



KINOVA™ Actuator series





User Guide

KINOVA
Achieve Extraordinary

Contents

About this document.....	3
Symbols, definitions, and acronyms.....	4
Warranty.....	5
Disclaimer.....	6
General Information.....	7
KA-Series actuators components.....	8
Controller external connectors.....	9
Actuators specifications.....	11
Controller specifications.....	13
KA-Series Actuators Mechanical integration.....	14
KA-Series actuators electrical integration.....	15
Integrating a new end effector (optional).....	16
Control integration.....	18
Normal Use Definition.....	19
Electromagnetic interference from radio wave sources.....	20
Maintenance and Disposal.....	21
Packing Materials.....	22
Contacting support.....	23

About this document

-  Read all instructions before using this product.
-  Keep these instructions for future reference.
-  Read all warnings on the product and in this guide.
-  Follow all instructions.

This document contains information regarding product setup and the operation. It is intended for:

- Field service, customer support and sales employees of authorized Kinova distributors
- Kinova product end users

Symbols, definitions, and acronyms



Important information regarding the safety related to the product and the user.



Tip on the maintenance, operation and manipulation of Kinova's products.



Refer to accompanying documents.



Direct current.



Alternating current.



Operating temperature range.



Compliance with WEEE2 directive.



Compliance with ROHS3 directive.



Type BF Applied Part device.

Warranty

This section describes the Kinova warranty terms.

Subject to the terms of this clause, Kinova warrants to End User that the Products are free of defects in materials and workmanship that materially affect their performance for a period of two (2) years from the date Kinova ships the Products to the End User ("Delivery Date").

Kinova agrees to repair or replace (at Kinova's option) all Products which fail to conform to the relevant warranty provided that:

1. Notification of the defect is received by Kinova within the warranty period specified above.
2. Allegedly defective Products are returned to Kinova, at the End User's expense, with Kinova's prior authorization within thirty (30) days of the defect becoming apparent.
3. The Products have not been altered, modified or subject to misuse, incorrect installation, maintenance, neglect, accident or damage by excessive current or used with incompatible parts
4. The End User is not in default under any of its obligations under this Agreement.
5. Replacement Products must have the benefit of the applicable warranty for the remainder of the applicable warranty period.

If Kinova diligently repairs or replace the Products in accordance with this section, it will have no further liability for a breach of the relevant warranty.

Allegedly defective Products returned to Kinova in accordance with this contract will, if found by Kinova on examination not to be defective, be returned to End User and Kinova may charge a fee for examination and testing.

The warranty cannot be assigned or transferred and is to the sole benefit of the End User.

Where the Products have been manufactured and supplied to Kinova by a third party, any warranty granted to Kinova in respect of the Products may be passed on to the End User.

Kinova is entitled in its absolute discretion to refund the price of the defective Products in the event that such price has already been paid.

Disclaimer

KINOVA™ and Kinova's logo are trademarks of Kinova Inc., herein referred to as Kinova. All other brand and product names are trademarks or registered trademarks of their respective corporations.

The mention of any product does not constitute an endorsement by Kinova. This manual is furnished under a lease agreement and may only be copied or used within accordance with the terms of such lease agreement. Except as permitted by such lease agreement, no part of this publication may be reproduced, stored in any retrieval system, or transmitted, in any form or by any means, electronic, mechanical, recording, or otherwise, without prior written consent of Kinova.

The content of this manual is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by Kinova. Kinova assumes no responsibility or liability for any errors or inaccuracies that may appear in this document.

Changes are periodically made to the information herein; these changes will be incorporated into new editions of this publication. Kinova may make improvements and/or changes in the products and/or software programs described in this publication at any time.


Address any questions or comments concerning this document, the information it contains or the product it describes to:


support@kinovarobotics.com


Kinova may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligations to you.

General Information

The K-series of modular actuators gives all the motion and sensing capabilities needed to easily build custom robotic applications.

 Do not modify this equipment without authorization of the manufacturer.

 The Normal Use Definition contains some fundamental information to the proper operation of the robotic arm. arm.

 It is not recommended to use the arm under heavy rain or snow.

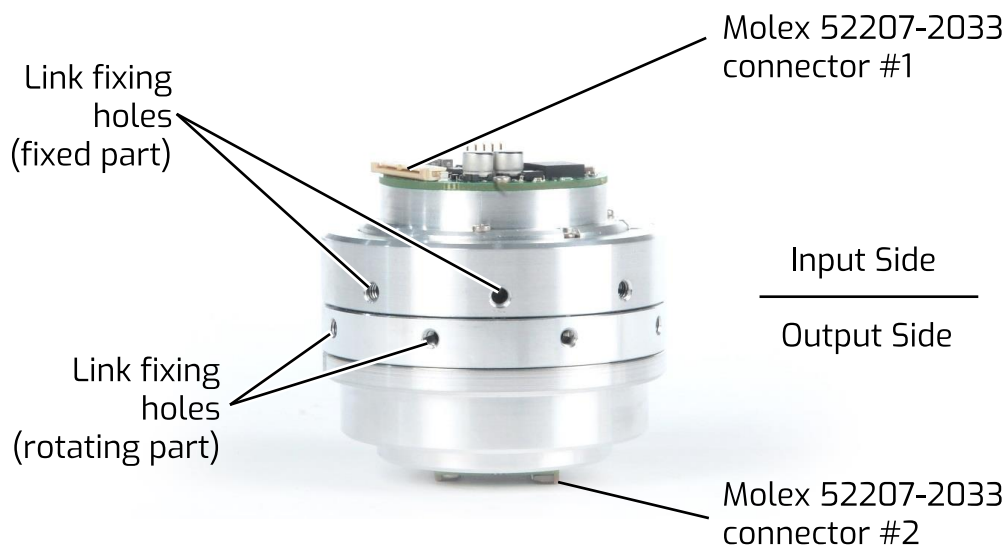
KA-Series actuators components

This section describes the components of the KA-Series actuators.

The KA-Series actuators consist of two disk-shaped sides:

- Input side
- Output side

Inside the actuator is a motor. Under the action of the motor, the two sides rotate with respect to one another around their common central axis. Both the input and output sides of the actuator have 20-pin Molex 52207-2033 connectors for carrying power and signals.

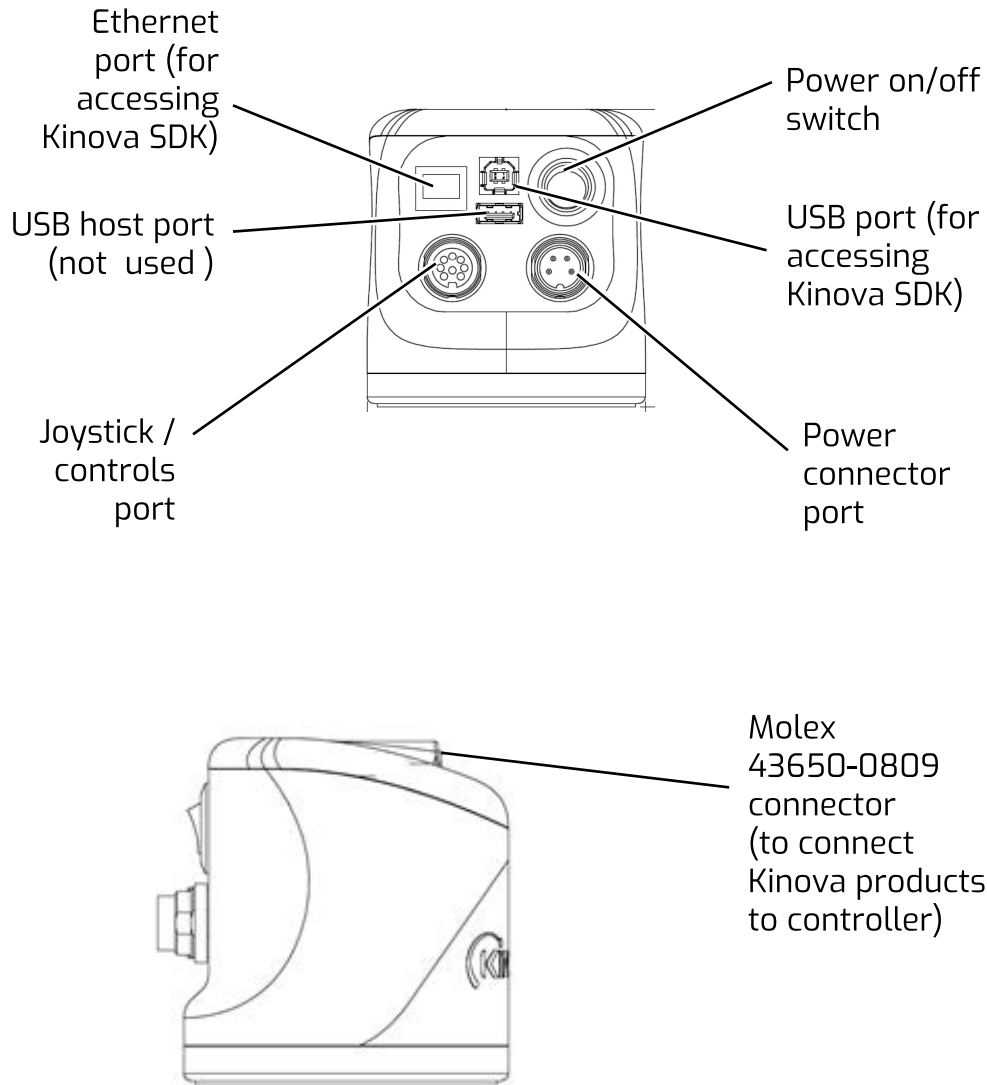


On each side of the actuator, there are six link fixing holes. These holes are designed to allow the actuator to be affixed to the body of the linkages on either side of the actuator in a robotic arm installation. The idea is that in rotations, the input side of the actuator and the input linkage are fixed while the output side of the actuator rotates, moving the output linkage.

Controller external connectors

This section describes the external connectors of the Kinova controller.

The following figures show the external connectors located on the controller:



The panel at the back of the controller has four connectors and a power on / off switch.




The **power on /off switch** is used to power up or power down the robotic arm.

The **power connector** port is used to connect the robotic arm to electrical power. The power connector port has four pins

The **joystick / controls port** is used to plug in controls for the arm. The joystick / controls port has six pins.

The **USB port** is used to connect to a computer.

⚠ The control Port and Power Connector are intended to be connected only with a Kinova approved device. Connecting other devices may result in bad performance or even make your arm inoperable and void your warranty.

-  Do not override 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.
-  To prevent risk of fire or electric shock, avoid overloading wall outlets and extension.
-  Protect the cords from being walked on or pinched.

Actuators specifications

	KA-75+	KA-58
Geared Motor (with 24 V supply)		
No load speed	12.2 rpm	20.3 rpm
Nominal torque	12.0 Nm	3.6 Nm
Nominal speed	9.4 rpm	15.0 rpm
Peak torque (software limitation)	30.5 Nm	6.8 Nm
Max motor efficiency	83%	81%
Max gearing efficiency	76%	69%
Torque gradient	13.8 Nm/A	7.8 Nm/A
Back-driving torque	1.7 to 5.2 Nm	0.8 to 7.0 Nm
Sensors		
Position sensor resolution	3 686 400 / turn	2 534 400 / turn
Motion before position indexation	±2.25°	±3.27°
Absolute position sensor precision at start-up (before indexation)	±1.5°	
Torque sensor precision (room temperature)	±0.4 Nm	
Torque sensor temperature drift (-10 °C to 40 °C)	±0.3 Nm	
Torque sensor cross-axis torque sensitivity	0% to 8%	
Accelerometers range and bandwidth (x, y and z)	±3g, 50 Hz	
Motor current sensor range and bandwidth	±5 A, 140 Hz	
Temperature sensor range and precision	-40 °C to 125 °C, ±2 °C	
Mechanical		
Weight	570 g	357 g
Motion range after start-up (software limitation)	±27.7 turns	±27.7 turns
Max axial, radial and flexion moment loads (static)	7.6 kN, 3.0 kN, 87 Nm	4.7 kN, 1.8 kN, 39 Nm

	KA-75+	KA-58
Dynamic axial, radial and flexion moment loads ratings of the main bearing	3.5 kN, 1.5 kN, 41 Nm	2.1 kN, 0.8 kN, 17 Nm
Thermal		
Operating temperature range	-10 °C to 40 °C	
Max frame temperature (overheat protection triggered)	75 °C	
Thermal time constant of the winding	22 s	16 s
Thermal time constant of the frame	39 min	35 min
Electronic		
Power supply voltage	18 to 29 VDC, 24 VDC nominal	
Communication protocol	RS-485	
Communication cables	20 pins flat flex cable	
Expansion pins	2 (on communication bus)	

Controller specifications

This section describes the specifications of the Controller.

Table 1: Controller specifications

Ports	
Joystick	1 Mbps CANBUS
Power Supply	18 to 29 VDC
USB 2.0 (API)	12 Mbps
Ethernet	100 Mbps
Control System Frequency	
High-level API	100 Hz (High level API)
Low-level API	up to 500 Hz (Low level API)
CPU	360 MHz
SDK	
APIs	High and low level
Compatibility	Windows, Linux (Ubuntu) & ROS
Port access	USB 2.0, Ethernet
Programming	C++
Control modes	Force, Angular, and Cartesian

KA-Series Actuators Mechanical integration

The procedure to link a KA-58 or KA-75+ mechanically is the same, with only the dimensions differing from one to another. In all cases, it should be attached on the input side of the actuator in a fixed manner (highlighted in black) and on the output side in a way that the link could rotate (also highlighted in black) and respect the dimensions (mm) provided in the following drawings.

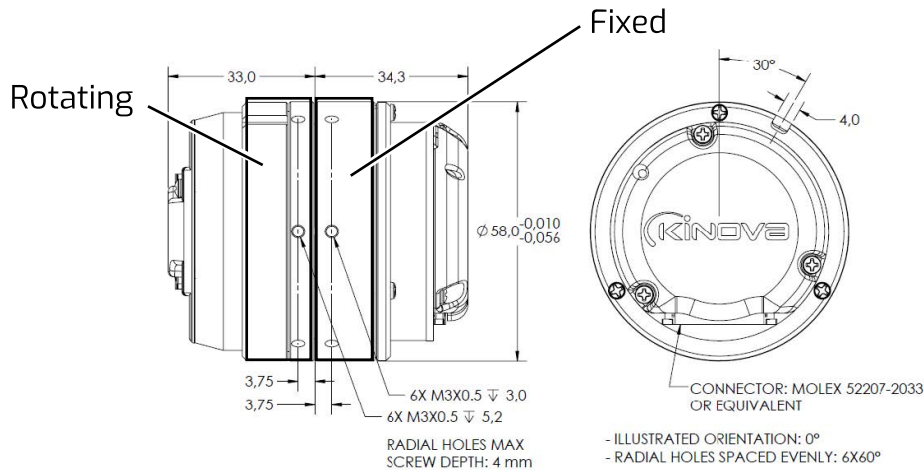


Figure 1: KA-58 actuator dimensions

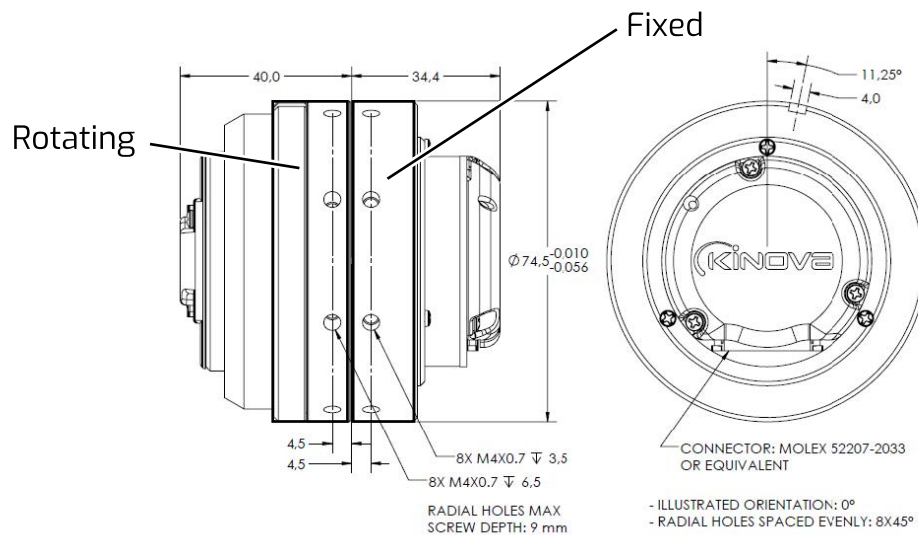


Figure 2: KA-75+ actuator dimensions

The attachment for the actuator should be a circular part with 6 M3 screw holes.

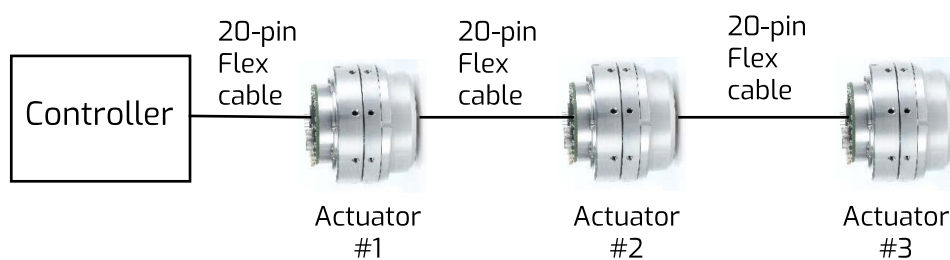
⚠ Note that there is a 4.0 mm groove on the actuators to correctly align it and have a reference alignment for the robot's inverse kinematics.

KA-Series actuators electrical integration

This section describes the electrical integration of a KA-Series actuator.

About this task

In an application, a controller unit is generally connected together with a number of actuators and (optionally) an end effector in a "daisy-chain" setup. The actuators are each connected to the previous actuator (or the controller, for the first actuator) using a 20-pin flex cables. The flex cable connects at one end to the 20-pin output of the previous actuator, and at the other end to the 20-pin input of the present actuator.



Note: Note that you cannot connect more than 20 KA-Series actuators and one KG-Series Gripper in a single daisy chain.

Procedure

1. Connect actuator #1 to the controller. Take the 20 pins flex flat cable coming out of the Controller and connect it to the Molex 52207-2033 connector #1 (input) on actuator #1. To do this, gently open the brown latch with your fingers, completely insert the 20 pins flex flat cable (blue side facing down) and then gently close the brown latch with your fingers.

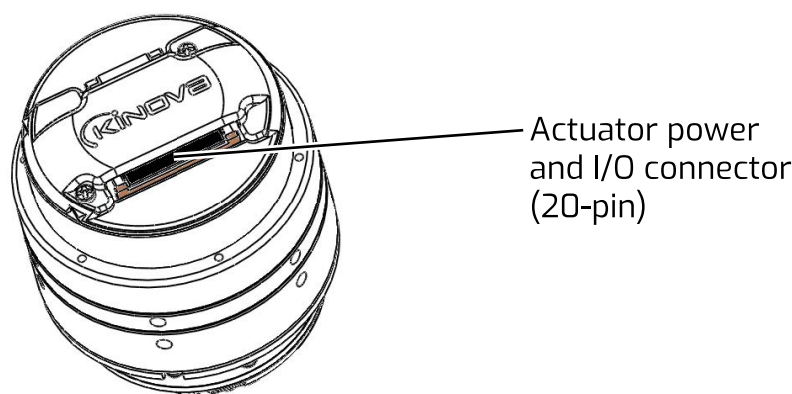
Note: For additional robustness of the connection, Kinova suggests to add hot melt adhesive on the connector to hold it firmly in place.

2. If you have more than one actuator, to connect the second one, insert a 20 pins flex flat cable in the Molex 52207-2033 connector #2 (output) on actuator #1, and then connect the other end of the flex cable to connector #1 (input) of actuator #2.
3. To connect a KG-Series Gripper to an actuator, insert the 10-pin flex flat cable of the KG-Series Gripper in the Molex 52207-2033 connector #2 (output) of the last actuator.

Integrating a new end effector (optional)

This section describes how to integrate a new end effector with Kinova actuators, whether in a Kinova robotic arm or custom application.

Kinova actuators, whether as part of a Kinova robotic arm, or as part of a researcher's custom-built robotics application, have the ability to be connected to end effectors. The output end of each actuator has a 20-pin power and I/O connector. Two of these pins are set aside as dedicated expansion communication and power lines. This allows you the option to connect an additional device to the end of a robotic arm or the end of a chain of actuators in a custom-built set-up.



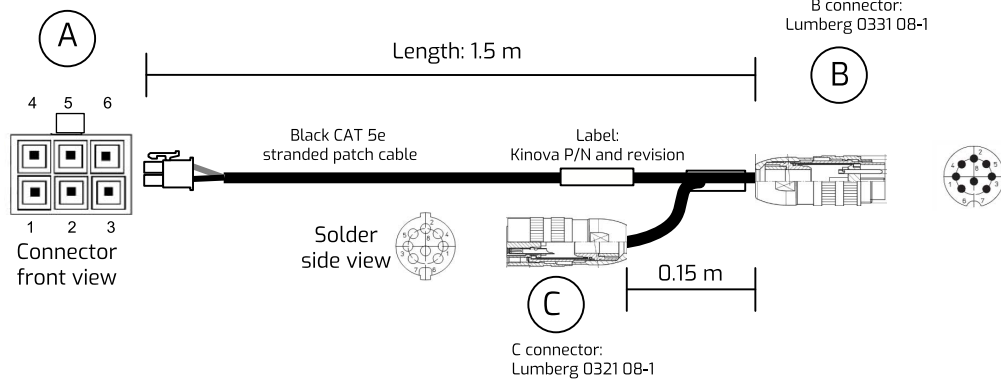
The pins and their function are described in the table below:

Table 2: K-58 actuator pinout

Pin #	Signal
1 to 8	24V input
9 to 16	GND
17	RS485 low
18	RS485 high
19	Expansion 0
20	Expansion 1

⚠ Make sure to connect your end effector using only pins 19 and/or 20. Using other pins could severely damage your robot. These two expansion lines are accessible for power and controls purposes via pins at the joystick port. The A “Y” cable is supplied with the robot to allow you to access both the joystick and the expansion lines.

A connector:
Molex housing 39-01-2060
Molex contact 39-00-0038



The output pinout of the two expansion lines is indicated in the table below.

Table 3: EH 01M5 0001 pinouts

Connector A		
Pin #	Signal	Function
1	COM1	RS485_low
2	GND	GND
3	COM3	Expansion 0
4	COM2	RS485_high
5	24V (max current: 1.5A)	24V
6	COM4	Expansion 1

Control integration

This section describes the control integration. This applies to both KA-Series actuators and KG-Series grippers.

Once previous integration steps are completed, you can power on the gripper by flipping the power switch on the Controller to ON. To control the gripper and access the sensors data, you need to use the API. Connect the USB cable supplied with your package to the USB port. Install and open the Kinova SDK and follow the procedure and documentation included in the SDK.

Normal Use Definition

The definition of normal use includes that you do not exceed the product specifications.

Electromagnetic interference from radio wave sources

This section describes electromagnetic interference considerations for the JACO robotic arm.

Even if the product complies with all relevant standards, your arm may still be susceptible to electromagnetic interference (EMI), which is interfering electromagnetic energy (EM) emitted from sources such as radio stations, TV stations, amateur radio (HAM) transmitters, two way radios, and cellular phones. The interference (from radio wave sources) can cause the product to stop moving for a period of 10 seconds. In this case, the device will simply re-initialize and you will be able to continue to use it. In extremely rare case, it can also permanently damage the control system.


The intensity of the interfering EM energy can be measured in volts per meter (V/m). The product can resist EMI up to certain intensity. This is called “immunity level”. The higher the immunity level is, the greater is the protection. At this time, current technology is capable of achieving at least a 20 V/m immunity level, which would provide useful protection from the more common sources of radiated EMI.


There are a number of sources of relatively intense electromagnetic fields in the everyday environment. Some of these sources are obvious and easy to avoid. Others are not apparent and exposure is unavoidable. However, we believe that by following the warnings listed below, your risk to EMI will be minimized.


The sources of radiated EMI can be broadly classified into three types:


1. Gripper-held portable transceivers (e.g. transmitters-receivers with the antenna mounted directly on the transmitting unit, including citizens band (CB) radios, walkie-talkie, security, fire and police transceivers, cellular phones, and other personal communication devices). Some cellular phones and similar devices transmit signals while they are ON, even if not being actively used.
2. Medium-range mobile transceivers, such as those used in police cars, fire trucks, ambulances and taxis. These usually have the antenna mounted on the outside of the vehicle.
3. Long-range transmitters and transceivers, such as commercial broadcast transmitters (radio and TV broadcast antenna towers) and amateur (HAM) radios. Other types of gripper-held devices, such as cordless phones, laptop computers, AM/FM radios, TV sets, CD players, cassette players, and small appliances, such as electric shavers and hair dryers, so far as we know, are not likely to cause EMI problems to your device.

Because EM energy rapidly becomes more intense as one move closer to the transmitting antenna (source), the EM fields from gripper-held radio wave sources (transceivers) are of special concern. It is possible to unintentionally bring high levels of EM energy very close to the control system while using these sorts of devices. Therefore, the warnings listed below are recommended to reduce the effects of possible interference with the control system.

 Do not operate gripper-held transceivers (transmitter's receivers), such as citizens band (CB) radios, or turn ON personal communication devices, such as cellular phones, while the device is turned ON.

 Be aware of nearby transmitters, such as radio or TV stations, and try to avoid coming close to them.

 Be aware that adding accessories or components, close to the device may make it more susceptible to EMI.

 Report all incidents of unintended shut down to your local distributor, and note whether there is a source of EMI nearby.

Maintenance and Disposal

This section describes maintenance and disposal considerations.

Cleaning instructions

Only the external surfaces of the product may be cleaned. Cleaning may be done using a damp cloth and light detergent. The following described the steps for the cleaning the product:

- Prepare a water/soap preparation using a proportion of about 2ml of dish soap for 100ml of water
- Immerse a clean cotton cloth in the preparation
- Take out the cloth and wring out thoroughly
- Gently rub the external surface to be cleaned

⚠ Do not wash more than three times per day.

⚠ Do not immerse any part of the product under water or snow.

⚠ The product is not intended to be sterile. No sterilization process should be applied to the product.

⚠ Do not rub the external surfaces with abrasive materials.

Preventive Maintenance

The product requires no maintenance. Fingers should be cleaned and lubricated every 6 months.

⚠ Refer all services to qualified service personnel. A service is required when the apparatus has been damaged in any way, for example if the power-supply cord or plug is damaged, if the product does not operate normally or has been dropped.

⚠ There is no “home serviceable” part inside the product. Do not open..

Disposal



■ The product contains parts that are deemed to be hazardous waste at the end of their life. For further information on recycling, contact your local recycling authority or local Kinova distributor. In any way, always dispose of product through a recognized agent.

Packing Materials

The product packing material can be disposed as recyclable material.

Metal parts

Metal parts can be disposed as recyclable scrap metal.

Electrical parts, circuit boards, and carbon fiber

Please contact your local distributor to have information regarding disposal of such parts. You can also address questions directly to Kinova through our website (see Contacting Support).

Contacting 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 comments!

To help us assist you more effectively with problem reports, the following information will be required when contacting Kinova or your distributor support:

- Product serial number (This will allow the support agent to have all the information regarding your product as the software version running in the device, the part revisions and characteristics, etc.)
- Date/Time of the problem
- Environment where the problem occurred
- Actions performed immediately before the problem occurred



Kinova Inc.

(Headquarters)

4333 Boul. de la Grande Allée
Boisbriand, Qc, Canada
J7H 1 M7

+1 (514) 277 – 3777

www.kinovarobotics.com

info@kinovarobotics.com

Kinova Europe GmbH

Friedrich-Ebert-Allee 13
53113 Bonn, Deutschland

+49 (0) 228-9293-9148

www.kinovarobotics.de

support@kinovarobotics.de