1024MB DDR3 – SDRAM SO-DIMM

204 Pin SO-DIMM

SGN01G64C1CQ1SA-XX[E/W]RT

1GByte in FBGA Technology

RoHS compliant

Options:

- Data Rate / Latency — Marking
  - DDR3 1333 MT/s CL9 — -CC
  - DDR3 1600 MT/s CL11 — -DC
- Module Density
  1GByte with 4 dies and 1 rank
- 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:

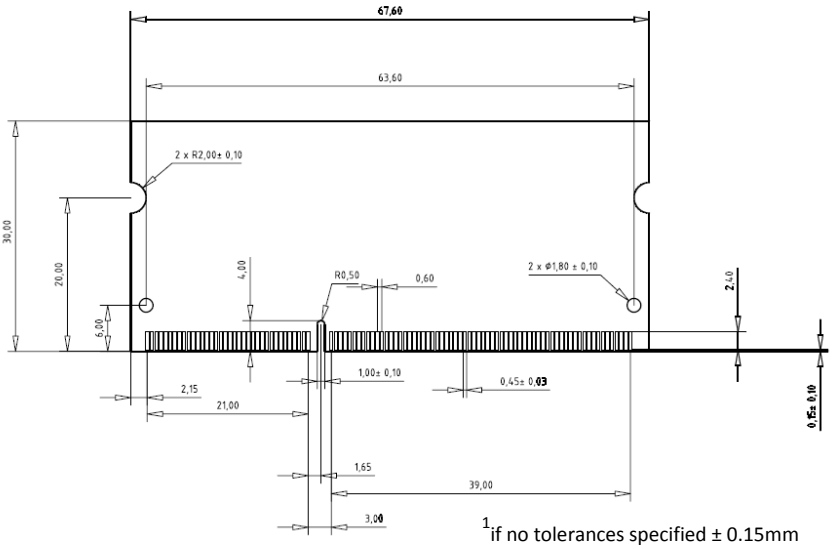
- Operating temperature (ambient)
  - Standard Grade 0°C to 70°C
  - Grade E 0°C to 85°C
  - Grade W -40°C to 85°C
- Operating Humidity
  10% to 90% relative humidity, noncondensing
- Operating Pressure
  105 to 69 kPa (up to 10000 ft.)
- Storage Temperature
  -55°C to 100°C
- Storage Humidity
  5% to 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: single rank 128M x 64
- V_{DD} = 1.5V ±0.075V, V_{DDQ} 1.5V ±0.075V
- 1.5V I/O (SSTL_15 compatible)
- Fly-by-bus with termination for C/A & CLK bus
- On-board I^2C 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 K4B2G1646Q**
- 128Mx16 DDR3 SDRAM in PG-TFBGA-96 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 dimensions[1]



[1] if no tolerances specified ± 0.15mm

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 I^2C 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
128M x 64bit	4 x 128M x 16bit (2Gbit)	13	BA0, BA1, BA2	10	8k	S0#

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

Timing Parameters

Part Number	Module Density	Transfer Rate	Clock Cycle/Data bit rate	Latency
SGN01G64C1CQ1SA-CC[E/W]RT	1GByte	10.6 GB/s	1.5ns / 1333MT/s	9-9-9
SGN01G64C1CQ1SA-DC[E/W]RT	1GByte	12.8 GB/s	1.25ns / 1600MT/s	11-11-11

Pin Name

A0 – A9, A11 – A12	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#	Chip Select
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
CKE	Clock Enable
ODT0	On-Die Termination
CK0	Clock Inputs, positive line
CK0#	Clock Inputs, negative line
V_{DD}	Supply Voltage (1.5V± 0.075V)

$V_{REF}DQ$	Reference voltage: DQ, DM ($V_{DD}/2$)
$V_{REF}CA$	Reference voltage: Control, command, and address ($V_{DD}/2$)
V_{SS}	Ground
V_{TT}	Termination voltage: Used for control, command, and address ($V_{DD}/2$).
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

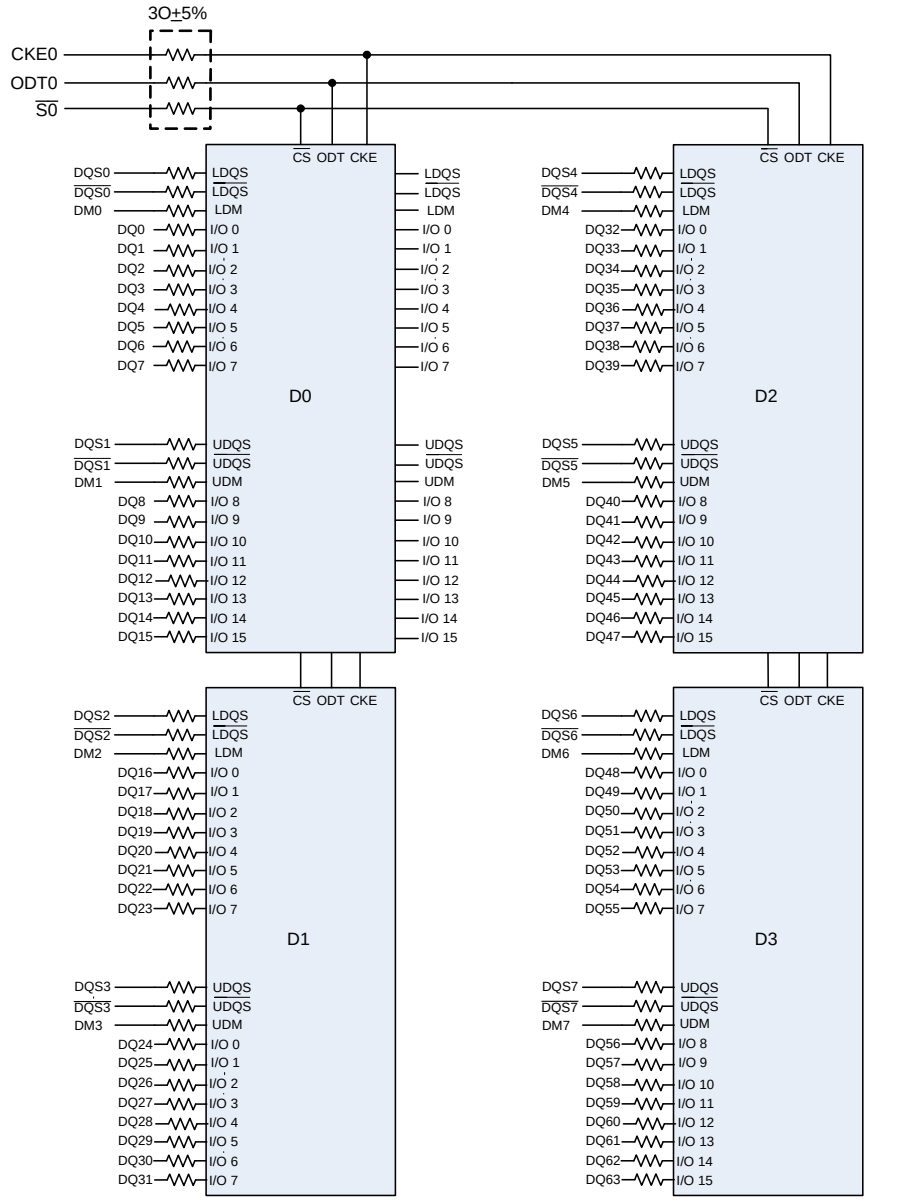
Frontside							
PIN#	**Symbol**	**PIN#**	**Symbol**	**PIN#**	**Symbol**	**PIN#**	**Symbol**
1	$V_{REF}DQ$	53	DQ19	103	CK0#	155	V_{SS}
3	V_{SS}	55	V_{SS}	105	V_{DD}	157	DQ42
5	DQ0	57	DQ24	107	A10/AP	159	DQ43
7	DQ1	59	DQ25	109	BA0	161	V_{SS}
9	V_{SS}	61	V_{SS}	111	V_{DD}	163	DQ48
11	DM0	63	DM3	113	WE#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

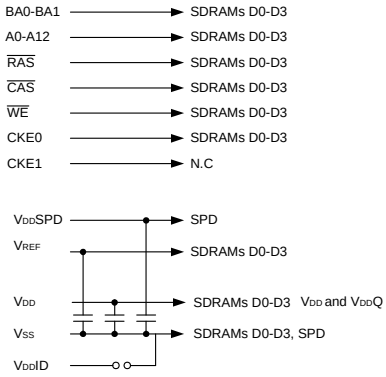
(Sig): Signal in brackets may be routed to the socket connector, but is not used on the module

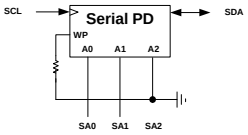
Backside							
PIN#	**Symbol**	**PIN#**	**Symbol**	**PIN#**	**Symbol**	**PIN#**	**Symbol**
2	V_{SS}	54	V_{SS}	104	NC (CK1#)	156	V_{SS}
4	DQ4	56	DQ28	106	V_{DD}	158	DQ46
6	DQ5	58	DQ29	108	BA1	160	DQ47
8	V_{SS}	60	V_{SS}	110	RAS#	162	V_{SS}
10	DQS0#	62	DQS3#	112	V_{DD}	164	DQ52
12	DQS0	64	DQS3	114	S0#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

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

FUNCTIONAL BLOCK DIAGRAMM 1024MB DDR3 SDRAM SODIMM, 1 RANK AND 4 COMPONENTS







* Clock Wiring	
Clock Input	SDRAM
CK0/CK0	NC
CK1/CK1	2 SDRAMs
CK2/CK2	2 SDRAMs

MAXIMUM ELECTRICAL DC CHARACTERISTICS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
V_{DD} Supply Voltage relative to V_{SS}	V_{DD}	-0.4	1.975	V
I/O V_{DD} Supply Voltage relative to V_{SS}	V_{DDQ}	-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 ≤ V_{IN} ≤ V_{DD}, V_{REF} pin 0V ≤ V_{IN} ≤ 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 ≤ V_{OUT} ≤ 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
I/O Reference Voltage	V_{REF}	0.49 x V_{DDQ}	0.50 x V_{DDQ}	0.51x V_{DDQ}	V
I/O Termination Voltage (system)	V_{TT}	0.49 x V_{DDQ}-20mV	0.50 x V_{DDQ}	0.51x 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		max. Symbol	12800 CL11	10600 CL9	Unit
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}	180	160	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}	220	200	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}	60	60	mA
	Slow Exit		52	52	
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}	80	80	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}	80	80	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}	80	68	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}	140	140	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}	360	300	mA

Parameter & Test Condition	Symbol	max. 12800 CL11	max. 10600 CL9	Unit
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}	380	320	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}	480	460	mA
SELF REFRESH CURRENT: CK and CK# at 0V; CKE $\leq 0.2V$; All other Control and Address bus inputs are floating at V_{REF}; DQ's are floating at V_{REF}	I_{DD6}	48	48	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}	560	540	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

I_{DD} MEASUREMENT CONDITIONS			
SYMBOL	**12800 CL11**	**10600 CL9**	**Unit**
CL (I_{DD})	11	9	t_{CK}
t_{RCD} (I_{DD})	13.75	13.5	ns
t_{RC} (I_{DD})	48.75	49.5	ns
t_{RRD} (I_{DD})	6.25	6	ns
t_{CK} (I_{DD})	1.25	1.5	ns
t_{RAS} MIN (I_{DD})	35	36	ns
t_{RAS} MAX (I_{DD})	70'200	70'200	ns
t_{RP} (I_{DD})	13.75	13.5	ns
t_{RFC} (I_{DD})	160	160	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		
PARAMETER		**SYMBOL**	**MIN**	**MAX**	**MIN**	**MAX**	**Unit**
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	ns
	CL = 7	t_{CK} (7)	1.875	<2.5	1.875	<2.5	ns
	CL = 6	t_{CK} (6)	2.5	3.3	2.5	3.3	ns
	CL = 5	t_{CK} (5)	3.0	3.3	3.0	3.3	ns
Read CMD to 1st data		t_{AA}	13.75	-	13.5	-	ns
CK high-level width		$t_{CH\ (AVG)}$	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	t_{CK}
Data-out high-impedance window from CK/CK#		t_{HZ}	-	225	-	250	ps
Data-out low-impedance window from CK/CK#		t_{LZ}	-450	225	-500	250	ps
DQ and DM input setup time relative to DQS		$t_{DS(Base)}$	-	-	30	-	ps
DQ and DM input hold time relative to DQS		$t_{DH(Base)}$	-	-	65	-	ps
DQ and DM input setup time relative to DQS V_{REF}=1V/ns		t_{DS1V}	160	-	180	-	ps
DQ and DM input hold time relative to DQS V_{REF}=1V/ns		t_{DH1V}	145	-	165	-	ps
DQ and DM input pulse width (for each input)		t_{DIPW}	360	-	400	-	ps
DQS, DQS# to DQ skew, per access		t_{DQSQ}	-	100	-	125	ps
DQ-DQS hold, DQS to first DQ to go non-valid, per access		t_{QH}	0.38	-	0.38	-	$t_{CK\ (AVG)}$
DQS input high pulse width		t_{DQSH}	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	t_{CK}
DQS, DQS# rising to/from CK, CK#		t_{DQSCK}	-225	225	-255	255	ps
DQS, DQS# rising to/from CK, CK# when DLL disabled		$t_{DQSCK\ DLL\_DIS}$	1	10	1	10	ns
DQS falling edge to CK rising - setup time		t_{DSS}	0.18	-	0.2	-	t_{CK}
DQS falling edge from CK rising - hold time		t_{DSH}	0.18	-	0.2	-	t_{CK}
DQS read preamble		t_{RPRE}	0.9	Note[1]	0.9	Note[1]	t_{CK}
DQS read postamble		t_{RPST}	0.3	Note[2]	0.3	Note[2]	t_{CK}
DQS write preamble		t_{WPRE}	0.9	-	0.9	-	t_{CK}
DQS write postamble		t_{WPST}	0.3	-	0.3	-	t_{CK}
Positive DQS latching edge to associated clock edge		t_{DQSS}	- 0.27	+ 0.27	- 0.25	+ 0.25	t_{CK}
Address and control input pulse width (for each input)		t_{IPW}	560	-	620	-	ps
CTRL, CMD, Addr setup to CK, CK#		$t_{IS(Base)}$	45	-	65	-	ps
CTRL, CMD, Addr setup to CK, CK#	V_{REF} @ 1V/ns	$t_{IS(1V)}$	220	-	240	-	ps

[1] The maximum preamble is bound by tLZDQS (MAX)

[2] The maximum postamble is bound by tHZDQS (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)

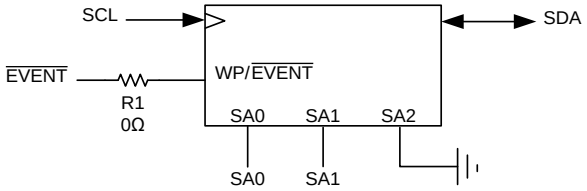
AC CHARACTERISTICS			12800 CL11		10600 CL9		
PARAMETER		SYMBOL	MIN	MAX	MIN	MAX	Unit
CTRL, CMD, Addr hold to CK, CK#		$t_{IH(Base)}$	120	-	140	-	ps
CTRL, CMD, Addr hold to CK, CK# V_{REF} @ 1V/ns		$t_{IH(1V)}$	220	-	240	-	ps
CAS# to CAS# command delay		t_{CCD}	4	-	4	-	t_{CK}
ACTIVE to ACTIVE (same bank) command period		t_{RC}	48.75	-	49.5	-	ns
ACTIVE bank *a* to ACTIVE bank *b* command		t_{RRD}	max 4nCK,6ns	-	max 4nCK,6ns	-	ns
ACTIVE to READ or WRITE delay		t_{RCD}	13.75	-	13.5	-	ns
Four bank Activate period	1K Page size	t_{FAW}	30	-	30	-	ns
	2K Page size		40	-	45	-	
ACTIVE to PRECHARGE command		t_{RAS}	35	70’200	36	70’200	ns
Internal READ to precharge command delay		t_{RTP}	max 4nCK,7.5ns	-	max 4nCK,7.5ns	-	ns
Write recovery time		t_{WR}	15	-	15	-	ns
Auto precharge write recovery + precharge time		t_{DAL}	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	-	ns
PRECHARGE command period		t_{RP}	13.75	-	13.5	-	ns
LOAD MODE command cycle time		t_{MRD}	4	-	4	-	t_{CK}
REFRESH to ACTIVE or REFRESH to REFRESH command interval		t_{RFC}	160	70’200	160	70’200	ns
Average periodic refresh interval 0 °C ≤ T_{CASE} ≤ 85°C		t_{REFI}	-	7.8	-	7.8	µs
85 °C < T_{CASE} ≤ 95°C		$t_{REFI\ (IT)}$	-	3.9	-	3.9	
RTT turn-on from ODTL on reference		t_{AON}	-225	225	-250	250	ps
RTT turn-on from ODTL off reference		t_{AOF}	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	ns
Asynchronous RTT turn-off delay (power Down with DLL off)		t_{AOFPD}	2	8,5	2	8,5	ns
RTT dynamic change skew		t_{ADC}	0.3	0.7	0.3	0.7	t_{CK}
Exit self refresh to commands not requiring a locked DLL		t_{XS}	max 5nCK,tRFC + 10ns	-	max 5nCK,tRFC + 10ns	-	ns
Write levelling setup from rising CK, CK# crossing to rising DQS, DQS# crossing		t_{WLS}	165	-	195	-	ps
Write levelling setup from rising DQS, DQS# crossing to rising CK, CK# crossing		t_{WLH}	165	-	195	-	ps
First DQS, DQS# rising edge		t_{WLMRD}	40	-	40	-	t_{CK}
DQS, DQS# delay		$t_{WLDQSEN}$	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		
PARAMETER	**SYMBOL**	**MIN**	**MAX**	**MIN**	**MAX**	**Unit**
Exit reset from CKE HIGH to a valid command	t_{XPR}	max 5nCK, t_{RFC} + 10ns	-	max 5nCK, t_{RFC} + 10ns	-	t_{CK}
Begin power supply ramp to power supplies stable	t_{VDDPR}	-	200	-	200	ms
RESET# LOW to power supplies stable	t_{RPS}	0	200	-	200	ms
RESET# LOW to I/O and RTT High-Z	t_{IOz}	-	20	-	20	ns
Exit precharge power-down to any non-READ command	t_{XP}	max 3nCK,6ns	-	max 3nCK,6ns	-	t_{CK}
CKE minimum high/low time	t_{CKE}	max 3nCK, 5ns	-	max 3nCK, 5.625ns	-	t_{CK}

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: Vdd = 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: Iout = 2.1mA	V_{OL}	-	400	mV
Input current	I_{IN}	-5.0	5.0	µA
Temperature sensing range		T.B.D	T.B.D	°C
Temperature sensor accuracy		T.B.D	T.B.D	°C

A.C. Characteristics of Temperature Sensor

V_{CC} = 3.3 V ± 10%, T_A = −40°C to +125°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 V ± 10%, T_A = −40°C to +125°C

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

[1] Power Dissipation is defined as $P_J = (T_J - T_A)/\theta_{JA}$, where TJ is the junction temperature and TA 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#

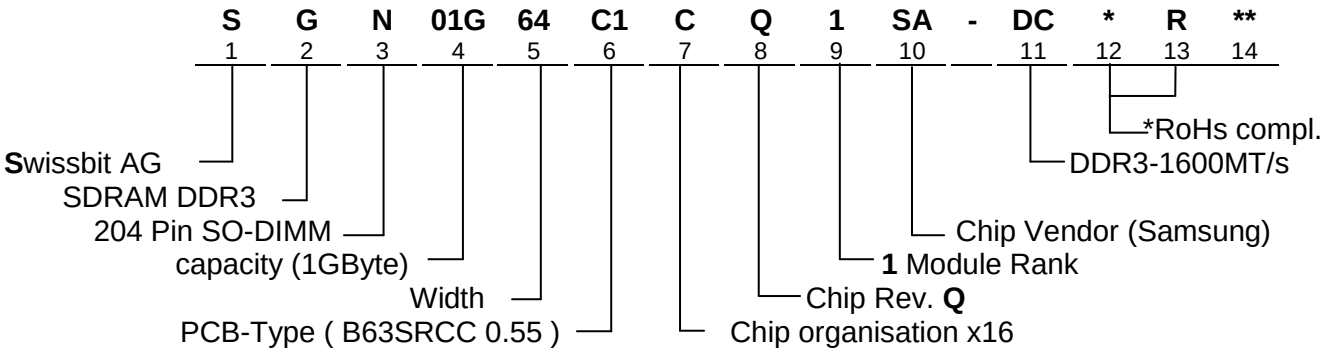
[1] The most significant bit, b7, is sent first.

SERIAL PRESENCE-DETECT MATRIX

Byte	Byte Description	12800 CL11	10600 CL9
0	CRC RANGE, EEPROM BYTES, BYTES USED	0x92	
1	SPD REVISON	0x11	
2	DRAM DEVICE TYPE	0x0B	
3	MODULE TYPE (FORM FACTOR)	0x03	
4	SDRAM DEVICE DENSITY & BANKS	0x03	
5	SDRAM DEVICE ROW & COLUMN COUNT	0x11	
6	DDR3-MODULE NOMINAL VDD	0x00	
7	MODULE RANKS & DEVICE DQ COUNT	0x02	
8	ECC TAG & MODULE MEMORY BUS WIDTH	0x03	
9	FINE TIMEBASE DIVIDEND/DIVISOR	0x11	
10	MEDIUM TIMEBASE DIVIDEND	0x01	
11	MEDIUM TIMEBASE DIVISOR	0x08	
12	MIN SDRAM CYCLE TIME ($t_{CK\ MIN}$)	0x0A	0x0C
13	BYTE 13 RESERVED	0x00	
14	CAS LATENCIES SUPPORTED (CL4 => CL11)	0xFE	0x3C
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	
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
23	MIN ACTIVE TO ACTIVE/REFRESH DELAY ($t_{RC\ MIN}$)	0x81	0x89
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	0x01	0x00
29	MIN FOUR ACTIVE WINDOW DELAY ($t_{FAW\ MIN}$) LSB	0x40	0xF0
30	SDRAM DEVICE OUTPUT DRIVERS SUPPORTED	0x83	
31	SDRAM DEVICE THERMAL & REFRESH OPTIONS	0x05	

Byte	Byte Description	12800 CL11	10600 CL9
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	0x42	
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	0x0D2F	0x3F04
128-145	MODULE PART NUMBER	"SGN01G64C1CQ1SA-xx"	
146	MODULE DIE REV	X	
147	MODULE PCB REV	X	
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

Revision History		
Revision	Changes	Date
1.0	First release	18.02.2014

Locations

Swissbit AG
Industriestrasse 4
CH – 9552 Bronschhofen
Switzerland
Phone: +41 (0)71 913 03 03
Fax: +41 (0)71 913 03 15

Swissbit Germany GmbH
Wolfener Strasse 36
D – 12681 Berlin
Germany
Phone: +49 (0)30 93 69 54 – 0
Fax: +49 (0)30 93 69 54 – 55

Swissbit NA, Inc.
1117 E Plaza Drive Unit E Suites 105/205
Eagle, ID 83616
USA
Phone: +1 208 258-6254
Fax: +1 208 938-4525

Swissbit Japan, Inc.
3F Core Koenji,
2-1-24 Koenji-Kita, Suginami-Ku,
Tokyo 166-0002
Japan
Phone: +81 3 5356 3511
Fax: +81 3 5356 3512

CE Declaration of Conformity

We

Manufacturer: **Swissbit AG**
Industriestrasse 4
CH-9552 Bronschhofen
Switzerland

declare under our sole responsibility that the product

Product Type: **1GB DDR3 SO-DIMM**
Brand Name: **SWISSMEMORY™**
Product Series: **DDR3 SO-DIMM**
Part Number: **SGN01G64C1CQ1SA-xxxRT**

to which this declaration relates is in conformity with the following directives:

2002/96/EC Category 3 (WEEE)

following the provisions of Directive

Restriction of the use of certain hazardous substances 2011/65/EU

Swissbit AG, February 2014

Manuela Kögel
Head of Quality Management