

HYUNDAI

HY5117400A Series

4M x 4-bit CMOS DRAM

DESCRIPTION

The HY5117400A is the new generation and fast dynamic RAM organized 4,194,304 x 4-bit. The HY5117400A utilizes Hyundai's CMOS silicon gate process technology as well as advanced circuit techniques to provide wide operating margins to the users. Multiplexed address inputs permit the HY5117400A to be packaged in a standard 24/26 pin plastic SOJ, TSOP-II and Reverse TSOP-II.

The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipments. System oriented feature includes single power supply of 5V \pm 10% tolerance and direct interfacing capability with high performance logic families such as Schottky TTL.

FEATURES

- Low power dissipation
Max. battery back-up 3.3mW (SL-part)
Max. CMOS standby 2.2mW (SL-part)
5.5mW
Max. TTL standby 11.0mW
Max. operating

Speed	Power
50	798mW
60	660mW
40	550mW

- Single power supply of 5V \pm 10%
- TTL compatible inputs and outputs
- Fast access Time

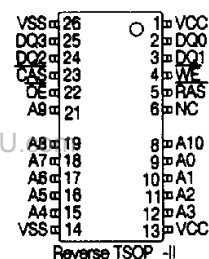
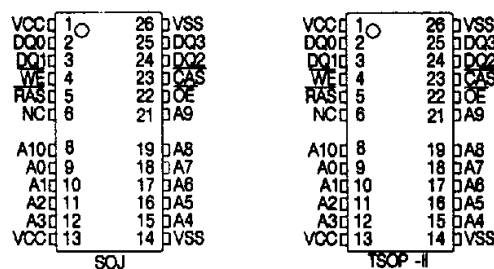
Speed	t _{RAC}	t _{CAC}	t _{PC}
50	50ns	13ns	35ns
60	60ns	15ns	40ns
70	70ns	18ns	45ns

- Fast page mode operation
- Multi-bit test capability
- Read-Modify-Write capability
- CAS-before-RAS, RAS-only, Hidden refresh and Self Refresh capability
- 2048 refresh cycles / 256ms (SL-part)
2048 refresh cycles / 32ms

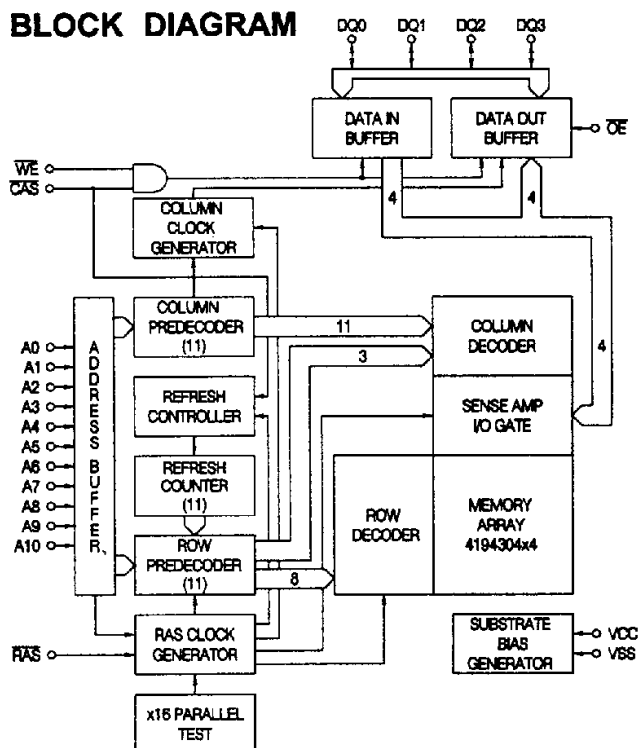
PIN DESCRIPTION

RAS	Row Address Strobe
CAS	Column Address Strobe
WE	Write Enable
OE	Output Enable
A0-A10	Address input
DQ0-DQ3	Data Input/Output
V _{cc}	Power (+5V)
V _{ss}	Ground

PIN CONNECTION



BLOCK DIAGRAM



This document is a general product description and is subject to change without notice. Hyundai Electronics does not assume any

ABSOLUTE MAXIMUM RATING

SYMBOL	PARAMETER	RATING	UNIT
TA	Ambient Temperature	0 to 70	°C
TSTG	Storage Temperature	-55 to 150	°C
VIN, VOUT	Voltage on Any Pin Relative to Vss	-1.0 to 7.0	V
VCC	Voltage on VCC Relative to Vss	-1.0 to 7.0	V
Ios	Short Circuit Output Current	50	mA
PD	Power Dissipation	1.0	W
TSOLDER	Soldering Temperature • Time	260 • 10	°C • sec

NOTE: Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

RECOMMENDED DC OPERATING CONDITIONS

(TA=0°C to 70°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
VCC	Power Supply Voltage	4.5	5.0	5.5	V
VIH	Input High Voltage	2.4	-	Vcc+1.0	V
VIL	Input Low Voltage	-1.0	-	0.8	V

NOTE: All Voltage are referenced to Vss.

DC CHARACTERISTICS

(TA=0°C to 70°C, VCC=5V±10%, VSS=0V, unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS	SPEED/ POWER	MIN.	MAX.	UNIT	NOTE
ILI	Input Leakage Current (Any Input Pins)	$V_{SS} \leq V_{IN} \leq V_{CC}+1.0$, All other pins not under test = V_{SS}		-10	10	μA	
ILO	Output Leakage Current (High impedance State)	$V_{SS} \leq V_{OUT} \leq V_{CC}$ \overline{RAS} & \overline{CAS} at V_{IH}		-10	10	μA	
ICC1	VCC Supply Current, Operating	$t_{RC} = t_{RC}(\text{min.})$	50 60 70	- - -	145 120 100	mA	1,2,3
ICC2	VCC Supply Current, Operating.	\overline{RAS} & \overline{CAS} at $V_{IH}(\text{min.})$, other inputs $\geq V_{SS}$		-	2	mA	
ICC3	VCC Supply Current, \overline{RAS} -only refresh	$t_{RC} = t_{RC}(\text{min.})$	50 60 70	- - -	145 120 100	mA	1,3
ICC4	VCC Supply Current, Fast Page mode	$t_{PC} = t_{PC}(\text{min.})$	50 60 70	- - -	90 80 70	mA	1,2,3
ICC5	VCC Supply Current, CMOS Standby	\overline{RAS} & $\overline{CAS} \leq V_{CC}-0.2V$	SL-part	-	1 0.4	mA	5
ICC6	VCC Supply Current, \overline{CAS} -before- \overline{RAS} refresh	$t_{RC} = t_{RC}(\text{min.})$	50 60 70	- - -	145 120 100	mA	1,3
ICC7	VCC Supply Current, Battery Back up (L-part only)	$t_{RC}=125\mu s$, $\overline{CAS} = \text{CBR cycling or } 0.2V$ $\overline{WE} = V_{CC}-0.2V$, $A0-A10 = V_{CC}-0.2V \text{ or } 0.2V$ $DQ0-DQ3=V_{CC}-0.2V, V_{CC}-0.2V$ or open	$t_{RAS} \leq$ 300ns $t_{RAS} \leq$ 1 μs	-	300 500	μA	1,4,5
ICC8	VCC Supply Current Self Refresh (L-part only)	\overline{RAS} & $\overline{CAS} 0.2V$ \overline{OE} & \overline{WE} & $A0-A10=V_{CC}-0.2V \text{ or } 0.2V$, $DQ0-DQ3=V_{CC}-0.2V, 0.2V \text{ or open}$		-	300	μA	5
VOL	Output Low Voltage	$I_{OL} = 4.2mA$		-	0.4	V	
VOH	Output High Voltage	$I_{OH} = -5mA$		2.4	-	V	

NOTE :

1. ICC1, ICC3, ICC4, ICC6 and ICC7 depend on cycle rates.
2. ICC1 and ICC4 depend on output loading. specified values are obtained with the output open.
3. It depends on user whether column address is changed or not at least once while $\overline{RAS}=V_{IL}$ and $\overline{CAS}=V_{IH}$.
4. $t_{RAS}(\text{max.})=1\mu s$ is only applied to refresh of battery backup but $t_{RAS}(\text{max.})=10\mu s$ is applied to normal functional operation .
5. ICC5(max.) =0.4mA and ICC7 and ICC8 are applied to L-parts only (HY5117400ASLJ, HY5117400ASLT and HY5117400ASLR).

AC CHARACTERISTICS

(TA=0°C to 70°C, Vcc=5V±10%, Vss=0V, unless otherwise noted.) NOTE1,2,3

#	SYMBOL	PARAMETER	HY5117400AJT/R/SLJ/SLT/SLR						UNIT	NOTE
			- 50		- 60		- 70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	tRC	Random Read or Write Cycle Time	90	-	110	-	130	-	ns	
2	tRWC	Read-Modify-Write Cycle Time	140	-	160	-	180	-	ns	
3	tHPC	Fast Page Mode Cycle Time	35	-	40	-	45	-	ns	
4	tHPRWC	Fast PageMode Read-Modify-Write Cycle Time	80	-	85	-	90	-	ns	
5	tRAC	Access Time from RAS	-	50	-	60	-	70	ns	4,9,10
6	tCAC	Access Time from CAS	-	13	-	15	-	18	ns	4,9
7	tAA	Access Time from Column Address	-	25	-	30	-	35	ns	4,10
8	tCPA	Access Time from CAS Precharge	-	30	-	35	-	40	ns	4
9	tCLZ	CAS to Output Low Impedance	0	-	0	-	0	-	ns	4
10	tDOM	Output Buffer Turn-off Delay	0	10	0	13	0	15	ns	
11	tT	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	3
12	tRP	RAS Precharge Time	30	-	40	-	50	-	ns	
13	tRAS	RAS Pulse Width	50	10K	60	10K	70	10K	ns	
14	tRAS _P	RAS Pulse Width (Fast Page Mode)	50	200K	60	200K	70	200K	ns	
15	tRSH	RAS Hold Time	13	-	15	-	18	-	ns	
16	tCSH	CAS Hold Time	50	-	60	-	70	-	ns	
17	tCAS	CAS Pulse width	13	10K	15	10K	18	10K	ns	
18	tRCD	RAS to CAS Delay	18	37	20	45	20	52	ns	9
19	tRAD	RAS to Column Address Delay Time	15	30	15	35	15	40	ns	10
20	tCRP	CAS to RAS Precharge Time	-	5	-	5	-	ns		
21	tCP	CAS Precharge Time	8	-	10	-	10	-	ns	
22	tASR	Row Address Set-up Time	0	-	0	-	0	-	ns	
23	tRAH	Row Address Hold time	8	-	10	-	10	-	ns	
24	tASC	Column Address Set-up Time	0	-	0	-	0	-	ns	
25	tCAH	Column Address Hold Time	10	-	10	-	10	-	ns	
26	tAR	Column Address Hold Time from RAS	50	-	50	-	55	-	ns	
27	tRAL	Column Address to RAS Lead Time	25	-	30	-	35	-	ns	
28	tRCS	Read Command Set-up Time	0	-	0	-	0	-	ns	
29	tRCH	Read Command Hold Time Referenced to CAS	0	-	0	-	0	-	ns	6
30	tRRH	Read Command Hold Time Referenced to RAS	0	-	0	-	0	-	ns	6
31	tWCH	Write Command Hold Time	8	-	10	-	10	-	ns	
32	tWCR	Write Command Hold Time from RAS	45	-	55	-	60	-	ns	
33	tWP	Write Command Pulse Width	8	-	10	-	10	-	ns	
34	tRWL	Write Command to RAS Lead Time	13	-	15	-	18	-	ns	
35	tCWL	Write Command to CAS Lead Time	13	-	15	-	15	-	ns	
36	tDS	Data-In Set-up Time	0	-	0	-	0	-	ns	7
37	tDH	Data-In Hold Time	10	-	10	-	10	-	ns	7
38	tDHR	Data-In Hold Time Referenced to RAS	50	-	50	-	55	-	ns	
39	tREF	Refresh Period (2048 cycles)	-	32	-	32	-	32	ms	12
		SL-part	-	256	-	256	-	256		11
40	tWCS	Write Command Set up Time	0	-	0	-	0	-	ns	8

AC CHARACTERISTICS

(continued)

#	SYMBOL	PARAMETER	HY5117400AJ/T/R/SLJ/SLT/SLR						UNIT	NOTE
			- 50		- 60		- 70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
41	tCWD	CAS to WE Delay Time	33	-	38	-	43	-	ns	8
42	tRWD	RAS to WE Delay Time	70	-	83	-	95	-	ns	8
43	tAWD	Column Address to WE Delay Time	45	-	53	-	60	-	ns	8
44	tCSR	CAS Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	
45	tCHR	CAS Hold Time (CBR Cycle)	10	-	10	-	10	-	ns	
46	tRPC	RAS to CAS Precharge Time	0	-	0	-	0	-	ns	
47	tCPT	CAS Precharge Time (CBR Counter Test)	15	-	20	-	25	-	ns	
48	tROH	RAS Hold Time Referenced to OE	0	-	0	-	0	-	ns	
49	tOEA	OE Access Time	-	15	-	18	-	20	ns	
50	tOED	OE to Data Delay	13	-	15	-	15	-	ns	
51	tOEZ	Output Buffer Turn Off Delay Time from OE	0	10	0	13	0	15	ns	
52	tOEH	OE Command Hold Time	10	-	10	-	10	-	ns	
53	tCPWD	WE Delay Time from CAS Precharge	30	-	35	-	40	-	ns	
54	tRHCP	RAS Hold Time from CAS Precharge	30	-	35	-	40	-	ns	
55	tWRP	WE to RAS Precharge Time(CBR Cycle)	10	-	10	-	10	-	ns	
56	tWRH	WE to RAS Hold Time(CBR Cycle)	10	-	10	-	10	-	ns	
57	tWTS	Write Command Set-up Time (Test Mode In)	10	-	10	-	10	-	ns	
58	tWTH	Write Command Hold Time (Test Mode In)	10	-	10	-	10	-	ns	
59	tRASS	RAS Pulse Width (Self Refresh Cycle)	100	-	100	-	100	-	μs	
60	tRPS	RAS Precharge Time (Self Refresh Cycle)	90	-	110	-	130	-	ns	
61	tCHS	CAS Hold Time (Self Refresh Cycle)	-50	-	-50	-	-50	-	ns	

AC CHARACTERISTICS IN TEST MODE

NOTE 13

#	SYMBOL	PARAMETER	HY5117400AJ/T/R/SLJ/SLT/SLR						UNIT	NOTE
			- 50		- 60		- 70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	t _{RC}	Random Read or Write Cycle Time	95	-	115	-	135	-	ns	
2	t _{RWC}	Read-Modify-Write Cycle Time	115	-	135	-	160	-	ns	
3	t _{PC}	Fast Page Mode Cycle Time	40	-	45	-	50	-	ns	
4	t _{PRWC}	Fast Page Mode Read-Modify-Write Cycle Time	60	-	65	-	75	-	ns	
5	t _{RAC}	Access Time from RAS	-	55	-	65	-	75	ns	4,9,10
6	t _{CAC}	Access Time from CAS	-	18	-	20	-	23	ns	4,9
7	t _{AA}	Access Time from Column Address	-	30	-	35	-	40	ns	4,10
8	t _{CPA}	Access Time from CAS Precharge	-	35	-	40	-	45	ns	4
13	t _{RAS}	RAS Pulse Width	55	10K	65	10K	75	10K	ns	
14	t _{RASP}	RAS Pulse Width (Fast Page Mode)	55	200K	65	200K	75	200K	ns	
15	t _{RS}	RAS Hold Time	18	-	20	-	23	-	ns	
16	t _{CS}	CAS Hold Time	55	-	65	-	75	-	ns	
17	t _{CAS}	CAS Pulse Width	18	10K	20	10K	23	10K	ns	
27	t _{RAL}	Column Address to RAS Lead Time	30	-	35	-	40	-	ns	
41	t _{CWD}	CAS to WE Delay Time	18	-	20	-	23	-	ns	8
42	t _{RWD}	RAS to WE Delay Time	55	-	65	-	75	-	ns	8
43	t _{AWD}	Column Address to WE Delay Time	30	-	35	-	40	-	ns	8
49	t _{OE}	OE Access Time	-	20	-	20	-	25	ns	
50	t _{OED}	OE to Data Delay	20	-	20	-	25	-	μs	
52	t _{OEH}	OE Command Hold Time	20	-	20	-	25	-	ns	

NOTE:

1. An initial pause of 200ms is required after power-up followed by any 8 $\overline{\text{RAS}}$ only or $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh cycle before proper device operation is achieved.
2. If $\overline{\text{RAS}}=V_{\text{SS}}$ during power-up, the HY5117400A could begin an active cycle. These condition results in higher current than necessary which is demanded from the power supply during power-up. It is recommended that $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ track with V_{CC} during power-up or be held at a valid V_{IH} in order to minimize the power-up current
3. $V_{\text{IH}}(\text{min.})$ and $V_{\text{IL}}(\text{max.})$ are reference levels for measuring timing of input signals. Also, transition times are measured between $V_{\text{IH}}(\text{min.})$ and $V_{\text{IL}}(\text{max.})$, and are assumed to be 5ns for all inputs.
4. Measured at $V_{\text{OH}}=2.4\text{V}$ and $V_{\text{OL}}=0.4\text{V}$ with a load equivalent to 2 TTL loads and 100pF.
5. $t_{\text{OFF}}(\text{max.})$ and t_{OEZ} define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
6. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
7. These parameters are referenced to $\overline{\text{CAS}}$ leading edge in early write cycles and to $\overline{\text{WE}}$ leading edge in Read-Modify-Write cycles.
8. t_{WCS} , t_{RWD} , t_{CWD} , t_{AWD} and t_{CPWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{min.})$, the cycle is an early write cycle and data out pin will remain open circuit (high impedance) through the entire cycle. if $t_{\text{RWD}} \geq t_{\text{RWD}}(\text{min.})$, $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{min.})$, $t_{\text{AWD}} \geq t_{\text{AWD}}(\text{min.})$, and $t_{\text{CPWD}} \geq t_{\text{CPWD}}(\text{min.})$, the cycle is a Read-Modify-Write cycle and data out will contain data read from the selected cell. If neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indetermined.
9. Operation within the $t_{\text{RCD}}(\text{max.})$ limit insures that $t_{\text{RAC}}(\text{max.})$ can be met. $t_{\text{RCD}}(\text{max.})$ is specified as a reference point only. If t_{RCD} is greater than the specified $t_{\text{RCD}}(\text{max.})$ limit, then access time is controlled by t_{CAC} .
10. Operation within the $t_{\text{RAD}}(\text{max.})$ limit insures that $t_{\text{RAC}}(\text{max.})$ can be met. $t_{\text{RAD}}(\text{max.})$ is specified as a reference point only. If t_{RAD} is greater than the specified $t_{\text{RAD}}(\text{max.})$ limit, then access time is controlled by t_{AA} .
11. $t_{\text{REF}}(\text{max.})=256\text{ms}$ is applied to L-Parts(HY5117400ALJC, HY5117400ALTC and HY5117400ALRC).
12. A burst of 2048 $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh cycles must be executed within 64ms(256ms for SL-part) after exiting self refresh.
13. These specifications are applied to the test Mode.

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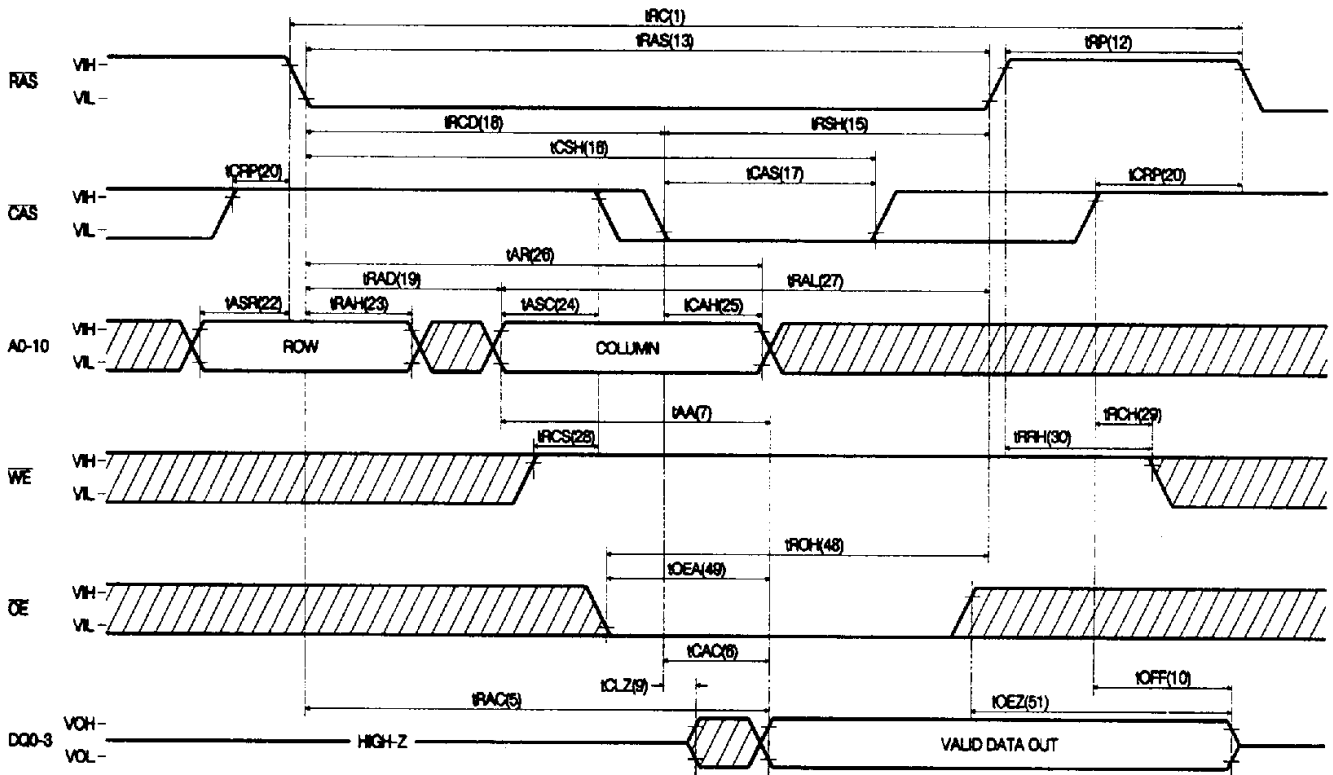
CAPACITANCE

(TA=25°C, VCC=5V±10%, VSS=0V, f=1MHz, unless otherwise noted.)

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
CIN1	Input Capacitance (A0-A10)	-	5	pF
CIN2	Input Capacitance(RAS, CAS, WE, OE)	-	7	pF
CDQ	Data Input/Output Capacitance(DQ0-DQ3)	-	7	pF

TIMING DIAGRAM

READ CYCLE

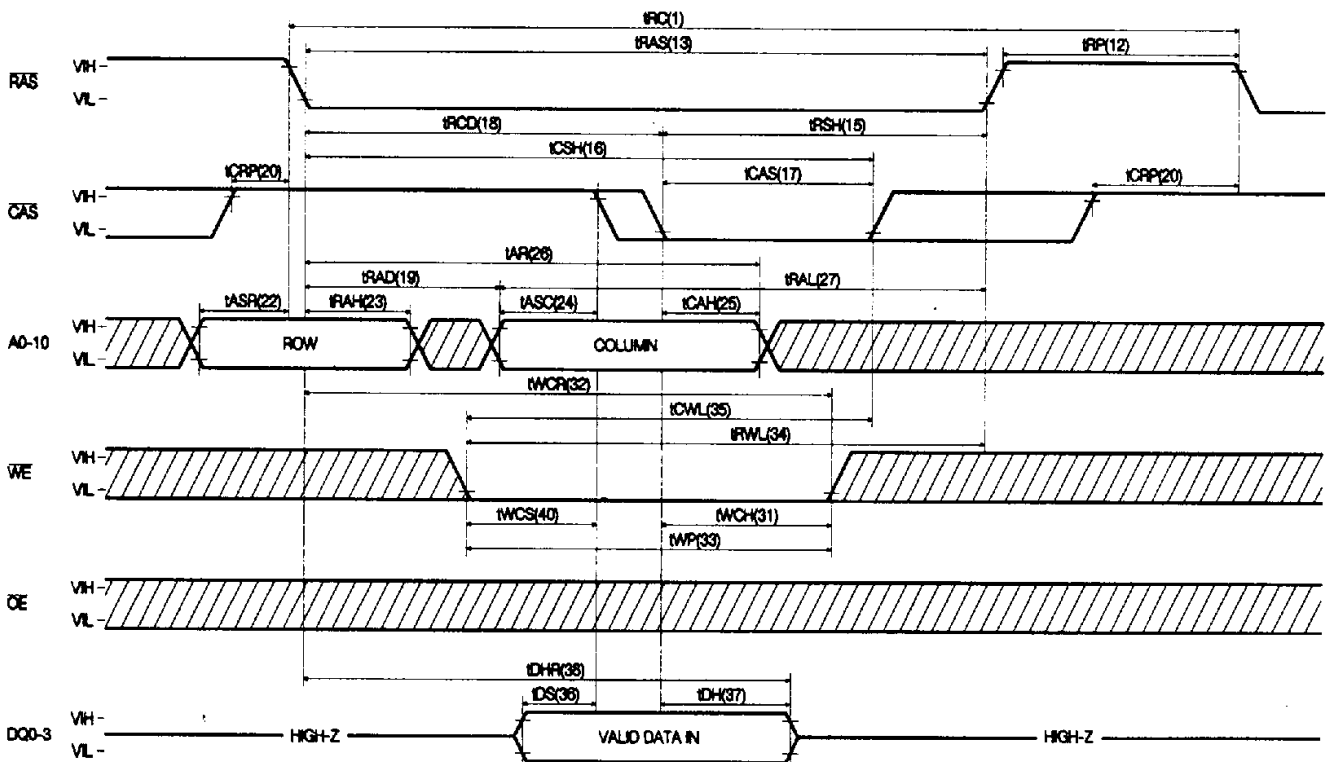


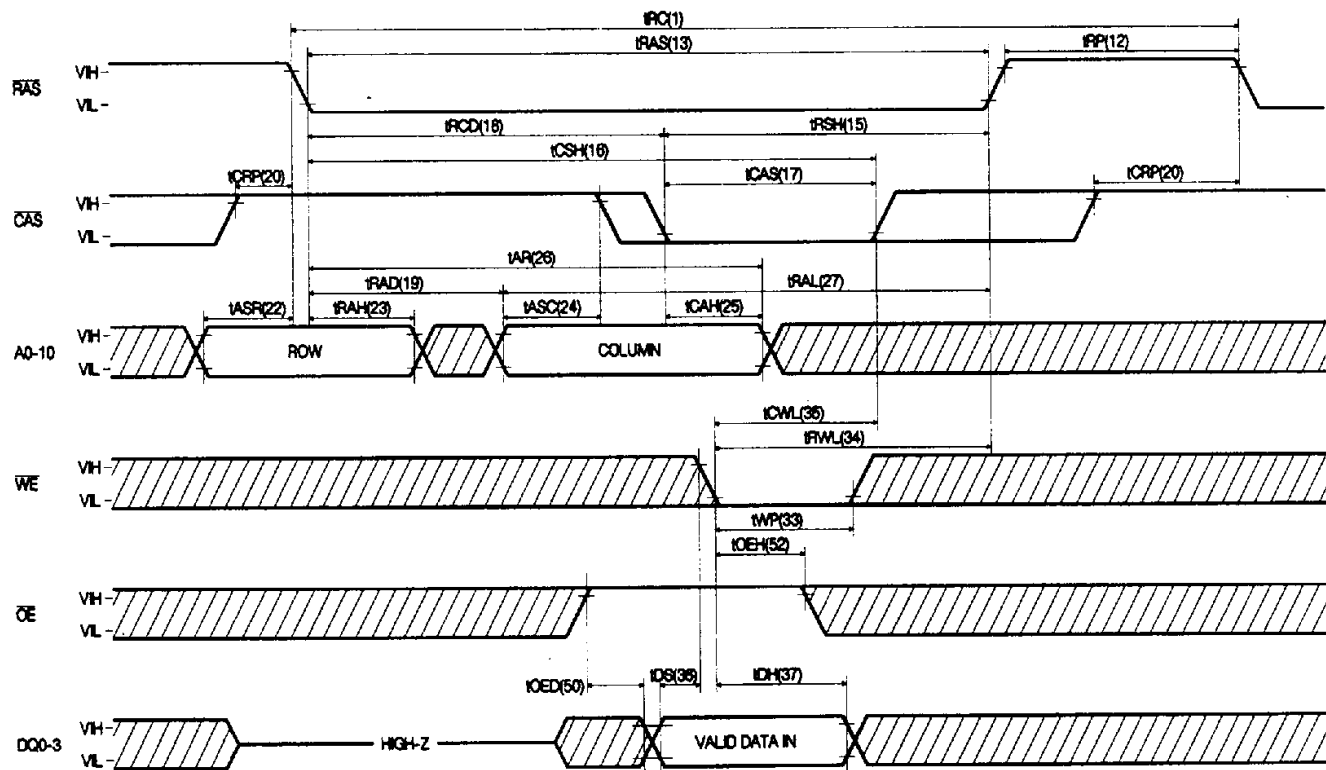
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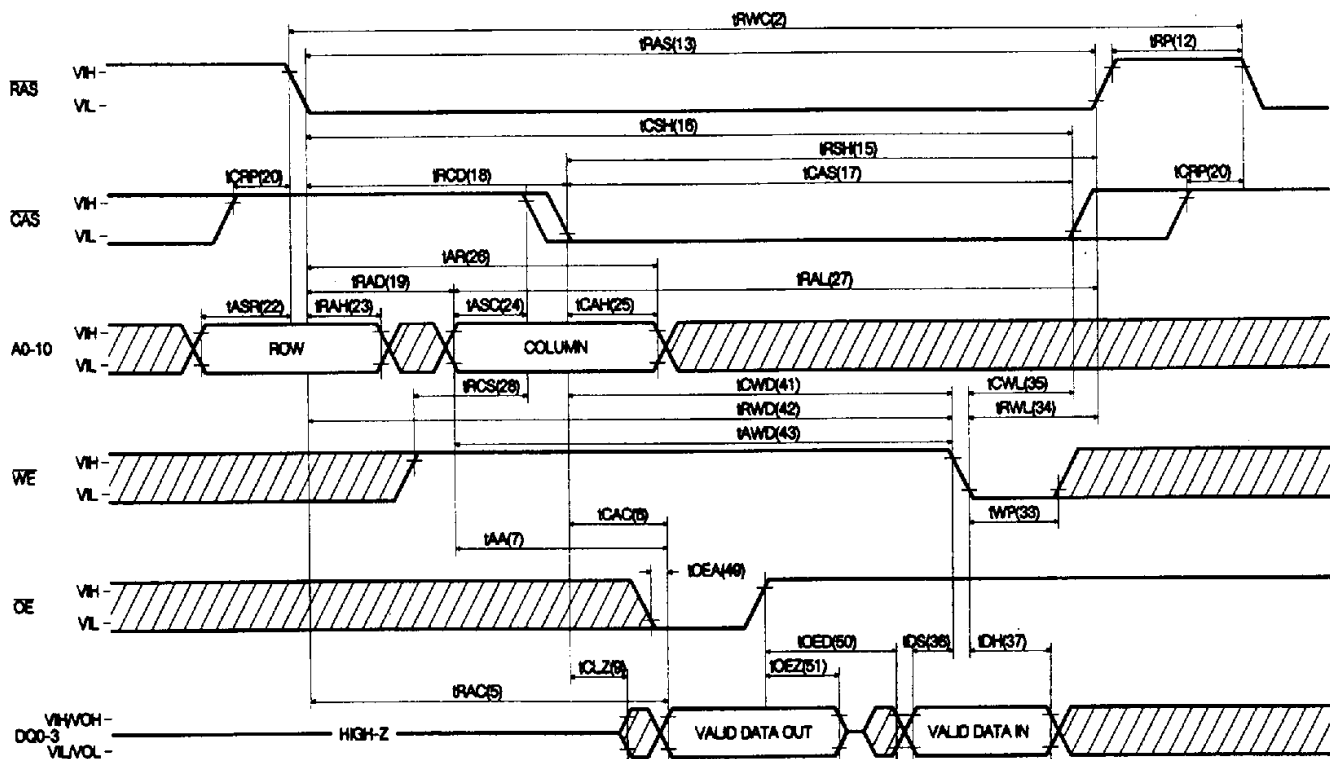
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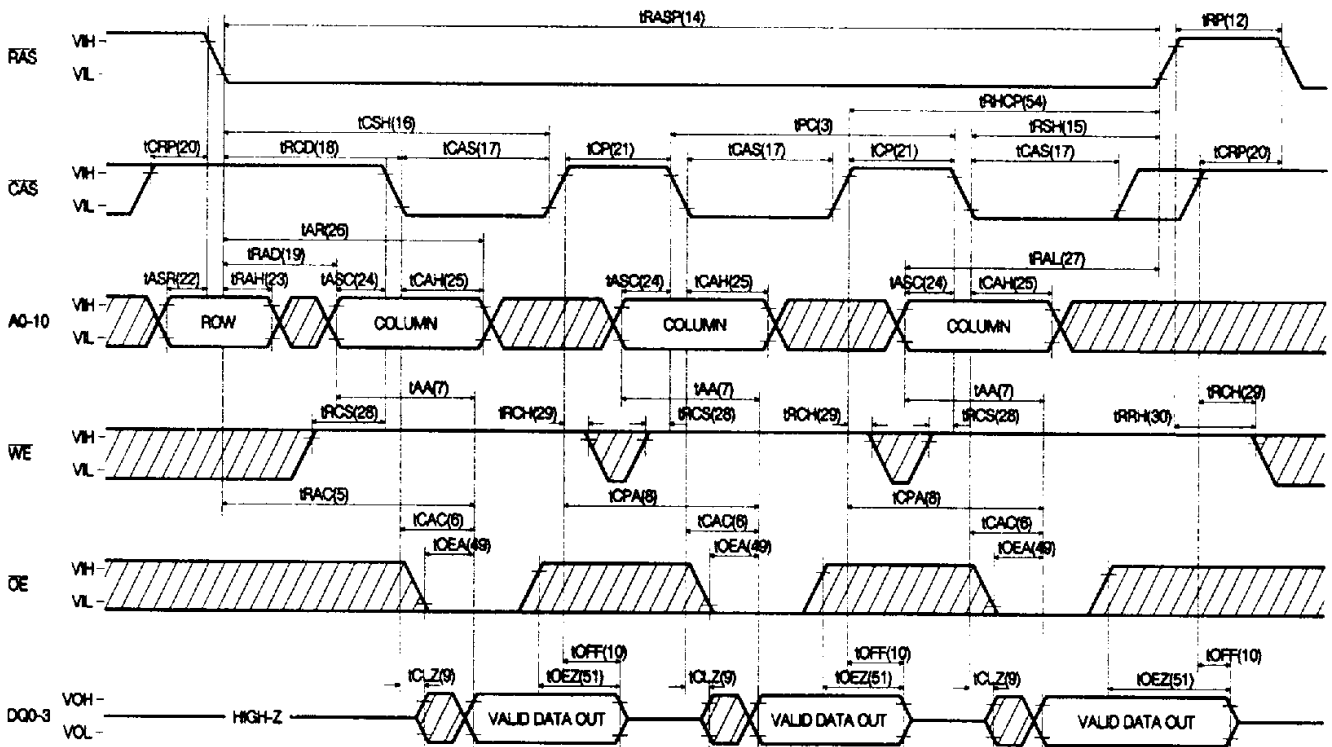
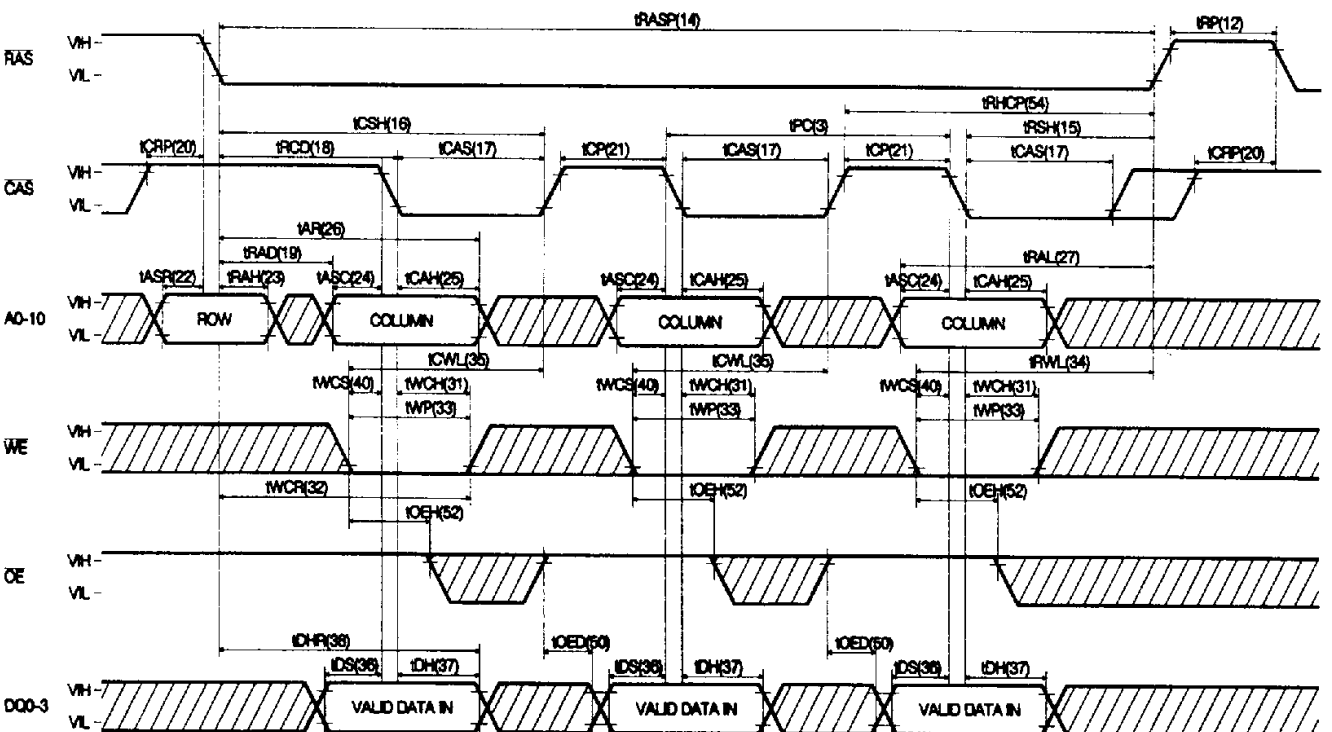
EARLY WRITE CYCLE



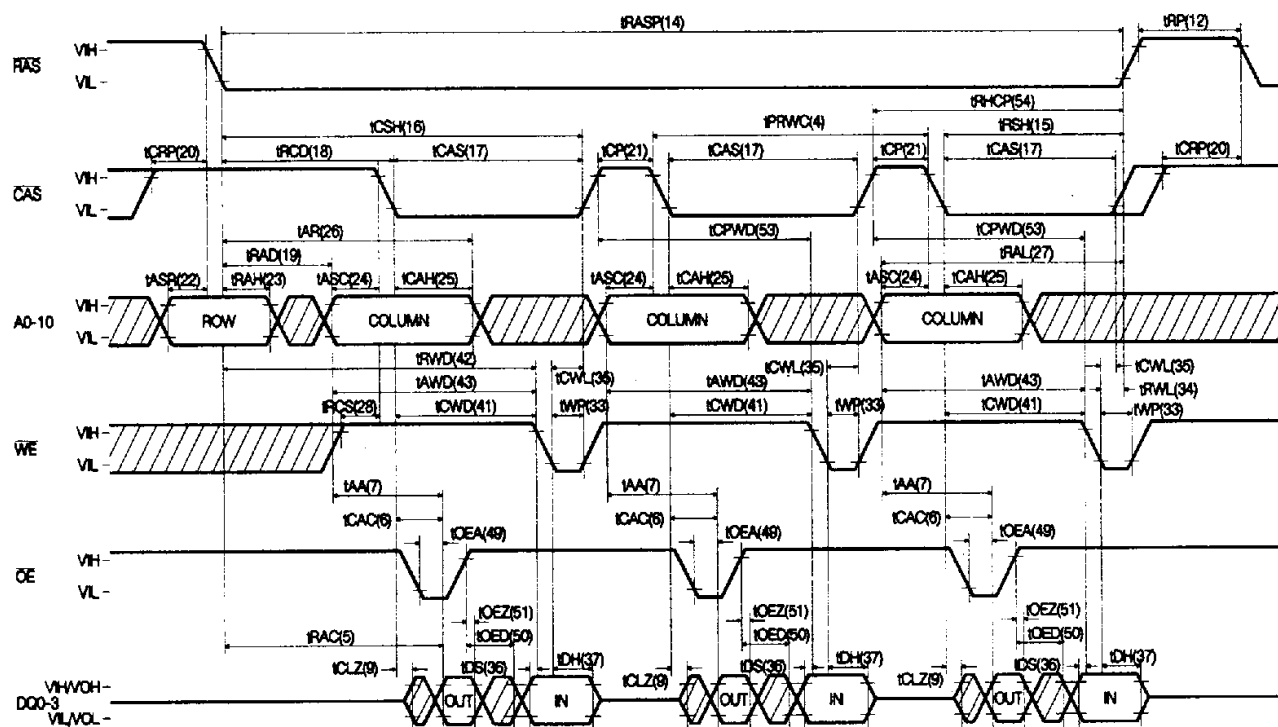
WRITE CYCLE (\overline{OE} CONTROLLED WRITE)

READ-MODIFY-WRITE CYCLE

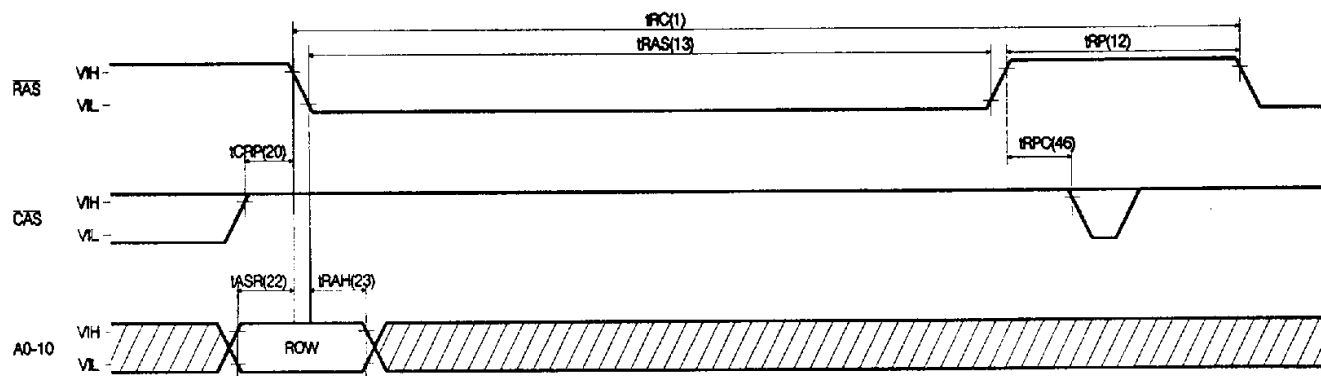


FAST PAGE MODE READ CYCLE**FAST PAGE MODE EARLY WRITE CYCLE**

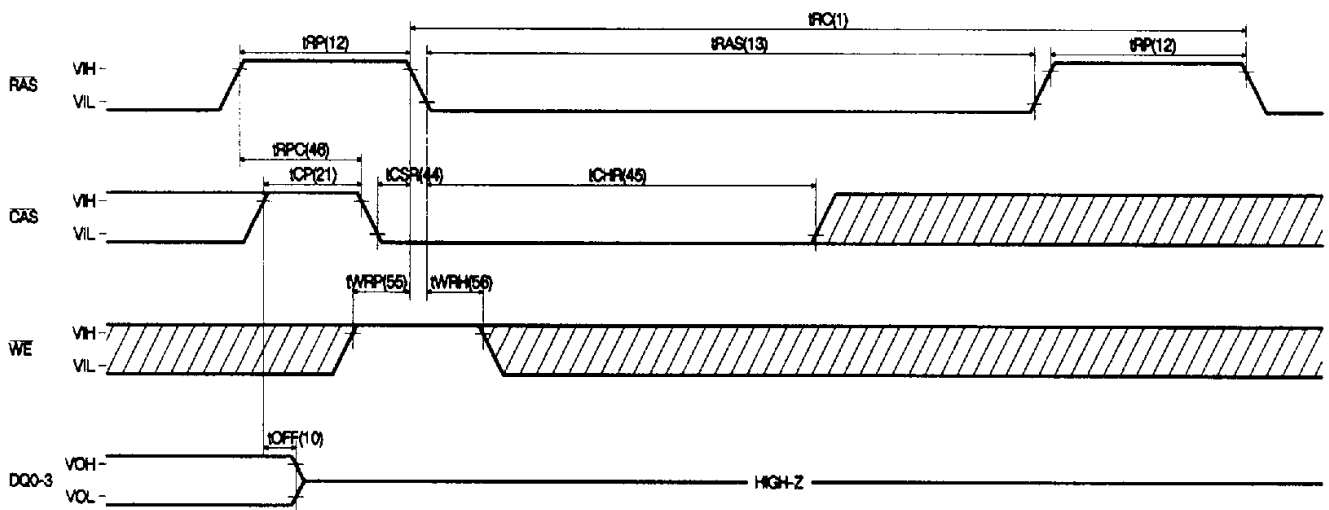
FAST PAGE MODE READ-MODIFY-WRITE CYCLE



RAS-ONLY REFRESH CYCLE

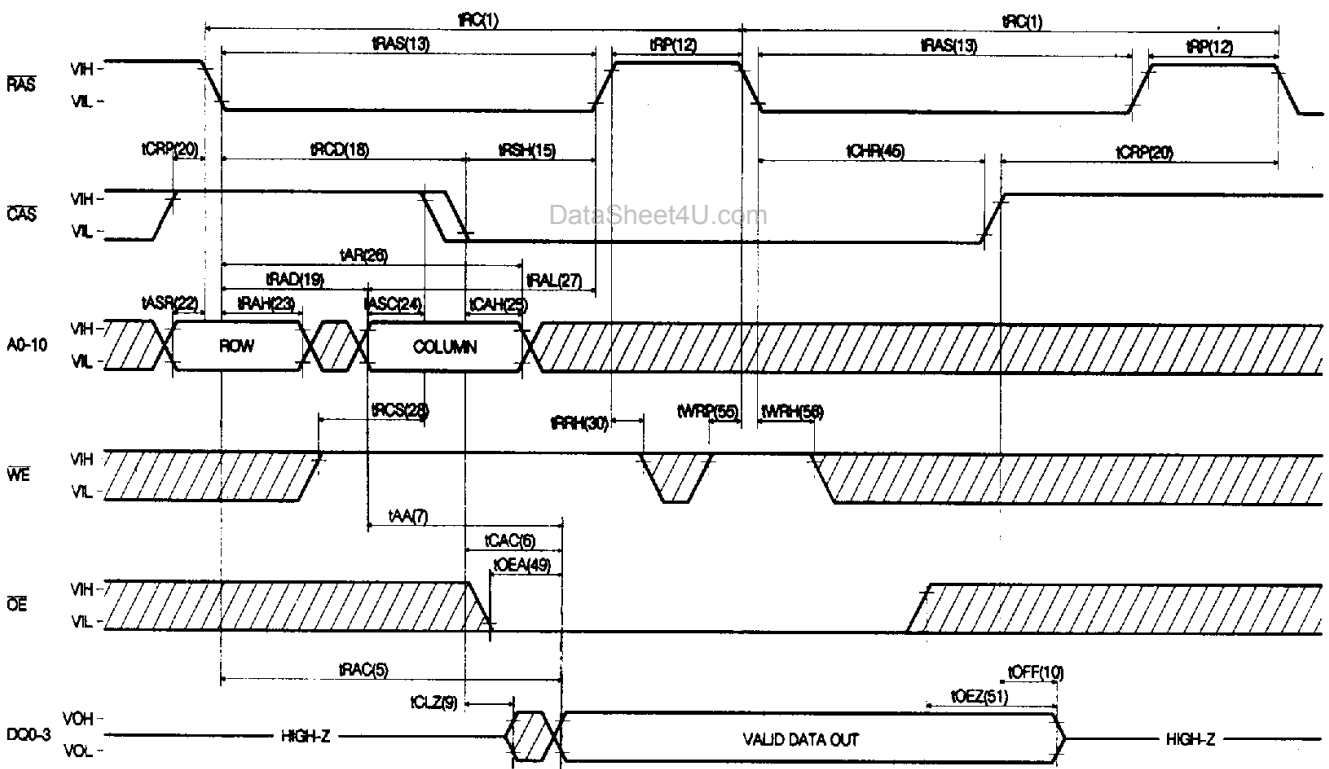


CAS-BEFORE-RAS REFRESH CYCLE

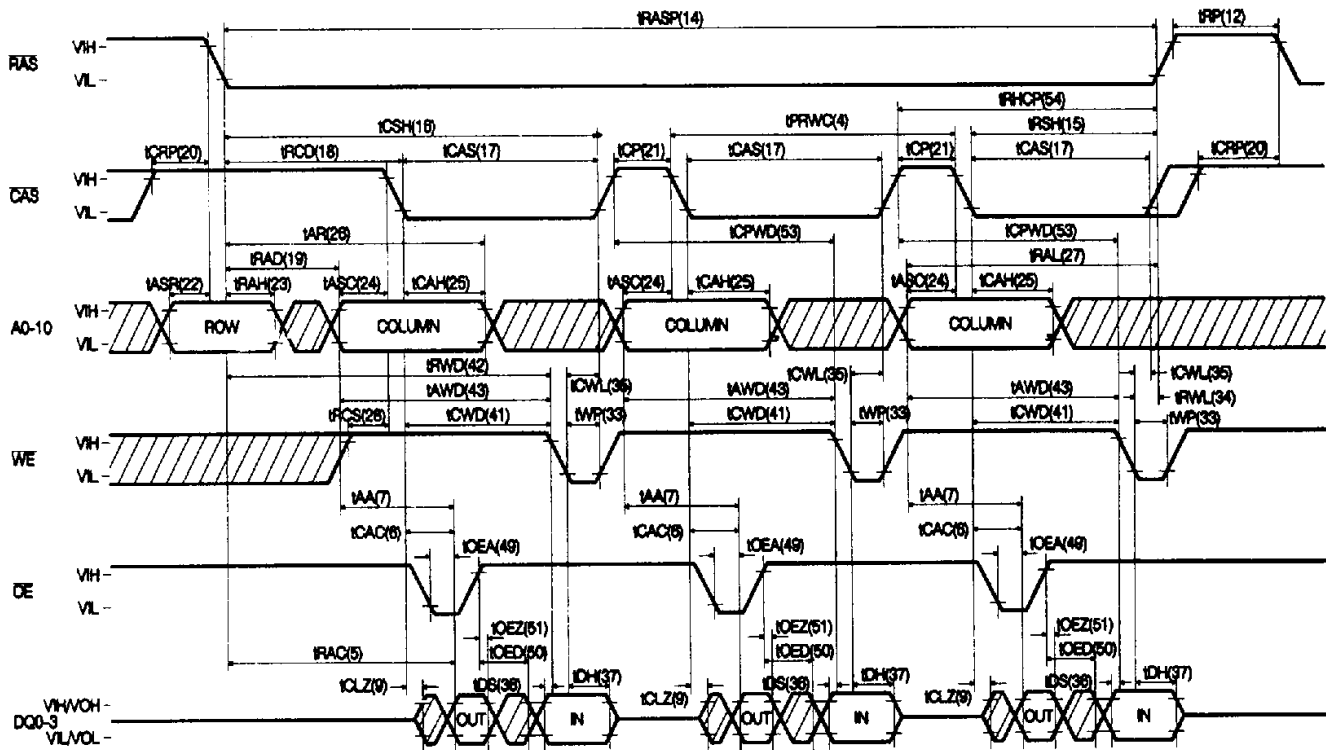


NOTE: A0-9 and OE="H" or "L"

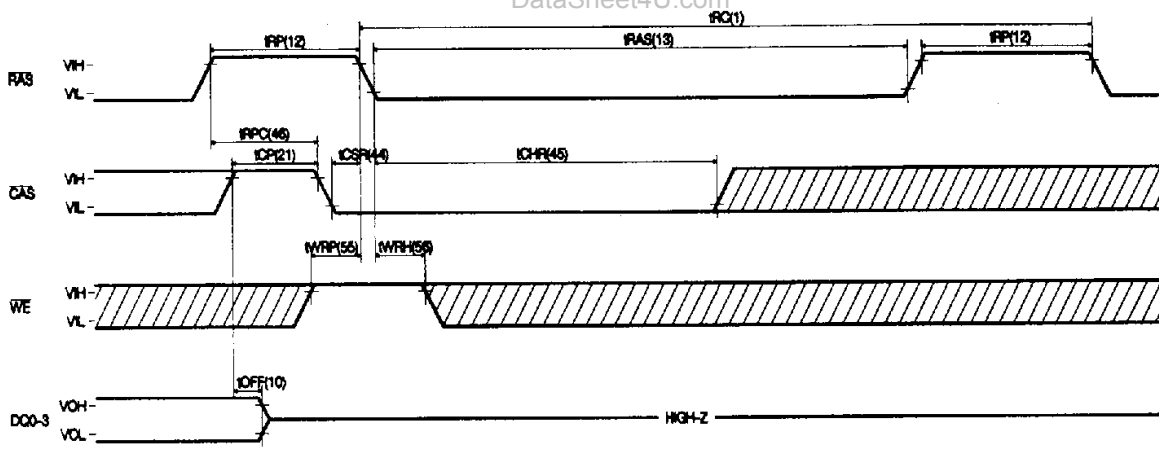
HIDDEN REFRESH CYCLE (READ)



HIDDEN REFRESH CYCLE (WRITE)

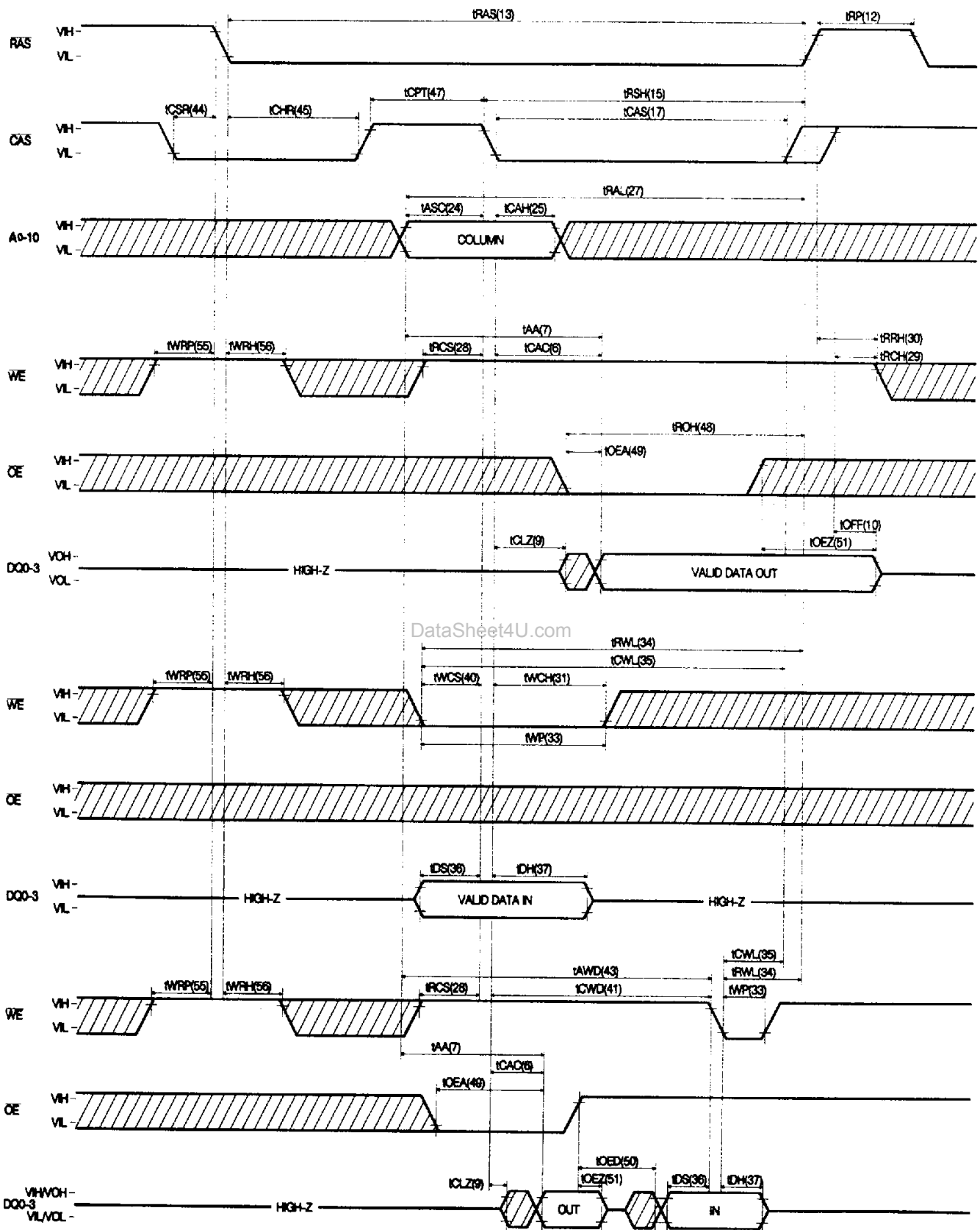


CAS-BEFORE-RAS SELF REFRESH CYCLE



NOTE : A0-10 OE and WE = "H" or "L"

CAS-BEFORE-RAS REFRESH CYCLE TEST CYCLE

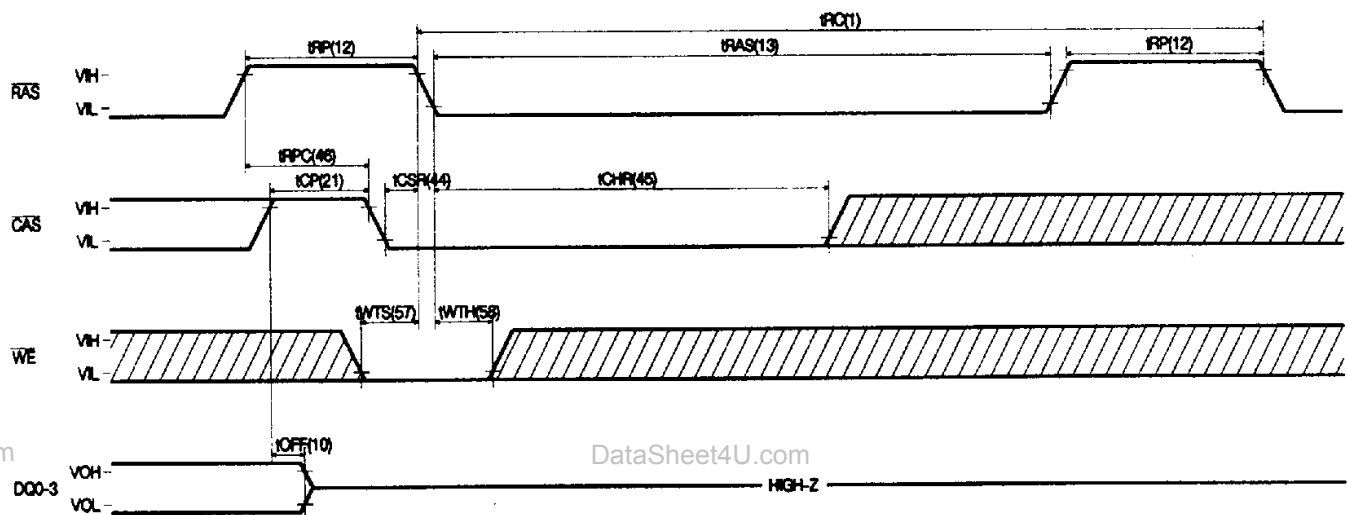


UL2E000 00000000 0000

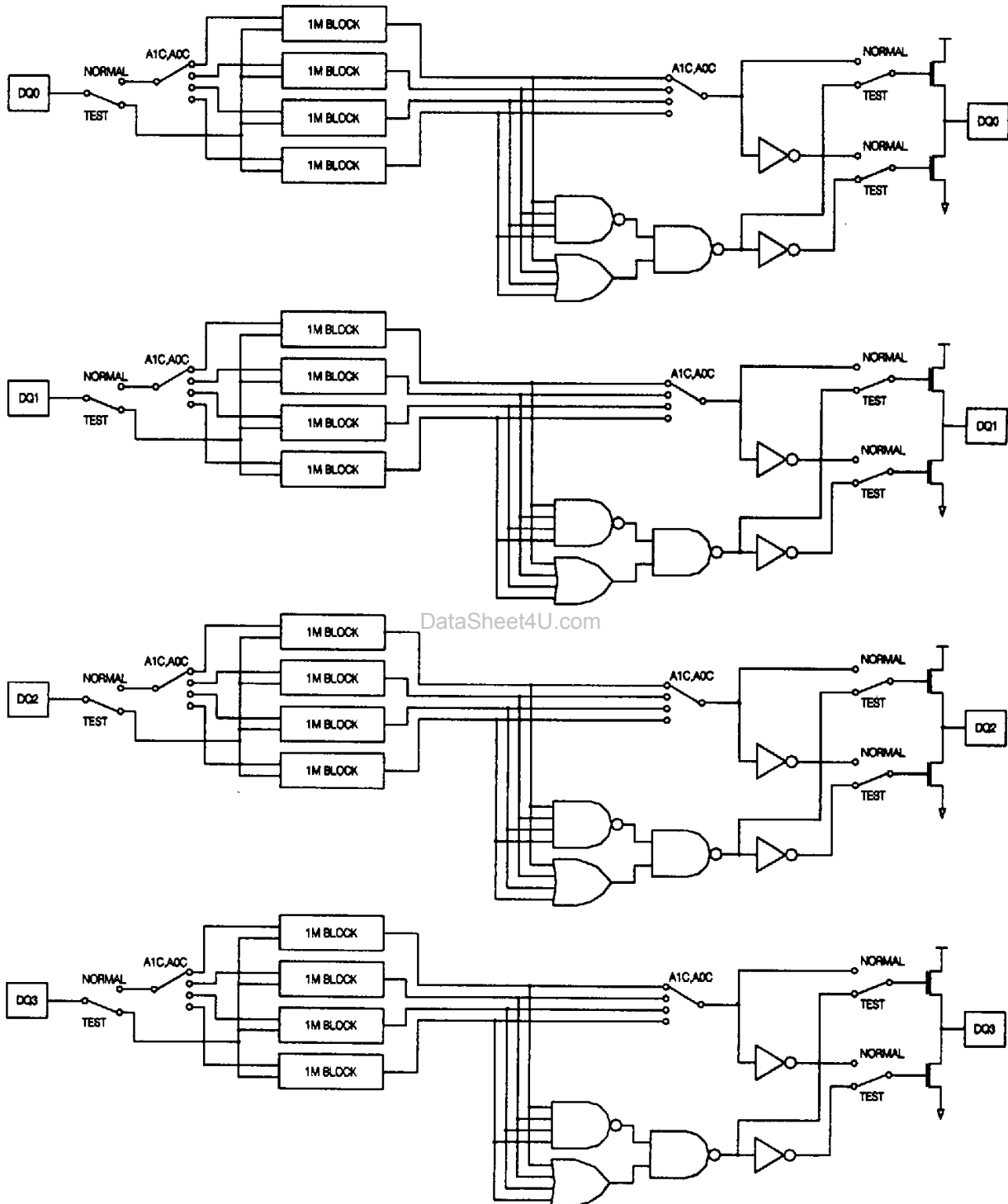
TEST MODE

The HY5117400A is a DRAM organized 4,194,304 x 4-bit. It is internally organized 1,048,576 x 16-bit. In Test Mode, data are written into 16 sectors (Each is composed of 512K bits) in parallel and retrieved the same way. Column address A0 is not used. If, upon reading, all 4-bit data from 4 sectors connected to one DQ pin are equal (all "1"s or "0"s), the DQ pin indicates a "1". If they are not equal, the DQ pin indicates a "0". Below shows the timing diagram of the HY5117400A to enter Test Mode. In Test Mode, the 4M x 4DRAM can be tested as if it were a 4M x 4DRAM. \overline{WE} , \overline{CAS} -before- \overline{RAS} cycle (Test Mode in Cycle) puts the HY5117400A into Test Mode and \overline{CAS} -before- \overline{RAS} or \overline{RAS} -only refresh cycle puts it back into Normal Mode. In Test Mode, \overline{WE} , \overline{CAS} -before- \overline{RAS} cycle shall be used for the refresh operation. The Test Mode function reduces test time. (1/4 in case of N test pattern)

TEST MODE IN CYCLE



BLOCK DIAGRAM IN TEST MODE



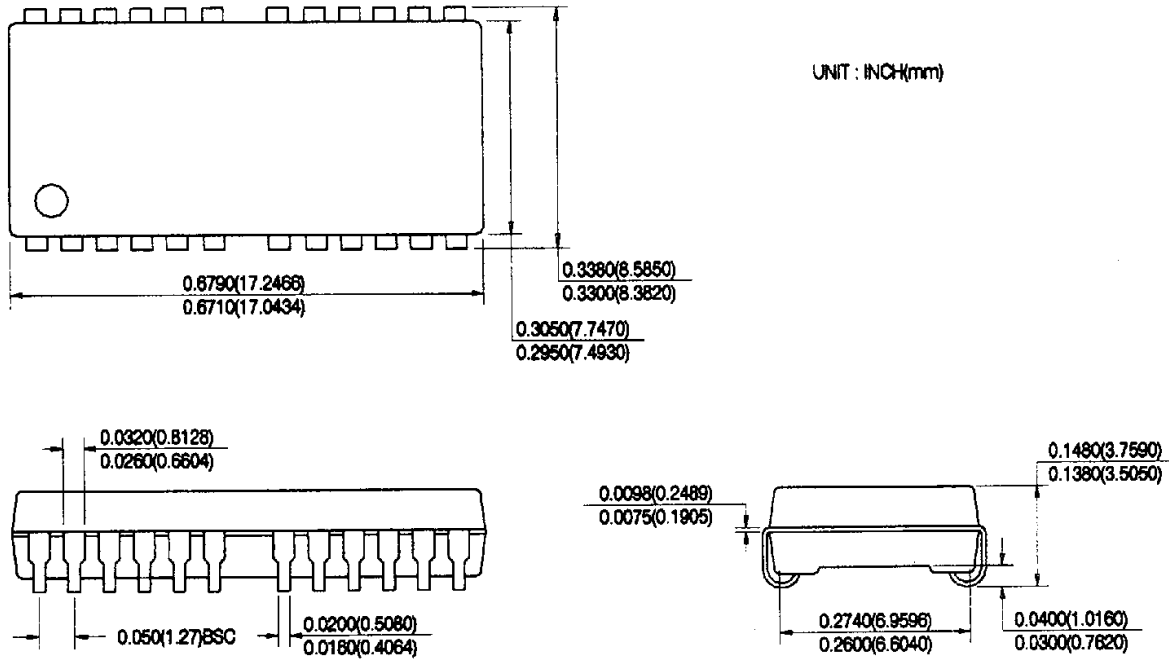
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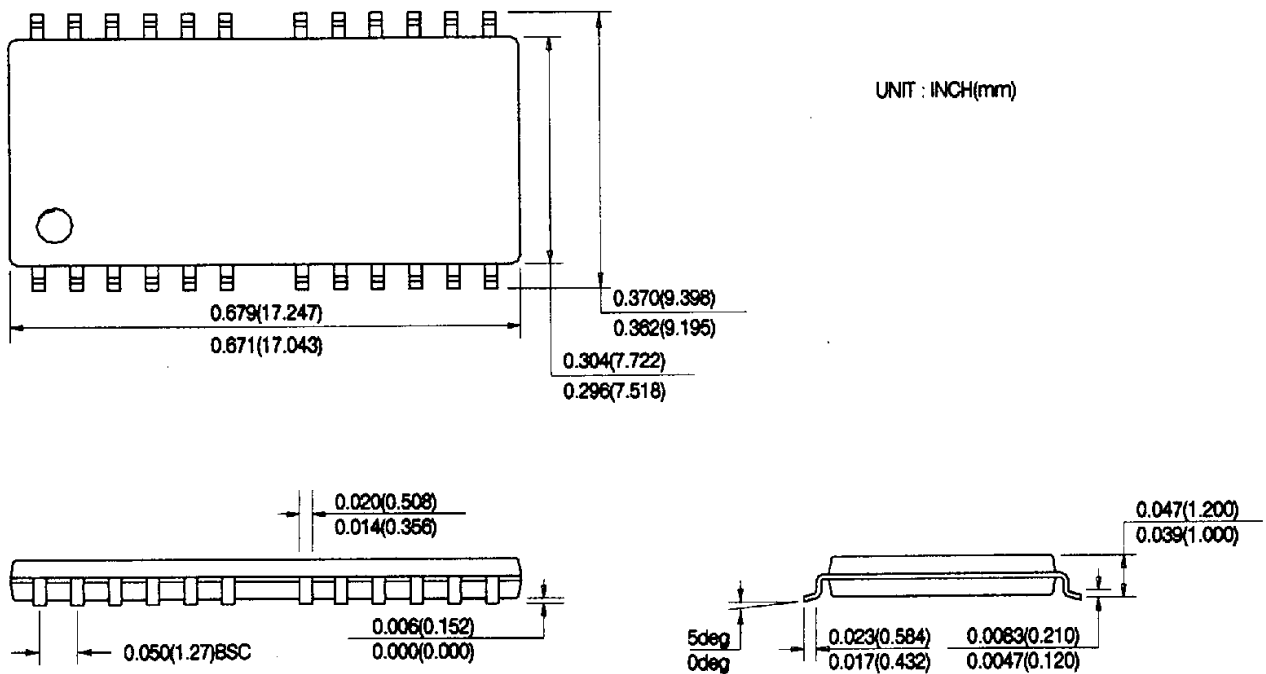
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PACKAGE INFORMATION

300 mil 24/26 pin Small Outline J-form Package (J)



300 mil 24/26 pin Thin Small Outline Package (T) (R)



ORDERING INFORMATION

PART NUMBER	SPEED	POWER	PACKAGE
HY5117400AJ	60/70/80		SOJ
HY5117400ASLJ	60/70/80	SL-part	SOJ
HY5117400AT	60/70/80		TSOP-II
HY5117400ASLT	60/70/80	SL-part	TSOP-II
HY5117400AR	60/70/80		TSOP-II(R)
HY5117400ASLR	60/70/80	SL-part	TSOP-II(R)