

2048MB DDR3 – SDRAM registered ECC VLP Mini-RDIMM

244 Pin ECC Mini-RDIMM

SGH02G72C1BD1MT-XX(W)RT

2GByte in FBGA Technology

RoHS compliant

Options:

- | | | |
|--------------------------------|-------------------|--------------------|
| ▪ Data Rate / Latency | | Marking |
| DDR3 1066 MT/s CL7 | | -BB |
| DDR3 1333 MT/s CL9 | | -CC |
| ▪ Module density | | |
| 2048MB with 9 dies and 1 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:

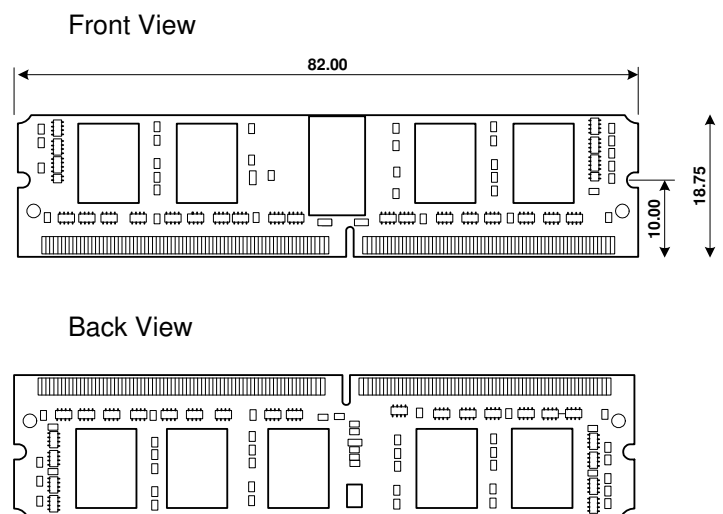
- Operating temperature (ambient)

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 VLP Mini-RDIMM module
- Module organization: single rank 256M x 72
- 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 I²C temperature sensor with integrated serial presence-detect (SPD) EEPROM
- Gold-contact pad
- Supports ECC error detection and correction
- Supports C/A bus parity
- This module is fully pin and functional compatible to the JEDEC PC3-10600 DDR3 SDRAM Mini-RDIMM design spec. and JEDEC- Standard MO-244 R/C E. (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 Micron MT41J256M8HX-15E:D**
- 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



¹ if no tolerances specified ± 0.15mm

This Swissbit module is an industry standard 244-pin DDR3 registered 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-RDIMM 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
256M x 72bit	9 x 256M x 8bit (2048Mbit)	15	BA0, BA1, BA2	10	8k	S0#

Module Dimensions

in mm

82.00 (long) x 18.75 (high) x 3.80 [max]

Timing Parameters

Part Number	Module Density	Transfer Rate	Memory clock/Data bit rate	Latency
SGH02G72C1BD1MT-BB[W]RT	2048MB	8.5 GB/s	1.875ns /1066MT/s	7-7-7
SGH02G72C1BD1MT-CC[W]RT	2048MB	10.6 GB/s	1.5ns /1333MT/s	9-9-9

Label Info

Part Number	JEDEC Module Label
SGH02G72C1BD1MT-BBRT	2GB 1Rx8 PC3-8500N-7-11-E0
SGH02G72C1BD1MT-CCRT	2GB 1Rx8 PC3-10600N-9-11-E0

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	Clock Enable
S0#	Chip Select
CK0	Clock Inputs, positive line
CK0#	Clock Inputs, negative line
Event#	Temperature event: The EVENT# pin is asserted by the temperature sensor when critical
Reset#	Reset signal for DDR3 SDRAMs and register
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 – SA2	Presence Detect Address Inputs
ODT0	On-Die Termination
Par_In	Parity bit for the Address and Control bus
Err_Out#	Parity error found on the Address and Control bus
NC	No Connection

Pin Configuration

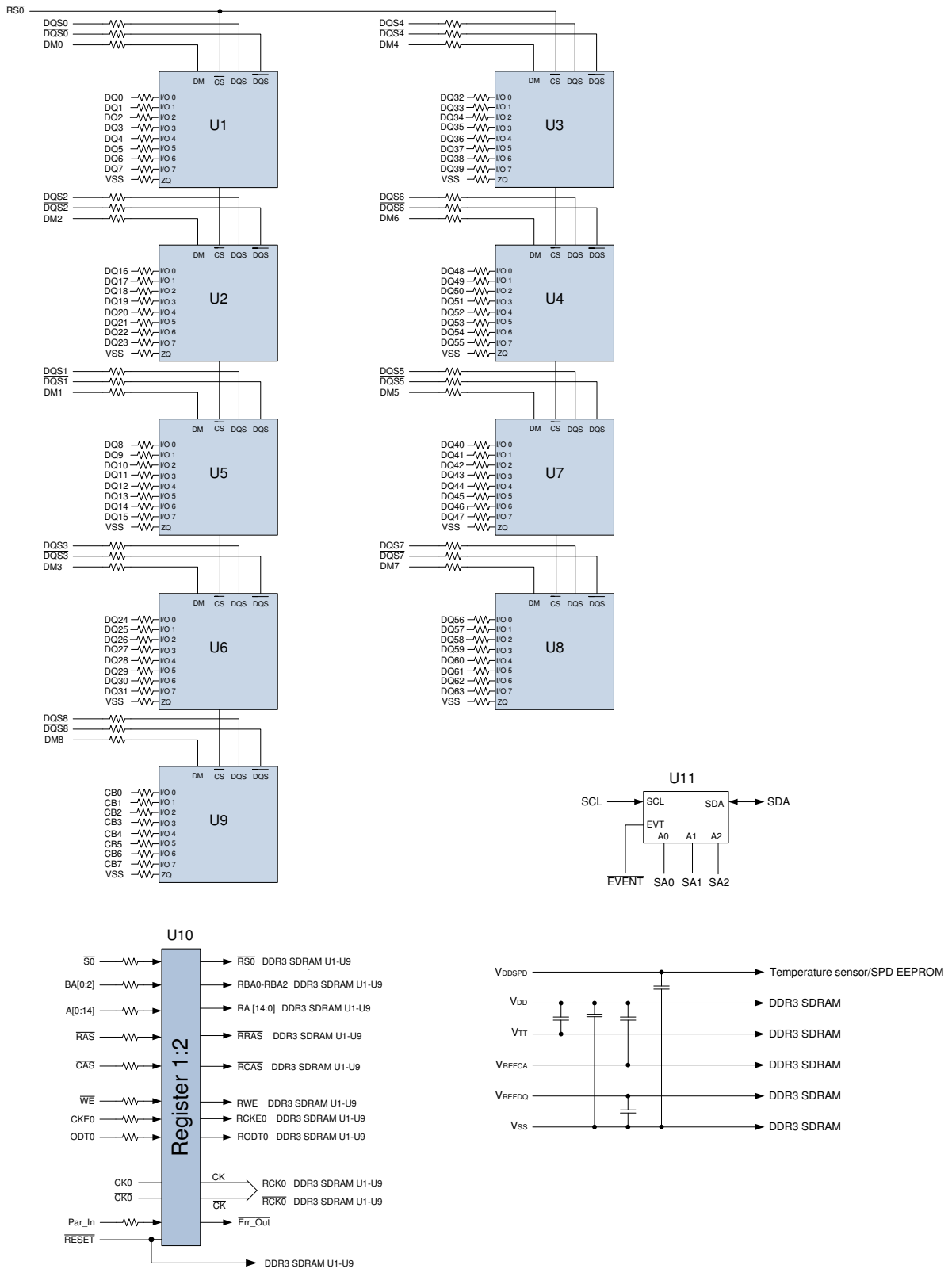
Frontside							
PIN	Symbol	PIN	Symbol	PIN	Symbol	PIN	Symbol
1	V _{TT}	31	DQ24	61	V _{DD}	92	DQ40
2	V _{REFDQ}	32	DQ25	62	A2	93	DQ41
3	V _{SS}	33	V _{SS}	63	V _{DD}	94	V _{SS}
4	DQ0	34	DQS3#	64	(CK1)	95	DQS5#
5	DQ1	35	DQS3	65	(CK1#)	96	DQS5
6	V _{SS}	36	V _{SS}	66	V _{DD}	97	V _{SS}
7	DQS0#	37	DQ26	67	V _{REFCA}	98	DQ42
8	DQS0	38	DQ27	68	V _{DD}	99	DQ43
9	V _{SS}	39	V _{SS}	69	Par_In	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	(S1#)	108	DQ51
18	V _{SS}	48	V _{SS}	78	(ODT1)	109	V _{SS}
19	DQ10	49	NC	79	V _{DD}	110	DQ56
20	DQ11	50	Reset#	80	(S2#)	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	Err_Out#	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	(TEST)	201	(S3#)	232	DQ61
142	V _{SS}	172	(CKE1)	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/BC#	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 2048MB DDR3 SDRAM Mini-RDIMM, 1 RANK AND 9 COMPONENTS



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}	765	675	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}	900	855	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}	270	225	mA
	Slow Exit		108	108	
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}	315	270	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}	333	288	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}	315	270	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}	360	315	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}	1440	1260	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}	1485	1305	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}	1800	1710	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}	108	108	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}	3465	3015	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 pulse width (for each input)		t _{DIPW}	400	-	490	-	ps
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 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

- 1 The maximum preamble is bound by t_{LZDQS} (MAX)
- 2 The maximum postamble is bound by t_{HZDQS} (MAX)

DQ, DQS and C/A signal setup and hold times t_{DS}, t_{DH}, t_{DQSQ}, t_{DSS}, t_{DQSS}, t_{DQSCK}, t_{IS}, t_{IH} need to be calculated with the respective DRAM derating tables and the driver slew rate or determined by simulation

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)
 $(0^{\circ}\text{C} \leq T_{\text{CASE}} \leq +85^{\circ}\text{C}; V_{\text{DDQ}} = +1.5\text{V} \pm 0.075\text{V}, V_{\text{DD}} = +1.5\text{V} \pm 0.075\text{V})$

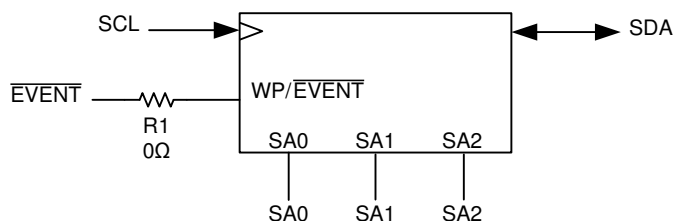
AC CHARACTERISTICS		10600-999		8500-777		Unit	
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX		
CAS# to CAS# command delay	t_{CCD}	4	-	4	-	t_{CK}	
ACTIVE to ACTIVE (same bank) command period	t_{RC}	49.5	-	50.625	-	ns	
ACTIVE bank <i>a</i> to ACTIVE bank <i>b</i> command	t_{RRD}	max 4nCK,10ns	-	max 4nCK,7.5ns	-	ns	
ACTIVE to READ or WRITE delay	t_{RCD}	13.5	-	13.125	-	ns	
Four bank Activate period	t_{FAW}	1K Page size	30	-	37.5	-	ns
		2K Page size	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}	$t_{\text{WR}} + t_{\text{RP}}/t_{\text{CK}}$	-	$t_{\text{WR}} + t_{\text{RP}}/t_{\text{CK}}$	-	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 $0^{\circ}\text{C} \leq T_{\text{CASE}} \leq 85^{\circ}\text{C}$	t_{REFI}	-	7.8	-	7.8	μs	
	t_{REFIIT}	-	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_{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,tR FC + 10ns	-	max 5nCK,tR 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	-	t _{CK}
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	-	t _{CK}
CKE minimum high/low time	t _{CKE}	max 3nCK, 5.625ns	-	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: 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#

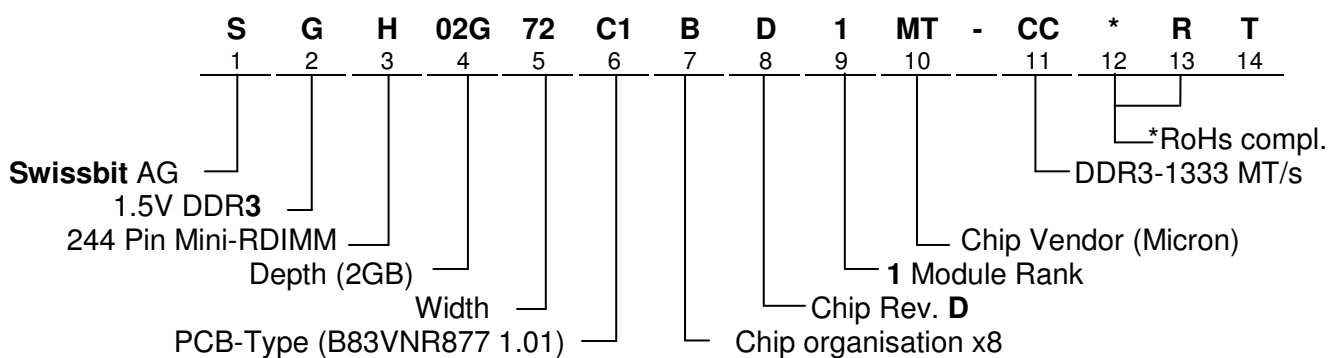
¹ The most significant bit, b7, is sent first.

SERIAL PRESENCE-DETECT MATRIX

Byte	Byte Description	10600-999	8500-777
0	CRC RANGE, EEPROM BYTES, BYTES USED	0x92	
1	SPD REVISION	0x11	
2	DRAM DEVICE TYPE	0x0B	
3	MODULE TYPE (FORM FACTOR) MiniRDIMM	0x05	
4	SDRAM DEVICE DENSITY & BANKS	0x03	
5	SDRAM DEVICE ROW & COLUMN COUNT	0x19	
6	BYTE 6 RESERVED	0x00	
7	MODULE RANKS & DEVICE DQ COUNT	0x01	
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	0x0f
13	BYTE 13 RESERVED	0x00	
14	CAS LATENCIES SUPPORTED (CL4 => CL11)	0x7E	0x1E
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	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 ($t_{RAS\ MIN}$)	0x20	0x2C
23	MIN ACTIVE TO ACTIVE/REFRESH DELAY ($t_{RC\ MIN}$)	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	0x01
29	MIN FOUR ACTIVE WINDOW DELAY ($t_{FAW\ MIN}$) LSB	0xF0	0x2C
30	SDRAM DEVICE OUTPUT DRIVERS SUPPORTED	0x82	
31	SDRAM DEVICE THERMAL & REFRESH OPTIONS	0x05	
32	DDR3-MODULE THERMAL SENSOR	0x80	
33	DDR3-SDRAM DEVICE TYPE	0x00	
34	DDR3-FINE OFFSET FOR $t_{CK\ MIN}$	0x00	
35-59	BYTES 33-59 RESERVED	0x00	
60	MODULE HEIGHT (NOMINAL)	0x03	

Byte	Byte Description	10600-999		8500-777	
61	MODULE THICKNESS (MAX)	0x11			
62	REFERENCE RAW CARD ID	0x03			
63	ADDRESS MAPPING EDGE CONECTOR TO DRAM	0x05			
64	RDIMM THERMAL HEAT SPREADER SOLUTION	0x00			
65	REGISTER MANUFACTURER ID CODE [LSB]	0x04			
66	REGISTER MANUFACTURER ID CODE [MSB]	0xB3			
67	REGISTER REVISION NUMBER	0x03			
68-116	BYTES 64-116 RESEVED	0x00			
117	MODULE MFR ID (LSB)	0x83			
118	MODULE MFR ID (MSB)	0xDA			
119	MODULE MFR LOCATION ID	CH = 0x01	DE = 0x02	US = 0x03	
120	MODULE MFR YEAR	X			
121	MODULE MFR WEEK	X			
122-125	MODULE SERIAL NUMBER	X			
126-127	CRC	0x5831		0xFB99	
128-145	MODULE PART NUMBER	"SGH02G72C1BD1MT-xx"			
146	MODULE DIE REV	X			
147	MODULE PCB REV	X			
148	DRAM DEVICE MFR ID (LSB)	0x80			
149	DRAM DEVICE MFR (MSB)	0x2C			
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
0.9	Preliminary Version	06.08.2012
1.0	Initial Revision	12.12.2012

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CE Declaration of Conformity

We

Manufacturer: Swissbit AG
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declare under our sole responsibility that the product

Product Type: 2GB DDR3 Mini-RDIMM
Brand Name: SWISSMEMORY™
Product Series: DDR3 Mini-RDIMM
Part Number: SGH02G72C1BD1MT-xxxRT

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

2002/96/EC Category 3 (WEEE)

following the provisions of Directive

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

Swissbit AG, Dezember 2012



Manuela Kögel
Head of Quality Management