RAMBUS

Advance Information

Rambus® SO-RIMM™ Module (with 128/144Mb RDRAMs)

Overview

The Rambus® SO-RIMM™ module is a general purpose high-performance memory subsystem suitable for a broad range of applications including computer memory, mobile “Thin and Light” PCs, networking systems, and other applications where high bandwidth and low latency are required.

The Rambus SO-RIMM module consists of 128Mb / 144Mb Rambus DRAM 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 800 MHz, 711 MHz or 600 MHz transfer rates while using conventional system and board design technologies. RDRAM devices are capable of sustained data transfers at 1.25 ns per two bytes (10ns per 16 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 high bus efficiency. The RDRAM's multibank architecture supports up to four simultaneous transactions per device.

Features

- High speed 800, 711 and 600 MHz RDRAM storage
- 160 edge connector pads with 0.65mm pad spacing
- Module PCB size: 67.60mm x 31.25mm x 1.00mm (2.667” x 1.230” x 0.043”)
- Gold plated edge connector pad contacts
- Serial Presence Detect (SPD) support
- Operates from a 2.5 volt supply (±5%)
- Low power and powerdown self refresh modes
- Separate RAS and CAS buses for higher efficiency

Key Timing Parameters

The following table lists the frequency and latency bins available for SO-RIMM modules.

Table 1: .SO-RIMM Module Frequency and Latency

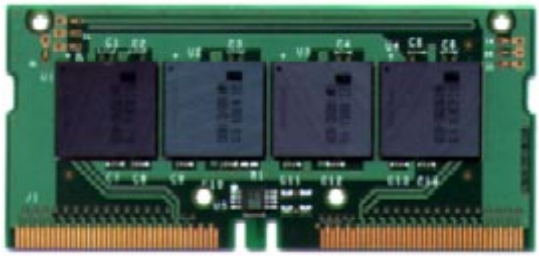
Organization	I/O Freq. MHz	t_{rac} (Row Access Time) ns
x 16	600	53
x 16	711	50
x 16	711	45
x 16	800	45
x 16	800	40
x 18	600	53
x 18	711	50
x 18	711	45
x 18	800	45
x 18	800	40

Related Documentation

Data sheets for the Rambus memory system components, including the Rambus DRAMs, SO-RIMM Module, and SO-RIMM Connector are available on the Rambus web site at http://www.rambus.com.

Form Factor

The Rambus SO-RIMM modules are offered in a 160-pad 0.65mm edge connector pad pitch form factor suitable for 160 contact SO-RIMM connectors. Figure 1 shows an eight device Rambus SO-RIMM module.



Note: On two sided modules, RDRAMs are also installed on bottom side of PCB.

Figure 1: Rambus® SO-RIMM™ Module without heat spreader

Table 2: Module Pad Number and Signal Names

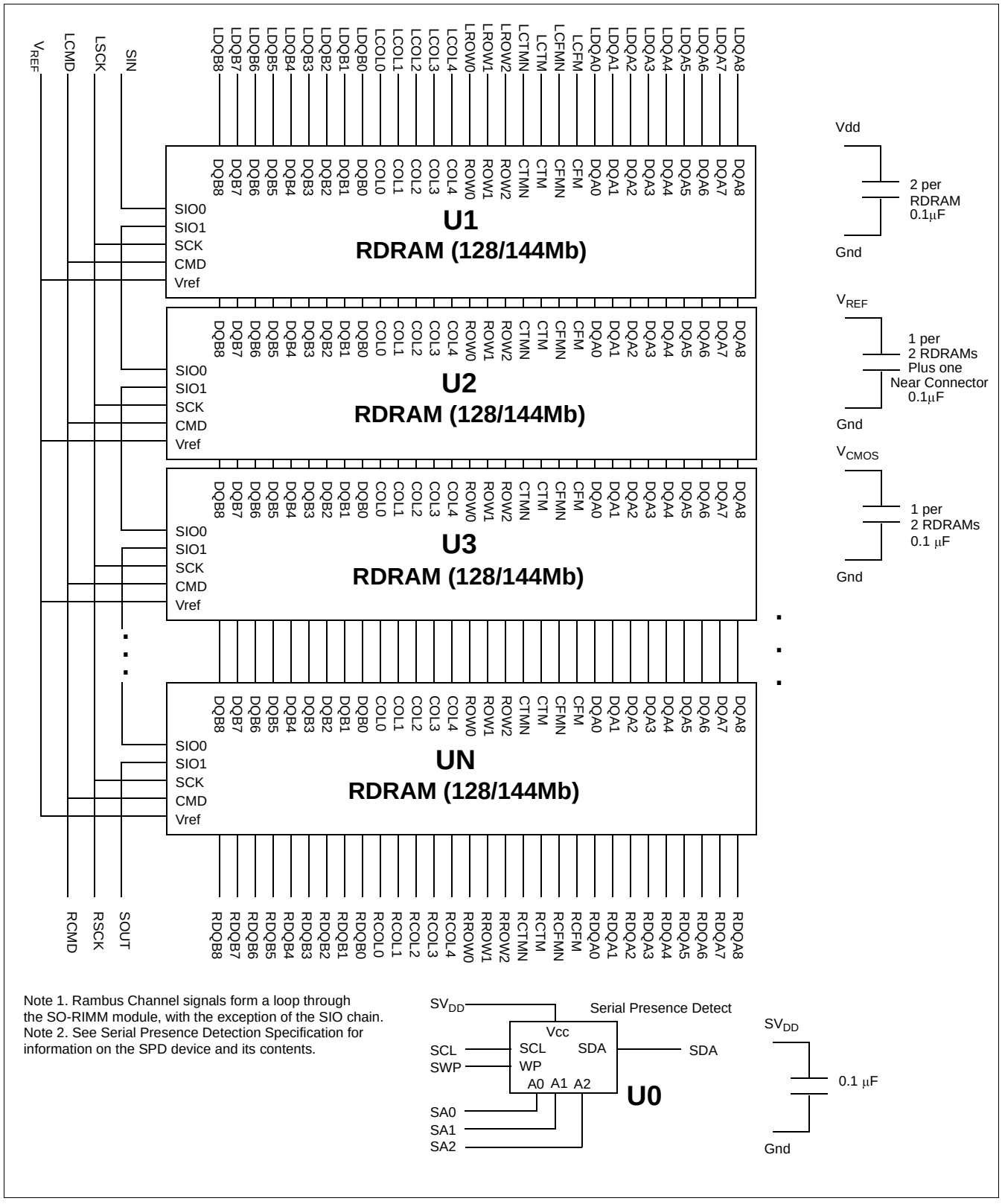
Pin	Pin Name	Pin	Pin Name
A1	Gnd	B1	Gnd
A2	LDQA8	B2	LDQA7
A3	Gnd	B3	Gnd
A4	LDQA6	B4	LDQA5
A5	Gnd	B5	Gnd
A6	LDQA4	B6	LDQA3
A7	Gnd	B7	Gnd
A8	LDQA2	B8	LDQA1
A9	Gnd	B9	Gnd
A10	LDQA0	B10	LCFM
A11	Gnd	B11	Gnd
A12	LCTM	B12	LCFMN
A13	Gnd	B13	Gnd
A14	LCTMN	B14	LROW2
A15	Gnd	B15	Gnd
A16	LROW1	B16	LROW0
A17	Gnd	B17	Gnd
A18	LCOL4	B18	LCOL3
A19	Gnd	B19	Gnd
A20	LCOL2	B20	LCOL1
A21	Gnd	B21	Gnd
A22	LCOL0	B22	LDQB1
A23	Gnd	B23	Gnd
A24	LDQB0	B24	LDQB3
A25	Gnd	B25	Gnd
A26	LDQB2	B26	LDQB5
A27	Gnd	B27	Gnd
A28	LDQB4	B28	LDQB7
A29	Gnd	B29	Gnd
A30	LDQB6	B30	LDQB8
A31	Gnd	B31	Gnd
A32	LSCK	B32	LCMD
A33	Gnd	B33	Gnd
A34	SOUT	B34	SIN
A35	Vdd	B35	Vdd
A36	NC	B36	NC
A37	Gnd	B37	Gnd
A38	NC	B38	NC
A39	Vcmos	B39	Vcmos
A40	NC	B40	NC

Pin	Pin Name	Pin	Pin Name
A41	NC	B41	NC
A42	Vref	B42	Vref
A43	SCL	B43	SA0
A44	Vdd	B44	Vdd
A45	SDA	B45	SA1
A46	Vdd	B46	Vdd
A47	SVdd	B47	SWP
A48	Gnd	B48	Gnd
A49	RSCK	B49	RCMD
A50	Gnd	B50	Gnd
A51	RDQB8	B51	RDQB6
A52	Gnd	B52	Gnd
A53	RDQB7	B53	RDQB4
A54	Gnd	B54	Gnd
A55	RDQB5	B55	RDQB2
A56	Gnd	B56	Gnd
A57	RDQB3	B57	RDQB0
A58	Gnd	B58	Gnd
A59	RDQB1	B59	RCOL0
A60	Gnd	B60	Gnd
A61	RCOL1	B61	RCOL2
A62	Gnd	B62	Gnd
A63	RCOL3	B63	RCOL4
A64	Gnd	B64	Gnd
A65	RROW0	B65	RROW1
A66	Gnd	B66	Gnd
A67	RROW2	B67	RCTMN
A68	Gnd	B68	Gnd
A69	RCFMN	B69	RCTM
A70	Gnd	B70	Gnd
A71	RCFM	B71	RDQA0
A72	Gnd	B72	Gnd
A73	RDQA1	B73	RDQA2
A74	Gnd	B74	Gnd
A75	RDQA3	B75	RDQA4
A76	Gnd	B76	Gnd
A77	RDQA5	B77	RDQA6
A78	Gnd	B78	Gnd
A79	RDQA7	B79	RDQA8
A80	Gnd	B80	Gnd

Table 3: 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, A37, A48, A50, A52, A54, A56, A58, A60, A62, A64, A66, A68, A70, A72, A74, A76, A78, A80, B1, B3, B5, B7, B9, B11, B13, B15, B17, B19, B21, B23, B25, B27, B29, B31, B33, B37, B48, B50, B52, B54, B56, B58, B60, B62, B64, B66, B68, B70, B72, B74, B76, B78, B80			Ground reference for RDRAM core and interface. 72 pins.
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	B32	**I**	**V_{CMOS}**	Serial Command Pin. Pin used to read from and write to the control registers. Also used for power management.
LCOL4.. LCOL0	A18, B18, A20, B20, A22	**I**	**RSL**	Column bus. 5-pin bus containing control and address information for column accesses.
LCTM	A12	**I**	**RSL**	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positive polarity.
LCTMN	A14	**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-pin bus carrying a byte of read or write data between the Channel and the RDRAM. LDQA8 is non-functional on x16 devices
LDQB8.. LDQB0	B30, B28, A30, B26, A28, B24, A26, B22, A24	**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 x16 devices.
LROW2.. LROW0	B14, A16, B16	**I**	**RSL**	Row bus. 3-pin bus containing control and address information for row accesses.
LSCK	A32	**I**	**V_{CMOS}**	Clock input. Pin used to read from and write to the control registers.
NC	A36, B36, A38, B38, A40, B40, A41, B41			These pins are not connected. These 8 pins are all reserved for future use.
RCFM	A71	**I**	**RSL**	Clock from master. Interface clock used for receiving RSL signals from the Channel. Positive polarity.
RCFMN	A69	**I**	**RSL**	Clock from master. Interface clock used for receiving RSL signals from the Channel. Negative polarity.
RCMD	B49	**I**	**V_{CMOS}**	Serial Command Input. Pin used to read from and write to the control registers. Also used for power management.

Signal	Module Connector Pads	I/O	Type	Description
RCOL4.. RCOL0	B63, A63, B61, A61, B59	**I**	**RSL**	Column bus. 5-pin bus containing control and address information for column accesses.
RCTM	B69	**I**	**RSL**	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positive polarity.
RCTMN	B67	**I**	**RSL**	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Negative polarity.
RDQA8.. RDQA0	B79, A79, B77, A77, B75, A75, B73, A73, B71	**I/O**	**RSL**	Data bus A. A 9-pin bus carrying a byte of read or write data between the Channel and the RDRAM. RDQA8 is non-functional on x16 devices.
RDQB8.. RDQB0	A51, A53, B51, A55, B53, A57, B55, A59, B57	**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 x16 devices.
RROW2. . RROW0	A67, B65, A65	**I**	**RSL**	Row bus. 3-pin bus containing control and address information for row accesses.
RSCK	A49	**I**	**V_{CMOS}**	Clock input. Pin used to read from and write to the control registers.
SA0	B43	**I**	**SV_{DD}**	Serial Presence Detect Address 0.
SA1	B45	**I**	**SV_{DD}**	Serial Presence Detect Address 1.
SCL	A43	**I**	**SV_{DD}**	Serial Presence Detect Clock.
SDA	A45	**I/O**	**SV_{DD}**	Serial Presence Detect Data (Open Collector I/O).
SIN	B34	**I/O**	**V_{CMOS}**	Serial I/O. Pin for reading from and writing to the control registers. Attaches to SIO0 of the first RDRAM on the module.
SOUT	A34	**I/O**	**V_{CMOS}**	Serial I/O. Pin for reading from and writing to the control registers. Attaches to SIO1 of the last RDRAM on the module.
SV_{DD}	A47			SPD Voltage. Used for signals SCL, SDA, SWP, SA0, SA1 and SA2.
SWP	B47	**I**	**SV_{DD}**	Serial Presence Detect Write Protect (active high). When low, the SPD can be written as well as read.
V_{CMOS}	A39, B39			CMOS I/O Voltage. Used for signals CMD, SCK, SIN, SOUT.
Vdd	A35, B35, A44, B44, A46, B46			Supply voltage for the RDRAM core and interface logic.
Vref	A42, B42			Logic threshold reference voltage for RSL signals.



Note 1. Rambus Channel signals form a loop through the SO-RIMM module, with the exception of the SIO chain.
Note 2. See Serial Presence Detection Specification for information on the SPD device and its contents.

Figure 2: SO-RIMM™ Module Functional Diagram

Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
$V_{I,ABS}$	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 VDD with respect to Gnd	- 0.5	V_{DD} + 1.0	V
T_{STORE}	Storage temperature	- 50	100	°C

Recommended DC Electrical Conditions

Symbol	Parameter and Conditions	Min	Max	Unit
V_{DD}	Supply voltage	2.50 - 0.13	2.50 + 0.13	**V**
V_{CMOS}	CMOS I/O power supply at pad for 2.5V controllers: CMOS I/O power supply at pad for 1.8V controllers:	VDD 1.8 - 0.1	VDD 1.8 + 0.2	**V** **V**
V_{REF}	Reference voltage[a]	1.4 - 0.2	1.4 + 0.2	**V**
V_{SPD}	Serial Presence Detector positive power supply	1.8	3.6	**V**

a. See RDRAM datasheet for more details.

SO-RIMM™ Module Current Profile

I_{DD}	**SO-RIMM™ Module Capacity:** / **No. of 128/144Mb RDRAMs:**	**128MB** / **8**	**64MB** / **4**	**Unit**
	SO-RIMM™ module power conditions [a]	**Max**	**Max**	
I_{DD1}	One RDRAM in Read[b], balance in NAP mode	596	580	mA
I_{DD2}	One RDRAM in Read[b], balance in Standby mode	1274	870	mA
I_{DD4}	One RDRAM in Write, balance in NAP mode	604	588	mA
I_{DD5}	One RDRAM in Write, balance in Standby mode	1282	878	mA

a. Actual power will depend on individual RDRAM component specifications, memory controller and usage patterns. Please refer to specific SO-RIMM module vendor data sheets for additional information. Power does not include Refresh Current. Max current computed for x16 128Mb RDRAMs. x18 144Mb RDRAMs use 8 mA more current per RDRAM in Read and 60mA more current per RDRAM in Write.
b. I/O current is a function of the % of 1's, to add I/O power for 50% 1's for a X16 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.

AC Electrical Specifications

Symbol	Parameter and Conditions	Min	Typ	Max	Unit
Z	Module Impedance	25.2	28	30.8	Ω
$Z_{UL\text{-}CMOS}$	Module Impedance for SCK and CMD signals	23.8	28	32.2	Ω
ΔT_{PD}	Propagation delay variation of RSL signals with respect to T_{PD}[b,c] for 2,4,8 device modules	-21	-	21	**ps**
$\Delta T_{PD\text{-}CMOS}$	Propagation delay variation of SCK and CMD signals with respect to an average clock delay[b]	-250	-	250	**ps**
$\Delta T_{PD\text{-}SCK,CMD}$	Propagation delay variation of SCK signal with respect to SCK signal.	-.200		.200	**ns**

b. T_{PD} or Average clock delay is defined as the average delay from finger to finger of all RSL clock nets (CTM, CTMN, CFM, and CFMN).
c. If the SO-RIMM module meets the following specification, then it is compliant to the specification. If the RIMM module does not meet these specifications, then the specification can be adjusted by the "Adjusted ΔT_{PD} Specification" table.

Adjusted ΔT_{PD} Specification

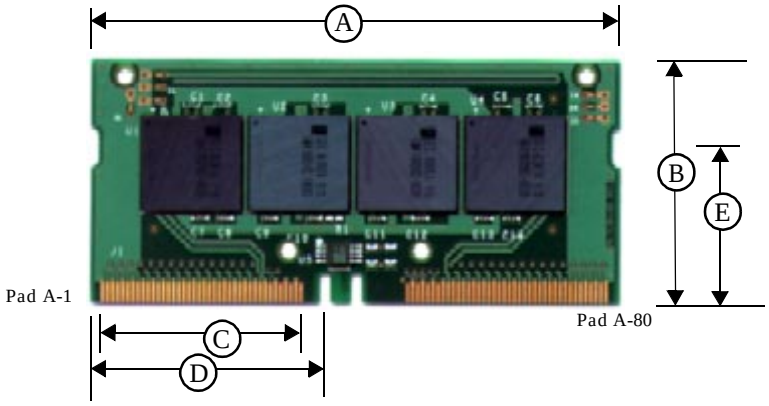
Symbol	Parameter and Conditions	Adjusted Min/Max	Absolute Min / Max		Unit
ΔT_{PD}	Propagation delay variation of RSL signals with respect to T_{PD} for 2, 4 device modules	+/-[17+(18*N*ΔZ0)][a]	-30	30	**ps**
	Propagation delay variation of RSL signals with respect to T_{PD} for 8 device modules	+/-[17+(18*N*ΔZ0)][a]	-30	30	**ps**

a. Where: N = Number of RDRAM devices installed on the SO-RIMM module
ΔZ0 = delta Z0% = (max Z0 - min Z0)/(min Z0)
(max Z0 and min Z0 are obtained from the loaded (high impedance) impedance coupons of all RSL layers on the modules)

AC Electrical Specifications for SO-RIMM Modules

Symbol	SO-RIMM™ Module Capacity: No. of 128/144Mb RDRAMs:	128MB 8	64MB 4,2	Continuity	Unit
	Parameter and Condition for -800, -711 & -600 SO-RIMM modules	**Max**	**Max**	**Max**	
T_{PD}	Propagation Delay, all RSL signals -800, -711, -600	1.320	1.060	0.850	ns
V_{α}/V_{IN}	Attenuation Limit -800, -711, -600	16	12	8	%
V_{XF}/V_{IN}	Forward crosstalk coefficient (300ps input rise time @ 20%-80%) -800, -711, -600	4	2	2	%
V_{XB}/V_{IN}	Backward crosstalk coefficient (300ps input rise time @ 20%-80%) -800, -711, -600	2.0	1.5	1.25	%
R_{DC}	DC Resistance Limit -800, -711, -600	1.4	0.9	0.5	Ω

Physical Dimensions



Dimension	Description	Min	Nom	Max	Unit
A	PCB length	67.45 2.656	67.60 2.661	67.75 2.667	mm in
B	PCB height	31.10 1.224	31.25 1.230	31.40 1.236	mm in
C	Center-center pad width from pad A1 to A40, A41 to A80, B1 to B40 or B41 to B80		25.35 0.998		mm in
D	Spacing from PCB left edge to center of connector left key notch		30.00 1.181		mm in
E	Spacing from bottom PCB edge to center of side edge retainer notch		20.00 0.787		mm in
F	PCB thickness	0.90 0.035	1.00 0.039	1.10 0.043	mm in
G	Heat spreader thickness from PCB surface (one side) to heat spreader top surface	TBD	3.50 0.138	TBD	mm in

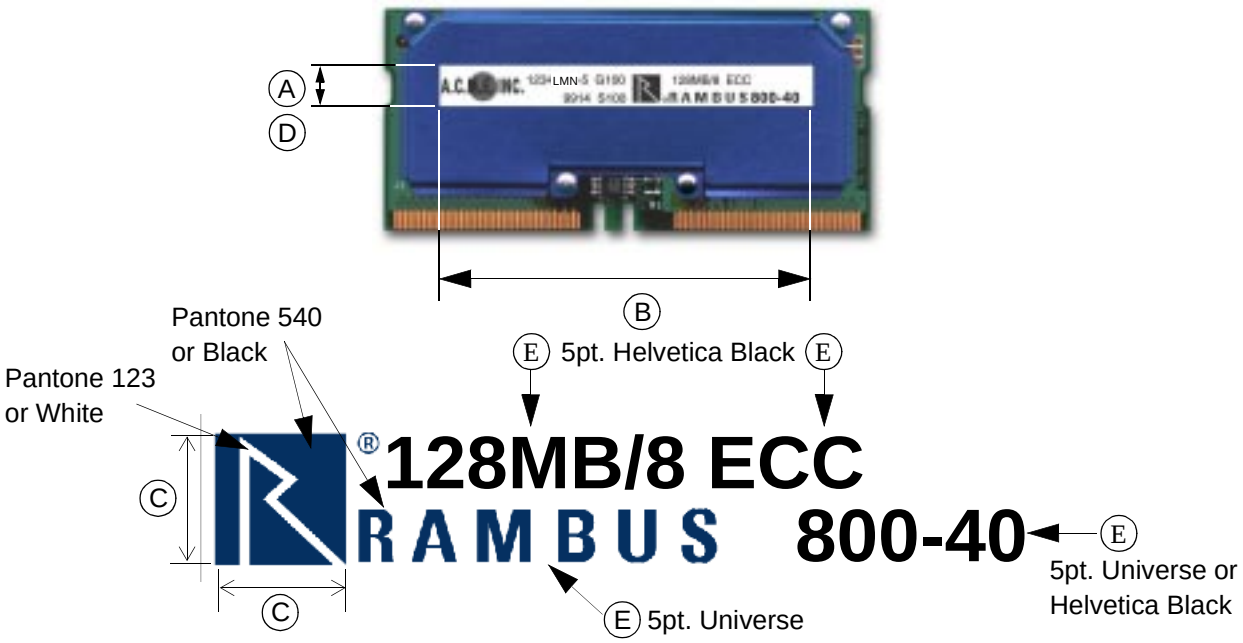
Figure 3: SO-RIMM™ Module PCB Physical Description

Serial Presence Detect

The SO-RIMM Module supports the use of a Serial Presence Detect EEPROM. The specification and definition of the contents of this function are documented in the Serial Presence Detect Specification (DL-0066).

SO-RIMM™ Module Marking

The SO-RIMM modules available from SO-RIMM module manufacturers will be marked per Figure 4 below. This industry standard marking will help OEMs and users identify the Rambus SO-RIMM modules when used in specific system applications. This marking will assist OEMs or users to specify and correctly verify if the correct SO-RIMM modules are installed in their systems. In the diagram, a label is shown attached to the SO-RIMM module's thermal cover. Information contained on the label's right side is the standard information specific to the SO-RIMM module and provides RDRAM information without requiring removal of the module's thermal cover. The label is centered on the SO-RIMM module.



Dimension	Description	Min	Typ	Max	Unit
A	Label Height		6.350 0.250	12.700 0.500	mm in.
B	Label Width			57.000 2.244	mm in.
C	Rambus Logo Height and Width	4.00 0.158	4.000 0.158		mm in.
D	RIMM Vendor Logo Height		6.000 0.236		mm in.
E	Text Type Size	5.0	5.0		pt.

Figure 4: Standard SO-RIMM™ Module Marking

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