

256MB – 2x16Mx64 DDR SDRAM UNBUFFERED

FEATURES

- Double-data-rate architecture
- PC2700@CL=2.5
- Bi-directional data strobes (DQS)
- Differential clock inputs (CK & CK#)
- Programmable Read Latency 2, 2, 5 (clock)
- Programmable Burst Length (2, 4, 8)
- Programmable Burst type (sequential & interleave)
- Edge aligned data output, center aligned data input
- Auto and self refresh, (8K/64ms refresh)
- Serial presence detect with EEPROM
- Power Supply: V_{cc}/V_{ccq} : 2.5V ± 0.20V
- Dual Rank
- Standard 200 pin SO-DIMM package
 - Package height options:
 - D4: 31.75mm (1.25") TYP.

DESCRIPTION

The WV3EG216M64STSU is a 2x16Mx64 Double Data Rate SDRAM memory module based on 256Mb DDR SDRAM components. The module consists of eight 16Mx16 DDR SDRAMs in 66 pin TSOP package mounted on a 200 Pin FR4 substrate.

Synchronous design allows precise cycle control with the use of system clock. Data I/O transactions are possible on both edges and Burst Lengths allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

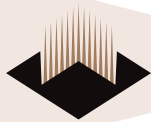
* This product is under development, is not qualified or characterized and is subject to change without notice.

NOTE: Consult factory for availability of:

- RoHS compliant products
- Vendor source control options
- Industrial temperature option

OPERATING FREQUENCIES

	DDR333@CL=2.5
Clock Speed	166MHz
CL-trCD-trp	2.5-3-3

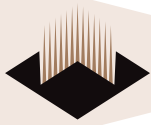


PIN CONFIGURATIONS

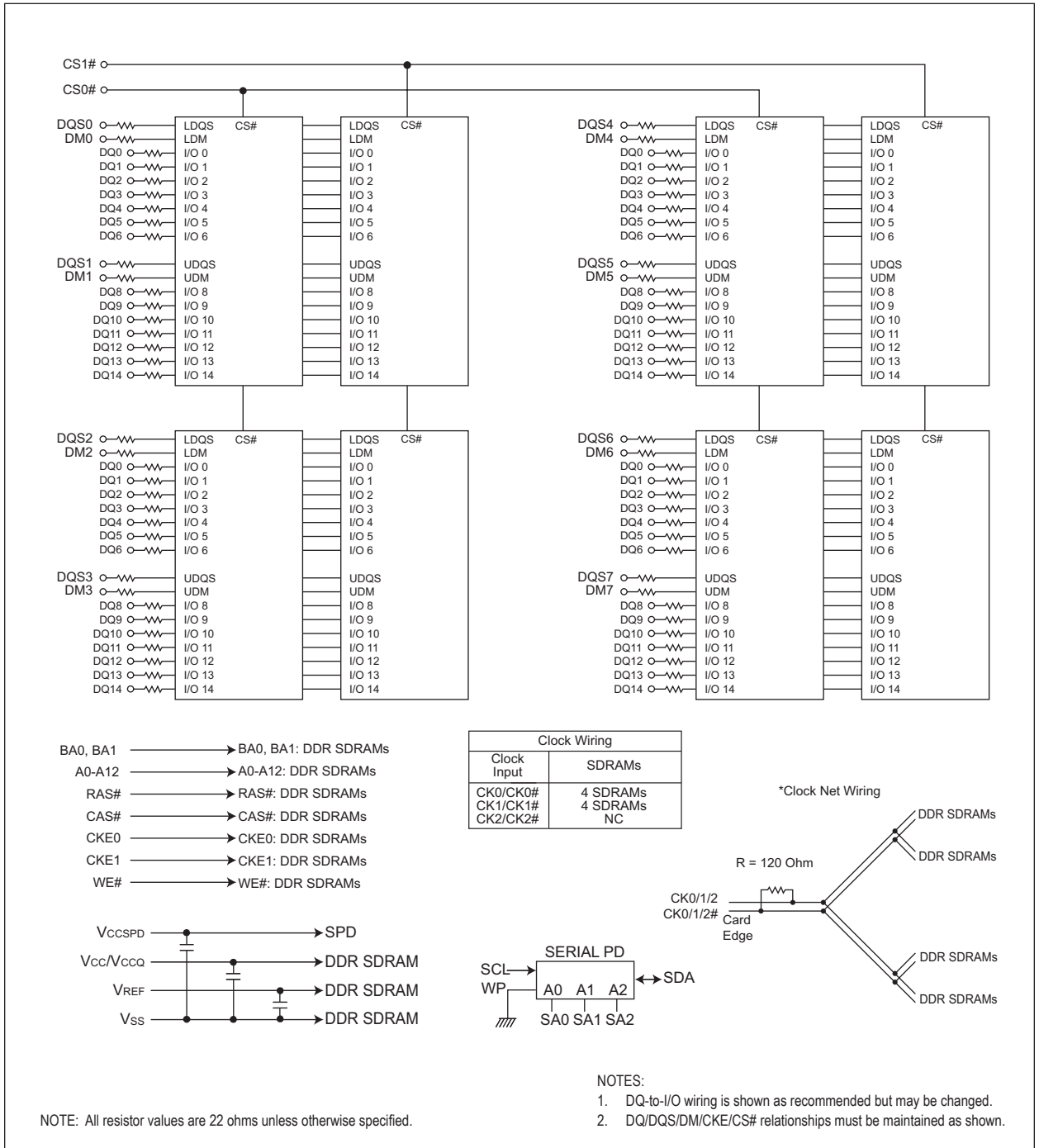
Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol
1	VREF	51	Vss	101	A9	151	DQ42
2	VREF	52	Vss	102	A8	152	DQ46
3	Vss	53	DQ19	103	Vss	153	DQ43
4	Vss	54	DQ23	104	Vss	154	DQ47
5	DQ0	55	DQ24	105	A7	155	Vcc
6	DQ4	56	DQ28	106	A6	156	Vcc
7	DQ1	57	Vcc	107	A5	157	Vcc
8	DQ5	58	Vcc	108	A4	158	CK1#
9	Vcc	59	DQ25	109	A3	159	Vss
10	Vcc	60	DQ29	110	A2	160	CK1
11	DQS0	61	DQS3	111	A1	161	Vss
12	DM0	62	DM3	112	A0	162	Vss
13	DQ2	63	Vss	113	Vcc	163	DQ48
14	DQ6	64	Vss	114	Vcc	164	DQ52
15	Vss	65	DQ26	115	A10	165	DQ49
16	Vss	66	DQ30	116	BA1	166	DQ53
17	DQ3	67	DQ27	117	BA0	167	Vcc
18	DQ7	68	DQ31	118	RAS#	168	Vcc
19	DQ8	69	Vcc	119	WE#	169	DQS6
20	DQ12	70	Vcc	120	CAS#	170	DM6
21	Vcc	71	NC	121	CS0#	171	DQ50
22	Vcc	72	NC	122	CS1#	172	DQ54
23	DQ9	73	NC	123	NC	173	Vss
24	DQ13	74	NC	124	NC	174	Vss
25	DQS1	75	Vss	125	Vss	175	DQ51
26	DM1	76	Vss	126	Vss	176	DQ55
27	Vss	77	NC	127	DQ32	177	DQ56
28	Vss	78	NC	128	DQ36	178	DQ60
29	DQ10	79	NC	129	DQ33	179	Vcc
30	DQ14	80	NC	130	DQ37	180	Vcc
31	DQ11	81	Vcc	131	Vcc	181	DQ57
32	DQ15	82	Vcc	132	Vcc	182	DQ61
33	Vcc	83	NC	133	DQS4	183	DQS7
34	Vcc	84	NC	134	DM4	184	DM7
35	CK0	85	NC	135	DQ34	185	Vss
36	Vcc	86	NC	136	DQ38	186	Vss
37	CK0#	87	Vss	137	Vss	187	DQ58
38	Vss	88	Vss	138	Vss	188	DQ62
39	Vss	89	NC	139	DQ35	189	DQ59
40	Vss	90	Vss	140	DQ39	190	DQ63
41	DQ16	91	NC	141	DQ40	191	Vcc
42	DQ20	92	Vcc	142	DQ44	192	Vcc
43	DQ17	93	Vcc	143	Vcc	193	SDA
44	DQ21	94	Vcc	144	Vcc	194	SA0
45	Vcc	95	CKE1	145	DQ41	195	SCL
46	Vcc	96	CKE0	146	DQ45	196	SA1
47	DQS2	97	NC	147	DQS5	197	VccSPD
48	DM2	98	NC	148	DM5	198	SA2
49	DQ18	99	A12	149	Vss	199	NC
50	DQ22	100	A11	150	Vss	200	NC

PIN NAMES

A0 – A12	Address input (Multiplexed)
BA0-BA1	Bank Select Address
DQ0-DQ63	Data Input/Output
DQS0-DQS7	Data Strobe Input/Output
CK0, CK1	Clock Input
CK0#, CK1#	Clock Input
CKE0, CKE1	Clock Enable Input
CS0#, CS1#	Chip select Input
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
DM0-DM7	Data-In Mask
Vcc	Power Supply
VccQ	Power Supply for DQS
Vss	Ground
VREF	Power Supply for Reference
VccSPD	Serial EEPROM Power Supply
SDA	Serial data I/O
SCL	Serial clock
SA0-SA2	Address in EEPROM
NC	No Connect



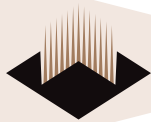
FUNCTIONAL BLOCK DIAGRAM



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

NOTES:

1. DQ-to-I/O wiring is shown as recommended but may be changed.
2. DQ/DQS/DM/CKE/CS# relationships must be maintained as shown.



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Units
Voltage on any pin relative to Vss	V _{IN} , V _{OUT}	-0.5 ~ 3.6	V
Voltage on Vcc and Vccq supply relative to Vss	V _{CC} , V _{CCQ}	-0.5 ~ 3.6	V
Storage temperature	T _{STG}	-55 ~ +150	°C
Operating temperature	T _A	0 ~ 70	°C
Power Dissipation	P _D	8	W
Short circuit output current	I _{OS}	50	mA

NOTES:

- 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.

DC CHARACTERISTICS

0°C □ T_A □ 70°C, V_{CC} = 2.5V ± 0.2V

Parameter	Symbol	Min	Max	Unit	Note
Supply voltage DDR266/DDR333 (nominal V _{CC} of 2.5V)	V _{CC}	2.3	2.7		
I/O Supply voltage DDR266/DDR333 (nominal V _{CC} of 2.5V)	V _{CCQ}	2.3	2.7	V	
I/O Reference voltage	V _{REF}	0.49*V _{CCQ}	0.51*V _{CCQ}	V	1
I/O Termination voltage	V _{TT}	V _{REF} -0.04	V _{REF} +0.04	V	2
Input logic high voltage	V _{IH} (DC)	V _{REF} +0.15	V _{CCQ} +0.30	V	
Input logic low voltage	V _{IL} (DC)	-0.3	V _{REF} -0.15	V	
Input voltage level, CK and CK#	V _{IN} (DC)	-0.3	V _{CCQ} +0.30	V	
Input differential voltage, CK and CK#	V _{ID} (DC)	0.3	V _{CCQ} +0.60	V	3
Input crossing point voltage, CK and CK#	V _{IX} (DC)	0.3	V _{CCQ} +0.60	V	
Input leakage current	Addr, CAS#, RAS#, WE#	I _I	-16	16	µA
	CS#, CKE		-8	8	µA
	CK, CK#		-8	8	µA
	DM		-4	4	µA
Output leakage current	I _{OZ}	-10	10	µA	
Output high current (normal strength); V _{OUT} = V + 0.84V	I _{OH}	-16.8	—	mA	
Output high current (normal strength); V _{OUT} = V _{TT} - 0.84V	I _{OL}	16.8	—	mA	
Output high current (half strength); V _{OUT} = V _{TT} + 0.45V	I _{OH}	-9	—	mA	
Output high current (half strength); V _{OUT} = V _{TT} - 0.45V	I _{OL}	9	—	mA	

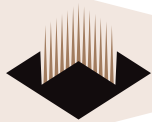
NOTES:

- V_{REF} is expected to be equal to 0.5*V_{CCQ} 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 ±2% of the DC value
- 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_{ID} is the magnitude of the difference between the input level on CK and the input level on CK#.

CAPACITANCE

V_{CC} = 2.5V, V_{CCQ} = 2.5V, T_A = 25°C, f = 1MHz

Parameter	Symbol	Min	Max	Unit
Input Capacitance (A0-A12, BA0-BA1, RAS#, CAS#, WE#)	C _{IN1}	20	28	pF
Input Capacitance (CKE0, CKE1)	C _{IN2}	12	16	pF
Input Capacitance (CS0#, CS1#)	C _{IN3}	12	16	pF
Input Capacitance (CK0, CK0#, CK1, CK1#)	C _{IN4}	12	16	pF
Input Capacitance (DM0-DM7)	C _{IN5}	12	14	pF
Data and DQS input/output capacitance (DQ0-DQ63), CB0-7	C _{OUT}	12	14	pF

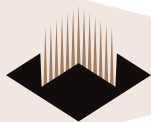


AC OPERATING TEST CONDITIONS

Parameter/Condition	Symbol	Min	Max	Unit	Note
Input High (Logic 1) Voltage	$V_{IH(AC)}$	$V_{REF} + 0.31$		V	1
Input Low (Logic 0) Voltage	$V_{IL(AC)}$		$V_{REF} - 0.31$	V	1
Input Differential Voltage, CK and CK# inputs	$V_{ID(AC)}$	0.7	$V_{CCQ} + 0.6$	V	
Input Crossing Point Voltage, CK and CK# inputs	$V_{IX(AC)}$	$0.5 \cdot V_{CCQ} - 0.2$	$0.5 \cdot V_{CCQ} + 0.2$	V	

NOTES:

- V_{IH} overshoot: $V_{IH} = V_{CCQ} + 1.5V$ for a pulse width $< 3ns$ and the pulse can not be greater than 1/3 of the cycle rate.
 V_{IL} undershoot: $V_{IL} = -1.5V$ for a pulse width $< 3ns$ and the pulse can not be greater than 1/3 of the cycle rate.



I_{CC} SPECIFICATIONS AND TEST CONDITIONS

0°C ≤ T_A ≤ 70°C, V_{CCQ} = 2.5V ±0.2V, V_{CC} = 2.5V ±0.2V

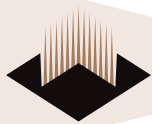
Parameter	Symbol	Conditions	DDR333 @ CL = 2.5 Max	Unit
Operating current - One bank Active-Precharge	I _{CC0*}	t _{RC} = t _{RC} (min); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; DQ,DM and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle	372	mA
Operating current - One bank operation	I _{CC1*}	One bank open, BL=4, Reads - Refer to the following page for detailed test condition	512	mA
Percharge power-down standby current	I _{CC2P**}	All banks idle; power - down mode; CKE = <V _{IL} (max); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; V _{IN} = V _{ref} for DQ,DQS and DM	24	mA
Precharge Floating standby current	I _{CC2F**}	CS# > = V _{IH} (min);All banks idle; CKE > = V _{IH} (min); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; Address and other control inputs changing once per clock cycle; V _{IN} = V _{REF} for DQ,DQS and DM	240	mA
Active power - down standby current	I _{CC3P**}	one bank active; power-down mode; CKE=< V _{IL} (max); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; V _{IN} = V _{REF} for DQ, DQS and DM	280	mA
Active standby current	I _{CC3N**}	CS# > = V _{IH} (min); CKE> = V _{IH} (min); one bank active; active - precharge; t _{RC} = t _{RASmax} ; t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; DQ, DQS and DM inputs changing twice per clock cycle; address and other control inputs changing once per clock cycle	440	mA
Operating current - burst read	I _{CC4R*}	Burst length = 2; reads; contiguous burst; One bank active; address and control inputs changing once per clock cycle; CL = 2 at t _{CK} = 100Mhz for DDR200, CL = 2 at t _{CK} = 133Mhz for DDR266A, CL = 2.5 at t _{CK} = 133Mhz for DDR266B ; 50% of data changing at every burst; I _{out} = 0mA	652	mA
Operating current - burst write	I _{CC4W*}	Burst length = 2; writes; continuous burst; One bank active address and control inputs changing once per clock cycle; CL = 2 at t _{CK} = 100Mhz for DDR200, CL = 2 at t _{CK} = 133Mhz for DDR266A, CL = 2.5 at t _{CK} = 133Mhz for DDR266B ; DQ, DM and DQS inputs changing twice per clock cycle, 50% of input data changing at every burst	652	mA
Auto refresh current	I _{CC5**}	t _{RC} = t _{RFC} (min) - 8*t _{CK} for DDR200 at 100Mhz, 10*t _{CK} for DDR266A & DDR266B at 133Mhz; distributed refresh	1440	mA
Self refresh current; CKE =< 0.2V	I _{CC6**}	External clock should be on; t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B	24	mA
Operating current - Four bank operation	I _{CC7A*}	Four bank interleaving with BL=4 -Refer to the following page for detailed test condition	1332	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 operation condition and other module rank in I_{CC2P} (CKE low) mode.

** Value calculated as all module ranks in this operation condition.



I_{CC} SPECIFICATIONS AND TEST CONDITIONS

0°C ≤ T_A ≤ 70°C, V_{CCQ} = 2.5V ±0.2V, V_{CC} = 2.5V ±0.2V

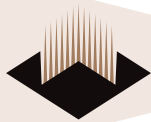
Parameter	Symbol	Conditions	DDR333 @ CL = 2.5 Max	Unit
Operating current - One bank Active-Precharge	I _{CC0*}	t _{RC} = t _{RC} (min); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; DQ,DM and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle	288	mA
Operating current - One bank operation	I _{CC1*}	One bank open, BL=4, Reads - Refer to the following page for detailed test condition	304	mA
Percharge power-down standby current	I _{CC2P**}	All banks idle; power - down mode; CKE = <V _{IL} (max); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; V _{IN} = V _{ref} for DQ,DQS and DM	32	mA
Precharge Floating standby current	I _{CC2F**}	CS# > = V _{IH} (min);All banks idle; CKE > = V _{IH} (min); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; Address and other control inputs changing once per clock cycle; V _{IN} = V _{REF} for DQ,DQS and DM	200	mA
Active power - down standby current	I _{CC3P**}	one bank active; power-down mode; CKE=< V _{IL} (max); t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; V _{IN} = V _{REF} for DQ, DQS and DM	80	mA
Active standby current	I _{CC3N**}	CS# > = V _{IH} (min); CKE> = V _{IH} (min); one bank active; active - precharge; t _{RC} = t _{RASmax} ; t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B; DQ, DQS and DM inputs changing twice per clock cycle; address and other control inputs changing once per clock cycle	312	mA
Operating current - burst read	I _{CC4R*}	Burst length = 2; reads; contiguous burst; One bank active; address and control inputs changing once per clock cycle; CL = 2 at t _{CK} = 100Mhz for DDR200, CL = 2 at t _{CK} = 133Mhz for DDR266A, CL = 2.5 at t _{CK} = 133Mhz for DDR266B ; 50% of data changing at every burst; I _{out} = 0mA	364	mA
Operating current - burst write	I _{CC4W*}	Burst length = 2; writes; continuous burst; One bank active address and control inputs changing once per clock cycle; CL = 2 at t _{CK} = 100Mhz for DDR200, CL = 2 at t _{CK} = 133Mhz for DDR266A, CL = 2.5 at t _{CK} = 133Mhz for DDR266B ; DQ, DM and DQS inputs changing twice per clock cycle, 50% of input data changing at every burst	408	mA
Auto refresh current	I _{CC5**}	t _{RC} = t _{RFC} (min) - 8*t _{CK} for DDR200 at 100Mhz, 10*t _{CK} for DDR266A & DDR266B at 133Mhz; distributed refresh	944	mA
Self refresh current; CKE =< 0.2V	I _{CC6**}	External clock should be on; t _{CK} = 100Mhz for DDR200, 133Mhz for DDR266A & DDR266B	16	mA
Operating current - Four bank operation	I _{CC7A*}	Four bank interleaving with BL=4 -Refer to the following page for detailed test condition	844	mA

NOTE:

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

* Value calculated as one module rank in this operation condition and other module rank in I_{CC2P} (CKE low) mode.

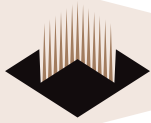
** Value calculated as all module ranks in this operation condition.



DDR SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

0°C ≤ T_A ≤ 70°C, V_{CCQ} = 2.5V ±0.2V, V_{CC} = 2.5V ±0.2V

Parameter	Symbol	335		Unit
		Min	Max	
Row Cycle Time	t _{RC}	60		ns
Refresh row cycle time	t _{RFC}	72		ns
Row active	t _{RAS}	42	120K	ns
RAS# to CAS# delay	t _{RCD}	18		ns
Row precharge time	t _{RP}	18		ns
Row active to row active delay	t _{RRD}	12		ns
Write recovery time	t _{WR}	15		ns
Last data into Read command	t _{WTR}	1		t _{CK}
Clock cycle time	CL=2.5 t _{CK}	6	12	ns
Clock high level width	t _{CH}	0.45	0.55	t _{CK}
Clock low level width	t _{CL}	0.55	0.55	t _{CK}
DQS-out access time from CK/CK#	t _{DQSCK}	-0.6	+0.6	ns
Output data access time from CK/CK#	t _{AC}	-0.7	+0.7	ns
Data strobe edge to output data edge	t _{DQSQ}	-	0.45	ns
Read Preamble	t _{RPRE}	0.9	1.1	t _{CK}
Read Postamble	t _{RPST}	0.4	0.6	t _{CK}
CK to valid DQS-in	t _{DQSS}	0.75	1.25	t _{CK}
DQS-in setup time	t _{WPRES}	0		ns
DQS-in hold time	t _{WPRE}	0.25		t _{CK}
DQS falling edge to CK rising-setup time	t _{DSS}	0.2		t _{CK}
DQS falling edge to CK rising-hold time	t _{DSH}	0.2		t _{CK}
DQS-in high level width	t _{DQSH}	0.35		t _{CK}
DQS-in low level width	t _{DQSL}	0.35		t _{CK}
Address and control input setup time (fast)	t _{IS}	0.75		ns
Address and control input hold time (fast)	t _{IH}	0.75		ns
Address and control input setup (slow)	t _{IS}	0.7		ns
Address and control input hold time (slow)	t _{IH}	0.7		ns
Data-out high impedance time from CK/CK#	t _{HZ}	-0.7	+0.7	ns
Data-out low impedance time from CK/CK#	t _{LZ}	-0.7	+0.7	ns
Mode register set cycle time	t _{MRD}	10		ns
DQ & DM setup time to DQS	t _{DS}	0.4		ns
DQ & DM hold time to DQS	t _{DH}	0.4		ns
Control & address input pulse width	t _{IPW}	2.2		ns
DQ & DM input pulse width	t _{DIPW}	1.75		ns
Exit self refresh o non-Read command	t _{XSNR}	75		ns
Exit self refresh to Read command	t _{XSRD}	200		t _{CK}
Refresh interval time	t _{REFI}		7.8	us
Output DQS valid window	t _{QH}	t _{HP} - t _{QHS}	—	ns
Clock half period	t _{HP}	t _{CLMIN} or t _{CHMIN}	—	ns
Data hold skew factor	t _{QHS}		0.55	ns
DQS write postamble	t _{WPST}	0.4	0.6	ns
Active Read with Auto precharge command	t _{RAP}	18		ns
Auto precharge Write recovery + Precharge time	t _{RAL}	(t _{WR} /t _{CK}) + (t _{RP} /t _{CK})		t _{CK}

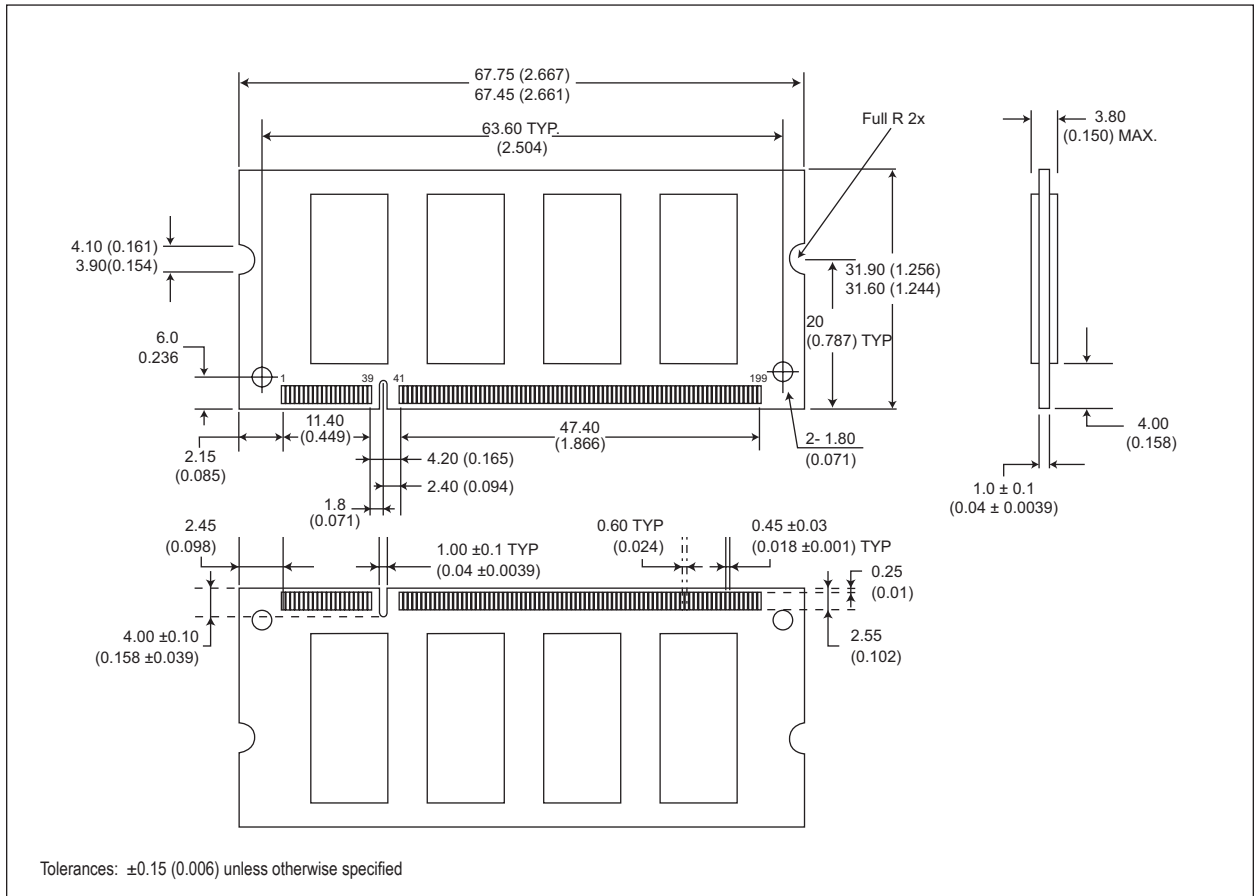


ORDERING INFORMATION FOR D4

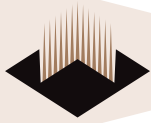
Part Number	Speed/Data Rate	Height*
WV3EG216M64STSU335D4xG	166MHz/333Mbps, CL=2.5	31.75mm (1.25") TYP.

- NOTES:
- Consult Factory for availability of RoHS compliant products. (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, N = Nanya & consult factory for others)
 - Consult factory for availability of industrial temperature (-40°C to 85°C) option

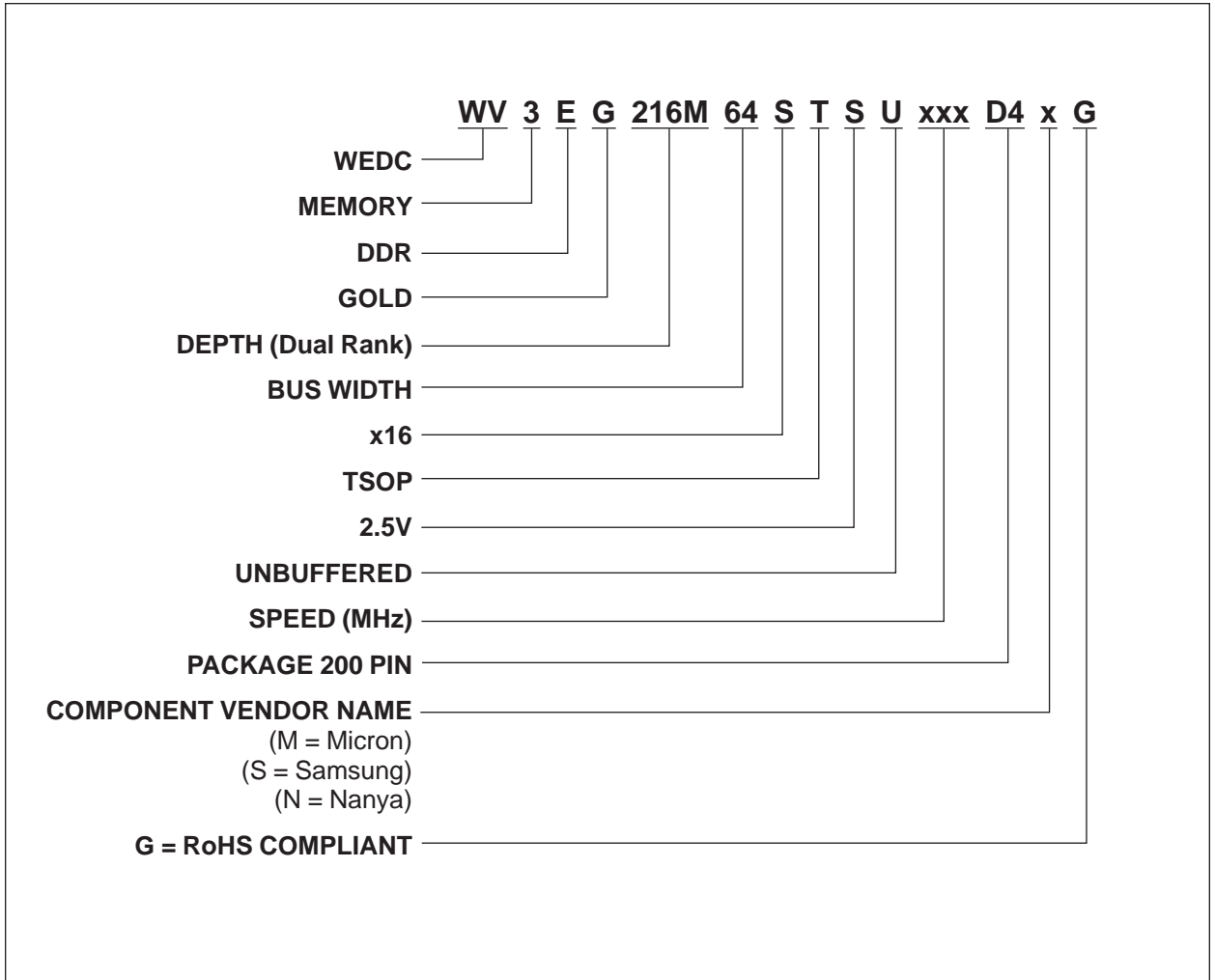
PACKAGE DIMENSIONS FOR D4

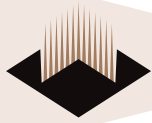


* ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES)



PART NUMBERING GUIDE





Document Title

256MB – 2x16Mx64, DDR SDRAM UNBUFFERED

Revision History

Rev #	History	Release Date	Status
Rev 0	Created	08-05	Preliminary
Rev 1	1.1 Added Samsung I _{DD} specs	12-05	Preliminary