



## 512MB - 64Mx64 SDRAM UNBUFFERED

### FEATURES

- PC100 and PC133 compatible
- Burst Mode Operation
- Auto and Self Refresh capability
- LVTTTL compatible inputs and outputs
- Serial Presence Detect with EEPROM
- Fully synchronous: All signals are registered on the positive edge of the system clock
- Programmable Burst Lengths: 1, 2, 4, 8 or Full Page
- 3.3V ± 0.3V Power Supply
- 144 Pin SO-DIMM JEDEC
  - Ultra-low package height:  
AD1: 27.94 mm (1.1")

### DESCRIPTION

The WED3DG6466V is a 64Mx64 synchronous DRAM module which consists of eight 64Mx8 SDRAM components in TSOP II package, and one 2K EEPROM in an 8 pin TSSOP package for Serial Presence Detect which are mounted on a 144 pin SO-DIMM multilayer FR4 Substrate.

\* This product is subject to change without notice.

NOTE: Because of the low package height, there are no termination resistors.

### PIN CONFIGURATIONS (FRONT SIDE/BACK SIDE)

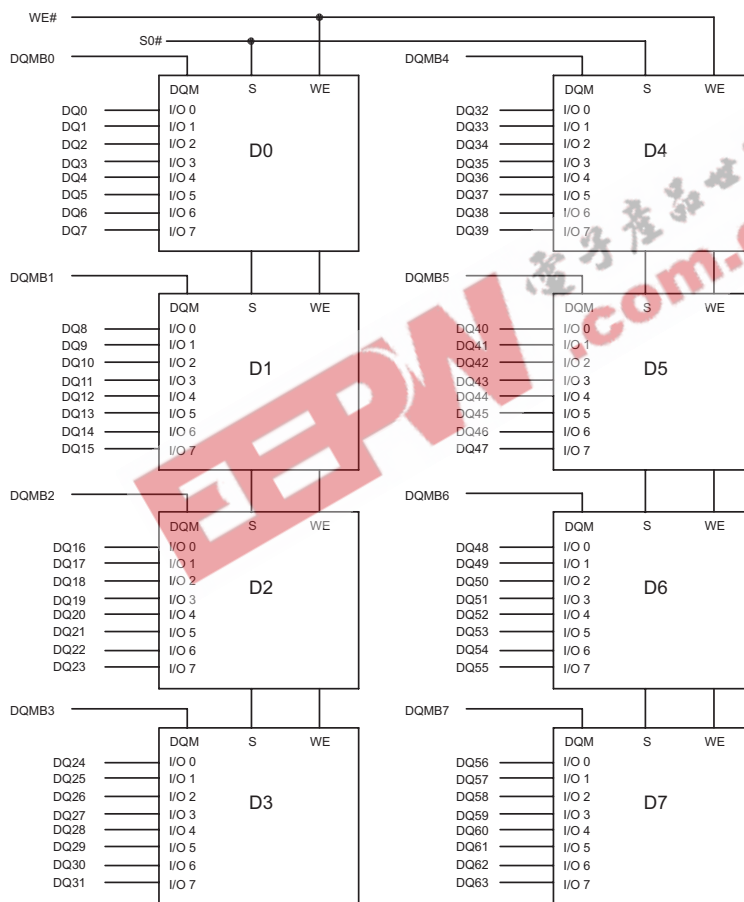
PINOUT											
PIN	FRONT	PIN	BACK	PIN	FRONT	PIN	BACK	PIN	BACK	PIN	BACK
1	V <sub>SS</sub>	2	V <sub>SS</sub>	49	DQ13	50	DQ45	97	DQ22	98	DQ54
3	DQ0	4	DQ32	51	DQ14	52	DQ46	99	DQ23	100	DQ55
5	DQ1	6	DQ33	53	DQ15	54	DQ47	101	V <sub>CC</sub>	102	V <sub>CC</sub>
7	DQ2	8	DQ34	55	V <sub>SS</sub>	56	V <sub>SS</sub>	103	A6	104	A7
9	DQ3	10	DQ35	57	NC	58	NC	105	A8	106	BA0
11	V <sub>CC</sub>	12	V <sub>CC</sub>	59	NC	60	NC	107	V <sub>SS</sub>	108	V <sub>SS</sub>
13	DQ4	14	DQ36	61	CKL0	62	CKE0	109	A9	110	BA1
15	DQ5	16	DQ37	63	V <sub>CC</sub>	64	V <sub>CC</sub>	111	A10	112	A11
17	DQ6	18	DQ38	65	RAS#	66	CAS#	113	V <sub>CC</sub>	114	V <sub>CC</sub>
19	DQ7	20	DQ39	67	WE#	68	NC	115	DQMB2	116	DQMB6
21	V <sub>SS</sub>	22	V <sub>SS</sub>	69	CS0#	70	A12	117	DQMB3	118	DQMB7
23	DQMB0	24	DQMB4	71	NC	72	NC	119	V <sub>SS</sub>	120	V <sub>SS</sub>
25	DQMB1	26	DQMB5	73	NC	74	CK1	121	DQ24	122	DQ56
27	V <sub>CC</sub>	28	V <sub>CC</sub>	75	V <sub>SS</sub>	76	V <sub>SS</sub>	123	DQ25	124	DQ57
29	A0	30	A3	77	NC	78	NC	125	DQ26	126	DQ58
31	A1	32	A4	79	NC	80	NC	127	DQ27	128	DQ59
33	A2	34	A5	81	V <sub>CC</sub>	82	V <sub>CC</sub>	129	V <sub>CC</sub>	130	V <sub>CC</sub>
35	V <sub>SS</sub>	36	V <sub>SS</sub>	83	DQ16	84	DQ48	131	DQ28	132	DQ60
37	DQ8	38	DQ40	85	DQ17	86	DQ49	133	DQ29	134	DQ61
39	DQ9	40	DQ41	87	DQ18	88	DQ50	135	DQ30	136	DQ62
41	DQ10	42	DQ42	89	DQ19	90	DQ51	137	DQ31	138	DQ63
43	DQ11	44	DQ43	91	V <sub>SS</sub>	92	V <sub>SS</sub>	139	V <sub>SS</sub>	140	V <sub>SS</sub>
45	V <sub>CC</sub>	46	V <sub>CC</sub>	93	DQ20	94	DQ52	141	SDA	142	SCL
47	DQ12	48	DQ44	95	DQ21	96	DQ53	143	V <sub>CC</sub>	144	V <sub>CC</sub>

### PIN NAMES

A0 – A12	Address Input (Multiplexed)
BA0-1	Select Bank
DQ0-63	Data Input/Output
CK0, CK1	Clock Input
CKE0	Clock Enable Input
CS0	Chip Select Input
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
DQMB0-7	DQM
V <sub>CC</sub>	Power Supply (3.3V)
V <sub>SS</sub>	Ground
SDA	Serial Data I/O
SCL	Serial Clock
DNU	Do Not Use
NC	No Connect



FUNCTIONAL BLOCK DIAGRAM



NOTE: DQ writing may differ than described in this drawing, however DQ/DQMB/CKE/S relationships must be maintained as shown.

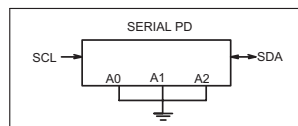
RAS# → RAS#: SDRAM D0-D7  
 CAS# → CAS#: SDRAM D0-D7  
 CKE0 → CKE: SDRAM D0-D7

BA0-BA1 → BA0-BA1: SDRAM D0-D7  
 A0-A12 → A0-A12: SDRAM D0-D7

VDD → D0-D7  
 VSS → D0-D7

*CLOCK WIRING	
CLOCK INPUT	SDRAMS
*CK0	4 - SDRAMs
*CK1	4 - SDRAMs

\*Wire per Clock Loading Table/Wiring Diagrams





**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Value	Units
Voltage on any pin relative to Vss	V <sub>IN</sub> , V <sub>OUT</sub>	-1.0 ~ 4.6	V
Voltage on Vcc supply relative to Vss	V <sub>CC</sub> , V <sub>CCQ</sub>	-1.0 ~ 4.6	V
Storage Temperature	T <sub>STG</sub>	-55 ~ +150	°C
Power Dissipation	P <sub>D</sub>	9	W
Short Circuit Current	I <sub>OS</sub>	50	mA

Note: Permanent device damage may occur if "ABSOLUTE MAXIMUM RATINGS" are exceeded.  
 Functional operation should be restricted to recommended operating condition.  
 Exposure to higher than recommended voltage for extended periods of time could affect device reliability.

**RECOMMENDED DC OPERATING CONDITIONS**

Voltage Referenced to: V<sub>SS</sub> = 0V, 0°C ≤ T<sub>A</sub> ≤ +70°C

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V	
Input High Voltage	V <sub>IH</sub>	2.0	3.0	V <sub>CCQ</sub> +0.3	V	1
Input Low Voltage	V <sub>IL</sub>	-0.3	—	0.8	V	2
Output High Voltage	V <sub>OH</sub>	2.4	—	—	V	I <sub>OH</sub> = -2mA
Output Low Voltage	V <sub>OL</sub>	—	—	0.4	V	I <sub>OL</sub> = -2mA
Input Leakage Current	I <sub>LI</sub>	-10	—	10	μA	3

Note: 1. V<sub>IH</sub> (max)= 5.6V AC. The overshoot voltage duration is ≤ 3ns.  
 2. V<sub>IL</sub> (min)= -2.0V AC. The undershoot voltage duration is ≤ 3ns.  
 3. Any input 0V ≤ V<sub>IN</sub> ≤ V<sub>CCQ</sub>  
 Input leakage currents include Hi-Z output leakage for all bi-directional buffers with Tri-State outputs.

**CAPACITANCE**

T<sub>A</sub> = 25°C, f = 1MHz, V<sub>CC</sub> = 3.3V, V<sub>REF</sub> = 1.4V ± 200mV

Parameter	Symbol	Max	Unit
Input Capacitance (A0-A12)	C <sub>IN1</sub>	35	pF
Input Capacitance (RAS#,CAS#,WE#)	C <sub>IN2</sub>	35	pF
Input Capacitance (CKE0)	C <sub>IN3</sub>	35	pF
Input Capacitance (CK0)	C <sub>IN4</sub>	16	pF
Input Capacitance (CS0#)	C <sub>IN5</sub>	35	pF
Input Capacitance (DQM0-DQM7)	C <sub>IN6</sub>	7	pF
Input Capacitance (BA0-BA1)	C <sub>IN7</sub>	35	pF
Data Input/Output Capacitance (DQ0-DQ63)	C <sub>OUT</sub>	10	pF

**OPERATING CURRENT CHARACTERISTICS** $V_{CC} = 3.3V$ ,  $T_A = 0^{\circ}C$  to  $+70^{\circ}C$ 

Parameter	Symbol	Conditions	Version		
			100/133	Units	Note
Operating Current (One bank active)	$I_{CC1}$	Burst Length = 1 $t_{RC} \leq t_{RC(min)}$ $I_{OL} = 0mA$	1080	mA	1
Precharge Standby Current in Power Down Mode	$I_{CC2P}$	$CKE \leq V_{IL(max)}$ , $t_{CC} = 10ns$	16	mA	
Active Standby Current in Non-Power Down Mode	$I_{CC3N}$	$CKE \geq V_{IH(min)}$ , $CS \geq V_{IH(min)}$ , $t_{CC} = 10ns$ Input signals are changed one time during 20ns	360	mA	
Operating Current (Burst mode)	$I_{CC4}$	$I_O = mA$ Page burst 4 Banks activated $t_{CCD} = 2CK$	1,200	mA	1
Refresh Current	$I_{CC5}$	$t_{RC} \geq t_{RC(min)}$	2,280	mA	2
Self Refresh Current	$I_{CC6}$	$CKE \leq 0.2V$	24	mA	

## Notes:

1. Measured with outputs open.
2. Refresh period is 64ms.



**AC TIMING PARAMETERS**

Symbol	Parameter	Speed Grade 100MHz		Speed Grade 133MHz		Units	Notes
		Min	Max	Min	Max		
t <sub>CK</sub>	Clock Period	10		7.5		ns	
t <sub>CH</sub>	Clock High Time Rated @1.5V	3		2.5		ns	
t <sub>CL</sub>	Clock Low Time	3		2.5		ns	
t <sub>IS</sub>	Input Setup Times	Address/ Command & CKE	2		1.5	ns	
		Data	2		1.5	ns	
t <sub>IH</sub>	Input Hold Times	Address/Command & CKE	1		0.8	ns	
		Data	1		0.8	ns	
t <sub>AC</sub>	Output Valid From Clock	CAS# Latency = 2 or 3, LVTTL levels, Rated @ 50 pF all outputs switching		6.0 (t <sub>CO</sub> = 5.2)	5.4 (t <sub>CO</sub> = 4.6)	ns	1
t <sub>OH</sub>	Output Hold From Clock Rated @ 50 pF (1.8 ns @ 0 pF)	3		2.7		ns	
t <sub>OHZ</sub>	Output Valid to Z	3	9	2.7	7	ns	
t <sub>CCD</sub>	CAS to CAS Delay	1		1		t <sub>CK</sub>	
t <sub>CBD</sub>	CAS Bank Delay	1		1		t <sub>CK</sub>	
t <sub>CKE</sub>	CKE to Clock Disable	1		1		t <sub>CK</sub>	
t <sub>RP</sub>	RAS Precharge Time	20		20		ns	
t <sub>RAS</sub>	RAS Active Time	50		45		ns	
t <sub>RCD</sub>	Activate to Command Delay (RAS to CAS Delay)	20		20		ns	
t <sub>RRD</sub>	RAS to RAS Bank Activate Delay	20		15		ns	
t <sub>RC</sub>	RAS Cycle Time	70		67.5		ns	
t <sub>DQD</sub>	DQM to Input Data Delay	0		0		t <sub>CK</sub>	
t <sub>DWD</sub>	Write Cmd. to Input Data Delay	0		0		t <sub>CK</sub>	
t <sub>MRD</sub>	Mode Register set to Active delay	3		3		t <sub>CK</sub>	
t <sub>ROH</sub>	Precharge to O/P in High Z		CL		CL	t <sub>CK</sub>	2
t <sub>DQZ</sub>	DQM to Data in High Z for read	2		2		t <sub>CK</sub>	
t <sub>DQM</sub>	DQM to Data mask for write	0		0		t <sub>CK</sub>	3
t <sub>DPL</sub>	Data-in to PRE Command Period	20		15		ns	
t <sub>DAL</sub>	Data-in to ACT (PRE) Command period (Auto precharge)	5		5		t <sub>CK</sub>	
t <sub>SB</sub>	Power Down Mode Entry		1		1	t <sub>CK</sub>	
t <sub>SRX</sub>	Self Refresh Exit Time	10		10		ns	4
t <sub>PDE</sub>	Power Down Exit Set up Time	1		1		t <sub>CK</sub>	5
t <sub>CKSTP</sub>	Clock Stop During Self Refresh or Power Down	200		200		t <sub>CK</sub>	6
t <sub>REF</sub>	Refresh Period		64		64	ms	
t <sub>RFC</sub>	Row Refresh Cycle Time	80.0		75.0		ns	

- Access times to be measured w/input signals of 1 V/ns edge rate, 0.8 V to 2.0 V, t<sub>CO</sub> is clock to output with no load.
- CL = CAS Latency
- Data Masked on the same clock
- Self refresh Exit is asynchronous, requiring 10 ns to ensure initiation. Self refresh exit is complete in 10 ns + t<sub>RC</sub>.
- Timing is asynchronous. If t<sub>IS</sub> is not met by rising edge of CK then CKE is assumed latched on next cycle.
- If the clock is stopped during self refresh or power down, 200 clocks are required before CKE is high.

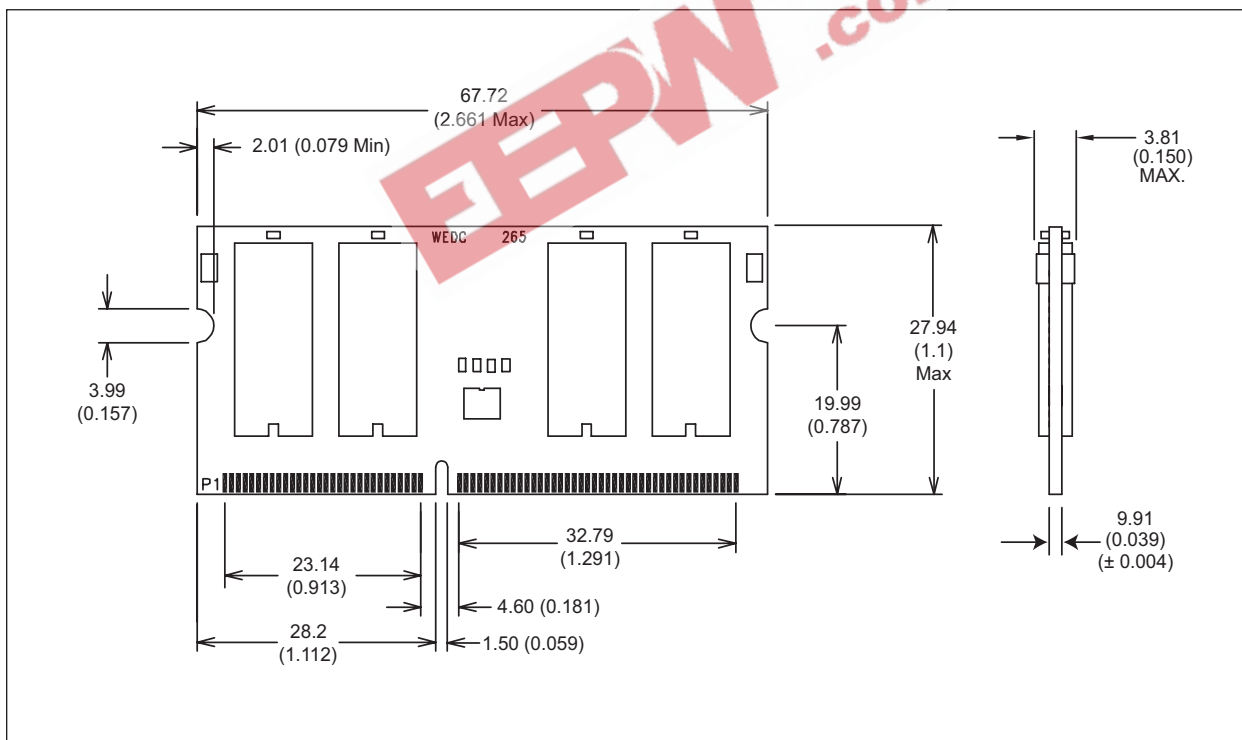


**PACKAGE DIMENSIONS FOR AD1**

Ordering Information	Speed	CAS Latency	Height*
WED3DG6466V10AD1	100MHz	CL=2	27.94 (1.1") MAX
WED3DG6466V7AD1	133MHz	CL=2	27.94 (1.1") MAX
WED3DG6466V75AD1	133MHz	CL=3	27.94 (1.1") MAX

Note: For industrial temperature range product, add an "I" to the end of the part number.

**PACKAGE DIMENSIONS FOR AD1**



\* All Dimensions are in millimeters and (inches).

**Document Title**

512MB - 64Mx64 SDRAM UNBUFFERED

**Revision History**

<b>Rev #</b>	<b>History</b>	<b>Release Date</b>	<b>Status</b>
Rev 0	Created Datasheet	6-4-03	Advanced
Rev 1	1.1 Updated Datasheet 1.2 Added AD1 package option	4-04	Preliminary
Rev 2	2.1 Added AC Timing Spec 2.2 Moved from Preliminary to Final	9-04	Final
Rev 3	3.1 Added "ED" to part number	7-05	Final