



PCIe® Electromechanical Updates

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Agenda

- 225/300 Watt High Power CEM Spec
 - ✓ Overview
 - ✓ System Volumetric
 - ✓ Connectors
 - ✓ Power Delivery
 - ✓ Card Keepout and Structure
 - ✓ Thermal and Acoustics
- CEM 3.0 Updates
 - ✓ Expected Changes
 - ✓ Connector Performance
 - ✓ Supported Topologies
 - ✓ Simulation Methodology
 - ✓ Key Tasks
- Summary



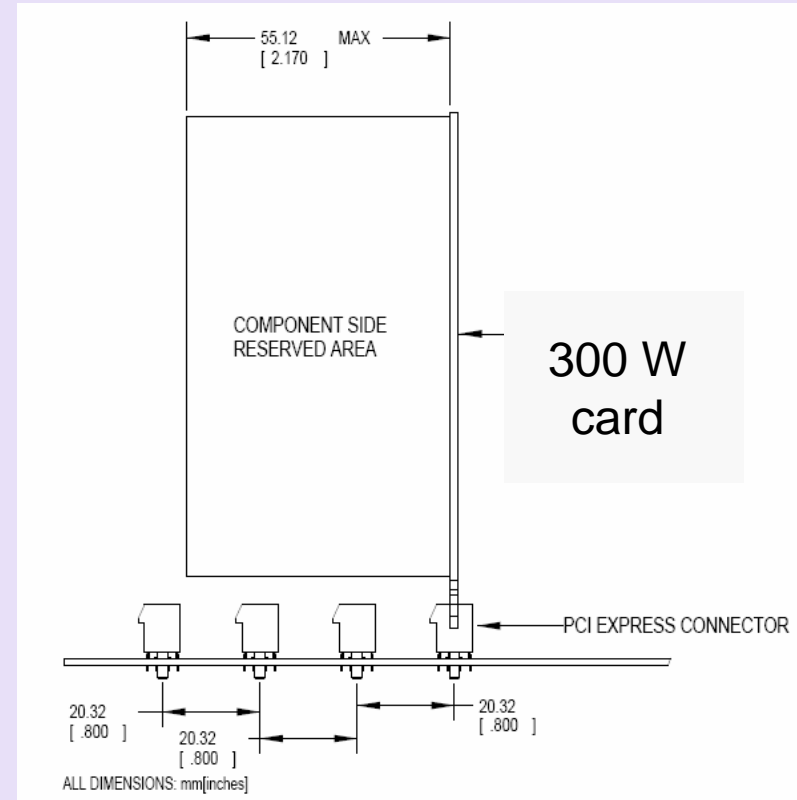
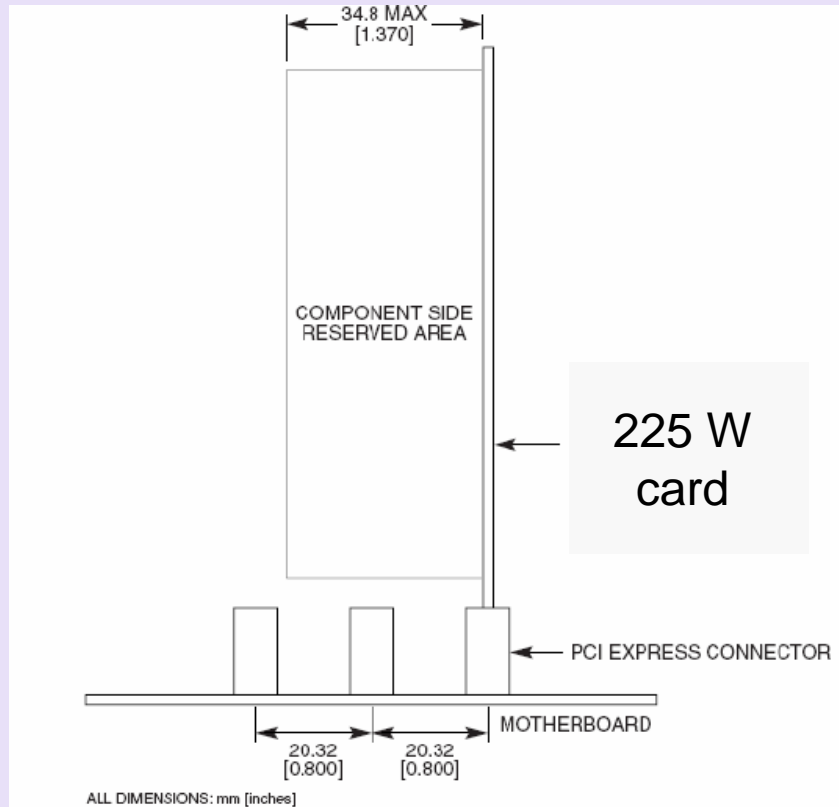
225/300 Watt High Power CEM Spec 1.0



High Power CEM Specification

- Support 225 W / 300 W high power requirements for add-in cards and systems
 - ✓ The 150W spec is no longer sufficient
- Standardize new power delivery connector and power-up sequencing scheme
- Define system boundary conditions for 225W/300W cards
 - ✓ Mechanical, thermal and acoustic
- Focus on the ATX form factor
- 1.0 spec released March 27th, 2008
 - ✓ http://www.pcisig.com/members/downloads/specifications/pciexpress/PCIe_225_300W_r1.0_27Mar08.pdf

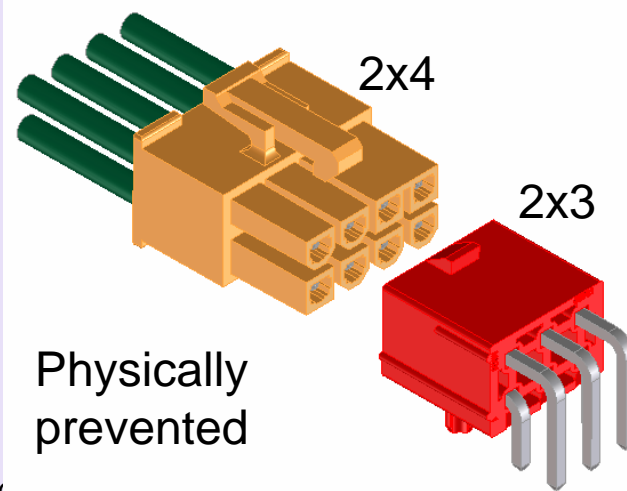
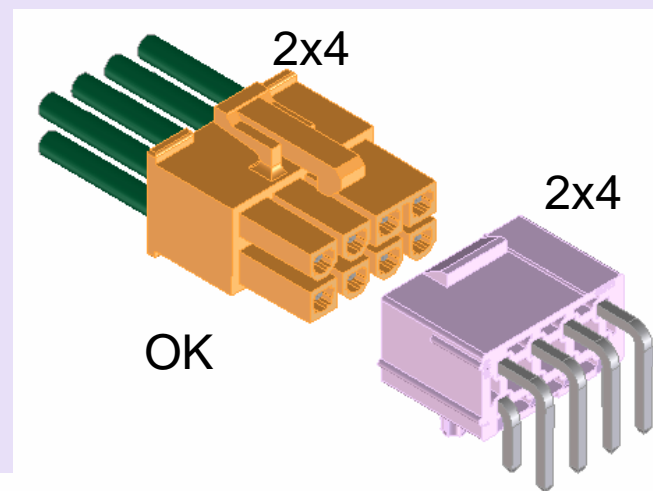
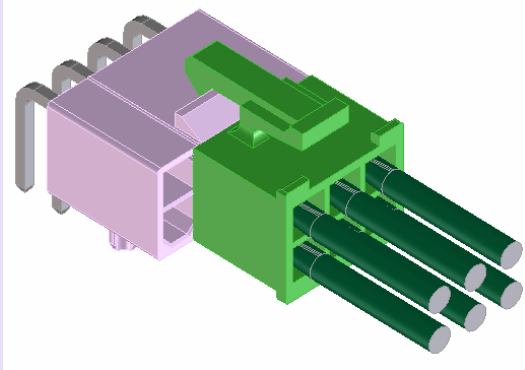
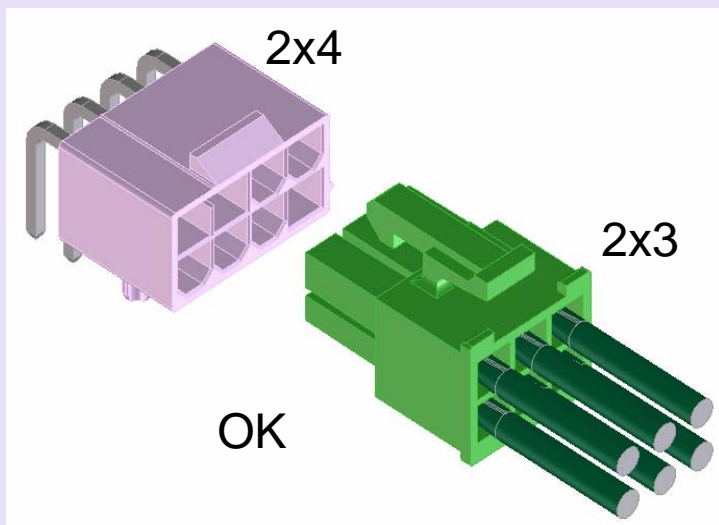
System Volumetric



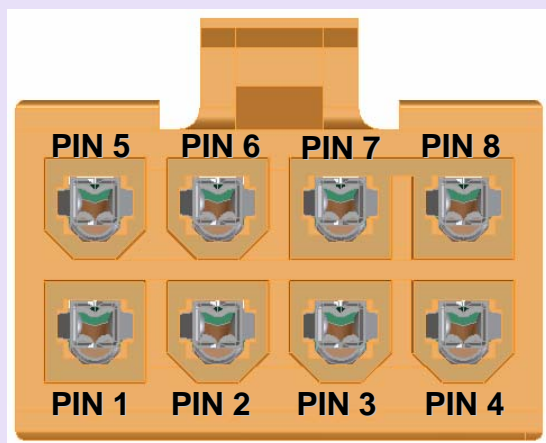
(150W-225W] cards can occupy two slots (225W-300W] cards may occupy three slots

2x4 Connector

- Besides the 2x3 connector defined in the 150W Graphics Spec 1.0, a new 2x4 connector is defined for delivering power to the 225/300W cards



2x4 Connector Pinout



Pin	Signal
1	+12 V
2	+12 V
3	+12 V
4	Sense1
5	Ground
6	Sense0
7	Ground
8	Ground

Sense1	Sense0	Comment
Ground	Ground	A 2x4 auxiliary power connector is plugged into the card. Card can draw up to 150W from the auxiliary power connector
Ground	Open	Reserved
Open	Ground	A 2x3 auxiliary power connector is plugged into the card. Card can only draw up to 75W from the auxiliary power connector
Open	Open	No auxiliary power connector is plugged in

Delivering Power to Cards

- A 300W add-in card can receive power by the following methods:
 - ✓ 75W from x16 PCIe[®] connector plus 150W from a 2x4 connector plus 75W from a 2x3 connector.
 - ✓ 75W from x16 PCIe connector plus 75W from a first 2x3 connector, plus 75W from a second 2x3 connector, plus 75W from a third 2x3 connector.
 - Note that this is not the preferred approach.
- A 225W add-in card can receive power by one of the following methods:
 - ✓ 75W from x16 PCIe connector plus 150W from a 2x4 connector.
 - ✓ 75W from x16 PCIe connector plus 75W from a 2x4 connector plus 75W from a 2x3 connector.
 - ✓ 75W from x16 connector plus 75W from a first 2x3 connector plus 75W from a second 2x3 connector.



Additional Power Delivery Requirements



- The +12V delivered from the standard x16 edge connector and the additional +12V(s) delivered via the dedicated 2x3 and/or 2x4 auxiliary power connector(s) must be treated as coming from independent separate system power supply rails.
- The different +12V input potentials from different connectors must not be electrically shorted at any point on a PCI Express® 225W/300W add-in card.
- The power pins of a single 2x3 or 2x4 auxiliary power connector can be shorted together.
- No specific power sequencing between the slot, 2x3 and 2x4 connector power can be assumed. A PCI Express 225W/300W add-in card must handle all possible combinations.

Power-up Sequencing

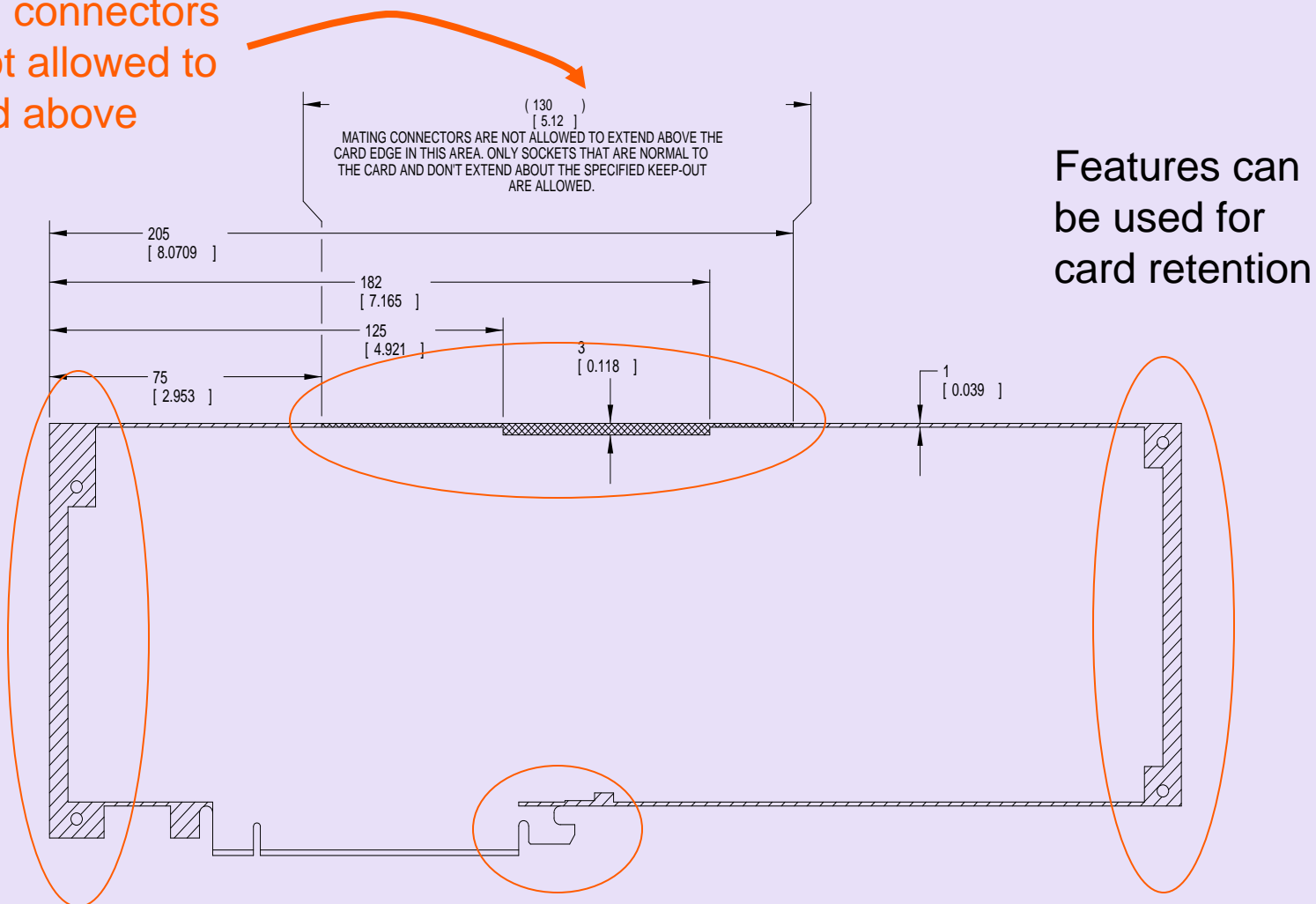
- At system power up, the permitted initial power draw depends on the auxiliary power connector configurations on the card and how many sense pins are detected
- After system reset is released and the PCI Express link is up, the card will receive the Slot_Power_Limit message.
 - ✓ If the Slot_Power_Limit is bigger than or equal to the permitted initial power draw, the card can then draw power up to the Slot_Power_Limit in any order from the PCI Express edge connector, the 2x3 connector (if exists) and the 2x4 connector (if exists), subject to and limited to the individual power ratings of the respective connectors.
 - ✓ If the Slot_Power_Limit is smaller than the permitted initial power draw, the card can ignore the Slot_Power_Limit message and continue draw the same amount of power as permitted at system power up time.

Permitted Initial Power-300W

2x4 Sense0 Detected?	2x4 Sense1 Detected?	2x3 Sense Detected?	Power draw permitted at system power up
N	N	N	25W available from PCI Express edge connector
N	N	Y	Total of 75W is available: 25W available from PCI Express edge connector 50W available from 2x3 connector
Y	N	N	Total of 75W is available: 25W available from PCI Express edge connector 50W available from 2x4 connector
Y	N	Y	Total of 125W is available: 25W available from PCI Express edge connector 50W available from 2x3 connector 50W available from 2x4 connector
Y	Y	N	Total of 125W is available: 25W available from PCI Express edge connector 100W available from 2x4 connector
Y	Y	Y	Total of 175W is available: 25W available from PCI Express edge connector 100W available from 2x4 connector 50W available from 2x3 connector

Card Keepout

Mated connectors
are not allowed to
extend above



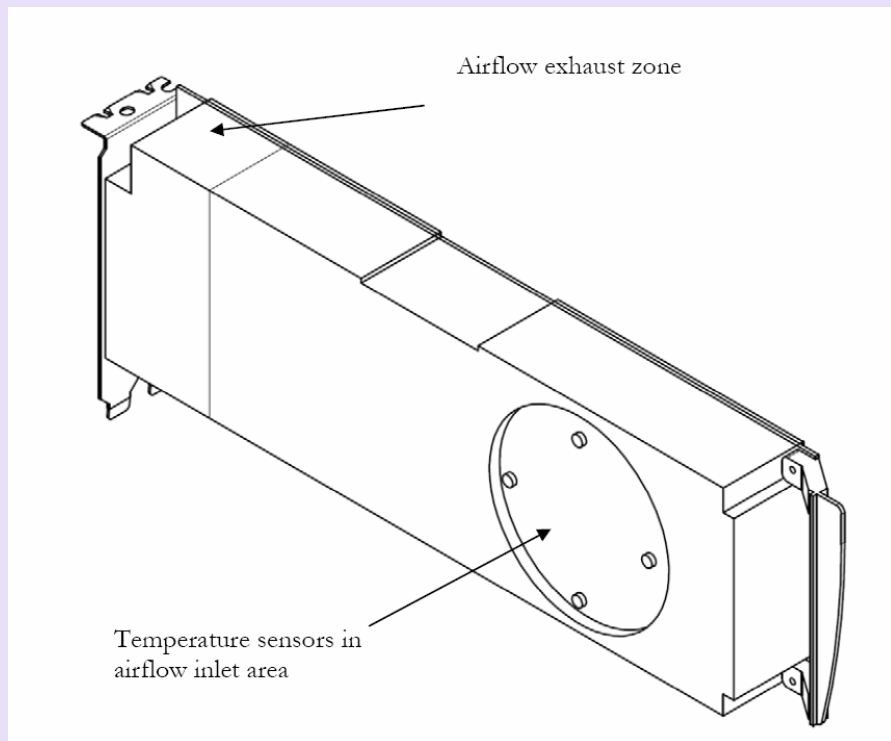
Features can
be used for
card retention

Other Mechanical Requirements

- Card total mass: ≤ 1.5 Kg
- All cards, including partial-length cards, shall have means of being extended to a full-length add-in card retainer as shown in CEM 2.0 Figure 6-6
- All cards, including partial-length cards, shall have means of being stiffened along their entire length from the rear bracket to the front card retainer

Thermal boundary condition

- Card inlet temperature:
 - ✓ 45°C for (150W- 225W] and (225W-300W] cards
 - ✓ In comparison, the 150W spec has an inlet of 55°C



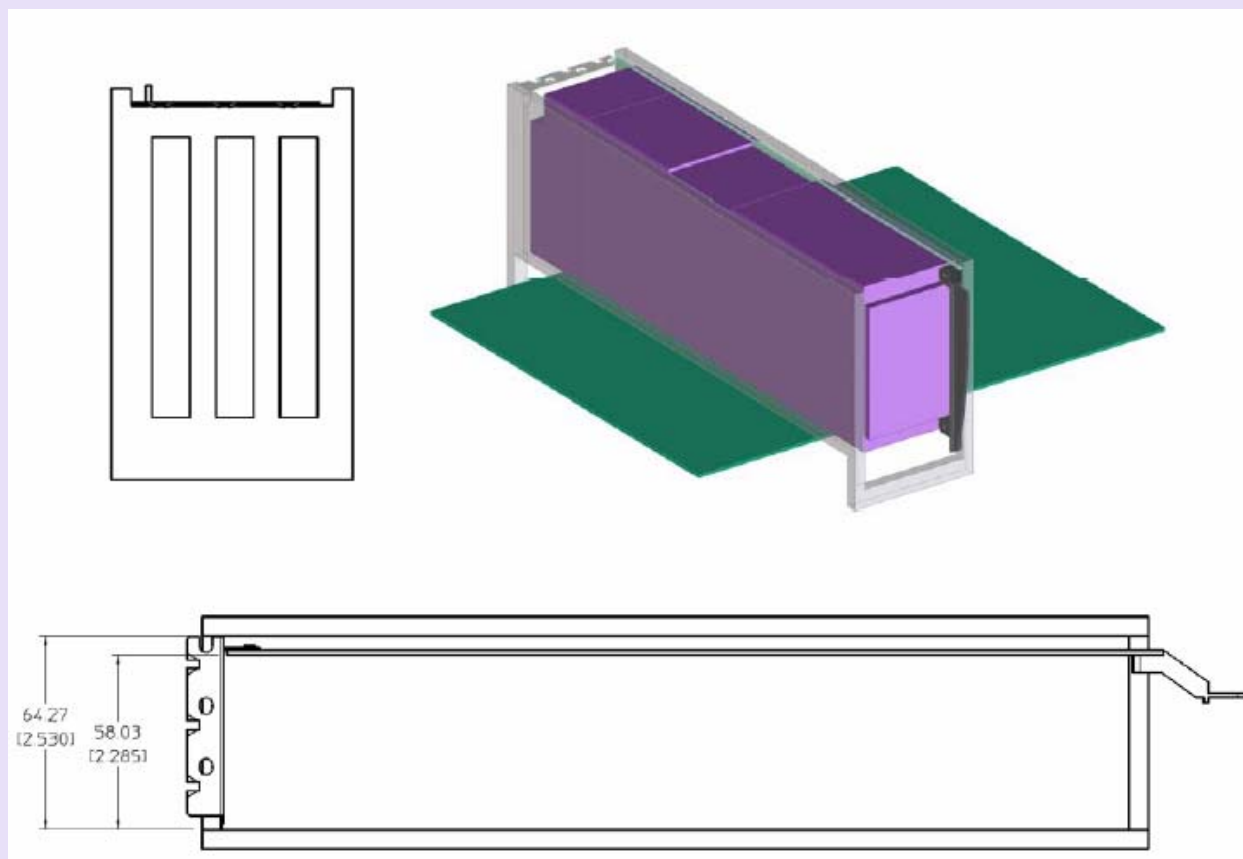
- Inlet temp is the averaged temp at the card fan inlet
- Airflow exhaust should be within 2" of the rear bracket to avoid recirculation

Thermal Measurements

- Open bench test done with fixtures in thermal chamber- adjust chamber temperature such that the card inlet temp is 45C

Characterization is performed under the “idle” and “full power” states:

- Critical component temperatures
- Critical temperature limits
- Inlet temperature
- Exhaust temperature
- Fan speed



Acoustic Management

- No acoustic requirement is specified
 - ✓ Market segments driven
- But metrology is specified for card vendors to report card acoustics
 - ✓ Consistent results
- Acoustic guidelines also provided

Acoustic Measurement

- Measurement and test setup should be as defined in ISO 3744, Acoustics – Determination of Sound Power Levels of Noise Sources Using Sound Pressure – Engineering Method in an Essentially Free Field Over a Reflecting Plane.
- Place the card in the acoustic chamber by itself, in free air, without the system board or any other system components. The card under test should be suspended by some type of “bungee cords” to avoid any fixturing effect on acoustics.
- It is not necessary to fully power or operate the card. Instead, it is necessary to operate only the fan.
- Measure and/or calculate the following acoustic emissions at both the “idle” and “full power” fan speeds:
 - ✓ Sound pressure, *LPA*
 - ✓ Sound power, *LWA*
 - ✓ 1/3-octave acoustic spectral content

Acoustic Guidelines

- The acoustic emissions should not include any prominent tones.
- Certain frequencies are more objectionable to humans than others.
- The card's fan(s) should be dynamically controlled to minimize noise over the complete range of expected operational and environmental conditions.
- The card's fan(s) should be controlled such that there are no abrupt changes or noticeable oscillations in acoustic levels or quality.
- The chassis should be designed so as to minimize coupling of vibrations and acoustic noise from the card to the chassis.
- The card should be designed so as to minimize coupling of vibrations from the card's fan to the card.



PCIe CEM 3.0 Updates



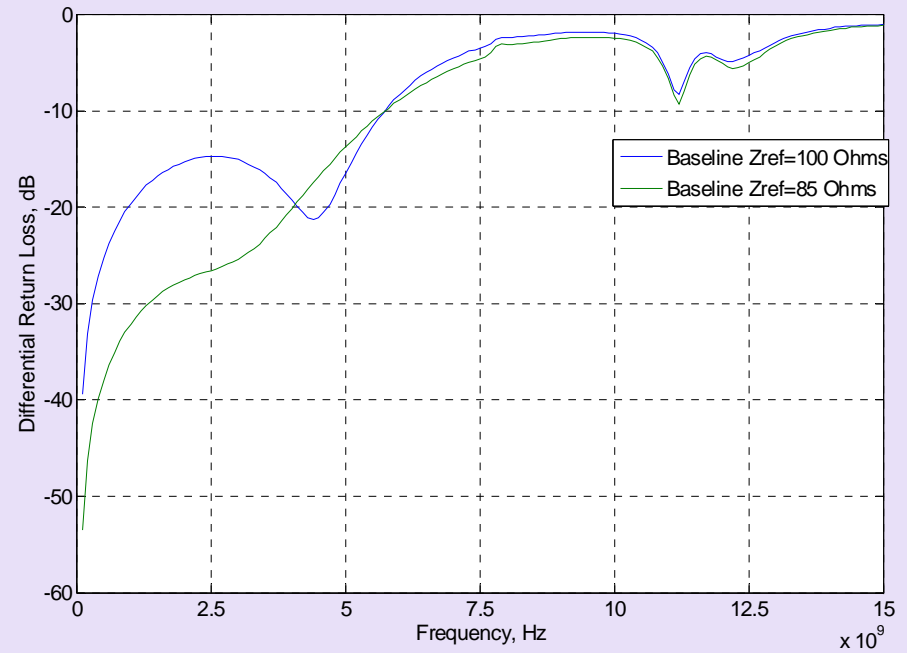
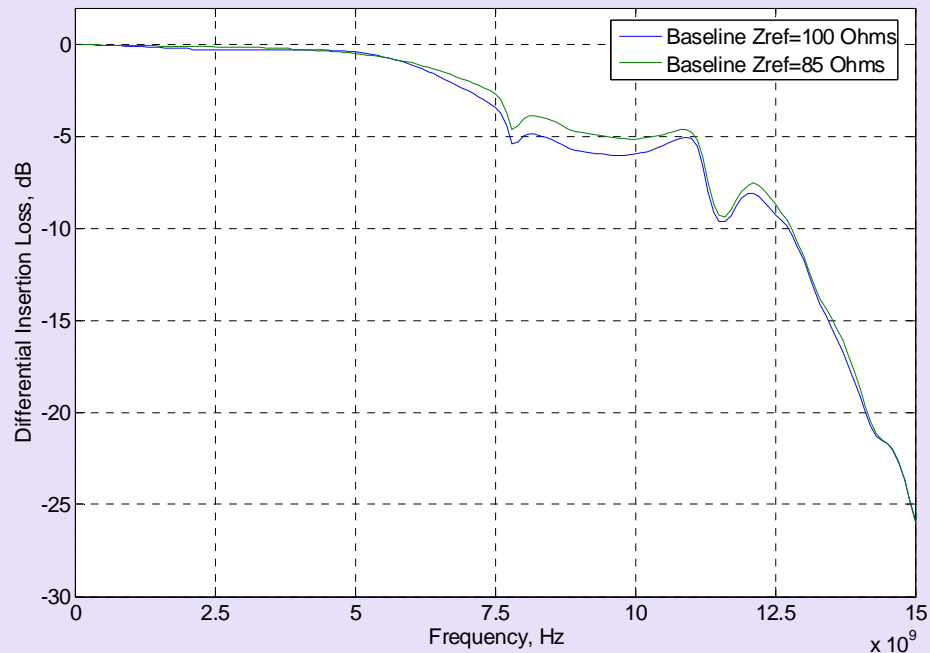
Disclaimer

- NOTE: Some information in this presentation refers to specifications still in the development process. This presentation reflects the current thinking of the workgroup, but all material is subject to change before the specifications are released.

Expected CEM 2.0 to 3.0 Changes

CEM 2.0 Spec Section	Areas Of Change
Auxiliary Signals	None
Hot Insertion And Removal	None
Electrical Requirements	Electrical Budgets Simulation methodology Eye Diagrams
Connector Specification	No connector change for desktop; some topologies may need improved connectors
Add-in Card Form Factors And Implementation	No substance change; only card drawings clean-ups

Connectors



The standard thru-hole PCIe connector has very reasonable performance for 8 GT/s. There *might* be a need for better connectors for topologies with long routes and thick PCB

Supported Topologies

- CEM 3.0 will continue to support the topologies supported by 2.0
 - ✓ One connector topology for clients
 - ✓ Two connector topology for servers

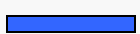
Example-
Client Topology

Seg	Description
A	MCH PKG
B	Break Out
C	MB Main 7"
D	MB post cap
F	Add in card main 3"
G	Add in card PKG Break out
H	Add in card PKG

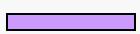
Figure Key



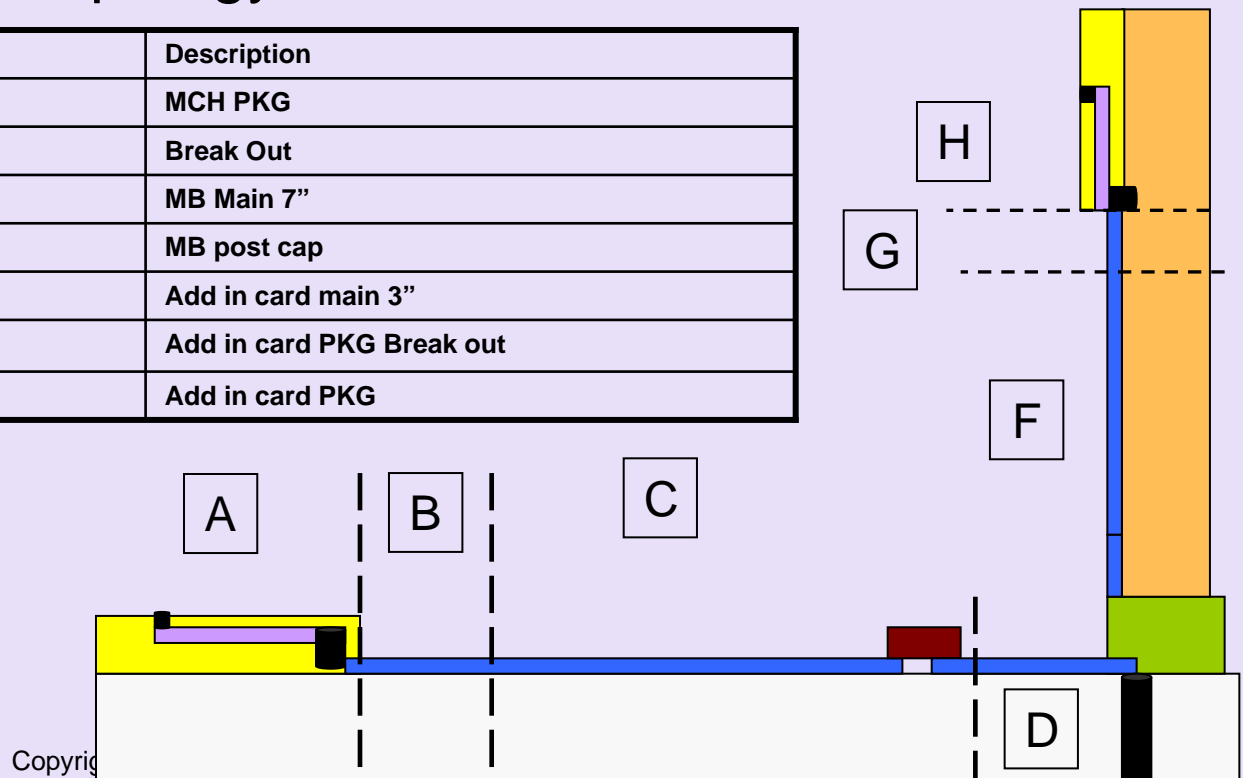
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- Microstrip

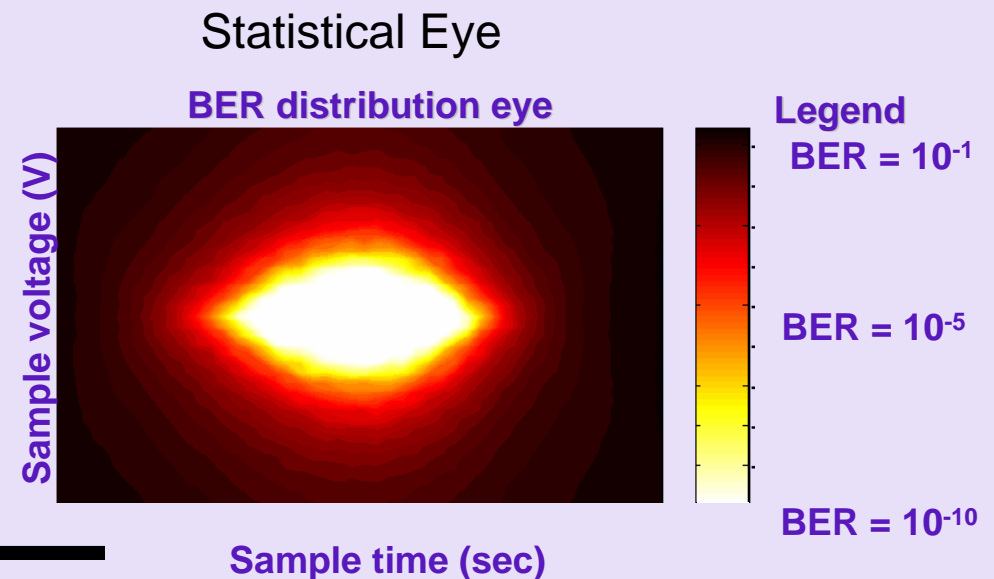
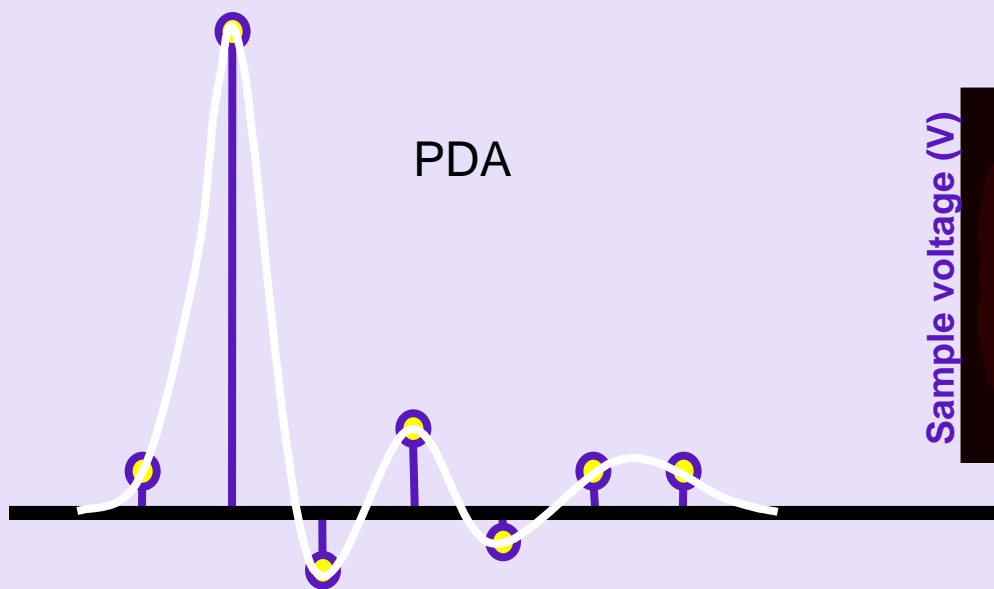


- Stripline



Simulation Methodology

- CEM 2.0 used Peak Distortion Analysis as the simulation methodology
 - ✓ Too pessimistic for Gen 3
- CEM 3.0 will use Statistical Analysis to gain some “statistical relief”



The Key Task

- The Base Spec defines the silicon and end-to-end electrical requirements
- The CEM Spec defines the Motherboard-Card interface electrical spec for add-in card interoperability with motherboards
- How to define the mid-bus budget at the PCIe connector that catches the end-to-end failure?
 - ✓ CEM 2.0 simulation process or other?
 - ✓ Are voltage + jitter sufficient for predicting end to end behavior from mid-bus?
- How to do compliance testing?

Summary

- 225/300 W High Power CEM Spec
 - ✓ The 1.0 spec is released, which supports the market need for > 150W high power PCI Express cards, mainly the graphic cards
 - ✓ The spec defines a new 2x4 connector for power delivery, power sequencing, and mechanical, thermal and acoustic boundary conditions and guidelines to support the interoperability of the high power cards with systems
- CEM 3.0 Spec Development
 - ✓ This is the current focus in the PCI SIG Electromechanical workgroup
 - ✓ Stay tuned for further specification updates from PCI-SIG (www.pcisig.com)
 - ✓ No major changes expected in connector and card form factors
 - ✓ All the changes over CEM 2.0 will be on electricals

Thank you for attending the
PCI-SIG Developers Conference 2008

For more information please go to
www.pcisig.com