1GB DDR2 – SDRAM registered DIMM

240 Pin RDIMM

SEP01G72J2BF1SA-30R

1GB PC2-5300 in FBGA Technology

RoHS compliant

Options:

Data Rate / Latency	Marking
DDR2 533MT/s CL4	-37
DDR2 667MT/s CL5	-30

- Module Density
  1024MB with 9 dies and 1 rank
- Standard Grade (T_A) 0°C to 70°C
  (T_C) 0°C to 85°C

Environmental Requirements:

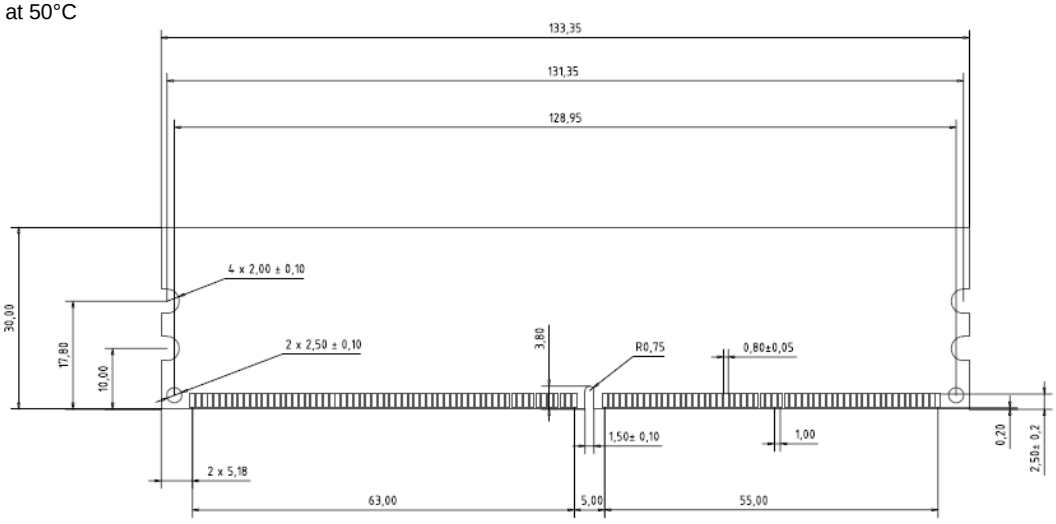
- Operating temperature ($T_{AMBIENT}$)
  Standard Grade 0°C to 70°C
- Operating Humidity
  10% to 90% relative humidity, noncondensing
- Operating Pressure
  105 to 69 kPa (up to 10000 ft.)
- Storage Temperature
  -55°C to 100°C
- Storage Humidity
  5% to 95% relative humidity, noncondensing
- Storage Pressure
  1682 PSI (up to 5000 ft.) at 50°C

Features:

- 240-pin 72-bit DDR2 registered Dual-In-Line Double Data Rate Synchronous DRAM Module for server applications
- Module organization: single rank 128M x 72
- V_{DD} = 1.8V ±0.1V, V_{DDQ} 1.8V ±0.1V
- 1.8V I/O (SSTL_18 compatible)
- Serial Presence Detect with EEPROM
- Supports ECC error detection and correction
- JEDEC compatible DDR2 PLL/Register component with parity bit support for address and control bus
- Gold-contact pad
- This module family is fully pin and functional compatible to JEDEC. (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)]

- **DDR2 SDRAM component Samsung K4T1G084QF**
- 128Mx8 DDR2 SDRAM in FBGA-60 package
- Four bit prefetch architecture
- Programmable CAS latency (CL)
- Posted CAS additive latency (AL)
- WRITE latency = READ latency – 1 t_{CK}
- Programmable burst length: 4 or 8
- Adjustable data-output drive strength
- On-die termination (ODT)
- DLL to align DQ and DQS transitions with CK

mechanical dimensions[1]



[1] if no tolerances specified ± 0.15mm

This Swissbit module is an industry standard 240-pin 8-byte DDR2 registered SDRAM Dual-In-line Memory Module (RDIMM) which is organized as x72 high speed CMOS memory arrays. All control and address signals are re-driven on the DIMM using register devices and a PLL for the clock distribution. This reduces capacitive loading to the system bus, but adds one cycle to the SDRAM timing. De-coupling capacitors, stub resistors, calibration resistors and termination resistors are mounted on the PCB board. The module uses double data rate architecture to achieve high-speed operation. DDR2 SDRAM modules operate from a differential clock (CK and CK#). READ and WRITE accesses to a DDR2 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 DDR2 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_18 compatible.
The DDR2 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 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	DDR2 SDRAMs used	Row Addr.	Device Bank Select	Column Addr.	Refresh	Module Bank Select
128M x 72bit	9 x 128M x 8bit (1Gbit)	14	BA0, BA1, BA2	10	8k	S0#

Module Dimensions in mm
133.33 (long) x 30(high) x 2.7 [max] (thickness)

Timing Parameters

Part Number	Module Density	Transfer Rate	Clock Cycle/Data bit rate	Latency
SEP01G72J2BF1SA-37R	1024 MB	4.2 GB/s	3.7ns/533MT/s	4-4-4
SEP01G72J2BF1SA-30R	1024 MB	5.3 GB/s	3.0ns/667MT/s	5-5-5

Pin Name

A0 - A13	Address Inputs
BA0, BA1, BA2	Bank Address Inputs
DQ0 – DQ63	Data Input / Output
CB0 – CB7	Check Bits
DM0-DM8	Input Data Mask
RAS#	Row Address Strobe
CAS#	Column Address Strobe
WE#	Write Enable
CKE0	Clock Enable
CK0	Clock Input, positive line
CK0#	Clock Input, negative line
DQS0 – DQS8	Data Strobe, positive line
DQS0# - DQS8#	Data Strobe, negative line (only used when differential data strobe mode is enabled)
S0#	Chip Select
Reset#	Asynchronously forces all registered outputs LOW when RESET# is LOW. This signal can be used during power-up to ensure that CKE is LOW and DQs are High-Z.

PAR_IN	Parity bit for the address and control bus.
ERR_OUT	Parity error found on the address and control bus.
V_{DD} / V_{DDQ}	Supply Voltage (1.8V± 0.1V)
V_{REF}	Input / Output Reference
V_{SS}	Ground
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
NC	No Connection

Pin Configuration

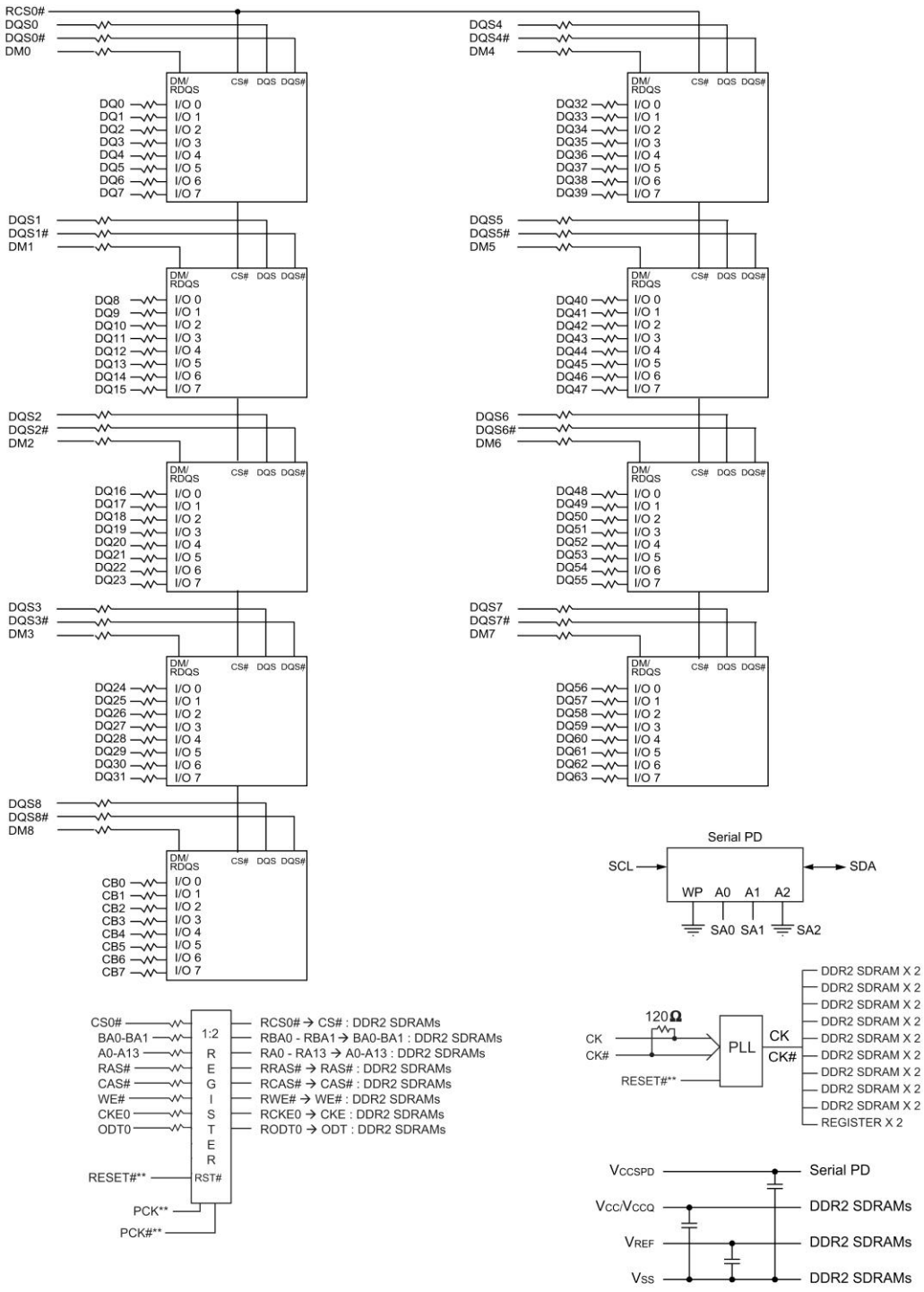
PIN #	Front Side	PIN #	Back Side	PIN #	Front Side	PIN #	Back Side
1	V_{REF}	121	V_{SS}	61	A4	181	V_{DDQ}
2	V_{SS}	122	DQ4	62	V_{DDQ}	182	A3
3	DQ0	123	DQ5	63	A2	183	A1
4	DQ1	124	V_{SS}	64	V_{DD}	184	V_{DD}
5	V_{SS}	125	DM0 (DQS9)	65	V_{SS}	185	CK0
6	DQS0#	126	NC (DQS9#)	66	V_{SS}	186	CK0#
7	DQS0	127	V_{SS}	67	V_{DD}	187	V_{DD}
8	V_{SS}	128	DQ6	68	Par_In	188	A0
9	DQ2	129	DQ7	69	V_{DD}	189	V_{DD}
10	DQ3	130	V_{SS}	70	A10/AP	190	BA1
11	V_{SS}	131	DQ12	71	BA0	191	V_{DDQ}
12	DQ8	132	DQ13	72	V_{DDQ}	192	RAS#
13	DQ9	133	V_{SS}	73	WE#	193	S0#
14	V_{SS}	134	DM1 (DQS10)	74	CAS#	194	V_{DDQ}
15	DQS1#	135	NC (DQS10#)	75	V_{DDQ}	195	ODT0
16	DQS1	136	V_{SS}	76	NC (S1#)	196	A13
17	V_{SS}	137	NC (CK1)	77	NC (ODT1)	197	V_{DD}
18	RESET	138	NC (CK1#)	78	V_{DDQ}	198	V_{SS}
19	NC	139	V_{SS}	79	V_{SS}	199	DQ36
20	V_{SS}	140	DQ14	80	DQ32	200	DQ37
21	DQ10	141	DQ15	81	DQ33	201	V_{SS}
22	DQ11	142	V_{SS}	82	V_{SS}	202	DM4 (DQS13)
23	V_{SS}	143	DQ20	83	DQS4#	203	NC (DQS13#)
24	DQ16	144	DQ21	84	DQS4	204	V_{SS}
25	DQ17	145	V_{SS}	85	V_{SS}	205	DQ38
26	V_{SS}	146	DM2 (DQS11)	86	DQ34	206	DQ39
27	DQS2#	147	NC (DQS11#)	87	DQ35	207	V_{SS}
28	DQS2	148	V_{SS}	88	V_{SS}	208	DQ44
29	V_{SS}	149	DQ22	89	DQ40	209	DQ45
30	DQ18	150	DQ23	90	DQ41	210	V_{SS}
31	DQ19	151	V_{SS}	91	V_{SS}	211	DM5 (DQS14)

PIN #	Front Side	PIN #	Back Side	PIN #	Front Side	PIN #	Back Side
32	V_{SS}	152	DQ28	92	DQS5#	212	NC (DQS14#)
33	DQ24	153	DQ29	93	DQS5	213	V_{SS}
34	DQ25	154	V_{SS}	94	V_{SS}	214	DQ46
35	V_{SS}	155	DM3 (DQS12)	95	DQ42	215	DQ47
36	DQS3#	156	NC (DQS12#)	96	DQ43	216	V_{SS}
37	DQS3	157	V_{SS}	97	V_{SS}	217	DQ52
38	V_{SS}	158	DQ30	98	DQ48	218	DQ53
39	DQ26	159	DQ31	99	DQ49	219	V_{SS}
40	DQ27	160	V_{SS}	100	V_{SS}	220	NC (CK2)
41	V_{SS}	161	CB4	101	SA2	221	NC (CK2#/)
42	CB0	162	CB5	102	NC (TEST)	222	V_{SS}
43	CB1	163	V_{SS}	103	V_{SS}	223	DM6 (DQS15)
44	V_{SS}	164	DM8 (DQS17)	104	DQS6#	224	NC (DQS15#)
45	DQS8#	165	NC (DQS17#)	105	DQS6	225	V_{SS}
46	DQS8	166	V_{SS}	106	V_{SS}	226	DQ54
47	V_{SS}	167	CB6	107	DQ50	227	DQ55
48	CB2	168	CB7	108	DQ51	228	V_{SS}
49	CB3	169	V_{SS}	109	V_{SS}	229	DQ60
50	V_{SS}	170	V_{DDQ}	110	DQ56	230	DQ61
51	V_{DD}	171	NC (CKE1)	111	DQ57	231	V_{SS}
52	CKE0	172	V_{DD}	112	V_{SS}	232	DM7 (DQS16)
53	V_{DD}	173	NC (A15)	113	DQS7#	233	NC (DQS16#)
54	BA2	174	NC (A14)	114	DQS7	234	V_{SS}
55	Par_Out	175	V_{DDQ}	115	V_{SS}	235	DQ62
56	V_{DDQ}	176	A12	116	DQ58	236	DQ63
57	A11	177	A9	117	DQ59	237	V_{SS}
58	A7	178	V_{DD}	118	V_{SS}	238	V_{DDSPD}
59	V_{DD}	179	A8	119	SDA	239	SA0
60	A5	180	A6	120	SCL	240	SA1

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

FUNCTIONAL BLOCK DIAGRAMM 1GB DDR2 ECC Registered DIMM, 1 RANK AND 9 COMPONENTS

FUNCTIONAL BLOCK DIAGRAM



** RESET#, PCK and PCK# connect to both Registers. Other signals connect to one of two Registers.
Note: All resistor values are 22 ohms ±5% unless otherwise specified.

MAXIMUM ELECTRICAL DC CHARACTERISTICS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{DD}	-1.0	2.3	V
I/O Supply Voltage	V_{DDQ}	-0.5	2.3	V
V_{DDL} Supply Voltage	V_{DDL}	-0.5	2.3	V
Voltage on any pin relative to V_{SS}	V_{in}, V_{out}	-0.5	2.3	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		-40	40	
CK, CK#		-20	20	
DM		-5	5	
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}	-16	16	µA

DC OPERATING CONDITIONS

PARAMETER/ CONDITION	SYMBOL	MIN	NOM	MAX	UNITS
Supply Voltage	V_{DD}	1.7	1.8	1.9	V
I/O Supply Voltage	V_{DDQ}	1.7	1.8	1.9	V
V_{DD}L Supply Voltage	V_{DDL}	1.7	1.8	1.9	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}	V_{REF} – 0.04	V_{REF}	V_{REF} + 0.04	V
Input High (Logic 1) Voltage	$V_{IH\ (DC)}$	V_{REF} + 0.125		V_{DDQ} + 0.3	V
Input Low (Logic 0) Voltage	$V_{IL\ (DC)}$	-0.3		V_{REF} – 0.125	V

AC INPUT OPERATING CONDITIONS

PARAMETER/ CONDITION	SYMBOL	MIN	MAX	UNITS
Input High (Logic 1) Voltage	$V_{IH\ (AC)}$	V_{REF} + 0.25	-	V
Input Low (Logic 0) Voltage	$V_{IL\ (AC)}$	-	V_{REF} - 0.25	V

CAPACITANCE

At DDR2 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} = +1.8V ± 0.1V, V_{DD} = +1.8V ± 0.1V)

Parameter & Test Condition		Symbol	max.		Unit
			5300-555	4200-444	
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}	387	368	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}	432	432	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}		I_{DD2P}	90	90	mA
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}	180	180	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}	216	207	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}	Fast PDN Exit MR[12] = 0	I_{DD3P}	198	189	mA
	Slow PDN Exit MR[12] = 1		135	135	
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}	270	252	mA

Parameter & Test Condition	Symbol	Max.		Unit
		5300-555	4200-444	
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}	630	540	mA
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}	540	480	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}	900	855	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}	90	90	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}	1305	1170	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	**5300-555**	**4200-444**	**Unit**
CL (I_{DD})	5	4	t_{CK}
t_{RCD} (I_{DD})	15	15	ns
t_{RC} (I_{DD})	60	60	ns
t_{RRD} (I_{DD})	7.5	7.5	ns
t_{CK} (I_{DD})	3.0	3.7	ns
t_{RAS} MIN (I_{DD})	45	45	ns
t_{RAS} MAX (I_{DD})	70'000	70'000	ns
t_{RP} (I_{DD})	15	15	ns
t_{RFC} (I_{DD})	127.5	127.5	ns

DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.8V ± 0.1V, V_{DD} = +1.8V ± 0.1V)

AC CHARACTERISTICS			5300-555		4200-444		Unit
PARAMETER		SYMBOL	MIN	MIN	MIN	MAX	
Clock cycle time	CL = 6	t_{CK} (6)	-	-	-	-	ns
	CL = 5	t_{CK} (5)	3.0	8.0	3.75	8.0	ns
	CL = 4	t_{CK} (4)	3.75	8.0	3.75	8.0	ns
	CL = 3	t_{CK} (3)	5.0	8.0	5.0	8.0	ns
CK high-level width		t_{CH}	0.48	0.52	0.45	0.55	t_{CK}
CK low-level width		t_{CL}	0.48	0.52	0.45	0.55	t_{CK}
Half clock period		t_{HP}	min (t_{CH}, t_{CL})		min (t_{CH}, t_{CL})		ps
Access window (output) of DQ_S from CK/CK#		t_{AC}	-0.45	+0.45	-0.50	+0.50	ns
Data-out high-impedance window from CK/CK#		t_{HZ}		+0.45 (= t_{AC} max)		+0.50 (= t_{AC} max)	ns
Data-out low-impedance window from CK/CK#		t_{LZ}	-0.45 (= t_{AC} min)	+0.45 (= t_{AC} max)	-0.50 (= t_{AC} min)	+0.50 (= t_{AC} max)	ns
DQ and DM input setup time relative to DQS		t_{DS}	0.10		0.10		ns
DQ and DM input hold time relative to DQS		t_{DH}	0.175		0.35		ns
DQ and DM input pulse width (for each input)		t_{DIPW}	0.35		0.35		t_{CK}
Data hold skew factor		t_{QHS}				0.4	ns
DQ-DQS hold, DQS to first DQ to go non-valid, per access		t_{QH}	t_{HP} - t_{QHS}		t_{HP} - t_{QHS}		ns
Data valid output window		t_{DVW}	t_{QH} - t_{DQSQ}		t_{QH} - t_{DQSQ}		ns
DQS input high pulse width		t_{DQSH}	0.35		0.35		t_{CK}
DQS input low pulse width		t_{DQSL}	0.35		0.35		t_{CK}
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 –DQ skew, DQS to last DQ valid, per group, per access		t_{DQSQ}		0.24		0.30	ns
DQS read preamble		t_{RPRE}	0.9	1.1	0.9	1.1	t_{CK}
DQS read postamble		t_{RPST}	0.4	0.6	0.4	0.6	t_{CK}
DQS write preamble		t_{WPRE}	0.35		0.35		t_{CK}
DQS write preamble setup time		t_{WPRES}	0		0		ns
DQS write postamble		t_{WPST}	0.4	0.6	0.4	0.6	t_{CK}
Positive DQS latching edge to associated clock edge		t_{DQSS}	-0.25	+0.25	- 0.25	+ 0.25	t_{CK}
Write command to first DQS latching transition			WL- t_{DQSS}	WL+ t_{DQSS}	WL- t_{DQSS}	WL+ t_{DQSS}	t_{CK}
Address and control input pulse width (for each input)		t_{IPW}	0.6		0.6		t_{CK}
Address and control input setup time		$t_{IS(base)}$	0.2		0.5		ns

DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.8V ± 0.1V, V_{DD} = +1.8V ± 0.1V)

AC CHARACTERISTICS		5300-555		4200-444		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	
Address and control input hold time	t_{IH}	0.275		0.5		ns
CAS# to CAS# command delay	t_{CCD}	2		2		t_{CK}
ACTIVE to ACTIVE (same bank) command period	t_{RC}	60		55		ns
ACTIVE bank *a* to ACTIVE bank *b* command	t_{RRD}	7.5		7.5		ns
ACTIVE to READ or WRITE delay	t_{RCD}	15		15		ns
Four bank Activate period	t_{FAW}	37.5		37.5		ns
ACTIVE to PRECHARGE command	t_{RAS}	45	70'000	45	70,000	ns
Internal READ to precharge command delay	t_{RTP}	7.5		7.5		ns
Write recovery time	t_{WR}	15		15		ns
Auto precharge write recovery + precharge time	t_{DAL}	$t_{WR} + t_{RP}$		$t_{WR} + t_{RP}$		ns
Internal WRITE to READ command delay	t_{WTR}	7.5		7.5		ns
PRECHARGE command period	t_{RP}	15		15		ns
PRECHARGE ALL command period	t_{RPA}	$t_{RP} + t_{CK}$		$t_{RP} + t_{CK}$		ns
LOAD MODE command cycle time	t_{MRD}	2		2		t_{CK}
CKE low to CK, CK# uncertainty	t_{DELAY}	$t_{IS} + t_{CK} + t_{IH}$		$t_{IS} + t_{CK} + t_{IH}$		t_{CK}
REFRESH to ACTIVE or REFRESH to REFRESH command interval	t_{RFC}	127.5		127.5		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}		3.9		3.9	µs
Exit SELF REFRESH to non-READ command	t_{XSNR}	t_{RFC}(min) + 10		t_{RFC}(min) + 10		ns
Exit SELF REFRESH to READ command	t_{XSRD}	200		200		t_{CK}
Exit SELF REFRESH timing reference	t_{ISXR}	t_{IS}		t_{IS}		ps
ODT turn-on delay	t_{AOND}	2	2	2	2	t_{CK}
ODT turn-on	t_{AON}	t_{AC}(min)	t_{AC}(max) + 0.7	t_{AC}(min)	t_{AC}(max) + 1,000	ps
ODT turn-off delay	t_{AOFD}	2.5	2.5	2.5	2.5	t_{CK}
ODT turn-off	t_{AOF}	t_{AC}(min)	t_{AC}(max) + 600	t_{AC}(min)	t_{AC}(max) + 600	ps
ODT turn-on (power-down mode)	t_{AONPD}	t_{AC}(min) + 2,000	2 x t_{CK} + t_{AC}(max) + 1,000	t_{AC}(min) + 2,000	2 x t_{CK} + t_{AC}(max) + 1,000	ps
ODT turn-off (power-down mode)	t_{AOFPD}	t_{AC}(min) + 2,000	2.5 x t_{CK} + t_{AC}(max) + 1,000	t_{AC}(min) + 2,000	2.5 x t_{CK} + t_{AC}(max) + 1,000	ps
ODT to power-down entry latency	t_{ANPD}	3		3		t_{CK}

DDR2 SDRAM COMPONENT ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS (Continued)

(0°C ≤ T_{CASE} ≤ + 85°C; V_{DDQ} = +1.8V ± 0.1V, V_{DD} = +1.8V ± 0.1V)

AC CHARACTERISTICS				4200-444		Unit
PARAMETER	SYMBOL	MIN	MAX	MIN	MAX	
ODT power-down exit latency	t_{AXPD}	8		8		t_{CK}
ODT enable from MRS command	t_{MOD}	0	12	0	12	ns
Exit active power-down to READ command, MR [bit 12 = 0]	t_{XARD}	2		2		t_{CK}
Exit active power-down to READ command, MR [bit 12 = 1]	t_{XARDS}	7 – AL		6 – AL		t_{CK}
Exit precharge power-down to any non-READ command	t_{XP}	2		2		t_{CK}
CKE minimum high/low time	t_{CKE}	3		3		t_{CK}

Register Specifications

Parameter	Symbol	Pins	Conditions	Min	Max	Units
DC high-level input voltage	$V_{IH(DC)}$	Address, control, command	SSTL_18	$V_{REF(DC)}$ + 125	V_{DDQ} + 250	mV
DC low-level input voltage	$V_{IL(DC)}$	Address, control, command	SSTL_18	0	$V_{REF(DC)}$ - 125	mV
AC high-level input voltage	$V_{IH(AC)}$	Address, control, command	SSTL_18	$V_{REF(DC)}$ + 250	V_{DD}	mV
AC low-level input voltage	$V_{IL(AC)}$	Address, control, command	SSTL_18	0	$V_{REF(DC)}$ - 250	mV
Output high voltage	V_{OH}	Parity output	LVCMOS	1.2	-	V
Output low voltage	V_{OL}	Parity output	LVCMOS	-	0.5	V
Input current	I_I	All pins	V_I = V_{DDQ} or V_{SSQ}	-5	+5	µA
Static standby	I_{DD}	All pins	RESET# = V_{SSQ} (I_O = 0)	-	100	µA
Static operating	I_{DD}	All pins	RESET# = V_{SSQ}; V_I = $V_{IH(AC)}$ or $V_{IL(DC)}$ I_O = 0	-	40	mA
Dynamic operating (clock tree)	I_{DDD}	n/a	RESET# = V_{DD}, V_I = $V_{IH(AC)}$ or $V_{IL(AC)}$, Io = 0; CK and CK# switching 50% duty cycle	-	Varies by manufacturer	µA
Dynamic operating (per each input)	I_{DDD}	n/a	RESET# = V_{DD}, V_I = $V_{IH(AC)}$ or $V_{IL(AC)}$, I_O = 0; CK and CK# switching 50% duty cycle; One data input switching at $t_{CK/2}$, 50% duty cycle	-	Varies by manufacturer	µA
Input capacitance (per device, per pin)	C_I	Data	V_I = V_{REF} ±250mV; V_{DDQ} = 1.8V	2.5	3.5	pF
Input capacitance (per device, per pin)	C_I	RESET#	V_I = V_{DDQ} or V_{SSQ}	-	Varies by manufacturer	pF

Notes: 1. Timing and switching specifications for the register listed above are critical for proper operation of the DDR2 SDRAM registered DIMMs. These are meant to be a subset of the parameters for the specific device used on the module. Detailed information for this register is available in JEDEC standard JESD82.

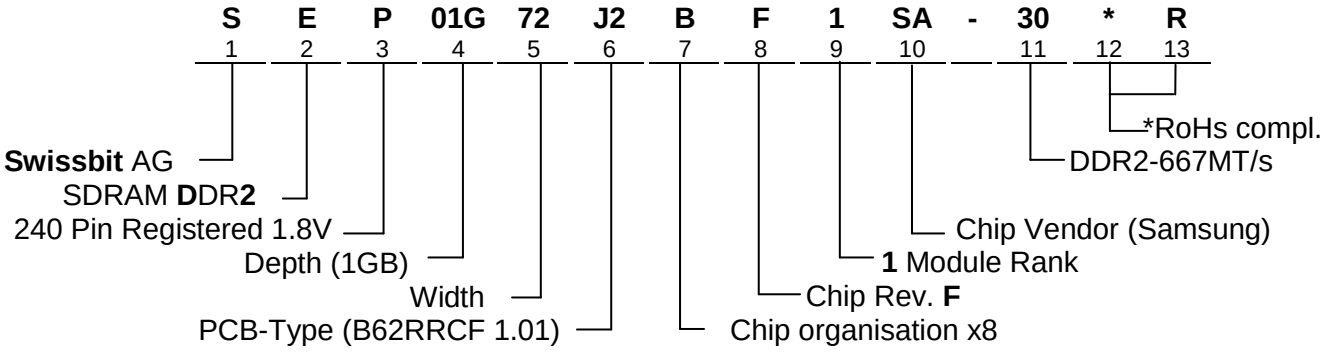
SERIAL PRESENCE-DETECT MATRIX

BYTE	DESCRIPTION	5300-555	4200-444
0	NUMBER OF SPD BYTES USED	0x80	
1	TOTAL NUMBER OF BYTES IN SPD DEVICE	0x08	
2	FUNDAMENTAL MEMORY TYPE	0x08	
3	NUMBER OF ROW ADDRESSES ON ASSEMBLY	0x0E	
4	NUMBER OF COLUMN ADDRESSES ON ASSEMBLY	0x0A	
5	DIMM HIGHT AND MODULE RANKS	0x60	
6	MODULE DATA WIDTH	0x48	
7	MODULE DATA WIDTH (continued)	0x00	
8	MODULE VOLTAGE INTERFACE LEVELS (V_{DDQ})	0x05	
9	SDRAM CYCLE TIME, (t_{CK}) [max CL] CAS LATENCY = 5 (4200 + 5300)	0x30	0x3D
10	SDRAM ACCESS FROM CLOCK, (t_{AC}) [max CL] CAS LATENCY = 5 (4200 + 5300)	0x45	0x50
11	MODULE CONFIGURATION TYPE	0x06	
12	REFRESH RATE / TYPE	0x82	
13	SDRAM DEVICE WIDTH (PRIMARY SDRAM)	0x08	
14	ERROR- CHECKING SDRAM DATA WIDTH	0x08	
15	MINIMUM CLOCK DELAY, BACK-TO-BACK RANDOM COLUMN ACCESS	0x00	
16	BURST LENGTHS SUPPORTED	0x0C	
17	NUMBER OF BANKS ON SDRAM DEVICE	0x08	
18	CAS LATENCIES SUPPORTED	0x38	
19	MODULE THICKNESS	0x01	
20	DDR2 DIMM TYPE	0x01	
21	SDRAM MODULE ATTRIBUTES	0x04	
22	SDRAM DEVICE ATTRIBUTES: Weak Driver and 50Ω ODT	0x07	
23	SDRAM CYCLE TIME, (t_{CK}) [max CL – 1] CAS LATENCY = 4 (4200 + 5300)	0x3D	
24	SDRAM ACCESS FROM CK, (t_{AC}) [max CL – 1] CAS LATENCY = 4 (4200 + 5300)	0x50	
25	SDRAM CYCLE TIME, (t_{CK}) [max CL – 2] CAS LATENCY = 3 (4200 + 5300)	0x50	
26	SDRAM ACCESS FROM CK, (t_{AC}) [max CL – 2] CAS LATENCY = 3 (4200 + 5300)	0x60	
27	MINIMUM ROW PRECHARGE TIME, (t_{RP})	0x3C	
28	MINIMUM ROW ACTIVE TO ROW ACTIVE, (t_{RRD})	0x1E	
29	MINIMUM RAS# TO CAS# DELAY, (t_{RCD})	0x3C	
30	MINIMUM RAS# PULSE WIDTH, (t_{RAS})	0x2D	
31	MODULE BANK DENSITY	0x01	

SERIAL PRESENCE-DTECT MATRIX (continued)

BYTE	DESCRIPTION	5300-555	4200-444
32	ADDRESS AND COMMAND SETUP TIME, (t_{ISb})	0x20	0x25
33	ADDRESS AND COMMAND HOLD TIME, (t_{IHb})	0x27	0x37
34	DATA / DATA MASK INPUT SETUP TIME, (t_{DSb})	0x10	
35	DATA / DATA MASK INPUT HOLD TIME, (t_{DHb})	0x17	0x22
36	WRITE RECOVERY TIME, (t_{WR})	0x3C	
37	WRITE to READ Command Delay, (t_{WTR})	0x1E	
38	READ to PRECHARGE Command Delay, (t_{RTP})	0x1E	
39	Mem Analysis Probe	0x00	
40	Extension for Bytes 41 and 42	0x06	
41	MIN ACTIVE AUTO REFRESH TIME, (t_{RC})	0x3C	
42	MINIMUM AUTO REFRESH TO ACTIVE / AUTO REFRESH COMMAND PERIOD, (t_{RFC})	0x7F	
43	SDRAM DEVICE MAX CYCLE TIME, (t_{CKMAX})	0x80	
44	SDRAM DEVICE MAX DQS-DQ SKEW TIME, (t_{DQSQ})	0x18	0x1E
45	SDRAM DEVICE MAX READ DATA HOLD SKEW FACTOR, (t_{QHS})	0x22	0x28
46	PLL Relock Time	0x0F	
47-61	Optional Features, not supported	0x00	
62	SPD REVISION	0x13	
63	CHECKSUM FOR BYTES 0-62	0x3F	0x83
64-66	MANUFACTURER`S JEDEC ID CODE	0x7F	
67	MANUFACTURER`S JEDEC ID CODE (continued)	0xDA	
68-71	RESERVED	0x00	
72	MANUFACTURING LOCATION	0x01 (Switzerland) | 0x02 (Germany) | 0x03 (USA)	
73-90	MODULE PART NUMBER (ASCII)	“SEP01G72J2BF1SA-XX”	
91	PCB IDENTIFICATION CODE	x	
92	IDENTIFICATION CODE (continued)	x	
93	YEAR OF MANUFACTURE IN BCD	x	
94	WEEK OF MANUFACTURE IN BCD	x	
95-98	MODULE SERIAL NUMBER	x	
99-127	MANUFACTURER-SPECIFIC DATA (RSVD)	0x00	
128-255	Open for customer use	0xff	

Part Number Code



* optional / additional information

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