

## Description

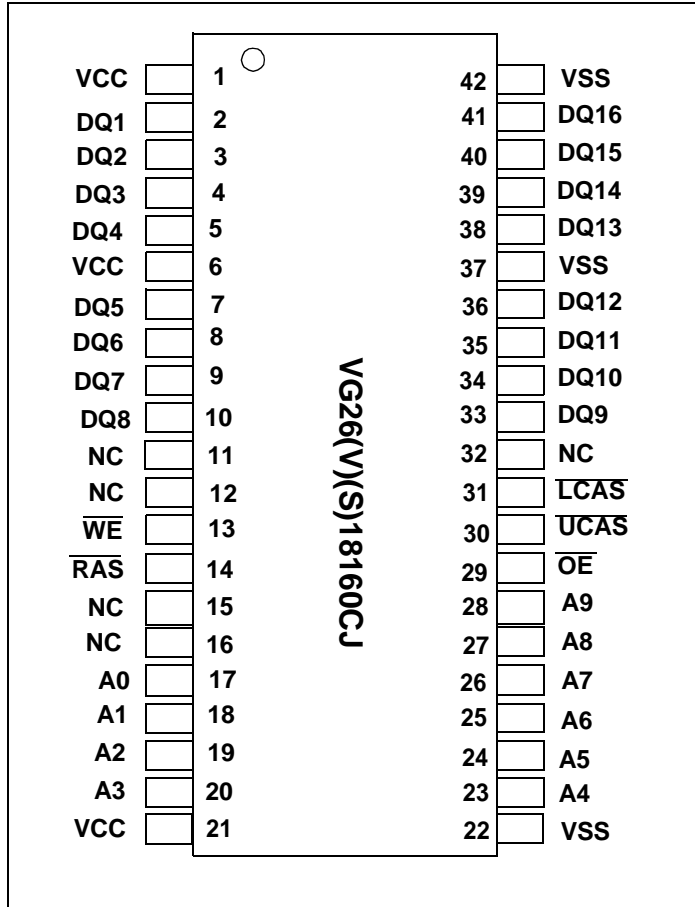
The device is CMOS Dynamic RAM organized as 1,048,576 words x 16 bits. It is fabricated with an advanced submicron CMOS technology and designed to operate from a single 5V only or 3.3V only power supply. Low voltage operation is more suitable to be used on battery backup, portable electronic application. A new refresh feature called " self-refresh " is supported and very slow CBR cycles are being performed. It is packaged in JEDEC standard 42 - pin plastic SOJ.

## Features

- Single 5V ( $\pm 10\%$ ) or 3.3V (+10%,-5%) only power supply
- High speed  $t_{RAC}$  access time : 50/60 ns
- Low power dissipation
  - Active mode : 5V version 605/550 mW (Max.)  
3.3V version 396/360 mW (Max.)
  - Standby mode : 5V version 1.375 mW (Max.)  
3.3V version 0.54 mW (Max.)
- Fast Page Mode access
- I/O level : TTL compatible ( $V_{CC} = 5V$ )  
LVTTL compatible ( $V_{CC} = 3.3V$ )
- 1024 refresh cycles in 16 ms (Std) or 128ms (S - version)
- 4 refresh mode :
  - $\overline{RAS}$  only refresh
  - $\overline{CAS}$ -before- $\overline{RAS}$  refresh
  - Hidden refresh
  - Self - refresh (S - version)

### Pin Configuration

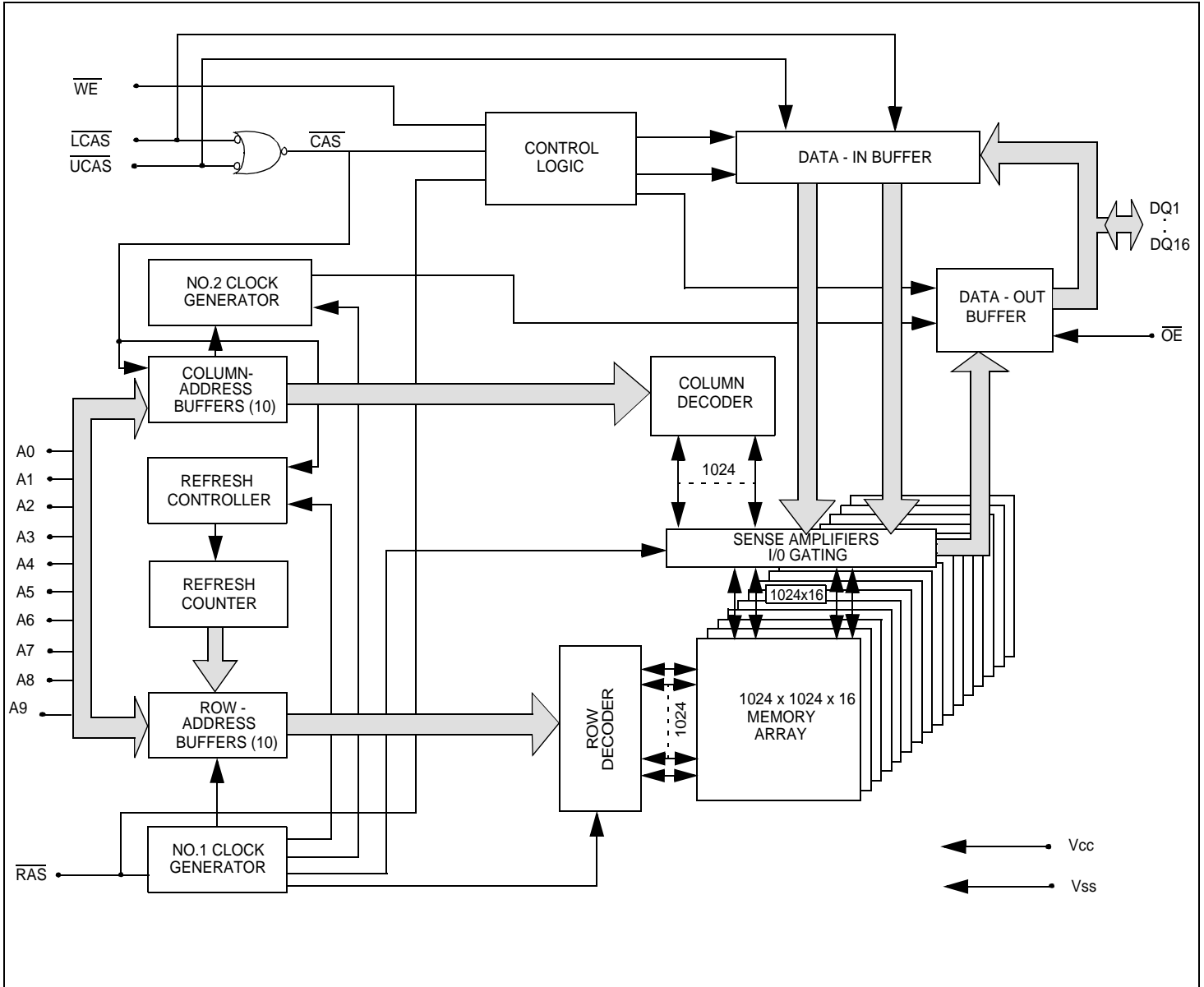
42-Pin 400mil Plastic SOJ



### Pin Description

Pin Name	Function
A0 - A9	Address inputs <ul style="list-style-type: none"> <li>- Row address A0 - A9</li> <li>- Column address A0 - A9</li> <li>- Refresh address A0 - A9</li> </ul>
DQ1 ~ DQ16	Data - in/data - out
RAS	Row address strobe
CAS	Column address strobe
WE	Write enable
OE	Output enable
V <sub>cc</sub>	Power (+ 5V or + 3.3V)
V <sub>ss</sub>	Ground

## Block Diagram



**Truth Table**

FUNCTION		$\overline{\text{RAS}}$	$\overline{\text{CAS}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	ADDRESSES		DQ <sub>S</sub>	Notes
						ROW	COL		
STANDBY		H	H → X	X	X	X	X	High - Z	
READ		L	L	H	L	ROW	COL	Data - Out	
WRITE : (EARLY WRITE)		L	L	L	X	ROW	COL	Data - In	
READ WRITE		L	L	H → L	L → H	ROW	COL	Data - Out, Data - In	
PAGE - MODE READ	1st Cycle	L	H → L	H	L	ROW	COL	Data - Out	
	2st Cycle	L	H → L	H	L	n/a	COL	Data - Out	
PAGE - MODE WRITE	1st Cycle	L	H → L	L	X	ROW	COL	Data - In	
	2st Cycle	L	H → L	L	X	n/a	COL	Data - In	
PAGE - MODE READ - WRITE	1st Cycle	L	H → L	H → L	L → H	ROW	COL	Data - Out, Data - In	
	2st Cycle	L	H → L	H → L	L → H	n/a	COL	Data - Out, Data - In	
HIDDEN REFRESH	READ	L → H → L	L	H	L	ROW	COL	Data - Out	
	WRITE	L → H → L	L	L	X	ROW	COL	Data - In	1
$\overline{\text{RAS}}$ - ONLY REFRESH		L	H	X	X	ROW	n/a	High - Z	
CBR REFRESH		H → L	L	H	X	X	X	High - Z	

Notes : 1. EARLY WRITE only.

**Absolute Maximum Rating**

Parameter	Symbol	Value	Unit
Voltage on any pin relative to Vss 5V 3.3V	$V_T$	-1.0 to + 7.0 -0.5 to + 4.6	V
Supply voltage relative to Vss 5V 3.3V	$V_{CC}$	-1.0 to + 7.0 -0.5 to + 4.6	V
Short circuit output current	$I_{OUT}$	50	mA
Power dissipation	$P_D$	1.0	W
Operating temperature	$T_{OPT}$	0 to + 70	°C
Storage temperature	$T_{STG}$	-55 to + 125	°C

**Recommended DC Operating Conditions**

Parameter/Condition	Symbol	5 Volt Version			3.3 Volt Version			Unit
		Min	Typ	Max	Min	Typ	Max	
Supply Voltage	$V_{CC}$	4.5	5.0	5.5	3.15	3.3	3.6	V
Input High Voltage, all inputs	$V_{IH}$	2.4	-	$V_{CC} + 1.0$	2.0	-	$V_{CC} + 0.3$	V
Input Low Voltage, all inputs	$V_{IL}$	-1.0	-	0.8	-0.3	-	0.8	V

**Capacitance**

$T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V} \pm 10\%$  or  $3.3\text{V} (+10\%, -5\%)$ ,  $f = 1\text{MHz}$

Parameter	Symbol	Typ	Max	Unit	Note
Input capacitance (Address)	$C_{I1}$	-	5	pF	1
Input capacitance (RAS, CAS, OE, WE)	$C_{I2}$	-	7	pF	1
Output capacitance (Data - in, Data - out)	$C_{I/O}$	-	7	pF	1,2

Note : 1. Capacitance measured with effective capacitance measuring method.

2. CAS =  $V_{IH}$  to disable Dout.

# DC Characteristics; 5 - Volt verion

(T<sub>a</sub> = 0 to 70°C, V<sub>CC</sub> = + 5V±10%, V<sub>SS</sub> = 0V)

Parameter		Symbol	Test Conditions	VG26 (V) (S) 18160C				Unit	Notes
				-5		-6			
				Min	Max	Min	Max		
Operating current		I <sub>CC1</sub>	RAS cycling CAS cycling t <sub>RC</sub> = min.	-	135	-	125	mA	1, 2
Standby Current	Low power S - version	I <sub>CC2</sub>	TTL interface RAS, CAS = V <sub>IH</sub> Dout = high - Z	-	2	-	2	mA	
			CMOS interface RAS, CAS ≥ V <sub>CC</sub> - 0.2V Dout = high - Z	-	0.25	-	0.25	mA	
	Standard power version		TTL interface RAS, CAS = V <sub>IH</sub> Dout = high - Z	-	2	-	2	mA	
			CMOS interface RAS, CAS ≥ V <sub>CC</sub> - 0.2V Dout = high - Z	-	1	-	1	mA	
RAS - only refresh current		I <sub>CC3</sub>	RAS cycling, CAS = V <sub>IH</sub> t <sub>RC</sub> = min.	-	135	-	125	mA	1, 2
Fast page mode current		I <sub>CC4</sub>	t <sub>PC</sub> = min.	-	90	-	80	mA	1,3
CAS - before - RAS refresh current		I <sub>CC5</sub>	t <sub>RC</sub> = min. RAS, CAS cycling	-	135	-	125	mA	1, 2
Self - refresh currant (S - Version)		I <sub>CC8</sub>	t <sub>RASS</sub> ≥ 100μS	-	350	-	350	μA	
CAS - before - RAS long refresh current (S - Version)		I <sub>CC9</sub>	Standby : V <sub>CC</sub> - 0.2V ≤ RAS CAS before RAS refresh : 1024 cycles/128ms RAS, CAS : 0V ≤ V <sub>IL</sub> ≤ 0.2V V <sub>CC</sub> - 0.2V ≤ V <sub>IH</sub> ≤ V <sub>IH</sub> (Max) Dout = high - Z, t <sub>RAS</sub> ≤ 300ns	-	500	-	500	μA	

**DC Characteristics ; 5 - Volt Version (cont.)**

( $T_a = 0$  to  $70^\circ\text{C}$ ,  $V_{CC} = +5V \pm 10\%$ ,  $V_{SS} = 0V$ )

Parameter	Symbol	Test Conditions	VG26 (V) (S) 18160C				Unit	Notes
			-5		-6			
			Min	Max	Min	Max		
Input leakage current	I <sub>LI</sub>	0V ≤ Vin ≤ V <sub>CC</sub> + 0.5V	-5	5	-5	5	μA	
Output leakage current	I <sub>LO</sub>	0V ≤ Vout ≤ V <sub>CC</sub> + 0.5V Dout = Disable	-5	5	-5	5	μA	
Output high voltage	V <sub>OH</sub>	I <sub>OH</sub> = -5mA	2.4	-	2.4	-	V	
Output low voltage	V <sub>OL</sub>	I <sub>OL</sub> = + 4.2mA	-	0.4	-	0.4	V	

**Notes :**

1.  $I_{CC}$  is specified as an average current. It depends on output loading condition and cycle rate when the device is selected.  $I_{CC}$  max is specified at the output open condition.
2. Address can be changed once or less while  $\overline{RAS} = V_{IL}$ .
3. For  $I_{CC4}$ , address can be changed once or less within one Fast page mode cycle time.

### DC Characteristics ; 3.3 - Volt Verion

( $T_a = 0$  to  $70^\circ\text{C}$ ,  $V_{CC} = +3.3\text{V}(+10\%, -5\%)$ ,  $V_{SS} = 0\text{V}$ )

Parameter		Symbol	Test Conditions	VG26 (V) (S) 18160C				Unit	Notes
				-5		-6			
				Min	Max	Min	Max		
Operating current		I <sub>CC1</sub>	$\overline{\text{RAS}}$ cycling $\overline{\text{CAS}}$ cycling t <sub>RC</sub> = min.	-	135	-	125	mA	1, 2
Standby Current	Low power S - version	I <sub>CC2</sub>	LVTTL interface RAS, CAS = V <sub>IH</sub> Dout = high - Z	-	0.5	-	0.5	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2\text{V}$ Dout = high - Z	-	0.25	-	0.25	mA	
	Standard power version		LVTTL interface RAS, CAS = V <sub>IH</sub> Dout = high - Z	-	2	-	2	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{\text{CC}} - 0.2\text{V}$ Dout = high - Z	-	0.5	-	0.5	mA	
RAS - only refresh current		I <sub>CC3</sub>	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}} = V_{\text{IH}}$ t <sub>RC</sub> = min.	-	135	-	125	mA	1, 2
Fast page mode current		I <sub>CC4</sub>	t <sub>PC</sub> = min.	-	90	-	80	mA	1,3
CAS - before - $\overline{\text{RAS}}$ refresh current		I <sub>CC5</sub>	t <sub>RC</sub> = min. RAS, CAS cycling	-	135	-	125	mA	1, 2
Self - refresh currant (S - Version)		I <sub>CC8</sub>	t <sub>RASS</sub> ≥ 100μS	-	250	-	250	μA	
CAS - before - $\overline{\text{RAS}}$ long refresh current (S - Version)		I <sub>CC9</sub>	Standby : V <sub>CC</sub> - 0.2V ≤ $\overline{\text{RAS}}$ $\overline{\text{CAS}}$ before RAS refresh : 1024 cycles/128ms RAS, CAS : 0V ≤ V <sub>IL</sub> ≤ 0.2V V <sub>CC</sub> - 0.2V ≤ V <sub>IH</sub> ≤ V <sub>IH</sub> (Max) Dout = high - Z, t <sub>RAS</sub> ≤ 300ns	-	300	-	300	μA	



**DC Characteristics ; 3.3 - Volt Version (cont.)**

( $T_a = 0$  to  $70^\circ\text{C}$ ,  $V_{CC} = +3.3\text{V}(+10\%, -5\%)$ ,  $V_{SS} = 0\text{V}$ )

Parameter	Symbol	Test Conditions	VG26 (V) (S) 18160C				Unit	Notes
			-5		-6			
			Min	Max	Min	Max		
Input leakage current	I <sub>LI</sub>	0V ≤ Vin ≤ V <sub>CC</sub> + 0.3V	-5	5	-5	5	μA	
Output leakage current	I <sub>LO</sub>	0V ≤ Vout ≤ V <sub>CC</sub> + 0.3V Dout = Disable	-5	5	-5	5	μA	
Output high voltage	V <sub>OH</sub>	I <sub>OH</sub> = -2mA	2.4	-	2.4	-	V	
Output low voltage	V <sub>OL</sub>	I <sub>OL</sub> = + 2mA	-	0.4	-	0.4	V	

**Notes :**

1.  $I_{CC}$  is specified as an average current. It depends on output loading condition and cycle rate when the device is selected.  $I_{CC}$  max is specified at the output open condition.
2. Address can be changed once or less while  $\overline{\text{RAS}} = V_{IL}$ .
3. For  $I_{CC4}$ , address can be changed once or less within one Fast page mode cycle time.

## AC Characteristics

(Ta = 0 to + 70°C, V<sub>CC</sub> = 5V ± 10% or 3.3V(+10%, -5%), V<sub>SS</sub> = 0V) \* 1, \* 2, \* 3, \* 4

Test conditions

- Output load : two TTL Loads and 50pF (V<sub>CC</sub> = 5.0V ± 10%)  
one TTL Load and 30pF (V<sub>CC</sub> = 3.3V(+10%, -5%))
- Input timing reference levels :  
V<sub>IH</sub> = 2.4V, V<sub>IL</sub> = 0.8V (V<sub>CC</sub> = 5.0V ± 10%);  
V<sub>IH</sub> = 2.0V, V<sub>IL</sub> = 0.8V (V<sub>CC</sub> = 3.3V(+10%, -5%))
- Output timing reference levels :  
V<sub>OH</sub> = 2.0V, V<sub>OL</sub> = 0.8V (V<sub>CC</sub> = 5V ± 10%, 3.3V(+10%, -5%))

## Read, Write, Read - Modify - Write and Refresh Cycles

### (Common Parameters)

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Random read or write cycle time	t <sub>RC</sub>	90	-	110	-	ns	
RAS precharge time	t <sub>RP</sub>	30	-	40	-	ns	
CAS precharge time in normal mode	t <sub>CPN</sub>	10	-	10	-	ns	
RAS pulse width	t <sub>RAS</sub>	50	10000	60	10000	ns	5
CAS pulse width	t <sub>CAS</sub>	12	10000	15	10000	ns	6
Row address setup time	t <sub>ASR</sub>	0	-	0	-	ns	
Row address hold time	t <sub>RAH</sub>	8	-	10	-	ns	
Column address setup time	t <sub>ASC</sub>	0	-	0	-	ns	7
Column address hold time	t <sub>CAH</sub>	8	-	10	-	ns	
RAS to CAS delay time	t <sub>RCD</sub>	17	37	20	45	ns	8
RAS to column address delay time	t <sub>RAD</sub>	12	25	15	30	ns	9
Column address to RAS lead time	t <sub>RAL</sub>	25	-	30	-	ns	
RAS hold time	t <sub>RSH</sub>	13	-	15	-	ns	
CAS hold time	t <sub>CSH</sub>	50	-	60	-	ns	
CAS to RAS precharge time	t <sub>CRP</sub>	5	-	5	-	ns	10
OE to Din delay time	t <sub>OED</sub>	12	-	15	-	ns	
Transition time (rise and fall)	t <sub>T</sub>	1	50	1	50	ns	11
Refresh period	t <sub>REF</sub>	-	16	-	16	ms	
Refresh period (S - Version)	t <sub>REF</sub>	-	128	-	128	ms	
CAS to output in Low-Z	t <sub>CLZ</sub>	0	-	0	-	ns	
CAS delay time from Din	t <sub>DZC</sub>	0	-	0	-	ns	
OE delay time from Din	t <sub>DZO</sub>	0	-	0	-	ns	

**Read Cycle**

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Access time from $\overline{\text{RAS}}$	$t_{\text{RAC}}$	-	50	-	60	ns	12
Access time from $\overline{\text{CAS}}$	$t_{\text{CAC}}$	-	13	-	15	ns	13,14
Access time from column address	$t_{\text{AA}}$	-	25	-	30	ns	14,15
Access time from $\overline{\text{OE}}$	$t_{\text{OEA}}$	-	13	-	15	ns	
Read command setup time	$t_{\text{RCS}}$	0	-	0	-	ns	7
Read command hold time to $\overline{\text{CAS}}$	$t_{\text{RCH}}$	0	-	0	-	ns	10,16
Read command hold time to $\overline{\text{RAS}}$	$t_{\text{RRH}}$	0	-	0	-	ns	16
Output buffer turn-off time	$t_{\text{OFF}}$	0	13	0	15	ns	17
Output buffer turn-off time from $\overline{\text{OE}}$	$t_{\text{OEZ}}$	0	13	0	15	ns	17

**Write Cycle**

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Write command setup time	t <sub>WCS</sub>	0	-	0	-	ns	7,18
Write command hold time	t <sub>WCH</sub>	8	-	10	-	ns	
Write command pulse width	t <sub>WP</sub>	8	-	10	-	ns	
Write command to $\overline{\text{RAS}}$ lead time	t <sub>RWL</sub>	13	-	15	-	ns	
Write command to $\overline{\text{CAS}}$ lead time	t <sub>CWL</sub>	8	-	10	-	ns	
Data-in setup time	t <sub>DS</sub>	0	-	0	-	ns	19
Data-in hold time	t <sub>DH</sub>	8	-	10	-	ns	19

**Read - Modify - Write Cycle**

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Read - modify - write cycle time	t <sub>RWC</sub>	125	-	150	-	ns	
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	t <sub>RWD</sub>	65	-	80	-	ns	18
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time	t <sub>CWD</sub>	30	-	35	-	ns	18
Column address to $\overline{\text{WE}}$ delay time	t <sub>AWD</sub>	40	-	50	-	ns	18
$\overline{\text{OE}}$ hold time from $\overline{\text{WE}}$	t <sub>OEH</sub>	8	-	10	-	ns	

### Refresh Cycle

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
$\overline{\text{CAS}}$ setup time (CBR refresh)	$t_{\text{CSR}}$	10	-	10	-	ns	
$\overline{\text{CAS}}$ hold time (CBR refresh)	$t_{\text{CHR}}$	10	-	10	-	ns	10
$\overline{\text{RAS}}$ precharge to $\overline{\text{CAS}}$ hold time	$t_{\text{RPC}}$	5	-	5	-	ns	7
$\overline{\text{RAS}}$ pulse width (self refresh)	$t_{\text{RASS}}$	100	-	100	-	$\mu\text{s}$	
$\overline{\text{RAS}}$ precharge time (self refresh)	$t_{\text{RPS}}$	90	-	110	-	ns	
$\overline{\text{CAS}}$ hold time (CBR self refresh)	$t_{\text{CHS}}$	-50	-	-50	-	ns	
$\overline{\text{WE}}$ setup time	$t_{\text{WSR}}$	0	-	0	-	ns	
$\overline{\text{WE}}$ hold time	$t_{\text{WHR}}$	10	-	10	-	ns	

### Fast Page Mode Cycle

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Fast page mode cycle time	t <sub>PC</sub>	35	-	40	-	ns	
Fast page mode $\overline{\text{CAS}}$ Precharge time	t <sub>CP</sub>	10	-	10	-	ns	
Fast page mode $\overline{\text{RAS}}$ pulse width	t <sub>RASP</sub>	50	10 <sup>5</sup>	60	10 <sup>5</sup>	ns	20
Access time from $\overline{\text{CAS}}$ precharge	t <sub>CPA</sub>	-	30	-	35	ns	10,14
$\overline{\text{RAS}}$ hold time from $\overline{\text{CAS}}$ precharge	t <sub>CPRH</sub>	30	-	35	-	ns	

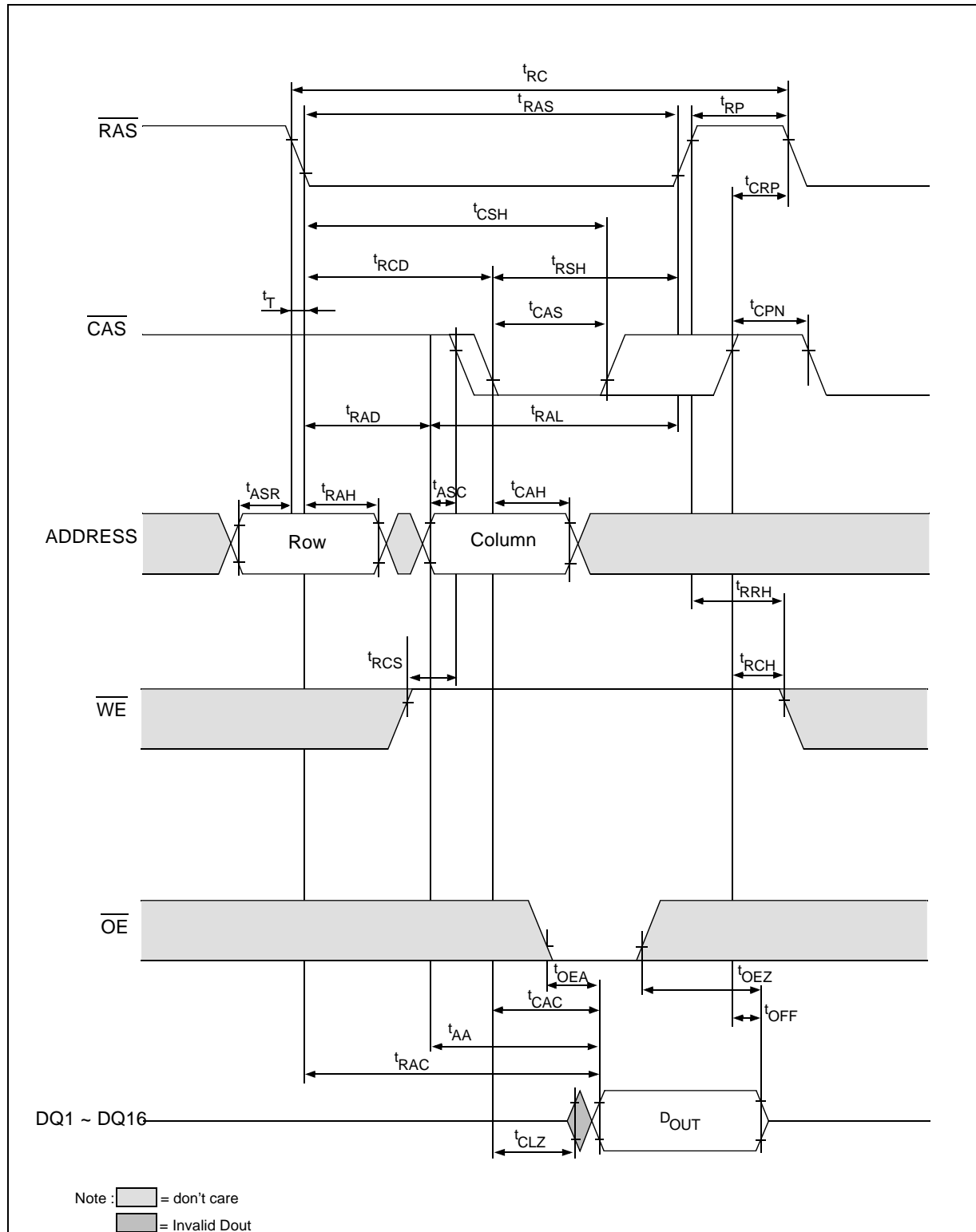
### Fast Page Mode Read Modify Write Cycle

Parameter	Symbol	VG26 (V) (S) 18160C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Fast page mode read - modify - write cycle CAS precharge to WE delay time	t <sub>CPW</sub>	45	-	55	-	ns	10
Fast page mode read - modify - write cycle time	t <sub>PRWC</sub>	70	-	80	-	ns	

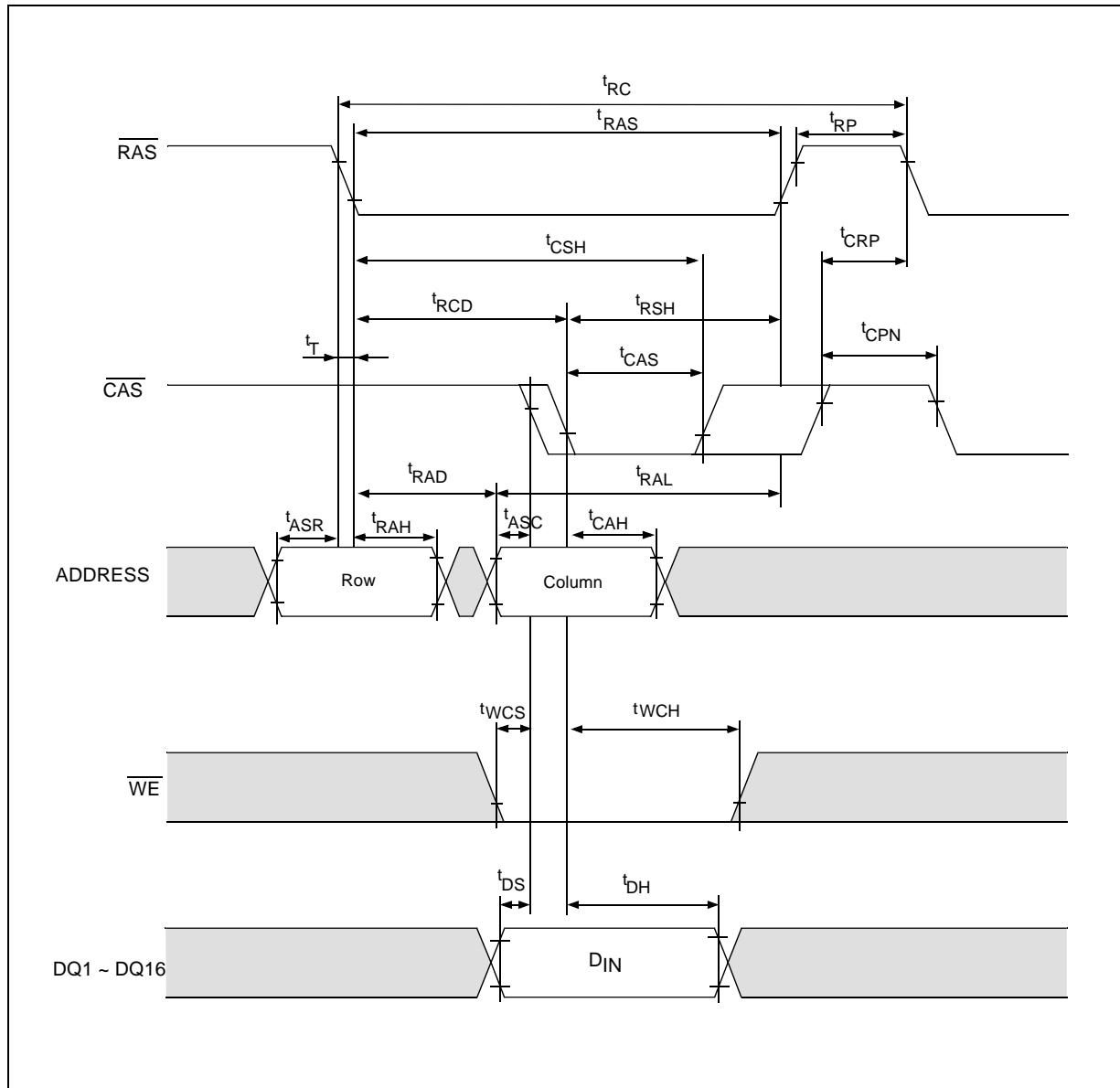
Notes :

1. AC measurements assume  $t_T = 5\text{ns}$ .
2. An initial pause of  $100\ \mu\text{s}$  is required after power up, and it followed by a minimum of eight initialization cycles ( $\overline{\text{RAS}}$ -only refresh cycle or  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh cycle). If the internal refresh counter is used, a minimum of eight  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh cycles are required.
3. In delayed write or read-modify-write cycles,  $\overline{\text{OE}}$  must disable output buffer prior to applying data to the device.
4. All the  $V_{CC}$  and  $V_{SS}$  pins shall be supplied with the same voltage.
5.  $t_{\text{RAS}}(\text{min}) = t_{\text{RWD}}(\text{min}) + t_{\text{RWL}}(\text{min}) + t_T$  in read - modify-write cycle.
6.  $t_{\text{CAS}}(\text{min}) = t_{\text{CWD}}(\text{min}) + t_{\text{CWL}}(\text{min}) + t_T$  in read - modify-write cycle.
7.  $t_{\text{ASC}}(\text{min})$ ,  $t_{\text{RCS}}(\text{min})$ ,  $t_{\text{WCS}}(\text{min})$  and  $t_{\text{RPC}}$  are determined by the falling edge of  $\overline{\text{CAS}}$ .
8.  $t_{\text{RCD}}(\text{max})$  is specified as a reference point only, and  $t_{\text{RAC}}(\text{max})$  can be met with the  $t_{\text{RCD}}(\text{max})$  limit. Otherwise,  $t_{\text{RAC}}$  is controlled exclusively by  $t_{\text{CAC}}$  if  $t_{\text{RCD}}$  is greater than the specified  $t_{\text{RCD}}(\text{max})$  limit.
9.  $t_{\text{RAD}}(\text{max})$  is specified as a reference point only, and  $t_{\text{RAC}}(\text{max})$  can be met with the  $t_{\text{RAD}}(\text{max})$  limit. Otherwise,  $t_{\text{RAC}}$  is controlled exclusively by  $t_{\text{AA}}$  if  $t_{\text{RAD}}$  is greater than the specified  $t_{\text{RAD}}(\text{max})$  limit.
10.  $t_{\text{CRP}}$ ,  $t_{\text{CHR}}$ ,  $t_{\text{RCH}}$ ,  $t_{\text{CPA}}$  and  $t_{\text{CPW}}$  are determined by the rising edge of  $\overline{\text{CAS}}$ .
11.  $V_{\text{IH}}(\text{min})$  and  $V_{\text{IL}}(\text{max})$  are reference levels for measuring timing or input signals. Therefore, transition time is measured between  $V_{\text{IH}}$  and  $V_{\text{IL}}$ .
12. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ . If  $t_{\text{RCD}}$  or  $t_{\text{RAD}}$  is greater than the maximum recommended value shown in this table,  $t_{\text{RAC}}$  exceeds the value shown.
13. Assumes that  $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ .
14. Access time is determined by the maximum among  $t_{\text{AA}}$ ,  $t_{\text{CAC}}$ ,  $t_{\text{CPA}}$ .
15. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$ .
16. Either  $t_{\text{RCH}}$  or  $t_{\text{RRH}}$  must be satisfied for a read cycle.
17.  $t_{\text{OFF}}(\text{max})$  and  $t_{\text{OEZ}}(\text{max})$  define the time at which the output achieves the open circuit condition (high impedance).
18.  $t_{\text{WCS}}$ ,  $t_{\text{RWD}}$ ,  $t_{\text{CWD}}$ , and  $t_{\text{AWD}}$  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 the data output will remain open circuit (high impedance) throughout 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  $t_{\text{CPW}} \geq t_{\text{CPW}}(\text{min})$ , the cycle is a read-modify-write and the data output will contain data read from the selected cell. If neither of the above sets of conditions is satisfied, the condition of the data output (at access time) is indeterminate.
19. These parameters are referenced to  $\overline{\text{CAS}}$  in an early write cycle and to  $\overline{\text{WE}}$  edge in a delayed write or a read-modify-write cycle.
20.  $t_{\text{RASp}}$  defines  $\overline{\text{RAS}}$  pulse width in Fast page mode cycles.

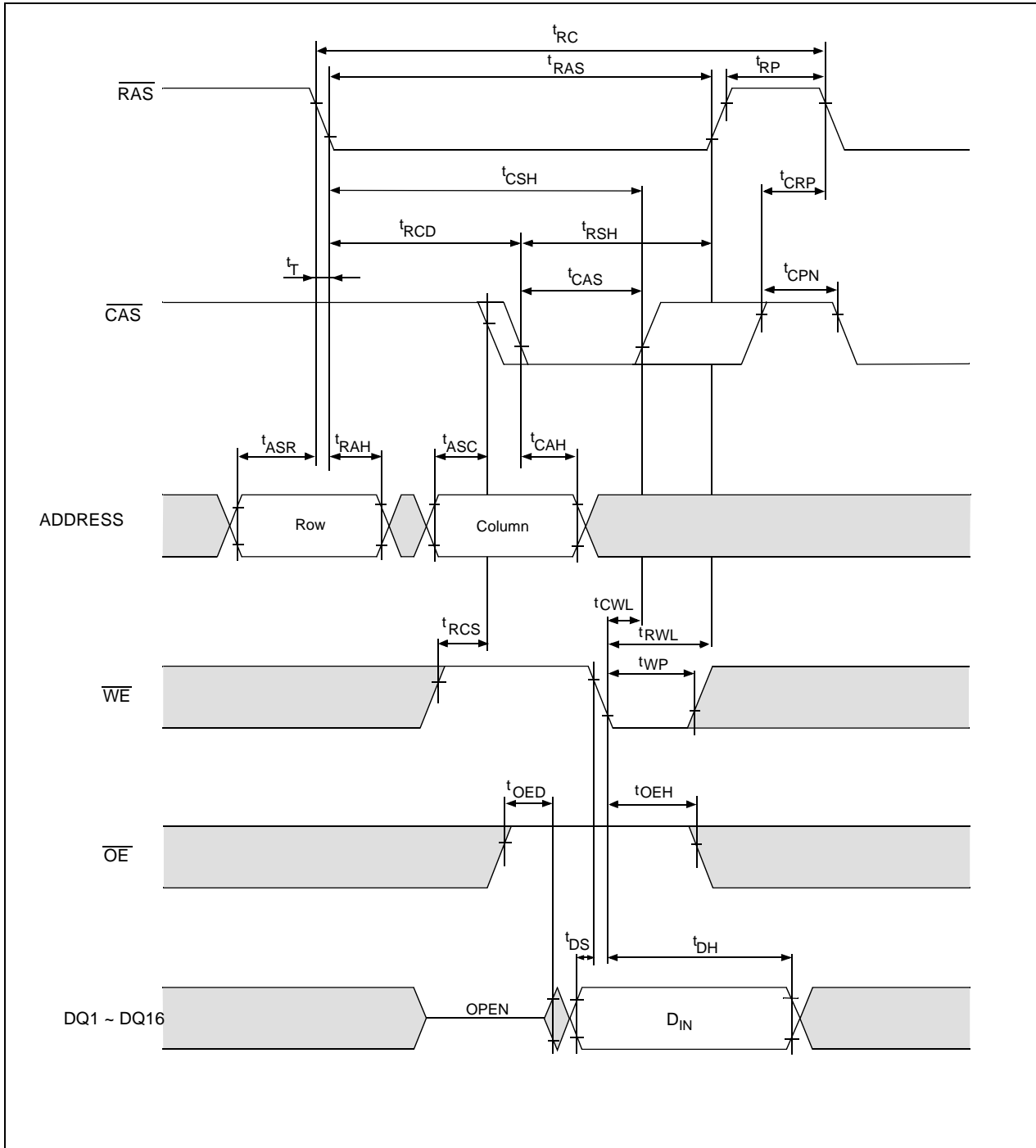
## Timing Waveforms • Read Cycle



## •Early Write Cycle

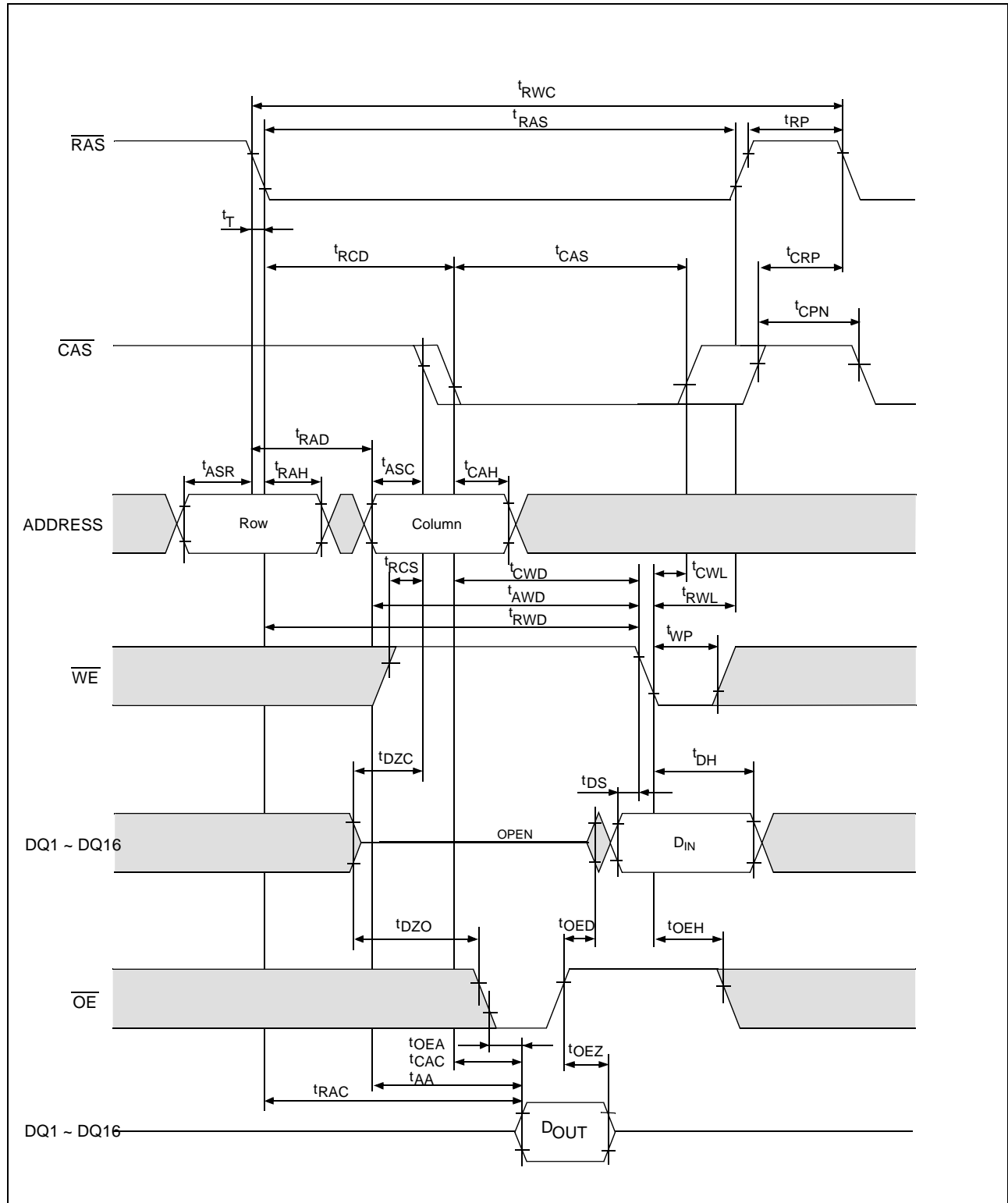


• Delayed Write Cycle



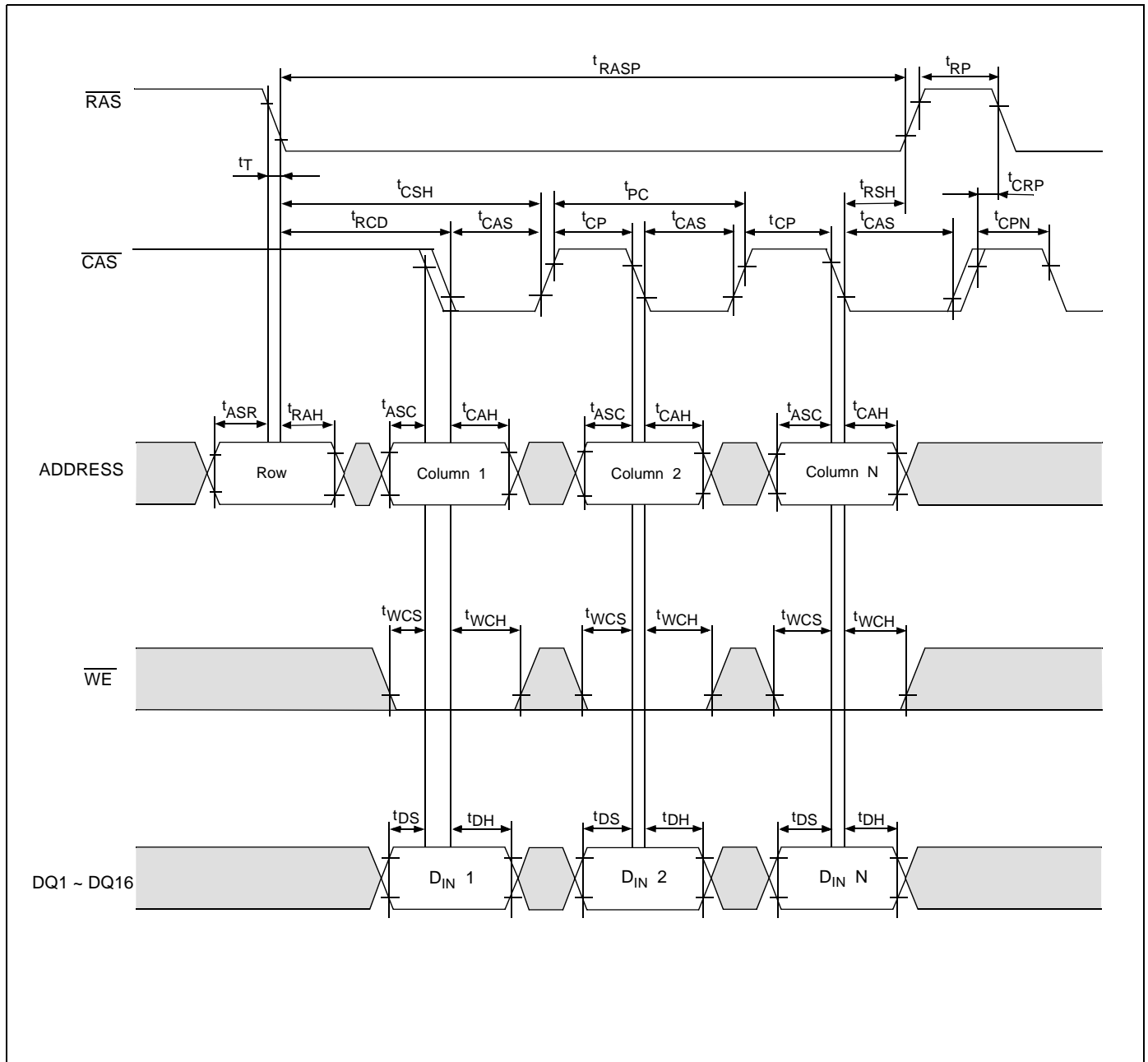


• Read - Modify - Write Cycle

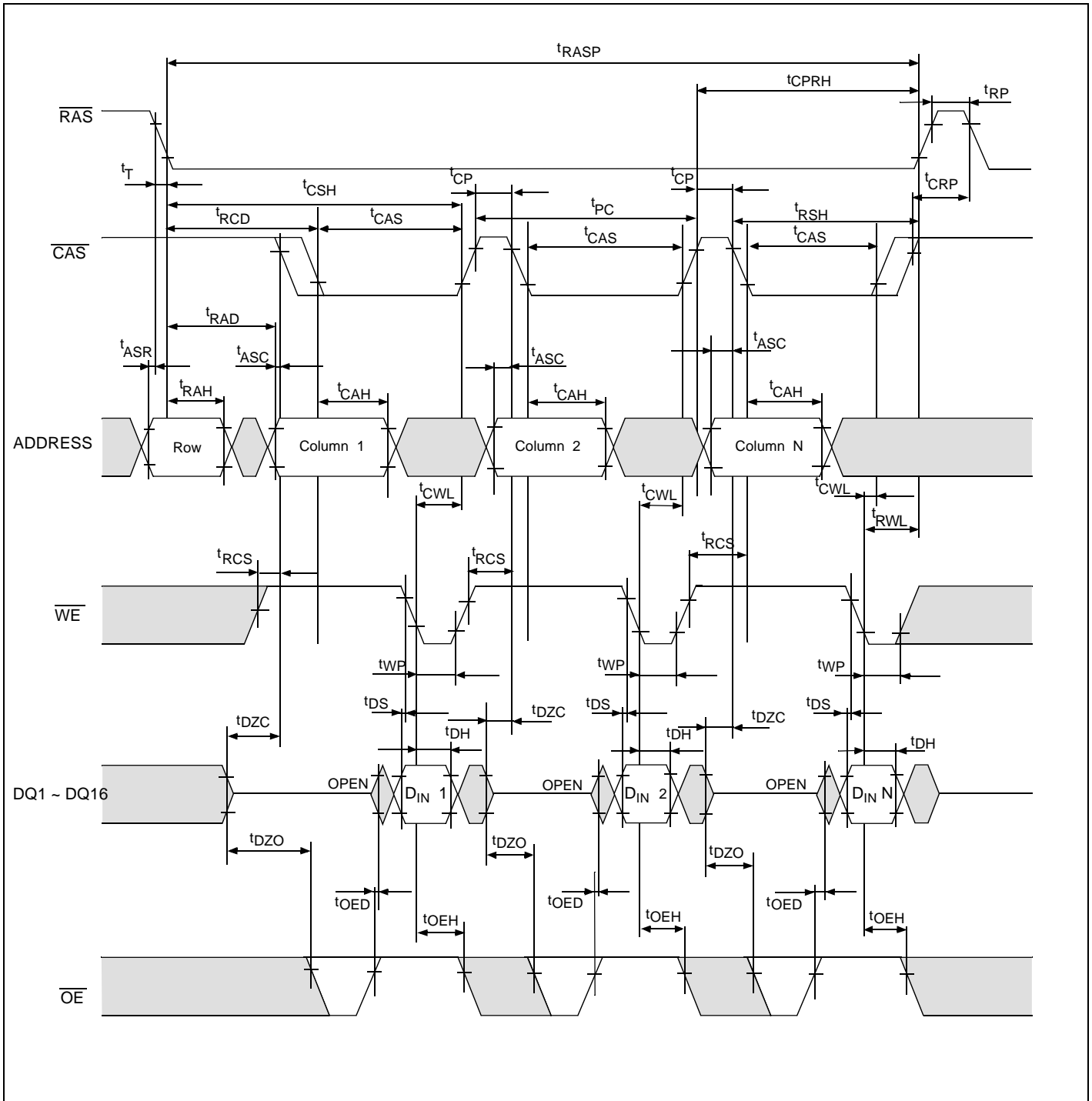


[illegible]

• Fast Page Mode Early Write Cycle

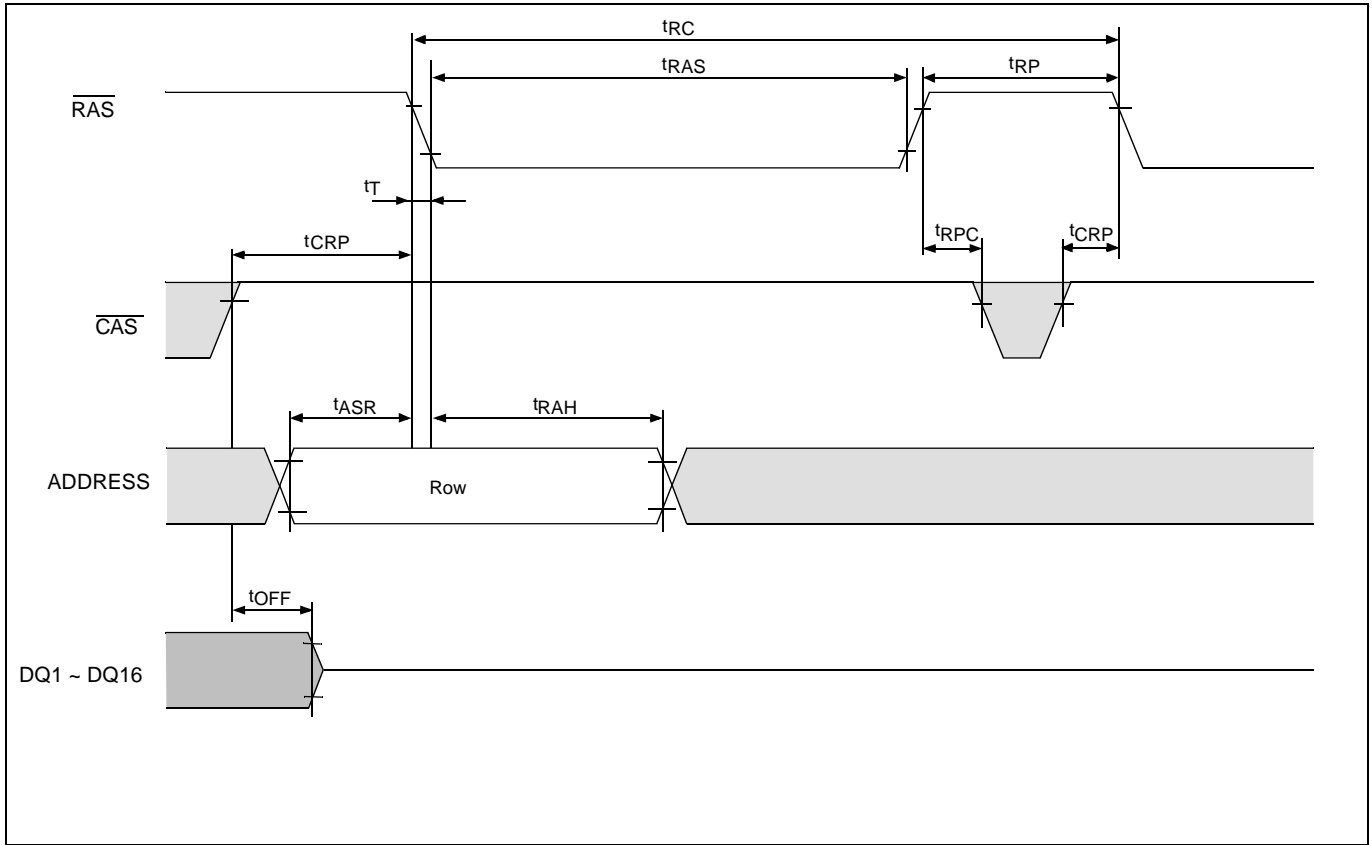


• Fast Page Mode Delayed Write Cycle

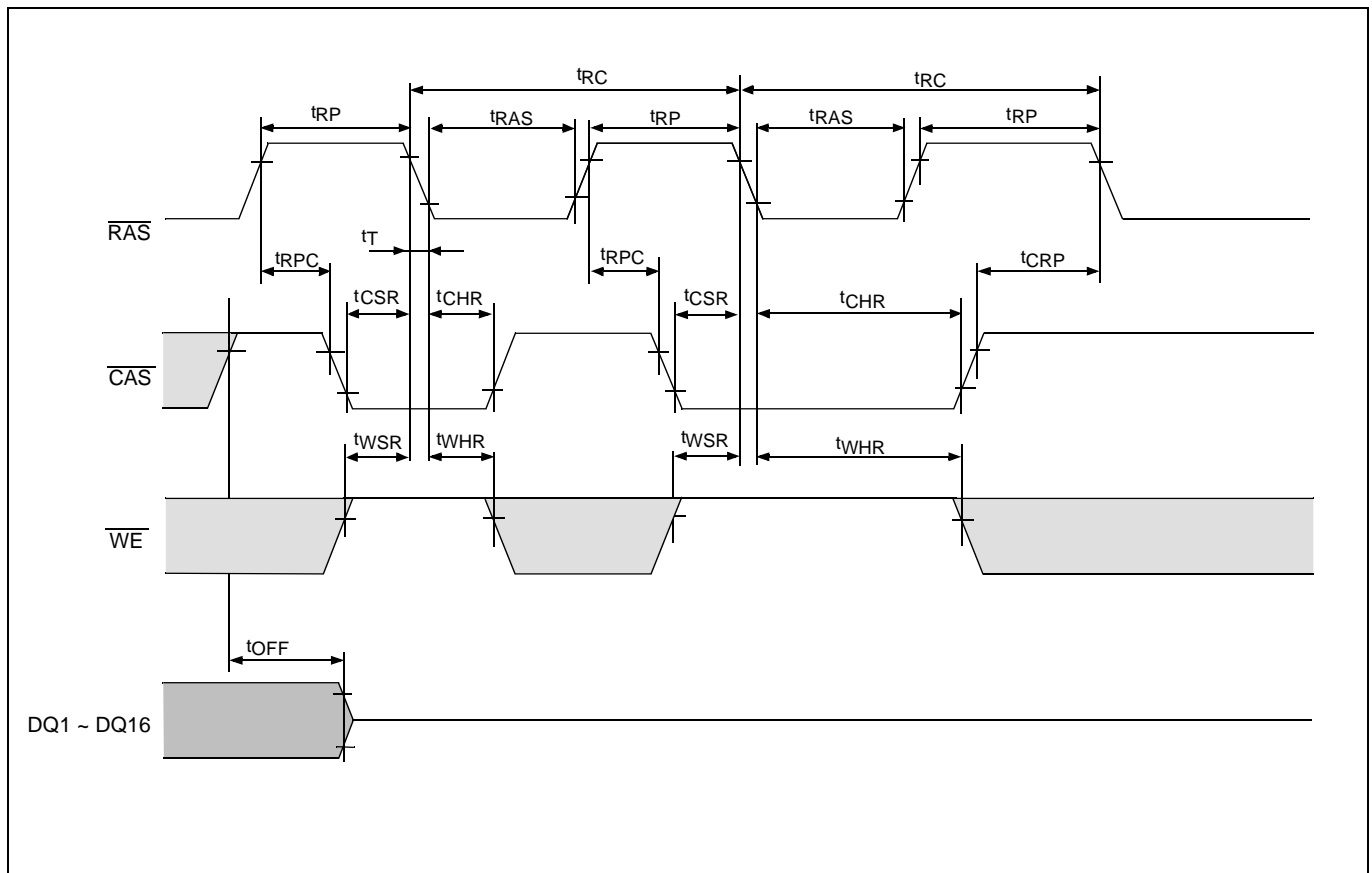




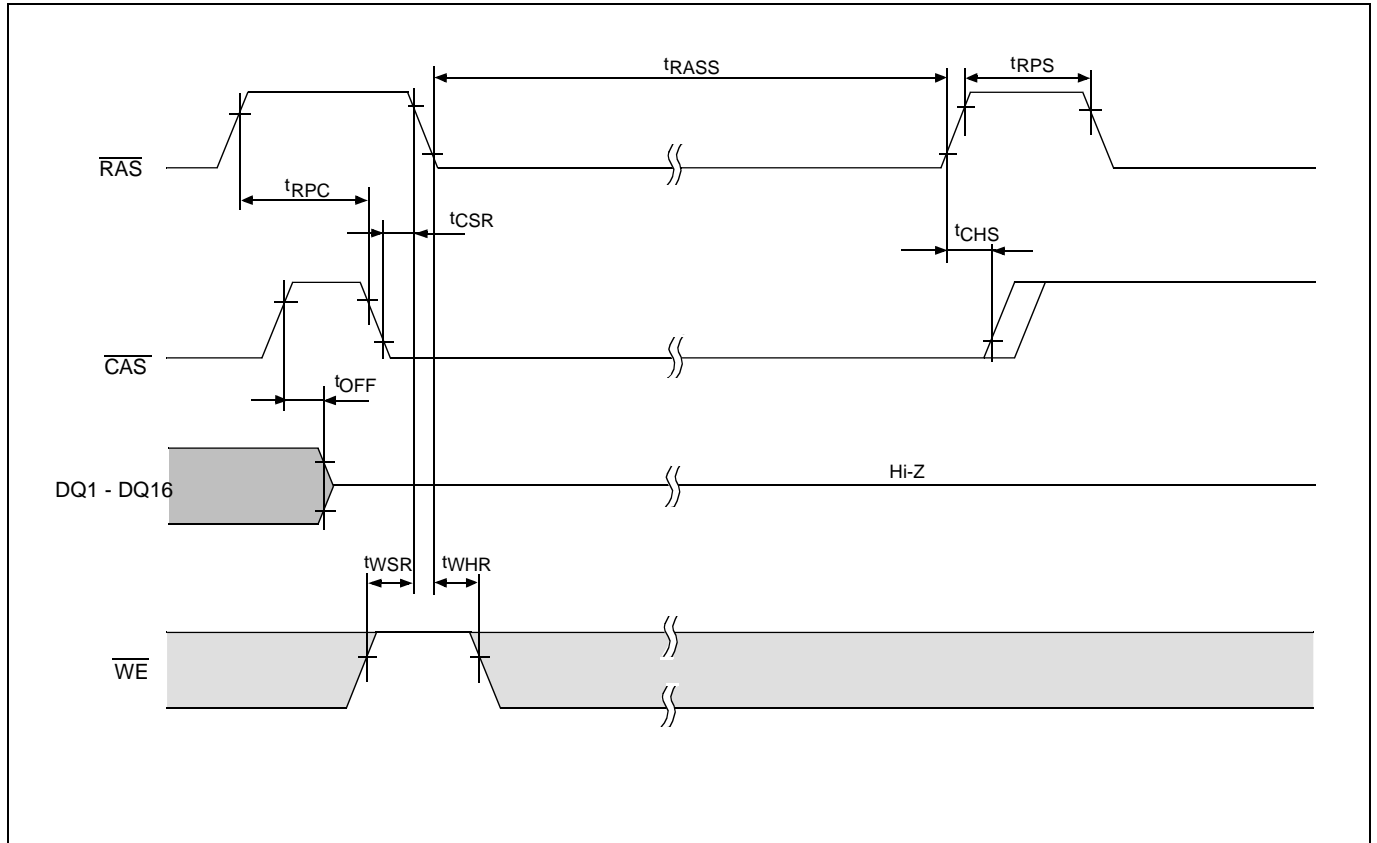
## RAS - Only Refresh Cycle



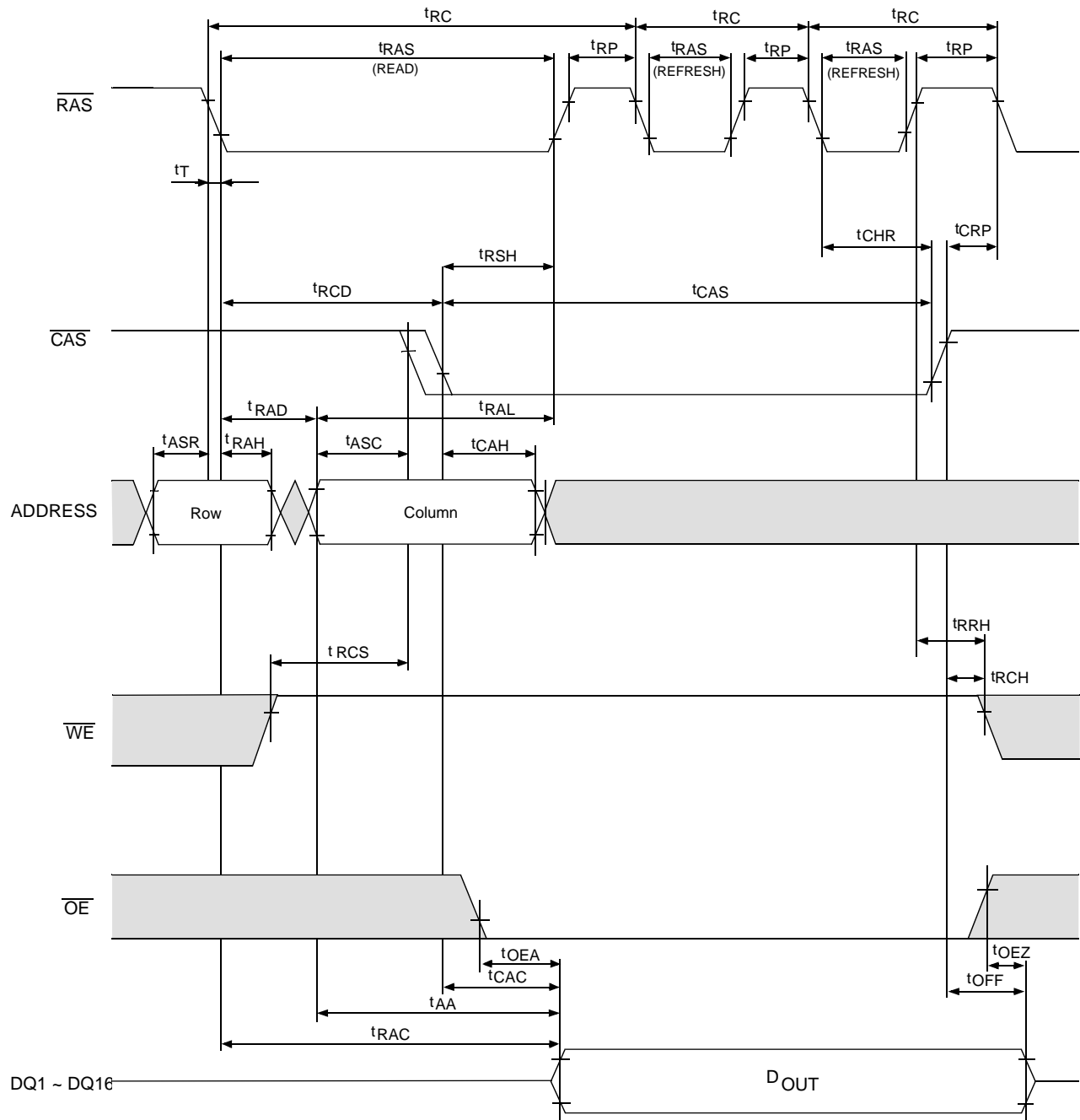
## CAS - Before - RAS Refresh Cycle



**CBR Self - Refresh Cycle ( S - Version Only )**



## • Hidden Refresh Cycle





## Ordering information

Part Number	Access time	Package
VG26(V)(S)18160CJ-5	50 ns	400mil 42-Pin
VG26(V)(S)18160J-6	60 ns	Plastic SOJ

## VG26(V)(S)18160CJ-5

- VG
- 26
- V
- S
- 18160
- C
- J
- 5
- VIS Memory Product
- Technology
- 3.3V Version
- Self refresh
- Device Type and Configuration
- Revision
- Package Type (J : SOJ, T : TSOP II)
- Speed (5 : 50 ns, 6 : 60 ns)