

TM2SJ64EPN 2097152 BY 64-BIT SYNCHRONOUS DYNAMIC RAM MODULES — SODIMM

SMMS697A – AUGUST 1997 – REVISED NOVEMBER 1997

- **Organization:**
 - TM2SJ64EPN . . . 2 097 152 x 64 Bits
- **Single 3.3-V Power Supply**
(±10% Tolerance)
- **Designed for 66-MHz 4-Clock Systems**
- **JEDEC 144-Pin Small-Outline Dual-In-Line Memory Module (SODIMM) Without Buffer for Use With Socket**
- **TM2SJ64EPN — Uses Eight 16M-Bit Synchronous Dynamic RAMs (SDRAMs) (2M × 8-Bit) in Plastic Thin Small-Outline Packages (TSOP)**
- **Byte-Read/Write Capability**
- **Read Latencies 2 and 3 Supported**
- **Performance Ranges:**
- **Support Burst-Interleave and Burst-Interrupt Operations**
- **Burst Length Programmable to 1, 2, 4, and 8**
- **Two Banks for On-Chip Interleaving (Gapless Access)**
- **Ambient Temperature Range**
0°C to 70°C
- **Gold-Plated Contacts**
- **Pipeline Architecture**
- **High-Speed, Low-Noise Low-Voltage TTL (LVTTTL) Interface**
- **Serial Presence-Detect (SPD) Using EEPROM**

	SYNCHRONOUS CLOCK CYCLE TIME		ACCESS TIME CLOCK TO OUTPUT		REFRESH INTERVAL
	t _{CK3} (CL = 3)‡	t _{CK2} (CL = 2)	t _{CK3} (CL = 3)	t _{CK2} (CL = 2)	
	'xSJ64EPN-10	10 ns	15 ns	7.5 ns	
'xSJ64EPN-12	12 ns	15 ns	8 ns	9 ns	64 ms

‡ CL = CAS latency

description

The TM2SJ64EPN is a 16M-byte, 144-pin small-outline dual-in-line memory module (SODIMM). The SODIMM is composed of eight TMS626812ADGE, 2097152 x 8-bit SDRAMs, each in a 400-mil, 44-pin plastic thin small-outline package (TSOP) mounted on a substrate with decoupling capacitors. See the TMS626812A data sheet (literature number SMOS691).

operation

The TM2SJ64EPN operates as eight TMS626812ADGE devices that are connected as shown in the TM2SJ64EPN functional block diagram.

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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.

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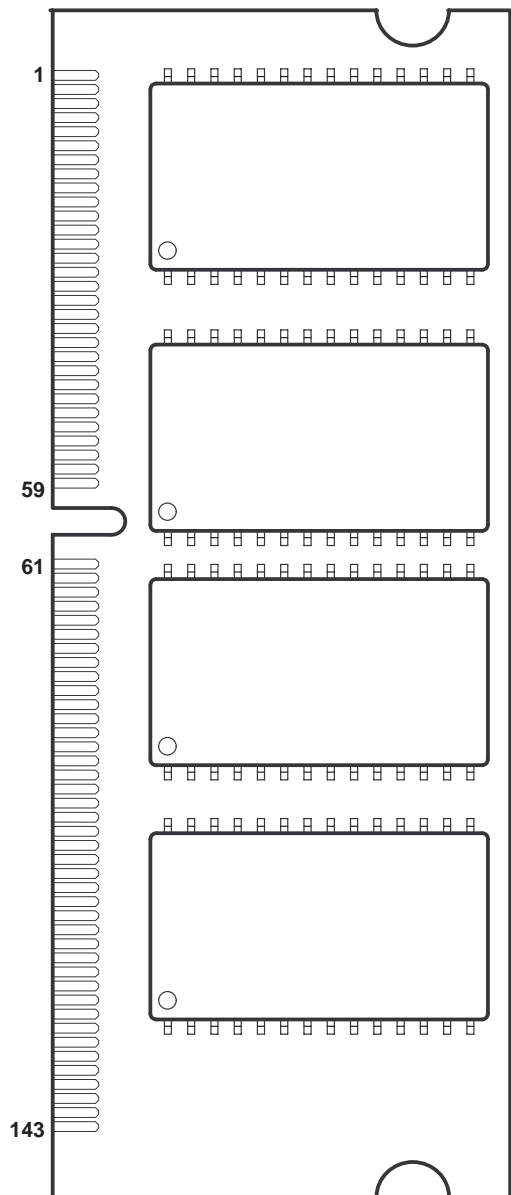
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DUAL-IN-LINE MEMORY MODULE (TOP VIEW)



TM2SJ64EPN (SIDE VIEW)



PIN NOMENCLATURE

A[0:10]	Row Address Inputs
A[0:8]	Column Address Inputs
A11/BA0	Bank-Select Zero
$\overline{\text{CAS}}$	Column-Address Strobe
CKE0	Clock Enable
CK[0:3]	System Clock
DQ[0:63]	Data-In/Data-Out
DQMB[0:7]	Data-In/Data-Out
	Mask Enable
NC	No Connect
$\overline{\text{RAS}}$	Row-Address Strobe
$\overline{\text{S0}}$	Chip-Select
SCL	SPD Clock
SDA	SPD Address/Data
V _{DD}	3.3-V Supply
V _{SS}	Ground
WE	Write Enable

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Pin Assignments

NO.	PIN NAME	NO.	PIN NAME	NO.	PIN NAME	NO.	PIN NAME
1	V _{SS}	37	DQ8	73	NC	109	A9
2	V _{SS}	38	DQ40	74	CK1	110	NC
3	DQ0	39	DQ9	75	V _{SS}	111	A10
4	DQ32	40	DQ41	76	V _{SS}	112	NC
5	DQ1	41	DQ10	77	NC	113	V _{DD}
6	DQ33	42	DQ42	78	NC	114	V _{DD}
7	DQ2	43	DQ11	79	NC	115	DQMB2
8	DQ34	44	DQ43	80	NC	116	DQMB6
9	DQ3	45	V _{DD}	81	V _{DD}	117	DQMB3
10	DQ35	46	V _{DD}	82	V _{DD}	118	DQMB7
11	V _{DD}	47	DQ12	83	DQ16	119	V _{SS}
12	V _{DD}	48	DQ44	84	DQ48	120	V _{SS}
13	DQ4	49	DQ13	85	DQ17	121	DQ24
14	DQ36	50	DQ45	86	DQ49	122	DQ56
15	DQ5	51	DQ14	87	DQ18	123	DQ25
16	DQ37	52	DQ46	88	DQ50	124	DQ57
17	DQ6	53	DQ15	89	DQ19	125	DQ26
18	DQ38	54	DQ47	90	DQ51	126	DQ58
19	DQ7	55	V _{SS}	91	V _{SS}	127	DQ27
20	DQ39	56	V _{SS}	92	V _{SS}	128	DQ59
21	V _{SS}	57	NC	93	DQ20	129	V _{DD}
22	V _{SS}	58	NC	94	DQ52	130	V _{DD}
23	DQMB0	59	NC	95	DQ21	131	DQ28
24	DQMB4	60	NC	96	DQ53	132	DQ60
25	DQMB1	61	CK0	97	DQ22	133	DQ29
26	DQMB5	62	CKE0	98	DQ54	134	DQ61
27	V _{DD}	63	V _{DD}	99	DQ23	135	DQ30
28	V _{DD}	64	V _{DD}	100	DQ55	136	DQ62
29	A0	65	$\overline{\text{RAS}}$	101	V _{DD}	137	DQ31
30	A3	66	$\overline{\text{CAS}}$	102	V _{DD}	138	DQ63
31	A1	67	$\overline{\text{WE}}$	103	A6	139	V _{SS}
32	A4	68	NC	104	A7	140	V _{SS}
33	A2	69	$\overline{\text{S0}}$	105	A8	141	SDA
34	A5	70	NC	106	A11/BA0	142	SCL
35	V _{SS}	71	NC	107	V _{SS}	143	V _{DD}
36	V _{SS}	72	NC	108	V _{SS}	144	V _{DD}

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absolute maximum ratings over ambient temperature range (unless otherwise noted)†

Supply voltage range, V_{DD}	–0.5 V to 4.6 V
Voltage range on any pin (see Note 1)	– 0.5 V to 4.6 V
Short-circuit output current	50 mA
Power dissipation: TM2SJ64EPN	8 W
Ambient 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_{DD} Supply voltage	3	3.3	3.6	V
V_{SS} Supply voltage	0			V
V_{IH} High-level input voltage	2	$V_{DD} + 0.3$		V
V_{IH-SPD} High-level input voltage for the SPD device	2	5.5		V
V_{IL} Low-level input voltage ‡	–0.3	0.8		V
T_A Ambient temperature	0	70		°C

‡ V_{IL} MIN = –1.5 V ac (pulse width \leq 5 ns)

capacitance over recommended ranges of supply voltage and ambient temperature, $f = 1$ MHz (see Note 2)

PARAMETERS	TM2SJ64EPN		UNIT
	MIN	MAX	
$C_{i(CK)}$ Input capacitance, CK input	18		pF
$C_{i(AC)}$ Input capacitance, address and control inputs: A0–A11, \overline{RASx} , \overline{CASx} , \overline{WEx}	42		pF
$C_{i(CKE)}$ Input capacitance, CKE input	42		pF
C_o Output capacitance	8.5		pF
$C_{i(DQMBx)}$ Input capacitance, DQMBx input	12		pF
$C_{i(Sx)}$ Input capacitance, \overline{Sx} input	22		pF
$C_{i/o(SDA)}$ Input/output capacitance, SDA input	9		pF
$C_{i(SPD)}$ Input capacitance, SPD inputs (except SDA)	7		pF

NOTE 2: $V_{DD} = 3.3 \text{ V} \pm 0.3 \text{ V}$. Bias on pins under test is 0 V.

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electrical characteristics over recommended ranges of supply voltage and ambient temperature (unless otherwise noted) (see Note 3)

TM2SJ64EPN

PARAMETER		TEST CONDITIONS	'2SJ64EPN-10		'2SJ64EPN-12		UNIT
			MIN	MAX	MIN	MAX	
V _{OH}	High-level output voltage	I _{OH} = - 2 mA	2.4		2.4		V
V _{OL}	Low-level output voltage	I _{OL} = 2 mA		0.4		0.4	V
I _I	Input current (leakage)	0 V < V _I < V _{DD} + 0.3 V, All other pins = 0 V to V _{DD}		± 10		± 10	µA
I _O	Output current (leakage)	0 V < V _O < V _{DD} + 0.3 V, Output disabled		± 10		± 10	µA
I _{CC1}	Operating current	Burst length = 1, t _{RC} ≥ t _{RC} MIN I _{OH} /I _{OL} = 0 mA, one bank activated (see Note 4)	CAS latency = 2	760	720		mA
			CAS latency = 3	840	720		mA
I _{CC2P}	Precharge standby current in power-down mode	CKE ≤ V _{IL} MAX, t _{CK} = 15 ns (see Note 5)		16	16		mA
I _{CC2PS}			CKE and CK ≤ V _{IL} MAX, t _{CK} = ∞ (see Note 6)		16	16	mA
I _{CC2N}	Precharge standby current in non-power-down mode	CKE ≥ V _{IH} MIN, t _{CK} = 15 ns (see Note 5)		200	200		mA
I _{CC2NS}			CKE ≥ V _{IH} MIN, CK ≤ V _{IL} MAX, t _{CK} = ∞ (see Note 6)		16	16	mA
I _{CC3P}	Active standby current in power-down mode	CKE ≤ V _{IL} MAX, t _{CK} = 15 ns (see Note 5)		24	24		mA
I _{CC3PS}			CKE and CK ≤ V _{IL} MAX, t _{CK} = ∞ (see Note 6)		24	24	mA
I _{CC3N}	Active standby current in non-power-down mode	CKE ≥ V _{IH} MIN, t _{CK} = 15 ns (see Note 5)		240	240		mA
I _{CC3NS}			CKE ≥ V _{IH} MIN, CK ≤ V _{IL} MAX, t _{CK} = ∞ (see Note 6)		80	80	mA
I _{CC4}	Burst current	Page burst, I _{OH} /I _{OL} = 0 mA All banks activated, n _{CCD} = one cycle (see Note 7)	CAS latency = 2	800	760		mA
			CAS latency = 3	1040	1000		mA
I _{CC5}	Auto-refresh current	t _{RC} ≤ t _{RC} MIN	CAS latency = 2	680	640		mA
			CAS latency = 3	760	640		mA
I _{CC6}	Self-refresh current	CKE ≤ V _{IL} MAX		16	16		mA

- NOTES: 3. All specifications apply to the device after power-up initialization. All control and address inputs must be stable and valid.
 4. Control, DQ, and address inputs change state twice during t_{RC}.
 5. Control, DQ, and address inputs change state once every 30 ns.
 6. Control, DQ, and address inputs do not change.
 7. Control, DQ, and address inputs change once every cycle.

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ac timing requirements†

	'2SJ64EPN-10		'2SJ64EPN-12		UNIT
	MIN	MAX	MIN	MAX	
t _{CK2} Cycle time, CLK, CAS latency = 2	15		15		ns
t _{CK3} Cycle time, CLK, CAS latency = 3	10		12		ns
t _{CH} Pulse duration, CLK high	3		4		ns
t _{CL} Pulse duration, CLK low	3		4		ns
t _{AC2} Access time, CLK high to data out, CAS latency = 2 (see Note 8)		8		9	ns
t _{AC3} Access time, CLK high to data out, CAS latency = 3 (see Note 8)		7.5		8	ns
t _{OH} Hold time, CLK high to data out	3		3		ns
t _{LZ} Delay time, CLK high to DQ in low-impedance state (see Note 9)	2		2		ns
t _{HZ} Delay time, CLK high to DQ in high-impedance state (see Note 10)		8		8	ns
t _{IS} Setup time, address, control, and data input	3		3		ns
t _{IH} Hold time, address, control, and data input	1		1		ns
t _{CESP} Power-down/self-refresh exit time	10		10		ns
t _{RAS} Delay time, ACTV command to DEAC or DCAB command	50	100 000	60	100 000	ns
t _{RC} Delay time, ACTV, REFR, or SLFR exit to ACTV, MRS, REFR, or SLFR command	80		90		ns
t _{RCD} Delay time, ACTV command to READ, READ-P, WRT, or WRT-P command (see Note 11)	30		30		ns
t _{RP} Delay time, DEAC or DCAB command to ACTV, MRS, REFR, or SLFR command	30		30		ns
t _{RRD} Delay time, ACTV command in one bank to ACTV command in the other bank	20		24		ns
t _{RSA} Delay time, MRS command to ACTV, MRS, REFR, or SLFR command	20		24		ns
t _{APR} Final data out of READ-P operation to ACTV, MRS, SLFR, or REFR command	$t_{RP} - (CL - 1) * t_{CK}$				ns
t _{APW} Final data in of WRT-P operation to ACTV, MRS, SLFR, or REFR command	$t_{RP} + t_{CK}$				ns
t _{WR} Delay time, final data in of WRT operation to DEAC or DCAB command	10		12		ns
t _T Transition time (see Note 12)	1	5	1	5	ns
t _{REF} Refresh interval		64		64	ms
n _{CCD} Delay time, READ or WRT command to an interrupting command	1		1		cycle
n _{CDD} Delay time, \overline{CS} low or high to input enabled or inhibited	0	0	0	0	cycle
n _{CLE} Delay time, CKE high or low to CLK enabled or disabled	1	1	1	1	cycle
n _{CWL} Delay time, final data in of WRT operation to READ, READ-P, WRT, WRT-P	1		1		cycle
n _{DID} Delay time, ENBL or MASK command to enabled or masked data in	0	0	0	0	cycle
n _{DOD} Delay time, ENBL or MASK command to enabled or masked data out	2	2	2	2	cycle
n _{HZP2} Delay time, DEAC or DCAB command to DQ in high-impedance state, CAS latency = 2		2		2	cycle
n _{HZP3} Delay time, DEAC or DCAB command to DQ in high-impedance state, CAS latency = 3		3		3	cycle
n _{WCD} Delay time, WRT command to first data in	0	0	0	0	cycle

† All references are made to the rising transition of CK unless otherwise noted.

- NOTES:
8. t_{AC} is referenced from the rising transition of CK that is previous to the data-out cycle. For example, the first data out t_{AC} is referenced from the rising transition of CK_x that is CAS latency – one cycle after the READ command. Access time is measured at output reference level 1.4 V.
 9. t_{LZ} is measured from the rising transition of CLK that is CAS latency – one cycle after the READ command.
 10. t_{HZ} MAX defines the time at which the outputs are no longer driven and is not referenced to output voltage levels.
 11. For read or write operations with automatic deactivate, t_{RCD} must be set to satisfy minimum t_{RAS}.
 12. Transition time, t_T, is measured between V_{IH} and V_{IL}.

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serial presence detect

The serial presence detect (SPD) is contained in a 2K-bit serial EEPROM located on the module. The SPD nonvolatile EEPROM contains various data such as module configuration, SDRAM organization, and timing parameters (see Table 1). Only the first 128 bytes are programmed by Texas Instruments, while the remaining 128 bytes are available for customer use. Programming is done through a IIC bus using the clock (SCL) and data (SDA) signals. All Texas Instruments modules comply with the current JEDEC SPD Standard. See the *Texas Instruments Serial Presence Detect Technical Reference* (literature number SMMU001) for further details.

Table 1 lists the functions of the TM2SJ64EPN.

Table 1. Serial-Presence-Detect Data for the TM2SJ64EPN

BYTE NO.	DESCRIPTION OF FUNCTION	TM2SJ64EPN-10		TM2SJ64EPN-12	
		ITEM	DATA	ITEM	DATA
0	Defines number of bytes written into serial memory during module manufacturing	128 bytes	80h	128 bytes	80h
1	Total number of bytes of SPD memory device	256 bytes	08h	256 bytes	08h
2	Fundamental memory type (FPM, EDO, SDRAM, . . .)	SDRAM	04h	SDRAM	04h
3	Number of row addresses on this assembly	11	0Bh	11	0Bh
4	Number of column addresses on this assembly	9	09h	9	09h
5	Number of module banks on this assembly	1 bank	01h	1 bank	01h
6	Data width of this assembly	64 bits	40h	64 bits	40h
7	Data width continuation		00h		00h
8	Voltage interface standard of this assembly	LVTTTL	01h	LVTTTL	01h
9	SDRAM cycle time at maximum supported CAS latency (CL), CL = X	t _{CK} = 10 ns	A0h	t _{CK} = 12 ns	C0h
10	SDRAM access from clock at CL = X	t _{AC} = 7.5 ns	75h	t _{AC} = 8 ns	80h
11	SODIMM configuration type (non-parity, parity, error-correcting code [ECC])	Non-Parity	00h	Non-Parity	00h
12	Refresh rate/type	15.6 μs/ self-refresh	80h	15.6 μs/ self-refresh	80h
13	SDRAM width, primary DRAM	x8	08h	x8	08h
14	Error-checking SDRAM data width	N/A	00h	N/A	00h
15	Minimum clock delay, back-to-back random column addresses	1 CK cycle	01h	1 CK cycle	01h
16	Burst lengths supported	1, 2, 4, 8	0Fh	1, 2, 4, 8	0Fh
17	Number of banks on each SDRAM device	2 banks	02h	2 banks	02h
18	CAS latencies supported	2, 3	06h	2, 3	06h
19	CS latency	0	01h	0	01h
20	Write latency	0	01h	0	01h
21	SDRAM module attributes	Non-buffered/ Non-registered	00h	Non-buffered/ Non-registered	00h
22	SDRAM device attributes: general	V _{DD} tolerance = (± 10%), Burst read/write, precharge all, auto precharge	0Eh	V _{DD} tolerance = (± 10%), Burst read/write, precharge all, auto precharge	0Eh
23	Minimum clock cycle time at CL = X – 1	t _{CK} = 15 ns	F0h	t _{CK} = 15 ns	F0h

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serial presence detect (continued)

Table 1. Serial-Presence-Detect Data for the TM2SJ64EPN (Continued)

BYTE NO.	DESCRIPTION OF FUNCTION	TM2SJ64EPN-10		TM2SJ64EPN-12	
		ITEM	DATA	ITEM	DATA
24	Maximum data-access time from clock at CL = X – 1	t _{AC} = 8 ns	80h	t _{AC} = 9 ns	90h
25	Minimum clock cycle time at CL = X – 2	N/A	00h	N/A	00h
26	Maximum data-access time from clock at CL = X – 2	N/A	00h	N/A	00h
27	Minimum row precharge time	t _{RP} = 30 ns	1Eh	t _{RP} = 30 ns	1Eh
28	Minimum row-active to row-active delay	t _{RRD} = 20 ns	14h	t _{RRD} = 24 ns	18h
29	Minimum $\overline{\text{RAS}}$ -to- $\overline{\text{CAS}}$ delay	t _{RCD} = 30 ns	1Eh	t _{RCD} = 30 ns	1Eh
30	Minimum $\overline{\text{RAS}}$ pulse width	t _{RAS} = 50 ns	32h	t _{RAS} = 60 ns	3Ch
31	Density of each bank on module	16M Bytes	04h	16M Bytes	04h
32–61	Superset features (may be used in the future)				
62	SPD revision	Rev. 1	01h	Rev. 1	01h
63	Checksum for byte 0–62	158	9Eh	231	E7h
64–71	Manufacturer's JEDEC ID code per JEP – 106E	97h	9700...00h	97h	9700...00h
72	Manufacturing location [†]	TBD		TBD	
73–90	Manufacturer's part number [†]	TBD		TBD	
91	Die revision code [†]	TBD		TBD	
92	PCB revision code [†]	TBD		TBD	
93–94	Manufacturing date [†]	TBD		TBD	
95–98	Assembly serial number [†]	TBD		TBD	
99–125	Manufacturer specific data [†]	TBD		TBD	
126–127	Vendor specific data [†]	TBD		TBD	
128–166	System integrator's specific data [‡]	TBD		TBD	
167–255	Open				

[†] TBD indicates values are determined at manufacturing time and are module dependent.

[‡] These TBD values are determined and programmed by the customer (optional).

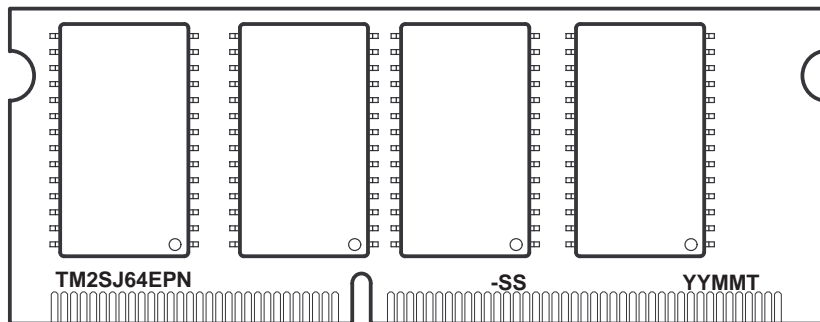
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device symbolization (TM2SJ64EPN)



YY = Year Code
MM = Month Code
T = Assembly Site Code
-SS = Speed Code

NOTE A: Location of symbolization may vary.

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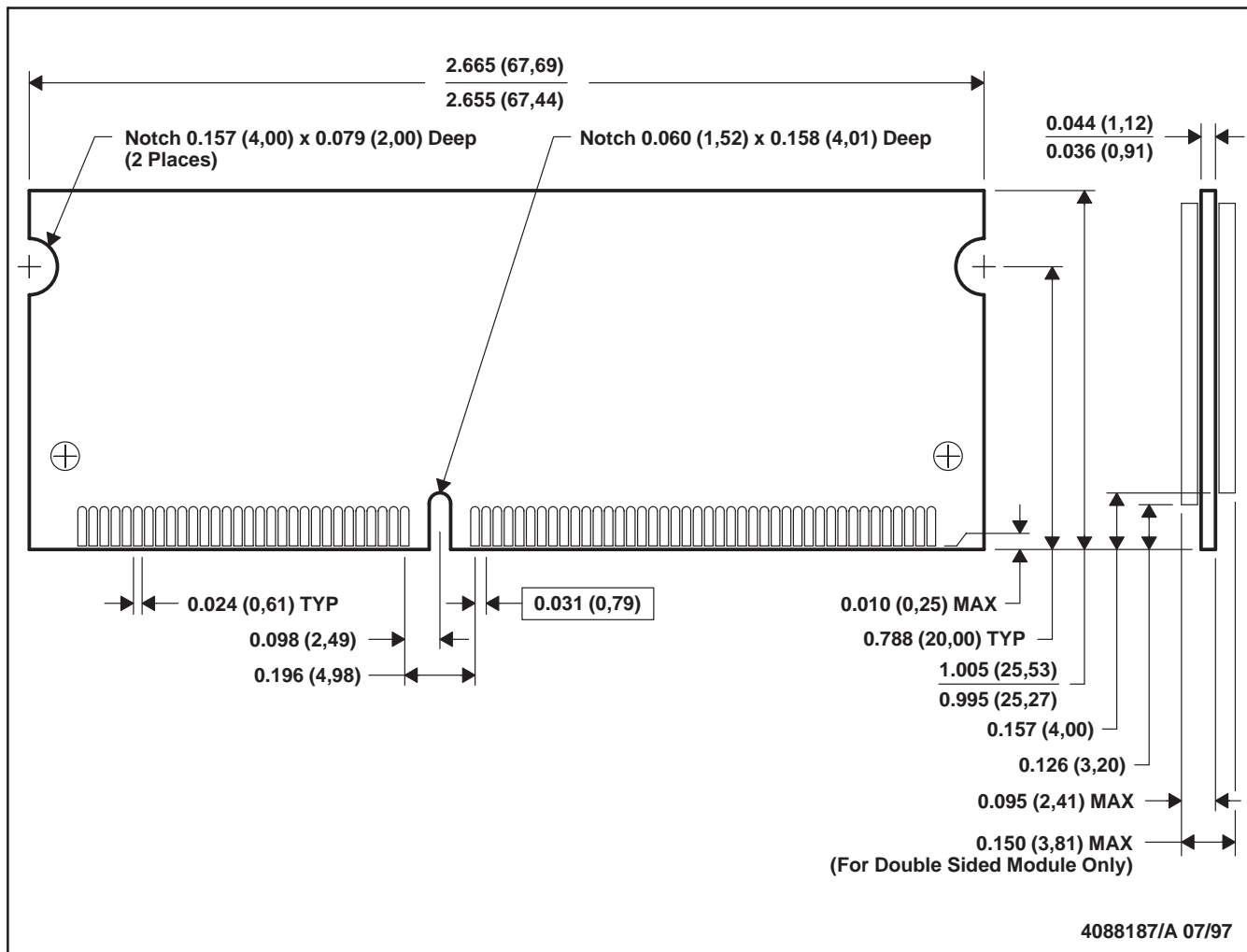
TM2SJ64EPN 2097152 BY 64-BIT
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MECHANICAL DATA

BDM (R-SODIMM-N144)

SMALL OUTLINE DUAL IN-LINE MEMORY MODULE



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- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MO-190



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