QUANSER
INNOVATE. EDUCATE.

PERIPHERALS TO ACCELERATE CONTROL SYSTEM DESIGN AND IMPLEMENTATION

Discover the Power of New Control Hardware for Engineering Education and Research

Specialists in optimization of control solutions that aid system development processes, Quanser offers a collection of control hardware components that are fully compatible with the education or research system. These control peripherals interface with the physical plant and control software to accelerate control system design and implementation for engineering labs worldwide.

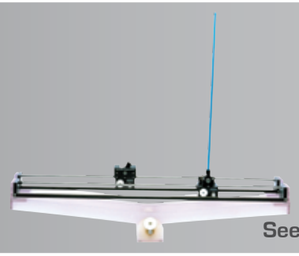
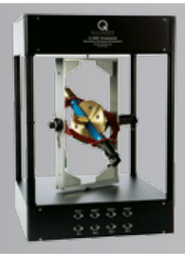
Modular connectors allow you to switch from one plant to another effortlessly. Whether you are using a Quanser plant, deploying an embedded system or exploring Hardware-In-The-Loop applications, you can find the best configuration for your needs within this range of peripherals. Read on to learn more about the technical capabilities of cutting-edge amplifiers and data acquisition boards from Quanser.

Quanser's turn-key solutions for engineering labs come complete with all of the components and peripherals you need; the experiment, amplifier, data acquisition boards and control software are supplied with purchase. You receive a versatile, robust, optimized and integrated workstation that offers peace of mind and maximum efficiency.

MIX AND MATCH COMPONENTS AND PERIPHERALS TO SUIT ANY EDUCATIONAL OR RESEARCH NEEDS

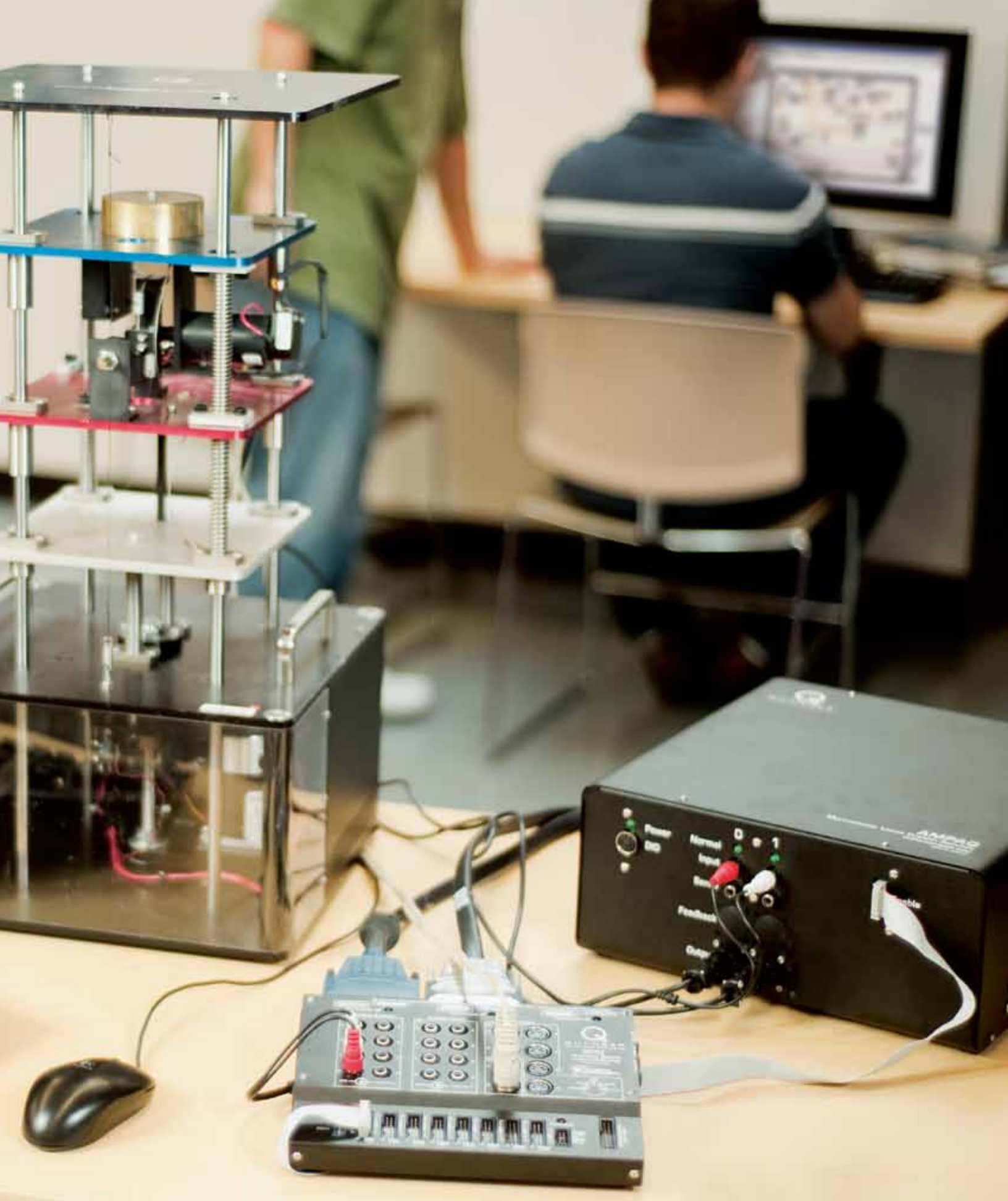
Quanser's modular range of control hardware allows you to use the same peripherals to control a wide variety of mechatronic experiments. The experiments are open-architecture and compatible with LabVIEW™ and MATLAB®/Simulink® to ensure we can conveniently support your unique requirements. Industry-relevant curriculum is included with many cutting-edge workstations that are strategically designed to help teach introductory, intermediate and advanced controls to students in Electrical, Mechanical, Mechatronics, Robotics, Aerospace, Civil and various other engineering disciplines. Several examples of workstations are presented here. Please note that the recommended Data Acquisition Boards shown in this diagram can be replaced by other boards to achieve the desired performance level.

Please contact us at info@quanser.com to discuss your needs.

	PLANTS	AMPLIFIERS	DATA AQUISITION BOARDS	LAB TOOLS	SOFTWARE
INTRODUCTORY	 Rotary Base Unit	 VoltPAQ-X1	 Q2-USB	 CONTROLLER & CURRICULUM*	 OR
INTERMEDIATE	 Seesaw Pendulum	 VoltPAQ-X2	 Q8-USB	 CONTROLLER & CURRICULUM*	
ADVANCED	 3 DOF Hover	 VoltPAQ-X4	QPIDe  QPIDe Terminal Board	 CONTROLLER	 OR
RESEARCH	 3 DOF Gyroscope	 AMPAQ-L4	QPIDe  QPIDe Terminal Board	 CONTROLLER	

Technical specifications of products and systems referred to herein are subject to change without notice. The systems are not pictured to scale. MATLAB® and Simulink® are registered trademarks of The MathWorks, Inc. LabVIEW™ is a trademark of the National Instruments.

* Instructor and student workbooks are supplied only in electronic format on CD.



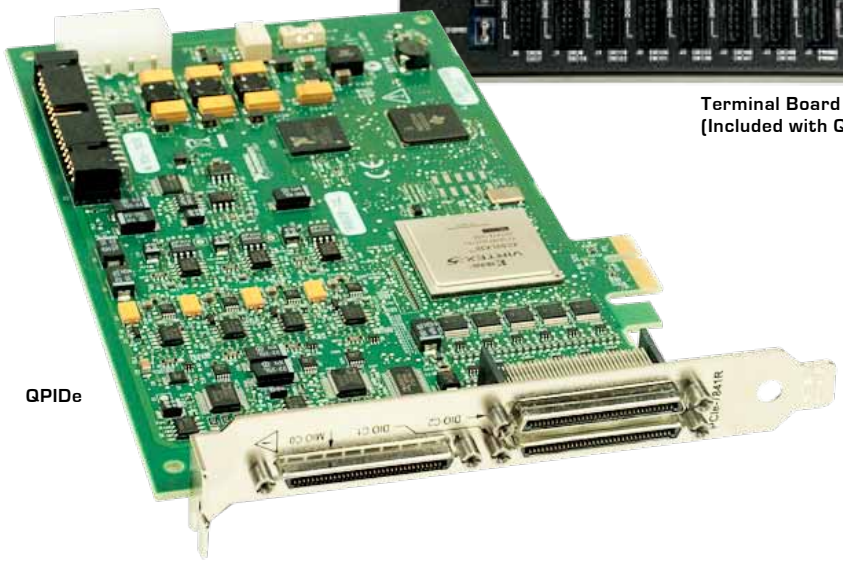
Pictured above: Active Suspension, QPID Terminal Board, AMPAQ-L2

TECHNICAL OVERVIEW:

DATA ACQUISITION BOARDS

QPID

Terminal Board
(Included with QPID and QPIDe)



QPIDe

QPID AND QPIDe ARE VERSATILE REAL-TIME MEASUREMENT CONTROL PCI AND PCI EXPRESS BOARDS

We recognize that researchers may need a precise, reliable way to process larger amounts of data. Quanser's new QPID and QPIDe Hardware-in-the-Loop (HIL) control boards are designed to do just that. These PCI/PCIe-based data acquisition boards are ideal for rapid control prototyping and deliver superior real-time performance for your workstation. QPID and QPIDe originated from National Instruments' RIO technology and are compatible with both LabVIEW™ and MATLAB® to give you easy and quick access to signals.

QPIDe is based on the PCI Express technology for data acquisition applications that require bandwidth to ensure data can be transferred to memory fast enough. With ultra-low I/O conversion times and simultaneous sampling of each I/O type, the QPID and QPIDe are suitable for complex controls configurations for research and teaching controls concepts. For example, in order to teach controls or conduct research in areas like Aerospace or Haptics (e.g. using Quanser High Definition Haptic Device), a more dependable real-time platform can be achieved by pairing QPID or QPIDe with a Quanser Power Amplifier (see page 12 or 14) and QUARC® control design software.

With the QPID/QPIDe's wide range of inputs and outputs, you can easily connect and control a variety of devices instrumented with analog and digital sensors, including quadrature encoders – all with one board! The QPID and QPIDe are supported by a QUARC Simulink® Blockset along with APIs for C, C++, ActiveX, .NET, LabVIEW™ and MATLAB®.

Request a free 30-day demo license of QUARC control design software. Visit www.quanser.com/QUARC

SYSTEM SPECIFICATIONS: QPID and QPIDe

FEATURES

- Optimized for real-time control performance with proven real-time targets or custom code
- PCI (QPID) and PCIe (QPIDe) versions available
- No expensive or inflexible DSP used, all processing via CPU
- Quick-connect terminal board and cabling provided
- Robust metal terminal board case
- Programmable counters and watchdog timer for maximum safety and flexibility
- Hardware-measured encoder velocities
- Simultaneous sampling of ADCs, PWM channels, encoders and 32-bit groups of digital inputs
- Simultaneous update of 32-bit groups of digital outputs, and pairs of Data Aquisition Boards
- Fuse-protected terminal board with LED status
- Fuse monitoring with watchdog and interrupt capability
- Multi-board synchronization
- External ADC triggering support
- Multiple OS compatibility: Windows® XP, Windows® Vista, Windows® 7
- Interrupt triggering from 8 digital inputs, encoder index pulses, configurable thresholds on 4 analog inputs, PWM period, watchdog expiry, fuse stake, RTSI trigger, and 1 dedicated external inturrupt input

SYSTEM REQUIREMENTS

QPID
- PCI Slot x1 (board is 0.17 m x 0.11 m)

QPIDe
- PCIe x1 Slot (board is 0.17 m x 0.11 m)
- Standard ATX peripheral power connector

I/O SUMMARY

QPID
- 8 ADCs
- 8 DACs
- 8 encoder inputs with 1X velocities
- 8 PWM
- 56 DIO
- SPI

QPIDe
- 8 ADCs
- 8 DACs
- 8 encoder inputs with 4X velocities
- 8 PWM
- 56 DIO
- SPI

ANALOG INPUTS

Number of Channels	8 differential (single ended with terminal board)
Resolution	16-bit
Input Range	± 10V
Conversion Time	4 µs

ANALOG OUTPUTS

Number of Channels	8
Resolution	16-bit
Slew Rate	10 V / µs
Output Range	± 10V
Conversion Time	1.0 µs
(All 8 channels simultaneous)	

FEATURES
- Known state on power-up or reset
- Configurable state on watchdog expiry
- Configurable as bipolar PWM

ENCODER INPUT COUNTERS

Number of Channels	8
Max. A and B Frequency in Quadrature	24
Max. A and B Frequency in Quadrature with Filtering	10 MHz
Max. Count Frequency in 4X Quadrature	5 MHz
Max. Count Frequency in 4X Quadrature with Filtering	40 MHz
Max. Count Frequency in Non-quadrature	20 MHz

FEATURES
- Simultaneous Sampling
- QPID: Hardware 1X quadrature velocities single-ended inputs
- QPIDe: Hardware 4X quadrature velocities single-ended inputs
- Non quadrature (count/direction) and 4X quadrature modes
- Individually programmable count and index modes, and filter clocks

DIGITAL I/O

Number of lines	56

FEATURES
- Known state on power-up or reset
- Individually software programmable
- Configurable state on watchdog expiry

GENERAL PURPOSE COUNTER-TIMERS

Number of 16-bit counter-timers	2
Timer Resolution	800 ns
Number of 32-bit counter-timers	2
Timer Resolution	25 ns

FEATURES
- One counter configurable as watchdog timer
- Trigger ADC conversions
- Special pin outputs
- Software enabling/disabling

WATCHDOG TIMERS

FEATURES
- Software enabling/disabling
- Configurable control of analog, PWM, and digital output states

PWM OUTPUTS

User-programmable PWM outputs	8

FEATURES
- Leading, centered, or trailing edge alignment
- Duty cycle, frequency, period, one-shot, and time modes
- Polarity control
- Unipolar, bipolar, paired and complementary configurations with deadband controls
- Configurable state on watchdog expiry

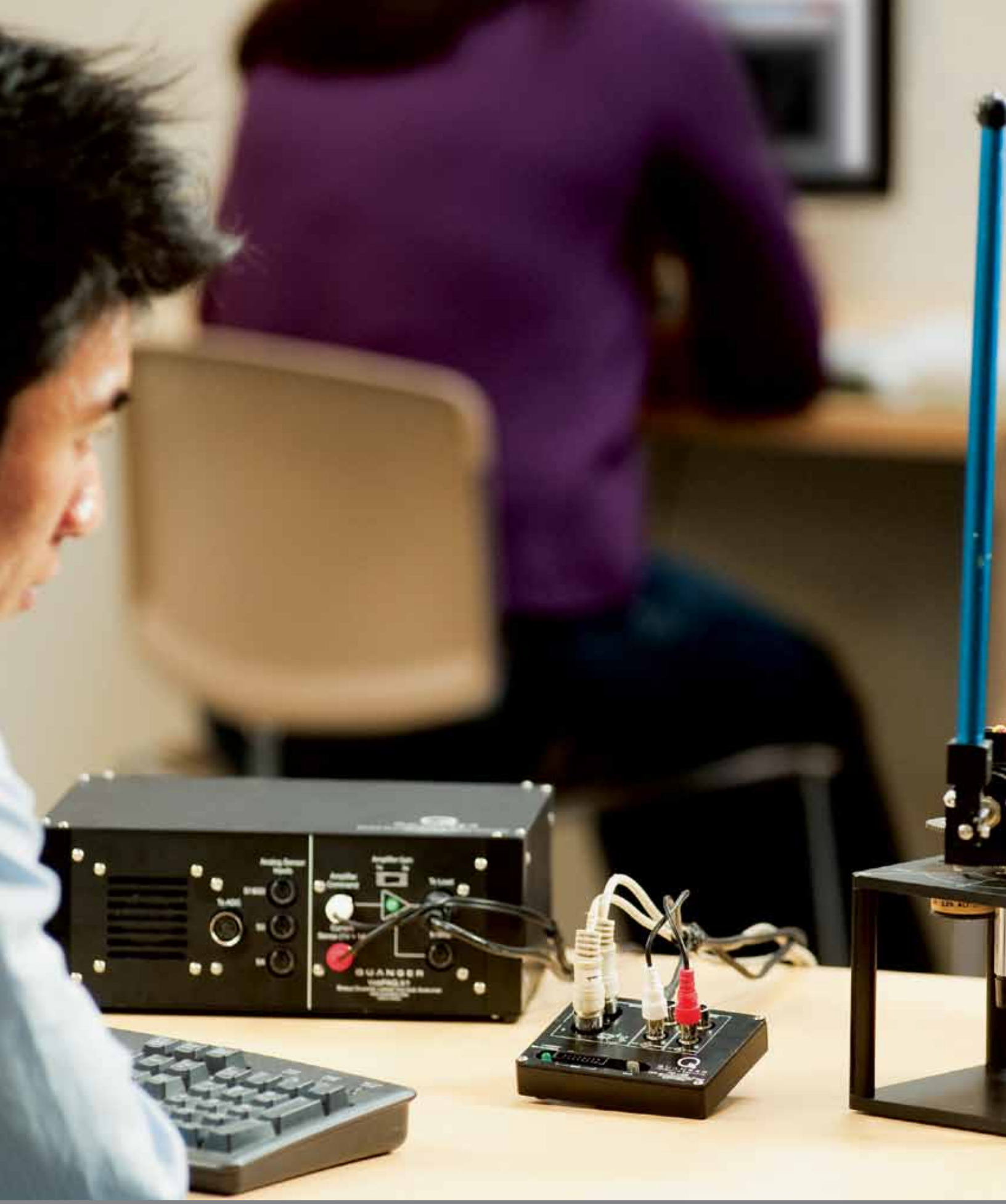
SPI

Data Rate	Up to 10 MHz

FEATURES
- Configurable polarity and phase
- Configurable bit width between 1 and 32 bits
- Integrated into the Stream API

SOFTWARE SUPPORT

TARGET SUPPORT	• Quanser QUARC® for Windows® • National Instruments LabVIEW™
OS DRIVERS	• Microsoft Windows® XP • Windows® Vista • Windows® 7
API	• C • C++ • ActiveX • .NET (VB, C#, C++ and others) • LabVIEW™ • MATLAB®



Pictured above: Rotary Inverted Pendulum, VoltPAQ-X1, Q2-USB

TECHNICAL OVERVIEW:

USB DATA ACQUISITION BOARDS

Q8-USB

Q2-USB

Q2-USB AND Q8-USB PROVIDE A PORTABLE AND AFFORDABLE OPTION FOR REAL-TIME MEASUREMENT AND CONTROL

Quanser's ground-breaking USB data acquisition technology delivers reliable real-time performance via a USB interface. Q2-USB and Q8-USB are combined with a terminal board for easy and quick access to signals. They include an extensive range of hardware features and software support capabilities and are compatible with both MATLAB® and LabVIEW™.

With low I/O conversion times and easy connectivity, the Q2-USB and Q8-USB are ideal for teaching controls concepts as the user can achieve up to a 2 kHz close-loop control rate. This control rate is superior to any other commercially available USB-DAQ technology.

When combined with a Quanser Power Amplifier (see pages 12 and 14) and QUARC® control design software, the Q2-USB or Q8-USB provides a convenient rapid prototyping and Hardware-In-The-Loop (HIL) development environment. With the wide range of inputs and outputs, you can easily connect and control a variety of devices instrumented with analog and digital sensors, including encoders – all with one board. The Q2-USB and Q8-USB are supported by the Quanser HIL SDK, which provides APIs for C, C++, ActiveX, .NET, LabVIEW™ and MATLAB®.

Request a free 30-day demo license of QUARC control design software. Visit www.quanser.com/QUARC

SYSTEM SPECIFICATIONS: Q8-USB AND Q2-USB

FEATURES

- Optimized for real-time control performance with QUARC or custom code
- USB 2.0 Hi-Speed Interface
- Combined with quick-connect terminal board
- Robust metal terminal board case
- Multiple OS compatibility: Windows® XP, Windows® Vista, Windows® 7
- 1X encoder velocities are provided in Q8-USB
- Multiple Q8-USB or Q2-USB can be used simultaneously
- Interrupt support is provided in Q8-USB for the encoder index pulses, external interrupt and external convert lines

SYSTEM REQUIREMENTS

Q2-USB
- Type A USB 2.0 connector (USB 2.0 driver is required)

Q8-USB
- Type A USB 2.0 connector (USB 2.0 driver is required)

DIMENSIONS

Q2-USB
0.085 x 0.102 x 0.018 m

Q8-USB
0.228 x 0.168 x 0.26 m

I/O SUMMARY

Q2-USB
- 2 ADCs
- 2 DACs
- 2 encoder inputs with full-quadrature positions
- 2 PWM
- 8 configurable DIO

Q8-USB
- 8 ADCs
- 8 DACs
- 8 encoder inputs with 4X quadrature position and 1X quadrature velocities
- 8 PWM
- 8 digital input
- 8 digital output

ANALOG INPUTS

	Q2-USB	Q8-USB
Number of Channels	2	8
Resolution	12-bit	16-bit
Input Range	± 10 V	± 5 V, ± 10 V
Conversion Time	250 ns†	4 us†
Input Impedance	10 MΩ	1 MΩ
Max Full Scale Range (FSR) Error	± 10 LSB	± 12 LSB, ± 6 LSB

ANALOG OUTPUTS

	Q2-USB	Q8-USB
Number of Channels	2	8
Resolution	12-bit	16-bit
Output Range	± 10 V	± 10.8 V, ± 10 V, ± 5 V, 10.8 V 10 V, 5 V.
Slew Rate	3.5 V / µs	3.5 V / µs
Conversion Time	10 µs†	10 µs†
DC Output Impedance	0.5 Ω	0.5 Ω
Short-circuit Current Clamp	20 mA	20 mA
Max Capacitive Load Stability	4000 pF	4000 pF
Non-linearity	± 1 LSB	± 1 LSB
Max Full Scale Range (FSR) Error	± 12 LSB	± 65 LSB
Max Load for Specified Performance	2 kΩ	2 kΩ

† The effective conversion time will be limited by USB communications at a 125 µs clock rate

ENCODER INPUT

	Q2-USB	Q8-USB
Number of Encoder Inputs	2	8
Input Low	0.66 V	1.50 V
Input High	2.31 V	3.50 V
Input Leakage Current	± 2 µA	± 2 µA
Max. A and B Frequency in Quadrature	6 MHz	24.883 MHz
Max. Count Frequency in 4X Quadrature	10 MHz	99.532 MHz
Encoder Velocities	N/A	99.532 MHz

DIGITAL INPUT

	Q2-USB	Q8-USB
Number of Lines	8	8
Input Low	0.66 V	1.50 V
Input High	2.31 V	3.50 V
Input Leakage Current	± 2 µA	± 2 µA

DIGITAL OUTPUT

	Q2-USB	Q8-USB
Number of Lines	8	8
Input Low	0.40 V	0.55 V
Input High	2.40 V	4.50 V

PWM OUTPUT

	Q2-USB	Q8-USB
Number of PWM Outputs	2†	8†
Output Low (Max)	0.40 V	0.55 V
Output High (Min)	2.40 V	4.50 V
Resolution	16-bit††	16-bit††
Minimum Frequency	2.385 Hz	23.7309 Hz
Maximum Frequency	40 MHz	49.766 MHz

† Shared with the digital outputs
†† This is dependent on the frequency selected for the PWM

SOFTWARE SUPPORT

	Q2-USB	Q8-USB
TARGET SUPPORT	• Quanser QUARC® for Windows® • National Instruments LabVIEW™	• Quanser QUARC® for Windows® • National Instruments LabVIEW™
OS DRIVERS	• Microsoft Windows® XP • Windows® Vista • Windows® 7	• Microsoft Windows® XP • Windows® Vista • Windows® 7
API	• C • C++ • ActiveX • .NET (VB, C#, C++ and others) • LabVIEW™ • MATLAB®	• C • C++ • ActiveX • .NET (VB, C#, C++ and others) • LabVIEW™ • MATLAB®

Pictured above: 2 DOF Helicopter, VoltPAQ-X2, Q8-USB

TECHNICAL OVERVIEW:

LINEAR VOLTAGE-CONTROLLED POWER AMPLIFIERS

VOLTPAQ AMPLIFIERS DELIVER RELIABLE REAL-TIME PERFORMANCE FOR HARDWARE-IN-THE-LOOP IMPLEMENTATIONS

The VoltPAQ line is a new generation of Quanser's Universal Power Modules, designed to turbo-charge your experiments. Smaller, more lightweight and portable, the VoltPAQ is ideal for all complex controls configurations related to educational or research needs.

These linear voltage-controlled power amplifiers are designed to achieve high performance with Hardware-In-The-Loop (HIL) implementations. However, a dependable real-time platform can be achieved by pairing a VoltPAQ with Quanser's data acquisition board (see page 5 and 9) and QUARC® control design software. These power amplifiers can drive Quanser experiments or other motors or actuators through easy-connect terminal boards and cables.

VoltPAQs come in three varieties: X1, X2 and X4. VoltPAQ-X1 is used for single degree-of-freedom (DOF) experiments, such as Linear or Rotary Inverted Pendulum where portability and space are an advantage. VoltPAQ-X2 is ideal for 2 DOF experiments such as 2 DOF Rotary Gantry or 2 DOF Helicopter. VoltPAQ-X4 is suitable for advanced, multi-DOF experiments such as 3 DOF Hover.

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SYSTEM SPECIFICATIONS: VoltPAQs

VoltPAQ-X1

VoltPAQ-X2

VoltPAQ-X4

Did you know?
Quanser offers a terminal board accessory for National Instruments™ E-Series and M-Series data aquisiton devices.

FEATURES

- Built-in universal power supply
- Current sense output is provided per channel
- Over-heating/over-current fault indication output
- Lightweight
- VoltPAQ-X1 includes a regulated ± 12 V DC power supply at 1 A
- Easy connect system enable switching from one experiment to another quickly

VOLTPAQ TECHNICAL SPECIFICATIONS

	VoltPAQ-X1	VoltPAQ-X2	VoltPAQ-X4
Size (L × W × H)	0.25 × 0.18 × 0.1 m	0.39 × 0.33 × 0.1 m	0.39 × 0.33 × 0.1 m
Mass	1.92 kg	4.42 kg	5.44 kg
Amplifier Voltage Gain	1 or 3* V/V	3 V/V	3 V/V
Amplifier Type	Linear	Linear	Linear
Number of Outputs	1	2	4
Amplifier Maximum Continuous Voltage	24 V	24 V	24 V
Amplifier Maximum Continuous DC Current	4.16 A	4.16 per channel A	4.16 per channel A
Supply AC Voltage	100-127 or 220-240	100-127 or 220-240	100-127 or 220-240
Continuous Output Power	100 W	200 W	400 W
Output Impedance	0.5-1.6 Ω	0.5-1.6 Ω per channel	0.5-1.6 Ω per channel
Number of Analog Input	4	0**	0**
Analog Input Range	±10 V	± 10 V per channel (Using the Analog Signal Adapter)**	± 10 V per channel (Using the Analog Signal Adapter)**

*The gain is selected by the gain toggle switch on the front panel

**When a plant has analog sensors, a Quanser Analog Signal Adapter is required. It is a standalone device designed to interface with analog sensors. Please note that the Analog Signal Adapter is sold separately.

Pictured above: Active Suspension, QPID Terminal Board, AMPAQ-L2

TECHNICAL OVERVIEW:
LINEAR CURRENT AMPLIFIERS

AMPAQ AMPLIFIERS ARE IDEAL FOR MECHATRONIC SYSTEMS REQUIRING RESPONSIVE CURRENT CONTROL

Precise current control is crucial in the performance of advanced mehcatornics systems such as Haptics or Robotics platforms. You can rely on the AMPAQ, a linear current amplifier system designed to drive the actuators of various Quanser experiments where a responsive current control is required. AMPAQ not only turbo-charges your experiments, it is a linear amplifier that eliminates deadband and reduces noise common to PWM amplifiers.

AMPAQs come in two varieties: L2 and L4. AMPAQ-L2 includes two analog outputs while AMPAQ-L4 includes four analog outputs. These amplifiers are ideal for all complex controls configurations often used for teaching and research. For example, in order to teach mechatronic controls with Quanser's 3 DOF Gyroscope, a dependable real-time platform can be achieved by pairing an AMPAQ with a Quanser's data acquisition board (see page 5 and 9) and QUARC® control design software. The AMPAQ is fully integrated with Quanser experiments, but can also be used to drive other motors or actuators. Connectivity is convenient with the easy-connect interface and cables.

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SYSTEM SPECIFICATIONS: AMPAQs

AMPAQ-L2

AMPAQ-L4

FEATURES

- Built-in universal power supply
- Current sense output is provided per channel
- Over-heating/over-current fault indication output
- Lightweight
- Easy connect system enable switching from one experiment to another quickly
- 8 Channel Digital I/O available at the "Enable" port

AMPAQ TECHNICAL SPECIFICATIONS

	AMPAQ-L2	AMPAQ-L4
Size (L × W × H)	0.30 × 0.3 × 0.14 m	0.30 × 0.3 × 0.14 m
Mass	5.1 kg	6.8 kg
Command (Input) Voltage Range	± 10 V	± 10 V
Amplifier Type (i.e. Linear or PWM)	Linear	Linear
Number of Outputs	2	4
Amplifier Maximum Continuous Current per Channel	3.5 A	3.5 A
Amplifier Peak Power	189 W	378 W
Amplifier Maximum Continuous Voltage	27 V	27 V
Supply AC Voltage	110 or 220-240 V	110 or 220-240 V
Bandwidth in Current Mode	10 kHz	10 kHz
Output Impedance	<3.2 Ω	<3.2 Ω
Current-Voltage Gain	0.5 A/V	0.5 A/V

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CONSIDER QUANSER YOUR PARTNER FOR EDUCATION AND RESEARCH

For over two decades Quanser continues to be one of the few companies solely dedicated to the development of systems and solutions for advanced control education and research. Over 2,500 universities and colleges around the world have Quanser solutions today.

Quanser develops complete workstations for your engineering labs to captivate undergraduate and graduate students, motivate them to study further and become future innovators. You can trust these workstations will be reliable, robust and built to perform. Choose from a variety of mechatronics experiments and control design tools appropriate for advanced research as well as teaching at all levels. Our engineering expertise includes mechatronics, electronics, software development and control system design. Lab equipment and curriculum are developed by enthusiastic engineers who hold Masters and PHD designations. As your teaching or research needs evolve over time, you can rely on Quanser's engineers for ongoing support in years to come.

Learn more at www.quanser.com or contact us at info@quanser.com

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Rev 1