

Description

The μ PD41257 is a 262,144-word by 1-bit dynamic NMOS RAM designed to operate from a single +5-volt power supply. A double-polylayer N-channel silicon gate fabrication process provides for high storage cell density, high performance, and high reliability. The device also uses a single-transistor dynamic storage cell and advanced dynamic circuitry, including 1024 sense amplifiers, which ensure that power dissipation is minimized. The negative voltage substrate bias is automatically generated internally.

The three-state output is controlled by $\overline{\text{CAS}}$ independent of $\overline{\text{RAS}}$. Nibble mode read or write cycles are available by cycling $\overline{\text{CAS}}$.

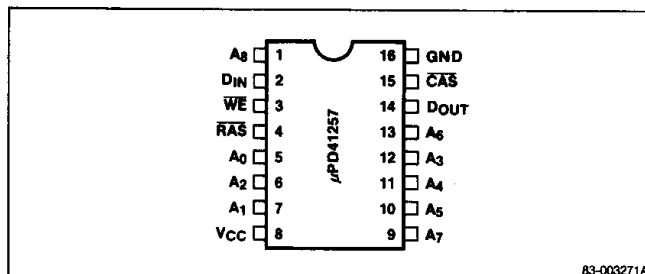
Refreshing is initiated by a $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ cycle that enables internal generation of the refresh address. Refreshing is also accomplished by means of $\overline{\text{RAS}}$ -only refresh cycles, hidden refresh cycles, or by normal read or write cycles on the 256 address combinations of A_0 - A_7 during a 4-ms period.

Features

- 262,144-word x 1-bit organization
- Multiplexed address inputs
- Single +5-volt $\pm 10\%$ power supply
- Nibble read, write, or read-modify-write cycles
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ internal refreshing
- Low power dissipation
 - 28 mW max (standby)
 - 413 mW max (active, $t_{RC} = 220$ ns)
- Nonlatched, three-state output
- TTL-compatible inputs with low input capacitance
- 256-cycle/4-ms refresh period (A_0 - A_7 are refresh addresses)
- High-density plastic DIP and PLCC packaging

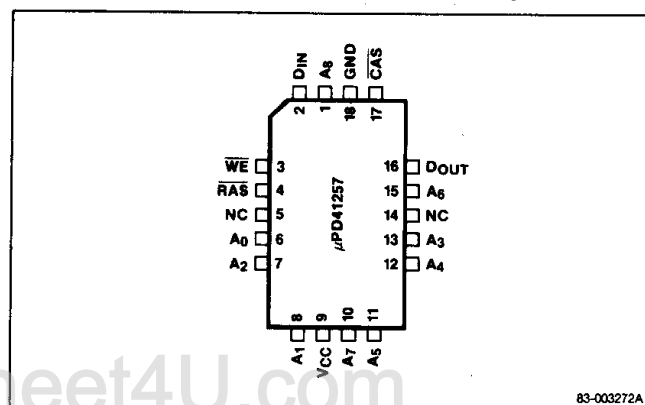
Pin Configurations

16-Pin Plastic DIP



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18-Pin Plastic Leaded Chip Carrier (PLCC)

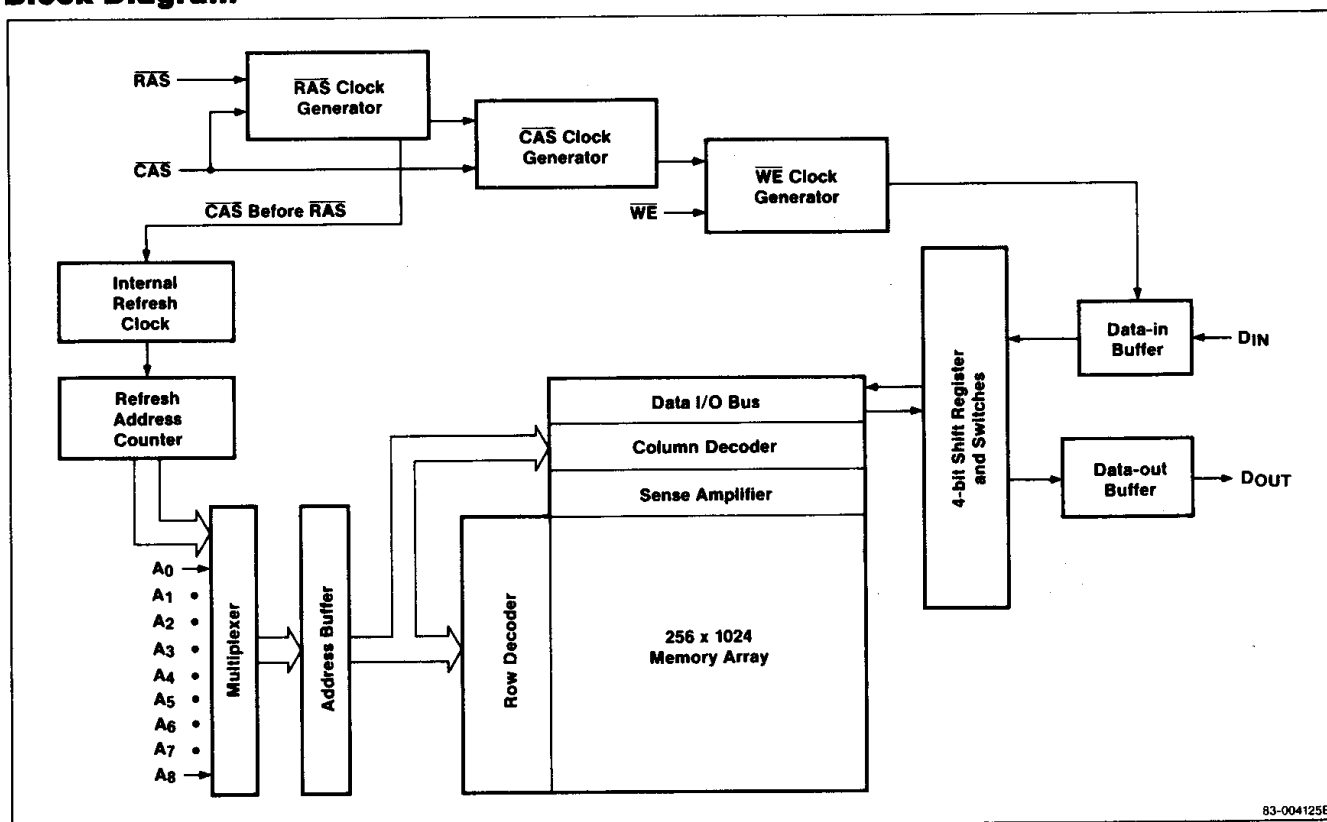


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μPD41257

Block Diagram



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Pin Identification

Symbol	Function
A ₀ -A ₈	Address inputs
D _{IN}	Data input
D _{OUT}	Data output
WE	Write enable
RAS	Row address strobe
CAS	Column address strobe
GND	Ground
V _{CC}	+5.0-volt power supply

Capacitance

T_A = 0 to +70°C; V_{CC} = +5.0 V ±10%

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Input capacitance	C ₁₁			5	pF	A ₀ -A ₈ , D _{IN}
	C ₁₂			8	pF	RAS, CAS, WE
Output capacitance	C ₀			7	pF	D _{OUT}

Absolute Maximum Ratings

Voltage on any pin relative to GND	-1.0 to +7.0 V
Short-circuit output current	50 mA
Power dissipation, P _D	1 W
Operating temperature, T _A	0 to +70°C
Storage temperature, T _{STG}	-55 to +150°C

Comment: Exposure to Absolute Maximum Ratings for extended periods may affect device reliability; exceeding the ratings could cause permanent damage. The device should be operated within the limits specified under DC and AC Characteristics.

Ordering Information

Part Number	Access Time (max)	R/W Cycle (min)	Package
μPD41257C-12	120 ns	220 ns	16-pin plastic DIP
C-15	150 ns	260 ns	
C-20	200 ns	330 ns	
μPD41257L-12	120 ns	220 ns	18-pin PLCC
L-15	150 ns	260 ns	
L-20	200 ns	330 ns	

DC Characteristics

 $T_A = 0 \text{ to } +70^\circ\text{C}; V_{CC} = 5.0 \text{ V } \pm 10\%; \text{GND} = 0 \text{ V}$

Parameter	Symbol	Limits			Unit	Test Conditions
		Min	Typ	Max		
Standby power supply current	I_{CC2}			5	mA	$\overline{\text{RAS}} = V_{IH}; D_{OUT} = \text{high impedance}$
Input leakage current	$I_{I(L)}$	-10		10	μA	Any input $V_{IN} = 0 \text{ V to } V_{CC}$; all other pins not under test = 0 V
Output leakage current	$I_{O(L)}$	-10		10	μA	D_{OUT} disabled; $V_{OUT} = 0 \text{ to } 5.5 \text{ V}$
Output voltage, high	V_{OH}	2.4		V_{CC}	V	$I_{OUT} = -5 \text{ mA}$
Output voltage, low	V_{OL}	0		0.4	V	$I_{OUT} = 4.2 \text{ mA}$
Supply voltage	V_{CC}	4.5	5.0	5.5	V	
	GND	0	0	0	V	
Input voltage, high	V_{IH}	2.4		5.5	V	All inputs
Input voltage, low	V_{IL}	-1.0		0.8	V	All inputs

AC Characteristics

 $T_A = 0 \text{ to } +70^\circ\text{C}; V_{CC} = 5.0 \text{ V } \pm 10\%$

Parameter	Symbol	Limits						Unit	Test Conditions
		μPD41257-12		μPD41257-15		μPD41257-20			
		Min	Max	Min	Max	Min	Max		
Standard Operation									
Average power supply operating current	I_{CC1}		75		70		60	mA	$\overline{\text{RAS}}, \overline{\text{CAS}}$ cycling; $t_{RC} = t_{RC} \text{ min (Note 5)}$
Average power supply current, refresh cycle	I_{CC3}		60		55		55	mA	$\overline{\text{RAS}}$ cycling; $\overline{\text{CAS}} = V_{IH}$; $t_{RC} = t_{RC} \text{ min (Note 5)}$
Random read or write cycle time	t_{RC}	220		260		330		ns	(Note 6)
Read-write cycle time	t_{RWC}	265		310		390		ns	(Note 6)
Access time from $\overline{\text{RAS}}$	t_{RAC}		120		150		200	ns	(Notes 7, 8)
Access time from $\overline{\text{CAS}}$	t_{CAC}		60		75		100	ns	(Notes 7, 9)
Output buffer turnoff delay	t_{OFF}	0	30	0	40	0	50	ns	(Note 10)
Rise and fall transition time	t_T	3	50	3	50	3	50	ns	(Note 4)
$\overline{\text{RAS}}$ precharge time	t_{RP}	90		100		120		ns	
$\overline{\text{RAS}}$ pulse width	t_{RAS}	120	10,000	150	10,000	200	10,000	ns	
$\overline{\text{RAS}}$ hold time	t_{RSH}	60		75		100		ns	
$\overline{\text{CAS}}$ pulse width	t_{CAS}	60	10,000	75	10,000	100	10,000	ns	
$\overline{\text{CAS}}$ hold time	t_{CSH}	120		150		200		ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	t_{RCD}	25	60	25	75	35	100	ns	(Note 11)
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	t_{CRP}	10		10		10		ns	(Note 12)
$\overline{\text{CAS}}$ precharge time	t_{CPN}	30		30		35		ns	
$\overline{\text{RAS}}$ precharge $\overline{\text{CAS}}$ hold time	t_{RPC}	0		0		0		ns	
Row address setup time	t_{ASR}	0		0		0		ns	

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AC Characteristics (cont)

Parameter	Symbol	μPD41257-12		μPD41257-15		μPD41257-20		Unit	Test Conditions
		Min	Max	Min	Max	Min	Max		
Standard Operation (cont)									
Row address hold time	t_{RAH}	15		15		25		ns	
Column address setup time	t_{ASC}	0		0		0		ns	
Column address hold time	t_{CAH}	20		25		55		ns	
Column address hold time referenced to \overline{RAS}	t_{AR}	80		100		155		ns	
Read command setup time	t_{RCS}	0		0		0		ns	
Read command hold time referenced to \overline{RAS}	t_{RRH}	10		10		25		ns	(Note 13)
Read command hold time referenced to \overline{CAS}	t_{RCH}	0		0		0		ns	(Note 13)
Write command hold time	t_{WCH}	30		40		55		ns	
Write command hold time referenced to \overline{RAS}	t_{WCR}	90		115		155		ns	
Write command pulse width	t_{WP}	20		25		55		ns	
Write command to \overline{RAS} lead time	t_{RWL}	40		45		55		ns	
Write command to \overline{CAS} lead time	t_{CWL}	40		45		55		ns	
Data-in setup time	t_{DS}	0		0		0		ns	(Note 14)
Data-in hold time	t_{DH}	30		40		55		ns	(Note 14)
Data-in hold time referenced to \overline{RAS}	t_{DHR}	90		115		155		ns	
Refresh period	t_{REF}		4		4		4	ms	
\overline{WE} command setup time	t_{WCS}	0		0		0		ns	(Note 15)
\overline{CAS} to \overline{WE} delay	t_{CWD}	60		75		100		ns	(Note 15)
\overline{RAS} to \overline{WE} delay	t_{RWD}	120		150		200		ns	(Note 15)
Nibble Mode									
Average power supply current, nibble mode	I_{CC6}		35		27		27	mA	$\overline{RAS} = V_{IL}$; \overline{CAS} cycling; $t_{NC} = t_{NC \text{ min}}$ (Note 5)
Nibble-mode cycle time	t_{NC}	60		70		100		ns	(Note 6)
Nibble-mode access time	t_{NAC}		30		35		50	ns	(Note 7)
Nibble-mode precharge time	t_{NP}	20		25		40		ns	
Nibble-mode \overline{WE} pulse width	t_{NWP}	20		25		40		ns	
Nibble-mode \overline{CAS} pulse width	t_{NAS}	30		35		50		ns	
Nibble-mode \overline{RAS} hold time (read cycle)	t_{NRRSH}	30		35		50		ns	
Nibble-mode \overline{RAS} hold time (write cycle)	t_{NWRSH}	35		35		50		ns	
Nibble-mode \overline{CAS} to \overline{WE} delay	t_{NCWD}	30		35		50		ns	
Nibble-mode \overline{WE} to \overline{CAS} lead time	t_{NCWL}	30		35		50		ns	

AC Characteristics (cont)

Parameter	Symbol	μPD41257-12		μPD41257-15		μPD41257-20		Unit	Test Conditions
		Min	Max	Min	Max	Min	Max		
CAS Before RAS Refresh Cycle									
Average power supply current, $\overline{\text{CAS}}$ before RAS refreshing	I_{CC4}		65		60		55	mA	$\overline{\text{RAS}}$ cycling; $\overline{\text{CAS}} = V_{IL}$; $t_{RC} = t_{RC \text{ min}}$ (Note 5)
$\overline{\text{CAS}}$ setup time for $\overline{\text{CAS}}$ before RAS refreshing	t_{CSR}	10		10		10		ns	
$\overline{\text{CAS}}$ hold time for $\overline{\text{CAS}}$ before RAS refreshing	t_{CHR}	25		30		30		ns	
Read or write cycle time (counter test cycle)	t_{TRC}	245		285		350		ns	
Read-write cycle time (counter test cycle)	t_{TRWC}	290		335		410		ns	
$\overline{\text{CAS}}$ precharge time (counter test cycle)	t_{TCP}	50		60		80		ns	

Notes:

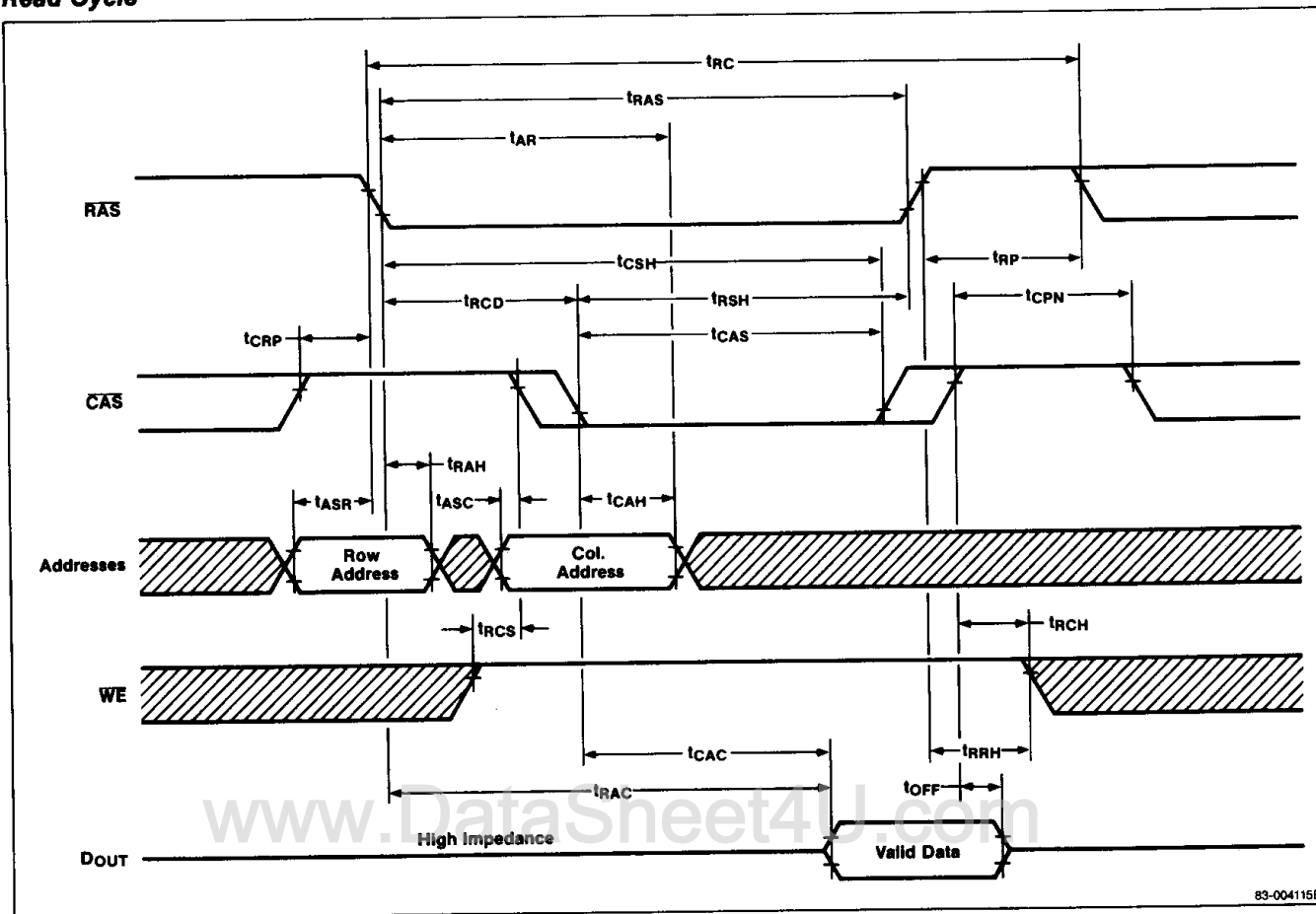
- (1) An initial pause of 100 μs is required after power-up, followed by any eight RAS cycles before proper device operation is achieved.
- (2) Ac measurements assume $t_T = 5 \text{ ns}$.
- (3) V_{IH} (min) and V_{IL} (max) are reference levels for measuring timing of input signals. Transition times are measured between V_{IH} and V_{IL} .
- (4) All voltages are referenced to GND.
- (5) I_{CC1} , I_{CC3} , I_{CC4} , and I_{CC6} depend on output loading and cycle rates. Specified values are obtained with the output open.
- (6) The minimum specifications are used only to indicate the cycle time at which proper operation over the full temperature range ($T_A = 0$ to $+70^\circ\text{C}$) is assured.
- (7) Load = 2 TTL loads and 100 pF.
- (8) Assumes that $t_{RCD} \leq t_{RCD}(\text{max})$. If t_{RCD} is greater than the maximum recommended value in this table, t_{RAC} increases by the amount that t_{RCD} exceeds the value shown. For the $\overline{\text{CAS}}$ before RAS refresh counter test cycle, t_{RAC} is specified as $t_{RAC} = t_{CHR} + t_{TCP} + t_{CAC} + 2t_T$ and is greater than the maximum specified value shown in this table.
- (9) Assumes that $t_{RCD} \geq t_{RCD}(\text{max})$.
- (10) $t_{OFF}(\text{max})$ defines the time at which the output achieves the open-circuit condition and is not referenced to V_{OH} or V_{OL} .
- (11) Operation within the $t_{RCD}(\text{max})$ limit assures that $t_{RAC}(\text{max})$ can be met. Time $t_{RCD}(\text{max})$ is specified as a reference point only; if t_{RCD} is greater than $t_{RCD}(\text{max})$, access time is controlled exclusively by t_{CAC} .
- (12) The t_{CRP} requirement should be applicable for $\overline{\text{RAS}}/\overline{\text{CAS}}$ cycles preceded by any cycle.
- (13) Either t_{RRH} or t_{RCH} must be satisfied for a read cycle.
- (14) These parameters are referenced to the leading edge of $\overline{\text{CAS}}$ for early write cycles and to the leading edge of $\overline{\text{WE}}$ for delayed write or read-modify-write cycles.
- (15) t_{WCS} , t_{CWD} , t_{NCWD} , and t_{RWD} are restrictive operating parameters in read-write/read-modify-write cycles only.
 - If $t_{WCS} \geq t_{WCS}(\text{min})$, the cycle is an early write cycle or a nibble mode early write cycle and the data output pin will remain open-circuit throughout the entire cycle.
 - If $t_{CWD} \geq t_{CWD}(\text{min})$ and $t_{RWD} \geq t_{RWD}(\text{min})$, the cycle is a read-write cycle and the data output pin will contain data read from the selected cell.
 - If $t_{NCWD} \geq t_{NCWD}(\text{min})$, the cycle is a nibble mode read-write cycle and the data output pin will contain data read from the selected cell.

If none of the above conditions is met, the condition of the data output pin (at access time and until $\overline{\text{CAS}}$ returns to V_{IH}) is indeterminate.

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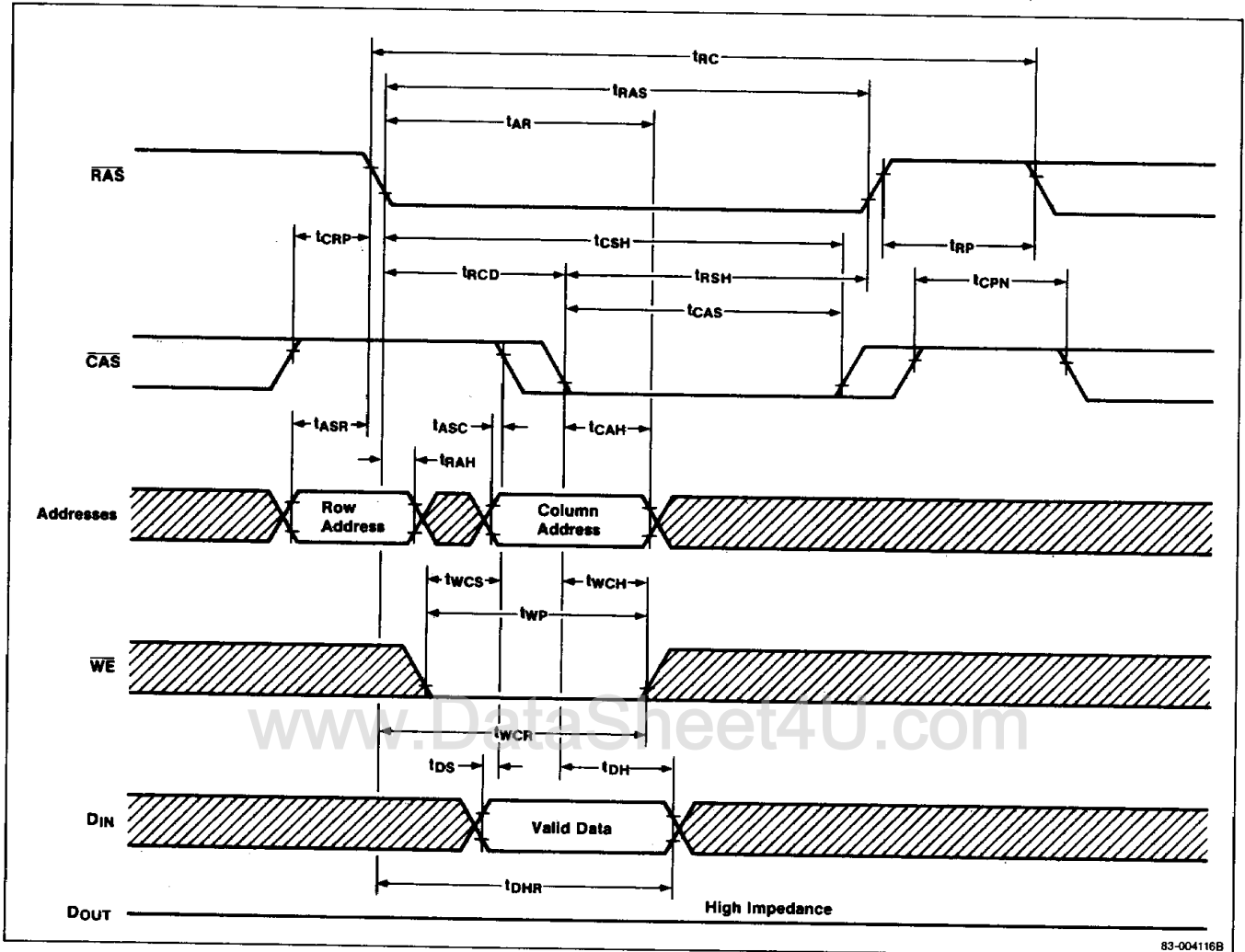
Timing Waveforms

Read Cycle



Timing Waveforms (cont)

Write Cycle (Early Write)



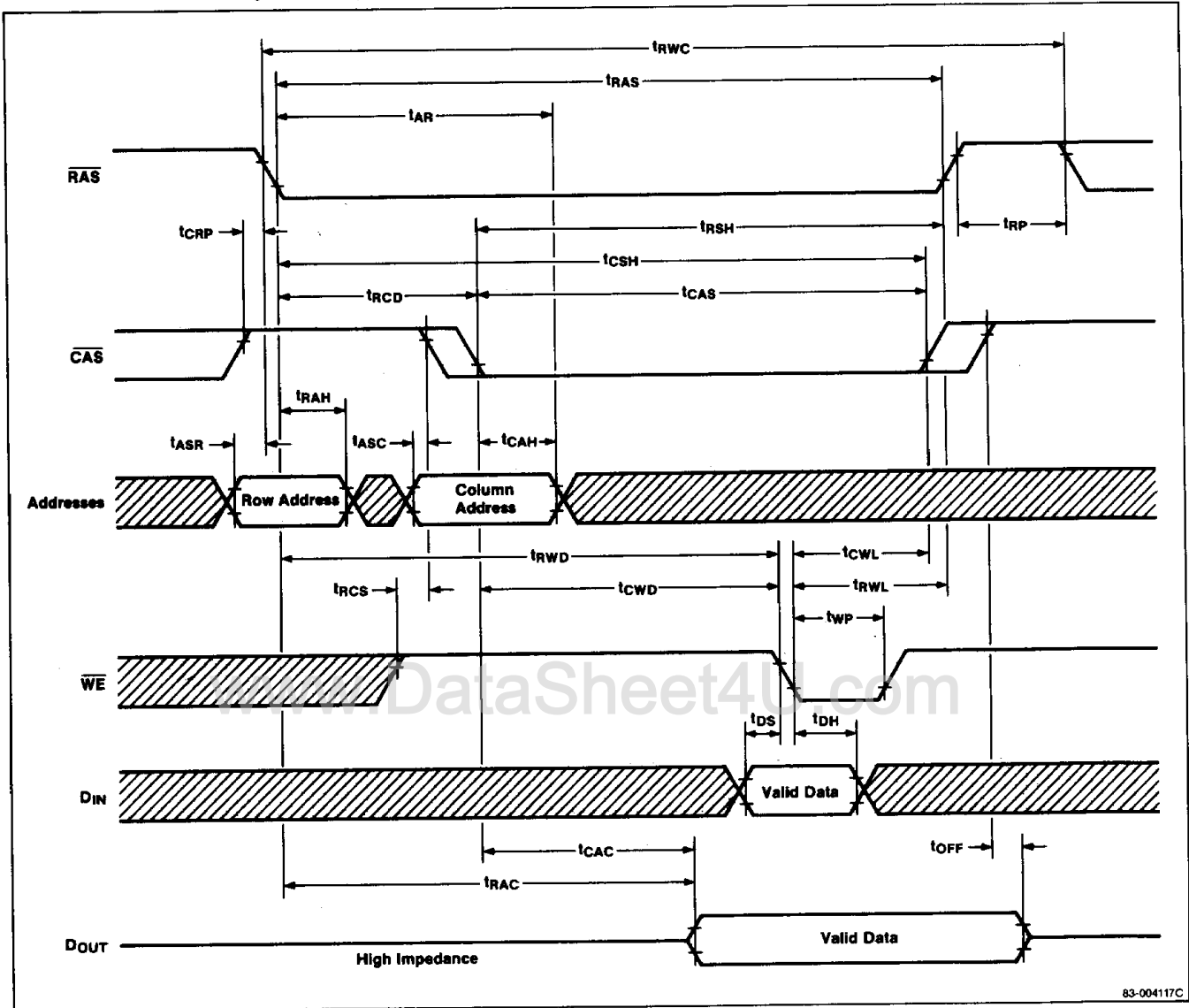
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Timing Waveforms (cont)

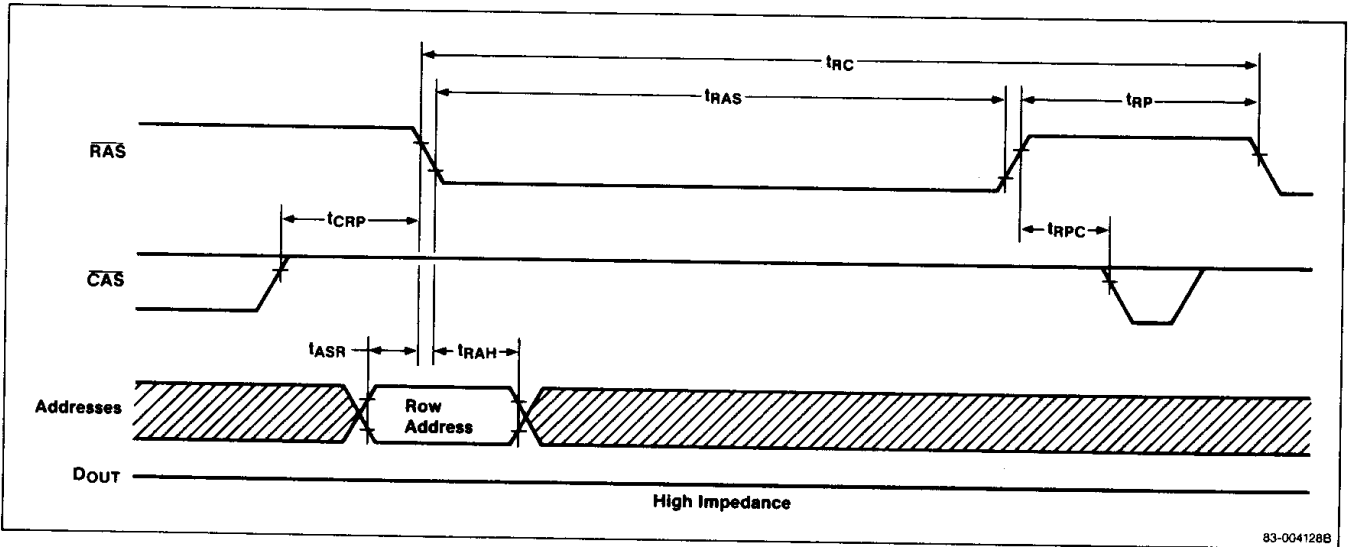
Read-Write/Read-Modify-Write Cycle



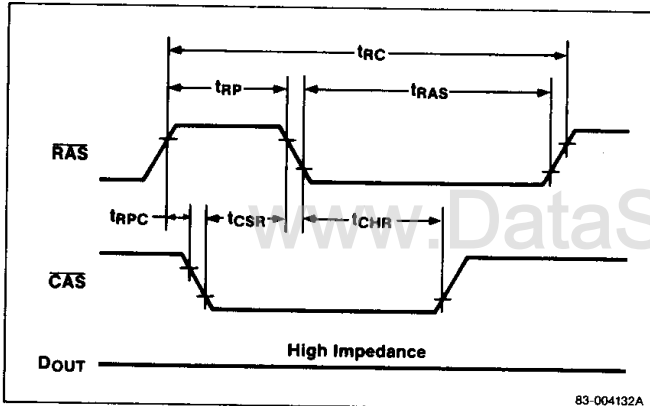
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Timing Waveforms (cont)

RAS-Only Refresh Cycle



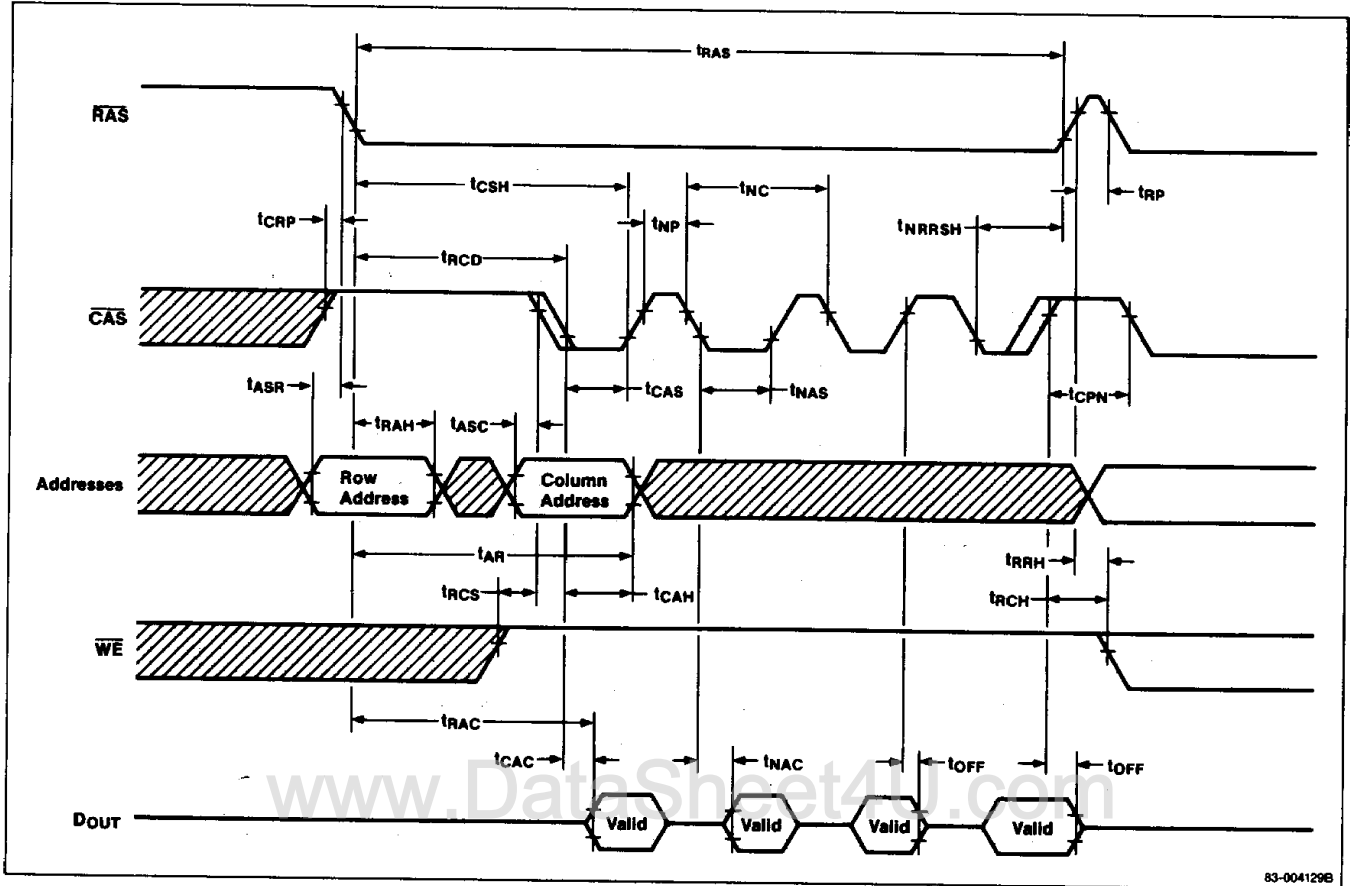
CAS Before RAS Refresh Cycle



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Timing Waveforms (cont)

Nibble Mode Read Cycle

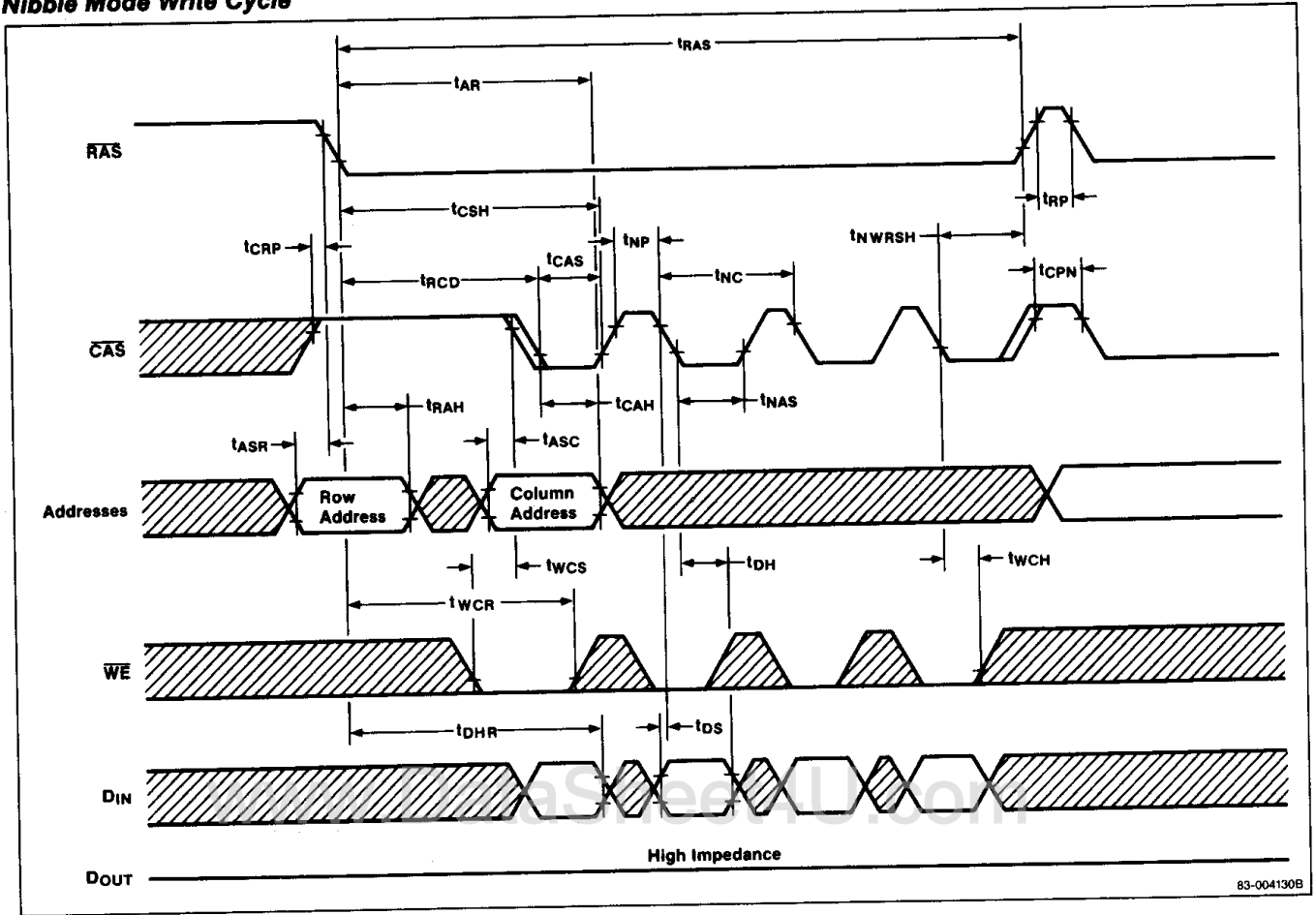


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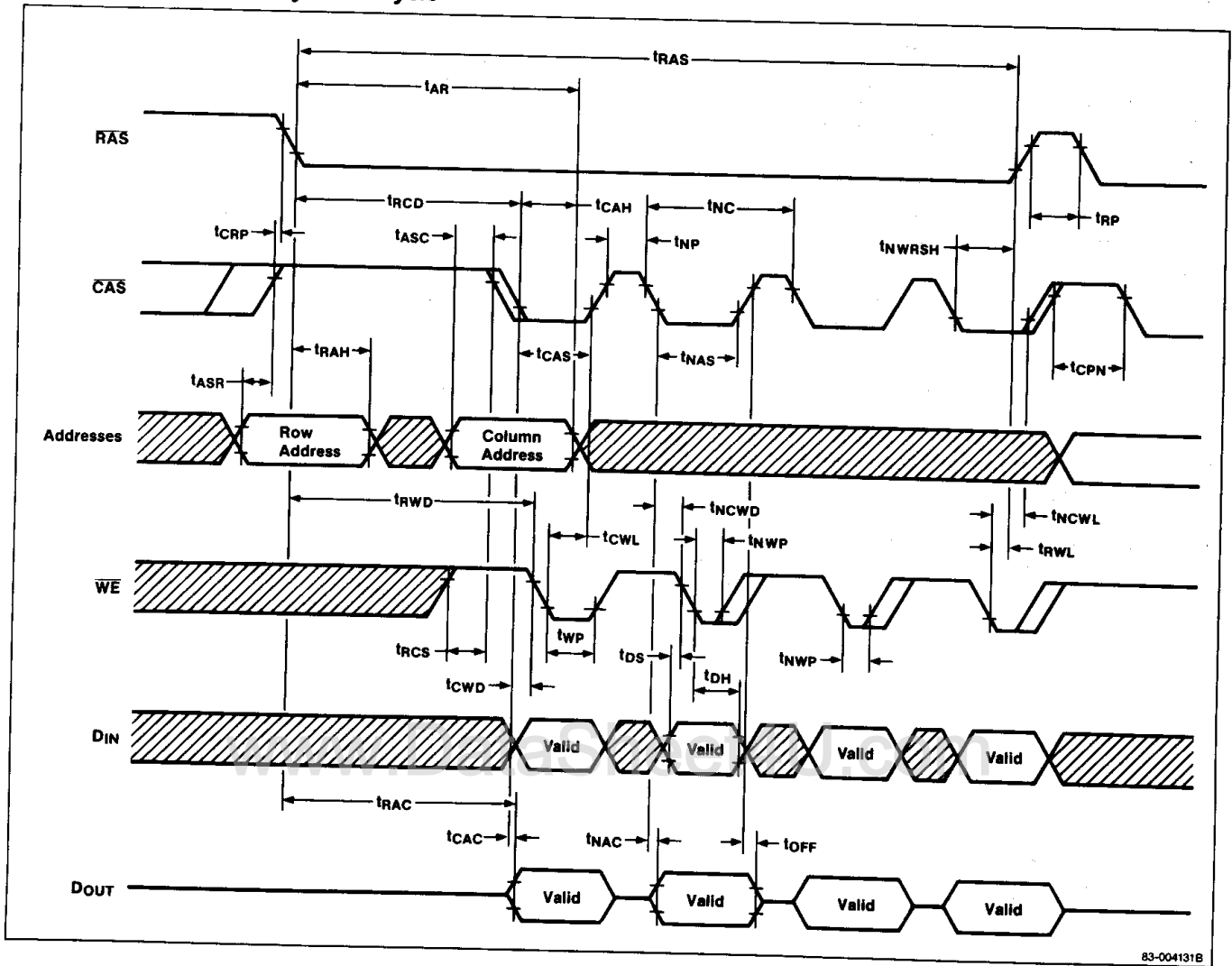
Timing Waveforms (cont)

Nibble Mode Write Cycle



Timing Waveforms (cont)

Nibble Mode Read-Modify-Write Cycle

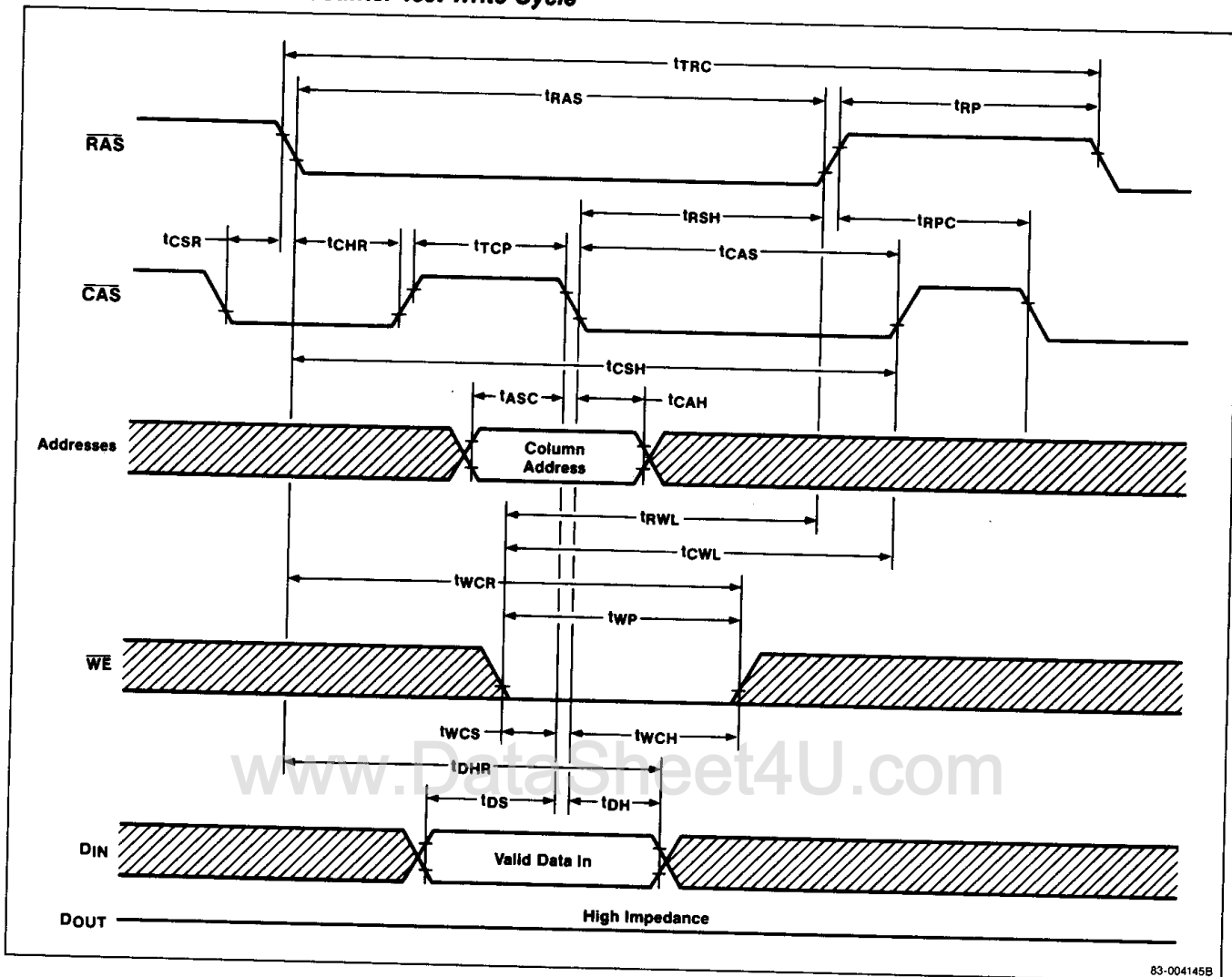


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Timing Waveforms (cont)

CAS Before RAS Refresh Counter Test Write Cycle

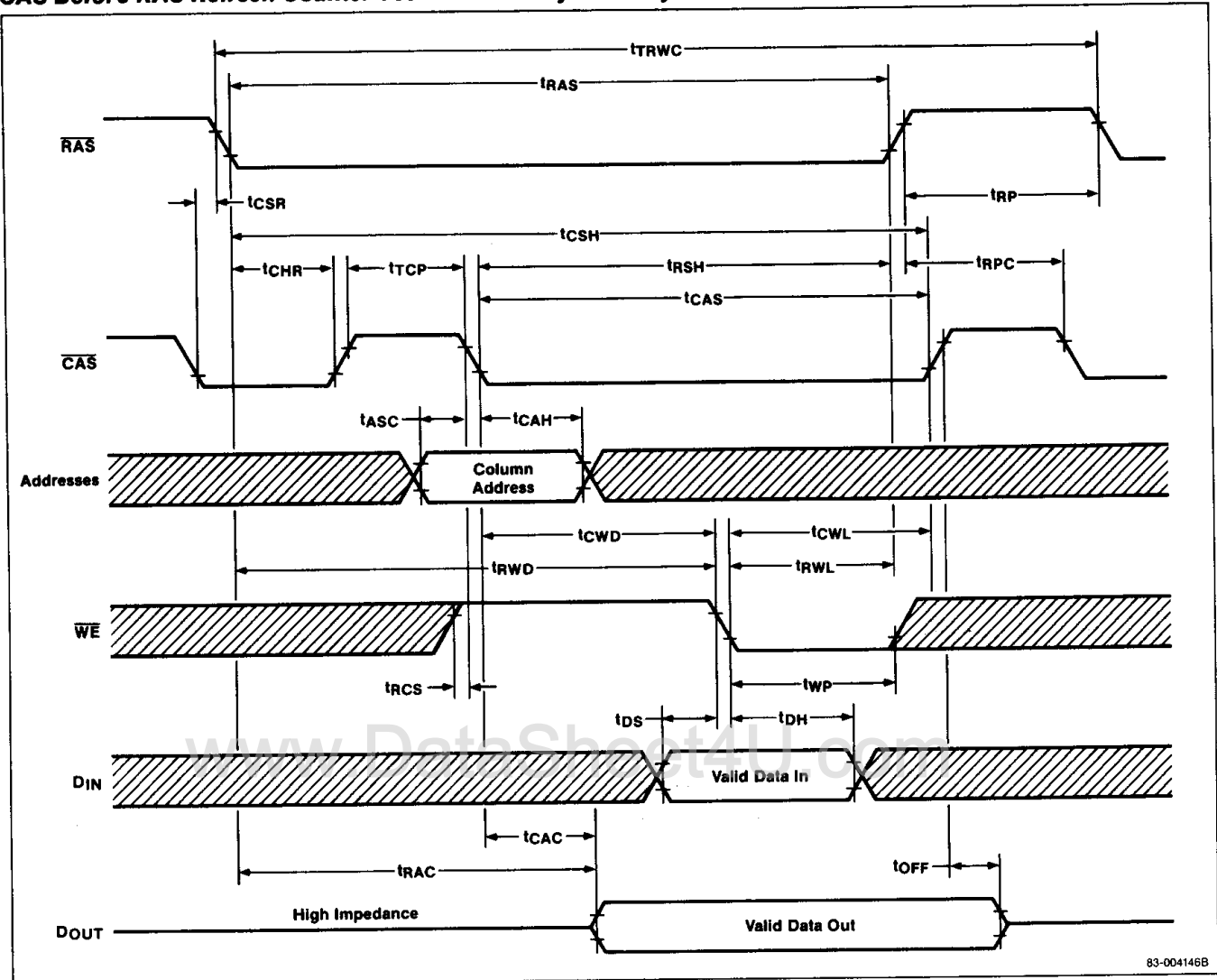


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Timing Waveforms (cont)

$\overline{\text{CAS}}$ Before $\overline{\text{RAS}}$ Refresh Counter Test Read-Modify-Write Cycle



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