JANOME DESKTOP ROBOT

JR3000 Series

Operation Manual

Screw Tightening Specifications

Thank you for purchasing this Janome Robot.

- **Before using your robot, read this manual thoroughly and always make sure you use the robot correctly. In particular, be sure to thoroughly read “For Your Safety” as it contains important safety information.**

- **After reading this manual, store in a safe place that can be easily accessed at any time by the operator.**

Original Instructions

JANOME

PREFACE

The Janome Desktop Robot JR3000 Series are new, low-cost, high-performance robots. With these robots we succeeded in reducing the price while maintaining functionality. The combined use of stepping motors and specialized micro step driving circuits saves both energy and installation space. There are several manuals pertaining to these robots.

This manual describes screw tightening specifications of the JR3200, JR3300, JR3400, JR3500 and the JR3600 Series. Other than this *Screw Tightening Specifications* operation manual, there are also operation manuals with common sections relevant to all robots in this series. Refer also to these manuals when operating this robot.

JR3000 Series

For Your Safety	This is important safety information. Make sure you read this before using the robot.
Setup	Explains how to set up the robot. ■ Make sure you read this manual when installing the robot ■ NOTE: This manual is designed for people who have received safety and installation training regarding the robot.
Maintenance	Explains maintenance procedures for the robot. ■ Make sure you read this manual when performing maintenance ■ NOTE: This manual is designed for people who have received safety and maintenance training regarding the robot.
Basic Instructions	Provides part names, data configurations, and the basic knowledge necessary to operate the robot.
Quick Start	Explains the actual operation of the robot by creating and running simple programs.
Teaching Pendant Operation	Explains how to operate the robot via the teaching pendant.
Functions I	Explains point teaching.
Functions II	Explains commands, variables, and functions.
Functions III	Explains functions such as All Program Common Settings and PLC programs.
Functions IV	Explains Customizing Functions.
External Control I (I/O / Fieldbus)	Explains I/O and Fieldbus. Refer to this manual if you are using Fieldbus.
Communication Control (COM/LAN)	Explains COM 1 – 3 and LAN communication control.
Camera & Sensor Functions	Explains the functions of the attachable camera and Z position sensor.
Specifications	Outlines general specifications such as the robot's operating range, mass, etc.
Auxiliary Axis Functions	Explains the auxiliary axis functions.
PC Operation	Explains how to use the PC software JR C-Points II.
Screw Tightening Specifications	Explains the specialized screw tightening specification functions.

Note: The content of this manual may differ from the robot in your possession due to updates to the product specifications.

For information regarding optional additions for this robot, refer to the “24. Specifications” in the *Specifications* operation manual. Except for diagrams, details about optional additions are omitted from this manual.

Attention

To make full use of the machine’s functions and capabilities, make sure that you use the robot according to the correct handling/operation procedures that are written in the manuals pertaining to this robot.

Attention

If you turn OFF the power after making changes to robot’s settings or data without saving, these changes are lost and the robot will revert to its original settings. Make sure that you save any changes to data and/or settings.

Attention

Before using this robot for the first time, make sure you back up robot data and save the individual configuration information. Individual configuration information is needed when replacing internal circuit boards.

Warning

Always **make sure the machine is grounded through the power cord. Do not use the machine when it is not grounded.**
Improper grounding causes electric shocks, fires, malfunction, and unit breakdown.

Warning

Make sure that the machine power supply is OFF before connecting the power cord.
Failure to do so could cause electric shock and/or injury.

Warning

Do not handle or operate the robot in ways not covered in the manuals pertaining to this robot. Contact Janome (listed on the back page of this manual) for repairs.
Failure to do so can cause electric shock and/or injury.

Note: The operation methods described in this manual are indicated as follows:

TP Operation via the teaching pendant

PC Operation via PC (JR C-Points II)

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FOR YOUR SAFETY

The safety notes outlined below are provided in order to ensure safe and correct usage of the product in addition to preventing injury to the operator, other people and damage to property as well.

····· Be sure to follow the safety guidelines detailed here ·····

Symbols are also listed alongside the safety note explanations. Refer to the list below for an explanation of these symbols.

■ Symbols that indicate the level of danger and/or damage.

The level of danger or damage that could occur as a result of ignoring these safety guidelines and misusing the robot are classified by the following symbols.

Danger	This symbol indicates an imminent risk of serious injury or death.
Warning	This symbol indicates a risk of serious injury or death.
Caution	This symbol indicates the possibility of serious injury or damage to property.

■ The following symbols list the nature of the danger and any necessary safety methods to be taken.

	Indicates caution must be taken
	Take Caution (General Precaution)
	Indicates a forbidden action
	Never do this (General Prohibition)
	Do not disassemble, modify or repair.
	Do not touch (Contact Prohibition)
	Indicates a required action
	Be sure to follow instructions (General Requirement)
	Be sure to unplug the power cord
	Make sure the machine is grounded

FOR YOUR SAFETY

If using auxiliary axis functions to operate a motor, such as a servo motor, that produces feedback and/or a motor with high output etc., or when using auxiliary axes in the robot setup etc., we ask that you perform a risk assessment on your side and take any necessary safety measures.

If Using Auxiliary Axis Functions in a Way that Require Safety Measures

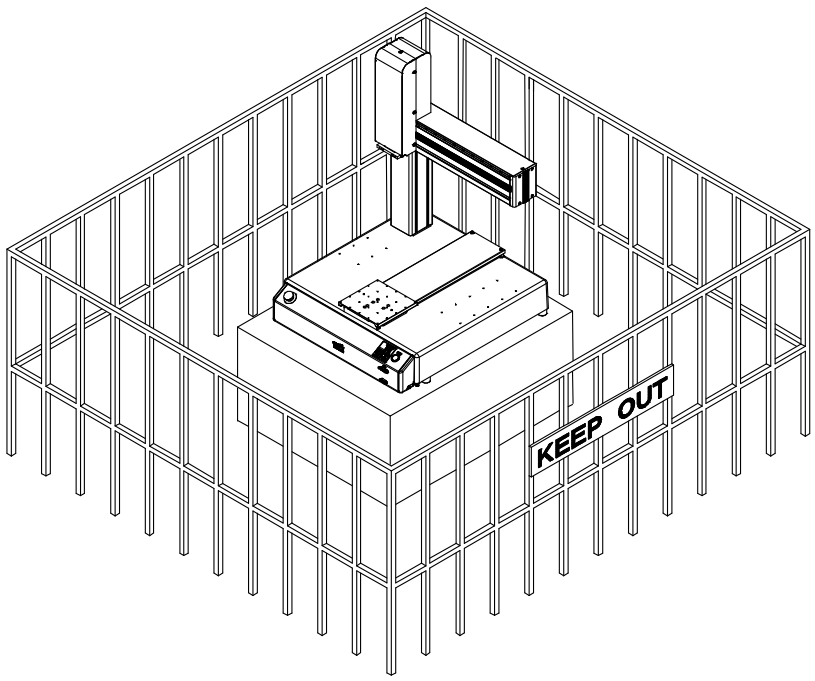
Danger

Always set up safety guards around the robot or the auxiliary axes so the moveable parts cannot be touched.

Anyone within the maximum reach of the robot and the auxiliary axes it is controlling may be injured. Using the I/O-S connector accessory, set up an **emergency stop interlock system that cuts off the motor power to the auxiliary axes and is triggered when the entrance to the safety guard is opened**. Make sure there is no other way of entering the restricted area.

Furthermore, put up a "**No Entry**" or "**Do Not Operate**" warning sign in a clearly visible place.

Example:



FOR YOUR SAFETY

If Using Auxiliary Axis Functions in a Way that Require Safety Measures

Danger

When power to the robot is ON, never enter the safety guard or put your face, hands, or any part of your body inside.
Entering the safety guard could result in injury.

When entering the safety guard due to something wrong with the robot or a peripheral device, or to inspect or lubricate the machine etc., **with both the power supply breaker and the robot switched OFF, make sure to lockout and tagout and confirm there is no electricity flowing to the robot.**
Failure to do so can cause electric shock or injury.

Warning

When creating a robot system using auxiliary axis functions, if the system can be categorized as an industrial robot, make sure to use the robot in accordance with the laws and guidelines of the country where it is used.

Before performing a run or operation, always check the following:

- **Obstacles**: Make sure there are no obstacles or people within the safety guard.
- **Installation**: Make sure the robot is installed properly, that there are no abnormalities with the robot and the surrounding devices, and that the teaching pendant and tools are in the appropriate places.
- **Emergency Stop Switch**: Make sure the I/O-S circuit (interlock) and emergency stop switch(s) are functioning properly.

It is potentially dangerous to operate the robot without making these checks first.

FOR YOUR SAFETY

If Using Auxiliary Axis Functions in a Way that Require Safety Measures

Warning	
	**Construct safety guards that are strong enough to protect the operator against such dangers as the tool or workpiece splintering, etc.** When working within the safety guard, use protective gear such as a helmet, protective gloves, protective goggles, and safety shoes. Failure to follow these safety measures can result in injury.
	If objects that the robot grasps have a risk of falling or being projected, **take into account the size, weight, and chemical composition of the objects for the required safety precautions**. Failure to do so can result in injury or unit breakdown.
	**When working within the safety guard, make sure not to come within the maximum range of the robot.** Failure to do so can cause injury.
	When starting a run, first confirm there are **no people inside of the safety guard and there are no obstacles that could interfere with the run.** Failure to do so can cause injury or unit breakdown.

FOR YOUR SAFETY

Danger

Do not use where flammable or corrosive gas is present.
Leaked gas accumulating around the unit causes explosions and fire.

Warning

Make sure that you securely install the unit in a place that can fully withstand both the unit's weight and its usage. Install the robot and switchbox on a workbench 60cm or higher above floor level, and install the robot in the center of the workbench.
In addition, **for units with a cooling fan on the back, allow for 30cm or more clearance between the back of the unit and the wall.**
If installation is inadequate, the unit can drop or fall over causing injury and unit breakdown. Also, inadequate installation causes overheating and fire.

Make sure to power the unit within its rated current range.
Failure to do so causes electric shocks, fires, and unit breakdown.

Plug the power cord into the power outlet firmly.
Failure to do so causes the plug to heat up resulting in fire.

Be sure to use the unit within its indicated voltage range.
Failure to do so causes fires and unit malfunction.

When replacing fuses, or inspecting or lubricating the unit, unplug the power cord from the power outlet, then remove the cord from the main unit and make sure there is no electrical current. Also, **do not touch any of the power inlet pins within 5 seconds of removing the power cord.** Failure to follow these steps causes electric shocks and injury.

FOR YOUR SAFETY

Warning	
	Always **make sure the machine is grounded through the power cord.** **Do not use the machine when it is not grounded.** Improper grounding causes electric shocks, fires, malfunction, and unit breakdown.
	**Wipe the power plug with a clean, dry cloth periodically to eliminate dust.** Dust accumulation deteriorates the electrical insulation and causes fires.
	**Be sure to unplug the power cord from the power outlet when the unit is not in use for long periods of time.** Dust accumulation causes fires.
	**Be sure to turn OFF the unit before inserting or removing cords and cables such as the teaching pendant cable or LAN cable.** Failure to do so causes electric shock, data loss, unit breakdown, and malfunction.
	**Do not attempt to disassemble or modify the unit.** Disassembly or modification causes electric shocks and unit breakdown.
	**Do not allow water or oil to come in contact with the unit, control box or the power cord.** Contact with water or oil causes electric shock, fire, and unit breakdown. IP Protection Rating: IP20.
	**If anything unusual occurs, such as a burning smell or unusual sound, stop operation and unplug the power cord immediately. Contact the dealer from whom you purchased the robot or the office listed on the last page of this manual.** Continuing to use the robot without addressing the problem causes electric shock, fire, or unit breakdown.

FOR YOUR SAFETY

Caution
Do not drop or jar the unit during transport and/or installation. This causes injuries or damages the unit.
Before performing any operation, ensure there is no imminent danger to any of the operators. Failure to do so causes injury.
Use the unit in an environment between 0 and 40°C, with a humidity level of 20 – 90%, and without condensation. Use outside of these conditions can cause unit breakdown.
Use the unit in an environment where no electrical noise is present. Failure to do so causes unit malfunction or breakdown.
For models with I/O-S circuits, when installing the unit, take safety measures such as setting up area sensors and safety guards. If there are no safety measures in place and someone enters the area of operation when the robot is running, they may be injured.
Keep the emergency stop switch within reach of the operator when running or operating the robot. If the robot is operated when the emergency switch is not within reach, it may not be possible to stop the robot immediately and safely. This is potentially dangerous.
Make sure that you regularly perform a function check of the emergency stop switch(s). Also, for models with I/O-S circuits, regularly perform an I/O-S circuit function check. If the robot is operated without making these checks, it may not be possible to stop the robot immediately and safely in an emergency. This is potentially dangerous.

FOR YOUR SAFETY

Caution	
	**When attaching tools etc., make sure they are securely fitted before running the robot.** Failure to do so causes injury or breakdown.
	**When using the machine for extended periods of time, check and make sure none of the main unit's mounting screws are loose, and perform a routine inspection every 3 months.** Failure to do so causes injury or breakdown.
	**Be sure to check the connections of the cords and cables to the main unit.** Improper wiring causes unit malfunction or breakdown.
	**Secure the movable parts of the unit before transportation.** Failure to do so causes injury or breakdown.
	**When lifting and transporting the robot, do so with 2 or more people.** Failure to do so causes injury or breakdown.
	**Use the unit in an environment that is not exposed to direct sunlight.** Direct sunlight causes unit malfunction or breakdown.
	Individual Configuration Information varies for each individual unit even if they are the same model. **Do not use backup data with a different robot. The robot cannot function normally with backup data from a different robot.**

1. OVERVIEW

A screw tightening operation is performed with the following process:

■ Preparation

1. Install the robot; refer to the operation manual *Setup*.
2. Attach the screwdriver unit to the robot.
3. Attach the electric screwdriver.
4. Connect the electric screwdriver controller to the robot.
   Install a screw feeder. (You can install 1 screw feeder for a JR3200 model, and up to 2 screw feeders for the JR3300 – JR3600 models)
5. If you want to stop the screwdriver spinning when the emergency stop switch is pressed, use one of the following methods:

   1) When you want to stop the screwdriver by cutting off the power supply.
   - Outlet Equipped Models:
     Connect the screwdriver unit's power cord to the outlet on the robot*1
   - No Outlet Models:
     Use the I/O-SYS "#sysOut7 Emergency Stop" signal to construct a system that cuts off power to the screwdriver unit when an emergency stop occurs*2

   2) When cutting off the power supply causes an error to occur (e.g. using a screwdriver type for which it is not possible to cut off the power). Do not connect the screwdriver unit to the robot outlet, but instead use the I/O-SYS "#sysOut7 Emergency Stop" signal to construct a system that inputs a reset signal to the screwdriver unit when an emergency stop occurs*2

   *1 Refer to the operation manual *External Control* for details regarding the internal circuit and outlet function.
   *2 Refer to the I/O-SYS circuitry diagrams in the operation manual *External Control*.

6. Check the electric screwdriver's rotation speed and mass.
   Example: 1000 r.p.m (if performing high precision screw tightening, measure the accurate values), 1kg, etc.
7. Check the screws you will use. (required information: screw pitch, screw length)
   Example: M3x6 → pitch 0.5mm, length 6mm, etc.
8. Install a workpiece fixture. Prepare this on your side.

■ Teaching

1. Set the “Screw Tightening Condition” ([Screw Tightening Condition] or [Tightening (Condition)]).
   The details from 5 and 6 above are required.
   Screw tightening types: [Full Tightening (With Pickup)], [Tighten, then Reverse], [Loose Tightening]
2. Enter the feeder point position.
3. Enter the screw tightening point.
4. When required, set an operation, etc., to perform when an error occurs.

■ Run

1. Make a data check and test run: refer to the operation manual *Teaching Pendant Operation*.
2. Change to Switch Run Mode or External Run Mode and make the run.

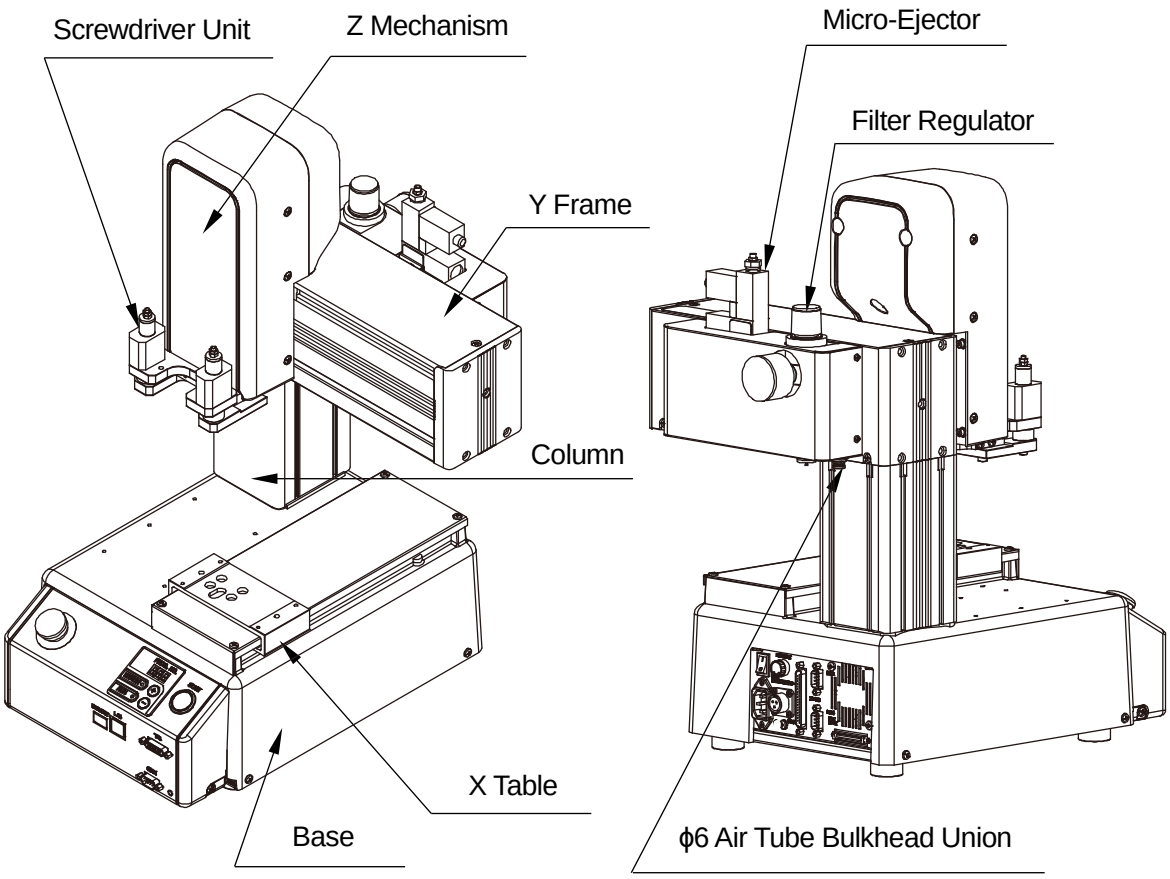
2. INSTALLATION

For information regarding dimensions and transport and installation precautions, refer to the operation manual *Installation*.

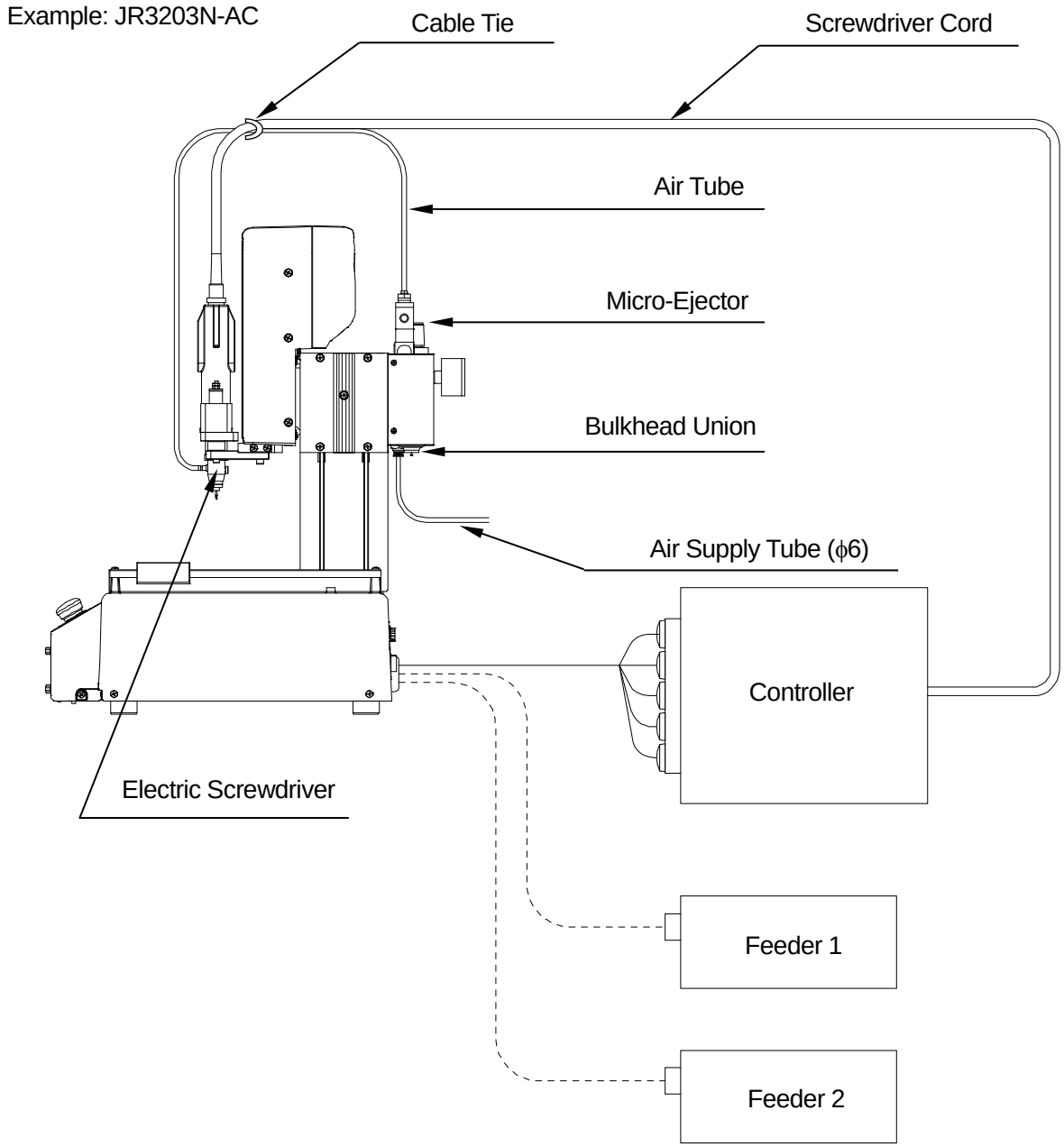
2.1 Robot

When installing, rotate the rubber feet to adjust the height and make sure the robot is stable on the installation surface.

Example: JR3203N-AC



2.2 Connections



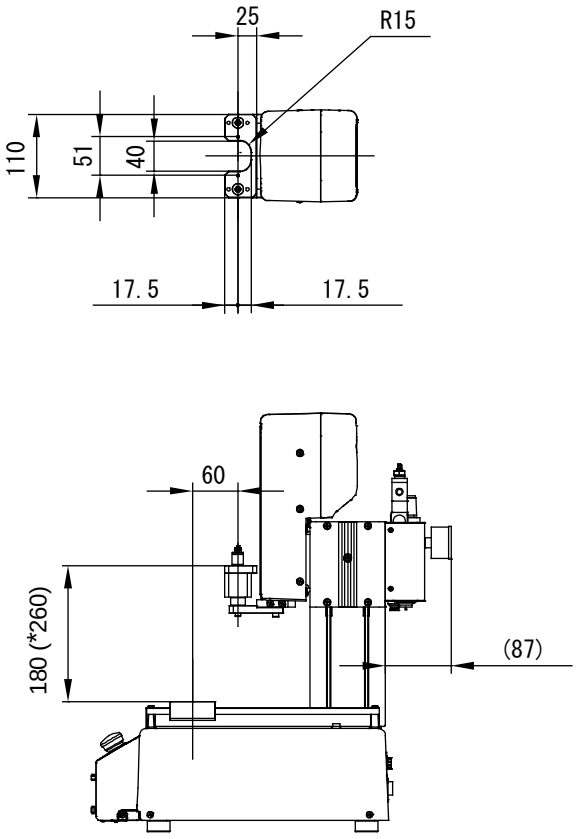
1. Connect the electric screwdriver cord to the electric screwdriver and the controller
2. Secure the electric screwdriver cord and the air tube together with a cable tie, etc., as illustrated above, so as not to obstruct the robot's movements. For further details, refer to"2.5.6 Attaching Devices" in the operation manual *Setup*.
3. Connect the air tube (ϕ6: Not included in the package) to the bulkhead union.

Attention

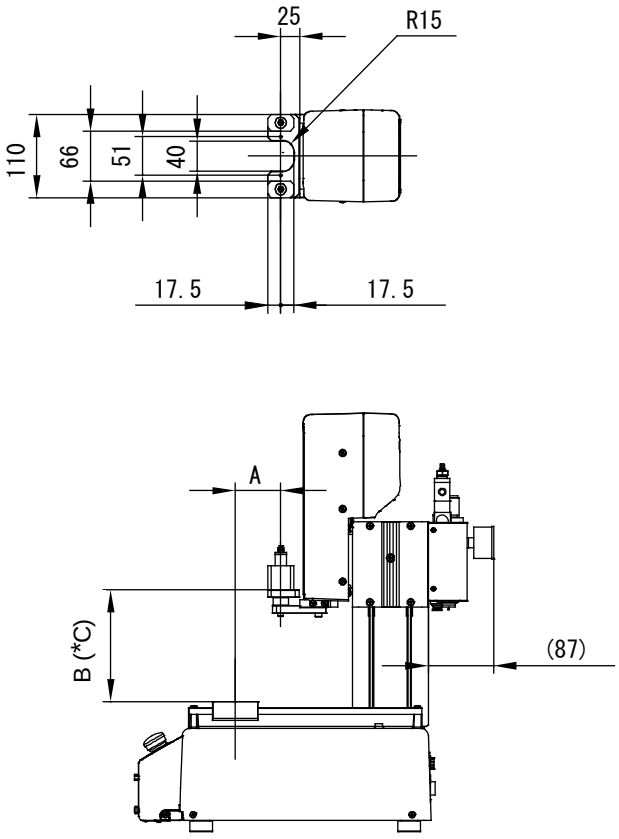
When securing the air tube, be careful not to pinch or bend the air tube by binding it too tightly.
A pinched or bent tube cannot pick up screws which can lead to malfunction.

2.3 Driver Mounting Unit

Standard Screwdriver (JR3203 Dedicated)



Mini Screwdriver



NOTE

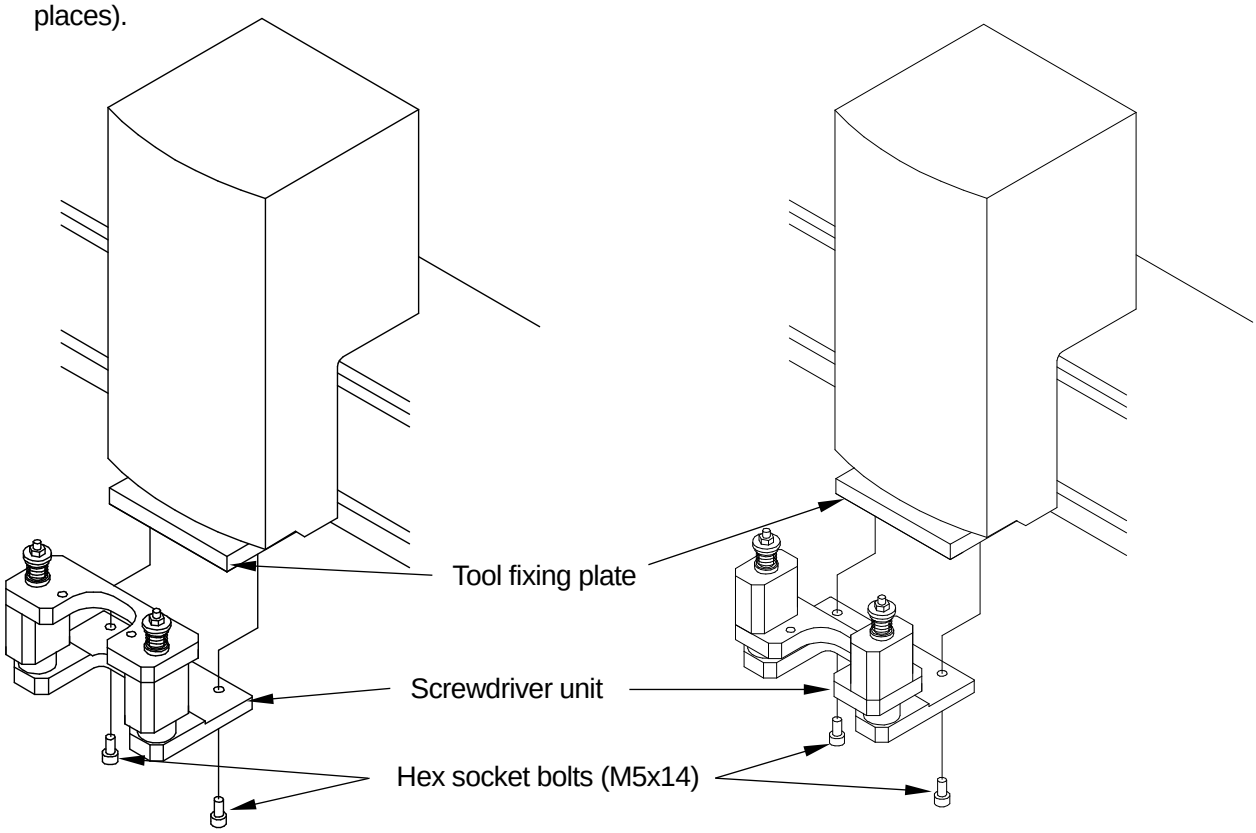
- The diagrams above are examples using the JR3203N-AC.
- For the JR3303 and larger models, the standard screwdriver can also be used with the mini screwdriver mounting unit.

	A	B	C
JR3203	60	148	228
JR3303	191	223	373
JR3403 – JR3603	251	323	373

The height dimensions indicated by *C are optional specifications.

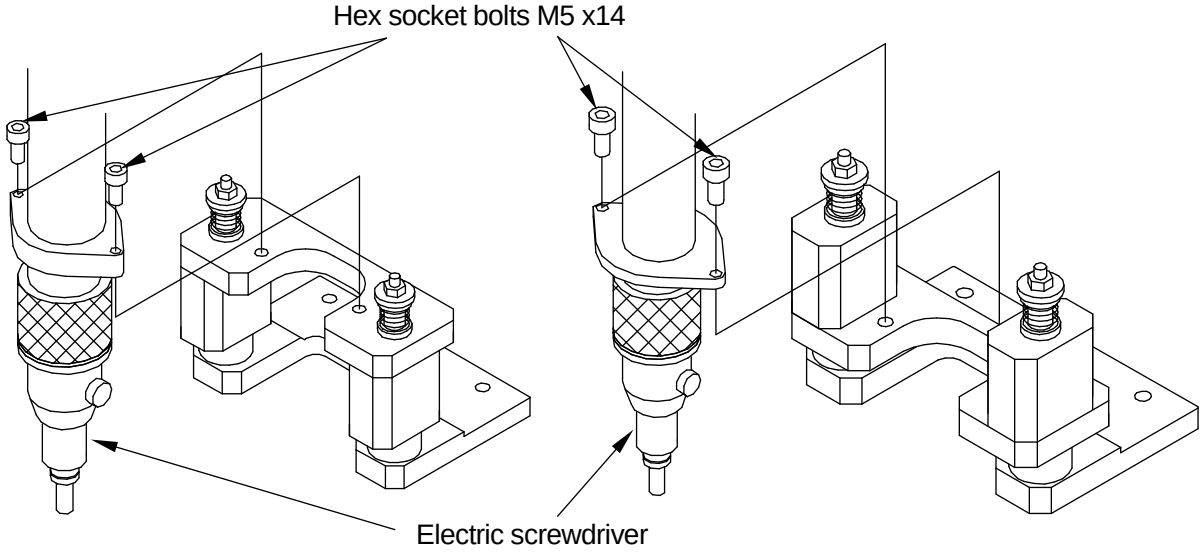
2.4 How to Mount the Screwdriver

1. Secure the screwdriver mounting unit to the tool fixing plate using the M5x14 hex socket bolts (2 places).



Standard Screwdriver (JR3203 Dedicated) **Mini Screwdriver**

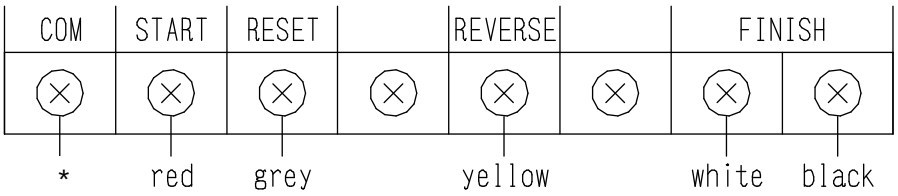
2. Mount the electric screwdriver onto the screwdriver unit using the M5x14 hex socket bolts (2 places).



Standard Screwdriver (JR3203 Dedicated) **Mini Screwdriver**

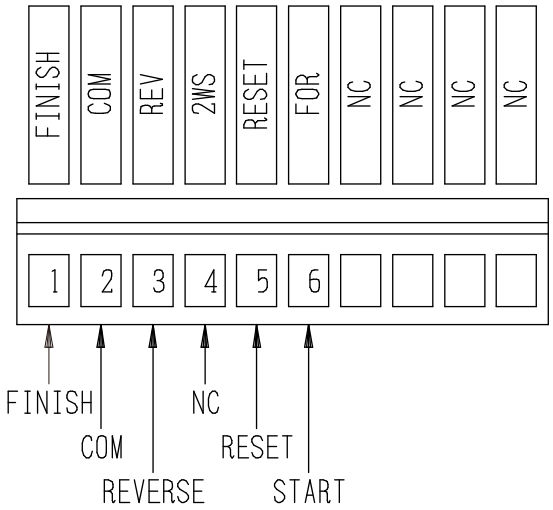
3. CONTROLLER CONNECTION DIAGRAM

CLT-AY-61/81 controller (transformer) with reverse function, manufactured by HIOS Inc.



*Cut the terminals off the brown, green, and blue wires, bundle and crimp them into one terminal and connect to the COM port.

BLT-AY-61 controller, manufactured by HIOS Inc.

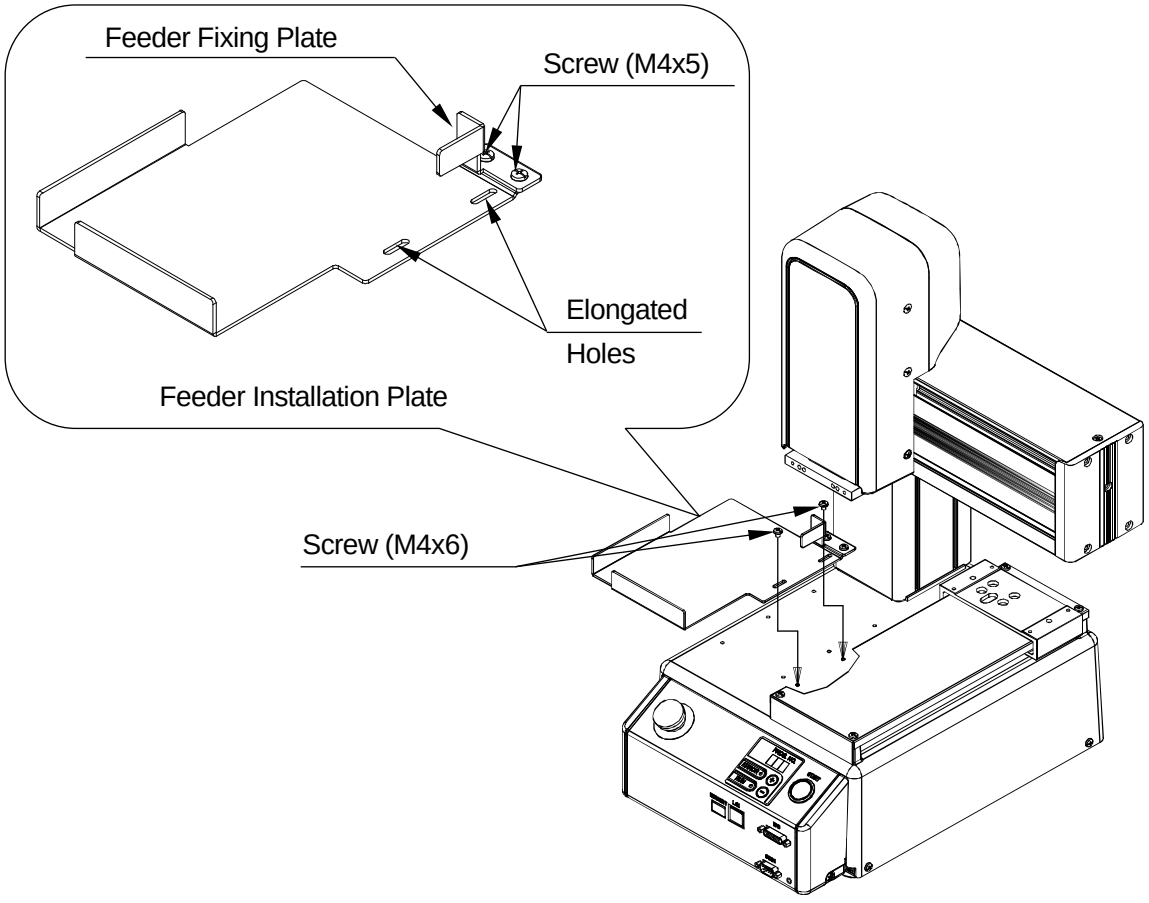


3.1 How to attach the Feeder (optional)

3.1.1 JR3200 Series

1. Attach the feeder fixing plate to the feeder installation plate, tightening the screws loosely. Set the feeder on the feeder installation plate. Align the positions so that there are no gaps between the feeder, the feeder fixing plate and the installation plate, and tighten down the screws securely.
   (Screws: +- binding screws M4x5 (2 included)).

2. Use the elongated holes to attach the feeder mounting plate to the robot, tightening the screws loosely. Set the feeder on the feeder installation plate, align it with the screwdriver, and securely tighten down the screws.
   (Screws: +- binding screws M4×6 (2 included)).

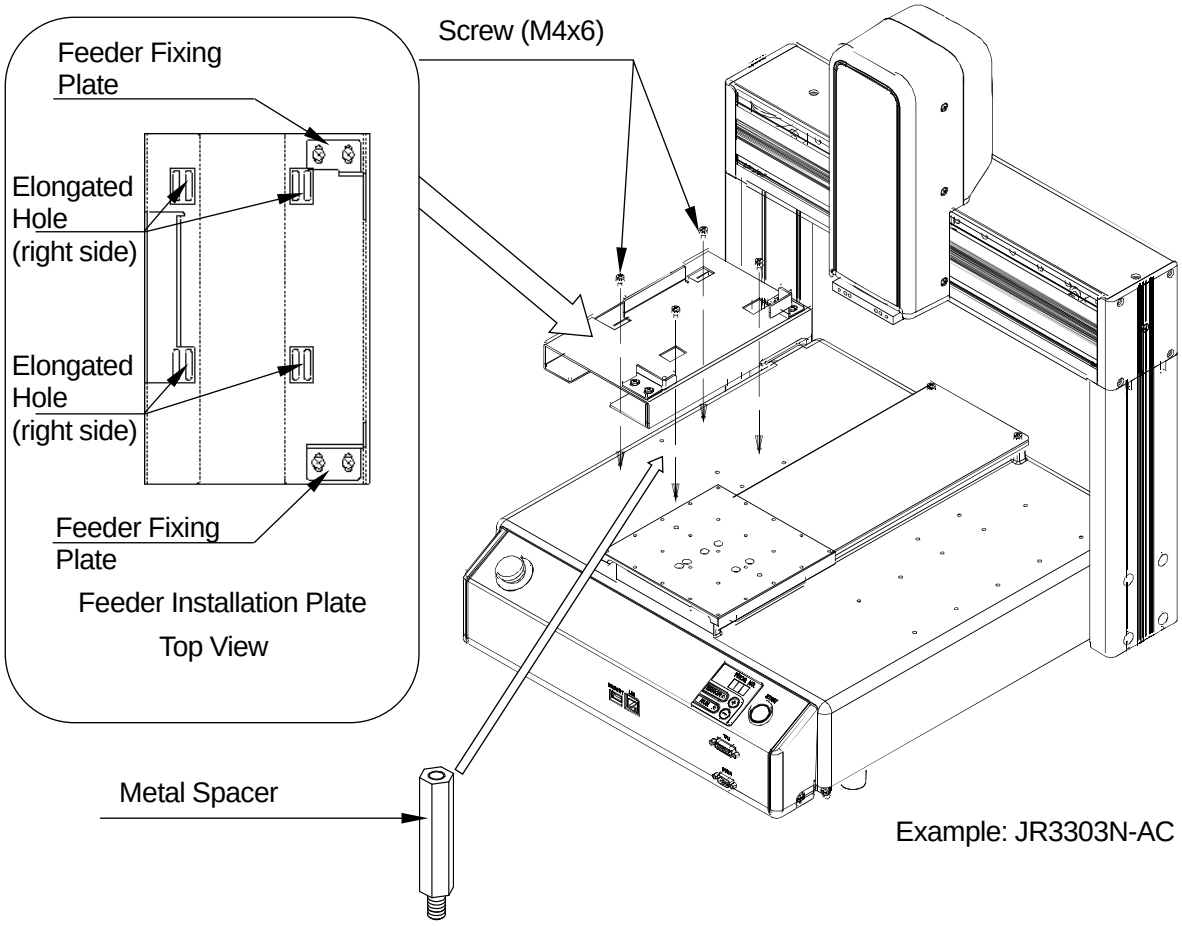


Example: JR3203N-AC

3.1.2 JR3300 Series

1. Attach the two feeder fixing plates to the feeder installation plate, tightening the screws loosely. Set the feeder on the feeder installation plate. Align the positions so that there are no gaps between the feeder, the feeder fixing plates and the feeder installation plate, and tighten down the screws securely.
   (Screws: +- binding screws M4×6 (4 included)).

2. Use the elongated holes on the right side to attach the feeder installation plate to the robot, tightening the screws loosely. Set the feeder on the feeder installation plate, align it with the screwdriver, and securely tighten down the screws.
   (Screws: +- binding screws M4×6 (4 included)).



NOTE

If the screwdriver does not reach the feeder, insert a metal spacer (M4 screws, 4 included) in between the robot base and the feeder installation plate and adjust the screwdriver height.

3.1.3 JR3300 Series: Installing Two Feeders

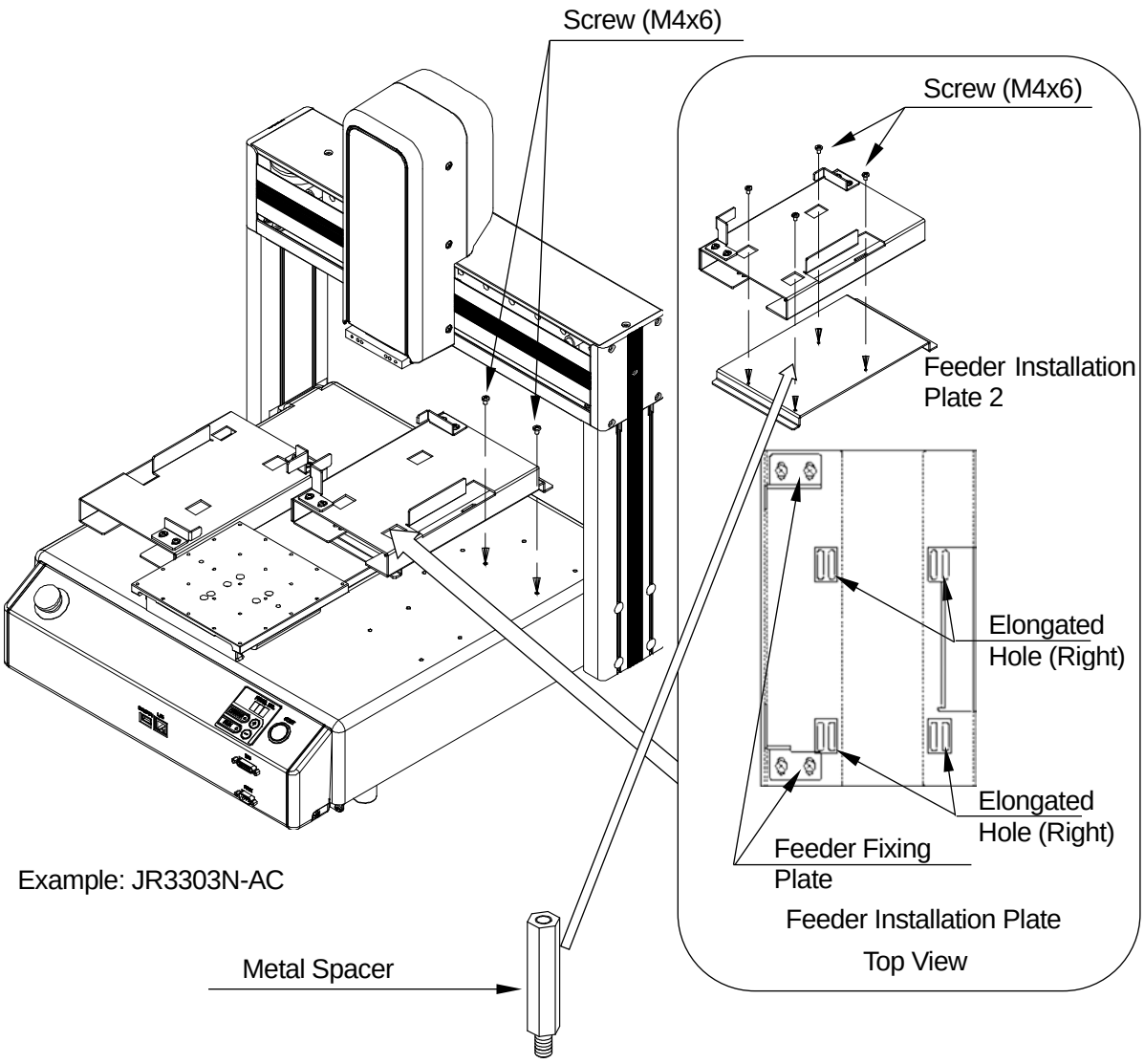
To attach a second feeder, Feeder Installation Plate 2 (optional) is required.

1. Attach the two feeder fixing plates to the feeder installation plate, tightening the screws loosely. Set the feeder on the feeder installation plate. Align the positions so that there are no gaps between the feeder, the feeder fixing plates and the feeder installation plate, and tighten down the screws securely.
   (Screws: +- binding screws M4x6 (4 included)).

2. As shown on the next page, make note of the direction the feeder fixing plate is facing and use the elongated holes on the right side to attach the feeder installation plate to Feeder Mounting Plate 2, tightening the screws loosely.
   (Screws: +- binding screws M4x6 (4 included)).

3. Attach Feeder Mounting Plate 2 to the robot.
   (Screws: +- binding screws M4x6 (2 included)).

4. Set the feeder on the feeder installation plate, align it with the screwdriver, and securely tighten down the screws.
   (Screws: +- binding screws M4x6 (4 included)).



NOTE

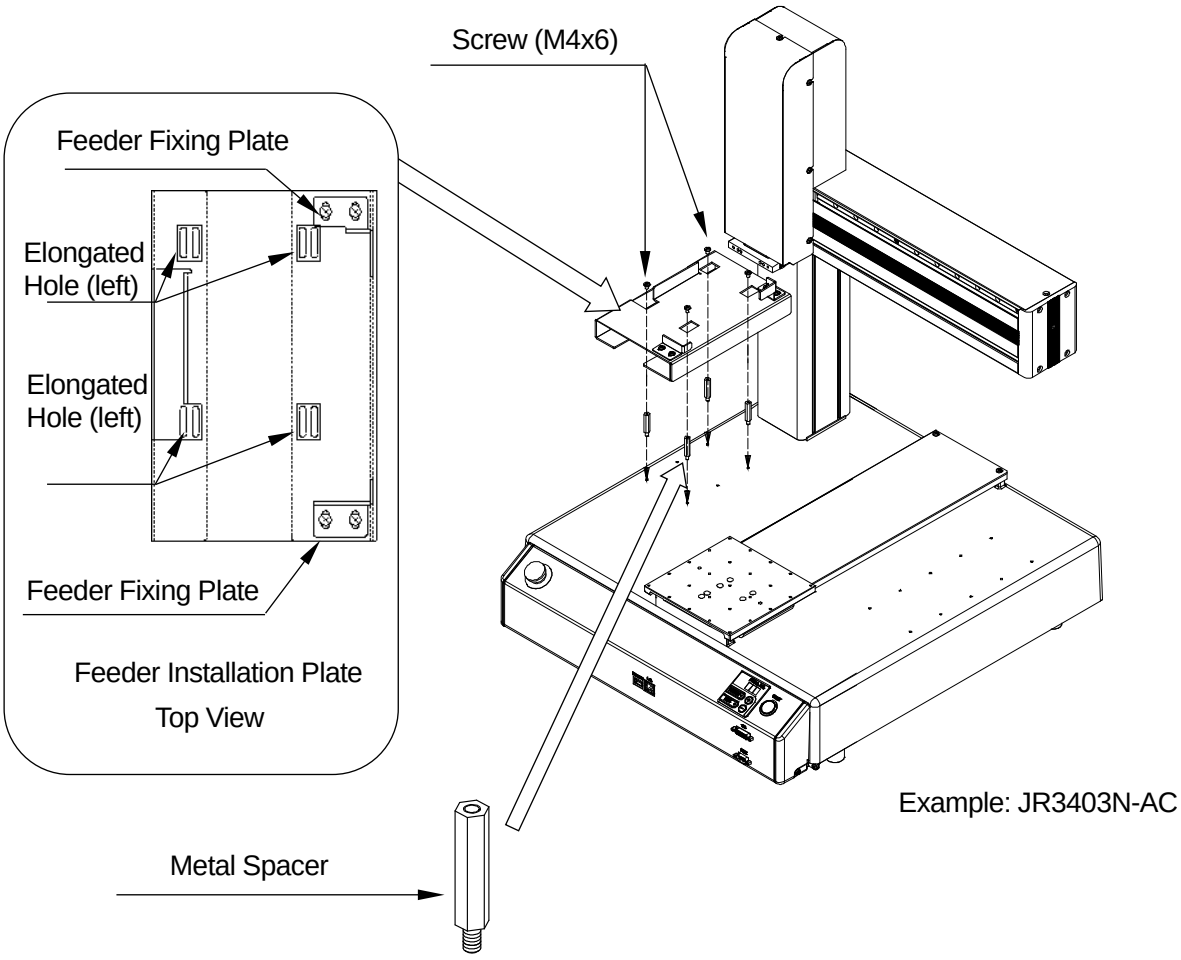
When the screwdriver does not reach the feeder, insert a metal spacer (M4 screws, 4 included) in between the robot base and the feeder installation plate and adjust the screwdriver height.

3.1.4 JR3400 Series – JR3600 Series

1. Attach the two feeder fixing plates to the feeder installation plate, tightening the screws loosely. Set the feeder on the feeder installation plate. Align the positions so that there are no gaps between the feeder, the feeder fixing plates and the feeder installation plate, and tighten down the screws securely.
   (Screws: +- binding screws M4x6 (4 included)).

2. Attach the metal spacers (M4: 4 included) to the robot.

3. Use the elongated holes on the left side to attach the feeder installation plate to the robot, tightening the screws loosely. Set the feeder on the feeder installation plate, align it with the screwdriver, and securely tighten down the screws.
   (Screws: +- binding screws M4x6 (4 included)).



3.1.5 JR3400 Series – JR3600: Installing Two Feeders

To attach a second feeder, Feeder Installation Plate 2 (optional) is required.

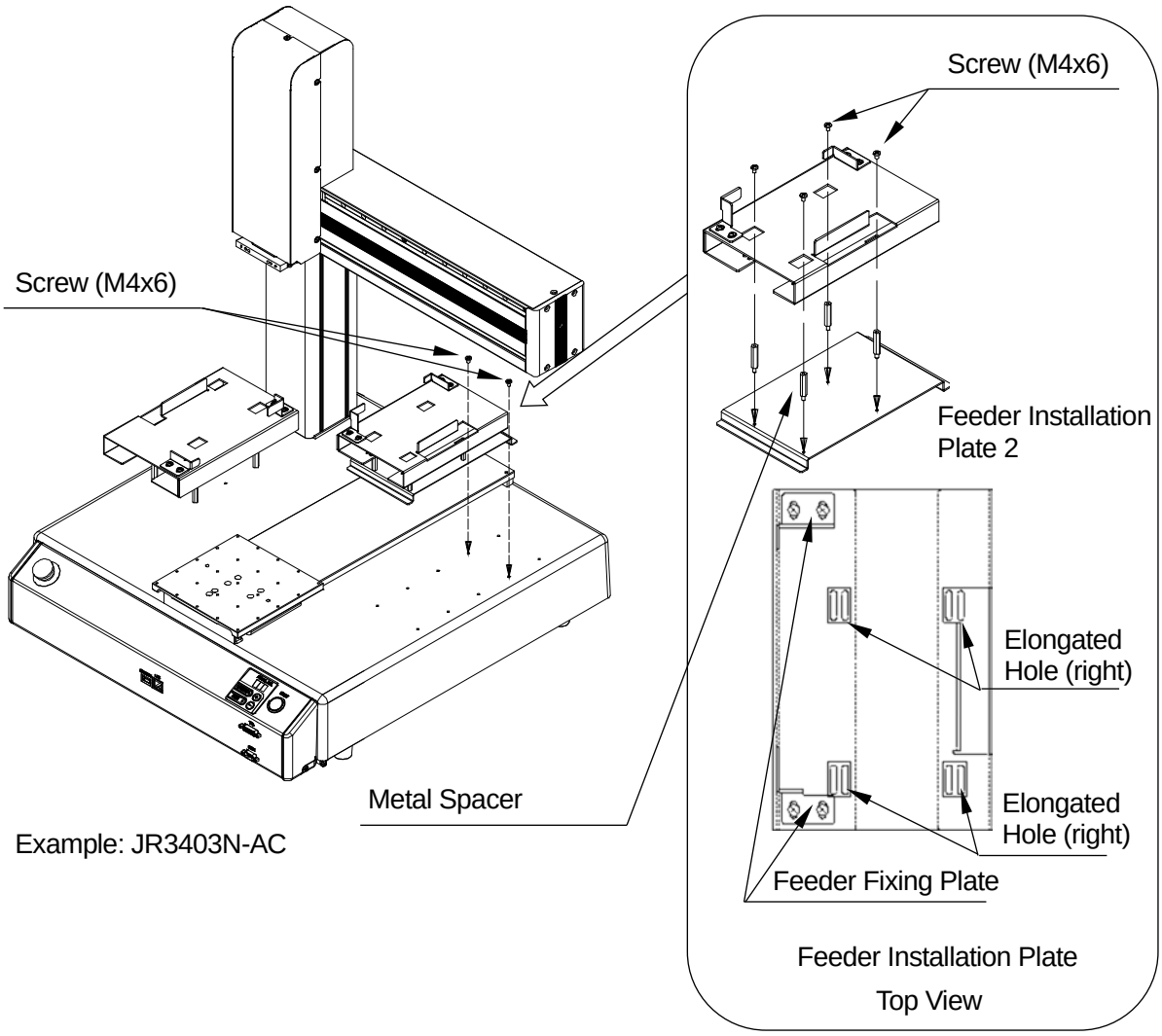
1. Attach the two feeder fixing plates to the feeder installation plate, tightening the screws loosely. Set the feeder on the feeder installation plate. Align the positions so that there are no gaps between the feeder, the feeder fixing plates and the feeder installation plate, and tighten down the screws securely.
   (Screws: +- binding screws M4x6 (4 included)).

2. Attach the metal spacers (M4: 4 included) to Feeder Installation Plate 2.

3. As shown on the next page, make note of the direction the feeder fixing plate is facing and use the elongated holes on the right side to attach the feeder installation plate to Feeder Mounting Plate 2, tightening the screws loosely.
   (Screws: +- binding screws M4x6 (4 included)).

4. Attach Feeder Mounting Plate 2 to the robot.
   (Screws: +- binding screws M4x6 (2 included)).

5. Set the feeder on the feeder installation plate, align it with the screwdriver, and securely tighten down the screws.
   (Screws: +- binding screws M4×6 (4 included)).


Screw (M4x6)
Screw (M4x6)
Feeder Installation Plate 2
Elongated Hole (right)
Elongated Hole (right)
Feeder Fixing Plate
Metal Spacer
Example: JR3403N-AC
Feeder Installation Plate
Top View

4. I/O FUNCTIONS

4.1 I/O-SYS Function Assignments

		Name	Function	Pin No.
Input	Ext	#sysIn1	Start/Free	1
		#sysIn2	Free/(B) Start Inhibition/(B) Stop-Start Inhibition/ (B) Software Interlock/(B) Urgent Stop/(A) Start Inhibition/ (A) Stop-Start Inhibition/(A) Software Interlock/(A) Urgent Stop	2
		#sysIn3	Program Number LOAD/Free	3
		#sysIn4	Program Number 1/Free	4
		#sysIn5	Program Number 2/Free	5
		#sysIn6	Program Number 4/Free	6
		#sysIn7	Program Number 8/Free	7
		#sysIn8	Program Number 16/Free	8
		#sysIn9	Program Number 32/Free	9
		#sysIn10	Program Number 64/Free	10
		#sysIn11	Last Work/Program Number 128/Error Reset/Free	11
		#sysIn12	Temporary Stop/Program Number 256/Free	12
	Var	#sysIn13	Driver Torque Up/Program Number 512/Free	13
	Var	#sysIn14	Screw Feeder ESC1/Free/(A) Start Inhibition/ (A) Stop-Start Inhibition/(A) Software Interlock/ (A) Urgent Stop/(B) Start Inhibition/(B) Stop-Start Inhibition/ (B) Software Interlock/(B) Urgent Stop	14
	Var	#sysIn15	Screw Feeder ESC2/Free/Last Work/Error Reset	15
		#sysIn16	Free/Temporary Stop	16
Output	Ext	#sysOut1	Ready for Start/Free	17
		#sysOut2	Robot Stopped/Free	18
		#sysOut3	Program Number ACK/Free	19
		#sysOut4	Program Number Error/Free	20
		#sysOut5	Running/Free	21
		#sysOut6	Error/Free	22
		#sysOut7	Emergency Stop/Free	23
		#sysOut8	Position Error/Free	24
	Var	#sysOut9	Screw Tightening Error/Free	25
	Var	#sysOut10	Driver Start/Free	26
	Var	#sysOut11	Driver Reverse/Free	27
	Var	#sysOut12	Driver Stop/Free/Finish Initialize	28
		#sysOut13	Free	29
		#sysOut14	Free	30
	Var	#sysOut15	Reserved (Ejector IN)/Free	31
	Var	#sysOut16	Reserved (Ejector OUT)/Free	32

Ext: Activated only in the External Run Mode.

Var: The arbitrary I/O function assignments can be changed. Change by selecting Teaching Mode → MENU key → [Device Signal] → [I/O Function Assignment].

NOTE: A type signals use positive logic and B type signals use negative logic.

		Name	Function	Pin No.
		–	No Connection	33
Others		COM+	DC24V	34
		COM–	GND	35
		COM–	GND	36
		COM–	GND	37

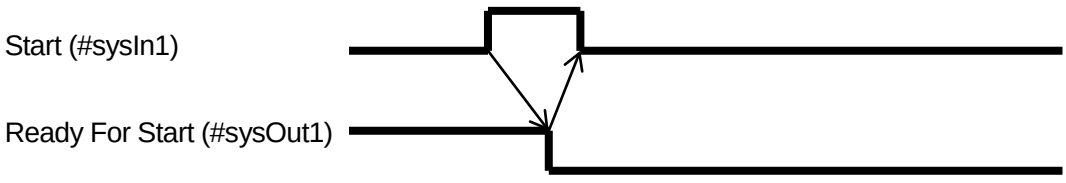
4.1.1 Input

- Start (#sysIn1)
  Turn ON this signal to start or restart a program in External Run Mode. In addition, this signal is used for moving to the work home position coordinates. This is enabled when Ready for Start (#sysOut1) is ON.

The Start (#sysIn1) signal starts, or restarts running programs with the robot under any of the following conditions when the I/O-S input is ON in External Run Mode:

1. Waiting for program start at the work home position.
2. Waiting for restart after a temporary stop.
3. Waiting for restart after stopping at the wait start stop point.
4. Waiting for start according to a point job *waitStart* command.

A Start (#sysIn1) signal with a pulse of 20msec or less is invalid due to noise elimination.
A pulse width of 30msec or wider is useable, however, rather than using time to establish the signal, we recommend to use the action of the Ready for Start (#sysIn1) signal turning OFF as an acknowledgment signal (ACK signal). When waiting to start as described above, the Ready for Start Signal (#sysOut1) goes ON.
The Ready for Start (#sysOut1) turns OFF when the Start (#sysIn1) turns ON.



- Free (#sysIn2, #sysIn16)
  The default for the #sysIn2, #sysIn16 signals is Free.
  These signals are useable as free signals unless their functions are changed in [I/O-SYS Function Assignment].

- Start Inhibition (#sysIn2, #sysIn14)
  This signal becomes a function to inhibit starts when Start Inhibition (#sysIn2, #sysIn14) is set in [I/O-SYS Function Assignment]. You can select either type A or type B for this signal.
  “(A) Start Inhibition” (#sysIn2, #sysIn14) works when it is ON (positive logic), and “(B) Start Inhibition” (#sysIn2, #sysIn14) works when it is OFF (negative logic). For example, starts are inhibited if “(A) Start Inhibition” (#sysIn2) is ON and the Robot Stopped (#sysOut2) signal is ON (when the robot is stopped). Even if you try to start the robot, it will not move. When the Robot Stopped (#sysOut2) signal is OFF (when the robot is moving), this signal is invalid.

- Stop-Start Inhibition (#sysIn2, #sysIn14)
  This signal becomes a function to temporarily stop operation or inhibit start when Stop/Start Inhibition (#sysIn2, #sysIn14) is set in [I/O-SYS Function Assignment]. You can select either type A or type B for this signal. “(A) Stop - Start Inhibition” (#sysIn2, #sysIn14) works when it is ON (positive logic), and “(B) Stop - Start Inhibition” (#sysIn2, #sysIn14) works when it is OFF (negative logic). For example, start is inhibited if “(A) Stop - Start Inhibition” (#sysIn2) is ON and the Robot Stopped (#sysOut2) signal is ON (the robot is stopped). Even if you try to start the robot, it will not move. If you turn this signal ON when the Robot Stopped (#sysOut2) signal is OFF (when the robot is moving), the robot completes its current PTP movement and then holds. To restart, input a start signal after turning OFF this signal.

- Software Interlock (#sysIn2, #sysIn14)
  If Software Interlock (#sysIn2, #sysIn14) is set in [I/O-SYS Function Assignment], this becomes a function to inhibit starts and make urgent stops during operation. You can select either type A or type B for this signal. “(A) Software Interlock” (#sysIn2, #sysIn14) works when it is ON (positive logic), and “(B) Software Interlock” (#sysIn2, #sysIn14) works when it is OFF (negative logic).
  For example, starts are inhibited if “(A) Software Interlock” (#sysIn2) is ON and the Robot Stopped (#sysOut2) signal is ON (the robot is stopped). Even if you try to start the robot, it will not move.
  If this signal is turned ON when the Robot Stopped (#sysOut2) signal is OFF (the robot is moving), the robot makes an urgent stop.

- Urgent Stop (#sysIn2, #sysIn14)
  When Urgent Stop (#sysIn2, #sysIn14) is set in [I/O-SYS Function Assignment], this becomes a function for making urgent stops. You can select either type A or type B for this signal. “(A) Urgent Stop” (#sysIn2, #sysIn14) works when it is ON (positive logic), and “(B) Urgent Stop” (#sysIn2, #sysIn14) works when it is OFF (negative logic).
  For example, the robot makes an urgent stop if “(A) Urgent Stop” (#sysIn2) is ON in Run Mode.

- Program Number Load (#sysIn3)
  This signal directs the loading of program numbers. When this signal goes ON, Program Number (#sysIn 4 to 10) is loaded. This function is enabled when [Administration Settings Mode] → [Program Number Change] → [I/O-SYS] is set to [Valid] and the Teaching Mode menu [All Program Common Settings] → [I/O Settings] → [Program Number Switching Method] is set to [LOAD/ACK Handshake].

- Program Number 1 – 64 (#sysIn4 – #sysIn10)
  You can specify program numbers by turning ON this signal.
  Example: If you want to specify program number [67]:
  67 = 64 (#sysIn10) +2 (#sysIn5) + 1 (#sysIn4) = Turn ON signals #sysIn10, #sysIn5 and #sysIn4
  This function is enabled when [Administration Settings Mode] → [Program Number Change] → [I/O-SYS] is set to [Valid]. If the Teaching Mode menu [All Program Common Settings] → [I/O Settings] → [Program Number Switching Method] is set to [Load at Start (I/O-SYS)], start the program after specifying the program number with this signal.
  If [Program Number Reading Format] is set to [Binary Code], specify the program number in binary code to this register.
  If [Program Number Reading Format] is set to [BCD (Binary Coded Decimal)], specify the program number in BCD to this register. For further information, refer to “8.2.2 Program Number Reading Format” in the operation manual *Setup*.

  NOTE
  Refer to the following signal (Program Number (word) (#fbIn101) (Fieldbus) for how to specify Fieldbus program numbers.

- Program Number (word) (#fbIn101) (Fieldbus)
  You can specify program numbers in this word register.
  This is valid if [Fieldbus] is set to [Valid] in [Change Program Number] in [Administration Settings Mode]. If [Program Number Switching Method] is set to [Load at Start (Fieldbus)], start the program after specifying the program number to this register.
  If [Program Number Reading Format] is set to [Binary Code], specify the binary code’s program number to this register.
  If [Program Number Reading Format] is set to [BCD (Binary Coded Decimal)], specify the BCD code’s program number to this register.

- Last Work (#sysIn11)
  When the Teaching Mode menu [Individual Program Settings] → [Cycle Mode] is set to [Continuous Playback] in the Teaching Mode menu, after finishing the last point, the robot moves to point 01 and repeats the operation. To end this function, end the program using a point job or turn this signal ON. This function is only valid at the point when the last point is finished (before moving). You cannot use this signal to terminate a program mid operation.

- Error Reset (#sysIn11, #sysIn15)
  If an error occurs when the robot is running programs, turn this signal ON to do an error reset. The program (run) is then terminated on the spot. In addition, the Error (#sysOut6) signal turns OFF when this signal is turned ON, so you can use Error (#sysOut6) as an ACK signal for this signal. Another way to use this signal is when the robot is holding or the Ready for Start (#sysOut1) signal is output and the robot is waiting to start, you can turn ON this signal to reset the program's execution and terminate the program on the spot.
  Program termination via this signal is enabled in the following situations:
  1. The robot is stopped due to an error during a run.
  2. The robot has stopped moving due to a hold and is awaiting a restart.
  3. The robot is holding at a Wait Start Point and is awaiting a restart.
  4. The robot is awaiting restart from a point job *waitStart* command.

- Program Number 128 (#sysIn11)
  When ON, this signal enables you to specify program numbers 128 and above.

- Temporary Stop (#sysIn12, #sysIn16)
  You can temporarily stop running programs by turning ON this signal. However, you cannot stop a CP movement while it is running. You can only hold at PTP points.
  Also, when this signal is ON, start is inhibited.

- Program Number 256 (#sysIn12)
  When ON, this signal enables you to specify program numbers 256 and above.

- Driver Torque Up (#sysIn13)
  If this signal is turned ON during a tightening operation, the robot determines that the tightening operation is complete. (Transformer: FINISH)

- Screw Feeder ESC (#sysIn14 – #sysIn15)
  If this signal is turned OFF during a feeding operation, the robot determines that there are no screws in the screw feeder and temporarily stops operation.
  If the [Feeder] is set to [No ESC], this signal is invalid and it can be used as a free input signal.
  If [Auto ESC] is set, the robot restarts its run when this signal is turned ON.
  If [Manual ESC] is set, the robot restarts operation when this signal is turned ON and the start/stop switch on the switchbox is pressed (in Run Mode) or when the Start (#sysIn1) signal is turned ON (in External Run Mode).

4.1.2 Output

- Ready for Start (#sysOut1)
  When the Start (#sysIn1) signal is enabled, this signal comes ON.

This occurs in the following situations:

1. Mechanical initialization standby when the power is turned ON.
2. Mechanical initialization standby after an emergency stop and emergency stop cancellation.
3. Waiting for program start at the work home position.
4. Waiting for restart after a temporary stop.
5. Waiting for restart after stopping at the wait start stop point.
6. Waiting for start due to a point job *waitStart* command.

If the Running (#sysOut5) signal is OFF, the robot is under conditions 1, 2 or 3.

Also, when the Ready for Start (#sysOut1) signal is ON, the Robot Stopped (#sysOut2) signal is always also ON. However, this is not so for the reverse. If the robot is stopped because it is waiting for a signal, then the Robot Stopped (#sysOut2) signal is ON, but the Ready for Start (#sysOut1) signal will not come ON.

- Robot Stopped (#sysOut2)
  When the robot is stopped this signal is ON, when the robot is moving, it is OFF. If you turn the “(A) Software Interlock” (#sysIn2, #sysIn14) signal ON when this signal is ON (the robot is stopped), start is inhibited. Even if you try to start the robot, it will not move.
  If you turn the “(A) Software Interlock” (#sysIn2, #sysIn14) signal ON when this signal is OFF (the robot is moving), it will make an urgent stop.

- Program Number ACK (#sysOut3)
  This is a response signal for Program Number LOAD (#sysIn3). When you turn Program Number LOAD (#sysIn3) ON, this signal comes ON after Program Number (#sysIn4 to #sysIn10) is loaded.
  If Program Number LOAD (#sysIn3) goes OFF, this signal also goes OFF.

- Program Number Error (#sysOut4)
  This signal goes ON when you specify an unregistered program number in Switch Run/External Run Mode.

- Running (#sysOut5)
  When you start to run a program this signal goes ON. When the program finishes it goes OFF.

- Error (#sysOut6)
  This signal goes ON when an error occurs.

- Emergency Stop (#sysOut7)
  This signal comes ON when an “Emergency Stop Error” occurs (due to the emergency stop switch being pushed, etc.) When this signal is ON, the Error (#sysOut6) signal comes ON at the same time.

- Position Error (#sysOut8)
  If the Teaching Mode menu [All Program Common Settings] → [Other Parameters] → [Position Error Check] is set to [Valid], the position sensor checks the position error just before the robot completes a run (before returning to the work home position). This signal turns ON if a position error is detected.

- Screw Tightening Error (#sysOut9)
  This signal comes ON when a screw tightening error occurs.
  It is turned OFF when the robot starts a run.
  The Error (#sysOut6) signal also comes ON when this signal is ON. The Error (#sysOut6) signal also turns OFF only in this case.

- Driver Start (#sysOut10)
  This signal rotates the screwdriver (regular, forward rotation).
  When the screwdriver reaches the feeder point for a feeding operation, this signal comes ON for 200msec.
  The screwdriver keeps rotating until the Driver Torque Up (#sysIn13) or Driver Stop (#sysOut12) signal is turned ON.

- Driver Reverse (#sysOut11)
  This signal rotates the screwdriver (reverse rotation).
  If the screw tightening type is set to [Tighten, then Reverse], this signal comes ON 0.3 seconds after the Driver Torque Up (#sysIn13) signal is turned ON.
  If the screw tightening type is set to [Unscrew], this signal comes ON when the screwdriver reaches the screw tightening point.
  The screwdriver keeps rotating until this signal is turned OFF or the Driver Stop (#sysOut12) signal comes ON.

- Driver Stop (#sysOut12)
  The screwdriver stops rotating when this signal comes ON (Pulse).
  If the screw tightening type is set to [Loose Tightening], this signal comes ON when the Z-Axis descends by the registered [Screw Amount].

- Free (#sysOut13, #sysOut14)
  The default for the #sysOut13, #sysOut14 signals is Free.
  These signals are useable as free signals unless their functions are changed in [I/O-SYS Function Assignment].

- Reserved (Ejector IN) (#sysOut15)
  This signal is already used in the robot system and cannot be reassigned.

- Reserved (Ejector OUT) (#sysOut16)
  This signal is already used in the robot system and cannot be reassigned.

4.2 I/O-1 Function Assignments

	Name	Function	Pin No.
Input	#genIn1	Free	1
	#genIn2	Free	2
	#genIn3	Free	3
	#genIn4	Free	4
	#genIn5	Free	5
	#genIn6	Free	6
	#genIn7	Free	7
	#genIn8	Free	8
Output	#genOut1	Free	9, 10
	#genOut2	Free	11, 12
	#genOut3	Free	13, 14
	#genOut4	Free	15, 16
	#genOut5	Free	17
	#genOut6	Free	18
	#genOut7	Free	19
	#genOut8	Free	20
Others	COM+	24V Power Supply	21
	COM+	24V Power Supply	22
	COM-	GND	23
	COM-	GND	24

4.3 I/O Polarity

There are two types of I/O polarity: NPN specifications and PNP specifications. After confirming your robot's polarity specifications, always connect tools (etc.) which are compatible with these specifications. The robot's I/O polarity can be confirmed on the I/O polarity nameplate.
For further details, refer to the operation manual *External Control (I/O / Fieldbus)*.

- COM+ (DC24V)
  If I/O-SYS is using external power supply specifications, connect the COM+ pin to the plus pole of the external power supply (DC24V).
  If I/O-SYS is using internal power supply specifications, DC24V (+) is output.

- COM- (GND)
  If I/O-SYS is using external power supply specifications, connect the COM- pin to the external power supply ground.
  If I/O-SYS is using internal supply specifications, use the pin as a common ground.

When I/O-SYS is set to [Internal], do not connect the robot to an external power supply. Doing so causes unit breakdown.

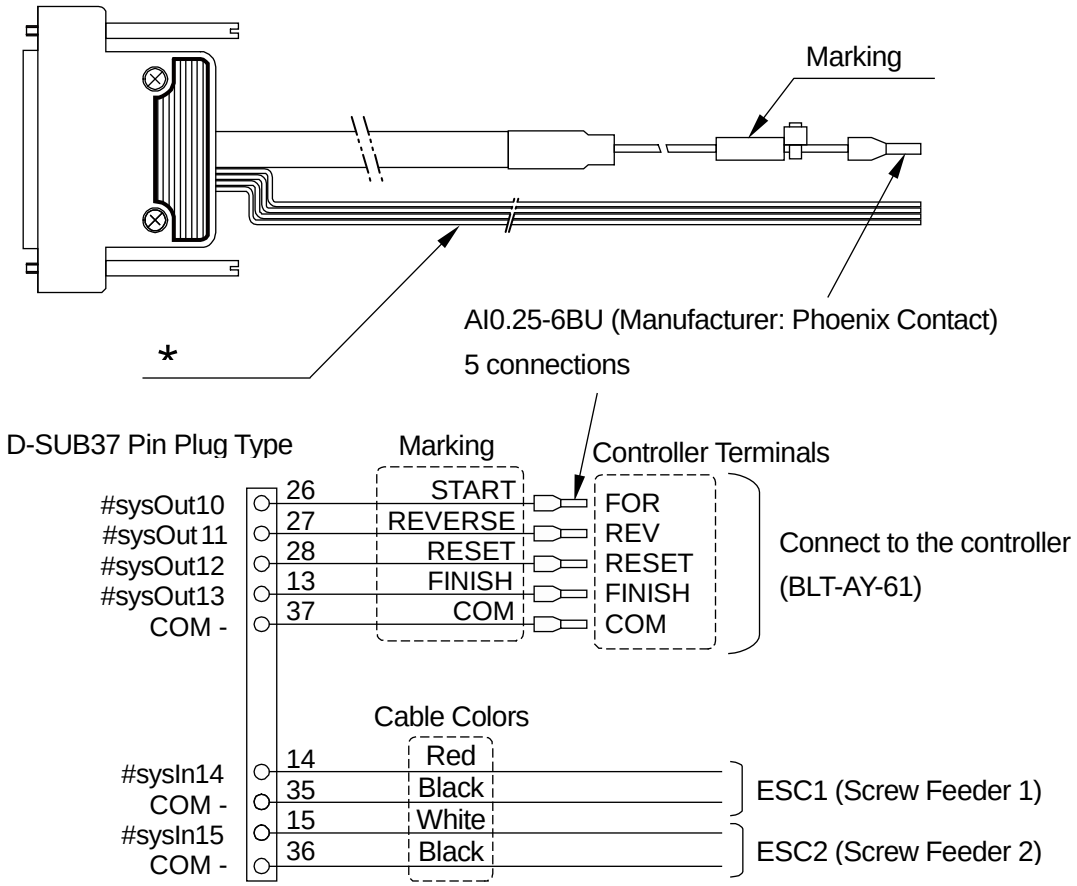
4.4 Other

For details regarding Fieldbus (optional), refer to the operation manual *External Control (I/O / Fieldbus)*.

5. I/O-SYS SCREW TIGHTENING CABLES

5.1 NPN Specification BLT-AY-61 (HIOS) Controller

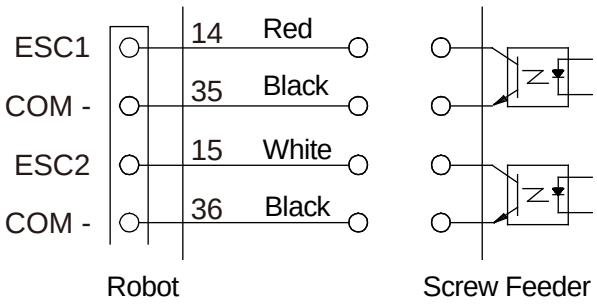
Part number: 963558011 I/O Screwdriver cord with ESC (Unit) (HIOS BL Series)



*The four ESC connection wires (14, 15, 35, 36) are cut off.

NOTE: The feeder connectors are not included.

■ ESC Connection

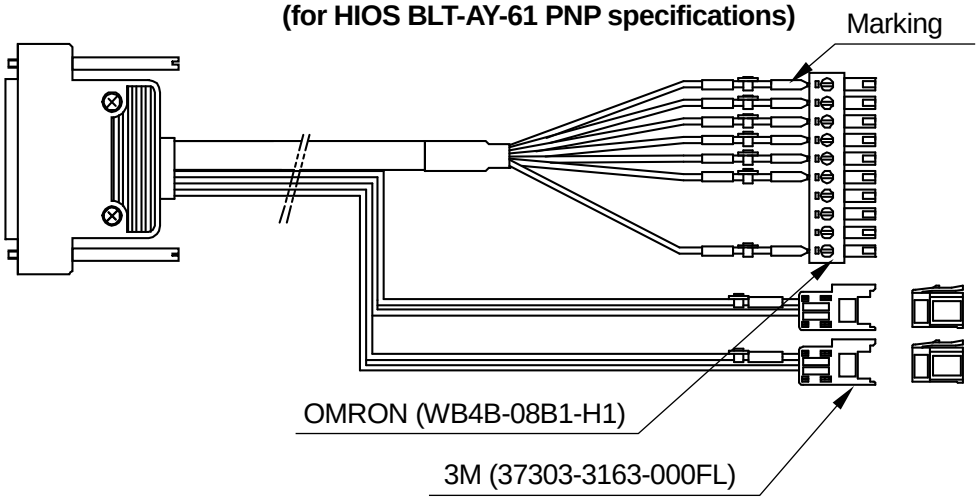


	Cable		Feeder (OHTAKE ROOT KOGYO)	Other Feeders*
	Pin	Cable Color	Cable Color	Cable
Feeder 1	14	Red	Purple	High Voltage
	35	Black	Grey	Low Voltage
Feeder 2	15	White	Purple	High Voltage
	36	Black	Grey	Low Voltage

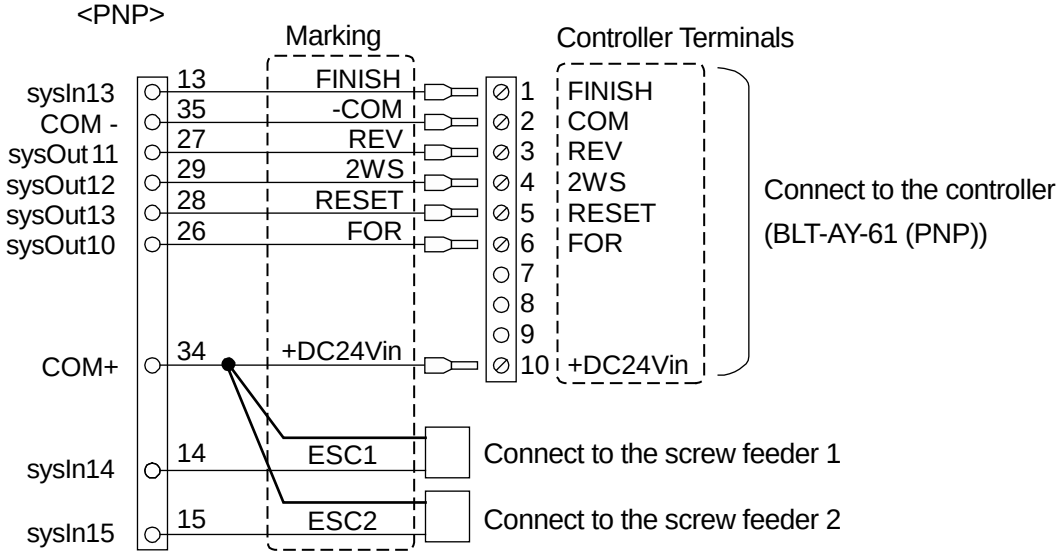
* For details, refer to the feeder's instruction manual.

5.2 PNP Specification BLT-AY-61 (HIOS) Controller

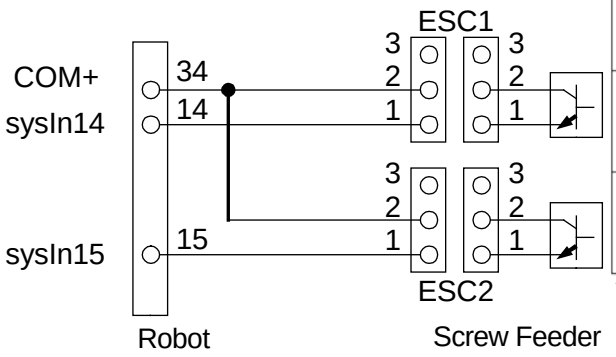
Part number: 964589003 I/O Screwdriver cord with ESC (Unit)
(for HIOS BLT-AY-61 PNP specifications)



D-SUB37Pin Plug Type
<PNP>



■ ESC Wiring



	Cable		Feeder (OHTAKE ROOT KOGYO)	Other Feeders*
	Pin	Cable Color	Cable Color	Cable
Feeder 1	34	Red	Purple	High Voltage
	14	Orange	Grey	Low Voltage
Feeder 2	34	Red	Purple	High Voltage
	15	Yellow	Grey	Low Voltage

* For details, refer to the feeder's instruction manual.

■ Connecting a Feeder

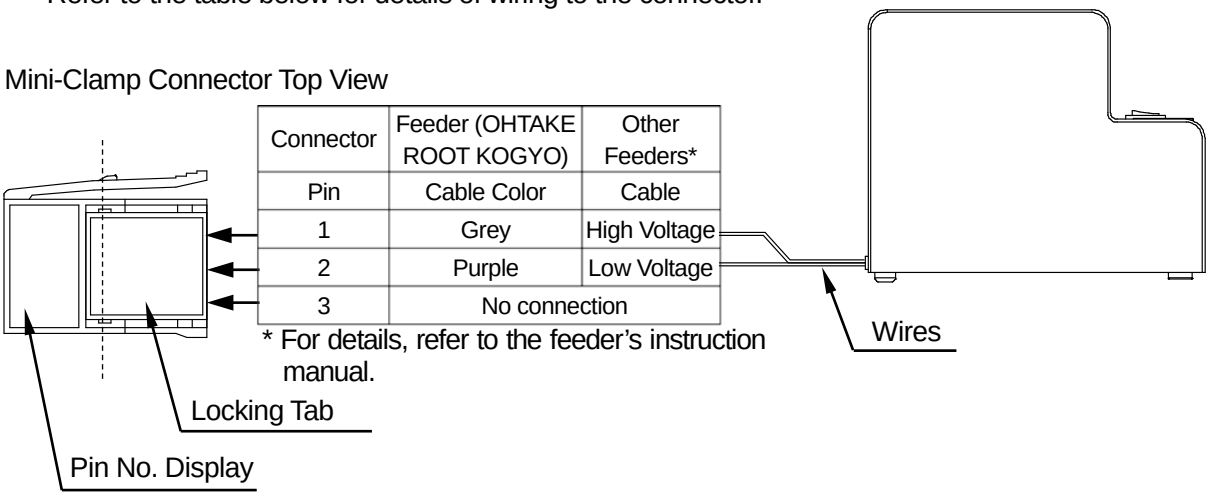
This cable comes complete with mini-clamp connectors attached. Attach the corresponding connector bit to the feeder. Refer to the explanation below.

Connect the accompanying mini clamp connector to the feeder's electrical wires.

1. Insert the wires from the feeder into the mini-clamp connector. There is no need to strip the wires.

   The pin numbers can be confirmed by checking the pin numbers on the mini clamp connector. Refer to the table below for details of wiring to the connector.

Mini-Clamp Connector Top View

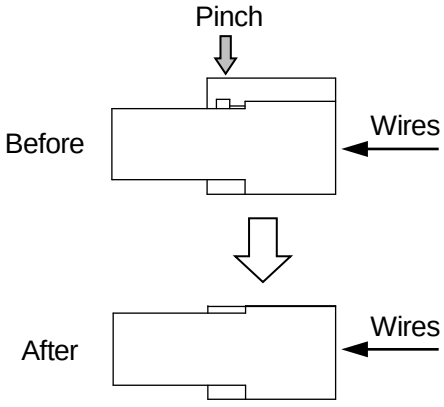


Connector	Feeder (OHTAKE ROOT KOGYO)	Other Feeders*
Pin	Cable Color	Cable
1	Grey	High Voltage
2	Purple	Low Voltage
3	No connection	

* For details, refer to the feeder's instruction manual.

2. The mini clamp connector is semitransparent, allowing you to check the wires are inserted sufficiently. Make sure the wires are inserted as far as the dotted line indicated on the diagram above. Pinch the locking tab on the mini-clamp connector using pliers, etc. Make sure the locking tab is pinched level on the mini-clamp connector (right diagram) and there is no gap.

Mini-Clamp Connector Side View



NOTE

If using a second feeder (JR3300 – JR3600 only), connect the mini clamp connector to the second feeder in the same way. You may want to mark each of the feeder connectors to help you distinguish one from the other.

Mini-Clamp Connector

3M: 37103-4101-G00 FL

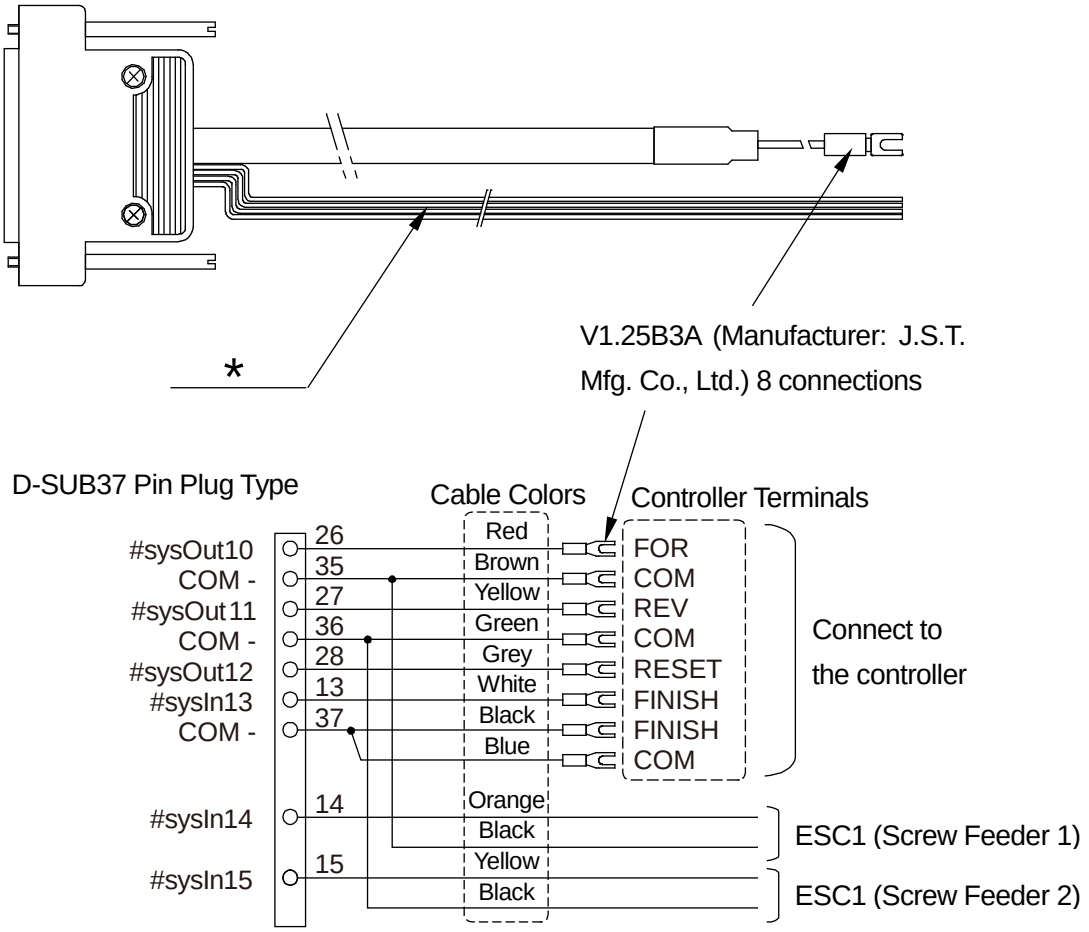
Feeder Wiring Compatibility:

- AWG26 to 28
- Nominal Cross-sectional Area 0.08 to 0.14mm^2 minimum
- Complete diameter: 0.8 to 1.0mm

5.3 Controllers other than the BLT-AY-61 (HIOS)

This cable is compatible with NPN specifications only.

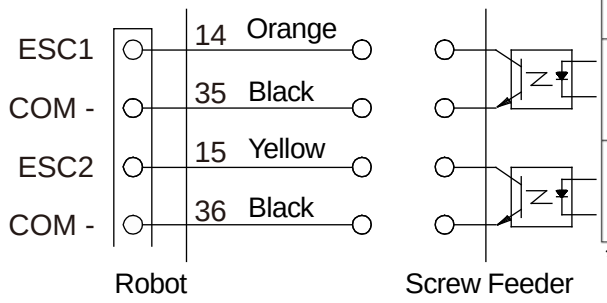
Part number: 963545004 I/O Screwdriver cord with ESC (Unit) (for NPN specs.)



*The four ESC connection wires (14, 15, 35, 36) are cut off.

NOTE: The feeder connectors are not included.

■ ESC Connection

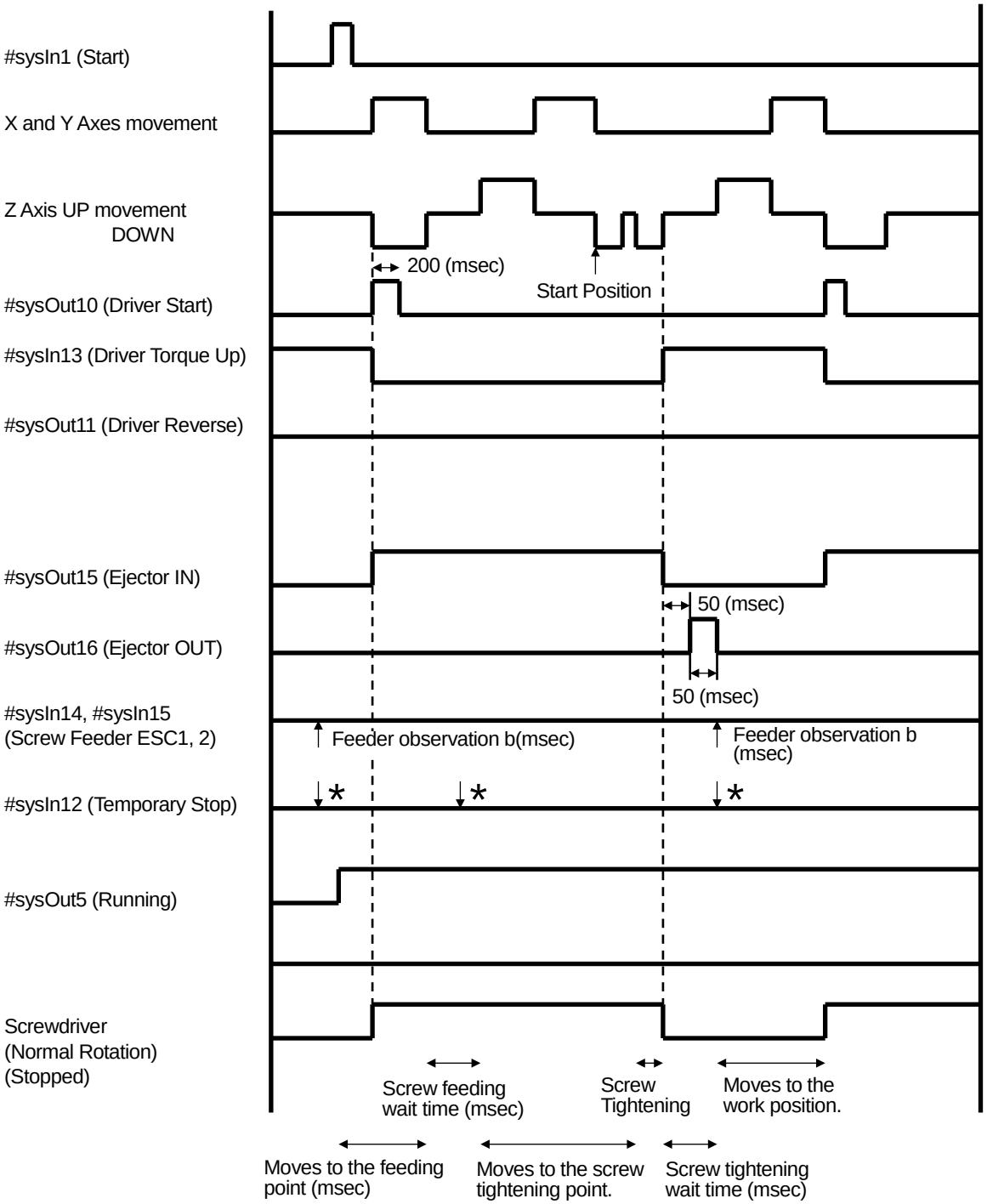


	Cable		Feeder (OHTAKE ROOT KOGYO)	Other Feeders*
	Pin	Cable Color	Cable Color	Cable
Feeder 1	14	Orange	Purple	High Voltage
	35	Black	Grey	Low Voltage
Feeder 2	15	Yellow	Purple	High Voltage
	36	Black	Grey	Low Voltage

* For details, refer to the feeder's instruction manual.

6. TIMING CHARTS

6.1 Screw Tightening

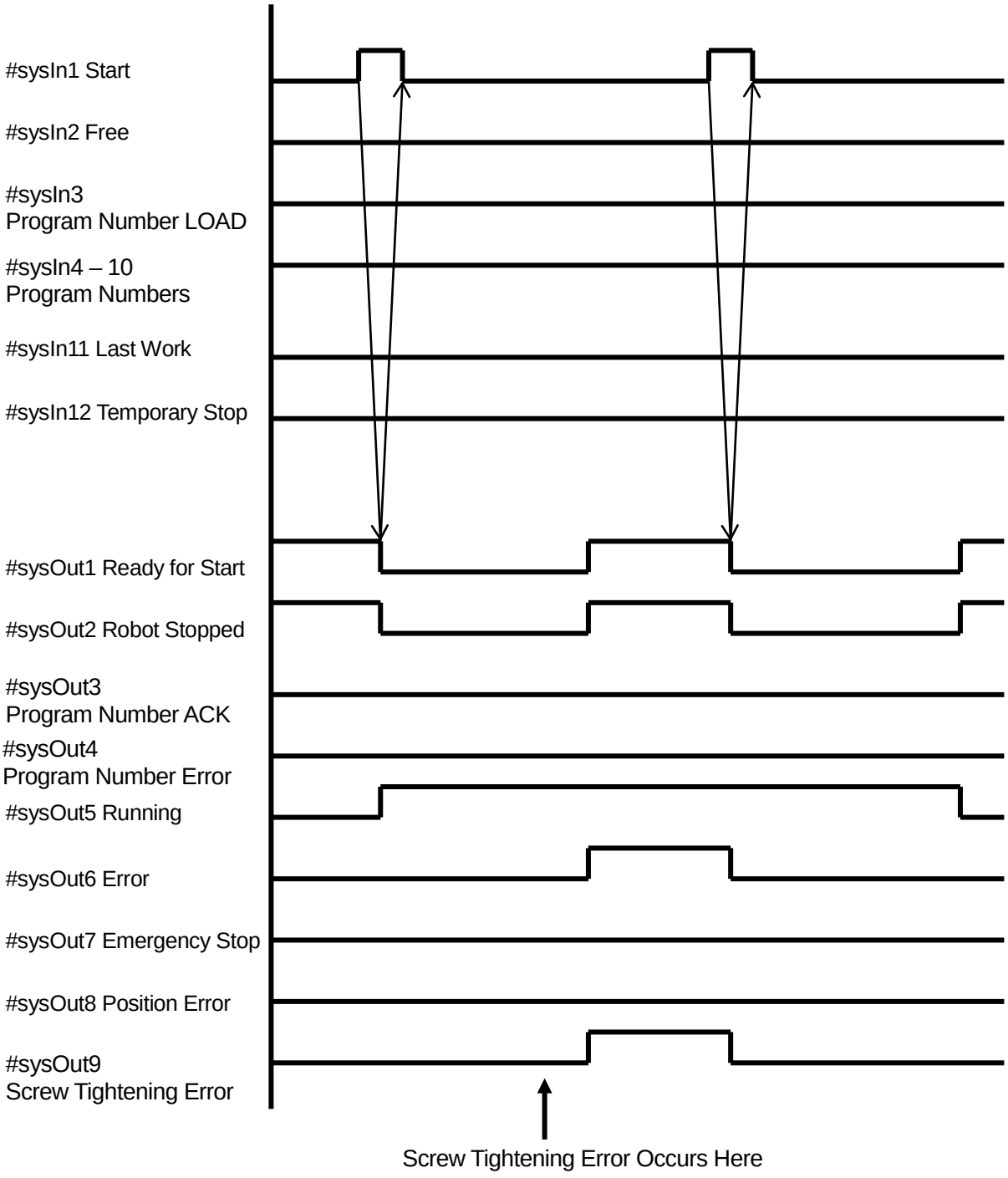


*Positions where the screwdriver can be stopped temporarily.

Turn ON the Temporary Stop signal before the screwdriver reaches these points and the robot stops there.

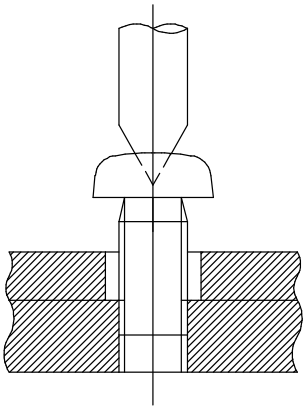
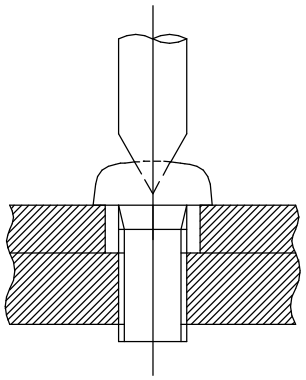
6.2 #sysOut9 Screw Tightening Error

When a screw tightening error occurs, the Screwdriver Error signal comes ON after the screwdriver moves to the error standby point. Make a run start to restart. Whether the operation restarts from the point where the error occurred or from the next point depends on the screw tightening condition settings.



7. SCREW TIGHTENING ERRORS

When a screw tightening error occurs, the program number display on the front of the operation panel alternately shows the “St” sign and the error number.

Error No.	Content	Diagram	Countermeasure
01	Early Finish Signal		This error occurs (as pictured to the left) if the completed tightening position (Torque Up position), is higher than the registered position minus the float amount. This error is referred to as the Early Finish Signal in this manual. Press the start switch to restart operation. The screwdriver restarts from either the same point or the next point. (Refer to “16. What to do When a Tightening Error Occurs”)
02	No Finish Signal		This error occurs if the tightening operation continues after exceeding the registered position (when the screwdriver continues to rotate but the screw does not tighten, as pictured to the left). This error is referred to as the No Finish Signal in this manual. Press the start switch to restart operation. The screwdriver restarts from either the same point or the next point. (Refer to “16. What to do When a Tightening Error Occurs”)
03	Feeder ESC Stop	This error occurs if there are no screws in the screw feeder. Refill the feeder with screws. (This error is not detected unless you use connect a screw feeder that can detect the presence/absence of screws, and you set the robot to stop when there are no screws in the screw feeder.) Press the start switch or turn OFF the ESC signal to restart operation. (Refer to “14. Feeder”)	

8. TEACHING DATA

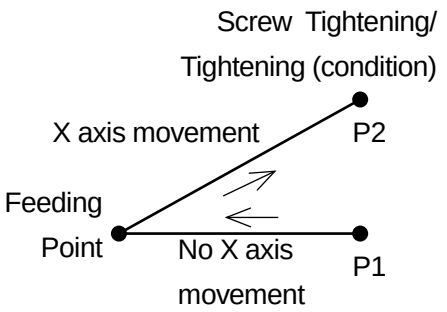
8.1 Point Types

Point types are defined according to the type of job or movement, such as tightening screws or waiting for a start signal.
In addition to the standard point types, there are eight point types for Screw Tightening Specifications.

1. Screw Tightening
   This point executes screw tightening according to the [Screw Tightening Condition] in individual program settings. After visiting the feeding point, the robot makes a PTP movement to this point. This does not affect [Screw Tightening Condition] specified by condition number.

2. Tightening (Condition)
   This point executes screw tightening according to the [Screw Tightening Condition] specified by condition number.
   After visiting the feeding point (when using [Full Tightening] or [Tighten, then Reverse]), the robot makes a PTP movement to this point. This does not affect [Screw Tightening Condition] in individual program settings.

3. Feeding Point
   The screwdriver picks up screws from the screw feeder at this point. The robot moves to this point from the previous point and picks up screws before going to a Screw Tightening or Tightening (Condition) point. The feeding point X coordinate is ignored, because when moving from the previous point to the Feeder Point, there is no X axis movement (the X table does not move). When moving from the Feeding Point to a Screw Tightening point or Tightening (Condition) point, there is X axis movement.



   The Feeder Point is set under [Screw Tightening Condition]. To pick up screws with the point type Screw Tightening, set the Feeding Point with a [Screw Tightening Condition] in individual program settings. To pick up screws with the point type Tightening (Condition), set the Feeding Point with a [Screw Tightening Condition] specified by condition number.

■ Screw Tightening Point Type

TP MENU [Individual Program Settings]
[Screw Tightening Condition]
[Feeder]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition] → [Feeder]

■ Tightening (Condition) Point Type

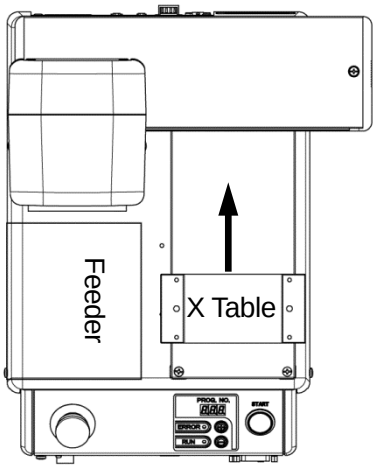
TP MENU [Screw Tightening Condition]
[Feeder]

PC [Data] → [Screw Tightening Condition] → [Add/Edit] → [Feeder]

4. Leaving Screw
   The screwdriver drops screws here after a loosening operation.
   A wait time after a screw is dropped can be set in “Leave Screw Time” for this point. Leaving Screw is set in [Screw Tightening Condition].

5. Evasion (Before Feeding)
   If you set a screw tightening point, the robot starts moving towards the screw tightening point after it picks up a screw from the feeder via a feeding point. If there is an obstacle in the way while the robot moves to the feeder, by setting an evasion (before feeding) point in advance, the robot can evade the obstacle and move the screwdriver to the feeding point.

6. Evasion (After Feeding)
   This point is used to evade an obstacle on the way from the feeder to the screw tightening point. By setting an evasion (after feeding) point in advance, the robot can evade an obstacle after picking up a screw.



Example: JR3203N-AC

7. Wait Start Point

   The robot holds at this position until the start button is pressed or the start signal is turned ON. The screwdriver makes a PTP movement to the next point.

8. Standby Point on Error

   The robot moves to this point and holds here when a screw tightening error occurs.

   Note that the screwdriver will not go to this point if [Action on Error] is not set to [Go to Standby Point on Error] in the [Screw Tightening Condition], even if a screw tightening error occurs.

   The [Standby Point on Error] is set in the [Screw Tightening Condition].

   An error at a Screw Tightening type point can be handled with [Screw Tightening Condition] in individual program settings. Set [Standby Point on Error] for errors at Tightening (Condition) type points in the [Screw Tightening Condition] specified by number.

■ [Standby Point on Error] for Screw Tightening points

TP MENU [Individual Program Settings]
[Screw Tightening Condition]
[Standby Point on Error]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition] → [Standby Point on Error]

■ [Standby Point on Error] for Tightening (Condition) points

TP MENU [Screw Tightening Condition]
[Standby Point on Error]

PC [Data] →[Screw Tightening Condition] → [Add/Edit] → [Standby Point on Error]

NOTE

Refer to the general operation manuals pertaining to this robot for explanations about standard point types.

The table below shows which point jobs and additional functions can be set to which point types.
The items available vary according to point type.

(✓: Settable, blank: Cannot be set)

Job/Additional Function / Point Type	Line Speed	Condition Number*1	Job before Moving*2	Job while Moving*2	Job after Moving*2	Job while CP Moving*2	PTP Condition	CP Condition	Tool Data	Pallet Routine	Work Adjustment	Execute Condition	Tag Code
Screw Tightening		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Tightening (Condition)		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Feeding Point		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Leaving Screw		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Evasion (Before Feeding)		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Evasion (After Feeding)							✓			✓		✓	
Wait Start Point		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Standby Point on Error		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
PTP Point		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
CP Start Point	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
CP Passing Point	✓				✓						✓	✓	✓
CP Stop Point	✓				✓	✓		✓			✓	✓	✓
CP Arc Point	✓				✓						✓	✓	✓
CP End Point					✓		✓				✓	✓	✓
PTP Evasion Point							✓			✓		✓	

*1 [Screw Tightening Condition] selected from [Condition Number] is different from [Condition Data] set from individual program settings. For further details, refer to “8.2 Screw Tightening Conditions.”

*2 If you add a point job etc., to any of the [Screw Tightening] – [Standby Point on Error] points, the job originally set to the point will not be done. For example, usually the robot holds until the start/stop switch is pushed or a start signal is sent for [Wait Start Point], however if you assign a different point job at your discretion, the robot will no longer hold.
Use the *callBase* command to execute both the newly assigned job and the original function assigned to the point type for these points.

8.2 Screw Tightening Condition

To perform a screw tightening operation, first register [Screw Tightening] or [Tightening (Condition)] to a point, then register [Screw Tightening Condition] settings according to the type of screws you are using.

There are two types of [Screw Tightening Condition]: One is in individual program settings and the other is selected by condition number.

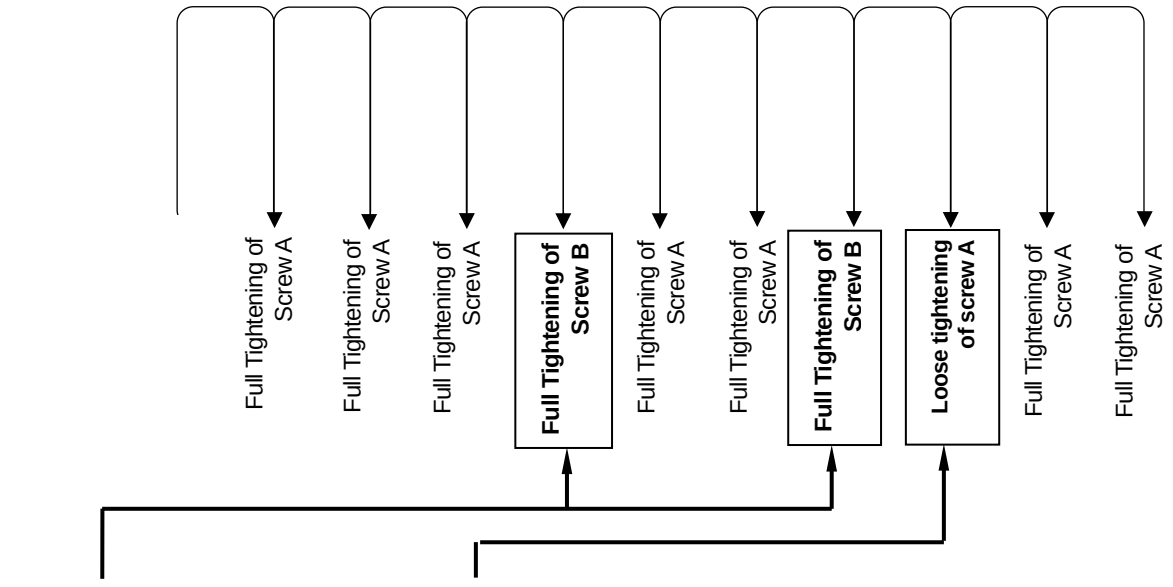
“Screw tightening conditions” included in individual program settings apply to [Screw Tightening] point types set in the same program.

“Screw tightening conditions” selected by condition number apply to [Tightening (Condition)] point types. Use this when you want to use different screws for only a few spots in the same run, or when you want to use different tightening methods with the same screws.

Example: when you want to execute screw tightening as per the diagram below, in individual program settings register the [Screw Tightening Condition] to fully tighten Screw A, and register all points where you want to fully tighten screw A with the point type [Screw Tightening]. All other screw tightening points, register as [Tightening (Condition)].

Register the independent [Screw Tightening Condition] respectively for fully tightening screw B and loosely tightening screw A, and then register the [Tightening (Condition)] numbers to those points.

□: Points where [Tightening (Condition)] is set

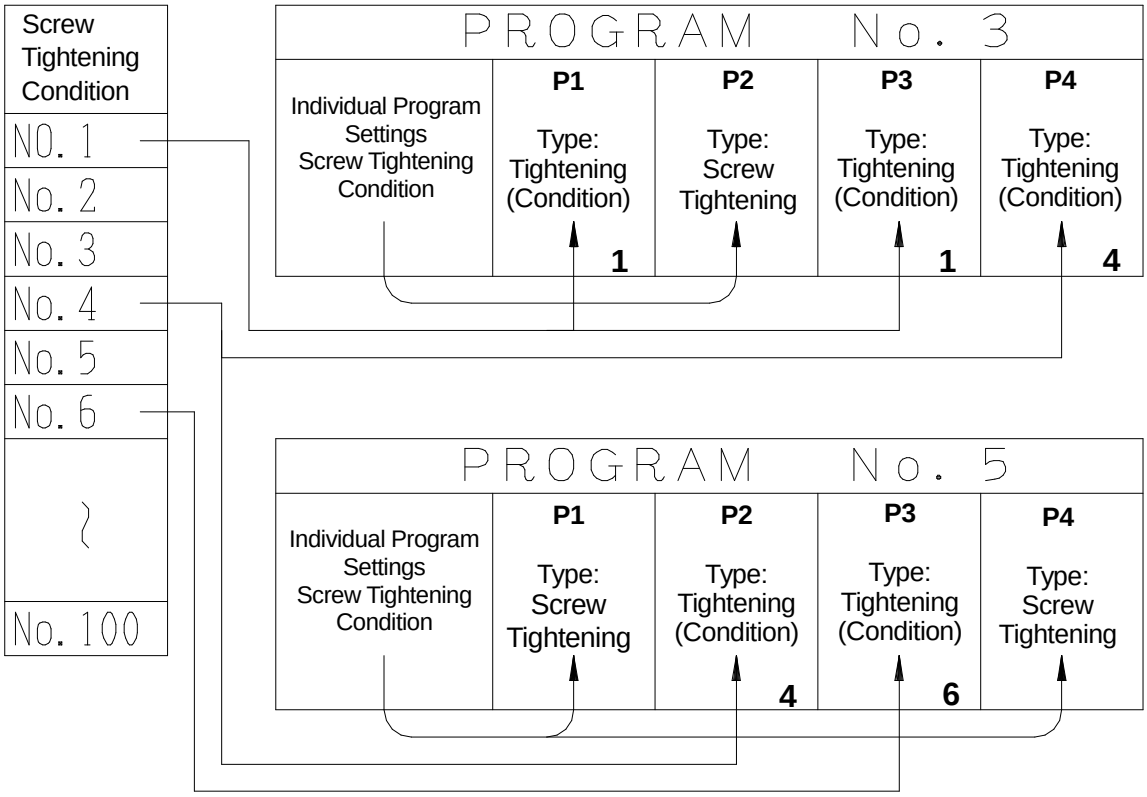


No.1 Full tightening for screw B	No.2 Full tightening for screw C	No.3 Loose tightening for screw A	No.4 Loose tightening for screw B	No.5 Loose tightening for screw C	...	No.100

8.2.1 Screw Tightening Condition (condition data)

The contents of “screw tightening conditions” in individual program settings and “screw tightening conditions” selected by condition number are the same settable item (the point they affect is different). “Screw tightening conditions” in individual program settings are applied only to [Screw Tightening] points set in the same program. “Screw tightening conditions” selected by condition number can be called and applied to [Tightening (Condition)] points in any program which are set with the condition number. (Refer to the diagram below).

[Screw Tightening Condition] data independently set to a [Screw Tightening] point is ignored.



[Screw Tightening Condition] has the following entries. Note that some items are not available depending on the screw tightening type.

1. Screw Tightening Type

Type	Description
Full Tightening (With Pickup)	Normal screw tightening
Tighten, then Reverse	After a normal screw tightening operation, the screwdriver rotates in reverse by the preset amount to loosen the screw.
Loose Tightening	The screwdriver stops before the tightening is complete.
Unscrew	The screwdriver loosens a fully tightened screw and brings it to the [Leaving Screw] point.
Full Tightening (No Pickup)	The screwdriver tightens a partially tightened screw. It does not pick up a screw from the feeder.

2. Thread Pitch
   Thread pitch of the screw you are using

3. Rotate Speed
   Rotation speed of the electric screwdriver

NOTE: The rotation speed is approximate. This is usually set as the max. screwdriver rotation speed.

4. Screw Length
   Shank length of the screw

5. Check Precision
   There are two types: [Normal] and [High].
   For regular operation, set to [Normal]. When [High] is selected, you need to enter the actual screwdriver rotation speed, measured accurately.

6. Float Amount
   After completing a full tightening, if the Z axis position is higher than the registered height and exceeds the preset [Float Amount], an Early Finish Signal occurs.

7. Time after Tighten
   The screwdriver stops for a preset time after completing screw tightening.

8. Draw Amount
   This is the Z-direction moving distance. With [Tighten, then Reverse], after tightening the screw the same as a Full Tightening operation, the driver rotates in reverse for exactly the [Draw Amount].

9. Screw Amount
   This is the Z-direction moving distance. With [Loose Tightening], the driver takes the screw to the screw tightening point and tightens it for exactly the [Screw Amount].

10. Feeder
    The point where screws are picked up from the feeder.
    - Coordinates
      The feeder point position coordinates.
    - ESC Signal
      Specify whether to use the [Screw Feeder ESC] signals when picking up screws from the feeder.
      NO ESC: The robot does not refer to the [Screw Feeder ESC] signals when picking up screws.

Manual ESC1: The robot holds if the [Screw Feeder ESC1] signal is OFF (there are no screws in the feeder). Turn ON the [Screw Feeder ESC1] signal, and then restart the run with the Start signal.

Auto ESC1: The robot holds if the [Screw Feeder ESC1] signal is OFF (there are no screws in the feeder). Turn ON the [Screw Feeder ESC1] signal to restart the run.

Manual ESC2: The robot holds if the [Screw Feeder ESC2] signal is OFF (there are no screws in the feeder). Turn ON the [Screw Feeder ESC2] signal, and restart the run with the Start signal.

Auto ESC2: The robot holds if the [Screw Feeder ESC2] signal is OFF (there are no screws in the feeder). Turn ON the [Screw Feeder ESC2] signal to restart the run.

- Screw Feed Time
  This is the time the robot holds when it picks up screws from the feeder.

11. Stop after Feeding
    Set whether or not to temporarily stop screwdriver rotation after picking up screws from the feeder.

12. Error Retry
    Set whether or not to retry screw tightening when an Early Finish Signal occurs. The robot can retry only once.

13. Action on Error
    Specify the action the robot takes when a screw tightening error occurs.
    - Stop at the Position
    - Up Z Axis
    - Go to Standby Point on Error

14. Standby Point on Error
    With this Action on Error, when a screw tightening error occurs, the robot will go to and hold at the [Standby Point on Error].
    After reaching the [Standby Point on Error], the screwdriver discards the screw through the ejector.

15. Restart after Early Finish Signal
    Choose to end the program or restart the operation at the same point/next point from where an Early Finish Signal occurs. After the robot has temporarily stopped due to the Early Finish Signal, if you restart the run, it is restarted from the point selected here.

16. Restart after No Finish Signal
    Choose to end the program or restart the operation at the same point/next point from where a No Finish Signal occurs. After the robot has temporarily stopped due to the No Finish Signal, if you restart the run, it is restarted from the point selected here.

17. Drive Amount

    The Z direction distance. To catch the screw effectively with the screw bit, the screwdriver rotates the [Drive Amount] one time in the tightening direction, and then rotates in reverse to loosen the screw.

18. Moving for Leaving

    After removing a screw with [Unscrew], set whether to move to the [Leaving Point] to dispose of the screw. [YES] or [NO].

19. Leaving Screw

    Point for screw disposal. After removing a screw with [Unscrew], the screwdriver moves to the [Leaving Screw] point and discards the screw through the ejector.

    - Coordinates

      The position coordinates of the disposal point
    - Leave Screw Time

      Set the actual [Leave Screw Time] required for discarding a screw after receiving the Ejector OUT signal.

Available Screw Tightening Conditions According to Screw Tightening Types

(Settable: ✓, Not Settable: blank)

	Thread Pitch	Rotate Speed	Screw Length	Check Precision	Float Amount	Time after Tighten	Draw Amount	Screw Amount	Feeder	Stop after Feeding	Error Retry	Action on Error	Standby Point on Error	Restart after Early Finish Signal	Restart after No Finish Signal	Drive Amount	Moving for Leaving	Leaving Screw
Full Tightening (With Pickup)	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			
Tighten, then Reverse	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			
Loose Tightening	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			
Unscrew	✓	✓	✓	✓	✓	✓										✓	✓	✓
Full Tightening (No Pickup)	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓			

8.3 Devices Signals

[Devices Signals] is a common setting for all programs.
You can set and change the start signal and where the screwdriver is connected.

1. I/O Function Assignment
   The assignments of the related device signals can be changed. By default, these are assigned as shown below:
   - Driver Torque Up: #sysIn13
   - Screw Feeder ESC1: #sysIn14
   - Screw Feeder ESC2: #sysIn15
   - Screw Tightening Error: #sysOut9
   - Driver Start: #sysOut10
   - Driver Reverse: #sysOut11
   - Driver Stop: #sysOut12
   - Reserved (Ejector IN): #sysOut15
   - Reserved (Ejector OUT): #sysOut16

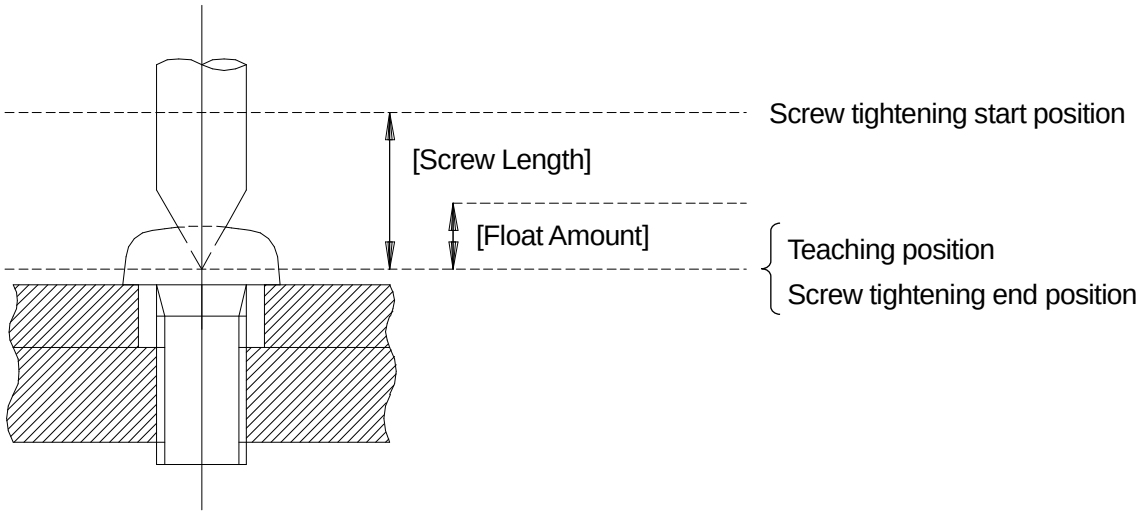
2. Start Signal Settings
   The start signal can be selected from the following two settings:
   - Pulse
     Sets the robot to operate with a device that starts and stops the driver via pulse signal.
   - Level
     Sets the robot to operate with a device that controls driver rotation with level signal.

9. SCREW TIGHTENING OPERATION

9.1 Full Tightening (With Pickup)

A [Full Tightening (With Pickup)] operation involves the screwdriver bit rotating while the Z-axis descends at the speed set in [Screw Tightening Speed] from the screw tightening start position to the position where the tightening is complete.
The position where screw tightening is complete is the screw tightening end position, which should be the same as the registered screw tightening point position.

([Check Precision] set to [Normal])
Screw tightening speed = (screwdriver rotation speed/60) x thread pitch x 1.1
([Check Precision] set to [High])
Screw tightening speed = (screwdriver rotation speed/60) x thread pitch



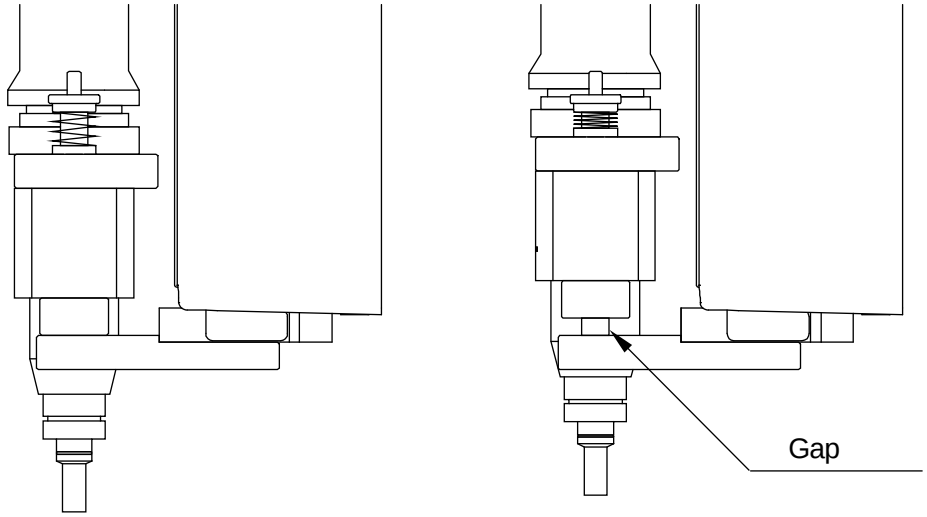
■ Early Finish Signal
If the screw goes in at an angle and the screw tightening end position is higher than: registered position minus the float amount, an Early Finish Signal will occur.
You can set [Error Retry] in the [Screw Tightening Condition] when an Early Finish Signal occurs.

■ No Finish Signal

If the screw tightening is not complete and [Check Precision] is set to [Normal], the Z-axis descends 3 mm. If [Check Precision] is set to [High], the Z-axis descends 1 mm.

If the “teaching position plus 3 mm” position is lower than the height of the workpiece, there is a discrepancy between the Z-axis height and the screwdriver height because the screwdriver position cannot be lower than the height of the workpiece. The difference is absorbed by the spring on the tip of the Z-axis (screwdriver unit part). (See illustration below)

If screw tightening is still not complete, the screwdriver keeps rotating for a time of [5mm/Screw tightening speed] (sec) in the same position. (The spring on screwdriver unit part keeps pressing the screw with the Z-Axis maintaining its position.) If screw tightening is not complete even after the above processes finish, a No Finish Signal occurs.



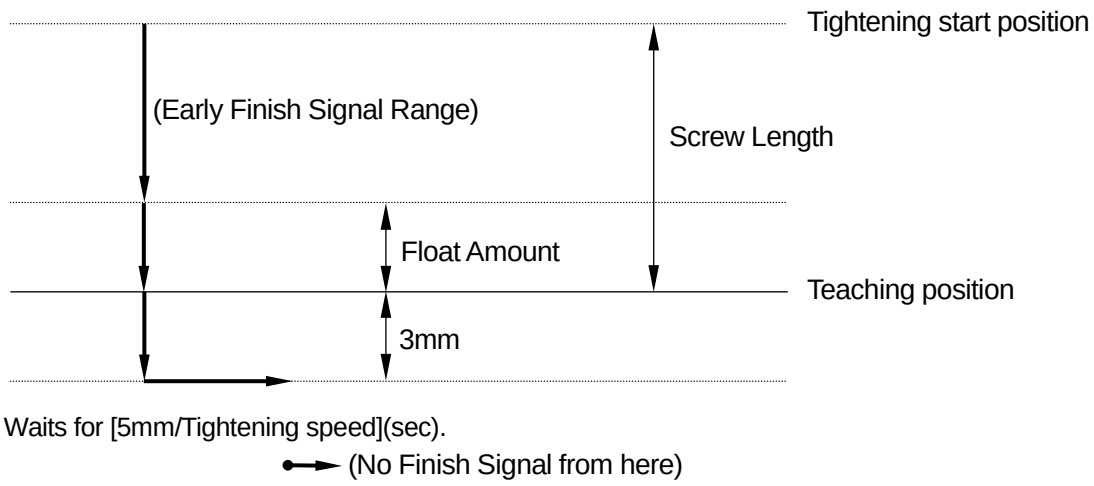
■ Screw Tightening Error and Driver Rotation Speed

If the frictional resistance between the screw and the workpiece is high, the screwdriver rotation speed may not reach the rated value. In this case, the rotation speed cannot keep up with the descending speed of the Z-axis and a No Finish Signal occurs.

To prevent this error, reduce the screw tightening speed. Set the value of [Rotate Speed] in the [Screw Tightening Condition] settings to slower than that of the rated speed.

Conversely, if the actual rotation speed is higher than the setting value, the screw is tightened faster than the descending speed of the Z-axis and may cause an Early Finish Signal.

Z axis movement in a [Full Tightening (With Pickup)] Operation
(The height does not match the screwdriver height.)



NOTE

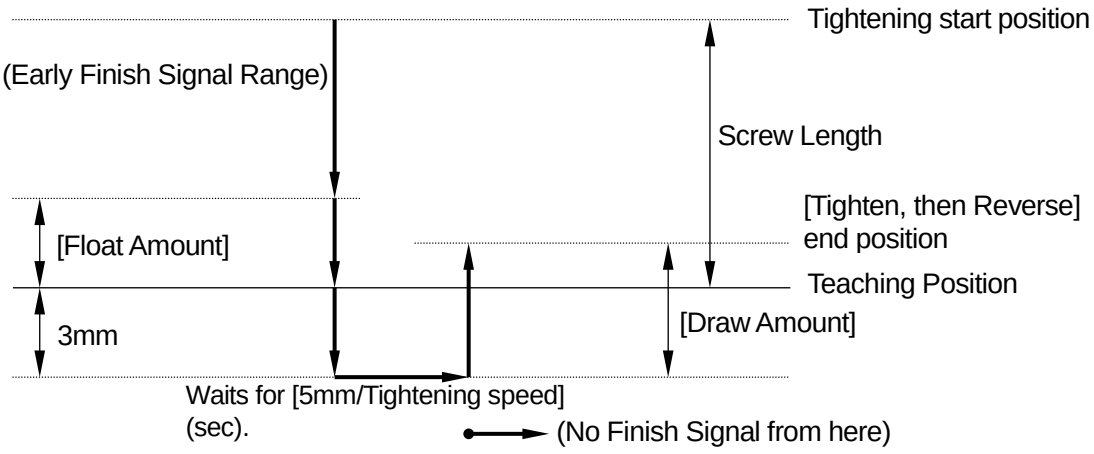
When the screw is fully tightened, screw tightening is complete.

9.2 Tighten, then Reverse

After completing [Full Tightening (With Pickup)], the Z-Axis ascends while the screwdriver rotates in reverse by the preset [Draw Amount] in the [Screw Tightening Condition] settings.

Ascending speed (mm/sec) = (Rotate Speed/60) x Thread Pitch x 0.9

- Z-axis movement in [Tighten, then Reverse] Operation.
  (The height does not match the screwdriver height.)



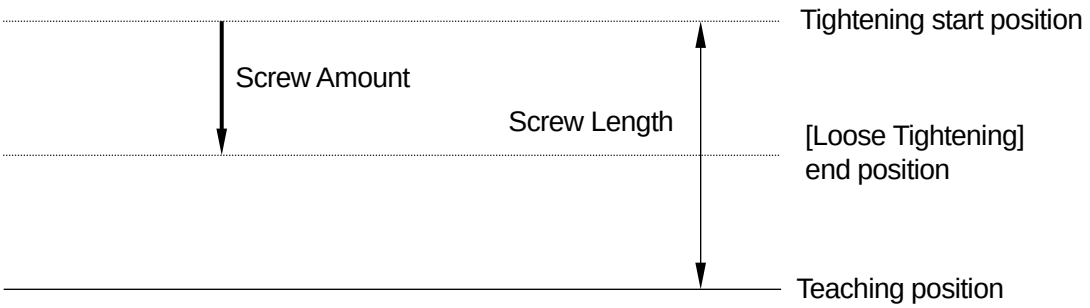
NOTE

The Z-axis starts ascending immediately after screw tightening is complete.

9.3 Loose Tightening

The Z-Axis descends from the tightening start position by the preset [Screw Amount] in the [Screw Tightening Condition] settings at the [Screw Tightening Speed].

- Z-axis movement in [Loose Tightening] Operation.
  (The height does not match the screwdriver height.)



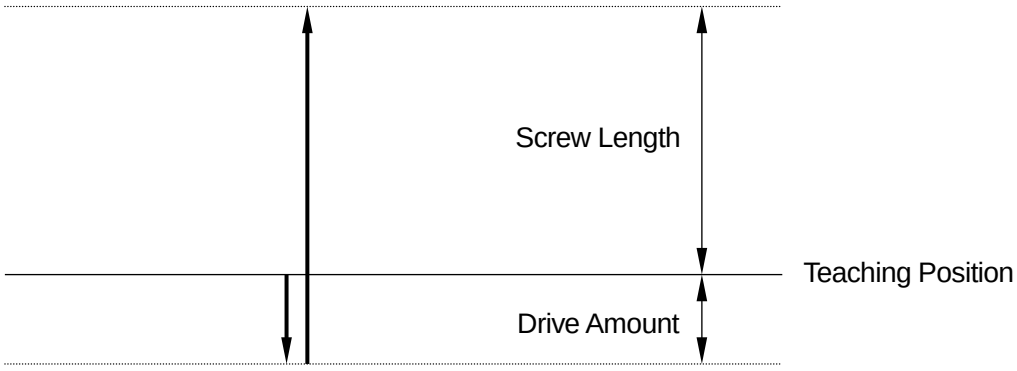
NOTE

If tightening is completed someplace between the tightening start position and the loose tightening end position, an Early Finish Signal occurs.

9.4 Unscrew

The Z-axis descends from the teaching position by [Drive Amount] so that the screwdriver bit can cleanly catch the slot on the screw head. After descending, the screwdriver rotates in reverse while Z-axis ascends by the [Screw Length]. The ascending speed is the same as that in the [Tighten, then Reverse] operation.
If [Moving for Leaving] is set to [YES], the screwdriver loosens a screw and brings it to the [Leave Screw] point.

- Z-axis movement in [Unscrew] Operation.
  (The height does not match with the screwdriver height.)

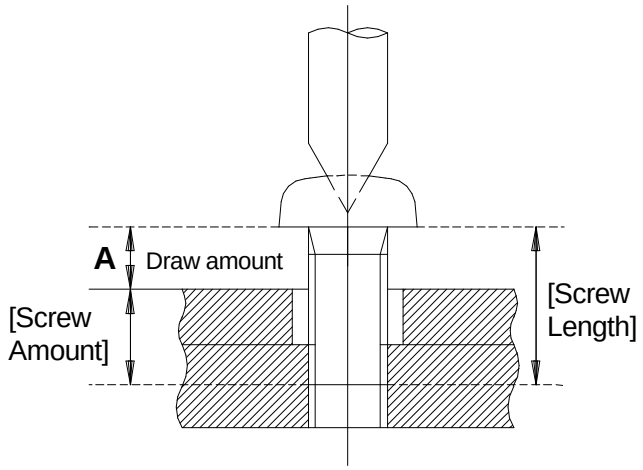


9.5 Full Tightening (No Pickup)

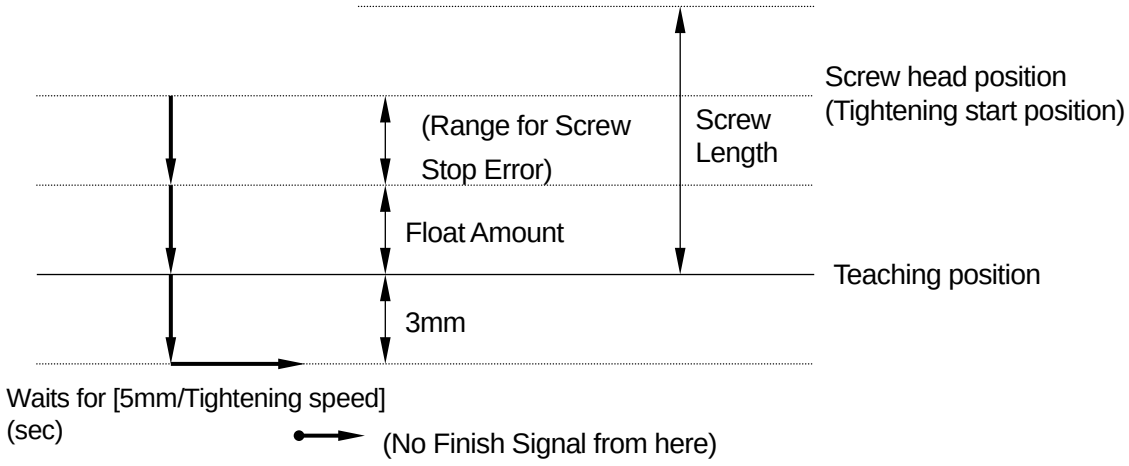
In a [Full Tightening (No Pickup)] operation, the screw head height becomes the tightening start position. Otherwise, this operation is the same as [Full Tightening (With Pickup)].

NOTE

With a [Full Tightening (No Pickup)] operation, set the [Screw Length] as the value for A in the diagram to the right. This is the same as the [Draw Amount] for a [Tighten, then Reverse] operation, or the [Screw Length] – [Screw Amount] for a [Full Tightening (No Pickup)] operation.



- Z-axis movement in [Full Tightening (No Pickup) Operation
  (The height does not match with the screwdriver height.)



NOTE

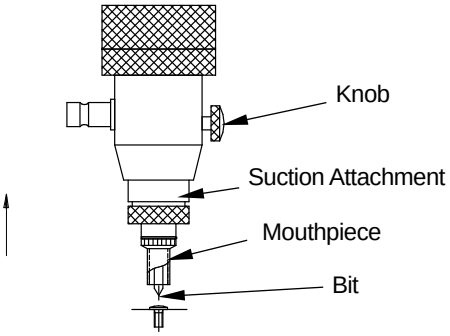
When the screw is fully tightened, the screw tightening operation is complete.

10. POSITION ENTRY

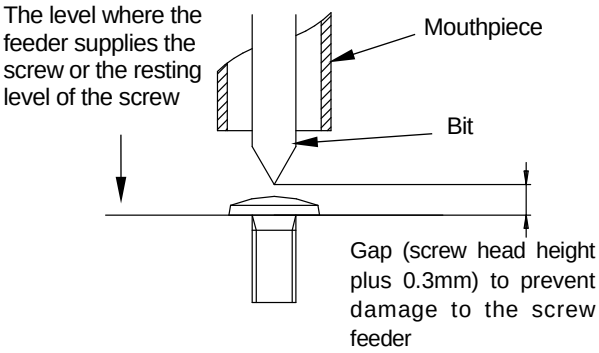
10.1 How to Enter a Feeder Point

■ Suction Attachment Adjustment

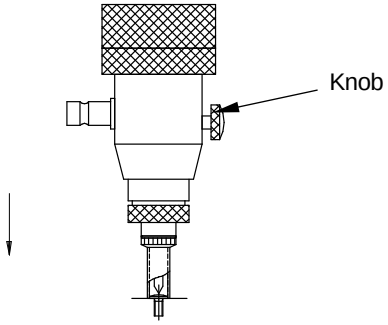
1. Loosen the knob keeping the suction attachment in place.
   Lift the suction attachment and then tighten the knob.



2. Leave a small gap (approx. 0.3mm) between the bit tip and the screw head.



3. Loosen the knob and lower the suction attachment. Check that the inner area of the mouthpiece reaches the resting area of the screw without hitting the screw head.



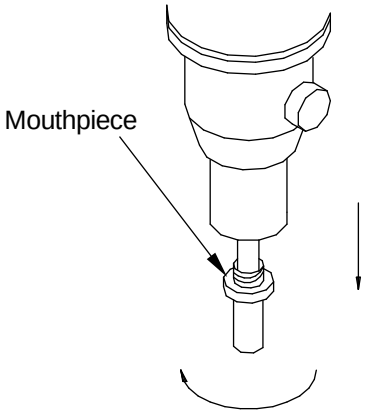
4. Tighten the knob.

NOTE

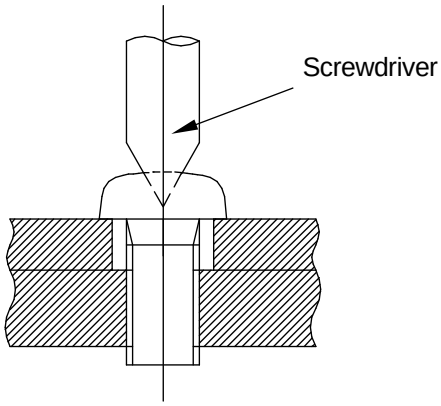
The X coordinates of the [Feeding Point] are ignored when the robot is running. When moving to the [Feeding Point] during a run, because the feeder is not on the X table, the X Table does not move.

10.2 How to Enter a Screw Tightening Point

When registering a screw tightening point, first remove the mouthpiece.
Next, be sure to take note of the two conditions below.
After registering a screw tightening point, reattach the mouthpiece.



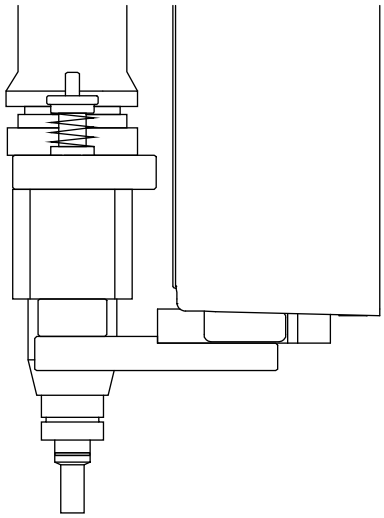
1. After tightening a screw, check that the tip of the screwdriver fits precisely into the bottom of the screw head slot (as shown to the right).



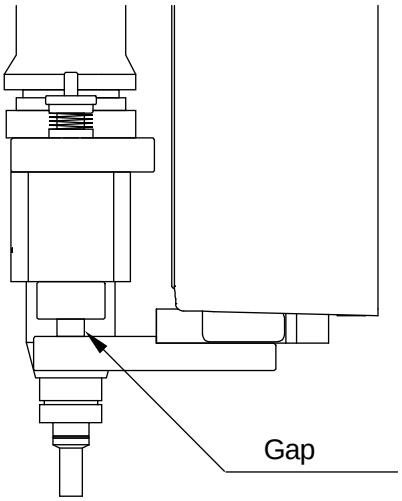
2. When the tip of the screwdriver is aligned with the slot of the screw head, if the Z-axis is lowered further, a gap appears as shown below. Make sure this gap does not appear.

NOTE

- If there is a gap present, the precision of the screw float detection is not accurate and the screw may jar the workpiece.
- If the tip of the screwdriver is not accurately aligned with the bottom of the screw head slot, the driver may rotate idly.



Screwdriver when there is no gap



Screwdriver when there is a gap

11. HOW TO PERFORM [FULL TIGHTENING]

Available Screw Tightening Conditions According to Screw Tightening Types

(Settable: ✓, Not Settable: blank)

	Thread Pitch	Rotate Speed	Screw Length	Check Precision	Float Amount	Time after Tighten	Draw Amount	Screw Amount	Feeder	Stop after Feeding	Error Retry	Action on Error	Standby Point on Error	Restart after Early Finish Signal	Restart after No Finish Signal	Drive Amount	Moving for Leaving	Leaving Screw
Full Tightening (With Pickup)	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			
Full Tightening (No Pickup)	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓			

To perform a [Full Tightening] operation, at minimum you need to set the 5 items from the [Screw Tightening Condition] settings list below. In a [Full Tightening (No Pickup)] the screwdriver does not go to the feeder point (you do not need to set [Feeder]).

1. Type (Set [Full Tightening (With Pickup)] or [Full Tightening (No Pickup)])
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Feeder

Here is an example of a new program registration.

■ Program/Point

TP PRG.NO Enter a program number.

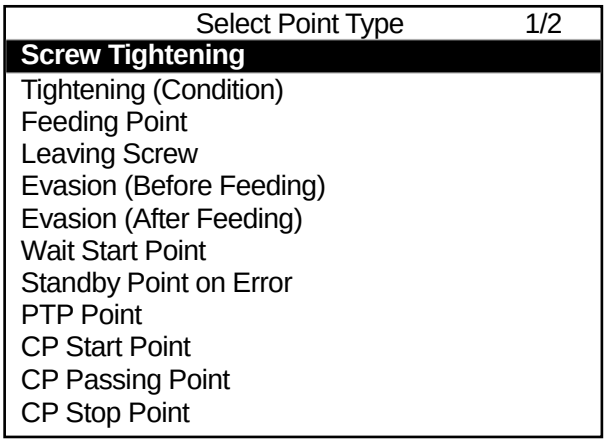
PC [Program] → [Add Program] → Enter a program number.

Press the SHIFT + ESC keys to return to the base screen and press the PRG.NO key.
The program number entry screen is displayed. Enter the program number you want to register.
The new position entry screen for Point 01 appears.

Enter the point position where you wish to perform [Full Tightening].
If you are registering a new point, the point type selection screen (shown to the right) appears after the coordinates are entered.
Select [Screw Tightening].

NOTE

If you register a program using a PC (JR C-Points II), after adding a program, click the  icon to add the point type [Screw Tightening] to the program.



Point Type Selection Screen

■ Screw Tightening Condition Settings

TP MENU [Individual Program Settings]
[Screw Tightening Condition]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition]

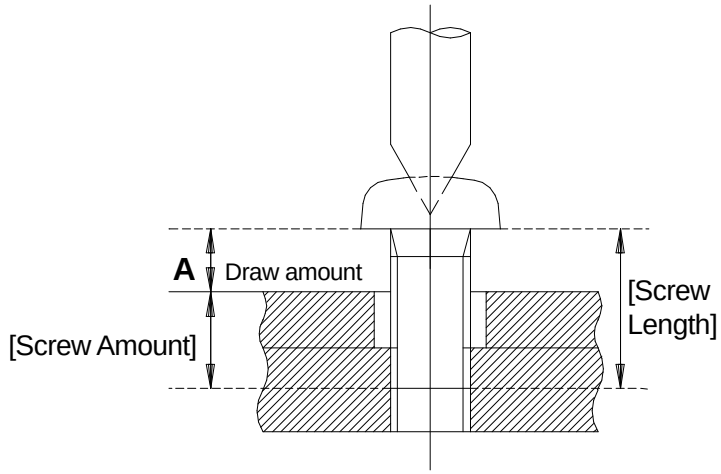
Set the values for the items below in the [Screw Tightening Condition] settings according to the screw, screwdriver and screw feeder you are using.

1. Type (Set [Full Tightening] or [Full Tightening (No Pickup)].)
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Feeder

NOTE

Set a time in [Time after Tighten] to hold the screwdriver for that duration after tightening is complete.

With a [Full Tightening (No Pickup)]] operation, set the [Screw Length] as the value for A in the diagram to the right. This is the same as the [Draw Amount] for a [Tighten, then Reverse] operation, or the [Screw Length] – [Screw Amount] for a [Full Tightening (No Pickup)] operation.



[Screw Tightening Condition] in individual program settings applies to points where the point type [Screw Tightening] is set.
To perform a tightening operation for only one point that differs from the other points in the same program, register the point type [Tightening (Condition)] and set the condition data number to that point. The independent condition data [Screw Tightening Condition] applies to points where the point type [Tightening (Condition)] is set.

12. HOW TO PERFORM [TIGHTEN, THEN REVERSE] AND [LOOSE TIGHTENING]

Available Screw Tightening Conditions According to Screw Tightening Types

(Settable: ✓, Not Settable: blank)

	Thread Pitch	Rotate Speed	Screw Length	Check Precision	Float Amount	Time after Tighten	Draw Amount	Screw Amount	Feeder	Stop after Feeding	Error Retry	Action on Error	Standby Point on Error	Restart after Early Finish Signal	Restart after No Finish Signal	Drive Amount	Moving for Leaving	Leaving Screw
Tighten, then Reverse	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			
Loose Tightening	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			

To perform [Tighten, then Reverse] or [Loose Tightening], at minimum you need to set the 6 items below from the [Screw Tightening Condition] settings.
Items [Draw Amount] and [Screw Amount] can be set only for the tightening types [Tighten, then Reverse] and [Loose Tightening] respectively.

1. Type (Set [Tighten, then Reverse] or [Loose Tightening].)
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Feeder
6. Draw Amount (for [Tighten, then Reverse]) or Screw Amount (for [Loose Tightening])

If a time for the screw tightening condition [Time after Tighten] is set for a [Tighten, then Reverse] operation, the screwdriver holds for that set time after the [Tighten, then Reverse] operation is complete.

Here is an example of a new program registration.

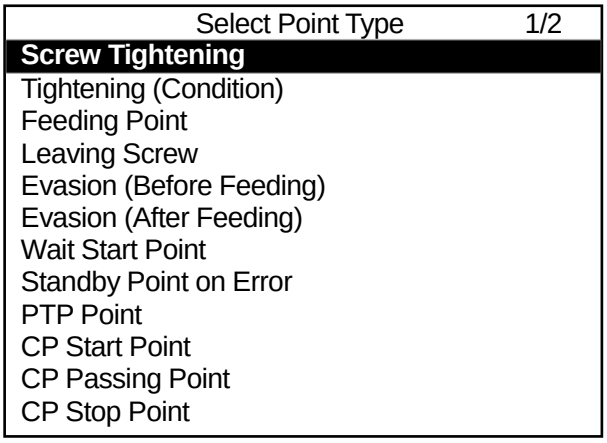
■ Program/Point

TP PRG.NO Enter a program number.

PC [Program] → [Add Program] → Enter a program number.

Press the SHIFT + ESC keys to return to the base screen and press the PRG.NO key.
The program number entry screen is displayed.
Enter the program number you want to register.
The new position entry screen for Point 01 appears.

Enter the point position where you want to perform [Loose Tightening].
If you are registering a new point, the point type selection screen (shown to the right) appears after the coordinates are entered.



Point Type Selection Screen

Select [Screw Tightening].

NOTE

If you register a program using a PC (JR C-Points II), after adding a program, click the icon to add the point type [Screw Tightening] to the program.

■ Screw Tightening Condition Settings

TP MENU [Individual Program Settings]
[Screw Tightening Condition]

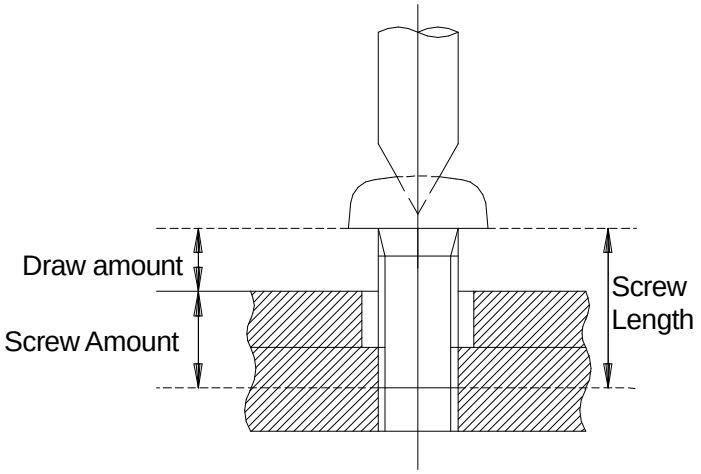
PC [Program] →[Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition]

Set the values for the items below in the [Screw Tightening Condition] settings according to the screw, screwdriver and screw feeder you are using:

1. Type (Set [Tighten, then Reverse] or [Loose Tightening].)
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Feeder
6. Draw Amount (for [Tighten, then Reverse]) or Screw Amount (for [Loose Tightening])

Draw Amount

The [Draw Amount] is the distance of movement in the -Z direction.
In a [Tighten, then Reverse] operation, the screwdriver tightens a screw in the same way as in [Full Tightening] and then rotates the screwdriver in reverse, loosening the screw by the amount set in [Draw Amount].



Screw Amount

The [Screw Amount] is the distance of movement in the +Z direction.
In a [Loose Tightening] operation, the screwdriver tightens the screw by the value set in [Screw Amount].

[Screw Tightening Condition] in individual program settings applies to points where the point type [Screw Tightening] is set.
To perform a tightening operation for only one point that differs from that for other points in the same program, register the point type [Tightening (Condition)] and set the condition data number to that point. The independent [Screw Tightening Condition] applies to points where the point type [Tightening (Condition)] is set.

13. HOW TO PERFORM [UNSCREW]

Available Screw Tightening Conditions According to Screw Tightening Types

(Settable: ✓, Not Settable: blank)

	Thread Pitch	Rotate Speed	Screw Length	Check Precision	Float Amount	Time after Tighten	Draw Amount	Screw Amount	Feeder	Stop after Feeding	Error Retry	Action on Error	Standby Point on Error	Restart after Early Finish Signal	Restart after No Finish Signal	Drive Amount	Moving for Leaving	Leaving Screw
Unscrew	✓	✓	✓	✓	✓	✓										✓	✓	✓

When the screw tightening type is set to [Unscrew] and the robot is run, it loosens tightened screws.
In an [Unscrew] operation, the screwdriver rotates once by the [Drive Amount] in the tightening direction to catch the screw in the screw bit, and then rotates in reverse to loosen the screw.
After removing the screw, the screwdriver moves to the preset [Leaving Screw] point and discards the screw at this point if [Moving for Leaving] is set to [YES]. If [Moving for Leaving] is set to [NO], the screwdriver immediately discards the screw through the ejector.
The items [Drive Amount], [Moving for Leaving], and [Leaving Screw] can only be set for an [Unscrew] operation.

To perform a [Unscrew] operation, at minimum you need to set the 6 items below from the [Screw Tightening Condition] settings:

1. Type
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Drive Amount
6. Moving for Leaving

Also, when discarding screws that get caught or for some reason are hard to discard, you can a [Leave Screw Time] to the [Leaving Screw] point. The screwdriver will blow air continuously for the set [Leave Screw Time].

NOTE

For unscrewing screws, set the screwdriver torque higher than for when tightening screws.

Here is an example of a new program registration.

■ Program/Point

TP PRG.NO Enter a program number.

PC [Program] → [Add Program] → Enter a program number.

Press the SHIFT + ESC keys to return to the base screen and press the PRG.NO key. The program number entry screen is displayed.
Enter the program number you want to register. The new position entry screen for Point 01 appears.
Enter the point position where you wish to perform [Unscrew].
If you are registering a new point, the point type selection screen (shown to the right) appears after the coordinates are entered.

Select Point Type	1/2
Screw Tightening	
Tightening (Condition)	
Feeding Point	
Leaving Screw	
Evasion (Before Feeding)	
Evasion (After Feeding)	
Wait Start Point	
Standby Point on Error	
PTP Point	
CP Start Point	
CP Passing Point	
CP Stop Point	

Point Type Selection Screen

Select [Screw Tightening].

NOTE

If you register a program using a PC (JR C-Points II), after adding a program, click the  icon to add the point type [Screw Tightening] to the program.

■ Screw Tightening Condition Settings

TP MENU [Individual Program Settings]
[Screw Tightening Condition]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition]

Set the values for the items below in the [Screw Tightening Condition] settings according to the screw, screwdriver and screw feeder you are using:

1. Type
2. Thread Pitch
3. Rotate Speed
4. Screw Length
5. Drive Amount
6. Moving for Leaving

■ Leaving Screw

In addition to [Leave Screw Time], you can set point job data and additional function data to the [Leaving Screw] point.

[Screw Tightening Condition] in individual data applies to points where the point type [Screw Tightening] is set.

To perform a tightening operation for only one point that differs from other points in the same program, register the point type [Tightening (Condition)] and set the condition data number to that point. The independent condition data [Screw Tightening Condition] applies to points where the point type [Tightening (Condition)] is set.

14. FEEDER

[Feeder] is one of the items settable in [Screw Tightening Condition]. Set the position from where the screwdriver picks up screws as the [Point of Feeding]. Except for special circumstances, you do not need to change the feeder point's point type from its default setting, [Point of Feeding]. Change the position (coordinates) only.
You can also set point job data and additional function data to [Feeder].

■ [Feeder] for the Point Type [Screw Tightening]

TP MENU [Individual Program Settings]
[Screw Tightening Condition]
[Feeder]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition] → [Feeder]

■ [Feeder] for the Point Type [Tightening (Condition)]

TP MENU [Screw Tightening Condition]
[Feeder]

PC [Data] → [Screw Tightening Condition] → [Add/Edit] → [Feeder]

Select a tightening condition registered with a number set to a point with the point type [Tightening (Condition)].

■ ESC Signal

Make the [ESC Signal] setting from the following 5 choices: [No Esc], [Manual ESC1], [Auto ESC1], [Manual ESC2] and [Auto ESC2].

- No ESC
  The robot does not refer to the [Screw Feeder ESC] signals when picking up screws. Select [No ESC] if the feeder you are using does not have a signal output function. If [No ESC] is selected, the robot cannot detect whether the screws are in the feeder or not.

- Manual ESC1
  The robot holds if the [Screw Feeder ESC1] signal is OFF (there are no screws in the feeder). When the [Screw Feeder ESC1] signal goes ON (screws are in the feeder), restart the run with a start instruction.

- Auto ESC1 (1: Feeder Number 1)
  The robot holds if the [Screw Feeder ESC1] signal is OFF (there are no screws in the feeder). When the [Screw Feeder ESC1] signal goes ON (screws are in the feeder), the run restarts.

- Manual ESC2 (2: Feeder Number 2)
  The robot holds if the [Screw Feeder ESC2] signal is OFF (there are no screws in the feeder). When the [Screw Feeder ESC2] signal goes ON (screws are in the feeder), restart the run with a start instruction.

- Auto ESC2 (2: Feeder Number 2)
  The robot holds if the [Screw Feeder ESC2] signal is OFF (there are no screws in the feeder). When the [Screw Feeder ESC2] signal goes ON (screws are in the feeder), the run restarts.

The ESC signals have default settings as follows: however, you can change the assignment under the [I/O Function Assignment].

Screw Feeder ESC1: #sysIn14
Screw Feeder ESC2: #sysIn15

■ Screw Feed Time

You can set [Screw Feed Time] to [Point of Feeding].
The screwdriver holds at the screw pickup position for the preset [Screw Feed Time].

■ Stop After Feeding

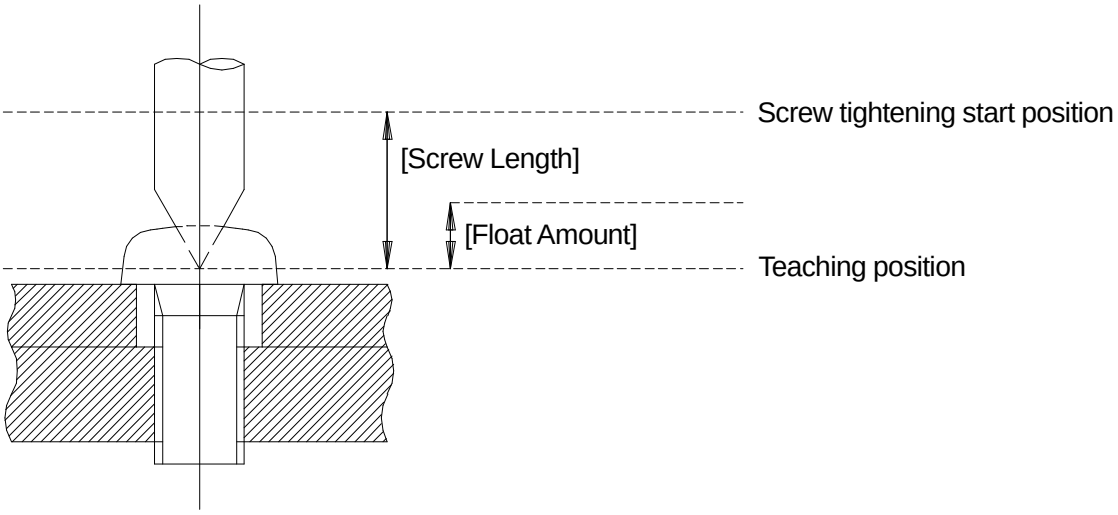
With [Stop After Feeding], you can set the electric screwdriver to rotate or hold.

15. CHECK PRECISION

[Check Precision] is one of the items settable in [Screw Tightening Condition]. You can select a screw float detection frequency of either [Normal] or [High].
If the [Check Precision] is set to [Normal], the Z-axis descends 1.1 times faster than the screw tightening speed. If it is set to [High], the Z-axis descends at the same speed as the screw tightening speed.

Screw Tightening Speed (Check Precision: Normal) = (Rotate Speed/60) x Screw Pitch x 1.1
Screw Tightening Speed (Check Precision: High) = (Rotate Speed/60) x Screw Pitch

If [High] is selected, enter an accurately measured screwdriver rotation speed.



■ Early Finish Signal

If the position when screw tightening is complete is higher than the teaching position minus the float amount, an Early Finish Signal occurs.

■ Operation for when an Early Finish Signal occurs at the [Screw Tightening] point type

TP MENU [Individual Program Settings]
[Screw Tightening Condition]
[Check Precision]

PC [Program] → [Individual Program Settings] → [Individual Data]
→ [Screw Tightening Condition] → [Check Precision]

■ Operation for when an Early Finish Signal occurs at the [Tightening (Condition)] point type

TP MENU [Screw Tightening Condition]
[Check Precision]

TP [Data] → [Screw Tightening Condition] → [Add/Edit] → [Check Precision]

For the tightening condition, select a tightening condition registered by number for a point with the [Tightening (Condition)] point type.

16. WHAT TO DO WHEN A TIGHTENING ERROR OCCURS

You can select or set one of the 5 following [Screw Tightening Condition] items as what to do when a screw tightening error occurs:

16.1 Error Retry

Set whether or not to retry the screw tightening operation ([YES] or [NO]) when an Early Finish Signal occurs.

16.2 Action on Error

Specify an action for the robot to take when a screw tightening error occurs.

- Stop at the Position
- Up Z Axis
- Go to Standby Point on Error

16.3 Standby Point on Error

If [Action on Error] is set to [Go to Standby Point on Error], the screwdriver moves to the coordinates set in [Standby Point on Error] when a screw tightening error occurs. The screwdriver then discards the screw and waits for a start signal.
Also, point job data and additional function data can be set to the [Standby Point on Error].

16.4 Restart after Early Finish Signal

Choose to end the program or restart the operation at the same point/next point from where an Early Finish Signal occurs. After the robot has temporarily stopped due to the Early Finish Signal, if you restart the run, it is restarted from the point selected here. If the screw tightening condition type is [Unscrew], you cannot set this as a way to prevent errors from occurring.

16.5 Restart after No Finish Signal

Choose to end the program or restart the operation at the same point/next point from where a No Finish Signal occurs. After the robot has temporarily stopped due to the No Finish Signal, if you restart the run, it is restarted from the point selected here. If the screw tightening condition type is [Unscrew], you cannot set this as a way to prevent errors from occurring.

■ Operation for a Screw Tightening Error with the Point Type [Screw Tightening]

TP MENU [Individual Program Settings]
[Screw Tightening Condition]
[Error Retry]
[Action on Error]
[Standby Point on Error]
[Restart after Early Finish Signal]
[Restart after No Finish Signal]

PC [Program] → [Individual Program Settings] → [Individual Data]
→[Screw Tightening Condition] → [Error Retry]
→ [Action on Error]
→ [Standby Point on Error]
→ [Restart after Early Finish Signal]
→ [Restart after No Finish Signal]

■ Operation for a Screw Tightening Error with the Point Type [Tightening (Condition)]

TP MENU [Screw Tightening Condition]
[Error Retry]
[Action on Error]
[Standby Point on Error]
[Restart after Early Finish Signal]
[Restart after No Finish Signal]

PC [Data] → [Screw Tightening Condition] → [Add/Edit] → [Error Retry]
→ [Action on Error]
→ [Standby Point on Error]
→ [Restart after Early Finish Signal]
→ [Restart after No Finish Signal]

For the tightening condition, select a tightening condition registered by condition number for a point with the [Tightening (Condition)] point type.

17. HOW TO EDIT SCREW TIGHTENING CONDITIONS

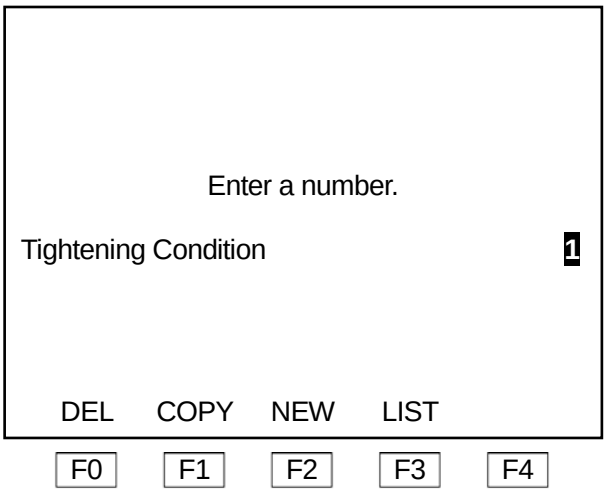
[Screw Tightening Condition] is the setting for screw tightening that is performed at points where the point types [Screw Tightening] and [Tightening (Condition)] are set.
There are two types of [Screw Tightening Condition]: one is contained in individual program settings and the other is selected by condition number.
“Screw tightening conditions” included in individual program settings apply to points where the point type [Screw Tightening] is set in that same program.
“Screw tightening conditions” selected by condition number apply to points where the point type [Tightening (Condition)] is set.
The following is an explanation of how to edit a “screw tightening condition” selected by condition number.

For both registering a new point and modifying a registered point, first, you need to display the settings screen. Use one of the following methods to display the Screw Tightening Condition settings screen.

1. Perform the following operation on the point settings screen (the base screen).

TP MENU [Screw Tightening Condition]
Enter a tightening condition number.

2. Display the Tightening Condition Number entry screen (shown to the right) by using method 1 above.
   Press the F2 (NEW) key on the Tightening Condition number entry screen to display the available numbers, or press the F3 (LIST) key to display a list of registered tightening conditions.
   Select a number from the list. The selected screw tightening condition settings are displayed on the screen.



Tightening Condition Number Entry Screen

3. From the point setting display screen select a screw tightening condition number. On the Tightening Condition Number Entry Screen push the [F4] (VIEW) key to display the tightening condition settings screen for the selected number.
   (Refer to “8. Teaching Data” for the points that are displayed on the settings screen for condition numbers).

Or you can set screw tightening conditions using the following method:

1. Perform the operation below on the point setting screen (base screen).

TP [MENU] [Screw Tightening Condition]
Enter the screw tightening condition number.

2. If you are registering a new [Tightening (Condition)] point, press the [F2] (NEW) key to display the available tightening condition numbers, and press the [F3] (LIST) key to display the registered tightening condition numbers on the Tightening Condition Number Entry Screen. Select a number from the list. The screw tightening condition settings screen for the selected number is displayed.
   Also, press the [F4] (VIEW) key on the Tightening Condition Number Entry Screen to display the tightening condition settings screen for the currently selected number.

17.1 How to Set a Screw Tightening Condition

Select the item you wish to set or change on the Screw Tightening Condition settings screen (shown to the right) and press the [ENTR] key.
The number entry screen or selection screen for the selected item is shown.
Enter the value or select the item that you want.

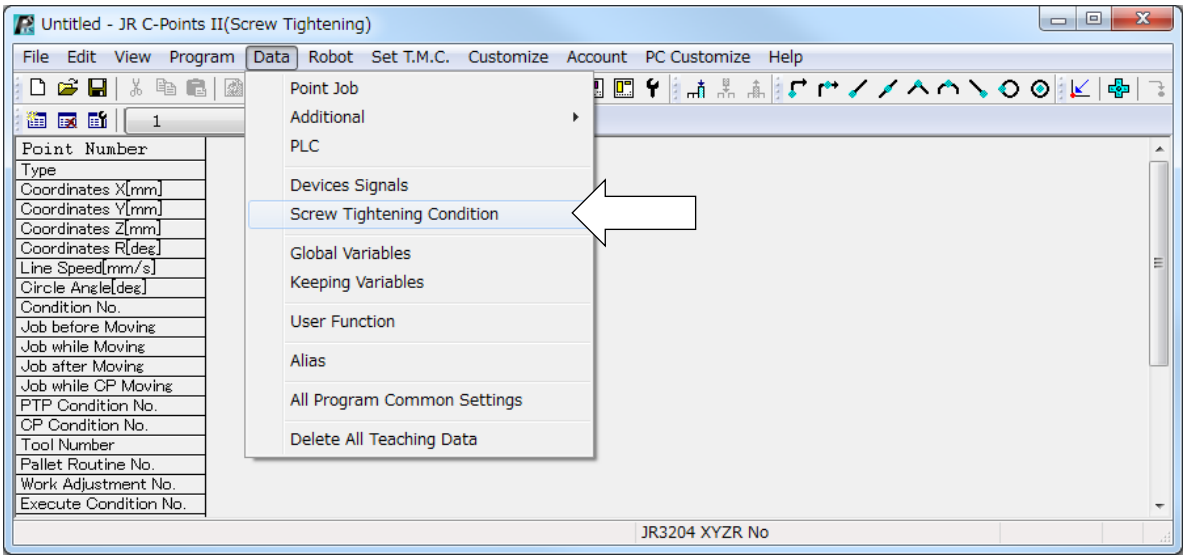
Press the [ESC] key to return to the previous screen.

Screw Tightening Condition 1	1/2
Type	**Tightening (With Pickup)**
Thread Pitch	0.5mm
Rotate Speed	600rpm
Screw Length	8mm
Check Precision	Normal
Float Amount	0.5mm
Time after Tighten	0.5sec
Draw Amount	0mm
Screw Amount	0mm
Feeder	
Stop After Feeding	NO
Error Retry	YES

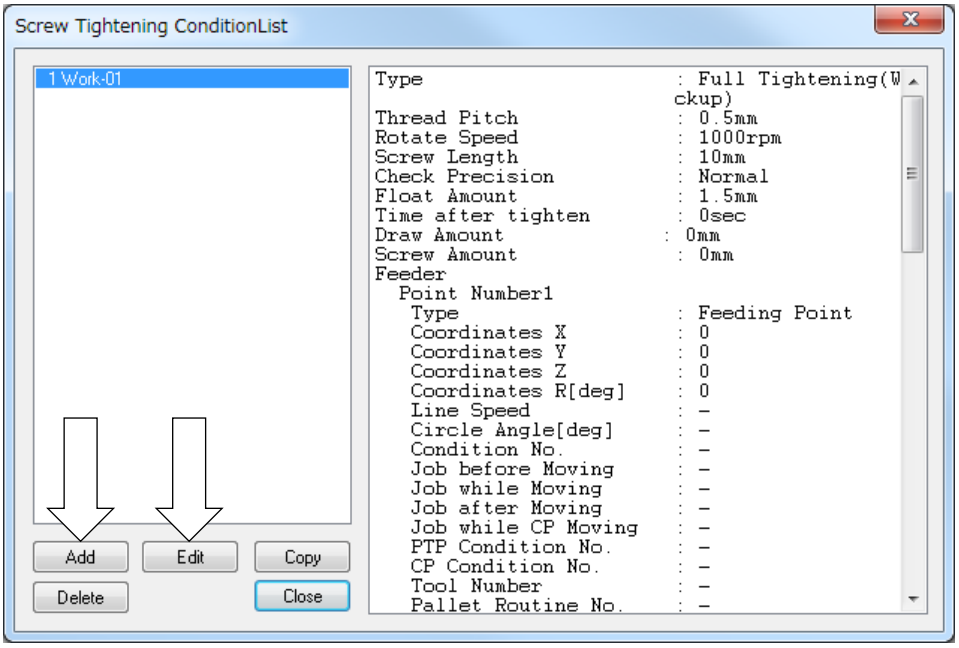
Tightening Condition Settings Screen

If you are using a PC, the following method displays the screw tightening condition settings screen for the Tightening (Condition) point type:

PC [Data] → [Screw Tightening Condition] → [Add]: When registering a new point
→ [Edit]: When modifying a registered point



Select [Screw Tightening Condition] from the [Data] pull-down menu. The Screw Tightening Condition List window is displayed (shown below). The registered screw tightening condition number list is on the left and the content for the currently selected screw tightening condition is displayed on the right. However, tightening conditions cannot be edited on this screen. To edit a registered screw tightening condition, select the tightening condition number you want (displayed on the left) and click [Edit]. The settings screen for the selected tightening condition will appear.
To create a new screw tightening condition, click [Add].



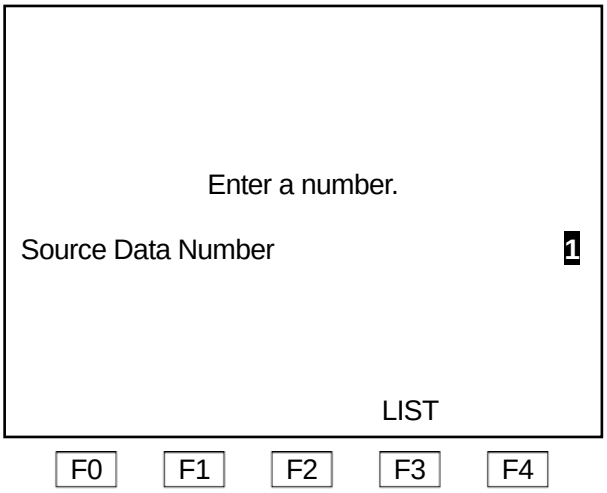
17.2 How to Copy a Screw Tightening Condition

If you want to register a screw tightening condition similar to an existing condition, it is useful to copy the existing condition and then modify it.

TP MENU [Teaching Data Copy, Delete, Conversion]
[Screw Tightening Condition]
[Copy Condition Data]

PC [Data] → [Screw Tightening Condition] → [Copy]

Perform the above operation, or push the F1 (COPY) key on the Screw Tightening Condition number entry screen. The source data number entry screen for the screw tightening condition is displayed (shown to the right).



Enter the source screw tightening condition data number.

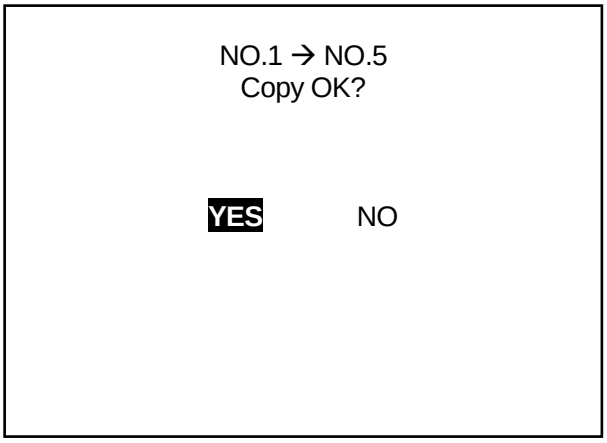
NOTE
Press the F3 (LIST) key on the source data number entry screen to display the registered screw tightening condition numbers. You can select a source screw tightening condition data number from the list.

After entering a source data number, the destination data number entry screen appears. On this screen enter the destination screw tightening condition data number.

NOTE
Press the F2 (NEW) key on the destination data number entry screen to display the available numbers. Press the F3 (LIST) key to display the registered condition numbers. You can select from one of these lists.

If the destination number you entered is already registered, the copy confirmation screen shown to the right is displayed.

Select [YES] to overwrite the existing data.



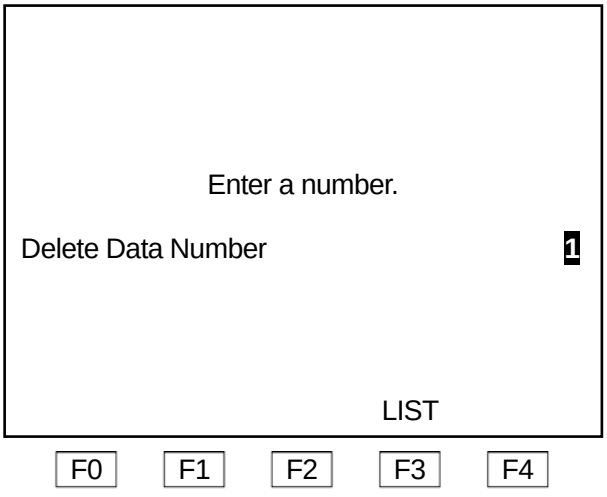
17.3 How to Delete a Screw Tightening Condition

TP MENU [Teaching Data Copy, Delete, Conversion]
[Screw Tightening Condition]
[Delete Condition Data]

PC [Data] → [Screw Tightening Condition] → [Delete]

Perform the above operation, or push the F0 (DEL) key on the screw tightening condition number entry screen.
The delete number entry screen (shown to the right) is displayed.

Enter the screw tightening condition data number you want to delete.



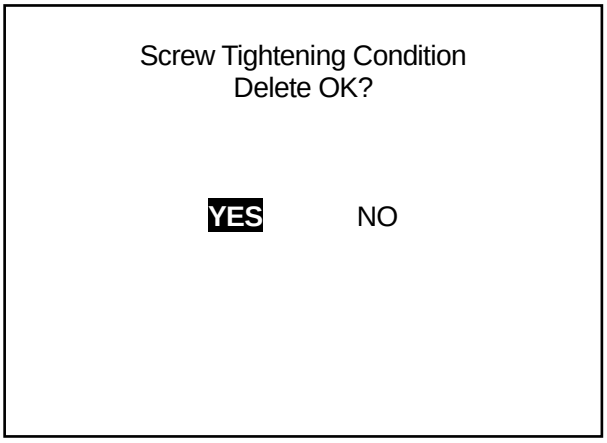
NOTE
When the Delete Data Number entry screen is displayed, press the F3 (LIST) key to display all the registered number lists. You can select a number to delete from the list.

After entering the number you want to delete, the Delete OK confirmation screen appears. Select [YES] to delete.

17.4 How to Delete All the Screw Tightening Conditions

TP MENU [Teaching Data Copy, Delete, Conversion]
[Screw Tightening Condition]
[Delete All Condition Data]

When [Delete All Condition Data] is selected, the delete all confirmation screen (shown to the right) is displayed.
Select [YES] to delete all screw tightening conditions.



This operation cannot be performed from a PC. Delete condition data entries one at a time, or partially save ([Save Piece Data]) C&T data excluding the screw tightening conditions.

NOTE

This operation does not delete the [Screw Tightening Condition] included in individual program settings.

18. DRIVER/FEEDER CONNECTIONS (DEVICE SIGNALS)

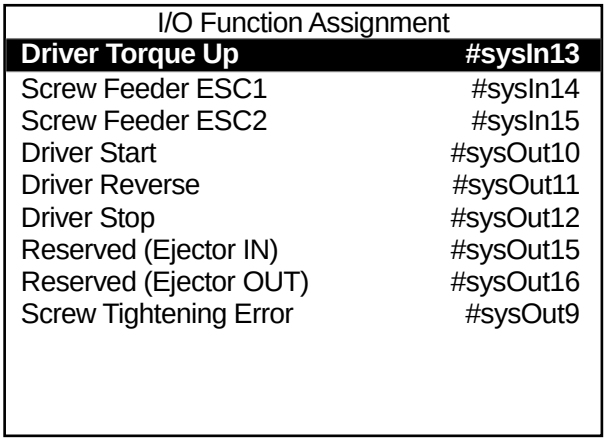
By default (factory settings) these signals are assigned as shown below. These are assigned on the assumption the screwdriver device is connected to I/O-SYS.
If you want to connect the screwdriver device to I/O-1, etc., you can change the given I/O assignments.

(I/O-SYS)

Function	Signal (Default)	Function	Signal (Default)
Driver Torque Up	#sysIn13	Driver Start	#sysOut10
Screw Feeder ESC1	#sysIn14	Driver Reverse	#sysOut11
Screw Feeder ESC2	#sysIn15	Driver Stop	#sysOut12
		Reserved (Ejector IN)	#sysOut15
		Reserved (Ejector OUT)	#sysOut16
		Screw Tightening Error	#sysOut9

TP MENU [Devices Signals]
[I/O Function Assignment]

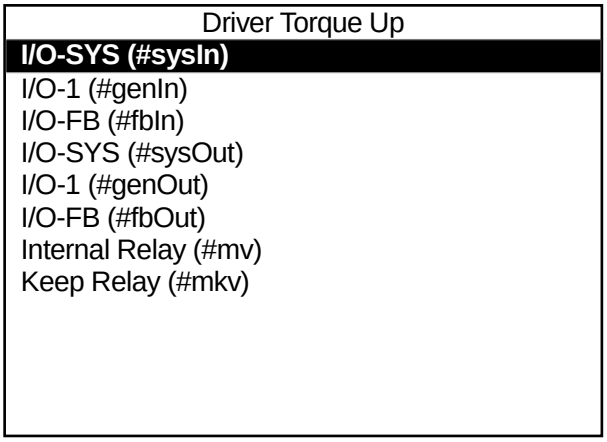
Upon selecting [I/O Function Assignment], the function assignments of the input/output signals relating to screw tightening (shown to the right) are displayed.
Select the signal you wish to set or change.



I/O Function Assignment Selection Screen

Driver Torque Up is an input signal and therefore, it is normally assigned to [I/O-SYS (#sysIn)] or [I/O-1 (#genIn)].
However, as a setting it is typically not only assignable for input, but also assignable for output (#sysOut, #genOut), the internal relay, and keep relay.

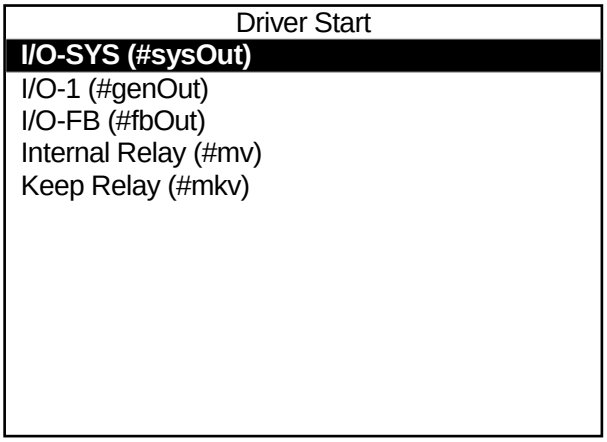
Upon selecting [I/O-SYS (#sysIn)] or [I/O-1 (#genIn)], the number entry screen is displayed. Enter an I/O number, and the screen returns to the I/O Function Assignment selection screen.



Driver Torque Up Signal Type Selection Screen

Driver Start is an output signal and therefore, it is normally assigned to [I/O-SYS (#sysOut)] or [I/O-1 (#genOut)].
However, as a setting it is typically also assignable to the internal relay, and keep relay.

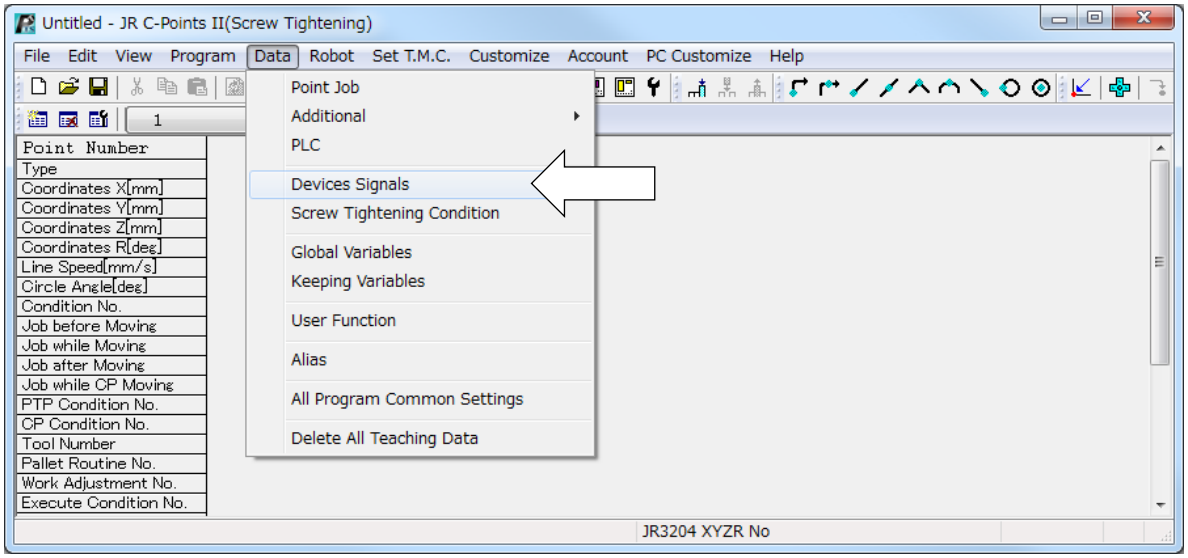
Upon selecting [I/O-SYS (#sysOut)] or [I/O-1 (#genOut)], the number entry screen is displayed. Enter an I/O number, and the screen returns to the I/O Function Assignment selection screen.



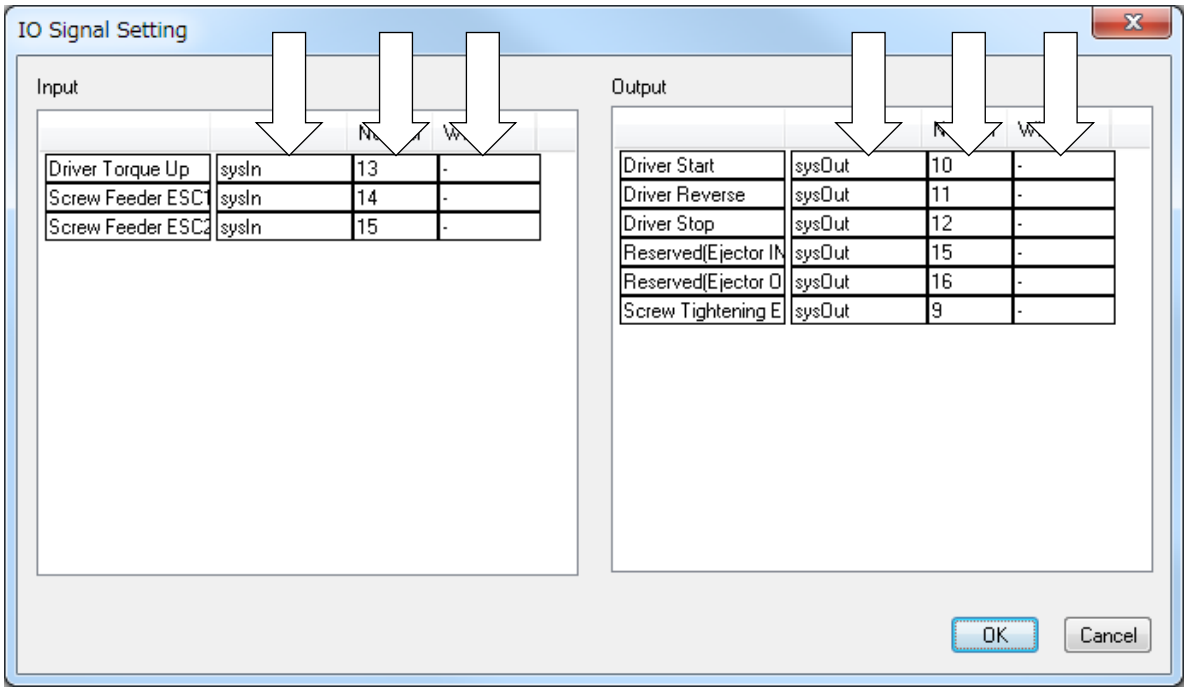
Driver Start Signal Type Selection Screen

PC [Data] → [Devices Signals] → [I/O Function Assignment]

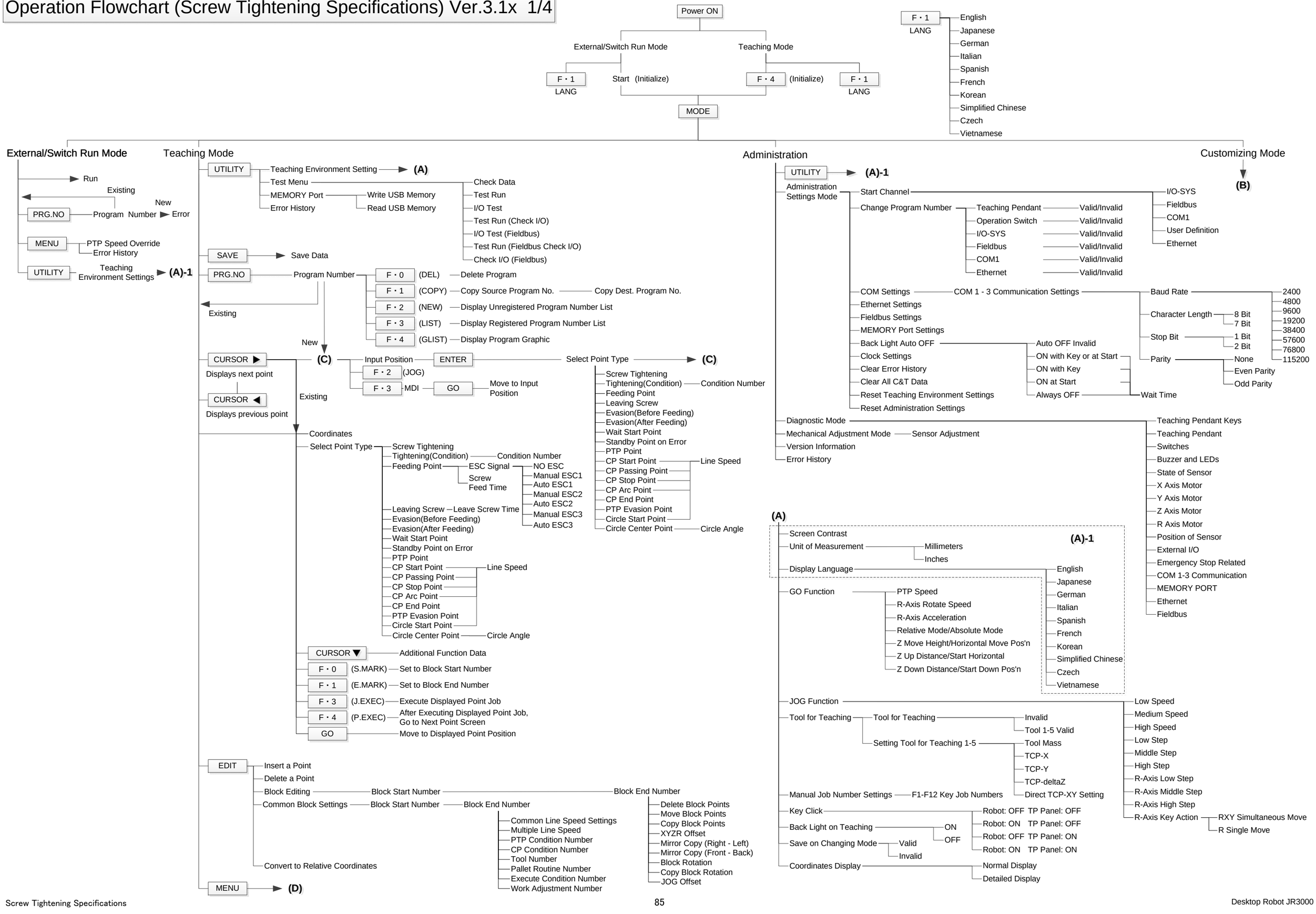
Select [Data] → [Devices Signals] → [I/O Function Assignment] to display the screen with the input/output signal assignments relating to screw tightening (shown below).



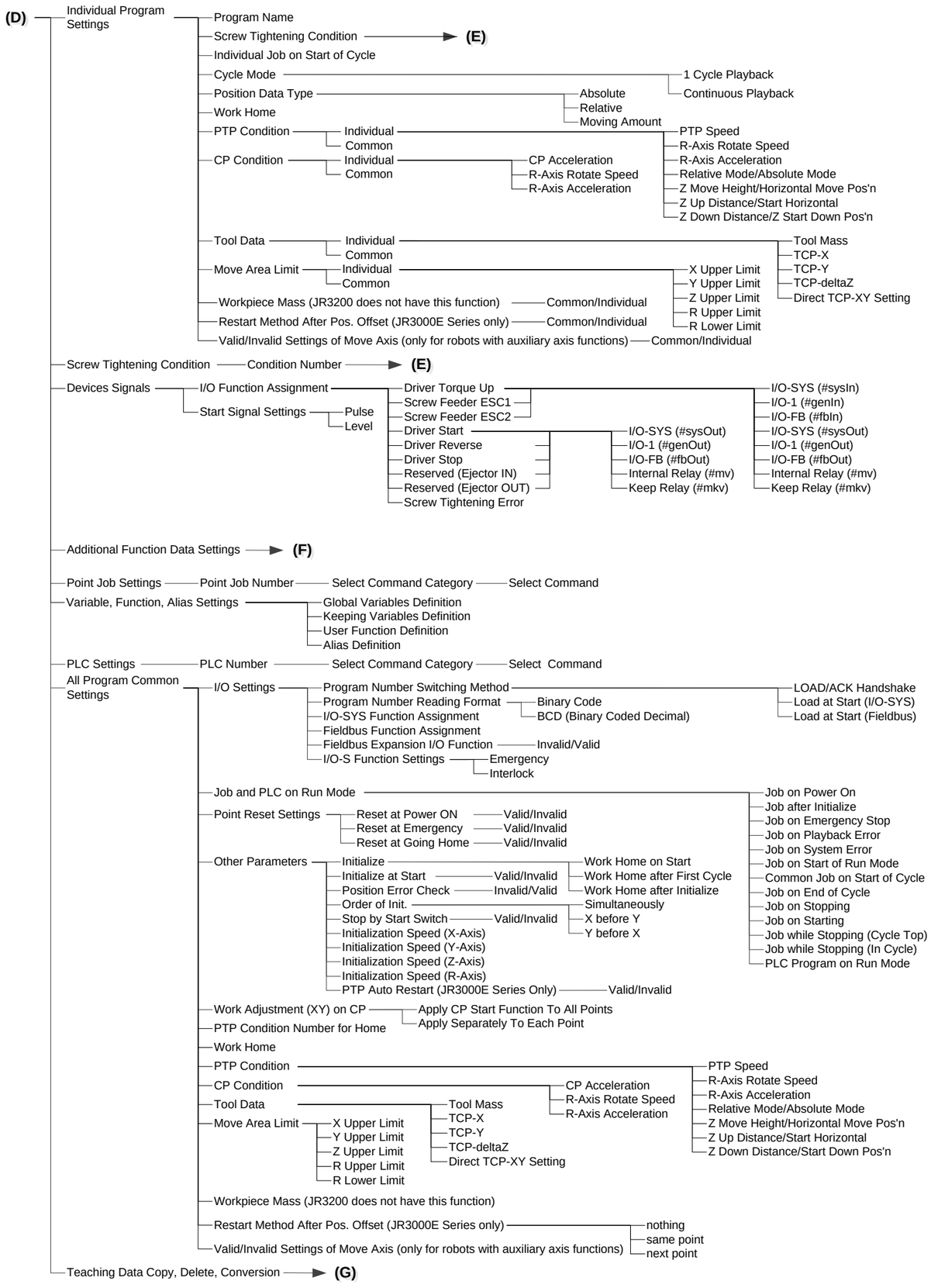
Enter or select the [Input Destination], [Output Destination], [Number] and [Width] for the signal you wish to set or change. Click the target cell to display the selectable items. For [Width], enter the numerical values.

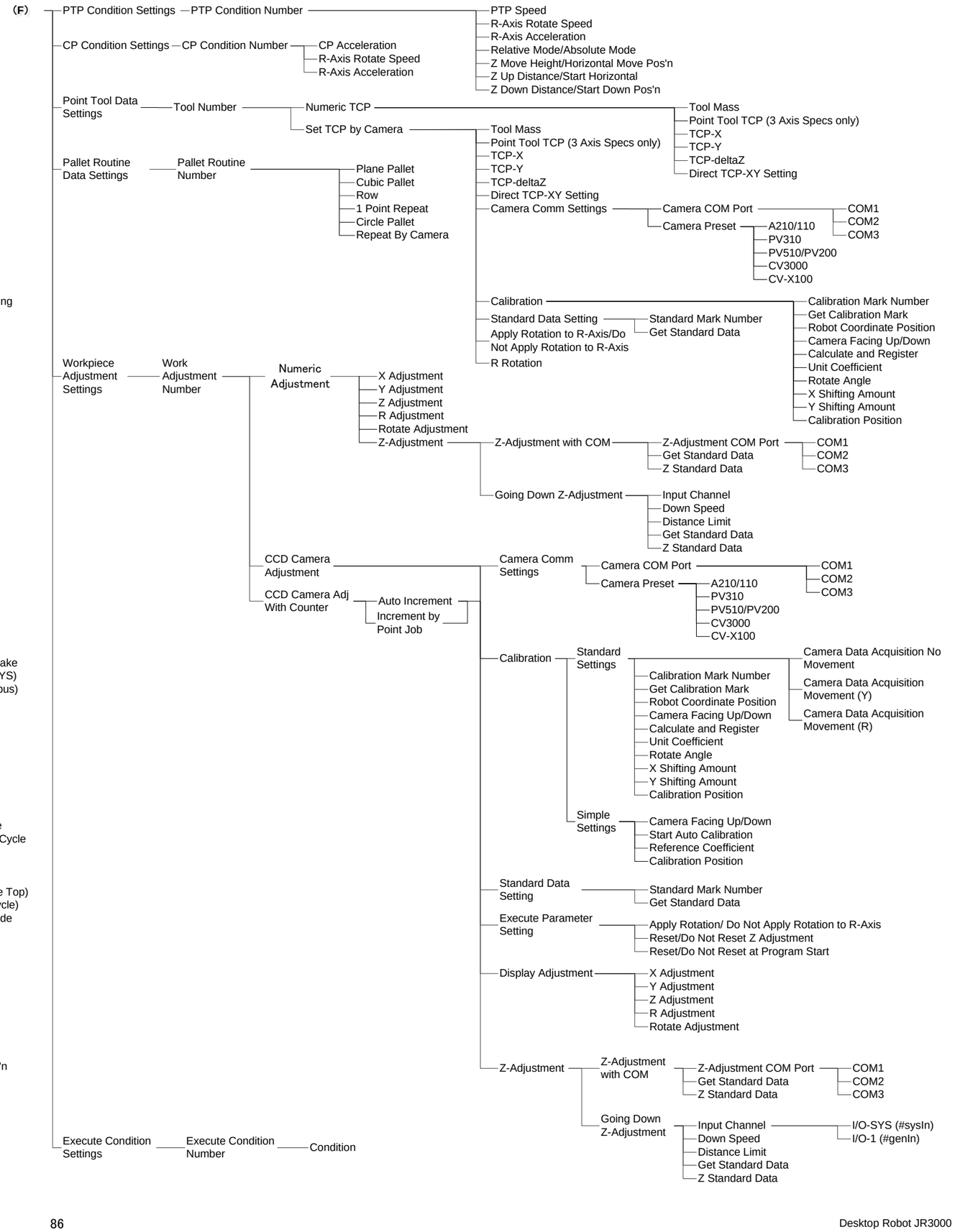


Operation Flowchart (Screw Tightening Specifications) Ver.3.1x 1/4

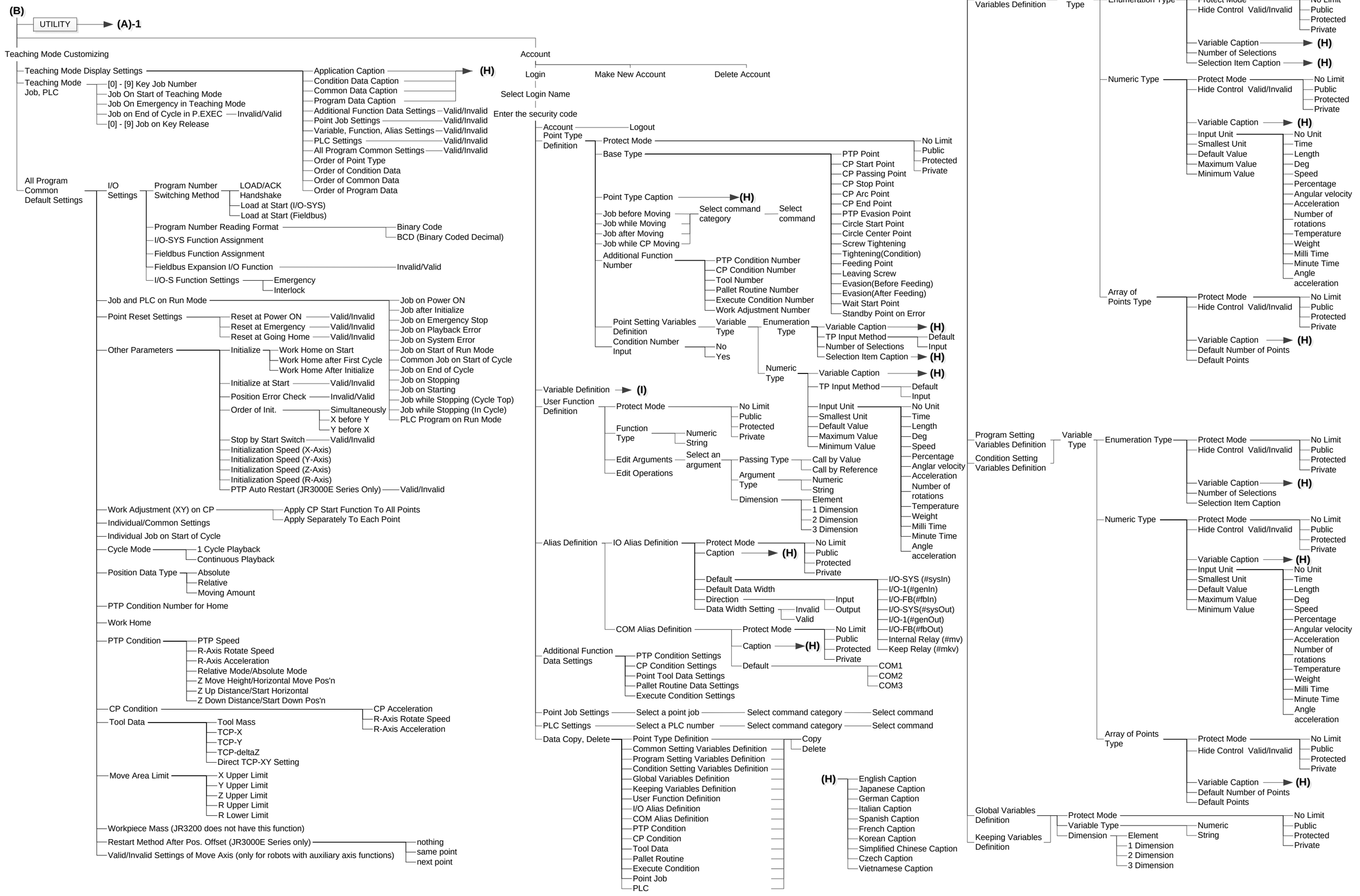


Operation Flowchart (Screw Tightening Specifications) Ver.3.1x 2/4

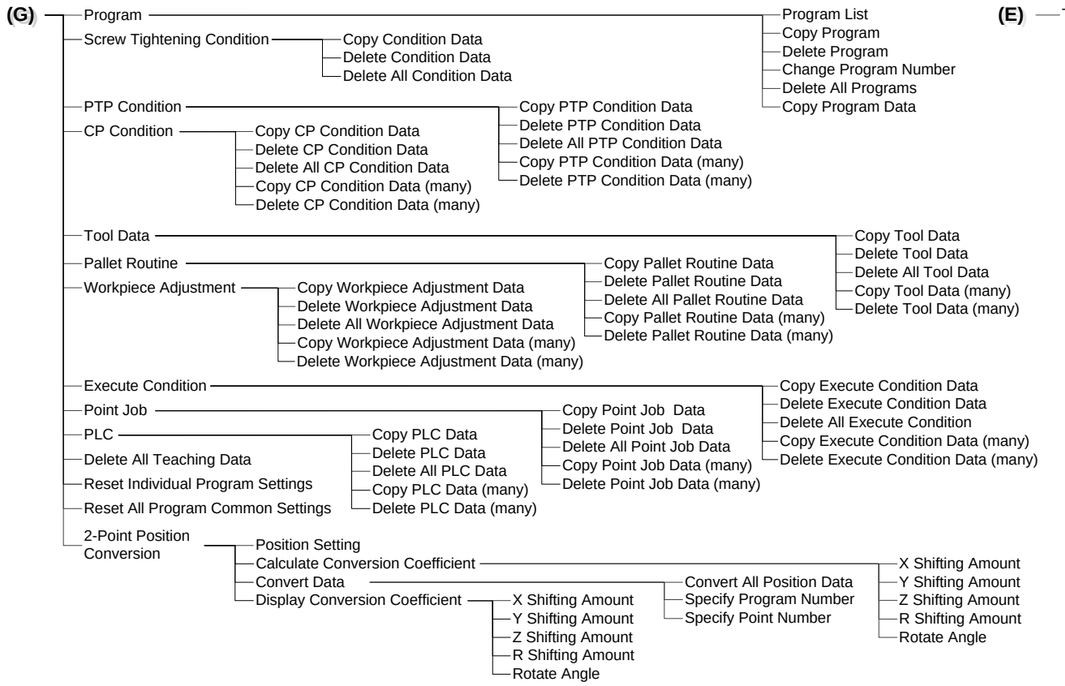


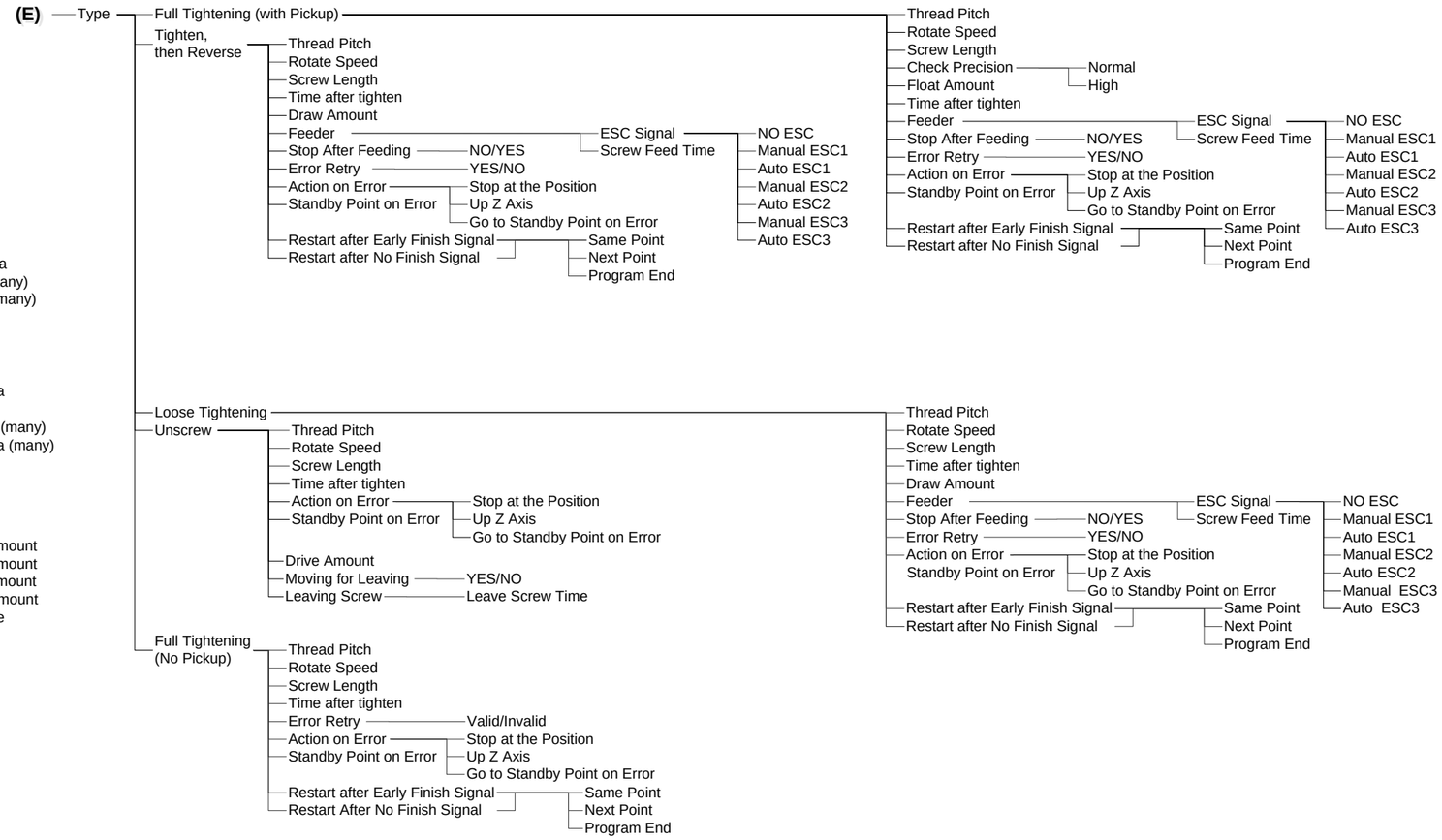


Operation Flowchart (Screw Tightening Specifications) Ver.3.1x 3/4



Operation Flowchart (Screw Tightening Specifications) Ver.3.1x 4/4





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