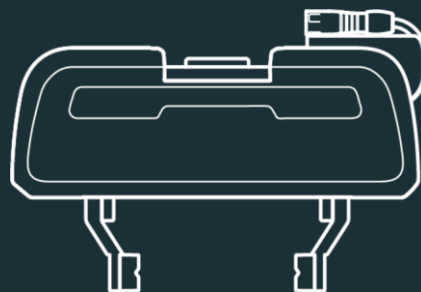




FRANKA HAND

Product Manual



ORIGINAL HANDBOOK

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The content of this document has been carefully checked against compliance with the hardware and software described. However, discrepancies cannot entirely be ruled out, which is why we assume no liability for complete compliance.

In the interest of our customers, we reserve the right to undertake improvements and corrections to hardware, software, and documentation at any point in time without notice.

We are always grateful for your suggestions and comments at documentation@franka.de.

The English documentation is the ORIGINAL DOCUMENTATION. Other languages are translations of this original document.

Complementary documents to this Hand product manual are:

- Connecting the Hand guide (Document number:220030)

Documentation number: 220010
Release Version: 1.0 (2022)



Get your manual and additional supporting material in English and other languages at www.franka.de/documents.

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1 ABOUT FRANKA EMIKA



FRANKA EMIKA

Enabling industrial automation

Franka Emika (FE) is a German tactile robotics platform company.

Our mission is to provide robotics as production services, making it intuitive and universally accessible for everyone. With this mission in mind, we redefined robotics with cost-efficient and the most easy-to-use robot for industrial automation – the Franka Production 3 robot.

Our human-centered design in the technology with seven axes is tactile and safety certified, making it available for all kinds of use cases in the industry.

Our AI-enabled collective learning platform enables scalable software solutions and reduces learning time and resources to a minimum with intuitive and simple programming.

We provide an inclusive robotics platform with hardware and software – operating within one ecosystem.

Designed, developed, manufactured, and serviced in Germany.

Introducing Franka World – a digital robotics platform

After redefining robotics and establishing a community, we launched a novel digital robotics platform to interconnect the digital world with the physical world.

Franka World allows community interaction between researchers, partners, customers, developers, suppliers, and robots. In addition, all users can easily gain integrated access to products and services and manage their entire robot fleets, independent of their physical location.

We strive for a world where everyone can use a robot, and we can reach that by connecting the world. We treasure our community of robotics professionals, academics, and enthusiasts, from whom we learn every single day.

As members of the community ourselves, we commit to supporting each other and thriving together. Franka Emika – a certified robotics platform with tactile intelligence

2 ABOUT FRANKA HAND

This is Franka Hand

is an electrical two-finger parallel gripper produced by Franka Emika. No external cabling is needed. Communication and power supply for the Hand is established via the flange connector of the Arm.

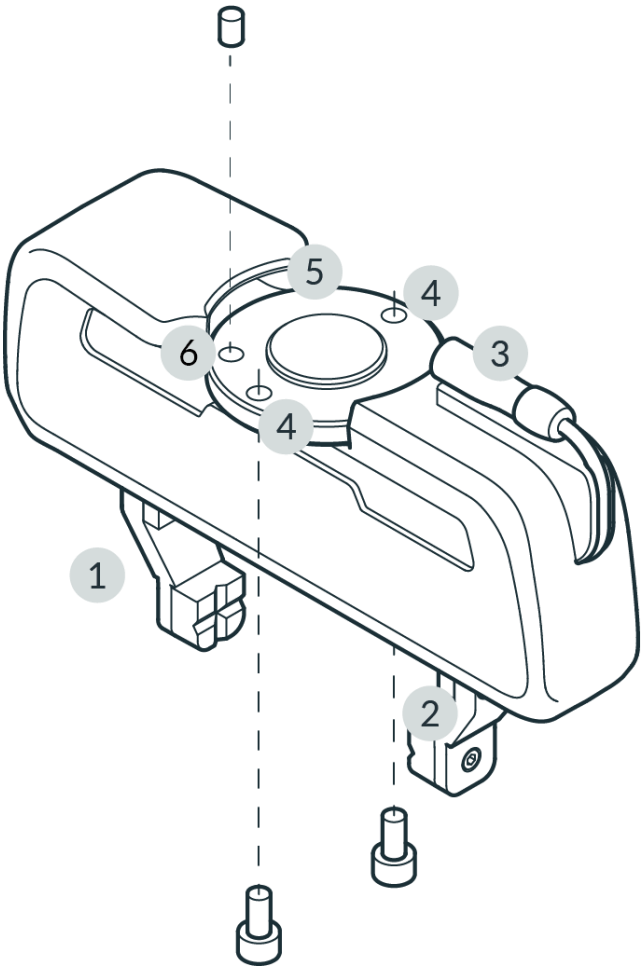


Figure 2.1

1	Finger	4	Screw holes
2	Fingertip	5	Flange to Arm
3	Plug	6	Hole for alignment pin

Fingertips	The fingertips can easily be changed and adapted to the objects to be grasped (e.g. using 3D-printed fingertips).
Fingers	The fingers can also be mounted in a rotated orientation in order to increase the span length of the gripper.
Plug	The plug is simply plugged into the X6 end effector connector port on the grip of the Arm.
Interface/flange	The interface/flange of Franka Hand is designed according to DIN ISO 9409-1-A50.

3 RIGHTS OF USE AND PROPERTY RIGHTS

3.1 General

Protected trademarks

In this handbook we refer to protected trademarks that are not designated explicitly as such in the continuing text. The absence of such indication may not imply that the corresponding product name is free of third-party rights. The following trademarks are protected trademarks:

- Franka and Franka Emika are registered trademarks.

Trademark rights

The responsible person is not granted any rights or claims to the trademark, logo, or trade names of Franka Emika.

Use of open-source codes

A complete list of all open-source licenses used by compatible Franka Emika robots can be accessed via the settings menu of the Franka UI.

3.2 Identification

Removal of identification

Copyright notices, serial numbers, and any other kind of labelling serving to identify the product or operating software may not be removed or modified.

4 SAFETY

4.1 Safety Instructions and General Indications

Before installation, start-up, and operation of the device, carefully read this manual and any additional documentation related to it. Take note of the safety instructions as well as general indications.

Warning notices are posted as follows:

CAUTION

Type of hazard
Potential consequences of hazard
Evasive/avoidance actions to be taken

Warning notices

The following warning notices are used in this manual:

DANGER

DANGER indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE indicates information considered important but not hazard related.

SAFETY- INSTRUCTION

SAFETY INSTRUCTION indicates processes that need to be strictly observed.

Indications



Indicates where further information can be obtained.

4.2 Notice of Liability

Franka Hand has been developed according to the relevant quality standards. A hazard and risk assessment according to EN ISO 12100 has been carried out through the course of development and is the basis for Franka Hand and this manual.

The present document includes assembly instructions for compatible Franka Emika robots as partly completed machinery. It contains descriptions of the conditions which must be met with a view to correct incorporation in the final machinery, so as not to compromise safety and health (e.g. Annex I of Machinery Directive 2006/42/EC).

4.3 Intended Use

Use the Hand only in connection with compatible Franka Emika robot systems and the associated intended use. Franka Hand can be used for research and industrial use.

The end effector may be applied only in the ambient and operating conditions described in this document for the tasks of e.g., testing and inspection, handling, or mounting.

Franka Hand may only be used in sound technical condition, for its intended purpose and within the technical specifications and operating conditions, with awareness of safety and possible dangers.

The present Franka Hand end effector is intended exclusively for use as described in this manual.

For the normal and extended working conditions under which the Hand should operate, see Technical Specifications.

4.4 Misuse

Misuse of the Hand voids the manufacturer's warranty and liability. Any application different to the intended purpose is considered a misuse and is not permissible.

WARNING

Misuse may lead to danger to life and limb, impairments, damage to the robot, and other material assets. The manufacturer is not liable for damages caused by misuse.

Misuse is any use that deviates from the warnings, notices, and instructions in this manual, in particular, but not limited to, the following uses:

- Transportation of people and animals
- Transportation without original packaging
- Use in potentially explosive areas
- Use below ground
- Use in handling of radioactive objects
- Use outdoors
- Use as a medical product
- Use in the vicinity of children
- Handling of liquids
- Use in any position other than upright
- Use outside of the specified operating limits

Modifications to the Hand that are not explicitly permitted by Franka Emika are not allowed and will lead to loss of warranty and liability claims. Not permitted modifications include, but are not limited to, the following:

- Any adaption of the mechanical structure
- Varnishing
- Enwrapping the robotic structure

It is prohibited to open the Hand enclosure and other equipment.

Franka Emika is not liable for damages caused by mounted, grasped or lost equipment or damages caused by misuse.

4.5 General Possible Dangers and Safety Measures when Working with Robots

An extensive but not definitive list of dangers that generally may be presented by a robot system can be found under EN ISO 10218-1:2011 ANNEX A.

Before putting the Hand into use with a robot, an application-specific risk assessment (e.g., according to EN ISO 12100 and/or EN ISO 10218-2) must be performed by the integrator.

SEEPS ("Safe End Effector Power Off" safety function) may be configured in the robot accordingly. For more information, see chapter Safety Settings and Watchman in the relevant Franka Production product manual.

5 TECHNICAL SPECIFICATIONS

Technical drawings

Interface flange of Hand

(tightening torque for fastening the Hand to the robot: M6, quality 8.8: 9.8 Nm)

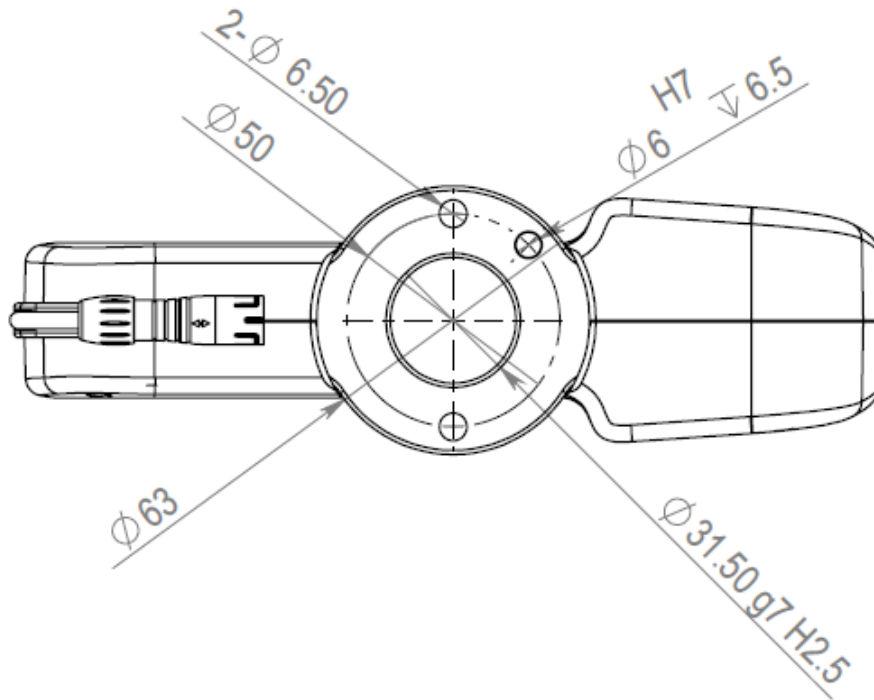


Figure 5.1

Hand to fingers interface

- Hand to fingers screws: 4x M4x12
- Thread diameter: 4 mm
- Tightening torque: 2.25 Nm.

Finger to fingertips screws: 2x DELTA PT® 40x10 WN 5451

- Thread diameter: 4 mm
- Tightening torque: 0.3 Nm

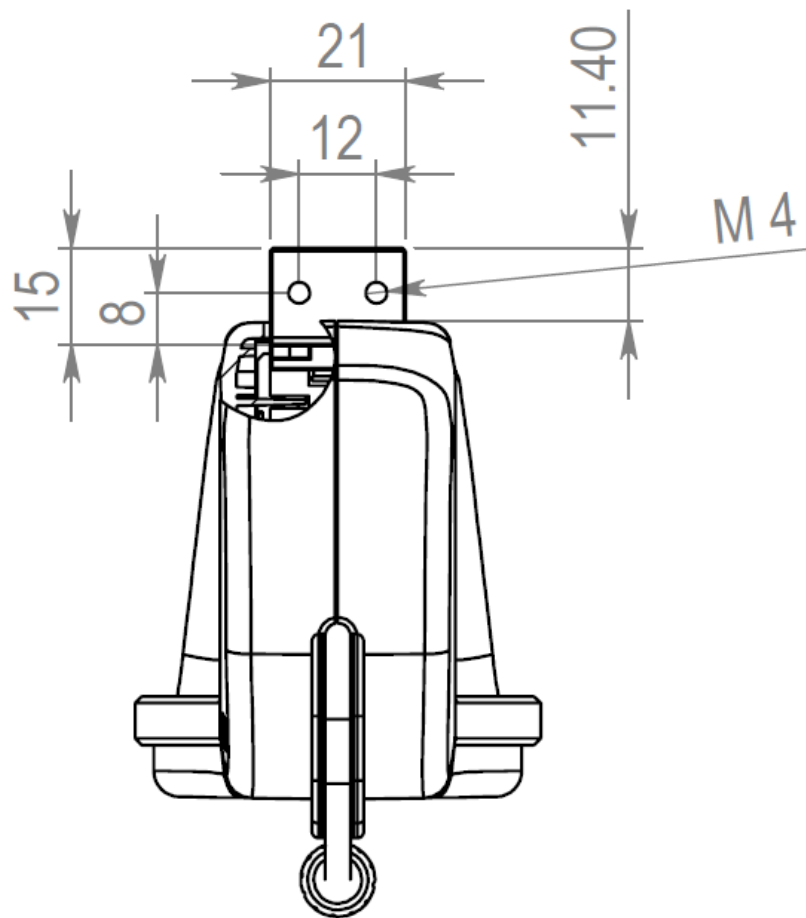


Figure 5.2

Finger to fingertips interface

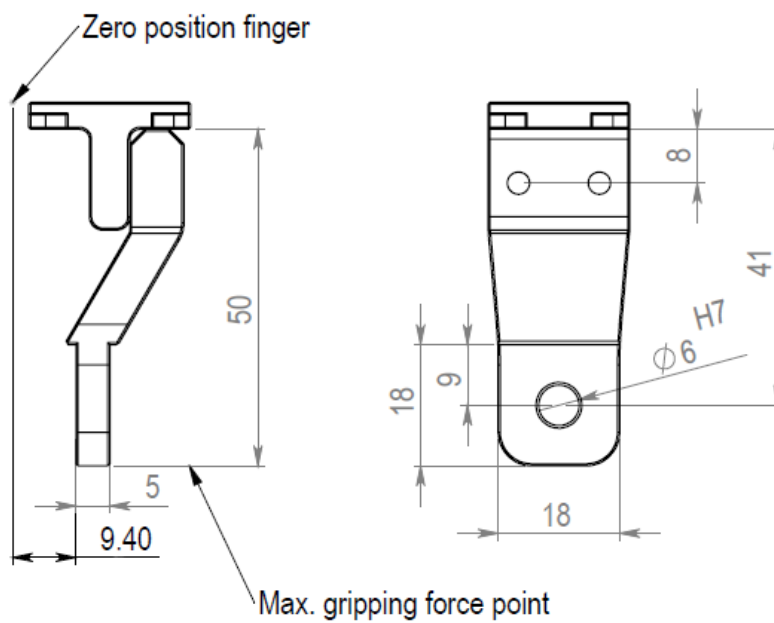


Figure 5.3

In the scope of delivery of the Hand there are standard fingertips which are suitable to be mounted to the fingers of the Hand. Should you design and mount other fingers to the Hand, the following needs to be noted:

Production standard

Carry out a risk assessment and implement the measures resulting from it.

Gripping of an object at a distance of the finger to the Hand will lead to tilting loads. The Hand is designed and tested for a finger length of 54 mm.

Mechanical data

Weight of Hand [kg] 0.73

Center of mass of Hand to end effector flange [m]

$$\mathbf{p}_{CoM} = \begin{bmatrix} x_{CoM} \\ y_{CoM} \\ z_{CoM} \end{bmatrix} = \begin{bmatrix} 0.01 \\ 0 \\ 0.03 \end{bmatrix}$$

Figure 5.4

Inertia tensor [kgm²]

$$\mathbf{I} = \begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix} = \begin{bmatrix} 0.001 & 0 & 0 \\ 0 & 0.0025 & 0 \\ 0 & 0 & 0.0017 \end{bmatrix}$$

Figure 5.5

Transformation matrix of end effector flange to Hand (i.e., to center point of fingertips when closed, as illustrated in the figure below)

$$\mathbf{F}^{T^{TCP}} = \begin{bmatrix} R_{xx} & R_{xy} & R_{xz} & p_x \\ R_{yx} & R_{yy} & R_{yz} & p_y \\ R_{zx} & R_{zy} & R_{zz} & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.707 & 0.707 & 0 & 0 \\ -0.707 & 0.707 & 0 & 0 \\ 0 & 0 & 1 & 0.1034 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Figure 5.6

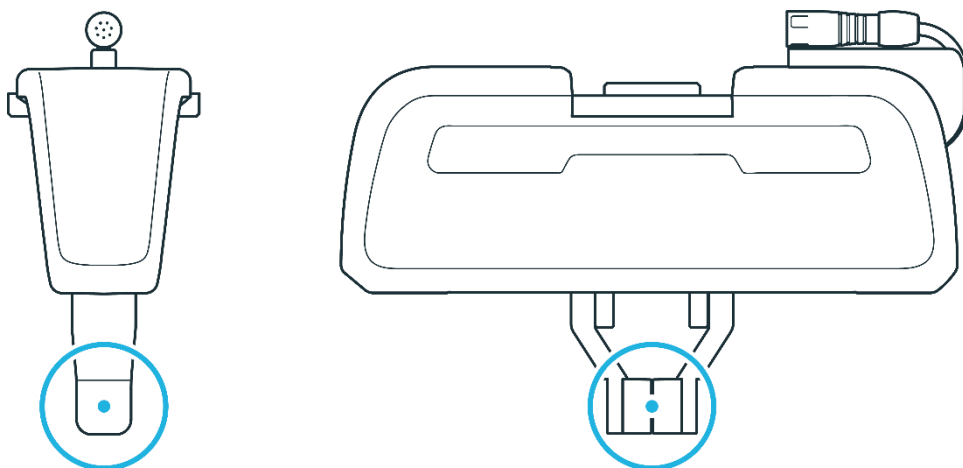


Figure 5.7

Grasping (continuous) force [N] adjustable: 30-70

Travel span [mm] 80

Travel speed (per finger) [mm/s] 50

6 SCOPE OF DELIVERY

Scope of delivery and additionally required equipment

Main components:

- Hand

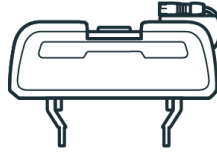


Figure 6.1

Also included:

- 1 set of fingertips
- 2 x DIN7984 M6x12 ST 8.8 screws
- 1 x ISO2338B 6x10 h8 A2 cylindrical pin
- Connecting the Hand Guide



Figure 6.2

Additional required equipment:

- Hex key size 4
- A compatible Franka Emika robot system

7 MOUNTING AND INSTALLATION

7.1 Correct Site of Installation

Ambient conditions

Site of installation

- Indoors, in enclosed buildings
- Not exposed to direct sunlight
- No vibrations
- External magnetic fields are allowed in the magnitude of the earth's magnetic field only

Type of installation

- Screwing connection to a compatible Franka Emika robot's end effector flange

Protection class

- IP 20 (according to EN 60529:1991)

Ambient medium

- Air
- Free from flammable substances (dust, gas, liquid)
- Free from aggressive media
- Free from corrosive substances
- Free from "flying parts"
- Free from spraying liquids
- Free from pressurized airstreams

Pollution degree

- Degree 2 (according to IEC 60664)

Only dry, non-conductive pollution occurs; occasionally temporary conductivity caused by condensation may occur.

Ambient temperature

- +15 °C to 25 °C (typical)
- +5 °C to + 45 °C (extended)
- -10 °C to + 60 °C (transport)
- +5 °C to + 25 °C (storage)

Relative air humidity

- 20 % - 80 %, non-condensing

Set-up altitude

- <= 2000 m above sea level

7.2 Mounting the Hand

WARNING

Falling Hand

Risk of severe injury, such as crushing to fingers, hands, upper body, head.

- Ensure the Hand is mounted correctly.

WARNING

Risk of electric shock

Risk of personal injury by electric shock.

- Disconnect the Arm from the mains power supply before mounting the Hand.

WARNING

Falling objects/tools

Objects or tools could fall at any time (e.g., due to loose couplings, malfunctions that can cause the Hand to open or when a compatible FrankaEmika robot is switched off, or the power to the robot system is cut) which could lead to injury to fingers, hands, toes, and feet.

- Take this into consideration while performing a hazard and risk assessment
- Take also the SEEPO into account in the risk assessment because the Hand will only be powered if brakes are open due to a configuration of the SEEPO

WARNING

Falling and/or flying tools from the robot

Tools that remain inserted in the robot may turn into projectiles during later motions of the Arm and lead to injuries.

- Do not leave any tools inside the robot.

Precondition: The robot is switched off before mounting the Hand.

Required material: 2x M6x12
Cylindrical pin

Mounting

1. If desired, insert the cylindrical pin in the H7 fit of the flange of the Hand.
2. Position the Hand with its flange on the end effector flange on the Arm.

Should you not use the cylindrical pin, make sure that the side of the Hand with the cable is attached on the side of the Pilot-Grip where the connector is located.

3. Attach the Hand with 2 x M6x12 screws (do not use other types of screws) and use 5 Nm of fastening torque.
4. Insert the plug connector of the Hand into the X6 connector on the Pilot-Grip of the Arm.

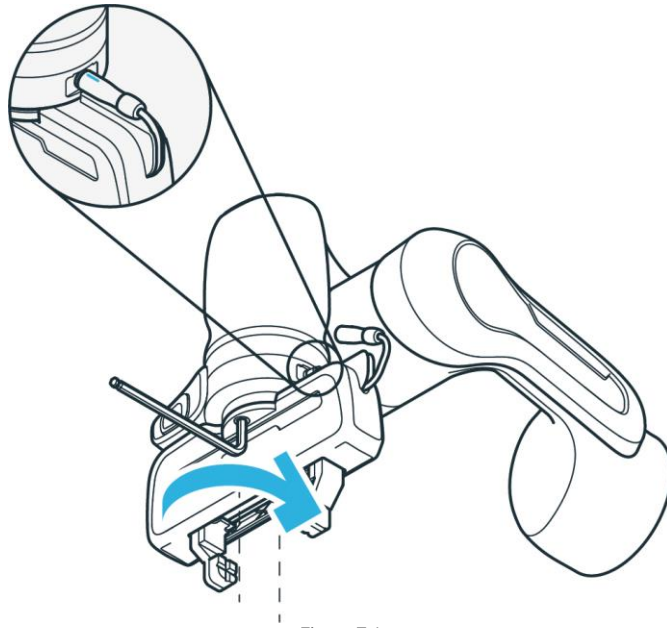


Figure 7.1

NOTICE

Material damage to the Hand

Using other screws and a higher torque than mentioned in the manual may lead to damage to the Hand.

- To fix the hand, only use 2x M6x12 screws.
- Only use 5 Nm of torque.

NOTICE

Material damage to the Hand

Connecting or disconnecting live cables or connectors during operation may lead to damaging the Arm or the Hand.

- Do not connect or disconnect the Hand while a compatible FrankaEmika robot is not safely disconnected from the mains power supply.

NOTICE

Using the above-mentioned screws, the screw-in depth is 8mm. This should never be exceeded!

7.3 Configuration

WARNING

Unexpected motions during guiding due to incorrectly configured end effectors

Incorrectly configured end effector mass and inertia may result in the gravitational forces not being fully compensated for. The resulting and unexpected behavior of the robot including end effector may lead to injuries such as crushing, tearing of skin, and puncturing.

- Always check the configuration of the end effector.
- When copying an already parametrized app or task to another compatible FrankaEmika robot system, ensure that the end effector configuration is still identical to the original one.

When first starting compatible Franka Emika robots – by means of the initial configuration – or at a later point in time by accessing the end effector settings, the Hand can be selected from a dedicated dropdown menu.

End effector

Power Status



Select End effector



Mechanical Data

Default

DOWNLOAD 

UPLOAD 

 You should find the required values in the **manual / specification** of your End-Effector.

Figure 7.2

If you want to use another gripper or adjust the configuration of the Hand, select “User Defined” from the drop-down menu and enter the corresponding values into the text fields.

The default settings of the Hand are as follows:

Franka Hand

▼

Mass

0.73

↕

kg

Flange to Center of Mass of Load Vector

-0.01

↕

0

↕

0.03

↕

m

Inertia Tensor

0.001

↕

0

↕

0

↕

0

↕

0.0025

↕

0

↕

kg × m².

0

↕

0

↕

0.0017

↕

Transformation Matrix from Flange to End-Effector

0.7071

↕

0.7071

↕

0

↕

0

↕

-0.7071

↕

0.7071

↕

0

↕

0

↕

0

↕

0

↕

1

↕

0.1034

↕

0

↕

0

↕

0

↕

1

↕

m

Figure 7.3

A correct configuration is essential for operating compatible Franka Emika robots. When configured incorrectly, gravitational forces are not entirely compensated and the Arm regulates to the wrong target values.

⚠ CAUTION

Unexpected moving of Arm

Incorrectly set mass and center of gravity values may lead to injuries, such as crushing.

- Check the mass and center of gravity for any end effector and the objects grasped by it.
- Correct the value if necessary.

When configured incorrectly:

- The Arm may pull towards certain directions in Guiding Mode.
- The regulation in Operating Mode may be affected so that the expected sensitivity of the Arm for collision detection is reduced.
- The tracking behavior may be affected.

For further information, refer to the Franka Production product manual.

If you are looking to attach additional tools between the Hand and flange and therefore require a longer connection cable, see chapter ADDITIONAL INFORMATION.

8 DISPOSAL

8.1 Cleaning

DANGER

Risk of electric shock

Improper use of liquid cleaning agents as well as incorrectly disconnecting devices from the mains supply can lead to fatal accidents.

- Do not clean devices that have not been safely disconnected from the mains supply.
- Do not use liquid cleaning agents for cleaning the devices.
- Do not switch on devices that have not fully dried.

The following things need to be kept in mind while cleaning:

- Cleaning may only be carried out by qualified persons.
- Cleaning of components is only permissible when compatible Franka Emika robots are safely disconnected from the power supply (Control disconnected from the mains).
- Switching off and unplugging the device is to be carried out by qualified persons.
- Do not spray any liquids directly onto the device.
- Do not use any cleaning chemicals.
- The components may only be cleaned using a dry cloth. Make sure that no moisture enters the devices.
- Do not apply great force to the Arm. The parts to be cleaned are to be supported manually, so as not to overload and possibly damage the Arm.
- Restarting is only permitted when all surfaces have dried completely.

NOTICE

Material damage to the end effector

- Do not use liquid cleaning agents for cleaning the end effector.

8.2 Disposal

Disposal

Disposal of Franka Hand may only take place according to the relevant country-specific laws, standards, and regulations.

Return of packaging waste

Please contact Franka Emika to process any returns of packaging waste.

9 SERVICE AND SUPPORT

NOTICE

If you have purchased your compatible Franka Emika robot at one of our sales partners or if you have cooperated with a service provider, please get in contact with them first. Our partners can consolidate information on our products and reach out to Franka Emika for troubleshooting and further support.

Please visit www.franka.world for supplemental material and additional information on our robots.

For any other requests regarding service and support please contact us at support@franka.de. A ticket for your request will be issued in our service and support center and our experts will respond as soon as possible.

10 PRODUCT CONFORMITY

10.1 Declaration of Conformity



Description of the machinery:

Product identification: Panda system component: Hand

Modell/Type:
Hand (#73912449)

We declare that the product complies with the essential requirements of the Machinery Directive 2006/42/EC.

In addition, the machinery is in conformity with the following EC Directives:
EC Directives 2014/30/EC relating to electromagnetic compatibility (EMC)

We declare that the relevant technical documentation is compiled in accordance with part A of Annex VII.

Applied harmonized standards

Machinery safety

Standard	Name
EN ISO 12100:2010 ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006/A1:2009/ A1:2010 IEC 60204-1:2005/A1:2008	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

EMC

Standard	Name
EN 61000-6-1:2007 IEC 61000-6-1:2005	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments
EN 61000-6-2:2005/ AC:2005 IEC 61000-6-2:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-3:2007/ A1:2011/AC:2012 IEC 61000-6-3:2006/ A1:2010	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
EN 61000-6-4:2007/ A1:2011 IEC 61000-6-4:2006/ A1:2010	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

We commit to transmit, in response to a reasoned request by the market surveillance authorities, relevant documents on the partly completed machinery. The industrial property rights remain unaffected!

Manufacturer:
Franka Emika GmbH
Infanteriestr. 19
80797 München
Deutschland

Representative in EU, authorized to compile the relevant technical documentation:
Johannes Schmid
Franka Emika GmbH
Infanteriestr. 19
80797 München
Deutschland

Datum
04.05.2018

Dr. Simon Haddadin, CEO

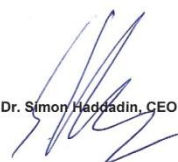


Figure 10.1

10.2 Further Statements

Further Information status: 08.04.2022 Franka Hand
Restriction of Hazardous Substances (RoHS): The product <i>Hand</i> does not fall within the scope of EU RoHS Directive 2011/65/EU, but still meets the requirements of the restricted substances and maximum concentration values that are allowed in homogenous materials: • Lead (0.1 %) • Mercury (0.1 %) • Cadmium (0.01 %) • Hexavalent chromium (0.1 %) • Polybrominated biphenyls (PBB) (0.1 %) • Polybrominated diphenyl ethers (PBDE) (0.1 %) The following exceptions are also applied: 6a: Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35 % lead by weight 6b: Lead as an alloying element in aluminum containing up to 0.4 % lead by weight 6c: Copper alloy containing up to 4 % lead by weight
REACH: <i>FRANKA EMIKA GmbH</i> is a "downstream user" as defined in REACH. Our products are exclusively non-chemical products (manufactured items). In addition, under normal conditions of use and the conditions which can reasonably be predicted, no substances are released (Article 7, REACH). We confirm that our products do not contain more than 0.1 percent by mass of any of the listed substances on the published ECHA candidate list (SVHC). Extensions published by the ECHA candidate list are matched with our products and if it is known that one of these newly added substances is contained in our products, we will inform you immediately. This confirmation was created based on currently available information of our suppliers.
WEEE Directive: The product <i>Hand</i> is not subject to the WEEE Directive 2002/96/EC for collection, recycling and recovery for electrical goods.

Figure 10.2

10.3 Labeling



Figure 10.3

11 USING THE HAND

⚠ WARNING

Falling objects/tools

Objects or tools could fall at any time (e.g., due to loose couplings, malfunctions that can cause the Hand to open or when a compatible Franka Emika robot is switched off, or the power to robot system is cut) which could lead to injury to fingers, hands, toes, and feet.

- Take this into consideration while performing a hazard and risk assessment.
- Take also the SEEPO into account in the risk assessment because the Hand will only be powered if brakes are open due to a configuration of the SEEPO.

To control the end effector, press the Pilot-Mode button of the Pilot-Disc on a compatible Franka Emika robot. The fingers of the Hand can be steered via the arrow keys:

- A To slowly open the Hand, keep the "left" key pressed.
- B To slowly close the Hand, keep the "right" key pressed.
- C To open the Hand to full width, press the "down" key once.
- D To make the Hand grasp with its holding force, press the "up" key once.

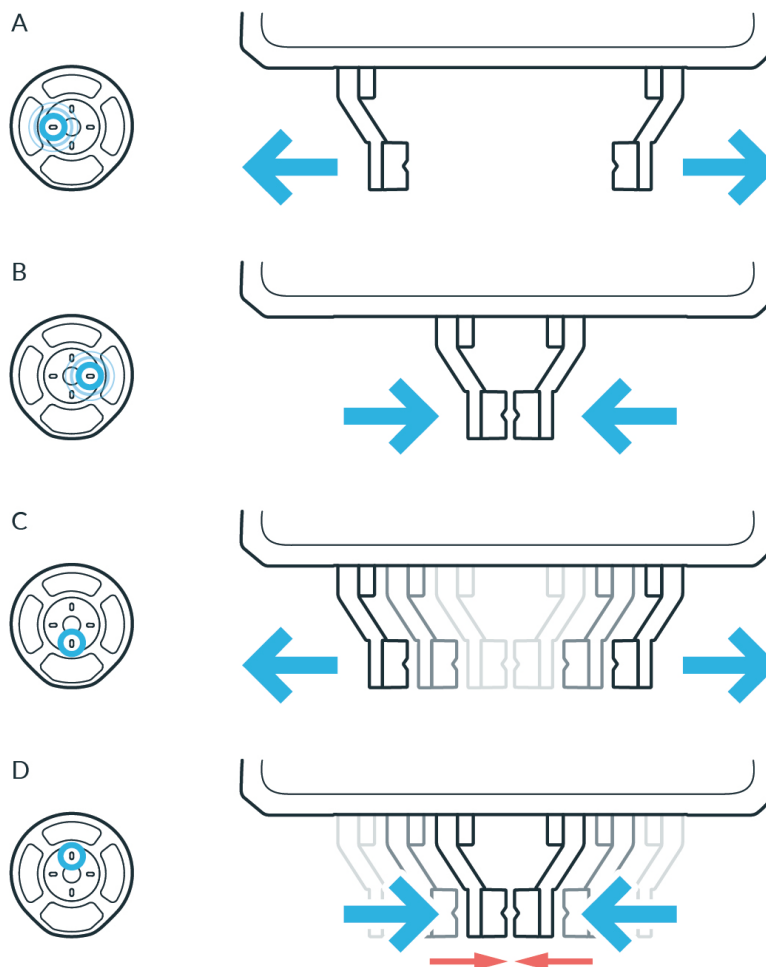


Figure 11.1

NOTICE

Material damage to the Hand

The Hand contains sensitive electromechanical components. These can be damaged if the Arm is moved into the transport position while the Hand is still attached! Remove any end effector before bringing the Arm into the transport position.

- Make sure that Hand has been removed before bringing the Arm into the transport position.

When the device is turned off, the Hand is not supplied with power either.

If the fingers of the Hand are jammed, they can be loosened by simply pulling the fingers open.

12 CUSTOMIZING

Use Franka Emika's 3D Lab to customize fingertips. 3D Lab is a web-based user interface to design 3D-printable fingertips, for an ideal, ad hoc object grip with your Franka Hand.

Access Franka Emika's 3D Lab from <https://world.franka.de/fingertip-configurator>

13 TROUBLESHOOTING

Desk shows Hand "disconnected"

Go to end effector settings and un-apply the Hand as end effector by choosing "None". Choose "Franka Hand" again and press apply. If the Hand is still disconnected:

1. Shut down the robot
2. Check if the Hand is connected properly or if any damages on the pins can be seen
3. Also check the connecting cable between Control and Arm for damaged pins or insufficient mounting
4. Reboot the robot

Fingertips are not moving / fingertips are stuck in the middle of a movement

If you cannot move the fingertips by Pilot-Disc buttons or command or if they get stuck, please check if the fingers can be moved by hand (to exclude physical damage). If so, please check the apps or commands you are using. Reboot the robot if necessary.

The Hand does not work with real time commands

Keep in mind that Franka Hand does not work with real time commands (applies only to research robots with FCI interface).

The Hand is moving down/up while hand guiding

Check the settings for the end effector in the Franka UI's Settings.

14 ADDITIONAL INFORMATION

Hand and SEEPO

Make sure the power to the end effector is applied by checking the SEEPO options of your compatible Franka Emika robot system in the safety setup in Watchman (Franka UI). SEEPO settings are to be derived from the above-mentioned application-specific risk assessment and may exemplarily be chosen as illustrated in picture.

END-EFFECTOR CONFIGURATION

Description
Franka Emika Hand

SEEPO Behavior
Safety Error

Power On Behavior
Automatic

Figure 14.1

Extending the connector cable

To add an equipment mounting flange between Hand and flange, extend the connector cable by adding an extension cable.

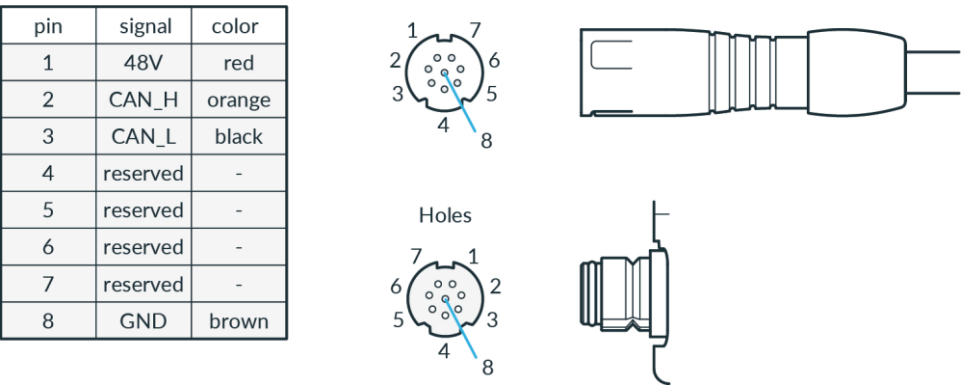


Figure 14.2

A Binder 8-pin male/female connection: Snap-in IP67 Series 620 is required.

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