

INNO-ASWS L7NH v1.0

Technical Manual

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1. Overview

This document is an introduction document of driver installation, library and tuning program of INNO_ASWS(LH_v1.0 Servo Drive), and includes the following items.

- Servo Drive Driver Install
- Servo Drive Parameter Setup
- Library
- Tuning Program

※ **Note** : This document refers to 200V / 900W Servo Motor and L7NH ver1.0 Servo Drive. The rated torque in the hardware specification referred to in this document is 8.59 Nm (100% force) and the maximum torque is 25.78 Nm (300% force).

1.1. File Path

The manual is provided in the USB package below.

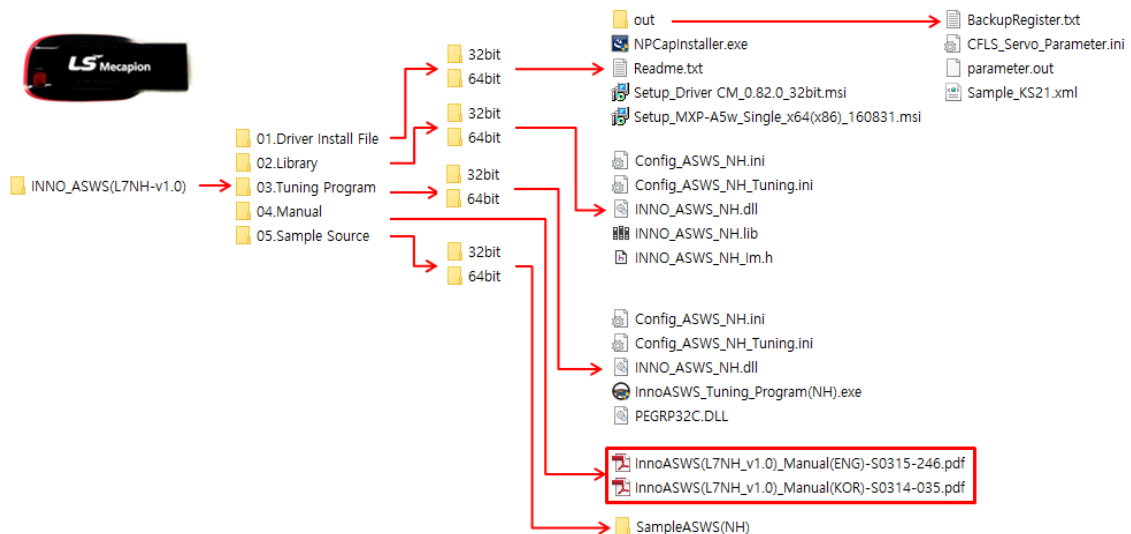


Figure 1. Manual File Path

2. System Configuration

INNOSIMULATION Co., Ltd provides a cabin system based on actual vehicle parts as a system for driving in a virtual environment. This document describes a steering reaction force device in a cabin system.

Force Feedback Steering Wheel is a system that provides the driver with a sense of steering similar to the actual driving in a virtual simulation environment.

※ **Note** : In this document, the steering reaction force system is called INNO_ASWS.

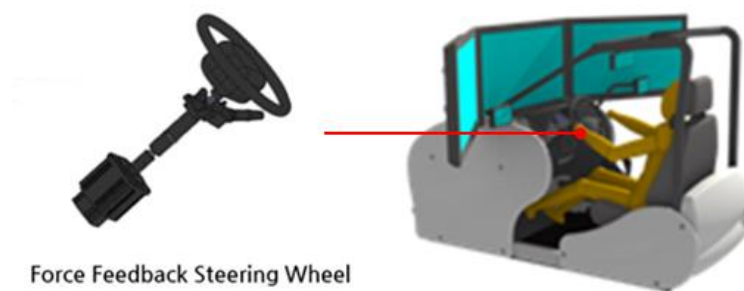


Figure 2. Force Feedback Steering Wheel System

INNO_ASWS consists of hardware and software.

The hardware of INNO_ASWS consists of Servo Motor and Servo Drive, and the software provides a library and a tuning program to control the controller.

2.1. Hardware Configuration

The hardware configuration of INNO_ASWS consists of servo motor which generates the reaction force of the handle and drive that controls the motor, and is connected to the Ethercat (LAN) for controlling this hardware.

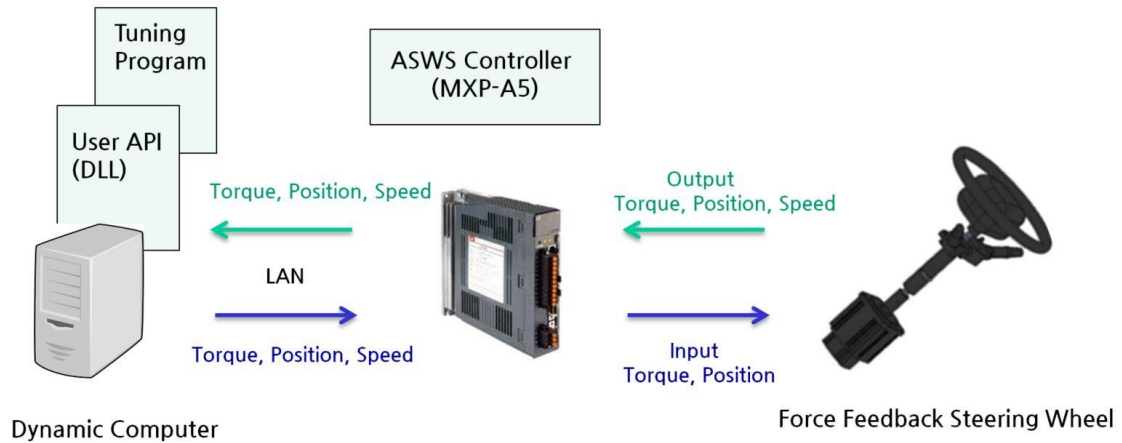
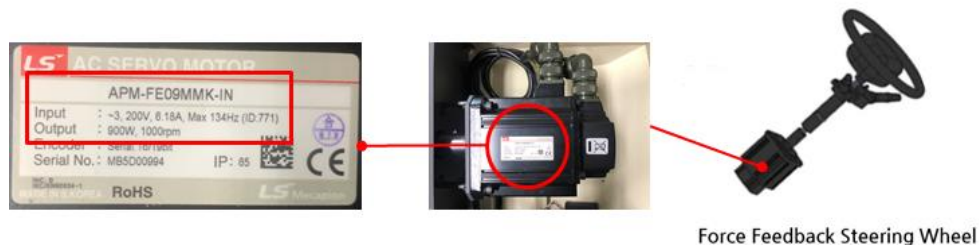


Figure 3. ASWS System Configuration

2.1.1. Servo Motor & Drive

The hardware specifications of the steering reaction force device are as follows.

- Servo Motor
 - 1) Model : APM-FE09MMK-IN
 - 2) Input : 200V, 6.18A
 - 3) Output : 900W, 1000rpm



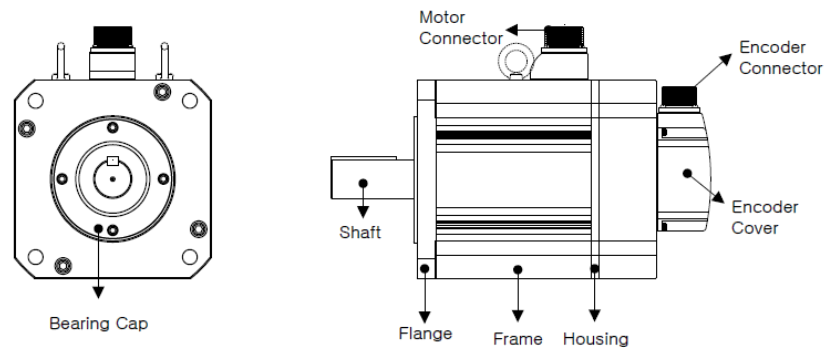


Figure 4. Servo Motor

Environment	Condition	
	Servo Drive	Servo Motor
Operating temperature	0 ~ 50 °C	0 ~ 40 °C
Storage temperature	-20 ~ 65 °C	-10 ~ 60 °C
Operating humidity	90% RH or less (No dew)	20 ~ 80% RH (No dew)
Conservation humidity		
Elevation	Below 1000m above sea level	
Installation Interval	<ul style="list-style-type: none">• When installing one unit from the control panel<ul style="list-style-type: none">• Upper and lower 40[mm] or more• Right and left 10[mm] or more• When two or more units are installed, from the control panel<ul style="list-style-type: none">• Above 100[mm] or more• Lower 40[mm] or more• Right and left 30[mm] or more• 2[mm] or more between products• Refer to “Installation in the top [mm] control panel”	

Other	<ul style="list-style-type: none"> Where there is no dust, iron, corrosive gas or explosive gas No abnormal vibration and no shock
-------	--

- Servo Drive
- Model : L7NHA010U-IN
 - Input : 200-230Vac, 6A, 50-60Hz
 - Output : 0-230Vac, 6.75A, 0-400Hz (1kW)

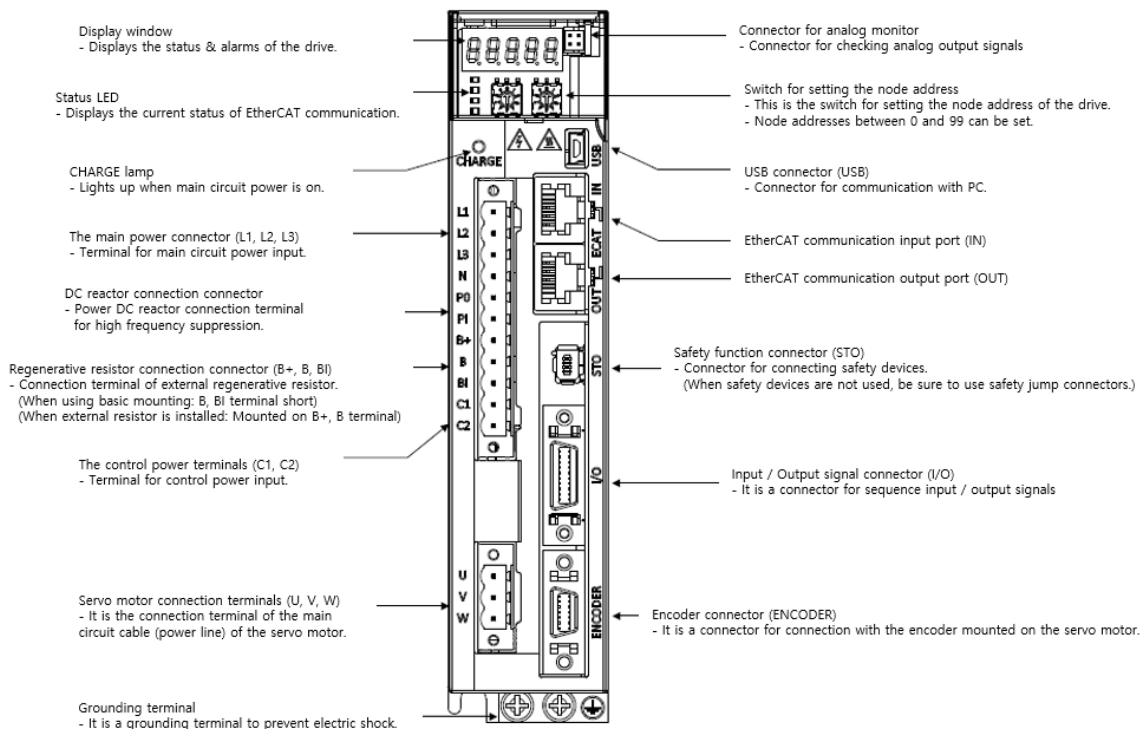


Figure 5. Servo Drive

2.1.2. Battery

The battery is connected to the encoder cable and connected to the servo drive. Also, it is used to store the parameter value stored in the servo drive in a state where the power supply is not supplied.



Figure 6. 3.6V Lithium-ion battery

The specification of the lithium-ion battery are as follows.

- Voltage: 3.6V
- Capacity: 2500mAh
- Maximum continuous discharge current: 60mA
- Maximum pulse discharge current: 100mA
- Operating temperature range: -55 ~ -85
- Size: 14.6mm x 50.5mm
- Weight: 16g

※ **Note** : When discharging battery, it is necessary to change to the same specification as the above specification, and the parameter setting value may be changed according to discharge. Therefore, software parameter re-entry and Zero Position Setting must be re-established (see 3.1.4 and 3.1.5 for parameter modification and Zero Position Setting method).

2.2. Software Configuration

INNO_ASWS provides the following software packages.

- Driver Install
- Library
- Tuning Program
- Manual
- Sample Source

2.2.1. USB Package Configuration

INNO_ASWS provides the related files with the delivery USB, and the package contents are as follows.

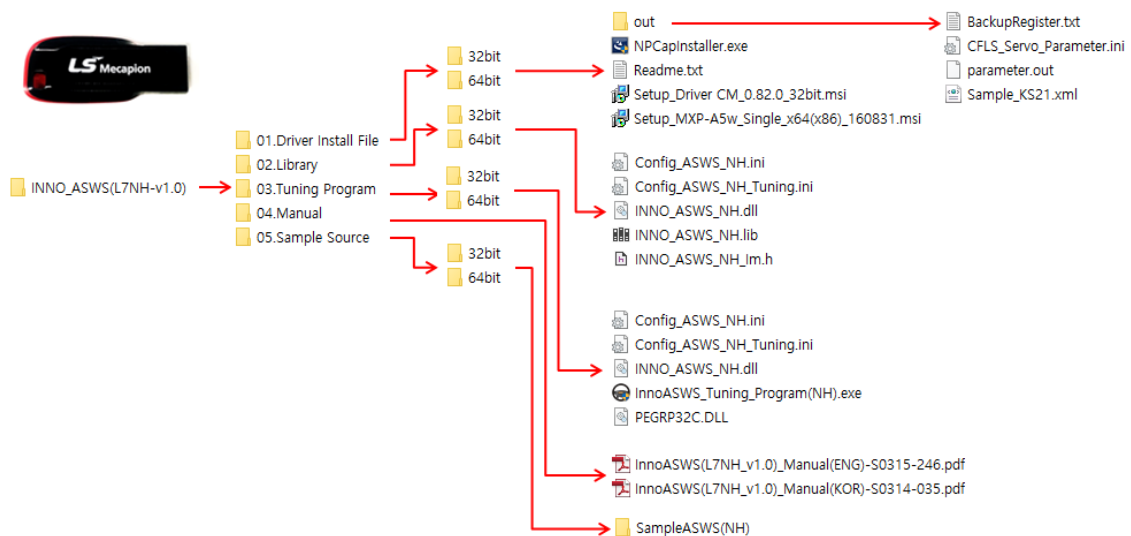


Figure 7. INNO_ASWS Delivery Package

3. Software Package

3.1. Driver Install

3.1.1. Pre-Installation Checklist

Check the following items before installing the driver file.

- Servo Drive & Motor : Check power connection
- ASWS dongle key : Check the connection status of PC dongle-key to be installed.
- Ethernet cable : Connect to PC to be installed and Servo Drive “CN3 or CN4” port (LAN)



Figure 8. ASWS License Dongle-Key

3.1.2. Driver Installation

Install it using the driver file of the supplied USB delivery package.

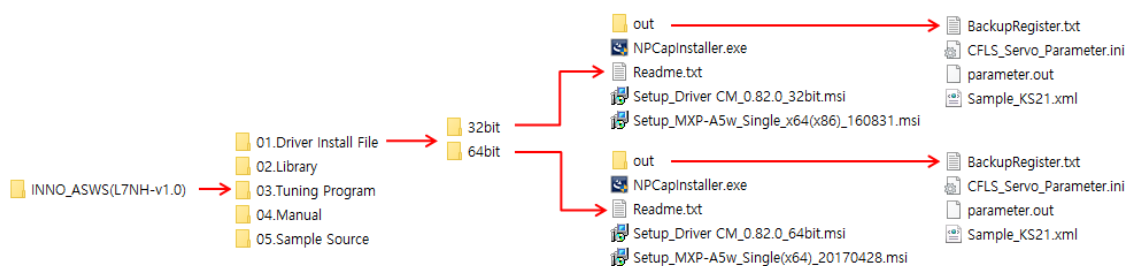


Figure 9. Driver Installation File

3.1.2.1. File Installation

- Running and installing Setup_MXP-A5w_Single ~.msi file

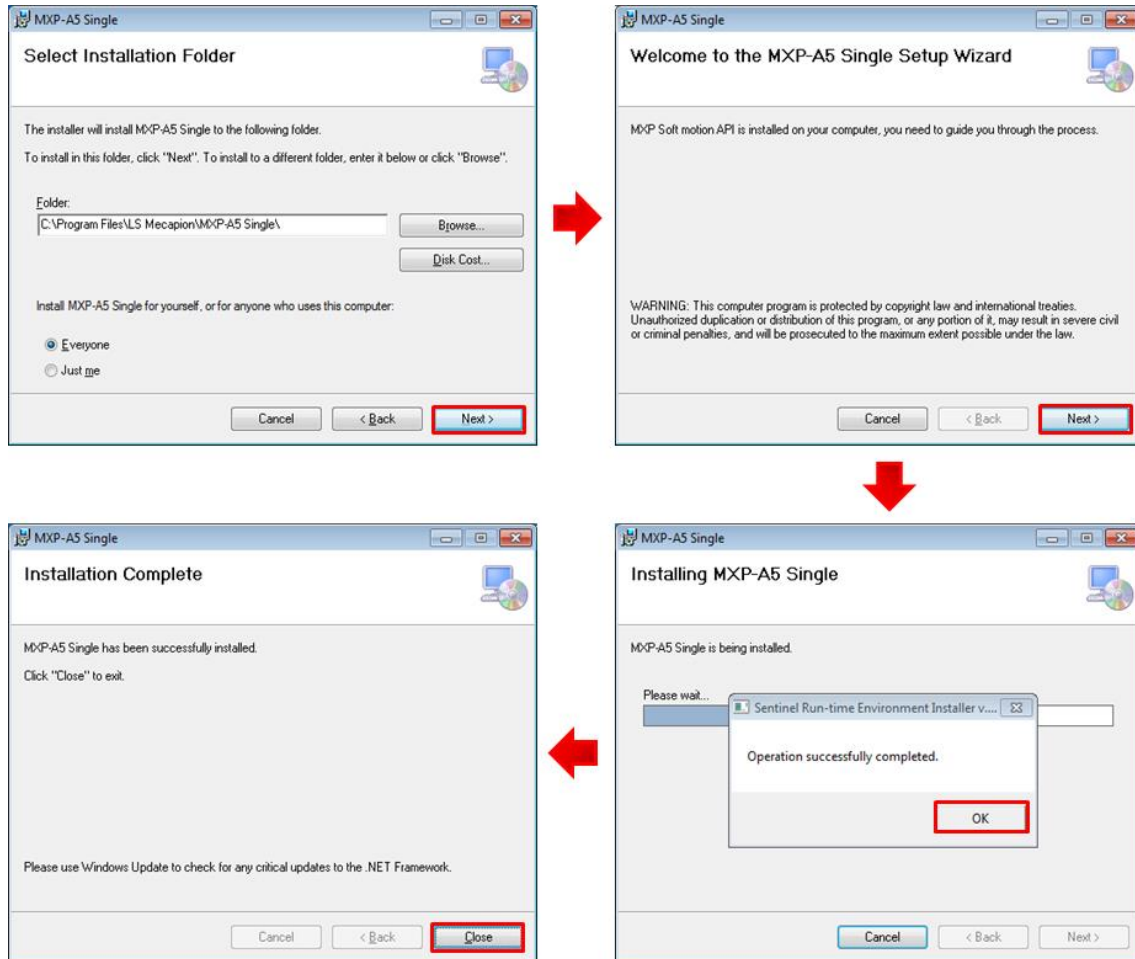


Figure 10. Driver Installation

- ※ **Note** : 'NPCapInstaller.exe' installation file is installed when AhnLab virus check program is installed on the installation PC.



3.1.2.2. 'Out' Folder Copy & Paste

After installing the driver, copy the 'out' folder inside 'Driver Install File' folder and paste it into the installed path.

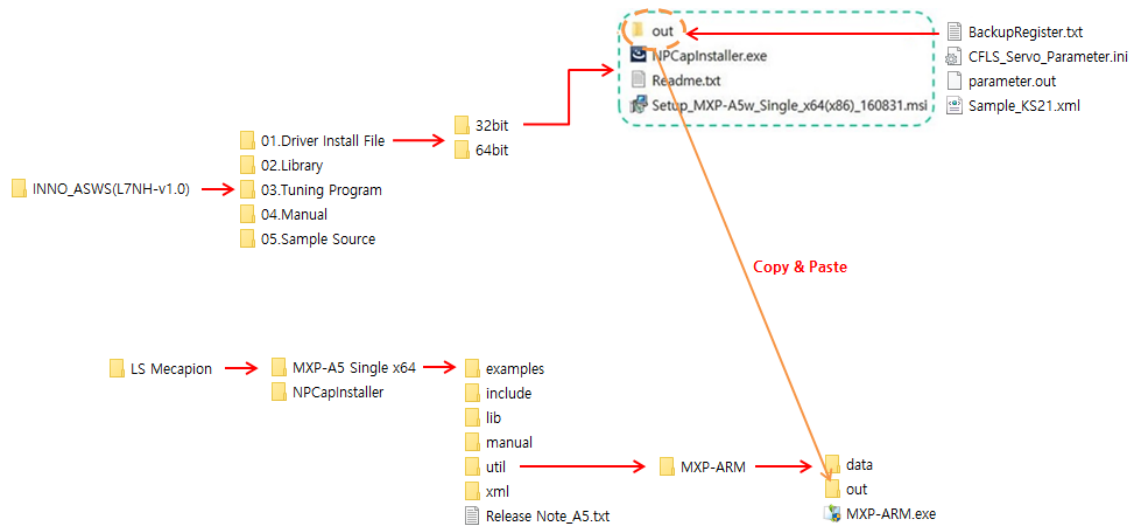


Figure 11. 'out' Folder Copy & Paste

3.1.2.3. Mac Address Settings

In the installed out folder, execute Sample_KS21.xml file as .txt file and input Mac Address of LAN port connected to Servo Drive.

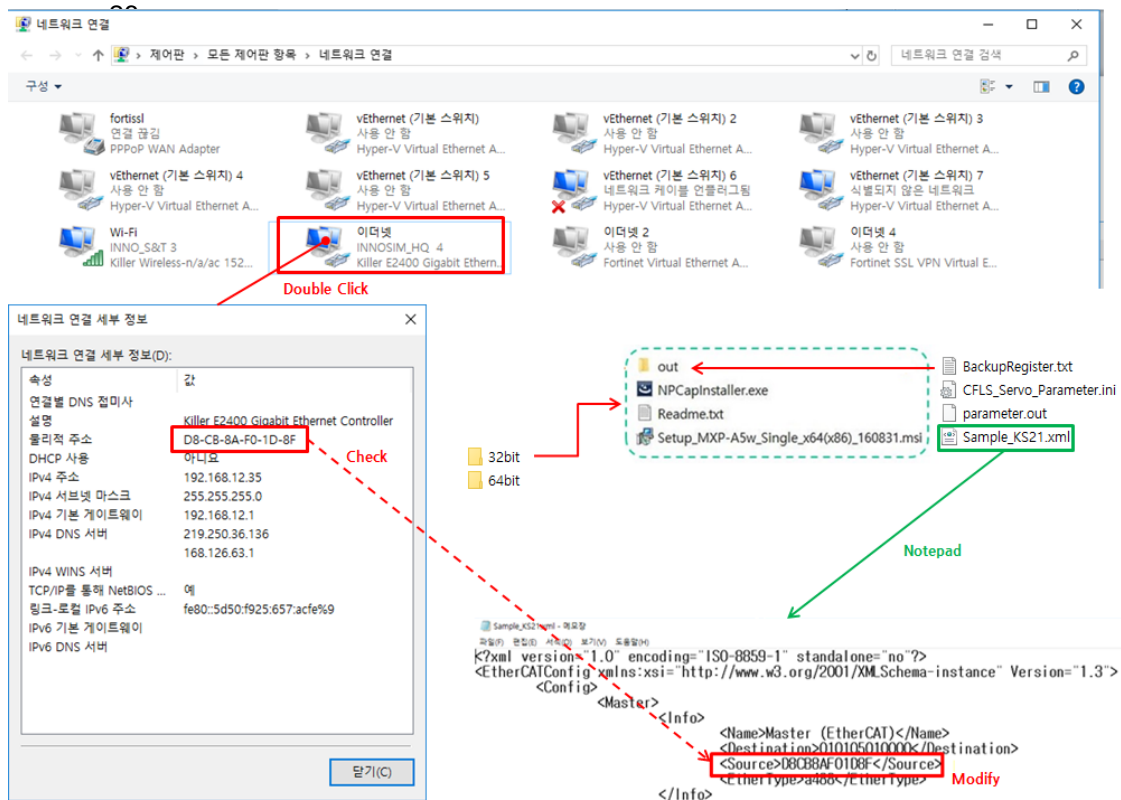


Figure 12. Mac Address Modify

※ **Note** : Internet Protocol version 4 (TCP / IPv4) property is set to automatic IP address

3.1.3. Parameter Settings

3.1.3.1. Running MXP-ARM

Run MXP-ARM to proceed with the driver installation.

- ※ **Note** : MXP-ARM must be run as an administrator.
- ※ **Note** : Functional description for MXP-ARM is described in 3.1.7 (page 43)

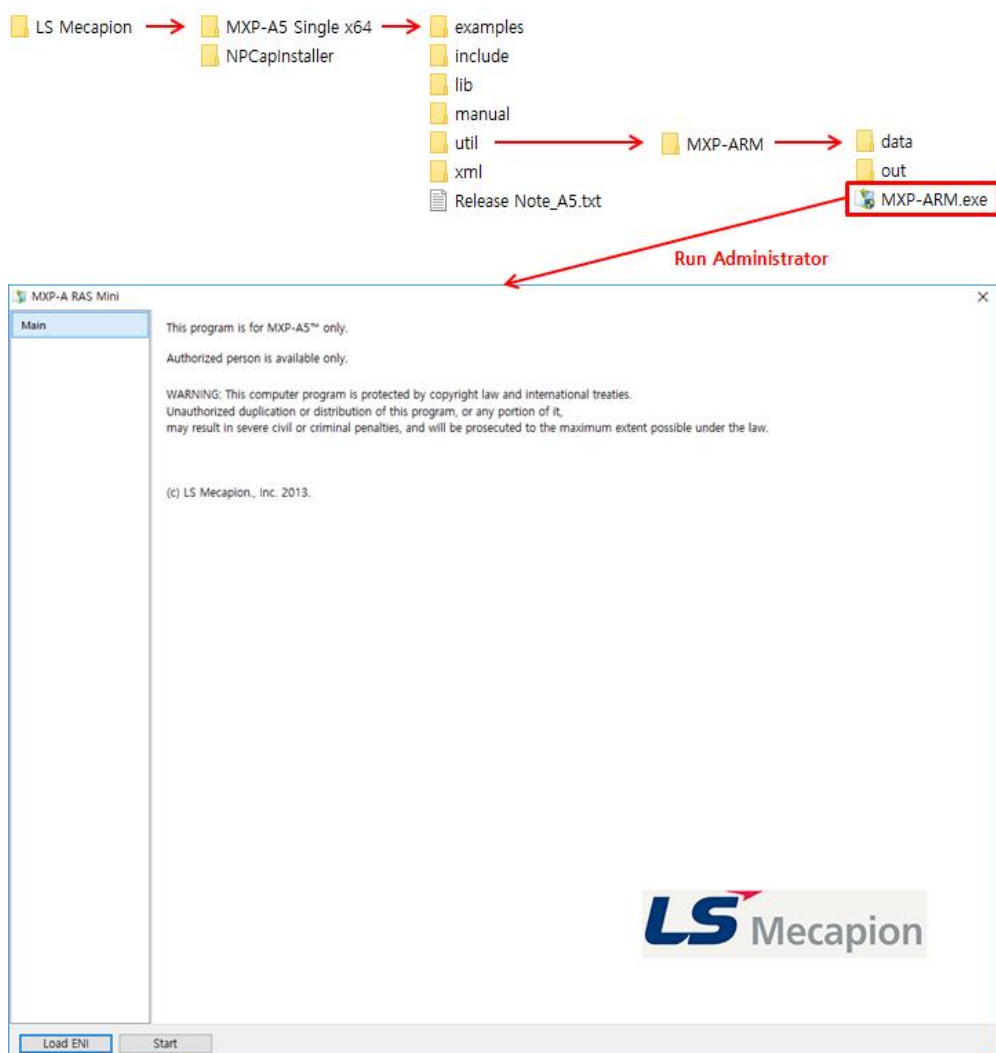


Figure 13. Running MXP-ARM

3.1.3.2. Load ENI File

In Main Page, user must load sample_KS21.xml file in 'out' folder for parameter setting.

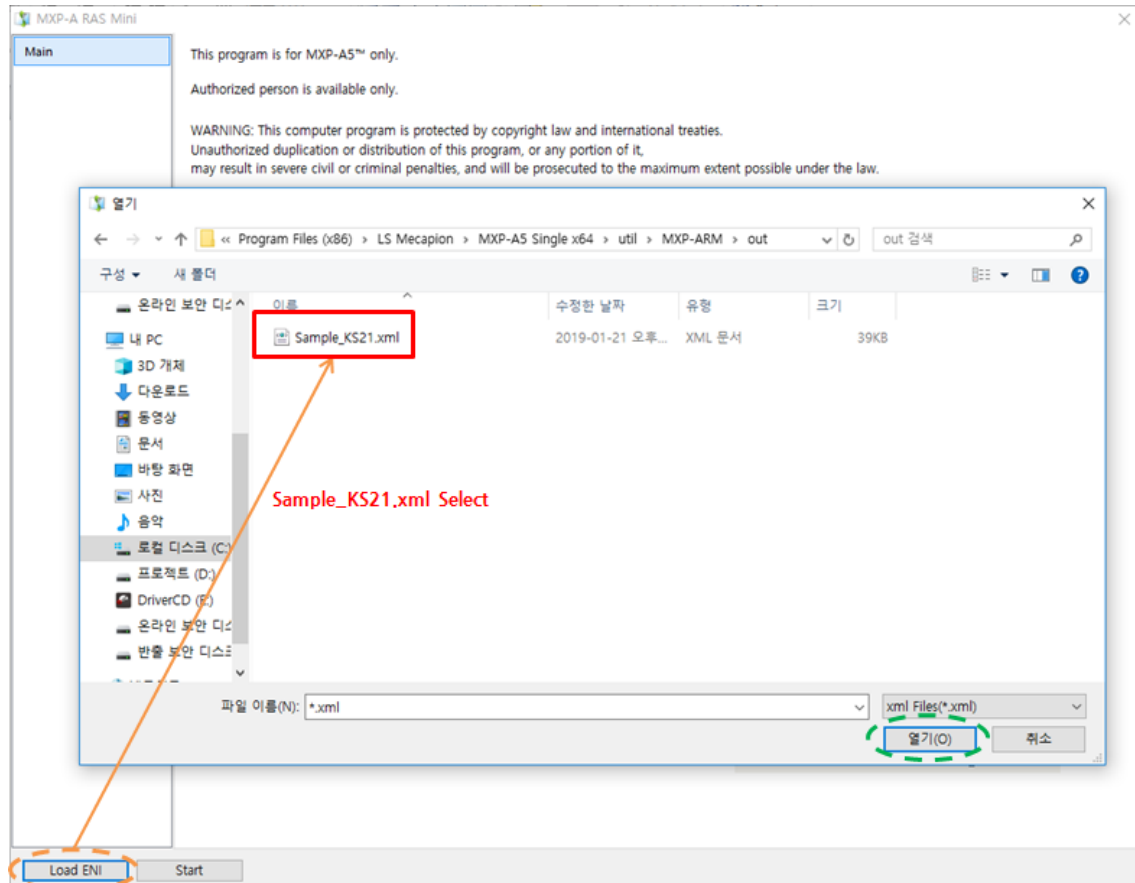


Figure 14. Load ENI

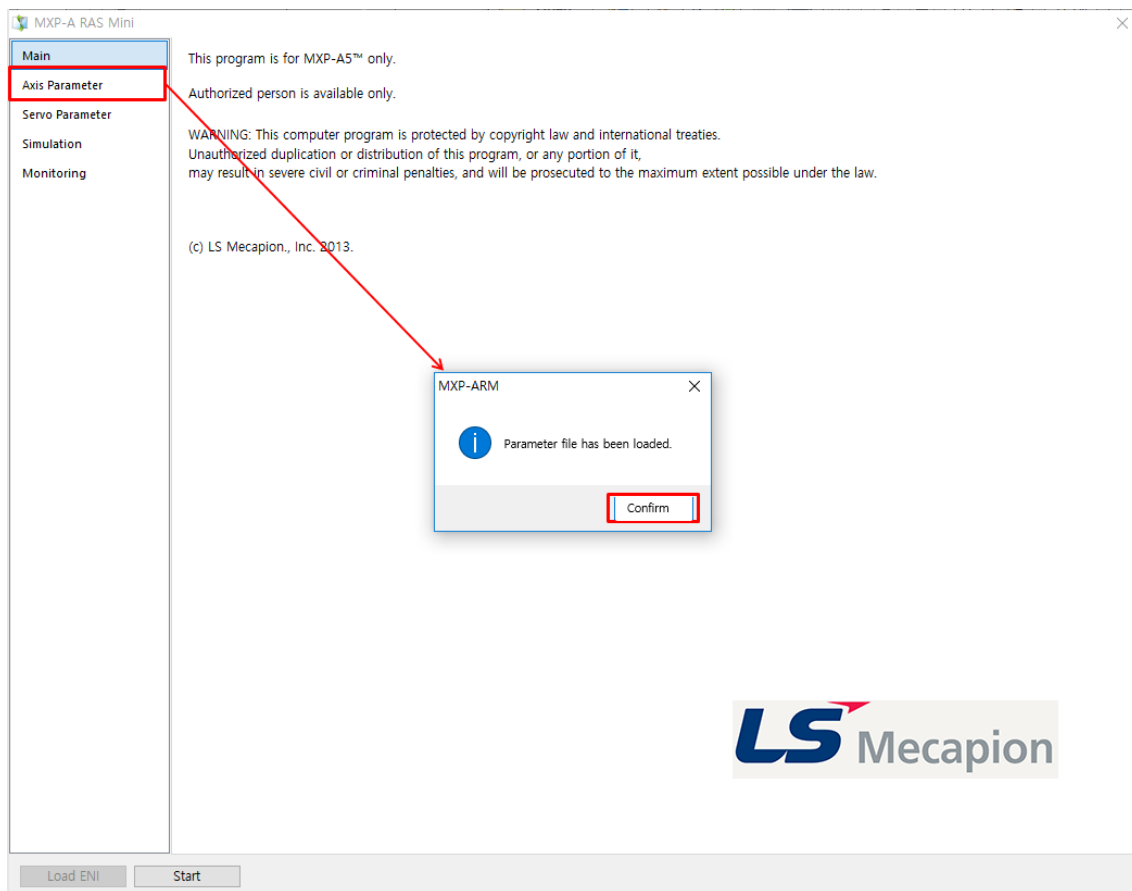


Figure 15. ENI File Loaded

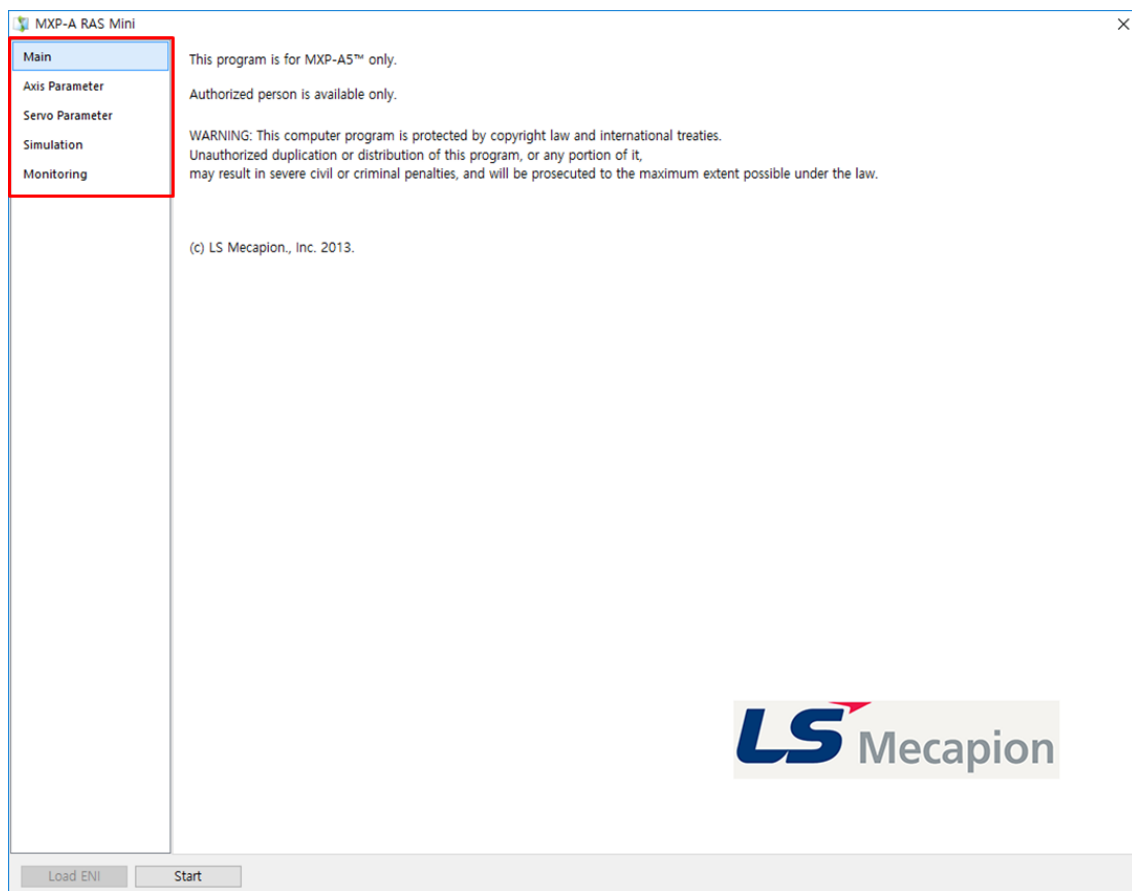


Figure 16. Create Parameter Input Tab

3.1.3.3. Axis Parameter Save & Download

After checking the items of Page 18, clicking the Save button is to create the 'Parameter.out' file in the 'out' folder and save the contents of the 'Sample_KS21.xml' file.

※ **Note** : You can recall the parameter file saved at the time of setting later.

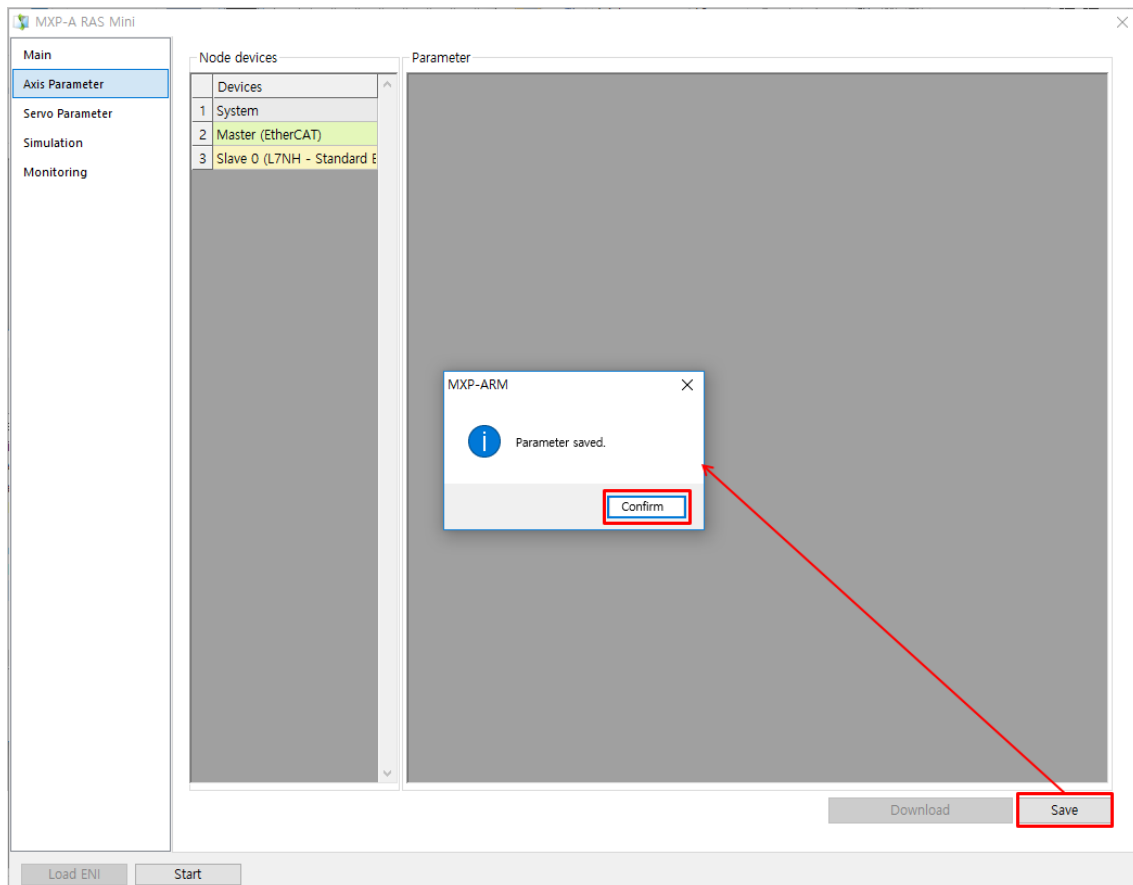


Figure 17. Parameter Save

Download the saved settings to the system.

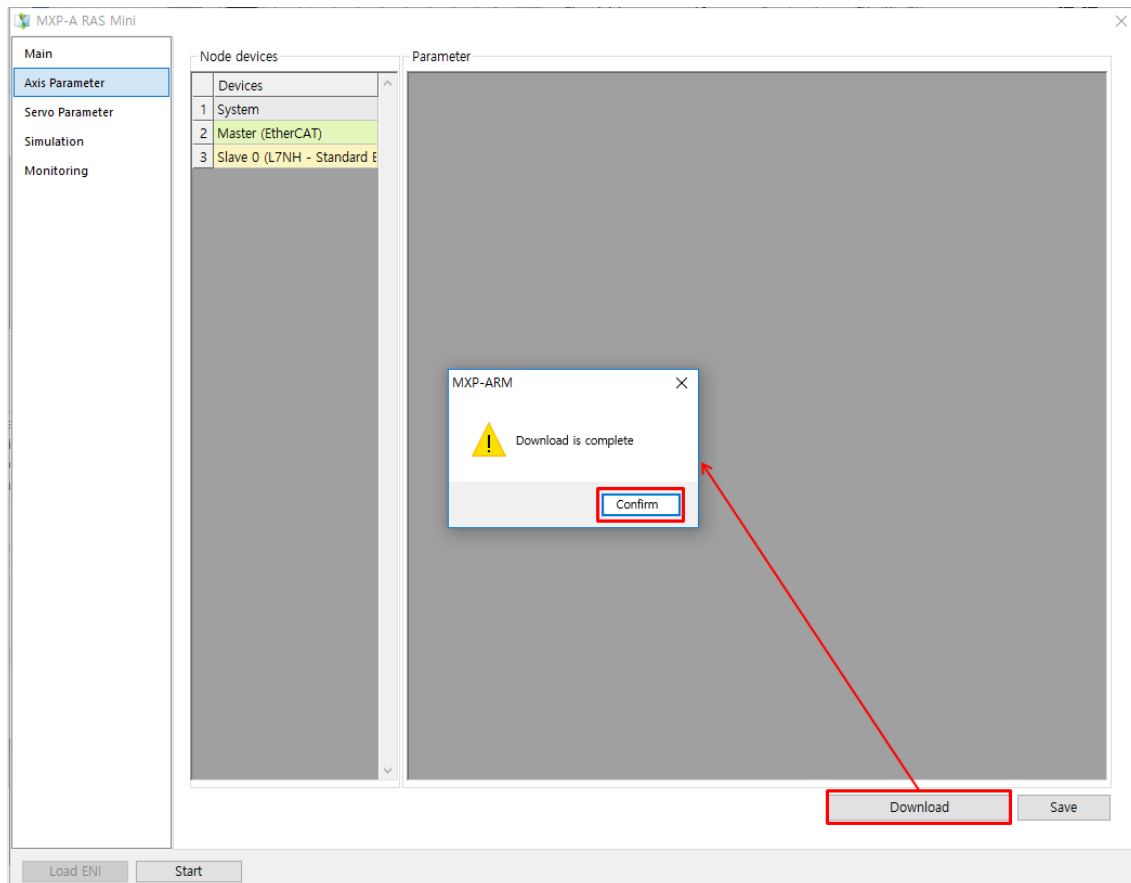


Figure 18. Parameter Download

3.1.3.4. Servo Drive Connection

Clicking the Start button will attempt to connect to the Servo Drive. If the System state is Run and Master & Slave 0 are changed to OP state, the connection is successful.

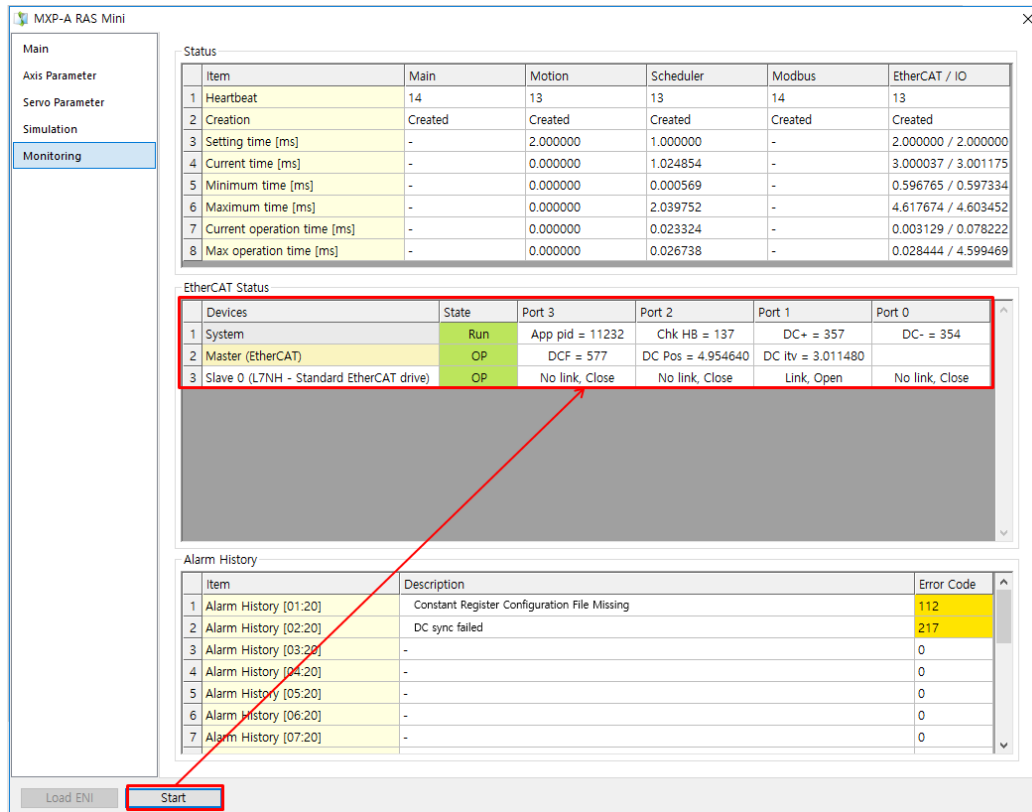


Figure 19. Servo Drive Connection

※ **Note** : If the status value does not change to Run / OP status, check the following status.

- 1) Check the LAN cable connection status
- 2) Mac Address input confirmation
- 3) Check the virus program
- 4) Check if the MXP related process is running in the Task Manager window

MXP_Win32.EtherCAT.exe	7184	Running
MXP_Win32.Main.exe	17860	Running
MXP_Win32.Modbus.exe	18312	Running

3.1.3.5. Parameter Settings

Click the Load button to load the settings of the 'CFLS_Servo_Parameter.ini' file in the 'out' folder.

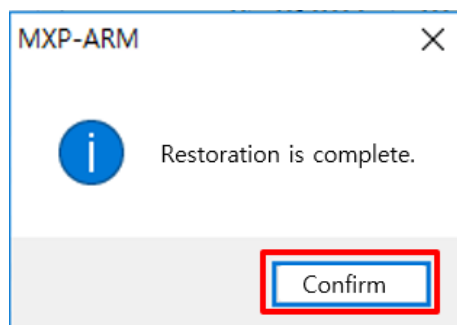
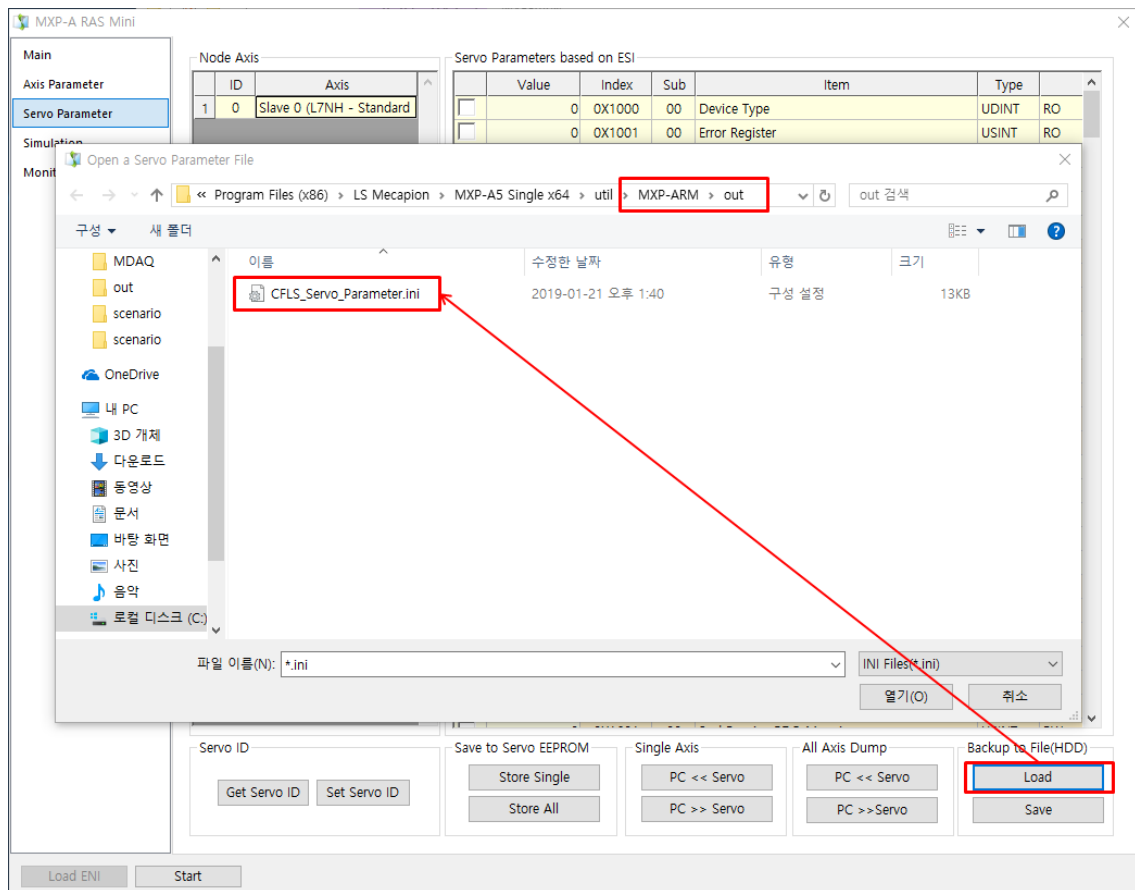


Figure 20. Servo Parameter Load

Click the 'PC » Servo' button to write the loaded parameter value from the PC to the Servo Drive.

※ **Note** : Before writing, proceed to 0 degree angle of the steering wheel.

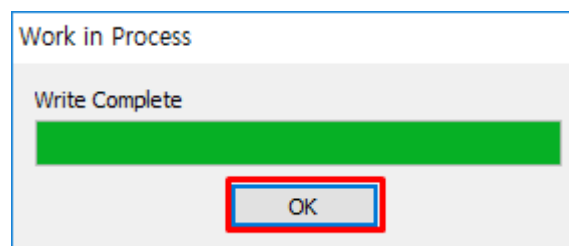
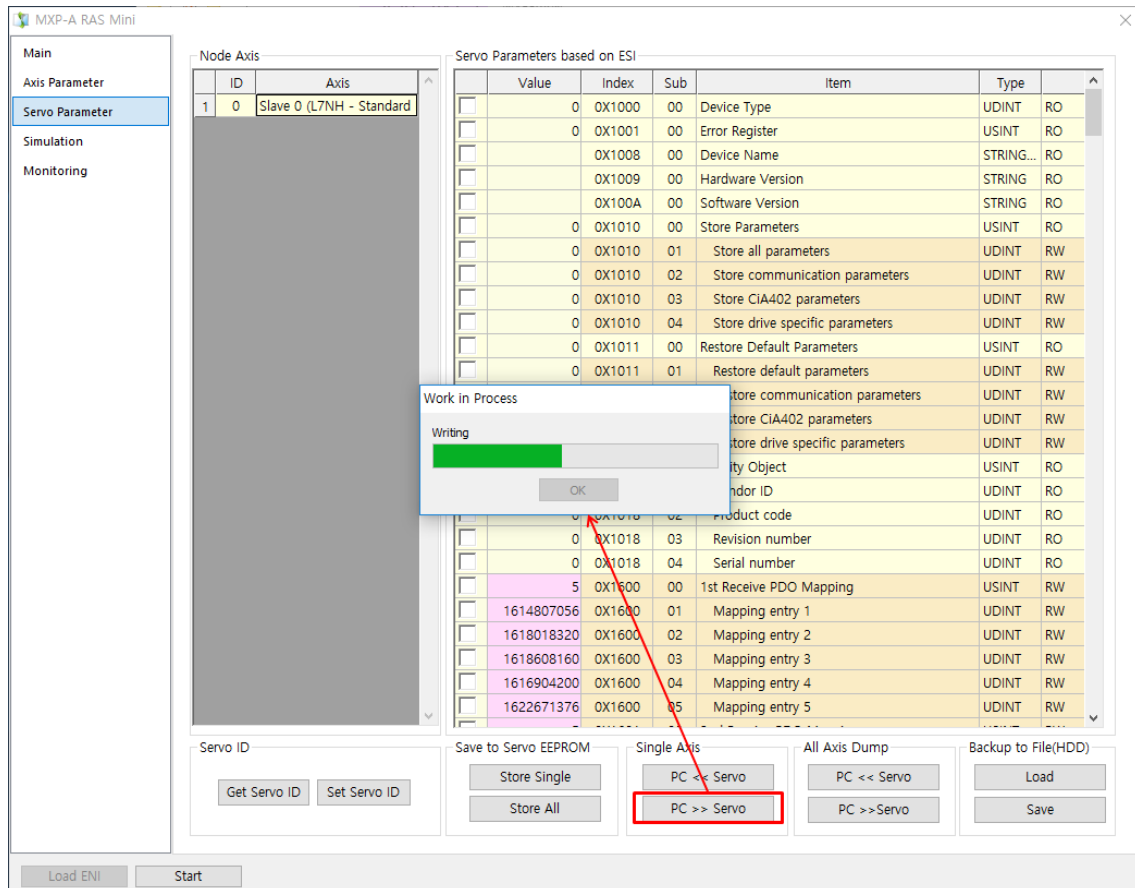


Figure 21. Write Servo Parameter Setting Value (PC » Servo)

Save the file to the Servo Drive.

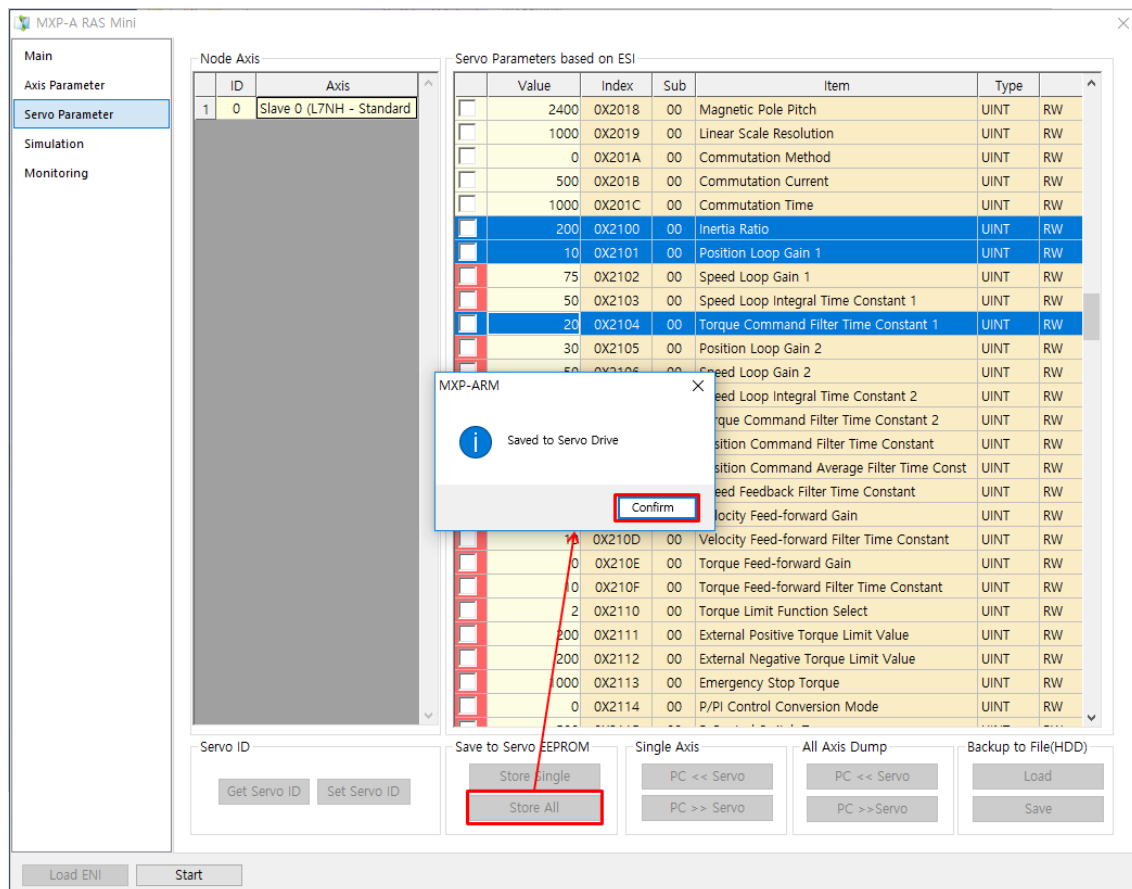


Figure 22. Save Servo Parameter Setting Value to Servo Drive EEPROM

3.1.3.6. Simulation

Next, after setting all the parameters, click the 'Servo On' button in the Simulation tab to check that the connection to the actual motor is completed.

After clicking the 'Servo On' button, when the motor is connected, the Axis based on ENI status changes to green, indicating that the connection is smooth.

Click the 'Servo Off' button and exit the MXP program to end the Drive installation.

- ※ **Note** : After Servo On, the ASWS is in the position control mode, so the handle does not rotate even if it is operated. The user should be careful not to forcibly turn the steering wheel, and make sure to turn the Servo Off immediately after checking the Servo On status.

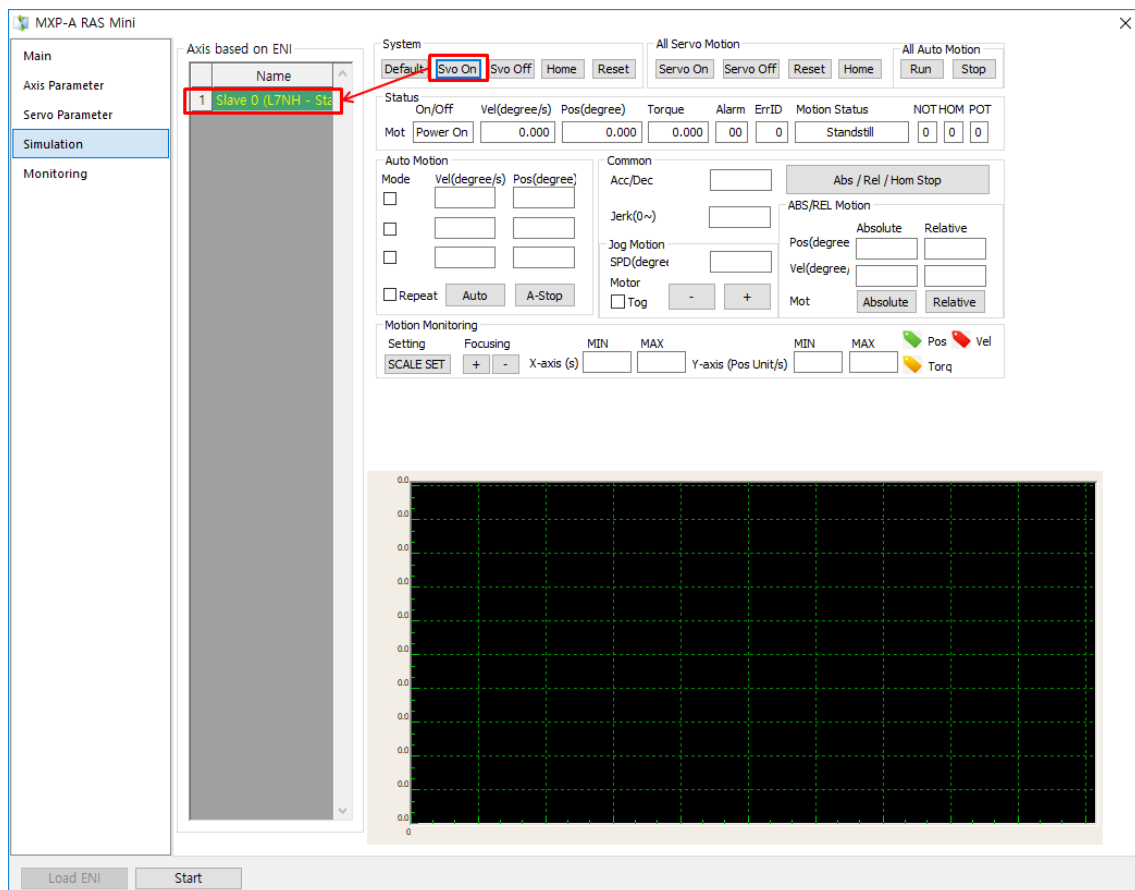


Figure 23. Running Simulation

3.1.4. Steering Angle Zero Position Setting (Absolute Encoder)

When installation is completed using MXP-A RAS program, absolute encoder value of Steering Angle value should be set to 0.

After entering the Encoder value, the Steering Angle value will be remembered as the 0 degree position.

- ※ **Note** : In order to memorize Encoder value, there must be battery connected to motor drive and if there is no battery, it cannot remembered as 0 degree value. Also, when replacing the battery, it is necessary to set 0 degree again or replace the battery with the power applied to the motor.

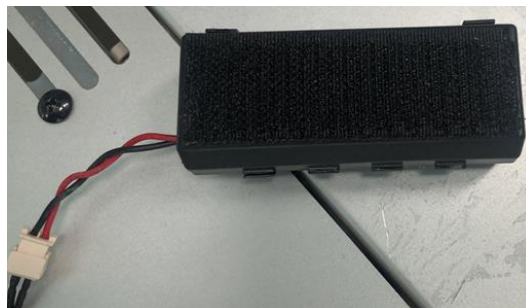


Figure 24. ASWS Drive Battery

In order to input the absolute zero value of encoder, 'Drive CM' program which can modify parameters of servo drive should be installed.

- ※ **Note** : The 'Drive CM' program is useful for modifying parameters of the servo drive.

3.1.4.1. File Path

Drive CM is provided in the following path inside the USB package.

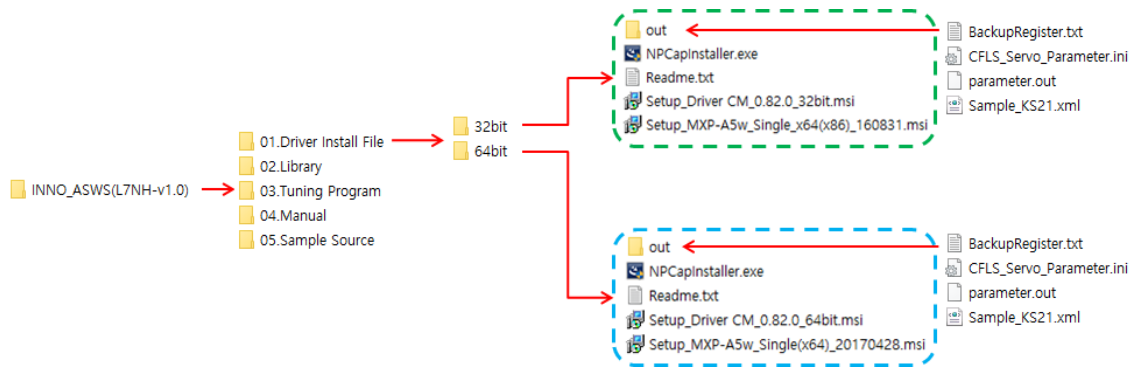


Figure 25. Drive CM File Path

3.1.4.2. How to Install Drive CM

- Running and installing the Setup_Drive CM_0.82.0_64bit.msi file

※ **Note** : You can install it according to Windows OS.

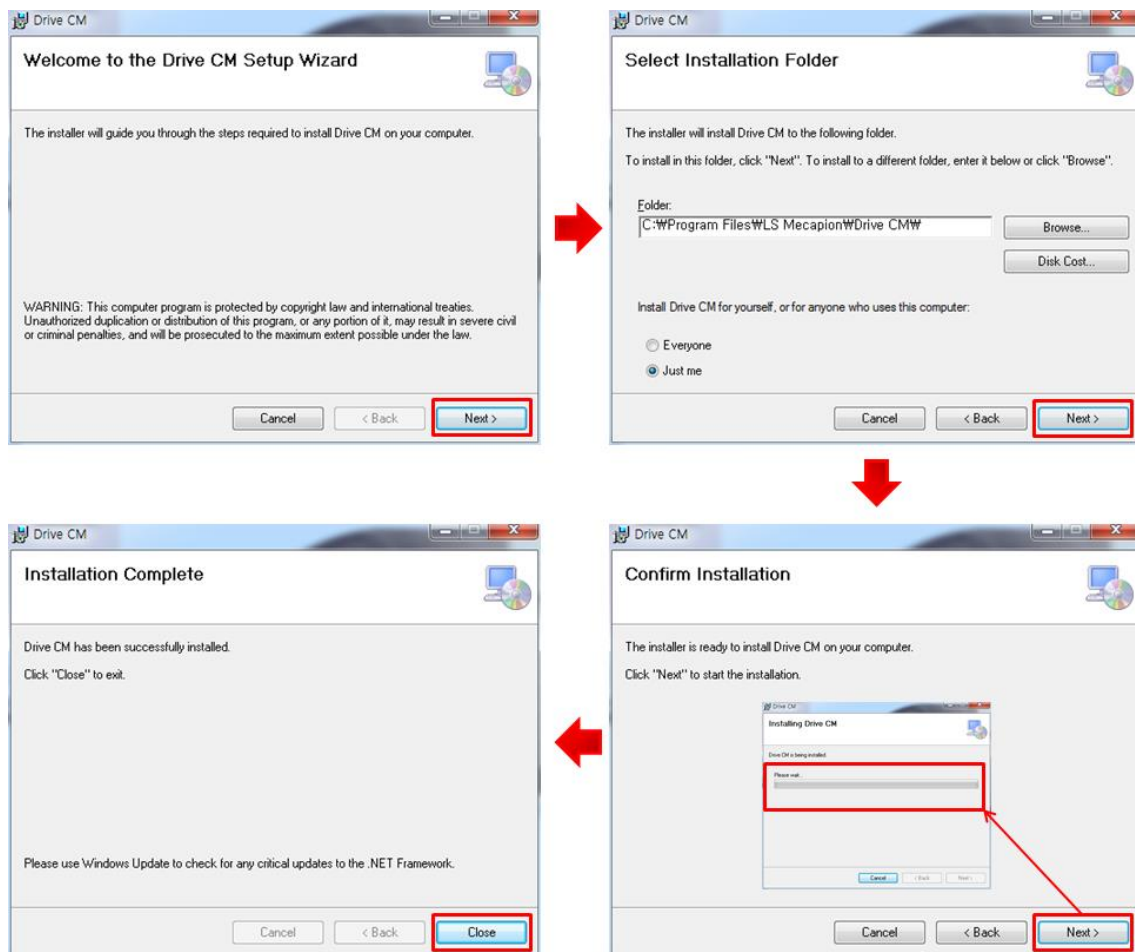


Figure 26. Drive CM Installation



Figure 27. Drive CM Icon

3.1.4.3. Drive CM Communication Port Connection

'Drive CM' provides 'USB' communication for connection with servo drive.

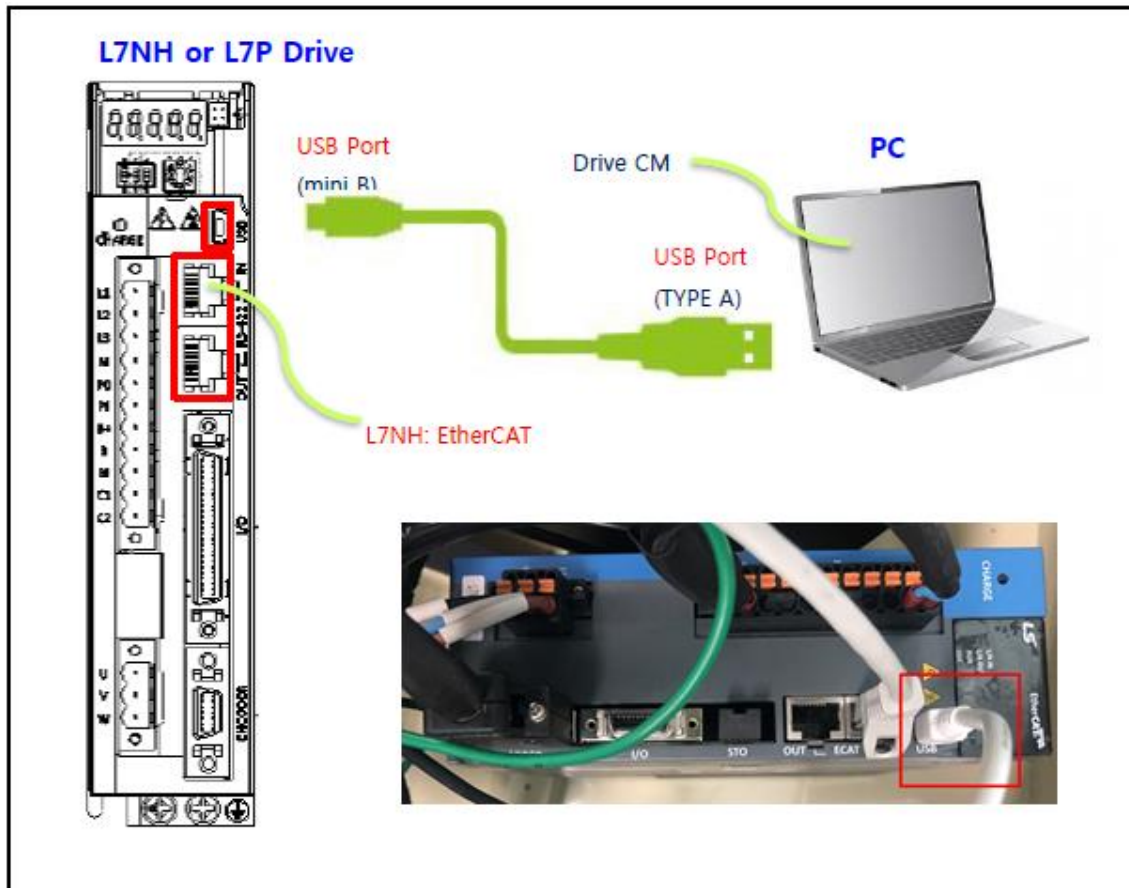


Figure 28. 'Drive CM' & Servo Drive USB Communication Port Connection

3.1.4.4. 'Drive CM' Screen Configuration

The screen configuration of 'Drive CM' is as follows.

- ① Main menu : Drive/Motor, I/O, Fault, Procedure, etc.
- ② Communication type selection : USB, Ethernet, RS-422
- ③ Drive type selection : PEGASUS, L7NH, L7P, etc
- ④ Communication connection or disconnection : Offline → Online, Online → Offline
- ⑤ Shortcut Icon
- ⑥ Main window : Drive/Motor, Monitoring, Advanced, Indexer, Object Dictionary
- ⑦ Auxiliary window : I/O, Procedure, Indexer
- ⑧ Communication connection status : Connection Closed, USB Connected
- ⑨ Alarm message : Ex. [31] Encoder cable open
- ⑩ Drive status display : SVON, WARN, RDY..

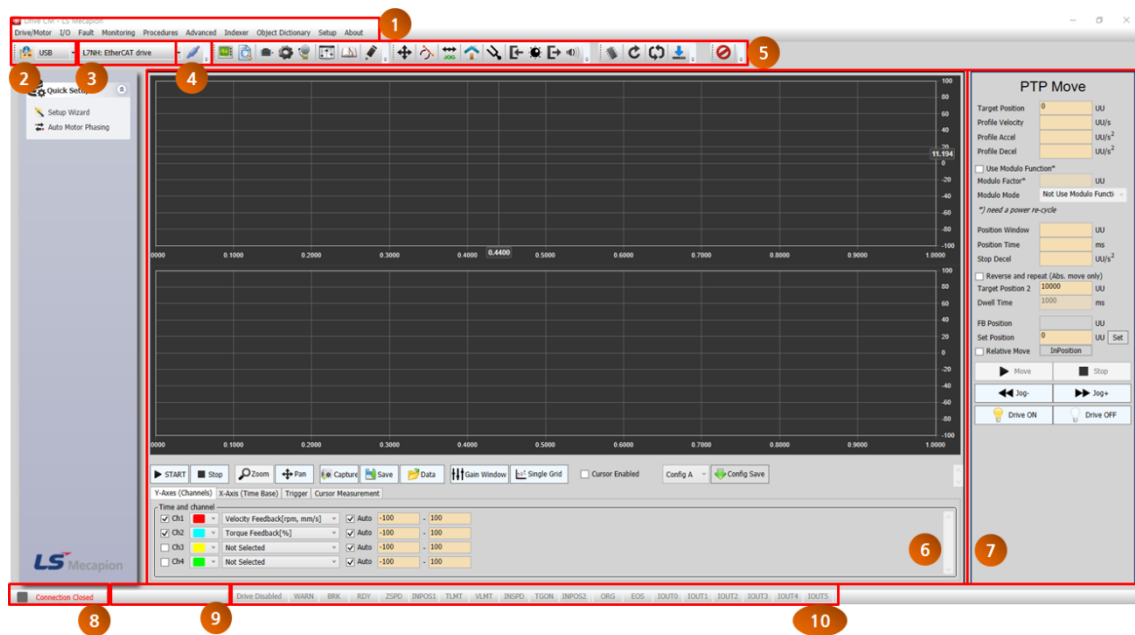
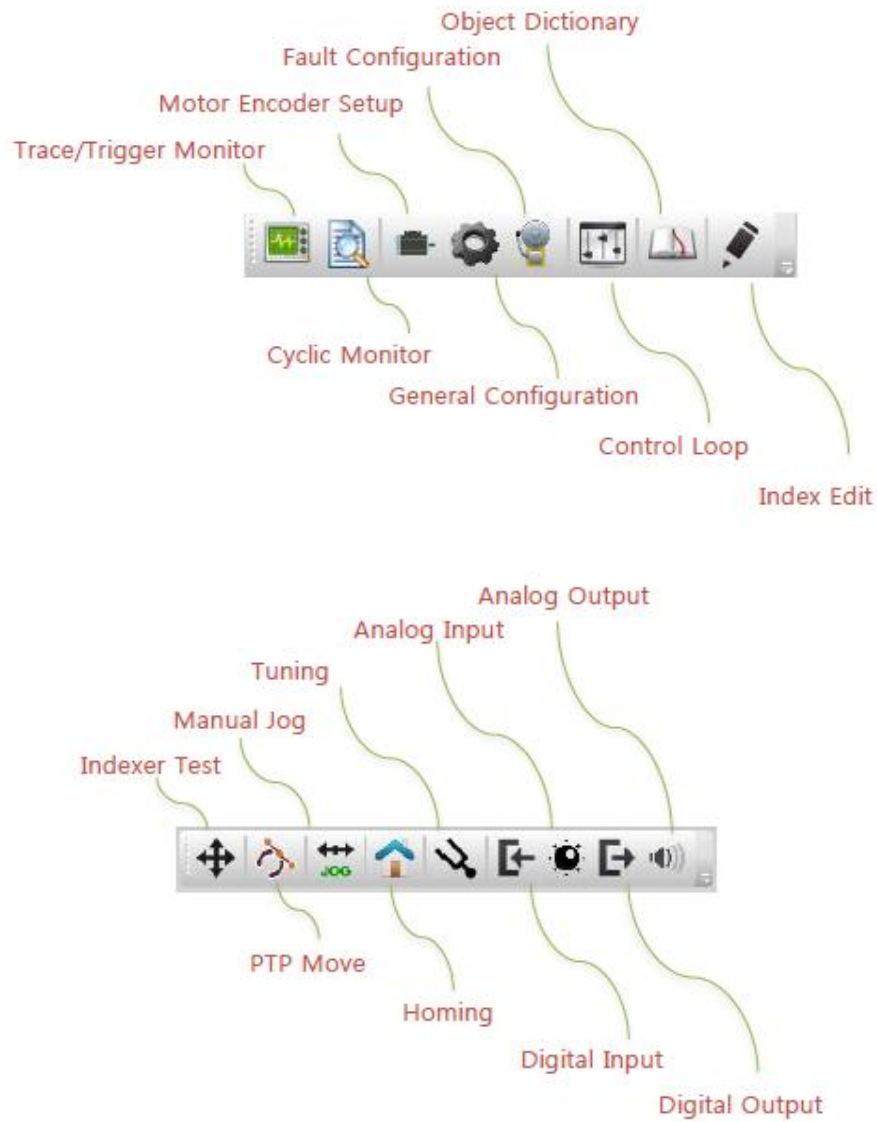


Figure 29. 'Drive CM' Screen Configuration

3.1.4.5. Shortcut Icon Description

Below is a description of the ⑤ shortcut icon.



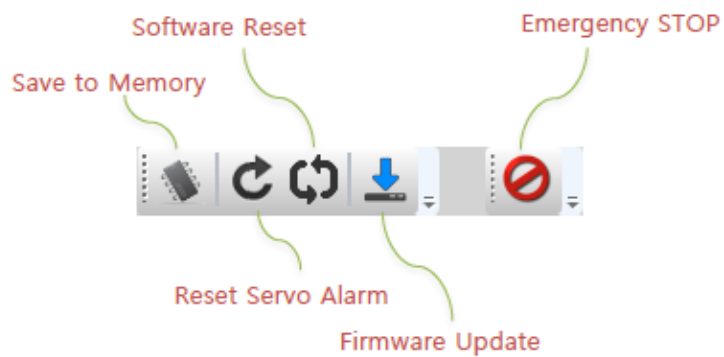


Figure 30. 'Drive CM' Shortcut Icons

3.1.4.6. Steering Angle Zero Position Setting using 'Drive CM'

Connect the communication between PC with 'Drive CM' program and servo drive via 'USB' communication cable.

※ **Note** : It is necessary to proceed in Servo Off state when parameter is changed.

- Execute 'Drive CM', servo drive parameter editing software.
- Select the communication method of the upper left as 'USB', the communication target as 'L7NH: EtherCAT drive', and click the communication connection button.
- When connection is made, 'USB Connected' is displayed at the bottom and it is flashing in green.



Figure 31. Communication Connection

- If the communication is confirmed, click the 'Object Dictionary' button at the top to activate the parameter window.
- When the parameter is created in the main window, change the value of '0x2005' from '1' to '0'.

※ **Note** : It is necessary to change the value of '0x2005' in order to always remember the absolute encoder value through the battery connected to the servo drive. And if you change from '1' to '0'. Enter '0' and Enter key to apply the change.

- Click 'Save to Memory' button at the top after changing and save it in memory.
- After saving, click 'Software Reset' button to restart the software.

※ **Note** : If you perform 'Software Reset', it will be automatically terminated and restarted.

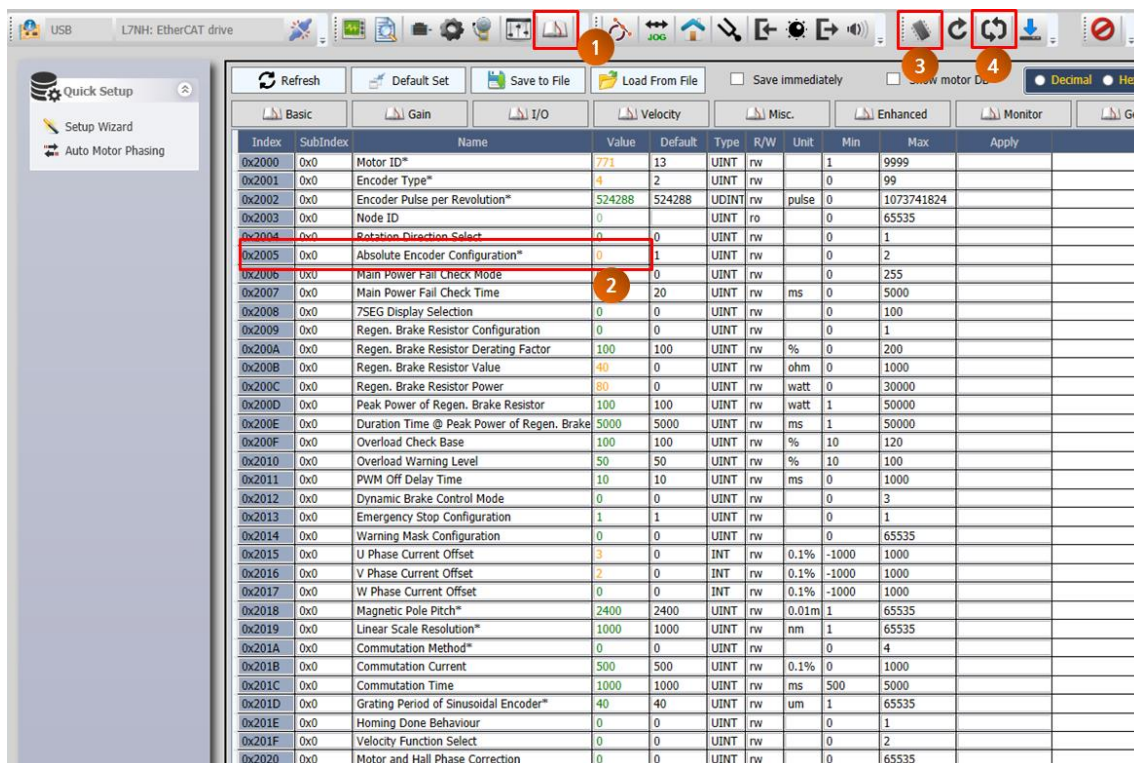


Figure 32. Parameter Modification

- Select 'Procedures – Misc. Functions' from the top menu.

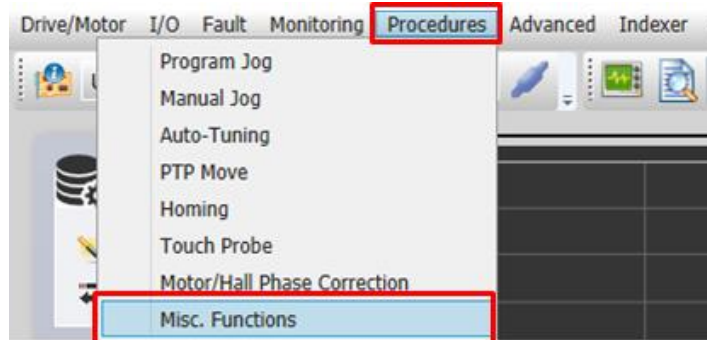


Figure 33. Procedures – 'Misc.Functions' Selection

- Reset the Multi-Turn Data value to 0 by clicking the 'Reset' button on the right Misc. Functions.

※ **Note** : Position the handle at 0 degree before initialization.

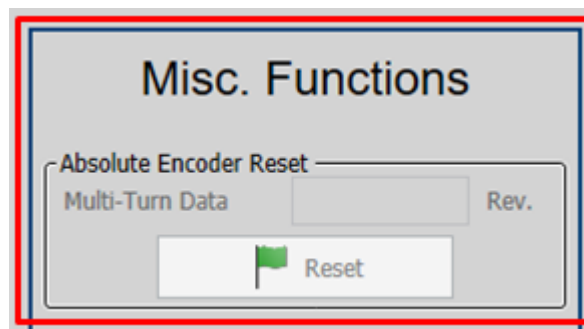


Figure 34. Misc.Functions - Reset 버튼 클릭

- After 'Reset', perform 'Software Reset' after 'Save to Memory' on the shortcut icon at the top.

※ **Note** : Always save and reset after parameter change or numerical change.



Figure 35. Save & Reset

※ **Note** : After all the work is done, turn the cabin off and on again.

3.1.5. How to Modify Parameters

3.1.5.1. Using Drive CM

'Drive CM' allows real time parameter tuning while INNO ASWS Tuning program is running. Therefore, it is possible to tune the vibration or noise of the motor in torque control mode and position control mode.

The section on parameter tuning is as follows.

- Torque Command Filter Time 1(2104): The tuning value for the feel or vibration of the handle during torque control (10 ~ 100).
- Inertia Ratio(2100): It is the inertia or holding force of the motor. It is the vibration tuning value of the motor during position control (100 ~ 200)
- Speed feedback filter time(210B): It is the tuning value applied when it cannot be solved with 2100. (5 ~ 15)
- Current controller gain(2514): It is the tuning value to apply when it cannot be solved with 210B. (50 ~ 150%)

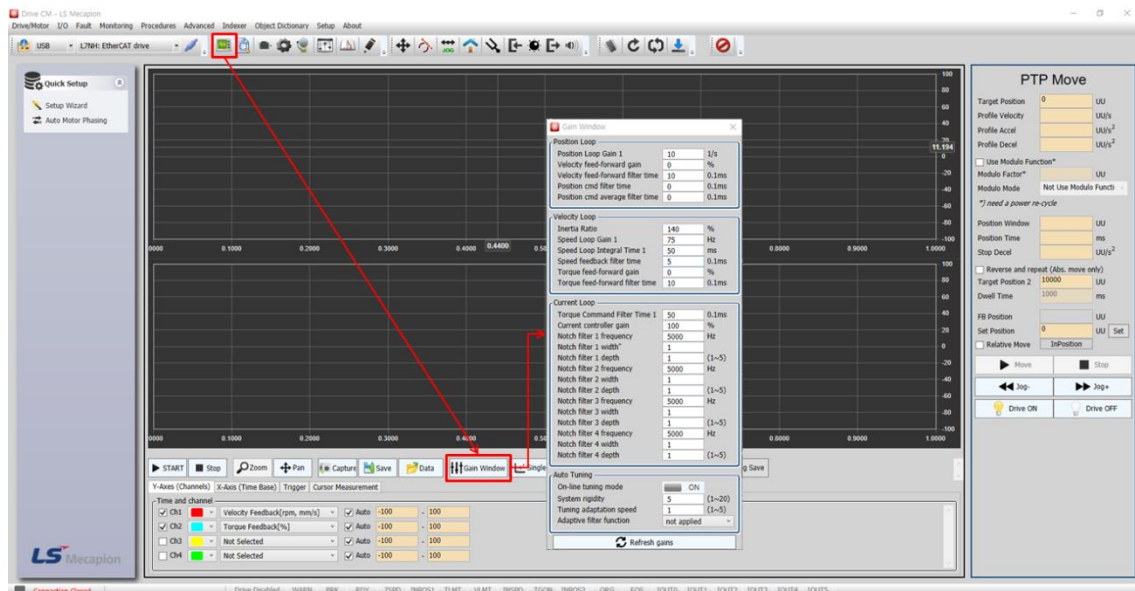


Figure 36. Drive CM Parameter Modification

3.1.5.2. Using MXP-A RAS mini

You can modify parameters in the 'Drive CM' program, but you can also modify it in the MXP-A RAS mini software.

Parameters are divided into read-only (RO) and read-write (RW), and can be modified only for RW items.

- ※ **Note** : In the case of MXP-ARM program's simulation mode, if the frequency sound is heard too much or the vibration of the motor is severe during Servo On, the user can process by changing parameter setting as below.

In Simulation mode, switch to Servo Parameter tab after Servo Off, then select the item to change and double click as below.

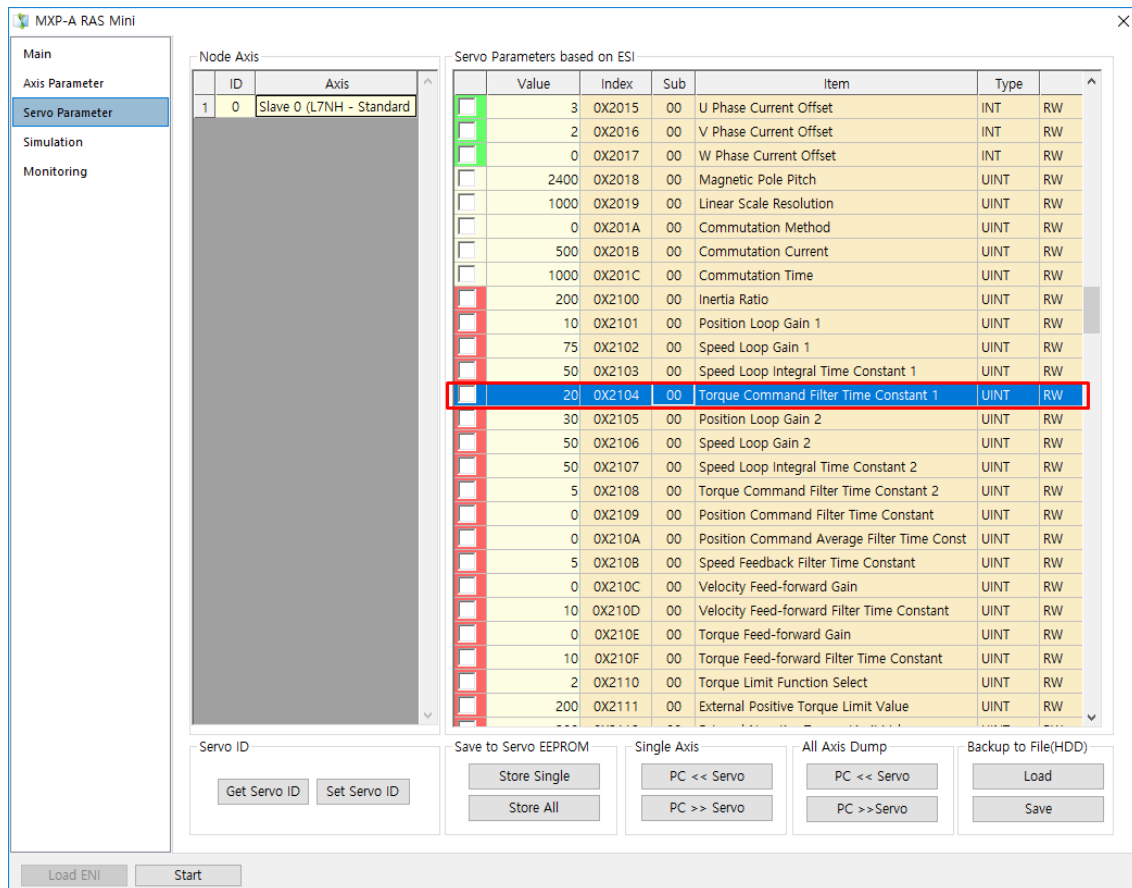


Figure 37. Preparing to change MXP-A RAS mini Parameter

When the 'Edit Parameter' window is created, change it to the desired value.

Changes to values can be entered in decimal and hexadecimal. Enter hexadecimal numbers except "0x".

For some parameters, input values should be supported, and values within the range should be entered. The 'When Enable' item indicates the state in which the changed value is reflected when the edited parameter is written to the servo. The changed values are reflected as below.

- Immediately: The changed value is applied immediately.
- Prohibit to change during Servo-On: The value change is prohibited when Servo Drive is Servo-On, and the change and application are possible in Servo-Off state.
- After Restart: It is applied after the servo drive power is turned off and on again.

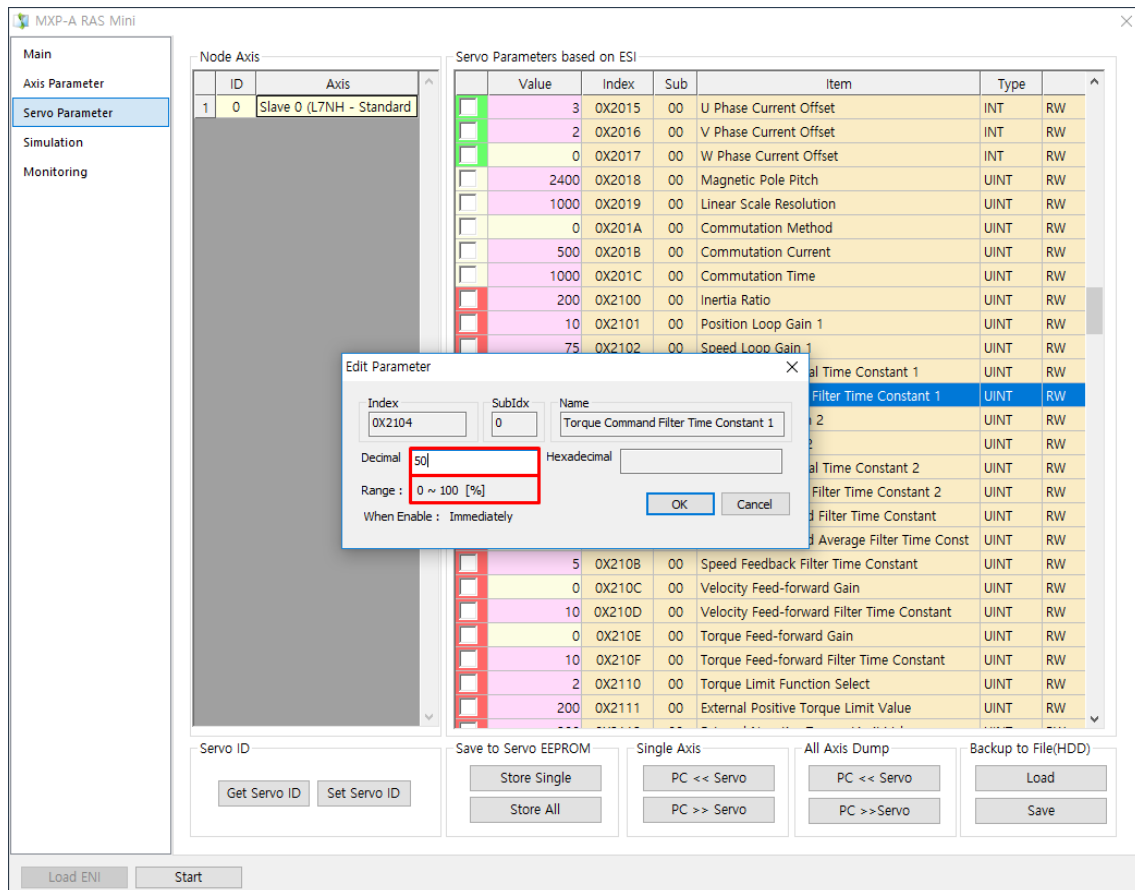


Figure 38. Parameter Modification Edit Window

When the parameter is changed, the status changes to green as shown below.

<input checked="" type="checkbox"/>	50	0X2104	00	Torque Command Filter Time Constant 1	UINT	RW
-------------------------------------	----	--------	----	---------------------------------------	------	----

Figure 39. Parameter Modification Example

The changed parameters are input to the servo separately by activating the check box.

<input checked="" type="checkbox"/>	50	0X2104	00	Torque Command Filter Time Constant 1	UINT	RW
-------------------------------------	----	--------	----	---------------------------------------	------	----

Figure 40. Activate Parameter Check to Modify

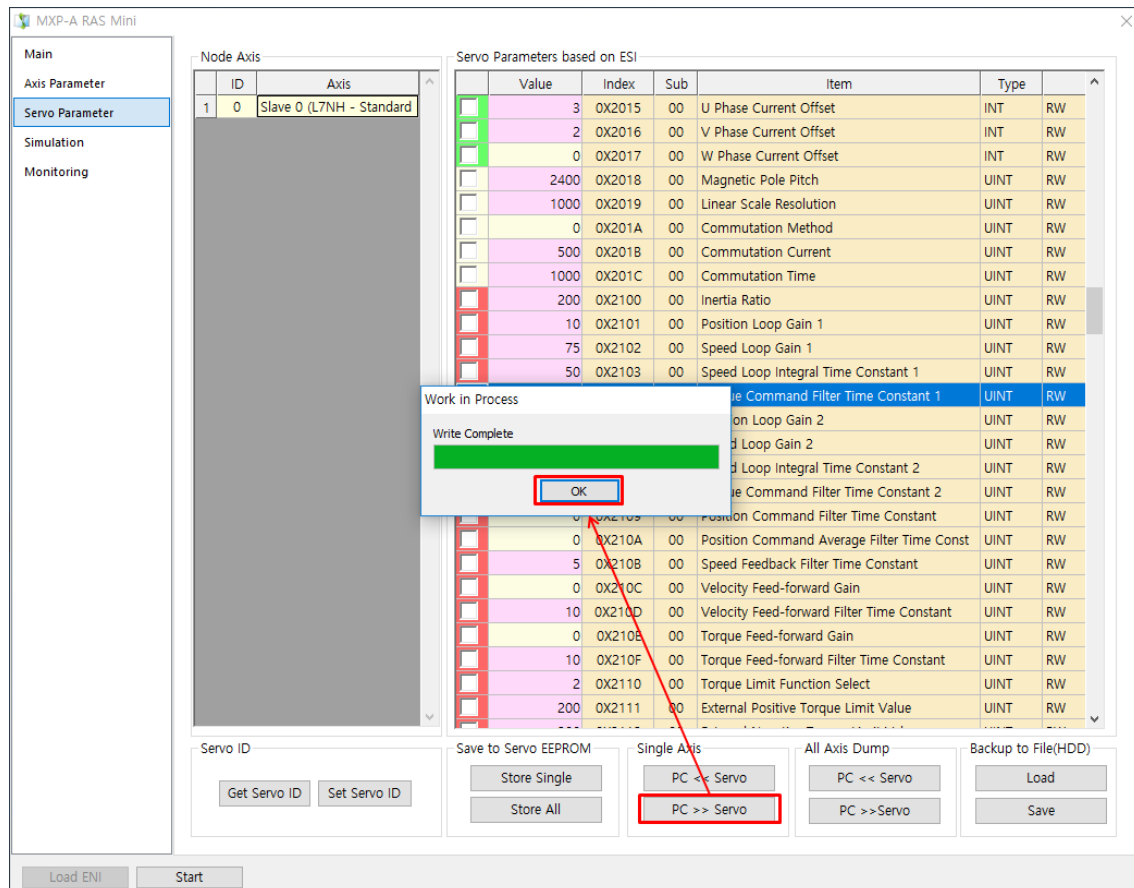


Figure 41. Write Modified Parameters

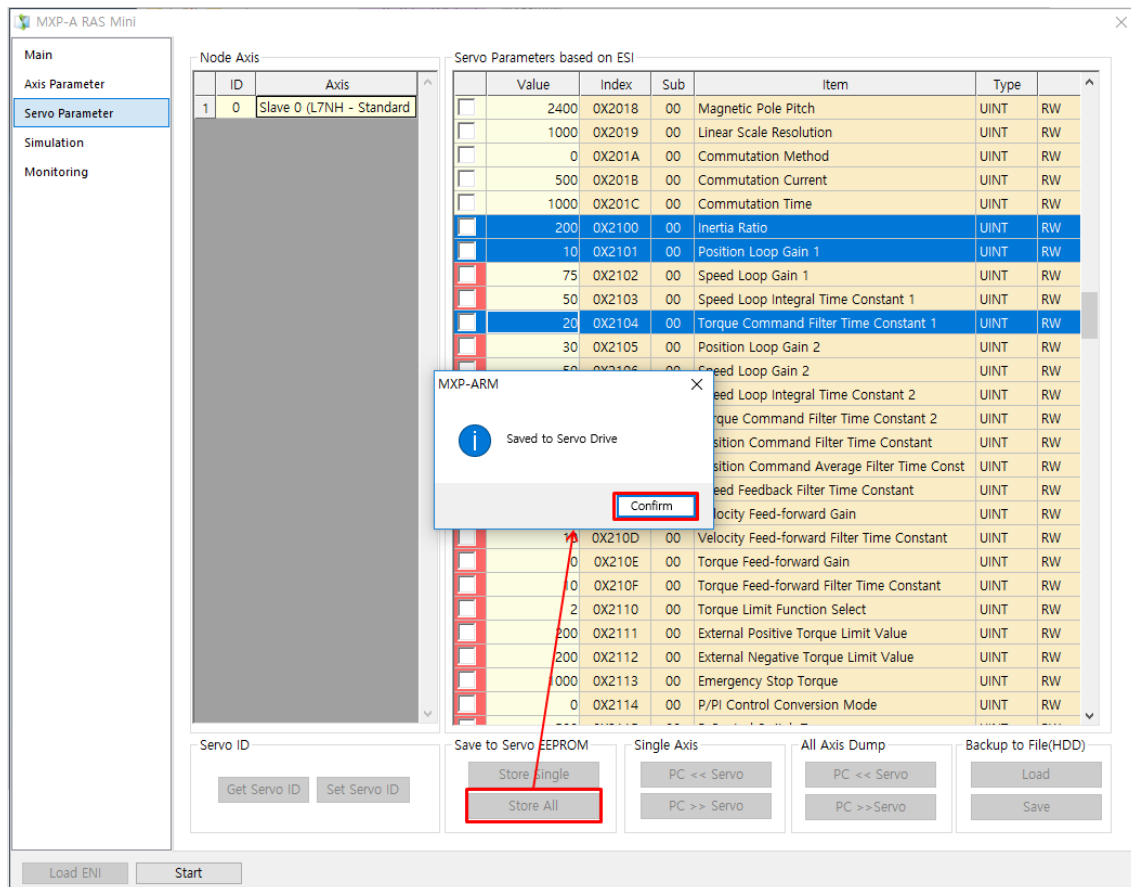


Figure 42. Store Single in Servo Drive EEPROM

Tests the changed parameters in simulation mode.

- ※ **Note** : Repeat the above procedure again if you feel the vibration of the frequency sound and the motor too much.

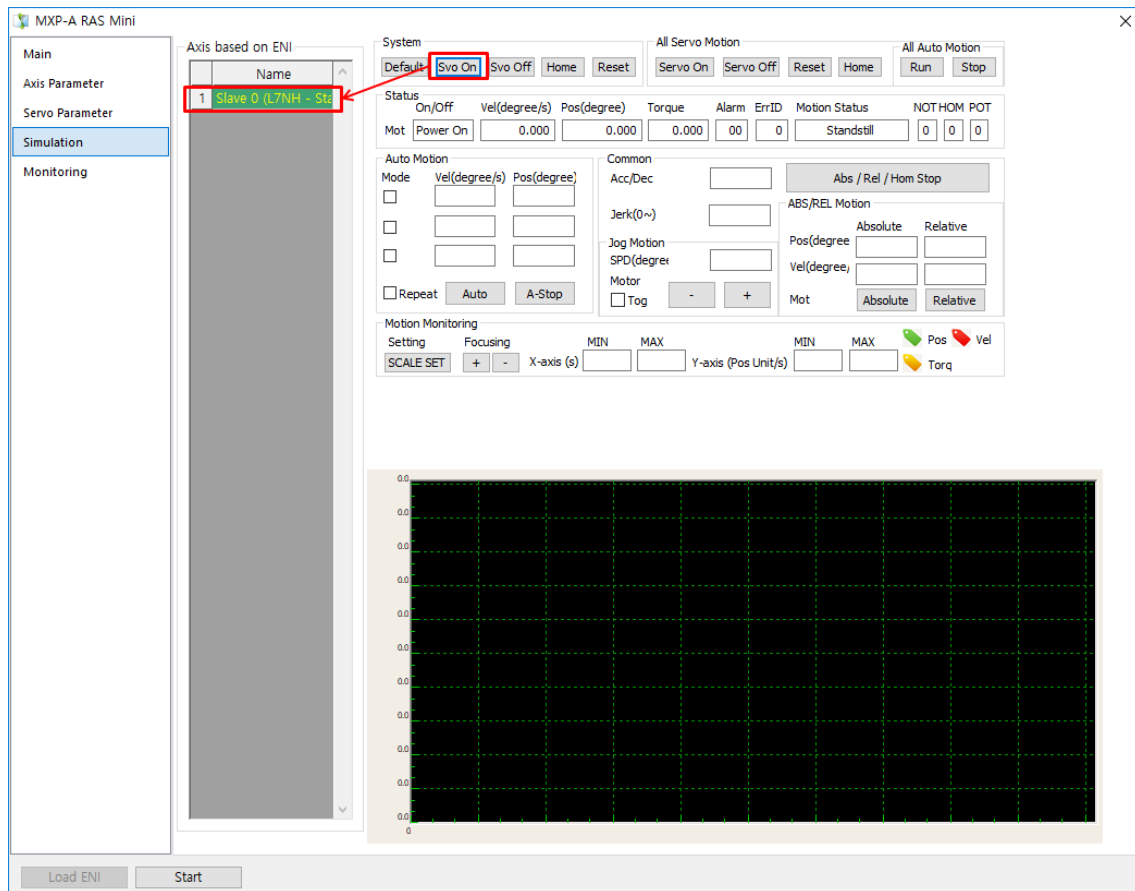


Figure 43. Simulation Test Servo On

3.1.6. Parameter Backup

The user completes all the installation process and performs data(parameter) backup. The data to back up is as follows.

- MXP parameter file: 'Out' folder

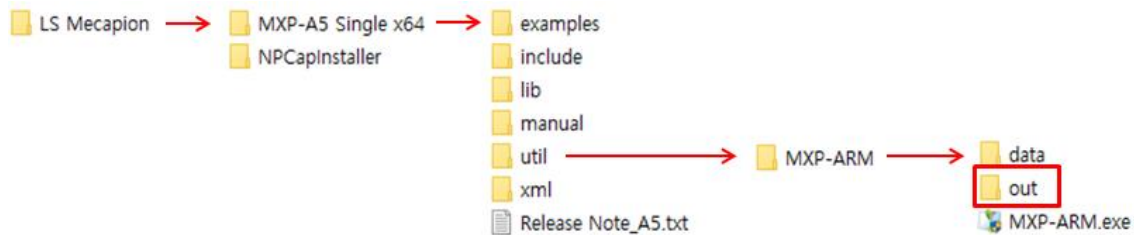


그림 44. 'Out' folder backup

- INNO_ASWS Config & dll file provided by INNOSIMULATION

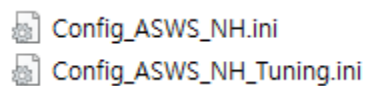


그림 45. Inno Config file backup

3.1.7. MXP-ARM Feature Description

The following describes the MXP-A RAS Mini program for driver parameter input, and the function description explains the detailed functions of the five screens.

3.1.7.1. Main Page

When the MXP-A RAS Mini program starts, only the buttons at the bottom of the screen are available, as shown in Figure 12. The function of each button is as follows.

※ **Note** : Execution of MXP program must be executed as administrator.

- ① **Load ENI** : Selects and loads an ENI file located in the 'out' folder.
- ② **Start** : Start communication. However, it does not work if the ENI file is not loaded.

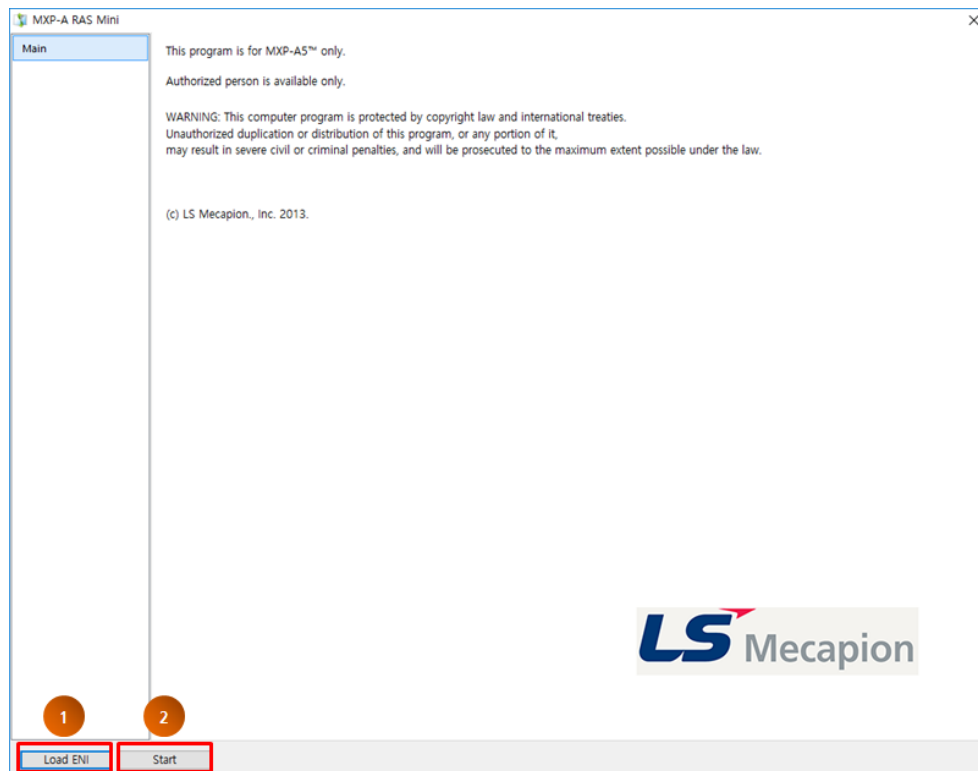


Figure 46. Main Page Screen Configuration

3.1.7.2. Axis Parameter Page

Click the Axis Parameter tab on the left side of the screen to switch to the Axis Parameter Page as follows.

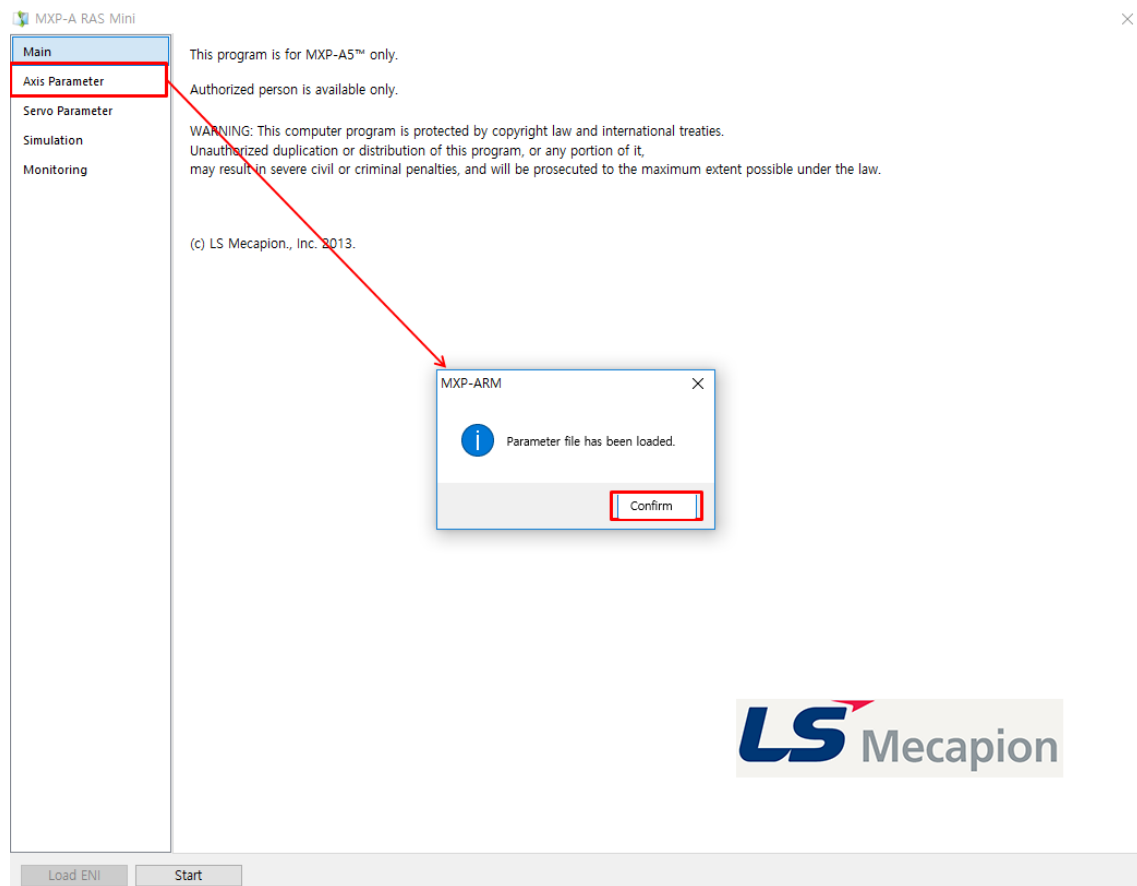


Figure 47. Axis Parameter Load

Axis Parameter Page can be divided into 4 parts as follows.

- ① Node devices : shows EtherCAT Master and Slave devices.
- ② Parameter : Displays the detailed parameters for the item clicked in ①. (Modifiable)
- ③ Save : Creates 'Parameter.out' file that stores the modified items in ② (saved in 'out' folder).
- ④ Download : Download the file saved in ③.

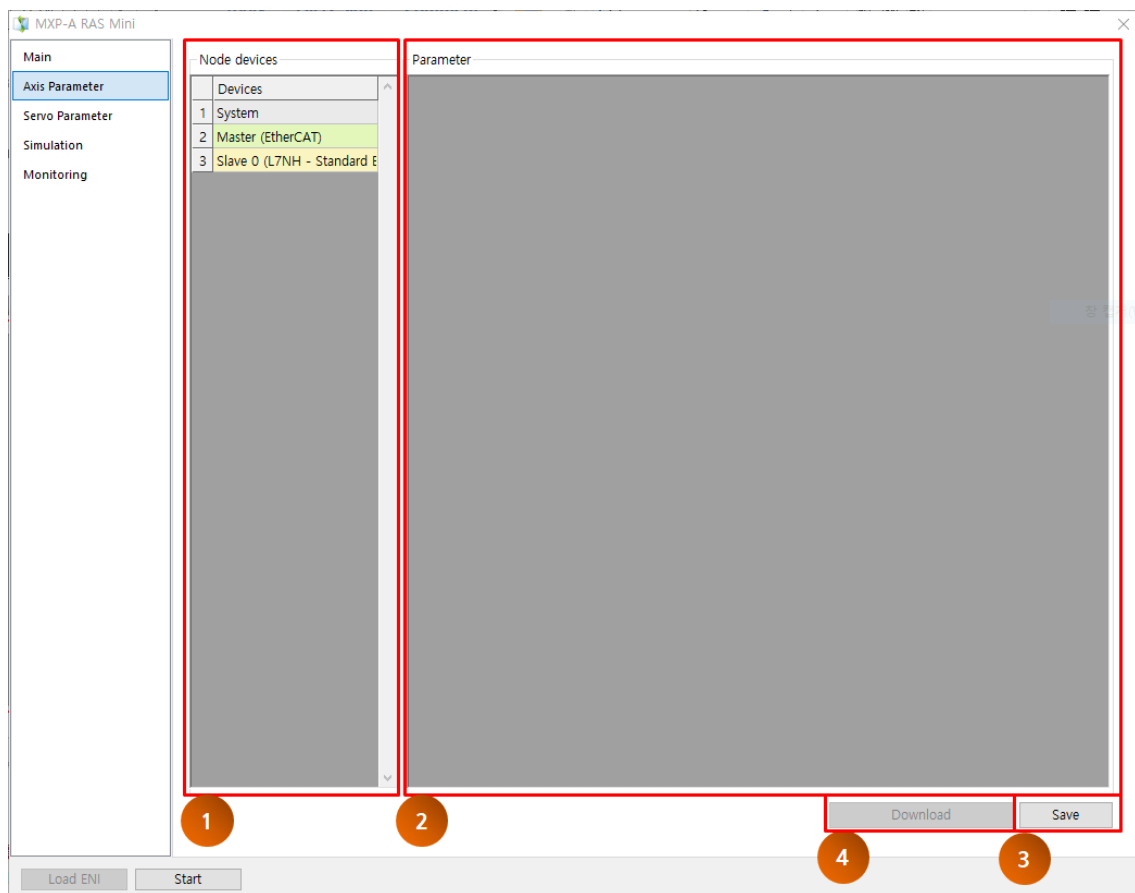


Figure 48. Axis Parameter Page Screen Configuration

Click on the Master (EtherCAT) tab in the node devices on the left side of the screen to switch to the EtherCAT parameter page as follows.

- Master Activation : Enable / disable EtherCAT (default: Used)
- Master Communication Cycle(0.1ms) : Sets the EtherCAT PDO data communication cycle. The unit is ms. (default: 40, 4ms setting)
- Master ENI XML File Name : The name of the ENI file loaded from the main page.
- Mac address : Device name and Mac address of EtherCAT Port connected between Servo Drive and PC

※ **Note** : 3.1.2.3. You can also check the modified Mac address in the Mac Address setting and modify it in the EtherCAT parameter.

Node devices

Devices

1

System

2

Master (EtherCAT)

3

Slave 0 (L7NH - Standard E

EtherCAT parameter

Item	Value	MAC address
1 Master Activation	Used	
2 Master Communication Cycle[0.1ms]	40	
3 Master ENI XML File Name	Sample_KS21.xml	
4 Mac address	Killer E2400 Gigabit Ethernet Controller-	d8cb8af01d8f

Figure 49. Master (EtherCAT) Parameter Settings

Click the Slave 0 (L7NH – Standard EtherCAT Drive) tab in the node devices on the left side of the screen to switch to the Axis parameter page as follows.

On the Parameter page, there is nothing that the user needs to change but just check the bottom part.

- 02.[W] System Position Unit : Sets the output unit of motor's current position (default: degree)
- 03.[W] System Velocity Unit : Set the output unit of motor's rotation velocity (default: /s, degree/s)
- 04.[W] Position Precision Unit : Motor's present position output accuracy (default: 0.01)
- 05.[W] Velocity Precision Unit : Motor's rotation velocity output accuracy (default: 0.01)
- 06.[B] Software Limit Enable: Use software limit (default: Used)
- 07.[B] Software Limit Stop Mode: Stop Mode (default: E-Stop)
- 08.[L] Negative Software Limit: Negative Limit Angle or Pulse (default: -63000)
- 16.[L] Travel Distance Per Machine Rotation: Motor 1 wheel angle (default: 360)
- 17.[L] Encoder Resolution: Pulse value for one rotation of motor (default: 524288)
- 18.[L] Rated Motor Speed Setting : Set motor's rotation speed (default: 1000)

※ **Note** : Axis parameter is fixed unit of INNO_ASWS system provided by INNOSIMULATION Co., Ltd.

※ **Note** : Exact stop in item 7 will display an error stop message in the motor driver at the time of limit.

※ **Note** : If item # 8 and item # 9 is 540 degrees as End Stop, items # 4 and # 5 have a precision of 0.01 degree, so you have to input 54000. However, when stopping the motor at 540 degrees, the motor stops with the Error Stop message. Therefore, allow a margin of 90 degrees and input 63000.

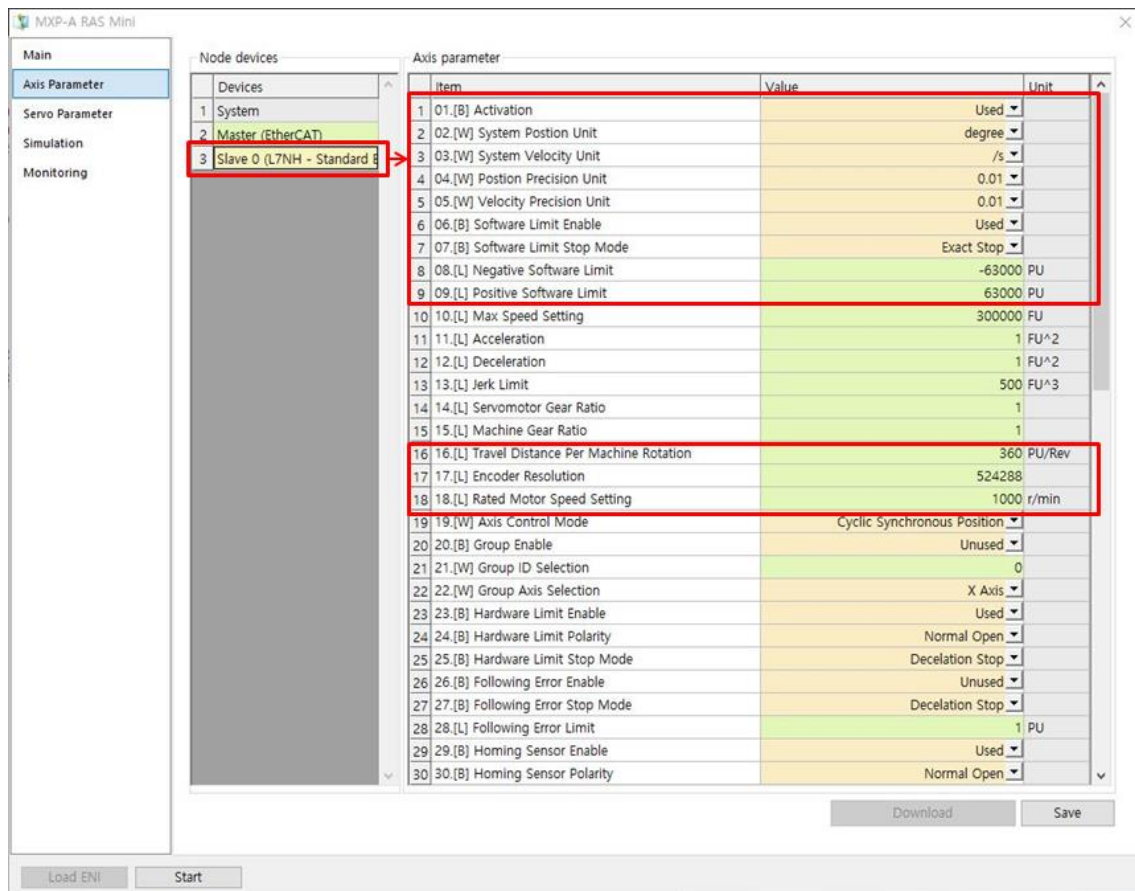


Figure 50. Slave 0 (L7NH - Standard EtherCAT Drive) Parameter Settings

3.1.7.3. Monitoring Page

Click the Monitoring tab on the left side of the screen to switch to Monitoring Page as shown below.

Status

Item	Main	Motion	Scheduler	Modbus	EtherCAT / IO
1 Heartbeat	0	0	0	0	0
2 Creation	Not Created	Not Created	Not Created	Not Created	Not Created
3 Setting time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
4 Current time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
5 Minimum time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
6 Maximum time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
7 Current operation time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
8 Max operation time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000

EtherCAT Status

Devices	State	Port 3	Port 2	Port 1	Port 0
1 System	-	App pid = 0	Chk H8 = 0	DC+ = 0	DC- = 0
2 Master (EtherCAT)	-	DCF = 0	DC Pos = 0.000000	DC Itv = 0.000000	
3 Slave 0 (L7NH - Standard EtherCAT drive)	-				

Alarm History

Item	Description	Error Code
1 Alarm History [01:20]	-	0
2 Alarm History [02:20]	-	0
3 Alarm History [03:20]	-	0
4 Alarm History [04:20]	-	0
5 Alarm History [05:20]	-	0
6 Alarm History [06:20]	-	0
7 Alarm History [07:20]	-	0

Buttons: Load ENI, Start

Figure 51. Monitoring Page

The Monitoring Page can be divided into three functions as follows.

- ① System Status: Indicate the status of installed PC.
- ② Output the status of 5 MXP-A5 Kernel including Main, Motion, Scheduler, Modbus, and EtherCAT
- ③ EtherCAT Status: Outputs EtherCAT slave status and port connection.
- ④ Alarm History: Output alarm history of MXP-A5.

Status

Item	Main	Motion	Scheduler	Modbus	EtherCAT / IO
1 Heartbeat	0	0	0	0	0
2 Creation	Not Created	Not Created	Not Created	Not Created	Not Created
3 Setting time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
4 Current time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
5 Minimum time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
6 Maximum time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
7 Current operation time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000
8 Max operation time [ms]	-	0.000000	0.000000	-	0.000000 / 0.000000

EtherCAT Status

Devices	State	Port 3	Port 2	Port 1	Port 0
1 System	-	App pid = 0	Chk HB = 0	DC+ = 0	DC- = 0
2 Master (EtherCAT)	-	DCF = 0	DC Pos = 0.000000	DC itv = 0.000000	
3 Slave 0 (L7NH - Standard EtherCAT drive)	-				

Alarm History

Item	Description	Error Code
1 Alarm History [01:20]	-	0
2 Alarm History [02:20]	-	0
3 Alarm History [03:20]	-	0
4 Alarm History [04:20]	-	0
5 Alarm History [05:20]	-	0
6 Alarm History [06:20]	-	0
7 Alarm History [07:20]	-	0

Load ENI Start

Figure 52. Monitoring Page Screen Configuration

Error ID	Description
100	System run error
101	System initialization error
102	System CPU usage exceeded
103	System Overflow
104	System Watchdog Error
105	Error initializing program file
106	Error initializing register file
107	System NULL point reference error
111	No parameter configuration file
112	No Constant configuration file
115	EtherCAT Scan time setting error
116	Use unproven Lock key or Lock key error
200	Modbus: Ethernet port device connection failed
201	Modbus: Function code request not supported
202	Modbus: unsupported addressing of registers
203	Modbus: Specify a range of data values that are not supported
204	EtherCAT: Invalid XML file input
205	EtherCAT: Ethernet port device connection failed
206	EtherCAT: normal communication initialization failure
207	EtherCAT: Request a job from an unconnected slave
208	EtherCAT: Unsupported slave device type
209	EtherCAT: No CiA402 Type Slave Set
210	EtherCAT: initial communication sending / receiving failure
211	EtherCAT: communication sending / receiving failure during communication
212	EtherCAT: Invalid SDO Input Data Usage

213	EtherCAT: Invalid SDO internal message reference encountered
214	EtherCAT: SDO transmit / receive timeout
215	EtherCAT: Invalid SDO Slave Number Assignment
216	EtherCAT: SDO send / receive internal error
500	Setting of 1 revolution linear distance of the axis Parameter error
501	Servo alarm has occurred.
502	The input value exceeds the range.
503	An invalid data type was entered.
504	You have entered invalid data.
505	The axis cannot execute the motion command.
506	The axis does not exist.
507	This group does not exist.
508	Homing has failed while a motion command has been entered during homing.
509	System Trajectory Profile creation error (internal error)
510	Soft Positive Limit detected.
511	Soft Negative Limit detected.
512	Hardware Positive Limit detected.
513	Hardware Negative Limit detected.
514	The position error range is exceeded.
515	Invalid speed (0) entered.
516	Servo off forced by user during motion.
517	Invalid EtherCAT network configuration.

Figure 53. Alarm ID

3.1.7.4. Servo Parameter Page

Click the Servo Parameter tab on the left of the screen to switch to the Servo Parameter Page as shown below.

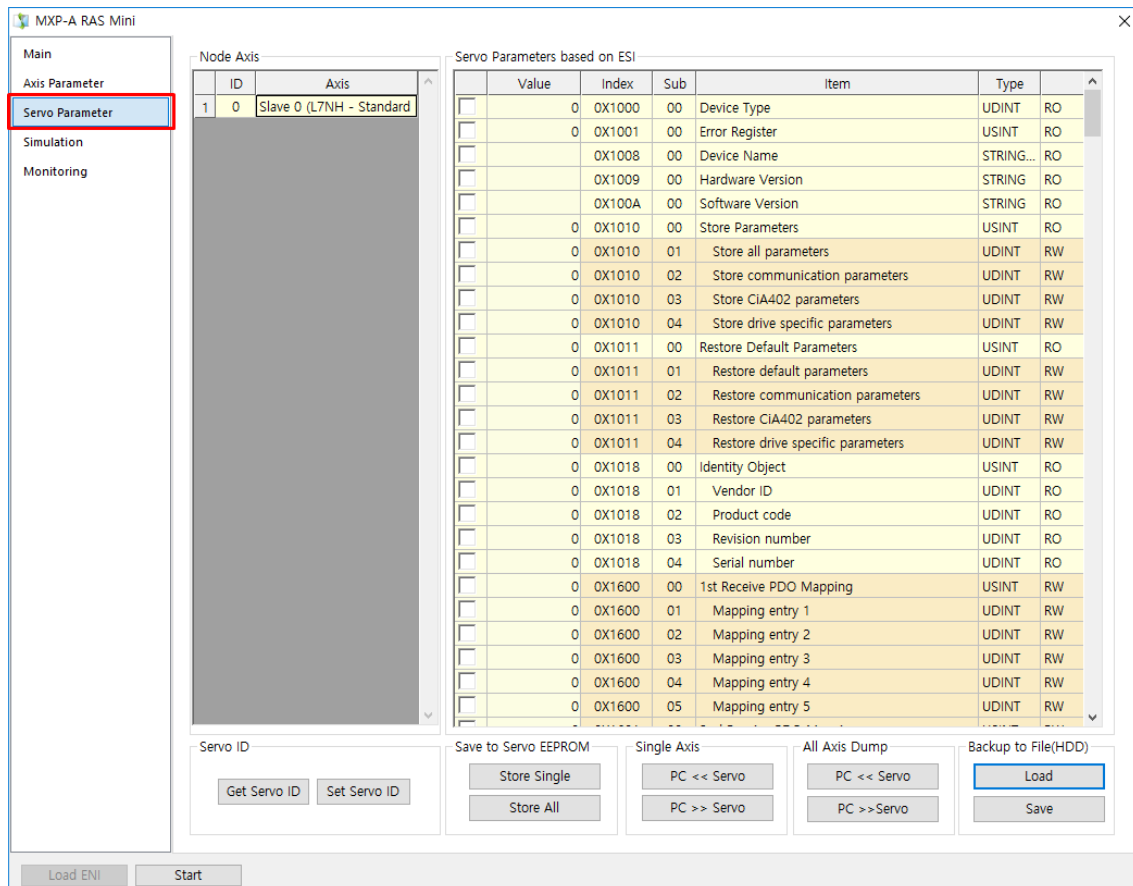


Figure 54. Servo Parameter Page

Servo Parameter Page provides CoE Parameter editing function of connected Servo Drive. The screen configuration is as follows, and has the following functions.

- ① Node Axis: Displays the axis name and ID connected to the installed PC.
- ② Servo Parameters: Output the Servo Parameter corresponding to the axis clicked in ①. 'RW' is marked in brown and can be modified by double clicking.
- ③ Servo ID: Read the axis ID connected to the installed PC by the Get Servo ID button. ① Click the ID item of the Node Axis to enter the value, and you can change the axis ID with the Set Servo ID button.
- ④ Save to Servo EEPROM: Save the modified parameter to the Servo Drive for the selected axis or all axes.
- ⑤ Single Axis: Function to read or write the value for the selected axis.
- ⑥ All Axis Dump: Function to read or write values for all axes connected to the installed PC.
- ⑦ Backup to File(HDD): Function to save or load the values to a file for all connected axes.

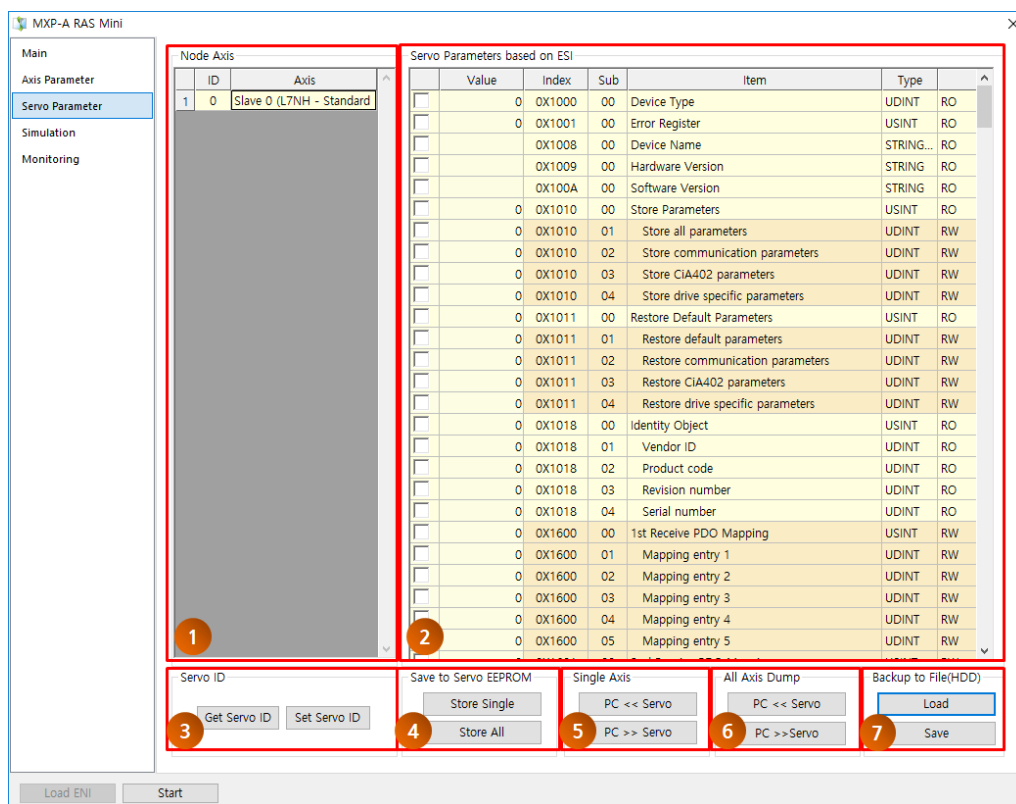


Figure 55. Servo Parameter Page Screen Configuration

3.1.7.5. Simulation Page

Click the Simulation tab on the left side of the screen to switch to the Simulation Page as shown below.

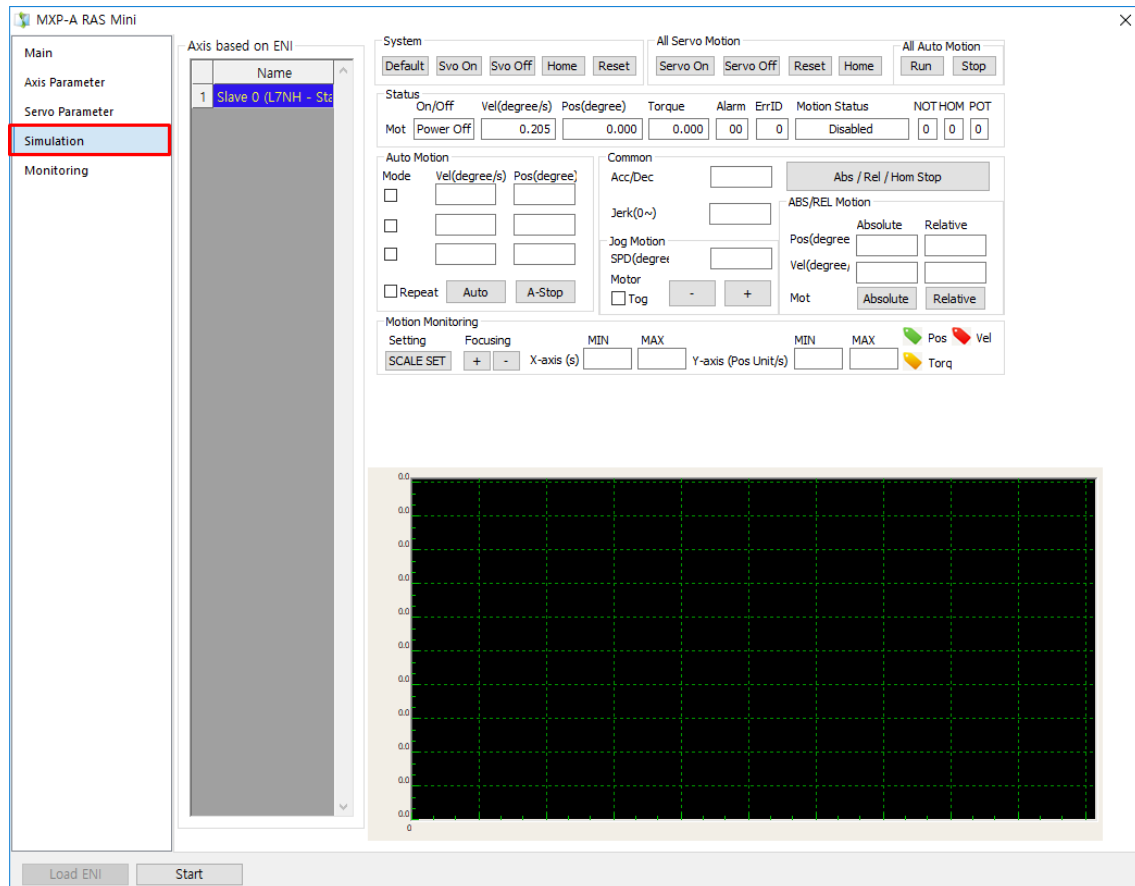


Figure 56. Simulation Page

The Simulation Page provides a Rapid Test environment. The Simulation Page enables easy and quick testing of the user through the various motion commands and graph plug-in for monitors as follows.

Functions are classified into 7 categories as follows.

- ① Axis based on ENI: Indicate axis name and status connected to the installed PC (Blue: Off, Green: On)
- ② Motion command button: provides simple motion command function such as Servo On/Off, Home, Reset
- ③ Status bar: Indicate the status for the selected axis.
- ④ Auto Motion: Repeat the operation set for the axis written in the Axis Text box.
- ⑤ Jog Motion: Perform Jog operation at the speed and acceleration / deceleration speed set for the selected axis.
- ⑥ ABS/REL Motion: Perform MoveAbsolute / MoveRelative operation on the selected axis.
- ⑦ Motion Monitoring: Sets the range of the graph to display the motion values for the selected axis.
- ⑧ Graph: Graphs the operation values.

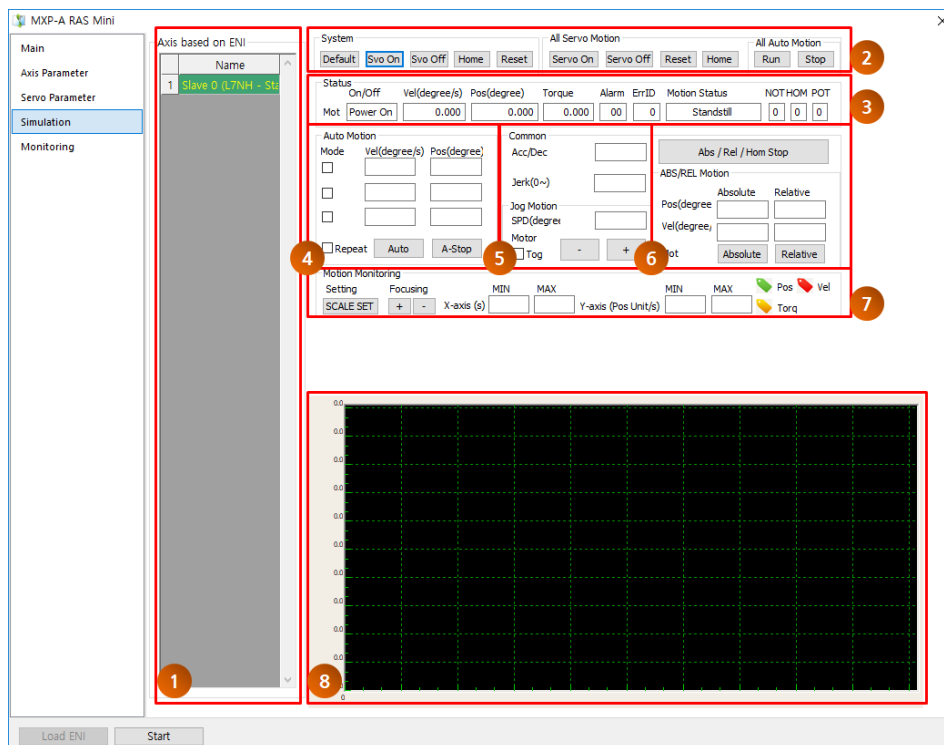


Figure 57. Simulation Page Screen Configuration

3.1.8. Servo Alarm(Trouble Shooting)

If the drive detects an error, it generates a servo alarm and transitions to the servo off state and stops. The stopping method at this time depends on the setting value of the emergency stop setting (0x2013).

※ **Note** : In case the user cannot solve the problem, it is solved through INNOSIMULATION.

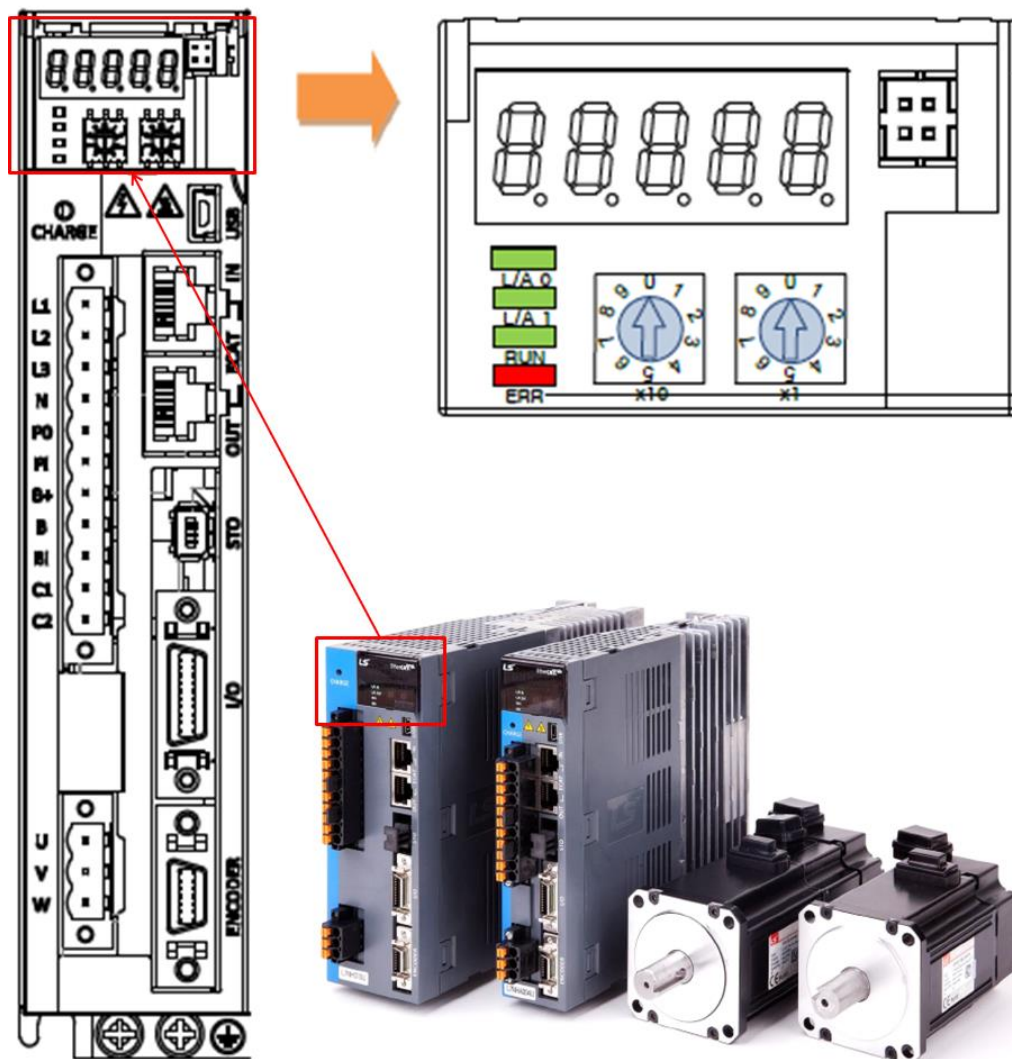


Figure 58. Servo Drive Alarm

The following is the alarm code displayed in the LED status window.

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 10 IPM fault AL - 14 Over current AL - 16 Current limit exceeded	Motor cable abnormality	Check wiring and short	Replace the motor cable.
	Encoder cable abnormality	Check wiring and short	Replace the encoder cable.
	Parameter setting error	Motor ID [0x2000], Encoder Type [0x2001], Encoder Type [0x2002] must be the same as Applicable motor label information	Modify the parameters to match the motor label information.
	Motor resistance check	Motor line resistance test (U-V, V-W, W-U several Ω or less)	Replace the motor.
	Abnormal state of mechanical parts	Check for equipment collision or constraint	Please check the mechanism.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
	Abnormal due to noise	Check how to improve noise environment such as wiring and installation.	Check the wiring of the PE. Please adjust the PE wire size to the drive main circuit wire size.
AL - 11 IPM temperature	Ambient temperature	Check that the ambient temperature is over 50 [°C].	Lower the ambient temperature of the drive.
	Continuous overload alarm	Check that the load is less than 100% with the cumulative operation overload rate [0x2603].	Change the drive and motor capacity. Adjust the gain.
	High frequency operation of regenerative drive or continuous regenerative operation	Check cumulative regenerative overload rate [0x2606]	Adjust the regenerative resistor setting [0x2009]. Use an external regenerative resistor.
	Drive Installation Direction	Check drive installation status.	Refer to "2 Wiring and Connection". Please.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 15 Current offset	Motor U, V phase current offset over setting	Check whether U / V / W phase current offset [0x2015] ~ [0x2017] is 5% or more of rated current	Perform phase current offset adjustment again.
	Drive failure		If the alarm is continuously generated after adjusting the phase current offset, replace the drive because there is a possibility that the drive is faulty.

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 21 Continuous overload	Continuous operation exceeding the rated load	Check whether the load is less than 100% with the cumulative operation load ratio [0x2603] at full speed and at stop.	Change the motor and drive capacity. Adjust the gain.
	Motor brake error	Check if the motor brake is open during SVON.	Supply power to the motor brake.
	Parameter setting error	Motor ID [0x2000], Encoder type [0x2001], Check encoder type [0x2002] setting value and applicable motor label information.	Modify the parameters to match the motor label information.
		Overload detection basic load ratio setting [0x200F] Check setting value.	Set it to the proper value.
	Abnormal state of mechanical parts	There will be no problems in running	Please check the mechanism.
	Motor cable abnormality	Check wiring and short	Replace the its cable.
	Encoder cable abnormality	Check wiring and short	
AL - 22 Drive temperature 1	Ambient temperature	Ensure that the ambient temperature is above 50 [° C]	Lower the ambient temperature of the drive.
	Drive failure	Drive temperature 1 [0x2608] when in normal state, check whether the displayed value differs from ambient temperature.	Replace the drive.
AL - 23 Regeneration overload	Over capacity due to high frequency operation or continuous regeneration operation	Check cumulative regenerative overload rate [0x2606] setting value.	Adjust the regeneration resistor setting [0x2009] after connecting external regenerative resistor and use external regenerative resistor.
	Parameter setting error	Regeneration resistance related parameters [0x2009] ~ [0x200E] Check setting value	Set it to the proper value.
	Above main power input voltage	Check that the mains voltage is above 544 [Vac].	Check the power supply again.
	Drive failure	Check if there is heat generation in regenerative resistor under non-operating condition.	Replace the drive.
AL - 24 Motor cable open	Parameter setting error	U, V, W phase current offset [0x2015] Check setting value	Execute the phase current offset adjustment procedure command.
	Motor cable abnormality	Check cable disconnection.	Replace the motor cable.
	Motor abnormality	Check the U, V, W shorts in the motor. (U-V, V-W, W-U)	Replace the motor.
	Drive failure		If SV-ON continuously generates the alarm, replace the drive because there is a possibility that the drive is faulty.
AL - 25 Drive temperature 2	Ambient temperature	Ensure that the ambient temperature is above 50 [° C]	Lower the ambient temperature of the drive.
	Drive failure	Drive temperature 1 [0x260C] when in normal state, check whether the displayed value differs from ambient temperature.	Replace the drive.
AL - 26 Encoder temperature	Reserved		

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 30 Encoder communication AL - 31 Encoder cable open AL - 32 Encoder data	Encoder cable abnormality	Check for disconnection, miswiring and short.	Replace the encoder cable.
	Parameter setting error	Encoder type [0x2001], Encoder resolution [0x2002] Setting value should be same as applied motor label information	Correct the same as the motor label information. If the modified contents do not apply after saving the parameters, replace the motor because it may cause an error in the motor.
	Encoder error		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Drive failure		
AL - 33 Motor setting	Motor ID setting	Motor ID [0x2000] setting value should be the same as applied motor label information	Correct the same as the motor label information. The corresponding alarm can be released when the power is turned off / on after modifying the parameter.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 34 Z Phase open	Parameter setting error	Confirm setting value of warning mask [0x2014]	Z-phase Motor not used (ex. step motor), Set the 14th bit in the warning mask setting to mask AL-34.
	Encoder cable abnormality	Check wiring and short	Replace the encoder cable.
	Encoder error		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Drive failure		
AL - 35 Low battery	Parameter setting error	Absolute encoder setting [0x2005] Check setting value	If you want to use the absolute encoder as an incremental encoder, set it to 1 and the alarm will not occur.
	Battery connection failure, unconnected	Check battery connection	Connect the battery correctly.
	Low battery voltage	Check that the battery voltage is 3.3V or higher.	Replace the battery.




AL - 36 Sinusoidal ENC amplitude AL - 37 Sinusoidal ENC frequency	Encoder cable abnormality	Check for disconnection, miswiring and short. Check for shield and PE disconnection.	Replace the encoder cable.
	Parameter setting error	Check encoder type [0x2001] setting value	Check the encoder type setting. Check the speed command. (Maximum: 250kHz)
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Converter error		
	Encoder error		
AL - 38 Encoder setting error	drive / motor combination error	Identify drive and motor branding label codes	Use drives and motors with the same brand label.
	Encoder cable abnormality	Check wiring and short	Replace the encoder cable.
	Encoder error		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Drive failure		

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 40 Under voltage	Above main power input voltage	Check that main power voltage is about 134 [Vac] or more	Check the power supply again.
	When the power supply voltage drops during operation	Check that DC link voltage [0x2605] value is above 190 [Vac] while main power is normally input.	Replace the drive.
AL - 41 Over voltage	Above main voltage input voltage	Check that the mains voltage is about 286 [Vac] or less.	Check the power supply again.
		Check that the value of DC link voltage [0x2605] is more than 405 [Vdc] while main power is normally input.	Replace the drive.
	When the external regenerative resistance value is large	Check operation condition and regenerative resistance value.	Please recheck the regenerative resistance value considering the operation condition and load.
	Acceleration / deceleration set value	Check if there is a rapid increase / decrease frequency	Set the acceleration / deceleration time longer.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 42 Main power fail	Above main power input voltage	Check voltage between L1, L2, L3 200 ~ 230 [Vac]	Check the power supply again.
	Parameter setting error	Check setting value of main power input mode setting[0x2006] according to main power input status.	Make parameter settings and wiring with 3-phase input power supply as possible.
	Momentary blackout	Check Main Power Loss Checking Time [0x2007] Setting Value	Increase Main Power Loss Checking Time [0x2007] setting value or check the power supply source.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 43 Control power fail	C1, C2 phase-to-phase voltage error	C1, C2 The phase voltage should be within 200 ~ 230 [Vac]	Please re-verify control power.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 50 Over speed limit	Motor cable abnormality	Check wiring and short	Replace the its cable.
	Encoder cable error	Check wiring and short	
	Parameter setting error	Motor ID [0x2000], Encoder Type [0x2001], Encoder Resolution [0x2002] must be the same as Applicable motor label information	Correct the same as applied motor label information.
		Check gear ratio [0x6091] setting value	Set the electronic gear ratio low.
		Check gain setting parameters [0x2100] ~ [0x211F]	Re-adjust the gain according to the operating conditions.
	Encoder error		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Drive failure		
AL - 51 POS following	Parameter setting error	Check gear ratio [0x6091] setting value	Set the electronic gear ratio low.
		Check setting value of Position error range [0x6065] and Position error excess time [0x6066]	Readjust the parameters according to the operating conditions.
	Abnormal state of mechanical parts	Check whether the drive is restrained	Please check the mechanism.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 53 Excessive SPD deviation	Motor cable abnormality	Check for disconnection, mis-wiring and short	Replace the its cable.
	Encoder cable abnormality	Check for disconnection, mis-wiring and short	
	Parameter setting error	Motor ID [0x2000], Encoder Type [0x2001], Encoder Resolution [0x2002] must be the same as Applicable motor label information	Correct the same as applied motor label information.
		Check gear ratio [0x6091] setting value	Set the electronic gear ratio low.
	Abnormal state of mechanical parts	Check whether the driving part is restrained. Limit Contact sensor operating status.	Please check the mechanism.
	Encoder error		If the alarm is continuously generated after the power is turned on again, there is a possibility that the it is defective. Please replace it.
	Drive failure		

Alarm code name	Factor of occurrence	Check list	How to cope
AL - 63 Parameter checksum	When O/S is changed	Check the parameter whose parameter setting value is set to the maximum value of the variable type.	Perform initial parameter restoration [0x1011]. When restoration is done, the values of the parameters you set will be changed to the initial values. Please set parameters before driving.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
AL - 71 Factory setting	Parameter setting error	Contact Us Check drive capacity with device name [0x1008] setting value.	Please reset the drive capacity and download the OS again. If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.

Name of warning state(CODE)	Factor of occurrence	Check list	How to cope
 PWR_FAIL (Main power phase loss)	Above main power input voltage	Check voltage between L1, L2, L3 200-230 [Vac]	Check the power supply again.
	Parameter setting error	Check setting value of Main power input mode setting according to main power input status [0x2006]	Make parameter settings and wiring with 3-phase input power supply as possible.
	Momentary power failure	Check main power phase check time [0x2007] setting.	Increase setting value of main power source current check time or check power source.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.
 LOW_BATT (Encoder Battery Low Voltage)	Parameter setting error	Check the setting value of absolute encoder setting [0x2005]	If you set the absolute encoder to 1 when you want to use the incremental encoder, the alarm will not occur.
	Battery connection failure, unconnected	Check battery connection	Connect the battery correctly.
	Low battery voltage	Check that the battery voltage is 3.3V or higher.	Replace the battery.
 SW_POS_LMT (Software Location Restrictions)	Parameter setting error	Check setting value of Software location restriction function setting [0x2400], Software location restriction [0x607D]	Change Software Position Limit Settings [0x2400] value or the minimum and maximum position value setting of software position limit [0x607D].
 OV_LOAD (Operation overload)	Continuous operation exceeding the rated load	Check setting value of Acceleration range and stopping Accumulated operation load ratio [0x2603], Overload warning level setting [0x2010]	Change the motor and drive capacity. Adjust the gain. Adjust the overload warning level [0x2010] setting value.
	Motor brake error	Check if the motor brake is open during SVON.	Supply power to the motor brake.
	Parameter setting error	Motor ID [0x2000], Encoder Type [0x2001], Encoder Type [0x2002] must be the same as Applicable motor label information	Modify the parameters to match the motor label information.
		Check setting value of Overload detection basic load ratio setting [0x200F]	Set it to the proper value.
	Abnormal state of mechanical parts	There will be no problems in running	Please check the mechanism.
	Motor cable abnormality	Check wiring and short	Replace the motor cable.
	Encoder cable error	Check wiring and short	Replace the encoder cable.

Name of warning state(CODE)	Factor of occurrence	Check list	How to cope
 820 SETUP (Setting error)	Over drive / motor combination	Check that the current capacity of the applied motor is larger than the drive current capacity.	Lower the torque limit or replace the motor with a motor that is lower than the drive current capacity.
	IO setting error	In Digital input signal setting [0x2200] ~ [0x2208], Digital output signal setting [0x2210] ~ [0x2213], Check whether signal assignment is duplicated.	Set the correct parameter according to the operating condition.
 840 UD_VTG (Low voltage)	Main power input voltage error	Check that main power voltage is 134 [Vac] or more. Check if DC link voltage [0x2605] is 190 ~ 405 [Vdc] while main power is normally input.	Check the power supply again. Replace the drive.
	When the power supply voltage drops during operation	Check main power wiring.	Use the supply voltage in 3 phases.
 880 EMG (Emergency signal input)	EMG contact point abnormality	Emergency stop by EMG contact. Check wiring and drive parameters (drive control input 1 [0x211F], digital input signal 1 setting [0x2200] to digital input signal 16 setting [0x220F]).	Set the wiring and parameters according to the operating conditions.
	Drive failure		If the alarm is continuously generated after the power is turned on again, there is a possibility that the drive is defective. Please replace the drive.

3.2. Library

INNO_ASWS provides a library for users to control ASWS directly.

3.2.1. File Path

The library file is provided in the following path inside the USB package.

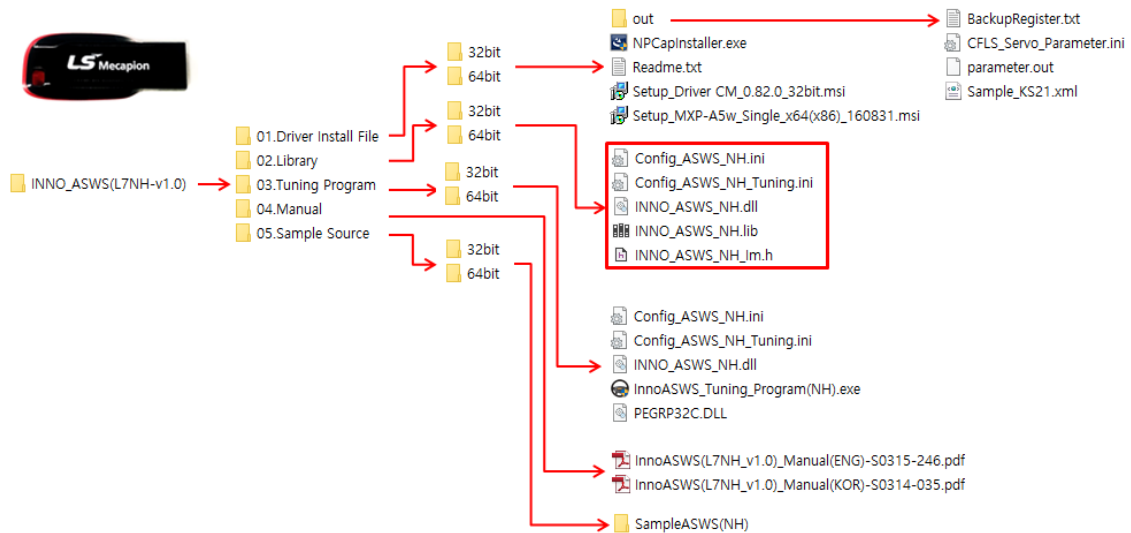


Figure 59. Library File Path

3.2.2. Library Configuration

The library file is composed as follows.

- Config_ASWS_NH.ini : Among various functions provided by INNO_ASWS, the tuning parameter value for Inno Torque Mode is set, and EndStopAngle and Dead Zone settings are possible.
- Config_ASWS_Tuning.ini : Effect related tuning parameter value is set.
- INNO_ASWS.dll : This is a dll file defined as a function to control INNO_ASWS.
- INNO_ASWS.lib : This is a library file defined as a function to control INNO_ASWS.
- INNO_ASWS_lm.h : This is a Header file defined as a function to control INNO_ASWS.
- MXP_SoftMotion.dll : It is a dll file related to MXP drive function.

※ **Note** : Tuning parameters set in ini file can be modified by tuning program.

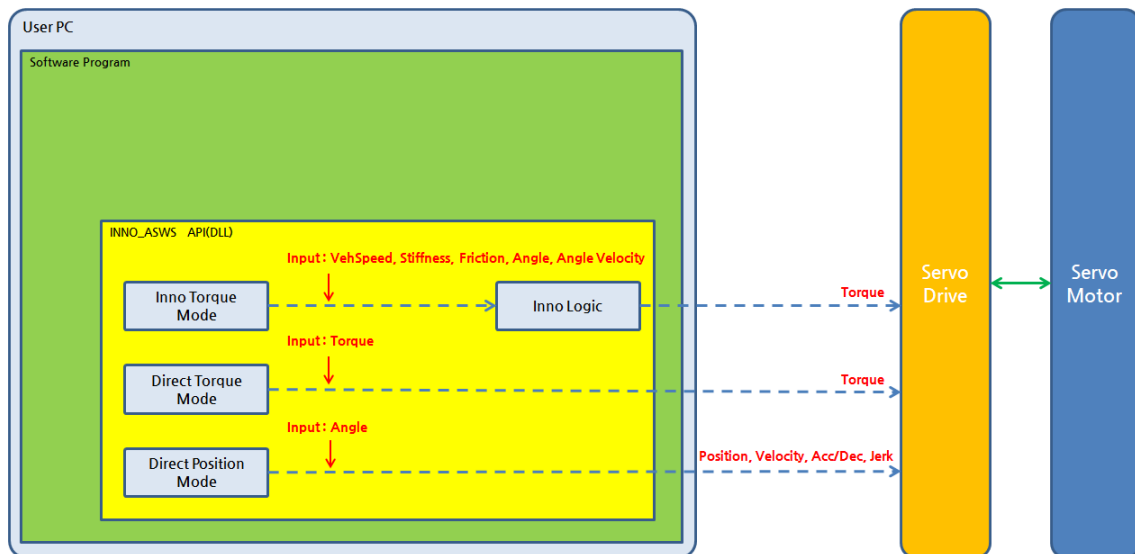


Figure 60. Library Function Block Diagram

3.2.3. Parameters in Config_ASWS_NH.ini File

The following is the [COEF_VALUE] part of the Config_ASWS_NH.ini file.

Parameter	Description	Default	Range
ENDSTOP_ANGLE	Sets the maximum angle of the handle. This is a feature that prevents the software from turning the handle any longer when the current angle of the handle is greater than EndStop Angle.	540	0 ~
DEAD_ZONE	The handle angles within the set Dead Zone range are all zero degrees.	0.0	-

The following is the [INNO_TORQUE_MODE] part of the Config_ASWS_NH.ini file.

Parameter	Description	Default	Range
Stiffnes_Zero	The value is used in the internal formula in Inno Torque Mode. It is used to adjust the reaction force of the steering wheel when the vehicle speed is zero. Adjusting with Friction value can adjust the reaction force.	0 ~	-
Friction_Zero	The value is used in the internal formula in Inno Torque Mode. It is used to adjust the reaction force of the steering wheel when the vehicle speed is zero. Adjusting with the Stiffness value adjusts the speed at which the reaction force returns.	0 ~	-
Stiffnes_xxx	The value is used in the internal formula in Inno Torque Mode. It is used to adjust the reaction force of the steering wheel when the vehicle speed is 0 or more. Adjusting with Friction value can adjust the reaction force.	0 ~	-
Friction_xxx	The value is used in the internal formula in Inno Torque Mode. It is used to adjust the reaction force of the steering wheel when the vehicle speed is 0 or more. Adjusting with the Stiffness value adjusts the speed at which the reaction force returns.	0 ~	-

3.2.4. INNO_ASWS Library Functions

The following is a briefly defined table of functions for INNO_ASWS.

Library Functions	Function Description	Page
expASWS_Thread_Start()	Prepare the INNO_ASWS operation.	Page 71 - 3.2.4.1
expASWS_Thread_Stop()	Stop INNO_ASWS operation.	Page 71 - 3.2.4.2
expASWS_SetActiveTorque(BOOL Active)	Activates / deactivates the torque reaction force of the handle.	Page 72 - 3.2.4.3
expASWS_SetMode(int mode)	It is a function to set control mode of Steering Wheel.	Page 72 - 3.2.4.4
expASWS_SetVehSpeed(float Speed)	This function is used in conjunction with Inno Torque Mode, which carries the necessary vehicle speed value for internal formula in Inno Torque Mode.	Page 73 - 3.2.4.5
expASWS_SetTorqueValue(float fTorque)	This function is used in conjunction with Direct Torque Mode, and it delivers the torque value.	Page 73 - 3.2.4.6
expASWS_SetDirectAngleValue(float fAngle)	This function is used in conjunction with Direct Position Mode, which carries the angle value of the handle.	Page 74 - 3.2.4.7
expASWS_SetEffectOnOff(float famp, float fnz, BOOL bActive)	Activates / deactivates Sine Effect.	Page 74 - 3.2.4.8
expASWS_SetRumbleEffectOnOff(float famp, BOOL bActive)	Activates / deactivates Rumble Effect.	Page 75 - 3.2.4.9
expASWS_SetPotholeEffectOn(float famp, float freq)	Activates Pot hole Effect.	Page 75 - 3.2.4.10
expASWS_SetCollisionEffectOn(float famp, float freq)	Activates the Collision Effect.	Page 76 - 3.2.4.11
expASWS_SetBumpEffectOn(float famp, float freq)	Activates the Bump Effect.	Page 76 - 3.2.4.12
expASWS_SetKerbEffectOn(float famp, float freq)	Activates the Kerb Effect.	Page 77 - 3.2.4.13
expASWS_GetSteerAngle()	Returns information about the current angle (position) value of the handle.	Page 77 - 3.2.4.14
expASWS_GetSteerVelocity()	Returns information about the current rotational speed value of the handle.	Page 78 - 3.2.4.15
expASWS_GetSteerInTorque()	Returns the torque information currently input to the motor.	Page 78 - 3.2.4.16
expASWS_GetSteerOutTorque()	Returns the Torque value information currently output from the motor.	Page 78 - 3.2.4.17
expASWS_GetSteerPulse()	Returns the current Pulse (position) value information of the handle.	Page 79 - 3.2.4.18
expASWS_GetErrorNumber()	If an error occurs in Servo Drive, it returns an error code.	Page 79 - 3.2.4.19
expASWS_GetStatus()	Returns the current state of the Servo Drive.	Page 80 - 3.2.4.20
expASWS_GetMotionStatus()	Returns the current operating state of the Servo Motor.	Page 81 - 3.2.4.21
expASWS_GetMode()	Returns the current mode state of INNO_ASWS.	Page 81 - 3.2.4.22
expASWS_SetTuningMode(BOOL bActive)	This function is used in Tuning Program.	Page 82 - 3.2.4.23
expASWS_SetDirectAngleTuningValue(float Velocity, float fAngle, float Acceleration, float Deceleration, float Jerk)	This function is used in the Tuning Program and is used to tune the rotational speed of the handle.	Page 82 - 3.2.4.24
expASWS_ReadParameters()	This function is used in Tuning Program.	Page 83 - 3.2.4.25
expASWS_SaveParameters(struct Mod_COEF *coef)	This function is used in Tuning Program.	Page 83 - 3.2.4.26
expASWS_SetVehicleParamValue(float fspeed, float fStiffness, float fFriction)	This function is used in Tuning Program.	Page 83 - 3.2.4.27

The followings are detailed definitions of the function for INNO_ASWS.

3.2.4.1. int expASWS_Thread_Start()

- Prepare for INNO_ASWS operation.
- Kernel initialization, network connection, Servo-On execution.
- It includes the function to be recovered automatically at the start.
- Return type is in type.

[Parameter]	-
[Return]	0 : Unknown 1 : Success

3.2.4.2. void expASWS_Thread_Stop()

- Stop INNO_ASWS operation.
- The kernel operation is stopped, the kernel is released, and Servo-Off is executed.

[Parameter]	-
[Return]	-

3.2.4.3. void expASWS_SetActiveTorque(BOOL Active)

- Activate / deactivate the torque reaction force of the steering wheel.
- If Active = true, the state of INNO_ASWS is changed from Normal to Run.
- If Active = false, the state of INNO_ASWS is changed from Run to Normal.

[Parameter]	0 : Not Active 1 : Active
[Return]	-

※ **Note** : It is called when ASWS status is Normal.

3.2.4.4. void expASWS_SetMode(int mode)

- It is a function to set control mode of Steering Wheel.
- INNO_ASWS supports 3 modes, and the following modes can be selected.
- Inno Torque Mode : This is the torque control mode. Torque force is applied by internal formula. (refer to 3.2.3.6)
- Direct Torque Mode : It is the torque control mode and reflects the torque value inputted by the user (refer to 3.2.3.7)
- Direct Position Mode : This is the position control mode, which reflects the value of the handle angle by the user (refer to 3.2.3.8)

[Parameter]	0 : Inno Torque Mode 1 : Direct Torque Mode 2 : Direct Position Mode
[Return]	-

※ **Note** : When switching from Position Mode to Torque Mode, the time to change depends on the angle of the handle. The larger the angle, the longer the switching time of the steering wheel. (Maximum travel time: approx. 4 ~ 5 sec.) This is because the state of the servo drive needs time to stabilize.

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.5. void expASWS_SetVehSpeed(float Speed)

- This function is used with Inno Torque Mode, which carries the necessary vehicle speed value for Inno Torque Mode internal formula.
- Use after switching to Inno Torque Mode.
- The maximum input value of the vehicle is 0 ~ 260 km/h.

[Parameter]	Vehicle speed (km/h)
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.6. void expASWS_SetTorqueValue(float fTorque)

- This function is used with Direct Torque Mode and it transmits Torque value.
- User after switching to Direct Torque Mode.
- Generates the reaction force of the handle with the torque value input by the user.
- The maximum torque input value is -8.59 ~ 8.59 Nm.

[Parameter]	Torque (N.m)
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

※ **Note** : Caution is required because it reflects user's input value.

※ **Note** : Input value should be '0' at the end of simulation or system shutdown.

3.2.4.7. void expASWS_SetDirectAngleValue(float fAngle)

- This function is used in conjunction with Direct Position Mode, which carries the angle value of the handle.
- Be sure to use after switching to Direct Position Mode.
- Controls the angle of the handle entered by the user.
- The maximum input value of the handle angle is ENDSTOP_ANGLE set in the Config_ASWS_NH.ini file.

[Parameter]	Handle angle (degree)
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. The program is controlled using the SetTimer () function.(Checked in the sample source)

3.2.4.8. void expASWS_SetEffectOnOff(float famp, float fhz, BOOL bActive)

- Enable / disable Sine Effect.
- When bActive = true, you can reproduce the effect of adding handle vibration.
- When bActive = false, turn off the vibration of the handle.
- famp adjust the strength of vibration of the handle, the larger the value, the greater the intensity of vibration.
- fhz controls the vibration period, and the larger the value, the more the vibration period increases.

[Parameter]	famp : intensity of vibration fhz : vibration period bActive : Use or Not use
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.9. void expASWS_SetRumbleEffectOnOff(float famp, BOOL bActive)

- Activate / deactivate Rumble Effect.
- When bActive = true, reproduces the effect of driving a gravel road.
- When bActive = false, turn off the vibration of the handle.
- famp adjusts the strength of vibration of the handle, the larger the value, the greater the intensity of vibration.

[Parameter]	famp : intensity of vibration bActive : Use or Not use
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.10. void expASWS_SetPotholeEffectOn(float famp)

- Activate the pot hole effect.
- Reproduces the effect of driving the pot hole route when famp values are applied.
- If the famp values are 0, they are deactivated.

[Parameter]	famp : intensity of vibration
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.11. void expASWS_SetCollisionEffectOn(float famp)

- Activate Collision Effect.
- Reproduce collision effect when applying famp values.
- If the famp values are 0, they are deactivated.

[Parameter]	famp : intensity of vibration
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.12. void expASWS_SetBumpEffectOn(float famp)

- Activate Bump Effect.
- Reproduce bump effect when applying famp values.
- If the famp values are 0, they are deactivated.

[Parameter]	famp : intensity of vibration
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.13. void expASWS_SetKerbEffectOn(float famp)

- Activate the Kerb Effect.
- When famp values are applied, the road kerb effect is reproduced.
- If the famp values are 0, they are deactivated.

[Parameter]	famp : intensity of vibration
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. Available in Inno / Direct Torque Mode.

3.2.4.14. float expASWS_GetSteerAngle()

- Returns the current angle (position) value information of the handle.
- Return type is float type.

[Parameter]	-
[Return]	The current angle value of the handle (degree)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.15. float expASWS_GetSteerVelocity()

- Returns the current rotational speed value information of the handle.
- Return type is float type.

[Parameter]	-
[Return]	Current rotational (degree/s)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.16. float expASWS_GetSteerInTorque()

- Torque value information currently input to the motor is returned.
- Return type is float type.

[Parameter]	-
[Return]	Input Torque value (N.m)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.17. float expASWS_GetSteerOutTorque()

- It returns the Torque value information currently output from the motor.
- Return type is float type.

[Parameter]	-
[Return]	Output Torque value (N.m)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.18. float expASWS_GetSteerPulse()

- Returns the current Pulse (position) value information of the handle.
- Return type is float type.

[Parameter]	-
[Return]	Current pulse value (pulse)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.19. unsigned short expASWS_GetErrorNumber()

- If an error occurs in Servo Drive, it returns an error code.
- Return type is unsigned short type.

[Parameter]	-
[Return]	Servo Drive error code (Refer to Figure 19)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.20. int expASWS_GetStatus()

- Returns the current status of Servo Drive.
- Return type is int type.

[Parameter]	-
[Return]	0 : Power Down 1 : Recovery 2 : Power On 3 : Normal (System Ready) 4 : Run (System Activation) 5 : Calibration -1 : Unknown -2 : Communication Error -3 : Overload Error

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.21. int expASWS_GetMotionStatus()

- It returns the current operation status of servo motor.
- If torque or position command is not executed, the command is waited in standstill state.
- DiscreMotion value is returned when position command is executed, and ContinuousMotion value is returned when torque command is executed.
- Return type is int type.

[Parameter]	-
[Return]	1 : Error Stop : Emergency stop status 2 : Disable : Servo off state 3 : Stopping : Axis stopping 4 : Homing : Homing 5 : Standstill : Waiting for command 6 : DiscreMotion : Executes position command (in position mode call) 7 : ContinuousMotion : Executes torque command (when calling torque mode)

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.22. int expASWS_GetMode()

- Returns the current mode status of INNO_ASWS
- Return type is int type.

[Parameter]	-
[Return]	0 : Inno Torque Mode 1 : Direct Torque Mode 2 : Direct Position Mode

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.23. void expASWS_SetTuningMode(BOOL bActive)

- This function is used in Tuning Program.
- Used when switching from Inno Torque Mode to Tuning Mode.

[Parameter]	bActive (0 : Activation, 1 : Disabled)
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.24. void expASWS_SetDirectAngleTuningValue(float Velocity, float fAngle, float Acceleration, float Deceleration, float Jerk)

- This function is used in conjunction with Direct Position Mode, which carries the angle value of the handle.
- Be sure to use after switching to Direct Position Mode.
- Controls the angle of the handle with the handle angle value entered by the user.
- The maximum input value of the handle angle is ENDSTOP_ANGLE set in the Config_ASWS_NH.ini file.
- Used to tune the speed of the steering wheel in the tuning program.

[Parameter]	bActive : Rotation speed of the handle fAngle : Handle angle (degree) fAcceleration : Rotation acceleration of the handle fDeceleration : Rotation deceleration of the handle fJerk : the value for the instantaneous or delayed rotation of the handle
[Return]	-

※ **Note** : It is called when the status of ASWS is Run. The program is controlled using the SetTimer() function.(Checked in the sample source)

3.2.4.25. void expASWS_ReadParameters()

- This function is used in Tuning Program.
- Used to read configuration parameter values in Config_ASWS_NH.ini file.

[Parameter]	-
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.26. void expASWS_SaveParameters(struct Mod_COEF *coef)

- This function is used in Tuning Program.
- Used to write the tuning setting value to the setting parameter value of the Config_ASWS_NH.ini file.
- The values to be written are the values of ENDSTOP_ANGLE and DEAD_ZONE.

[Parameter]	-
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

3.2.4.27. void expASWS_SetVehicleParamValue(float fspeed, float fStiffness, float fFriction)

- This function is used in Tuning Program.
- Used to write the tuning setting value to the setting parameter value of the Config_ASWS_NH.ini file.
- Write Value is Stiffness and Friction value per speed.

[Parameter]	-
[Return]	-

※ **Note** : It is called when the status of ASWS is Run.

3.2.5. Library Call Sequence

The following is a flowchart of the library call.

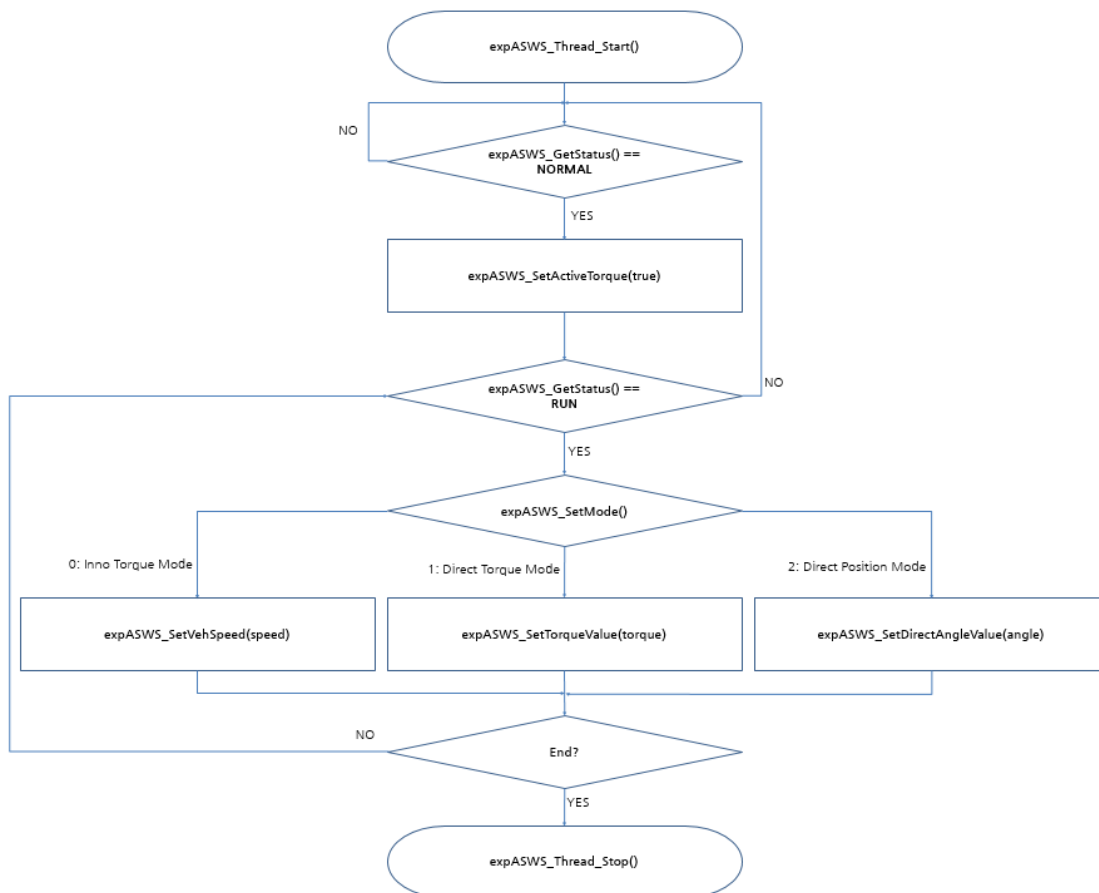


Figure 61. Library Call Flowchart

3.3. Tuning Program

INNO_ASWS provides a tuning program that allow the user to perform tuning / control directly.

3.3.1. File Path

The Tuning program is provided in the USB package below.
Tuning program is only 32bit program.

※ **Note** : The Tuning Program must be run as an administrator.

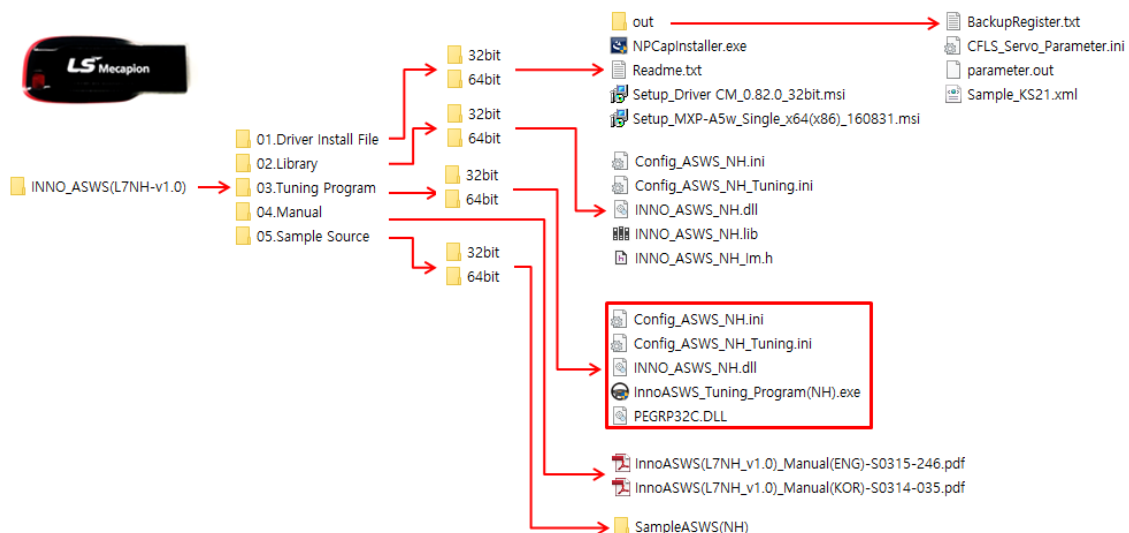


Figure 62. Tuning Program File Path

3.3.2. Tuning Program Screen Configuration

The following is the screen configuration of the Tuning Program and consists of 9 segments in total.

- ① Information : You can start / stop ASWS by using ASWS status check and control button.
- ② Control Mode : You can select 3 modes.
- ③ Parameter Tuning : You can check and modify parameters in the Config_ASWS_NH.ini file and save them.
- ④ ASWS Effect : You can check effect in Inno / Direct Torque Mode.
- ⑤ Vehicle Mode : In Inno Torque Mode, you can select driving or tuning mode.
- ⑥ Tuning : Tuning parameters can be adjusted in real time when tuning mode is selected, and parameter value can be changed by clicking Set button.
- ⑦ Input Direct Torque : You can input Torque value in Direct Torque Mode.
- ⑧ Input Direct Position : You can input Angle value in Direct Position Mode.
- ⑨ Steering Display : You can check the current angle, torque, and speed of the steering wheel in a graph.

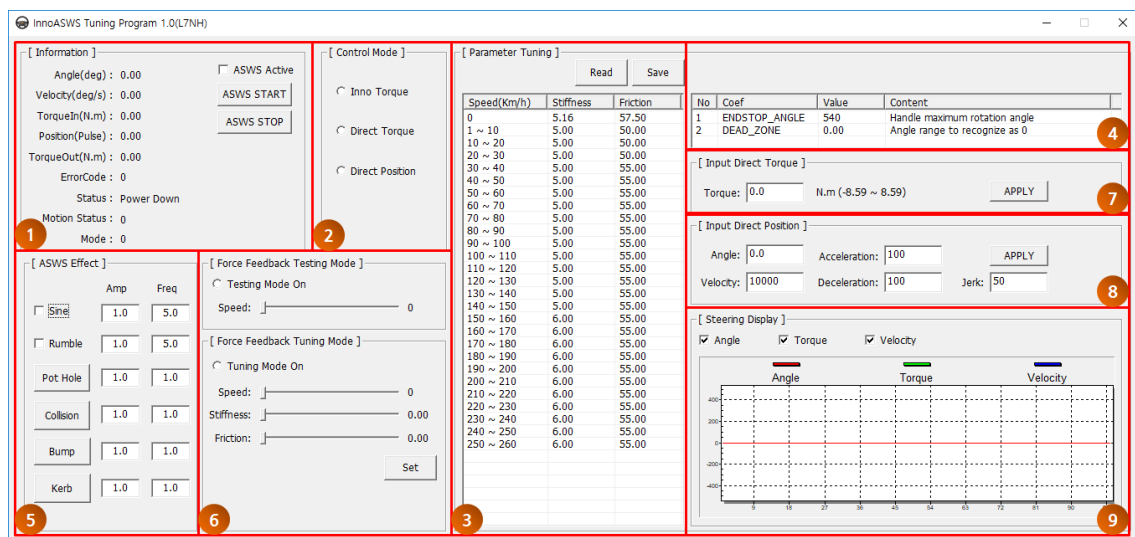


Figure 63. Tuning Program Screen Configuration

3.3.3. How to use Tuning Program

3.3.3.1. Information

Through 'Information', you can check the status information of INNO_ASWS in real time, and control INNO_ASWS using button.

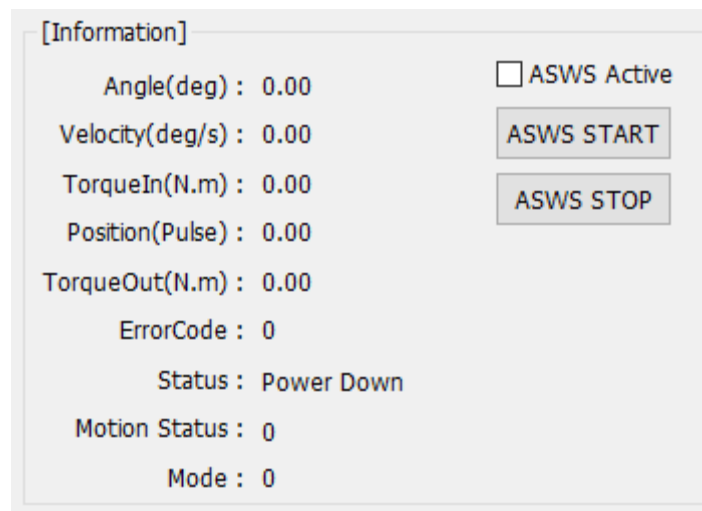


Figure 64. Tuning Program Information Part

- Activation step of ASWS

- 1) Click the ASWS Start button to set the status of ASWS from Init to Normal.
- 2) Check the ASWS Active button to set the ASWS status to Run.

※ **Note** : If you click 'ASWS START' button, the handle is automatically recovered to 0. When it reaches 0 degree, it is changed to Normal.

The following table describes the components of Information.

Item	Description
Angle	Displays the position of the current handle as [degree] value
Velocity	Displays current handle speed as [degree / s] value
TorqueIn	Displays the input torque value [N.m] of the current handle
Position	Display the current position of the handle as [Pulse] value
TorqueOut	Displays the output torque value [N.m] of the current handle
ErrorCode	Error code display when servo drive error occurs
Status	<p>Current ASWS status indication</p> <ul style="list-style-type: none"> • Power Down: Servo Off • Recovery: Kernel initialization and original position value storage • Normal: ASWS ready to use • Run: The state in which the reaction torque is generated • Calibration: Calibration is in progress • Communication_Error: Status when communication problem with servo motor • Overload_Error: The state that occurs when the load exceeds the limit torque. • Unknown: Unknown error
Motion Status	<p>Current ASWS motion operation status indication</p> <ul style="list-style-type: none"> • Error Stop: Emergency stop status • Disable: Servo off state • Stopping: Axis stopping • Homing: Homing • Standstill: Waiting for command • DiscreMotion: During position command execution (when calling position mode) • ContinuousMotion: Executes torque command (when calling torque mode)
Mode	<ul style="list-style-type: none"> • I_Torque : Inno Torque Mode • D_Torque : Direct Torque Mode • D_Position : Direct Position Mode
ASWS Active	Create Reaction Force Status: Switch from Normal to Run
ASWS Start	Servo Motor Power On
ASWS Stop	Servo Motor Power Off
Calibration	Specify the neutral position of the handle

3.3.3.2. Control Mode

Control Mode can select 3 modes provided by INNO_ASWS, and the corresponding mode is activated when selected.

※ **Note** : Select after INNO_ASWS is in Run state.

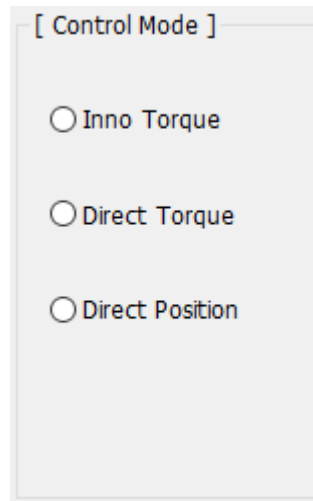


Figure 65. Tuning Program Control Mode 파트

The following table describes the components of 'Information'.

Item	Description
Inno Torque	Torque control mode, torque is applied by internal formula.
Direct Torque	Torque control mode, which reflects the value of the torque input by the user.
Direct Position	This is a position control mode and reflects the value of the handle angle input by the user.

3.3.3.3. Inno Torque Mode

Inno Torque Mode (refer to 3.3.3.2.) is a mode in which a reaction force is generated by the Inno-formula as described above. Inno Torque Mode is divided into 4 parts as below.

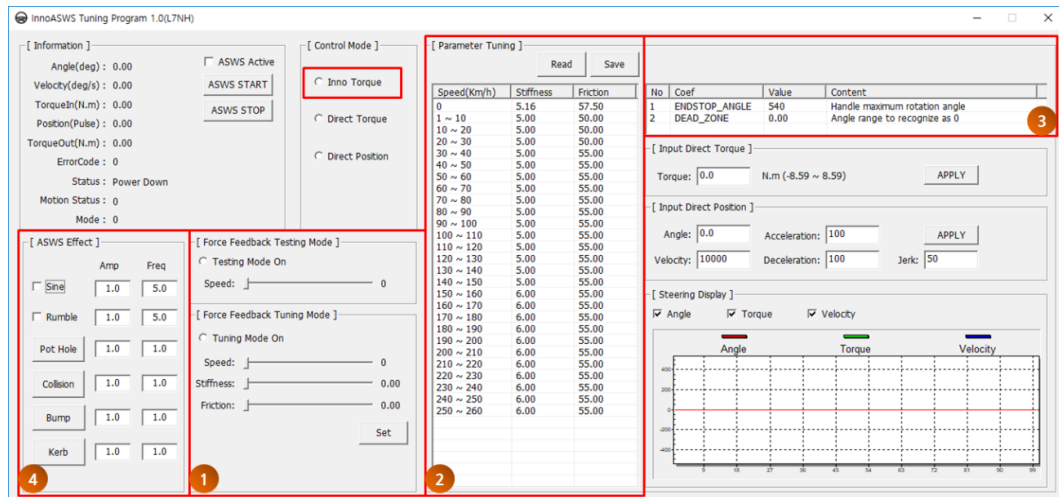


Figure 66. Inno Torque Mode

When activated by selecting Inno Torque mode, you can select test mode and tuning mode in item (1).

[Force Feedback Testing Mode] of the item (1) is a mode in which the reaction force of the steering wheel is applied according to the vehicle speed by using a parameter (item (2)) in the Config_ASWS_NH.ini file. In [Force Feedback Tuning Mode], You can tune the reaction force of the steering wheel in real time by adjusting the stiffness and friction according to the speed. Parameter value in item (2) is modified when the Set button is clicked and the tuned value is automatically saved in the Config_ASWS_NH.ini file when the Save button is clicked.

※ **Note** : If parameter value is changed in tuning mode, parameter value changed in [Force Feedback Testing Mode] is applied only when Read button is pressed.

(3) is the parameter tuning part of the Config_ASWS_NH.ini file for ENDSTOP_ANGLE and DEAD_ZONE, and ENDSTOP_ANGLE and DEAD_ZONE can be changed and saved in the ini file.

(4) is a part about the additional effect when the mode is Inno Torque, and Amp and Freq for each effect can be applied in real time. The applied value is saved in the Config_ASWS_Tuning.ini file when the Save button is clicked.

3.3.3.4. Direct Torque Mode

Direct Torque Mode (refer to 3.3.3.2) is a mode in which the reaction force input by the user is directly reflected. In Direct Torque Mode, it is divided into 1 part as shown below.

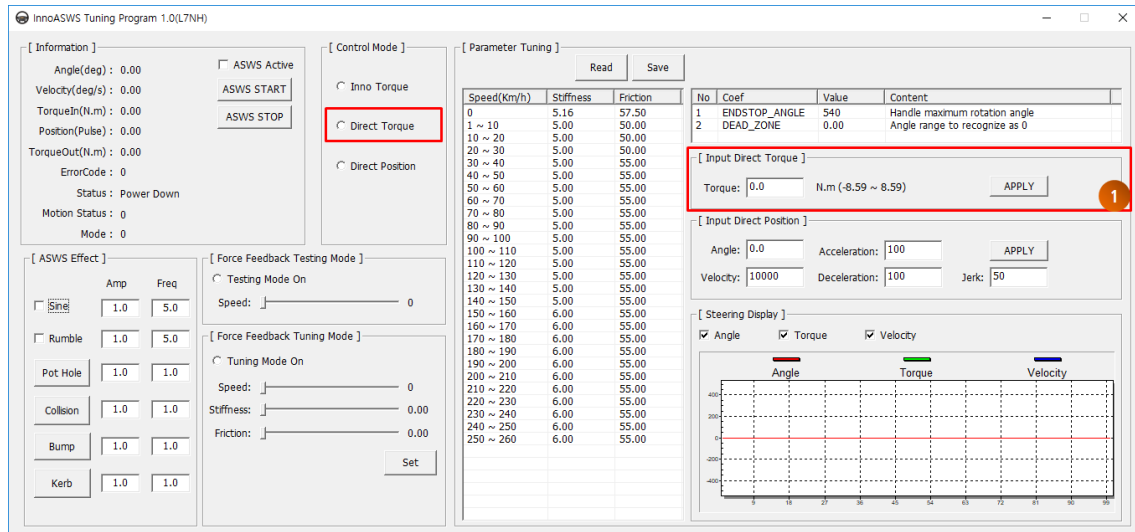


Figure 67. Direct Torque Mode

When Direct Torque Mode is activated by selecting it, item (1) is activated.

In the item (1), the torque value can be applied by using the slider bar as input by the user. In Tuning Program, the reaction force can be sensed in real time by the value of torque input by the user.

- ※ **Note** : Direct Torque Mode is used when the user wishes to control the reaction force of the steering wheel by using Steering Torque value in the dynamics of the simulation engine.
- ※ **Note** : Be careful not to input too large a value because it is to check if tuning program is running. (For example, input about 0.4, check if it is driven, and increase it by 0.1 to determine the force. Change it to 0.0 at the end.

3.3.3.5. Direct Position Mode

Direct Position Mode (refer to 3.3.3.2) is a mode that reflects the angle entered by the user. In Direct Position Mode, it is divided into 1 part as below.

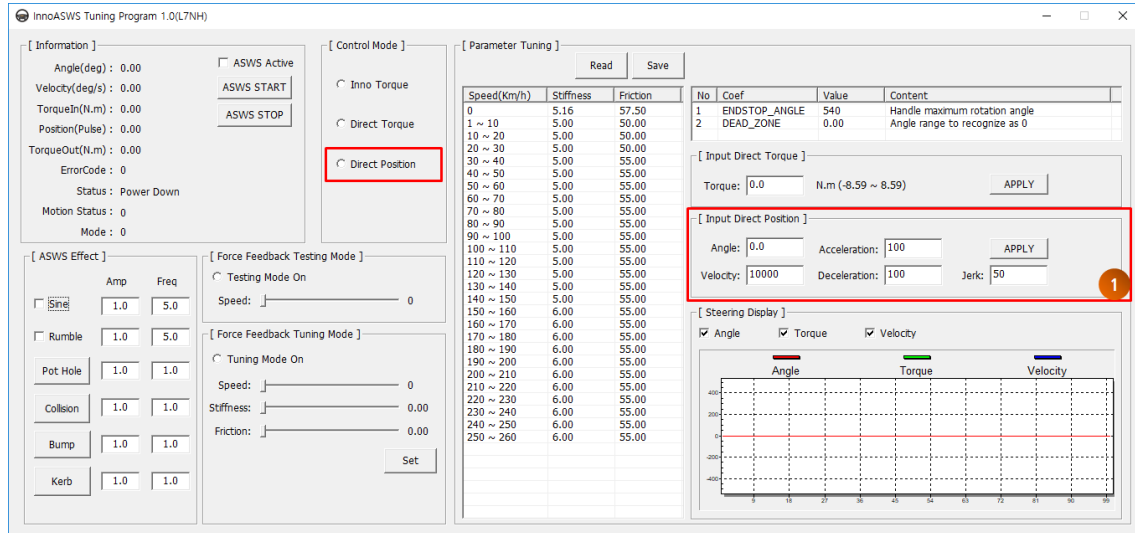


Figure 68. Direct Position Mode

When Direct Position Mode is activated by selecting it, item (1) is activated.

In the item (1), the angle value can be applied using the slider bar as entered by the user. In the tuning Program, the handle can be controlled by the angle value input by the user. You can also tune the speed of the handle according to Velocity, Acceleration, Deceleration, and Jerk values.

The tuning value is saved in the Config_ASWS_NH.ini file when the Save button is clicked.

- ※ **Note** : Direct Position Mode is a mode related to autonomous driving and is used when the user wants to directly control the angle of the steering wheel.

3.3.3.6. Steering Display

The Steering Display is used to check the angle, torque, and speed of the current steering wheel in real time. You can check only the value you want by using the checkbox.

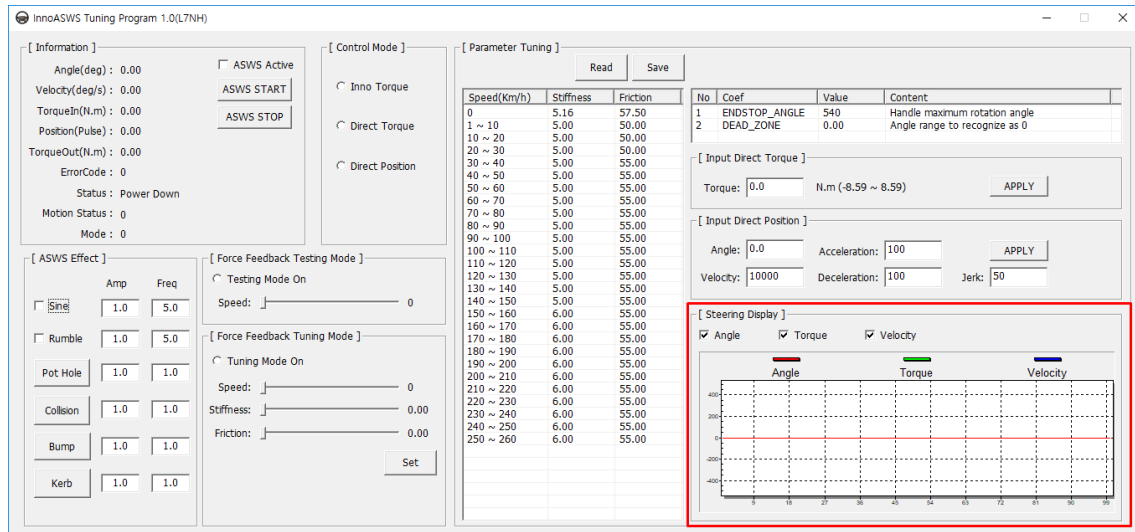


Figure 69. Steering Graph Display

※ **Note** : Graph applies only to 32bit tuning program.

3.4. Sample Source

INNO_ASWS provides a basic sample source for seamless programming when you create your own library.

The sample source is basically programmed for the necessary functions and the user can individually develop the desired ASWS program through the sample source.

3.4.1. File Path

The sample source is provided in the following path in the USB package.

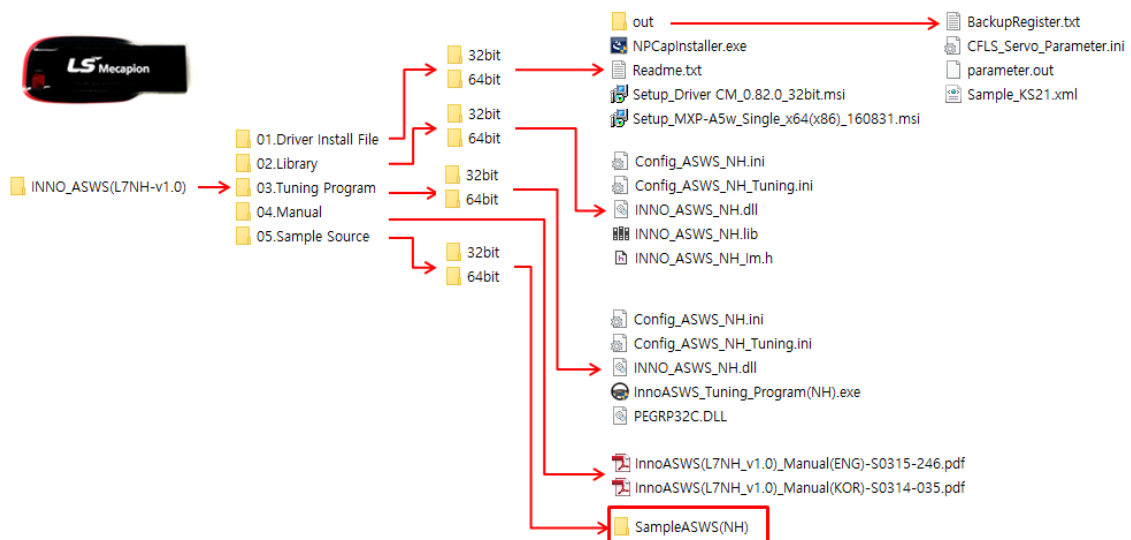


Figure 70. Sample Source File Path

3.4.2. Sample Source Screen Configuration

The following is the program screen structure that appears when the sample source is executed. There are two kinds of screen configuration, as follows.

- ① ASWS Control : Display current status of ASWS and enable Servo On / Off
- ② ASWS Mode : Switching and operating ASWS Mode

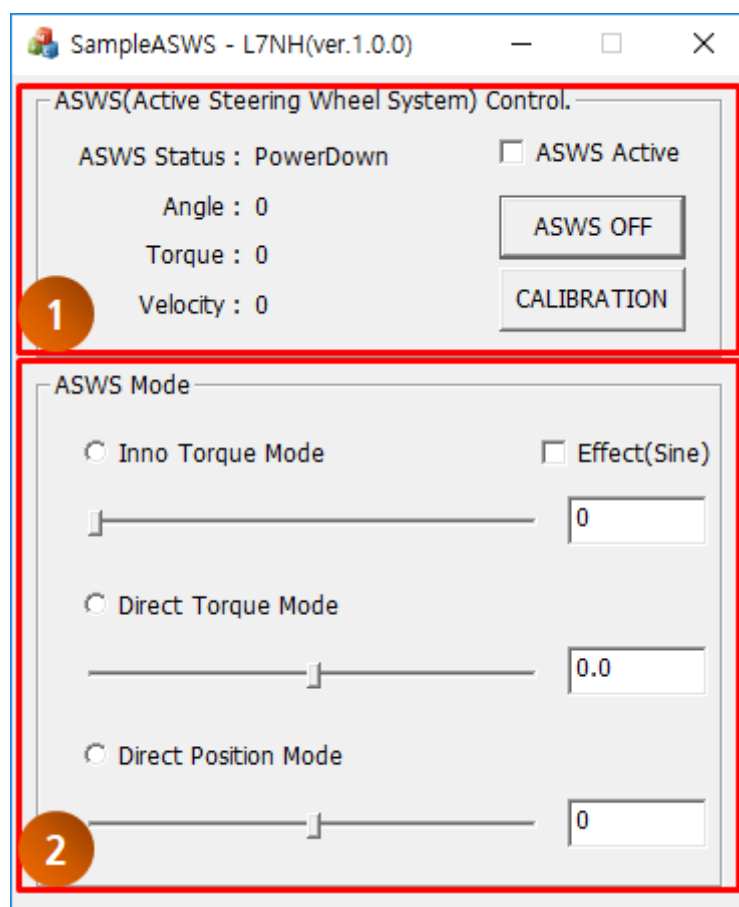


Figure 71. INNO_ASWS Sample Program Screen Configuration