Rev 1.1 64K X 32 SYNCHRONOUS PIPELINED BURST CMOS SRAM

FEATURES

- Single 3.3V -5% and +10% power supply
- Fast clock access time:
  5ns /100MHz, 6ns /75MHz, 7ns /66MHz
- 2 clocks chip enable/2 clock chip disable operation
- 5V-tolerant inputs, TTL/LVTTL compatible outputs
- Synchronous pipeline operation
- Internally self-timed WRITE cycle
- BYTE WRITE and GLOBAL WRITE control
- WRITE pass-through capability
- Burst control pin (interleaved or linear burst)
- ZZ snooze mode control
- 100-pin PQFP and TQFP package

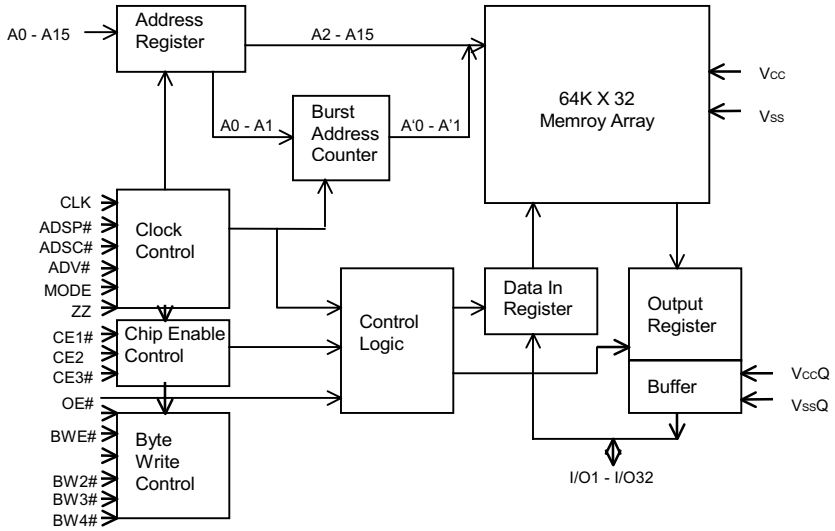
GENERAL DESCRIPTION

The UT6164C32 is a 2,097,152-bit synchronous pipelined brust CMOS SRAM organized as 65,536 words by 32 bits. It is fabricated with high performance and high reliability CMOS technology.

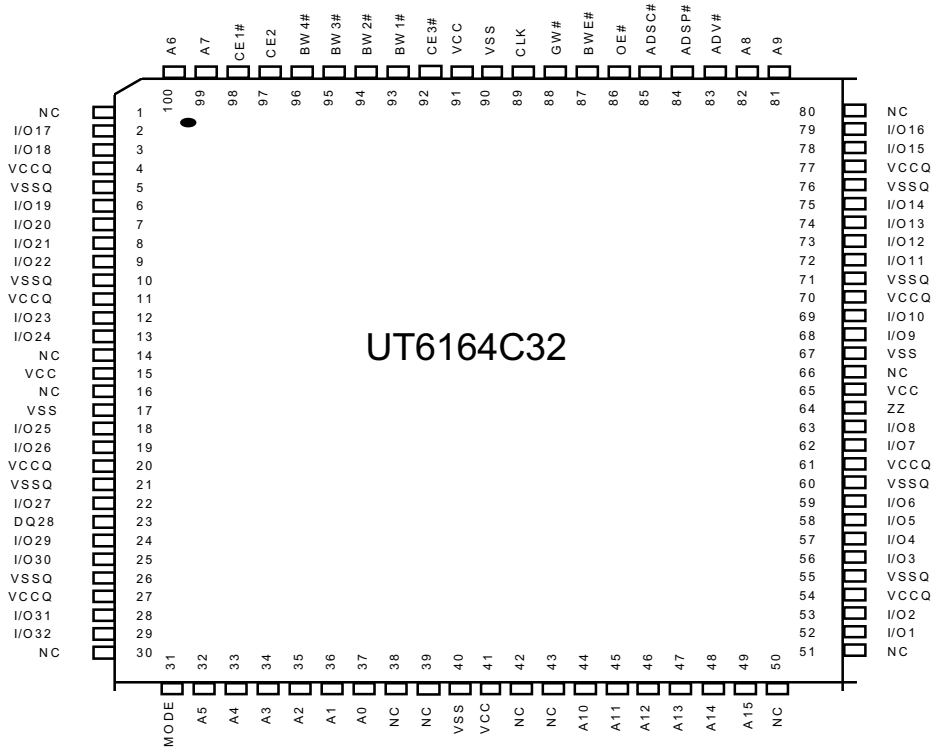
The UT6164C32 integrates 65,536 x 32 SRAM cells with advanced synchronous peripheral circuitry and a 2-bit counter for internal burst operation. All synchronous inputs are gated by registers controlled by a positive-edge-triggered clock input (CLK). The synchronous inputs include addresses, data inputs, address-pipelining chip enable (CE1#), depth-expansion chip enables (CE2 and CE3#), burst control inputs (ADSC#, ADSP#, and ADV#), write enables (BW1#, BW2#, BW3#, BW4#, and BWE#), and global write (GW#). Asynchronous inputs include the output enable (OE#), burst mode control (MODE), and sleep mode control (ZZ). The data outputs (I/O), enabled by OE#, are also asynchronous. Addresses and chip enables are registered 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, data inputs, and wire controls are registered on-chip to initiate self-timed WRITE cycle. WRITE cycles can be one to four bytes wide as controlled by the write control inputs. Individual byte write allows individual byte to be written. BW1# controls I/O1-I/O8. BW2# controls I/O9-I/O16. BW3# controls I/O17-I/O24. BW4# controls I/O25-I/O32. BW1#, BW2#, BW3#, and BW4# can be active only with BWE# being LOW. GW# being LOW causes all bytes to be written. WRITE pass-through capability allows written data available at the output for the immediately next READ cycle. This device also incorporates pipelined enable circuit for easy depth expansion without penalizing system performance.

The UT6164C32 operates from a +3.3V power supply. All inputs and outputs are TTL-compatible. The devise is ideally suited for 486, Pentium™, 680X0, and PowerPC systems and for systems that are benefited from a wide synchronous data bus.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

PIN NO.	SYMBOL	DESCRIPTION
37-32, 44-49 81, 82, 99, 100	A0 - A15	Address Inputs
89	CLK	Clock
84	ADSP#	Address Status Processor
85	ADSC#	Address Status Control
83	ADV#	Address Advance
98, 97, 92	CE1#, CE2, CE3#	Chip Enable
86	OE#	Output Enable
88	GW#	Global Write
87, 93-96	BWE#, BW1#, BW2#, BW3#, BW4#	Byte Write Enable
31	MODE	Burst Mode
64	ZZ	Snooze
52-53, 56-59, 62-63, 68-69, 72-75, 78-79, 2-3, 6-9, 12-13, 18-19, 22-25, 28-29	I/O1-I/O32	Data Inputs/Outputs
15, 41, 65, 91	VCC	Power Supply
17, 40, 67, 90	VSS	Ground
4, 11, 20, 27, 54, 61, 70, 77	VCCQ	Output Buffer Supply
5, 10, 21, 26, 55, 60, 71, 76	VSSQ	Output Buffer Ground
1, 14, 16, 30, 38, 39, 42, 43, 50-51, 66, 80	NC	No Connect

TRUTH TABLE

OPERATION	ADDRESS USED	CE1#	CE2	CE3#	ADSP#	ADSC#	ADV#	WRITE#	OE#	CLK	I/O
Deselected Cycle. Power Down	None	H	X	X	X	L	X	X	X	L-H	High-Z
Deselected Cycle. Power Down	None	L	L	X	L	X	X	X	X	L-H	High-Z
Deselected Cycle. Power Down	None	L	X	H	L	X	X	X	X	L-H	High-Z
Deselected Cycle. Power Down	None	L	L	X	H	L	X	X	X	L-H	High-Z
Deselected Cycle. Power Down	None	L	X	H	H	L	X	X	X	L-H	High-Z
READ Cycle. Begin Burst	External	L	H	L	L	X	X	X	L	L-H	Q
READ Cycle. Begin Burst	External	L	H	L	L	X	X	X	H	L-H	High-Z
WRITE Cycle. Begin Burst	External	L	H	L	H	L	X	L	X	L-H	D
READ Cycle. Begin Burst	External	L	H	L	H	L	X	H	L	L-H	Q
READ Cycle. Begin Burst	External	L	H	L	H	L	X	H	H	L-H	High-Z
READ Cycle. Continue Burst	Next	X	X	X	H	H	L	H	L	L-H	Q
READ Cycle. Continue Burst	Next	X	X	X	H	H	L	H	H	L-H	High-Z
READ Cycle. Continue Burst	Next	H	X	X	X	H	L	H	L	L-H	Q
READ Cycle. Continue Burst	Next	H	X	X	X	H	L	H	H	L-H	High-Z
WRITE Cycle. Continue Burst	Next	X	X	X	H	H	L	L	X	L-H	D
WRITE Cycle. Continue Burst	Next	H	X	X	X	H	L	L	X	L-H	D
READ Cycle. Suspend Burst	Current	X	X	X	H	H	H	H	L	L-H	Q
READ Cycle. Suspend Burst	Current	X	X	X	H	H	H	H	H	L-H	High-Z
READ Cycle. Suspend Burst	Current	H	X	X	X	H	H	H	L	L-H	Q
READ Cycle. Suspend Burst	Current	H	X	X	X	H	H	H	H	L-H	High-Z
WRITE Cycle. Suspend Burst	Current	X	X	X	H	H	H	L	X	L-H	D
WRITE Cycle. Suspend Burst	Current	H	X	X	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 [BWE# + BW1# * BW2# * BW3# * BW4#] * GW# equals LOW. WRITE = H means [BWE# + BW1# * BW2# * BW3# * BW4#] * GW# equals HIGH.
2.BW1# enables write to I/O1-I/O8. BW2# enables write to I/O9-I/O16. BW3# enables write to I/O17-I/O24. BW4# enables write to I/O25-I/O32.
3.All inputs except OE# must meet setup and hold times around the rising edge (LOW to HIGH) of CLK.
4.Suspending burst generates wait cycle.
5. For a write operation following a read operation. OE# must be high before the input data required setup time plus High-Z time for OE# and staying 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 along with chip being selected always initiates a READ cycle at the L-H edge of CLK. A WRITE cycle can be performed by setting WRITE LOW for the CLK L-H edge of the subsequent wait cycle. Refer to WRITE timing diagram for clarification.

PARTIAL TRUTH TABLE FOR WRITE

FUNCTION	GW#	BWE#	BW1#	BW2#	BW3#	BW4#
READ	**H**	**H**	**X**	**X**	**X**	**X**
READ	**H**	**L**	**H**	**H**	**H**	**H**
WRITE one byte	**H**	**L**	**L**	**H**	**H**	**H**
WRITE all bytes	**H**	**L**	**L**	**L**	**L**	**L**
WRITE all bytes	**L**	**X**	**X**	**X**	**X**	**X**

INTERLEAVED BURST ADDRESS TABLE (MODE=NC/Vcc)

FIRST ADDRESS (EXTERNAL)	SECOND ADDRESS (INTERNAL)	THIRD ADDRESS (INTERNAL)	FOURTH ADDRESS (INTERNAL)
A...A00	A...A01	A...A10	A...A11
A...A01	A...A00	A...A11	A...A10
A...A10	A...A11	A...A00	A...A01
A...A11	A...A10	A...A01	A...A00

LINEAR BURST ADDERSS TABLE (MODE=GND)

FIRST ADDRESS (EXTERNAL)	SECOND ADDRESS (INTERNAL)	THIRD ADDRESS (INTERNAL)	FOURTH ADDRESS (INTERNAL)
A...A00	A...A01	A...A10	A...A11
A...A01	A...A10	A...A11	A...A00
A...A10	A...A11	A...A00	A...A01
A...A11	A...A00	A...A01	A...A10

PASS-THROUGH TRUTH TABLE

PREVIOUS CYCLE		PRESENT CYCLE				NEXT CYCLE
OPERATION	BWN#	OPERATION	CE#	BWN#	OE#	OPERATION
Initiate WRITE cycle, all bytes Address=A(n-1). data=D(n-1)	All L[2, 3]	READ cycle. Register A(n). Q=D(n-1)	L	H	L	Read D(n)
Initiate WRITE cycle, all bytes Address=A(n-1). data=D(n-1)	All L[2, 3]	READ cycle. Register A(n). Q=HIGH-Z	L	H	H	Read D(n)
Initiate WRITE cycle, one byte Address=A(n-1). data=D(n-1)	One L[2, 3]	READ cycle. Register A(n). Q=D(n-1) for one byte	L	H	L	Read D(n)
Initiate WRITE cycle, all bytes Address=A(n-1). data=D(n-1)	All L[2]	Deselect cycle Q=HIGH-Z	H	X	X	No carry-over from previous cycle

Note: 1.Previous cycle may be any cycle (non-burst, burst, or wait) and next cycle is read cycle (non-burst, burst, or wait).
2.BWE# is LOW for individual byte WRITE.
3.GW# LOW yields the same result for all-byte WRITE operation.

ABSOLUTE MAXIMUM RATINGS*

PARAMETER	RATING	UNIT
Voltage on V_{CC} Supply Relative to V_{SS}	-0.5 to +4.6	V
V_{IN}	-0.5 to +6	V
Storage Temperature (plastic)	-55 to +150	℃
Junction Temperature	+150	℃
Power Dissipation	1.6	W
Short Circuit Output Current	100	mA

*Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings 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 the absolute maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS (V_{CC} = 3.3V -5% and +10%, T_A = 0℃ to 70℃)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	MAX.	UNIT	NOTES
Input High (Logic 1) Voltage	V_{IH}		2.0	5.5	V	1, 2
Input Low (Logic 0) Voltage	V_{IL}		- 0.3	0.8	V	1, 2
Input Leakage Current	IL_I	$0V \le V_{IN} \le V_{CC}$	- 1	1	μA	14
Output Leakage Current	IL_O	Output(s) disabled. $0V \le V_{OUT} \le V_{CC}$	- 1	1	μA	
Output High Voltage	V_{OH}	I_{OH}= - 4mA	2.4	-	V	1, 11
Output Low Voltage	V_{OL}	I_{OL} = 8mA	-	0.4	V	1, 11
Supply Voltage	V_{CC}		3.1	3.6	V	1

DESCRIPTION	CONDITIONS	SYM	TYP	-5ns	-6ns	-7ns	UNIT	NOTES
Power Supply Current Operating	Device selected: all inputs ≤ V_{IL} or ≥ V_{IH} cycle time ≥ t_{KC} MIN; V_{CC}=MAX; outputs open	I_{CC}	180	360	315	270	mA	3, 12, 13
Power Supply Current Idle	Device deselected: ADSC#, ADSP#, ADV#, GW#, BWE# ≥ V_{IH}, all other inputs ≤ V_{IL} or ≥ V_{IH} V_{CC}=MAX; cycle time ≥ t_{KC} MIN; outputs open	I_{SB1}	30	60	55	50	mA	12, 13
CMOS Stand by	Device deselected: V_{CC}=MAX; all inputs ≤ V_{SS}+0.2 or ≥ V_{CC}-0.2; all inputs static; CLK frequency = 0	I_{SB2}	1	10	10	10	mA	12, 13
TTL Stand by	Device deselected: all inputs ≤ V_{IL} or ≥ V_{IH} all inputs static; V_{CC}=MAX; CLK frequency = 0	I_{SB3}	15	25	25	25	mA	12, 13
Clock Running	Device deselected: all inputs ≤ V_{IL} or ≥ V_{IH}; V_{CC}=MAX; CLK cycle time ≥ t_{KC} MIN	I_{SB4}	30	60	55	50	mA	12, 13
Power-Down Mode Current	ZZ ≥ Vcc - 0.2	I_{ZZ}	1	10	10	10	mA	12, 13

CAPACITANCE (T_A = 25℃, f = 1MHz)

PARAMETER	SYMBOL	TYP.	MAX.	UNIT	NOTES
Input Capacitance	C_{IN}	3	4	pF	4
Input/Output Capacitance	$C_{I/O}$	6	7	pF	4

AC ELECTRICAL CHARACTERISTICS (V_{CC} = 3.3V -5% and +10%, T_A = 0℃ to 70℃)

PARAMETER	SYM	-5 MIN	MAX	-6 MIN	MAX	-7 MIN	MAX	UNITS	NOTES
Clock									
Clock cycle time	t_{KC}	10	-	12	-	15	-	ns	-
Clock HIGH time	t_{KH}	4	-	4	-	5	-	ns	-
Clock LOW time	t_{KL}	4	-	4	-	5	-	ns	-
Output Times									
Clock to output valid	t_{KO}	-	5	-	6	-	7	ns	-
Clock to output invalid	t_{KOX}	2	-	2	-	2	-	ns	-
Clock to output in Low-Z	t_{KOZ}	3	-	3	-	3	-	ns	6, 7
Clock to output in High-Z	t_{KOHZ}	-	5	-	5	-	6	ns	6, 7
OE# to output valid	t_{OEO}	-	5	-	5	-	5	ns	9
OE# to output in Low-Z	t_{OELZ}	0	-	0	-	0	-	ns	6, 7
OE# to output in High-Z	t_{OEHZ}	-	4	-	5	-	6	ns	6, 7
Setup Times									
Address setup	t_{AS}	2.5	-	2.5	-	2.5	-	ns	10
Address status setup	t_{ADSS}	2.5	-	2.5	-	2.5	-	ns	10
Address advance setup	t_{ADVS}	2.5	-	2.5	-	2.5	-	ns	10
Write setup	t_{WS}	2.5	-	2.5	-	2.5	-	ns	10
Data setup	t_{DS}	2.5	-	2.5	-	2.5	-	ns	10
Chip enable setup	t_{CES}	2.5	-	2.5	-	2.5	-	ns	10
Hold Times									
Address status hold	t_{ADSH}	0.5	-	0.5	-	0.5	-	ns	10
Address advance hold	t_{ADVH}	0.5	-	0.5	-	0.5	-	ns	10
Write hold	t_{WH}	0.5	-	0.5	-	0.5	-	ns	10
Data hold	t_{DH}	0.5	-	0.5	-	0.5	-	ns	10
Chip enable hold	t_{CEH}	0.5	-	0.5	-	0.5	-	ns	10
ZZ stand by	t_{ZZS}	-	100	-	100	-	100	ns	16
ZZ recovery	t_{ZZREC}	100	-	100	-	100	-	ns	16

AC TEST CONDITIONS

Input pulse levels	0V to 3.0V
Input rise and fall times	1.5ns
Input timing reference levels	1.5V
Output reference levels	1.5V
Output load	See Figures 1 and 2

OUTPUT LOADS

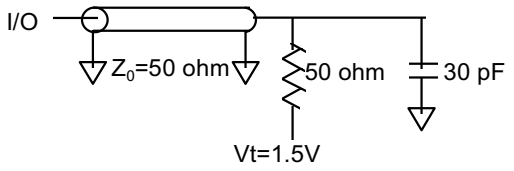


Fig.1 Output Load Equivalent

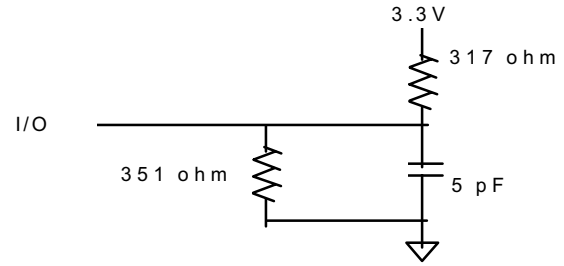


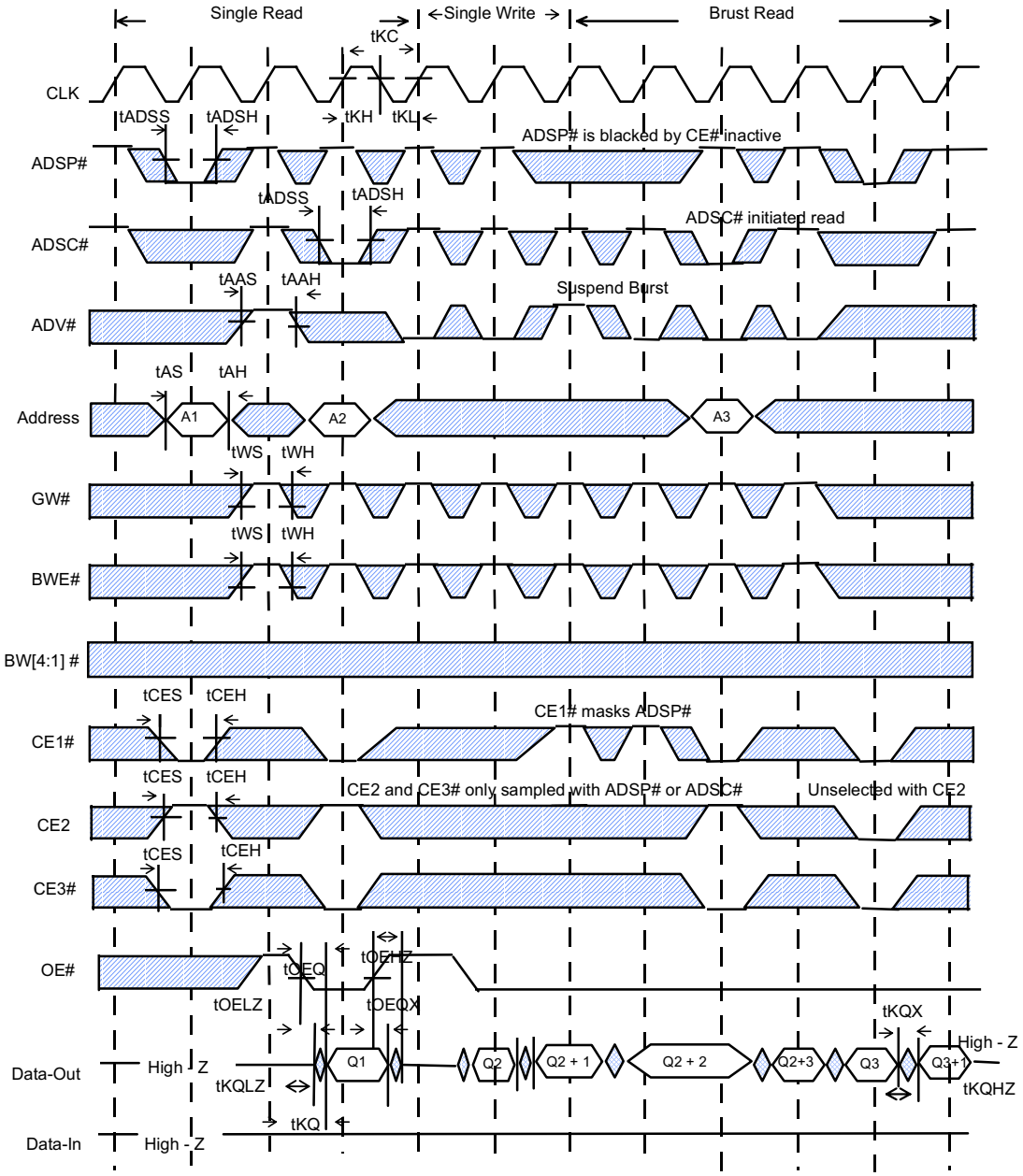
Fig.2 Output Load Equivalent

NOTES:

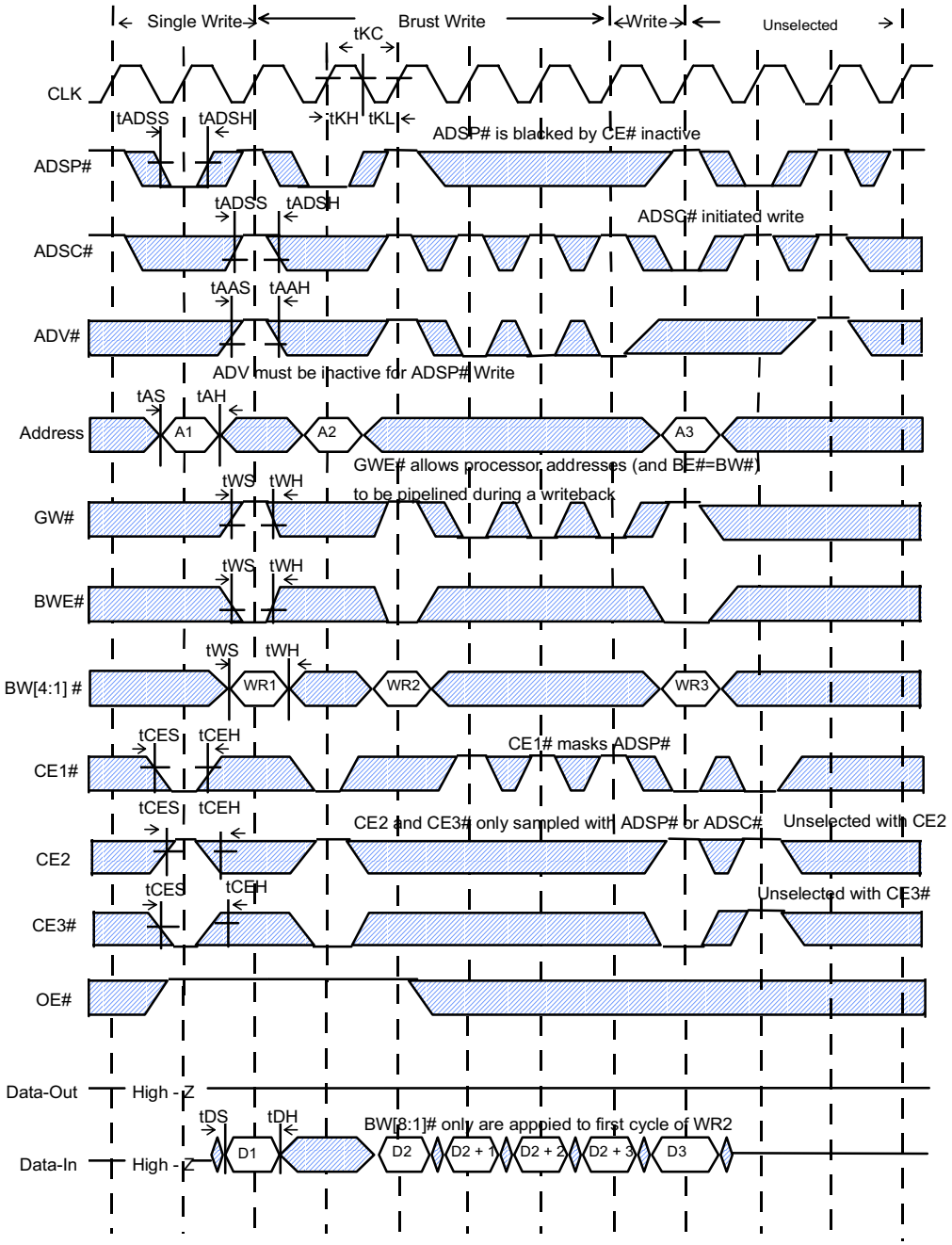
1. All voltages referenced to Vss.
2. Overshoot: $V_{IH} \leq +0.6V$ for $t \leq t_{KC}/2$.
   Undershoot: $V_{IH} \leq -2.0V$ for $t \leq t_{KC}/2$.
3. I_{CC} is given with no output current. I_{CC} increases with greater output loading and faster cycle times.
4. This parameter is sampled.
5. Test conditions as specified with the output loading as shown in Fig. 1 unless otherwise noted.
6. Output loading is specified with C_L=5pF as in Fig. 2.
7. At any given temperature and voltage condition. t_{KQHZ} is less than t_{KQLZ} and t_{OEHZ} is less than t_{OELZ}.
8. A READ cycle is defined by byte write enables all HIGH or ADSP# LOW along with chip enables being active for the required setup and hold times. A WRITE cycle is defined by at one byte or all byte WRITE per READ/WRITE TRUTH TABLE.
9. OE# is a "don't care" when a byte write enable is sampled LOW.
10. This is a synchronous device. All synchronous inputs must meet specified setup and hold time, except for "don't care" as defined in the truth table.
11. AC I/O curves are available upon request.
12. "Device Deselected" means the device is in POWER-DOWN mode as defined in the truth table. "Device Selected" means the device is active.
13. Typical values are measured at 3.3V, 25℃ and 20ns cycle time.
14. MODE pin has an internal pull-up and ZZ pin has an internal pull-down. These two pins exhibit an input leakage current of $\pm$ 30μA.
15. Capacitance derating applies to capacitance different from the load capacitance shown in Fig. 1.
16. The assertion off ZZ alows the SRAM to enter a low power state than when deselected within the time specified.

TIMING WAVEFORMS

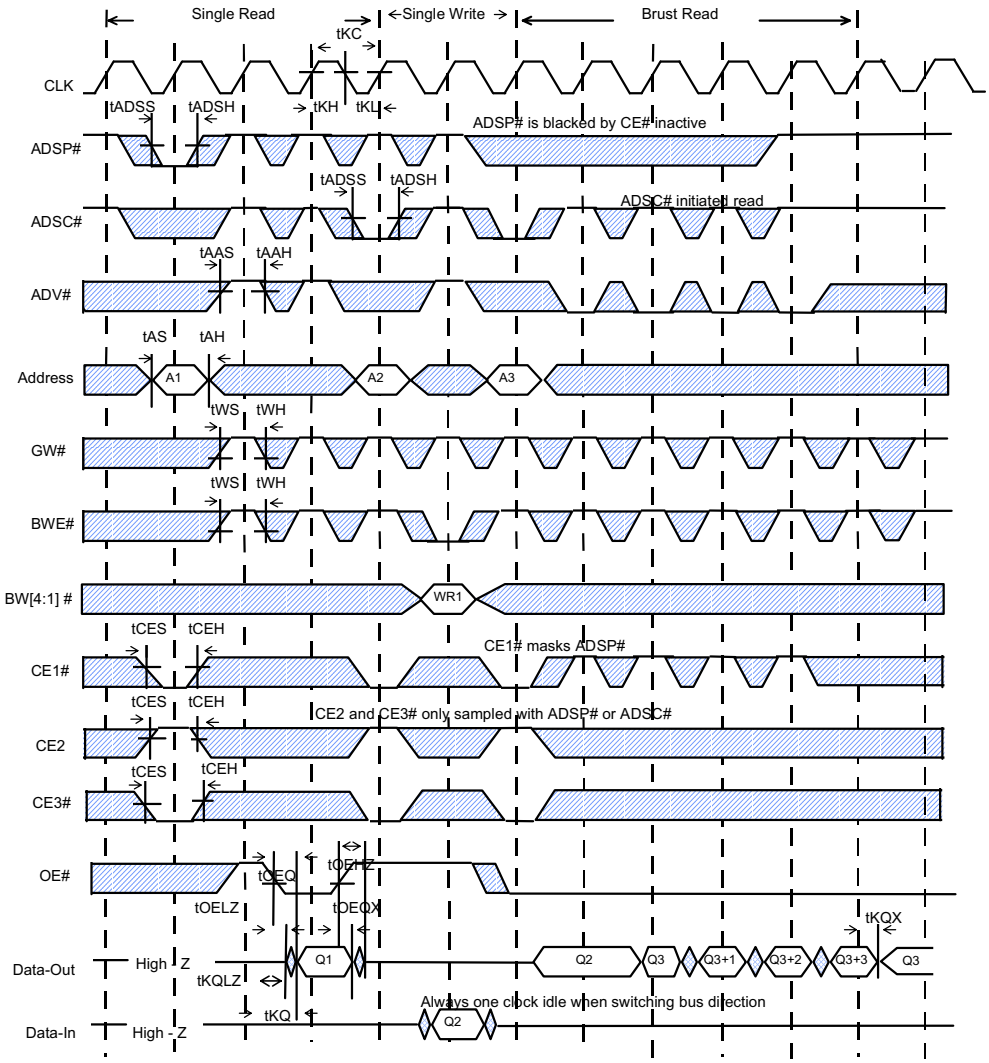
READ CYCLE



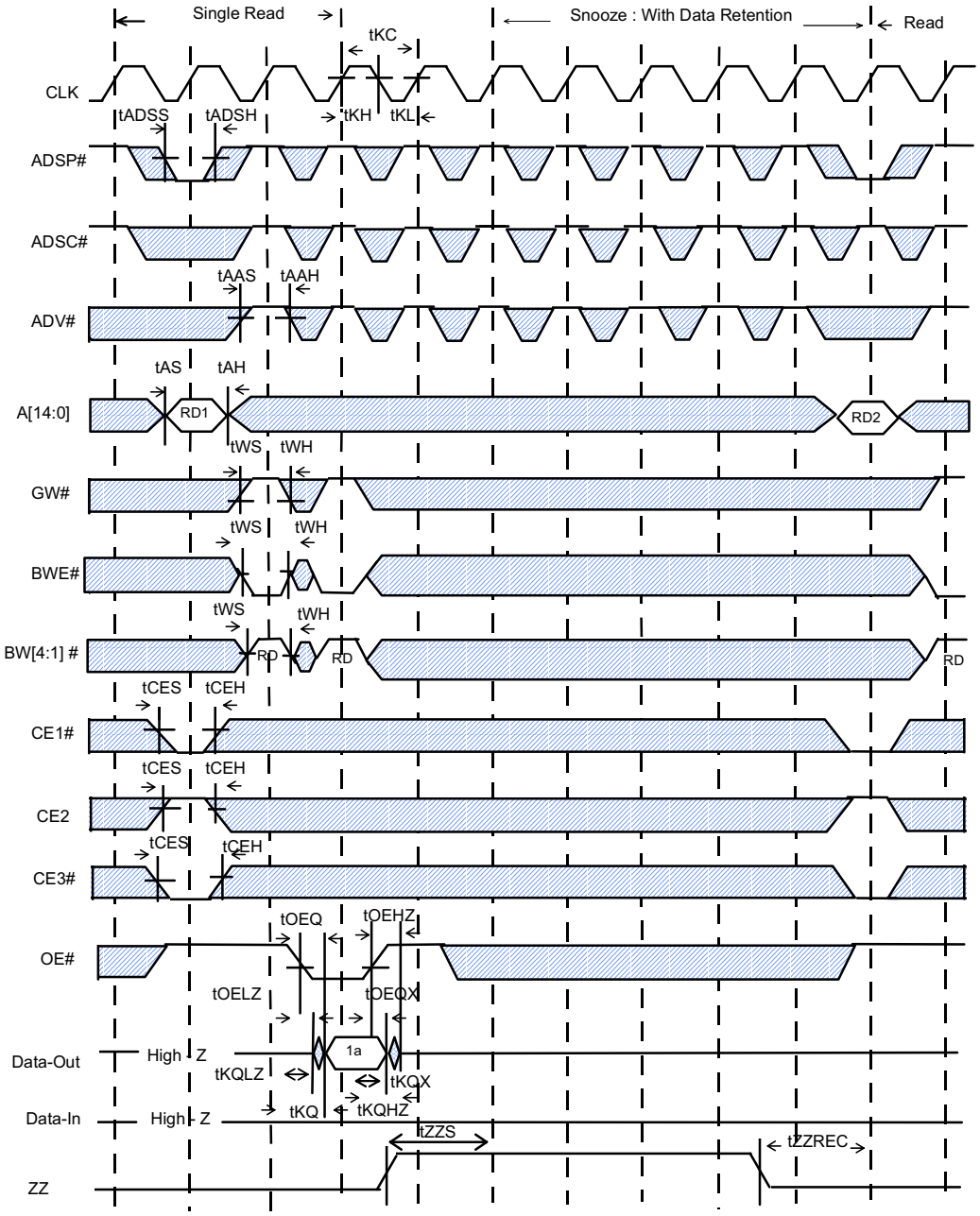
WRITE CYCLE


Single Write
Brust Write
Write
Unselected
tKC
CLK
tADSS
tADSH
tKH
tKL
ADSP# is blacked by CE# inactive
ADSP#
tADSS
tADSH
ADSC# initiated write
ADSC#
tAAS
tAAH
ADV#
ADV must be inactive for ADSP# Write
tAS
tAH
Address
A1
A2
A3
GWE# allows processor addresses (and BE#=BW#)
to be pipelined during a writeback
tWS
tWH
GW#
BWE#
BW[4:1] #
WR1
WR2
WR3
tCES
tCEH
CE1#
CE1# masks ADSP#
CE2
CE2 and CE3# only sampled with ADSP# or ADSC#
Unselected with CE2
CE3#
Unselected with CE3#
OE#
Data-Out
High - Z
tDS
tDH
BW[8:1]# only are apppied to first cycle of WR2
Data-In
D1
D2
D2 + 1
D2 + 2
D2 + 3
D3

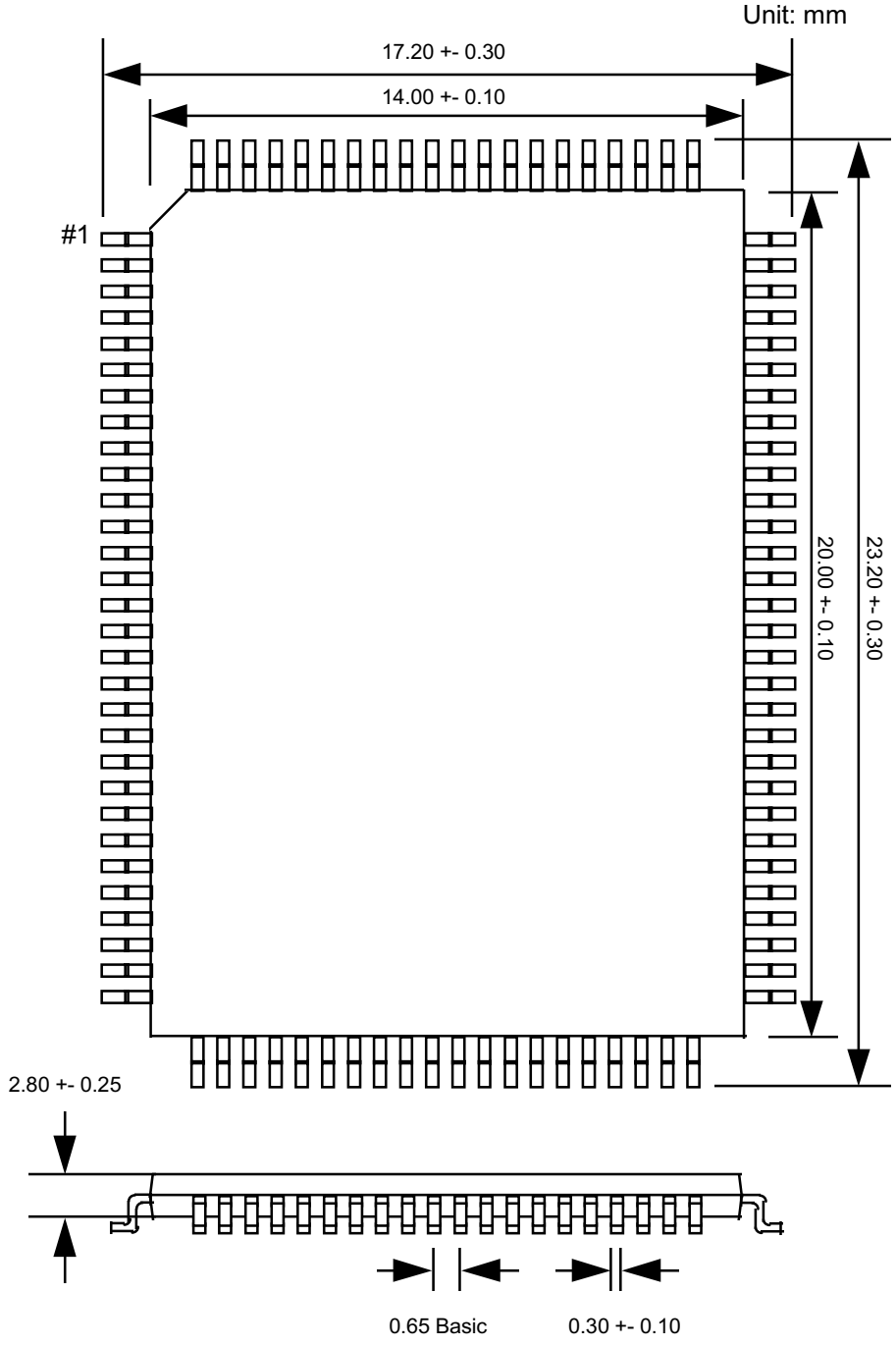
READ / WRITE CYCLE



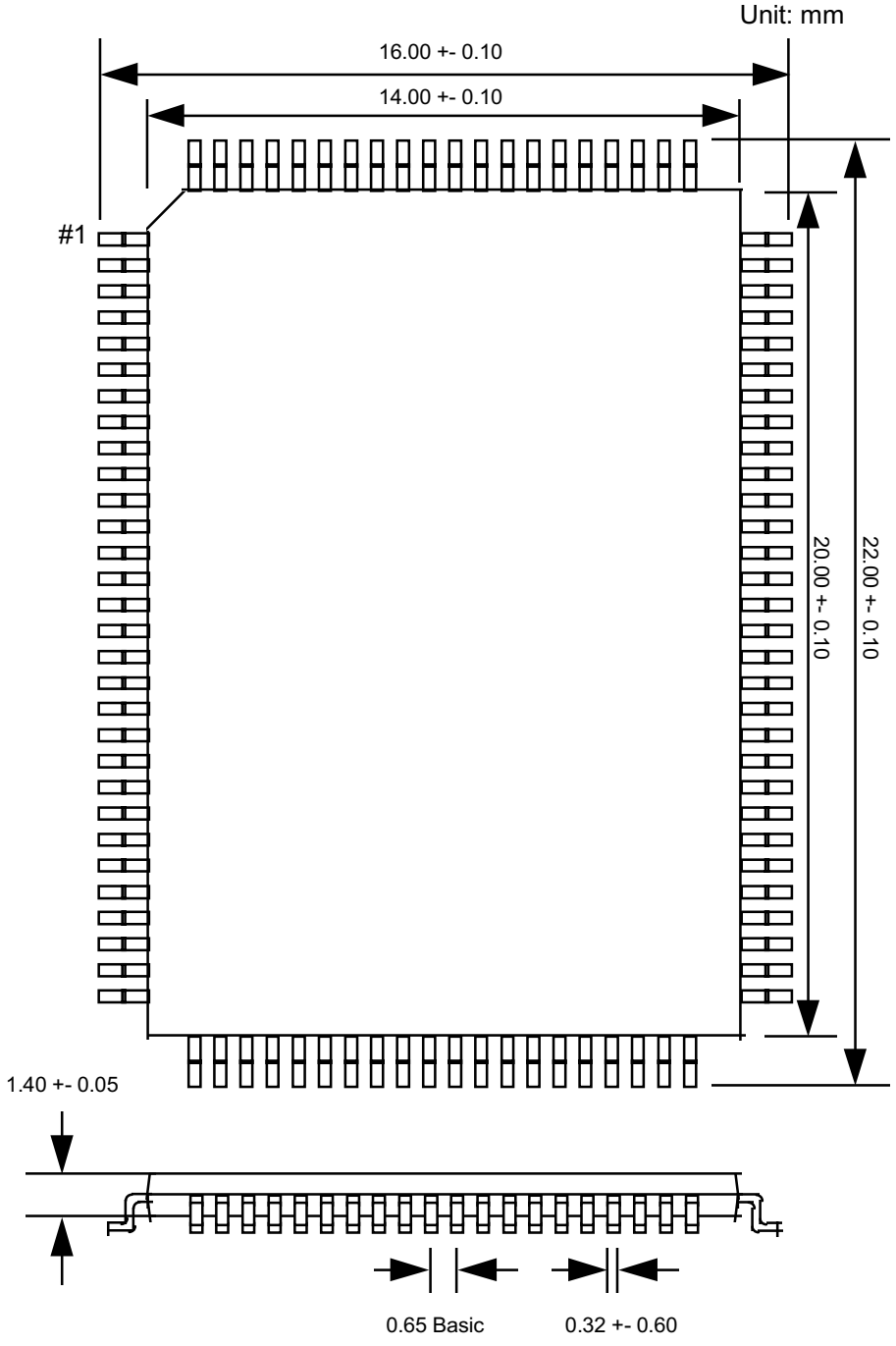
ZZ TIMING


Single Read
Snooze : With Data Retention
Read
tKC
CLK
tADSS
tADSH
tKH
tKL
ADSP#
ADSC#
tAAS
tAAH
ADV#
tAS
tAH
A[14:0]
RD1
RD2
tWS
tWH
GW#
BWE#
BW[4:1] #
RD
tCES
tCEH
CE1#
CE2
CE3#
tOEQ
tOEHZ
OE#
tOELZ
tOEQX
Data-Out
High - Z
1a
tKQLZ
tKQX
tKQ
tKQHZ
Data-In
tZZS
tZZREC
ZZ

100 PIN PQFP PACKAGE DIMENSIONS



100 PIN TQFP PACKAGE DIMENSIONS



ORDERING INFORMAITON

PART NO.	ACCESS TIMES (ns)	PACKAGE
UT6164C32Q-6	6	100 PIN PQFP
UT6164C32T-6	6	100 PIN TQFP