LH5P860

CMOS 512K (64K × 8) Pseudo-Static RAM

FEATURES

- 65,536 × 8 bit organization
- Access time: 80 ns (MAX.)
- Cycle time: 140 ns (MIN.)
- Single +5 V power supply
- Pin compatible with 1M standard SRAM
- Power consumption (MAX.):
  Operating: 440 mW
  Self refresh (TTL level): 5.5 mW
  Self refresh (CMOS level): 2.75 mW
- TTL compatible I/O
- 512 refresh cycles/8 ms (MAX.)
- Available for auto-refresh and self-refresh modes
- Packages:
  32-pin, 600-mil DIP
  32-pin, 525-mil SOP

DESCRIPTION

The LH5P860 is a 512K-bit Pseudo-Static RAM organized as 65,536 × 8 bits. It is fabricated using silicon-gate CMOS process technology. With its built-in oscillator, it is easy to refresh memories without an external clock.

PIN CONNECTIONS

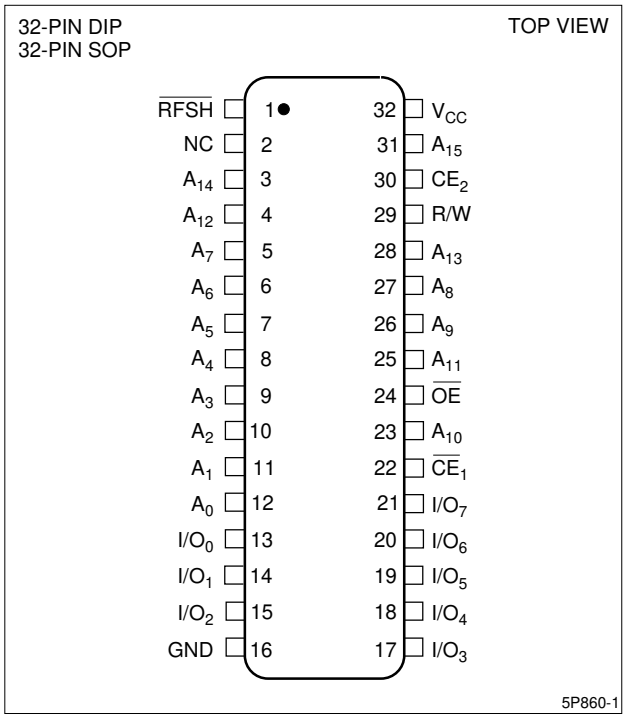


Figure 1. Pin Connections for DIP and SOP Packages

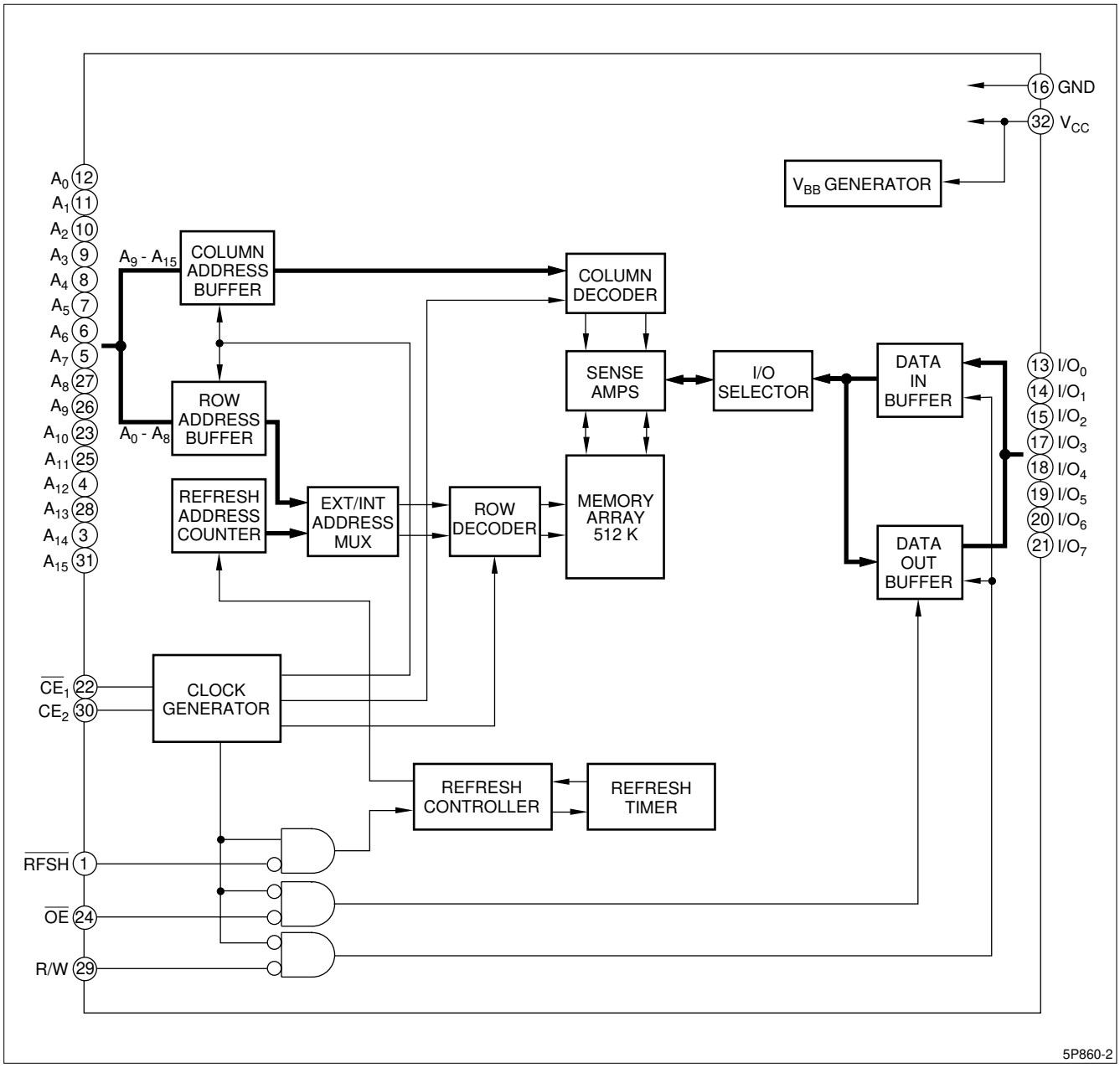


Figure 2. LH5P860 Block Diagram

PIN DESCRIPTION

SIGNAL	PIN NAME
A_0 - A_{15}	Address input
R/W	Read/Write input
$\overline{OE}$	Output Enable input
$\overline{RFSH}$	Refresh input
$\overline{CE_1}$, CE_2	Chip Enable input

SIGNAL	PIN NAME
I/O_0 - I/O_7	Data input/output
V_{CC}	Power Supply
GND	Ground
NC	No Connection

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	NOTE
Applied voltage on all pins	V_T	–1.0 to +7.0	V	1
Output short circuit current	I_O	50	mA	
Power dissipation	P_D	600	mW	
Operating temperature	Topr	0 to +70	°C	
Storage temperature	Tstg	–65 to +150	°C	

NOTE:
1. The maximum applicable voltage on any pin with respect to GND.

RECOMMENDED OPERATING CONDITIONS (T_A = 0 to +70°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage	V_{CC}	4.5	5.0	5.5	V
	GND	0	0	0	V
Input voltage	V_{IH}	2.4		V_{CC} + 0.3	V
	V_{IL}	–1.0		0.8	V

CAPACITANCE (T_A = 0 to +70°C, f = 1 MHz, V_{CC} = 5.0 V ±10%)

PARAMETER	CONDITIONS	SYMBOL	MIN.	MAX.	UNIT
Input capacitance	$A_0 – A_{15}$	C_{IN1}		8	pF
	R/W, $\overline{OE}$, $\overline{RFSH}$	C_{IN2}		5	pF
	$\overline{CE_1}$, CE_2	C_{IN3}		5	pF
Input/Output capacitance	$I/O_0 – I/O_7$	C_{OUT1}		10	pF

DC CHARACTERISTICS (T_A = 0 to +70°C, V_{CC} = 5.0 V ±10%)

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNIT	NOTE
Average supply current in normal operation	I_{CC1}			80	mA	1, 2
Supply current in standby mode	I_{CC2}	TTL input		1.0	mA	1, 3
		CMOS input		0.5		1, 4
Average supply current in self refresh cycle	I_{CC3}	TTL input		1.0	mA	1, 5
		CMOS input		0.5		1, 6
Input leakage current	I_{LI}	0 V ≤ V_{IN} ≤ 6.5 V, 0 V except on test pins	–10	10	µA	
I/O leakage current	I_{LO}	0 V ≤ V_{OUT} ≤ V_{CC} + 0.3 V, Outputs in high-impedance state	–10	10	µA	
Output HIGH voltage	V_{OH}	I_{OUT} = –1.0 mA	2.4		V	
Output LOW voltage	V_{OL}	I_{OUT} = 4.0 mA		0.4	V	

NOTES:
1. Specified values are with outputs open.
2. I_{CC1} depends on the cycle time.
3. $\overline{CE_1}$ = V_{IH}, $\overline{RFSH}$ = V_{IH}.
4. $\overline{CE_1}$ = V_{CC} – 0.2 V, $\overline{RFSH}$ = V_{CC} – 0.2 V.
5. $\overline{CE_1}$ = V_{IH}, $\overline{RFSH}$ = V_{IL}.
6. $\overline{CE_1}$ = V_{CC} – 0.2 V, $\overline{RFSH}$ = 0.2 V.

AC CHARACTERISTICS [1, 2, 3] (T_A = 0 to +70°C, V_{CC} = 5.0 V ±10%)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT	NOTE
Random read, write cycle time	t_{RC}	140		ns	
Read modify write cycle time	t_{RMW}	205		ns	
$\overline{CE}$ pulse width	t_{CE}	80	10,000	ns	
$\overline{CE}$ precharge time	t_P	50		ns	
Address setup time	t_{AS}	0		ns	4
Address hold time	t_{AH}	20		ns	4
Read command setup time	t_{RCS}	0		ns	
Read command hold time	t_{RCH}	0		ns	
$\overline{CE}$ access time	t_{CEA}		80	ns	5
$\overline{OE}$ access time	t_{OEA}		30	ns	5
Output enable time from $\overline{CE}$	t_{CLZ}	20		ns	
Output enable time from $\overline{OE}$	t_{OLZ}	0		ns	
Output enable time from R/W	t_{WLZ}	0		ns	
Output disable time from $\overline{CE}$	t_{CHZ}		25	ns	
Output disable time from $\overline{OE}$	t_{OHZ}		25	ns	
Output diable time from R/W	t_{WHZ}		25	ns	
$\overline{OE}$ setup time	t_{OES}	10		ns	
$\overline{OE}$ hold time	t_{OEH}	10		ns	
Write command pulse width	t_{WP}	30		ns	
Write command setup time	t_{WCS}	30		ns	
Write command hold time	t_{WCH}	50		ns	
Data setup time from R/W	t_{DSW}	30		ns	6
Data setup time from $\overline{CE}$	t_{DSC}	30		ns	6
Data hold time from R/W	t_{DHW}	0		ns	6
Data hold time from $\overline{CE}$	t_{DHC}	0		ns	6
Transition time (rise and fall)	t_T	3	35	ns	
Refresh time interval	t_{REF}		8	ms	
Refresh command hold time	t_{RHC}	15		ns	
Auto refresh cycle time	t_{FC}	130		ns	
Refresh delay time from $\overline{CE}$	t_{RFD}	50		ns	
Refresh pulse width (Auto refresh)	t_{FAP}	30	8,000	ns	
Refresh precharge time (Auto refresh)	t_{FP}	30		ns	
Refresh pulse width (Self refresh)	t_{FAS}	8,000		ns	
$\overline{CE}$ delay time from refresh precharge (Self refresh)	t_{FRS}	160		ns	

NOTES:

1. In order to initialize the circuit, an initialize pause of 100 µs with $\overline{CE_1}$ = V_{IH}, RFSH = V_{IH} (or CE_2 = V_{IL}, RFSH = V_{IH}) is required after power-up, followed by at least 8 dummy cycles.
2. AC characteristics are measured at t_T = 5 ns.
3. AC characteristics are measured at the following condition (see figure at right):
4. Address is latched at the negative edge of $\overline{CE_1}$ or at the positive edge of CE_2.
5. Measured with a load equivalent to 2TTL + 100 pF.
6. Data is latched at the positive edge of R/W, at the positive edge of $\overline{CE_1}$, or at the negative edge of CE_2.

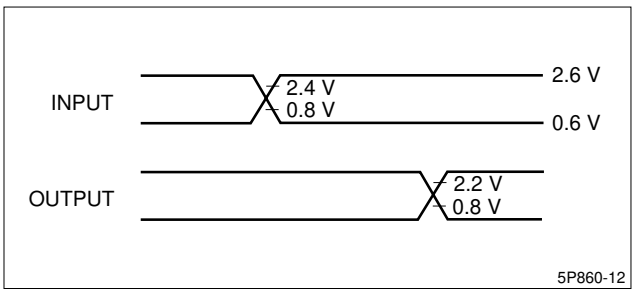
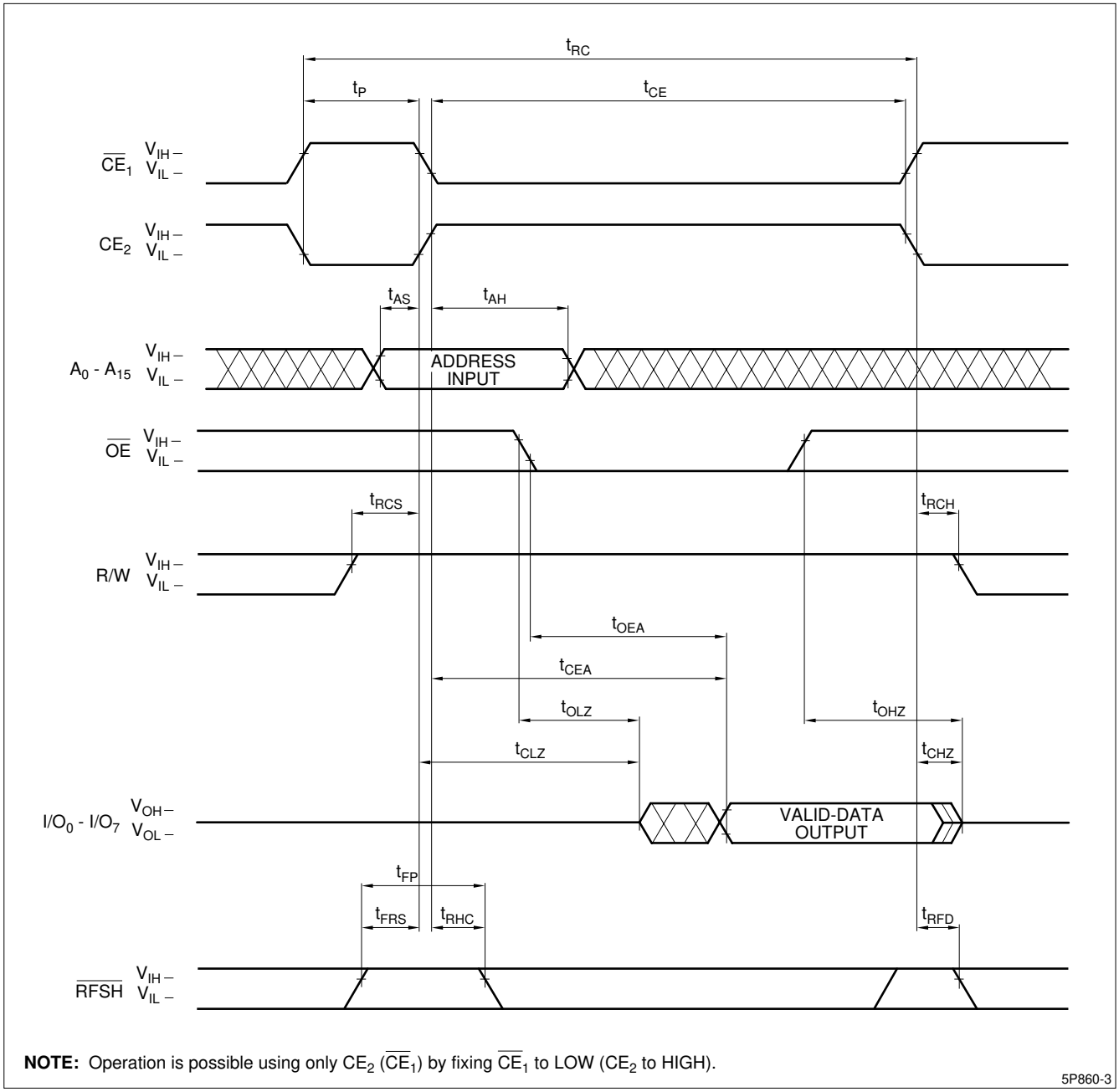


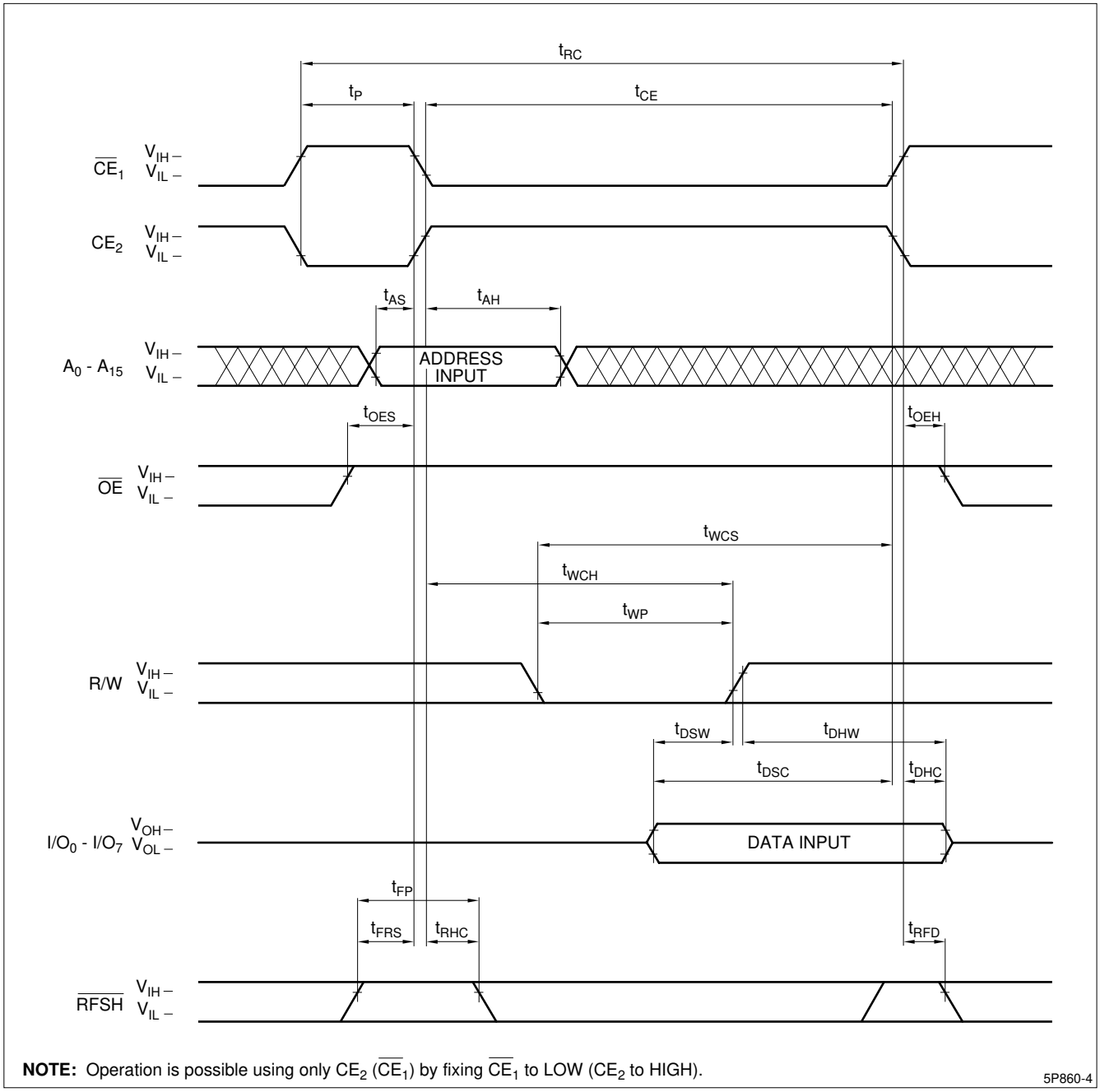
Figure 3. AC Characteristics



NOTE: Operation is possible using only CE_2 ($\overline{CE}_1$) by fixing $\overline{CE}_1$ to LOW (CE_2 to HIGH).

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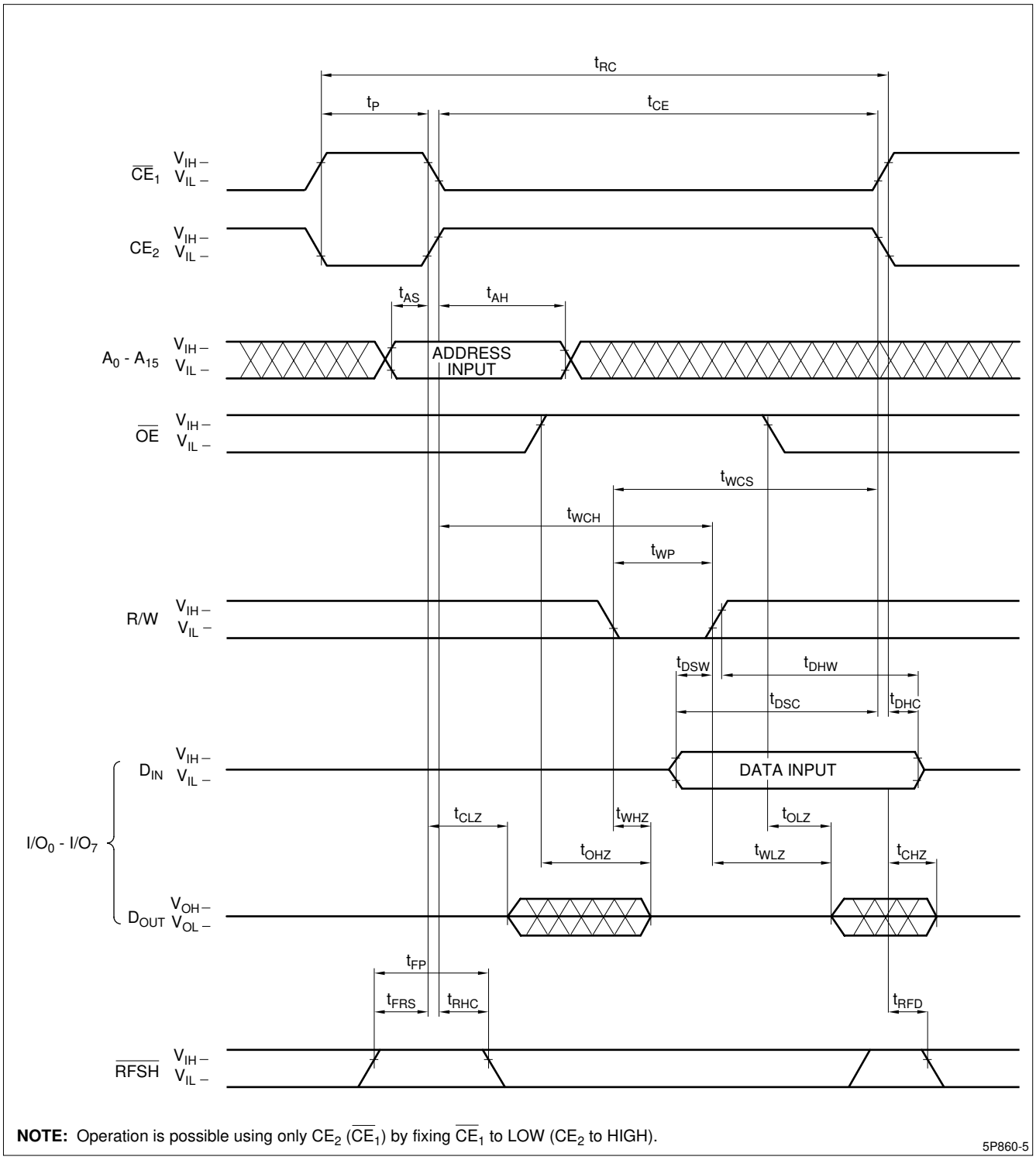
Figure 4. Read Cycle



NOTE: Operation is possible using only CE_2 ($\overline{CE_1}$) by fixing $\overline{CE_1}$ to LOW (CE_2 to HIGH).

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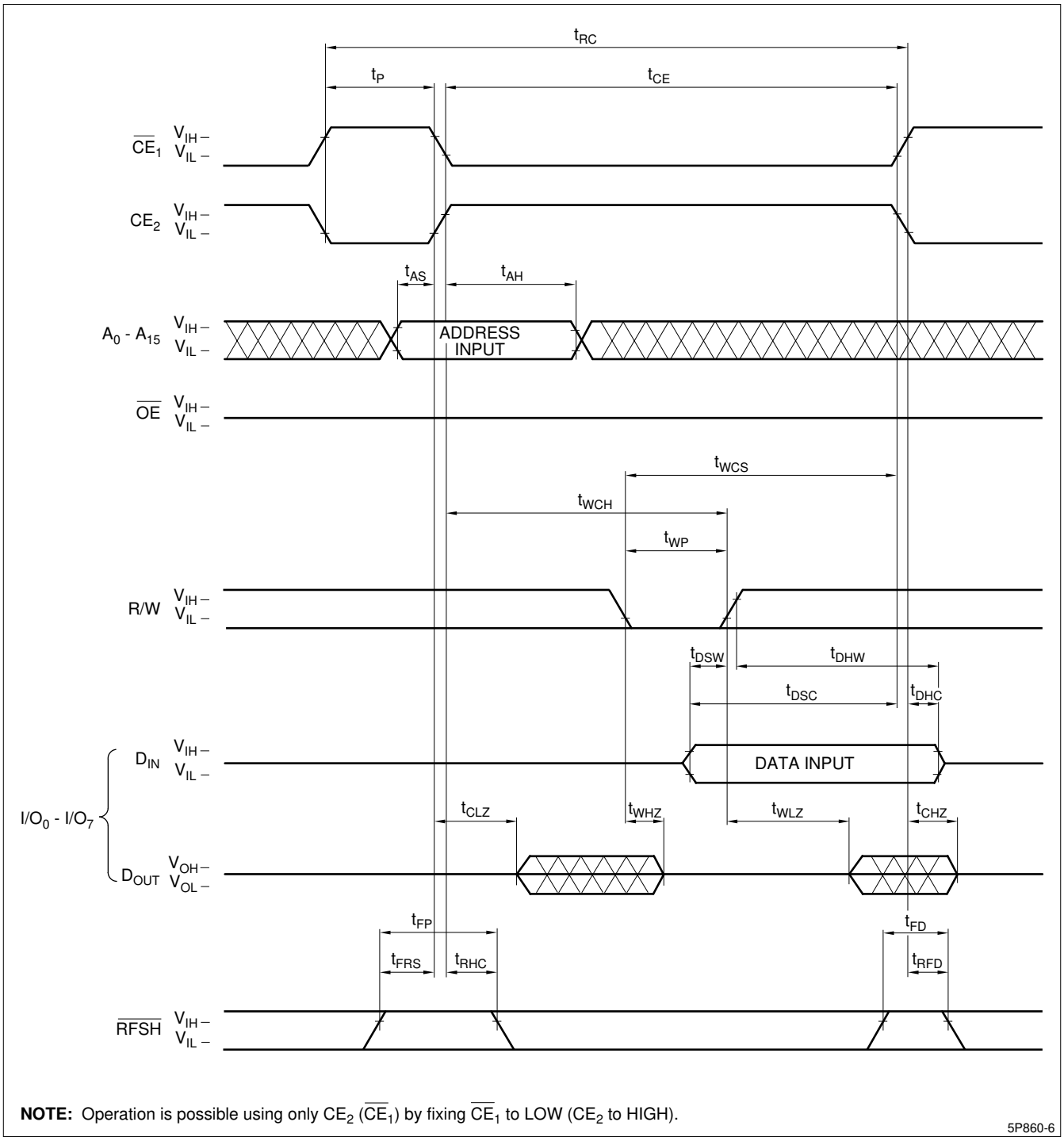
Figure 5. Write Cycle 1 ($\overline{OE}$ = Fix 'H')



NOTE: Operation is possible using only CE_2 ($\overline{CE}_1$) by fixing $\overline{CE}_1$ to LOW (CE_2 to HIGH).

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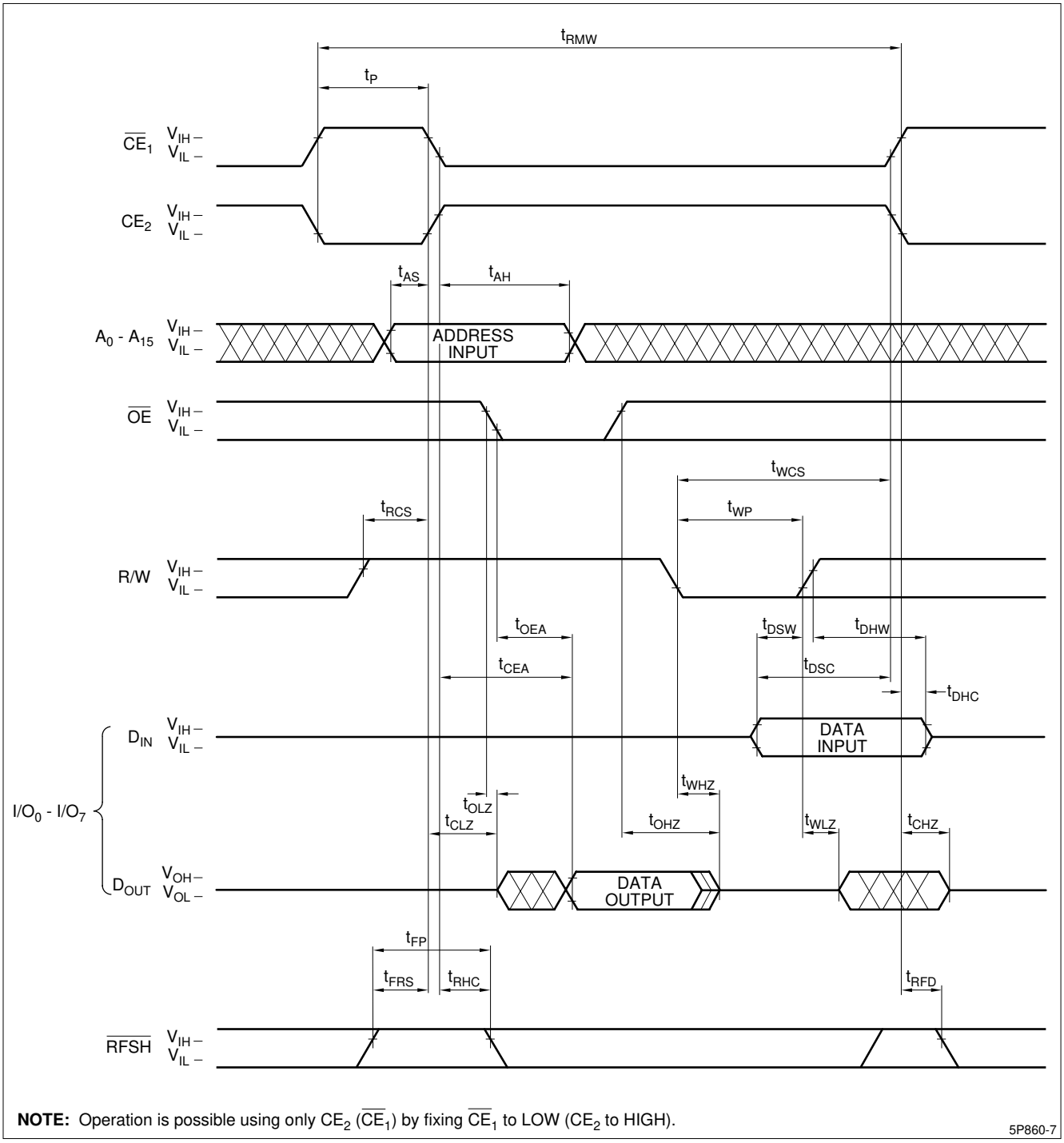
Figure 6. Write Cycle 2 ($\overline{OE}$ Clock)



NOTE: Operation is possible using only CE_2 ($\overline{CE_1}$) by fixing $\overline{CE_1}$ to LOW (CE_2 to HIGH).

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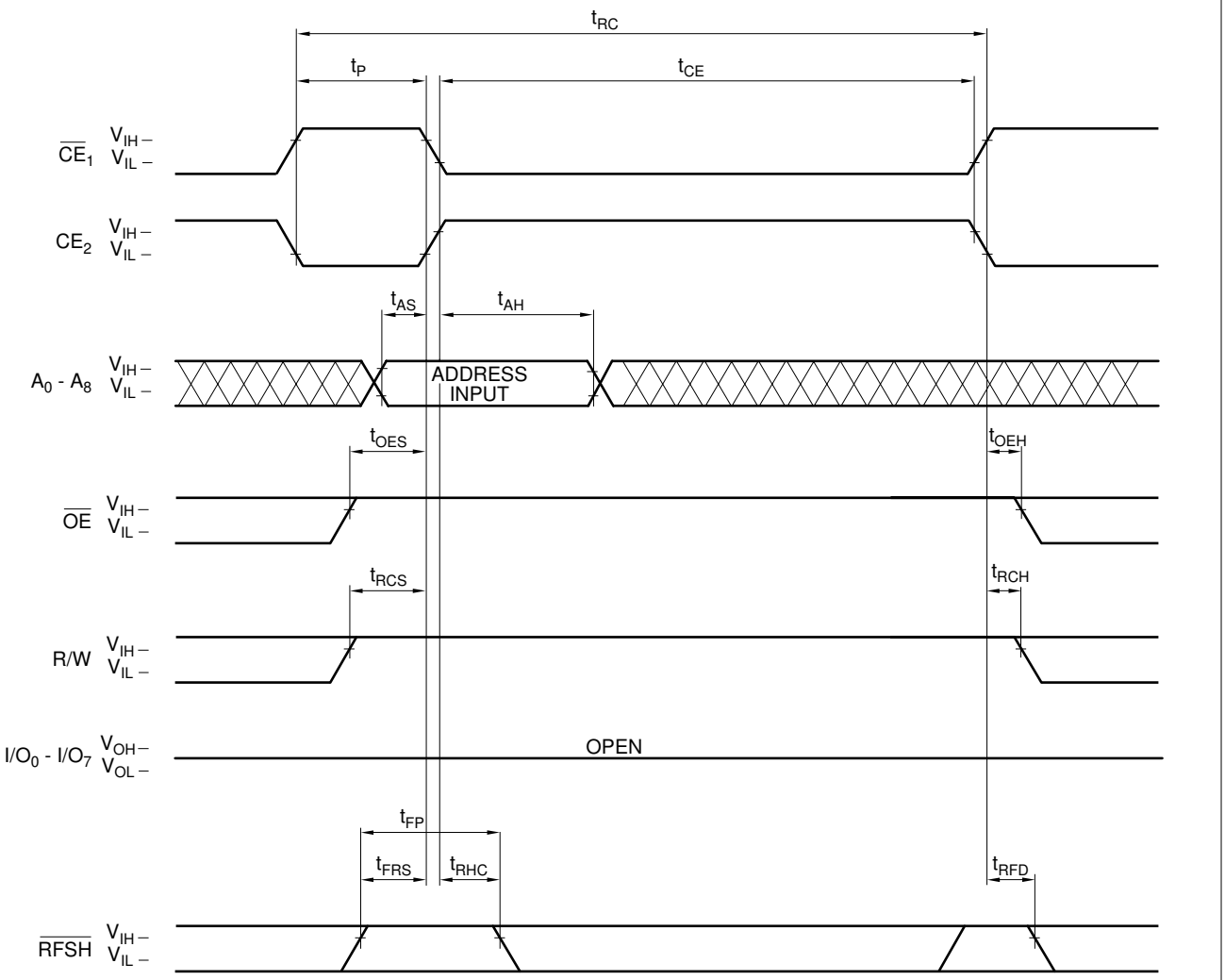
Figure 7. Write Cycle 3 ($\overline{OE}$ = Fix 'L')



NOTE: Operation is possible using only CE_2 ($\overline{CE}_1$) by fixing $\overline{CE}_1$ to LOW (CE_2 to HIGH).

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Figure 8. Read-Modify-Write Cycle



NOTES:
1. Operation is possible using only CE_2 ($\overline{CE_1}$) by fixing $\overline{CE_1}$ to LOW (CE_2 to HIGH).
2. A_9 - A_{16} = Don't Care.

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Figure 9. $\overline{CE}$ Only Refresh Cycle

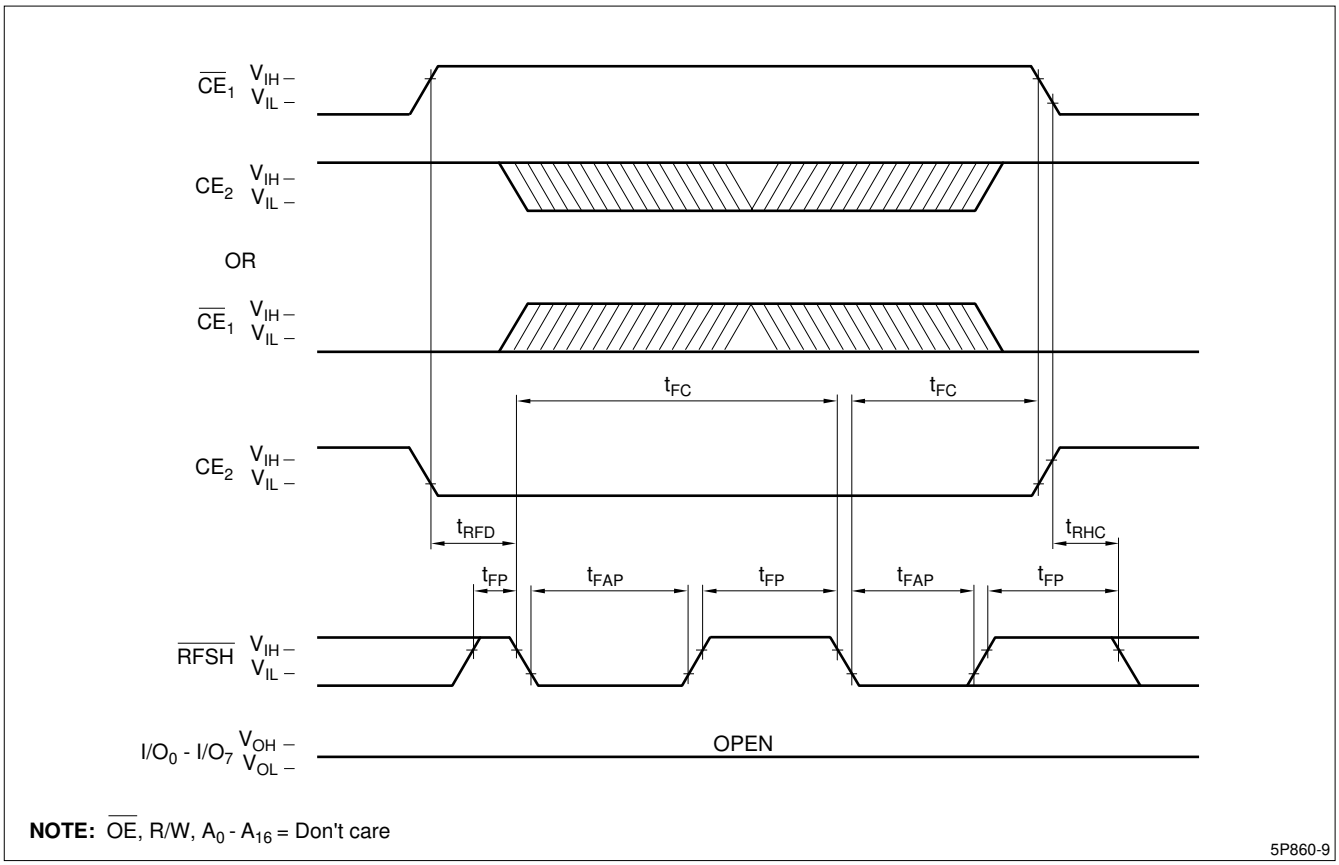


Figure 11. Auto Refresh Cycle

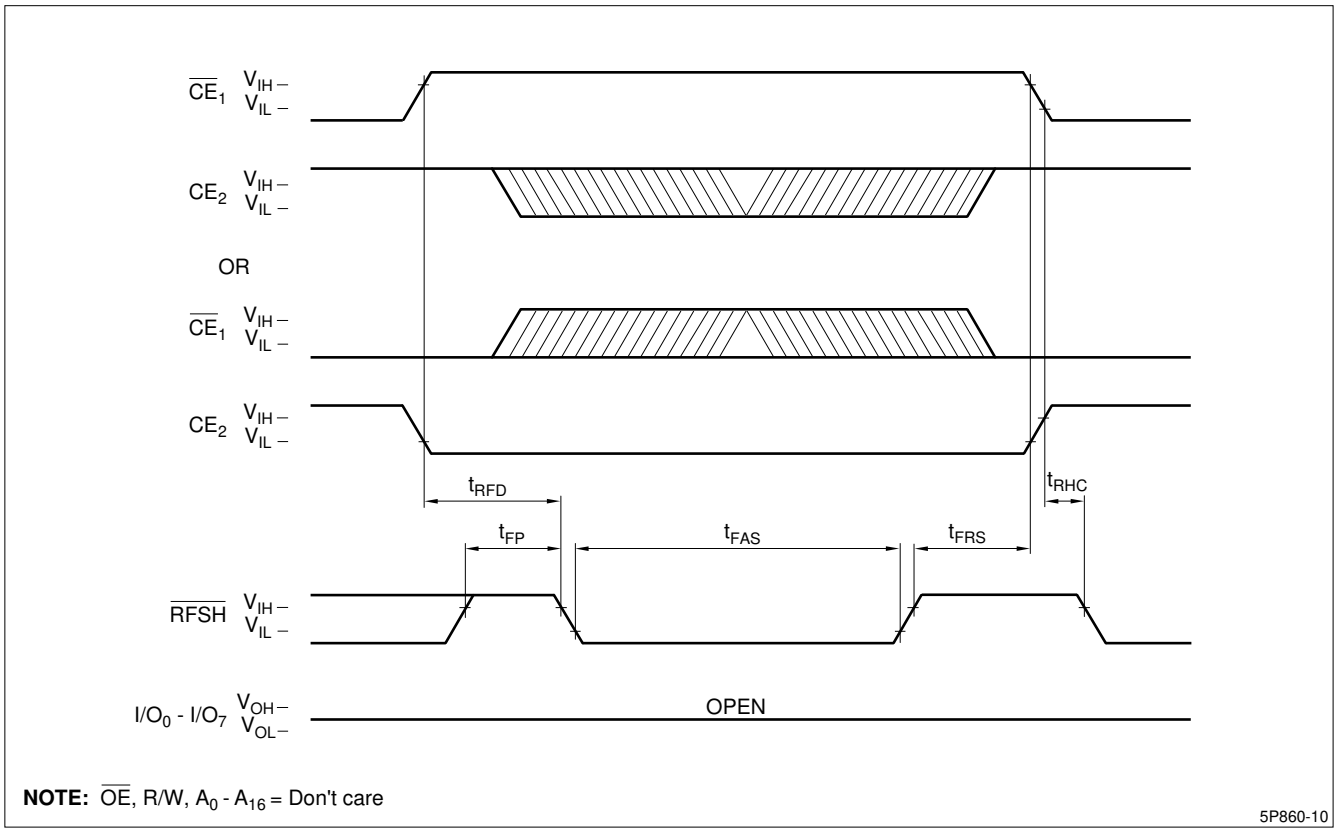
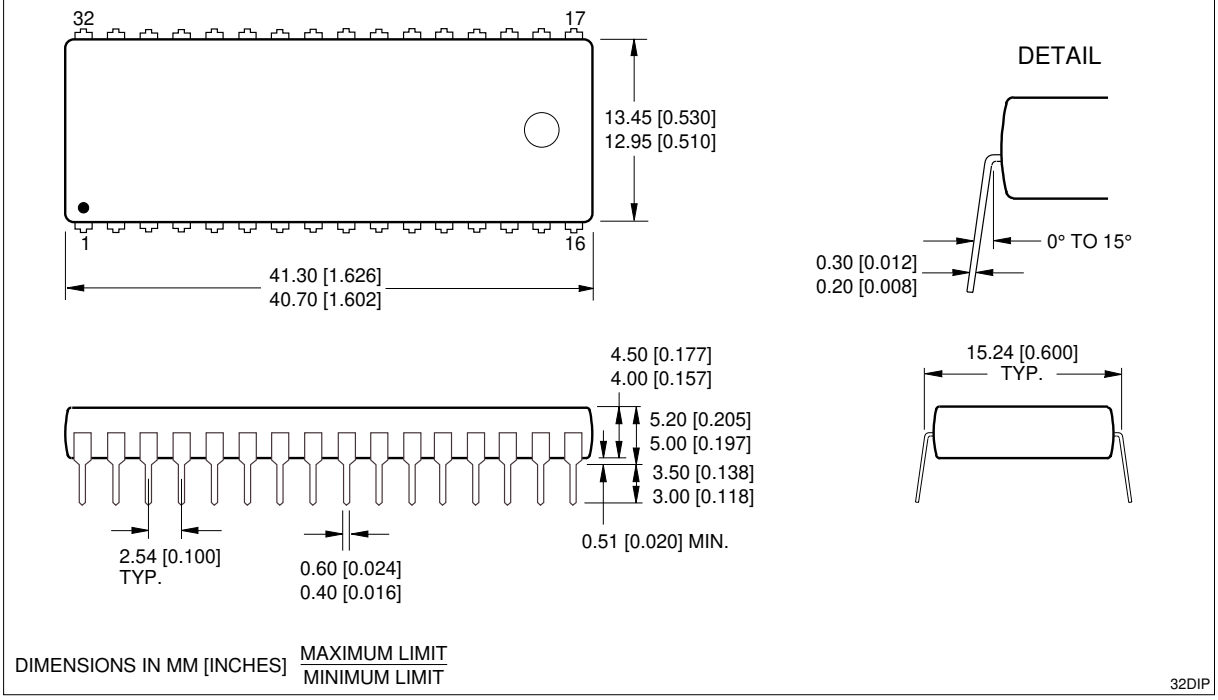


Figure 10. Self Refresh Cycle

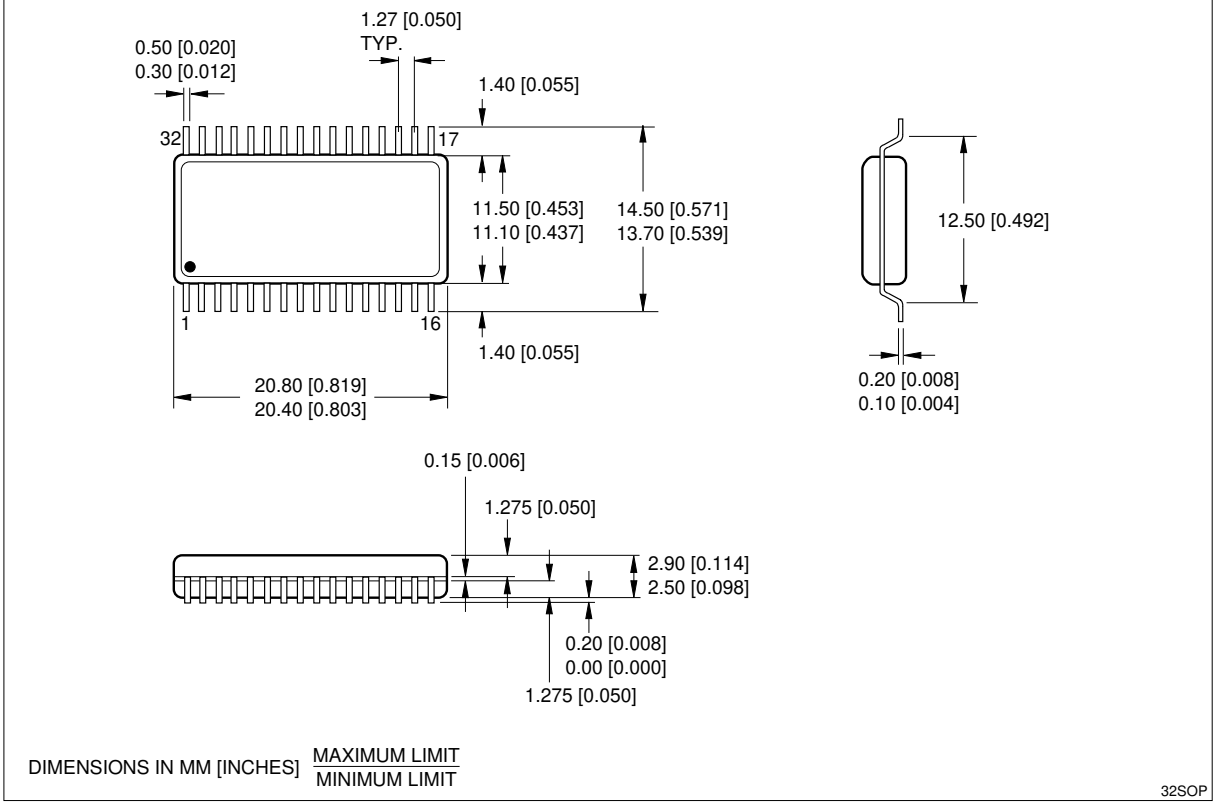
PACKAGE DIAGRAMS

32DIP (DIP032-P-0600)



32-pin, 600-mil DIP

32SOP (SOP032-P-0525)



32-pin, 525-mil SOP

ORDERING INFORMATION

