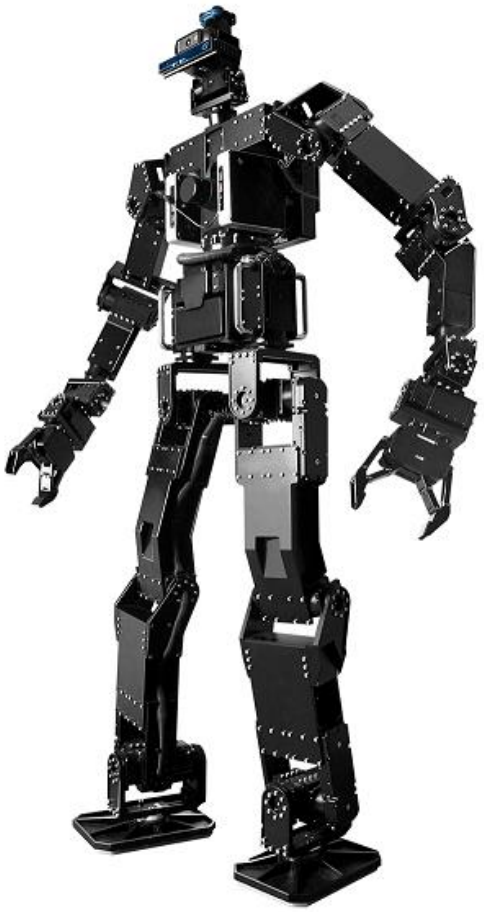


THORMANG3

# THORMANG3 Tutorial

Hardware

# Agenda

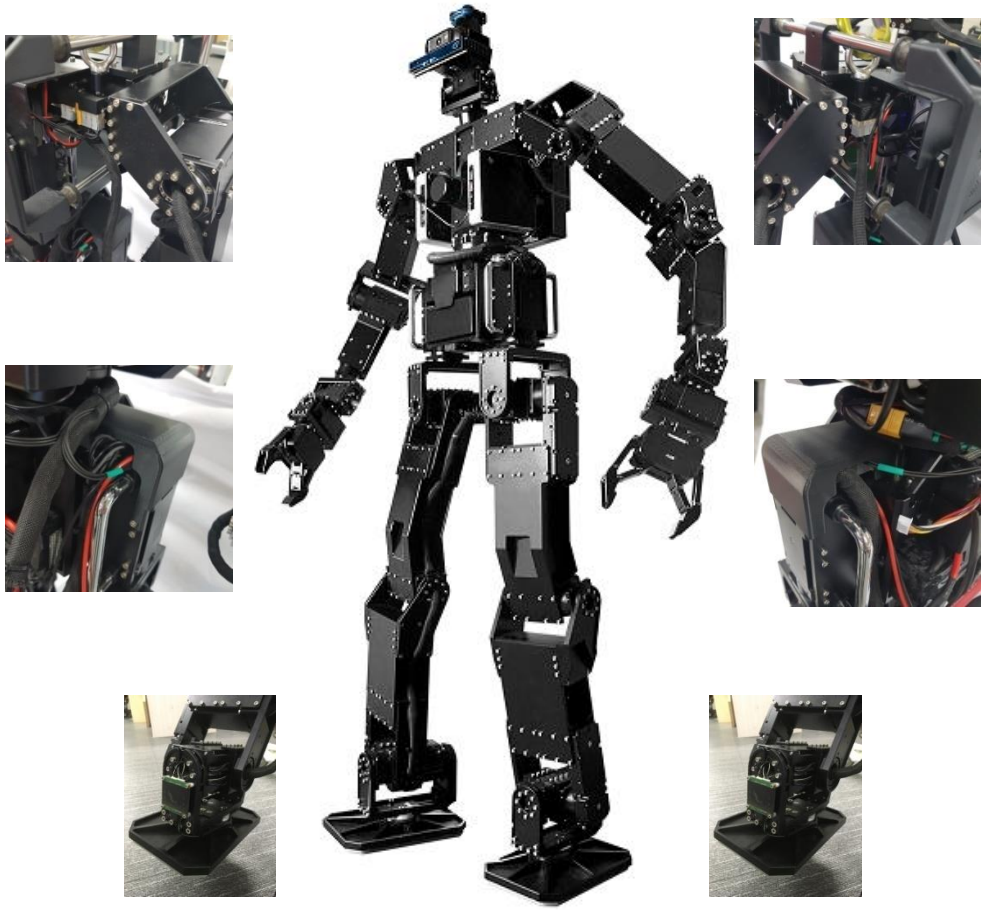
- **Mechanism Part**
  - Mechanism Inspection
  - 5 Part Disassembly

- **System Harnessing (Electrical Part)**
  - USB to RS485 Board Wiring
  - Dynamixel Pro Power Wiring
  - Power Board Wiring

# Mechanism Part

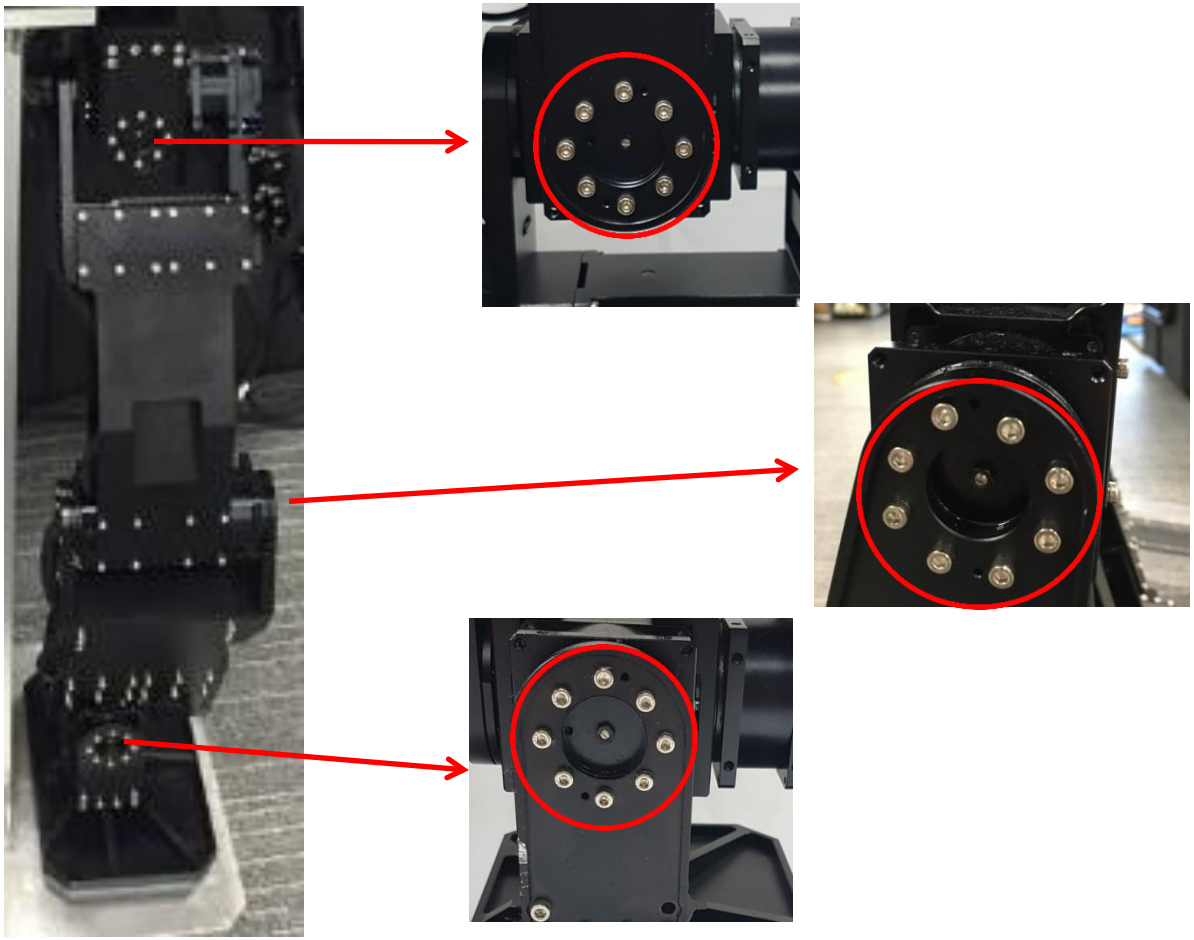
# Mechanism Inspection(1)

- Check NUC PCs, DXL-PRO and additional components are assembled in properly.
- Check for any external damages or missing bolts
- Check cables and cable shields are securely attached without any possible collisions with the platform. Also check arms and legs harnessing along with the FT sensors.



# Mechanism Inspection(2)

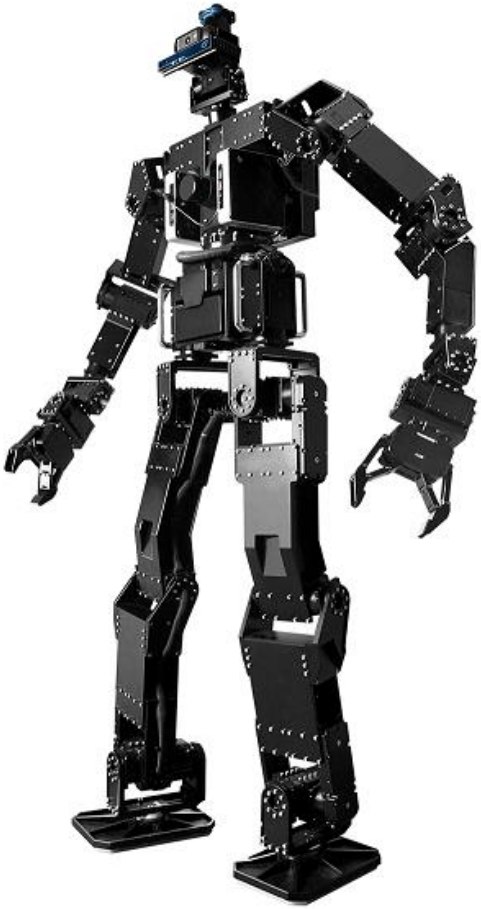
- Thormang is a human-sized humanoid robot and as it is bipedal robot, lower body parts are heavily loaded when it is in operation.
- A slight gap between DXL-pro horn and the metal frame due to the machining error might cause vibration when calibration takes effect during walking motion.
- Although lock-tight solution is applied and proper treatment is done for bolt assembly, there might be loosen bolts as total operation time increases.
- Be sure to tighten any loosen bolts before the operation for better performance.

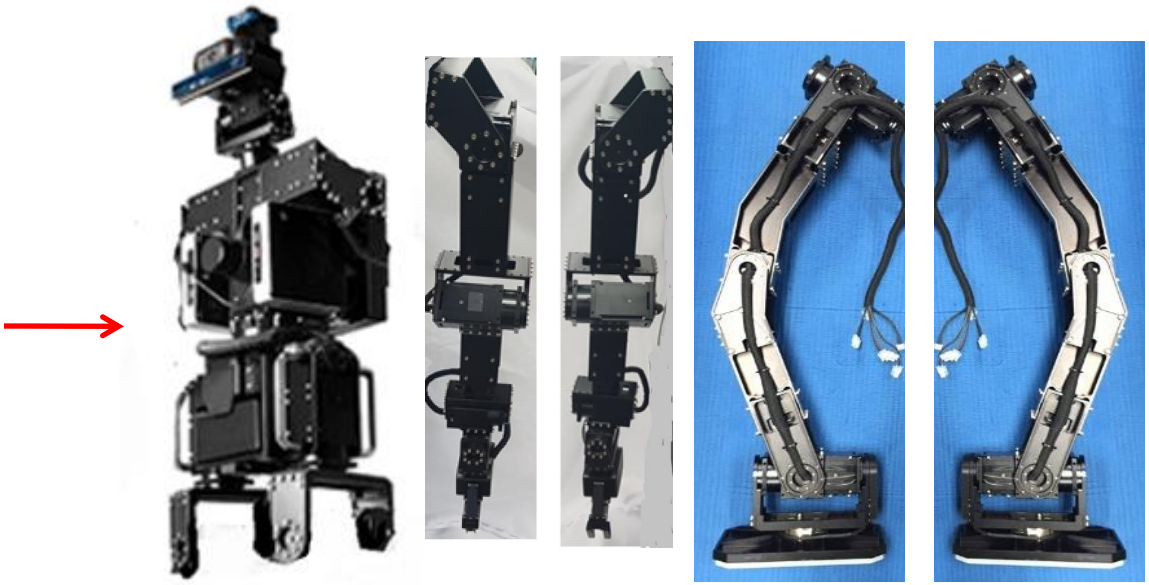


- Description is written for the left leg. Right leg also has to be checked.

# 5 Part Disassembly(1)

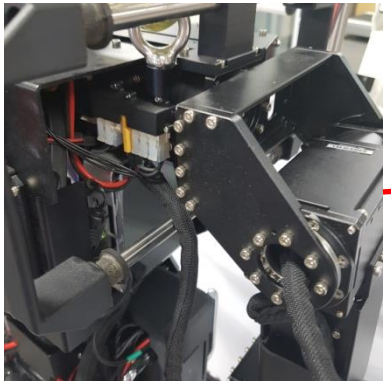
- The robot can be easily separated into five parts(Torso, Left & Right arm, Left & Right leg).
- Convenient to deliver the robot to other location as well as making it easy to replace or maintaining problematic part.



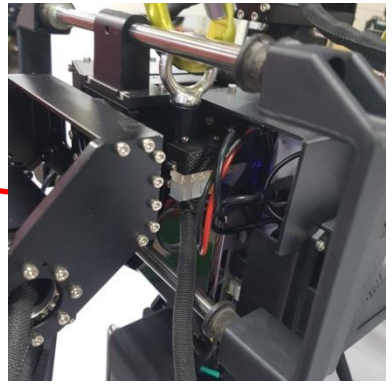


# 5 Part Disassembly(2)

• Disconnect power cables and communication cables.

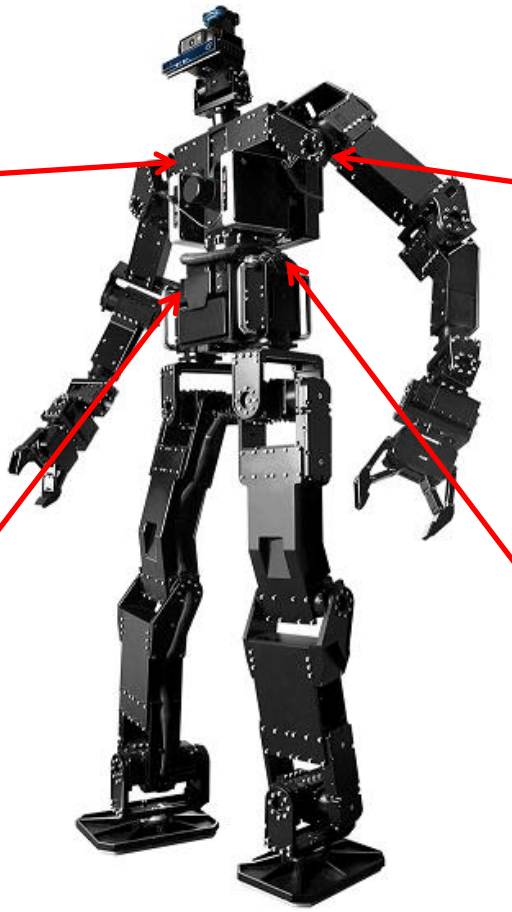


• Disconnect 3 PWR cables &
1 COM Cable for the Right arm



• Disconnect 3 PWR cables &
1 COM Cable for the Left arm

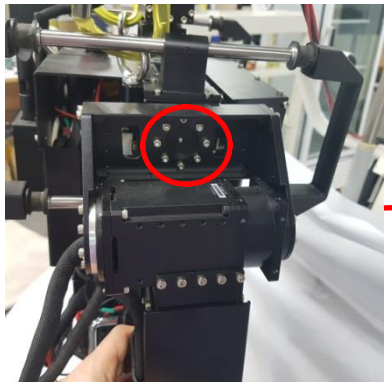
• Remove the Cable Protection Case
• Disconnect 5 PWR cables &
1 COM Cable for the Right leg



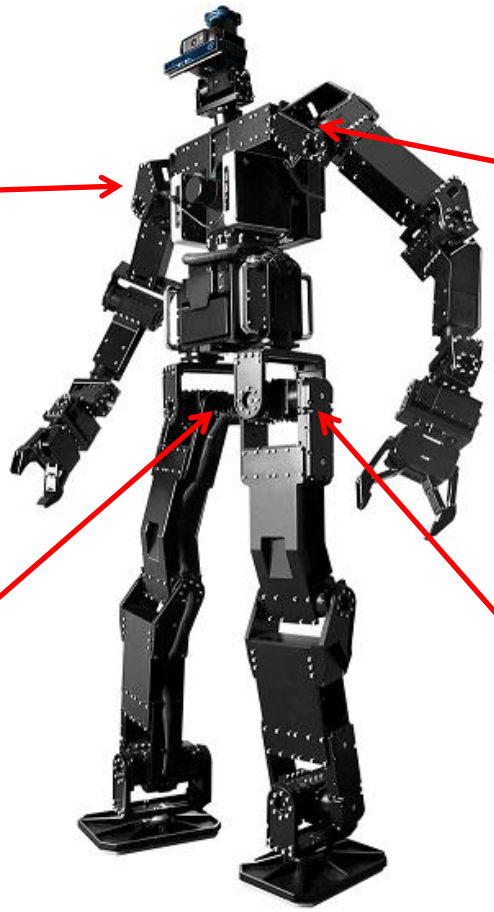
• Remove the Cable Protection Case
• Disconnect 5 PWR cables &
1 COM Cable for the Left leg

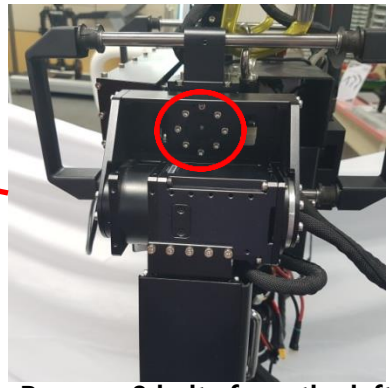
# 5 Part Disassembly(3)

• Remove Socket Headed Wrench Bolts

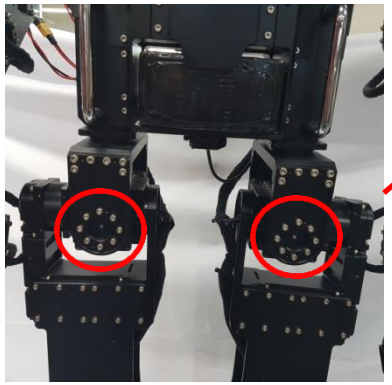


• Remove 8 bolts from the right arm
• Use round headed hexagon wrench

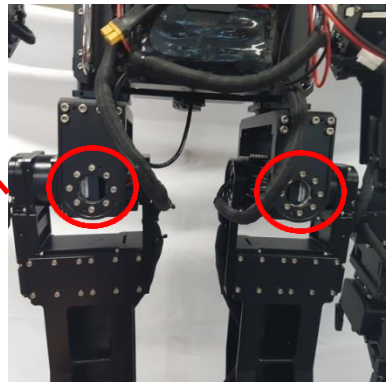




• Remove 8 bolts from the left arm
• Use round headed hexagon wrench



• Remove 16 bolts from the front pelvic



• Remove 16 bolts from the rear pelvic

# 5 Part Disassembly(4)

- Please lift the robot on the lift during the disassembly
- When disassembling parts, at least two engineers must work together because of the heavy weight.
- One engineer should hold the removing part while the other removes bolts and cables.



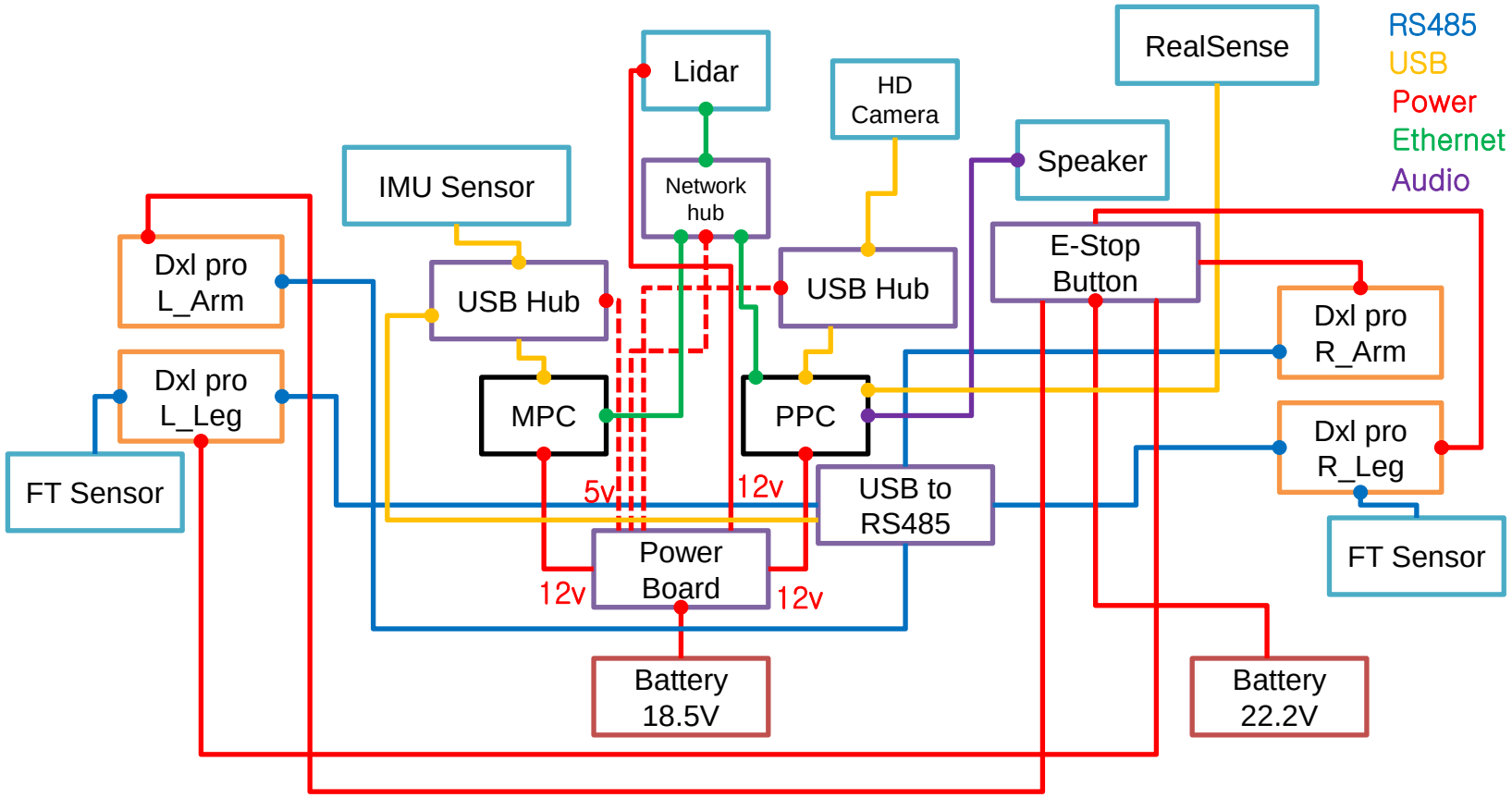


# System Harnessing

According to the assembly order,
cabling can be divided into 3 sections.

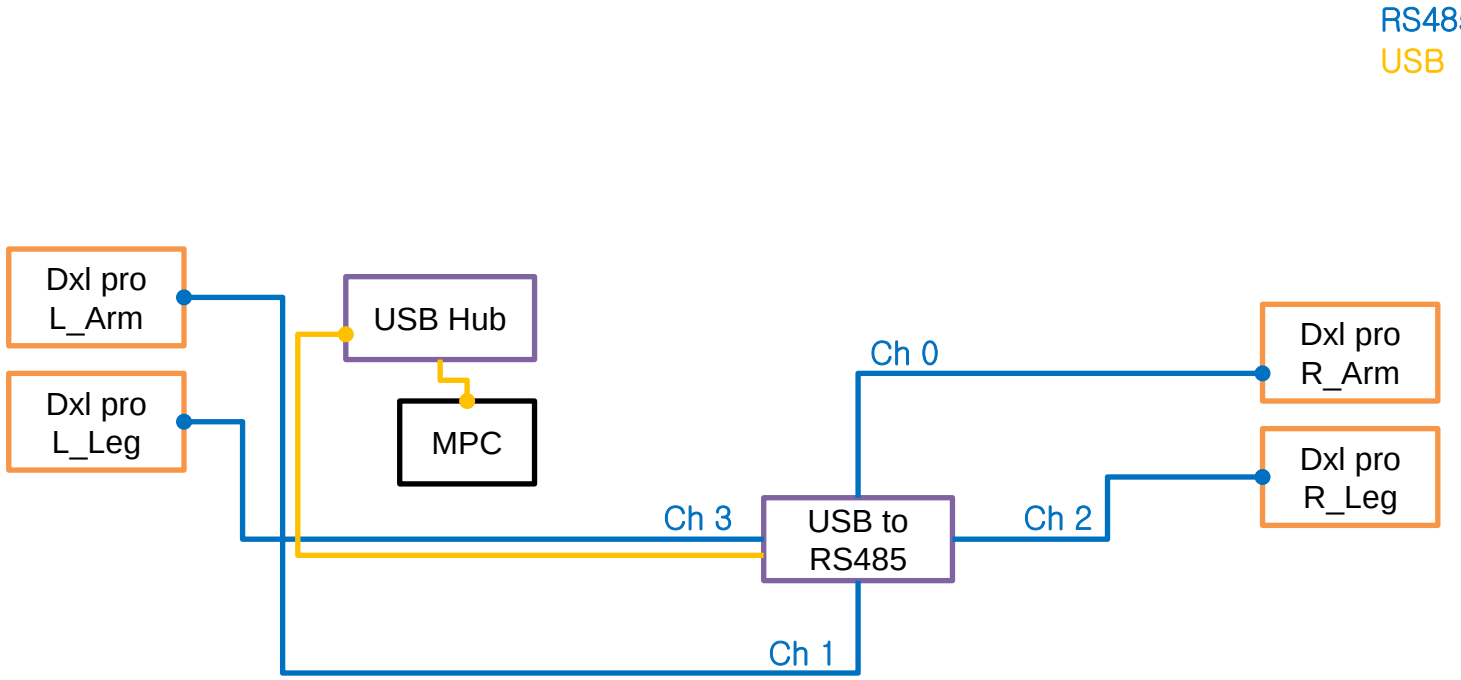
# USB to RS485 Board Wiring(1)

- System Block Diagram (all)



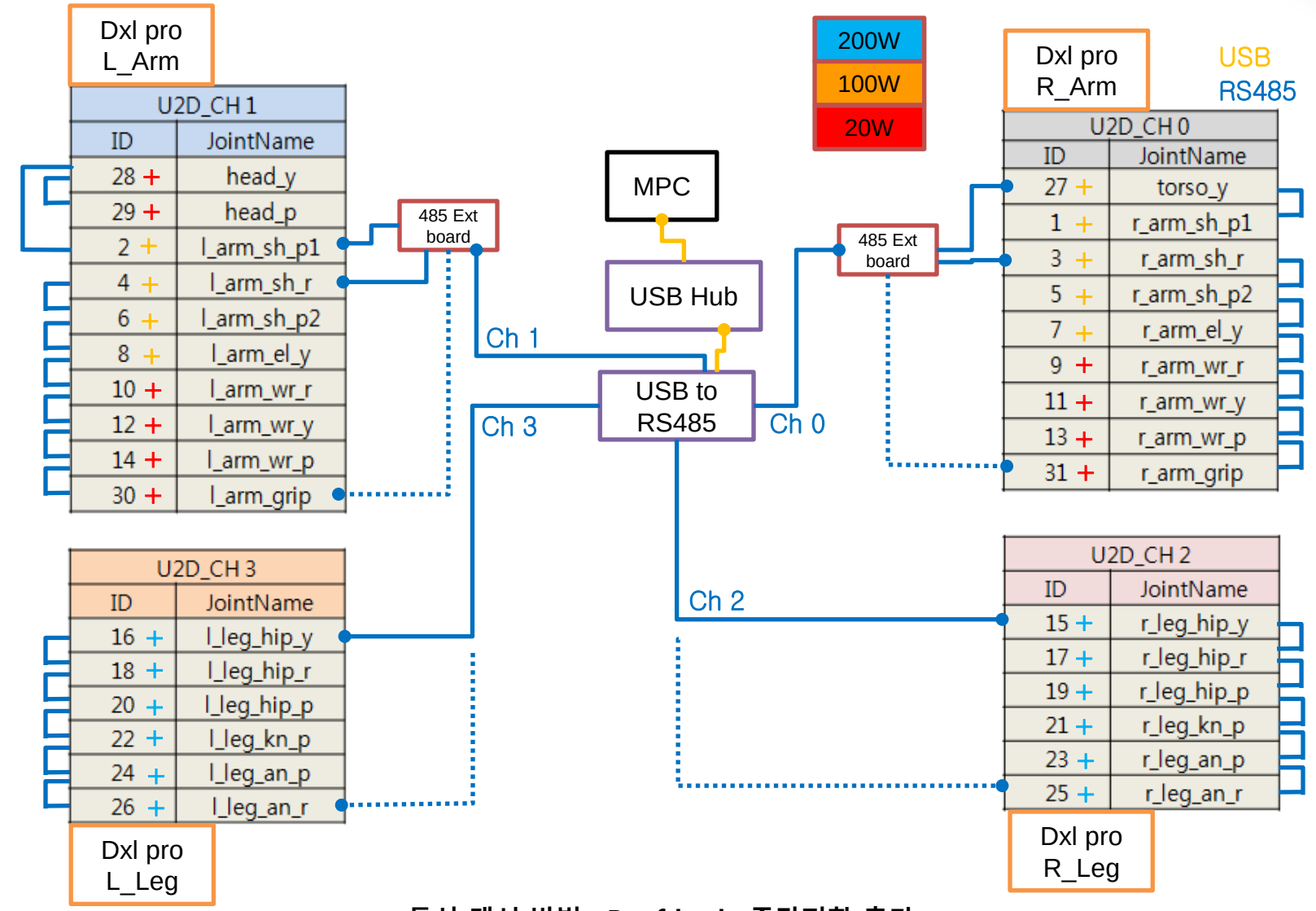
# USB to RS485 Board Wiring(2-1)

- System Block Diagram (USB to RS485)



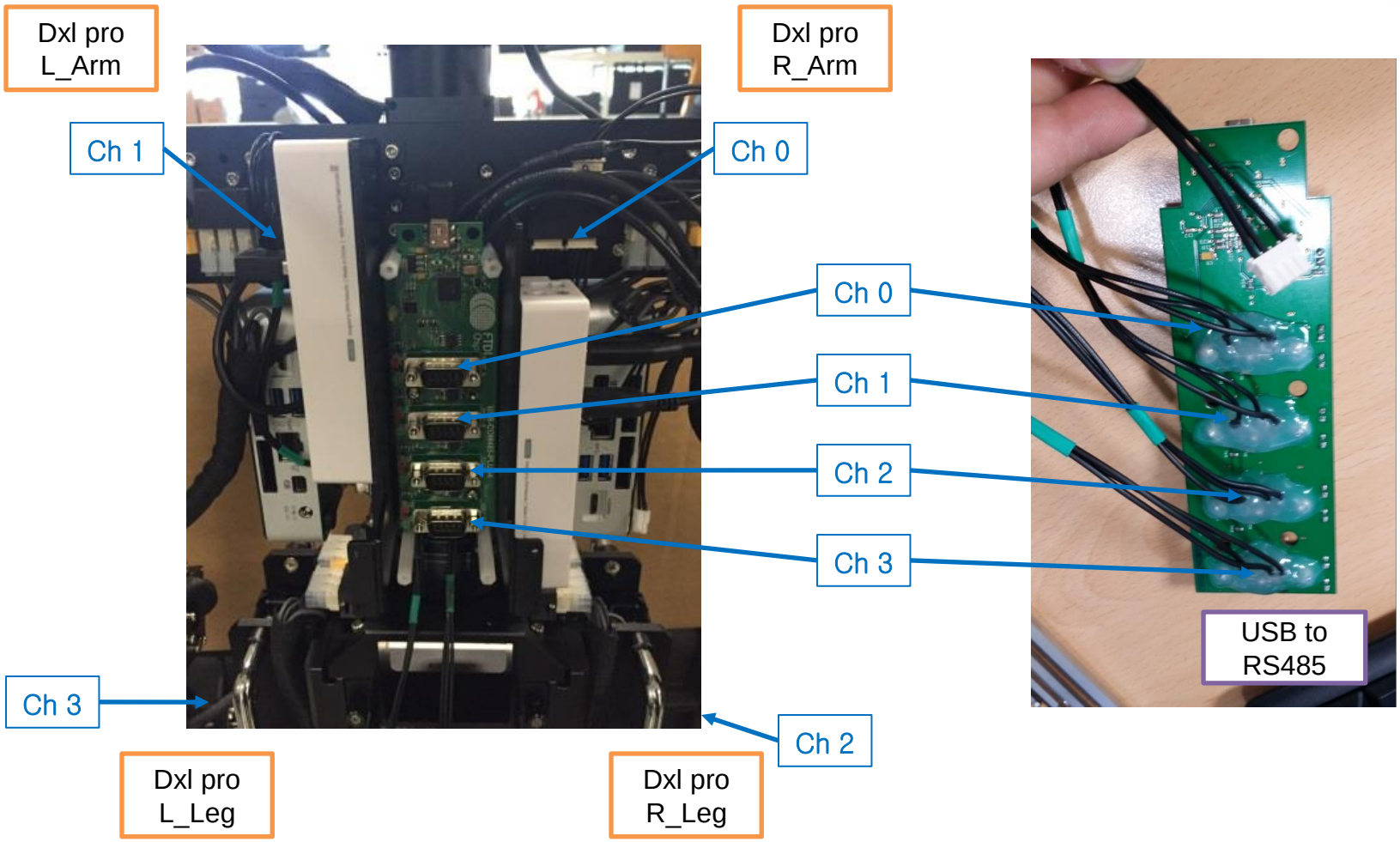

- **This diagram describes communication wiring between DXL PROs and the MPC.**
- **USB cables connect the MPC, USB hub and USB to RS485 Board(Orange Lines).**
- **USB to RS485 board splits into 4 channels to connect DXL-PRO communication lines.**
- **1 waist joint is included in the right arm, and 2 head joints are included in the left arm.**

# USB to RS485 Board Wiring(2-2)




- **통신 개선 방법 : Roof-back, 종단저항 추가**

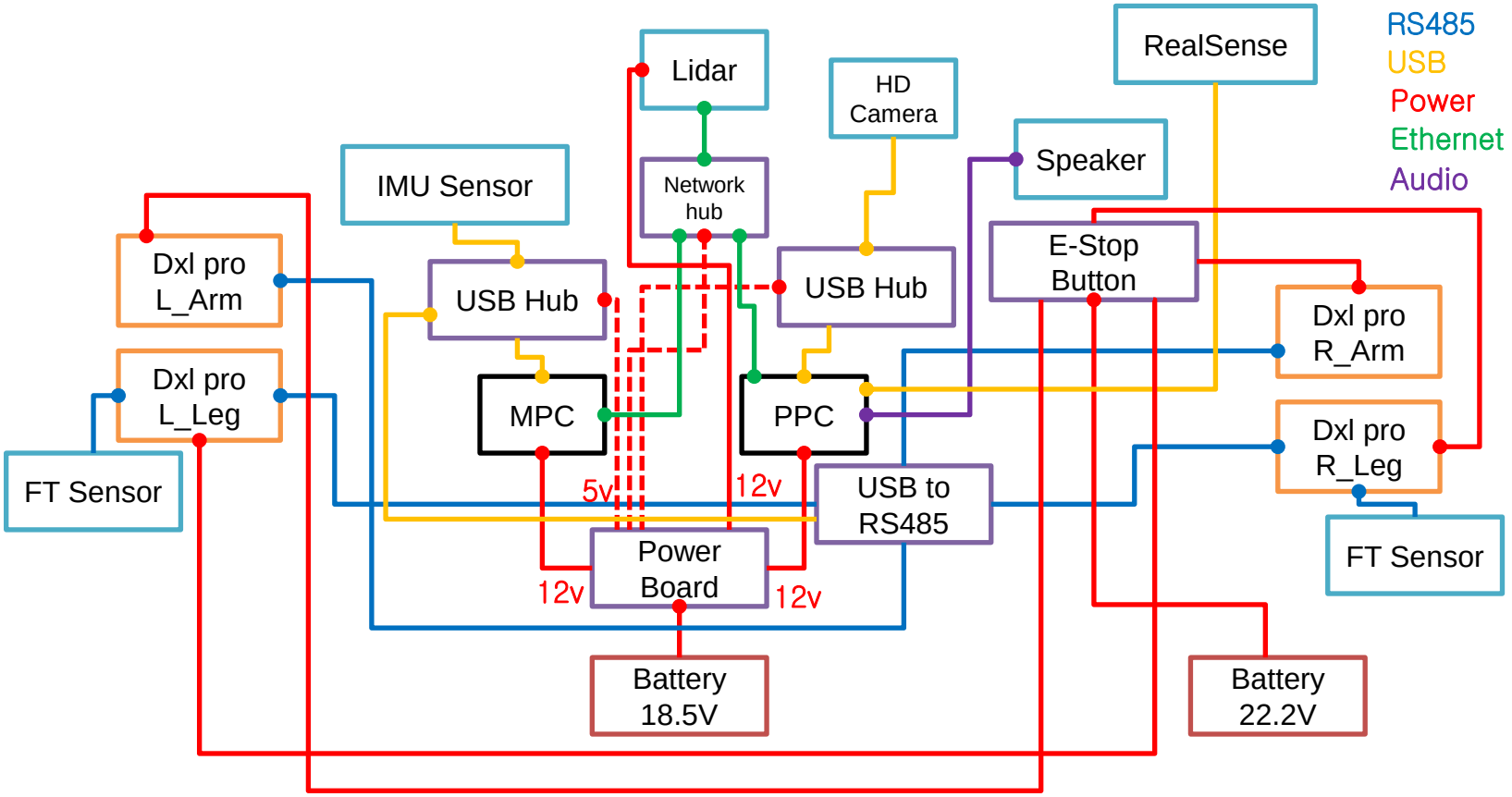
# USB to RS485 Board Wiring(3)




- **Each channels are connected as shown in the above picture of the disassembled back of Thormang.**
- **Ch 0 and 1 are connected from the inside of the frame.**
- **Ch 2 and 3 are connected around the waist..**

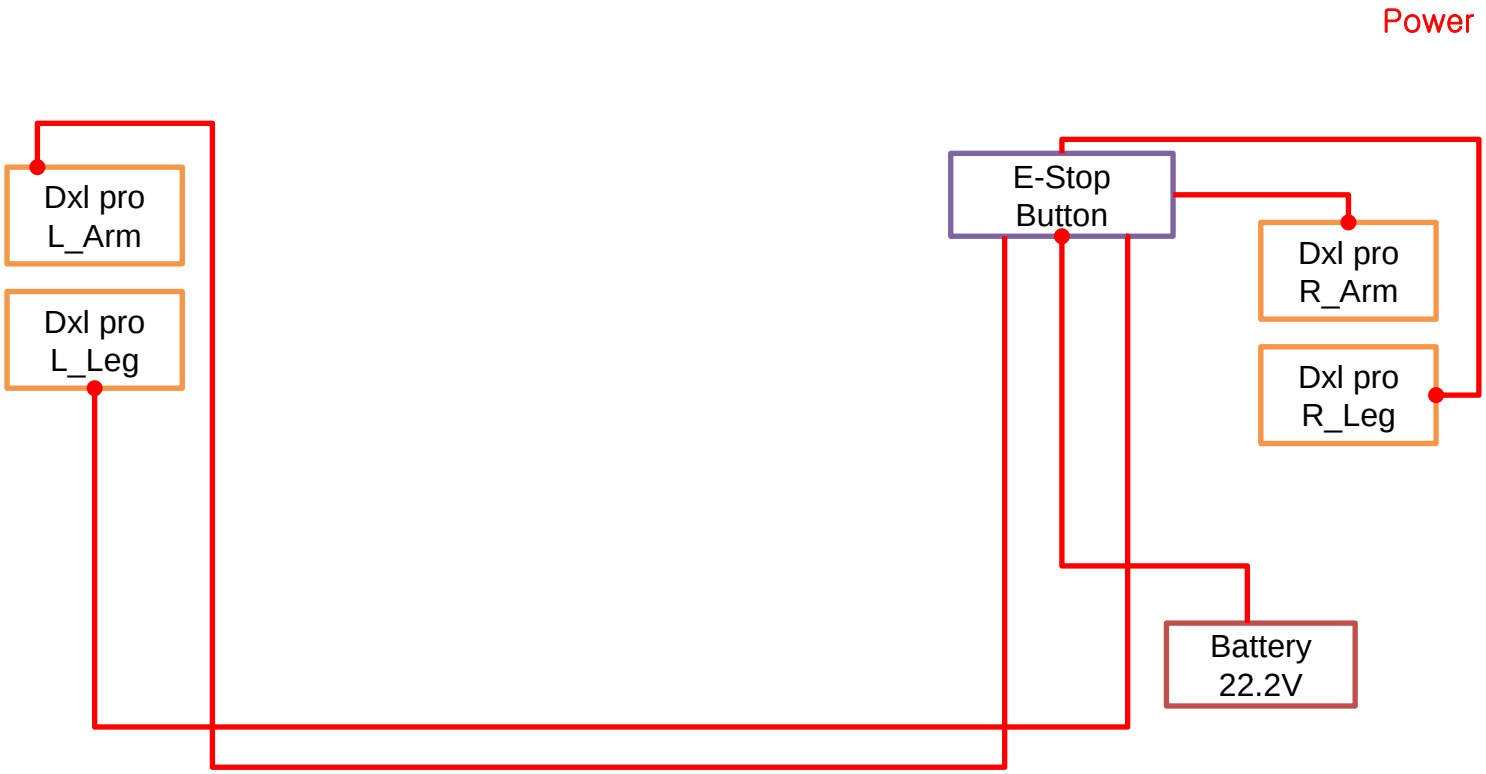
# Dynamixel Pro Power Wiring (1)

- System Block Diagram (all)



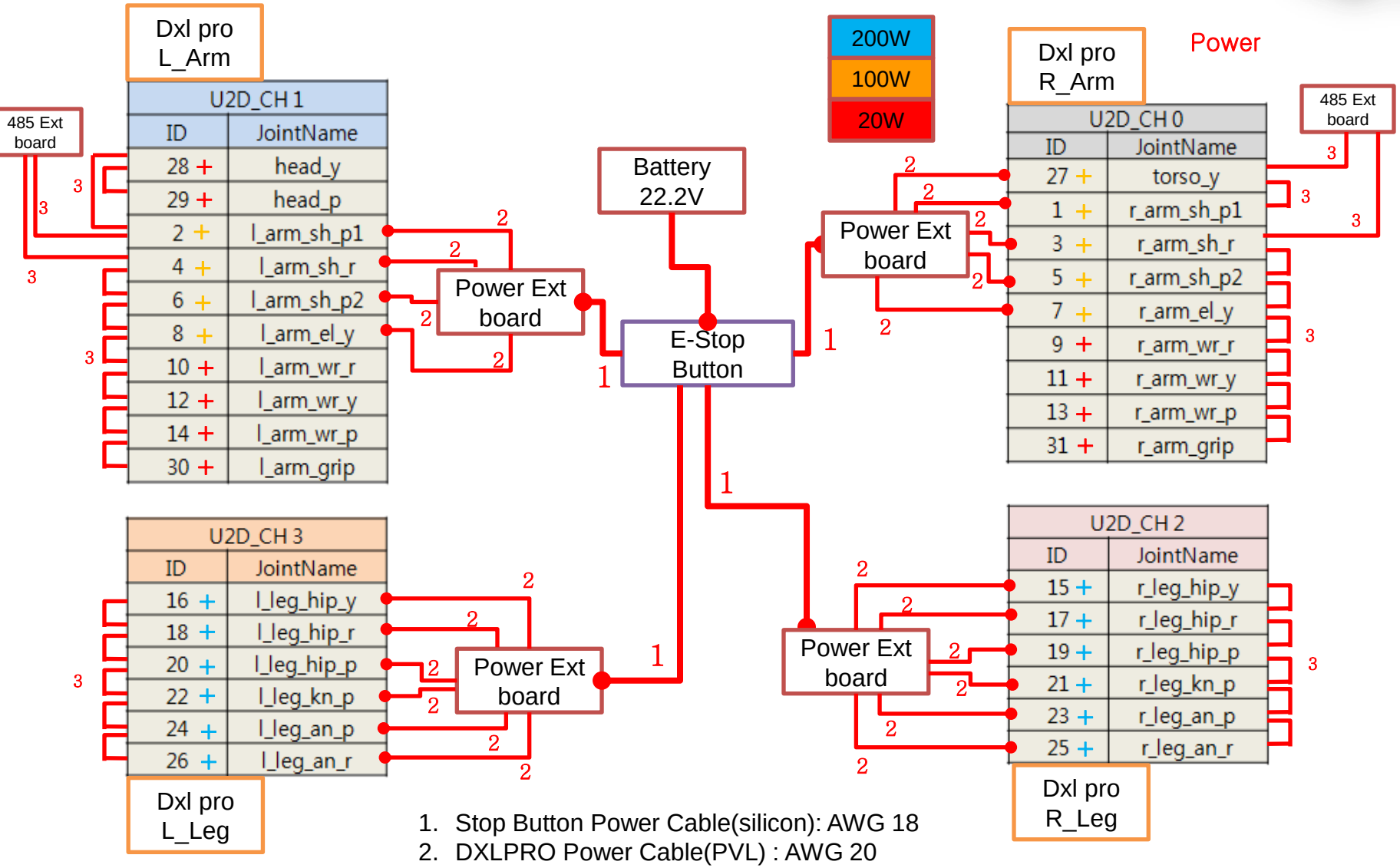
# Dynamixel Pro Power Wiring (2-1)

- System Block Diagram (DXL-PRO POWER)



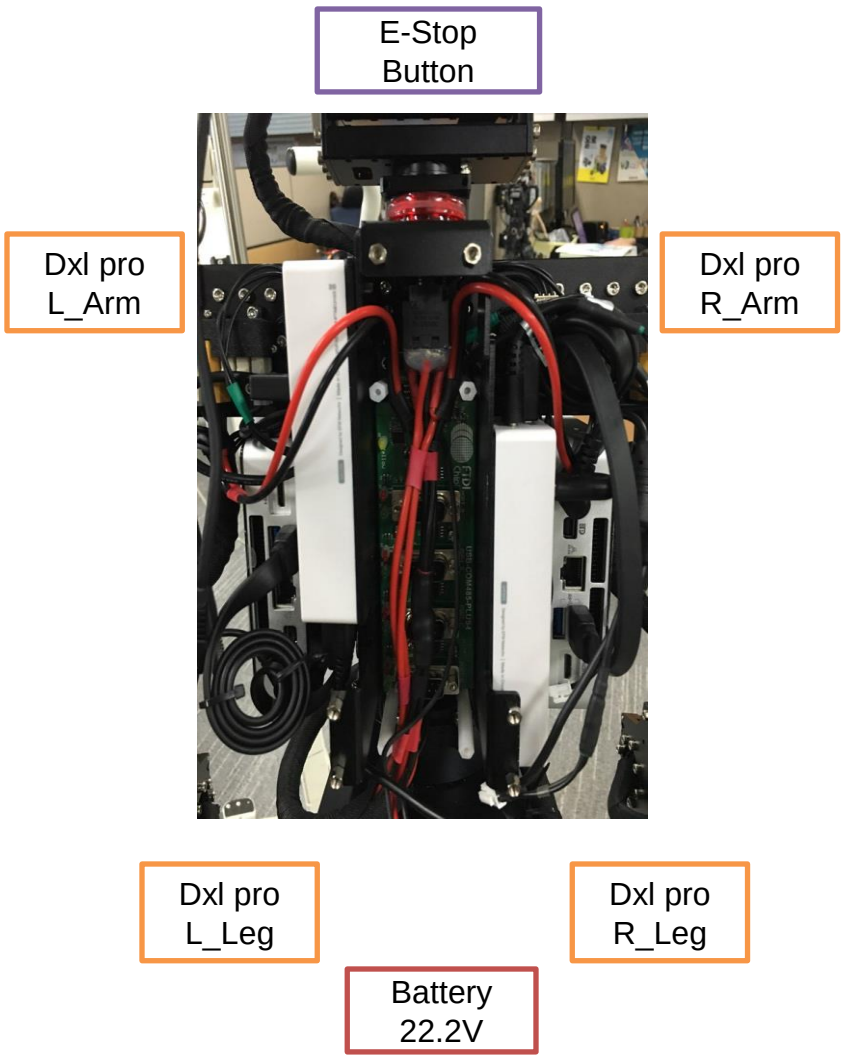

- **This diagram describes power supply for DXL PROs.**
- **22.2V battery is splitted into 4 parts via E-Stop Button.**
- **1 waist joint is included in the right arm, and 2 head joints are included in the left arm.**

# Dynamixel Pro Power Wiring (2-2)




1. Stop Button Power Cable(silicon): AWG 18
2. DXLPRO Power Cable(PVL) : AWG 20
3. 485 Cable: AWG 21

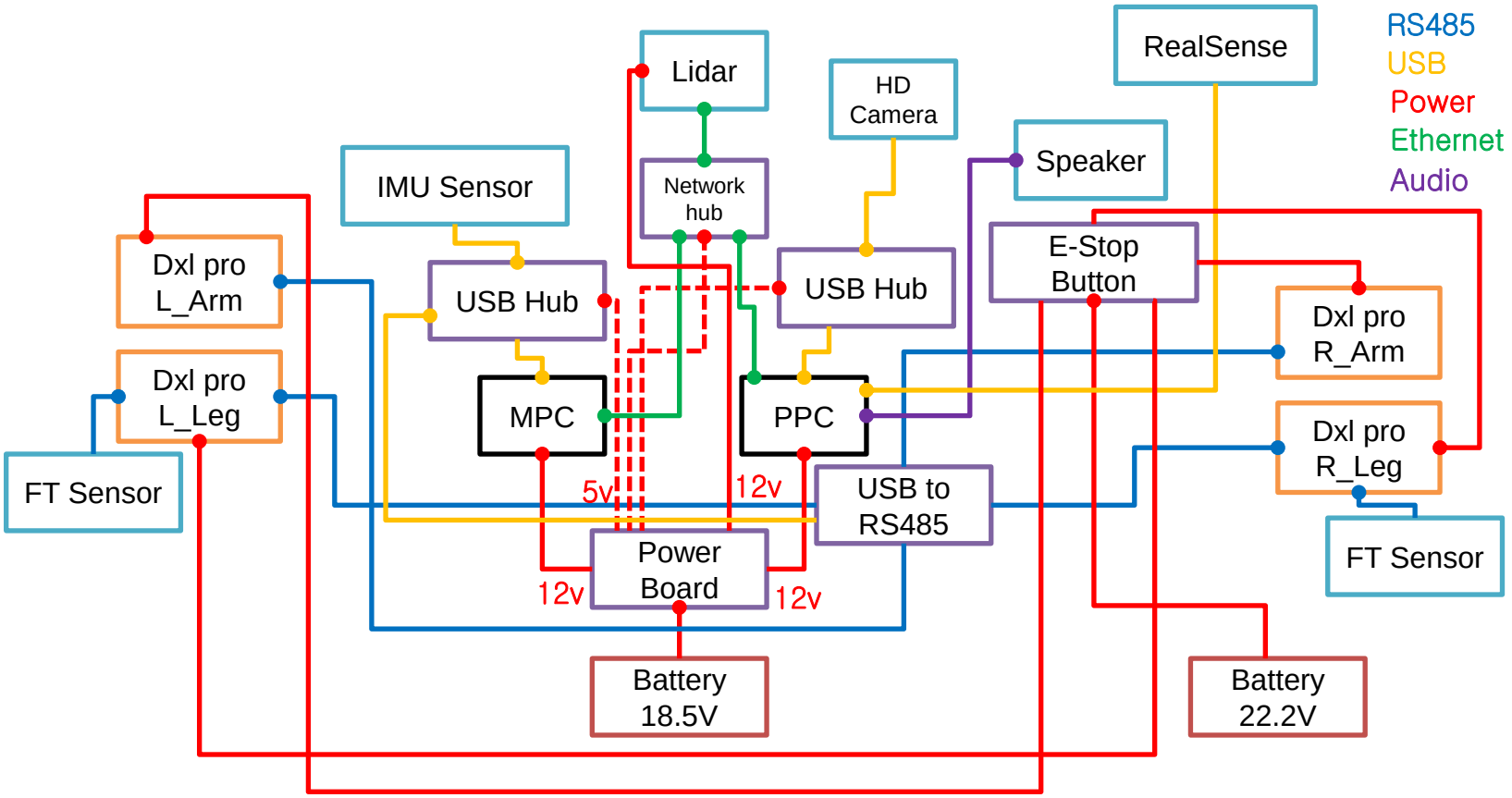
# Dynamixel Pro Power Wiring (3)




- **Power cables are much thicker than other cables as shown in the disassembled robot picture on the right.**
- **The power is splitted into 4 parts through the power splitting hub.**
- **Power cables for arms are directly connected and those for legs are wrapped around the waist and then connected to the legs.**

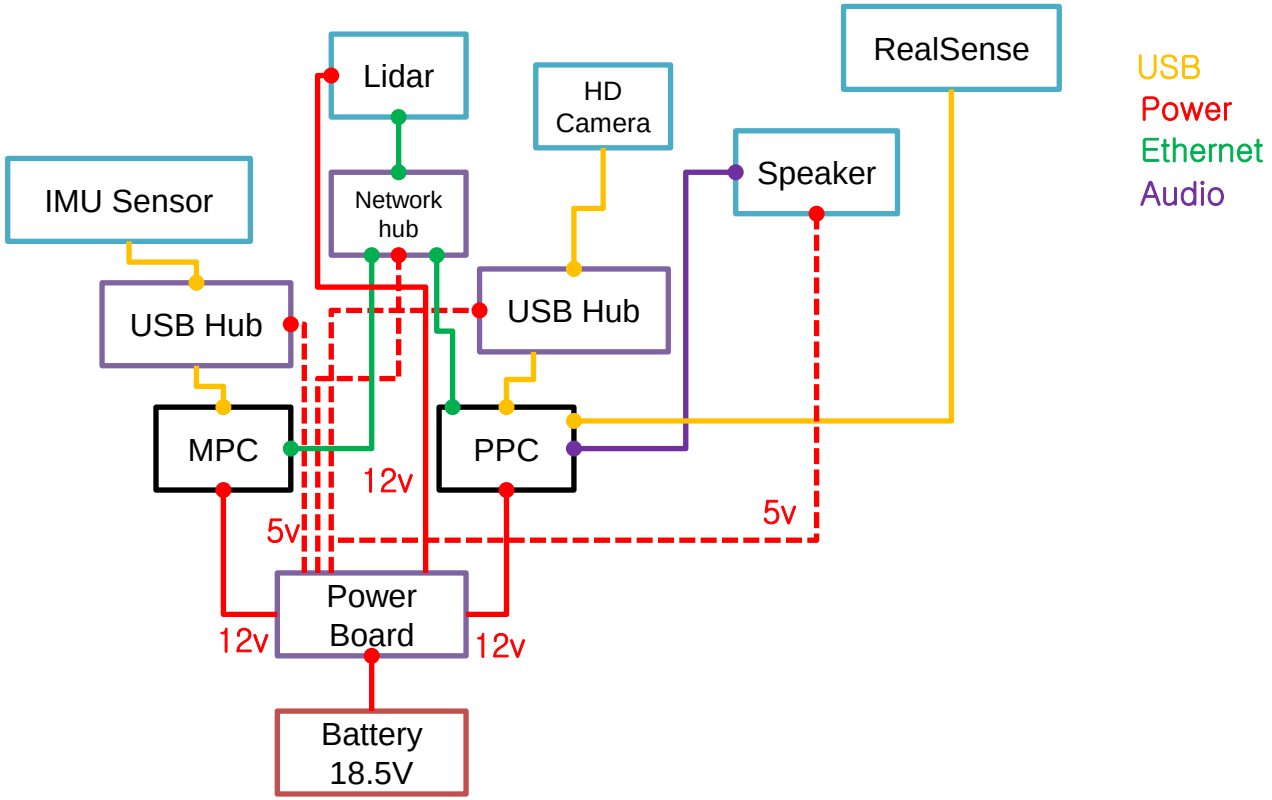
# Power Board Wiring(1)

- System Block Diagram (all)



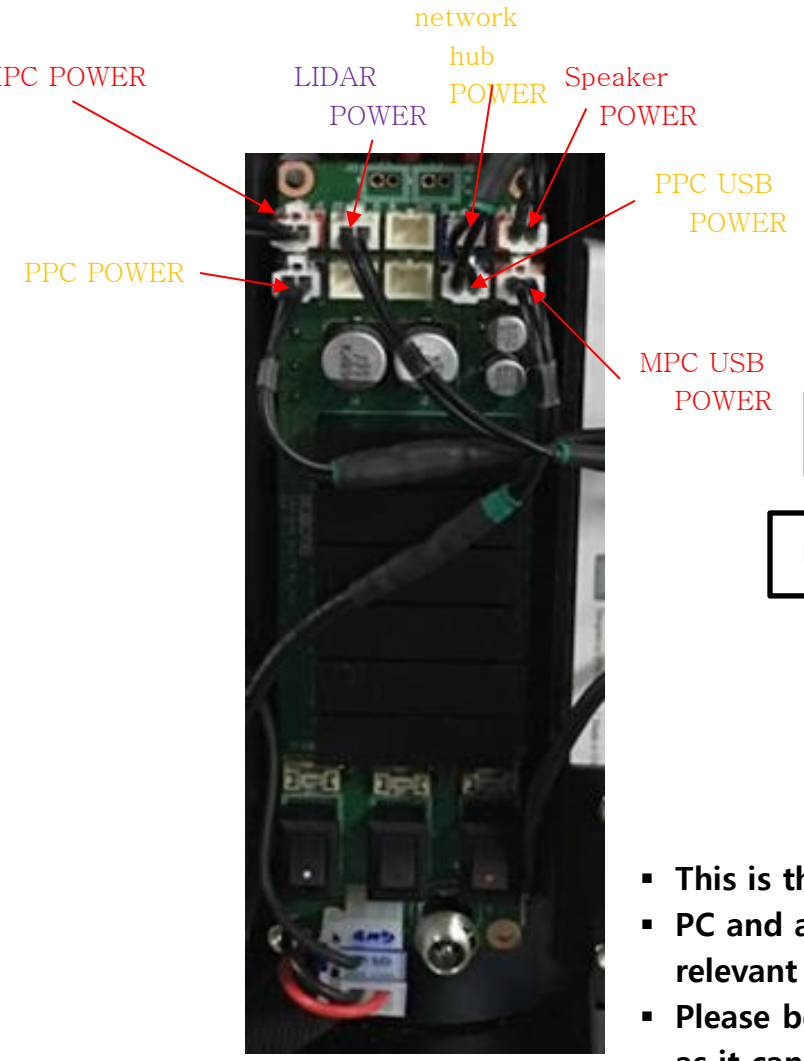
# Power Board Wiring(2)

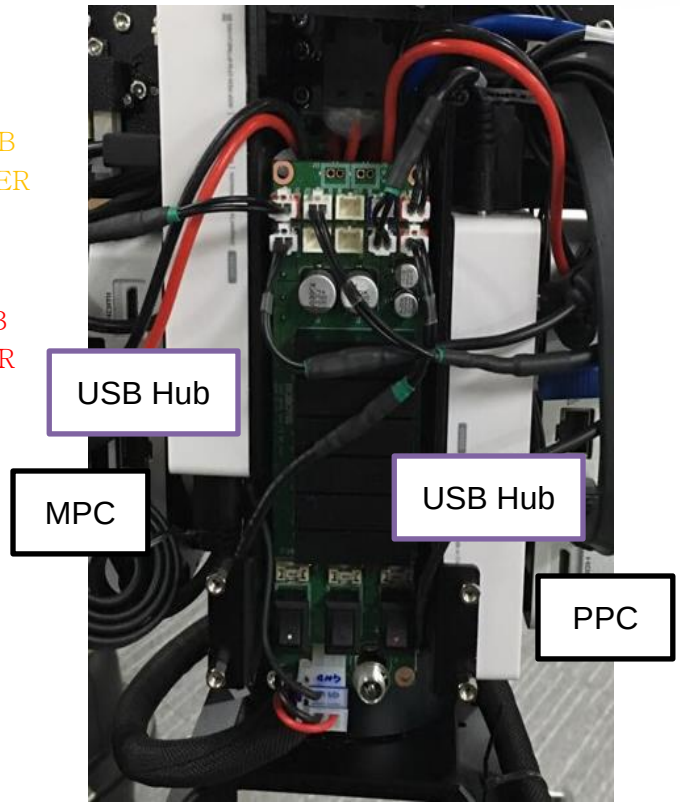
- System Block Diagram (power board)




- **This diagram describes power supply for PCs, LIDAR and other components, and their communication wirings.**
- **18.5V battery is used for the Power Board.**
- **Regulated 12V from the Power Board is supplied to the PPC, MPC and Lidar, regulated 5V is supplied to the UBS Hub, Network hub and Speaker.**

# Power Board Wiring(3)


- This is the most complicated part.
- PC and a USB hub must be connected to the relevant color-coded power port.
- Please be cautious when connecting the power as it can cause serious damage on the components and the power board when failing to connect on the right connector.