Ordering number : EN5823

CMOS IC

LC35256D-10, LC35256DM, DT-70/10

Dual Control Pins: $\overline{OE}$ and $\overline{CE}$
256K (32768-word × 8-bit) SRAM

Overview

The LC35256D, LC35256DM, and LC35256DT are 32768-word × 8-bit asynchronous silicon gate CMOS static RAMs. These devices use a 6-transistor full CMOS memory cell, and feature low-voltage operation, low current drain, and an ultralow standby current. They provide two control signal inputs: an $\overline{OE}$ input for high-speed access and a chip select ($\overline{CE}$) input for device selection and low power operating mode. This makes these devices optimal for systems that require low power or battery backup, and they allow memory to be expanded easily. Their ultralow standby current allows capacitor-based backup to be used as well. Since they support 3-V operation, they are appropriate for use in portable systems that operate from batteries.

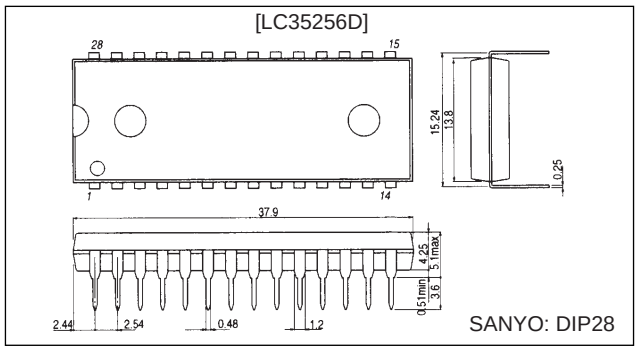
Features

- Supply voltage range: 2.7 to 5.5 V
  - — 5-V operation: 5.0 V±10%
  - — 3-V operation: 2.7 to 3.6 V
- Access times
  - — 5-V operation
    LC35256DM, DT-70: 70 ns (max)
    LC35256D, DM, DT-10: 100 ns (max)
  - — 3-V operation
    LC35256DM, DT-70: 200 ns (max)
    LC35256D, DM, DT-10: 500 ns (max)
- Standby current
  - — 5-V operation: 1.0 µA (Ta ≤ 60°C),
    5.0 µA (Ta ≤ 85°C)
  - — 3-V operation: 0.8 µA (Ta ≤ 60°C),
    4.0 µA (Ta ≤ 85°C)
- Operating temperature range: –40 to +85°C
- Data retention supply voltage: 2.0 to 5.5 V
- All I/O levels
  - — 5-V operation: TTL compatible
  - — 3-V operation: V_{CC} – 0.2 V/0.2 V
- Shared I/O pins and 3-state outputs
- No clock signal required.
- Packages
  - — 28-pin DIP (600 mil) plastic package: LC35256D
  - — 28-pin SOP (450 mil) plastic package: LC35256DM
  - — 28-pin TSOP (8 × 13.4 mm) plastic package: LC35256DT

Package Dimensions

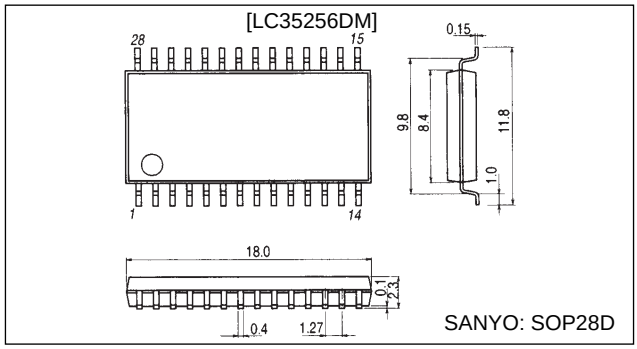
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3012A-DIP28



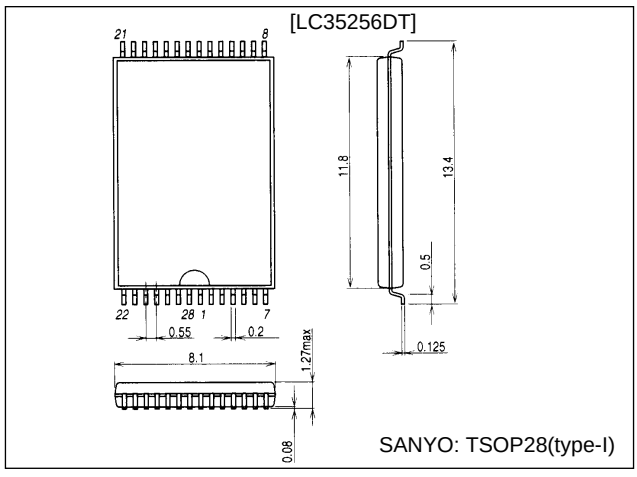
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3187-SOP28D



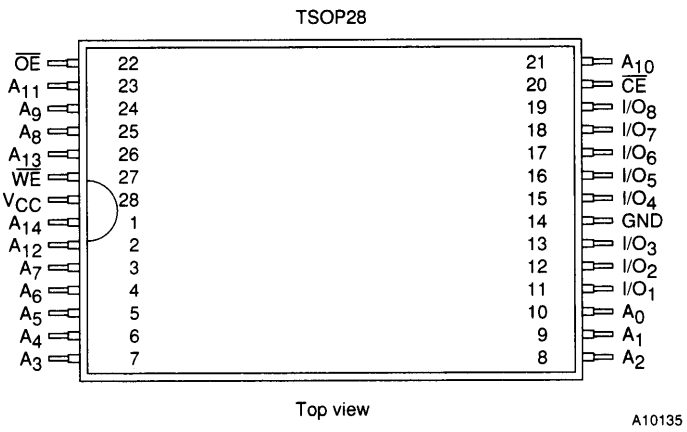
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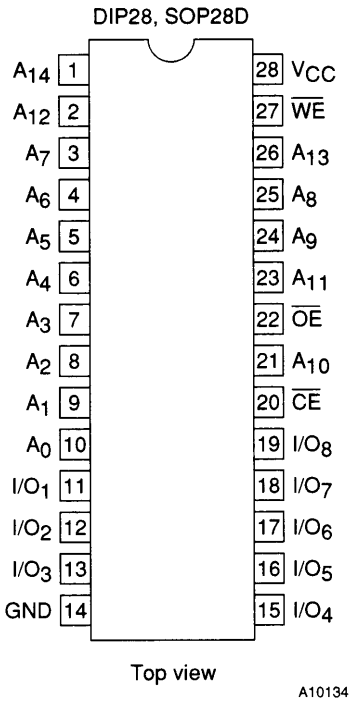
3221-TSOP28(type-I)



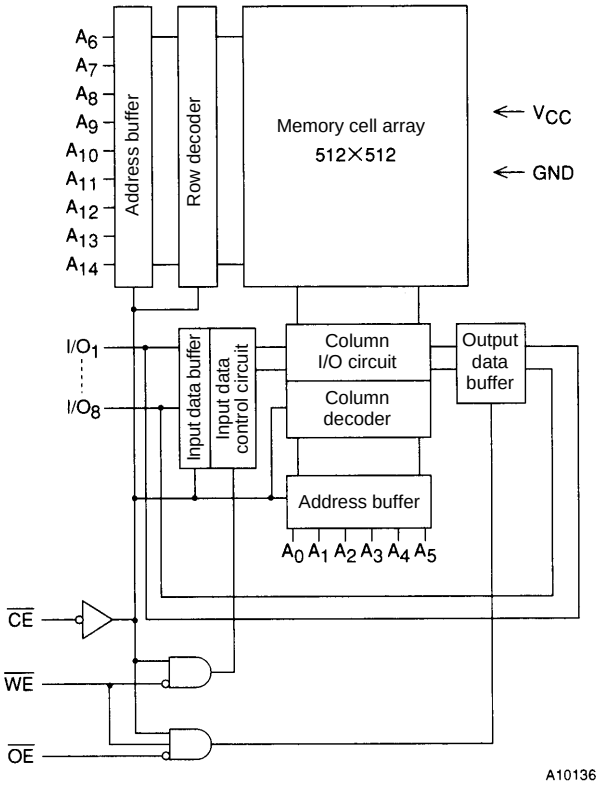
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Pin Assignment





Block Diagram



Pin Functions

A0 to A14	Address inputs
$\overline{WE}$	Read/write control input
$\overline{OE}$	Output enable input
$\overline{CE}$	Chip enable input
I/O1 to I/O8	Data I/O
V_{CC}, GND	Power supply, ground

Function Table

Mode	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O	Supply current
Read cycle	L	L	H	Data output	I_{CCA}
Write cycle	L	X	L	Data input	I_{CCA}
Output disable	L	H	H	High-impedance	I_{CCA}
Unselected	H	X	X	High-impedance	I_{CCS}

X : H or L

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		7.0	V
Input pin voltage	V_{IN}		–0.3* to V_{CC} + 0.3	V
I/O pin voltage	$V_{I/O}$		–0.3 to V_{CC} + 0.3	V
Operating temperature	Topr		–40 to +85	°C
Storage temperature	Tstg		–55 to +125	°C

Note *: –3.0 V for pulse widths of up to 30 ns.

I/O Capacitances at Ta = 25°C, f = 1 MHz

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
I/O pin capacitance	$C_{I/O}$	$V_{I/O}$ = 0 V		6	10	pF
Input pin capacitance	C_{IN}	V_{IN} = 0 V		6	10	pF

Note: These parameters are not measured in all units, but rather are only measured in sampled units.

[5-V Operation]

DC Allowable Operating Ranges at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		4.5	5.0	5.5	V
Input voltages	V_{IH}		2.2		V_{CC} + 0.3	V
	V_{IL}		–0.3*		+0.8	V

Note *: –3.0 V for pulse widths of up to 30 ns.

DC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

Parameter		Symbol	Conditions			Ratings			Unit
						min	typ*	max	
Input leakage current		I_{LI}	V_{IN} = 0 to V_{CC}			–1.0		+1.0	µA
Output leakage current		I_{LO}	$V_{\overline{CE}}$ = V_{IH} or $V_{\overline{OE}}$ = V_{IH} or $V_{\overline{WE}}$ = V_{IL}, $V_{I/O}$ = 0 to V_{CC}			–1.0		+1.0	µA
High-level output voltage		V_{OH}	I_{OH} = –1.0 mA			2.4			V
Low-level output voltage		V_{OL}	I_{OL} = 2.0 mA					0.4	V
Operating current drain	TTL inputs	I_{CCA2}	$V_{\overline{CE}}$ = V_{IL}, $I_{I/O}$ = 0 mA, V_{IN} = V_{IH} or V_{IL}					5.0	mA
		I_{CCA3}	$V_{\overline{CE}}$ = V_{IL}, V_{IN} = V_{IH} or V_{IL}, $I_{I/O}$ = 0 mA, Duty 100%	min cycle	LC35256DM, DT-70		35	40	mA
					LC35256D, DM, DT-10		25	30	mA
				1 µs cycle			3.5	6.0	mA
Standby mode current drain	V_{CC} – 0.2 V/ 0.2 V inputs	I_{CCS1}	$V_{\overline{CE}}$ ≥ V_{CC} – 0.2 V, V_{IN} = 0 to V_{CC}		Ta ≤ 25°C		0.01		µA
					Ta ≤ 60°C			1.0	µA
					Ta ≤ 85°C			5.0	µA
	TTL inputs	I_{CCS2}	$V_{\overline{CE}}$ = V_{IH}, V_{IN} = 0 to V_{CC}					1.0	mA

Note *: Reference value at Ta = 25°C, V_{CC} = 5 V.

AC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 4.5 to 5.5 V

AC test conditions		
Input pulse voltage level		V_{IH} = 2.4 V, V_{IL} = 0.6 V
Input rise and fall times		5 ns
Input and output timing level		1.5 V
Output load	LC35256DM, DT-70	One TTL gate + 30 pF (Including jig capacitances.)
	LC35256D, DM, DT-10	One TTL gate + 100 pF (Including jig capacitances.)

Read Cycle

Parameter	Symbol	LC35256D, DM, DT				Unit
		-70*		-10		
		min	max	min	max	
Read cycle time	t_{RC}	70		100		ns
Address access time	t_{AA}		70		100	ns
$\overline{CE}$ access time	t_{CA}		70		100	ns
$\overline{OE}$ access time	t_{OA}		35		50	ns
Output hold time	t_{OH}	10		10		ns
$\overline{CE}$ output enable time	t_{COE}	10		10		ns
$\overline{OE}$ output enable time	t_{OOE}	5		5		ns
$\overline{CE}$ output disable time	t_{COD}		30		30	ns
$\overline{OE}$ output disable time	t_{OOD}		25		25	ns

Note *: Specification values for the LC35256DM and LC35256DT.

Write Cycle

Parameter	Symbol	LC35256D, DM, DT				Unit
		-70*		-10		
		min	max	min	max	
Write cycle time	t_{WC}	70		100		ns
Address setup time	t_{AS}	0		0		ns
Write pulse width	t_{WP}	55		60		ns
$\overline{CE}$ setup time	t_{CW}	60		70		ns
Write recovery time	t_{WR}	0		0		ns
$\overline{CE}$ write recovery time	t_{WR1}	0		0		ns
Data setup time	t_{DS}	35		40		ns
Data hold time	t_{DH}	0		0		ns
$\overline{CE}$ data hold time	t_{DH1}	0		0		ns
$\overline{WE}$ output enable time	t_{WOE}	5		5		ns
$\overline{WE}$ output disable time	t_{WOD}		30		30	ns

Note *: Specification values for the LC35256DM and LC35256DT.

[3-V Operation]

DC Allowable Operating Ranges at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.6 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		2.7	3.0	3.6	V
Input voltages	V_{IH}		V_{CC} – 0.2		V_{CC} + 0.3	V
	V_{IL}		–0.3*		+0.2	V

Note *: –2.0 V for pulse widths of up to 30 ns.

DC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.6 V

Parameter		Symbol	Conditions			Ratings min	Ratings typ*	Ratings max	Unit
Input leakage current		I_{LI}	V_{IN} = 0 to V_{CC}			–1.0		+1.0	µA
Output leakage current		I_{LO}	$V_{\overline{CE}} = V_{IH}$ or $V_{\overline{OE}} = V_{IH}$ or $V_{\overline{WE}} = V_{IL}$, $V_{I/O}$ = 0 to V_{CC}			–1.0		+1.0	µA
High-level output voltage		V_{OH}	I_{OH} = –0.5 mA			V_{CC} – 0.2			V
Low-level output voltage		V_{OL}	I_{OL} = 1.0 mA					0.2	V
Operating current drain	V_{CC} – 0.2 V/ 0.2 V inputs	I_{CCA4}	$V_{\overline{CE}} = V_{IL}$, $V_{IN} = V_{IH}$ or V_{IL}, $I_{I/O}$ = 0 mA, Duty 100%	min cycle	LC35256DM, DT-70		7	10	mA
					LC35256D, DM, DT-10		3	5	mA
				1 µs cycle			1.5	2.5	mA
Standby mode current drain	V_{CC} – 0.2 V/ 0.2 V inputs	I_{CCS1}	$V_{\overline{CE}} \geq V_{CC}$ – 0.2 V, V_{IN} = 0 to V_{CC}		Ta ≤ 25°C		0.01		µA
					Ta ≤ 60°C			0.8	µA
					Ta ≤ 85°C			4.0	µA

Note *: Reference value at Ta = 25°C, V_{CC} = 3 V.

AC Electrical Characteristics at Ta = –40 to +85°C, V_{CC} = 2.7 to 3.6 V

AC test conditions		
Input pulse voltage level		$V_{IH} = V_{CC}$ – 0.2 V, V_{IL} = 0.2 V
Input rise and fall times		10 ns
Input and output timing level		1.5 V
Output load	LC35256DM, DT-70	30 pF (Including jig capacitances.)
	LC35256D, DM, DT-10	100 pF (Including jig capacitances.)

Read Cycle

Parameter	Symbol	LC35256D, DM, DT -70* min	LC35256D, DM, DT -70* max	LC35256D, DM, DT -10 min	LC35256D, DM, DT -10 max	Unit
Read cycle time	t_{RC}	200		500		ns
Address access time	t_{AA}		200		500	ns
$\overline{CE}$ access time	t_{CA}		200		500	ns
$\overline{OE}$ access time	t_{OA}		100		250	ns
Output hold time	t_{OH}	20		20		ns
$\overline{CE}$ output enable time	t_{COE}	20		20		ns
$\overline{OE}$ output enable time	t_{OOE}	10		10		ns
$\overline{CE}$ output disable time	t_{COD}		60		120	ns
$\overline{OE}$ output disable time	t_{OOD}		50		100	ns

Note *: Specification values for the LC35256DM and LC35256DT.

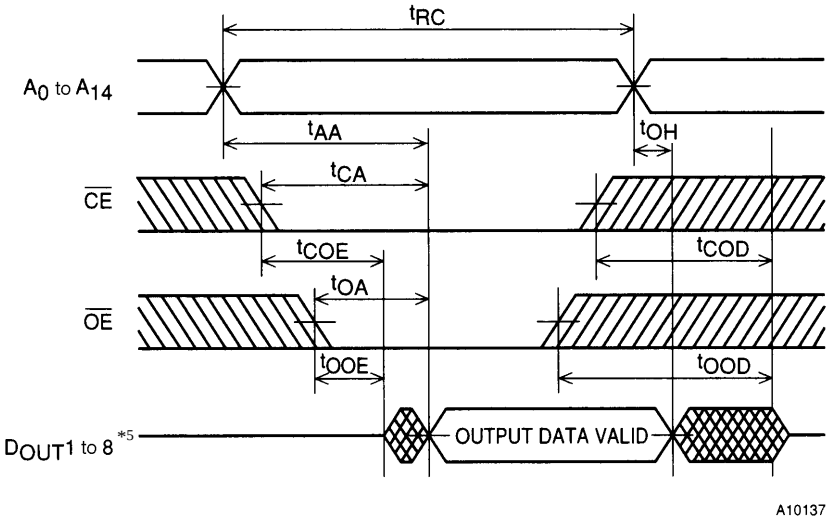
Write Cycle

Parameter	Symbol	LC35256D, DM, DT				Unit
		-70*		-10		
		min	max	min	max	
Write cycle time	t_{WC}	200		500		ns
Address setup time	t_{AS}	0		0		ns
Write pulse width	t_{WP}	140		200		ns
$\overline{CE}$ setup time	t_{CW}	150		250		ns
Write recovery time	t_{WR}	0		0		ns
$\overline{CE}$ write recovery time	t_{WR1}	0		0		ns
Data setup time	t_{DS}	130		180		ns
Data hold time	t_{DH}	0		0		ns
$\overline{CE}$ data hold time	t_{DH1}	0		0		ns
$\overline{WE}$ output enable time	t_{WOE}	10		10		ns
$\overline{WE}$ output disable time	t_{WOD}		60		120	ns

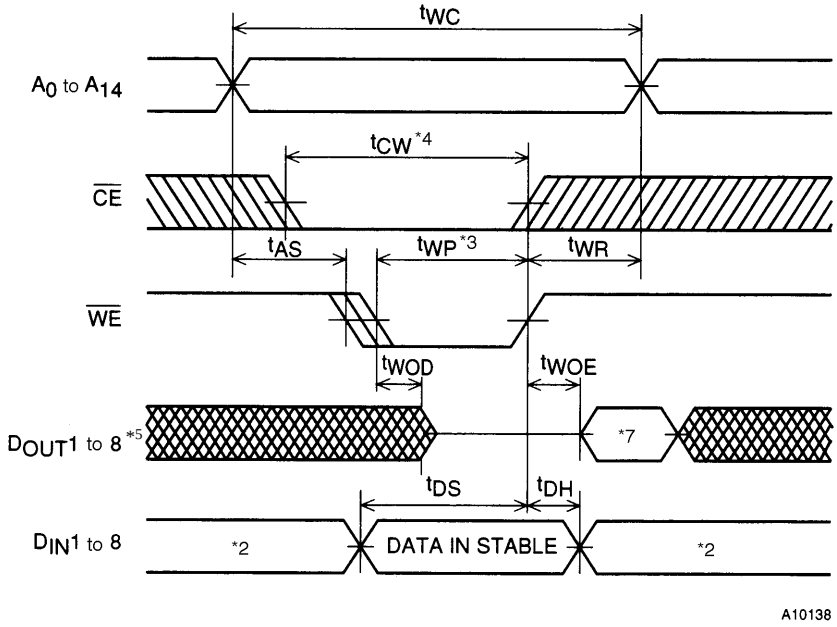
Note *: Specification values for the LC35256DM and LC35256DT.

Timing Charts

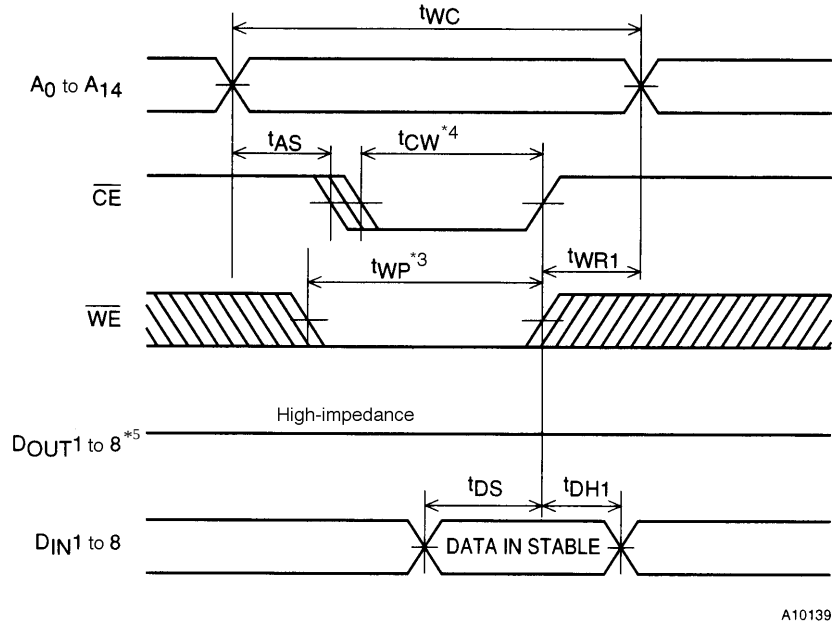
Read Cycle *1



Write Cycle 1 ($\overline{WE}$ write) *6



Write Cycle 2 ($\overline{CE}$ write) *6



Notes: 1. Applications must set $\overline{WE}$ high during the read cycle.
2. External circuits in the application must not apply reverse phase signals to the D_{OUT} pins when those pins are in the output state.
3. The time t_{WP} is the period when $\overline{CE}$ and $\overline{WE}$ are both low. It is defined as the time from the fall of $\overline{WE}$ to the rise of $\overline{CE}$ or the rise of $\overline{WE}$, whichever occurs first.
4. The time t_{CW} is the period when $\overline{CE}$ and $\overline{WE}$ are both low. It is defined as the time from the fall of $\overline{CE}$ to the rise of $\overline{CE}$ or the rise of $\overline{WE}$, whichever occurs first.
5. The data outputs (D_{OUT}) go to the high-impedance state if any one of the following conditions hold: $\overline{OE}$ is high, $\overline{CE}$ is high, or $\overline{WE}$ is low.
6. $\overline{OE}$ must be held either high or low during the write cycle.
7. The D_{OUT} pins have the same phase as the write cycle write data.

Notes on Circuit Design

Take the following operations into account when designing circuits that use these products to assure that none of the items in the maximum ratings are exceeded.

- Supply voltage variations and fluctuations
- Manufacturing variations in the electrical characteristics of the electrical components, including semiconductor devices, resistors, and capacitors.
- Ambient temperature
- Variations and fluctuations in the input and clock signals
- Possible application of abnormal pulses

Parameters listed in the allowable operating ranges must never exceed their stipulated ranges.

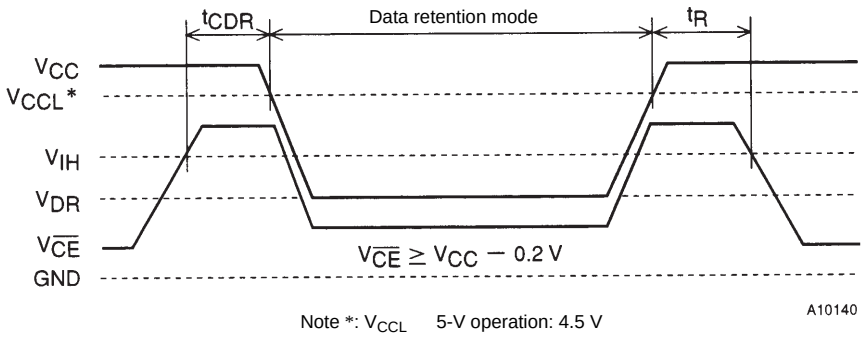
If input pins to a CMOS IC are left open, through currents may occur in internal circuits to which intermediate potentials are input and result in incorrect circuit operation. Always verify that any unused pins are set up in appropriate states.

Data Retention Characteristics at Ta = –40 to +85°C

Parameter	Symbol	Conditions		Ratings min	Ratings typ*1	Ratings max	Unit
Data retention supply voltage	V_{DR}	$V_{\overline{CE}} \geq V_{CC} - 0.2$ V		2.0		5.5	V
Data retention current drain	I_{CCDR}	V_{CC} = 3.0 V, $V_{\overline{CE}} \geq V_{CC} - 0.2$ V	Ta ≤ 25°C		0.01		µA
			Ta ≤ 60°C			0.7	µA
			Ta ≤ 85°C			3.5	µA
Chip enable setup time	t_{CDR}			0			ns
Chip enable hold time	t_R			t_{RC}*2			ns

Notes: 1. Reference value at Ta = 25°C, V_{CC} = 3 V.
2. t_{RC}: Read cycle time

Data Retention Waveforms



Note *: V_{CCL} 5-V operation: 4.5 V
3-V operation: 2.7 V

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