

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 5V ± 10% 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 μA standby current (typ) when chip enable (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 normal and reverse pinout plastic 32-pin thin-small-outline package(TSOP).

## FEATURES

- Low-power dissipation  
Operating: 55 mW/MHz (typical)
- Single power supply voltage of 5 V ± 10 %
- 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
- Standby Current (maximum) :

	TC554001AFI/AFTI/ATRI	
	-70, -85, -10	-75L, -85L, -10L
5.5V	200 μA	100 μA
3.0V	100 μA	50 μA

- Access Time (maximum)

	TC554001AFI/AFTI/ATRI		
	-70, -70L	-85, -85L	-10, -10L
Access Time	70 ns	85 ns	100 ns
$\overline{CE}$ Access Time	70 ns	85 ns	100 ns
$\overline{OE}$ Access Time	35 ns	45 ns	50 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 <sub>DD</sub>	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	

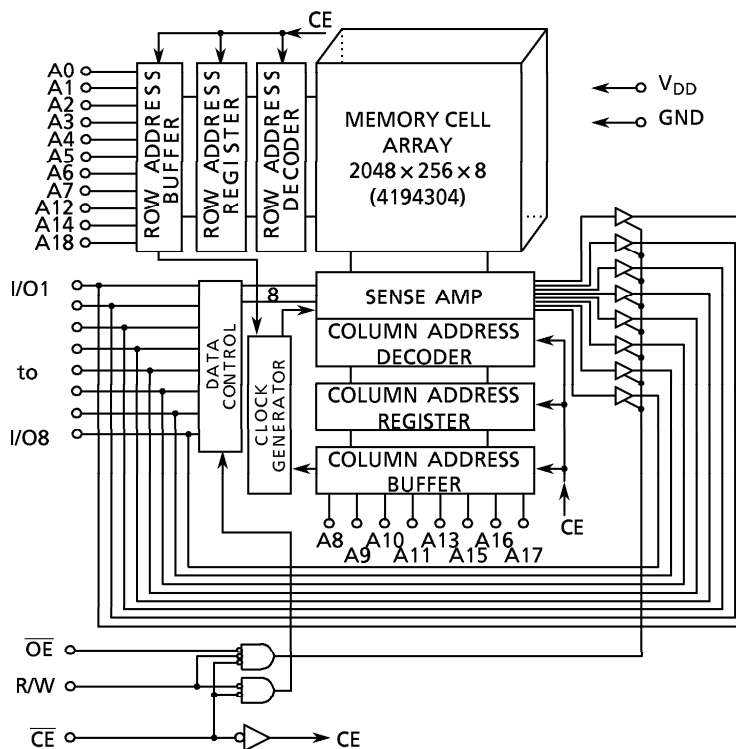
## PIN NAMES

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 <sub>DD</sub>	Power (+ 5 V)
GND	Ground

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BLOCK DIAGRAM



OPERATION MODE

OPERATION MODE	CE	OE	R/W	I/O1 to I/O8	POWER
Read	L	L	H	D <sub>OUT</sub>	I <sub>DDO</sub>
Write	L	x	L	D <sub>IN</sub>	I <sub>DDO</sub>
Output Disabled	L	H	H	High-Z	I <sub>DDO</sub>
Standby	H	x	x	High-Z	I <sub>DDs</sub>

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

ABSOLUTE MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
V <sub>DD</sub>	Power Supply Voltage	- 0.3 to 7.0	V
V <sub>IN</sub>	Input Voltage	- 0.3* to 7.0	V
V <sub>I/O</sub>	Input and Output Voltage	- 0.5 to V <sub>DD</sub> + 0.5	V
P <sub>D</sub>	Power Dissipation	0.6	W
T <sub>solder</sub>	Soldering Temperature (10 s)	260	°C
T <sub>strg.</sub>	Storage Temperature	- 55 to 150	°C
T <sub>opr.</sub>	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	MIN	TYP	MAX	UNIT
V <sub>DD</sub>	Power Supply Voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	Input High Voltage	2.4	-	V <sub>DD</sub> + 0.3	V
V <sub>IL</sub>	Input Low Voltage	- 0.3*	-	0.6	V
V <sub>DH</sub>	Data Retention Supply Voltage	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<sub>DD</sub> = 5 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION		MIN	TYP	MAX	UNIT	
I <sub>IL</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to V <sub>DD</sub>		-	-	± 1.0	μA	
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> = 2.4 V		- 1.0	-	-	mA	
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.4 V		2.1	-	-	mA	
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or R/W = V <sub>IL</sub> or $\overline{OE} = V_{IH}$ V <sub>OUT</sub> = 0 V to V <sub>DD</sub>		-	-	± 1.0	μA	
I <sub>DDO1</sub>	Operating Current	$\overline{CE} = V_{IL}$ and R/W = V <sub>IH</sub> I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>IH</sub> /V <sub>IL</sub>	Tcycle	min	-	-	70	mA
				1 μs	-	15	-	
I <sub>DDO2</sub>	Operating Current	$\overline{CE} = 0.2$ V and R/W = V <sub>DD</sub> - 0.2 V I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> - 0.2 V/0.2 V	Tcycle	min	-	-	60	mA
				1 μs	-	10	-	
I <sub>DDS1</sub>	Standby Current	$\overline{CE} = V_{IH}$		-	-	3	mA	
I <sub>DDS2</sub>		$\overline{CE} = V_{DD} - 0.2$ V V <sub>DD</sub> = 2.0 to 5.5 V	-70, -85, -10	Ta = 25°C	-	2		-
				Ta = -40° to 85°C	-	-		200
		-70L, -85L, -10L	Ta = 25°C	-	2	5		
			Ta = -40° to 85°C	-	-	100	μA	

**CAPACITANCE** (Ta = 25°C, f = 1 MHz)

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = GND	10	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = GND	10	pF

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

**AC CHARACTERISTICS AND OPERATING CONDITIONS** ( $T_a = -40^\circ$  to  $85^\circ\text{C}$ ,  $V_{DD} = 5\text{V} \pm 10\%$ )

**READ CYCLE**

SYMBOL	PARAMETER	TC554001AFI/AFTI/ATRI						UNIT
		-70, -70L		-85, -85L		-10, -10L		
		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 Access Time	-	70	-	85	-	100	
$t_{OE}$	Output Enable Access 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 High to Output High-Z	-	30	-	35	-	40	
$t_{ODO}$	Output Enable High to Output High-Z	-	30	-	35	-	40	
$t_{OH}$	Output Data Hold Time	10	-	10	-	10	-	

**WRITE CYCLE**

SYMBOL	PARAMETER	TC554001AFI/AFTI/ATRI						UNIT
		-70, -70L		-85, -85L		-10, -10L		
		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 Hige 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

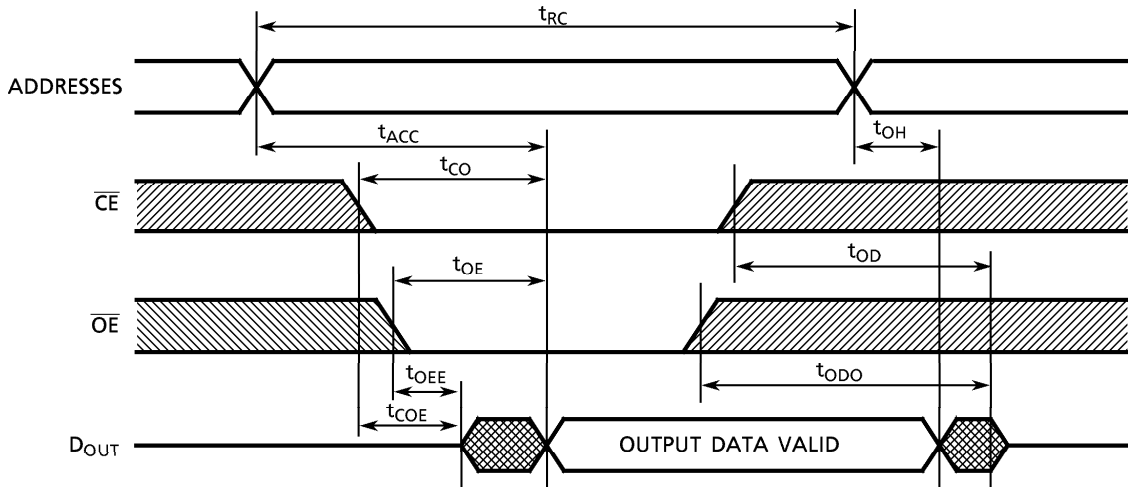
Timing Measurements: 1.5 V

Reference Level: 1.5 V

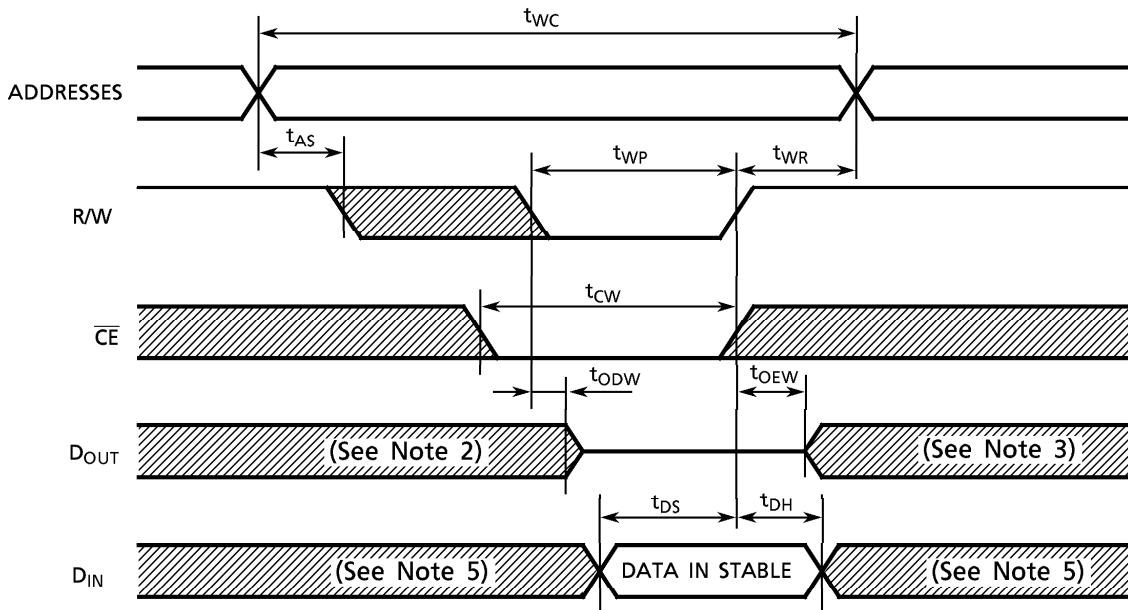
$t_r, t_f$ : 5 ns

TIMING WAVEFORMS

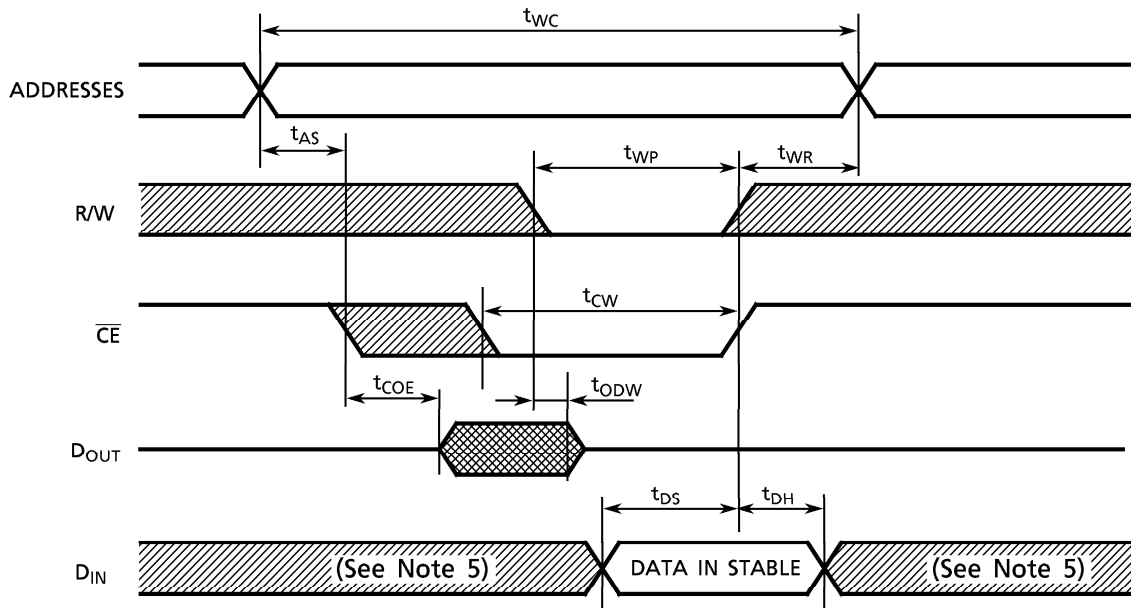
READ CYCLE (See Note 1)



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



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



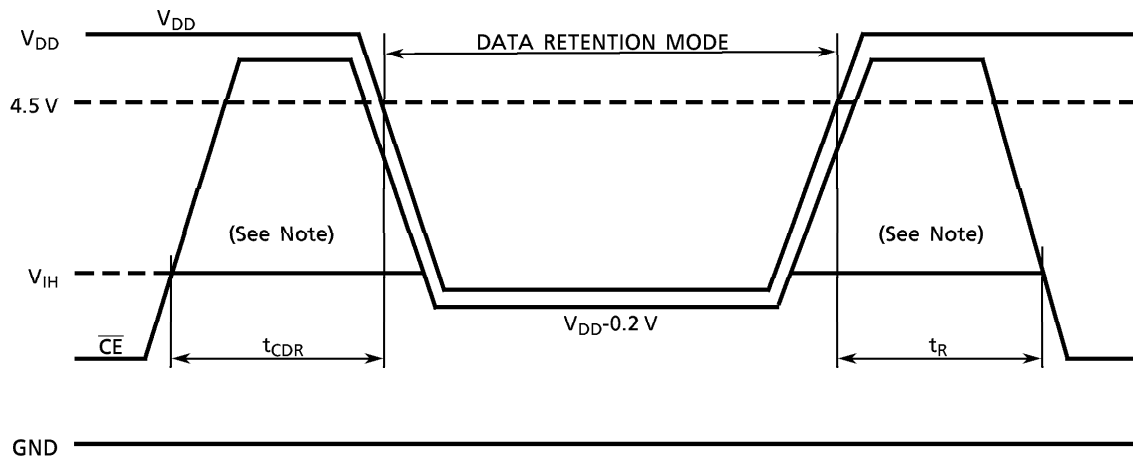
- (1) R/W remains High for Read Cycle.
- (2) If  $\overline{CE}$  goes coincident with or after R/W goes LOW, the output will remain at high impedance.
- (3) If  $\overline{CE}$  goes HIGH coincident with or before R/W goes HIGH, the output will remain at high impedance.
- (4) IF  $\overline{CE}$  is 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 <sub>DH</sub>	Data Retention Supply Voltage		2.0	-	5.5	V	
I <sub>DD52</sub>	Standby Current	-70, -85, -10	V <sub>DH</sub> = 3.0 V	-	-	100	μA
			V <sub>DH</sub> = 5.5 V	-	-	200	
		-70L, -85L, -10L	V <sub>DH</sub> = 3.0 V	-	-	50*	
			V <sub>DH</sub> = 5.5 V	-	-	100	
t <sub>CDR</sub>	Chip Deselect to Data Retention Mode Time		0	-	-	nS	
t <sub>R</sub>	Recovery Time		5	-	-	mS	

\* 5 μA (max) at Ta = -40° to 40°C

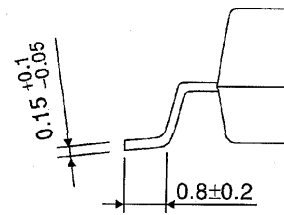
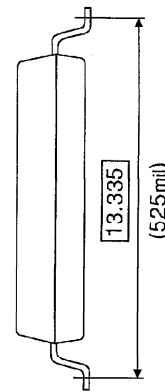
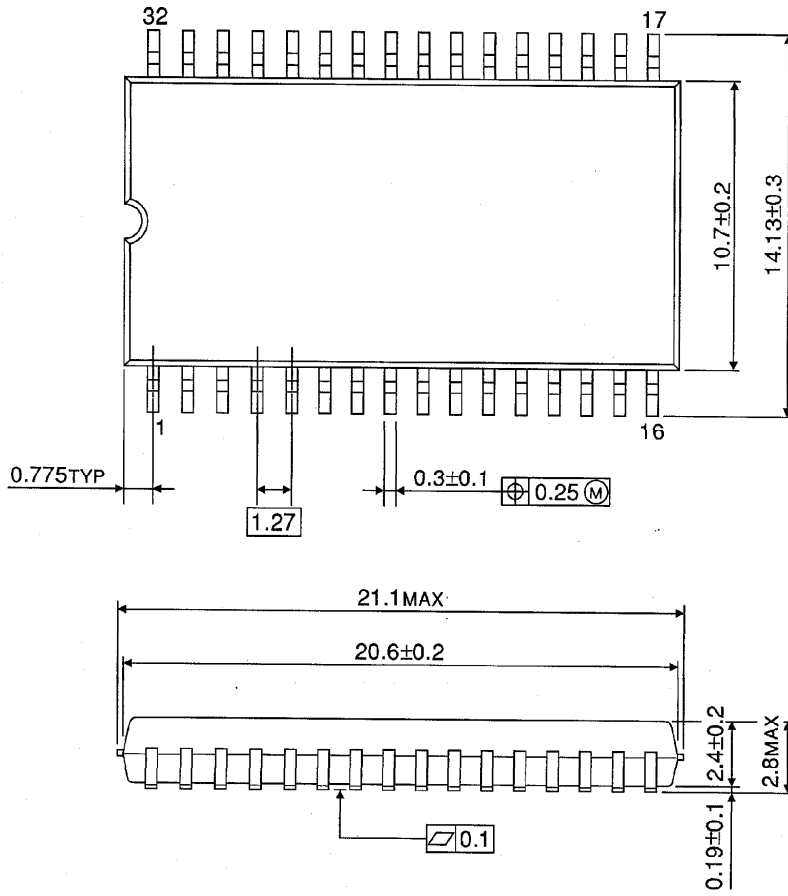
**CE Controlled Data Retention Mode**



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

PACKAGE DIMENSIONS (SOP32-P-525-1.27)

Unit in mm

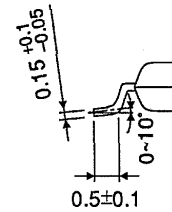
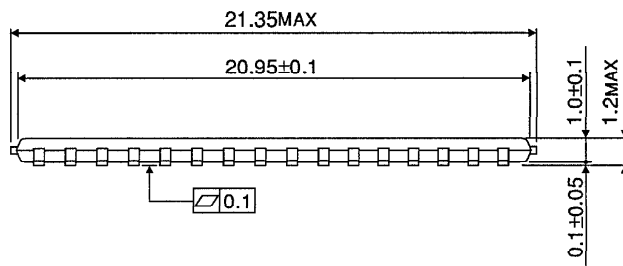
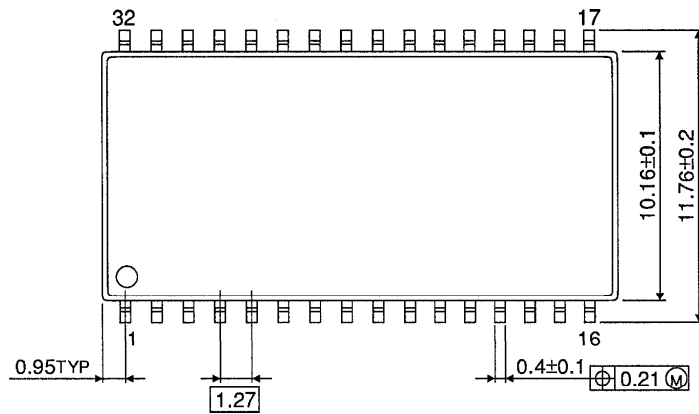


Weight: g (typ)



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

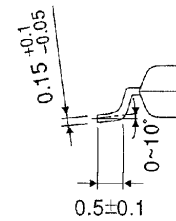
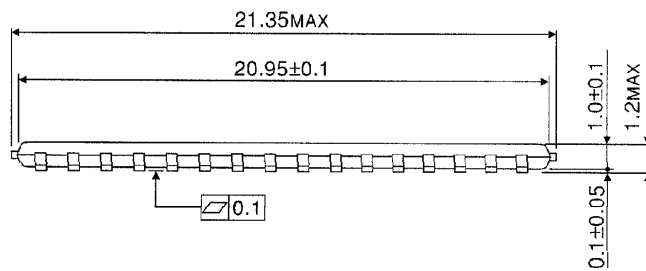
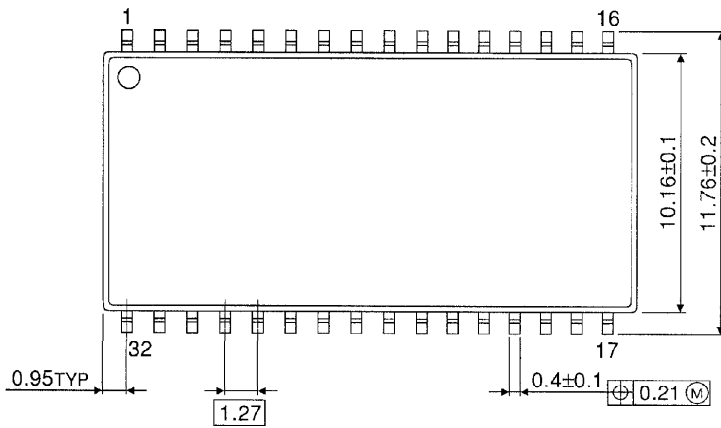
Unit in mm



Weight: g (typ)

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

Unit in mm



Weight: g (typ)