Memory Modules for ATCA and AMC

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Server Market

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Old Roadmap #1... Divergence

	2006	2007	2008
HE Server	DDR2-400 RDIMM 2 Rank	DDR2-533 FB-DIMM 2 Rank	DDR2-667 FB-DIMM 2 Rank DDR3-800 FB-DIMM 4 Rank
Mid Server	DDR2-400 RDIMM 2 Rank		
LE Server	DDR2-400 RDIMM 2 Rank		
HPC	DDR2-533 UDIMM 2 Rank	DDR2-667 UDIMM 2 Rank	DDR3-1066 UDIMM 2 Rank

"RDIMM is obsolete in 2006"

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Server Market Perspective #2

	2006	2007	2008
HE Server	DDR2-533 RDIMM 4 Rank	DDR2-533 RDIMM 4 Rank	DDR3-800 RDIMM 4 Rank
Mid Server	DDR2-667 RDIMM 4 Rank	DDR2-667 RDIMM 4 Rank	DDR3-1066 RDIMM 4 Rank
LE Server	DDR2-667 RDIMM 4 Rank	DDR2-667 RDIMM 4 Rank	DDR3-1066 RDIMM 4 Rank
HPC	DDR2-533 UDIMM or RDIMM 2 or 4 Rank	DDR2-667 UDIMM or RDIMM 2 or 4 Rank	DDR3-1066 UDIMM or RDIMM 2 or 4 Rank

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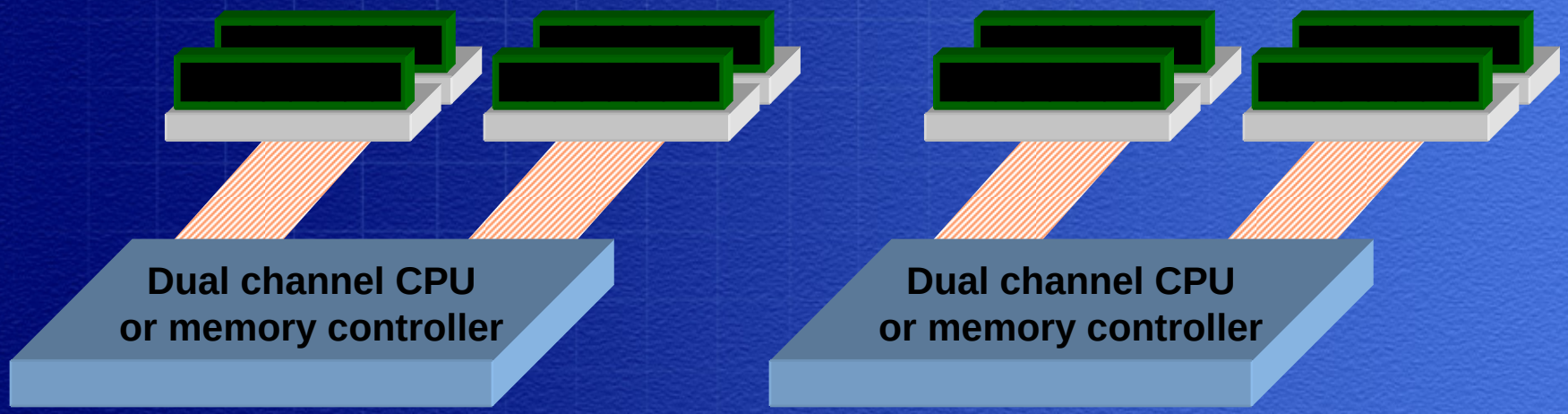
Mainstream Dual-CPU Server



RDIMM 2 ranks of 512Mb	8GB/CPU	16GB Total
RDIMM 4 ranks of 512Mb	16GB/CPU	32GB Total

Conclusion: 2 slot enablement allows DDR3 RDIMM

to continue to meet the needs of server market

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New Roadmap #1... Convergence

	2006	2007		2008
HE Server	DDR2-400 RDIMM 2 Rank	DDR2-533 FB-DIMM 2 Rank	DDR2-667 FB-DIMM 2 Rank	DDR3-800 FB-DIMM 4 Rank
Mid Server	DDR2-400 RDIMM 2 Rank	DDR2-533 FB-DIMM 2 Rank	DDR2-667 FB-DIMM 2 Rank	DDR3-1066 RDIMM 4 Rank
LE Server	DDR2-400 RDIMM 2 Rank	DDR2-533 FB-DIMM 2 Rank	DDR2-667 FB-DIMM 2 Rank	DDR3-1066 RDIMM 4 Rank
HPC	DDR2-533 UDIMM 2 Rank	DDR2-667 UDIMM 2 Rank		DDR3-1066 UDIMM or RDIMM? 2 Rank

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FB-DIMM

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FB-DIMM Summary: High Risk

- DDR2 FB-DIMM intro under way (2 rank only)

…but…

- Price decline in DDR2 FB-DIMM not likely
- ATCA FB-DIMM efforts halted
  - ATCA FB-DIMM solution requires angled sockets
- DDR3 FB-DIMM will die off

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ATCA DDR2 RDIMM

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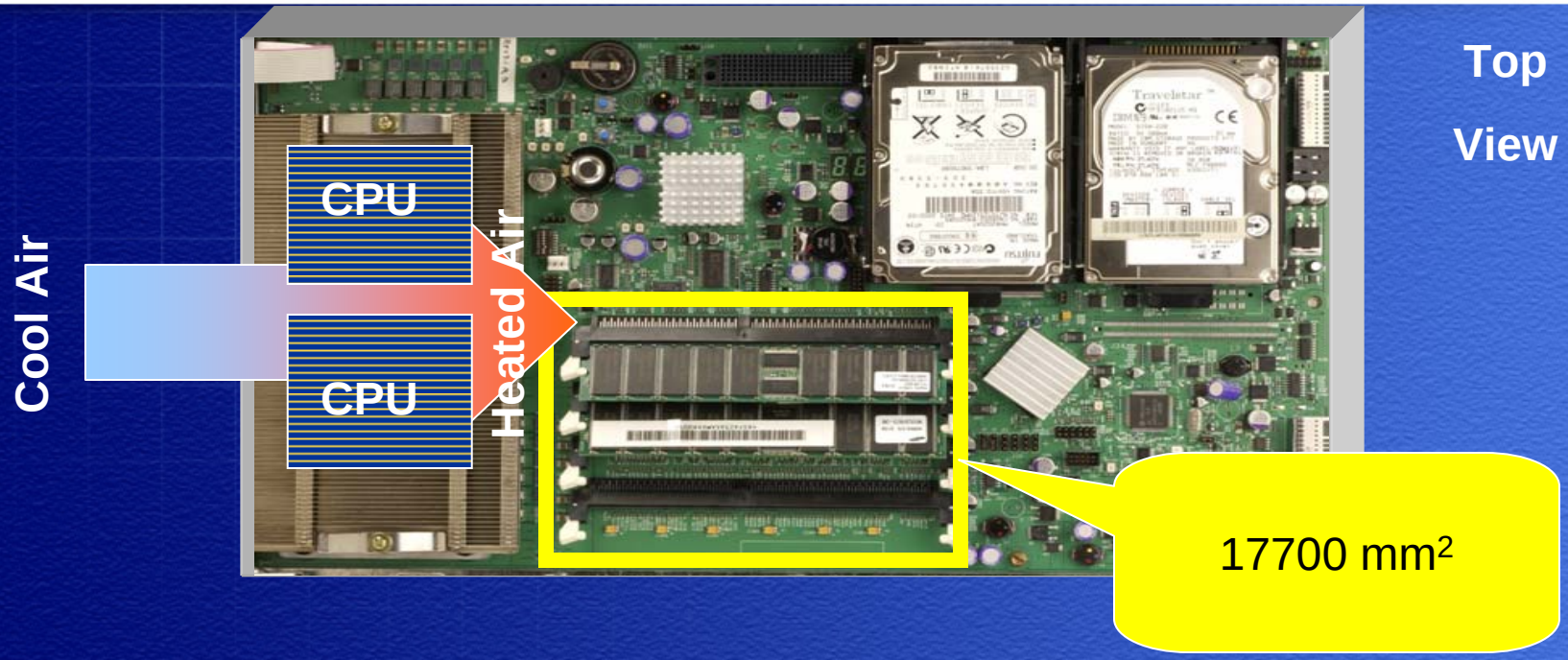
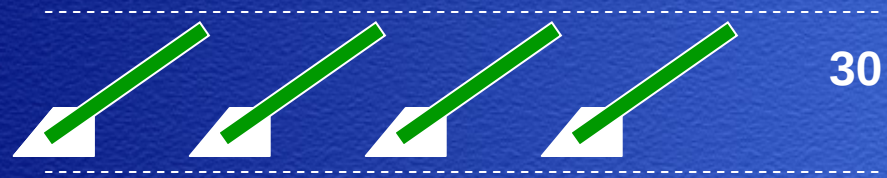
Case Study: Blade Server, LP DIMM



Angled Socket



30 mm DIMM

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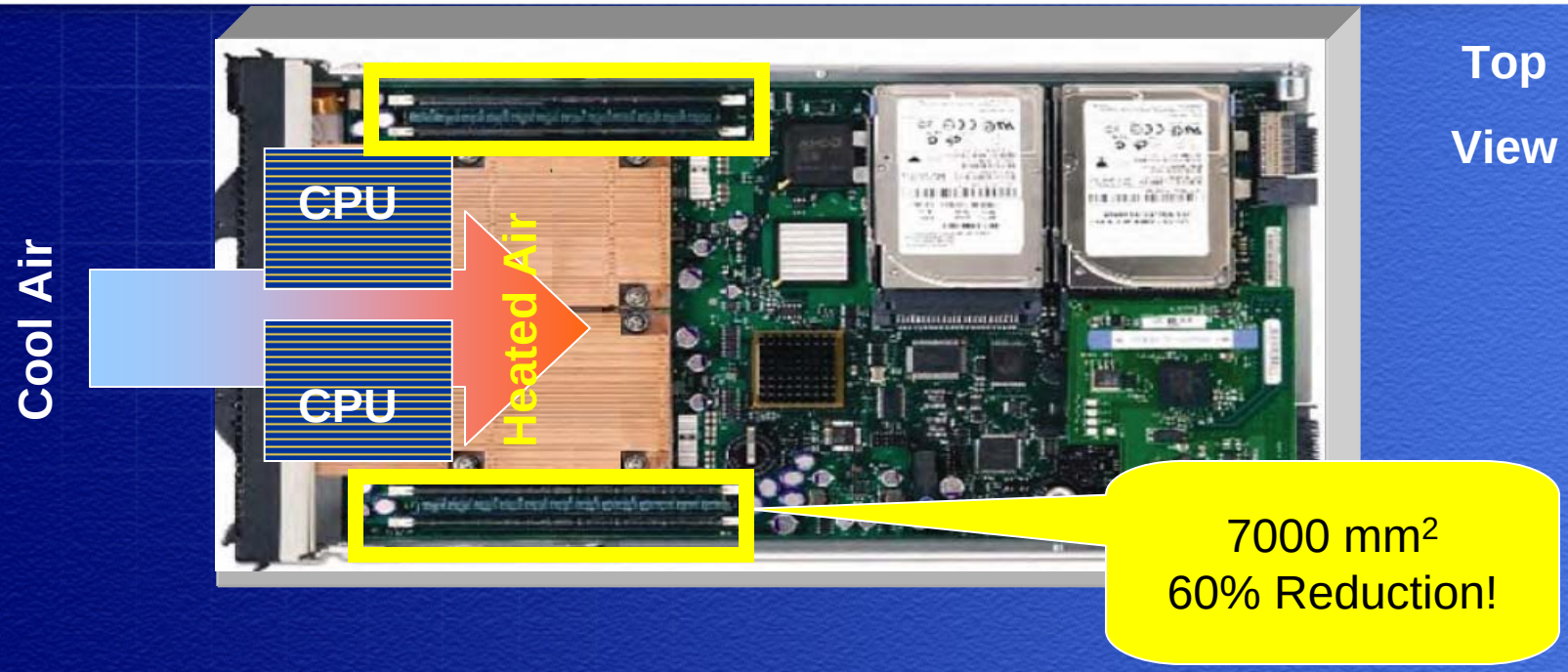
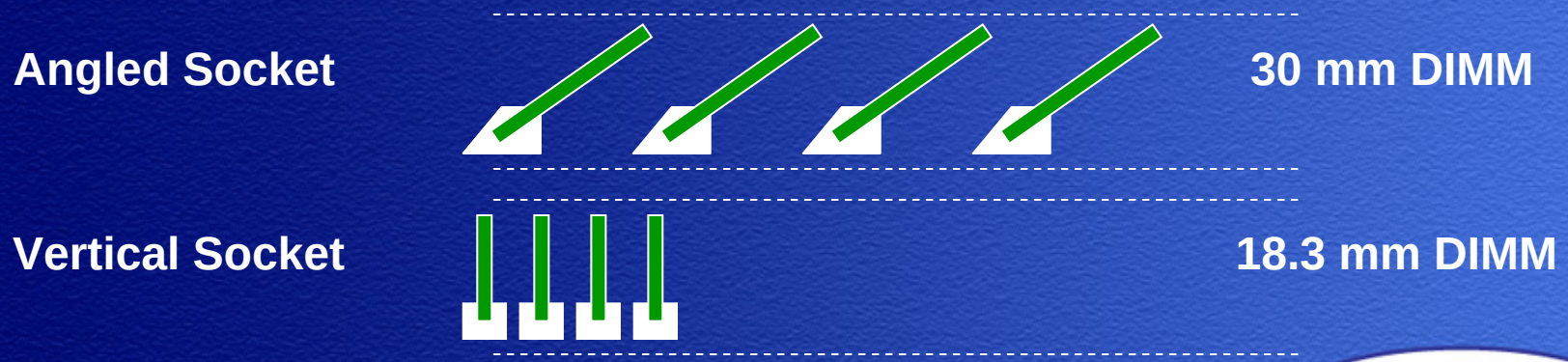
Case Study: Blade Server, VLP DIMM





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Lessons Learned from VLP

- One size does NOT fit all
- Angled sockets create big problems
- VLP reduces board space consumed
- VLP simplifies internal routing
- VLP improves flexibility DIMM location
- VLP enables wider slot spacing
- Holistic system thermal analysis needed

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ATCA DDR2 RDIMM Summary

- Full family of VLP DDR2 RDIMMs approved: 1Rx8, 2Rx8, 1Rx4, 2Rx4
- However, height of VLP is a little too high for ATCA

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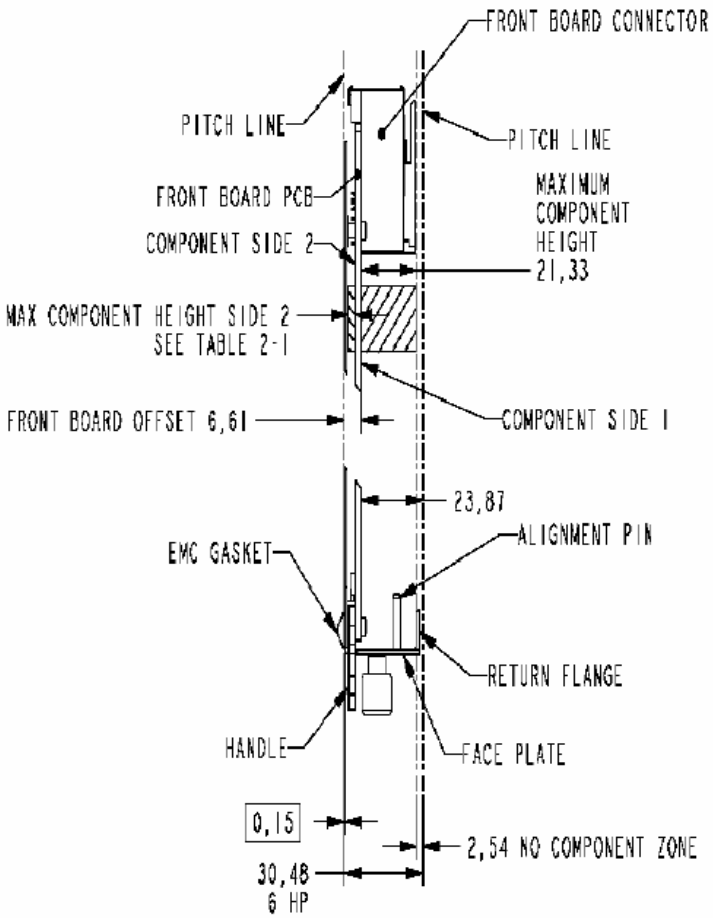
ATCA Blade Form Factor



- 21.33 mm maximum component height on side 1
- maximum component height on side 2 depends on the board design
- ~2.41 mm without side 2 cover and 1.6 mm PCB
- ~1.61 mm without side 2 cover and 2.4 mm PCB
- ~2.53 mm with 1 mm side 2 cover and 1.6 mm PCB
- ~1.73 mm with 1 mm side 2 cover and 2.4 mm PCB

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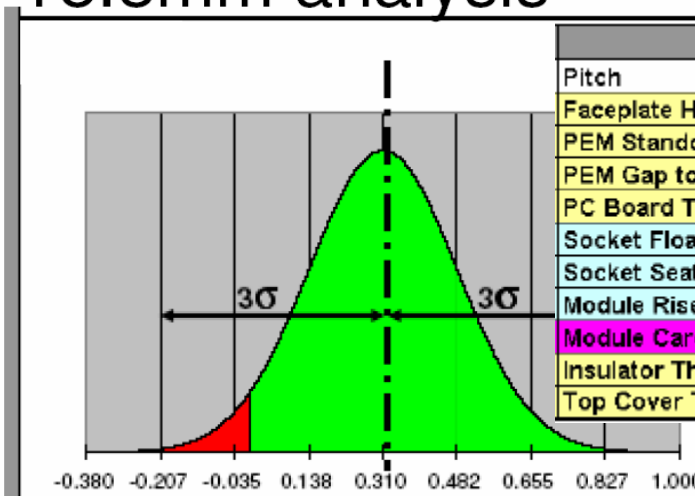
Statistical Analysis Under Way

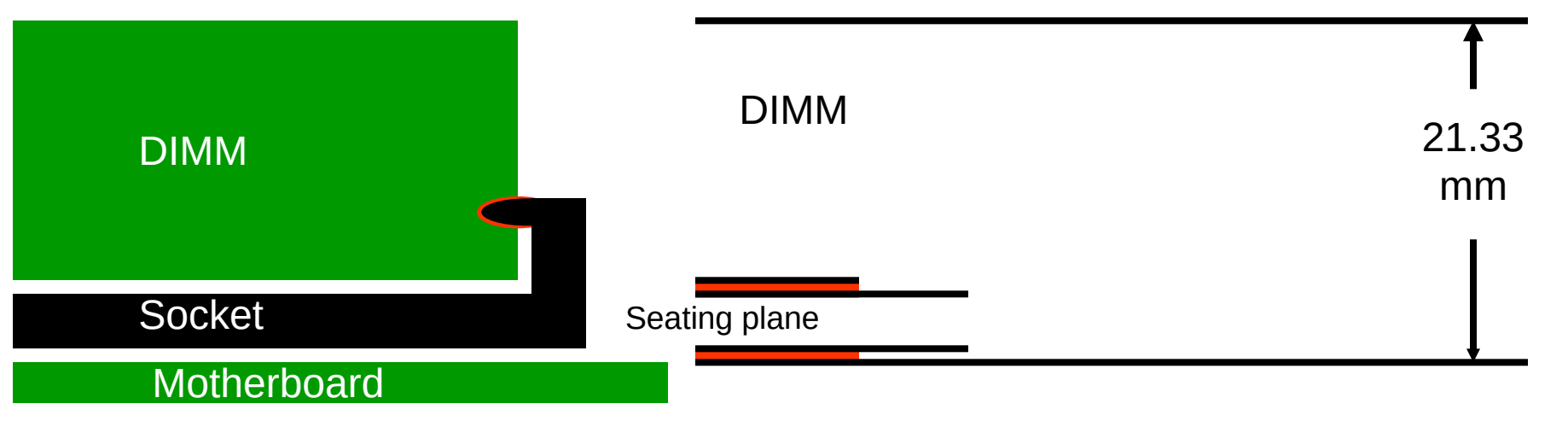
18.3mm analysis



Variable	Nominal	± Tolerance	StDev	Comments
Pitch	30.48	N/A	N/A	Per ATCA Spec
Faceplate Height	28.950	0.380	0.12667	Per ATCA Spec
PEM Standoff Height	3.800	0.080	0.02667	PEM Tolerance
PEM Gap to PCB	0.130	0.130	0.04333	ATCA Tolerance Range: 0 - 0.26
PC Board Thickness	2.400	0.240	0.08000	± 10% (Industry Standard)
Socket Float off PCB	0.065	0.065	0.02167	Tyco Range: 0 - 0.13
Socket Seating Plane	2.850	0.100	0.03333	Tyco Recommendation
Module Rise in Socket (Variable)	0.19 & 0.00	0.19 & 0.00	0.06330	Variable: Tyco Range: 0 - 0.38, 0 analyzed
Module Card Height (Variable)	17.80 to 18.30	0.100	0.03333	Variable Height and Tolerance
Insulator Thickness (Variable)	0.13 & 0.00	0.05 & 0.00	0.01660	Variable: 0.13 & 0 analyzed
Top Cover Thickness	0.650	0.100	0.03333	Per AMC Spec

							Worst Case				RSS			
Name	direction (V)	geometry factor (f)	V*f	Specification			Symmetry		min	max	Cpk	3 sigma (99.73%)		
				dimension	tol (-)	tol (+)	mean	tol (+/-)				range (+/-)	min	max
1	-1	1.00	-1.00	18.30	0.150	0.150	18.300	0.150	18.150	18.450	1.00	0.150	18.150	18.450
2	-1	1.00	-1.00	0.35	0.178	0.178	0.350	0.178	0.172	0.528	1.00	0.178	0.172	0.528
3	-1	1.00	-1.00	2.75	0.100	0.100	2.750	0.100	2.650	2.850	1.00	0.100	2.650	2.850
4	-1	1.00	-1.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	1.00	0.000	0.000	0.000
5	-1	1.00	-1.00	2.40	0.200	0.200	2.400	0.200	2.200	2.600	1.00	0.200	2.200	2.600
6	-1	1.00	-1.00	0.26	0.000	0.000	0.260	0.000	0.260	0.260	1.00	0.000	0.260	0.260
7	-1	1.00	-1.00	3.80	0.080	0.080	3.800	0.080	3.720	3.880	1.00	0.080	3.720	3.880
8	1	1.00	1.00	28.95	0.380	0.380	28.950	0.380	28.570	29.330	1.00	0.380	28.570	29.330
9	-1	1.00	-1.00	0.65	0.100	0.100	0.650	0.100	0.550	0.750	1.00	0.100	0.550	0.750
10	-1	1.00	-1.00	0.13	0.050	0.050	0.130	0.050	0.080	0.180	1.00	0.050	0.080	0.180
						J =	0.310	1.238	-0.928	1.548		0.517	-0.207	0.827

ATCA Vertical Stackup



- Rise from motherboard during reflow?
- Rise in socket from seating plane until latches engage?
- A current strawman proposal
  - DIMM @ 18.20 ±0.10 mm
  - Socket @ 2.85 ±0.10 mm
  - Rise effects = 0.80 mm total

ATCA DDR3 RDIMM

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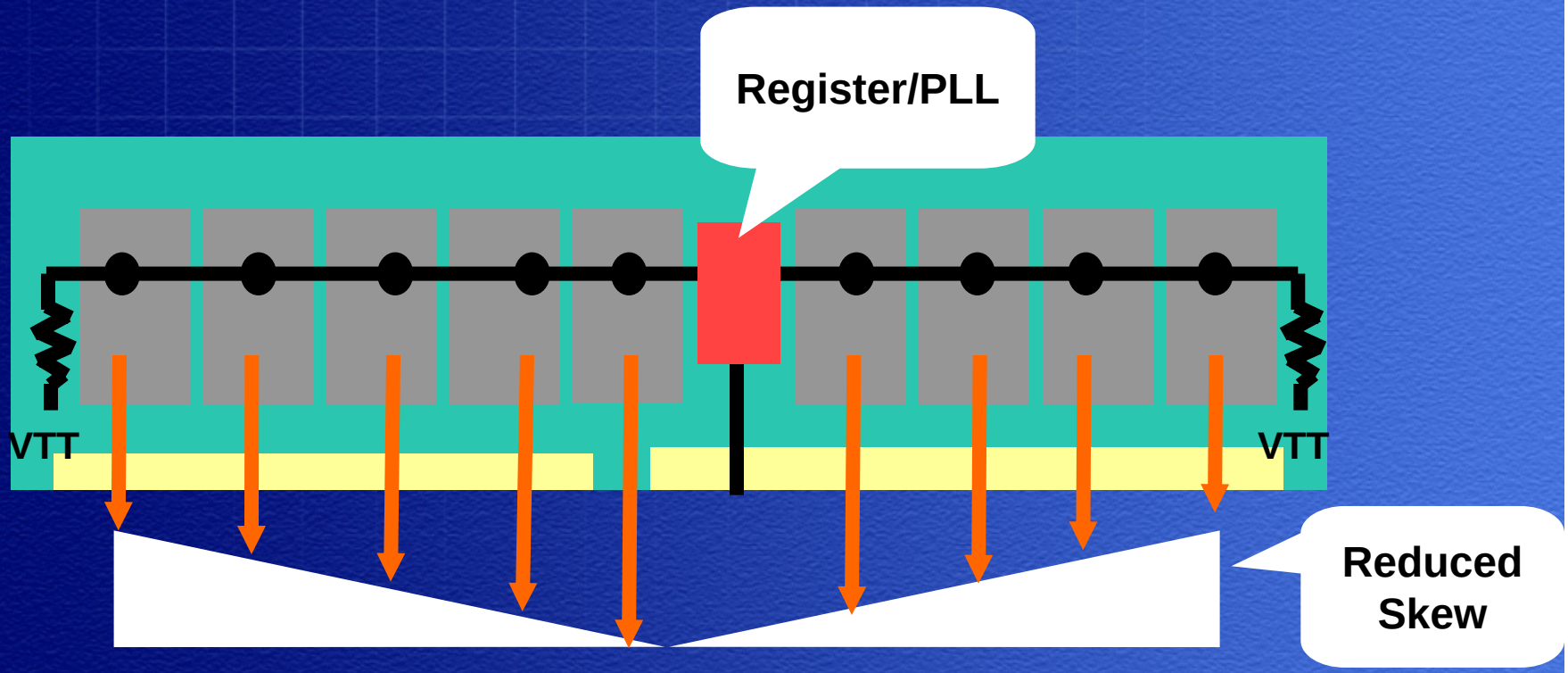
DDR3 RDIMM Inside-Out Fly-By



Support for 2 ranks (36 DRAMs) and 4 ranks (72 DRAMs) – <u>ATCA enabled</u>

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DDR3 RDIMM Summary

- Compatible with UDIMM controller
- Single register/PLL small enough for ATCA
- Integrated PLL with only 4 output pairs
- 4 rank support designed in

- Supported by AMD & Intel

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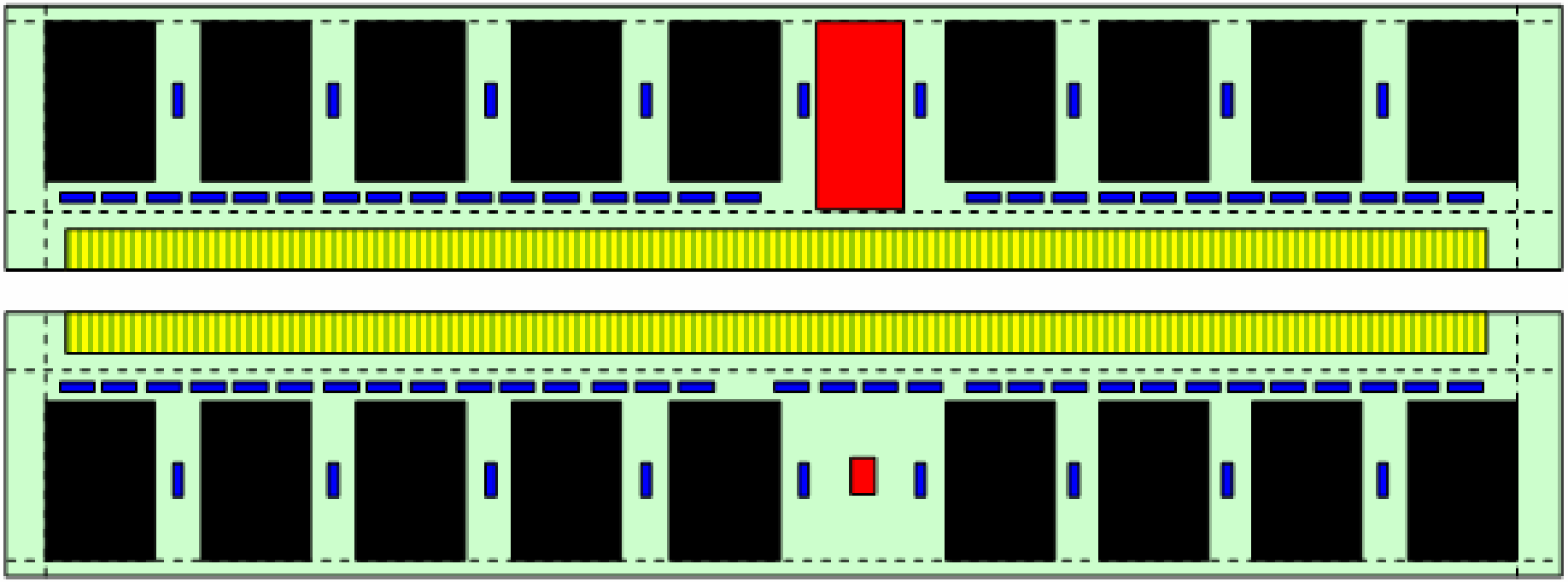
ATCA DDR3 RDIMM, Caps Between



X-Dimension	Front	Standard	Aggressive
	DIMM Width	133.35	133.35
	Edge keepout, West	2.8	2.8
	Edge keepout, East	2.8	2.8
	#cap gaps	9	9
	Cap gap	1.5	1.1
	#DRAMs	9	9
	Register X	8.1	8.1
	DRAM max X	11.79	12.19

Y-Dimension	DRAM area	Standard	Aggressive
	DIMM height, min	18.1	18.1
	Finger keepout	4	4
	Cap gap	1.5	1.1
	DRAM max Y	12.6	13

Register area	Standard	Aggressive
DIMM height, min	18.1	18.1
Finger keepout	4	4
Top edge to Register	0.5	0.3
Register height	13.6	13.6
Remainder	0	0.2

DDR3 ATCA RDIMM Task Group

- Family of reference cards in definition
  - 1Rx8 → 512MB to 2GB
  - 2Rx8 → 1GB to 4GB
  - 1Rx4 → 1GB to 4GB
  - 2Rx4 → 2GB to 8GB
  - 4Rx4 → 4GB to 16GB

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Summary of Socket/DIMM Height

- Current DDR2 sockets (3.3 mm)
  - Module height < 17.9 mm
- Coming DDR2/DDR3 sockets (2.85 mm)
  - Module height < 18.2 mm
- Control socket to motherboard coplanarity
- Debate continues in JEDEC…

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AMC
Advanced Mezzanine Card

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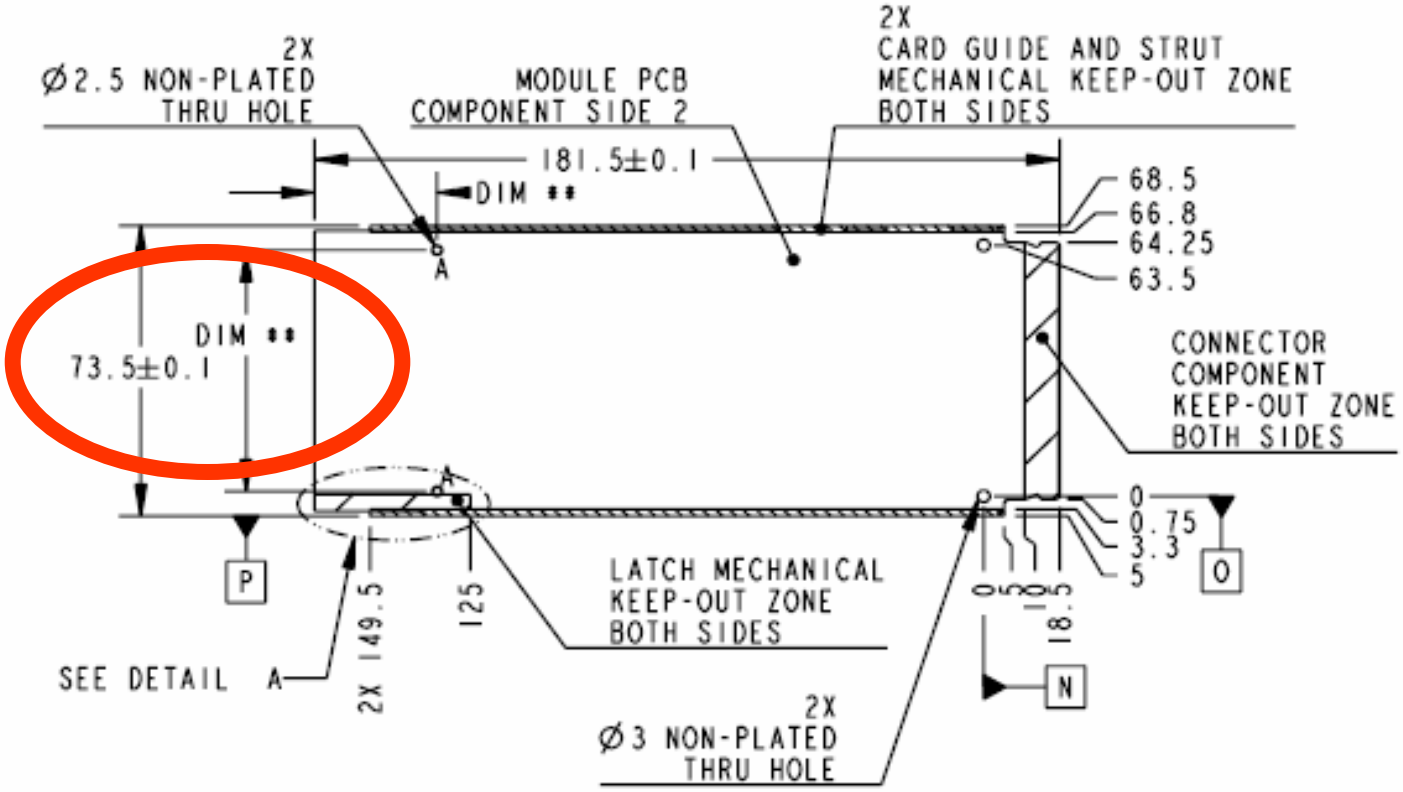
AMC Width Limitation

HOLE CHART:
A = REQUIRED HOLE FOR MODULE FACE PLATE MOUNTING

DIM ** = DIMENSION DEPENDS ON FACE PLATE AND LATCH IMPLEMENTATION. SEE APPENDIX FOR EXAMPLES



AMC With SO or Mini

244 pin Mini-RDIMM

200 pin Mini-RDIMM

200 pin SO-DIMM

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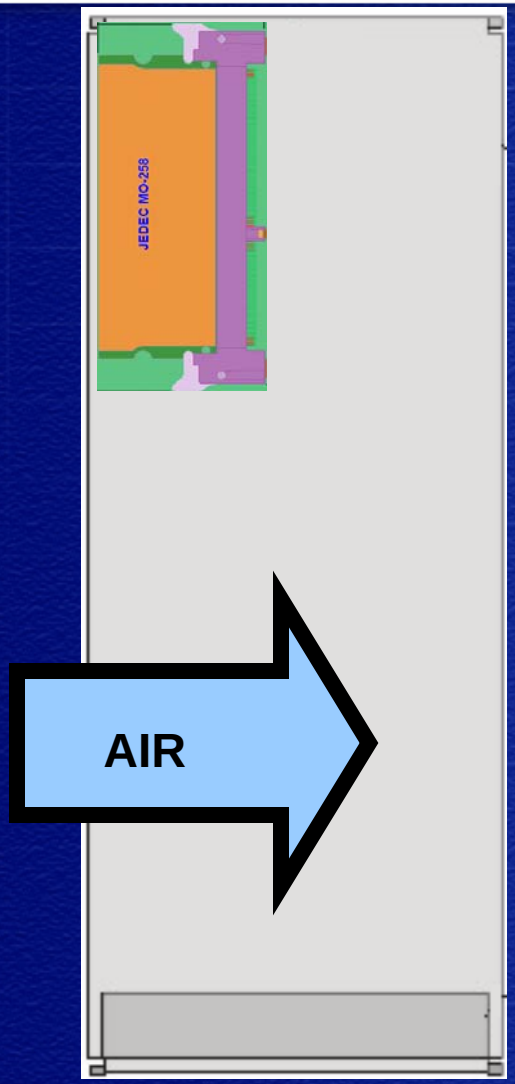
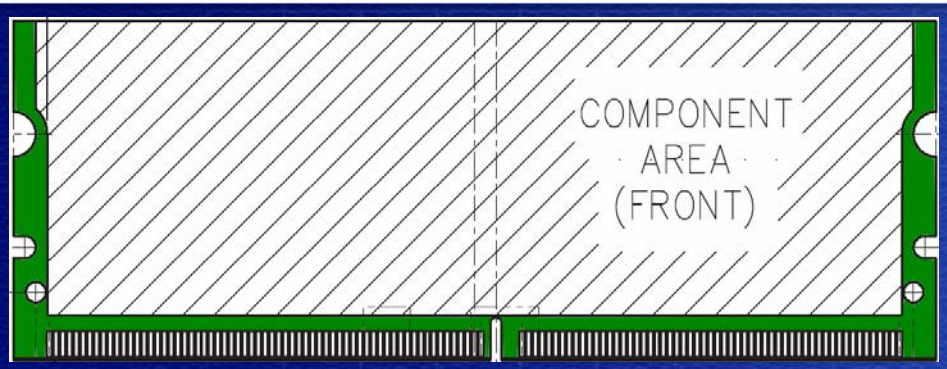
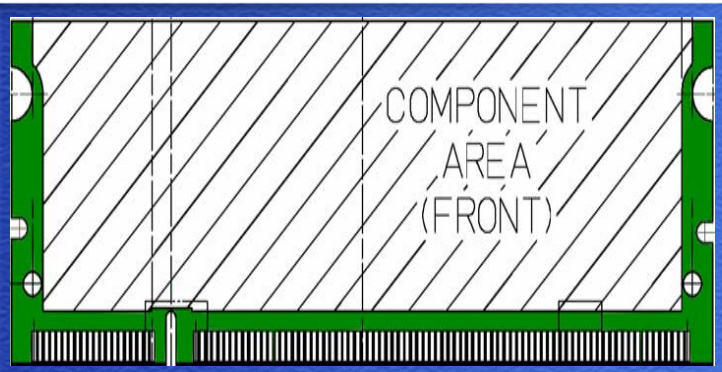
Rotate Memory Module?



- Can’t rotate due to memory bus routing
- Airflow wrong for this orientation

Mini-RDIMM versus 72b-SO-RDIMM





- Mechanical
  - Module = 82 x 30mm
  - 244 pins, 0.6 mm pitch
  - New socket
- Features
  - x4 DRAMs supported
  - Address parity

- Mechanical
  - Module = 67.6 x 30mm
  - 200 pins, 0.6 mm pitch
  - Reuses mobile socket
- Features
  - No x4 DRAM support
  - No address parity

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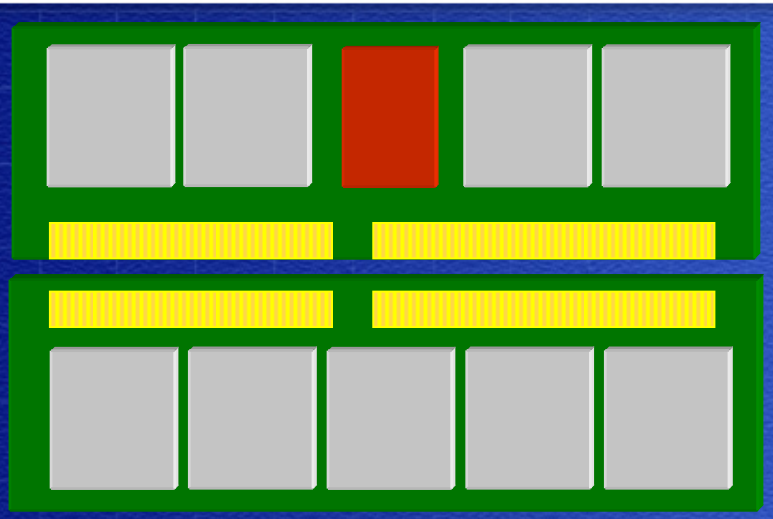
ATCA DDR3 72b-SO-RDIMM or Mini-



- Register designed for Mini/SO
- Customer feedback needed:
  - Mini or SO?
  - ATCA height or 30mm

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Peripherals & Narrow Buses

Peripherals & Narrow Buses

	2005		2006	2007
Peripherals	DDR1 32b-DIMM	DDR1 16b-SO-DIMM	DDR2 16b-SO-DIMM	DDR2 32b-SO-DIMM

- Devices that need smaller granularity
  - A single 512Mb chip contains 64MB of data!
- Small footprint is desirable
  - 1 to 4 DRAMs typical
- Reuses SDRAM 144-pin SO-DIMM form
- Common pinout for DDR1/2/3 and 16/32 bits

Summary

ATCA/AMC Memory Solutions

- ATCA
  - DDR2 solutions: RDIMM, FB-DIMM
    - RDIMM can be vertical
    - FB-DIMM must be angled
  - VLP modules a little too tall
  - DDR3 RDIMM designed for ATCA
- AMC
  - 72b-SO-DIMM
  - Mini-RDIMM

Thank You

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For more information on JEDEC: www.jedec.org