TACTILE SENSORS | RESEARCH EDITION

User guide

#DG 4TSE 0001
Version 2.0.0
November 2013

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1. About this document

Please read all the information concerning this product before using it.

No modification of this equipment is allowed.

This document gives an overview of Kinova's tactile sensors and its accompanying software.

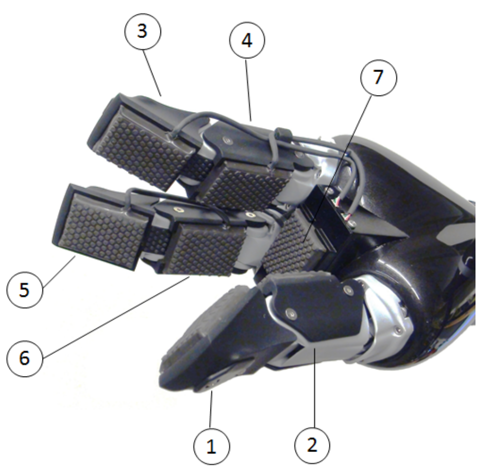
This document is addressed to Kinova's tactile sensors clients and authorized and certified partners and distributors.

Additional information on the installation of the tactile sensor kit in the following document:

- ✓ DG 4TSE 0002: Tactile Sensor Installation Guide

2. General Information

2.1 Part Identification



PART ID	NAME
1	Distal Sensor assembly #1
2	Proximal Sensor assembly #1
3	Distal Sensor assembly #2
4	Proximal Sensor assembly #2
5	Distal Sensor assembly #3
6	Proximal Sensor assembly #3
7	Palm Sensor assembly

Each proximal and distal assembly are composed by a holder (plastic part fixed on the finger), a sensor (sensing fabric fixed to the holder) and a cable.

In a right-handed configuration, finger #1 represents the “thumb”, finger #2 represents the “index” and the other finger (not closing with finger #1) represents finger #3. In a left-handed configuration where the action of finger #2 and #3 has been inverted with the adequate configuration, finger #1 represents the “thumb”, finger #3 represents the “index” and the other finger (not closing with finger #1) represents finger #2.

2.2 Specifications

ENVIRONMENT

General

- Ambient temperature from 0ºC to 30ºC
- Can be used under light rainfall for limited period (IPX2 rating)
- Can be used under normal atmospheric pressure conditions

Storage

- Ambient temperature from 0ºC to 50ºC
- Relative Humidity : 55% max

ELECTRICAL

Input Power

- Voltage: 18V to 29V d.c.
- Current : 2A in normal use, 10A max

MECHANICAL

Static pressure sensing

- Range: 5E-4N to 20N on the area of a taxel (36 mm^2)

Dynamic sensing

- Frequence: 1 to 500 Hz

USER INTERFACE

***Kinova Sensor User Interface* recommended PC requirements:**

- OS: Windows XP, Vista, 7, 8 (32 or 64 bit)
- CPUs: Tested successfully on Intel Pentium, Intel Core i5 and i7
- Ports: USB 2.0. Also compatible with USB 3.0, but data acquisition might not be as fast as with USB 2.0, especially when the USB 3.0 ports are using Intel chipsets / Intel USB 3.0 controllers

3. User Interface

Before starting to use the sensors, one must first ensure the USB/RS-485 converter's driver is installed. Once this step has been completed, the User Interface (UI) can then be installed.

3.1 USB/RS-485 Driver

To install the driver, first insert the CD from B&B Electronics that was provided with your product or go to http://www.bb-elec.com/Products/USB-Connectivity/USB-to-Serial-Adapters/Mini-USB-to-Serial-Converters/485USBTB-2W.aspx to download the installer manually. Launch the installer and follow the wizard to complete the installation.

****Important:** Once the driver has been installed, it is important to change the default latency and bit per second. This is needed for allowing the communication between your computer and the sensors to be as fast as possible. To achieve that, follow these steps:

1) Click on *Start* (located at the bottom-left corner of your screen), right-click on *Computer* and click on *Manage* (Administrator privileges may be required).

2) On the left pane, click on *Device Manager* and expand the *Ports (COM & LPT)* list. Locate your device and open its properties by right-clicking on it:

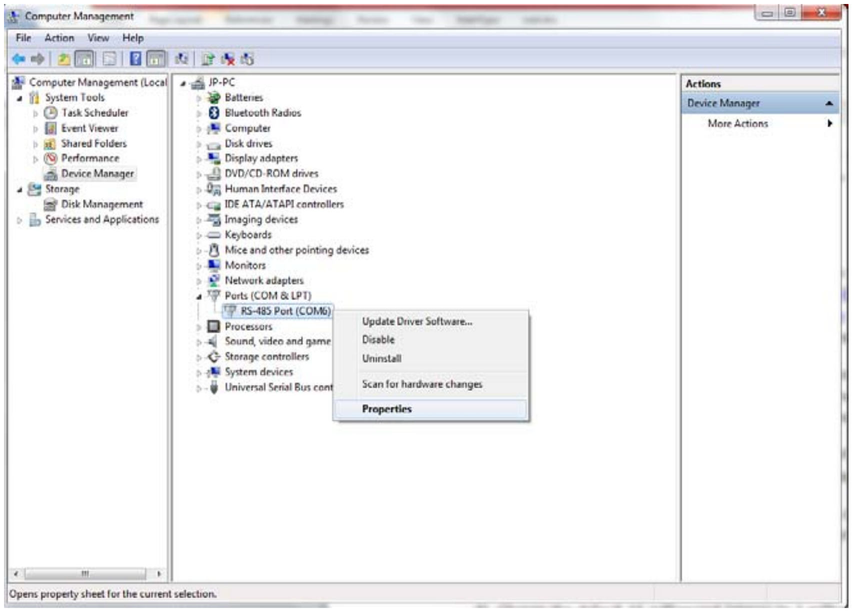


Figure 1 - Locating the RS-485 device and opening its properties

3) Click on the *Port Parameters* tab and change the bit(s) per second to 460800

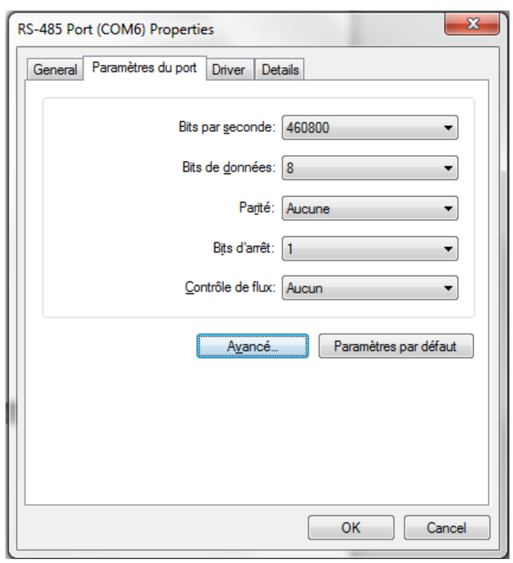


Figure 2 - RS485 Port Parameters

4) Click on *Advanced…* and change the default 16 millisecond latency for 1 millisecond.

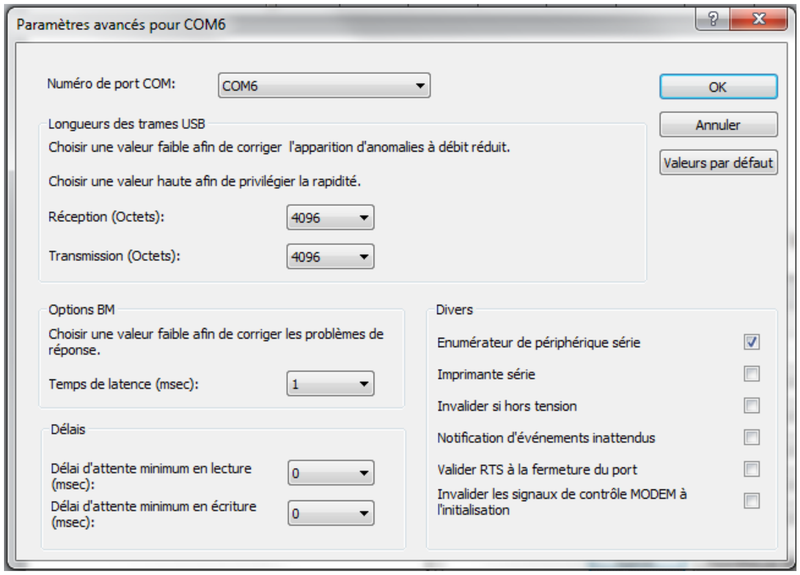


Figure 3 - RS485 Advanced Settings with latency set at 1 msec

5) Apply all changes and close the window. You are now ready to install the User Interface.

3.2 Software

To install the User Interface, plug the USB stick that was provided with your product in your computer, locate the installer (KinovaSensorUI_Installer.exe) and launch it.

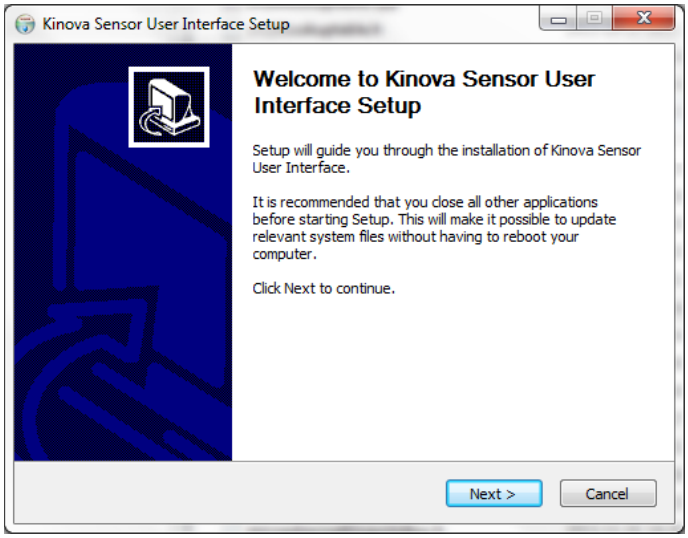


Figure 4 - Installer Welcome Page

After agreeing to the license terms, you will reach the components selection page:

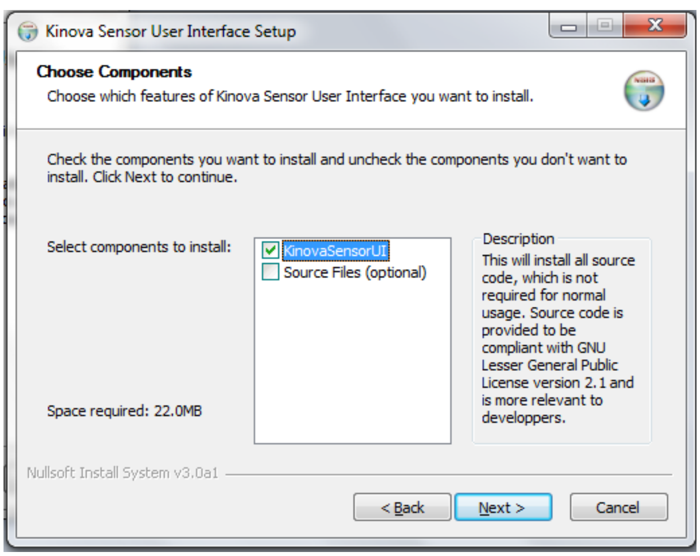


Figure 5 - Components Installation Page

Since the software complies with GNU General Public License version 3 as published by the Free Software Foundation, you can choose to install the software along with the source code. Note that this is not required for normal usage and should only be considered by advanced users for developing, customizing or reverse-engineering purposes. Follow the rest of the instructions to finish installing the software.

4. Tactile sensors operation

To operate the tactile sensors, users can start developing their own applications by referring to the communication protocols, as described in section 4.3. On the other hand, one can rely on the User Interface (UI) provided along with the sensors, as the latter allows visualization and logging of the tactile sensors' data. There are two types of data that can be transmitted by sensors: static and dynamic.

4.1 Static

Static Data are related to the pressure applied on the tactile sensor. They are composed of twelve numbers representing the capacitance measured at different points. Below is a 3D representation of static data, where the twelve data points are interpolated by a bicubic spline.

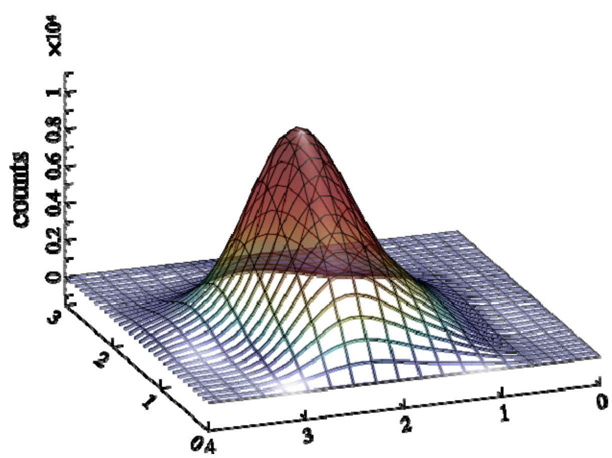


Figure 6 - Static Data Illustration (by Kinova Sensor User Interface)

4.2 Dynamic

Dynamic Data represent the vibrations measured by the tactile sensor. As an example, an object vibrating at a steady frequency of 125 Hz has been placed on a tactile sensor. Figure 7 shows a plot of the raw dynamic data, while Figure 8 is the FFT (*Fast Fourier Transform*) of that signal.

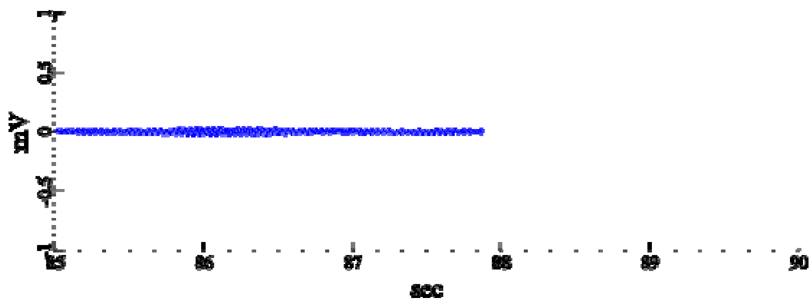


Figure 7 - Dynamic Signal Oscillating at 125 Hz (by Kinova Sensor User Interface)

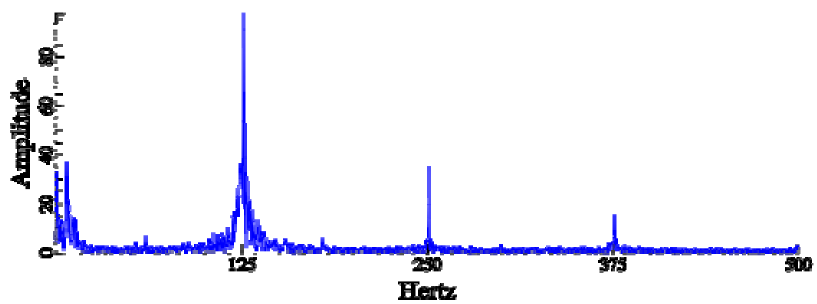


Figure 8 - Fast Fourier Transform of the Dynamic Signal (by Kinova Sensor User Interface)

4.3 Communication protocols

This section is useful for developers as it describes the content of the messages that needs to be sent to the sensor (requests) in order to get the static or dynamic data from the sensor (answers).

1.1.1 Static Data Request and Answer

Request structure:

$$\underbrace{\langle 0xFA \quad Sensor\_ID \quad CRC16\_1st\_Byte \quad CRC16\_2nd\_Byte \rangle}_{4\ \text{Bytes}}$$

-The first byte is always 0xFA and is simply a header that indicates sensors that a message is coming.

-The second byte is the ID of the sensor to get the data from (from 0x01 to 0x07)

-The third and fourth bytes are the CRC16 (using 0xA001 as the XOR constant) of the two first bytes (0xFA and SensorID). Check out Simply Modbus' website at http://www.simplymodbus.ca/FAQ.htm#CRC and/or download their *CRC Calculator* to learn more about CRC16 computation.

Answer structure:

$$\underbrace{\langle 0xFA \quad Sensor\_ID \quad 1st\_Data\_MSB \quad 1st\_Data\_LSB \quad \cdots \quad 12th\_Data\_MSB \quad 12th\_Data\_LSB \rangle}_{24 bytes}$$

-The first byte is always 0xFA and is simply a header that indicates sensors that a message is coming.

-The second byte is the ID of the sensor to get the data from.

-The remaining bytes are the data, where MSB stands for "Most Significant Byte" while LSB stands for "Less Significant Byte". Refer to the table below for finding how each of these data corresponds to a single measuring point on the sensor (Top view):

UP

12	11	10
9	8	7
6	5	4
3	2	1

1.1.2 Dynamic Data Request and Answer

Request structure:

$$\underbrace{\langle 0xFA \quad 128+Sensor\_ID \rangle}_{2\ \text{Bytes}}$$

-The first byte is always 0xFA and is simply a header that indicates sensors that a message is coming.

-The second byte is the sum of 128 and the ID of the sensor to get the data from (from 0x01 to 0x07). Adding 128 to the sensor ID is for telling the sensor that the request is for dynamic data instead of static.

Answer structure:

$$\underbrace{\langle 0xFA \quad 128+Sensor\_ID \quad Dynamic\_Data\_MSB \quad Dynamic\_Data\_LSB \rangle}_{4 bytes}$$

-The first byte is always 0xFA and is simply a header that indicates sensors that a message is coming.

-The second byte is byte is the sum of 128 and the ID of the sensor to get the data from.

-The remaining bytes are the data.

1.1.3 Communication examples

-This is a request made to sensor #7 to send its static data:

$$\langle 0xFA \quad 0x07 \quad 0x02 \quad 0xD2 \rangle$$

-This is a request made to sensor #3 to send its dynamic data:

$$\langle 0xFA \quad 0x83 \rangle$$

4.4 Tactile sensors maintenance

Protect the cords from being pinched.

The connection and installation of the tactile sensor kit is defined in guide DG 4TSE 0002.

To replace a tactile sensor, please contact a Kinova representative.

5. Contact support

If you need help or have any questions about this product, this guide or the information detailed in it, please contact a Kinova representative at

Support@KinovaRobotics.com

We value your feedback!

www.KinovaRobotics.com