-0 to the flash memory buffer.
	B7	B6	B5	B4	B3	B2	B1	B0	
	W7	W6	W5	W4	W3	W2	W1	W0	
BYTER	1	0	1	0	0	0	0	B8	Reads data inside the buffer at the address indicated by B8-0.
	B7	B6	B5	B4	B3	B2	B1	B0	
WEND	1	0	1	1	0	0	0	0	Writes buffer data to the flash memory then quits.
END	1	1	0	0	0	0	0	0	Quits without writing buffer data to the flash memory.
INIT	1	1	1	0	1	0	1	0	Initializes the voice area part of the flash memory.
	0	0	0	0	0	0	F1	F0	
	U7	U6	U5	U4	U3	U2	U1	U0	
STATUS	1	1	1	1	1	1	1	1	Outputs the status.

C5 to C0 : Phrase No.  
 S2 to S1 : Sampling frequency  
 Pb to P0 : Page address on the flash memory  
 B8 to B0 : Block address on the flash memory  
 F1 to F0 : Type of flash memory connected  
 U7 to U0 : Number of user data blocks

X=don't care

**MODE0 setting**

M0	Function
0	Flash playback
1	ROM playback

**MODE1 setting**

M1	Function
0	Sets the number of blocks to be record/played back with D7-0.
1	Sets the channel recorded with D7-0 and outputs the recording time.

**Channel designation**

C7	C6	C5	C4	C3	C2	C1	C0	Function
0	0	0	0	0	0	0	1	Phrase1
0	0	0	0	0	0	1	0	Phrase2
0	0	0	0	0	0	1	1	Phrase3
			•			•		•
			•			•		•
			•			•		•
0	0	1	1	1	0	1	1	Phrase59
0	0	1	1	1	1	1	1	Phrase63
0	1	0	0	0	0	0	0	Phrase64 (ROM only)
			•			•		•
			•			•		•
1	1	1	1	1	1	1	1	Phrase254 (ROM only)
1	1	1	1	1	1	1	1	Phrase255 (ROM only)

**Page designation**

Pb	Pa	P9	P8	P7	P6	P5	P4	P3	P2	P1	p0	Function
0	0	0	0	0	0	0	0	0	0	0	0	Designates flash memory page 000h.
0	0	0	0	0	0	0	0	0	0	0	1	Designates flash memory page 001h.
0	0	0	0	0	0	0	0	0	0	1	0	Designates flash memory page 002h.
0	0	0	0	0	0	0	0	0	0	1	1	Designates flash memory page 003h.
			•			•				•		•
			•			•				•		•
			•			•				•		•
1	1	1	1	1	1	1	1	1	1	0	1	Designates flash memory page FFDh.
1	1	1	1	1	1	1	1	1	1	1	0	Designates flash memory page FFEh.
1	1	1	1	1	1	1	1	1	1	1	1	Designates flash memory page FFFh.

**COMMAND DESCRIPTIONS**

1) NOP

• Command 

0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---

- Description Non-operation  
No function available.

2) REC

• Command 

0	0	0	1	0	S2	S1	S0
C7	C6	C5	C4	C3	C2	C1	C0

- Description Records the phrases designated by C7-C0 with the sampling frequency designated by S2-S0.

- Others

**Sampling frequency**

S2	S1	S0	Function
0	0	0	2kHz
0	0	1	2.7kHz
0	1	0	3.2kHz
0	1	1	4kHz
1	0	1	5.3kHz
1	1	0	6.4kHz
1	1	1	8kHz

**Phrase designation (1 to 63 phrases)**

C7	C6	C5	C4	C3	C2	C1	C0	Function
0	0	0	0	0	0	0	1	Phrase1
0	0	0	0	0	0	1	0	Phrase2
0	0	0	0	0	0	1	1	Phrase3
			•			•		•
			•			•		•
			•			•		•
0	0	1	1	1	1	1	0	Phrase62
0	0	1	1	1	1	1	1	Phrase63



3) PLY

- Command

0	0	1	0	0	0	0	M0
C7	C6	C5	C4	C3	C2	C1	C0

- Description Plays back the phrases recorded on the flash memory when M0 is "0". Designate the phrases with C7-C0 (1 to 63 phrases).

Plays back the phrases in the mask ROM when M0 is "1". Designate the phrases with C7-C0 (1 to 255 phrases).

4) STOP

- Command

0	0	1	1	0	0	0	0
---	---	---	---	---	---	---	---

- Description Quits recording or playback.

5) PAUSE

- Command

0	1	0	0	0	0	0	0
---	---	---	---	---	---	---	---

- Description Pauses recording or playback. Restarts recording or playback if the PAUSE command is input again.

6) BLKRW

- Command

0	1	0	1	0	0	0	M1
D7	D6	D5	D4	D3	D2	D1	D0

Output

O7	O6	O5	O4	O3	O2	O1	O0
----	----	----	----	----	----	----	----

- Note Outputs O7-O0 only when M1 is "1".
- Description Designate the number of blocks to be recorded/played back with D7-D0 when M1 is "0". Outputs, using O7-O0, the number of blocks that recorded the phrases (1 to 63 phrases) designated with D7-D0.

- Blocks The entire flash memory is divided into 256 blocks.

$$\text{One-block size} = \frac{\text{Flash memory size}}{256} \text{ (bits)}$$

7) DTRW

- Command

0	1	1	0	Pb	Pa	P9	P8
P7	P6	P5	P4	P3	P2	P1	P0

- Description Selects the DTRW mode. Inputs data to or outputs data from the flash memory page designated with Pb-P0. To reset the DTRW mode, input the WEND command or END command. The flash memory consists of 264 bytes per page. The number of pages on each flash memory is as follows:

	M9891L	M9892L	M9893L	M9894L
Memory size	1M bits	2M bits	4M bits	8M bits
One-block size	4224 bits	8448 bits	16896 bits	33792 bits
Number of pages	512 Pages	1024 Pages	2048 Pages	4096 Pages

8) DEL

- Command

0	1	1	1	0	0	0	0
C7	C6	C5	C4	C3	C2	C1	C0

- Description Erases the phrases designated with C7-C0 (flash memory only).

9) PDWN

- Command

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

- Description Stops the clock and sets the power-down mode after the command is input. To reset the power-down mode, input RESET.

10) BYTEW

- Command

1	0	0	1	0	0	0	B8
B7	B6	B5	B4	B3	B2	B1	B0
W7	W6	W5	W4	W3	W2	W1	W0

- Note This command is valid only in DTRW mode.
- Description Rewrites the content of the page designated with the DTRW command in units of bytes. Designate the address in the page with B8-B0 and input data with W7-W0.

11) BYTER

- Command

1	0	1	0	0	0	0	B8
B7	B6	B5	B4	B3	B2	B1	B0

Output

07	06	05	04	03	02	01	00
----	----	----	----	----	----	----	----

- Note This command is valid only in DTRW mode.
- Description Reads the content of the page designated with the DTRW command in units of byte. When the address in the page is designated with B8-B0, data is output after the command input.

12) WEND

- Command

1	0	1	1	0	0	0	0
---	---	---	---	---	---	---	---

- Note This command is valid only in DTRW mode.
- Description Writes the content of the page designated with the DTRW command to the flash memory then exits the DTRW mode.

13) END

- Command

1	1	0	0	0	0	0	0
---	---	---	---	---	---	---	---

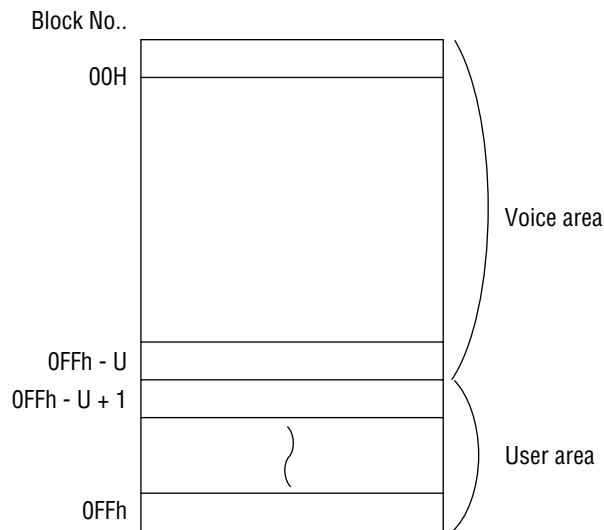
- Note This command is valid only in DTRW mode.
- Description Exits the DTRW mode without writing the content of the page designated with the DTRW command to the flash memory.

14) INIT

• Command

1	1	1	0	1	0	1	0
0	0	0	0	0	0	F1	F0
U7	U6	U5	U4	U3	U2	U1	U0

- Description Initializes the area that eliminates the number of blocks designated with U7-U0) from the end of the flash memory blocks as the recording/playback area. Also, selects the type of the flash memory with F1-F0.



F1	F0	Flash memory size	Product name
0	0	1Mbits	MSM9891L
0	1	2Mbits	MSM9892L
1	0	4Mbits	MSM9893L
1	1	8Mbits	MSM9894L

15) STATUS

• Command 

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

Output 

07	06	05	04	03	02	01	00
----	----	----	----	----	----	----	----

• Description Outputs the M9888 status.

O7; MON

Outputs "1" during execution of the REC or PLY command. It includes the memory management time in addition to the recording/playback time. Also, outputs the same value as that of the MON pin.

O6; VPM

Outputs "1" during pause.

O5; RPM

Outputs "1" during actual recording by the REC command or during voice output by the PLT command. Otherwise, "0" is output.

O3; MEMFUL

Outputs "1" when there is no voice area on the flash memory.

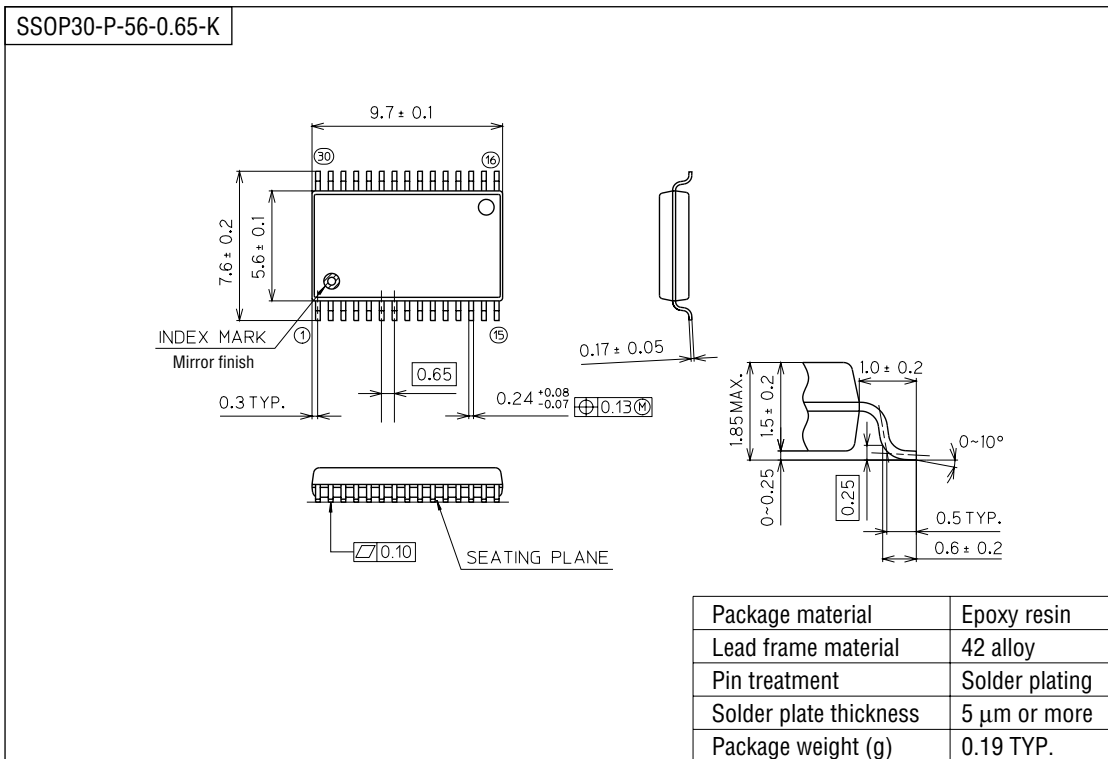
O2; NAR

Outputs "0" when the next phrase can be input during continuous voice playback.

O4, O1, and O0 have no function.

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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