

IS61NLP102436A/IS61NVP102436A IS61NLP204818A/IS61NVP204818A



1Mb x 36 and 2Mb x 18 36Mb, PIPELINE 'NO WAIT' STATE BUS SRAM

SEPTEMBER 2007

FEATURES

- 100 percent bus utilization
- No wait cycles between Read and Write
- Internal self-timed write cycle
- Individual Byte Write Control
- Single R/W (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 and 165-ball PBGA packages
- Power supply:
NVP: $V_{\text{DD}} 2.5\text{V} (\pm 5\%)$, $V_{\text{DDQ}} 2.5\text{V} (\pm 5\%)$
NLP: $V_{\text{DD}} 3.3\text{V} (\pm 5\%)$, $V_{\text{DDQ}} 3.3\text{V}/2.5\text{V} (\pm 5\%)$
- Industrial temperature available
- Lead-free available

DESCRIPTION

The 36 Meg 'NLP/NVP' 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.

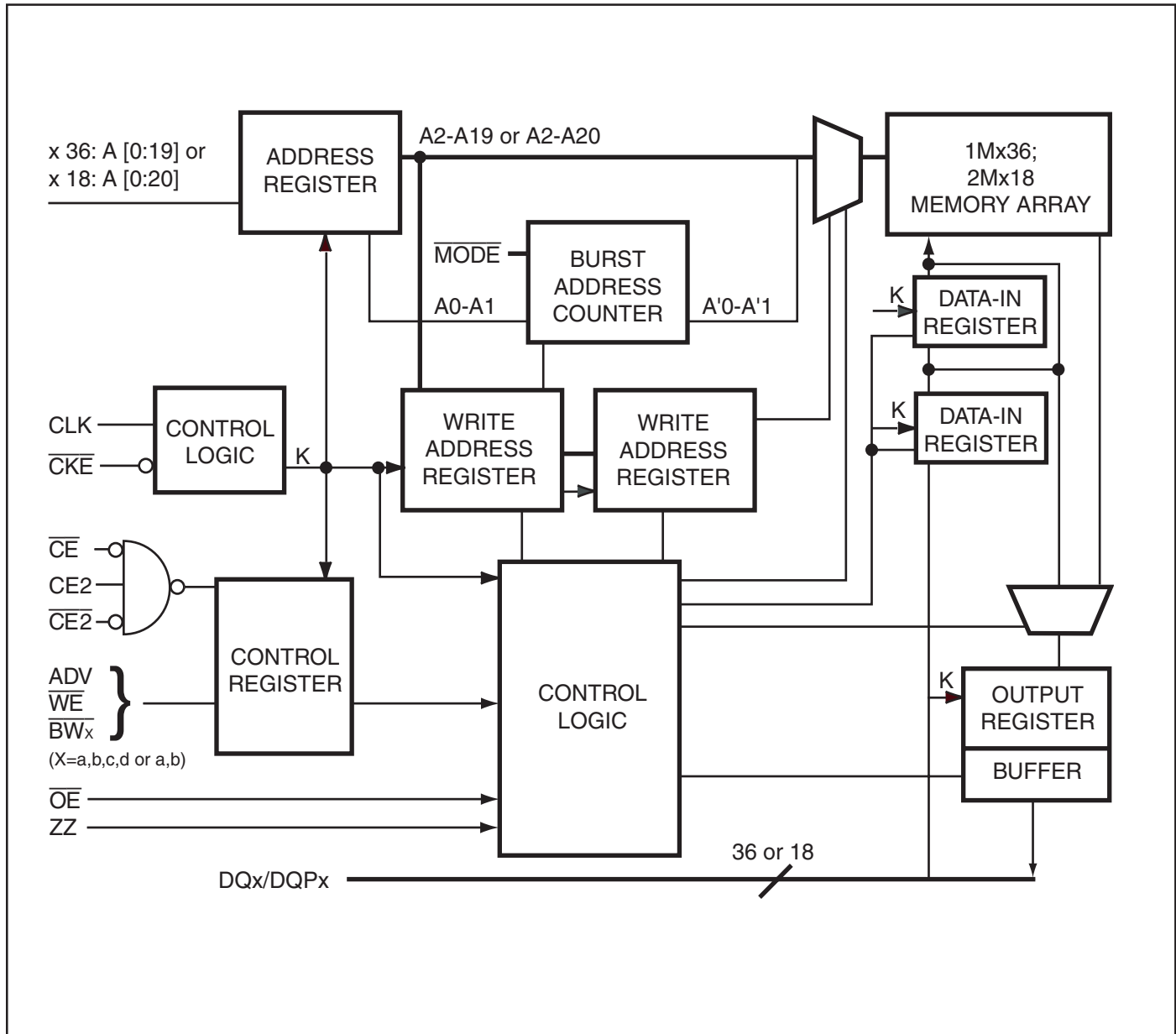
A burst mode pin (MODE) defines the order of the burst sequence. When tied HIGH, the interleaved burst sequence is selected. When tied LOW, the linear burst sequence is selected.

FAST ACCESS TIME

Symbol	Parameter	-200	-166	Units
t_{KQ}	Clock Access Time	3.1	3.5	ns
t_{Kc}	Cycle Time	5	6	ns
	Frequency	200	166	MHz

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BLOCK DIAGRAM



PIN CONFIGURATION — 1M x 36, 165-Ball PBGA (TOP VIEW)

	1	2	3	4	5	6	7	8	9	10	11
A	NC	A	\overline{OE}	\overline{BWc}	\overline{BWb}	$\overline{CE2}$	\overline{CKE}	ADV	A	A	NC
B	NC	A	CE2	\overline{BWd}	\overline{BWA}	CLK	\overline{WE}	\overline{OE}	A	A	NC
C	DQPc	NC	VDDQ	VSS	VSS	VSS	VSS	VSS	VDDQ	NC	DQPb
D	DQc	DQc	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQb	DQb
E	DQc	DQc	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQb	DQb
F	DQc	DQc	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQb	DQb
G	DQc	DQc	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQb	DQb
H	NC	NC	NC	VDD	VSS	VSS	VSS	VDD	NC	NC	ZZ
J	DQd	DQd	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQa	DQa
K	DQd	DQd	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQa	DQa
L	DQd	DQd	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQa	DQa
M	DQd	DQd	VDDQ	VDD	VSS	VSS	VSS	VDD	VDDQ	DQa	DQa
N	DQPd	NC	VDDQ	VSS	NC	NC	NC	VSS	VDDQ	NC	DQPd
P	NC	NC	A	A	NC	A1*	NC	A	A	A	NC
R	MODE	A	A	A	NC	A0*	NC	A	A	A	A

Note: A0 and A1 are the two least significant bits (LSB) of the address field and set the internal burst counter if burst is desired. (Under Evaluation)

PIN DESCRIPTIONS

Symbol	Pin Name
A	Address Inputs
A0, A1	Synchronous Burst Address Inputs
ADV	Synchronous Burst Address Advance/Load
\overline{WE}	Synchronous Read/Write Control Input
CLK	Synchronous Clock
\overline{CKE}	Clock Enable
\overline{CE} , $\overline{CE2}$, CE2	Synchronous Chip Enable
\overline{BWx} (x=a-d)	Synchronous Byte Write Inputs
\overline{OE}	Output Enable
ZZ	Power Sleep Mode

MODE	Burst Sequence Selection
VDD	3.3V/2.5V Power Supply
NC	No Connect
DQx	Data Inputs/Outputs
DQPx	Parity Data I/O
VDDQ	Isolated output Power Supply 3.3V/2.5V
VSS	Ground

165-PIN PBGA PACKAGE CONFIGURATION — 2M x 18 (TOP VIEW)

	1	2	3	4	5	6	7	8	9	10	11
A	NC	A	\overline{CE}	\overline{BWb}	NC	$\overline{CE2}$	\overline{CKE}	ADV	A	A	A
B	NC	A	CE2	NC	\overline{BWa}	CLK	\overline{WE}	\overline{OE}	A	A	NC
C	NC	NC	VDDQ	Vss	Vss	Vss	Vss	Vss	VDDQ	NC	DQP _a
D	NC	DQ _b	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	NC	DQ _a
E	NC	DQ _b	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	NC	DQ _a
F	NC	DQ _b	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	NC	DQ _a
G	NC	DQ _b	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	NC	DQ _a
H	NC	NC	NC	VDD	Vss	Vss	Vss	VDD	NC	NC	ZZ
J	DQ _b	NC	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	DQ _a	NC
K	DQ _b	NC	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	DQ _a	NC
L	DQ _b	NC	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	DQ _a	NC
M	DQ _b	NC	VDDQ	VDD	Vss	Vss	Vss	VDD	VDDQ	DQ _a	NC
N	DQP _b	NC	VDDQ	Vss	NC	NC	NC	Vss	VDDQ	NC	NC
P	NC	NC	A	A	NC	A ₁ *	NC	A	A	A	NC
R	MODE	A	A	A	NC	A ₀ *	NC	A	A	A	A

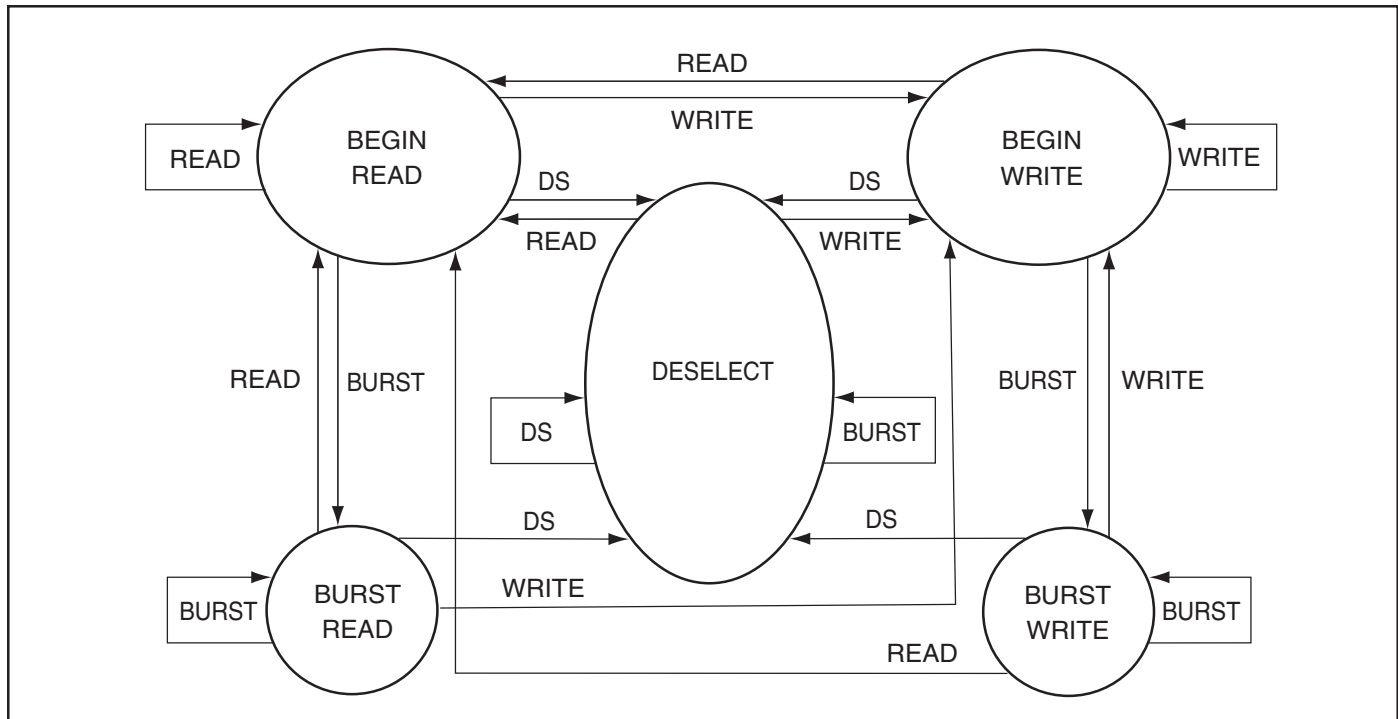
Note: A0 and A1 are the two least significant bits (LSB) of the address field and set the internal burst counter if burst is desired. (Under Evaluation)

PIN DESCRIPTIONS

Symbol	Pin Name
A	Address Inputs
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ADV	Synchronous Burst Address Advance/Load
\overline{WE}	Synchronous Read/Write Control Input
CLK	Synchronous Clock
\overline{CKE}	Clock Enable
\overline{CE} , $\overline{CE2}$, CE2	Synchronous Chip Enable
\overline{BWx} (x=a,b)	Synchronous Byte Write Inputs
\overline{OE}	Output Enable
ZZ	Power Sleep Mode

MODE	Burst Sequence Selection
VDD	3.3V/2.5V Power Supply
NC	No Connect
DQ _x	Data Inputs/Outputs
DQP _x	Parity Data I/O
VDDQ	Isolated output Power Supply 3.3V/2.5V
Vss	Ground

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	WE	BW _a	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	WE	BW _a	BW _b	BW _c	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

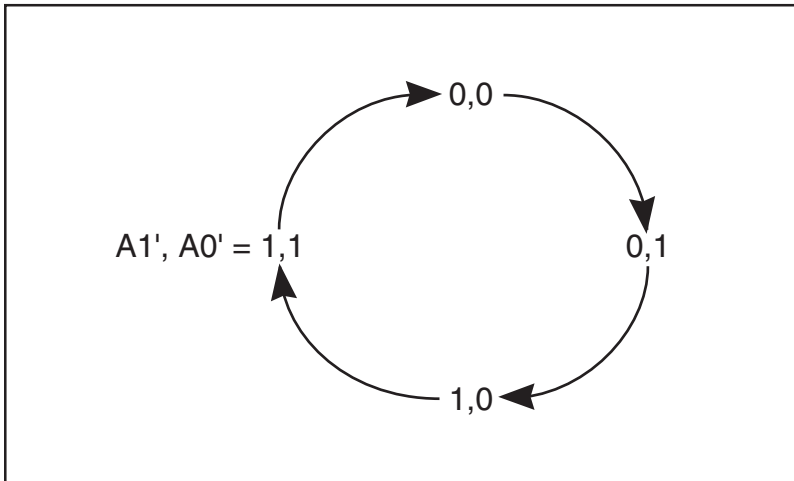
Notes:

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 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 (IS61NLPx)

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 (IS61NVPx)

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} , $\overline{OE} = V_{IH}$	-5	5	-5	5	μA

POWER SUPPLY CHARACTERISTICS⁽¹⁾ (Over Operating Range)

Symbol	Parameter	Test Conditions	Temp. range	-200 MAX		-166 MAX		Unit
				x18	x36	x18	x36	
I _{CC}	AC Operating Supply Current	Device Selected, $\overline{OE} = V_{IH}$, ZZ ≤ V _{IL} , All Inputs ≤ 0.2V or ≥ V _{DD} - 0.2V, Cycle Time ≥ t _{kc} min.	Com. Ind. typ. ⁽²⁾	450 475 390	450 475	400 450 340	400 450	mA
I _{SB}	Standby Current TTL Input	Device Deselected, V _{DD} = Max., All Inputs ≤ V _{IL} or ≥ V _{IH} , ZZ ≤ V _{IL} , f = Max.	Com. Ind.	260 270	260 270	250 260	250 260	mA
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. Ind. typ. ⁽²⁾	105 110 30	105 110	105 110 30	105 110	mA

Note:

- MODE pin has an internal pullup and should be tied to V_{DD} or V_{SS}. It exhibits ±100μA maximum leakage current when tied to ≤ V_{SS} + 0.2V or ≥ V_{DD} - 0.2V.
- 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

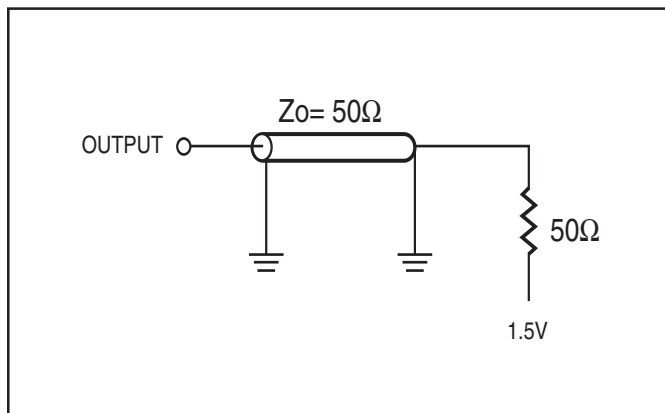


Figure 1

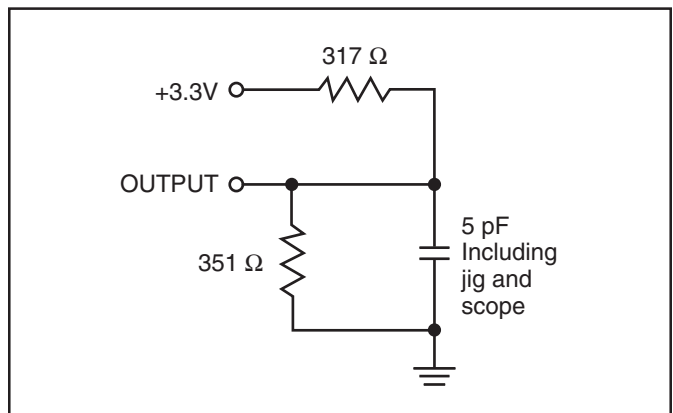


Figure 2

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

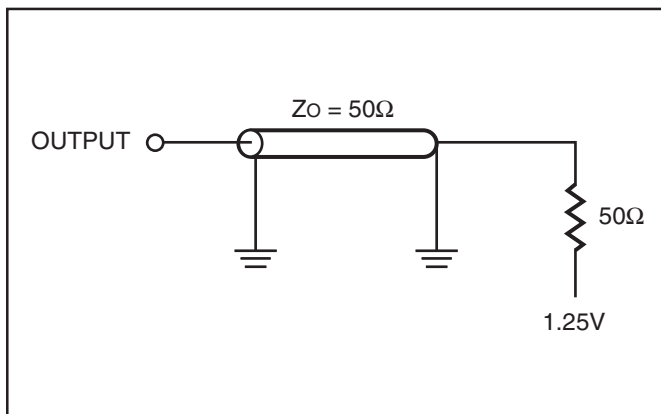


Figure 3

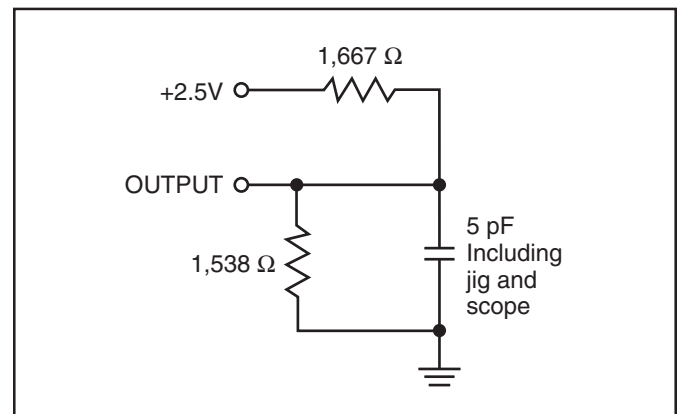


Figure 4

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

Symbol	Parameter	-200		-166		Unit
		Min.	Max.	Min.	Max.	
fmax	Clock Frequency	—	200	—	166	MHz
t _{κC}	Cycle Time	5	—	6	—	ns
t _{κH}	Clock High Time	2	—	2.5	—	ns
t _{κL}	Clock Low Time	2	—	2.5	—	ns
t _{κQ}	Clock Access Time	—	3.1	—	3.5	ns
t _{κQX⁽²⁾}	Clock High to Output Invalid	1.5	—	1.5	—	ns
t _{κQLZ^(2,3)}	Clock High to Output Low-Z	1	—	1	—	ns
t _{κQHZ^(2,3)}	Clock High to Output High-Z	—	3.0	—	3.4	ns
t _{OEQ}	Output Enable to Output Valid	—	3.1	—	3.5	ns
t _{OE^(2,3)}	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OE^(2,3)}	Output Disable to Output High-Z	—	3.0	—	3.4	ns
t _{AS}	Address Setup Time	1.4	—	1.5	—	ns
t _{WS}	Read/Write Setup Time	1.4	—	1.5	—	ns
t _{CES}	Chip Enable Setup Time	1.4	—	1.5	—	ns
t _{SE}	Clock Enable Setup Time	1.4	—	1.5	—	ns
t _{ADVS}	Address Advance Setup Time	1.4	—	1.5	—	ns
t _{DS}	Data Setup Time	1.4	—	1.5	—	ns
t _{AH}	Address Hold Time	0.4	—	0.5	—	ns
t _{HE}	Clock Enable Hold Time	0.4	—	0.5	—	ns
t _{WH}	Write Hold Time	0.4	—	0.5	—	ns
t _{CEH}	Chip Enable Hold Time	0.4	—	0.5	—	ns
t _{ADVH}	Address Advance Hold Time	0.4	—	0.5	—	ns
t _{DH}	Data Hold Time	0.4	—	0.5	—	ns
t _{PDS}	ZZ High to Power Down	—	2	—	2	cyc
t _{PUS}	ZZ Low to Power Down	—	2	—	2	cyc

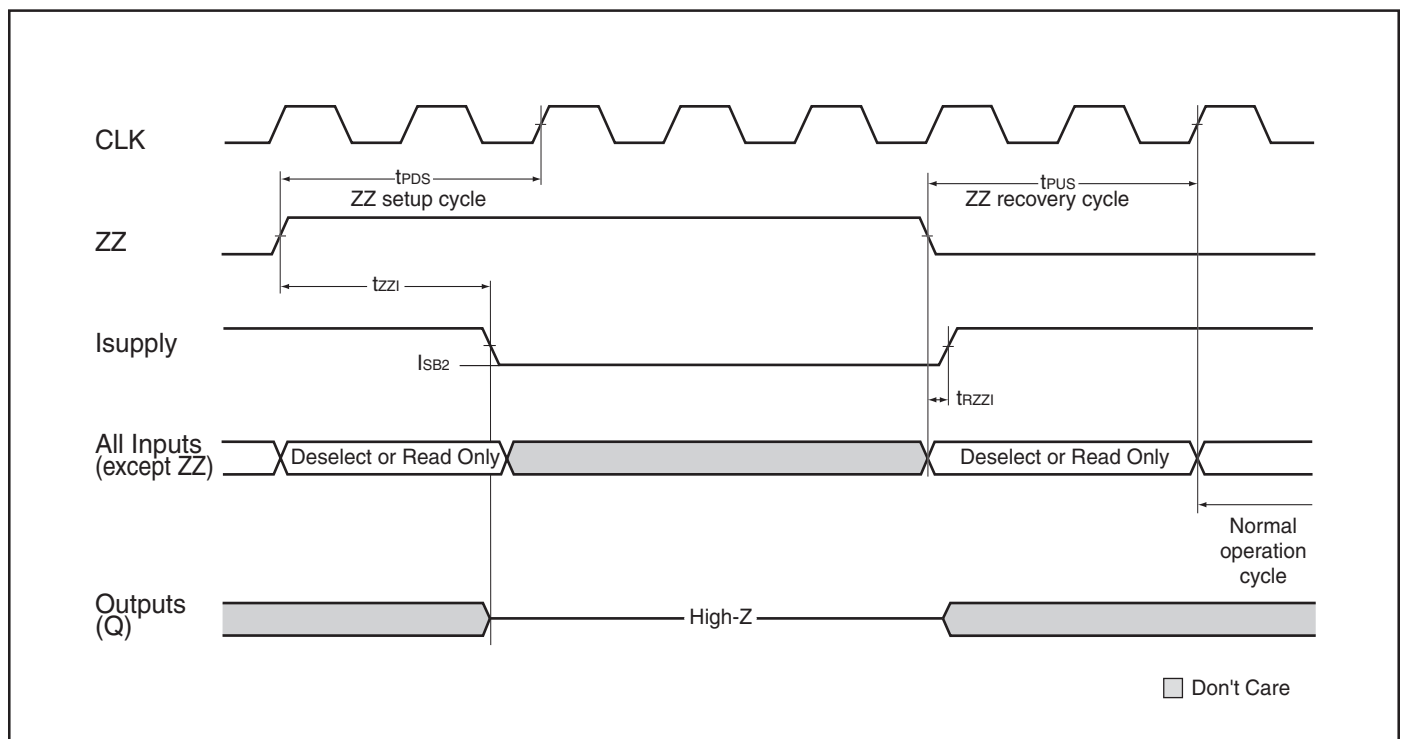
Notes:

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.

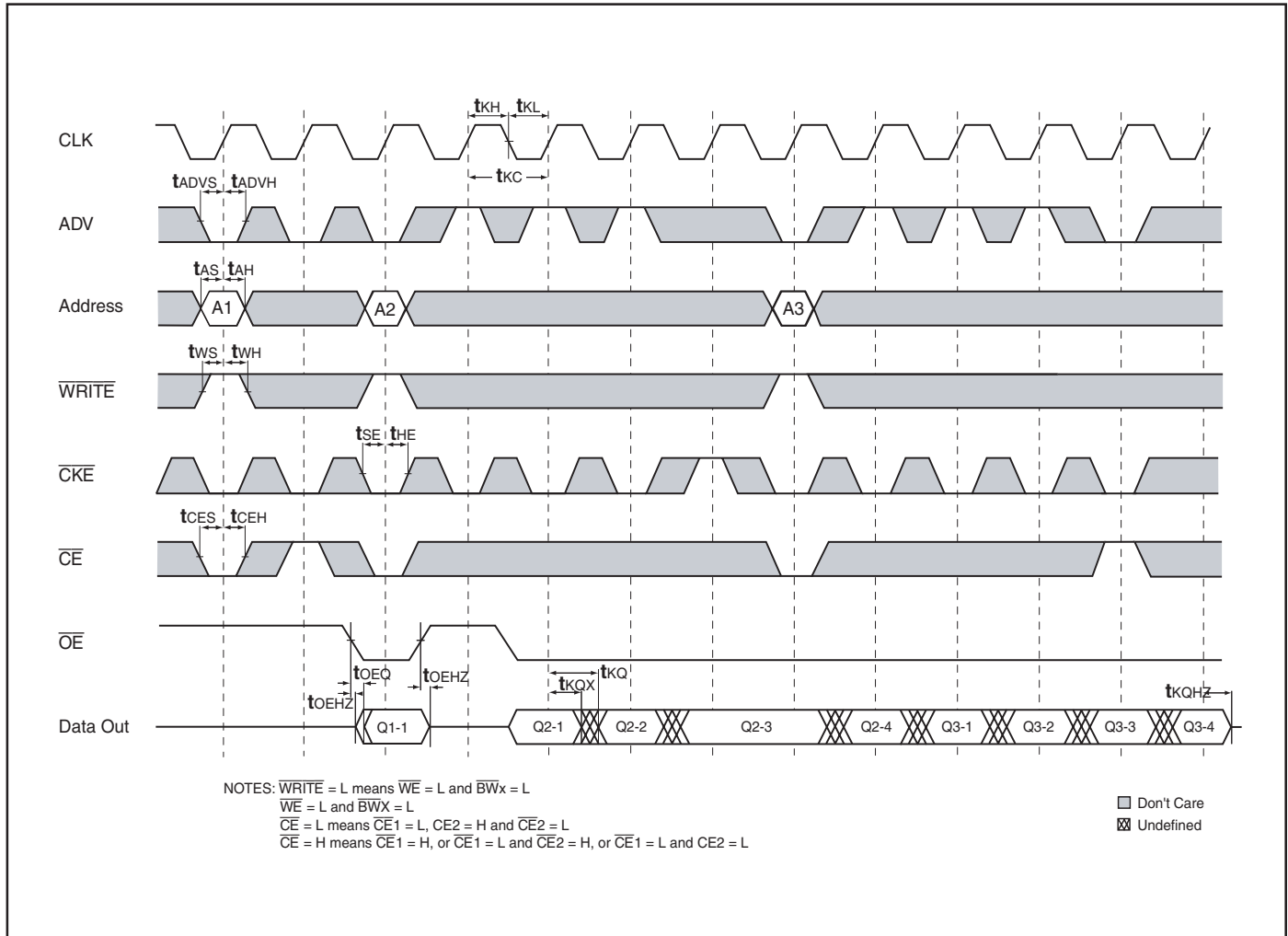
SLEEP MODE ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Max.	Unit
I _{SB2}	Current during SLEEP MODE	ZZ ≥ V _{IH}		75	mA
t _{PDS}	ZZ active to input ignored		2		cycle
t _{PUS}	ZZ inactive to input sampled		2		cycle
t _{ZZ1}	ZZ active to SLEEP current		2		cycle
t _{ZZI}	ZZ inactive to exit SLEEP current		0		ns

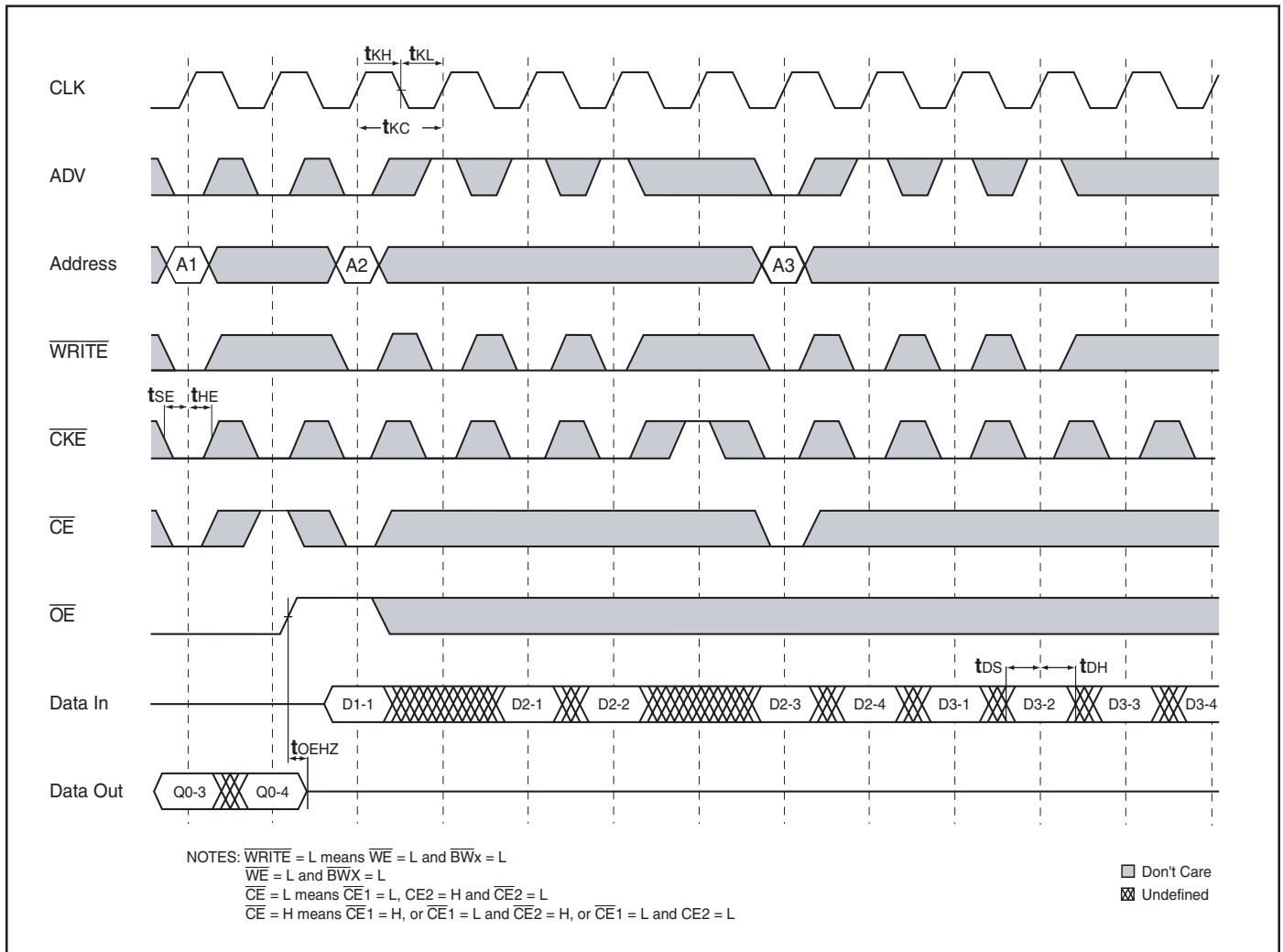
SLEEP MODE TIMING



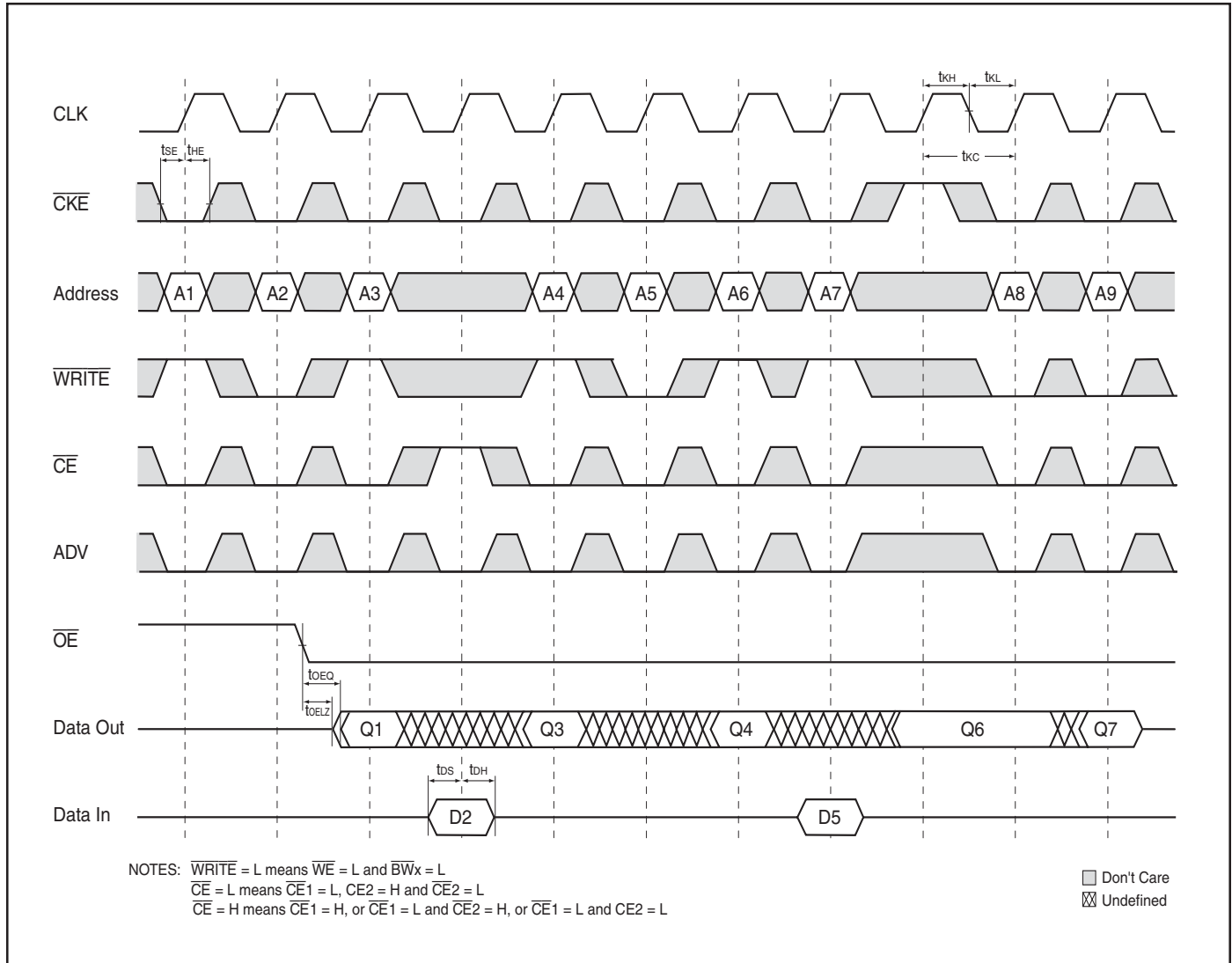
READ CYCLE TIMING



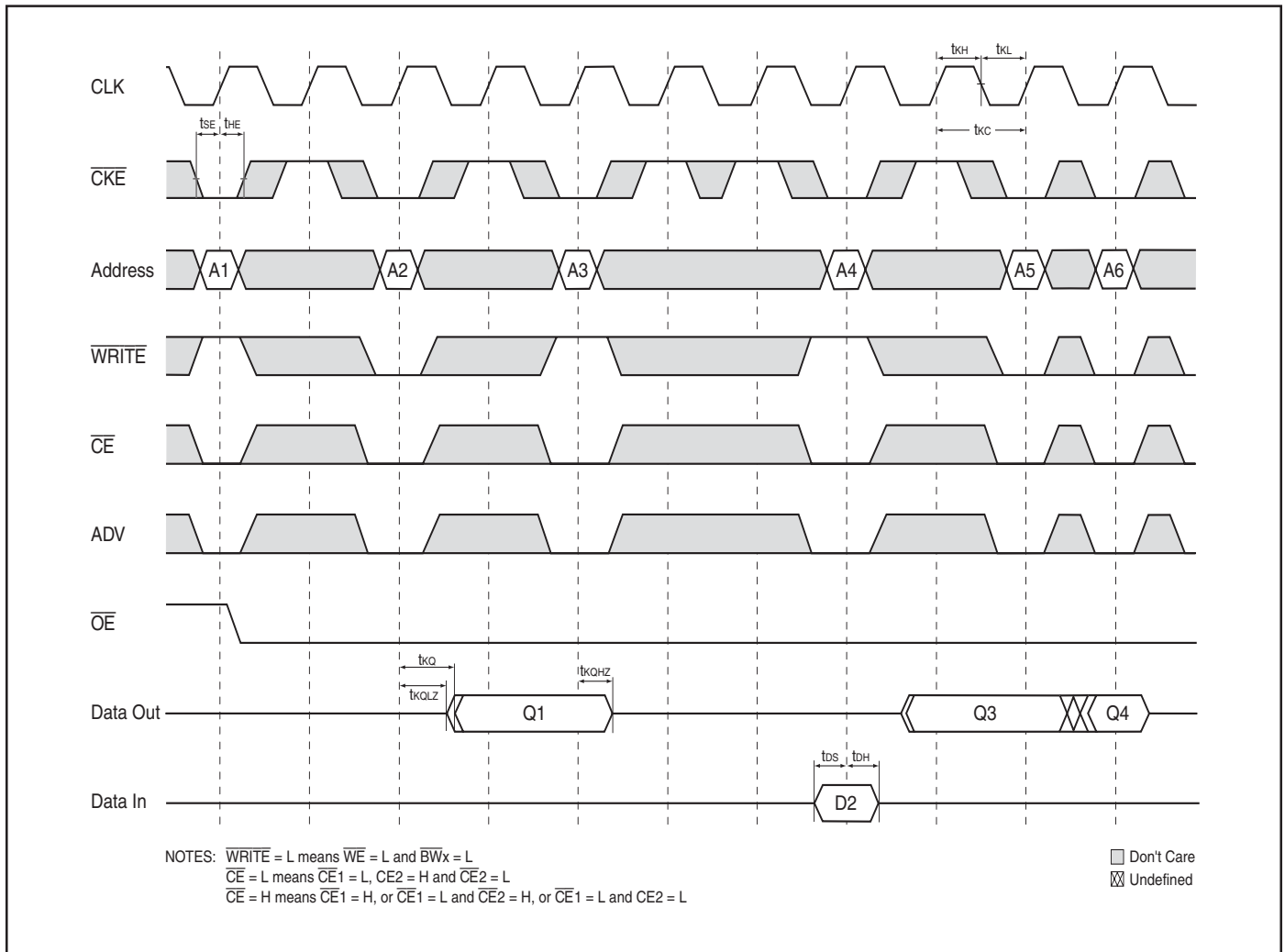
WRITE CYCLE TIMING



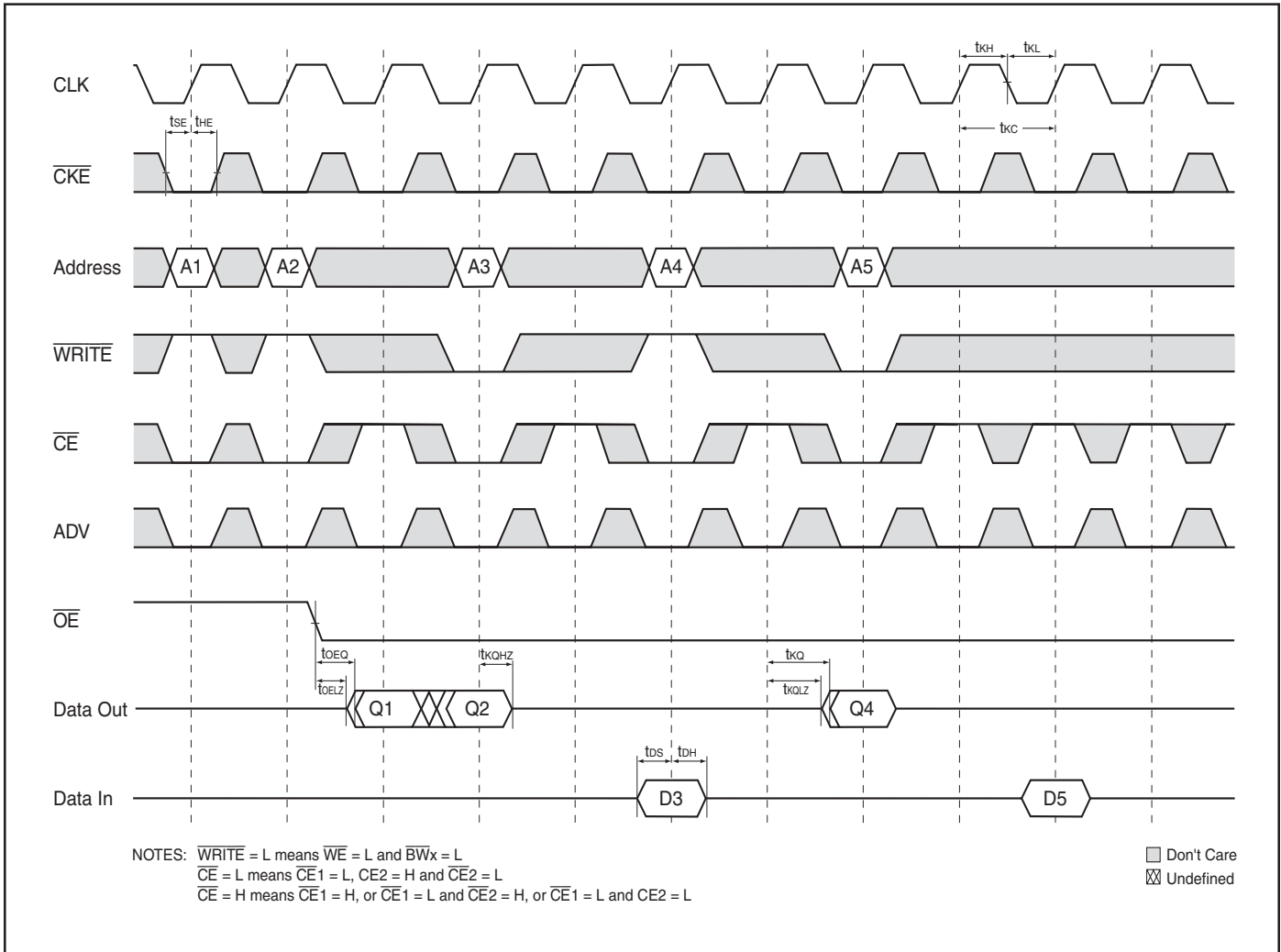
SINGLE READ/WRITE CYCLE TIMING



CKE OPERATION TIMING



CE OPERATION TIMING



ORDERING INFORMATION (3.3V core/2.5V- 3.3V I/O)

Commercial Range: 0°C to +70°C

Configuration	Access Time	Order Part Number	Package
1Mx36	166	IS61NLP102436A-166TQ	100 TQFP
		IS61NLP102436A-166TQL	100 TQFP, Lead-free
		IS61NLP102436A-166B3	165 PBGA
2Mx18	166	IS61NLP204818A-166TQ	100 TQFP
		IS61NLP204818A-166TQL	100 TQFP, Lead-free
		IS61NLP204818A-166B3	165 PBGA

Industrial Range: -40°C to +85°C

Configuration	Access Time	Order Part Number	Package
1Mx36	166	IS61NLP102436A-166TQI	100 TQFP
		IS61NLP102436A-166TQLI	100 TQFP, Lead-free
		IS61NLP102436A-166B3I	165 PBGA
2Mx18	166	IS61NLP204818A-166TQI	100 TQFP
		IS61NLP204818A-166TQLI	100 TQFP, Lead-free
		IS61NLP204818A-166B3I	165 PBGA



ORDERING INFORMATION (2.5V core/2.5V I/O)

Commercial Range: 0°C to +70°C

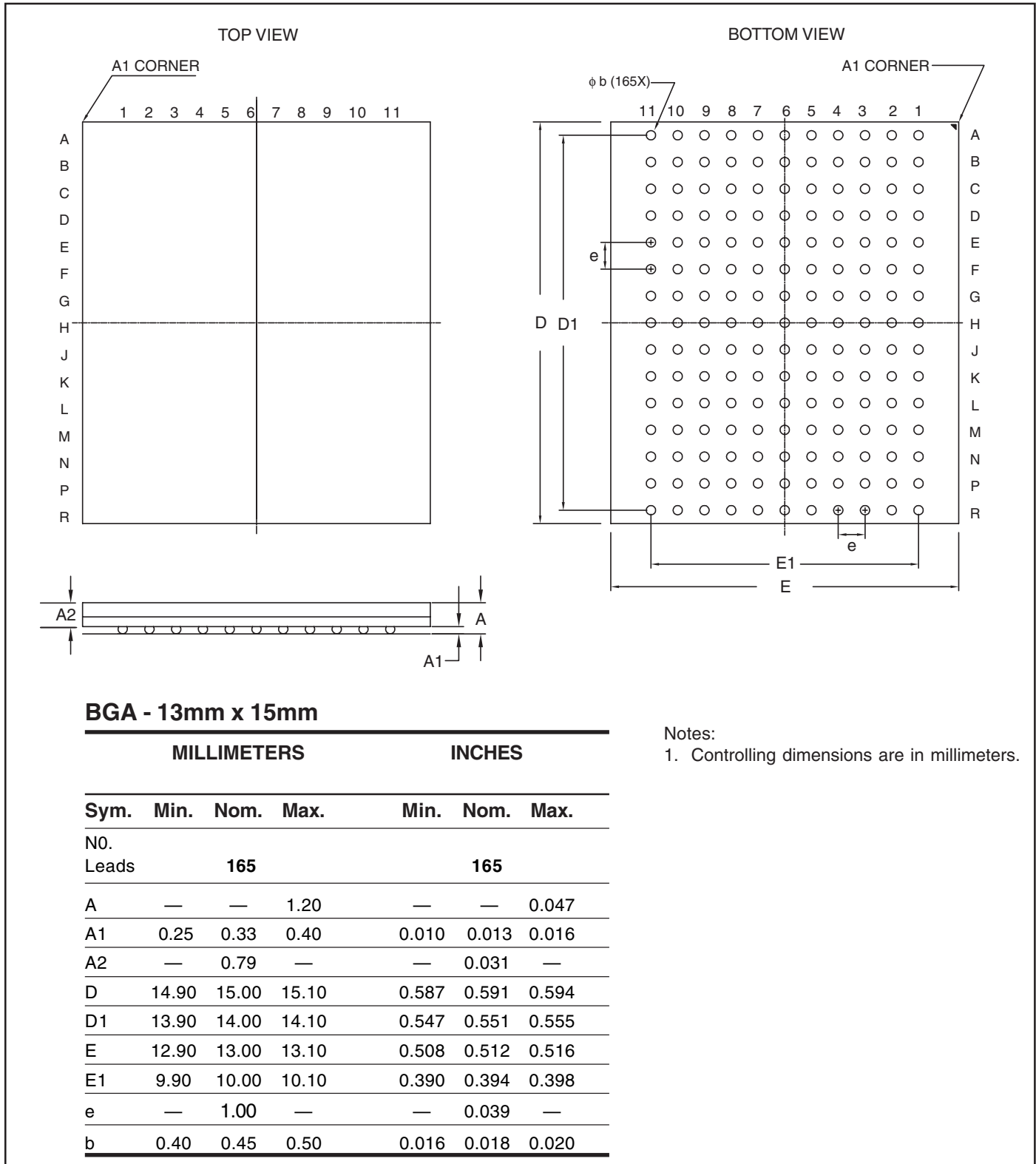
Configuration	Access Time	Order Part Number	Package
1Mx36	166	IS61NVP102436A-166TQ	100 TQFP
		IS61NVP102436A-166TQL	100 TQFP, Lead-free
		IS61NVP102436A-166B3	165 PBGA
	2Mx18	166	IS61NVP204818A-166TQ
IS61NVP204818A-166TQL	100 TQFP, Lead-free		
IS61NVP204818A-166B3	165 PBGA		

Industrial Range: -40°C to +85°C

Configuration	Access Time	Order Part Number	Package
1Mx36	166	IS61NVP102436A-166TQI	100 TQFP
		IS61NVP102436A-166TQLI	100 TQFP, Lead-free
		IS61NVP102436A-166B3I	165 PBGA
	2Mx18	166	IS61NVP204818A-166TQI
IS61NVP204818A-166B3I	165 PBGA		

PACKAGING INFORMATION

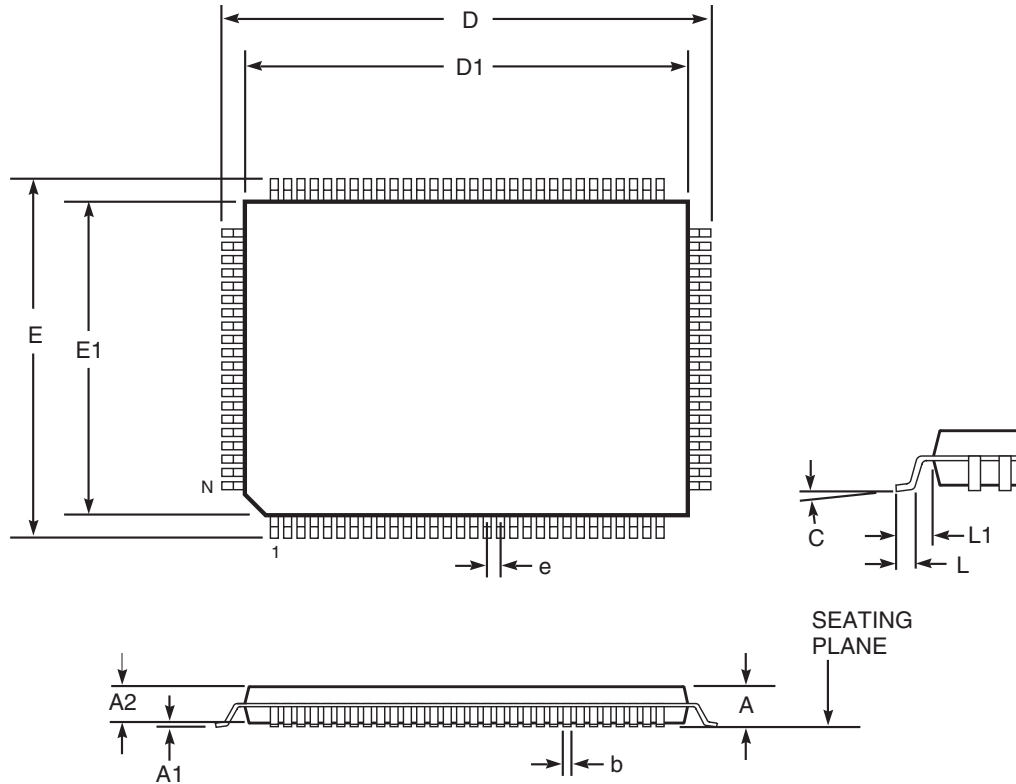
Ball Grid Array Package Code: B (165-pin)



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PACKAGING INFORMATION

TQFP (Thin Quad Flat Pack Package)
Package Code: TQ



Thin Quad Flat Pack (TQ)									
Symbol	Millimeters		Inches		Symbol	Millimeters		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
Ref. Std.									
No. Leads (N)	100				128				
A	—	1.60	—	0.063	—	1.60	—	0.063	
A1	0.05	0.15	0.002	0.006	0.05	0.15	0.002	0.006	
A2	1.35	1.45	0.053	0.057	1.35	1.45	0.053	0.057	
b	0.22	0.38	0.009	0.015	0.17	0.27	0.007	0.011	
D	21.90	22.10	0.862	0.870	21.80	22.20	0.858	0.874	
D1	19.90	20.10	0.783	0.791	19.90	20.10	0.783	0.791	
E	15.90	16.10	0.626	0.634	15.80	16.20	0.622	0.638	
E1	13.90	14.10	0.547	0.555	13.90	14.10	0.547	0.555	
e	0.65 BSC		0.026 BSC		0.50 BSC		0.020 BSC		
L	0.45	0.75	0.018	0.030	0.45	0.75	0.018	0.030	
L1	1.00 REF.		0.039 REF.		1.00 REF.		0.039 REF.		
C	0°	7°	0°	7°	0°	7°	0°	7°	

Notes:

1. All dimensioning and tolerancing conforms to ANSI Y14.5M-1982.
2. Dimensions D1 and E1 do not include mold protrusions. Allowable protrusion is 0.25 mm per side. D1 and E1 do include mold mismatch and are determined at datum plane -H-.
3. Controlling dimension: millimeters.