QUANSER
INNOVATE · EDUCATE

USER MANUAL

Quanser Robotics Package for Education

Set Up and Configuration

CAPTIVATE. MOTIVATE. GRADUATE.

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1 PRESENTATION

The Quanser Robotics Package for Education is based on the 4DOF MICO Open-Architecture robotic platform from Kinova, a suitable platform for undergraduate students to learn the basic theories, practical challenges, and industrial applications of robots. MICO arm is a light-weight robotic arm composed of four inter-linked segments and a two-finger gripper or hand. Using the QUARC® open-architecture the user can control the robot in three-dimensional space, grasp or release objects with the hand, visualize the robot in a virtual environment and examine the theories behind robot control such as DH parameters, forward and inverse kinematics, trajectory planning and motion control.

Figure 1.1: The Quanser Robotics Package for Education is based on the 4DOF MICO robotic arm

The interface to the target computer is Matlab® Simulink® with QUARC®. The Quanser Robotics Package is accessible through MICO block sets available in QUARC®.

The general system description, component nomenclature, specifications, and model parameters are all given in 2. 3 goes into detail on how to setup the Quanser Robotics Package communication with the PC and contains testing and troubleshooting guide.

■ **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.

2 SYSTEM HARDWARE

Quanser Robotics Package for Education is made up of 5 main components: the 4DOF MICO robotic arm, the base holder and associated clamps, power supply, data acquisition card (DAQ) and the adapter cable for the DAQ are provided with the package.

2.1 The 4DOF MICO Robotic arm and peripherals

The main components of the Quanser Robotics Package, including the 4DOF MICO robotic arm and its cables, base holder and clamps are included in the MICO case as shown in Figure 2.1.

(a) MICO case (closed) (b) MICO case (open) (c) MICO case (lower level)

Figure 2.1: MICO case

When the MICO case is first opened (Figure 2.1b), the 4DOF MICO arm itself will be visible on the top level. Once the top level is taken out, the MICO connection cables and the robot base holder will be visible (Figure 2.1c).

The MICO base holder includes a plate, a bar and a screw as shown in Figure 2.2a. Two clamps are provided with the MICO arm in order for the user to secure the base holder to a table, once the arm is installed (Figure 2.2b). MICO control signal cable, shown in Figure 2.2c is also included in the MICO case.

(a) MICO base holder parts (b) Clamps to secure the MICO base holder to a table.) (c) MICO control signal cable

Figure 2.2: MICO arm peripherals

Figure 2.3: MICO arm power supply.

In a separate small box, you will find MICO arm power supply as shown in Figure 2.3).

2.1.1 MICO hardware assembly

To mount the MICO robotic arm to a table, first assemble the MICO base holder parts as shown in Figure 2.4a. Secure the base to the table using the clamps, and then tighten the MICO base screws (Figure 2.4b).

(a) MICO base holder assembly

(b) MICO base installation on a table

Figure 2.4: Assembly of the MICO base hardware

2.1.2 MICO arm nomenclature

The main components of the 4DOF MICO Robotic arm are listed in Table 2.1. Figure 2.5 shows the listed components, including the external connectors for the arm located on the MICO arm base.

ID	Component	ID	Component
1	Base (Fixed)	8	Joint 4
2	Joint 1	9	Link 4 (Hand)
3	Link 1	10	Fingers
4	Joint 2	11	Control port
5	Link 2	12	Power connector
6	Joint 3	13	Power switch
7	Link 3		

Table 2.1: 4DOF MICO Components

Figure 2.5: Components of the 4DOF MICO robotic arm.

2.1.3 Cable Connections

The MICO control signal cable (Figure 2.2c) connects to the control port and connects the MICO to the PC via the FSCC card serial port. The power supply cable (Figure 2.3) is connected to the power connector. If the robot is off, it can be manually manipulated into to any desired pose. The arm will hold the current pose when power is applied using the power switch. The Quanser Robotics Package follows the Quanser® standard for body frame axes (base frame), where the x-axis is in the forward direction, the y-axis is to the left (where the cable connectors are found), and the z-axis is up.

Note: The USB port is not intended to be used by the end users.

Note: Do not defeat the safety purpose of the polarized or grounding type plug. If the provided cable does not fit in your outlet, consult an electrician for replacement of obsolete outlet.

Note: Control Port and Power Connector are intended to be connected only with Kinova approved device. Connecting other devices may result in bad performance or even make your device inoperable and void your warranty.

Note: Protect the cords from being walked on or pinched.

2.2 The Quanser Robotics Package Data Acquisition Card (DAQ)

The Quanser Robotics Package requires an FSCC Universal PCI Bus Synchronous Dual Port RS422/RS485 Communications Adapter Card (Figure 2.6) for control signal communication to the PC.

The steps for installing the FSCC card are described in Section 3.

Note: Make sure you follow the installation procedure provided in the next section and do not try an automatic installation by Windows; otherwise, you may encounter communication issues with your robotic arm.

Figure 2.6: FSCC card for MICO

3 SETUP

3.1 Installation of the FSCC card

The Quanser Robotics Package package comes with a FSCC card, its adapter cable and a software/driver DVD. Disconnect power from the PC and open up the computer case. Plug the FSCC card in to an open PCI slot and secure the card as necessary. Power up the PC. Installation of the FSCC card requires a manual installation of the FSCC driver to ensure communication ports are assigned in the correct order. Section 3.1.1 describes the process for installing the FSCC card driver. The steps for installing the drivers for the individual communication ports are described in sections 3.1.2 and 3.1.3.

3.1.1 Installing the FSCC card driver

1. Load the driver DVD for the FSCC card into the PC DVD reader. If an auto-run dialog box appears on the screen, ignore and close it.
2. Go to the Start menu and type "device manager" in the search box.
3. Click and open the "Device Manager". A device called "PCI Simple Communication Controller" should appear under "Other Devices" with a warning sign beside it (see Figure 3.1). Right click on this line and select properties.

Figure 3.1: Device manager.

4. Under "General", click "Update Driver".

Figure 3.2: Updating the driver.

5. Click "Browse my computer for driver software (Locate and install driver software manually). See Figure 3.3

Figure 3.3: Browsing for the driver file folder.

6. For a 64-bit operating system, enter the path "F: \Drivers\FSCC Drivers\windows\64" where F:\ is the PC DVD drive (see 3.4). Alternately, for a 32-bit operating system, enter the path "F: \Drivers\FSCC Drivers\windows\32" then click "Next".

Figure 3.4: Setting up the driver path.

7. Windows should recognize the FSCC (Ports) and a Windows security pop-up window should appear (Figure 3.5); click "Install".

Figure 3.5: Windows security message for FSCC driver.

8. Return to the device manager. Four "Multifunction" devices should now appear and under "Other Devices." These devices should appear with warning signs (see Figure 3.6.) These devices relate to the individual ports that need to be manually installed. Note that Windows may arrange these ports randomly and it is very important to install them in the correct order compatible with MICO I/O channels.The drivers for each port must be installed as described in sections 3.1.2 and 3.1.3 in the following order:

   (a) FSCC\Port1
   (b) FSCC\Port2
   (c) SerialFC\Port1
   (d) SerialFC\Port2

3.1.2 Installing the FSCC Port1 and Port2 drivers

1. Right click on the first multifunction device and select properties (see 3.6).

Figure 3.6: Multifunction devices.

2. Under Property, select Hardware Ids. If the hardware ID is Fscc\Port1 (see Figure 3.7), go to the next step. Otherwise, close the properties window and repeat the step 1 with the next multifunction device. Check each device's hardware ID until the device with Hardware Id Fscc\Port1 is selected.

Figure 3.7: Check Hardware Ids of multifunction devices until you locate FSCC Port1.

3. Once the properties menu for the device with the correct hardware ID (Fscc\Port1) has been found, install the driver by navigating to the "General" Tab and clicking "Update Driver".

4. Choose "Browse my computer for software" and enter the same path as before (see step 6 in Section 3.1.) Click next. A window should appear indicating that the "Windows has successfully updated the driver software for FSCC Port (e.g. FSCC0) under "Ports (FSCC)" (see Figure 3.8).

Figure 3.8: FSCC Port (e.g. FSCC0) successfully installed.

5. Return to the device manager. Three unknown "Multifunction devices" should remain under "Other Devices". An identified FSCC port (e.g. FSCC0) should now appear under "Ports (FSCC)". Right click on the first multifunction device and select properties (see Figure 3.9).

Figure 3.9: Three multifunction devices left.

6. Repeat steps 1-4 in Section 3.1.2, this time selecting the device with the hardware ID Fscc\Port2
7. After installing the second FSCC port driver and returning to the device manager two unknown "multifunction devices" should now remain under "Other Devices". Two identified FSCC ports (e.g. FSCC0 and FSCC1) should also now appear under "Ports (FSCC)" (see Figure 3.10).

Figure 3.10: Two multifunction devices left.

3.1.3 Installing the SerialFC Port1 and Port2 drivers

1. Right click on the first remaining multifunction device and select properties (see Figure 3.6).
2. Select Hardware Ids. If the hardware Id is SerialFC\Port1 (see Figure 3.11), go to the next step. Otherwise, close the properties window and repeat the step 1 with the other multifunction device. Select the multifunction device with the hardware ID SerialFC\Port1.

Figure 3.11: Check Hardware Ids of multifunction devices until you locate SerialFC Port1.

3. Once the properties menu for the device with the correct hardware ID (SerialFC\Port1) has been found, install the driver by navigating to the "General" Tab and clicking "Update Driver".
4. Choose "Browse my computer for software" and enter the same path as before (see step 6 in Section 3.1.) Click next. A Windows Security pop-up window should appear; click "Install" (see Figure 3.12).

Figure 3.12: Windows Security message for COM port driver installation.

5. After installation, a window should appear indicating that the "Windows has successfully updated the driver software" (See Figure 3.13).

Figure 3.13: Communication Port (e.g. COM5) successfully installed.

6. Return to the device manager. Under "Other Devices" only one unknown "multifunction device" should remain. Two identified FSCC ports (e.g. FSCC0 and FSCC1) should appear under "Ports (FSCC)"' as well as a communication port (e.g. COM5) under "Ports (COM & LPT)" (see Figure 3.14).

Figure 3.14: One multifunction devices left.

7. Right click on the remaining multifunction device and select properties.
8. Repeat steps 3 and 4 in Section 3.1.3 with the selected device.
9. Return to the device Manager. Two identified FSCC ports (e.g. FSCC0 and FSCC1) should appear under "Ports (FSCC). As well, two communication ports (e.g. COM5 and COM6) should appear under "Ports (COM & LPT)" (see Figure 3.15) in addition to the previously installed ports. The two new port numbers (e.g. COM5 and COM6) under "Ports (COM & LPT)" should be used to communicate with the MICO device in QUARC.

Figure 3.15: All multifunction devices installed.

Note: If the hardware Id for the last multifunction device is not SerialFC\Port2 or at any point during the installation the order of the installed communication ports does not match that described in sections 3.1.2 and 3.1.3 the driver installation procedure must be undone and begun again. To do so, uninstall and remove all the previously installed drivers for this device and then begin the procedure again from step 1 of Section 3.1.2. To uninstall the drivers, right click on the COM and FSCC ports and select uninstall, one by one. Select "Delete the driver software for this device" and click OK.

Note: If the FSCC card is at any time physically removed from the PC and reinstalled there may be errors in the driver setup. To verify the setup check the Hardware Ids of the automatically identified COM ports. The lower numbered COM port should be related to SerialFC\Port1 and the higher numbered COM port should

be related to SerialFC\Port2. If the orders do not match, the driver installation procedure must be undone and begun again. To do so, uninstall and remove all the previously installed drivers for this device and then begin the procedure again from step 1 of Section 3.1.2. For this, right click on the COM ports first and select uninstall, one by one. To uninstall the drivers, right click on the COM and FSCC ports and select uninstall, one by one. Select "Delete the driver software for this device" and click OK.

3.2 Testing the FSCC DAQ installation

The FASTCOMM driver DVD provided with the card includes a test program for verifying the successful installation of the FSCC card and drivers. Navigate to "Drivers\FSCC Drivers\windows\terminal\serialfc" and double click on Termite.exe. Click on Settings and select the first COM port related to the card and click OK. Type any key in the text field. The application should return an echo of that key. If the application returns an echo of the same key on the screen, the FSCC card and drivers are properly installed (3.16).

Figure 3.16: Evaluating driver installation for the FSCC card.

If the program stops working or the entered text is not echoed on the screen, there is an error in the FSCC driver setup. To rectify any such errors, the driver installation procedure must be undone and begun again. To do so, uninstall and remove all the previously installed drivers for this device and then begin the procedure again from step 1 of Section 3.1.2. For this, right click on the COM ports first and select uninstall, one by one. To uninstall the drivers, right click on the COM and FSCC ports and select uninstall, one by one. Select "Delete the driver software for this device" and click OK. If problems persist, please contact Quanser technical support at tech@quanser.com

3.3 Wiring the robot and the PC

The MICO signal cable (Figure 2.2c) connects to the control port of the robot (See 2.5 - ID# 11) and the serial port of the FSCC card (Figure 2.6).

MICO power cable connects to the power connector of the robot (Figure 2.5 - ID# 12). Once the robot is supplied with power, turning the arm on should cause it to hold the current pose. if the arm fails to hold the current pose when powered on, check the power cords and connectors. If problems persist, please contact Quanser technical support at tech@quanser.com

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