

4GB DDR3L – SDRAM ECC SO-UDIMM

204 Pin ECC SO-UDIMM

SLN04G72F1BA1HY-xxRT

4GByte in FBGA Technology

RoHS compliant

Options:

- | | | | | | |
|--|---|-------------------|-------------|-------------------|-------------|
| <ul style="list-style-type: none"> Data Rate / Latency
DDR3 1333 MT/s CL9
DDR3 1600 MT/s CL11 | <p>Marking</p> <p>-CC
-DC</p> | | | | |
| <ul style="list-style-type: none"> Module Density
4GByte with 9 dies and 1 rank | | | | | |
| <ul style="list-style-type: none"> Standard Grade | <table border="0"> <tr> <td>(T_A)</td> <td>0°C to 70°C</td> </tr> <tr> <td>(T_C)</td> <td>0°C to 85°C</td> </tr> </table> | (T _A) | 0°C to 70°C | (T _C) | 0°C to 85°C |
| (T _A) | 0°C to 70°C | | | | |
| (T _C) | 0°C to 85°C | | | | |

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

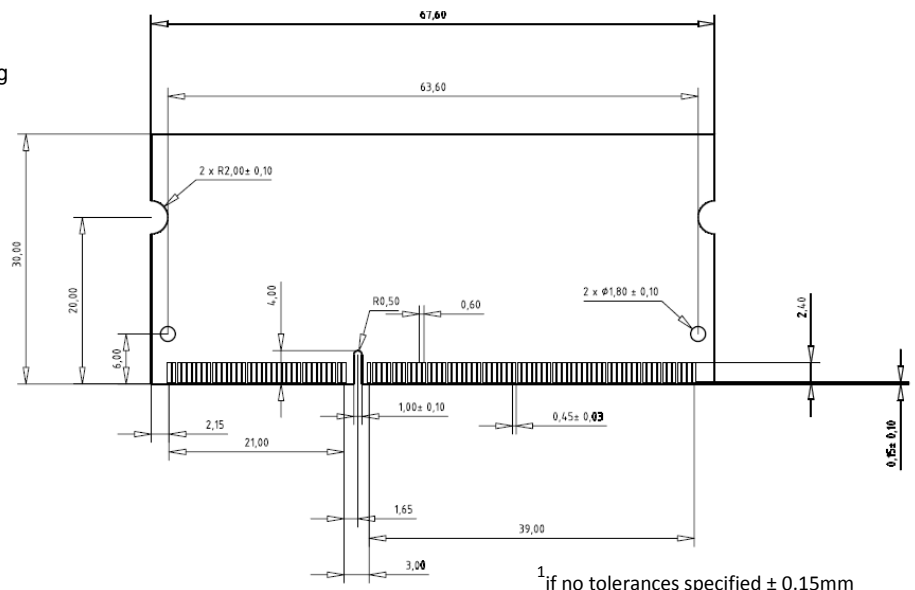
Environmental Requirements:

- Operating temperature (ambient)
Standard Grade 0°C to 70°C
- 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 72-bit DDR3 Small Outline, Dual-In-Line Double Data Rate synchronous DRAM Module
- Module organization: single rank 512M x 72
- V_{DD} = 1.35V and 1.5V
- V_{DDQ} 1.35V and 1.5V
- 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
- This module is fully pin and functional compatible to the JEDEC EP3-12800 DDR3 SDRAM 72bit-SO-DIMM design 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)]
- DDR3L - SDRAM component Hynix H5TC4G83AFR-PBA**
 - 512Mx8 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



This Swissbit module is an industry standard 204-pin 8-byte DDR3 SDRAM ECC Small Outline Dual-In-line Memory Module (SO-UDIMM) 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 Addr.	Column Addr.	Refresh	Module Bank Select
512M x 72bit	9 x 512M x 8bit (4Gbit)	16	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
SLN04G72F1BA1HY-CCRT	4GByte	10.6 GB/s	1.5ns / 1333MT/s	9-9-9
SLN04G72F1BA1HY-DCRT	4GByte	12.8 GB/s	1.25ns / 1600MT/s	11-11-11

Pin Name

A0 – A9, A11 – A15	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
V _{DD}	Supply Voltage (1.35V -0.067V/+0.1V and 1.5V ± 0.075V)
V _{REFDQ}	Reference voltage: DQ, DM (V _{DD} /2)
V _{REFCA}	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
ODT0	On-Die Termination
NC	No Connection

Pin Configuration

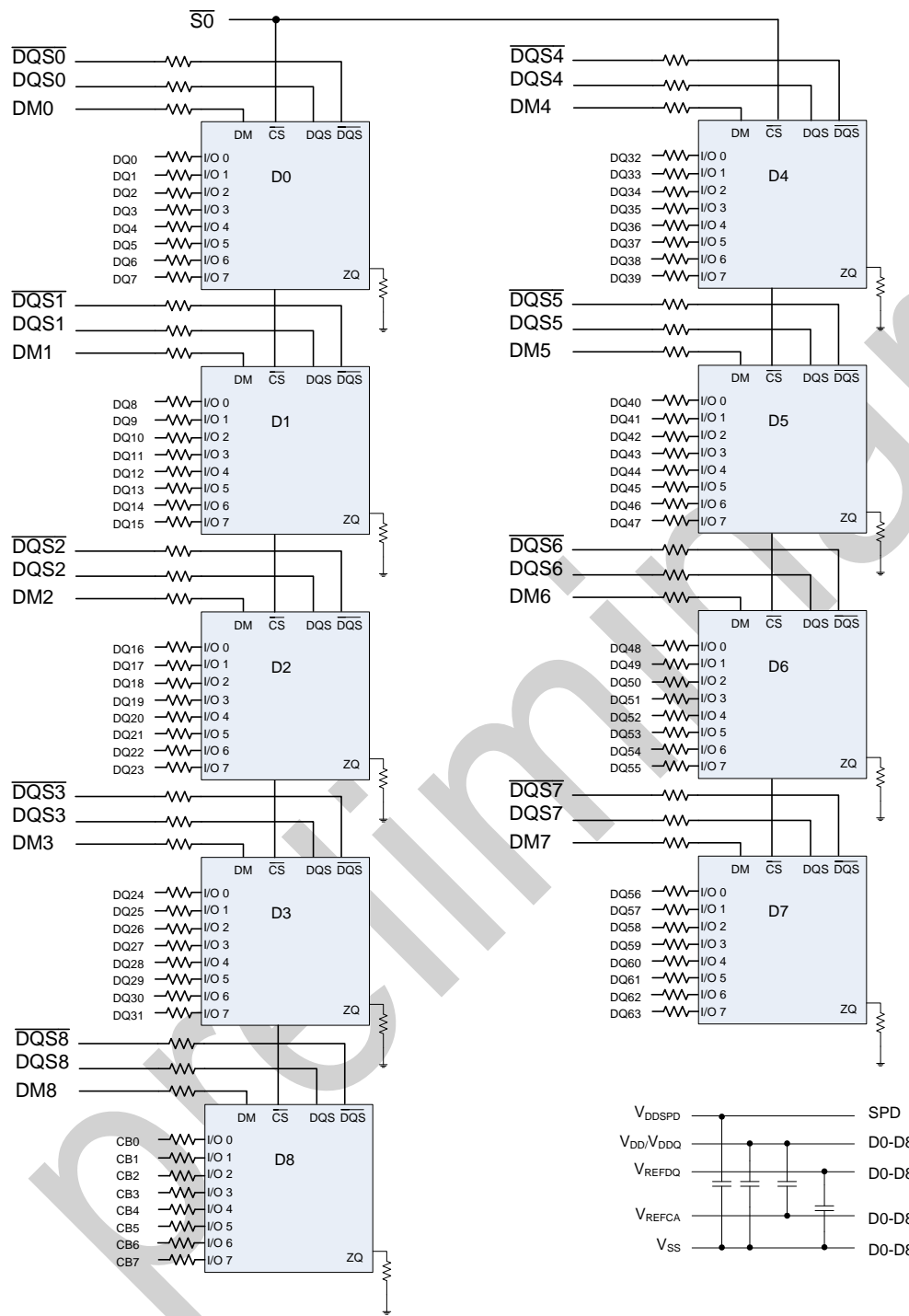
Frontside							
PIN	Symbol	PIN	Symbol	PIN	Symbol	PIN	Symbol
1	V _{REFDQ}	53	V _{SS}	103	A3	155	V _{SS}
3	V _{SS}	55	DQ24	105	A1	157	DM5
5	DQ0	57	DQ25	107	A0	159	DQ42
7	DQ1	59	DM3	109	V _{DD}	161	DQ43
9	V _{SS}	61	V _{SS}	111	CK0	163	V _{SS}
11	DM0	63	DQ26	113	CK0#	165	DQ48
13	DQ2	65	DQ27	115	V _{DD}	167	DQ49
15	DQ3	67	V _{SS}	117	A10/AP	169	V _{SS}
17	V _{SS}	69	CB0	119	BA0	171	DQS6#
19	DQ8	71	CB1	121	WE#	173	DQS6
21	DQ9	Key		123	V _{DD}	175	V _{SS}
23	V _{SS}	73	V _{SS}	125	CAS#	177	DQ50
25	DQS1#	75	DQS8#	127	S0#	179	DQ51
27	DQS1	77	DQS8	129	NC(S1#)	181	V _{SS}
29	V _{SS}	79	V _{SS}	131	V _{DD}	183	DQ56
31	DQ10	81	CB2	133	DQ32	185	DQ57
33	DQ11	83	CB3	135	DQ33	187	V _{SS}
35	V _{SS}	85	V _{DD}	137	V _{SS}	189	DM7
37	DQ16	87	CKE0	139	DQS4#	191	DQ58
39	DQ17	89	NC(CKE1)	141	DQS4	193	DQ59
41	V _{SS}	91	BA2	143	V _{SS}	195	V _{SS}
43	DQS2#	93	V _{DD}	145	DQ34	197	SA0
45	DQS2	95	A12/BC#	147	DQ35	199	V _{DDSPD}
47	V _{SS}	97	A8	149	V _{SS}	201	SA1
49	DQ18	99	A5	151	DQ40	203	V _{TT}
51	DQ19	101	V _{DD}	153	DQ41		

(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	DQ28	104	A4	156	DQS5
4	DQ4	56	DQ29	106	A2	158	V _{SS}
6	DQ5	58	V _{SS}	108	BA1	160	DQ46
8	V _{SS}	60	DQS3#	110	V _{DD}	162	DQ47
10	DQS0#	62	DQS3	112	NC(CK1)	164	V _{SS}
12	DQS0	64	V _{SS}	114	NC(CK1#)	166	DQ52
14	V _{SS}	66	DQ30	116	V _{DD}	168	DQ53
16	DQ6	68	DQ31	118	NC(S3#)	170	V _{SS}
18	DQ7	70	V _{SS}	120	NC(S2#)	172	DM6
20	V _{SS}	72	CB4	122	RAS#	174	DQ54
22	DQ12	Key		124	V _{DD}	176	DQ55
24	DQ13	74	CB5	126	ODT0	178	V _{SS}
26	V _{SS}	76	DM8	128	NC(ODT1)	180	DQ60
28	DM1	78	V _{SS}	130	A13	182	DQ61
30	Reset#	80	CB6	132	V _{DD}	184	V _{SS}
32	V _{SS}	82	CB7	134	DQ36	186	DQS7#
34	DQ14	84	V _{REFCA}	136	DQ37	188	DQS7
36	DQ15	86	V _{DD}	138	V _{SS}	190	V _{SS}
38	V _{SS}	88	A15	140	DM4	192	DQ62
40	DQ20	90	A14	142	DQ38	194	DQ63
42	DQ21	92	A9	144	DQ39	196	V _{SS}
44	DM2	94	V _{DD}	146	V _{SS}	198	EVENT#
46	V _{SS}	96	A11	148	DQ44	200	SDA
48	DQ22	98	A7	150	DQ45	202	SCL
50	DQ23	100	A6	152	V _{SS}	204	V _{TT}
52	V _{SS}	102	V _{DD}	154	DQS5#		

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

**FUNCTIONAL BLOCK DIAGRAM 4096MB DDR3 SDRAM SO-UDIMM,
1 RANK AND 9 COMPONENTS**



- BA0-BA2 → BA0-BA2: SDRAM D0-D8
- A0-A14 → A0-A14: SDRAM D0-D8
- RAS → RAS: SDRAM D0-D8
- CAS → CAS: SDRAM D0-D8
- WE → WE: SDRAM D0-D8
- ODT0 → ODT: SDRAM D0-D8
- CKE0 → CKE: SDRAM D0-D8
- CK0 → CK: SDRAM D0-D8
- CK0 → CK: SDRAM D0-D8
- RESET → RESET: SDRAM D0-D8

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
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}	1.283	1.35	1.450	V
I/O Supply Voltage	V_{DDQ}	1.283	1.35	1.450	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	$V_{IH(DC90)}$	$V_{REF} + 90mV$		$V_{DDQ} + 0.3$	V
Input Low (Logic 0) Voltage	$V_{IL(DC90)}$	-0.3		$V_{REF} - 90mV$	V

Under 1.5V operation this DDR3L device operates in accordance to the following specification:
SGN04G72F1BA1HY-XXRT

AC INPUT OPERATING CONDITIONS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Input High (Logic 1) Voltage	$V_{IH(AC135)}$	$V_{REF} + 0.135mV$	-	V
Input Low (Logic 0) Voltage	$V_{IL(AC135)}$	-	$V_{REF} - 0.135mV$	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}, V_{DD} = +1.283V – 1.45V)

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}	264	256	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}	320	312	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}	80	80	mA
	Slow Exit		64	64	
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}	136	136	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}	136	128	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}	144	136	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}	208	200	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}	680	600	mA	

Parameter & Test Condition	max.			
	Symbol	12800-CL11	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}	720	640	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}	1600	1600	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}	96	96	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}	1080	1040	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	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})	260	260	ns

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

 (0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ}, V_{DD} = +1.283V – 1.45V)

AC CHARACTERISTICS		12800-CL11		10600-CL9		Unit	
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX		
Clock cycle time	CL = 11	t _{CK} (11)	1.25	-	-	-	ns
	CL = 10	t _{CK} (10)	1.5	<1.875	1.5	<1.875	
	CL = 9	t _{CK} (9)	1.5	<1.875	1.5	<1.875	
	CL = 8	t _{CK} (8)	1.875	<2.5	1.875	<2.5	
	CL = 7	t _{CK} (7)	1.875	<2.5	1.875	<2.5	
	CL = 6	t _{CK} (6)	2.5	3.3	2.5	3.3	
	CL = 5	t _{CK} (5)	3.0	3.3	3.0	3.3	
Internal READ command to first data	t _{AA}	13.75	-	13.5	-		
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 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	-250	250	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 t_{LZDQS} (MAX)

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

DDR3 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)
 $(0^{\circ}\text{C} \leq T_{\text{CASE}} \leq +85^{\circ}\text{C}; V_{\text{DDQ}}, V_{\text{DD}} = +1.283\text{V} - 1.45\text{V})$

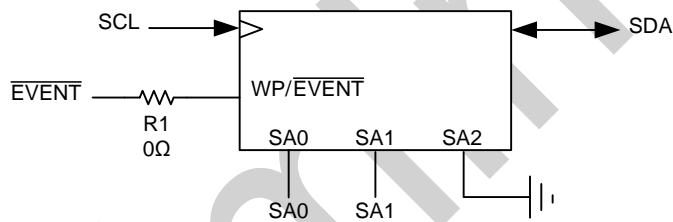
AC CHARACTERISTICS		12800-CL11		10600-CL9		Unit	
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX		
CTRL, CMD, Addr hold to CK, CK#	$t_{\text{IH(Base)}}$	120	-	140	-	ps	
CTRL, CMD, Addr hold to CK, CK# $V_{\text{REF}} @ 1\text{V/ns}$	$t_{\text{IH(1V)}}$	220	-	240	-	ps	
CAS# to CAS# command delay	t_{CCD}	4	-	4	-	t_{CK}	
ACTIVE to ACTIVE (same bank) command period	t_{RC}	48.75	-	49.5	-	ns	
ACTIVE to ACTIVE minimum command period	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	t_{FAW}	1K Page size	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}	$t_{\text{WR}} + t_{\text{RP}}/t_{\text{CK}}$	-	$t_{\text{WR}} + t_{\text{RP}}/t_{\text{CK}}$	-	ns	
Internal WRITE to READ command delay	t_{WTR}	max 4nCK,7.5ns	-	max 4nCK,7.5ns	-	ns	
PRECHARGE command period	t_{RP}	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}	260	70'200	260	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	
$85^{\circ}\text{C} < T_{\text{CASE}} \leq 95^{\circ}\text{C}$	$t_{\text{REFI (IT)}}$	-	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,tR FC + 10ns	-	max 5nCK,tR FC + 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}, V_{DD} = +1.283V – 1.45V)

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 _{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}	0	200	0	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: 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		T.B.D	T.B.D	°C
Temperature sensor accuracy		T.B.D	T.B.D	°C

A.C. Characteristics of Temperature Sensor

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

Symbol	Parameter / Condition	MIN	MAX	Unit
fSCL	SCL clock frequency	10	400	kHz
tBUF	Bus Free Time Between STOP and START	1300		ns
tF	SDA fall time		300	ns
tR	SDA rise time		300	ns
tHD:DAT	Data hold time (accepted for Input Data)	0		ns
	Data Hold Time (guaranteed for Output Data)	300	900	ns
tH:STA	Start condition hold time	600		ns
tHIGH	High Period of SCL	600		ns
tLOW	Low Period of SCL	1300		ns
tsU:DAT	Data setup time	100		ns
tsU:STA	Start condition setup time	600		ns
tsU:STO	Stop condition setup time	600		ns
tTIMEOUT	SMBus SCL Clock Low Timeout	25	35	ms
ti	Noise Pulse Filtered at SCL and SDA Inputs		100	ns
tWR	Write Cycle Time		5	ms
tPU	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#

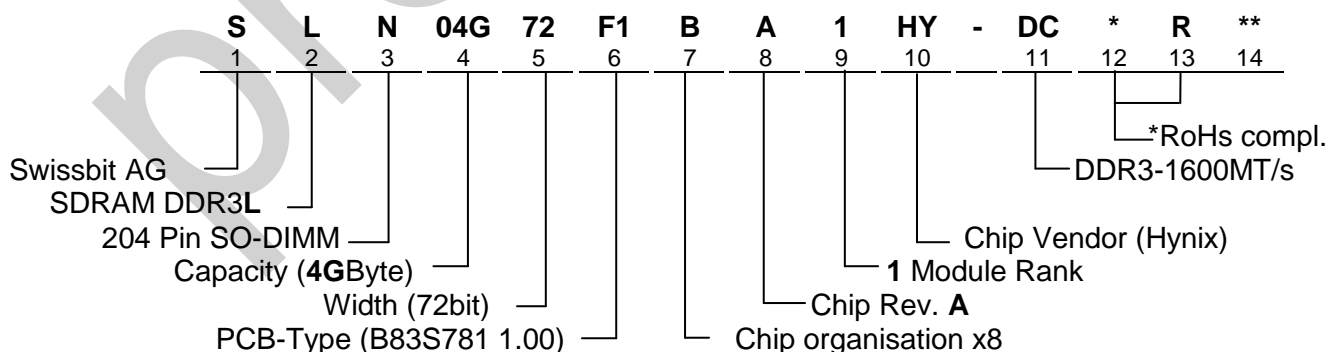
¹ The most significant bit, b7, is sent first.

SERIAL PRESENCE-DETECT MATRIX

Byte	Byte Description	12800-CL11	10600-CL9
0	CRC RANGE, EEPROM BYTES, BYTES USED	0x92	
1	SPD REVISION	0x11	
2	DRAM DEVICE TYPE	0x0B	
3	MODULE TYPE (FORM FACTOR)	0x08	
4	SDRAM DEVICE DENSITY & BANKS	0x04	
5	SDRAM DEVICE ROW & COLUMN COUNT	0x21	
6	MODULE NOMINAL VOLTAGE, V_{DD}	0x02	
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 ($t_{CK\ MIN}$)	0x0A	0x0C
13	BYTE 13 RESERVED	0x00	
14	CAS LATENCIES SUPPORTED (CL4 => CL11)	0xFE	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 ($t_{RAS\ MIN}$)	0x18	0x20
23	MIN ACTIVE TO ACTIVE/REFRESH DELAY ($t_{RC\ MIN}$)	0x81	0x89
24	MIN REFRESH RECOVERY DELAY ($t_{RFC\ MIN}$) LSB	0x20	
25	MIN REFRESH RECOVERY DELAY ($t_{RFC\ MIN}$) MSB	0x08	
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	12800-CL11	10600-CL9
32	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	0x02	
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	0x5D0E	0x5D09
128-145	MODULE PART NUMBER	"SLN04G72F1BA1HY-xx"	
146	MODULE DIE REV	X	
147	MODULE PCB REV	X	
148	DRAM DEVICE MFR ID (LSB)	0x80	
149	DRAM DEVICE MFR (MSB)	0xAD	
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	11.06.2013

preliminary

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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: 4GB DDR3L SO-UDIMM
Brand Name: SWISSMEMORY™
Product Series: DDR3L SO-UDIMM
Part Number: SLN04G72F1BA1HY-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, Juni 2013



Manuela Kögel
Head of Quality Management