



UTRON

UT6164C32

Rev 1.1 64K X 32 SYNCHRONOUS PIPELINED BURST CMOS SRAM

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## 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 burst 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 write 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 device is ideally suited for 486, Pentium™, 680X0, and PowerPC systems and for systems that are benefited from a wide synchronous data bus.

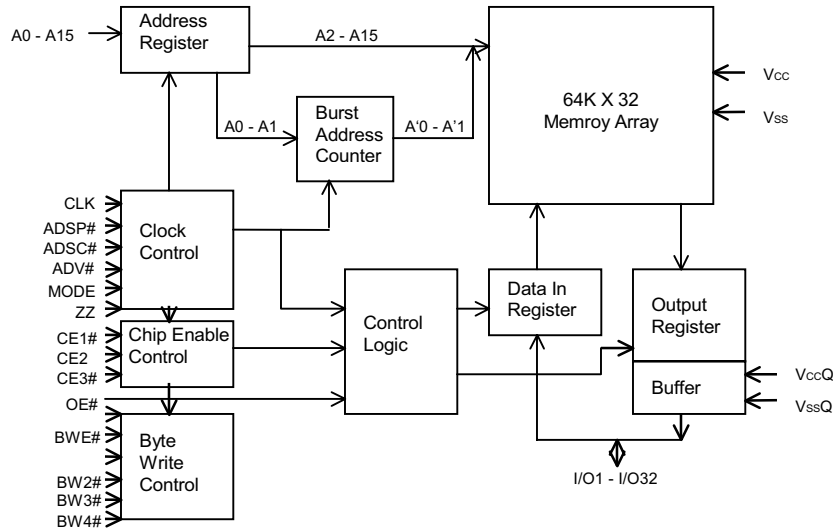


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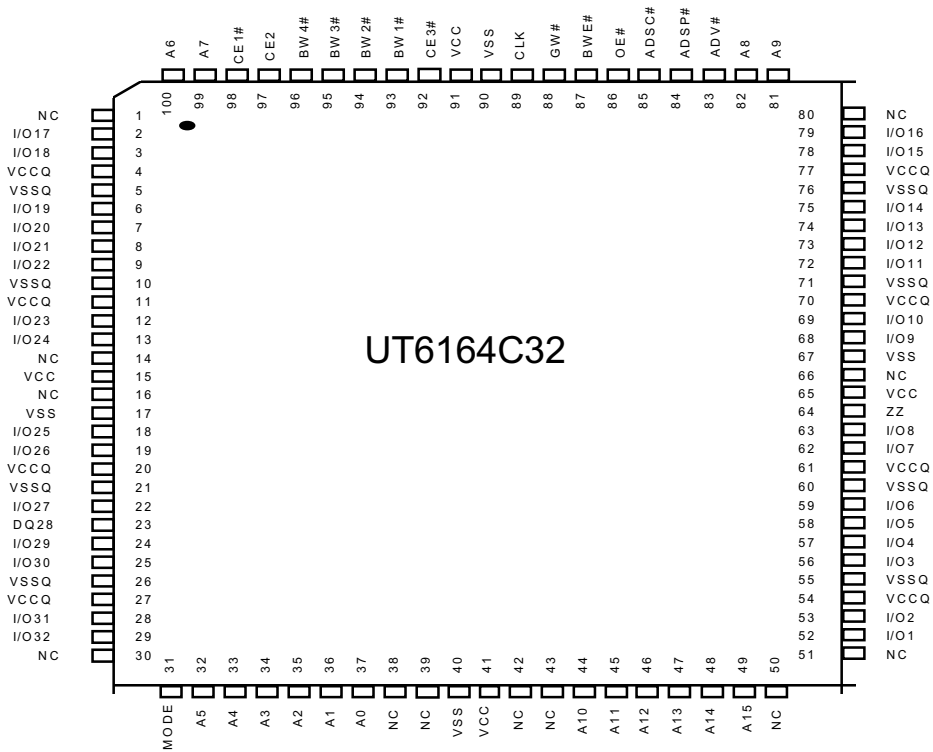
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FUNCTIONAL BLOCK DIAGRAM



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/V<sub>CC</sub>)**

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 ADDRESS 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 <sup>2,3</sup>	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 <sup>2,3</sup>	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 <sup>2,3</sup>	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 <sup>2</sup>	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 <sub>CC</sub> Supply Relative to V <sub>SS</sub>	-0.5 to +4.6	V
V <sub>IN</sub>	-0.5 to +6	V
Storage Temperature (plastic)	-55 to +150	°C
Junction Temperature	+150	°C
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  $+10\%$ ,  $T_A = 0^{\circ}C$  to  $70^{\circ}C$ )

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	$I_{L1}$	$0V \leq V_{IN} \leq V_{CC}$	- 1	1	$\mu A$	14
Output Leakage Current	$I_{LO}$	Output(s) disabled. $0V \leq V_{OUT} \leq V_{CC}$	- 1	1	$\mu A$	
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 $\leq V_{IL}$ or $\geq V_{IH}$ cycle time $\geq t_{KC}$ 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# $\geq V_{IH}$ , all other inputs $\leq V_{IL}$ or $\geq V_{IH}$ $V_{CC} = MAX$ ; cycle time $\geq t_{KC}$ MIN; outputs open	$I_{SB1}$	30	60	55	50	mA	12, 13
CMOS Stand by	Device deselected: $V_{CC} = MAX$ ; all inputs $\leq V_{SS} + 0.2$ or $\geq V_{CC} - 0.2$ ; all inputs static; CLK frequency = 0	$I_{SB2}$	1	10	10	10	mA	12, 13
TTL Stand by	Device deselected: all inputs $\leq V_{IL}$ or $\geq V_{IH}$ all inputs static; $V_{CC} = MAX$ ; CLK frequency = 0	$I_{SB3}$	15	25	25	25	mA	12, 13
Clock Running	Device deselected: all inputs $\leq V_{IL}$ or $\geq V_{IH}$ ; $V_{CC} = MAX$ ; CLK cycle time $\geq t_{KC}$ MIN	$I_{SB4}$	30	60	55	50	mA	12, 13
Power-Down Mode Current	$ZZ \geq V_{CC} - 0.2$	$I_{ZZ}$	1	10	10	10	mA	12, 13

**CAPACITANCE** ( $T_A = 25^{\circ}C$ ,  $f = 1MHz$ )

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  $+10\%$ ,  $T_A = 0^\circ C$  to  $70^\circ C$ )

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

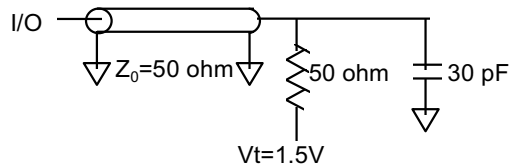


Fig.1 Output Load Equivalent

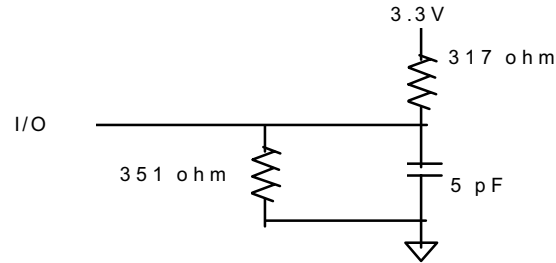


Fig.2 Output Load Equivalent

## NOTES:

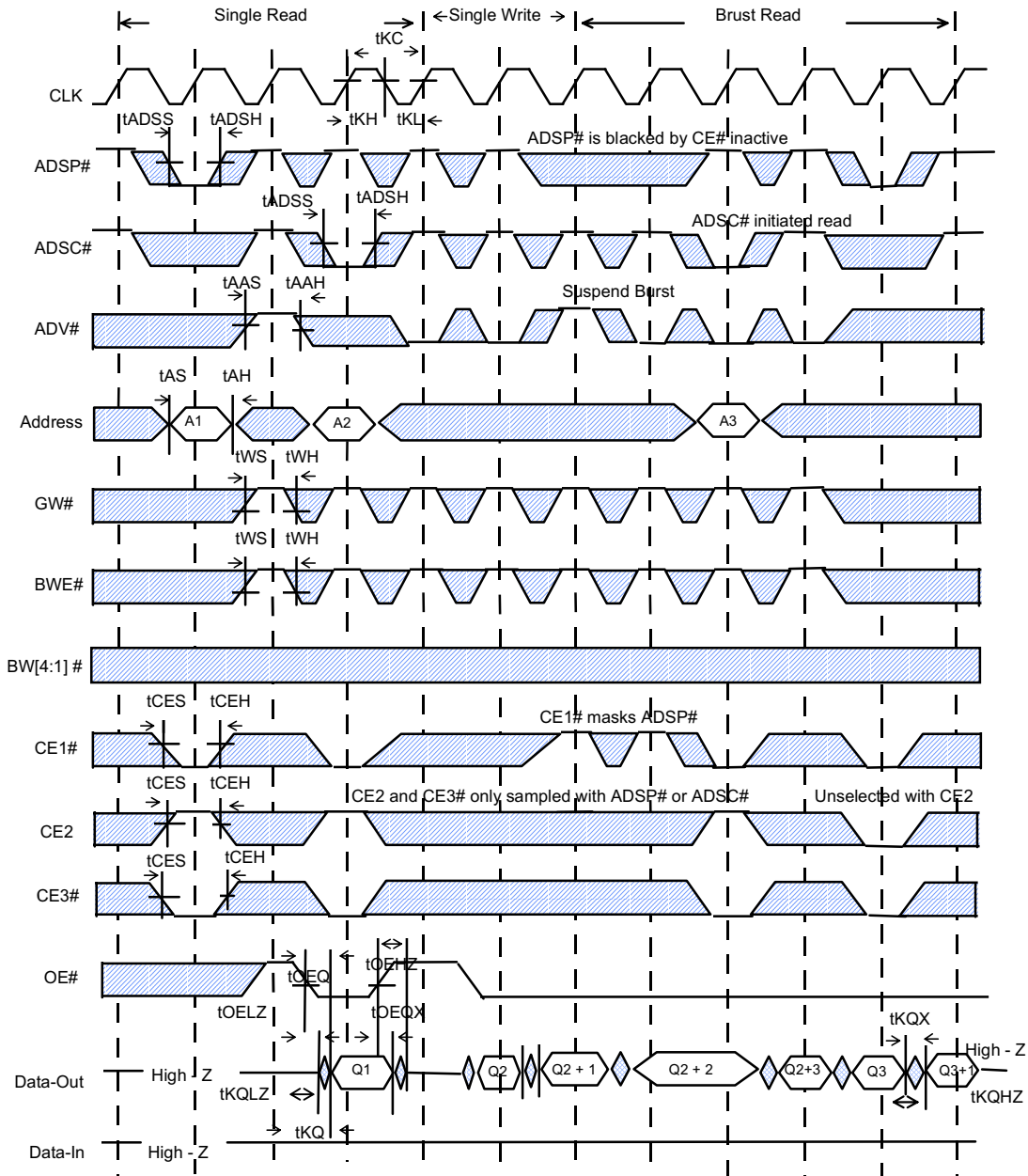
1. All voltages referenced to Vss.
2. Overshoot:  $V_{IH} \leq +0.6V$  for  $t \leq t_{KC}/2$ .  
Undershoot:  $V_{IH} \leq -2.0V$  for  $t \leq t_{KC}/2$ .
3.  $I_{CC}$  is given with no output current.  $I_{CC}$  increases with greater output loading and faster cycle times.
4. This parameter is sampled.
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  $t_{OEZH}$  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°C 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  $\pm 30\mu A$ .
15. Capacitance derating applies to capacitance different from the load capacitance shown in Fig. 1.
16. The assertion off ZZ allows the SRAM to enter a low power state than when deselected within the time specified.





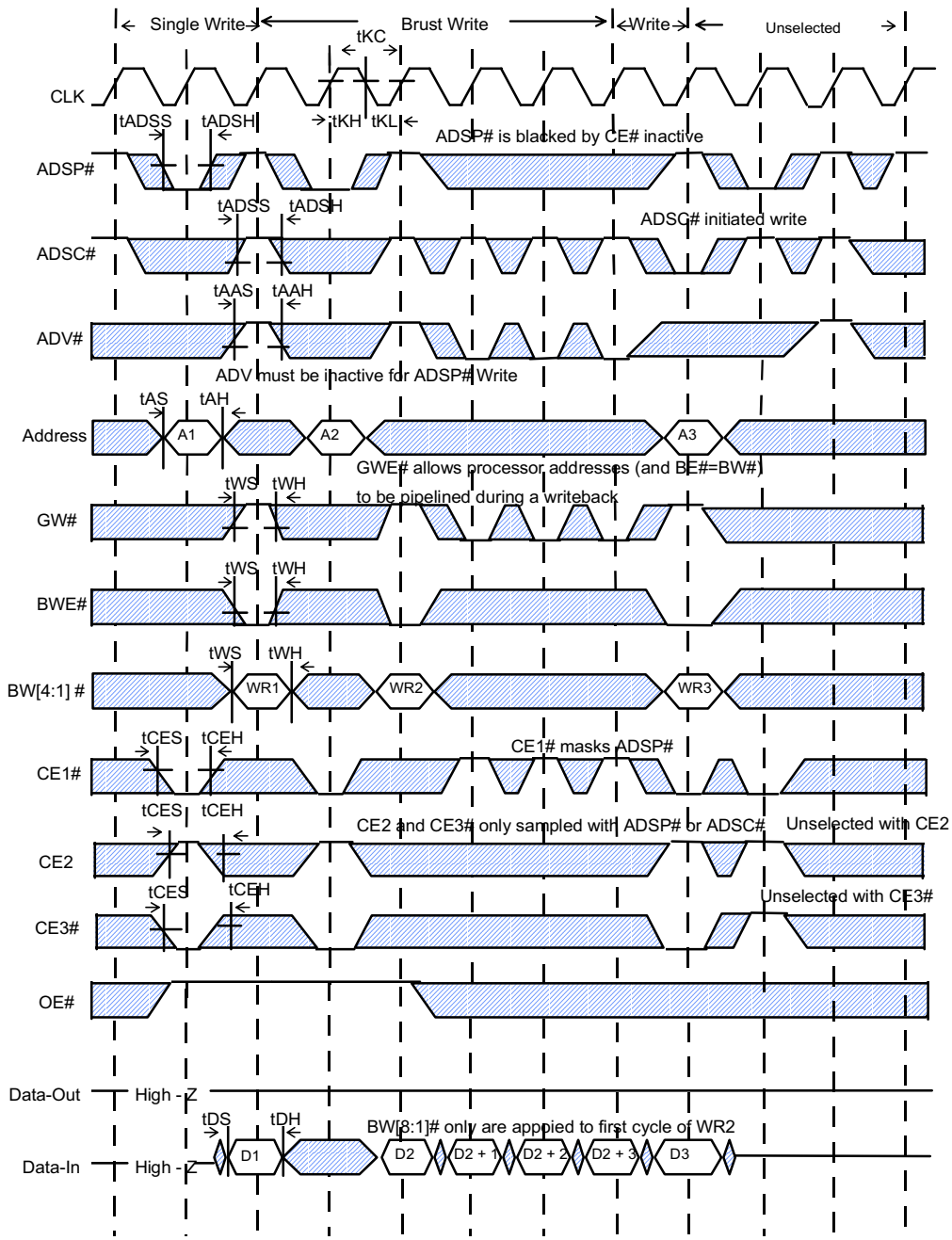
TIMING WAVEFORMS

READ CYCLE



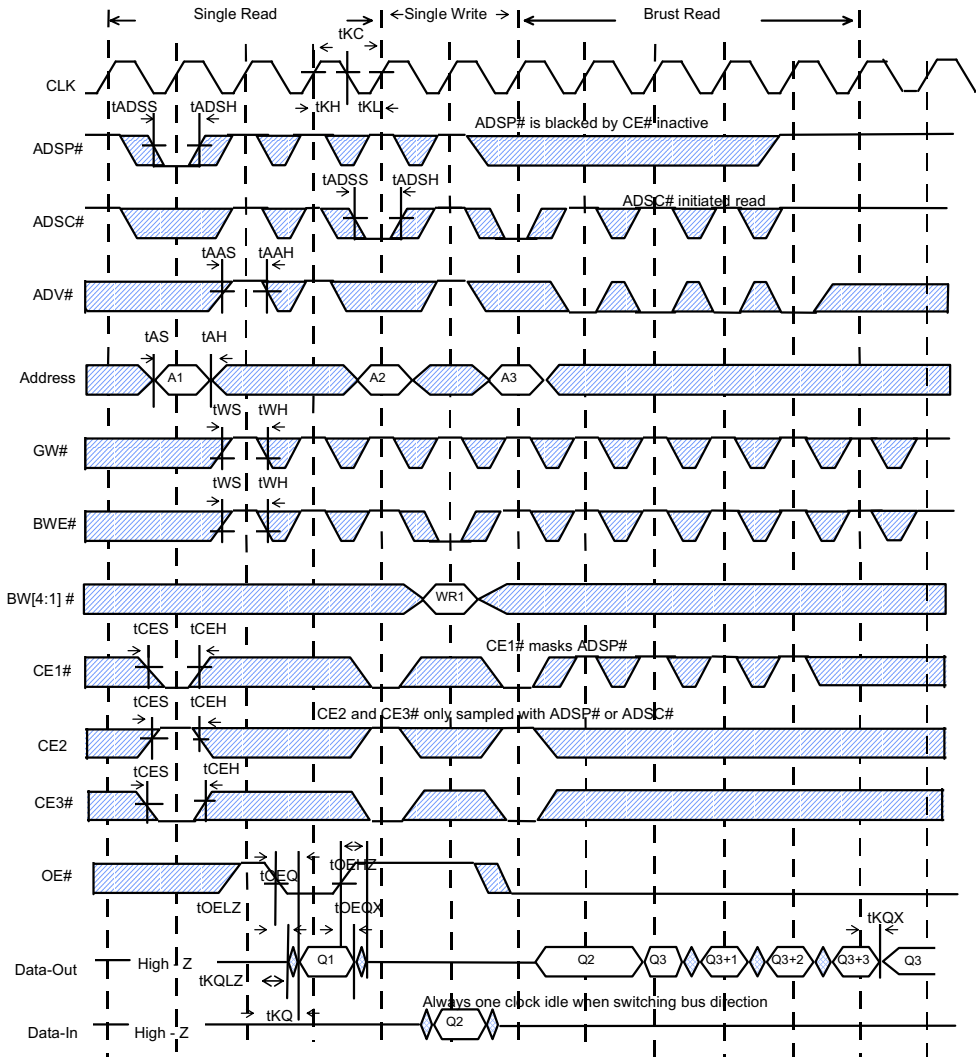


WRITE CYCLE



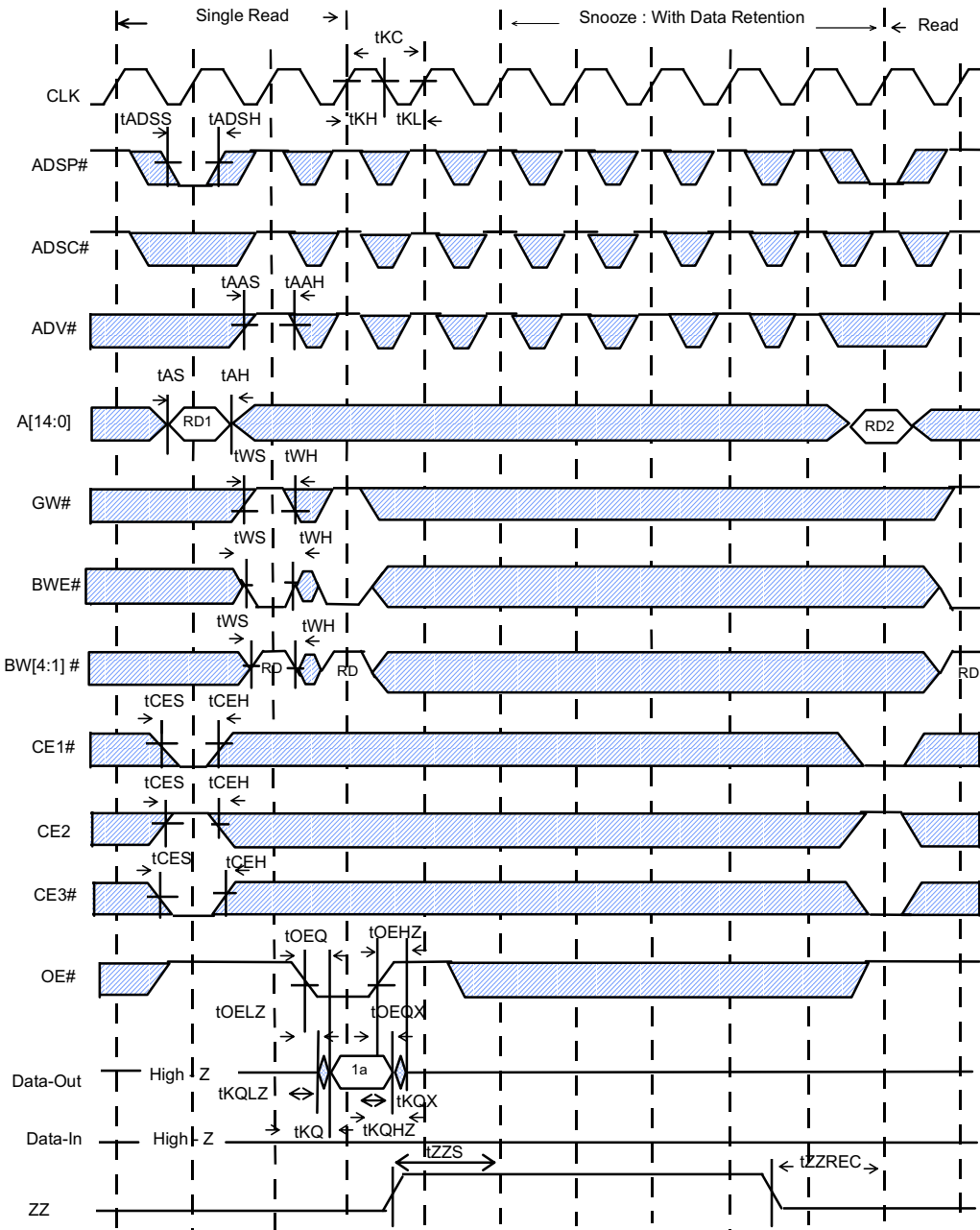


READ / WRITE CYCLE





ZZ TIMING





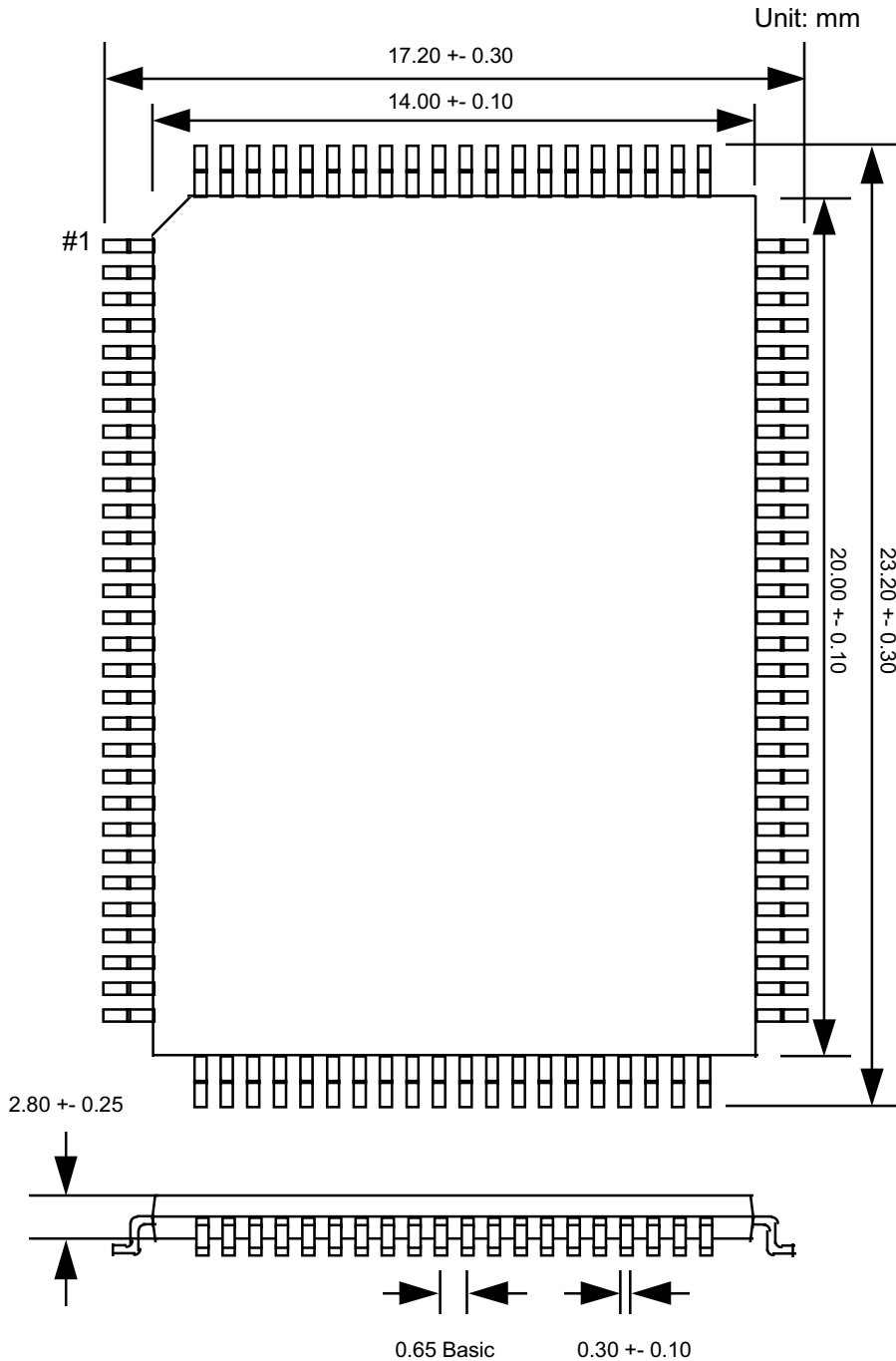
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Rev 1.1

64K X 32 SYNCHRONOUS PIPELINED BURST CMOS SRAM

100 PIN PQFP PACKAGE DIMENSIONS





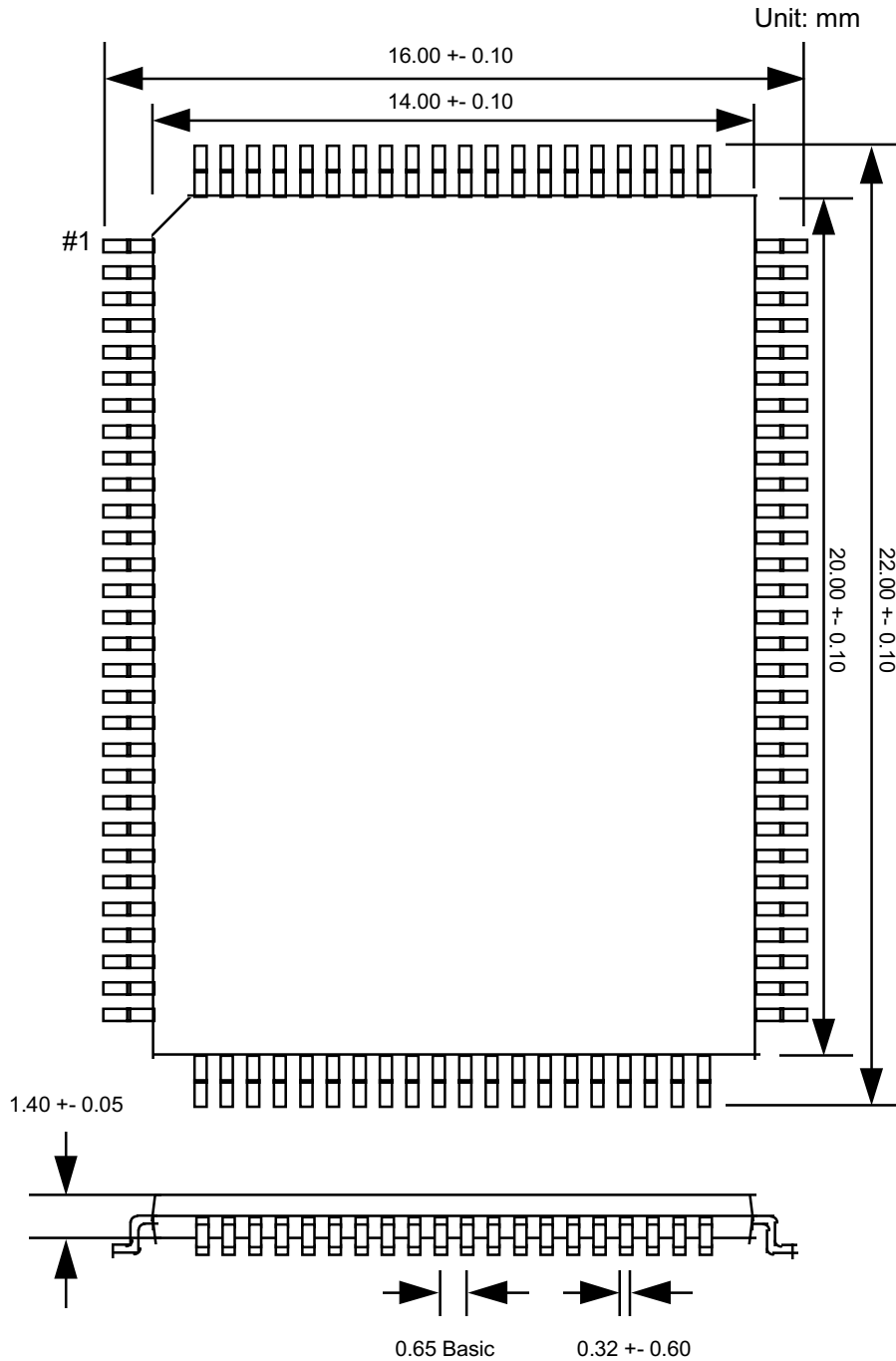
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100 PIN TQFP PACKAGE DIMENSIONS





**UTRON**

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**Rev 1.1**

**64K X 32 SYNCHRONOUS PIPELINED BURST CMOS SRAM**

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**ORDERING INFORMATION**

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