



512MB – 64Mx72 DDR2 SDRAM, UNBUFFERED SO-DIMM, w/PLL

FEATURES

- Unbuffered 200-pin (SO-DIMM), Small-Outline dual in-line memory module
- Fast data transfer rates: PC2-6400*, PC2-5300*, PC2-4200 and PC2-3200
- $V_{CC} = V_{CCQ} 1.8V \pm 0.1V$
- $V_{CCSPD} = 1.7V$ to 3.6V
- JEDEC standard 1.8V I/O (SSTL_18-compatible)
- Differential data strobe (DQS, DQS#) option
- Four-bit prefetch architecture
- Multiple internal device banks for concurrent operation
- Differential clock inputs (CK, CK#)
- Programmable CAS# latency (CL): 3, 4, 5* and 6*
- Posted CAS# additive latency: 0, 1, 2, 3 and 4
- 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
- Single Rank
- RoHS compliant
- JEDEC proposed pin-out
- Package
 - 200 Pin SO-DIMM: 30.00mm (1.181") TYP.

DESCRIPTION

The WV3HG64M72EEU is a 64Mx72 Double Data Rate DDR2 SDRAM high density module. This memory module consists of nine 64Mx8 bit with 4 banks DDR2 Synchronous DRAMs in FBGA packages, mounted on a 200-pin SO-DIMM FR4 substrate.

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

NOTE: Consult factory for availability of:

- Vendor source control options
- Industrial temperature option

OPERATING FREQUENCIES

	PC2-3200	PC2-4200	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

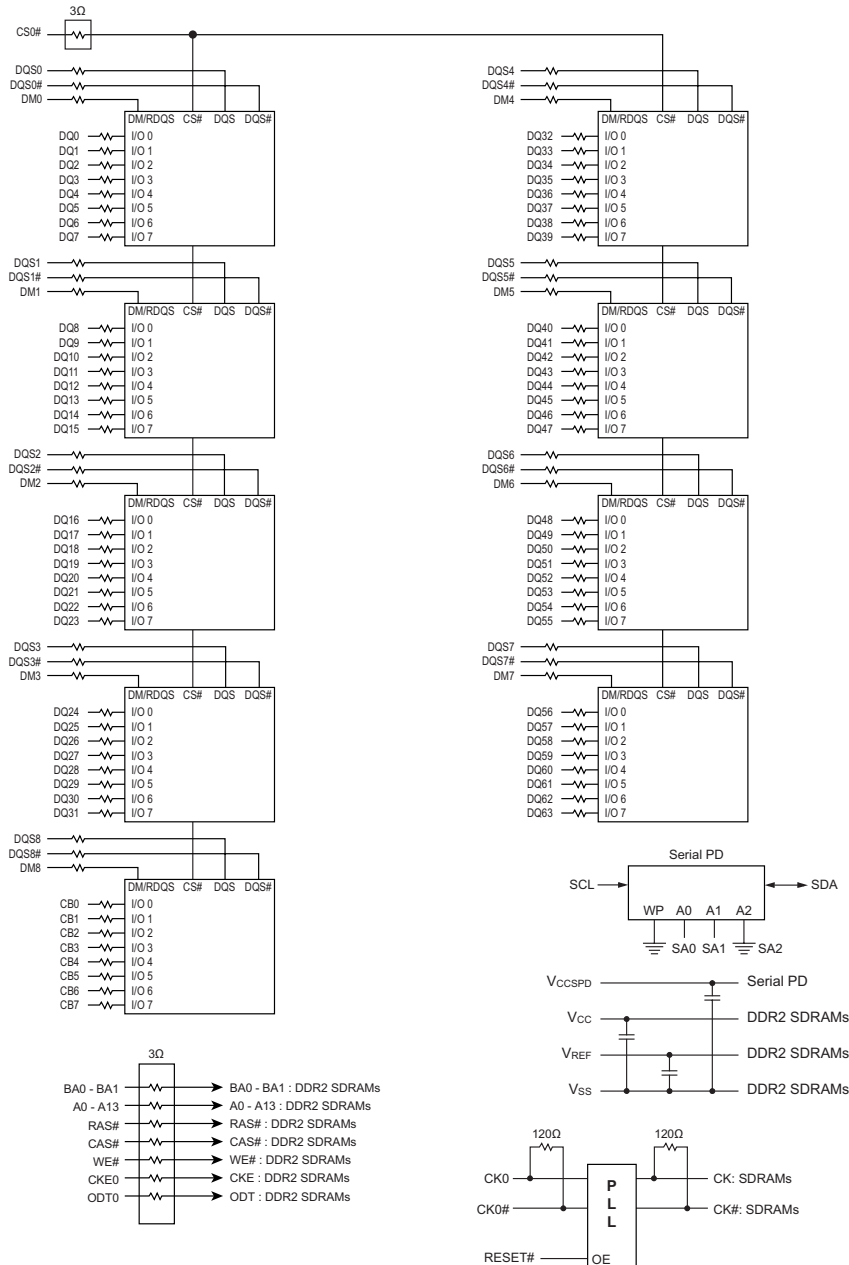
Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	V _{REF}	51	DQ18	101	V _{CC}	151	V _{SS}
2	V _{SS}	52	V _{SS}	102	A6	152	V _{SS}
3	DQ0	53	DQ19	103	A5	153	DQS5#
4	DQ4	54	DQ28	104	A4	154	DM5
5	V _{SS}	55	V _{SS}	105	A3	155	DQS5
6	DQ5	56	DQ29	106	V _{CC}	156	V _{SS}
7	DQ1	57	DQ24	107	A2	157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

PIN NAMES

Pin Name	Function
A0-A13	Address Inputs
BA0, BA1	SDRAM Bank Address
DQ0-DQ63	Data Input/Output
CB0-CB7	Check Bits
DM0-DM8	Data-in mask
DQS0-DQS8	Data strobes
DQS0#-DQS8#	Data strobes negative
ODT0	On-die termination control
CK, CK#	Clock Input
CKE0	Clock enable input
CS0#	Chip select input
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
V _{CC}	Core Power
RESET#	PLL Output enable
V _{SS}	Ground
SA0-SA1	SPD address
SDA	Serial Data Input/Output
V _{REF}	Input/Output Reference
V _{CC} SPD	Serial EEPROM power supply
SCL	SPD Clock Input
NC	Spare pins, No connect



FUNCTIONAL BLOCK DIAGRAM



NOTE: All resistor values are 22 ohms ±5% unless otherwise specified.



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Units	
V _{CC}	Voltage on V _{CC} pin relative to V _{SS}	-1.0	2.3	V	
V _{IN} , V _{OUT}	Voltage on any pin relative to V _{SS}	-0.5	2.3	V	
T _{STG}	Storage Temperature	-55	100	°C	
I _L	Input leakage current; Any input 0V < V _{IN} < V _{CC} ; V _{REF} input 0V, V _{IN} , 0.95V; Other pins not under test = 0V	Command/Address, RAS#, CAS#, WE#,	-45	45	μA
		CS#, CKE	-45	45	μA
		CK, CK#	-10	10	μA
		DM	-5	5	μA
I _{OZ}	Output leakage current; 0V < V _{IN} < V _{CC} ; DQs and ODT are disable	-5	5	μA	
I _{VREF}	V _{REF} leakage current; V _{REF} = Valid V _{REF} level	-18	18	μA	

DC OPERATING CONDITIONS

All voltages referenced to V_{SS}

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Supply Voltage	V _{CC}	1.7	1.8	1.9	V	3
I/O Reference Voltage	V _{REF}	0.49 x V _{CC}	0.50 x V _{CC}	0.51 x V _{CC}	V	1
I/O Termination Voltage	V _{TT}	V _{REF} -0.04	V _{REF}	V _{REF} +0.04	V	2
SPD Supply Voltage	V _{CCSPD}	1.7	-	3.6	V	

Notes:

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

OPERATING TEMPERATURE CONDITION

Parameter	Symbol	Rating	Units	Notes
Operating Case Temperature (Commercial)	TOPER	0 to +85°C	°C	1, 2

NOTE:

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



INPUT DC LOGIC LEVEL

All voltages referenced to V_{SS}

Parameter	Symbol	Min	Max	Unit
Input High (Logic 1) Voltage	V _{IH} (DC)	V _{REF} + 0.125	V _{CC} + 0.300	V
Input High (Logic 0) Voltage	V _{IL} (DC)	-0.300	V _{REF} - 0.125	V

INPUT AC LOGIC LEVEL

All voltages referenced to V_{SS}

Parameter	Symbol	Min	Max	Unit
AC Input High (Logic 1) Voltage DDR2-400 & DDR2-533	V _{IH} (AC)	V _{REF} + 0.250	-	V
AC Input High (Logic 1) Voltage DDR2-667	V _{IH} (AC)	V _{REF} + 0.200	-	V
AC Input High (Logic 0) Voltage DDR2-400 & DDR2-533	V _{IL} (AC)	-	V _{REF} - 0.250	V
AC Input High (Logic 0) Voltage DDR2-667	V _{IL} (AC)	-	V _{REF} - 0.200	V

INPUT/OUTPUT CAPACITANCE

T_A=25°C, f=100MHz

Parameter	Symbol	Min	Max	Unit
Input capacitance (A0-A13, BA0-BA1, RAS#, CAS#, WE#)	C _{IN1}	13	22	pF
Input capacitance (CKE0), (ODT0)	C _{IN2}	13	22	pF
Input capacitance (CS0#)	C _{IN3}	13	22	pF
Input capacitance (CK, CK#)	C _{IN4}	6	7	pF
Input capacitance (DM0-DM8), (DQS0-DQS8)	C _{IN5} (665)	6.5	7.5	pF
	C _{IN5} (534, 403)	6.5	8	pF
Input capacitance (DQ0-DQ63), (CB0-CB7)	C _{OUT1} (665)	6.5	7.5	pF
	C _{OUT1} (534, 403)	6.5	8	pF



DDR2 I_{CC} SPECIFICATIONS AND CONDITIONS

Includes DDR2 SDRAM components only

V_{CC} = +1.8V ± 0.1V

Symbol	Proposed Conditions	806	665	534	403	Units	
I _{CC0*}	Operating one bank active-precharge current; t _{CK} = t _{CK} (I _{CC}), t _{RC} = t _{RC} (I _{CC}), t _{RAS} = t _{RASmin} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	1,065	1,020	1,020	mA	
I _{CC1*}	Operating one bank active-read-precharge current; I _{OUT} = 0mA; BL = 4, CL = CL(I _{CC}), AL = 0; t _{CK} = t _{CK} (I _{CC}), t _{RC} = t _{RC} (I _{CC}), t _{RAS} = t _{RASmin} (I _{CC}), t _{RCD} = t _{RCD} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as I _{CC4W}	TBD	1,200	1,115	1,155	mA	
I _{CC2P*}	Precharge power-down current; All banks idle; t _{CK} = t _{CK} (I _{CC}); CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	TBD	372	372	372	mA	
I _{CC2Q**}	Precharge quiet standby current; All banks idle; t _{CK} = t _{CK} (I _{CC}); CKE is HIGH, CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	TBD	615	570	570	mA	
I _{CC2N**}	Precharge standby current; All banks idle; t _{CK} = t _{CK} (I _{CC}); CKE is HIGH, CS# is HIGH; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	660	615	615	mA	
I _{CC3P**}	Active power-down current; All banks open; t _{CK} = t _{CK} (I _{CC}); CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	Fast PDN Exit MRS(12) = 0	TBD	570	570	570	mA
		Slow PDN Exit MRS(12) = 1	TBD	408	408	408	mA
I _{CC3N**}	Active standby current; All banks open; t _{CK} = t _{CK} (I _{CC}), t _{RAS} = t _{RASmax} (I _{CC}), t _{RP} = t _{RP} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	795	750	750	mA	
I _{CC4W*}	Operating burst write current; All banks open, Continuous burst writes; BL = 4, CL = CL(I _{CC}), AL = 0; t _{CK} = t _{CK} (I _{CC}), t _{RAS} = t _{RASmax} (I _{CC}), t _{RP} = t _{RP} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	1,560	1,380	1,290	mA	
I _{CC4R*}	Operating burst read current; All banks open, Continuous burst reads, I _{OUT} = 0mA; BL = 4, CL = CL(I _{CC}), AL = 0; t _{CK} = t _{CK} (I _{CC}), t _{RAS} = t _{RASmax} (I _{CC}), t _{RP} = t _{RP} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as I _{CC4W}	TBD	1,605	1,425	1,290	mA	
I _{CC5B**}	Burst auto refresh current; t _{CK} = t _{CK} (I _{CC}); Refresh command at every t _{REFC} (I _{CC}) interval; CKE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	TBD	1,650	1,560	1,560	mA	
I _{CC6**}	Self refresh current; CK and CK ₁ at 0V; CKE 0.2V; Other control and address bus inputs are FLOATING; Data bus inputs are FLOATING	Normal	TBD	72	72	72	mA
I _{CC7*}	Operating bank interleave read current; All bank interleaving reads, I _{OUT} = 0mA; BL = 4, CL = CL(I _{CC}), AL = t _{RCD} (I _{CC})-1*t _{CK} (I _{CC}); t _{CK} = t _{CK} (I _{CC}), t _{RC} = t _{RC} (I _{CC}), t _{RRD} = t _{RRD} (I _{CC}), t _{RCD} = 1*t _{CK} (I _{CC}); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are STABLE during DESELECTS; Data bus inputs are SWITCHING.	TBD	2,280	2,280	2,280	mA	

Note: I_{CC} specification is based on SAMSUNG components. Other DRAM Manufacturers specification may be different.

*: Value calculated as one module rank in this operating condition, and all other module ranks in I_{CC2P} (CKE LOW) mode.

** : Value calculated reflects all module ranks in this operating condition.



AC TIMING PARAMETERS & SPECIFICATIONS

AC CHARACTERISTICS			806		665		534		403			
PARAMETER			SYMBOL	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Clock	Clock cycle time	CL = 6	t _{CK} (6)	TBD	TBD							ps
		CL = 5	t _{CK} (5)	TBD	TBD	3,000	8,000					ps
		CL = 4	t _{CK} (4)	TBD	TBD	3,750	8,000	3,750	8,000	5,000	8,000	ps
		CL = 3	t _{CK} (3)	TBD	TBD	5,000	8,000	5,000	8,000	5,000	8,000	ps
	CK high-level width		t _{CH}	TBD	TBD	0.45	0.55	0.45	0.55	0.45	0.55	t _{CK}
	CK low-level width		t _{CL}	TBD	TBD	0.45	0.55	0.45	0.55	0.45	0.55	t _{CK}
	Half clock period		t _{HP}	TBD	TBD	MIN(t _{CH} , t _{CL})		MIN(t _{CH} , t _{CL})		MIN(t _{CH} , t _{CL})		ps
Clock jitter		t _{JIT}	TBD	TBD	-125	125	-125	125	-125	125	ps	
Data	DQ output access time from CK/CK#		t _{AC}	TBD	TBD	-450	+450	-500	+500	-600	+600	ps
	Data-out high-impedance window from CK/CK#		t _{HZ}	TBD	TBD		t _{AC} (MAX)		t _{AC} (MAX)		t _{AC} (MAX)	ps
	Data-out low-impedance window from CK/CK#		t _{LZ}	TBD	TBD	t _{AC} (MIN)	t _{AC} (MAX)	t _{AC} (MIN)	t _{AC} (MAX)	t _{AC} (MIN)	t _{AC} (MAX)	ps
	DQ and DM input setup time relative to DQS		t _{DS}	TBD	TBD	100		100		150		
	DQ and DM input hold time relative to DQS		t _{DH}	TBD	TBD	225		225		275		
	DQ and DM input pulse width (for each input)		t _{DLPW}	TBD	TBD	0.35		0.35		0.35		t _{CK}
	Data hold skew factor		t _{DHS}	TBD	TBD		340		400		450	ps
	DQ...DQS hold, DQS to first DQ to go nonvalid, per access		t _{DH}	TBD	TBD	t _{HP} - t _{DHS}		t _{HP} - t _{DHS}		t _{HP} - t _{DHS}		ps
	Data valid output window (DVW)		t _{DVW}	TBD	TBD	t _{DH} - t _{DOSQ}		t _{DH} - t _{DOSQ}		t _{DH} - t _{DOSQ}		ns
Data Strobe	DQS input high pulse width		t _{DOSH}	TBD	TBD	0.35		0.35		0.35		t _{CK}
	DQS input low pulse width		t _{DOSL}	TBD	TBD	0.35		0.35		0.35		t _{CK}
	DQS output access time from CK/CK#		t _{DOSCK}	TBD	TBD	-400	+400	-450	+450	-500	+500	ps
	DQS falling edge to CK rising ... setup time		t _{DSS}	TBD	TBD	0.2		0.2		0.2		t _{CK}
	DQS falling edge from CK rising ... hold time		t _{DSH}	TBD	TBD	0.2		0.2		0.2		t _{CK}
	DQS...DQ skew, DQS to last DQ valid, per group, per access		t _{DOSQ}	TBD	TBD		240		300		350	ps
	DQS read preamble		t _{RPRE}	TBD	TBD	0.9	1.1	0.9	1.1	0.9	1.1	t _{CK}
	DQS read postamble		t _{RPST}	TBD	TBD	0.4	0.6	0.4	0.6	0.4	0.6	t _{CK}
	DQS write preamble setup time		t _{WPRES}	TBD	TBD	0		0		0		ps
	DQS write preamble		t _{WPRE}	TBD	TBD	0.35		0.35		0.35		t _{CK}
	DQS write postamble		t _{WPST}	TBD	TBD	0.4	0.6	0.4	0.6	0.4	0.6	t _{CK}
Write command to first DQS latching transition		t _{DOSS}	TBD	TBD	WL- 0.25	WL+ 0.25	WL- 0.25	WL+ 0.25	WL- 0.25	WL+ 0.25	t _{CK}	
Address and control input pulse width for each input		t _{IPW}	TBD	TBD	0.6		0.6		0.6		t _{CK}	
Address and control input setup time		t _{IS}	TBD	TBD	200		250		250		ps	
Address and control input hold time		t _{IH}	TBD	TBD	275		375		475		ps	
Address and control input hold time		t _{ICCD}	TBD	TBD	2		2		2		t _{CK}	

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

Continued on next page



AC TIMING PARAMETERS (cont'd)

AC CHARACTERISTICS			806		665		534		403		
PARAMETER		SYMBOL	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Command and Address	ACTIVE to ACTIVE (same bank) command	t _{RC}	TBD	TBD	55		60		35		ns
	ACTIVE bank a to ACTIVE bank b command	t _{RRD}	TBD	TBD	7.5		7.5		7.5		ns
	ACTIVE to READ or WRITE delay	t _{RCD}	TBD	TBD	15		15		15		ns
	Four Bank Activate period	t _{FAW}	TBD	TBD	37.5	37.5	37.5	37.5	37.5	37.5	ns
	ACTIVE to PRECHARGE command	t _{RAS}	TBD	TBD	45	70,000	45	70,000	45	70,000	ns
	Internal READ to precharge command delay	t _{RTP}	TBD	TBD	7.5		7.5		7.5		ns
	Write recovery time	t _{WR}	TBD	TBD	15		15		15		ns
	Auto precharge write recovery + precharge time	t _{DAL}	TBD	TBD	t _{WR} +t _{RP}		t _{WR} +t _{RP}		t _{WR} +t _{RP}		ns
	Internal WRITE to READ command delay	t _{WTR}	TBD	TBD	10		7.5		7.5		ns
	PRECHARGE command period	t _{RP}	TBD	TBD	15		15		15		ns
	PRECHARGE ALL command period	t _{RPA}	TBD	TBD	t _{RP} +t _{CK}		t _{RP} +t _{CK}		t _{RP} +t _{CK}		ns
	LOAD MODE command cycle time	t _{MRD}	TBD	TBD	2		2		2		t _{CK}
CKE low to CK,CK# uncertainty	t _{DELAY}	TBD	TBD	4.375		4.375		4.375		ns	
Self Refresh	REFRESH to Active of Refresh to Refresh command interfal	t _{RFC}	TBD	TBD	105	70,000	105	70,000	105	70,000	ns
	Average periodic refresh interval	t _{REFI}	TBD	TBD		7.8		7.8		7.8	μs
	Exit self refresh to non-READ command	t _{XS_{NR}}	TBD	TBD	t _{RFC(MIN)} +10		t _{RFC(MIN)} +10		t _{RFC(MIN)} +10		ns
	Exit self refresh to READ command	t _{XS_{RD}}	TBD	TBD	200		200		200		t _{CK}
	Exit self refresh timing reference	t _{IS_{XR}}	TBD	TBD	t _{IS}		t _{IS}		t _{IS}		ps
ODT	ODT turn-on delay	t _{AOND}	TBD	TBD	2	2	2	2	2	2	t _{CK}
	ODT turn-on	t _{AON}	TBD	TBD	t _{AC(MIN)}	t _{AC(MAX)} +1000	t _{AC(MIN)}	t _{AC(MAX)} +1000	t _{AC(MIN)}	t _{AC(MAX)} +1000	ps
	ODT turn-off delay	t _{AOFD}	TBD	TBD	2.5	2.5	2.5	2.5	2.5	2.5	t _{CK}
	ODT turn-off	t _{AOF}	TBD	TBD	t _{AC(MIN)}	t _{AC(MAX)} +600	t _{AC(MIN)}	t _{AC(MAX)} +600	t _{AC(MIN)}	t _{AC(MAX)} +600	ps
	ODT turn-on (power-down mode)	t _{AONPD}	TBD	TBD	t _{AC(MIN)} +2000	2 x t _{CK} +t _{AC(MIN)} +1000	t _{AC(MIN)} +2000	2 x t _{CK} +t _{AC(MIN)} +1000	t _{AC(MIN)} +2000	2 x t _{CK} +t _{AC(MIN)} +1000	ps
	ODT turn-off (power-down mode)	t _{AOFPD}	TBD	TBD	t _{AC(MIN)} +2000	2.5 x t _{CK} +t _{AC(MIN)} +1000	t _{AC(MIN)} +2000	2.5 x t _{CK} +t _{AC(MIN)} +1000	t _{AC(MIN)} +2000	2.5 x t _{CK} +t _{AC(MIN)} +1000	ps
	ODT to power-down entry latency	t _{ANPD}	TBD	TBD	3		3		3		t _{CK}
	ODT power-down exit latency	t _{AXPD}	TBD	TBD	8		8		8		t _{CK}
Power-Down	Exit active power-down to READ command, MR[bit12=0]	t _{XARD}	TBD	TBD	2		2		2		t _{CK}
	Exit active power-down to READ command, MR[bit12=1]	t _{XARDS}	TBD	TBD	7-AL		6-AL		6-AL		t _{CK}
	A Exit precharge power-down to any non-READ command.	t _{XP}	TBD	TBD	2		2		2		t _{CK}
	CKE minimum high/low time	t _{CKE}	TBD	TBD	3		3		3		t _{CK}

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



ORDERING INFORMATION FOR PD4

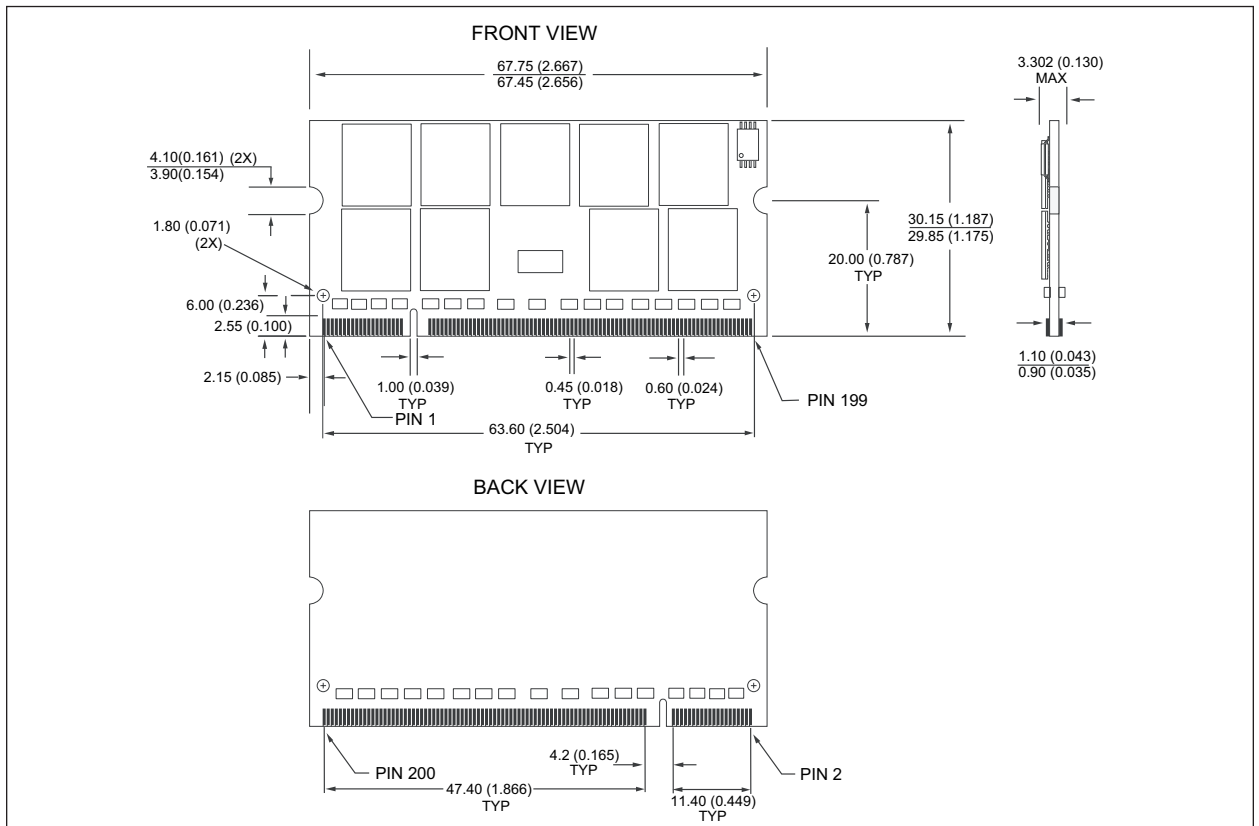
Part Number	Speed/Data Rate Frequency	CAS Latency	t _{RC} D	t _{RP}	Height*
WV3HG64M72EEU806PD4xxG**	400MHz/800Mb/s	6	6	6	30.00mm (1.181") TYP
WV3HG64M72EEU665PD4xxG**	333MHz/667Mb/s	5	5	5	30.00mm (1.181") TYP
WV3HG64M72EEU534PD4xxG	266MHz/533Mb/s	4	4	4	30.00mm (1.181") TYP
WV3HG64M72EEU403PD4xxG	200MHz/400Mb/s	3	3	3	30.00mm (1.181") TYP

** Consult factory for availability

NOTES:

- RoHS compliant product (G = RoHS Compliant)
- Vendor specific part numbers are used to provide memory components source control. The place holder for this is shown as lower case "x" in the part numbers above and is to be replaced with the 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

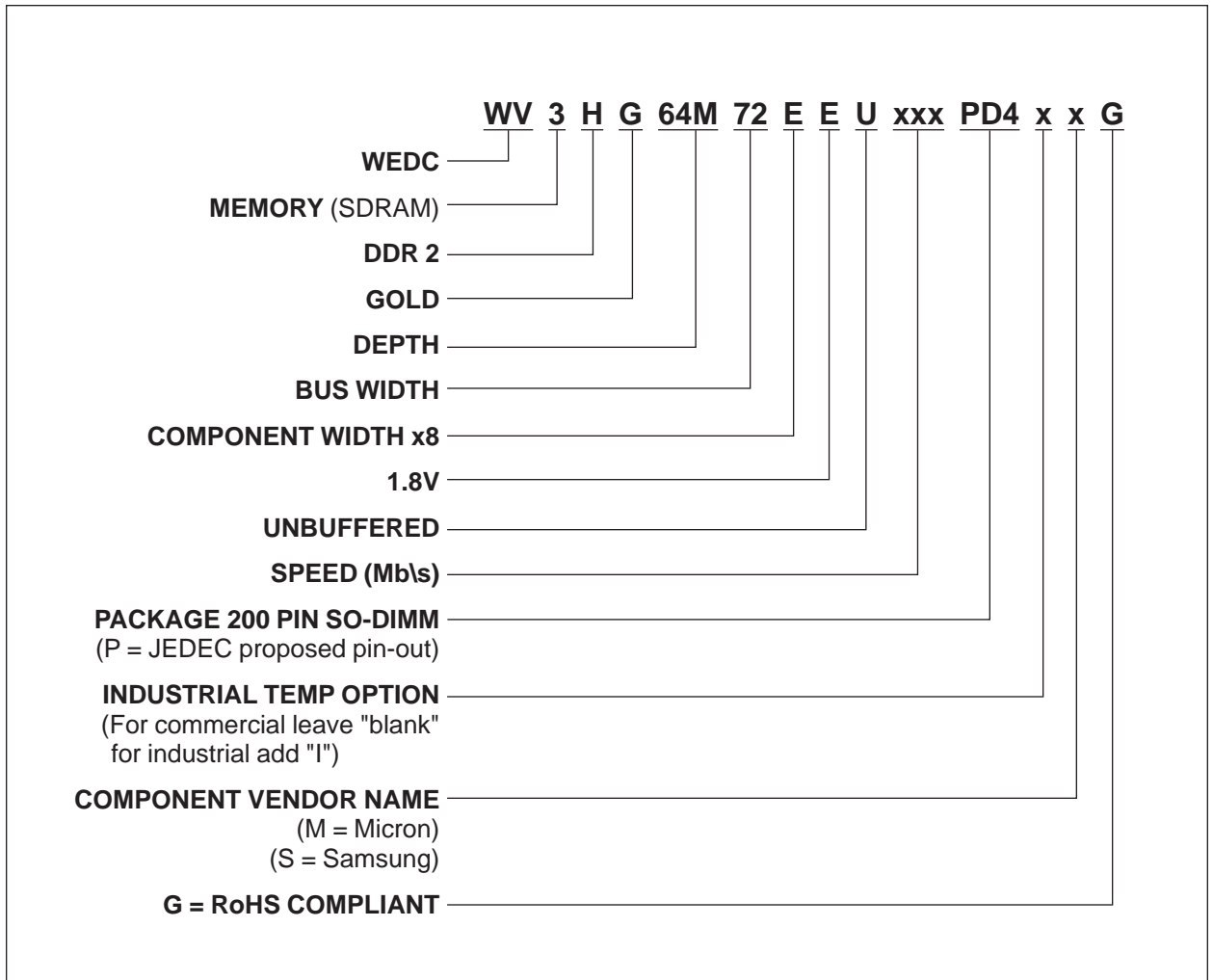
PACKAGE DIMENSIONS FOR PD4



* ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
Tolerances: ±0.13 (0.005) unless otherwise specified



PART NUMBERING GUIDE



**Document Title**

512MB – 64Mx72 DDR2 SDRAM UNBUFFERED, w/PLL

DRAM DIE OPTIONS:

- SAMSUNG: C-Die, will move to E-Die Q2'06
- MICRON: U37Y: B-Die

Revision History

Rev #	History	Release Date	Status
Rev 0	Created	January 2006	Advanced
Rev 1	1.1 Updated pin-out to JECED proposed pin-outs 1.2 Added "P" for JECED proposed pin-out 1.3 Added die rev info 1.4 Added V_{CCSPD} voltage specification	May 2006	Advanced
Rev 2	2.1 Updated resistors in block diagram	June 2006	Advanced