

# 2GB DDR2 – SDRAM DIMM

240 Pin DIMM

SEU02G64B3BF2SA-25R

2GB PC2-6400 in FBGA Technology

RoHS compliant

Options:

- |                                 |                   |             |
|---------------------------------|-------------------|-------------|
| ▪ Data Rate / Latency           |                   | Marking     |
| DDR2 800 MT/s CL6               |                   | -25         |
| DDR2 667 MT/s CL5               |                   | -30         |
| ▪ Module density                |                   |             |
| 2048MB with 16 dies and 2 ranks |                   |             |
| ▪ Standard Grade                | (T <sub>A</sub> ) | 0°C to 70°C |
|                                 | (T <sub>C</sub> ) | 0°C to 85°C |

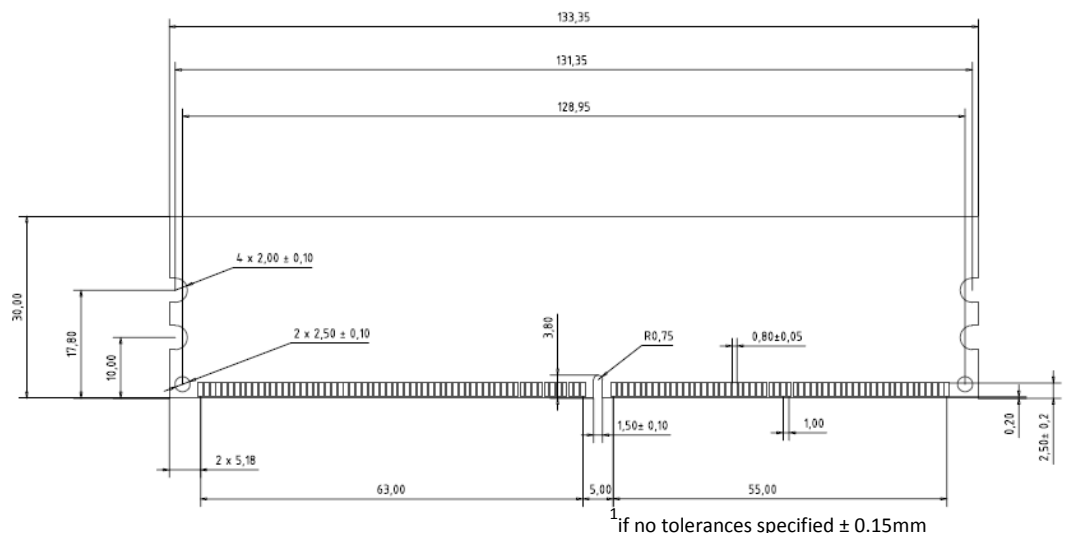
Environmental Requirements:

- Operating temperature (ambient)  
Standard Grade 0°C to 70°C
- Operating Humidity  
10% to 90% relative humidity, noncondensing
- Operating Pressure  
105 to 69 kPa (up to 10000 ft.)
- Storage Temperature  
-55°C to 100°C
- Storage Humidity  
5% to 95% relative humidity, noncondensing
- Storage Pressure  
1682 PSI (up to 5000 ft.) at 50°C

Features:

- 240-pin 64-bit Dual-In-Line Double Data Rate synchronous DRAM Module
- Module organization: dual rank 256M x 64
- V<sub>DD</sub> = 1.8V ±0.1V, V<sub>DDQ</sub> 1.8V ±0.1V
- 1.8V I/O ( SSTL\_18 compatible)
- Auto Refresh (CBR) and Self Refresh 8k Refresh every 64ms
- Serial Presence Detect with EEPROM
- Gold-contact pad
- This module is fully pin and functional compatible to the JEDEC PC2-6400 spec. and JEDEC- Standard MO-237. (see [www.jedec.org](http://www.jedec.org))
- The pcb and all components are manufactured according to the RoHS compliance specification [EU Directive 2002/95/EC Restriction of Hazardous Substances (RoHS)]
- **DDR2 - SDRAM component SAMSUNG K4T1G084QF DIE Rev. F**
- 128Mx8 DDR2 SDRAM in FBGA-60 package
- 4-bit prefetch architecture
- DLL to align DQ and DQS transitions with CK
- Multiple internal device banks for concurrent operation
- Programmable CAS latency (CL)
- Posted CAS additive latency (AL)
- WRITE latency = READ latency – 1 t<sub>CK</sub>
- Programmable burst length: 4 or 8
- Adjustable data-output drive strength
- On-die termination (ODT)

Figure: mechanical dimensions<sup>1</sup>



This Swissbit module is an industry standard 240-pin 8-byte DDR2 SDRAM Dual-In-line Memory Module (UDIMM) which is organized as x64 high speed CMOS memory arrays. The module uses internally configured octal-bank DDR2 SDRAM devices. The module uses double data rate architecture to achieve high-speed operation. DDR2 SDRAM modules operate from a differential clock (CK and CK#). READ and WRITE accesses to a DDR2 SDRAM module is burst-oriented; accesses start at a selected location and continue for a programmed number of locations in a programmed sequence. The burst length is either four or eight locations. An auto precharge function can be enabled to provide a self-timed row precharge that is initiated at the end of a burst access. The DDR2 SDRAM devices have a multibank architecture which allows a concurrent operation that is providing a high effective bandwidth. A self refresh mode is provided and a power-saving "power-down" mode. All inputs and all full drive-strength outputs are SSTL\_18 compatible.

The DDR2 SDRAM module uses the optional serial presence detect (SPD) function implemented via serial EEPROM using the standard I<sup>2</sup>C protocol. This nonvolatile storage device contains 256 bytes. The first 128 bytes are utilized by the DIMM manufacturer (swissbit) to identify the module type, the module's organization and several timing parameters. The second 128 bytes are available to the end user.

### Module Configuration

Organization	DDR2 SDRAMs used	Row Addr.	Device Bank Addr.	Column Addr.	Refresh	Module Bank Select
256M x 64bit	16 x 128M x 8bit (1024Mbit)	14	BA0, BA1, BA2	10	8k	S0#, S1#

### Module Dimensions

in mm

133.35 (long) x 30(high) x 4.00 [max] (thickness)

### Timing Parameters

Part Number	Module Density	Transfer Rate	Clock Cycle/Data bit rate	Latency
SEU02G64B3BF2SA-25R	2048 MB	6.4 GB/s	2.5ns/800MT/s	6-6-6
SEU02G64B3BF2SA-30R	2048 MB	5.3 GB/s	3.0ns/667MT/s	5-5-5

### Pin Name

A0-9, A11 – A13	Address Inputs
A10/AP	Address Input / Autoprecharge Bit
BA0 – BA2	Bank Address Inputs
DQ0 – DQ63	Data Input / Output
DM0-DM7	Input Data Mask
DQS0 - DQS7	Data Strobe, positive line
DQS0# - DQS7#	Data Strobe, negative line (only used when differential data strobe mode is enabled)
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
CKE0 – CKE1	Clock Enable
S0#, S1#	Chip Select
CK0 – CK2	Clock Inputs, positive line
CK0# - CK2#	Clock Inputs, negative line

V <sub>DD</sub>	Supply Voltage (1.8V± 0.1V)
V <sub>REF</sub>	Input / Output Reference
V <sub>SS</sub>	Ground
V <sub>DDSPD</sub>	Serial EEPROM Positive Power Supply
SCL	Serial Clock for Presence Detect
SDA	Serial Data Out for Presence Detect
SA0 – SA1	Presence Detect Address Inputs
ODT0, ODT1	On-Die Termination
NC	No Connection

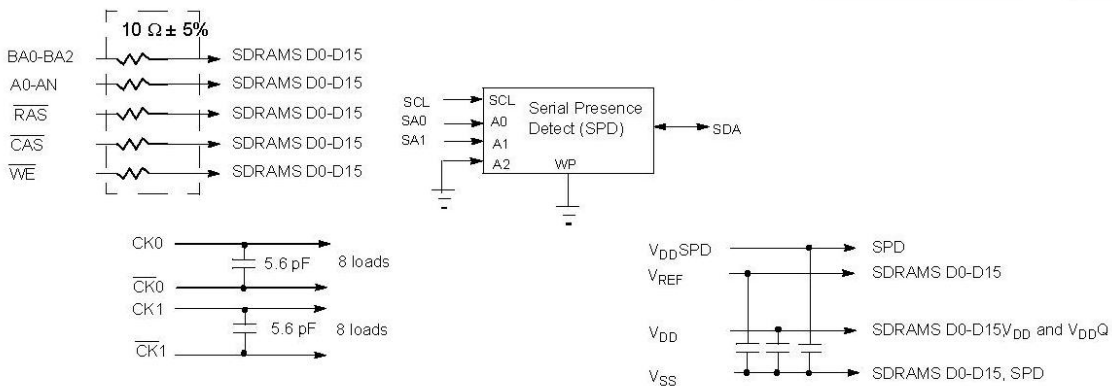
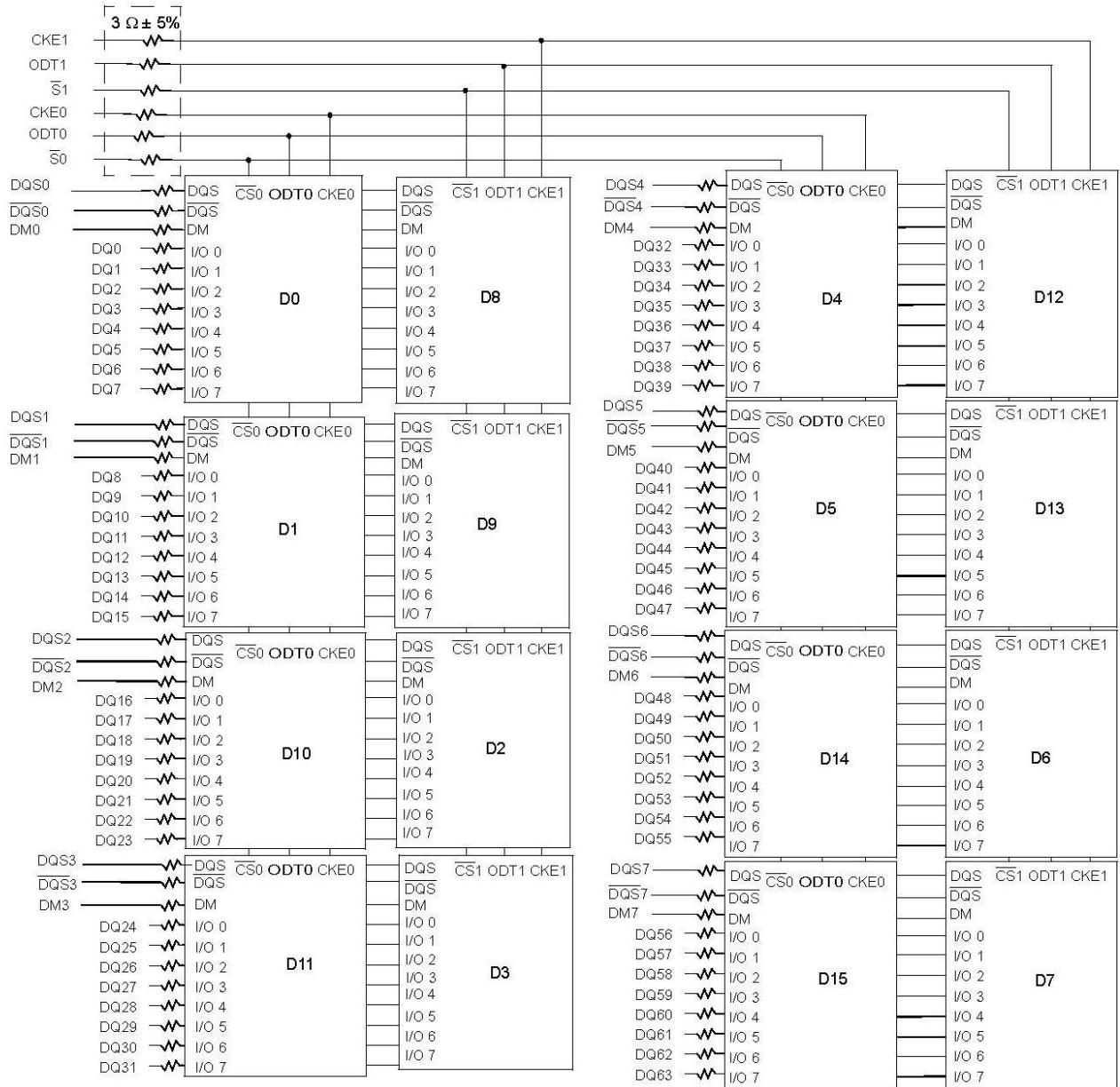
**Pin Configuration**

PIN #	Front Side	PIN #	Back Side	PIN #	Front Side	PIN #	Back Side
1	V <sub>REF</sub>	121	V <sub>SS</sub>	61	A4	181	V <sub>DDQ</sub>
2	V <sub>SS</sub>	122	DQ4	62	V <sub>DDQ</sub>	182	A3
3	DQ0	123	DQ5	63	A2	183	A1
4	DQ1	124	V <sub>SS</sub>	64	V <sub>DD</sub>	184	V <sub>DD</sub>
5	V <sub>SS</sub>	125	DM0 (DQS9)	65	V <sub>SS</sub>	185	CK0
6	DQS0#	126	NC (DQS9#)	66	V <sub>SS</sub>	186	CK0#
7	DQS0	127	V <sub>SS</sub>	67	V <sub>DD</sub>	187	V <sub>DD</sub>
8	V <sub>SS</sub>	128	DQ6	68	NC (Par_In)	188	A0
9	DQ2	129	DQ7	69	V <sub>DD</sub>	189	V <sub>DD</sub>
10	DQ3	130	V <sub>SS</sub>	70	A10/AP	190	BA1
11	V <sub>SS</sub>	131	DQ12	71	BA0	191	V <sub>DDQ</sub>
12	DQ8	132	DQ13	72	V <sub>DDQ</sub>	192	RAS#
13	DQ9	133	V <sub>SS</sub>	73	WE#	193	S0#
14	V <sub>SS</sub>	134	DM1 (DQS10)	74	CAS#	194	V <sub>DDQ</sub>
15	DQS1#	135	NC (DQS10#)	75	V <sub>DDQ</sub>	195	ODT0
16	DQS1	136	V <sub>SS</sub>	76	S1#	196	A13
17	V <sub>SS</sub>	137	CK1	77	ODT1	197	V <sub>DD</sub>
18	NC(RESET#)	138	CK1#	78	V <sub>DDQ</sub>	198	V <sub>SS</sub>
19	NC	139	V <sub>SS</sub>	79	V <sub>SS</sub>	199	DQ36
20	V <sub>SS</sub>	140	DQ14	80	DQ32	200	DQ37
21	DQ10	141	DQ15	81	DQ33	201	V <sub>SS</sub>
22	DQ11	142	V <sub>SS</sub>	82	V <sub>SS</sub>	202	DM4 (DQS13)
23	V <sub>SS</sub>	143	DQ20	83	DQS4#	203	NC (DQS13#)
24	DQ16	144	DQ21	84	DQS4	204	V <sub>SS</sub>
25	DQ17	145	V <sub>SS</sub>	85	V <sub>SS</sub>	205	DQ38
26	V <sub>SS</sub>	146	DM2 (DQS11)	86	DQ34	206	DQ39
27	DQS2#	147	NC (DQS11#)	87	DQ35	207	V <sub>SS</sub>
28	DQS2	148	V <sub>SS</sub>	88	V <sub>SS</sub>	208	DQ44
29	V <sub>SS</sub>	149	DQ22	89	DQ40	209	DQ45
30	DQ18	150	DQ23	90	DQ41	210	V <sub>SS</sub>
31	DQ19	151	V <sub>SS</sub>	91	V <sub>SS</sub>	211	DM5 (DQS14)
32	V <sub>SS</sub>	152	DQ28	92	DQS5#	212	NC (DQS14#)

PIN #	Front Side	PIN #	Back Side	PIN #	Front Side	PIN #	Back Side
33	DQ24	153	DQ29	93	DQS5	213	V <sub>SS</sub>
34	DQ25	154	V <sub>SS</sub>	94	V <sub>SS</sub>	214	DQ46
35	V <sub>SS</sub>	155	DM3 (DQS12)	95	DQ42	215	DQ47
36	DQS3#	156	NC (DQS12#)	96	DQ43	216	V <sub>SS</sub>
37	DQS3	157	V <sub>SS</sub>	97	V <sub>SS</sub>	217	DQ52
38	V <sub>SS</sub>	158	DQ30	98	DQ48	218	DQ53
39	DQ26	159	DQ31	99	DQ49	219	V <sub>SS</sub>
40	DQ27	160	V <sub>SS</sub>	100	V <sub>SS</sub>	220	CK2
41	V <sub>SS</sub>	161	NC (CB4)	101	SA2	221	CK2#
42	NC (CB0)	162	NC (CB5)	102	NC (TEST)	222	V <sub>SS</sub>
43	NC (CB1)	163	V <sub>SS</sub>	103	V <sub>SS</sub>	223	DM6 (DQS15)
44	V <sub>SS</sub>	164	NC (DM8,DQS17)	104	DQS6#	224	NC (DQS15#)
45	NC (DQS8#)	165	NC (DQS17#)	105	DQS6	225	V <sub>SS</sub>
46	NC (DQS8)	166	V <sub>SS</sub>	106	V <sub>SS</sub>	226	DQ54
47	V <sub>SS</sub>	167	NC (CB6)	107	DQ50	227	DQ55
48	NC (CB2)	168	NC (CB7)	108	DQ51	228	V <sub>SS</sub>
49	NC (CB3)	169	V <sub>SS</sub>	109	V <sub>SS</sub>	229	DQ60
50	V <sub>SS</sub>	170	V <sub>DDQ</sub>	110	DQ56	230	DQ61
51	V <sub>DD</sub>	171	CKE1	111	DQ57	231	V <sub>SS</sub>
52	CKE0	172	V <sub>DD</sub>	112	V <sub>SS</sub>	232	DM7 (DQS16)
53	V <sub>DD</sub>	173	NC (A15)	113	DQS7#	233	NC (DQS16#)
54	BA2	174	NC (A14)	114	DQS7	234	V <sub>SS</sub>
55	NC(Par_Out)	175	V <sub>DDQ</sub>	115	V <sub>SS</sub>	235	DQ62
56	V <sub>DDQ</sub>	176	A12	116	DQ58	236	DQ63
57	A11	177	A9	117	DQ59	237	V <sub>SS</sub>
58	A7	178	V <sub>DD</sub>	118	V <sub>SS</sub>	238	V <sub>DDSPD</sub>
59	V <sub>DD</sub>	179	A8	119	SDA	239	SA0
60	A5	180	A6	120	SCL	240	SA1

(Sig): Signal in brackets may be routed to the socket connector, but is not used on the module

**FUNCTIONAL BLOCK DIAGRAM 2048MB DDR2 SDRAM DIMM, 2 RANKS AND 16 COMPONENTS**



**MAXIMUM ELECTRICAL DC CHARACTERISTICS**

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Supply Voltage	$V_{DD}$	-1.0	2.3	V
I/O Supply Voltage	$V_{DDQ}$	-0.5	2.3	V
$V_{DDL}$ Supply Voltage	$V_{DDL}$	-0.5	2.3	V
Voltage on any pin relative to $V_{SS}$	$V_{IN}, V_{OUT}$	-0.5	2.3	V
<b>INPUT LEAKAGE CURRENT</b> Any input $0V \leq V_{IN} \leq V_{DD}$ , $V_{REF}$ pin $0V \leq V_{IN} \leq 0.95V$ (All other pins not under test = 0V)	$I_I$			$\mu A$
Command/Address RAS#, CAS#, WE#, S#, CKE		-40	40	
CK, CK#		-20	20	
DM		-5	5	
<b>OUTPUT LEAKAGE CURRENT</b> (DQ's and ODT are disabled; $0V \leq V_{OUT} \leq V_{DDQ}$ )	$I_{OZ}$	-5	5	$\mu A$
DQ, DQS, DQS#				
$V_{REF}$ LEAKAGE CURRENT ; $V_{REF}$ is on a valid level	$I_{VREF}$	-16	16	$\mu A$

**DC OPERATING CONDITIONS**

PARAMETER/ CONDITION	SYMBOL	MIN	NOM	MAX	UNITS
Supply Voltage	$V_{DD}$	1.7	1.8	1.9	V
I/O Supply Voltage	$V_{DDQ}$	1.7	1.8	1.9	V
$V_{DDL}$ Supply Voltage	$V_{DDL}$	1.7	1.8	1.9	V
I/O Reference Voltage	$V_{REF}$	$0.49 \times V_{DDQ}$	$0.50 \times V_{DDQ}$	$0.51 \times V_{DDQ}$	V
I/O Termination Voltage (system)	$V_{TT}$	$V_{REF} - 0.04$	$V_{REF}$	$V_{REF} + 0.04$	V
Input High (Logic 1) Voltage	$V_{IH(DC)}$	$V_{REF} + 0.125$		$V_{DDQ} + 0.3$	V
Input Low (Logic 0) Voltage	$V_{IL(DC)}$	-0.3		$V_{REF} - 0.125$	V

**AC INPUT OPERATING CONDITIONS**

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Input High (Logic 1) Voltage	$V_{IH(AC)}$	$V_{REF} + 0.25$	-	V
Input Low (Logic 0) Voltage	$V_{IL(AC)}$	-	$V_{REF} - 0.25$	V

**CAPACITANCE**

At DDR2 data rates, it is recommended to simulate the performance of the module to achieve optimum values. When inductance and delay parameters associated with trace lengths are used in simulations, they are significantly more accurate and realistic than a gross estimation of module capacitance. Simulations can then render a considerably more accurate result. JEDEC modules are now designed by using simulations to close timing budgets.

**I<sub>DD</sub> Specifications and Conditions**

 (0°C ≤ T<sub>CASE</sub> ≤ +85°C ; V<sub>DDQ</sub> = +1.8V ± 0.1V, V<sub>DD</sub> = +1.8V ± 0.1V)

Parameter & Test Condition	Symbol	max.		Unit	
		6400-666	5300-555		
<b>OPERATING CURRENT *) :</b> One device bank Active-Precharge; t <sub>RC</sub> = t <sub>RC</sub> (I <sub>DD</sub> ); t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; DQ inputs changing once per clock cycle; Address and control inputs changing once every two clock cycles	I <sub>DD0</sub>	440	424	mA	
<b>OPERATING CURRENT *) :</b> One device bank; Active-Read-Precharge; I <sub>OUT</sub> = 0mA; BL = 4, CL = CL (I <sub>DD</sub> ), AL = 0; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ), t <sub>RC</sub> = t <sub>RC</sub> (I <sub>DD</sub> ), t <sub>RAS</sub> = t <sub>RAS</sub> MIN (I <sub>DD</sub> ), t <sub>RCD</sub> = t <sub>RCD</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; Address inputs changing once every two clock cycles; Data Pattern is same as I <sub>DD4W</sub>	I <sub>DD1</sub>	488	464	mA	
<b>PRECHARGE POWER-DOWN CURRENT:</b> All device banks idle; Power-down mode; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); CKE is LOW; All Control and Address bus inputs are not changing; DQ's are floating at V <sub>REF</sub>	I <sub>DD2P</sub>	160	160	mA	
<b>PRECHARGE QUIET STANDBY CURRENT:</b> All device banks idle; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH; All Control and Address bus inputs are not changing; DQ's are floating at V <sub>REF</sub>	I <sub>DD2Q</sub>	320	320	mA	
<b>PRECHARGE STANDBY CURRENT:</b> All device banks idle; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH; All other Control and Address bus inputs are changing once every two clock cycles; DQ inputs changing once per clock cycle	I <sub>DD2N</sub>	400	384	mA	
<b>ACTIVE POWER-DOWN CURRENT:</b> All device banks open; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); CKE is LOW; All Control and Address bus inputs are not changing; DQ's are floating at V <sub>REF</sub>	I <sub>DD3P</sub>	Fast PDN Exit MR[12] = 0	368	352	mA
		Slow PDN Exit MR[12] = 1	240	240	
<b>ACTIVE STANDBY CURRENT:</b> All device banks open; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ), t <sub>RAS</sub> = t <sub>RAS</sub> MAX (I <sub>DD</sub> ), t <sub>RP</sub> = t <sub>RP</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; All other Control and Address bus inputs are changing once every two clock cycles; DQ inputs changing once per clock cycle	I <sub>DD3N</sub>	512	480	mA	
<b>OPERATING READ CURRENT*) :</b> All device banks open, Continuous burst reads; One module rank active; I <sub>OUT</sub> = 0mA; BL = 4, CL = CL (I <sub>DD</sub> ), AL = 0; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ), t <sub>RAS</sub> = t <sub>RAS</sub> MAX (I <sub>DD</sub> ), t <sub>RP</sub> = t <sub>RP</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are changing once every two clock cycles; DQ inputs changing once per clock cycle	I <sub>DD4R</sub>	720	640	mA	

Parameter & Test Condition	Symbol	max.		Unit
		6400-666	5300-555	
<b>OPERATING WRITE CURRENT*) :</b> All device banks open, Continuous burst writes; One module rank active; BL = 4, CL = CL (I <sub>DD</sub> ), AL = 0; t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ), t <sub>RAS</sub> = t <sub>RAS</sub> MAX (I <sub>DD</sub> ), t <sub>RP</sub> = t <sub>RP</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are changing once every two clock cycles; DQ inputs changing once per clock cycle	I <sub>DD4W</sub>	616	560	mA
<b>BURST REFRESH CURRENT:</b> t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ); refresh command at every t <sub>RFC</sub> (I <sub>DD</sub> ) interval, CKE is HIGH, CS# is HIGH between valid commands; All other Control and Address bus inputs are changing once every two clock cycles; DQ inputs changing once per clock cycle	I <sub>DD5</sub>	1680	1600	mA
<b>SELF REFRESH CURRENT:</b> CK and CK# at 0V; CKE ≤ 0.2V; All other Control and Address bus inputs are floating at V <sub>REF</sub> ; DQ's are floating at V <sub>REF</sub>	I <sub>DD6</sub>	160	160	mA
<b>OPERATING CURRENT*) :</b> Four device bank interleaving READs, I <sub>OUT</sub> = 0mA; BL = 4, CL = CL (I <sub>DD</sub> ), AL = t <sub>RCD</sub> (I <sub>DD</sub> ) - 1 x t <sub>CK</sub> (I <sub>DD</sub> ); t <sub>CK</sub> = t <sub>CK</sub> (I <sub>DD</sub> ), t <sub>RC</sub> = t <sub>RC</sub> (I <sub>DD</sub> ), t <sub>RRD</sub> = t <sub>RRD</sub> (I <sub>DD</sub> ), t <sub>RCD</sub> = t <sub>RCD</sub> (I <sub>DD</sub> ); CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are not changing during DESELECT; DQ inputs changing once per clock cycle	I <sub>DD7</sub>	1360	1240	mA

\*) Value calculated as one module rank in this operating condition, and all other module ranks in IDD2P (CKE LOW) mode.

**TIMING VALUES USED FOR I<sub>DD</sub> MEASUREMENT**

I <sub>DD</sub> MEASUREMENT CONDITIONS			
SYMBOL	6400-666	5300-555	Unit
CL (I <sub>DD</sub> )	6	5	t <sub>CK</sub>
t <sub>RCD</sub> (I <sub>DD</sub> )	15	15	ns
t <sub>RC</sub> (I <sub>DD</sub> )	60	60	ns
t <sub>RRD</sub> (I <sub>DD</sub> )	7.5	7.5	ns
t <sub>CK</sub> (I <sub>DD</sub> )	2.5	3.0	ns
t <sub>RAS</sub> MIN (I <sub>DD</sub> )	45	45	ns
t <sub>RAS</sub> MAX (I <sub>DD</sub> )	70'000	70'000	ns
t <sub>RP</sub> (I <sub>DD</sub> )	15	15	ns
t <sub>RFC</sub> (I <sub>DD</sub> )	127.5	127.5	ns



**DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS**
 $(0^{\circ}\text{C} \leq T_{\text{CASE}} \leq +85^{\circ}\text{C}; V_{\text{DDQ}} = +1.8\text{V} \pm 0.1\text{V}, V_{\text{DD}} = +1.8\text{V} \pm 0.1\text{V})$ 

AC CHARACTERISTICS			6400-666		5300-555		
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	Unit	
Clock cycle time	CL = 6	$t_{\text{CK}}(6)$	2.5	8.0	-	-	ns
	CL = 5	$t_{\text{CK}}(5)$	3.0-	8.0-	3.0	8.0	ns
	CL = 4	$t_{\text{CK}}(4)$	3.75	8.0	3.75	8.0	ns
	CL = 3	$t_{\text{CK}}(3)$	-	-	5.0	8.0	ns
CK high-level width	$t_{\text{CH}}$	0.48	0.52	0.48	0.52	$t_{\text{CK}}$	
CK low-level width	$t_{\text{CL}}$	0.48	0.52	0.48	0.52	$t_{\text{CK}}$	
Half clock period	$t_{\text{HP}}$	min ( $t_{\text{CH}}, t_{\text{CL}}$ )		min ( $t_{\text{CH}}, t_{\text{CL}}$ )		ps	
Access window (output) of $DQ_s$ from CK/CK#	$t_{\text{AC}}$	-0.40	+0.40	-0.45	+0.45	ns	
Data-out high-impedance window from CK/CK#	$t_{\text{HZ}}$		$t_{\text{AC max}}$		+0.45 (= $t_{\text{AC max}}$ )	ns	
Data-out low-impedance window from CK/CK#	$t_{\text{LZ}}$	$t_{\text{AC min}}$	$t_{\text{AC max}}$	-0.45 (= $t_{\text{AC min}}$ )	+0.45 (= $t_{\text{AC max}}$ )	ns	
DQ and DM input setup time relative to DQS	$t_{\text{DS}}$	0.05		0.10		ns	
DQ and DM input hold time relative to DQS	$t_{\text{DH}}$	0.125		0.175		ns	
DQ and DM input pulse width ( for each input )	$t_{\text{DIPW}}$	0.35		0.35		$t_{\text{CK}}$	
Data hold skew factor	$t_{\text{QHS}}$		0.3		0.34	ns	
DQ-DQS hold, DQS to first DQ to go non-valid, per access	$t_{\text{QH}}$	$t_{\text{HP}} - t_{\text{QHS}}$		$t_{\text{HP}} - t_{\text{QHS}}$		ns	
Data valid output window	$t_{\text{DVW}}$	$t_{\text{QH}} - t_{\text{DQSQ}}$		$t_{\text{QH}} - t_{\text{DQSQ}}$		ns	
DQS input high pulse width	$t_{\text{DQSH}}$	0.35		0.35		$t_{\text{CK}}$	
DQS input low pulse width	$t_{\text{DQSL}}$	0.35		0.35		$t_{\text{CK}}$	
DQS falling edge to CK rising - setup time	$t_{\text{DSS}}$	0.2		0.2		$t_{\text{CK}}$	
DQS falling edge from CK rising - hold time	$t_{\text{DSH}}$	0.2		0.2		$t_{\text{CK}}$	
DQS -DQ skew, DQS to last DQ valid, per group, per access	$t_{\text{DQSQ}}$		0.2		0.24	ns	
DQS read preamble	$t_{\text{RPRE}}$	0.9	1.1	0.9	1.1	$t_{\text{CK}}$	
DQS read postamble	$t_{\text{RPST}}$	0.4	0.6	0.4	0.6	$t_{\text{CK}}$	
DQS write preamble	$t_{\text{WPRE}}$	0.35		0.35		$t_{\text{CK}}$	
DQS write preamble setup time	$t_{\text{WPRES}}$	0		0		ns	
DQS write postamble	$t_{\text{WPST}}$	0.4	0.6	0.4	0.6	$t_{\text{CK}}$	
Positive DQS latching edge to associated clock edge	$t_{\text{DQSS}}$	- 0.25	+ 0.25	- 0.25	+ 0.25	$t_{\text{CK}}$	
Write command to first DQS latching transition		WL- $t_{\text{DQSS}}$	WL+ $t_{\text{DQSS}}$	WL- $t_{\text{DQSS}}$	WL+ $t_{\text{DQSS}}$	$t_{\text{CK}}$	
Address and control input pulse width ( for each input )	$t_{\text{IPW}}$	0.6		0.6		$t_{\text{CK}}$	
Address and control input setup time	$t_{\text{IS}}$	0.175		0.2		ns	

**DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)**
 $(0^{\circ}\text{C} \leq T_{\text{CASE}} \leq +85^{\circ}\text{C}; V_{\text{DDQ}} = +1.8\text{V} \pm 0.1\text{V}, V_{\text{DD}} = +1.8\text{V} \pm 0.1\text{V})$ 

AC CHARACTERISTICS		6400-666		5300-555		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	
Address and control input hold time	$t_{\text{IH}}$	0.25		0.275		ns
CAS# to CAS# command delay	$t_{\text{CCD}}$	2		2		$t_{\text{CK}}$
ACTIVE to ACTIVE (same bank) command period	$t_{\text{RC}}$	60		60		ns
ACTIVE bank a to ACTIVE bank b command	$t_{\text{RRD}}$	7.5		7.5		ns
ACTIVE to READ or WRITE delay	$t_{\text{RCD}}$	15		15		ns
Four bank Activate period	$t_{\text{FAW}}$	37.5		37.5		ns
ACTIVE to PRECHARGE command	$t_{\text{RAS}}$	45	70'000	45	70'000	ns
Internal READ to precharge command delay	$t_{\text{RTP}}$	7.5		7.5		ns
Write recovery time	$t_{\text{WR}}$	15		15		ns
Auto precharge write recovery + precharge time	$t_{\text{DAL}}$	$t_{\text{WR}} + t_{\text{RP}}$		$t_{\text{WR}} + t_{\text{RP}}$		ns
Internal WRITE to READ command delay	$t_{\text{WTR}}$	7.5		7.5		ns
PRECHARGE command period	$t_{\text{RP}}$	15		15		ns
PRECHARGE ALL command period	$t_{\text{RPA}}$	$t_{\text{RP}} + t_{\text{CK}}$		$t_{\text{RP}} + t_{\text{CK}}$		ns
LOAD MODE command cycle time	$t_{\text{MRD}}$	2		2		$t_{\text{CK}}$
CKE low to CK, CK# uncertainty	$t_{\text{DELAY}}$	$t_{\text{IS}} + t_{\text{CK}} + t_{\text{IH}}$		$t_{\text{IS}} + t_{\text{CK}} + t_{\text{IH}}$		$t_{\text{CK}}$
REFRESH to ACTIVE or REFRESH to REFRESH command interval	$t_{\text{RFC}}$	127.5	70'000	127.5	70'000	ns
Average periodic refresh interval $0^{\circ}\text{C} \leq T_{\text{CASE}} \leq 85^{\circ}\text{C}$ ----- $85^{\circ}\text{C} < T_{\text{CASE}} \leq 95^{\circ}\text{C}$	$t_{\text{REFI}}$		7.8 3.9		7.8 3.9	$\mu\text{s}$
Exit SELF REFRESH to non-READ command	$t_{\text{XSNR}}$	$t_{\text{RFC}}(\text{min}) + 10$		$t_{\text{RFC}}(\text{min}) + 10$		ns
Exit SELF REFRESH to READ command	$t_{\text{XSRD}}$	200		200		$t_{\text{CK}}$
Exit SELF REFRESH timing reference	$t_{\text{ISXR}}$	$t_{\text{IS}}$		$t_{\text{IS}}$		ps
ODT turn-on delay	$t_{\text{AOND}}$	2	2	2	2	$t_{\text{CK}}$
ODT turn-on	$t_{\text{AON}}$	$t_{\text{AC}}(\text{min})$	$t_{\text{AC}}(\text{max}) + 1,000$	$t_{\text{AC}}(\text{min})$	$t_{\text{AC}}(\text{max}) + 1,000$	ps
ODT turn-off delay	$t_{\text{AOFD}}$	2.5	2.5	2.5	2.5	$t_{\text{CK}}$
ODT turn-off	$t_{\text{AOF}}$	$t_{\text{AC}}(\text{min})$	$t_{\text{AC}}(\text{max}) + 600$	$t_{\text{AC}}(\text{min})$	$t_{\text{AC}}(\text{max}) + 600$	ps
ODT turn-on (power-down mode)	$t_{\text{AONPD}}$	$t_{\text{AC}}(\text{min}) + 2,000$	$2 \times t_{\text{CK}} + t_{\text{AC}}(\text{max}) + 1,000$	$t_{\text{AC}}(\text{min}) + 2,000$	$2 \times t_{\text{CK}} + t_{\text{AC}}(\text{max}) + 1,000$	ps
ODT turn-off (power-down mode)	$t_{\text{AOFPD}}$	$t_{\text{AC}}(\text{min}) + 2,000$	$2.5 \times t_{\text{CK}} + t_{\text{AC}}(\text{max}) + 1,000$	$t_{\text{AC}}(\text{min}) + 2,000$	$2.5 \times t_{\text{CK}} + t_{\text{AC}}(\text{max}) + 1,000$	ps
ODT to power-down entry latency	$t_{\text{ANPD}}$	3		3		$t_{\text{CK}}$

### DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)

(0°C ≤ T<sub>CASE</sub> ≤ + 85°C ; V<sub>DDQ</sub> = +1.8V ± 0.1V, V<sub>DD</sub> = +1.8V ± 0.1V)

AC CHARACTERISTICS		6400-666		5300-555		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	
ODT power-down exit latency	t <sub>AXPD</sub>	8		8		t <sub>CK</sub>
ODT enable from MRS command	t <sub>MOD</sub>	12		12		ns
Exit active power-down to READ command, MR [bit 12 = 0]	t <sub>XARD</sub>	2		2		t <sub>CK</sub>
Exit active power-down to READ command, MR [bit 12 = 1]	t <sub>XARDS</sub>	8 - AL		7 - AL		t <sub>CK</sub>
Exit precharge power-down to any non-READ command	t <sub>XP</sub>	2		2		t <sub>CK</sub>
CKE minimum high/low time	t <sub>CKE</sub>	3		3		t <sub>CK</sub>

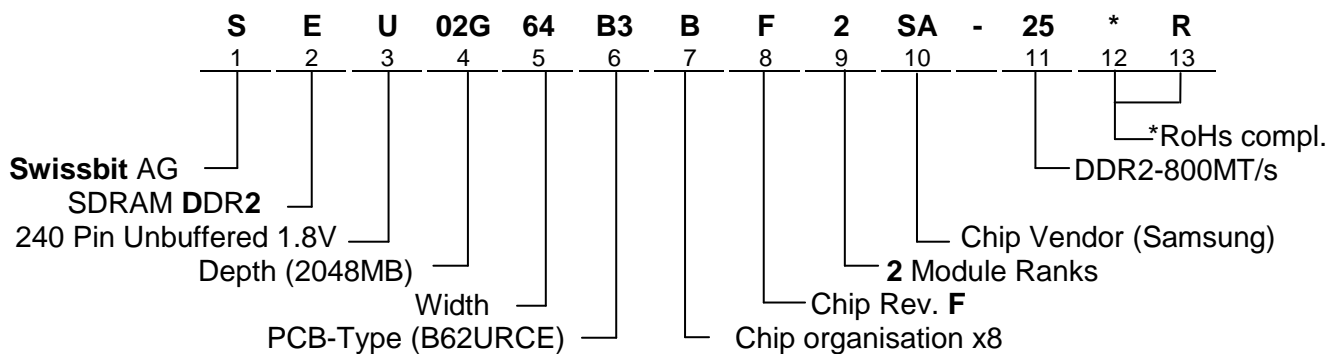
**SERIAL PRESENCE-DETECT MATRIX**

BYTE	DESCRIPTION	6400-666	5300-555
0	NUMBER OF SPD BYTES USED	0x80	
1	TOTAL NUMBER OF BYTES IN SPD DEVICE	0x08	
2	FUNDAMENTAL MEMORY TYPE	0x08	
3	NUMBER OF ROW ADDRESSES ON ASSEMBLY	0x0E	
4	NUMBER OF COLUMN ADDRESSES ON ASSEMBLY	0x0A	
5	DIMM HIGHT AND MODULE RANKS	0x61	
6	MODULE DATA WIDTH	0x40	
7	MODULE DATA WIDTH (continued)	0x00	
8	MODULE VOLTAGE INTERFACE LEVELS (V <sub>DDQ</sub> )	0x05	
9	SDRAM CYCLE TIME, (t <sub>CK</sub> ) [max CL] CAS LATENCY = 6 (6400), CL = 5 (5300)	0x25	0x30
10	SDRAM ACCESS FROM CLOCK, (t <sub>AC</sub> ) [max CL] CAS LATENCY = 6 (6400); CL = 5 (5300)	0x40	0x45
11	MODULE CONFIGURATION TYPE	0x00	
12	REFRESH RATE / TYPE	0x82	
13	SDRAM DEVICE WIDTH (PRIMARY SDRAM)	0x08	
14	ERROR- CHECKING SDRAM DATA WIDTH	0x00	
15	MINIMUM CLOCK DELAY, BACK-TO-BACK RANDOM COLUMN ACCESS	0x00	
16	BURST LENGTHS SUPPORTED	0x0C	
17	NUMBER OF BANKS ON SDRAM DEVICE	0x08	
18	CAS LATENCIES SUPPORTED	0x70	0x38
19	MODULE THICKNESS	0x01	
20	DDR2 DIMM TYPE	0x02	
21	SDRAM MODULE ATTRIBUTES	0x00	
22	SDRAM DEVICE ATTRIBUTES: Weak Driver and 50Ω ODT	0x07	
23	SDRAM CYCLE TIME, (t <sub>CK</sub> ) [max CL – 1] CAS LATENCY = 5 (6400), CL = 4 (5300)	0x30	0x3D
24	SDRAM ACCESS FROM CK, (t <sub>AC</sub> ) [max CL – 1] CAS LATENCY = 5 (6400), CL = 4 (5300)	0x45	0x50
25	SDRAM CYCLE TIME, (t <sub>CK</sub> ) [max CL – 2] CAS LATENCY = 4 (6400), CL = 3 (5300)	0x3D	0x50
26	SDRAM ACCESS FROM CK, (t <sub>AC</sub> ) [max CL – 2] CAS LATENCY = 4 (6400), CL = 3 (5300)	0x50	0x60
27	MINIMUM ROW PRECHARGE TIME, (t <sub>RP</sub> )	0x3C	
28	MINIMUM ROW ACTIVE TO ROW ACTIVE, (t <sub>R RD</sub> )	0x1E	
29	MINIMUM RAS# TO CAS# DELAY, (t <sub>R CD</sub> )	0x3C	
30	MINIMUM RAS# PULSE WIDTH, (t <sub>R AS</sub> )	0x2D	
31	MODULE BANK DENSITY	0x01	

**SERIAL PRESENCE-DETECT MATRIX (continued)**

BYTE	DESCRIPTION	6400-666	5300-555
32	ADDRESS AND COMMAND SETUP TIME, (t <sub>ISb</sub> )	0x17	0x20
33	ADDRESS AND COMMAND HOLD TIME, (t <sub>IHb</sub> )	0x25	0x27
34	DATA / DATA MASK INPUT SETUP TIME, (t <sub>DSb</sub> )	0x05	0x10
35	DATA / DATA MASK INPUT HOLD TIME, (t <sub>DHb</sub> )	0x12	0x17
36	WRITE RECOVERY TIME, (t <sub>WR</sub> )	0x3C	
37	WRITE to READ Command Delay, (t <sub>WTR</sub> )	0x1E	
38	READ to PRECHARGE Command Delay, (t <sub>RTP</sub> )	0x1E	
39	Mem Analysis Probe	0x00	
40	Extension for Bytes 41 and 42	0x06	
41	MIN ACTIVE AUTO REFRESH TIME, (t <sub>RC</sub> )	0x3C	
42	MINIMUM AUTO REFRESH TO ACTIVE / AUTO REFRESH COMMAND PERIOD, (t <sub>RFC</sub> )	0x7F	
43	SDRAM DEVICE MAX CYCLE TIME, (t <sub>CKMAX</sub> )	0x80	
44	SDRAM DEVICE MAX DQS-DQ SKEW TIME, (t <sub>DQSQ</sub> )	0x14	0x18
45	SDRAM DEVICE MAX READ DATA HOLD SKEW FACTOR, (t <sub>QHS</sub> )	0x1E	0x22
46	PLL Relock Time	0x00	
47-61	Optional Features, not supported	0x00	
62	SPD REVISION	0x12	
63	CHECKSUM FOR BYTES 0-62	0xE1	0x17
64-66	MANUFACTURER'S JEDEC ID CODE	0x7F	
67	MANUFACTURER'S JEDEC ID CODE (continued)	0xDA	
72	MANUFACTURING LOCATION	0x00	
73-90	MODULE PART NUMBER (ASCII)	"SEU02G64B3BF2SA-xx"	
91	PCB IDENTIFICATION CODE	X	
92	IDENTIFICATION CODE (continued)	X	
93	YEAR OF MANUFACTURE IN BCD	X	
94	WEEK OF MANUFACTURE IN BCD	X	
95-98	MODULE SERIAL NUMBER	X	
99-127	MANUFACTURER-SPECIFIC DATA (RSVD)	X	
128-255	Open for customer use	0xff	

**Part Number Code**



\* optional / additional information

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