

### Description

The **TM54S416T** is organized as 4-bank x 1048576-word x 16-bit(**4Mx16**), fabricated with high performance CMOS technology. Synchronous design allows precise cycle control with the use of system clock I/O transactions are possible on every clock cycle. Range of operating frequencies, programmable burst length and programmable latencies allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

### Features

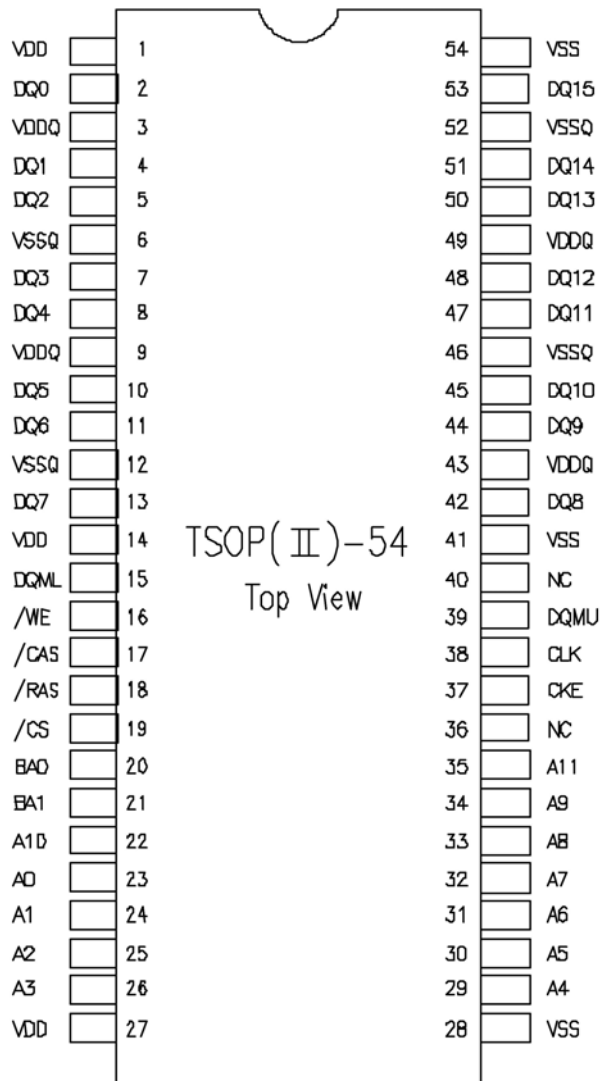
- Package 400-mil 54-pin TSOP(II)
- JEDEC PC133/PC100 compatible
- Single 3.3V Power Supply
- LVTTTL Signal Compatible
- Programmable
  - CAS Latency (3 or 2 clocks)
  - Burst Length (1,2,4,8 & full page)
  - Burst type (Sequential & Interleave)
- Auto and Self Refresh
- 64ms refresh period (4K cycles)
- Bank organization
- Pin36 and 40 are “No Connected”
- Fully synchronous operation referenced to clock rising edge

### Frequency vs. AC Parameter

.....	.....	- 6	- 7	- 75	Unit
$t_{CK}$	Min. clock cycle time @CL=3	6	7	7.5	ns
$f_{CK}$	Max. operating frequency @CL=3	166.7	143	133.3	Mhz
$t_{AC}$	Max. access time from CLK @CL=3	5.0	5.4	5.4	ns
$t_{rcd}$	Min. row to column delay	18	18	20	ns

**Pin Description**

Pin Name	Function	Pin Name	Function
CLK	Master Clock	DQML/DQMU	Output Disable(Write Mask)
CKE	Clock Enable	A0-11	Address Input
/CS	Chip Select	BA1,BA0	Bank Address
/RAS	Row Address Strobe	Vdd	Power Supply
/CAS	Column Address Strobe	VddQ	Power Supply for Output
/WE	Write Enable	Vss/VssQ	Ground
DQ0~DQ15	Data I/O	NC	No Connection



**Pin Function**

<b>Pin</b>	<b>Name</b>	<b>Pin Function</b>
CLK	System clock	Active on the positive going edge to sample all inputs.
/CS	Chip select	Disables or enables device operation by masking or enabling all inputs except CLK,CKE and DQML/DQMU.
CKE	Clock enable	Masks system clock to freeze operation from the next clock cycle. CKE should be enabled at least one cycle prior to new command. Disable input buffers for power down in standby.
A0~A11	Address input	Row/column addresses are multiplexed on the same pins. Row address:A0~A11, Column address:A0~A7
BA1,BA0	Bank address	Selects bank to be activated during row address latch time. Selects bank for read/write during column address latch time.
/RAS	Row address strobe	Latches row addresses on the positive going edge of the CLK with /RAS low. Enables rows access & pre-charge.
/CAS	Column address strobe	Latches column addresses on the positive going edge of the CLK with /CAS low. Enables column access.
/WE	Write enable	Enables write operation and row pre-charge. Latches data in starting from /CAS,/WE active.
DQMU/DQML	Data I/O mask	Makes data output Hi-Z, tSHZ after the clock and masks the output. Blocks data input when DQML/DQMU active.
DQ0~15	Data input/output	Data inputs/outputs are multiplexed on the same pins.
Vdd/Vss	Power supply/ground	Power and ground for the input buffers and the core logic.
VddQ/VssQ	Data output power / ground	Isolated power supply and ground for the output buffers to provide improved noise immunity.
NC/RFU	No connection / reserved for future use	This pin is recommended to be left no connection on the device.

**Absolute maximum ratings**

Parameter	Symbol	Ratings	Unit
Voltage on any pin relative to Vss	V <sub>IN</sub> , V <sub>OUT</sub>	-0.5 to 4.6	V
Voltage supply relative to Vss(VssQ)	V <sub>DD</sub> , V <sub>DDQ</sub>	-0.5 to 4.6	V
Operating temperature	T <sub>opr</sub>	0 to +70	• •
Power dissipation	PD	1	W
Output Shorted current	I <sub>OS</sub>	50	mA

**DC OPERATING CONDITIONS**

Recommended operating conditions(Referenced to V<sub>SS</sub>=0V, T<sub>A</sub>=0• •to 70• •)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V <sub>DD</sub> , V <sub>DDQ</sub>	3.0	3.3	3.6	V
Input Logic High Voltage	V <sub>IH</sub>	2.0	-	V <sub>DD</sub> +0.3	V
Input Logic Low Voltage	V <sub>IL</sub>	-0.3	-	0.8	V
Output Logic High Voltage	V <sub>OH</sub>	2.4	-	-	V
Output Logic Low Voltage	V <sub>OL</sub>	-	-	0.4	V
Input/Output Leakage Current	I <sub>IL</sub> , I <sub>OL</sub>	-5	-	5	• A

**DC Characteristics**

(Recommended operating condition T<sub>A</sub> = 0• •to 70• • ; unless otherwise noted.)

Parameter	Symbol	Test Conditions	Limits			Unit
			-6	-7	-75	
Operating Current (One bank active)	I <sub>CC1</sub>	Burst length=1, CL=3, t <sub>RC</sub> = t <sub>RC</sub> (min), t <sub>CK</sub> = t <sub>CK</sub> (min)	95	85	85	mA
Pre-charge Standby Current in Power Down Mode	I <sub>CC2P</sub>	CKE=V <sub>IL</sub> (max), t <sub>CK</sub> = 15ns	2			mA
	I <sub>CC2PS</sub>	CKE & CLK=V <sub>IL</sub> (max)	2			
Pre-charge Standby Current in Non-Power Down Mode	I <sub>CC2N</sub>	CKE>=V <sub>IH</sub> (min),/CS> = V <sub>IH</sub> (min) , t <sub>CK</sub> = 15ns	20			mA
	I <sub>CC2NS</sub>	CKE>=V <sub>IH</sub> (min),/CS> = V <sub>IH</sub> (min), CLK<= V <sub>IL</sub> (max) ,	20			
Active Standby Current in Power Down Mode	I <sub>CC3P</sub>	CKE<=V <sub>IL</sub> (max), t <sub>CK</sub> =10ns	7			mA
	I <sub>CC3PS</sub>	CKE & CLK<=V <sub>IL</sub> (max)	5			
Active Standby Current in Non-Power Down Mode	I <sub>CC3N</sub>	/CS=CKE=V <sub>IH</sub> (min), t <sub>CK</sub> =15ns	35			mA
	I <sub>CC3NS</sub>	/CS=CKE=V <sub>IH</sub> (min), CLK= V <sub>IL</sub> (max)	35			
Operating Current (Burst mode)	I <sub>CC4</sub>	BL=4,CL=3,All Banks Active	130	100	100	mA
Auto Refresh Current	I <sub>CC5</sub>	CBR Command cycling	150	130	130	mA
Self Refresh Current	I <sub>CC6</sub>	CKE<= 0.2V	2			mA

**AC Characteristics**

Recommended operating conditions( $V_{dd}=V_{ddQ}=3.3V, V_{ss}=0V, T_A = 0 \text{ to } 70^\circ \text{C}$ )

	Symbol	Parameter	-6		-7		-75		Unit
			Min	Max	Min	Max	Min	Max	
1	$t_{CK}$	Clock Cycle Time,CL=3	6.0		7.0		7.5		ns
2	$f_{CK}$	Clock Frequency,CL=3		166.7		143		133.3	Mhz
3	$t_{AC}$	Clock Access Time,CL=3		5.0		5.4		5.4	ns
4	$t_{CH}$	Clock High Pulse Width	2.5		2.5		2.5		ns
5	$t_{CL}$	Clock Low Pulse Width	2.5		2.5		2.5		ns
6	$t_{IS}$	Input Setup time(all inputs)	1.5		1.5		1.5		ns
7	$t_{IH}$	Input Hold time(all inputs)	0.8		0.8		0.8		ns
8	$t_T$	Transition time of clock	1.0	10	1.0	10	1.0	10	ns
9	$t_{RCD}$	Row to Column delay	18		18		20		ns
10	$t_{RC}$	Row Cycle time	60		63		67		ns
11	$t_{RAS}$	Row active time	42		42		45		ns
12	$t_{RP}$	Row Pre-charge time	15		18		20		ns
13	$t_{RRD}$	Row active to active delay	12		14		15		ns
14	$t_{REF}$	Refresh time	64		64		64		ms

