

SYNCHRONOUS SRAM

128K x32/36 SRAM

+3.3V SUPPLY, +2.5V I/O, FLOW-THROUGH AND SELECTABLE BURST MODE

NEW SYNCBURST FLOW-THROUGH - 2.5V I/O

FEATURES

- Fast access times: 8.5, 9, 10, 11 and 12ns
- Fast OE# access times: 5 and 6ns
- +3.3V +0.3V/-0.165V power supply (Vcc)
- Separate +2.5V +0.4V/-0.125V isolated output buffer supply (VccQ)
- 3.3V-tolerant inputs
- 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, registered, address, data and control
- Internally self-timed WRITE cycle
- Burst control pin (interleaved or linear burst)
- Automatic power-down for portable applications
- 100-lead TQFP package for high density, high speed
- Low capacitive bus loading
- High 30pF output drive capability at rated access time
- DIMMs also available
- x32 or x36 versions available

OPTIONS

- Timing
 - 8.5ns access/12ns cycle
 - 9ns access/13ns cycle
 - 10ns access/15ns cycle
 - 11ns access/15ns cycle
 - 12ns access/20ns cycle

MARKING

- Configuration

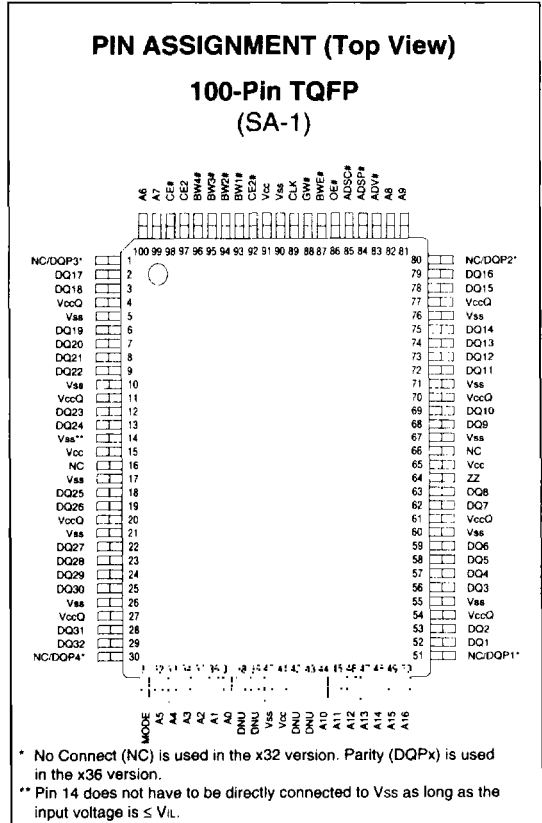
| | |
|-----------|----------------|
| 128K x 32 | MT58LC128K32E1 |
| 128K x 36 | MT58LC128K36E1 |
- Packages

| | |
|--------------|----|
| 100-pin TQFP | LG |
|--------------|----|
- Part Number Example: MT58LC128K36E1LG-9

GENERAL DESCRIPTION

The Micron SyncBurst SRAM family employs high-speed, low-power CMOS designs using a four-transistor memory cell. Micron SRAMs are fabricated using an advanced CMOS process.

The MT58LC128K32/36E1 SRAM integrates a 128K x 32 or 128K 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 (BW1#, BW2#, BW3#, BW4#, BWE#) and global write (GW#).

Asynchronous inputs include the output enable (OE#), clock (CLK) and snooze enable (ZZ). 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 1 to 4 bytes wide as controlled by the write control inputs.

GENERAL DESCRIPTION (continued)

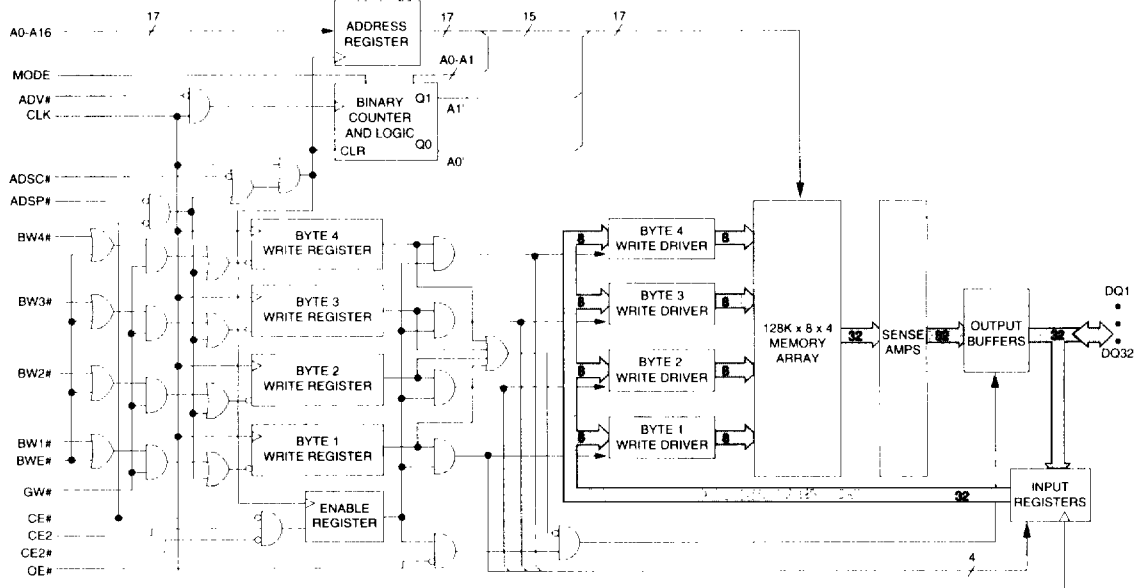
Burst operation can be initiated with either address status processor (ADSP#) or address status controller (ADSC#) input pins. Subsequent burst addresses can be internally generated as controlled by the burst advance pin (ADV#).

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. BW1# controls DQ1-DQ8 and DQP1, BW2# controls DQ9-DQ16 and DQP2, BW3# controls DQ17-DQ24 and DQP3, and BW4# controls DQ25-DQ32 and DQP4, conditioned by

BWE# being LOW. GW# LOW causes all bytes to be written. Parity bits are available in the x36 version only.

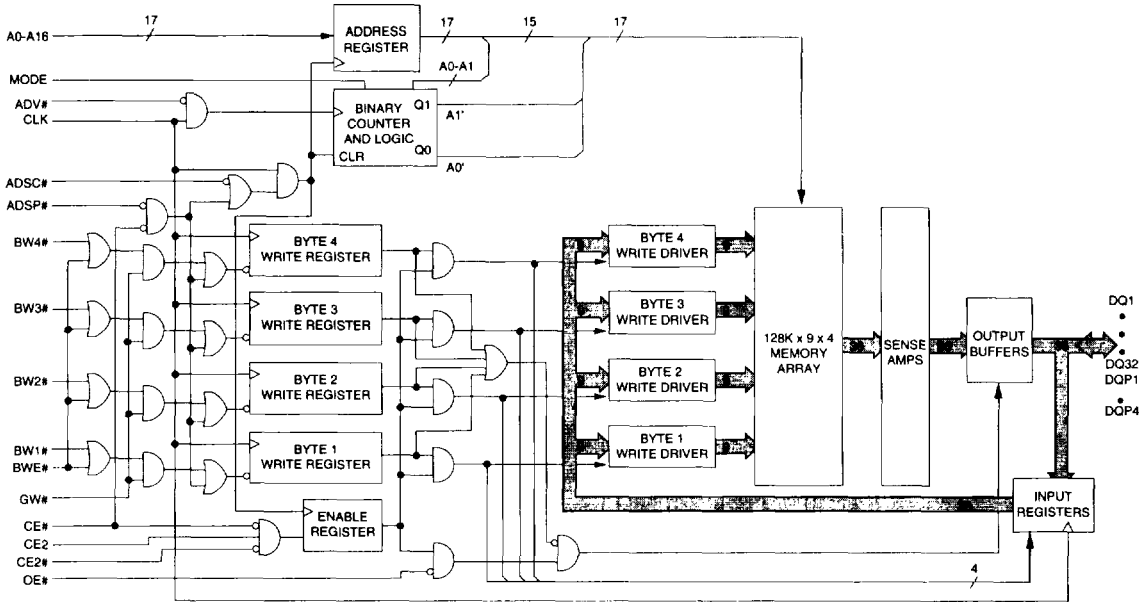
The MT58LC128K32/36E1 operates from a +3.3V power supply and all inputs and outputs can communicate with other 2.5V I/O. All inputs are 3.3V-tolerant and can be used in mixed 3.3V and 2.5V systems. The device is ideally suited for systems that benefit from a wide synchronous data bus and 2.5V I/O. The device is also ideal in generic 32-, 36-, 64- and 72-bit-wide applications.

**FUNCTIONAL BLOCK DIAGRAM
128K x 32**



NOTE: 1. Functional Block Diagrams illustrate simplified device operation. See Truth Table, Pin Descriptions and timing diagrams for detailed information.

FUNCTIONAL BLOCK DIAGRAM
128K x 36



NEW SYNCBURST FLOW-THROUGH - 2.5V I/O

PIN DESCRIPTIONS

| TQFP PINS | SYMBOL | TYPE | DESCRIPTION |
|---|---------------------------------|-------|--|
| 37, 36, 35, 34, 33, 32, 100, 99, 82, 81, 44, 45, 46, 47, 48, 49, 50 | A0-A16 | Input | Synchronous Address Inputs: These inputs are registered and must meet the setup and hold times around the rising edge of CLK. |
| 93, 94, 95, 96 | BW1#, BW2#, BW3#, BW4# | Input | Synchronous Byte Write Enables: These active LOW inputs allow individual bytes to be written when BWE# is LOW 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. BW1# controls DQ1-DQ8 and DQP1. BW2# controls DQ9-DQ16 and DQP2. BW3# controls DQ17-DQ24 and DQP3. BW4# controls DQ25-DQ32 and DQP4. Data I/O are tristated if any of these four inputs are LOW. |
| 89 | CLK | Input | Clock: This signal registers the address, data, chip enables, 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 | CE# | Input | Synchronous Chip Enable: This active LOW input is used to enable the device and conditions the internal use of ADSP#. This input is sampled only when a new external address is loaded. |
| 92 | CE2# | Input | Synchronous Chip Enable: This active LOW input is used to enable the device. This input is sampled only when a new external address is loaded. This input can be used for memory depth expansion. |
| 97 | CE2 | Input | Synchronous Chip Enable: This active HIGH input is used to enable the device. This input is sampled only when a new external address is loaded. This input can be used for memory depth expansion. |
| 86 | OE# | Input | Output Enable: This active LOW asynchronous input enables the data I/O output drivers. |
| 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). This pin must be HIGH at the rising edge of the first clock after an ADSP# cycle is initiated if a WRITE cycle is desired (to ensure use of correct address). |
| 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 CE2 and CE2#. ADSP# is ignored if CE# is HIGH. Power-down state is entered if CE2 is LOW or CE2# is HIGH. |
| 85 | ADSC# | Input | Synchronous Address Status Controller: This active LOW input interrupts any ongoing burst and causes a new external address to be registered. A READ or WRITE is performed using the new address if all chip enables are active. Power-down state is entered if one or more chip enables are inactive. |



PIN DESCRIPTIONS (continued)

| TQFP PINS | SYMBOL | TYPE | DESCRIPTION |
|---|---------------------|------------------|--|
| 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 active, all other inputs are ignored. |
| 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 | GW# | Input | Global Write: This active LOW input allows a full 36-bit WRITE to occur independent of the BWE# and BWn# lines and must meet the setup and hold times around the rising edge of CLK. |
| 16, 66 | NC | - | No Connect: These signals are not internally connected. These signals may be connected to ground to improve package heat dissipation. |
| 38, 39, 42, 43 | DNU | - | Do Not Use: These signals may either be unconnected or wired to GND to improve package heat dissipation. |
| 52, 53, 56, 57, 58, 59, 62, 63, 68, 69, 72, 73, 74, 75, 78, 79, 2, 3, 6, 7, 8, 9, 12, 13, 18, 19, 22, 23, 24, 25, 28, 29 | DQ1-DQ32 | Input/ Output | SRAM Data I/O: Byte 1 is DQ1-DQ8; Byte 2 is DQ9-DQ16; Byte 3 is DQ17-DQ24; Byte 4 is DQ25-DQ32. Input data must meet setup and hold times around the rising edge of CLK. |
| 51, 80, 1, 30 | NC/DQP1- NC/DQP4 | NC/ I/O | No Connect/Parity Data I/O: On the x36 version, Byte 1 Parity is DQP1; Byte 2 Parity is DQP2; Byte 3 Parity is DQP3; Byte 4 Parity is DQP4. On the x32 version, these pins are No Connects (NC). |
| 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. |
| 15, 41, 65, 91 | Vcc | Supply | Power Supply: +3.3V +10%/-5% |
| 4, 11, 20, 27, 54, 61, 70, 77 | VccQ | Supply | Isolated Output Buffer Supply: +2.5V +0.4V/-0.125V. |
| 5, 10, 14, 17, 21, 26, 40, 55, 60, 67, 71, 76, 90 | Vss | Supply | Ground: GND. Pin 14 does not have to be connected directly to GND as long as the input voltage is $\leq V_{IL}$. |

NEW SYNCBURST FLOW-THROUGH - 2.5V I/O

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 = GND)

| 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

| Function | GW# | BWE# | BW1# | BW2# | BW3# | BW4# |
|-----------------|-----|------|------|------|------|------|
| READ | H | H | X | X | X | X |
| READ | H | L | H | H | H | H |
| WRITE Byte 1 | 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 BW1# through BW4#, 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." H means logic HIGH. L means logic LOW. WRITE#=L means any one or more byte write enable signals (BW1#, BW2#, BW3# or BW4#) and BWE# are LOW or GW# is LOW. WRITE#=H means all byte write enable signals and GW# are HIGH.
 2. BW1# enables WRITES to Byte 1 (DQ1-DQ8, DQP1). BW2# enables WRITES to Byte 2 (DQ9-DQ16, DQP2). BW3# enables WRITES to Byte 3 (DQ17-DQ24, DQP3). BW4# enables WRITES to Byte 4 (DQ25-DQ32, DQP4). DQP1-DQP4 are available on the x36 version only.
 3. All inputs except OE# and ZZ must meet setup and hold times around the rising edge (LOW to HIGH) of CLK.
 4. Wait states are inserted by suspending burst.
 5. 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.
 6. This device contains circuitry that will ensure the outputs will be in High-Z during power-up.
 7. 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 Vcc Supply Relative to Vss | -0.5V to +4.6V |
| Voltage on VccQ Supply Relative to Vss | -0.5V to +4.6V |
| V _{IN} (DQxx) | -0.5V to VccQ +0.5V |
| V _{IN} (inputs) | -0.5V to Vcc +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.

ELECTRICAL CHARACTERISTICS AND RECOMMENDED DC OPERATING CONDITIONS

(0°C ≤ T_A ≤ 70°C; V_{cc} = +3.3V +0.3V/-0.165V; V_{ccQ} = +2.5V +0.4V/-0.125V unless otherwise noted)

| DESCRIPTION | CONDITIONS | SYMBOL | MIN | MAX | UNITS | NOTES |
|-------------------------------|---|------------------|-------|-----------------------|-------|-------|
| Input High (Logic 1) Voltage | Databus (DQxx) | V _{IHQ} | 1.7 | V _{ccQ} +0.3 | V | 1, 2 |
| | Inputs | V _{IH} | 1.7 | V _{cc} +0.3 | V | 1, 2 |
| Input Low (Logic 0) Voltage | | V _{IL} | -0.3 | 0.7 | V | 1, 2 |
| Input Leakage Current | 0V ≤ V _{IN} ≤ V _{cc} | I _{LI} | -1 | 1 | μA | 13 |
| Output Leakage Current | Output(s) disabled, 0V ≤ V _{IN} ≤ V _{ccQ} (DQxx) | I _{LO} | -1 | 1 | μA | |
| Output High Voltage | I _{OH} = -2.0mA | V _{OH} | 1.7 | | V | 1 |
| | I _{OH} = -1.0mA | V _{OH} | 2.0 | | V | 1 |
| Output Low Voltage | I _{OL} = 2.0mA | V _{OL} | | 0.7 | V | 1 |
| | I _{OL} = 1.0mA | V _{OL} | | 0.4 | V | 1 |
| Supply Voltage | | V _{cc} | 3.135 | 3.6 | V | 1 |
| Isolated Output Buffer Supply | | V _{ccQ} | 2.375 | 2.9 | V | 1 |

ELECTRICAL CHARACTERISTICS AND RECOMMENDED DC OPERATING CONDITIONS

(0°C ≤ T_A ≤ 70°C; V_{CC} = +3.3V +0.3V/-0.165V; V_{CCQ} = +2.5V +0.4V/-0.125V unless otherwise noted)

| DESCRIPTION | CONDITIONS | SYM | TYP | MAX | | | | | UNITS | NOTES |
|---------------------------------|---|------------------|-----|------|-----|-----|-----|-----|-------|-----------|
| | | | | -8.5 | -9 | -10 | -11 | -12 | | |
| Power Supply Current: Operating | Device selected; all inputs ≤ V _{IL} or ≥ V _{IH} ; cycle time ≥ 1KC MIN; V _{CCQ} = MAX; V _{CC} = MAX; outputs open | I _{CC} | TBD | 250 | 230 | 200 | 200 | 150 | mA | 3, 11, 12 |
| Power Supply Current: Idle | Device selected; V _{CC} = MAX; V _{CCQ} = MAX; ADSC#, ADSP#, ADV#, GW#, BW# ≥ V _{IH} ; inputs ≤ V _{SS} +0.2 or ≥ V _{CC} -0.2; Data (DQxx) ≤ V _{SS} +0.2 or ≥ V _{CCQ} -0.2; cycle time ≥ 1KC MIN; outputs open | I _{CC1} | TBD | 75 | 75 | 70 | 60 | 45 | mA | 11, 12 |
| CMOS Standby | Device deselected; V _{CC} =MAX; V _{CCQ} =MAX; inputs ≤ V _{SS} +0.2 or ≥ V _{CC} -0.2; Data (DQxx) ≤ V _{SS} +0.2 or ≥ V _{CCQ} -0.2; all inputs static; CLK frequency = 0 | I _{SB2} | TBD | 5 | 5 | 5 | 5 | 5 | mA | 11, 12 |
| TTL Standby | Device deselected; V _{CC} = MAX V _{CCQ} = MAX; all inputs ≤ V _{IL} or ≥ V _{IH} ; all inputs static; CLK frequency = 0 | I _{SB3} | TBD | 25 | 25 | 25 | 25 | 25 | mA | 11, 12 |
| Clock Running | Device deselected; V _{CC} =MAX; V _{CCQ} =MAX inputs ≤ V _{SS} +0.2 or ≥ V _{CC} -0.2; Data (DQxx) ≤ V _{SS} +0.2 or ≥ V _{CCQ} -0.2; cycle time ≥ 1KC MIN | I _{SB4} | TBD | 75 | 75 | 70 | 60 | 45 | mA | 11, 12 |

CAPACITANCE

| DESCRIPTION | CONDITIONS | SYMBOL | TYP | MAX | UNITS | NOTES |
|-------------------------------------|---|----------------|-----|-----|-------|-------|
| Control Input Capacitance | T _A = 25°C; f = 1 MHz V _{CCQ} = 2.5V | C _I | 3 | 4 | pF | 1 |
| Input/Output Capacitance (DQ) | | C _O | 6 | 8 | pF | 1 |
| Address and Clock Input Capacitance | | C _A | 2.5 | 3 | pF | 1 |

THERMAL CONSIDERATIONS

| DESCRIPTION | CONDITIONS | SYMBOL | TYP | UNITS | NOTES |
|--|----------------------------------|-----------------|-----|-------|-------|
| Thermal resistance - Junction to Ambient | Still Air, soldered on 4.25 x | θ _{JA} | TBD | °C/W | 1 |
| Thermal resistance - Junction to Case | 1.125 inch 4-layer circuit board | θ _{JC} | TBD | °C/W | 1 |

NOTE: 1. This parameter is sampled.



NEW SYNCBURST FLOW-THROUGH - 2.5V I/O

ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

 (Note 5) (0°C ≤ T_A ≤ 70°C; V_{CC} = +3.3V +0.3V/-0.165V; V_{CCQ} = +2.5V +0.4V/-0.125V)

| DESCRIPTION | SYM | -8.5 | | -9 | | -10 | | -11 | | -12 | | UNITS | NOTES |
|--|-------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|---------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | | |
| Clock | | | | | | | | | | | | | |
| Clock cycle time | 'KC | 12 | | 13 | | 15 | | 15 | | 20 | | ns | |
| Clock HIGH time | 'KH | 4 | | 4 | | 5 | | 5 | | 6 | | ns | |
| Clock LOW time | 'KL | 4 | | 4 | | 5 | | 5 | | 6 | | ns | |
| Output Times | | | | | | | | | | | | | |
| Clock to output valid | 'KQ | | 8.5 | | 9 | | 10 | | 11 | | 12 | ns | |
| Clock to output invalid | 'KQX | 3 | | 3 | | 3 | | 3 | | 3 | | ns | |
| Clock to output in Low-Z | 'KQLZ | 4 | | 4 | | 4 | | 4 | | 4 | | ns | 4, 6, 7 |
| Clock to output in High-Z | 'KQHZ | | 5 | | 5 | | 5 | | 5 | | 6 | ns | 4, 6, 7 |
| OE# to output valid | 'OEQ | | 5 | | 5 | | 5 | | 5 | | 6 | ns | 9 |
| OE# to output in Low-Z | 'OELZ | 0 | | 0 | | 0 | | 0 | | 0 | | ns | 4, 6, 7 |
| OE# to output in High-Z | 'OEHZ | | 5 | | 5 | | 5 | | 5 | | 6 | ns | 4, 6, 7 |
| Setup Times | | | | | | | | | | | | | |
| Address | 'AS | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Address Status (ADSC#, ADSP#) | 'ADSS | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Address Advance (ADV#) | 'AAS | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Byte Write Enables (BW1#, BW2#, BW3#, BW4#, BWE#, GW#) | 'WS | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Data-in | 'DS | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Chip Enable (CE#, CE2#, CE2) | 'CES | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns | 8, 10 |
| Hold Times | | | | | | | | | | | | | |
| Address | 'AH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |
| Address Status (ADSC#, ADSP#) | 'ADSH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |
| Address Advance (ADV#) | 'AAH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |
| Byte Write Enables (BW1#, BW2#, BW3#, BW4#, BWE#, GW#) | 'WH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |
| Data-in | 'DH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |
| Chip Enable (CE#, CE2#, CE2) | 'CEH | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns | 8, 10 |

AC TEST CONDITIONS

| | |
|-------------------------------------|-------------------------|
| Input pulse levels | V _{ss} to 2.5V |
| Input rise and fall times | 2.5ns |
| Input timing reference levels | 1.25V |
| Output reference levels | 1.25V |
| Output load | See Figures 1 and 2 |

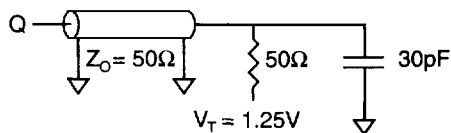


Fig. 1 OUTPUT LOAD EQUIVALENT

NOTES

1. All voltages referenced to V_{ss} (GND).
2. Overshoot: V_{IH} ≤ +4.6V for t ≤ ¹KC / 2 for I ≤ 20mA
Undershoot: V_{IL} ≥ -0.7V for t ≤ ¹KC / 2 for I ≤ 20mA
Power-up: V_{IH} ≤ +3.6V, V_{CC} ≤ 3.135V
and V_{CCQ} ≤ 2.375V for t ≤ 200ms
3. I_{CC} is given with no output current. I_{CC} increases with faster cycle times.
4. This parameter is sampled.
5. Test conditions as specified with the output loading as shown in Fig. 1 unless otherwise noted.
6. Output loading is specified using Fig. 1 with C_L = 5pF versus 30pF. Transition is measured ±150mV from steady state voltage.
7. At any given temperature and voltage condition, ¹KQHZ is less than ¹KQLZ.
8. A WRITE cycle is defined by at least one byte write enable LOW and ADSP# HIGH for the required setup and hold times. A READ cycle is defined by all byte write enables HIGH and (ADSC# or ADV# LOW) or ADSP# LOW for the required setup and hold times.

9. OE# is a "don't care" when a byte write enable is sampled LOW.
10. 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.
11. "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).
12. Typical values are measured at V_{CC} = 3.3V, V_{CCQ} = 2.5V, 25°C, and 15ns cycle time.
13. MODE pin has an internal pull-up and exhibits an input leakage current of ±10μA.

LOAD DERATING CURVES

Micron 128K x 32 and 128K x 36 Synchronous SRAM timing is dependent upon the capacitive loading on the outputs. The data sheet is written assuming a load of 30pF.

Consult the factory for copies of I/O current versus voltage curves. For capacitive loading derating curves see Micron Technical Note TN-05-20, "3.3V SRAM Capacitive Loading."

NEW SYNCBURST FLOW-THROUGH - 2.5V I/O

SNOOZE MODE

SNOOZE MODE is a low current, "power-down" mode in which the device is deselected and current is reduced to I_{SB2} . The duration of SNOOZE MODE is dictated by the length of time the ZZ pin is in a HIGH state. After entering SNOOZE MODE, all inputs except ZZ become gated inputs and are ignored.

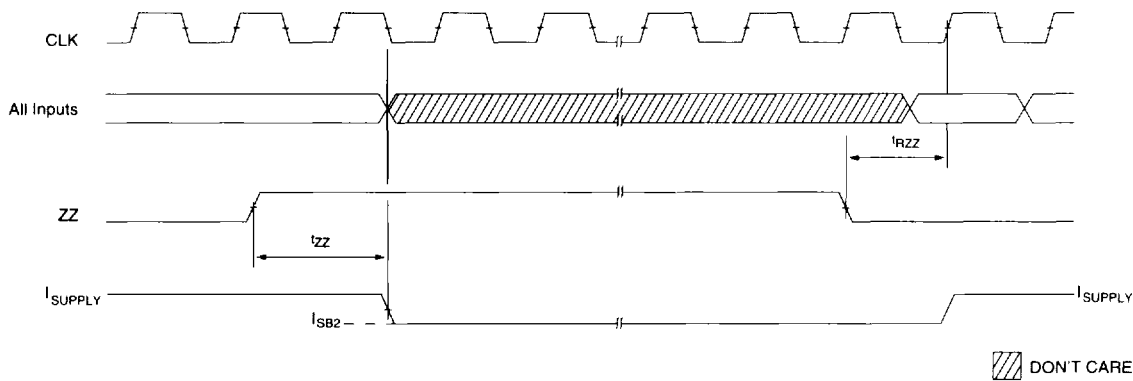
The ZZ pin (pin 64) is an asynchronous, active HIGH input that causes the device to enter SNOOZE MODE. When the ZZ pin becomes a logic HIGH, I_{SB2} is guaranteed after the setup time t'_{ZZ} is met. Any access pending when entering SNOOZE MODE is not guaranteed to successfully complete. Therefore, SNOOZE MODE must not be initiated until valid pending operations are completed.

SNOOZE MODE ELECTRICAL CHARACTERISTICS

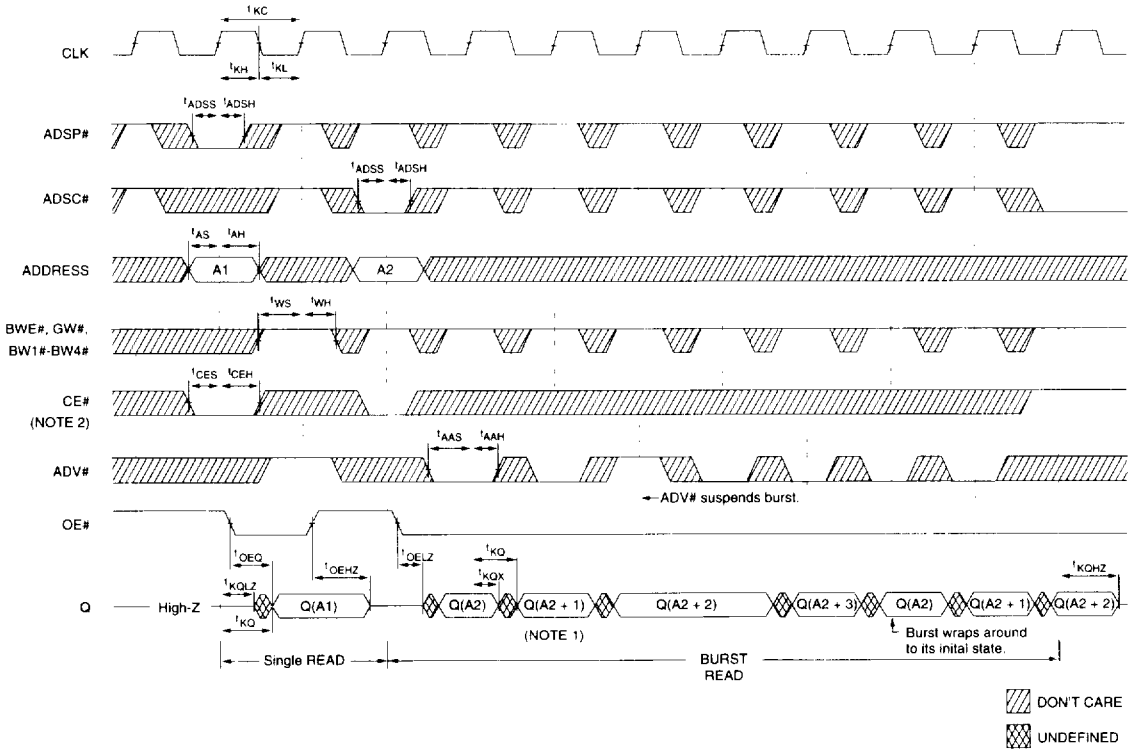
| DESCRIPTION | CONDITIONS | SYMBOL | MIN | MAX | UNITS | NOTES |
|-------------------------------------|------------------|------------|-----------|-----------|-------|-------|
| Current during SNOOZE MODE | $ZZ \geq V_{IH}$ | I_{SB2Z} | | 5 | mA | |
| ZZ HIGH to SNOOZE MODE time | | t'_{ZZ} | t'_{KC} | | ns | 1 |
| SNOOZE MODE Operation recovery time | | t'_{RZZ} | | t'_{KC} | ns | 1 |

NOTE: 1. This parameter is sampled.

SNOOZE MODE WAVEFORM



READ TIMING



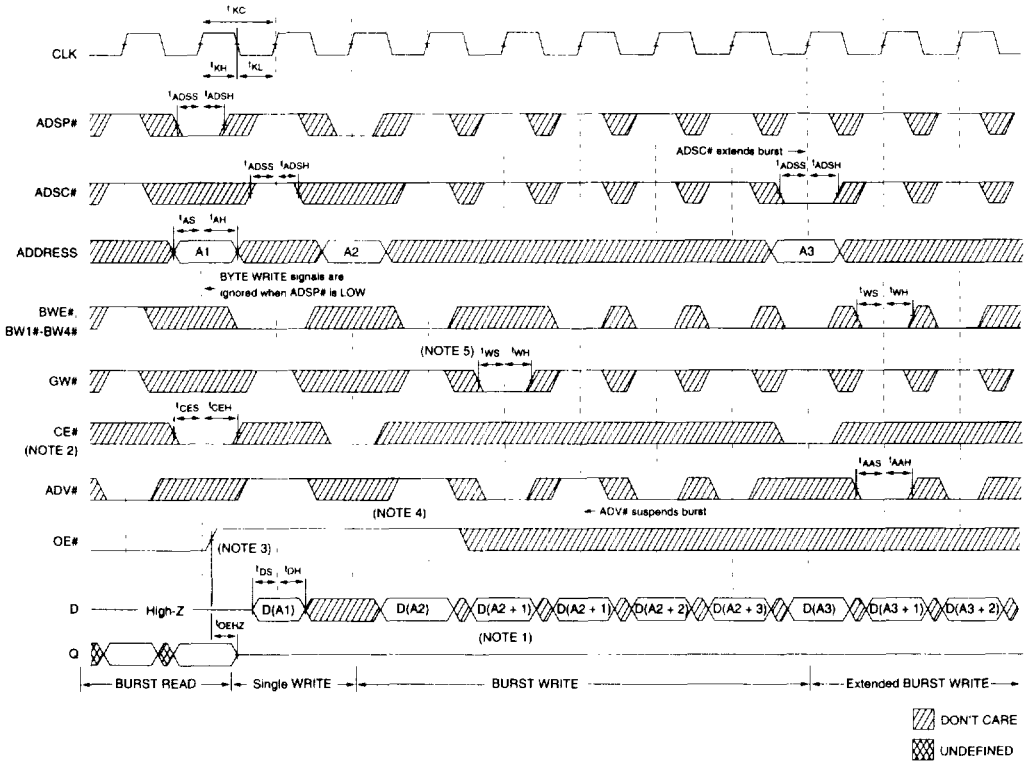
- NOTE:**
1. Q(A2) refers to output from address A2. Q(A2+1) refers to the output from the next internal burst address following A2.
 2. CE2# and CE2 have timing identical to CE#. On this diagram, when CE# is LOW, CE2# is LOW and CE2 is HIGH. When CE# is HIGH, CE2# is HIGH and CE2 is LOW.
 3. Timing is shown assuming that the device was not enabled before entering into this sequence. OE# does not cause Q to be driven until after the following clock rising edge.

READ TIMING PARAMETERS

| | -8.5 | | -9 | | -10 | | -11 | | -12 | | |
|-------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SYM | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | UNITS |
| t _{KC} | 12 | | 13 | | 15 | | 15 | | 20 | | ns |
| t _{KH} | 4 | | 4 | | 5 | | 5 | | 6 | | ns |
| t _{KL} | 4 | | 4 | | 5 | | 5 | | 6 | | ns |
| t _{KQ} | | 8.5 | | 9 | | 10 | | 11 | | 12 | ns |
| t _{KQX} | 3 | | 3 | | 3 | | 3 | | 3 | | ns |
| t _{KQLZ} | 4 | | 4 | | 4 | | 4 | | 4 | | ns |
| t _{KQHZ} | | 5 | | 5 | | 5 | | 5 | | 6 | ns |
| t _{OEQ} | | 5 | | 5 | | 5 | | 5 | | 6 | ns |
| t _{OELZ} | 0 | | 0 | | 0 | | 0 | | 0 | | ns |
| t _{OEHZ} | | 5 | | 5 | | 5 | | 5 | | 6 | ns |

| | -8.5 | | -9 | | -10 | | -11 | | -12 | | |
|-------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SYM | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | UNITS |
| t _{AS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{ADSS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{AAS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{WS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{CES} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{AH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{ADSH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{AAH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{WH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{CEH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |

WRITE TIMING



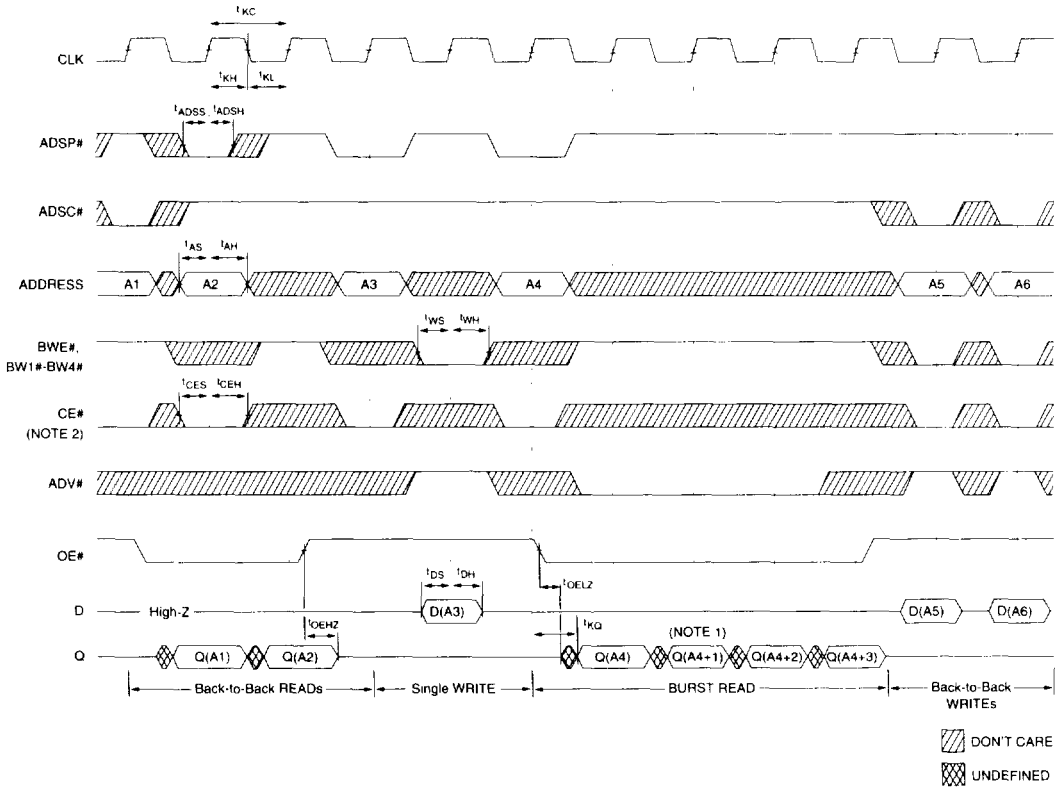
- NOTE:
1. D(A2) refers to input for address A2. D(A2+1) refers to input for the next internal burst address following A2.
 2. CE2# and CE2 have timing identical to CE#. On this diagram, when CE# is LOW, CE2# is LOW and CE2 is HIGH. When CE# is HIGH, CE2# is HIGH and CE2 is LOW.
 3. OE# must be HIGH 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#, BW1#- BW4# LOW.

WRITE TIMING PARAMETERS

| SYM | -8.5 | | -9 | | -10 | | -11 | | -12 | | UNITS |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t'_{KC} | 12 | 13 | 13 | 15 | 15 | 15 | 15 | 20 | | | ns |
| t'_{KH} | 4 | 4 | 5 | 5 | 5 | 5 | 6 | | | | ns |
| t'_{KL} | 4 | 4 | 5 | 5 | 5 | 5 | 6 | | | | ns |
| t'_{OEZH} | | 5 | | 5 | | 5 | | 5 | | 6 | ns |
| t'_{AS} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | | ns |
| t'_{ADSS} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | | ns |
| t'_{AAL} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | | ns |
| t'_{WS} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | | ns |

| SYM | -8.5 | | -9 | | -10 | | -11 | | -12 | | UNITS |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t'_{DS} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | ns |
| t'_{CES} | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3 | | | | ns |
| t'_{AH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |
| t'_{ADSH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |
| t'_{AAH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |
| t'_{WH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |
| t'_{DH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |
| t'_{CEH} | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | | | | ns |

READ/WRITE TIMING



▨ DON'T CARE
▩ UNDEFINED

- 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#.

READ/WRITE TIMING PARAMETERS

| | -8.5 | | -9 | | -10 | | -11 | | -12 | | |
|-------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SYM | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | UNITS |
| t _{KC} | 12 | | 13 | | 15 | | 15 | | 20 | | ns |
| t _{KH} | 4 | | 4 | | 5 | | 5 | | 6 | | ns |
| t _{KL} | 4 | | 4 | | 5 | | 5 | | 6 | | ns |
| t _{KQ} | | 8.5 | | 9 | | 10 | | 11 | | 12 | ns |
| t _{OELZ} | 0 | | 0 | | 0 | | 0 | | 0 | | ns |
| t _{OEHZ} | | 5 | | 5 | | 5 | | 5 | | 6 | ns |
| t _{AS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{ADSS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |

| | -8.5 | | -9 | | -10 | | -11 | | -12 | | |
|-------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| SYM | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | UNITS |
| t _{WS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{DS} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{CES} | 2.5 | | 2.5 | | 2.5 | | 2.5 | | 3 | | ns |
| t _{AH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{ADSH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{WH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{DH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |
| t _{CEH} | 0.5 | | 0.5 | | 0.5 | | 0.5 | | 0.5 | | ns |