DINGS
Precision Motion Specialist

VER 1.1

DINGS′ Servo Studio Manual

DS-BVS/BVM-Series

DINGS
Precision Motion Specialist

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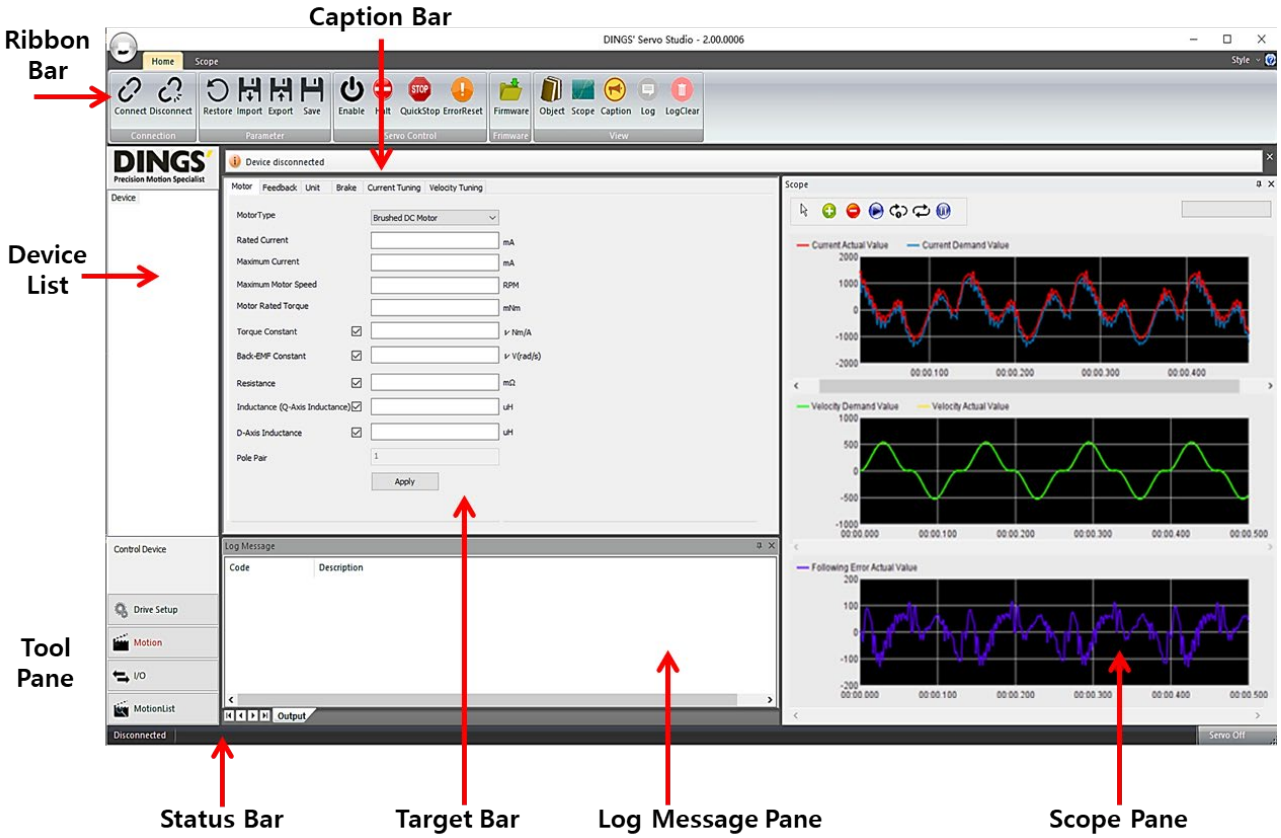
2. Screen Layout



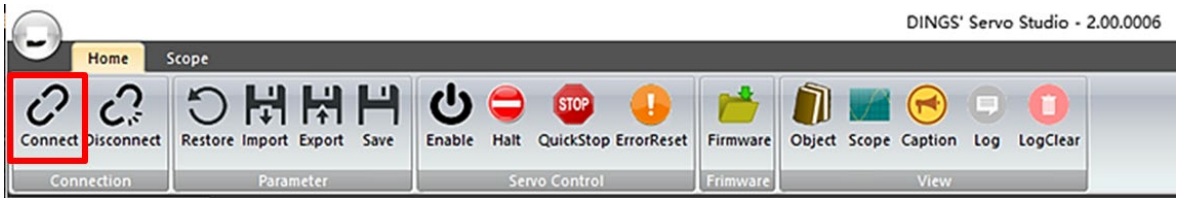
Name	Description
Ribbon Bar	Function Button Connection Parameter Management Servo Control Firmware Update. Scope Setting
Caption Bar	Check important messages
Device List	Check and select from list of connected drives
Tool Pane	Menu selection Drive Setup: Motor & Feedback Settings, Tuning Motion: Motor Drive Object Dictionary: Load & Download Object List I/O: I/O Monitor & Test Motion List: Sequence Motion Modification & Drive Test
Status Bar	Indicates device status
Target Pane	Settings, Command Entry Window Differs with tool pane selection
Log Message	Check device connection status and error messages

3. Device Connection

3.1 Connecting CAN Communication

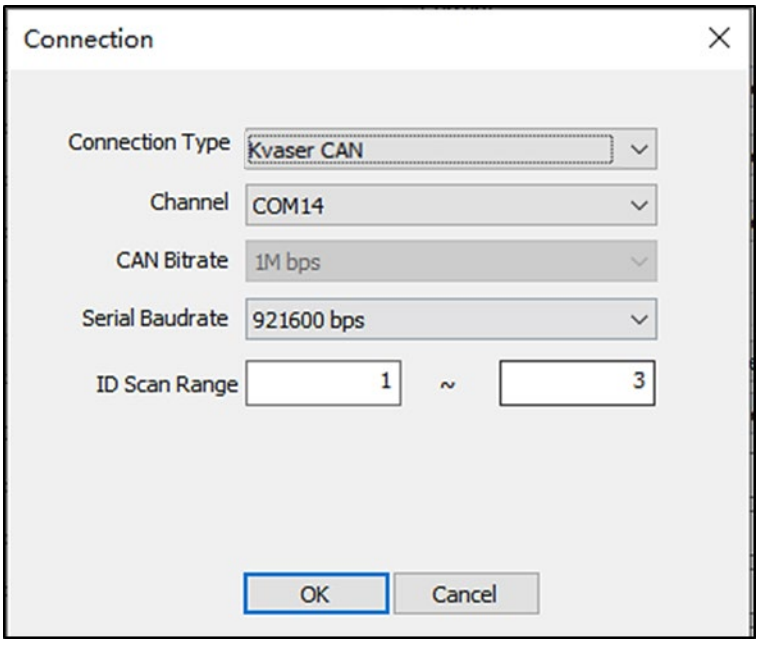
3.1.1 Connecting method for CAN communication

(1) Execute DINGS' Servo Studio and click [Connect] in the Ribbon Bar



(2) Select Connection Type in the Connection Window

Select Type corresponding to Kvaser CAN, Peak-System CAN, or Zhcxgd CAN



(3) Select CAN bitrate (Default: 1M bps)

Set ID Scan Range. (Drive default ID = 1)

If the Device ID is known, set the range according to the ID.

To connect multiple drives, the ID must be set differently for each drive before connecting the drive.

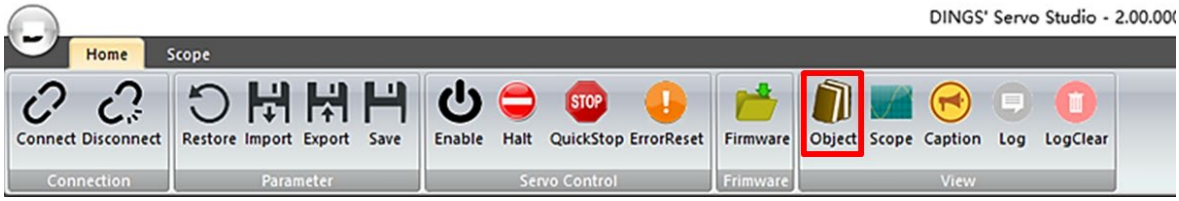
(4) Click OK

(5) When the drive is connected, a connection message appears in the Log Message window, and a list of connected drives appears in the Device List window.

3.1.2 Changing CAN communication

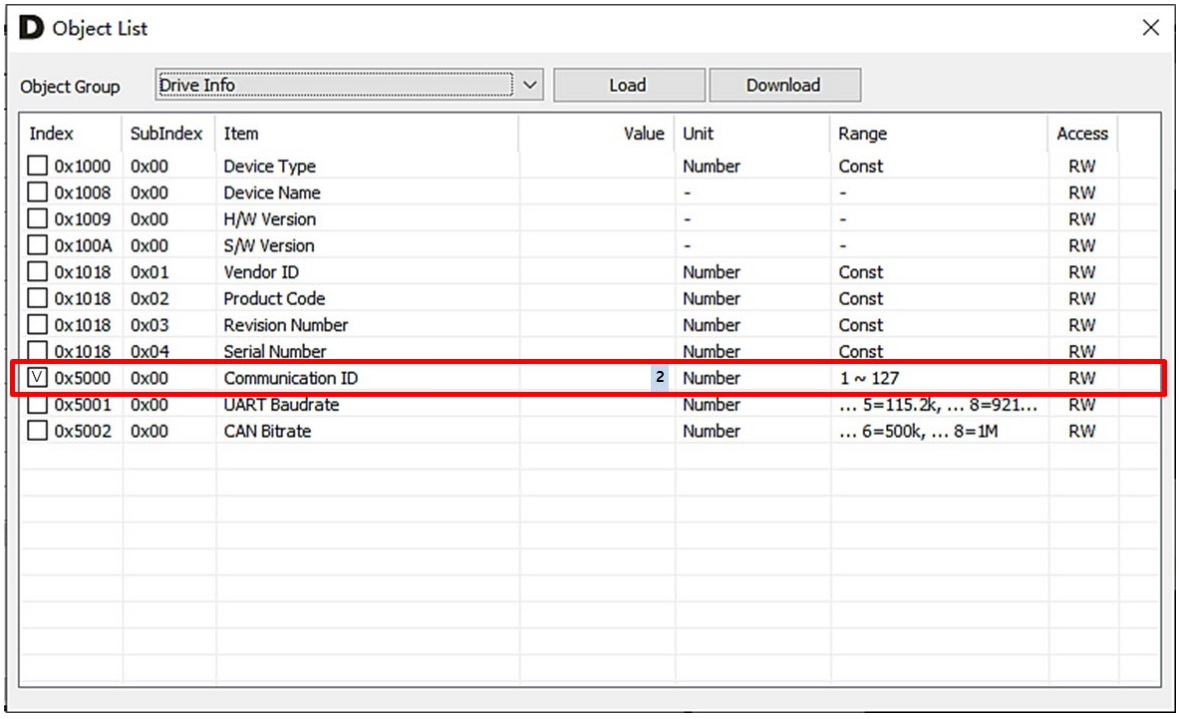
- To connect multiple drives through CAN communication, set different ID for each drive. If the ID is duplicated, communication failure occurs.

(1) Click [Object Dictionary] on the ribbon bar



(2) Select Object Group as Drive Info

(3) Modify the communication ID (Index: 0x5000) in the Object List and click the [Download] button. Communication ID can be set from 1 to 127

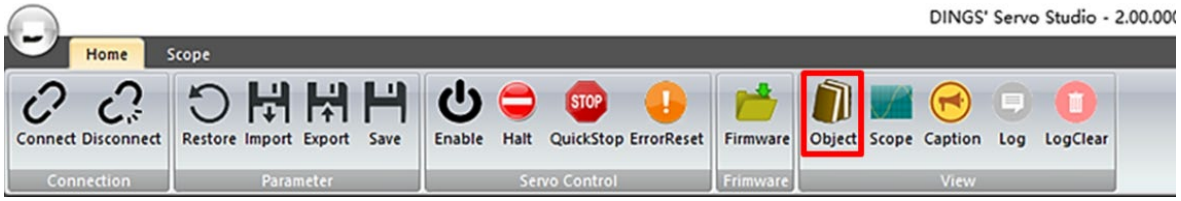


(4) Click the [Save] button to save the changed ID

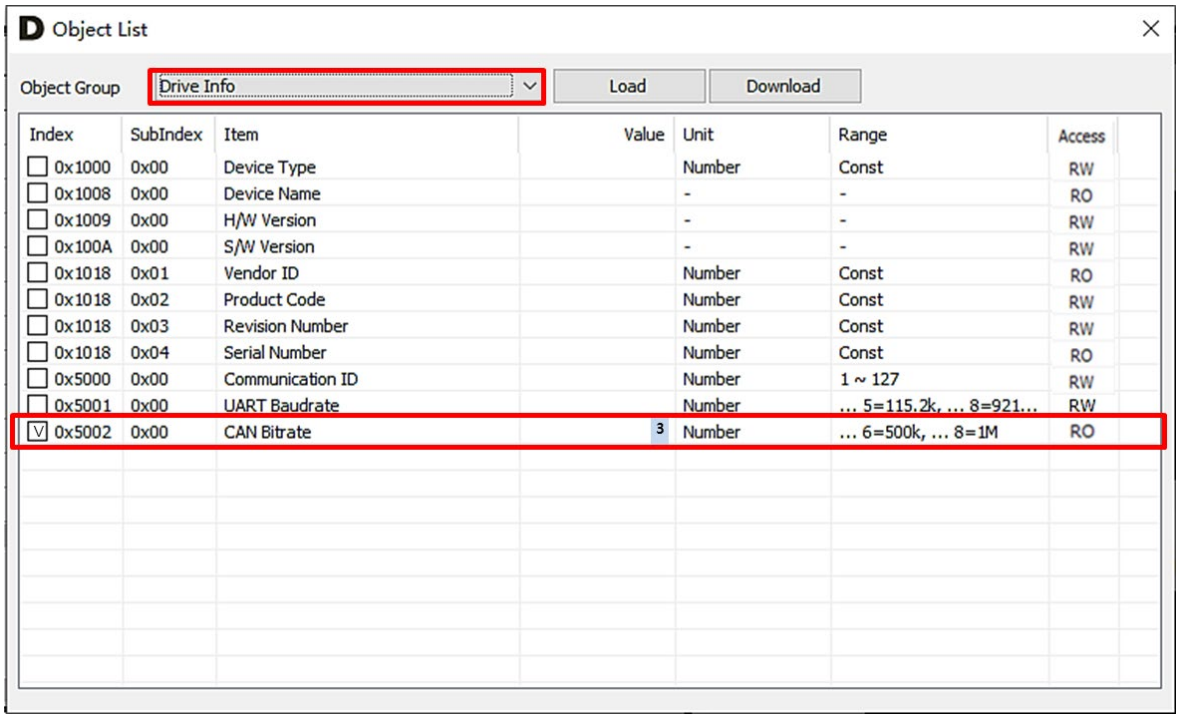
(5) Drive Power OFF -> ON

3.1.3 Changing CAN Bitrate

(1) Click [Object Dictionary] on the ribbon bar



(2) Select Object Group as Drive Info



(3) Modify CAN Bitrate (Index: 0x5002) in the Object List and click the [Download] button..

Value	Description
0	None
1	10 kbps (Not Supported)
2	20 kbps
3	50 kbps
4	125 kbps
5	250 kbps
6	500 kbps
7	800 kbps(Not Supported)
8	1 Mbps

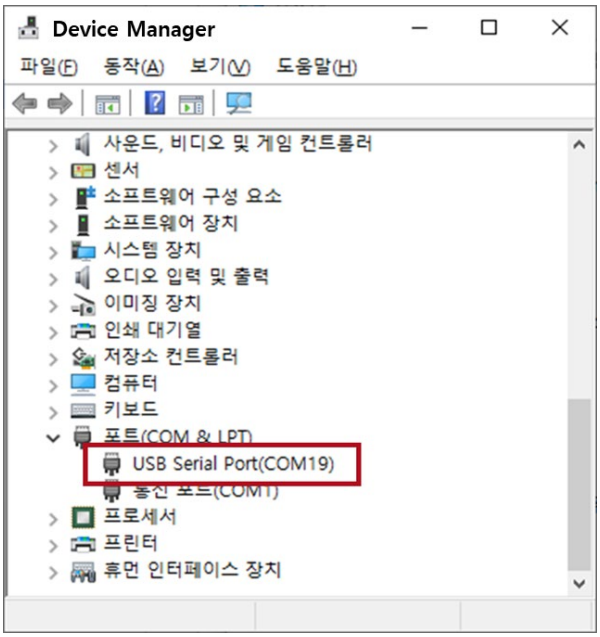
(4) Click the [Save] button to save the changed CAN Bitrate.

(5) Drive Power OFF -> ON

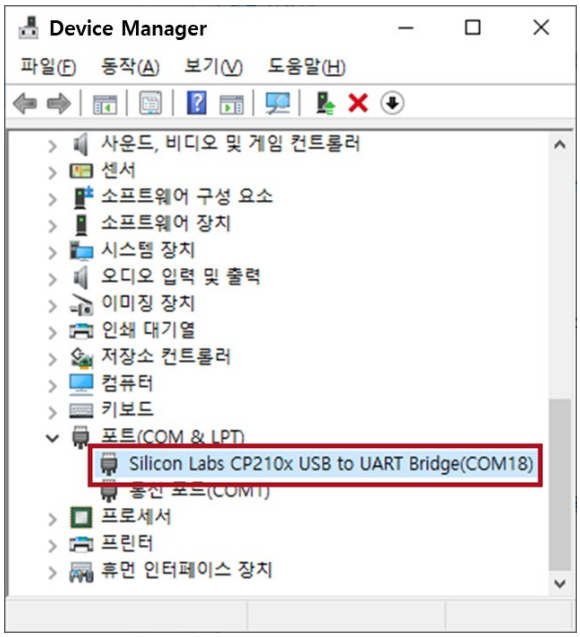
3.2 Connecting USB

- USB drive is installed under the condition of Internet connection.

- USB drives are installed differently depending on the servo drive model.
- When connecting the servo drive to the PC for the first time, check the USB drive installed in the Device Manager and connect it using the appropriate connection method for the installed USB drive as shown in the figure below.

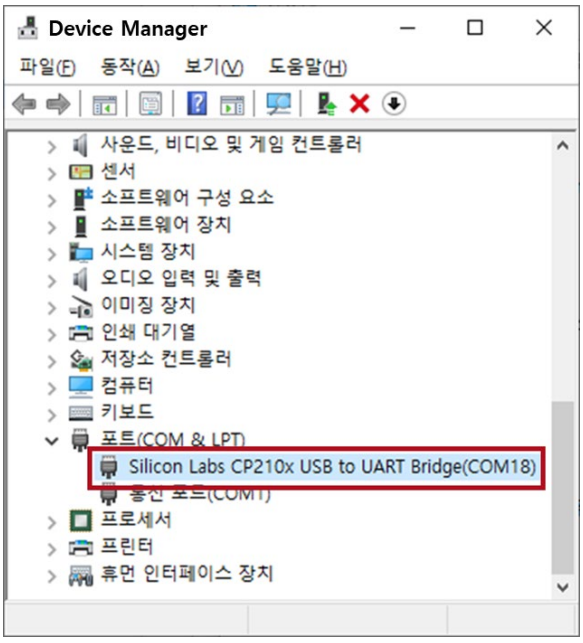


▶ USB Connection method 1



▶ USB Connection method 2

3.2.1 USB Connection Method 1



(1)

(2)

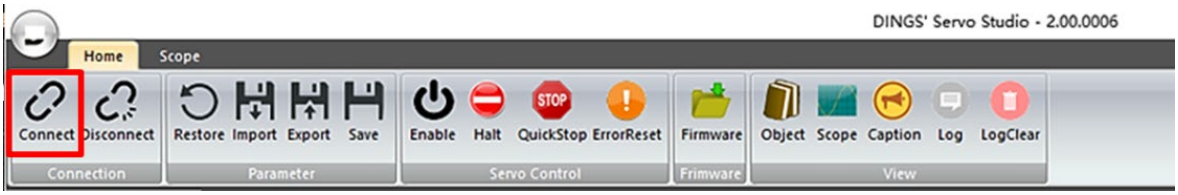
(3)

(4)

(5)

(1) Connect PC and servo drive with USB cable

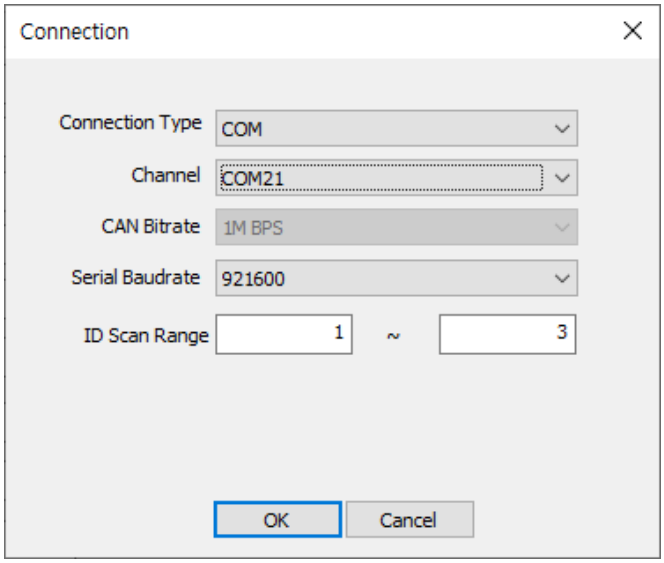
(2) After executing DINGS Servo Studio, click the [Connect] button on the Ribbon Bar.



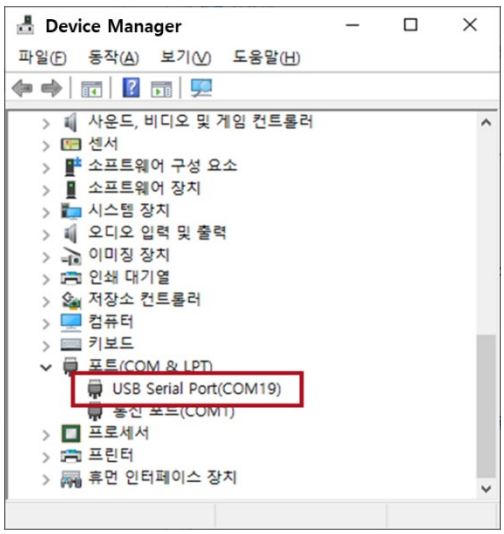
(3) In the Connection window, select the Connection Type as COM

(4) Select Channel & Serial Baud rate then click OK Button (Default: 3Mbps)

If the connection is not possible at 3Mbps, change the serial transmission speed to 921600 bps and connect

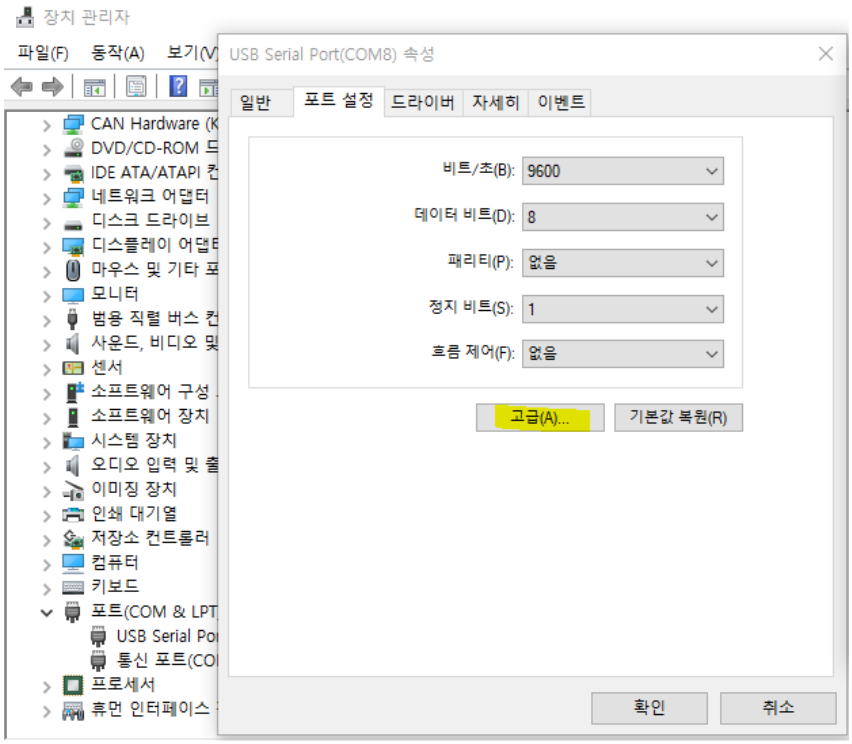


3.2.2 USB Connection Method 2

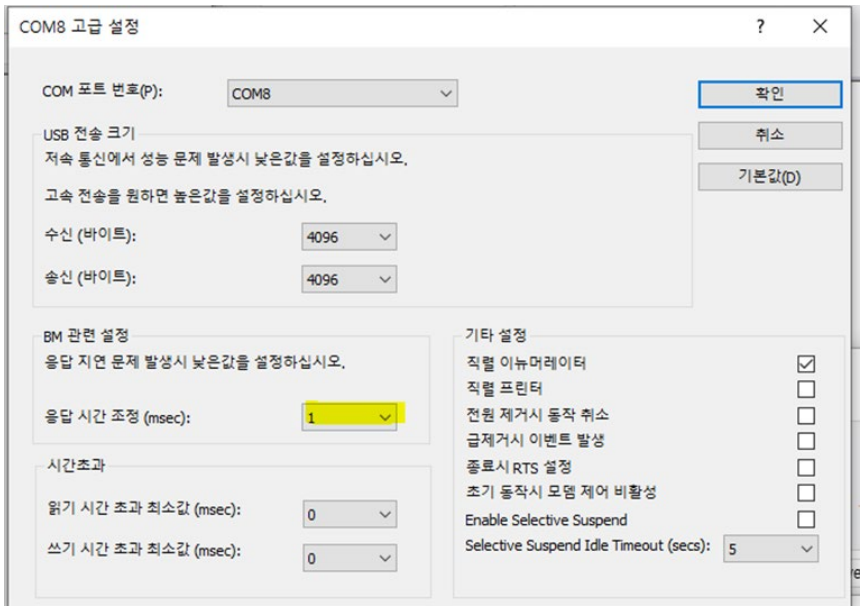


(1) Connect PC with drive USB cable

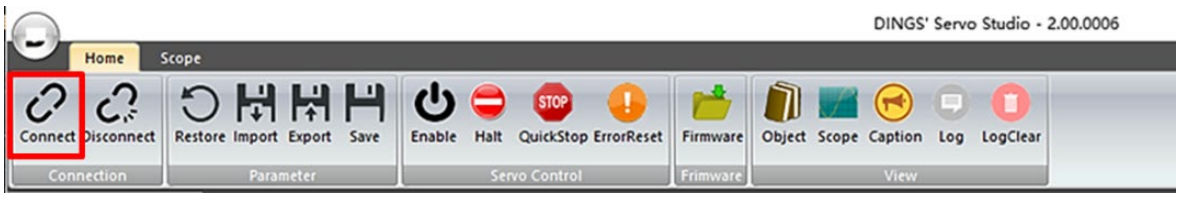
(2) Select [Device Manager]-[Port]-[USB Serial Port Properties]-[Port Settings]-[Advanced]



(3) Set the response time adjustment in the BM-related settings to 1

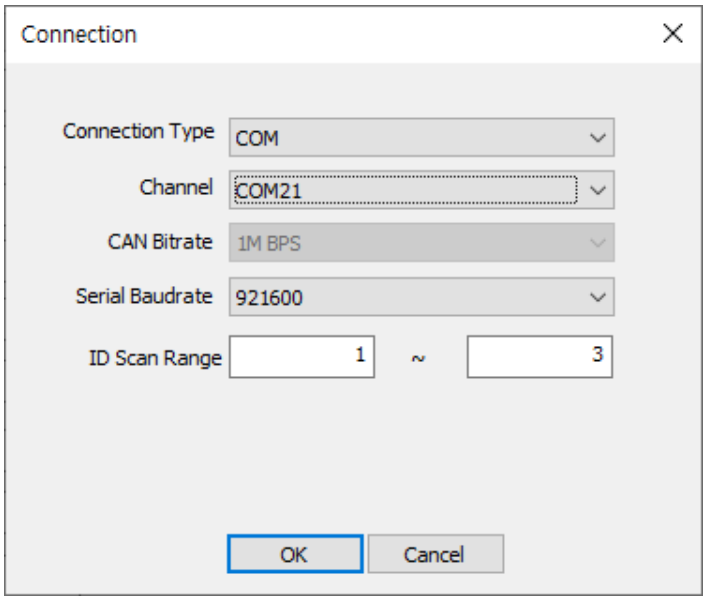


(4) Execute DINGS Servo Studio and click [Connect] in the Ribbon Bar



(5) Select COM for the Connection Type in the Connection Window

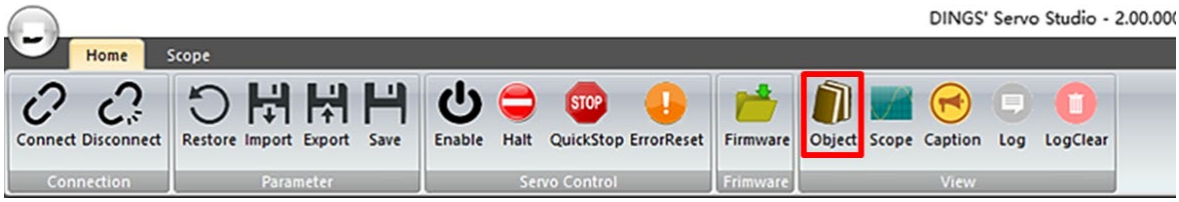
(6) Select Channel, select Serial Baud rate, and click OK (Default: 921600)



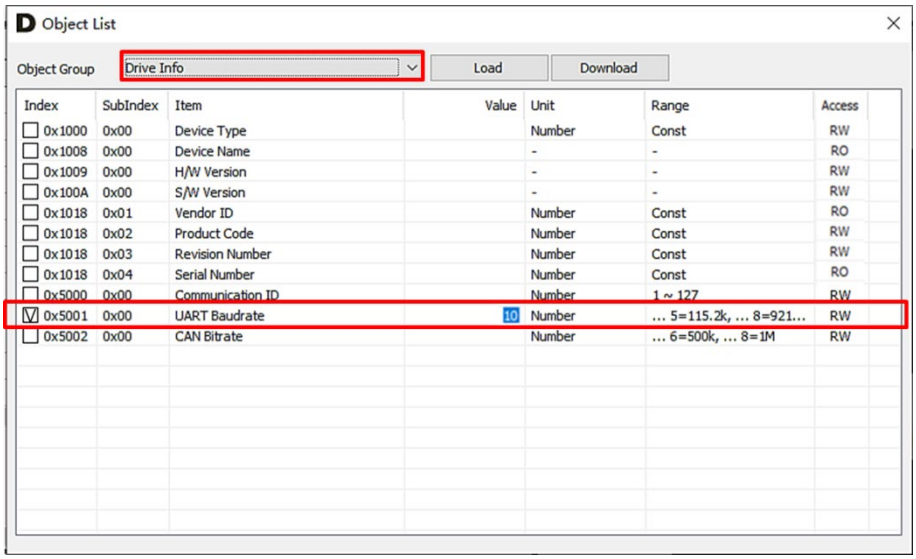
◈ If the USB does not connect, disconnect the USB cable from the USB port and reconnect the cable.

3.2.3 Changing USB Band Rate

(1) Click Object Dictionary



(2) Select Object Group as Drive Info



(3) Modify the USB Baudrate (Index: 0x5001) in the Object List and click the [Download] button.

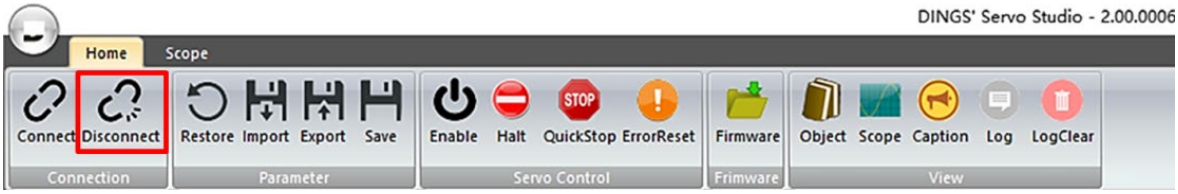
Value	Description
0	None
1	9600 bps
2	19200 bps
3	38400 bps
4	57600 bps
5	115200 bps
6	230400 bps
7	460800 bps
8	921600 bps
9	1 Mbps
10	3 Mbps

(4) Click the [Save] button to save the changed ID

(5) Drive Power OFF -> ON

3.3 Disconnect

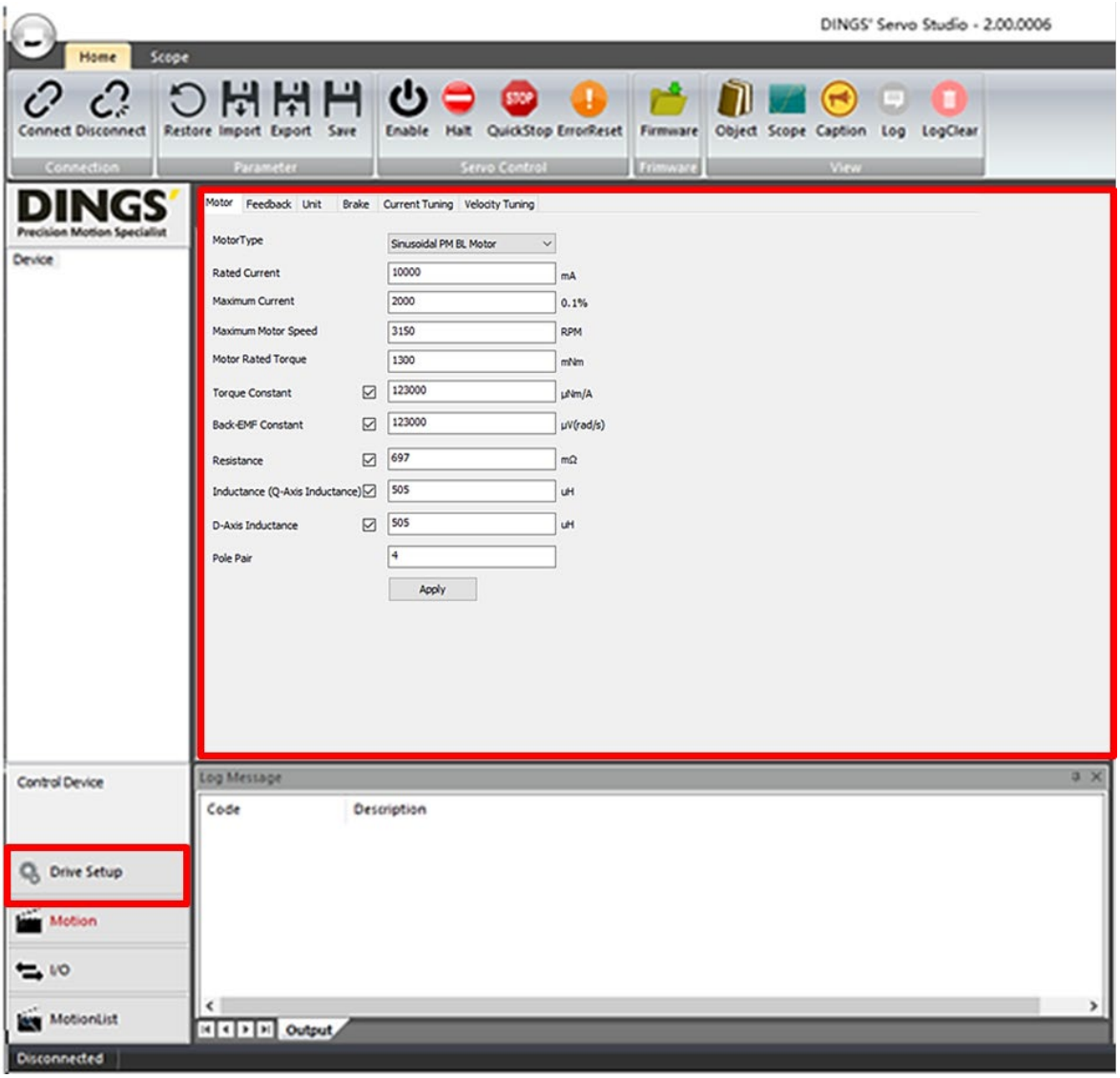
(1) Click [Disconnect] in the Ribbon Bar



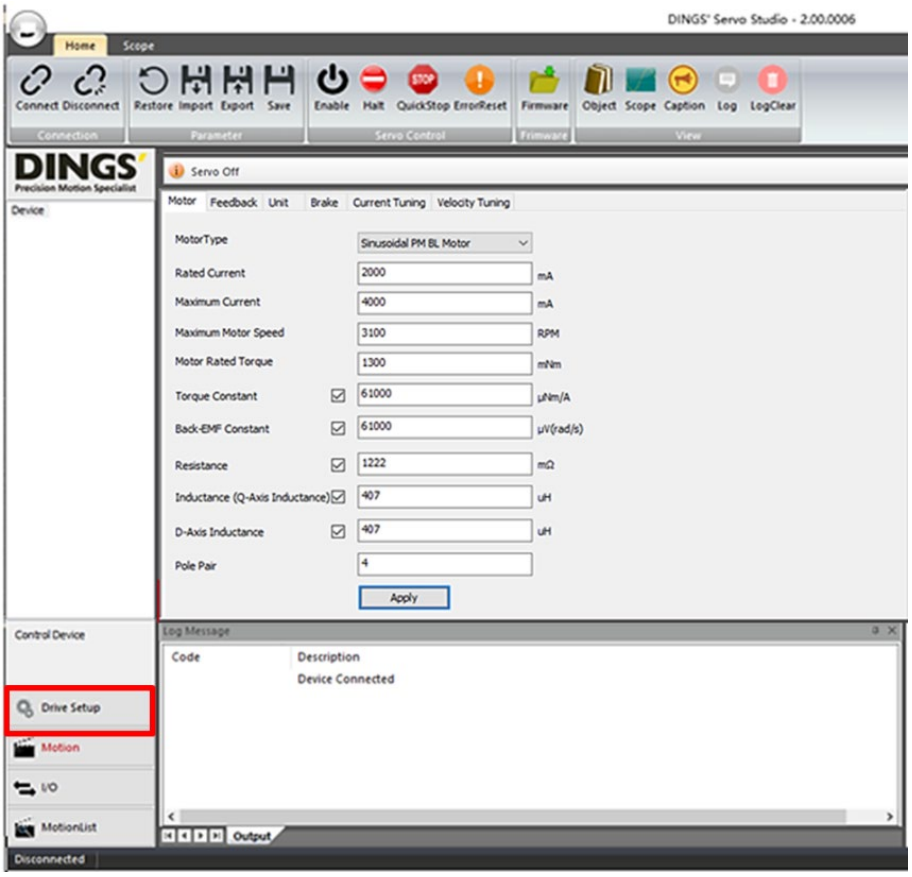
4. Drive Setup

- Motor, Feedback, and Brake Settings

(1) Click [Drive Setup] in the Tool Pane. Set Motor, Feedback, and Brake in the Target Pane.



4.1 Motor Setting



(1) Select the [Motor] tab in Drive Setup

(2) Input motor information

- Please enter the unit carefully
- Motor information with a check box - such as Torque Constant, Back-EMF Constant, Resistance, and Inductance - is checked when the motor specifications are known and data is entered
- Torque Constant and Back-EMF Constant are automatically changed to the values calculated by the following formula when the check box is cleared.
- Torque Constant (μNm/A or μN/A)
  = Motor Rated Torque (mNm or mN) x 1000 / Rate Current (mA) x 1000
- Resistance, Inductance (Q-Axis Inductance) and D-Axis Inductance are automatically measured during Current Auto Tuning. The values do not need to be entered separately.
- If there is no Back-EMF Constant in the motor specification, input the same value as

Torque Constant.

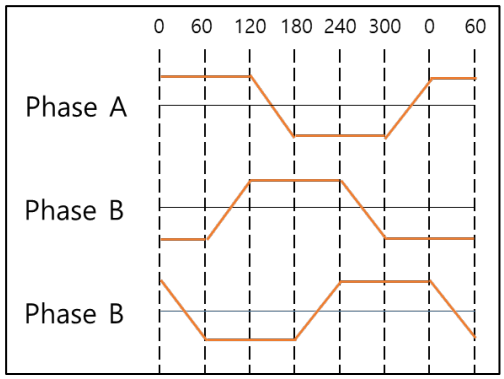
- Pole is the number of poles of a permanent magnet, and the number of pole pairs is half of the number of poles.

(3) After inputting the motor information, click [Apply] to apply the motor information to the drive.

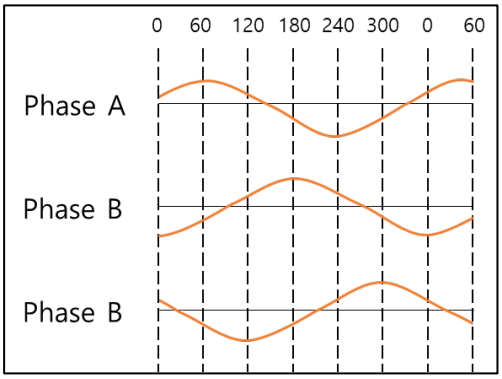
(4) To save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

4.1.1 Refer to Motor Type

- Brushed DC Motor
  For Rotary DC Motor, select Brushed DC Motor Type.
- Sinusoidal PM BL Motor
  Synchronous brushless motor with sine wave back EMF.
  For Rotary PMSM or BLDC Motor, select Sinusoidal PM BL Motor Type
- Trapezoidal PM BL Motor
  Synchronous brushless motor type with trapezoidal back EMF.
  For Rotary BLDC Motor, select Trapezoidal PM BL Motor Type.
- Linear Brushed DC Motor
  For Linear DC Motor, select Linear Brushed DC Motor Type
- Linear Sinusoidal PM BL Motor
  Synchronous brushless motor with sine wave back EMF
  For linear PMSM or BLDC motors, select the linear sinusoidal PM BL motor type.
- Trapezoidal PM BL Motor
  Synchronous brushless motor type with trapezoidal back EMF.
  For Linear BLDC Motor, select Linear Trapezoidal PM BL Motor Type.
- Linear Voice Coil Motor
  It is the same as the principle of a permanent magnet speaker. When a current flows through a coil of a magnetic field by a permanent magnet, a force is generated and it goes straight.



[Trapezoidal Back-EMF]



[Sinusoidal Back-EMF]

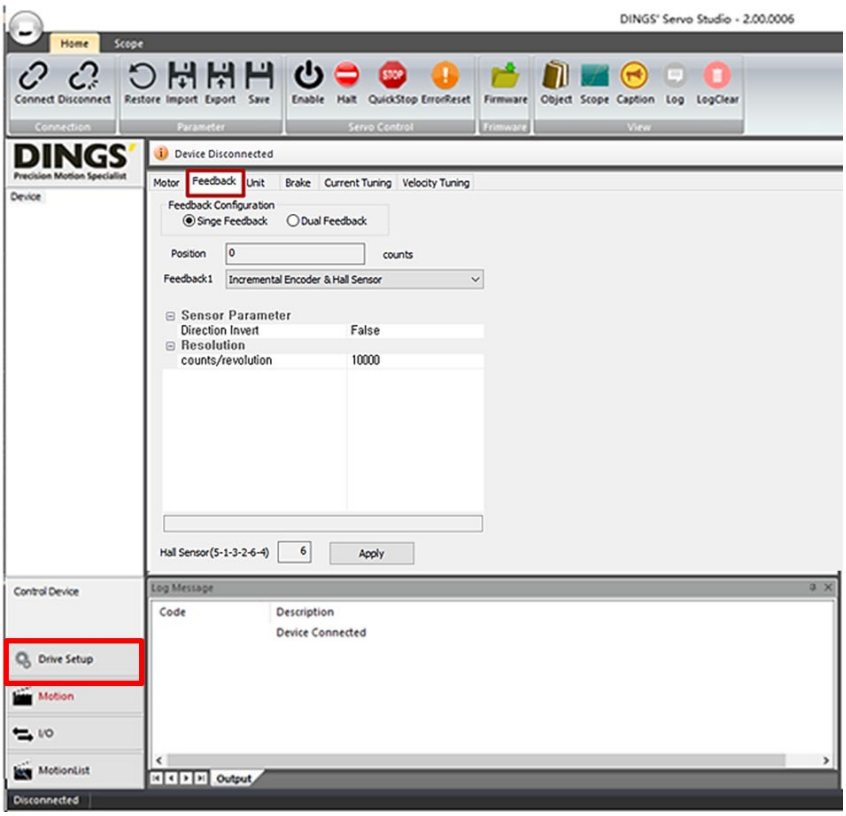
4.1.2 Motor information input example

(1) Sinusoidal PM BL Motor

Motor Manual		DINGS' Servo Studio Parameter	
Item	Value [unit]	Item	Value [unit]
Motor Type	Rotary Servo Motor	Motor Type	Rotary Sinusoidal PM BL Motor
Rated Current	5.2 [A]	Rated Current	5200 [mA]
Peak Current	15.6 [A]	Maximum Current	15600[mA]
Motor Rated Torque	0.32 [Nm]	Motor Rated Torque	320 [mNm]
Torque Constant	0.061 [Nm/A]	Torque Constant	61000 [uNm/A]
Voltage Constant	3.8 [V(rms)/Krpm]	Back_EMF	3.3/(2π/60*1000) = 61000 [V/(rad/s)]
Poles	8	Pole Pair	4
Winding Resistance	0.48 [Ω]	Resistance	480 [mΩ]
Winding Inductance	0.58 [mH]	D Axis Inductance	580 [uH]
		Q Axis Inductance	580 [uH]

- Maximum Current =15.6 (Peak Current) / 5.2 (Rated Current) x 1000
- Torque Constant =
- 320 mNm (Motor Rated Torque) x 1000 / 5200 mA (Rated Current) x 1000
- Back-EMF Constant = Torque Constant
- Pole Pair = 4 (8 Pole Motor)

4.2 Feedback Setting (Encoder)



(1) Select the [Feedback] tab in Drive Setup

(2) Select Single Feedback or Dual Feedback

- When using Dual Feedback, Feedback1 is used for voltage, current, and speed control. Feedback2 is used for position control.

(3) Input Feedback Information

- Position displays the current position value
- Select Feedback Type. (Refer to the next page for setting according to Feedback Type)
- When Direction Invert is set to true, the direction of the position data is reversed.
- When using Incremental Encoder, set the resolution to CPR: Count per Revolution.
  In the case of Rotary Motor, resolution is set in units of count/revolution. For linear motor, it is set in count/m unit (1 um, 1,000,000 setting)
  PPR(Pulse per Revolution) * 4 = CPR(Count per Revolution)

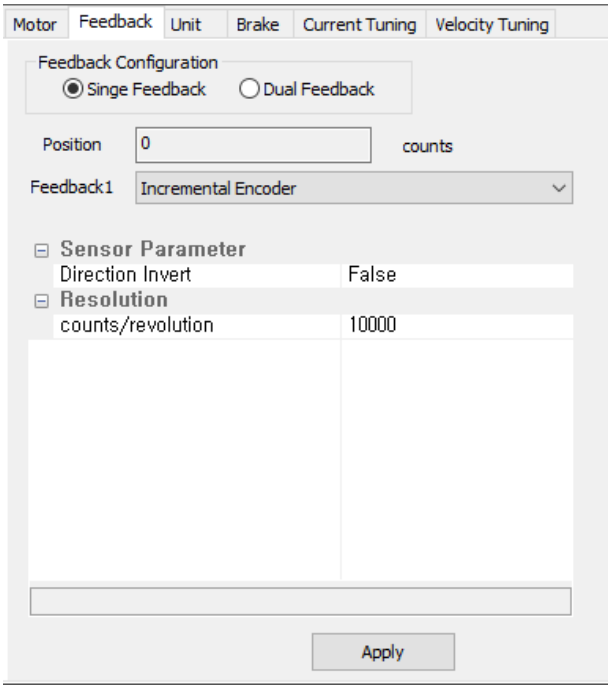
(4) After inputting the feedback information, click [Apply] to apply the feedback information to the drive.

(5) To save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

4.2.1 Setting according to Feedback Type

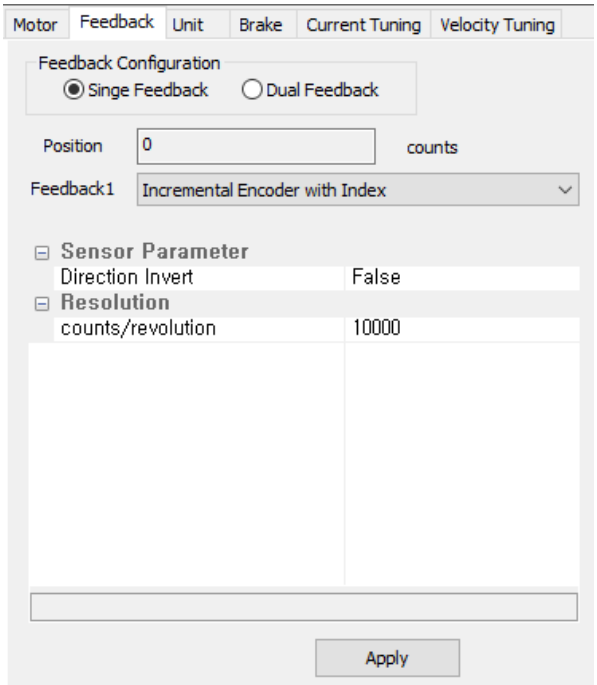
(1) Incremental Encoder

Incremental Encoder is a position sensor that measures the amount of change in position by receiving A and B phases.



(2) Incremental Encoder with Index

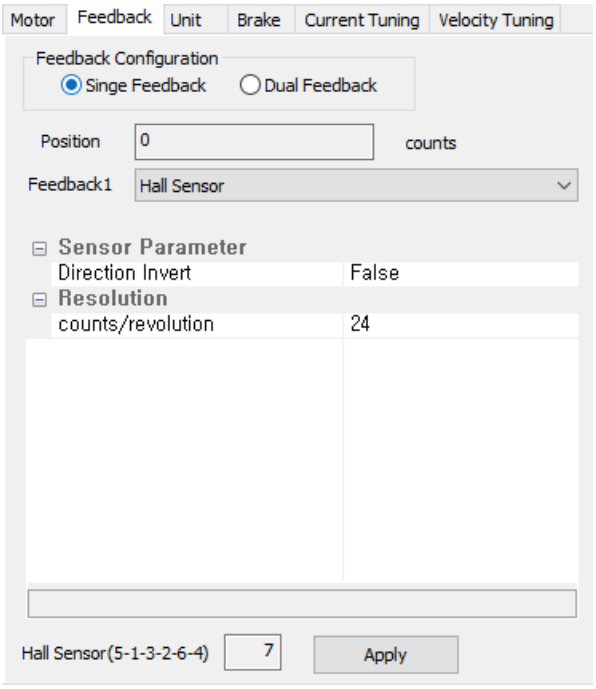
It uses Incremental Encoder and Index pulse, and Index pulse provides a single pulse per rotation.



(3) Hall Sensor

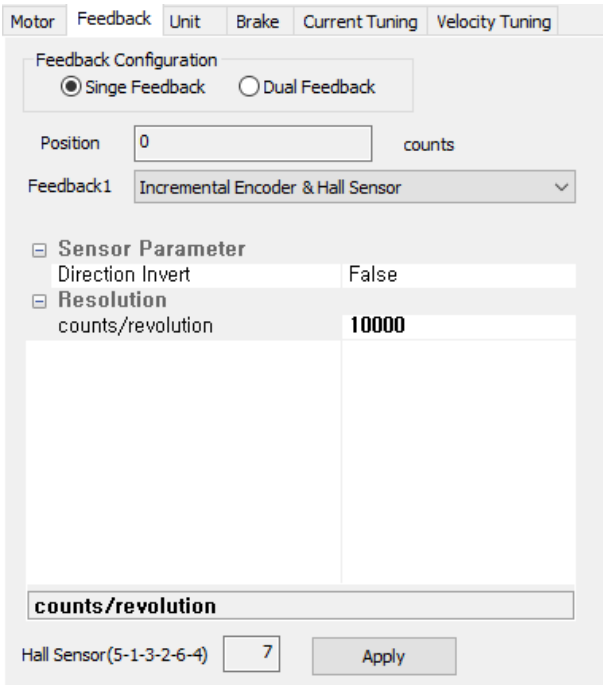
Only Hall Sensor is used as Feedback.

Resolution = Pole pair x 6 is automatically set. (Pole Pair is set in the Motor setting window)



(4) Incremental Encoder & Hall Sensor

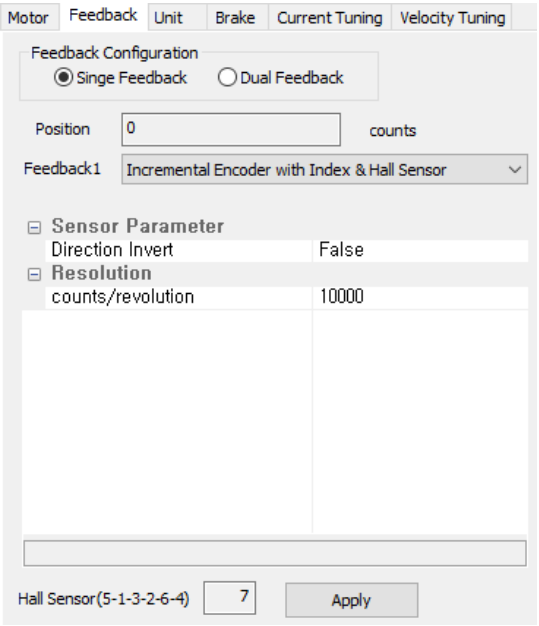
As Feedback, Incremental Encoder and Hall Sensor are used. Hall sensor is used to find the initial electric angle of the motor



When moving the motor, Hall sensor data must be changed in the order of 5-1-3-2-6-4 or 4-6-2-3-1-5 for proper operation.

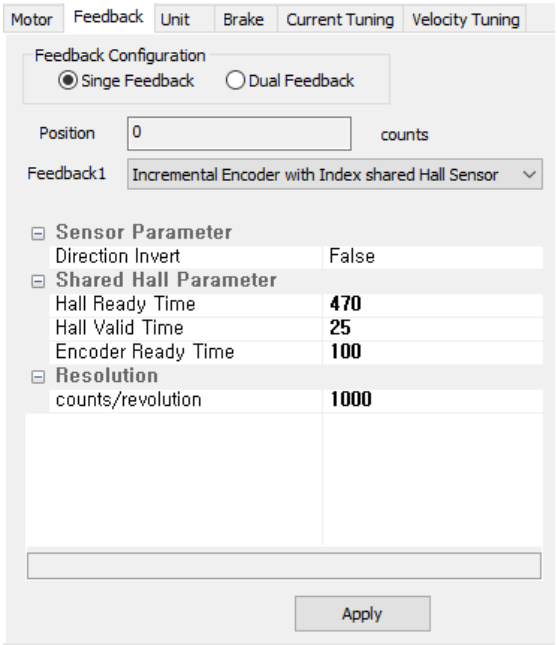
(5) Incremental Encoder with Index & Hall Sensor

Hall Sensor is used to find the initial electric angle of the motor. Other than that, it is the same as Incremental Encode with Index encoder.



When moving the motor, Hall sensor data must be changed in the order of 5-1-3-2-6-4 or 4-6-2-3-1-5 for proper operation.

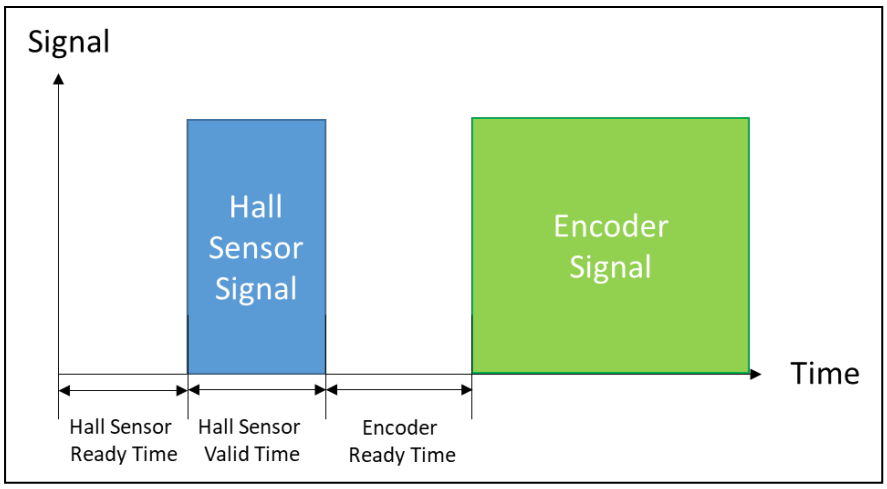
(6) Incremental Encoder with Index shared Hall Sensor



It is an encoder in which Hall Sensor signal and Encoder with Index signal are output on the same line. When the power is applied, the Hall sensor signal is output for a certain period of time and then the encoder signal is output.

In general, the index signal and the electric angle 0 degree are matched to accurately detect the electric angle.

Set Hall Ready Time, Hall Valid Time, Encoder Ready Time(refer to the following figure)



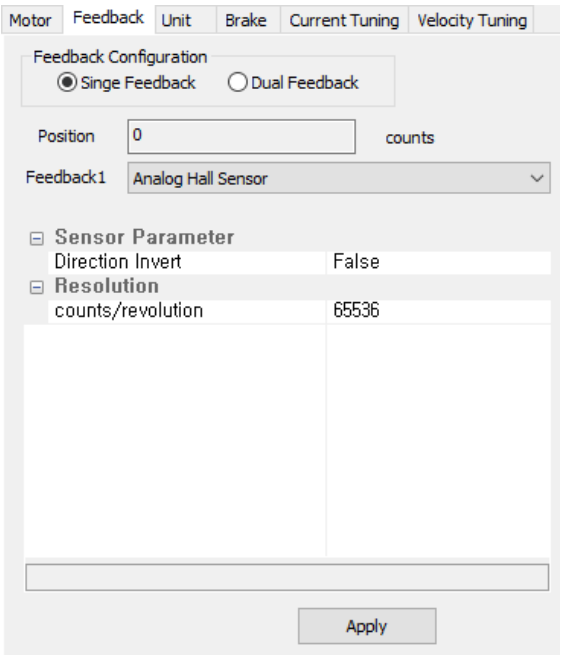
(7) Analog Hall Sensor

When Feedback is selected as Analog Hall Sensor, the resolution is automatically calculated as follows.

Rotary Motor: Resolution = (16384 * Pole Pair)

Linear Motor: Resolution = 16384 * (1000/Magnetic Pitch)

Analog Hall sensor signals have different signal levels (voltage) depending on the product or product status, so the motor must be moved manually so that the analog Hall sensor signals can change one or more cycles. When the motor moves, the drive finds the maximum/minimum value of the signal.



(8) Sin/Con Encoder

If you select Sin/Con Encoder as Feedback and input Sin/Cos Pitch information, the resolution is automatically calculated as follows.

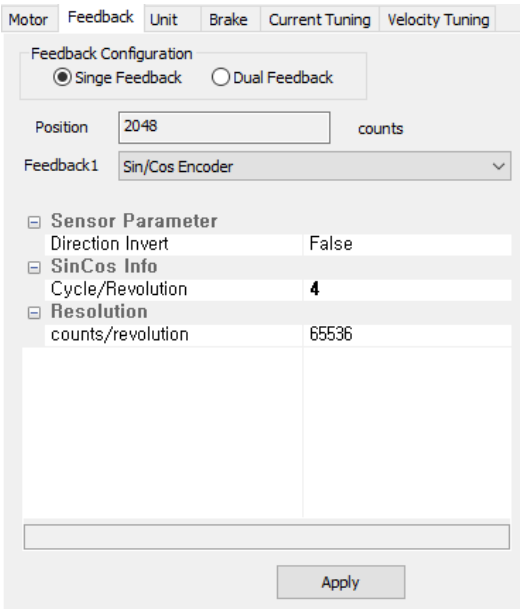
Rotary Motor: Resolution= (16384 * (SinCos Cycle/Revolution))

Linear Motor: Resolution = (16384 / (Pitch/ SinCos Cycle)) x 1000000

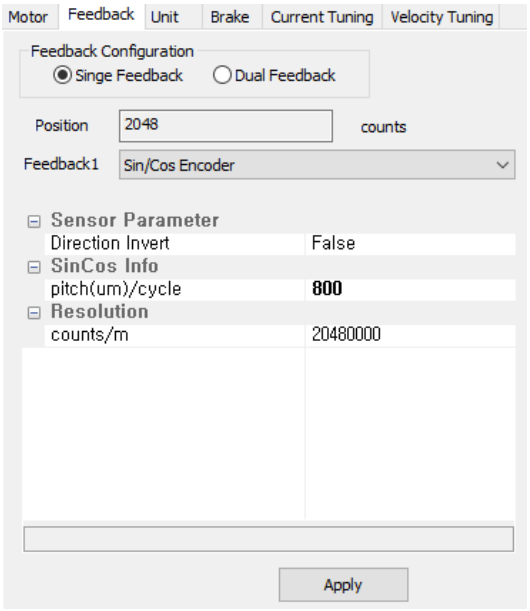
The signal of Sin/Cos encoder has different signal level (voltage) according to the product or product status, so you need to move the motor manually so that the sin/Cos encoder signal can change more than one cycle.

When the motor moves, the drive finds the maximum/minimum value of the signal.

In order to use the index signal as a home signal in a linear system, the motor must be moved until the index signal is detected.



[Rotary Motor]



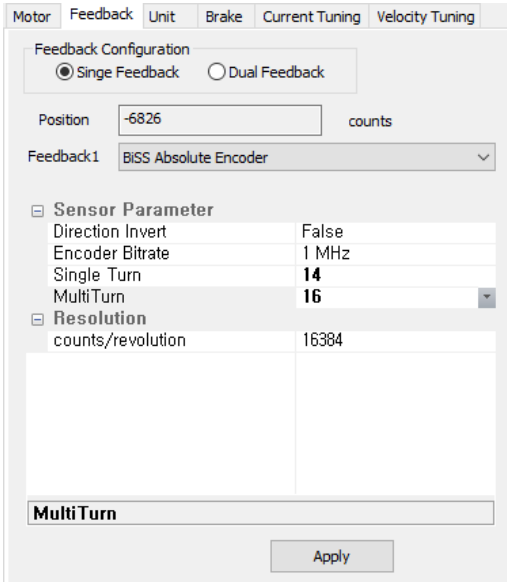
[Linear Motor]

(9) BiSS Absolute Encoder

If Single Turn and Multi Turn information is selected, the resolution is automatically calculated as 2^(Single Turn).

If only single turn is used, multi turn is set to 0.

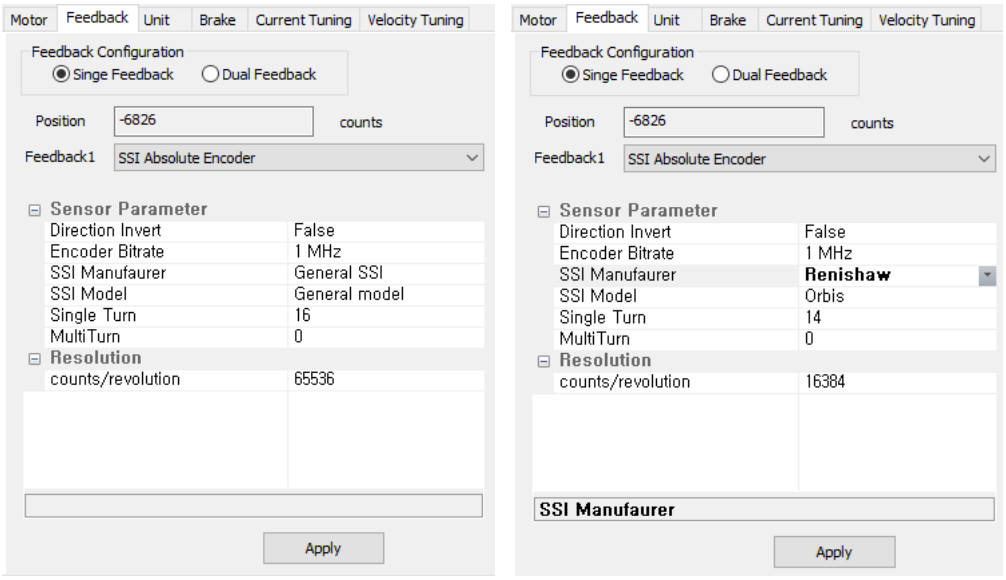
Encoder Bitrate should be set below the speed allowed by the product.



(10) SSI Absolute Encoder

- SSI has different protocols for each manufacturer, so the supported models are limited. The supported models are as follows.
  - General SSI-SSI encoder using only data without using Status bit
  - SIKO-NSA111C
  - Renishaw-Orbis

  Select the corresponding [SSI Manufacturer] and [SSI Mode], and select Single Turn and Multi Turn.



(11) Dual Feedback encoder correspondence table

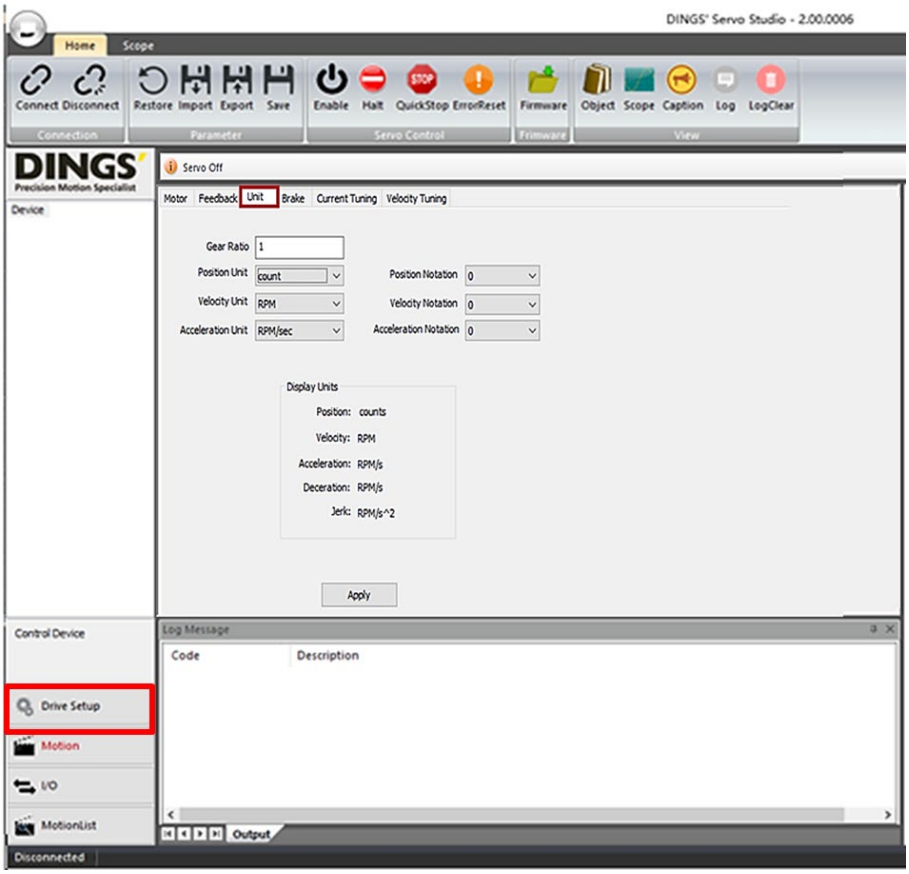
- Encoder correspondence table that can be used with dual feedback

Feedback2 / Feedback1	Incremental Encoder	Incremental Encoder with Index	Hall Sensor	Sin/Cos Encoder	BiSS/SSI	Analog Hall Sensor
Incremental Encoder	O	O	X	O	O	O
Incremental Encoder with Index	O	O	X	O	O	O
Incremental Encoder & Hall Sensor	O	O	X	O	O	O
Incremental Encoder with Index & Hall Sensor	O	O	X	O	O	O
Incremental Encoder with Index shared Hall Sensor	O	O	X	O	O	O
Sin/Cos Encoder	O	O	X	X	O	O
BiSS/SSI	O	O	X	O	X	X
Analog Hall Sensor	O	O	X	X	O	X
TAMAGAWA Encoder	O	O	X	O	X	X

- When using dual feedback, only one encoder with Hall sensor can be selected.

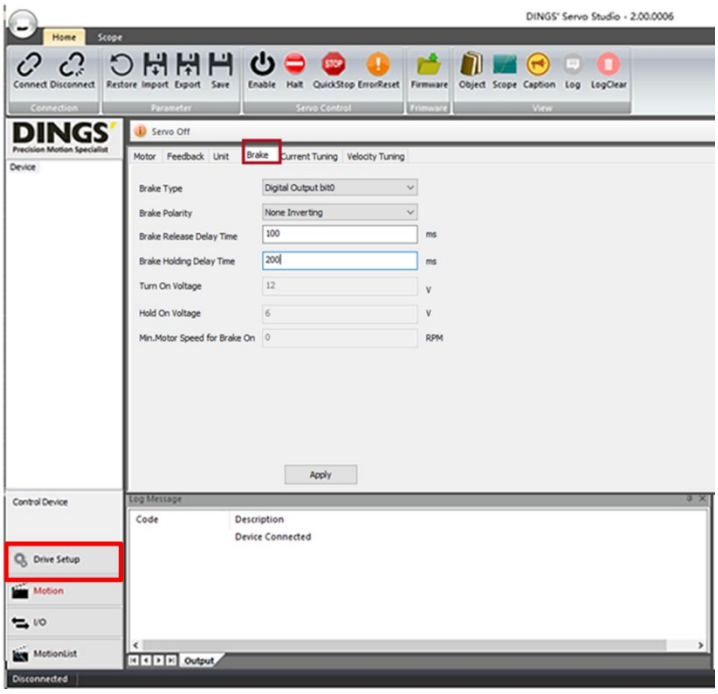
4.3 Unit Setting

- Unit of data can be set by changing Unit and Notation.
- Express the exponent by setting Notation.
- Click the [Apply] button to check the data unit set in the Display Unit.



- For rotary motors:
  - Position Unit: Count, degree can be selected. ex) If Position Unit is selected as degree and Notation is -3, Position data unit is deg*10^-3. If the position data is 1 deg*10^-3, it means 1000 degree.
  - Velocity Unit: RPM, degree/sec selectable
  - Acceleration Unit: RPM/sec, degree/sec^2
- For linear motors:
  - Position Unit: Selectable count or meter. Ex) If you select meter for Position Unit and -3 as Notation, the unit of Position data is mm.
  - Velocity Unit: Unit meter/sec is used, change notation to select m, cm, mm
  - Acceleration Unit: Unit meter/sec^2 is used, if notation is changed, it can be selected in units of m, cm, and mm

4.4 Brake Setting



(1) Select the [Brake] tab in Drive Setup

(2) Input the Brake information

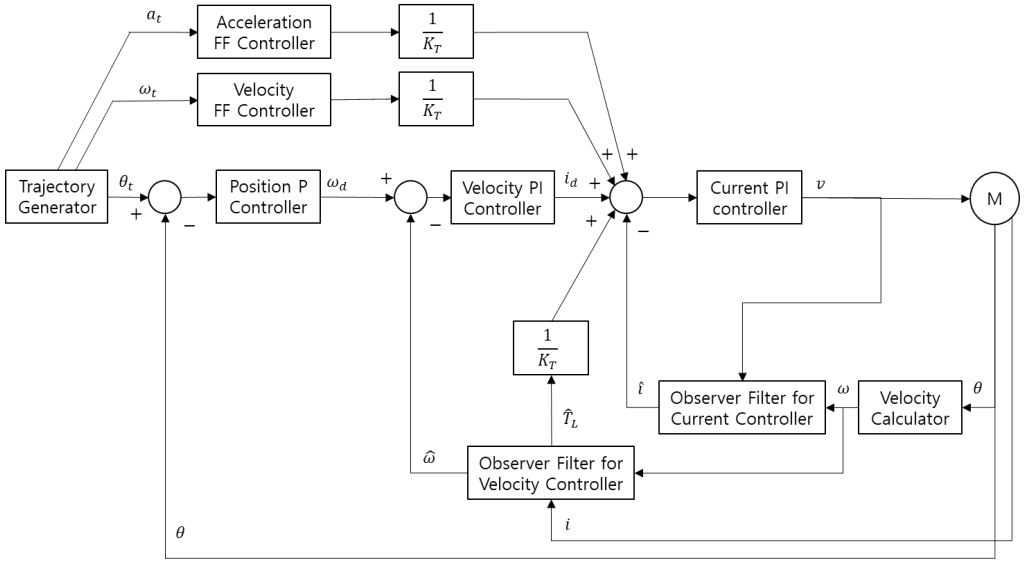
- Select Brake Type
  - None: No brake is used
  - Digital Output bit0: Sends a signal to Digital output bit0 to Servo on/off.
  - Voltage Control: When Servo On, the set voltage of Turn on voltage is output to the brake output terminal, and the set voltage of Hold on voltage is maintained after 1 second
- Brake Polarity: Non Invert is set as default
  - Non Invert: Digital output signal goes high when Servo On, and digital output signal goes low when Servo Off.
  - Invert: Digital output goes Low when Servo On, and Digital output goes High when Servo Off.
- Brake Release Delay Time: Set the time to release the brake after Servo On is commanded. (If set to 100, release the brake after 100msec after Servo on.)
- Brake Holding delay Time: Set the time to Servo Off after the brake is held when Servo Off is commanded.(If set to 100, the brake is maintained and the servo turns off after 100msec)

(3) After inputting the brake information, click [Apply] to apply the brake information to the drive.

(4) To save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

5. Tuning

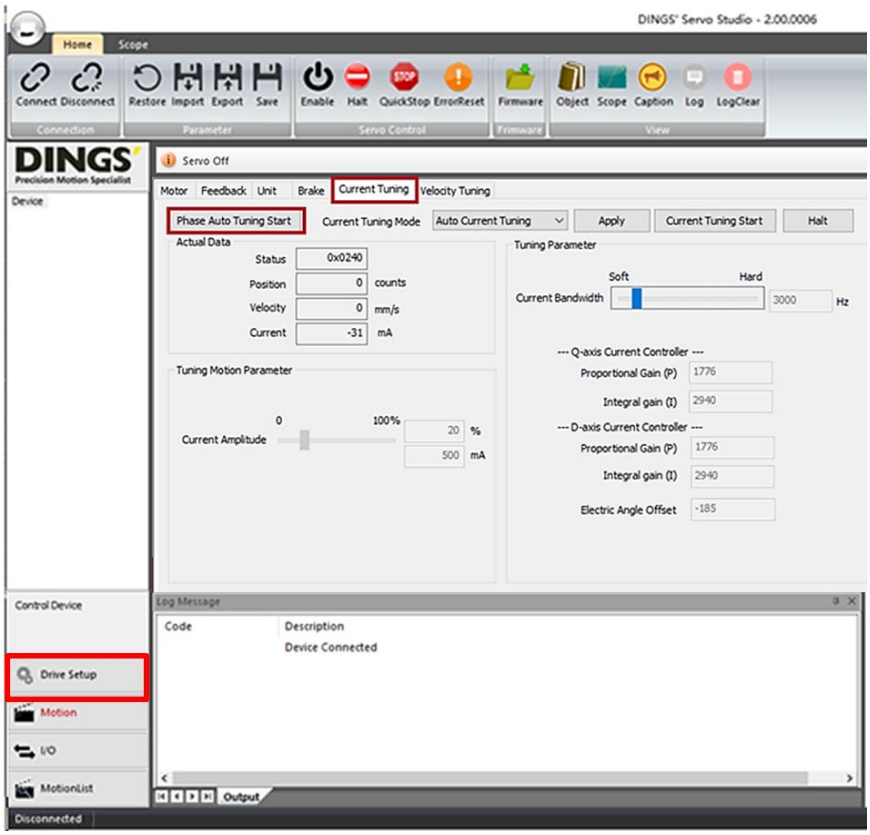
- The drive consists of three types of control loops: position loop, velocity loop and current loop.



- Bandwidth is the control period inside the servo drive. Bandwidths are determined by the minimum/maximum values by the control period.
- The higher the bandwidth, the higher the gain of the controller, so the control response can be increased. However, if this value is too large, it may cause noise or vibration, so you need to set an appropriate bandwidth for your system.
- Before tuning, proceed after checking whether motor information is correctly entered.

5.1 Phase Auto Tuning

- When using DC Motor or VCM, skip Phase Auto Tuning.
- Phase Auto Tuning automatically finds the UVW phase of the motor.
- The algorithm to find the phase is different according to the type of feedback sensor.
- In the case of a system with high friction due to a load installed outside the motor, an error may occur between the measured electric angle and the actual electric angle, resulting in a decrease in output torque efficiency. Therefore, it is recommended to proceed without external load when performing Phase Auto Tuning.



(1) Select the [Current Tuning] tab in Drive Setup

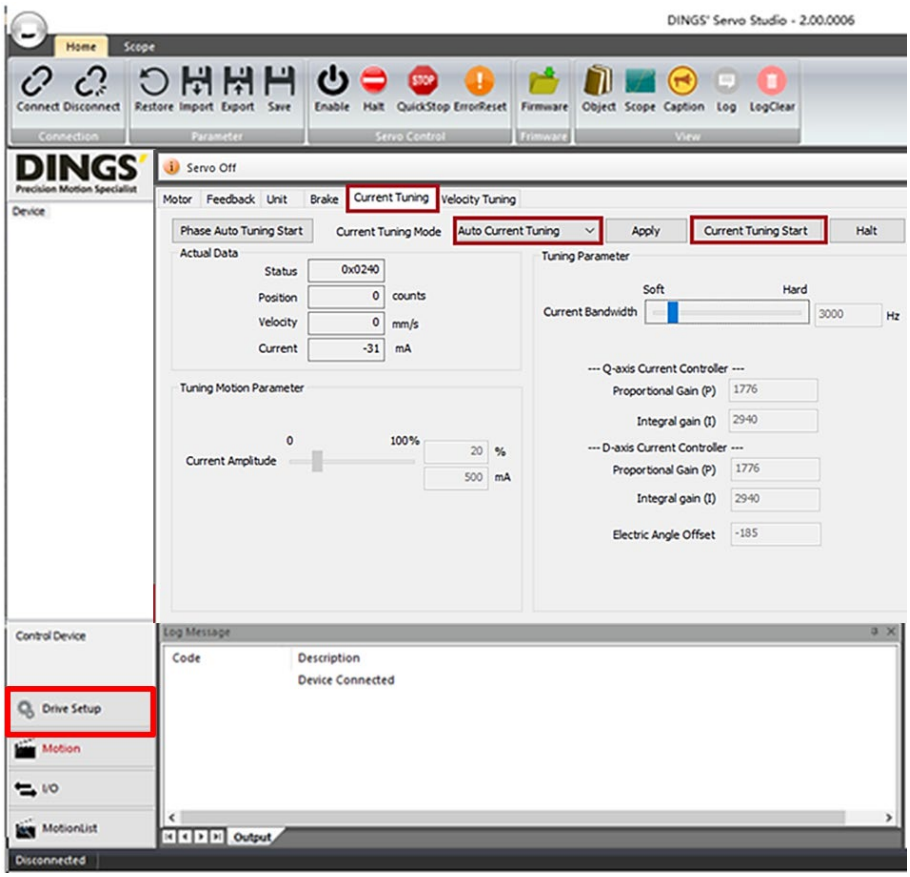
(2) Click [Phase Auto Tuning]. Click [Yes] in the pop-up window to start the motor and execute Phase Auto Tuning.

- Search for Motor Phase, Position Sensor1 Polarity, and Electrical Angle Offset while forcibly moving the motor. For details on each item, see the reference manual.

(3) When tuning is completed, a message window appears.

5.2 Current Tuning

5.2.1 Auto Current Tuning



(1) Select the [Current Tuning] tab in Drive Setup

(2) Select Current Tuning Mode as Auto Current Tuning.

(3) Adjust the Current Controller Bandwidth using the slide bar

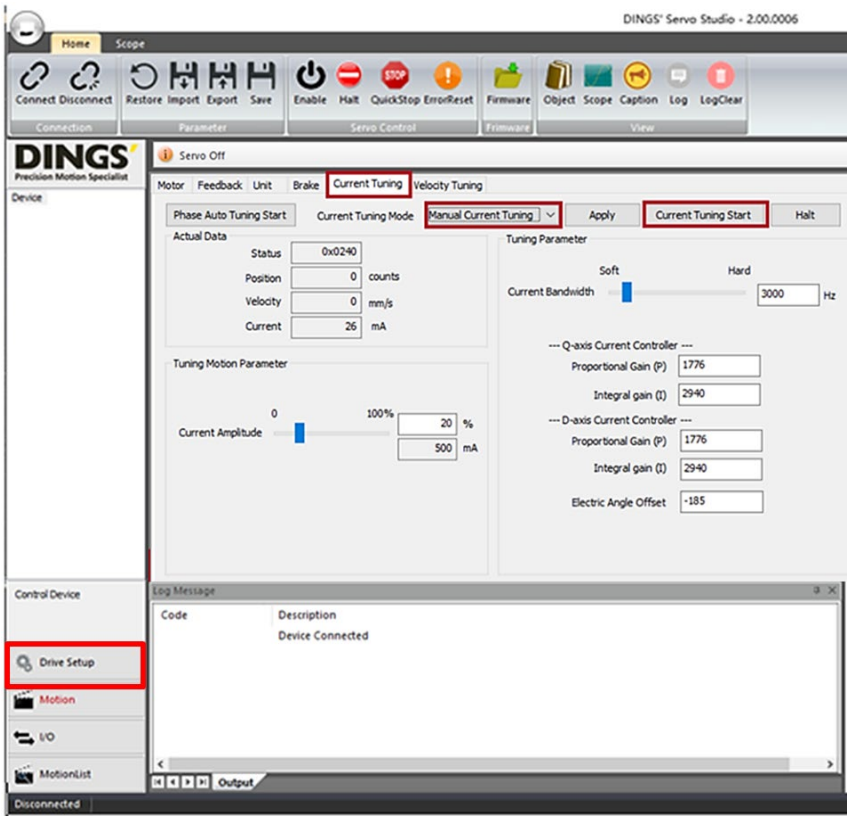
- Current Controller Bandwidth sets the responsiveness of Current Controller
- Motor information is corrected by estimating resistance and inductance during current tuning.
- P and I Gain are calculated from resistance, inductance, and bandwidth.
- The higher the bandwidth, the better the responsiveness, but noise and vibration may occur. The lower the bandwidth, the less the noise and vibration but the less responsiveness.

(4) Click [Current Tuning Start]. Click [Yes] in the pop-up window to start the motor and execute Current Auto Tuning.

(5) When tuning is completed, a message window appears

(6) To save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

5.2.2 Manual Current Tuning



(1) Select the [Current Tuning] tab in Drive Setup

(2) Select Current Tuning Mode as Manual Current Tuning.

(3) Adjust the slide bar of Current Amplitude of Tuning Motion Parameter. Current Amplitude is set by default as a current value of 20% of the rated current, and it is repeatedly driven with the set Current Amplitude.

(4) Adjust the Current Controller Bandwidth by using the slide bar or directly input the Gain value.

- Current Controller Bandwidth sets the responsiveness of Current Controller.
- The higher the bandwidth, the better the responsiveness, but noise and vibration may occur. The lower the bandwidth, the less the noise and vibration but the less responsiveness.

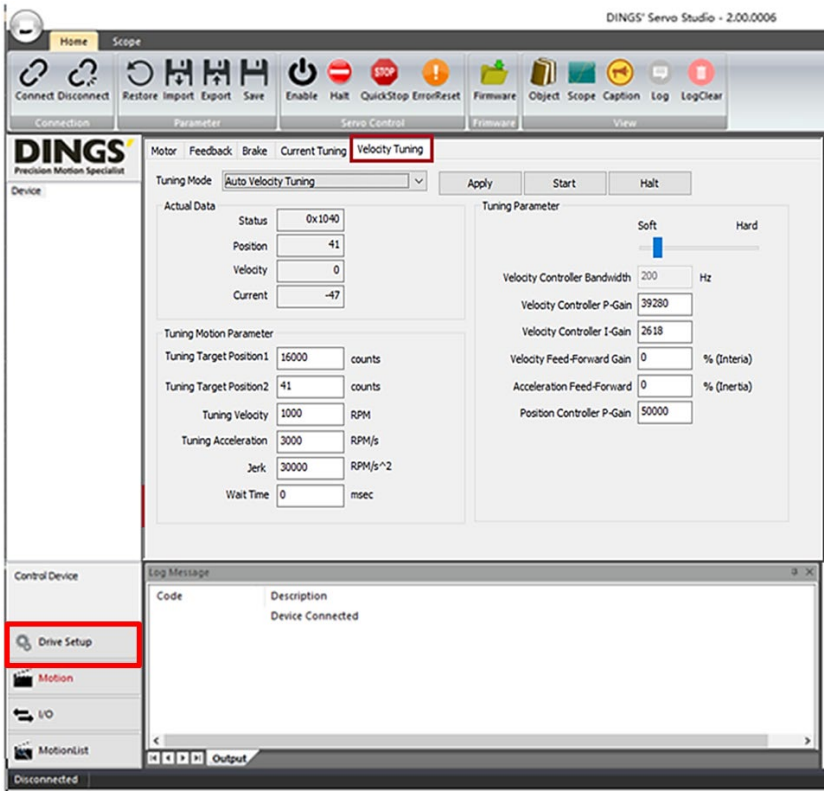
(5) Click the [Apply] button and then the [Current Tuning Start] button. If you click the [Yes] button in the pop-up window, it runs repeatedly with the set Current Amplitude.

(6) At this time, perform current tuning by changing the Current Controller Bandwidth or Gain value. After changing the value, it is applied to the drive only by clicking the [Apply] button.

(7) When tuning is complete, press the [Halt] button to stop the motor.

(8) To save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

5.3 Velocity Tuning



5.3.1 Velocity Auto Tuning Mode

(1) Select [Auto Velocity Tuning] for the Tuning Mode in the [Velocity Tuning] tab.

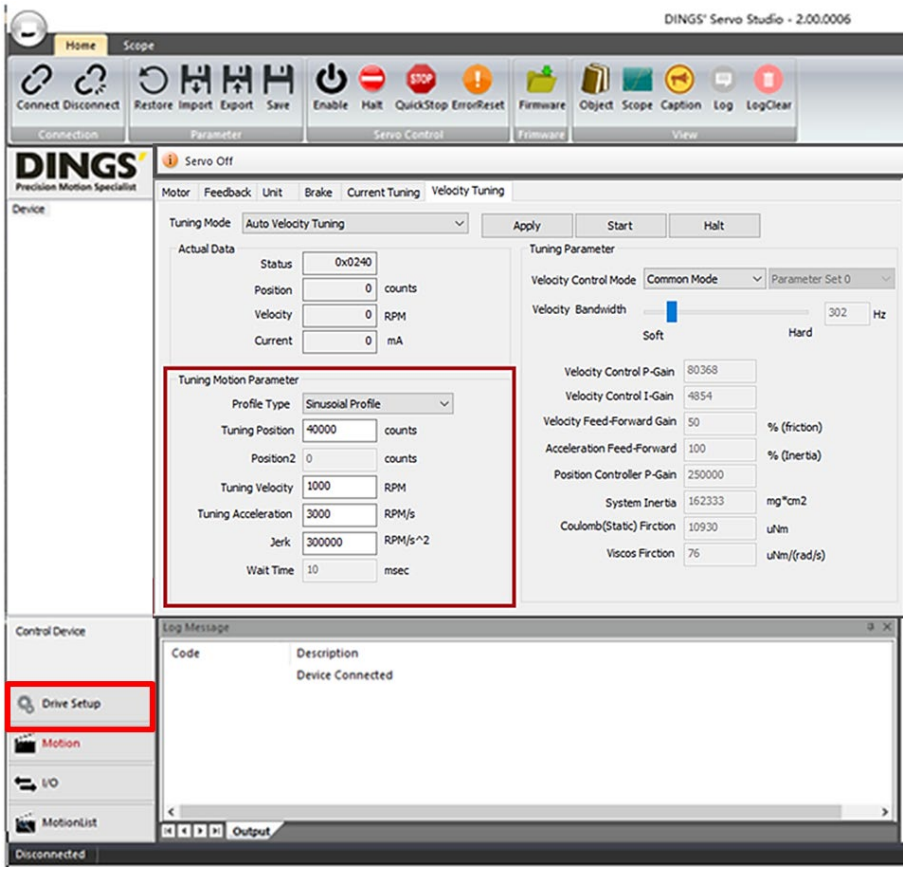
(2) Input Tuning Motion Parameter. Input Target Positions, Velocity, and Acceleration values of the Profile Position Motion. In Velocity Auto Tuning, it operates only with trapezoidal profile. (±Move as much as Target Position1 value set based on the current position)

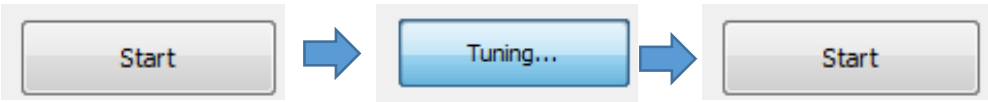
(3) Adjust the Velocity Controller Bandwidth using the slide bar.

- If you change the bandwidth, the Velocity Controller P-Gain and I-Gain values are changed.
- The Gains are calculated by Torque Constant, Inertia, and Bandwidth.
- Velocity Controller Bandwidth determines how quickly the Velocity Controller responds to changes in the controlled velocity.
- If the inertia of the system is high, set a high bandwidth within a range that does not vibrate. (In a system with a large inertia, it is recommended to operate by increasing the Velocity Bandwidth from 100Hz. If vibration occurs even after setting to 100Hz, it should be run gradually lowering it)

- Hard Bandwidth increases the response speed of the system, but the system becomes unstable.

(4) Click [Apply] and then [Start] to execute Velocity Auto Tuning.

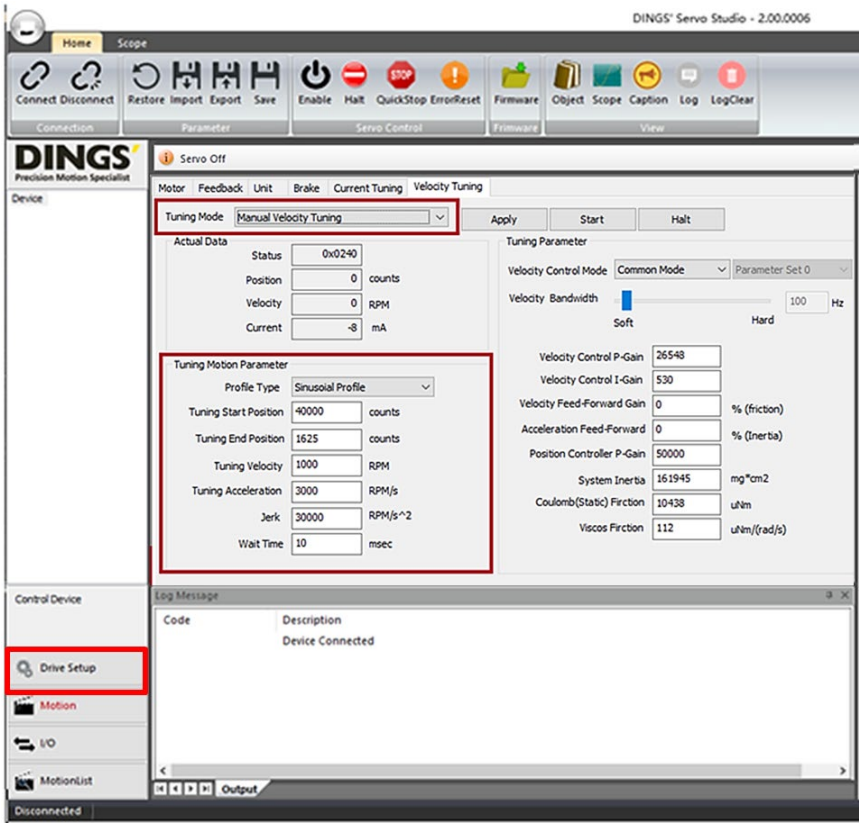




(5) As Auto Tuning starts, the [Start] button changes to Tuning, and once Tuning is completed, it changes back to Start.

(6) Once Tuning is completed, to save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

5.3.2 Manual Velocity Tuning



(1) Select Manual Velocity Tuning for the Tuning Mode in the Velocity Tuning tab.

(2) Input Tuning Motion Parameters. Input the Target Position, Acceleration, Velocity, jerk, and wait time values of Profile Position Motion to be executed during tuning. When using the trapezoidal profile, the value of Jerk is ignored.

(3) Click [Start] to repeatedly drive TargetPosition1 ↔ TargetPosition2.

(4) Use the slider to change Velocity Controller Bandwidth

(5) If the Bandwidth is changed, the Velocity Controller P-Gain and I-Gain values are changed. The values of the PI Gain can be modified directly.

- P-Gain determines the correction signal to reduce the error. As P-Gain increases, the control system response speed increases. However, if the P-Gain is too large, the vibration increases and the system become unstable.
- I-Gain outputs a value proportional to the sum of the accumulated errors. If I-Gain increases, responsiveness increases, but oscillation and instability occur.
- After changing Feed Forward Gain and Position Controller Gain, click the [Apply] button to apply to the drive.

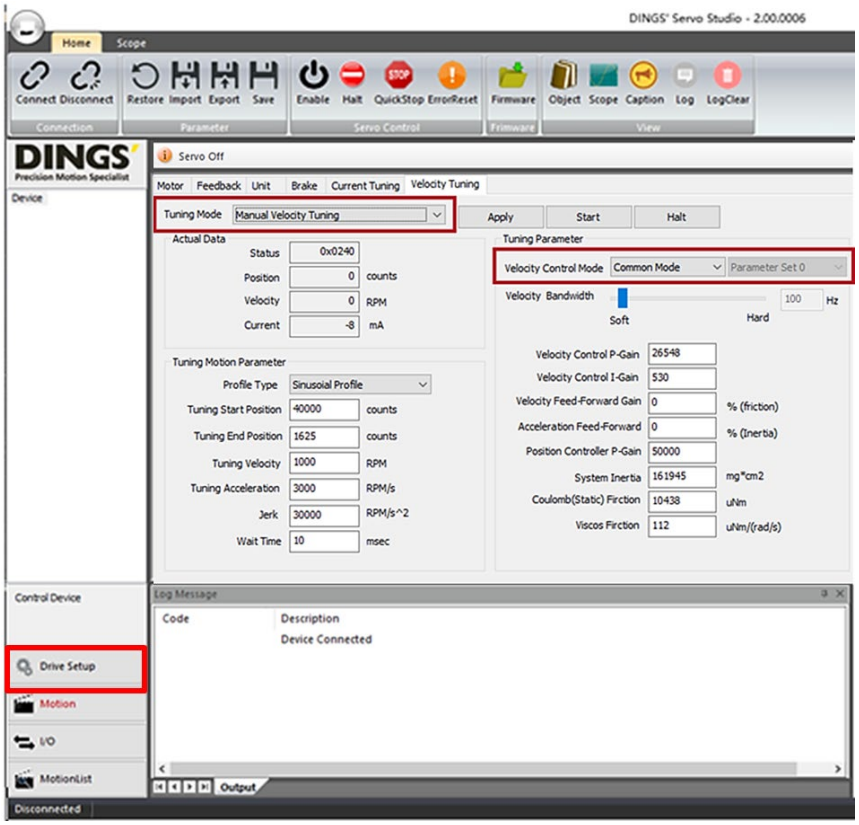
- As the control system does not vibrate because it is not affected by Feed Forward Gain feedback, it does not affect stability and improves system response.
- Feed Forward Gain improves system responsiveness and is stable because it operates outside the loop.
- Velocity Feed Forward Gain is used to compensate for static friction and motion friction measured through Velocity Auto Tuning. Set the percentage of friction compensation.
- Acceleration Feed Forward is used to compensate for the inertia measured through Velocity Auto Tuning. It sets what % to compensate for inertia.

(6) After changing tuning parameter, click [Apply] to apply them to the drive.

(7) Once Tuning is completed, to save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

5.3.3 Multi Gain

- User can select and use multiple speed control parameters.



(1) Select Velocity Control Mode.

- Common Mode: Use only the control parameters set in Parameter Set0, the basic speed control parameter.
- Separated Mode: The trajectory control section is controlled by Parameter Set0, and the In position section after the trajectory is completed is controlled by Parameter Set1. In the stop state within 1 pulse after completion of In Position, it is controlled using the control parameter of Parameter Set3.
- Dual Mode: It is controlled by Parameter Set0 or Parameter Set2 until in position, and after completion of in position, it is controlled by the control parameter of Parameter Set1 or Parameter Set3. Parameter Set0 and Parameter Set1 form a pair, and Parameter Set2 and Parameter Set3 form a pair.
- Index Mode: Set 4 parameter sets and the user selects and uses them.

(2) After selecting the parameter to be used from Parameter Set0 to Parameter Set3, proceed with Auto Tuning and Manual Tuning. After changing a parameter in each parameter set, it is applied only by pressing the [Apply] button.

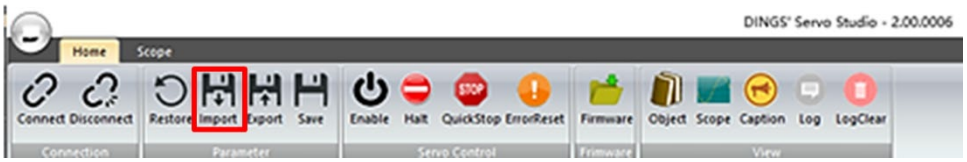
(3) In Dual Mode, if you select Parameter Set0 or Parameter set1, Parameter set0 & Parameter set1 are used, and if you select Parameter set2 or Parameter set3, Parameter set2 & Parameter set3 are used.

(4) Once Tuning is completed, to save the currently applied parameters to drive flash memory, click [Save] in the Ribbon Bar.

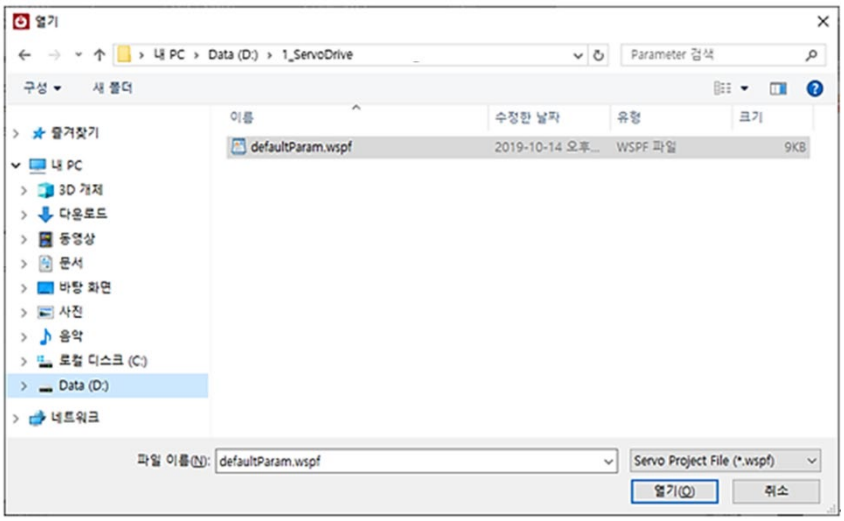
6. Parameter

6.1 Parameter File Import

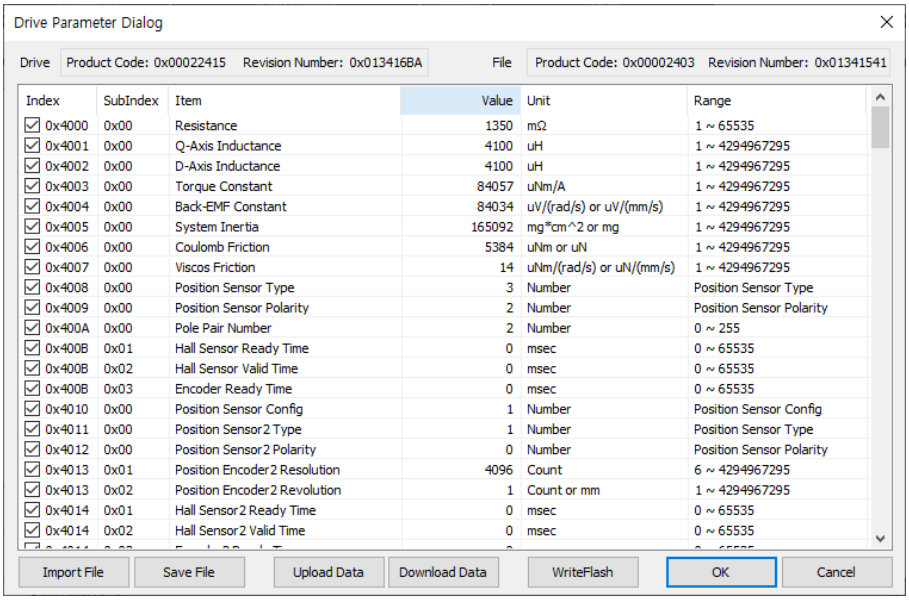
(1) Click [Import] in the Ribbon Bar



(2) Select *.wspf (DINGS' Servo Parameter File) and click Open



(3) The Parameter List of the imported parameter file is displayed.



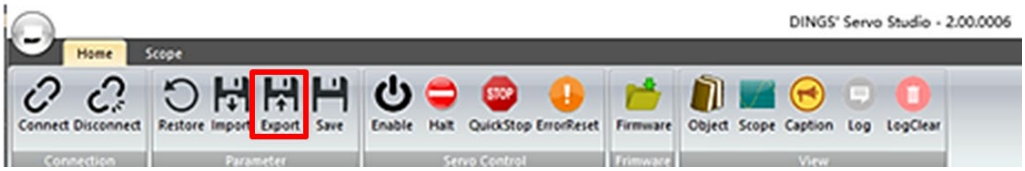
Index	SubIndex	Item	Value	Unit	Range
0x4000	0x00	Resistance	1350	mΩ	1 ~ 65535
0x4001	0x00	Q-Axis Inductance	4100	uH	1 ~ 4294967295
0x4002	0x00	D-Axis Inductance	4100	uH	1 ~ 4294967295
0x4003	0x00	Torque Constant	84057	uNm/A	1 ~ 4294967295
0x4004	0x00	Back-EMF Constant	84034	uV/(rad/s) or uV/(mm/s)	1 ~ 4294967295
0x4005	0x00	System Inertia	165092	mg*cm^2 or mg	1 ~ 4294967295
0x4006	0x00	Coulomb Friction	5384	uNm or uN	1 ~ 4294967295
0x4007	0x00	Viscos Friction	14	uNm/(rad/s) or uN/(mm/s)	1 ~ 4294967295
0x4008	0x00	Position Sensor Type	3	Number	Position Sensor Type
0x4009	0x00	Position Sensor Polarity	2	Number	Position Sensor Polarity
0x400A	0x00	Pole Pair Number	2	Number	0 ~ 255
0x400B	0x01	Hall Sensor Ready Time	0	msec	0 ~ 65535
0x400B	0x02	Hall Sensor Valid Time	0	msec	0 ~ 65535
0x400B	0x03	Encoder Ready Time	0	msec	0 ~ 65535
0x4010	0x00	Position Sensor Config	1	Number	Position Sensor Config
0x4011	0x00	Position Sensor2 Type	1	Number	Position Sensor Type
0x4012	0x00	Position Sensor2 Polarity	0	Number	Position Sensor Polarity
0x4013	0x01	Position Encoder2 Resolution	4096	Count	6 ~ 4294967295
0x4013	0x02	Position Encoder2 Revolution	1	Count or mm	1 ~ 4294967295
0x4014	0x01	Hall Sensor2 Ready Time	0	msec	0 ~ 65535
0x4014	0x02	Hall Sensor2 Valid Time	0	msec	0 ~ 65535

(4) To apply the parameters to the drive, check the checkboxes of the parameters to download and click [Download Data].

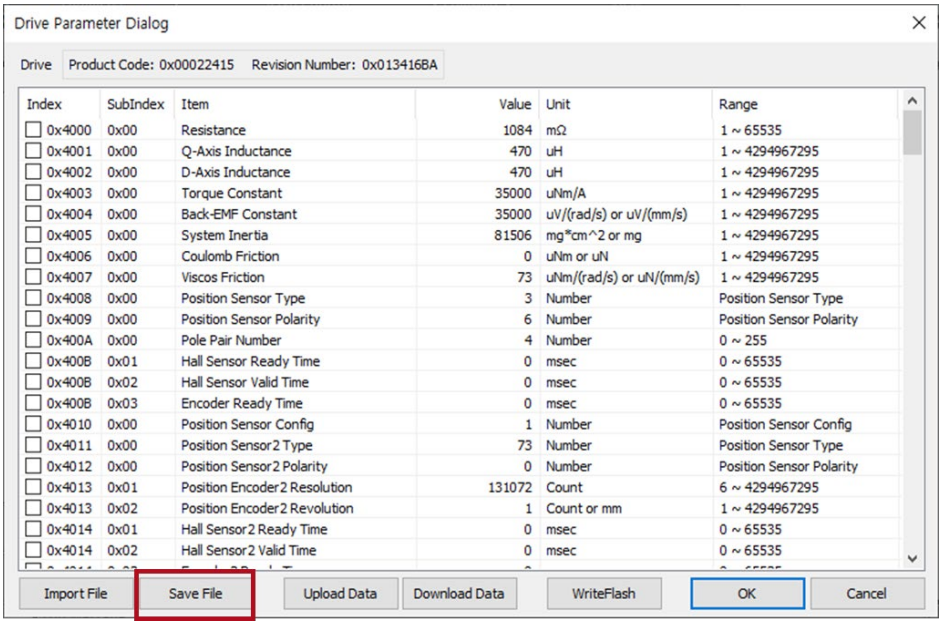
(5) After downloading the parameters, click [Write Flash] to save them to the drive flash memory.

6.2 Parameter File Export

(1) Click [Export] in the Ribbon Bar



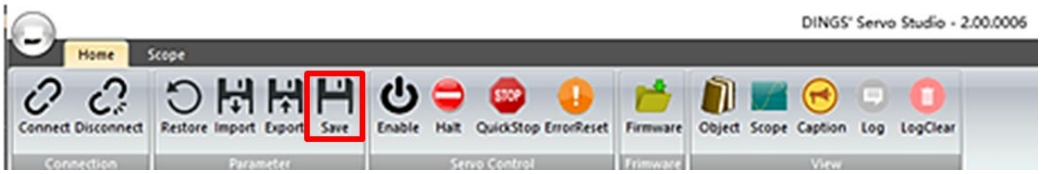
(2) Click [Save File] to save the parameter file.



Index	SubIndex	Item	Value	Unit	Range
0x4000	0x00	Resistance	1084	mΩ	1 ~ 65535
0x4001	0x00	Q-Axis Inductance	470	uH	1 ~ 4294967295
0x4002	0x00	D-Axis Inductance	470	uH	1 ~ 4294967295
0x4003	0x00	Torque Constant	35000	uNm/A	1 ~ 4294967295
0x4004	0x00	Back-EMF Constant	35000	uV/(rad/s) or uV/(mm/s)	1 ~ 4294967295
0x4005	0x00	System Inertia	81506	mg*cm^2 or mg	1 ~ 4294967295
0x4006	0x00	Coulomb Friction	0	uNm or uN	1 ~ 4294967295
0x4007	0x00	Viscos Friction	73	uNm/(rad/s) or uN/(mm/s)	1 ~ 4294967295
0x4008	0x00	Position Sensor Type	3	Number	Position Sensor Type
0x4009	0x00	Position Sensor Polarity	6	Number	Position Sensor Polarity
0x400A	0x00	Pole Pair Number	4	Number	0 ~ 255
0x400B	0x01	Hall Sensor Ready Time	0	msec	0 ~ 65535
0x400B	0x02	Hall Sensor Valid Time	0	msec	0 ~ 65535
0x400B	0x03	Encoder Ready Time	0	msec	0 ~ 65535
0x4010	0x00	Position Sensor Config	1	Number	Position Sensor Config
0x4011	0x00	Position Sensor2 Type	73	Number	Position Sensor Type
0x4012	0x00	Position Sensor2 Polarity	0	Number	Position Sensor Polarity
0x4013	0x01	Position Encoder2 Resolution	131072	Count	6 ~ 4294967295
0x4013	0x02	Position Encoder2 Revolution	1	Count or mm	1 ~ 4294967295
0x4014	0x01	Hall Sensor2 Ready Time	0	msec	0 ~ 65535
0x4014	0x02	Hall Sensor2 Valid Time	0	msec	0 ~ 65535

6.3 Parameter Save (Write Flash)

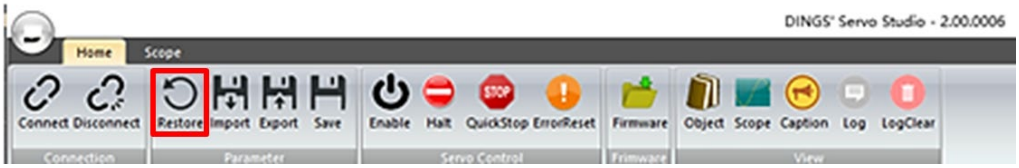
(1) Click [Save] in the Ribbon Bar. The data set in the drive is saved to the drive flash memory.



6.4 Parameter Restore

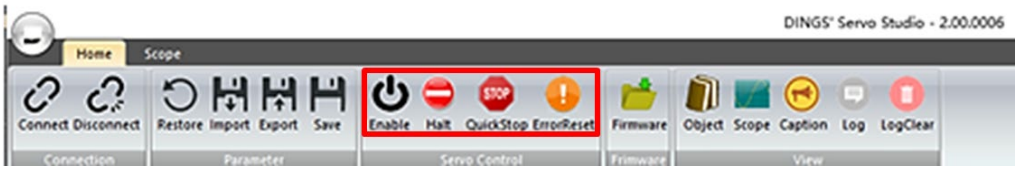
(1) Click the [Restore] button on the Ribbon Bar. The data set in the drive is initialized. Click the [Save] button to save the initial status to the drive flash memory.

(2) If you press the [Restore] button only and turn the power off without pressing the [Save] button, the parameters saved in the drive before initialization are maintained.



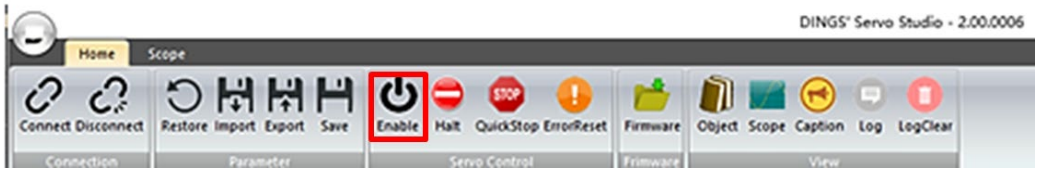
7. Motion

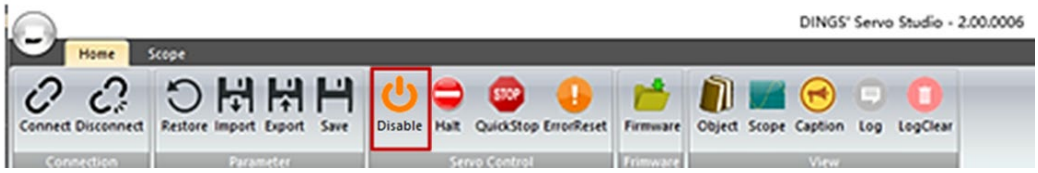
7.1 Servo Control



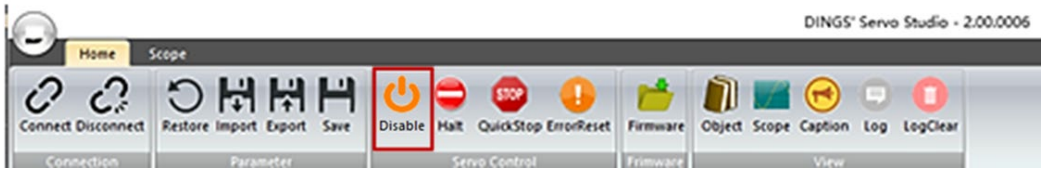
Button	Description
Enable/Disable	Operation Enable/Disable
Quick Stop	Quick Stop
HALT	Stop
Fault Reset	Error Reset when an error occurs

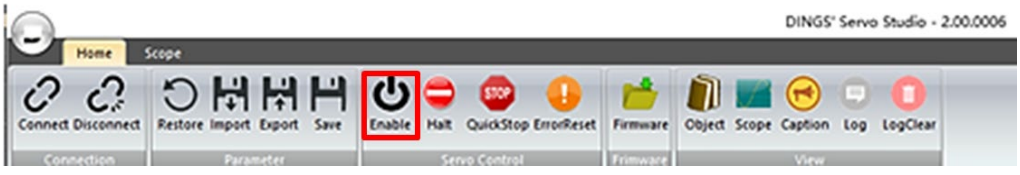
(1) Servo On: Click [Enable] on the Ribbon Bar to switch to Servo On state. The button will turn orange.





(2) Servo Off: Click [Disable] on the Ribbon Bar to switch to Servo Off state. The button will turn black.

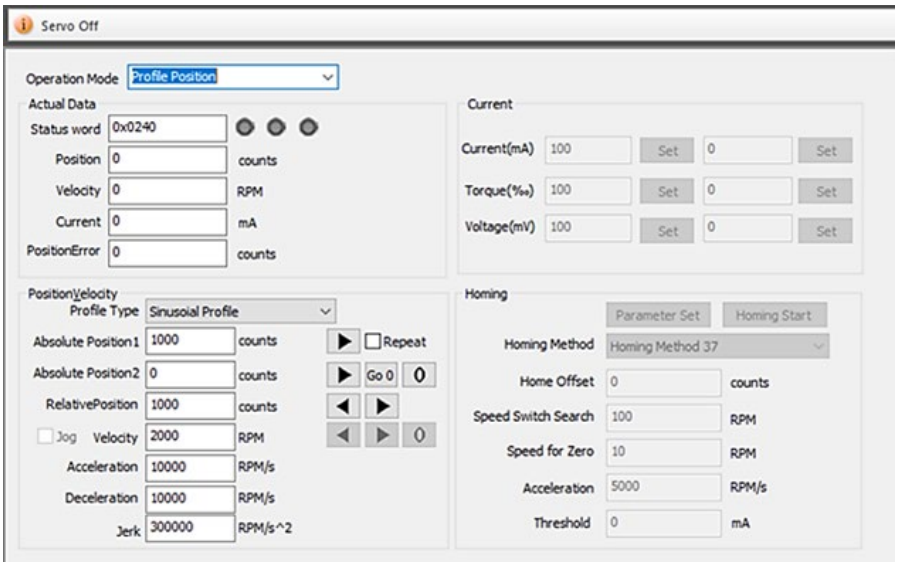




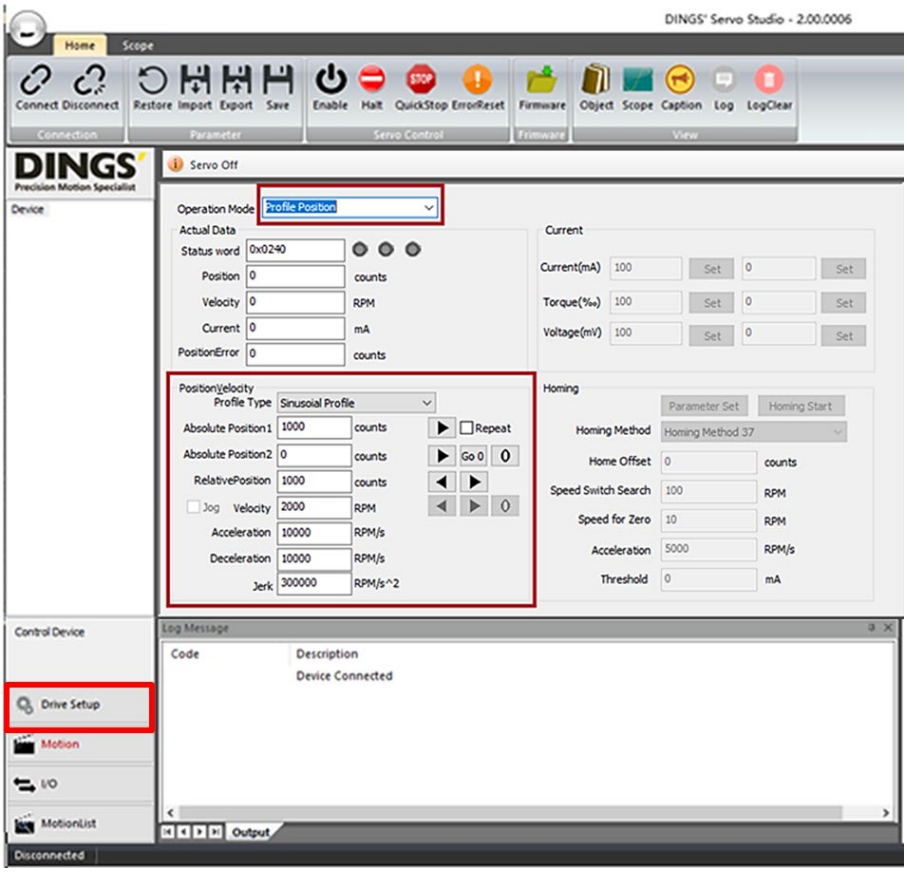
7.2 Motion

- Execute Motion by mode

(1) Click [Motion] in the Tool Pane to display the window for executing Motion in the Target Pane.



7.2.1 Profile Position Mode



(1) Select Profile Position for the Operation Mode.

(2) When the Position / Velocity Parameter input window is activated, input the parameter values.

(3) Click [Enable] on the Ribbon Bar to switch to Servo On state, after which Motion is executed.

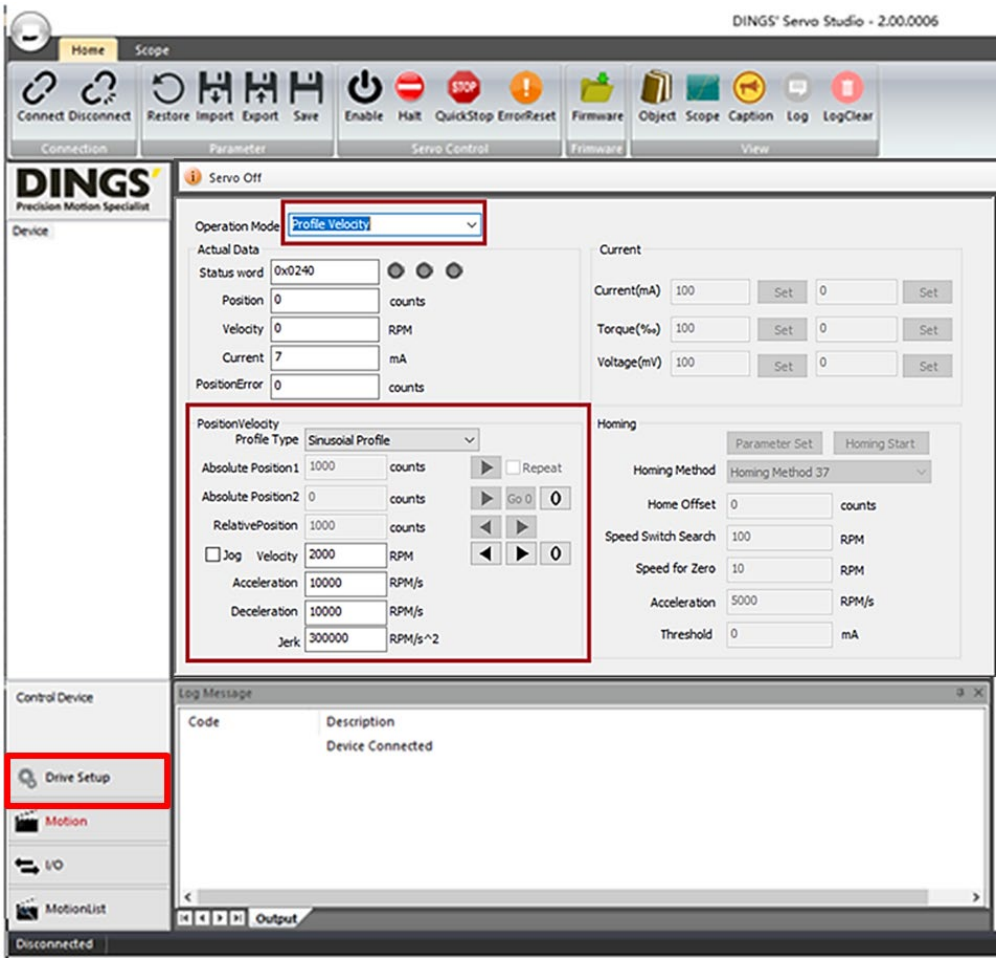
(4) Click Absolute Position button [>] to move to the inputted Absolute Position. Check Repeat and then click Absolute Position button [>] to repeatedly move between Position1↔Position2.

(5) Click the [0] button to set the current position to 0.

(6) Click [Go 0] to move to the position at which Absolute Position is 0.

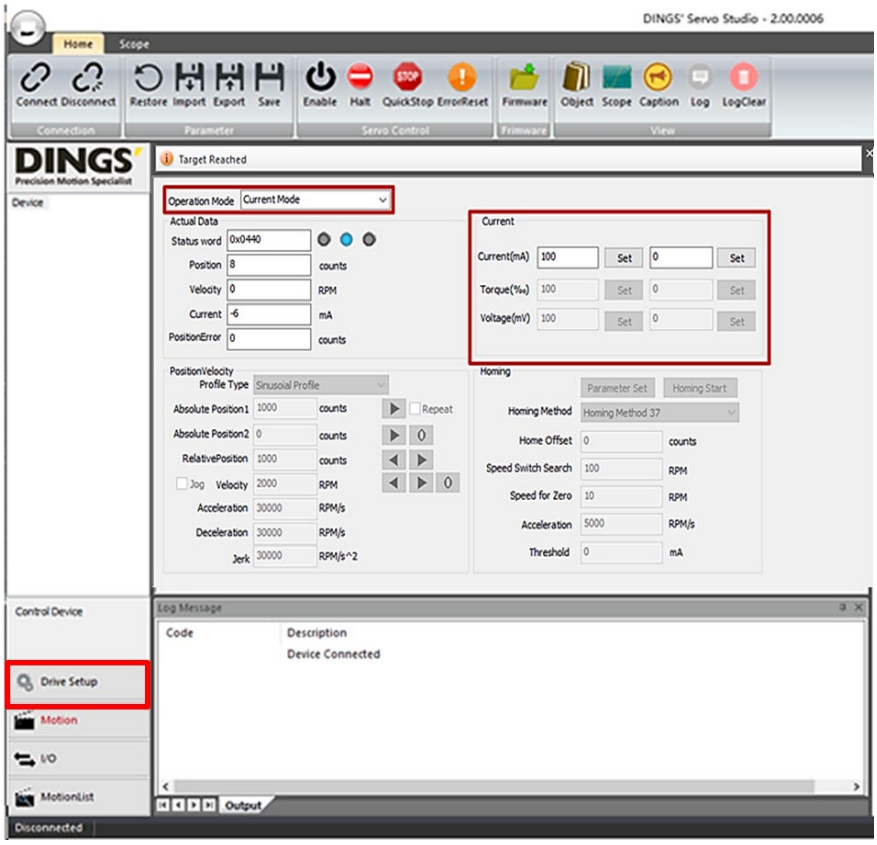
(7) Click Relative Position button [>] to move in the positive direction from the current position by the Relative Position value, and click [<] to move in the negative direction.

7.2.2 Profile Velocity Mode



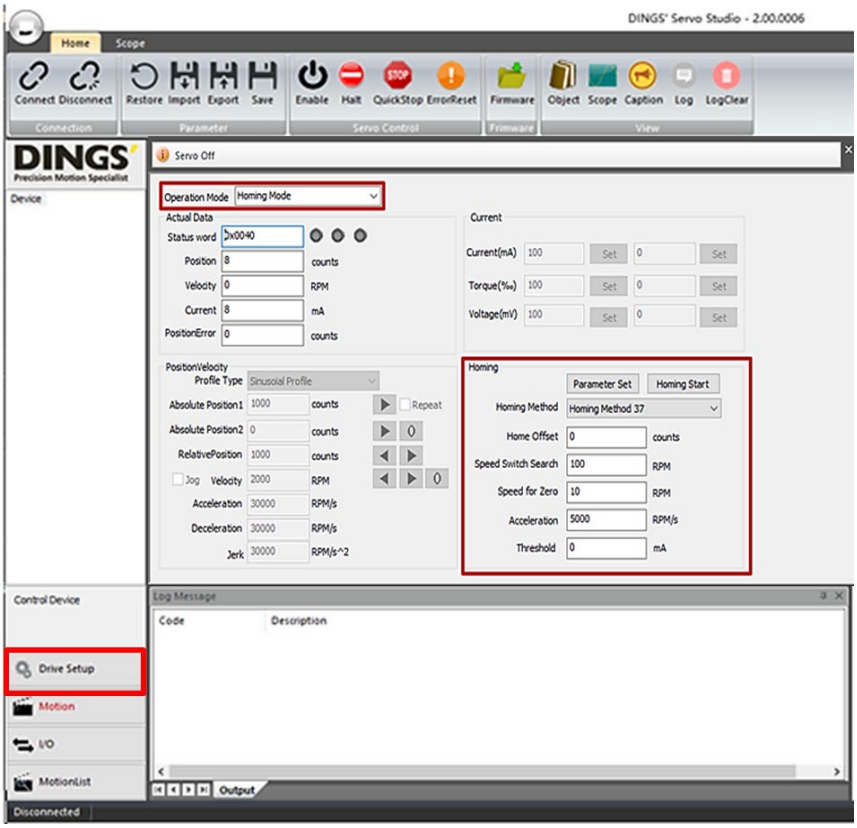
(1) In the Motion execution window, select Profile Velocity for the Operation Mode.
(2) When the Velocity Parameter input window is activated, input the parameter values.
(3) After changing to Servo On, click [>] to drive the motor in the positive direction of the inputted speed, and click [<] to drive in the negative direction.
(4) Click [0] to reduce the speed to 0 and stop.
(5) Checking Jog drives the motor at the input speed only while pressing [<] or [>].

7.2.3 Current / Torque / Voltage Mode



(1) Select Current/Torque/Voltage for the Operation Mode.
The mode can be changed to Current, Torque, or Voltage only in the Servo Off state.
(2) When the Parameter input window is activated, input the parameter values.
After changing to Servo On, click [Set] to execute Motion for the inputted parameter values according to the mode.

7.2.4 Homing Mode



(1) Select Homing for the Operation Mode

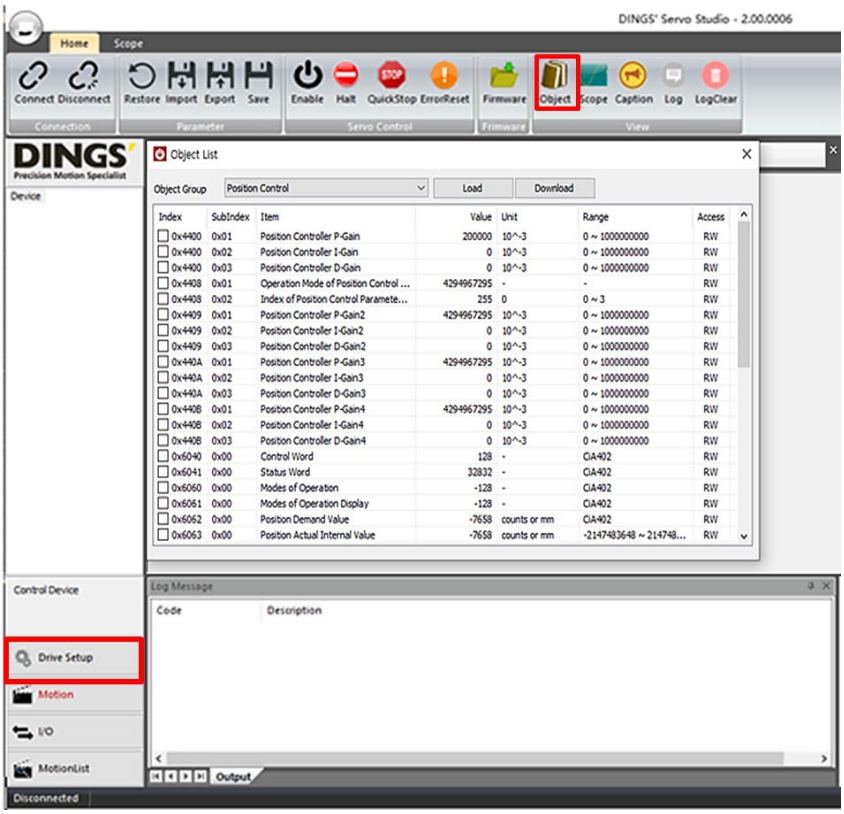
(2) When the Homing Parameter input window is activated, select the Homing Method and input the parameter values.

(3) Click [Parameter Set] to set the parameter values in the drive, and click [Homing Start] to execute Homing.

- Please refer to the Reference Manual regarding the Homing Method.

8. Object Dictionary

- Load / Download the drive-supported objects.



(1) Select the group of objects to check or change to display the Object List corresponding to the group.

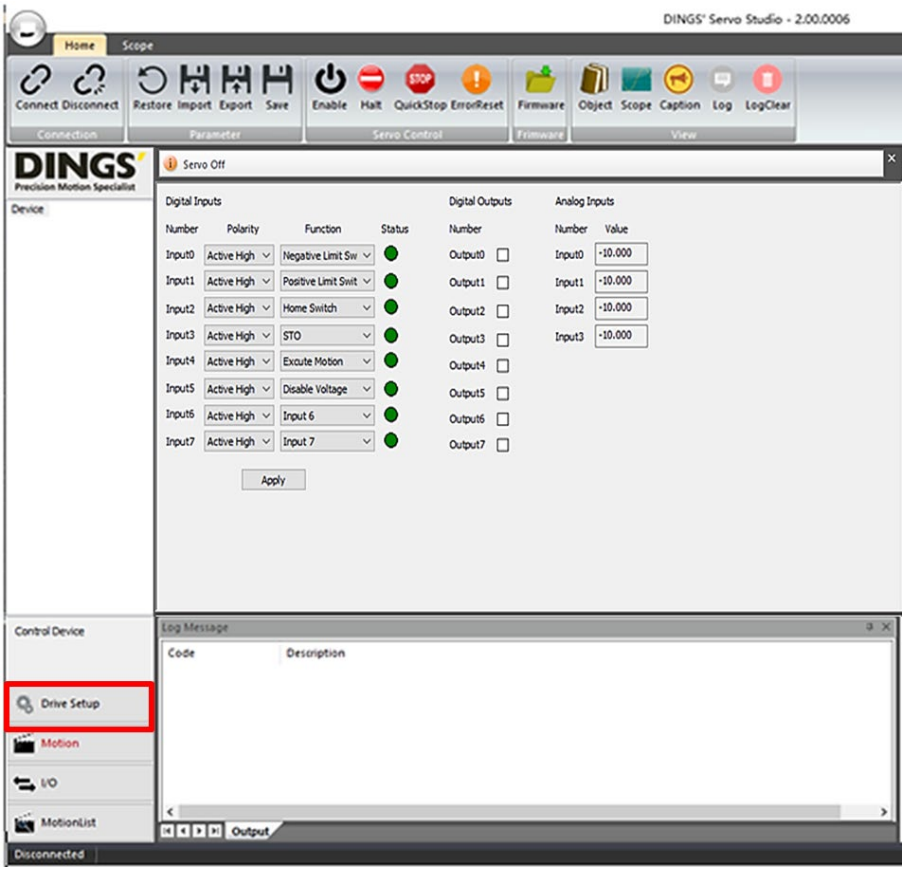
(2) Click [Load] to read the values of the object list from the drive.

(3) After changing the object value, check the checkbox for the corresponding object and click [Download] to apply the value of the checked object to the drive.

(4) After changing the object value, click [Save] in the Ribbon Bar to save the applied value to the drive flash memory.

9. I/O

- Digital Input Function Settings
- I/O Test



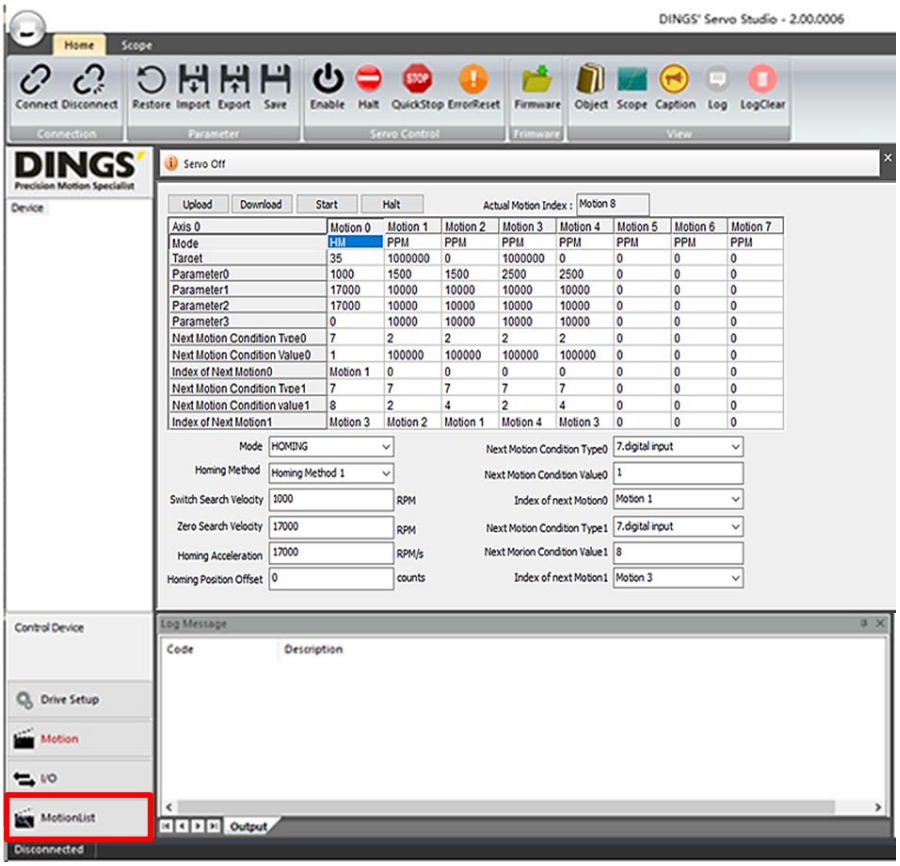
(1) Click [I / O] in the Tool Pane to display the I/O window in the Target Pane.

(2) For the Digital Inputs, the Polarity and Function can be set. After setting the Polarity and Function, click [Apply].

(3) Digital Output can be executed by checking or unchecking the Digital Output checkbox.

10. Motion List (Motion Sequence)

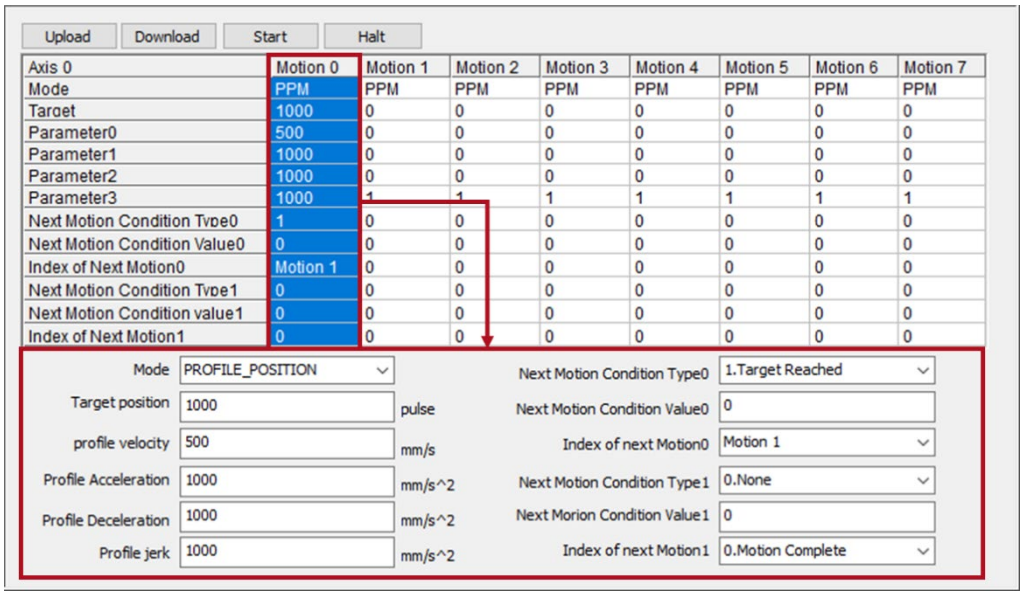
- Define the motion table to perform motions according to the conditions
- Input the motion parameters for each motion (Motion0 - Motion7) to generate the Motion List.
- Motion Sequence Modification and Drive Test



- Motion List button
  - **Upload**: Loads the Motion List from the drive
  - **Download**: Download the changed Motion List to the Drive.
  - **Start**: After selecting the motion to start, click [Start] to execute from the selected motion.
  - **Halt**: Stop Motion

10.1.1 Motion List Edit

(1) Select the Motion List column to display the parameters for the selected motion at the bottom of the list, which can be modified.



(2) After modifying the motion parameters, click [Download] to apply the changed parameters to the drive.

(3) After modifying each motion, click [Download] to apply the modifications to the drive.

Name	Description
Mode	Mode of motion Homing /Profile Position/Profile Velocity/Current
Target	Target and Parameter 0-3 vary depending on the Mode.
Parameter0	
Parameter1	
Parameter2	
Parameter3	
Next Motion Condition Type 0	The conditions under which the next motion is executed
Next Motion Condition Value 0	The values corresponding to the conditions under which the next motion is executed
Index of Next Motion 0	The index of the next motion
Next Motion Condition Type 1	The conditions under which the next motion is executed
Next Motion Condition Value 1	The values corresponding to the conditions under which the next motion is executed
Index of Next Motion 1	The index of the next motion

10.1.2 Motion Mode

The table below shows the operation modes that can be set in the motion table.

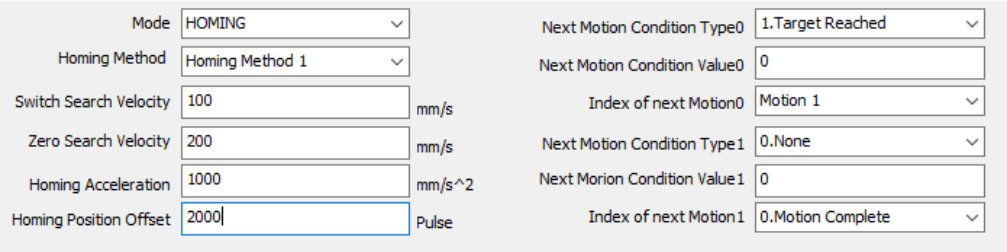
Value	Description
6	Homing Mode (HM)
3	Profile Velocity Mode (PVM)
1	Profile Position Mode (PPM)
-12	Current Regulation Mode (CRM)

10.1.3 Motion Parameter

- Target and Parameter 0-3 vary depending on the Motion Mode.
- The Target Value is the target value according to the operation mode. When the Modes of Operation is Homing mode, the Target Value is Homing Method. Parameter0, Parameter1, Parameter2, and Parameter3 are the control parameters required for each operation mode. The following table shows the definitions of Target Value, Parameter0, Parameter1, Parameter2, and Parameter3 according to the Modes of Operation.

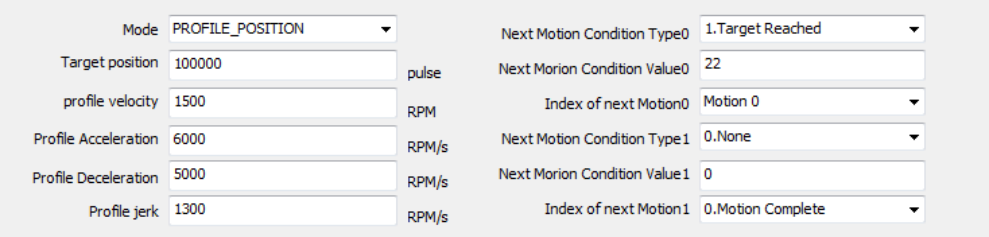
Sub-index	Profile Position Mode	Profile Velocity Mode	Torque Regulation Mode	Homing Mode
Modes of Operation	1	3	-12	6
Target Value	Target Position	Target Velocity	Target Current	Homing Method
Parameter0	Profile Velocity	Profile Acceleration	-	Switch Search Velocity
Parameter1	Profile Acceleration	Profile Deceleration	-	Zero Search Velocity
Parameter2	Profile Deceleration	-	-	Homing Acceleration
Parameter3	Profile Jerk	-	-	Home Offset

- **Homing Mode Parameter**
  - The homing function is executed according to the set homing method, speed, acceleration, and offset



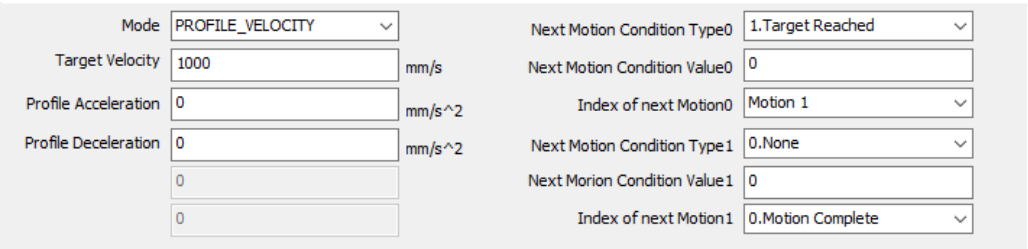
Homing Mode Parameter			
Object	**Data**	**Description**	**Unit**
Target	Homing Method	Settings for homing execution method	Number
Parameter0	Switch Search Velocity	Speed to move to home position	RPM, mm/s
Parameter1	Zero Search Velocity	Movement speed to Home Offset	RPM, mm/s
Parameter2	Homing Acceleration	Acceleration used in Homing Mode	RPM/s, mm/s^2
Parameter3	Homing Position Offset	The home position setting after moving the amount of the set value at the end of the homing sequence. Negative when Homing Method is -3 and positive when -4	Pulse

- **Profile Position Mode Parameter**
  - Creates a profile with the profile velocity, acceleration, and deceleration data and drives based on the target position



Profile Position Mode		
Object	**Data Name**	**Unit**
Target	Target Position	Pulse
Parameter0	Profile Velocity	RPM or mm/s
Parameter1	Profile Acceleration	RPM/s or mm/s^2
Parameter2	Profile Deceleration	RPM/s or mm/s^2
Parameter3	Profile Jerk	RPM/^{2} or mm/s^3

- **Profile Velocity Mode Parameter**
  - Creates a profile with the profile velocity, acceleration, and deceleration data and drives based on the target speed



Profile Velocity Mode		
Object	**Data Name**	**Unit**
Target	Target Position	Pulse
Parameter0	Profile Velocity	RPM or mm/s
Parameter1	Profile Acceleration	RPM/s or mm/s^2
Parameter2	Profile Deceleration	RPM/s or mm/s^2
Parameter3	-	-

- **Current Regulation Mode Parameter**
  - Perform current control by the target current value

Current Mode		
Object	**Data Name**	**Unit**
Target	Target Current	mA
Parameter0	-	-
Parameter1	-	-
Parameter2	-	-
Parameter3	-	-

10.1.4 Next Motion Parameter

Two conditions can be set to execute the next motion.

After comparing the Next Motion Condition Type0, if the conditions are not correct, then compare Next Motion Condition Type1. Set the conditions for executing the next motion through the Next Motion Condition Type, and input the settings for executing the next motion according to the Next Motion Condition Type. For the next motion index, input the motion or motion index to be executed when the set conditions are satisfied.

Value	Name	Description
0	None	The next motion is not performed.
1	Target Reached	When the current motion is completed, the next motion is performed.
2	Target Reached and Wait	When the current motion is completed, the system waits for the time set in sub index 0x08 and then performs the next motion.
3	Less than position	If the current position is smaller than the value set in Next Motion Condition Value, the next motion is performed.
4	More than position	If the current position is larger than the value set in Next Motion Condition Value, the next motion is performed.
5	Duration	After the current motion is completed, the next motion is executed after the time set in Next Motion Condition Value.
6	External Load Torque/ Force	If the external load is larger than the value set in Next Motion Condition Value, the next motion is performed.
7	Digital Input	If the data received through the digital input port is equal to the set Next Motion Condition Value, then the next motion is performed.

- **Next Motion Condition Value**

Next Motion Condition Value		
Condition Type	**Next Motion Condition Value**	**Value Unit**
None	-	Ignored
Target Reached	-	Ignored
Target Reached and Wait	Wait time after target completion	ms
Less than position	Location data	pulse
More than position	Position data	Pulse
Duration	Current duration in the current mode	ms
Load Torque	Torque data	mNm or mN
Digital Input	Digital input setting	Digital Input Status

- **Index of Next Motion**

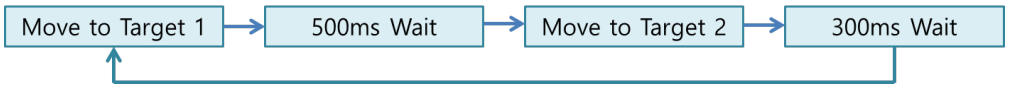
Index of Next Motion		
Value	**Name**	**Description**
0x0000	Motion Complete	Motion is completed at the set next motion condition
0x0001	Quick Stop	Motion is stopped at the set next motion condition
0x0002	Disable Operation	Operation is disabled at the set next motion condition
0x0003	Shutdown	Status changes to Servo Off at the set next motion condition
0x4710~0x4719 (Index0~Index 9)	Motion Index	Motion of the inputted index is executed at the set next motion condition
Other value	Motion Complete	Motion is completed

Next Motion Condition Value		
Condition Type	**Next Motion Condition Value**	**Value Unit**
None	-	Ignored
Target Reached	-	Ignored
Target Reached and Wait	Wait time after the target is reached	ms
Less than position	Position data	pulse
More than position	Position data	Pulse
Duration	Duration to maintain the Current Mode	ms
Load Torque	Torque data	mNm or mN
Digital Input	Enable/disable Digital Input	Digital Input Status

- **Index of Next Motion**

Index of Next Motion		
Value	**Name**	**Description**
0x0000	Motion Complete	Complete the motion when the Next Motion Condition is met
0x0001	Quick Stop	Stop the motion when the Next Motion Condition is met
0x0002	Disable Operation	Disable the operation when the Next Motion Condition is met
0x0003	Shutdown	Turn the servo off when the Next Motion Condition net
0x4710~0x4719 (Index0~Index 9)	Motion Index	Execute the Motion entered in the index when the Next Motion Condition is met
Other value	Motion Complete	Complete the Motion

10.1.5 Motion List Example



- Motion0: Moves to Target1 (-13000), waits for 500 ms after reaching the target position, and executes Motion1
- Motion1: Moves to Target2 (-6000), waits for 500 ms after reaching the target position, and executes Motion0

(1) As follows, select Motion and input the parameters.

(2) After inputting the parameters, click [Download]

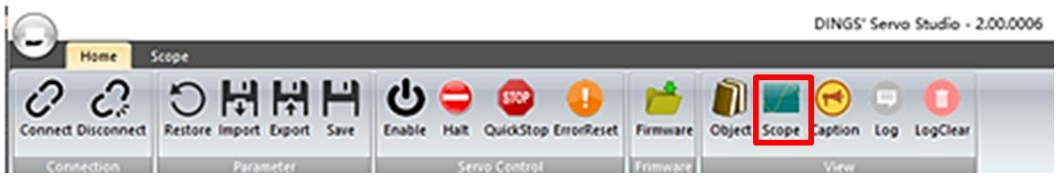
Item	Motion0 Value	Motion1 Value
Mode	Profile Position Mode	Profile Position Mode
Target Position	-13000	-6000
Profile Velocity	5000	5000
Profile Acceleration	1000000	1000000
Profile Deceleration	1000000	1000000
Profile Jerk	1000000	1000000
Next Motion Condition Type 0	1.Target Reached and Wait	1.Target Reached and Wait
Next Motion Condition Value 0	0	0
Index of Next Motion 0	Index 1	Index 1
Next Motion Condition Type 1	0.None	0.None
Next Motion Condition Value 1	0	0
Index of Next Motion 1	0	0

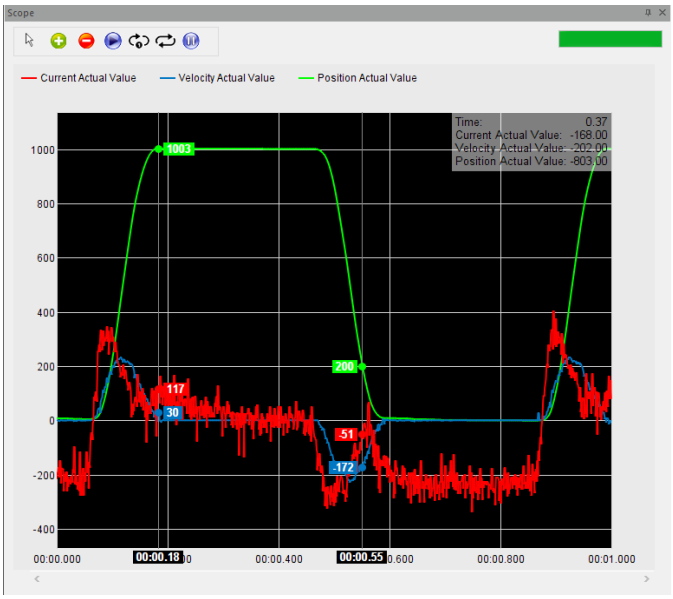
(3) For the test, after changing to Servo On, click [Start].

(4) To first execute Motion1(Index1), select Index1 for Index in the Motion Edit window, and click [Start]. Index1 will execute first, after which the connected Motion0(Index0) motion will execute.

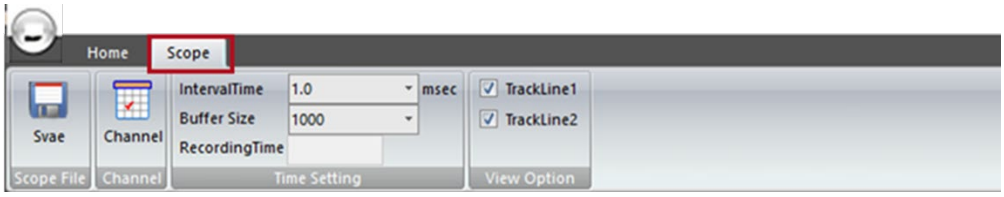
11. Scope

(1) If there is no Scope window, click [Scope] in the Ribbon Bar to display the Scope window. If Scope window is open, click [Scope] in the Ribbon Bar to hide the Scope window.



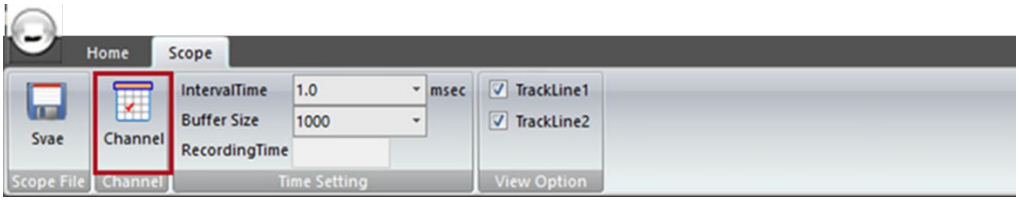


(2) Select the [Scope] tab in the Ribbon Bar

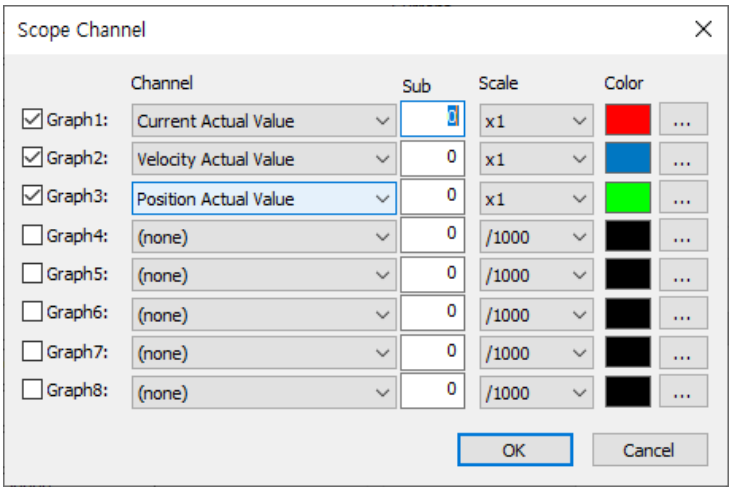


- Save: Save the graph data as a CSV file
- Channel: Select the data to monitor and the scale and color of the displayed graph.
- Interval Time: Set the interval time for storing the data to monitor in the drive buffer.
- Buffer Size: When saving the data to monitor in the drive buffer, set the buffer size to save.
- Recording Time(msec) = Interval Time * Buffer Size
- Track Line: When checked, the track line will appear on the graph, showing the data of the checked track line position.
- Synchronize: If checked, when there are multiple graphs, the track line time is synchronized.

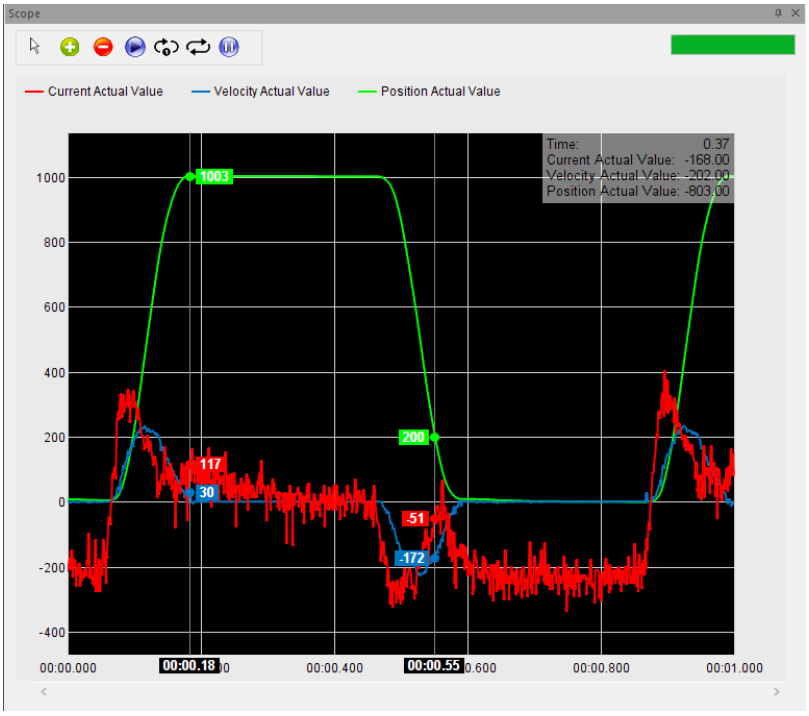
(3) Click [Channel] on the Ribbon Bar to display the window to select the Scope Channel.

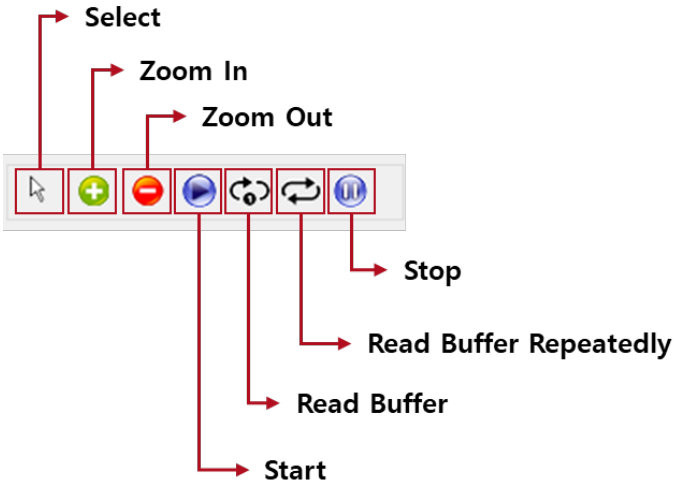


(4) In the Scope Channel window, select the data to monitor and check the checkbox. After setting the scale and color of the data to display on the graph, click [OK].



(5) Use the buttons in the Scope window to execute Scope.



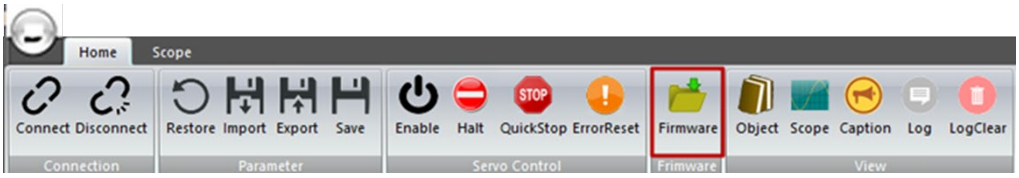


- Select: When the graph is enlarged, the position can be moved or the Track Line can be selected.
- Zoom In/Out: After clicking [Zoom In] or [Zoom Out], click the left mouse button, move the mouse cursor inside the graph, and use the mouse wheel to zoom in our out.
- Start: Periodically reads data from the connected communication method and draws the graph of the data to monitor. (Not Real Time)
- Read buffer: Reads the data saved in the drive buffer once for the set Interval Time period according to the set Buffer Size and shows it in the graph. If the Interval Time and Buffer Size are large, the graph takes a long time to update.
- Read buffer repeatedly: Repeatedly reads the data saved in the drive buffer for the set Interval Time period according to the set Buffer Size and shows it in the graph. If the Interval Time and Buffer Size are large, the graph takes a long time to update.

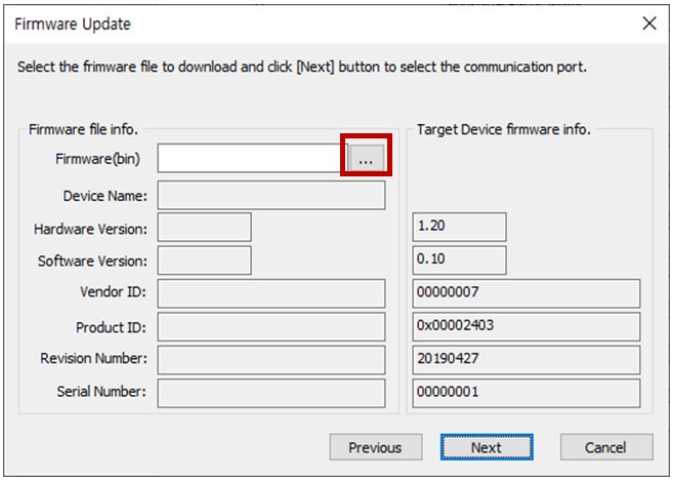
12. Firmware

- **Download drive firmware**

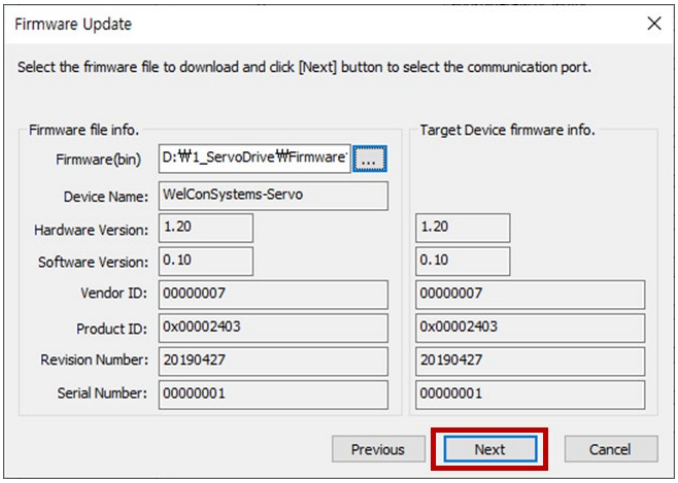
(1) Click [Firmware] in the Ribbon Bar.



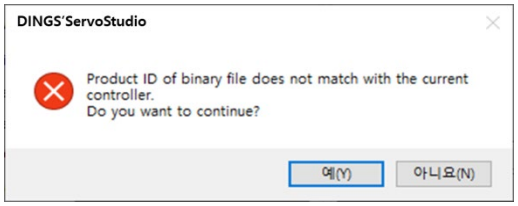
(2) Load the firmware file.



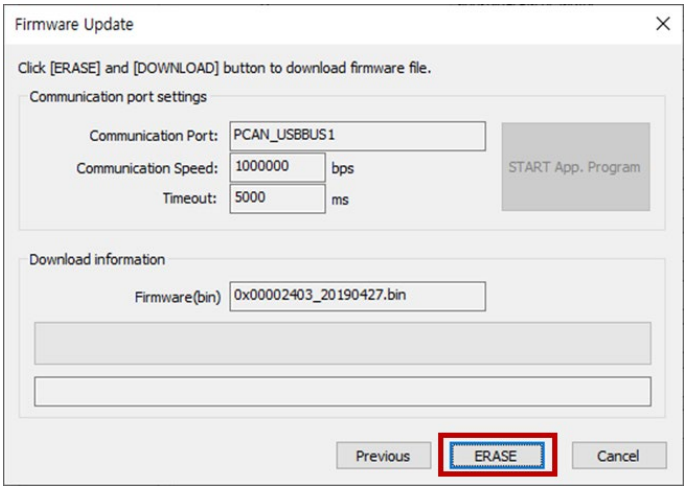
(3) Click [Next]



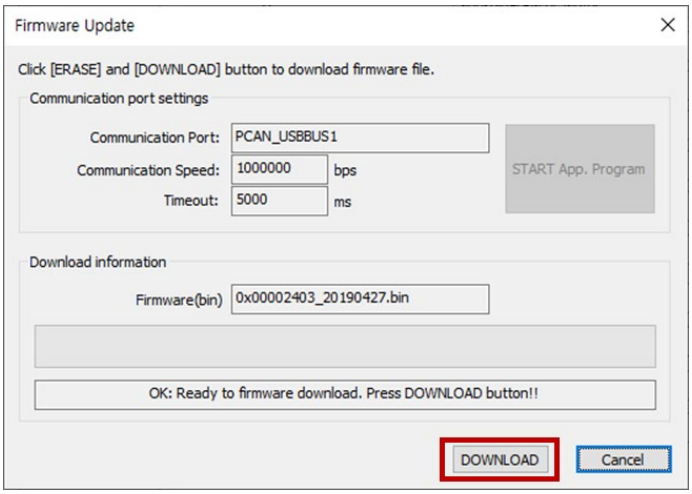
* A message box occurs when device name and product ID are inconsistent (Check Firmware.)



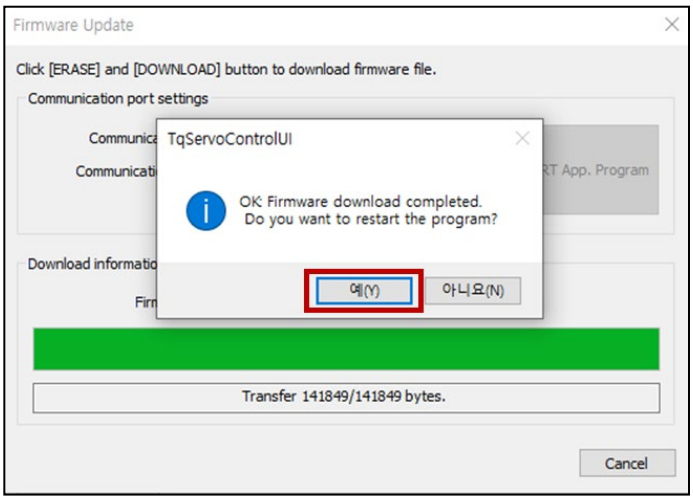
(4) Click [Erase] - Delete the drive firmware and then download.



(5) Click [Download].



(6) When the firmware download is complete, click [Yes (Y)] in the pop-up window that appears to execute the drive program.



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