

# ROBOTIS Manipulator SDK

## Quick Start



**ROBOTIS**

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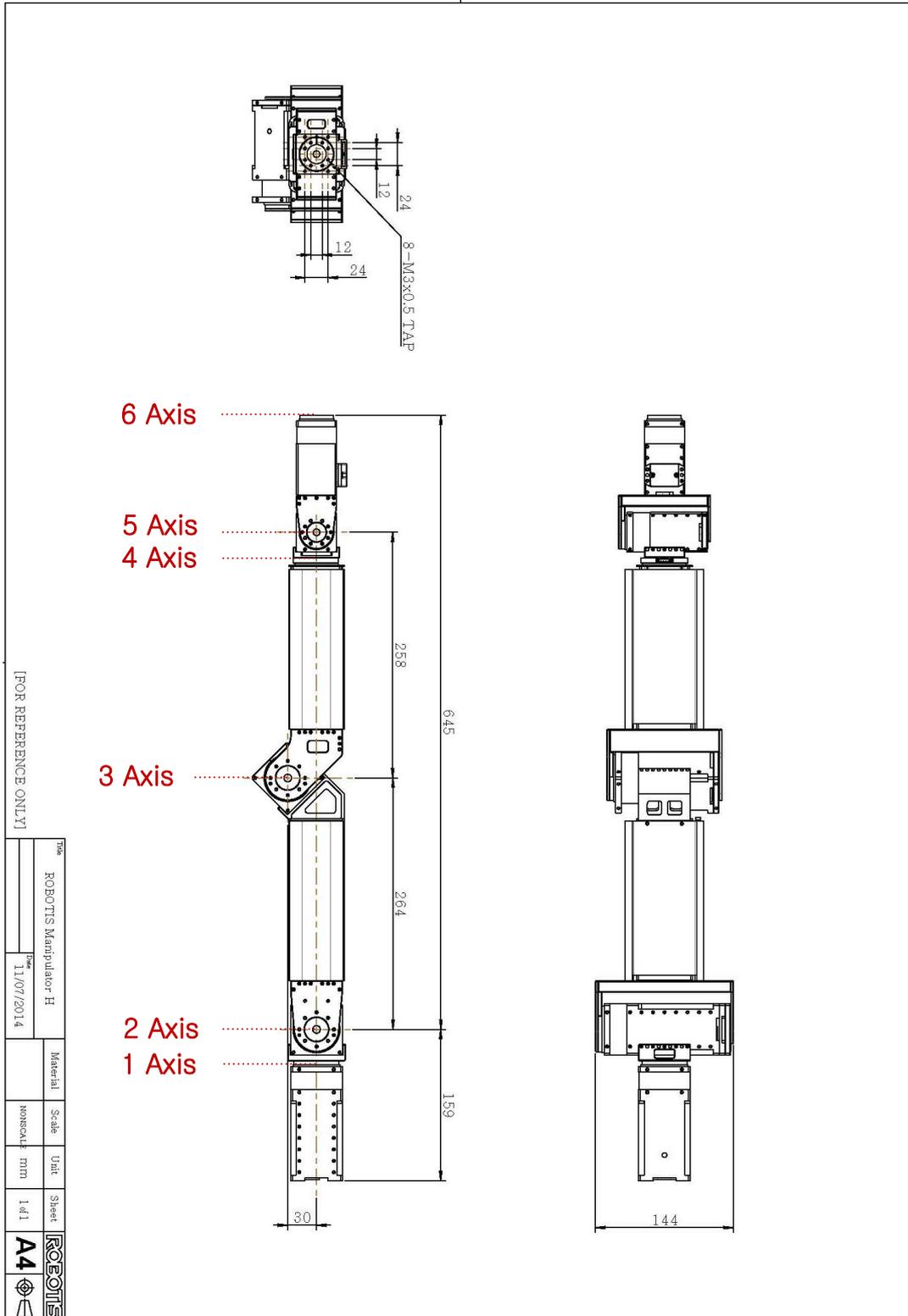
# 1 Introduction

## 1.1 About this document

- i. This Quick Start has been created to offer users an easy instruction guide to use the ROBOTIS Manipulator based on the User Manual.
- ii. This Quick Start includes the ROBOTIS Manipulator SDK to operate the ROBOTIS Manipulator SDK.
- iii. The examples in this manual are based on Windows10 and Visual Studio Express 2013.
- iv. It is strongly recommended for those who are used to Dynamixel PRO C/C++ to read through this manual.
- v. The units utilized in the ROBOTIS Manipulator SDK are in radians (rad) and millimeters (mm).
- vi. Last updated on September 23, 2015

## 1.2 Layout

### H Series – ROBOTIS Manipulator Dimension



### 1.3 Specification

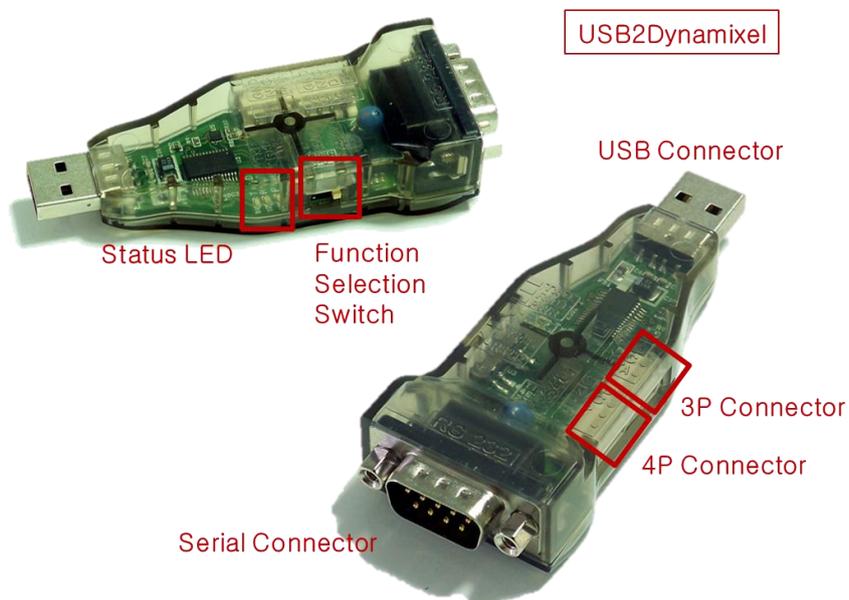
#### H Series – ROBOTIS Manipulator Specification

Item		Description
DOF		6 [DOF]
Arm Weight		5.551 [kg]
Operating Voltage		24 [V]
Dynamixel PRO Model Name	1 Axis	H54-200-S500-R
	2 Axis	
	3 Axis	H54-100-S500-R
	4 Axis	
	5 Axis	H42-20-S300-R
	6 Axis	
Operating Range	1 Axis	$-\pi \sim \pi$ [rad]
	2 Axis	$-0.5\pi \sim 0.5\pi$ [rad]
	3 Axis	$-0.5\pi \sim 0.75\pi$ [rad]
	4 Axis	$-\pi \sim \pi$ [rad]
	5 Axis	$-0.5\pi \sim 0.5\pi$ [rad]
	6 Axis	$-\pi \sim \pi$ [rad]
Default ID		1 Axis (ID 2), 1 Axis (ID 2), 3 Axis (ID 3) 4 Axis (ID 4), 5 Axis (ID 5), 6 Axis (ID 6)
Baudrate		RS485

## 2 Getting Started

### 2.1 Preparation

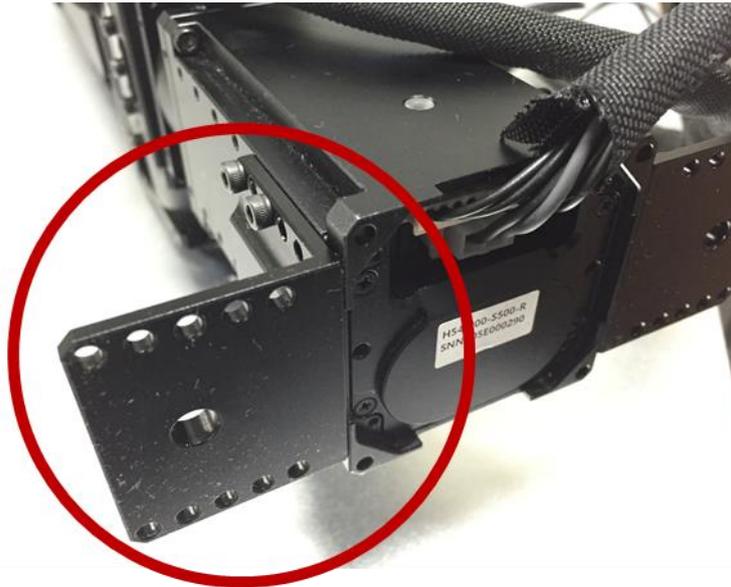
- i. Power Supply
  - The manipulator requires 24V for operations. Ensure the power supply is capable of supplying 24V and 15A or higher.
- ii. 4P Cable
  - The 4P Cable connects the manipulator and USB2Dynamixel.
- iii. Power Cable
  - The power cable supplies power to the manipulator.
- iv. USB2Dynamixel
  - The USB2Dynamixel sends ArmSDK commands to the manipulator. Connect the USB2Dynamixel to the PC via USB hub.



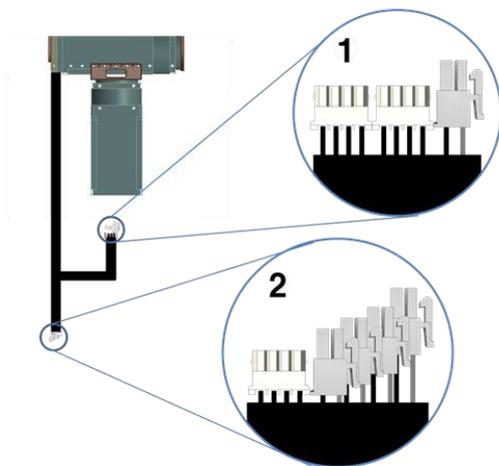
## 2.2 Installation of Manipulator

 The contents below are based on a specific application base plate and can differ from the actual base plate used.

- i. Rest and fix joint #1 of the manipulator.



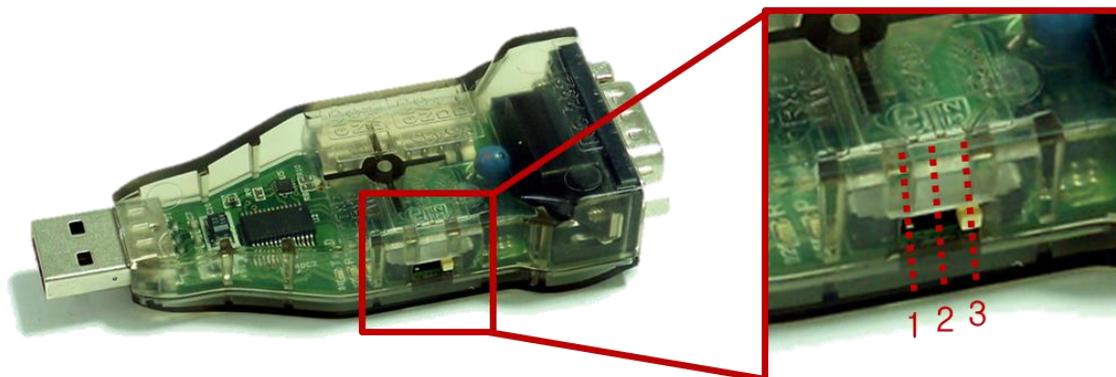
- ii. The photo on the left is the external wiring for the arm. Label #1 shows a pair of 4P cables and power connector; these connect to joint #1 as shown on the right picture.





- vi. Connect the USB2Dynamixel to the PC via USB hub. The USB hub acts as an isolator to protect the PC from any possible unexpected surges caused by arm action.

## 2.3 USB2Dynamixel Setting



<b>1. TTL Communication</b>	AX series, AX-S1, 3-pin MX; communicates with 3-pin Dynamixel
<b>2. RS485 Communication</b>	DX series, RX series, EX series, communicated with 4-pin Dynamixel PRO
<b>3. RS232 Communication</b>	CM-5, CM-510; communicates with controllers using serial cable



The manipulator is based on the RS-485 communications so make sure to set to the dongle to 2.RS-485.

## 2.4 Manipulator Test using Dynamixel Wizard

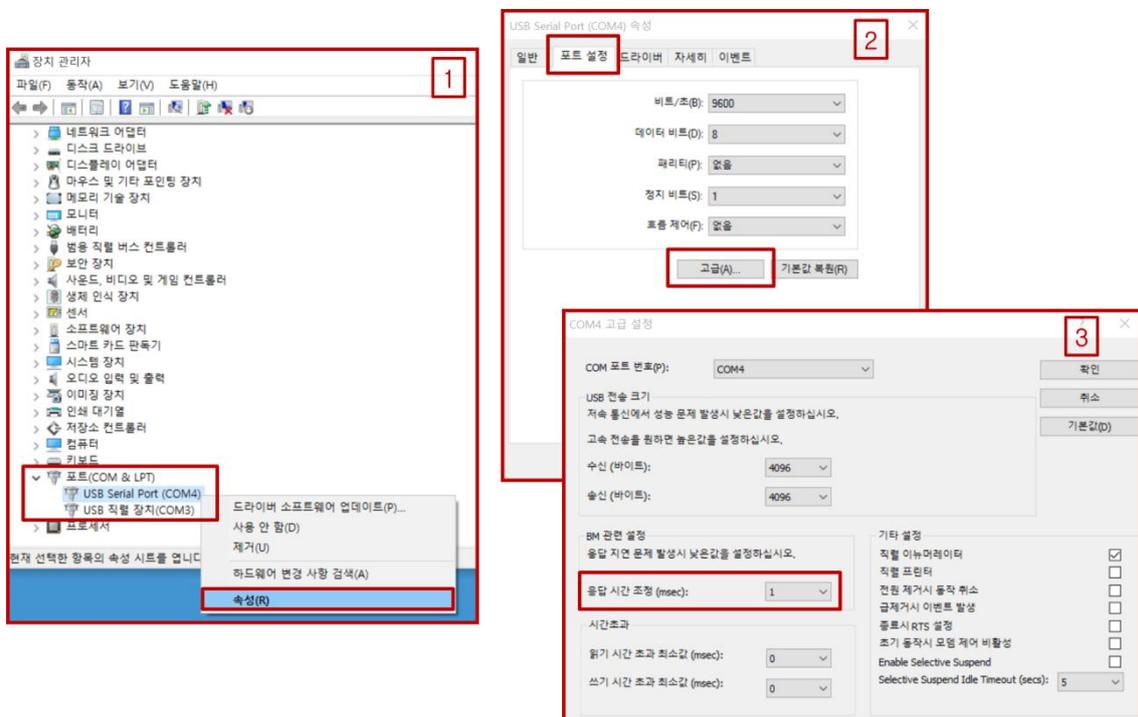
### 2.4.1 Run Dynamixel Wizard

- I. Test the arm with Dynamixel Wizard before running the SDK to check for any anomalies.
- II. Dynamixel Wizard is included in RoboPlus program. RoboPlus can be downloaded from the ROBOTIS website 'Support' → Download.  
([http://www.robotis.com/BlueAD/board.php?bbs\\_id=service\\_03](http://www.robotis.com/BlueAD/board.php?bbs_id=service_03))
- III. Install and run RoboPlus; Click on the "Expert" tab, then click on the **'Dynamixel Wizard'** button.



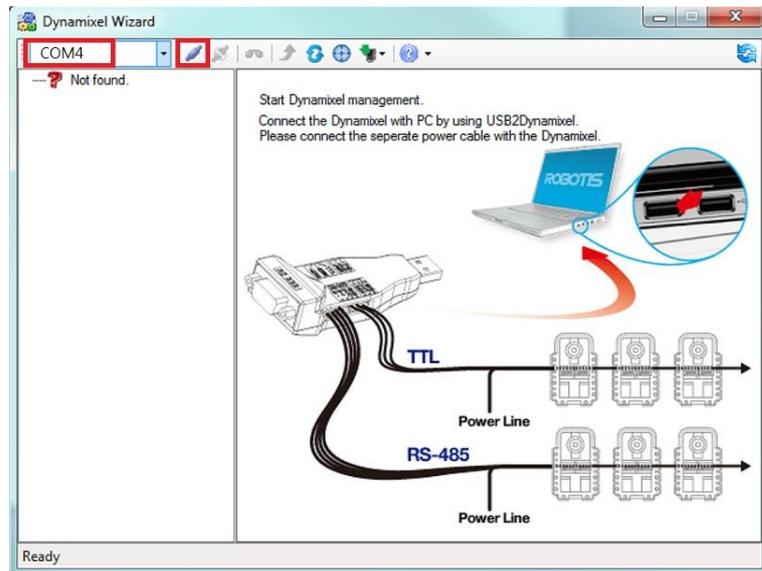
## 2.4.2 Check and Select Port

- I. Before starting Dynamixel Wizard ensure the arm is extended and fixed to the base plate. In case the Manipulator is not fixed to the plate, it may cause physical harm or damage.
- II. Connect the USB2Dynamixel to the PC after wiring is complete. Check the port number connected to the USB2Dynamixel. **‘Device Manager → Port (COM & LPT) → USB Serial Port’**
- III. After checking the Port number, set the msec to 1. **‘Properties → Port Setting → Advance Setting → Change Latency Time (msec)’**

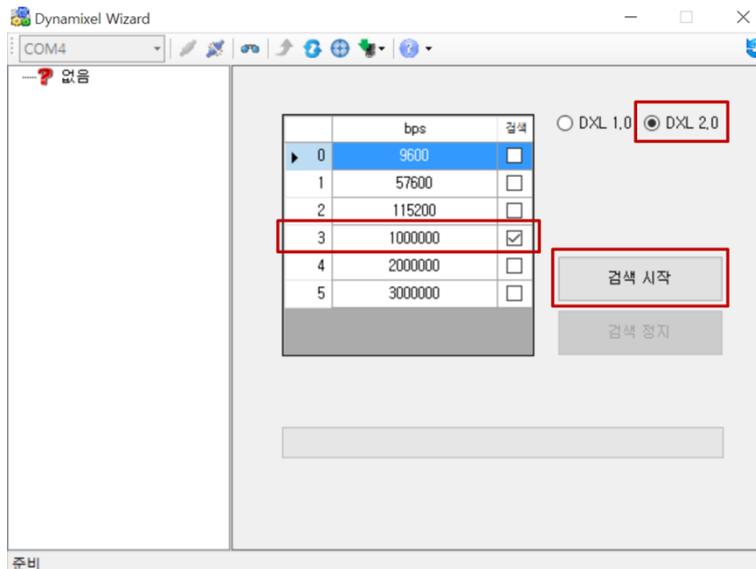


Always ensure the wiring is complete before powering on. If the power is on, do not change wires; otherwise it may cause undesired operations.

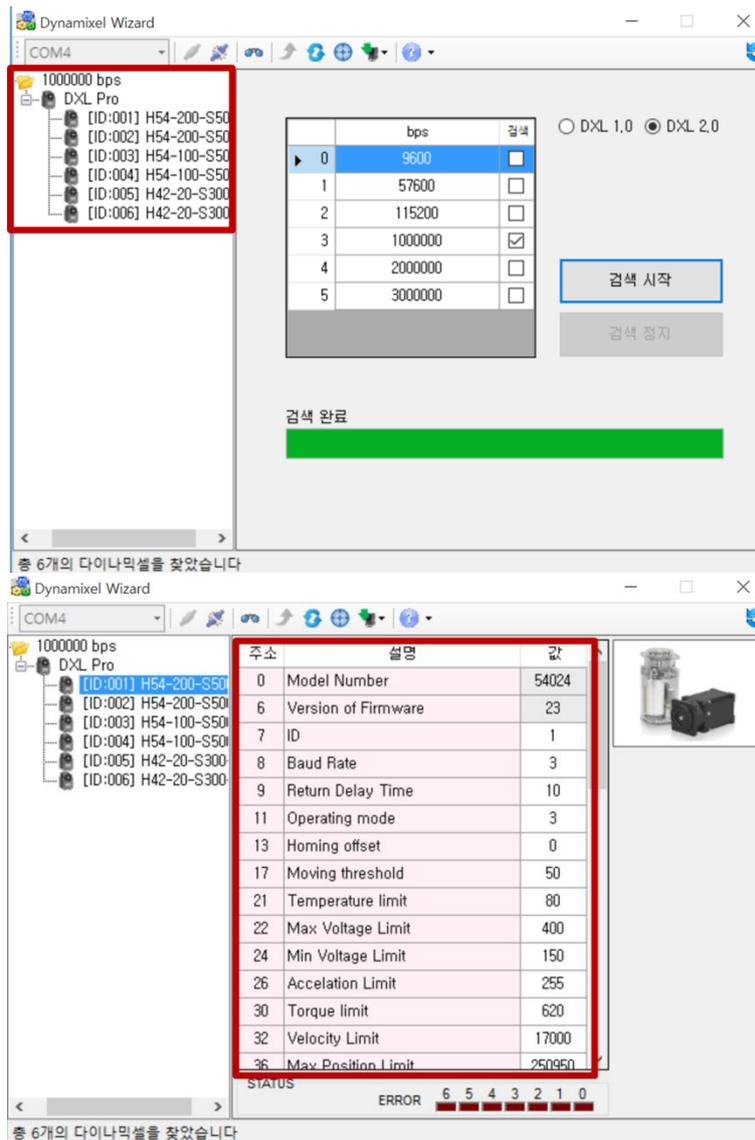
- IV. The picture on the upper left shows the port number which is connected to the USB2Dynamixel connected to the ROBOTIS Manipulator. After making sure this is correct, click on  reconnect.



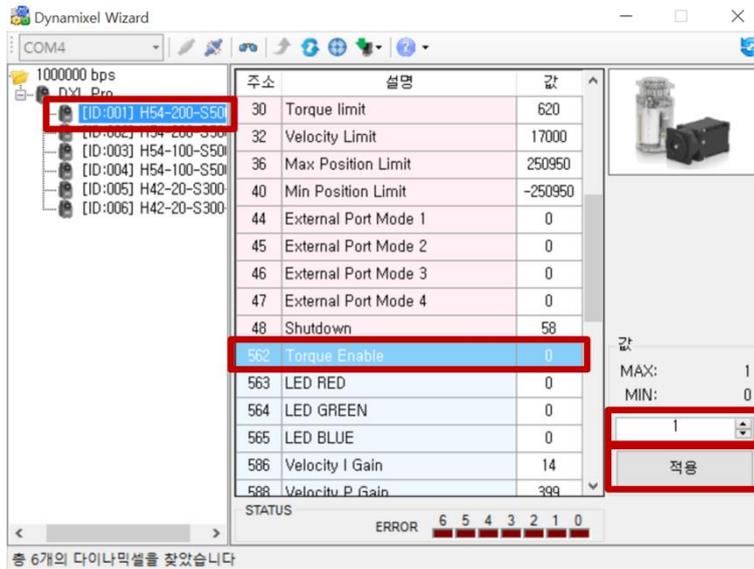
- V. Once connected, select DXL2.0 and then make sure that **1000000bps** box is checked. Then click Search. The manipulator's default baudrate is 1Mbps.



- VI. Once the search is complete, the Dynamixel PROs that make up the ROBOTIS Manipulator will appear on the left side. Click on the individual Dynamixel PRO to display the contents of the Control Table.

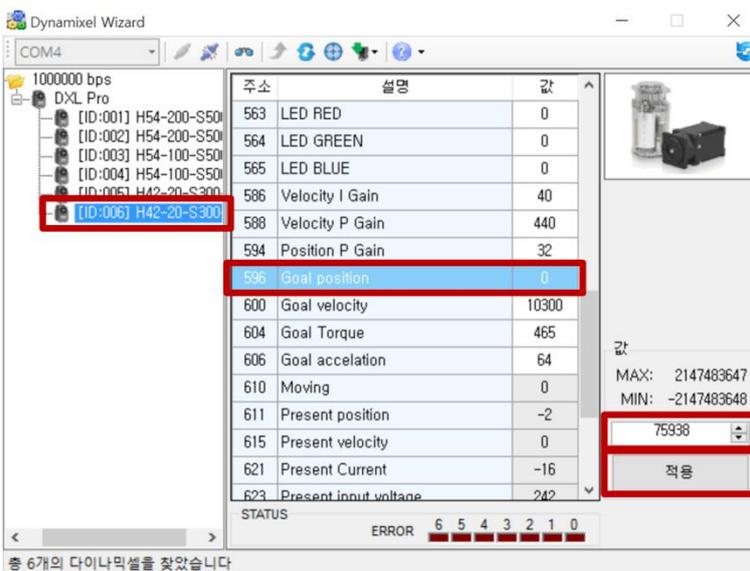


VII. Unlike the the other Dynamixels, the Dynamixel PRO only operates when the Torque is On. The Torque can be turned on using “Torque Enable” function is located in the middle of Dynamixel Wizard on Table address 562. Change the value on the lower right side to “1 then click ‘Apply’ to turn on.



VIII. After checking that all the settings for the Dynamixel PROs are set to “1” for ‘Torque Enable,’ make sure the Manipulator is fixed to the plate. Then click on the Dynamixel with ID #6.

IX. Now let’s verify whether the properly moved to the set Goal Position. Joint #6 which is closest to the End Effector is safest to move and test. Set the Goal Position of joint #6 to about 90 degrees. The position value for joint #6 (H42-20-S300-R) for 90 degrees is 75938). Please refer to the User Manual for more information on the Resolution for the Joint Position.



X. Once the Goal Position is set to 90 degrees, check if the Manipulator has actually moved 90 degrees from its starting point.

- XI. Click 'Apply' to start operating the Dynamixel Pro to its set Goal Position. If there is no movement, double check if the value for Torque Enable has been set to 1 and try again. Change the Torque Enable value to 0 to move the Dynamixel PRO to its original position.
- XII. Do the same procedure for all the other joints.

**Once the test is complete, be sure to “Off” the Torque Enable function by changing the value to 0 then start using the ROBOTIS Manipulator SDK Example.**

### 3 ROBOTIS Manipulator SDK Example

#### 3.1 How to use Robotis Manipulator SDK

##### 3.1.1 Preparation before SDK

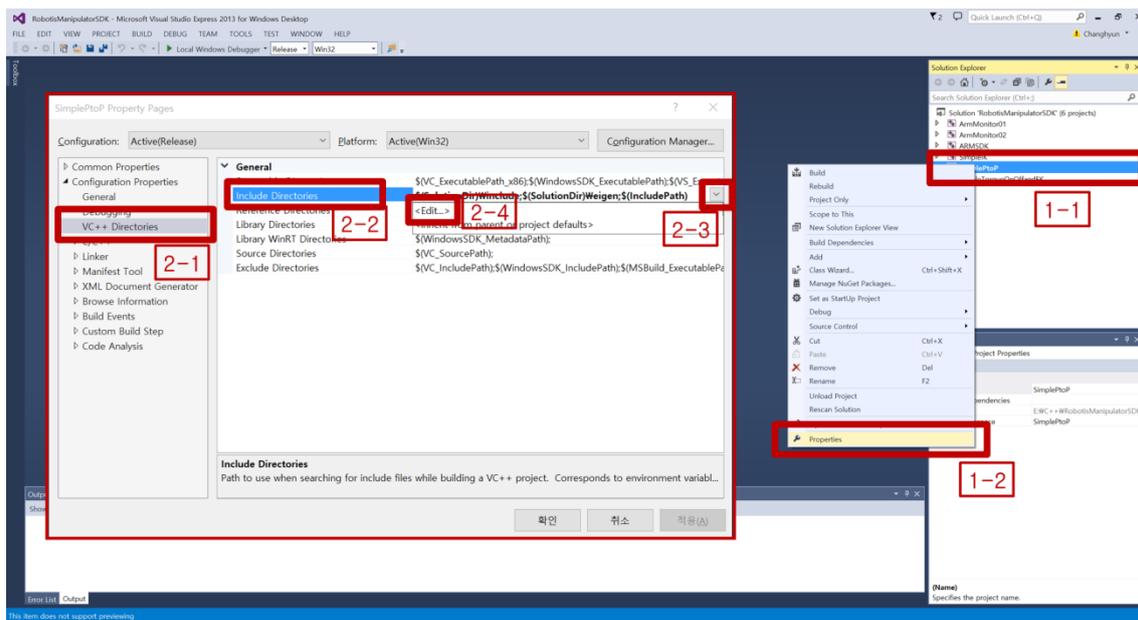
I. The following are pre-requisites to use the SDK..

**Eigen Package** (<http://eigen.tuxfamily.org>, version 3.0.6 or Later)

##### 3.1.2 Package Installation

I. Download and extract the Eigen Package.

II. Go to **'Project Properties → VC++ Directories → Include Directories'** and designate the folder where the Eigen sources are located.



III. Repeat procedures I and II to include the examples and include directories.

IV. Preparation now complete. Press F7 to start compiling. In case a compile error occurs, repeat the procedures above.

### 3.2 Example

The **ROBOTIS Manipulator SDK** offers **5 examples**.

- 1) **ArmMonitor01:** Outputs the current position and goal position of the Manipulator's joint, Pose and Joint Parameter (Velocity, Acceleration, Position P, I, D Gain, Velocity P, I Gain) of the End Effector in the terminal window for viewing and enables users to adjust this value.
- 2) **ArmMonitor02:** Has the same functions as ArmMonitor01, and also allows direct control of the End Effector. When controlling the End Effector, Inverse Kinematics (ComputeIK function) moves each Joint using Solution position (rad).
- 3) **SimplePtoP:** This example enables the End Effector to move points P1 and P2
- 4) **SimpleIK:** This example enables users to control the pose of the End Effector, and can control the end effector's Position (X, Y, Z), Orientation (Roll, Pitch, Yaw) with a with keys.
- 5) **SimpleTorqueOnOffandFK:** Turns the manipulator's joints' torque On/Off. When the Torque Off→On Forward Kinematics runs and outputs all joints pose (Rad\_ and end effector's Position and Orientation.

The examples in this Quick Start are based on SimplePtoP. Please refer to the User Manual for details and usage on the other examples and source codes.

### 3.2.1 How to Use SimplePtoP

 The movement of this example is very fast. When testing this example, please keep a safe distance away from the Manipulator and be prepared to shut down the power in case anything goes wrong.

- I. Before running SimplePtoP, you must start a new project to execute the example then press the Ctrl + F5 key.
- II. Input the Com port number and Baud number. For baudrate 1Mbps, the Baud number is 3. For more information on the Baud number, please refer to the eManual. ([http://support.robotis.com/ko/product/dynamixel\\_pro/control\\_table.htm](http://support.robotis.com/ko/product/dynamixel_pro/control_table.htm))

```
C:\WINDOWS\system32\cmd.exe
Input COM port number : 4
Input baud number : 3
Succeed to open USB2Dynamixel
Press any key to move first pose
move to first pose
Press any key to start P2P Motion
```

- III. Once input for both numbers is successful, you will see **‘Succeed to open USB2Dynamixel.’** Then you will see **‘Press any key to move first pose,’** press any key to move to the Manipulator to its first pose. Press again any key to start the saved PtoP Motion once it completes its first pose. The photo on the right side is the first pose.

- IV. Prints the joint’s position (rad) starting from the left from ID #1~#6 while using the **SimplePtoP program.** When running SimplePtoP, press ‘p’ or ‘P’ to pause the Motion and ‘ESC’ to end the program.

V.

```
C:\WINDOWS\system32\cmd.exe
Input COM port number : 4
Input baud number : 3
Succeed to open USB2Dynamixel
Press any key to move first pose
move to first pose
Press any key to start P2P Motion
start
Current Calculated Angle is
0.28600 -1.17164 -0.61255 0.28600 0.28600 0.28600
```

