

**THORMANG3**

# THORMANG3 Tutorial

Assembly Manual



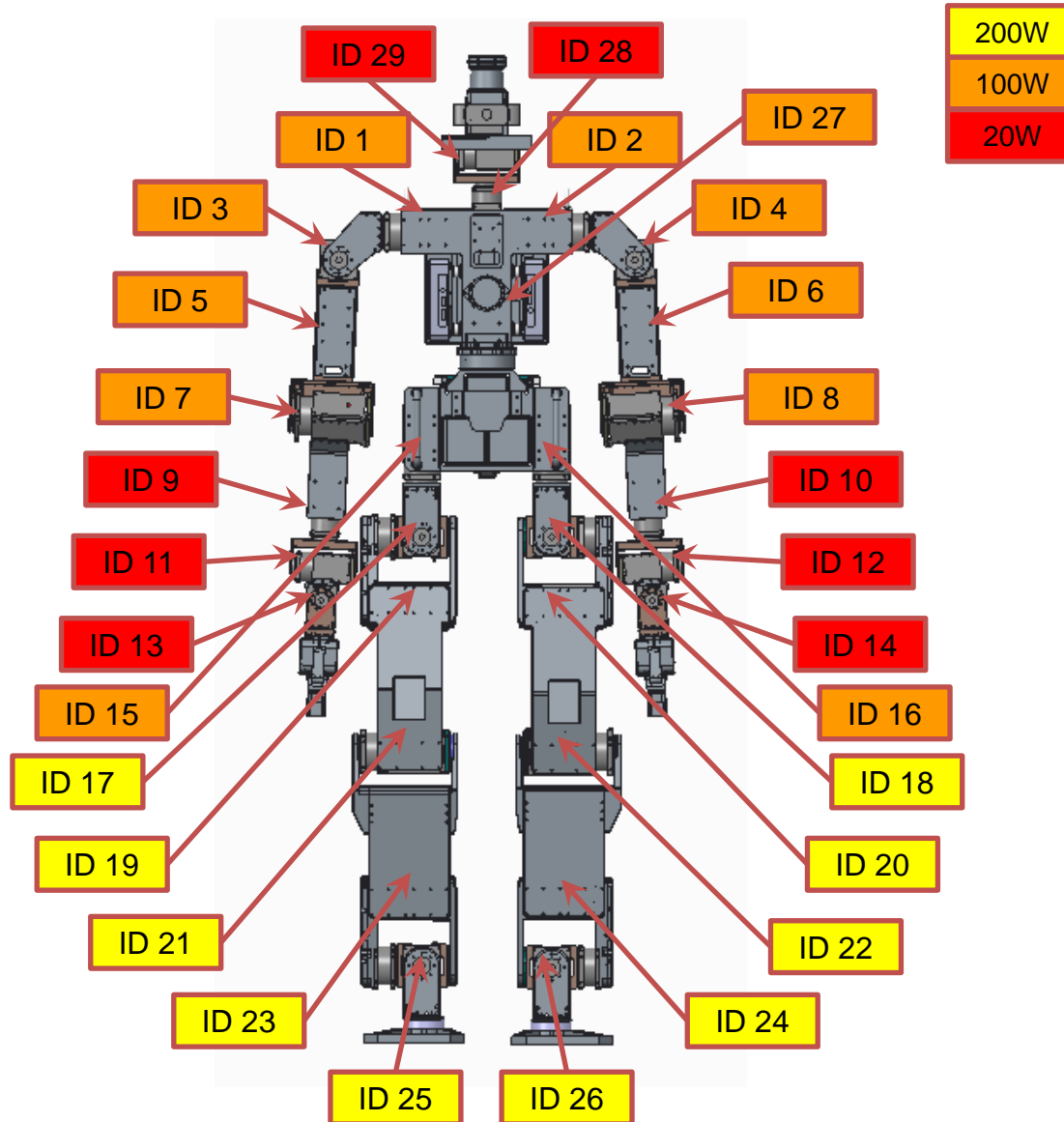
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# ID Map





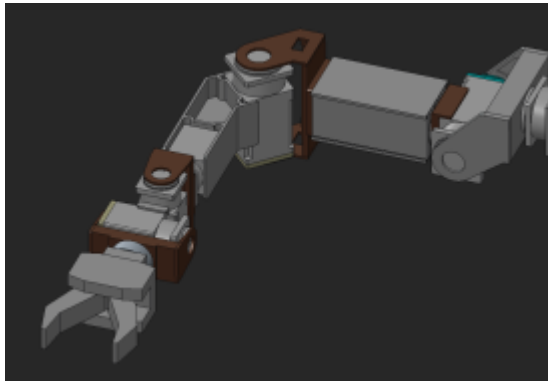
# Assembly Process (Arm)



\*Cable (Longest one used from the gripper, 20W actuators do not require PW-cables)

\*PW-Cable 400mm , 600mm, 800mm \* 2

\*4Pin-Cable 140mm , 240mm, 300mm \* 4



## 1. Arm

### (1) Upper Arm

\*Quantity 2 (One each for left & right arm)

\*Frame

PR15\_B03\_ARM\_PROFILE-54\_1\_PR23 \* 1 EA

NX05\_B03\_ADAPTOR-2-2 \* 1EA

NX05\_B03\_HINGE\_PR23\_SH\_01 \* 1EA

\*Symmetry (Frames that are symmetric)

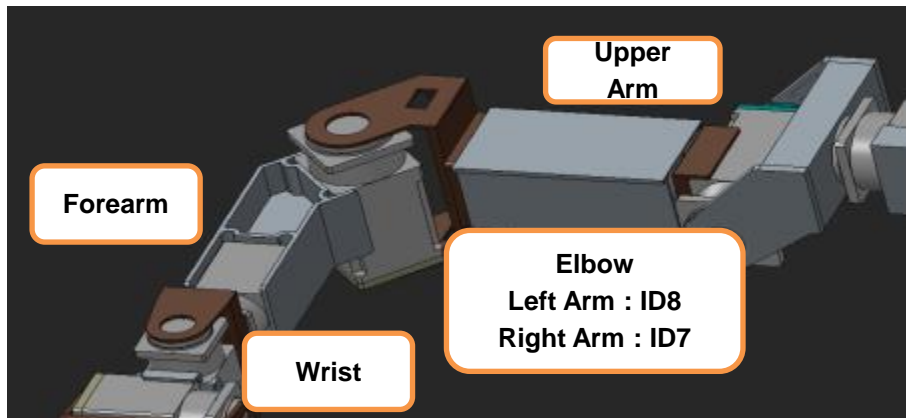
PR15\_B03\_ARM\_PROFILE-54\_1\_PR23 \* 1 EA

NX05\_B03\_ADAPTOR-2-2 \* 1EA

NX05\_B03\_HINGE\_PR23\_SH\_01 \* 1EA

\*Locking

WB M3 \* 8mm





# Assembly Process (Arm)



## 1. Arm

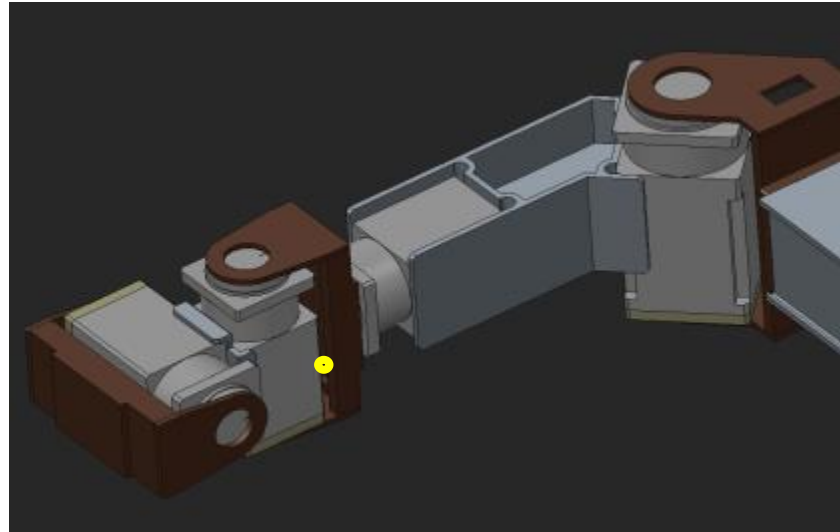
### (2) Forearm

\*Quantity 2 (One each for left & right arm)

\*Frame  
PR23\_FRM\_FOREARM \* 2EA  
DUMMY\_NX05\_CRB \* 1EA

\*Symmetry  
Wiring, limiter

\*Locking  
WB M3 \* 8mm





# Assembly Process (Arm)



## 1. Arm

### (3) Wrist

\*Quantity 2 (One each for left & right arm)

#### \*Frame & Actuators

PR23\_FRM\_WRIST \* 1 EA  
H42-20-S500-R \* 3EA (ID 9,11,13)  
NX03\_B03\_HINGE-7G \* 2EA  
DUMMY\_NX03\_CRB \* 2EA

#### \*Symmetry

PR23\_FRM\_WRIST \* 1 EA  
H42-20-S500-R \* 3EA (ID 10,12,14)  
NX03\_B03\_HINGE-7G \* 2EA  
DUMMY\_NX03\_CRB \* 2EA

#### \*Locking

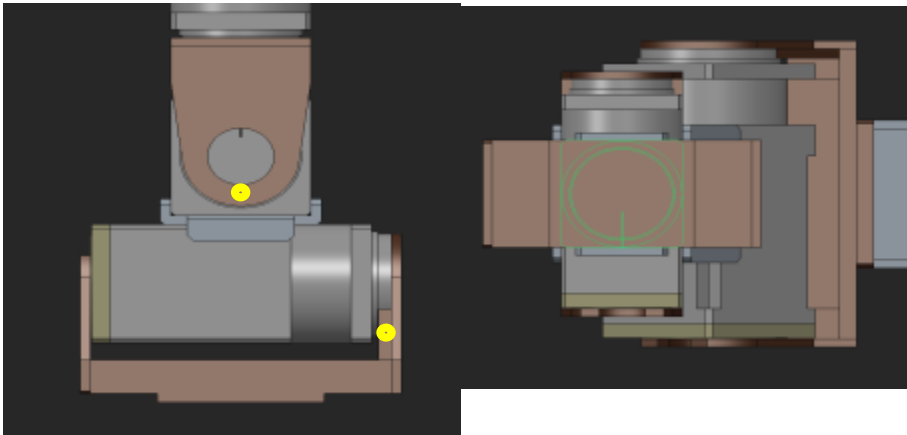
WB M3 \* 8mm

#### [Assembly/Wiring Procedure]

1. ID9 or 10 – NX03\_B03\_HINGE-7G
2. NX03\_B03\_HINGE-7G – ID11 or 12
3. ID11 or 12 – PR23\_FRM\_WRIST
4. PR23\_FRM\_WRIST – ID13 or 14
5. ID13 or 14 – NX03\_B03\_HINGE-7G

Use 4Pin (300mm) from ID 1-3

Use 4Pin (140mm) from the gripper to ID 5





# Assembly Process (Arm)



Limiter location shown below



## 1. Arm (4) Elbow

\*Quantity 2 (One each for left & right arm)

\*Frame & Actuators

H54-100-S500-R \* 1EA (ID 7)

NX05\_B03\_HINGE-5C \* 1EA

Fore-arm Part

\*Symmetry

H54-100-S500-R \* 1EA (ID 8)

NX0-5\_B03\_HINGE-5C \* 1EA

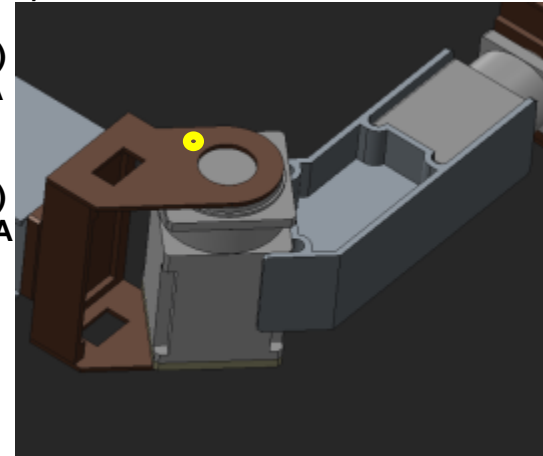
Fore-arm Part

\*Locking

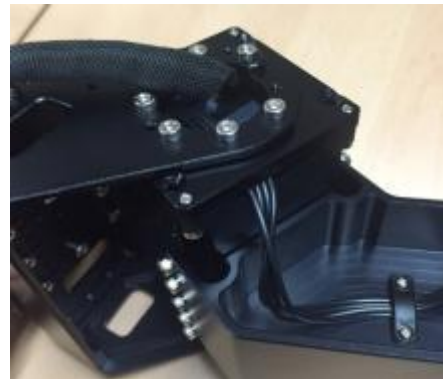
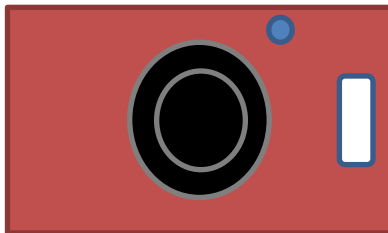
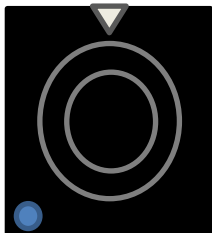
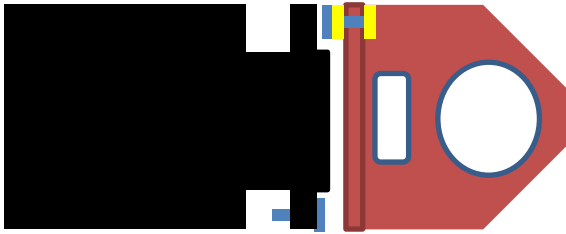
WB M3 \* 6mm

WB M3 \* 8mm

FHS M3 \* 8mm



**Calibrate the origin of the actuator to the yellow marked circle**







# Assembly Process (Arm)



## 1. Arm

### (5) Upper Arm Wiring/Assembly

**\*Quantity** 2 (One each for left & right arm)

**\*Frame & Actuators**

H54-100-S500-R \* 2EA (ID 3,5)  
NX05\_B03\_HINGE-PR23\_SH\_01  
\* 1EA

Upper Arm Frame

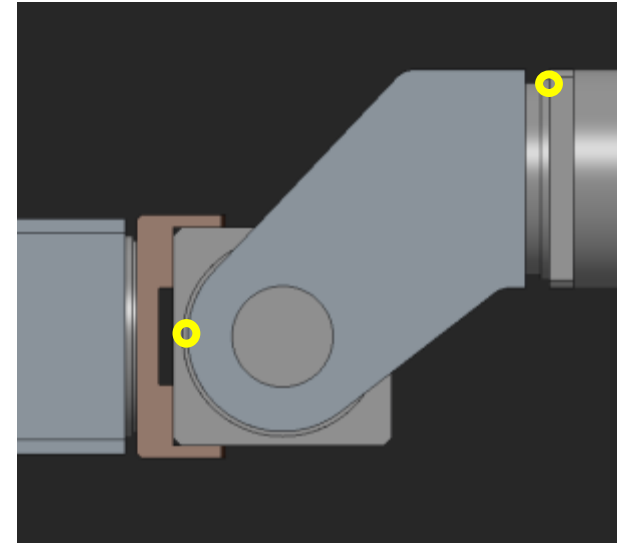
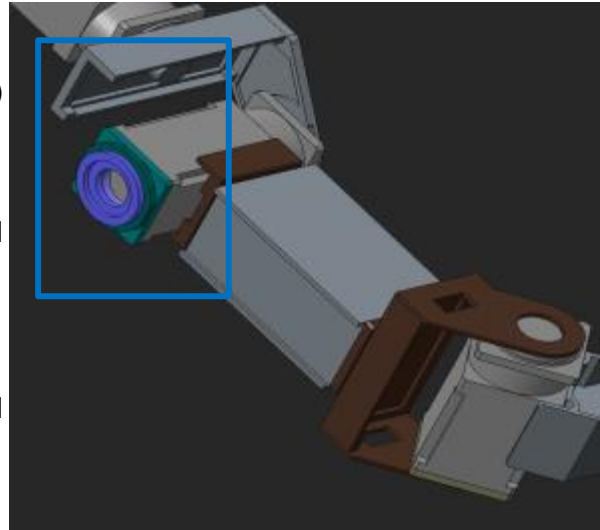
**\*Symmetry**

H54-100-S500-R \* 2EA (ID 4,6)  
NX05\_B03\_HINGE-PR23\_SH\_01  
\* 1EA

Upper Arm Part

**\*Locking**

WB M3 \* 6,8 mm  
FHS M3 \* 8mm



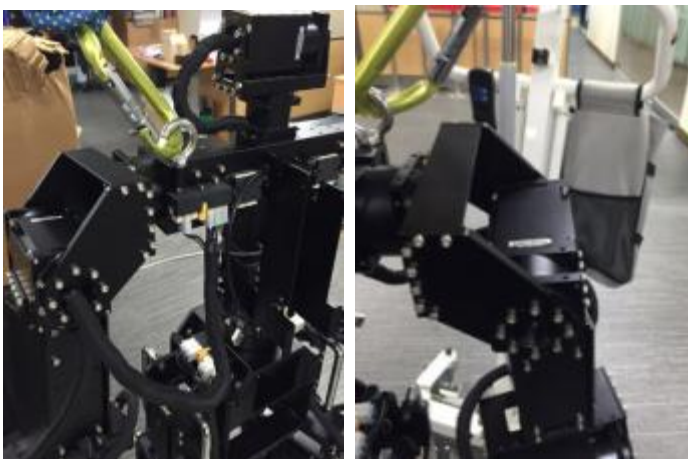
**Calibrate the origin of the actuator to the yellow marked circle**







## Assembly Process (Arm)



**\*Repeat the same procedure for the other (left/right) arm. The two arms should be symmetric**





# Assembly Process (Leg)



## \*Cable

### \*PW-Cable

100mm, 500mm , 600mm  
800mm, 1000mm , 1200mm \* 2EA

### \*4Pin-Cable

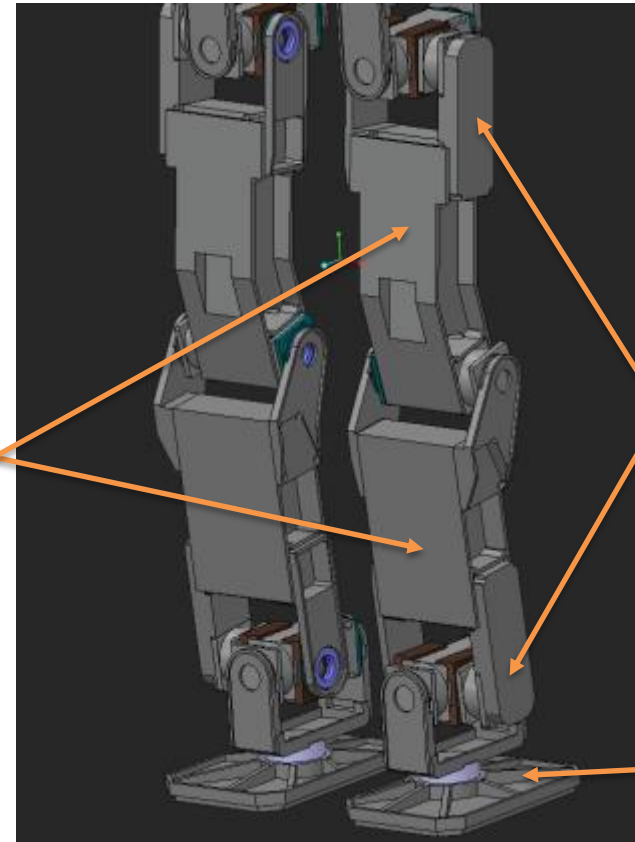
300mm,\*8EA 600mm \* 2EA

(Longest PW-Cable used from the Foot & Ankle, so the order will go 1200,1000,800,600,500,100 from the bottom to the top)

**Total of 4 Belt Module Set needs to be made  
(2 on the left & 2 on the right)**

Make your way up from the Foot Ankle to the Belt Module connected to the thigh

Make sure all the wires are not damaged



Thigh & Calf

Belt Module Set

Foot & Ankle



# Assembly Process (Leg)



## 2. Leg

### (1) Foot & Ankle

\*Quantity 2 (One each for left & right foot)

\*Frame & Sensor

PR23\_A01\_FOOT \* 1EA

PR23\_FRM\_HINGE\_X\_02\_B \* 1 set

ATI FT sensor \* 1EA

\*Symmetry **(The foot frame are symmetrical not identical)**

PR23\_A01\_FOOT \* 1EA

PR23\_FRM\_HINGE\_X\_02\_B \* 1 set

ATI FT sensor \* 1EA

\*Locking

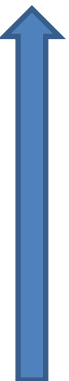
WB M4 \* 10mm

FHS M4 \* 10mm

**FT sensors must be located as shown exactly below**



**FRONT**







# Assembly Process (Leg)



## 2. Leg

### (2) Belt Module Set (Assembly & Wiring)

\* Quantity 2 (One each for left & right arm)

\* Frame & Actuator

PR23\_A01\_FOOT \* 1EA

PR23\_FRM\_HINGE\_X\_02\_B \* 1 set

ATI FT sensor \* 1EA

\*Symmetry

PR23\_A01\_FOOT \* 1EA

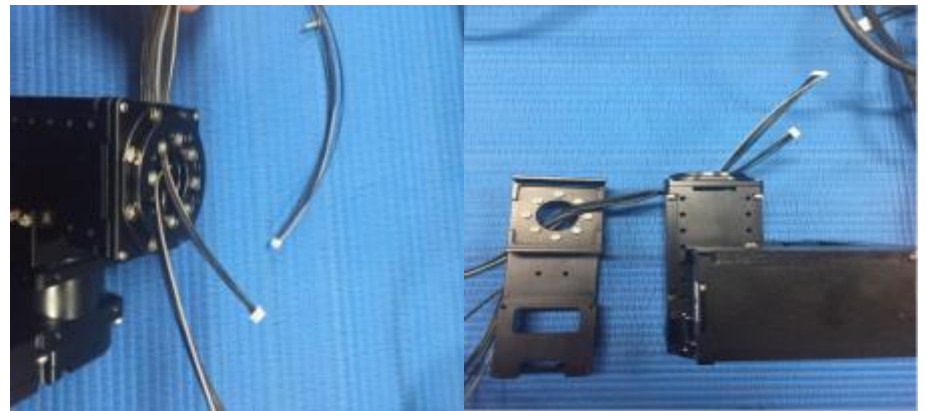
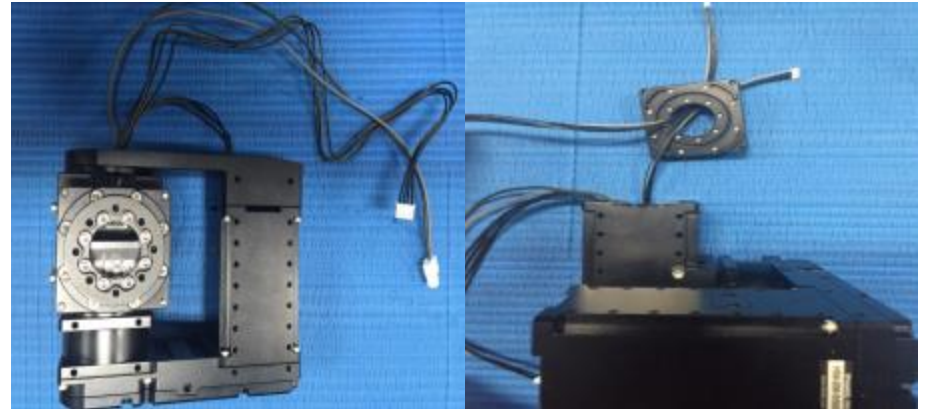
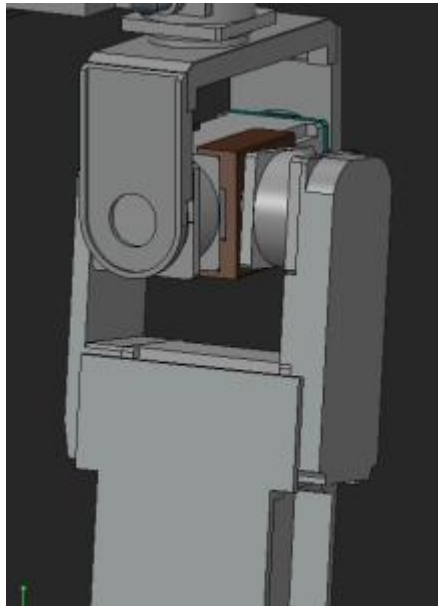
PR23\_FRM\_HINGE\_X\_02\_B \* 1 set

ATI FT sensor \* 1EA

\*Locking

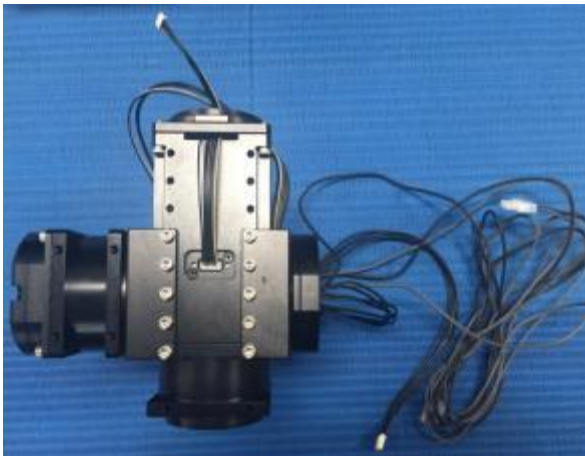
WB M5 \* 10mm

FHS M4 \* 10mm





## Assembly Process (Leg)





# Assembly Process (Leg) Step by step procedures



Actuators needed for the belt module set are ID 17 & ID 19 (Right Thigh), ID 18 & ID 20 (Left Thigh), ID 23 & ID 25 (Right Ankle), ID 24 & ID 26 (Left Ankle). Need a total of 2 set (Right and left leg)

Follow the instruction to assemble ID 24 & ID 26 (Left Ankle) belt module set. Other three modules are assembled with the same procedure.

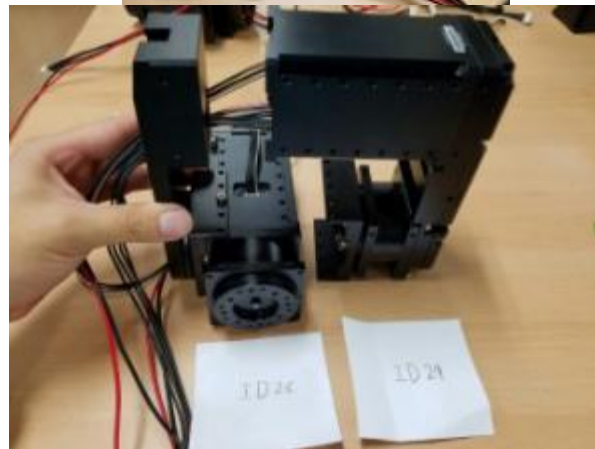
Reference p42 for ID 24 actuator assembly  
Reference p43 for Belt Module Idler Bearing







# Assembly Process (Leg) Step by step procedures





# Assembly Process (Leg)



2 Leg

(3) Thigh & Calf

\*Quantity 2

\*Frame & Actuator

Belt Module set x 1EA

Belt Module Idler Bearing x 1EA

Idler Bearing x 2EA

ID17 ~ 24(odd)

PR23\_FRM\_THIGH\_L\_B

PR23\_FRM\_CALF\_L\_B

PR23\_FRM\_CALF\_HINGE

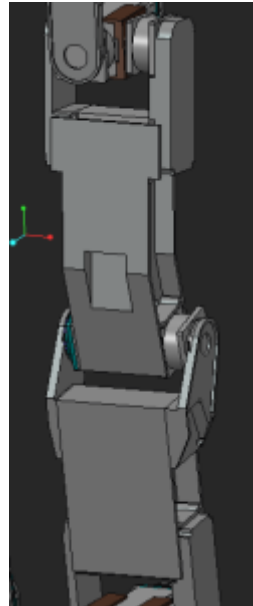
PR23\_FRM\_CALF\_HINGE\_MIR

\*Symmetry

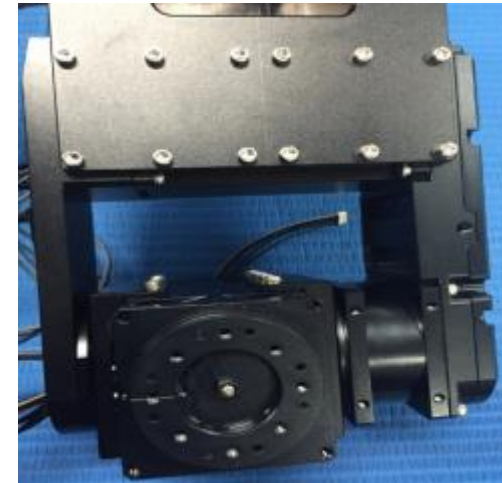
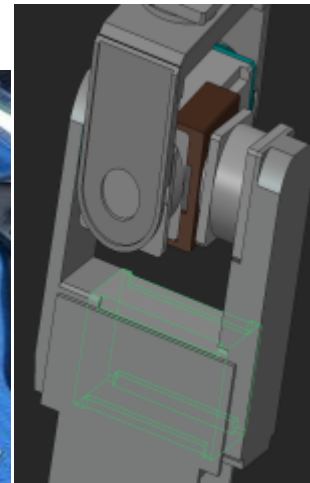
Actuator location & Wiring

\*Locking

WB M3 \* 6, 8mm

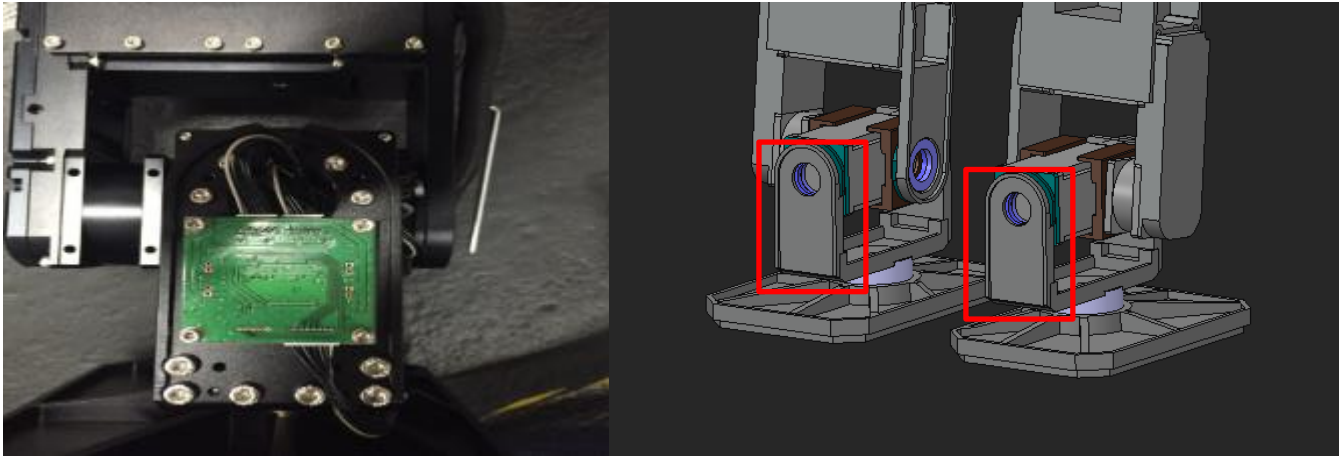


The frame has a groove by the red box shown above where the wires can exit



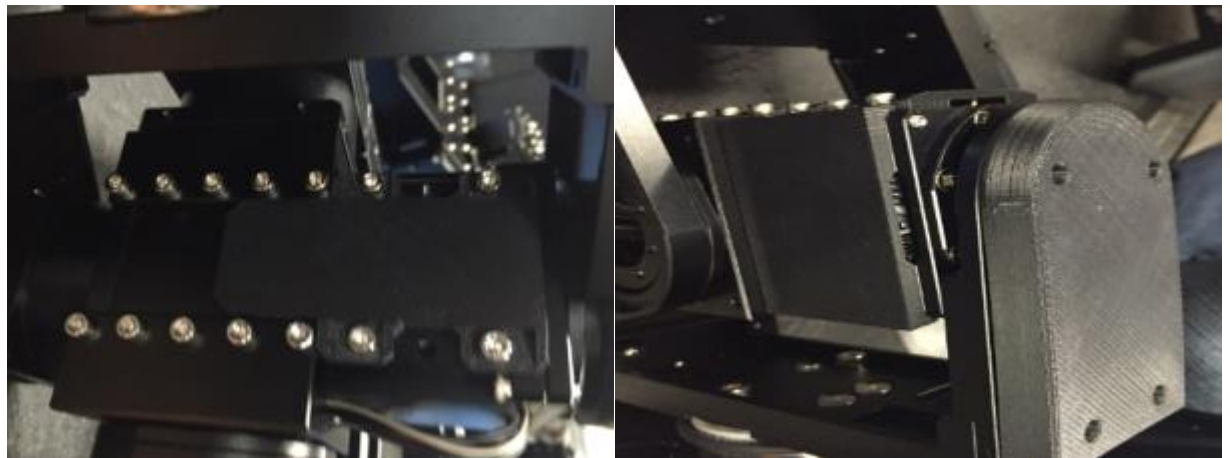


## Assembly Process (Leg)



**Attach the ATI FT sensor Board to the back side of the foot as shown on the left**

**Attach the cover case to protect the wires as shown on the right**



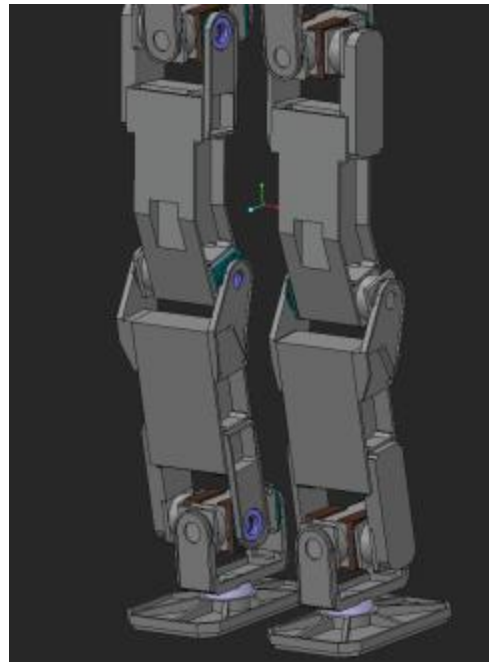




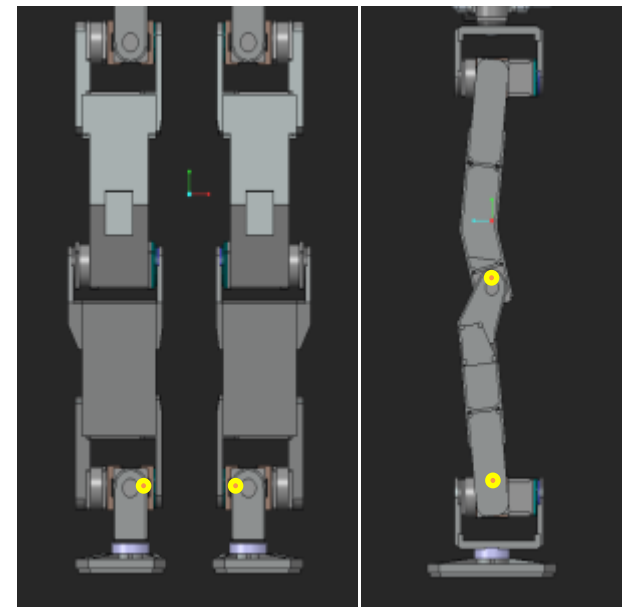
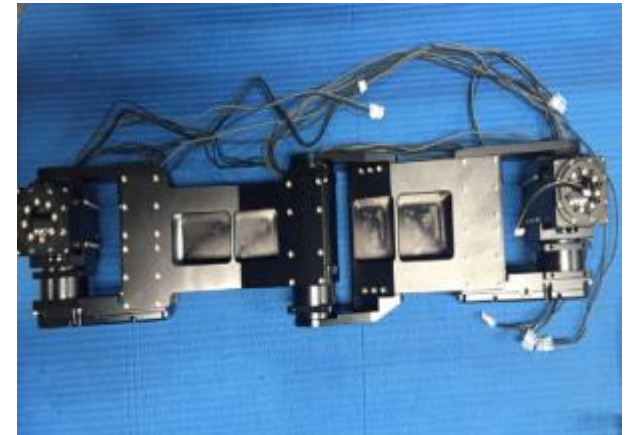
## Assembly Process (Leg)



Final assembly of the leg



**\*Repeat the same procedure for the other (left/right) leg.  
The two legs should be symmetric**





# Assembly Process (Upper Body)



## 1. Upper Body (1) Chest

\* Quantity 1

\* Frame & Actuator

PR23\_FRM\_CHEST\_01 \* 1EA

PR23\_FRM\_BACK\_01 \* 1EA

H54-100-S500-R \* 3EA [1,2,27]

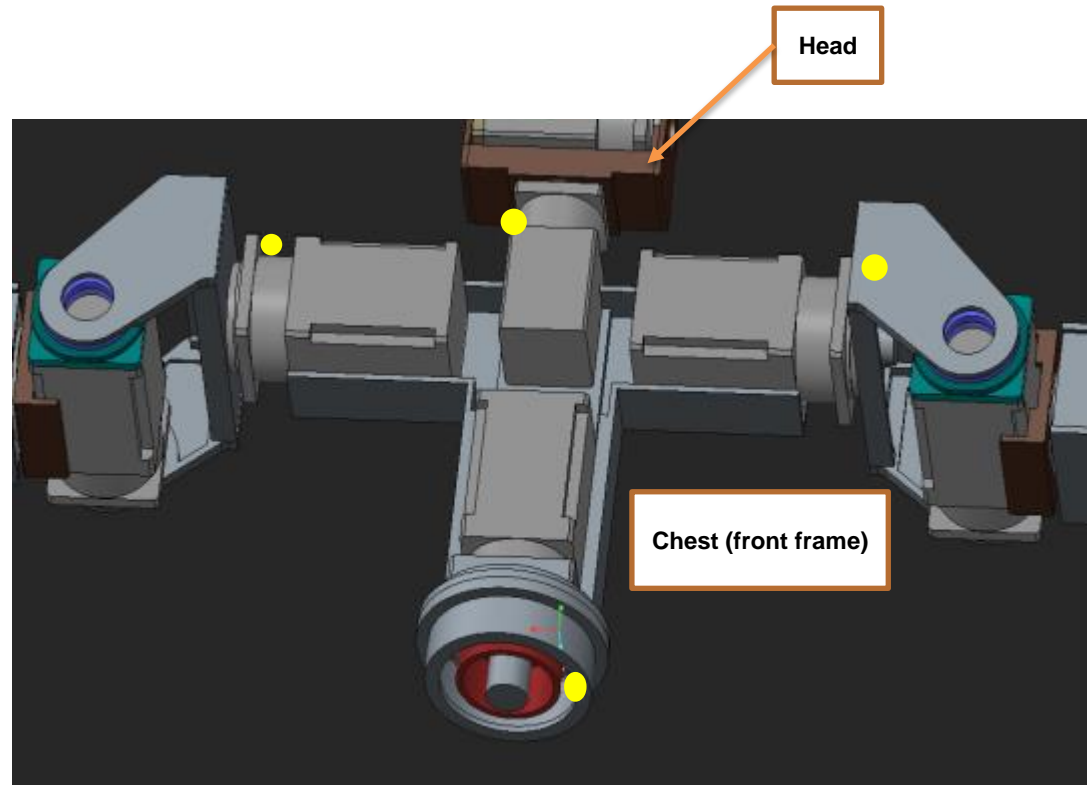
H42-20-S500-R \* 1EA [28]

Angular Ball Bearing Set \* 1EA

\* No symmetry

\* Locking

WB M3 \* 6, 8mm



**Calibrate the origin of the actuator to the yellow marked circle**

**Attach the front chest frame once all the wiring is complete**



## Assembly Process (Upper Body)



**Align the yellow mark of the ball angular ball bearing with the yellow mark of the actuator**

[RED Circle] : Insert ID 27 to the Angular Ball Bearing by using the Press Machine

**Reference p33-34 for assembling the Angular Ball Bearing**

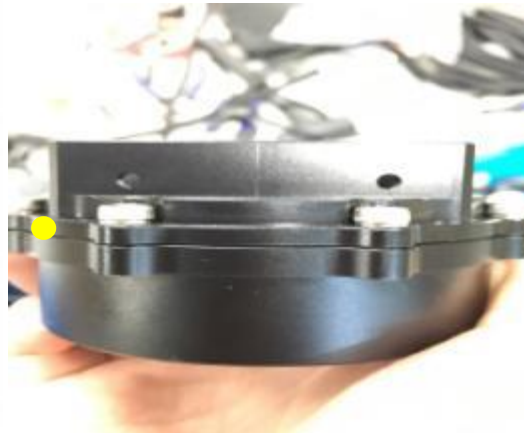
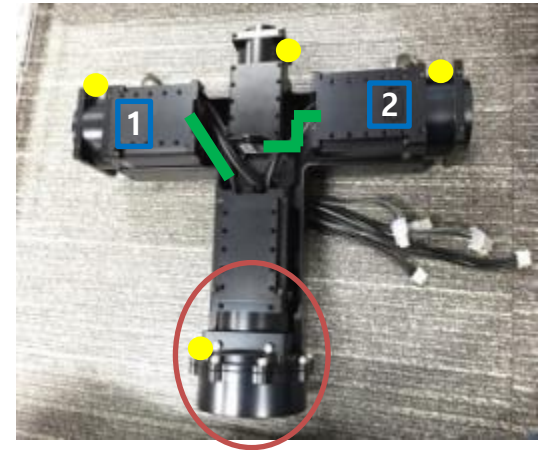
[Wiring] – [Green Line] : 4Pin-100/140mm

ID1 - ID27 , ID2 – ID28

[Others] : through 'PR23\_FRM\_BACK\_01' hole  
PW-200mm x 3 EA

4Pin-240mm x 2 EA

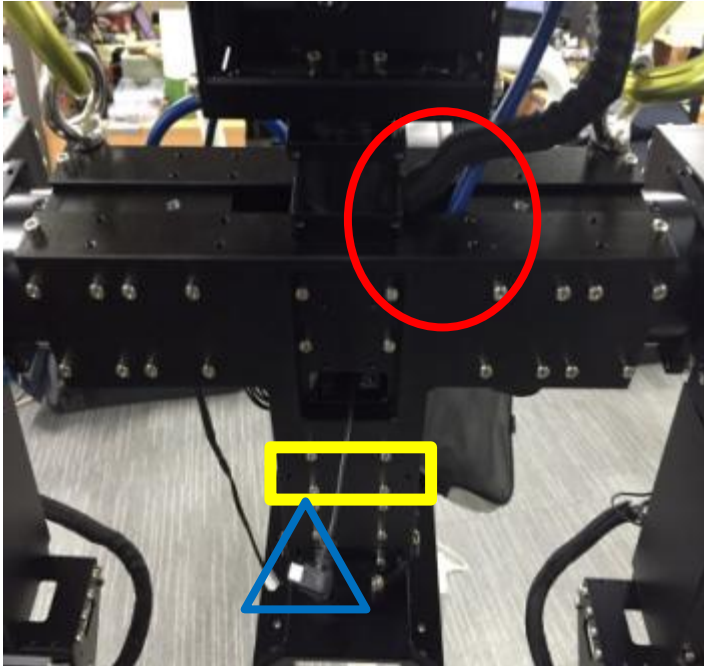
Make sure actuator ID 1 and ID 2 are pointing the ceiling and actuator ID 28 is pointing to the right (3 O'clock direction)







## Assembly Process (Upper Body)



Bolt the power expansion board and the 4Pin expansion board in the order shown below

PW - 4Pin - 4Pin - PW

[Yellow Square] Don't bolt these location since it's used for speaker  
[Red Circle] Inter RealSense Cable  
[Blue Triangle] Speaker Cable: Wire from the back plate through the chest  
Attach the chest plate once all the wiring is complete



# Assembly Process (Upper Body)



(1) Upper Body

(2) Head

\*Quantity 1

\*Frame & Actuator

Assembled Upper Body \* 1EA

Logitech WEBCAM \* 1EA

Intel Realsense \* 3EA [1,2,27]

LIDAR \* 1EA [28]

Camera frame \* 1EA

H42-20-S500-R \* 1EA [29]

H42 Hinge Frame \* 1EA

\*Symmetry None

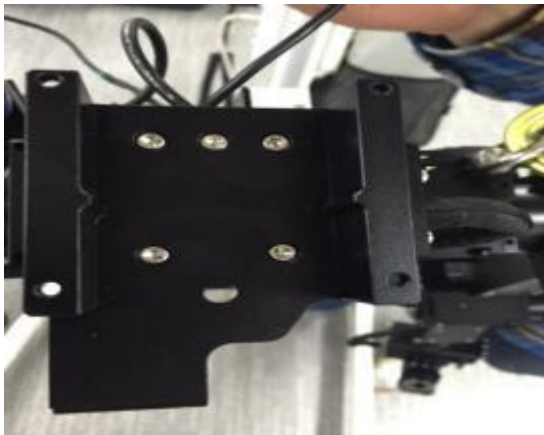
\*Locking

WB M3 \* 6, 8mm

Camera Fixing Bolt



Attach the actuator ID 28 to the hinge frame and the actuator ID 29 frame. Then wire the cable as shown above. Other cables should come out from the back plate (shown in the red square) and connected to the expansion board



Attach the camera frame to the actuator ID29



## Assembly Process (Upper Body)



**Do not use an electric drill. Do it manually by hand since it can cause damage.**

**Connect the bottom of the LIDAR to the camera frame. Use WB Me\*12 mm. Also do it by hand**



# Assembly Process (Upper Body)



## Control Box



\* Control Box assemble procedure

PC

USB Hub

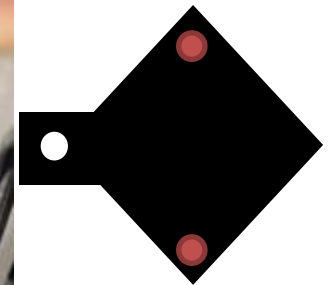
PCB\_FTDI\_USB\_COM485\_PLUS4(under)

PR15\_B04\_SW\_E-STOP

PR15\_B03\_ASSY\_ELEC\_BOARD-DLINK\_DIR\_806A(over)



Front(Chest) →

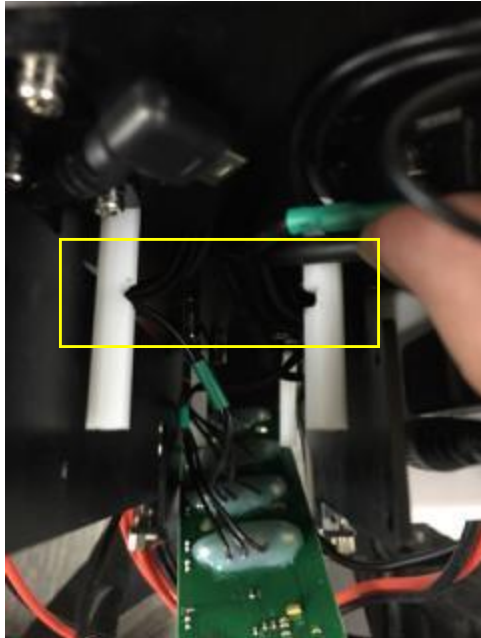


CBSS (PC locking)  
PR23\_FRM\_CHEST & BACK  
Vibration-proof supporter  
PC\_PL(PC Plate)





## Assembly Process (Upper Body)



Create a groove about 13mm from the end of the 40mm hexagon supporter. Use a dremel for this procedure. This protocol will fix the USBtoDYNAMIXEL in place.

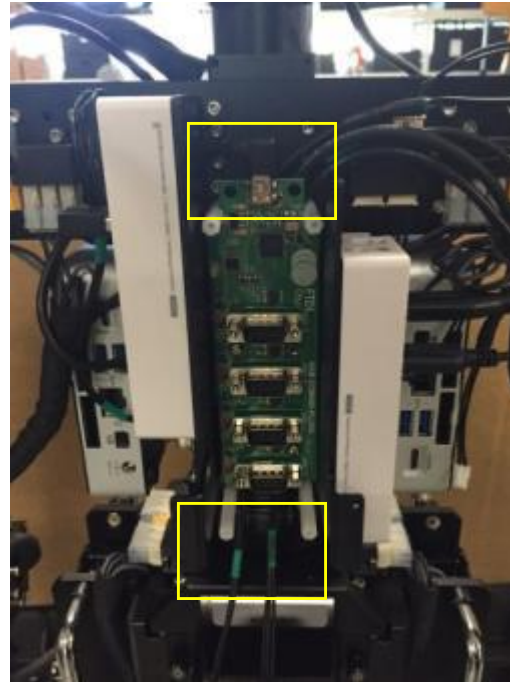
Do not use the port for the power supply. Place a scotch tape on it.



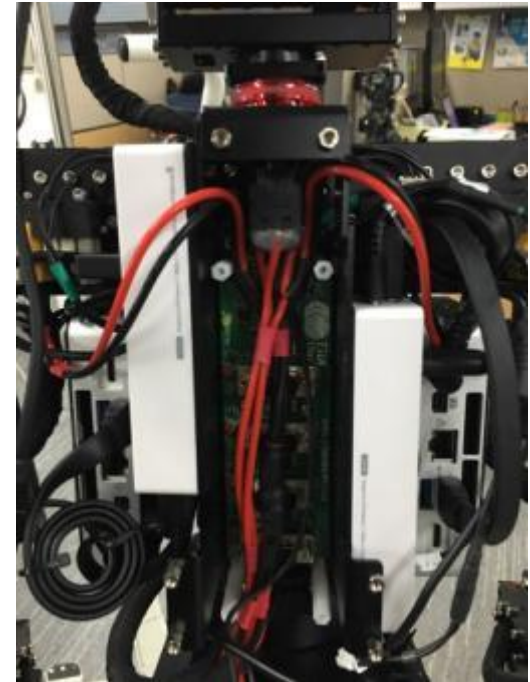
## Assembly Process (Upper Body)



**Be cautious with wiring**



**Place the USBtoDYNAMIXEL,  
organize the 4 Pin cables**  
Ch.0 – Upper Right  
Ch.1 – Upper Left  
CH.2,3 – Bottom



**E-stop SW placement**  
2 short wires – Arm  
2 long wires – Battery, Leg  
1 longest wire - Leg





## Assembly Process (Upper Body)



12V MPC	12V Lidar	12V	5V network HUB	5V SPEAKER
12V PPC	12V	12V	5V PPC USB HUB	5V MPC USB HUB



## Assembly Process (Upper Body)



Be cautious with wiring



Be cautious with wiring



Be cautious with wiring



# Assembly Process (Whole Body)



## (1) Whole Body

### (1) Pelvis

\*Quantity 1

\*Frame

Upper Body (Upper Body + Arms)

Lower Body (Legs + hip)

PR23\_FRM\_PELV\_01,02,03

H54-100-S500-R \* 2EA [15,16]

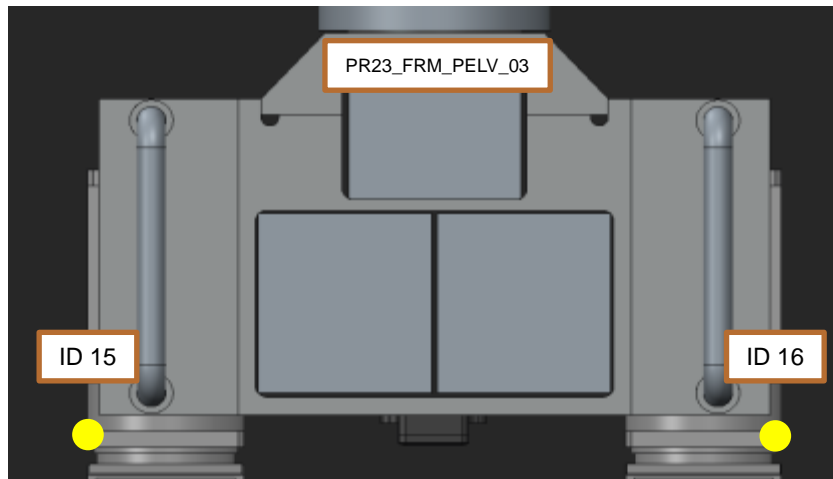
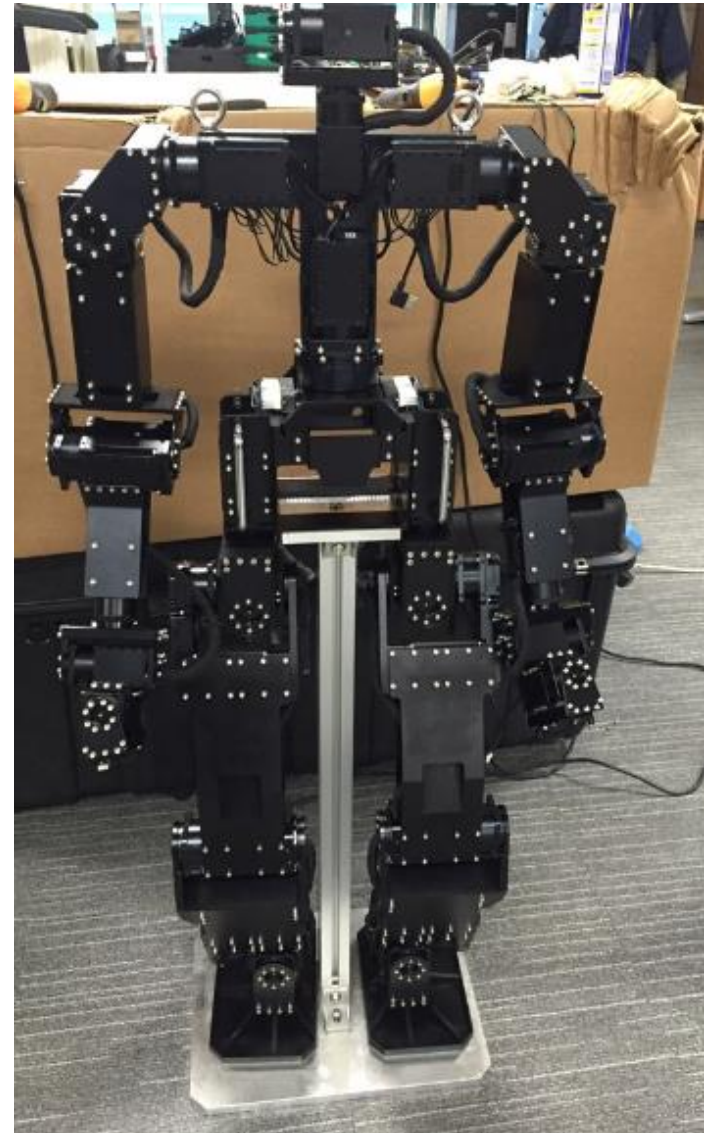
\*Symmetry

None

\*Locking

WB M3 \* 8 mm

WB M4 \* 10 mm

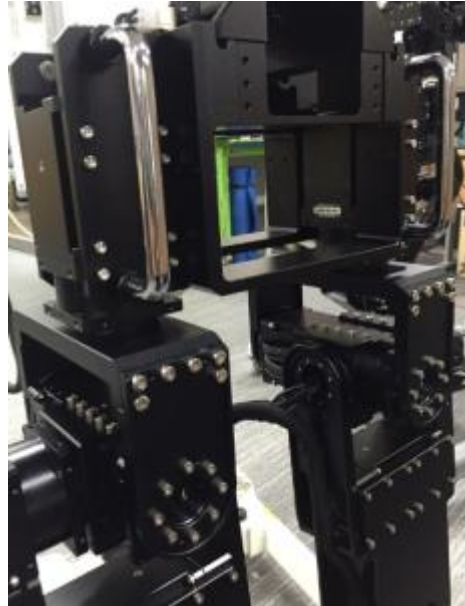




## Assembly Process (Whole Body)



**Attach the Upper Body with the  
H54 hip frame**



**Attach both legs**

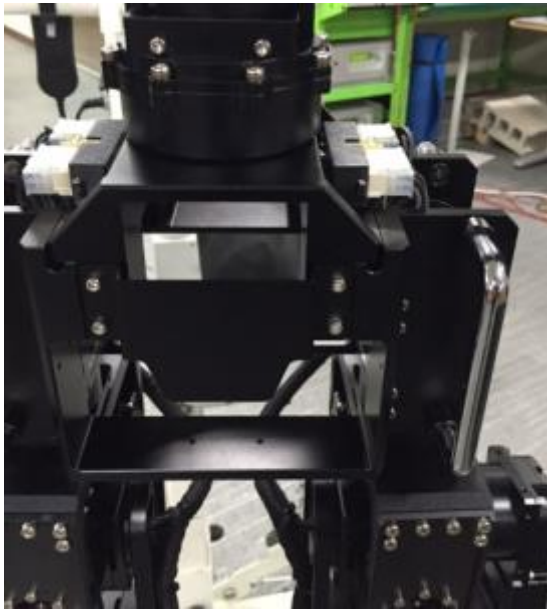


**Organize the wiring. Insert  
shorter wires to the closest port**

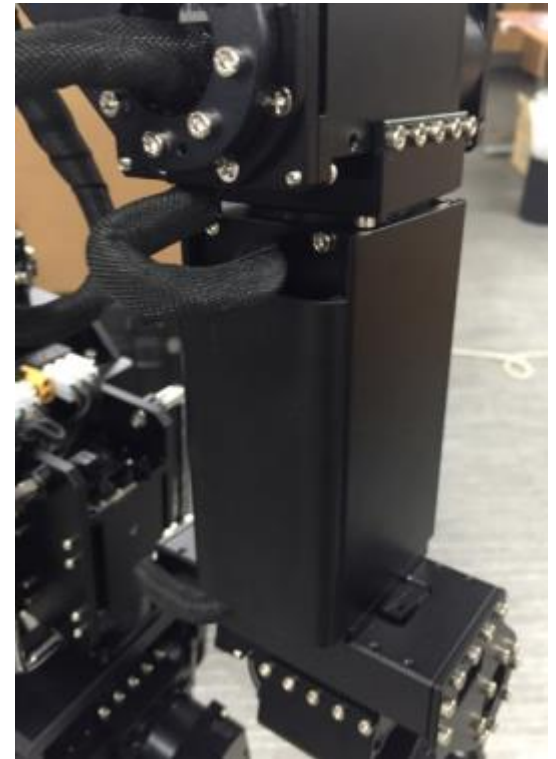




## Assembly Process (Whole Body)



**Attach the battery frame both front and back**



**Enclose the frame with a cover**



# Assembly Process (Reference)



## (1) Reference

### (1) Arm Frame

(1) NX05\_B03\_HINGE\_PR23\_SH\_01,02  
<NX05\_B03\_HINGE\_PR23\_SHLD>

\*Quantity 5

\*Frame

NX03\_B03\_HINGE-H-T-7 \* 1 EA  
NX03\_B03\_HINGE-H-T-S-GA \* 1 EA  
NX03\_B03\_HINGE-H-T-S-GB \* 1 EA

\*Symmetry None

\*Locking

SHAFT M2x6.9mm  
WB M3 x 12mm

## (1) Reference

### (1) Arm Frame

(2) NX03\_B03\_HINGE-7G

\*Quantity 2

\*Frame

NX05\_B03\_HINGE-5C\_PR23\_SHLD\_T1 \* 1 EA  
NX05\_B03\_HINGE-5C\_PR23\_SHLD\_S1 \* 1 EA  
NX05\_B03\_HINGE-5C\_PR23\_SHLD\_S2 \* 1 EA

\*Symmetry

NX05\_B03\_HINGE-5C\_PR23\_SHLD\_T1\_MIR \* 1 EA  
NX05\_B03\_HINGE-5C\_PR23\_SHLD\_S1 \* 1 EA  
NX05\_B03\_HINGE-5C\_PR23\_SHLD\_S2 \* 1 EA

\*Locking

SHAFT M2x6.9mm (Use the Press Machine)  
WB M3 x 8mm







# Assembly Process (Reference)



## (1) Reference

### (1) Arm Frame

#### (3) NX05\_B03\_HINGE-5C

\*Quantity 2

\*Frame

NX05\_B03\_HINGE-H-T-5 \* 1 EA

NX05\_B03\_HINGE-H-S-CA \* 1 EA

NX05\_B03\_HINGE-H-S-CB \* 1 EA

\*Symmetry

NX05\_B03\_HINGE-H-T-5 \* 1 EA

NX05\_B03\_HINGE-H-S-CA\_MIR \* 1 EA

NX05\_B03\_HINGE-H-S-CB\_MIR \* 1 EA

\*Locking

SHAFT M2x6.9mm

WB M3 x 8mm



## (1) Reference

### (2) Bearing Module

#### (1) Angular Ball Bearing

\*Quantity 1

\*Frame

PR23\_FRM\_WAIST\_TOP \* 1EA

PR15\_A03\_WAIST\_SHAFT \* 1EA

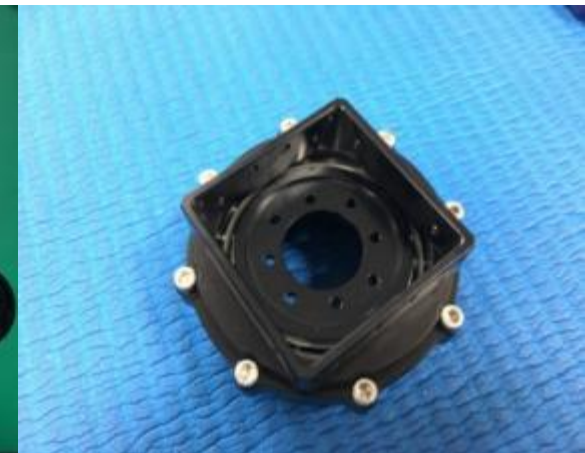
PR15\_B04\_WAIST\_BEARING\_HOUSING \* 1EA

YK-31397(SUPER PRECISION BEARINGS) \* 2EA

\*Symmetry None

\* Locking

WB M4 \* 8mm

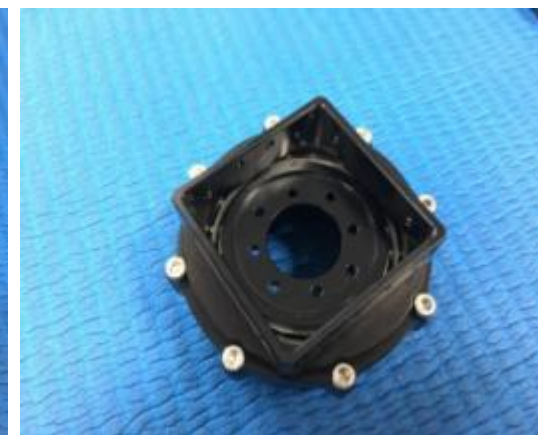
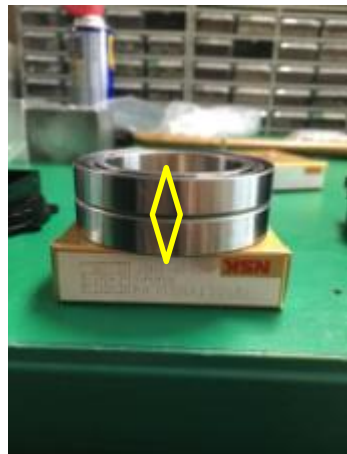




## Assembly Process (Reference)



[Caution]  
Align the V mark that is on the bearing to form a rhombus shape ◇, as shown on the left



Use the Press Machine to insert the housing

(HOUSING SET)

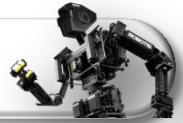
PR15\_B04\_WAIST\_BEARING\_HOUSING – YK-31397

YK-31397 – PR15\_A03\_WAIST\_SHAFT

(HOUSING SET) – PR23\_FRM\_WAIST\_TOP



# Assembly Process (Reference)



## (1) Reference

### (2) Bearing Module

#### (2) PR15\_MODULE\_IDLER

\*Quantity 12

\*Frame

PR15\_B04\_IDLER\_HOUSING \* 1EA

PR15\_B03\_BELT\_BEARING\_6707 \* 1EA

PR15\_B04\_IDLER\_SHAFT \* 1EA

PR15\_B04\_IDLER\_SHAFT\_RTN \* 1EA

PR15\_B04\_ILDER\_HOUSING\_RTN \* 1EA

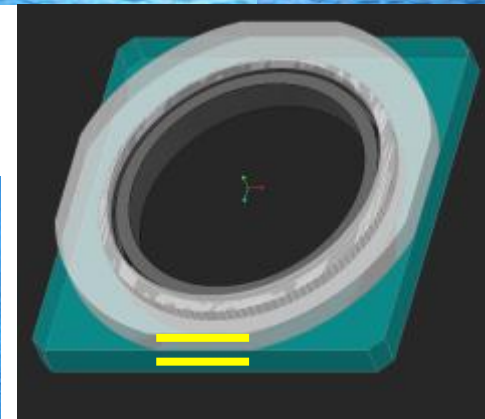
\*Symmetry None

\*Locking

WB M3 x 8mm

FHS M3 x 8mm

[Support] WB M3 x 12mm x 2EA



(HOUSING PART)

PR15\_B04\_IDLER\_HOUSING

PR15\_B03\_BELT\_BEARING\_6707

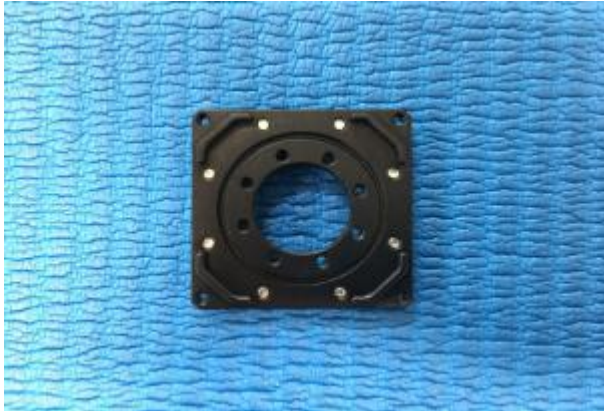
PR15\_B04\_IDLER\_HOUSING\_RTN

Locking : FHS M3 x 8mm

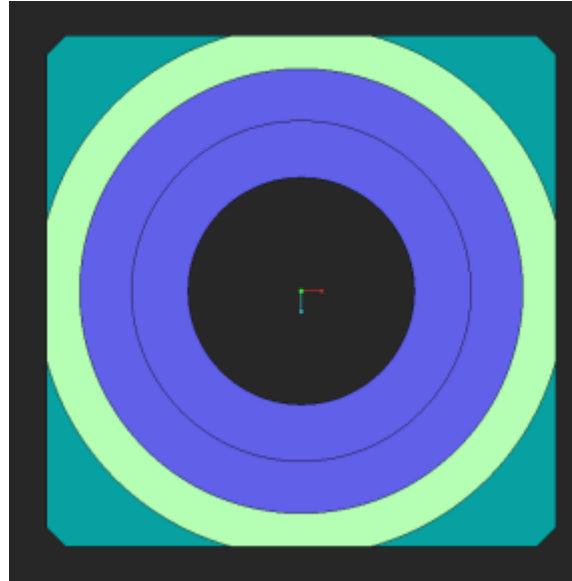




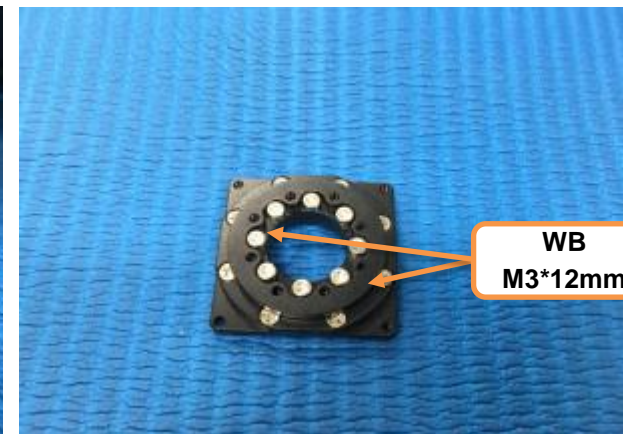
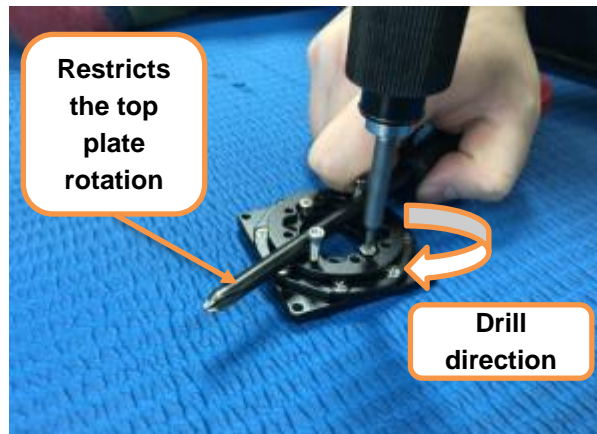
# Assembly Process (Reference)



HOUSING PART – PR15\_B04\_IDLER\_SHAFT ↑  
Place the top part face the floor as shown in the picture on the right  
HOUSING PART –  
PR15\_B04\_IDLER\_SHAFT\_RTN



[Tip]  
Firmly screw the WB M3\*12mm on opposite sides as shown on the far left bottom picture. Place a screwdriver or anything that can restrict the rotation when using the drill. Make sure to place the screwdriver on the correct direction. This method will save a lot of time since 12 sets need to be made







# Assembly Process (Reference)



(1) Reference

(3) Belt Module(PR23\_FRM\_MODULE\_BELT\_BASE)

(1) Strain Part

\*Quantity 8

\*Frame

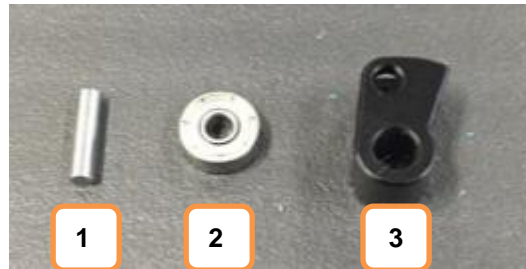
1 \* 1EA

2 \* 1EA

3 \* 1EA

\*Symmetry None

\*Locking 2-3-1



Use the Press Machine





# Assembly Process (Reference)



## (1) Reference

### (3) Belt Module (PR23\_FRM\_MODULE\_BELT\_BASE)

#### (2) Belt Module Assembly

\*Quantity 4  
\*Frame

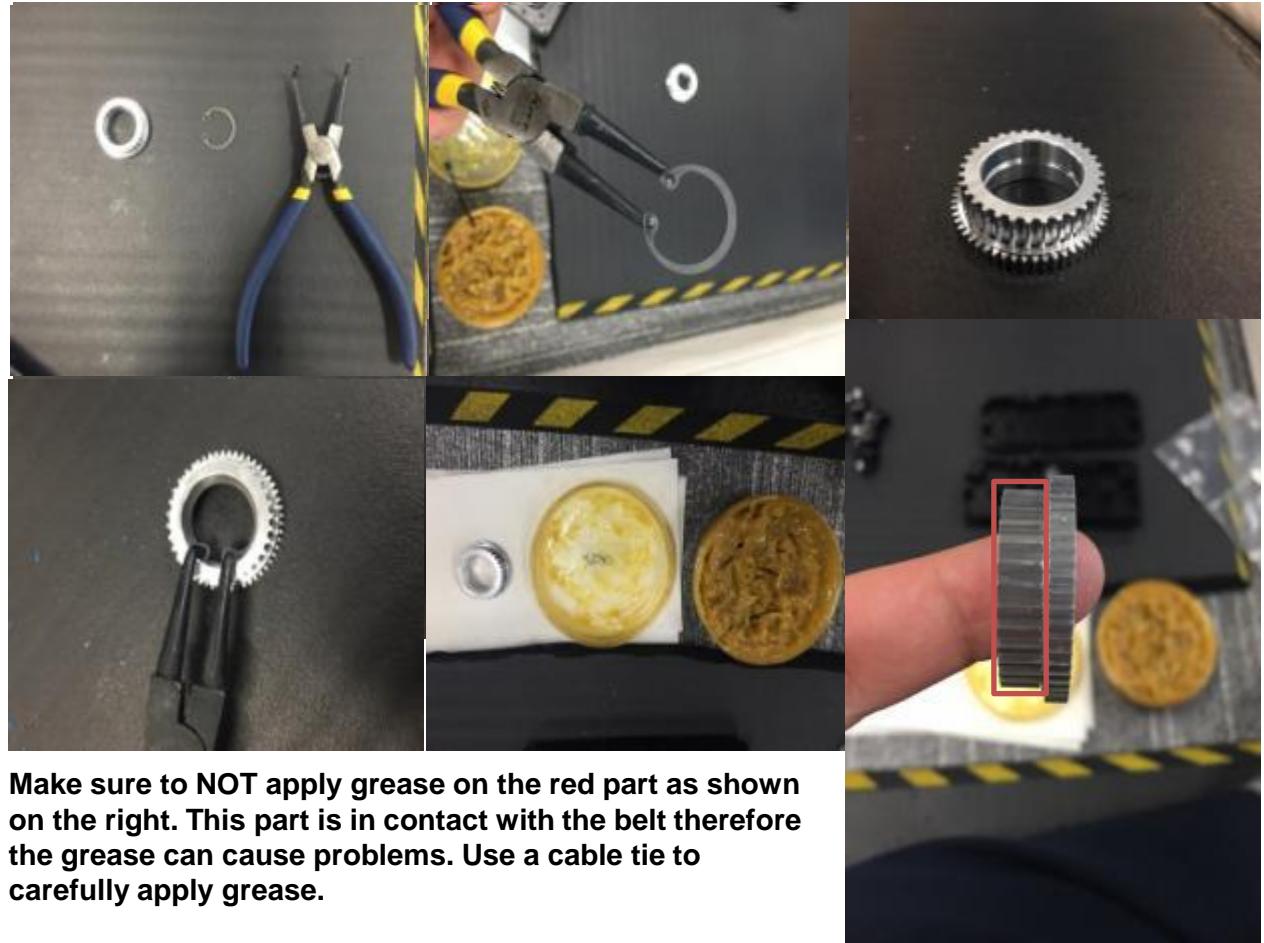
Strain Part \* 2EA (P37)  
Belt Module Base \* 1EA  
Belt Module Cover \* 1EA  
Belt Module Gear \* 2EA  
Belt \* 1EA  
Belt Module Bearing \* 4EA  
C ring \* 2EA

\*Symmetry None

\*Locking

FWB M4 \* 10mm  
WB M3 \* 8mm

grease(AL)

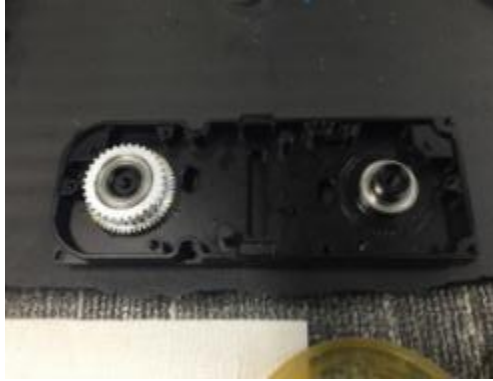


Make sure to NOT apply grease on the red part as shown on the right. This part is in contact with the belt therefore the grease can cause problems. Use a cable tie to carefully apply grease.

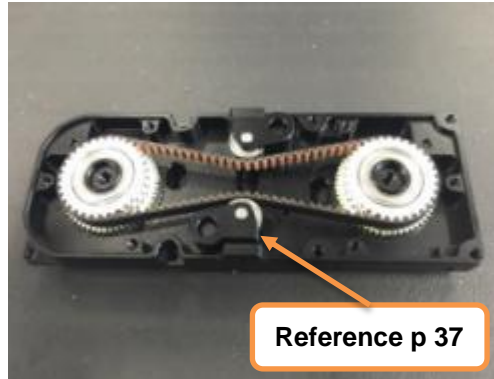
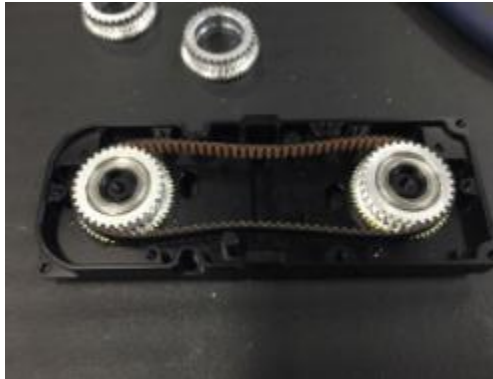
Pace the bearing on each side of the C ring



## Assembly Process (Reference)



**Belt Module Base – Bearing \* 2EA – Gear \* 2EA – Bearing \* 2EA**



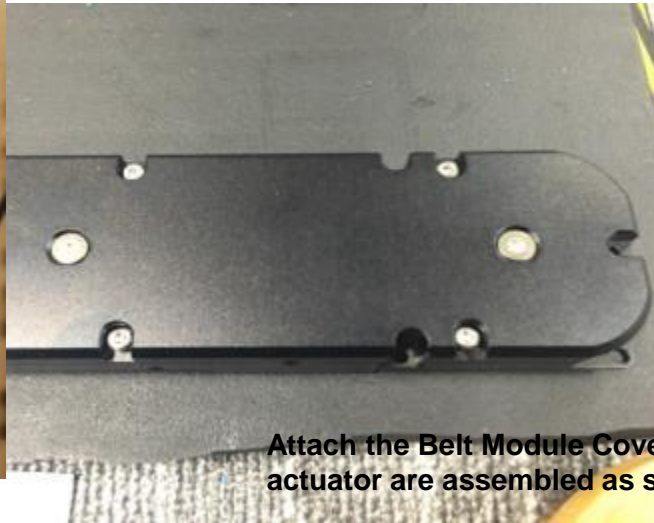
Use cable organizer to clean up the wiring (Make sure that the wires do not touch the belt)



## Assembly Process (Reference)



Use PHS M2 \* 5 for the cable organizer



Attach the Belt Module Cover after the Belt Module Base and the actuator are assembled as shown in p 42.

M3\*6 – 6EA  
M4\*10 – 2EA





# Assembly Process (Reference)



## (1) Reference (5) Belt Module Assembly

\*Quantity 4

\*Frame

Assembled Belt Module\* 1EA

H54-200-S500-R \* 1 EA [ID 19,20,23,24]

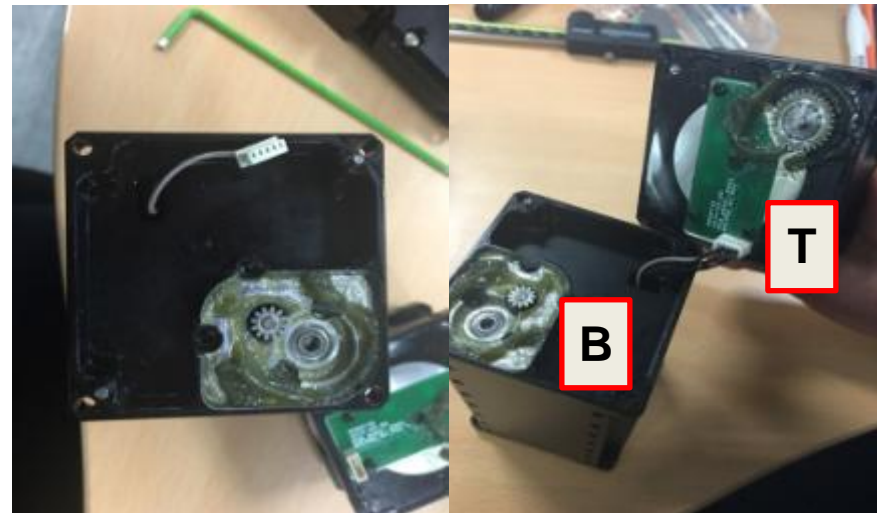
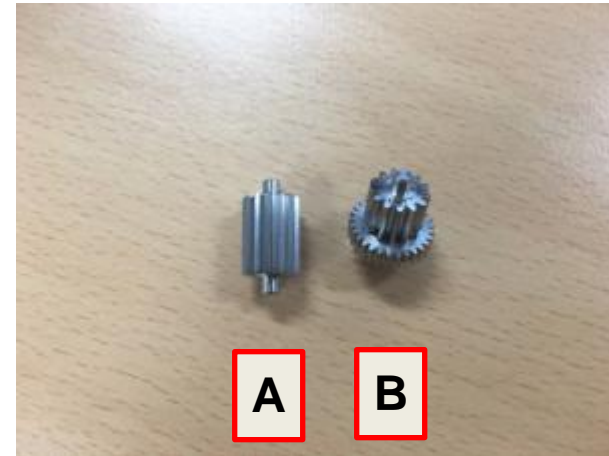
Belt Module Gear \* 1EA [ A,B type ]

\*Symmetry None

\*Lock

WB M3 \* 12 mm

5Pin-Cable



Detach Part M (DYNAMIXEL BODY) from part N

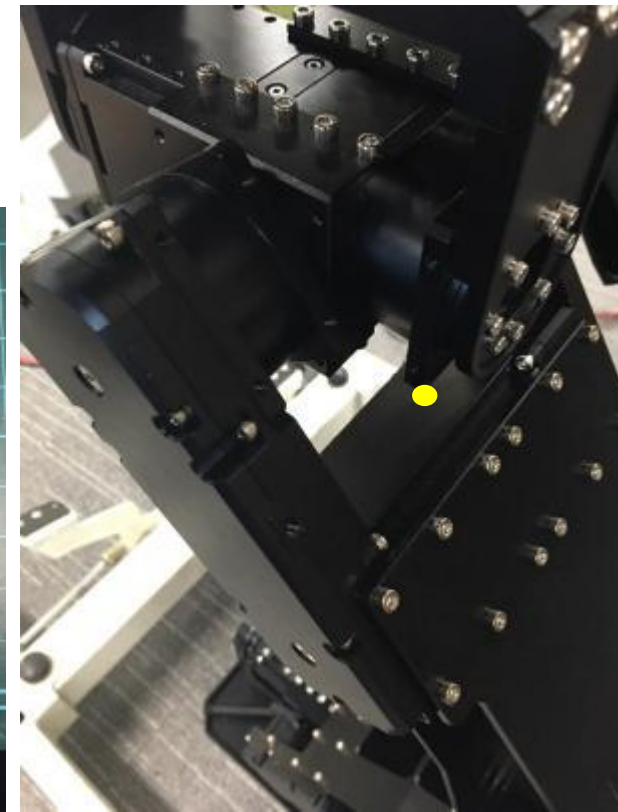
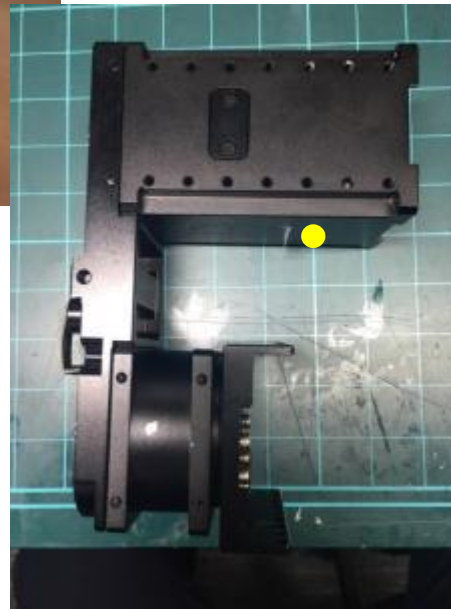
Place the 5Pin Cable as shown above



## Assembly Process (Reference)



Insert the A type gear into part T  
Insert the B type gear into part B



Once the Belt Module Base and the actuator are attached correctly, the origin should be pointing to the direction shown above (yellow mark)



# Assembly Process (Reference)



## (1) Reference

### (4) Belt Module Idler Bearing

\*Quantity 4

\*Frame

PR23\_FRM\_THIGH\_HINGE \* 1EA  
PR15\_B03\_BELT\_BEARING\_6707 \* 1EA  
PR15\_B04\_IDLER\_SHAFT \* 1EA  
PR15\_B04\_IDLER\_SHAFT\_RTN \* 1EA  
PR15\_B04\_ILDER\_HOUSING\_RTN \* 1EA  
PR15\_B04\_ADAPTOR-1\_REV2 \* 1 EA

\*Symmetry

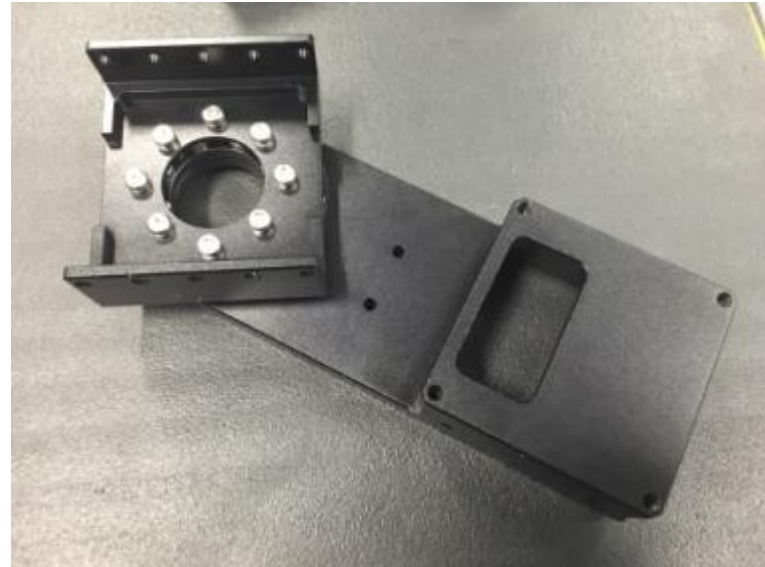
\*Locking

FHS M3 \* 6mm

WB M3 \* 8mm

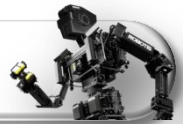
[Support] WB M3 \* 12 mm

Reference p35 for Bearing Module





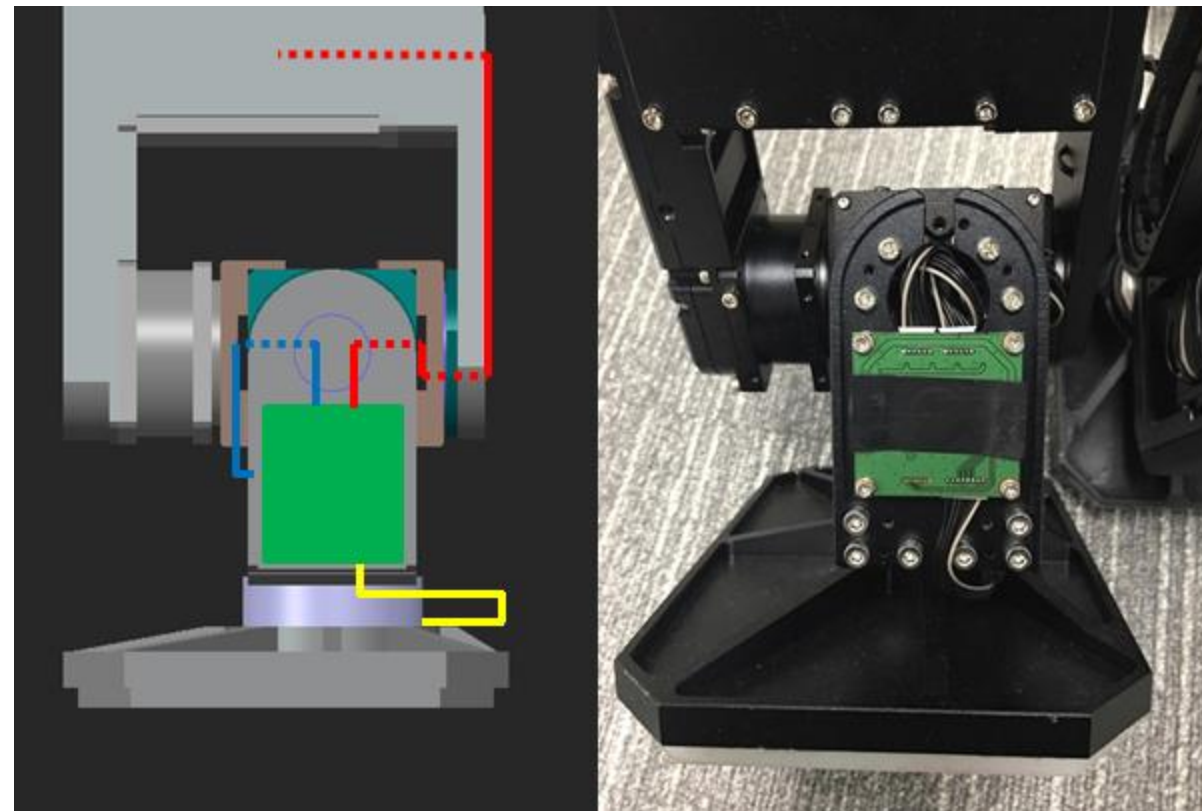
# Assembly Process (Reference)



## (1) Reference (5) Foot FT sensor Wiring

\*Cable

6Pin-Cable : 250mm, 500mm \* 2EA



[Yellow] : FT sensor cable – PCB

[Red] : 6Pin-Cable 250mm ID25,26 - PCB

[Blue] : 6Pin-Cable 500mm ID23,24 - PCB

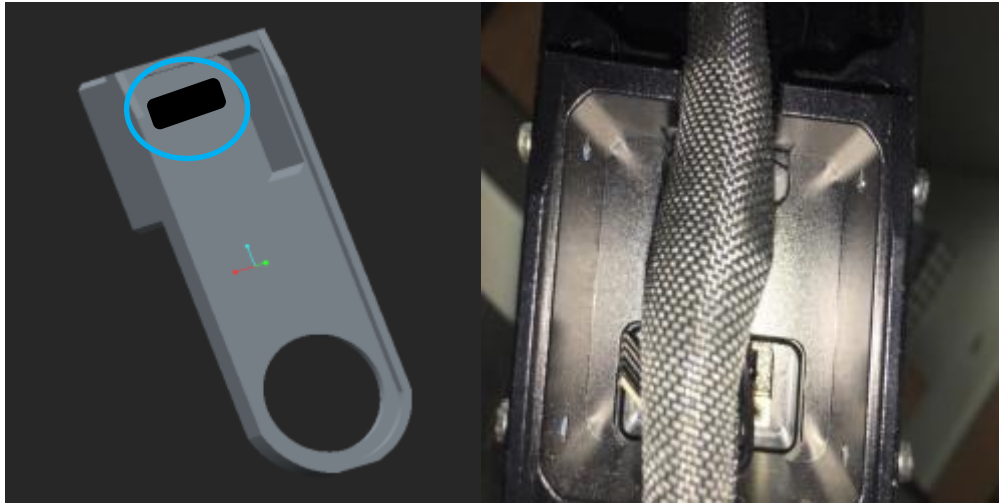
[Green square] : FT sensor PCB







## Assembly Process (Reference)

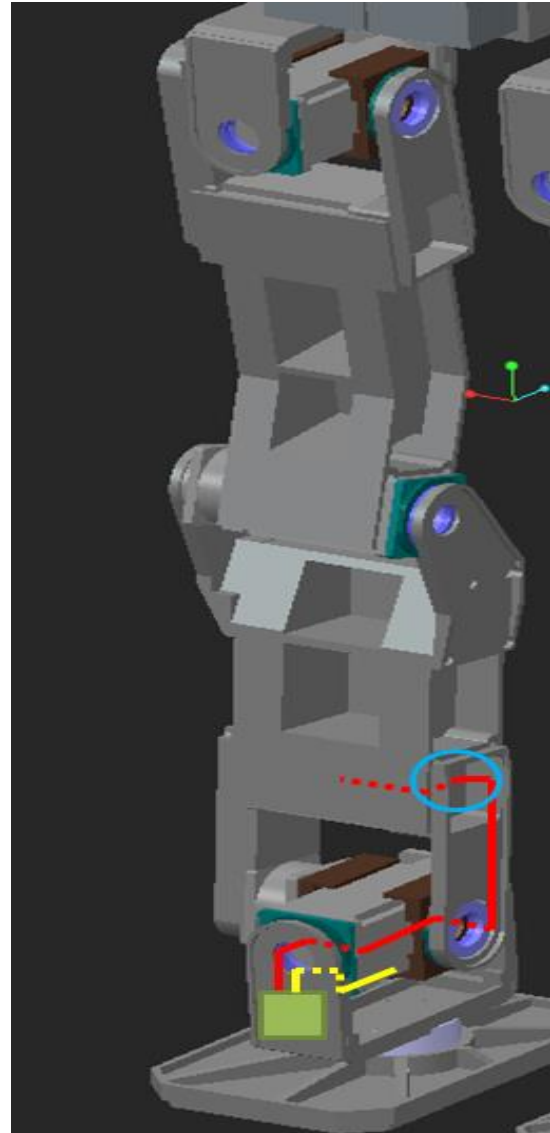


Sensor cable length & path

[Yellow] 250mm

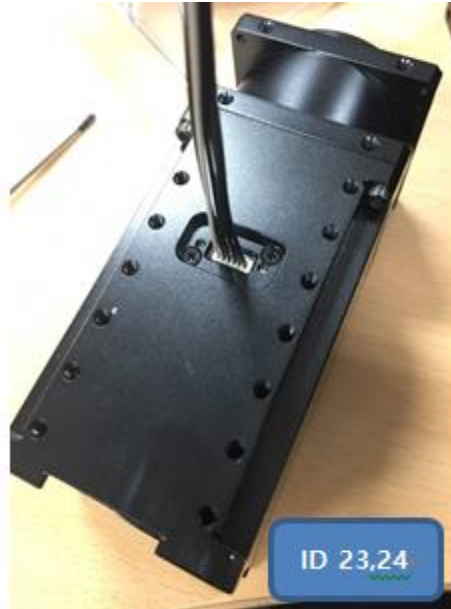
[Red] 500mm

[Blue Circle] Through a hole





## Assembly Process (Reference)



Be cautious that the 6Pin does not get damaged when sliding the actuator to the frame. There is a groove for the wire that slide through as shown above. If done correctly, the 6Pin wire will not be damaged and the frame will slide in.





# Assembly Process (Reference)



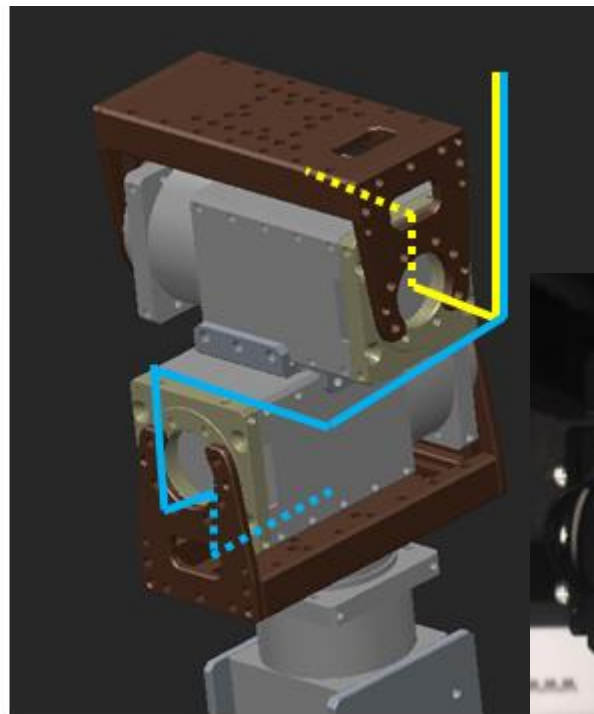
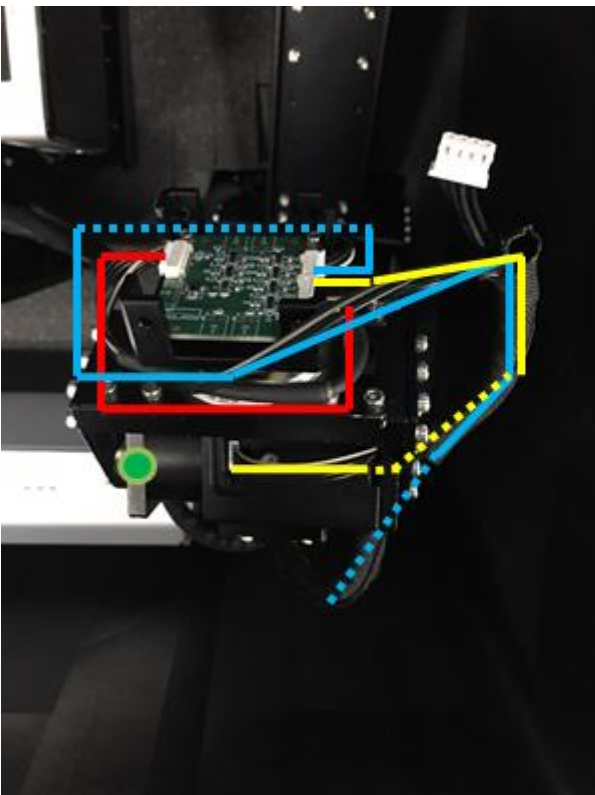
## (1) Reference

### (6) Arm FT sensor Wiring

Need two more additional frames

#### \*Cable

6Pin-Cable : 250mm, 500mm \* 2EA



[RED] FT sensor(wrist) – FT sensor PCB  
[BLUE] FT sensor PCB – ID 11,12  
[YELLOW] FT sensor PCB – ID13,14  
[GREEN circle] Starting Point

