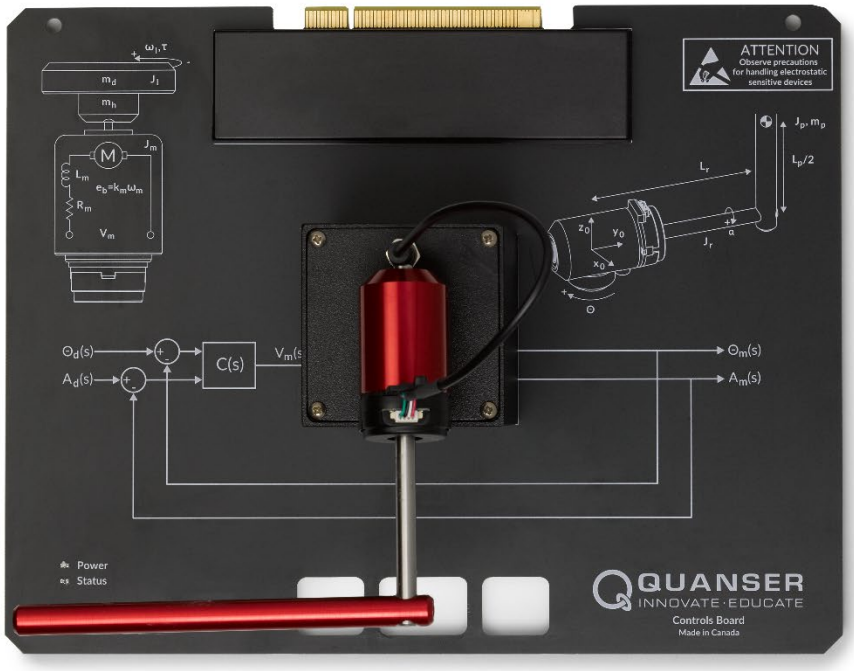
User Manual

Quanser Controls Board for NI ELVIS III



Setup and Configuration

Printed in Markham, Ontario.

Safety Information

The following symbols and definitions are interchangeably used throughout the User Manual:

Symbol	Description
	Caution: consult documentation for additional information
	Attention: Observe precautions for handling electrostatic sensitive devices

The Quanser Controls Board

The Quanser Controls board, pictured in Figure 1 is a complete platform for investigating almost all aspects of modern control theory from system modeling and PID control to stability and digital control design. The system consists of a deterministic DC motor with a high-resolution encoder, as well as a pendulum attachment for balance control. Complete courseware and software is provided for a large compliment of typical control challenges.

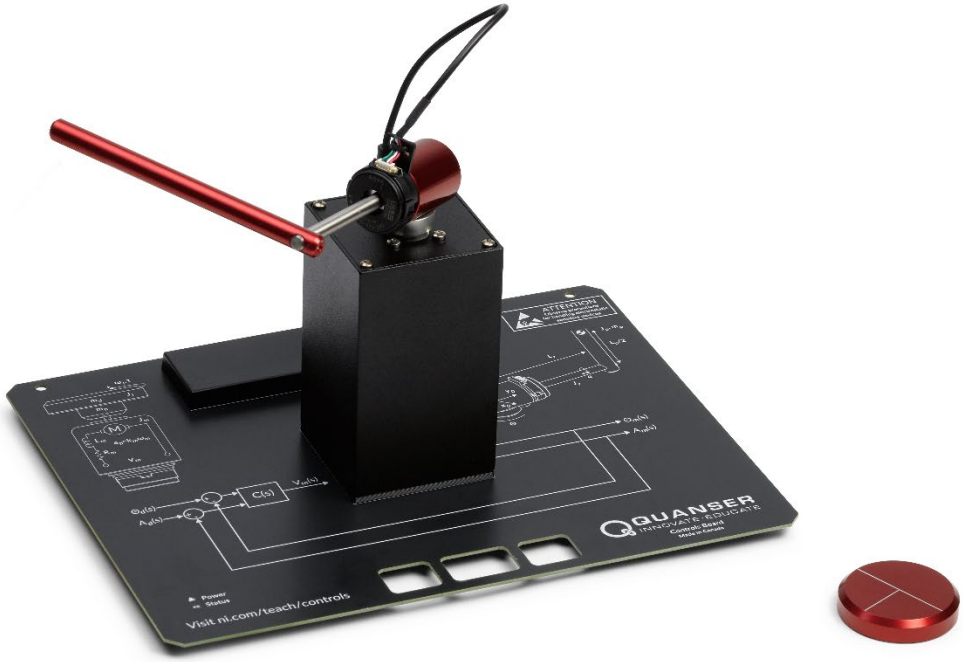


Figure 1: The Quanser Controls board

Main Features

- Direct-drive brushed DC motor
- 512 count encoder mounted on the motor (giving 2048 count granularity with quadrature decoding), and on the pendulum arm
- Built in deterministic PWM amplifier mapped to theoretical motor models
- DC motor current sense

Caution

This equipment is designed to be used for educational and research purposes and is not intended for use by the general public. The user is responsible to ensure that the equipment will be used by technically qualified personnel only.

System Hardware Components

The major components of the application board are identified in Figure 3.

Table 1: Application board hardware components

ID	Component	ID	Component
1	Inertia Load	4	PCI Connector for interfacing with NI ELVIS III
2	DC motor and encoder	5	Pendulum encoder (optional)
3	Pendulum encoder connector	6	Pendulum encoder data cable (optional)

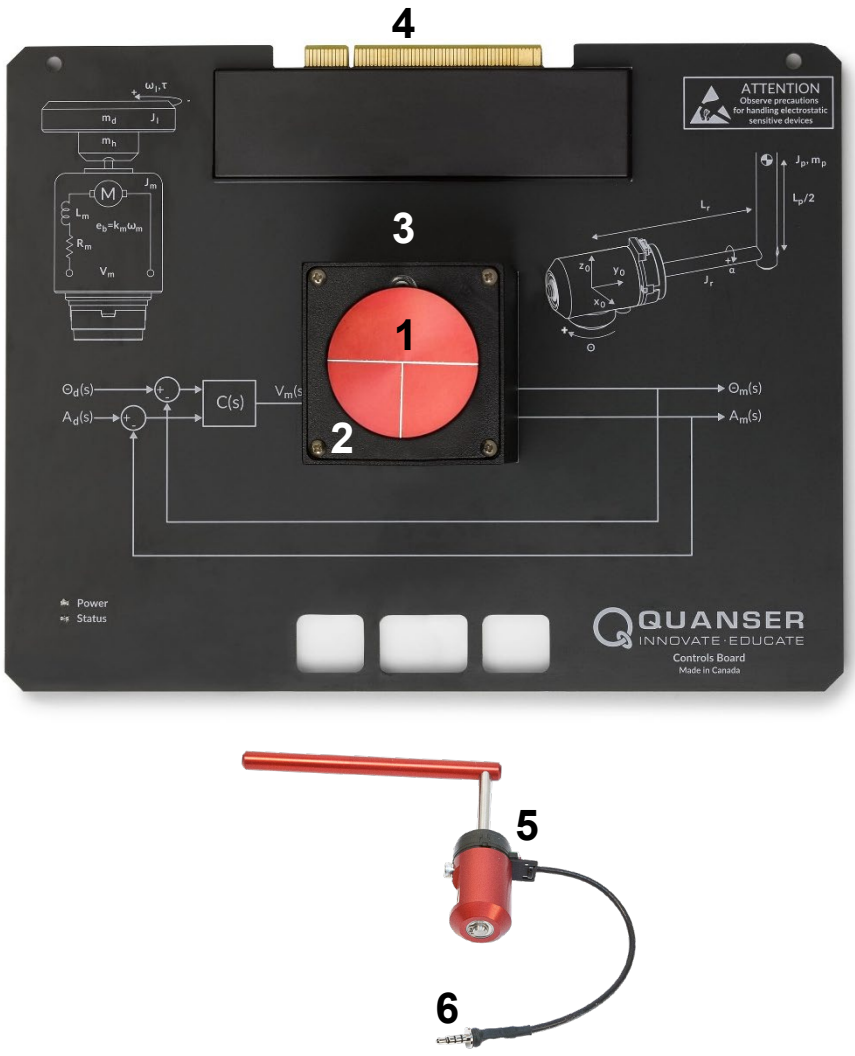


Figure 3: Quanser mechatronic systems board components

DC Motor

The application board includes a direct-drive brushed DC motors to drive either the inertia load or pendulum arm. The motor specifications are given in Table 2.

The included motor is a Premotec CL40 Series Coreless DC Motors. The complete specification sheet for the motor is available from Allied Motion.

Caution Exposed moving parts.

Encoder

The encoders used to measure the angular position of the motor and pendulum are single-ended, optical shaft encoders. They output 2048 counts per revolution in quadrature mode (512 lines per revolution).

The included encoders are the US Digital E8P-512-118 single-ended optical shaft encoder. The complete specification sheet of the encoders is available from US Digital.

Environmental

The QNET Mechatronic Systems is designed to function under the following environmental conditions:

- Standard rating
- Indoor use only
- Temperature 5◦C to 40◦C
- Altitude up to 2000 m
- Maximum relative humidity of 80% up to 31◦C decreasing linearly to 50% relative humidity at 40◦C
- Pollution Degree 2
- Maximum transient overvoltage 2500 V
- Marked degree of protection to IEC 60529: Ordinary Equipment (IPX0)

System Parameters

Table 2: Application board system parameters

Symbol	Description	Value
DC Motor		
V_{nom}	Nominal motor voltage	18.0 V
τ_{nom}	Nominal motor torque	22.0 Nmm
ω_{nom}	Nominal speed	3050 RPM
I_{nom}	Nominal current	0.540 A
R_m	Terminal resistance	8.4 Ω
k_t	Torque constant	0.042 Nm/A
k_m	Motor back-emf constant	0.042 V/(rad/s)
J_m	Rotor inertia	4.0×10^{-6} kgm^2
L_m	Rotor inductance	1.16 mH
Θ_E	Encoder count angle (in quadrature)	0.176 deg
m_h	Module attachment hub mass	0.0106 kg
r_h	Module attachment hub radius	0.0111 m
J_h	Module attachment moment of inertia	0.6×10^{-6} kg-m^2
Inertia Disc		
m_d	Disc mass	0.053 kg
r_d	Disc radius	0.0248 m
Rotary Pendulum Module (Optional)		
m_r	Rotary arm mass	0.095 kg
L_r	Rotary arm length	0.085 m
m_p	Pendulum link mass	0.024 kg
L_p	Pendulum link length	0.129 m

System Setup

The procedure to set up the Quanser Controls board on the NI ELVIS III module is detailed in this section.

Caution

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

ESD Warning

The electrical components on the Quanser Mechatronic Systems board are sensitive to electrostatic discharge (ESD). Before handling the board ensure that you have been properly grounded.

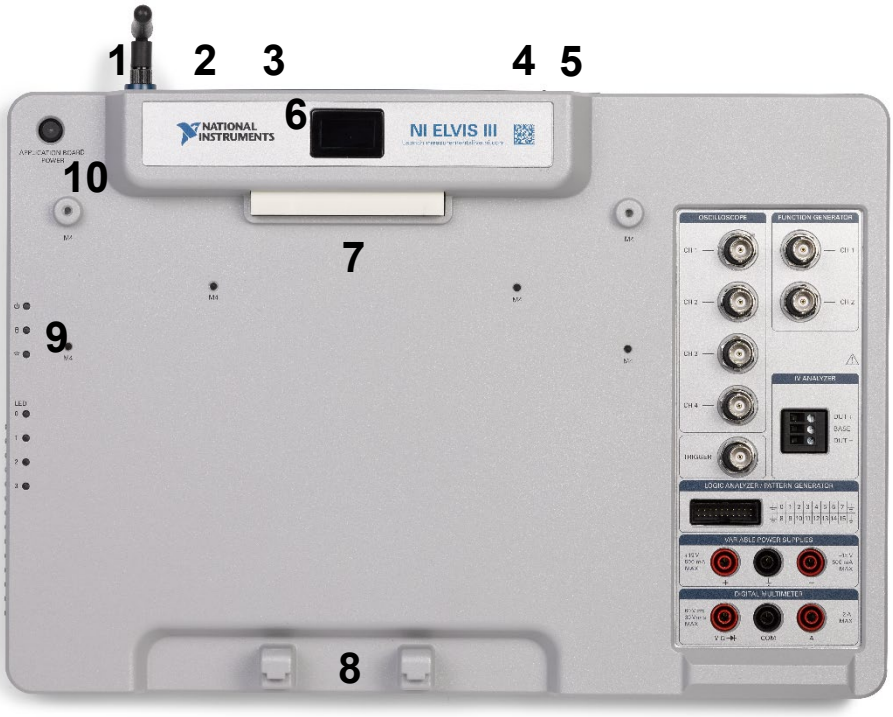


Figure 3: Components of the NI ELVIS III

ID	Component	ID	Component
1	Antenna connector	6	Connection data screen
2	Ethernet connector	7	PCI connector
3	USB C connector	8	Handle latching hooks
4	Power cable	9	Status LEDs
5	Power switch	10	Application board power button

Caution

Do NOT make the following connections while power is supplied to the application board!

Follow these instructions to setup the application board on the NI ELVIS III:

1. Power on the ELVIS III
2. Connect the ELVIS III to the network or to your computer via USB C
3. Ensure the LED on the application board power button is NOT lit
4. Position the handle of the application board over the handle latching hooks
5. Position the PCI connector on the application board so that it aligns with the PCI connector on the ELVIS III
6. Push the application board upward until the PCI connector is firmly seated
7. Press the application board power button and ensure the LED on the button is lit

Troubleshooting

Please review the following before contacting technical support.

1. Verify the board is properly seated on the ELVIS III and that it has power.
2. Verify that the ELVIS III is correctly set up as outlined in the NI product documentation.

You are getting 'VI Missing' messages

Make sure the required LabVIEW add-ons listed in the Quick-Start Guide are installed. Verify that the correct LabVIEW version is installed (The ELVIS III is only compatible with LabVIEW 2018 or later).

Board does not respond

Check that the source distribution has been deployed as outlined above.