Micron™

2Mb: 128K x 18, 64K x 32/36 FLOW-THROUGH SYNCBURST SRAM

2Mb SYNCBURST™ SRAM

MT58L128L18F, MT58L64L32F, MT58L64L36F; MT58L128V18F, MT58L64V32F, MT58L64V36F

3.3V V$_{DD}$, 3.3V or 2.5V I/O, Flow-Through

FEATURES
- Fast clock and OE# access times
- Single +3.3V +0.3V/-0.165V power supply (V$_{DD}$)
- Separate +3.3V or +2.5V isolated output buffer supply (V$_{DD}$Q)
- SNOOZE MODE for reduced-power standby
- Common data inputs and data outputs
- Individual BYTE WRITE control and GLOBAL WRITE
- Three chip enables for simple depth expansion and address pipelining
- Clock-controlled and registered addresses, data I/Os and control signals
- Internally self-timed WRITE cycle
- Burst control pin (interleaved or linear burst)
- Automatic power-down
- 100-pin TQFP package
- Low capacitive bus loading
- x18, x32, and x36 versions available

100-Pin TQFP*

*JEDEC-standard MS-026 BHA (LQFP).

OPTIONS   MARKING
- Timing (Access/Cycle/MHz)
  6.8ns/8.0ns/125 MHz   -6.8
  7.5ns/8.8ns/113 MHz   -7.5
  8.5ns/10ns/100 MHz   -8.5
  10ns/15ns/66 MHz   -10
- Configurations
  3.3V I/O
    128K x 18   MT58L128L18F
    64K x 32   MT58L64L32F
    64K x 36   MT58L64L36F
  2.5V I/O
    128K x 18   MT58L128V18F
    64K x 32   MT58L64V32F
    64K x 36   MT58L64V36F
- Packages
  100-pin TQFP   T
- Operating Temperature Range
  Commercial (0°C to +70°C)   None

Part Number Example:
MT58L64L36FT-8.5
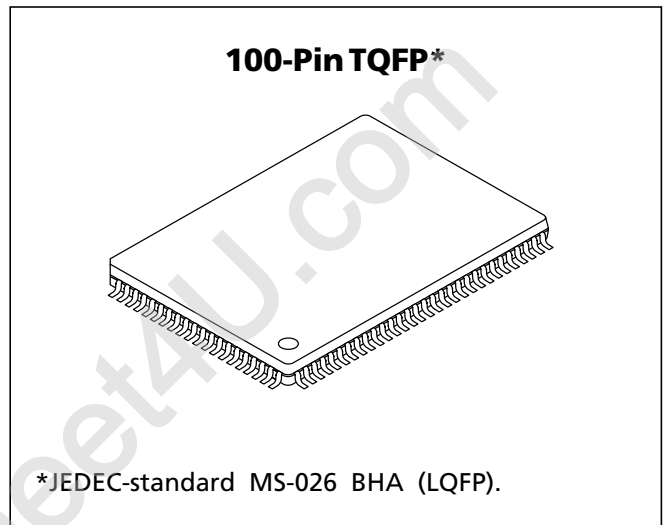
GENERAL DESCRIPTION

The Micron® SyncBurst™ SRAM family employs high-speed, low-power CMOS designs that are fabricated using an advanced CMOS process.

Micron's 2Mb SyncBurst SRAMs integrate a 128K x 18, 64K x 32, or 64K x 36 SRAM core with advanced synchronous peripheral circuitry and a 2-bit burst counter. All synchronous inputs pass through registers controlled by a positive-edge-triggered single clock input (CLK). The synchronous inputs include all addresses, all data inputs, active LOW chip enable (CE#), two additional chip enables for easy depth expansion (CE2, CE2#), burst control inputs (ADSC#, ADSP#, ADV#), byte write enables (BWx#) and global write (GW#).

Asynchronous inputs include the output enable (OE#), snooze enable (ZZ) and clock (CLK). There is also a burst mode pin (MODE) that selects between interleaved and linear burst modes. The data-out (Q), enabled by OE#, is also asynchronous. WRITE cycles can be from one to two bytes wide (x18) or from one to four bytes wide (x32/x36), as controlled by the write control inputs.
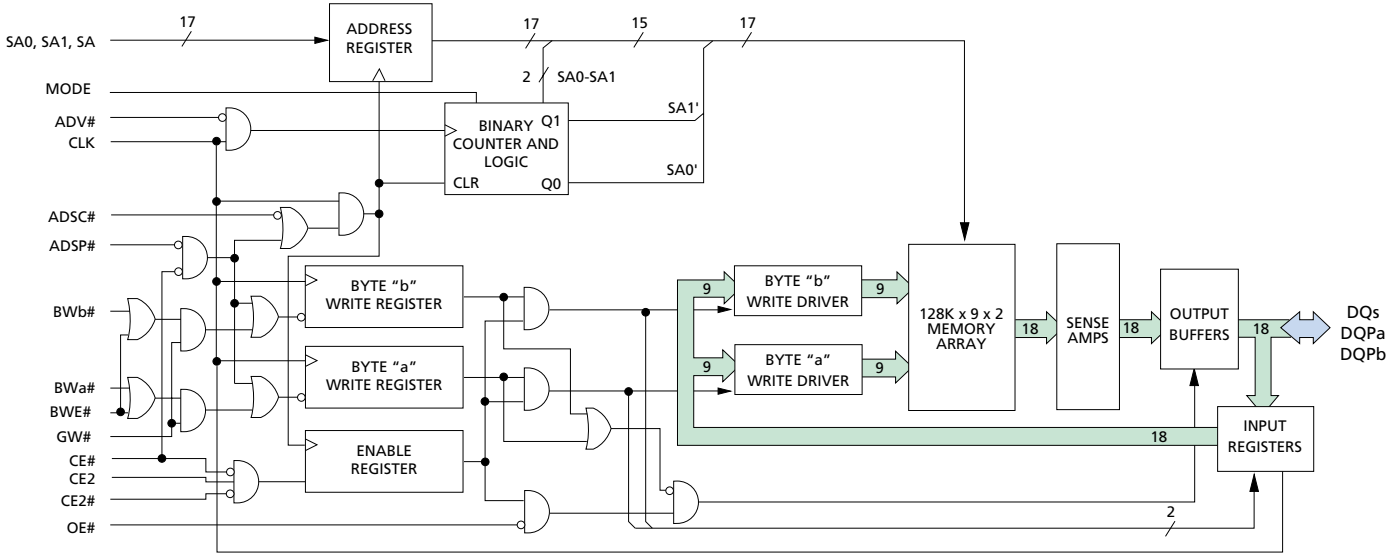
Burst operation can be initiated with either address status processor (ADSP#) or address status controller (ADSC#) input pins. Subsequent burst addresses can be internally generated as controlled by the burst advance pin (ADV#).

PRODUCTS AND SPECIFICATIONS DISCUSSED HEREIN ARE SUBJECT TO CHANGE BY MICRON WITHOUT NOTICE.

FUNCTIONAL BLOCK DIAGRAM
128K x 18

FUNCTIONAL BLOCK DIAGRAM
64K x 32/36
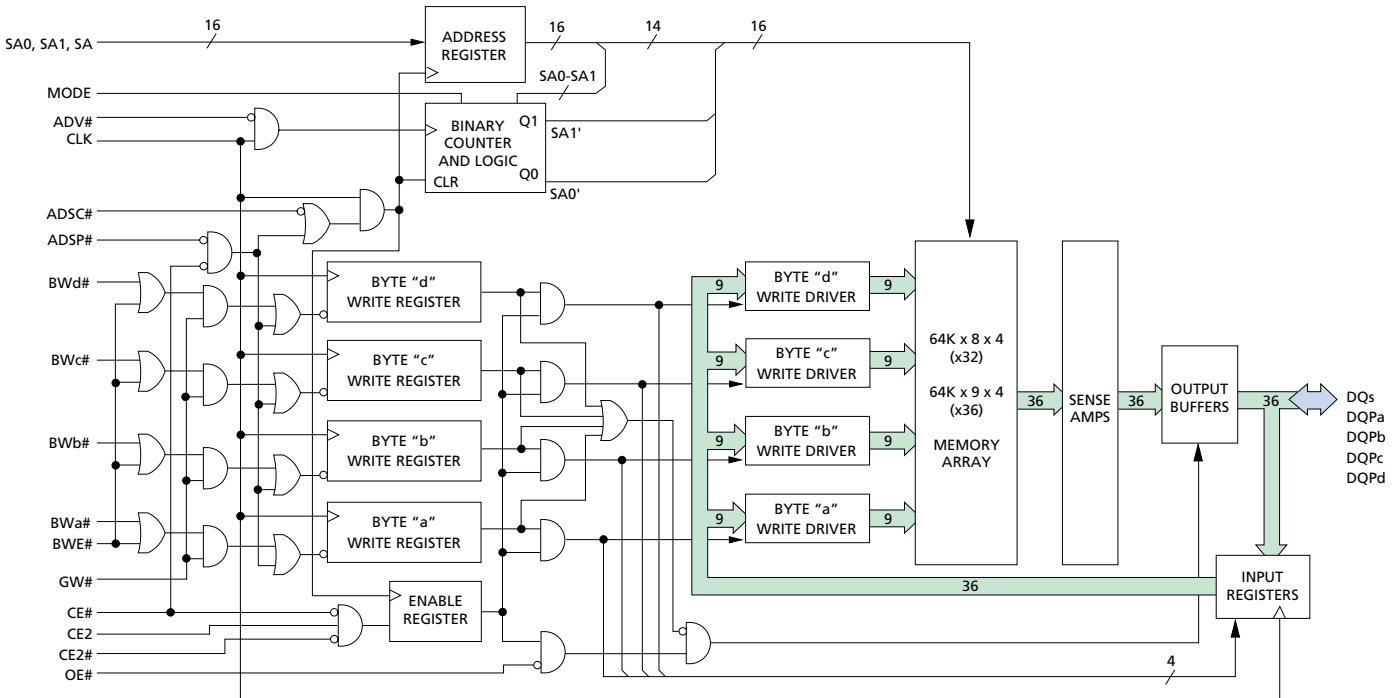
NOTE: Functional Block Diagrams illustrate simplified device operation. See truth table, pin descriptions and timing diagrams for detailed information.

GENERAL DESCRIPTION (continued)

Address and write control are registered on-chip to simplify WRITE cycles. This allows self-timed WRITE cycles. Individual byte enables allow individual bytes to be written.

During WRITE cycles on the x18 device, BWa# controls DQa pins and DQPa; BWb# controls DQb pins and DQPb. During WRITE cycles on the x32 and x36 devices, BWa# controls DQa pins and DQPa; BWb# controls DQb pins and DQPb; BWc# controls DQc pins and DQPc; BWd# controls DQd pins and DQPd. GW# LOW causes all bytes to be written. Parity bits are only available on the x18 and x36 versions.

Micron's 2Mb SyncBurst SRAMs operate from a +3.3V V$_{DD}$ power supply, and all inputs and outputs are TTL-compatible. Users can choose either a 3.3V or 2.5V I/O version. The device is ideally suited for 486, Pentium®, 680X0, and PowerPC systems and systems that benefit from a very wide data bus. The device is also ideal in generic 16-, 18-, 32-, 36-, 64-, and 72-bit-wide applications.

Please refer to Micron's Web site (www.micron.com/sramds) for the latest data sheet.

TQFP PIN ASSIGNMENT TABLE

PIN #	x18	x32/x36	PIN #	x18	x32/x36	PIN #	x18	x32/x36	PIN #	x18	x32/x36
1	NC	NC/DQPc**	26	Vss		51	NC	NC/DQPa**	76	Vss	
2	NC	DQc	27	VDDQ		52	NC	DQa	77	VDDQ	
3	NC	DQc	28	NC	DQd	53	NC	DQa	78	NC	DQb
4	VDDQ		29	NC	DQd	54	VDDQ		79	NC	DQb
5	Vss		30	NC	NC/DQPd**	55	Vss		80	SA	NC/DQPb**
6	NC	DQc	31	MODE		56	NC	DQa	81	SA	
7	NC	DQc	32	SA		57	NC	DQa	82	SA	
8	DQb	DQc	33	SA		58	DQa		83	ADV#	
9	DQb	DQc	34	SA		59	DQa		84	ADSP#	
10	Vss		35	SA		60	Vss		85	ADSC#	
11	VDDQ		36	SA1		61	VDDQ		86	OE#	
12	DQb	DQc	37	SA0		62	DQa		87	BWE#	
13	DQb	DQc	38	DNU		63	DQa		88	GW#	
14	Vss		39	DNU		64	ZZ		89	CLK	
15	VDD		40	Vss		65	VDD		90	Vss	
16	NC		41	VDD		66	NC		91	VDD	
17	Vss		42	DNU		67	Vss		92	CE2#	
18	DQb	DQd	43	DNU		68	DQa	DQb	93	BWa#	
19	DQb	DQd	44	SA		69	DQa	DQb	94	BWb#	
20	VDDQ		45	SA		70	VDDQ		95	NC	BWc#
21	Vss		46	SA		71	Vss		96	NC	BWd#
22	DQb	DQd	47	SA		72	DQa	DQb	97	CE2	
23	DQb	DQd	48	SA		73	DQa	DQb	98	CE#	
24	DQPb	DQd	49	SA		74	DQPa	DQb	99	SA	
25	NC	DQd	50	NC/SA*		75	NC	DQb	100	SA	

*Pin 50 is reserved for address expansion.
**No Connect (NC) is used on the x32 version. Parity (DQPx) is used on the x36 version.

PIN ASSIGNMENT (Top View)
100-Pin TQFP

x18

Top pins (80–51): SA, NC, NC, VDDQ, Vss, NC, DQPa, DQa, DQa, Vss, VDDQ, DQa, Vss, NC, VDD, ZZ, DQa, DQa, VDDQ, Vss, DQa, DQa, NC, NC, VDDQ, NC, NC, NC

Left pins:
81 SA
82 SA
83 ADV#
84 ADSP#
85 ADSC#
86 OE#
87 BWE#
88 GW#
89 CLK
90 Vss
91 VDD
92 CE2#
93 BWa#
94 BWb#
95 NC
96 NC
97 CE2
98 CE#
99 SA
100 SA

Right pins:
50 NC/SA*
49 SA
48 SA
47 SA
46 SA
45 SA
44 SA
43 DNU
42 DNU
41 VDD
40 Vss
39 DNU
38 DNU
37 SA0
36 SA1
35 SA
34 SA
33 SA
32 SA
31 MODE

Bottom pins (1–30): NC, NC, NC, VDDQ, Vss, NC, DQb, DQb, Vss, VDDQ, DQb, DQb, Vss, VDD, NC, Vss, DQb, DQb, VDDQ, Vss, DQb, DQb, DQPb, NC, Vss, VDDQ, NC, NC, NC

x32/x36

Top pins (80–51): NC/DQPb**, DQb, DQb, VDDQ, DQb, DQb, DQb, DQb, Vss, VDDQ, DQb, DQb, DQb, NC, VDD, ZZ, DQa, DQa, VDDQ, Vss, DQa, DQa, DQa, DQa, Vss, VDDQ, DQa, NC/DQPa**

Left pins:
81 SA
82 SA
83 ADV#
84 ADSP#
85 ADSC#
86 OE#
87 BWE#
88 GW#
89 CLK
90 Vss
91 VDD
92 CE2#
93 BWa#
94 BWb#
95 BWc#
96 BWd#
97 CE2
98 CE#
99 SA
100 SA

Right pins:
50 NC/SA*
49 SA
48 SA
47 SA
46 SA
45 SA
44 SA
43 DNU
42 DNU
41 VDD
40 Vss
39 DNU
38 DNU
37 SA0
36 SA1
35 SA
34 SA
33 SA
32 SA
31 MODE

Bottom pins (1–30): NC/DQPc**, DQc, DQc, VDDQ, DQc, DQc, DQc, DQc, Vss, VDDQ, DQc, DQc, Vss, VDD, NC, Vss, DQd, DQd, VDDQ, Vss, DQd, DQd, DQd, DQd, Vss, VDDQ, DQd, DQd, NC/DQPd**

*Pin 50 is reserved for address expansion.
**No Connect (NC) is used on the x32 version. Parity (DQPx) is used on the x36 version.

TQFP PIN DESCRIPTIONS

x18	x32/x36	SYMBOL	TYPE	DESCRIPTION
37 36 32-35, 44-49, 80-82, 99, 100	37 36 32-35, 44-49, 81, 82, 99, 100	SA0 SA1 SA	Input	Synchronous Address Inputs: These inputs are registered and must meet the setup and hold times around the rising edge of CLK.
93 94 – –	93 94 95 96	BWa# BWb# BWc# BWd#	Input	Synchronous Byte Write Enables: These active LOW inputs allow individual bytes to be written and must meet the setup and hold times around the rising edge of CLK. A byte write enable is LOW for a WRITE cycle and HIGH for a READ cycle. For the x18 version, BWa# controls DQa pins and DQPa; BWb# controls DQb pins and DQPb. For the x32 and x36 versions, BWa# controls DQa pins and DQPa; BWb# controls DQb pins and DQPb; BWc# controls DQc pins and DQPc; BWd# controls DQd pins and DQPd. Parity is only available on the x18 and x36 versions.
87	87	BWE#	Input	Byte Write Enable: This active LOW input permits BYTE WRITE operations and must meet the setup and hold times around the rising edge of CLK.
88	88	GW#	Input	Global Write: This active LOW input allows a full 18-, 32-, or 36-bit WRITE to occur independent of the BWE# and BWx# lines and must meet the setup and hold times around the rising edge of CLK.
89	89	CLK	Input	Clock: This signal registers the address, data, chip enable, byte write enables and burst control inputs on its rising edge. All synchronous inputs must meet setup and hold times around the clock's rising edge.
98	98	CE#	Input	Synchronous Chip Enable: This active LOW input is used to enable the device and conditions the internal use of ADSP#. CE# is sampled only when a new external address is loaded.
92	92	CE2#	Input	Synchronous Chip Enable: This active LOW input is used to enable the device and is sampled only when a new external address is loaded.
97	97	CE2	Input	Synchronous Chip Enable: This active HIGH input is used to enable the device and is sampled only when a new external address is loaded.
86	86	OE#	Input	Output Enable: This active LOW, asynchronous input enables the data I/O output drivers.
83	83	ADV#	Input	Synchronous Address Advance: This active LOW input is used to advance the internal burst counter, controlling burst access after the external address is loaded. A HIGH on this pin effectively causes wait states to be generated (no address advance). To ensure use of correct address during a WRITE cycle, ADV# must be HIGH at the rising edge of the first clock after an ADSP# cycle is initiated.
84	84	ADSP#	Input	Synchronous Address Status Processor: This active LOW input interrupts any ongoing burst, causing a new external address to be registered. A READ is performed using the new address, independent of the byte write enables and ADSC#, but dependent upon CE#, CE2 and CE2#. ADSP# is ignored if CE# is HIGH. Power-down state is entered if CE2 is LOW or CE2# is HIGH.

Micron™

2Mb: 128K x 18, 64K x 32/36
FLOW-THROUGH SYNCBURST SRAM

TQFP PIN DESCRIPTIONS (continued)

x18	x32/x36	SYMBOL	TYPE	DESCRIPTION
85	85	ADSC#	Input	Synchronous Address Status Controller: This active LOW input interrupts any ongoing burst, causing a new external address to be registered. A READ or WRITE is performed using the new address if CE# is LOW. ADSC# is also used to place the chip into power-down state when CE# is HIGH.
31	31	MODE	Input	Mode: This input selects the burst sequence. A LOW on this pin selects "linear burst." NC or HIGH on this pin selects "interleaved burst." Do not alter input state while device is operating.
64	64	ZZ	Input	Snooze Enable: This active HIGH, asynchronous input causes the device to enter a low-power standby mode in which all data in the memory array is retained. When ZZ is active, all other inputs are ignored.
(a) 58, 59, 62, 63, 68, 69, 72, 73 (b) 8, 9, 12, 13, 18, 19, 22, 23	(a) 52, 53, 56-59, 62, 63 (b) 68, 69, 72-75, 78, 79 (c) 2, 3, 6-9, 12, 13 (d) 18, 19, 22-25, 28, 29	DQa DQb DQc DQd	Input/Output	SRAM Data I/Os: For the x18 version, Byte "a" is DQa pins; Byte "b" is DQb pins. For the x32 and x36 versions, Byte "a" is DQa pins; Byte "b" is DQb pins; Byte "c" is DQc pins; Byte "d" is DQd pins. Input data must meet setup and hold times around the rising edge of CLK.
74 24 – –	51 80 1 30	NC/DQPa NC/DQPb NC/DQPc NC/DQPd	NC/I/O	No Connect/Parity Data I/Os: On the x32 version, these pins are No Connect (NC). On the x18 version, Byte "a" parity is DQPa; Byte "b" parity is DQPb. On the x36 version, Byte "a" parity is DQPa; Byte "b" parity is DQPb; Byte "c" parity is DQPc; Byte "d" parity is DQPd.
15, 41, 65, 91	15, 41, 65, 91	V_{DD}	Supply	Power Supply: See DC Electrical Characteristics and Operating Conditions for range.
4, 11, 20, 27, 54, 61, 70, 77	4, 11, 20, 27, 54, 61, 70, 77	V_{DDQ}	Supply	Isolated Output Buffer Supply: See DC Electrical Characteristics and Operating Conditions for range.
5, 10, 14, 17, 21, 26, 40, 55, 60, 67, 71, 76, 90	5, 10, 14, 17, 21, 26, 40, 55, 60, 67, 71, 76, 90	V_{SS}	Supply	Ground: GND.
38, 39, 42, 43	38, 39, 42, 43	DNU	–	Do Not Use: These signals may either be unconnected or wired to GND to improve package heat dissipation.
1-3, 6, 7, 16, 25, 28-30, 51-53, 56, 57, 66, 75, 78, 79, 95, 96	16, 66	NC	–	No Connect: These signals are not internally connected and may be connected to ground to improve package heat dissipation.
50	50	NC/SA	–	No Connect: This pin is reserved for address expansion.

INTERLEAVED BURST ADDRESS TABLE (MODE = NC OR HIGH)

FIRST ADDRESS (EXTERNAL)	SECOND ADDRESS (INTERNAL)	THIRD ADDRESS (INTERNAL)	FOURTH ADDRESS (INTERNAL)
X...X00	X...X01	X...X10	X...X11
X...X01	X...X00	X...X11	X...X10
X...X10	X...X11	X...X00	X...X01
X...X11	X...X10	X...X01	X...X00

LINEAR BURST ADDRESS TABLE (MODE = LOW)

FIRST ADDRESS (EXTERNAL)	SECOND ADDRESS (INTERNAL)	THIRD ADDRESS (INTERNAL)	FOURTH ADDRESS (INTERNAL)
X...X00	X...X01	X...X10	X...X11
X...X01	X...X10	X...X11	X...X00
X...X10	X...X11	X...X00	X...X01
X...X11	X...X00	X...X01	X...X10

PARTIAL TRUTH TABLE FOR WRITE COMMANDS (x18)

FUNCTION	GW#	BWE#	BWa#	BWb#
READ	H	H	X	X
READ	H	L	H	H
WRITE Byte "a"	H	L	L	H
WRITE Byte "b"	H	L	H	L
WRITE All Bytes	H	L	L	L
WRITE All Bytes	L	X	X	X

PARTIAL TRUTH TABLE FOR WRITE COMMANDS (x32/x36)

FUNCTION	GW#	BWE#	BWa#	BWb#	BWc#	BWd#
READ	H	H	X	X	X	X
READ	H	L	H	H	H	H
WRITE Byte "a"	H	L	L	H	H	H
WRITE All Bytes	H	L	L	L	L	L
WRITE All Bytes	L	X	X	X	X	X

NOTE: Using BWE# and BWa# through BWd#, any one or more bytes may be written.

TRUTH TABLE

OPERATION	ADDRESS USED	CE#	CE2#	CE2	ZZ	ADSP#	ADSC#	ADV#	WRITE#	OE#	CLK	DQ
Deselected Cycle, Power-Down	None	H	X	X	L	X	L	X	X	X	L-H	High-Z
Deselected Cycle, Power-Down	None	L	X	L	L	L	X	X	X	X	L-H	High-Z
Deselected Cycle, Power-Down	None	L	H	X	L	L	X	X	X	X	L-H	High-Z
Deselected Cycle, Power-Down	None	L	X	L	L	H	L	X	X	X	L-H	High-Z
Deselected Cycle, Power-Down	None	L	H	X	L	H	L	X	X	X	L-H	High-Z
SNOOZE MODE, Power-Down	None	X	X	X	H	X	X	X	X	X	X	High-Z
READ Cycle, Begin Burst	External	L	L	H	L	L	X	X	X	L	L-H	Q
READ Cycle, Begin Burst	External	L	L	H	L	L	X	X	X	H	L-H	High-Z
WRITE Cycle, Begin Burst	External	L	L	H	L	H	L	X	L	X	L-H	D
READ Cycle, Begin Burst	External	L	L	H	L	H	L	X	H	L	L-H	Q
READ Cycle, Begin Burst	External	L	L	H	L	H	L	X	H	H	L-H	High-Z
READ Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	L	L-H	Q
READ Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	H	L-H	High-Z
READ Cycle, Continue Burst	Next	H	X	X	L	X	H	L	H	L	L-H	Q
READ Cycle, Continue Burst	Next	H	X	X	L	X	H	L	H	H	L-H	High-Z
WRITE Cycle, Continue Burst	Next	X	X	X	L	H	H	L	L	X	L-H	D
WRITE Cycle, Continue Burst	Next	H	X	X	L	X	H	L	L	X	L-H	D
READ Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	H	L	L-H	Q
READ Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	H	H	L-H	High-Z
READ Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	H	L	L-H	Q
READ Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	H	H	L-H	High-Z
WRITE Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	L	X	L-H	D
WRITE Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	L	X	L-H	D

NOTE: 1. X means "Don't Care." # means active LOW. H means logic HIGH. L means logic LOW.
2. For WRITE#, L means any one or more byte write enable signals (BWa#, BWb#, BWc#, or BWd#) and BWE# are LOW or GW# is LOW. WRITE# = H for all BWx#, BWE#, GW# HIGH.
3. BWa# enables WRITEs to DQa pins, DQPa. BWb# enables WRITEs to DQb pins, DQPb. BWc# enables WRITEs to DQc pins, DQPc. BWd# enables WRITEs to DQd pins, DQPd. DQPa and DQPb are only available on the x18 and x36 versions. DQPc and DQPd are only available on the x36 version.
4. All inputs except OE# and ZZ must meet setup and hold times around the rising edge (LOW to HIGH) of CLK.
5. Wait states are inserted by suspending burst.
6. For a WRITE operation following a READ operation, OE# must be HIGH before the input data setup time and held HIGH throughout the input data hold time.
7. This device contains circuitry that will ensure the outputs will be in High-Z during power-up.
8. ADSP# LOW always initiates an internal READ at the L-H edge of CLK. A WRITE is performed by setting one or more byte write enable signals and BWE# LOW or GW# LOW for the subsequent L-H edge of CLK. Refer to WRITE timing diagram for clarification.

ABSOLUTE MAXIMUM RATINGS*

Voltage on V_{DD} Supply
   Relative to V_{SS} .... -0.5V to +4.6V
Voltage on $V_{DD}Q$ Supply
   Relative to V_{SS} .... -0.5V to +4.6V
V_{IN} .... -0.5V to $V_{DD}Q$ + 0.5V
Storage Temperature (plastic) .... -55°C to +150°C
Junction Temperature** .... +150°C
Short Circuit Output Current 100mA

*Stresses 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.

**Maximum junction temperature depends upon package type, cycle time, loading, ambient temperature and airflow. See Micron Technical Note TN-05-14 for more information.

3.3V I/O DC ELECTRICAL CHARACTERISTICS AND OPERATING CONDITIONS

(0°C $\leq T_A \leq$ +70°C; V_{DD}, $V_{DD}Q$ = +3.3V +0.3V/-0.165V unless otherwise noted)

DESCRIPTION	CONDITIONS	SYMBOL	MIN	MAX	UNITS	NOTES
Input High (Logic 1) Voltage		V_{IH}	2.0	V_{DD} + 0.3	V	1, 2
Input Low (Logic 0) Voltage		V_{IL}	-0.3	0.8	V	1, 2
Input Leakage Current	$0V \leq V_{IN} \leq V_{DD}$	IL_I	-1.0	1.0	µA	3
Output Leakage Current	Output(s) disabled, $0V \leq V_{IN} \leq V_{DD}$	IL_O	-1.0	1.0	µA	
Output High Voltage	I_{OH} = -4.0mA	V_{OH}	2.4	–	V	1, 4
Output Low Voltage	I_{OL} = 8.0mA	V_{OL}	–	0.4	V	1, 4
Supply Voltage		V_{DD}	3.135	3.6	V	1
Isolated Output Buffer Supply		$V_{DD}Q$	3.135	V_{DD}	V	1, 5

2.5V I/O DC ELECTRICAL CHARACTERISTICS AND OPERATING CONDITIONS

(0°C $\leq T_A \leq$ +70°C; V_{DD} = +3.3V +0.3V/-0.165V; $V_{DD}Q$ = +2.5V +0.4V/-0.125V unless otherwise noted)

DESCRIPTION	CONDITIONS	SYMBOL	MIN	MAX	UNITS	NOTES
Input High (Logic 1) Voltage	Data bus (DQx)	V_{IHQ}	1.7	$V_{DD}Q$ + 0.3	V	1, 2
	Inputs	V_{IH}	1.7	V_{DD} + 0.3	V	1, 2
Input Low (Logic 0) Voltage		V_{IL}	-0.3	0.7	V	1, 2
Input Leakage Current	$0V \leq V_{IN} \leq V_{DD}$	IL_I	-1.0	1.0	µA	3
Output Leakage Current	Output(s) disabled, $0V \leq V_{IN} \leq V_{DD}Q$ (DQx)	IL_O	-1.0	1.0	µA	
Output High Voltage	I_{OH} = -2.0mA	V_{OH}	1.7	–	V	1, 4
	I_{OH} = -1.0mA	V_{OH}	2.0	–	V	1, 4
Output Low Voltage	I_{OL} = 2.0mA	V_{OL}	–	0.7	V	1, 4
	I_{OL} = 1.0mA	V_{OL}	–	0.4	V	1, 4
Supply Voltage		V_{DD}	3.135	3.6	V	1
Isolated Output Buffer Supply		$V_{DD}Q$	2.375	2.9	V	1

NOTE:
1. All voltages referenced to V_{SS} (GND).
2. Overshoot: $V_{IH} \leq$ +4.6V for t $\leq$ $^tKC/2$ for I $\leq$ 20mA
   Undershoot: $V_{IL} \geq$ -0.7V for t $\leq$ $^tKC/2$ for I $\leq$ 20mA
   Power-up: $V_{IH} \leq$ +3.6V and $V_{DD} \leq$ 3.135V for t $\leq$ 200ms
3. MODE pin has an internal pull-up, and input leakage = ±10µA.
4. The load used for V_{OH}, V_{OL} testing is shown in Figure 2 for 3.3V I/O and Figure 4 for 2.5V I/O. AC load current is higher than the stated DC values. AC I/O curves are available upon request.
5. $V_{DD}Q$ should never exceed V_{DD}. V_{DD} and $V_{DD}Q$ can be connected together for 3.3V I/O.

I_{DD} OPERATING CONDITIONS AND MAXIMUM LIMITS

(Note: 1) (0°C ≤ T_A ≤ +70°C; V_{DD} = +3.3V +0.3V/-0.165V unless otherwise noted)

DESCRIPTION	CONDITIONS	SYM	TYP	MAX -6.8	MAX -7.5	MAX -8.5	MAX -10	UNITS	NOTES
Power Supply Current: Operating	Device selected; All inputs ≤ V_{IL} or ≥ V_{IH}; Cycle time ≥ ^{t}KC (MIN); V_{DD} = MAX; Outputs open	I_{DD}	65	265	245	225	150	mA	2, 3, 4
Power Supply Current: Idle	Device selected; V_{DD} = MAX; ADSC#, ADSP#, ADV#, GW#, BWx# ≥ V_{IH}; All inputs ≤ V_{SS} + 0.2 or ≥ V_{DD} - 0.2; Cycle time ≥ ^{t}KC (MIN); Outputs open	I_{DD1}	20	70	65	65	50	mA	2, 3, 4
CMOS Standby	Device deselected; V_{DD} = MAX; All inputs ≤ V_{SS} + 0.2 or ≥ V_{DD} - 0.2; All inputs static; CLK frequency = 0	I_{SB2}	0.5	10	10	10	10	mA	3, 4
TTL Standby	Device deselected; V_{DD} = MAX; All inputs ≤ V_{IL} or ≥ V_{IH}; All inputs static; CLK frequency = 0	I_{SB3}	6	25	25	25	25	mA	3, 4
Clock Running	Device deselected; V_{DD} = MAX; ADSC#, ADSP#, ADV#, GW#, BWx# ≥ V_{IH}; All inputs ≤ V_{SS} + 0.2 or ≥ V_{DD} - 0.2; Cycle time ≥ ^{t}KC (MIN)	I_{SB4}	20	70	65	65	50	mA	3, 4

NOTE:
1. $V_{DD}Q$ = +3.3V +0.3V/-0.165V for 3.3V I/O configuration; $V_{DD}Q$ = +2.5V +0.4V/-0.125V for 2.5V I/O configuration.
2. I_{DD} is specified with no output current and increases with faster cycle times. $I_{DD}Q$ increases with faster cycle times and greater output loading.
3. "Device deselected" means device is in power-down mode as defined in the truth table. "Device selected" means device is active (not in power-down mode).
4. Typical values are measured at 3.3V, 25°C and 15ns cycle time.
5. $V_{DD}Q$ = +3.3V +0.3V/-0.165V for 3.3V I/O configuration; $V_{DD}Q$ = +2.5V +0.4V/-0.125V for 2.5V I/O configuration.
6. I_{DD} is specified with no output current and increases with faster cycle times. $I_{DD}Q$ increases with faster cycle times and greater output loading.
7. "Device deselected" means device is in power-down mode as defined in the truth table. "Device selected" means device is active (not in power-down mode).
8. Typical values are measured at 3.3V, 25°C, and 15ns cycle time.

TQFP CAPACITANCE

DESCRIPTION	CONDITIONS	SYMBOL	TYP	MAX	UNITS	NOTES
Control Input Capacitance	T_A = 25°C; f = 1 MHz; V_{DD} = 3.3V	C_I	2.7	3.5	pF	1
Input/Output Capacitance (DQ)		C_O	4	5	pF	1
Address Capacitance		C_A	2.5	3.5	pF	1
Clock Capacitance		C_{CK}	2.5	3.5	pF	1

TQFP THERMAL RESISTANCE

DESCRIPTION	CONDITIONS	SYMBOL	TYP	UNITS	NOTES
Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	θ_{JA}	40	°C/W	1
Thermal Resistance (Junction to Top of Case)		θ_{JC}	8	°C/W	1

NOTE: 1. This parameter is sampled.

ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

(Note 1) (0°C ≤ T$_A$ ≤ +70°C; V$_{DD}$ = +3.3V +0.3V/-0.165V)

DESCRIPTION	SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS	NOTES
Clock											
Clock cycle time	^{t}KC	8.0		8.8		10.0		15		ns	
Clock frequency	^{f}KF		125		113		100		66	MHz	
Clock HIGH time	^{t}KH	1.8		1.9		1.9		4.0		ns	2
Clock LOW time	^{t}KL	1.8		1.9		1.9		4.0		ns	2
Output Times											
Clock to output valid	^{t}KQ		6.8		7.5		8.5		10.0	ns	
Clock to output invalid	^{t}KQX	1.5		1.5		3.0		3.0		ns	3
Clock to output in Low-Z	^{t}KQLZ	1.5		1.5		1.5		1.5		ns	3, 4, 5, 6
Clock to output in High-Z	^{t}KQHZ		3.8		4.2		5.0		5.0	ns	3, 4, 5, 6
OE# to output valid	^{t}OEQ		3.8		4.2		5.0		5.0	ns	7
OE# to output in Low-Z	^{t}OELZ	0		0		0		0		ns	3, 4, 5, 6
OE# to output in High-Z	^{t}OEHZ		3.8		4.2		5.0		5.0	ns	3, 4, 5, 6
Setup Times											
Address	^{t}AS	1.8		2.0		2.0		2.5		ns	8, 9
Address status (ADSC#, ADSP#)	^{t}ADSS	1.8		2.0		2.0		2.5		ns	8, 9
Address advance (ADV#)	^{t}AAS	1.8		2.0		2.0		2.5		ns	8, 9
Byte write enables (BWa#-BWd#, GW#, BWE#)	^{t}WS	1.8		2.0		2.0		2.5		ns	8, 9
Data-in	^{t}DS	1.8		2.0		2.0		2.5		ns	8, 9
Chip enable (CE#)	^{t}CES	1.8		2.0		2.0		2.5		ns	8, 9
Hold Times											
Address	^{t}AH	0.5		0.5		0.5		0.5		ns	8, 9
Address status (ADSC#, ADSP#)	^{t}ADSH	0.5		0.5		0.5		0.5		ns	8, 9
Address advance (ADV#)	^{t}AAH	0.5		0.5		0.5		0.5		ns	8, 9
Byte write enables (BWa#-BWd#, GW#, BWE#)	^{t}WH	0.5		0.5		0.5		0.5		ns	8, 9
Data-in	^{t}DH	0.5		0.5		0.5		0.5		ns	8, 9
Chip enable (CE#)	^{t}CEH	0.5		0.5		0.5		0.5		ns	8, 9

NOTE:
1. Test conditions as specified with the output loading shown in Figure 1 for 3.3V I/O (V$_{DDQ}$ = +3.3V +0.3V/-0.165V) and Figure 3 for 2.5V I/O (V$_{DDQ}$ = +2.5V +0.4V/-0.125V).
2. Measured as HIGH above V$_{IH}$ and LOW below V$_{IL}$.
3. This parameter is measured with the output loading shown in Figure 2 for 3.3V I/O and Figure 4 for 2.5V I/O.
4. This parameter is sampled.
5. Transition is measured ±500mV from steady state voltage.
6. Refer to Technical Note TN-58-09, "Synchronous SRAM Bus Contention Design Considerations," for a more thorough discussion on these parameters.
7. OE# is a "Don't Care" when a byte write enable is sampled LOW.
8. A READ cycle is defined by byte write enables all HIGH or ADSP# LOW for the required setup and hold times. A WRITE cycle is defined by at least one byte write enable LOW and ADSP# HIGH for the required setup and hold times.
9. This is a synchronous device. All addresses must meet the specified setup and hold times for all rising edges of CLK when either ADSP# or ADSC# is LOW and chip enabled. All other synchronous inputs must meet the setup and hold times with stable logic levels for all rising edges of clock (CLK) when the chip is enabled. Chip enable must be valid at each rising edge of CLK when either ADSP# or ADSC# is LOW to remain enabled.

3.3V I/O AC TEST CONDITIONS

Input pulse levels	$V_{IH} = (V_{DD}/2.2) + 1.5V$
....	$V_{IL} = (V_{DD}/2.2) - 1.5V$
Input rise and fall times	1ns
Input timing reference levels	$V_{DD}/2.2$
Output reference levels	$V_{DD}Q/2.2$
Output load	See Figures 1 and 2

2.5V I/O AC TEST CONDITIONS

Input pulse levels	$V_{IH} = (V_{DD}/2.64) + 1.25V$
....	$V_{IL} = (V_{DD}/2.64) - 1.25V$
Input rise and fall times	1ns
Input timing reference levels	$V_{DD}/2.64$
Output reference levels	$V_{DD}Q/2$
Output load	See Figures 3 and 4

3.3V I/O Output Load Equivalents
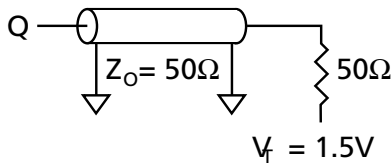
Figure 1

2.5V I/O Output Load Equivalents
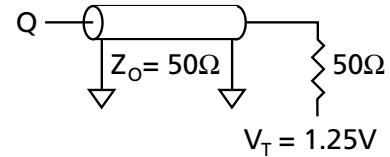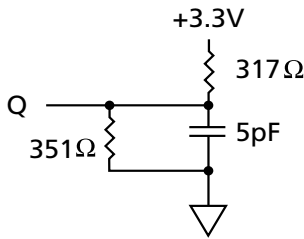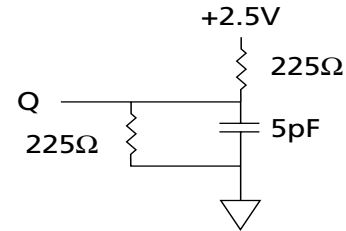

Figure 3

Figure 2

Figure 4

LOAD DERATING CURVES

   The Micron 128K x 18, 64K x 32, and 64K x 36 SyncBurst SRAM timing is dependent upon the capacitive loading on the outputs.

   Consult the factory for copies of I/O current versus voltage curves.

SNOOZE MODE

SNOOZE MODE is a low-current, "power-down" mode in which the device is deselected and current is reduced to I_{SB2Z}. The duration of SNOOZE MODE is dictated by the length of time the ZZ pin is in a HIGH state. After the device enters SNOOZE MODE, all inputs except ZZ become gated inputs and are ignored.

The ZZ pin is an asynchronous, active HIGH input that causes the device to enter SNOOZE MODE. When the ZZ pin becomes a logic HIGH, I_{SB2Z} is guaranteed after the setup time ^tZZ is met. Any access pending when the device enters SNOOZE MODE is not guaranteed to complete successfully. Therefore, SNOOZE MODE must not be initiated until valid pending operations are completed.

SNOOZE MODE ELECTRICAL CHARACTERISTICS

DESCRIPTION	CONDITIONS	SYMBOL	MIN	MAX	UNITS	NOTES
Current during SNOOZE MODE	$ZZ \geq V_{IH}$	I_{SB2Z}		10	mA	
ZZ active to input ignored		^tZZ		^tKC	ns	1
ZZ inactive to input sampled		^tRZZ	^tKC		ns	1
ZZ active to snooze current		^tZZI		^tKC	ns	1
ZZ inactive to exit snooze current		^tRZZI	0		ns	1

NOTE: 1. This parameter is sampled.

SNOOZE MODE WAVEFORM
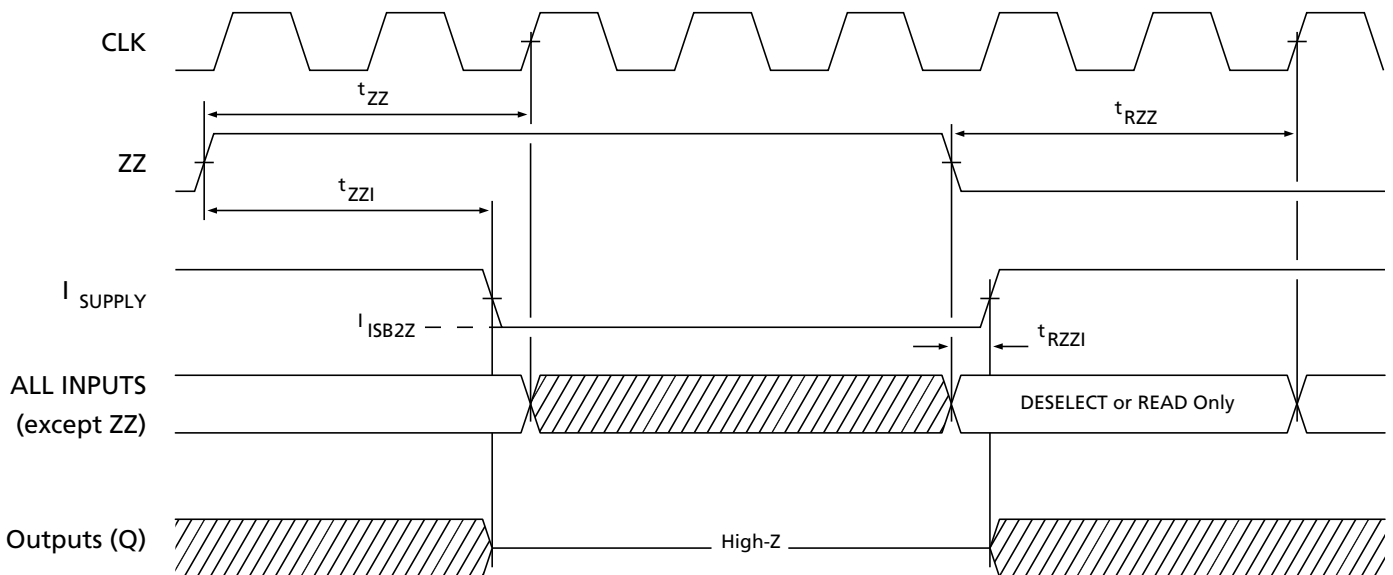
DON'T CARE

READ TIMING
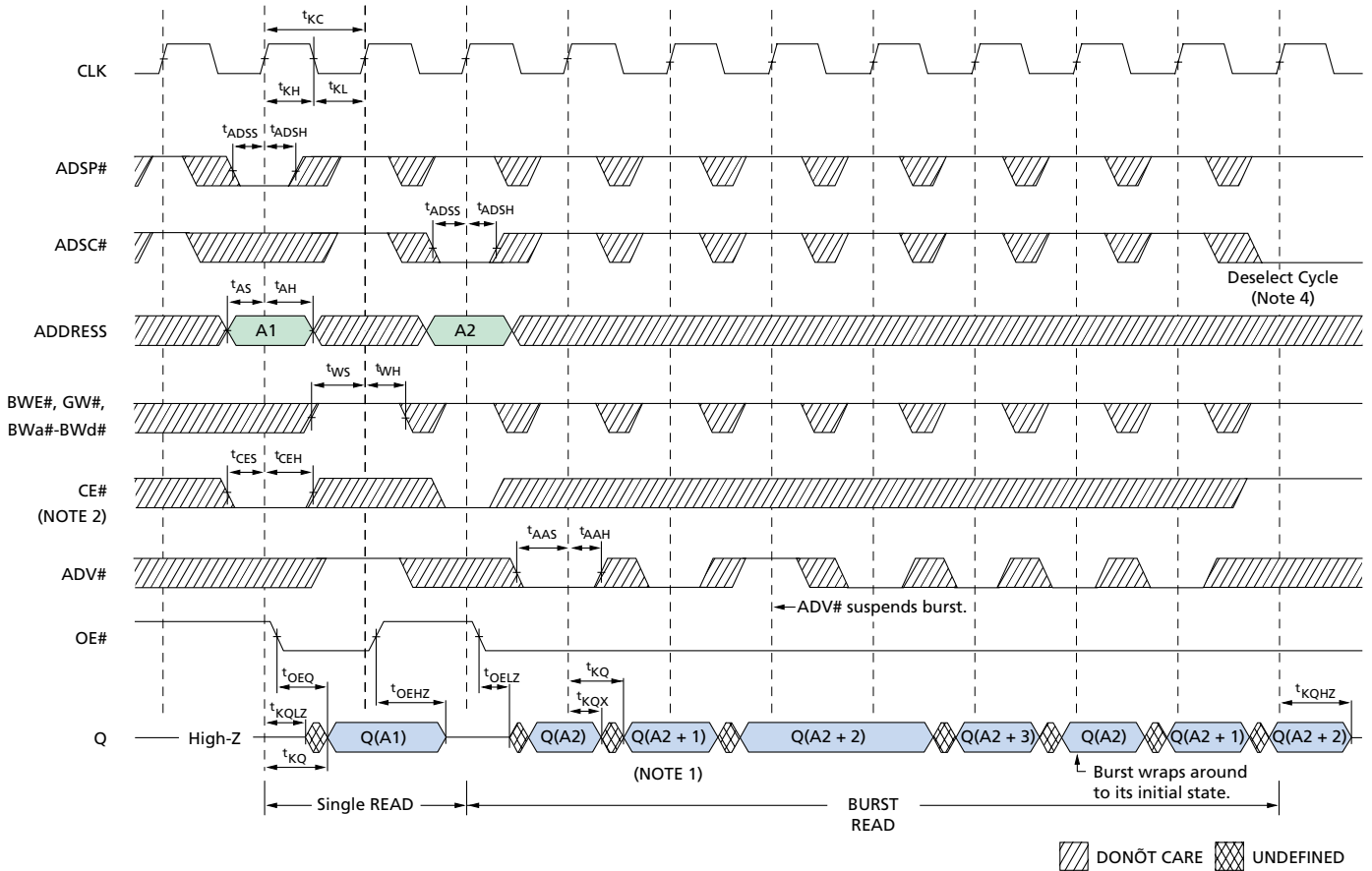
READ TIMING PARAMETERS

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
^tKC	8.0		8.8		10.0		15		ns
^fKF		125		113		100		66	MHz
^tKH	1.8		1.9		1.9		4.0		ns
^tKL	1.8		1.9		1.9		4.0		ns
^tKQ		6.8		7.5		8.5		10.0	ns
^tKQX	1.5		1.5		3.0		3.0		ns
^tKQLZ	1.5		1.5		1.5		1.5		ns
^tKQHZ		3.8		4.2		5.0		5.0	ns
^tOEQ		3.8		4.2		5.0		5.0	ns
^tOELZ	0		0		0		0		ns
^tOEHZ		3.8		4.2		5.0		5.0	ns

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
^tAS	1.8		2.0		2.0		2.5		ns
^tADSS	1.8		2.0		2.0		2.5		ns
^tAAS	1.8		2.0		2.0		2.5		ns
^tWS	1.8		2.0		2.0		2.5		ns
^tCES	1.8		2.0		2.0		2.5		ns
^tAH	0.5		0.5		0.5		0.5		ns
^tADSH	0.5		0.5		0.5		0.5		ns
^tAAH	0.5		0.5		0.5		0.5		ns
^tWH	0.5		0.5		0.5		0.5		ns
^tCEH	0.5		0.5		0.5		0.5		ns

NOTE:
1. Q(A2) refers to output from address A2. Q(A2 + 1) refers to output from the next internal burst address following A2.
2. CE2# and CE2 have timing identical to CE#. On this diagram, when CE# is LOW, CE2# is LOW and CE2 is HIGH. When CE# is HIGH, CE2# is HIGH and CE2 is LOW.
3. Timing is shown assuming that the device was not enabled before entering into this sequence.
4. Outputs are disabled ^tKQHZ after deselect.
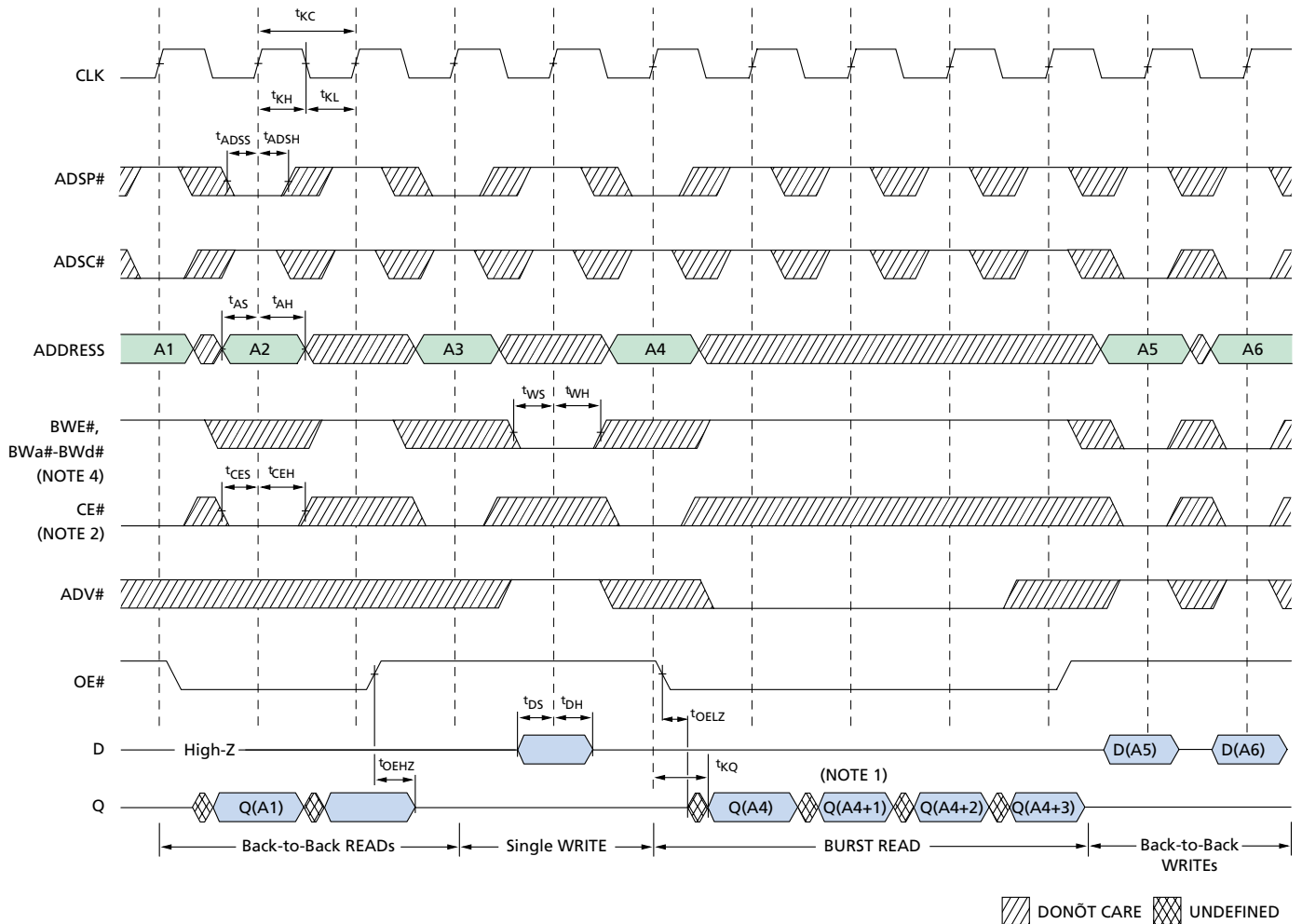
WRITE TIMING
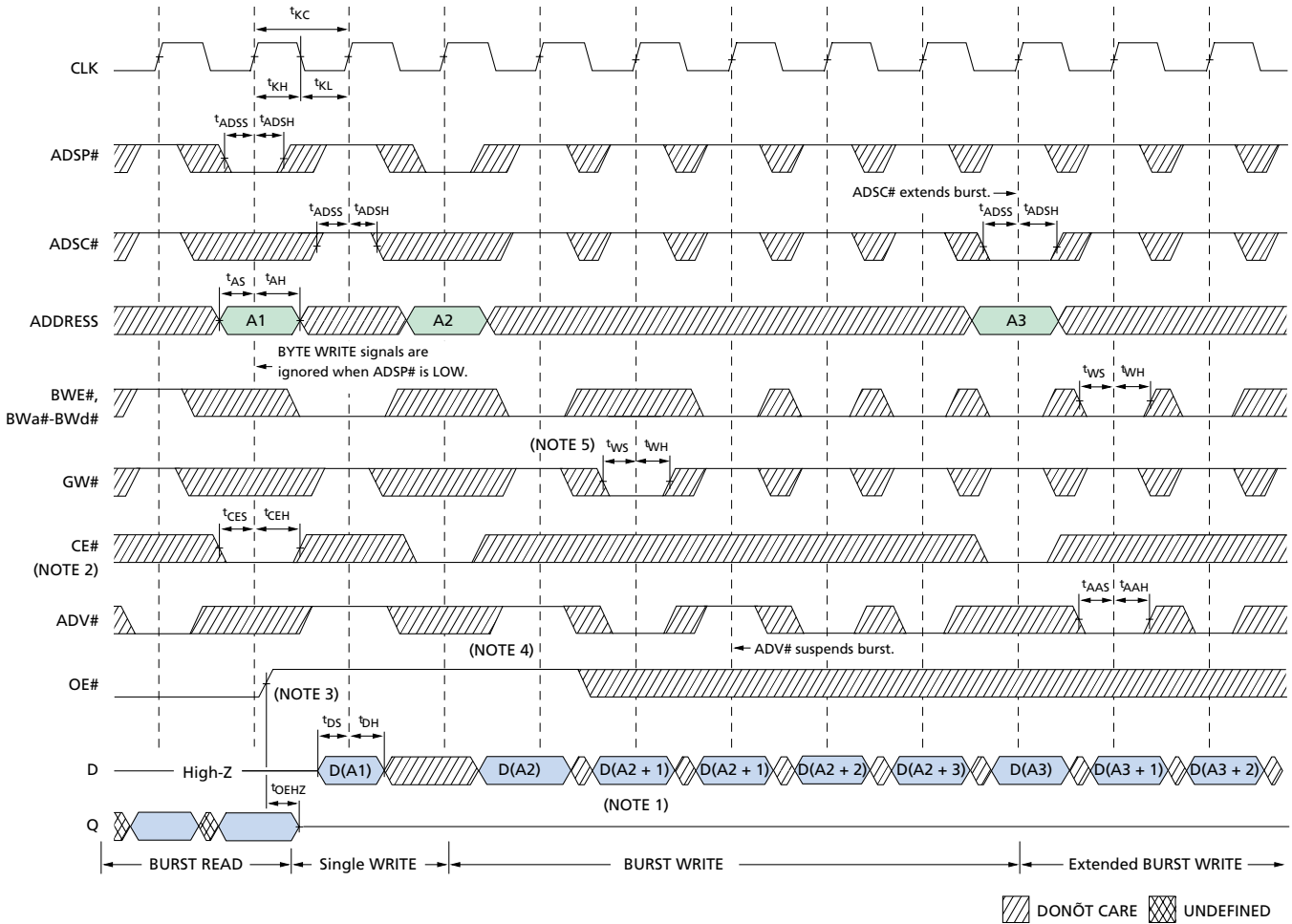
WRITE TIMING PARAMETERS

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
^tKC	8.0		8.8		10.0		15		ns
^fKF		125		113		100		66	MHz
^tKH	1.8		1.9		1.9		4.0		ns
^tKL	1.8		1.9		1.9		4.0		ns
^tOEHZ		3.8		4.2		5.0		5.0	ns
^tAS	1.8		2.0		2.0		2.5		ns
^tADSS	1.8		2.0		2.0		2.5		ns
^tAAS	1.8		2.0		2.0		2.5		ns
^tWS	1.8		2.0		2.0		2.5		ns

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
^tDS	1.8		2.0		2.0		2.5		ns
^tCES	1.8		2.0		2.0		2.5		ns
^tAH	0.5		0.5		0.5		0.5		ns
^tADSH	0.5		0.5		0.5		0.5		ns
^tAAH	0.5		0.5		0.5		0.5		ns
^tWH	0.5		0.5		0.5		0.5		ns
^tDH	0.5		0.5		0.5		0.5		ns
^tCEH	0.5		0.5		0.5		0.5		ns

NOTE: 1. D(A2) refers to input for address A2. D(A2 + 1) refers to input for the next internal burst address following A2.
2. CE2# and CE2 have timing identical to CE#. On this diagram, when CE# is LOW, CE2# is LOW and CE2 is HIGH. When CE# is HIGH, CE2# is HIGH and CE2 is LOW.
3. OE# must be HIGH before the input data setup and held HIGH throughout the data hold time. This prevents input/output data contention for the time period prior to the byte write enable inputs being sampled.
4. ADV# must be HIGH to permit a WRITE to the loaded address.
5. Full-width WRITE can be initiated by GW# LOW; or GW# HIGH and BWE#, BWa# and BWb# LOW for the x18 version; or GW# HIGH and BWE#, BWa#-BWd# LOW for the x32 and x36 versions.

READ/WRITE TIMING

READ/WRITE TIMING PARAMETERS

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
t_{KC}	8.0		8.8		10.0		15		ns
f_{KF}		125		113		100		66	MHz
t_{KH}	1.8		1.9		1.9		4.0		ns
t_{KL}	1.8		1.9		1.9		4.0		ns
t_{KQ}		6.8		7.5		8.5		10.0	ns
t_{OELZ}	0		0		0		0		ns
t_{OEHZ}		3.8		4.2		5.0		5.0	ns
t_{AS}	1.8		2.0		2.0		2.5		ns
t_{ADSS}	1.8		2.0		2.0		2.5		ns

SYMBOL	-6.8 MIN	-6.8 MAX	-7.5 MIN	-7.5 MAX	-8.5 MIN	-8.5 MAX	-10 MIN	-10 MAX	UNITS
t_{WS}	1.8		2.0		2.0		2.5		ns
t_{DS}	1.8		2.0		2.0		2.5		ns
t_{CES}	1.8		2.0		2.0		2.5		ns
t_{AH}	0.5		0.5		0.5		0.5		ns
t_{ADSH}	0.5		0.5		0.5		0.5		ns
t_{WH}	0.5		0.5		0.5		0.5		ns
t_{DH}	0.5		0.5		0.5		0.5		ns
t_{CEH}	0.5		0.5		0.5		0.5		ns

NOTE: 1. Q(A4) refers to output from address A4. Q(A4 + 1) refers to output from the next internal burst address following A4.
2. CE2# and CE2 have timing identical to CE#. On this diagram, when CE# is LOW, CE2# is LOW and CE2 is HIGH. When CE# is HIGH, CE2# is HIGH and CE2 is LOW.
3. The data bus (Q) remains in High-Z following a WRITE cycle unless an ADSP#, ADSC# or ADV# cycle is performed.
4. GW# is HIGH.
5. Back-to-back READs may be controlled by either ADSP# or ADSC#.

100-PIN PLASTIC TQFP (JEDEC LQFP)
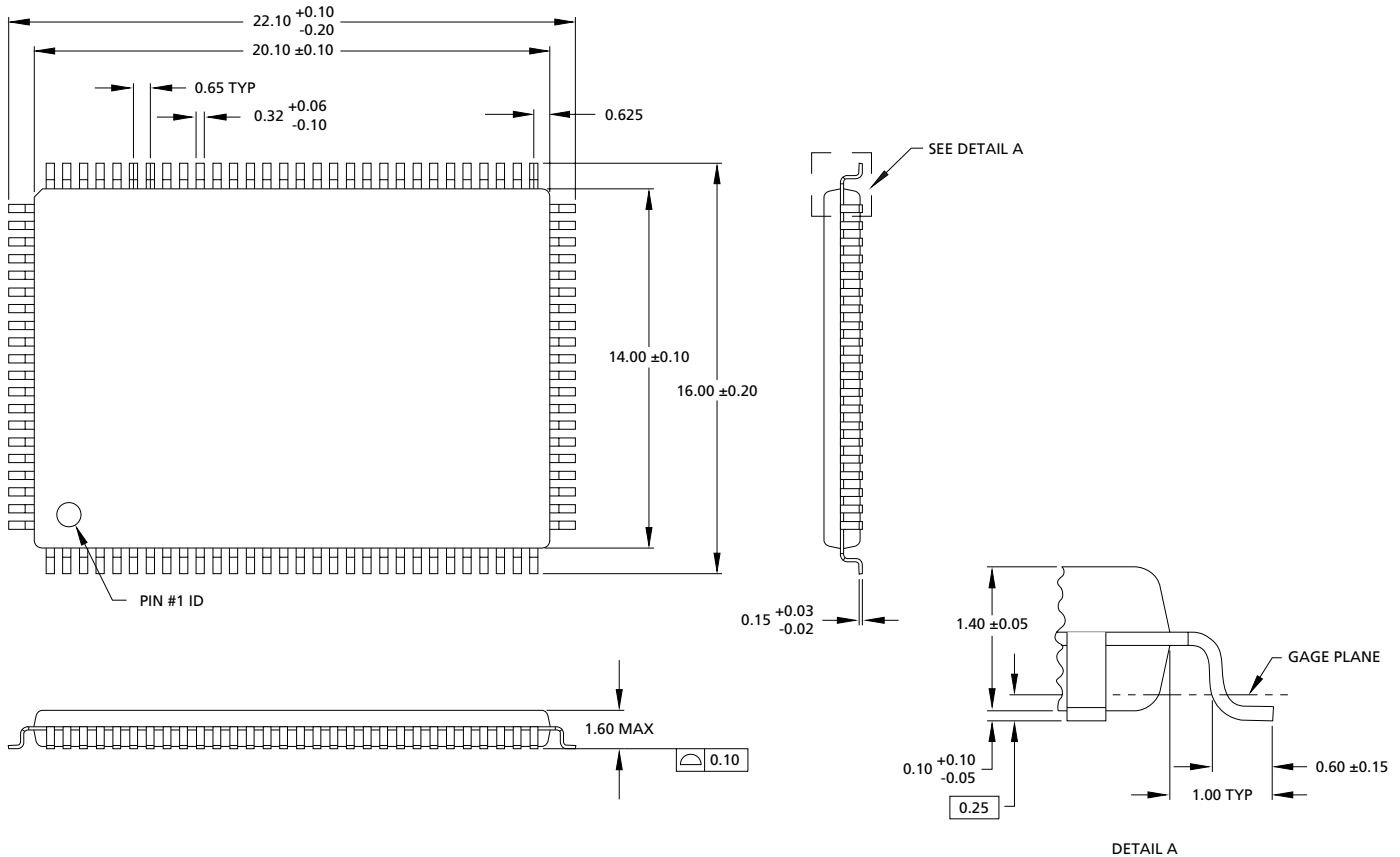
NOTE: 1. All dimensions in millimeters $\frac{MAX}{MIN}$ or typical here noted.
2. Package width and length do not include mold protrusion; allowable mold protrusion is 0.25mm per side.

DATA SHEET DESIGNATIONS

No Marking: This data sheet contains minimum and maximum limits specified over the complete power supply and temperature range for production devices. Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.

REVISION HISTORY

Added "NOT RECOMENDED FOR NEW DESIGNS," REV. C, Pub. 11/02, FINAL November/21/02

Removed 165-pin FBGA package, Rev. 6/01 .... June/7/01

Removed FBGA Part Marking Guide, REV 8/00, FINAL August/22/00

Changed FBGA capacitance values, REV 8/00, FINAL August/7/00
C_I; TYP 2.5pF from 4pF; MAX. 3.5pF from 5pF
C_O; TYP 4pF from 6pF; MAX. 5pF from 7pF
C_{CK}; TYP 2.5pF from 5pF; MAX. 3.5pF from 6pF

Removed IT References, REV 7/00, FINAL July/10/00
Added FBGA Part Marking Guide
Added Revision History to Datasheet

Removed IT from Part Number Example, REV 6/00, FINAL June/21/00
Added # of datalines to the databus in x32/36 Block Diagram
Changed tKQLZ from 4.0ns MIN to 1.5ns MIN
Added Note - "Preliminary Package Data" to FBGA Capacitance and Thermal Resistance Tables
Changed heading on Mechanical Drawing from BGA to FBGA

Added 165-Pin FBGA package, REV 3/00, FINAL May/23/00
Added PRELIMINARY PACKAGE DATA to diagram