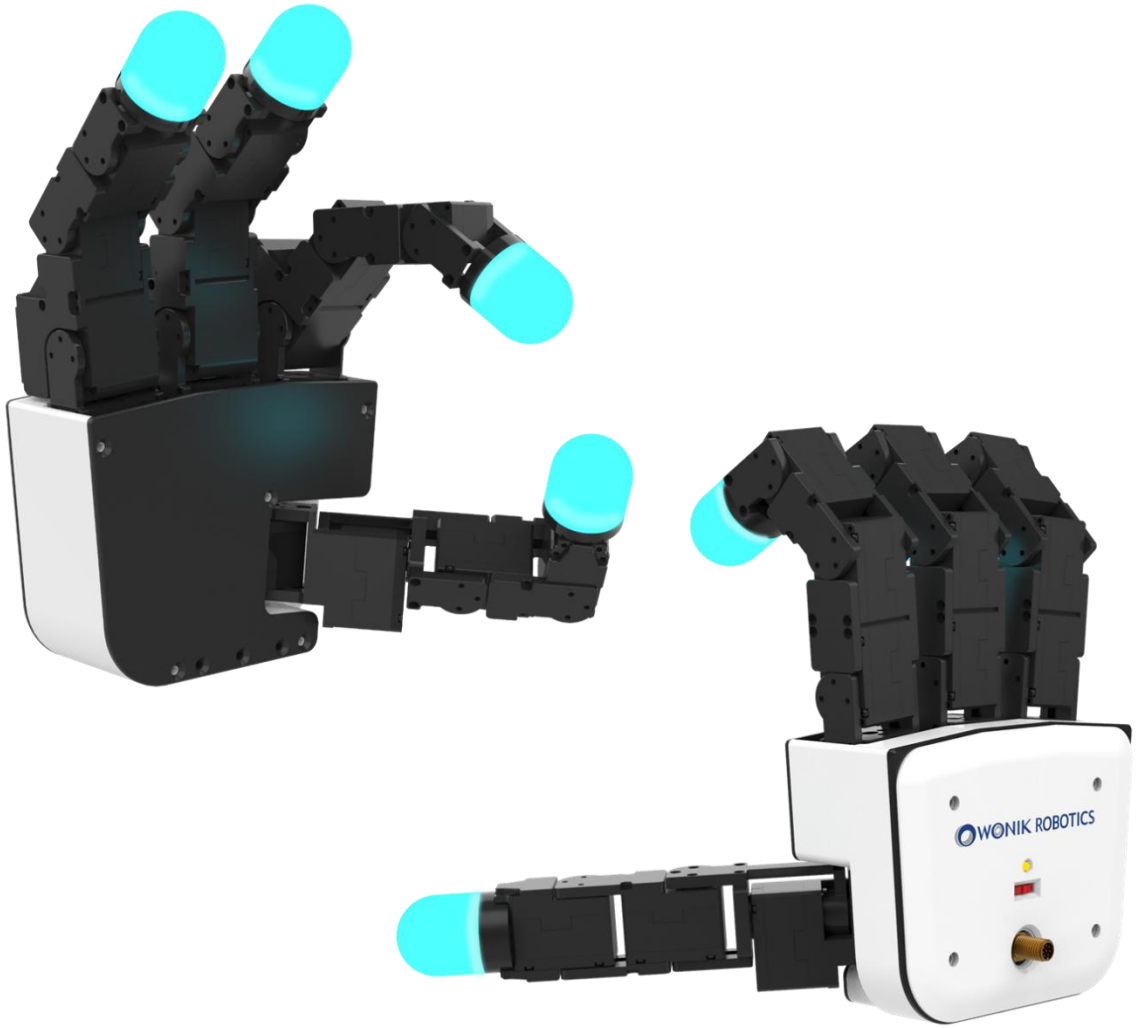
Allegro Hand V5

User's Manual



WONIK ROBOTICS

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Allegro Hand V5(F4)/(F4) Plus User's Manual

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1. Quick Start Guide

1.1 In the Box

Included are the software and hardware necessary to get you started.

1.	Allegro Hand	1 EA
2.	Allegro Hand Case	1 EA
3.	Power and Communication Cable (8 pin)	1 EA
4.	Desktop Stand	1 EA
5.	AC/DC Power Adapter	1 EA

1.2 Power Supply

When providing a separate power source to the Allegro Hand, the following specifications must be followed:

- Voltage: 24.0V
- Amperage: 5.0A
- Power: 120W

1.3 CAN Device

We usually recommend the PEAK device.

Model: PCAN-USB (IPEH-002021 or IPEH-002022)

Wonik Robotics does not sell CAN equipment.

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2. Allegro Hand Overview



Allegro Hand is a low-cost and highly adaptive robotic hand.

With four fingers and sixteen independent current-controlled joints, it's the perfect platform for grasp and manipulation research.

Features

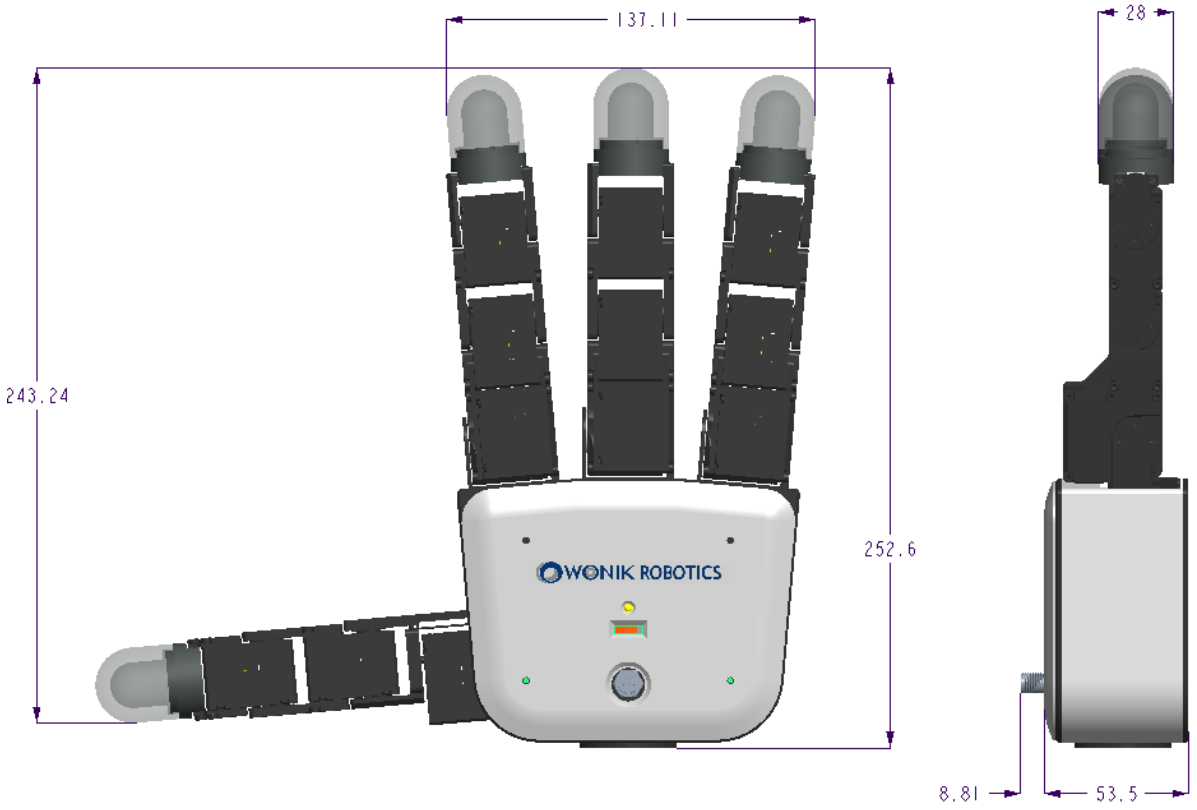
- Lightweight and portable anthropomorphic design
- Low-cost dexterous manipulation with applications in research and industry
- Multiple ready-to-use grasping algorithms capable of handling a variety of object geometries
- 16 independent current-controlled joints (4 fingers x 4 DOF ea.)
- Support for real-time control and online simulation
- By applying omnidirectional tactile sensors to the fingertips, it provides pressure values at the fingertips

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3. Technical Specifications

Number of Fingers	3 fingers + 1 thumb = 4	
Degrees of Freedom	4 fingers x 4 = 16 (active)	
Actuation	Type	DC motor
	Gear Ratio	288.35:1 (Plus: 576.7:1, 2nd joint of the finger excluding the thumb)
	Stall Torque	0.92 Nm (Plus: 1.84 Nm, 2nd joint of the finger excluding the thumb)
	Nominal Torque	0.23 Nm (Plus: 0.46 Nm, 2nd joint of the finger excluding the thumb)
Payload	Max. 10kg (Plus: 15kg)	
Weight	1000g (Plus: 1024 g)	
Joint Resolution	0.088 deg	
Communication	Type	CAN
	Frequency	500 Hz (CAN)
Power Requirement	24.0 V / 5.0 A / 120 W	
Tactile Sensor(optional) *Pressure Sensor	Pressure Operating Range	30~125 kPa
	Color Indicator	Returns '0' at atmospheric pressure (101.3 kPa) Blue: 0~124 Pa Cyan: 125~249 Pa Green: 250~375 Pa Yellow: 376~500 Pa Red: 500~24,000 Pa
	Temperature Operating Range	-40~85 ℃
	Pressure Accuracy	6 Pa

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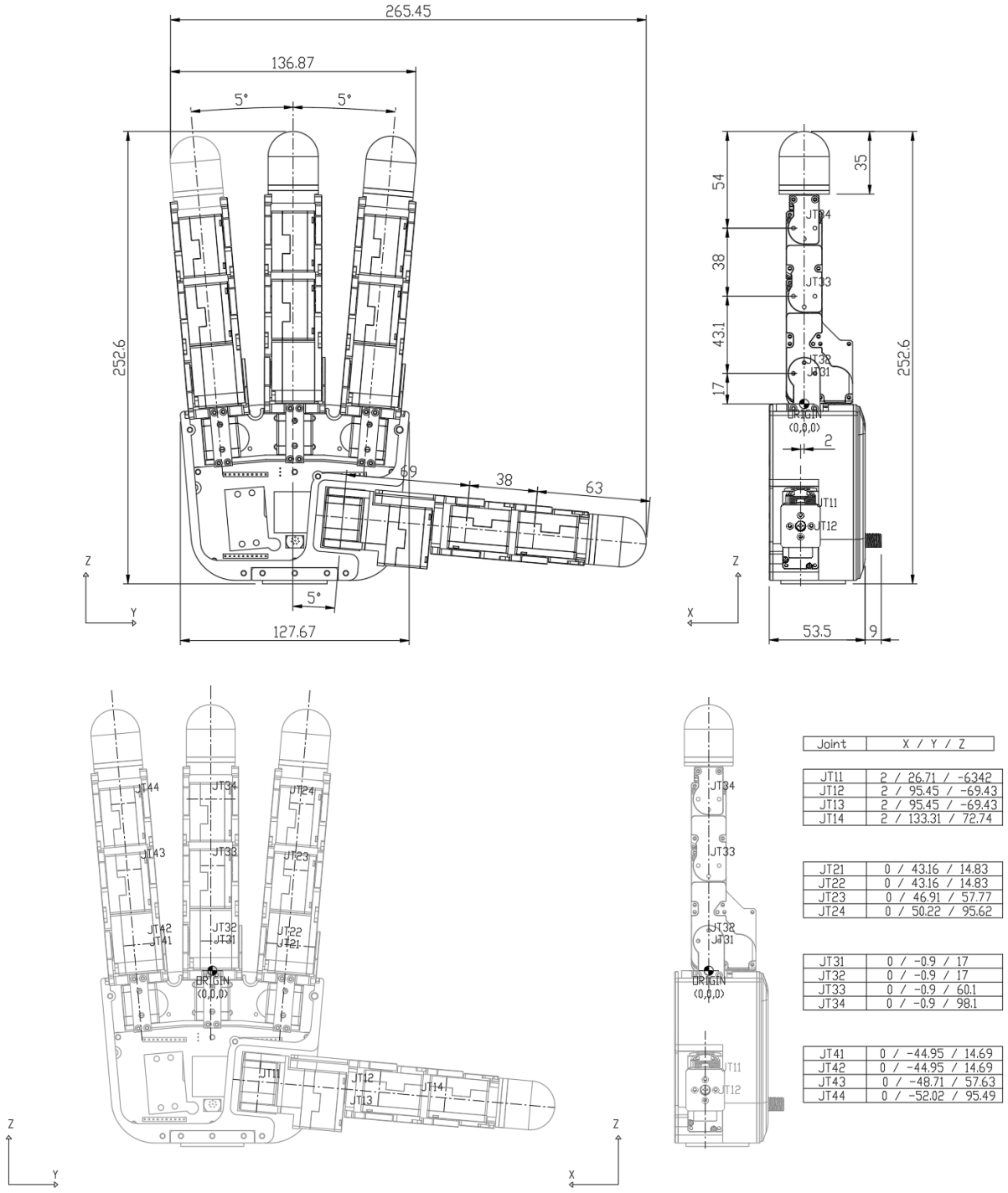
4. System Requirement

CPU	Intel® Core™ i3-8109U or higher
RAM	at least 2GB
Storage	at least 2GB
Graphics	OpenGL 3.0 H/W Acceleration enabled with at least 64Mb of video RAM
OS	Windows® 10 & 11 Ubuntu® 20.04 LTS & 22.04 LTS
Additional S/W	Visual Studio® 2022, ROS

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5. Joint Dimensions

All dimensions are displayed in millimeters (mm) and degrees.

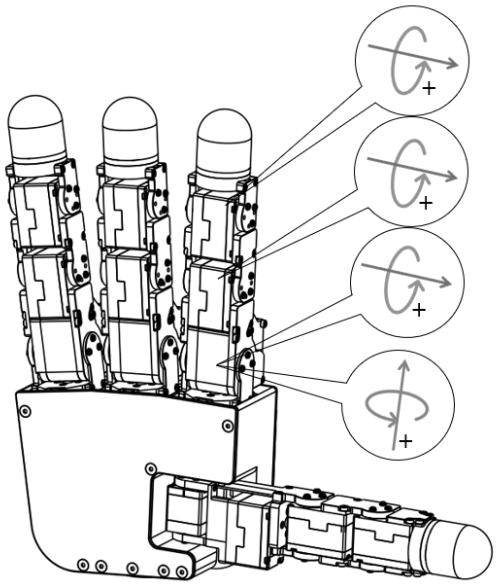


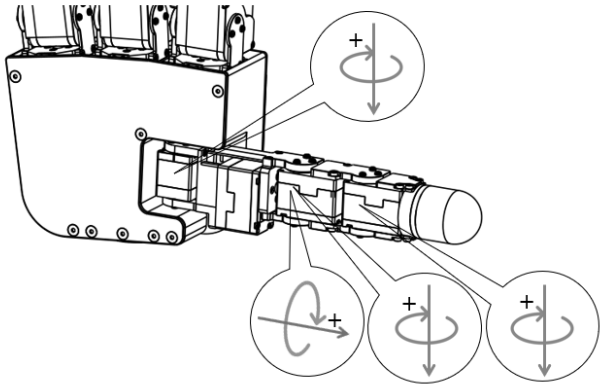
Joint	X / Y / Z
JT11	2 / 26.71 / -6342
JT12	2 / 95.45 / -69.43
JT13	2 / 95.45 / -69.43
JT14	2 / 133.31 / 72.74
JT21	0 / 43.16 / 14.83
JT22	0 / 43.16 / 14.83
JT23	0 / 46.91 / 57.77
JT24	0 / 50.22 / 95.62
JT31	0 / -0.9 / 17
JT32	0 / -0.9 / 17
JT33	0 / -0.9 / 60.1
JT34	0 / -0.9 / 98.1
JT41	0 / -44.95 / 14.69
JT42	0 / -44.95 / 14.69
JT43	0 / -48.71 / 57.63
JT44	0 / -52.02 / 95.49

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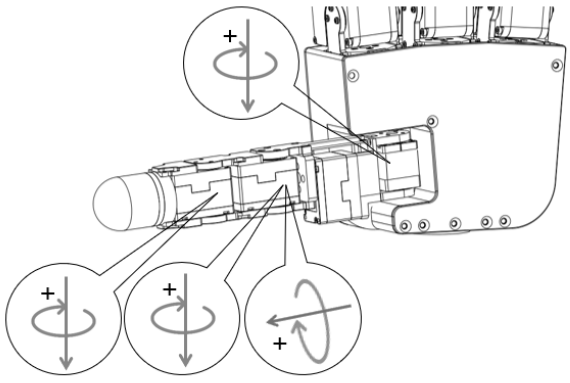
6. Joint Directions

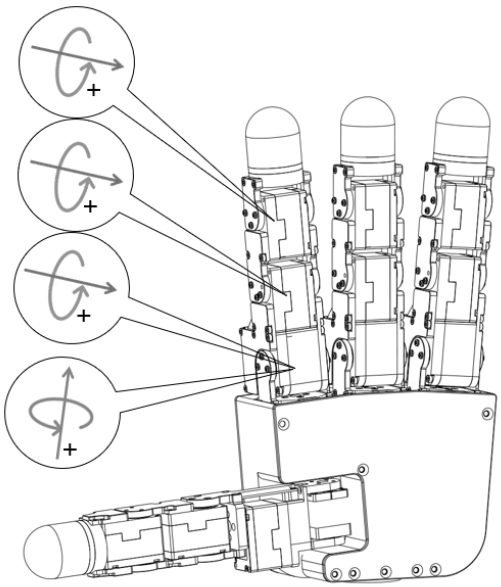
6.1 Right Hand





6.2 Left Hand





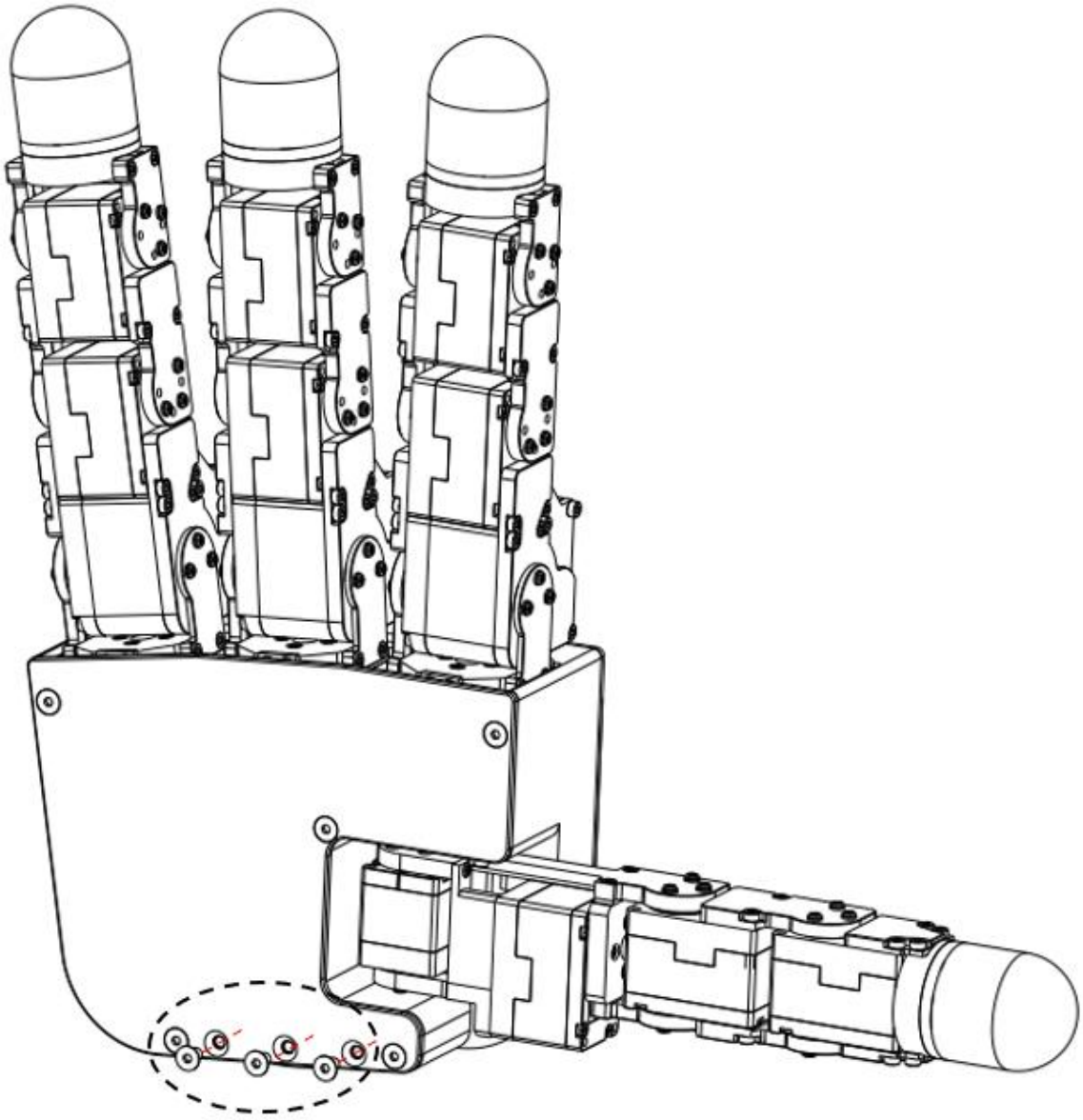
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7. Mounting the Allegro Hand

All dimensions are displayed in millimeters (mm) and degrees.

7.1 Mounting Block Removal

The mounting block is connected to the Allegro Hand using six M3 flat-head screws (3 on each side).

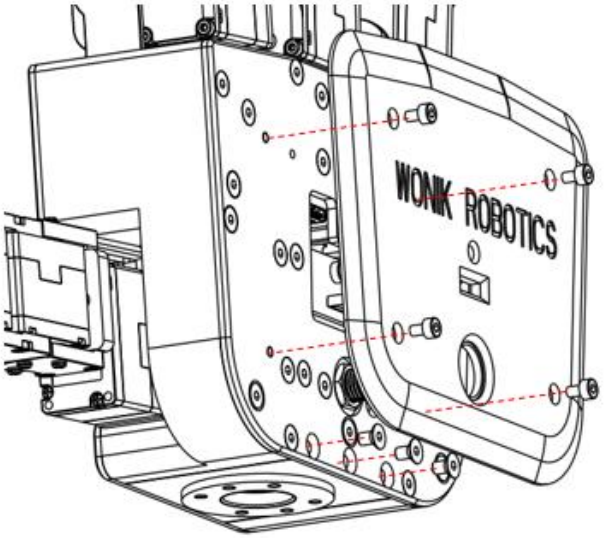


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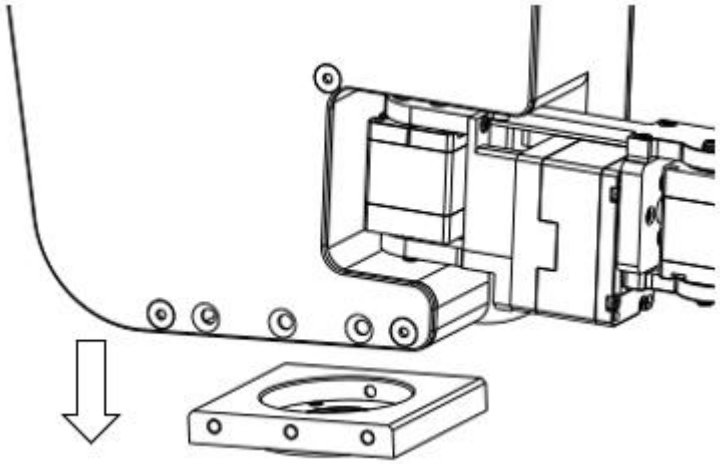
Remove Back cover with 4-M2.5 hex socket head cap screws

Remove 3 screws on either side of the hand.

Note: Secure the hand while unscrewing the mounting block to avoid dropping the hand once disconnected.



Once the 6 screws have been removed, the mounting block can be removed from the bottom of the hand.

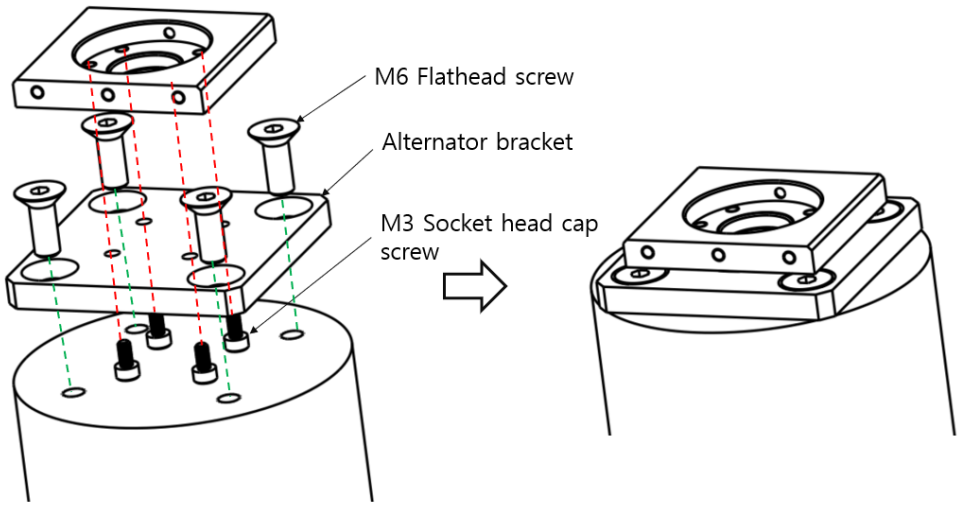


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7.2 Mounting

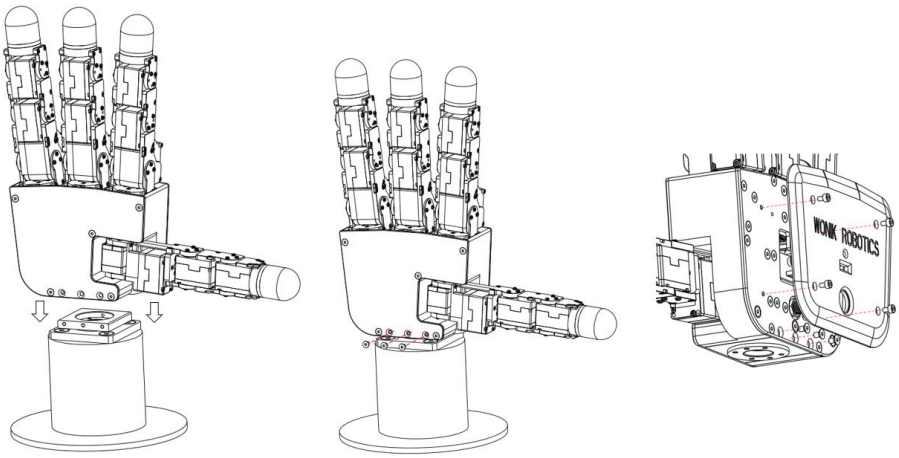
The block can be mounted to a surface using a alternator bracket and four (4) M3 screws and four(4) M6 Flathead screws

Note: The hand should be mounted to a raised area so as to avoid thumb-mount interference during hand movement.



7.3 Reassembly

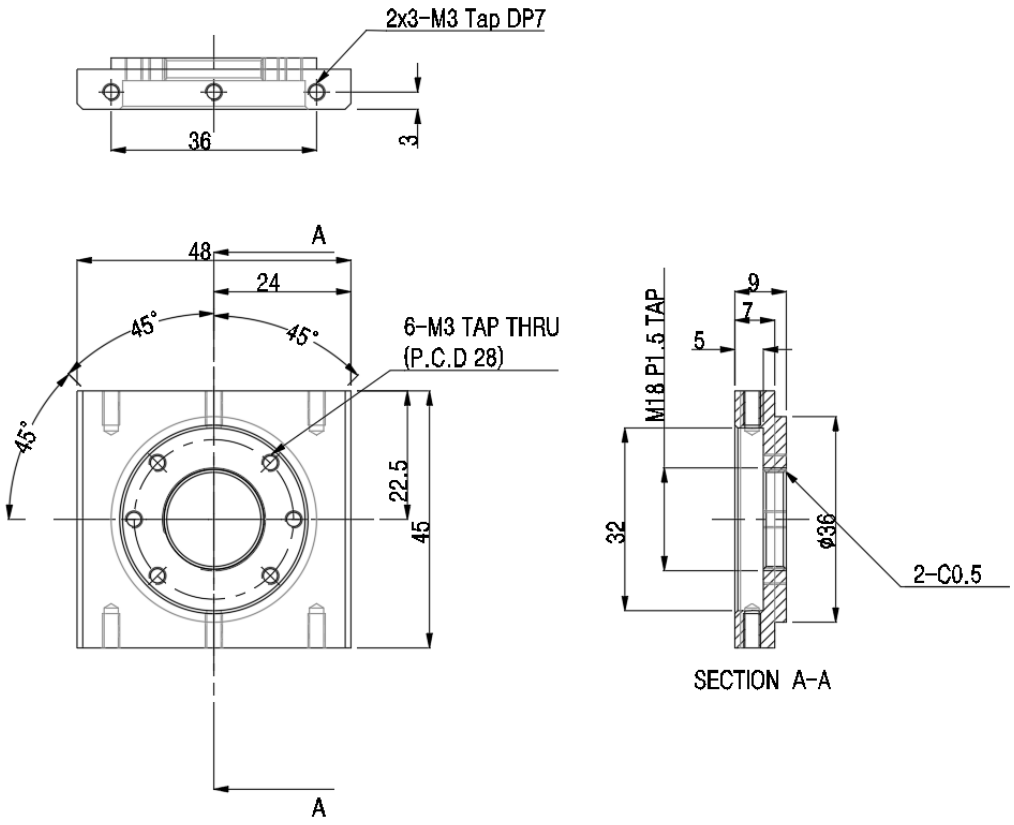
Place the hand onto the mounting block and replace the six (6) M3 flat-head screws (3 on each side).



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7.4 Mounting Block Dimensions

The relevant dimensions of the mounting block are presented in millimeters (mm).



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8. Allegro Hand Wiring

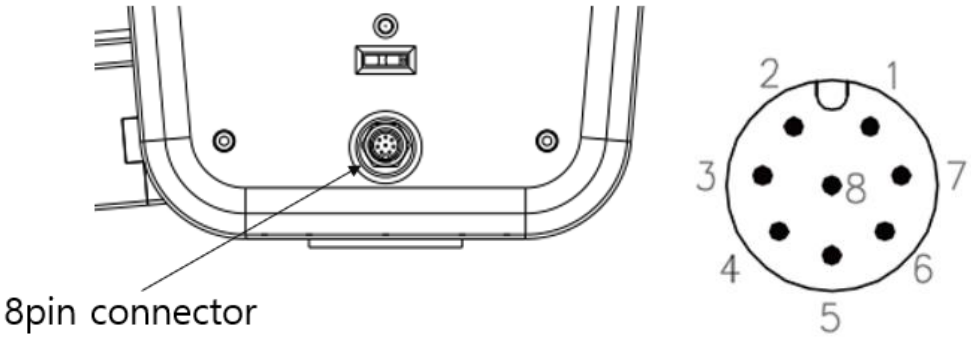
8.1 Wiring

On the back of the Allegro Hand, you will see a connector. This connector is used to supply power to hand. It also has external interface. Connector used is MB08MSAFF08ST part.

	Part Name	Note
Panel Mount Connector	MB08MSAFF08ST	M8 Stecker 8P, A-coding
Cable Connector		M8-F-Angle-8P-3m

Connector Pinout

No.	Description	Wiring Color
1	N/A	White
2	N/A	Brown
3	CAN L	Green
4	CAN H	Yellow
5	24VDC_in	Gray
6	GND	Pink
7	24VDC_in	Blue
8	GND	Red



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8.2 Power

The Allegro Hand must be powered by DC 24V, 5A power supply. If a capacity of power supply is not sufficient, it will not work properly.

Once the power is supplied at the rated values, the power switch on the back of the Allegro Hand can be switched on to provide power to the hand.

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9. CAN Driver Installation

9.1 PEAK PCAN-USB (Drivers available for Windows and Linux)

PEAK PCAN-USB driver should be installed or plugged in to your computer before installing the proper driver.

CAN Hardware drivers can be downloaded from the respective manufacturer's website. For CAN interface available through WONIK ROBOTICS**,** product driver and documentation are available at the following websites.

Note(Windows): After installation, check in Start Menu > Control Panel > Device Manager to make sure that a driver has installed successfully.

Note(Linux): After installation, type command *pcaninfo* in terminal to make sure that a driver has installed successfully. If you use Allegro Hand with **ROS2**, you don't need to install CAN driver.

PEAK PCAN-USB

Product Page: *http://www.peak-system.com/PCAN-USB.199.0.html?&L=1*

Driver Page (Windows): *https://www.peak-system.com/Drivers.523.0.html?&L=1*

Driver Page (Linux): *https://www.peak-system.com/fileadmin/media/linux/index.php*

Note: You may be required to reboot after your CAN driver installation. PEAK PCAN-USB can be purchased through WONIK ROBOTICS.

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10. CAN Protocol

The Allegro Hand designed with CAN specification 2.0.

10.1 Baud-Rate

The CAN communication baud-rate is 1Mbps.

10.2 Periodic Communication

The Allegro Hand control software attempts to communicate with the Allegro Hand at a regular control interval. Every 2 milliseconds, the join torques are calculated and the joint angles are updated.

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11. CAN Frames

11.1 Arbitration Identifier

The Allegro Hand uses 11-bit standard arbitration identifier.

MAB	9	8	7	6	5	4	3	2	1	LSB
Message ID									0	0

11.2 Message ID

Message	Message ID	RTR	Description
Servo ON	0x040		Engage joint motor driver
Servo OFF	0x041		Disable joint motor driver
Set Torque Finger 1	0x060		Set torque of finger #1
Set Torque Finger 2	0x061		Set torque of finger #2
Set Torque Finger 3	0x062		Set torque of finger #3
Set Torque Finger 4	0x063		Set torque of finger #4
Information	0x080	R	Product information and status
Serial Number Read	0x088	R	Product serial number read
Position Finger 1	0x020	R	Current angle position of finger #1
Position Finger 2	0x021	R	Current angle position of finger #2
Position Finger 3	0x022	R	Current angle position of finger #3
Position Finger 4	0x023	R	Current angle position of finger #4
Fingertip pressure 1	0xF0		Current pressure of fingertip sensor #1
Fingertip pressure 2	0xF2		Current pressure of fingertip sensor #2
Pick	0x11		Pick motion commend
Place	0x12		Place motion commend
Error	0xEE		Error

Messages marked with RTR can be sent by host in remote frame, and the Allegro Hand will respond it.

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11.3 Data Structure

Each message has different data filed format. All multi-byte data structures in data filed uses little endian.

11.3.1 Servo ON

Data length = 0

This message does not have data field.

11.3.2 Servo OFF

Data length = 0

This message does not have data field.

11.3.3 Set Torque Finger

Data length = 8

Each finger has 4 joints. This message sets joint torque set-point. Torque set-point is 2 byte signed digit. Data field is composed as below.

Torque Data [0:7]							
0	1	2	3	4	5	6	7
Joint1		Joint2		Joint3		Joint4	

11.3.4 Information

Data length = 7

Information message is composed with hardware version and firmware version. The Allegro Hand sends this message when the host request by remote frame.

Information Data [0:6]						
0	1	2	3	4	5	6
Hardware Ver.		Firmware Ver.		0	0	1

Hardware Ver. and **Firmware Ver.** is 2-byte number.

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11.3.5 Serial Number Read

Data length = 8

Serial number can be retrieved using CAN interface. It is stored in ASCII characters. The Allegro Hand sends this message when the host request by remote frame.

11.3.6 Position Finger

Data length = 8

Joint position is reported through this message format. The Allegro Hand sends this message when the host request by remote frame or report period comes. All values are represented as signed 2-byte integer.

Position Data [0:7]							
0	1	2	3	4	5	6	7
Joint1		Joint2		Joint3		Joint4	

Joint angle can be calculated by this equation

$$angle[rad] = \frac{(position\ data) * \pi}{180} * 0.088$$

11.3.7 Fingertip Pressure

Data length = 8

Fingertip sensor data is reported through this message format. The Allegro Hand sends this message when report period comes. All values are represented as signed 4-byte integer.

Fingertip Pressure1 Data [0:7]							
0	1	2	3	4	5	6	7
Index Finger Pressure				Middle Finger Pressure			
Fingertip Pressure2 Data [0:7]							
0	1	2	3	4	5	6	7
Ring Finger Pressure				Thumb Finger Pressure			

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Fingertip sensor data is expressed in pascal (Pa) units, indicating the pressure applied to the fingertip.

11.3.8 Pick

Data length = 0

This message does not have data field. This message indicates that the Allegro Hand has been commanded to pick.

11.3.9 Place

Data length = 0

This message does not have data field. This message indicates that the Allegro Hand has been commanded to place.

11.3.10 Error

Data length = 2

Error message is reported through this message format.

Error Data [0:1]	
0	1
Motor ID	Error code

The error code is displayed as a result of a bitwise OR operation for each situation, and its meaning is as follows.

Bit	Error	Description
7		Always 0
6		Always 0
5	Overload	A load that cannot be controlled by the motor's maximum output is continuously applied
4	Electrical Shock	When the circuit experiences an electrical shock or there is insufficient input power, the motor may fail to operate normally

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3		Always 0
2	Overheating	When the motor's temperature exceeds or falls below the set temperature
1		Always 0
0	Input Voltage	When the applied voltage exceeds or falls below the specified operating voltage range

If an error occurs, the LED on the back of the hand changes from green to red.

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12. Using Allegro Hand Sample Program

12.1 Download Sample Program

The Allegro Hand sample program is available to download from git repository. There are windows and Linux programs so you can test it on both environments.

Windows: https://github.com/Wonikrobotics-git/allegro_hand_windows_v5.git

Linux (ROS1): https://github.com/Wonikrobotics-git/allegro_hand_ros_v5.git

Linux (ROS2): https://github.com/Wonikrobotics-git/allegro_hand_ros2_v5.git

12.2 BHand Library

BHand Library provides several grasping algorithms that users can integrate with their robot research such as robot arms. You might start with the sample program which is mentioned above to experience this library. Please check commands below before executing.

12.2.1 Home

Press "H" button on a keyboard. The position assumed by the Allegro Hand is a starting position that ensures that all joints are oriented properly for executing a grasp.

12.2.2 Grasp 3

Press "H" button on a keyboard to prepare the hand for a grasp. Now press "G" button. This grasping algorithm is a torque-controlled, three-fingered grip. This grasp can be used for pick-and-place style object grasping as the object is held between the tips of the thumb, index and middle fingers.

12.2.3 Grasp 4

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Press “H” button on a keyboard to prepare the hand for a grasp. Press “K” button. This grasping algorithm is a torque-controlled, four-fingered grip. This grasp can be used for pick-and-place style object grasping as the object is held between the tips of the thumb and three fingers.

12.2.4 Pinching with index finger

Press “H” button on a keyboard to prepare the hand for a grasp. Press “P” button. This grasping algorithm is a torque-controlled, two-fingered pinch. This grasp can be used for pick-and-place style object grasping and more dexterous manipulation as the object is held between the tips of the thumb and the index finger.

12.2.5 Pinching with middle finger

Press “H” button on a keyboard to prepare the hand for a grasp. Press “M” button. This grasping algorithm is a torque-controlled, two-fingered pinch. This grasp can be used for pick-and-place style object grasping and more dexterous manipulation as the object is held between the tips of the thumb and the middle finger.

12.2.6 Envelop

Press “H” button on a keyboard to prepare the hand for a grasp. Press “E” button. This grasping algorithm can be used to fully envelop an object within the hand's four fingers. This algorithm can handle a variety of object geometries.

12.2.7 Gravity Compensation

Press “A” button on a keyboard. This algorithm can be used to fix all joints regardless of how they move.

12.2.8 Torque Off

Press “f” button on a keyboard. All motors will be torqued off. In this mode, you can still get encoder values.

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12.3 ROS Program

The Allegro Hand supported three optional visualized ROS programs. These programs are available in only ROS environments.

12.3.1 Rviz

This program shows moving Allegro Hand on your screen in real-time by Rviz. You can activate this program by launching Allegro Hand main program with arguments "VISUALIZE:=true"

12.3.2 MOVEIT

This program shows Allegro Hand on your screen in real-time by MOVEIT.

You can make and save the position of Allegro Hand more easily.

12.3.3 Control with GUI

This program makes Allegro Hand to be controlled more easily by pressing button on GUI. You can change the position, the time of movement, the force of grasping motion. Also, you can repeat some actions.

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13. Firmware Update

Allegro Hand can update firmware.

13.1 Download Firmware Image

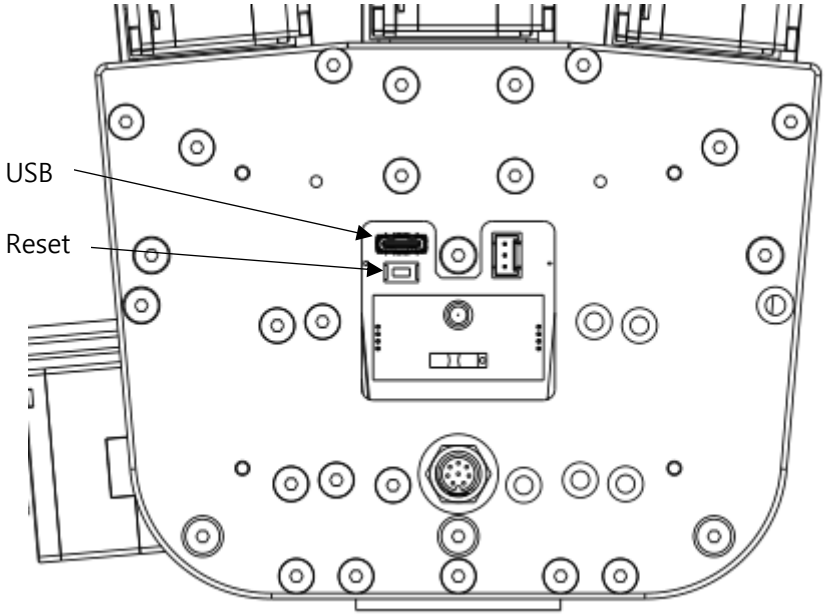
The Allegro Hand firmware image is available to download from the Allegro Hand website.

https://www.allegrohand.com/material-1/5bf3dfaf-343d-4a1c-85f2-ec01764e5989

13.2 Update Firmware Image to Allegro Hand

13.2.1 Connect to Allegro Hand

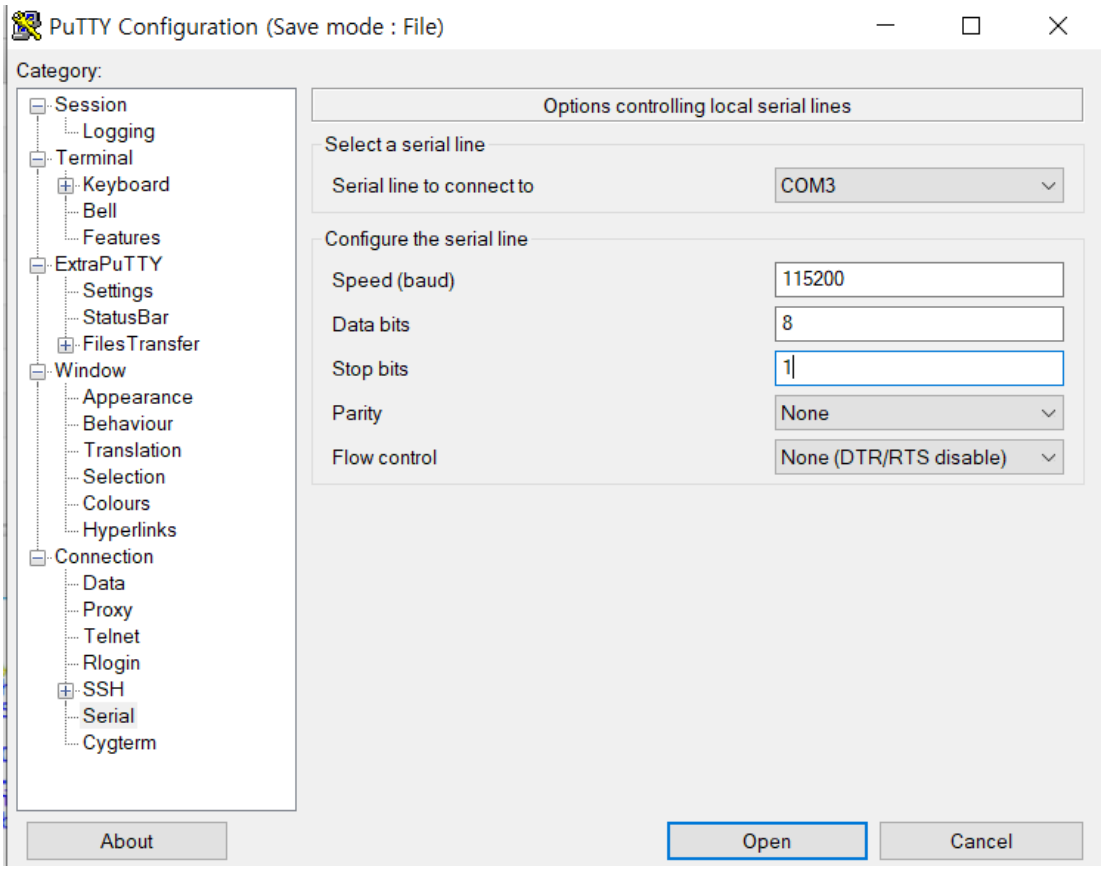
Remove the back cover of the Allegro Hand and connect the USB-C port to a PC.



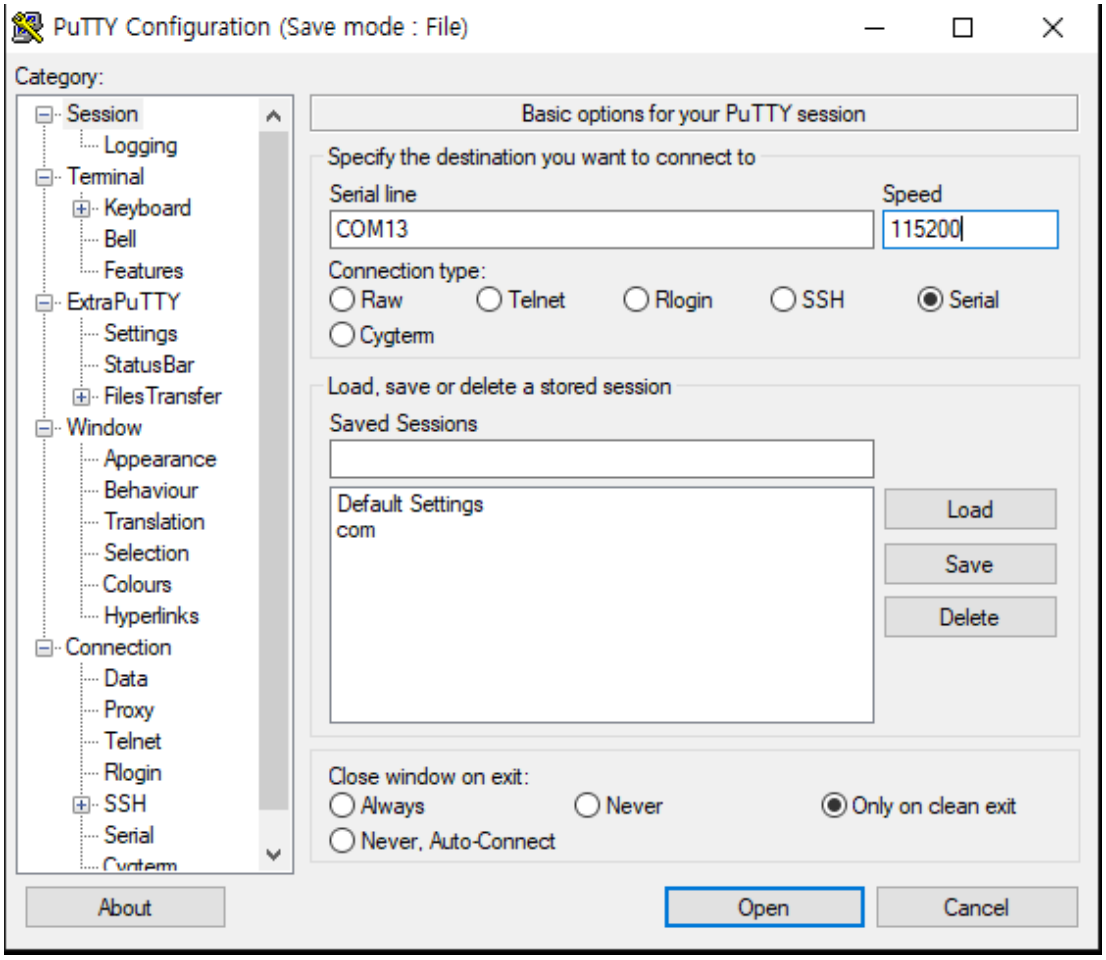
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Access using a serial console (recommended software: Extra PuTTY) with the following settings.

- Baud Rate: 115200
- Data bits: 8
- Stop bits: 1
- Parity: none
- Flow control: none



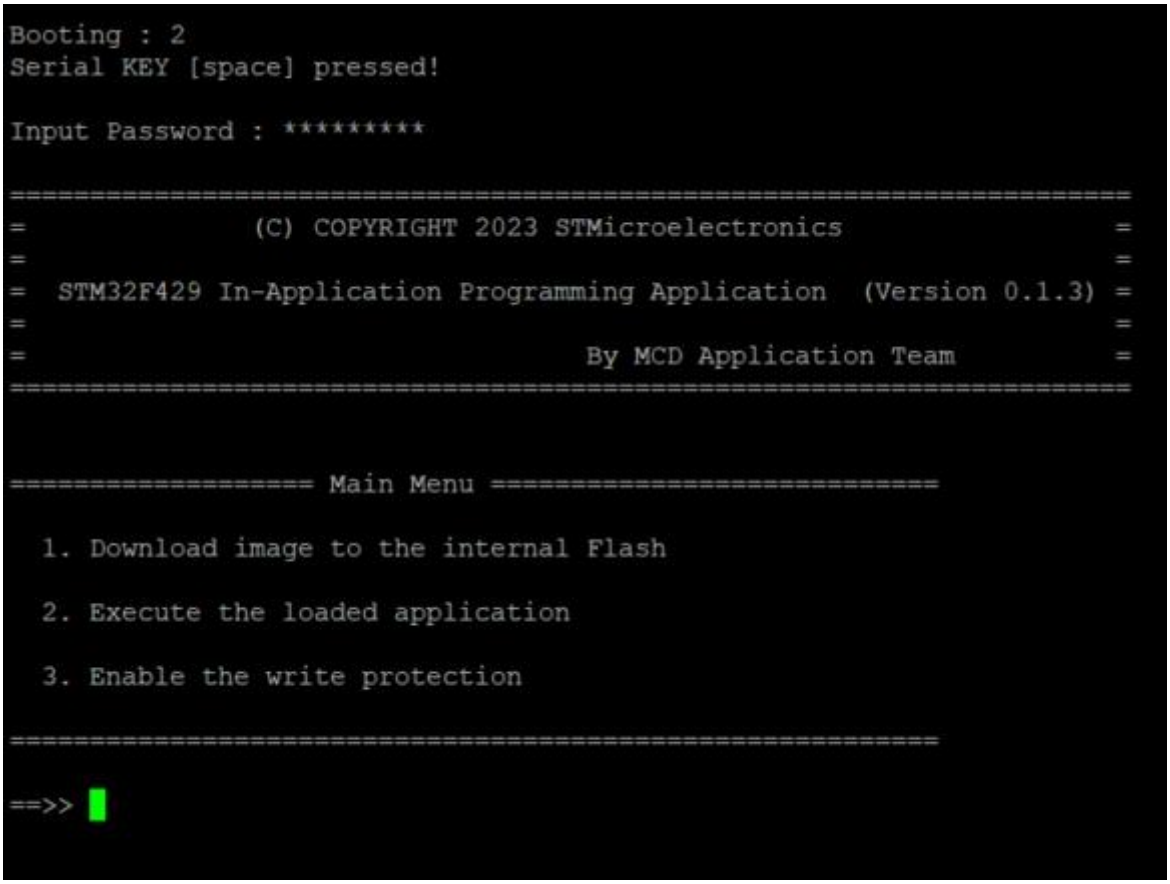
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13.2.2 Enter the Boot Loader Menu

After connecting the serial console and pushing the reset button, you will have 3 seconds to enter input as the system displays 'Booting 3, 2, 1'. Press the spacebar and enter '**wonik1234**' in the Password window (If the count reaches 0, the application will automatically run).

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13.2.3 File Transfer to Allegro Hand

By pressing the number '1' on the keyboard and then hitting Enter, you can enter download mode. From the menu bar of the Extra PuTTY Tool, select **Files Transfer**, then choose **Y modem** → **Send**. After selecting the firmware binary file, the download will begin.

13.2.4 Run the Application

After the file transfer is completed, press the number '2' on the keyboard and then hit Enter to run the application.

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14. Technical Support

The newest version of all documents found in this manual can be found in the Allegro Hand website at

https://www.allegrohand.com/

A forum is also available on the website where users can share problems and solutions with each other and with WONIK ROBOTICS.

For any further questions please contact us.

Address	Wonik Bldg. 4F, 20, Pangyo-ro 255beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
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15. FAQ

15.1 Hardware FAQ

1. CAD STL Files
   If you purchase, we will provide STL files.
   Please give us your Hand's serial number.

2. Communication interface
   Only CAN communication is supported.
   RS-485 communication is part of the future plan.

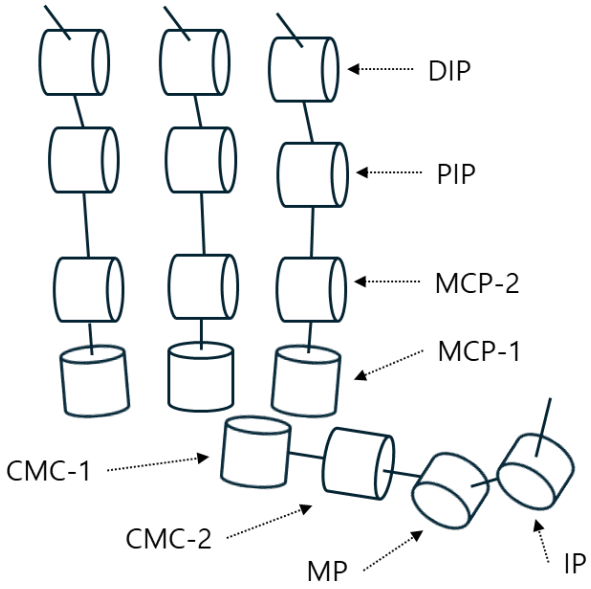
3. CAN Device purchase
   We usually recommend the PEAK device.
   Model: PCAN-USB (IPEH-002021 or IPEH-002022)

   Wonik Robotics does not sell CAN equipment.

4. Fingertip sensor
   The contact surface of the fingertip sensor is made of silicone, and it operates by measuring internal air pressure. If it is punctured by sharp objects such as an awl or knife, internal air may leak, which can cause malfunction.

5. How robust is it to collisions?
   Difficult to use in harsh environments.
   It should be noted that this is for research purposes only.
   Please avoid hitting a hammer or applying any excessive force.
6. Range of motion

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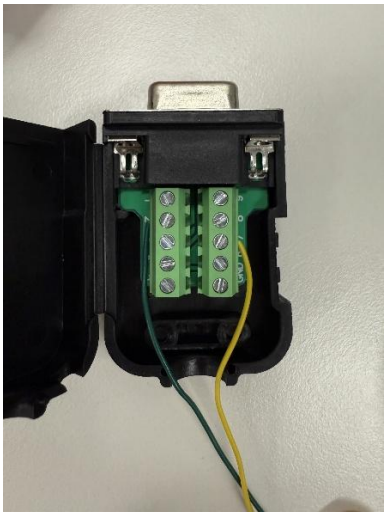


	Joint	ROM [deg]
Finger	MCP-1	-16 ~ 16
	MCP-2	-10 ~ 110 (Plus: -5 ~ 110)
	PIP	-3 ~ 102
	DIP	-5 ~ 105
Thumb	CMC-1	0 ~ 105
	CMC-2	-6 ~ 107
	MP	-5 ~ 106
	IP	-4 ~ 104

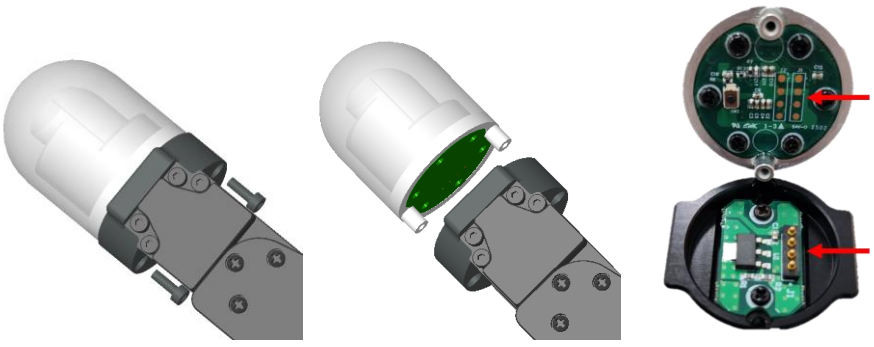
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7. CAN wiring

   If you want to use CAN communication with the PCAN-USB, connect it to the D-SUB connector as shown in the picture below. Connect the green wire (CAN L) to pin 2 and the yellow wire (CAN H) to pin 7.



8. Changing a fingertip sensor
9. If you need to replace the fingertip sensor, you can do so as shown in the image below. First, remove the M2 socket bolts on both sides of the fingertip. This will allow you to remove the fingertip sensor. The replaced sensor can be reassembled by following the disassembly steps in reverse order.



Note: Please make sure the pogo pins are oriented correctly at the interface between the fingers and the sensors.

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15.2 Software FAQ

1. Is it possible to use V3 or V4 software?
   No.
   As mentioned above, there are many differences between V5 and previous versions.

2. How are the joints controlled?
   It is controlled by CAN communication with the external controller and UART communication between the joint(16ea) and the main board inside the hand. The only motor control command is the "**Set Torque Finger**" command.
   The unit of Torque data is [mA]. It is the value obtained by converting joint torque into current for motor operation.

3. Is PID position control possible?
   Since the main board only can "Torque" control, position control works are required on the PC side. "Home" motion is playing such a role. The joint position encoder value is needed.
   If you want to perform PID position control, you will need to configure the controller yourself. However, since the main board only provides joint position encoder values, precise control may be challenging. Please check the control frequency.

4. How to set (left or right) and (A or B) type of hand in SW?

   From this version (V5) onwards, all software (Windows, ROS1, ROS2) automatically applies to the appropriate handedness and hand type through the serial number. Therefore**, you can simply use it as is**.

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5. Where can PC S/W issues be supported?

   You can use our official Forum: https://www.allegrohand.com/forum

   Or you can check our official GitHub latest release, see the link below.

   https://github.com/Wonikrobotics-git

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Release Note

Date	Ver.	Description	Editor
2024.11.12	1.0	Initial draft	Lucas
2024.11.25	1.1	CAN wiring correction	Lucas
2025.01.09	1.2	Power supply correction	Lucas
2025.03.26	1.2.1	Update [Changing a Fingertip sensor]	Lucas

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