# QUADRO K4200 GRAPHICS BOARD (GK104 / P2004 SKU 503)

BD-07284-001_v03 | August 2014

**Board Specification**

# DOCUMENT CHANGE HISTORY

BD-07284-001_v03

| Version | Date | Authors | Description of Change |
|---|---|---|---|
| 01 | May 23, 2014 | JK, SM, VS | Initial Release |
| 02 | May 30, 2014 | JK, SM | •Updated Table 1 with MTBF data<br>•Added average and peak current specifications (Table 8) |
| 03 | August 15, 2014 | TY, SM | Removed all confidentiality as product has been released |

# TABLE OF CONTENTS

**Overview** ..... **1**
Key Features ..... 1
Graphics Card Description ..... 3
NVIDIA GPU BOOST ..... 3
Configuration ..... 4
Mean Time Between Failures ..... 4
**Mechanical Specifications** ..... **5**
PCI Express System ..... 5
Placement of Standard I/O Connectors ..... 6
Display Connectors ..... 7
DisplayPort ..... 8
DVI ..... 10
3-Pin Stereo Connector ..... 11
Power Connectors and Headers ..... 11
Auxiliary 6-Pin Power Connector ..... 12
SDI, SLI and 3D Stereo Connector Placement ..... 13
Extenders ..... 13
HDCP Support ..... 15
**Power Specifications** ..... **16**
Power by Rail ..... 16
Energy Star Report ..... 17
**Thermal Specifications** ..... **18**
Thermal Qualification Summary ..... 18
Cooling Solution ..... 20
**Support Information** ..... **22**
Certificates and Agencies ..... 22
Certifications ..... 22
Agencies ..... 22
Languages ..... 23

# LIST OF FIGURES

Figure 1. Quadro K4200 Graphics Board ..... 5
Figure 2. Quadro K4200 Connector Placement ..... 6
Figure 3. Optional 3D Stereo Bracket ..... 7
Figure 4. DisplayPort Connector ..... 8
Figure 5. DVI-I Connector ..... 10
Figure 6. 3-Pin Stereo Connector Pinout ..... 11
Figure 7. Auxiliary 6-Pin Power Connector ..... 12
Figure 8. SDI, SLI, and 3D Stereo Connection ..... 13
Figure 9. Short Straight Extender ..... 14
Figure 10. Long Extender with Offset ..... 14
Figure 11. Active Fan Sink ..... 20

# LIST OF TABLES

Table 1. Board Configuration ..... 4
Table 2. DisplayPort Connector Pinout ..... 9
Table 3. DVI-I Connector ..... 10
Table 4. 3-Pin Stereo Connector Pinout ..... 11
Table 5. Auxiliary 6-Pin Power Connector Pinout ..... 12
Table 6. Configuration with External Power Connector ..... 16
Table 7. Power by Rail ..... 16
Table 8. Average and Peak Current Specifications ..... 16
Table 9. Energy Star Report ..... 17
Table 10. Test Setup and Configuration ..... 19
Table 11. Thermal Results ..... 19
Table 12. Fan Specifications ..... 20
Table 13. Board Environmental Conditions ..... 21
Table 14. Languages Supported ..... 23

# OVERVIEW

The NVIDIA Quadro® K4200 graphics board (GK104 / P2004 SKU 503) is a full-height form factor graphics add-in card based on the NVIDIA® Kepler™ architecture graphics processing unit (GPU). The Quadro® K4200 graphics board is targeted as a high-performance workstation graphics solution for PCI Express systems and brings a whole new level of performance and features to professional graphics and GPU computing applications.

The Quadro K4200 graphics board supports a variety of display types including CRTs, digital flat panels, projectors, and HDTVs.

## KEY FEATURES

### GPU

- Maximum core clock: 771 MHz
- NVIDIA® CUDA® cores: 1344
- Supports NVIDIA GPU Boost™ to maximize performance
- 10-bit internal display processing, including hardware support for 10-bit scan-out
- Full Microsoft DirectX 11 Shader Model 5.0 Support
- Full OpenGL 4.4 support
- API support for CUDA C, CUDA C++, DirectCompute 5.0, OpenCL™, Java, Python, Fortran

## Board

- PCI Express 2.0 ×16 system interface
- Physical dimensions: 4.376 inches × 9.5 inches, single-slot
- Board power: 108 W

## Display Connectors

- Two VESA® DisplayPort™ connectors
- One DVI-I connector
- 3-pin mini-DIN stereo connector (available via optional bracket)

## Power Connectors and Headers

- One 6-pin PCI Express power connector
- 4-pin high-density header for stereo signal set and ground

## Memory

- Maximum memory clock: 2700 MHz
- Memory I/O interface: 256-bit
- Total board memory: 4 GB
  - 16 pieces 128M × 16 GDDR5
- Memory bandwidth: 173 GB/s

## Display Support

- 400 MHz integrated RAMDAC
  - Maximum resolution over VGA (through DVI to VGA cable): 2048 × 1536 × 32 bpp at 85 Hz
- Dual-link internal TMDS (DVI 1.0)
  - Maximum resolution over digital port (single GPU mode): 2560 × 1600 × 32 bpp at 60 Hz (reduced blanking)
- Single-link internal TMDS (DVI 1.0)
  - Maximum resolution over digital port (single GPU mode):1920 × 1200 × 32 bpp at 60 Hz (reduced blanking)
- DisplayPort 1.2
  - Maximum resolution: 3840 × 2160 × 36 bpp at 60Hz
  - HDMI (via optional dongle)
  - Maximum resolution: 1920 × 1080 × 32 bpp at 60Hz

## BIOS

- 2Mbit serial ROM
- UEFI supported

# GRAPHICS CARD DESCRIPTION

The Quadro K4200 graphics card is NVIDIA's next generation high-end graphics board, significantly raising the bar for High Performance Visualization and Computation. It delivers Microsoft DirectX 11.0 and Shader Model 5.0 hardware acceleration.

# NVIDIA GPU BOOST

The Quadro K4200 provides NVIDIA GPU Boost, a mechanism that automatically maximizes application performance while staying within the specified power envelope. For workloads that do not reach the allowed power level, the GPU clock is automatically increased to a higher performance state (Boost State) in order to leverage the remaining power budget for additional increased performance. The GPU will always try to reach the higher boost state in order to maximize application performance.

The NVIDIA GPU Boost algorithm analyzes a variety of operating parameters for determining whether it can run at the higher boost clock level.

The algorithm will be disabled in the following scenarios:

- If a clock jitter sensitive "workstation feature" like Quadro Sync, SDI or NVIDIA® SLI® is enabled, the Quadro K4200 will lock to Base Clock automatically.
- If the user manually selects the "Prefer Consistent Performance" Control Panel option to lock explicitly to the base clock (can be useful for performance tuning during application development).

# CONFIGURATION

Table 1 lists the configuration for the Quadro K4200 graphics board.

Table 1. Board Configuration

| Specification | Description |
|---|---|
| Generic SKU reference | 699-52004-0503-400 |
| Chip | GK104-850 |
| Package size GPU | 40 mm x 40 mm |
| Core clock | 771 MHz |
| Idle core clock | 324 MHz |
| Memory clock | 2700 MHz |
| Idle memory clock | 324 MHz |
| CUDA cores | 1344 |
| Frame buffer | 4 GB |
| Memory I/O | 256-bit |
| Memory configuration | 16 pcs 128M x 16 GDDR5 SGRAM |
| Memory bandwidth | 173 GB/s |
| BAR1 size | 256 MB |
| Display connectors | •Two DisplayPort connectors<br>•One DVI-I connector<br>•3-pin stereo connector (available with optional bracket, NVPN: 930-50764-0000-000) |
| Power connectors and headers | •6-pin auxiliary power connector<br>•4-pin high-density header for stereo signal set and ground |
| Total board power | 108 W |
| HDCP supported | Yes |
| Thermal cooling solution | Active fan sink |
| Mean time between failures (MTBF) | •Uncontrolled environment: 417,982 hours at 35 °C<br>•Controlled environment: 835,987 hours at 35 °C |
| Weight without extender | ~461 gms |
| Extender | •Straight Extender (short)<br>•Offset Extender (long) |

## Mean Time Between Failures

Starting in January of 2013, NVIDIA began using Telcordia (TelC3) SR-332, Issue 3 for all reliability calculations for mean time between failures (MTBF). The MTBF data can be found in Table 1.

# MECHANICAL SPECIFICATIONS

## PCI EXPRESS SYSTEM

The Quadro K4200 graphics board conforms to the PCI Express full height form factor.

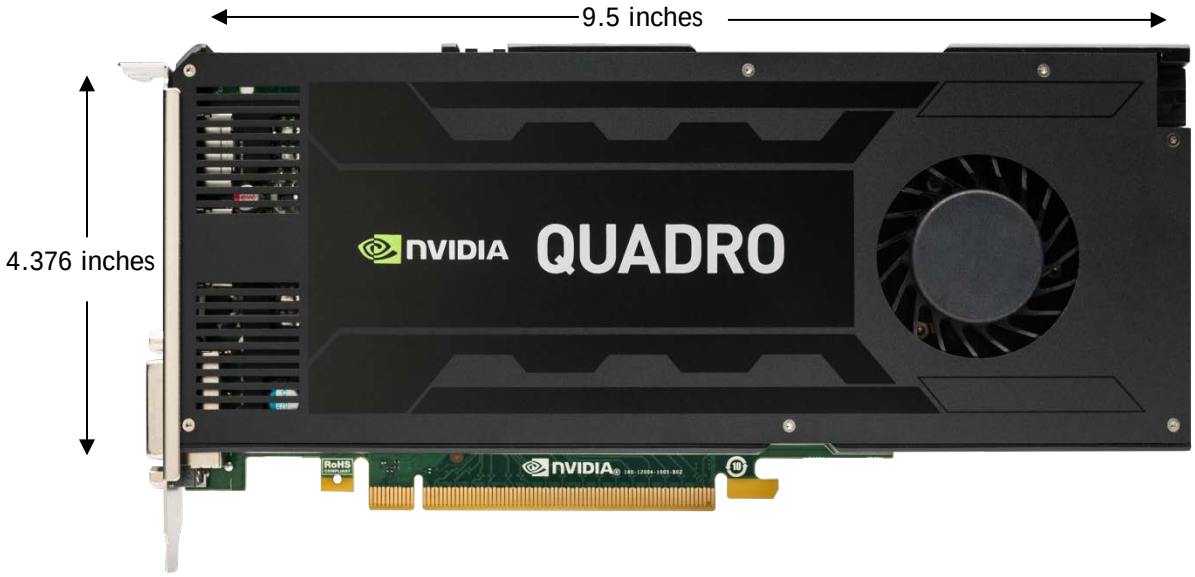


Figure 1. Quadro K4200 Graphics Board

# PLACEMENT OF STANDARD I/O CONNECTORS

Figure 2 shows the standard placement of the connectors for the Quadro K4200 graphics board. Figure 3 shows the optional 3D stereo bracket (NVPN: 930-50764-0000-000), with the 3-pin mini-DIN connector placement.

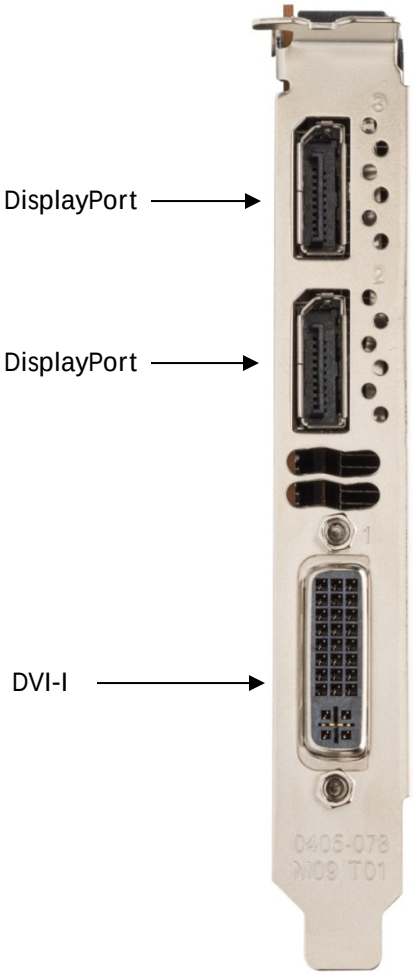


Figure 2. Quadro K4200 Connector Placement

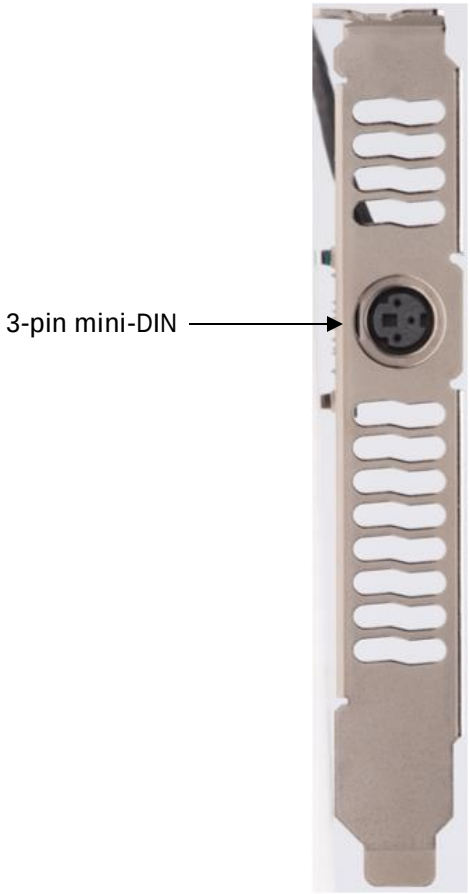


Figure 3. Optional 3D Stereo Bracket

## DISPLAY CONNECTORS

The Quadro K4200 graphics board supports the following connectors.

- Two DisplayPort connectors
- One DVI-I connector
- One 3-pin mini-DIN stereo connector (available on optional bracket)

## DisplayPort

The Quadro K4200 graphics board is capable of supporting the 20-pin VESA DisplayPort connector (Figure 4). The DisplayPort connector interfaces between your system and your display. Table 2 provides the connector pinout.

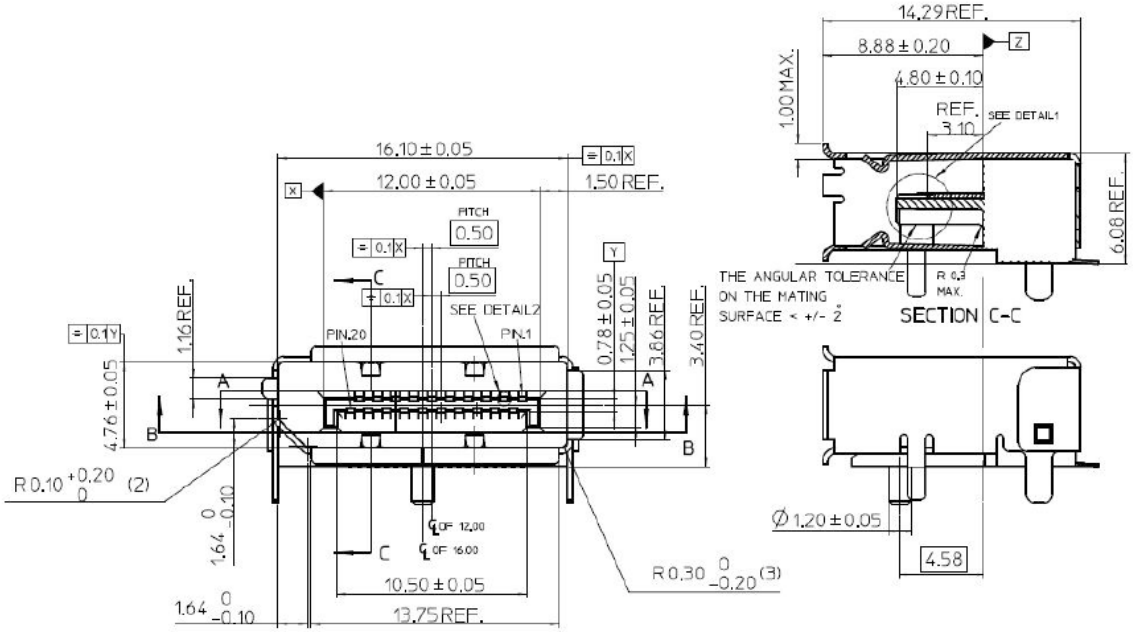


Figure 4. DisplayPort Connector

## Table 2. DisplayPort Connector Pinout

| Pin | Signal Name | Description |
|---|---|---|
| 1 | ML_Lane 0 (p) | Out |
| 2 | GND | Ground |
| 3 | ML_Lane 0 (n) | Out |
| 4 | ML_Lane 1 (p) | Out |
| 5 | GND | Ground |
| 6 | ML_Lane 1 (n) | Out |
| 7 | ML_Lane 2 (p) | Out |
| 8 | GND | Ground |
| 9 | ML_Lane 2 (n) | Out |
| 10 | ML_Lane 3 (p) | Out |
| 11 | GND | Ground |
| 12 | ML_Lane 3 (n) | Out |
| 13 | CONFIG1 | CONFIG |
| 14 | CONFIG2 | CONFIG |
| 15 | AUX CH (p) | I/O |
| 16 | GND | Ground |
| 17 | AUX CH (n) | I/O |
| 18 | Hot Plug Detect | In |
| 19 | Return | RTN |
| 20 | DP_PWR | Power out |

# DVI

The Quadro K4200 graphics board supports the DVI-I combined analog and digital interface connector (Figure 5). Table 3 lists the DVI-I connector pinout.

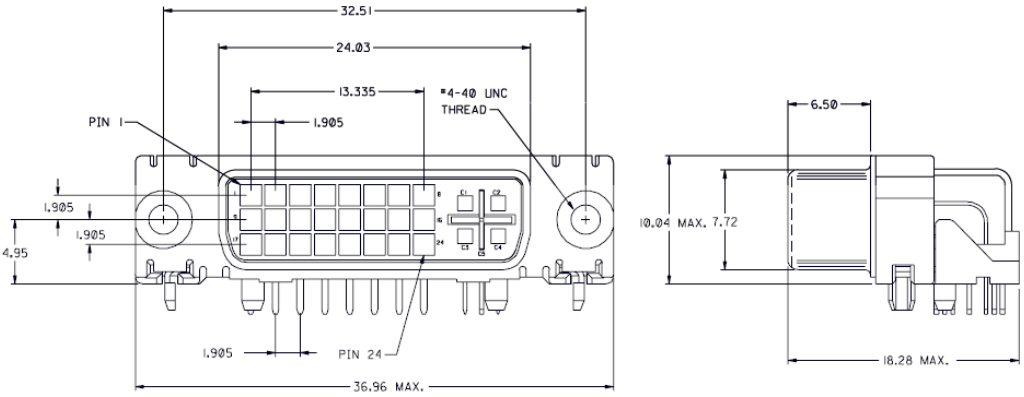


Figure 5. DVI-I Connector

Table 3. DVI-I Connector

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | TMDS data 2- | 13 | TMDS data 3+ |
| 2 | TMDS data 2+ | 14 | +5VDC power |
| 3 | TMDS data 2/4 shield | 15 | Ground (Return for +5) |
| 4 | TMDS data 4- | 16 | Hot plug detected |
| 5 | TMDS data 4+ | 17 | TMDS data 0- |
| 6 | DDC clock | 18 | TMDS data 0+ |
| 7 | DDC data | 19 | TMDS data 0/5 shield |
| 8 | Analog vertical sync | 20 | TMDS data 5- |
| 9 | TMDS data 1- | 21 | TMDS data 5+ |
| 10 | TMDS data 1+ | 22 | TMDS clock shield |
| 11 | TMDS data 1/3 shield | 23 | TMDS clock+ |
| 12 | TMDS data 3- | 24 | TMDS clock- |
| C1 | Analog red | C4 | Analog horizontal sync |
| C2 | Analog green | C5 | Analog ground (RGB return) |
| C3 | Analog blue | | |

## 3-Pin Stereo Connector

Circuits have been added to support stereo on the Quadro K4200 graphics board through a standard VESA 3-pin mini-DIN connector (Figure 6). It includes a small PCB (P764 board) in order to attach the 3-pin stereo connector on the bracket. The end user would have to use the cable that comes from this bracket and attach it to the 4-pin header on the Quadro K4200 graphics board to enable the stereo option. Table 4 lists the connector pinout.

**Note:** This connector is only available via an optional bracket.

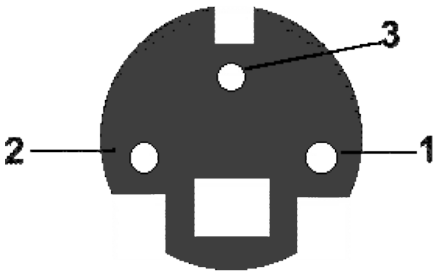


Figure 6. 3-Pin Stereo Connector Pinout

Table 4. 3-Pin Stereo Connector Pinout

| Pin | Description |
|---|---|
| 1 | +5 V DC power out |
| 2 | Ground |
| 3 | Stereo sync out |

# POWER CONNECTORS AND HEADERS

The Quadro K4200 graphics board supports the following internal connectors and headers.

- Auxiliary 6-pin power connector
- 4-pin high-density header for stereo signal set and ground

# Auxiliary 6-Pin Power Connector

The Quadro K4200 graphics board is a high powered board solution and it utilizes power from the PCI Express connector as well as the external power (a single 6-pin auxiliary power connector is required for Quadro K4200). Figure 7 shows the specification, and Table 5 shows the pinouts for the 6-pin external auxiliary power connector.

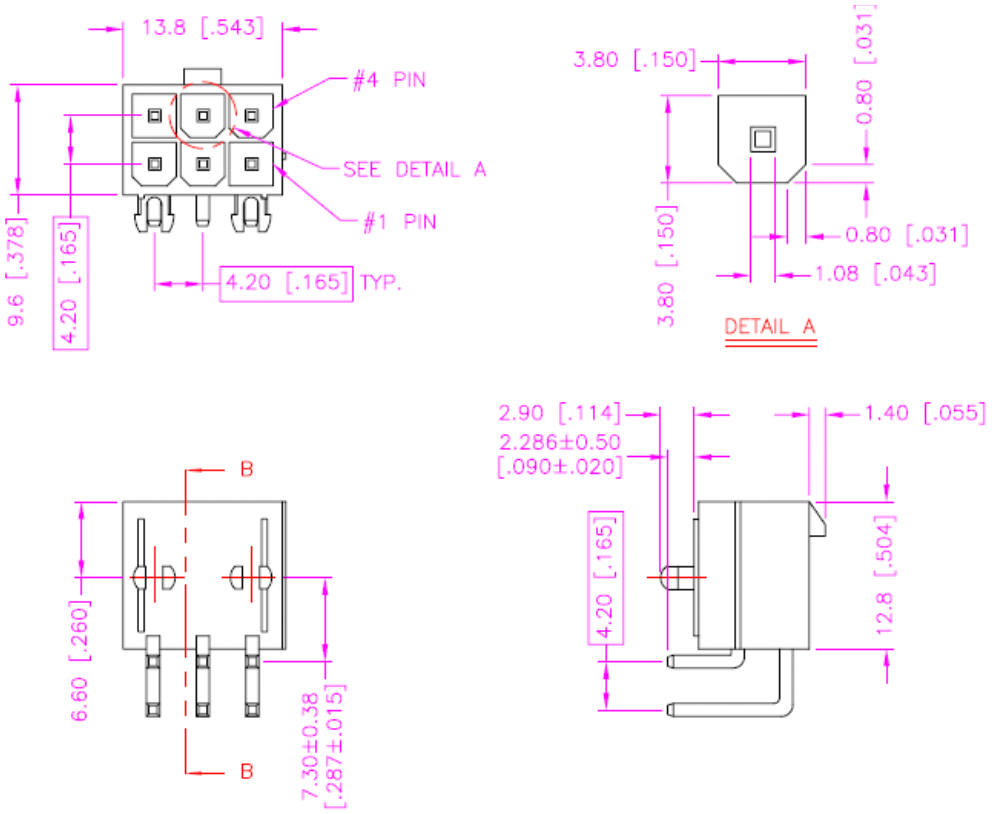


Figure 7. Auxiliary 6-Pin Power Connector

Table 5. Auxiliary 6-Pin Power Connector Pinout

| Pin Number | Description |
|---|---|
| 1 | +12 V |
| 2 | +12 V |
| 3 | +12 V |
| 4 | GND |
| 5 | No connection |
| 6 | GND |

## SDI, SLI and 3D Stereo Connector Placement

Figure 8 shows the connector hook ups for the SDI, SLI, and 3D stereo on the Quadro K4200 graphics board.

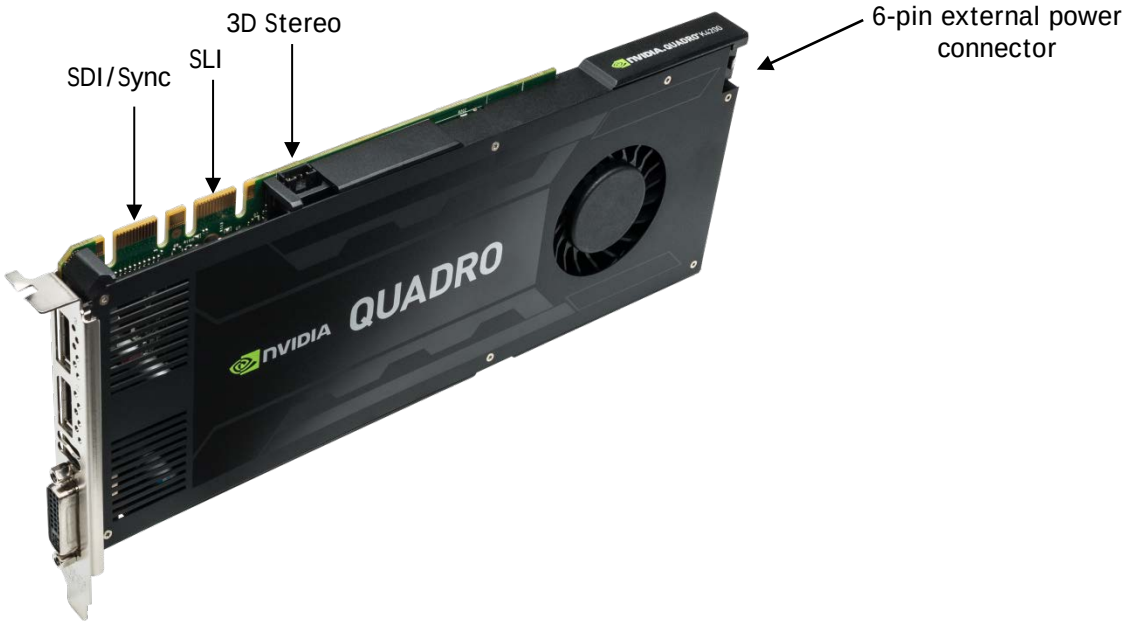


Figure 8. SDI, SLI, and 3D Stereo Connection

# EXTENDERS

The Quadro K4200 graphics board provides one extender option as shown in Figure 9.

- NVPN: 320-0503-000 – Short Straight Extender (Figure 9)
  - Card + Extender = 12.283 inches (312 mm) full length
- NVPN: 320-0501-000 – Long Extender with Offset (Figure 10)
  - Card + Extender = 13.34 inches (338.96 mm) full length

Figure 9. Short Straight Extender

Figure 10. Long Extender with Offset

# HDCP SUPPORT

Support for high definition content protection (HDCP) comes integrated in the GPU used on the Quadro K4200 graphics board.

The full HDCP specification is available upon request.

# POWER SPECIFICATIONS

The Quadro K4200 graphics board is a performance optimized high-end board solution. Power is taken from the PCI Express host bus as well as a 6-pin auxiliary power connector.

Without auxiliary power provided to the Quadro K4200 graphics board, a message will appear on the display asking the user to power down the system and reboot after plugging in the auxiliary power cable.

Table 6 outlines the different possible scenarios as well as the resulting behaviors.

Table 6. Configuration with External Power Connector

| 6-Pin Power Connector | Result |
|---|---|
| Connected | Full power – |
| Not connected | Message on display will alert the user to connect the auxiliary power cable. |

## POWER BY RAIL

Table 7 lists the power by rail numbers for the Quadro K4200 graphics board. Table 8 lists the average and peak current specifications.

Table 7. Power by Rail

| TDP Application | PEX12V | PEX3V3 | EXT12V | Total Board Power |
|---|---|---|---|---|
| 3DMark 11 | 44 W | 4.9 W | 58.8 W | 108 W |

Table 8. Average and Peak Current Specifications

| Current | PEX 12V | 6-Pin Auxiliary 12V | Time Scale |
|---|---|---|---|
| Average current[1] | 3.7 A | 5.1 A | 1 s |
| Average power | 44.0 W | 58.8 W | 1 s |
| Peak current[2] | 5.6 A | 7.7 A | 1 ms |

**Notes:**

[1] The average current values provided in Table 8 are an average of measurements, each taken over a one second time scale. These are values based on characterization data using the TDP application under TDP test conditions.

[2] The peak current values provided in Table 8 are characterized over a 1 ms time scale, with 5-sigma confidence. These are values based on characterization data using the TDP application under TDP test conditions.

Peak current values may be higher with applications that consume more power than the TDP application.

# ENERGY STAR REPORT

Table 9 lists the energy star report for the Quadro K4200 graphics board.

## Table 9. Energy Star Report

| Specification | Description |
|---|---|
| Brand | Quadro K4200 |
| GPU | GK104-850 |
| Board | P2004 |
| SKU | 503 |
| Clocks | •771 MHz (core)<br>•2700 MHz (memory) |
| Frame buffer | 256-bit |
| Memory | GDDR5 SGRAM |
| PEX | ×16 |
| Idle power: ASPM OFF | 15.5 W |
| Maximum power: ASPM OFF | 80.7 W |
| Maximum idle ratio: ASPM OFF | 5:1 |

# THERMAL SPECIFICATIONS

## THERMAL QUALIFICATION SUMMARY

The information contained in this summary report is intended to provide users of the Quadro K4200 graphics processor with thermal information necessary to assist in thermal management efforts. This information is not intended to provide a specific thermal management solution. However, it does show an approach that result in the reliable operation of the Quadro K4200 GPU.

The product and cooling solutions used are:

- Device product: Quadro K4200 graphics board.
- Cooling solution: Active fan sink solution (designed by NVIDIA, supplied by Cooler Master), NV P/N: 580-52004-0503-000. The cooling solution assembly includes a heat sink, fan, baseplate, thermal grease interface material and screws. Full specification available upon request.
- Result: Under the operating conditions described in the following tables, the Quadro K4200 passed thermal qualification.

## Table 10. Test Setup and Configuration

| System Part | Description |
|---|---|
| PC | Open chassis |
| Motherboard | Z68 |
| Motherboard processor | Intel Core i7-2600K, 3.4 GHz |
| Motherboard memory | 6 GB, DDR3, 1600 MHz |
| PC operating system | Windows 7, 64-bit |
| Graphics board | P2004 SKU 503 |
| BIOS | 80.04.F1.00.00 |
| Display driver | 334.75 |
| GPU | GK104-850 |
| Clock speeds | •771 MHz (core)<br>•2700 MHz (memory) |

## Table 11. Thermal Results

| Test Application (3DMark-11) | Temperature (°C) |
|---|---|
| GPU temperature (measured) | 96.8 |
| GPU slowdown temperature (maximum $T_j$) | 98 |
| GPU shutdown temperature ($T_j$) | 103 |
| Maximum fan inlet temperature | 55 |

# COOLING SOLUTION

NVIDIA has designed an active fan sink (Figure 11) to cool the GPU, memories and power components. For fan specifications refer to Table 12 and for board environmental conditions refer to Table 13.

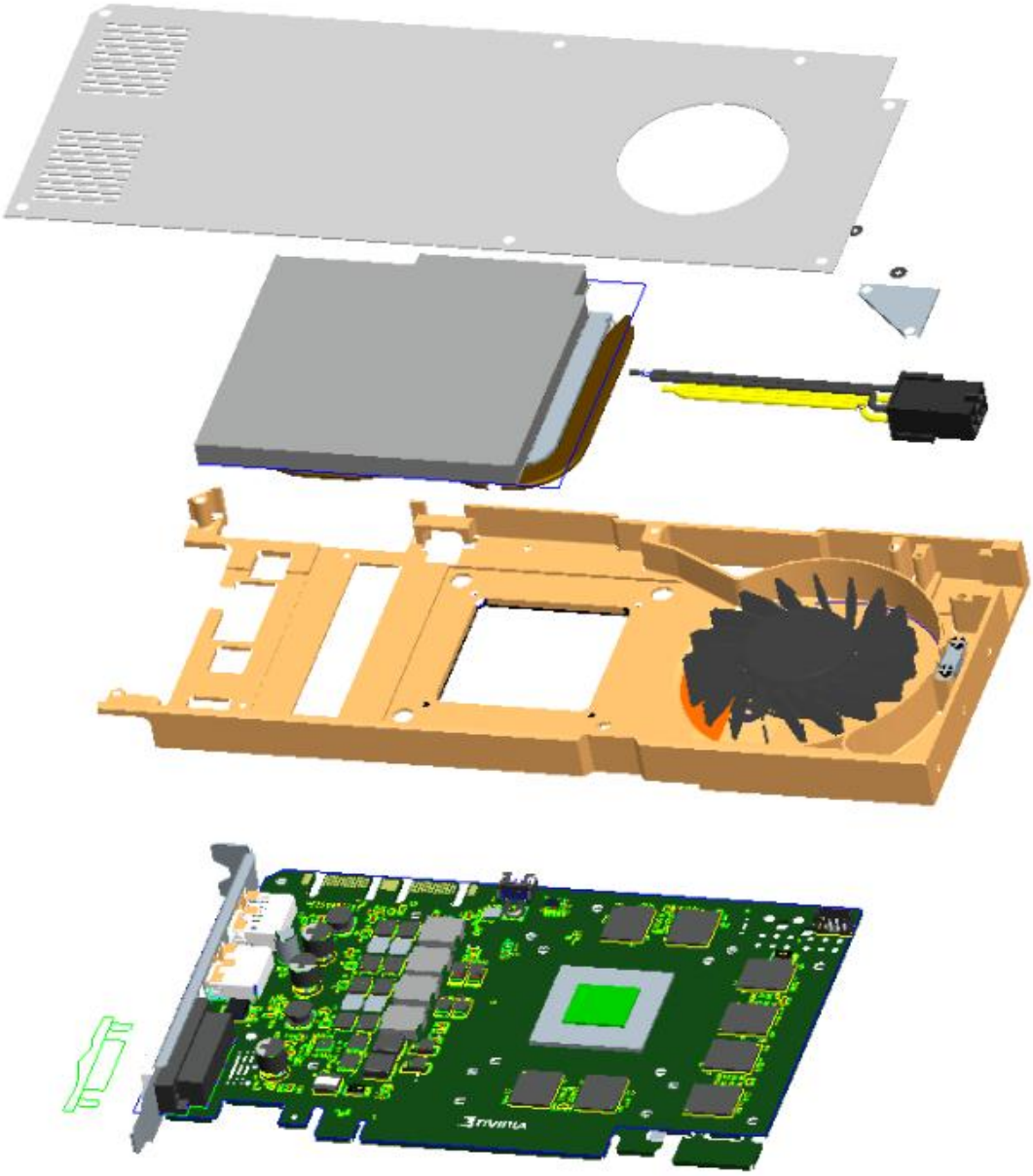

Figure 11. Active Fan Sink

Table 12. Fan Specifications

| Specifications | Conditions |
|---|---|
| Rated voltage | 12.0 V D.C. |
| Operating voltage | 7.0 V to 13.2 V D.C. |
| Rated Current | 0.33 Amp |
| Rated Power | 3.96 W |
| Speed | 5500 RPM ± 10% |
| Fan life expectancy | 50,000 hours continuously at 55 °C 15% to 65% relative humidity |

## Table 13. Board Environmental Conditions

| Specifications | Conditions |
|---|---|
| Operating temperature | 0 °C to 55 °C |
| Storage temperature | -40 °C to 75 °C |
| Operating humidity | 5% to 90% relative humidity |
| Storage humidity | 5% to 95% relative humidity |

# SUPPORT INFORMATION

## CERTIFICATES AND AGENCIES

### Certifications

- Windows Hardware Quality Lab (WHQL):
  - Certified Windows 7 and Windows 8
- Ergonomic requirements for office work W/VDTs (ISO 9241)
- EU Reduction of Hazardous Substances (EU RoHS)
- Joint Industry guide (J-STD) / Registration, Evaluation, Authorization, and Restriction of Chemical Substance (EU) – (JIG / REACH)
- Halogen Free (HF)

### Agencies

- Australian Communications Authority and Radio Spectrum Management Group of New Zealand (C-Tick)
- Bureau of Standards, Metrology, and Inspection (BSMI)
- Conformité Européenne (CE)
- Federal Communications Commission (FCC)
- Industry Canada - Interference-Causing Equipment Standard (ICES)
- Korean Communications Commission (KCC)
- Underwriters Laboratories (cUL, UL)
- Voluntary Control Council for Interference (VCCI)

# LANGUAGES

## Table 14. Languages Supported

| | Windows 7 | Windows 8 | Linux |
|---|---|---|---|
| English (U.S.) | Yes | Yes | Yes |
| English (U.K.) | Yes | Yes | Yes |
| Arabic | Yes | Yes | |
| Chinese, Simplified | Yes | Yes | |
| Chinese, Traditional | Yes | Yes | |
| Czech | Yes | Yes | |
| Danish | Yes | Yes | |
| Dutch | Yes | Yes | |
| Finnish | Yes | Yes | |
| French | Yes | Yes | |
| German | Yes | Yes | |
| Greek | Yes | Yes | |
| Hebrew | Yes | Yes | |
| Hungarian | Yes | Yes | |
| Italian | Yes | Yes | |
| Japanese | Yes | Yes | |
| Korean | Yes | Yes | |
| Norwegian | Yes | Yes | |
| Polish | Yes | Yes | |
| Portuguese (Brazil) | Yes | Yes | |
| Portuguese (European/Iberian) | Yes | Yes | |
| Russian | Yes | Yes | |
| Slovak | Yes | Yes | |
| Slovenian | Yes | Yes | |
| Spanish | Yes | Yes | |
| Spanish (Latin America) | Yes | Yes | |
| Swedish | Yes | Yes | |
| Thai | Yes | Yes | |
| Turkish | Yes | Yes | |

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