



1M x 36 and 2M x 18 36Mb, FLOW THROUGH 'NO WAIT' STATE BUS SRAM

FEBRUARY 2012

FEATURES

- 100 percent bus utilization
- No wait cycles between Read and Write
- Internal self-timed write cycle
- Individual Byte Write Control
- Single Read/Write control pin
- Clock controlled, registered address, data and control
- Interleaved or linear burst sequence control using MODE input
- Three chip enables for simple depth expansion and address pipelining
- Power Down mode
- Common data inputs and data outputs
- $\overline{\text{CKE}}$ pin to enable clock and suspend operation
- JEDEC 100-pin TQFP package
- Power supply:
NVF: V_{DD} 2.5V ($\pm 5\%$), V_{DDQ} 2.5V ($\pm 5\%$)
NLF: V_{DD} 3.3V ($\pm 5\%$), V_{DDQ} 3.3V/2.5V ($\pm 5\%$)
- Industrial temperature available
- Lead-free available

DESCRIPTION

The 36 Meg 'NLF/NVF' product family feature high-speed, low-power synchronous static RAMs designed to provide a burstable, high-performance, 'no wait' state, device for networking and communications applications. They are organized as 1M words by 36 bits and 2M words by 18 bits, fabricated with ISSI's advanced CMOS technology.

Incorporating a 'no wait' state feature, wait cycles are eliminated when the bus switches from read to write, or write to read. This device integrates a 2-bit burst counter, high-speed SRAM core, and high-drive capability outputs into a single monolithic circuit.

All synchronous inputs pass through registers are controlled by a positive-edge-triggered single clock input. Operations may be suspended and all synchronous inputs ignored when Clock Enable, $\overline{\text{CKE}}$ is HIGH. In this state the internal device will hold their previous values.

All Read, Write and Deselect cycles are initiated by the ADV input. When the ADV is HIGH the internal burst counter is incremented. New external addresses can be loaded when ADV is LOW.

Write cycles are internally self-timed and are initiated by the rising edge of the clock inputs and when $\overline{\text{WE}}$ is LOW. Separate byte enables allow individual bytes to be written.

A burst mode pin (MODE) defines the order of the burst sequence. When tied HIGH, the interleaved burst sequence is selected. When tied LOW, the linear burst sequence is selected.

FAST ACCESS TIME

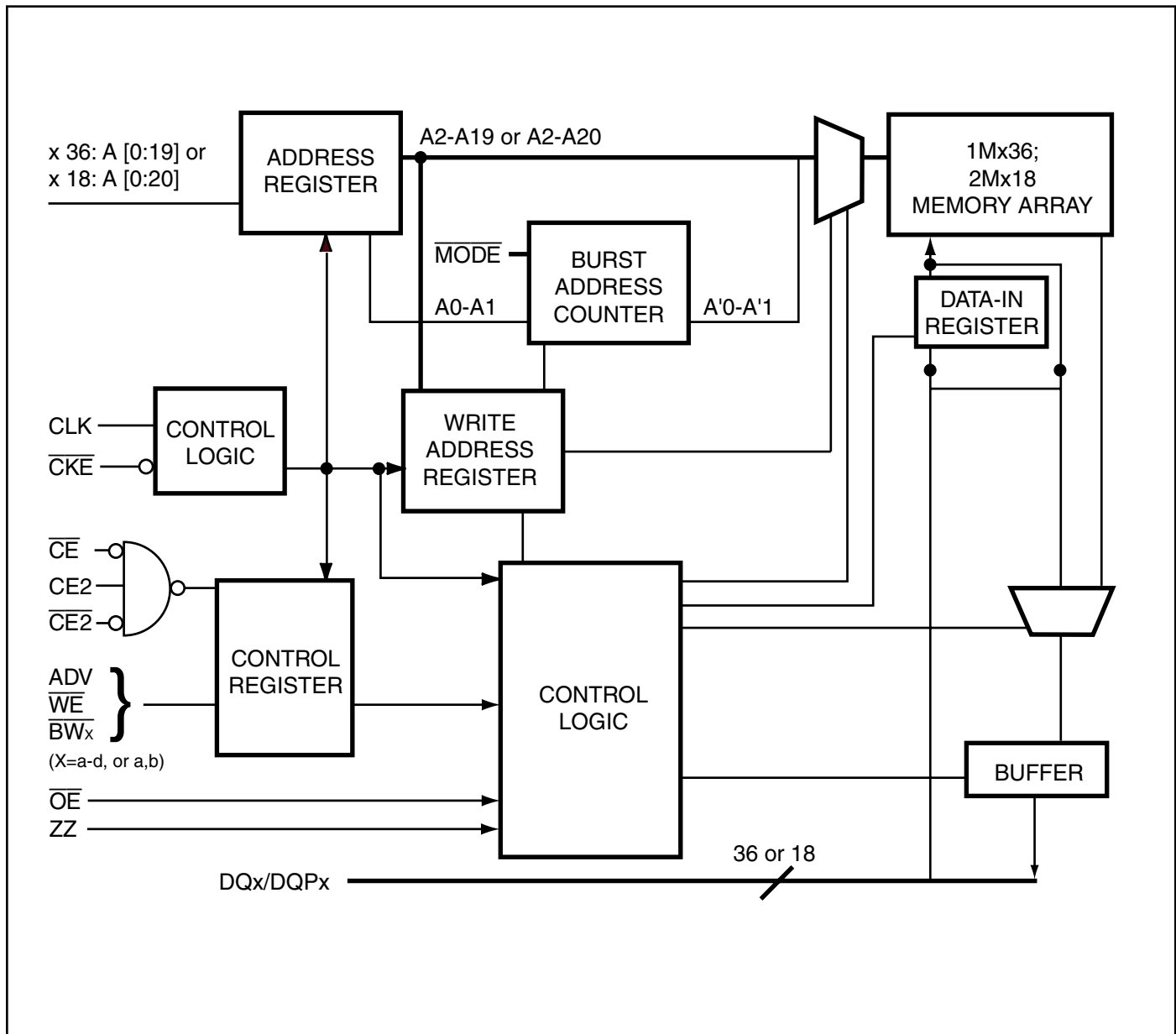
Symbol	Parameter	6.5	7.5	Units
t_{kQ}	Clock Access Time	6.5	7.5	ns
t_{kC}	Cycle Time	7.5	8.5	ns
	Frequency	133	117	MHz

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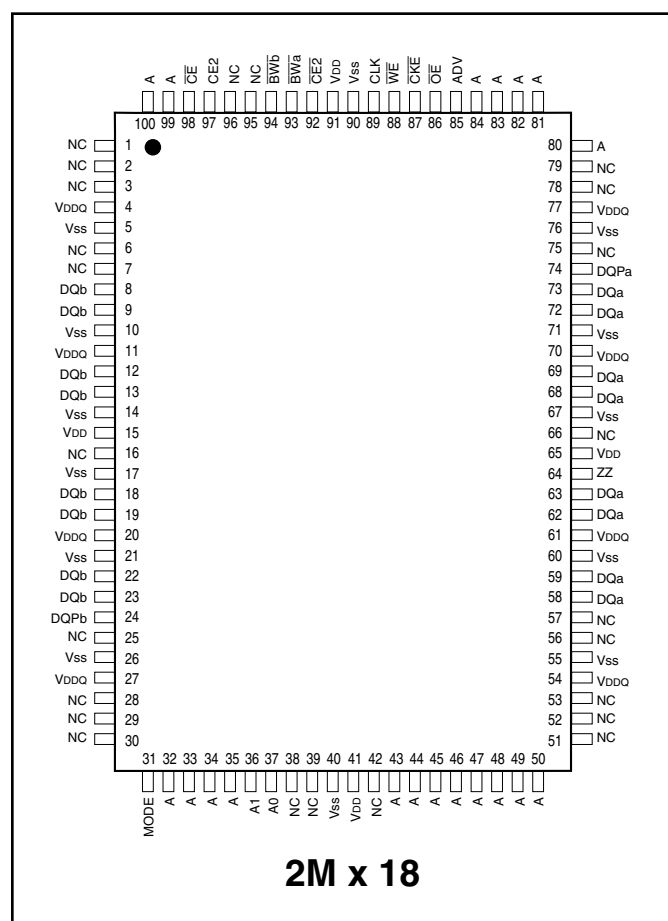
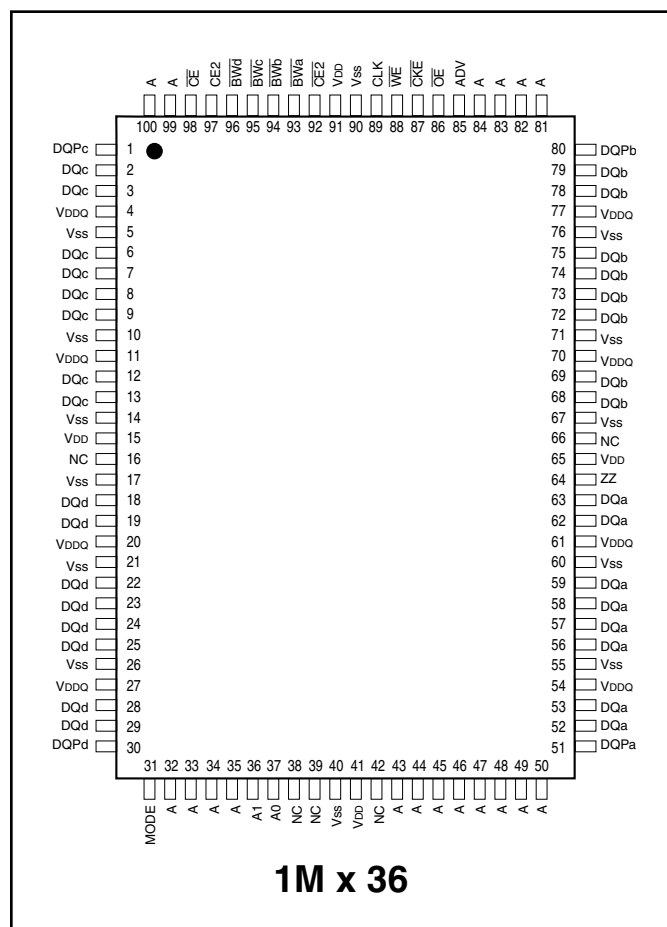
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BLOCK DIAGRAM



PIN CONFIGURATION
100-Pin TQFP

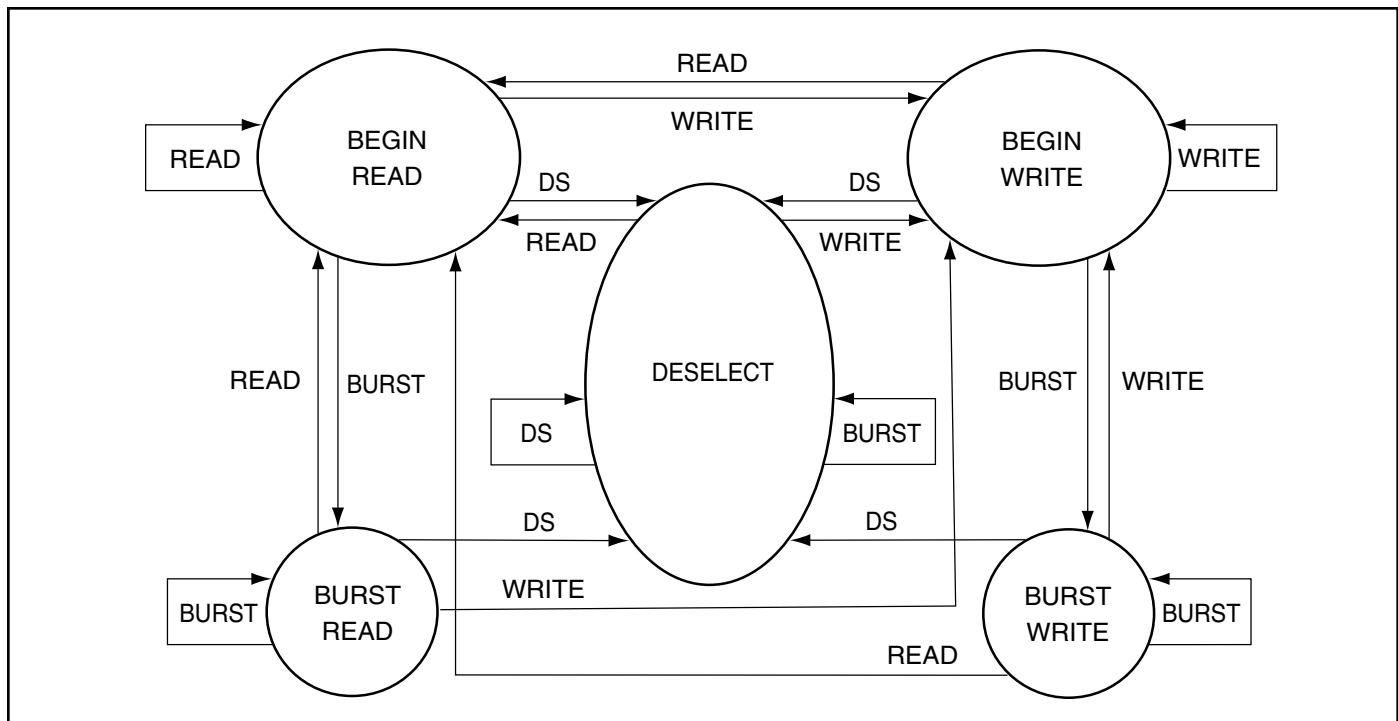


PIN DESCRIPTIONS

A0, A1	Synchronous Address Inputs. These pins must be tied to the two LSBs of the address bus.
A	Synchronous Address Inputs
CLK	Synchronous Clock
ADV	Synchronous Burst Address Advance
BWd-BWd	Synchronous Byte Write Enable
WE	Write Enable
CKE	Clock Enable
Vss	Ground for Core
NC	Not Connected

CE, CE2, CE2	Synchronous Chip Enable
OE	Output Enable
DQa-DQd	Synchronous Data Input/Output
DQPd-DQPd	Parity Data I/O
MODE	Burst Sequence Selection
VDD	+3.3V/2.5V Power Supply
Vss	Ground for output Buffer
VDDQ	Isolated Output Buffer Supply: +3.3V/2.5V
ZZ	Snooze Enable

STATE DIAGRAM



SYNCHRONOUS TRUTH TABLE⁽¹⁾

Operation	Address Used	\overline{CE}	CE2	$\overline{CE2}$	ADV	\overline{WE}	$\overline{BW_x}$	\overline{OE}	\overline{CKE}	CLK
Not Selected	N/A	H	X	X	L	X	X	X	L	↑
Not Selected	N/A	X	L	X	L	X	X	X	L	↑
Not Selected	N/A	X	X	H	L	X	X	X	L	↑
Not Selected Continue	N/A	X	X	X	H	X	X	X	L	↑
Begin Burst Read	External Address	L	H	L	L	H	X	L	L	↑
Continue Burst Read	Next Address	X	X	X	H	X	X	L	L	↑
NOP/Dummy Read	External Address	L	H	L	L	H	X	H	L	↑
Dummy Read	Next Address	X	X	X	H	X	X	H	L	↑
Begin Burst Write	External Address	L	H	L	L	L	L	X	L	↑
Continue Burst Write	Next Address	X	X	X	H	X	L	X	L	↑
NOP/Write Abort	N/A	L	H	L	L	L	H	X	L	↑
Write Abort	Next Address	X	X	X	H	X	H	X	L	↑
Ignore Clock	Current Address	X	X	X	X	X	X	X	H	↑

Notes:

- "X" means don't care.
- The rising edge of clock is symbolized by ↑
- A continue deselect cycle can only be entered if a deselect cycle is executed first.
- $\overline{WE} = L$ means Write operation in Write Truth Table.
 $\overline{WE} = H$ means Read operation in Write Truth Table.
- Operation finally depends on status of asynchronous pins (\overline{ZZ} and \overline{OE}).

ASYNCHRONOUS TRUTH TABLE⁽¹⁾

Operation	ZZ	\overline{OE}	I/O STATUS
Sleep Mode	H	X	High-Z
Read	L	L	DQ
	L	H	High-Z
Write	L	X	Din, High-Z
Deselected	L	X	High-Z

Notes:

1. X means "Don't Care".
2. For write cycles following read cycles, the output buffers must be disabled with \overline{OE} , otherwise data bus contention will occur.
3. Sleep Mode means power Sleep Mode where stand-by current does not depend on cycle time.
4. Deselected means power Sleep Mode where stand-by current depends on cycle time.

WRITE TRUTH TABLE (x18)

Operation	\overline{WE}	$\overline{Bw_a}$	$\overline{Bw_b}$
READ	H	X	X
WRITE BYTE a	L	L	H
WRITE BYTE b	L	H	L
WRITE ALL BYTES	L	L	L
WRITE ABORT/NOP	L	H	H

Notes:

1. X means "Don't Care".
2. All inputs in this table must be setup and hold time around the rising edge of CLK.

WRITE TRUTH TABLE (x36)

Operation	\overline{WE}	$\overline{Bw_a}$	$\overline{Bw_b}$	$\overline{Bw_c}$	$\overline{Bw_d}$
READ	H	X	X	X	X
WRITE BYTE a	L	L	H	H	H
WRITE BYTE b	L	H	L	H	H
WRITE BYTE c	L	H	H	L	H
WRITE BYTE d	L	H	H	H	L
WRITE ALL BYTES	L	L	L	L	L
WRITE ABORT/NOP	L	H	H	H	H

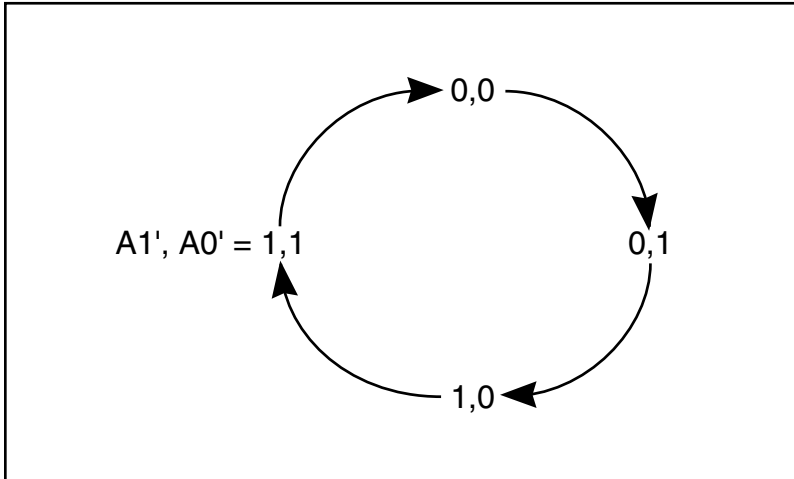
Notes:

1. X means "Don't Care".
2. All inputs in this table must be setup and hold time around the rising edge of CLK.

INTERLEAVED BURST ADDRESS TABLE (MODE = V_{DD} or NC)

External Address A1 A0	1st Burst Address A1 A0	2nd Burst Address A1 A0	3rd Burst Address A1 A0
00	01	10	11
01	00	11	10
10	11	00	01
11	10	01	00

LINEAR BURST ADDRESS TABLE (MODE = V_{SS})



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Parameter	Value	Unit
T _{STG}	Storage Temperature	-65 to +150	°C
P _D	Power Dissipation	1.6	W
I _{OUT}	Output Current (per I/O)	100	mA
V _{IN} , V _{OUT}	Voltage Relative to V _{SS} for I/O Pins	-0.5 to V _{DDQ} + 0.3	V
V _{IN}	Voltage Relative to V _{SS} for for Address and Control Inputs	-0.3 to 4.6	V

Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, precautions may be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.
3. This device contains circuitry that will ensure the output devices are in High-Z at power up.

OPERATING RANGE (IS61NLFx)

Range	Ambient Temperature	V _{DD}	V _{DDQ}
Commercial	0°C to +70°C	3.3V ± 5%	3.3V / 2.5V ± 5%
Industrial	-40°C to +85°C	3.3V ± 5%	3.3V / 2.5V ± 5%

OPERATING RANGE (IS61NVFx)

Range	Ambient Temperature	V _{DD}	V _{DDQ}
Commercial	0°C to +70°C	2.5V ± 5%	2.5V ± 5%
Industrial	-40°C to +85°C	2.5V ± 5%	2.5V ± 5%

DC ELECTRICAL CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	Test Conditions	3.3V		2.5V		Unit
			Min.	Max.	Min.	Max.	
V _{OH}	Output HIGH Voltage	I _{OH} = -4.0 mA (3.3V) I _{OH} = -1.0 mA (2.5V)	2.4	—	2.0	—	V
V _{OL}	Output LOW Voltage	I _{OL} = 8.0 mA (3.3V) I _{OL} = 1.0 mA (2.5V)	—	0.4	—	0.4	V
V _{IH}	Input HIGH Voltage		2.0	V _{DD} + 0.3	1.7	V _{DD} + 0.3	V
V _{IL}	Input LOW Voltage		-0.3	0.8	-0.3	0.7	V
I _{LI}	Input Leakage Current	V _{SS} ≤ V _{IN} ≤ V _{DD} ⁽¹⁾	-5	5	-5	5	μA
I _{LO}	Output Leakage Current	V _{SS} ≤ V _{OUT} ≤ V _{DDQ} , OE = V _{IH}	-5	5	-5	5	μA

POWER SUPPLY CHARACTERISTICS⁽¹⁾ (Over Operating Range)

Symbol	Parameter	Test Conditions	Temp. range	6.5 MAX		7.5 MAX		Unit
				x18	x36	x18	x36	
I _{CC}	AC Operating Supply Current	Device Selected, OE = V _{IH} , ZZ ≤ V _{IL} , All Inputs ≤ 0.2V or ≥ V _{DD} - 0.2V, Cycle Time ≥ t _{kc} min.	Com.	400	400	375	375	mA
			Ind.	425	425	400	400	
I _{SB}	Standby Current TTL Input	Device Deselected, V _{DD} = Max., All Inputs ≤ V _{IL} or ≥ V _{IH} , ZZ ≤ V _{IL} , f = Max.	Com.	200	200	190	190	mA
			Ind.	210	210	200	200	
I _{SBI}	Standby Current CMOS Input	Device Deselected, V _{DD} = Max., V _{IN} ≤ V _{SS} + 0.2V or ≥ V _{DD} - 0.2V f = 0	Com.	100	100	100	100	mA
			Ind.	105	105	105	105	
			typ. ⁽²⁾	390		340		
			typ. ⁽²⁾	40		40		

Note:

1. MODE pin has an internal pullup and should be tied to V_{DD} or V_{SS}. It exhibits ±100 μA maximum leakage current when tied to ≤ V_{SS} + 0.2V or ≥ V_{DD} - 0.2V.
2. Typical values are measured at V_{CC} = 3.3V, T_A = 25°C and not 100% tested.

CAPACITANCE^(1,2)

Symbol	Parameter	Conditions	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	6	pF
C _{OUT}	Input/Output Capacitance	V _{OUT} = 0V	8	pF

Notes:

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T_A = 25°C, f = 1 MHz, V_{DD} = 3.3V.

3.3V I/O AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0V to 3.0V
Input Rise and Fall Times	1.5 ns
Input and Output Timing and Reference Level	1.5V
Output Load	See Figures 1 and 2

3.3V I/O OUTPUT LOAD EQUIVALENT

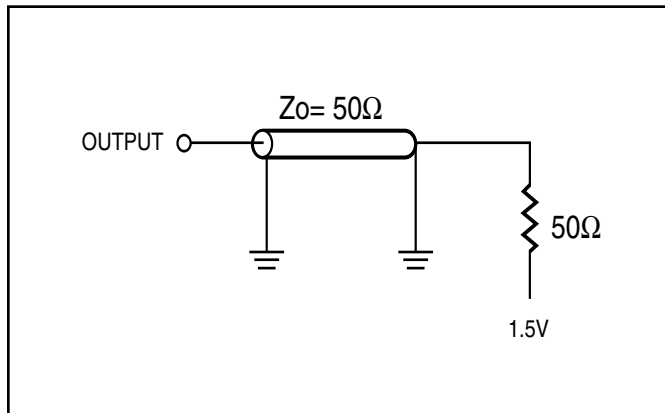


Figure 1

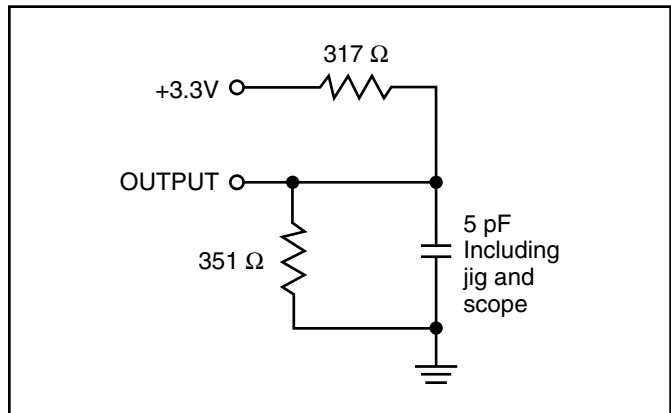


Figure 2

2.5V I/O AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0V to 2.5V
Input Rise and Fall Times	1.5 ns
Input and Output Timing and Reference Level	1.25V
Output Load	See Figures 3 and 4

2.5V I/O OUTPUT LOAD EQUIVALENT

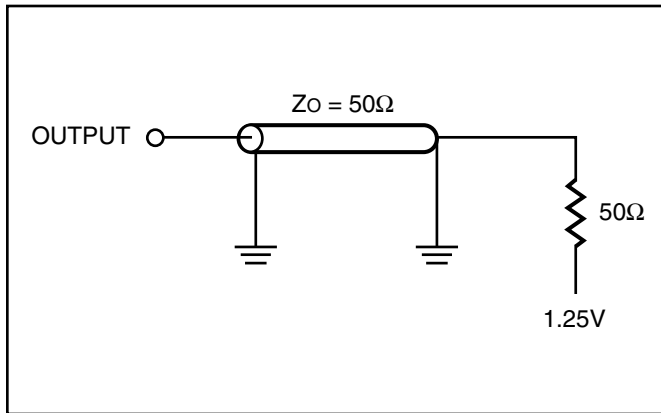


Figure 3

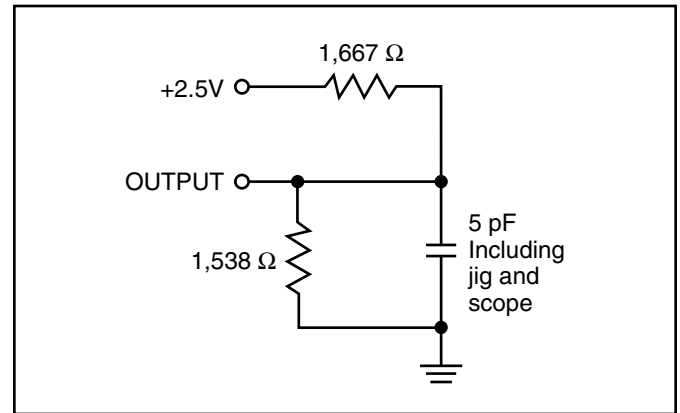


Figure 4

READ/WRITE CYCLE SWITCHING CHARACTERISTICS⁽¹⁾ (Over Operating Range)

Symbol	Parameter	6.5		7.5		Unit
		Min.	Max.	Min.	Max.	
fmax	Clock Frequency	—	133	—	117	MHz
tkc	Cycle Time	7.5	—	8.5	—	ns
tkH	Clock High Time	2.2	—	2.5	—	ns
tkL	Clock Low Time	2.2	—	2.5	—	ns
tkQ	Clock Access Time	—	6.5	—	7.5	ns
tkQX ⁽²⁾	Clock High to Output Invalid	2.5	—	2.5	—	ns
tkQLZ ^(2,3)	Clock High to Output Low-Z	2.5	—	2.5	—	ns
tkQHZ ^(2,3)	Clock High to Output High-Z	—	3.8	—	4.0	ns
toEQ	Output Enable to Output Valid	—	3.2	—	3.4	ns
toELZ ^(2,3)	Output Enable to Output Low-Z	0	—	0	—	ns
toEHZ ^(2,3)	Output Disable to Output High-Z	—	3.5	—	3.5	ns
tAS	Address Setup Time	1.5	—	1.5	—	ns
tWS	Read/Write Setup Time	1.5	—	1.5	—	ns
tCES	Chip Enable Setup Time	1.5	—	1.5	—	ns
tSE	Clock Enable Setup Time	1.5	—	1.5	—	ns
tADVS	Address Advance Setup Time	1.5	—	1.5	—	ns
tDS	Data Setup Time	1.5	—	1.5	—	ns
tAH	Address Hold Time	0.65	—	0.65	—	ns
tHE	Clock Enable Hold Time	0.5	—	0.5	—	ns
tWH	Write Hold Time	0.5	—	0.5	—	ns
tCEH	Chip Enable Hold Time	0.5	—	0.5	—	ns
tADVH	Address Advance Hold Time	0.5	—	0.5	—	ns
tDH	Data Hold Time	0.5	—	0.5	—	ns
tpDS	ZZ High to Power Down	—	2	—	2	cyc
tpUS	ZZ Low to Power Down	—	2	—	2	cyc

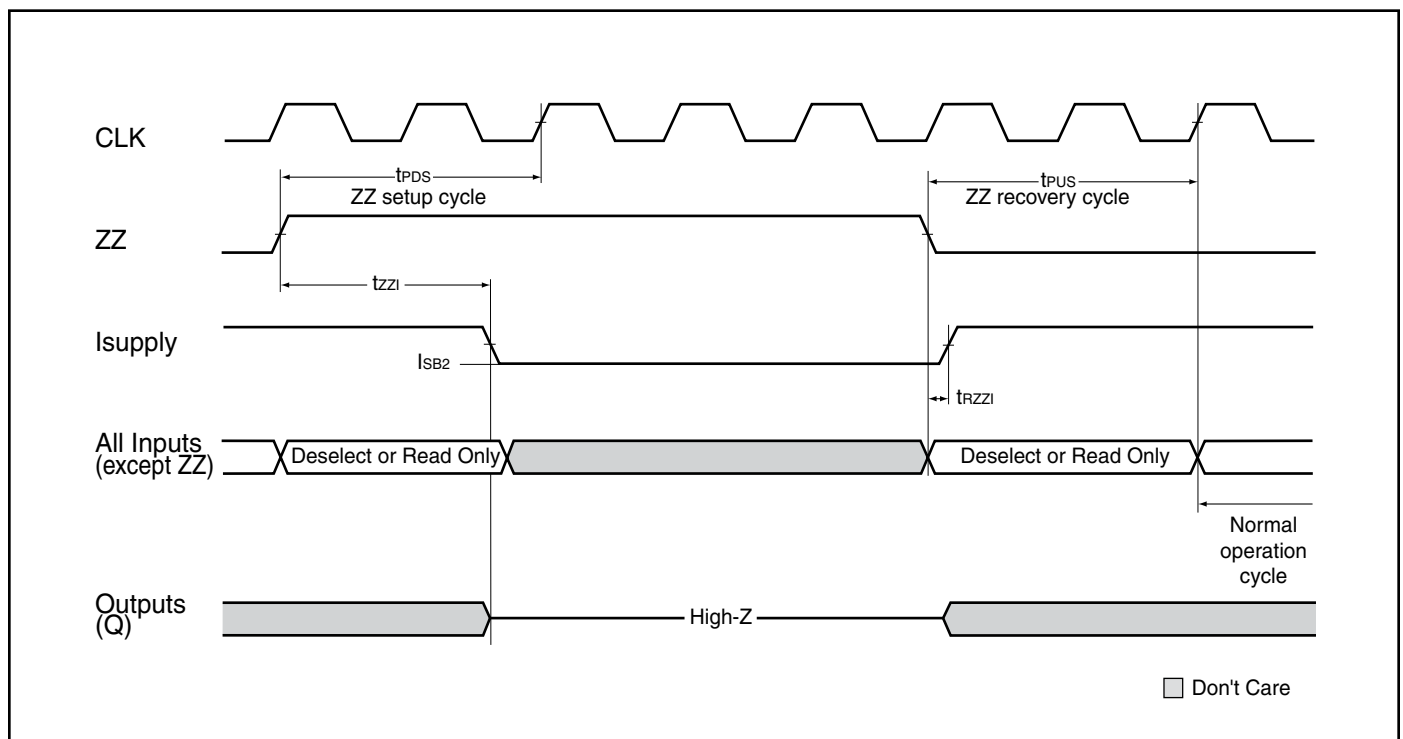
Notes:

1. Configuration signal MODE is static and must not change during normal operation.
2. Guaranteed but not 100% tested. This parameter is periodically sampled.
3. Tested with load in Figure 2.

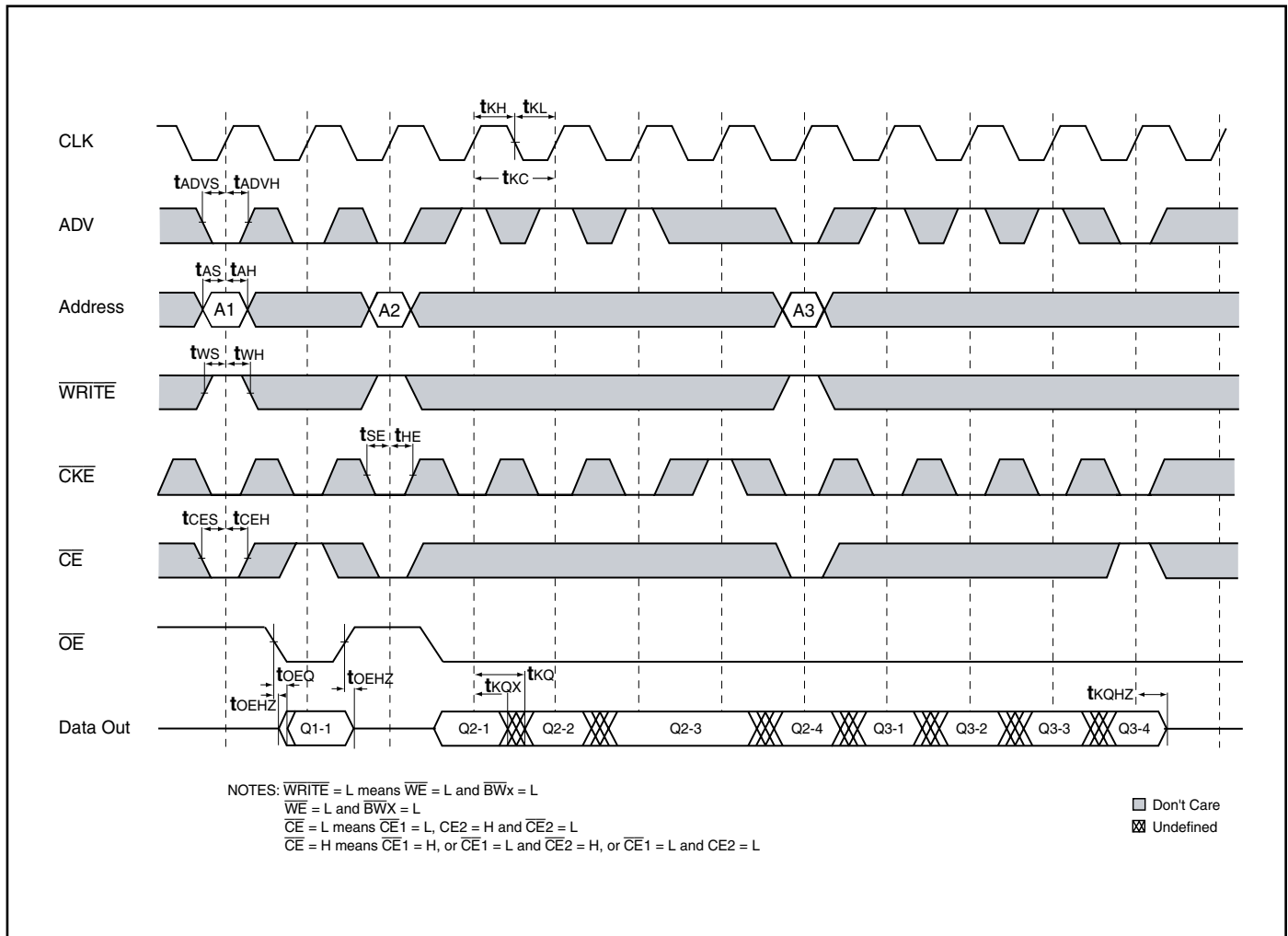
SLEEP MODE ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Max.	Unit
I_{SB2}	Current during SLEEP MODE	$ZZ \geq V_{IH}$		80	mA
t_{PDS}	ZZ active to input ignored			2	cycle
t_{PUS}	ZZ inactive to input sampled		2		cycle
t_{ZZI}	ZZ active to SLEEP current		2		cycle
t_{RZZI}	ZZ inactive to exit SLEEP current		0		ns

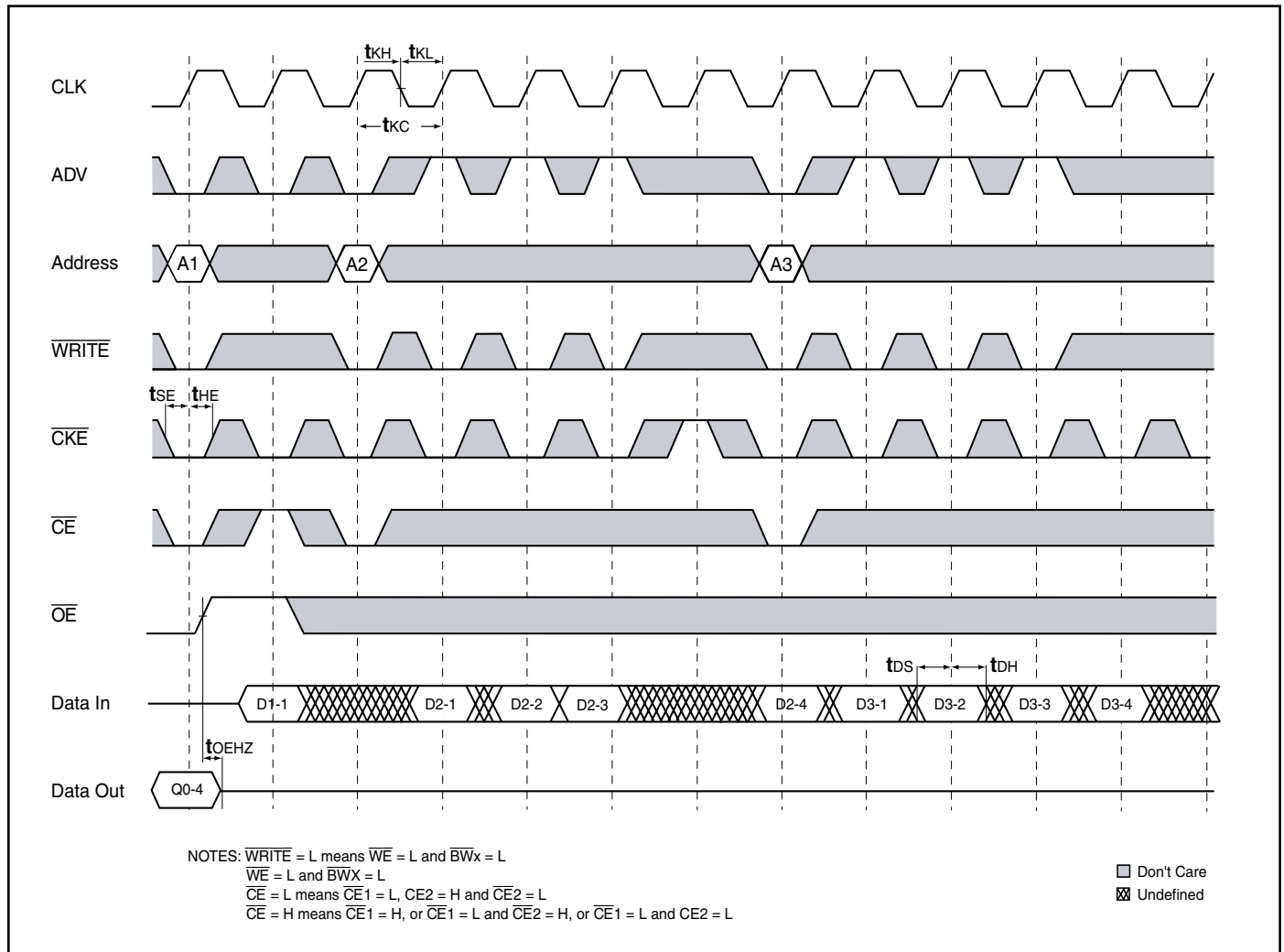
SLEEP MODE TIMING



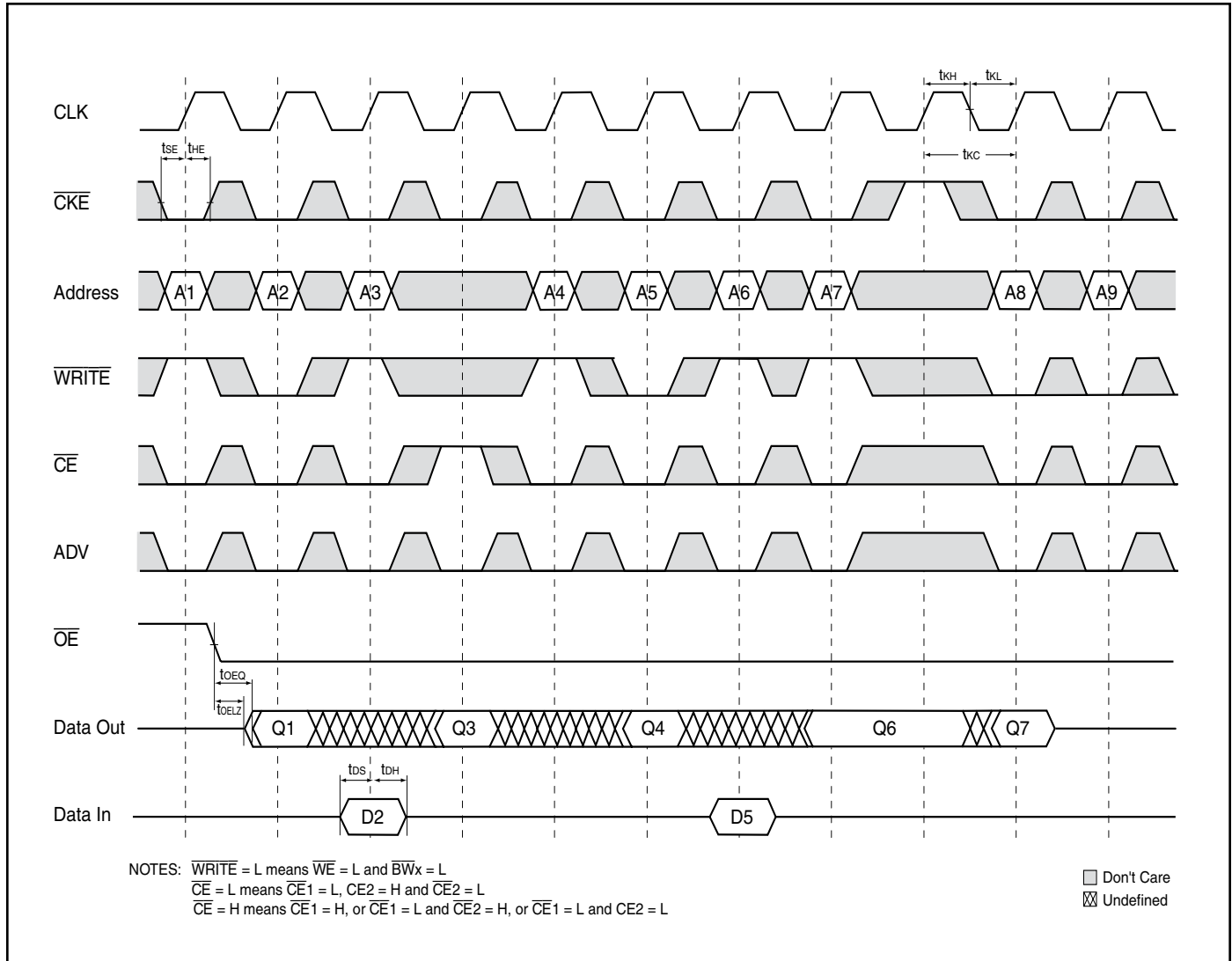
READ CYCLE TIMING



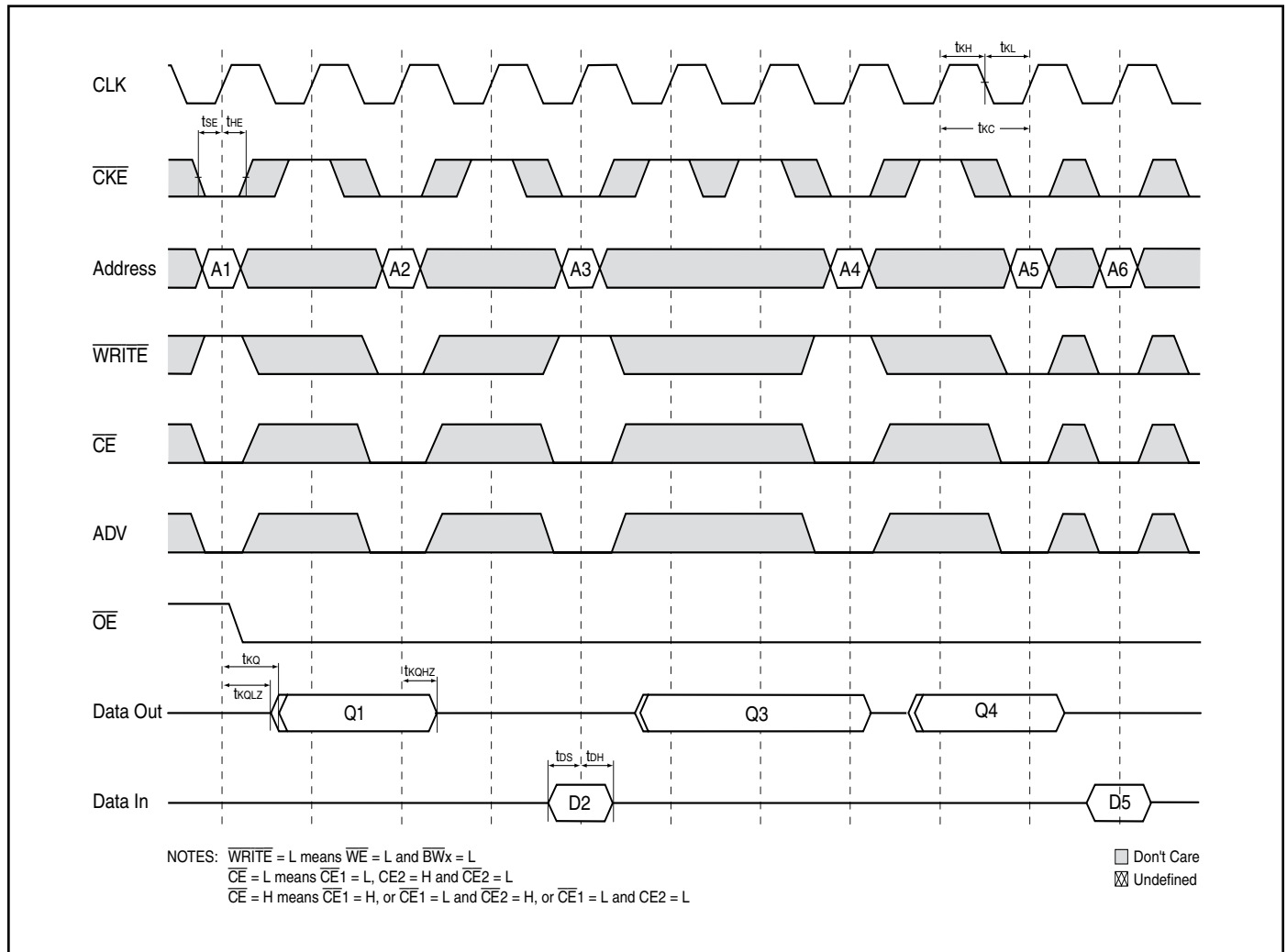
WRITE CYCLE TIMING



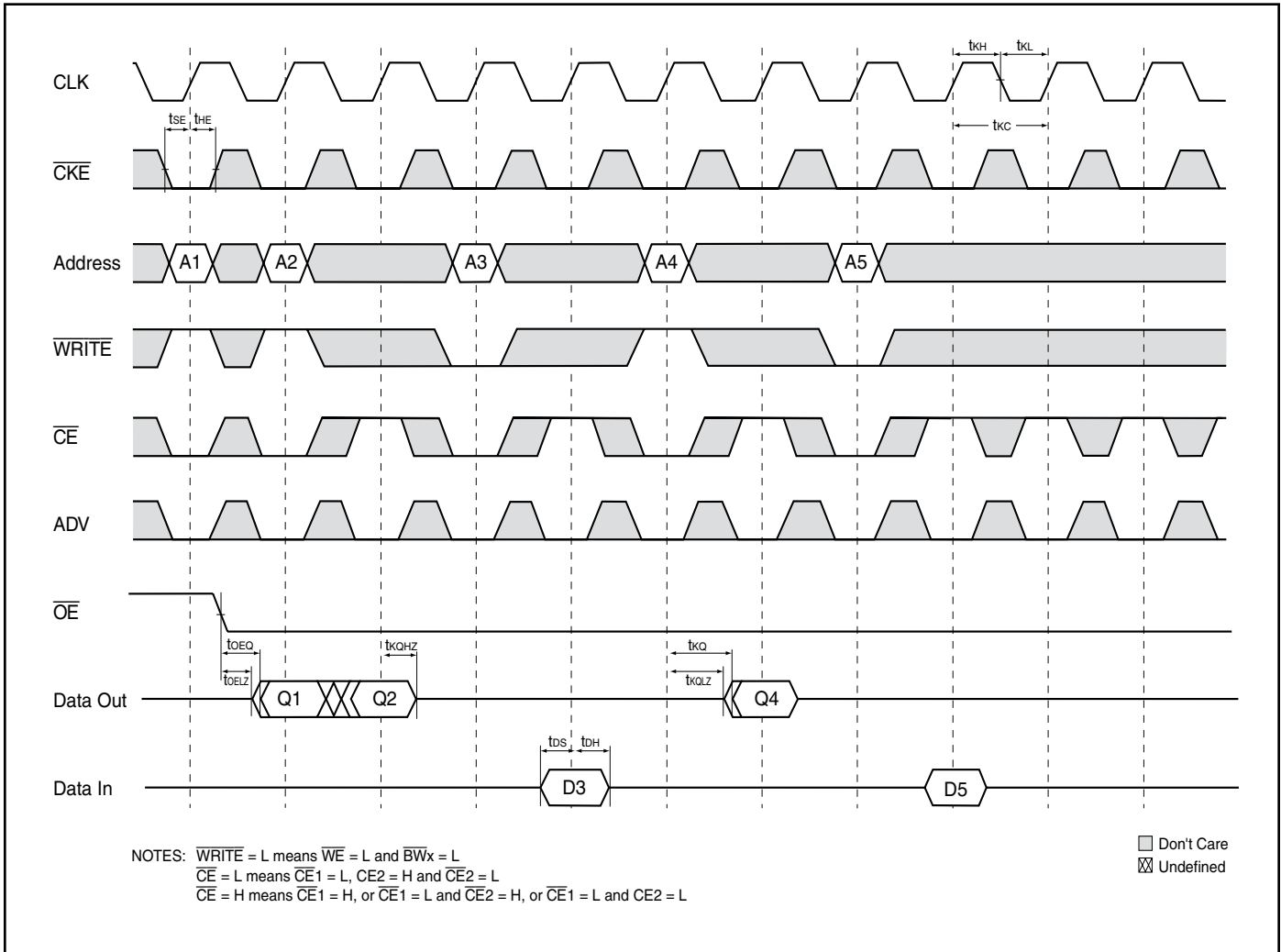
SINGLE READ/WRITE CYCLE TIMING



CKE OPERATION TIMING



CE OPERATION TIMING



ORDERING INFORMATION ($V_{DD} = 3.3V/V_{DDQ} = 2.5V- 3.3V$)

Commercial Range: 0°C to +70°C

Access Time	Order Part Number	Package
1Mx36		
6.5	IS61NLF102436A-6.5TQ	100 TQFP
7.5	IS61NLF102436A-7.5TQ	100 TQFP
2Mx18		
6.5	IS61NLF204818A-6.5TQ	100 TQFP
7.5	IS61NLF204818A-7.5TQ	100 TQFP

Industrial Range: -40°C to +85°C

Access Time	Order Part Number	Package
1Mx36		
6.5	IS61NLF102436A-6.5TQI	100 TQFP
7.5	IS61NLF102436A-7.5TQI	100 TQFP
	IS61NLF102436A-7.5TQLI	100 TQFP, Lead-free
2Mx18		
6.5	IS61NLF204818A-6.5TQI	100 TQFP
7.5	IS61NLF204818A-7.5TQI	100 TQFP
	IS61NLF204818A-7.5TQLI	100 TQFP, Lead-free

ORDERING INFORMATION ($V_{DD} = 2.5V /V_{DDQ} = 2.5V$)

Commercial Range: 0°C to +70°C

Access Time	Order Part Number	Package
1Mx36		
6.5	IS61NVF102436A-6.5TQ	100 TQFP
7.5	IS61NVF102436A-7.5TQ	100 TQFP
2Mx18		
6.5	IS61NVF204818A-6.5TQ	100 TQFP
7.5	IS61NVF204818A-7.5TQ	100 TQFP

Industrial Range: -40°C to +85°C

Access Time	Order Part Number	Package
1Mx36		
6.5	IS61NVF102436A-6.5TQI	100 TQFP
7.5	IS61NVF102436A-7.5TQI	100 TQFP
2Mx18		
6.5	IS61NVF204818A-6.5TQI	100 TQFP
7.5	IS61NVF204818A-7.5TQI	100 TQFP