



2GB – 2x128Mx72 DDR SDRAM REGISTERED ECC, w/PLL, FBGA

FEATURES

- Double-data-rate architecture
- DDR266, DDR333, and DDR400
- Bi-directional data strobes (DQS)
- Phase-lock loop (PLL) clock driver to reduce loading
- Differential clock inputs (CK & CK#)
- ECC error detection and correction
- 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
- Serial presence detect
- Dual Rank
- RoHS compliant products
- Power Supply:
 - $V_{CC} = V_{CCQ} = +2.5V \pm 0.2$ (133 and 166MHz)
 - $V_{CC} = V_{CCQ} = +2.6V \pm 0.1$ (200MHz)
- JEDEC standard 184 pin DIMM package
 - Package height options:
 - Low-profile: 30.48mm (1.20") MAX

NOTE: Consult factory for availability of:

- Vendor source control options
- Industrial temperature option

DESCRIPTION

The W3EG2128M72AFSR is a 2x128Mx72 Double Data Rate SDRAM memory module based on 512Mb DDR SDRAM components. The module consists of thirty-six 128Mx4 components, in FBGA packages mounted on a 184 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 subject to change without notice.

OPERATING FREQUENCIES

	DDR400@CL=3	DDR333@CL=2.5	DDR266@CL=2	DDR266@CL=2	DDR266@CL=2.5
Clock Speed	200MHz	166MHz	133MHz	133MHz	133MHz
CL-tRCD-tRP	3-3-3	2.5-3-3	2-2-2	2-3-3	2.5-3-3



PIN CONFIGURATION

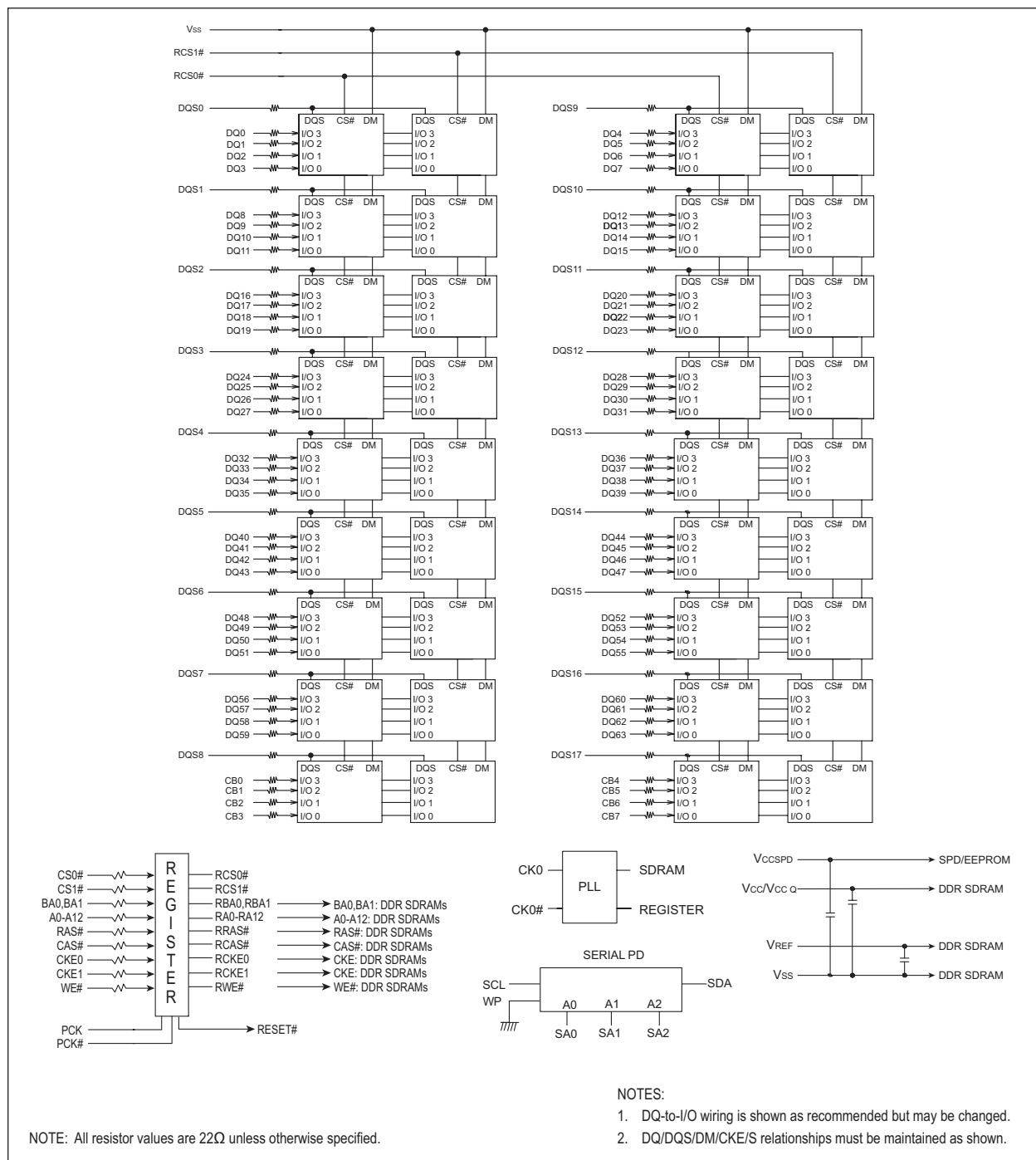
PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL
1	V _{REF}	47	DQS8	93	V _{SS}	139	V _{SS}
2	DQ0	48	A0	94	DQ4	140	DQS17
3	V _{SS}	49	CB2	95	DQ5	141	A10
4	DQ1	50	V _{SS}	96	V _{CC}	142	CB6
5	DQS0	51	CB3	97	DQS9	143	V _{CC}
6	DQ2	52	BA1	98	DQ6	144	CB7
7	V _{CC}	53	DQ32	99	DQ7	145	V _{SS}
8	DQ3	54	V _{CC}	100	V _{SS}	146	DQ36
9	NC	55	DQ33	101	NC	147	DQ37
10	RESET#	56	DQS4	102	NC	148	V _{CC}
11	V _{SS}	57	DQ34	103	NC	149	DQS13
12	DQ8	58	V _{SS}	104	V _{CC}	150	DQ38
13	DQ9	59	BA0	105	DQ12	151	DQ39
14	DQS1	60	DQ35	106	DQ13	152	V _{SS}
15	V _{CC}	61	DQ40	107	DQS10	153	DQ44
16	NC	62	V _{CC}	108	V _{CC}	154	RAS#
17	NC	63	WE#	109	DQ14	155	DQ45
18	V _{SS}	64	DQ41	110	DQ15	156	V _{CC}
19	DQ10	65	CAS#	111	CKE1	157	CS0#
20	DQ11	66	V _{SS}	112	V _{CC}	158	CS1#
21	CKE0	67	DQS5	113	NC	159	DQS14
22	V _{CC}	68	DQ42	114	DQ20	160	V _{SS}
23	DQ16	69	DQ43	115	A12	161	DQ46
24	DQ17	70	V _{CC}	116	V _{SS}	162	DQ47
25	DQS2	71	NC	117	DQ21	163	NC
26	V _{SS}	72	DQ48	118	A11	164	V _{CC}
27	A9	73	DQ49	119	DQS11	165	DQ52
28	DQ18	74	V _{SS}	120	V _{CC}	166	DQ53
29	A7	75	NC	121	DQ22	167	NC
30	V _{CC}	76	NC	122	A8	168	V _{CC}
31	DQ19	77	V _{CC}	123	DQ23	169	DQS15
32	A5	78	DQS6	124	V _{SS}	170	DQ54
33	DQ24	79	DQ50	125	A6	171	DQ55
34	V _{SS}	80	DQ51	126	DQ28	172	V _{CC}
35	DQ25	81	V _{SS}	127	DQ29	173	NC
36	DQS3	82	V _{CCID}	128	V _{CC}	174	DQ60
37	A4	83	DQ56	129	DQS12	175	DQ61
38	V _{CC}	84	DQ57	130	A3	176	V _{SS}
39	DQ26	85	V _{CC}	131	DQ30	177	DQS16
40	DQ27	86	DQS7	132	V _{SS}	178	DQ62
41	A2	87	DQ58	133	DQ31	179	DQ63
42	V _{SS}	88	DQ59	134	CB4	180	V _{CC}
43	A1	89	V _{SS}	135	CB5	181	SA0
44	CB0	90	NC	136	V _{CC}	182	SA1
45	CB1	91	SDA	137	CK0	183	SA2
46	V _{CC}	92	SCL	138	CK0#	184	V _{CCSPD}

PIN NAMES

A0-A12	Address input (Multiplexed)
BA0-BA1	Bank Select Address
DQ0-DQ63	Data Input/Output
CB0-CB7	Check bits
DQS0-DQS17	Data Strobe Input/Output
CK0	Clock Input
CK0#	Clock Input
CKE0, CKE1	Clock Enable input
CS0#, CS1#	Chip Select Input
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
V _{CC}	Power Supply
V _{SS}	Ground
V _{REF}	Power Supply for Reference
V _{CCSPD}	Serial EEPROM Power Supply
SDA	Serial data I/O
SCL	Serial clock
SA0-SA2	Address in EEPROM
V _{CCID}	V _{CC} Identification Flag
NC	No Connect
RESET#	Reset Enable



FUNCTIONAL BLOCK DIAGRAM





ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Units
Voltage on any pin relative to V _{SS}	V _{IN} , V _{OUT}	-0.5 - 3.6	V
Voltage on V _{CC} supply relative to V _{SS}	V _{CC} , V _{CCQ}	-1.0 - 3.6	V
Storage Temperature	T _{STG}	-55 - +150	°C
Power Dissipation	P _D	27	W
Short Circuit Current	I _{OS}	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

DC CHARACTERISTICS

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

Parameter	Symbol	Min	Max	Unit
Supply Voltage*	V _{CC}	2.3	2.7	V
Supply Voltage*	V _{CCQ}	2.3	2.7	V
Reference Voltage	V _{REF}	.49 x V _{CCQ}	.51 x V _{CCQ}	V
Termination Voltage	V _{TT}	V _{REF} - .04	V _{REF} + .04	V
Input High Voltage	V _{IH}	V _{REF} + 0.15	V _{CCQ} + 0.3	V
Input Low Voltage	V _{IL}	-0.3	V _{REF} - 0.15	V
Output High Current	I _{OH}	16.8	—	mA
Output Low Current	I _{OL}	16.8	—	mA

Note:

- * DDR400 V_{CC} = V_{CCQ} = 2.6V ± 0.1V.

CAPACITANCE

T_A = 25°C, f = 1MHz, V_{CC} = 2.5V ± 0.2V

Parameter	Symbol	Max	Unit
Input Capacitance (A0-A12)	C _{IN1}	5.5	pF
Input Capacitance (RAS#, CAS#, WE#)	C _{IN2}	5.5	pF
Input Capacitance (CKE0)	C _{IN3}	5.5	pF
Input Capacitance (CK0, CK0#)	C _{IN4}	5.5	pF
Input Capacitance (CS0#)	C _{IN5}	5.5	pF
Input Capacitance (DQM0-DQM8)	C _{IN6}	13.0	pF
Input Capacitance (BA0-BA1)	C _{IN7}	5.5	pF
Data input/output capacitance (DQ0-DQ63)(DQS)	C _{OUT}	13.0	pF
Data input/output capacitance (CB0-CB7)	C _{OUT}	13.0	pF

Note:

- These parameters serve to support both **SAMSUNG** and **MICRON** components based modules.



I_{CC} SPECIFICATIONS AND TEST CONDITIONS

Recommended operating conditions, 0°C ≤ T_A ≤ +70°C, V_{CCQ} = 2.5V ± 0.2V, V_{CC} = 2.5V ± 0.2V.

Includes DDR SDRAM components only

Parameter	Symbol	Rank 1 Conditions	DDR400@CL=3 Max	DDR333@CL=2.5 Max	DDR266@CL=2, 2.5 Max	Units	Rank 2 Standby State
Operating Current	I _{CC0}	One device bank; Active - Precharge; t _{RC} = t _{RC} (MIN); t _{CK} = t _{CK} (MIN); DQ, DM and DQS inputs changing once per clock cycle; Address and control inputs changing once every two cycles.	3870	2780	2790	mA	I _{CC3N}
Operating Current	I _{CC1}	One device bank; Active-Read-Precharge Burst = 2; t _{RC} = t _{RC} (MIN); t _{CK} = t _{CK} (MIN); I _{OUT} = 0mA; Address and control inputs changing once per clock cycle.	4410	3780	3780	mA	I _{CC3N}
Precharge Power-Down Standby Current	I _{CC2P}	All device banks idle; Power-down mode; t _{CK} = t _{CK} (MIN); CKE = (low)	180	180	180	mA	I _{CC2P}
Idle Standby Current	I _{CC2F}	CS# = High; All device banks idle; t _{CK} = t _{CK} (MIN); CKE = High; Address and other control inputs changing once per clock cycle. V _{IN} = V _{REF} for DQ, DQS and DM.	1980	1620	1620	mA	I _{CC2F}
Active Power-Down Standby Current	I _{CC3P}	One device bank active; Power-Down mode; t _{CK} (MIN); CKE = (low)	1620	1260	1260	mA	I _{CC3P}
Active Standby Current	I _{CC3N}	CS# = High; CKE = High; One device bank; Active-Precharge; t _{RC} = t _{RAS} (MAX); t _{CK} = t _{CK} (MIN); DQ, DM and DQS inputs changing twice per clock cycle; Address and other control inputs changing once per clock cycle.	2160	1800	1800	mA	I _{CC3N}
Operating Current	I _{CC4R}	Burst = 2; Reads; Continuous burst; One device bank active; Address and control inputs changing once per clock cycle; t _{CK} = t _{CK} (MIN); I _{OUT} = 0mA.	4500	3870	3870	mA	I _{CC3N}
Operating Current	I _{CC4W}	Burst = 2; Writes; Continuous burst; One device bank active; Address and control inputs changing once per clock cycle; t _{CK} = t _{CK} (MIN); DQ, DM and DQS inputs changing once per clock cycle.	4590	4050	3690	mA	I _{CC3N}
Auto Refresh Current	I _{CC5}	t _{RC} = t _{RC} (MIN)	7290	6120	6120	mA	I _{CC3N}
Self Refresh Current	I _{CC6}	CKE ≤ 0.2V	180	180	180	mA	I _{CC6}
Operating Current	I _{CC 7A}	Four bank interleaving Reads (BL=4) with auto precharge with t _{RC} =t _{RC} (MIN); t _{CK} =t _{CK} (MIN); Address and control inputs change only during Active Read or Write commands.	9180	8190	8100	mA	I _{CC3N}

Note:

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DETAILED TEST CONDITIONS FOR DDR SDRAM I_{CC1} & I_{CC7A}I_{CC1} : OPERATING CURRENT : ONE BANK

1. Typical Case : V_{CC}=2.5V, T=25°C
2. Worst Case : V_{CC}=2.7V, T=10°C
3. Only one bank is accessed with t_{RC} (min), Burst Mode, Address and Control inputs on NOP edge are changing once per clock cycle. I_{OUT} = 0mA
4. Timing Patterns :
 - DDR200 (100 MHz, CL=2) : t_{CK}=10ns, CL2, BL=4, t_{RCD}=2*t_{CK}, t_{RAS}=5*t_{CK}
Read : A0 N R0 N N P0 N A0 N - repeat the same timing with random address changing; 50% of data changing at every burst
 - DDR266 (133MHz, CL=2.5) : t_{CK}=7.5ns, CL=2.5, BL=4, t_{RCD}=3*t_{CK}, t_{RC}=9*t_{CK}, t_{RAS}=5*t_{CK}
Read : A0 N N R0 N P0 N N A0 N - repeat the same timing with random address changing; 50% of data changing at every burst
 - DDR266 (133MHz, CL=2) : t_{CK}=7.5ns, CL=2, BL=4, t_{RCD}=3*t_{CK}, t_{RC}=9*t_{CK}, t_{RAS}=5*t_{CK}
Read : A0 N N R0 N P0 N N A0 N - repeat the same timing with random address changing; 50% of data changing at every burst
 - DDR333 (166MHz, CL=2.5) : t_{CK}=6ns, BL=4, t_{RCD}=10*t_{CK}, t_{RAS}=7*t_{CK}
Read : A0 N N R0 N P0 N N A0 N - repeat the same timing with random address changing; 50% of data changing at every burst
 - DDR400 (200MHz, CL=3) : t_{CK}=5ns, BL=4, t_{RCD}=15*t_{CK}, t_{RAS}=7*t_{CK}
Read : A0 N N R0 N P0 N N A0 N - repeat the same timing with random address changing; 50% of data changing at every burst

I_{CC7A} : OPERATING CURRENT : FOUR BANKS

1. Typical Case : V_{CC}=2.5V, T=25°C
2. Worst Case : V_{CC}=2.7V, T=10°C
3. Four banks are being interleaved with t_{RC} (min), Burst Mode, Address and Control inputs on NOP edge are not changing. I_{OUT}=0mA
4. Timing Patterns :
 - DDR200 (100 MHz, CL=2) : t_{CK}=10ns, CL2, BL=4, t_{RRD}=2*t_{CK}, t_{RCD}=3*t_{CK}, Read with Autoprecharge
Read : A0 N A1 R0 A2 R1 A3 R2 A0 R3 A1 R0 - repeat the same timing with random address changing; 100% of data changing at every burst
 - DDR266 (133MHz, CL=2.5) : t_{CK}=7.5ns, CL=2.5, BL=4, t_{RRD}=3*t_{CK}, t_{RCD}=3*t_{CK}
Read with Autoprecharge
Read : A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 - repeat the same timing with random address changing; 100% of data changing at every burst
 - DDR266 (133MHz, CL=2) : t_{CK}=7.5ns, CL2=2, BL=4, t_{RRD}=2*t_{CK}, t_{RCD}=2*t_{CK}
Read : A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 - repeat the same timing with random address changing; 100% of data changing at every burst
 - DDR333 (166MHz, CL=2.5) : t_{CK}=6ns, BL=4, t_{RRD}=3*t_{CK}, t_{RCD}=3*t_{CK}, Read with Autoprecharge
Read : A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 - repeat the same timing with random address changing; 100% of data changing at every burst
 - DDR400 (200MHz, CL=3) : t_{CK}=5ns, BL=4, t_{RRD}=10*t_{CK}, t_{RCD}=15*t_{CK}, Read with Autoprecharge
Read : A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 - repeat the same timing with random address changing; 100% of data changing at every burst

Legend:

A = Activate, R = Read, W = Write, P = Precharge, N = NOP

A (0-3) = Activate Bank 0-3

R (0-3) = Read Bank 0-3



DDR SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

DDR400: $V_{CC} = V_{CCQ} = +2.6V \pm 0.1V$; DDR333, 266: $V_{CC} = V_{CCQ} = +2.5V \pm 0.2V$

AC Characteristics			403		335		262		265			
Parameter	Symbol		Min	Max	Min	Max	Min	Max	Min	Max	Units	Notes
Access window of DQs from CK, CK#	t_{AC}		-0.70	+0.70	-0.70	+0.70	-0.75	+0.75	-0.75	+0.75	ns	
CK high-level width	t_{CH}		0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55	t_{CK}	16
CK low-level width	t_{CL}		0.45	0.55	0.45	0.55	0.45	0.55	0.45	0.55	t_{CK}	16
Clock cycle time	CL=3	$t_{CK} (3)$	5	7.5	6	13	7.5	13	7.5	13	ns	22
	CL=2.5	$t_{CK} (2.5)$	6	12	6	12	7.5	12	7.5	12	ns	22
	CL=2	$t_{CK} (2)$	7.5	12	7.5	12	7.5	12	10	12	ns	22
DQ and DM input hold time relative to DQS	t_{DH}		0.40		0.45		0.5		0.5		ns	14,17
DQ and DM input setup time relative to DQS	t_{DS}		0.40		0.45		0.5		0.5		ns	14,17
DQ and DM input pulse width (for each input)	t_{DIPW}		1.75		1.75		1.75		1.75		ns	17
Access window of DQS from CK, CK#	t_{DQSCK}		-0.60	+0.60	-0.60	+0.60	-0.75	+0.75	-0.75	+0.75	ns	
DQS input high pulse width	t_{DQSH}		0.35			0.35	0.35		0.35		t_{CK}	
DQS input low pulse width	t_{DQSL}		0.35			0.35	0.35		0.35		t_{CK}	
DQS-DQ skew, DQS to last DQ valid, per group, per access	t_{DQSQ}			0.40		0.45		0.5		0.5	ns	13,14
Write command to first DQS latching transition	t_{DQSS}		0.72	1.28	0.75	1.25	0.75	1.25	0.75	1.25	t_{CK}	
DQS falling edge to CK rising - setup time	t_{DSS}		0.2		0.2		0.2		0.2		t_{CK}	
DQS falling edge from CK rising - hold time	t_{DSH}		0.2		0.2		0.2		0.2		t_{CK}	
Half clock period	t_{HP}	t_{CH}, t_{CL}			t_{CH}, t_{CL}		t_{CH}, t_{CL}		t_{CH}, t_{CL}		ns	18
Data-out high-impedance window from CK, CK#	t_{HZ}			+0.70		+0.70		+0.75		+0.75	ns	8,19
Data-out low-impedance window from CK, CK#	t_{LZ}		-0.70		-0.70		-0.75		-0.75		ns	8,20
Address and control input hold time (slew rate $\geq 5V/ns$)	t_{IHf}		0.60		0.75		0.90		0.90		ns	6
Address and control input set-up time (slew rate $\geq 5V/ns$)	t_{ISf}		0.60		0.75		0.90		0.90		ns	6
Address and control input hold time (slow slew rate)	t_{IHs}		N/A		0.80		1		1		ns	6
Address and control input setup time (slow slew rate)	t_{ISs}		N/A		0.80		1		1		ns	6
Address and control input pulse width (for each input)	t_{IPW}		2.2		2.2		2.2		2.2		ns	
LOAD MODE REGISTER command cycle time	t_{MRD}		10		12		15		15		ns	
DQ-DQS hold, DQS to first DQ to go non-valid, per access	t_{QH}	$t_{HP}-t_{QHS}$			$t_{HP}-t_{QHS}$		$t_{HP}-t_{QHS}$		$t_{HP}-t_{QHS}$		ns	13,14
Data hold skew factor	t_{QHS}			0.55		0.55		0.75		0.75	ns	
ACTIVE to PRECHARGE command	t_{RAS}		40	70,000	42	70,000	40	120,000	40	120,000	ns	15
ACTIVE to READ with Auto precharge command	t_{RAP}		15		15		15		15		ns	

Note:

- These parameters serve to support both **SAMSUNG** and **MICRON** components based modules.

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DDR SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (continued)

DDR400: $V_{CC} = V_{CCQ} = +2.6V \pm 0.1V$; DDR333, 266: $V_{CC} = V_{CCQ} = +2.5V \pm 0.2V$

AC Characteristics		403		335		262		265			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Units	Notes
ACTIVE to ACTIVE/AUTO REFRESH command period	t_{RC}	55		60		60		60		ns	
AUTO REFRESH command period	t_{RFC}	70		72		75		75		ns	21
ACTIVE to READ or WRITE delay	t_{RCD}	15		15		15		15		ns	
PRECHARGE command period	t_{RP}	15		15		15		15		ns	
DQS read preamble	t_{RPRE}	0.9	1.1	0.9	1.1	0.9	1.1	0.9	1.1	t _{CK}	
DQS read postamble	t_{RPST}	0.4	0.6	0.4	0.6	0.4	0.6	0.4	0.6	t _{CK}	
ACTIVE bank a to ACTIVE bank b command	t_{RRD}	10		12		15		15		ns	
DQS write preamble	t_{WPRE}	0.25		0.25		0.25		0.25		t _{CK}	
DQS write preamble setup time	t_{WPRES}	0		0		0		0		ns	10,11
DQS write postamble	t_{WPST}	0.4	0.6	0.4	0.6	0.4	0.6	0.4	0.6	t _{CK}	9
Write recovery time	t_{WR}	15		15		15		15		ns	
Internal WRITE to READ command delay	t_{WTR}	2		1		1		1		t _{CK}	
Data valid output window	NA	$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		ns	13
REFRESH to REFRESH command interval	t_{REFC}		70.3		70.3		70.3		70.3	μs	12
Average periodic refresh interval	t_{REFI}		7.8		7.8		7.8		7.8	μs	12
Terminating voltage delay to V_{CC}	t_{VTD}	0		0		0		0		ns	
Exit SELF REFRESH to non-READ command	t_{XSNR}	70		75		75		75		ns	
Exit SELF REFRESH to READ command	t_{XSRD}	200		200		200		200		t _{CK}	

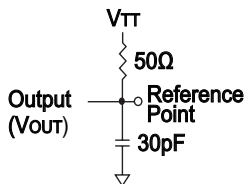
Note:

- These parameters serve to support both **SAMSUNG** and **MICRON** components based modules.



Notes

1. All voltages referenced to V_{SS}
2. Tests for AC timing, I_{CC} , and electrical AC and DC characteristics may be conducted at normal reference / supply voltage levels, but the related specifications and device operations are guaranteed for the full voltage range specified.
3. Outputs are measured with equivalent load:



4. AC timing and I_{CC} tests may use a V_{IL} -to- V_{IH} swing of up to 1.5V in the test environment, but input timing is still referenced to V_{REF} (or to the crossing point for CK/CK#), and parameter specifications are guaranteed for the specified AC input levels under normal use conditions. The minimum slew rate for the input signals used to test the device is 1V/ns in the range between $V_{IL}(AC)$ and $V_{IH}(AC)$.
5. The AC and DC input level specifications are defined in the SSTL_2 standard (i.e., the receiver will effectively switch as a result of the signal crossing the AC input level, and will remain in that state as long as the signal does not ring back above [below] the DC input LOW [high] level).
6. For slew rates less than 1V/ns and greater than or equal to 0.5V/ns. If the slew rate is less than 0.5V/ns, timing must be derated: t_{is} has an additional 50ps per each 100mV/ns reduction in slew rate from the 500mV/ns. t_{IH} has 0ps added, that is, it remains constant. If the slew rate exceeds 4.5V/ns, functionality is uncertain. For 335, slew rates must be greater than or equal to 0.5V/ns.
7. Inputs are not recognized as valid until V_{REF} stabilizes. Exception: during the period before V_{REF} stabilizes, $CKE \leq 0.3 \times V_{CCQ}$ is recognized as LOW.
8. t_{HZ} and t_{LZ} transitions occur in the same access time windows as valid data transitions. These parameters are not referenced to a specific voltage level, but specify when the device output is no longer driving (HZ) and begins driving (LZ).
9. The intent of the "Don't Care" state after completion of the postamble is the DQS-driven signal should either be HIGH, LOW, or high-Z, and that any signal transition within the input switching region must follow valid input requirements. That is, if DQS transitions HIGH (above V_{IHDC} (MIN)) then it must not transition LOW (below V_{IHDC}) prior to t_{DQSH} (MIN).
10. This is not a device limit. The device will operate with a negative value, but system performance could be degraded due to bus turnaround.
11. It is recommended that DQS be valid (HIGH or LOW) on or before the WRITE command. The case shown (DQS going from High-Z to logic LOW) applies when no WRITES were previously in progress on the bus. If a previous WRITE was in progress, DQS could be high during this time, depending on t_{DQSS} .
12. The refresh period is 64ms. This equates to an average refresh rate of 7.8125 μ s. However, an AUTO REFRESH command must be asserted at least once every 70.3 μ s; burst refreshing or posting by the DRAM controller greater than eight refresh cycles is not allowed.
13. The valid data window is derived by achieving other specifications - t_{HP} ($t_{CK}/2$), t_{DQSQ} , and t_{QH} ($t_{QH} = t_{HP} - t_{QHS}$). The data valid window derates directly proportional with the clock duty cycle and a practical data valid window can be derived. The clock is allowed a maximum duty cycled variation of 45/55. Functionality is uncertain when operating beyond a 45/55 ratio. The data valid window derating curves are provided below for duty cycles ranging between 50/50 and 45/55.
14. Referenced to each output group: x4 = DQS with DQ0-DQ3.
15. READs and WRITEs with auto precharge are not allowed to be issued until t_{RAS} (MIN) can be satisfied prior to the internal precharge command being issued.
16. JEDEC specifies CK and CK# input slew rate must be $\geq 1V/ns$ (2V/ns differentially).
17. DQ and DM input slew rates must not deviate from DQS by more than 10%. If the DQ/DM/DQS slew rate is less than 0.5V/ns, timing must be derated: 50ps must be added to t_{DS} and t_{DH} for each 100mV/ns reduction in slew rate. If slew rates exceed 4V/ns, functionality is uncertain.
18. t_{HP} min is the lesser of t_{CL} min and t_{CH} min actually applied to the device CK and CK# inputs, collectively during bank active.
19. t_{HZ} (MAX) will prevail over the t_{DQSQ} (MAX) + t_{RPST} (MAX) condition. t_{LZ} (MIN) will prevail over t_{DQSQ} (MIN) + PRE (MAX) condition.
20. For slew rates greater than 1V/ns the (LZ) transition will start about 310ps earlier.
21. CKE must be active (High) during the entire time a refresh command is executed. That is, from the time the AUTO REFRESH command is registered, CKE must be active at each rising clock edge, until t_{RFC} has been satisfied.
22. Whenever the operating frequency is altered, not including jitter, the DLL is required to be reset. This is followed by 200 clock cycles (before READ commands).



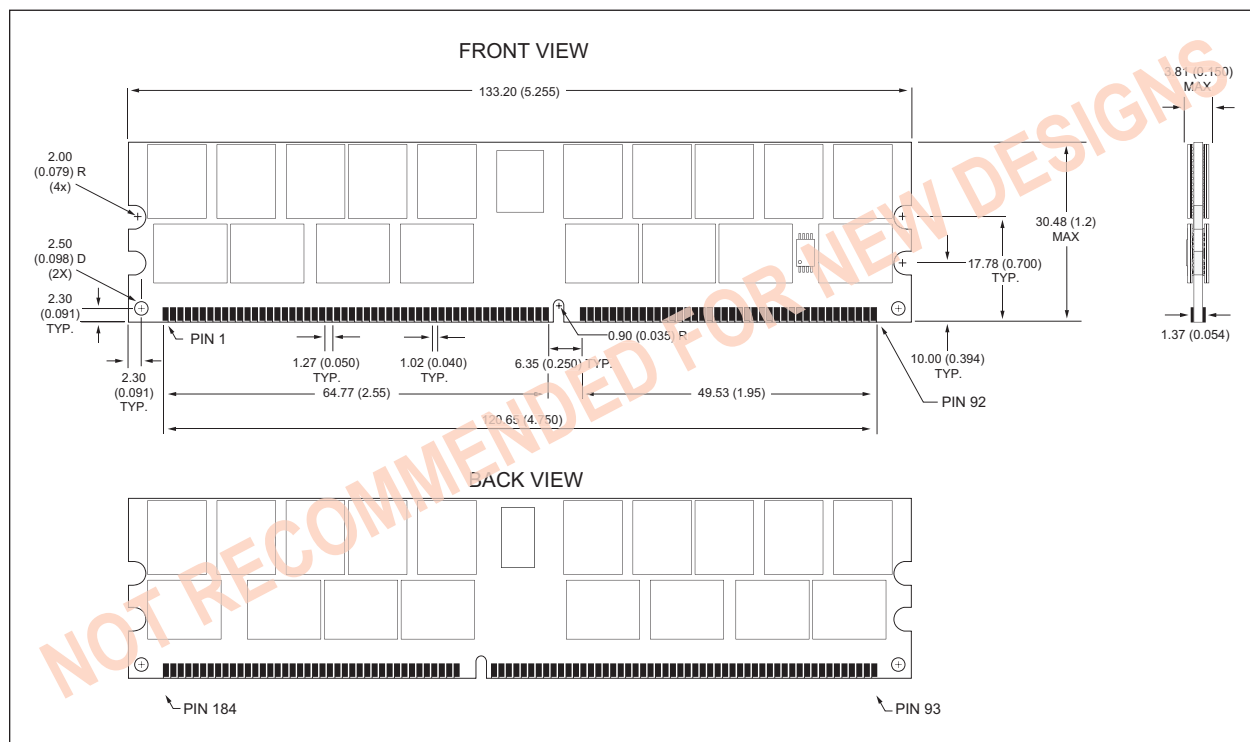
ORDERING INFORMATION FOR D3

Part Number	Speed/Data Rate	CAS Latency	t _{RCD}	t _{RP}	Height*
W3EG2128M72AFSR265D3xG	133MHz/266Mb/s	2.5	3	3	30.48 (1.20") MAX

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
- In an effort to support our customer's traceability and control requirements (which enables them to quickly identify component speed grades used on modules in the field); WEDC has created a "26A" module part number option. The W3EG2128M72AFSR26AD3xG product part number meets all the requirements of the W3EG2128M72AFSR265D3xG product however it is built using 400Mhz rated components. We recommend therefore that customers include both the "26A" and "265" final part numbers on their AVL in order to support flexibility of sourcing and to allow for the best module sourcing lead times. For those customers who wish to allow both sourcing options but only would like to include one product part number on their AVL, WEDC can accommodate. Please consult factory for more details.

LOW-PROFILE D3 184-PIN DDR DIMM DIMENSIONS



* ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES).



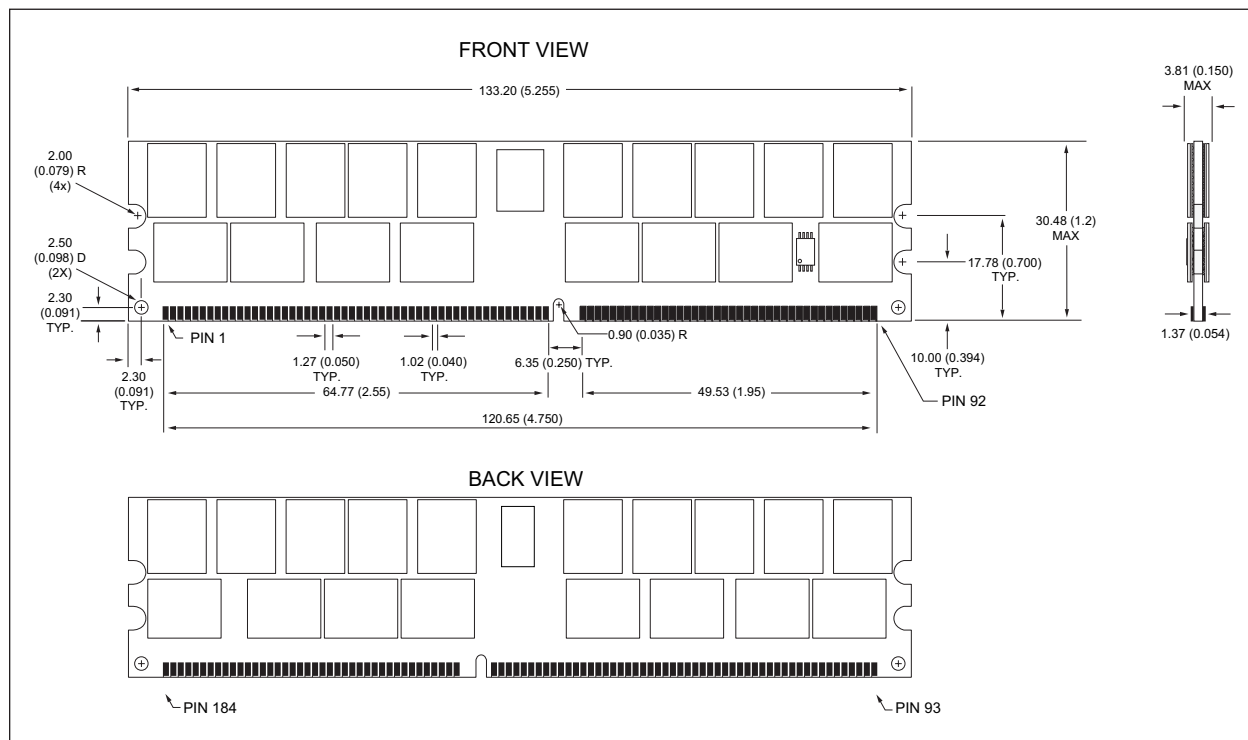
ORDERING INFORMATION FOR AD3

Part Number	Speed/Data Rate	CAS Latency	t _{RCD}	t _{RP}	Height*
W3EG2128M72AFSR403AD3xG	200MHz/400Mb/s	3	3	3	30.48 (1.20") MAX
W3EG2128M72AFSR335AD3xG	166MHz/333Mb/s	2.5	3	3	30.48 (1.20") MAX
W3EG2128M72AFSR262AD3xG	133MHz/266Mb/s	2	2	2	30.48 (1.20") MAX
W3EG2128M72AFSR263AD3xG	133MHz/266Mb/s	2	3	3	30.48 (1.20") MAX
W3EG2128M72AFSR265AD3xG	133MHz/266Mb/s	2.5	3	3	30.48 (1.20") MAX

NOTES:

- 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 & consult factory for others)
- Consult factory for availability of industrial temperature (-40°C to 85°C) option
- In an effort to support our customer's traceability and control requirements (which enables them to quickly identify component speed grades used on modules in the field); WEDC has created a "26A" module part number option. The W3EG2128M72AFSR26AAD3xG product part number meets all the requirements of the W3EG2128M72AFSR265AD3xG product however it is built using 400Mhz rated components. We recommend therefore that customers include both the "26A" and "265" final part numbers on their AVL in order to support flexibility of sourcing and to allow for the best module sourcing lead times. For those customers who wish to allow both sourcing options but only would like to include one product part number on their AVL, WEDC can accommodate. Please consult factory for more details.

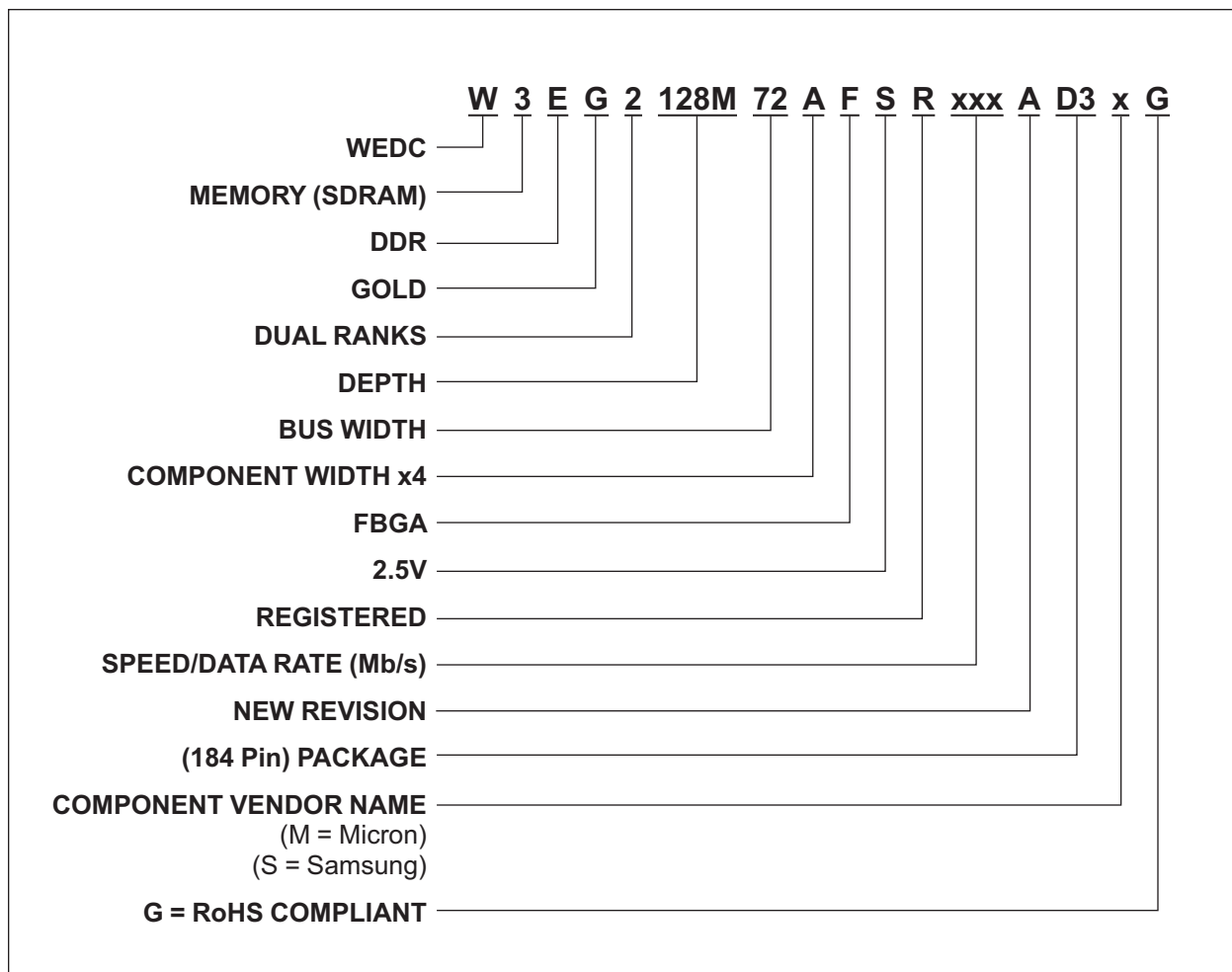
LOW-PROFILE AD3 184-PIN DDR DIMM DIMENSIONS



* ALL DIMENSIONS ARE IN MILLIMETERS AND (INCHES).



PART NUMBERING GUIDE



**Document Title**

2GB - 2x128Mx72, DDR SDRAM Registered ECC, w/PLL, FBGA

Revision History

Rev #	History	Release Date	Status
Rev 0	Initial Release	September 2004	Advanced
Rev 1	1.1 Added Lead-free option 1.2 Added vendor code options M = Micron S = Samsung	November 2004	Advanced
Rev 2	2.1 Removed DDR200 specifications 2.2 Added "AD3" package option 2.3 Added the "26A" module part number option 2.4 Indicated "D3" not recommended for new design or new qualifications, insted use "AD3" option 2.5 Removed 333Mb/s, 266Mb/s (CL 2-2-2), 266Mb/s (CL 2-3-3) and 200Mb/s (CL 2-2-2) specifications for "D3" package option 2.6 Added "A" in part number guide.	December 2005	Advanced
Rev 3	3.1 Added 400 MHz clock speed 3.2 Datasheet AC's and DC's updated to support both Micron's 512Mb specification: 512MBDDR4x8x16_1.fm-revJ1/06EN and Samsung's 512Mb C-Die specification: Rev 1.1 June 2005 3.3 Data Sheet move to final	January 2006	Final