

1,048,576 WORDS x 32 BIT DYNAMIC RAM MODULE

PRELIMINARY

DESCRIPTION

The THM321020S is a 1,048,576 words by 32 bits dynamic RAM module which assembled 8 pcs of TC514400J on the printed circuit board. The THM321020S can be as well used as 2,097,152 words by 16 bits dynamic RAM module, by means of connecting DQ0 and DQ16, DQ1 and DQ17, DQ2 and DQ18,, DQ15 and DQ31, respectively. The THM321020S is optimized for application to the systems which are required high density and large capacity such as main memory of the computers and as image memory systems, and to the others which are requested compact size.

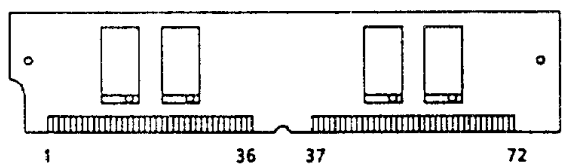
FEATURES

- 1,048,576 words by 32 bits organization
- Fast access time and cycle time

	THM321020 S-80	THM321020 S-10
t_{RAC} \overline{RAS} Access Time	80ns	100ns
t_{AA} Column Address Access Time	40ns	50ns
t_{CAC} \overline{CAS} Access Time	20ns	25ns
t_{rc} Cycle Time	150ns	180ns
t_{pc} Fast Page Mode Cycle Time	50ns	60ns

- Single power supply of 5V ± 10%
- Low power
4,620mW MAX. Operating (THMxxxxxx-80)
3,960mW MAX. Operating (THMxxxxxx-10)
44mW MAX. Standby
- \overline{CAS} before \overline{RAS} refresh, \overline{RAS} only refresh, Hidden refresh, and Fast Page Mode capability.
- All inputs and outputs TTL compatible
- 1024 Refresh cycles/16ms
- Tin-Lead Contact: THM321020S-80,10
- Gold Contact: THM321020SG-80,10

PIN CONNECTION (TOP VIEW)



PIN NAMES

A0~A9	Address Inputs
DQ0~DQ31	Data Input/Outputs
$\overline{CAS0}$ ~ $\overline{CAS3}$	Column Address Strobe
$\overline{RAS0}$, $\overline{RAS2}$	Row Address Strobe
\overline{W}	Read/Write Input
V_{CC}	Power (+5V)
V_{SS}	Ground
PD	Presence Detect Pin

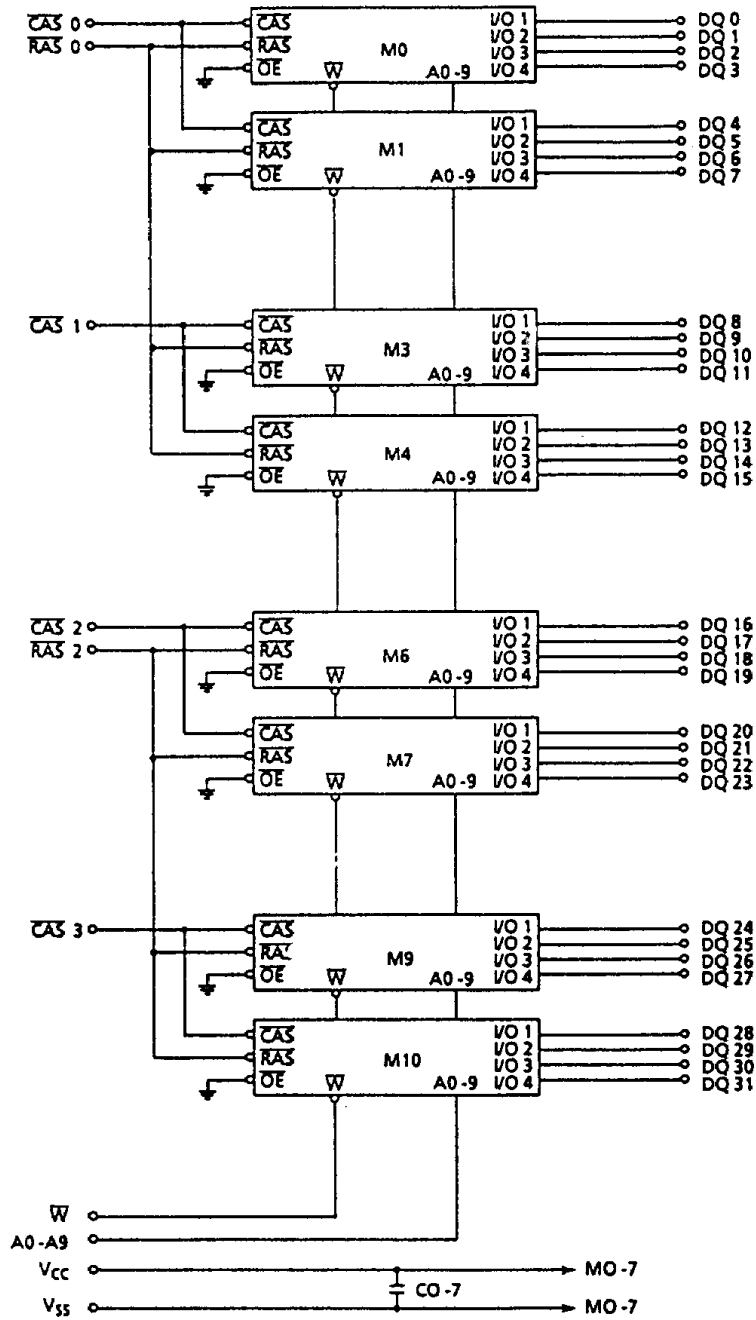
1	V_{SS}	13	A1	25	DQ22	37	NC	49	DQ8	61	DQ13
2	DQ0	14	A2	26	DQ7	38	NC	50	DQ24	62	DQ30
3	DQ16	15	A3	27	DQ23	39	V_{SS}	51	DQ9	63	DQ14
4	DQ1	16	A4	28	A7	40	$\overline{CAS0}$	52	DQ25	64	DQ31
5	DQ17	17	A5	29	NC	41	$\overline{CAS2}$	53	DQ10	65	DQ15
6	DQ2	18	A6	30	V_{CC}	42	$\overline{CAS3}$	54	DQ26	66	NC
7	DQ18	19	NC	31	A8	43	$\overline{CAS1}$	55	DQ11	67	PD0
8	DQ3	20	DQ4	32	A9	44	$\overline{RAS0}$	56	DQ27	68	PD1
9	DQ19	21	DQ20	33	NC	45	NC	57	DQ12	69	PD2
10	V_{CC}	22	DQ5	34	$\overline{RAS2}$	46	NC	58	DQ28	70	PD3
11	NC	23	DQ21	35	NC	47	\overline{W}	59	V_{CC}	71	NC
12	A0	24	DQ6	36	NC	48	NC	60	DQ29	72	V_{SS}

	- 80	- 10
PD0	V_{SS}	V_{SS}
PD1	V_{SS}	V_{SS}
PD2	NC	V_{SS}
PD3	V_{SS}	V_{SS}

THM321020S-80, 10

THM321020SG-80, 10

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNITS	NOTES
Input Voltage	V _{IN}	-1.0~7.0	V	1
Output Voltage	V _{OUT}	-1.0~7.0	V	1
Power Supply Voltage	V _{CC}	-1.0~7.0	V	1
Operating Temperature	T _{OPR}	.0~70	°C	1
Storage Temperature	T _{STG}	-55~125	°C	1
Soldering Temperature·Time	T _{SOLDER}	260·10	°C·sec	1
Power Dissipation	P _D	4.8	W	1
Short Circuit Output Current	I _{OUT}	50	mA	1

RECOMMENDED DC OPERATING CONDITIONS (T_a = 0~70°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	NOTES
V _{CC}	Supply Voltage	4.5	5.0	5.5	V	2
V _{IH}	Input High Voltage	2.4	-	6.5	V	2
V _{IL}	Input Low Voltage	-1.0	-	0.8	V	2

THM321020S-80, 10

THM321020SG-80, 10

DC ELECTRICAL CHARACTERISTICS ($V_{CC} = 5V \pm 10\%$, $T_a = 0 \sim 70^\circ C$)

SYMBOL	PARAMETER	MIN.	MAX.	UNITS	NOTES	
I_{CC1}	OPERATING CURRENT Average Power Supply Operating Current (\overline{RAS} , \overline{CAS} , Address Cycling: $t_{RC} = t_{RC} \text{ MIN.}$)			mA	3, 4	
		THM321020S-80	-			840
		THM321020S-10	-			720
I_{CC2}	STANDBY CURRENT Power Supply Standby Current ($\overline{RAS} = \overline{CAS} = V_{IH}$)	-	16	mA		
I_{CC3}	\overline{RAS} ONLY REFRESH CURRENT Average Power Supply Current, \overline{RAS} Only Mode (\overline{RAS} Cycling, $\overline{CAS} = V_{IH}$; $t_{RC} = t_{RC} \text{ MIN.}$)			mA	3	
		THM321020S-80	-			840
		THM321020S-10	-			720
I_{CC4}	FAST PAGE MODE CURRENT Average Power Supply Current, Fast Page Mode ($\overline{RAS} = V_{IL}$, \overline{CAS} Address Cycling: $t_{PC} = t_{PC} \text{ MIN.}$)			mA	3, 4	
		THM321020S-80	-			560
		THM321020S-10	-			480
I_{CC5}	STANDBY CURRENT Power Supply Standby Current ($\overline{RAS} = \overline{CAS} = V_{CC} - 0.2V$)	-	8	mA		
I_{CC6}	\overline{CAS} BEFORE \overline{RAS} REFRESH CURRENT Average Power Supply Current, \overline{CAS} Before \overline{RAS} Mode (\overline{RAS} , \overline{CAS} Cycling: $t_{RC} = t_{RC} \text{ MIN.}$)			mA	3	
		THM321020S-80	-			840
		THM321020S-10	-			720
$I_{I(L)}$	INPUT LEAKAGE CURRENT Input Leakage Current, any Input ($0V \leq V_{IN} \leq 6.5V$, All Other Pins not under Test = $0V$)	-80	80	μA		
$I_{O(L)}$	OUTPUT LEAKAGE CURRENT (D_{OUT} is disabled, $0V \leq V_{OUT} \leq 5.5V$)	-10	10	μA		
I_{OH}	OUTPUT LEVEL Output "H" Level Voltage ($I_{OUT} = -5mA$)	2.4	-	V		
V_{OL}	OUTPUT LEVEL Output "L" Level Voltage ($I_{OUT} = 4.2mA$)	-	0.4	V		

ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

($V_{CC} = 5V \pm 10\%$, $T_a = 0 \sim 70^\circ C$) (Notes 5, 6, 7)

SYMBOL	PARAMETER	THM321020S-80		THM321020S-10		UNIT	NOTES
		MIN.	MAX.	MIN.	MAX.		
t_{RC}	Random Read or Write Cycle Time	150	-	180	-	ns	
t_{PC}	Fast Page Mode Cycle Time	50	-	60	-	ns	
t_{RAC}	Access Time from \overline{RAS}	-	80	-	100	ns	8, 13
t_{CAC}	Access Time from \overline{CAS}	-	20	-	25	ns	8, 13
t_{AA}	Access Time from Column Address	-	40	-	50	ns	8, 14
t_{CPA}	Access Time from \overline{CAS} Precharge	-	45	-	55	ns	8
t_{CLZ}	\overline{CAS} to Output in Low-Z	0	-	0	-	ns	8
t_{OFF}	Output Buffer Turn-off Delay	0	20	0	20	ns	9
t_T	Transition Time (Rise and Fall)	3	50	3	50	ns	7
t_{RP}	\overline{RAS} Precharge Time	60	-	70	-	ns	
t_{RAS}	\overline{RAS} Pulse Width	80	10,000	100	10,000	ns	
t_{RASP}	\overline{RAS} Pulse Width (Fast Page Mode)	80	200,000	100	200,000	ns	
t_{RSH}	\overline{RAS} Hold Time	20	-	25	-	ns	
t_{CSH}	\overline{CAS} Hold Time	80	-	100	-	ns	
t_{CAS}	\overline{CAS} Pulse Width	20	10,000	25	10,000	ns	
t_{RCD}	\overline{RAS} to \overline{CAS} Delay Time	20	60	25	75	ns	13
t_{RAD}	\overline{RAS} to Column Address Delay Time	15	40	20	50	ns	14
t_{CRP}	\overline{CAS} to \overline{RAS} Precharge Time	5	-	10	-	ns	
t_{CP}	\overline{CAS} Precharge Time (Fast Page Mode)	10	-	10	-	ns	
t_{ASR}	Row Address Set-Up Time	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	15	-	ns	
t_{ASC}	Column Address Set-Up Time	0	-	0	-	ns	
t_{CAH}	Column Address Hold Time	15	-	20	-	ns	
t_{AR}	Column Address Hold Time referenced to \overline{RAS}	60	-	75	-	ns	
t_{RAL}	Column Address to \overline{RAS} Lead Time	40	-	50	-	ns	
t_{RCS}	Read Command Set-Up Time	0	-	0	-	ns	
t_{RCH}	Read Command Hold Time	0	-	0	-	ns	10
t_{RAH}	Read Command Hold Time referenced to \overline{RAS}	0	-	0	-	ns	10
t_{WCH}	Write Command Hold Time	15	-	20	-	ns	
t_{WCR}	Write Command Hold Time referenced to \overline{RAS}	60	-	75	-	ns	

THM321020S-80, 10

THM321020SG-80, 10

ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

(Continued)

SYMBOL	PARAMETER	THM321020S-80		THM321020S-10		UNIT	NOTES
		MIN.	MAX.	MIN.	MAX.		
t _{WP}	Write Command Pulse Width	15	-	20	-	ns	
t _{RWL}	Write Command to \overline{RAS} Lead Time	20	-	25	-	ns	
t _{CWL}	Write Command to \overline{CAS} Lead Time	20	-	25	-	ns	
t _{DS}	Data Set-Up Time	0	-	0	-	ns	11
t _{DH}	Data Hold Time	15	-	20	-	ns	11
t _{DHR}	Data Hold Time referenced to \overline{RAS}	60	-	75	-	ns	
t _{REF}	Refresh Period	-	16	-	16	ms	
t _{WCS}	Write Command Set-Up Time	0	-	0	-	ns	12
t _{CSR}	\overline{CAS} Set-Up Time (\overline{CAS} before \overline{RAS} Cycle)	5	-	10	-	ns	
t _{CHR}	\overline{CAS} Hold Time (\overline{CAS} before \overline{RAS} Cycle)	15	-	20	-	ns	
t _{RPC}	\overline{RAS} to \overline{CAS} Precharge Time	0	-	0	-	ns	
t _{CPT}	\overline{CAS} Precharge Time (\overline{CAS} before \overline{RAS} Counter Test Cycle)	40	-	50	-	ns	
t _{WRP}	WRITE to \overline{RAS} Precharge Time (\overline{CAS} before \overline{RAS} Cycle)	10	-	10	-	ns	
t _{WRH}	WRITE to \overline{RAS} Hold Time (\overline{CAS} before \overline{RAS} Cycle)	10	-	10	-	ns	

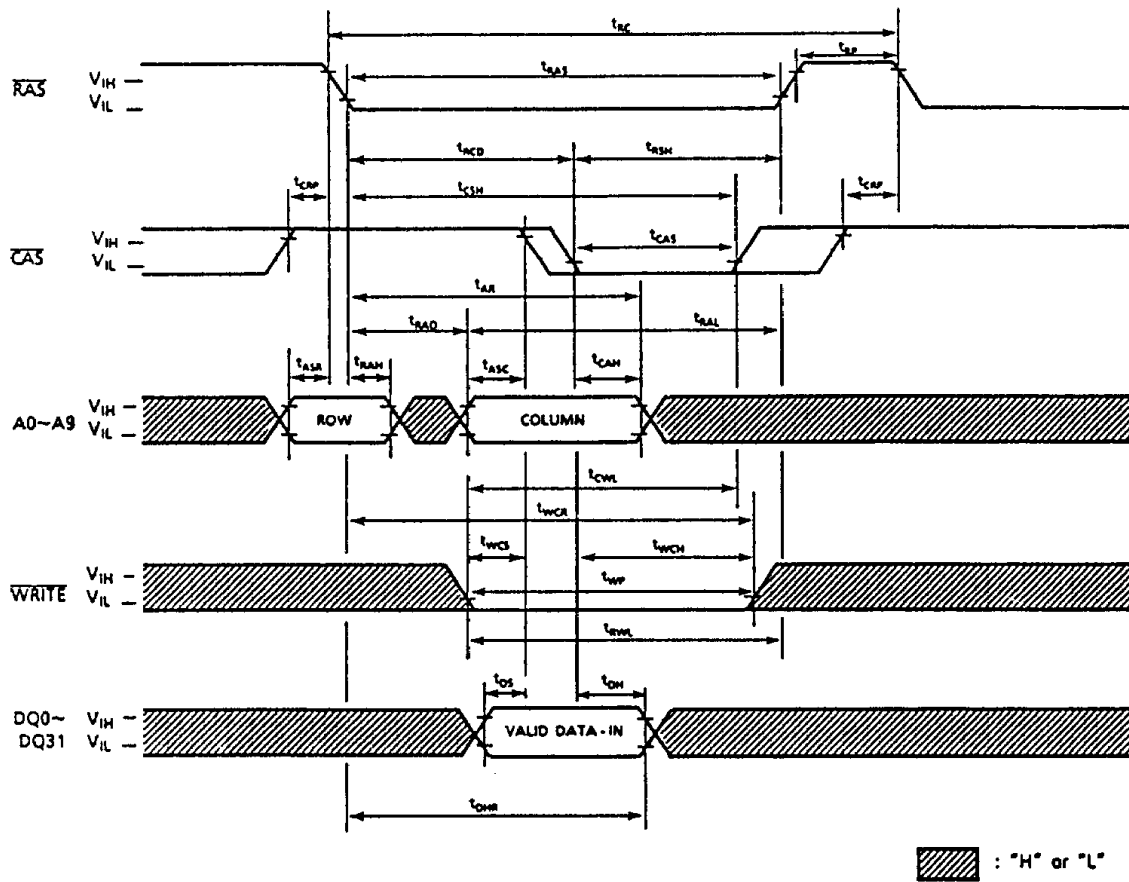
CAPACITANCE ($V_{CC} = 5V \pm 10\%$, $f = 1MHz$, $T_a = 0 \sim 70^\circ C$)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
C11	Input Capacitance (A0-A9)	-	88	pF
C12	Input Capacitance (W)	-	84	pF
C13	Input Capacitance ($\overline{RAS0}$, $\overline{RAS2}$)	-	42	pF
C14	Input Capacitance ($\overline{CAS0}$ - $\overline{CAS3}$)	-	36	pF
CDQ1	I/O Capacitance (DQ0-31)	-	17	pF

NOTES:

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.
2. All voltages are referenced to V_{SS} .
3. I_{CC1} , I_{CC3} , I_{CC4} , I_{CC6} depend on cycle rate.
4. I_{CC1} , I_{CC4} depend on output loading. Specified values are obtained with the output open.
5. An initial pause of 200 μ s is required after power-up followed by 8 \overline{RAS} cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 \overline{CAS} before \overline{RAS} initialization cycles instead of 8 \overline{RAS} cycles are required.
6. AC measurements assume $t_r = 5$ ns.
7. $V_{IH}(\text{min.})$ and $V_{IL}(\text{max.})$ are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL} .
8. Measured with a load equivalent to 2 TTL loads and 100pF.
9. $t_{OFF}(\text{max.})$ defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
10. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
11. These parameters are referenced to \overline{CAS} leading edge.
12. t_{WCS} is not restrictive operating parameters. This is included the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}(\text{min.})$, the cycle is an early write cycle and data out pin will remain open circuit (high impedance).
13. Operation within the $t_{RCD}(\text{max.})$ limit insures that $t_{RAC}(\text{max.})$ can be met. $t_{RCD}(\text{max.})$ is specified as a reference point only: If t_{RCD} is greater than the specified $t_{RCD}(\text{max.})$ limit, then access time is controlled by t_{CAC} .
14. Operation within the $t_{RAD}(\text{max.})$ limit, insures that $t_{RAC}(\text{max.})$ can be met. $t_{RAD}(\text{max.})$ is specified as a reference point only: If t_{RAD} is greater than the specified $t_{RAD}(\text{max.})$ limit, then access time is controlled by t_{AA} .

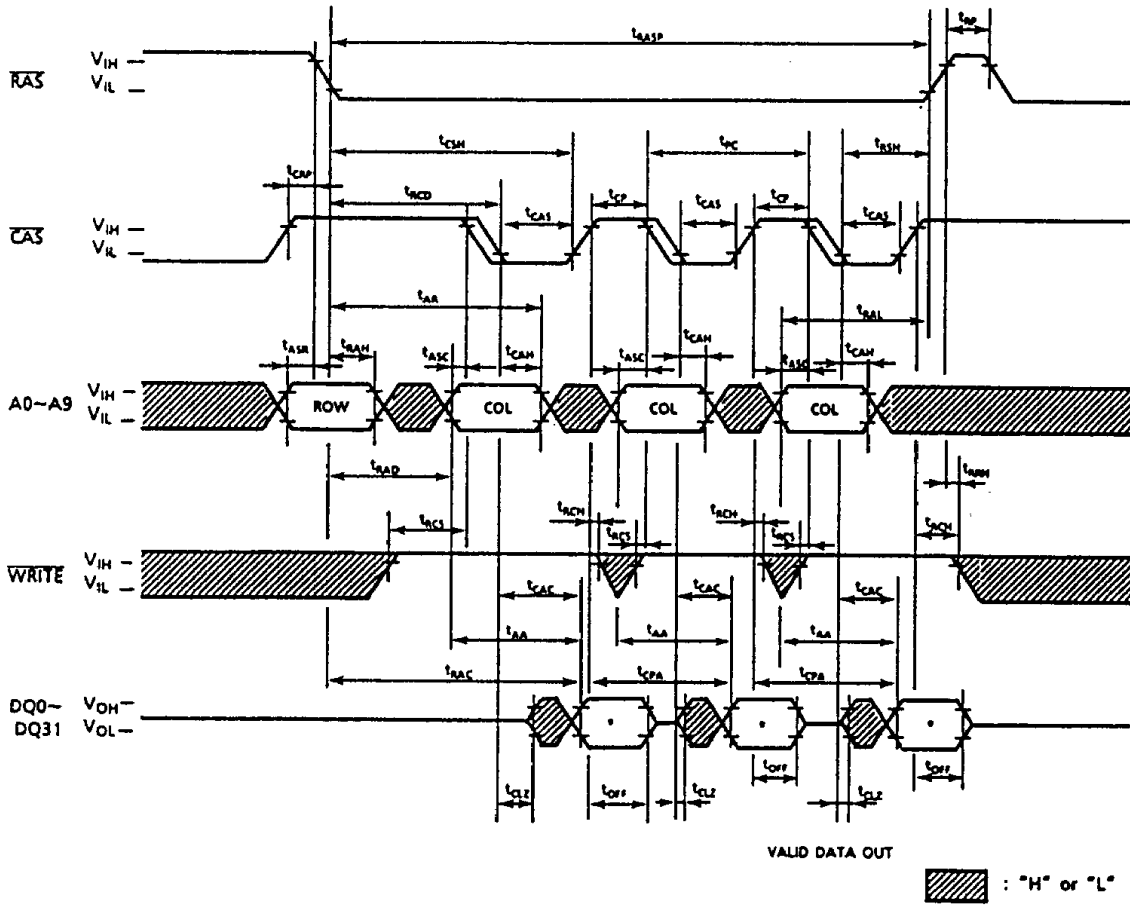
EARLY WRITE CYCLE



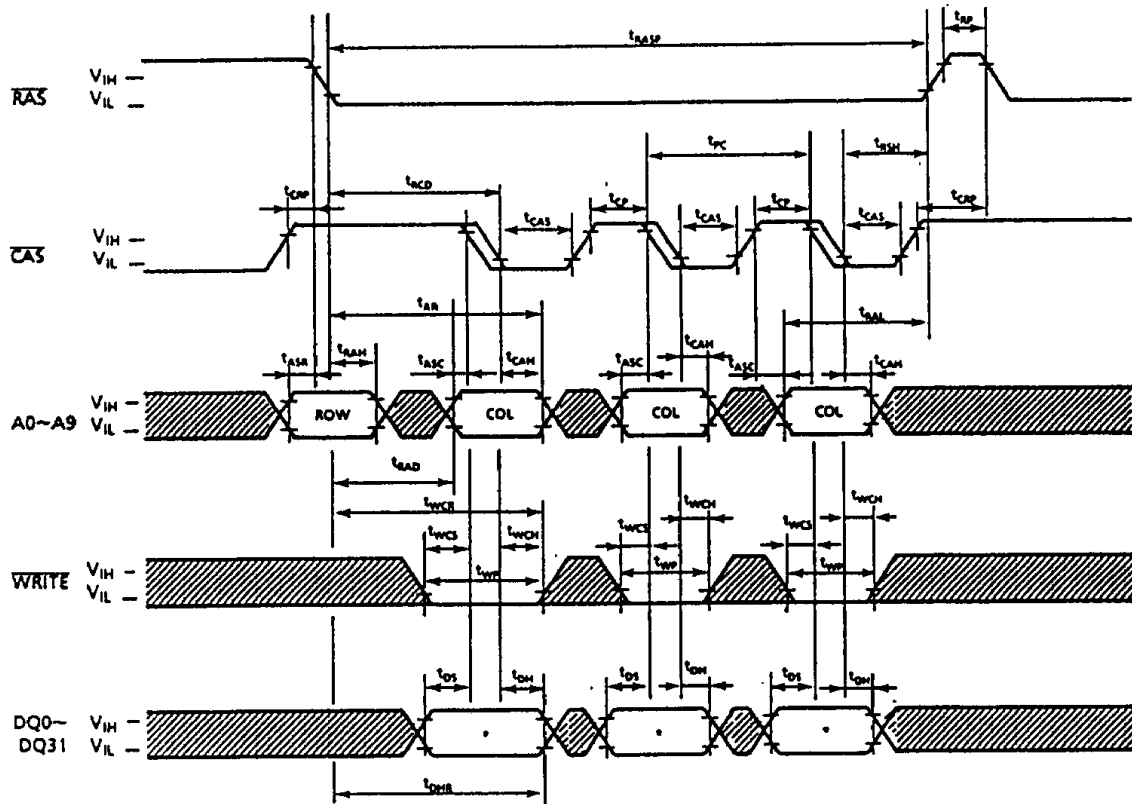
THM321020S-80, 10

THM321020SG-80, 10


FAST PAGE MODE READ CYCLE



FAST PAGE MODE WRITE CYCLE (EARLY WRITE)



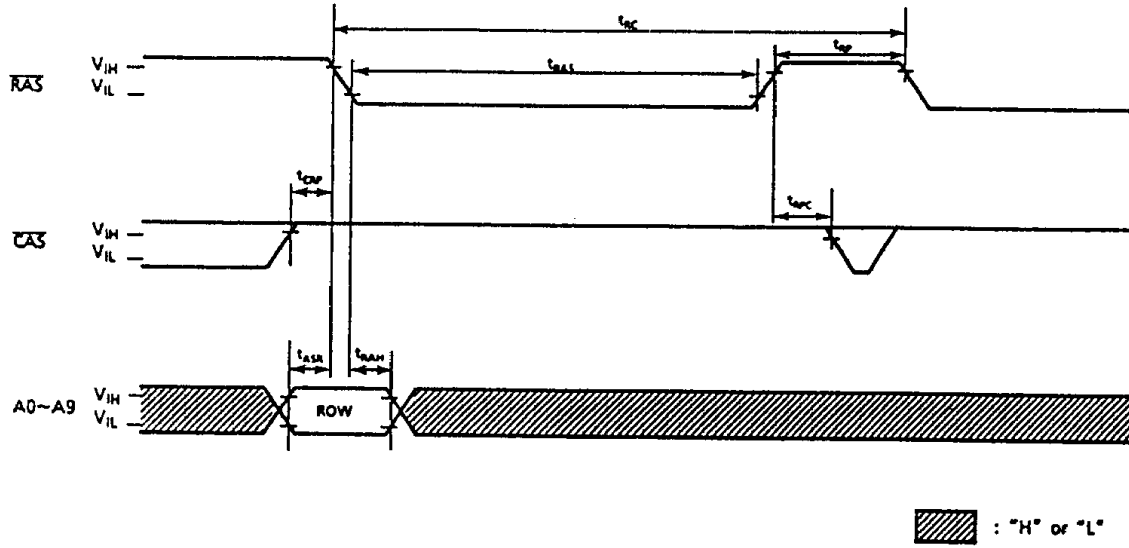
VALID DATA IN

 : "H" or "L"

THM321020S-80, 10

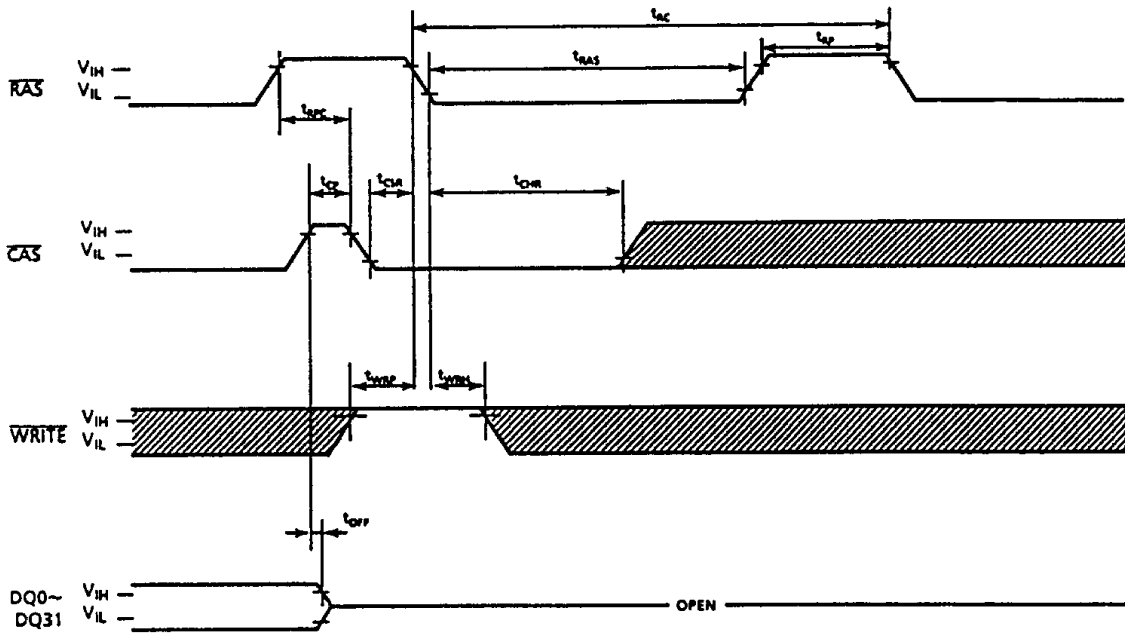
THM321020SG-80, 10


RAS ONLY REFRESH CYCLE



Note: WRITE = "H" or "L"

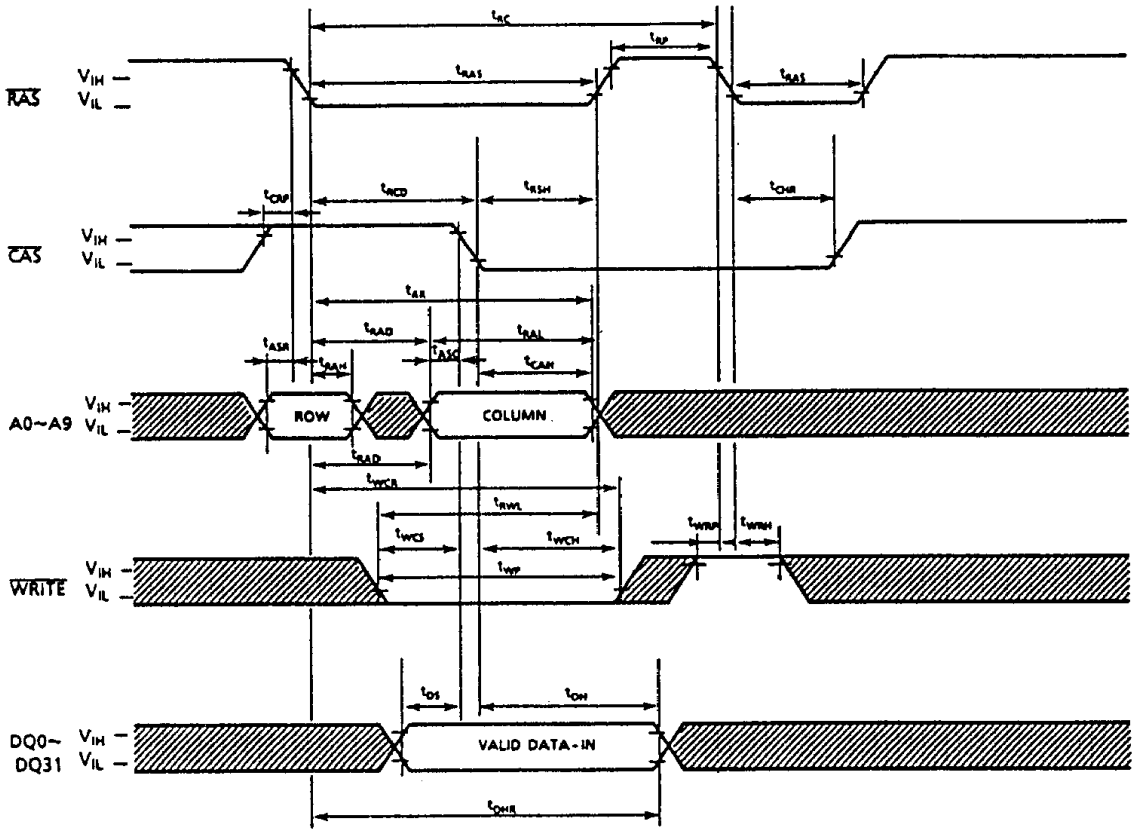
CAS BEFORE RAS REFRESH CYCLE




 : "H" or "L"

Note: A0~A9 = "H" or "L"

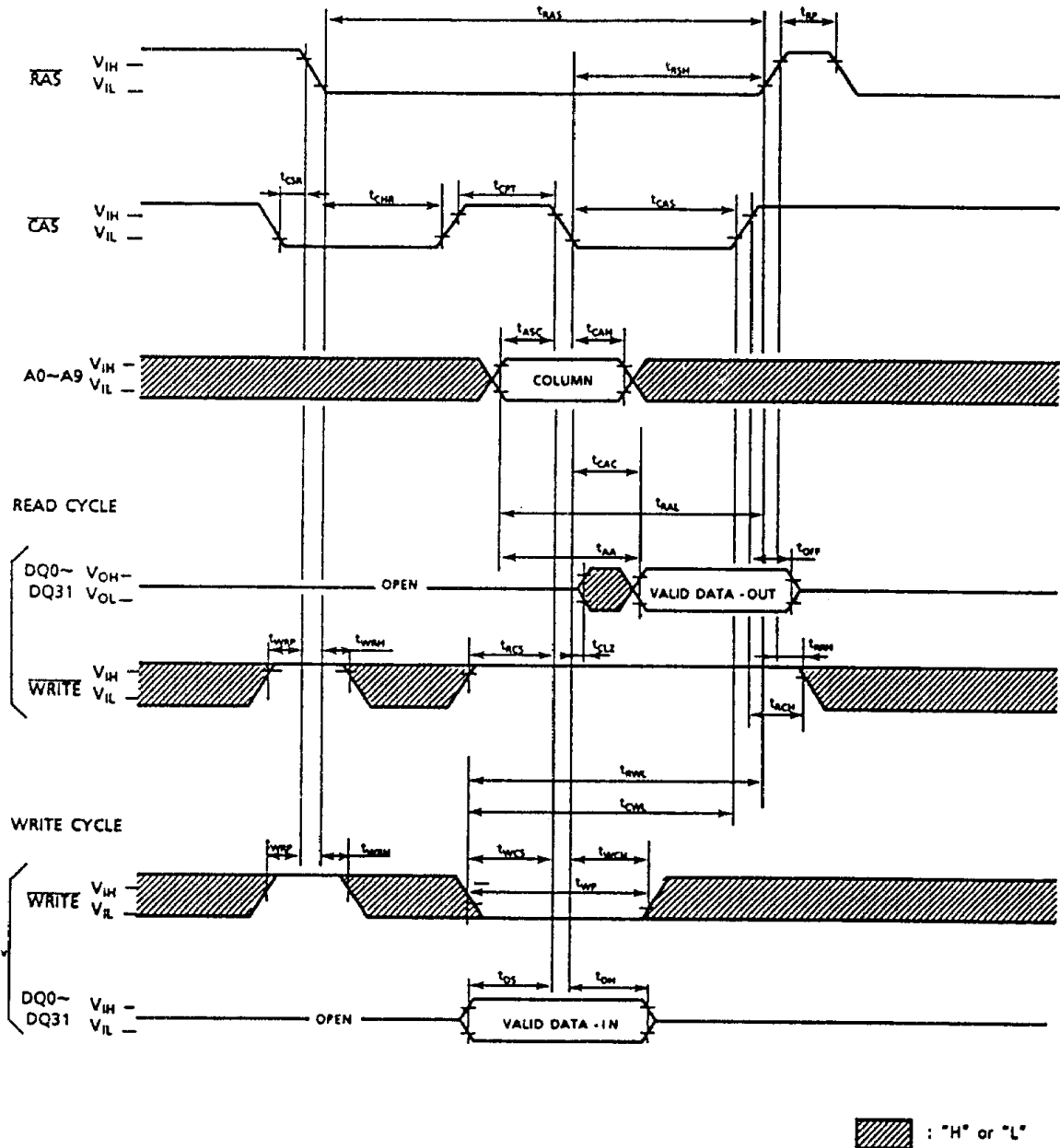
HIDDEN REFRESH CYCLE (WRITE)



 : "H" or "L"

THM321020S-80, 10
 THM321020SG-80, 10

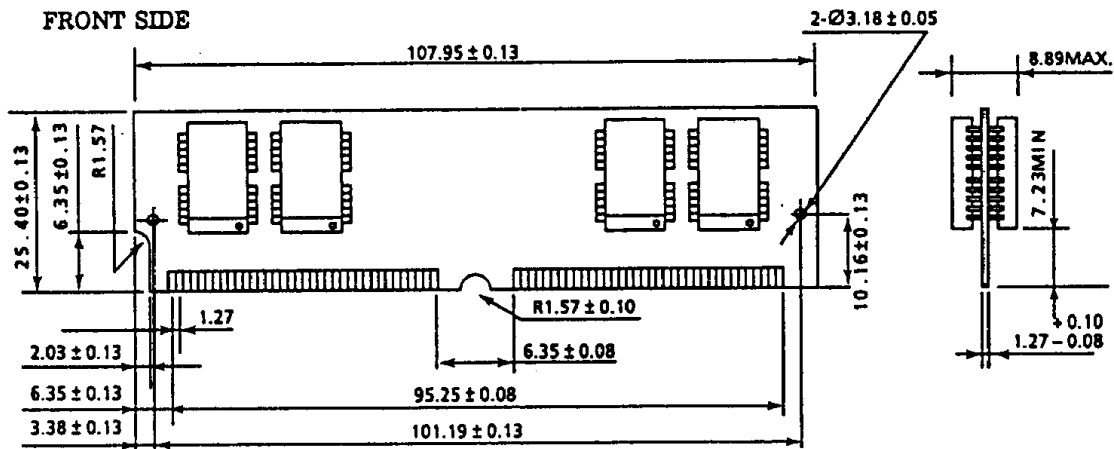
CAS BEFORE RAS REFRESH COUNTER TEST CYCLE



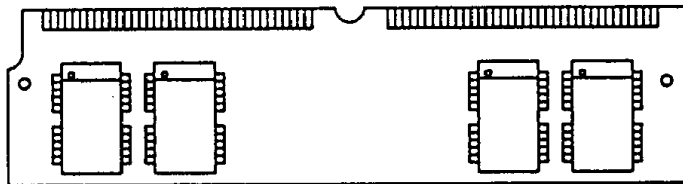
THM321020S-80, 10 THM321020SG-80, 10

OUTLINE DRAWINGS

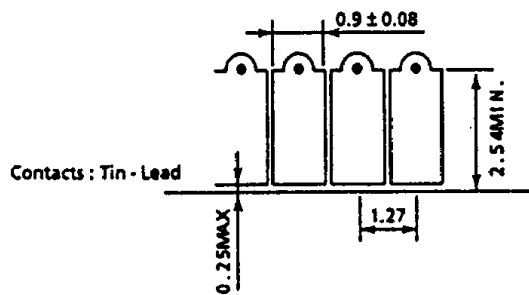
Unit in mm



BACK SIDE



• THM321020S



• THM321020SG

