TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

524,288-WORD BY 8-BIT STATIC RAM

DESCRIPTION

The TC554001AF/AFT/ATR 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 5.5 V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 10 mA/MHz (typ) and a minimum cycle time of 70 ns. It is automatically placed in low-power mode at 2 μA 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. The TC554001AF/AFT/ATR 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

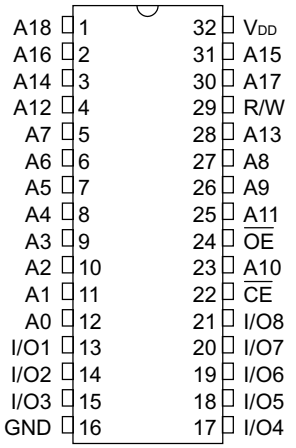
- Low-power dissipation
  Operating: 55 mW/MHz (typical)
- Standby current of 5 μA (maximum) at Ta = 25°C
- Single power supply voltage of 2.7 to 5.5 V
- Power down features using $\overline{CE}$.
- Data retention supply voltage of 2.0 to 5.5 V
- Direct TTL compatibility for all inputs and outputs
- Access Times (maximum):

	5 V ± 10%			2.7 V~5.5 V	
	-70V	-85V	-10V	-70V	-85V/-10V
Access Time	70 ns	85 ns	100 ns	120 ns	150 ns
$\overline{CE}$ Access Time	70 ns	85 ns	100 ns	120 ns	150 ns
$\overline{OE}$ Access Time	35 ns	45 ns	50 ns	70 ns	75 ns

- Package:
  SOP32-P-525-1.27 (AF) (Weight: 1.14 g typ)
  TSOP II32-P-400-1.27 (AFT) (Weight: 0.53 g typ)
  TSOP II32-P-400-1.27A (ATR) (Weight: 0.53 g typ)

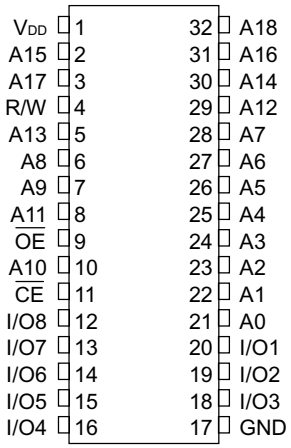
PIN ASSIGNMENT (TOP VIEW)

32 PIN SOP & TSOP



(AF/AFT)

32 PIN TSOP

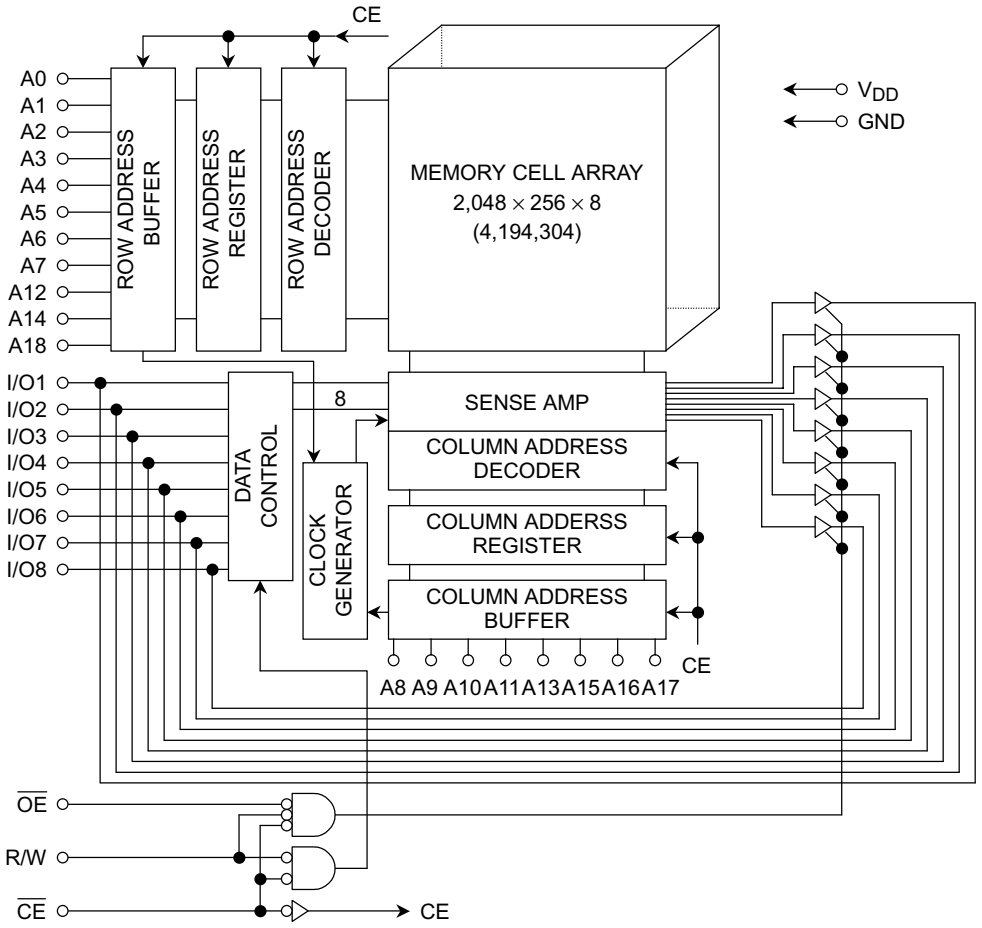


(ATR)

PIN NAMES

A0~A18	Address Inputs
R/W	Read/Write Control
$\overline{OE}$	Output Enable
$\overline{CE}$	Chip Enable
I/O1~I/O8	Data Inputs/Outputs
V_{DD}	Power (+5 V)
GND	Ground

BLOCK DIAGRAM



OPERATING MODE

MODE	$\overline{CE}$	$\overline{OE}$	R/W	I/O1~I/O8	POWER
Read	L	L	H	Output	I_{DDO}
Write	L	*	L	Input	I_{DDO}
Output Deselect	L	H	H	High-Z	I_{DDO}
Standby	H	*	*	High-Z	I_{DDS}

* = don't care
H = logic high
L = logic low

MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
V_{DD}	Power Supply Voltage	−0.3~7.0	V
V_{IN}	Input Voltage	−0.3*~7.0	V
$V_{I/O}$	Input/Output Voltage	−0.5~V_{DD} + 0.5	V
P_D	Power Dissipation	0.6	W
T_{solder}	Soldering Temperature (10s)	260	°C
T_{stg}	Storage Temperature	−55~150	°C
T_{opr}	Operating Temperature	0~70	°C

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

DC RECOMMENDED OPERATING CONDITIONS (Ta = 0° to 70°C)

SYMBOL	PARAMETER	5 V ± 10%			2.7 V~5.5 V			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	2.2	—	V_{DD} + 0.3	V_{DD} − 0.2	—	V_{DD} + 0.3	V
V_{IL}	Input Low Voltage	−0.3*	—	0.8	−0.3*	—	0.2	V
V_{DH}	Data Retention Supply Voltage	2.0	—	5.5	2.0	—	5.5	V

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

DC CHARACTERISTICS (Ta = 0° to 70°C, V_{DD} = 5 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT
I_{IL}	Input Leakage Current	V_{IN} = 0 V~V_{DD}			—	—	±1.0	μA
I_{LO}	Output Leakage Current	$\overline{CE}$ = V_{IH} or R/W = V_{IL} or $\overline{OE}$ = V_{IH}, V_{OUT} = 0 V~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 Input = V_{IH}/V_{IL}		t_{cycle} = MIN	—	—	70	mA
				t_{cycle} = 1 μs	—	15	—	
I_{DDO2}		$\overline{CE}$ = 0.2 V and R/W = V_{DD} − 0.2 V, I_{OUT} = 0 mA, Other Input = V_{DD} − 0.2 V/0.2 V		t_{cycle} = MIN	—	—	60	mA
				t_{cycle} = 1 μs	—	10	—	
I_{DDS1}	Standby Current	$\overline{CE}$ = V_{IH}			—	—	3	mA
I_{DDS2}		$\overline{CE}$ = V_{DD} − 0.2 V,	V_{DD} = 2.0 V~5.5 V	Ta = 25°C	—	2	5	μA
				Ta = 0~70°C	—	—	50	
			V_{DD} = 3.0 V	Ta = 25°C	—	2	—	
				Ta = 0~40°C	—	—	5	
				Ta = 0~70°C	—	—	25	

DC CHARACTERISTICS (Ta = 0° to 70°C, V_{DD} = 3.0 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT
I_{IL}	Input Leakage Current	V_{IN} = 0 V~V_{DD}			—	—	±1.0	μA
I_{LO}	Output Leakage Current	$\overline{CE}$ = V_{IH} or R/W = V_{IL} or $\overline{OE}$ = V_{IH}, V_{OUT} = 0 V~V_{DD}			—	—	±1.0	μA
I_{OH}	Output High Current	V_{OH} = V_{DD} − 0.2 V			−1.0	—	—	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 Input = V_{DD} − 0.2 V/0.2 V		t_{cycle} = MIN	—	—	30	mA
				t_{cycle} = 1 μs	—	5	—	
I_{DDS2}	Standby Current	$\overline{CE}$ = V_{DD} − 0.2 V,	V_{DD} = 3.0 ± 0.3 V	Ta = 25°C	—	2	3	μA
				Ta = 0~70°C	—	—	28	
			V_{DD} = 3.0 V	Ta = 25°C	—	2	—	
				Ta = 0~40°C	—	—	5	
				Ta = 0~70°C	—	—	25	

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 = 0° to 70°C, V_{DD} = 5 V ± 10%)

READ CYCLE

SYMBOL	PARAMETER	TC554001AF/AFT/ATR						UNIT
		-70V		-85V		-10V		
		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	10	—	10	—	10	—	
t_{OEE}	Output Enable Low to Output Active	5	—	5	—	5	—	
t_{OD}	Chip Enable High to Output High-Z	—	25	—	30	—	35	
t_{ODO}	Output Enable High to Output High-Z	—	25	—	30	—	35	
t_{OH}	Output Data Hold Time	10	—	10	—	10	—	

WRITE CYCLE

SYMBOL	PARAMETER	TC554001AF/AFT/ATR						UNIT
		-70V		-85V		-10V		
		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	—	25	—	30	—	35	
t_{OEW}	R/W High to Output Active	5	—	5	—	5	—	
t_{DS}	Data Setup Time	30	—	35	—	40	—	
t_{DH}	Data Hold Time	0	—	0	—	0	—	

AC TEST CONDITIONS

PARAMETER	TEST CONDITION
Output load	100 pF + 1 TTL Gate
Input pulse level	0.6 V, 2.4 V
Timing measurements	1.5 V
Reference level	1.5 V
t_R, t_F	5 ns

AC CHARACTERISTICS AND OPERATING CONDITIONS

(Ta = 0° to 70°C, V_{DD} = 2.7 V to 5.5 V)

READ CYCLE

SYMBOL	PARAMETER	TC554001AF/AFT/ATR				UNIT
		-70V		-85V/-10V		
		MIN	MAX	MIN	MAX	
t_{RC}	Read Cycle Time	120	—	150	—	ns
t_{ACC}	Address Access Time	—	120	—	150	
t_{CO}	Chip Enable Access Time	—	120	—	150	
t_{OE}	Output Enable Access Time	—	70	—	75	
t_{COE}	Chip Enable Low to Output Active	10	—	10	—	
t_{OEE}	Output Enable Low to Output Active	5	—	5	—	
t_{OD}	Chip Enable High to Output High-Z	—	50	—	50	
t_{ODO}	Output Enable High to Output High-Z	—	50	—	50	
t_{OH}	Output Data Hold Time	10	—	10	—	

WRITE CYCLE

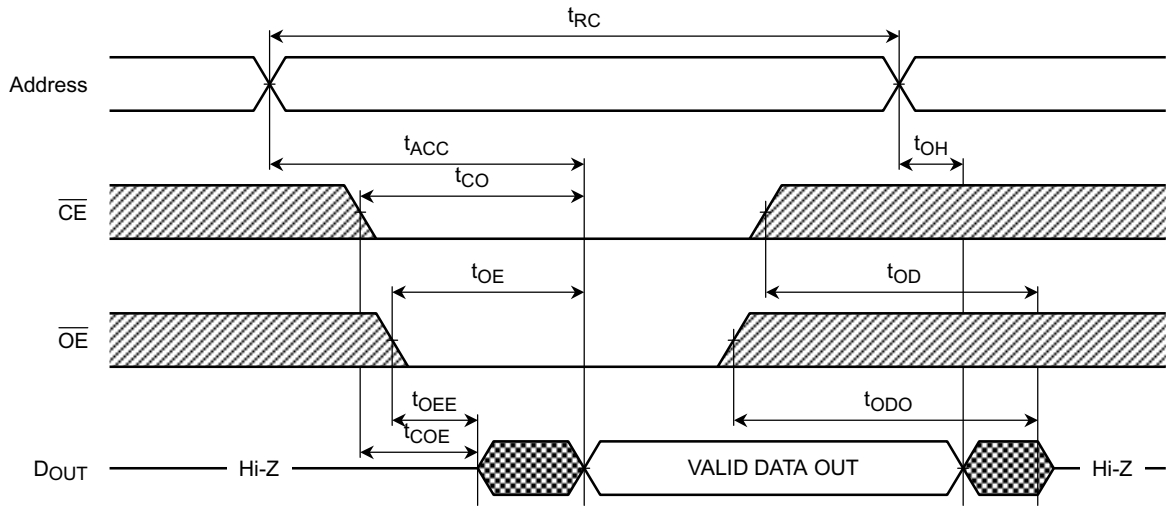
SYMBOL	PARAMETER	TC554001AF/AFT/ATR				UNIT
		-70V		-85V/-10V		
		MIN	MAX	MIN	MAX	
t_{WC}	Write Cycle Time	120	—	150	—	ns
t_{WP}	Write Pulse Width	80	—	100	—	
t_{CW}	Chip Enable to End of Write	100	—	120	—	
t_{AS}	Address Setup Time	0	—	0	—	
t_{WR}	Write Recovery Time	0	—	0	—	
t_{ODW}	R/W Low to Output High-Z	—	50	—	50	
t_{OEW}	R/W High to Output Active	5	—	5	—	
t_{DS}	Data Setup Time	50	—	60	—	
t_{DH}	Data Hold Time	0	—	0	—	

AC TEST CONDITIONS

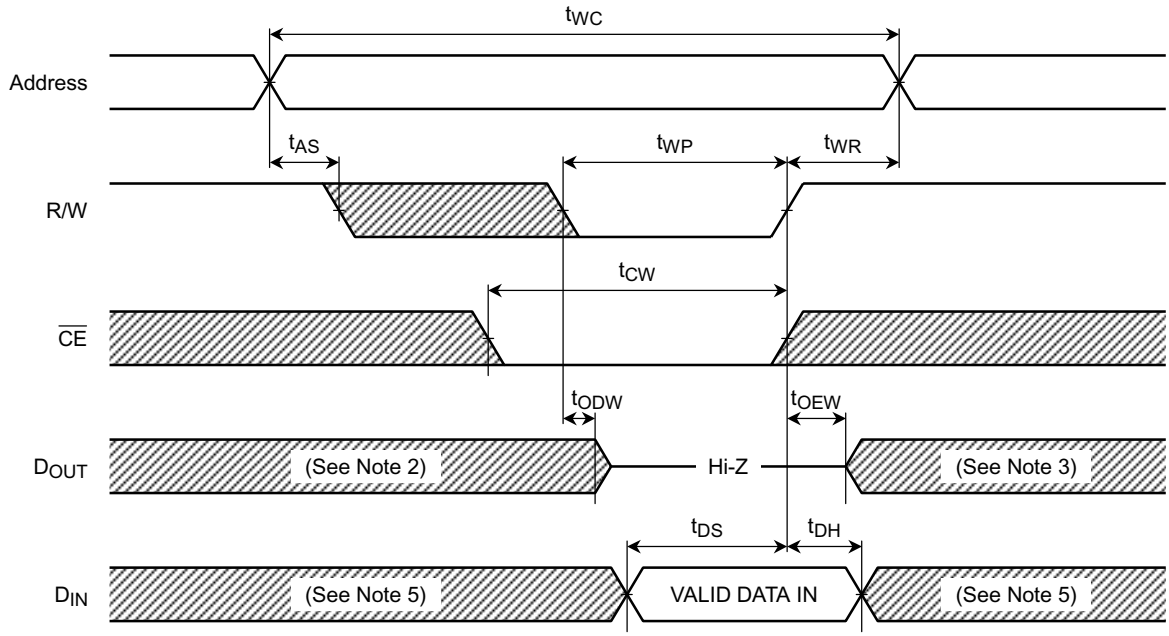
PARAMETER	TEST CONDITION
Output load	100 pF (Include Jig)
Input pulse level	V_{DD} – 0.2 V, 0.2 V
Timing measurements	1.5 V
Reference level	1.5 V
t_R, t_F	5 ns

TIMING DIAGRAMS

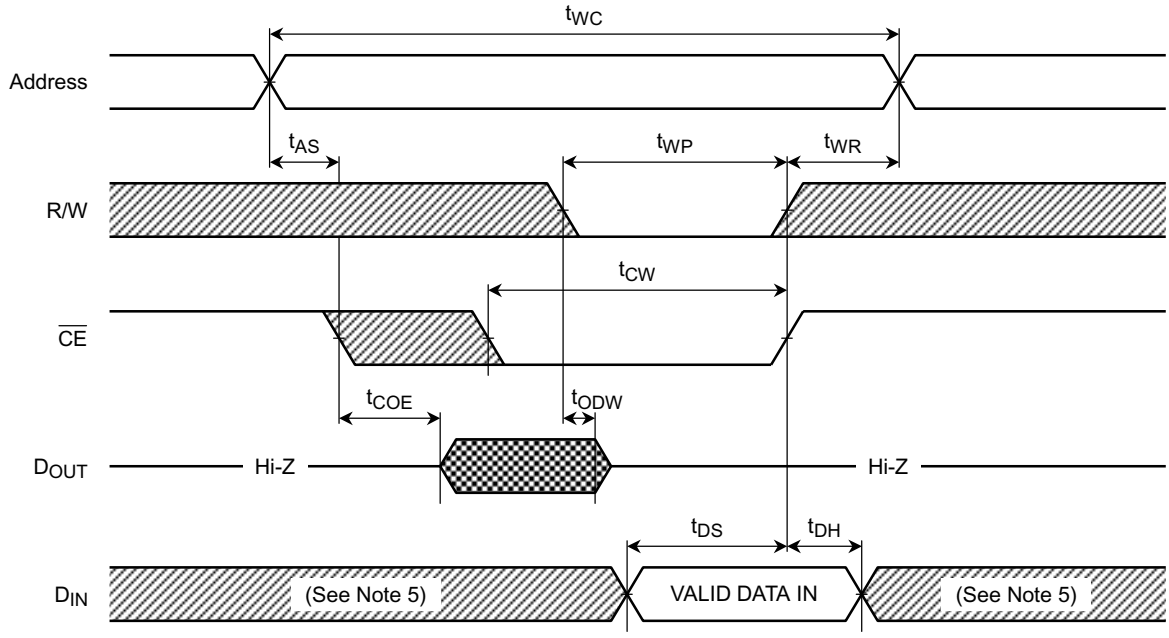
READ CYCLE (See Note 1)



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



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



Note:

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

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

(3) If $\overline{CE}$ goes HIGH 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.

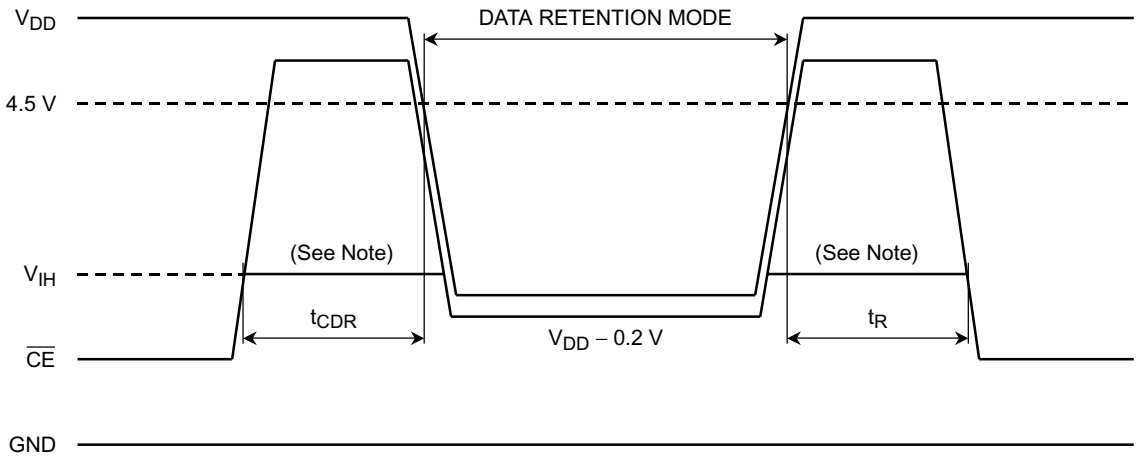
(5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

DATA RETENTION CHARACTERISTICS (Ta = 0° to 70°C)

SYMBOL	PARAMETER		MIN	TYP	MAX	UNIT
V_{DH}	Data Retention Supply Voltage		2.0	—	5.5	V
I_{DDS2}	Standby Current	V_{DH} = 3.0 V	—	—	25*	μA
		V_{DH} = 5.5 V	—	—	50	
t_{CDR}	Chip Deselect to Data Retention Mode Time		0	—	—	ns
t_R	Recovery Time		5	—	—	ms

*: 5 μA (max) at Ta = 0° to 40°C

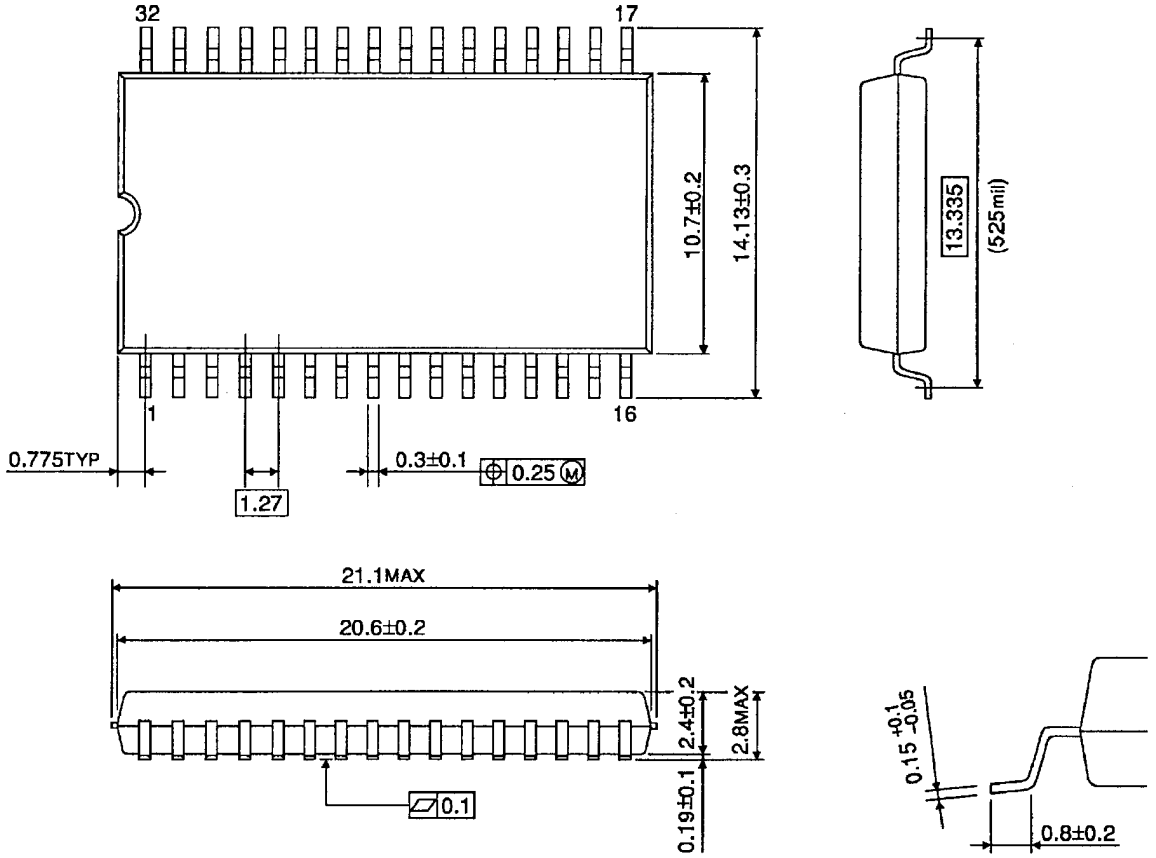
$\overline{CE}$ CONTROLLED DATA RETENTION MODE



Note: When $\overline{CE}$ is operating at the V_{IH} level (2.2V), the standby current is given by I_{DDS1} during the transition of V_{DD} from 4.5 to 2.4V.

PACKAGE DIMENSIONS

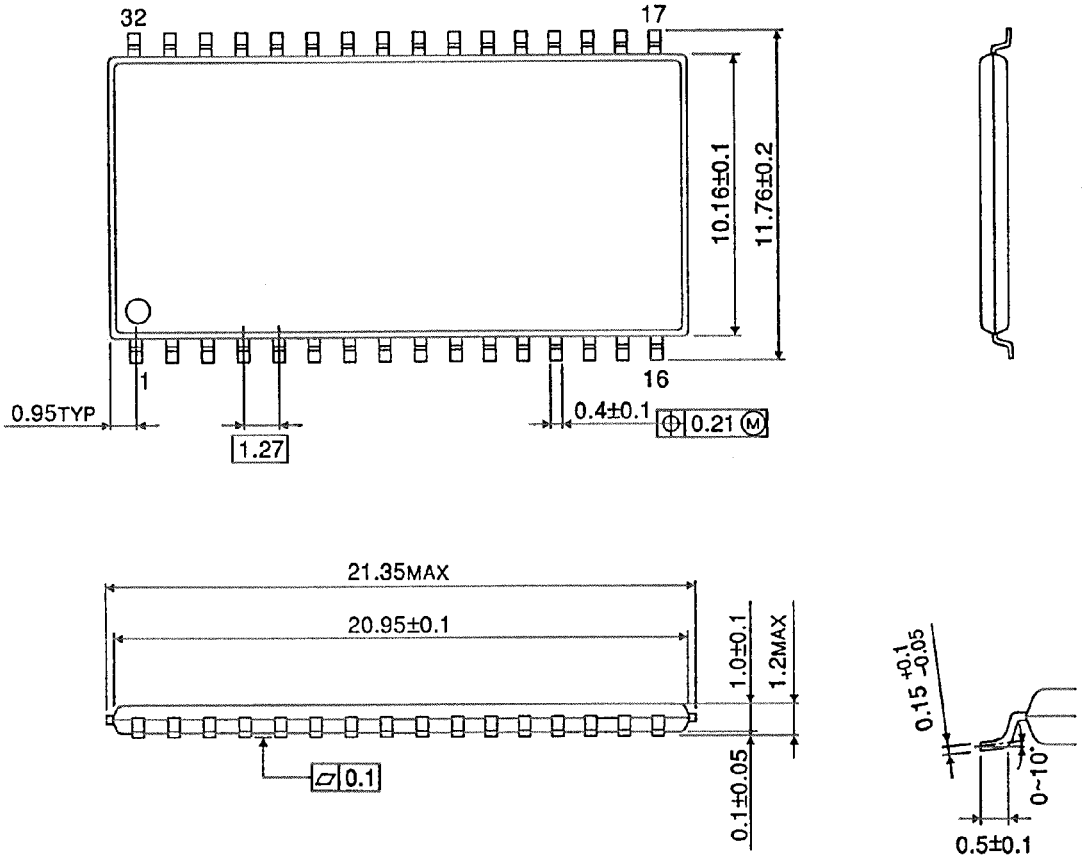
SOP32-P-525-1.27 Unit : mm



Weight: 1.14 g (typ)

PACKAGE DIMENSIONS

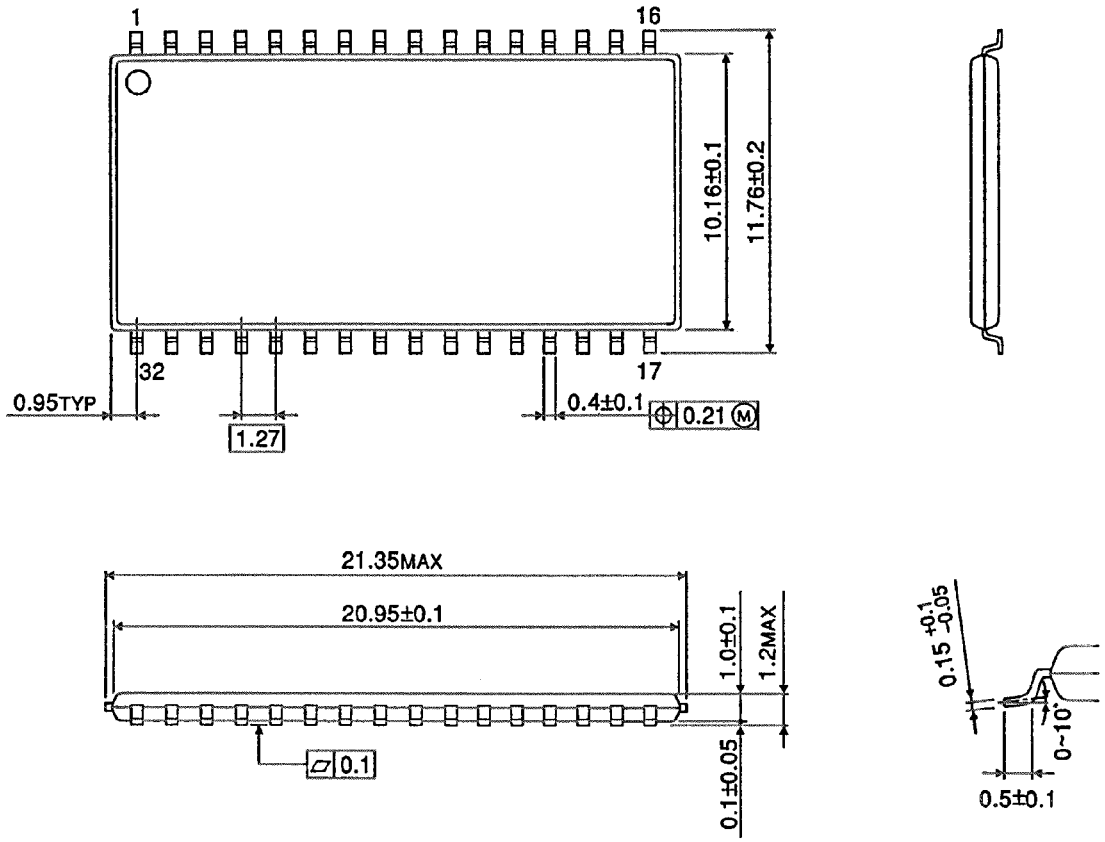
TSOPII32-P-400-1.27 Unit: mm



Weight: 0.53 g (typ)

PACKAGE DIMENSIONS

TSOPII32-P-400-1.27A Unit: mm



Weight: 0.53 g (typ)

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