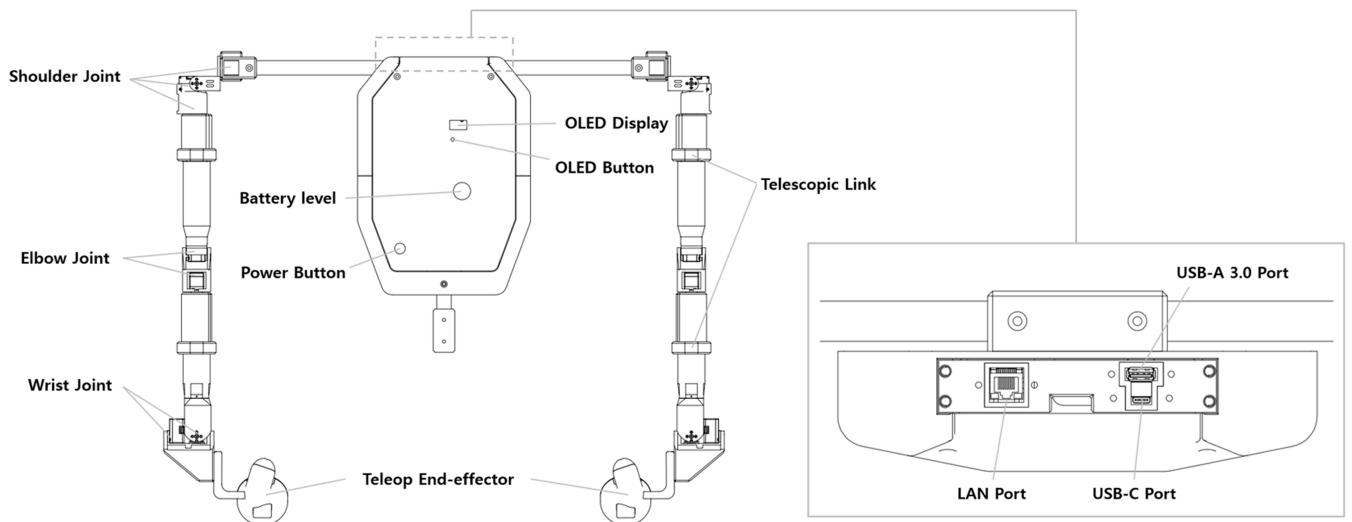


Teleop Device

(Teleop Device) 연결

1. Product Introduction

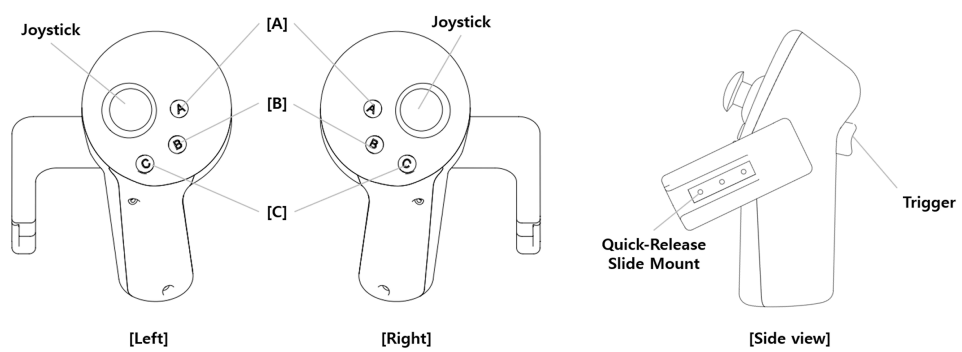
- The **Teleop Device** is a device for remotely operating humanoid robots, developed to enable intuitive control of various humanoid robots in research and experimental environments. The system consists broadly of the **Backpack Control Unit**, which handles integrated signal processing, robot communication, and power management; the **arm modules**, which measure the user's arm movements; and the end effector that controls the robot's movement commands and various functions, the **Teleop End-effector**.
- The **Backpack Control Unit** is equipped with various I/O ports and a Wi-Fi module to support flexible communication with external devices. It also allows real-time monitoring of system operating status via an OLED display, and uses a built-in IMU sensor to measure the user's upper-body posture for use in robot control.
- Users can control the humanoid robot in an intuitive way that directly reflects their own movements. Tilting the upper body forward/backward or left/right moves the robot's waist joint in the same direction and angle, and the user's shoulder, elbow, and wrist movements each map to the corresponding robot joints, implementing natural upper-limb motion. Additionally, the joystick mounted on the **Teleop End-effector** can be used to move the robot forward/backward/left/right or rotate it in place, and the mounted switches allow easy switching of operation modes and execution of user-defined functions.



[Figure1] Components of the Teleop Device

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[Figure2] Teleop End-effector (End-effector of the Teleop Device)

2. Product Specifications

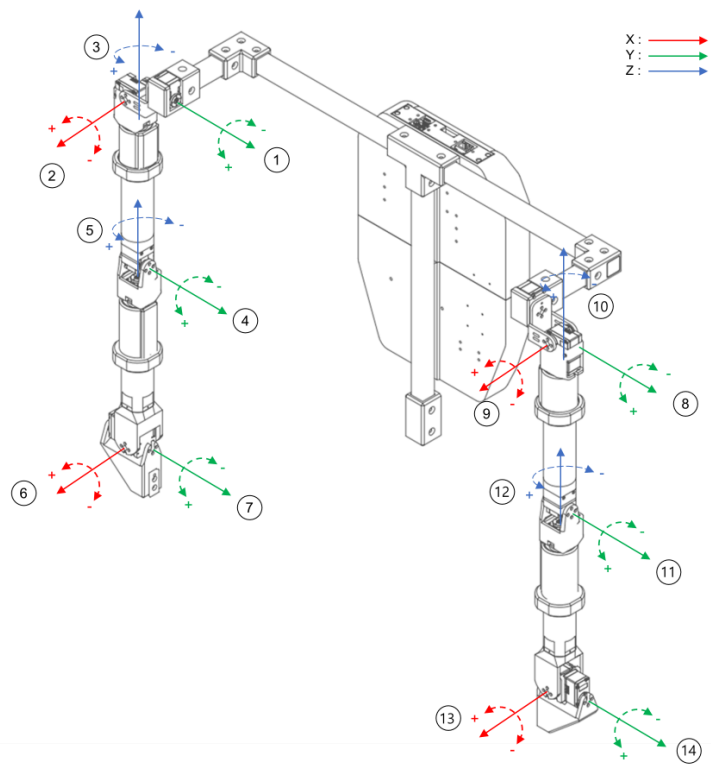
- General Specifications

Item	Specification
Model Name	Teleop Device
Dimensions	800 mm x 670 mm x 270 mm
Degrees of Freedom (DOF)	17 DOF
Battery	10,000 mAh / 7.7 V
I/O	USB-A 3.0 x 1, LAN (1 Gbps) x 1, USB-C x 1 (charge only, 5 V / 5 A)
Sensors & Control Interface	IMU x 1, Joystick x 2, Function buttons x 8, Power button x 1, OLED control button x 1, OLED display x 1
Communication Protocol / Middleware	DDS / Cyclone DDS
Communication Method	Wired Ethernet / Wireless AP, Wi-Fi supported

- Joint Degrees of Freedom and Range of Motion

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[Figure3] Teleop Device Joint Axes

	Joint	Motor ID	MIN(°)	MAX(°)
1	SHOULDER_PITCH_R	11	-180	60
2	SHOULDER_ROLL_R	12	-180	10
3	SHOULDER_YAW_R	13	-90	90
4	ELBOW_PITCH_R	14	-120	0
5	WRIST_YAW_R	15	-90	90
6	WRIST_ROLL_R	16	-50	80
7	WRIST_PITCH_R	17	-35	35
8	SHOULDER_PITCH_L	21	-180	60
9	SHOULDER_ROLL_L	22	-10	180
10	SHOULDER_YAW_L	23	-90	90
11	ELBOW_PITCH_L	24	-120	0
12	WRIST_YAW_L	25	-90	90
13	WRIST_ROLL_L	26	-80	50
14	WRIST_PITCH_L	27	-35	35

3. Getting Started

- This section describes the basic procedure for using the **Teleop Device**. Please refer to the accompanying demonstration video for how to wear the device and operate it in practice.
- Putting on the Teleop Device
 - Put on the **Backpack Control Unit** on your back.
 - Put on and secure both **arm modules**.
 - Put the left and right **Teleop End-effectors** on your hands.
 - Check all cables and connections.

- Connecting the Teleop System
 - Turn on the main power of the **Backpack Control Unit**.
 - Verify that the OLED Display boots up normally.
 - Select the communication method appropriate for your environment.
 - If the communication status is normal, the LED on the **Teleop End-effector** will light up blue.
 - Press the **[A]** button on the left-hand **Teleop End-effector** to initialize the IMU sensor.
 - Press the **[B]** button on the left-hand **Teleop End-effector** to activate sync between the **Teleop Device** and the robot.
- Ending Teleop
 - End the sync between the **Teleop Device** and the robot.
 - Turn off the main power of the **Backpack Control Unit**.
 - Shut down the robot system.
- OLED Display
 - The OLED Display shows the following information:
 - Domain ID, Namespace, communication frequency (Hz), system status, hardware telemetry
- Teleop End-effector
 - Use the joystick to control the robot.
 - Forward/backward, left/right movement, in-place rotation
 - Use the function buttons to control the robot's end effector.
 - Grip/release hand, bend/extend individual fingers, gripper pinch/release, etc.

4. Using the Web Dashboard

- The status of the **Teleop Device** can be monitored and configured in real time via a web browser.
 - Real-time graphs allow intuitive monitoring of communication status and control performance.
 - The communication method can be changed and configured depending on the network environment.
 - Settings required for DDS communication can also be changed.
 - After changing settings, please restart the system for the settings to take effect properly.
- Device Status & Telemetry
 - System connection status, USB and sensor connection status
 - Hardware Error Log

- Joint Position, Angular Velocity, Torque
- IMU Data
- Control Frequency (Hz)
- Network Settings
 - AP Mode: The **Teleop Device** operates as an access point (AP), providing a 1:1 wireless connection.
 - Wi-Fi Mode: Connects to and communicates over an existing wireless network (AP).
 - Ethernet Mode: A low-latency communication mode using gigabit wired LAN.
- DDS Communication Settings
 - Namespace
 - Domain ID
 - IP Address

5. Inspection and Maintenance

- Pre-use Inspection
 - *Exterior inspection*
 - Before using the product, check for cracks, damage, deformation, or severe contamination on the exterior.
 - If there is dust or foreign matter on the body or sensor surfaces, wipe with a dry microfiber cloth or soft cloth.
 - A slightly damp cloth may be used if necessary, but do not spray water directly onto the product or use detergents.
 - After cleaning, use the product only once it is completely dry.
 - *Sensor and control inspection*
 - Verify that input devices such as the IMU, joysticks, and buttons are operating normally.
 - Verify that the system status is displayed correctly on the OLED Display.
 - If sensor calibration is needed, perform initialization according to the procedure in the user manual.
 - *Cable and power inspection*
 - Check cables for breaks, damaged insulation, or severe kinking.
 - Verify that all connectors are properly seated.
 - Check that the battery level is sufficient before use.

- Care and Maintenance

- *General*

- Perform regular inspection and cleaning to maintain product performance and extend its lifespan.
 - After use, remove dust and foreign matter from the exterior surfaces to keep the product clean.

- *Storage*

- If not using the product for an extended period, fully power it off before storing.
 - Avoid direct sunlight and hot, humid environments; store in a dry, well-ventilated location.
 - Store in a stable location with minimal shock or vibration.
 - Arrange cables so they are not bent or crushed during storage.

- *Power and Wiring*

- Use power cables and connectors that match the rated specifications.
 - Do not pull on the cable; disconnect by holding the connector.
 - Replace damaged cables or connectors immediately.

- *System Management*

- If abnormal behavior occurs, restart the system and check the status again.
 - If the same issue recurs, inspect the device or contact an administrator.
 - This product is precision electronic equipment; do not disassemble, modify, or attempt unauthorized repairs without manufacturer approval.
 - If maintenance is needed, follow the designated procedure or contact authorized service personnel.

6. Error Codes and Troubleshooting

Error Code (OLED / Web)	Symptom	LED Status	Cause	Solution
ERR_NET_DISCON N	Real-time communication with the robot is interrupted, making remote operation of the robot impossible.	Red LED blinking	The network connection has been lost, or the DDS communication settings (Domain ID, Namespace) do not match.	Check the network (Ethernet/Wi-Fi) connection status. Verify that the Domain ID and Namespace settings match the robot, then reconnect. If necessary, switch to an Ethernet connection to check the communication status.
ERR_IMU_DRIFT	The robot's waist posture tilts even when the user maintains a neutral forward posture.	Blue/Red alternating blink	The IMU sensor's reference posture (offset) has not been set correctly.	While in a flat/neutral posture, press the [A] button on the left-hand controller to re-perform IMU calibration.

7. Precautions for Use

- Do not disassemble or remove the backpack cover on your own.
The backpack cover on the rear of the product is a structure that protects the internal electronic components and wiring. Disassembling or removing it without authorization may cause product malfunction and may limit free warranty coverage and official technical support (A/S).
- Before powering on, align the Teleop Device and the robot to the reference posture.
Before starting the system, always verify that both the Teleop Device and the robot are in the reference posture. If sync (synchronization between the Teleop Device and the robot) is started while the postures do not match, the robot may move in an unexpected direction, potentially causing damage to surrounding equipment or injury to the operator.
- Do not disconnect the device's cables and connectors on your own.
Do not disconnect or connect the cables and connectors of the product's actuators, motors, or other devices on your own. Disconnecting a connector while power is applied may cause circuit damage or system errors.
- Do not put on or take off the product while power is applied.
Putting on or removing the product while sync is active may cause unintended inputs, resulting in unexpected robot movement. Always end sync and power off before putting on or removing the product.

- Do not apply strong impact or excessive force during use.
Applying strong impact to the product or forcibly moving the joints may damage the sensors and mechanical components.
- Stop use immediately if abnormal behavior occurs.
If abnormal noise, vibration, heat, or communication issues occur, immediately stop sync, power off, and check the system status. If the problem persists, contact official technical support (A/S).