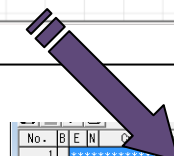
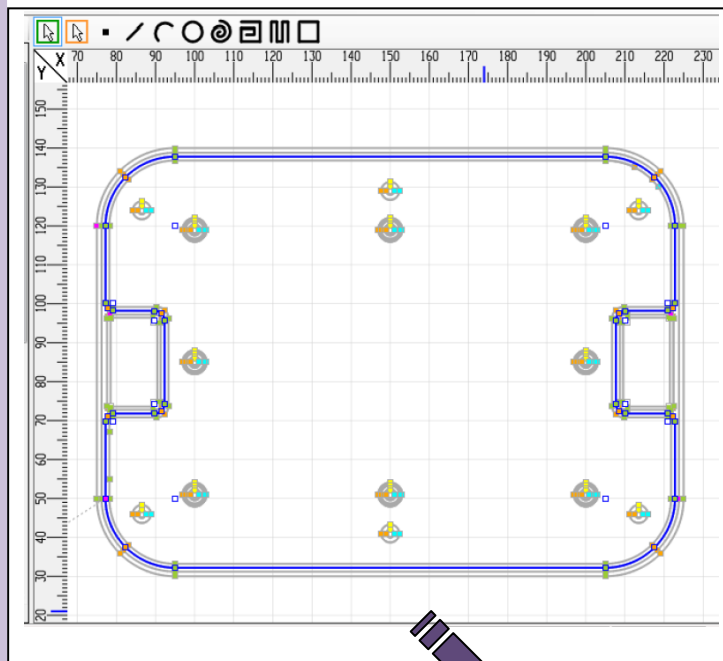


# SEL Program Generator (Screw Tightening Type)

## Operation Manual Third Edition



| No. | B | E | N | Comment                        | Operand 1 | Operand 2 | Pst     |  |                 |
|-----|---|---|---|--------------------------------|-----------|-----------|---------|--|-----------------|
| 1   |   |   |   | *****                          |           |           |         |  |                 |
| 2   |   |   |   | * This program was generated * |           |           |         |  |                 |
| 3   |   |   |   | * by SEL program generator. *  |           |           |         |  |                 |
| 4   |   |   |   | * 2015/10/30 09:59:49 *        |           |           |         |  |                 |
| 5   |   |   |   | *****                          |           |           |         |  |                 |
| 6   |   |   |   |                                |           |           |         |  |                 |
| 7   |   |   |   | *****                          |           |           |         |  |                 |
| 8   |   |   |   | *Initialize                    |           |           |         |  |                 |
| 9   |   |   |   | *****                          |           |           |         |  |                 |
| 10  |   |   |   | BT0F                           | 300       |           |         |  |                 |
| 11  |   |   |   | ACHZ                           | 3         |           |         |  | Z-axis for arch |
| 12  |   |   |   | *****                          |           |           |         |  |                 |
| 13  |   |   |   | *Home return                   |           |           |         |  |                 |
| 14  |   |   |   | *****                          |           |           |         |  |                 |
| 15  |   |   |   | HOME                           | 100       |           |         |  |                 |
| 16  |   |   |   | HOME                           | 11        |           |         |  |                 |
| 17  |   |   |   |                                |           |           |         |  |                 |
| 18  |   |   |   |                                | 321.000   | 89.500    | 143.000 |  |                 |
| 19  |   |   |   |                                | 407.300   | 83.500    | 143.000 |  |                 |
| 20  |   |   |   |                                | 448.000   | 90.000    | 143.000 |  |                 |

**IAI Corporation**





## Please Read Before Use

Thank you for purchasing our product.

This manual explains how you can use this feature and necessary information to use it safely. Before the operation, read this manual carefully and fully understand it to operate this product. The enclosed DVD in this product package includes the Instruction Manual for this product.

For the operation of this product, print out the necessary sections in the Instruction Manual or display them using the personal computer.

After reading through this manual, keep this Instruction Manual at hand so that the operator of this product can read it whenever necessary.

### [Important]

- This Manual is original.
- The product cannot be operated in any way unless expressly specified in this Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Manual is subject to change without notice for the purpose of product improvement.
- If you have any question or comment regarding the content of this manual, please contact the IAI sales office near you.
- Using or copying all or part of this Manual without permission is prohibited.
- The company names, names of products and trademarks of each company shown in the sentences are registered trademarks.

**IAI** \_\_\_\_\_

## Safety Guide

“Safety Guide” has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

### Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

| No. | Operation Description | Description  |
|-----|-----------------------|--|
| 1   | Model Selection       | <ul style="list-style-type: none"><li>• This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications.<ol style="list-style-type: none"><li>1) Medical equipment used to maintain, control or otherwise affect human life or physical health.</li><li>2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility)</li><li>3) Important safety parts of machinery (Safety device, etc.)</li></ol></li><li>• Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product.</li><li>• Do not use it in any of the following environments.<ol style="list-style-type: none"><li>1) Location where there is any inflammable gas, inflammable object or explosive</li><li>2) Place with potential exposure to radiation</li><li>3) Location with the ambient temperature or relative humidity exceeding the specification range</li><li>4) Location where radiant heat is added from direct sunlight or other large heat source</li><li>5) Location where condensation occurs due to abrupt temperature changes</li><li>6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid)</li><li>7) Location exposed to significant amount of dust, salt or iron powder</li><li>8) Location subject to direct vibration or impact</li></ol></li><li>• For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.</li></ul> |

| No. | Operation Description    | Description   |
|-----|--------------------------|---|
| 2   | Transportation           | <ul style="list-style-type: none"> <li>• When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane.</li> <li>• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers.</li> <li>• When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped.</li> <li>• Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the instruction manual for each model.</li> <li>• Do not step or sit on the package.</li> <li>• Do not put any heavy thing that can deform the package, on it.</li> <li>• When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work.</li> <li>• When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit.</li> <li>• Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength.</li> <li>• Do not get on the load that is hung on a crane.</li> <li>• Do not leave a load hung up with a crane.</li> <li>• Do not stand under the load that is hung up with a crane.</li> </ul> |
| 3   | Storage and Preservation | <ul style="list-style-type: none"> <li>• The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation.</li> <li>• Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.</li> </ul>  |
| 4   | Installation and Start   | <p>(1) Installation of Robot Main Body and Controller, etc.</p> <ul style="list-style-type: none"> <li>• Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall-over or drop due to an act of God such as earthquake.</li> <li>• Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life.</li> <li>• When using the product in any of the places specified below, provide a sufficient shield.             <ol style="list-style-type: none"> <li>1) Location where electric noise is generated</li> <li>2) Location where high electrical or magnetic field is present</li> <li>3) Location with the mains or power lines passing nearby</li> <li>4) Location where the product may come in contact with water, oil or chemical droplets</li> </ol> </li> </ul>  |

| No. | Operation Description  | Description   |
|-----|------------------------|---|
| 4   | Installation and Start | <p>(2) Cable Wiring</p> <ul style="list-style-type: none"> <li>● Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool.</li> <li>● Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error.</li> <li>● Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error.</li> <li>● When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction.</li> <li>● Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product.</li> <li>● Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.</li> </ul> <p>(3) Grounding</p> <ul style="list-style-type: none"> <li>● The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation.</li> <li>● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm<sup>2</sup> (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards).</li> <li>● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).</li> </ul> |

| No. | Operation Description  | Description  |
|-----|------------------------|--|
| 4   | Installation and Start | <p>(4) Safety Measures</p> <ul style="list-style-type: none"> <li>• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers.</li> <li>• When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury.</li> <li>• Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation.</li> <li>• Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product.</li> <li>• Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input.</li> <li>• When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury.</li> <li>• Take the measure so that the work part is not dropped in power failure or emergency stop.</li> <li>• Wear protection gloves, goggle or safety shoes, as necessary, to secure safety.</li> <li>• Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire.</li> <li>• When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.</li> </ul> |



| No. | Operation Description | Description  |
|-----|-----------------------|--|
| 5   | Teaching              | <ul style="list-style-type: none"> <li>• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers.</li> <li>• Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well.</li> <li>• When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency.</li> <li>• When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly.</li> <li>• Place a sign “Under Operation” at the position easy to see.</li> <li>• When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.</li> </ul> <p>* Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.</p> |
| 6   | Trial Operation       | <ul style="list-style-type: none"> <li>• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers.</li> <li>• After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation.</li> <li>• When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation.</li> <li>• Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc.</li> <li>• Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.</li> </ul>  |





| No. | Operation Description | Description   |
|-----|-----------------------|---|
| 7   | Automatic Operation   | <ul style="list-style-type: none"><li>• Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence.</li><li>• Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication.</li><li>• Make sure to operate automatic operation start from outside of the safety protection fence.</li><li>• In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product.</li><li>• When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.</li></ul> |

| No. | Operation Description      | Description   |
|-----|----------------------------|---|
| 8   | Maintenance and Inspection | <ul style="list-style-type: none"> <li>• When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers.</li> <li>• Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well.</li> <li>• When the work is to be performed inside the safety protection fence, basically turn OFF the power switch.</li> <li>• When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency.</li> <li>• When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly.</li> <li>• Place a sign "Under Operation" at the position easy to see.</li> <li>• For the grease for the guide or ball screw, use appropriate grease according to the Instruction Manual for each model.</li> <li>• Do not perform the dielectric strength test. Failure to do so may result in a damage to the product.</li> <li>• When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.</li> <li>• The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation.</li> <li>• Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works.<br/>Use in incomplete condition may cause damage to the product or an injury.</li> </ul> <p>* Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.</p> |
| 9   | Modification and Dismantle | <ul style="list-style-type: none"> <li>• Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.</li> </ul>  |
| 10  | Disposal                   | <ul style="list-style-type: none"> <li>• When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste.</li> <li>• When removing the actuator for disposal, pay attention to drop of components when detaching screws.</li> <li>• Do not put the product in a fire when disposing of it.<br/>The product may burst or generate toxic gases.</li> </ul>  |

| No. | Operation Description | Description  |
|-----|-----------------------|--|
| 11  | Other                 | <ul style="list-style-type: none"><li>• Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device.</li><li>• See Overseas Specifications Compliance Manual to check whether complies if necessary.</li><li>• For the handling of actuators and controllers, follow the dedicated instruction manual of each unit to ensure the safety.</li></ul> |

## Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Instruction Manual for each model.

| Level   | Degree of Danger and Damage   | Symbol  |
|---------|---|---|
| Danger  | This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.        |  Danger  |
| Warning | This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.       |  Warning |
| Caution | This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage. |  Caution |
| Notice  | This indicates lower possibility for the injury, but should be kept to use this product properly.   |  Notice  |

## Construction of Instruction Manual and This Manual

### ● Basic Specifications

- Screw Tightening Operation — ■ SEL Program Generator (this manual) \_\_\_\_\_ ME0373

### ★ Program

- SEL Program Language — ■ SEL Language Programing Manual \_\_\_\_\_ ME0224

### ■ Applicable Controller (including actuator integrated type)

- TTA — ■ TTA Instruction Manual \_\_\_\_\_ ME0320
- MSEL — ■ MSEL Instruction Manual \_\_\_\_\_ ME0336

### ■ Teaching Tool

- PC Software — ■ PC Software \_\_\_\_\_ ME0154

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## 1. Introduction

### 1.1 Overview of SEL Program Generator (Screw-Tightening Type)

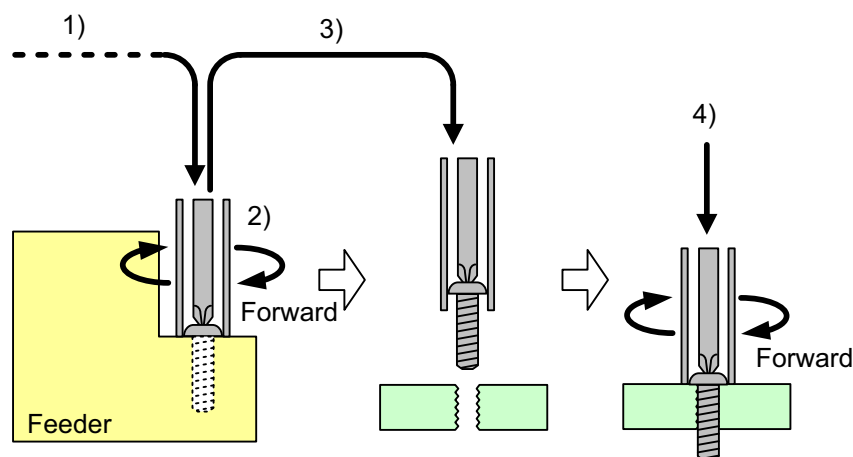
SEL Program Generator (Screw-Tightening Type) is a tool that automatically generates the "SEL programs" and "position data" which are necessary in order to perform screw tightening work.

Shown below are the features supported by this generator.

- Final Tightening
- Temporary Tightening
- Temporary Insertion
- Final Tightening of Screw Temporarily Inserted
- Loosening
- Screw Tightening Error Detection

#### 1.1.1 Final Tightening

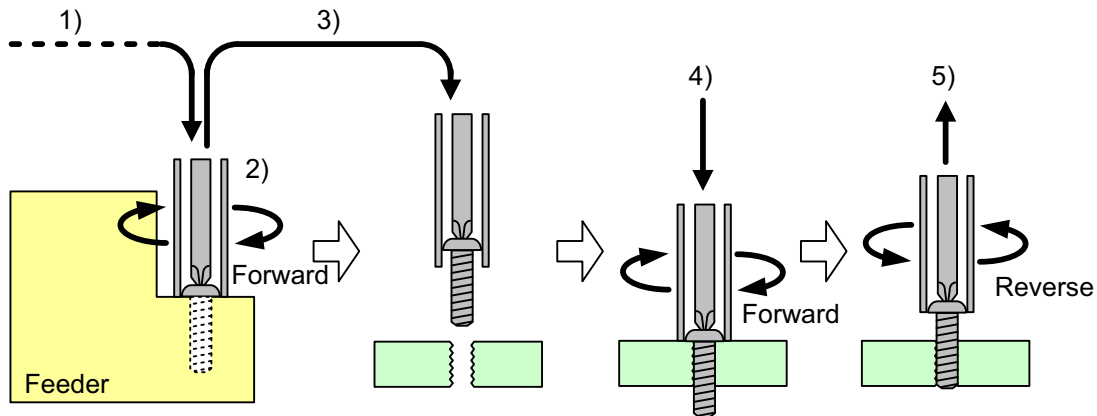
A screw taken out of a feeder should be tightened till the torque of the screwdriver increases.



- 1) The screwdriver moves to the screw feeding position on the feeder.
- 2) Make the screwdriver turn clockwise and have a screw stick on the screwdriver to take it out.
- 3) The screwdriver moves to the position of screw tightening.
- 4) The screwdriver turns clockwise and drops down till the torque increases.

## 1.1.2 Temporary Tightening

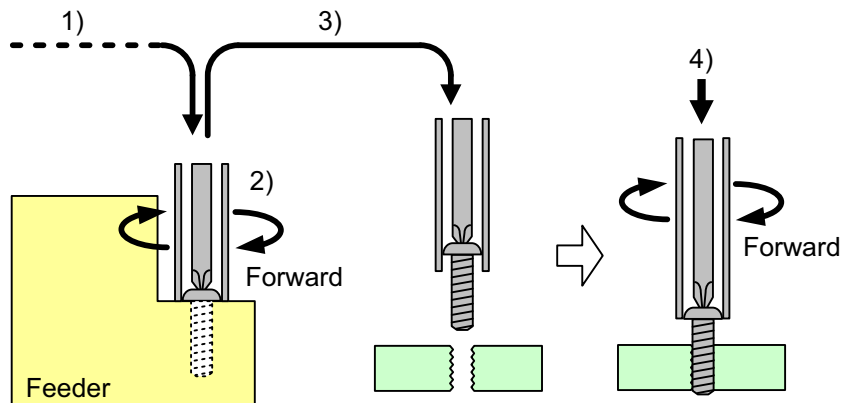
The screw gets loosened for the indicated amount after the final tightening is conducted.



- 1) The screwdriver moves to the screw feeding position on the feeder.
- 2) Make the screwdriver turn clockwise and have a screw stick on the screwdriver to take it out.
- 3) The screwdriver moves to the position of screw tightening.
- 4) The screwdriver turns clockwise and drops down till the torque increases.
- 5) The screwdriver turns counterclockwise and rises up to the indicated position.

## 1.1.3 Temporary Insertion

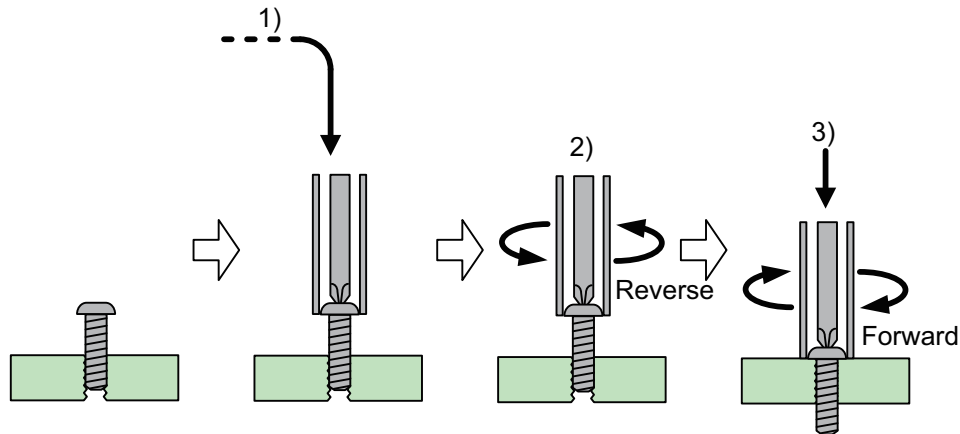
A screw taken out of a feeder should be tightened for the indicated amount.



- 1) The screwdriver moves to the screw feeding position on the feeder.
- 2) Make the screwdriver turn clockwise and have a screw stick on the screwdriver to take it out.
- 3) The screwdriver moves to the position of screw tightening.
- 4) The screwdriver turns clockwise and drops down to the indicated position.

## 1.1.4 Final Tightening of Screw Temporarily Inserted

A screw inserted or tightened temporarily should be tightened till the torque increases.

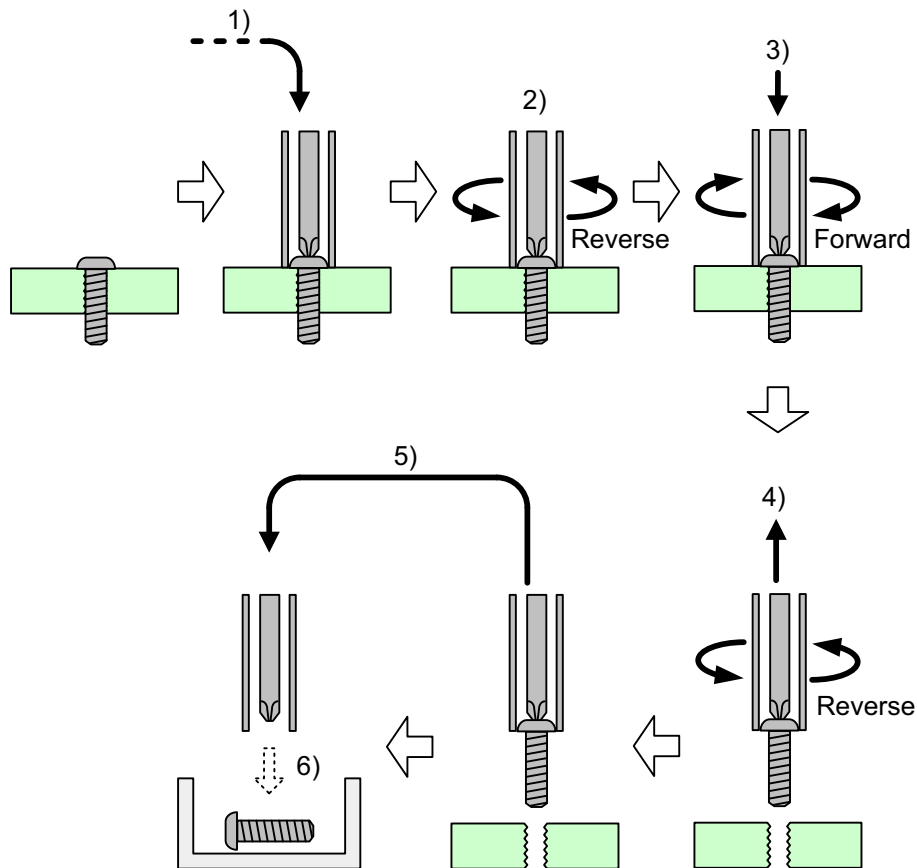


- 1) Tip of the screwdriver bit moves to the position of a screw head which is temporarily inserted (tightened).
- 2) The screwdriver turns counterclockwise so the bit tip fits to the slots on the screw head. <sup>(Note1)</sup>
- 3) The screwdriver turns clockwise and drops down till the torque increases.

Note 1 The operation in Step 2) is called “bit fitting operation”. Whether to activate the bit fitting operation or not can be selected for your needs.

## 1.1.5 Loosening

A tightened screw can be taken out and thrown away at the indicated position.



- 1) The tip of the screwdriver bit moves to the position of a screw head which is tightened up.
- 2) The screwdriver turns counterclockwise so the bit tip fits to the slots on the screw head. <sup>(Note1)</sup>
- 3) The screwdriver turns clockwise and drops down to the indicated position. <sup>(Note2)</sup>
- 4) The screwdriver turns counterclockwise and rises up to the indicated position.
- 5) The screwdriver moves to the indicated position (position to throw away a screw).
- 6) Screw sticking is stopped and screw gets thrown away.

Note 1 The operation in Step 2) is called "bit fitting operation". Whether to activate the bit fitting operation or not can be selected for your needs.

Note 2 The operation in Step 3) makes the bit tip bite the screw head stronger. This is called "Driving operation". Whether to activate the further biting operation or not can be selected for your needs.

## 1.2 Environment for Operation

In order to operate this software, it is necessary that your personal computer satisfies the following conditions.

|                            |   |
|----------------------------|---|
| OS                         | Windows 7 <sup>(Note1)</sup><br>Windows 8<br>Windows 8.1<br>Windows 10<br><br>Note1 It is necessary to install Microsoft .NET Framework 4.x separately. |
| Computer Main Unit         | Personal computer capable to operate the OS above   |
| Memory Capacity            | Capacity required to operate the OS above   |
| Open Capacity in Hard Disk | 10MB or more  |
| Display Resolution         | XGA (1024×768) or more  |

Windows is registered trademarks of Microsoft Corporation.

## 1.3 Applicable Robot Controllers

This software is applicable for the following robot controllers.

- Table-Top Type Robot TTA (with built-in controller)
- MSEL-PC/PG/PCF/PGF (Cartesian, Single-axis Robot Control Type)  
(It is applicable only for those with the same construction as TTA has, which is 1st axis = X-axis, 2nd axis = Y-axis, 3rd axis = Z-axis and 4th axis = R-axis)



**Caution:**

SEL program generator is not applicable for the work and tool coordinate system features.  
When the TTA and MSEL controller to be used is applicable for the work and tool coordinate system features <sup>\*1</sup>, set the work coordinate offset and tool coordinate offset to "0.000mm" for all the axes before executing the program.

**When the work coordinate offset and tool coordinate offset are not set to "0.000mm" for all the axes, unexpected operation may occur, which could cause interference of robot, tool, workpiece, etc., and cause malfunction.**

\*1 Supported versions of work and tool coordinate systems

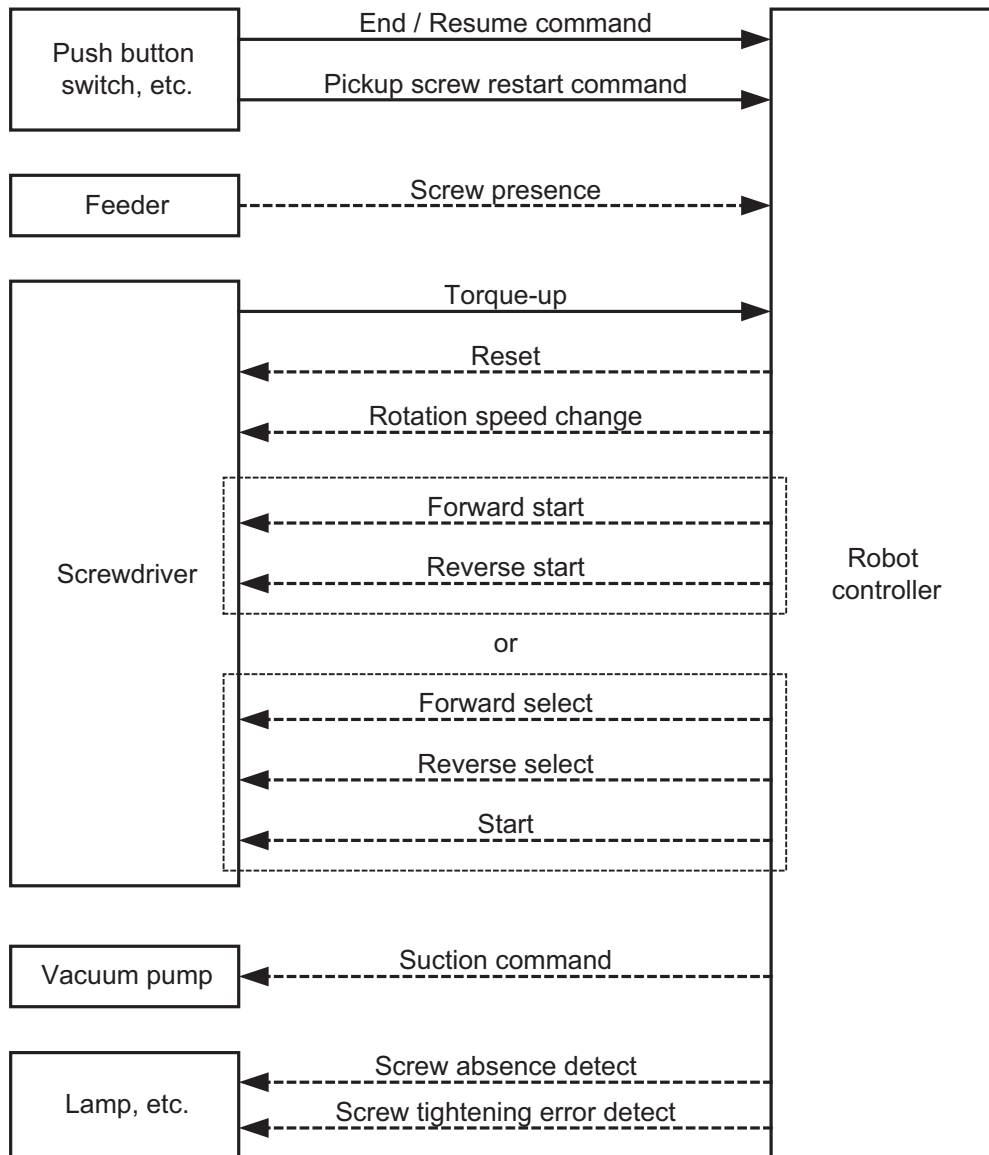
TTA : Main Application Part V2.00 and later

MSEL : Main Application Part V2.00 and later

The SEL programs, position data and simulations generated in SEL program generator should be applicable only when using the table top type robot and cartesian robot. They are not applicable when using only the single axis (including gripper, rotary, etc.), wrist unit (including cartesian robot combined) or SCARA Robot (IXP).

## 1.4 Input and Output Signals to be Used (PIO)

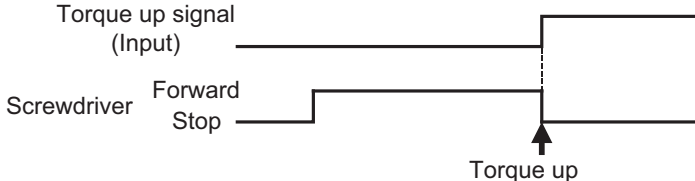
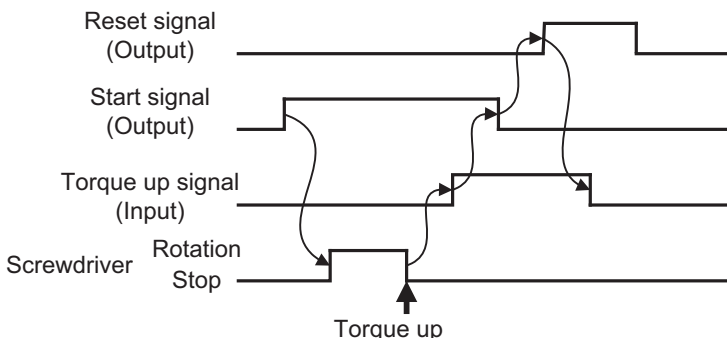
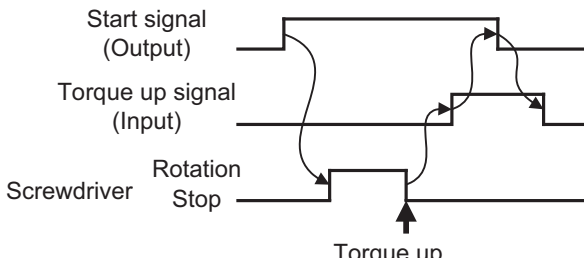
PIO signals are to be used for command/response between a robot controller and external devices (such as tightening screwdriver).



- Solid line signals are mandatory
- Dashed line signals are optional (Related functions require them)

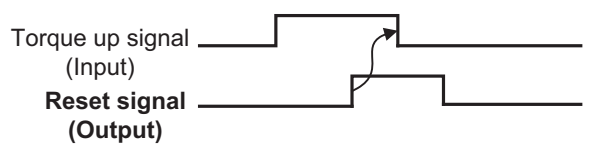
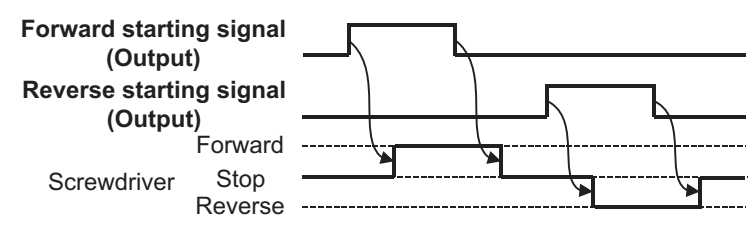
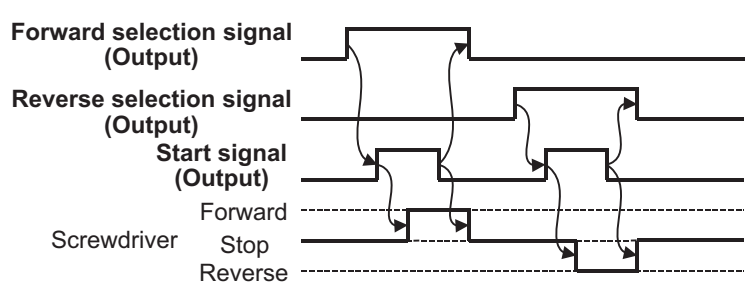
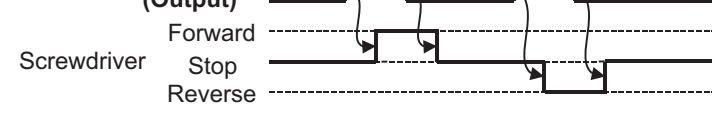
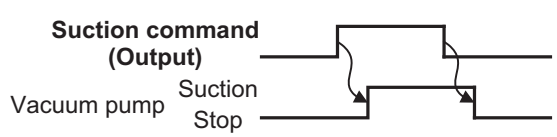


## 1.4.1 Input Signals (External Device => Robot Controller)

| Signal Name                         | Functions   |
|-------------------------------------|---|
| End / Resume command<br>[Mandatory] | <p>End / Resume command signal (signals such as pressing button switch) of the robot program that was paused due to error detection is to be input.</p> <p>Signal level should be selected from the following.</p> <ul style="list-style-type: none"> <li>• OFF-level</li> <li>• ON-level</li> <li>• OFF-edge</li> <li>• ON-edge</li> </ul>   |
| Torque-up<br>[Mandatory]            | <p>Torque-up signal (screw-tightening complete signal) of the tightening screwdriver is to be input.</p> <p>It turns ON when the torque of the tightening screwdriver increases.</p>  <p>Also, it resets in one of the following ways.</p> <ul style="list-style-type: none"> <li>• Reset by "Reset signal" output ON pulse</li> </ul>  <ul style="list-style-type: none"> <li>• Reset by "Start signal" output OFF</li> </ul>  |

| Signal Name                  | Functions  |
|------------------------------|--|
| Screw presence               | <p>Screw existence signal of the screw feeder is to be input.<br/>It is ON when there are screws at the feeding point and turns OFF when gone.</p> <div style="text-align: center;"> <p><b>Screw existence signal (Input)</b></p> <p>Exist<br/>Screw Empty</p> </div> <p>Refer to [6.6 Pickup Screw] for details.</p>            |
| Pickup screw restart command | <p>Screw feeding operation that was paused due to screw absence detection is to be resumed.<br/>Signal level should be selected from the following.</p> <ul style="list-style-type: none"> <li>• OFF-level</li> <li>• ON-level</li> <li>• OFF-edge</li> <li>• ON-edge</li> </ul> <p>Refer to [6.6 Pickup Screw] for details.</p> |

## 1.4.2 Output Signals (Robot Controller => External Device)

| Signal Name           | Functions   |
|-----------------------|---|
| Reset                 | <p>Torque-up signal of the tightening screwdriver is to be reset.</p>  <p>Pulse band can be set up from the range between 0.01 and 99.00sec.</p>  |
| Rotation speed change | <p>Revolution speed of the screw driver can be switched (Low/High). It should be used in a case that the revolution speed is required to be changed for different screw types, screw tightening points and so on.</p>   |
| Forward start         | <p>The revolution of the screwdriver can be controlled between clockwise and counterclockwise. It turns clockwise / stops with the ON / OFF of "Forward starting signal". It turns counterclockwise / stops with the ON / OFF of "Reverse starting signal".</p>                                     |
| Reverse start         |    |
| Forward select        | <p>The revolution of the screwdriver can be controlled between clockwise and counterclockwise. Select the direction of screw turn (clockwise / counterclockwise) with "Forward selection signal" and "Reverse selection signal" and starts turning / stops with the ON / OFF of "Start signal".</p> |
| Reverse Select        |   |
| Start                 |   |
| Suction command       | <p>It makes a screw stick on.</p>   |

| Signal Name                   | Functions  |
|-------------------------------|--|
| Screw absence detect          | It turns ON when there is no screw at the screw feeding point at the start of screw tightening operation.<br>It should be used to notify an operator that all the screws are gone.     |
| Screw tightening error detect | It turns ON when a screw tightening error (screw not seated properly, loose hole) was detected.<br>It should be used to notify an operator that a screw tightening error was detected. |

## 1.5 Data to be Used (Variables, Flags and Subroutines)

Following data should be used in SEL programs generated by this software.

| Data Type               | Used Range   |
|-------------------------|--------------|
| Local Integer Variables | 1050 to 1099 |
| Local Real Variables    | 1170 to 1199 |
| Local Flags             | 980 to 999   |
| Subroutines             | 41 to 99     |



Caution: There is a concern that operation would not be performed in normal condition in case any change (such as to change values, reuse for another purpose, etc.) is made to the data above.  
Pay special attention in case it is required to change the generated program.

## 1.6 Devices Necessary for Screw Tightening

In order to perform screw tightening with the program generated by this tool, it is necessary to have the following devices.

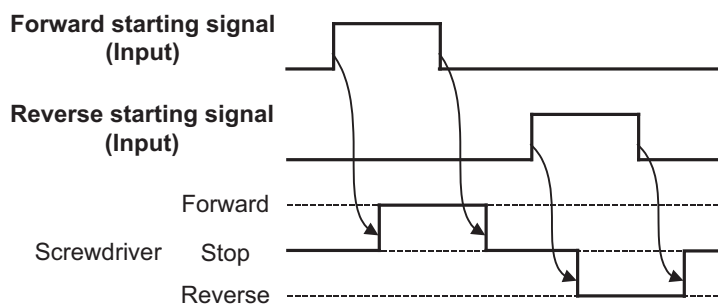
- Automatic Screwdriver <sup>(Note1)</sup> <sup>(Note2)</sup>
- Screw Feeder <sup>(Note 3)</sup>
- Screw Suction Vacuum Pump <sup>(Note4)</sup>

### 1.6.1 Automatic Screwdriver

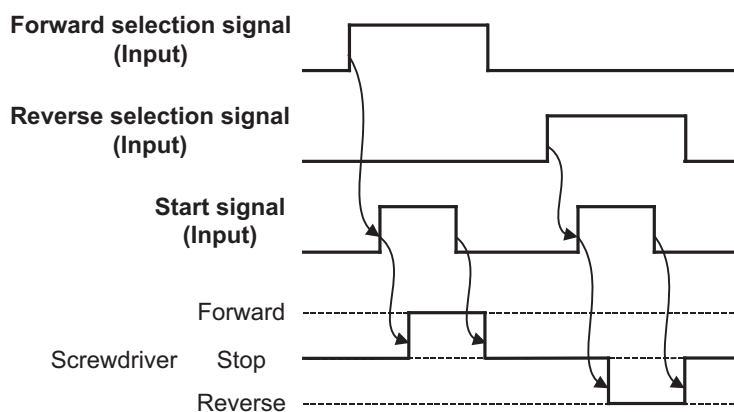
Use a model that satisfies the following two conditions.

- 1) It possesses either of the ways shown below in order to make a command for turn (clockwise / counterclockwise) and stop of a screwdriver.

(A) Forward starting signal / Reverse starting signal

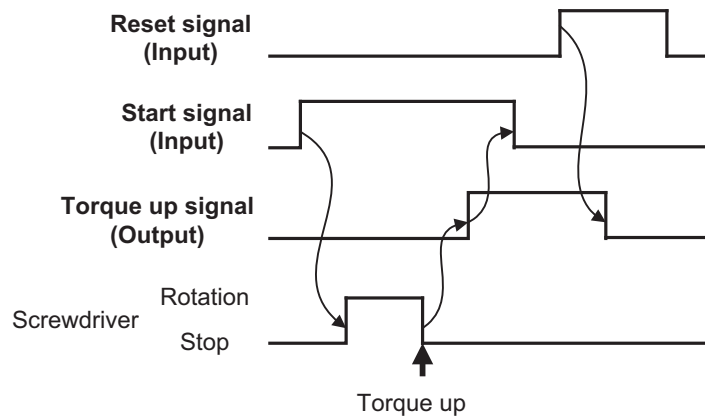


(B) Direction select signal + Start signal

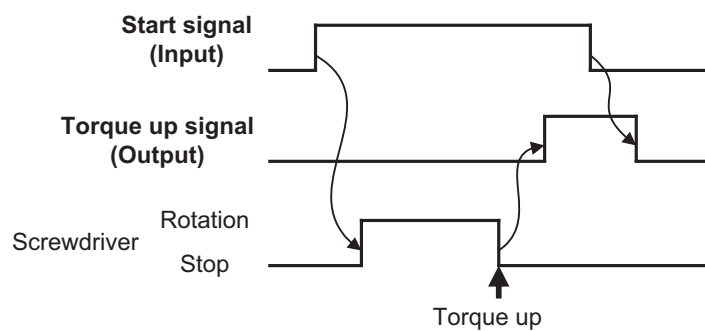


2) It possesses either of the ways shown below in order to reset the torque-up signal.

(A) Reset signal ON pulse



(B) Start signal OFF



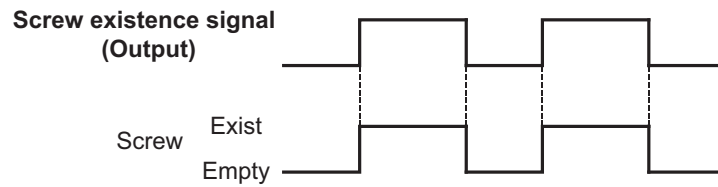
### <Regarding Robot Installation>

In order to reduce the stress, robot should be installed via dumper structure.

- Stress applied to screws and screwdriver caused by a shock when a workpiece contacts
- Stress applied to screws and workpiece caused by the velocity difference between Z-axis feeding speed and screw forwarding

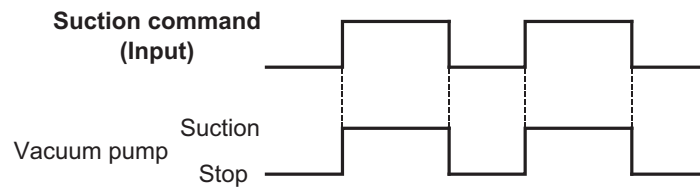
## 1.6.2 Screw Feeder

Use a model that possesses the following signals.



## 1.6.3 Screw Suction Vacuum Pump

Use a model that possesses the following signals.

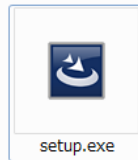




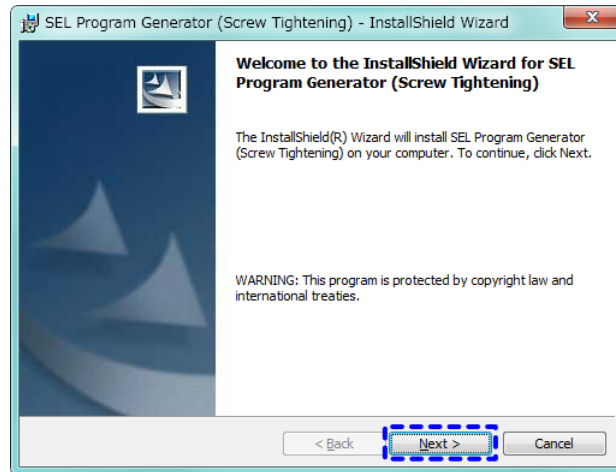
## 2. Installation

Install the software in the following procedure.

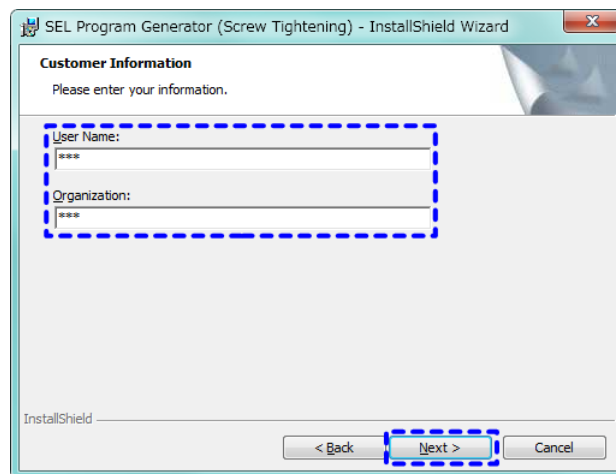
- 1) Double-click “Setup.exe”.



- 2) Once the installer is ready, click on **Next** button.

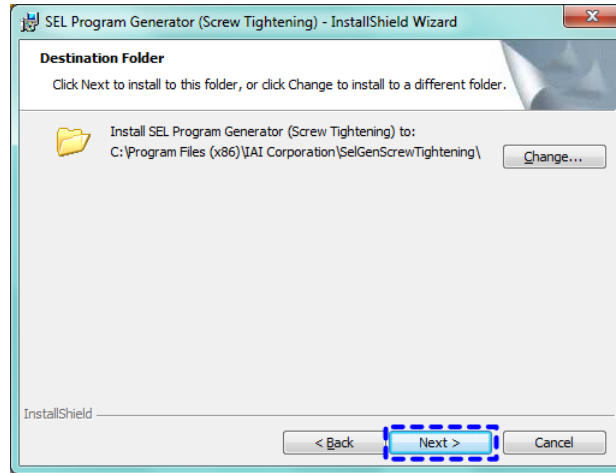


- 3) Input the information in “User Name” and “Organization”, and click on **Next** button.



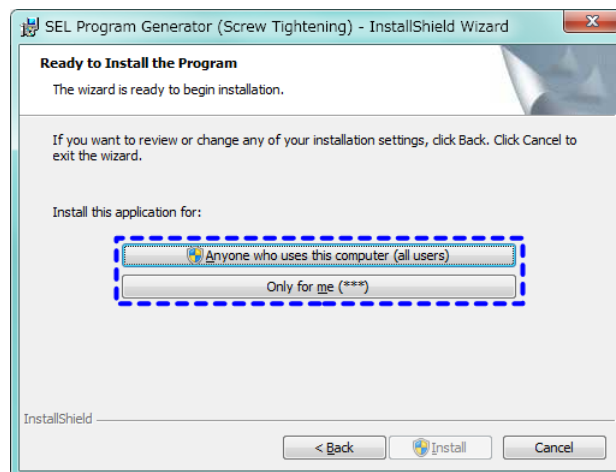
- 4) Click on **Next** button.

(Note) When it is necessary to change the domain to install, click on **Change...** button and select a domain to install.

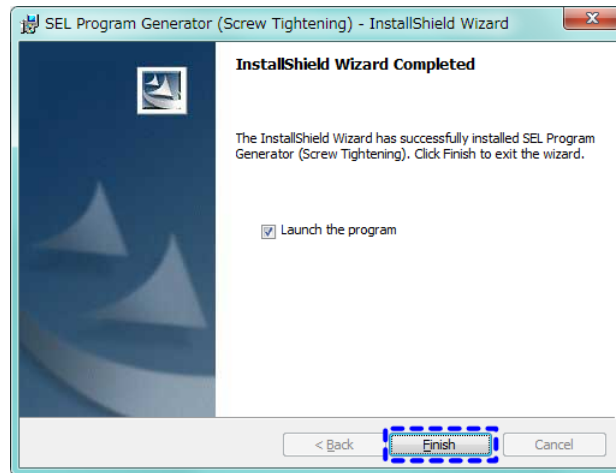


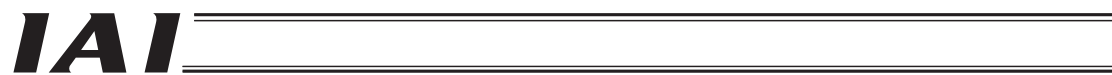
- 5) Select a subject to install (click a button) and installation process will start.

(Note) If “User Account Control” dialog window appears, click on **Yes** button to continue the installation process.



- 6) Click on **Finish** button to finish the installation.

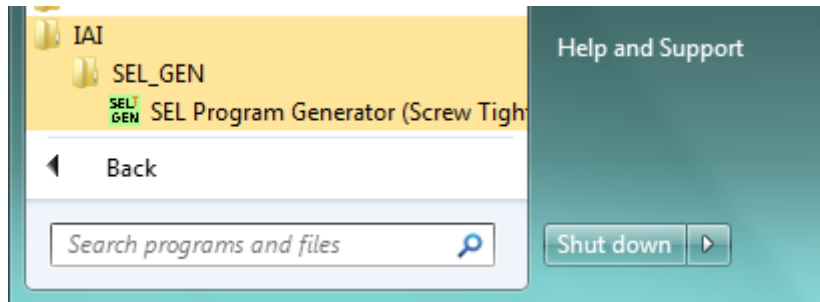




## 3. Startup and Finish


### 3.1 Start

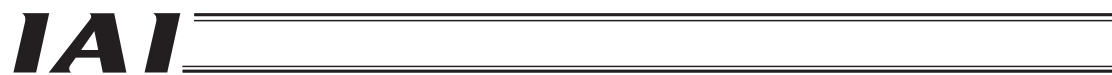
Select [All Programs] - [IAI] - [SEL\_GEN] - [SEL Program Generator (Screw Tightening)] in Start Menu of Windows.



### 3.2 Finish

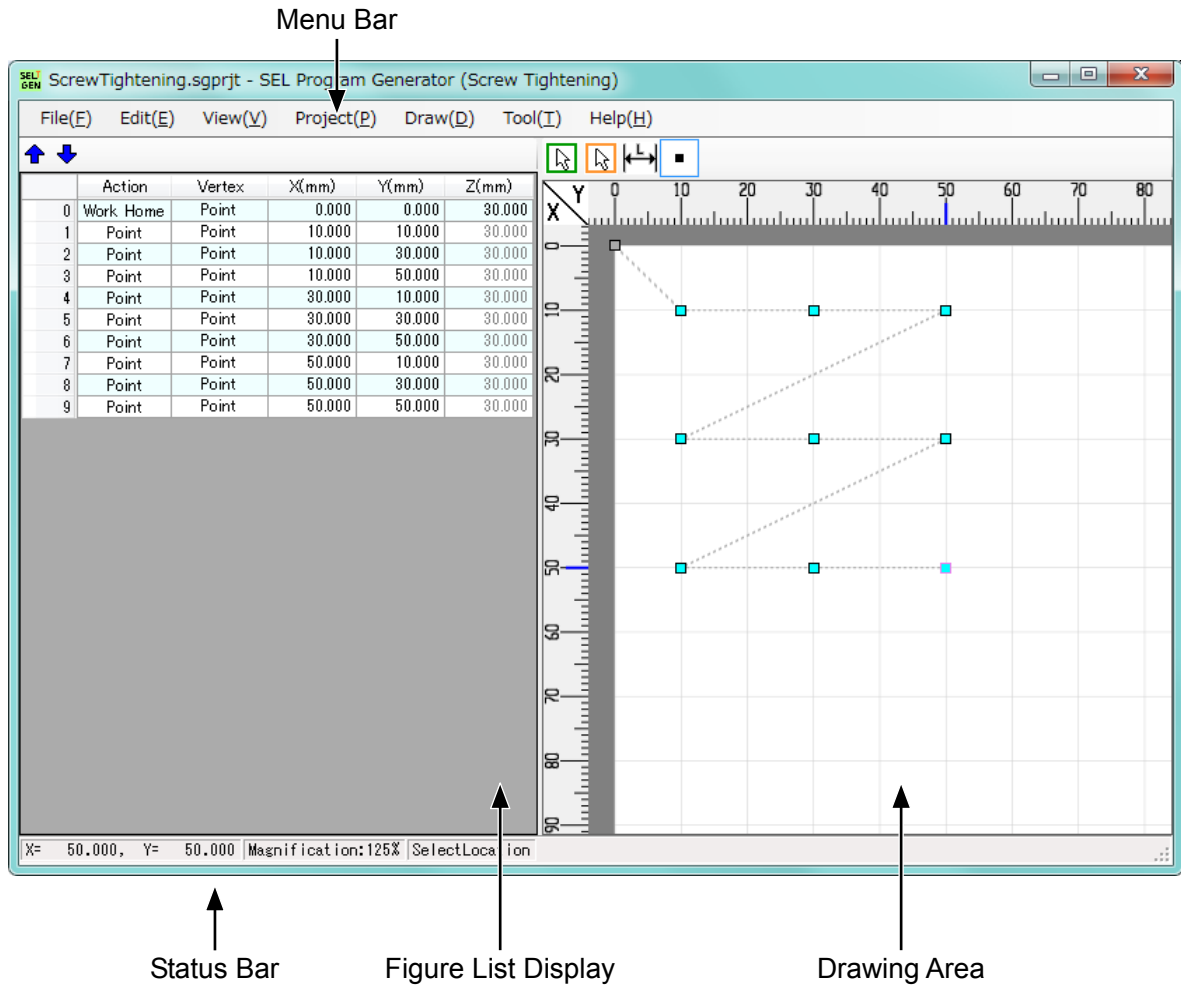
Choose either way to exit.

- Select [File (F)] - [Exit (X)] in the menu bar.
- Click on  button on the top right of the main window.



## 4. Explanation of Windows

If you start up this software, the “Main Window” as shown below will appear.



## 4.1 Menu Bar

You can execute each type of operation from the pull-down menu.

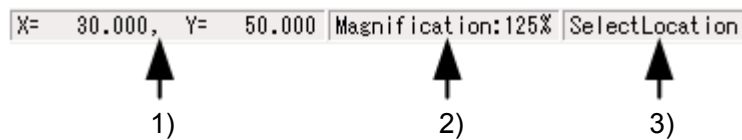
| Menu        | Sub Menu                    | Functions  |
|-------------|-----------------------------|--|
| File (F)    | New Project (N)             | A new project can be created.  |
|             | Open Project (O)            | An existing project can be opened.   |
|             | Save As (A)                 | You can put a name to a project and save it.                                 |
|             | Save (S)                    | You can overwrite a project.   |
|             | Dxf data (D)                | • Read (R)<br>DXF figure data can be read out from a file.                   |
|             |                             | • Clear (C)<br>The DXF figure already read in can be cleared.                |
|             | Reference data (F)          | • Read (R)<br>Figure data for reference can be read out from a file.         |
|             |                             | • Clear (C)<br>The figure data for reference already read in can be cleared. |
|             | Background image (B)        | • Read (R)<br>Background image data can be read out from a file.             |
|             |                             | • Clear (C)<br>The image data for background already read in can be cleared. |
|             | Track data (T)              | • Read (R)<br>Track data can be read out from a file.                        |
|             |                             | • Clear (C)<br>The data for track already read in can be cleared.            |
|             | Exit (X)                    | This software will be finished   |
| Edit (E)    | Undo (U)                    | The figure editing operation can be undone.                                  |
|             | Redo (R)                    | The figure editing operation can be redone.                                  |
|             | Cut (T)                     | The selected figure can be cut.  |
|             | Copy (C)                    | The selected figure can be copied.   |
|             | Paste (P)                   | The figure which was cut or copied can be pasted.                            |
|             | Delete (D)                  | The selected figure can be deleted.  |
|             | Select All (A)              | All of the figure can be selected.   |
| View (V)    | Display lines (W)           | Created figure can be selected whether to show or hide.                      |
|             | Display DXF lines (X)       | DXF figure can be selected whether to show or hide.                          |
|             | Display reference lines (R) | Reference figure can be selected whether to show or hide.                    |
|             | Display track lines (T)     | Track line data can be selected whether to show or hide.                     |
|             | Zoom (Z)                    | Display magnification of a figure can be selected (from 10% to 8000%).       |
| Project (P) | Generate (G)                | SEL program and position data can be generated.                              |
|             | Simulate (S)                | Simulation should be performed to check the operation track and cycle time.  |
|             | Property (P)                | Property setting of a project can be established.                            |
| Draw (D)    | Select drawing items (W)    | Drawing Mode cab be changed to "Select drawing items mode".                  |
|             | Select dxf items (X)        | Drawing Mode cab be changed to "Select dxf items mode".                      |
|             | Measure distance (M)        | Drawing Mode cab be changed to "Measure distance mode".                      |
|             | Point (P)                   | Drawing Mode cab be changed to "Point drawing mode".                         |
|             | Translation (T)             | The selected figure can be moved.  |
|             | Rotation (R)                | The selected figure can be rotated.  |
|             | Invert (I)                  | The selected figure can be inverted.   |
| Tool (T)    | Option (O)                  | Tool option setting can be established.                                      |
| Help (H)    | About (A)                   | The version information of this software can be shown.                       |



## 4.2 Status Bar

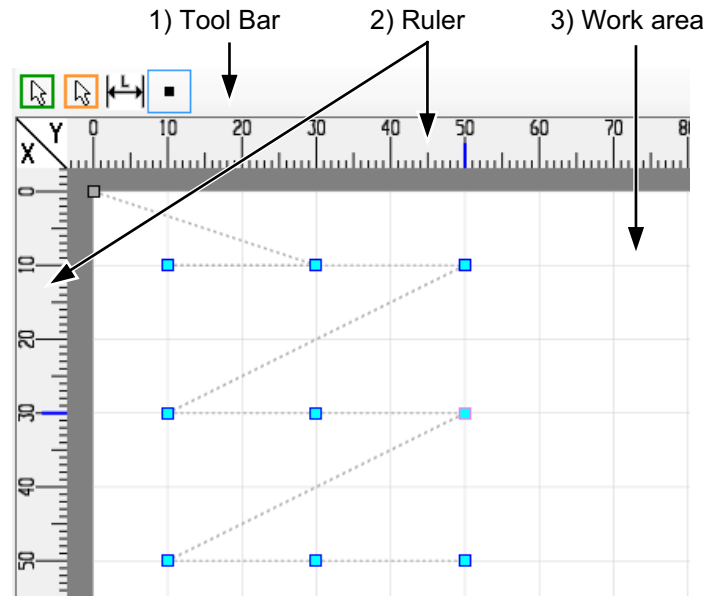
The status bar shows you the following information.

- 1) Coordinates of mouse cursor position  
The coordinates (X coordinate and Y coordinate) of the mouse cursor displayed position should be shown.
- 2) Magnification  
Magnification of the drawing area is shown.
- 3) Drawing Operation / Two-Point Distance  
The current action of drawing operation such as “Select Location” and “Select Start Location” is shown.  
If the drawing mode is “Measure distance”, the distance between the indicated two points should be displayed.



## 4.3 Drawing Area

You can create a figure (motion path).  
The drawing area is constructed as shown below.



- 1) Tool Bar  
There are buttons allocated to switch the edit mode.  
(Refer to [4.3.4 Edit Mode] for the edit mode.)

| Button | Functions                                    |
|--------|--|
|        | Mode changed to "Select drawing items mode". |
|        | Mode changed to "Select dxf items mode".     |
|        | Mode changed to "Measure distance mode".     |
|        | Mode changed to "Point drawing mode".        |

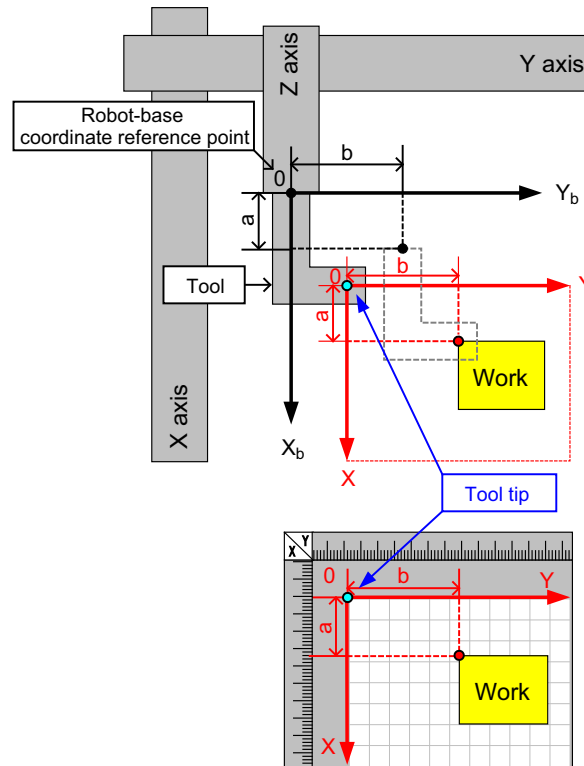
- 2) Ruler  
Scales of X-axis and Y-axis are shown. (Unit: mm)
- 3) Work Area  
It is the work area of X-axis and Y-axis.  
A figure (motion path) should be created in the range of this area.

## 4.3.1 Coordinate System in Work Area

Shown below is the relation between the coordinate system of the work area and that of the robot.

Shown with “a” and “b” in the figure is the relation between the position of the tool tip and that of the workpiece when X-axis and Y-axis are positioned at the robot base coordinate datum (0, 0).

Confirm “a” and “b” in advance in a device drawing and so on.



**This software is not applicable for the work and tool coordinate system features. When the controller to be used is applicable for the work and tool coordinate system features<sup>\*1</sup>, set the work coordinate offset and tool coordinate offset to “0.000mm” for all the axes before executing the program.**

**When the work coordinate offset and tool coordinate offset are not set to “0.000mm” for all the axes, unexpected operation may occur, which could cause interference of robot, tool, workpiece, etc., and cause malfunction.**

\*1 Supported versions of work and tool coordinate systems

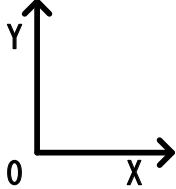
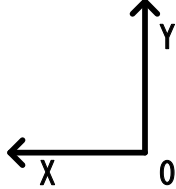
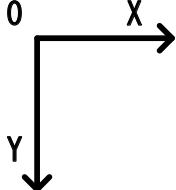
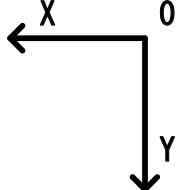
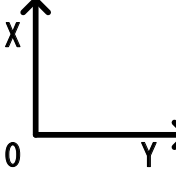
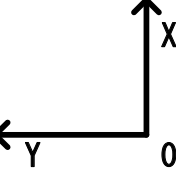
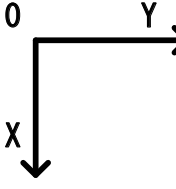
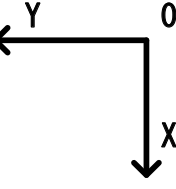
TTA : Main Application Part V2.00 and later

MSEL : Main Application Part V2.00 and later

The SEL programs, position data and simulations generated in SEL program generator should be applicable only when using the table top type robot and cartesian robot.

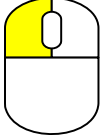
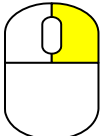
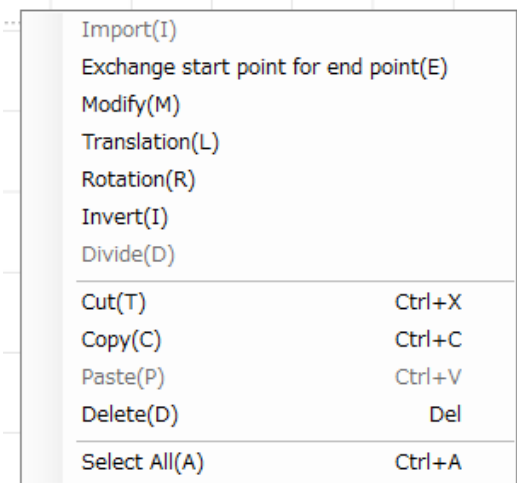
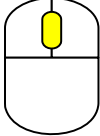
They are not applicable when using only the single axis (including gripper, rotary, etc.), wrist unit (including cartesian robot combined) or SCARA Robot (IXP).

The orientation of the coordinates display in the work area should be selected from the eight types below.

| TYPE 1  | TYPE 2   |
|---|--|
|    |    |
| TYPE 3  | TYPE 4   |
|    |    |
| TYPE 5  | TYPE 6   |
|  |  |
| TYPE 7  | TYPE 8   |
|  |  |















## 4.3.2 Basic Operation

Basic operations should be performed on a mouse and keyboard.

| Button  | Operation | Functions   |
|---|-----------|---|
|    | Click     | <ul style="list-style-type: none"> <li>In Select Drawing Item Mode / Select DXF Items Mode, A figure which the cursor is pointing on can be selected<br/>Press [Shift] key and hold it down while clicking on a figure and multiple figures can be selected at once.</li> </ul> |
|   |           | <ul style="list-style-type: none"> <li>In Point Drawing Mode / Measure Distance Mode, This determines the peak points (measurement start point in measure distance mode).</li> </ul>  |
|   | Drag      | <ul style="list-style-type: none"> <li>When a figure is selected<br/>The position of the selected figure can be moved.</li> </ul>   |
|   |           | <ul style="list-style-type: none"> <li>When no figure is selected<br/>Range of a figure can be selected.</li> </ul>   |
|    | Click     | <p>Popup menu should open.</p>   |
|  | Rotate    | <ul style="list-style-type: none"> <li>When [Ctrl] key is held down<br/>Display can be zoomed in and out. (10% to 8000%)</li> </ul>   |
|   |           | <ul style="list-style-type: none"> <li>When [Shift] key is held down<br/>Display can be scrolled right and left.</li> </ul>   |
|   |           | <ul style="list-style-type: none"> <li>In condition other than above<br/>Display can be scrolled up and down.</li> </ul>  |
|   | Drag      | Display can be scrolled to the direction that you dragged.  |





## 4.3.3 Types of Displayed Points and Lines

The types of dots and lines displayed in the work area are as shown below.

| Display   | Contents   |
|---|--|
|    | Work Home  |
|    | Point / Starting Point of a Line / Starting Point of a Circle / Starting Point of an Arc |
|    | End Point of a Line / End Point of an Arc  |
|    | 1st Pass Point of a Circle   |
|    | 2nd Pass Point of a Circle / Pass Point of an Arc  |
|    | Center Point of a Circle   |
|    | Linked Point of a Line / Circle / Arc  |
|    | Created Figure (with no screw tightening operation)                                      |
|    | Created Figure (with screw tightening operation)   |
|    | Created Figure (selected)  |
|   | Figure read out of a DXF file  |
|  | Figure read out of a DXF file (selected)   |
|  | Figure under working   |
|  | Movement Route between Figures   |

## 4.3.4 Edit Mode

Create Drawing / Edit can be switched over by switching the edit mode in the work area.  
See below for the feature of each edit mode and how to switch between them.

| Mode                 | Functions  |
|----------------------|--|
| Select drawing items | A created figure can be selected on a mouse.<br>[Mode Change in Menu Bar]<br>Execute [Draw (D)] - [Select drawing items (W)]<br>[Mode Change in Tool Button]<br>Click on  button            |
| Select dxf items     | A figure read out of a DXF file can be selected on a mouse.<br>[Mode Change in Menu Bar]<br>Execute [Draw (D)] - [Select dxf items (X)]<br>[Mode Change in Tool Button]<br>Click on  button |
| Measure distance     | Distance can be measured between any two points.<br>[Mode Change in Menu Bar]<br>Execute [Draw (D)] - [Measure distance (M)]<br>[Mode Change in Tool Button]<br>Click on  button            |
| Point drawing        | A dot can be drawn.<br>[Mode Change in Menu Bar]<br>Execute [Draw (D)] - [Point (P)]<br>[Mode Change in Tool Button]<br>Click on  button  |

### 4.3.5 Selecting a Figure

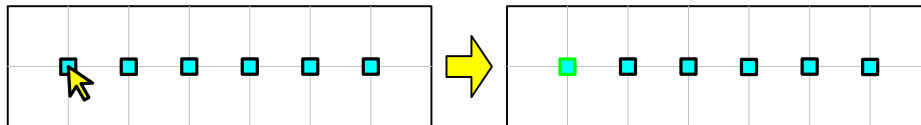
Change the edit mode to “Select drawing items” and the created figure gets available to select.

Also, choose “Select dxf items” and DXF figures get available.

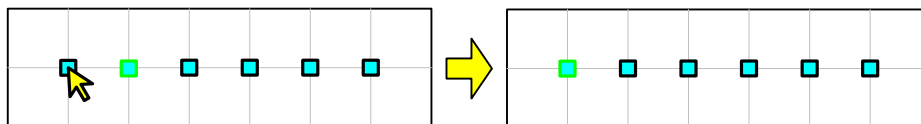
There are four types of figure select.

- Single Select

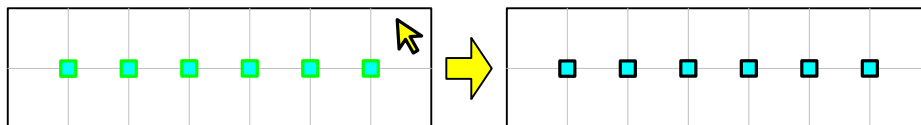
Click in a figure and this figure can be selected.



A figure that has been already selected will be cancelled if any.

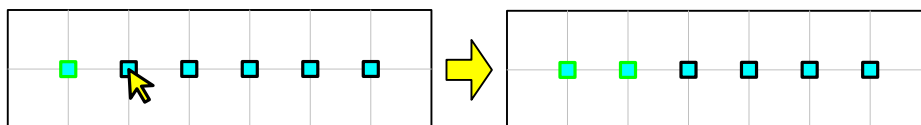


Also, if a space with no figure gets clicked, all the selection of the figures should be cancelled.

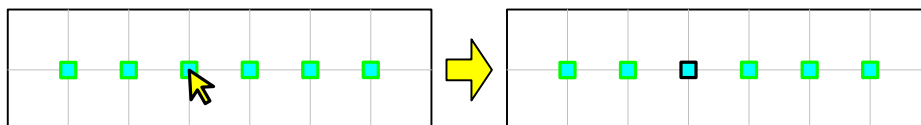


- Multiple Select

Hold down [Shift] key while selecting a figure, and the figure will be selected in addition to the figure that has been already selected.



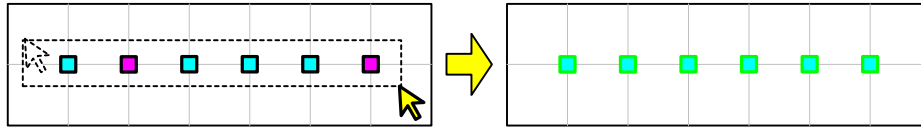
Click on a figure that is already selected, and the selection of this figure will be cancelled.



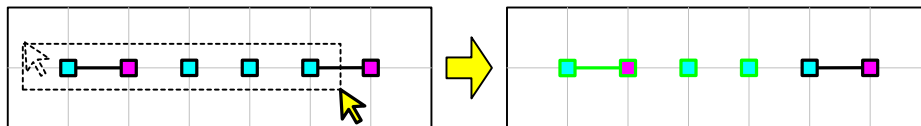


## ● Range Select

Drag the cursor and all the figures included in the dotted rectangle can be selected at once.



A line can be selected only when both start and end points are included.



## ● Select All

All the figures can be selected at once in either of the ways below.

- Execute [Edit (E)] - [Select all (A)] from the menu bar
- Execute [Select All (A)] from the pop-up menu

## 4.3.6 Show Reference Figure Data

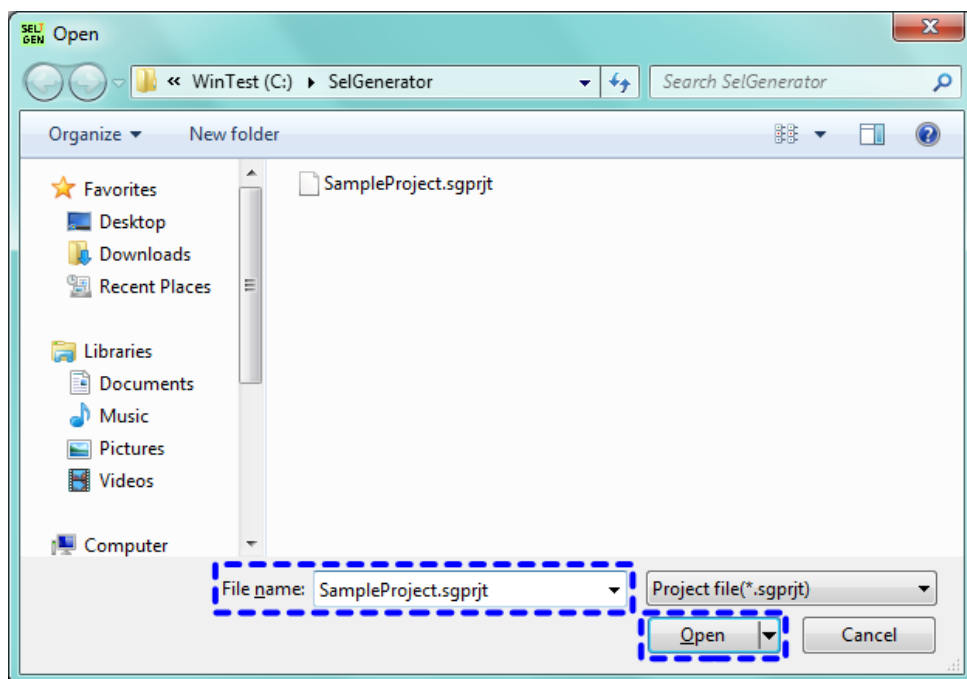
Drawing data in an existing project file can be shown<sup>(Note 1)</sup> as a reference drawing.

Note 1 Only the lines of the figure should be shown and peak points will not.

### [1] Read

In order to read the reference figure data, follow the procedure below.

- 1) Execute [File (F)] - [Reference data (F)] - [Read (R)] from the menu bar.
- 2) Select a file name that you would like to show as a reference, and click on Open button.

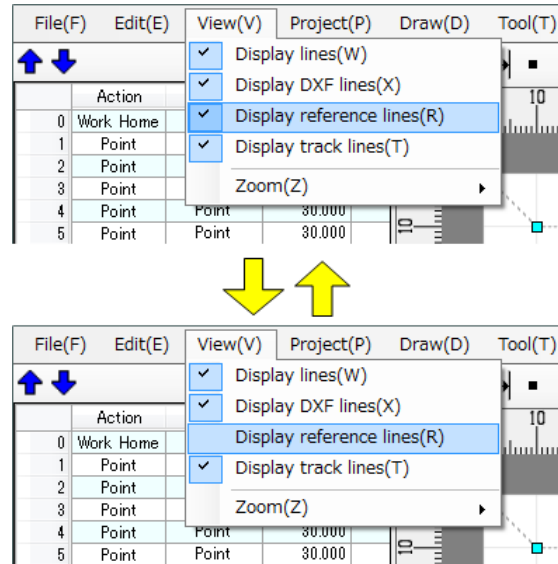


### [2] Clear

Execute [File (F)] - [Reference data (F)] - [Clear (C)] in the menu bar, and the reference data being displayed can be cleared.

## [3] Switchover of Show/Hide

Execute [View (V)] - [Display reference lines (R)] in the menu bar, and the reference figure can be switched between show and hide.



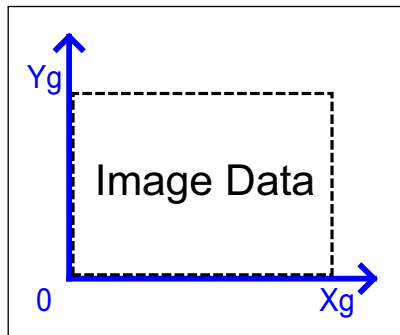
## 4.3.7 Show Background Image Data

An image file (jpeg format) can be read in and shown as the background of the work area.

### Coordinate System for Image Data ( $X_g$ , $Y_g$ )

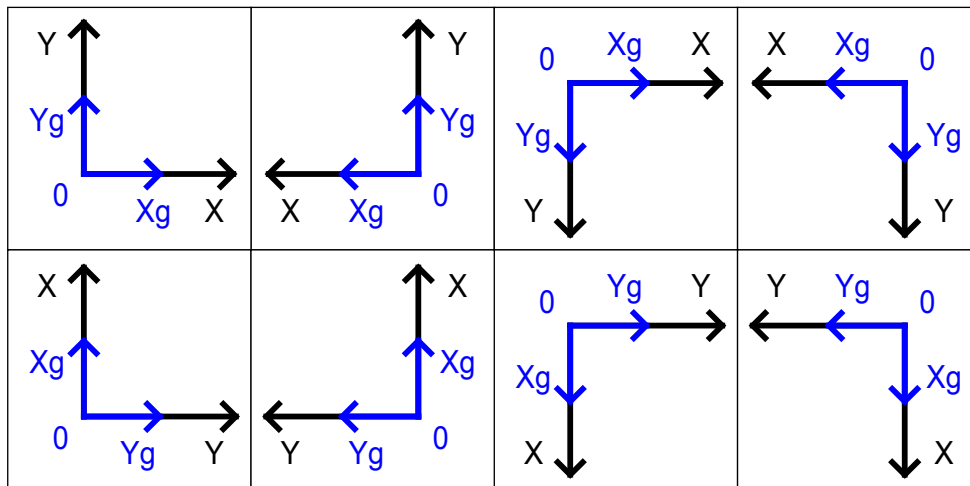
The coordinate system for image data  $X_g$ ,  $Y_g$  should be defined as follows.

- Positive Direction of  $X_g$ : Right Side in Horizontal
- Positive Direction of  $Y_g$ : Upper Side in Vertical



### Relation between Coordinate System for Image Data ( $X_g$ , $Y_g$ ) and Coordinate System in Work Area ( $X$ , $Y$ )

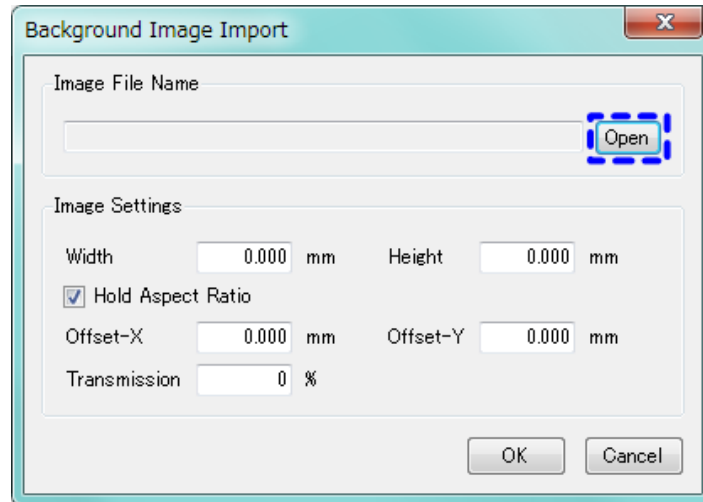
Shown below is how to read in image data and set directions of  $X_g$  and  $Y_g$  in line with directions of  $X$  and  $Y$  in the work area, and set (0, 0) of the image data coordinates at (0, 0) of the work area coordinates.



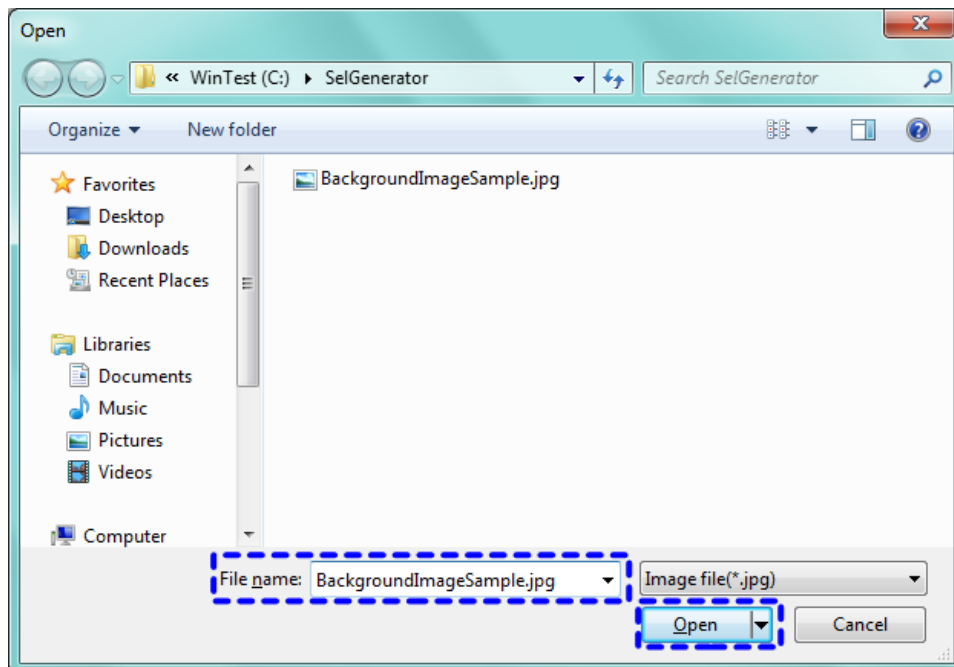
## [1] Read

In order to read the background image data, follow the procedure below.

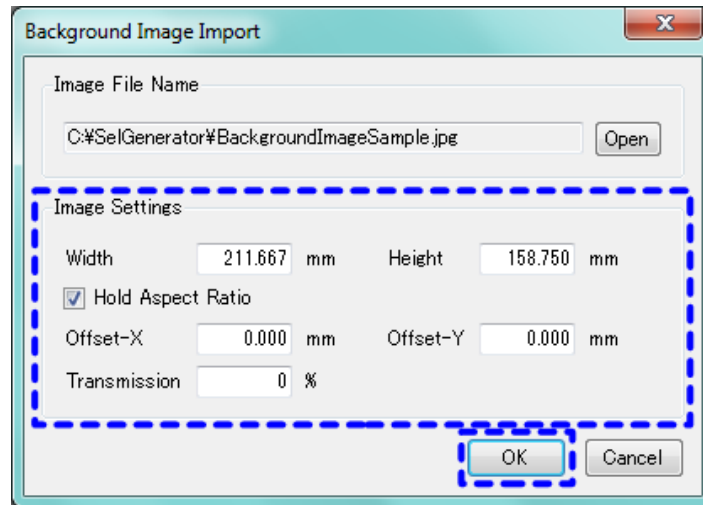
- 1) Execute [File (F)] – [Background image (B)] - [Read (R)] from the menu bar.
- 2) Click on **Open** button in “Background Image Import” window.



- 3) Select a file name of the image data that you would like to show as a background image, and click on **Open** button.



- 4) Establish the display setups for the image, and click on **OK** button.



- Width : Set the display width (X direction) of the image. (Unit: mm)  
 Height : Set the display height (Y direction) of the image. (Unit: mm)  
 Hold Aspect Ratio : Display height (width) should be automatically adjusted in response to the aspect ratio of the image data when the width (height) has been changed.  
 Offset-X : Set the offset position in X direction. (Unit: mm)  
 Offset-Y : Set the offset position in Y direction. (Unit: mm)  
 By having an offset, the relation between the coordinate system in the work area and the position of a workpiece should be adjusted to the actual positions.  
 Transmission : Set the transmittance of background image. (Unit: %)

## [2] Clear

Execute [File (F)] - [Background image (B)] - [Clear (C)] in the menu bar, and the background image being displayed can be cleared.

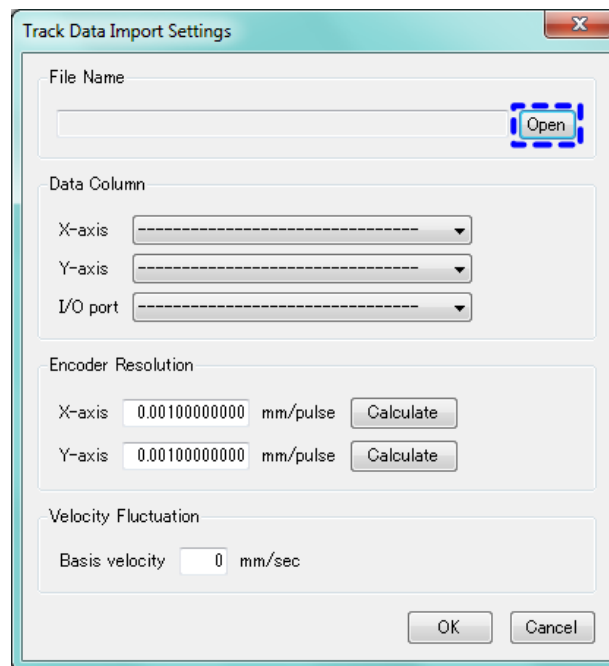
## 4.3.8 Show Track Data

The feedback pulse at the actual operation gathered by “XSEL PC Software” is able to be shown as the actual operation tracks.  
By putting the drawing data (motion path) and the actual operation tracks together to show in the same screen, it is possible to adjust the drawing data while checking dispersion.

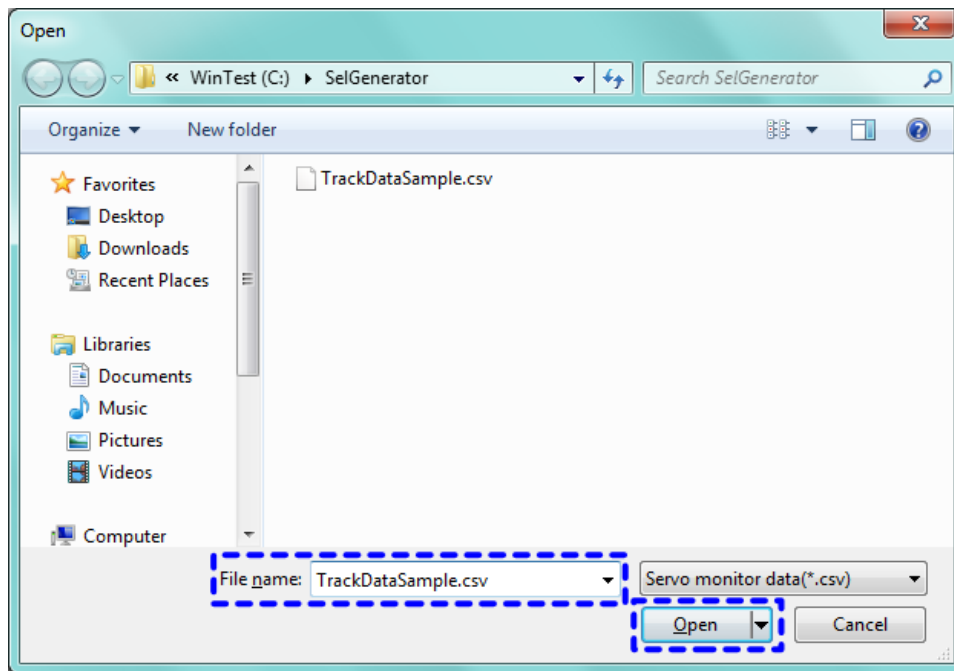
### [1] Read

In order to read the track data, follow the procedure below.

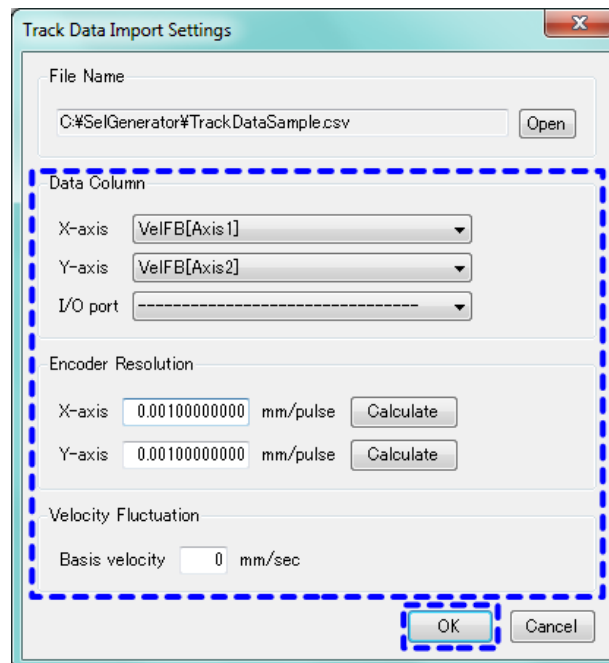
- 1) Execute [File (F)] – [Track data (T)] – [Read (R)] from the menu bar.
- 2) Click on Open button in “Track Data Import Settings” window.



- 3) Select a file name of the tracks, and click on **Open** button.



- 4) Establish the settings for “Data Column”, “Encoder Resolution” and “Velocity Fluctuation”, and click on **OK** button.



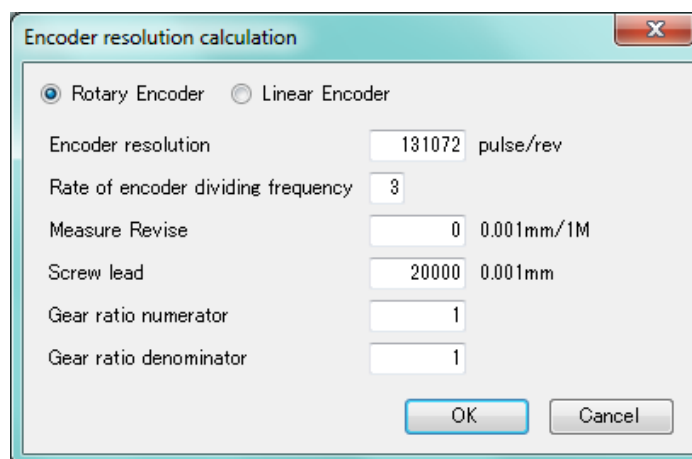


## Setting of "Data Column"

- X-axis : Indicate the feedback pulse data train in X-axis.
- Y-axis : Indicate the feedback pulse data train in Y-axis.
- I/O port : Indicate the I/O monitor data train.  
Indicate this item and only the tracks while the applicable I/O port (or flag) is ON will be shown.  
If "-----" is indicated, tracks in all the sections should be displayed.

## Setting of "Encoder Resolution"

- X-axis : Setup of the encoder resolution for X-axis can be established.  
(Unit: mm/pulse)
- Y-axis : Setup of the encoder resolution for Y-axis can be established.  
(Unit: mm/pulse)
- \* Click on **Calculate** button, and the following window shows up.  
Establish the settings for the indicated items only and the encoder resolution can be figured out.  
For the settings of each item, look in the setting values for each applicable item in each axis parameter in "XSEL PC Software".



## Setting of "Velocity Fluctuation"

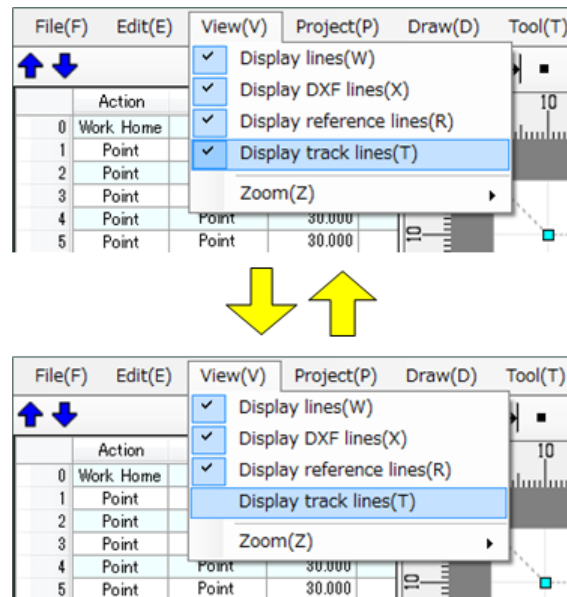
- Basis Velocity : If you desire to change the width of the track lines in response to the operation speed, it is necessary to set up the standard speed (such as the indicated speed when track data was gathered). (Unit: mm/sec)  
The operation tracks in the area that is faster than the standard speed should be expressed in narrow lines while that which is slower expressed in wide lines.  
Set to "0" and the track lines will be expressed in constant width.

## [2] Clear

Execute [File (F)] - [Track data (T)] - [Clear (C)] in the menu bar, and the track data being displayed can be cleared.

## [3] Switchover of Show/Hide

Execute [View (V)] - [Display track lines (T)] in the menu bar, and the track line can be switched between show and hide.



## 4.4 Figure List Display

The figure list display is constructed as shown below.

(2) Tool Bar      (1) Figure Information List

|   | Action    | Vertex | X(mm)  | Y(mm)  | Z(mm)  |
|---|-----------|--------|--------|--------|--------|
| 0 | Work Home | Point  | 0.000  | 0.000  | 30.000 |
| 1 | Point     | Point  | 10.000 | 30.000 | 30.000 |
| 2 | Point     | Point  | 10.000 | 10.000 | 30.000 |
| 3 | Point     | Point  | 10.000 | 50.000 | 30.000 |
| 4 | Point     | Point  | 30.000 | 10.000 | 30.000 |
| 5 | Point     | Point  | 30.000 | 30.000 | 30.000 |

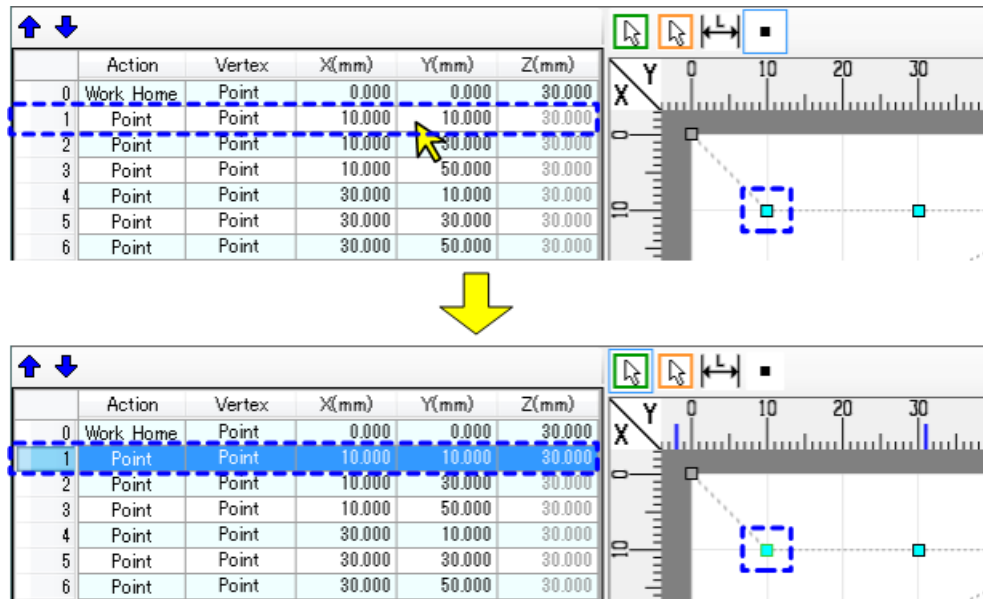
### (1) Figure Information List

The information of the created figures should be shown in a list.

|    |           |       |        |        |        |
|----|-----------|-------|--------|--------|--------|
| 1) | 2)        | 3)    | 4)     | 5)     | 6)     |
|    |           |       |        |        |        |
| 0  | Work Home | Point | 0.000  | 0.000  | 30.000 |
| 1  | Point     | Point | 10.000 | 30.000 | 30.000 |
| 2  | Point     | Point | 10.000 | 10.000 | 30.000 |
| 3  | Point     | Point | 10.000 | 50.000 | 30.000 |
| 4  | Point     | Point | 30.000 | 10.000 | 30.000 |
| 5  | Point     | Point | 30.000 | 30.000 | 30.000 |

| No. | Contents   |
|-----|--|
| 1)  | Numbers of figures should be shown.                                  |
| 2)  | Types of operations (figure types) should be shown.                  |
| 3)  | Types of peak points should be shown.                                |
| 4)  | Values in Coordinate X of peak points should be shown.<br>(Unit: mm) |
| 5)  | Values in Coordinate Y of peak points should be shown.<br>(Unit: mm) |
| 6)  | Values in Coordinate Z of peak points should be shown.<br>(Unit: mm) |

Click on the figure information in the mouse, and the figure can be selected.



## (2) Tool Bar

There are buttons allocated to swap the order of the created figures.

| Button | Functions   |
|--------|---|
|        | Moves the order of the selected figure one step forward.  |
|        | Moves the order of the selected figure one step backward. |

|   | Action    | Vertex | X(mm)  | Y(mm)  | Z(mm)  |
|---|-----------|--------|--------|--------|--------|
| 0 | Work Home | Point  | 0.000  | 0.000  | 30.000 |
| 1 | Point     | Point  | 10.000 | 10.000 | 30.000 |
| 2 | Point     | Point  | 10.000 | 30.000 | 30.000 |
| 3 | Point     | Point  | 10.000 | 50.000 | 30.000 |
| 4 | Point     | Point  | 30.000 | 10.000 | 30.000 |
| 5 | Point     | Point  | 30.000 | 30.000 | 30.000 |



|   | Action    | Vertex | X(mm)  | Y(mm)  | Z(mm)  |
|---|-----------|--------|--------|--------|--------|
| 0 | Work Home | Point  | 0.000  | 0.000  | 30.000 |
| 1 | Point     | Point  | 10.000 | 30.000 | 30.000 |
| 2 | Point     | Point  | 10.000 | 10.000 | 30.000 |
| 3 | Point     | Point  | 10.000 | 50.000 | 30.000 |
| 4 | Point     | Point  | 30.000 | 10.000 | 30.000 |
| 5 | Point     | Point  | 30.000 | 30.000 | 30.000 |

## 5. Screw Tightening Point

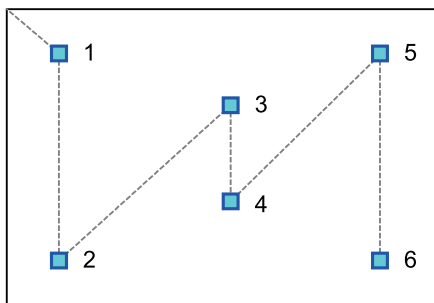
The position where screw tightening work is to be conducted is called “screw tightening point”.

### 5.1 Screw Tightening Condition Number Setting

“Screw tightening condition” to be used in screw tightening work should be selected at each point in the created figure.

(For how to set up the screw tightening condition, refer to [10.7.5 Screw Tightening Condition Setting] and [13. Screw Tightening Conditions Setting].)

Drawn figures



| Figure No. | Condition No. |
|------------|---------------|
| 1          | 3             |
| 2          | 3             |
| 3          | 2             |
| 4          | 2             |
| 5          | 1             |
| 6          | 1             |
| .          | .             |
| .          | .             |

Screw tightening conditions  
(Set by property)

| Condition No. 3 |         |
|-----------------|---------|
| Type            | Unscrew |
| Start position  | 0.00    |
| End position    | 0.00    |
| Feeder No.      | 1       |
| .               | .       |
| .               | .       |

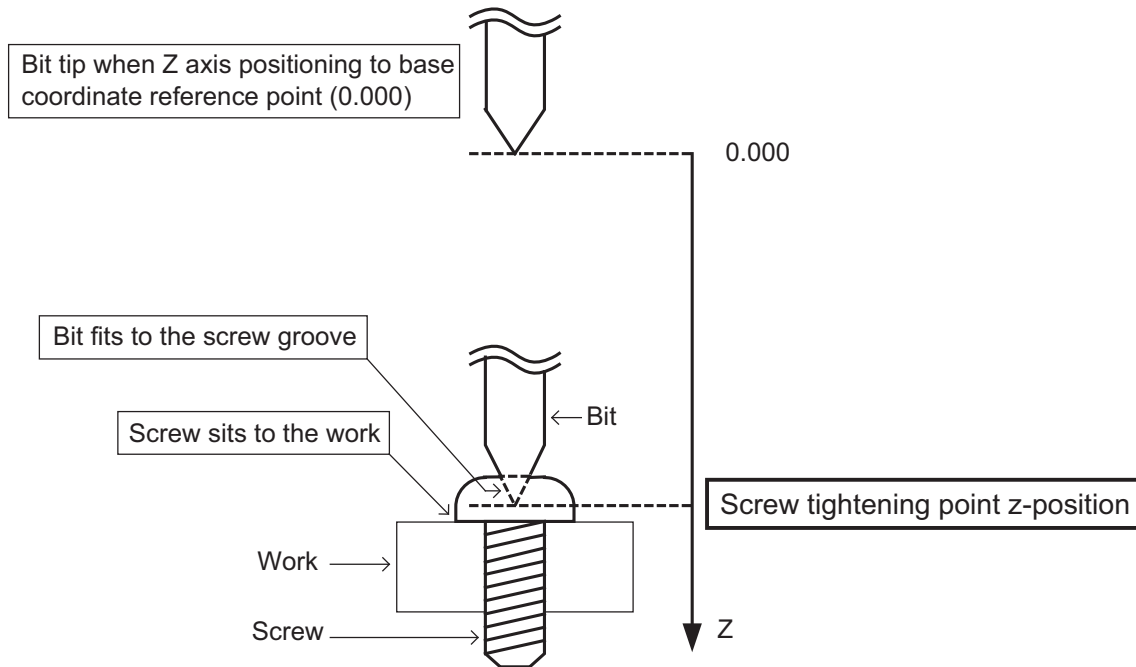
| Condition No. 2 |                  |
|-----------------|------------------|
| Type            | Loose tightening |
| Start position  | 0.00             |
| End position    | 0.00             |
| Feeder No.      | 1                |
| .               | .                |
| .               | .                |

| Condition No. 1 |                 |
|-----------------|-----------------|
| Type            | Full tightening |
| Start position  | -10.000         |
| End position    | 3.000           |
| Feeder No.      | 1               |
| .               | .               |
| .               | .               |

## 5.2 Coordinate Z Setting

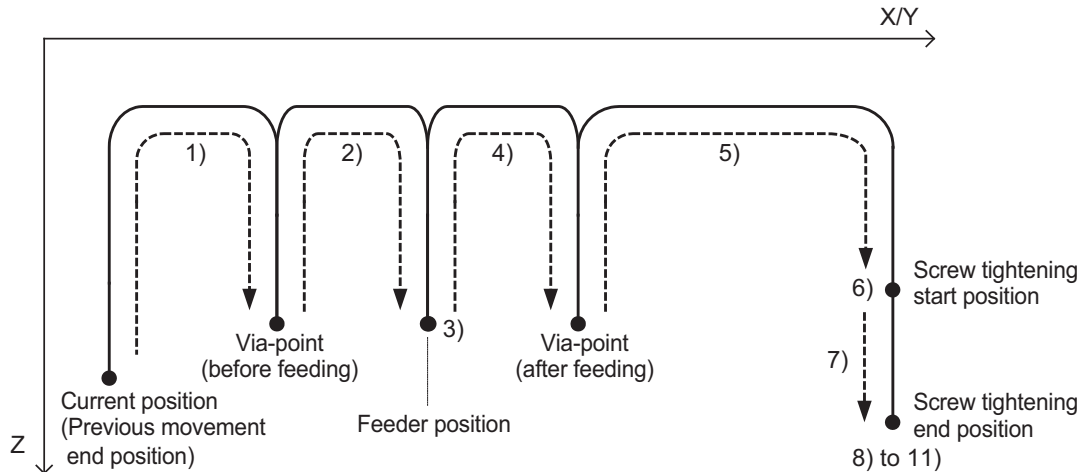
Coordinate Z of the “screw tightening point” should be set as shown in the figure below.



## 6. Screw Tightening Motion

### 6.1 Full Tightening

“Full tightening” should be performed in a flow as shown below.



| No. | Operation   |
|-----|---|
| 1)  | Move to “Via-point (before feeding)”. (Note 1)  |
| 2)  | Move to “Feeder position”.  |
| 3)  | Pick up a screw.<br>(Refer to [6.6 Pickup Screw] for details.)                              |
| 4)  | Move to “Via-point (after feeding)”. (Note 2)   |
| 5)  | Move to “Screw tightening start position”.  |
| 6)  | Start the screwdriver rotation forward (Note 3).  |
| 7)  | Have the Z-axis move downward until “Screw tightening end position”.                        |
| 8)  | Stop the screwdriver rotation forward.  |
| 9)  | Make a judgment for screw tightening error (Screw floating error and Screw slipping error). |
| 10) | Stand by for a specified period of time (Note 4).   |
| 11) | Stop gripping a screw.  |

Note 1 It is available to select from “go through / not to go through”.

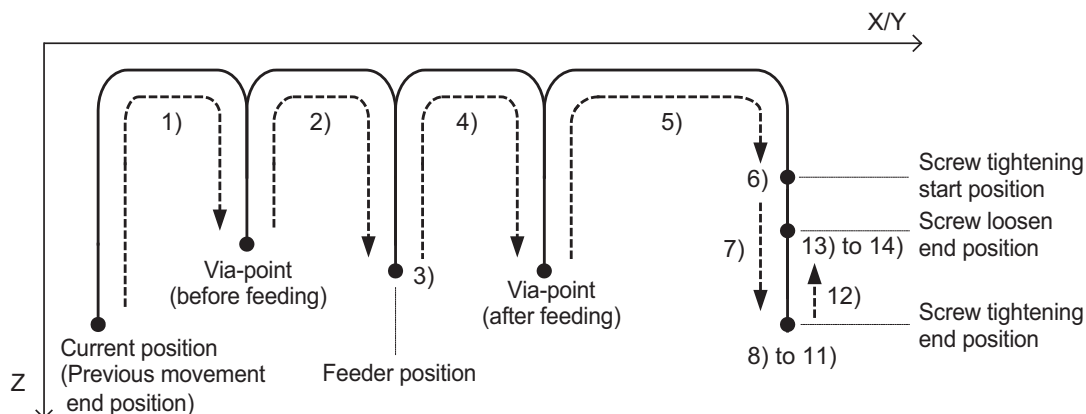
Note 2 It is available to select from “go through / not to go through”.

Note 3 It is available to select from “Low speed / High speed”.

Note 4 “After screw tightening wait time” is available for setting.

## 6.2 Tighten, then Reverse

“Tighten, then reverse” should be performed in a flow as shown below.



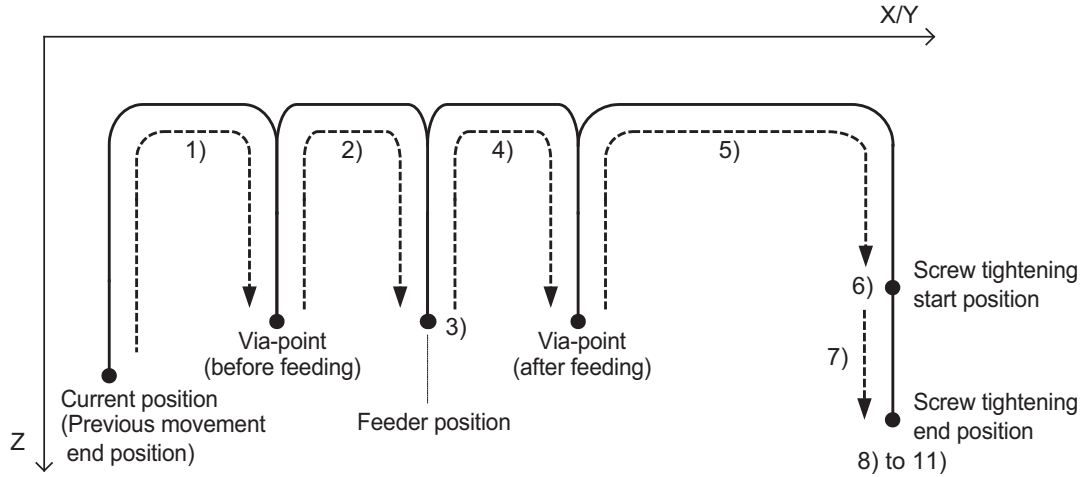
| No. | Operation  |
|-----|--|
| 1)  | Move to "Via-point (before feeding)". (Note 1)   |
| 2)  | Move to "Feeder position".   |
| 3)  | Pick up a screw.<br>(Refer to [6.6 Pickup Screw] for details.)                               |
| 4)  | Move to "Via-point (after feeding)". (Note 2)  |
| 5)  | Move to "Screw tightening start position".   |
| 6)  | Start the screwdriver rotation forward (Note 3).   |
| 7)  | Have the Z-axis move downward until "Screw tightening end position".                         |
| 8)  | Stop the screwdriver rotation forward.   |
| 9)  | Make a judgment for screw tightening error (Screw floating error and Screw slipping error).  |
| 10) | Stand by for a specified period of time (Note 4).  |
| 11) | Start the screwdriver rotation reversed (Note 5).  |
| 12) | Have the Z-axis move upward until "Screw loosen end position".                               |
| 13) | Stop the screwdriver rotation reversed and stand by for a specified period of time (Note 6). |
| 14) | Stop gripping a screw.   |

- Note 1 It is available to select from "go through / not to go through".  
 Note 2 It is available to select from "go through / not to go through".  
 Note 3 It is available to select from "Low speed / High speed".  
 Note 4 "After screw tightening wait time" is available for setting.  
 Note 5 It is available to select from "Low speed / High speed".  
 Note 6 "After screw loosen wait time" is available for setting.



## 6.3 Loose Tightening

“Loose tightening” should be performed in a flow as shown below.



| No. | Operation   |
|-----|---|
| 1)  | Move to “Via-point (before feeding)”. (Note 1)                              |
| 2)  | Move to “Feeder position”.  |
| 3)  | Pick up a screw.<br>(Refer to [6.6 Pickup Screw] for details.)              |
| 4)  | Move to “Via-point (after feeding)”. (Note 2)                               |
| 5)  | Move to “Screw tightening start position”.                                  |
| 6)  | Start the screwdriver rotation forward (Note 3).                            |
| 7)  | Have the Z-axis move downward until “Screw tightening end position”.        |
| 8)  | Stop the screwdriver rotation forward.                                      |
| 9)  | Make a judgment for screw tightening error (Screw floating error). (Note 4) |
| 10) | Stand by for a specified period of time (Note 5).                           |
| 11) | Stop gripping a screw.  |

Note 1 It is available to select from “go through / not to go through”.

Note 2 It is available to select from “go through / not to go through”.

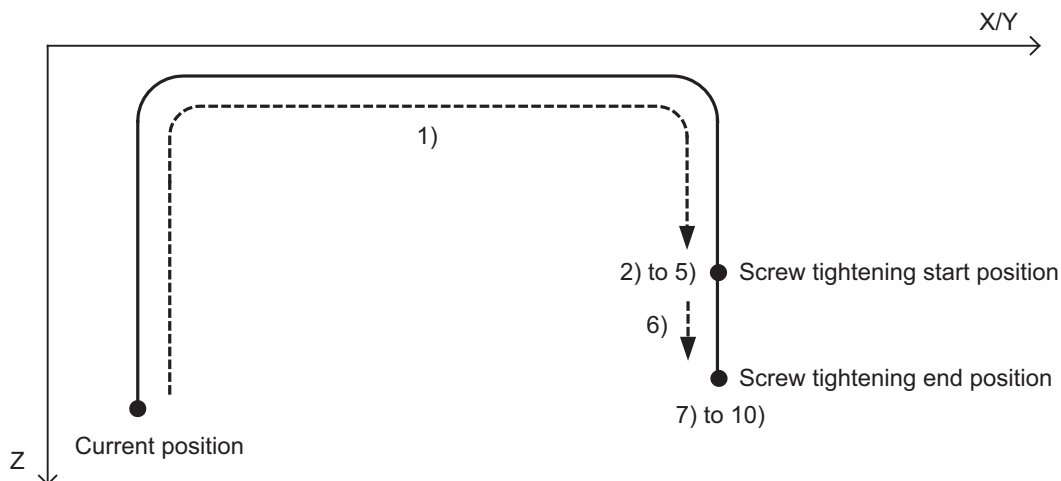
Note 3 It is available to select from “Low speed / High speed”.

Note 4 Detection of “Screw slipping error” will not be conducted.

Note 5 “After screw tightening wait time” is available for setting.

## 6.4 Full Tightening (No Pickup)

“Full tightening (No pickup)” should be performed in a flow as shown below.



| No.                    | Operation   |
|------------------------|---|
| 1)                     | Move to “Screw tightening start position”.  |
| 2)                     | Start gripping a screw.   |
| 3) <sup>(Note 1)</sup> | Start the screwdriver rotation reversed <sup>(Note 2)</sup> and stand by for a specified period of time <sup>(Note 3)</sup> . |
| 4) <sup>(Note 1)</sup> | Stop the screwdriver rotation reversed and stand by for a specified period of time <sup>(Note 4)</sup> .                      |
| 5)                     | Start the screwdriver rotation forward <sup>(Note 5)</sup> .  |
| 6)                     | Have the Z-axis move downward until “Screw tightening end position”.  |
| 7)                     | Stop the screwdriver rotation forward.  |
| 8)                     | Make a judgment for screw tightening error (Screw floating error and Screw slipping error).                                   |
| 9)                     | Stand by for a specified period of time <sup>(Note 5)</sup> .   |
| 10)                    | Stop gripping a screw.  |

Note 1 It will not be performed when bit fitting operation is not to be conducted.

Note 2 It is available to select from “Low speed / High speed”.

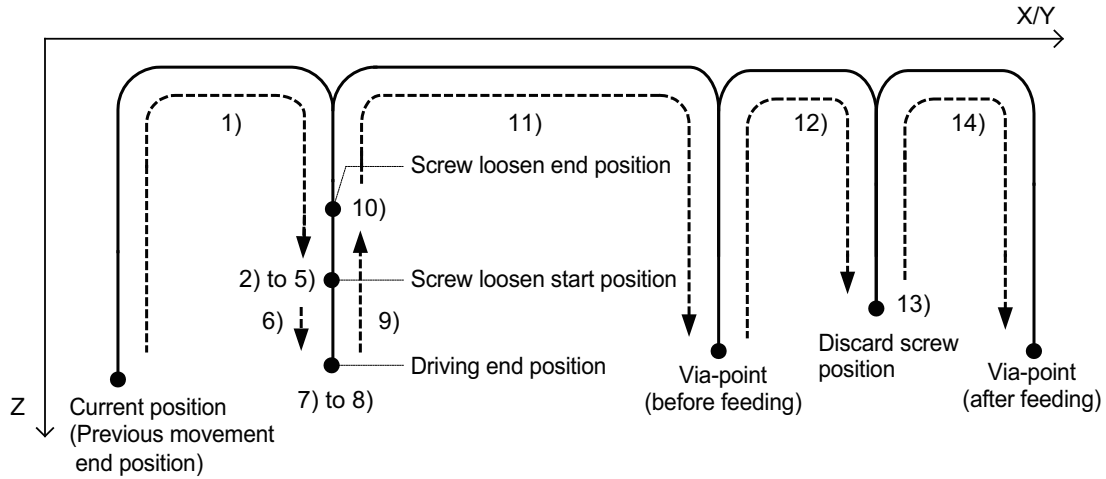
Note 3 “Bit fitting wait time” is available for setting.

Note 4 “After bit fitting wait time” is available for setting.

Note 5 “After screw tightening wait time” is available for setting.

## 6.5 Unscrew

“Unscrew” should be performed in a flow as shown below.



| No.                   | Operation   |
|-----------------------|---|
| 1)                    | Move to “Screw loosen start position”.  |
| 2)                    | Start gripping a screw.   |
| 3) <sup>(Note1)</sup> | Start the screwdriver rotation reversed <sup>(Note 2)</sup> and stand by for a specified period of time <sup>(Note 3)</sup> . |
| 4) <sup>(Note1)</sup> | Stop the screwdriver rotation reversed and stand by for a specified period of time <sup>(Note 4)</sup> .                      |
| 5) <sup>(Note5)</sup> | Start the screwdriver rotation forward <sup>(Note 6)</sup> .  |
| 6) <sup>(Note5)</sup> | Have the Z-axis move downward until “Driving end position”.   |
| 7) <sup>(Note5)</sup> | Stop the screwdriver rotation forward and stand by for a specified period of time <sup>(Note 7)</sup> .                       |
| 8)                    | Start the screwdriver rotation reversed <sup>(Note 8)</sup> .   |
| 9)                    | Have the Z-axis move upward until “Screw loosen end position”.  |
| 10)                   | Stop the screwdriver rotation reversed and stand by for a specified period of time <sup>(Note 9)</sup> .                      |
| 11)                   | Move to “Via-point (before feeding)” <sup>(Note10)</sup> .  |
| 12)                   | Move to “Discard screw position”.   |
| 13)                   | Discard a screw.<br>Refer to [6.7 Discard Screw] for details.   |
| 14)                   | Move to “Via-point (after feeding)” <sup>(Note11)</sup> .   |

Note 1 It will not be performed when bit fitting operation is not to be conducted.

Note 2 It is available to select from “Low speed / High speed”.

Note 3 “Bit fitting wait time” is available for setting.

Note 4 “After bit fitting wait time” is available for setting.

Note 5 It will not be performed when further biting operation is not to be conducted.

Note 6 It is available to select from “Low speed / High speed”.

Note 7 “After driving wait time” is available for setting.

Note 8 It is available to select from “Low speed / High speed”.

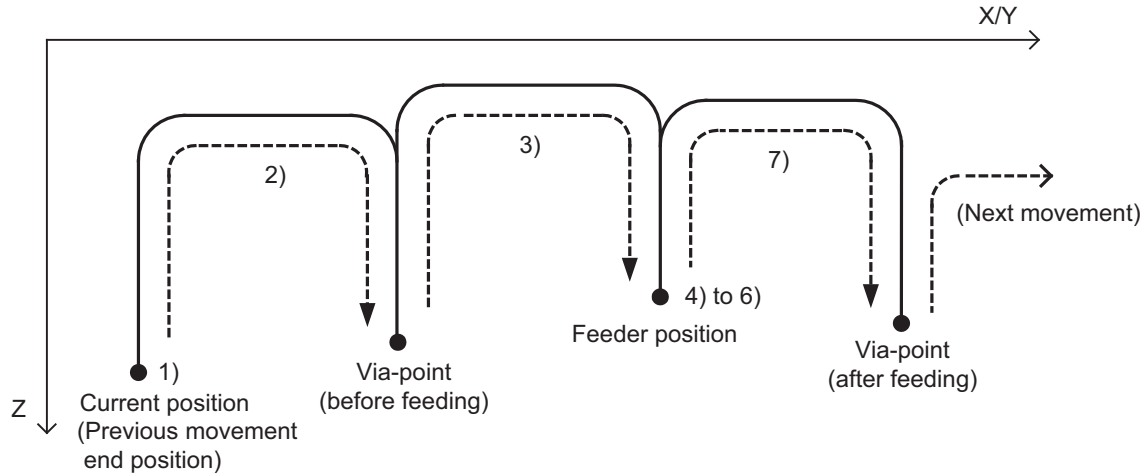
Note 9 “After screw loosen wait time” is available for setting.

Note 10 It is available to select from “go through / not to go through”.

Note 11 It is available to select from “go through / not to go through”.

## 6.6 Pickup Screw

“Pickup Screw” should be performed in a flow as shown below.



| No. | Operation  |
|-----|--|
| 1)  | <p>Confirm if there is a screw existed or not by the input status <sup>(Note 1)</sup> of “Screw existence signal”.</p> <p>If there is no screw detected, “Screw absence detection signal” will be output <sup>(Note 2)</sup>, and wait for input of “Pickup screw restart command signal”. <sup>(Note 3)</sup></p> <p>Once “Pickup screw restart command signal” gets input, a check will be conducted again to see if there is a screw existed.</p> |
| 2)  | Move to “Via-point (before feeding)”. <sup>(Note 4)</sup>  |
| 3)  | Move to “Feeder position”.   |
| 4)  | Start gripping a screw.  |
| 5)  | Start the screwdriver rotation forward <sup>(Note 5)</sup> and stand by for a specified period of time <sup>(Note 6)</sup> .   |
| 6)  | Stop the screwdriver rotation forward <sup>(Note 7)</sup> and stand by <sup>(Note 9)</sup> for a specified period of time <sup>(Note 8)</sup> .  |
| 7)  | Move to “Via-point (after feeding)”. <sup>(Note 10)</sup>  |

Note 1 Signal level (ON when screw existed / OFF when no screw existed) can be selected.

Note 2 It is available to select from “output / not to output”.

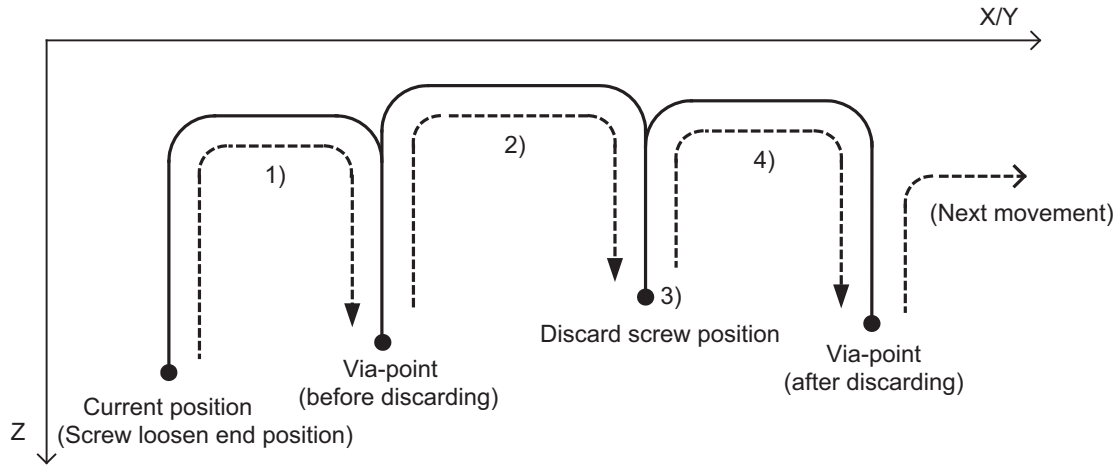
Note 3 It is available to select from “wait for input / not to wait”.

Note 4 It is available to select from “go through / not to go through”.

- Note 5 It is available to select from “Low speed / High speed”.
- Note 6 “Pickup wait time” is available for setting.
- Note 7 It is available to select from “stop / not to stop”.
- Note 8 “After rotation stop wait time” is available for setting.
- Note 9 Standby will not happen unless the screwdriver stops rotation.
- Note 10 It is available to select from “go through / not to go through”.

## 6.7 Discard Screw

“Discard Screw” should be performed in a flow as shown below.

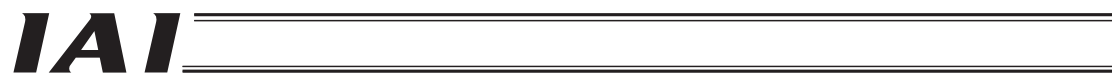


| No. | Operation   |
|-----|---|
| 1)  | Move to “Via-point (before discarding)”. <sup>(Note1)</sup>                             |
| 2)  | Move to “Discard screw position”.   |
| 3)  | Stop gripping a screw and stand by for a specified period of time <sup>(Note 2)</sup> . |
| 4)  | Move to “Via-point (after discarding)”. <sup>(Note3)</sup>                              |

Note 1 It is available to select from “go through / not to go through”.

Note 2 “After discarding wait time” is available for setting.

Note 3 It is available to select from “go through / not to go through”.





## 7. Screw Tightening Error

When having a screw tightening motion, there are two types of errors detectable, “Screw floating error” and “Screw slipping error”.

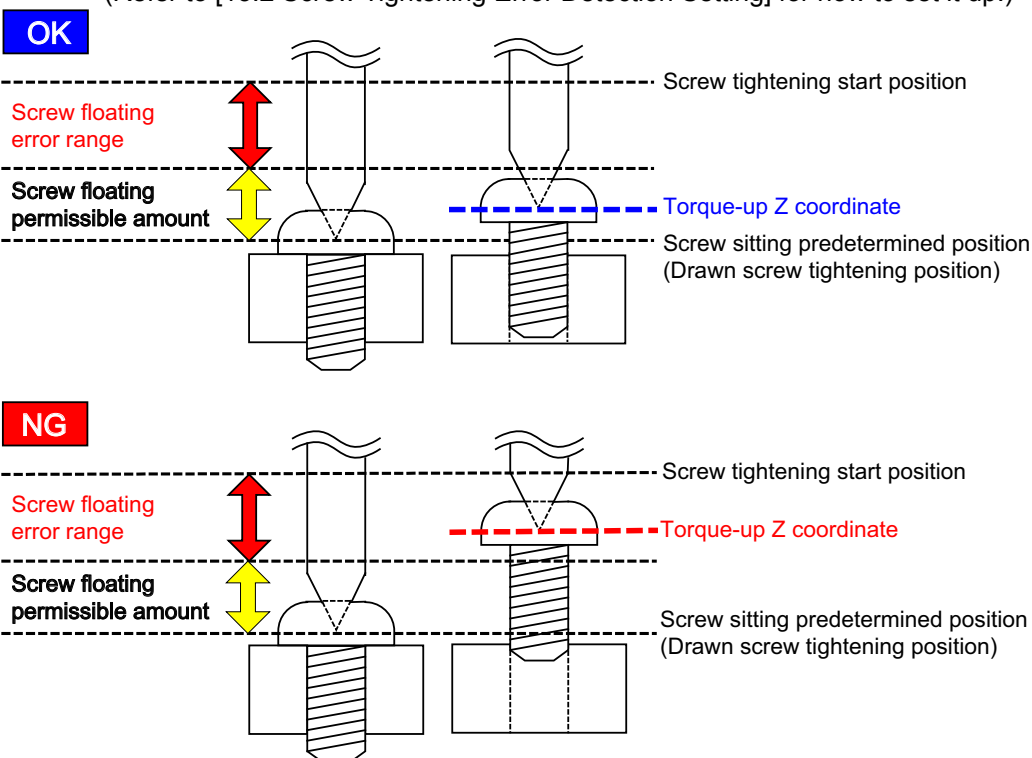
| Screw Tightening Type       | Screw floating error detection | Screw slipping error detection |
|-----------------------------|--------------------------------|--------------------------------|
| Full tightening             | ○                              | ○                              |
| Tighten, then reverse       | ○                              | ○                              |
| Loose tightening            | ○                              | ×                              |
| Full tightening (No pickup) | ○                              | ○                              |
| Unscrew                     | ×                              | ×                              |

### 7.1 Screw Floating Error Detection (Full Tightening / Tighten, then Reverse / Full Tightening (No Pickup))

“Screw floating error” will occur when the torque of the screwdriver has increased above the screw sitting predetermined position <sup>(Note 1)</sup> for the amount of “Screw floating permissible amount” <sup>(Note 2)</sup>.

Note 1 The screw tightening point created in the drawing should be the screw sitting predetermined position.

Note 2 Setting of “Screw floating permissible amount” can be established in the screw tightening conditions.  
(Refer to [13.2 Screw Tightening Error Detection Setting] for how to set it up.)



#### <Important>

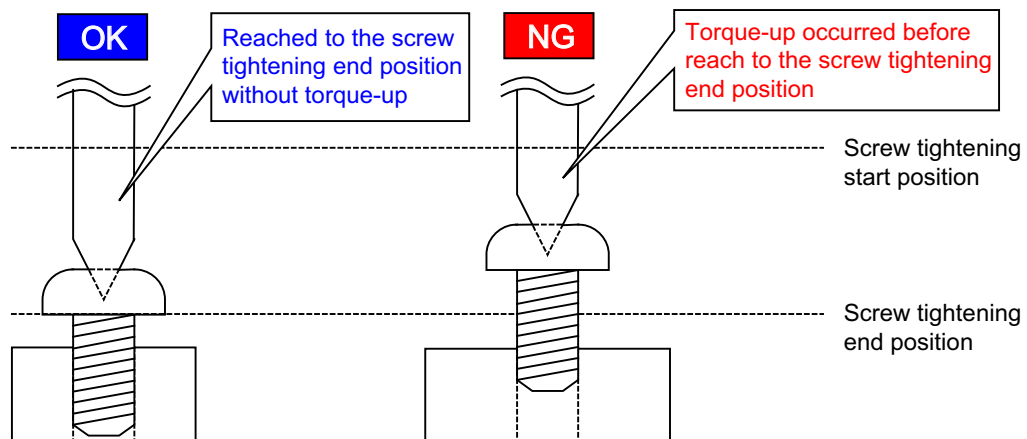
There is a concern that a gap could be generated between the Z-axis driving amount and the actual amount of screw tightening due to causes stated below, which would disturb accurate detection of the screw floating error.

- Gap between the Z-axis speed and screw feeding speed
- Warp of workpiece

Refer to it just as a quick method to detect an error.

## 7.2 Screw Floating Error Detection (Loose Tightening)

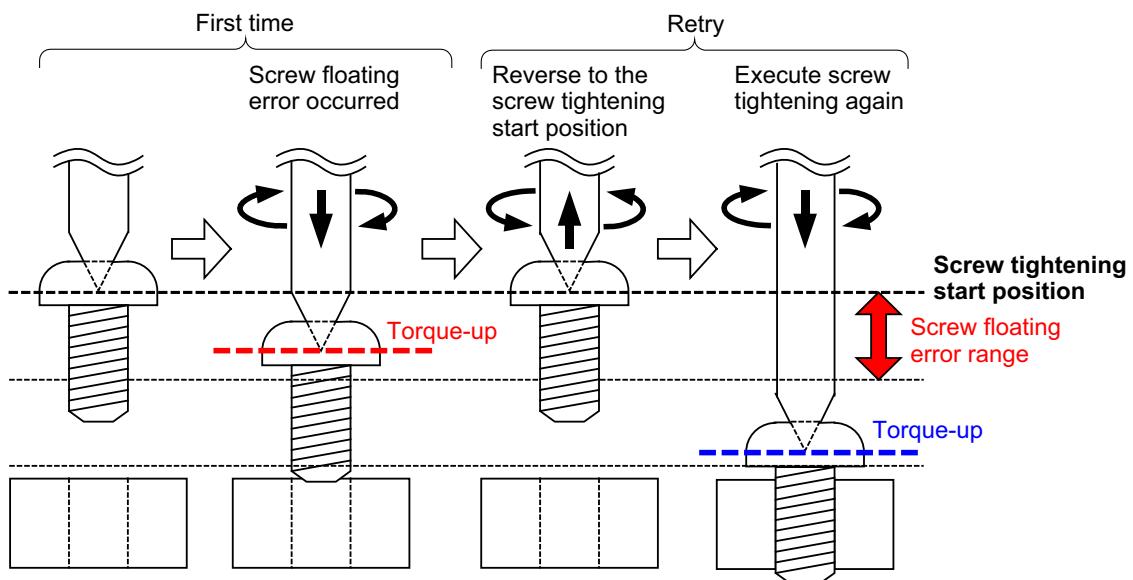
“Screw floating error” will occur when the torque of the screwdriver has increased before it reaches the screw tightening end position.



## 7.3 Retry when Screw Floating Error Occurred

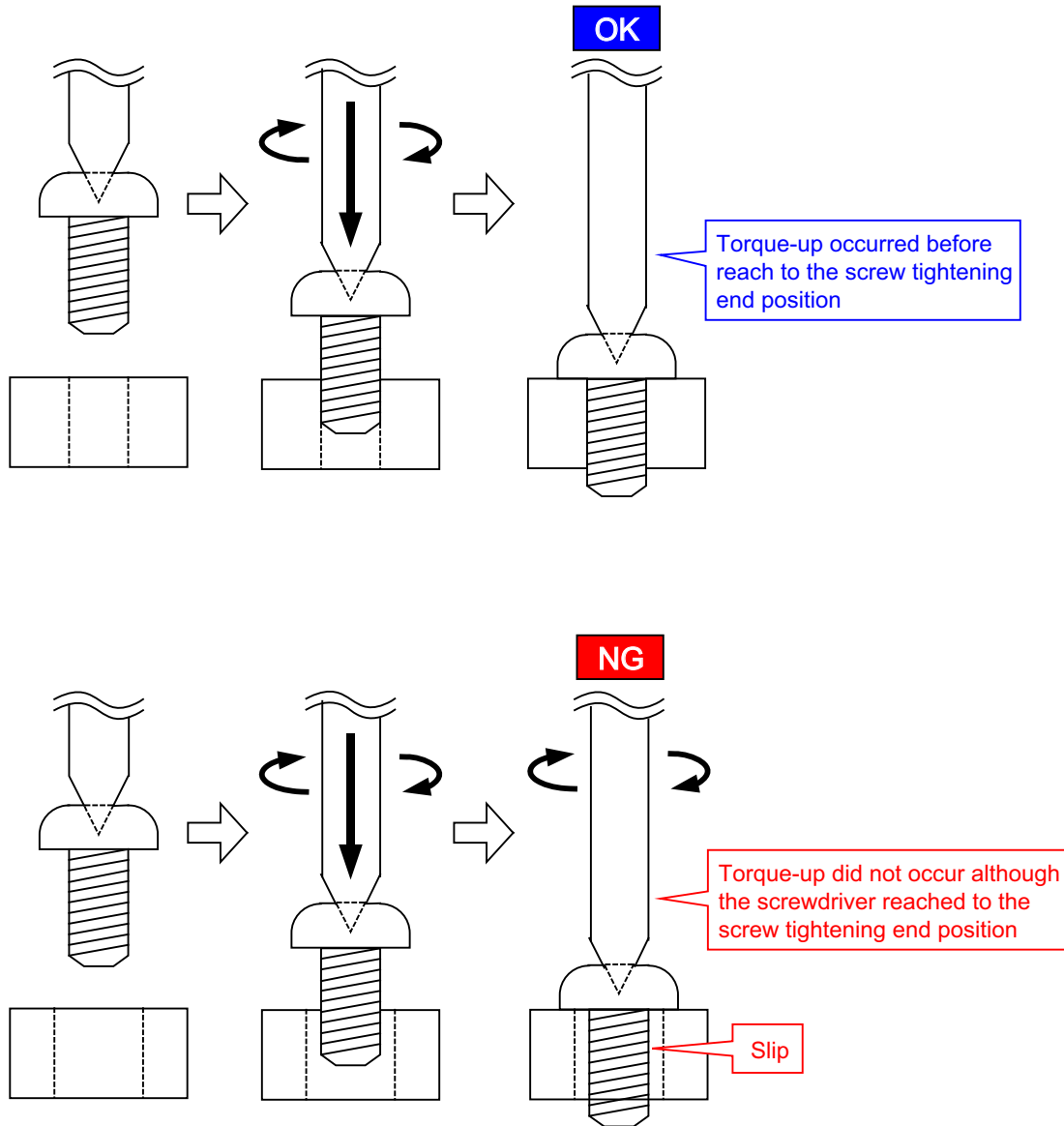
Retry can be performed when “Screw floating error” has occurred for a number of times specified in the screw tightening conditions. (Refer to [13.2 Screw Tightening Error Detection Setting] for how to set it up.)

In a retry, the screwdriver loses a screw till it gets to “Screw tightening start position” once, and then tries to tighten the screw again.



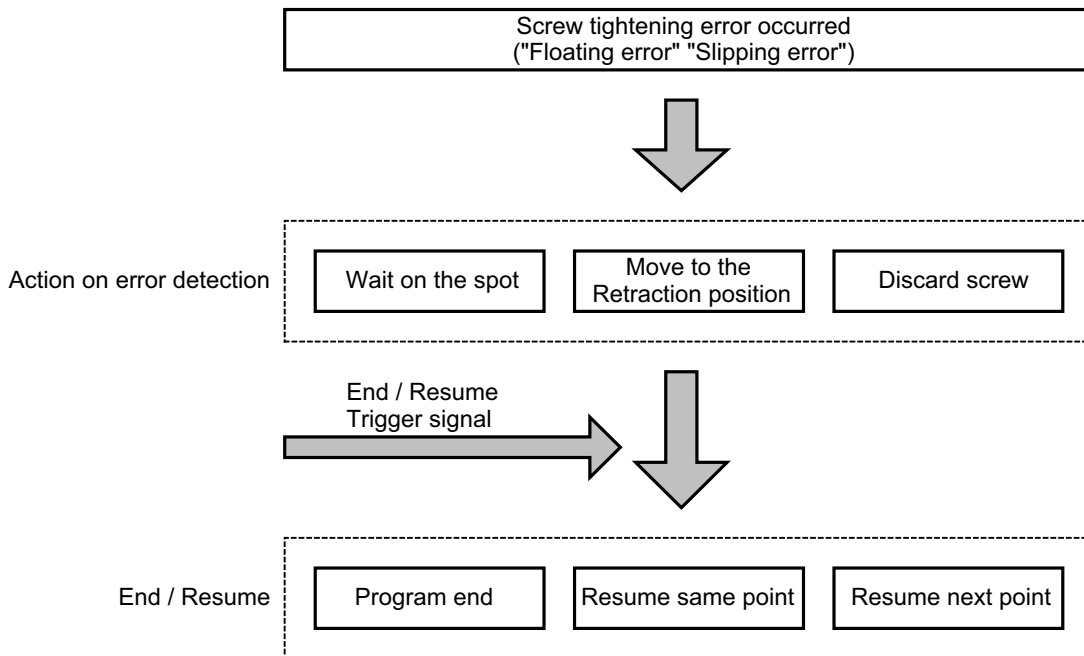
## 7.4 Screw Slipping Error Detection

“Screw slipping error” will occur when the torque of the screwdriver would not increase even after the screwdriver reaches the screw tightening end position.



## 7.5 Actions after Screw Tightening Error Occurred

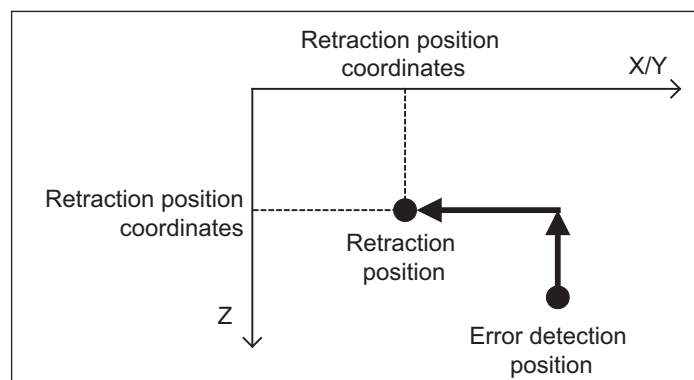
Settings to determine what actions to take when a screw tightening error has occurred can be established for each screw tightening condition.  
(Refer to [13.2 Screw Tightening Error Detection Setting] for how to set it up.)



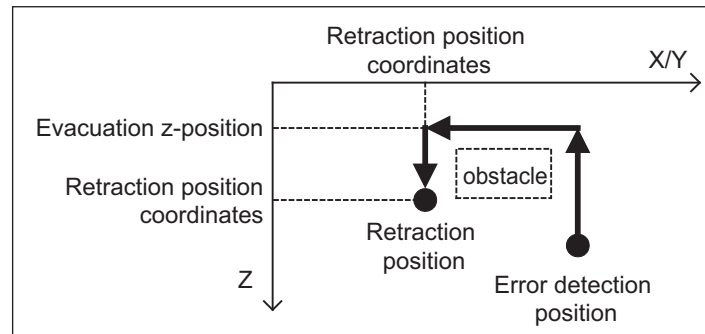
### 7.5.1 Action on Error Detection

Select an action to take when an error has been detected from those below.

- 1) Wait on the spot  
The screwdriver stands by at the point where an error has occurred.
- 2) Move to the Retraction position  
The screwdriver moves to the specified retraction position and stands by.  
The movement to the retraction position should be performed in the order shown in the figure below.

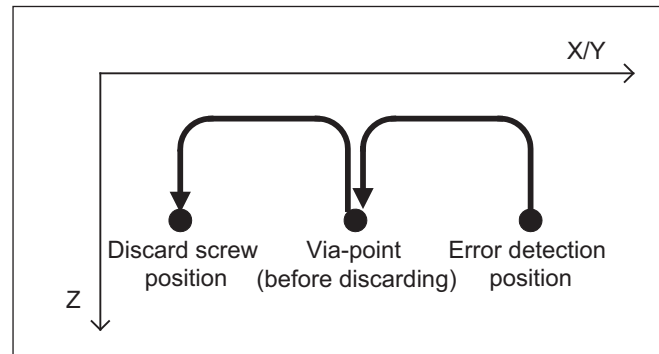


Also, it is available to avoid interference on the way to the retraction position by setting "Evacuation z-position".



### 3) Discard screw

The screwdriver loosens a screw, move to a specified "Discard screw position" and throws it away. After that, the screwdriver stands by at the discard screw position.



#### <Important>

**Make sure that a screw has been removed by having a certain inspection such as a visual check.**

**In case a screw has not been taken away, take it off with hand.**

## 7.5.2 End / Resume

It is available to make a selection whether to have the program finished or resumed after an error detection.

### 1) Program end

The screwdriver moves back to the working home position and the program finishes.

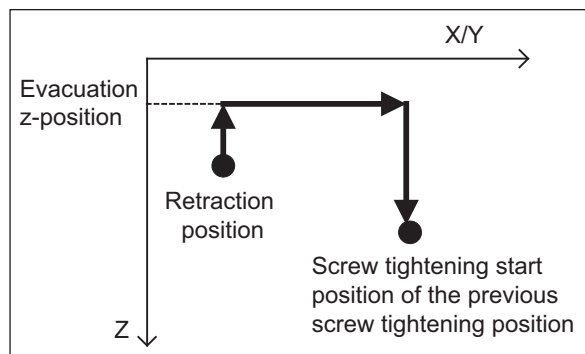
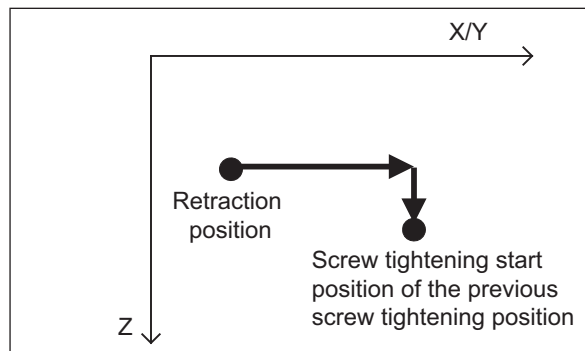
### 2) Resume same point

Operation resumes from the screw tightening point that an error was detected.

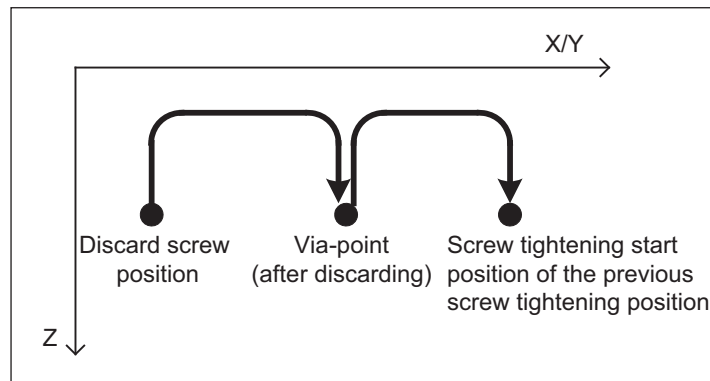
If an action was made to "Move to the retraction position" or to "Discard screw" at an error detection, the screwdriver goes to "Screw tightening start position of the previous screw tightening position" and resumes the operation.

If an action was made to move to the retraction position, the screwdriver goes to "Screw tightening start position of the previous screw tightening position" in the back order of the movement to the retraction position.

The movement velocity / acceleration / deceleration in this action should be the same as those in movement to retraction position.



If an action was made to discard a screw, the screwdriver goes to "Screw tightening start position of the previous screw tightening position" through "Via-point (after discarding)". The way to make an action to "Via-point (after discarding)" and "Screw tightening start position of the previous screw tightening position" applies the movement setting established at each point.



## <Important>

1. If "Action on error detection" is to "Wait on the spot", do not attempt to select "Resume same point".
2. If "Action on error detection" is to "Move to the Retraction position", take a screw off the screwdriver with hand before resuming.
3. If "Action on error detection" is to "Discard screw", check visually that a screw has been taken off the screwdriver before resuming. Take the screw off with hand before resuming if it is remained on the screwdriver.

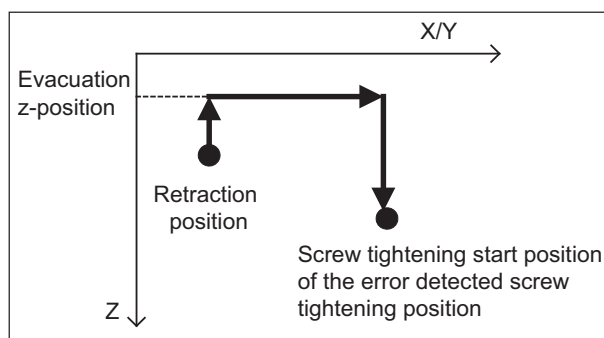
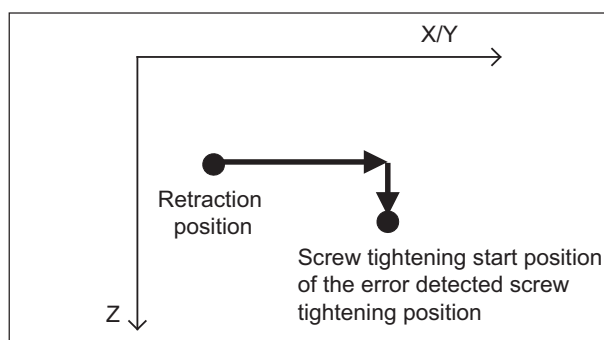
## 3) Resume next point

Operation should be resumed from the screw tightening point next to the one that an error was detected.

If an action was made to “Move to the retraction position” or to “Discard screw” at an error detection, the screwdriver goes to “Screw tightening start position of the error detected screw tightening position” and resumes the operation.

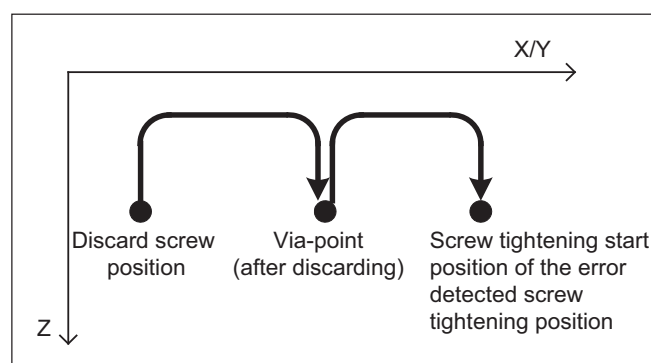
If an action was made to move to the retraction position, the screwdriver goes to “Screw tightening start position of the error detected screw tightening position” in the back order of the movement to the retraction position.

The movement velocity / acceleration / deceleration in this action should be the same as those in movement to retraction position.



If an action was made to discard a screw, the screwdriver goes to “Screw tightening start position of the error detected screw tightening position” through “Via-point (after discarding)”.

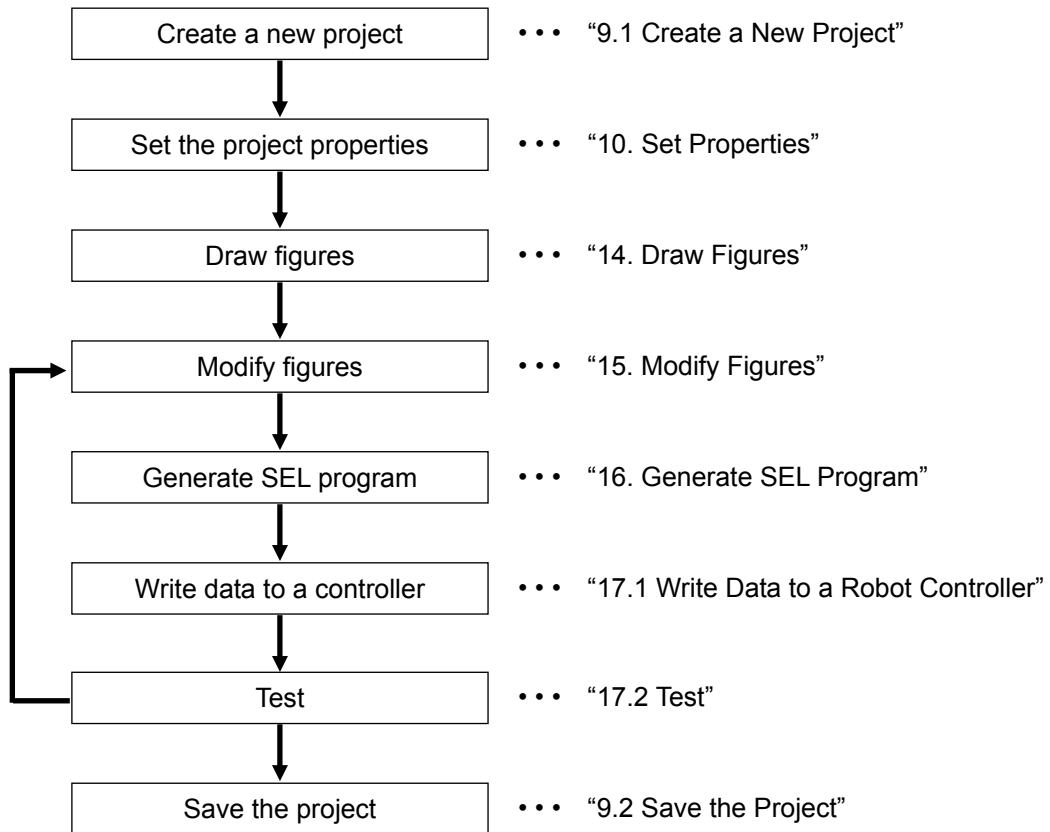
The way to make an action to “Via-point (after discarding)” and “Screw tightening start position of the error detected screw tightening position” applies the movement setting established at each point.





## 8. Work Flow Chart

A SEL program should be generated in a flow as shown below.



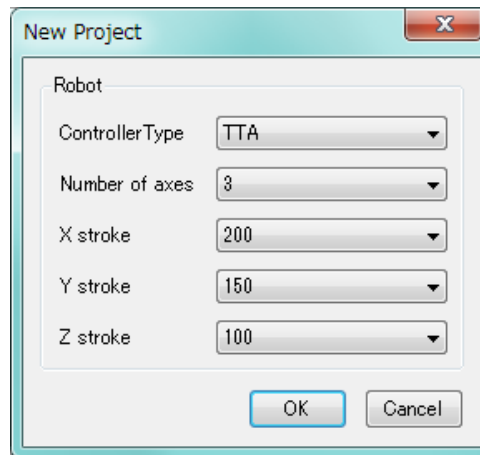


## 9. Creating and Saving a Project

### 9.1 Create a New Project

Create a project following the process below.

- 1) Execute [File (F)] - [New Project (N)] in the menu bar and open [New Project Drawing Window].



- 2) Establish the settings for the robot to be used.

| Item            | Contents   |
|-----------------|--|
| Controller Type | The type of the robot controller should be selected. |
| Number of axes  | The number of axes on a robot should be selected.    |
| X stroke        | X-axis stroke should be selected.                    |
| Y stroke        | Y-axis stroke should be selected.                    |
| Z stroke        | Z-axis stroke should be selected.                    |

## 9.2 Save the Project

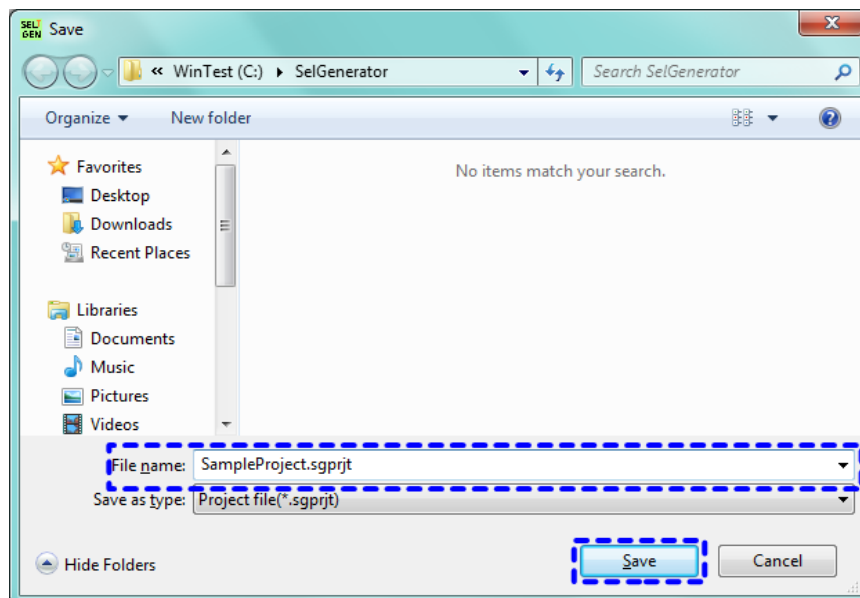
There are two ways as shown to save a project.

- Save As
- Save

### 9.2.1 Save As

A file should be saved as a new name.

- 1) Execute [File (F)] - [Save As (A)] from the menu bar.
- 2) Indicate a file name to save and click on **Save** button.



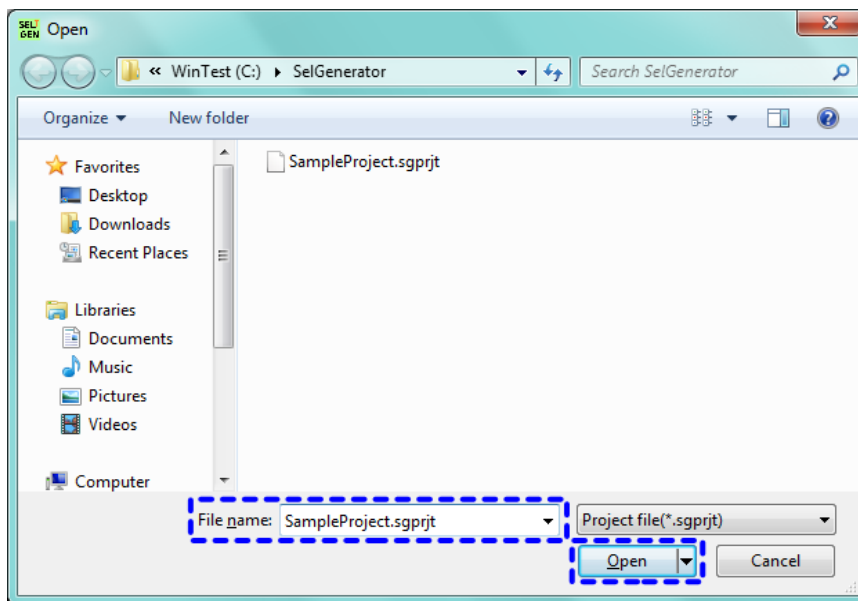
### 9.2.2 Save

Execute [File (F)] - [Save (S)] in the menu bar and the project file under editing should be overwritten.

### 9.3 Open a Project

To open an existing project in a file, follow the process described below.

- 1) Execute [File (F)] - [Open Project (O)] from the menu bar.
- 2) Select a file in a project that you would like to open, and click on **Open** button.

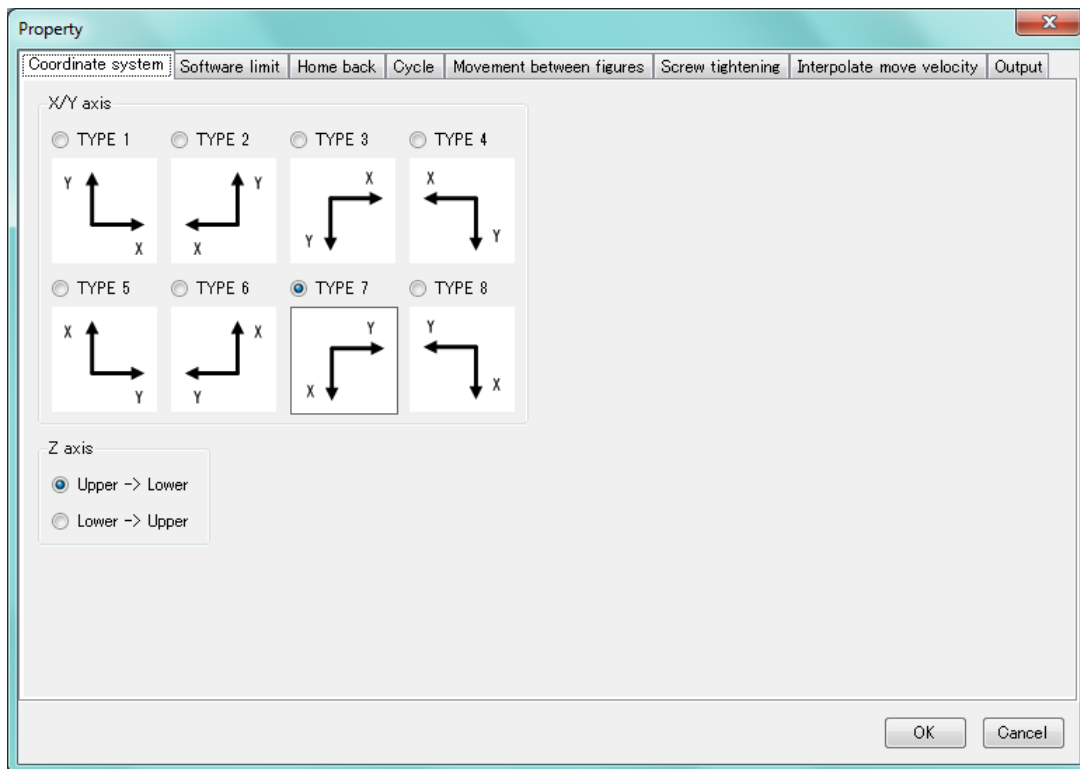




## 10. Set Properties

Open "Property Setting Window" and settings can be conducted on the following items.

- Coordinate System Setting
- Software Limit Setting
- Home Back Setting
- Cycle Setting
- Movement between Figures Setting
- Screw Tightening Setting
- Interpolate Move Velocity Setting
- Output Setting
- Simulation



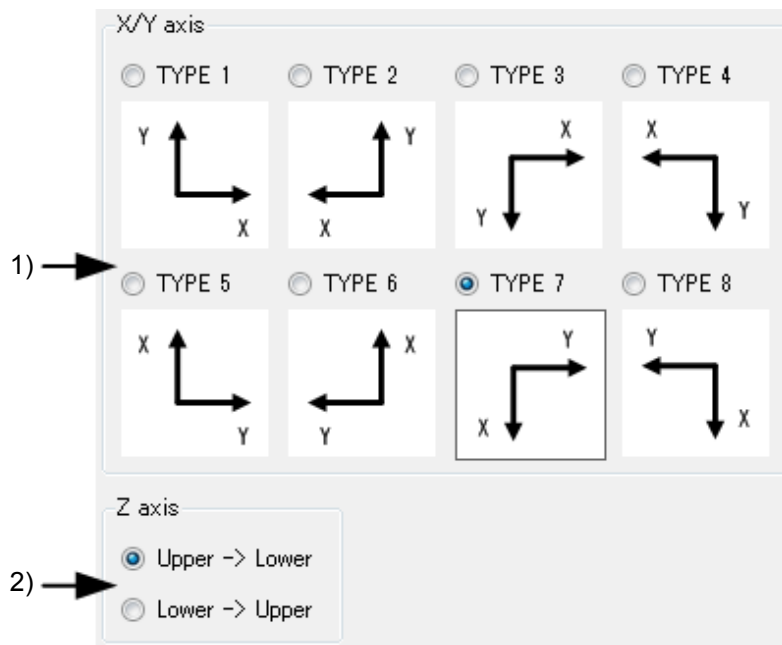
### 10.1 How to Show Property Setting Window

Execute [Project (P)] - [Property (P)] from the menu bar of the main window.

## 10.2 Coordinate System Setting

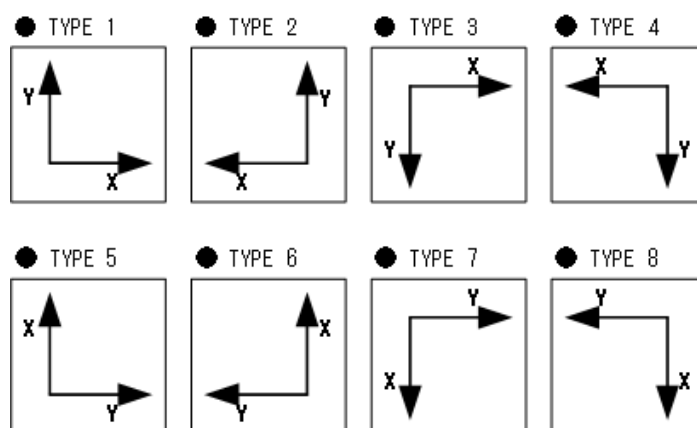
Setting of the orientation of the coordinates in the working area can be selected.

(Note) It will not change the direction of the actual robot operation.



### 1) X/Y axis

Select an orientation of the coordinates from these below for the working area (main window drawing area).

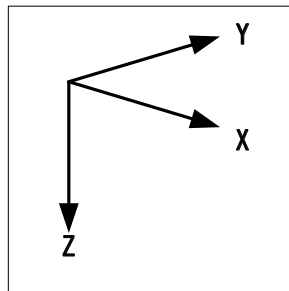




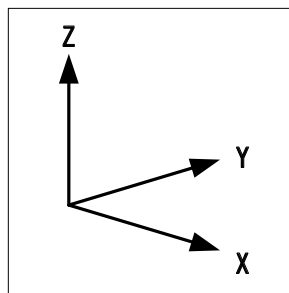
## 2) Z axis

Select the direction of the Z-axis upward end in the motion path simple display (Generate SEL Program Window).

- Upper -> Lower  
It shows the negative side of the soft limit as the upward end.



- Lower -> Upper  
It shows the positive side of the soft limit as the upward end.



## 10.3 Software Limit Setting

Setting of the display range of the working area can be conducted.

(Note) It will not change the range of actual the robot operation.

Also, as the initial setting can be established in response to the stroke set when the project was created, it is not necessary to have this setting changed in normal use.

|        | Minus side | Plus side |
|--------|------------|-----------|
| X-axis | 0.000      | 500.000   |
| Y-axis | 0.000      | 350.000   |
| Z-axis | 0.000      | 150.000   |
| R-axis |            |           |

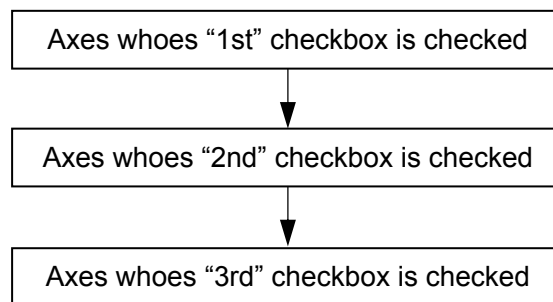
| Item   |            | Contents  |
|--------|------------|---|
| X-axis | Minus side | Soft limit value in negative side on X-axis should be set. (Unit: mm) |
|        | Plus side  | Soft limit value in positive side on X-axis should be set. (Unit: mm) |
| Y-axis | Minus side | Soft limit value in negative side on Y-axis should be set. (Unit: mm) |
|        | Plus side  | Soft limit value in positive side on Y-axis should be set. (Unit: mm) |
| Z-axis | Minus side | Soft limit value in negative side on Z-axis should be set. (Unit: mm) |
|        | Plus side  | Soft limit value in positive side on Z-axis should be set. (Unit: mm) |
| R-axis | Minus side | (No need of setting for screw tightening type)                        |
|        | Plus side  |   |

## 10.4 Home Back Setting

Set the order to perform home back operation.

|     |                            |                            |                            |                            |
|-----|----------------------------|----------------------------|----------------------------|----------------------------|
| 1st | <input type="checkbox"/> X | <input type="checkbox"/> Y | <input type="checkbox"/> Z | <input type="checkbox"/> R |
| 2nd | <input type="checkbox"/> X | <input type="checkbox"/> Y | <input type="checkbox"/> Z | <input type="checkbox"/> R |
| 3rd | <input type="checkbox"/> X | <input type="checkbox"/> Y | <input type="checkbox"/> Z | <input type="checkbox"/> R |
| 4th | <input type="checkbox"/> X | <input type="checkbox"/> Y | <input type="checkbox"/> Z | <input type="checkbox"/> R |

Home-return operation should be conducted in the following procedures.



Remove all the check marks from "1st" to "3rd" in case it is not necessary to have the home-return operation performed.

## 10.5 Cycle Setting

Setting of the way to have a cycle operation should be established.

### 1) Count

| Item        | Contents   |
|-------------|--|
| Not specify | A cycle should be repeated infinitely.   |
| Specify     | A cycle should be executed for the indicated number of times and the program finishes. |
| Cycle count | Set the number of cycles to be executed.   |

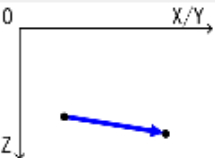
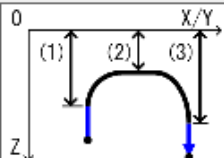
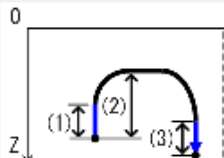
### 2) Trigger

| Item        | Contents   |
|-------------|--|
| Not specify | A cycle starts as soon as moved to the working home position.  |
| Specify     | Waits for the start trigger signal getting input before starting a cycle after moved to the home position.   |
| Port/Flag   | Setting of a port / flag number and the signal level used as the start trigger signal should be established.<br>Signal level can be selected from the followings. <ul style="list-style-type: none"> <li>• OFF (Level)</li> <li>• ON (Level)</li> <li>• OFF (Edge)</li> <li>• ON (Edge)</li> </ul> |

## 10.6 Movement between Figures Setting

The setting of how to move between figures (from the end point of the previous figure to the start point of the next figure) should be established.

☐ InterpolateMove
 ☒ Absolute coordinates(Arch)
 ☐ Relative coordinates(Arch)

Start trigger z-position:  mm --- (1)

Top z-position:  mm --- (2)

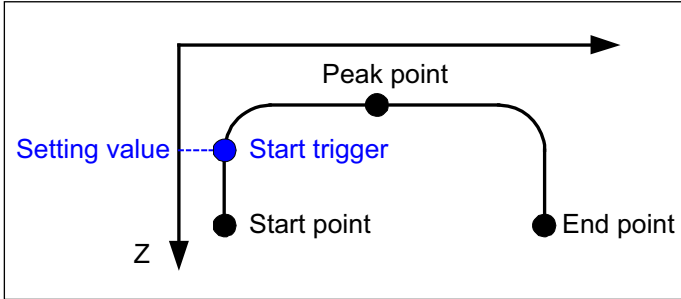
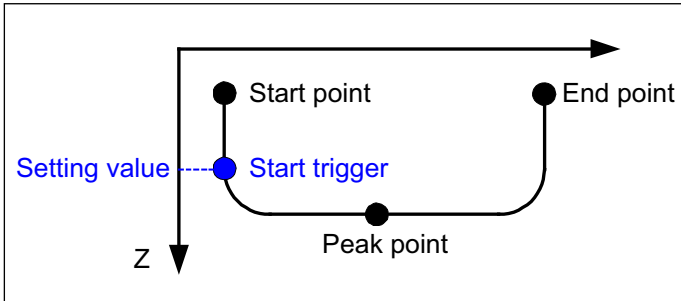
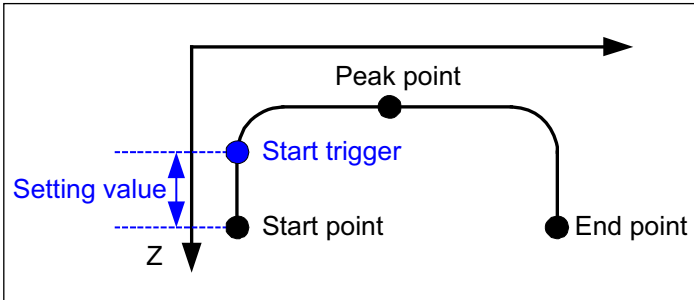
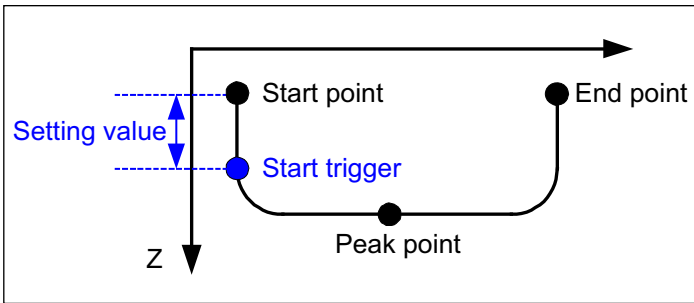
End trigger z-position:  mm --- (3)

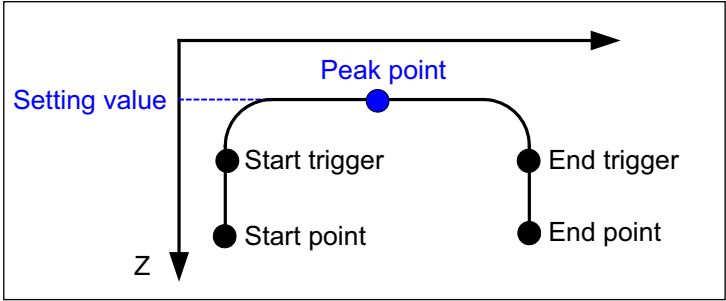
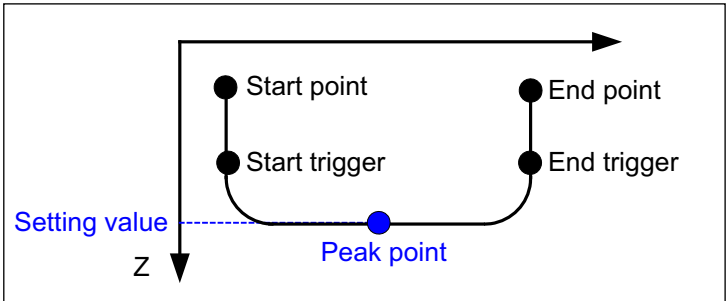
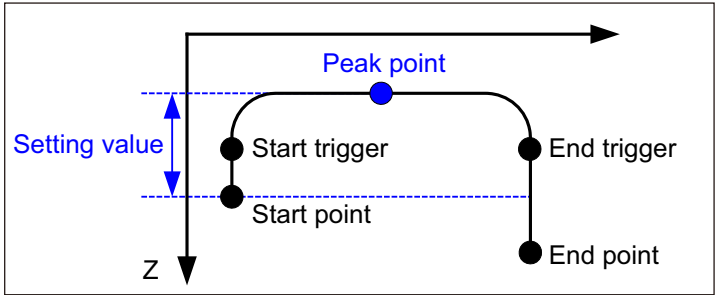
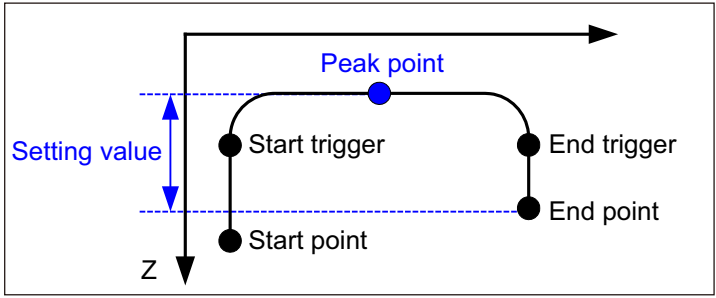
Velocity:  mm/sec

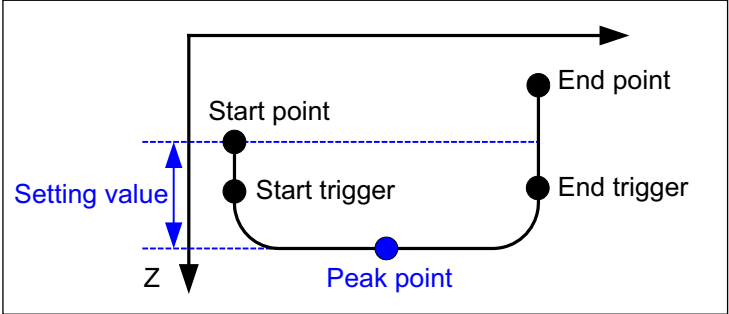
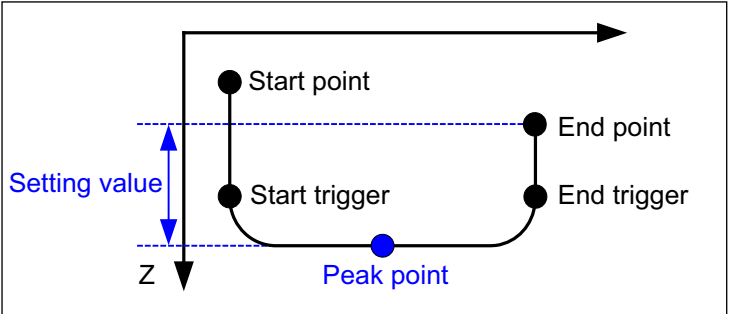
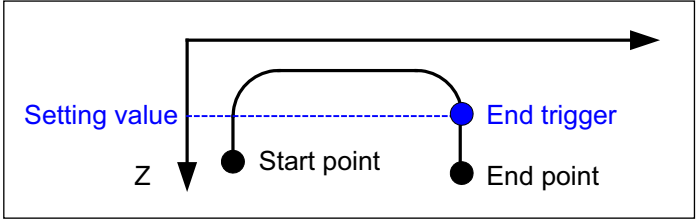
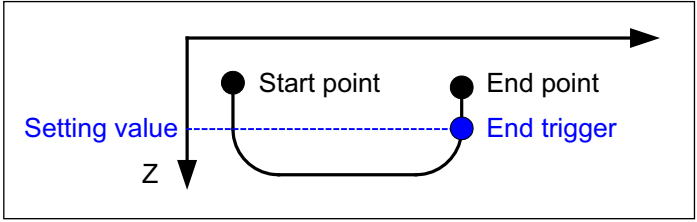
Acceleration:  G

Deceleration:  G

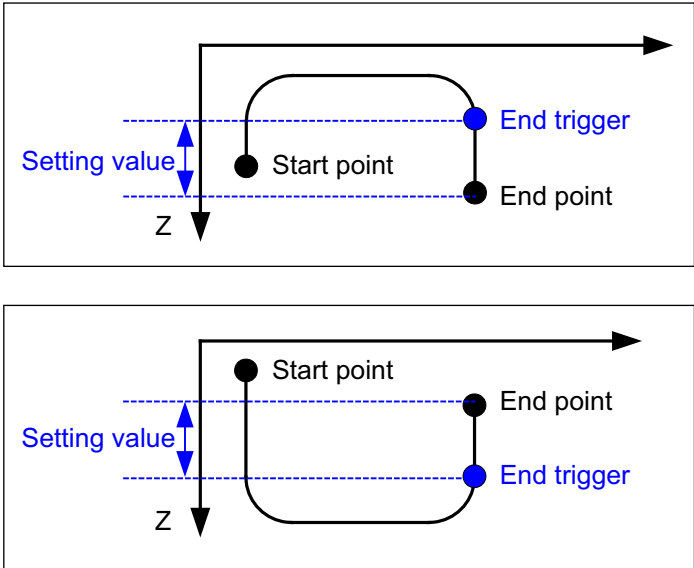
| Item             | Contents  |
|------------------|---|
| Operation Method | <p>Select from those below for how to move.</p> <ul style="list-style-type: none"> <li>• Interpolate Move<br/>Movement should be made with a linear interpolation motion.</li> <li>• Absolute coordinates (Arch)<br/>Movement should be made with an arch motion.<br/>The start point trigger Z-coordinate, peak point Z-coordinate and end point trigger Z-coordinate should be indicated in the absolute coordinate values.</li> <li>• Relative coordinates (Arch)<br/>Movement should be made with an arch motion.<br/>The start point trigger Z-coordinate, peak point Z-coordinate and end point trigger Z-coordinate should be indicated in the relative coordinate values to the start point and the end point.</li> </ul> |

| Item                     | Contents   |
|--------------------------|--|
| Start trigger z-position | <p>Set the start point trigger Z-coordinate for an arch motion.</p>   <p>For the relative-coordinate indicated arch motion, the result of this setting added to the start point coordinate value should be the start position trigger Z-coordinate.</p> <p><b>(Note)</b> The relation of the start point and start point trigger positions will be determined by the sign (positive / negative) of the value set in this.</p>   |

| Item           | Contents   |
|----------------|--|
| Top z-position | <p>Set the peak point Z-coordinate for an arch motion.</p>   <p>For the relative-coordinate indicated arch motion, the result of this setting added to the start point or end point Z-coordinate value should be the peak position Z-coordinate.</p> <p>The coordinate subject to addition will be determined by the relation of positions for the start point and the start point trigger.</p> <ul style="list-style-type: none"> <li>When Start Point Trigger Z-Coordinate &lt; Start Point Z-coordinate;<br/> <u>Addition should be conducted to the smaller of Start Point Z-Coordinate and End Point Z-Coordinate</u></li> </ul>   |

| Item                   | Contents  |
|------------------------|---|
| Top z-position         | <ul style="list-style-type: none"> <li>When Start Point Trigger Z-Coordinate &gt; Start Point Z-coordinate;<br/>Addition should be conducted to the larger of Start Point Z-Coordinate and End Point Z-Coordinate</li> </ul>   |
| End trigger z-position | <p>Set the end point trigger Z-coordinate for an arch motion.</p>     |



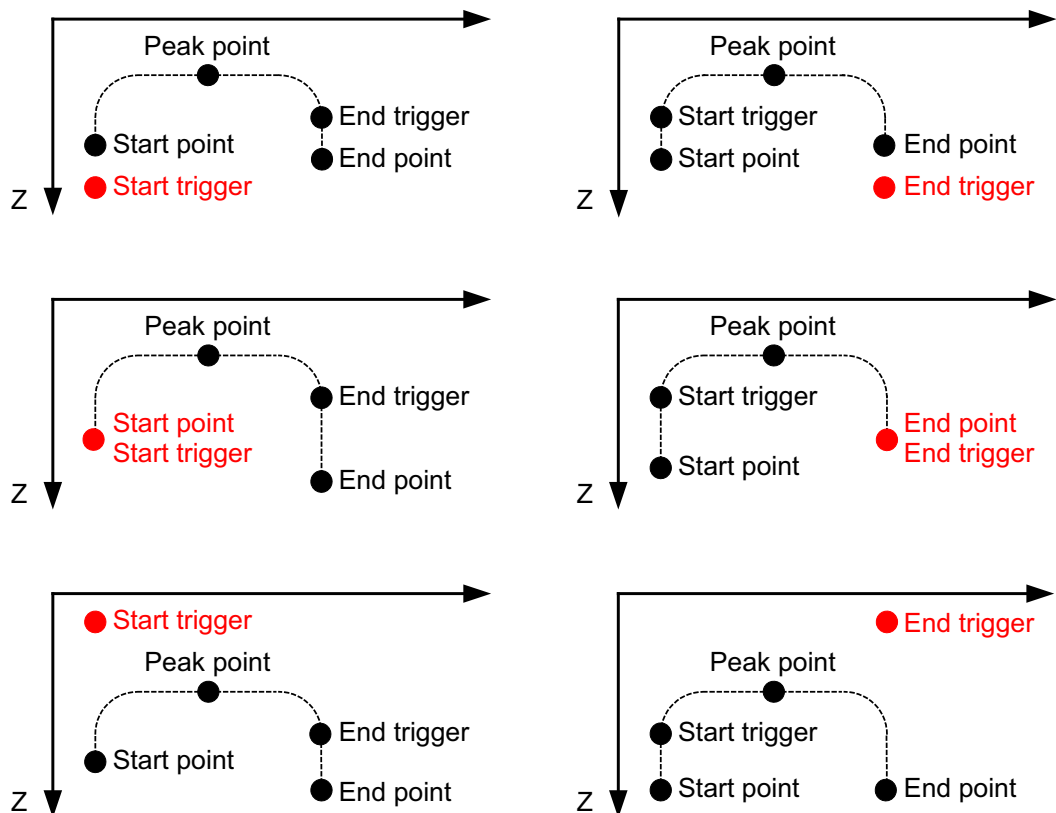
| Item                      | Contents  |
|---------------------------|---|
| End trigger<br>z-position | <p>For the relative-coordinate indicated arch motion, the result of this setting added to the end point coordinate value should be the end position trigger Z-coordinate.</p> <p><b>(Note)</b> The relation of the end point and end point trigger positions will be determined by the sign (positive / negative) of the value set in this.</p>  |
| Velocity                  | Set the speed. (Unit: mm/sec)   |
| Acceleration              | Set the acceleration. (Unit: G)   |
| Deceleration              | Set the deceleration. (Unit: G)   |

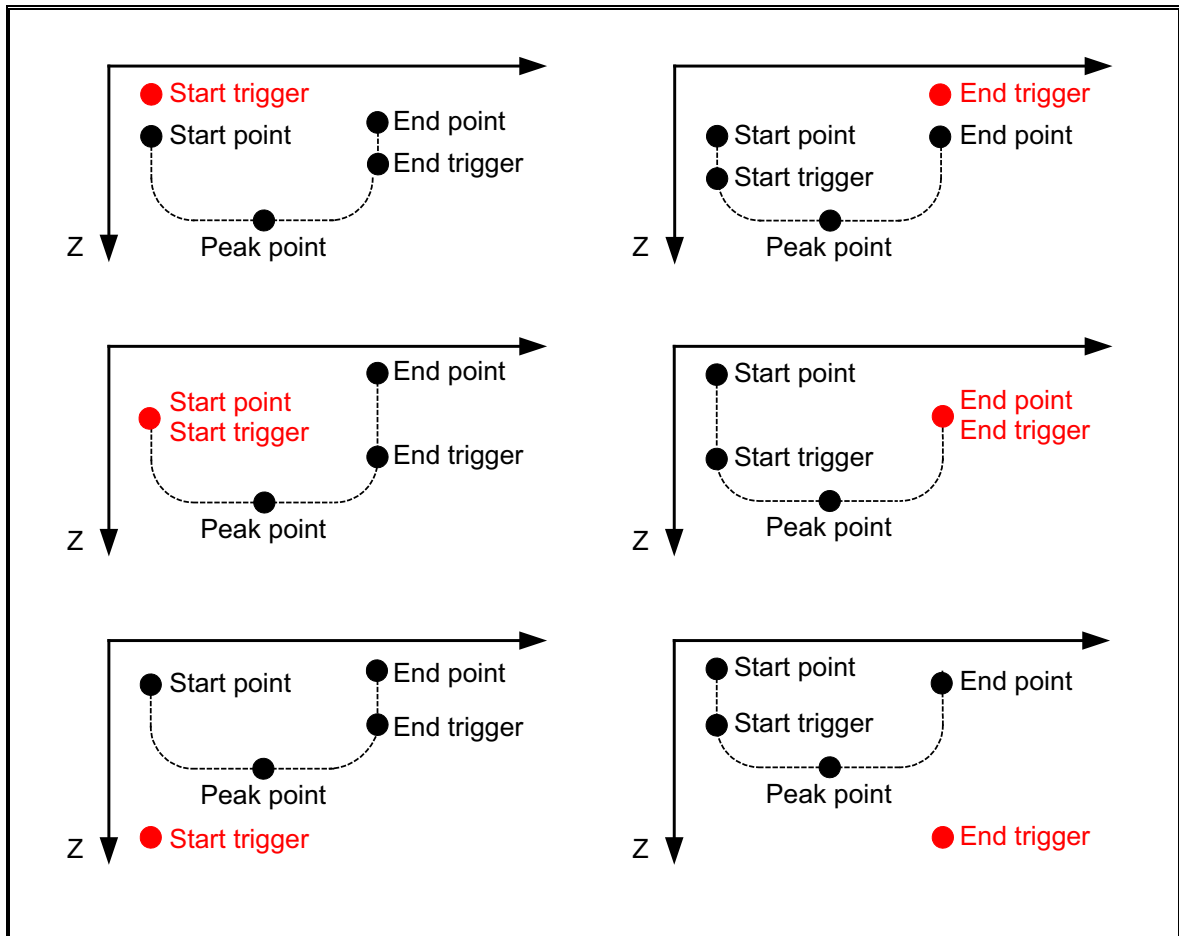
## ⚠ Caution:

Make sure that the following conditions are satisfied for the relation of the positions for “Start point”, “Start trigger” and “Peak point” and for the relation of the positions for “End point”, “End trigger” and “Peak point”.

- For arch motion to coordinate negative direction;  
 $\text{Start point Z-Coordinate} < \text{Start trigger Z-Coordinate} \leq \text{Peak point Z-Coordinate}$   
 $\text{End point Z-Coordinate} < \text{End trigger Z-Coordinate} \leq \text{Peak point Z-Coordinate}$
- For arch motion to coordinate positive direction;  
 $\text{Start point Z-Coordinate} > \text{Start trigger Z-Coordinate} \geq \text{Peak point Z-Coordinate}$   
 $\text{End point Z-Coordinate} > \text{End trigger Z-Coordinate} \geq \text{Peak point Z-Coordinate}$

In case these conditions are not satisfied, an error could occur at execution or an unexpected operation could occur.





## 10.7 Screw Tightening Setting

Establish the settings related to screw tightening operation.

- Driver Setting
- Z Motion Setting
- Feeder Point Setting
- Discard Screw Point Setting
- Condition Setting
- Error Setting

The screenshot shows the 'Property' dialog box with the 'Screw tightening' tab selected. The 'Driver' sub-tab is active. The settings are as follows:

- Start signal:**
  - ☒ Individual start signal
    - Forward start signal output port number: 317
    - Reverse start signal output port number: 318
  - ☐ Common start signal
    - Start signal output port number: 300
    - Forward signal output port number: 300 (ON level active)
    - Reverse signal output port number: 300 (ON level active)
    - Direction signal setup time: 0.20 sec
- Rotation speed switching signal:**
  - ☒ Use
    - Output port number: 319 (OFF: High speed, ON: Low speed)
- Torque-up signal:**
  - Input port number: 16
  - ☒ Reset by a reset signal on pulse
    - Output port number: 320
    - Pulse width: 0.10 sec
  - ☐ Reset by the start signal OFF
- Suction command signal:**
  - Output port number: 325 (ON level active)

Buttons: OK, Cancel

## 10.7.1 Driver Setting

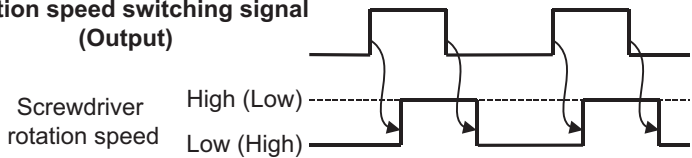
Setting should be established for the input and output signals between a robot controller and a screwdriver.

### 1) Start signal

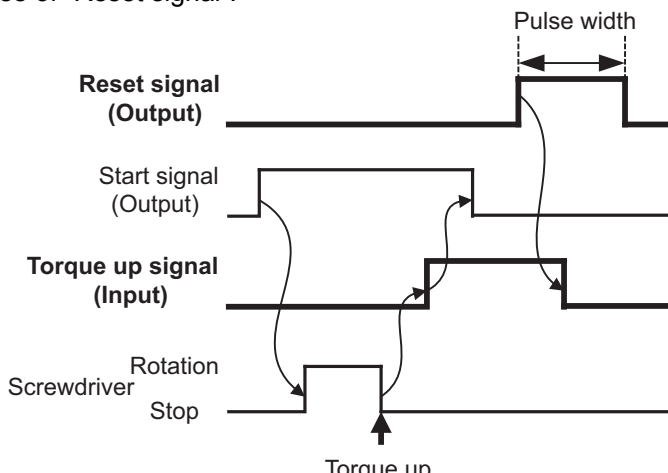
| Signal Name                             | Functions   |
|---|---|
| Individual start signal                 | <p>Select this if it is required to have the forward and reversed rotations conducted with individual start signals.</p>                              |
| Forward start signal output port number | <p>Set the output port number for "Forward starting signal". It is necessary to establish the setting when "Individual start signal" is selected.</p> |
| Reverse start signal output port number | <p>Set the output port number for "Reverse starting signal". It is necessary to establish the setting when "Individual start signal" is selected.</p> |

| Signal Name                       | Functions  |
|-----------------------------------|--|
| Common start signal               | <p>Select this if it is required to have the forward and reversed rotations conducted with start signal in common.</p> <p>Setup time</p> <p>Forward selection signal (Output)</p> <p>Reverse selection signal (Output)</p> <p>Start signal (Output)</p> <p>Forward</p> <p>Screwdriver Stop</p> <p>Reverse</p>  |
| Start signal output port number   | <p>Set the output port number for "Start signal" in common for forward and reversed.</p> <p>It is necessary to establish the setting when "Common start signal" is selected.</p>   |
| Forward signal output port number | <p>Set the output port number for "Forward selection signal".</p> <p>Also, select a signal level from those below.</p> <ul style="list-style-type: none"> <li>• OFF level active</li> <li>• ON level active</li> </ul> <p>It is necessary to establish the setting when "Common start signal" is selected.</p> |
| Reverse signal output port number | <p>Set the output port number for "Reverse selection signal".</p> <p>Also, select a signal level from those below.</p> <ul style="list-style-type: none"> <li>• OFF level active</li> <li>• ON level active</li> </ul> <p>It is necessary to establish the setting when "Common start signal" is selected.</p> |
| Direction signal setup time       | <p>Set the period of time to turn ON "Start signal" after "Forward selection signal" or "Reverse selection signal" gets turned ON/OFF. (Unit: sec)</p> <p>It is necessary to establish the setting when "Common start signal" is selected.</p>   |

## 2) Rotation speed switching signal

| Signal Name        | Functions  |
|--------------------|--|
| Use                | <p>Set whether to use "Rotation speed switching signal".</p> <p><b>Rotation speed switching signal (Output)</b></p>  <p>Screwdriver rotation speed</p> <p>High (Low)</p> <p>Low (High)</p> |
| Output port number | <p>Set the output port number for "Rotation speed switching signal". Also, select a signal level from those below.</p> <ul style="list-style-type: none"> <li>• OFF: Low speed, ON: High speed</li> <li>• OFF: High speed, ON: Low speed</li> </ul>                          |

## 3) Torque-up signal

| Signal Name                      | Functions   |
|----------------------------------|---|
| Input port number                | Set the input port number for "Torque up signal".   |
| Reset by a reset signal on pulse | <p>Select this if it is required to reset "Torque up signal" by outputting ON-pulse of "Reset signal".</p>  <p>Reset signal (Output)</p> <p>Start signal (Output)</p> <p>Torque up signal (Input)</p> <p>Screwdriver Rotation Stop</p> <p>Pulse width</p> <p>Torque up</p> |
| Output port number               | Set the output port number for "Reset signal".  |
| Pulse width                      | Set the pulse band width (ON-time) for "Reset signal". (Unit: sec)  |

| Signal Name                   | Functions   |
|-------------------------------|---|
| Reset by the start signal OFF | <p>Select this if it is required to reset Torque up signal by turning OFF "Start signal".</p> |

#### 4) Suction command signal

| Signal Name        | Functions   |
|--------------------|---|
| Output port number | <p>Set the output port number for "Suction command signal". Also, select a signal level from those below.</p> <ul style="list-style-type: none"> <li>• OFF level active            </li> <li>• ON level active            </li> </ul> |



## 10.7.2 Z Motion Setting

Set the way to move robot Z-axis when tightening / loosening a screw.

The screenshot displays four configuration panels for Z-axis motion settings. Each panel includes a 'Method' dropdown menu (all set to 'Positioning'), a 'Current limit' field (all set to 20 %), and three fields for 'Velocity', 'Acceleration', and 'Deceleration'.

- Forward (High speed):** Velocity is 7 mm/sec. Labeled with arrow 1.
- Reverse (High speed):** Velocity is 7 mm/sec. Labeled with arrow 3.
- Forward (Low speed):** Velocity is 5 mm/sec. Labeled with arrow 2.
- Reverse (Low speed):** Velocity is 10 mm/sec. Labeled with arrow 4.

Acceleration and Deceleration are set to 0.30 G for Forward (High/Low speed) and 0.10 G for Reverse (High/Low speed).

### 1) Forward (High speed)

Set the way to move the Z-axis when screwing the screwdriver forward (screw tightening and twisting in when loosening) in high speed.

| Item          | Contents  |
|---------------|---|
| Method        | Select a way to move from the those below. <ul style="list-style-type: none"> <li>• Positioning</li> <li>• Pressing</li> </ul>              |
| Current limit | Set the pressing current limit value. (Unit: %) <p>It is necessary to establish this setting when the way to move is set to "Pressing".</p> |
| Velocity      | Set the velocity. (Unit: mm/sec)  |
| Acceleration  | Set the acceleration. (Unit: G)   |
| Deceleration  | Set the deceleration. (Unit: G)   |

### 2) Forward (Low speed)

Set the way to move the Z-axis when screwing the screwdriver forward (screw tightening and twisting in when loosening) in low speed.

The details of settings are the same as those in "1) Forward (High speed)".

### 3) Reverse (High speed)

Set the way to move the Z-axis when screwing the screwdriver reversed (unscrewing) in high speed.

The details of settings are the same as those in "1) Forward (High speed)".

#### 4) Reverse (Low speed)

Set the way to move the Z-axis when screwing the screwdriver reversed (unscrewing) in low speed.

The details of settings are the same as those in “1) Forward (High speed)”.



Caution: Pay attention to the followings when determining the setting values for each item.

Also, make sure to check the operation on the actual device after the setting is conducted.

##### 1) About Pressing Current Limit Value

Make sure that you will have an operation check on the actual device before determining the setting.

If setting is too low, screw tightening may finish before it gets to the expected point (screw floats) due to the pressing detection.

##### 2) About Velocity, Acceleration and Deceleration

Determine the setting value considering the rotation speed of the screwdriver and the pitch of the screw thread to be used. A screw tightening error (screw floating (screw not seated properly) or screw slipping (loose hole)) or come-out (bit comes out of the screw slot) may occur if the setting is appropriate.

## 10.7.3 Feeder Point Setting

Have the feeder point setting (position to pick up a screw and way to move) established. Four types of feeder point can be set at the maximum.

| No. | Name  |
|-----|-------|
| 1   | M3*10 |
| 2   |       |
| 3   |       |
| 4   |       |

Buttons: Edit, Copy, Clear

| No. | Contents  |
|-----|---|
| 1)  | Feeder point number should be displayed.  |
| 2)  | Feeder point name should be displayed.  |
| 3)  | Feeder point information in the line where the cursor is placed on should be edited.<br>For how to edit, refer to [11. Feeder Point Setting]. |
| 4)  | Feeder point information in the line where the cursor is placed on should be copied to another feeder point.                                  |
| 5)  | Feeder point information in the line where the cursor is placed on should be returned to the initial setting.                                 |

## 10.7.4 Discard Screw Point Setting

Have the discard screw point setting (position to discard a screw and way to move) established.

Four types of discard screw point can be set at the maximum.

|   | Name  |
|---|-------|
| 1 | M3*10 |
| 2 |       |
| 3 |       |
| 4 |       |

| No. | Contents  |
|-----|---|
| 1)  | Discard screw point number should be displayed.   |
| 2)  | Discard screw point name should be displayed.   |
| 3)  | Discard screw point information in the line where the cursor is placed on should be edited.<br>For how to edit, refer to [12. Discard Screw Point Setting]. |
| 4)  | Discard screw point information in the line where the cursor is placed on should be copied to another discard screw point.                                  |
| 5)  | Discard screw point information in the line where the cursor is placed on should be returned to the initial setting.  |

## 10.7.5 Condition Setting

Condition of screw tightening should be edited.

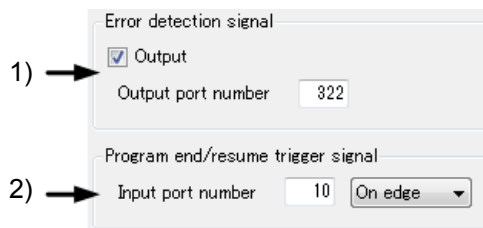
|    |   | Name                  |
|----|---|-----------------------|
| 1  | * | Full tightening M3*10 |
| 2  |   | Discard screw M3*10   |
| 3  |   |                       |
| 4  |   |                       |
| 5  |   |                       |
| 6  |   |                       |
| 7  |   |                       |
| 8  |   |                       |
| 9  |   |                       |
| 10 |   |                       |
| 11 |   |                       |
| 12 |   |                       |
| 13 |   |                       |
| 14 |   |                       |
| 15 |   |                       |
| 16 |   |                       |

4)
5)
6)
7)
8)

| No. | Contents  |
|-----|---|
| 1)  | The screw tightening condition number should be displayed.  |
| 2)  | "*" should be displayed when it is set in the initial setting for drawing.  |
| 3)  | The screw tightening condition name should be displayed.  |
| 4)  | The screw tightening condition number in the line where the cursor is placed on hold be set as the initial setting for drawing.<br>If it is set as the initial setting for drawing, the screw tightening condition number in the new drawing should be set automatically. |
| 5)  | The initial setting for drawing should be cancelled.  |
| 6)  | The screw tightening condition in the line where the cursor is placed on should be edited.<br>For how to edit, refer to [13. Screw Tightening Conditions Setting].  |
| 7)  | The screw tightening condition in the line where the cursor is placed on should be copied to another screw tightening condition.  |
| 8)  | The screw tightening condition in the line where the cursor is placed on should be returned to the initial setting.   |

## 10.7.6 Error Setting

Settings related to screw tightening errors should be established.



### 1) Error detection signal

| Item               | Contents  |
|--------------------|---|
| Output             | Set whether to output “Error detection signal” when a screw tightening error gets detected. |
| Output port number | Set the output port number for “Error detection signal”.                                    |

### 2) Program end/resume trigger signal

| Item              | Contents  |
|-------------------|---|
| Input port number | <p>Set the input port number and signal level for “Program end/resume trigger signal”.<br/>The signal level should be selected from those below.</p> <ul style="list-style-type: none"> <li>• OFF level</li> <li>• ON level</li> <li>• OFF edge</li> <li>• ON edge</li> </ul> |

## 10.8 Interpolate Move Velocity Setting

The setting of the velocity / acceleration / deceleration for the interpolation motion (movement between start point and end point on a line) should be established.

|              |                                   |        |
|--------------|-----------------------------------|--------|
| Velocity     | <input type="text" value="100"/>  | mm/sec |
| Acceleration | <input type="text" value="0.30"/> | G      |
| Deceleration | <input type="text" value="0.30"/> | G      |

| Item         | Contents  |
|--------------|---|
| Velocity     | Set the velocity for the interpolation motion. (Unit: mm/sec) |
| Acceleration | Set the acceleration for the interpolation motion. (Unit: G)  |
| Deceleration | Set the deceleration for the interpolation motion. (Unit: G)  |

## 10.9 Output Setting

Settings related to the output data when SEL program / position data get generated should be established.

|              |                                |
|--------------|--------------------------------|
| Position No. | <input type="text" value="1"/> |
|--------------|--------------------------------|

| Item         | Contents                     |
|--------------|------------------------------|
| Position No. | Set the top position number. |

## 10.10 Simulation

Settings should be established regarding simulation.

### 1) Parameter

Controller parameters in simulation should be set up. It is available establish the setting by reading in values from another project file or controller parameter file by using the import button.

\* In case the parameter setting values differ from the actual device, dispersion in simulation for the cycle time and operation track may get large.

**Property**

Software limit | Home back | Cycle | Movement between figures | Screw tightening | Interpolate move velocity | Output | **Simulation**

Parameter | Track data

Common to All Axes Parameters

| No. | Name             | Value | Unit  |
|-----|------------------|-------|-------|
| 22  | Acceleration max | 999   | 0.01G |
| 23  | Deceleration max | 999   | 0.01G |

Axis-Specific Parameters

| No. | Name                                | X-axis | Y-axis | Z-axis | R-axis | Unit            |
|-----|-------------------------------------|--------|--------|--------|--------|-----------------|
| 6   | Select act direction                | 1      | 1      | 1      |        |                 |
| 28  | Max speed axis                      | 3000   | 3000   | 3000   |        | mm/sec, deg/sec |
| 42  | Encoder resolution                  | 131072 | 131072 | 131072 |        | pulse/rev       |
| 43  | Rate of encoder dividing frequency  | 3      | 3      | 3      |        |                 |
| 44  | Measure revise                      | 0      | 0      | 0      |        | 0.001mm/1M      |
| 47  | Screw lead                          | 16000  | 16000  | 6000   |        | 0.001mm         |
| 50  | Gear ratio numerator                | 1      | 1      | 20     |        |                 |
| 51  | Gear ratio denominator              | 1      | 1      | 24     |        |                 |
| 60  | Position gain                       | 30     | 30     | 30     |        | /s              |
| 66  | Rotation move axis mode select      | 0      | 0      | 0      |        |                 |
| 67  | Rotation move axis short-cut select | 0      | 0      | 0      |        |                 |

Import

OK Cancel



## [Details of Common to All Axes Parameters Contents]

| No. | Parameter name   | Input range | Unit  | Remarks |
|-----|------------------|-------------|-------|---------|
| 22  | Acceleration max | 1 to 999    | 0.01G |         |
| 23  | Deceleration max | 1 to 999    | 0.01G |         |

## [Details of Axis-Specific Parameters Contents]

| No. | Parameter name                      | Input range           | Unit       | Remarks  |
|-----|-------------------------------------|-----------------------|------------|--|
| 6   | Select act direction                | 0 to 1                |            | Do not attempt to change the initial values or the values in the parameter file.   |
| 28  | Max speed axis                      | 1 to 3000             | mm/s       |  |
| 42  | Encoder resolution                  | 800, 131072           | pulse/rev  | Set it to 800 in incremental and to 131072 in battery-less absolute.   |
| 43  | Rate of encoder dividing frequency  | 0, 2 to 5             |            | Set it to 0 in incremental, to 4 in battery-less absolute and pulse motor at the same time and to 3 in battery-less absolute and AC servomotor at the same time.   |
| 44  | Measure revise                      | -99999999 to 99999999 | 0.001mm/1M | It changes coordinates in proportion.<br>Valid only for linear drive axes  |
| 47  | Screw lead                          | 1 to 99999999         | 0.001mm    | Make sure to establish the setting to satisfy "Lead Described in Catalog or Instruction Manual" = "Screw Lead" × "Numerator of Gear Ratio" / "Denominator of Gear Ratio" for X, Y and Z-axes. * Do not attempt to change the initial value or the values in the parameter file for R-axis. |
| 50  | Gear ratio numerator                | 1 to 99999999         |            |  |
| 51  | Gear ratio denominator              | 1 to 99999999         |            |  |
| 60  | Position gain                       | 1 to 9999             | /s         | Set it to 50 for pulse motor type TTA and to 30 for servomotor type TTA.   |
| 66  | Rotation move axis mode select      | 0 to 5                |            | 0: Normal Mode, 1: Index Mode  |
| 67  | Rotation move axis short-cut select | 0 to 5                |            | 0: Not Selected, 1: Selected<br>(Valid only in index mode and INC encoder at the same time)  |

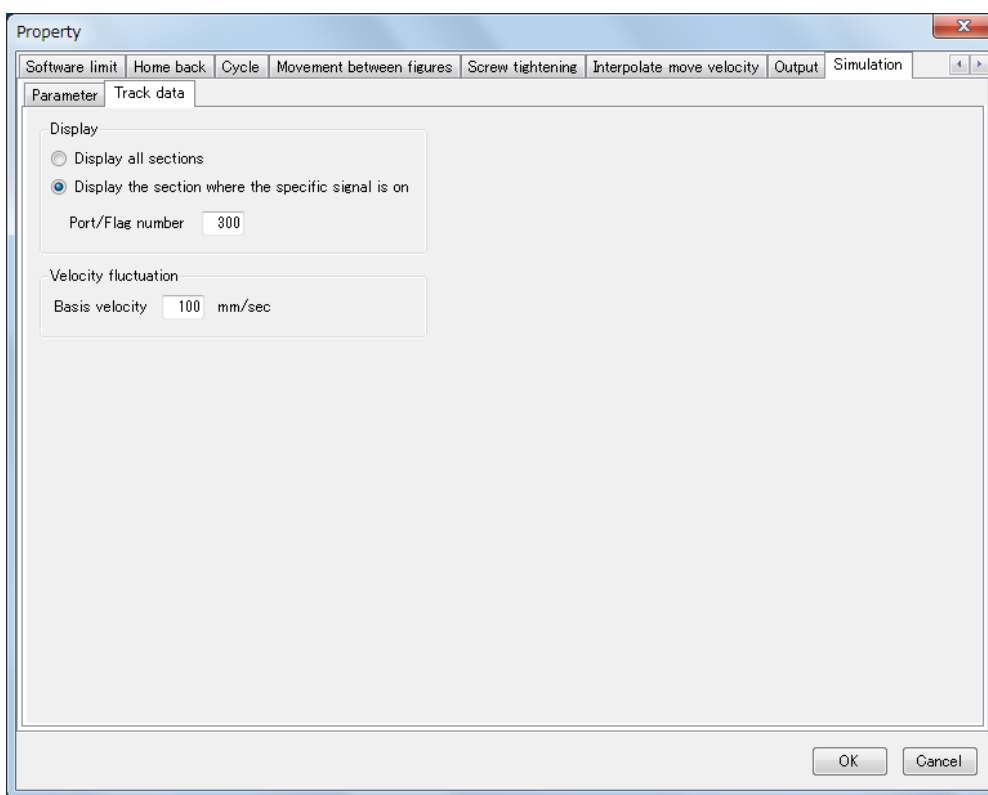
\* Example of Setting for Axis-Specific Parameters 47, 50 and 51

| Lead [mm]        | Axis-Specific Parameters setting value |    |    |
|------------------|--|----|----|
|                  | 47                                     | 50 | 51 |
| 24 or equivalent | 16000                                  | 36 | 24 |
| 16               | 16000                                  | 1  | 1  |
| 3                | 3000                                   | 1  | 1  |

## 2) Track data

Display settings for the operation track in simulation should be established.

- **Display**  
Select either "Display all sections" or "Display the section where the specific signal is on". It is required to set a signal to be specified in the Port/Flag number box when "Display the section where the specific signal is on" is selected.
- **Velocity fluctuation**  
It is necessary to establish the standard velocity when you would like to change the track line thickness in response to the operation velocity. (Unit: mm/sec)  
The operation track should be shown thin in the area faster than the standard while the track shown thick in the area slower than the standard.  
The track line should be shown in constant width when the parameter is set to "0".



\* The settings above should be reflected only to the simulation track display (not to the track display in the actual device servo monitor data).

## 11. Feeder Point Setting

Setting of the feeder point setting should be established in “Feeder Point Setting Window”.  
(For how to display window, refer to [10.7.3 Feeder Point Setting].)

The items to establish settings are as shown below.

- Feeder Position
- Via-point (before Feeding)
- Via-point (after Feeding)
- Feeding Motion
- Name

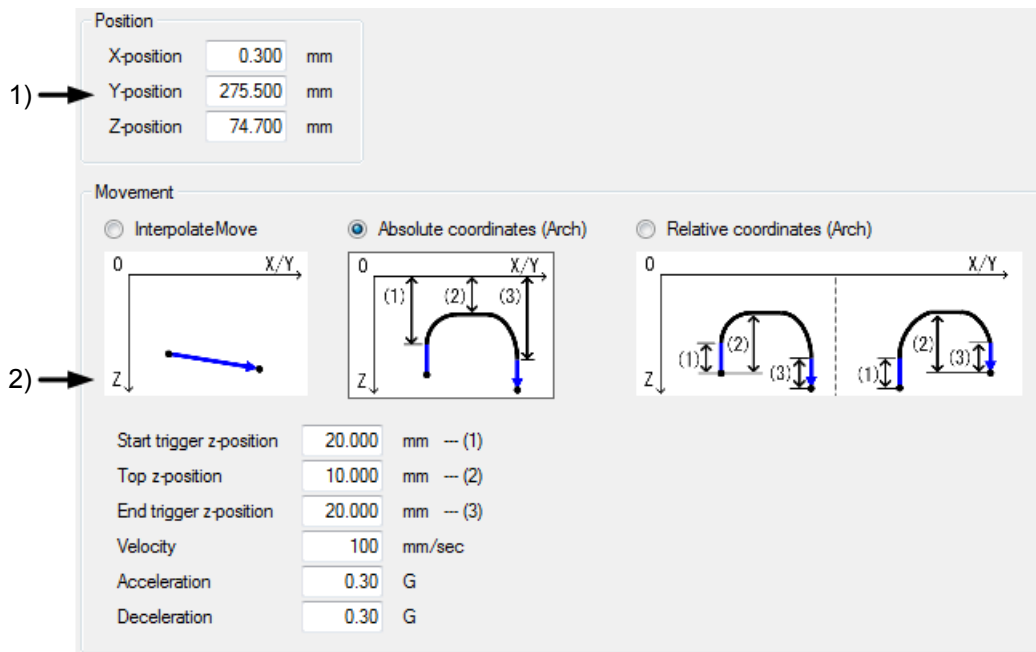
The screenshot shows the "Feeder [No.1]" window with the following settings:

- Feeder position** (selected tab):
  - X-position: 0.300 mm
  - Y-position: 275.500 mm
  - Z-position: 74.700 mm
- Movement** (selected tab):
  - ☐ Interpolate Move
  - ☒ Absolute coordinates (Arch)
  - ☐ Relative coordinates (Arch)
- Start trigger z-position**: 20.000 mm -- (1)
- Top z-position**: 10.000 mm -- (2)
- End trigger z-position**: 20.000 mm -- (3)
- Velocity**: 100 mm/sec
- Acceleration**: 0.30 G
- Deceleration**: 0.30 G

The window also includes three diagrams illustrating the movement paths for the selected settings. The "Absolute coordinates (Arch)" diagram shows a path with three points labeled (1), (2), and (3). The "Relative coordinates (Arch)" diagram shows a similar path but with relative coordinates.

## 11.1 Feeder Position Setting

Set the feeder position (position to pick up a screw) and the way to move.



- 1) Position  
Set the feeder position.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 2) Movement  
Set the way to move to the feeder position.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 11.2 Via-point (before Feeding) Setting

Set the point to go through when moving to the feeder position and the way to move.

1) → ☒ Move to the feeder position after passing the specified via-point

2) →

Position

X-position  mm

Y-position  mm

Z-position  mm

3) →

Movement

☐ Interpolate Move ☒ Absolute coordinates (Arch) ☐ Relative coordinates (Arch)

Start trigger z-position  mm --- (1)

Top z-position  mm --- (2)

End trigger z-position  mm --- (3)

Velocity  mm/sec

Acceleration  G

Deceleration  G

- 1) Move to the feeder position after passing the specified via-point  
Set whether to go through the indicated point when moving to the feeder position.
- 2) Position  
Set the position to go through.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 3) Movement  
Set the way to move to the position to go through.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 11.3 Via-point (after Feeding) Setting

Set the point to go through when moving to the screw tightening start position after picking up a screw and the way to move.

1) → ☒ Move to the next screw tightening position after passing the specified via-point

2) → **Position**

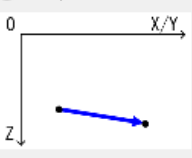
X-position  mm

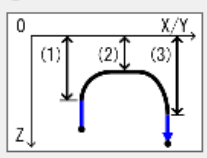
Y-position  mm

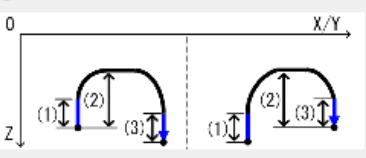
Z-position  mm

3) → **Movement**

☐ InterpolateMove ☒ Absolute coordinates (Arch) ☐ Relative coordinates (Arch)







Start trigger z-position  mm --- (1)

Top z-position  mm --- (2)

End trigger z-position  mm --- (3)

Velocity  mm/sec

Acceleration  G

Deceleration  G

- 1) Move to the next screw tightening position after passing the specified via-point  
Set whether to go through the indicated point before moving to the screw tightening start position.
- 2) Position  
Set the position to go through.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 3) Movement  
Set the way to move to the position to go through.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 11.4 Feeding Motion Setting

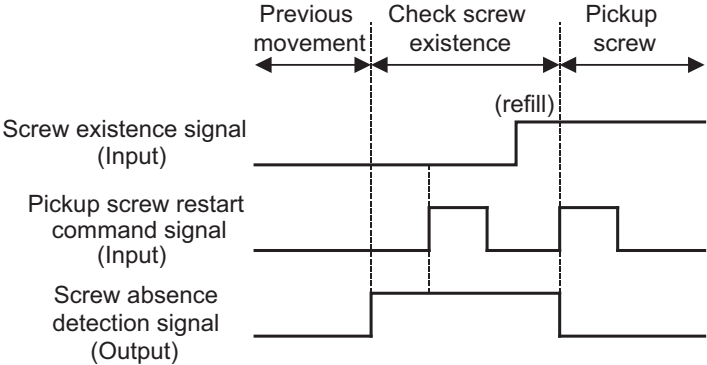
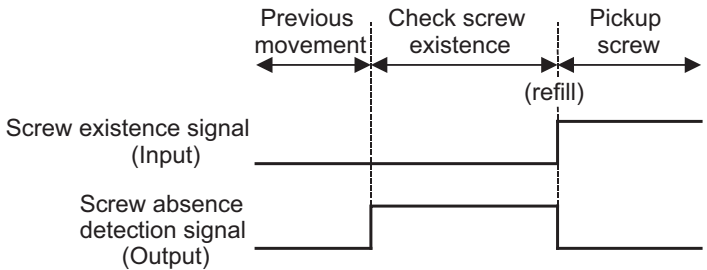
Set the screw feeding motion.

1) →

2) →

### 1) Confirm screw presence

| Item                                  | Contents   |
|---------------------------------------|--|
| Confirm screw presence signal         | Set whether to check if a screw exists with "Screw existence signal" output from the feeder before moving to the feeder position. <ul style="list-style-type: none"> <li>To check<br/>In case there is no screw found, standby will be held until screws get supplied.</li> <li>Not to check<br/>The screwdriver moves to the feeder position and performs screw feeding regardless of screw existence.</li> </ul> |
| Input port number                     | Set the input port number and signal level for "Screw existence signal". The signal level should be selected from those below. <ul style="list-style-type: none"> <li>OFF level<br/>Input turns OFF when there are screws.</li> <li>ON level<br/>Input turns ON when there are screws.</li> </ul>  |
| Output screw absence detection signal | Set whether to output "Screw absence detection signal" to an external device when there was no screw detected.   |
| Output port number                    | Set the output port number for "Screw absence detection signal".   |

| Item  | Contents  |
|---|---|
| Wait for restart command signal after screw absence detection | <p>Set whether to resume screw feeding after waiting for “Pickup screw restart command signal” to be input.</p> <ul style="list-style-type: none"> <li>• To wait<br/>The screwdriver waits for “Pickup screw restart command signal” to be input, and checks if there are screws existed.<br/>If there are screws, it moves to the feeder position and starts feeding action. If there is not, it waits for “Pickup screw restart command signal” to be input again.</li> </ul>  <ul style="list-style-type: none"> <li>• Not to wait<br/>If “Screw existence signal” turns ON (or OFF) after screws are supplied, the screwdriver moves to the feeder position and starts feeding action.</li> </ul>  |
| Input port number   | <p>Set the input port number and signal level for “Pickup screw restart command signal”. The signal level should be selected from those below.</p> <ul style="list-style-type: none"> <li>• OFF level</li> <li>• ON level</li> <li>• OFF edge</li> <li>• ON edge</li> </ul>   |



## 2) Screw feeding

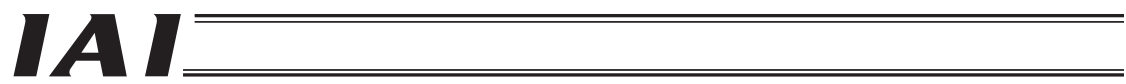
| Item                                    | Contents   |
|---|--|
| Screwdriver rotation speed              | Set the screwdriver rotation speed (Low speed / High speed) when picking up a screw.<br>Rotate the screwdriver in the set speed and get a screw gripped.   |
| Feeding time                            | Set the period of time to wait in screw picking (gripping). (Unit: sec)<br>The screwdriver starts gripping a screw at the feeding position, waits for the specified period of time and then moves to the screw tightening start position.  |
| Screwdriver rotation stop after feeding | Set whether to stop the screwdriver to rotate after picking up a screw. <ul style="list-style-type: none"> <li>To stop<br/>The screwdriver stops rotation and moves to the screw tightening start position (Rotation resumed when starting to tightening screw)</li> <li>Not to stop<br/>The screwdriver keeps its rotation and moves to the screw tightening start position.</li> </ul> |
| After rotation stop wait time           | Set the period of time to wait after the screwdriver rotation gets stopped. (Unit: sec)<br>The screwdriver waits for the specified period of time and moves to the screw tightening start position.  |

## 11.5 Name Setting

Set a feeder point name. (Character string in 0 to 32 bytes)

|      |       |
|------|-------|
| Name | M3*10 |
|------|-------|

The name set to the feeder points should be displayed in “Feeder Point Setting Page” in “Property Setting Window”.  
(Refer to [10.7.3 Feeder Point Setting].)



## 12. Discard Screw Point Setting

Setting of the discard screw point setting should be established in “Discard Screw Setting Window”.

(For how to display window, refer to [10.7.4 Discard Screw Point Setting].)

The items to establish settings are as shown below.

- Discard Screw Position
- Via-point (before Discarding)
- Via-point (after Discarding)
- Discarding Motion
- Name

Discard screw [No.1]

Discard screw position   Via-point (before discarding)   Via-point (after discarding)   Discarding motion   Name

☒ Move to the specified position

Position

X-position: 489.500 mm

Y-position: 274.800 mm

Z-position: 98.000 mm

Movement

☐ Interpolate Move   ☒ Absolute coordinates (Arch)   ☐ Relative coordinates (Arch)

Start trigger z-position: 20.000 mm -- (1)

Top z-position: 10.000 mm -- (2)

End trigger z-position: 20.000 mm -- (3)

Velocity: 100 mm/sec

Acceleration: 0.30 G

Deceleration: 0.30 G

OK   Cancel

## 12.1 Discard Screw Position Setting

Set the position to discard a screw taken off a workpiece and the way to move.

1) → ☒ Move to the specified position

2) →

Position

X-position 489.500 mm

Y-position 274.800 mm

Z-position 98.000 mm

3) →

Movement

☐ InterpolateMove ☒ Absolute coordinates (Arch) ☐ Relative coordinates (Arch)

Start trigger z-position 20.000 mm -- (1)

Top z-position 10.000 mm -- (2)

End trigger z-position 20.000 mm -- (3)

Velocity 100 mm/sec

Acceleration 0.30 G

Deceleration 0.30 G

- 1) Move to the specified position  
Set whether to move to the indicated position to discard a screw or to discard a screw at the current position.
- 2) Position  
Set the discard screw position.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 3) Movement  
Set the way to move to the discard screw position.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 12.2 Via-point (before Discarding) Setting

Set the point to go through when moving to the discard screw position and the way to move.

1) → ☒ Move to the discard screw position after passing the specified via-point

2) →

Position

X-position 0.000 mm

Y-position 0.000 mm

Z-position 0.000 mm

3) →

Movement

☐ Interpolate Move ☒ Absolute coordinates (Arch) ☐ Relative coordinates (Arch)

Start trigger z-position 0.000 mm -- (1)

Top z-position 0.000 mm -- (2)

End trigger z-position 0.000 mm -- (3)

Velocity 100 mm/sec

Acceleration 0.30 G

Deceleration 0.30 G

- 1) Move to the discard screw position after passing the specified via-point  
Set whether to go through the indicated point when moving to the discard screw position.
- 2) Position  
Set the position to go through.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 3) Movement  
Set the way to move to the position to go through.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 12.3 Via-point (after Discarding) Setting

Set the point to go through after throwing a screw away and before moving to the next working position and the way to move.

1) → ☒ Execute the next action after passing the specified via-point

2) → **Position**

X-position 0.000 mm

Y-position 0.000 mm

Z-position 0.000 mm

3) → **Movement**

☐ InterpolateMove ☒ Absolute coordinates (Arch) ☐ Relative coordinates (Arch)

Start trigger z-position 0.000 mm -- (1)

Top z-position 0.000 mm -- (2)

End trigger z-position 0.000 mm -- (3)

Velocity 100 mm/sec

Acceleration 0.30 G

Deceleration 0.30 G

- 1) Execute the next action after passing the specified via-point  
Set whether to go through the indicated point before making the next operation.
- 2) Position  
Set the position to go through.

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

- 3) Movement  
Set the way to move to the position to go through.  
The detail of settings should be the same as the movement settings between figures in the project property.  
Refer to [10.6 Movement between Figures Setting] for details.

## 12.4 Discarding Motion Setting

Set the period of time to wait after discarding a screw. (Unit: mm)

After discarding wait time  sec

## 12.5 Name Setting

Set a discard screw point name. (Character string in 0 to 32 bytes)

Name

The name set to the discard screw points should be displayed in “Discard Screw Point Setting Page” in “Property Setting Window”.  
(Refer to [10.7.4 Discard Screw Point Setting].)





## 13. Screw Tightening Conditions Setting

Setting of the screw tightening conditions setting should be established in “Screw Tightening Conditions Setting Window”.  
(For how to display window, refer to [10.7.5 Screw Tightening Condition Setting].)

The items to establish settings are as shown below.

- Tightening Motion
- Error Detection
- Z Motion
- Name

**Screw Tightening Conditions [No.1]**

Tightening motion | Error detection | Z motion | Name

Type: Full tightening

**Feeding**

Feeder point number: 1

**Bit fitting**

☒ Reverse the screwdriver

Screwdriver rotation speed: High speed

Screwdriver rotation time: 0.10 sec

After bit fitting wait time: 0.20 sec

**Screw tightening**

Screwdriver rotation speed: High speed

Start relative z-position: -11.000 mm

End relative z-position: 1.000 mm

After screw tightening wait time: 0.10 sec

**Driving**

☐ Operate

Screwdriver rotation speed: High speed

End relative z-position: 0.000 mm

After driving wait time: 0.00 sec

**Screw loosen**

Screwdriver rotation speed: High speed

End relative z-position: 0.000 mm

After screw loosen wait time: 0.00 sec

**Discard screw**

Discard screw point number: 1

OK Cancel

## 13.1 Tightening Motion Setting

Have the screw tightening operation setting established.

1) → Type

2) → Feeder point number

3) → Screwdriver rotation speed

4) → Start relative z-position  mm

5) → Screwdriver rotation speed

6) → End relative z-position  mm

7) → Discard screw point number

- 1) Type  
Select a screw tightening type from those below.

| Type                        | Items that Setting Required |             |                  |         |              |               |
|-----------------------------|-----------------------------|-------------|------------------|---------|--------------|---------------|
|                             | Feeding                     | Bit fitting | Screw tightening | Driving | Screw loosen | Discard screw |
| Full tightening             | •                           |             | •                |         |              |               |
| Tighten, then reverse       | •                           |             | •                |         | •            |               |
| Loose tightening            | •                           |             | •                |         |              |               |
| Full tightening (No pickup) |                             | •           | •                |         |              |               |
| Unscrew                     |                             | •           |                  | •       | •            | •             |

- 2) Feeding

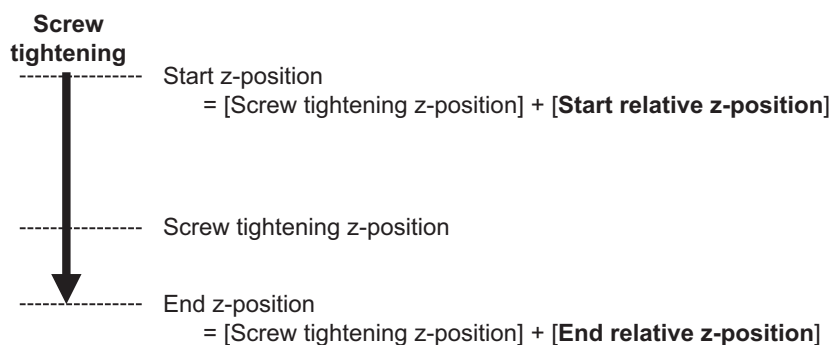
| Item                | Contents                 |
|---------------------|--------------------------|
| Feeder point number | Select the feeder point. |

## 3) Bit fitting

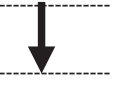
| Item                        | Contents   |
|-----------------------------|--|
| Reverse the screwdriver     | Set whether to turn the screwdriver reversed in order to fit the bit to a screw.   |
| Screwdriver rotation speed  | Set the rotation speed of the screwdriver when fitting the bit.  |
| Screwdriver rotation time   | Set the duration of screwdriver rotation. (Unit: sec)<br>(Note) Since the screwdriver turns reversed without having the Z-axis go upward, having the rotation duration too long may apply too much stress to a workpiece, screw and screwdriver.                   |
| After bit fitting wait time | Set the standby time after the screwdriver stops its rotation. (Unit: sec)<br>(Note) If a setting is established on a screwdriver for automatic operation to hold for a certain while till the next start, set a value that is longer than the indicated duration. |

## 4) Screw tightening


| Item                             | Contents   |
|----------------------------------|--|
| Screwdriver rotation speed       | Set the rotation speed of the screwdriver at screw tightening.   |
| Start relative z-position        | Set the screw tightening start position in a relative coordinate to "Screw tightening z-position". (Unit: mm)  |
| End relative z-position          | Set the screw tightening end position in a relative coordinate to "Screw tightening z-position". (Unit: mm)  |
| After screw tightening wait time | Set the standby time after finishing screw tightening. (Unit: sec)<br>(Note) In case the period between a rotation stop and the next rotation is too short, there may be a concern that the screwdriver would not rotation.<br>If a setting is established on a screwdriver for automatic operation to hold for a certain while till the next start, establish a setting in this item and set it so that there is longer period to hold than the indicated duration. |



## 5) Driving

| Item                       | Contents   |
|----------------------------|--|
| Operate                    | Set whether to turn further in order to make the bit tip bite the screw head stronger.   |
| Screwdriver rotation speed | Set the rotation speed of the screwdriver when turning further. (Low speed or High speed)  |
| End relative z-position    | <p>Set the Z-coordinate for the turning further finish position in a relative coordinate to "Screw tightening z-position". (Unit: mm)</p> <p><b>Driving</b></p>  <p>----- Screw tightening z-position</p> <p>----- End z-position<br/>= [Screw tightening z-position] + [End relative z-position]</p> |
| After driving wait time    | <p>Set the duration of the standby time after finishing turning further. (Unit: sec)</p> <p>(Note) If a setting is established on a screwdriver for automatic operation to hold for a certain while till the next start, set a value that is longer than the indicated duration.</p>   |

## 6) Screw loosen

| Item                         | Contents   |
|------------------------------|--|
| Screwdriver rotation speed   | Set the rotation speed of the screwdriver when screw loosen. (Low speed or High speed)   |
| End relative z-position      | <p>Set the screw loosen end position in a relative coordinate to "Screw tightening z-position". (Unit: mm)</p> <p>----- End z-position<br/>= [Screw tightening z-position] + [End relative z-position]</p>  <p>----- Screw tightening z-position</p> <p><b>Screw loosen</b></p> |
| After screw loosen wait time | Set the duration of the standby time after finishing screw loosen. (Unit: sec)   |

## 7) Discard screw

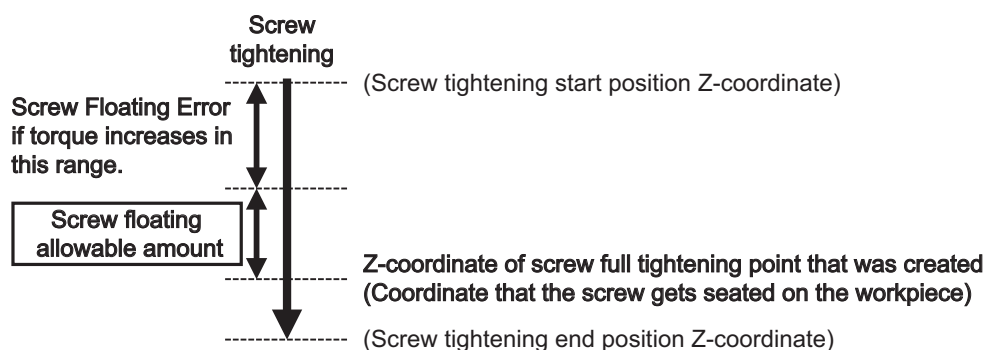
| Item                       | Contents                      |
|----------------------------|-------------------------------|
| Discard screw point number | Select a discard screw point. |

## 13.2 Error Detection Setting

Set the detection condition of a screw tightening error (Screw floating error and Screw slipping error) and the action after detection.

### 1) Screw floating error detection conditions

| Item               | Contents   |
|--------------------|--|
| Detect             | Set if screw floating error should be detected.  |
| Permissible amount | Set the allowable amount for screw floating. (Unit: mm)<br>Screw floating error will be issued when the amount of screw floating exceeds this setting value. |
| Retry count        | Set the number of retries when screw floating error is detected.   |



#### <Important>

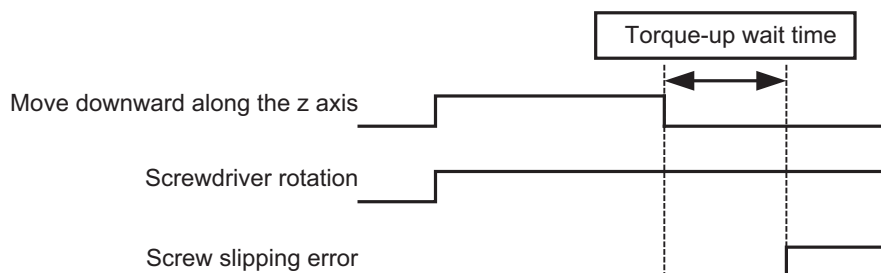
There is a concern that a gap could be generated between the Z-axis driving amount and the actual amount of screw tightening due to causes stated blow, which would disturb accurate detection of the screw floating error.

- Gap between the Z-axis speed and screw feeding speed
- Warpage of workpiece

Refer to it just as a quick method to detect an error.

## 2) Screw slipping error detection conditions

| Item                | Contents  |
|---------------------|---|
| Detect              | Set if screw slipping error should be detected.   |
| Torque-up wait time | Set the time till screw slipping error gets detected. (Unit: sec)<br>Screw slipping error will be issued when the torque would not increase after a certain period of time that is set in this setting since the Z-axis reaches the screw tightening finish position. |



## 3) Action on error detection

Select an action when a screw tightening error (Screw floating error or screw slipping error) was detected from those below.

- Wait on the spot  
The screwdriver stands by at the point that the error was detected.
- Move to the retraction position  
The screwdriver moves to the evacuation point and stands by.  
Refer to [7.5.1 Action on Error Detection] for the details of evacuation action.

| item                  | Contents  |
|-----------------------|---|
| X-position            | Set the X-coordinate on the evacuation point. (Unit: mm)<br>If it is not set (left blank), evacuation motion in X-axis will not be conducted.   |
| Y-position            | Set the Y-coordinate on the evacuation point. (Unit: mm)<br>If it is not set (left blank), evacuation motion in Y-axis will not be conducted.   |
| Z-position            | Set the Z-coordinate on the evacuation point. (Unit: mm)<br>It is mandatory to set this up when it is necessary to have a movement.   |
| Velocity              | Set the velocity for evacuation motion. (Unit: mm/sec)  |
| Acceleration          | Set the acceleration for evacuation motion. (Unit: G)   |
| Deceleration          | Set the deceleration for evacuation motion. (Unit: G)   |
| Evacuation z-position | Set up the Z-coordinate at evacuation motion.<br>This item should be invalid (not available for setting) in case no evacuation motion is required for the axes other than the Z-axis (X-axis/Y-axis). |

- Discard screw

The screwdriver loosens a screw and take it out, and then moves to the discard screw point and throws away the screw.

Refer to [7.5.1 Action on Error Detection] for details.

| Item                       | Contents                      |
|----------------------------|-------------------------------|
| Discard screw point number | Select a discard screw point. |

**<Important>**

**Make sure that a screw has been removed by having a certain inspection such as a visual check.**

**In case a screw has not been taken away, take it off with hand.**

## 4) Screw loosen

| Item   | Contents  |
|--|---|
| Screwdriver rotation speed                   | Set the rotation speed of the screwdriver when loosening a screw in order to have "retries due to screw floating" or "Discard screw". (Low speed / High speed)  |
| Screw loosen end position when discard screw | <p>Select a screw loosening finish position when discard screw.</p> <ul style="list-style-type: none"> <li>• Loose to the start position<br/>This sets the screw tightening start position as the loosening finish position.</li> <li>• Loose to the specified position<br/>This sets the indicated coordinates as the loosening finish position.</li> </ul> <p>In case of "Full tightening (No pickup)", the setting should always be "Loose to the specified position".</p> |
| Specified relative z-position                | <p>Set the loosening finish position when discard screw. (Unit: mm)</p> <p>It is mandatory to set this up when "Screw loosen end position when discard screw" is set to "Loose to the specified position".</p>  |
| Before screw loosen wait time                | <p>Set the duration of the standby time before starting screw loosen. (Unit: sec)</p> <p>The screwdriver waits for specified period of time after a screw tightening error was detected until it starts to loosen a screw.</p> <p>(Note) If a setting is established on a screwdriver for automatic operation to hold for a certain while till the next start, set a value that is longer than the indicated duration.</p>  |
| After screw loosen wait time                 | <p>Set the duration of the standby time after finishing screw loosen. (Unit: sec)</p> <p>(Note) If a setting is established on a screwdriver for automatic operation to hold for a certain while till the next start, set a value that is longer than the indicated duration.</p>   |

## 5) Program end/ resume

| Item              | Contents  |
|-------------------|---|
| Program end       | The screwdriver goes back to the work home position and robot program finishes.   |
| Resume same point | <p>Operation resumes from the screw tightening point where an error occurred.</p> <p>Refer to [7.5.2 End / Resume] for details.</p> |
| Resume next point | <p>Operation resumes from the next figure.</p> <p>Refer to [7.5.2 End / Resume] for details.</p>                                    |



## 13.3 Z Motion Setting

Establish the setting how to get the Z-axis move in screw tightening operation.

1) → ☒ Individual setting

2) → Forward (High speed)

3) → Forward (Low speed)

4) → Reverse (High speed)

5) → Reverse (Low speed)

- 1) Individual setting  
Put a check mark when it is required to set the way of Z-axis movement individually in a screw tightening operation under the applicable screw tightening conditions.  
Remove the check mark when it is required to apply the way of Z-axis movement set in the property [10.7.2 Z Motion Setting].
- 2) Forward (High speed)  
How to establish setting is the same as that for property setting.  
Refer to [10.7.2 Z Motion Setting] for details.
- 3) Forward (Low speed)  
How to establish setting is the same as that for property setting.  
Refer to [10.7.2 Z Motion Setting] for details.
- 4) Reverse (High speed)  
How to establish setting is the same as that for property setting.  
Refer to [10.7.2 Z Motion Setting] for details.
- 5) Reverse (Low speed)  
How to establish setting is the same as that for property setting.  
Refer to [10.7.2 Z Motion Setting] for details.

## 13.4 Name Setting

Set a screw tightening condition name. (Character string in 0 to 32 bytes)

|      |                       |
|------|-----------------------|
| Name | Full tightening M3*10 |
|------|-----------------------|

The set name should be displayed in the cases below.

- On “Screw Tightening Condition Setting Page” in “Property Setting Window” (Refer to [10.7.5 Screw Tightening Condition Setting].)
- On “Screw tightening Setting Page” in “Editing Information of a Figure” (Refer to [15.10.4 Screw Tightening Setting].)

## 14. Draw Figures

Create drawing in one of the ways below.

- Reading figures in from CAD data
- Creating figures with mouse operation

### 14.1 Reading Figures in from CAD Data

Figures <sup>(Note1)</sup> necessary for work can be read in from the CAD data in work.

Note1 Only dot figures (POINT) are available to read in.

#### 14.1.1 CAD Data Format Available for Reading

The CAD data format available to read in is as shown below.

- Format : DXF (ASCII Format)
- Version : AutoCAD Release 14

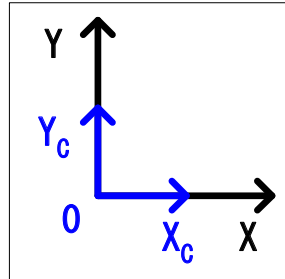
#### 14.1.2 Types of Figures Available for Reading

The figures available to read in are as shown below.

- POINT
- LINE
- CIRCLE
- ARC
- POLYLINE
- LWPOLYLINE
- SPLINE
- ELLIPSE
- TRACE
- SOLID

## 14.1.3 Relation of CAD Drawing Coordinates and Working Area Coordinates

The relation of the CAD drawing coordinates  $X_c$ ,  $Y_c$  and the working area coordinates  $X$ ,  $Y$  are as shown below.



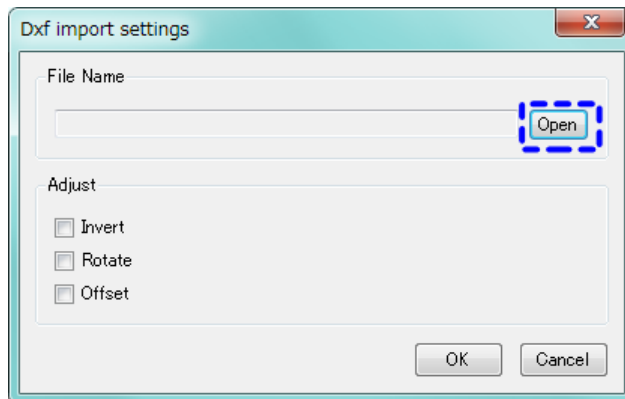
The orientation of the CAD drawing should change in relation to the coordinate orientation of the working area.

| Coordinate Operation of Working Area: TYPE 1 | Coordinate Operation of Working Area: TYPE 2 |
|--|--|
|  |  |
| Coordinate Operation of Working Area: TYPE 3 | Coordinate Operation of Working Area: TYPE 4 |
|  |  |
| Coordinate Operation of Working Area: TYPE 5 | Coordinate Operation of Working Area: TYPE 6 |
|  |  |
| Coordinate Operation of Working Area: TYPE 7 | Coordinate Operation of Working Area: TYPE 8 |
|  |  |

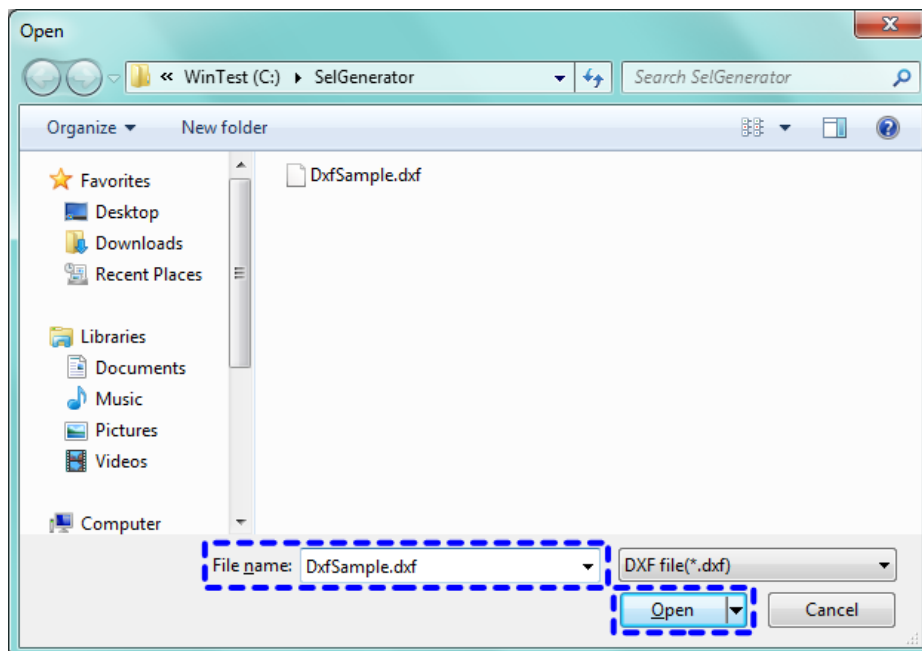
## 14.1.4 Read the DXF Data

In order to read the DXF data, follow the procedure below.

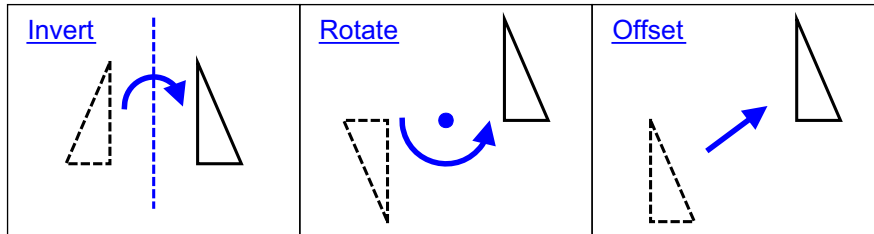
- 1) Prepare a DXF data for work drawing.
- 2) Execute [File (F)] - [Dxf data (D)] - [Read (R)] from the menu bar.
- 3) Click on **Open** button in “Dxf import settings” window.



- 4) Select a file name of the DXF data, and click on **Open** button.

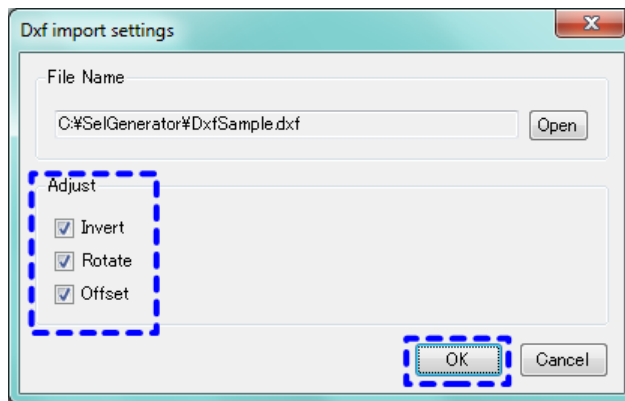


- 5) In order to adjust the relation between the coordinates (0, 0) (= tool tip position) of the working area and the work position, operate the figures that was read in to “Invert”, “Rotate” and “Offset”.



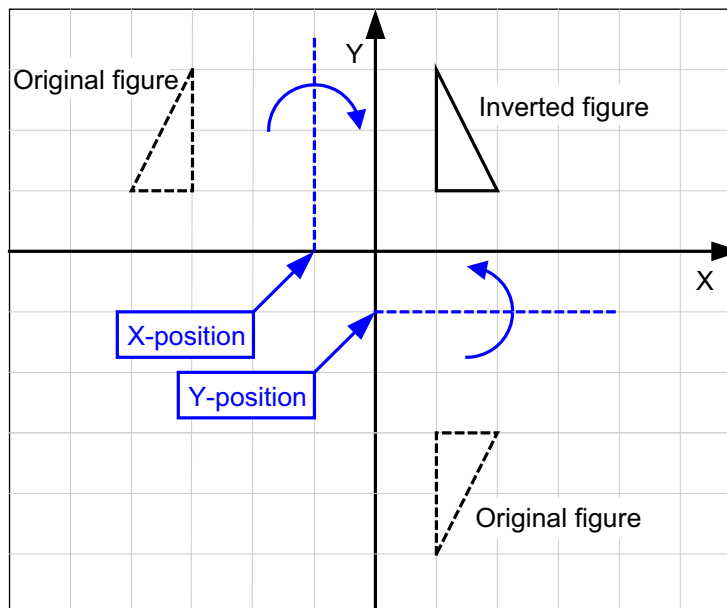
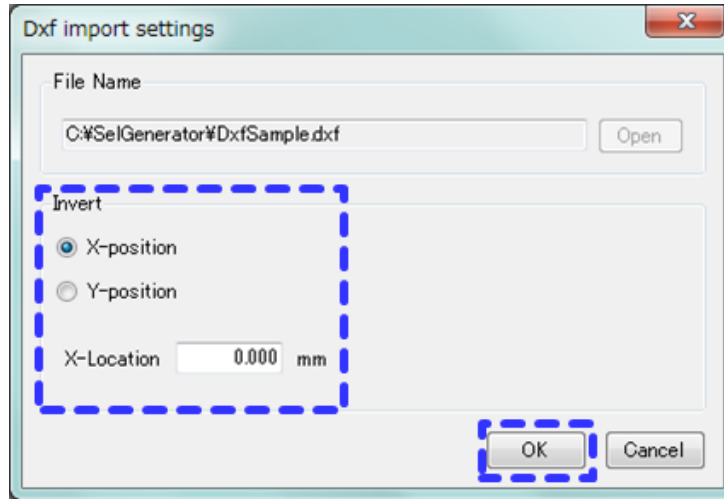
Select an item to execute, and click on **OK** button.

(Note) If multiple items are selected, the coordinates should be converted in the order of “Invert” => “Rotate” => “Offset”.



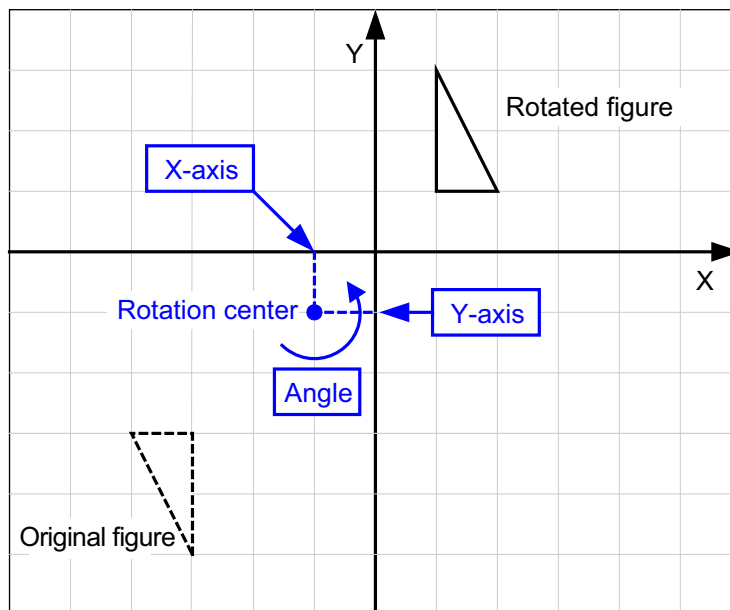
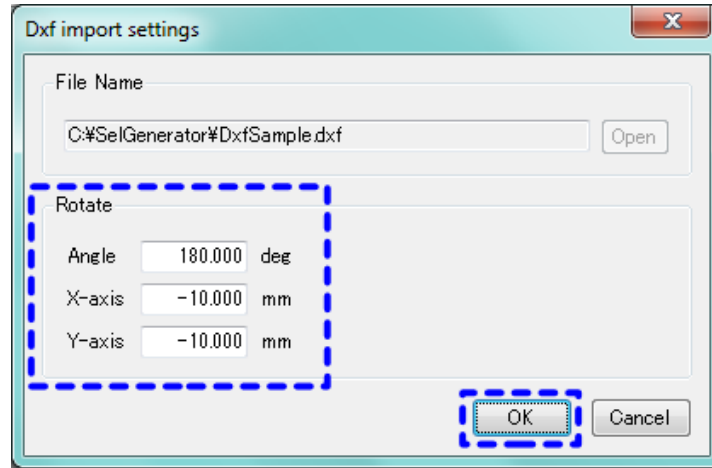
- 6) Set the datum coordinate for inversion and click on **OK** button.

[If “Invert” is selected in 5)]



- 7) Set the rotation angle and the center coordinate and click on **OK** button.

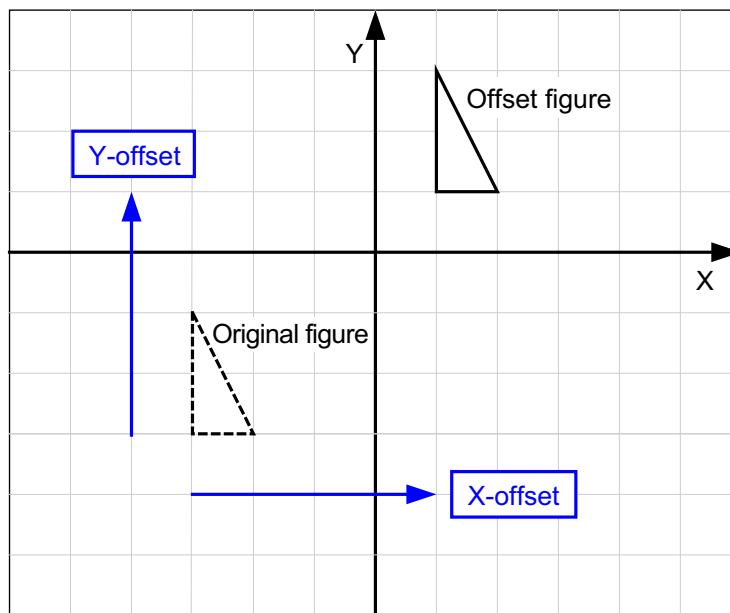
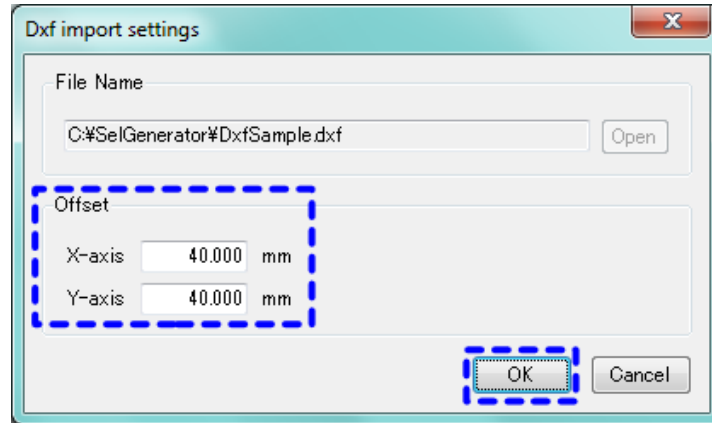
[If “Rotate” is selected in 5)]






- 8) Set the offset values and click on  button.

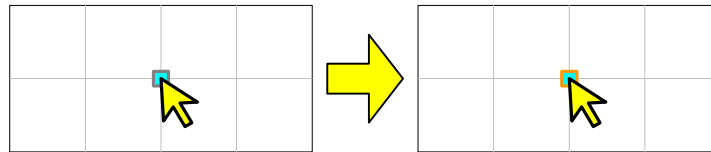
[If “Offset” is selected in 5)]



## 14.1.5 Import the Figure

In order to import the DXF figure, follow the procedure below.

- 1) Change the edit mode to "Select dxf items" in one of the ways below.
  - Click on  (Select dxf items) button in the tool bar
  - Execute [Draw (D)] - [Select dxf items (X)] from the menu bar
- 2) Click on a figure (dot figure) that you would like to take in with a mouse and select.



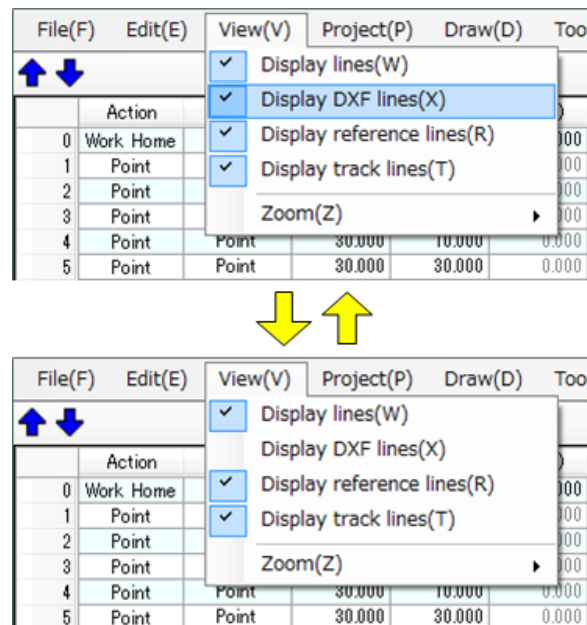
- 3) Right-click the mouse to open the popup menu and execute [Import (I)].

## 14.1.6 Clear the Figure

Execute [File (F)] - [Dxf data (D)] - [Clear (C)] in the menu bar, and the DXF figure being displayed can be cleared.


## 14.1.7 Show / Hide a Figure

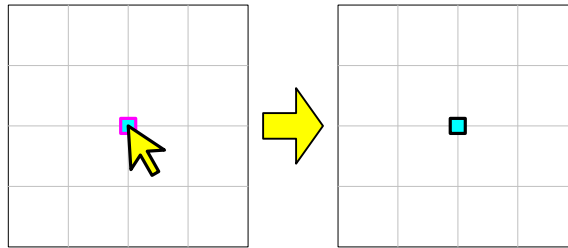
Execute [View (V)] - [Display DXF lines (X)] in the menu bar, and the DXF figure can be switched between show and hide.



## 14.2 Creating a Figure with Mouse Operation

Follow the procedures below to create a dot figure.

- 1) Change the edit mode to “Point drawing” in one of the ways below.
  - Click on  (Point) button in the tool bar
  - Execute [Draw (D)] - [Point (P)] from the menu bar
- 2) Move the mouse cursor to the position that you would like to place a point and click there.

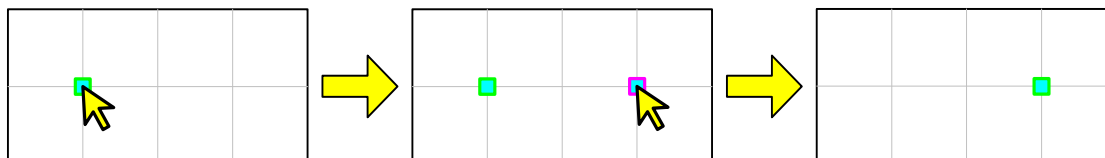




## 15. Modify Figures

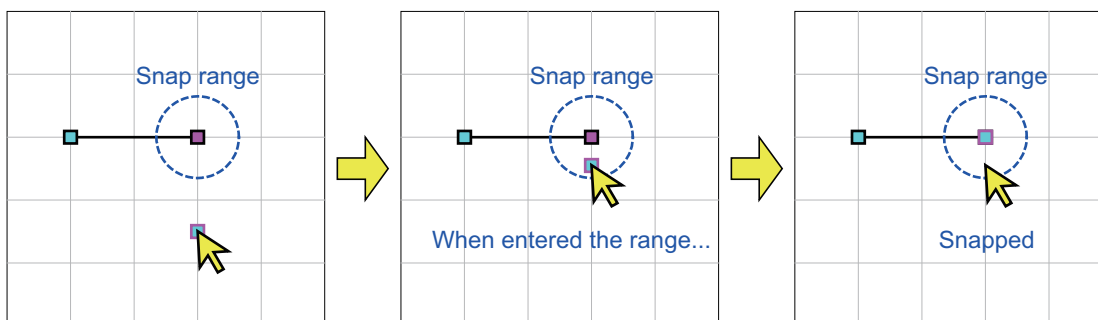
### 15.1 Moving Peak Point / Figure by Mouse Drag

Drag a created figure with the mouse and the figure can change its position. (It is limited only to when the edit mode is set to "Select drawing items".)

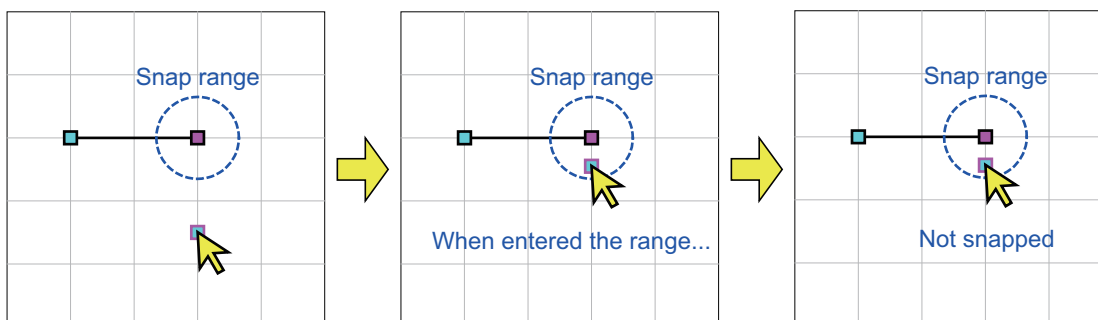


### 15.2 Peak Snap

When selecting a peak point, get the mouse cursor close to a peak point of another figure, and the dragged point will get snapped to that peak point.



When you desire not to have the cursor snapped, hold down [Ctrl] key and [Shift] key while you move the mouse cursor.



The snap range can be changed in the tool option ([18.3 Drawing Setting]).

## 15.3 Cut

The created figure can be cut in the procedures below.

- 1) Select a created figure that you would like to cut.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Edit (E)] - [Cut (T)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Cut (T)]

## 15.4 Copy

The created figure can be copied in the procedures below.

- 1) Select a created figure that you would like to copy.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Edit (E)] - [Copy (C)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Copy (C)]

## 15.5 Paste

A figure that has been cut / copied can be pasted by any operation of those below.

- Execute [Edit (E)] - [Paste (P)] from the menu bar
- Right-click in a working area to open the popup menu, and execute [Paste (P)]

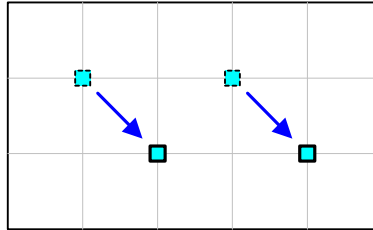
## 15.6 Delete

The created figure can be deleted in the procedures below.

- 1) Select a created figure that you would like to delete.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Edit (E)] - [Delete (D)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Delete (D)]

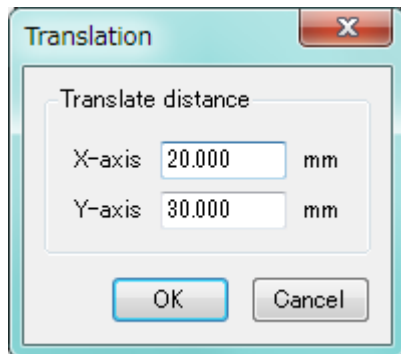
## 15.7 Translation

A created figure can be moved in parallel orientation.



The procedures are as follows.

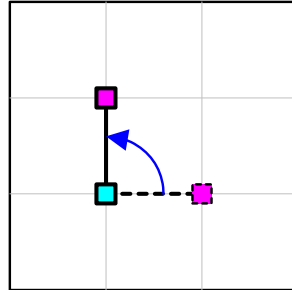
- 1) Select a created figure.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Draw (D)] - [Translation (T)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Translation (L)]
- 3) Set the amount to move for X-axis and Y-axis, and click on **OK** button.



| Item   | Contents                                       |
|--------|--|
| X-axis | Set the movement amount for X-axis. (Unit: mm) |
| Y-axis | Set the movement amount for Y-axis. (Unit: mm) |

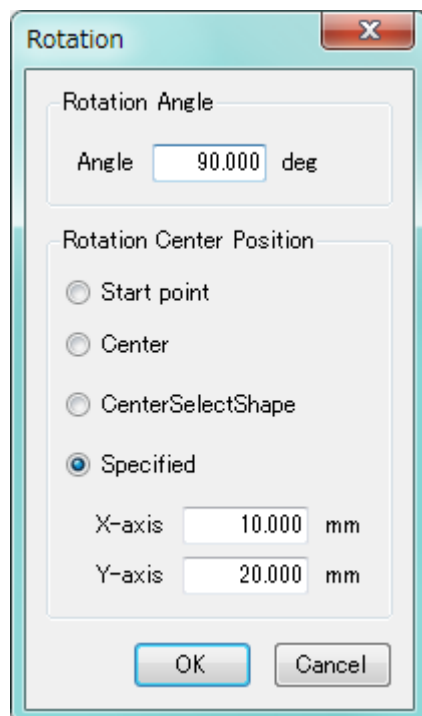
## 15.8 Rotation

A created figure can be rotated.

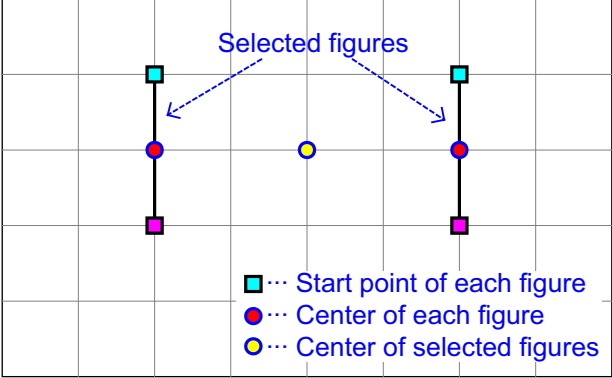
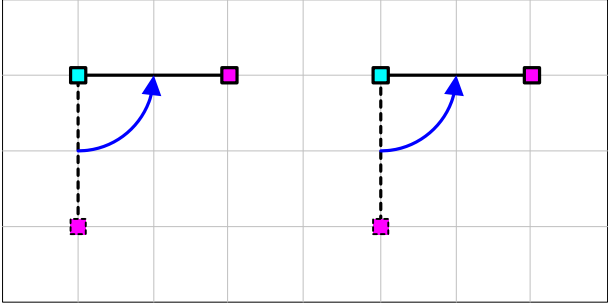
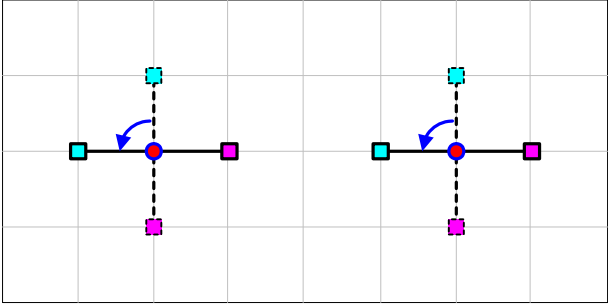


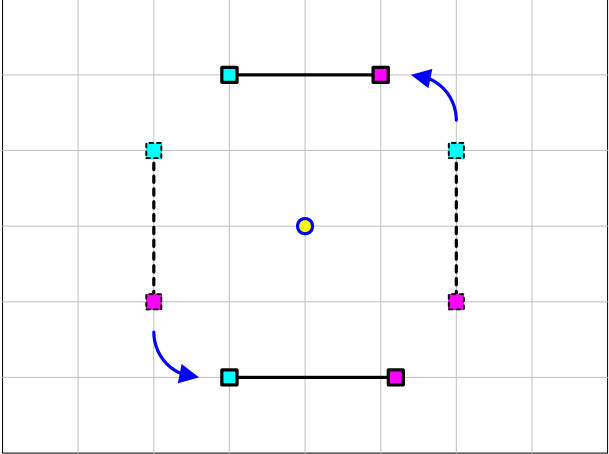
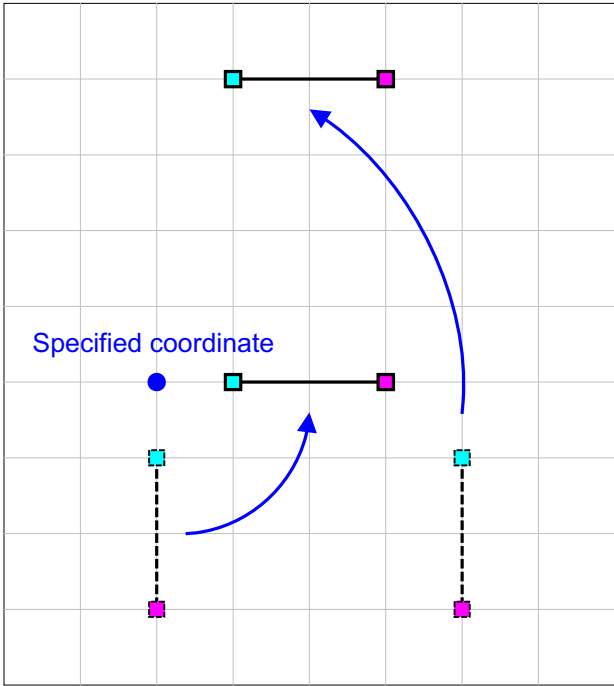
The procedures are as follows.

- 1) Select a created figure.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Draw (D)] - [Rotation (R)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Rotation (R)]
- 3) Set the rotation angle and the rotation center coordinate, and click on **OK** button.



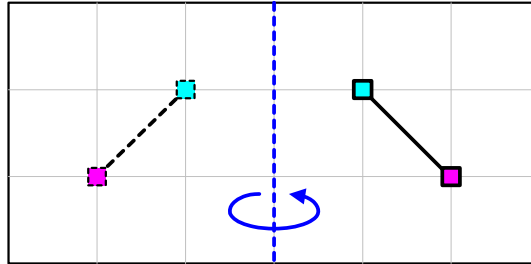


| Item                     | Contents   |
|--------------------------|--|
| Rotation Angle           | Set the rotation angle. (Unit: deg)  |
| Rotation Center Position | <p>Select / specify the coordinates that should be the center for rotation.</p>  <ul style="list-style-type: none"> <li>Start point</li> </ul>  <ul style="list-style-type: none"> <li>Center</li> </ul>  |

| Item                     | Contents  |
|--------------------------|---|
| Rotation Center Position | <ul style="list-style-type: none"> <li>Center Select Shape  </li> <li>Specified  </li> </ul> |

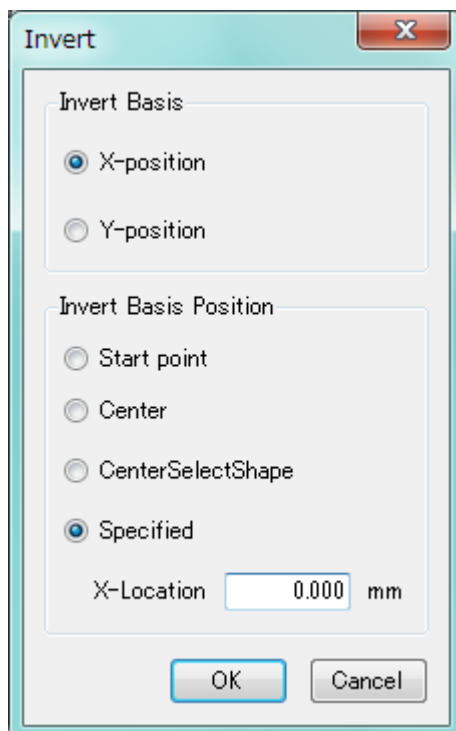
## 15.9 Invert

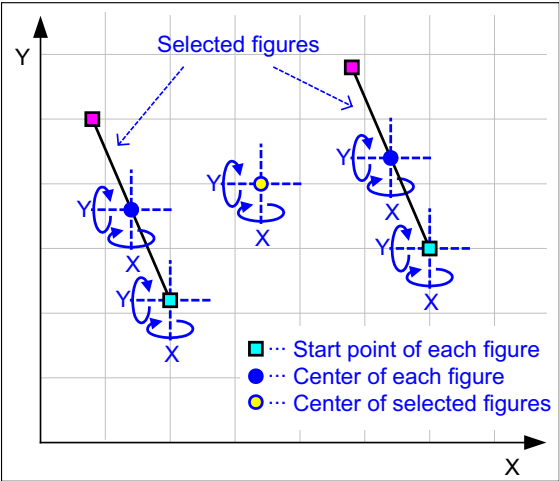
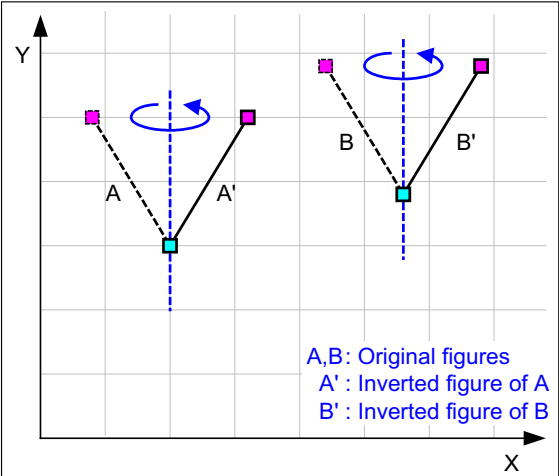
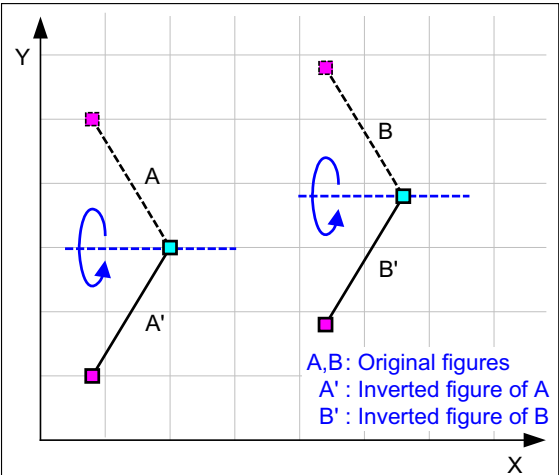
A created figure can be inverted.

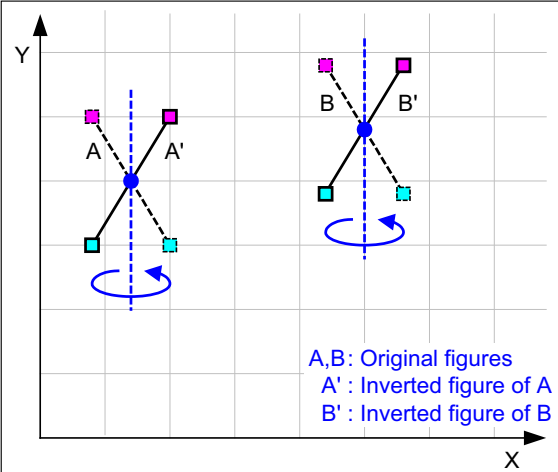
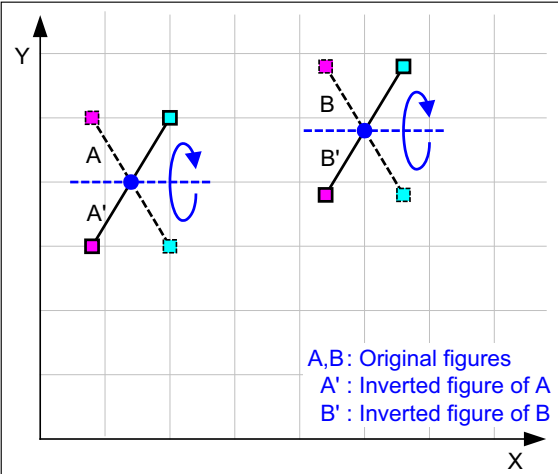
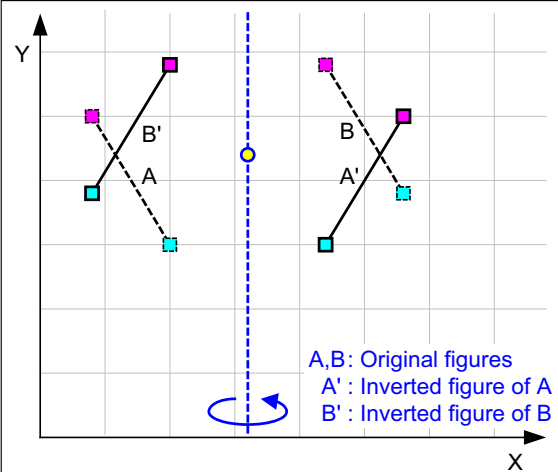


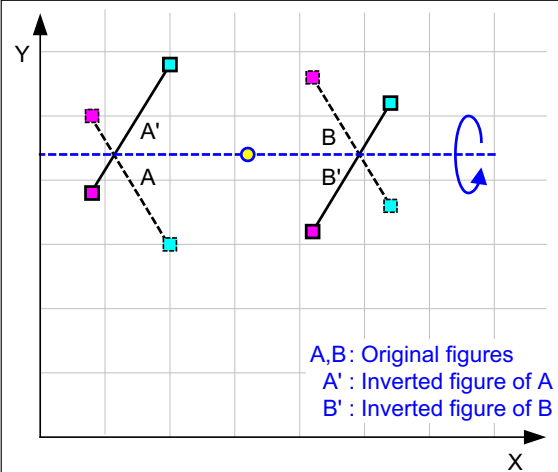
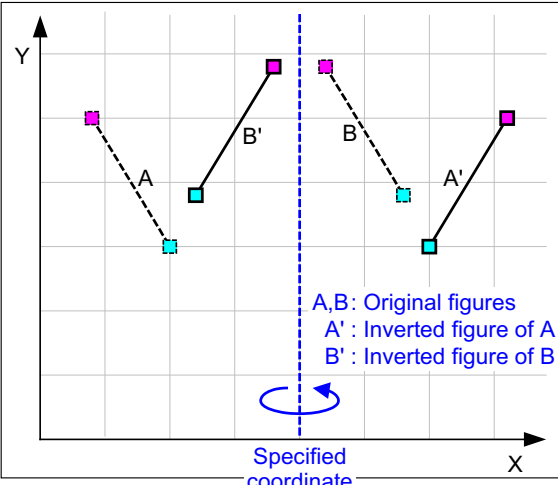
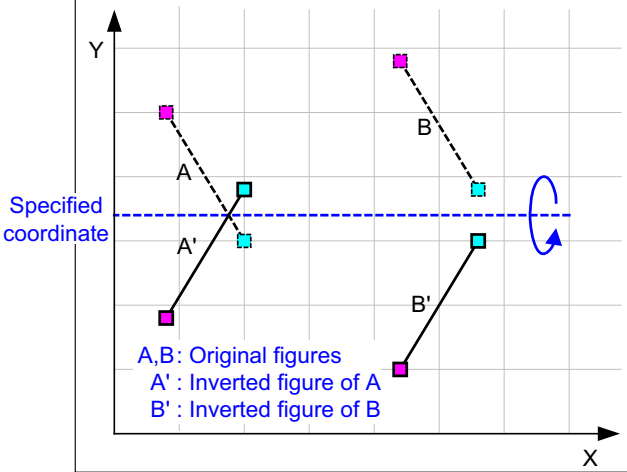
The procedures are as follows.

- 1) Select a created figure.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Execute an operation from those below.
  - Execute [Draw (D)] - [Invert (I)] from the menu bar
  - Right-click in a working area to open the popup menu, and execute [Invert (I)]
- 3) Set the inversion datum and the inversion datum coordinate, and click on OK button.



| Item                  | Contents  |
|-----------------------|---|
| Invert Basis          | Select a coordinate (X-coordinate or Y-coordinate) that should be the datum for inversion.  |
| Invert Basis Position | <p>Select / specify the inversion datum coordinate.</p>  <p>• Start point (X-Position)</p>  <p>• Start point (Y-Position)</p>  |

| Item                  | Contents   |
|-----------------------|--|
| Invert Basis Position | <ul style="list-style-type: none"> <li>Center (X-Position)            <p>A,B: Original figures<br/>A': Inverted figure of A<br/>B': Inverted figure of B</p> </li> <li>Center (Y-Position)            <p>A,B: Original figures<br/>A': Inverted figure of A<br/>B': Inverted figure of B</p> </li> <li>Center Select Shape (X-Position)            <p>A,B: Original figures<br/>A': Inverted figure of A<br/>B': Inverted figure of B</p> </li> </ul> |

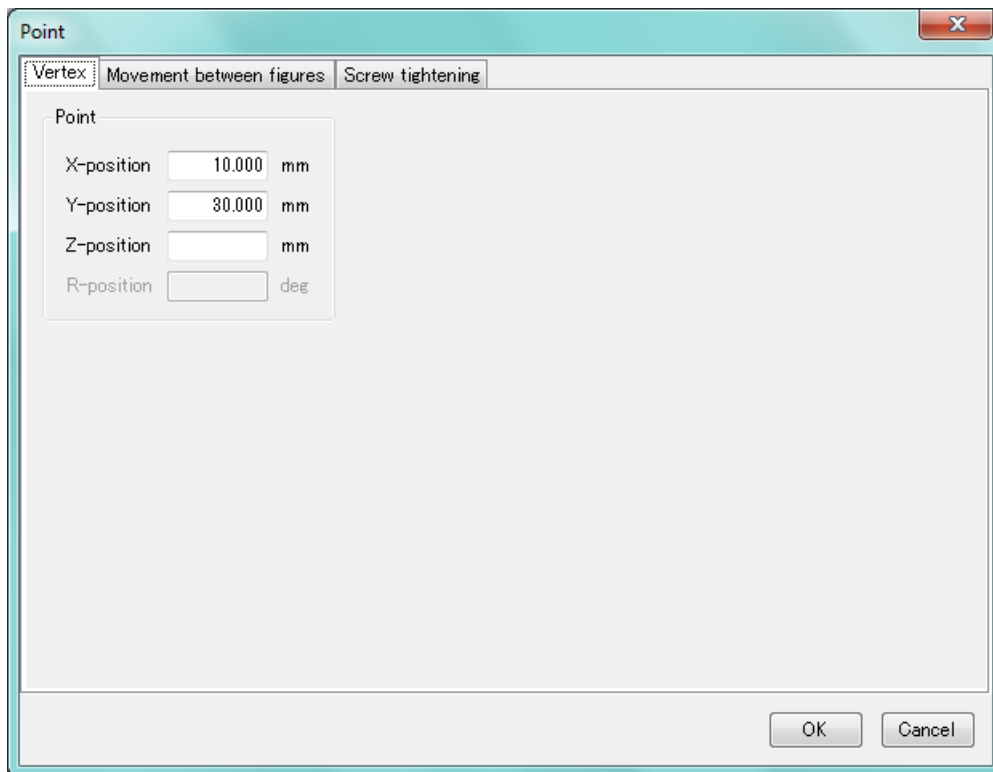
| Item                  | Contents  |
|-----------------------|---|
| Invert Basis Position | <ul style="list-style-type: none"> <li>Center Select Shape (Y-Position)  <p>A,B : Original figures<br/>A' : Inverted figure of A<br/>B' : Inverted figure of B</p> </li> <li>Specified (X-Location)  <p>A,B : Original figures<br/>A' : Inverted figure of A<br/>B' : Inverted figure of B</p> <p>Specified coordinate</p> </li> <li>Specified (Y-Location)  <p>A,B : Original figures<br/>A' : Inverted figure of A<br/>B' : Inverted figure of B</p> <p>Specified coordinate</p> </li> </ul> |

## 15.10 Editing Information of a Figure

The information of a created figure can be edited.

The types of information of a figure available to edit are as shown below.

- Vertex Setting
- Movement between Figures Setting
- Screw Tightening Setting



### 15.10.1 How to Display Edit Window

Show “Figure Information Edit Window” in the procedures stated below.

- 1) Select a created figure that you would like to edit.  
(For how to select a figure, refer to [4.3.5 Selecting a Figure].)
- 2) Right-click in the working area or on the drawing data list to open the popup menu, and execute [Modify (M)].

## 15.10.2 Vertex Setting

Establish the settings such as coordinates for a peak point of each figure.

[1] Work home

| Point      |                                     |     |
|------------|-------------------------------------|-----|
| X-position | <input type="text" value="0.000"/>  | mm  |
| Y-position | <input type="text" value="0.000"/>  | mm  |
| Z-position | <input type="text" value="30.000"/> | mm  |
| R-position | <input type="text"/>                | deg |

| Item       | Contents                         |
|------------|----------------------------------|
| X-position | Set the X-coordinate. (Unit: mm) |
| Y-position | Set the Y-coordinate. (Unit: mm) |
| Z-position | Set the Z-coordinate. (Unit: mm) |

[2] Point

| Point      |                                     |     |
|------------|-------------------------------------|-----|
| X-position | <input type="text" value="10.000"/> | mm  |
| Y-position | <input type="text" value="30.000"/> | mm  |
| Z-position | <input type="text"/>                | mm  |
| R-position | <input type="text"/>                | deg |

| Item       | Contents  |
|------------|---|
| X-position | Set the X-coordinate. (Unit: mm)  |
| Y-position | Set the Y-coordinate. (Unit: mm)  |
| Z-position | Set the Z-coordinate. (Unit: mm)<br>If no setting is conducted (blank), the Z-coordinate of the end point for the figure before it should be applied. |



## 15.10.3 Movement between Figures Setting

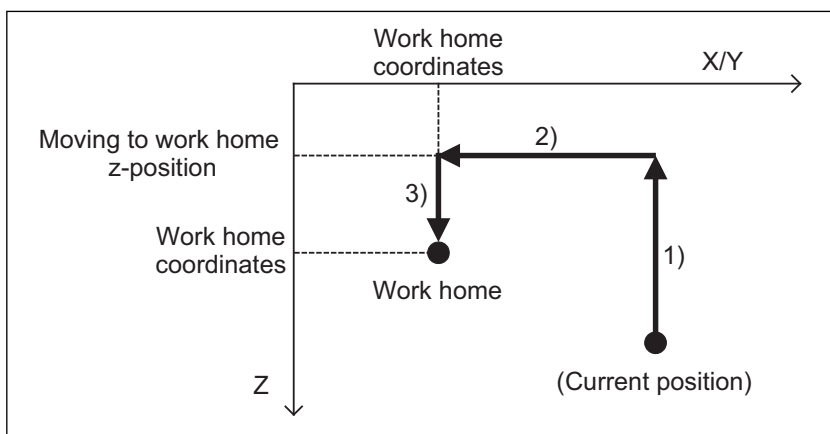
Set the way to move from the end point of the previous figure to the start point of the applicable figure.

### [1] Work home

Set the Z-axis of when moving to the work home point. (Unit: mm)

Z-position when moving to work starting point  mm

The movement to the work home point should be performed in the order from 1) to 3) as shown in the figure below.



### [2] Figures other than work home point

Set the way to move from the end point of the previous figure to the start point of the applicable figure.

☒ Individual setting

☐ InterpolateMove
 ☒ Absolute coordinates(Arch)
 ☐ Relative coordinates(Arch)

Start trigger z-position  mm --- (1)  
 Top z-position  mm --- (2)  
 End trigger z-position  mm --- (3)  
 Velocity  mm/sec  
 Acceleration  G  
 Deceleration  G

#### (1) Individual setting

Select whether to set the way to move to the start point of the applicable figure. If no setting is conducted, the movement setting between figures set in the project property should be applied.

#### (2) Individual setting for movement between figures

The detail of settings should be the same as the movement settings between figures in the project property.

Refer to [10.6 Movement between Figures Setting] for details.

## 15.10.4 Screw Tightening Setting

Settings related to screw tightening actions performed in the applicable figure (except for work home position) should be established.

Screw tightening condition number

1 [Full tightening M3\*10]

<Not tighten>

1 [Full tightening M3\*10]

2 [Discard screw M3\*10]

3

4

5

6

7

8

9

10

11

12

13

14

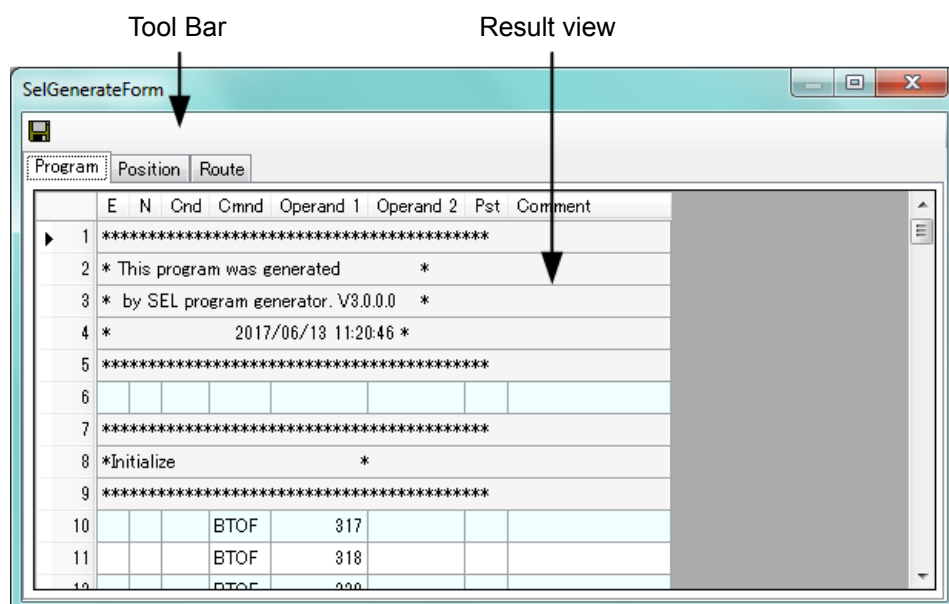
15

16

| Item                              | Contents   |
|-----------------------------------|--|
| Screw tightening condition number | Select a screw tightening condition number to apply. |

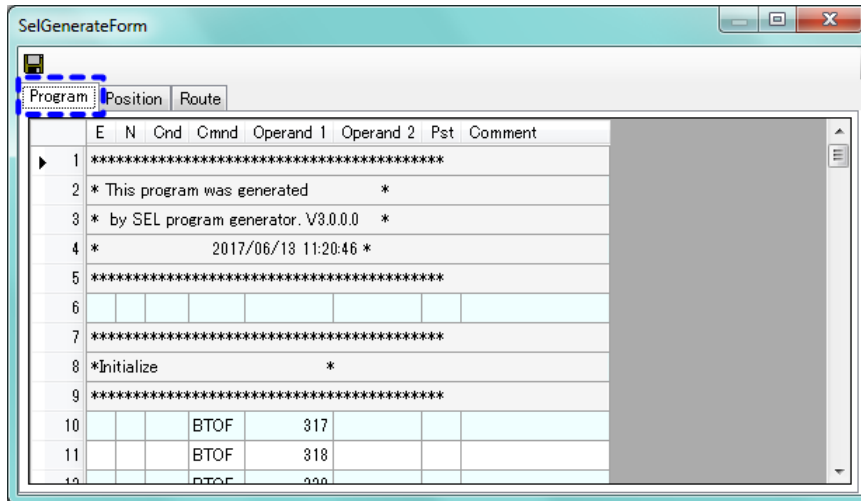
## 16. Generate SEL Program

Execute [Project (P)] - [Generate (G)] in the menu bar to generate a SEL program. Once it is finished to be generated, "Sel Generate Form Window" shows up.



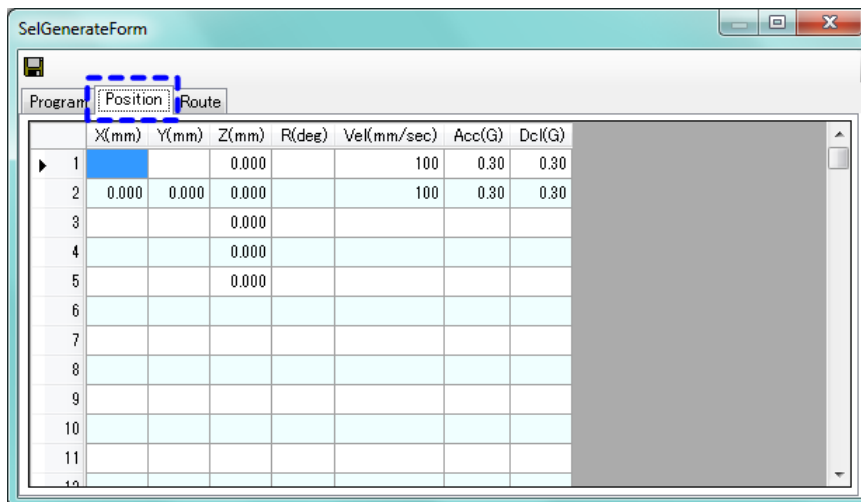
## 16.1 SEL Program Display

Select “Program” Tab in the Generation Result Display Area, and the generated SEL program should be displayed.



## 16.2 Position Data Display

Select “Position” Tab in the Generation Result Display Area, and the generated position data should be displayed.



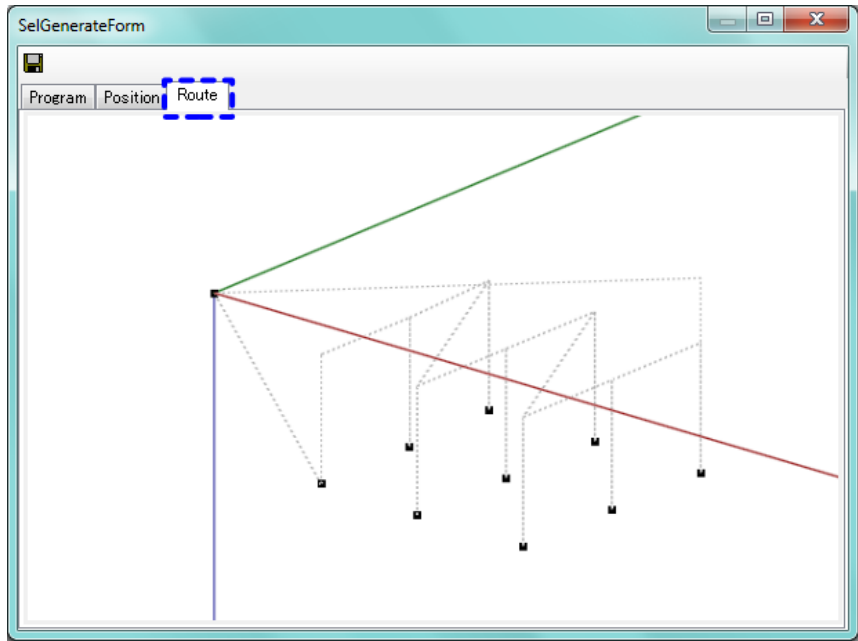
## 16.3 Simple Motion Path Display

Select “Route” Tab in the Generation Result Display Area, and the generated motion path should be displayed in a simple form.



**Caution:**


- The route of evacuation / return operation at home return operation or error detection should not be displayed.
- This display would not guarantee the actual motion path and its accuracy.

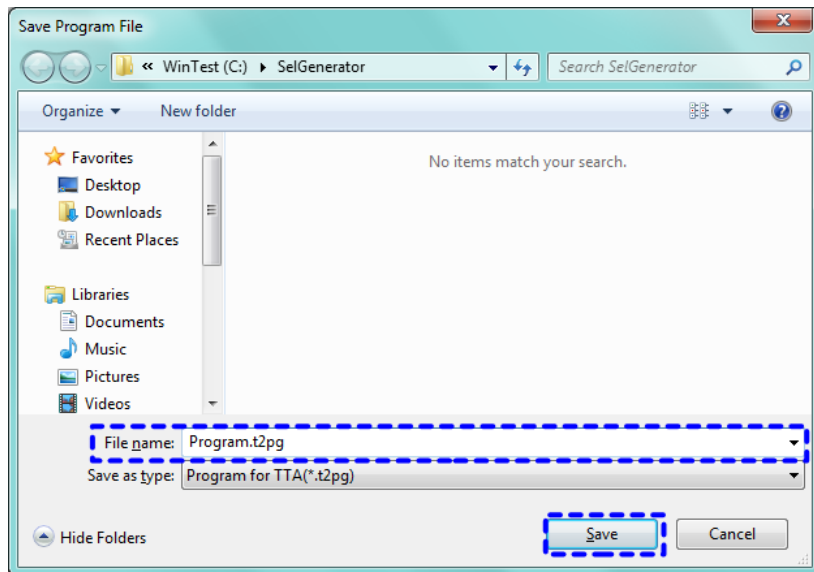


| Button | Operation | Functions   |
|--------|-----------|---|
|        | Drag      | The display rotates in the dragged direction.   |
|        | Rotate    | <ul style="list-style-type: none"> <li>• When [Ctrl] key is held down<br/>Display can be zoomed in and out.</li> </ul>        |
|        |           | <ul style="list-style-type: none"> <li>• When [Shift] key is held down<br/>Display can be scrolled right and left.</li> </ul> |
|        |           | <ul style="list-style-type: none"> <li>• In condition other than above<br/>Display can be scrolled up and down.</li> </ul>    |
|        | Drag      | Display can be scrolled to the direction that you dragged.  |

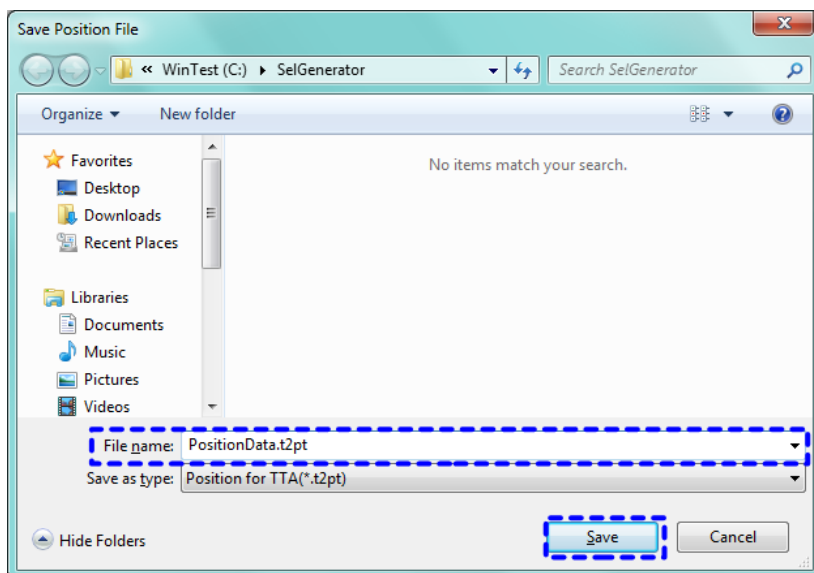
## 16.4 How to Save the SEL Program/Position Data

The generated SEL program and position data should be able to be saved to a file with a format capable to be read in “XSEL PC Software”.

- 1) Click on  (Save As) button in the tool bar.
- 2) Indicate a file name of a SEL program to be saved, and click on Save button.



- 3) Indicate a file name of a position data to be saved, and click on Save button.



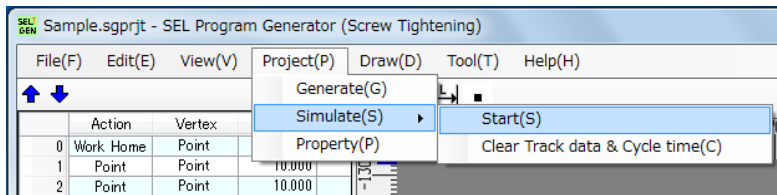
## 16.5 Simulation

The generated program can be simulated so you can get to know the operation track and cycle time as a reference.

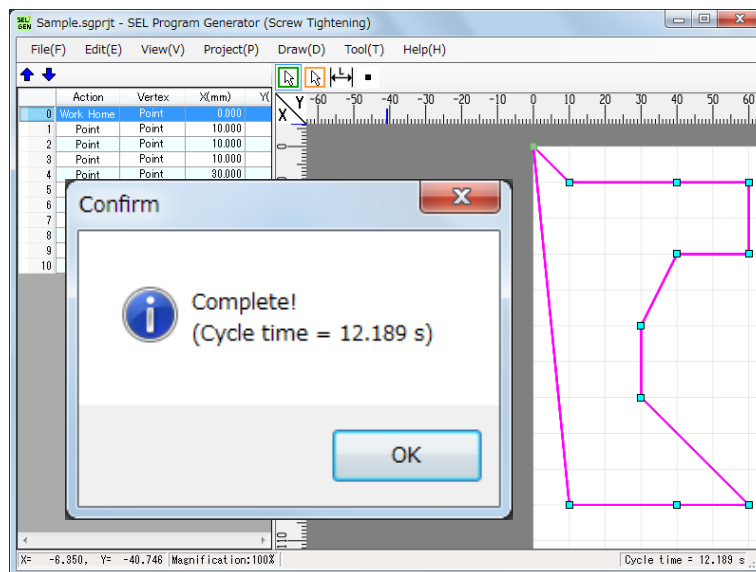


- Note that the operation track is a movement command to a controller, and it does not include the dispersion (caused by load, finishing, etc.) which can be assumed in the actual use of the device.
- The cycle time display may change depending on the performance or load of your computer, and it does not include the dispersion (caused by load, finishing, etc.) which can be assumed in the actual use of the device. Close all the softwares other than this software as much as possible when running a simulation and use it as a reference.
- The cycle time should be calculated assuming that the external input standby operation gets cancelled immediately.
- The cycle time should be calculated assuming that the home-return operation gets completed immediately.
- The track and the cycle time should be calculated under condition that the Z-axis movement (stop at screw seating detection) gets substituted by the operations below in the screw tightening type.
  - 1) When Z-axis movement is set to “positioning”;  
The actuator should decelerate and stop at the point of Z-coordinate 0 relative to the screw tightening position.
  - 2) When Z-axis movement is set to “pressing” and also;
    - (A) When the actuator goes through the point of Z-coordinate 0 relative to the screw tightening position during the movement from the screw tightening start position to the screw tightening end position;  
The actuator should decelerate and stop at the point of Z-coordinate 0 relative to the screw tightening position.
    - (B) When the actuator does not go through the point of Z-coordinate 0 relative to the screw tightening position during the movement from the screw tightening start position to the screw tightening end position;  
The actuator should decelerate and stop at the screw tightening end position.

- 1) Execute [Project (P)] - [Simulate (S)] - [Start (S)] from the menu bar.



- 2) Operation track and cycle time should be displayed after the simulation is complete.





## [Cycle time]

It is the sum total of the operation time in one cycle of “work home position → drawn figure → work home position” and time required for related processes. It shows the process time required to perform “Cycle top (DWLT Command in figure)” → “Cycle end (EDDO Command in figure)” in the generated program.

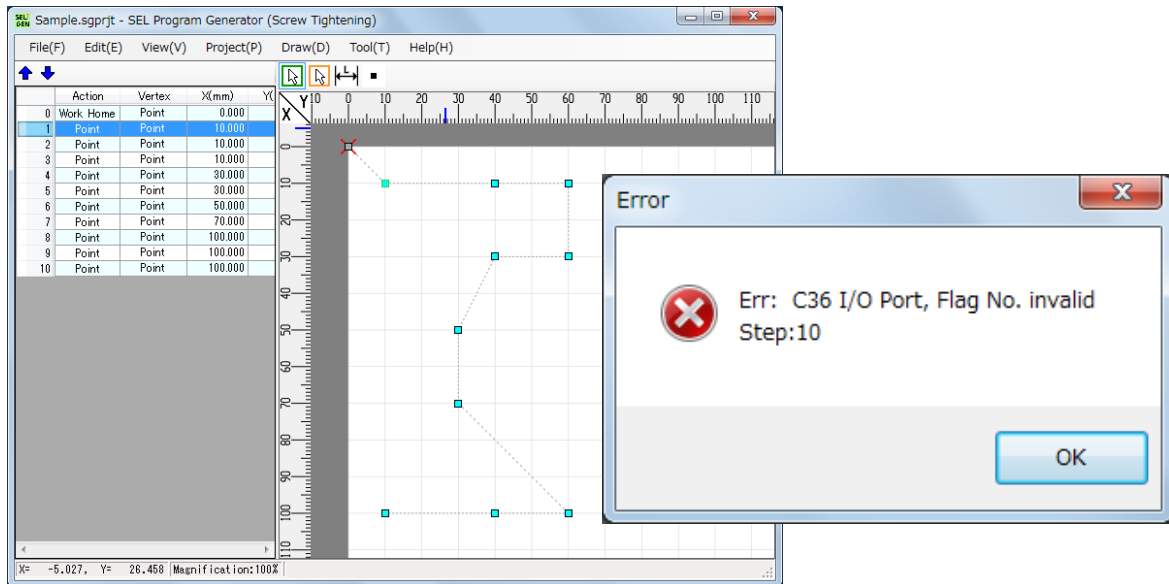
\* The program shown in the figure on the right is an example.

A set of process subject to cycle time calculation

|    | E | N | Cnd | Cmd  | Operand 1 | Operand 2 | Pst | Comment                                |
|----|---|---|-----|------|-----------|-----------|-----|--|
| 1  |   |   |     |      |           |           |     | *****                                  |
| 2  |   |   |     |      |           |           |     | * This program was generated *         |
| 3  |   |   |     |      |           |           |     | * by SEL program generator. V9.0.0.1 * |
| 4  |   |   |     |      |           |           |     | * 2017/05/17 20:31:55 *                |
| 5  |   |   |     |      |           |           |     | *****                                  |
| 6  |   |   |     |      |           |           |     |  |
| 7  |   |   |     |      |           |           |     | *****                                  |
| 8  |   |   |     |      |           |           |     | *Initialize *                          |
| 9  |   |   |     |      |           |           |     | *****                                  |
| 10 |   |   |     | BTOF | 300       |           |     |  |
| 11 |   |   |     | ACHZ | 3         |           |     | Z-axis for arch                        |
| 12 |   |   |     |      |           |           |     | *****                                  |
| 13 |   |   |     |      |           |           |     | *Home return *                         |
| 14 |   |   |     |      |           |           |     | *****                                  |
| 15 |   |   |     | HOME | 100       |           |     |  |
| 16 |   |   |     | HOME | 11        |           |     |  |
| 17 |   |   |     |      |           |           |     | *****                                  |
| 18 |   |   |     |      |           |           |     | *[0000] *                              |
| 19 |   |   |     |      |           |           |     | *****                                  |
| 20 |   |   |     | EXSR | 99        |           |     | Execute subroutine                     |
| 21 |   |   |     |      |           |           |     | *****                                  |
| 22 |   |   |     |      |           |           |     | *Cycle top *                           |
| 23 |   |   |     |      |           |           |     | *****                                  |
| 24 |   |   |     | DWLT | 1099      | 100       |     |  |
| 25 |   |   |     |      |           |           |     | *****                                  |
| 26 |   |   |     |      |           |           |     | *[0001]-[0003] *                       |
| 27 |   |   |     |      |           |           |     | *****                                  |
| 28 |   |   |     | MOVL | 6         |           |     |  |
| 29 |   |   |     | BTOM | 300       |           |     |  |
| 30 |   |   |     | PATH | 7         | 9         |     | [0001]-[0003]                          |
| 31 |   |   |     | BTOF | 300       |           |     |  |
| 32 |   |   |     |      |           |           |     | *****                                  |
| 33 |   |   |     |      |           |           |     | *[0000] *                              |
| 34 |   |   |     |      |           |           |     | *****                                  |
| 35 |   |   |     | EXSR | 99        |           |     | Execute subroutine                     |
| 36 |   |   |     |      |           |           |     | *****                                  |
| 37 |   |   |     |      |           |           |     | *Cycle end *                           |
| 38 |   |   |     |      |           |           |     | *****                                  |
| 39 |   |   |     | ADD  | 1099      | 1         |     | Counter increment                      |
| 40 |   |   |     | EDDO |           |           |     | Jump to cycle top                      |
| 41 |   |   |     |      |           |           |     | *****                                  |
| 42 |   |   |     |      |           |           |     | *Program end *                         |
| 43 |   |   |     |      |           |           |     | *****                                  |
| 44 |   |   |     | EXIT |           |           |     | Program end                            |
| 45 |   |   |     |      |           |           |     |  |

[Error view]

If an error gets detected in the simulation, content as shown below should be displayed in the error window, and a cross (x) mark should be shown on the figure or track that the error was detected. Correct the figure or track referring to the information.



[Contents Displayed in Error Window (display to be shown only for contents with information)]

- Err : Error Number and Error Name
  - Step : Error Detection Program Step \*
  - Axis : Error Detected Axis Number
  - Pos : Error Detected Position Number \*
- \* Applicable for SEL Program Generation Window Display displayed by selecting [Project (P)] - [SEL Program Generation (G)]

## 17. Operation Check of Generated SEL Program

The generated SEL program should be written in the robot controller and checked the operation in the actual device.

### 17.1 Write Data to a Robot Controller

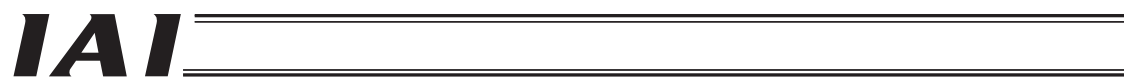
Write the SEL program and position data saved in a file in the robot controller with using "XSEL PC Software".

For the procedures how to write in, refer to the instruction manual for "XSEL PC Software".

### 17.2 Test

Execute the written SEL program to check the operation.

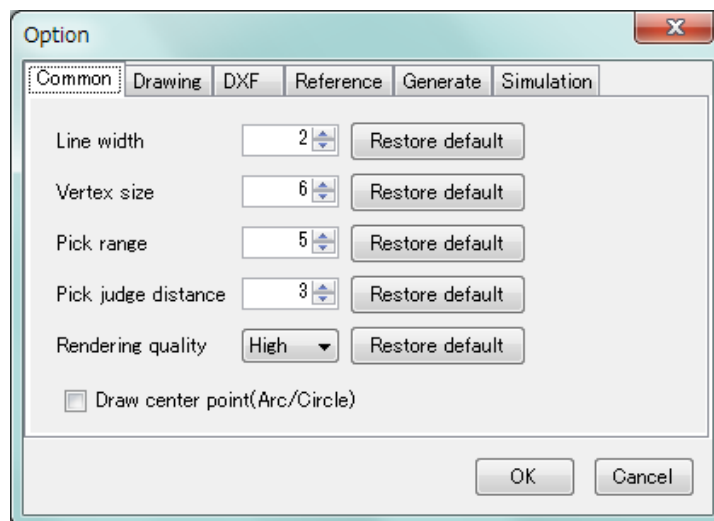
For how to execute a program, refer to the instruction manual for "XSEL PC Software".



## 18. Tool Option Setting

Setting should be established for each option in this software.

- Common Setting
- Drawing Setting
- DXF Setting
- Reference Setting
- Generate Setting
- Simulation



### 18.1 How to Display Setting Window




Execute [Tool (T)] - [Option (O)] from the menu bar.

## 18.2 Common Setting

|  |                                     |  |
|--|-------------------------------------|--|
| Line width   | <input type="text" value="2"/>      | <input type="button" value="Restore default"/> |
| Vertex size  | <input type="text" value="6"/>      | <input type="button" value="Restore default"/> |
| Pick range   | <input type="text" value="5"/>      | <input type="button" value="Restore default"/> |
| Pick judge distance                                    | <input type="text" value="3"/>      | <input type="button" value="Restore default"/> |
| Rendering quality                                      | <input type="button" value="High"/> | <input type="button" value="Restore default"/> |
| <input type="checkbox"/> Draw center point(Arc/Circle) |                                     |  |




| Item                             | Contents  |
|----------------------------------|---|
| Line width                       | Set the line width of a line figure.<br>Unit: Pixel<br>Settable Range: 1 to 10 (Default: 2)   |
| Vertex size                      | Set the size of a peak point.<br>Unit: Pixel<br>Settable Range: 0 to 10 (Default: 6)  |
| Pick range                       | Set the picking range of the mouse cursor when clicking a figure with a mouse.<br>Unit: Pixel<br>Settable Range: 1 to 10 (Default: 5)   |
| Pick judge distance              | A figure starts moving after the figure gets picked (selected) and dragged for the distance set in this setting or more.<br>Unit: Pixel<br>Settable Range: 0 to 10 (Default: 3) |
| Rendering quality                | Set the drawing quality of a figure.<br>Set it to "Low" and the load of drawing process should be reduced.<br>Settable Range: Low or High (Default: High)                       |
| Draw center point (Arc / Circle) | Set if a center of a circle / arc should be shown.  |

## 18.3 Drawing Setting

|                             |   |                 |
|-----------------------------|---|-----------------|
| Normal line color           |  | Restore default |
| Screw tightening line color |  | Restore default |
| Selected line color         |  | Restore default |
| Decimal places              | <input type="text" value="0"/>  | Restore default |
| Snap range                  | <input type="text" value="10"/>   | Restore default |

| Item                        | Contents   |
|-----------------------------|--|
| Normal line color           | Set the color to display normal figures (figures not selected and no screw tightening conducted).  |
| Screw tightening line color | Set the color to display figures with screw tightening conducted.  |
| Selected line color         | Set the color to display selected figures.   |
| Decimal places              | Set the number of digits under decimal point for the coordinate values at the position where the mouse cursor points at.<br>Unit: Digit<br>Settable Range: 0 to 3 (Default: 3) |
| Snap range                  | Set the snap range of a peak point.<br>Set it to "0" and the snap function will be inactivated.<br>Unit: Pixel<br>Settable Range: 0 to 100 (Default: 10)                       |

## 18.4 DXF Setting

|  |  |                 |
|--|--|-----------------|
| Normal line color                                |                                   | Restore default |
| Selected line color                              |                                   | Restore default |
| Spline 1st division distance                     | <input type="text" value="1.0"/>  | Restore default |
| <input type="checkbox"/> Import Z-coordinate     |  |                 |
| <input type="checkbox"/> Remove imported figures |  |                 |

| Item                         | Contents   |
|------------------------------|--|
| Normal line color            | Set the color to display figures not selected.   |
| Selected line color          | Set the color to display selected figures.   |
| Spline 1st division distance | Set the distance to divide a spline figure into straight lines.<br>Settable Range: 0.1 to 100.0 (Default: 1.0) |
| Import Z-coordinate          | Set if the Z-axis should be read in when a dxf drawing is read in.   |
| Remove imported figures      | Set if the read dxf drawing should be deleted.   |



## 18.5 Reference Setting

Line color 

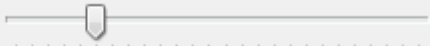
| Item       | Contents                                    |
|------------|---|
| Line color | Set the color to display reference figures. |

## 18.6 Generate Setting

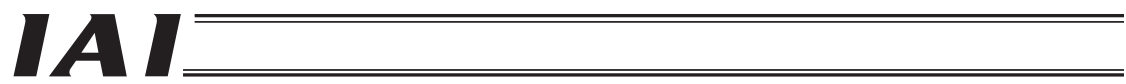
☐ Suppress coordinate so that it falls within software limit  
☐ Simple arch motion conversion when arch motion is not established

| Item  | Contents  |
|---|---|
| Suppress coordinate so that it falls within software limit        | Set if adjustment should be conducted to get in the soft limit range when a figure falls out of the soft limit range. A warning message will appear if no adjustment is conducted.                          |
| Simple arch motion conversion when arch motion is not established | Set whether to switch to the simple arch motion (go up in Z-axis -> move horizontally -> go down in Z-axis) when "Relative Coordinate Indicated Arch Motion" should not satisfy the arch motion conditions. |

## 18.7 Simulation

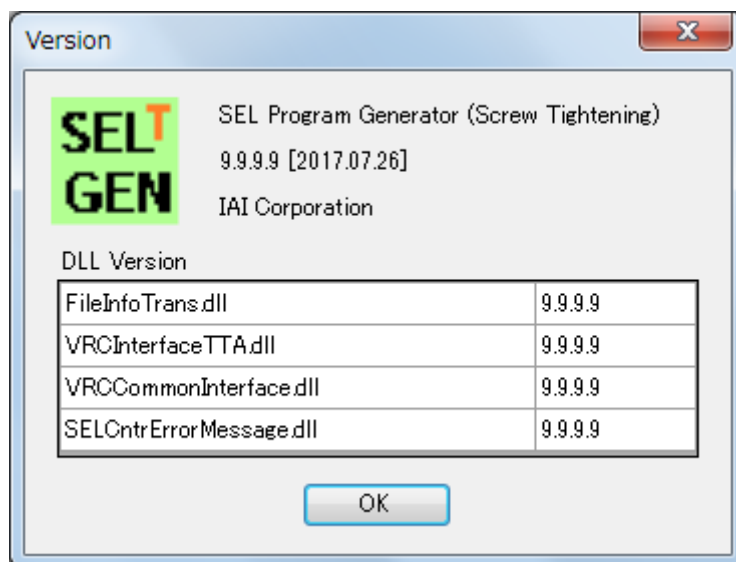
Adjust cycle time   
fast 0 slow

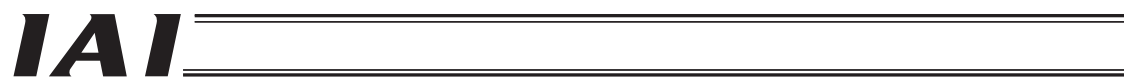
| Item              | Contents  |
|-------------------|---|
| Adjust cycle time | It is for adjustment at the manufacturer. Keep it set at 0. |



## 19. Version Information

Execute [Help (H)] - [About (A)] from the menu bar, display the “Version Information Window”.





## Change History

| Revision Date | Revision Description   |
|---------------|--|
| 2017.07       | First Edition  |
| 2017.09       | Second Edition <ul style="list-style-type: none"><li>• “MSEL” added in applicable controllers</li><li>• Simulation feature added</li></ul> |
| 2019.06       | Third Edition<br>Descriptions revised in general   |







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