JANOME DESKTOP ROBOT

JR3000 Series

JANOME CARTESIAN ROBOT

JC-3 Series

JANOME SCARA ROBOT

JS3 Series

Operation Manual

Auxiliary Axis Functions

Thank you for purchasing this Janome Robot.

- **Before using this 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

This manual covers the JR3200, JR3300, JR3400, JR3500, JR3600, JC-3, and the JS3 Series.

There are several manuals pertaining to these robots.

Manual	Details	JR3000	JC-3	JS3
Read This First	• For Your Safety Be sure to thoroughly read “For Your Safety” as it contains important safety information. (Refer to the operation manual *Special Specifications* if you use the special specifications.) • Package Contents (JS3 Series only) Check the items included with your robot. • CD-ROM Contents Explains the CD-ROM contents.	✓	✓	✓
Setup (JR3000 / JC-3) Installation (JS3)	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.	✓ (Common)		✓
Quick Start	Explains the actual operation of the robot by creating and running simple programs.	✓ (Common)		✓
Teaching Pendant Operation	Explains how to operate the robot via the teaching pendant.	✓ (Common)		✓
Functions I	Explains point teaching.	✓ (Common)		
Functions II	Explains commands, variables, and functions.	✓ (Common)		
Functions III	Explains functions such as All Program Common Settings and PLC programs.	✓ (Common)		
Functions IV	Explains Customizing Functions.	✓ (Common)		
External Control (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.	✓ (Common)		

Manual	Details	JR3000	JC-3	JS3
Camera & Sensor Functions	Explains the functions of the attachable camera and Z position sensor.	✓ (Common)		
Specifications	Outlines general specifications such as the robot's operating range, mass, etc.	✓	✓	—
Auxiliary Axis Functions	Explains the auxiliary axis functions.	✓ (Common)		
Application Specifications	Explains the specialized functions of the various application specifications.	Standard model: - Application model: ✓		
Special Specifications	Explains installation and maintenance procedures for the robot. ■ Make sure you read this manual when performing installation and maintenance ■ NOTE: This manual is designed for people who have received safety, and installation and maintenance trainings regarding the robot.	—	✓	—

⚠ Warning

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

⚠ Caution

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.

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

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.
For details on how to back up robot data, refer to "3. BACKING UP AND RESTORING ROBOT DATA" in the operation manual *Setup* for the JR3000 Series, "6.1 Backing Up and Restoring Robot Data" in the operation manual *Setup* for the JC-3 Series, and "9.1 Backing Up and Restoring Robot Data" in the operation manual *Installation* for the JS3 Series.

- The descriptions within this manual are based on standard specifications. The menu item names etc. may vary depending on the model type.
- For information regarding optional additions for this robot, refer to “24. SPECIFICATIONS” in the operation manual *Specifications* for the JR3000 Series,“14. SPECIFICATIONS” in the operation manual *Specifications* for the JC-3 Series, and “15. SPECIFICATIONS” in the operation manual *Basic Intructions* for the JS3 Series. The notation “optional” is not used in the main text of this manual except for diagrams.
- Machine specifications may be modified without prior notice to improve quality.

Remarks:

- 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)

- Click text that appears blue and is underlined to jump to that section.
  Example: Refer to “1. OVERVIEW.”

CONTENTS

FOR YOUR SAFETY

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

・・・・・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 indicate the nature of the danger and any necessary safety precautions 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 supply cord
	Make sure the machine is grounded

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

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

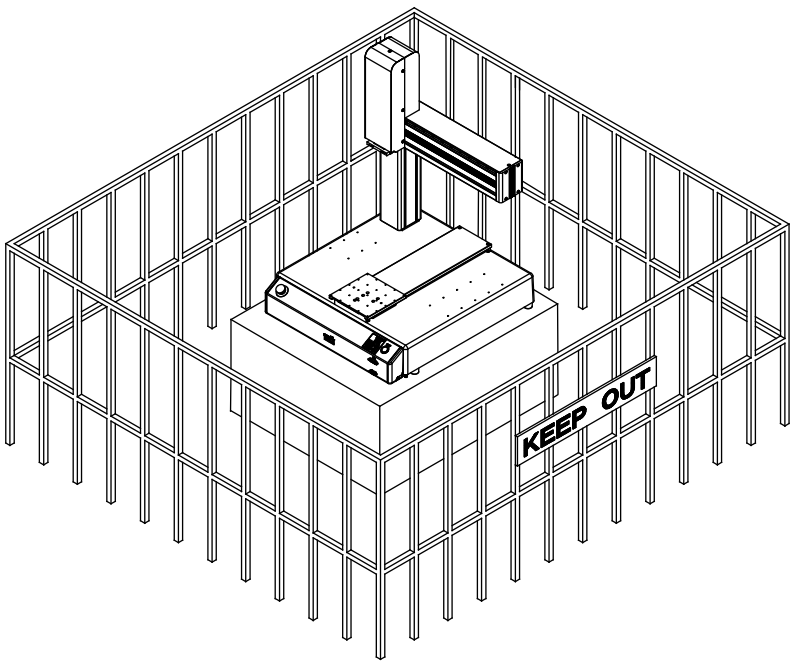
Always set up safety guards around the robot or the auxiliary axes so the moveable parts cannot be touched.

Anyone within the maximum reach of the robot and the auxiliary axes being controlled by the robot may be injured. Set up an **emergency stop interlock device that cuts off the motor power to the auxiliary axes when the entrance to the safety guard is opened** and make sure this entrance is the only way to access the machine.

NOTE: A stop made via a device connected to the I/O-S connector is a category 2 stop. Make sure to perform a separate risk assessment of the interlock device.

Furthermore, put up a **"Keep Out"** or **"Do Not Operate"** warning sign in a clearly visible place.

Example:



FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

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 head, 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(es) are functioning properly.

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

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

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, mass, 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

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

⚠ Danger

Do not use where flammable or corrosive gas is present.
Leaked gas accumulating around the unit causes explosions or 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 on a workbench 600 mm or higher above floor level, in the center of the workbench.
In addition, **for units with a cooling fan on the back, allow for 300 mm or more clearance between the back of the unit and the wall.**
Install the switchbox 600 mm or more above floor level in an easily accessible place.
If installation is inadequate, the unit can drop or fall over causing injury and unit breakdown. Also, inadequate installation causes overheating or fire.

Make sure to power the unit within its rated current range.
Failure to do so causes electric shock, fire, or 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 unit breakdown, fire, or electric shock.

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 cords. Failure to follow these steps causes electric shock or injury.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

⚠ 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 shock, fire, malfunction, or unit breakdown.
	**Wipe the power plug with a clean, dry cloth periodically to eliminate dust.** Dust accumulation deteriorates the electrical insulation or causes fire.
	**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 fire.
	**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, or malfunction.
	**If disassembling this machine, follow the instructions in the operation manual *Maintenance*, and do not disassemble in any other way other than those specified.** Do not modify the machine in any way. Inappropriate disassembly or modification causes electric shock or 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, or 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 Janome (details on the back of this manual) or a Janome dealer.** Continuing to use the robot without addressing the problem causes electric shock, fire, or unit breakdown.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

⚠ Caution	
	**Do not drop or jar the unit during transport and/or installation.** This can cause injury or damage 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 to 85 %, and without condensation.** Use outside of these conditions can cause unit breakdown or malfunction.
	**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(es). 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.

* A stop made via a device connected to the I/O-S connector is a category 2 stop. Make sure to perform a separate risk assessment of the interlock device.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JR3000 Series ■■■■■■■■■■■■■■■■■■■■

⚠ Caution	
	**When attaching tools, a USB camera, or any other device, 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 or after every 750 hours of operation.** 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.
	**When lifting or transporting the robot, do so in accordance with the following:** • **Secure the movable parts of the unit (the Z/ZR mechanism) before transportation.** • **Lift and transport the JR3200 Series with 2 or more people.** • **Lift and transport the JR3300 – JR3600 Series with 2 or more people or use a lifter.** • **Hold the bottom of the base and keep the robot horizontal.** • **Do not hold the robot by the column or Y body.** Failure to adhere to this can cause injury or damage the robot.
	**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.**

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■■

Industrial Robot Safety Standards

Make sure to use the robot in accordance with the laws and guidelines of the country where it is used.

FOR YOUR SAFETY

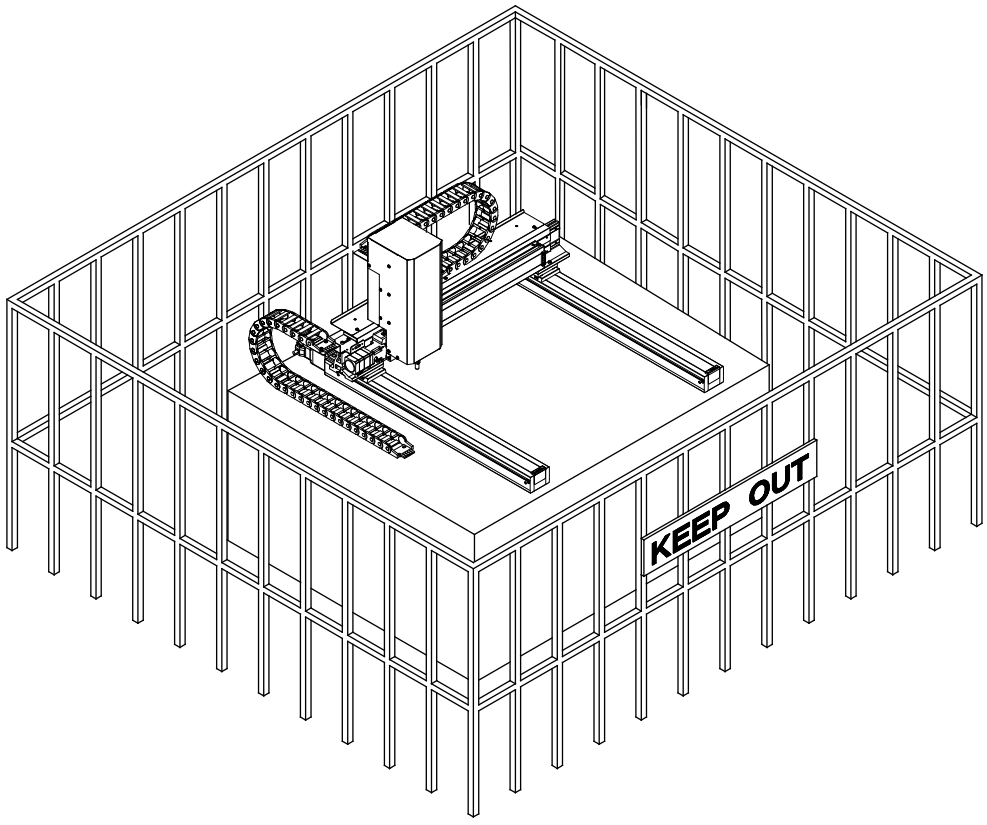
■■■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■■■

⚠ Danger

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

Always set up safety guards.
Anyone within the maximum reach of the robot may be injured.
Using the included EMG OUT connector, set up an emergency stop interlock system that is triggered when the entrance to the safety guard is opened and make sure this entrance is the only way to access the machine.
Furthermore, put up a **"Keep Out"** or **"Do Not Operate"** warning sign in a clearly visible place.

Example:



FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■

⚠ Danger

Construct a safety circuit before operating the robot.
Use the EMG OUT connector to maintain safety by installing a relay such as an external stop device on the power supply line which cuts the DC 48 V power input. Construct the safety circuit so it operates as a category 0 stop when the emergency stop switch is pressed. Without the construction of a safety circuit, motor power 48 V will not be cut OFF even if the emergency stop switch is pressed, leading to unexpected accidents and injury. An error will occur if you construct the safety circuit without it operating as a category 0 stop when the emergency stop switch is pressed.

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

Before entering the safety guard or inspecting or performing maintenance on the robot, make sure there is no electrical current.

- **Unplug the controller power cord from the power outlet. Do not touch any of the power inlet pins within 5 seconds of removing the power cords.**
- **If using a controller with a terminal block (DC 48 V), turn the power OFF and remove the wiring from the terminal block.**

Failure to follow these steps can cause unexpected operation, electric shock, or injury.

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 surrounding devices, and that the teaching pendant and tools are in the appropriate places.
- **Emergency Stop Switch** : Make sure the EMG OUT circuit (interlock) and emergency stop switch(es) are functioning properly.

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

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■

⚠ Danger

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(es). Also regularly perform an EMG OUT 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.

⚠ Warning

Use protective gear such as a helmet, protective gloves, protective goggles, and safety shoes when installing the robot.
Failure to do so can cause injury.

Make sure to power the unit within its rated current range.
Failure to do so causes electric shock, fire, or unit breakdown.

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

Make sure to connect and use crimp terminals with the power cord connecting to the terminal block (DC 48 V input) and to securely tighten the terminal block screws. Failure to do so causes electric shock, fire, or unit breakdown.

Make sure to perform work from outside of the safety guards when the power is ON. Failure to do so can cause injury.

Be sure to use the unit within its indicated voltage range.
Failure to do so causes unit breakdown, fire, or electric shock.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■■■

⚠ Warning

Install the controller within an industrial control panel, and make sure when the industrial control panel door is opened, the controller power is automatically cut off. In addition, for controllers with a cooling fan, allow for a clearance of 300 mm or more from the top of the controller, as well as 100 mm or more from the air vent on the side. Inadequate installation can cause overheating, fire, electric shock, or injury.

With the 3 axis specifications, if releasing the brake, do so after either removing the attached tool or taking measures to prevent the tool from dropping.
If you release the brake when turning the power ON in Teaching Mode, Switch Run Mode, or External Run Mode, the axis may drop down depending on the mass attached to the Z axis. If the Z axis drops down, it can cause injury or unit breakdown.

When inspecting or performing maintenance on the controller, **make sure there is no electrical current and perform the following**:

- **Unplug the controller power cord from the power outlet. Do not touch any of the power inlet pins within 5 seconds of removing the power cords.**
- **If using a controller with a terminal block (DC 48 V), turn the power OFF and remove the wiring from the terminal block.**

Failure to follow these steps can cause electric shock, injury, data loss, unit breakdown, or malfunction.

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 shock, fire, malfunction, or unit breakdown.

Wipe the power plug with a clean, dry cloth periodically to eliminate dust.
Dust accumulation deteriorates the electrical insulation or causes fire.

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 fire.

If disassembling this machine, follow the instructions in the operation manual *Maintenance*, and do not disassemble in any other way other than those specified. Do not modify the machine in any way.
Inappropriate disassembly or modification causes electric shock or unit breakdown.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■

⚠ Warning

Do not allow water or oil to come in contact with the unit, controller or the power cord. Contact with water or oil causes electric shock, fire, or unit breakdown.
IP Protection Rating: IP20.

If anything unusual occurs, such as a burning smell or unusual sound, stop the run, unplug the controller power cord from the power outlet, and make sure there is no electrical current. Contact Janome (details on the back of this manual) or a Janome dealer.

- **Unplug the controller power cord from the power outlet. Do not touch any of the power inlet pins within 5 seconds of removing the power cords.**
- **If using a controller with a terminal block (DC 48 V), turn the power OFF and remove the wiring from the terminal block.**

Continuing to use the robot without addressing the problem causes electric shock, fire, or unit breakdown.

⚠ Caution

Do not drop or jar the unit during transport and/or installation.
This can cause injury or damage 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 to 85 %, and without condensation.
Use outside of these conditions can cause unit breakdown or malfunction.

Use the unit in an environment where no electrical noise is present.
Failure to do so causes unit malfunction or breakdown.

When attaching tools, a USB camera, or any other device, make sure they are securely fitted before running the robot.
Failure to do so causes injury or breakdown.

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JC-3 Series ■■■■■■■■■■■■■■■■■■

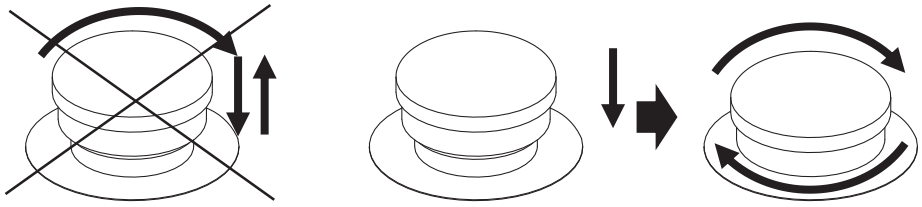
⚠ Caution

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 or after every 750 hours of operation. Failure to do so causes injury or breakdown.

Be sure to check the connections of the cords and cables to the main unit and controller.
Improper wiring causes unit malfunction or breakdown.

Make sure to wait for at least 1 second before power cycling the robot after the external power supply to the controller (DC 48 V) is cut off. Failure to do so can cause unit breakdown.
Make sure to wait for at least 1 second between the following operations:

- When power cycling after the external power supply DC 48 V is cut off
- When releasing the emergency stop after the emergency stop switch is pressed down
- When releasing the emergency stop after an external emergency stop device is activated
- Operations to reset the emergency stop switch on the switchbox and teaching pendant II when it is released



Do not push down emergency stop switch again when it is already rotated for release

Press straight down

Turn and release (Do not pull)

⚠ Caution	
	**Make sure to construct a power circuit allowing for the rated current so that an interruption to the external power supply DC 48 V does not occur.** Failure to do so can cause unit breakdown. External Power Supply Output:DC 48 V, 10 A or more
	**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.**

FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JS3 Series ■■■■■■■■■■■■■■■■■■

Industrial Robot Safety Standards

Make sure to use the robot in accordance with the laws and guidelines of the country where it is used.

FOR YOUR SAFETY

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Safety Precautions Regarding Installation

Robot Unit

⚠ Danger

Anyone within the maximum reach of the robot may be injured.
Install safety guards in adherence with the following:

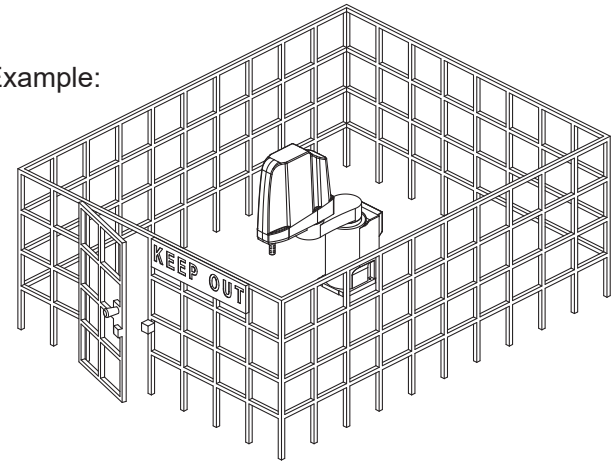
- The safety guards cannot easily be moved.
- The safety guards cannot easily fall over or be broken.
- Allow enough clearance between the robot and the safety guards so that even if the robot falls over, it does not hit the safety guards.
- No part of your body, such as your head or hands, can enter the safety guards.
- Install an interlock device on the entrance to the safety guards that activates an emergency stop when opened and make sure this entrance is the only way to access the machine. Connect the interlock device to the controller by using the included I/O-S connector.
- Place a warning sign such as “Keep Out” or “Do not Operate” on the safety guard entrance in a location that is easily visible.
- Affix the included danger sticker (shown below) in a location that is easily visible.

NOTE:

- A stop made via a device connected to the I/O-S connector is a category 1 stop. Make sure to perform a separate risk assessment for the interlock device.
- Refer to the operation manual *Installation* for details regarding I/O-S connections.
- After installing the unit, make sure to perform pre-operation checks from outside of the safety guards.

Warning Sticker

Example:



FOR YOUR SAFETY

■■■■■■■■■■■■■■■■■■ JS3 Series ■■■■■■■■■■■■■■■■■■

⚠ Danger

Do not remove the fixing plates from the robot arm until after transportation is complete.
Failure to do this can cause injury or breakdown.

If temporarily placing the robot on a mount, etc., make sure to secure the robot to the mount by tightening 2 or more bolts into the mounting holes on the mounting base to prevent the robot from tipping over.
Failure to do this may cause the robot to fall, resulting in injury or breakdown.

To set the home position for the J3 or J4-axis, release the brake and move the J3-axis (shaft) manually with two hands. When releasing the brake, take the following precautions:

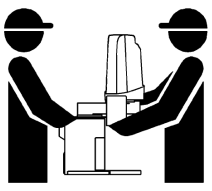
- Always release the brake with at least 2 people present.
- After the brake is released, the tool mass may cause the J3-axis to drop down. Make sure no people are within the operating range of the robot before releasing the brake.
- If there is risk that the robot may hit a peripheral device, make sure to position the robot arm appropriately before releasing the brake.

Failure to adhere to this can cause injury or breakdown.

⚠ Warning

Construct safety guards that are strong enough to protect the operator against such dangers as the tool or workpiece splintering, etc.
For the safety of the operator when working within the safety guard, use protective gear such as a helmet, protective gloves, protective goggles, and safety shoes.
Entering the safety guards could result in injury.

Always have 2 people carry the robot with the fixtures attached as shown in the illustration to the right.
Mass: JS3-3520: Approx. 39 kg, JS3-4520: Approx. 40 kg
JS3-5520: Approx. 41 kg
Refer to “2.3 Transporting the Robot Unit” in the operation manual *Installation* for further details.



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⚠ Warning

Avoid using the robot in operating environments such as the ones below. If using the robot in environments such as these, take measures to protect the robot from the direct effects of the work environment.

- An environment where the robot vibrates or is bumped at 3.5 G or more during transportation.
- An environment where the robot vibrates or is bumped at 0.5 G or more during operation.

Using the robot in these environments can cause malfunction or breakdown.

Avoid using the robot in an environment that exceeds the radiation tolerance value for the average person. If using the robot in an environment such as this, take measures to protect the robot from the direct effects of the work environment. Using the robot in this environment can cause malfunction or breakdown.

⚠ Caution

Do not hold the robot from the left and right sides or hold the robot by the covers. Doing so may tip the robot over or the covers may break; causing the robot to fall resulting in injury.

Do not hold the robot by the J2 arm cover during transportation.
Doing so can damage the cover.

Do not apply force to the shaft (J3-axis).
Doing so can damage the shaft and cause an overload error to occur when the robot is run.

Do not tip or place the robot on its side.
Doing so can cause a grease leak or breakdown.

Mount the robot on a steel base that is designed to withstand both the robot's mass and the force generated during runs. Inadequate installation may cause the robot to fall, resulting in injury or breakdown.

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⚠ Caution	
	Firmly fix the robot to a specified horizontal mounting surface using the mounting bolts and make sure that positional displacements cannot occur.
	Install the robot in a location that provides enough clearance to replace the battery at the front of the robot and enough clearance to connect the motor power cable and the encoder cable to the back of the robot. Also, do not install the robot in a place where it is exposed to direct sunlight or heat from lighting. The robot surface may heat up and cause errors to occur.
	The robot requires periodic lubrication. Make sure you install the robot in a location where greasing is possible. (Refer to “4.8 Lubrication” in the operation manual *Maintenance.*
	Check the air tubing is connected correctly, has not come loose, or cannot easily come loose. If there is a problem, reconnect the tubing as required. Failure to do so can cause injury or breakdown.
	**After installing the robot, make sure to remove the fixing plates attached to the robot arm.** Failure to do so may cause breakdown.
	After installation, perform a periodic inspection (every 3 months or 750 hours of use, depending on how often the robot is in use) to check the tightening torque of the mounting screws with a torque wrench, etc.
	Adhere to the following when constructing or selecting a hand for the robot: • Make sure the total mass of the hand and the workpiece does not exceed the rated payload capacity of the robot. Especially if attaching an unconventional hand, check that the wrist does not exceed the allowable moment of inertia. • Use a hand or tool that has sufficient ability to grasp workpieces. • Secure the hand to the mechanical interface using bolts that are sized accordingly for the attachment dimensions. Make sure the tool has no protruding parts or sharp edges, other than those required for operation, and construct a cover for the tool if required. Failure to adhere to this can cause injury or breakdown.

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⚠ Caution

If connecting cables or hoses to the hand, make sure they do not restrict the robot movements and make sure the robot operations do not cause the cables or hoses to get tangled and/or cause them to break.
Improperly attached cables or hoses can cause breakdown.

If using a pneumatic hand, make sure to provide clean air at the specified pressure. Also, make sure the air pressure does not exceed 0.7 MPa (7 kgf/cm^2).
Air pressure higher than this may cause the robot's internal air hoses to burst.

Robot Unit and Controller

⚠ Danger

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

⚠ Warning

Use protective gear such as a helmet, protective gloves, protective goggles, and safety shoes when installing the machine.
Entering the safety guards could result in injury.

Before wiring the power cords, make sure there is no electrical current and perform the following:

- **Lockout/tagout with the power source circuit breaker in the OFF position, and remove the power cords from the terminal block.**
- Do not touch the terminal block within 5 seconds of removing the power cords.

Failure to adhere to this may cause electric shock, injury, data loss or breakdown.

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⚠ Warning

	**Be sure to use the unit within its indicated voltage range.** **Failure to do so causes unit breakdown, fire, or electric shock.**
	Make sure to isolate the robot motor power cable, the encoder cable, and external I/O cables from the power cable or grounding wire of other devices. Also make sure the external I/O cables are shielded. Do not apply voltages to terminals other than those specified in the operation manuals. Doing so can damage the robot or cause the terminal to explode.

⚠ Caution

	When transporting the robot, **do not excessively shock or vibrate the robot.** Doing so can cause malfunction or breakdown.
	**Do not drop or jar the unit during transport and/or installation.** This can cause injury or damage the unit.
	**Use the robot in an indoor environment where it is not exposed to direct sunlight.** Direct sunlight can cause unit malfunction or breakdown.
	**Place the machine in a well-ventilated area for the health and safety of the operator.**

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⚠ Caution

Use the robot in an environment that meets the following conditions:

- **Ambient temperature of 0 to 40 °C**
- **Relative humidity of 45 to 85 % (no condensation)**
- **Altitude not exceeding 1000 m**
- **The installation space is not in a vacuum.**

Use outside of these conditions may cause malfunction or unit breakdown. If the unit is used where these conditions are not met, we cannot guarantee its operation. IP protection rating for the both the robot and the controller is IP20.

Use the unit in an environment where no electrical noise is present.
Noise may cause unit malfunction or breakdown.

Do not use the machine in an environment that is damp or dusty.
Dust and moisture can cause malfunction or breakdown. IP protection rating for the both the robot and the controller is IP20 (not water resistant).

Install the cables and connectors so there is no stress on them and do not forcefully bend or pull, or stand on them after they are installed. Protect the cables and connectors by using piping and covers, etc., as necessary.
Make sure the latches and screws securing the cables and connectors are firmly secured. If the cables and connectors are not secure, they may come loose during a run.

If the hand input cable (optional) has free terminals, make sure to insulate them before supplying power to the hand input cable (optional). Uncovered terminals can cause a short circuit to occur.

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Controller

⚠ Danger	
	**Mount the controller outside of the safety guards in a location where the switches can easily be reached and the controller can always be monitored by the operator without turning their back on the robot unit itself.** Mount the controller so that the operation panel is 600 mm or more above floor level for maintenance work.
	Before connecting a Fieldbus, make sure safety can be maintained at all times when the robot is run. If signals such as a start signal, etc., are assigned to the Fieldbus, the Fieldbus may standby waiting to send signals and cause the robot to start running immediately after it is connected. Failure to do so can cause injury or breakdown.

⚠ Warning	
	Use a lifter, etc., to transport the controller. Failure to do so can cause injury or breakdown.
	If external vibrations can cause the controller to move, fix it in place using the base plate of the controller. (Do so without removing the rubber feet)
	**Make sure that you securely install the unit in a place that can fully withstand both the unit's mass and its usage.** If installation is inadequate, the unit can drop or fall over causing injury and unit breakdown. Inadequate installation can also cause overheating and fire.
	The controller has a fan and ventilation intakes for cooling. Do not block these openings and make sure there is a clearance of at least 20 mm on both the left and right sides and at least 40 mm on the back side. Blocking these openings can cause overheating or breakdown.

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⚠ Warning	
	Leave approximately 200 mm or more clearance from the front of the controller so there is no stress on the connectors and enough room to work. Failure to do so can cause malfunction or breakdown.
	In addition to the clearance required for installation, leave sufficient space around the controller for removing covers (with a screwdriver) as a contingency for maintenance work. The controller may get hot during a malfunction. Do not touch the controller immediately after use.
	Make sure the power cord prepared on your side uses the **correct crimped terminals for connecting to the terminal block. Make sure they are within the sizes outlined below and never forcefully connect them.** Incorrect connections may cause fire or breakdown. • Conductor size: AWG10 (cross-sectional area: 6.0 mm^2) • Crimped terminal: M4, with a width of 9.5 mm or less
	After wiring the power supply terminal block, attach the cover included to prevent electric shock. An unprotected terminal block can cause electric shock, fire, or unit breakdown.
	**Always make sure to connect the protective ground through the power cord.** **Do not use the machine when the protective ground is not connected.** **Make sure the protective grounding resistance is 100 Ω or less.** Improper grounding causes electric shock, fire, malfunction, or unit breakdown, etc.

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⚠ Caution	
	Do not apply pressure to any protruding parts, such as a switch, the terminal block, or a connector when transporting the controller. Doing so can cause breakdown.
	If you want to use the controller, operation box (optional), or teaching pendant as a monitor while in Run Mode, **mount the respective device 600 mm or more above floor level in an easily accessible place so that the emergency stop switch can be immediately reached in the event of an emergency.** It is dangerous to operate the machine without the emergency stop switch within reach; you will not be able to stop the robot immediately and safely in the event of an emergency. Installing one of these devices too low can also result in malfunction from people knocking the device with their feet, etc.
	Make sure installation allows for access to the memory port during maintenance.

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Safety Precautions Regarding Usage

Robot Unit

⚠ Warning	
	If objects that the robot grasps have a risk of falling or being projected, **take into account the size, mass, and chemical composition of the objects for the required safety precautions.** Failure to do so can result in injury or unit breakdown.
	**When manually moving the robot arm, do not insert your hands or fingers into any of the joints or openings.** Your hands or fingers may get caught in these openings depending on the robot pose.

⚠ Caution	
	Before performing any operation, make sure there is no imminent danger to any of the operators. Failure to do so causes injury.
	**When attaching tools, a USB camera, or any other device, make sure they are securely fitted before running the robot.** A loose tool can cause injury or breakdown.
	If weight is applied to the J3 (Z) / J4 (R) axis, the load may cause the J3/J4 axis to drop down when the power to the robot is turned OFF. To prevent this from happening, remove the load from the J3/J4 axis or install a safety block, etc.
	When performing work inside the safety guards, perform your own risk assessment and establish **"work regulations", as outlined below, with thorough planning for safety.** Entering the safety guards may result in injury. • Work regulations should be relevant and appropriate for the type of work, and consist of details such as robot operating procedures and signs to be used between operators. • When creating work regulations, incorporate the opinion of operators and work safety specialists. Make sure to review and update the contents of the work regulations regularly.

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⚠ Caution	
	If manually moving the robot arm, do so slowly. Moving the arm at high speed can cause large amounts of backlash, reducing the robot's accuracy and damage the backup data.
	Depending on the arm pose, the shaft may come in contact with the robot base even when operating the robot within the work envelope. Make sure the shaft does not come in contact with the base while making JOG movements*. * A JOG movement refers to moving the robot arm via the teaching pendant.
	The J3 (Z) axis is equipped with a brake. Do not forcibly move the J3-axis using an external source when the brake is active. Forcibly moving the axis can reduce accuracy and/or wear the brake, damaging the reduction drive.
	If the robot picks up a workpiece that is charged with static electricity, the electricity is discharged through the hand and the robot arm. To prevent the robot from malfunctioning, make sure to insulate the hand and robot arm. Also, when the robot places a charged workpiece on a device, the electricity is discharged through the device and may cause it to malfunction. Configure the system so that it provides a route for appropriate electrical discharge from charged workpieces. Failure to do so can cause malfunction or unit breakdown.
	The lubricant is not completely effective at low temperatures. Make sure to use the warmup function to prevent loss of positioning accuracy and to prevent servo errors such as Excessive Margin of Error.
	Take care when affixing tape that has a strong adhesive, such as gummed tape, to the painted surfaces on the robot. The tape may damage the painted surfaces when it is peeled off.

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Robot Unit and Controller

⚠ Danger	
	**When power to the robot is ON, never enter the safety guard or put your head, hands, or any part of your body inside.** Entering the safety guards could result in injury.
	When changing modes or 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.** Entering the safety guards could result in injury.
	**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 Function Check Make sure the I/O-S circuit (interlock) and emergency stop switch(es) are functioning properly. Operating the robot without making these checks is dangerous.
	If entering the safety guards without cutting off the power, **always make sure the select switch on the teaching pendant is set to TEACH (Teaching Mode).** If the select switch is set to AUTO (Run Mode), external commands can start the robot while you are inside the safety guards. Failure to adhere to this can cause injury or breakdown.
	If there are any safety devices that you disable while teaching, make sure to enable them after teaching to reestablish full functionality. Example: Enable the interlock device on the safety guard entrance, etc. Failure to do so can result in injury.

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⚠ Warning	
	**Make sure to use a power source that is in accordance with the range indicated on the rating identification plate.** Failure to do so causes electric shock, fire, or unit breakdown.
	**Do not allow water or oil to come in contact with the unit or power cord.** Contact with water or oil causes electric shock, fire, or unit breakdown. IP Protection Rating: IP20.
	**Make sure that no foreign objects can enter the robot or controller.** In particular, a conductive or flammable foreign matter, such as a screw, metal shard or oil, can cause an explosion or damage the unit, etc.
	**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 can cause electric shock, data loss, unit breakdown, or malfunction.
	**Firmly connect and secure the power cord after checking that the connection area is not covered with dust, etc.** If the power cord is not firmly plugged in, the connectors may heat up and cause a fire.
	**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 may cause fire.
	**If anything unusual occurs, such as a burning smell or unusual sound, stop operation and turn the power supply circuit breaker OFF. Unplug the power cord after confirming there is no power supplied to the robot and then contact Janome or a Janome dealer.** Continuing to use the robot without addressing the problem causes electric shock, fire, or unit breakdown.

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⚠ Caution	
	**Be sure to check the connections of the cords and cables to the main unit.** Improper wiring may result in unit malfunction or breakdown.
	Make sure to save if you modify any settings or data. If you turn OFF the power after making changes to robot settings or data without saving, those changes are lost and the robot will revert to its original settings.
	Diagnostic Mode and Mechanical Adjustment Mode are for maintenance personnel* use only.

* Maintenance personnel are individuals who have received maintenance training from Janome or from a Janome dealer.

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Controller

⚠ Warning

Do not touch the terminal block when there is an electrical current present.
Touching the terminal block can result in electric shock or injury.

⚠ Caution

Keep the emergency stop switch within reach of the operator when running or operating the robot.
If you operate the robot without the emergency switch in reach, you may not be able to stop the robot immediately and safely. This is potentially dangerous.

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.

Do not turn OFF the power while the robot is running.
Turning OFF the power during a run can cause the arm to drop down or coast to a stop, which may result in the arm hitting a peripheral device.

When an error occurs, the error code that appears on the 7 segment LED and the teaching pendant display are useful indicators for finding the source of the error. Record the error number and then refer to the operation manual *Maintenance* for the countermeasure.

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Safety Precautions Regarding Maintenance

Robot Unit

⚠ Warning	
	Do not touch or come in contact with any potentially hot components on the robot. Doing so can result in burns and serious accidents. The servomotor may get hot. Do not touch or come in contact with the servomotor while the power is ON, only do so when the power is OFF and after it has cooled down.

⚠ Caution	
	**Check that the mounting screws are always firmly tightened with a periodic inspection (every 3 months or 750 hours of use, depending on how often the robot is in use).** A loose tool can cause injury or breakdown.
	**Periodically replace the robot unit battery.** Failure to do so can cause malfunction or breakdown. Replace the battery approximately every 1 year.

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Robot Unit and Controller

⚠ Danger	
	**If entering the safety guards, turn the power source circuit breaker OFF, lock and tag it, and then make sure there is no power supplied to the robot before continuing.** Failure to do so can cause electric shock, injury, or the robot may move unexpectedly.
	**If entering the safety guards, perform your own risk assessment and establish "work regulations," as outlined below, with thorough planning for safety.** • Work regulations should be relevant and appropriate for the type of work, and consist of details such as robot operating procedures and signs to be used between operators. • When creating work regulations, incorporate the opinion of operators and work safety specialists. Make sure to review and update the contents of the work regulations regularly.
	**When setting the home position or other such work that requires you to enter the safety guards with the power ON, make sure to activate the emergency stop switch before entering the safety guards and to perform the work with the robot in this state.** Failure to do so can result in injury.

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⚠ Warning

When inspecting or performing maintenance on the controller, **make sure there is no electrical current and perform the following:**

- **Lockout/tagout with the power source circuit breaker in the OFF position, and remove the power cords from the terminal block.**
- Do not touch the terminal block within 5 seconds of removing the power cords.

Failure to adhere to this may cause electric shock, injury, data loss or breakdown.

If disassembling this machine, follow the instructions in the operation manual *Maintenance*, and do not dissemble in any ways other than as specified. Do not modify the machine in any way.
Inappropriate disassembly or modification causes electric shock or unit breakdown.

For your safety, **do not modify the machine in any way.**
Inappropriate disassembly or modification causes electric shock or unit breakdown.
We cannot accept any responsibility for machines that malfunction due to modification.

After cutting OFF power to the system, energy stored by the devices is potentially dangerous, so make sure to establish means to reduce this risk.

- Controller
  Make sure the energy stored by the controller is discharged before opening the controller.
- Hand
  Use a hose connected to the solenoid valve to expel compressed air from a pneumatic chuck hand.

⚠ Caution

Perform daily and periodic inspections to check and make sure there are no abnormalities with the robot or peripheral devices. Additionally, keep records of the inspections and store them for 3 years or more so that the details can be referred to for future inspections.

Place a sign such as “Robot Inspection in Progress” in the necessary locations and establish means so as to prevent operation of the robot by those who may be unaware of the maintenance work. Whenever possible, also perform maintenance with at least one other person present so as to stop any unexpected robot movements.

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⚠ Caution	
	For a smooth and long operating life, **lubricate the shaft once for every 2,000 km the robot is run.** If the robot is run for 24 hour periods, lubricate the machine more frequently because the running time between lubrication periods is longer. The lubrication periods are calculated based on runs at maximum speed.
	Make sure to use the specified grease. Use of grease other than the specified grease can adversely affect the robot's performance or cause breakdown.
	If the arm joints or the Z-axis is subject to only minute operational angles or distances, fretting may occur in the internal robot bearings. Fretting refers to wear that occurs when minute operation angles do not allow the lubricant within the bearings to fully coat the working parts as required. This is also applies to axes that are inactive, as the counterforce from other axis operations or vibrations from the robot mounting surface cause minute movements in the inactive axes, which may result in fretting damage. To prevent fretting damage, we recommend running the arm joints more than 30 degrees and the Z-axis more than 20 mm per day.
	Do not charge, dispose of in a fire, or reuse the robot unit battery or controller battery (unit) in any way.
	The robot unit battery and controller battery (unit) are considered industrial waste. Make sure they are disposed of in accordance with the national and/or local authority laws and legislations.

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Controller

⚠ Danger

Before entering the safety guard because of something wrong with the robot or a peripheral device, or to **inspect or lubricate the machine etc., always make sure to turn the controller and power source circuit breakers OFF, lock and tag them, and make sure there is no electrical current.**
Failure to follow these steps can cause electric shock or injury.

⚠ Warning

When replacing fuses, or inspecting or lubricating the unit, turn OFF the power supply, then remove the cord from the main unit and make sure there is no power supplied to the robot before continuing.
Also, **do not touch the terminal block within 5 seconds of removing the power cords.** Failure to follow these steps can cause electric shock or injury.

1. OVERVIEW

By equipping the JR3000/JC-3/JS3 Series robot with an I/O-MT connector (optional: with the JR3200 series you can select the optional I/O-MT or I/O-1 connector), the robot can control 2 supportive axes: MT1 and MT2, referred to as “auxiliary axes,” in addition to the 4 axes: X axis, Y axis, Z axis, and R axis.
If you connect a motor driver device, prepared on your side, to the I/O-MT connector, you can teach and run programs and points for the device and robot as one unit.
With [Auxiliary Axis Configuration] you can set the resolution, moveable range, speed, acceleration, and I/O functions making the robot compatible with various motor driver types and devices.

1.1 Control Methods

The robot controls the device connected to the I/O-MT via command pulse output.
The device operates in conjunction with the operations of the X axis, Y axis, Z axis, and R axis of the robot.

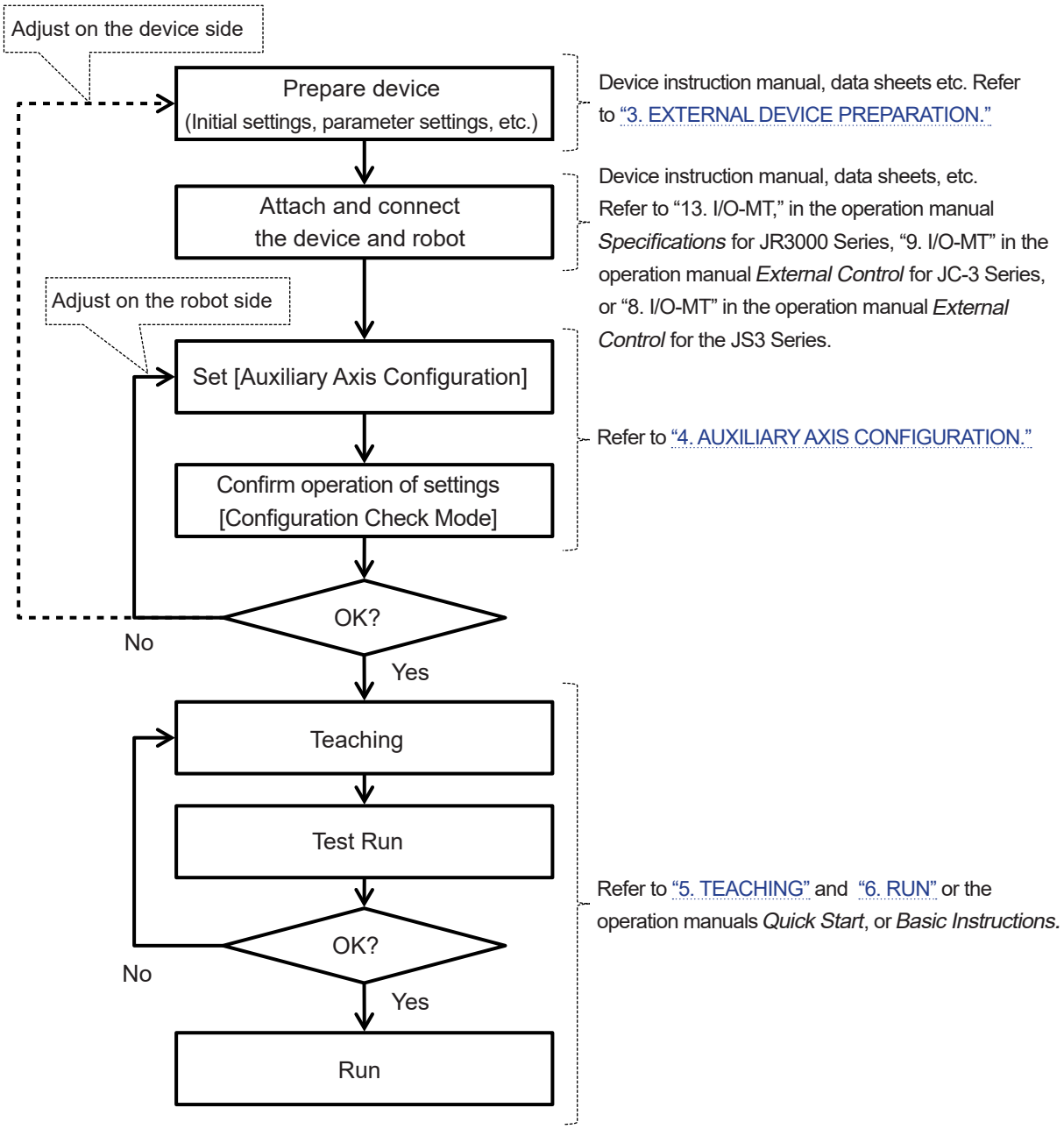
■ PTP Movement
MT1 and MT2 work together with the X axis, Y axis, and R axis. The speed of each axis is adjusted so that they arrive at their destinations the same time and their movements are synchronous.
The Z axis ascends/descends independently from the other axes.

■ CP Movement
R axis, MT1, and MT2 work together in response to the combined speed of the X axis, Y axis, and Z axis. The speed of each axis is adjusted so that they arrive at their destinations at the same and their movements are synchronous.

■ Movement via Point Jobs
Point job commands related to movements consist of *lineMove* commands and *monoMove* commands. *lineMove* commands are for linear movements made by CP movements. The R axis, MT1 axis, and MT2 axis move in succession with the combined speed of the X, Y, and Z axes.
Conversely, *monoMove* commands are for single axis movements. You can specify the distance, speed, and acceleration for *monoMove* commands.

1.2 Preparations Before Running the Robot

To make a run which includes auxiliary axis functions, you need to make preparations on the device side and settings on the robot side etc. The preparation flow is as shown in the figure below.



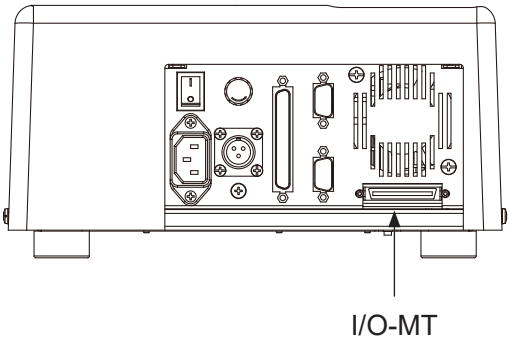
2. I/O-MT

I/O-MT is a connector for connecting and controlling devices such as the motor driver for an externally attached motor.

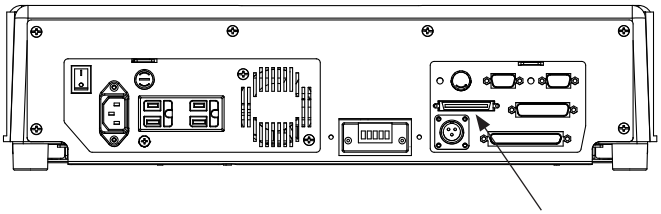
NOTE: With the JR3200 Series, the I/O-MT and I/O-1 connectors are factory options. If you select to equip the I/O-MT connector, you cannot equip the I/O-1 connector.

2.1 Connector

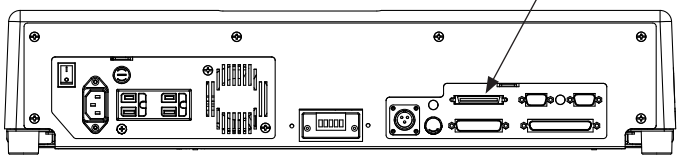
JR3200 Series
Example: JR3203N-AC/BC



JR3300 Series
Example: JR3303N-AJ/BJ



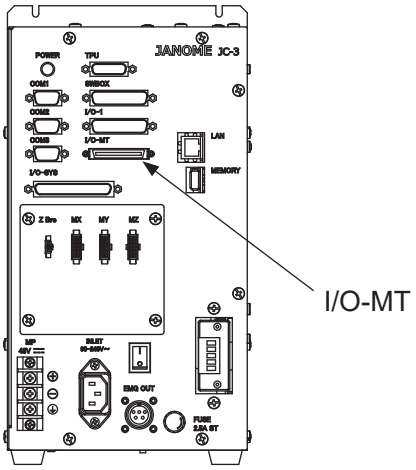
JR3400 – JR3600 Series
Example: JR3403N-AJ/BJ



JC-3 Series

Controller Front

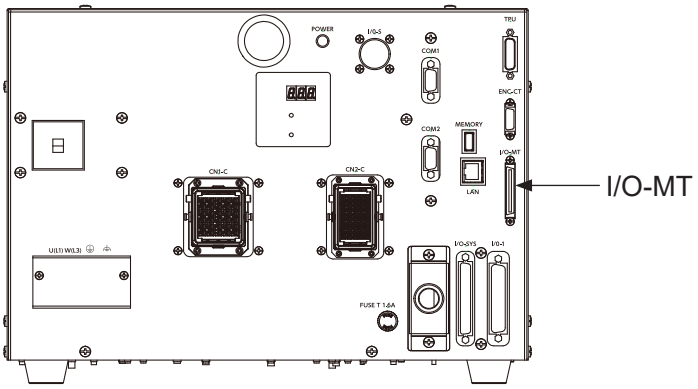
Example: JC-3C-3



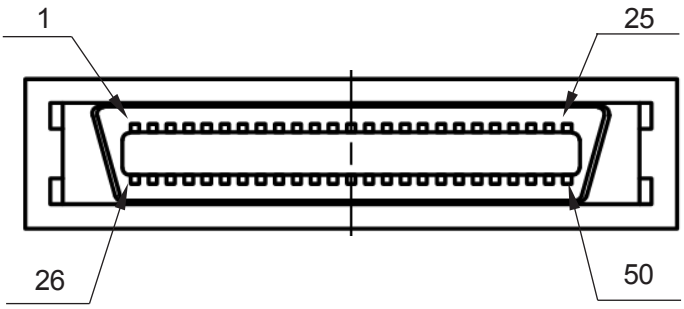
JS3 Series

Controller Front

Example: JSC3-3520



2.2 Pin Nos. (Robot Side)



Connector Model Number: PCR-E50PMC (Manufacturer: Honda Tsushin Kogyo)

2.3 Function Assignment (NPN)

■ MT1

	Name	Function	Pin No.
Input	MT1 Input 1	Driver Ready	13
	MT1 Input 2	Positioning Complete	12
	MT1 Input 3	Homing Complete	11
	MT1 Input 4	Driver Error	10
	MT1 Input 5	General Input	9
	MT1 Input 6	General Input	8
	MT1 Input 7	General Input	7
	MT1 Input 8	General Input	6
	MT1 Input COM+	General Input DC 24 V COM+	20
Sensor Input	MT1 Sensor Input 2	Timing Signal	4
	MT1 Sensor Input 1	Home Sensor	22
	MT1 Sensor COM-	Sensor Input COM-	23
	MT1 Sensor COM+	Sensor Input DC+5 V COM+	25
Output	MT1 Output 1	Excitation ON	14
	MT1 Output 2	Deviation Reset	15
	MT1 Output 3	Homing Start Request	16
	MT1 Output 4	Driver Error Reset	17
	MT1 Output 5	Release Brake	18
	MT1 Output 6	General Output	19
	MT1 Output COM-	General Output COM-	21
Pulse Output	MT1 Pulse Output 1	CW Pulse Output	1
	MT1 Pulse Output 2	CCW Pulse Output	2
	MT1 Pulse Output COM-	Pulse Output COM-	3
	MT1 Pulse Output COM+	Pulse Output DC+5 V - 24 V COM+	24
Other	GND	GND	5

■ MT2

	Name	Function	Pin No.
Input	MT2 Input 1	Driver Ready	38
	MT2 Input 2	Positioning Complete	37
	MT2 Input 3	Homing Complete	36
	MT2 Input 4	Driver Error	35
	MT2 Input 5	General Input	34
	MT2 Input 6	General Input	33
	MT2 Input 7	General Input	32
	MT2 Input 8	General Input	31
	MT2 Input COM+	General Input DC 24 V COM+	45
Sensor Input	MT2 Sensor Input 2	Timing Signal	29
	MT2 Sensor Input 1	Home Sensor	47
	MT2 Sensor COM-	Sensor Input COM-	48
	MT2 Sensor COM+	Sensor Input DC+5 V COM+	50
Output	MT2 Output 1	Excitation ON	39
	MT2 Output 2	Deviation Reset	40
	MT2 Output 3	Homing Start Request	41
	MT2 Output 4	Reset Driver Error	42
	MT2 Output 5	Release Brake	43
	MT2 Output 6	General Output	44
	MT2 Output COM-	General Output COM-	46
Pulse Output	MT2 Pulse Output 1	CW Pulse Output	26
	MT2 Pulse Output 2	CCW Pulse Output	27
	MT2 Pulse Output COM-	Pulse Output COM-	28
	MT2 Pulse Output COM+	Pulse Output DC+5 V - 24 V COM+	49
Other	GND	GND	30

2.4 Function Assignment (PNP)

■ MT1

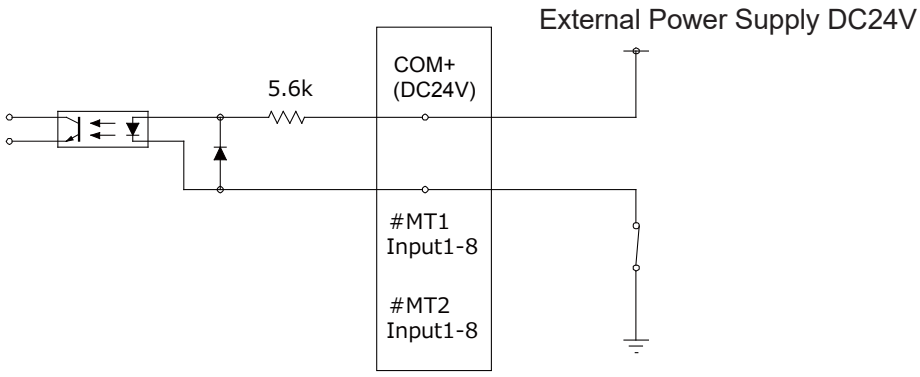
	Name	Function	Pin No.
Input	MT1 Input 1	Driver Ready	13
	MT1 Input 2	Positioning Complete	12
	MT1 Input 3	Homing Complete	11
	MT1 Input 4	Driver Error	10
	MT1 Input 5	General Input	9
	MT1 Input 6	General Input	8
	MT1 Input 7	General Input	7
	MT1 Input 8	General Input	6
	MT1 Input COM-	General Input COM-	20
Sensor Input	MT1 Sensor Input 2	Timing Signal	4
	MT1 Sensor Input 1	Home Sensor	22
	MT1 Sensor COM-	Sensor Input COM-	23
	MT1 Sensor COM+	Sensor Input DC+5 V COM+	25
Output	MT1 Output 1	Excitation ON	14
	MT1 Output 2	Deviation Reset	15
	MT1 Output 3	Homing Start Request	16
	MT1 Output 4	Driver Error Reset	17
	MT1 Output 5	Release Brake	18
	MT1 Output 6	General Output	19
	MT1 Output COM+	General Output DC+ 24 V COM+	21
Pulse Output	MT1 Pulse Output 1	CW Pulse Output	1
	MT1 Pulse Output 2	CCW Pulse Output	2
	MT1 Pulse Output COM-	Pulse Output COM-	3
	MT1 Pulse Output COM+	Pulse Output DC +5 - 24V COM+	24
Other	GND	GND	5

■ MT2

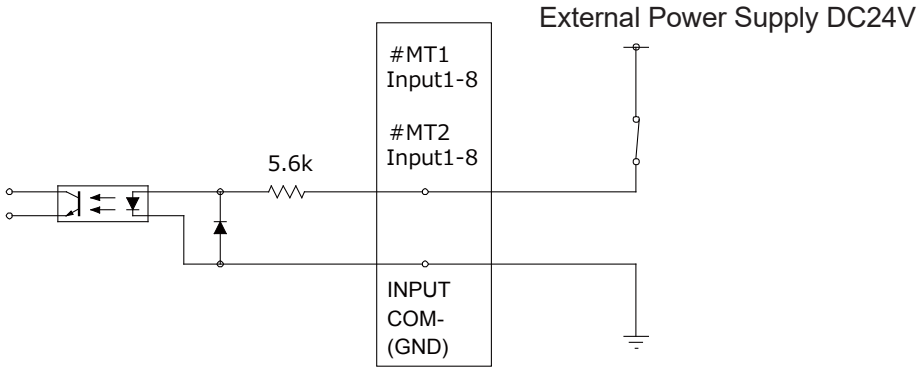
	Name	Function	Pin No.
Input	MT2 Input 1	Driver Ready	38
	MT2 Input 2	Positioning Complete	37
	MT2 Input 3	Homing Complete	36
	MT2 Input 4	Driver Error	35
	MT2 Input 5	General Input	34
	MT2 Input 6	General Input	33
	MT2 Input 7	General Input	32
	MT2 Input 8	General Input	31
	MT2 Input COM-	General Input COM-	45
Sensor Input	MT2 Sensor Input 2	Timing Signal	29
	MT2 Sensor Input 1	Home Sensor	47
	MT2 Sensor COM-	Sensor Input COM-	48
	MT2 Sensor COM+	Sensor Input DC+5 V COM+	50
Output	MT2 Output 1	Excitation ON	39
	MT2 Output 2	Deviation Reset	40
	MT2 Output 3	Homing Start Request	41
	MT2 Output 4	Reset Driver Error	42
	MT2 Output 5	Release Brake	43
	MT2 Output 6	General Output	44
	MT2 Output COM+	General Output DC +24V COM+	46
Pulse Output	MT2 Pulse Output 1	CW Pulse Output	26
	MT2 Pulse Output 2	CCW Pulse Output	27
	MT2 Pulse Output COM-	Pulse Output COM-	28
	MT2 Pulse Output COM+	Pulse Output DC +5 - 24V COM+	49
Other	GND	GND	30

2.5 I/O Signals

2.5.1 Input Signals



NPN



PNP

Input signals are treated as active when the photocoupler is ON.

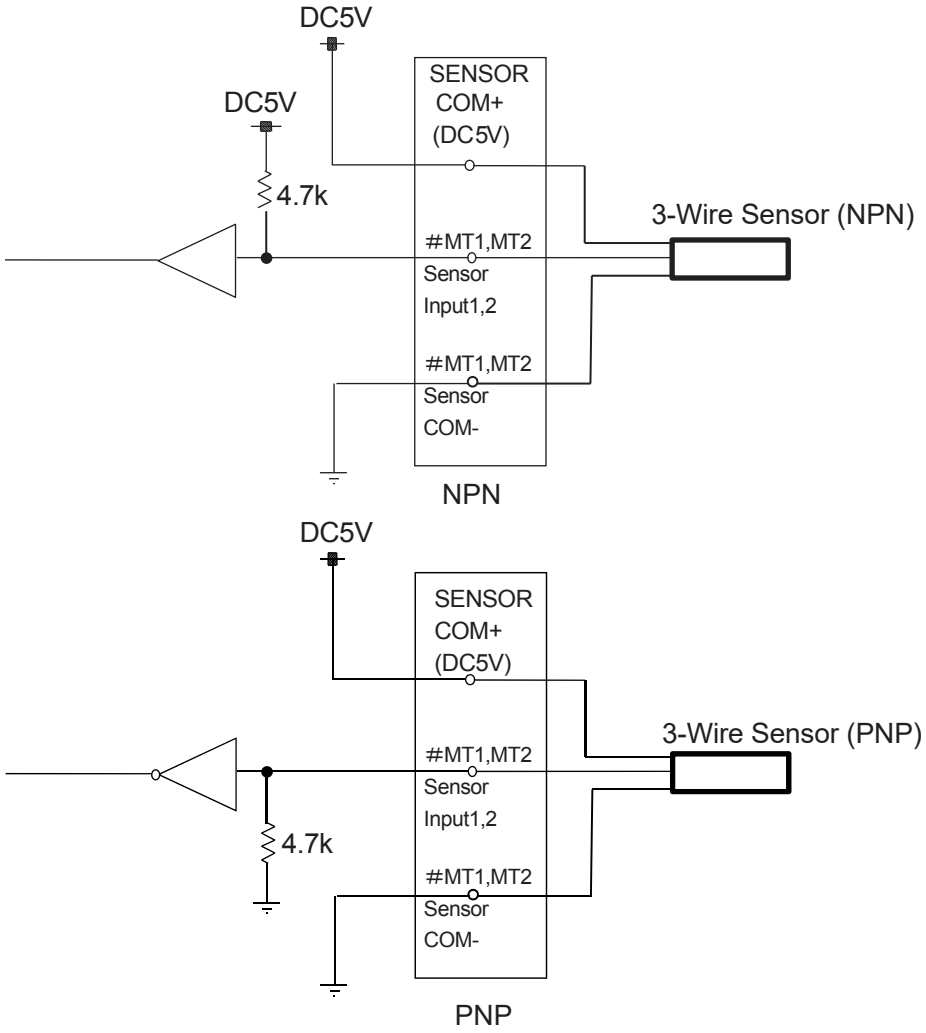
MT1 and MT2 each have 8 input signal channels (a total of 16).

MT1 and MT2 are both equipped with an individual general input COM+/COM- terminal. Make sure to wire the MT1/MT2 general input COM+/COM- terminals individually.

⚠ Caution

Do not assign wiring other than the wiring specified above.
Assigning the wrong wiring can damage the internal circuits.

2.5.2 Sensor Input Signals



The input circuit is equipped with a 4.7 K Ω 5 V pull-up resistor (NPN), pull-down resistor (PNP) for sensor input. The input circuit has no internal overvoltage protection circuit, so make sure to use it within a 0 to 5 V input voltage range.

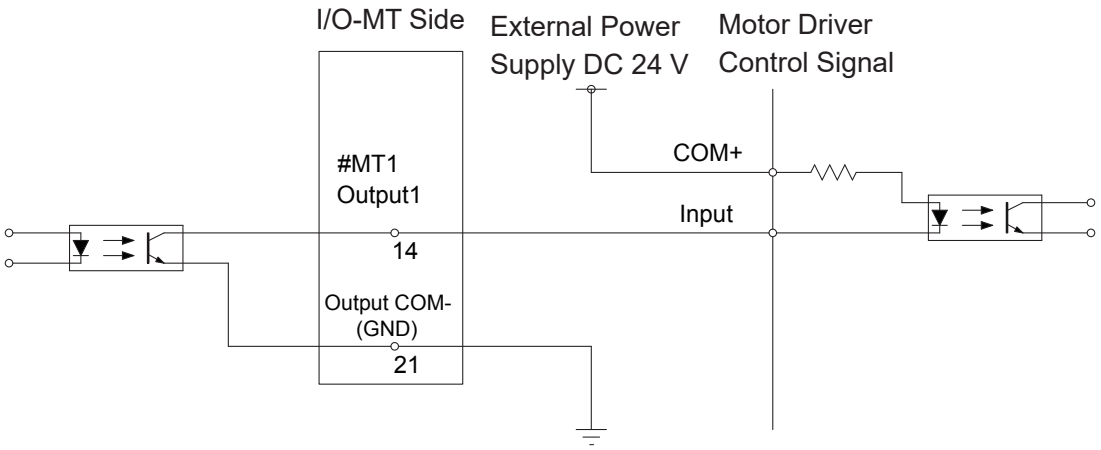
NOTE:

- The sensor input signals come ON with an L voltage level and OFF with an H voltage level. (VIL = 0.8 Vmax, VIH = 2.0 Vmin)
  The sensor input signal COM+ terminal does not have a overvoltage protection function, so make sure to use it within a range that does not exceed 100 mA, including when it is in a transient state. Connect the sensor input signal COM- terminal to the frame ground via the internal GND terminal.
- Sensor input is compatible only with a 3-wire sensor. Do not use a 2-wire sensor.

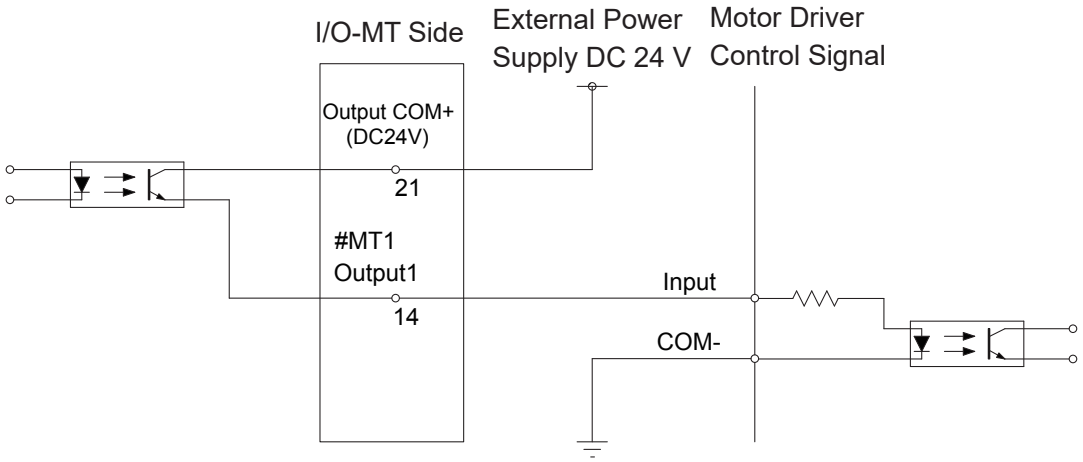
⚠ Caution

Do not assign wiring other than the wiring specified above.
Assigning the wrong wiring can damage the internal circuits.

2.5.3 Output Signals



NPN



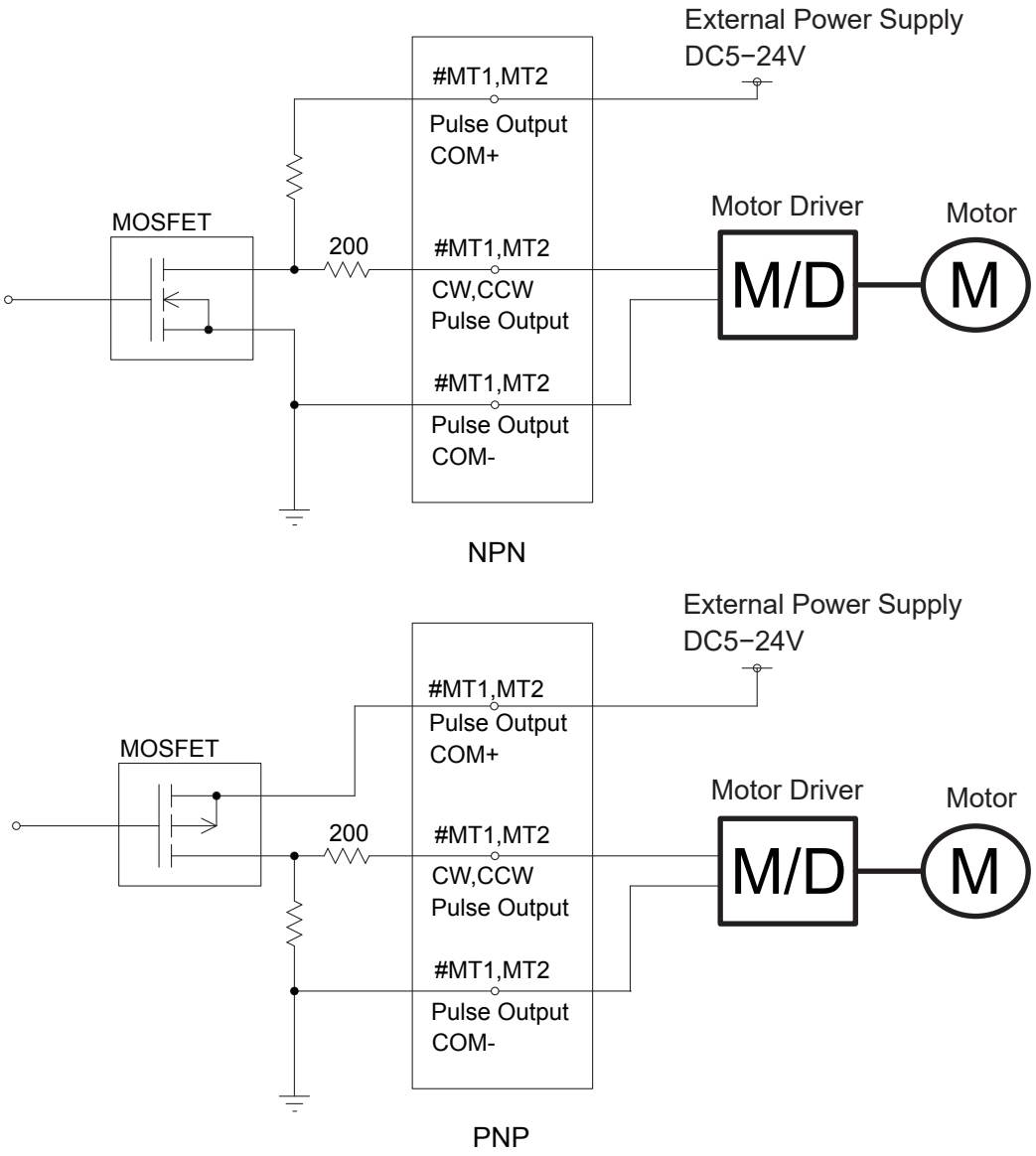
PNP

MT1 and MT2 each have 6 output signal channels (a total of 12).
MT1 and MT2 are both equipped with an individual general output COM+/COM- terminal. Make sure to wire the MT1/MT2 general output COM+/COM- terminals separate from each other.

⚠ Caution

Do not assign wiring other than the wiring specified above.
Assigning the wrong wiring can damage the internal circuits.

2.5.4 Pulse Output Signals



NOTE: This is a representation of the internal circuits.

MT1 and MT2 each have pulse output signal channel; one for CW and one for CCW (a total of 2).
With an NPN circuit, connect the pulse output COM- terminal to the motor driver ground terminal.
With a PNP circuit, connect the pulse output COM- terminal to the motor driver ground terminal.
MT1 and MT2 are both equipped with an individual pulse output COM+ terminal. Make sure to wire the MT1/MT2 pulse output COM+ terminals separate from each other.

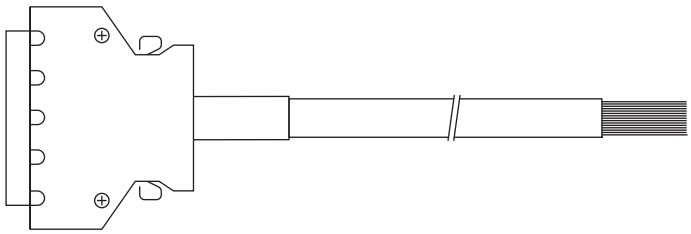
Connect external current limiting resistors to the output terminals (CW, CCW) as necessary to ensure the electric current does not exceed 30 mA.
Make sure the external power supply connected to the pulse output COM+ terminal uses a voltage appropriate for the pulse input voltage of the external device.

2.6 I/O-MT Option Cord (Unit)

■ I/O-MT Option Cord (Unit) (Optional)

NOTE: The part number varies according to the cable length.

Cable Length [m]	Janome Part No.
0.5	170551104
1	170551207
3	170551001
5	170551300

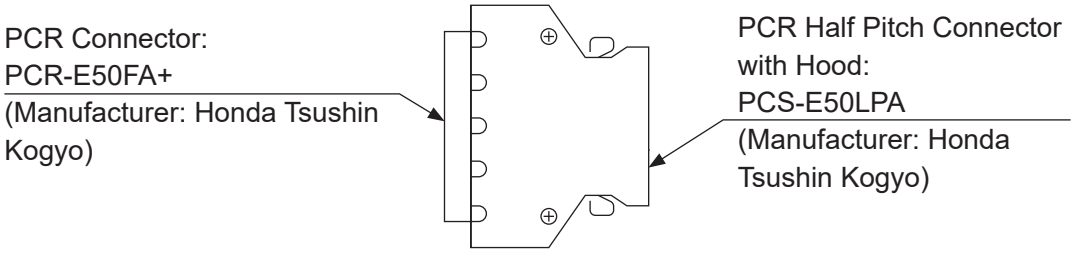


Cable Wiring

Pin No.	Cord Color (Dot)	Pin No.	Cord Color (Dot)	Pin No.	Cord Color (Dot)
1	Orange (Black 1)	18	Yellow (Red 2)	35	White (Black 4)
2	Orange (Red 1)	19	Pink (Black 2)	36	White (Red 4)
3	Gray (Black 1)	20	Pink (Red 2)	37	Yellow (Black 4)
4	Gray (Red 1)	21	Orange (Black 3)	38	Yellow (Red 4)
5	White (Black 1)	22	Orange (Red 3)	39	Pink (Black 4)
6	White (Red 1)	23	Gray (Black 3)	40	Pink (Red 4)
7	Yellow (Black 1)	24	Gray (Red 3)	41	Orange (Black continuous)
8	Yellow (Red 1)	25	White (Black 3)	42	Orange (Red continuous)
9	Pink (Black 1)	26	White (Red 3)	43	Gray (Black continuous)
10	Pink (Red 1)	27	Yellow (Black 3)	44	Gray (Red continuous)
11	Orange (Black 2)	28	Yellow (Red 3)	45	White (Black continuous)
12	Orange (Red 2)	29	Pink (Black 3)	46	White (Red continuous)
13	Gray (Black 2)	30	Pink (Red 3)	47	Yellow (Black continuous)
14	Gray (Red 2)	31	Orange (Black 4)	48	Yellow (Red continuous)
15	White (Black 2)	32	Orange (Red 4)	49	Pink (Black continuous)
16	White (Red 2)	33	Gray (Black 4)	50	Pink (Red continuous)
17	Yellow (Black 2)	34	Gray (Red 4)		

■ I/O-MT Connector (Unit) (Optional)

Janome Part No.: 170554004



2.7 Output Capacity

⚠ Caution

Adhere to the voltage capacities outlined in the table below. If you exceed the values listed below, the internal circuits may be damaged.

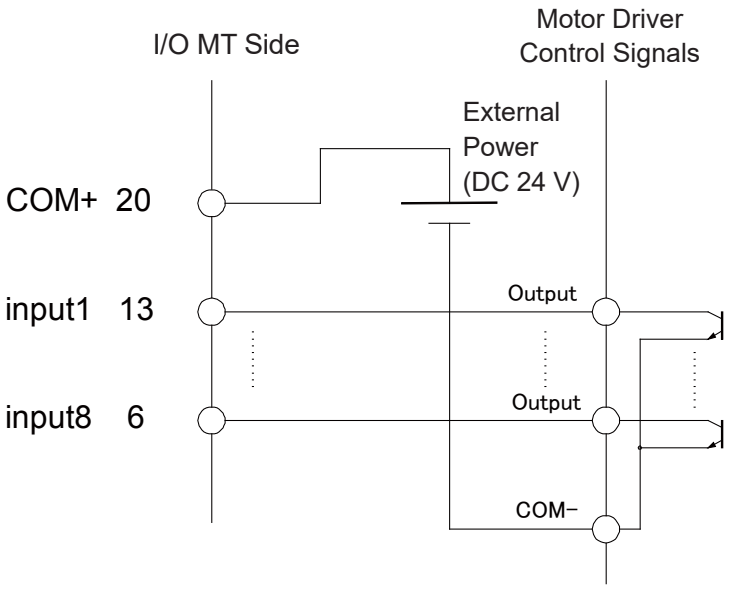
		Type	Rated Output / Input
Output Pin	MT1 Output 1 – 6	Photocoupler	DC 24 V, 100 mA/pin
	MT1 Output COM+	Photocoupler	DC 24 V, 600 mA/pin
	MT1 Pulse Output 1 – 2	FET	DC 24 V, 30 mA/pin
	MT1 Pulse Output COM+	FET	DC 24 V, 100 mA/pin
	MT2 Output 1 – 6	Photocoupler	DC 24 V, 100 mA/pin
	MT2 Output COM+	Photocoupler	DC 24 V, 600 mA/pin
	MT2 Pulse Output 1 – 2	FET	DC 24 V, 30 mA/pin
	MT2 Pulse Output COM+	FET	DC 24 V, 100 mA/pin
Input Pin	MT1 Input 1 – 8	Photocoupler	DC 24 V, 100 mA/pin
	MT1 Sensor Input 1 – 2	Photocoupler	DC 5 V, 50 mA/pin
	MT2 Input 1 – 8	Photocoupler	DC 24 V, 100 mA/pin
	MT2 Sensor Input 1 – 2	Photocoupler	DC 5 V, 50 mA/pin

For the external power supply, prepare a power supply (DC 24 V) on your side.

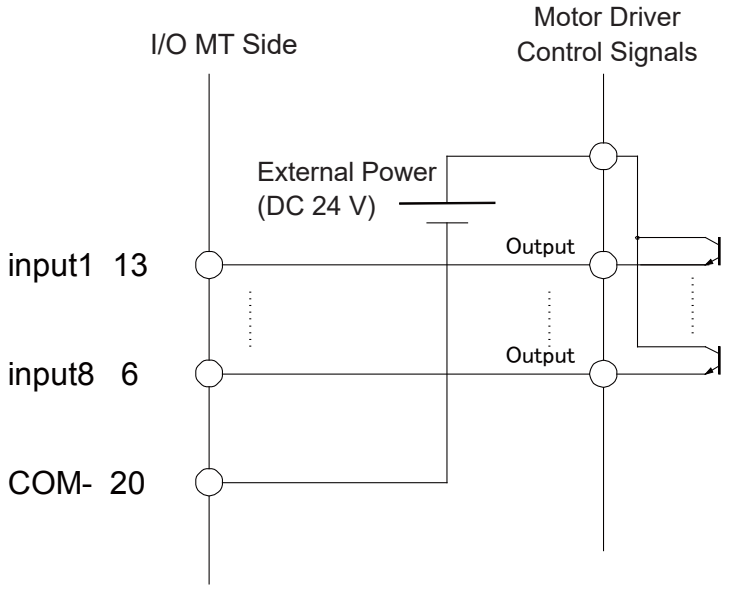
2.8 Connection Example

2.8.1 Input Signals

Connection Example: Open Collector (MT1)

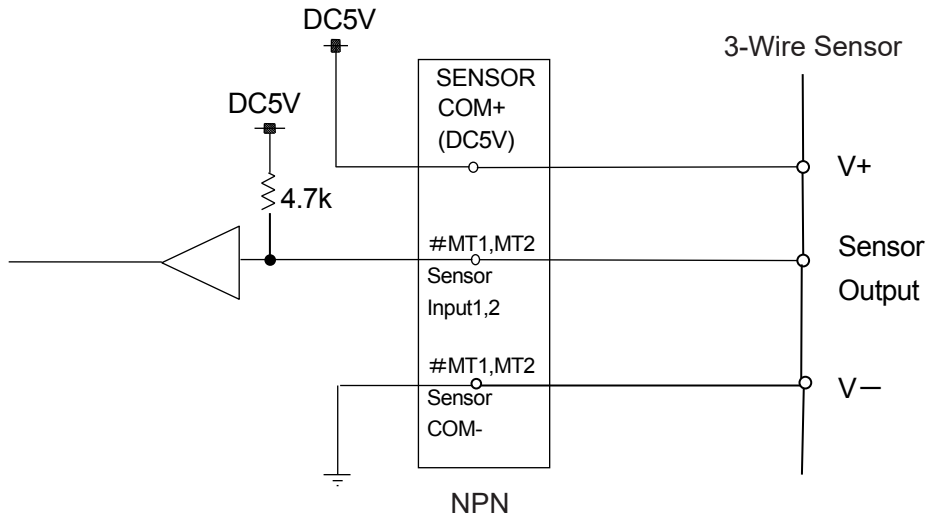


NPN

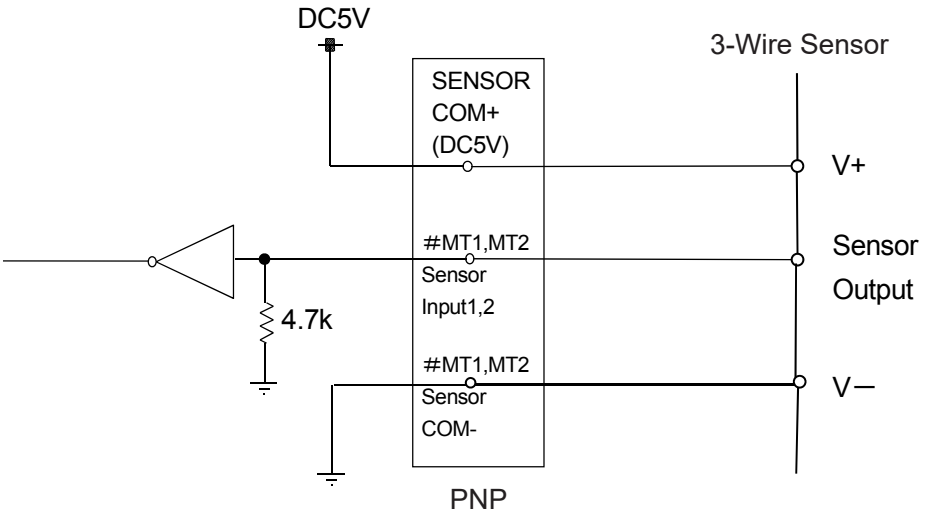


PNP

2.8.2 Sensor Input Signals



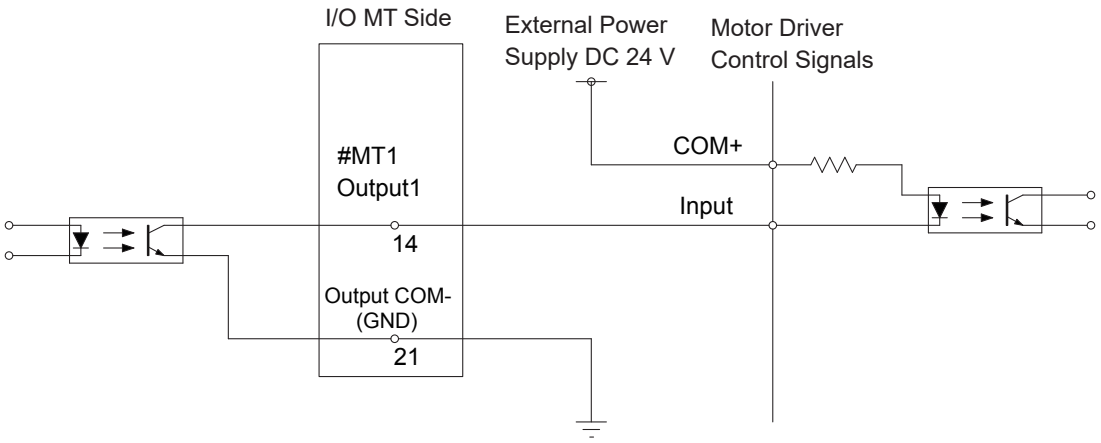
NPN



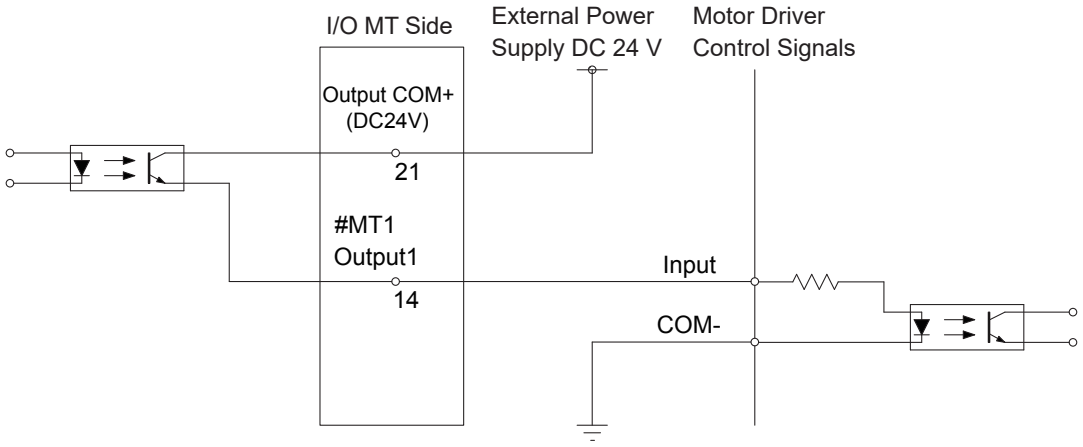
PNP

2.8.3 Output Signals

Connection Example: Photocoupler Input (MT1)



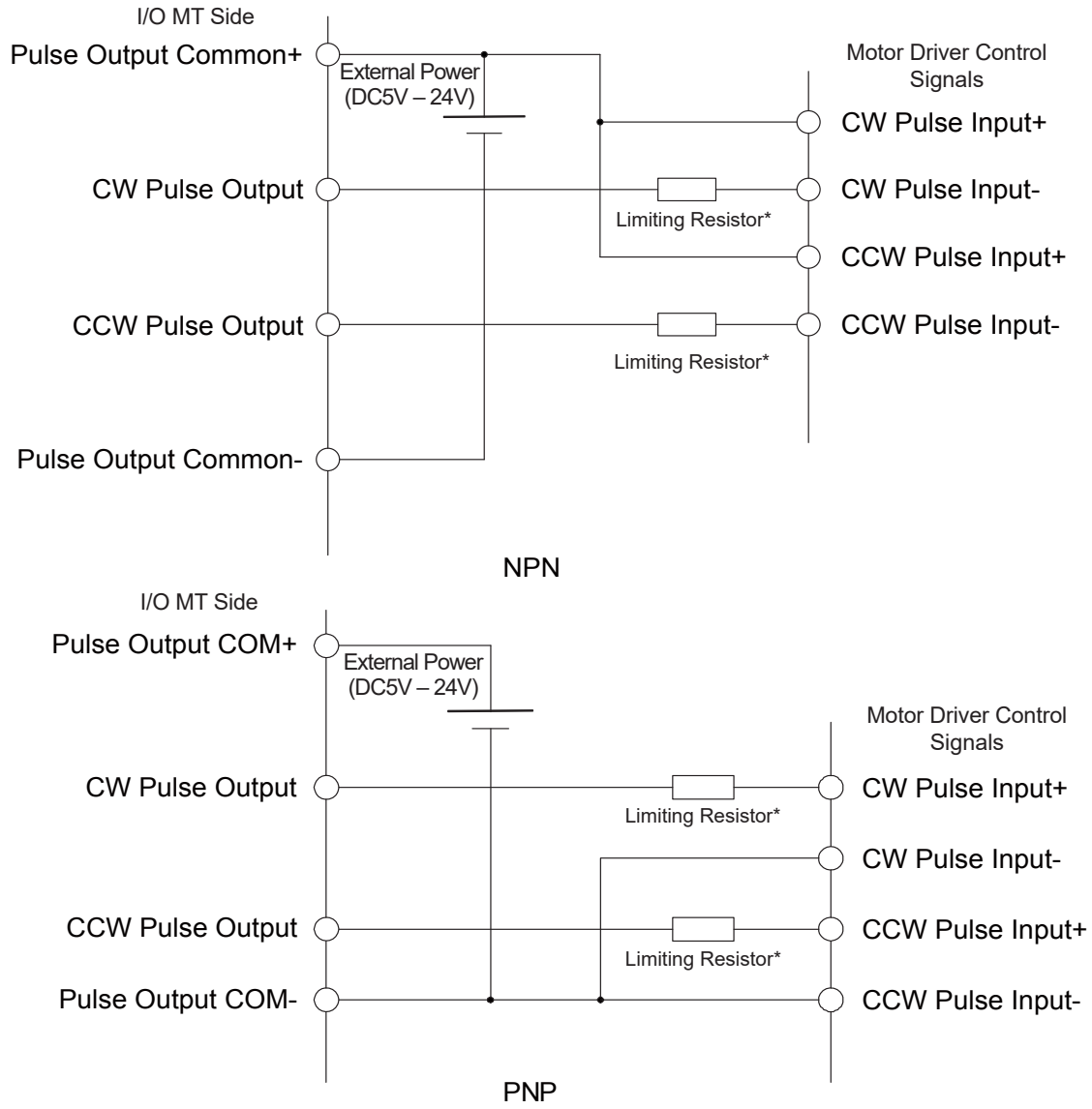
NPN



PNP

2.8.4 Pulse Output Signals

■ Connection Example: Photocoupler Input Type Driver

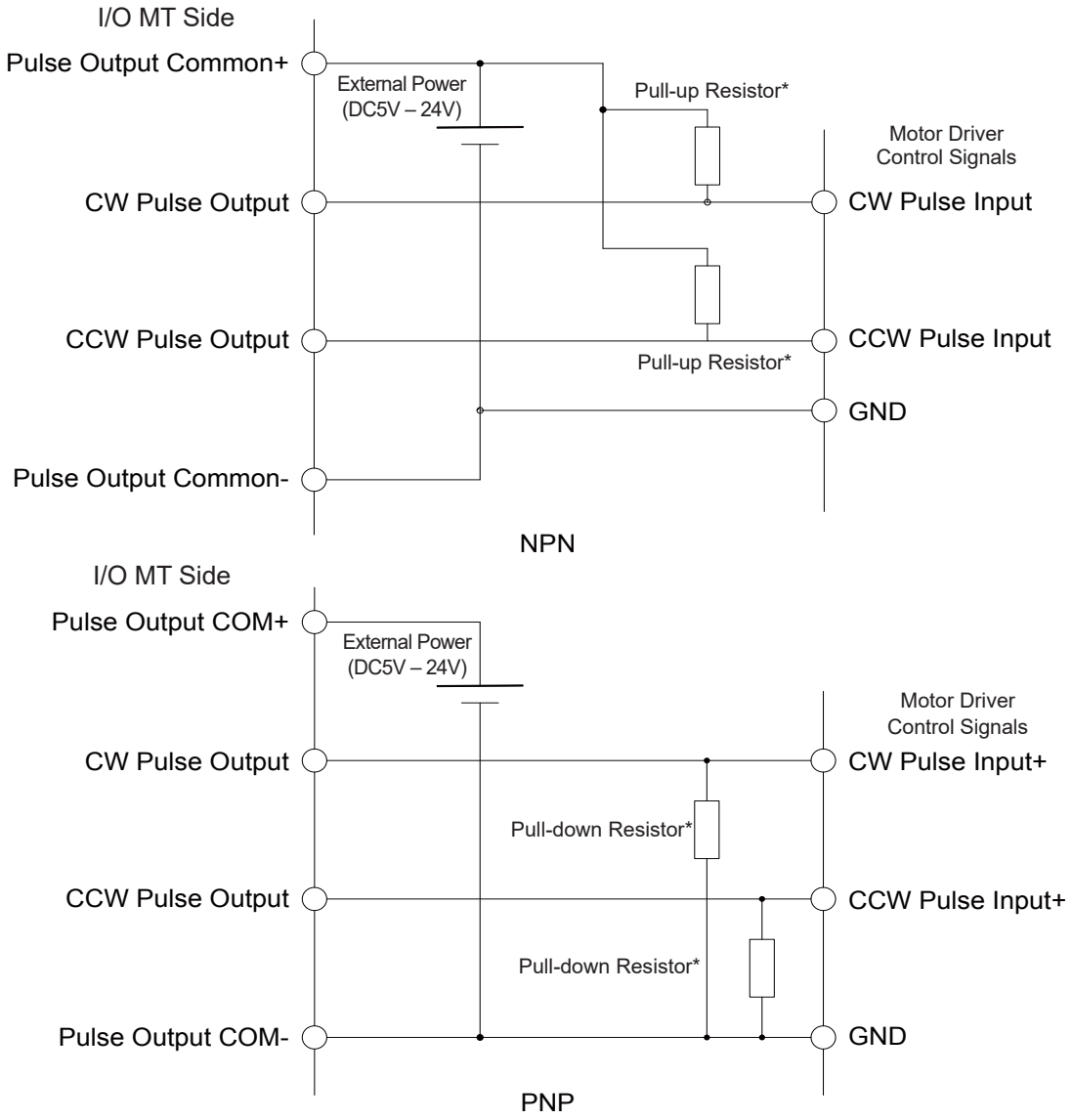


* If using a photocoupler input type external device, connect a limiting resistor to the pulse output line as necessary to ensure the electric current does not exceed 30 mA. If the driver has a built-in limiting resistor, you do not need an external limiting resistor.

⚠ Caution

Make sure to supply the I/O-MT pulse output COM+ terminal with the same pulse voltage as the external device.
Supplying an incorrect voltage can cause breakdown.

■ Connection Example: Single Ended Input Type Driver



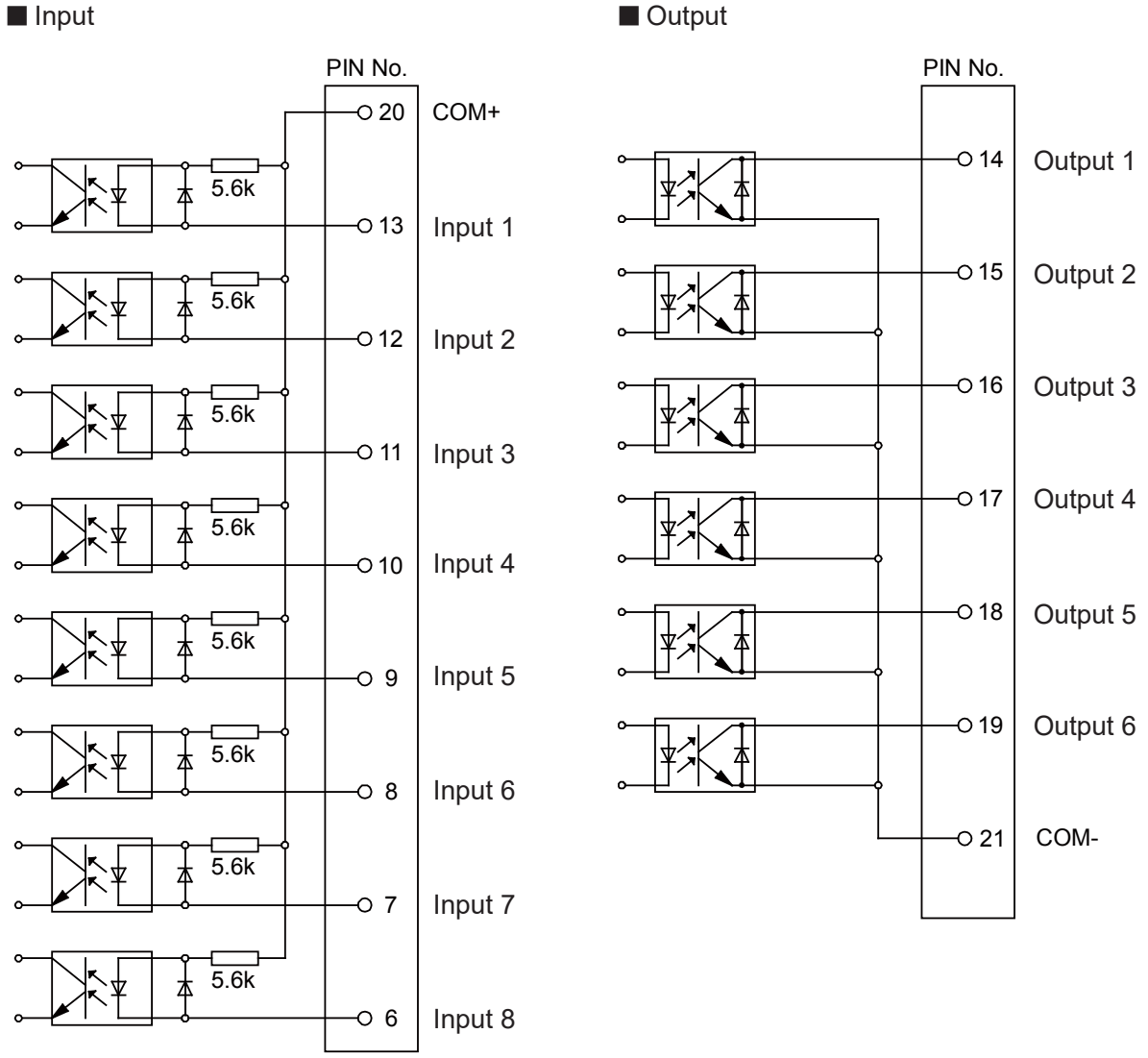
* If the external device uses single ended input, attach an external pull-up resistor for an NPN circuit; or an external pull-down resistor for a PNP circuit.
Use pull-up/pull-down resistors that provide a resistance of 10 k Ω or more. Also make sure to use the appropriate rated power resistance in compliance with the power supply voltage connected to the pulse output COM + terminal and the pull-up resistance / pull-down resistance value. If the driver has built-in pull-up/pull-down resistors, you do not need external pull-up/pull-down resistors.

⚠ Caution

Make sure to supply the I/O-MT pulse output COM+ terminal with the same pulse voltage as the external device.
Supplying an incorrect voltage can cause breakdown.

2.9 Circuit Diagram (NPN)

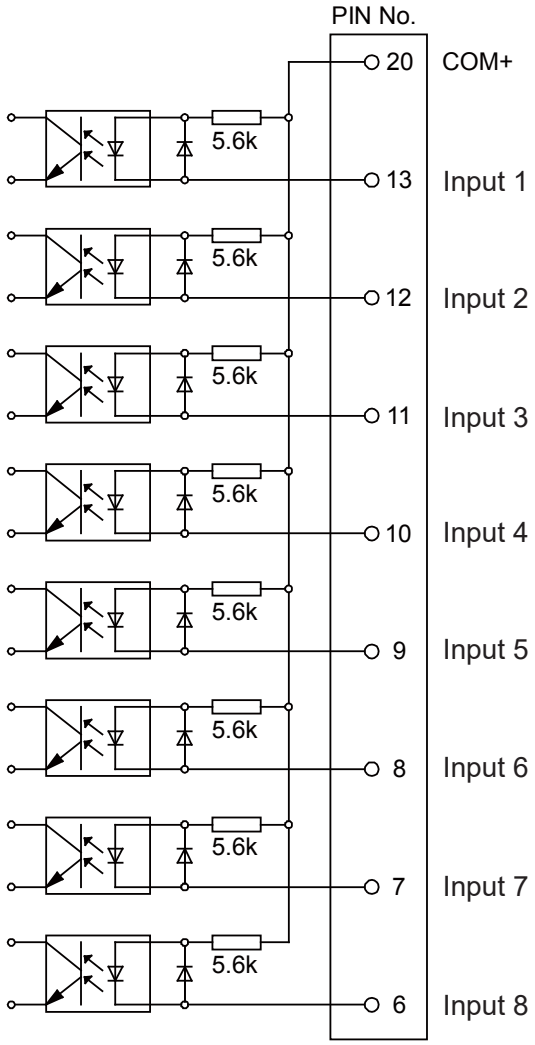
MT1 Circuit Diagram NPN



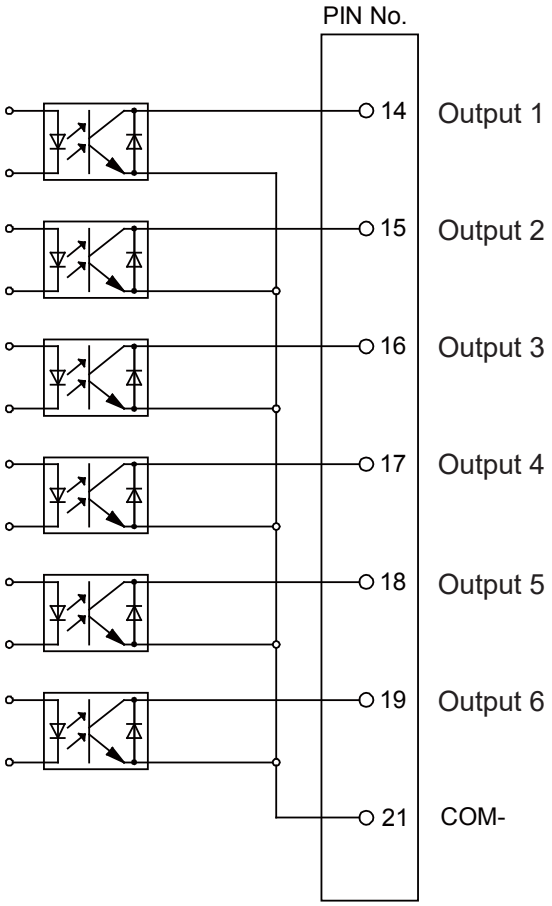
NPN

MT2 Circuit Diagram NPN

■ Input



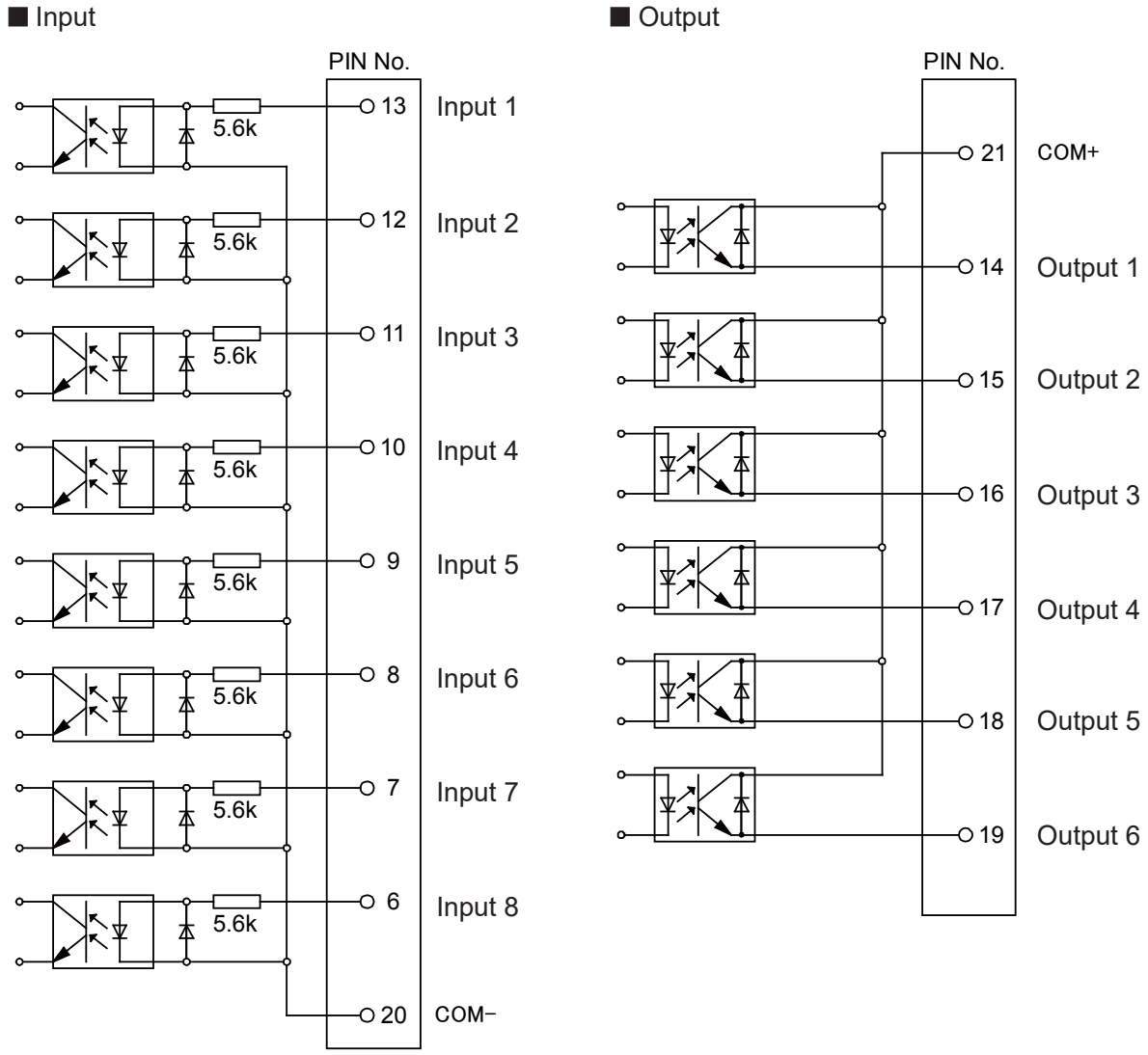
■ Output



NPN

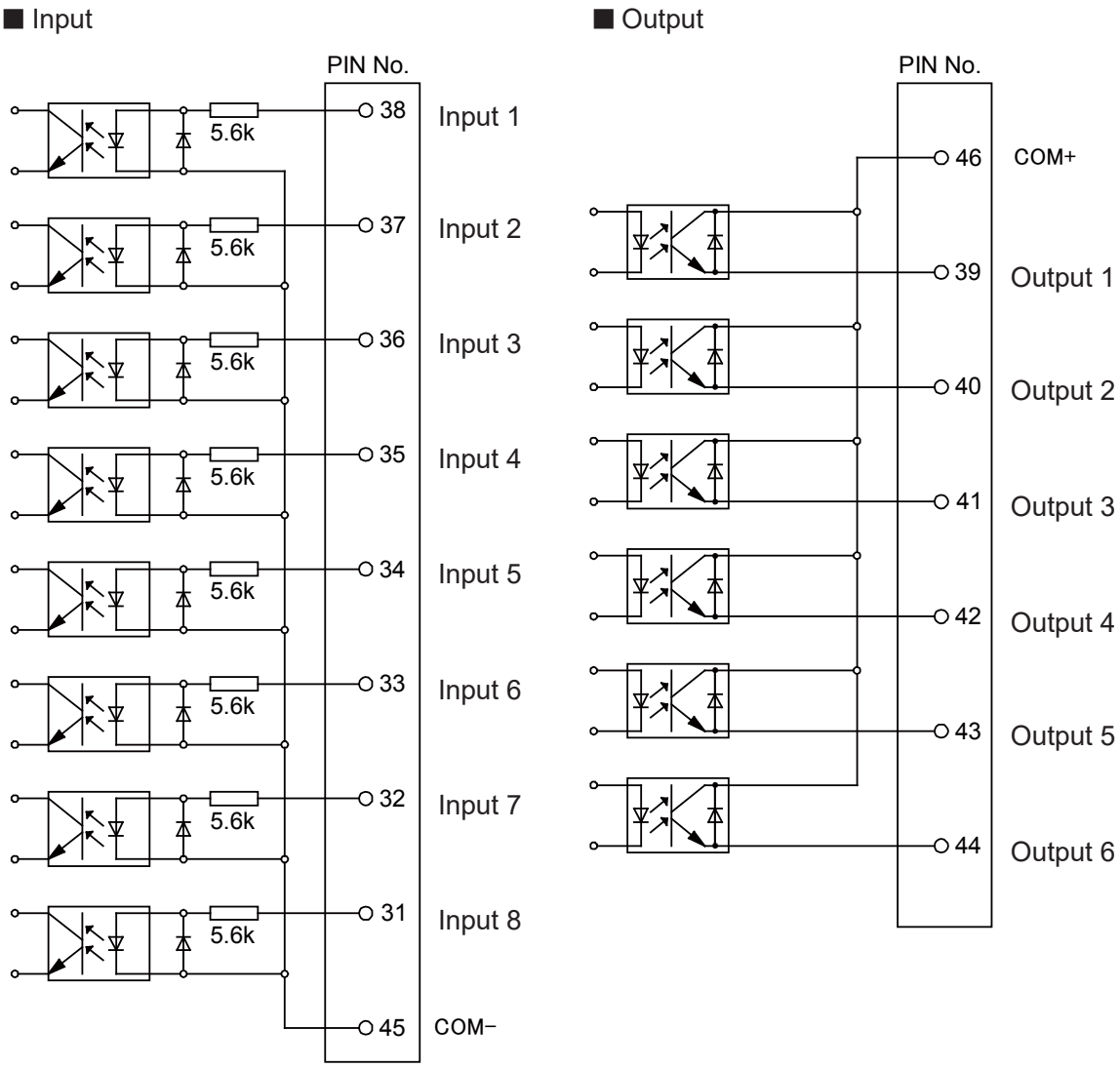
2.10 Circuit Diagram (PNP)

MT1 Circuit Diagram PNP



PNP

MT2 Circuit Diagram PNP



PNP

2.11 Pulse Output

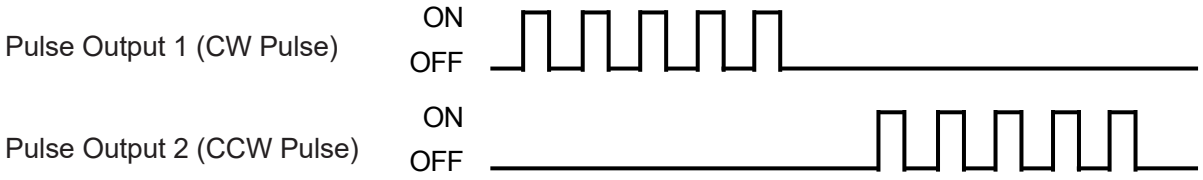
With the auxiliary axis configuration [Output Pulse Type], you can select an output wave-type pulse.

NOTE:

- The MT1, MT2 pulse output signals have a maximum of 250 kHZ (250 kPPS).
- The pulse duty ratio is 50 % when the speed is 1000 [Hz] (1000 [PPS]) or more. When less than 1000 [Hz] (1000 [PPS]), the pulse width is fixed at 0.5 msec and the pulse duty ratio is less than 50 %.

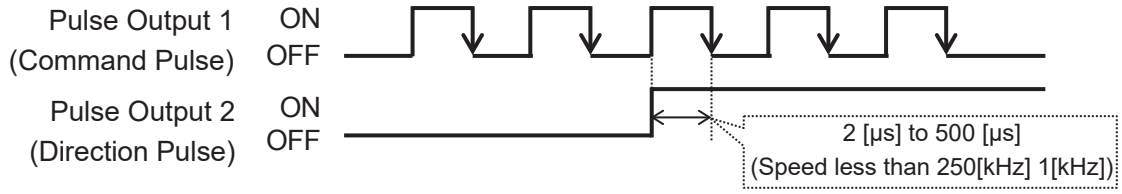
2.11.1 Type 1 (CW/CCW Output)

Pulses (CW pulse) that shows positive direction is output from pulse output 1 terminal.
Pulses (CCW pulse) that shows negative direction is output from pulse output 2 terminal.



2.11.2 Type 2 (Command Pulse + Directional Signal Output)

Signals which indicate the pulse number are output from pulse output 1 terminal.
Signals which indicate the direction are output from pulse output 2 terminal.
If the signals are OFF, the pulses are positive direction; if the signals are ON, the pulses are negative direction.



After the direction signal changes ON/OFF, the time until the edge where the next command pulse goes ON → OFF is dependent on the pulse speed (frequency). If the speed is 250 [kHz], the time is 2 [µs]. If the speed is 1 [kHz] or less, the time is 500 [µs].

⚠ Caution

If using type 2, use a device which receives a command generated from the edge of an ON → OFF command pulse.
It is possible that the directional signal cannot be determined with a device which receives commands from the OFF → ON edge as directional pulses go ON/OFF simultaneously at an edge where the command pulse goes OFF → ON.

3. EXTERNAL DEVICE PREPARATION

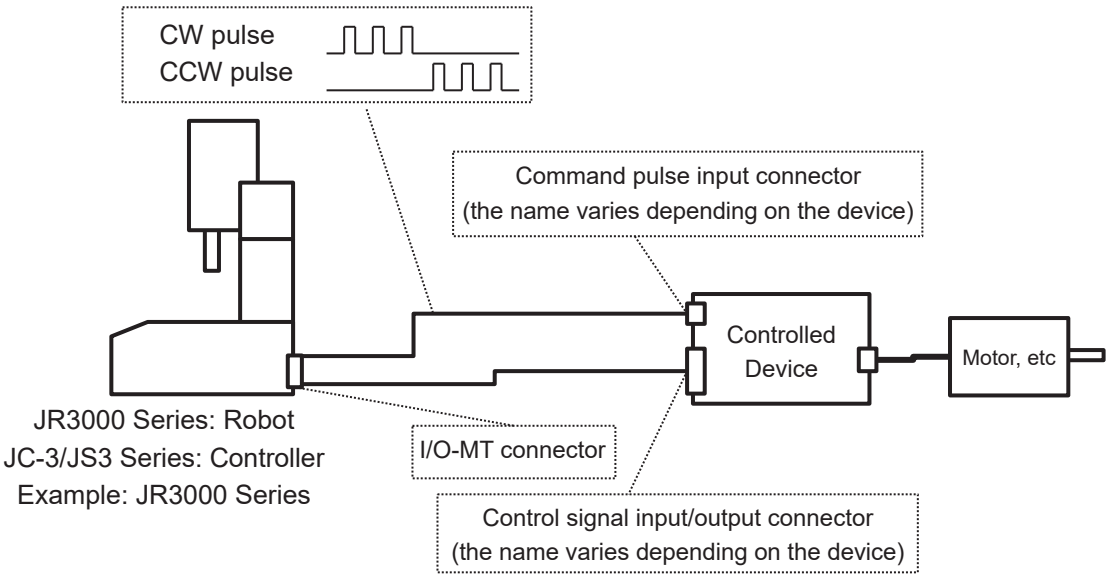
3.1 Device Compatibility Standards

This section explains device compatibility standards.
Note however that even if you comply with these standards, there are times you cannot control the external device with this robot. Thoroughly read and make sure you understand this manual and the instruction manual and/or specifications of the device you are connecting. Confirm that the device is controllable with this robot and in addition, beware of assigning commands that exceed the functionality of the connectable device.

3.1.1 Device Types and Instruction Methods

With auxiliary axis functions, it is possible to control devices such as a stepping motor driver, servomotor driver, single-axis actuator driver, motion controller, etc. However, these are limited to pulse string input type devices.

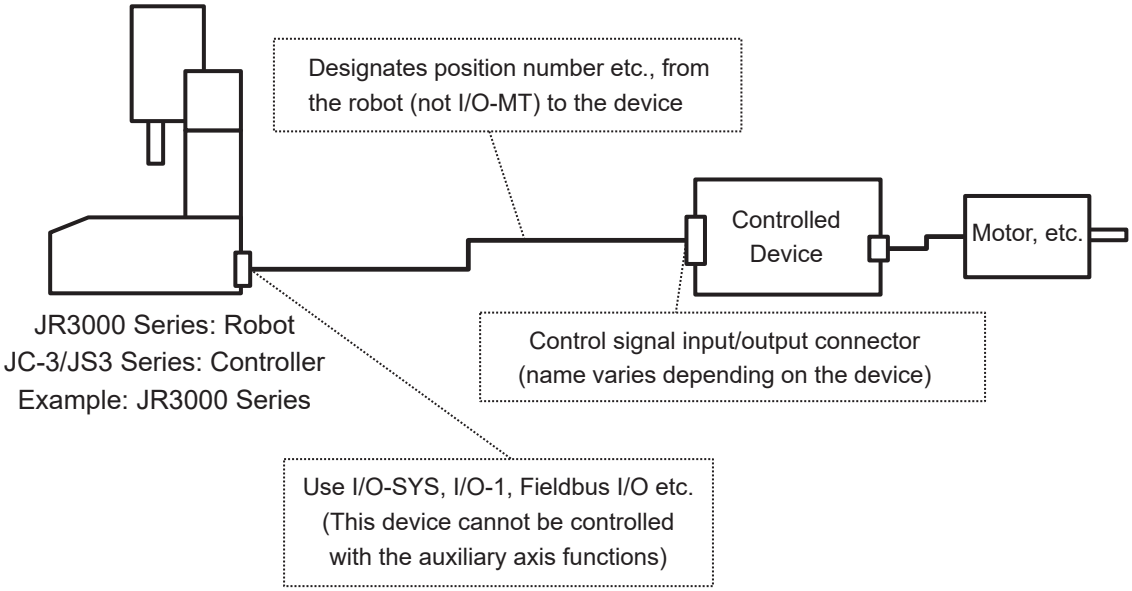
■ Pulse String Input Devices
This is a device type which is controlled by accepting pulse command inputs from an external pulse transmitter. You can control operations via command outputs from I/O-MT.



■ Position Table Devices and Built-In Positioning Function Devices

These are device types equipped with functions for setting and executing position tables and operation programs, etc., and are controlled by designating external position numbers and/or program numbers. Device types such as these cannot be controlled from command pulses and therefore cannot be controlled with the auxiliary axis functions described in this manual. Consider using I/O-SYS, I/O-1, or Fieldbus I/O etc. to control the device. If using a device controlled by serial communication, consider using COM communication functions to control the device.

For information regarding I/O-SYS, I/O-1, Fieldbus I/O, refer to the operation manual *External Control* or for COM communication functions, refer to the operation manual *Communication Control*.



3.1.2 Device Control Methods

There are certain precautions that need to be taken according to the device's control methods.

■ Open Loop Type Devices (Stepping Motor, etc.)

With open loop type devices such as a stepping motor etc., a step-out occurs (there is a discrepancy between the instructed position and the actual position) if a speed, acceleration and/or external force exceeding the rated value is assigned to the device. If you continue operations while stepped-out, conflicts and other such problems with the mechanical limitations of the device and/or robot and peripheral devices may occur. If stepped-out, you need to return to the home position and then match the actual position to the position coordinate values. Due to limitations such as the ones above, use the device within conditions that do not cause step-outs.

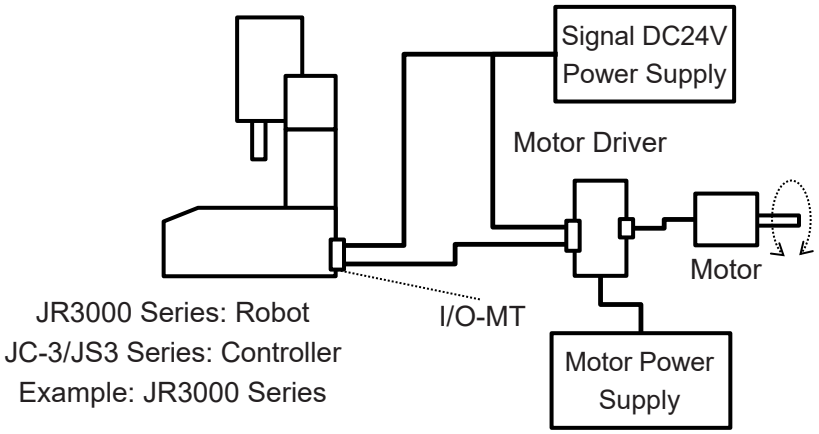
■ Closed Loop Type Devices (Servomotor, etc.)

For closed loop type devices such as a servomotor etc., the device is equipped with control functions to align the actual position with the instructed position.
However, there may be a delay for the actual operation to follow the corresponding command pulse inputs. Also, if a speed, acceleration and/or external force exceeding the rated values are assigned to the device, the device goes into error and/or alarm status and operations may stop.
If the device goes into error and/or alarm status, perform the corresponding error and/or alarm clear operation; you may need to deal with the error/alarm by turning the power to the device OFF and then ON again etc.

3.2 Connection and Wiring Standards

3.2.1 System Structure Example

This is an example of connecting a motor driver to I/O-MT and powering the motor.



Prepare the signal DC24V power supply and motor power supply on your end.

⚠ Caution

- The safety circuit of the device connected to I/O-MT needs to be constructed by the user. If the user does not construct the safety circuit for the device connected to I/O-MT, the power of the device connected to I/O-MT is not cut OFF during an emergency stop of the robot. Perform a risk assessment and, if necessary, construct a safety circuit for the device connected to I/O-MT.

- If you do not use I/O-MT excitation output ON signal, the robot does not control the motor excitation signal during an emergency stop. Therefore, in the case of a circuit configuration that does not cut OFF the power, the motor maintains the excited state even during an emergency stop. Perform a risk assessment and, if necessary, control the motor excitation signal by using Job On Emergency Stop.

- When the power of the device connected to I/O-MT is cut OFF or the excitation is turned OFF, the shaft may move due to the mass of the workpiece or tool, and external force, etc. Perform a risk assessment and, if necessary, take measures such as incorporating a non-excitation actuated brake for holding.

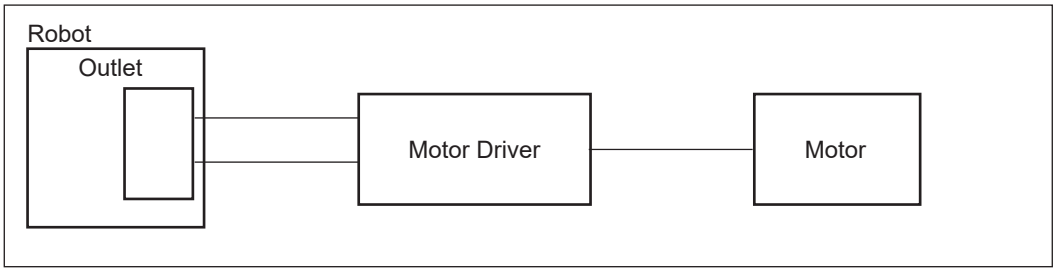
The following shows an example of the safety circuit.

1. JR3000 Series

(1) With Outlet

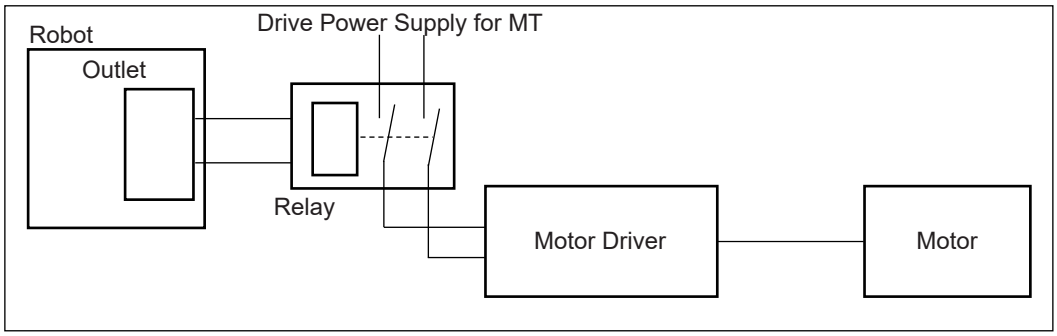
The outlet is linked to the robot's emergency stop switch, and the output is cut OFF during an emergency stop. The power supply voltage supplied from the outlet is the same as the power supply voltage supplied to INLET, and the current can be used up to 3A. Therefore, if the drive power supply of the motor driver is the same as the power supply voltage of the robot and is 3A or less, the drive power supply of the motor driver can be taken from the outlet of the robot to shut OFF the drive power supply in the event of an emergency stop.

Circuit Example



If the drive power supply of the motor driver is different from the power supply voltage of the robot, or if it exceeds 3A, connect a relay to the outlet and control the drive power supply with that relay.

Circuit Example



For details on the outlet, refer to “1. OUTLET” in the operation manual *External Control* for the JR3000 Series.

(2) Without Outlet

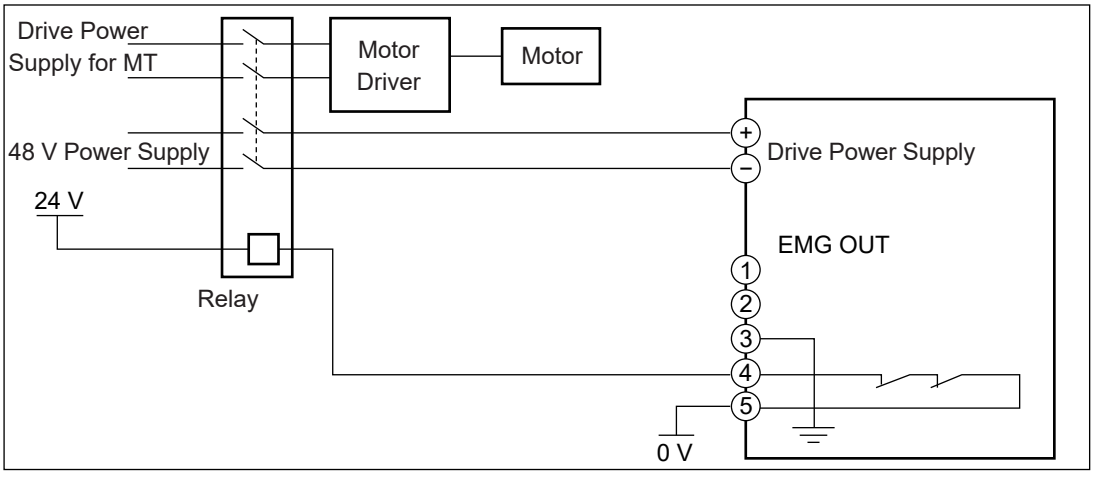
Use I/O-SYS Emergency Stop Output signal to shut OFF the drive power of the device to which I/O-MT is also connected.

Refer to “2.13 AC Power Control of an External Device during an Emergency Stop” in the JR3000 Series operation manual *External Control* for details.

2. JC-3 Series

Use the EMG OUT connector to construct a circuit that shuts OFF the drive power of I/O-MT as well as the drive power input of the controller.

Circuit Example



For details on EMG OUT, refer to “5.7 EMG OUT” in the JC-3 Series operation manual *Setup*.

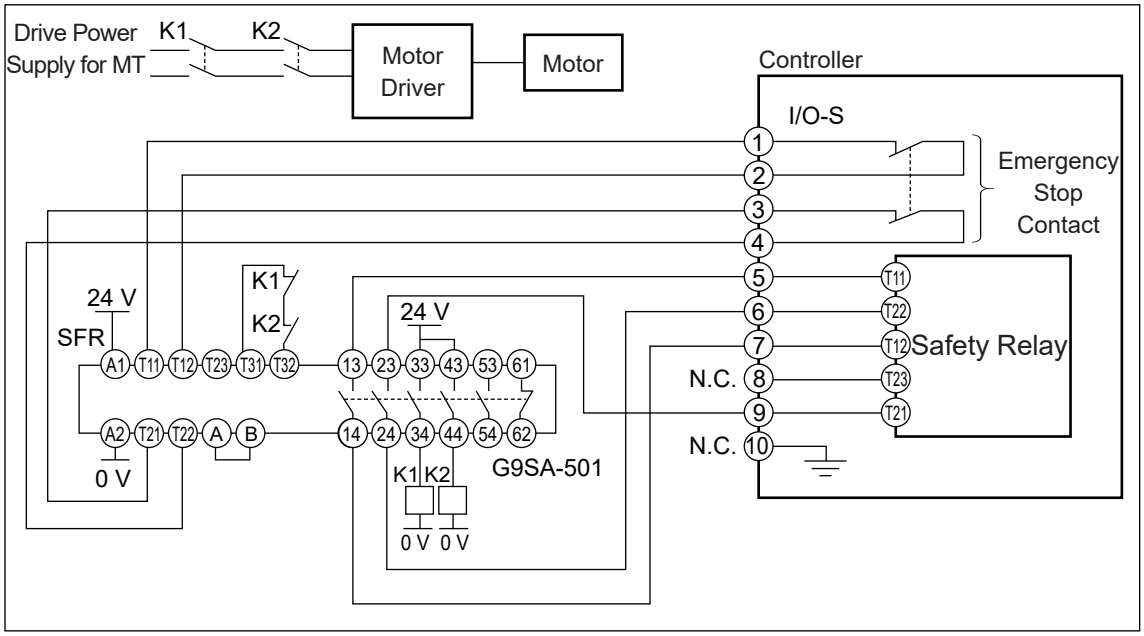
3. JS3 Series

Use the I/O-S connector to construct a circuit that shuts OFF the drive power supply for I/O-MT.

Push the emergency stop switch to open the emergency stop contact.
The safety circuit monitors the emergency stop contacts 1-2 and 3-4 of I/O-S, and if it detects that one of the contacts is open, shut OFF the drive power supply for the MT axes. At the same time, open the safety relays T11-T12 and T21-T22 connected to I/O-S 5-9.

If it is detected that both of the I/O-S 1-2 and 3-4 emergency stop contacts have returned, restore the drive power supply for MT, at the same time, close the safety relays T11-T12 and T21-T22 connected to I/O-S 5-9.

Circuit Example



K1, K2: Forced Guide Relay or Electromagnetic Contactor
SFR: Safety Relay (G9SA-501 (Manufacturer: OMRON), etc., 2ch Input, Safety Output 4ch or more, Auto Reset Operation)

For details on wiring, refer to the operation manual of the safety relay to be used.
For details on I/O-S, refer to “3.2 I/O-S” in the JS3 Series operation manual *Installation*.

3.2.2 Control Signal Support Example

The table below shows an example of robot side signal and device side signal relationship.

Robot Side Signals (I/O-MT)			Device (motor driver etc.) Side Signal Examples	
Input	Driver Ready	Pos. logic	READY signal, Ready, Servo Ready, Ready to Run, etc.	Output
		Neg. logic	Not Ready, etc.	
	Positioning Complete	Pos. logic	END signal, Positioning Complete, Stopped, etc.	
		Neg. logic	MOVE signal, Operating, Running, etc.	
	Homing Complete	Pos. logic	Return to Home Complete, etc.	
		Neg. logic	Returning to Home, etc.	
	Driver Error	Pos. logic	ALM signal, Error, Alarm, Warning, etc.	
		Neg. logic	Normal Status, etc.	
Sensor Input	Home Sensor	Pos. logic	Home Sensor, Initialization Sensor, One Direction Limit Sensor, etc.	
		Neg. logic		
	Timing Signal	Pos. logic	Z Phase Signal, Timing Signal, Home Phase Signal, etc.	
		Neg. logic		
Output	Excitation ON	Pos. logic	Current ON, Servo ON, Motor Power ON, etc.	Input
		Neg. logic	De-energized, Current OFF, Servo OFF, Motor Power Down, etc.	
	Deviation Reset	Pos. logic	Deviation Clear, Deviation Count Clear, Excess Pulse Clear, etc.	
		Neg. logic		
	Homing Start Request	Pos. logic	HOME signal, Homing Start Request, Return to Home, etc.	
		Neg. logic		
	Driver Error Reset	Pos. logic	Error Clear, Alarm Clear, Cancel Alarm, etc.	
		Neg. logic		
	Release Brake	Pos. logic	Release Brake, Free Motor, etc.	
		Neg. logic	Hold Brake, Hold Motor, etc.	
Pulse Output (Type 1)	CW Pulse Output 		CW Pulse, Positive Direction Pulse, etc.	Pulse Input
	CCW Pulse Output 		CCW Pulse, Negative Direction Pulse, etc.	
Pulse Output (Type 2)	Pulse No. Output 		PLS Signal, Command Pulse Input, etc.	Pulse Input
	Direction Output 		DIR Signal, Direction Input, etc.	

It is not necessary to connect all signals. Only connect the necessary signals.

Set the signals you do not need to [Invalid] with the I/O-MT signal logical settings. By doing so, these signals cannot be controlled on the robot side.

■ Caution

Signals with the same names may have different operations depending on the device. Refer to the instruction manual and/or specifications and data sheets etc. for your device, and confirm whether or not the signals are compatible with the robot side.

There may be no signal controls with the auxiliary axis functions which match the operations of the device you are controlling. If this is the case, use point jobs and/or customizing functions with commands and/or functions to perform appropriate signal control of the device. If using commands and/or functions to turn I/O-MT signals ON/OFF, set the I/O-MT signal logical settings to [Invalid].

Refer to the operation manuals below for information regarding point jobs and customizing functions.

- Point job usage and execution timing: *Basic Instructions*
- Auxiliary axis commands, functions, and system flags: "5.5 Commands, Variables and Functions"
- Commands, functions and system flags other than those for the auxiliary axis: *Functions II*
- Customizing functions: *Functions IV*

3.3 Device Assembly

When attaching the controllable device and other such related equipment to the robot or controller, refer to the operation manual *Setup* and/or *Specifications* (JR3000/JC-3 Series), or *External Control* (JS3 Series) and make sure to attach them appropriately. When attaching devices to the moveable robot axes (X, Y Z, R), take care that the workpiece mass and/or tool mass does not exceed the portable load capacity of each axis. For information regarding portable load capacity, tool mass and workpiece mass refer to the operation manuals *Setup* and/or *Specifications* (JR3000/JC-3 Series).

4. AUXILIARY AXIS CONFIGURATION

Before teaching or running points and programs, first make the auxiliary axis configuration settings. Auxiliary axis configuration is a settable function to adjust the command pulses and/or various control signal output methods from the robot in accordance with the amount of movement and operation methods of your device. By making auxiliary axis configuration settings, you are able to control the device from the robot and teach and run points and programs which use auxiliary axis functions.

For details of the auxiliary axis configuration operation, refer to the operation flowchart in the operation manual *Teaching Pendant Operation* or the operation flowchart in the application operation manual. Auxiliary axis configuration consists of the following settable items:

Settable Item	Details	
Axis Name	Displayed as the title for Teaching Mode position coordinate values. Set a character string to show the name of the controllable device and/or operation content.	
Unit Name	Attached to and displayed at the end of position coordinate values. Set a character string to show the unit for the amount of movement with the controllable device.	
Resolution	Sets the amount of movement for when one command pulse is input to the controllable device.	
Move Area Setting	Settings to limit the pulse number range of output pulses. You can limit the operation area of the connectable device with this.	
Speed/Acceleration Settings	Sets the output pulse maximum speed and maximum acceleration. You can limit the operation speed and acceleration of the controllable device with this.	
I/O-MT Function Settings	Pulse Output Type	Selects the output pulse type.
	I/O-MT Signal Logic Settings	Sets the response and relationship of the I/O-MT input/output status (energized/de-energized) and the signal logic (true/false).
	I/O-MT Input Signal Filter	Enables/disables the software noise filter of the I/O-MT input signal.
Homing Settings	Sets the parameters and method of returning home. The return home operation is a process and operation to coincide the home position administered by the robot (the position with an output pulse number of ±0) with the home position of the controllable device.	
JOG Move Settings	Sets the operation speed and amount of movement when operating in JOG Mode with the teaching pendant.	
Configuration Check Mode	This is a mode to confirm the setting content of the auxiliary axis configuration. You can check by actually moving the device.	

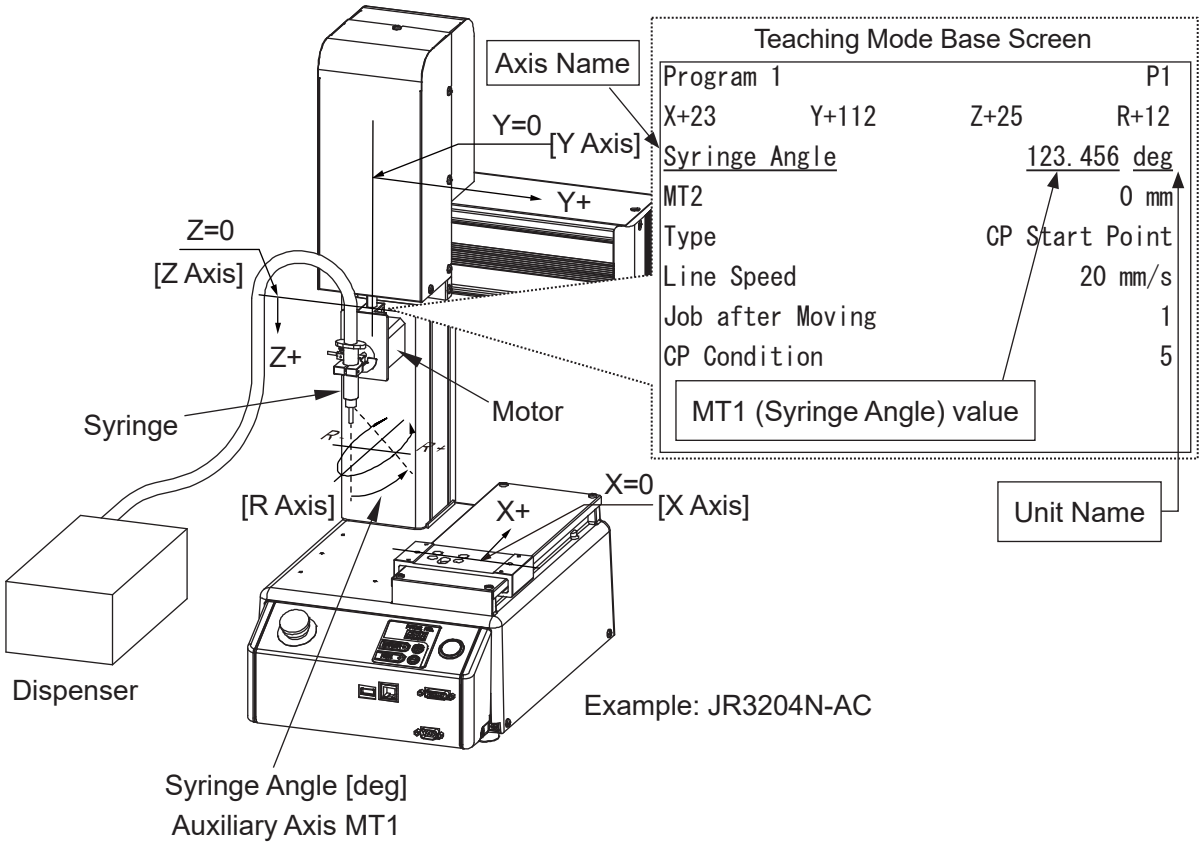
■ Caution

Make note of the following in regards to Axis Name, and Unit Name.

- You cannot leave the Axis Name blank. You need to set at least one character.
- Set character strings which you can easily distinguish from the (X, Y, Z, R) axes of the robot.
- The number of characters that can be entered varies depending on the character type. You can enter up to 10 – 30 characters.
- You cannot display different character strings for each of the display languages. The character string is displayed as set regardless of the display language.
- You can only enter half-width characters with the teaching pendant. To enter full-width characters, use JR C-Points II.

4.1 Axis Name

This is displayed as a title for the point position coordinate values on the Teaching Mode base screen and position entry screen. MT1 is [MT1] and MT2 is [MT2] by default.
Set a character string which indicates the name and/or operation of the controllable device. In the example below, where MT1 is controlling the angle of the dispensing syringe attached to a JR3204N-AC robot, it would be efficient to set “Syringe Angle” as the character string.

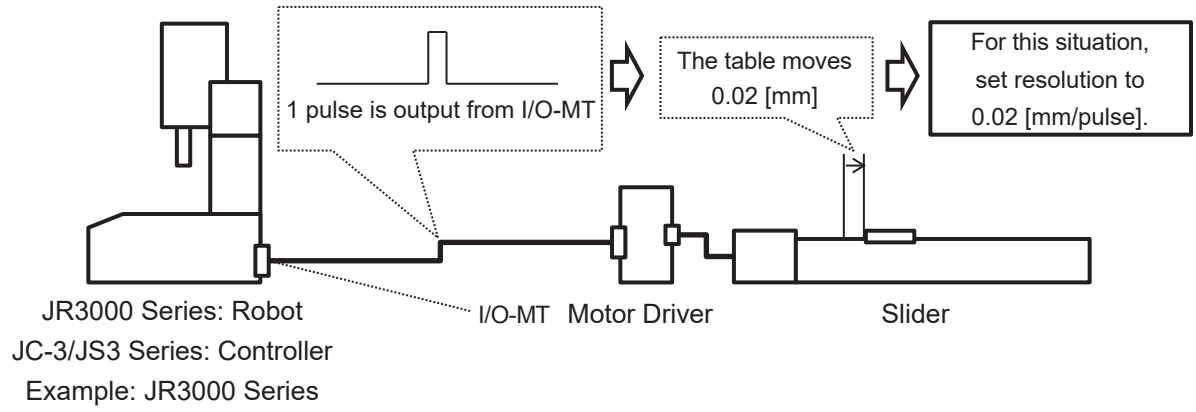


4.2 Unit Name

This is attached to and displayed at the end of point position coordinate values in Teaching Mode on the base screen and position entry screens etc. This is “mm” by default.
Set a character string that indicates the unit for the amount of movement by the controlled device. For example, if the device controls the dispensing syringe angle, set “deg” as the character string.

4.3 Resolution

Set the amount of movement when a command pulse inputs 1 pulse to the controllable device. For example, if controlling an electric slider that moves a table 0.02 mm in a straight direction when there is 1 pulse input, set [Resolution] to “0.02.” Also, if you set [Unit Name] with the character string “mm,” this is displayed as “0.02 mm/pulse.”



After making these settings, create point teaching data to move the electric slider to a position of 10mm. When a run is made, the electric slider table moves to the 10 mm position.
Also, the output pulse number used to move 10 mm can be calculated using the resolution value as shown below.

10 [mm] ÷ 0.02 [mm/pulse] = 500 [pulse]

⚠ Caution

Set unit name and resolution appropriately according to the controlled device. If the settings are not made appropriately, the values displayed and entered during teaching will not match up with the device’s actual amount of movement.
If you teach or make runs when there is such a mismatch, conflicts with the mechanical limitations of the device and/or robot and peripheral devices may occur.

4.4 Move Area Settings

This is a setting to limit the pulse range of output pulses. With this you can limit the operating range of the controlled device.

The following items can be set:

Settable Items	Details	
Area Out Detection	Valid	If the operation position coordinate values exceed either the maximum move area or minimum move area, or the area specified by the move area limit*, a position out of range error occurs and pulse output is stopped. For information regarding the position out of range error, refer to “7. ERROR MESSAGE LIST.”
	Invalid	When set to invalid, pulse outputs can be made with no limit. However, with point teaching, a position that exceeds ±9999.999 cannot be entered. If you want to move the device to a position that exceeds ±9999.999, set the position data type to [Moving Amount] or use the *lineMove* command.
Upper Move Limit	The maximum coordinate value for the operation range.	
Lower Move Limit	The minimum coordinate value for the operation range.	

* For information regarding move area limit and position data type, refer to the operation manual *Basic Instructions*.

⚠ Caution

The robot stops pulse output after it detects the output pulses have exceeded the move area, causing the actual movement to exceed the upper/lower limits of the move area in some cases.
Teach positions so that they do not exceed the upper/lower limits of the move area. This can cause conflicts with the mechanical limitations of the device and/or robot and peripheral devices.

If there are limitations to the operation range, set [Area Out Detection] to [Valid]. Also accordingly set [Upper Move Limit] and [Lower Move Limit] appropriate to these limitations.
If [Area Out Detection] is set to [Invalid] or the max/min settings are not appropriate, conflicts with the mechanical limitations of the device and/or robot and peripheral devices may occur.

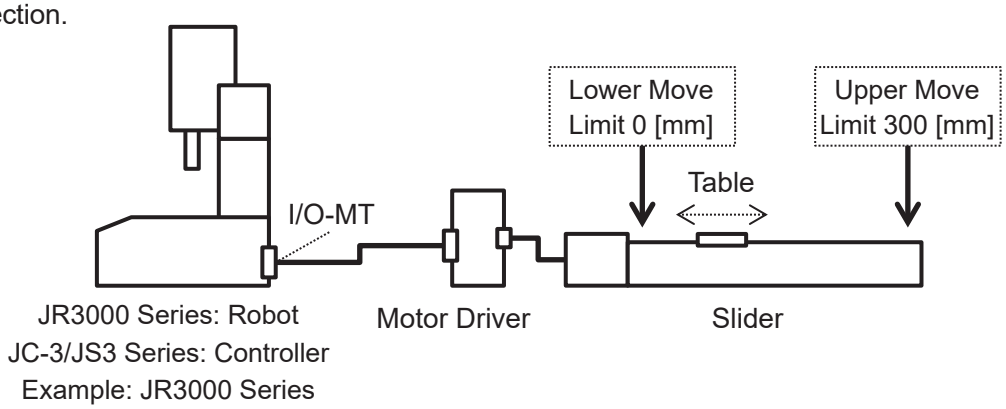
If [Area Out Detection] is set to [Invalid], you can continue to output pulses in one direction. However, if the number of output pulses exceeds ±2 billion ($20x10^8$) pulses, take note that the robot internal position counter will cycle over and you will not be able to manage positions with absolute coordinates.
Make sure not to exceed ±2 billion ($20x10^8$) pulses.

⚠ Caution

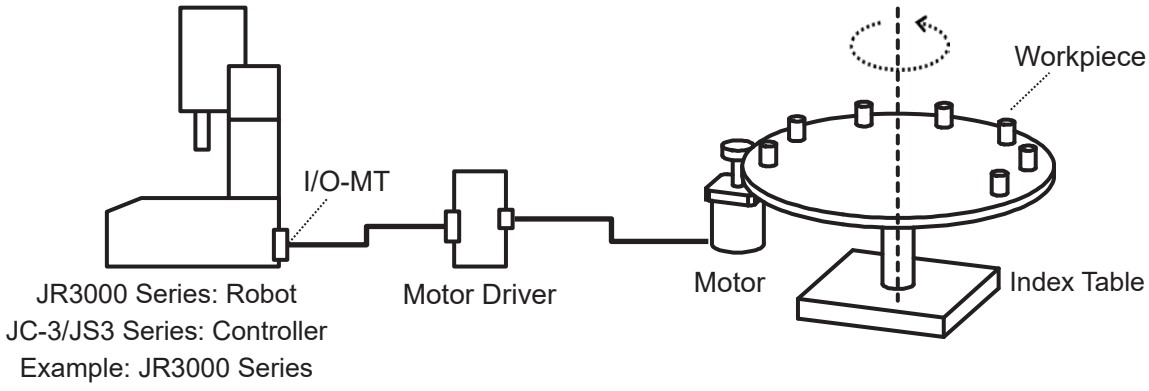
Depending on the characteristics of the controlled device, the operation following the corresponding command may be delayed. If this happens, the number of command pulses will reach the movable area and stop pulse output before the actual position reaches the movable range. Also, the device may continue delayed operations even after the command pulses have stopped. Create teaching data so that the actual position does not exceed the movable range with operations such as these.
Failure to do so may cause conflicts with the controlled device and the robot's peripheral devices.

Create teaching data so that the actual positions do not exceed the movable range due to inertia from the device after pulse output has stopped. Failure to do so may cause conflicts with the controlled device and the robot's peripheral devices.

■ Setup Example (When [Area Out Detection] is set to [Valid])
Set [Area Out Detection] to [Valid] if controlling an electric slider that moves a table in a straight direction.



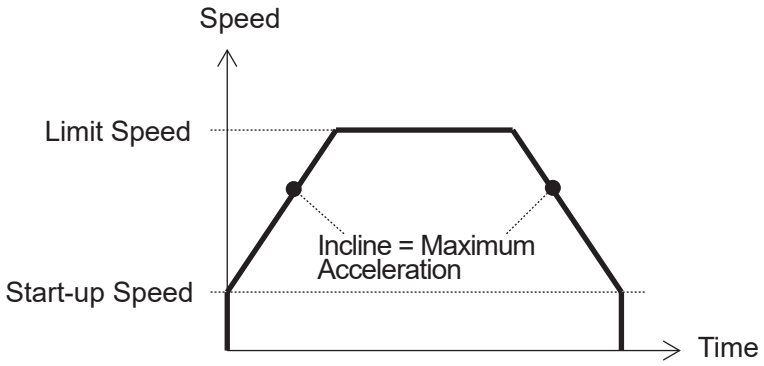
■ Setup Example (When [Area Out Detection] is set to [Invalid])
When using a device with no operation range limitations, if you set [Area Out Detection] to [Invalid], the device can continue operating in one direction.
For example, when controlling an index table for workpiece delivery, if you set [Area Out Detection] to [Invalid], you can have an operation with the index table turning continuously.



4.5 Speed/Acceleration Settings

This sets the maximum speed and maximum acceleration of the output pulses. With this you can limit the operation speed and/or acceleration of the controlled device.
The following items can be set:

Settable Items	Details
Start-up Speed	This is the initial speed when movement starts.
Limit Speed	This is the maximum speed when moving.
Maximum Acceleration	This is the maximum acceleration when moving.



⚠ Caution

The I/O-MT output pulse speed (frequency) makes speed adjustments to match the X, Y, Z, R axis operations of the robot.
Accordingly, the I/O-MT output pulse speed (frequency) may slow down to match the X, Y, Z, R axes. Also, the X, Y, Z, R axis operations may slow down to match the I/O-MT output pulse speed (frequency).
Create teaching data so that the controllable device and the robot, as well as each of the robot axes, do not conflict with one another.
Failure to do so can cause injury and breakdown.

■ Output Pulse Restrictions

The maximum pulse output wave number is 250 kPPS (250 kHz). A speed exceeding this cannot be made. With the expression below you can calculate the possible pulse output maximum speed.

Possible Pulse Output Maximum Speed = 250,000 [PPS] x resolution.

For example, if you set resolution with 0.02[mm/pulse] the expression is as follows:

Possible Pulse Output Maximum Speed = 250,000 [PPS] x 0.02 [mm/pulse] = 5000 [mm/s]

However, make sure to limit the speed so that the controlled device does not exceed its functionality.

4.6 I/O-MT Function Settings

With I/O-MT function settings, you can set the input and output methods for the various input/output signals. For details regarding input/output signal timing charts, refer to “6.3 Timing Charts.”
For details regarding the I/O-MT connector internal circuit, refer to “2. I/O-MT.”

4.6.1 Pulse Output Type

With this you can select the output pulse type.

Settable Items	Details
Type 1	A pulse (CW pulse) that shows positive direction is output from pulse output 1 terminal. A pulse (CCW pulse) that shows negative direction is output from pulse output 2 terminal.
Type 2	Pulses which indicate the pulse number are output from pulse output 1 terminal Signals which indicate the direction are output from pulse output 2 terminal.

For details regarding the pulse types, refer to “2.11 Pulse Output.”

4.6.2 I/O-MT Signal Logic Settings

The I/O-MT various input/output signals are input/output through the internal photocoupler.
With the I/O-MT signal logic settings you can set the response relationship as to whether or not to handle energization/de-energization of the internal photocoupler as [True] or [False].
For information regarding the I/O-MT connector internal circuit, refer to “2. I/O-MT.”
The I/O-MT signal logic can be selected from the following items:

Selectable Items	Details
Invalid	Input signals are not applied to auxiliary axis functions at all. However, you can use and obtain the statuses of point job commands and/or functions etc. Output signals are not controlled through auxiliary axis functions. However, you can control point job commands and/or functions etc.
Positive Logic	The input/output is automatically processed with auxiliary axis functions. The energized (ON) state of the internal photocoupler is treated as “True.” The de-energized (OFF) state of the internal photocoupler is treated as “False.”
Negative Logic	The input/output is automatically processed with auxiliary axis functions. The energized (ON) state of the internal photocoupler is treated as “False.” The de-energized (OFF) state of the internal photocoupler is treated as “True.”

■ When output signals are set to [Negative Logic]

When output signals are set to [Negative Logic], they go into the “True” state (the internal photocoupler is de-energized) immediately after the robot is turned ON. Once the robot completes run preparation, the signals go into the “False” state (the internal photocoupler is energized).
If this action causes problems, after setting the I/O-MT signal logic to [Positive Logic], handle the signal by reversing the signal in the robot’s external circuitry, or by modifying the signal logic with the settable functions on the controlled device.

⚠ Caution

Output signals set as [Positive Logic] or [Negative Logic] are automatically controlled ON/OFF from the auxiliary axis functions.
When this happens, do not use point job commands and/or functions etc., to turn signals ON/OFF. These may conflict with control from the auxiliary axis functions and you may not be able to control the device properly.

I/O-MT Signal Logic can be set for the signals as shown in the table below.

Name	Function	True/False Details	
Input 1	Driver Ready	True	The device is able to receive command pulses and start operation. The device is ready.
		False	The device is not able to receive command pulses and start operation. The device is not ready.
Input 2	Positioning Complete	True	The device has completed the positioning operation.
		False	The device is performing the positioning operation.
Input 3	Homing Complete	True	The device has completed the homing operation.
		False	The device is performing the homing operation.
Input 4	Driver Error	True	An error has occurred with the device (error status, alarm status, malfunction etc.)
		False	The device is operating correctly.
Sensor Input 1	Home Sensor	True	The sensor is in detection status. If using a photo interrupter, incident rays are being blocked.
		False	The sensor is not in detection status. If using a photo interrupter, incident rays are passing through.
Sensor Input 2	Timing Signal	True	The device’s timing signals are ON.
		False	The device’s timing signals are OFF.
Output 1	Excitation ON	True	The device’s motor is excited.
		False	The device’s motor is not excited.

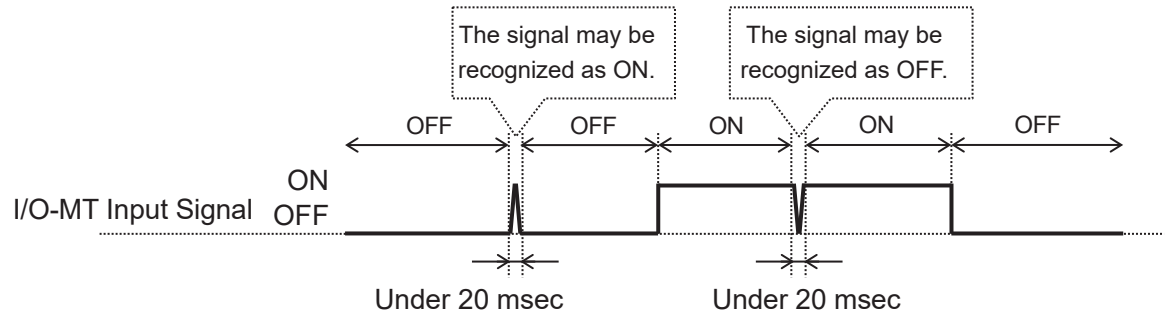
Name	Function	True/False Details	
Output 2	Deviation Reset	True	Request to clear the deviation between the command position and the actual position for the device.
		False	Drop the request to clear the deviation for the device.
Output 3	Homing Start Request	True	Request to perform a homing operation for the device.
		False	Drop the request to perform a homing operation for the device.
Output 4	Driver Error Reset	True	Request to reset the error status for the device.
		False	Drop the request to reset the error status for the device.
Output 5	Release Break	True	Release the brake attached to the device's motor and put the output axis of the motor into a rotatable state.
		False	Keep the brake attached to the device's motor ON and secure the output axis of the motor.

4.6.3 I/O-MT Input Signal Filter

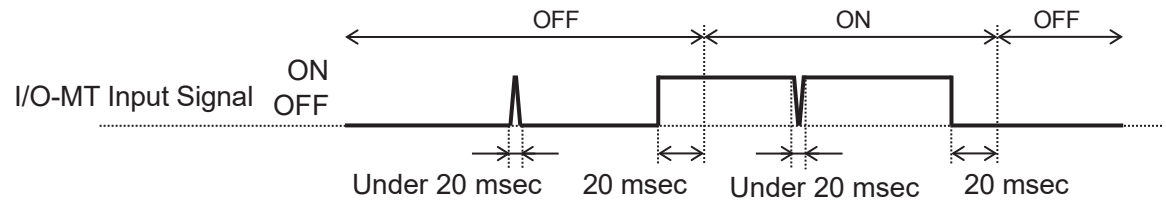
The I/O-MT input signal filter works for the I/O-MT input signals and the sensor input signals.

Selectable Item	Details
Invalid	The software noise filter for the I/O-MT input signal is disabled. There is no delay from filter processing when the robot recognizes input signals. However, noise and/or chatter may be recognized as a signal.
Valid	The software noise filter for the I/O-MT input signal is enabled. The robot can prevent noise and/or chatter being recognized as a signal. However, input signal recognition is delayed by 20 msec due to filter processing.

■ When Disabled



■ When Enabled



4.7 Homing Settings

The homing operation is a process and/or operation to match the home position administered by the robot (the position with an output pulse number of 0) with the home position of the controllable device.
You can set the homing method and/or parameters with the homing settings.

4.7.1 Homing Type

You can make the following selections with homing type:

Selectable Item	Details
No	The homing operation or process is not performed. The number of output pulses is not cleared to 0 until the robot power is cut off.
Start and Completion	This can be used if the device has a homing function. The robot commands a homing request for the device and waits for the device to complete the homing operation. The position where the homing operation is completed for the device is used as the standard for determining the home position.
Sensor Position Type	The position detected by the homing sensor is used as the standard for determining the home position.
Timing Signal Type	After using the homing sensor detection, the position detected by the timing signal is used as the standard for determining the home position.
Point Job	Select this method if the device is not compatible with the above methods. The point job for the registered number is performed. Create a separate point job for the purpose of the homing operation.

Refer to “6.1 Homing Operation” for information regarding the details of the homing operation.

■ When Performing the Homing Operation with a Point Job
Point jobs created for homing operations have different limitations and precautions from normal point jobs. For further details, refer to “5.6 Homing Operations via Point Jobs.”

4.7.2 Homing Parameters

With homing parameters you can set the distance and speed related to the homing operation. Make sure to set an appropriate distance and speed which matches the characteristics of the controllable device so as to not cause position offsets etc. The required parameters vary depending on the homing operation method.

■ No

There are no necessary parameters.

■ Start and Completion

Homing Parameters	Details
Execution Timing	Select the execution timing for the homing operation of the auxiliary axes.
Timeout Period	A homing error occurs if the device does not complete the homing operation within this time.
Offset Distance	The distance the auxiliary axes are offset from the position where the device completes the homing operation. If no offset required, set this to 0.
Homing Speed 3	The speed at which the Offset Distance movement is made.

■ Sensor Position Type, Timing Signal Type

Homing Parameters	Details	
Execution Timing	Select the execution timing for the homing operation of the auxiliary axes.	
Timeout Period	A homing error occurs if the device does not complete the homing operation within this time. If no timeout limitation is required, set this to 0.	
Valid Distance	The maximum distance moved until the homing sensor comes ON. If the auxiliary axes move this exact distance but the homing sensor does not come ON, a homing operation error occurs.	
Reverse Distance	After the homing sensor comes ON, this is the distance the auxiliary axes move until the reverse movement is started. After moving this distance, the auxiliary axes move until they reach the position where the homing sensor turns OFF.	
Timing Signal Distance	A [Timing Signal Type] dedicated parameter. After the homing goes ON and then OFF, this is the maximum distance the auxiliary axes move until the timing signal comes ON. If the auxiliary axes move exactly this distance but the signal does not come ON, a homing operation error occurs.	
Offset Distance	Sensor Position Type	The distance the auxiliary axes are offset from the position where the homing sensor goes OFF.
	Timing Signal Type	The distance the auxiliary axes are offset from the position where the timing signal comes ON.

The Offset Distance and Timing Signal Distance also affect position offset operations made via the homing sensor. For further details, refer to “6.2.3 Position Offset Detection Functions via the Homing Sensor.”

Homing Parameters	Details
Homing Speed 1	The speed at which the [Valid Distance] movement is made.
Homing Speed 2	After the [Reverse Distance] movement is made, this is the speed at which the auxiliary axes move until the homing sensor goes OFF and/or the speed at which the [Timing Signal Distance] movement is made. This is a speed for precise positioning, therefore the speed is limited to 1000 [PPS]. In addition, if the Positioning Complete signal is set to [Positive Logic] or [Negative Logic], the speed of the operation may be reduced as the robot waits for the device to get into position.
Homing Speed 3	The speed at which the [Offset Distance] movement is made.

■ Point Job

Homing Parameters	Details
Execution Timing	Select the execution timing for the homing operation of the auxiliary axes.
Point Job Number	The point job numbers of the point jobs used to execute the homing operation.

Refer to “6.1 Homing Operation” for information regarding the details of the homing operation.

4.7.3 Execution Timing

Execution Timing is one of the homing parameter items.

It allows you to choose when during the course of an operation to perform auxiliary axis homing.

Homing Parameters	Details
Before Mech. Init. (JR3000/JC-3 Series only)	The homing operation for the auxiliary axes is performed before mechanical initialization of the robot axes (X, Y, Z, R).
After Mech. Init. (JR3000/JC-3 Series only)	The homing operation for the auxiliary axes is performed after mechanical initialization of the robot axes (X, Y, Z, R).
On Start of Cycle	The homing operation is executed when a program run is started. Executed before a Common Job on Start of Cycle*.

* For details regarding Common Job on Start of Cycle, refer to the operation manual *Functions III*.

If MT1 and MT2 are set with the same execution timing, the homing operation movements for MT1 and MT2 are executed simultaneously. However, if the homing type is [Point Job], homing for MT1 and MT2 are performed separately.

JC-3 absolute encoder models and the JS3 Series do not perform a mechanical initialization before a run and therefore provides the following sections:

Homing Parameters	Details
On Start of Cycle	The homing operation for the auxiliary axes is performed when the program run starts. Executed before a Common Job on Start of Cycle*.
Before Work Home Move	The homing operation for the auxiliary axes is performed before the robot axes (X, Y, Z) move to the work home.
After Work Home Move	The homing operation for the auxiliary axes is performed after the robot axes (X, Y, Z) move to the work home.

* For details regarding Common Job on Start of Cycle, refer to the operation manual *Functions III*.

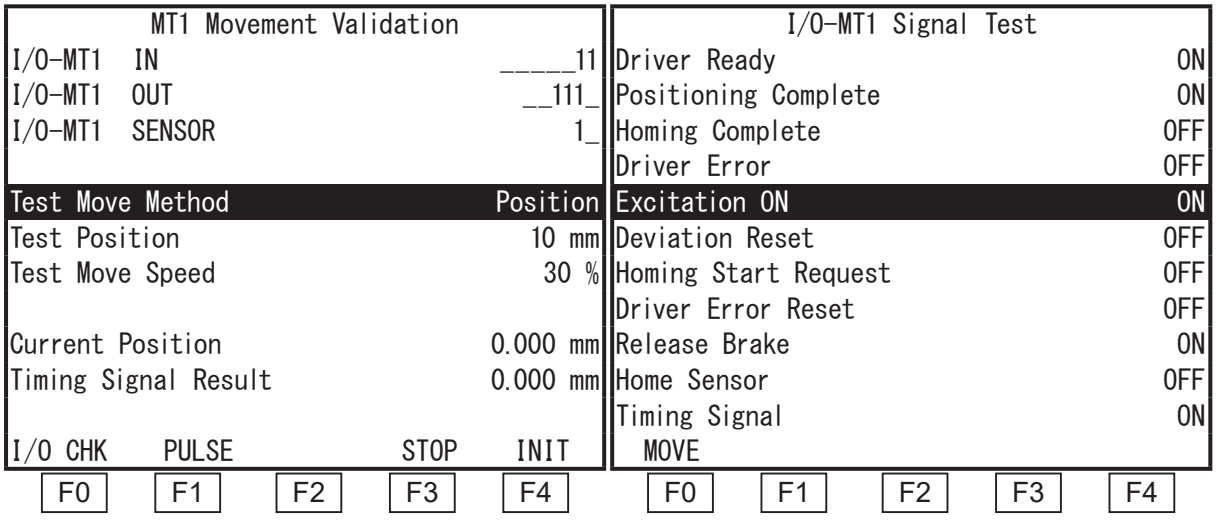
4.8 JOG Movement Speed

This sets the movement speed or amount of movement during JOG operations with the teaching pendant.

Item	Details
Low Speed	Sets the speed of a low speed JOG movement.
Medium Speed	Sets the speed of a medium speed JOG movement.
High Speed	Sets the speed of a high speed JOG movement.
Low Step	Sets the amount of movement for a low speed JOG step.
Middle Step	Sets the amount of movement for a medium speed JOG step.
High Step	Sets the amount of movement for a high speed JOG step.

4.9 Configuration Check Mode

This is a mode to check the settable content of the auxiliary axis configuration.



Press the F0 (I/O CHK/MOVE) key to switch between the movement validation and the signal test screens.

■ MT1 Movement Validation Screen/MT2 Movement Validation Screen

At this screen, you can perform GO key movements, JOG movements, and homing operations. You can also check the I/O-MT signals and the current position within a movement.

Item	Details
I/O-MT1/MT2 IN I/O-MT1/MT2 OUT I/O-MT1/MT2 SENSOR	This displays the input/output status of the I/O-MT signals. Regardless of the I/O-MT signal logic settings, if the internal photocoupler is energized, it is displayed as “1,” if it is de-energized; it is displayed as “_.” You can turn the output signal (OUT) ON/OFF by moving the cursor to the signal and pressing the ENTR key.
Test Move Method	You can select either [Position] or [Distance] as the movement method used when the GO key is pressed.
Test Position/Test Distance	You can specify the position or distance of the movement destination for when the GO key is pressed. When the test move method is set to [Position], you can specify [Test Position], and when set to [Distance], you can specify [Test Distance].
Test Move Speed	You can specify the speed and acceleration for when the GO key is pressed. Specify the ratio (%) for the value registered in [Speed/Acceleration Setting] of the auxiliary axis configuration. The default value is set to 30 %. If you set this to 100 %, the GO key function is performed exactly as set in [Speed/Acceleration Setting].
Current Position	This displays the current position.
Timing Signal Result	This is only displayed when the homing type is set as [Timing Signal Type]. The values are updated after the homing operation is performed. For further information, refer to “6.1.3 Timing Signal Type.”

The current position and each I/O-MT signal is updated every 100 msec. Any changes during an interval shorter than this are not displayed.

The teaching pendant key functions are as follows:

Key	Function
F0 (I/O CHK/MOVE)	Switches to the I/O-MT signal test screen.
F1 (PULSE/UNIT)	Changes the display unit for the position and distance values. • With the settable unit display (UNIT), the numerical values are displayed as normal values ({pulse number x resolution} values). The character string units are displayed as the character strings set in [Unit Name] in auxiliary axis configuration. • With the pulse number display (PULSE), the numerical values are displayed in pulse numbers. Character string units are not displayed.
F3 (STOP)	Stops movements made by the GO key
F4 (INIT)	Performs the homing operation.

Key	Function
GO	When the test move method is set to [Position], the axes move to the specified position. When set to [Distance], the axes move from the current position by the exact specified distance. The speed and acceleration of the axes is performed in accordance with the values specified in the test speed.
JOG Key (MT1+, MT1-/MT2+, MT2-)	Performs a JOG movement. • With the JR3000/JC-3 Series, hold down the SHIFT key and press a JOG key to make a high speed JOG movement. • With the JS3 Series, press the F4 (SPEED) key to cycle through the Low → Medium → High movement speeds. The distance the axes move from one press of a JOG key and the speed at which the axes move when a JOG key is held down are set in [JOG Function]. Refer to "4.8 JOG Movement Speed" for further details.
CURSOR △ ▽	Moves the cursor up/down a line. You can only select [I/O-MT1 OUT], [I/O-MT2 OUT], [Test Move Method], [Test Position], [Test Distance], and [Test Move Speed] with the cursor.
CURSOR ◁ ▷	Moves the cursor left/right when the cursor is on the [I/O-MT1 OUT] or [I/O-MT2 OUT] line.
ENTR	Sets the selectable items.
ESC	Returns the teaching pendant to the previous screen.

If an error occurs due to a GO key, F4 (INIT), or JOG key movement, the error name appears.

■ I/O-MT1 Signal Test Screen / I/O-MT2 Signal Test Screen

This is different from the movement validation screen as it is displayed based on the I/O-MT signal logic settings. You can confirm whether or not the signals responding to the device attached to the I/O-MT turn ON/OFF correctly according to the robot's I/O-MT signal logic settings.

- When signals have I/O-MT signal logic set to [Invalid], I/O-MT input signals are displayed as "OFF" regardless of the output on the device side.
- Signals with I/O-MT signal logic set to [Positive Logic] are displayed as "ON" when the internal photocoupler is energized. When it is de-energized, they are displayed as "OFF."
- Signals with I/O-MT signal logic set to [Negative Logic] are displayed as "OFF" when the internal photocoupler is energized. When it is de-energized, they are displayed as "ON."

The teaching pendant key functions are as follows:

Key	Function
F0 (I/O CHK/MOVE)	Switches to the I/O-MT move validation screen.
CURSOR △ ▽	Moves the cursor up/down a line. You can only select output signals with the cursor.
ENTR	Switches the output signal selected with the cursor ON/OFF. However, signals set with I/O-MT signal logic settings to [Invalid] stay OFF.
ESC	Returns the teaching pendant to the previous screen.

5. TEACHING

Before creating teaching data, set auxiliary axis configuration and confirm the settable content. If auxiliary axis configuration is not set properly, the values displayed and entered will not match the actual operation and other such problems can occur.

TP Administration Mode
[Administration Settings Mode]
[Auxiliary Axis Configuration]

TP Teaching Mode
F0 (MT1/MT2)
[Auxiliary Axis Configuration]

For details regarding the operation procedure, refer to the operation flowchart in the operation manual *Teaching Pendant Operation* or the operation flowchart in the application operation manual.

5.1 PTP Conditions

PTP conditions can be set in additional functions, individual program settings, and all program common settings. The settings related to MT1 and MT2 are shown below. For information regarding other PTP condition items, refer to the PTP condition explanations in the operation manual *Functions I*.

■ JR3000 Series

Item	Model
MT1, MT2-Axis Move Speed	JR3xx3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Move Speed	JR3xx4 Series (4 Axis Specification Models)
MT1, MT2-Axis Acceleration	JR3xx3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Acceleration	JR3xx4 Series (4 Axis Specification Models)

- R, MT1, MT2-Axis Move Speed
  With this you can specify the target speed as a percentage (%) for when making PTP movements. This setting works with the R, MT1, and MT2 axes.

- R, MT1, MT2-Axis Acceleration
  With this you can specify the acceleration as a percentage (%) for when making PTP movements. This setting works with the R, MT1, and MT2 axes.

■ JC-3 Series

Item	Model
X Speed Limit	JC-3 Series (3 Axis/4 Axis Specification Models)
X Acceleration Limit	
Y Speed Limit	
Y Acceleration Limit	
Z Speed Limit	
Z Acceleration Limit	
MT1, MT2-Axis Move Speed	JC-3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Move Speed	JC-3 Series (4 Axis Specification Models)
MT1, MT2-Axis Acceleration	JC-3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Acceleration	JC-3 Series (4 Axis Specification Models)

- R, MT1, MT2-Axis Move Speed
  With this you can specify the target speed as a percentage (%) for when making PTP movements.
  This setting works with the R, MT1, and MT2 axes.

- R, MT1, MT2-Axis Acceleration
  With this you can specify the acceleration as a percentage (%) for when making PTP movements.
  This setting works with the R, MT1, and MT2 axes.

■ JS3 Series

Item
J1 Speed Limit
J1 Acceleration Limit
J2 Speed Limit
J2 Acceleration Limit
J3 Speed Limit
J3 Acceleration Limit
J4 MT1 MT2 Speed Limit
J4 MT1 MT2 Acceleration Limit

- J4 MT1 MT2 Speed Limit
  With this you can specify the target speed as a percentage (%) for when making PTP movements.
  This setting works with the J4, MT1, and MT2 axes.

- J4 MT1 MT2 Acceleration Limit
  With this you can specify the acceleration as a percentage (%) for when making PTP movements.
  This setting works with the J4, MT1, and MT2 axes.

5.2 CP Conditions

CP conditions can be set in additional functions, individual program settings, and all program common settings. The setting related to MT1 and MT2 are shown below. For information regarding other CP condition items, refer to the CP condition explanations in the operation manual *Functions I*.

Item	Model
MT1, MT2-Axis Move Speed	JR3xx3 Series (3 Axis Specification Models) JC-3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Move Speed	JR3xx4 Series (4 Axis Specification Models) JC-3 Series (4 Axis Specification Models) JS3 Series
MT1, MT2-Axis Acceleration	JR3xx3 Series (3 Axis Specification Models) JC-3 Series (3 Axis Specification Models)
R, MT1, MT2-Axis Acceleration	JR3xx4 Series (4 Axis Specification Models) JC-3 Series (4 Axis Specification Models) JS3 Series

■ R, MT1, MT2-Axis Move Speed/MT1, MT2-Axis Move Speed

With this you can specify the target speed as a percentage (%) for when making CP movements. This setting works with the R, MT1, and MT2 axes. A “CP Speed Over” error may occur if you try to make CP movements over a short distance with only the MT1 or MT2 axis. This occurs when the movement distance is too short and the axis cannot accelerate to 100 % speed ([Limit Speed] in auxiliary axis configuration).

If this happens, reduce the value entered in [R, MT1, MT2-Axis Move Speed]. To prevent the “CP Speed Over” error from occurring, reduce the speed to one to which the axis can accelerate.

■ R, MT1, MT2-Axis Acceleration/MT1, MT2-Axis Acceleration

With this you can specify the target acceleration as a percentage (%) for when making CP movements. This setting works with the R, MT1, and MT2 axes. If you reduce the acceleration, a “CP Speed Over” error may occur as the axis cannot accelerate to the target speed.

If this happens, increase the values of [R, MT1, MT2-Axis Acceleration] or reduce the values of [R, MT1, MT2-Axis Move Speed].

5.3 All Program Common Settings, Individual Program Settings

This section explains the settable content for the auxiliary axes.
For basic information regarding all program common settings and individual program settings, refer to the operation manuals *Basic Instructions*, *Functions I*, and *Functions III*.

5.3.1 Move Area Limit Settings

You can set the move area limit for the auxiliary axes in the same way that you do for the X, Y, Z, R axes of the robot.
An out of area error occurs when the range specified by [Upper Move Limit] and [Lower Move Limit] in auxiliary axis configuration or the range specified by the move area limit is exceeded.
For details regarding an out of area error, refer to "7. ERROR MESSAGE LIST."

Settable Item	Details
X Upper Limit	The X axis move area upper limit
Y Upper Limit	The Y axis move area upper limit
Z Upper Limit	The Z axis move area upper limit
R Upper Limit	The R axis move area upper limit
R Lower Limit	The R axis move area lower limit
MT1 Upper Limit	The MT1 axis move area upper limit
MT1 Lower Limit	The MT1 axis move area lower limit
MT2 Upper Limit	The MT2 axis move area upper limit
MT2 Lower Limit	The MT2 axis move area lower limit

5.3.2 Valid/Invalid Settings of Move Axis

You can specify whether or not to run the auxiliary axes. You can individually set this for both MT1 and MT2.

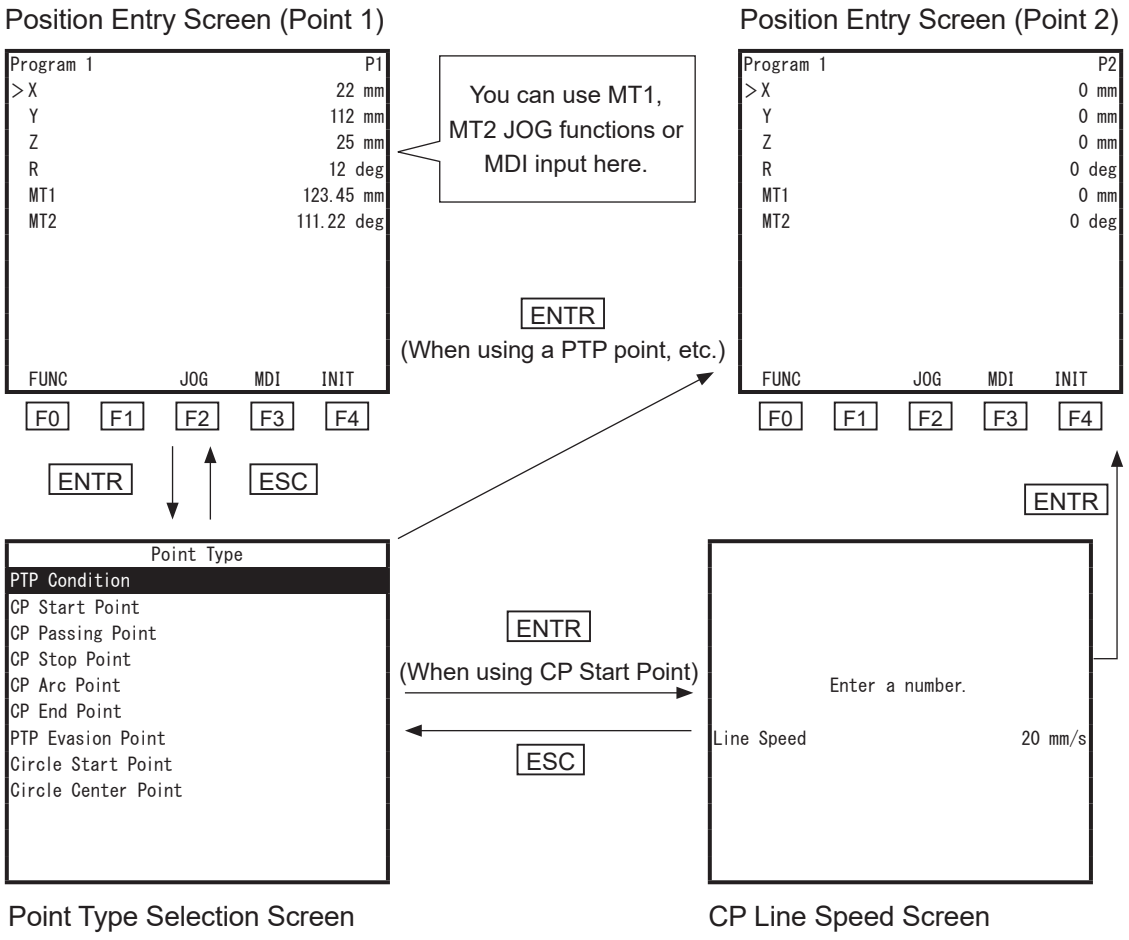
Settable Item	Details
Valid	The axis moves.
Invalid	The axis does not move. Even position coordinate values registered during teaching are ignored. However, the axis does move with homing operations (mechanical initialization)*.

* With the JR3000/JC-3 Series, the auxiliary axis moves to its mechanical home when the robot is mechanically initialized.

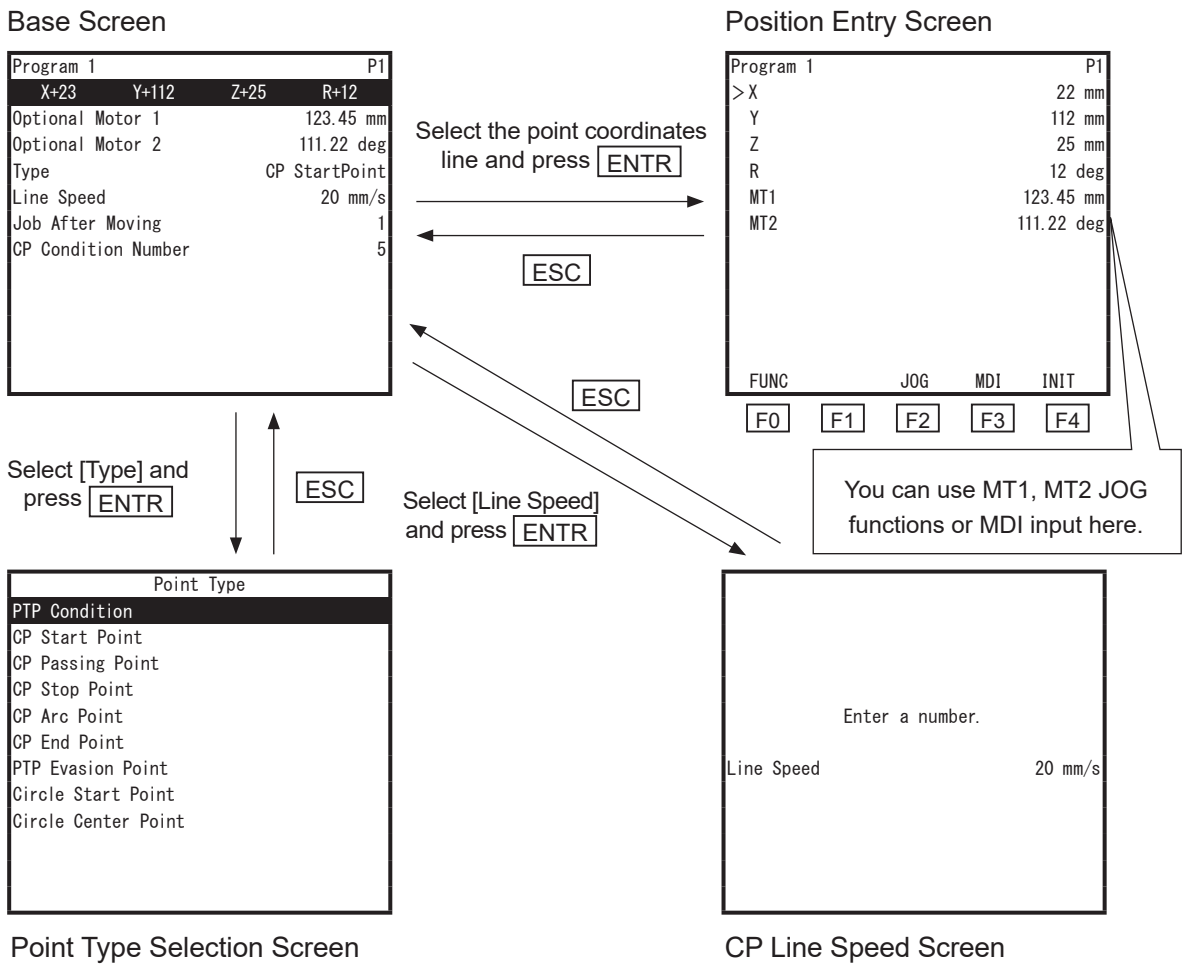
5.4 Point Teaching

You can teach points using JOG function and MDI input in the same way that you do for the X, Y, Z, R axes of the robot.

When entering new points in Teaching Mode, the screens appear like the ones shown below.



When you have points with content already entered into them, the screens appear like the ones below.



For information regarding Teaching Mode operation, refer to the operation manuals *Basic Instructions* and *Teaching Pendant Operation*.

5.5 Commands, Variables and Functions

This section explains the commands, variables and functions related to the auxiliary axes.
num is a numeric type (numerical value type) and *str* is a string type (character string).

5.5.1 Commands

■ Category: Movement

Command	Parameter	Details
lineMove	Speed Distance	A CP linear movement is made by the exact specified move speed and move distance. The move distance is an absolute distance from the current position. The move speed is a combined speed of the XYZ axes. The R, MT1, and MT2 speeds are automatically adjusted so that all of the axes (XYZ included) reach their destination distances at the same time. This command is displayed and spread out over multiple lines as shown below: lineMoveSpeed 100 lineMoveX 10 lineMoveY 20 lineMoveZ 5 lineMoveR 30 lineMoveMT1 10 lineMoveMT2 20 endLineMove NOTE: Axes which are not operated can be omitted.
lineMoveStopif	-	Stop the movement by *lineMove* according to the conditions.
endLineMove	-	End of *lineMoveStopIf* condition statements.

<table>
<tr><th>Command</th><th>Parameter</th><th>Details</th></tr>
<tr><td>initMec</td><td>Specified axis</td><td>Perform a homing operation (mechanical initialization) with the specified axes.
JR3000/JC-3 Series:
<table>
<tr><th>Specified axis</th><th>Details</th></tr>
<tr><td>all</td><td>This is a homing operation for all axes (X, Y, Z, R, MT1, MT2). Executed in the following order:
1. The axes (MT1, MT2) specified in [Execution Timing] → [Before Mech. Init].
2. X, Y, Z, R (the sequence is performed according to [Order of Init.]).
3. The axes (MT1, MT2) specified in [Execution Timing] → [After Mech. Init].
Homing operations for axes specified in [On Start of Cycle] in [Execution Timing] are not performed.</td></tr>
<tr><td>x</td><td>Perform a mechanical initialization for the X axis.</td></tr>
<tr><td>y</td><td>Perform a mechanical initialization for the Y axis.</td></tr>
<tr><td>z</td><td>Perform a mechanical initialization for the Z axis.</td></tr>
<tr><td>r</td><td>Perform a mechanical initialization for the R axis.</td></tr>
<tr><td>MT1</td><td>Perform a homing operation for the MT1 axis. Performed even if the execution timing is set to [On Start of Cycle].</td></tr>
<tr><td>MT2</td><td>Perform a homing operation for the MT2 axis. Performed even if the execution timing is set to [On Start of Cycle].</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Command</th><th>Parameter</th><th>Details</th></tr>
<tr><td>initMec</td><td>Specified axis</td><td>JS3 Series:
<table>
<tr><th>Specified axis</th><th>Details</th></tr>
<tr><td>All</td><td>This is a homing operation for the auxiliary axes (MT1, MT2). Executed in the following order:
1. The axes (MT1, MT2) specified [Execution Timing] → [Before Work Home Move].
2. The axes (MT1, MT2) specified in [Execution Timing] → [After Work Home Move].
Homing operations for axes specified in [On Start of Cycle] are not performed.</td></tr>
<tr><td>J1</td><td>Immediately end the command without returning the J1-axis to the work home.</td></tr>
<tr><td>J2</td><td>Immediately end the command without returning the J2-axis to the work home.</td></tr>
<tr><td>J3</td><td>Immediately end the command without returning the J3-axis to the work home.</td></tr>
<tr><td>J4</td><td>Immediately end the command without returning the J4-axis to the work home.</td></tr>
<tr><td>MT1</td><td>Perform a homing operation for the MT1 axis. Performed even if the execution timing is set to [On Start of Cycle].</td></tr>
<tr><td>MT2</td><td>Perform a homing operation for the MT2 axis. Performed even if the execution timing is set to [On Start of Cycle].</td></tr>
</table></td></tr>
<tr><td>checkPos (JR3000/JC-3 only)</td><td>-</td><td>Perform a position offset check with the home sensor (initialization sensor), and perform a homing operation (mechanical initialization) if there is a position offset.
For MT1 and MT2, only the axes set to the homing type [Sensor Position Type] or [Timing Signal Type] are executed.
For further operation details, refer to “5.7 Example of a Homing Operation via a Point Job.”</td></tr>
</table>

■ Category: Mono Movement

Command	Parameter	Details
monoMove	Specified axis	Makes movement for 1 specified axis. You can specify the axis from among the X, Y, Z, R axes and the auxiliary MT1 and MT2 axes of the robot.
mMoveDistance *1	Distance	This specifies the distance for movement using the *monoMove* command. The unit parameter varies depending on the axis specified.
mMoveSpeed *1*2	Speed	Specifies the speed for movement using the *monoMove* command. The unit parameter varies depending on the axis specified.
mMoveAccelRate *1*2*3	Acceleration rate (%)	These specify the acceleration for movement using the *monoMove* command. Specify either the *mMoveAccelRate* or *mMoveAccelTime* command. With the *mMoveAccelRate* command, acceleration is specified as a percentage (%) of the default acceleration. With the *mMoveAccelTime* command, acceleration is specified as the time (msec) it takes to reach the speed specified for the *mMoveSpeed* command.
mMoveAccelTime	Acceleration time (msec)	
monoMoveStopIf	-	This ends the movement made by the *monoMove* command when the conditions are met. You only need to input this command when using conditions to stop the movement.
endMonoMove	-	This indicates the end of the movement for the *monoMove* command.

*1: When entering commands using the teaching pendant or JR C-Points II, you can select the *mMoveDistance*, *mMoveSpeed*, *mMoveAccelRate*, and *mMoveAccelTime* commands from the *monoMoveParam* setting.

*2: The speed and acceleration commands can be omitted. The default speed/acceleration is applied when these commands are omitted. The default speed and acceleration values are determined according to the values of the X, Y, Z, and R axes of the robot. For the MT1 and MT2 axes, these are determined by the values set in [Auxiliary Axis Configuration] → [Limit Speed] and [Maximum Acceleration].

*3: With deceleration, speed is decreased at the same rate as it is increased for acceleration. You cannot specify an individual rate of deceleration.

For examples of point jobs using mono movement commands, refer to “17.5 Moving Only the Specified Axis” in the operation manual *Functions II*.

With the *mMoveAccelTime* command, the rate of acceleration during the movement (the amount of speed increased every 1 second) is determined from the acceleration time and speed. Depending on the acceleration time and speed combination, acceleration may exceed the default acceleration rate (100 %) or the robot may instantly reach the specified speed with no area of acceleration.

⚠ Caution

With movements using the auxiliary I/O-MT axes, make sure to never set an extreme acceleration that exceeds the specifications or capabilities of the connected device (external motor, etc).
When making a movement at high acceleration or making a movement that has no area of acceleration using the *mMoveAccelTime* command, we recommend operations that enable the stepping motor to self-start.

5.5.2 Built-In Variables

Type	Identifier	Details
num	#point_MT1	MT1 coordinate values of the point currently being performed.
num	#point_MT2	MT2 coordinate values of the point currently being performed.
num	#P_MT1 (1 – last point no.)	MT1 coordinate values of the specified point.
num	#P_MT2 (1 – last point no.)	MT2 coordinate values of the specified point.
num	#prog_P_MT1 (1 – 999, 1 – last point no.)	MT1 coordinate values of the specified program and specified point.
num	#prog_P_MT2 (1 – 999, 1 – last point no.)	MT2 coordinate values of the specified program and specified point.

5.5.3 Built-In Functions

Type	Identifier	Details
num	getMtIn (num mt, num in_no)	This returns the I/O-MT input signal status.
num	getMtOut (num mt, num out_no)	This returns the I/O-MT output signal status.
num	setMtOut (num mt, num out_no, num onoff)	This outputs the I/O-MT output signal.
num	getMtSensor (num mt, num sensor_no)	This returns the I/O-MT sensor input status.
num	getMtPosition (num mt)	This returns the current position coordinate values.

The following are functions for processing homing operations. Do not use these for anything other than homing operations.

Type	Identifier	Details
num	disableMtMoveArea (num mt)	Temporarily disables the area out detection. The axes are able to exceed and operate outside of the range specified by the [Upper Move Limit] and [Lower Move Limit] or the range specified by the move area limit.
num	enableMtMoveArea (num mt)	Re-enable the area out detection which was temporarily disabled by the *disableMtMoveArea()* function.
num	clearMtPosition (num mt)	Sets the current position coordinate values to 0.

⚠ Caution

Only perform *disableMtMoveArea()* when it is required. When it is no longer required, perform *enableMtMoveArea()* as soon as possible.
If you make runs as usual with the area out detection disabled, conflicts and other such problems with the mechanical limitations of the device and/or robot and peripheral devices may occur.

■ getMtIn

Identifier	num getMtIn (num mt, num in_no)
Explanation	Returns the I/O-MT input signal status. The setting content of the I/O-MT signal logical settings is not applied.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) in_no: Specify input number. For details regarding input numbers, refer to "2. I/O-MT." If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the input signal ON/OFF status 0: OFF 1: ON
Example	When MT1 input 4 comes ON, the buzzer sounds for 500 msec.

```
if
  ld getMtIn (1, 4)      MT1 input 4
then
  set #FBZ               The buzzer sounds
  delay 500              Wait 500 msec
  reset #FBZ             The buzzer stops
endIf
```

■ getMtOut

Identifier	num getMtOut (num mt, num out_no)
Explanation	Returns the I/O-MT output signal status. The setting contents of the I/O-MT signal logical settings are not applied.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) out_no: Specify output number. For details regarding output numbers, refer to "2. I/O-MT." If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the input signal ON/OFF status 0: OFF 1: ON
Example	When MT2 input 1 comes ON, a character string is displayed on the LCD screen.

```
if
  ld getMtOut(2,1)          MT2 input 1
then
  outLCD 6,1,"Motor Power ON"  The character string is displayed on the 6th
                               line of the LCD
  delay 3000                Wait 3 seconds
  clrLineLCD                Erase the information displayed on the 6th line.
endIf
```

■ setMtOut

Identifier	num setMtOut (num mt, num out_no, num onoff)
Explanation	Outputs the I/O-MT output signal. The setting contents of the I/O-MT signal logical settings are not applied.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) out_no: Specify output number. For details regarding output numbers, refer to "2. I/O-MT." onoff: Specify ON/OFF output. (0: OFF, 1: ON) If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the function execution result 0: Normal
Example	After MT1 output 1 comes ON, MT1 waits 500 msec, and then MT1 output 1 turns OFF.

```
let setMtOut (1, 1, 1)    MT1 output 1 comes ON
delay 500                 Wait 500 msec
let setMtOut (1, 1, 0)    MT1 output 1 goes OFF
```

■ getMtSensor

Identifier	num getMtSensor (num mt, num sensor_no)
Explanation	Returns the I/O-MT sensor input signal status. The setting contents of the I/O-MT signal logical settings are not applied.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) sensor_no: Specify sensor input number. For details regarding sensor input numbers, refer to "2. I/O-MT." If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the output signal ON/OFF status. 0: OFF 1: ON
Example	After MT1 sensor input 1 comes ON, MT1 goes into standby while sounding the buzzer.

```
if
  ld getMtSensor (1, 1)    MT1 sensor input 1
then
  waitStartBZ              Go into standby while sounding the buzzer
endIf
```

■ getMtPosition

Identifier	num getMtPosition (num mt)
Explanation	Returns the position coordinate values of the current command. The position coordinate values are values derived by multiplying the output pulse number to the resolution. Depending on the characteristics of the device to be controlled, tracking may be delayed with respect to the command. In that case, note that the value obtained by this function may not match the actual operation.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the position coordinate values of the current command.
Example	The position coordinate values of the current MT1 command are displayed on the teaching pendant LCD.

```
declare numeric pos
let pos=getMtPosition(1)      Acquire the position of the current MT1 command
eoutLCD 8,1,str(pos)          Display the position values in character string on
                              the 8th line of LCD.
delay 5000                    Wait 5 seconds
clrLineLCD 8                  Erase the information displayed on the 8 th line.
```

■ disableMtMoveArea

This is a function to process homing operations. Do not use this for anything other than homing operations.

Identifier	num disableMtMoveArea (num mt)
Explanation	Temporarily disables the area out detection. The axes are able to exceed and move outside of the range specified by the [Upper Move Limit] and [Lower Move Limit] or the range specified by the move area limit. With any point job other than a homing operation, an expression evaluation error occurs and the point job cannot be executed.
Argument	mt: Specify MT1/MT2 (1:MT1, 2:MT2) If the argument is incorrect, an expression evaluation error occurs.
Value Returned	Returns the execution results. 0: Disabled the area out detection.
Example	Refer to “5.7 Example of a Homing Operation via a Point Job.”

■ enableMtMoveArea

This is a function to process homing operations. Do not use this for anything other than homing operations.

Identifier	num enableMtMoveArea (num mt)	
Explanation	Re-enable area out detection which was temporarily disabled by the *disableMtMoveArea()* function. With any point job other than a homing operation, an expression evaluation error occurs and the point job cannot be executed.	
Argument	mt	Specify MT1/MT2 (1:MT1, 2:MT2)
Value Returned	Returns the execution result.	
	0	Enabled the area out detection.
Example	Refer to “5.7 Example of a Homing Operation via a Point Job.”	

■ clearMtPosition

This is a function to process homing operations. Do not use this for anything other than homing operations.

Identifier	num clearMtPosition (num mt)	
Explanation	Clears the output pulse number to 0. With any point job other than a homing operation, an expression evaluation error occurs and the point job cannot be executed.	
Argument	mt	Specify MT1/MT2 (1:MT1, 2:MT2)
Value Returned	Returns the execution result.	
	0	Cleared the output pulse number.
Example	Refer to “5.7 Example of a Homing Operation via a Point Job.”	

■ System Flags

System flags differ from the built-in functions *getMtIn()*, *getMtOut()*, *getMtSensor()* as they return true (1) / false (0) responses according to the I/O-MT signal logic settings.

No.	Identifier	Details	True (1) Conditions
200	#Fmt1Moving	MT1 is moving	*
201	#Fmt2Moving	MT2 is moving	*
202	#Fmt1Ready	MT1 driver is prepared	*
203	#Fmt2Ready	MT2 driver is prepared	*
204	#Fmt1InPosition	MT1 positioning complete	*
205	#Fmt2InPosition	MT2 positioning complete	*
206	#Fmt1Initialize	MT1 homing operation is complete	*
207	#Fmt2Initialize	MT2 homing operation is complete	*
208	#Fmt1Error	MT1 error	*
209	#Fmt2Error	MT2 error	*
210	#Fmt1Sensor	MT1 home sensor	*
211	#Fmt2Sensor	MT2 home sensor	*
212	#Fmt1Timing	MT1 timing signal	*
213	#Fmt2Timing	MT2 timing signal	*

* Refer to the following tables.

■ No.200 #Fmt1Moving/No.201 #Fmt2Moving

This shows whether or not MT1 / MT2 is moving. The true (1) / false (0) responses vary according to the [Positioning Complete] I/O-MT signal logic settings.

I/O-MT Signal Logic	True (1) Conditions
Invalid	When the robot is generating pulse output
Positive Logic	When the robot is generating pulse output, or the [Positioning Complete] signal is de-energized (OFF)
Negative Logic	When the robot is generating pulse output, or the [Positioning Complete] signal is energized (ON)

■ No.202 #Fmt1Ready / No.203 #FmtReady

The true (1) / false (0) responses vary according to the [Driver Ready] I/O-MT signal logic settings.

I/O-MT Signal Logic	True (1) Conditions
Invalid	Always true
Positive Logic	When the [Driver Ready] signal is energized (ON)
Negative Logic	When the [Driver Ready] signal is de-energized (OFF)

■ No.204 #Fmt1InPosition / No.205 #Fmt2InPosition

The true (1) / false (0) responses vary according to the [Positioning Complete] I/O-MT signal logic settings.

I/O-MT Signal Logic	True (1) Conditions
Invalid	Always true
Positive Logic	When the [Positioning Complete] signal is energized (ON)
Negative Logic	When the [Positioning Complete] signal is de-energized (OFF)

■ No.206 #Fmt1Initialize / No.207 #Fmt2Initialize

The true (1) / false (0) responses vary according to the homing operation parameter [Homing Type], and [Homing Complete] I/O-MT signal logic settings.

Homing Operation	I/O-MT Signal Logic	True (1) Conditions
No	Invalid	Always true
	Positive Logic	
	Negative Logic	
Start and Completion	Invalid	Always true
	Positive Logic	When the [Positioning Complete] signal is energized (ON)
	Negative Logic	When the [Positioning Complete] signal is de-energized (OFF)
Sensor Position Type Timing Signal Type Point Job	Invalid	The homing operation is complete
	Positive Logic	
	Negative Logic	

■ No.208 #Fmt1Error/No.209 #Fmt2Error

The true (1) / false (0) responses vary according to the [Driver Error] I/O-MT signal logic settings.

I/O-MT Signal Logic	True (1) Conditions
Invalid	None (always false (0))
Positive Logic	When the [Driver Error] signal is energized (ON)
Negative Logic	When the [Driver Error] signal is de-energized (OFF)

■ No.210 #Fmt1Sensor/No.211 #Fmt2Sensor

The true (1) / false (0) responses vary according to the [Home Sensor] I/O-MT signal logic settings.

I/O-MT Signal Logic	True (1) Conditions
Invalid	None (always false (0))
Positive Logic	When the [Home Sensor] signal is energized (ON)
Negative Logic	When the [Home Sensor] signal is de-energized (OFF)

■ No.212 #Fmt1Timing/No.213 #Fmt2Timing

The true (1) / false (0) responses vary according to the I/O-MT signal logic settings of [Timing Signal].

I/O-MT Signal Logic	True (1) Conditions
Invalid	None (always false (0))
Positive Logic	When the [Timing Signal] signal is energized (ON)
Negative Logic	When the [Timing Signal] signal is de-energized (OFF)

5.6 Homing Operations via Point Jobs

If performing a homing operation via a point job, take note of the following:

5.6.1 MT1/MT2 Configuration Settings

1. Set the I/O-MT signal logic settings to [Invalid].
   Before creating the point job, set the I/O-MT signal logic settings to [Invalid].
   If the I/O-MT signal logic settings are not set to [Invalid], signal control from point job commands and signal control from auxiliary axis functions will conflict and you may not be able to control the device properly.

TP [MT1/MT2 Configuration]
[I/O-MT1/MT2 Function Settings]
[I/O-MT Signal Logic Settings]

PC [Robot] → [Administration] → [Administration Settings] → [MT1/MT2] → [I/O-MT1/MT2 Signal Logic Settings]

2. Register the homing type to a point job.
   Set the given point job number which contains the homing type to the point job number list.

TP [MT1/MT2 Configuration]
[Homing Settings]

PC [Robot] → [Administration] → [Administration Settings] → [MT1/MT2] → [Homing Settings]

5.6.2 Point Job Creation

1. Temporarily disable “Area Out Detection” (only when required).
   To perform a homing operation, you may need to temporarily move the axes to a position which exceeds the move area. To do this, use the built-in function *disableMtMoveArea()*.
   This can temporarily disable “Area Out Detection”.
   However, once the operation for the homing operation is complete, re-enable the move area with *enableMtMoveArea()* as soon as possible. If you make runs as usual with “Area Out Detection” disabled, conflicts and other such problems with the mechanical limitations of the device and/or robot and peripheral devices may occur.
   When you temporarily disable “Area Out Detection” and once the point job for the homing operation is complete (including when it finishes due to an expression evaluation error or emergency stop), the move area is re-enabled automatically.

2. Clear the output pulse number to 0 once the operation is complete.
   Once the job for the homing operation is complete and the axes stop at the position designated as the home position, execute the built-in function *clearMtPosition()* and clear the output pulse number to 0.

3. There are some functions and command limitations.
   If a point job is executed and handled as a homing operation, there are some command and function limitations.

Command	Limitation
initMec	Cannot be executed.
callProg	Cannot be executed.
callPoints	Cannot be executed.
waitStart	Cannot be executed.
waitStartBZ	Cannot be executed.
checkPos	Cannot be executed.
lineMove	Only operate the axes which are subject to the homing operation. Do not operate any axes which are not subject to the homing operation. For example, if the X axis and Y axis are operated for a MT1 homing operation, mechanical initialization of the X axis and Y axis may not be performed properly.

Built-in Functions	Limitation
moveAPTP()	Cannot be executed.
moveRPTP()	Cannot be executed.
Pause()	Cannot be executed.

5.7 Example of a Homing Operation via a Point Job

This section shows an example of a point job when signals such as the ones below are connected.

I/O-MT Signal	Signals on the controlled device
MT1 Output 1	This signal excites the motor. OFF when the motor is excited. ON when it is not excited.
MT1 Sensor Input 1	Homing signal sensor. OFF when the sensor is blocked. ON when it is released.

■ Point Job Example

```
delay 500
let setMtOut (1,1,0)          Excite the motor (turn OFF I/O-MT1 Output)
delay 1000                    Wait for the motor to stabilize.
let disableMtMoveArea (1)     Temporarily disable the MT1 area out detection.
monoMove MT1                  Start the MT1 movement
  mMoveDistance -360            Distance: -360 (deg)
  mMoveSpeed 20                 Speed: 20 (deg/s)
  mMoveAccelRate 30             Acceleration: 30 % of default acceleration
monoMoveStopIf                Stop conditions
  ldi getMtSensor (1, 1)          MT1 home sensor is blocked (I/O-MT1 sensor1 is OFF)
endMonoMove
if
  ldi #sysFlag(34)            If the lineMove command does not meet the conditions
then
  outLCD 8,5,“Sensor Error 1”   “Sensor Error 1” is displayed on the pendant LCD
  jump L1                       Jump to error process Label 1
endIf
delay 1000                    After the CP movement stops, wait for motor to stabilize
monoMove MT1                  Start the MT1 movement
  mMoveDistance 180             Distance: 180 (deg)
  mMoveSpeed 20                 Speed: 20 (deg/s)
  mMoveAccelRate 30             Acceleration: 30 % of default acceleration
monoMoveStopIf                Stop conditions
  ldi getMtSensor (1, 1)      MT1 home sensor is released (I/O-MT1 sensor1 is ON)
endMonoMove
if
  ldi #sysFlag (34)           If the lineMove command does not meet the conditions
then
  outLCD 8,5,“Sensor Error 2”   “Sensor Error 2” is displayed on the pendant LCD
  jump L1                       Jump to error process Label 1
endIf
```

let enableMtMoveArea (1)	Re-enable the MT1 area out detection
delay 1000	After the CP movement stops, wait for the motor to stabilize
let clearMtPosition (1)	Clear the MT1 output pulse number to 0
returnJob	End the point job (homing operation complete)
Label1	Error treatment label
let enableMtMoveArea (1)	Re-enable the area out detection
set #FBZ	Sound the buzzer
delay 3000	
reset #FBZ	Stop the buzzer
do	Prevent continued processes with an endless loop
loop	

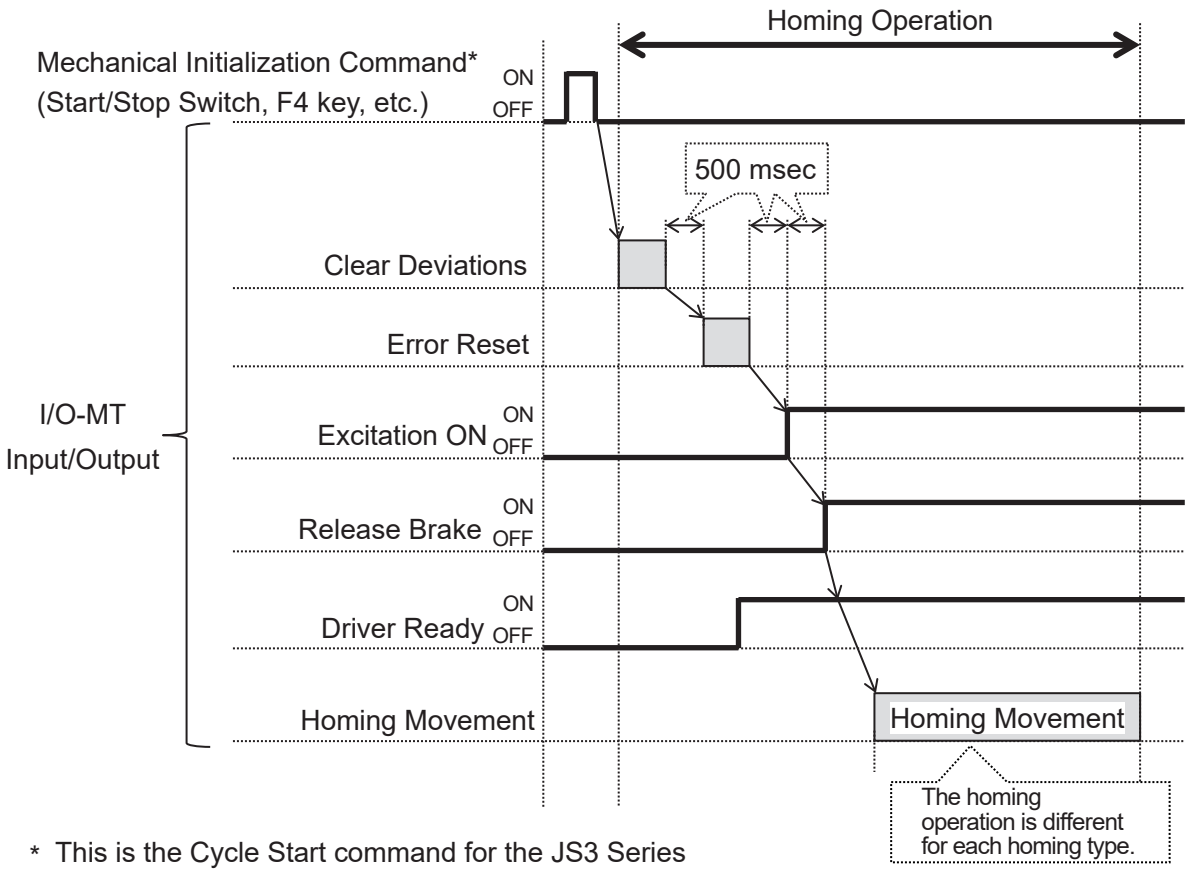
6. RUN

The ON/OFF indicators of the I/O-MT signals are shown when I/O-MT signal logic settings are set to [Positive Logic]. When set to [Negative Logic], the ON/OFF indicators are backwards.

6.1 Homing Operation

Before the homing operation movements are made, the following processes are performed:

1. Clear the deviations.
2. Reset the errors.
3. Turn ON [Excitation ON]
4. Turn ON [Release Break]
   If after step 4, [Driver Ready] does not come ON within 5 seconds, the device goes into the [Not Ready] error status and the homing operation is not performed.

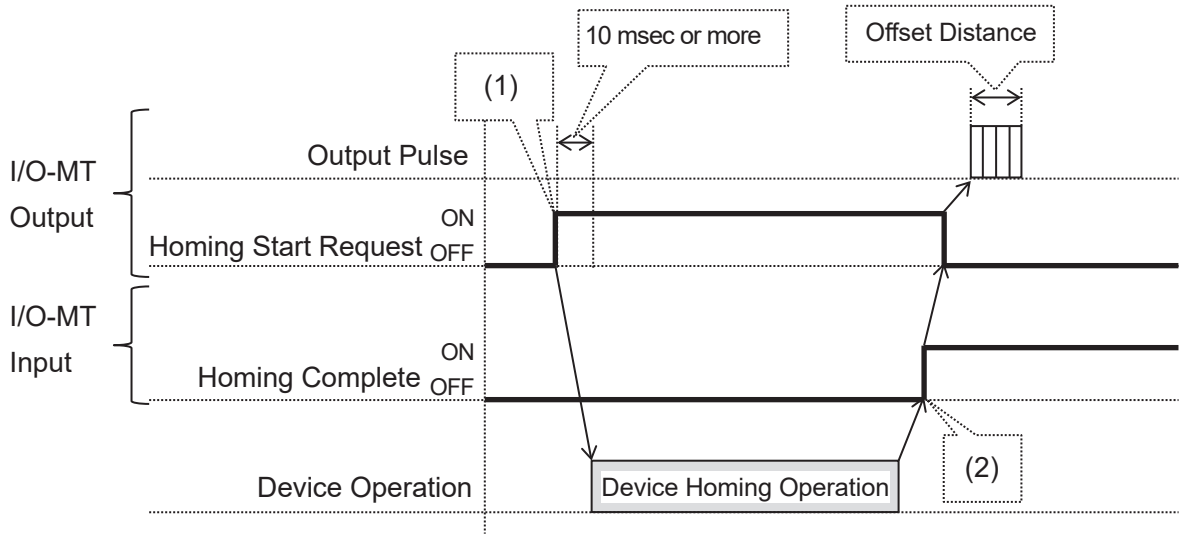


* This is the Cycle Start command for the JS3 Series

Refer to "6.3.8 Driver Error Reset" for information regarding the error reset operation and "6.3.6 Deviation Reset" for information regarding the deviation reset operation.
The homing operation is different for each [Homing Type].

6.1.1 Start and Completion

■ Timing Chart

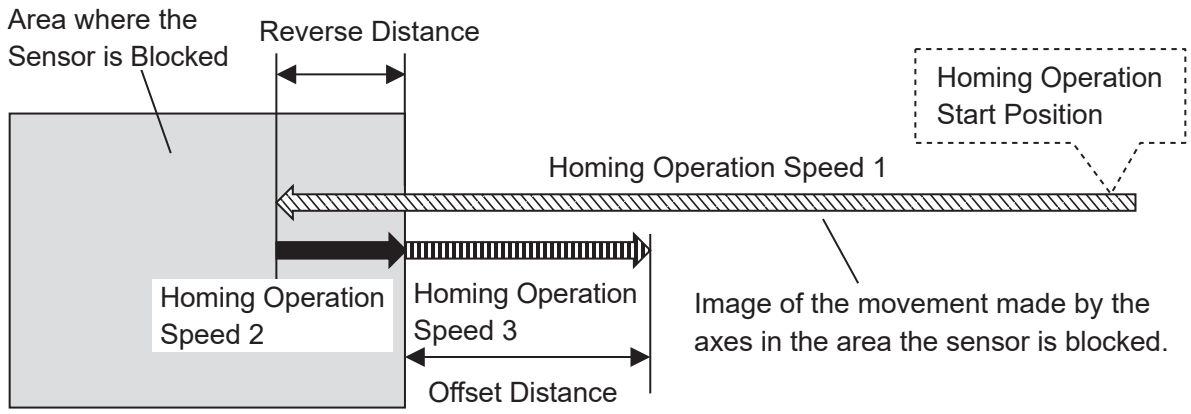


If there is a problem with the homing operation, the error in the following table occurs:

Error	Details
Homing Move Timeout Error	The time from when the “Homing Start Request” signal came ON until the “Homing Complete” signal turned ON exceeded the homing operation parameter [Timeout Period]. (The time from 1 until 2 exceeded the setting [Timeout Period])

6.1.2 Sensor Position Type

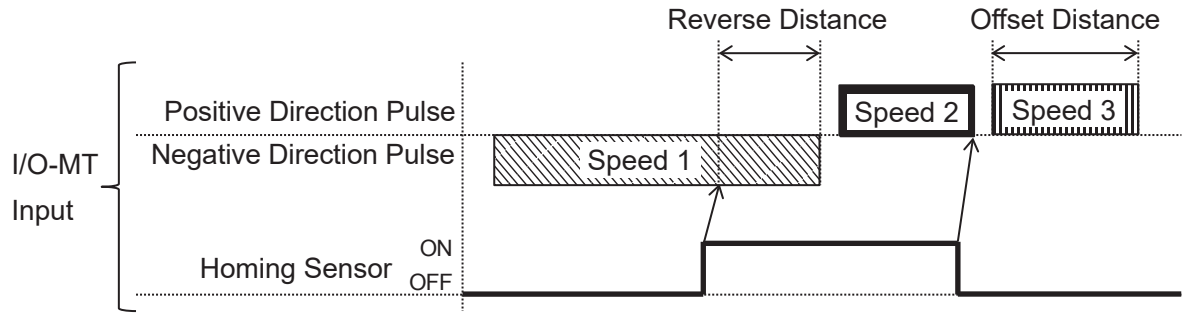
■ Operation Image



At the start of the homing operation, if the axes are already in the area where the sensor is blocked, the axes move at homing operation speed 2 in the positive direction until they exceed the area where the sensor is blocked, and then continue to move in the positive direction by the exact offset distance.

After this, the operation in the above diagram starts.

■ Timing Chart

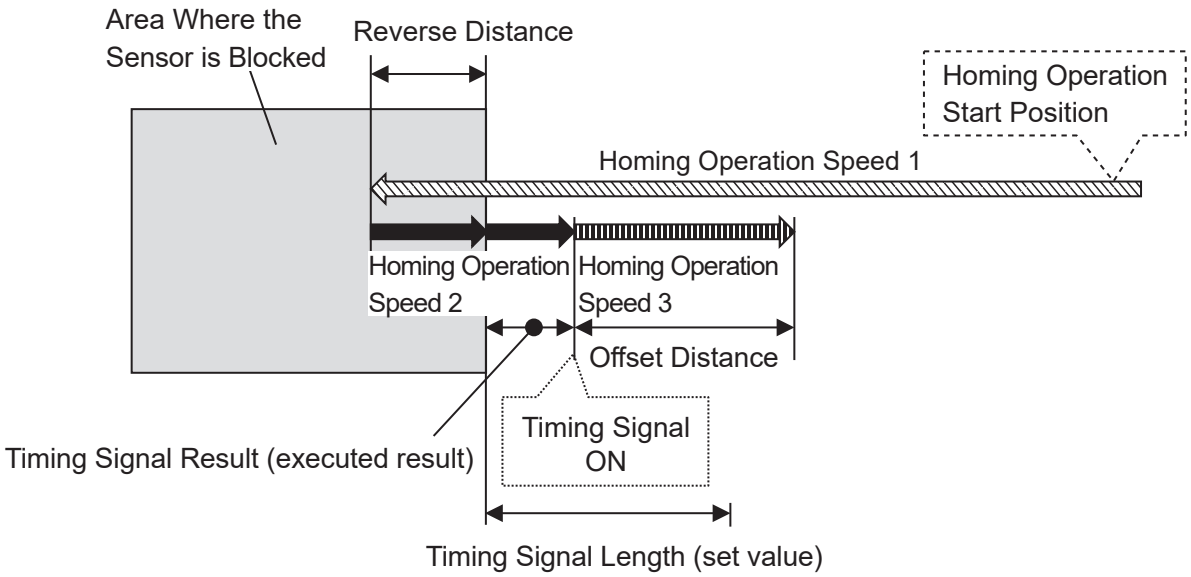


If there is a problem with the homing operation, the error in the following table occurs:

Error	Details
Homing Move Timeout Error	The elapsed time from the start of the homing operation exceeded the homing operation parameter [Timeout Period].
Homing Operation Sensor Error	1. Movement started from outside of the area where the sensor is blocked and even though the axes moved the distance specified in the homing operation parameter [Valid Distance], the axes did not enter the area where the sensor is blocked. 2. Movement started from inside the area where the sensor is blocked and even though the axes moved the distance specified in the homing operation parameter [Valid Distance], the axes did not exceed the area where the sensor is blocked.

6.1.3 Timing Signal Type

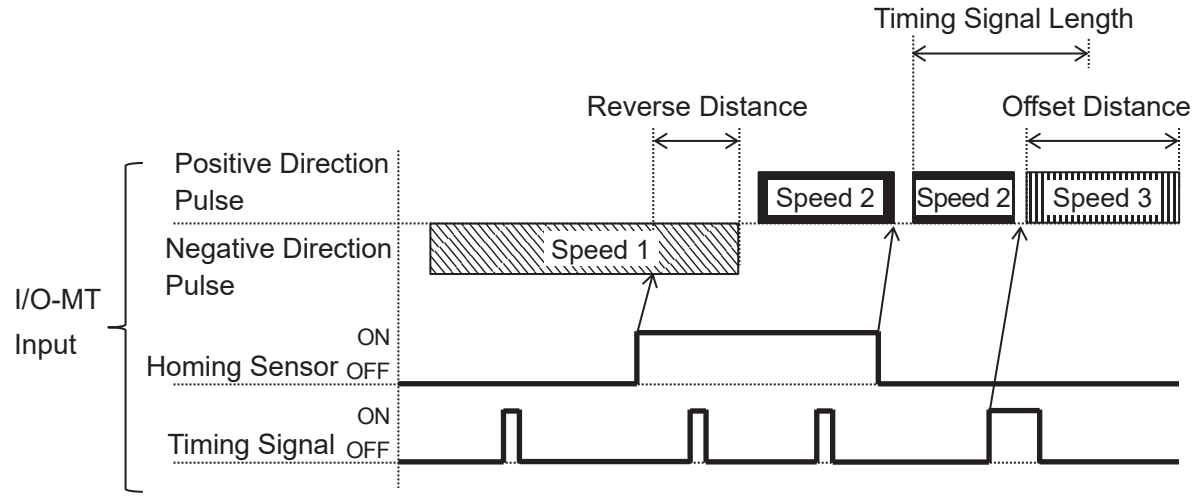
■ Operation Image



At the start of the homing operation, if the axes are already in the area where the sensor is blocked, the axes move at homing operation speed 2 in the positive direction until the sensor is released, and then continue to move in the positive direction by the exact offset distance. After this, the operation in the diagram above starts.

The Timing Signal Result is the execution result of the homing operation. The timing signal varies depending on the position relationship between the position which is output and the position detected by the sensor. Timing Signal Result can be confirmed by using the Configuration Check Mode.

■ Timing Chart



If there is a problem with the homing operation, the error in the following table occurs:

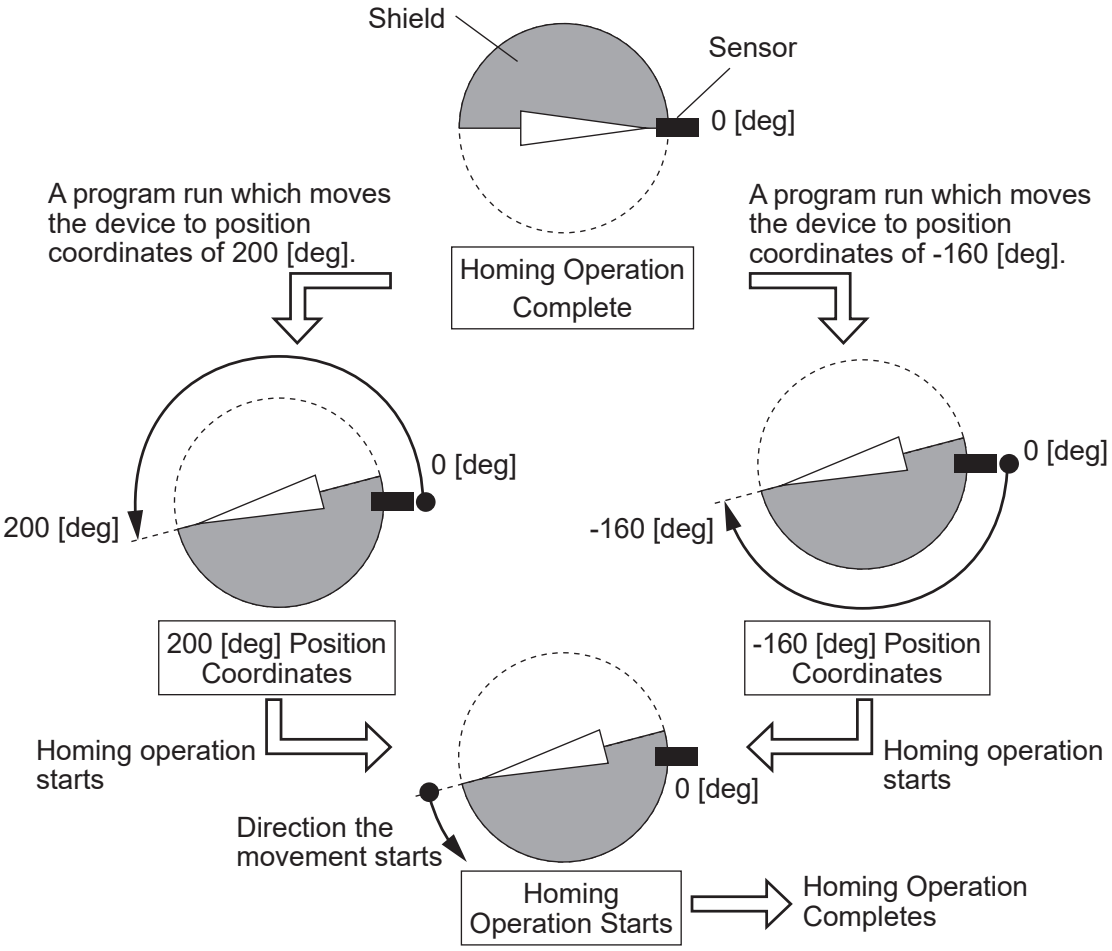
Error	Details
Homing Move Timeout Error	The elapsed time from the start of the homing operation exceeded the homing operation parameter [Timeout Period].
Homing Operation Sensor Error	Movement started from outside of the area where the sensor is blocked and even though the axes moved the distance specified in the homing operation parameter [Valid Distance], the axes did not enter the area where the sensor is blocked. Movement started from inside the area where the sensor is blocked and even though the axes moved the distance specified in the homing operation parameter [Valid Distance], the axes did not exceed the area where the sensor is blocked.
Homing Move Timing Signal Error	Even though the axes moved the exact distance specified in the homing operation parameter [Timing Signal Distance], the timing signal did not come ON.

■ Homing Operation Precautions for Devices with Rotational Motions

The direction of operation for homing operations performed via the [Sensor Position Type] or [Timing Signal Type] are determined depending on the sensor ON/OFF status, regardless of the position coordinate values at the start of the operation.

For controlled devices with rotational motions such as for a dispensing syringe etc., you need to take note of the rotation.

For example, if using a semicircular shield to block the sensor, a homing operation from 200 [deg] position coordinates and a homing operation from -160 [deg] position coordinates start the homing operation in the same direction.



In addition, homing operations are performed in accordance to the sensor switching ON/OFF even if the total angle exceeds 360 [deg] due to multiple rotations. Devices will not make return operations according to the sum of multiple rotations.

6.2 Movement

6.2.1 PTP Movement

MT1 and MT2 are paired with the X axis, Y axis, and R axis. The speed of each axis is adjusted so that they arrive at their destinations at the same time and their movements are synchronous. The Z axis ascends/descends independently from the other axes.

6.2.2 CP Movement

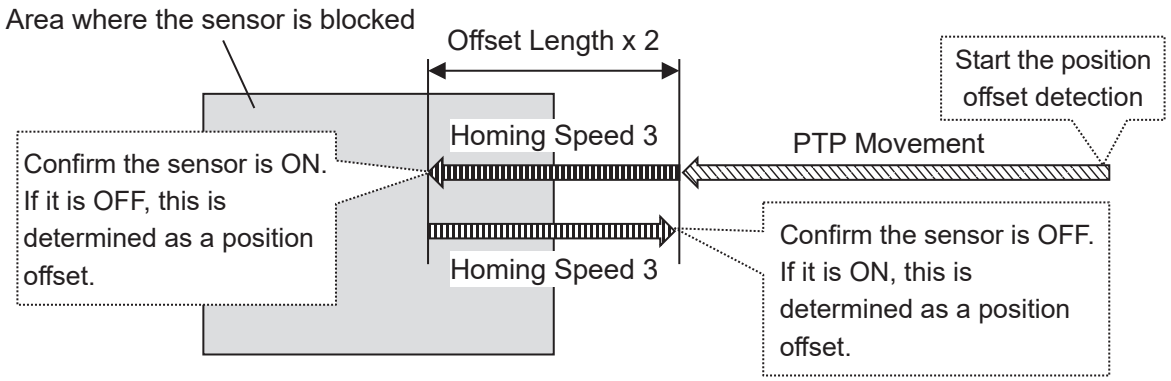
The R axis, MT1, and MT2 are paired according to the combined speed of the X axis, Y axis, and Z axis. The speed of each axis is adjusted so that they arrive at their destinations at the same time and their movements are synchronous.

6.2.3 Position Offset Detection Functions via the Homing Sensor

If [Initialize at Start] or [Position Error Check] in all program common settings is set [Valid] or the *checkPos* command is executed, a position offset detection operation is executed.
If the robot determines there is a position offset, a homing operation is automatically executed.
The position offset detection operation varies depending on the homing operation method.

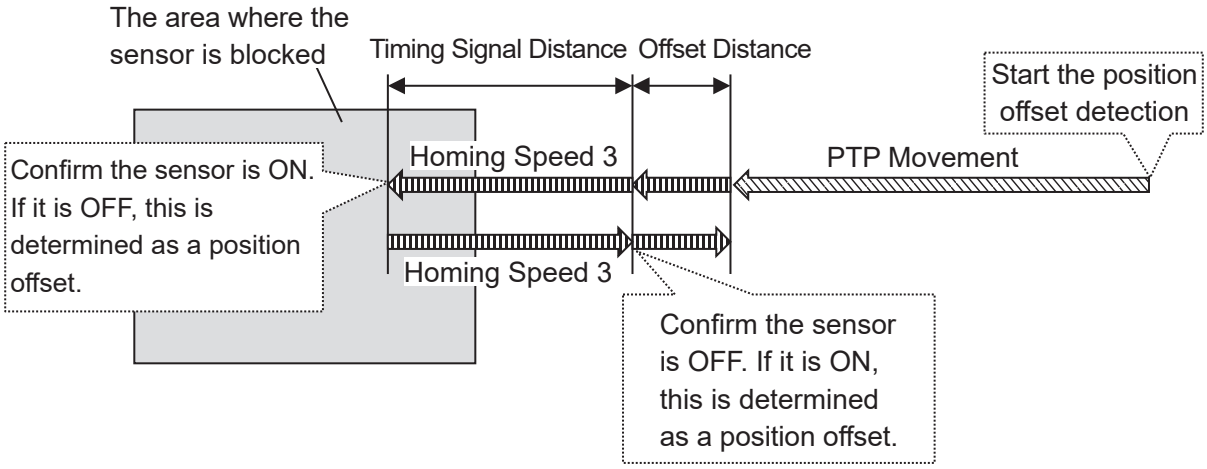
■ [Sensor Position Type] Homing Operation

1. Start the position offset detection movement.
2. Make a PTP movement until the position coordinate values are 0.
3. Move in the negative direction for twice the distance of the homing operation parameter [Offset Distance].
4. Confirm the homing sensor is ON. If it is OFF, this is determined as a position offset.
5. Move in the positive direction twice the distance of the homing operation parameter [Offset Distance].
6. Confirm the homing sensor is OFF. If it is ON, this is determined as a position offset.



■ [Timing Signal Type] Homing Operation

1. Start the position offset detection movement
2. Make a PTP movement until the position coordinate values are 0.
3. Move in the negative direction for the distance of the homing operation parameter [Offset Distance].
4. Move in the negative direction for the distance of the homing operation parameter [Timing Signal Distance].
5. Confirm the homing sensor is ON. If it is OFF, this is determined as a position offset.
6. Move in the positive direction for the distance of the homing operation parameter [Timing Signal Distance].
7. Confirm the homing sensor is OFF. If it is ON, this is determined as a position offset.

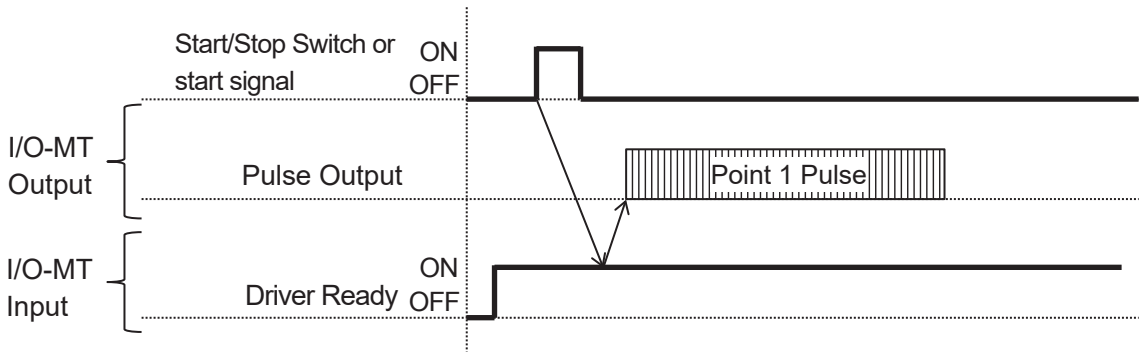


6.3 Timing Charts

I/O control with the JR3000/JC-3/JS3 Series robot is fundamentally an exchange where the I/O device and the robot reciprocally watch the status and responses of one another to advance processes (handshake).
The ON/OFF indicators of the I/O-MT signals are shown when I/O-MT signal logic settings are set to [Positive Logic]. When set to [Negative Logic], the ON/OFF indicators are backwards.
For information regarding I/O-MT signal logic settings refer to “4.6.2 I/O-MT Signal Logic Settings.”

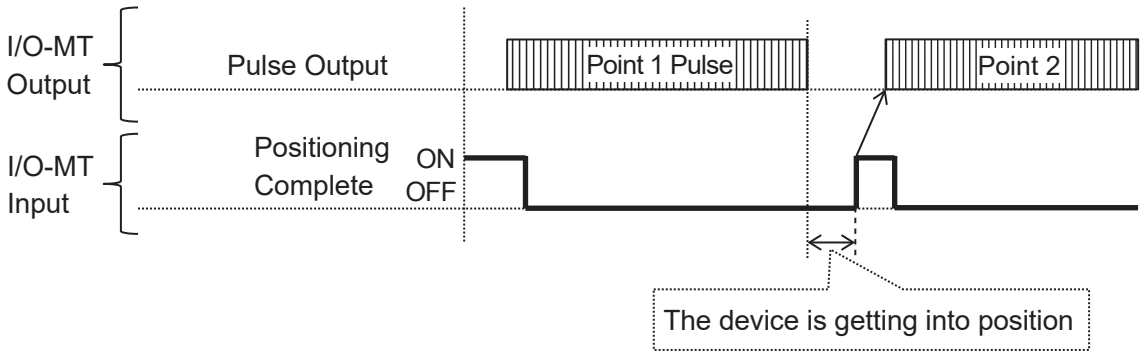
The I/O-MT input signals are shown when the I/O-MT input signal filter is set to [Invalid]. When set to [Valid], the robot recognizes the I/O-MT input signal after a delay of 20 msec.
For details regarding the I/O-MT input signal filter, refer to “4.6.3 I/O-MT Input Signal Filter.”

6.3.1 Driver Ready



If Driver Ready is OFF at the start of the run, a “not ready” error occurs and the pulse output is not started.

6.3.2 Positioning Complete

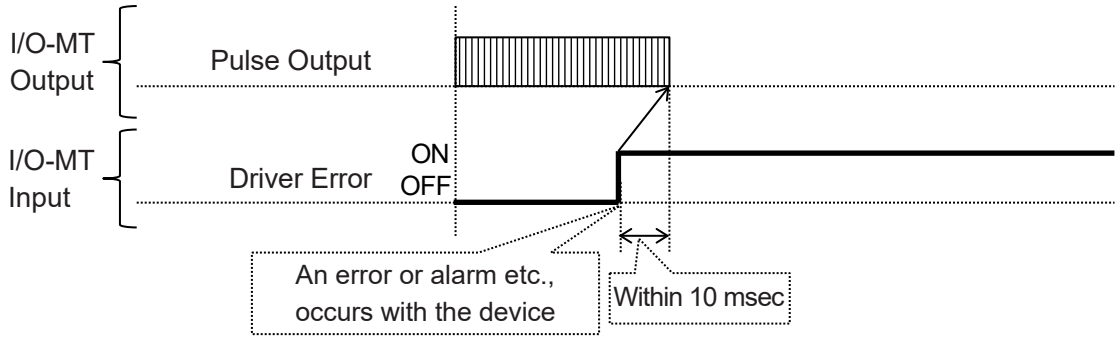


When a run is executed, the robot waits for the pulse output to complete and then for the Positioning Complete signal to come ON. Once it comes ON, the pulse output for the next point starts.
After the pulse output is complete, if the Positioning Complete signal does not come ON within 5 seconds, a “positioning error” occurs and the pulse output for the next point cannot start.

6.3.3 Homing Complete

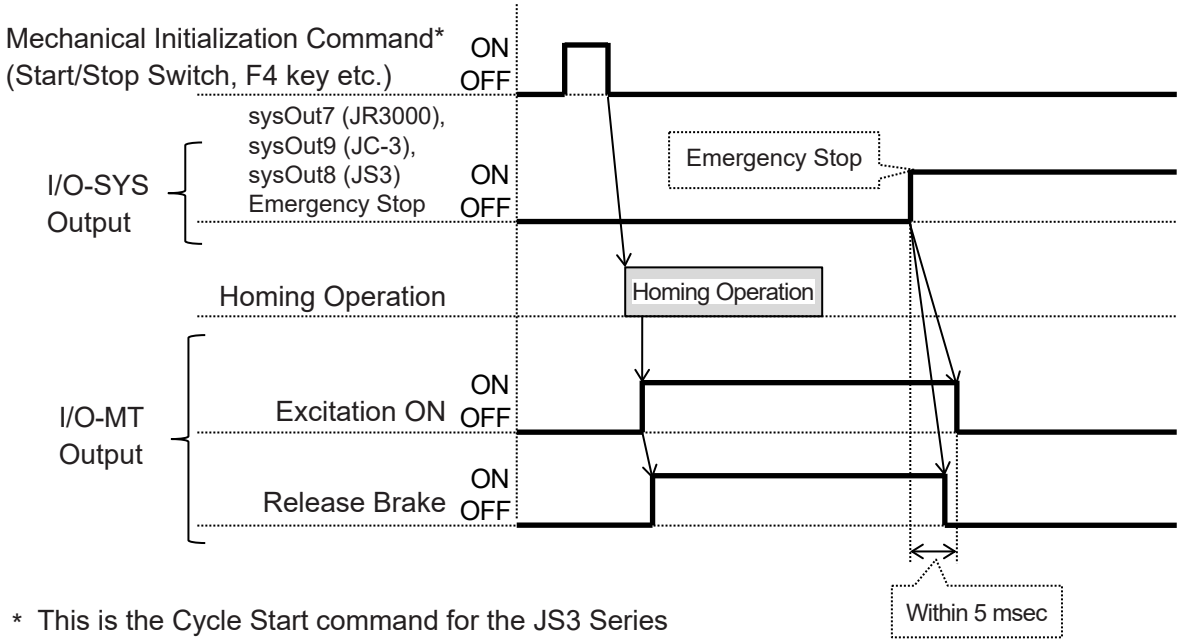
This is active when [Homing Settings] is set to [Start and Completion].
For further details, refer to “6.1.1 Start and Completion.”

6.3.4 Driver Error



If Driver Error comes ON during a run or when starting a run, an error occurs and pulse output stops. For further details regarding error resets after an error has occurred, refer to "6.3.8 Driver Error Reset."

6.3.5 Excitation ON



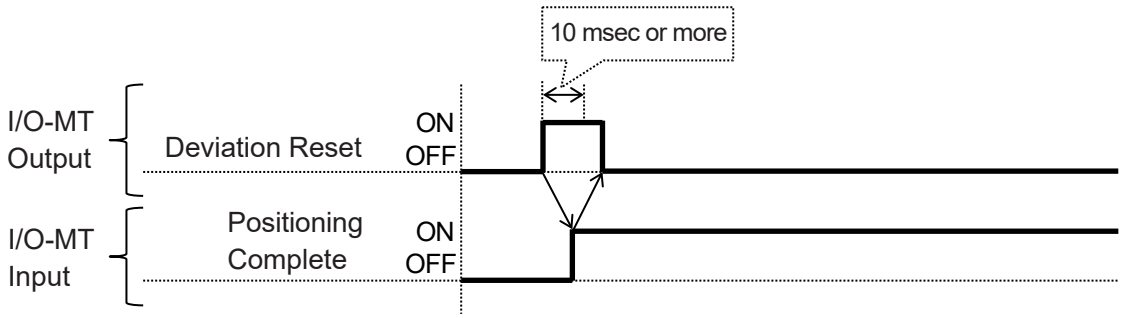
* This is the Cycle Start command for the JS3 Series

The Excitation ON signal comes ON during the homing operation and goes OFF when an emergency stop occurs. For information regarding homing operations, refer to "6.1 Homing Operation."

6.3.6 Deviation Reset

Deviation Reset is performed during a homing operation.

For information regarding homing operations, refer to “6.1 Homing Operation.”



The Deviation Reset operation consists of the following:

1. Turn [Deviation Reset] ON.
2. Wait for [Positioning Complete] to come ON.
3. Turn [Deviation Reset] OFF.

If [Positioning Complete] does not come ON within 5 seconds, a “positioning error” occurs.

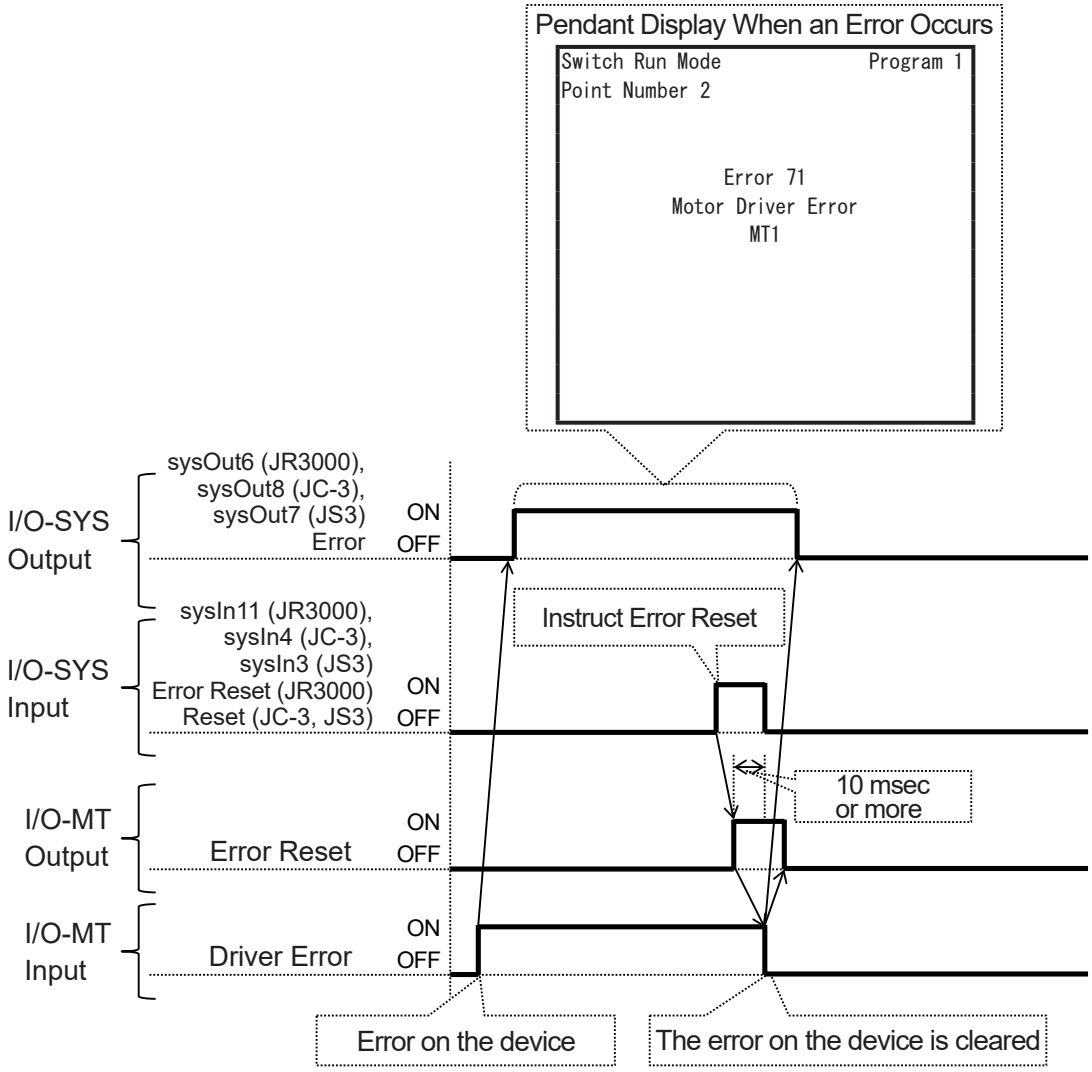
6.3.7 Homing Start Request

This is active when [Homing Settings] is set [Start and Completion].

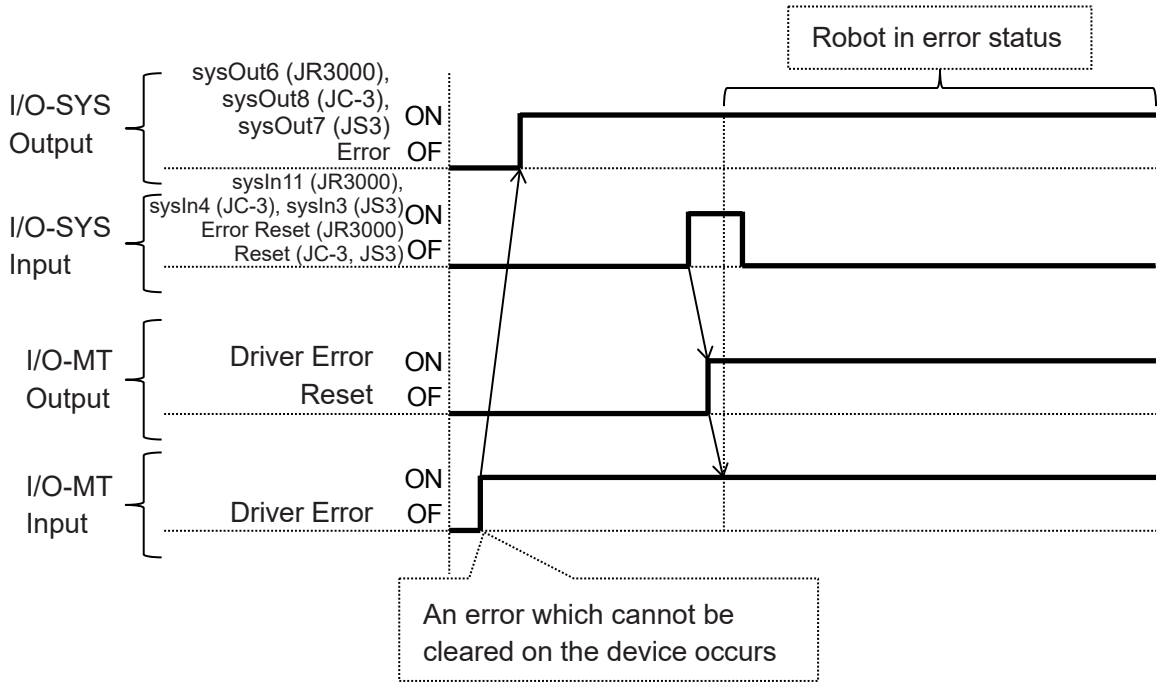
For further details, refer to “6.1.1 Start and Completion.”

6.3.8 Driver Error Reset

Errors and alarms which occur on the device can be cleared by instructing an error reset from I/O-SYS.



If an alarm or error occurs on the device and the I/O-MT [Driver Error] signal comes ON, the robot also goes into an error status and the I/O-SYS [Error] signal comes ON.
If you turn ON [Error Reset] (JR3000), [Reset] (JC-3/JS3) when the robot is in an error status, the I/O-MT [Driver Error Reset] signal comes ON.
Once the device's error status is cleared and the I/O-MT [Driver Error] signal goes OFF, the I/O-MT [Driver Error Reset] signal and the I/O-SYS [Error] signal go OFF.
When the I/O-SYS [Error] signal goes OFF, the error status of the robot is cleared and the next run can be made.



Depending on the device type and/or the error type, there are some situations where errors cannot be cleared on the device. If this occurs, the robot also goes into an error status, [Error] in I/O-SYS comes ON, and the pendant displays the error.
For information regarding the error types and whether or not you can clear them, refer to the device's instruction manual, specifications, and/or data sheets etc.

6.3.9 Release Brake

With the homing operation, after the [Excitation ON] signal comes ON and after 500 msec, the [Release Brake] signal comes ON. When an emergency stop is performed, the [Release Brake] signal goes OFF before the [Excitation ON] signal goes OFF.

For further details refer to "6.1 Homing Operation"and "6.3.5 Excitation ON."

7. ERROR MESSAGE LIST

The error numbers for errors relating to the auxiliary axes are the same for MT1 and MT2. The name of the error and the affected axis (“MT1” or “MT2”) are displayed on the teaching pendant. For details regarding errors relating to the robot’s drive axes (X, Y, Z, R) or errors not listed in the table below, refer to the operation manual *Maintenance*.

Error No.	Display	Details, Methods of Handling
007	Position is out of range	The destination of the PTP movement exceeds the move area and/or move area limit*. The robot exceeded the move area and/or the move area limit during the movement. Teach positions so they are within range of both the max/min move area of auxiliary axis configuration and the upper/lower limits of the move area limit.
022	CP Speed Over	The speed of MT1 or MT2 could not accelerate to the maximum speed because the movement distance was too short. Increase the movement distance or reduce the maximum speed in CP conditions. For details regarding CP conditions, refer to “5.2 CP Conditions.”
069	Motor Driver Positioning Error	The controlled device could not complete the positioning operation at the position where the movement stopped. This error does not occur if [Positioning Complete] in I/O-MT signal logical settings is set to [Invalid].
071	Motor Driver Error	The controlled device had an error or alarm occur during the movement. This error does not occur if [Driver Error] in I/O-MT signal logical settings is set to [Invalid].
074	Motor Driver Not Ready	The controlled device was not in a ready status (not able to receive command pulses) when the movement started. This error does not occur if [Driver Ready] in I/O-MT signal logical settings is set to [Invalid].
080	Pulse Generator Error	There was an error with the MT1, MT2 pulse generator, likely due to one of the following: • The pulse generator circuit board (MCD board) it not attached. • The pulse generator circuit board (MCD board) if faulty.

Error No.	Display	Details, Methods of Handling
103	Homing Move Sensor Error	The homing sensor did not respond to the homing operation. For further details, refer to “6.1.2 Sensor Position Type” or “6.1.3 Timing Signal Type.”
104	Homing Move Timing Signal Error	The timing signal did not respond to the homing operation. For further details, refer to “6.1.3 Timing Signal Type.”
105	Homing Move Timeout Error	The elapsed time from the start of the homing operation exceeded the homing operation parameter [Timeout Period]. For further details, refer to “6.1.1 Start and Completion”, “6.1.2 Sensor Position Type” and “6.1.3 Timing Signal Type.”

* For information regarding the move area limit, refer to “5.3.1 Move Area Limit Settings” or the operation manual *Basic Instructions*.

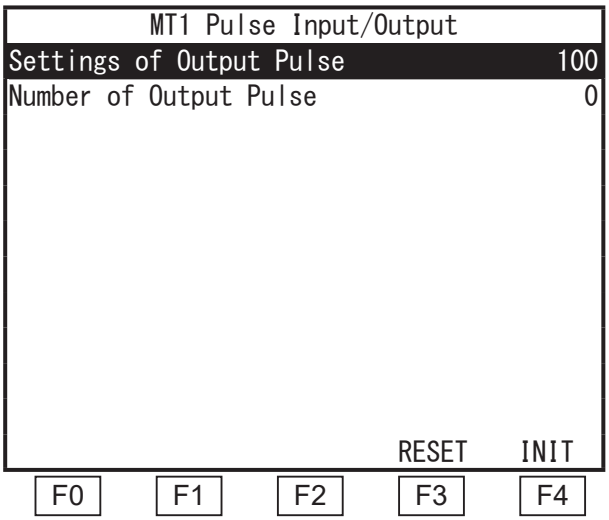
8. DIAGNOSTIC MODE

⚠ Caution

After performing diagnostics, always make sure to turn the robot OFF. If you make runs or perform jobs without turning the robot OFF, the robot may not function correctly.

8.1 MT1/MT2 Pulse Input/Output

This is a screen for performing diagnostics on the I/O-MT output pulses.

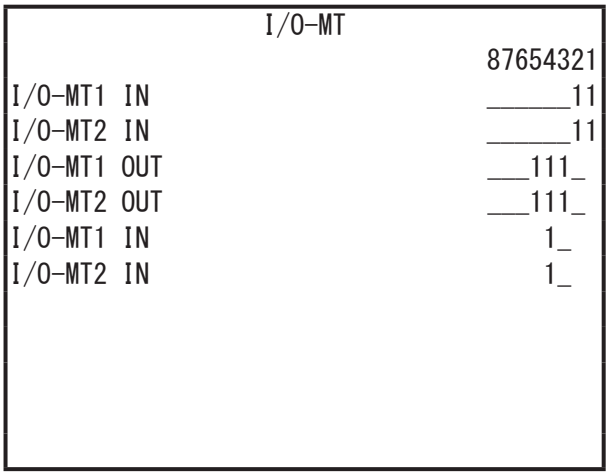


The teaching pendant key functions are as follows:

Key	Function
F3 (RESET)	Clears the robot's internal pulse count value. The output pulse value becomes 0. The homing operation is not performed.
F4 (INIT)	Executes the homing operation.
GO	Outputs positive direction pulses by the exact pulse number set in [Settings of Output Pulse].
SHIFT+GO	Outputs negative direction pulses by the exact pulse number set in [Settings of Output Pulse].
ENTR	Changes the display to the Settings of Output Pulse screen.
ESC	Returns the display to the previous screen.

8.2 I/O-MT

This is a screen for performing diagnostics on the various I/O-MT input/output signals.
Signals ON (the internal photocoupler is energized) are displayed as “1,” and signals OFF (the internal photocoupler is de-energized) are displayed as “_.”



The teaching pendant key functions are as follows:

Key	Function
CURSOR △ ▽	Moves the cursor up/down. You can only move the cursor to [I/O-MT1 OUT] and [I/O-MT2 OUT].
CURSOR ◁ ▷	Moves the cursor left/right. You can move the cursor to the 1 – 6 input/output signals of [I/O-MT1 OUT] or [I/O-MT2 OUT].
ENTR	Switches the signal which the cursor is aligned to ON/OFF.
ESC	Returns the display to the previous screen.

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