

## Description

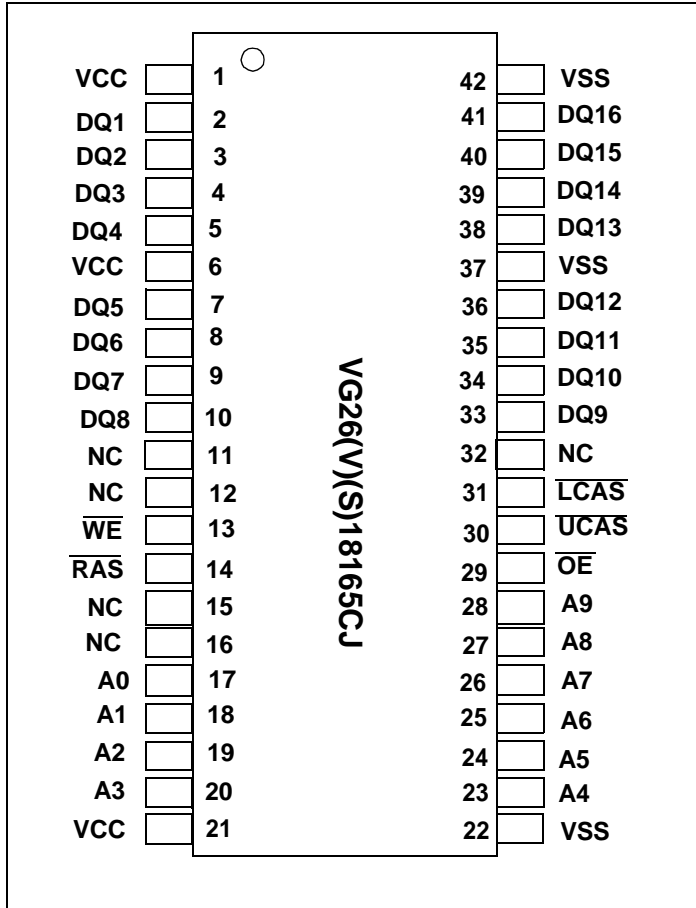
The device CMOS Dynamic RAM organized as 1,048,576 words x 16 bits with extended data out access mode. It is fabricated with an advanced submicron CMOS technology and designed to operate from a single 5V only or 3.3V only power supply. Low voltage operation is more suitable to be used on battery backup, 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( $\pm 10\%$ ) only power supply
- High speed  $t_{RAC}$  access time: 50/60ns
- Low power dissipation
  - Active mode : 5V version 660/605 mW (Mas)  
3.3V version 432/396 mW (Mas)
  - Standby mode: 5V version 1.375 mW (Mas)  
3.3V version 0.54 mW (Mas)
- Extended - data - out(EDO) page mode access
- I/O level: TTL compatible ( $V_{cc} = 5V$ )  
LVTTTL compatible ( $V_{cc} = 3.3V$ )
- 1024 refresh cycle in 16 ms(Std.) or 128 ms(S-version)
- 4 refresh modes:
  - $\overline{RAS}$  only refresh
  - $\overline{CAS}$  - before -  $\overline{RAS}$  refresh
  - Hidden refresh
  - Self-refresh(S-version)

**Pin Configuration**

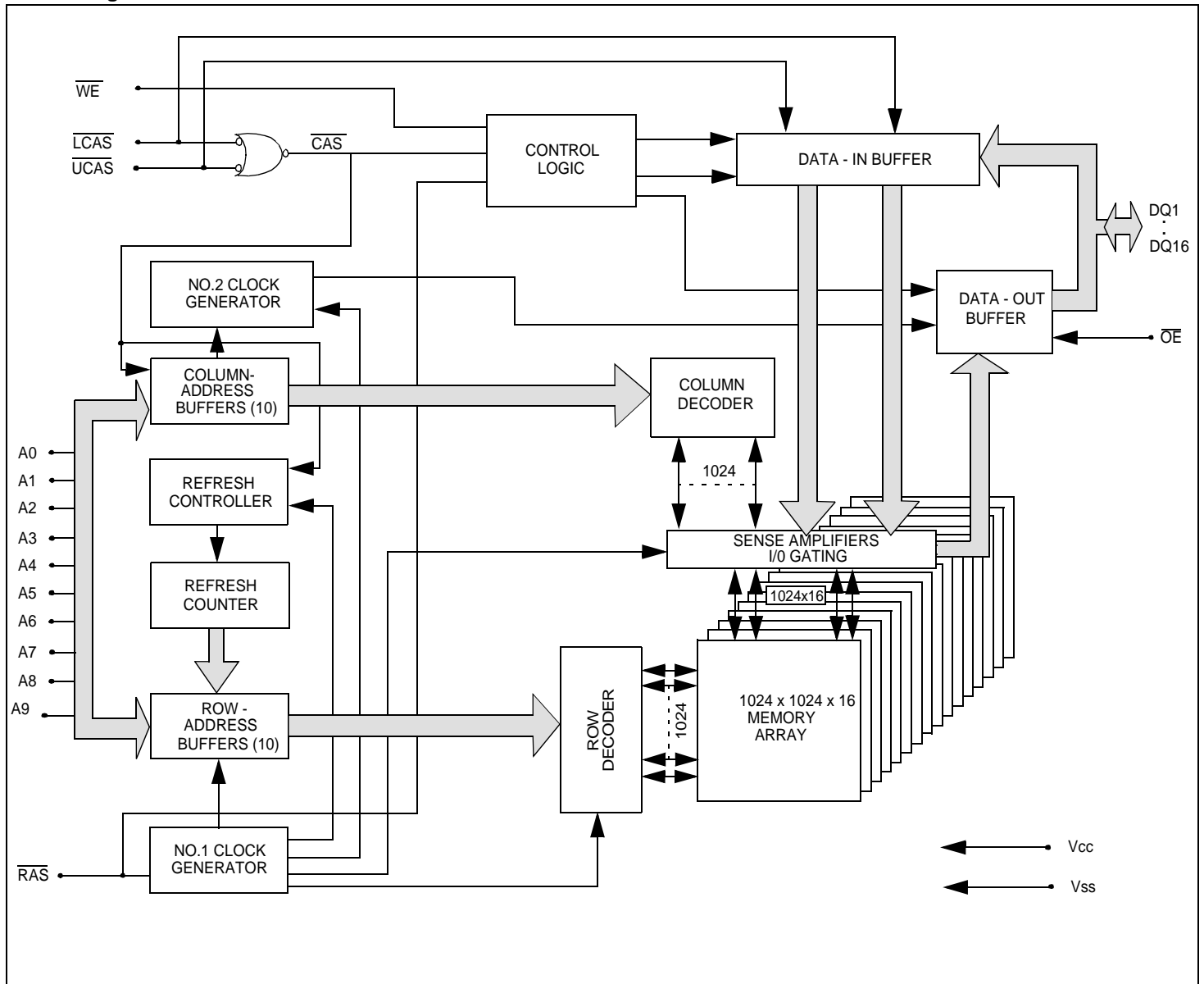
42-Pin 400mil Plastic SOJ



**Pin Description**

Pin Name	Function
A0-A9	Address inputs - Row address           A0-A9 - Column address       A0-A9 - Refresh address       A0-A9
DQ1~DQ16	Data-in / data-out
RAS	Row address strobe
UCAS, LCAS	Column address strobe
WE	Write enable
OE	Output enable
Vcc	Power (+5 V or + 3.3V)
Vss	Ground

**Block Diagram**



**TRUTH TABLE**

FUNCTION		$\overline{\text{RAS}}$	$\overline{\text{LCAS}}$	$\overline{\text{UCAS}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	ADDRESSES		DQ <sub>S</sub>	Notes
							ROW	COL		
STANDBY		H	H → X	H → X	X	X	X	X	High-Z	
READ : WORD		L	L	L	H	L	ROW	COL	Data-Out	
READ : LOWER BYTE		L	L	H	H	L	ROW	COL	Lower Byte: Data-Out Upper Byte: High-Z	
READ: UPPER BYTE		L	H	L	H	L	ROW	COL	Lower Byte: High-Z Upper Byte: Data-Out	
WRITE: WORD (EARLY WRITE)		L	L	L	L	X	ROW	COL	Data-In	
WRITE: LOWER BYTE (EARLY)		L	L	H	L	X	ROW	COL	Lower Byte: Data-In Upper Byte: High-Z	
WRITE : UPPER BYTE (EARLY)		L	H	L	L	X	ROW	COL	Lower Byte: High-Z Upper Byte: Data-In	
READ WRITE		L	L	L	H → L	L → H	ROW	COL	Data-Out, Data-In	1,2
PAGE-MODE READ	1st Cycle	L	H → L	H → L	H	L	ROW	COL	Data-Out	2
	2nd Cycle	L	H → L	H → L	H	L	n/a	COL	Data-Out	2
PAGE-MODE WRITE	1st Cycle	L	H → L	H → L	L	X	ROW	COL	Data-In	1
	2nd Cycle	L	H → L	H → L	L	X	n/a	COL	Data-In	1
PAGE-MODE READ- WRITE	1st Cycle	L	H → L	H → L	H → L	L → H	ROW	COL	Data-Out, Data-In	1,2
	2nd Cycle	L	H → L	H → L	H → L	L → H	n/a	COL	Data-Out, Data-In	1,2
HIDDEN REFRESH	READ	L → H → L	L	L	H	L	ROW	COL	Data-Out	2
	WRITE	L → H → L	L	L	L	X	ROW	COL	Data-In	1,3
$\overline{\text{RAS}}$ -ONLY REFRESH		L	H	H	X	X	ROW	n/a	High-Z	
CBR REFRESH		H → L	L	L	H	X	X	X	High-Z	4

- Notes: 1. These WRITE cycles may also be BYTE WRITE cycles (either  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active).
2. These READ cycles may also be BYTE READ cycles (either  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  active).
3. EARLY WRITE only.
4. At least one of the two  $\overline{\text{CAS}}$  signals must be active ( $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$ ).

**Absolute Maximum Ratings**

Parameter	Symbol	Value	Unit
Voltage on any pin relative to V <sub>SS</sub>	V <sub>T</sub>	5V -1.0 to + 7.0	V
		3.3V -0.5 to + 4.6	
Supply voltage relative to V <sub>SS</sub>	V <sub>CC</sub>	5V -1.0 to + 7.0	V
		3.3V -0.5 to + 4.6	
Short circuit output current	I <sub>OUT</sub>	50	mA
Power dissipation	P <sub>D</sub>	1.0	W
Operating temperature	T <sub>OPT</sub>	0 to + 70	°C
Storage temperature	T <sub>STG</sub>	-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 <sub>CC</sub>	4.5	5.0	5.5	3.0	3.3	3.6	V
Input High Voltage, all inputs	V <sub>IH</sub>	2.4	-	V <sub>CC</sub> + 1.0	2.0	-	V <sub>CC</sub> + 0.3	V
Input Low Voltage, all inputs	V <sub>IL</sub>	-1.0	-	0.8	-0.3	-	0.8	V

**Capacitance**

T<sub>a</sub> = 25°C, V<sub>CC</sub> = 5V ±10 % or 3.3V ±10 %, f = 1MHz

Parameter	Symbol	Typ	Max	Unit	Note
Input capacitance (Address)	C <sub>I1</sub>	-	5	pF	1
Input capacitance (RAS, LCAS, UCAS, OE, WE)	C <sub>I2</sub>	-	7	pF	1
Output capacitance (Data-in, Data-out)	C <sub>I/O</sub>	-	7	pF	1, 2

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

2. RAS, LCAS and UCAS = V<sub>IH</sub> to disable Dout.

**DC Characteristics; 5- Volt Verion**
 $(T_a = 0 \text{ to } +70 \text{ }^\circ\text{C}, V_{CC} = +5V \pm 10\%, V_{SS} = 0V)$ 

Parameter		Symbol	Test Conditions	VG26(V)(S)18165C				Unit	Notes
				-5		-6			
				Min	Max	Min	Max		
Operating current		$I_{CC1}$	$\overline{\text{RAS}}$ cycling $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ cycling $t_{RC} = \text{min}$	-	120	-	110	mA	1, 2
Standby Current	Low power S-version	$I_{CC2}$	TTL interface $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ Dout = High-Z	-	2	-	2	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{CC} - 0.2V$ Dout = High-Z	-	0.25	-	0.25	mA	
	Standard power version		TTL interface $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ Dout = High-Z		2	-	2	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{CC} - 0.2V$ Dout = High-Z		1	-	1	mA	
RAS-only refresh current		$I_{CC3}$	$\overline{\text{RAS}}$ cycling, $\overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ $t_{RC} = \text{min}$	-	120	-	110	mA	1, 2
EDO page mode current		$I_{CC4}$	$t_{RC} = \text{min}$	-	90	-	80	mA	1, 3
$\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh current		$I_{CC5}$	$t_{RC} = \text{min}$ $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}}$ cycling	-	120	-	110	mA	1, 2
Self-refresh current (S - Version)		$I_{CC8}$	$t_{RAS} \geq 100\mu\text{s}$	-	350	-	350	$\mu\text{A}$	
$\overline{\text{CAS}}$ - before- $\overline{\text{RAS}}$ long refresh current (S-Version)		$I_{CC9}$	Standby: $V_{CC} - 0.2V \leq \overline{\text{RAS}}$ CAS before RAS refresh: 2048 cycles / 128ms $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}}$ : $0V \leq V_{IL} \leq 0.2V$ $V_{CC} - 0.2V \leq V_{IH} \leq V_{IH} (\text{Max})$ Dout = High-Z, $t_{RAS} \leq 300\text{ns}$	-	500	-	500	$\mu\text{A}$	

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

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

Parameter	Symbol	Test Conditions	VG26(V)(S)18165C				Unit	Notes
			-5		-6			
			Min	Max	Min	Max		
Input leakage current	$I_{LI}$	$0\text{V} \leq V_{IN} \leq V_{CC} + 0.5\text{V}$	-5	5	-5	5	$\mu\text{A}$	
Output leakage current	$I_{LO}$	$0\text{V} \leq V_{OUT} \leq V_{CC} + 0.5\text{V}$ Dout = Disable	-5	5	-5	5	$\mu\text{A}$	
Output high Voltage	$V_{OH}$	$I_{OH} = -5\text{mA}$	2.4	-	2.4	-	V	
Output low voltage	$V_{OL}$	$I_{OL} = +4.2\text{mA}$	-	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 EDO page mode cycle time.

**DC Characteristics ; 3.3 - Volt Version**
 $(T_a = 0 \text{ to } 70^\circ\text{C}, V_{CC} = + 3.3\text{V} \pm 10\%, V_{SS} = 0\text{V})$ 

Parameter		Symbol	Test Conditions	VG26(V)(S)18165C				Unit	Notes
				-5		-6			
				Min	Max	Min	Max		
Operating current		$I_{CC1}$	$\overline{\text{RAS}}$ cycling $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ cycling $t_{RC} = \text{min}$	-	120	-	110	mA	1, 2
Standby Current	Low power S-version	$I_{CC2}$	LVTTL interface $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ Dout = High-Z	-	0.5	-	0.5	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{CC} - 0.2\text{V}$ Dout = High-Z	-	0.15	-	0.15	mA	
	Standard power version	$I_{CC2}$	LVTTL interface $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ Dout = High-Z	-	2	-	2	mA	
			CMOS interface $\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{CC} - 0.2\text{V}$ Dout = High-Z	-	0.5	-	0.5	mA	
RAS- only refresh current		$I_{CC3}$	$\overline{\text{RAS}}$ cycling $\overline{\text{LCAS}} / \overline{\text{UCAS}} = V_{IH}$ $t_{RC} = \text{min}$	-	120	-	110	mA	1, 2
EDO page mode current		$I_{CC4}$	$t_{PC} = \text{min}$	-	90	-	80	mA	1, 3
CAS- before- RAS refresh current		$I_{CC5}$	$t_{RC} = \text{min}$ $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}}$ cycling	-	120	-	110	mA	1, 2
Self- refresh current (S-Version)		$I_{CC8}$	$t_{RASS} \geq 100\mu\text{s}$	-	250	-	250	$\mu\text{A}$	
CAS- before- RAS long refresh current (S-Version)		$I_{CC9}$	Standby: $V_{CC} - 0.2\text{V} \leq \overline{\text{RAS}}$ CAS before $\overline{\text{RAS}}$ refresh: 2048 cycles / 128ms $\overline{\text{RAS}}, \overline{\text{LCAS}} / \overline{\text{UCAS}}$ : $0\text{V} \leq V_{IL} \leq 0.2\text{V}$ $V_{CC} - 0.2\text{V} \leq V_{IH} \leq V_{IH}(\text{max})$ Dout = High-Z, $t_{RAS} \leq 300\text{ns}$	-	300	-	300	$\mu\text{A}$	



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

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

Parameter	Symbol	Test Conditions	VG26(V)(S)18165C				Unit	Notes
			-5		-6			
			Min	Max	Min	Max		
Input leakage current	$I_{LI}$	$0\text{V} \leq V_{in} \leq V_{CC} + 0.3\text{V}$	-5	5	-5	5	$\mu\text{A}$	
Output leakage current	$I_{LO}$	$0\text{V} \leq V_{out} \leq V_{CC} + 0.3\text{V}$ Dout = Disable	-5	5	-5	5	$\mu\text{A}$	
Output high Voltage	$V_{OH}$	$I_{OH} = -2\text{mA}$	2.4	-	2.4	-	V	
Output low voltage	$V_{OL}$	$I_{OL} = +2\text{mA}$	-	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 EDO page mode cycle time.

**AC Characteristics**
 $(T_a = 0 \text{ to } +70^\circ\text{C}, V_{CC} = 5V \pm 10\% \text{ or } 3.3V \pm 10\%, V_{SS} = 0V) *1, *2, *3, *4, *5$ 

Test conditions

- Output load: two TTL Loads and 50pF ( $V_{CC} = 5.0V \pm 10\%$ )  
     one TTL Load and 50pF ( $V_{CC} = 3.3V \pm 10\%$ )
- Input timing reference levels:  
 $V_{IH} = 2.4V, V_{IL} = 0.8V$  ( $V_{CC} = 5.0V \pm 10\%$ );  $V_{IH} = 2.0V, V_{IL} = 0.8V$  ( $V_{CC} = 3.3V \pm 10\%$ )
- Output timing reference levels:  
 $V_{OH} = 2.0V, V_{OL} = 0.8V$  ( $V_{CC} = 5V \pm 10\%, 3.3V \pm 10\%$ )

**Read, Write, Read- Modify- Write and Refresh Cycles**
**(Common Parameters)**

Parameter	Symbol	VG26(V)(S) 18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Random read or write cycle time	$t_{RC}$	84	-	104	-	ns	
$\overline{RAS}$ precharge time	$t_{RP}$	30	-	40	-	ns	
$\overline{LCAS}$ / $\overline{UCAS}$ precharge time in normal mode	$t_{CPN}$	10	-	10	-	ns	
$\overline{RAS}$ pulse width	$t_{RAS}$	50	10000	60	10000	ns	6
$\overline{LCAS}$ / $\overline{UCAS}$ pulse width	$t_{CAS}$	8	10000	10	10000	ns	7
Row address setup time	$t_{ASR}$	0	-	0	-	ns	
Row address hold time	$t_{RAH}$	8	-	10	-	ns	
Column address setup time	$t_{ASC}$	0	-	0	-	ns	8
Column address hold time	$t_{CAH}$	8	-	10	-	ns	
$\overline{RAS}$ to $\overline{LCAS}$ / $\overline{UCAS}$ delay time	$t_{RCD}$	12	37	14	45	ns	9
$\overline{RAS}$ to column address delay time	$t_{RAD}$	10	25	12	30	ns	10
Column address to $\overline{RAS}$ lead time	$t_{RAL}$	25	-	30	-	ns	
$\overline{RAS}$ hold time	$t_{RSH}$	8	-	10	-	ns	
$\overline{LCAS}$ / $\overline{UCAS}$ hold time	$t_{CSH}$	38	-	40	-	ns	
$\overline{LCAS}$ / $\overline{UCAS}$ to $\overline{RAS}$ precharge time	$t_{CRP}$	5	-	5	-	ns	11
$\overline{OE}$ to Din delay time	$t_{OED}$	12	-	15	-	ns	
Transition time (rise and fall)	$t_T$	1	50	1	50	ns	12
Refresh period	$t_{REF}$	-	16	-	16	ms	
Refresh period (S- Version)	$t_{REF}$	-	128	-	128	ms	
$\overline{LCAS}$ / $\overline{UCAS}$ to output in Low- Z	$t_{CLZ}$	0	-	0	-	ns	
$\overline{LCAS}$ / $\overline{UCAS}$ delay time from Din	$t_{DZC}$	0	-	0	-	ns	
$\overline{OE}$ delay time from Din	$t_{DZO}$	0	-	0	-	ns	

**Read Cycle**

Parameter	Symbol	VG26(V)(S)18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Access time from $\overline{\text{RAS}}$	$t_{\text{RAC}}$	-	50	-	60	ns	13
Access time from $\overline{\text{LCAS}} / \overline{\text{UCAS}}$	$t_{\text{CAC}}$	-	13	-	15	ns	14, 15
Access time from column address	$t_{\text{AA}}$	-	25	-	30	ns	15, 16
Access time from $\overline{\text{OE}}$	$t_{\text{OEA}}$	-	12	-	15	ns	
Read command setup time	$t_{\text{RCS}}$	0	-	0	-	ns	8
Read command hold time to $\overline{\text{LCAS}} / \overline{\text{UCAS}}$	$t_{\text{RCH}}$	0	-	0	-	ns	11, 17
Read command hold time to $\overline{\text{RAS}}$	$t_{\text{RRH}}$	10	-	10	-	ns	17
Output buffer turn-off time	$t_{\text{OFF}}$	0	12	0	15	ns	18
Output buffer turn-off time from $\overline{\text{OE}}$	$t_{\text{OEZ}}$	0	12	0	15	ns	18

**Write Cycle**

Parameter	Symbol	VG26(V)(S)18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Write command setup time	$t_{\text{WCS}}$	0	-	0	-	ns	8, 19
Write command hold time	$t_{\text{WCH}}$	8	-	10	-	ns	
Write command pulse width	$t_{\text{WP}}$	8	-	10	-	ns	
Write command to $\overline{\text{RAS}}$ lead time	$t_{\text{RWL}}$	13	-	15	-	ns	
Write command to $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ lead time	$t_{\text{CWL}}$	8	-	10	-	ns	20
Data-in setup time	$t_{\text{DS}}$	0	-	0	-	ns	21
Data-in hold time	$t_{\text{DH}}$	8	-	10	-	ns	21
$\overline{\text{WE}}$ to Data-in delay	$t_{\text{WED}}$	10	-	10	-	ns	

**Read- Modify- Write Cycle**

Parameter	Symbol	VG26(V)(S) 18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
Read-modify- write cycle time	$t_{\text{RWC}}$	108	-	133	-	ns	
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	$t_{\text{RWD}}$	64	-	77	-	ns	19
$\overline{\text{LCAS}} / \overline{\text{UCAS}}$ to $\overline{\text{WE}}$ delay time	$t_{\text{CWD}}$	26	-	32	-	ns	19
Column address to $\overline{\text{WE}}$ delay time	$t_{\text{AWD}}$	39	-	47	-	ns	19
$\overline{\text{OE}}$ hold time from $\overline{\text{WE}}$	$t_{\text{OEH}}$	8	-	10	-	ns	

**Refresh Cycle**

Parameter	Symbol	VG26(V)(S)18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
$\overline{\text{LCAS}} / \overline{\text{UCAS}}$ setup time (CBR refresh)	$t_{\text{CSR}}$	5	-	5	-	ns	
$\overline{\text{LCAS}} / \overline{\text{UCAS}}$ hold time (CBR refresh)	$t_{\text{CHR}}$	8	-	10	-	ns	11
$\overline{\text{RAS}}$ precharge to $\overline{\text{CAS}}$ hold time	$t_{\text{RPC}}$	5	-	5	-	ns	8
$\overline{\text{RAS}}$ 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	
$\overline{\text{LCAS}} / \overline{\text{UCAS}}$ 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	

**EDO Page Mode Cycle**

Parameter	Symbol	VG26(V)(S)18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
EDO page mode cycle time	$t_{\text{PC}}$	20	-	25	-	ns	
EDO page mode $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ precharge time	$t_{\text{CP}}$	10	-	10	-	ns	
EDO page mode $\overline{\text{RAS}}$ pulse width	$t_{\text{RASP}}$	50	$10^5$	60	$10^5$	ns	22
Access time from $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ precharge	$t_{\text{CPA}}$	-	30	-	35	ns	11, 15
$\overline{\text{RAS}}$ hold time from $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ precharge	$t_{\text{CPRH}}$	30	-	35	-	ns	
$\overline{\text{OE}}$ high hold time from $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ high	$t_{\text{OEHC}}$	5	-	5	-	ns	
$\overline{\text{OE}}$ high pulse width	$t_{\text{OEP}}$	10	-	10	-	ns	
Data output hold time after $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ low	$t_{\text{COH}}$	5	-	5	-	ns	
Output disable delay from $\overline{\text{WE}}$	$t_{\text{WHZ}}$	3	10	3	10	ns	
$\overline{\text{WE}}$ pulse width for output disable when $\overline{\text{LCAS}} / \overline{\text{UCAS}}$ high	$t_{\text{WPZ}}$	7	-	7	-	ns	

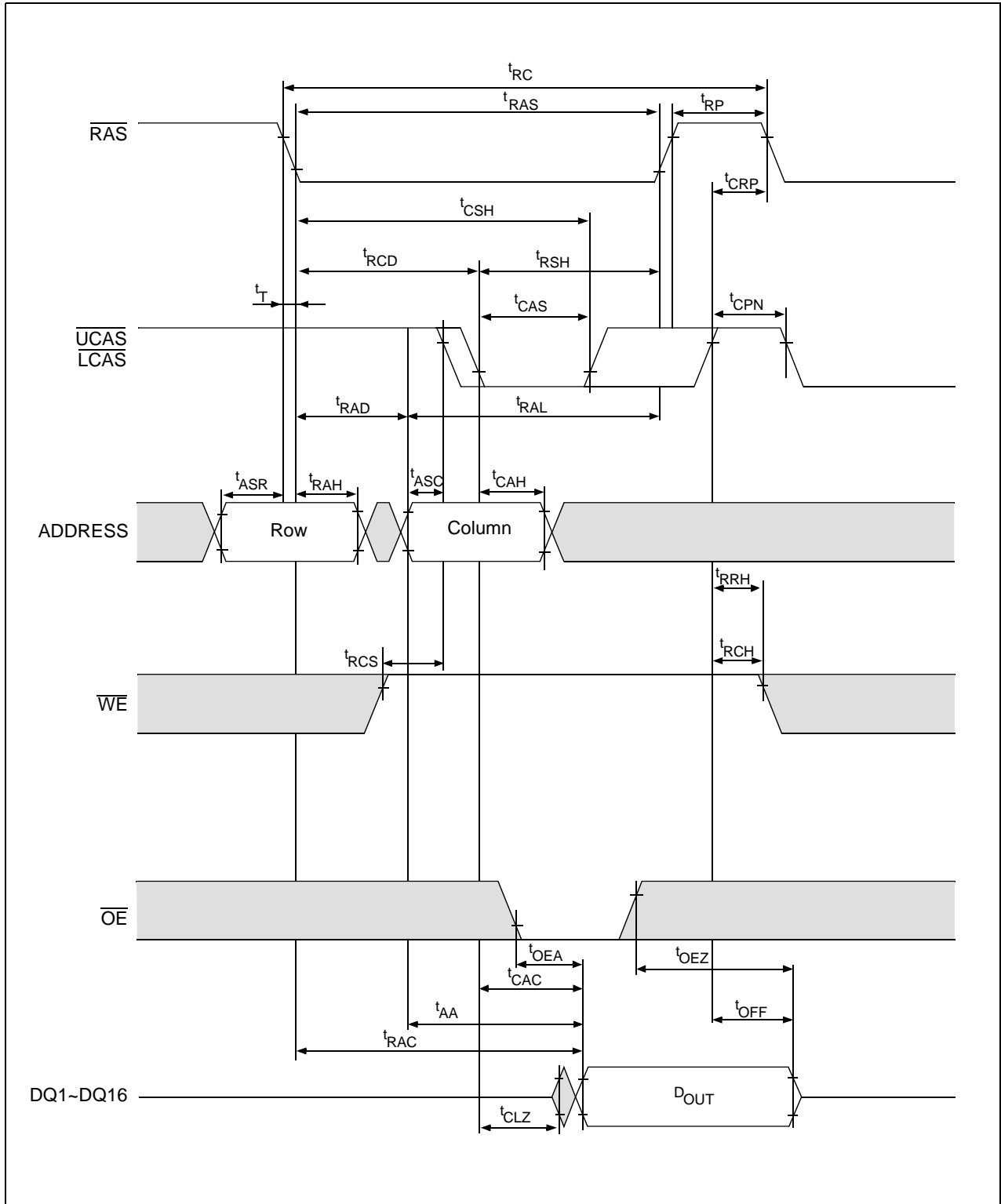
**EDO Page Mode Read Modify Write Cycle**

Parameter	Symbol	VG26(V)(S)18165C				Unit	Notes
		-5		-6			
		Min	Max	Min	Max		
EDO page mode read- modify- write cycle LCAS / UCAS precharge to WE delay time	$t_{CPW}$	45	-	55	-	ns	11
EDO page mode read- modify- write cycle time	$t_{PRWC}$	56	-	68	-	ns	

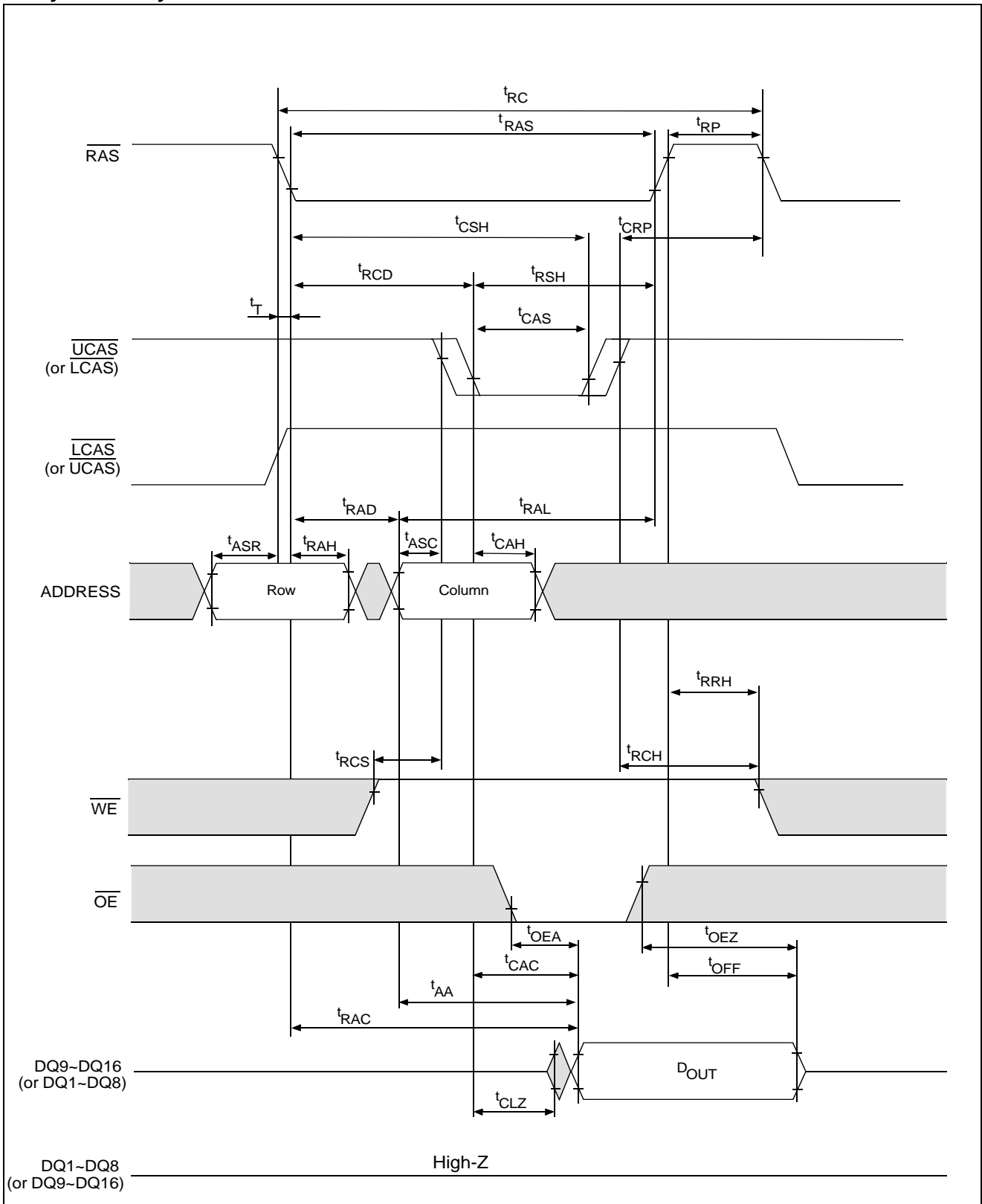
Notes :

1. AC measurements assume  $t_T = 2\text{ns}$ .
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 voltages.
5. When both  $\overline{\text{LCAS}}$  and  $\overline{\text{UCAS}}$  go low at the same time, all 16-bits data are written into the device.  $\overline{\text{LCAS}}$  and  $\overline{\text{UCAS}}$  cannot be staggered within the same write/read cycles.
6.  $t_{\text{RAS}}(\text{min}) = t_{\text{RWD}}(\text{min}) + t_{\text{RWL}}(\text{min}) + t_T$  in read-modify-write cycle.
7.  $t_{\text{CAS}}(\text{min}) = t_{\text{CWD}}(\text{min}) + t_{\text{CWL}}(\text{min}) + t_T$  in read-modify-write cycle.
8.  $t_{\text{ASC}}(\text{min})$ ,  $t_{\text{RCS}}(\text{min})$ ,  $t_{\text{WCS}}(\text{min})$ , and  $t_{\text{RPC}}$  are determined by the falling edge of  $\overline{\text{CAS}}$ .
9.  $t_{\text{RCD}}(\text{max})$  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.
10.  $t_{\text{RAD}}(\text{max})$  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.
11.  $t_{\text{CRP}}$ ,  $t_{\text{CHR}}$ ,  $t_{\text{RCH}}$ ,  $t_{\text{CPA}}$  and  $t_{\text{CPW}}$  are determined by the rising edge of  $\overline{\text{CAS}}$ .
12.  $V_{\text{IH}}(\text{min})$  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  $V_{\text{IL}}$ .
13. 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.
14. Assumes that  $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ .
15. Access time is determined by the maximum of  $t_{\text{AA}}$ ,  $t_{\text{CAC}}$ ,  $t_{\text{CPA}}$ .
16. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$ .
17. Either  $t_{\text{RCH}}$  or  $t_{\text{RRH}}$  must be satisfied for a read cycle.
18.  $t_{\text{OFF}}(\text{max})$  and  $t_{\text{OEZ}}(\text{max})$  define the time at which the output achieves the open circuit condition (high impedance).  $t_{\text{OFF}}$  is determined by the later rising edge of  $\overline{\text{RAS}}$  or  $\overline{\text{CAS}}$ .
19.  $t_{\text{WCS}}$ ,  $t_{\text{RWD}}$ ,  $t_{\text{CWD}}$ , 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 out 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.
20.  $t_{\text{CWL}}$  shall be satisfied by both  $\overline{\text{LCAS}}$  and  $\overline{\text{UCAS}}$ .
21. These parameters are referenced to  $\overline{\text{LCAS}}$  or  $\overline{\text{UCAS}}$  separately in an early write cycle and to  $\overline{\text{WE}}$  edge in a delayed write or a read-modify-write cycle.
22.  $t_{\text{RASP}}$  defines  $\overline{\text{RAS}}$  pulse width in EDO page mode cycles.

Timing Waveforms  
 • Word Read Cycle

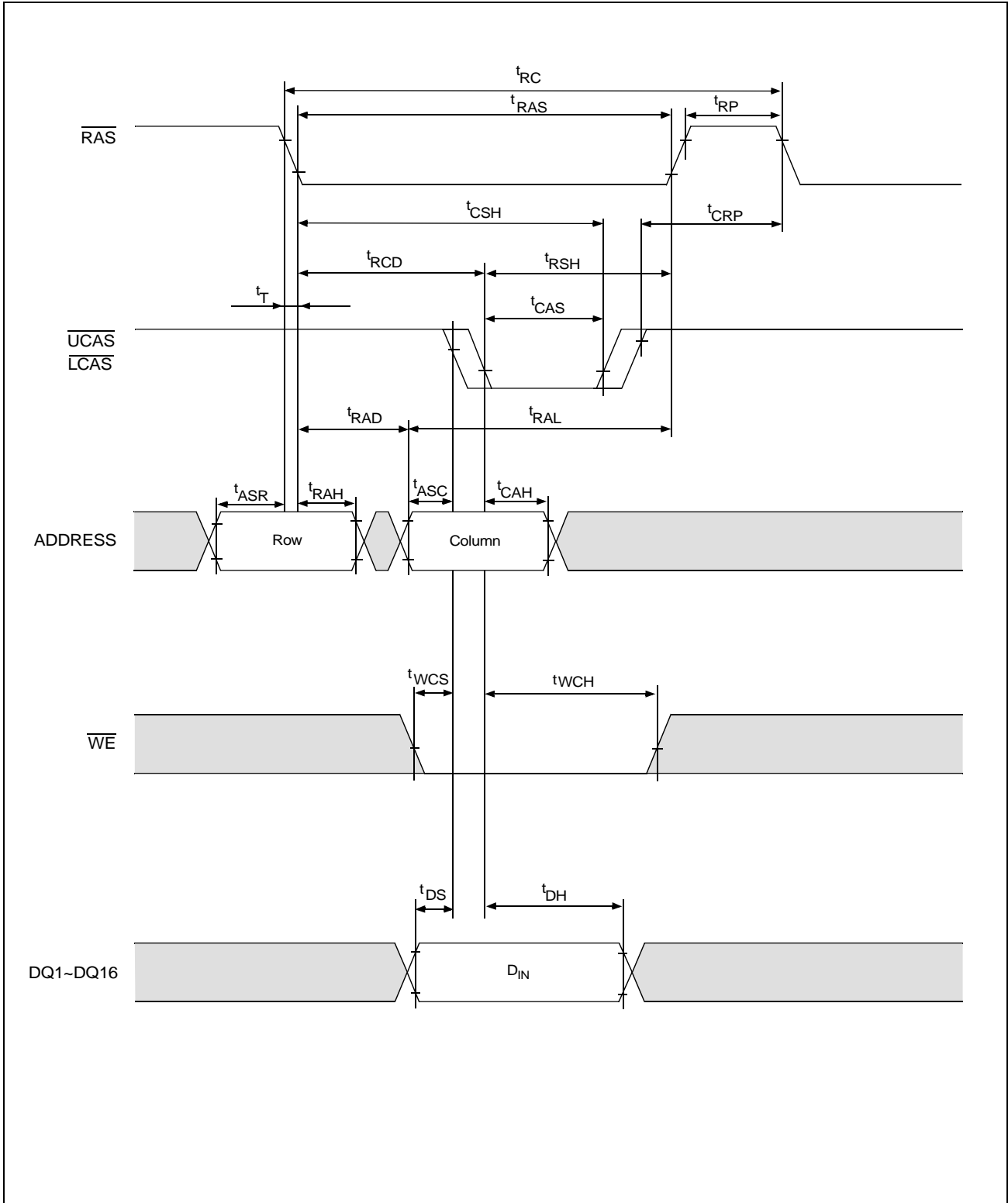


• Byte Read Cycle

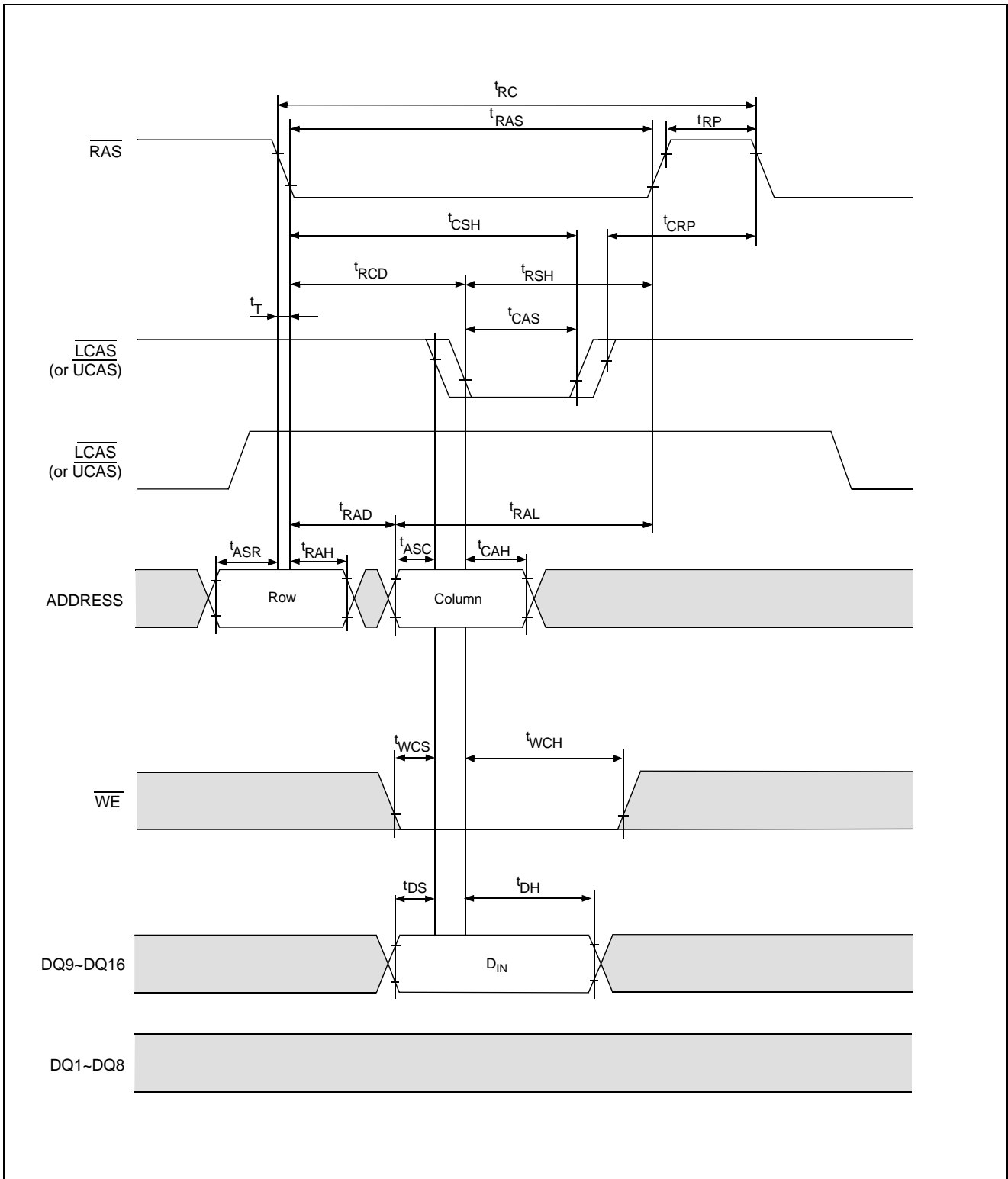




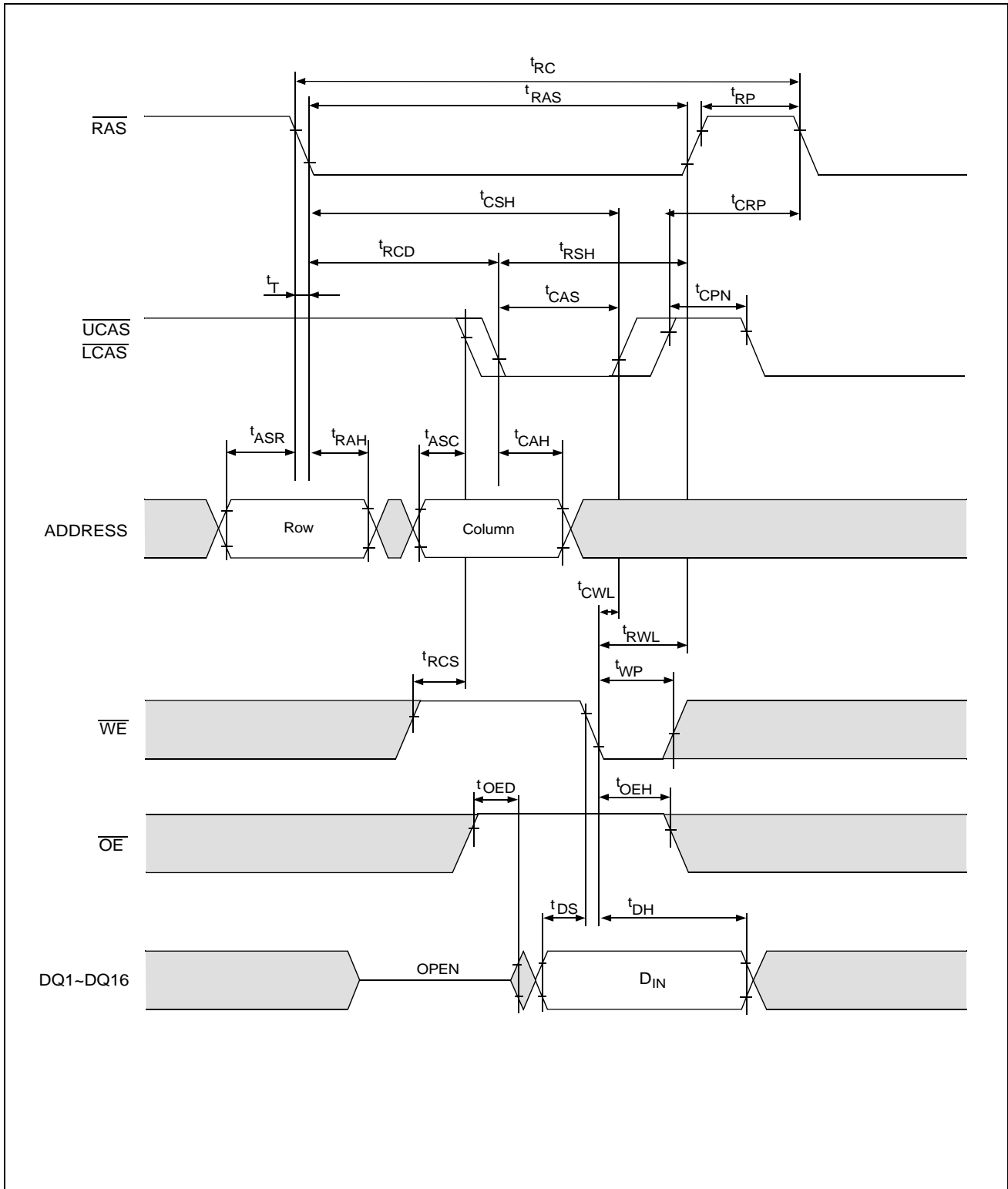
• Word Early Write Cycle



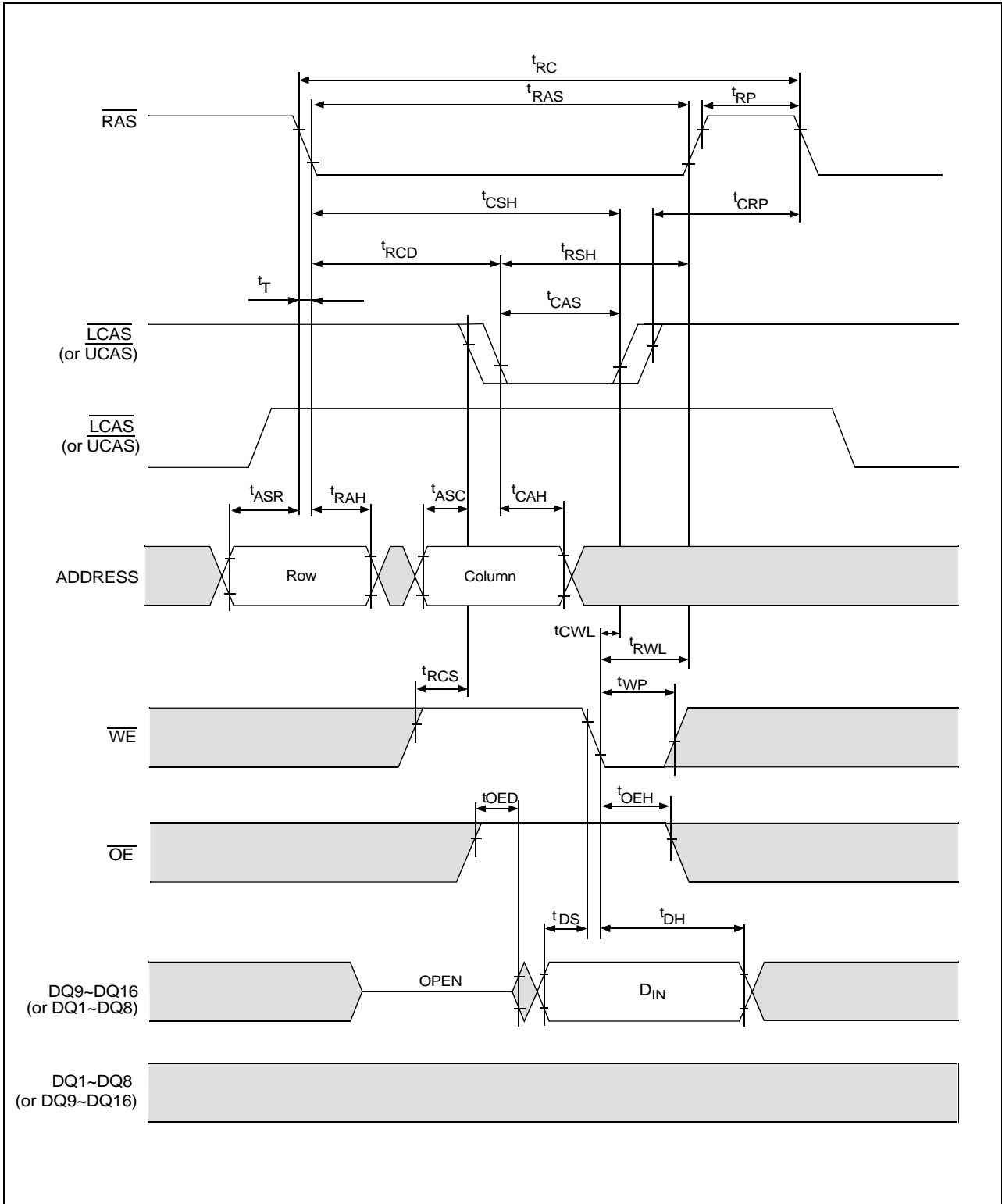
• Byte Early Write Cycle



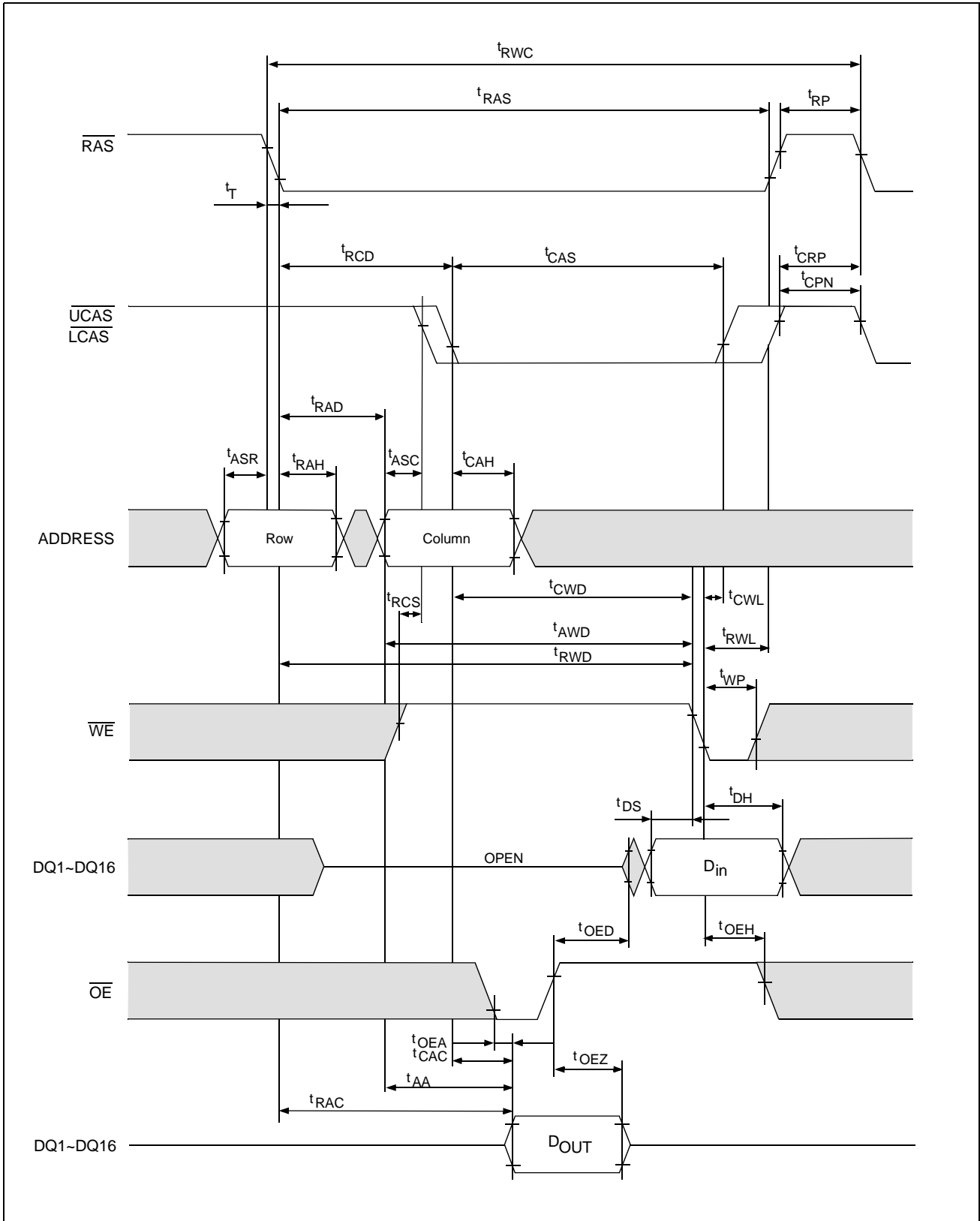
• Word Delayed Write Cycle



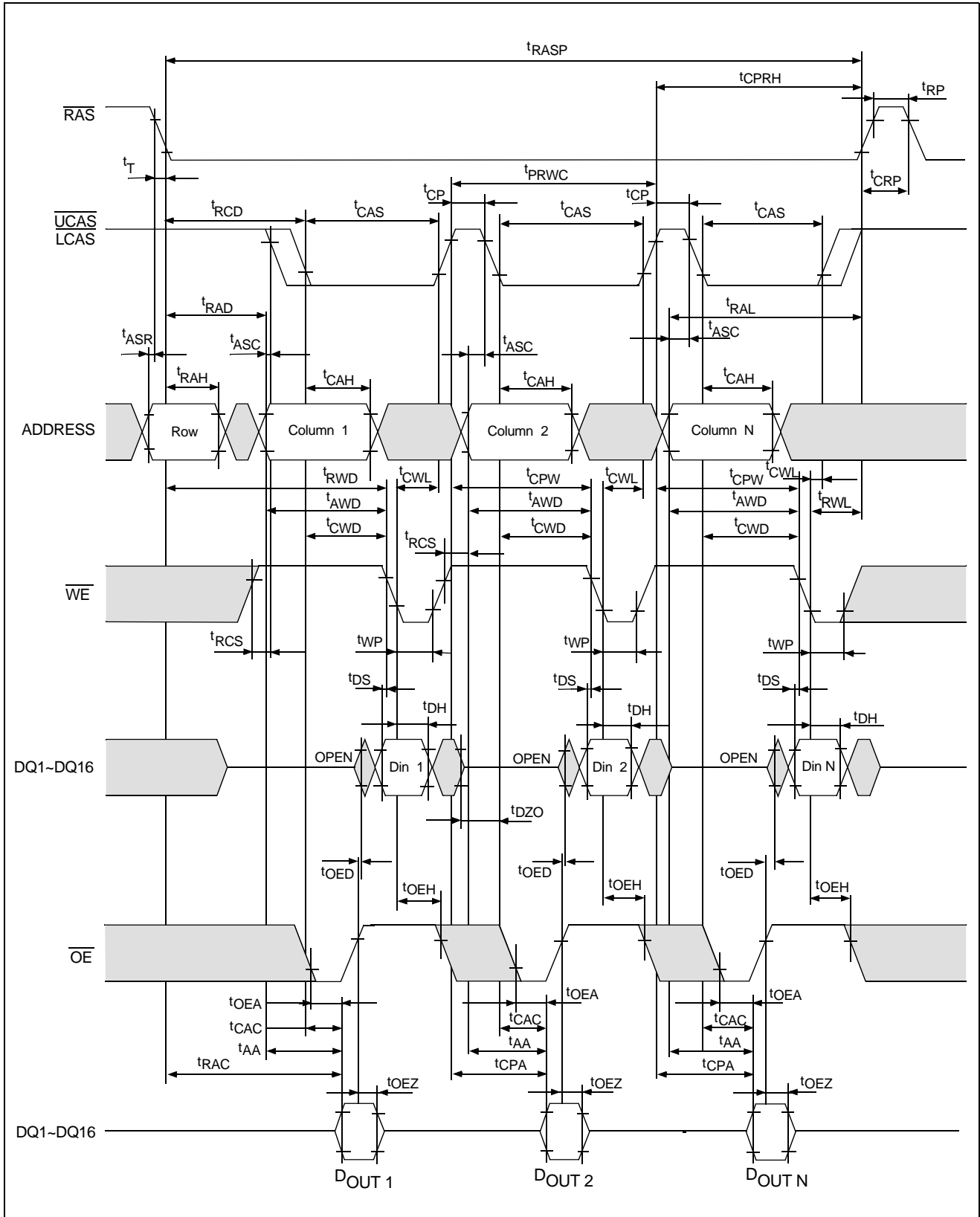
• Byte Delayed Write Cycle



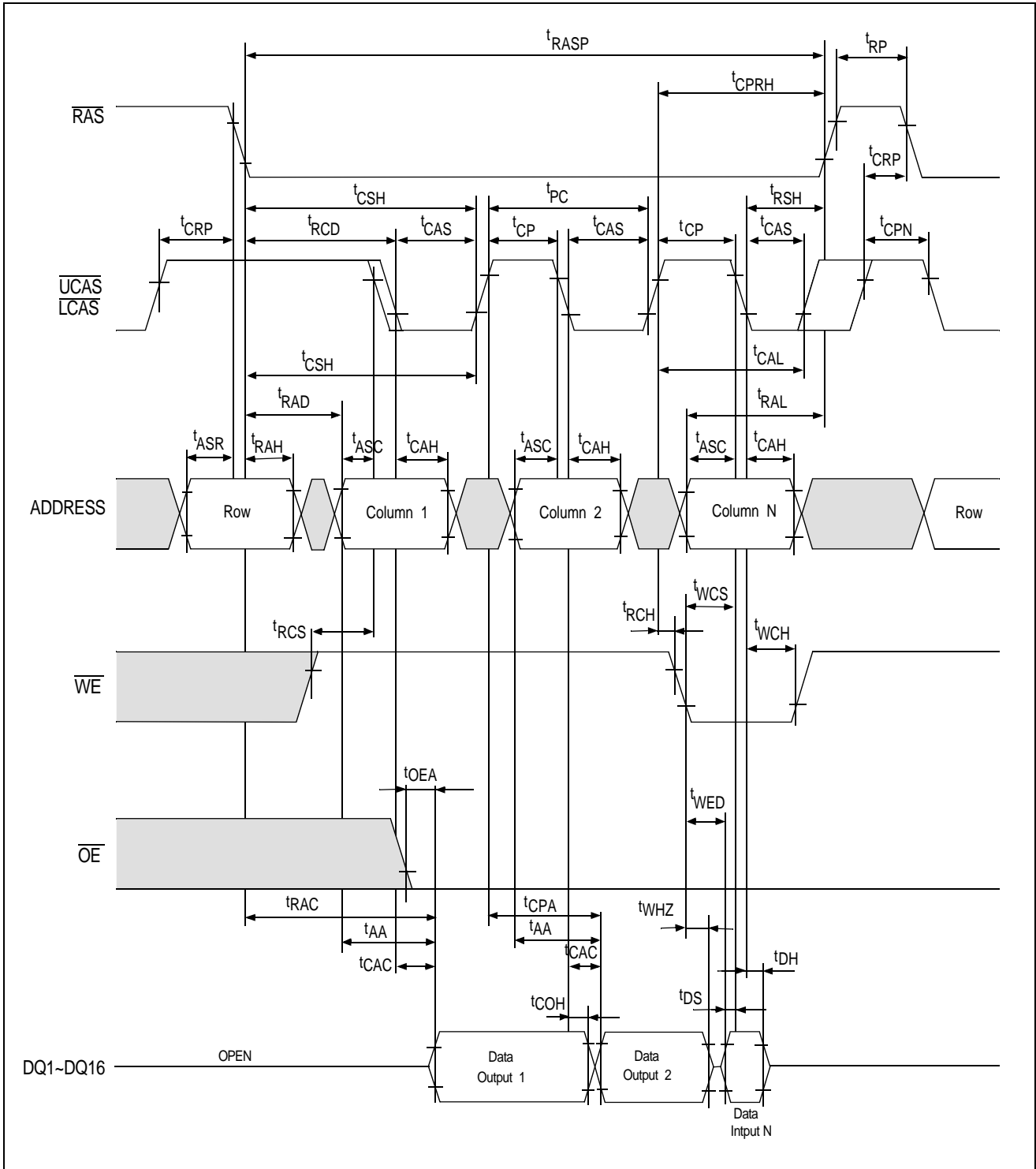
• Word Read-Modify-Write Cycle



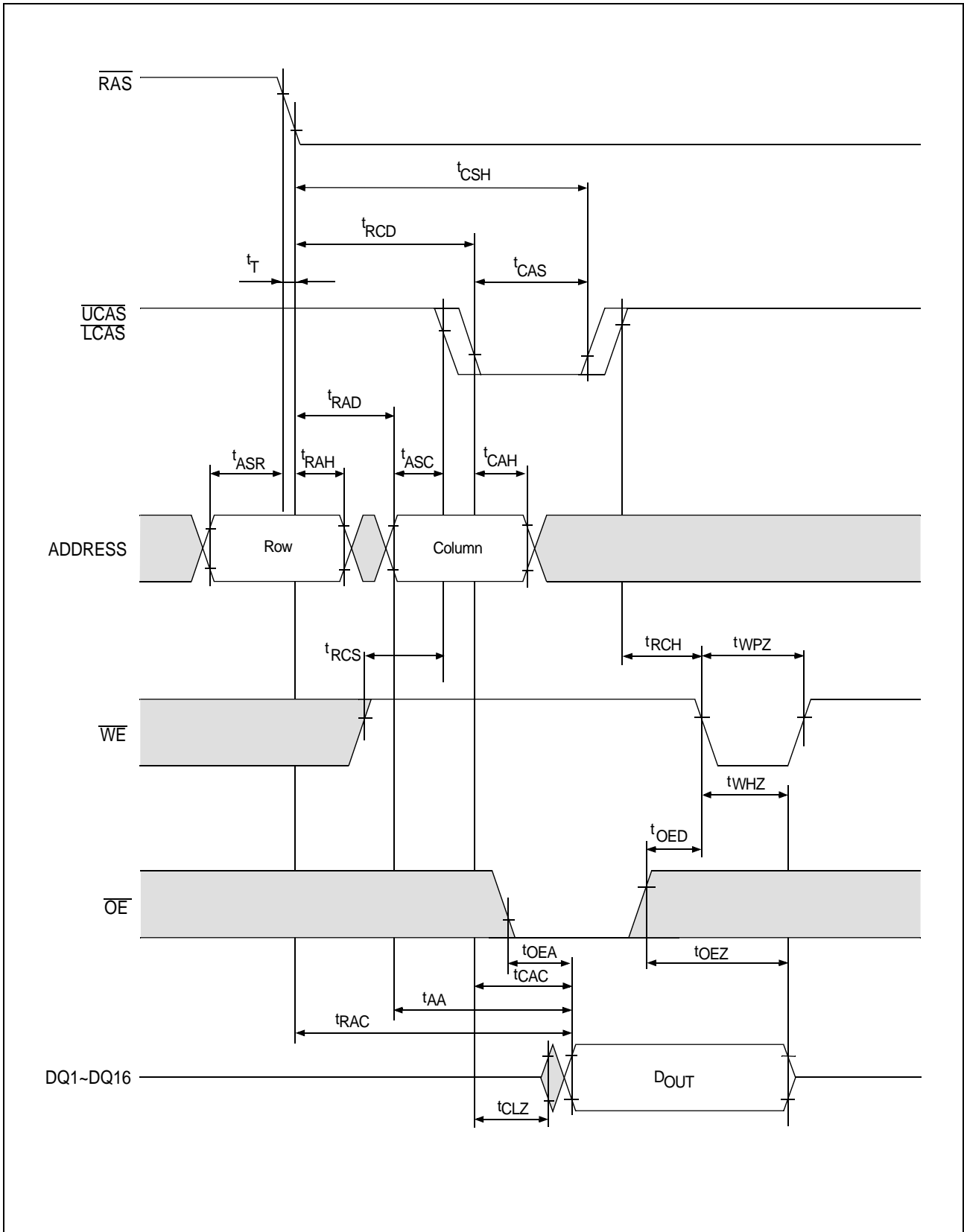
• EDO Page Mode Word Read-Modify-Write Cycle



• EDO Page Mode Word Read-Early-Write Cycle

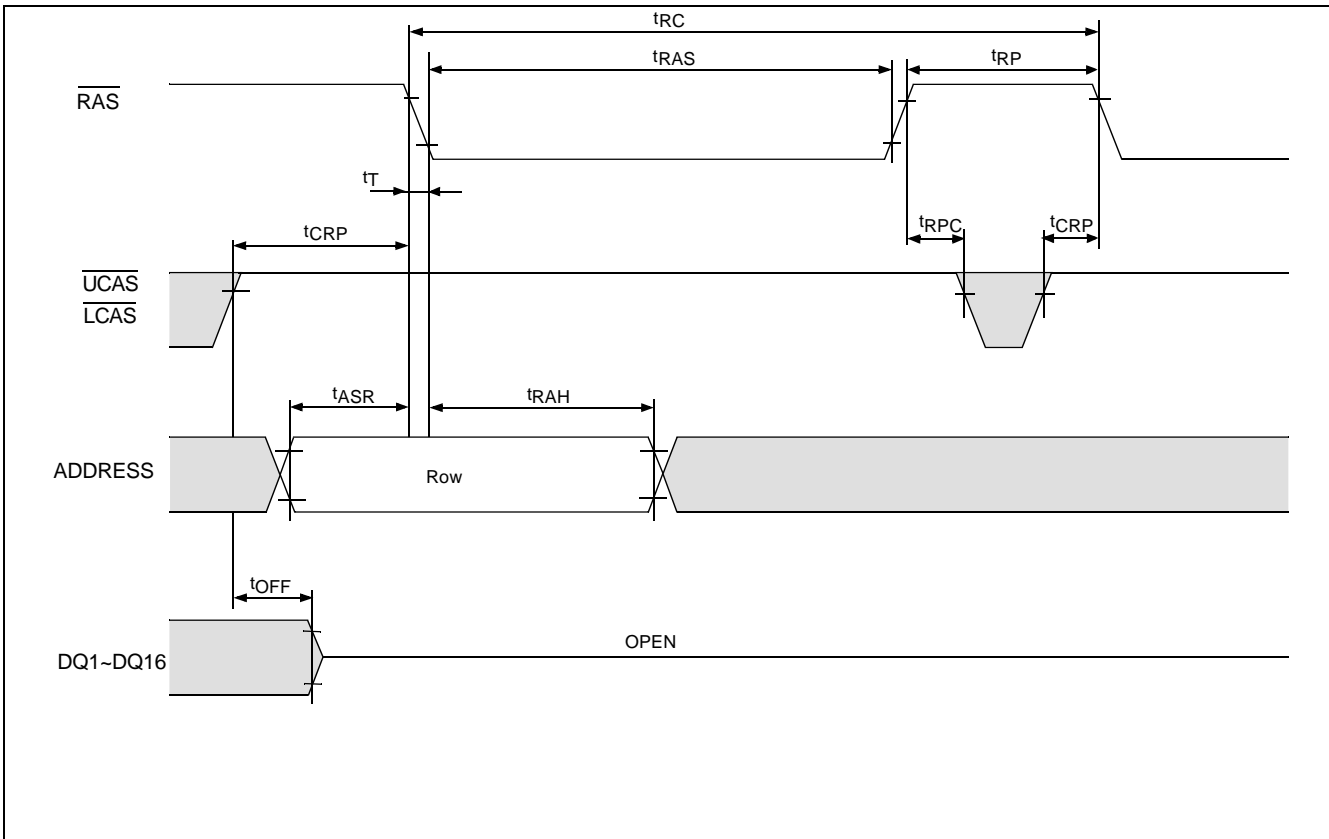


• Read Cycle with  $\overline{WE}$  Controlled Disable

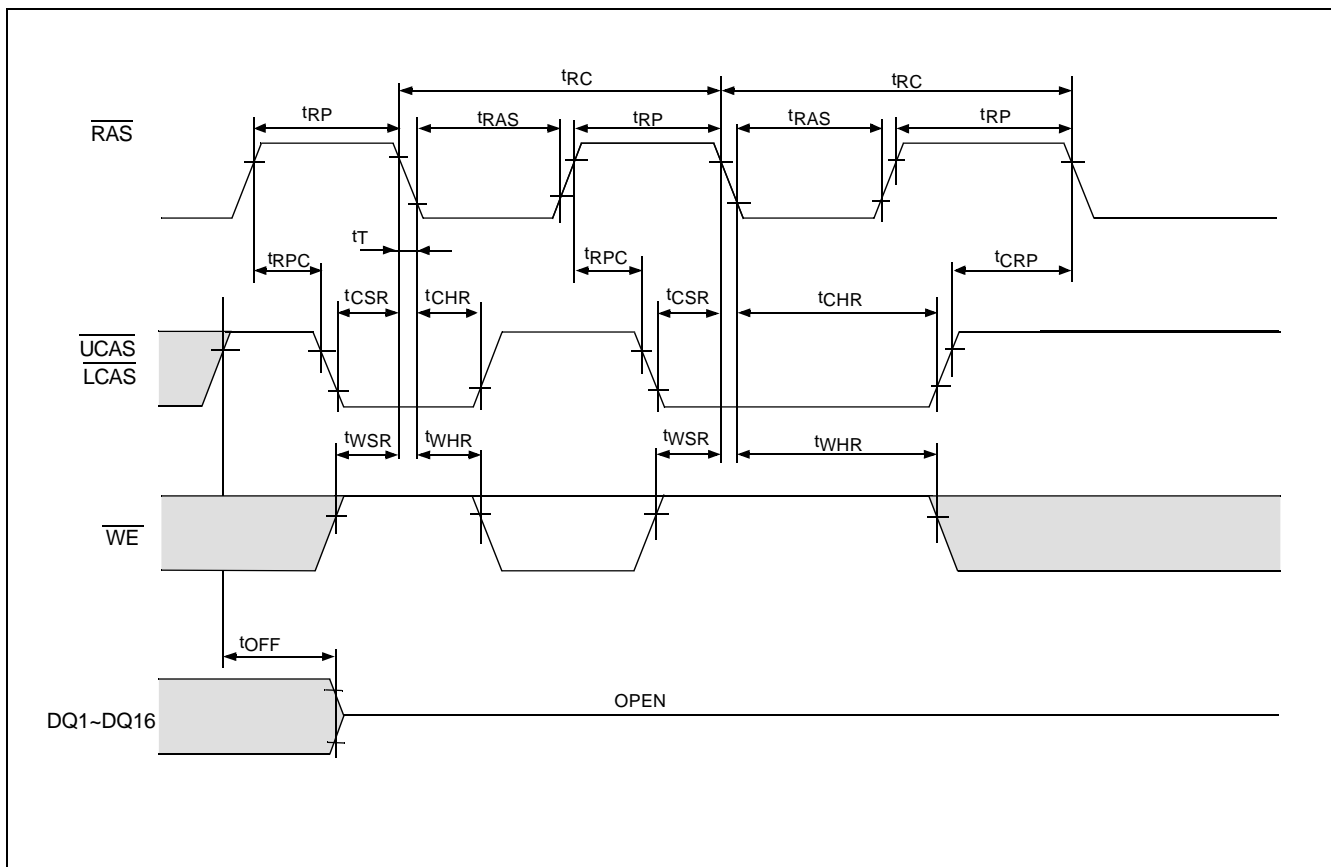




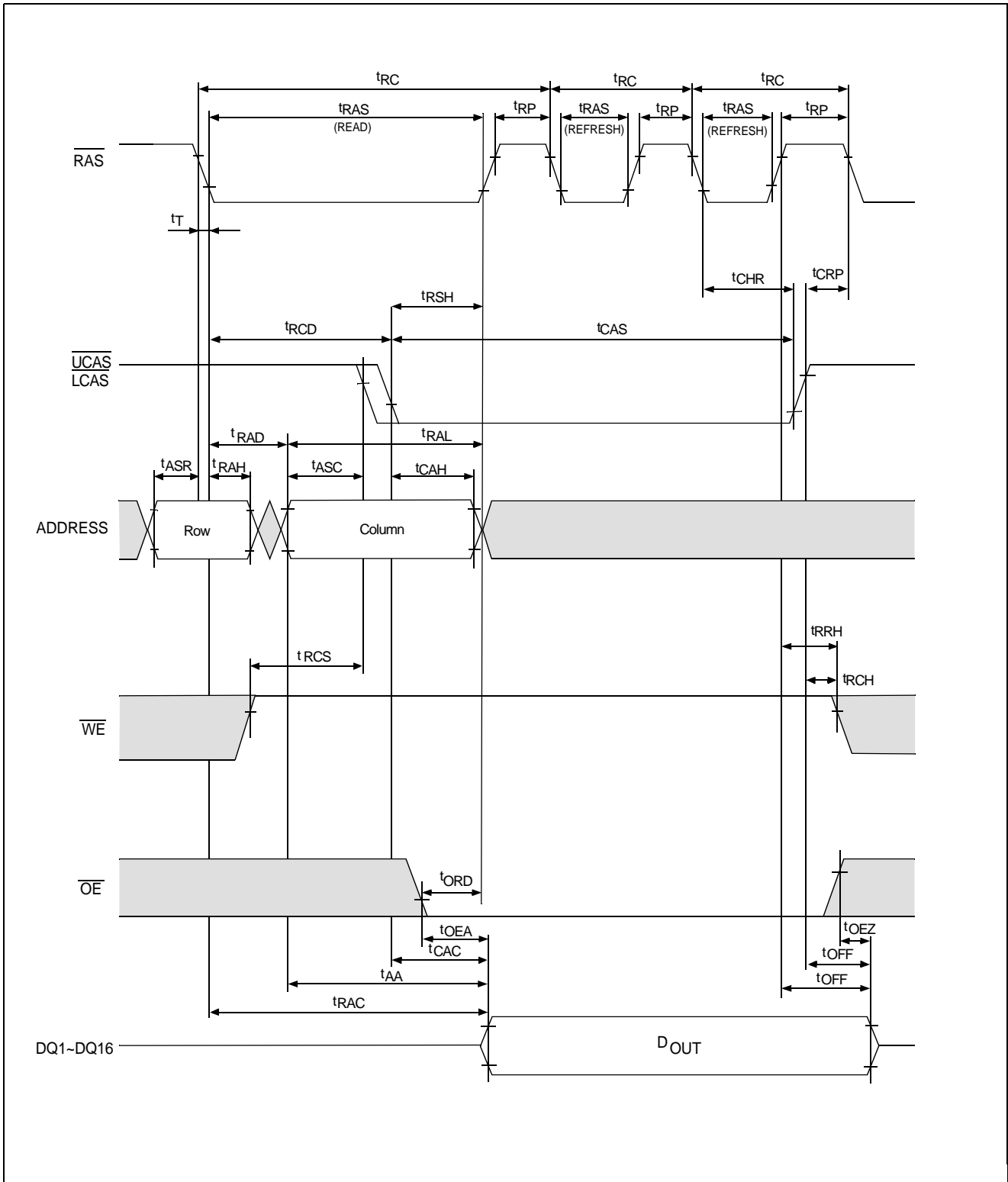
**RAS - Only Refresh Cycle**



**CAS-Before-RAS Refresh Cycle**



• Hidden Refresh Cycle



**Ordering information**

Part Number	Access time	Package
VG26(V)(S)18165CJ-5	50 ns	400mil 42-Pin
VG26(V)(S)18165CJ-6	60 ns	Plastic SOJ

**VG26(V)(S)18165CJ-5**

- VG → • VIS Memory Product
- 26 → • Technology
- V → • 3.3V Version
- S → • Self refresh
- 18165 → • Device Type and Configuration
- C → • Revision
- J → • Package Type (J : SOJ, T : TSOP II)
- 5 → • Speed (5 : 50 ns, 6 : 60 ns)