

TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

131,072-WORD BY 8-BIT STATIC RAM

DESCRIPTION

The TC55V1001FI/FTI/TRI/STI/SRI is a 1,048,576-bit static random access memory (SRAM) organized as 131,072 words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 2.7 to 3.6 V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 3 mA/MHz (typ) and a minimum cycle time of 85 ns. It is automatically placed in low-power mode at 1 μ A standby current (typ) when chip enable (CE1) is asserted high or (CE2) is asserted low. There are three control inputs. CE1 and CE2 are used to select the device and for data retention control, and output enable (OE) provides fast memory access. This device is well suited to various microprocessor system applications where high speed, low power and battery backup are required. And, with a guaranteed operating range of -40° to 85°C, the TC55V1001FI/FTI/TRI/STI/SRI can be used in environments exhibiting extreme temperature conditions. The TC55V1001FI/FTI/TRI/STI/SRI is available in a plastic 32-pin small-outline package (SOP) and normal and reverse pinout plastic 32-pin thin-small-outline package (TSOP).

FEATURES

- Low-power dissipation
Operating: 10.8 mW/MHz (typical)
- Standby current of 3 μ A (maximum) at Ta = 25°C
- Single power supply voltage of 2.7 to 3.6 V
- Power down features using CE1 and CE2.
- Data retention supply voltage of 2 to 3.6 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of -40° to 85°C

● Access Times (maximum):

| | 2.7 to 3.6 V | |
|-----------------|--------------|--------|
| | -85 | -10 |
| Access Time | 85 ns | 100 ns |
| CE1 Access Time | 85 ns | 100 ns |
| CE2 Access Time | 85 ns | 100 ns |
| OE Access Time | 45 ns | 50 ns |

● Packages:

| | |
|------------------------------|----------------------|
| SOP32-P-525-1.27 (FI) | (Weight: 1.04 g typ) |
| TSOP I 32-P-0820-0.50 (FTI) | (Weight: 0.34 g typ) |
| TSOP I 32-P-0820-0.50A (TRI) | (Weight: 0.34 g typ) |
| TSOP I 32-P-0.50 (STI) | (Weight: 0.24 g typ) |
| TSOP I 32-P-0.50A (SRI) | (Weight: 0.24 g typ) |

PIN ASSIGNMENT (TOP VIEW)

○ 32 PIN SOP

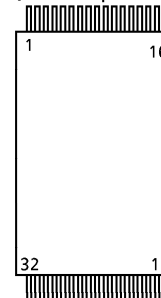
| | | | |
|------|----|----|-----------------|
| NC | 1 | 32 | V _{DD} |
| A16 | 2 | 31 | A15 |
| A14 | 3 | 30 | CE2 |
| A12 | 4 | 29 | R/W |
| A7 | 5 | 28 | A13 |
| A6 | 6 | 27 | A8 |
| A5 | 7 | 26 | A9 |
| A4 | 8 | 25 | A11 |
| A3 | 9 | 24 | OE |
| A2 | 10 | 23 | A10 |
| A1 | 11 | 22 | CE1 |
| A0 | 12 | 21 | I/O8 |
| I/O1 | 13 | 20 | I/O7 |
| I/O2 | 14 | 19 | I/O6 |
| I/O3 | 15 | 18 | I/O5 |
| GND | 16 | 17 | I/O4 |

○ 32 PIN TSOP

(Normal pinout)



(Reverse pinout)



PIN NAMES

| | |
|-----------------|--------------------|
| A0 to A16 | Address Inputs |
| R/W | Read/Write Control |
| OE | Output Enable |
| CE1, CE2 | Chip Enable |
| I/O1 to I/O8 | Data Input/Output |
| V _{DD} | Power |
| GND | Ground |
| NC | No Connection |

| | | | | | | | | | | | | | | | | |
|----------|-----------------|----------------|----------------|-----------------|------|------|-----------------|-----------------|------|-----------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|
| Pin No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Pin Name | A ₁₁ | A ₉ | A ₈ | A ₁₃ | R/W | CE2 | A ₁₅ | V _{DD} | NC | A ₁₆ | A ₁₄ | A ₁₂ | A ₇ | A ₆ | A ₅ | A ₄ |
| Pin No. | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| Pin Name | A ₃ | A ₂ | A ₁ | A ₀ | I/O1 | I/O2 | I/O3 | GND | I/O4 | I/O5 | I/O6 | I/O7 | I/O8 | CE1 | A ₁₀ | OE |

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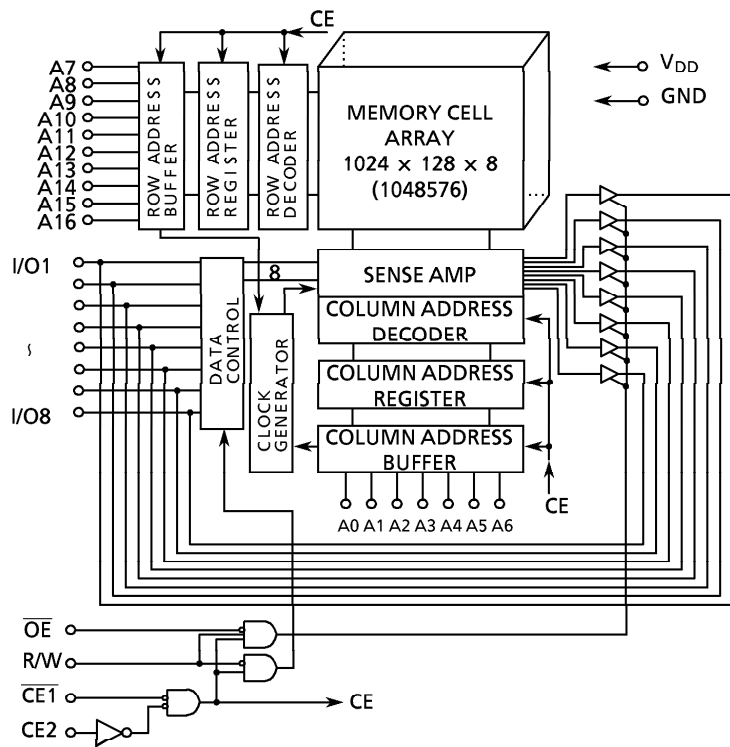
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BLOCK DIAGRAM



OPERATION MODE

| MODE | $\overline{CE1}$ | CE2 | \overline{OE} | R/W | I/O1 to I/O8 | POWER |
|------------------|------------------|-----|-----------------|-----|------------------|------------------|
| Read | L | H | L | H | D _{OUT} | I _{DDO} |
| Write | L | H | x | L | D _{IN} | I _{DDO} |
| Outputs Disabled | L | H | H | H | High-Z | I _{DDO} |
| Standby | H | x | x | x | High-Z | I _{DDs} |
| | x | L | x | x | High-Z | I _{DDs} |

Note: x = don't care. H = logic high. L = logic low.

ABSOLUTE MAXIMUM RATINGS

| SYMBOL | RATING | VALUE | UNIT |
|---------------------|------------------------------|--------------------------------|------|
| V _{DD} | Power Supply Voltage | - 0.3 to 4.6 | V |
| V _{IN} | Input Voltage | - 0.3* to 4.6 | V |
| V _{I/O} | Input/Output Voltage | - 0.5 to V _{DD} + 0.5 | V |
| P _D | Power Dissipation | 0.8 | W |
| T _{solder} | Soldering Temperature (10 s) | 260 | °C |
| T _{strg.} | Storage Temperature | - 55 to 150 | °C |
| T _{opr.} | Operating Temperature | - 40 to 85 | °C |

* - 3.0 V when measured at a pulse width of 50 ns

** SOP

DC RECOMMENDED OPERATING CONDITIONS (Ta = - 40° to 85°C)

| SYMBOL | PARAMETER | 2.7 to 3.6 V | | | UNIT |
|-----------------|-------------------------------|--------------|-----|-----------------------|------|
| | | MIN | TYP | MAX | |
| V _{DD} | Power Supply Voltage | 2.7 | - | 3.6 | V |
| V _{IH} | Input High Voltage | 2.2 | - | V _{DD} + 0.3 | |
| V _{IL} | Input Low Voltage | - 0.3* | - | 0.6 | |
| V _{DH} | Data Retention Supply Voltage | 2.0 | - | 3.6 | |

* - 3.0 V when measured at a pulse width of 50 ns

DC CHARACTERISTICS (Ta = - 40° to 85°C, V_{DD} = 2.7 to 3.6 V)

| SYMBOL | PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT | | | |
|-----------------------------|------------------------|---|---------------------------------|--------------------|-------|------|----|----|----|
| I _{IL} | Input Leakage Current | V _{IN} = 0 V to V _{DD} | - | - | ± 1.0 | μA | | | |
| I _{OH} | Output High Current | V _{OH} = V _{DD} - 0.5 V | - 0.5 | - | - | mA | | | |
| I _{OL} | Output Low Current | V _{OL} = 0.4 V | 2.1 | - | - | mA | | | |
| I _{LO} | Output Leakage Current | $\overline{CE1} = V_{IH}$ or CE2 = V _{IL} or RW = V _{IL} or $\overline{OE} = V_{IH}$, V _{OUT} = 0 V to V _{DD} | - | - | ± 1.0 | μA | | | |
| I _{DDO1} | Operating Current | $\overline{CE1} = V_{IL}$ and CE2 = V _{IH} and RW = V _{IH} , I _{OUT} = 0 mA Other Input = V _{IH} /V _{IL} | V _{DD} = 3 V ± 10% | Tcycle | min | - | - | 35 | mA |
| | | | | | 1 μs | - | - | 10 | |
| I _{DDO2} | Operating Current | $\overline{CE1} = 0.2$ V and CE2 = V _{DD} - 0.2 V RW = V _{DD} - 0.2 V, I _{OUT} = 0 mA Other Inputs = V _{DD} - 0.2 V/0.2 V | V _{DD} = 3 V ± 10% | Tcycle | min | - | - | 30 | |
| | | | | | 1 μs | - | - | 5 | |
| I _{DDO2} | Operating Current | $\overline{CE1} = 0.2$ V and CE2 = V _{DD} - 0.2 V RW = V _{DD} - 0.2 V, I _{OUT} = 0 mA Other Inputs = V _{DD} - 0.2 V/0.2 V | V _{DD} = 3.3 V ± 0.3 V | Tcycle | min | - | - | 35 | |
| | | | | | 1 μs | - | - | 6 | |
| I _{DDS1} | Standby Current | $\overline{CE1} = V_{IH}$ or CE2 = V _{IL} | | | - | - | 2 | mA | |
| I _{DDS2} (Note) | | $\overline{CE1} = V_{DD} - 0.2$ V or CE2 = 0.2 V V _{DD} = 2.0 to 3.6 V | V _{DD} = 3 V ± 10% | Ta = 25°C | - | 1 | 2 | μA | |
| | | | | Ta = - 40° to 85°C | - | - | 40 | | |
| | | | V _{DD} = 3.3 V ± 0.3 V | Ta = 25°C | - | 2 | 3 | | |
| | | | | Ta = - 40° to 85°C | - | - | 45 | | |
| | | | V _{DD} = 3.0 V | Ta = 25°C | - | 1 | - | | |
| Ta = - 40° to 40°C | - | - | 3 | | | | | | |
| Ta = - 40° to 85°C | - | - | 35 | | | | | | |

Note: In standby mode with $\overline{CE1} \geq V_{DD} - 0.2$ V, these limits are assured for the condition CE2 $\geq V_{DD} - 0.2$ V or CE2 ≤ 0.2 V.

CAPACITANCE (Ta = 25°C, f = 1 MHz)

| SYMBOL | PARAMETER | TEST CONDITION | MAX | UNIT |
|------------------|--------------------|------------------------|-----|------|
| C _{IN} | Input Capacitance | V _{IN} = GND | 10 | pF |
| C _{OUT} | Output Capacitance | V _{OUT} = GND | 10 | |

Note: This parameter is periodically sampled and is not 100% tested.

AC CHARACTERISTICS AND OPERATING CONDITIONS ($T_a = -40^\circ$ to 85°C , $V_{DD} = 2.7$ to 3.6 V)

READ CYCLE

| SYMBOL | PARAMETER | TC55V1001FI/FTI/TRI/STI/SRI | | | | UNIT |
|-----------|-------------------------------------|-----------------------------|-----|-----|-----|------|
| | | -85 | | -10 | | |
| | | MIN | MAX | MIN | MAX | |
| t_{RC} | Read Cycle Time | 85 | – | 100 | – | ns |
| t_{ACC} | Address Access Time | – | 85 | – | 100 | |
| t_{CO1} | Chip Enable (CE1) Access Time | – | 85 | – | 100 | |
| t_{CO2} | Chip Enable (CE2) Access Time | – | 85 | – | 100 | |
| t_{OE} | Output Enable Access Time | – | 45 | – | 50 | |
| t_{COE} | Chip Enable Low to Output Active | 5 | – | 5 | – | |
| t_{OEE} | Output Enable Low to Output Active | 0 | – | 0 | – | |
| t_{OD} | Chip Enable High to Output High-Z | – | 35 | – | 40 | |
| t_{ODO} | Output Enable High to Output High-Z | – | 35 | – | 40 | |
| t_{OH} | Output Data Hold Time | 10 | – | 10 | – | |

WRITE CYCLE

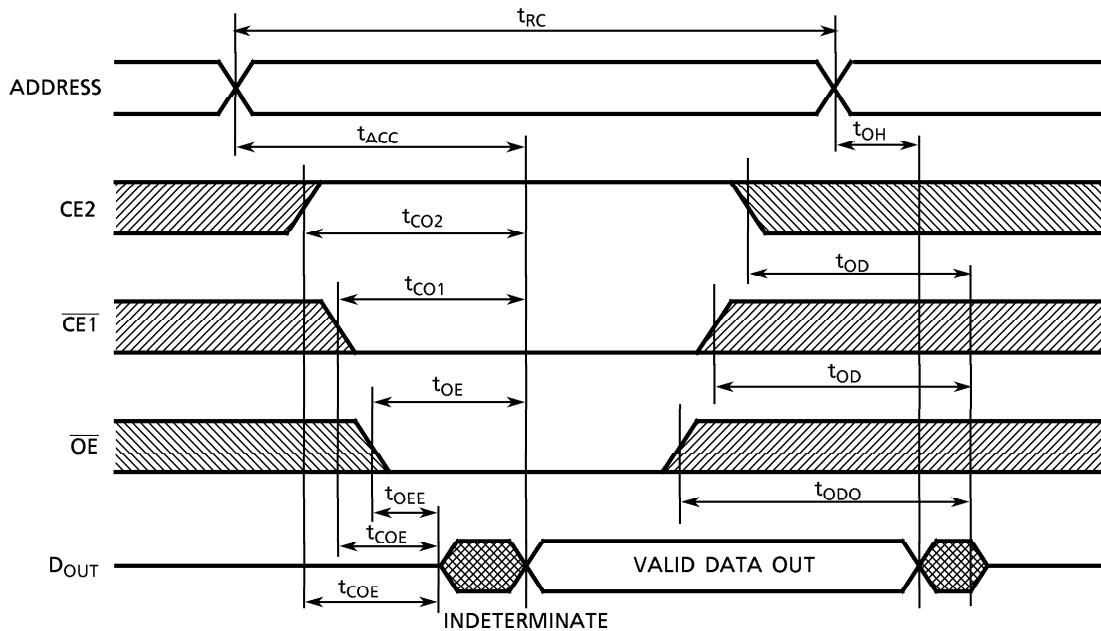
| SYMBOL | PARAMETER | TC55V1001FI/FTI/TRI/STI/SRI | | | | UNIT |
|-----------|-----------------------------|-----------------------------|-----|-----|-----|------|
| | | -85 | | -10 | | |
| | | MIN | MAX | MIN | MAX | |
| t_{WC} | Write Cycle Time | 85 | – | 100 | – | ns |
| t_{WP} | Write Pulse Width | 60 | – | 60 | – | |
| t_{CW} | Chip Enable to End of Write | 75 | – | 80 | – | |
| t_{AS} | Address Setup Time | 0 | – | 0 | – | |
| t_{WR} | Write Recovery Time | 0 | – | 0 | – | |
| t_{ODW} | R/W Low to Output High-Z | – | 35 | – | 40 | |
| t_{OEW} | R/W High to Output Active | 0 | – | 0 | – | |
| t_{DS} | Data Set up Time | 35 | – | 40 | – | |
| t_{DH} | Data Hold Time | 0 | – | 0 | – | |

AC TEST CONDITIONS

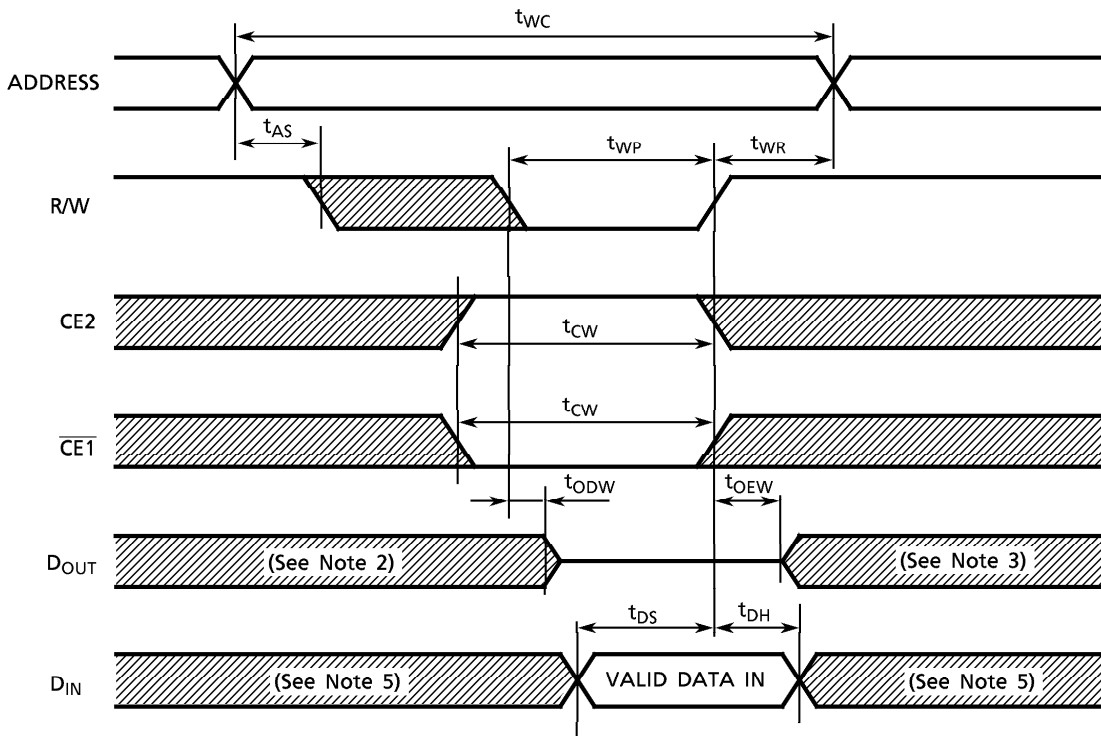
Output load: 100 pF + one TTL gate
 Input pulse level: 0.4 V, 2.4 V
 Timing measurements: 1.5 V
 Reference level: 1.5 V
 t_R, t_F : 5 ns

TIMING DIAGRAMS

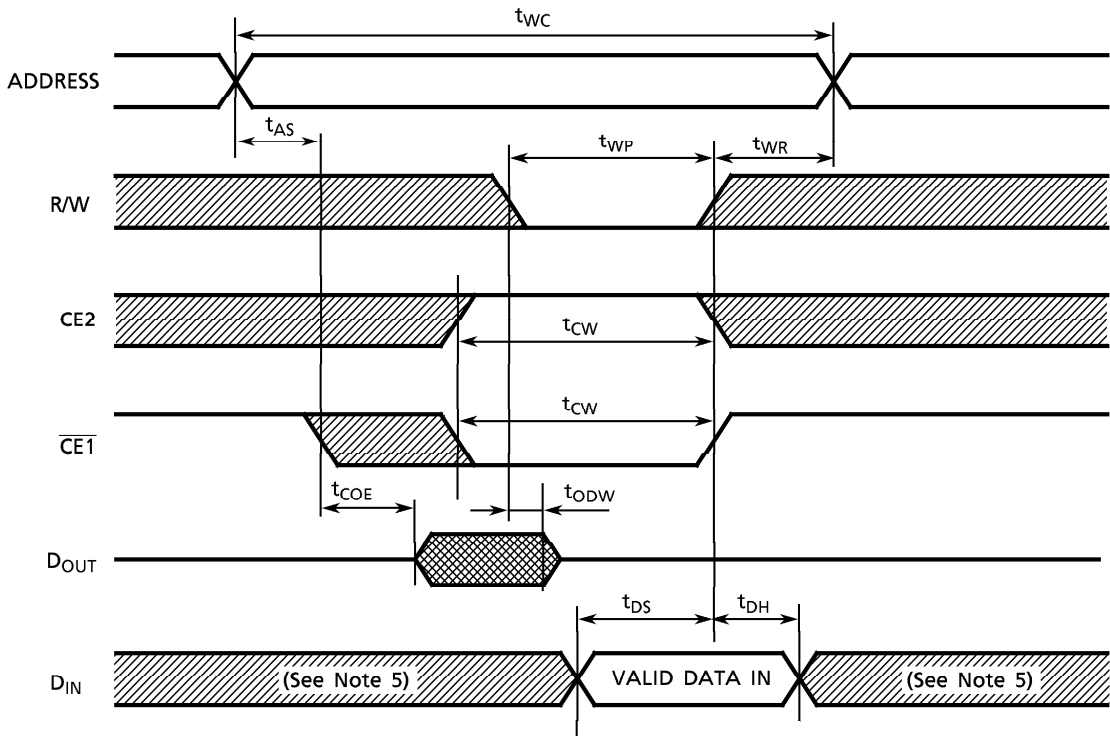
READ CYCLE (See Note 1)



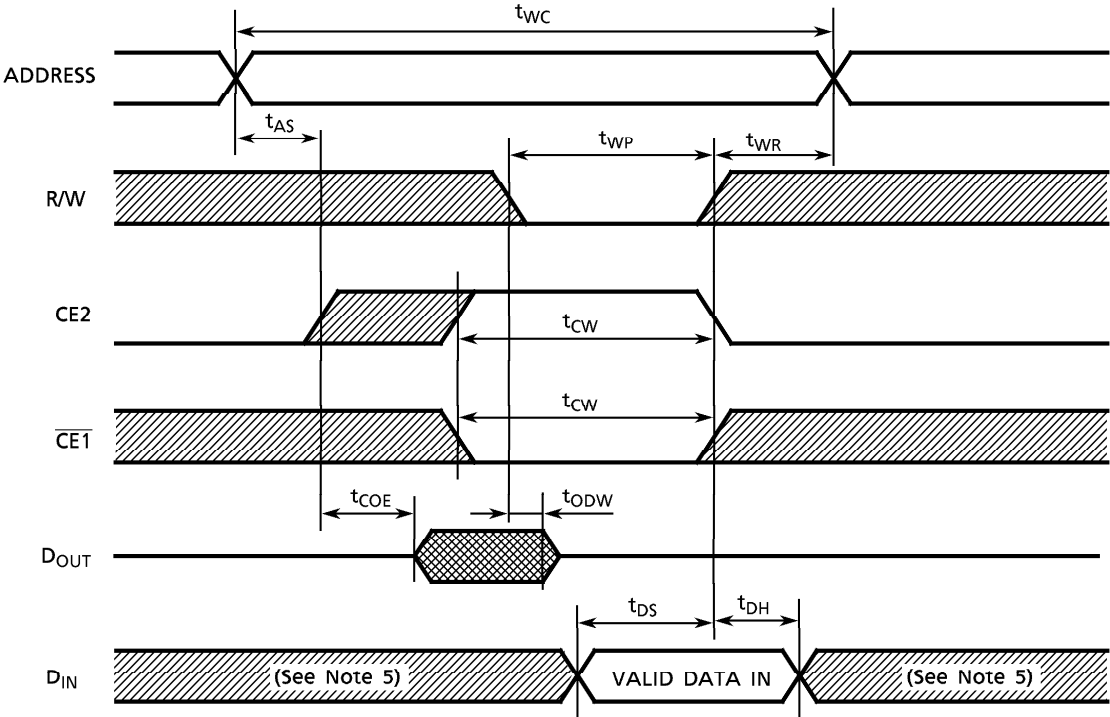
WRITE CYCLE 1 (R/W CONTROLLED) (See Note 4)



WRITE CYCLE 2 (CE1 CONTROLLED) (See Note 4)



WRITE CYCLE 3 (CE2 CONTROLLED) (See Note 4)



Note: (1) R/W remains HIGH for the read cycle.

(2) If \overline{CE} goes LOW (or CE2 goes HIGH) coincident with or after R/W goes LOW, the outputs will remain at high impedance.

(3) If \overline{CE} goes HIGH (or CE2 goes LOW) coincident with or before R/W goes HIGH, the outputs will remain at high impedance.

(4) If \overline{OE} is HIGH during the write cycle, the outputs will remain at high impedance.

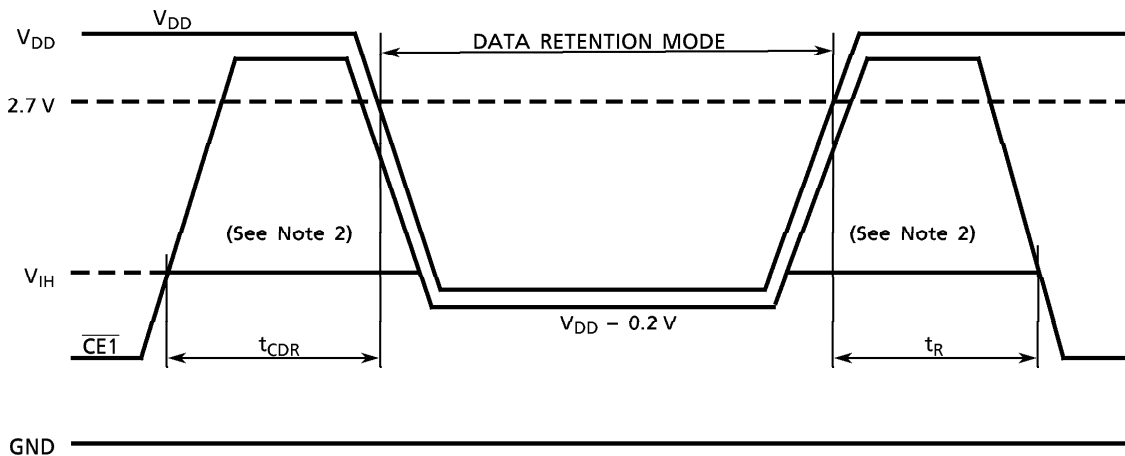
(5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

DATA RETENTION CHARACTERISTICS (Ta = - 40° to 85°C)

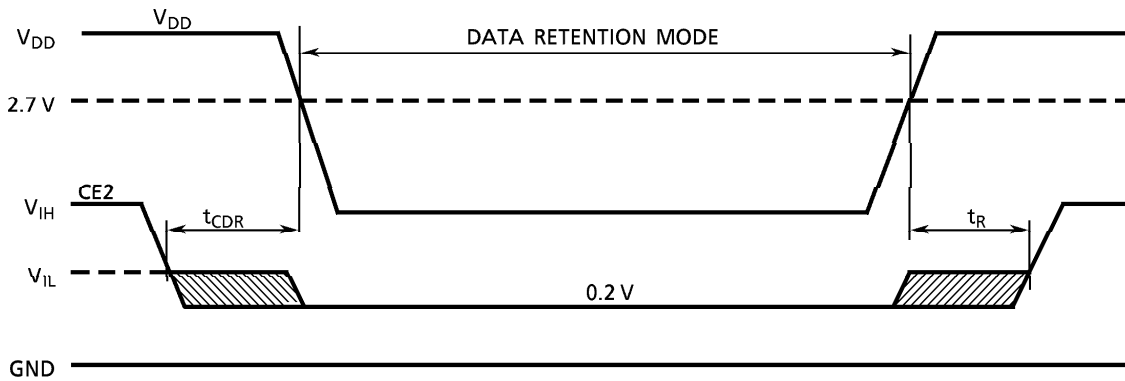
| SYMBOL | PARAMETER | MIN | TYP | MAX | UNIT |
|-------------------|---|-------------------------|-----|-----|------|
| V _{DH} | Data Retention Supply Voltage | 2.0 | - | 3.6 | V |
| I _{DDS2} | Standby Current | V _{DH} = 3.0 V | - | 35* | μA |
| | | V _{DH} = 3.6 V | - | 45 | |
| t _{CDR} | Chip Deselect to Data Retention Mode Time | 0 | - | - | nS |
| t _R | Recovery Time | 5 | - | - | mS |

* 3 μA (max) at Ta = - 40° to 40°C

CE1 CONTROLLED DATA RETENTION MODE (See Note 1)



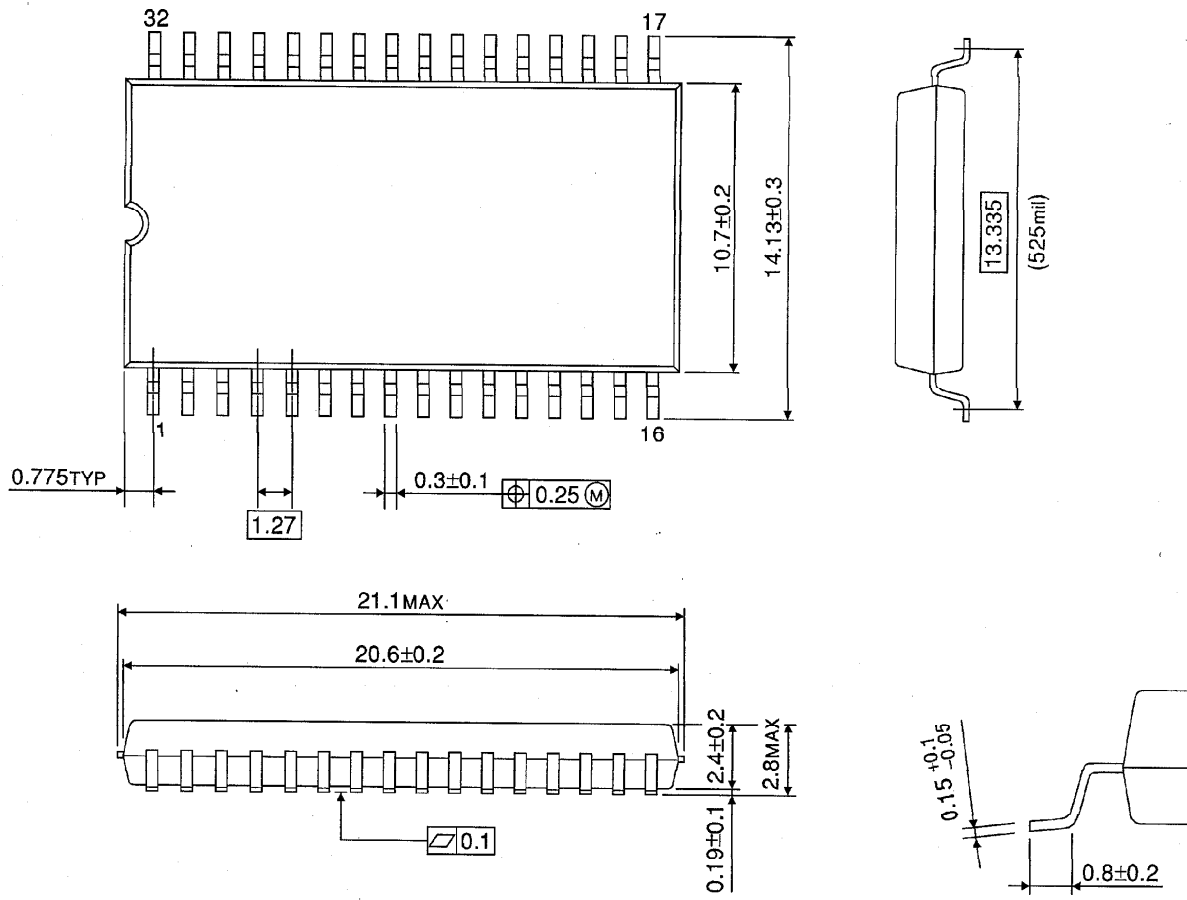
CE2 CONTROLLED DATA RETENTION MODE (See Note 3)



- Note: (1) In $\overline{CE1}$ controlled data retention mode, minimum standby current mode is entered when $CE2 \leq 0.2 \text{ V}$ or $CE2 \geq V_{DD} - 0.2 \text{ V}$.
- (2) When $\overline{CE1}$ is operating at the V_{IH} level (2 V), the operating current is given by I_{DD51} during the transition of V_{DD} from 3.6 to 2.2 V.
- (3) In $CE2$ controlled data retention mode, minimum standby current mode is entered when $CE2 \leq 0.2 \text{ V}$.

PACKAGE DIMENSIONS (SOP32-P-525-1.27)

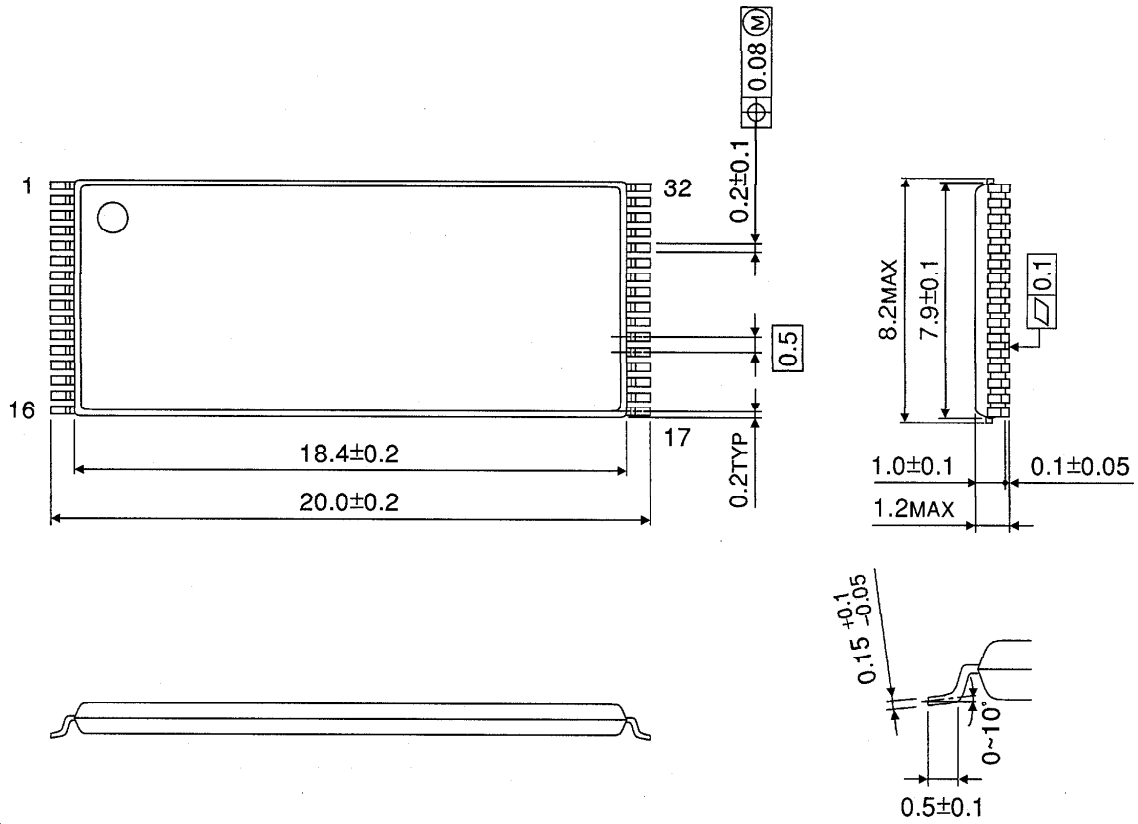
Units in mm



Weight: 1.04 g (typ)

PACKAGE DIMENSIONS (TSOP I 32-P-0820-0.50)

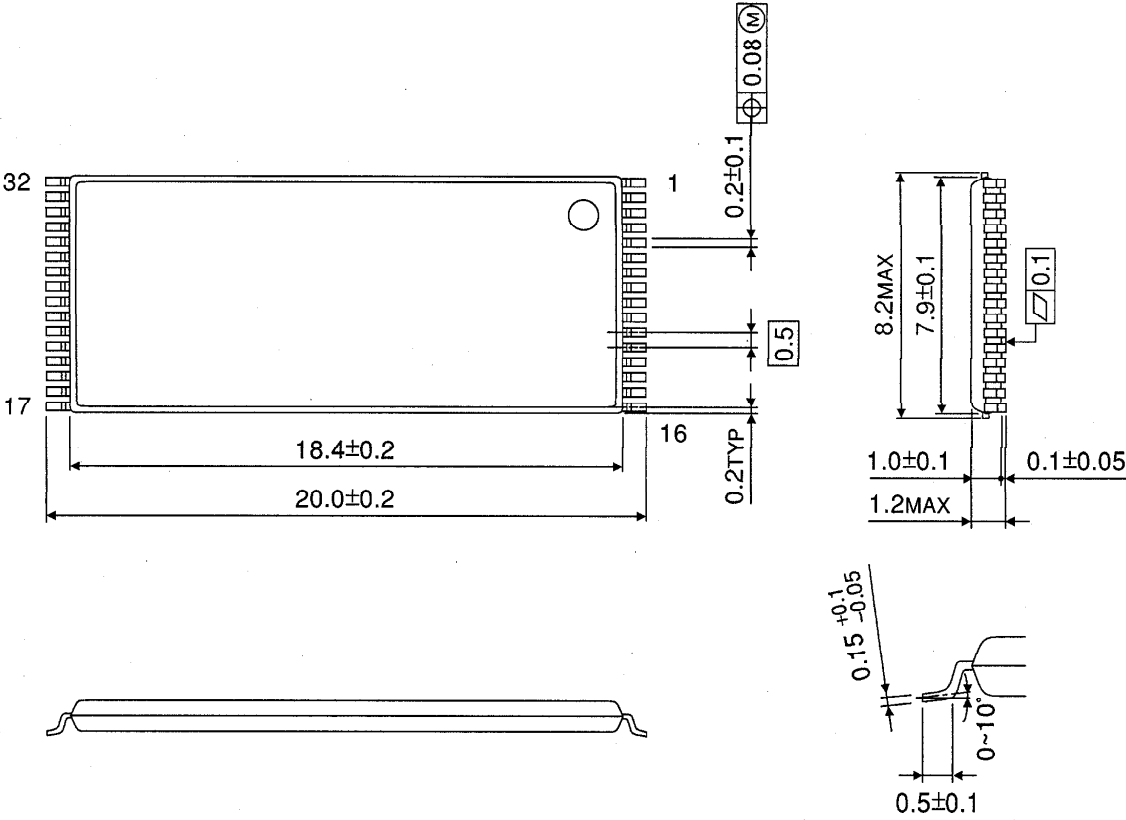
Units in mm



Weight: 0.34 g (typ)

PACKAGE DIMENSIONS (TSOP I 32-P-0820-0.50A)

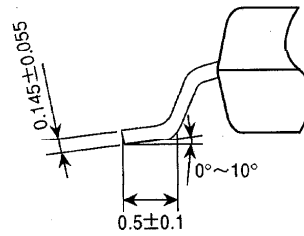
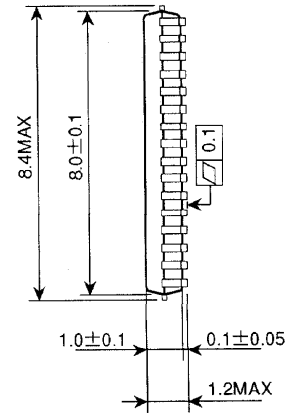
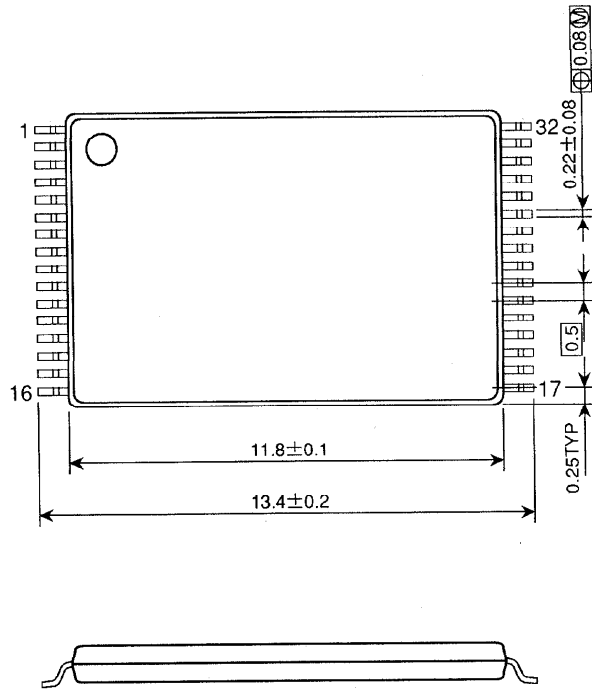
Units in mm



Weight: 0.34 g (typ)

PACKAGE DIMENSIONS (TSOP I 32-P-0.50)

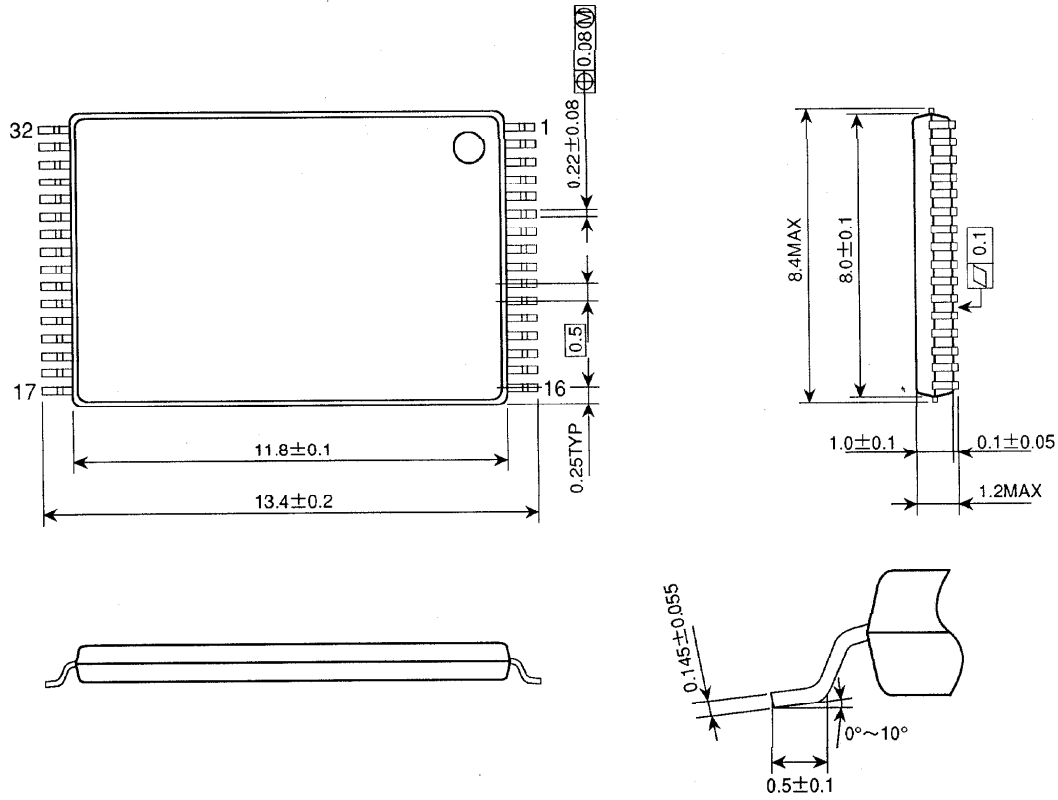
Units in mm



Weight: 0.24 g (typ)

PACKAGE DIMENSIONS (TSOP I 32-P-0.50A)

Units in mm



Weight: 0.24 g (typ)