

4096MB DDR3 – SDRAM SO-DIMM

204 Pin SO-DIMM

SGN04G64E1BD2SA-xxRT

4GByte in FBGA Technology

RoHS compliant

Options:

▪ Data Rate / Latency		Marking
DDR3 1066 MT/s CL7		-BB
DDR3 1333 MT/s CL9		-CC
DDR3 1600 MT/s CL11		-DC
▪ Module density		
4096MB with 16 dies and 2 ranks		
▪ Standard Grade	(T _A) 0°C to 70°C	
	(T _C) 0°C to 85°C	
Grade E	(T _A) 0°C to 85°C	
	(T _C) 0°C to 95°C *)	
Grade W	(T _A) -40°C to 85°C	
	(T _C) -40°C to 95°C *)	

*) The refresh rate has to be doubled when 85°C < T_C < 95°C

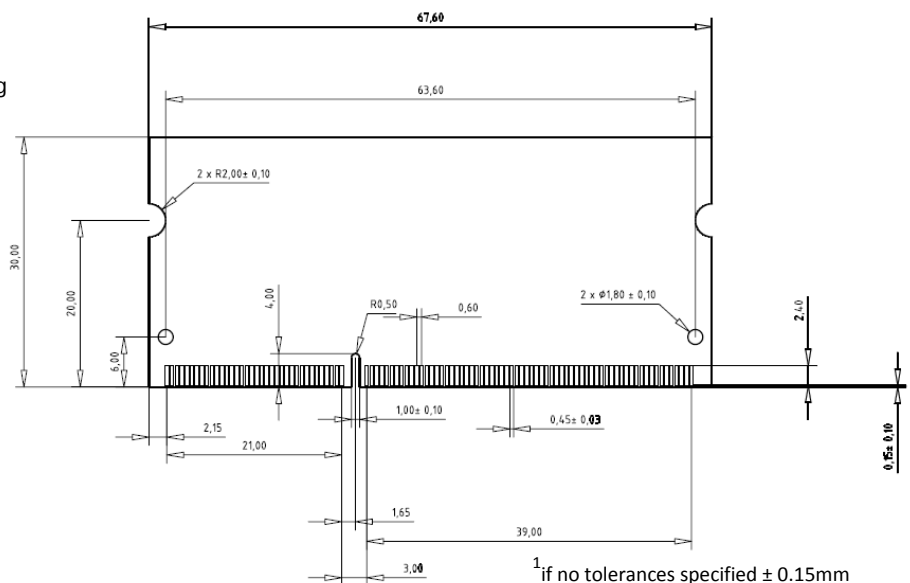
Environmental Requirements:

- Operating temperature (ambient)
 - Standard Grade 0°C to 70°C
 - Grade E 0°C to 85°C
 - Grade W -40°C to 85°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:

- 204-pin 64-bit DDR3 Small Outline Dual-In-Line Double Data Rate Synchronous DRAM module
- Module organization: dual rank 512M x 64
- V_{DD} = 1.5V ±0.075V, V_{DDQ} 1.5V ±0.075V
- 1.5V I/O (SSTL_15 compatible)
- On-board I2C temperature sensor with integrated serial presence-detect (SPD) EEPROM
- Gold-contact pads
- This module is fully pin and functional compatible to the JEDEC PC3-12800 spec. and JEDEC- Standard MO-268. (see 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)]
- DDR3 - SDRAM component Samsung K4B2G0846D**
- 256Mx8 DDR3 SDRAM in PG-TFBGA-78 package
- 8-bit pre-fetch architecture
- Programmable CAS Latency, CAS Write Latency, Additive Latency, Burst Length and Burst Type.
- On-Die-Termination (ODT) and Dynamic ODT for improved signal integrity.
- Refresh. Self Refresh and Power Down Modes.
- ZQ Calibration for output driver and ODT.
- System Level Timing Calibration Support via Write Leveling and Multi Purpose Register (MPR) Read Pattern.

Figure: mechanical dimensions¹



This Swissbit module is an industry standard 204-pin 8-byte DDR3 SDRAM Small Outline Dual-In-line Memory Module (SO-DIMM) which is organized as x64 high speed CMOS memory arrays. The module uses internally configured octal-bank DDR3 SDRAM devices. The module uses double data rate architecture to achieve high-speed operation. DDR3 SDRAM modules operate from a differential clock (CK and CK#). READ and WRITE accesses to a DDR3 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 DDR3 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_15 compatible.

The DDR3 SDRAM module uses the serial presence detect (SPD) function implemented via serial EEPROM using the standard I²C protocol. This nonvolatile storage device contains 256 bytes. The first 128 bytes are utilized by the SO-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	DDR3 SDRAMs used	Row Addr.	Device Bank Addr.	Column Addr.	Refresh	Module Bank Select
512M x 64bit	16 x 256M x 8bit (2048Mbit)	15	BA0, BA1, BA2	10	8k	S0#, S1#

Module Dimensions in mm
67.60 (long) x 30(high) x 3.80 [max] (thickness)

Timing Parameters

Part Number	Module Density	Data Rate	Clock Cycle/Data bit rate	Latency
SGN04G64E1BD2SA-BB[E/W]RT	4096MB	8.5 GB/s	1.87ns /1066MT/s	7-7-7
SGN04G64E1BD2SA-CC[E/W]RT	4096MB	10.6 GB/s	1.5ns / 1333MT/s	9-9-9
SGN04G64E1BD2SA-DC[E/W]RT	4096MB	12.8 GB/s	1.25ns / 1600MT/s	11-11-11

Pin Name

A0-9, A11 – A14	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)
S0#, S1#	Chip Select
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
CKE0, CKE1	Clock Enable
ODT0, ODT1	On-Die Termination
CK0, CK1	Clock Inputs, positive line

CK0#, CK1#	Clock Inputs, negative line
V _{DD}	Supply Voltage (1.5V± 0.075V)
V _{REFDQ}	Reference voltage: DQ, DM (VDD/2)
V _{REFCA}	Reference voltage: Control, command, and address (VDD/2)
V _{SS}	Ground
V _{TT}	Termination voltage: Used for control, command, and address (VDD/2).
V _{DDSPD}	Serial EEPROM Positive Power Supply
SCL	Serial Clock for Presence Detect
SDA	Serial Data Out for Presence Detect
SA0 – SA1	Presence Detect Address Inputs
Event#	Temperature event: The EVENT# pin is asserted by the temperature sensor when critical
NC	No Connection

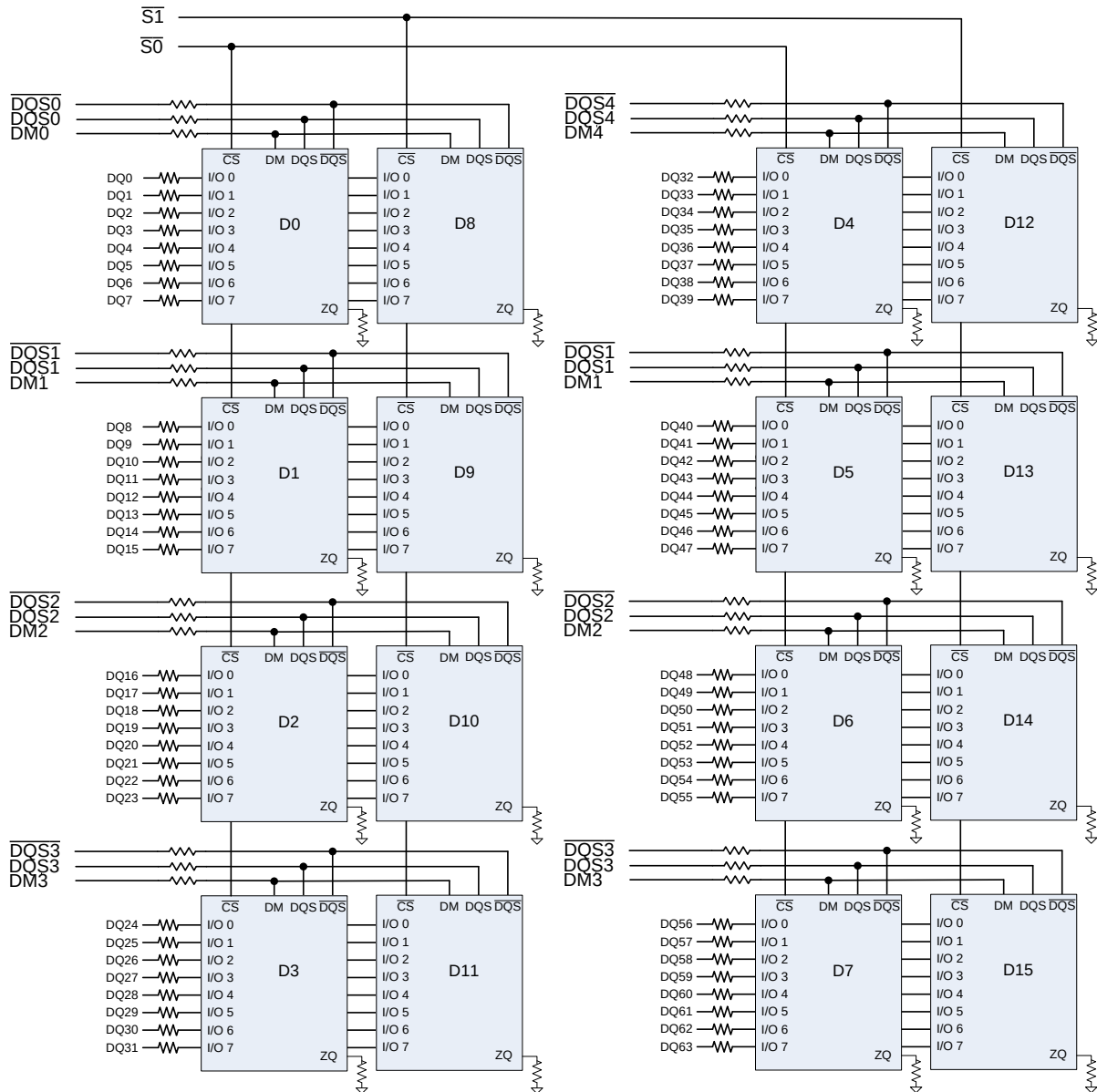
Pin Configuration

Frontside							
PIN	Symbol	PIN	Symbol	PIN	Symbol	PIN	Symbol
1	V _{REFDQ}	53	DQ19	105	V _{DD}	155	V _{SS}
3	V _{SS}	55	V _{SS}	107	A10/AP	157	DQ42
5	DQ0	57	DQ24	109	BA0	159	DQ43
7	DQ1	59	DQ25	111	V _{DD}	161	V _{SS}
9	V _{SS}	61	V _{SS}	113	WE#	163	DQ48
11	DM0	63	DM3	115	CAS#	165	DQ49
13	V _{SS}	65	V _{SS}	117	V _{DD}	167	V _{SS}
15	DQ2	67	DQ26	119	A13	169	DQS6#
17	DQ3	69	DQ27	121	S1#	171	DQS6
19	V _{SS}	71	V _{SS}	123	V _{DD}	173	V _{SS}
21	DQ8	73	CKE0	125	NC(TEST)	175	DQ50
23	DQ9	75	V _{DD}	127	V _{SS}	177	DQ51
25	V _{SS}	77	NC	129	DQ32	179	V _{SS}
27	DQS1#	79	BA2	131	DQ33	181	DQ56
29	DQS1	81	V _{DD}	133	V _{SS}	183	DQ57
31	V _{SS}	83	A12/BC#	135	DQS4#	185	V _{SS}
33	DQ10	85	A9	137	DQS4	187	DM7
35	DQ11	87	V _{DD}	139	V _{SS}	189	V _{SS}
37	V _{SS}	89	A8	141	DQ34	191	DQ58
39	DQ16	91	A5	143	DQ35	193	DQ59
41	DQ17	93	V _{DD}	145	V _{SS}	195	V _{SS}
43	V _{SS}	95	A3	147	DQ40	197	SA0
45	DQS2#	97	A1	149	DQ41	199	V _{DDSPD}
47	DQS2	99	V _{DD}	151	V _{SS}	201	SA1
49	V _{SS}	101	CK0	153	DM5	203	V _{TT}
51	DQ18	103	CK0#				

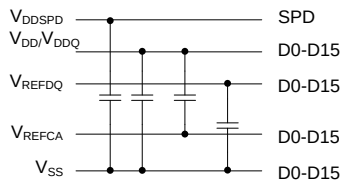
Signal in brackets may be routed to the socket connector, but is not used on the module

Backside							
Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol
2	Vss	54	Vss	106	VDD	156	Vss
4	DQ4	56	DQ28	108	BA1	158	DQ46
6	DQ5	58	DQ29	110	RAS#	160	DQ47
8	Vss	60	Vss	112	VDD	162	Vss
10	DQS0#	62	DQS3#	114	S0#	164	DQ52
12	DQS0	64	DQS3	116	ODT0	166	DQ53
14	Vss	66	Vss	118	VDD	168	Vss
16	DQ6	68	DQ30	120	ODT1	170	DM6
18	DQ7	70	DQ31	122	NC	172	Vss
20	Vss	72	Vss	124	VDD	174	DQ54
22	DQ12	74	CKE1	126	VREFCA	176	DQ55
24	DQ13	76	VDD	128	Vss	178	Vss
26	Vss	78	NC(A15)	130	DQ36	180	DQ60
28	DM1	80	A14	132	DQ37	182	DQ61
30	Reset#	82	VDD	134	Vss	184	Vss
32	Vss	84	A11	136	DM4	186	DQS7#
34	DQ14	86	A7	138	Vss	188	DQS7
36	DQ15	88	VDD	140	DQ38	190	Vss
38	Vss	90	A6	142	DQ39	192	DQ62
40	DQ20	92	A4	144	Vss	194	DQ63
42	DQ21	94	VDD	146	DQ44	196	Vss
44	Vss	96	A2	148	DQ45	198	EVENT#
46	DM2	98	A0	150	Vss	200	SDA
48	Vss	100	VDD	152	DQS5#	202	SCL
50	DQ22	102	CK1	154	DQS5	204	VTT
52	DQ23	104	CK1#				

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

**FUNCTIONAL BLOCK DIAGRAM 4096MB DDR3 SDRAM SODIMM,
2 RANKS AND 16 COMPONENTS**


BA0-BA2	→	BA0-BA2: SDRAM D0-D15
A0-A14	→	A0-A14: SDRAM D0-D15
RAS	→	RAS: SDRAM D0-D15
CAS	→	CAS: SDRAM D0-D15
WE	→	WE: SDRAM D0-D15
ODT0	→	ODT: SDRAM D0-D7
ODT1	→	ODT: SDRAM D8-D15
CKE0	→	CKE: SDRAM D0-D7
CKE1	→	CKE: SDRAM D8-D15
CK0,CK1	→	CK: SDRAM D0-D15
CK0,CK1	→	CK: SDRAM D0-D15
RESET	→	RESET: SDRAM D0-D15


Notes:

1. DQ-to-I/O wiring is shown as recommended but may be changed.
2. DQ/DQS/DQS/ODT/DM/CKE/S relationship must be maintained as shown.
3. DQ, DM, DQS/DQS resistors: Refer to associated topology diagram.
4. Refer to the appropriate clock wiring topology under the DIMM wiring details section of the JEDEC document.
5. For each DRAM, a unique ZQ resistor is connected to GND. The ZQ resistor is 240Ω±1%.
6. Refer to associated figure for SPD details.

MAXIMUM ELECTRICAL DC CHARACTERISTICS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{DD}	-0.4	1.975	V
I/O Supply Voltage	V_{DDQ}	-0.4	1.975	V
V_{DDL} Supply Voltage	V_{DDL}	-0.4	1.975	V
Voltage on any pin relative to V_{SS}	V_{IN}, V_{OUT}	-0.4	1.975	V
INPUT LEAKAGE CURRENT 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			μA
Command/Address RAS#, CAS#, WE#, S#, CKE		-16	16	
CK, CK#		-16	16	
DM		-2	2	
OUTPUT LEAKAGE CURRENT (DQ's and ODT are disabled; $0V \leq V_{OUT} \leq V_{DDQ}$)	I_{OZ}	-5	5	μA
DQ, DQS, DQS#				
V_{REF} LEAKAGE CURRENT ; V_{REF} is on a valid level	I_{VREF}	-8	8	μA

DC OPERATING CONDITIONS

PARAMETER/ CONDITION	SYMBOL	MIN	NOM	MAX	UNITS
Supply Voltage	V_{DD}	1.425	1.5	1.575	V
I/O Supply Voltage	V_{DDQ}	1.425	1.5	1.575	V
V_{DDL} Supply Voltage	V_{DDL}	1.425	1.5	1.575	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}	$0.49 \times V_{DDQ} - 20mV$	$0.50 \times V_{DDQ}$	$0.51 \times V_{DDQ} + 20mV$	V
Input High (Logic 1) Voltage	$V_{IH(DC)}$	$V_{REF} + 0.1$		$V_{DDQ} + 0.3$	V
Input Low (Logic 0) Voltage	$V_{IL(DC)}$	-0.3		$V_{REF} - 0.1$	V

AC INPUT OPERATING CONDITIONS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Input High (Logic 1) Voltage	$V_{IH(AC)}$	$V_{REF} + 0.175$	-	V
Input Low (Logic 0) Voltage	$V_{IL(AC)}$	-	$V_{REF} - 0.175$	V

CAPACITANCE

At DDR3 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_{DD} Specifications and Conditions

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.5V ± 0.075V, V_{DD} = +1.5V ± 0.075V)

Parameter & Test Condition		Symbol	max.			Unit
			12800 CL11	10600 CL9	8500 CL7	
OPERATING CURRENT *) : One device bank Active-Precharge; t _{RC} = t _{RC} (I _{DD}); t _{CK} = t _{CK} (I _{DD}); 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 _{DD0}	456	416	376	mA
OPERATING CURRENT *) : One device bank; Active-Read-Precharge; I _{OUT} = 0mA; BL = 4, CL = CL (I _{DD}), AL = 0; t _{CK} = t _{CK} (I _{DD}), t _{RC} = t _{RC} (I _{DD}), t _{RAS} = t _{RAS} MIN (I _{DD}), t _{RCD} = t _{RCD} (I _{DD}); CKE is HIGH, CS# is HIGH between valid commands; Address inputs changing once every two clock cycles; Data Pattern is same as I _{DD4W}		I _{DD1}	536	496	456	mA
PRECHARGE POWER-DOWN CURRENT: All device banks idle; Power-down mode; t _{CK} = t _{CK} (I _{DD}); CKE is LOW; All Control and Address bus inputs are not changing; DQ's are floating at V _{REF}	Fast Exit	I _{DD2P}	240	240	240	mA
	Slow Exit		192	192	192	
PRECHARGE QUIET STANDBY CURRENT: All device banks idle; t _{CK} = t _{CK} (I _{DD}); CKE is HIGH, CS# is HIGH; All Control and Address bus inputs are not changing; DQ's are floating at V _{REF}		I _{DD2Q}	320	320	272	mA
PRECHARGE STANDBY CURRENT: All device banks idle; t _{CK} = t _{CK} (I _{DD}); 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 _{DD2N}	320	320	272	mA
ACTIVE POWER-DOWN CURRENT: All device banks open; t _{CK} = t _{CK} (I _{DD}); CKE is LOW; All Control and Address bus inputs are not changing; DQ's are floating at V _{REF} (always fast exit)		I _{DD3P}	320	272	272	mA
ACTIVE STANDBY CURRENT: All device banks open; t _{CK} = t _{CK} (I _{DD}), t _{RAS} = t _{RAS} MAX (I _{DD}), t _{RP} = t _{RP} (I _{DD}); 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 _{DD3N}	560	560	480	mA
OPERATING READ CURRENT: All device banks open, Continuous burst reads; One module rank active; I _{OUT} = 0mA; BL = 4, CL = CL (I _{DD}), AL = 0; t _{CK} = t _{CK} (I _{DD}), t _{RAS} = t _{RAS} MAX (I _{DD}), t _{RP} = t _{RP} (I _{DD}); 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 _{DD4R}	816	696	616	mA

Parameter & Test Condition	Symbol	max.			Unit
		12800 CL11	10600 CL9	8500 CL7	
OPERATING WRITE CURRENT: All device banks open, Continuous burst writes; One module rank active; BL = 4, CL = CL (I _{DD}), AL = 0; t _{CK} = t _{CK} (I _{DD}), t _{RAS} = t _{RAS} MAX (I _{DD}), t _{RP} = t _{RP} (I _{DD}); 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 _{DD4W}	856	736	656	mA
BURST REFRESH CURRENT: t _{CK} = t _{CK} (I _{DD}); refresh command at every t _{RFC} (I _{DD}) 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 _{DD5}	1056	1016	976	mA
SELF REFRESH CURRENT: CK and CK# at 0V; CKE ≤ 0.2V; All other Control and Address bus inputs are floating at V _{REF} ; DQ's are floating at V _{REF}	I _{DD6}	192	192	192	mA
OPERATING CURRENT*) : Four device bank interleaving READs, I _{OUT} = 0mA; BL = 4, CL = CL (I _{DD}), AL = t _{RCD} (I _{DD}) - 1 x t _{CK} (I _{DD}); t _{CK} = t _{CK} (I _{DD}), t _{RC} = t _{RC} (I _{DD}), t _{RRD} = t _{RRD} (I _{DD}), t _{RCD} = t _{RCD} (I _{DD}); 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 _{DD7}	1216	1176	936	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_{DD} MEASUREMENT

SYMBOL	I _{DD} MEASUREMENT CONDITIONS			
	12800 CL11	10600 CL9	8500 CL7	Unit
CL (I _{DD})	11	9	7	t _{CK}
t _{RCD} (I _{DD})	13.75	13.5	13.125	ns
t _{RC} (I _{DD})	48.75	49.5	50.625	ns
t _{RRD} (I _{DD})	6.25	6	7.5	ns
t _{CK} (I _{DD})	1.25	1.5	1.87	ns
t _{RAS} MIN (I _{DD})	35	36	37.5	ns
t _{RAS} MAX (I _{DD})	70'200	70'200	70'200	ns
t _{RP} (I _{DD})	13.75	13.5	13.125	ns
t _{RFC} (I _{DD})	128	107	86	t _{CK}

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.5V ± 0.075V, V_{DD} = +1.5V ± 0.075V)

AC CHARACTERISTICS			12800 CL11		10600 CL9		8500 CL7		Unit
PARAMETER		SYMBOL	MIN	MAX	MIN	MAX	MIN	MAX	
Clock cycle time	CL = 11	t _{CK} (11)	1.25	1.5	-	-	-	-	ns
	CL = 10	t _{CK} (10)	1.5	<1.875	1.5	<1.875	-	-	ns
	CL = 9	t _{CK} (9)	1.5	<1.875	1.5	<1.875	-	-	ns
	CL = 8	t _{CK} (8)	1.875	<2.5	1.875	<2.5	1.875	<2.5	ns
	CL = 7	t _{CK} (7)	1.875	<2.5	1.875	<2.5	1.875	<2.5	ns
	CL = 6	t _{CK} (6)	2.5	3.3	2.5	3.3	2.5	3.3	ns
	CL = 5	t _{CK} (5)	3.0	3.3	3.0	3.3	3.0	3.3	ns
Read CMD to 1 st data		t _{AA}	13.75	-	13.5	-	13.125	-	ns
CK high-level width		t _{CH} (avg)	0.47	0.53	0.47	0.53	0.47	0.53	t _{CK}
CK low-level width		t _{CL} (avg)	0.47	0.53	0.47	0.53	0.47	0.53	t _{CK}
Data-out high-impedance window from CK/CK#		t _{HZ}	-	225		250		300	ps
Data-out low-impedance window from CK/CK#		t _{LZ}	-450	225	-500	250	-600	300	ps
DQ and DM input setup time relative to DQS		t _{DS(Base)}	-	-	30		25		ps
DQ and DM input hold time relative to DQS		t _{DH(Base)}	-	-	65		100		ps
DQ and DM input setup time relative to DQS V _{REF} =1V/ns		t _{DS1V}	160	-	180		200		ps
DQ and DM input hold time relative to DQS V _{REF} =1V/ns		t _{DH1V}	145	-	165		200		ps
DQ and DM input pulse width (for each input)		t _{DIPW}	360		400		490		ps
DQS, DQS# to DQ skew, per access		t _{DQSQ}	-	100		125		150	ps
DQ-DQS hold, DQS to first DQ to go non-valid, per access		t _{QH}	0.38	-	0.38		0.38		t _{CK} (AVG)
DQS input high pulse width		t _{DQSH}	0.45	0.55	0.45	0.55	0.45	0.55	t _{CK}
DQS input low pulse width		t _{DQSL}	0.45	0.55	0.45	0.55	0.45	0.55	t _{CK}
DQS, DQS# rising to/from CK, CK#		t _{DQSCK}	-225	225	-255	255	-300	300	ps
DQS, DQS# rising to/from CK, CK# when DLL disabled		t _{DQSCK} DLL DIS	1	10	1	10	1	10	ns
DQS falling edge to CK rising - setup time		t _{DSS}	0.18	-	0.2		0.2		t _{CK}
DQS falling edge from CK rising - hold time		t _{DSH}	0.18	-	0.2		0.2		t _{CK}
DQS read preamble		t _{RPRE}	0.9	Note1	0.9	Note1	0.9	Note1	t _{CK}
DQS read postamble		t _{RPST}	0.3	Note2	0.3	Note2	0.3	Note2	t _{CK}
DQS write preamble		t _{WPRE}	0.9		0.9		0.9		t _{CK}
DQS write postamble		t _{WPST}	0.3		0.3		0.3		t _{CK}
Positive DQS latching edge to associated clock edge		t _{DQSS}	- 0.27	+ 0.27	- 0.25	+ 0.25	- 0.25	+ 0.25	t _{CK}
Address and control input pulse width (for each input)		t _{IPW}	560	-	620		780		ps
CTRL, CMD, Addr setup to CK, CK#		t _{IS(Base)}	45	-	65		125		ps
CTRL, CMD, Addr setup to CK, CK# V _{REF} @ 1V/ns		t _{IS(1V)}	220	-	240		300		ps

1 The maximum preamble is bound by t_{LZDQS} (MAX)

2 The maximum postamble is bound by t_{HZDQS} (MAX)

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.5V ± 0.075V, V_{DD} = +1.5V ± 0.075V)

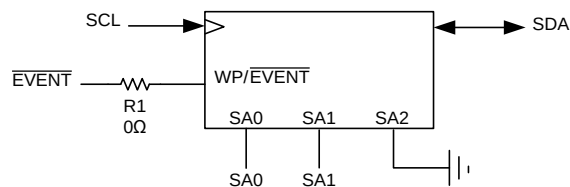
AC CHARACTERISTICS		12800 CL11		10600 CL9		8500 CL7		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	MIN	MAX	
CTRL, CMD, Addr hold to CK, CK#	t _{IH(Base)}	120	-	140		200		ps
CTRL, CMD, Addr hold to CK, CK# V _{REF} @ 1V/ns	t _{IH(1V)}	220	-	240		300		ps
CAS# to CAS# command delay	t _{CCD}	4	-	4		4		t _{CK}
ACTIVE to ACTIVE (same bank) command period	t _{RC}	48.75	-	49.5		50.625		ns
ACTIVE bank a to ACTIVE bank b command	t _{RRD}	max 4nCK, 6ns		max 4nCK, 6ns		max 4nCK, 7.5ns		ns
ACTIVE to READ or WRITE delay	t _{RCD}	13.75	-	13.5		13.125		ns
Four bank Activate period	1K Page size 2K Page size t _{FAW}	30	-	30		37.5		ns
		40	-	45		50		
ACTIVE to PRECHARGE command	t _{RAS}	35	70'200	36	70'200	37.5	70'200	ns
Internal READ to precharge command delay	t _{RTP}	max 4nCK, 7.5ns	-	max 4nCK, 7.5ns		max 4nCK, 7.5ns		ns
Write recovery time	t _{WR}	15	-	15		15		ns
Auto precharge write recovery + precharge time	t _{DAL}	t _{WR} + t _{RP} /t _{CK}	-	t _{WR} + t _{RP} /t _{CK}		t _{WR} + t _{RP} /t _{CK}		ns
Internal WRITE to READ command delay	t _{WTR}	max 4nCK, 7.5ns	-	max 4nCK, 7.5ns		max 4nCK, 7.5ns		ns
PRECHARGE command period	t _{RP}	13.75	-	13.5		13.125		ns
LOAD MODE command cycle time	t _{MRD}	4	-	4		4		t _{CK}
REFRESH to ACTIVE or REFRESH to REFRESH command interval	t _{RFC}	160	70'200	160	70'200	160	70'200	ns
Average periodic refresh interval 0 °C ≤ T _{CASE} ≤ 85°C	t _{REFI}	-	7.8		7.8		7.8	μs
85 °C < T _{CASE} ≤ 95°C	t _{REFI} (IT)	-	3.9		3.9		3.9	
RTT turn-on from ODTL on reference	t _{AON}	-225	225	-250	250	-300	300	ps
RTT turn-on from ODTL off reference	t _{AOFF}	0.3	0.7	0.3	0.7	0.3	0.7	t _{CK}
Asynchronous RTT turn-on delay (power Down with DLL off)	t _{AONPD}	2	8,5	2	8,5	2	8,5	ns
Asynchronous RTT turn-off delay (power Down with DLL off)	t _{AOFPD}	2	8,5	2	8,5	2	8,5	ns
RTT dynamic change skew	t _{ADC}	0.3	0.7	0.3	0.7	0.3	0.7	t _{CK}
Exit self refresh to commands not requiring a locked DLL	t _{XS}	max 5nCK, t _{IR} FC + 10ns	-	max 5nCK, t _{IR} FC + 10ns		max 5nCK, t _{IR} FC + 10ns		ns
Write levelling setup from rising CK, CK# crossing to rising DQS, DQS# crossing	t _{WLS}	165	-	195		245		ps
Write levelling setup from rising DQS, DQS# crossing to rising CK, CK# crossing	t _{WLH}	165	-	195		245		ps
First DQS, DQS# rising edge	t _{WLMRD}	40	-	40		40		t _{CK}
DQS, DQS# delay	t _{WLDOSEN}	25	-	25		25		t _{CK}

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.5V ± 0.075V, V_{DD} = +1.5V ± 0.075V)

AC CHARACTERISTICS		12800 CL11		10600 CL9		8500 CL7		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	MIN	MAX	
Exit reset from CKE HIGH to a valid command	t _{XPR}	max 5nCK, t _{RFC} + 10ns		max 5nCK, t _{RFC} + 10ns		max 5nCK, t _{RFC} + 10ns		
Begin power supply ramp to power supplies stable	t _{VDDPR}		200		200		200	ms
RESET# LOW to power supplies stable	t _{RPS}	0	200		200		200	ms
RESET# LOW to I/O and RTT High-Z	t _{IOZ}	-	20		20		20	ns
Exit precharge power-down to any non-READ command	t _{XP}	max 3nCK, 6ns	-	max 3nCK, 6ns		max 3nCK, 7.5ns		
CKE minimum high/low time	t _{CKE}	max 3nCK, 5ns	-	max 3nCK, 5.625ns		max 3nCK, 5.625ns		

Temperature Sensor with Serial Presence-Detect EEPROM



Temperature Sensor with Serial Presence-Detect EEPROM Operating Conditions

Parameter / Condition	Symbol	MIN	MAX	Unit
Supply voltage	V _{DDSPD}	+3	+3.6	V
Supply current: V _{DD} = 3.3V	I _{DD}		+2.0	mA
Input high voltage: Logic 1; SCL, SDA	V _{IH}	+1.45	V _{DDSPD} + 1	V
Input low voltage: Logic 0; SCL, SDA	V _{IL}	-	550	mV
Output low voltage: I _{OUT} = 2.1mA	V _{OL}	-	400	mV
Input current	I _{IN}	-5.0	5.0	μA
Temperature sensing range		TBD	TBD	°C
Temperature sensor accuracy		TBD	TBD	°C

A.C. Characteristics of Temperature Sensor

$V_{CC} = 3.3 \text{ V} \pm 10\%$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$

Symbol	Parameter / Condition	MIN	MAX	Unit
f _{SCL}	SCL clock frequency	10	400	kHz
t _{BUF}	Bus Free Time Between STOP and START	1300		ns
t _F	SDA fall time		300	ns
t _R	SDA rise time		300	ns
t _{HD:DAT}	Data hold time (accepted for Input Data)	0		ns
	Data Hold Time (guaranteed for Output Data)	300	900	ns
t _{H:STA}	Start condition hold time	600		ns
t _{HIGH}	High Period of SCL	600		ns
t _{LOW}	Low Period of SCL	1300		ns
t _{SU:DAT}	Data setup time	100		ns
t _{SU:STA}	Start condition setup time	600		ns
t _{SU:STO}	Stop condition setup time	600		ns
t _{TIMEOUT}	SMBus SCL Clock Low Timeout	25	35	ms
t _i	Noise Pulse Filtered at SCL and SDA Inputs		100	ns
t _{WR}	Write Cycle Time		5	ms
t _{PU}	Power-up Delay to Valid Temperature Recording		100	ms

Temperature Characteristics of Temperature Sensor

$V_{CC} = 3.3 \text{ V} \pm 10\%$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$

Parameter	Test Conditions/Comments	MAX	Unit
Temperature Reading Error Class B, JC42.4 compliant	$+75^\circ\text{C} \leq T_A \leq +95^\circ\text{C}$, active range	± 1.0	$^\circ\text{C}$
	$+40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, monitor range	± 2.0	$^\circ\text{C}$
	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, sensing range	± 3.0	$^\circ\text{C}$
ADC Resolution		12	Bits
Temperature Resolution		0.0625	$^\circ\text{C}$
Conversion Time		100	Ms
Thermal Resistance ¹ θ_{JA}	Junction-to-Ambient (Still Air)	92	$^\circ\text{C/W}$

¹ Power Dissipation is defined as $P_J = (T_J - T_A)/\theta_{JA}$, where T_J is the junction temperature and T_A is the ambient temperature. The thermal resistance value refers to the case of a package being used on a standard 2-layer PCB.

Slave Address Bits of Temperature Sensor

Device	Device Type Identifier				Select Address Signals			R/W#
	b7 ¹	b6	b5	b4	b3	b2	b1	b0
EEPROM	1	0	1	0	A ₂	A ₁	A ₀	R/W#
Temp. Sensor	0	0	1	1	A ₂	A ₁	A ₀	R/W#

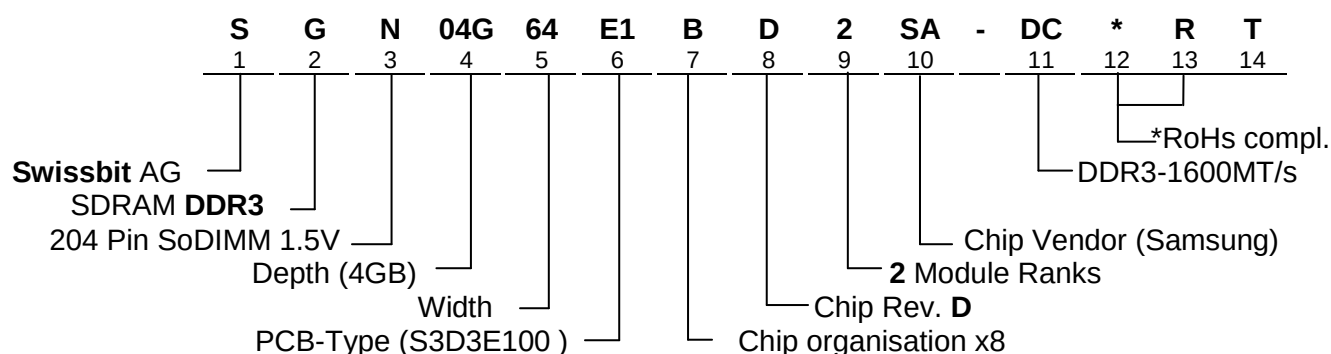
¹ The most significant bit, b7, is sent first.

SERIAL PRESENCE-DETECT MATRIX

Byte	Byte Description	12800 CL11	10600 CL9	8500 CL7
0	CRC RANGE, EEPROM BYTES, BYTES USED	0x92		
1	SPD REVISION	0x11	0x10	
2	DRAM DEVICE TYPE	0x0B		
3	MODULE TYPE (FORM FACTOR)	0x03		
4	SDRAM DEVICE DENSITY & BANKS	0x03		
5	SDRAM DEVICE ROW & COLUMN COUNT	0x19		
6	DDR3-MODULE NOMINAL VDD	0x00		
7	MODULE RANKS & DEVICE DQ COUNT	0x09		
8	ECC TAG & MODULE MEMORY BUS WIDTH	0x03		
9	FINE TIMEBASE DIVIDEND/DIVISOR	0x11	0x52	
10	MEDIUM TIMEBASE DIVIDEND	0x01		
11	MEDIUM TIMEBASE DIVISOR	0x08		
12	MIN SDRAM CYCLE TIME (t _{CK MIN})	0x0A	0x0C	0x0F
13	BYTE 13 RESERVED	0x00		
14	CAS LATENCIES SUPPORTED (CL4 => CL11)	0xFE	0x3C	0x1C
15	CAS LATENCIES SUPPORTED (CL12 => CL18)	0x00		
16	MIN CAS LATENCY TIME (t _{AA MIN})	0x69		
17	MIN WRITE RECOVERY TIME (t _{WR MIN})	0x78		
18	MIN RAS# TO CAS# DELAY (t _{RCD MIN})	0x69		
19	MIN ROW ACTIVE TO ROW ACTIVE DELAY (t _{RRD MIN})	0x30	0x30	0x3C
20	MIN ROW PRECHARGE DELAY (t _{RP MIN})	0x69		
21	UPPER NIBBLE FOR t _{RAS} & t _{RC}	0x11		
22	MIN ACTIVE TO PRECHARGE DELAY (t _{RAS MIN})	0x18	0x20	0x2C
23	MIN ACTIVE TO ACTIVE/REFRESH DELAY (t _{RC MIN})	0x81	0x89	0x95
24	MIN REFRESH RECOVERY DELAY (t _{RFC MIN}) LSB	0x00		
25	MIN REFRESH RECOVERY DELAY (t _{RFC MIN}) MSB	0x05		
26	MIN INTERNAL WRITE TO READ CMD DELAY (t _{WTR MIN})	0x3C		
27	MIN INTERNAL READ TO PRECHARGE CMD DELAY (t _{RTP MIN})	0x3C		
28	MIN FOUR ACTIVE WINDOW DELAY (t _{FAW MIN}) MSB	0x00	0x00	0x01
29	MIN FOUR ACTIVE WINDOW DELAY (t _{FAW MIN}) LSB	0xF0	0xF0	0x2C
30	SDRAM DEVICE OUTPUT DRIVERS SUPPORTED	0x83		
31	SDRAM DEVICE THERMAL & REFRESH OPTIONS	0x01		

Byte	Byte Description	12800 CL11	10600 CL9	8500 CL7
32	DDR3-MODULE THERMAL SENSOR	0x80		
33-59	BYTES 32-59 RESERVED	0x00		
60	MODULE HEIGHT (NOMINAL)	0x0F		
61	MODULE THICKNESS (MAX)	0x11		
62	REFERENCE RAW CARD ID	0x05		
63	ADDRESS MAPPING EDGE CONECTOR TO DRAM	0x00		
64-116	BYTES 64-116 RESEVED	0x00		
117	MODULE MFR ID (LSB)	0x83		
118	MODULE MFR ID (MSB)	0xDA		
119	MODULE MFR LOCATION ID	0x01 (Switzerland) 0x02 (Germany) 0x03 (USA)		
120	MODULE MFR YEAR	X		
121	MODULE MFR WEEK	X		
122-125	MODULE SERIAL NUMBER	X		
126-127	CRC	0x44FE	0xAF6A	0xEDC3
128-145	MODULE PART NUMBER	" SGN04G64E1BD2SA-xx "		
146	MODULE DIE REV	n.a.		
147	MODULE PCB REV	n.a.		
148	DRAM DEVICE MFR ID (LSB)	0x80		
149	DRAM DEVICE MFR (MSB)	0xCE		
150-175	MFR RESERVED BYTES 150-175	0x00		
176-255	CUSTOMER RESERVED BYTES 176-255	0xFF		

Part Number Code



* optional / additional information
 T=Thermal Sensor

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