

4096MB DDR3 – SDRAM unbuffered ECC Mini-UDIMM

244 Pin ECC Mini-UDIMM

SGL04G72B1BD2SA-CCWRT-V

4GB in FBGA Technology

RoHS compliant

Options:

- | | | |
|---------------------------------|-------------------|------------------|
| ▪ Data Rate / Latency | | Marking |
| DDR3 1333 MT/s CL9 | | -CC |
| ▪ Module density | | |
| 4096MB with 18 dies and 2 ranks | | |
| ▪ Standard Grade | (T _A) | 0°C to 70°C |
| | (T _C) | 0°C to 85°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:

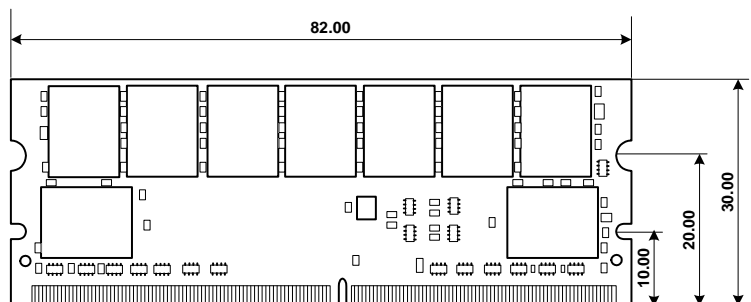
- Operating temperature (ambient)

Standard Grade	0°C to 70°C
W-Grade	-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:

- 244-pin 72-bit DDR3 ECC Mini-UDIMM module
 - Module organization: dual rank 512M x 72
 - VDD = 1.5V ±0.075V, VDDQ 1.5V ±0.075V
 - 1.5V I/O (SSTL_15 compatible)
 - Fly-by-bus with termination for C/A & CLK bus
 - On-board I2C temperature sensor with integrated serial presence-detect (SPD) EEPROM
 - Gold-contact pad
 - Dip Coated with HumiSeal 1A33
 - Coating Thickness 1-3 mils
 - With anodized aluminum heat spreader
 - This module is fully pin and functional compatible to the JEDEC PC3-10600 DDR3 SDRAM Mini-UDIMM design spec. and JEDEC- Standard MO-244 R/C B. (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 prefetch 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



¹if no tolerances specified ± 0.15mm

This Swissbit module is an industry standard 244-pin DDR3 SDRAM ECC Mini-DIMM which is organized as x72 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-UDIMM 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 Select	Column Addr.	Refresh	Module Bank Select
512M x 72bit	18 x 256M x 8bit (2048Mbit)	15	BA0, BA1, BA2	10	8k	S0#, S1#

Module Dimensions

in mm

82.00 (long) x 30.00 (high) x 5.30 [max] (thickness with heat spreader)

Timing Parameters

Part Number	Module Density	Transfer Rate	Memory clock/Data bit rate	Latency
SGL04G72B1BD2SA-CCWRT-V	4096MB	10.6 GB/s	1.5ns /1333MT/s	9-9-9

Label Info

Part Number	JEDEC Module Label
SGL04G72B1BD2SA-CCWRT-V	4GB 2Rx8 PC3-10600W-9-11-B0

Pin Name

A0-9, A11 – A14	Address Inputs
A10/AP	Address Input / Autoprecharge Bit
BA0 – BA2	Bank Address Inputs
DQ0 – DQ63	Data Input / Output
CB0 – CB07	ECC check bits
DM0-DM8	Input Data Mask
DQS0 – DQS8	Data Strobe, positive line
DQS0# - DQS8#	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 – CK1	Clock Inputs, positive line
CK0# - CK1#	Clock Inputs, negative line
Event#	Temperature event: The EVENT# pin is asserted by the temperature sensor when critical
Reset#	Reset signal for DDR3 SDRAMs
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
ODT0, ODT1	On-Die Termination
NC	No Connection

Pin Configuration

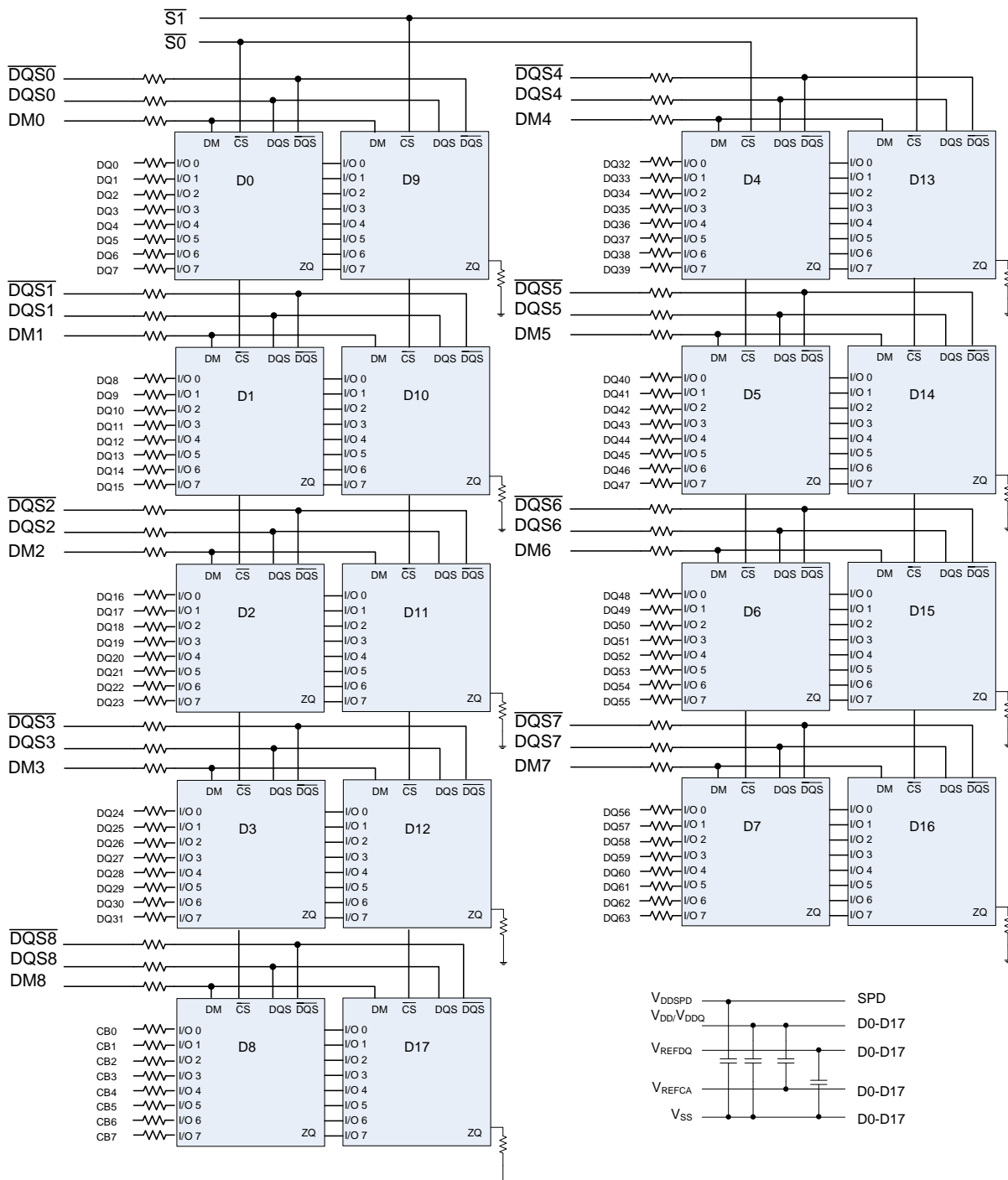
Frontside							
PIN	Symbol	PIN	Symbol	PIN	Symbol	PIN	Symbol
1	V _{TT}	31	DQ24	61	V _{DD}	92	DQ40
2	V _{REFDQ}	32	DQ25	62	A2	93	DQ41
3	V _{SS}	33	V _{SS}	63	V _{DD}	94	V _{SS}
4	DQ0	34	DQS3#	64	CK1	95	DQS5#
5	DQ1	35	DQS3	65	CK1#	96	DQS5
6	V _{SS}	36	V _{SS}	66	V _{DD}	97	V _{SS}
7	DQS0#	37	DQ26	67	V _{REFCA}	98	DQ42
8	DQS0	38	DQ27	68	V _{DD}	99	DQ43
9	V _{SS}	39	V _{SS}	69	NC	100	V _{SS}
10	DQ2	40	CB0	70	V _{DD}	101	DQ48
11	DQ3	41	CB1	71	A10	102	DQ49
12	V _{SS}	42	V _{SS}	72	BA0	103	V _{SS}
13	DQ8	43	DQS8#	73	V _{DD}	104	DQS6#
14	DQ9	44	DQS8	74	WE#	105	DQS6
15	V _{SS}	45	V _{SS}	75	CAS#	106	V _{SS}
16	DQS1#	46	CB2	76	V _{DD}	107	DQ50
17	DQS1	47	CB3	77	NC	108	DQ51
18	V _{SS}	48	V _{SS}	78	NC	109	V _{SS}
19	DQ10	49	NC	79	V _{DD}	110	DQ56
20	DQ11	50	Reset#	80	NC	111	DQ57
21	V _{SS}	51	CKE0	81	NC	112	V _{SS}
22	DQ16	52	V _{DD}	82	V _{SS}	113	DQS7#
23	DQ17	53	BA2	83	DQ32	114	DQS7
24	V _{SS}	54	NC	84	DQ33	115	V _{SS}
25	DQS2#	55	V _{DD}	85	V _{SS}	116	DQ58
26	DQS2	56	A11	86	DQS4#	117	DQ59
27	V _{SS}	57	A7	87	DQS4	118	V _{SS}
28	DQ18	58	V _{DD}	88	V _{SS}	119	SA0
29	DQ19	59	A5	89	DQ34	120	SCL
30	V _{SS}	60	A4	90	DQ35	121	SA2
				91	V _{SS}	122	V _{TT}

(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
123	V _{TT}	153	DQ29	183	A3	214	DQ45
124	V _{SS}	154	V _{SS}	184	A1	215	V _{SS}
125	DQ4	155	DM3	185	V _{DD}	216	DM5
126	DQ5	156	NC	186	CK0	217	NC
127	V _{SS}	157	V _{SS}	187	CK0#	218	V _{SS}
128	DM0	158	DQ30	188	V _{DD}	219	DQ46
129	NC	159	DQ31	189	V _{DD}	220	DQ47
130	V _{SS}	160	V _{SS}	190	Event#	221	V _{SS}
131	DQ6	161	CB4	191	A0	222	DQ52
132	DQ7	162	CB5	192	V _{DD}	223	DQ53
133	V _{SS}	163	V _{SS}	193	BA1	224	V _{SS}
134	DQ12	164	DM8	194	V _{DD}	225	DM6
135	DQ13	165	NC	195	RAS#	226	NC
136	V _{SS}	166	V _{SS}	196	CS0#	227	V _{SS}
137	DM1	167	CB6	197	V _{DD}	228	DQ54
138	NC	168	CB7	198	ODT0	229	DQ55
139	V _{SS}	169	V _{SS}	199	A13	230	V _{SS}
140	DQ14	170	NC	200	V _{DD}	231	DQ60
141	DQ15	171	NC	201	NC	232	DQ61
142	V _{SS}	172	NC	202	NC	233	V _{SS}
143	DQ20	173	V _{DD}	203	V _{SS}	234	DM7
144	DQ21	174	(A15)/NC	204	DQ36	235	NC
145	V _{SS}	175	A14	205	DQ37	236	V _{SS}
146	DM2	176	V _{DD}	206	V _{SS}	237	DQ62
147	NC	177	A12	207	DM4	238	DQ63
148	V _{SS}	178	A9	208	NC	239	V _{SS}
149	DQ22	179	V _{DD}	209	V _{SS}	240	V _{DDSPD}
150	DQ23	180	A8	210	DQ38	241	SA1
151	V _{SS}	181	A6	211	DQ39	242	SDA
152	DQ28	182	V _{DD}	212	V _{SS}	243	V _{SS}
				213	DQ44	244	V _{TT}

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

**FUNCTIONAL BLOCK DIAGRAM 4096MB DDR3 SDRAM Mini-DIMM,
2 RANK AND 18 COMPONENTS**



- BA0-BA2 → BA0-BA2: SDRAM D0-D17
- A0-A14 → A0-A14: SDRAM D0-D17
- RAS → RAS: SDRAM D0-D17
- CAS → CAS: SDRAM D0-D17
- WE → WE: SDRAM D0-D17
- ODT0 → ODT: SDRAM D0-D8
- ODT1 → ODT: SDRAM D9-D17
- CKE0 → CKE: SDRAM D0-D8
- CKE1 → CKE: SDRAM D9-D17
- CK0,CK1 → CK: SDRAM D0-D17
- CK0,CK1 → CK: SDRAM D0-D17
- RESET → RESET: SDRAM D0-D17

- 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	
		10600-999	8500-777		
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}	648	603	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}	783	738	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}	360	360	mA
	Slow Exit		216	216	
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}	540	540	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}	630	540	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}	540	540	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}	990	900	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}	1143	1008	mA	

Parameter & Test Condition	Symbol	max.		Unit
		10600-999	8500-777	
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}	1368	1143	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}	3060	3060	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}	216	216	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}	1998	1638	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	10600-999	8500-777	Unit
CL (I _{DD})	9	7	t _{CK}
t _{RCD} (I _{DD})	13.5	13.125	ns
t _{RC} (I _{DD})	49.5	50.625	ns
t _{RRD} (I _{DD})	6	7.5	ns
t _{CK} (I _{DD})	1.5	1.87	ns
t _{RAS} MIN (I _{DD})	36	37.5	ns
t _{RAS} MAX (I _{DD})	70'200	70'200	ns
t _{RP} (I _{DD})	13.5	13.125	ns
t _{RFC} (I _{DD})	160	160	ns

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			10600-999		8500-777		
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	Unit	
Clock cycle time	CL = 10	t _{CK} (10)	1.5	<1.875	-	-	ns
	CL = 9	t _{CK} (9)	1.5	<1.875	-	-	ns
	CL = 8	t _{CK} (8)	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
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}		250		300	ps	
Data-out low-impedance window from CK/CK#	t _{LZ}	-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}	180		200		ps	
DQ and DM input hold time relative to DQS V _{REF} =1V/ns	t _{DH1V}	165		200		ps	
DQ and DM input pulse width (for each input)	t _{DIPW}	400		490		ps	
DQS, DQS# to DQ skew, per access	t _{DQSQ}		125		150	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}	-255	255	-300	300	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}	0.2		0.2		t _{CK}	
DQS falling edge from CK rising - hold time	t _{DSH}	0.2		0.2		t _{CK}	
DQS read preamble	t _{RPRE}	0.9	Note1	0.9	Note1	t _{CK}	
DQS read postamble	t _{RPST}	0.3	Note2	0.3	Note2	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}	- 0.25	+ 0.25	- 0.25	+ 0.25	t _{CK}	
Address and control input pulse width (for each input)	t _{IPW}	620		780		ps	
CTRL, CMD, Addr setup to CK, CK#	t _{IS(Base)}	65		125		ps	
CTRL, CMD, Addr setup to CK, CK# V _{REF} @ 1V/ns	t _{IS(1V)}	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)

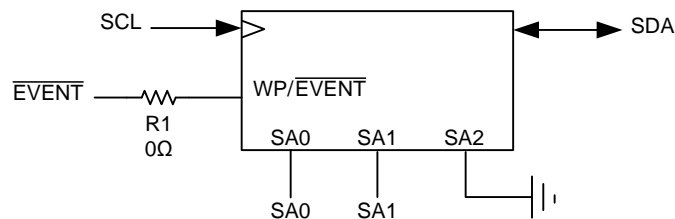
AC CHARACTERISTICS		10600-999		8500-777		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	
CTRL, CMD, Addr hold to CK, CK#	t _{IH(Base)}	140		200		ps
CTRL, CMD, Addr hold to CK, CK# V _{REF} @ 1V/ns	t _{IH(1V)}	240		300		ps
CAS# to CAS# command delay	t _{CCD}	4		4		t _{CK}
ACTIVE to ACTIVE (same bank) command period	t _{RC}	49.5		50.625		ns
ACTIVE bank a to ACTIVE bank b command	t _{RRD}	max 4nCK,10ns		max 4nCK,7.5ns		ns
ACTIVE to READ or WRITE delay	t _{RCD}	13.5		13.125		ns
Four bank Activate period	1K Page size 2K Page size	t _{FAW}	30		37.5	ns
		t _{FAW}	45		50	
ACTIVE to PRECHARGE command	t _{RAS}	36	70'200	37.5	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}	15		13.125		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
	t _{REFI IT}		3.9		3.9	
RTT turn-on from ODTL on reference	t _{AON}	-250	250	-300	300	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 _{AOFFPD}	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,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}	195		245		ps
Write levelling setup from rising DQS, DQS# crossing to rising CK, CK# crossing	t _{WLH}	195		245		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		10600-999		8500-777		
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	Unit
Exit reset from CKE HIGH to a valid command	t _{XPR}	max 5nCK, t _{REFC} + 10ns		max 5nCK, t _{REFC} + 10ns		
Begin power supply ramp to power supplies stable	t _{VDDPR}		200		200	ms
RESET# LOW to power supplies stable	t _{RPS}		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, 7.5ns		
CKE minimum high/low time	t _{CKE}	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°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

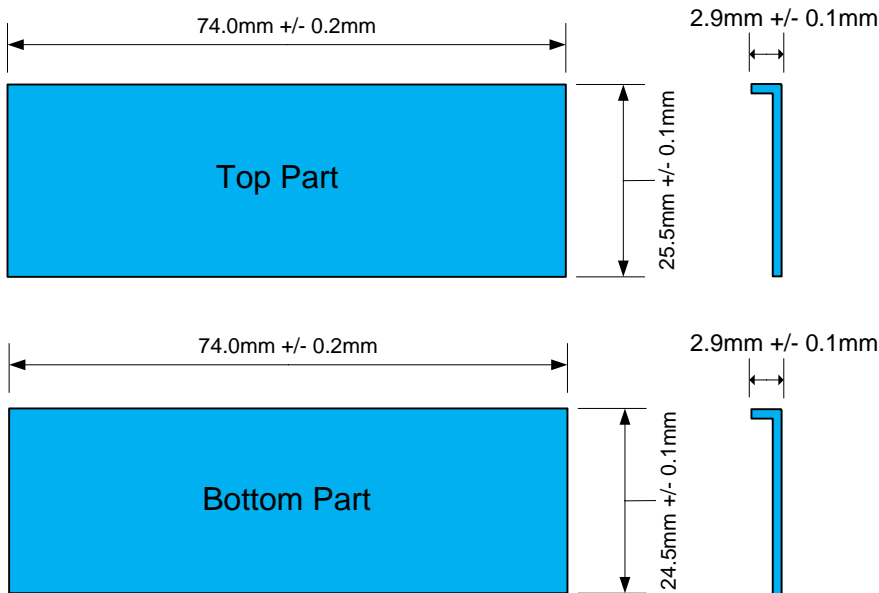
¹ Power Dissipation is defined as $P_J = (T_J - T_A)/\theta_{JA}$, where T_J is the junction temperature and T_A is the ambient temperature. The thermal resistance value refers to the case of a package being used on a standard 2-layer PCB.

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.

Heatspreader: two part anodized aluminium 1050, attached with adhesive thermally conductive tape



Thickness: 0.5mm +/- 0.05mm Aluminum 1100
 Color: Anodized Cyan Blue

Adhesive thermally conductive tape: PPI-TC-150B or equivalent:

Property	PPI-TC 150B	Test Methodology
Carrier type	filled Acrylate	
Adhesive Thickness	0.15 mm	BS 3924
Total thickness	0.15 mm +/- 10%	
Color	white	
Holding power (kg/cm)	> 0.08 (kg/cm)	BS 3924
180° Peel off force (kg/25mm) 30min R.T.	> 1.2	BS 3924
Thermal Conductivity (W/m K)	0.5	DIN V 54462
Insulation strength (kV)	3.5	ASTM D-149

Conformal Coating:

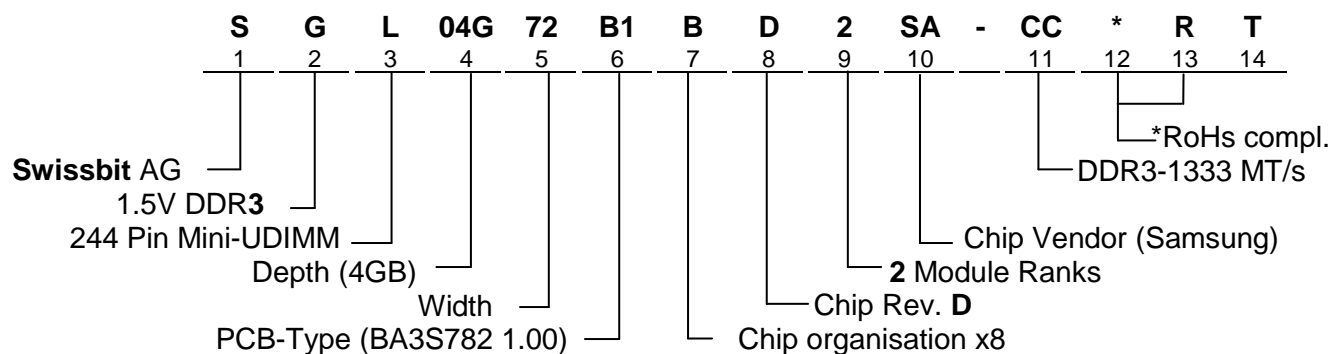
- Dip Coated with HumiSeal 1A33
- Coating Thickness 1-3 mils
- Coating covers complete module surface except gold edge connector.

SERIAL PRESENCE-DETECT MATRIX

Byte	Byte Description	10600-999
0	CRC RANGE, EEPROM BYTES, BYTES USED	0x92
1	SPD REVISION	0x11
2	DRAM DEVICE TYPE	0x0B
3	MODULE TYPE (FORM FACTOR)	0x06
4	SDRAM DEVICE DENSITY & BANKS	0x03
5	SDRAM DEVICE ROW & COLUMN COUNT	0x19
6	BYTE 6 RESERVED	0x00
7	MODULE RANKS & DEVICE DQ COUNT	0x09
8	ECC TAG & MODULE MEMORY BUS WIDTH	0x0B
9	FINE TIMEBASE DIVIDEND/DIVISOR	0x11
10	MEDIUM TIMEBASE DIVIDEND	0x01
11	MEDIUM TIMEBASE DIVISOR	0x08
12	MIN SDRAM CYCLE TIME ($t_{CK\ MIN}$)	0x0C
13	BYTE 13 RESERVED	0x00
14	CAS LATENCIES SUPPORTED (CL4 => CL11)	0x3E
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 ($t_{RAS\ MIN}$)	0x20
23	MIN ACTIVE TO ACTIVE/REFRESH DELAY ($t_{RC\ MIN}$)	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	0x00
29	MIN FOUR ACTIVE WINDOW DELAY ($t_{FAW\ MIN}$) LSB	0xF0
30	SDRAM DEVICE OUTPUT DRIVERS SUPPORTED	0x83
31	SDRAM DEVICE THERMAL & REFRESH OPTIONS	0x01

Byte	Byte Description	10600-999
32	DDR3-MODULE THERMAL SENSOR	0x80
33	DDR3-SDRAM DEVICE TYPE	0x00
34	DDR3-FINE OFFSET FOR t_{CKMIN}	0x00
35-59	BYTES 33-59 RESERVED	0x00
60	MODULE HEIGHT (NOMINAL)	0x0F
61	MODULE THICKNESS (MAX)	0x22
62	REFERENCE RAW CARD ID	0x01
63	ADDRESS MAPPING EDGE CONECTOR TO DRAM	0x00
64	DDR3-HEATSPREADER SOLUTION	0x80
65-116	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	0x6225
128-145	MODULE PART NUMBER	"SGL04G72B1BD2SA-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

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