

Direct RDRAM RIMM Modules (with 128/144 Mbit RDRAMs)

Overview

The Direct Rambus™ RIMM™ module is a general purpose high-performance memory subsystem suitable for use in a broad range of applications including computer memory, personal computers, workstations, and other applications where high bandwidth and low latency are required.

The Direct Rambus RIMM module consists of 128 MB/144 Mbit Direct Rambus DRAM (Direct RDRAM™) devices. These are extremely high-speed CMOS DRAMs organized as 8M words by 16 or 18 bits. The use of Rambus Signaling Level (RSL) technology permits 600 MHz to 800 MHz transfer rates while using conventional system and board design technologies. Direct RDRAM devices are capable of sustained data transfers at 1.25 ns per two bytes (10 ns per sixteen bytes).

The RDRAM architecture enables the highest sustained bandwidth for multiple, simultaneous, randomly addressed, memory transactions. The separate control and data buses with independent row and column control yield over 95% bus efficiency. The RDRAM's 32-bank architecture supports up to four simultaneous transactions per device.

Form Factor

The Rambus RIMM modules are offered in a 184-pad 1 mm edge connector pad pitch form factor suitable for 184 contact RIMM connectors. The RIMM module is suitable for desktop and other system applications. The next figure shows an eight device Rambus RIMM module without heat spreader.

Features

- High speed 800, 711 & 600 MHz RDRAM storage
- 184 edge connector pads with 1 mm pad spacing
- Maximum module PCB size:
133.5 mm × 31.75 mm × 1.37 mm
(5.25" × 1.25" × 0.05")
- Each RDRAM has 32 banks, for a total of
512, 256 or 128 banks on each 256/288 MB,
128/144MB or 64/72 MB module
respectively.
- Gold plated edge connector pad contacts
- Serial Presence Detect (SPD) support
- Operates from a 2.5 V supply ($\pm 5\%$)
- Low power and powerdown self refresh modes
- Separate Row and Column buses for higher efficiency

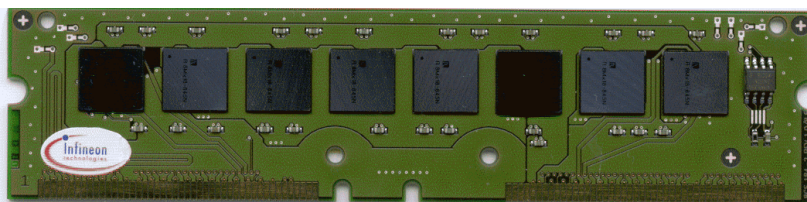


Fig.1 : Rambus RIMM module
(without heat spreader)

Part Number Designators

Organization	Capacity	I/O Frequency [MHz]	Part Designator	# of RDRAMs	RDRAM Density
64 MB/72 MB					
32 MB × 16	64 MB	600	HYR163230G-653	4	128 Mbit
32 MB × 16	64 MB	711	HYR163230G-745	4	
32 MB × 16	64 MB	800	HYR163230G-845	4	
32 MB × 16	64 MB	800	HYR163230G-840	4	
32 MB × 18	72 MB	600	HYR183220G-653	4	144 Mbit
32 MB × 18	72 MB	711	HYR183220G-745	4	
32 MB × 18	72 MB	800	HYR183220G-845	4	
32 MB × 18	72 MB	800	HYR183220G-840	4	
128 MB/144 MB					
64 MB × 16	128 MB	600	HYR166430G-653	8	128 Mbit
64 MB × 16	128 MB	711	HYR166430G-745	8	
64 MB × 16	128 MB	800	HYR166430G-845	8	
64 MB × 16	128 MB	800	HYR166430G-840	8	
64 MB × 18	144 MB	600	HYR186420G-653	8	144 Mbit
64 MB × 18	144 MB	711	HYR186420G-745	8	
64 MB × 18	144 MB	800	HYR186420G-845	8	
64 MB × 18	144 MB	800	HYR186420G-840	8	
256 MB/288 MB					
128 MB × 16	256 MB	600	HYR1612830G-653	16	128 Mbit
128 MB × 16	256 MB	711	HYR1612830G-745	16	
128 MB × 16	256 MB	800	HYR1612830G-845	16	
128 MB × 16	256 MB	800	HYR1612830G-840	16	
128 MB × 18	288 MB	600	HYR1812820G-653	16	144 Mbit
128 MB × 18	288 MB	711	HYR1812820G-745	16	
128 MB × 18	288 MB	800	HYR1812820G-845	16	
128 MB × 18	288 MB	800	HYR1812820G-840	16	

Pin Configuration

PIN	Pin Name
A1	GND
A2	LDQA8
A3	GND
A4	LDQA6
A5	GND
A6	LDQA4
A7	GND
A8	LDQA2
A9	GND
A10	LDQA0
A11	GND
A12	LCTMN
A13	GND
A14	LCTM
A15	GND
A16	N.C.
A17	GND
A18	LROW1
A19	GND
A20	LCOL4
A21	GND
A22	LCOL2
A23	GND
A24	LCOL0
A25	GND
A26	LDQB1
A27	GND
A28	LDQB3
A29	GND
A30	LDQB5
A31	GND
A32	LDQB7
A33	GND

PIN	Pin Name
B1	GND
B2	LDQA7
B3	GND
B4	LDQA5
B5	GND
B6	LDQA3
B7	GND
B8	LDQA1
B9	GND
B10	LCFM
B11	GND
B12	LCFMN
B13	GND
B14	N.C.
B15	GND
B16	LROW2
B17	GND
B18	LROW0
B19	GND
B20	LCOL3
B21	GND
B22	LCOL1
B23	GND
B24	LDQB0
B25	GND
B26	LDQB2
B27	GND
B28	LDQB4
B29	GND
B30	LDQB6
B31	GND
B32	LDQB8
B33	GND

PIN	Pin Name
A47	N.C.
A48	N.C.
A48	N.C.
A50	N.C.
A51	V _{REF}
A52	GND
A53	SCL
A54	V _{DD}
A55	SDA
A56	SVdd
A57	SWP
A58	V _{DD}
A59	RSCK
A60	GND
A61	RDQB7
A62	GND
A63	RDQB5
A64	GND
A65	RDQB3
A66	GND
A67	RDQB1
A68	GND
A69	RCOL0
A70	GND
A71	RCOL2
A72	GND
A73	RCOL4
A74	GND
A75	RROW1
A76	GND
A77	N.C.
A78	GND
A79	RCTM

PIN	Pin Name
B47	N.C.
B48	N.C.
B49	N.C.
B50	N.C.
B51	V _{REF}
B52	GND
B53	SA0
B54	V _{DD}
B55	SA1
B56	SVdd
B57	SA2
B58	V _{DD}
B59	RCMD
B60	GND
B61	RDQB8
B62	GND
B63	RDQB6
B64	GND
B65	RDQB4
B66	GND
B67	RDQB2
B68	GND
B69	RDQB0
B70	GND
B71	RCOL1
B72	GND
B73	RCOL3
B74	GND
B75	RROW0
B76	GND
B77	RROW2
B78	GND
B79	N.C.

Pin Configuration (cont'd)

PIN	Pin Name	PIN	Pin Name	PIN	Pin Name	PIN	Pin Name
A34	LSCK	B34	LCMD	A80	GND	B80	GND
A35	V _{CMOS}	B35	V _{CMOS}	A81	RCTMN	B81	RCFMN
A36	SOUT	B36	SIN	A82	GND	B82	GND
A37	V _{CMOS}	B37	V _{CMOS}	A83	RDQA0	B83	RCFM
A38	N.C.	B38	N.C.	A84	GND	B84	GND
A39	GND	B39	GND	A85	RDQA2	B85	RDQA1
A40	N.C.	B40	N.C.	A86	GND	B86	GND
A41	V _{DD}	B41	V _{DD}	A87	RDQA4	B87	RDQA3
A42	V _{DD}	B42	V _{DD}	A88	GND	B88	GND
A43	N.C.	B43	N.C.	A89	RDQA6	B89	RDQA5
A44	N.C.	B44	N.C.	A90	GND	B90	GND
A45	N.C.	B45	N.C.	A91	RDQA8	B91	RDQA7
A46	N.C.	B46	N.C.	A92	GND	B92	GND

Module Connector Pad Description

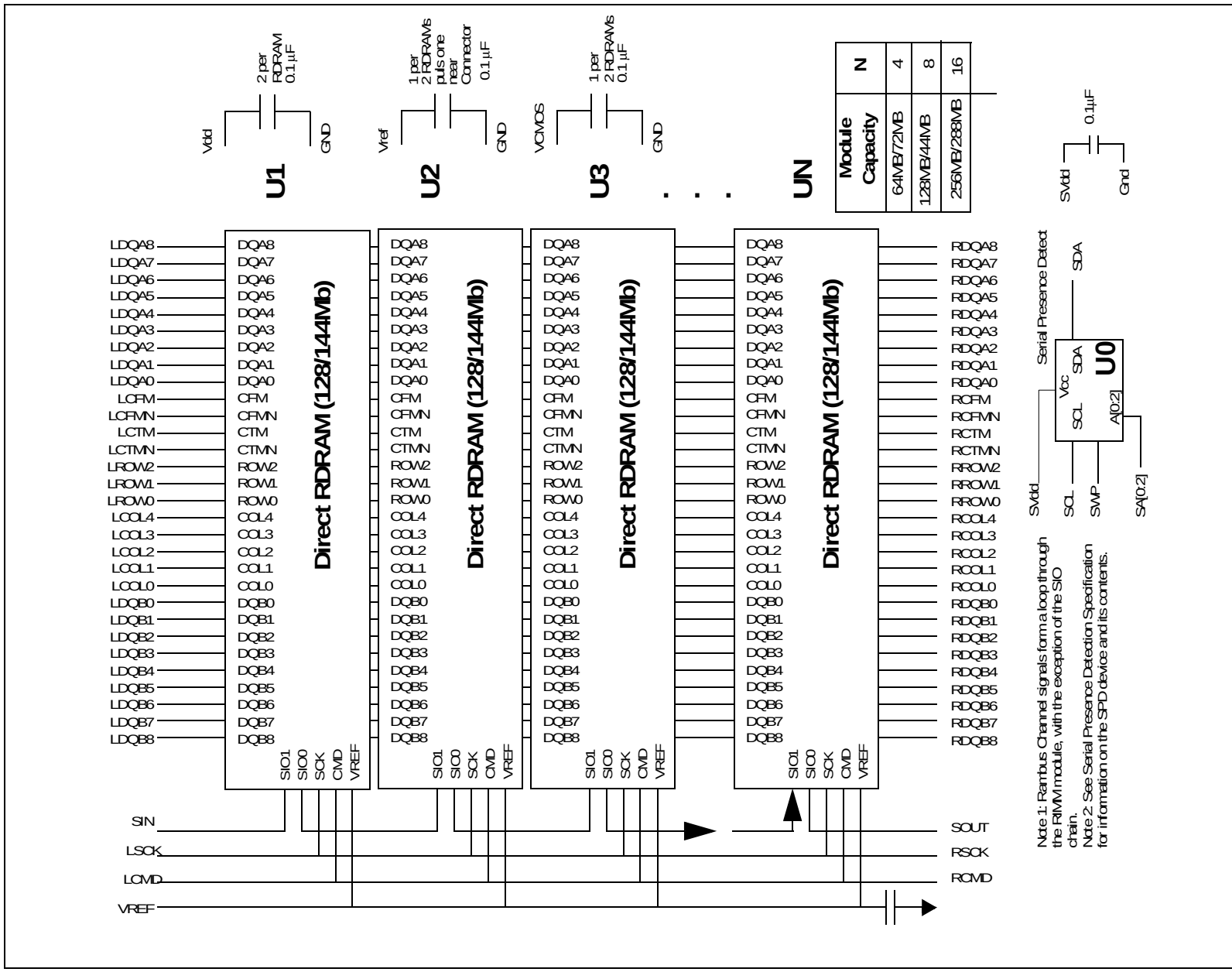
Signal	Module Connector Pads	I/O	Type	Description
GND	A1, A3, A5, A7, A9, A11, A13, A15, A17, A19, A21, A23, A25, A27, A29, A31, A33, A39, A52, A60, A62, A64, A66, A68, A70, A72, A74, A76, A78, A80, A82, A84, A86, A88, A90, A92, B1, B3, B5, B7, B9, B11, B13, B15, B17, B19, B21, B23, B25, B27, B29, B31, B33, B39, B52, B60, B62, B64, B66, B68, B70, B72, B74, B76, B78, B80, B82, B84, B86, B88, B90, B92	–	–	Ground reference for RDRAM core and interface. 72 PCB connector pads.
LCFM	B10	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Positive polarity.
LCFMN	B12	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Negative polarity.
LCMD	B34	I	V _{CMOS}	Serial Command used to read from and write to the control registers. Also used for power management.
LCOL4 ... LCOL0	A20, B20, A22, B22, A24	I	RSL	Column bus. 5-bit bus containing control and address information for column accesses.
LCTM	A14	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positive polarity.
LCTMN	A12	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Negative polarity.
LDQA8 ... LDQA0	A2, B2, A4, B4, A6, B6, A8, B8, A10	I/O	RSL	Data bus A. A 9-bit bus carrying a byte of read or write data between the Channel and the RDRAM. LDQA8 is non-functional on modules with x16 RDRAM devices.

Module Connector Pad Description (cont'd)

Signal	Module Connector Pads	I/O	Type	Description
LDQB8 ... LDQB0	B32, A32, B30, A30, B28, A28, B26, A26, B24	I/O	RSL	Data bus B. A 9-bit bus carrying a byte of read or write data between the Channel and the RDRAM. LDQB8 is non-functional on modules with x16 RDRAM devices.
LROW2 ... LROW0	B16, A18, B18	I	RSL	Row bus. 3-bit bus containing control and address information for row accesses.
LSCK	A34	I	V _{CMOS}	Serial Clock input. Clock source used to read from and write to the RDRAM control registers.
N.C.	A16, B14, A38, B38, A40, B40, A77, B79; A43, B43, A44, B44, A45, B45, A46, B46, A47, B47, A48, B48, A49, B49, A50, B50	—	—	These pads are not connected. These connector pads are reserved for future use.
RCFM	B83	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Positive polarity.
RCFMN	B81	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Negative polarity.
RCMD	B59	I	V _{CMOS}	Serial Command Input used to read from and write to the control registers. Also used for power management.
RCOL4 ... RCOL0	A73, B73, A71, B71, A69	I	RSL	Column bus. 5-bit bus containing control and address information for column accesses.
RCTM	A79	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positive polarity.
RCTMN	A81	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Negative polarity.
RDQA8 ... RDQA0	A91, B91, A89, B89, A87, B87, A85, B85, A83	I/O	RSL	Data bus A. A 9-bit bus carrying a byte of read or write data between the Channel and the RDRAM. RDQA8 is non-functional on modules with x16 RDRAM devices.

Module Connector Pad Description (cont'd)

Signal	Module Connector Pads	I/O	Type	Description
RDQB8 ... RDQB0	B61, A61, B63, A63, B65, A65, B67, A67, B69	I/O	RSL	Data bus B. A 9-bit bus carrying a byte of read or write data between the Channel and the RDRAM. RDQB8 is non-functional on modules with x16 RDRAM devices.
RROW2 ... RROW0	B77, A75, B75	I	RSL	Row bus. 3-bit bus containing control and address information for row accesses.
RSCK	A59	I	V _{CMOS}	Serial Clock input. Clock source used to read from and write to the RDRAM control registers.
SA0	B53	I	SVDD	Serial Presence Detect Address 0.
SA1	B55	I	SVDD	Serial Presence Detect Address 1.
SA2	B57	I	SVDD	Serial Presence Detect Address 2.
SCL	A53	I	SVDD	Serial Presence Detect Clock.
SDA	A55	I/O	SVDD	Serial Presence Detect Data (Open Collector I/O).
SIN	B36	I/O	V _{CMOS}	Serial I/O for reading from and writing to the control registers. Attaches to SIO0 of the first RDRAM on the module.
SOUT	A36	I/O	V _{CMOS}	Serial I/O for reading from and writing to the control registers. Attaches to SIO1 of the last RDRAM on the module.
SVDD	A56, B56	–	–	SPD Voltage. Used for signals SCL, SDA, SWE, SA0, SA1 and SA2.
SWP	A57	I	SVDD	Serial Presence Detect Write Protect (active high). When low, the SPD can be written as well as read.
V _{CMOS}	A35, B35, A37, B37	–	–	CMOS I/O Voltage. Used for signals CMD, SCK, SIN, SOUT.
V _{DD}	A41, A42, A54, A58, B41, B42, B54, B58	–	–	Supply voltage for the RDRAM core and interface logic.
V _{REF}	A51, B51	–	–	Logic threshold reference voltage for RSL signals.



RIMM Module Functional Diagram

Absolute Maximum Ratings

Symbol	Parameter	Limit Values		Unit
		min.	max.	
$V_{I,ABS}$	Voltage applied to any RSL or CMOS signal pad with respect to GND	- 0.3	$V_{DD} + 0.3$	V
$V_{DD,ABS}$	Voltage on V_{DD} with respect to GND	- 0.5	$V_{DD} + 1.0$	V
T_{STORE}	Storage temperature	- 50	100	°C

DC Recommended Electrical Conditions

Symbol	Parameter and Conditions	Limit Values		Unit
		min.	max.	
V_{DD}	Supply voltage	2.50 - 0.13	2.50 + 0.13	V
V_{CMOS}	CMOS I/O power supply at pad for 2.5 V controllers:	2.5 - 0.13	2.5 + 0.25	V
	CMOS I/O power supply at pad for 1.8 V controllers:	1.8 - 0.1	1.8 + 0.2	V
V_{REF}	Reference voltage	1.4 - 0.2	1.4 + 0.2	V
V_{IL}	RSL input low voltage	$V_{REF} - 0.5$	$V_{REF} - 0.2$	V
V_{IH}	RSL input high voltage	$V_{REF} + 0.2$	$V_{REF} + 0.5$	V
$V_{IL,CMOS}$	CMOS input low voltage	- 0.3	$0.5 V_{CMOS} - 0.25$	V
$V_{IH,CMOS}$	CMOS input high voltage	$0.5 V_{CMOS} + 0.25$	$V_{CMOS} + 0.7$	V
$V_{OL,CMOS}$	CMOS output low voltage @ $I_{OL,CMOS} = 1 \text{ mA}$	-	0.3	V
$V_{OH,CMOS}$	CMOS output high voltage @ $I_{OH,CMOS} = - 0.25 \text{ mA}$	$V_{CMOS} - 0.3$	-	V
I_{REF}	V_{REF} current @ $V_{REF,MAX}$	- 10 × no. RDRAMs ¹⁾	10 × no. RDRAMs ¹⁾	μA
$I_{SCK,CMD}$	CMOS input leakage current @ ($0 \leq V_{CMOS} \leq V_{DD}$)	- 10 × no. RDRAMs ¹⁾	10 × no. RDRAMs ¹⁾	μA
$I_{SIN,SOUT}$	CMOS input leakage current @ ($0 \leq V_{CMOS} \leq V_{DD}$)	- 10.0	10.0	μA

1) The table below shows the number of 128 Mbit RDRAM devices contained in a RIMM module of listed memory storage capacity.

RIMM Module Capacity	64/72 MB	128/144 MB	256/288 MB
Number of 128/144 Mbit RDRAM devices	4	8	16

AC Electrical Specifications

Symbol	Parameter and Conditions	Limit Values			Unit
		min.	typ.	max.	
Z	Module Impedance	25.2	28	30.8	Ω
T_{PD}	Average clock delay from finger of all RSL clock nets (CTM, CTMN, CFM and CFMN)	–	–	See Table ¹⁾	ns
ΔT_{PD}	Propagation delay variation of RSL signals with respect to $T_{PD}^{2)3)}$ for 4 and 8 device modules	– 21	–	21	ps
	Propagation delay variation of RSL signals with respect to $T_{PD}^{2)3)}$ for 16 device modules	– 24	–	24	ps
$\Delta T_{PD-CMOS}$	Propagation delay variation of SCK and CMD signals with respect to an average clock delay ²⁾	– 100	–	100	ps
V_A/V_{IN}	Attenuation Limit	–	–	See Table ¹⁾	%
V_{XF}/V_{IN}	Forward crosstalk coefficient (300 ps input rise time @ 20%-80%)	–	–	See Table ¹⁾	%
V_{XB}/V_{IN}	Backward crosstalk coefficient (300 ps input rise time @ 20%-80%)	–	–	See Table ¹⁾	%

1) Table below lists parameters and specifications for different storage capacity RIMM Modules that use 128 Mbit or 144 Mbit RDRAM devices.

2) Average clock delay is defined as the average delay from finger to finger of all RSL clock nets (CTM, CTMN,CFM and CFMN).

3.) If the RIMM module meets the following specifications, then it is compliant to the specification. If the RIMMmodule does not meet these specifications, then the specification can be adjusted by the "Adjusted ΔT_{PD} -Specification" table.

Adjusted ΔT_{PD} Specification

Symbol	Parameter and Conditions	Adjusted Min/Max	Absolute Min /Max		Unit
ΔT_{PD}	Propagation delay variation of RSL signals with respect to T_{PD} for 4 and 8 device modules	$\pm [17 + (18 \cdot N \cdot \Delta Z0)]^a$	-30	30	ps
	Propagation delay variation of RSL signals with respect to T_{PD} for 16 device modules	$\pm [24 + (18 \cdot N \cdot \Delta Z0)]$	-50	50	ps

a) Where:

N = Number of RDRAM devices installed on the RIMM module

$\Delta Z0 = \Delta Z0\% = (\max Z0 - \min Z0) / (\min Z0)$

(max Z= and min Z0 are obtained from the loaded (high impedance) impedance coupons of all RSL layers on the modules)

AC Electrical Specifications for RIMM Modules

Symbol	RIMM Module Capacity: No. of 128/144 Mbit RDRAMs:	64/72 MB 4	128/144 MB 8	256/288 MB 16	Unit
	Parameter and Conditions for -800, 711& -600 RIMM Modules	max.	max.	max.	
T_{PD}	Propagation Delay, all RSL signals -800, -711	1.25	1.50	2.06	ns
	Propagation Delay, all RSL signals -600	1.25	1.60	2.10	ns
V_A/V_{IN}	Attenuation Limit -800, -711	12	16	25	%
	Attenuation Limit -600	8	10	21	%
V_{XF}/V_{IN}	Forward crosstalk coefficient (300 ps input rise time @ 20% - 80%) -800, -711, -600	2	4	8	%
V_{XB}/V_{IN}	Backward crosstalk coefficient (300 ps input rise time @ 20%-80%) -800, -711, -600	1.5	2.0	2.5	%
R_{DC}	DC Resistance Limit -800, -711, -600	0.6	0.8	1.2	Ω

RIMM Module Current Profile

I_{DD}	RIMM Module Capacity: No. of 128/144 Mbit RDRAMs:		64/72 MB 4	128/144 MB 8	256/288 MB 16	Unit
	RIMM Modules Power Conditions ^{a)}	Freq.	max.	max.	max.	
I_{DD1}	One RDRAM in Read ^{b)} , balance in NAP mode	-800	530/585	545/600	580/635	mA
		-711	480/530	495/545	530/580	mA
		-600	420/460	435/475	470/510	mA
I_{DD2}	One RDRAM in Read ^{b)} , balance in Standby mode	-800	820/875	1220/1275	2020/2075	mA
		-711	755/805	1135/1185	1895/1945	mA
		-600	680/720	1040/1080	1760/1800	mA
I_{DD3}	One RDRAM in Read ^{b)} , balance in Active mode	-800	970/1025	1570/1625	2770/2825	mA
		-711	905/955	1485/1535	2645/2695	mA
		-600	830/870	1390/1430	2510/2550	mA
I_{DD4}	One RDRAM in Write, balance in Active mode	-800	585/645	600/660	635/695	mA
		-711	525/580	540/595	575/630	mA
		-600	460/505	475/520	510/555	mA
I_{DD5}	One RDRAM in Write, balance in Standby mode	-800	875/935	1275/1335	2075/2135	mA
		-711	800/855	1180/1235	1940/1995	mA
		-600	720/765	1080/1125	1800/1845	mA
I_{DD6}	One RDRAM in Write, balance in Active mode	-800	1025/1085	1625/1685	2825/2885	mA
		-711	950/1005	1530/1585	2690/2745	mA
		-600	870/915	1430/1475	2550/2595	mA

a) Actual power will depend on individual memory controller and usage pattern. Power does not include Refresh Current.

b) I/O power is a function of % 1's to add I/O power for 50% 1's for a x 16 need to add 257mA or 290mA for x18 ECC module for the following: $V_{DD} = 2.5V$, $V_{TERM} = 1.8V$, $V_{REF} = 1.4V$ and $V_{DIL} = V_{REF} = 0.5V$.

The following defines the RIMM module dimensions. All units are in millimeters.

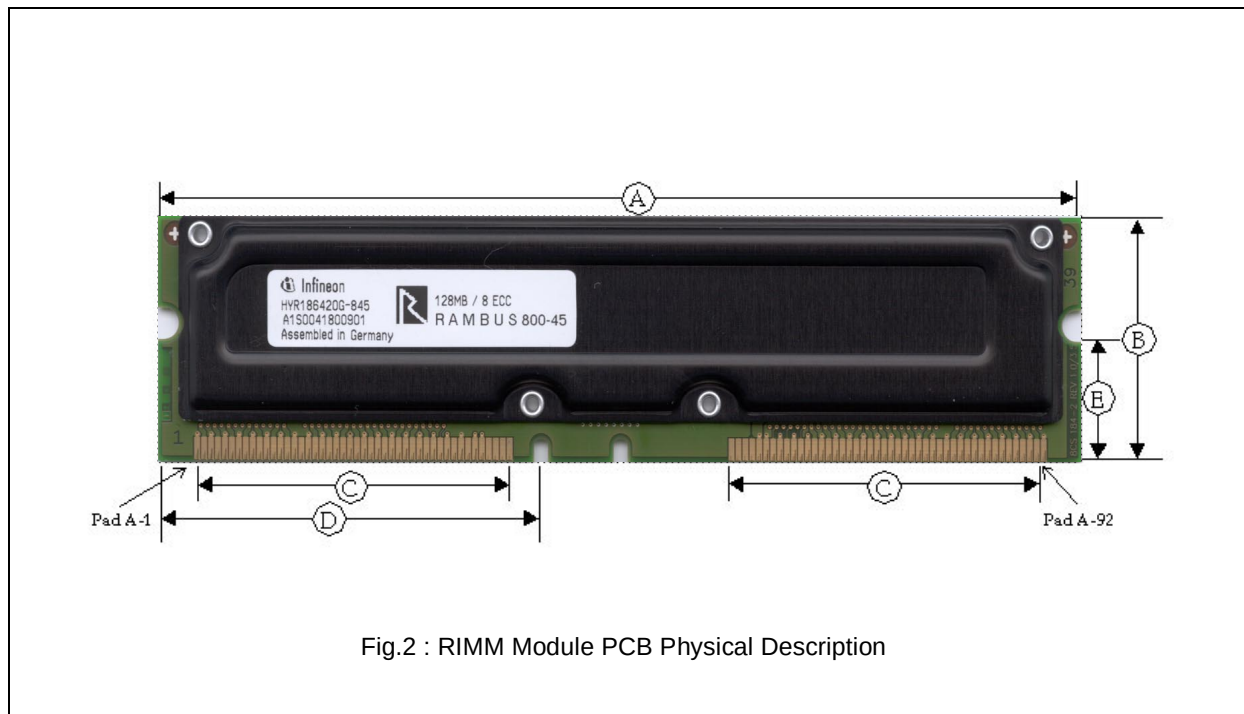


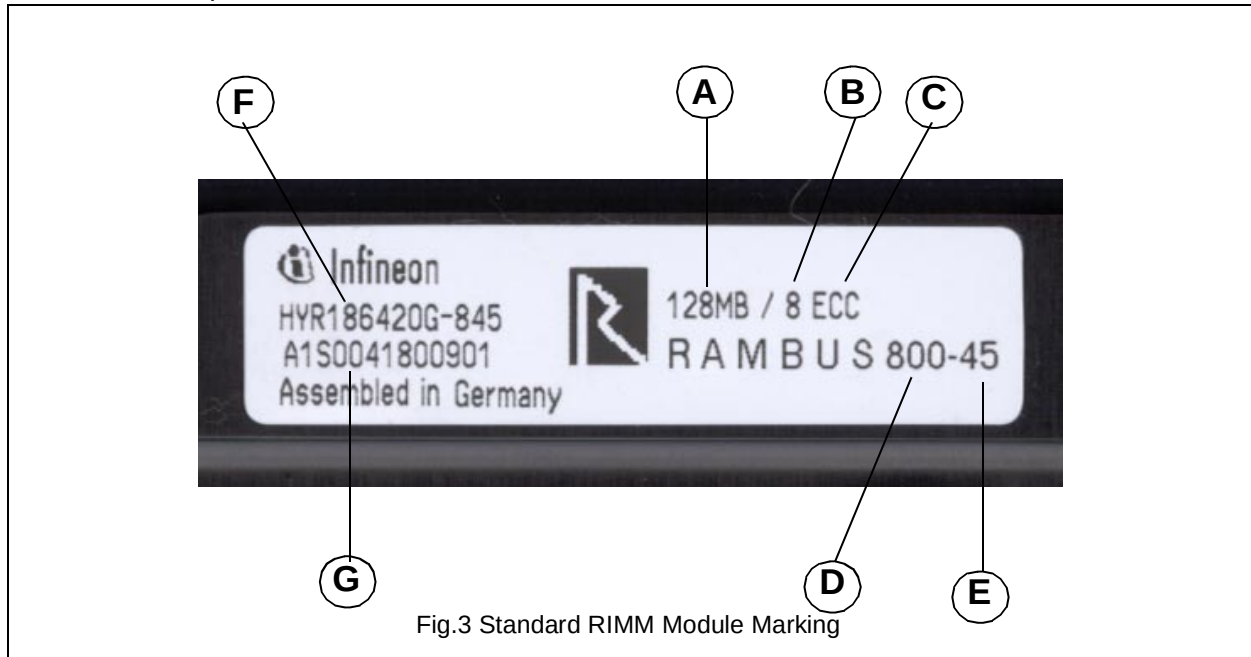
Fig.2 : RIMM Module PCB Physical Description

RIMM Module PCB Physical Description

Dimension	Description	Limit Values			Unit
		min.	nom.	max.	
A	PCB length	133.20 5.244	133.35 5.250	133.50 5.256	mm in
B	PCB height	–	–	31.75 1.25	mm in
C	Center-center pad width from pad A1 to A46, A47 to A92, B1 to B46 or B47 to B92	–	–	45.00 1.770	mm in
D	Spacing from PCB left edge to connector key notch	55.10 2.169	55.175 2.172	55.25 2.175	mm in
E	Spacing from contact pad PCB edge to side edge retainer notch	–	–	17.78 0.700	mm in
F	PCB thickness	1.17 0.046	1.27 0.050	1.37 0.054	mm in
G	Heat spreader thickness from PCB surface (one side) to heat spreader top surface	–	–	3.02 0.119	mm in

Standard RIMM Module Marking

The RIMM modules available from INFINEON Technologies will be marked per Figure 3 below. This marking will help OEMs and users identify the Rambus RIMM modules when used in specific system applications. This will assist OEMs or users to specify and correctly verify if the correct RIMM modules are installed in their systems. In the diagram, a label is shown attached to the RIMM module's heat spreader.



Standard RIMM Module Marking

	Label Field	Description	Marked Text	Unit
A	Module Memory Capacity	Number of 8-bit or 9-bit MBytes of RDRAM storage in RIMM module	256MB, 128MB, 64MB	MB
B	Number of RDRAMs	Number of RDRAM devices contained in the RIMM module	16, 8, 4	RDRAM devices
C	ECC Support	Indicates whether the RIMM module supports 8-bit (no ECC) or 9-bit (ECC) Bytes	blank = 8-bit Byte ECC = 9-bit Byte	–
D	Memory Speed	Data transfer speed for RDRAM RIMM module	800, 711, 600	MHz
E	t_{RAC}	Row Access Time	-45, -53	ns
F	Part Number	INFINEON part number		
G	Manufacturing Code	Date Code etc.		