ENGINEERING CHANGE NOTICE

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Name: Dave Zenz Email: Dave_zenz@dell.com

Company: Dell Mailstop:

Address: One Dell Way

City: Round Rock State/Province: TX

Country: USA Zip/Postal Code: 78682

Phone: 512-723-0906 FAX:

Your Company SIG Voting Member Name:

Phone: Email:

PART I

Brief description of the functional changes proposed:
Increase of maximum x16 graphics add-in card power dissipation to 75W from 60W
Specification(s) this proposed change is against:
PCI Express Card Electromechanical Specification – latest version (1.0a)
Benefits as a result of the proposed changes:
A 75W power dissipation level in the base PCI Express Card Electrometrical Specification provides graphics
the ability to achieve higher performance levels and therefore helps to ensure that PCI Express graphics
can achieve similar performance levels to existing AGP graphics of the time.
An assessment of the impact to the existing revision and systems that currently conform to the PCI specification:
Minimal impact to existing revision, see details of the ECR below. No systems currently conform to the PCI
Express specification.
An analysis of the hardware implications:
Allocation of an existing reserved pin present on the standard x1 connector for 12V. See ECR details below.
An analysis of the software implications:
Slot power limit control registers of platforms supporting 75W x16 graphics will need to populated with
the new 75W value.

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PART II

THE FOLLOWING CRITERIA APPLIES TO DEFINING A RESERVED PIN ON THE PCI CONNECTOR OR TO REQUEST A NEW COMMAND:

- The function is deemed to be important for the Continued growth and long-term well being of PCI. (A shot-term fixes to a problem does not merit consideration, i.e., IDEIRZ14.)

- There is no other effective way for the function to be implemented except using a reserved pin or new command. (Is there a solution that can be implemented in configuration space?)

Describe how the new function (on an Addin Card) works with an existing system and other existing Addin Cards?
No impact – no existing systems or Addin cards.
Describe how existing Addin Cards work when added into a system with the new function?
No impact – no existing systems or Addin cards.
Are there any combinations not addressed by the previous two items? If yes, specify them and describe the interaction between new device and existing devices.
No.

Environmental justification for this ECN

As one of the leading applications of the PCI Express transition graphics must be closely scrutinized to ensure that a compelling user experience can be achieved within prescribed boundaries. The power projections developed by the PCI Express graphics workgroup indicate that graphics solutions will continue to drive increasing power requirements as the performance and complexity of graphics continues to grow. This main objective of this ECN is not to address the highest end of graphics (another specification is in development for this support) in the PCI Express era but simply to provide a sufficient power level as compared to the AGP levels that will already be well established at that time. As such the GWG power projections are not included due to the fact that a 70W single slot AGP graphics solution has already been announced (ATI 9800Pro & NVIDIA GeForceFX 5800 Ultra – dual). The cards at this power level are consumer solutions that typically retail for $349-399.

The following data was collected in February of 2003:

- From AnandTech IDF coverage: “One of the major advantages of the PCI Express interface over AGP for graphics happens to be that the AGP specification only allows for 20 - 40W of power for graphics cards, whereas PCI Express will support power consumption of approximately 60W. Looking at the GeForce FX with its 70 - 75W power draw, we wonder if even the boosted power PCI Express will be too little given the way GPUs are increasing power consumption.”

- Fact: Mainstream AGP systems are now shipping with ~60W graphics with ~70W+ around the corner
- All of the following *mainstream* platforms are available with a ~60W, single slot, graphics card for months
    - Dell Dimension 4550
    - hp pavilion 700
    - Compaq Presario 8000
    - Gateway 500S
- Average system price WITH a $399 retail card is ~$1150
- This is the level of graphics experience that customers will look for with PCI Express
- Point: 60W will not allow us to provide the same level of graphics experience as the AGP system that’s being replaced whereas 75W will get us much closer to equality

ECN Change Details

1) Change table 4-1 to indicate 5.5 A as the maximum supply current on +12V using the x16 connector as noted below

Table 4-1: Power Supply Rail Requirements

Power Rail	x1 Connector	x4/x8 Connector	x16 Connector
+3.3V			
Voltage tolerance	±9% (max)	±9% (max)	±9% (max)
Supply Current	3.0 A (max)	3.0 A (max)	3.0 A (max)
Capacitive Load	1000 µF (max)	1000 µF (max)	1000 µF (max)
+12V			
Voltage tolerance	±8%	±8%	±8%
Supply Current	0.5 A	2.1 A (max)	~~4.4~~ 5.5 A (max)
Capacitive Load	300 µF (max)	1000 µF (max)	2000 µF (max)
+3.3Vaux			
Voltage tolerance	±9% (max)	±9% (max)	±9% (max)
Supply Current			
Wake Enabled	375 mA (max)	375 mA (max)	375 mA (max)
Non-wake Enabled	20 mA (max)	20 mA (max)	20 mA (max)
Capacitive Load	150 µF (max)	150 µF (max)	150 µF (max)

Notes:

- The maximum current slew rate for each add-in card shall be no more than 0.1 A/µs.
- Each add-in card shall limit its bulk capacitance on each power rail to less than the values shown in Table 4-1.
- System boards that support hot plug add-in cards shall limit the voltage slew rate so that the inrush current to the card shall not exceed the specified maximum current. This is calculated by the equation dV/dt = I/C; where:

  I = maximum allowed current (A)
  C = maximum allowed bulk capacitance (F)
  dV/dt = maximum allowed voltage slew rate (V/s)

2) Section 4.2 Power Consumption change
   a) Update table 4-2 as noted below to increase maximum power dissipation of a x16 Add-in card to 75W and reference footnotes 2 and 4
   b) Update the 4-60W table footnotes to 75W as highlighted below

4.2. Power Consumption

This specification provides various sizes of cards for system implementation. Each card size provides support for a certain number of PCI Express lanes, and a corresponding difference in specified power consumption as shown in Table 4-2.

Table 4-2: Add-in Card Power Dissipation

	X1		x4/x8	x16	
Standard height	10 W[1] (max)	25 W[1] (max)	25 W (max)	25 W[2] (max)	~~60 W[2]~~ (max)
Low profile card[3]	10 W (max)		10 W (max)	25 W (max)	

75W (2,4)

Change 60W to 75W and add footnotes 2 & 4

Notes:

1. A standard height x1 add-in card intended for desktop applications is limited in length to a half-length add-in card and 10 W maximum power dissipation. A standard height x1 add-in card intended for server I/O applications with 25 W maximum power dissipation must be greater than 177.80 mm (7.0 inches) in length, but must not exceed a full-length add-in card. See Table 6-1 for add-in card size definitions. The same server I/O add-in card must, at initial power-up, not exceed 10 W of power dissipation, until configured as a high power device, at which time it must not exceed 25 W of power dissipation. Refer to Chapter 6 of the *PCI Express Base Specification* for information on the power configuration mechanism.
2. A standard height x16 add-in card intended for server I/O applications must limit its power dissipation to 25 W. A standard height x16 add-in card intended for graphics applications must, at initial power-up, not exceed 25 W of power dissipation, until configured as a high power device, at which time it must not exceed 60 W of power dissipation. Refer to Chapter 6 of the *PCI Express Base Specification* for information on the power configuration mechanism.
3. All low profile add-in cards are limited in length to a half-length add-in card and must not exceed the power dissipation values shown in Table 4-2.
4. A x16 graphics card is limited to 60 W. The 60 W maximum can be drawn via the combination of +12V and +3.3V rails, but each rail draw is limited as defined in Table 4-1, and the sum of the draw on the two rails cannot exceed 60 W.

Change the 4-60W references (highlighted) to 75W

The power limits for respective connector widths, x1, x4/x8, and x16, represent the add-in card and system capacity to provide cooling for the slot. The 10 W limit assumes natural convection cooling in a system that provides air exchanges. The 25 W and above add-in card power limits assume that sufficient cooling is provided to the slot by the cards in the present chassis environment.

PCI Express allows for higher maximum power for graphics cards than AGP. In case such a graphics card is used in a system, implementers should pay special attention to system level thermal, acoustic, structure, and power delivery requirements.

(Add the following sentence to the last paragraph of section 4.2):
To insure optimum performance, it is recommended that the system designer refer to the "PCI Express Graphics Card Thermal and Mechanical Guideline for Desktop Systems."

3) Connector Pinout change
   a) Allocate RSVD pin B3 for 12V (as noted below). This will provide a total of 5-12V power pins in addition to the existing 3-3.3V pins for an aggregate 76.89W (although maximum limit will be 75W).

5.1. Connector Pinout

Table 5-1 shows the pinout definition for the x1, x4, x8, and x16 PCI Express connectors. The auxiliary pins are identified in the shaded areas.

Table 5-1: PCI Express Connectors Pinout

Pin #	Side B		Side A	
	Name	Description	Name	Description
1	+12V	12 V power	PRSNT1#	Hot plug presence detect
2	+12V	12 V power	+12V	12 V power
3	~~RSVD~~ +12V	~~Reserved~~ 12 V Power	+12V	12 V power
4	GND	Ground	GND	Ground
5	SMCLK	SMBus (System Management Bus) clock	JTAG2	TCK (Test Clock), clock input for JTAG interface
6	SMDAT	SMBus (System Management Bus) data	JTAG3	TDI (Test Data Input)
7	GND	Ground	JTAG4	TDO (Test Data Output)
8	+3.3V	3.3 V power	JTAG5	TMS (Test Mode Select)
9	JTAG1	TRST# (Test Reset) resets the JTAG interface	+3.3V	3.3 V power
10	3.3Vaux	3.3 V auxiliary power	+3.3V	3.3 V power
11	WAKE#	Signal for link reactivation	PWRGD	Power good

Revision History

V0.1 – 3/11/03 – Initial version
V0.2 – 3/24/03 – Added implementation statement to section 4.2