

MICO

User guide - Research



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 the setup and the operation of Kinova's MICO arm. It is intended for:

- Field service, customer support and sales employees of authorized distributor of MICO
- End user

Symbols, definitions and acronyms



Important information regarding the safety of Kinova's products and their operator.¹



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



Refer to accompanied documents



Direct current



Alternating current



Operating temperature range



Compliance with WEEE² directive



Compliance with ROHS³ directive



Type BF Applied Part device

Warranty

For more information regarding the warranty included with your product, please refer to the sheet included in the MICO arm case.

¹ In order to ease the use of this document, a list of the most important warnings is presented in Appendix 5.

² Waste electrical and electronic equipment

³ Restriction of hazardous substances

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GENERAL INFORMATION

The MICO arm is a light-weight robot composed of six inter-linked segments, the last of which is a two-fingered hand. Through the controller or through the computer, the user can move the robot's hand in three-dimensional space and grasp or release objects with the hand.

The MICO arm has a weight of 5.0 kg, can reach approximately 70 cm in all directions and can lift objects of up to 750 g⁴. It can be mounted on any mobile platform or to a fix station. Kinova strongly recommends that the installation of your MICO arm be entrusted by a certified technician. A short review of the installation procedure is detailed in Appendix 3. The warranty may be void if MICO is not installed properly.



Do not modify this equipment without authorization of the manufacturer.



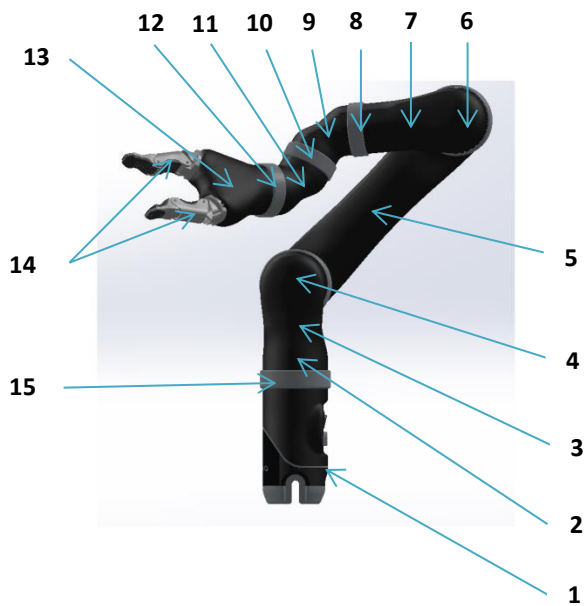
The Normal Use Definition contains some fundamental information to the proper operation of the MICO arm.



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

⁴ See the Normal Use Definition for more details on the MICO arm prescribed usage.

Part Identification



PART ID	NAME
1	Fixed Base
2	Actuator #1
3	Shoulder
4	Actuator #2
5	Arm
6	Actuator #3
7	Forearm
8	Actuator #4
9	Wrist #1
10	Actuator #5
11	Wrist #2
12	Actuator #6
13	Hand
14	Fingers
15	Plastic Ring

Figure 1 - MICO part ID

External Connection

The following figure shows the external connectors located on the MICO arm fixed base⁵.

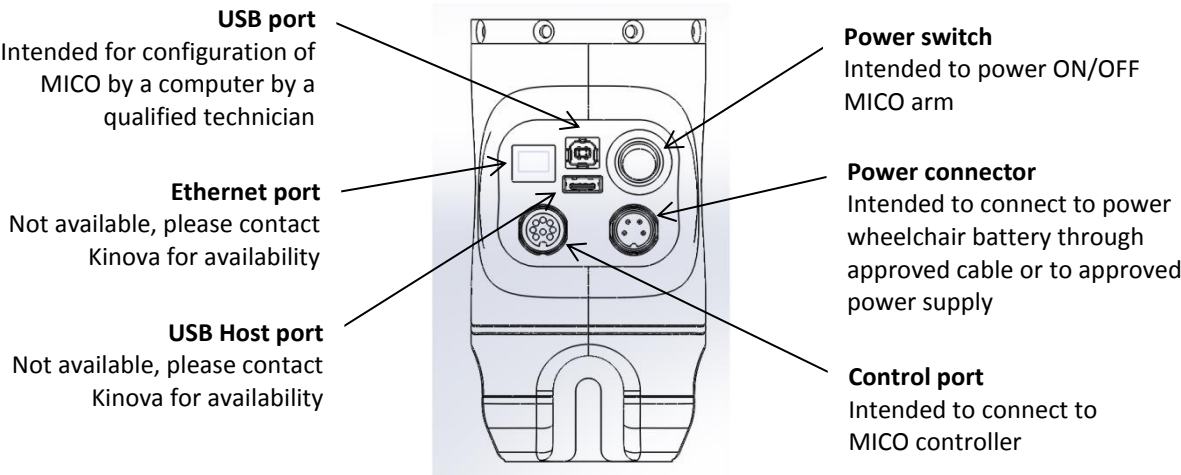


Figure 2 – MICO fixed base external connectors

⁵ If you need more specific information about the use of any optional accessories and/or system, please contact your local distributor or Kinova Support (see Contacting Support).



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 MICO inoperable and void your warranty.



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. (For table mounted unit only)



To prevent risk of fire or electric shock, avoid overloading wall outlets and extension. (For table mounted unit only)



Protect the cords from being walked on or pinched.

Specifications

ENVIRONMENT	General <ul style="list-style-type: none"> Ambient temperature from -10°C to 40°C Can be used under light rainfall for limited period (IPX2 rating) Can be used under normal atmospheric pressure conditions Normal use relative humidity : 0% to 85% max. Storage <ul style="list-style-type: none"> Ambient temperature from -10°C to 50°C Relative Humidity : 55% max
	Input Power <ul style="list-style-type: none"> Voltage: 18V to 29V d.c. Current : 1A in normal use, 3.5A max Powered by a 24V battery or external power supply Output Power (controller port) <ul style="list-style-type: none"> Voltage: 24V +/- 20% d.c. Current : 1.5A continuous, 3A max Power Supply <ul style="list-style-type: none"> Input power: 100V to 240V a.c., 50Hz to 60Hz, 2.0A Output power: 24V d.c., 4.2A Model: MENB1100A2403F01 Mark: SL POWER ELECTRONICS CORP. Type: I.T.E POWER SUPPLY
MECHANICAL	General <ul style="list-style-type: none"> Total weight: 5.0Kg Maximum Load : 1.25kg at mid-range (35cm) Maximum Load : 750 g at full-range (70cm) Reach : 70cm Maximum linear arm speed : 20cm/sec

MECHANICAL	Hand and fingers <ul style="list-style-type: none"> ▪ 2 fingers utilisation ▪ Finger force limited to 9N ▪ Flexible fingers for durability
FIRMWARE	<ul style="list-style-type: none"> ▪ Each axis controlled independently ▪ Redundant security on each axis / fingers ▪ Redundant error check in joints and in control system ▪ Position and error calculation every 0.01 second ▪ Automatic recovery on system fault.

Marking and Label

Please note that these labels may slightly differ from the ones accompanying your device depending of your country. The following figure depicts the information about the label affixed on the MICO arm fixed base.

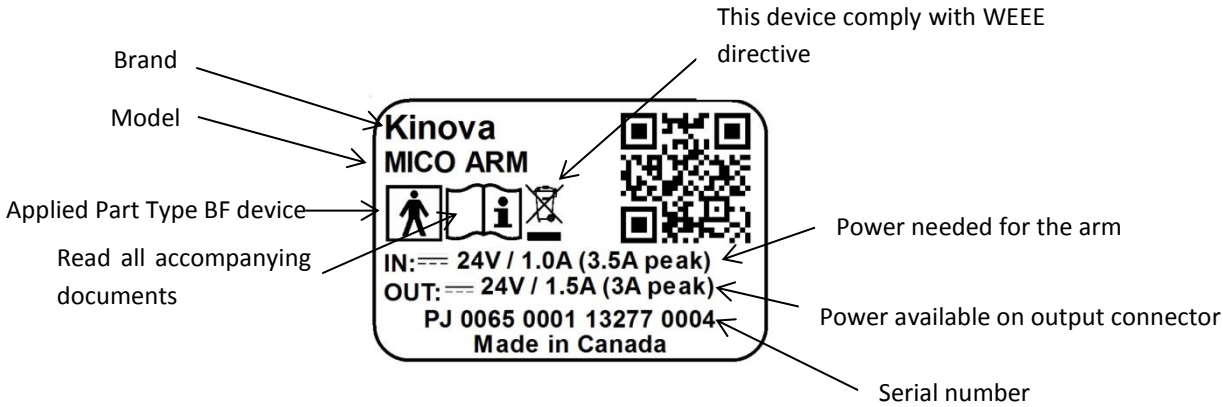


Figure 3 - MICO Label view

The following figure presents more info about the label apposed on the MICO arm box.

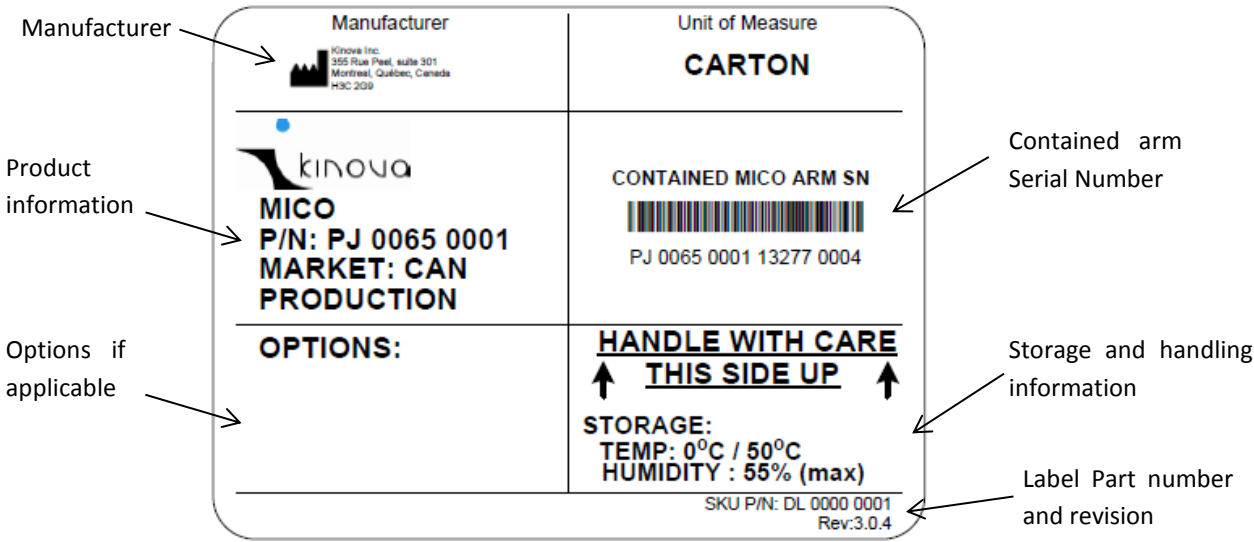


Figure 4 - MICO Box Label view

KINOVA'S JOYSTICK

The Kinova's standard controller is a 3 axis joystick mounted on a support which includes 5 independent push buttons and 4 external auxiliary inputs (on the back side).

Part Identification

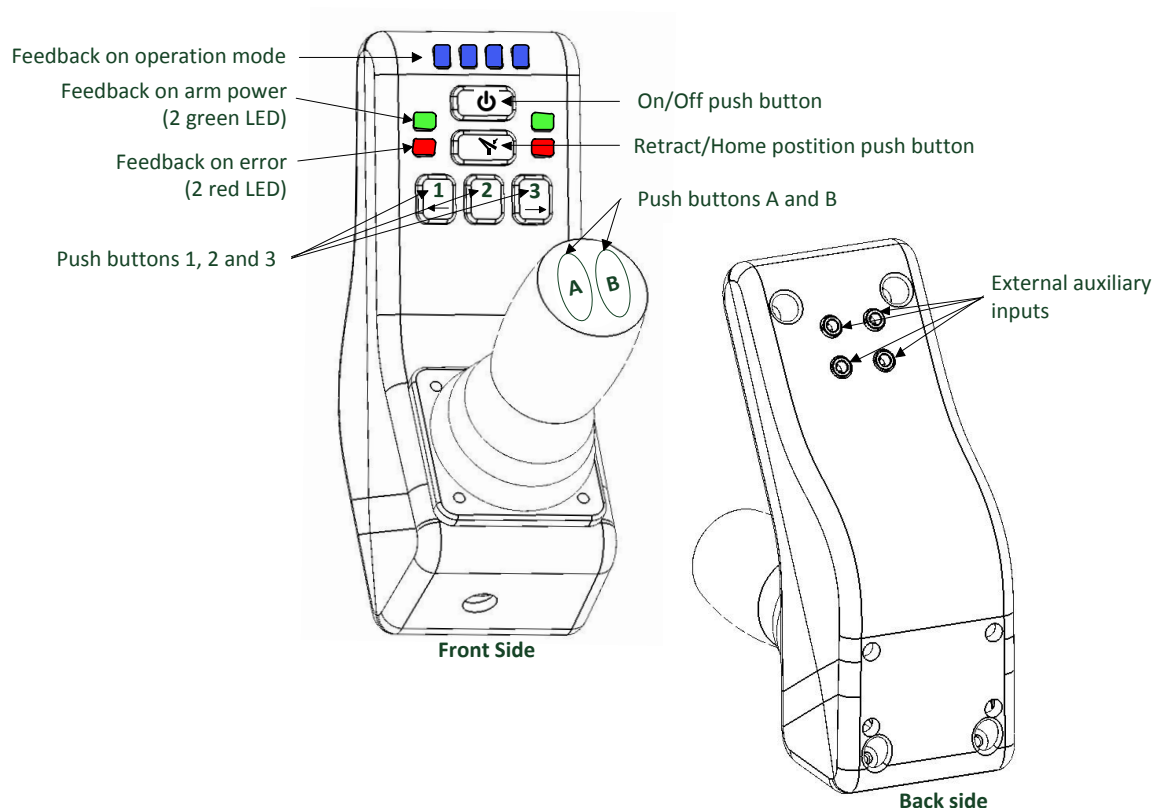


Figure 5 - Kinova's joystick part ID

Kinova's Joystick's Functions

Kinova's joystick allows two operation modes, i.e. the joystick may control the MICO arm using either 2 or 3 axis. The "2-axis" operation mode will disable the rotation of the lever⁶.

The following table lists the default factory settings for the use of the joystick's buttons for 3-axis and 2-axis control⁷.

⁶ See Appendix 1 for joystick movements).

⁷ Please note that the Kinova's joystick is entirely configurable by a certified technician.



BUTTONS		ONE CLICK	HOLD 2 SEC (*HOLD UNTIL POSITION IS REACHED)
		Deactivate/Activate Joystick	Change joystick operating mode (2-axis Vs 3-axis)
		---	HOME/RETRACT function*
3-AXIS			
1		Deactivate/Activate <u>Drinking</u> mode	---
2		---	Set Position
3		---	Go to pre-set position*
A		Reach <u>Finger</u> mode	Decrease speed
B		Reach <u>Translation</u> & <u>Wrist</u> mode	Increase speed
Ext1		Reach <u>Finger</u> mode	Decrease speed
Ext2		Reach <u>Translation</u> & <u>Wrist</u> mode	Increase speed
Ext3		---	HOME/RETRACT function*
Ext4		Deactivate/Activate Drinking mode	---
2-AXIS			
1		Deactivate/Activate <u>Drinking</u> mode	---
2		Reach <u>Wrist orientation</u> & <u>Finger</u> mode	Decrease speed
3		Reach <u>Translation-X/Y</u> & <u>Translation-Z/Wrist rotation</u> mode	Increase speed
A		---	---
B		---	---
Ext1		Reach <u>Wrist orientation</u> & <u>Finger</u> mode	Decrease speed
Ext2		Reach <u>Translation-X/Y</u> & <u>Translation-Z/Wrist rotation</u> mode	Increase speed
Ext3		---	HOME/RETRACT function*
Ext4		Deactivate/Activate Drinking mode	---

Figure 6 - Joystick Buttons Use

Visual retroaction

Kinova's joystick offers visual retroaction such as:

- Blue lights : Feedback on control mode (see following table)
- Green lights : Feedback on arm power
- Red lights : Feedback on error

BLUE LIGHTS RETROACTION













































	BLUE LIGHTS	CONTROL MODE
3-Axis	   	Translation (X-Y-Z)
	   	Wrist
	   	Fingers
	   	Drinking mode (to use with wrist rotation mode)
	   	Disabled controller
2-Axis	   	Translation (X-Y)
	   	Translation (Z) / Wrist Rotation
	   	Wrist Orientation
	   	Fingers
	   	Drinking mode (to use with wrist rotation mode)
	   	Disabled controller

Figure 7 – Feedback on control mode

When no blue lights are visible, the controller is disabled. To enable the controller, you must either proceed with the following options:

- The On/Off button must be pushed;
- The MICO arm must be set in its HOME position by holding the HOME/RETRACT function until the MICO arm stops moving.

GREEN LIGHTS RETROACTION

The green lights offer visual feedback on the power status of the MICO arm:

GREEN LIGHTS	POWER STATUS
Flashing	The MICO arm has just been turned on and the internal communication is stabilizing. The MICO arm is not yet ready to use.
Solid	The MICO arm is powered and ready to use.

Figure 8 – Visual feedback on power status

RED LIGHTS RETROACTION

The red lights offer visual feedback on possible errors that may occur while operating the MICO arm:

RED LIGHTS	CAUSES OF THE ERROR STATUS	ACTIONS TO BE TAKEN IN ORDER TO RESOLVE THE SITUATION
Flashing	The weight that is being lifted is too heavy or too much force is applied on the arm.	Safely put down the object, or release force applied on the arm, and wait until red lights turn off.
	The temperature of a section of the arm is too high.	The usage of the arm is excessive and doesn't respect the normal use definition. Safely put down any object that is in MICO's hand, bring back the arm to its RETRACT position, and wait until red lights turn off.
	The input voltage to the arm (or batteries) is too low.	Safely put down any object that is in MICO's hand, bring back the arm to its RETRACT position. Ensure the power supply is appropriate and connections are secure, or batteries are charged properly before using the arm again.
Solid	The MICO arm is in fault.	Turn off the arm and turn it back on. If the problem remains, contact your distributor or Kinova.

Figure 9 – Visual feedback on error status

OPERATING PRINCIPLES

The MICO arm operating principles are very simple and intuitive. The MICO arm may be operated through several controllers. The following sections present the general control principles through Kinova's joystick.

Basic movements

The control over the MICO arm is said to be Cartesian as the user only controls movements of and around the hand. The different joints are piloted automatically following the given command. The MICO arm is capable of 16 different movements which may be divided into several modes of control. The following figure summarizes the different movements and modes of control related.

In the *"Translation mode"*, the user controls the position of the hand in space. The hand will always keep its parallelism to the base of the arm. Translation X refers to left/right movements of the hand. Translation Y refers to front/back movements of the hand. Translation Z refers to up/down movements of the hand.

In the *"Wrist mode"*, the user controls the position of the arm around the center point of the hand (reference point) which will not move (or move slightly) when operating this mode. Lateral orientation refers to a thumb/index circular movement of the wrist around the reference point. Vertical orientation refers to a top/bottom circular movement of the wrist around the reference point. Wrist rotation refers to a circular movement of the hand around itself.

The *"Drinking mode"* is to be used with the wrist rotation only. While operating the MICO arm in the *"Drinking mode"*, the reference point (normally set in the middle of the hand), is offset in height and length to produce a rotation that will make a rotation around another point in the space of the arm

In the *"Finger mode"*, the user controls the opening and closing of the fingers.



The MICO arm will sometimes respond differently to a given command than described in this section. This may be due to the singularity avoidance algorithms embedded in the kinematics. It is a normal protective behaviour of the MICO arm and is position dependant.

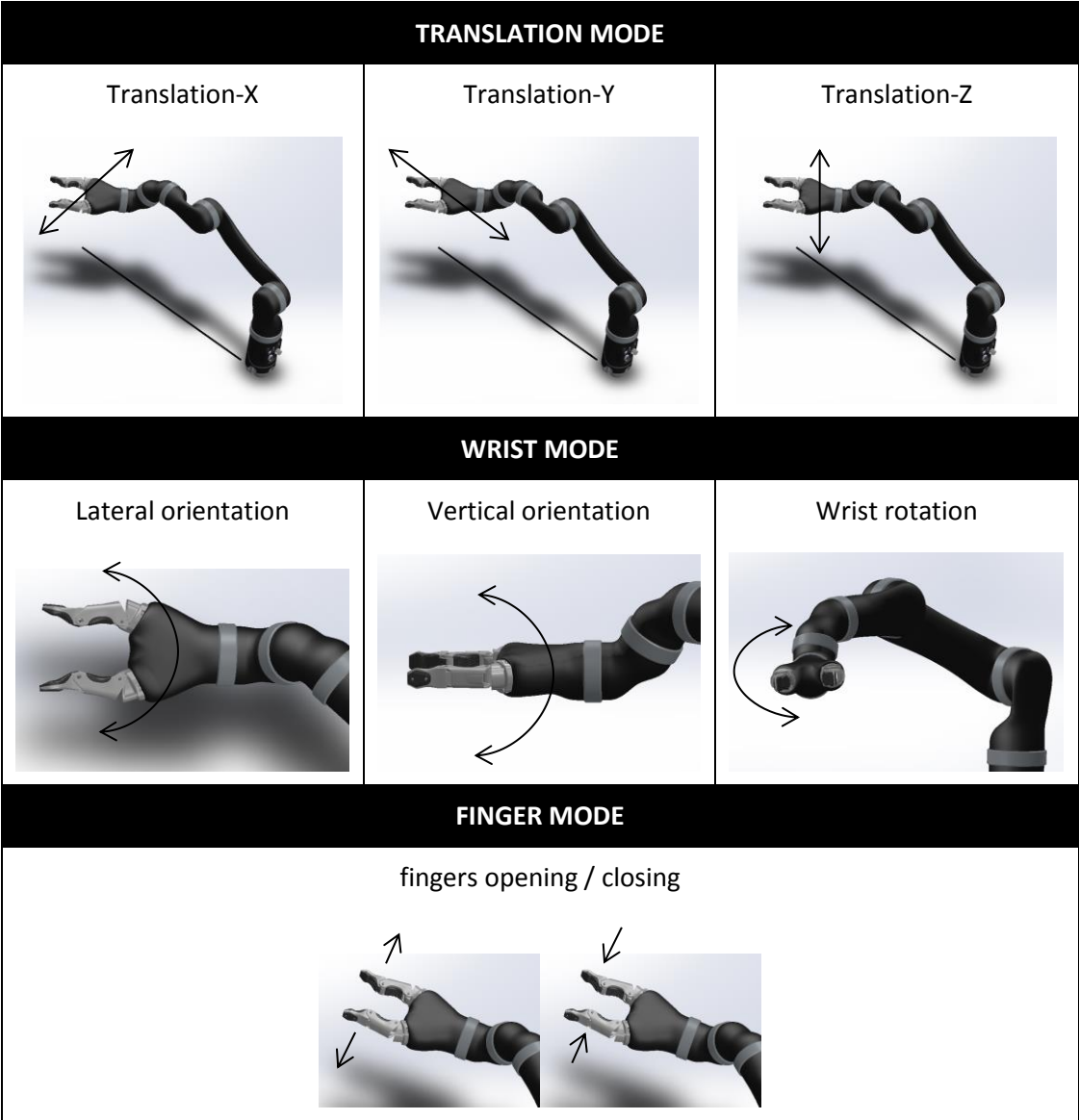


Figure 10 - The MICO arm basic movements

HOME/RETRACT Positions

The MICO arm comes with two factory default pre-set positions that may be configured by a certified technician: the HOME and the RETRACT position.

- The HOME position refers to the position of the arm when it is ready to be used. In the HOME position, MICO is awaiting a command from the joystick.
- The RETRACT position refers to the position of the arm when it is not used. The user should always place the arm in the RETRACT position when it is unused as it diminishes the physical volume occupied by the arm. In the RETRACT position, MICO is in standby mode; the joystick features are disabled and power consumption is much lower.



Never use the HOME/RETRACT function when carrying liquid. The HOME position is pre-set and the wrist may have to rotate and drop the liquid.

Operating the MICO arm via Joystick

This section explains how to operate the MICO arm with factory configuration⁸, contact your reseller for operation instructions with your adapted configuration.



Before operating the MICO arm, please make sure it is properly installed.



Do not manipulate cutting, very sharp or any dangerous tools or objects with the MICO arm.



This equipment is not designed to act as a lift.



This equipment is not designed to be used in presence of flammable mixture. (Not AP or APG rated).



Do not install the MICO arm near any heat sources, such as radiators. Do not use it to directly manipulate hot objects.

⁸ You may also refer to the reminder presented in appendix 4.

MICO - User Guide

The following instructions will help you start with the device⁹. For a step-by-step formation on the use of the MICO arm, please refer to appendix 2.

- 1) Turn ON the device by pushing the On/Off switch located on the MICO arm fixed base.
- 2) Wait until the green lights on the controller stop flashing.
- 3) Put the MICO arm in its HOME position by holding the HOME/RETRACT function until the MICO arm stops moving. The arm will slowly reach the HOME position.

When starting the MICO arm, you are in 3-Axis operation mode and *"Translation mode"*.



One must open the fingers at their maximum opening range when using them after powering up MICO.

To change the operating mode of the Joystick, hold the On/Off button for 2 seconds. At this point, the stick rotation is not effective anymore.



When the power is turned off, the MICO arm will fall on itself and may damage itself, depending on its position at the time of disconnection. Be sure to support its wrist before turning the power off.

⁹ Those steps may change upon different configurations.

THREE-AXIS MODE

<u>JOYSTICK MOVEMENT</u>	<u>MICO ARM MOVEMENT</u>
TRANSLATION MODE	
Incline FRONT	Hand moves forward
Incline BACK	Hand moves backward
Incline LEFT	Hand moves left
Incline RIGHT	Hand moves right
Rotate stick CLOCKWISE	Hand moves up
Rotate stick COUNTER-CLOCKWISE	Hand moves down
WRIST MODE	
Incline FRONT	Vertical orientation – Top side
Incline BACK	Vertical orientation – Bottom side
Incline LEFT	Lateral orientation – Thumb side
Incline RIGHT	Lateral orientation – Index side
Rotate stick CLOCKWISE	Wrist rotation clockwise
Rotate stick COUNTER-CLOCKWISE	Wrist rotation counter-clockwise
FINGER MODE	
Incline LEFT	Close Fingers
Incline RIGHT	Open Fingers

Figure 11 – Reminder for 3-Axis operation mode

TWO-AXIS MODE

<u>JOYSTICK MOVEMENT</u>	<u>MICO ARM MOVEMENT</u>
TRANSLATION-X & TRANSLATION-Y	
Incline FRONT	Hand moves forward
Incline BACK	Hand moves backward
Incline LEFT	Hand moves left
Incline RIGHT	Hand moves right
TRANSLATION-Z & WRIST ROTATION	
Incline FRONT	Hand moves up
Incline BACK	Hand moves down
Incline LEFT	Wrist rotation clockwise
Incline RIGHT	Wrist rotation counter-clockwise
WRIST ORIENTATION	
Incline FRONT	Vertical orientation – Top side
Incline BACK	Vertical orientation – Bottom side
Incline LEFT	Lateral orientation – Thumb side
Incline RIGHT	Lateral orientation – Index side
FINGER MODE	
Incline LEFT	Close Fingers
Incline RIGHT	Open Fingers

Figure 12 – Reminder for 2-Axis operation mode

Operating the MICO arm via the API

All functionalities of the external Joystick and a lot more are accessible via a computer API that can be accessed through the USB port. Please refer to the complete API documentation in order to use this operating mode of MICO.

Normal Use Definition

The definition of a normal use of the MICO arm also includes that you can lift, push, pull or manipulate a maximum load of:

- 1.25 Kg from minimum to middle reach (35 cm distance between the fixed base of MICO and the load);
- 750 g from middle to full reach (70 cm distance between the fixed base of MICO and the load);

The arm is designed to be able to hold objects in the environment of the user, but it is a manipulator that in some positions and loads near the maximum reach and maximum loads holds for a long period, it can heat. When this occurs, before overheating and being dangerous for either the user or the arm, red lights on controller will blink. This is a warning, simply put down any object in the hand, and brings back the arm to HOME or RETRACT positions and wait until the warning goes away before using the arm.

If you don't use a Joystick controller in your application, make sure to read all the error statuses and temperature of all actuators modules via the API to ensure that they do not go higher than recommended parameters. If this occurs, the arm should be held in an idle position near the base for a certain time without any object in the hand to cool down the arm.



When lifting weight near the maximum load and reach, if the red lights of the controller blinks, put down the object in the hand, and bring back the arm to HOME or RETRACT position and wait until the warning goes away before using it.



During normal operation, the joints are subject to heating. The joints are normally covered with plastic rings which will protect the user from any danger that may be occurred by the heating of the metal parts.

CONSERVATIVE USE OF THE HAND AND FINGERS

The fingers of the MICO arm are made flexible in order to protect the internal mechanism. When using the fingers to push on objects, the user must take special care not flex the fingers beyond their maximal opening as this could damage the internal mechanism.



Do not force the fingers beyond their maximal opening as this could damage some internal components.

ELECTROMAGNETIC INTERFERENCE FROM RADIO WAVE SOURCE

Even if MICO 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 MICO stop moving for a period of 10 seconds. In this case, the MICO arm will simply re-initialize and you will be able to continue to use it. In extremely rare case, it can also permanently damage the MICO arm control system.

The intensity of the interfering EM energy can be measured in volts per meter (V/m). MICO 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) Hand-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 devices¹⁰).
- 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) radios¹¹.

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

¹⁰ Some cellular phones and similar devices transmit signals while they are ON, even when not being used.

¹¹ Other types of hand-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 MICO.



Do not operate hand-held transceivers (transmitter's receivers), such as citizens band (CB) radios, or turn ON personal communication devices, such as cellular phones, while the MICO 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 MICO's base, may make it more susceptible to EMI (There is no easy way to evaluate their effect on the overall immunity of the power wheelchair and/or your MICO).



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

MAINTENANCE AND DISPOSAL

Cleaning Instruction

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

- Prepare a water/soap preparation using a proportion of about 2ml of dish soap for 100ml of water;
- Immerge 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 MICO arm under water or snow.



MICO is not intended to be sterile. No sterilization process should be applied to the arm.



Do not rub the external surfaces with abrasive materials.

Preventive Maintenance

The MICO arm requires no maintenance other than cleaning and lubricating the fingers 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 MICO arm does not operate normally or has been dropped.



There is no “home serviceable” part inside MICO, do not open.

Disposal



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

PACKING MATERIAL

The MICO arm packing material can be disposed as recyclable material.

METAL PARTS

The MICO arm metal part 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

- MICO's serial number¹²
- Date/Time of the problem
- Environment where the problem occurred (per example 30° Celsius, raining, ...)
- Actions performed immediately before the problem occurred



355 Peel, #301
Montreal, Quebec (Canada)
H3C 2G9

www.KinovaRobotics.com

¹² This will allow the support agent to have all the information regarding your MICO as the software version running in the device, the part revisions and characteristics, etc.

APPENDIX 1: JOYSTICK MOVEMENTS

As previously stated, the Kinova's joystick is a 3-Axis joystick mounted on a support. The joystick axes refer to the following actions:

- Incline left/right
- Incline front/back
- Rotation of the lever clockwise/counter-clockwise

The following figure shows Kinova's joystick's movements.

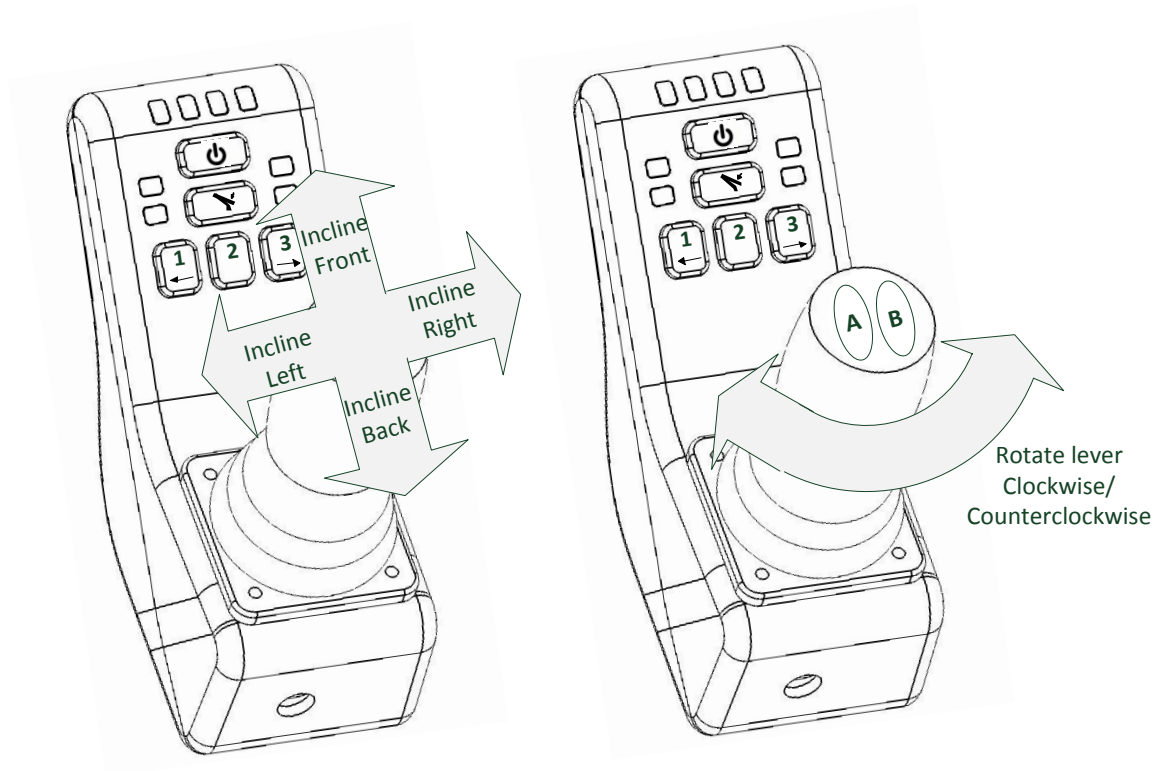



Figure 13 - Kinova's joystick possible commands

APPENDIX 2: STEP-BY-STEP APPROACH TO OPERATE THE MICO ARM

This section explains how to operate the MICO arm with the factory default configuration.

Getting started

- 1) Turn ON the device by pushing the **ON/OFF switch** located on the MICO arm base.
- 2) Wait until the green lights on the controller stop flashing.
- 3) Put the MICO arm in its **HOME** position by holding the **HOME/RETRACT** function () until the MICO arm stops moving. The arm will slowly reach the **HOME** position.



When starting the MICO arm, you are in 3-Axis operation mode, “Translation control mode”, meaning that any movement of the joystick will move the center of the hand parallel to the floor.



To change the operating mode of the Joystick, hold the ON/OFF button for 2 seconds. At this point, the stick rotation is not effective anymore.

- 4) You may move the 3 axis of the joystick to experience the Translation control mode.



Don't forget the lever rotation.

- 5) One hit on **Button B** will bring you in Wrist control mode meaning that any movement of the joystick will result in a rotation around the center of the hand.



Another hit on Button B will bring you back in Translation control mode.


- 6) One hit on **Button 1** will activate the Drinking mode which may be used only in Wrist mode. When rotating the joystick lever, you will see the MICO arm's wrist rotation now compensate for height and distance while turning. This movement is ideal when trying to drink directly from a glass.




Another hit on Button 1 will disable Drinking mode.


- 7) One hit on **Button A** will bring you in the Finger control mode. The fingers will move according to a left/right inclination of the joystick.



At any time, you may use the HOME/RETRACT function () until the arm stops moving to bring it back into its HOME position.



If you hold the HOME/RETRACT function () again, the arm will start to move toward its RETRACT position.

- 8) Hold the **On/Off Button** () for 2 seconds to change the operating mode. This will disable the stick rotation. You are now in a 2-Axis Translation control mode.

As the stick rotation won't have any effect, you may only control the horizontal translation of the arm (Translation-X and Translation-Y)

- 9) One hit on **Button 3** will bring you to control the vertical translation of the hand (Translation-Z) and Wrist rotation.



Another hit on Button 3 will bring you back in Translation-X and Translation-Z control mode.

- 10) One hit on **Button 1** will activate the Drinking mode which may be used only in Wrist mode. When rotating the joystick lever, you will see that the MICO arm's wrist rotation now compensate for height and distance while turning. This movement is ideal when drinking directly from a glass.

- 11) One hit on **Button 2** will bring you to control the wrist orientation (Lateral orientation and Vertical orientation).

- 12) One hit on **Button 2** will bring you to Finger control mode. The fingers will move according to a left/right inclination of the joystick.



Another hit on Button 2 will bring you back in Lateral orientation and Vertical orientation control mode.

APPENDIX 3: INSTALLATION OF THE MICO ARM

The MICO arm's installation on the wheelchair comprises the following three steps:

- 1) Mechanical integration;
- 2) Electrical integration;
- 3) Control integration.

Mechanical integration

The MICO arm is devoted to be installed on a mobile platform or fixed base. Please make sure the arm is fixed in a way that its base cannot fall or break during maximum reach operations of the arm.

Electrical integration

The MICO arm is powered via the wheelchair batteries (24V) using the charging connector.

Control integration

The MICO arm is controlled using the Kinova's joystick or via a computer through API. An adequate location should be determined for the joystick. An adequate location refers to a place where normal movements of the user won't interfere with.

APPENDIX 4: REMINDER ON THE MICO ARM OPERATION

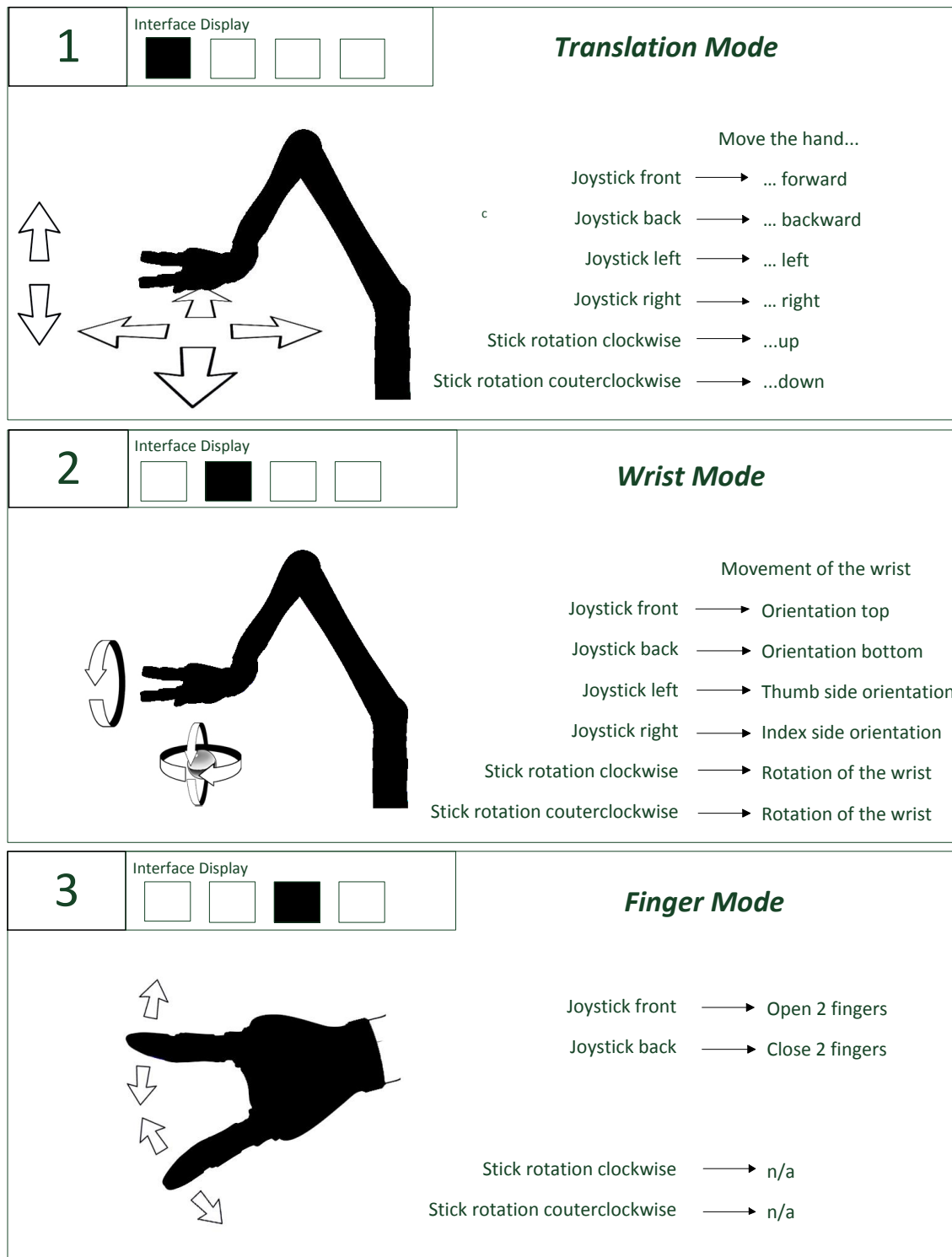


Figure 14 - Visual reminder for 3-Axis operation mode

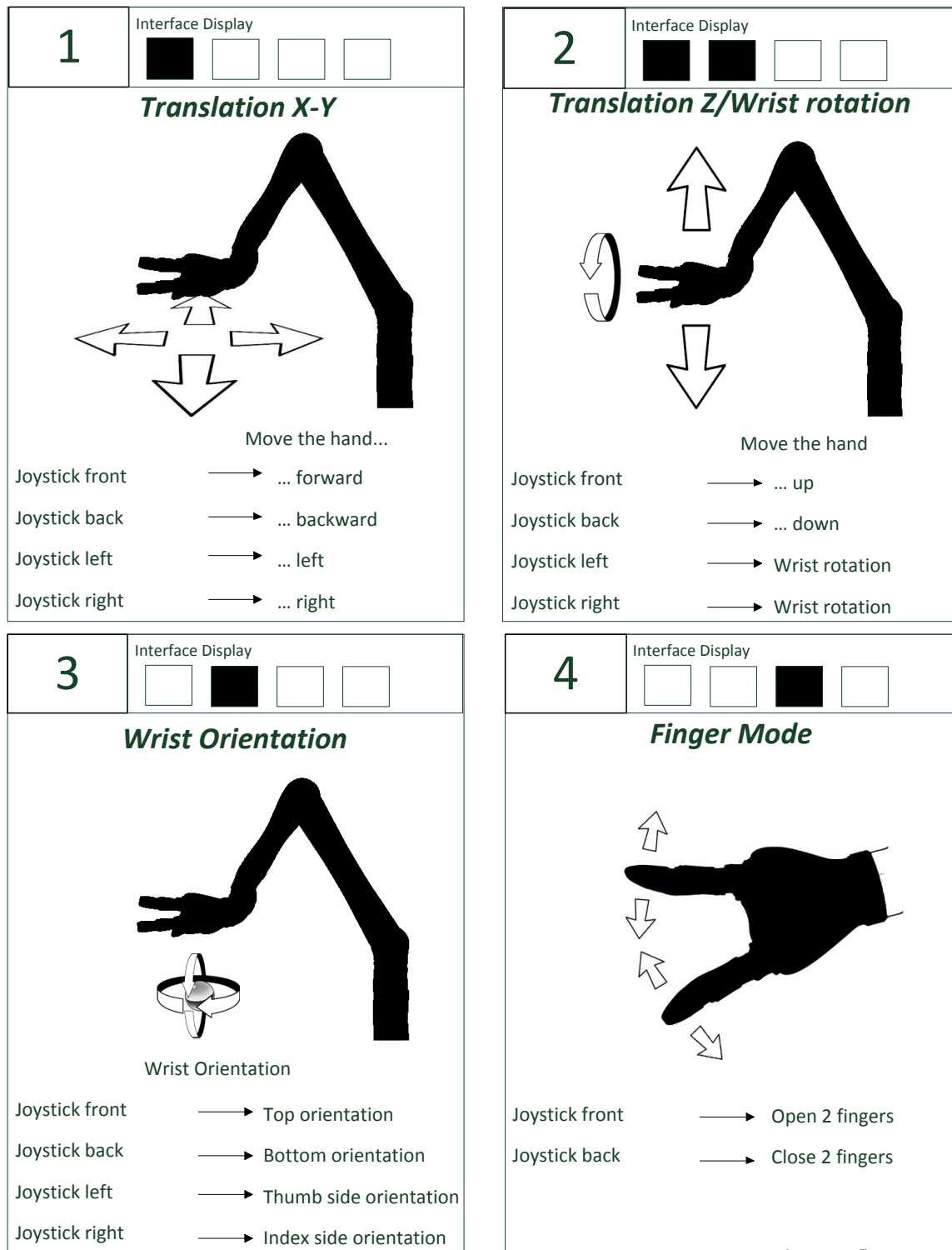


Figure 15 - Visual reminder for 2-Axis operation mode

APPENDIX 5: MAJOR WARNING REMINDER



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



Never use the HOME/RETRACT function when carrying liquid. The HOME position is pre-set and the wrist may have to rotate and drop the liquid.



Do not manipulate cutting, very sharp or any dangerous tools or objects with the MICO arm.



When the power is turned off, the MICO arm will fall on itself and may damage itself, depending on its position at the time of disconnection. Be sure to support its wrist before turning the power off.



Do not force the fingers beyond their maximal opening as this could damage some internal components.



Do not immerse any part of the MICO arm under water or snow.



When lifting weight near the maximum load and reach, if the red lights of the controller blinks, put down the object in the hand, and bring back the arm to HOME or RETRACT position and wait until the warning goes away before using it.