

TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE

SMMS660 – MARCH 1996

- **Organization**
TM124FBK32F . . . 1 048 576 × 32
TM248GBK32F . . . 2 097 152 × 32
- **Single 5-V Power Supply ($\pm 10\%$ Tolerance)**
- **72-Pin Single In-Line Memory Module (SIMM) for Use With Socket**
- **TM124FBK32F – Utilizes Two 16M-Bit Dynamic Random-Access Memories (DRAMs) in Plastic Small-Outline J-Lead (SOJ) Package**
- **TM248GBK32F – Utilizes Four 16M-Bit DRAMs in Plastic SOJ Package**
- **Long Refresh Period**
16 ms (1024 Cycles)
- **All Inputs, Outputs, Clocks Fully TTL-Compatible**
- **3-State Output**
- **Common $\overline{\text{CAS}}$ Control for Eight Common Data-In and Data-Out Lines in Four Blocks**
- **Extended Data Out (EDO) Operation With $\overline{\text{CAS}}$ -Before-RAS (CBR), RAS-Only, Hidden Refresh, and Self Refresh**

- **Presence Detect**
- **JEDEC First Generation 72-Pin SIMM Pinout**

● Performance Ranges:

	ACCESS TIME t_{RAC} (MAX)	ACCESS TIME t_{AA} (MAX)	ACCESS TIME t_{CAC} (MAX)	EDO CYCLE t_{HPC} (MIN)
'124FBK32F-60	60 ns	30 ns	15 ns	25 ns
'124FBK32F-70	70 ns	35 ns	18 ns	30 ns
'124FBK32F-80	80 ns	40 ns	20 ns	35 ns
'248GBK32F-60	60 ns	30 ns	15 ns	25 ns
'248GBK32F-70	70 ns	35 ns	18 ns	30 ns
'248GBK32F-80	80 ns	40 ns	20 ns	35 ns

- **Low Power Dissipation**
- **Operating Free-Air Temperature Range**
0°C to 70°C
- **Gold-Tabbed Versions Available:[†]**
TM124FBK32F
TM248GBK32F
- **Tin-Lead Solder-Tabbed Versions Available:**
TM124FBK32U
TM248GBK32U

description

TM124FBK32F

The TM124FBK32F is a 4M-byte DRAM organized as four times 1048576 × 8 in a 72-pin SIMM. The SIMM is composed of two TMS418169DZ 1 048 576 × 16-bit DRAMs, each in a 42-lead plastic SOJ package mounted on a substrate with decoupling capacitors. The TMS418169DZ is described in the TMS418169 data sheet (literature number SMKS886). The TM124FBK32F SIMM is available in the single-sided BK-leadless module for use with sockets.

TM248GBK32F

The TM248GBK32F is an 8M-byte DRAM organized as four times 2 097 152 × 8 in a 72-pin SIMM. The SIMM is composed of four TMS418169DZ 1 048 576 × 16-bit DRAMs, each in a 42-lead plastic SOJ package mounted on a substrate with decoupling capacitors. The TMS418169DZ is described in the TMS418169 data sheet (literature number SMKS886). The TM248GBK32F SIMM is available in the double-sided BK-leadless module for use with sockets.

operation

The TM124FBK32F operates as two TMS418169DZs connected as shown in the functional block diagram and in Table 1. The TM248GBK32F operates as four TMS418169DZs connected as shown in the functional block diagram and in Table 1. The common I/O feature dictates the use of early-write cycles to prevent contention on D and Q.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

[†] Part numbers in this data sheet are for the gold-tabbed version; the information applies to both gold-tabbed and solder-tabbed versions.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

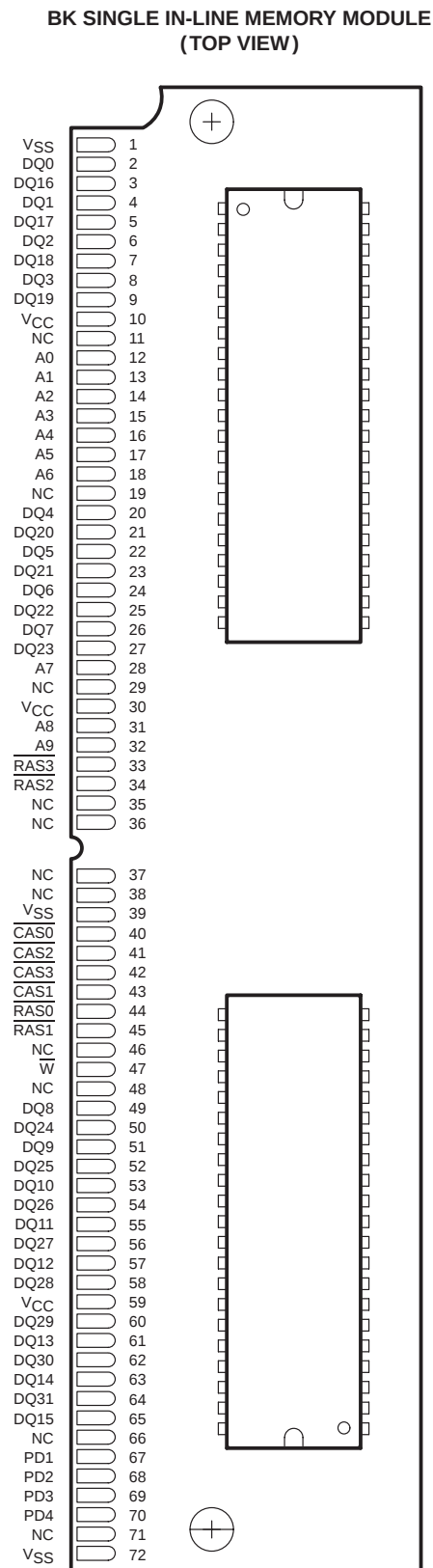
**TEXAS
INSTRUMENTS**

POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251-1443

Copyright © 1996, Texas Instruments Incorporated

TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE
TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE

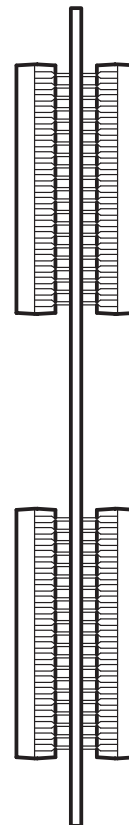
SMMS660 – MARCH 1996



**TM124FBK32F
(SIDE VIEW)**



**TM248GBK32F
(SIDE VIEW)**



PIN NOMENCLATURE	
A0–A9	Address Inputs
CAS0–CAS3	Column-Address Strobe
DQ0–DQ31	Data In/Data Out
NC	No Connection
PD1–PD4	Presence Detects
RAS0–RAS3	Row-Address Strobe
VCC	5-V Supply
VSS	Ground
W	Write Enable

PRESENCE DETECT					
SIGNAL (PIN)		PD1 (67)	PD2 (68)	PD3 (69)	PD4 (70)
TM124FBK32F	80 ns	VSS	VSS	NC	VSS
	70 ns	VSS	VSS	VSS	NC
	60 ns	VSS	VSS	NC	NC
TM248GBK32F	80 ns	NC	NC	NC	VSS
	70 ns	NC	NC	VSS	NC
	60 ns	NC	NC	NC	NC

Table 1. Connection Table

DATA BLOCK	RASx		CASx
	SIDE 1	SIDE 2†	
DQ0–DQ7	RAS0	RAS1	CAS0
DQ8–DQ15	RAS0	RAS1	CAS1
DQ16–DQ23	RAS2	RAS3	CAS2
DQ24–DQ31	RAS2	RAS3	CAS3

† Side 2 applies to the TM248GBK32F and the TM248GBK32U.

single in-line memory module and components

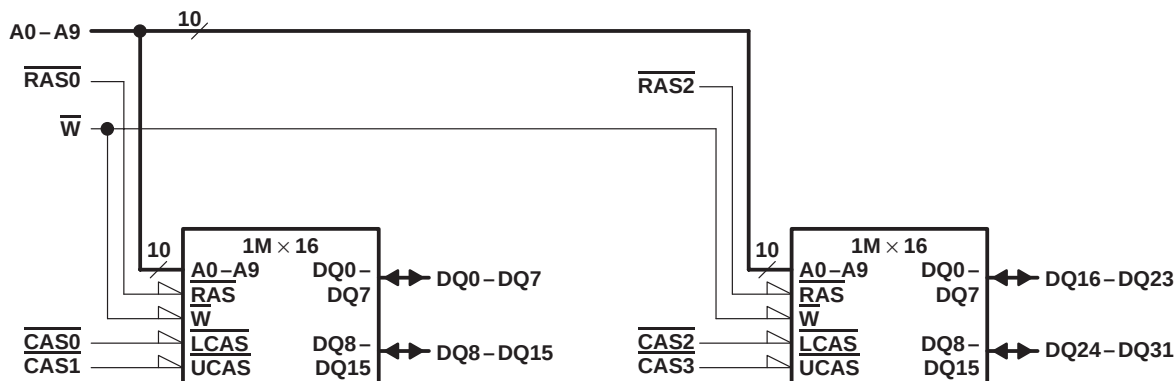
PC substrate: 1,27 ± 0,1 mm (0.05 inch) nominal thickness; 0.005 inch/inch maximum warpage

Bypass capacitors: Multilayer ceramic

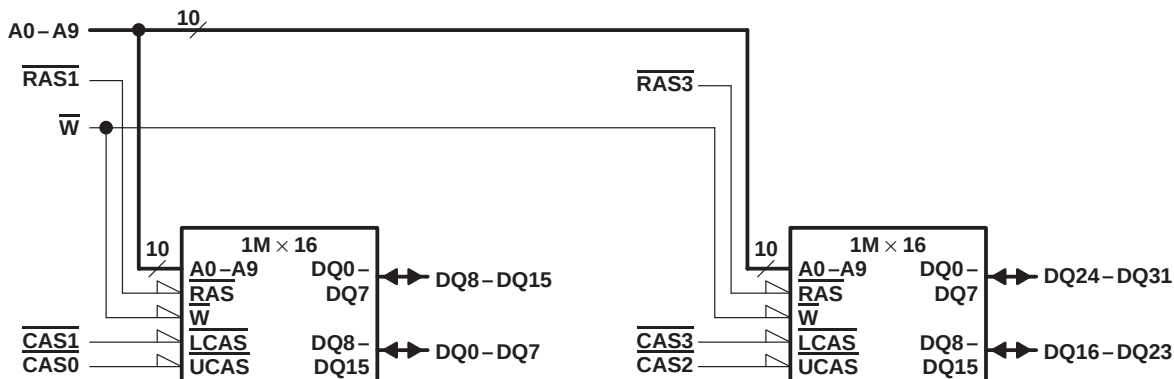
Contact area for TM124FBK32F and TM248GBK32F: Nickel plate and gold plate over copper

Contact area for TM124FBK32U and TM248GBK32U: Nickel plate and tin/lead over copper

functional block diagram (TM124FBK32F and TM248GBK32F, side 1)



functional block diagram (TM248GBK32F, side 2)



TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE

SMMS660 – MARCH 1996

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC} (see Note 1)	– 1 V to 7 V
Voltage range on any pin (see Note 1)	– 1 V to 7 V
Short-circuit output current	50 mA
Power dissipation: TM124FBK32F, TM124FBK32U	2 W
TM248GBK32F, TM248GBK32U	4 W
Operating free-air temperature range, T_A	0°C to 70°C
Storage temperature range, T_{stg}	– 55°C to 125°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values are with respect to V_{SS} .

recommended operating conditions

	MIN	NOM	MAX	UNIT
V_{CC} Supply voltage	4.5	5	5.5	V
V_{IH} High-level input voltage	2.4		6.5	V
V_{IL} Low-level input voltage (see Note 2)	– 1		0.8	V
T_A Operating free-air temperature	0		70	°C

NOTE 2: The algebraic convention, where the more negative (less positive) limit is designated as minimum, is used for logic-voltage levels only.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS [‡]	'124FBK32F-60		'124FBK32F-70		'124FBK32F-80		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
V_{OH} High-level output voltage	$I_{OH} = -5$ mA	2.4		2.4		2.4		V
V_{OL} Low-level output voltage	$I_{OL} = 4.2$ mA		0.4		0.4		0.4	V
I_I Input current (leakage)	$V_{CC} = 5.5$ V, $V_I = 0$ V to 6.5 V, All other pins = 0 V to V_{CC}		± 10		± 10		± 10	µA
I_O Output current (leakage)	$V_{CC} = 5.5$ V, $V_O = 0$ V to V_{CC} , $\overline{CAS}$ high		± 10		± 10		± 10	µA
I_{CC1} Read- or write-cycle current (see Note 3)	$V_{CC} = 5.5$ V, Minimum cycle		380		360		340	mA
I_{CC2} Standby current	$V_{IH} = 2.4$ V (TTL), After one memory cycle, $\overline{RAS}$ and $\overline{CAS}$ high		4		4		4	mA
	$V_{IH} = V_{CC} - 0.2$ V (CMOS), After one memory cycle, $\overline{RAS}$ and $\overline{CAS}$ high		2		2		2	mA
I_{CC3} Average refresh current ($\overline{RAS}$ only or CBR) (see Note 3)	$V_{CC} = 5.5$ V, Minimum cycle, $\overline{RAS}$ cycling, $\overline{CAS}$ high ($\overline{RAS}$ only); $\overline{RAS}$ low after $\overline{CAS}$ low (CBR)		380		360		340	mA
I_{CC4} Average EDO current (see Note 4)	$V_{CC} = 5.5$ V, $t_{HPC} = \text{MIN}$, $\overline{RAS}$ low, $\overline{CAS}$ cycling		200		180		160	mA

[‡] For test conditions shown as MIN/MAX, use the appropriate value specified under recommended operating conditions.

NOTES: 3. Measured with a maximum of one address change while $\overline{RAS} = V_{IL}$

4. Measured with a maximum of one address change while $\overline{CAS} = V_{IH}$



TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE
TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE

SMMS660 – MARCH 1996

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (continued)

PARAMETER	TEST CONDITIONS †	'248GBK32F - 60		'248GBK32F - 70		'248GBK32F - 80		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
V _{OH} High-level output voltage	I _{OH} = – 5 mA	2.4		2.4		2.4		V
V _{OL} Low-level output voltage	I _{OL} = 4.2 mA		0.4		0.4		0.4	V
I _I Input current (leakage)	V _{CC} = 5.5 V, V _I = 0 V to 6.5 V, All other pins = 0 V to V _{CC}		± 10		± 10		± 10	µA
I _O Output current (leakage)	V _{CC} = 5.5 V, V _O = 0 V to V _{CC} , $\overline{\text{CAS}}$ high		± 20		± 20		± 20	µA
I _{CC1} Read- or write-cycle current (see Note 3)	V _{CC} = 5.5 V, Minimum cycle		384		364		344	mA
I _{CC2} Standby current	V _{IH} = 2.4 V (TTL), After one memory cycle, $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ high		8		8		8	mA
	V _{IH} = V _{CC} – 0.2 V (CMOS), After one memory cycle, $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ high		4		4		4	mA
I _{CC3} Average refresh current ($\overline{\text{RAS}}$ only or CBR) (see Notes 3 and 5)	V _{CC} = 5.5 V, Minimum cycle, $\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}}$ high ($\overline{\text{RAS}}$ only); $\overline{\text{RAS}}$ low after $\overline{\text{CAS}}$ low (CBR)		760		720		680	mA
I _{CC4} Average EDO current (see Note 4)	V _{CC} = 5.5 V, t _{PC} = MIN, $\overline{\text{RAS}}$ low, $\overline{\text{CAS}}$ cycling		204		184		164	mA

† For test conditions shown as MIN/MAX, use the appropriate value specified under recommended operating conditions.

- NOTES: 3. Measured with a maximum of one address change while $\overline{\text{RAS}}$ = V_{IL}
4. Measured with a maximum of one address change while $\overline{\text{CAS}}$ = V_{IH}
5. Measured with both sides in CBR cycle

capacitance over recommended ranges of supply voltage and operating free-air temperature, f = 1 MHz (see Note 6)

PARAMETER		'124FBK32F		'248GBK32F		UNIT
		MIN	MAX	MIN	MAX	
C _{i(A)}	Input capacitance, A0–A9		12		22	pF
C _{i(R)}	Input capacitance, $\overline{\text{RAS}}$ inputs		8		8	pF
C _{i(C)}	Input capacitance, $\overline{\text{CAS}}$ inputs		8		15	pF
C _{i(W)}	Input capacitance, $\overline{\text{W}}$		16		30	pF
C _{o(DQ)}	Output capacitance on DQ0–DQ31		8		15	pF

NOTE 6: V_{CC} = 5 V ± 0.5 V, and the bias on pins under test is 0 V.



TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE

SMMS660 – MARCH 1996

switching characteristics over recommended ranges of supply voltage and operating free-air temperature

PARAMETER	'124FBK32F - 60 '248GBK32F - 60		'124FBK32F - 70 '248GBK32F - 70		'124FBK32F - 80 '248GBK32F - 80		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
t _{AA} Access time from column address		30		35		40	ns
t _{CAC} Access time from $\overline{\text{CAS}}$ low		15		18		20	ns
t _{RAC} Access time from $\overline{\text{RAS}}$ low		60		70		80	ns
t _{CPA} Access time from column precharge		35		40		45	ns
t _{CLZ} $\overline{\text{CAS}}$ to output in low-impedance state	0		0		0		ns
t _{REZ} Output disable time after $\overline{\text{RAS}}$ high (see Note 7)	3	15	3	18	3	20	ns
t _{WEZ} Output disable time after $\overline{\text{W}}$ low (see Note 7)	3	15	3	18	3	20	ns

NOTE 7: t_{REZ} and t_{WEZ} are specified when the output is no longer driven.

EDO timing requirements over recommended ranges of supply voltage and operating free-air temperature

	'124FBK32F - 60 '248GBK32F - 60		'124FBK32F - 70 '248GBK32F - 70		'124FBK32F - 80 '248GBK32F - 80		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
t _{HPC} Cycle time, EDO page-mode read or write	25		30		35		ns
t _{PRWC} Cycle time, EDO read-write	80		90		100		ns
t _{CSH} Hold time, $\overline{\text{CAS}}$ from $\overline{\text{RAS}}$	50		55		60		ns
t _{DOH} Hold time, output from $\overline{\text{CAS}}$	3		3		3		ns
t _{CAS} Pulse duration, $\overline{\text{CAS}}$	10	10 000	12	10 000	15	10 000	ns
t _{WPE} Pulse duration, $\overline{\text{W}}$ (output disable only)	5		5		5		ns
t _{CP} Precharge time, $\overline{\text{CAS}}$	5		5		5		ns

timing requirements over recommended ranges of supply voltage and operating free-air temperature

	'124FBK32F - 60 '248GBK32F - 60		'124FBK32F - 70 '248GBK32F - 70		'124FBK32F - 80 '248GBK32F - 80		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
t _{RC} Cycle time, random read or write (see Note 8)	110		130		150		ns
t _{RWC} Cycle time, read-write	150		175		200		ns
t _{RASP} Pulse duration, page mode, $\overline{\text{RAS}}$ low	60	100 000	70	100 000	80	100 000	ns
t _{RAS} Pulse duration, nonpage mode, $\overline{\text{RAS}}$ low	60	10 000	70	10 000	80	10 000	ns
t _{RP} Pulse duration, $\overline{\text{RAS}}$ high (precharge)	40		50		60		ns
t _{WP} Pulse duration, $\overline{\text{W}}$ low	10		10		10		ns
t _{RASS} Pulse duration, self refresh entry from $\overline{\text{RAS}}$ low	100		100		100		μs
t _{RPS} Pulse duration, $\overline{\text{RAS}}$ precharge after self refresh	110		130		150		ns
t _{ASC} Setup time, column address before $\overline{\text{CAS}}$ low	0		0		0		ns
t _{ASR} Setup time, row address before $\overline{\text{RAS}}$ low	0		0		0		ns
t _{DS} Setup time, data before $\overline{\text{CAS}}$ low	0		0		0		ns
t _{RCS} Setup time, $\overline{\text{W}}$ high before $\overline{\text{CAS}}$ low	0		0		0		ns
t _{CWL} Setup time, $\overline{\text{W}}$ low before $\overline{\text{CAS}}$ high	10		12		15		ns

NOTE 8: The ac parameter assumes t_f = 5 ns.



**TM124FBK32F, TM124FBK32U 1048576 BY 32-BIT DYNAMIC RAM MODULE
TM248GBK32F, TM248GBK32U 2097152 BY 32-BIT DYNAMIC RAM MODULE**

SMMS660 – MARCH 1996

timing requirements over recommended ranges of supply voltage and operating free-air temperature (continued)

		'124FBK32F - 60 '248GBK32F - 60		'124FBK32F - 70 '248GBK32F - 70		'124FBK32F - 80 '248GBK32F - 80		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t _{RWL}	Setup time, $\overline{W}$ low before $\overline{RAS}$ high	10		12		15		ns
t _{WCS}	Setup time, $\overline{W}$ low before $\overline{CAS}$ low	0		0		0		ns
t _{CAH}	Hold time, column address after $\overline{CAS}$ low	10		15		15		ns
t _{DH}	Hold time, data after $\overline{CAS}$ low	10		15		15		ns
t _{RAH}	Hold time, row address after $\overline{RAS}$ low	10		10		10		ns
t _{RCH}	Hold time, $\overline{W}$ high after $\overline{CAS}$ high (see Note 9)	0		0		0		ns
t _{RRH}	Hold time, $\overline{W}$ high after $\overline{RAS}$ high (see Note 9)	0		0		0		ns
t _{WCH}	Hold time, $\overline{W}$ low after $\overline{CAS}$ low	10		15		15		ns
t _{RHCP}	Hold time, $\overline{RAS}$ high from $\overline{CAS}$ precharge	35		40		45		ns
t _{CHS}	Hold time, $\overline{CAS}$ low after $\overline{RAS}$ high (self refresh)	- 50		- 50		- 50		ns
t _{CHR}	Delay time, $\overline{RAS}$ low to $\overline{CAS}$ high (CBR refresh only)	10		10		10		ns
t _{CRP}	Delay time, $\overline{CAS}$ high to $\overline{RAS}$ low	5		5		5		ns
t _{CSR}	Delay time, $\overline{CAS}$ low to $\overline{RAS}$ low (CBR refresh only)	5		5		5		ns
t _{RAD}	Delay time, $\overline{RAS}$ low to column address (see Note 10)	15	30	15	35	15	40	ns
t _{RAL}	Delay time, column address to $\overline{RAS}$ high	30		35		40		ns
t _{CAL}	Delay time, column address to $\overline{CAS}$ high	20		25		30		ns
t _{RCD}	Delay time, $\overline{RAS}$ low to $\overline{CAS}$ low (see Note 10)	20	45	20	52	20	60	ns
t _{RPC}	Delay time, $\overline{RAS}$ high to $\overline{CAS}$ low (CBR only)	0		0		0		ns
t _{RSH}	Delay time, $\overline{CAS}$ low to $\overline{RAS}$ high	10		12		15		ns
t _{REF}	Refresh time interval		16		16		16	ms
t _T	Transition time	2	30	2	30	2	30	ns

NOTES: 9. Either t_{RRH} or t_{RCH} must be satisfied for a read cycle.
10. The maximum value is specified only to assure access time.



SMMS660 – MARCH 1996

BK (R-PSIM-N72)

4.255 (108,08)
4.245 (107,82)

0.125 (3,18) TYP

0.054 (1,37)
0.047 (1,19)

1.005 (25,53)
0.995 (25,27)

0.050 (1,27)

0.128 (3,25)
0.120 (3,05)

0.010 (0,25) MAX

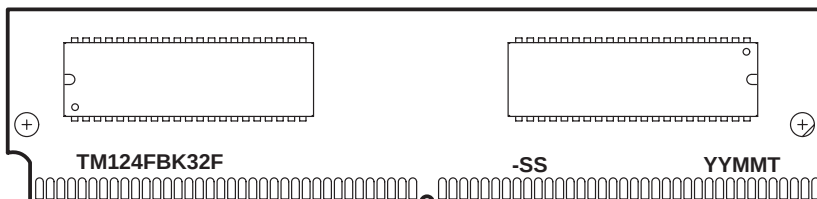
0.400 (10,16) TYP

0.040 (1,02) TYP

0.208 (5,28) MAX

0.360 (9,14) MAX
(For Double-Sided SIMM)

device symbolization (TM124FBK32F illustrated)



NOTE: Location of symbolization may vary.

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.