

TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

524,288 WORDS × 8 BIT STATIC RAM

DESCRIPTION

The TC554001AFI/AFTI/ATRI is a 4,194,304-bit static random access memory (SRAM) organized as 524,288 words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 2.7 to 5.5V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 10mA/MHz(typ) and minimum cycle time of 70 ns. It is automatically placed in low-power mode at 2 μ A standby current (typ) when chip enable (\overline{CE}) is asserted high. There are two control inputs. \overline{CE} is used to select the device and for data retention control, and output enable (\overline{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 TC554001AFI/AFTI/ATRI can be used in environments exhibiting extreme temperature conditions. The TC554001AFI/AFTI/ATRI is available in a standard plastic 32-pin small-outline package(SOP) and 32-pin thin-small-outline package(TSOP).

FEATURES

- Low-power dissipation
Operating: 55 mW/MHz (typical)
- Standby current of 5 μ A (maximum) at
Ta = 25°C
- Single power supply voltage of 2.7 to 5.5 V
- Power down features using \overline{CE}
- Data retention supply voltage of 2.0 to 5.5 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of -40° to 85°C

● Access Time (maximum)

	5V \pm 10%			2.7 to 5.5V
	-70V	-85V	-10V	-70V/-85V/-10V
Access Time	70 ns	85 ns	100 ns	150 ns
\overline{CE} Access Time	70 ns	85 ns	100 ns	150 ns
\overline{OE} Access Time	35 ns	45 ns	50 ns	75 ns

● Package:

- SOP32-P-525-1.27 (AFI) (Weight: g typ)
- TSOP II 32-P-400-1.27 (AFTI) (Weight: g typ)
- TSOP II 32-P-400-1.27A (ATRI) (Weight: g typ)

PIN ASSIGNMENT (TOP VIEW)

○ 32 PIN AFI/AFTI				○ 32 PIN ATRI			
A18	1	32	V _{DD}	32	1	A18	
A16	2	31	A15	31	2	A16	
A14	3	30	A17	30	3	A14	
A12	4	29	R/W	29	4	A12	
A7	5	28	A13	28	5	A7	
A6	6	27	A8	27	6	A6	
A5	7	26	A9	26	7	A5	
A4	8	25	A11	25	8	A4	
A3	9	24	\overline{OE}	24	9	A3	
A2	10	23	A10	23	10	A2	
A1	11	22	\overline{CE}	22	11	A1	
A0	12	21	I/O8	21	12	A0	
I/O1	13	20	I/O7	20	13	I/O1	
I/O2	14	19	I/O6	19	14	I/O2	
I/O3	15	18	I/O5	18	15	I/O3	
GND	16	17	I/O4	17	16	GND	

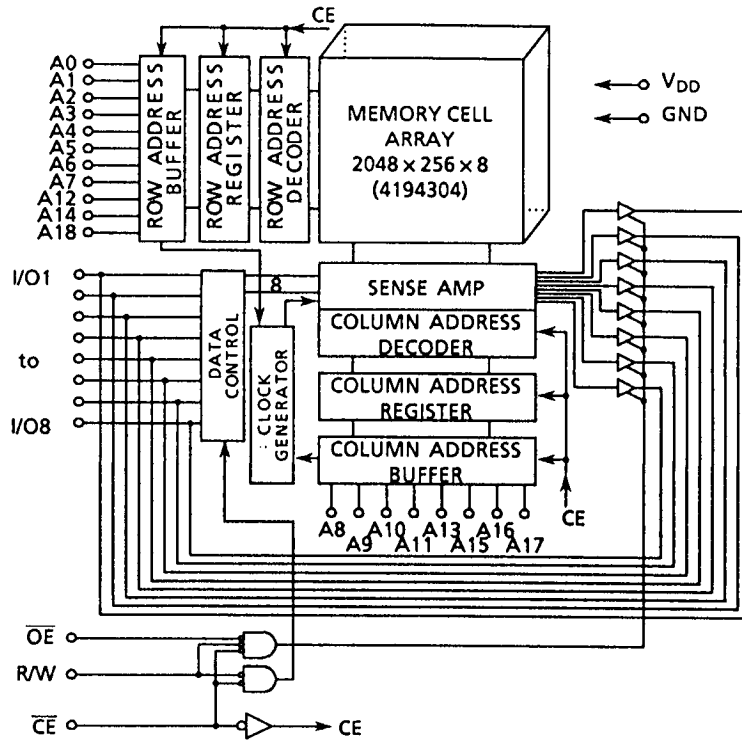
PIN NAMES

A0 to A18	Address Inputs
R/W	Read/Write Control
\overline{OE}	Output Enable
\overline{CE}	Chip Enable
I/O1 to I/O8	Data Input/Output
V _{DD}	Power
GND	Ground

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BLOCK DIAGRAM



OPERATION MODE

OPERATION MODE	\overline{CE}	\overline{OE}	R/W	I/O1 to I/O8	POWER
Read	L	L	H	D _{OUT}	I _{DDO}
Write	L	x	L	D _{IN}	I _{DDO}
Output Disabled	L	H	H	High-Z	I _{DDO}
Standby	H	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 7.0	V
V _{IN}	Input Voltage	- 0.3* to 7.0	V
V _{IO}	Input and Output Voltage	- 0.5 to V _{DD} + 0.5	V
P _D	Power Dissipation	0.6	W
T _{solder}	Soldering Temperature (10s)	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

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

SYMBOL	PARAMETER	5V ± 10%			2.7 to 5.5V			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V _{DD}	Power Supply Voltage	4.5	5.0	5.5	2.7	5.0	5.5	V
V _{IH}	Input High Voltage	2.4	-	V _{DD} + 0.3	V _{DD} - 0.2	-	V _{DD} + 0.3	V
V _{IL}	Input Low Voltage	- 0.3*	-	0.6	- 0.3*	-	0.2	V
V _{DH}	Data Retention Supply Voltage	2.0	-	5.5	2.0	-	5.5	V

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

DC CHARACTERISTICS (Ta = -40° to 85°C, V_{DD} = 5V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT						
I _{IL}	Input Leakage Current	V _{IN} = 0 V to V _{DD}	-	-	± 1.0	μA						
I _{LO}	Output Leakage Current	$\overline{CE} = V_{IH}$ or $\overline{OE} = V_{IH}$ or R/W = V _{IL} V _{OUT} = 0 V to V _{DD}	-	-	± 1.0	μA						
I _{OH}	Output High Current	V _{OH} = 2.4 V	- 1.0	-	-	mA						
I _{OL}	Output Low Current	V _{OL} = 0.4 V	2.1	-	-	mA						
I _{DDO1}	Operating Current	$\overline{CE} = V_{IL}$ and R/W = V _{IH} I _{OUT} = 0 mA Other Inputs = V _{IH} /V _{IL}	Tcycle	min	-	-	70	mA				
				1 μs	-	15	-					
I _{DDO2}	Operating Current	$\overline{CE} = 0.2$ V and R/W = V _{DD} -0.2 V I _{OUT} = 0 mA Other Inputs = V _{DD} -0.2 V/0.2 V	Tcycle	min	-	-	60	mA				
				1 μs	-	10	-					
I _{DDs1}	Standby Current	$\overline{CE} = V_{IH}$					3	mA				
I _{DDs2}							V _{DD} = 2.0 to 5.5 V		Ta = 25°C	-	2	5
									Ta = -40° to 85°C	-	-	100
							V _{DD} = 3.0 V		Ta = 25°C	-	2	-
	Ta = -40° to 85°C	-	-	50								

DC CHARACTERISTICS (Ta = -40° to 85°C, V_{DD} = 3.0V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT				
I _{IL}	Input Leakage Current	V _{IN} = 0 V to V _{DD}	-	-	± 1.0	μA				
I _{LO}	Output Leakage Current	$\overline{CE} = V_{IH}$ or $\overline{OE} = V_{IH}$ or R/W = V _{IL} V _{OUT} = 0 V to V _{DD}	-	-	± 1.0	μA				
I _{OH}	Output High Current	V _{OH} = V _{DD} -0.2 V	- 0.1	-	-	mA				
I _{OL}	Output Low Current	V _{OL} = 0.2 V	0.1	-	-	mA				
I _{DDO2}	Operating Current	$\overline{CE} = 0.2$ V and R/W = V _{DD} -0.2 V I _{OUT} = 0 mA Other Inputs = V _{DD} -0.2 V/0.2 V	Tcycle	min	-	-	30	mA		
				1 μs	-	5	-			
I _{DDs2}	Standby Current	$\overline{CE} = V_{DD} - 0.2$ V					Ta = 25°C	-	2	3
							Ta = -40° to 85°C	-	-	56
							Ta = 25°C	-	2	-
							Ta = -40° to 85°C	-	-	50

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	pF

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

AC CHARACTERISTICS AND OPERATING CONDITIONS (Ta = -40° to 85°C, VDD = 5V ± 10%)

READ CYCLE

SYMBOL	PARAMETER	TC554001AFI/AFTI/ATRI						UNIT
		-70 V		-85 V		-10 V		
		MIN	MAX	MIN	MAX	MIN	MAX	
t _{RC}	Read Cycle Time	70	-	85	-	100	-	ns
t _{ACC}	Address Access Time	-	70	-	85	-	100	
t _{CO}	Chip Enable Acces Time	-	70	-	85	-	100	
t _{OE}	Output Enable Acces Time	-	35	-	45	-	50	
t _{COE}	Chip Enable Low to Output Active	5	-	5	-	5	-	
t _{OEE}	Output Enable Low to Output Active	0	-	0	-	0	-	
t _{OD}	Chip Enable Hige to Output High-Z	-	25	-	30	-	35	
t _{ODO}	Output Enable Hige to Output High-Z	-	25	-	30	-	35	
t _{OH}	Output Data Hold Time	10	-	10	-	10	-	

WRITE CYCLE

SYMBOL	PARAMETER	TC554001AFI/AFTI/ATRI						UNIT
		-70 V		-85 V		-10 V		
		MIN	MAX	MIN	MAX	MIN	MAX	
t _{WC}	Write Cycle Time	70	-	85	-	100	-	ns
t _{WP}	Write Pulse Width	50	-	55	-	60	-	
t _{CW}	Chip Enable to End of Write	60	-	70	-	80	-	
t _{AS}	Address Setup Time	0	-	0	-	0	-	
t _{WR}	Write Recovery Time	0	-	0	-	0	-	
t _{ODW}	R/W Low to Output High-Z	-	30	-	35	-	40	
t _{OEW}	R/W High to Output Active	0	-	0	-	0	-	
t _{DS}	Data Setup Time	30	-	35	-	40	-	
t _{DH}	Data Hold Time	0	-	0	-	0	-	

AC TEST CONDITIONS

Output Load: 100 pF + one TTL gate

Input Pulse Level: 0.4 V, 2.6 V

Timing Measurements: 1.5 V

Reference Level: 1.5 V

t_r, t_p: 5 ns

AC CHARACTERISTICS AND OPERATING CONDITIONS ($T_a = -40^\circ$ to 85°C , $V_{DD} = 2.7\text{V}$ to 5.5V)READ CYCLE

SYMBOL	PARAMETER	MIN	MAX	UNIT
t_{RC}	Read Cycle Time	150	—	ns
t_{ACC}	Address Access Time	—	150	
t_{CO}	Chip Enable (\overline{CE}) Access Time	—	150	
t_{OE}	Output Enable to Output in Valid	—	75	
t_{COE}	Chip Enable (\overline{CE}) to Output in Low-Z	5	—	
t_{OEE}	Output Enable to Output in Low-Z	0	—	
t_{OD}	Chip Enable (\overline{CE}) to Output in High-Z	—	50	
t_{ODO}	Output Enable to Output in High-Z	—	50	
t_{OH}	Output Data Hold Time	10	—	

WRITE CYCLE

SYMBOL	PARAMETER	MIN	MAX	UNIT
t_{WC}	Write Cycle Time	150	—	ns
t_{WP}	Write Pulse Width	100	—	
t_{CW}	Chip Enable to End of Write	120	—	
t_{AS}	Address Setup Time	0	—	
t_{WR}	Write Recovery Time	0	—	
t_{ODW}	R/W Low to Output High-Z	—	50	
t_{OEW}	R/W High to Output Active	0	—	
t_{DS}	Data Setup Time	60	—	
t_{DH}	Data Hold Time	0	—	

AC TEST CONDITIONS

Output Load: 100 pF (Include Jig)

Input Pulse Level: $V_{DD} - 0.2\text{V}/0.2\text{V}$

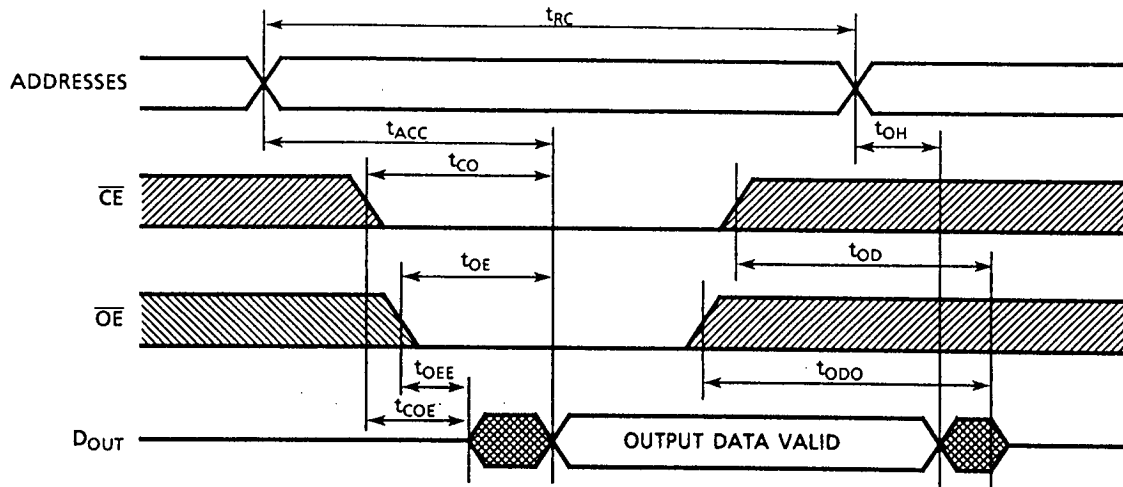
Timing Measurements: 1.5 V

Reference Level: 1.5 V

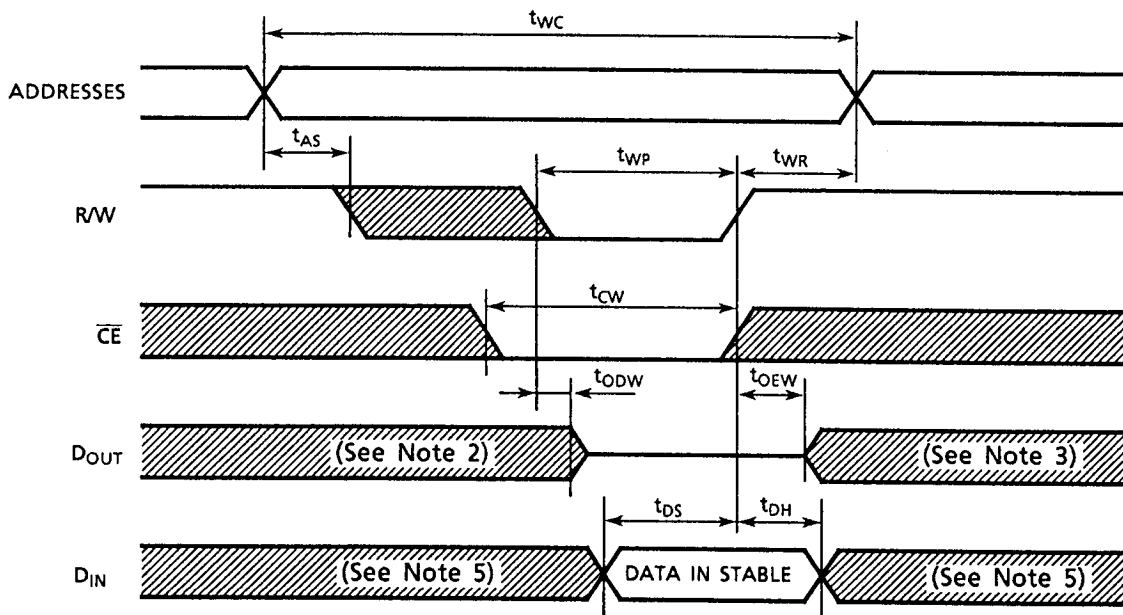
 $t_r, t_f : 5\text{ ns}$

TIMING WAVEFORMS

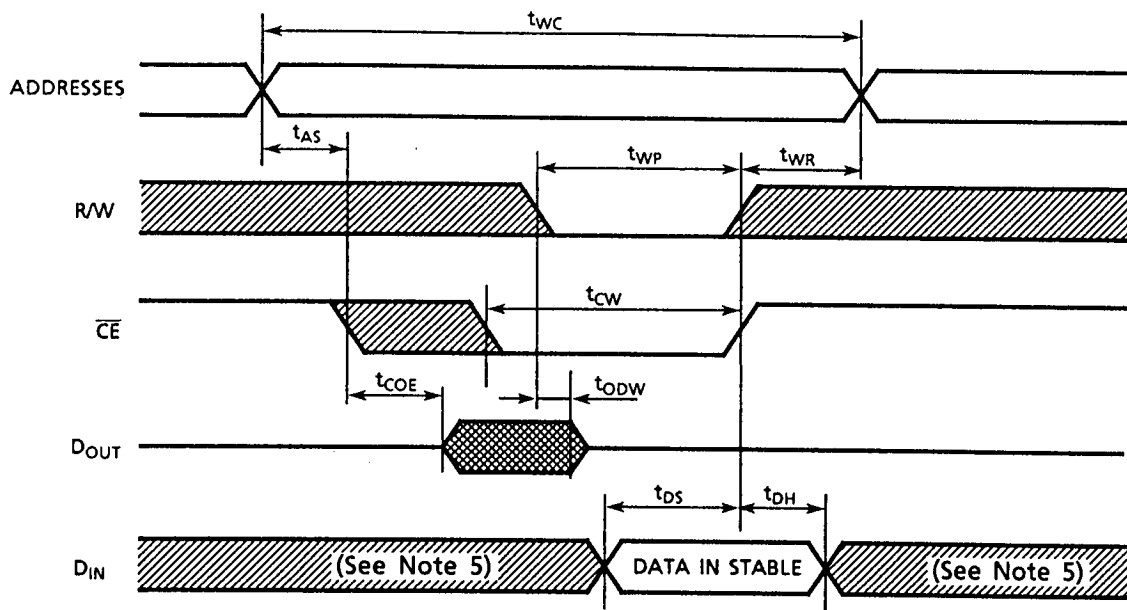
READ CYCLE (See Note 1)



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



WRITE CYCLE 2 (\overline{CE} CONTROLLED) (See Note 4)



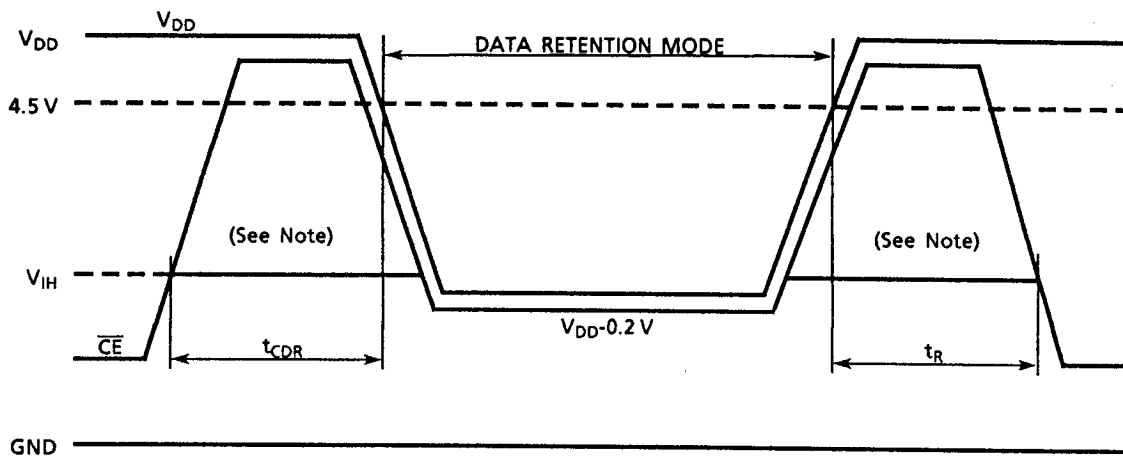
- (1) R/W remains High for Read Cycle.
- (2) If \overline{CE} goes coincident with or after R/W goes LOW, the output will remain at high impedance.
- (3) If \overline{CE} goes HIGH coincident with or before R/W goes HIGH, the output will remain at high impedance.
- (4) IF \overline{CE} is HIGH during 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	-	5.5	V
I _{DD52}	Standby Current	V _{DH} = 3.0 V	-	50*	μA
		V _{DH} = 5.5 V	-	100	
t _{CDR}	Chip Deselect to Data Retention Mode Time	0	-	-	nS
t _R	Recovery Time	5	-	-	mS

*) 5 μA (max) Ta = -40° to 40°C

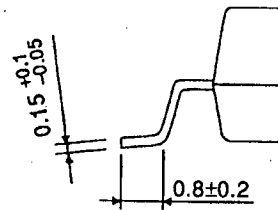
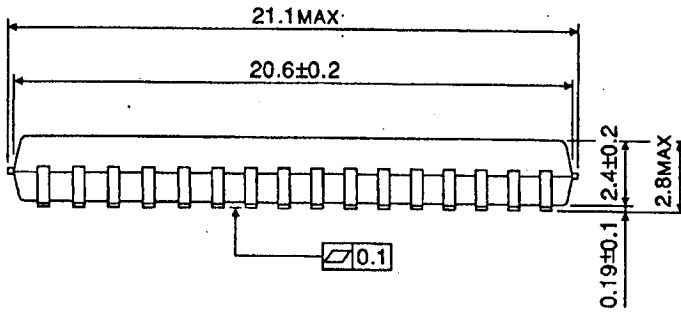
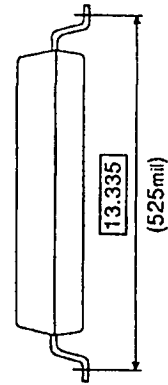
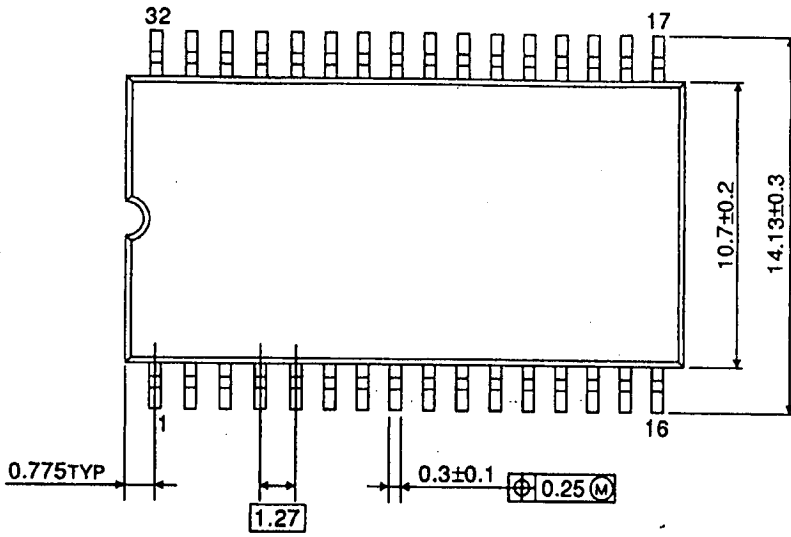
CE Controlled Data Retention Mode



Note: When \overline{CE} is operating at the V_{IH} level (2.4V), the standby current is given by I_{DD51} during the transition of V_{DD} from 4.5 to 2.6V.

PACKAGE DIMENSIONS (SOP32-P-525-1.27)

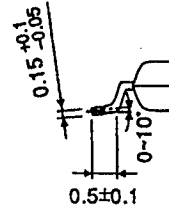
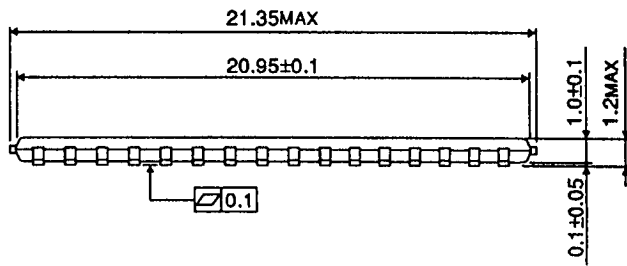
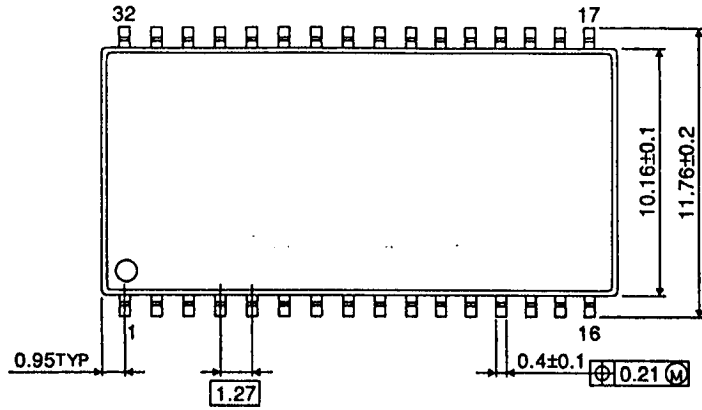
Unit in mm



Weight: g (typ)

PACKAGE DIMENSIONS (TSOPII 32-P-400-1.27)

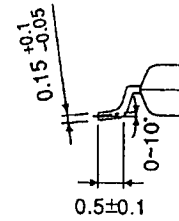
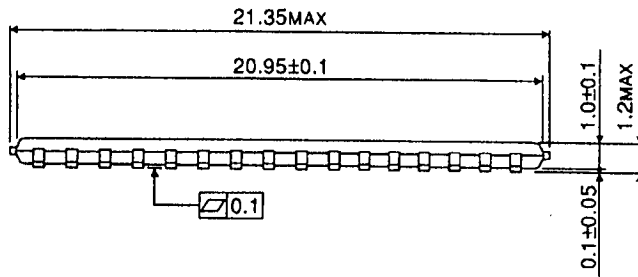
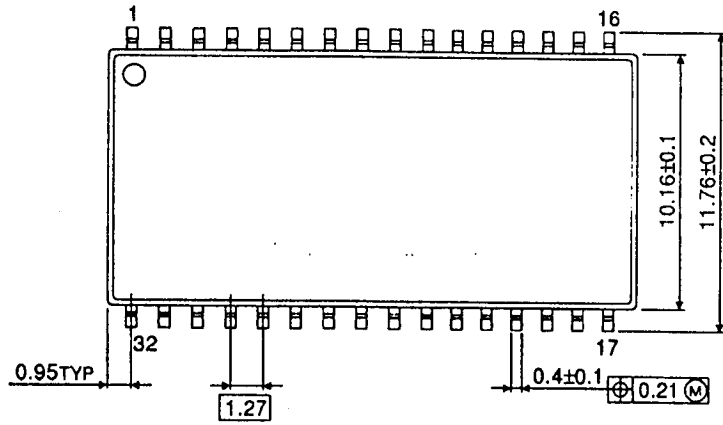
Unit in mm



Weight: g (typ)

PACKAGE DIMENSIONS (TSOPII 32-P-400-1.27A)

Unit in mm



Weight: g (typ)