

MOSEL VITELIC

V33644Q15KG

3.3 VOLT 4M x 64 HIGH PERFORMANCE
UNBUFFERED DIMM MODULE

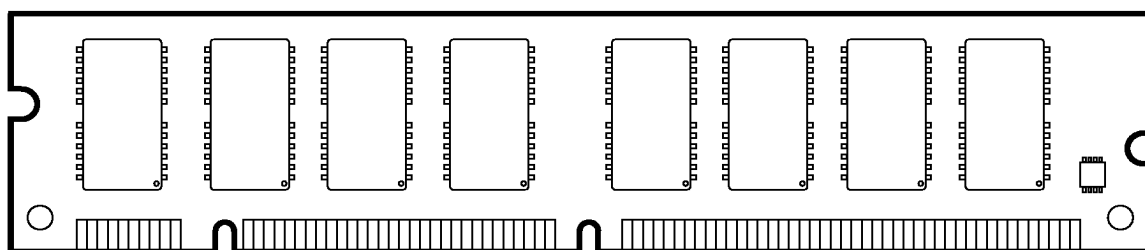
HIGH PERFORMANCE	50	60
Max. $\overline{\text{RAS}}$ Access Time, (t_{RAC})	50 ns	60 ns
Max. $\overline{\text{CAS}}$ Access Time, (t_{CAC})	13 ns	15 ns
Min. Cycle Time, (t_{RC})	84 ns	104 ns
Min. EDO Mode Cycle Time, (t_{PC})	20 ns	25 ns

Features

- 168 Pin JEDEC standard, Unbuffered 16 byte dual in-line EDO module
- 1 Bank 4M x 64 organization
- Utilizes 16 4M x 4 EDO SOJ DRAMs
- Fast Access Times: 50 or 60 ns
- JEDEC standard EDO DRAM
- Low power dissipation
- Read-Modify-Write, $\overline{\text{RAS}}$ -Only Refresh, $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$ Refresh
 - Refresh Interval: 2048 cycles/32 ms 2K
- Single 3.3V $\pm 10\%$ Power Supply
- Decoupling capacitors mounted on substrate
- LVTTTL Interface
- Fully pin and architecture compatible with 168 pin unbuffered DRAM DIMMs
- Serial Present Detect (SPD)

Description

The V33644Q15KG memory module is organized as 4,194,304 x 64 bits in a 168 pin dual in-line memory module. The 4M x 64 memory uses 16 Mosel Vitelic 4M x 4 EDO DRAMs. The x64 modules are ideal for use in high performance computer systems where increased memory density and fast access time are required.



V35644Q15KG-01

Device Usage Chart

Operating Temperature Range	Package Outline		Access Time (ns)		Power	Temperature Mark
	K	T	50	60	Std.	
0°C to 70°C	•	•	•	•	•	Blank
-40°C to +85°C	•	•	•	•	•	I

Pin Configurations (Front Side/Back Side)

Pin	Front	Pin	Front	Pin	Front	Pin	Back	Pin	Back	Pin	Back
1	VSS	29	$\overline{\text{CAS1}}$	57	I/O19	85	VSS	113	$\overline{\text{CAS5}}$	141	I/O51
2	I/O1	30	$\overline{\text{RAS0}}$	58	I/O20	86	I/O33	114	NC	142	I/O52
3	I/O2	31	$\overline{\text{OE0}}$	59	VCC	87	I/O34	115	NC	143	VCC
4	I/O3	32	VSS	60	I/O21	88	I/O35	116	VSS	144	I/O53
5	I/O4	33	A0	61	NC	89	I/O36	117	A1	145	NC
6	VCC	34	A2	62	NC	90	VCC	118	A3	146	NC
7	I/O5	35	A4	63	NC	91	I/O37	119	A5	147	NC
8	I/O6	36	A6	64	VSS	92	I/O38	120	A7	148	VSS
9	I/O7	37	A8	65	I/O22	93	I/O39	121	A9	149	I/O54
10	I/O8	38	A10	66	I/O23	94	I/O40	122	NC	150	I/O55
11	I/O9	39	NC	67	I/O24	95	I/O41	123	NC	151	I/O56
12	VSS	40	VCC	68	VSS	96	VSS	124	VCC	152	VSS
13	I/O10	41	VCC	69	I/O25	97	I/O42	125	NC	153	I/O57
14	I/O11	42	NC	70	I/O26	98	I/O43	126	NC	154	I/O58
15	I/O12	43	VSS	71	I/O27	99	I/O44	127	VSS	155	I/O59
16	I/O13	44	$\overline{\text{OE2}}$	72	I/O28	100	I/O45	128	NC	156	I/O60
17	I/O14	45	$\overline{\text{RAS2}}$	73	VCC	101	I/O46	129	NC	157	VCC
18	VCC	46	$\overline{\text{CAS2}}$	74	I/O29	102	VCC	130	$\overline{\text{CAS6}}$	158	I/O61
19	I/O15	47	$\overline{\text{CAS3}}$	75	I/O30	103	I/O47	131	$\overline{\text{CAS7}}$	159	I/O62
20	I/O16	48	$\overline{\text{WE2}}$	76	I/O31	104	I/O48	132	NC	160	I/O63
21	NC	49	VCC	77	I/O32	105	NC	133	VCC	161	I/O64
22	NC	50	NC	78	VSS	106	NC	134	NC	162	VSS
23	VSS	51	NC	79	NC	107	VSS	135	NC	163	NC
24	NC	52	NC	80	NC	108	NC	136	NC	164	NC
25	NC	53	NC	81	NC	109	NC	137	NC	165	SA0
26	VCC	54	VSS	82	SDA	110	VCC	138	VSS	166	SA1
27	$\overline{\text{WE0}}$	55	I/O17	83	SCL	111	NC	139	I/O49	167	SA2
28	$\overline{\text{CAS0}}$	56	I/O18	84	VCC	112	$\overline{\text{CAS4}}$	140	I/O50	168	VCC

Pin Names

A0–A10	Addresses
I/O1–I/O65	Data Inputs/Outputs
$\overline{\text{RAS0}}$, $\overline{\text{RAS2}}$	Row Address Strokes
$\overline{\text{CAS0}}$ – $\overline{\text{CAS7}}$	Column Address Strokes
$\overline{\text{WE0}}$, $\overline{\text{WE2}}$	Write Enable
$\overline{\text{OE0}}$, $\overline{\text{OE2}}$	Output Enable
SDA	Serial Input/Output
SCL	Serial Clock
SA0–SA2	Serial PD Address
VCC	+3.3V
VSS	Ground
NC	No Connection

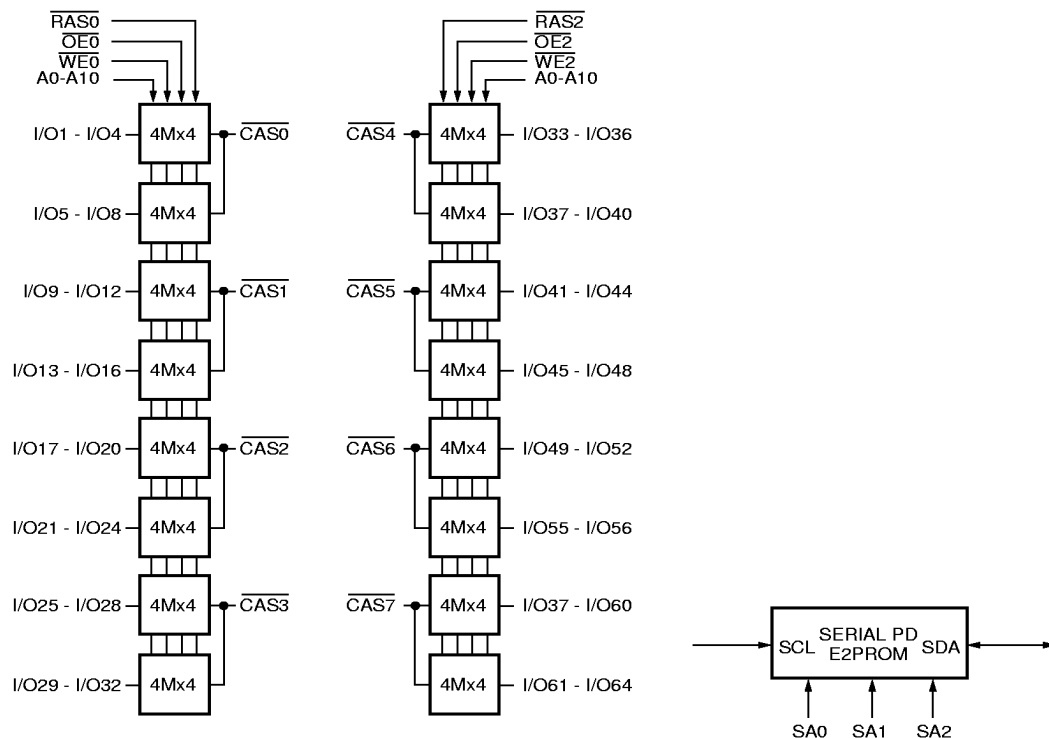
Serial Presence Detect Information

- SPD Interface Protocol: IIC
- Current sink capability of SDA driver $\leq 3\text{mA}$
- Maximum Clock Frequency: 100 KHz\

Byte Number	Function Described		SPD Entry Value	Hex 2K Refresh 50/60ns EDO
0	Number of SPD bytes		15	0F
1	Total bytes in serial PD		256	08
2	Memory type		EDO	02
3	Number of ROW addresses		11	0B
4	Number of COLUMN addresses		11	0B
5	Number of Banks		1	01
6	Module Data Width		64	40
7	Module Data Width (continued)		0	00
8	Module Interface Levels		LVTTL	01
9	RAS Access Time	50 ns	50	32
		60 ns	60	3C
10	CAS Access Time	50 ns	13	0D
		60 ns	15	0F
11	DIMM Config (Error Det./Corr.)		none	00
12	Refresh Rate/Type		Normal/SF(15.6 μ s)-00/80	00
13	DRAM width, Primary		X4	04
14	Error Checking DRAM Data Width		UND	00
15-31	Reserved for Future Offerings			00h
32	Superset Memory Type (may be used in future)			00h
33-62	Superset Memory Specific Feature (may be used in future)			00h
63	Checksum for bytes 0-62			3Dh
64	Manufacturers JEDEC ID Code per JEP-106E		Continuation Code	7Fh
65			MVI	40h
66-71				00h
72	Manufacturing Location			
73	Manufacturer's Part Number	V	V33644Q15KG	56h
74		3		33h
75		3		33h
76		6		36h
77		4		34h
78		4		34h
79		Q		51h

Byte Number	Function Described	SPD Entry Value	Hex 2K Refresh 50/60ns EDO
80	1		31h
81	5		35h
82	K		4Bh
83	G		47h
84			20h
85			20h
86			20h
87			20h
88			20h
89			20h
90			20h
91–92	Revision Code	Rev0	00h
93	Date Code	WW	00h
94	Year	YY	62h (98)
95–98	Assembly Serial Number	Binary Incremental	00h
99–125	Manufacturer Specific Data'	n/a	00h
126–127	Rerved		00h
128–255	Oper User Free-Form arean \$ not defined		00h

Functional Block Diagram



Truth Table

FUNCTION		RAS	CAS	WE	OE	ROW ADDR	COL ADDR	I/O1-I/O4
Standby		H	X	X	X	X	X	High Impedance
Read		L	L	H	L	ROW	COL	Data Out
Early-Write		L	L	L	X	ROW	COL	Data In
Late-Write		L	L	H - L	H	ROW	COL	Data In
Read-Modify-Write (RMW)		L	L	H - L	L - H	ROW	COL	Data Out, Data In
EDO Page Mode Read	1st Cycle	L	H - L	H	L	ROW	COL	Data Out
	2nd Cycle	L	H - L	H	L	n/a	COL	Data Out
EDO Page Mode Write	1st Cycle	L	H - L	L	X	ROW	COL	Data In
	2nd Cycle	L	H - L	L	X	n/a	COL	Data In
EDO Page Mode RMW	1st Cycle	L	H - L	H - L	L - H	ROW	COL	Data Out, Data In
	2st Cycle	L	H - L	H - L	L - H	n/a	COL	Data Out, Data In
$\overline{\text{RAS}}$ only refresh		L	H	X	X	ROW	n/a	High Impedance
$\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh		H - L	L	H	X	X	n/a	High Impedance
Hidden Refresh	READ	L-H-L	L	H	L	ROW	COL	Data Out
	WRITE	L-H-L	L	L	X	ROW	COL	Data In
Self Refresh		H - L	L	H	X	X	X	High Impedance

Absolute Maximum Ratings*

Parameter	Commercial	Units
Operating Temperature Range	0 to 70	°C
Storage Temperature	-55 to +150	°C
Input/Output Voltage	-0.5 to min ($V_{CC}+0.5$, 4.6)	V
Power Supply Voltage	-1.0 to +4.6	V
Power Dissipation	9.95	W
Data Out Current (short circuit)	50	mA

***Note:** 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.

Capacitance*

$T_A = 0$ to 70°C , $V_{CC} = 3.3\text{ V} \pm 10\%$, $f = 1\text{ MHz}$

Symbol	Parameter	Min.	Max.	Unit
C_{I1}	Input Capacitance (A0 to A10)	—	100	pF
C_{I2}	Input Capacitance ($\overline{\text{RAS0}}$, $\overline{\text{RAS2}}$)	—	75	pF
C_{I3}	Input Capacitance ($\overline{\text{WE0}}$, $\overline{\text{WE2}}$, $\overline{\text{OE0}}$, $\overline{\text{OE2}}$)	—	18	pF
C_{IO1}	I/O Capacitance (I/O1-I/O64)	—	75	pF
C_S	Input Capacitance (SCL, SA0-2)	—	8	pF
C_S	Input/Output Capacitance (SDA)	—	10	pF

***Note:** Capacitance is sampled and not 100% tested.

DC and Operating Characteristics (1-2)

$T_A = 0^{\circ}\text{C}$ to 70°C , $V_{CC} = 3.3\text{ V} \pm 10\%$, $V_{SS} = 0\text{ V}$, $t_T = 2\text{ ns}$, unless otherwise specified.

Symbol	Parameter	Access Time	V33644Q15KG			Unit	Test Conditions	Notes
			Min.	Typ.	Max.			
I_{LI}	Input Leakage Current (any input pin)		-10		10	μA	$V_{SS} \leq V_{IN} \leq V_{CC} + 0.5\text{ V}$	1
I_{LO}	Output Leakage Current (for High-Z State)		-10		10	μA	$V_{SS} \leq V_{OUT} \leq V_{CC} + 0.5\text{ V}$ $\overline{\text{RAS}}, \overline{\text{CAS}}$ at V_{IH} other input $\geq V_{SS}$	1
I_{CC1}	V_{CC} Supply Current, Operating	50			1280	mA	$t_{RC} = t_{RC}(\text{min.})$	2, 3, 4
		60			1120			
I_{CC2}	V_{CC} Supply Current, TTL Standby				32	mA	$\overline{\text{RAS}}, \overline{\text{CAS}}$ at V_{IH} other inputs $\geq V_{SS}$	
I_{CC3}	V_{CC} Supply Current, $\overline{\text{RAS}}$ -Only Refresh	50			1280	mA	$t_{RC} = t_{RC}(\text{min.})$	2, 4
		60			1120			
I_{CC4}	V_{CC} Supply Current, EDO Page Mode Operation	50			560	mA	Minimum Cycle	2, 3, 4
		60			480			
I_{CC5}	V_{CC} Supply Current, during $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh	50			1920	mA		2, 4
		60			1760			
		70			1600			
I_{CC6}	V_{CC} Supply Current, CMOS Standby				16	mA	$\overline{\text{RAS}} \geq V_{CC} - 0.2\text{ V}$, $\overline{\text{CAS}} \geq V_{CC} - 0.2\text{ V}$ other input $\geq V_{SS}$	1
V_{CC}	Power Supply Voltage		4.5	5.0	5.5	V		
V_{IL}	Input Low Voltage		-0.5		0.8	V		1
V_{IH}	Input High Voltage		2.4		$V_{CC} + 0.5$	V		1
V_{OL}	Output Low Voltage				0.4	V	$I_{OL} = 4.2\text{ mA}$	1
V_{OH}	Output High Voltage		2.4			V	$I_{OH} = -5\text{ mA}$	1

AC Characteristics^(5, 6) $T_A = 0^\circ\text{C to } 70^\circ\text{C}, V_{CC} = 3.3 \text{ V} \pm 10\%, t_T = 2 \text{ ns}$

#	Symbol	Parameter	-50		-60		Unit	Note
			min.	max.	min.	max.		
Common Parameters								
1	t _{RC}	Random read or write cycle time	84	—	104	—	ns	
2	t _{RP}	$\overline{\text{RAS}}$ precharge time	30	—	40	—	ns	
3	t _{RAS}	$\overline{\text{RAS}}$ pulse width	50	10k	60	10k	ns	
4	t _{CAS}	$\overline{\text{CAS}}$ pulse width	8	10k	10	10k	ns	
5	t _{ASR}	Row address setup time	0	—	0	—	ns	
6	t _{RAH}	Row address hold time	8	—	10	—	ns	
7	t _{ASC}	Column address setup time	0	—	0	—	ns	
8	t _{CAH}	Column address hold time	8	—	10	—	ns	
9	t _{RCD}	$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	12	37	14	45	ns	
10	t _{RAD}	$\overline{\text{RAS}}$ to column address delay	10	25	12	30	ns	
11	t _{RSH}	$\overline{\text{RAS}}$ hold time	13		15	—	ns	
12	t _{CSH}	$\overline{\text{CAS}}$ hold time	40		50	—	ns	
13	t _{CRP}	$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	5	—	5	—	ns	
14	t _T	Transition time (rise and fall)	1	50	1	50	ns	7
15	t _{REF}	Refresh period	—	32	—	32	ms	
Read Cycle								
16	t _{RAC}	Access time from $\overline{\text{RAS}}$	—	50	—	60	ns	8, 9
17	t _{CAC}	Access time from $\overline{\text{CAS}}$	—	13	—	15	ns	8, 9
18	t _{CAA}	Access time from column address	—	25	—	30	ns	8,10
19	t _{OEA}	$\overline{\text{OE}}$ access time	—	13	—	15	ns	
20	t _{RAL}	Column address to $\overline{\text{RAS}}$ lead time	25	—	30	—	ns	
21	t _{RCS}	Read command setup time	0	—	0	—	ns	
22	t _{RCH}	Read command hold time	0	—	0	—	ns	11
23	t _{RRH}	Read command hold time referenced to $\overline{\text{RAS}}$	0	—	0	—	ns	11
24	t _{CLZ}	$\overline{\text{CAS}}$ to output in low-Z	0	—	0	—	ns	8
25	t _{OFF}	Output buffer turn-off delay	0	13	0	15	ns	12
26	t _{OEZ}	Output turn-off delay from $\overline{\text{OE}}$	0	13	0	15	ns	12
27	t _{DZC}	Data to $\overline{\text{CAS}}$ low delay	0	—	0	—	ns	13
28	t _{DZO}	Data to $\overline{\text{OE}}$ low delay	0	—	0	—	ns	13
29	t _{CDD}	$\overline{\text{CAS}}$ high to data delay	10	—	13	—	ns	14
30	t _{ODD}	$\overline{\text{OE}}$ high to data delay	10	—	13	—	ns	14

AC Characteristics^(5, 6) $T_A = 0^{\circ}\text{C to } 70^{\circ}\text{C}, V_{CC} = 3.3 \text{ V} \pm 10\%, t_T = 2 \text{ ns}$

#	Symbol	Parameter	-50		-60		Unit	Note
			min.	max.	min.	max.		
Write Cycle								
31	t _{WCH}	Write command hold time	8	–	10	–	ns	
32	t _{WP}	Write command pulse width	8	–	10	–	ns	
33	t _{WCS}	Write command setup time	0	–	0	–	ns	15
34	t _{RWL}	Write command to $\overline{\text{RAS}}$ lead time	8	–	10	–	ns	
35	t _{CWL}	Write command to $\overline{\text{CAS}}$ lead time	8	–	10	–	ns	
36	t _{DS}	Data setup time	0	–	0	–	ns	16
37	t _{DH}	Data hold time	8	–	10	–	ns	16
Read-modify-Write Cycle								
38	t _{RWC}	Read-write cycle time	113	–	138	–	ns	
39	t _{RWD}	$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	64	–	77	–	ns	15
40	t _{CWD}	$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time	27	–	32	–	ns	15
41	t _{AWD}	Column address to $\overline{\text{WE}}$ delay time	39	–	47	–	ns	15
42	t _{OEh}	$\overline{\text{OE}}$ command hold time	10	–	13	–	ns	
EDO Page Mode Cycle								
43	t _{PC}	EDO page mode cycle time	20	–	25	–	ns	
44	t _{CP}	$\overline{\text{CAS}}$ precharge time	8	–	10	–	ns	
45	t _{CPA}	Access time from $\overline{\text{CAS}}$ precharge	–	27	–	32	ns	7
46	t _{COH}	Output data hold time	5	–	5	–	ns	
47	t _{RASP}	$\overline{\text{RAS}}$ pulse width in EDO mode	50	200k	60	200k	ns	
48	t _{RHPC}	$\overline{\text{CAS}}$ precharge to $\overline{\text{RAS}}$ Delay	27	–	32	–	ns	
49	t _{OES}	$\overline{\text{OE}}$ setup time prior to $\overline{\text{CAS}}$	5	–	5		ns	
EDO Page Mode Read-modify-Write Cycle								
50	t _{PRWC}	EDO page mode read-write cycle time	58	–	68	–	ns	
51	t _{CPWD}	$\overline{\text{CAS}}$ precharge to $\overline{\text{WE}}$	41	–	49	–	ns	
$\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle								
52	t _{CSR}	$\overline{\text{CAS}}$ setup time	10	–	10	–	ns	
53	t _{CHR}	$\overline{\text{CAS}}$ hold time	10	–	10	–	ns	
54	t _{RPC}	$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ precharge time	5	–	5	–	ns	
55	t _{WRP}	Write to $\overline{\text{RAS}}$ precharge time	10	–	10	–	ns	
56	t _{WRH}	Write hold time referenced to $\overline{\text{RAS}}$	10	–	10	–	ns	

Notes:

- 1) All voltages are referenced to V_{SS} .
- 2) I_{CC1} , I_{CC3} , I_{CC4} and I_{CC5} depend on cycle rate.
- 3) I_{CC1} and I_{CC4} depend on output loading. Specified values are obtained with the output open.
- 4) Address can be changed once or less while $\overline{RAS} = V_{IL}$. In case of I_{CC4} it can be changed once or less during a EDO page mode cycle
- 5) An initial pause of 200 μs is required after power-up followed by 8 $\overline{RAS}$ cycles of which at least one cycle has to be a refresh cycle, before proper device operation is achieved. In case of using the internal refresh counter, a minimum of 8 $\overline{CAS}$ -before- $\overline{RAS}$ initialization cycles instead of 8 $\overline{RAS}$ cycles are required.
- 6) AC measurements assume $t_T = 2$ ns.
- 7) $V_{IH(min.)}$ and $V_{IL(max.)}$ are reference levels for measuring timing of input signals. Transition times are also measured between V_{IH} and V_{IL} .
- 8) Measured with the specified current load and 100 pF at $V_{OL} = 0.8$ V and $V_{OH} = 2.0$ V. Access time is determined by the latter of t_{RAC} , t_{CAC} , t_{CAA} , t_{CPA} , t_{OEA} . t_{CAC} is measured from tristate.
- 9) Operation within the $t_{RCD(max.)}$ limit ensures that $t_{RAC(max.)}$ can be met. $t_{RCD(max.)}$ is specified as a reference point only. If t_{RCD} is greater than the specified $t_{RCD(max.)}$ limit, then access time is controlled by t_{CAC} .
- 10) Operation within the $t_{RAD(max.)}$ limit ensures that $t_{RAC(max.)}$ can be met. $t_{RAD(max.)}$ is specified as a reference point only. If t_{RAD} is greater than the specified $t_{RAD(max.)}$ limit, then access time is controlled by t_{CAA} .
- 11) Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
- 12) $t_{OFF(max.)}$, $t_{OEZ(max.)}$ define the time at which the output achieves the open-circuit conditions and are not referenced to output voltage levels. t_{OFF} is referenced from the rising edge of $\overline{RAS}$ or $\overline{CAS}$, whichever occurs last.
- 13) Either t_{DZC} or t_{DZO} must be satisfied.
- 14) Either t_{CDD} or t_{ODD} must be satisfied.
- 15) t_{WCS} , t_{RWD} , t_{CWD} and t_{AWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} > t_{WCS(min.)}$, the cycle is an early write cycle and data out pin will remain open-circuit (high impedance) through the entire cycle; if $t_{RWD} > t_{RWD(min.)}$, $t_{CWD} > t_{CWD(min.)}$ and $t_{AWD} > t_{AWD(min.)}$, the cycle is a read-write cycle and I/O will contain data read from the selected cells. If neither of the above sets of conditions is satisfied, the condition of I/O (at access time) is indeterminate.
- 16) These parameters are referenced to the $\overline{CAS}$ leading edge in early write cycles and to the $\overline{WE}$ leading edge in read-write cycles.

Package Diagrams

168 Pin DIMM

