

**32K X 36 BURST SRAM**

Features

- 32K x 36 Organization
 - 0.5 μ CMOS Technology
 - Synchronous Burst Mode of Operation Compatible with i486TM and PentiumTM Processors
 - Supports PentiumTM Processor Address Pipelining
 - Single +3.3V \pm 5% Power Supply and Ground
 - 5V Tolerant I/O
 - LVTTTL I/O Compatible
 - Fast \overline{OE} times: 4, 5, 6ns
 - Common I/O
 - Registered Addresses, Data Ins and Control Signals
 - Asynchronous Output Enable
 - Self-Timed Write Operation and Byte Write Capability
 - Low Power Dissipation
 - 960 mW Active at 66MHz
 - 90 mW Standby
 - 100 Pin Thin Quad Flat Pack
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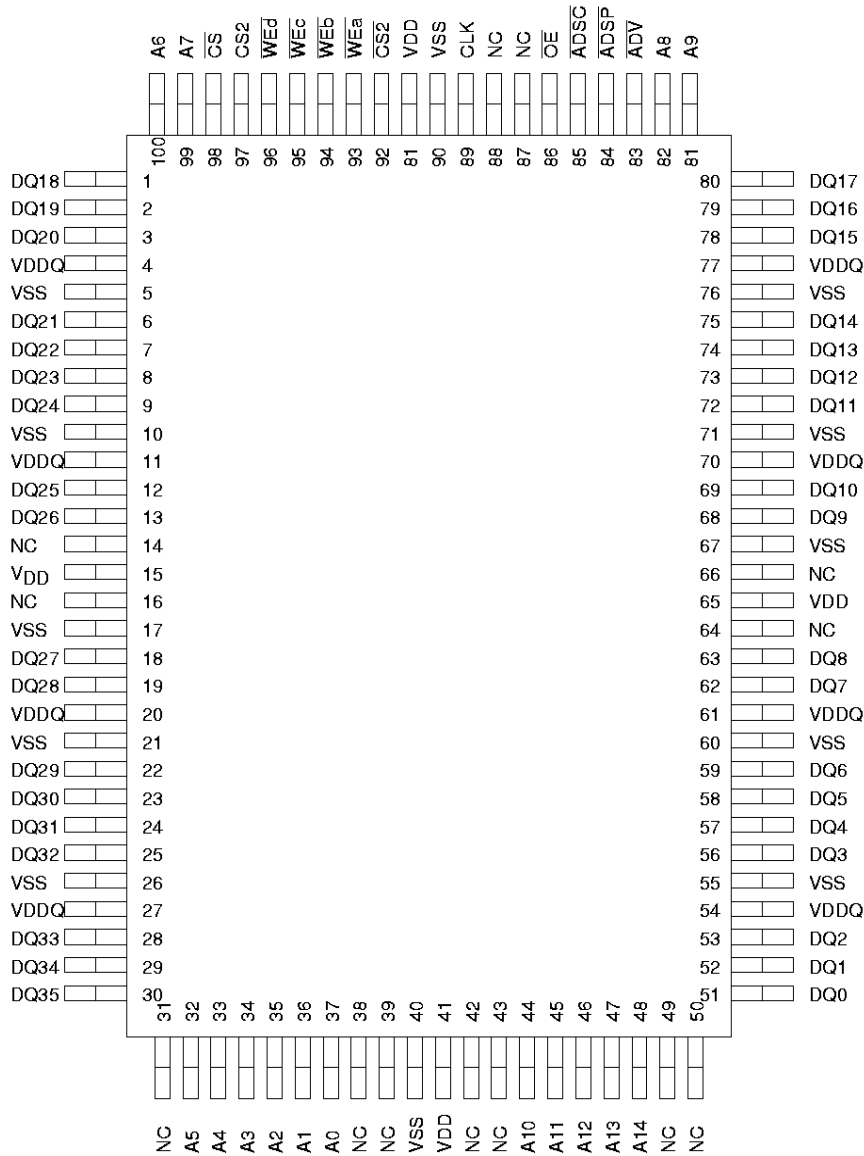
Description

IBM Microelectronics 1M SRAM is a Synchronous Burstable, high performance CMOS Static RAM that is versatile, wide I/O, and achieves 8 nsec access. A single clock is used to initiate the read/write operation and all internal operations are self-timed. At the rising edge of the Clock, all Addresses, Data Ins and Control Signals are registered internally. Burst mode operation, compatible with the i486TM and PentiumTM Processor's sequence, is accomplished by integrating input registers, internal 2-bit burst counter and high speed SRAM in a single chip. Burst reads are initiated with either \overline{ADSP} or \overline{ADSC} being LOW with a valid address during the rising edge of clock. Data from this address plus the three subsequent addresses will be output. The chip is operated with a single +3.3 V power supply and is compatible with LVTTTL I/O interfaces.



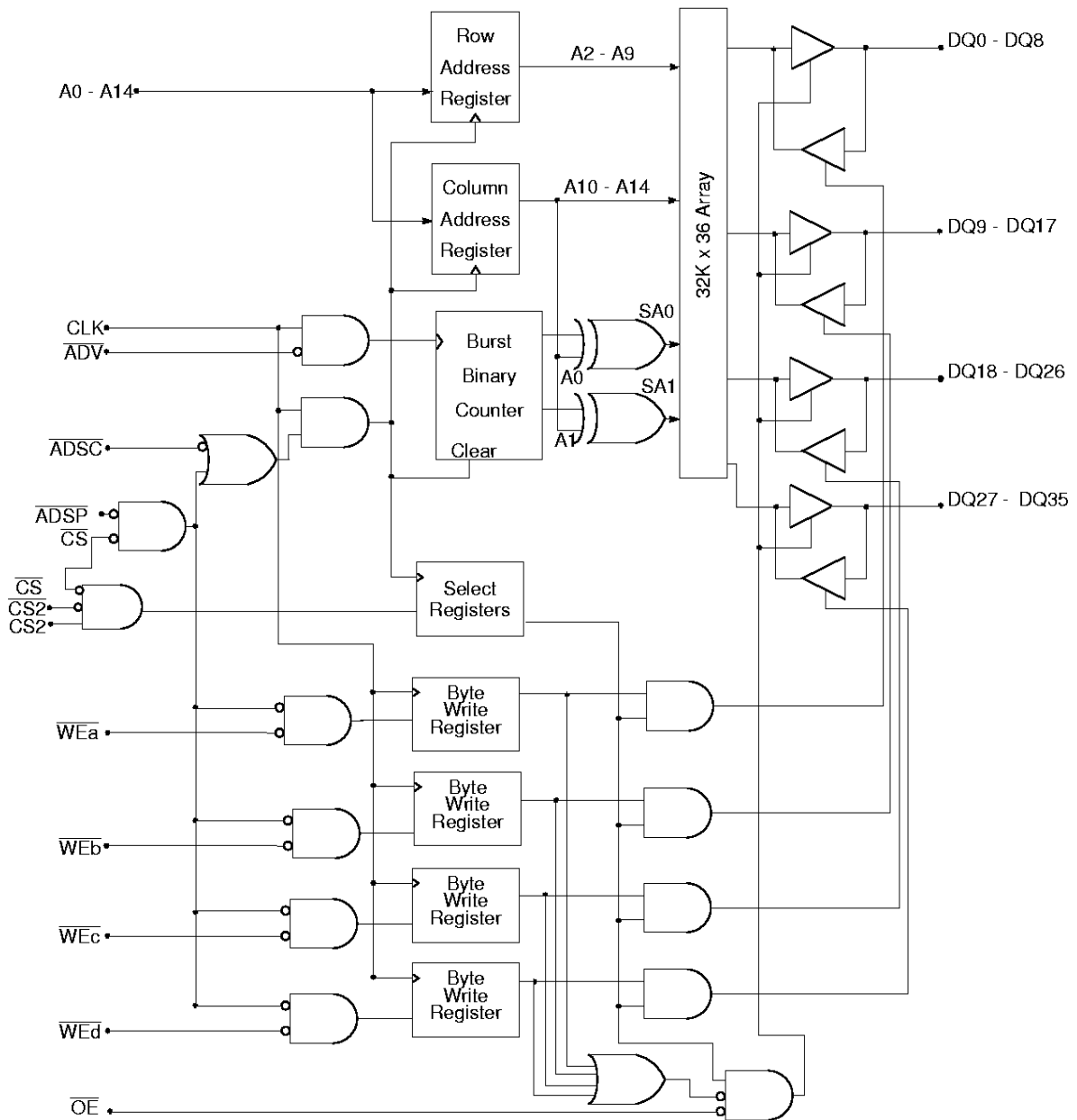
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X36 TQFP Pin Array Layout



Pin Description

A0-A14	Address input	ADSP	Address Status Processor
DQa - DQd	Data Input/Output (0-8,9-17,18-26,27-35)	ADSC	Address Status Controller
CLK	Clock	ADV	Burst Advance Control
WEa	Write Enable, Byte a (0 to 8)	CS	ADSP Gated Chip Select
WEb	Write Enable, Byte b (9 to 17)	VDD	Power Supply (+3.3V)
WEc	Write Enable, Byte c (18 to 26)	VSS	Ground
WEd	Write Enable, Byte d (27 to 35)	VDDQ	Output Power Supply (+3.3V)
OE	Output Enable	NC	No Connect
CS2, CS2	Chip Selects		

Block Diagram

Ordering Information

Part Number	Organization	Speed	Leads	Notes
IBM043612PQK-8	32K x 36	8 ns Access / 15 ns Cycle	100 pin TQFP	
IBM043612PQK-9	32K x 36	9 ns Access / 15 ns Cycle	100 pin TQFP	
IBM043612PQK-10	32K x 36	10 ns Access / 15 ns Cycle	100 pin TQFP	
IBM043612PQK-11	32K x 36	11 ns Access / 15 ns Cycle	100 pin TQFP	



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Burst SRAM Clock Truth Table

CLK	$\overline{CS}2$	CS2	\overline{CS}	ADSP	ADSC	ADV	WE	\overline{OE}	DQ	Operation
L→H	H	X	L	L	X	X	X	X	High-Z	Deselected Cycle
L→H	X	L	L	L	X	X	X	X	High-Z	Deselected Cycle
L→H	H	X	X	X	L	X	X	X	High-Z	Deselected Cycle
L→H	X	L	X	X	L	X	X	X	High-Z	Deselected Cycle
L→H	L	H	L	L	X	X	X	L	Q	Read from External Address, Begin Burst
L→H	L	H	L	L	X	X	X	H	High-Z	Read from External Address, Begin Burst
L→H	L	H	L	H	L	X	H	L	Q	Read from External Address, Begin Burst
L→H	L	H	L	H	L	X	L	X	D	Write to External Address, Begin Burst
L→H	X	X	X	H	H	L	H	L	Q	Read from next Add., Continue Burst
L→H	X	X	X	H	H	L	L	X	D	Write to next Add., Continue Burst
L→H	X	X	X	H	H	H	H	L	Q	Read from Current Add., Suspend Burst
L→H	X	X	X	H	H	H	L	X	D	Write to Current Add., Suspend Burst
L→H	X	X	H	X	L	X	X	X	High-Z	Deselect Cycle
L→H	X	X	H	X	H	L	H	L	Q	Read from next Add., Continue Burst
L→H	X	X	H	X	H	L	L	X	D	Write to next Add., Continue Burst
L→H	X	X	H	X	H	H	H	L	Q	Read from current Add., Suspend Burst
L→H	X	X	H	X	H	H	L	X	D	Write to current Add., Suspend Burst

1. For a write operation preceded by a read cycle, \overline{OE} must be HIGH early enough to allow Input Data Setup, and must be kept HIGH through Input Data Hold Time.
2. \overline{WE} refers to \overline{WEa} , \overline{WEb} , \overline{WEc} , \overline{WEd} .
3. ADSP is gated by \overline{CS} , and \overline{CS} is used to block ADSP when $\overline{CS} = V_{IH}$, as required in applications using Processor Address Pipelining.
4. All Addresses, Data In and Control signals are registered on the rising edge of CLK.

Burst Sequence Truth Table

External Address	A14-A2	(A1,A0)				Notes
		(0,0)	(0,1)	(1,0)	(1,1)	
1st Access	A14-A2	(0,0)	(0,1)	(1,0)	(1,1)	
2nd Access	A14-A2	(0,1)	(0,0)	(1,1)	(1,0)	
3rd Access	A14-A2	(1,0)	(1,1)	(0,0)	(0,1)	
4th Access	A14-A2	(1,1)	(1,0)	(0,1)	(0,0)	

**Write Enable Truth Table**

\overline{WEa}	\overline{WEb}	\overline{WEc}	\overline{WEd}	Byte Written	Notes
H	H	H	H	Read All Bytes	
L	L	L	L	Write All Bytes	
L	H	H	H	Write Byte A (D _{IN} 0 - 8)	
H	L	H	H	Write Byte B (D _{IN} 9 - 17)	
H	H	L	H	Write Byte C (D _{IN} 18 - 26)	
H	H	H	L	Write Byte D (D _{IN} 27 - 35)	

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units	Notes
Power Supply Voltage	V _{DD}	-0.5 to 4.6	V	1
Input Voltage	V _{IN}	-0.5 to 6.0	V	1
Output Voltage	V _{OUT}	-0.5 to V _{DD} +0.5	V	1
Operating Temperature	T _{OPR}	0 to +70	°C	1
Storage Temperature	T _{STG}	-55 to +125	°C	1
Power Dissipation	P _D	2.0	W	1
Short Circuit Output Current	I _{OUT}	50	mA	1

1. 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.

Recommended DC Operating Conditions (T_A=0 to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Supply Voltage	V _{DD}	3.135	3.3	3.465	V	1, 4
Input High Voltage	V _{IH}	2.2	—	5.5	V	1, 2, 4
Input Low Voltage	V _{IL}	-0.3	—	0.8	V	1, 3, 4
Output Current	I _{OUT}	—	5	8	mA	4

1. All voltages referenced to GND. All V_{DD(Q)} and V_{SS(Q)} pins must be connected.
2. V_{IH}(Max)DC = 5.5 V, V_{IH}(Max)AC = 6.0 V (pulse width ≤ 4.0ns).
3. V_{IL}(Min)DC = -0.3 V, V_{IL}(Min)AC = -1.5 V (pulse width ≤ 4.0ns).
4. Input voltage levels are tested to the following DC conditions: 1 microsecond cycle and 200 ns set-up and hold times.

32K X 36 BURST SRAM**Capacitance** ($T_A=0$ to $+70^\circ\text{C}$, $V_{DD}=3.3\text{V} \pm 5\%$, $f=1\text{MHz}$)

Parameter	Symbol	Test Condition	Max	Units	Notes
Input Capacitance	C_{IN}	$V_{IN} = 0\text{V}$	5	pF	
Data I/O Capacitance (DQ0-DQ35)	C_{OUT}	$V_{OUT} = 0\text{V}$	5	pF	

DC Electrical Characteristics ($T_A=0$ to $+70^\circ\text{C}$, $V_{DD}=3.3\text{V} \pm 5\%$)

Parameter	Symbol	Min.	Max.	Units	Notes
Operating Current Average Power Supply Operating Current ($\overline{OE} = V_{IH}$, $I_{OUT} = 0$)	I_{DD15}	—	275	mA	2, 3
Standby Current Power Supply Standby Current ($CS2 = V_{IH}$ or $CS2 = V_{IL}$ or $\overline{CS} = V_{IH}$ All other inputs = V_{IH} or V_{IL} , $I_{OUT} = 0$, Clock @ 66 MHz)	I_{SB}	—	25	mA	1, 3
Input Leakage Current Input Leakage Current, any input ($V_{IN} = 0$ & V_{DD})	I_{LI}	—	+1	μA	4
Output Leakage Current ($V_{OUT} = 0$ & V_{DD} , $\overline{OE} = V_{IH}$)	I_{LO}	—	+1	μA	
Output High Level Output "H" Level Voltage ($I_{OH} = -8\text{mA}$ @ 2.4V)	V_{OH}	2.4	—	V	
Output Low Level Output "L" Level Voltage ($I_{OL} = +8\text{mA}$ @ 0.4V)	V_{OL}	—	0.4	V	
<ol style="list-style-type: none"> I_{SB} = Stand-by Current. I_{DD} = Selected Current. I_{OUT} = Chip Output Current. The input leakage current for 5.5V inputs is 200 μA for Clk, Chip Selects, and Output Enable. Other inputs have 100 μA of leakage current at 5.5V. 					

AC Test Conditions ($T_A=0$ to $+70^\circ\text{C}$, $V_{DD}=3.3\text{V} \pm 5\%$)

Parameter	Symbol	Conditions	Units	Notes
Input Pulse High Level	V_{IH}	3.0	V	
Input Pulse Low Level	V_{IL}	0.0	V	
Input Rise Time	T_R	2.0	ns	
Input Fall Time	T_F	2.0	ns	
Input and Output Timing Reference Level		1.5	V	
Output Load Conditions				1
<ol style="list-style-type: none"> See AC Test Loading figure 1 on page 8. 				



AC Characteristics ($T_A=0$ to $+70^\circ\text{C}$, $V_{DD}=3.3\text{V} \pm 5\%$, Units in nsec)

Parameter	Symbol	-8		-9		-10		-11		Notes
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Cycle Time	t_{CYCLE}	15.0	—	15.0	—	15.0	—	15.0	—	
Clock Pulse High	t_{CH}	3.0	—	3.0	—	3.0	—	3.0	—	
Clock Pulse Low	t_{CL}	3.0	—	3.0	—	3.0	—	3.0	—	
Clock to Output Valid	t_{CQ}	—	8.0	—	9.0	—	10.0	—	11.0	3
Address Status Controller Setup Time	t_{ADSCS}	2.5	—	2.5	—	2.5	—	2.5	—	
Address Status Controller Hold Time	t_{ADSCH}	0.5	—	0.5	—	0.5	—	0.5	—	
Address Status Processor Setup Time	t_{ADSPS}	2.5	—	2.5	—	2.5	—	2.5	—	
Address Status Processor Hold Time	t_{ADSPH}	0.5	—	0.5	—	0.5	—	0.5	—	
Advance Setup Time	t_{ADVS}	2.5	—	2.5	—	2.5	—	2.5	—	
Advance Hold Time	t_{ADVH}	0.5	—	0.5	—	0.5	—	0.5	—	
Address Setup Time	t_{AS}	2.5	—	2.5	—	2.5	—	2.5	—	
Address Hold Time	t_{AH}	0.5	—	0.5	—	0.5	—	0.5	—	
Chip Selects Setup Time	t_{CSS}	2.5	—	2.5	—	2.5	—	2.5	—	
Chip Selects Hold Time	t_{CSH}	0.5	—	0.5	—	0.5	—	0.5	—	
Write Enables Setup Time	t_{WES}	2.5	—	2.5	—	2.5	—	2.5	—	
Write Enables Hold Time	t_{WEH}	0.5	—	0.5	—	0.5	—	0.5	—	
Data In Setup Time	t_{DS}	2.5	—	2.5	—	2.5	—	2.5	—	
Data In Hold Time	t_{DH}	0.5	—	0.5	—	0.5	—	0.5	—	
Data Out Hold Time	t_{CQX}	3.0	—	3.0	—	3.0	—	3.0	—	3
Clock High to Output High-Z	t_{CHZ}	—	5.0	—	5.0	—	5.5	—	5.5	1, 2, 4
Clock High to Output Active	t_{CLZ}	2.5	—	2.5	—	2.5	—	2.5	—	1, 2, 4
Output Enable to High-Z	t_{OHZ}	2.0	5.0	2.0	5.5	2.0	6.0	2.0	6.5	1, 4
Output Enable to Low-Z	t_{OLZ}	0.25	—	0.25	—	0.25	—	0.25	—	1, 4
Output Enable to Output Valid	t_{OQ}	—	4.0	—	5.0	—	5.0	—	6.0	3

1. Transitions are measured ± 200 mV from steady state voltage.
2. At any given voltage and temperature, T_{CHZ} (max) is always less than T_{CLZ} (min) for a given device and from device to device. For any read cycle preceded by a write or deselect cycle, the data bus will transition glitch-free from High-Z to new RAM data.
3. See AC Test Loading figure 1 on page 8.
4. See AC Test Loading figure 2 on page 8.

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AC Test Loading

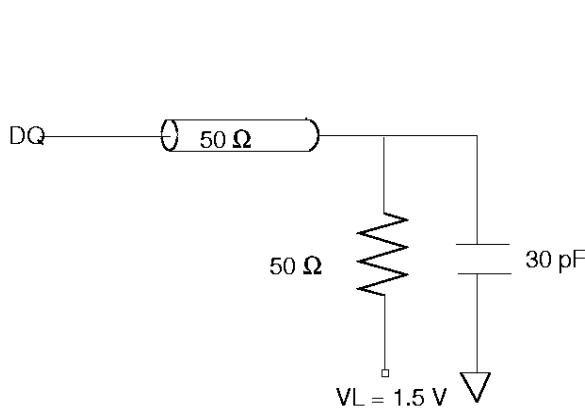


Fig. 1 Test Equivalent Load

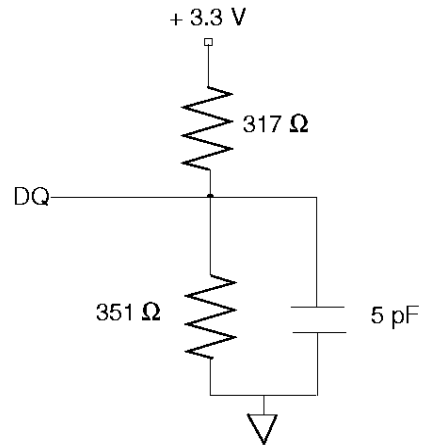
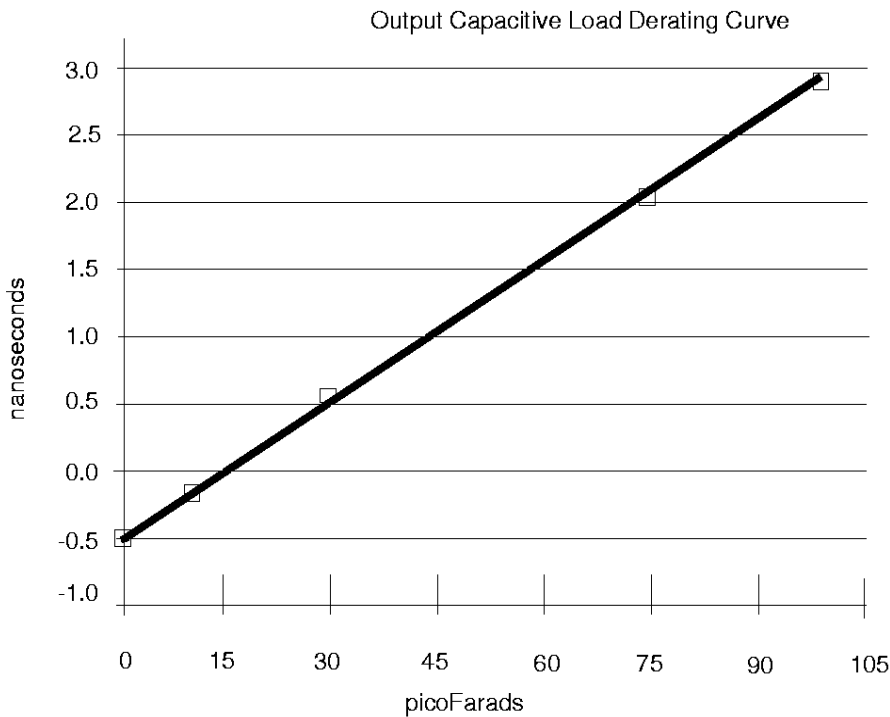
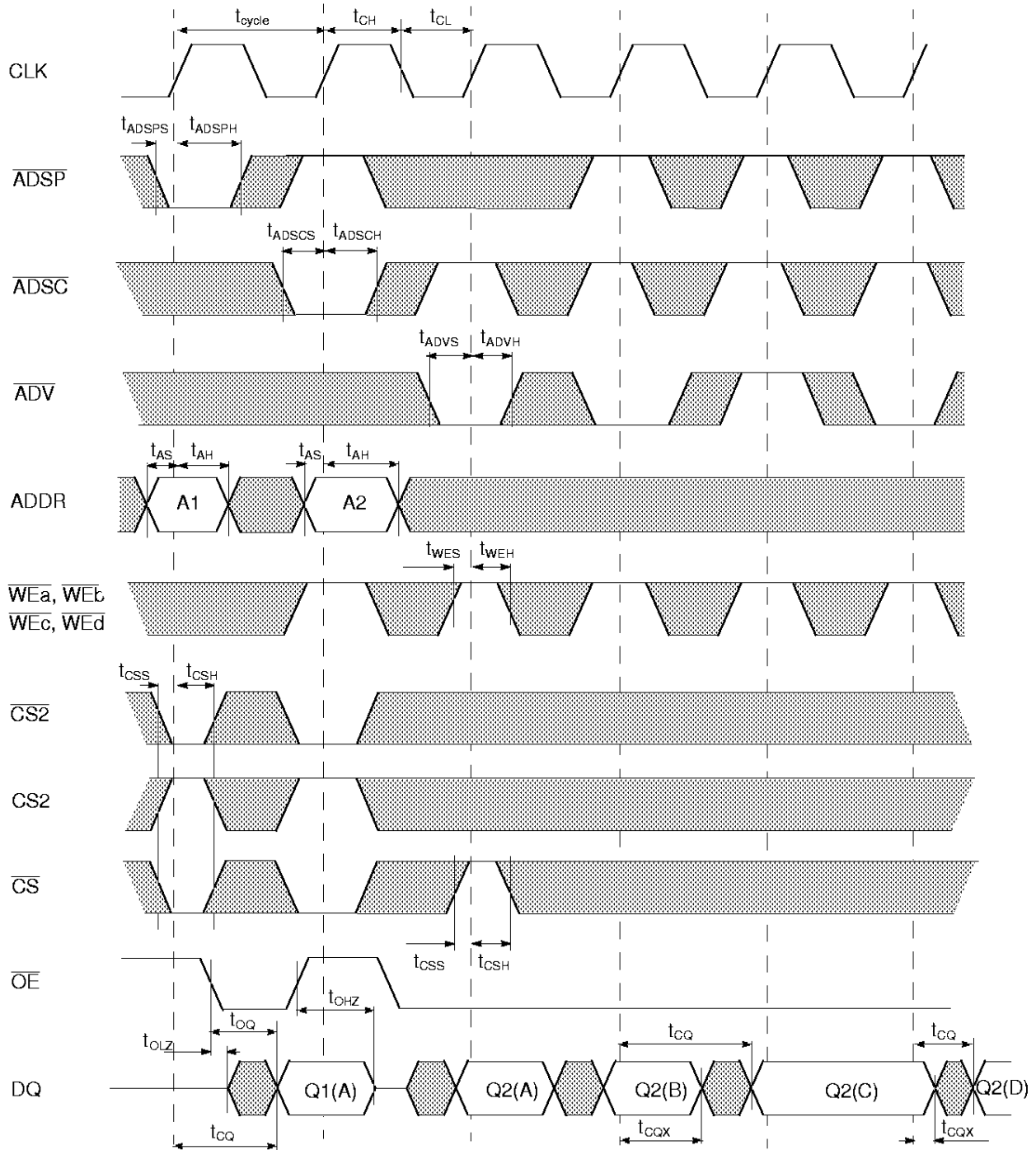


Fig. 2 Test Equivalent Load



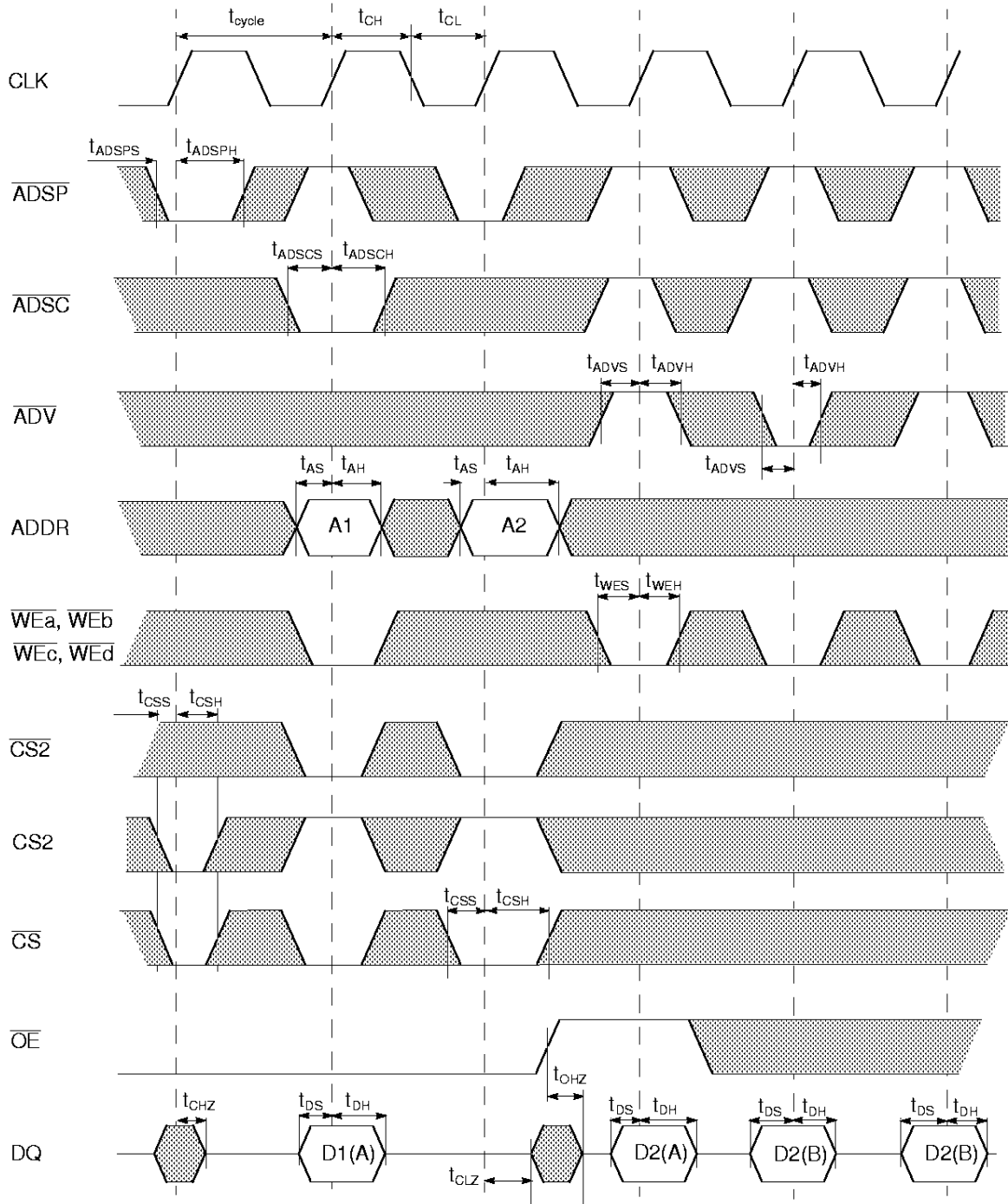
The derating curve above is for a purely capacitive load on the output driver. For example, a part specified at 8ns access time will behave as though it has an 8.5 ns access time if a 30 pF load with no DC component was attached to the output driver. The access times guaranteed in the datasheets are based on a 50 ohm terminated test load. For unterminated loads the derating curve should be used. This curve is based on nominal process conditions with worst case parameters $V_{DD} = 3.14 \text{ V}$, $T_A = 70^\circ \text{ C}$.

Timing Diagram (Burst Read)

Notes:

1. Q1(A) and Q2(A) refer to data read from address A1 and A2.
2. Q2(B), Q2(C) and Q2(D) refer to data read from subsequent internal burst counter addresses.

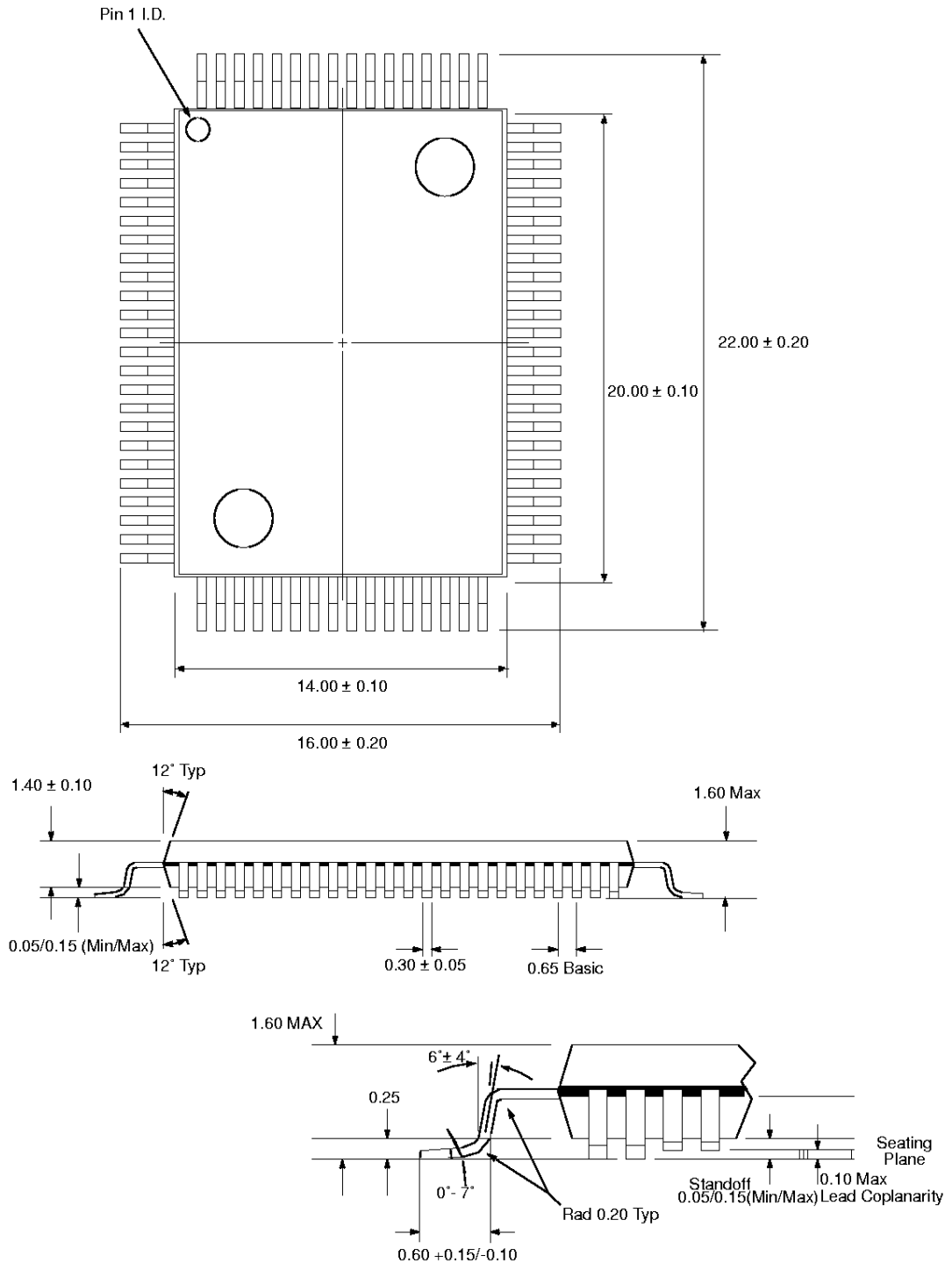
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Timing Diagram (Burst Write)



Notes:

1. D1(A) and D2(A) refer to data written to address A1 and A2.
2. D2(B) refers to data written to a subsequent internal burst counter address.
3. \overline{WEa} , \overline{WEb} , \overline{WEc} and \overline{WEd} are don't cares when ADSP is sampled LOW.

100 Pin TQFP Package Diagram




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Revision Log

Rev	Contents of Modification
5/94	Initial Release of the 32K x 36 (8/9/11) TQFP BURST MODE Application Spec.
3/95	Updated -8, -9, -11; Added -10 Specifications.
7/95	Removed Preliminary classification.



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