



# 4GB – 2x256Mx72 DDR2 SDRAM RDIMM, w/PLL

## FEATURES

- 240-pin, dual in-line memory module (DIMM)
- Fast data transfer rates: PC2-6400\*, PC2-5300\*, PC2-4300 and PC2-3200
- Support ECC error detection and correction
- $V_{CC} = V_{CCQ} = 1.8V \pm 0.1V$
- $V_{CCSPD} = +1.7V$  to  $+3.6V$
- JEDEC standard 1.8V I/O (SSTL\_18-compatible)
- Differential data strobe (DQS, DQS#) option
- Four-bit prefetch architecture
- DLL to align DQ and DQS transitions with CK
- Multiple internal device banks for concurrent operation
- Supports duplicate output strobe (RDQS/RDQS#)
- Programmable CAS# latency (CL): 3, 4, 5\* and 6\*
- Adjustable data-output drive strength
- On-die termination (ODT)
- Serial Presence Detect (SPD) with EEPROM
- Auto & self refresh: 64ms 8,192 cycle refresh
- Gold edge contacts
- RoHS compliant
- Dual Rank
- Package option
  - 240 Pin DIMM
  - PCB –30.00mm (1.181") TYP

## DESCRIPTION

The WV3HG2256M72AER is a 2x256Mx72 Double Data Rate DDR2 SDRAM high density module based on 1Gb DDR2 SDRAM components. This memory module consists of eighteen stacks of 256Mx4 bit with 8 banks DDR2 Synchronous DRAMs in FBGA packages, two - 14 bit registered buffers in BGA packages mounted on a 240-pin DIMM FR4 substrate.

\* This product is under development, is not qualified or characterized and is subject to change without notice.

NOTE: Consult factory for availability of:

- Vendor source control options
- Industrial temperature option

## OPERATING FREQUENCIES

	PC2-3200	PC2-4300	PC2-5300*	PC2-6400*
Clock Speed	200MHz	266MHz	333MHz	400MHz
CL-trcd-trp	3-3-3	4-4-4	5-5-5	6-6-6

\* Consult factory for availability



## PIN CONFIGURATION

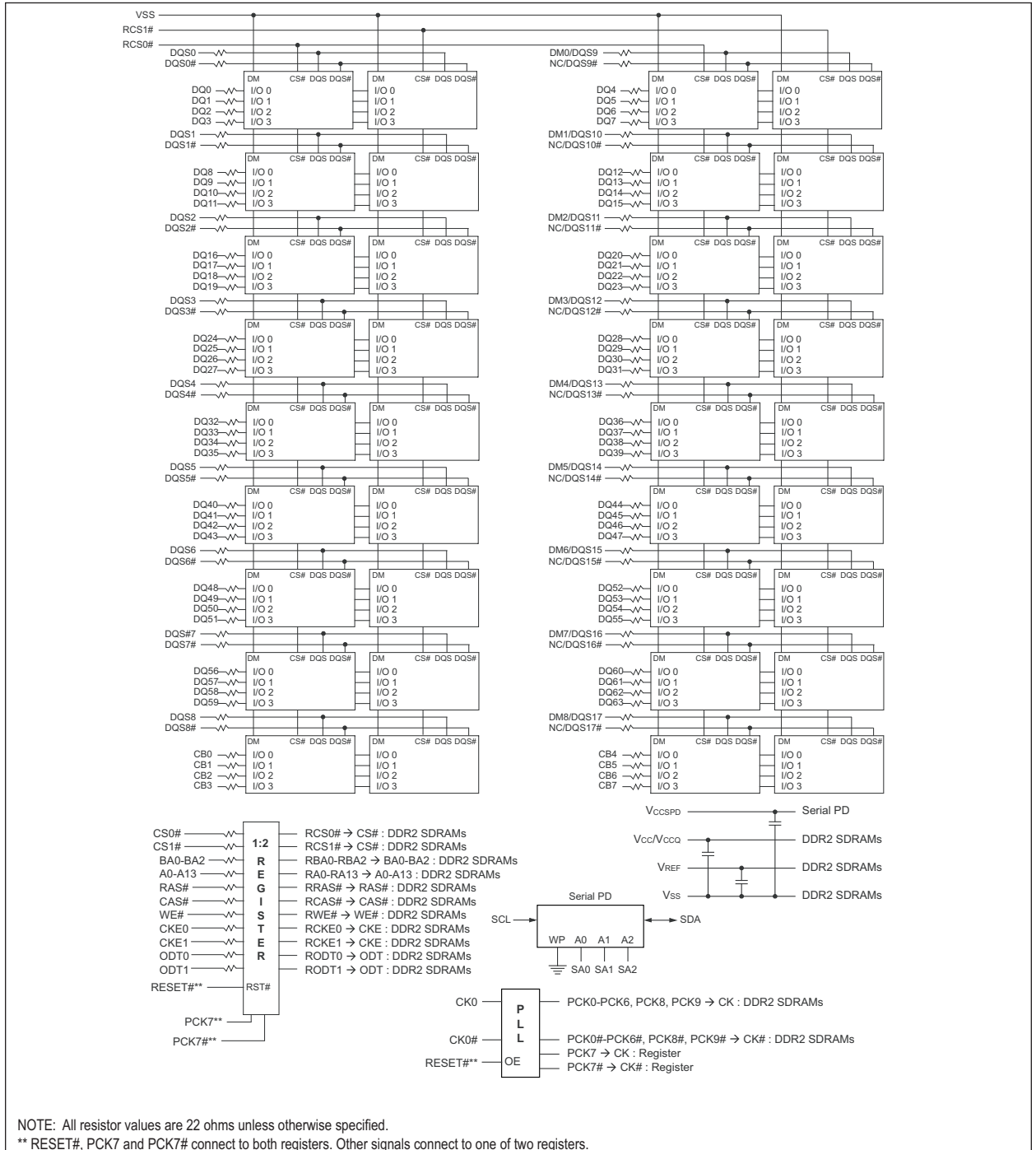
Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	VREF	61	A4	121	Vss	181	Vccq
2	Vss	62	Vccq	122	DQ4	182	A3
3	DQ0	63	A2	123	DQ5	183	A1
4	DQ1	64	Vcc	124	Vss	184	Vcc
5	Vss	65	Vss	125	DM0/DQS9	185	CK0
6	DQS0#	66	Vss	126	NC/DQS9#	186	CK0#
7	DQS0	67	Vcc	127	Vss	187	Vcc
8	Vss	68	NC	128	DQ6	188	A0
9	DQ2	69	Vcc	129	DQ7	189	Vcc
10	DQ3	70	A10/AP	130	Vss	190	BA1
11	Vss	71	BA0	131	DQ12	191	Vccq
12	DQ8	72	Vccq	132	DQ13	192	RAS#
13	DQ9	73	WE#	133	Vss	193	CS0#
14	Vss	74	CAS#	134	DM1/DQS10	194	Vccq
15	DQS1#	75	Vccq	135	NC/DQS10#	195	ODT0
16	DQS1	76	CS1#	136	Vss	196	A13
17	Vss	77	ODT1	137	NC	197	Vcc
18	RESET#	78	Vccq	138	NC	198	Vss
19	NC	79	Vss	139	Vss	199	DQ36
20	Vss	80	DQ32	140	DQ14	200	DQ37
21	DQ10	81	DQ33	141	DQ15	201	Vss
22	DQ11	82	Vss	142	Vss	202	DM4/DQS13
23	Vss	83	DQS4#	143	DQ20	203	NC/DQS13#
24	DQ16	84	DQS4	144	DQ21	204	Vss
25	DQ17	85	Vss	145	Vss	205	DQ38
26	Vss	86	DQ34	146	DM2/DQS11	206	DQ39
27	DQS2#	87	DQ35	147	NC/DQS11#	207	Vss
28	DQS2	88	Vss	148	Vss	208	DQ44
29	Vss	89	DQ40	149	DQ22	209	DQ45
30	DQ18	90	DQ41	150	DQ23	210	Vss
31	DQ19	91	Vss	151	Vss	211	DM5/DQS14
32	Vss	92	DQS5#	152	DQ28	212	NC/DQS14#
33	DQ24	93	DQS5	153	DQ29	213	Vss
34	DQ25	94	Vss	154	Vss	214	DQ46
35	Vss	95	DQ42	155	DM3/DQS12	215	DQ47
36	DQS3#	96	DQ43	156	NC/DQS12#	216	Vss
37	DQS3	97	Vss	157	Vss	217	DQ52
38	Vss	98	DQ48	158	DQ30	218	DQ53
39	DQ26	99	DQ49	159	DQ31	219	Vss
40	DQ27	100	Vss	160	Vss	220	NC
41	Vss	101	SA2	161	CB4	221	NC
42	CB0	102	NC	162	CB5	222	Vss
43	CB1	103	Vss	163	Vss	223	DM6/DQS15
44	Vss	104	DQS6#	164	DM8/DQS17	224	NC/DQS15#
45	DQS8#	105	DQS6	165	NC/DQS17#	225	Vss
46	DQS8	106	Vss	166	Vss	226	DQ54
47	Vss	107	DQ50	167	CB6	227	DQ55
48	CB2	108	DQ51	168	CB7	228	Vss
49	CB3	109	Vss	169	Vss	229	DQ60
50	Vss	110	DQ56	170	Vccq	230	DQ61
51	Vccq	111	DQ57	171	CKE1	231	Vss
52	CKE0	112	Vss	172	Vcc	232	DM7/DQS16
53	Vcc	113	DQS7#	173	NC	233	NC/DQS16#
54	BA2	114	DQS7	174	NC	234	Vss
55	NC	115	Vss	175	Vccq	235	DQ62
56	Vccq	116	DQ58	176	A12	236	DQ63
57	A11	117	DQ59	177	A9	237	Vss
58	A7	118	Vss	178	Vcc	238	VccSPD
59	Vcc	119	SDA	179	A8	239	SA0
60	A5	120	SCL	180	A6	240	SA1

## PIN NAMES

Pin Name	Function
A0-A13	Address Inputs
BA0,BA2	SDRAM Bank Address
DQ0-DQ63	Data Input/Output
CB0-CB7	Check Bits
DQS0-DQS17	Data strobes
DQS0#-DQS17#	Data strobes complement
DM0-DM8	Data Masks
ODT0, ODT1	On-die termination control
CK0,CK0#	Clock Inputs, positive line
CKE0, CKE1	Clock Enables
CS0#, CS1#	Chip Selects
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
RESET#	Register Reset Input
SA0-SA2	SPD address
SDA	SPD Data Input/Output
SCL	SPD Clock Input
Vcc	Core Power
Vccq	I/O Power
Vss	Ground
VREF	Power Supply for Reference
VccSPD	SPD Power supply
NC	No connect



FUNCTIONAL BLOCK DIAGRAM



NOTE: All resistor values are 22 ohms unless otherwise specified.  
 \*\* RESET#, PCK7 and PCK7# connect to both registers. Other signals connect to one of two registers.



### RECOMMENDED DC OPERATING CONDITIONS

All Voltages Referenced to V<sub>SS</sub>

Parameter	Symbol	Rating			Units	Notes
		Min.	Type	Max.		
Supply Voltage	V <sub>CC</sub>	1.7	1.8	1.9	V	3
I/O Input Reference Voltage	V <sub>REF</sub>	0.49*V <sub>CC</sub>	0.50*V <sub>CC</sub>	0.51*V <sub>CC</sub>	V	1
I/O Termination Voltage	V <sub>TT</sub>	V <sub>REF</sub> -0.04	V <sub>REF</sub>	V <sub>REF</sub> +0.04	V	2
SPD Supply Voltage	V <sub>CCSPD</sub>	1.7	—	3.6	V	

Notes:

- V<sub>REF</sub> is expected to equal V<sub>CCQ</sub>/2 of the transmitting device and to track variations in the DC level of the same. Peak-to-peak noise on V<sub>REF</sub> may not exceed ±1 percent of the DC value. Peak-to-peak AC noise on V<sub>REF</sub> may not exceed ±2 percent of V<sub>REF</sub>. This measurement is to be taken at the nearest V<sub>REF</sub> bypass capacitor..
- V<sub>TT</sub> is not applied directly to the device. V<sub>TT</sub> is a system supply for signal termination resistors, is expected to be set equal to V<sub>REF</sub> and must track variations in the DC level of V<sub>REF</sub>.
- V<sub>CCQ</sub> of all IC's are tied to V<sub>CC</sub>.

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Units
V <sub>CC</sub>	Voltage on V <sub>CC</sub> pin relative to V <sub>SS</sub>	-0.5	2.3	V
V <sub>IN</sub> , V <sub>OUT</sub>	Voltage on any pin relative to V <sub>SS</sub>	-0.5	2.3	V
T <sub>STG</sub>	Storage Temperature	-55	100	°C
I <sub>L</sub>	Input leakage current; Any input 0V<V <sub>IN</sub> <V <sub>CC</sub> ; V <sub>REF</sub> input 0V<V <sub>IN</sub> <0.95V; Other pins not under test = 0V	-10	10	µA
I <sub>OZ</sub>	Output leakage current; 0V<V <sub>OUT</sub> <V <sub>CCQ</sub> ; DQs and ODT are disable	-10	10	µA
I <sub>VREF</sub>	V <sub>REF</sub> leakage current; V <sub>REF</sub> = Valid V <sub>REF</sub> level	-72	72	µA

### CAPACITANCE

T<sub>A</sub> = 25°C, f = 100MHz, V<sub>CC</sub> = 1.8V

Parameter	Symbol	Min	Max	Units
Input Capacitance: (A0 ~ A13, BA0 ~ BA2, RAS#, CAS#, WE#)	C <sub>IN1</sub>	10	12	pF
Input Capacitance: (CKE0, CKE1), (ODT0, ODT1)	C <sub>IN2</sub>	10	12	pF
Input Capacitance: (CS0#, CS1#)	C <sub>IN3</sub>	10	12	pF
Input Capacitance: (CK0, CK0#)	C <sub>IN4</sub>	10	11	pF
Input Capacitance: (DM0 ~ DM8), (DQS0 ~ DQ17)	C <sub>IN5</sub> (665)	9	11	pF
	C <sub>IN5</sub> (534, 403)	9	12	pF
Input/Output Capacitance: (DQ0 ~ DQ63), (CB0 ~ CB7)	C <sub>OUT1</sub> (665)	9	11	pF
	C <sub>OUT1</sub> (534, 403)	9	12	pF



**OPERATING TEMPERATURE CONDITION**

Parameter	Symbol	Rating	Units	Notes
Operating temperature (commercial)	TOPER	0 to +85°C	°C	1, 2

- Notes:
1. Operating temperature is the case surface temperature on the center/top side of the DRAM. For the measurement conditions, please refer to JEDED JESD51.2
  2. At 0°C to +85°C, operation temperature range, all DRAM specification will be supported.

**INPUT DC LOGIC LEVEL**

All voltages referenced to V<sub>SS</sub>

Parameter	Symbol	Min	Max	Units
Input High (Logic 1) Voltage	V <sub>IH</sub> (DC)	V <sub>REF</sub> + 0.125	V <sub>CC</sub> + 0.300	V
Input Low (Logic 0) Voltage	V <sub>IL</sub> (DC)	-0.300	V <sub>REF</sub> - 0.125	V

**INPUT AC LOGIC LEVEL**

All voltages referenced to V<sub>SS</sub>

Parameter	Symbol	Min	Max	Units
AC Input High (Logic 1) Voltage DDR2-400 & DDR-533	V <sub>IH</sub> (AC)	V <sub>REF</sub> + 0.250	-	V
AC Input High (Logic 1) Voltage DDR2-667*	V <sub>IH</sub> (AC)	V <sub>REF</sub> + 0.200	-	V
AC Input Low (Logic 0) Voltage DDR2-400 & DDR2-533	V <sub>IL</sub> (AC)	-	V <sub>REF</sub> - 0.250	V
AC Input Low (Logic 0) Voltage DDR2-667*	V <sub>IL</sub> (AC)	-	V <sub>REF</sub> - 0.200	V

\* Consult factory for availability



**DDR2 Icc SPECIFICATIONS AND CONDITIONS**

V<sub>CC</sub> = +1.8V ± 0.1V

Symbol	Proposed Conditions	806	665	534	403	Units	
I <sub>CC0*</sub>	Operating one bank active-precharge current; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RC</sub> = t <sub>RC(Icc)</sub> , t <sub>RAS</sub> = t <sub>RASmin(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	2,336	2,246	2,156	mA	
I <sub>CC1*</sub>	Operating one bank active-read-precharge current; I <sub>OUT</sub> = 0mA; BL = 4, CL = CL(Icc), AL = 0; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RC</sub> = t <sub>RC(Icc)</sub> , t <sub>RAS</sub> = t <sub>RASmin(Icc)</sub> , t <sub>RCD</sub> = t <sub>RCD(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as I <sub>CC4W</sub>	TBD	2,516	2,426	2,336	mA	
I <sub>CC2P**</sub>	Precharge power-down current; All banks idle; t <sub>CK</sub> = t <sub>CK(Icc)</sub> ; CE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	TBD	932	932	932	mA	
I <sub>CC2Q**</sub>	Precharge quiet standby current; All banks idle; t <sub>CK</sub> = t <sub>CK(Icc)</sub> ; CE is HIGH, CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	TBD	1,940	1,760	1,760	mA	
I <sub>CC2N**</sub>	Precharge standby current; All banks idle; t <sub>CK</sub> = t <sub>CK(Icc)</sub> ; CE is HIGH, CS# is HIGH; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	2,120	1,940	1,940	mA	
I <sub>CC3P**</sub>	Active power-down current; All banks open; t <sub>CK</sub> = t <sub>CK(Icc)</sub> ; CE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	Fast PDN Exit MRS(12) = 0	TBD	1,580	1,400	1,400	mA
		Slow PDN Exit MRS(12) = 1	TBD	932	932	932	mA
I <sub>CC3N**</sub>	Active standby current; All banks open; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RAS</sub> = t <sub>RASmax(Icc)</sub> , t <sub>RP</sub> = t <sub>RP(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	2,300	2,120	2,120	mA	
I <sub>CC4W*</sub>	Operating burst write current; All banks open, Continuous burst writes; BL = 4, CL = CL(Icc), AL = 0; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RAS</sub> = t <sub>RASmax(Icc)</sub> , t <sub>RP</sub> = t <sub>RP(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	3,056	2,876	2,516	mA	
I <sub>CC4R*</sub>	Operating burst read current; All banks open, Continuous burst reads, I <sub>OUT</sub> = 0mA; BL = 4, CL = CL(Icc), AL = 0; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RAS</sub> = t <sub>RASmax(Icc)</sub> , t <sub>RP</sub> = t <sub>RP(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as I <sub>CC4W</sub>	TBD	3,056	2,876	2,516	mA	
I <sub>CC5B**</sub>	Burst auto refresh current; t <sub>CK</sub> = t <sub>CK(Icc)</sub> ; Refresh command at every t <sub>REF(Icc)</sub> interval; CE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	8,420	8,240	8,060	mA	
I <sub>CC6**</sub>	Self refresh current; CK and CK# at 0V; CE 0.2V; Other control and address bus inputs are FLOATING; Data bus inputs are FLOATING	Normal	TBD	360	360	360	mA
I <sub>CC7*</sub>	Operating bank interleave read current; All bank interleaving reads, I <sub>OUT</sub> = 0mA; BL = 4, CL = CL(Icc), AL = t <sub>RCD(Icc)</sub> -1*t <sub>CK(Icc)</sub> ; t <sub>CK</sub> = t <sub>CK(Icc)</sub> , t <sub>RC</sub> = t <sub>RC(Icc)</sub> , t <sub>RRD</sub> = t <sub>RRD(Icc)</sub> , t <sub>RCD</sub> = 1*t <sub>CK(Icc)</sub> ; CE is HIGH, CS# is HIGH between valid commands; Address bus inputs are STABLE during DESELECTs; Data pattern is same as I <sub>CC4R</sub> ; Refer to the following page for detailed timing conditions	TBD	6,116	5,756	5,396	mA	

Note:

I<sub>CC</sub> specs are based on **SAMSUNG** components. Other DRAM manufacturers parameters may be different.

\* Value calculated as one module rank in this operation condition, and all other module ranks in I<sub>CC2P</sub> (CE LOW) mode.



**AC TIMING PARAMETERS**

V<sub>CC</sub> = +1.8V ± 0.1V

AC Characteristics			806		665		534		403			
Parameter			Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Unit
Clock	Clock cycle time	CL = 6	t <sub>CK(6)</sub>	TBD	TBD							ps
		CL = 5	t <sub>CK(5)</sub>	TBD	TBD	3,000	8,000					ps
		CL = 4	t <sub>CK(4)</sub>	TBD	TBD	3,750	8,000	3,750	8,000	5,000	8,000	ps
		CL = 3	t <sub>CK(3)</sub>	TBD	TBD	5,000	8,000	5,000	8,000	5,000	8,000	ps
	CK high-level width		t <sub>CH</sub>	TBD	TBD	0.45	0.55	0.45	0.55	0.45	0.55	t <sub>CK</sub>
	CK low-level width		t <sub>CL</sub>	TBD	TBD	0.45	0.55	0.45	0.55	0.45	0.55	t <sub>CK</sub>
	Half clock period		t <sub>HP</sub>	TBD	TBD	MIN (t <sub>CH</sub> , t <sub>CL</sub> )		MIN (t <sub>CH</sub> , t <sub>CL</sub> )		MIN (t <sub>CH</sub> , t <sub>CL</sub> )		ps
Clock jitter		t <sub>JIT</sub>	TBD		-125	125	-125	125	-125	125	ps	
Data	DQ output access time from CK/CK#		t <sub>AC</sub>	TBD	TBD	-450	+450	-500	+500	-600	+600	ps
	Data-out high-impedance window from CK/CK#		t <sub>HZ</sub>	TBD	TBD		t <sub>AC</sub> (MAX)		t <sub>AC</sub> (MAX)		t <sub>AC</sub> (MAX)	ps
	Data-out low-impedance window from CK/CK#		t <sub>LZ</sub>	TBD	TBD	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX)	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX)	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX)	ps
	DQ and DM input setup time relative to DQS		t <sub>DS</sub>	TBD	TBD	100		100		150		t <sub>CK</sub>
	DQ and DM input hold time relative to DQS		t <sub>DH</sub>	TBD	TBD	175		225		275		ps
	DQ...DQS hold, DQS to first DQ to go nonvalid, per access relative to DQS		t <sub>DIPW</sub>	TBD	TBD	0.35		0.35		0.35		ps
	Data hold skew factor		t <sub>QHS</sub>	TBD	TBD		340		400		450	
	DQ-DQS hold, DQS to first DQ to go nonvalid, per access		t <sub>QH</sub>	TBD	TBD	t <sub>HP</sub> - t <sub>QHS</sub>		t <sub>HP</sub> - t <sub>QHS</sub>		t <sub>HP</sub> - t <sub>QHS</sub>		
Data valid output window (DVW)		t <sub>DVW</sub>	TBD	TBD	t <sub>QH</sub> - t <sub>DQSQ</sub>		t <sub>QH</sub> - t <sub>DQSQ</sub>		t <sub>QH</sub> - t <sub>DQSQ</sub>			
Data Strobe	DQS input high pulse width		t <sub>DQSH</sub>	TBD	TBD	0.35		0.35		0.35		t <sub>CK</sub>
	DQS input low pulse width		t <sub>DQSL</sub>	TBD	TBD	0.35		0.35		0.35		t <sub>CK</sub>
	DQS output access time from CK/CK#		t <sub>DQSCK</sub>	TBD	TBD	-400	+400	-450	+450	-500	+500	ps
	DQS falling edge to CK rising- setup time		t <sub>DSS</sub>	TBD	TBD	0.2		0.2		0.2		t <sub>CK</sub>
	DQS falling edge from CK rising - hold time		t <sub>DSH</sub>	TBD	TBD	0.2		0.2		0.2		t <sub>CK</sub>
	DQS-DQ skew, DQS to last DQ valid, per group, per access		t <sub>DQSQ</sub>	TBD	TBD		240		300		350	ps
	DQS read preamble		t <sub>RPRE</sub>	TBD	TBD	0.9	1.1	0.9	1.1	0.9	1.1	t <sub>CK</sub>

Note:

- AC specification is based on **SAMSUNG** components. Other DRAM manufactures specification may be different.

Continued on next page



**AC TIMING PARAMETERS (Continued)**

V<sub>CC</sub> = +1.8V ± 0.1V

AC Characteristics			806		665		534		403		
Parameter		Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Unit
Data Strobe	DQS read preamble	t <sub>RPST</sub>	TBD	TBD	0.4	0.6	0.4	0.6	0.4	0.6	t <sub>CK</sub>
	DQS write preamble setup time	t <sub>WPRES</sub>	TBD	TBD	0		0		0		ps
	DQS write preamble	t <sub>WPRE</sub>	TBD	TBD	0.35		0.35		0.35		t <sub>CK</sub>
	DQS write postamble	t <sub>WPST</sub>	TBD	TBD	0.4	0.6	0.4	0.6	0.4	0.6	t <sub>CK</sub>
	Write command to first DQS latching transition	t <sub>DQSS</sub>	TBD	TBD	WL-0.25	WL+0.25	WL-0.25	WL+0.25	WL-0.25	WL+0.25	t <sub>CK</sub>
Command and Address	Address and control input pulse width for each input	t <sub>IPW</sub>	TBD	TBD	0.6		0.6		0.6		t <sub>CK</sub>
	Address and control input setup time	t <sub>ISA</sub>	TBD	TBD	200		250		350		ps
	Address and control input hold time	t <sub>IHA</sub>	TBD	TBD	275		375		475		ps
	CAS# to CAS# command delay	t <sub>CCD</sub>	TBD	TBD	2		2		2		t <sub>CK</sub>
	Active to Active (same bank) command	t <sub>RC</sub>	TBD	TBD	54		55		55		ns
	Active bank a to Active b bank command	t <sub>RRA</sub>	TBD	TBD	7.5		7.5		7.5		ns
	Active to Read or Write delay	t <sub>RCD</sub>	TBD	TBD	15		15		15		ns
	Four Bank Activate period	t <sub>FAW</sub>	TBD	TBD	37.5	37.5	37.5	37.5	37.5	37.5	ns
	Active to precharge command	t <sub>RAS</sub>	TBD	TBD	39	70,000	40	70,000	40	70,000	ns
	Internal Read to precharge command delay	t <sub>RTP</sub>	TBD	TBD	7.5		7.5		7.5		ns
	Write recovery time	t <sub>WR</sub>	TBD	TBD	15		15		15		ns
	Auto precharge write recovery and precharge time	t <sub>DAL</sub>	TBD	TBD	t <sub>WR</sub> +t <sub>RP</sub>		t <sub>WR</sub> +t <sub>RP</sub>		t <sub>WR</sub> +t <sub>RP</sub>		ns
	Interval Write to Read command delay	t <sub>WTR</sub>	TBD	TBD	7.5		7.5		10		ns
	Precharge command period	t <sub>RP</sub>	TBD	TBD	15		15		15		ns
	Precharge All command period	t <sub>RPA</sub>	TBD	TBD	t <sub>RP</sub> +t <sub>CK</sub>		t <sub>RP</sub> +t <sub>CK</sub>		t <sub>RP</sub> +t <sub>CK</sub>		ns
	Load Mode command cycle time	t <sub>MRD</sub>	TBD	TBD	2		2		2		t <sub>CK</sub>
CKE low to CK,CK# uncertainty	t <sub>DELAY</sub>	TBD	TBD	t <sub>IS</sub> +t <sub>CK</sub> +t <sub>IH</sub>		t <sub>IS</sub> +t <sub>CK</sub> +t <sub>IH</sub>		t <sub>IS</sub> +t <sub>CK</sub> +t <sub>IH</sub>		ns	

Note:

- AC specification is based on **SAMSUNG** components. Other DRAM manufactures specification may be different.

Continued on next page





**AC TIMING PARAMETERS (Continued)**

V<sub>CC</sub> = +1.8V ± 0.1V

AC Characteristics			806		665		534		403		
Parameter		Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Unit
	Refresh to Active or Refresh to Refresh command interval	t <sub>RFC</sub>	TBD	TBD	127.5	70,000	127.5	70,000	127.5	70,000	ns
	Average periodic refresh interval	t <sub>REFI</sub>	TBD	TBD		7.8		7.8		7.8	μs
	Exit self refresh to non-read command	t <sub>ξSNR</sub>	TBD	TBD	t <sub>RFC</sub> (MIN)+10		t <sub>RFC</sub> (MIN)+10		t <sub>RFC</sub> (MIN)+10		ns
	Exit self refresh to read command	t <sub>ξSRD</sub>	TBD	TBD	200		200		200		t <sub>CK</sub>
	Exit self refresh timing reference	t <sub>ξSR</sub>	TBD	TBD	t <sub>IS</sub>		t <sub>IS</sub>		t <sub>IS</sub>		ps
ODT	ODT turn-on delay	t <sub>AOND</sub>	TBD	TBD	2	2	2	2	2	2	t <sub>CK</sub>
	ODT turn-on	t <sub>AON</sub>	TBD	TBD	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +1,000	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +1,000	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +1,000	ps
	ODT turn-off delay	t <sub>AOFD</sub>	TBD	TBD	2.5	2.5	2.5	2.5	2.5	2.5	t <sub>CK</sub>
	ODT turn-off	t <sub>AOF</sub>	TBD	TBD	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +600	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +600	t <sub>AC</sub> (MIN)	t <sub>AC</sub> (MAX) +600	ps
	ODT turn-on (power-down mode)	t <sub>AONPD</sub>	TBD	TBD	t <sub>AC</sub> (MIN) +2,000	2x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	t <sub>AC</sub> (MIN) +2,000	2x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	t <sub>AC</sub> (MIN) +2,000	2x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	ps
	ODT turn-off (power-down mode)	t <sub>AOPD</sub>	TBD	TBD	t <sub>AC</sub> (MIN) +2,000	2.5x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	t <sub>AC</sub> (MIN) +2,000	2.5x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	t <sub>AC</sub> (MIN) +2,000	2.5x t <sub>CK</sub> + t <sub>AC</sub> (MAX) + 1,000	t <sub>CK</sub>
	ODT to power-down entry latency	t <sub>ANPD</sub>	TBD	TBD	3		3		3		t <sub>CK</sub>
	ODT power-down exit latency	t <sub>AXPD</sub>	TBD	TBD	8		8		8		t <sub>CK</sub>
Power-Down	Exit active power-down to READ command, MR[bit12=0]	t <sub>ξARD</sub>	TBD	TBD	2		2		2		t <sub>CK</sub>
	Exit active power-down to READ command, MR[bit12=1]	t <sub>ξARDS</sub>	TBD	TBD	7-AL		6-AL		6-AL		t <sub>CK</sub>
	Exit precharge power-down to any non-READ command.	t <sub>ξP</sub>	TBD	TBD	2		2		2		t <sub>CK</sub>
	CKE minimum high/low time	t <sub>CKE</sub>	TBD	TBD	3		3		3		t <sub>CK</sub>

Note:

- AC specification is based on **SAMSUNG** components. Other DRAM manufactures specification may be different.



### ORDERING INFORMATION FOR D6

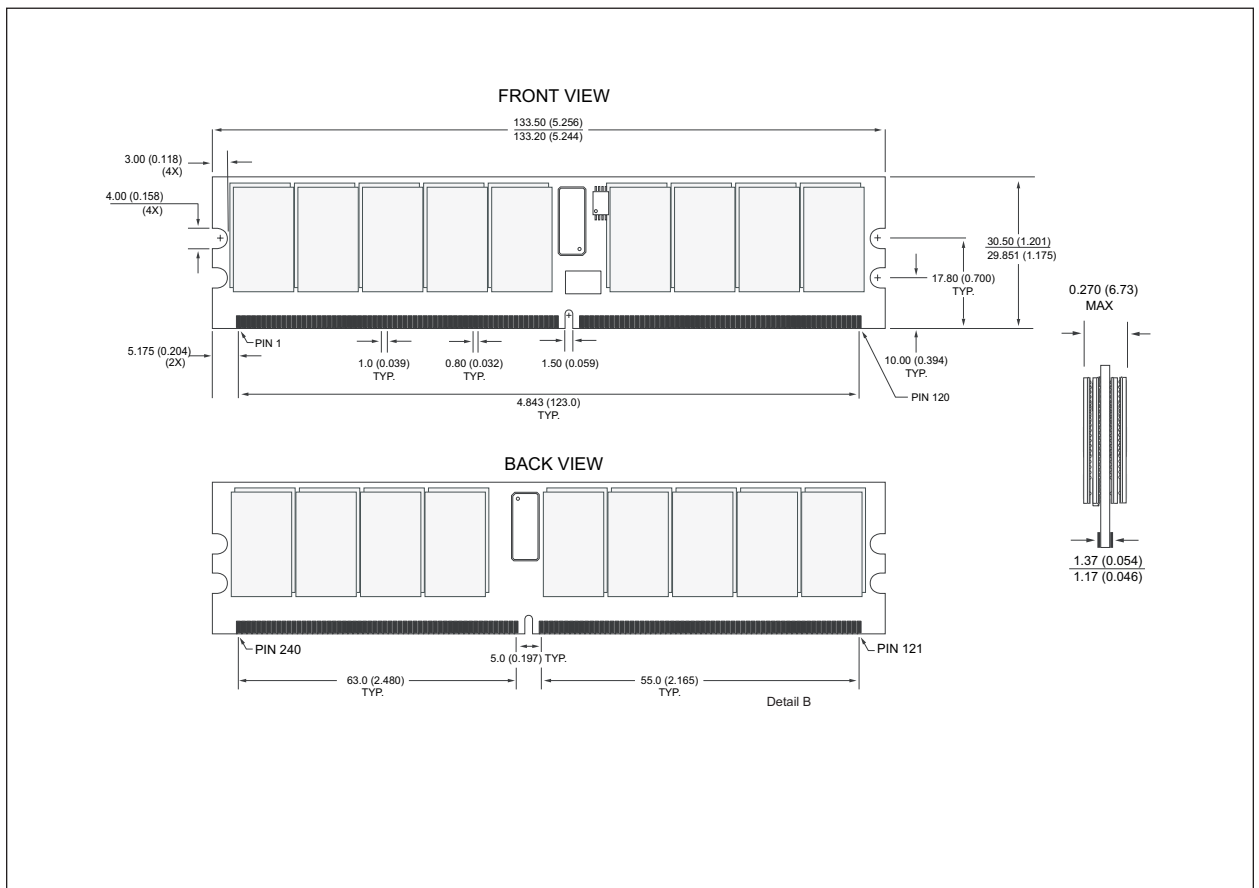
Part Number	Speed/Data Rate	CAS Latency	t <sub>RC</sub> D	t <sub>RP</sub>	Height*
W3HG2256M72ACER806D6xxG**	400MHz/800Mb/s	6	6	6	30.00mm (1.181") TYP
W3HG2256M72ACER665D6xxG**	333MHz/667Mb/s	5	5	5	30.00mm (1.181") TYP
W3HG2256M72ACER534D6xxG	266MHz/533Mb/s	4	4	4	30.00mm (1.181") TYP
W3HG2256M72ACER403D6xxG	200MHz/400Mb/s	3	3	3	30.00mm (1.181") TYP

\*\* Contact factory for availability

Notes:

- RoHS compliant product. (G = RoHS Compliant)
- Vendor specific part numbers are used to provide memory component source control. The place holder for this is shown as a lower case "x" in the part numbers above and is to be replaced with respective vendors code. Consult factory for qualified sourcing options. (M = Micron, S = Samsung & consult factory for others)
- Consult factory for availability of industrial temperature (-40°C to 85°C) option

### PACKAGE DIMENSIONS FOR D6

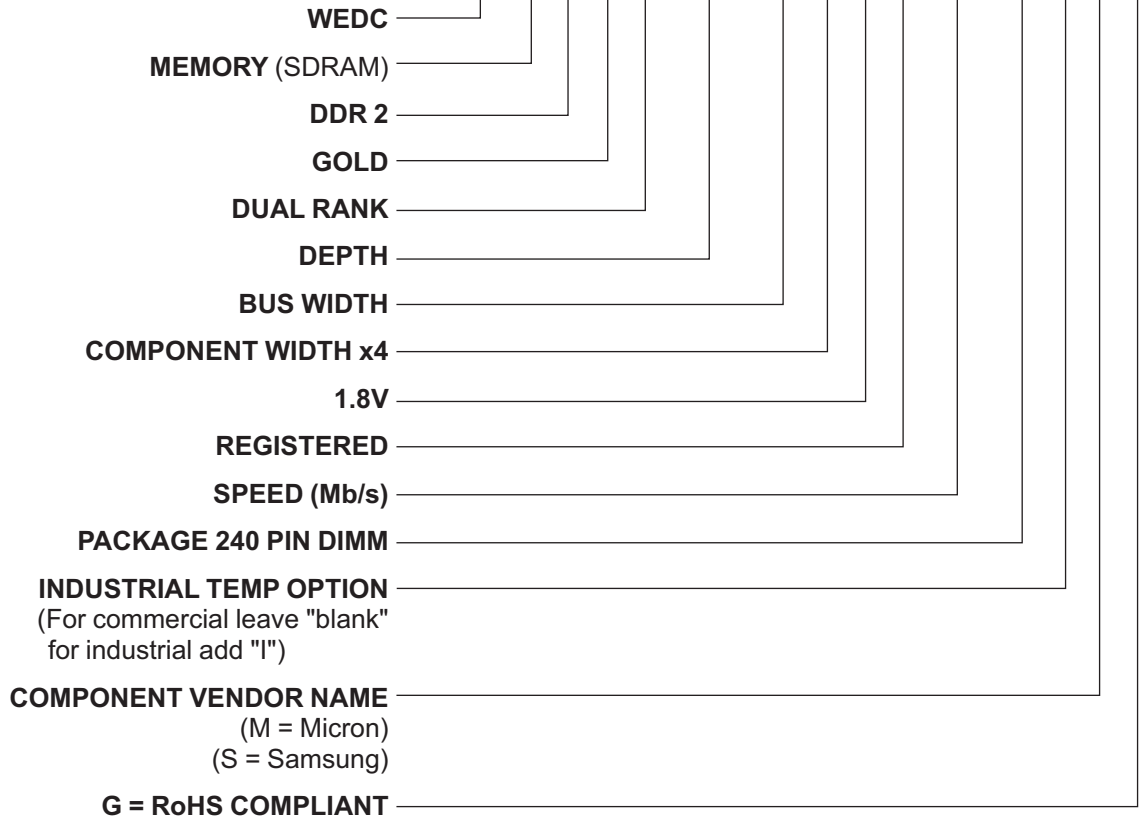


\* ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES)



**PART NUMBERING GUIDE**

**WV 3 H G 2 256M 72 A E R xxx D6 x x G**





## Document Title

4GB – 2x256Mx72 DDR2 SDRAM REGISTERED, w/PLL

### DRAM DIE OPTIONS:

- SAMSUNG: A-Die, will move to B-Die Q1'07
- MICRON: U28A: A-Die, will move to U38Z: D-Die Q4'06

## Revision History

Rev #	History	Release Date	Status
Rev 0	Evaluation and review	March 2006	Concept
Rev 1	1.0 Update Vcc specifications	April 2006	Advanced
	1.1 Moved from concept to advanced		
	1.2 Added DRAM die verification		