General Purpose Robot Arm for Industry Use

ZERO

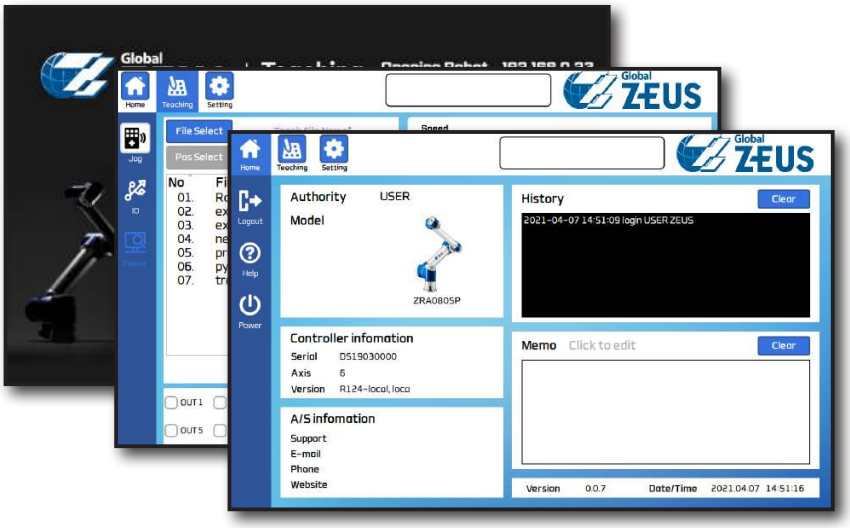
Teaching Pendant User's Guide

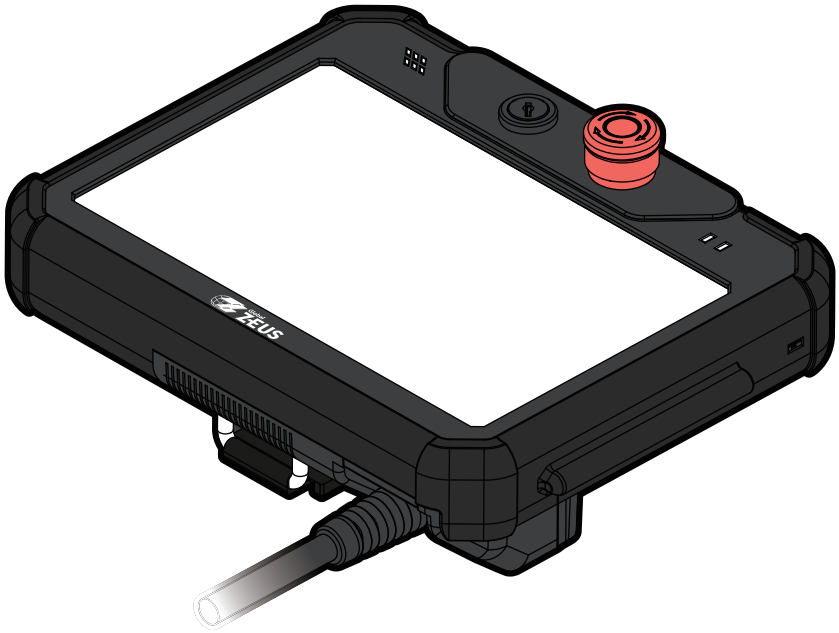
Document Number : M-0501-220228

February 2022

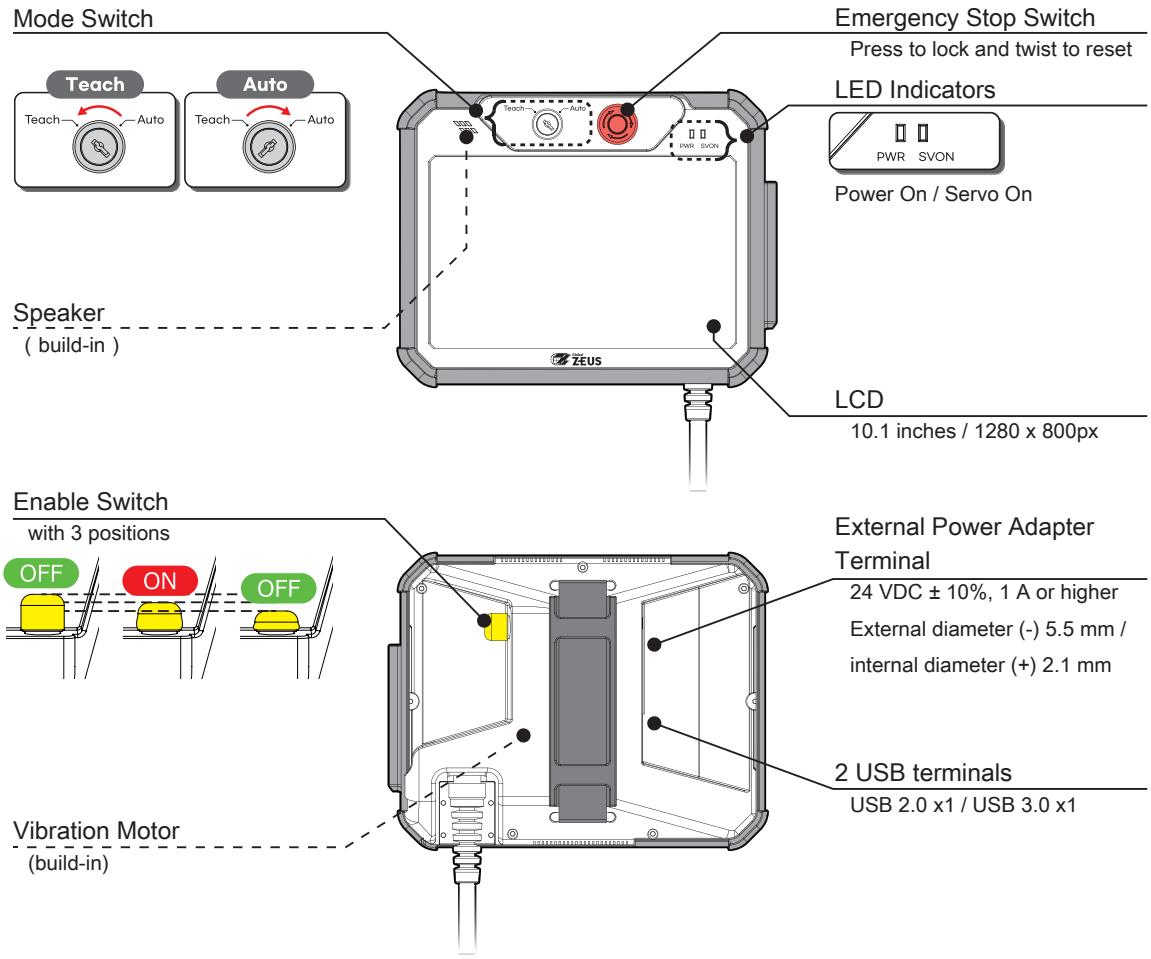
1. Features

The teaching pendant is used to teach the robot by connecting to the ZERO controller. It can be used as a substitute for the jog stick, and additional functions can be added later.





2. Name of each components



3. Components' details

Name	Function
Emergency Stop Switch	To make an emergency stop, press down the switch hard. To turn the servo on again, turn the switch clockwise to cancel the emergency stop; then push the enable switch.
Enable Switch	Push it for Servo-On. For Servo-OFF, release it or push harder.
Mode Switch	Toggles operation mode between teaching mode and remote mode (auto-driving mode) Switch position: Left / Right Mode: Teaching mode / Remote mode
External power adapter terminal	The teaching pendant is powered on when the power adapter is connected. It is not used in normal circumstances. 24VDC ± 10%, 1A or higher External diameter (-) 5.5mm / Internal diameter (+) 2.1mm ※ Do not connect the adapter with power applied.
USB terminal	Export data as teaching data, error logs, etc. stored in the teaching pendant. Upload software update files, etc. USB 2.0 x 1 / USB 3.0 x 1
LED indicator	Displays a status of the robot with green light. ・ PWR: Pendant Power ON (green light)/ OFF(dim) ・ SVON: Pendant Servo ON (green light)/ OFF(dim)
LCD	Displays teaching screen of the Pendant. Displays a status of the Pendant and robot.
Speaker	Notifies a status with buzzing sound ・ buzzes during teaching.
Vibration motor	Notifies a status with vibration. ・ vibrates when the manipulator is approaching a singularity point.

Sound Type of Speaker

Buzzing sound	Description
「Beep」	1 short beep when: ・ the manipulator is approaching a singularity point, speed and joint angle limit.

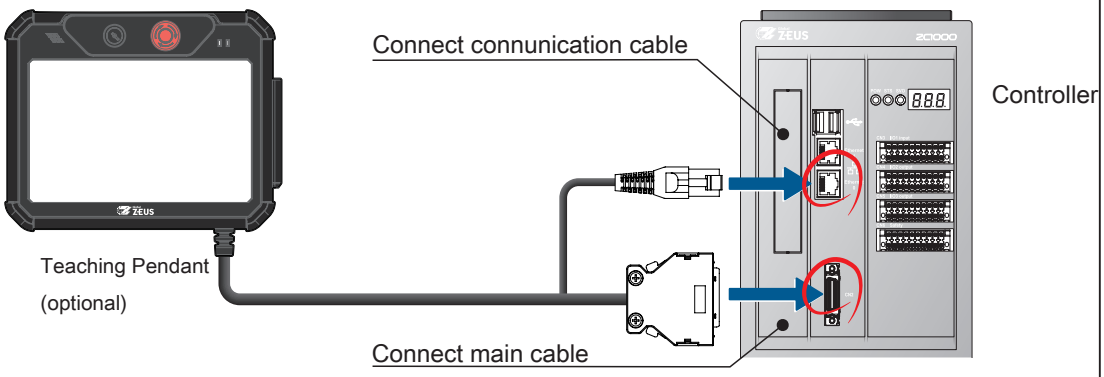
CAUTION		
	When operating the manipulator for the first time, select the JOINT Coordinate System. Before teaching the robot, be sure that there are no obstacles in the work envelope of the robot. Keep an eye on the manipulator all times while teaching the robot. In the event of emergency, press the emergency stop switch on the Jog stick to stop the manipulator motion.	
	Do not power off the controller while the manipulator is still in motion.	

1. Operation mode

The robot's operation mode varies depending upon which is connected to the controller's CN2 connector.

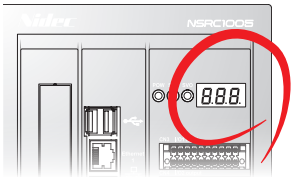
For teaching the robot (Teachig Pendant)

Teaching pendant cable consists of two strands of cable.
Connect communication cable to the controller's Ethernet 0(below).
Connect main cable to the controller's CN2.



When log in is done at the home screen, the 7 segment display on the controller shows "tch".

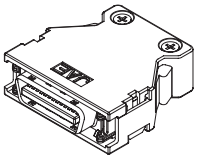
stand-by teach mode



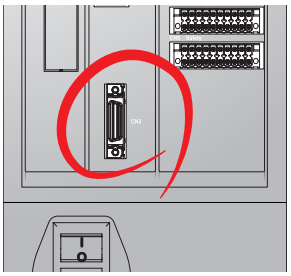
For Automatic Operation

AUTO mode where the robot is automatically controlled by the Python program.

Connect the jumper connector to the controller.



Jumper Connector
(included)



Controller

	When you are not using the JOG stick or teaching pendant, connect the jumper connector to the controller.	
	When disconnecting the teaching pendant to change the operation mode, please log out, shutting down the teaching pendant and disconnect the main cable.	

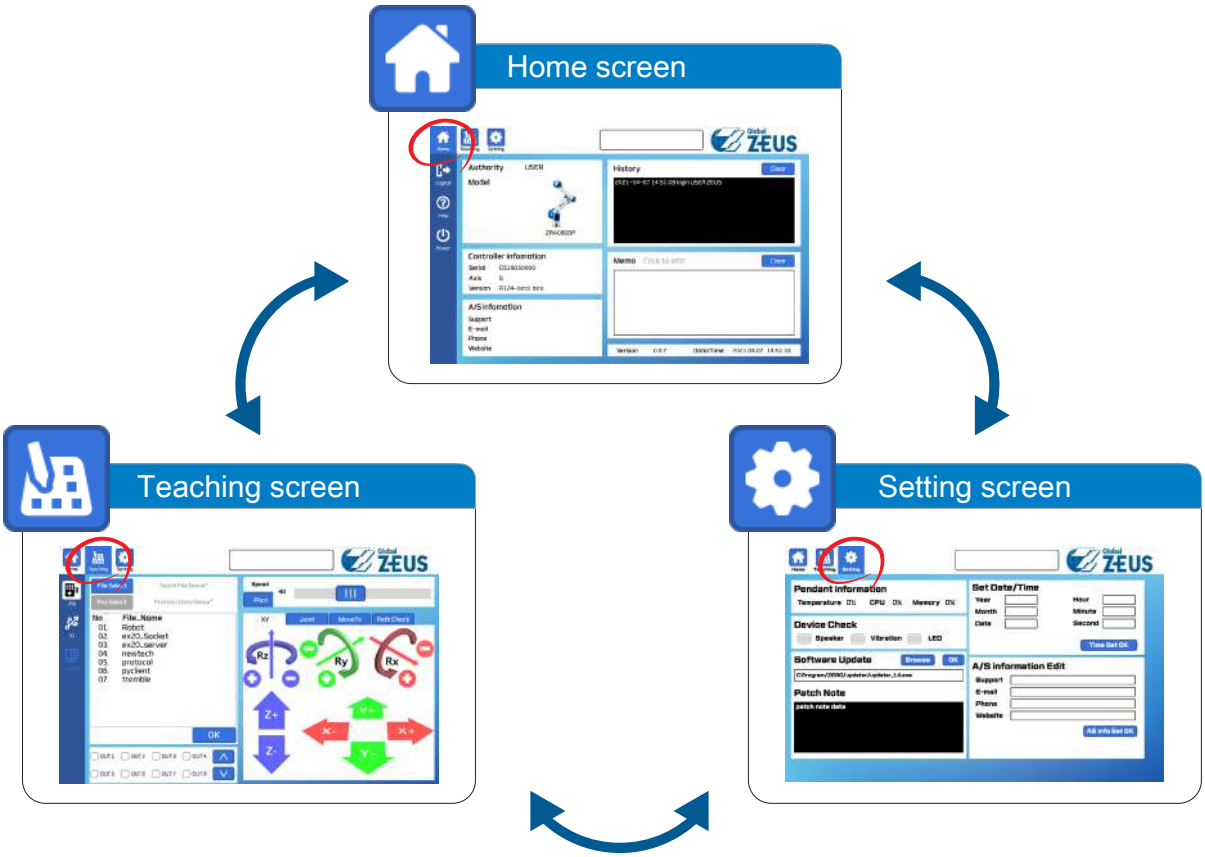
2. Teaching screen

Configuration of the teaching screen

When the power is applied, the loading proceeds through the intro screen.

The teaching function is divided into 3 main screens:

You can enter the desired screen by clicking the button on the top menu.

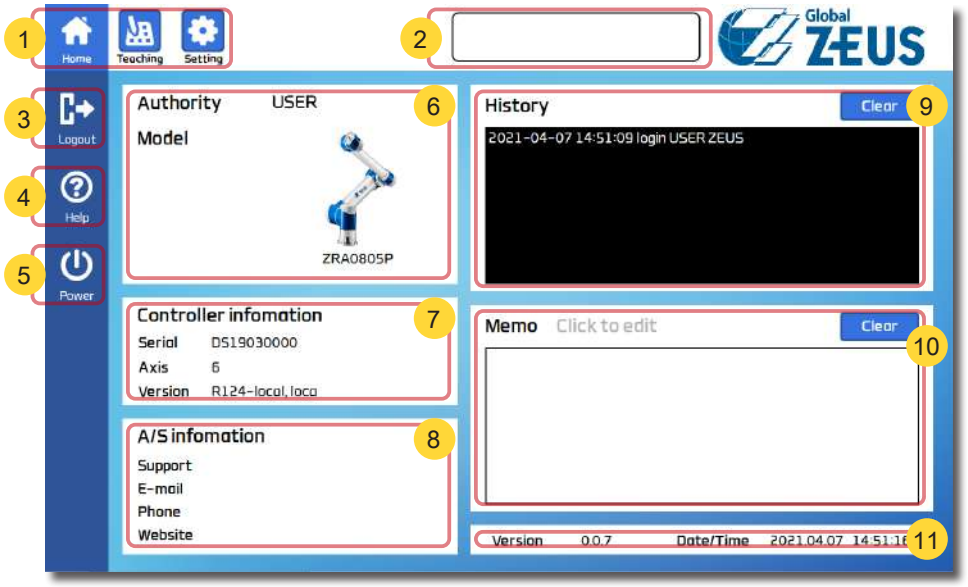


Teaching screen | Setting screen

Home screen

This is the default screen for the teaching pendant. Basic information is here.

Login is required to utilize the functions of the other screens.



Title		Function
Top menu	1	Home · Teaching · Setting button. Can switch to the current screen or another.
	2	System status display window. Displays various information about the system.
Left side menu	3	Login · Logout button
	4	Help button. Shows help screen..
	5	Power button. Can shut down the teaching pendant.
Main screen	6	Information of currently using robot
	7	Information of currently using controller
	8	A/S information
	9	Operation history and clear button
	10	Memo function and clear button
	11	S/W version, date and time

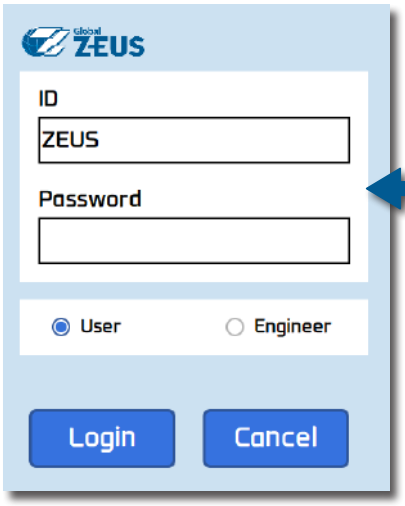
Teaching screen | Setting screen

Home screen

3 Login · Logout button

Login is required to utilize the functions of the other screens.

Login screen shows when press the button.



Select User, enter ID and password.

Press the Login button to log in.

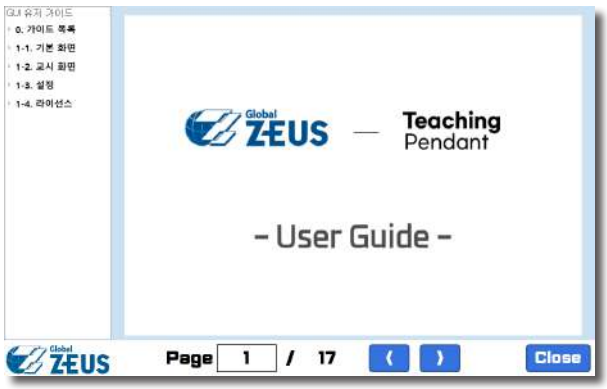
User mode access

ID: ZEUS

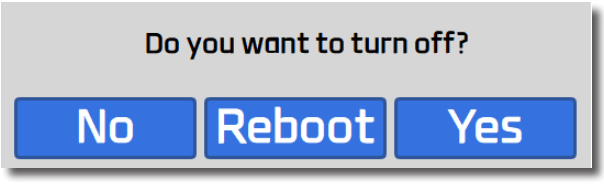
Password: ZERO

4 Help button

User Manual feature which provides detailed instructions in each operations.



5 Power button



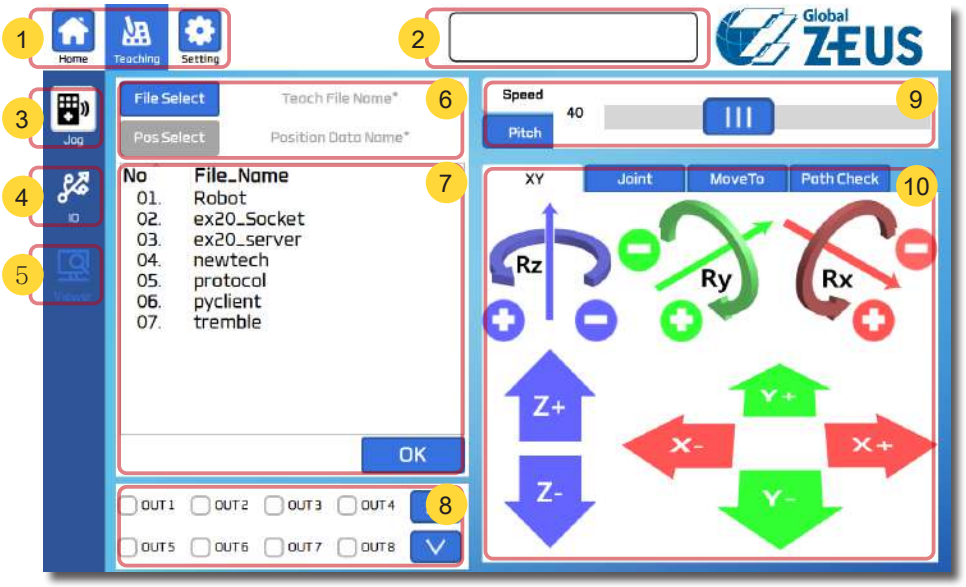
Press the Power button

to exit or reboot the software.

Setting screen | Home screen

Teaching screen

After login, can switch to the Teaching screen and use various teaching operations



Title		Function
Top menu	1	Home · Teaching · Setting button. Can switch to the current screen or another.
	2	System status display window. Displays various information about the system.
Left side menu	3	Jog screen button. Can select teaching file, position data, and do the JOG operation.
	4	IO screen button. Can view the inputs and control the outputs of Digital I/O and Arm I/O.
	5	Viewer screen button. Can view and modify position data within a selected teaching file.
Main screen	6	Select a teaching file button and select position data within the teaching file button.
	7	Displays file selection, position selection, and position's information.
	8	A collection of OUTPUT buttons on the controller. Controlls the outputs.
	9	Speed control. Can control the speed mode and the speed.
	10	Select teaching mode. XYZ mode, Joint mode, MoveTo mode, and Path Check mode.

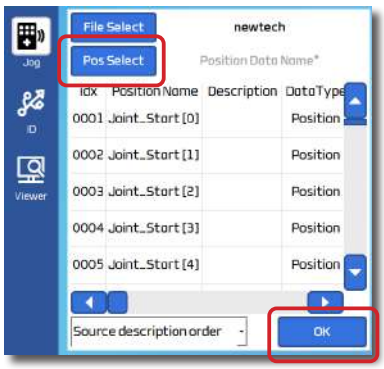
Setting screen | Home screen

Teaching screen

3 Jog screen

Jog screen is divided into 2 interafaces.

6 7 Select teaching file, position data function



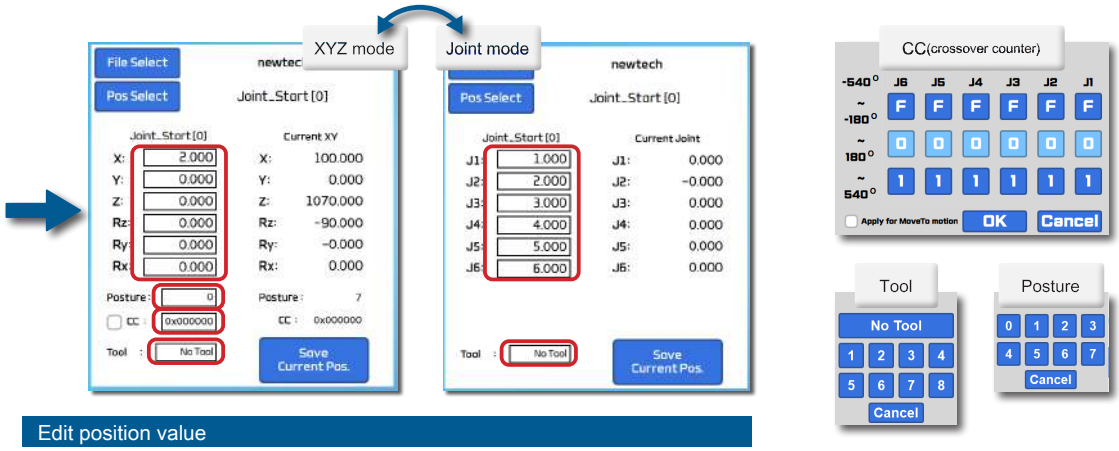
File Select

Can select the teaching files stored on the controller.

Pos Select

The Post Select button is available after File Select.

Select the desired position with the OK button.



Edit position value

Depending on whether ' 10 Teaching Functions' is selected XYZ mode or Joint mode, a different setup screen appears.

Can edit a value directly or save the current location by clicking the value to set.

Depending on the robot, there may be a Posture value and a Crossover Counter (CC) value to express the robot's posture in the XY coordinate system.

For more information, refer the topic 「C Teaching 5 Coordinate systems and posture」 in the User's Guide.

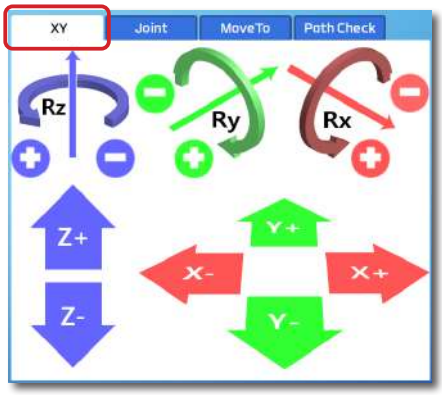
Can set the robot's tool offset by selecting the tool number you want to specify and then click the Tool Offset value.

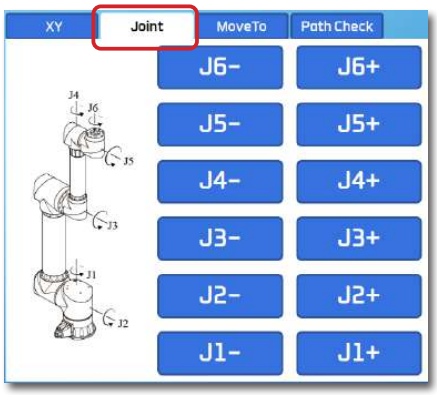
Setting screen | Home screen

Teaching screen

3 Jog screen

10 Select teaching mode. XYZ mode, Joint mode, MoveTo mode, and Path Check mode.



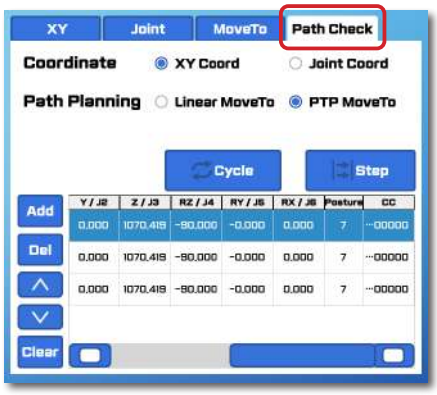


XY

Can operate robot to X, Y, Z, Rz, Ry, Rx directions.

Joint

Can operate robot by rotating each joints of it.



MoveTo

Can operate robot to selected target position

- MoveTo Target : Move to selected position.
- Back : Return to previous position.

- Linear MoveTo : Option to move along shortest path to target position.
- PTP MoveTo : Option to move along smooth curves at constant angular velocity to target position.

- Hand Alignment : Move to nearest plane among XY, YZ, ZX plane.
For details, please refer "Operation by the「Hand Alignment」".

Path Check

Can operate robot sequentially to multiple target positions from the list of selected positions.

- Add : Add selected target position from left side to the right list.
- Del : Delete selected position from the position list.
- Upward arrow : Move selected position 1 line up.
- Downward arrow : Move selected position 1 line down.
- Clear : Delete all positions from the list.

- Cycle : Operate robot to positions following list from beginning to end.
- Step : Operate Robot from selected position to next position in the list.

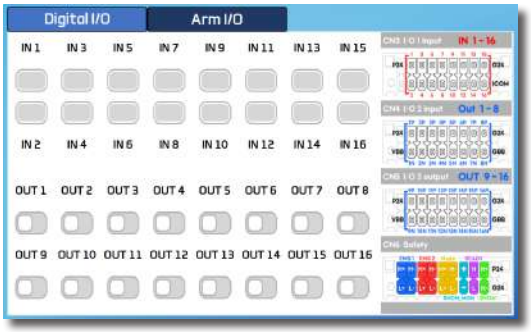
Teaching screen

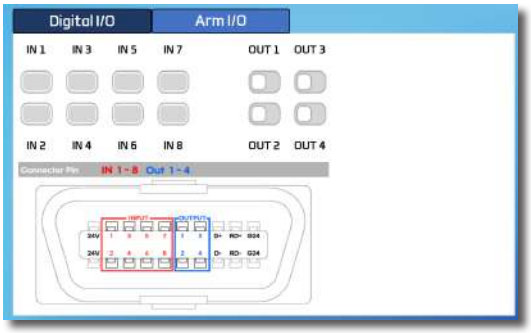
4 IO screen

Can view the inputs and control the outputs of Digital I/O and Arm I/O.

Check input signal seeing IN labeled button.

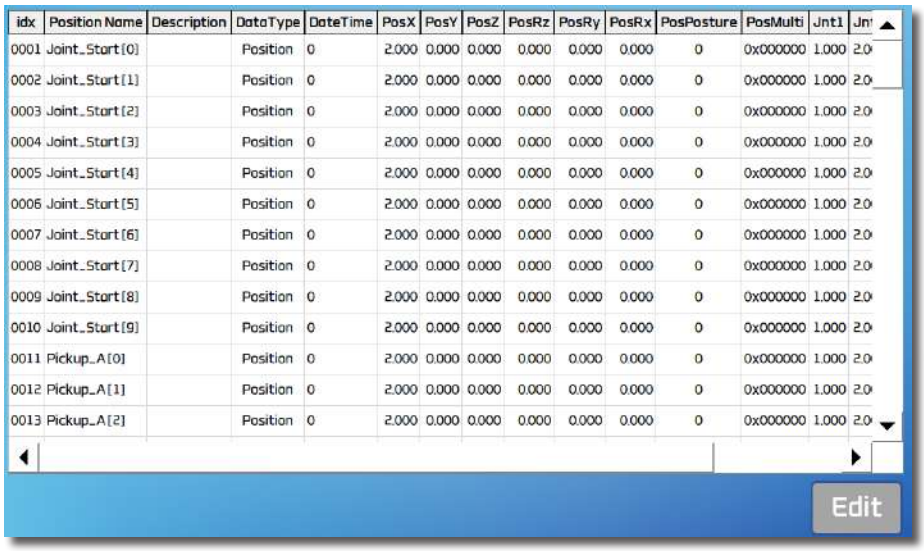
Turn output signal on and off by clicking OUT labeled button.





5 Viewer screen

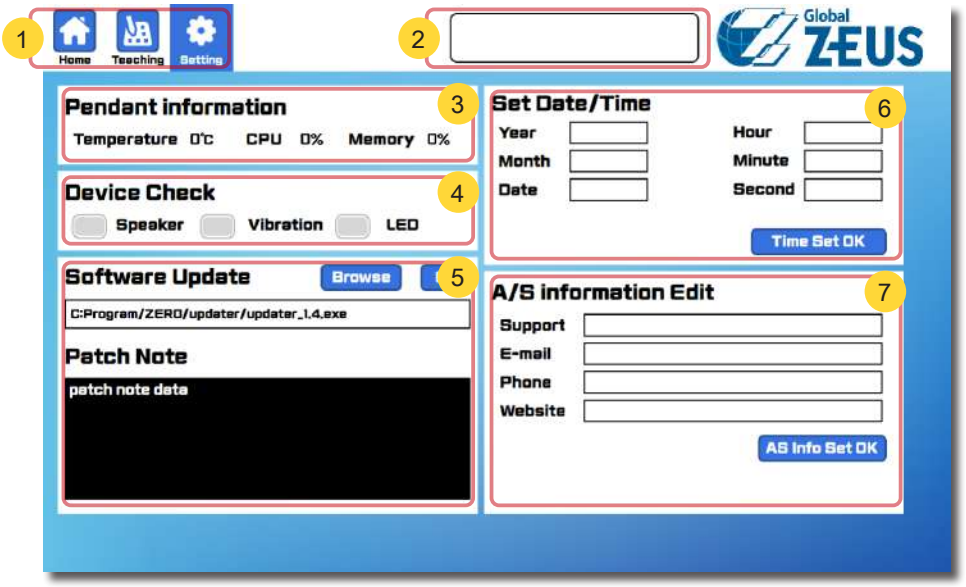
Can view and modify position data within a selected teaching file.



Home screen | Teaching screen

Setting screen

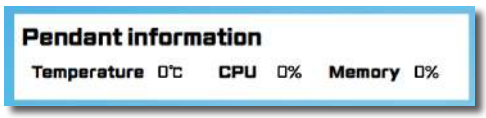
Can change several teaching pendent setting for operation.



Title		Function
Top menu	1	Home · Teaching · Setting button. Can switch to the current screen or another.
	2	System status display window. Displays various information about the system.
Main screen	3	Hardware status display window. Displays various information about the hardware.
	4	Device Check function. Can check the hardware availability.
	5	Software Update
	6	Set date and time.
	7	Edit A/S information

Setting screen

3 Pendant information



Displays various information about the system.

4 Device Check

Can check the hardware availability as speaker, vibration motor, LED. Check by clicking each button.

5 Software Update

can update the software by downloading the update file from the ZEUS homepage.

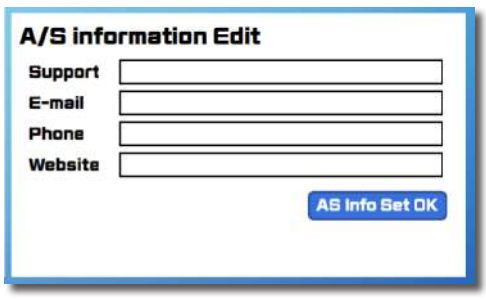
See the topic '4. Software Update' for details.

6 Set date and time.

Can set the current time.

Confirm changes by clicking Time Set OK button.

7 Edit A/S information



Can set A/S information in Home screen.

Enter the company information that can perform technical support.

Teaching operation process

Connect the robot to the teaching pendant and set speed and pitch.

Teach positions and operate on Home Position | Encoder Reset Position | Hand Alignment | MoveTo Target | Path Check .

When the teaching point is confirmed, please save the coordinate data as a teaching file.

Generate teaching file P.17

Generate desired teaching data for user.

Edit and save position data P.19

Edit manipulator position data and save on teaching file

Operate desired motion

Homing by the「Home Postion」 P.23

Home Position Operate manipulator to home position.

Operation by the「Encoder Reset Position」 P.24

Encoder Reset Position Operate manipulator to Encoder Reset.

Operation by the「Hand Alignment」 P.25

Hand Alignment Align the tool plane to nearest plane among XY, YZ, ZX plane.

Operation by the「MoveTo Target」 P.26

MoveTo Target Operate manipulator to selected target position

Operation by the「Path Check」 P.28

Path Check Operate robot sequentially to multiple target positions from the list.

Recovery from singularity P.29

Escape the manipulator from singularity

Replenishment: In cartesian coordinate system, JOG operation, MoveTo Target, and Hand Alignment at home position is not available.

Generate teaching file

Creating a teaching file requires python programming.

After connecting to the remote mode, can create the desired teaching file.

Example of writting 'newtech.py' file

Import library Import the zeus teach library

```
## 티칭  모듈 가져오기 ####################
from zeusteach import *
```

Teach Constructor Generate teach object

```
## 교시 로봇 생성자 ######################
zt          = ZeusTeach()
```

Teach Data Generate teach data.

```
### 교시 데이터 생성 ###################################
Joint_Start     = zt.TJoint(10)
Get_Position    = zt.TPosition(10)
Put_Position    = zt.TPosition(10)
GetPut_Position = zt.TPosition(30)  # 최대 30개까지 생성
```

* Teaching file stores up to 100 in total and 10 per variable.

Write an automation program using the teaching data.

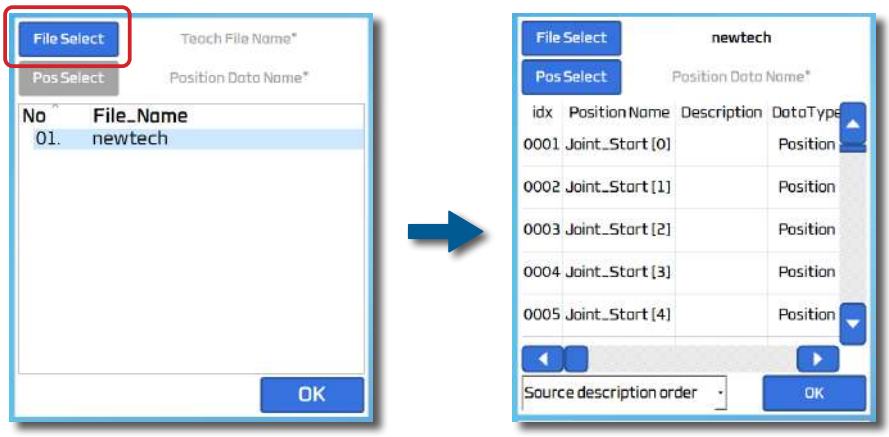
Use of Teaching Data

Write a program to utilize the data.

```
# Get_Position[0] 이동
rb.line(Get_Position[0].offset(dz=100))
rb.line(Get_Position[0])
rb.line(Get_Position[0].offset(dz=100))

# Get_Position[1] 이동
rb.line(Get_Position[1].offset(dz=100))
rb.line(Get_Position[1])
rb.line(Get_Position[1].offset(dz=100))
```

Check Data from Pendant



Select generated teaching file on Pendant. Check teaching data defined and generated.

Edit and save position data

Edit the position data of and save it to a teaching file on Current Position Screen .

Step 1 Select position data and edit

- Select position data :

  Click Pos Select button to see position data select screen.

  Click position data to select.

- Edit position data :

  Click OK button.

  Current Position Screen apears on jog screen's left.

  Click value to select, enter number with 10-key panel.

Current Position Screen

- In case of setting tool offset, manipulator posture :

  ➡ Click value to edit on Current Position Screen . Popup screen apears.

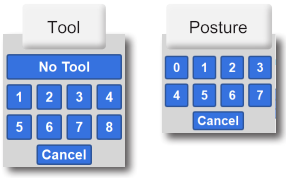
  Select parameter.

  Tool offset:

  Select correspond to equipped tool.
  Setup number : "–"(turn off), "1" ~ "7"

  Posture:

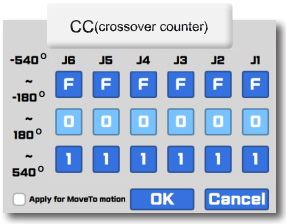
  Select correspond to manipulator posture.



- In case of setting crossover counter(*1) :

  ➡ Click the CC value on Current Position Screen . Popup screen apears.

  Select correspond to range of joint angles.



To use crossover counter information, turn on 「 ☑ Apply for MoveTo motion 」on CC value popup screen, or turn on 「 ☑ CC 」on Current Position Screen .

*1) Crossover counter is the setting for covert posture data from cartesian coordinate system to joint coordinate system.
It is set on positional data's multiturn parameter.
For more information, refer the topic 「D Software 2 Robot Library」 in the User's Guide.

Step 2 Save Position data

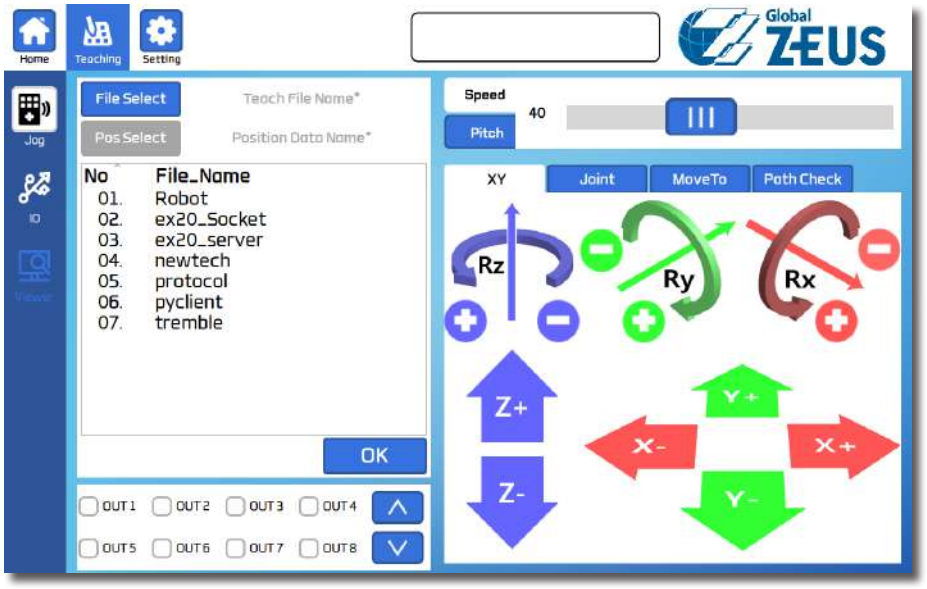
Click Save Current Pos to save current position on teaching file.

	Do not turn off power of the controller while saving data.	

Joint 모드 | MoveTo 모드 | PathCheck 모드

XYZ mode

Can operate robot to X, Y, Z, Rz, Ry, Rx directions.

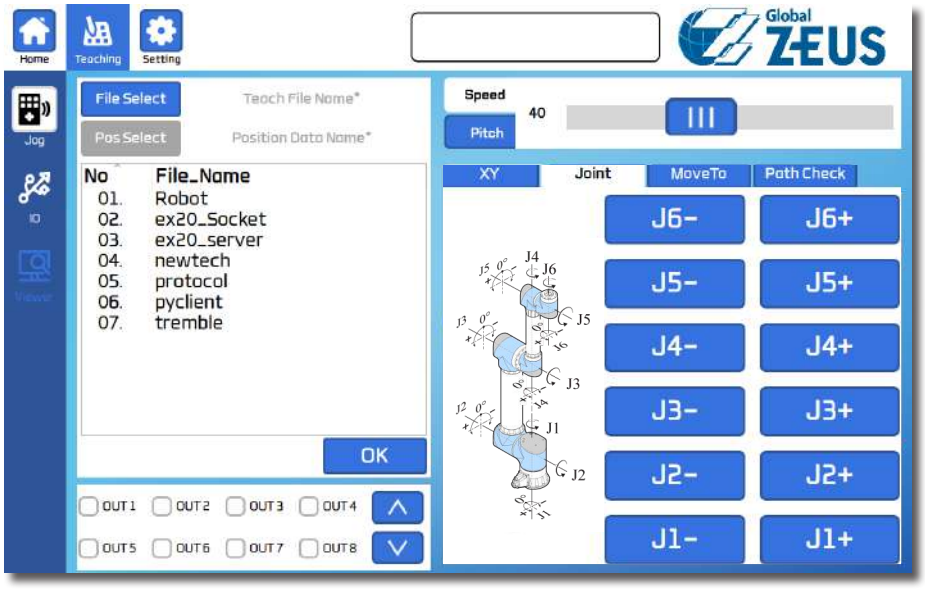


For more information about each robot's axial orientation, refer the topic 「C Teaching 5 Coordinate systems and posture」 in the User's Guide.

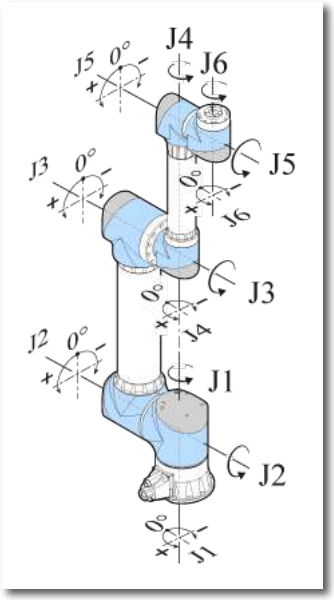
XYZ 모드 | MoveTo 모드 | PathCheck 모드

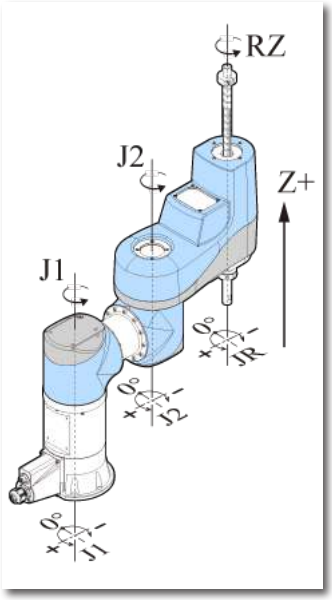
Joint mode

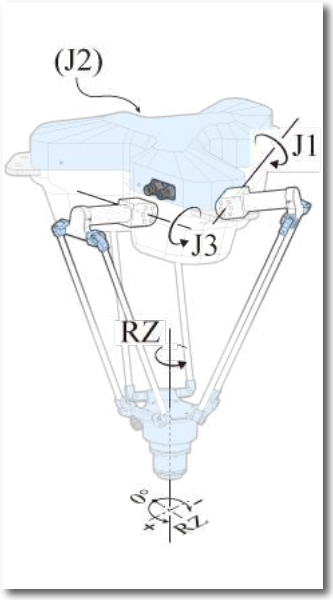
Can operate robot by rotating each joints of it.



Appears each joints' rotational direction of connected manipulator.







XYZ 모드 | Joint 모드 | PathCheck 모드

MoveTo mode

Can set operation setting, operate functions such as「MoveTo Target」.

1 Operation setting

Coordinate

Selecte coordinate system which want to operate.

- XY Coord: Can operate robot to X, Y, Z, Rz, Ry, Rx directions.
- Joint Coord : Can operate robot by rotating each joints of it.

Path Planning

Select how to operate .

- Linear MoveTo : Option to move along shortest path to target position..
- PTP MoveTo : Option to move along smooth curves at constant angular velocity to target position.

2 MoveTo Target Button

MoveTo Target Operate manipulator to selected target position

☞ P.26 Operation by the「MoveTo Target」

3 Home Position / Encoder Reset Position / Hand Alignment Button

Home Position Operate manipulator to home position

☞ P.23 Homing by the「Home Position」

Encoder Reset Position Operate manipulator to encoder reset position

☞ P.24 Operation by the「Encoder Reset Position」

Hand Alignment Move to nearest plane among XY, YZ, ZX plane.

☞ P.25 Operation by the「Hand Alignment」

Homing by the「Home Postion」

Home Position : Operate manipulator to home position

Step 1 Set the operation speed

Click Speed button on teaching screen.

Check that speed value is 10%.

It is recommended that the speed be about 10%. Check the safety before operating in case of speed up the operation.

Teaching screen

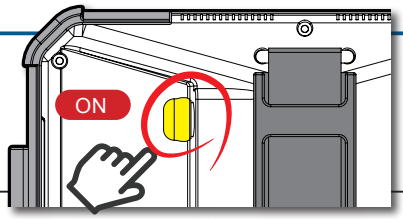
Step 2 Activate the operation

After clicking Home Position button, popup screen apears.

Click yes to activate the operation.

Step 3 Servo ON

Press the Enable switch on the pendant body to turn on the servo.



Step 4 Start move

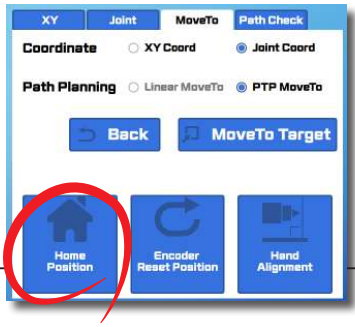
With the servo ON maintained,

click Home Position button to start move.

【pause】: Release Home Position button or Enable switch on the pendant.

【done】: Popup screen apears.

MoveTo screen



Tip!

While moving to target position・・・

1) Button on screen or enable switch on the teaching pendant is released during operation

Stop the operation and stop at the current position.

2) Pass singularity in operation

The operation is interrupted. (The unreach message dialog box is displayed.)

Operation by the「Encoder Reset Position」

Encoder Reset Position : Operate manipulator to encoder reset position

Step 1 Set the operation speed

Click Speed button on teaching screen.

Check that speed value is 10%.

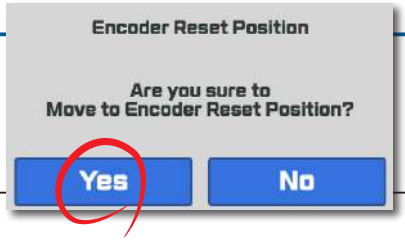
It is recommended that the speed be about 10%. Check the safety before operating in case of speed up the operation.

Teaching scren

Step 2 Activate the operation

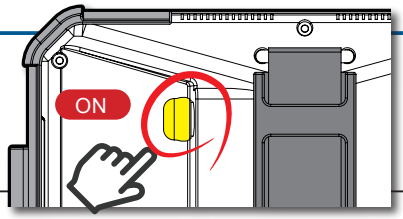
After clicking Encoder Reset Position button, popup screen apears.

Click yes to activate the operation.



Step 3 Servo ON

Press the Enable switch on the pendant body to turn on the servo.



Step 4 Start move

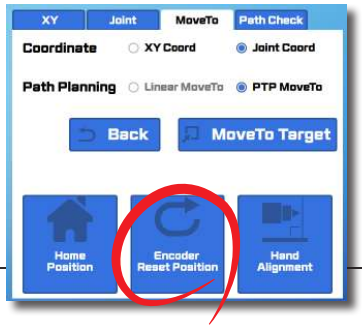
With the servo ON maintained,

click Encoder Reset Position button to start move.

【pause】: Release Encoder Reset Position button or Enable switch on the pendant.

【done】: Popup screen apears.

MoveTo screen



If tool is installed to end flange, please be careful of collisions on the move while「Encoder Reset Position」operation.

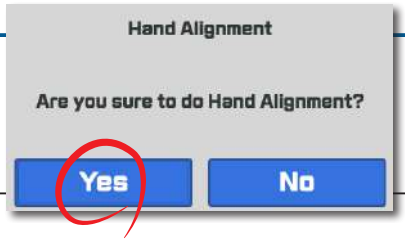
Operation by the 「Hand Alignment」

Hand Alignment : Align the tool plane to nearest plane among XY, YZ, ZX plane.

Step 1 Activate the operation

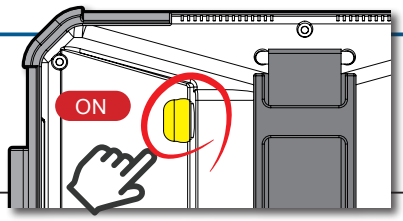
After clicking Hand Alignment button, popup screen apears.

Click yes to activate the operation.



Step 2 Servo ON

Press the Enable switch on the pendant body to turn on the servo.



Step 3 Start move

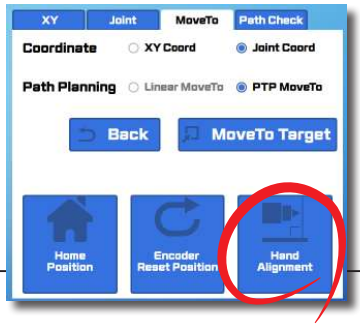
With the servo ON maintained,

click Hand Alignment button to start move.

【pause】: Release Hand Alignment button or Enable switch on the pendant.

【done】: Popup screen apears.

MoveTo screen



TIP!

Hand Alignment explanation

Hand Alignment is function which adjust facing direction of end Flange while maintaining x,y,z coordinate. Direction will change depending on facing direction of end Flange.

Pattern 1

The end flange is close to the downward direction.

Pattern 2

The end flange is close to the horizonntal direction.

Pattern 3

The end flange is close to the upward direction.

Replenishment : Hand Alignment operation is only available on articulated robot.

Operation by the「MoveTo Target」

MoveTo Target : Operate manipulator to selected target position

Step 1 Select target position

- Select position data :
  - Click Pos Select button on JOG screen to see position data.
  - Click position data to select.

Jog screen

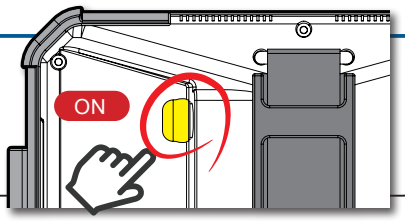
Step 2 Set the operation speed, coordinate and setting

- Coordinate system :
  Match the selected teaching file with the coordinate system which want to operate.
  - XY Coord Cartesian coordinate systerm
  - Joint Coord Joint coordinate systerm
- Operation setting :
  Select operation setting at cartesian coordinate system, XY Coord
  - Linear MoveTo : Option to move along shortest path to target position.
  - PTP MoveTo : Option to move along smooth curves at constant angular velocity to target position.
- Operation speed :
  Drag silder to adjust operation speed(%).

MoveTo screen

Step 3 Servo ON

Press the Enable switch on the pendant body to turn on the servo.



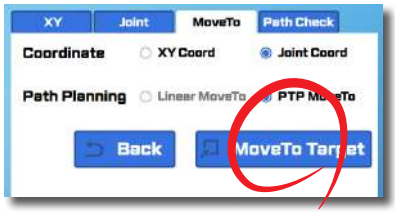
Step 4 Start move

With the servo ON maintained,

click MoveTo Target or Back button to start move.

【pause】: Release button on screen or Enable switch on the pendant.
【done】: Popup screen apears.

MoveTo screen



XYZ 모드 | MoveTo 모드 | Joint 모드

PathCheck mode

Operate robot sequentially to multiple target positions from the list. Can check teaching positions and manipulator motions.

1 Operation setting (Each position data is set individually.)

Coordinate

Selecte coordinate system which want to operate.

- XY Coord: Can operate robot to X, Y, Z, Rz, Ry, Rx directions.
- Joint Coord : Can operate robot by rotating each joints of it.

Path Planning

Select how to operate .

- Linear MoveTo : Option to move along shortest path to target position..
- PTP MoveTo : Option to move along smooth curves at constant angular velocity to target position.

2 Operation button

Cycle | Step — Operate robot to position following the list.

P.28 Operation by the 「Path Check」

3 List of positions

- Add — Add selected target position from left side to the right list.
- Del — Delete selected position from the position list.
- △ — Move selected position 1 line up.
- ▽ — Move selected position 1 line down.
- Clear — Delete all positions from the list.

Operation by the「Path Check」

Path Check : operate robot sequentially to multiple target positions from the list.

Step 1 Add positions on list from teaching file

・ Select position data :

→ Click position data on JOG screen left to select.

Click Add button to add selected target position from left side to the right list.

Make the list of positions by using Add , Del , △ , ▽ , Clear buttons.

Jog screen

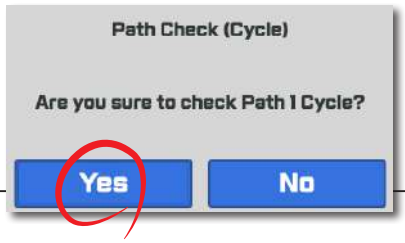
Step 2 Select and activate the operation

Cycle
Operate robot to positions following list from beginning to end.

Step
Operate Robot from selected position to next position in the list.

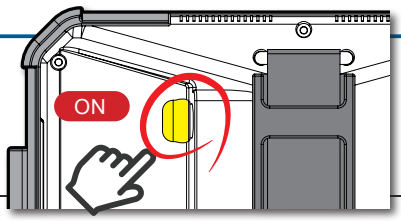
Path Check screen

After clicking Cycle or Step button, popup screen apears. Click yes to activate the operation.



Step 3 Servo ON

Press the Enable switch on the pendant body to turn on the servo.



Step 4 Start move

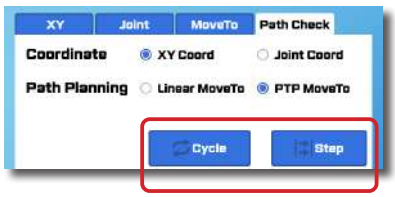
With the servo ON maintained,

click Cycle or Step button to start move.

【pause】: Release button on screen or Enable switch on the pendant.

【done】: Popup screen apears.

Path Check screen



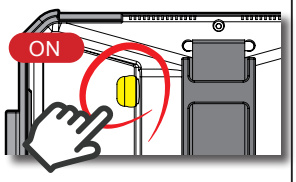
Recovery from singularity

Escape the manipulator from singularity.

Method 1 JOG operation in joint coordinate system

Operate manipulator to configurable posture (not a singularity in cartesian coordinate system) by using teaching pendant in joint coordinate system.

Step 1 Press the Enable switch on the pendant body to turn on the servo.



Step 2 Operate manipulator to configurable posturein Joint screen.

Example of the configurable posture

Image of posture

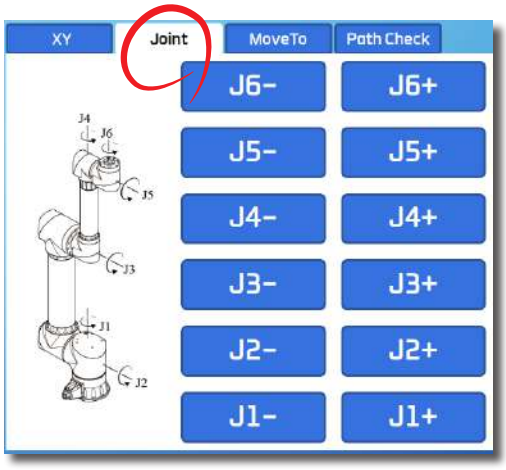
Be in a position similar to the left picture.

Please check the angle of each joint on the current position screen while operating.

Each joint angle value

J1 : 0 deg
J2 : -20 deg
J3 : -100 deg
J4 : 0 deg
J5 : -60 deg
J6 : 0 deg

Joint screen



Method 2 Operate to teaching point by MoveTo Target in joint coordinate system

To be prepare, save configurable posture on teaching point in cartesian coordinate system.
Even if manipulator is on singularity in the cartesian coordinate system during teaching, can easily operate to saved position by MoveTo Target in joint coordinate system
After recovery, can switch to caretsian coordinate system to resume teaching.

Example：Save configurable posture onJoint_Start[0].

Image of posture

Each joint angle value

J1 : 0 deg
J2 : -20 deg
J3 : -100 deg
J4 : 0 deg
J5 : -60 deg
J6 : 0 deg

MoveTo screen

TIP!

In case JOG and MoveTo Target operation is not available, Release the brakes on the manipulator and operate it manually. For more information, refer the topic「A General Information 4 Unpacking」in the User's Guide.

TIP!

Use joint coordinate system when avoiding singularity in the cartesian coordinate system.

Cartesian coordinate system

Even within the range of motion, there are singularities depending on the posture.

Joint coordinate system

Can operate freely within range of motion.

4. Software Update

1. Upload to Teaching Pendant from PC

Recommend that back up teaching files to PC before software update.

Home screen

The version of the teaching pendant software can check on the Home screen.

※ The version in image is an example during development.

Step 1 Download the software update file.

Download the software update file from ZEUS ZERO website.

web address : http://zero.globalzeus.com/downloads/

If you are unable to verify the update file at this address, please contact distributor.

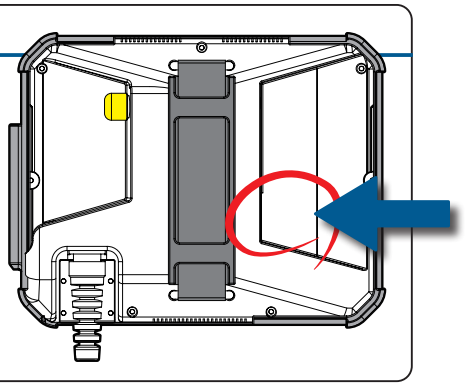
Service center ZEUS : 132, Annyeongnam-ro, Hwaseong-si, Gyeonggi-do, South Korea

e-mail zero@globalzeus.com TEL 031-5187-1000~1 FAX 031-267-4720

Step 1 Upload file to Teaching Pendant from PC.

Save software update files to the top of USB memory

Connect the USB memory to the USB terminal on the teaching pendant body.



2. Software Update on Teaching Pendant

Step 1 Select the software update file.

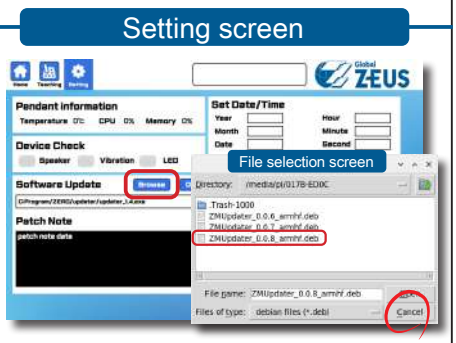
Click Browse button on Setting screen, Software Update.

File selection pop-up screen appears.

Move to USB memory path '/media/pi'

and select USB memory folder.

Click Open button to select file.

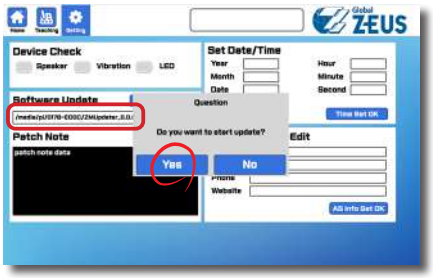


Step 2 Start software update.

Check selected software update file.

Click OK button on Setting screen, Software Update.

Click YES button on pop-up screen to start software update.



Wait until software update is complete.

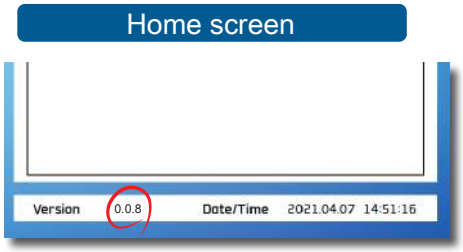
(1~2 minutes)

!	Do not shut off the power during the update process. A program error occurs.	⚠

Step 3 Reboot and check that the update is complete.

Pop-up screen appears when the update is complete.

Click YES button to proceed reboot.



Check software version

on Setting screen.

MEMO

MEMO