

**SANYO**

No. 4816A

**LC36128ML-70/85/10****128 K (16384 words × 8 bits) SRAM**

## Overview

The LC36128ML are fully asynchronous silicon gate CMOS static RAMs with a 16384 words × 8 bits configuration.

This series has a  $\overline{CE}$  chip enable pin for device select/non-select control and an  $\overline{OE}$  output enable pin for output control, and features high speed as well as low power dissipation.

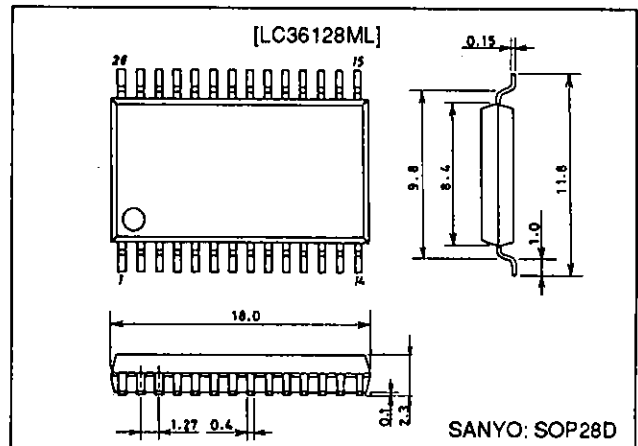
For these reasons, the series is especially suited for use in systems requiring high speed, low power, and battery backup, and it is easy to expand memory capacity.

## Features

- Access time
  - 70 ns (max.) : LC36128ML-70
  - 85 ns (max.) : LC36128ML-85
  - 100 ns (max.) : LC36128ML-10
- Low current dissipation
  - During standby
    - 1  $\mu$ A (max.) /  $T_a = 25^\circ\text{C}$
    - 2  $\mu$ A (max.) /  $T_a = 0$  to  $+40^\circ\text{C}$
    - 12  $\mu$ A (max.) /  $T_a = 0$  to  $+70^\circ\text{C}$
  - During data retention
    - 0.4  $\mu$ A (max.) /  $T_a = 25^\circ\text{C}$
    - 1  $\mu$ A (max.) /  $T_a = 0$  to  $+40^\circ\text{C}$
    - 5  $\mu$ A (max.) /  $T_a = 0$  to  $+70^\circ\text{C}$
  - During operation (DC)
    - 10 mA (max.)
- Single 5 V power supply:  $5\text{ V} \pm 10\%$
- Data retention power supply voltage: 2.0 to 5.5 V
- No clock required (Fully static memory)
- All input and output levels are TTL compatible
- Common input/output pins, with three output states
- Package
  - SOP 28-pin (450 mil) plastic package : LC36128ML

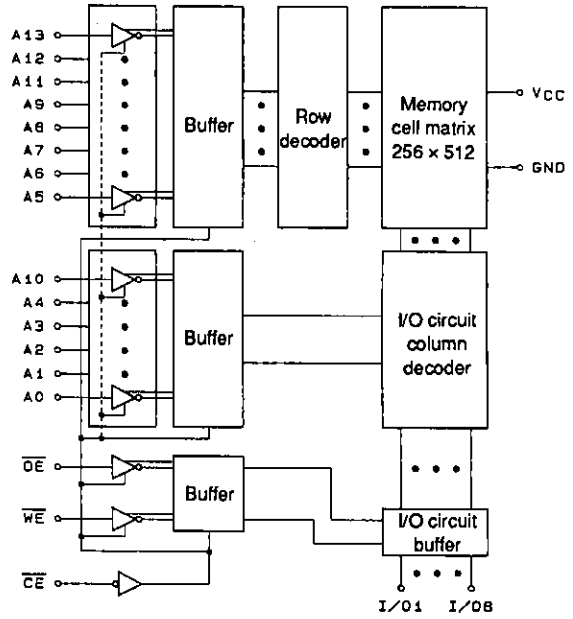
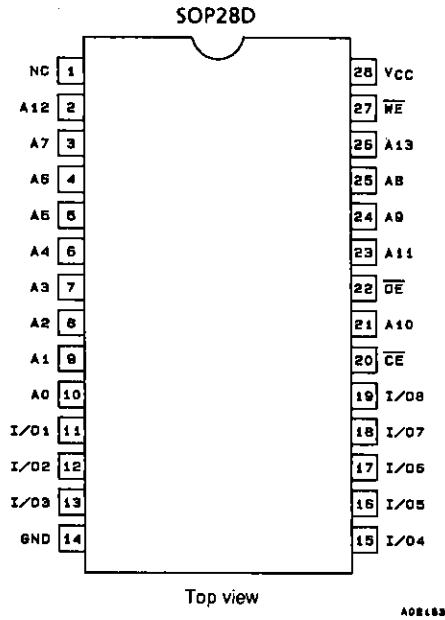
## Package Dimensions

unit: mm

**3187-SOP28D**

Pin Assignment

Block Diagram



Pin Functions

A0 to A13	Address input
WE	Read/write control input
OE	Output enable input
CE	Chip enable input
I/O1 to I/O8	Data input/output
VCC, GND	Power supply pins

Functions Logic

Mode	CE	OE	WE	I/O	Supply current
Read cycle	L	L	H	Data output	I <sub>CCA</sub>
Write cycle	L	X	L	Data input	I <sub>CCA</sub>
Output disable	L	H	H	High impedance	I <sub>CCA</sub>
Non-select	H	X	X	High impedance	I <sub>CCS</sub>

X: H or L

## Specifications

### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		7.0	V
Input pin voltage	V <sub>IN</sub>		-0.5* to V <sub>CC</sub> + 0.5	V
I/O pin voltage	V <sub>I/O</sub>		-0.5* to V <sub>CC</sub> + 0.5	V
Allowable power dissipation	Pd max		0.7	W
Operating temperature range	T <sub>opr</sub>		0 to +70	°C
Storage temperature range	T <sub>stg</sub>		-55 to +150	°C

\* -3.0 V when pulse width is less than 50 ns

### DC Recommended Operating Ranges at Ta = 0 to +70°C

Parameter	Symbol	min	typ	max	Unit
Power supply voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Input high level voltage	V <sub>IH</sub>	2.2		V <sub>CC</sub> + 0.3	V
Input low level voltage	V <sub>IL</sub>	-0.3*		+0.8	V

\* -3.0 V when pulse width is less than 50 ns

### DC Electrical Characteristics at Ta = 0 to +70°C, V<sub>CC</sub> = 5 V ± 10%

Parameter	Symbol	Conditions	min	typ*	max	Unit	
Input leakage current	I <sub>LI</sub>	V <sub>IN</sub> = 0 to V <sub>CC</sub>	-1.0		+1.0	μA	
I/O leakage current	I <sub>LO</sub>	V <sub>CE</sub> = V <sub>IH</sub> or V <sub>OE</sub> = V <sub>IH</sub> , V <sub>I/O</sub> = 0 to V <sub>CC</sub>	-1.0		+1.0	μA	
Output high level voltage	V <sub>OH</sub>	I <sub>OH</sub> = -1.0 mA	2.4			V	
Output low level voltage	V <sub>OL</sub>	I <sub>OL</sub> = 2.1 mA			0.4	V	
Operating supply current (DC)	I <sub>CCA1</sub>	V <sub>CE</sub> ≤ 0.2 V, V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V, I <sub>I/O</sub> = 0 mA		1	5	mA	
	I <sub>CCA2</sub>	V <sub>CE</sub> = V <sub>IL</sub> , I <sub>I/O</sub> = 0 mA		3	10	mA	
Average operating supply current	I <sub>CCA3</sub>	min cycle Duty = 100% I <sub>I/O</sub> = 0 mA	Access time	70 ns	30	50	mA
				85 ns	25	50	
				100 ns	23	50	
Standby supply current	I <sub>CCS1</sub>	V <sub>CE</sub> ≥ V <sub>CC</sub> - 0.2 V	0 to +70°C		12	μA	
			0 to +40°C		2		
	I <sub>CCS2</sub>		V <sub>CE</sub> = V <sub>IH</sub>		0.4		2

\* Reference values at V<sub>CC</sub> = 5 V, Ta = 25°C

## LC36128ML-70/85/10

### Input/Output Capacitance at $T_a = 25^\circ\text{C}$ , $f = 1\text{ MHz}$

Parameter	Symbol	Conditions	min	typ	max	Unit
Input/output capacitance	$C_{I/O}$	$V_{I/O} = 0\text{ V}$			8	pF
Input capacitance	$C_{IN}$	$V_{IN} = 0\text{ V}$			6	pF

Note: These parameters were obtained through sampling, and not full-lot measurement.

### AC Electrical Characteristics at $T_a = 0$ to $+70^\circ\text{C}$ , $V_{CC} = 5\text{ V} \pm 10\%$

#### AC testing conditions

- Input pulse voltage level : 0.8 V, 2.2 V
- Input rise and fall time : 5 ns
- Input - output timing level : 1.5 V
- Output load : 1 TTL gate +  $C_L = 100\text{ pF}$  (85 ns/100 ns)  
1 TTL gate +  $C_L = 30\text{ pF}$  (70 ns)  
(including scope and jig capacitance)

### Read Cycle

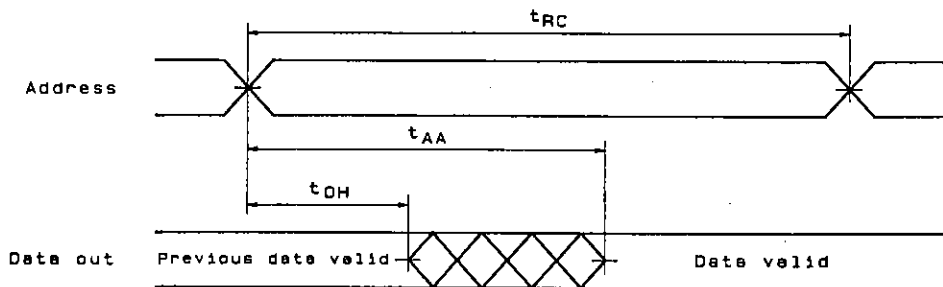
Parameter	Symbol	LC36128ML						Unit
		-70		-85		-10		
		min	max	min	max	min	max	
Read cycle time	$t_{RC}$	70		85		100		ns
Address access time	$t_{AA}$		70		85		100	ns
$\overline{\text{CE}}$ access time	$t_{CA}$		70		85		100	ns
$\overline{\text{OE}}$ access time	$t_{OA}$		35		45		50	ns
Output hold time	$t_{OH}$	20		20		20		ns
$\overline{\text{CE}}$ output enable time	$t_{COE}$	10		10		10		ns
$\overline{\text{OE}}$ output enable time	$t_{OOE}$	5		5		5		ns
$\overline{\text{CE}}$ output disable time	$t_{COD}$	0	30	0	30	0	30	ns
$\overline{\text{OE}}$ output disable time	$t_{OOD}$	0	30	0	30	0	30	ns

### Write Cycle

Parameter	Symbol	LC36128ML						Unit
		-70		-85		-10		
		min	max	min	max	min	max	
Write cycle time	$t_{WC}$	70		85		100		ns
Address valid to end of write	$t_{AW}$	65		75		80		ns
Address setup time	$t_{AS}$	0		0		0		ns
Write pulse width	$t_{WP}$	50		50		60		ns
$\overline{\text{CE}}$ setup time	$t_{CW}$	65		75		80		ns
Write recovery time ( $\overline{\text{WE}}$ )	$t_{WR}$	0		0		0		ns
Write recovery time ( $\overline{\text{CE}}$ )	$t_{WR1}$	0		0		0		ns
Data setup time	$t_{DS}$	30		30		35		ns
Data hold time	$t_{DH}$	0		0		0		ns
$\overline{\text{WE}}$ output enable time	$t_{WOE}$	10		10		10		ns
$\overline{\text{WE}}$ output disable time	$t_{WOD}$	0	25	0	25	0	25	ns

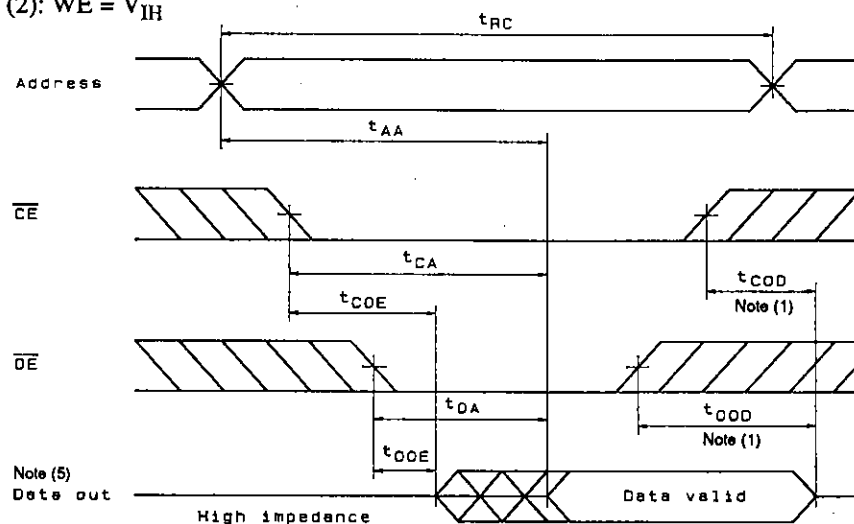
Timing Chart

- Read Cycle (1):  $\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$



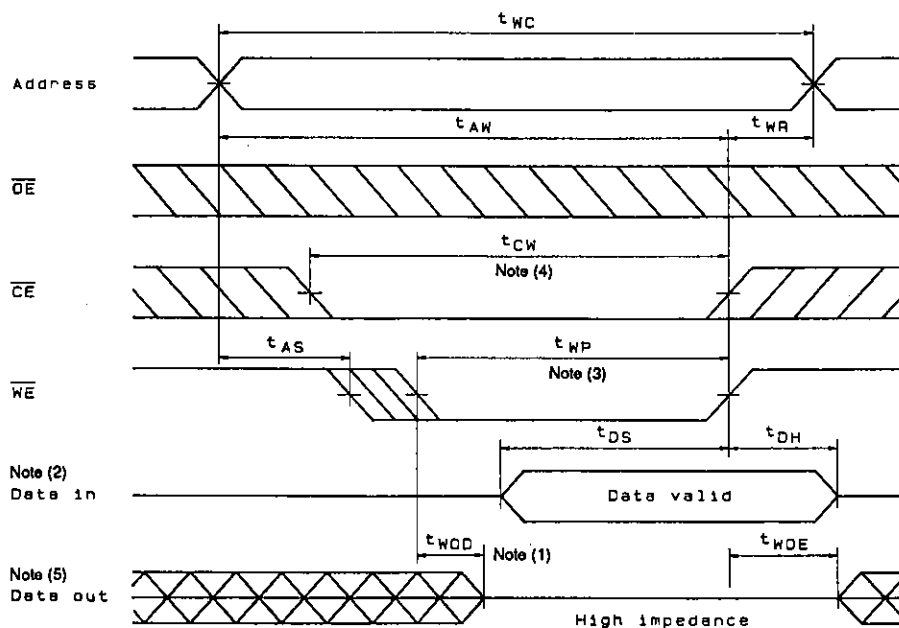
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- Read Cycle (2):  $\overline{WE} = V_{IH}$



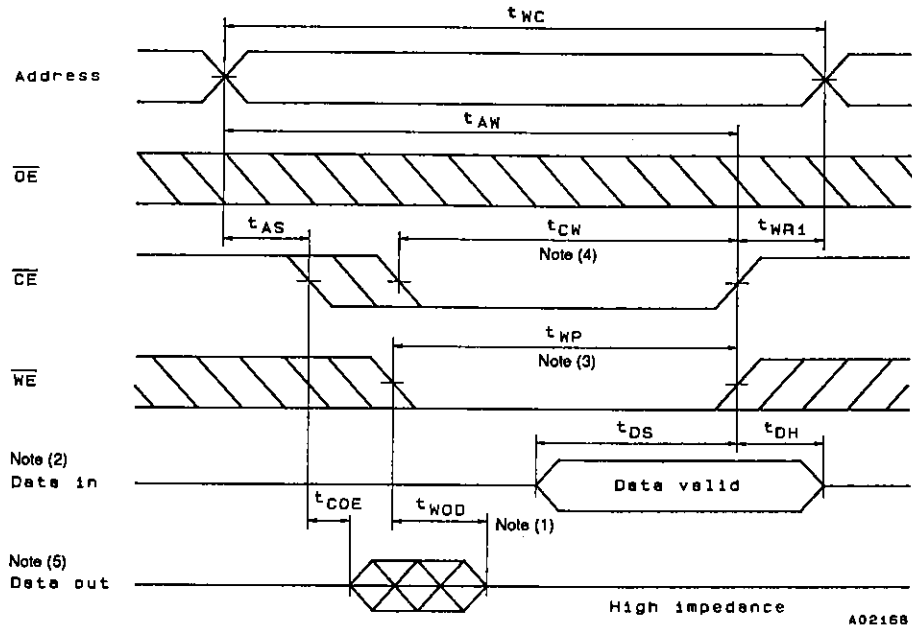
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- Write Cycle (1):  $\overline{WE}$  Control Note (6)



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• Write Cycle (2):  $\overline{CE}$  Control Note (6)



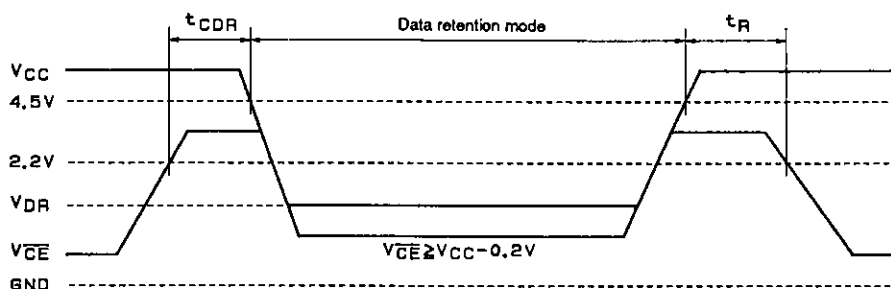
- Notes: (1)  $t_{COD}$ ,  $t_{OOD}$ , and  $t_{WOD}$  are defined as the time at which the outputs becomes the high impedance state and are not referred to output voltage levels.
- (2) An external antiphase signal must not be applied when  $D_{OUT}$  is in the output state.
- (3)  $t_{WP}$  is the time interval that  $\overline{CE}$  and  $\overline{WE}$  are low-level and is defined as the interval from the falling of  $\overline{WE}$  to the rising of  $\overline{CE}$  or  $\overline{WE}$ , whichever is earlier.
- (4)  $t_{CW}$  is the time interval that  $\overline{CE}$  and  $\overline{WE}$  are low-level and is defined as the time from the falling of  $\overline{CE}$  to the rising of  $\overline{CE}$  or  $\overline{WE}$ , whichever is earlier.
- (5)  $D_{OUT}$  goes to the high-impedance state when either  $\overline{OE}$  is high-level,  $\overline{CE}$  is high-level, or  $\overline{WE}$  is low-level.
- (6) When  $\overline{OE}$  is high-level during the write cycle,  $D_{OUT}$  goes to the high-impedance state.

**Data Retention Characteristics at Ta = 0 to +70°C**

Parameter	Symbol	Conditions	min	typ	max	Unit
Data retention supply voltage	V <sub>DR</sub>	V <sub>CE</sub> ≥ V <sub>CC</sub> - 0.2 V	2.0		5.5	V
Data retention supply current	I <sub>CCDR1</sub>	V <sub>CC</sub> = 3.0 V, V <sub>CE</sub> ≥ 2.8 V	0 to +70°C		5	μA
			0 to +40°C		1	
			25°C		0.4	
	I <sub>CCDR2</sub>	V <sub>CC</sub> = 2.0 to 5.5 V, V <sub>CE</sub> ≥ V <sub>CC</sub> - 0.2 V			12	μA
CE setup time	t <sub>CDR</sub>		0			ns
CE hold time	t <sub>R</sub>		t <sub>RC</sub> *			ns

\* t<sub>RC</sub> = Read Cycle time

**Data Retention Waveform**



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