ITOH DENKI
TECHNOLOGY FOR TOMORROW

POWER MOLLER PLUS

Sorting

Right Angle Transfer Module

M-RAT

Mighty - Right Angle Transfer

User Manual

Read this manual before use

Thank you for purchasing the Right Angle Transfer Module
(hereinafter referred to as “this product”).
＊This product refers to all products including standard accessories.

Make sure to read this manual carefully before using, and start using only after you have understood all the product’ s functions, safety information and precautions.
After reading the manual, make sure to keep it safe in a specified place for future use, whenever necessary.

ITOH DENKI

Module

No.664

1. Introduction

Features

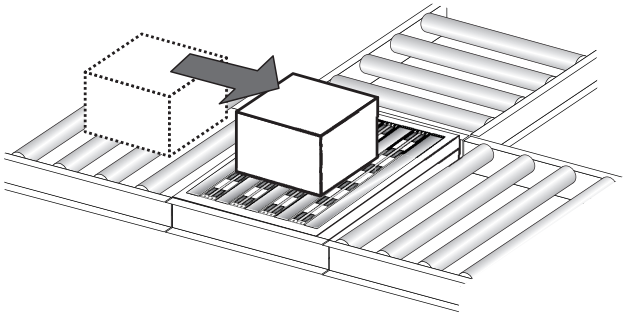
Features of this product

- This product is a module to transfer trays by diverting at a right angle.
  Since trays can be diverted at a right angle without changing their level, there will be no impact on the trays.
- All-electric control. No pneumatics or hydraulic pressure.

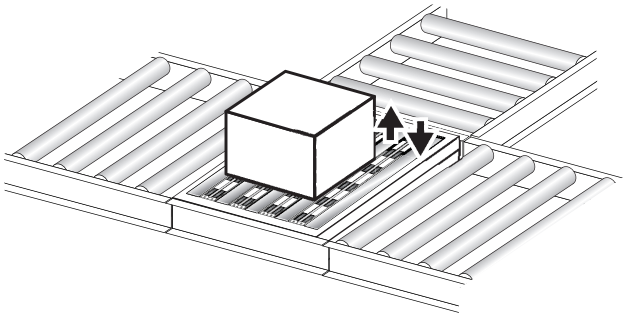
Operation description

(when diverting at a right angle)

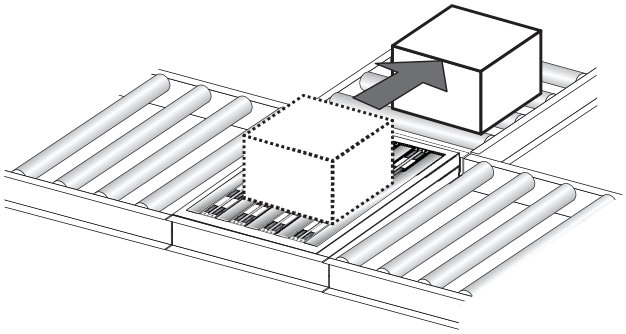
Induction



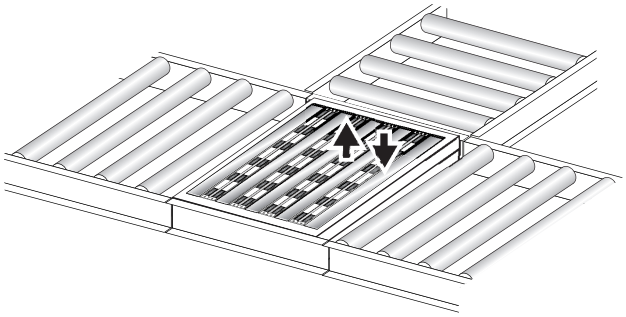
Switch to the diverting direction



Discharge



Switch to the straight direction



1. Introduction

Disclaimer

- This product is designed as a general industrial device. Do not use for other applications. We do not take any responsibility for any damage that may result from the disregarding of these warnings.
- In the event that an accident results from the use of this product, we do not compensate for any damage, including abnormalities of equipment, connection devices, and/or software, any damage resulting from malfunctions, and/or any other secondary damage.
- Using the product in a combination other than our MDR and driver card/controller (combination with similar products or products by third party) could result in fire and/or accidents. We are not responsible for any damage that results from the disregarding of the above precaution.

Notes on industrial property rights

There are some examples of parts that need to be prepared by customers, as explained within this manual. However, this does not provide any guarantee against the existence of any rights, such as our industrial property rights, or those of other companies.

Notes on technical support

We respond to technical inquiries based on the contents described within this manual, and on this product within the range of general items for this product unit.
There are some descriptions in this manual, about parts, equipment, and wiring arranged by customers, as well as the controls and operation under such circumstances. However, these are not included in the guaranteed operating range and/or support.
When in use, please check and perform the aforementioned based on your responsibility and operation needs.

About the performance level (PL) for this system

This product is based on the performance level "C"*2 in ISO13849-1*1.

*1：International Organization for Standardization
*2：This indicates that even though events that would result in serious injury occur infrequently under assumed risk environment, there is a high probability to avoid danger if you observe the safety contents described in this manual.

About installation environment

This product is not equipped with special dust proof/waterproof countermeasures, and is intended to be used in environments of "Pollution Degree 2"*2, as defined in IEC60664 -1*1.

*1：Insulation coordination for equipment within low-voltage supply systems - Part 1 of the International Standard.
*2：Non-conductive pollution will occur, but it is assumed that condensation will happen to generate conductive property.

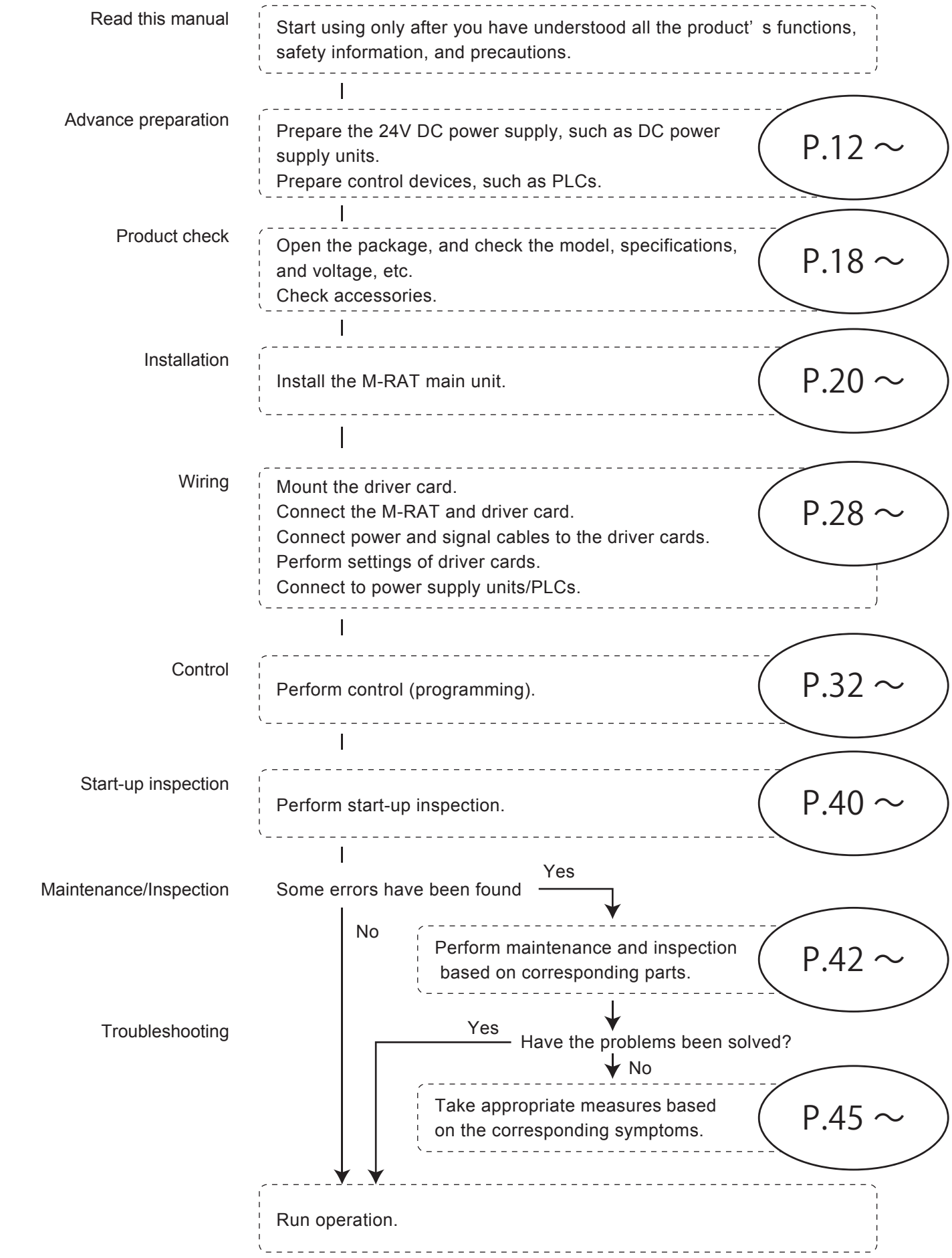
About description of the product

・Depending on the signal type (NPN/PNP) specified by customers, different models of control driver cards are supplied as being the standard for this product.
・In this manual, the driver card model is described as follows: NPN and PNP input and output models are described separately, whenever needed.

Driver card model		Description in this manual
NPN input and output signals	PNP input and output signals	
CBK-109FN-M1-15 CBK-109FN-M1-30	CBK-109FP-M1-15 CBK-109FP-M1-30	CBK-109 or CBK-109F□-M1-□
CBK-109FN-M3-MR	CBK-109FP-M3-MR	CBK-109 or CBK-109F□-M3-MR
CB-016BN6-M2-15 CB-016BN6-M2-30	CB-016BP6-M2-15 CB-016BP6-M2-30	CB-016 or CB-016B□6-M2-□

1. Introduction

Procedures from installation to operation



2. INDEX

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3. Safety precautions

For parts names in sentences, refer to Structures (P.18).

3. Safety precautions

Danger level

To prevent hazards to users and/or others, and/or damage to property in advance, we explain important precautions to be followed securely as below.

■ The degree of hazard and/or damage that may result if a user disregards the description and operates the product improperly is categorized as the following symbols and explained below.

⚠ WARNING	This indicates a high possibility that severe injury or even death may result.
⚠ CAUTION	This indicates a high possibility that injury or only property damage may result.

Symbol explanation

■ We categorize the type of those precautions using the following symbols throughout the manual.

	This symbol indicates forced operations that users should always perform.
	This symbol indicates operations that are prohibited.
	This symbol indicates a reminder you should pay attention to.

3. Safety precautions

3-1. General precautions

⚠ WARNING

Do not use the product near places subject to explosive, flammable gas, and/or corrosive atmosphere, and/or combustible materials.

Failure to follow this could result in explosion, fire, electric shock and/or injury.

When using the product in places where serious accidents and/or damage may possibly occur, install backup and/or fail-safe functions systematically.

Failure to follow this could result in the inability to control this product due to controller malfunction, which could lead to serious accidents.

Do not apply strong impact and/or excessive force to the product, such as hitting it with objects, or dropping it.
Do not use the product of which the appearance has become deformed.

Failure to follow this could result in serious or unexpected accidents.

Do not step on or over this product.

Failure to follow this could result in people falling and/or malfunction.

⚠ CAUTION

Do not come into contact with the moving parts, such as the carrier wheels, transfer rollers, or lifting sections, and/or allow clothes to get close to them.

Failure to follow this could result in hands getting caught and/or stuck.

Never remodel the product.

Failure to follow this could result in serious accidents. We assume no responsibility for remodeled products.

Make sure to attach ground wires to this product and the DC power supply unit.

Failure to follow this could result in electric shock if any malfunction or leakage occurs.

Do not put water and/or oil on the product, and do not transfer wet and/or oily trays.

Failure to follow this could result in electric shock, and/or malfunction.

Stop operation when abnormal sound is heard during operation.

Failure to follow this could result in unexpected accidents.

Do not use in a way exceeding the range of the product specifications.

Failure to follow this could result in malfunction, fire, and/or injury.

Turn off the power supply to the product before moving, installing, and/or wiring the product, and before performing maintenance and inspection (excluding cases when the power is to remain turned on).

Working while the power is on could result in unexpected accidents.

3. Safety precautions

3-1. General precautions

CAUTION

Do not turn on/off relays and/or contactors near power cables, signal cables, and/or controllers.

Failure to follow this could result in malfunction due to noise generation.

LED or Pull-up/Pull-down circuits implemented on the output of control devices could result in unexpected operation.

Carefully check the output circuit.

Turn ON the power in the order of external control devices, and then this product.
Turn OFF the power in the order of this product, and then external control devices.

Turning on/off the power in the wrong order could result in malfunction.

Do not forcibly rotate carrier wheels or transfer rollers with external force.

Failure to follow this could result in damage to controllers, and/or their lifetime to be significantly shortened.

When disposing of the product, make consigning contracts with licensed industrial waste disposers, and consign the disposal to them.

3-2. Precautions on installation

WARNING

Ensure the safety of the surrounding area, transportation route, and footing when carrying the product.

Failure to follow this could result in serious or unexpected accidents.

Have the appropriate number of persons assist when installing the product.

When moving the product, be sure to use carrying equipment, such as a transport dolly, pallet truck, and forklift.

Using only manpower could result in unexpected accidents.

When hoisting this product, never enter the area under the suspended load.

When hoisting, use appropriate hoisting equipment, and pay special attention to prevent the balance of the suspended load from being lost and/or falling.
Also, have only qualified workers conduct the operation.
Insufficient hoisting could result in serious accidents.

Do not lift this product with goods loaded.

Failure to follow this could result in injury, accidents, and/or damage due to load collapse.

3. Safety precautions

3-2. Precautions on installation

⚠ WARNING

Take appropriate measures to prevent trays from popping out of the equipment.
For example, mount guide rails on the conveyor frames.
Failure to follow this could result in workers getting injured by trays popping out of the equipment.

Do not put hands or fingers in between the machine and frame, and between the machine and stay.
Failure to follow this could result in hands or fingers getting stuck.

⚠ CAUTION

When handling, wear protective equipment, such as gloves.
Failure to follow this could result in hands getting injured by metal parts.

Make sure to use the recommended tightening torque to tighten screws for fixing the main unit and/or fastening screws of controllers.
Failure to follow this could result in bolts and/or screws loosening, and/or malfunction.

If necessary warning/caution labels become hidden after installation, affix again on places where they can be seen.

3-3. Precautions on wiring

⚠ CAUTION

When attaching or removing connectors, turn off the power first, securely hold connectors, and perform operation.
Do not apply excessive force to the controller connection parts, such as obliquely attaching or removing connectors.
Failure to follow this could result in electric shock, malfunction, and/or accidents due to unexpected operation.

Perform wiring to connectors so that cables make secure contact with connectors.
Barb lines from the cable core could result in heat generation and/or fire due to changes of contact resistance, and/or short circuit with the adjacent contact.

Do not forcibly bend and/or pull cables.
Do not put heavy materials on cables, or do not get them stuck between cables.
Failure to follow this could result in fire and/or electric shock due to cable damage.

3-4. Precautions related to operation

⚠ WARNING

Do not get close to the product during operation.
If you get close to the product out of need, check the flow of trays and surrounding conditions, and ensure safety before approaching.

3. Safety precautions

3-4. Precautions related to operation

⚠ CAUTION

Do not forcibly move trays when they are placed on the product.
Failure to follow this could result in damage and/or malfunction.

Make sure to perform the start-up inspection before starting operation.
Wear protective equipment, such as gloves.

Do not unplug power and/or signal cables during operation. Do not run/stop this product using the power supply.
Failure to follow this could result in malfunction.

In the event that any abnormalities occur, for example, if abnormal noise is heard from the product, the temperature becomes high, or electric leakage occurs, turn off the power immediately.
Failure to follow this could result in unexpected injury.

3-5. Precautions on start-up inspection/maintenance and inspection

⚠ WARNING

If any abnormalities are found, do not use this product until the causes have been eliminated completely.
Using this product with unattended abnormalities could result in not only damage to the devices, but also unexpected accidents.

Have specialists (or people who have sufficiently acquired skills) perform maintenance and inspection under instructions by management supervisors.

At the time of maintenance and inspection, post warning labels so as to prevent unauthorized persons from turning on the power.
Failure to follow this could result in unexpected accidents.

⚠ CAUTION

Secure the working space for maintenance around this product.
Working in the forced position could result in injury and/or unexpected accidents.

For maintenance and inspection, wear protective equipment, such as gloves.
Failure to follow this could result in hands getting injured by metal parts.

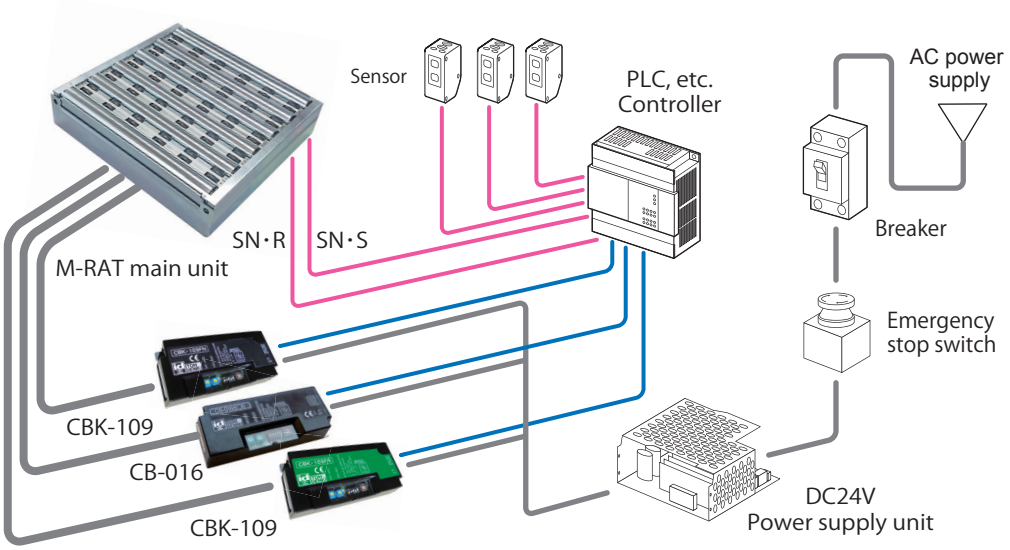
Do not disassemble sections and/or parts other than those specified.
Failure to follow this could result in malfunction and/or unexpected accidents.

Make sure to prepare maintenance parts designated by us.
Using parts other than those designated by us could result in malfunction.

4. Advance preparation

4. Advance preparation

Wiring image



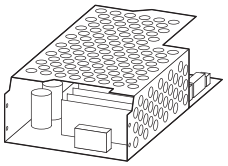
Important ・As for the sensor input, and input/output signals of driver cards, adopt the number of inputs/outputs based on your operation needs.

Items to be prepared by customers

Before introducing this product, prepare the following devices separately.

① 24V DC power supply

Power supply equipment to supply 24V DC to this product



- Switching power supply
- 24V DC battery

Specifications of the power supply unit

・24V DC / 8A, 192 W or more
・Peak current 30 A (1 msec or less)

About control

■ M-RAT uses MDR for carrier wheel transfer, roller transfer, and transfer surface switch (3 axes in total). We recommend controlling to allow each axis to run independently.

■ A switching power supply is recommended as the DC power supply (24V DC±10%) for the driver card.
■ Use a stabilized power supply that has an adequate capacity and does not fluctuate due to load variation.
■ The power supply shall have a capacity larger than the total of the MDR rated values.
■ A transformer type power supply cannot be used.
■ Secure a voltage of 24V DC±10% at the power supply terminal of a driver card.
■ If the power supply capacity is less than the rated power of this product, it may result in malfunction and/or damage due to the supply voltage drop. Be sure to use a power supply with a capacity larger than the rated power of this product.
■ In addition, the power supply should not activate protection when the peak current flows for 1 msec or less.
■ For the power supply unit, use an isolation type switching power supply compliant with the safety standard (IEC62368-1 or UL62368-1). Do not use a non-isolation type power supply for safety reasons, since it may not conform to the radiation noise regulations.

4. Advance preparation

Items to be prepared by customers

② Stay (option)

・A stay used to install the M-RAT main unit. For details on how to mount, refer to P.26.

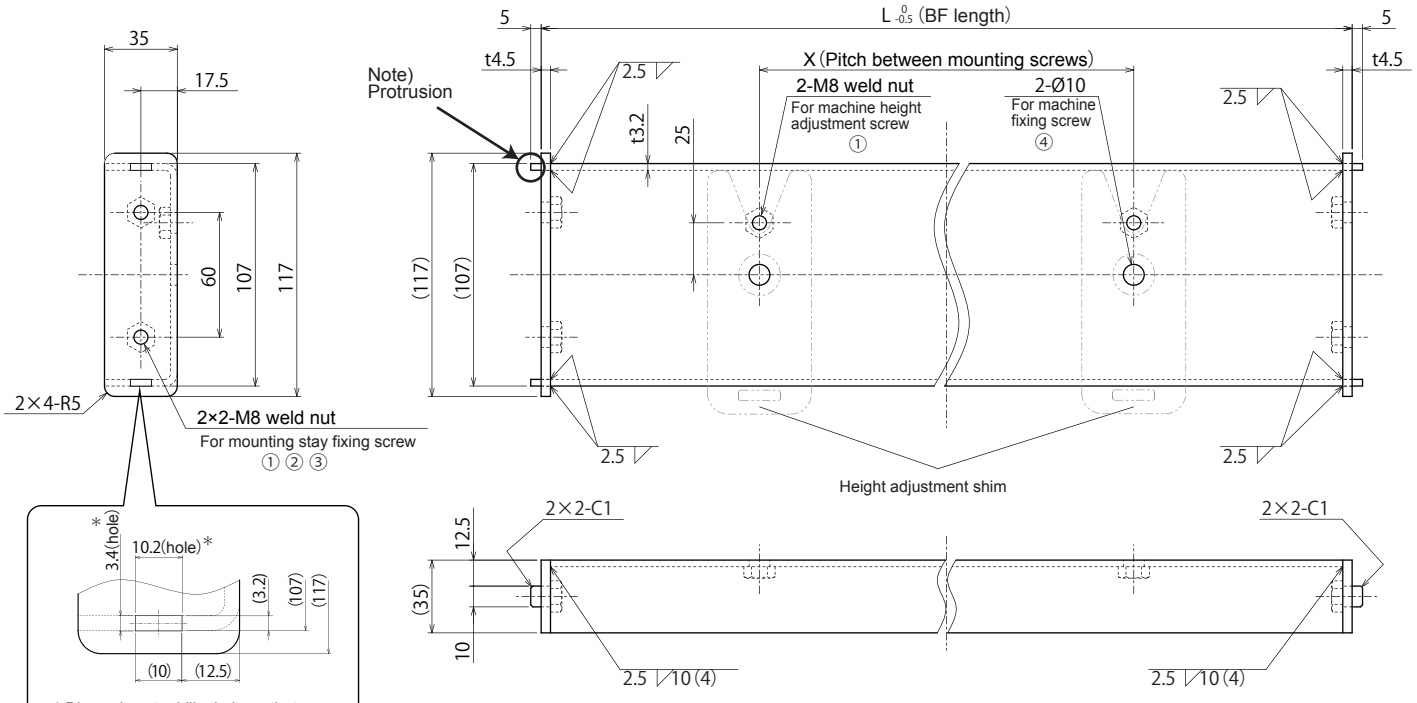
■ Stays, mounting bolts, and washers are not included in the product. Order separately.

■ When installing the M-RAT main unit, make sure to use the designated stay.

Model	Piece*	Remarks
Model：MRAT-FST L：BF length (mm)	1	・With eight height adjustment shims ・With mounting bolts/washers

＊Two stays are necessary for one unit.

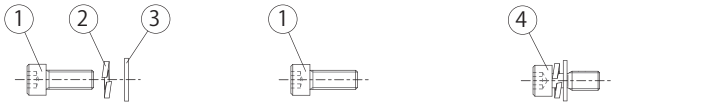
Type	Dimension X	Dimension Y
6060 / 7560	380mm	590～709mm
7570	500mm	710～829mm
7580	620mm	830～949mm



＊Dimensions to drill a hole so that a protrusion will come out when making the stay.

Note) Holes need to be drilled in the frame where the stay is mounted. (Refer to P.18)

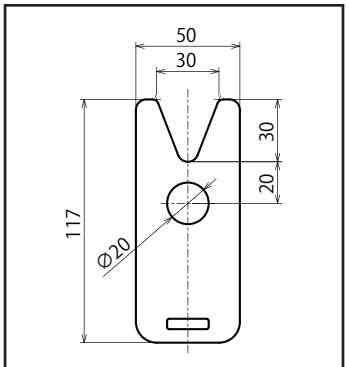
Mounting bolts/washers



		Part name	Piece
①	For fixing the stay	Hex. socket head bolt M8x20	4 (8)
②		Spring washer No.2 M8	4 (8)
③		Plain washer normal type M8	4 (8)
①	For machine height adjustment	Hex. socket head bolt M8x20	2 (4)
④	For fixing the machine	Hex. bolt with spring washer No.2 and plain washer large type M8x20	2 (4)

■ The number in parentheses shows pieces per M-RAT unit (for two stays).

Height adjustment shim

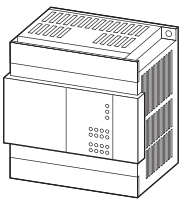


Material: SUS/Board thickness: t0.5

4. Advance preparation

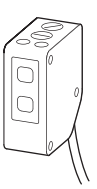
③ Control devices

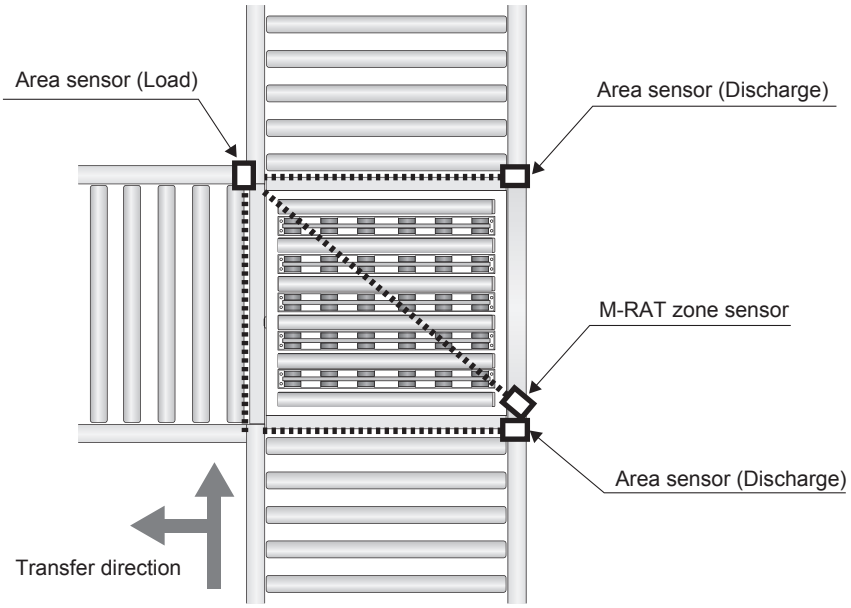
Devices to control this product, such as PLCs



④ Sensors

Zone sensors to check the tray, and area sensors to check loading and discharging, etc.





Term

Zone sensor
A sensor to detect the existence of trays within the zone

Area sensor
A sensor to detect load and discharge of trays

⑤ Wiring materials

Necessary for wiring of power and signal cables, branch connectors, driver cards, controllers, such as sensors or PLCs, and power supply.

Available wire diameter for driver card connectors

Driver card / Connector	CBK-109	CB-016
Power connector	0.8～1.5㎟（AWG：18～14）	0.5～1.5㎟（AWG：20～14）
Control connector	0.08～0.5㎟（AWG：28～20）	

■ To select the current capacity of wiring materials, secure a high safety margin based on the current value in the equipment to be used.
■ Longer wiring between the power supply unit and driver cards/controllers could cause the voltage to decrease, resulting in malfunction and/or damage.

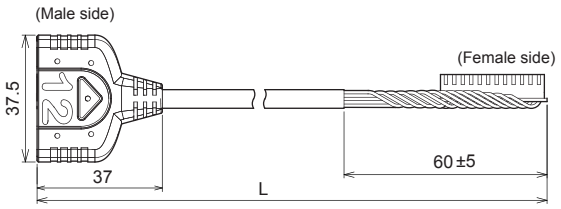
4. Advance preparation

⑥ MDR extension cables (Option)

Necessary when the installing location of the M-RAT main unit is far from that of the driver card.

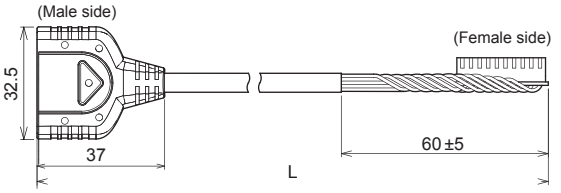
■ CBK-109：12P extension cable

Model	12P extension cable length
ACE-CBM-G0600	L= 600mm
ACE-CBM-G1200	L=1200mm



■ CB-016：10P extension cable

Model	10P extension cable length
ACE-CBM-A0600	L= 600mm
ACE-CBM-A0850	L= 850mm
ACE-CBM-A1200	L=1200mm

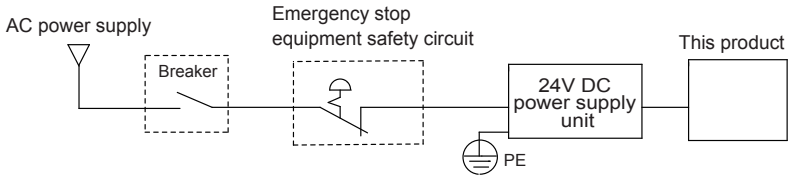


■ Use an extension cable of 1200 mm or less.
■ Do not extend cables by connecting multiple extension cables.

⑦ About the emergency stop equipment

This product does not include the emergency stop equipment. Customers must make sure to install it.

Install the emergency stop equipment on the side of the 24V DC power unit to which the power is supplied.



⑧ Checking the breaker

Regarding equipment where this product is installed, check that a breaker with appropriate capacity for AC input specifications of the 24V DC power supply unit has been installed. If abnormal operation should occur, protection through the breaker could be effective.
When using an earth leakage breaker, select one that is “inverter corresponding”. Some inverter non-corresponding earth leakage breakers could result in malfunction, since they may recognize high-frequency components of the switching power supply as leakage.

⑨ Operation check

When the 24V DC power supply unit has been installed, check that the breaker and safety circuit can work properly. Perform operation following the trial operation after checking them.

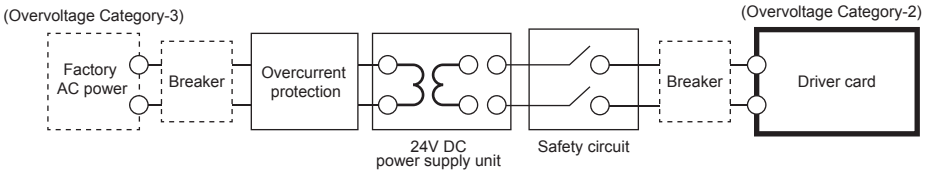
① Input to the 24V DC power supply unit (AC power) is securely turned ON/OFF when turning ON/OFF the breaker.
② This product input (24V DC) is securely turned OFF/ON when turning ON/OFF the safety circuit.

4. Advance preparation

⑩ About the wiring method

⑩-1 When overcurrent protection devices are required

When overcurrent protection devices need to be installed to the 24V DC power supply unit, some power supplies that need to conform to the safety standards (UL62368-1, etc.) require installation of the specified overcurrent protection device based on their specifications. In such cases make sure to install the specified overcurrent protection device as described in the figure below. When overcurrent protection devices are not required in specifications of the 24V DC power supply unit, they do not need to be installed.

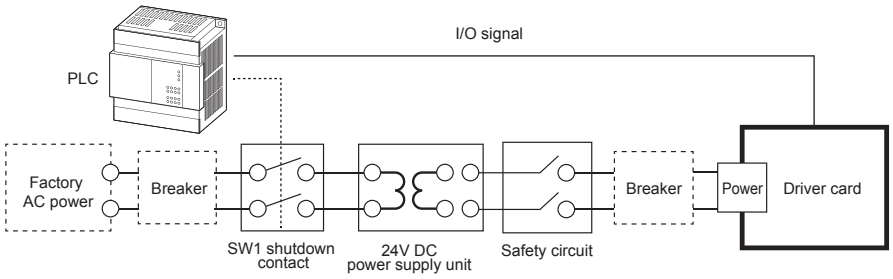


⑩-2 Installing overcurrent protection devices

When using a power supply other than a limited power supply, install an overcurrent protection device on the 24V DC line.

⑩-3 Adding the power shutdown circuit of this product in the event of a failure

In the event that a failure occurs, such as overload or abnormal temperature, the driver card will transmit the data of failure generation to PLC devices, as well as stopping product operation. However, the product does not have the power shutdown function. Accordingly, if the product's power needs to be shut down in the event of a failure, as described in SW1 of the figure below, add the power shutdown circuit using a PLC.



■ At the time of power shutdown, not only the main unit power, but also the driver card control power will be shut down.

4. Advance preparation

Checking appearance

After unpacking, check that there is no abnormalities in the product.

① Check that the main unit is free from any abnormalities, such as traces of scratches, dents, dirt, and/or corrosion (rust).

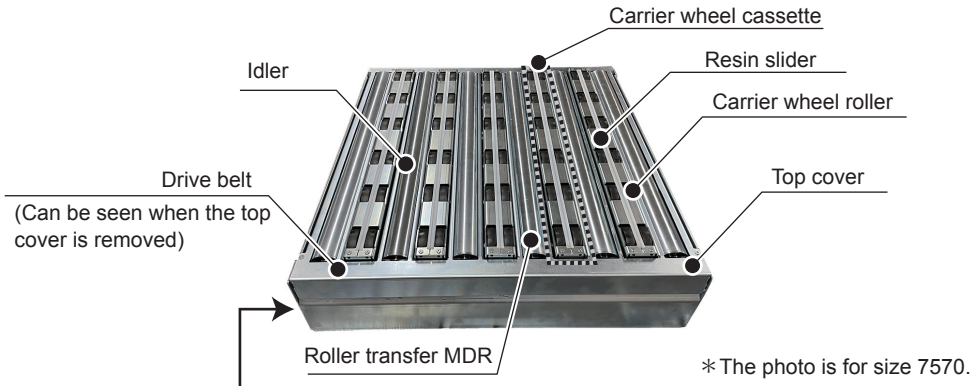
② Check that there is no omission and/or looseness of screws.

If any abnormalities are found, contact the supplier immediately.

Checking the model

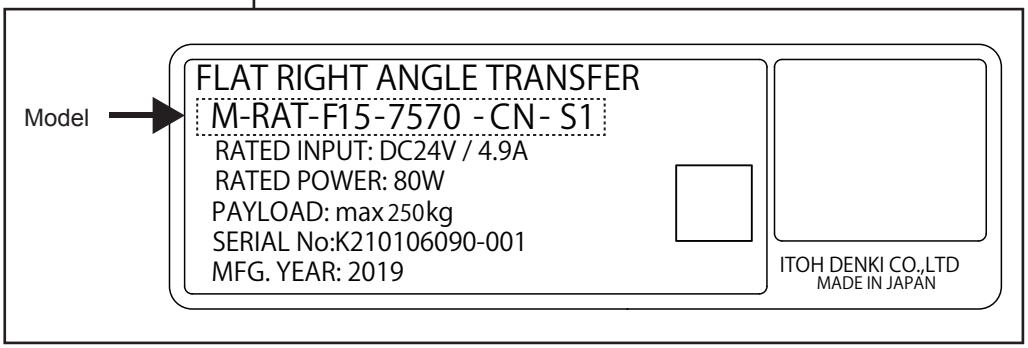
Check that the product model is what you ordered.

Structures



＊The photo is for size 7570.

Product label details



Product designation

M-RAT-F15-7570-CN-S1

① Motor specifications
- F ··· FE Series + KT Series

② Nominal speed
- 15 / 30 (m/min)

③ Size (machine length × machine width) mm
- 6060 ··· L598 × W580 mm
- 7560 ··· L748 × W580 mm
- 7570 ··· L748 × W700 mm
- 7580 ··· L748 × W820 mm

(These are reference dimensions.)

④ Driver card type
- C ··· CBK-109 / CB-016

⑤ Input and output signals
- N ··· NPN
- P ··· PNP

⑥ Version

Terminology

Nominal speed

This is a formal indication of the transfer speed. Values differ from the actual speed.

4. Advance preparation

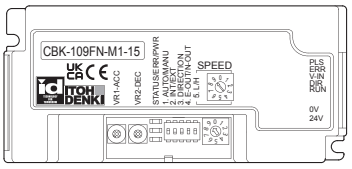
Checking accessories

Check that all the following items are included.

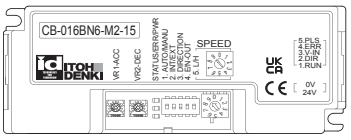
Inclusive driver cards vary depending on the M-RAT input and output signal type and nominal speed.

Driver card

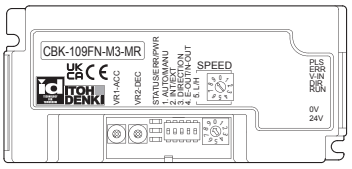
For M−RAT−F15−□□□□−CN−S1



Driver card CBK-109FN-M1-15
〈 For carrier wheel transfer 〉
1

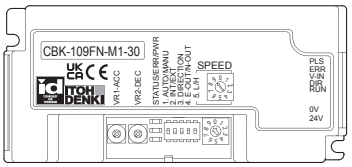


Driver card CB-016BN6-M2-15
〈 For roller transfer 〉
1

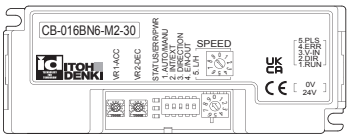


Driver card CBK-109FN-M3-MR
〈 For transfer surface switch 〉
1

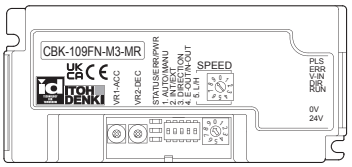
For M−RAT−F30−□□□□−CN−S1



Driver card CBK-109FN-M1-30
〈 For carrier wheel transfer 〉
1

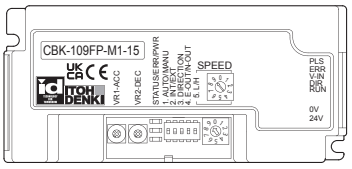


Driver card CB-016BN6-M2-30
〈 For roller transfer 〉
1

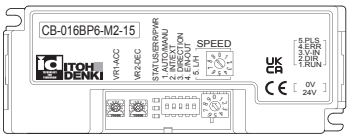


Driver card CBK-109FN-M3-MR
〈 For transfer surface switch 〉
1

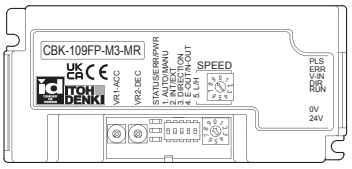
For M−RAT−F15−□□□□−CP−S1



Driver card CBK-109FP-M1-15
〈 For carrier wheel transfer〉
1

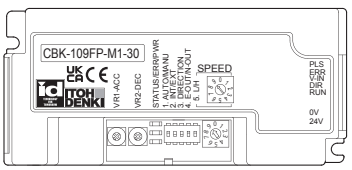


Driver card CB-016BP6-M2-15
〈 For roller transfer 〉
1

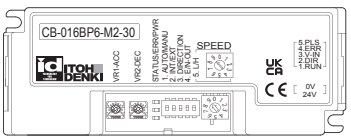


Driver card CBK-109FP-M3-MR
〈 For transfer surface switch 〉
1

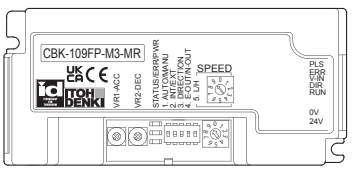
For M−RAT−F30−□□□□−CP−S1



Driver card CBK-109FP-M1-30
〈 For carrier wheel transfer 〉
1

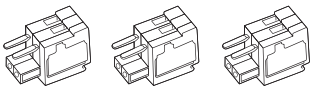


Driver card CB-016BP6-M2-30
〈 For roller transfer 〉
1

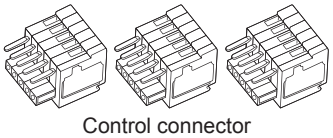


Driver card CBK-109FP-M3-MR
〈 For transfer surface switch 〉
1

Accessories common to all driver cards



Power connector
〈 Common to each driver card 〉
EAHB05 3



Control connector
〈 Common to each driver card 〉
PACB16 3

Cross-recessed head SW screw M4×15 / Hex. nut M4
〈 for securing each driver card 〉
6sets

5. Installation/Wiring

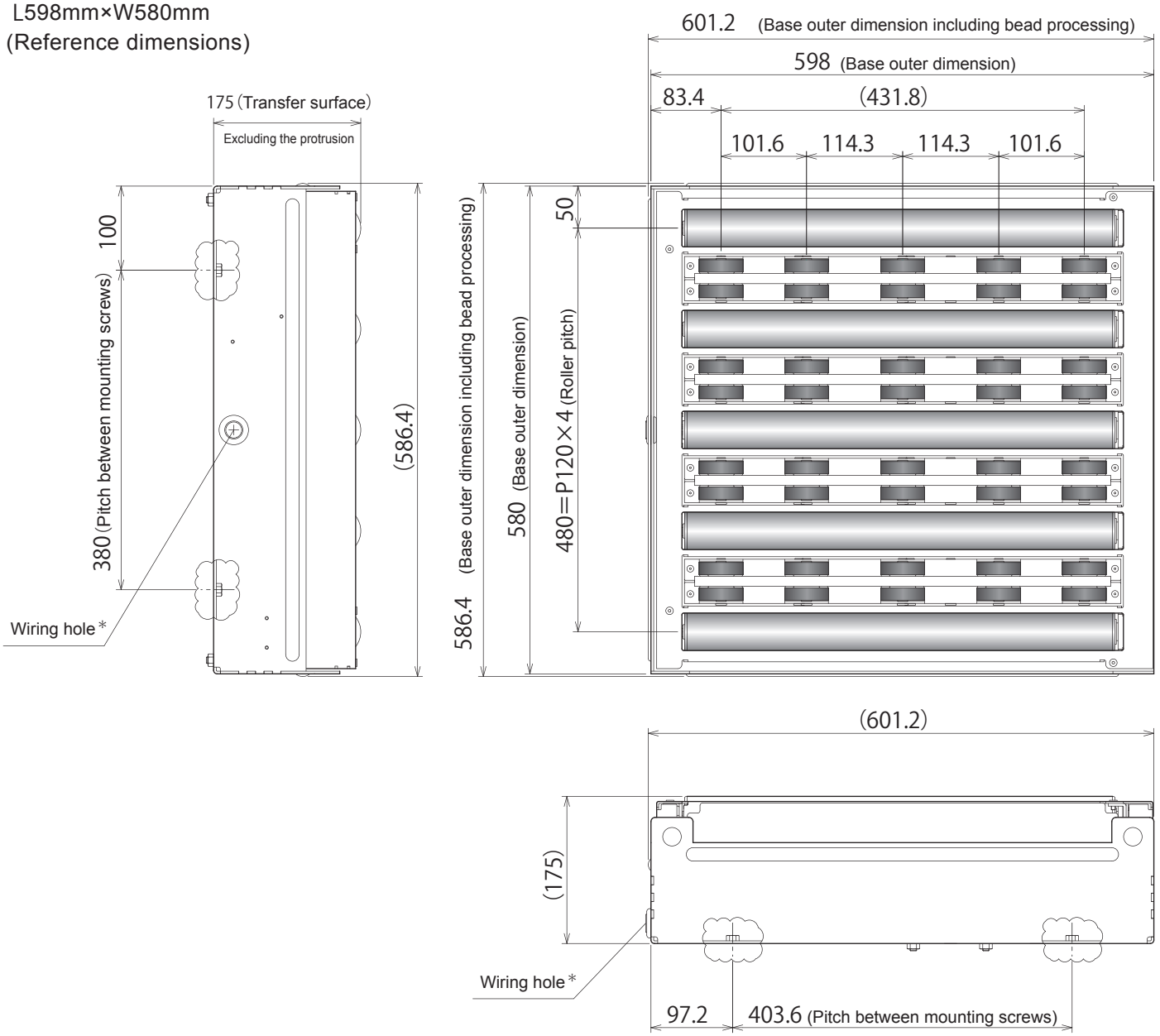
5. Installation/Wiring

5-1. Before installation

- When installing the machine, make sure to use the designated stay.
- Prepare stands, and process conveyor frames in advance.
- Determine the mounting location for zone sensors to check the existence of trays, and area sensors to check loading and discharging. Then, prepare for them to be mounted.

Machine dimensions

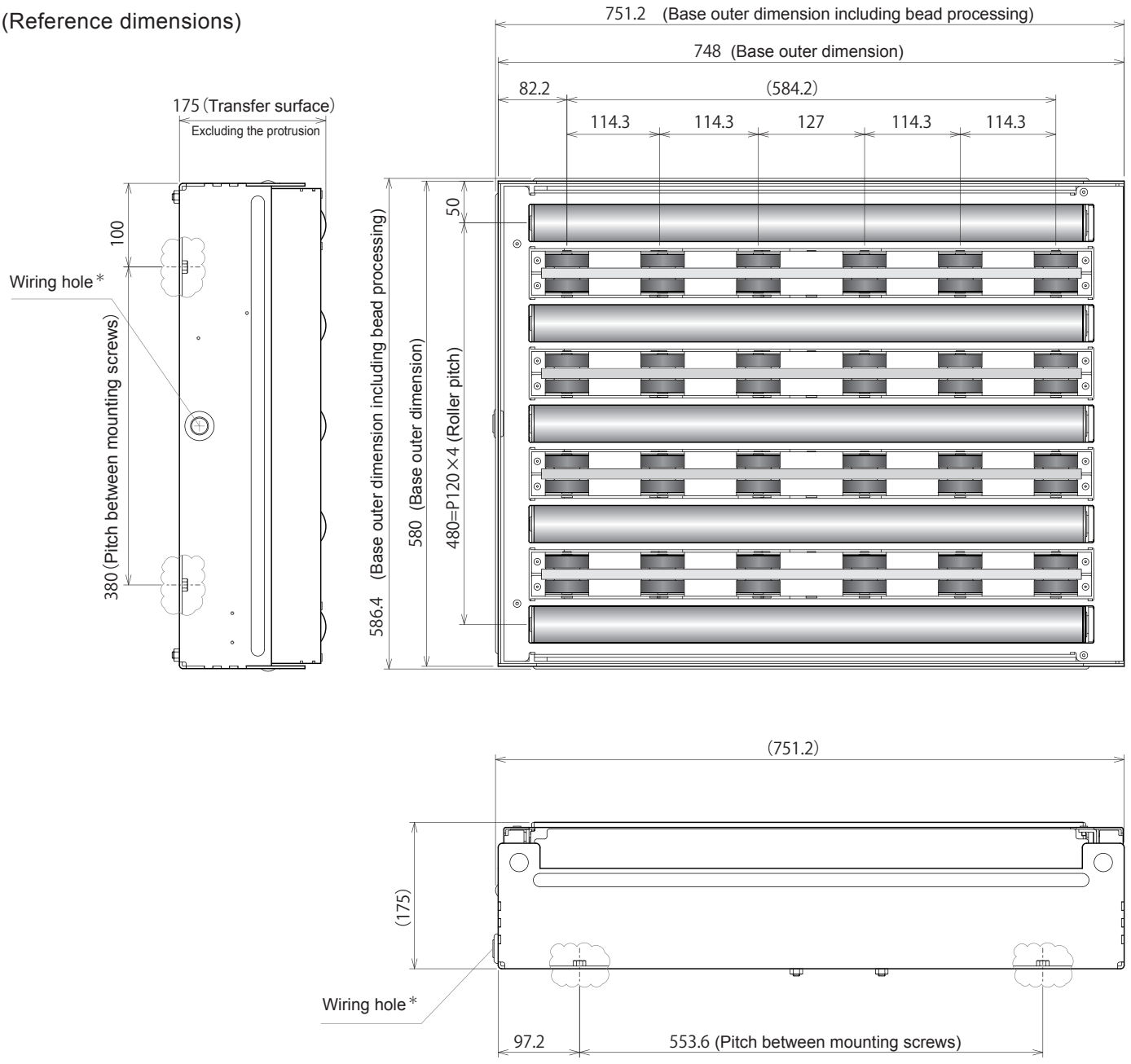
Size 6060
L598mm×W580mm
(Reference dimensions)



*Guide for cable marginal projecting length	(mm)
M1 : For carrier wheel transfer	750
M2 : For roller transfer	750
M3 : For transfer surface switch	1300
SN・S (Proximity sensor)	800
SN・R (Proximity sensor)	750

5. Installation/Wiring

Size 7560
L748mm×W580mm
(Reference dimensions)

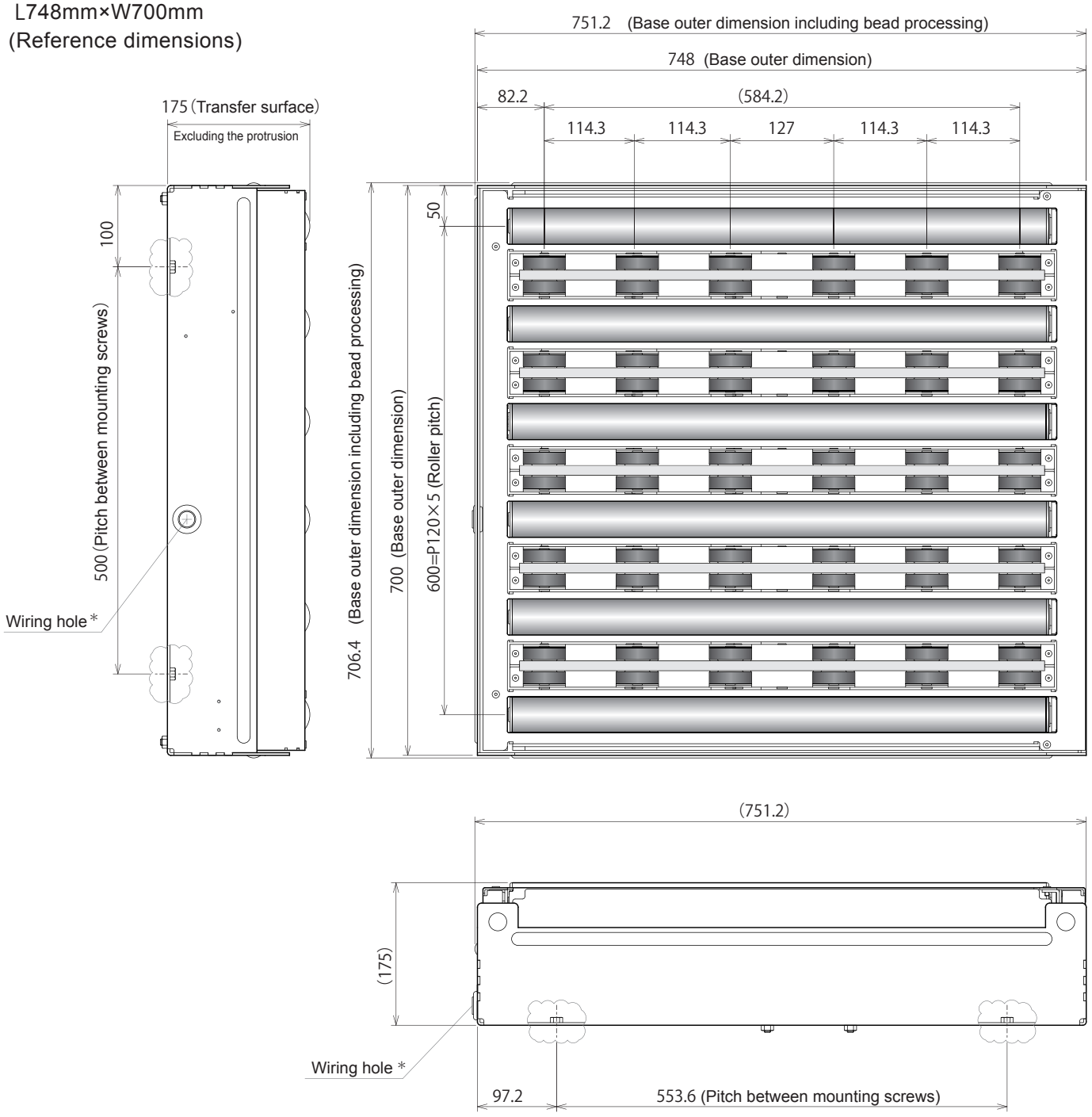


＊Guide for cable marginal projecting length (mm)

M1 : For carrier wheel transfer	750
M2 : For roller transfer	750
M3 : For transfer surface switch	1300
SN・S (Proximity sensor)	800
SN・R (Proximity sensor)	750

5. Installation/Wiring

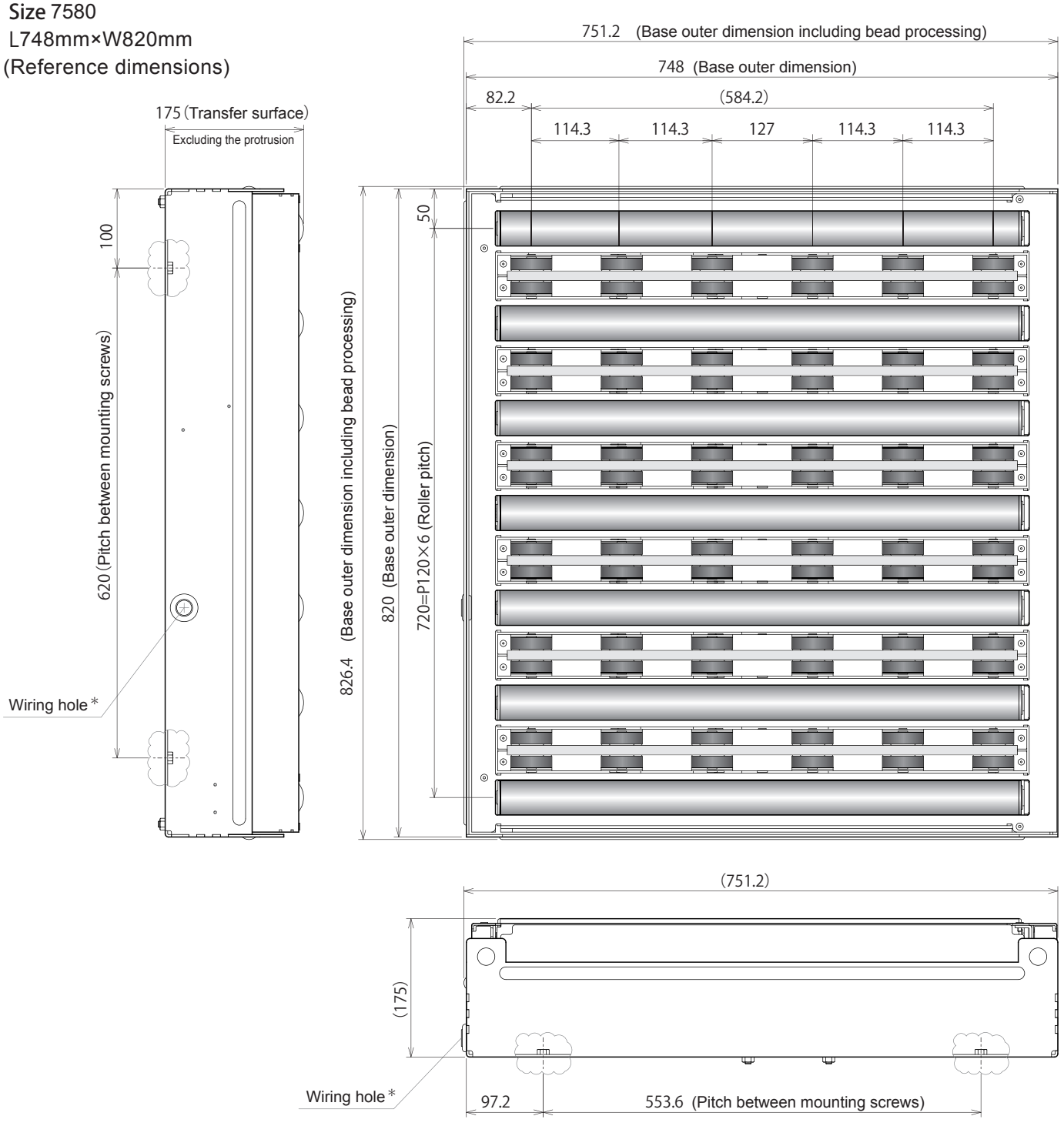
Size 7570
L748mm×W700mm
(Reference dimensions)



* Guide for cable marginal projecting length	(mm)
M1 : For carrier wheel transfer	750
M2 : For roller transfer	650
M3 : For transfer surface switch	1300
SN・S (Proximity sensor)	800
SN・R (Proximity sensor)	750

5. Installation/Wiring

Size 7580
L748mm×W820mm
(Reference dimensions)



*Guide for cable marginal projecting length	(mm)
M1 : For carrier wheel transfer	750
M2 : For roller transfer	650
M3 : For transfer surface switch	1300
SN・S (Proximity sensor)	800
SN・R (Proximity sensor)	750

5. Installation/Wiring

Preparation to mount driver cards

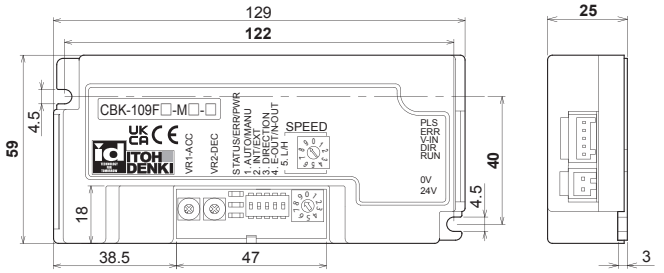
Hole processing on frames and control panel

1

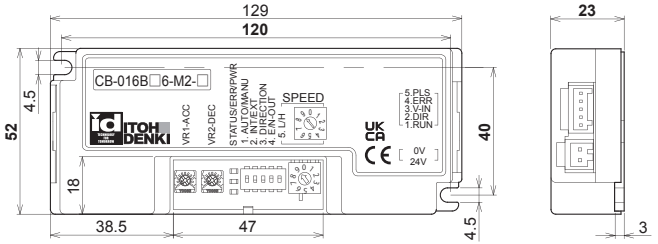
- Perform mounting processing on the frames and control panel by reference to the mounting holes for driver cards.
- For cable opening and projection from the M-RAT main unit, refer to Mounting preparation for the M-RAT main unit (P.21).

■ Mount driver cards on a flat surface where heat can be released easily.
■ Prevent chips generated during processing from entering driver cards.

■CBK-109



■CB-016



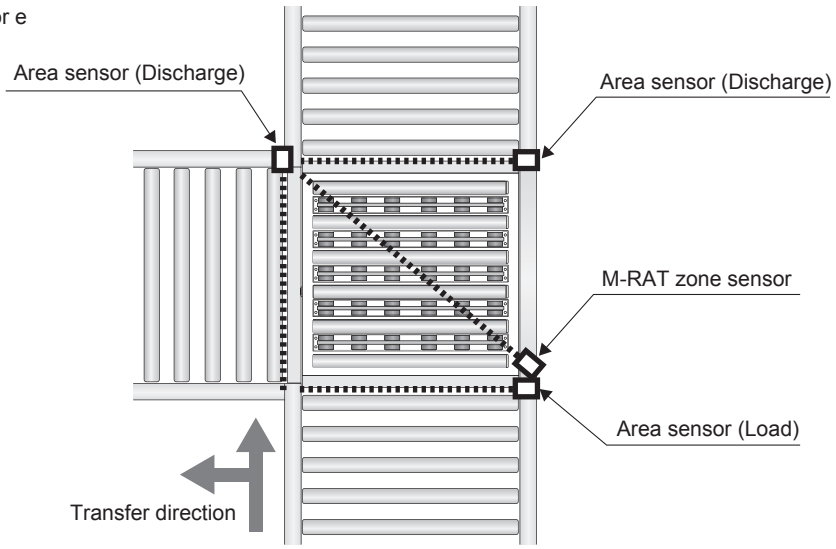
Preparation of MDR extension cables

When the installation location of the M-RAT main unit is far from that of the driver card, prepare MDR extension cables separately. (Refer to P.16)

Mounting preparation for sensors

Determine the mounting location for zone sensors and loading/discharging area sensors. Then, prepare for them to be mounted.

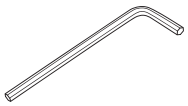
Example)
Mounting location for e ach sensor



5. Installation/Wiring

5-2. Installation

Items to be prepared



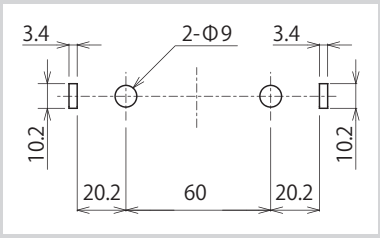
- Stay
- Hanging hook (with lock)
- Cargo handling equipment such as hanging belts

Installing the M-RAT main unit

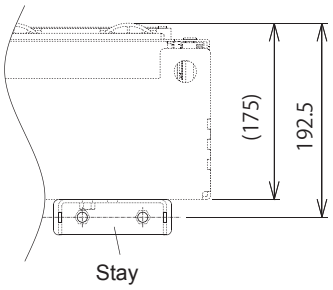
1 Mount stays on conveyor frames.

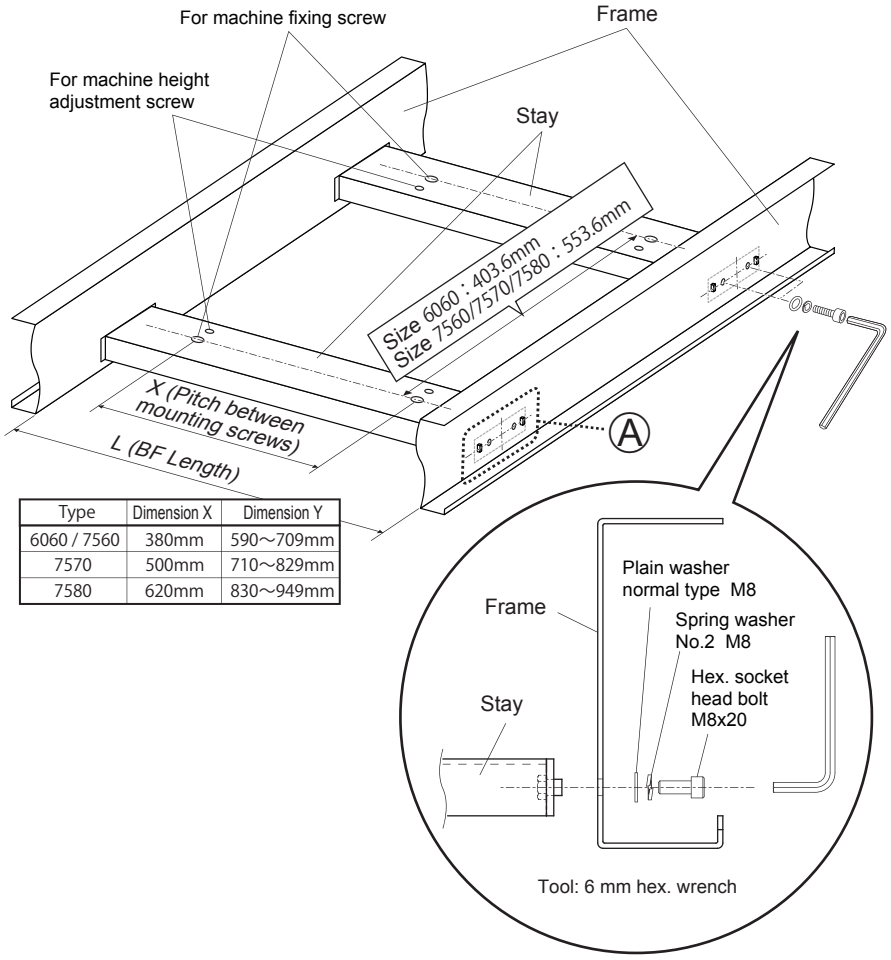
■ Recommended tightening torque : 25～29Nm

Ⓐ Frame processing figure



Transfer surface height from the stay mounting position

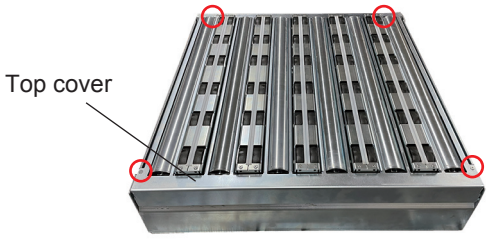




Type	Dimension X	Dimension Y
6060 / 7560	380mm	590～709mm
7570	500mm	710～829mm
7580	620mm	830～949mm

2 Follow the steps below when transporting/moving the machine.

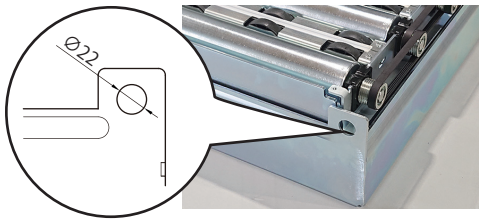
1 Remove the top cover of the machine.



Tool: 3 mm hex. wrench

2 Hang the hanging hooks with locks into the holes at the four corners (four positions) of the machine, and pull it up at the four positions.

■ Pull the machine vertically at all four positions.
Do not pull at the center of the machine, like with crane operation.



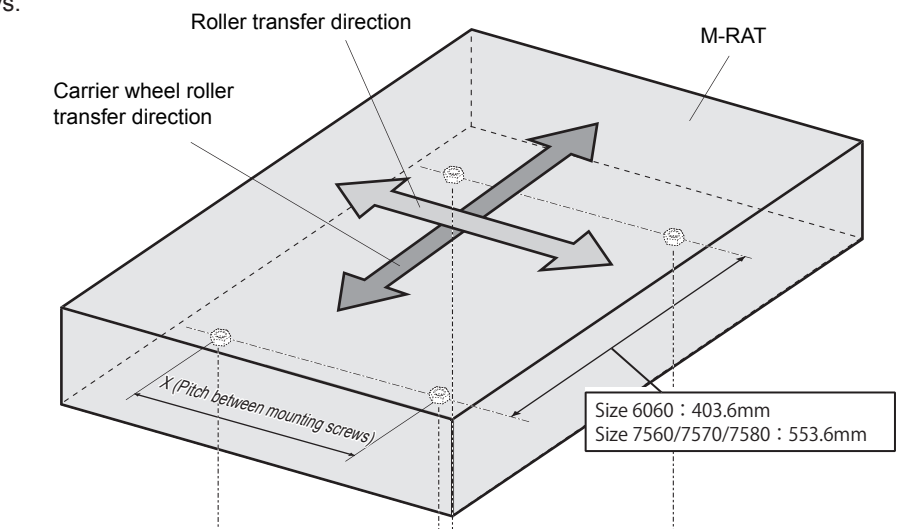
5. Installation/Wiring

3 After checking the machine installation direction, hang the machine and secure it to the stays.

■ Recommended tightening torque：
25～29Nm

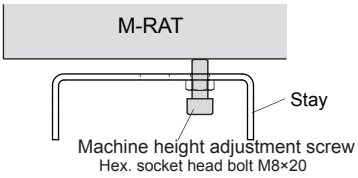
Type	Dimension X	Dimension Y
6060 / 7560	380mm	590～709mm
7570	500mm	710～829mm
7580	620mm	830～949mm

※ If transfer cannot be carried out smoothly, or the transfer surface inclination is 0.5% or more, perform the following steps to adjust the level.



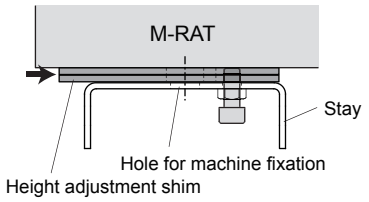
― Machine height adjustment ―

①Mount the bolts for machine height adjustment, and adjust the height of the M-RAT main unit.



②Put the height adjustment shims based on the adjusted height.

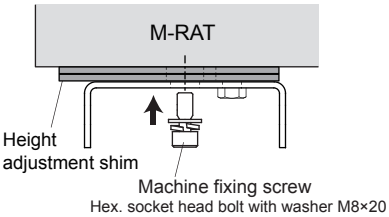
- Align the height adjustment shims with the holes so that the machine fixing bolts can be mounted.

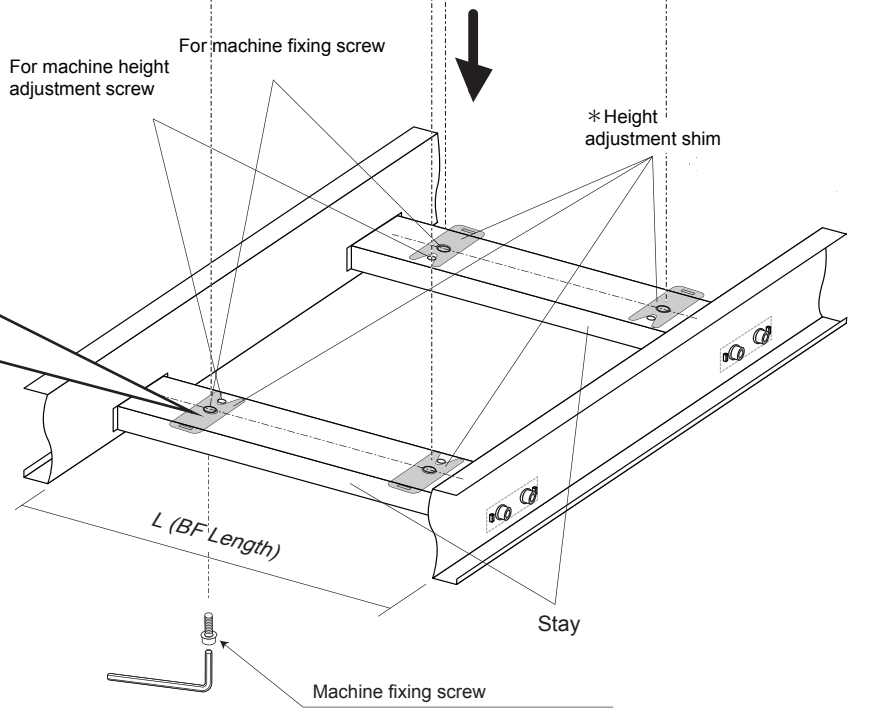


③Remove the bolts for machine height adjustment.

■ After adjustment, make sure to remove the machine height adjustment screws.

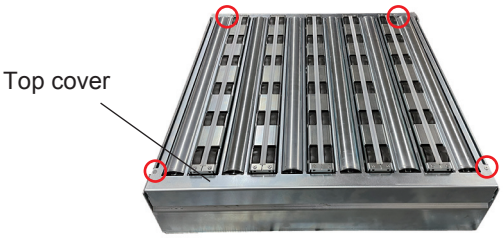
④Secure the M-RAT using the machine fixing bolts.





4 Remove the hooks and mount the top cover.

■ Top cover tightening torque：
2.9～3.5Nm



5 Align levels of the machine and adjacent conveyors, etc.

(For level adjustment, refer to step **3** .)

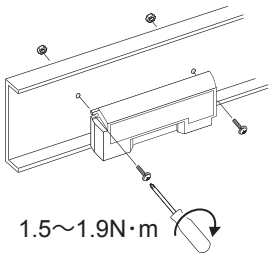
5. Installation/Wiring

Mounting driver cards

Mounting driver cards

Use the included screws and nuts to mount driver cards on the conveyor frames or control panel.

■ Recommended tightening torque: 1.5～1.9N・m



Mounting sensors, control devices, and power supply units

Mounting sensors, control devices, and power supply units

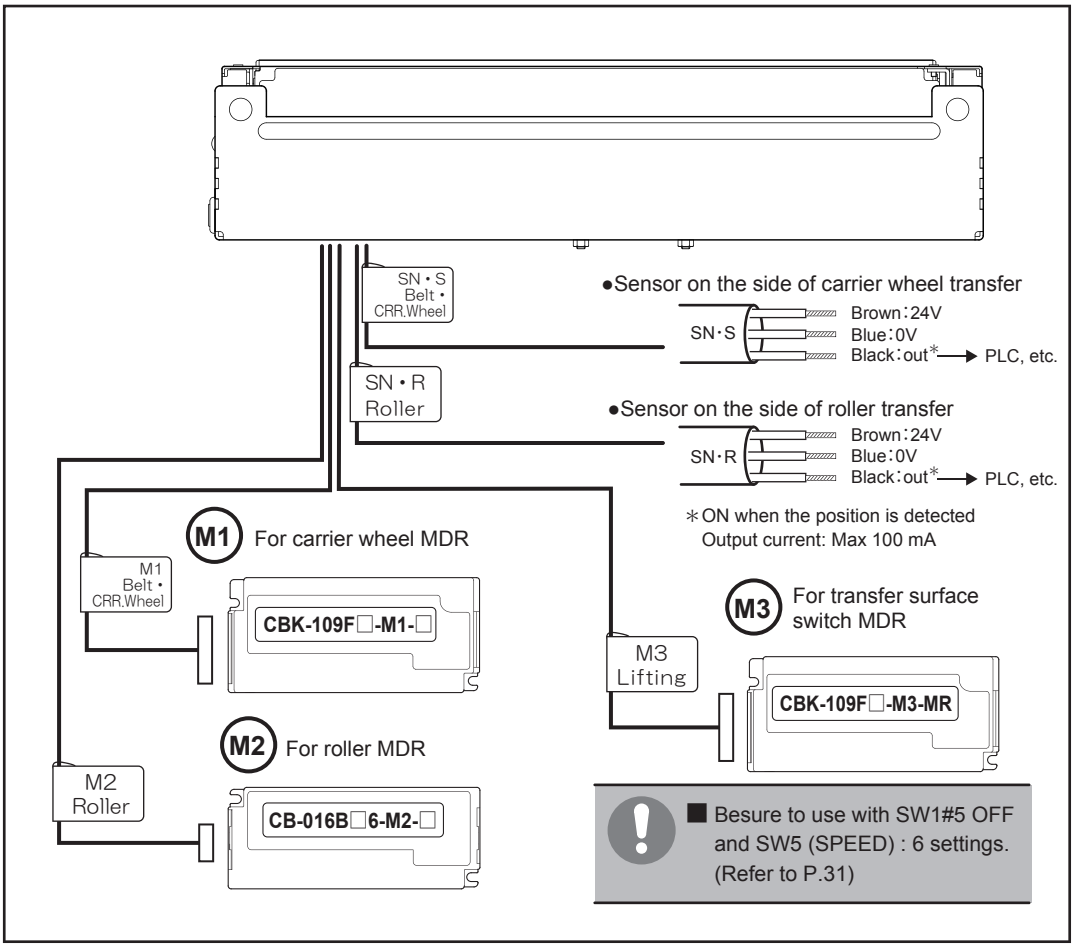
Mount customer-prepared zone sensor and area sensor for loading and discharging, as well as power supply units, and PLCs.

5-3. Wiring

Connecting the M-RAT main unit and driver cards

Connecting the M-RAT main unit and driver cards

- Refer to the labels for cables coming from M-RAT main unit, and securely connect the MDR connectors and driver cards.
- When using extension cables, securely connect the MDR connector and extension cable, as well as the extension cable and driver card.



5. Installation/Wiring

M1: For carrier wheel transfer

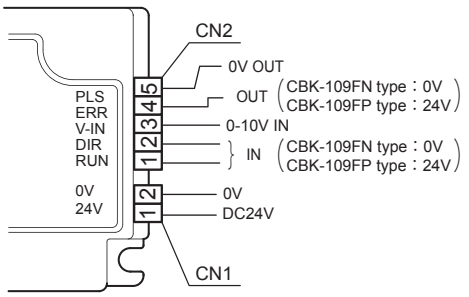
M3: For transfer surface switch

Wiring for CBK-109

CBK-109

■ Connector description

CN1 (Power)	#2	0V
	#1	24V DC



		Function		Detailed description
CN2 (Control)	#5	Output	Motor pulse output	・Outputs 2 pulse signals for each rotation of the internal motor. ・NPN open collector output. (NPN output only) ・Attach protection resistance so that the output is 25mA or less. ・Protection resistance of 100 Ω is included inside driver cards.
	#4	Output	Error signal output	・Outputs when MDR abnormalities have detected. ・Signal output settings under the normal condition/when an error occurs can be specified using DIP-SW1#4 ON/OFF. ・Open collector output.（CBK-109FN : 0V / CBK-109FP : 24V） ・Attach protection resistance so that the output is 25mA or less. ・ Protection resistance of 100 Ω is included inside driver cards.
	＊1 #3	Analog input	MDR external speed setting	The transfer speed can be set using 0-10 V voltage input.
	#2	Input	MDR rotation direction switching	The transfer direction can be switched.
	#1	Input	MDR RUN/STOP	RUN/STOP signal.

＊1 Cannot be used for CBK-109F□-M3-MR.

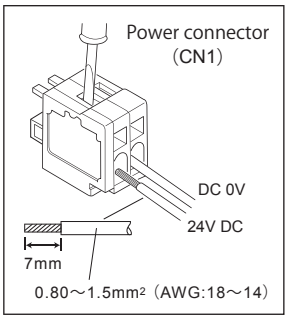
Power connector (CN1)

1 Connect the 24V DC and 0V DC cables to CN1 (2 pins).

■ Do not connect multiple power cables to one pin.Failure to follow this could result in electric shock, short circuit, and/or damage due to the capacity of connectors being exceeded.
(Connector capacity: 10 A)

■ Connect the 24V DC and 0V DC cables correctly.

■ Do not connect cables when connectors are plugged in.



Control connector (CN2)

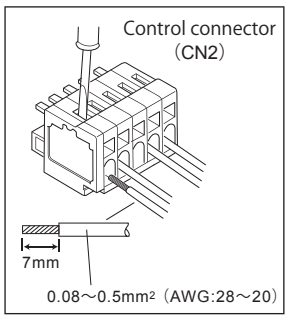
2 Connect each cable to CN2 (5 contacts).

＊Refer to the above, and perform wiring based on your operation needs.

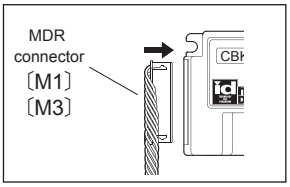
＊Switch the transfer surface using MDR RUN/STOP and rotation direction switching. As such, CBK-109 for M3: transfer surface switch needs CN2#1 and #2 wiring.

■ Use the same voltage to be input to CN2#1 (MDR RUN/STOP) and CN2#2 (MDR rotation direction) as the power supply voltage.
(Connector capacity: 4 A)

■ When connecting a relay coil, etc., to the signal output, use surge protector devices, or perform surge protection measures using diodes.
Using devices without surge protection measures could result in damage to the remote output terminal, if counter electromotive voltage is generated when switching the output signal.



3 Connect the power connector (CN1), control connector (CN2), and M1/M3 MDR connectors to each driver cards.



For more details on CBK-109, please download the driver card user manual from our web page.

ITOH DENKI Home>Download/Support>User Manual

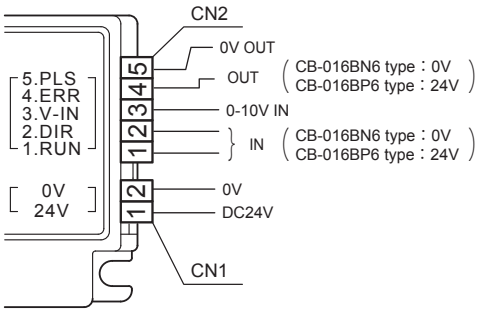
https://www.itohdenki.co.jp/support/manual.html

5. Installation/Wiring

M2: For roller transfer

CB-016 wiring

CB-016



■ Connector description

CN1 (Power)	#2	0V
	#1	24V DC

		Function		Detailed description
CN2 (Control)	#5	Output	Motor pulse output	• Outputs 2 pulse signals for each rotation of the internal motor. • NPN open collector output. (NPN output only) • Attach protection resistance so that the output is 25mA or less. • Protection resistance of 100 Ω is included inside driver cards.
	#4	Output	Error signal output	• Outputs when MDR abnormalities have detected. • Signal output settings under the normal condition/when an error occurs can be specified using DIP-SW1#4 ON/OFF. • Open collector output. (CBK-109FN : 0V / CBK-109FP : 24V) • Attach protection resistance so that the output is 25mA or less. • Protection resistance of 100 Ω is included inside driver cards.
	#3	Analog input	MDR external speed setting	The transfer speed can be set using 0-10 V voltage input.
	#2	Input	MDR rotation direction switching	The transfer direction can be switched.
	#1	Input	MDR RUN/STOP	RUN/STOP signal.

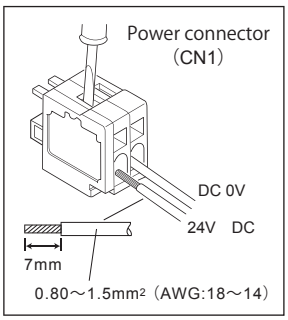
Power connector (CN1)

1 Connect the 24V DC and 0V DC cables to CN1 (2 pins).

■ Do not connect multiple power cables to one pin.Failure to follow this could result in electric shock, short circuit, and/or damage due to the capacity of connectors being exceeded.
(Connector capacity: 10 A)

■ Connect the 24V DC and 0V DC cables correctly.

■ Do not connect cables when connectors are plugged in.

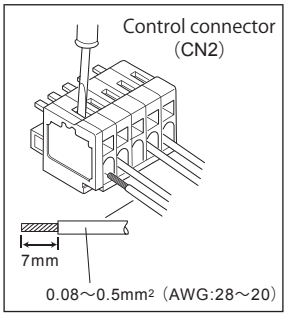


Control connector (CN2)

2 Connect each cable to CN2 (5 contacts).
＊Refer to the above, and perform wiring based on your operation needs.

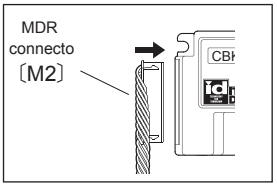
■ Use the same voltage to be input to CN2#1 (MDR RUN/STOP) and CN2#2 (MDR rotation direction) as the power supply voltage.
(Connector capacity: 4 A)

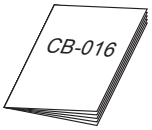
■ When connecting a relay coil, etc., to the signal output, use surge protector devices, or perform surge protection measures using diodes.
Using devices without surge protection measures could result in damage to the remote output terminal, if counter electromotive voltage is generated when switching the output signal.



Connecting to driver cards

3 Connect the power connector (CN1), control connector (CN2), and M2 MDR connector to driver cards.





For more details on CB-016, please download the driver card user manual from our web page.

ITOH DENKI Home>Download/Support>User Manual
https://www.itohdenki.co.jp/support/manual.html

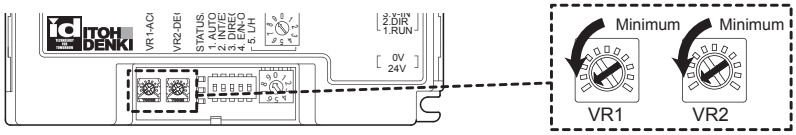
5. Installation/Wiring

Setting driver cards

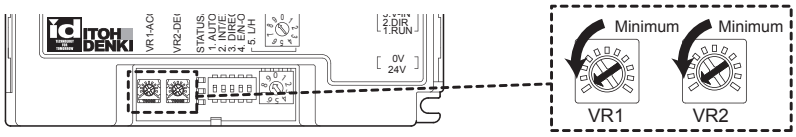
Setting driver cards

Check that each driver has the following settings (factory settings).

CBK-109F□-M1-□

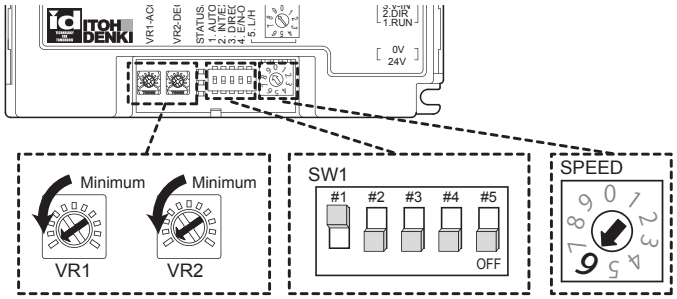


CB-016B□6-M2-□



CBK-109F□-M3-MR

■ Make sure to use under the following settings.



5-4.
Connecting to devices

Connecting to power supply units

Connecting to power supply units

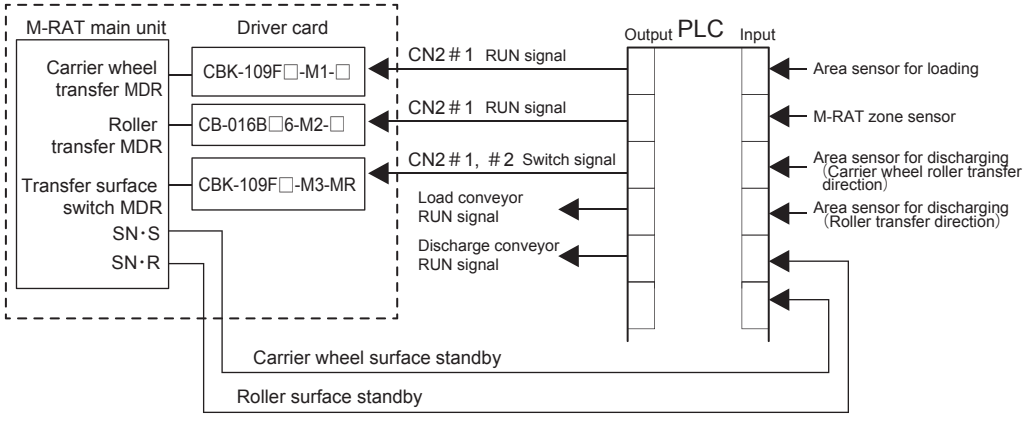
The power is supplied to the driver card from the power connector (CN1).
Connect customer-prepared power cables of zone and area sensors for loading and discharging.

Connecting signal cables of driver cards/sensors to PLCs

Connecting signal cables of driver cards/sensors to PLCs

Connect signal cables of driver cards or standby surfaces to controllers, such as PLCs.
Connect customer-prepared signal cables of zone and area sensors for loading and discharging.

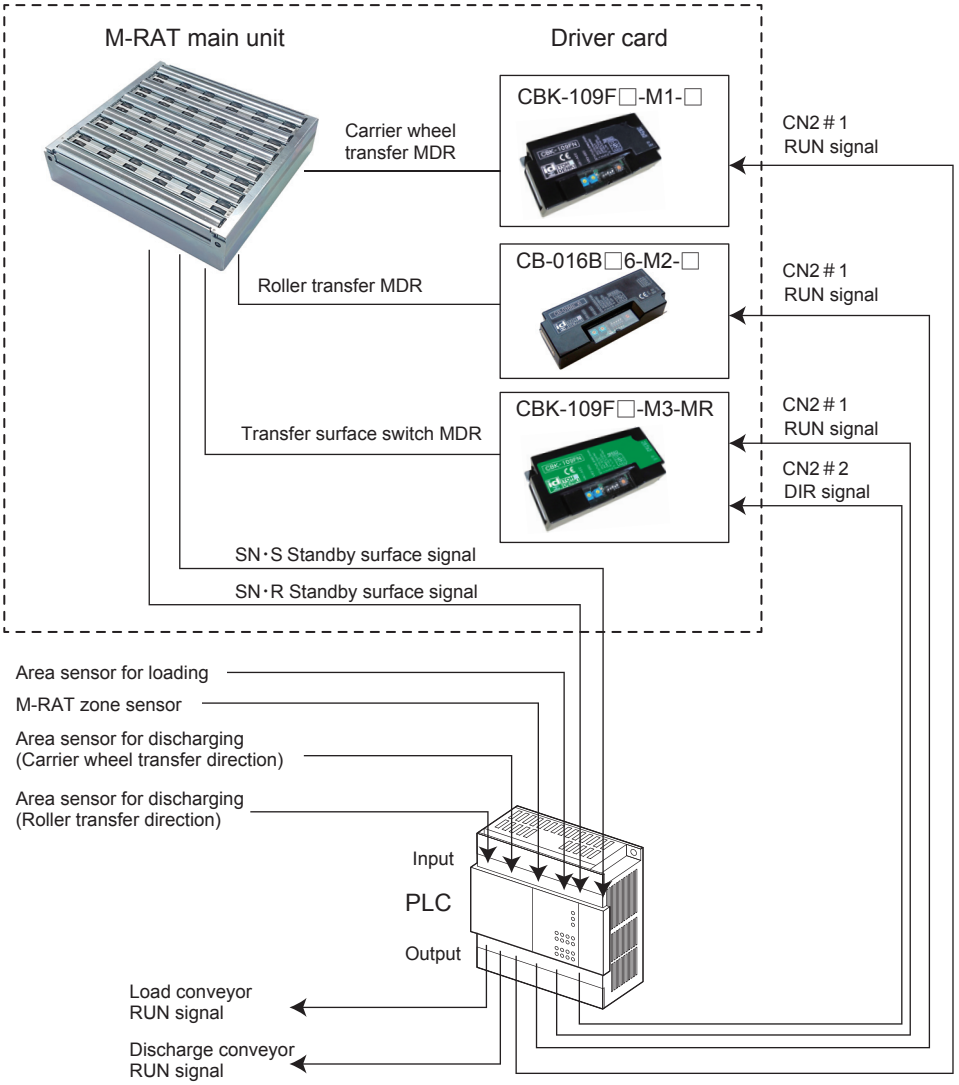
— Connection example — The following figure is an example. For input and output of each signal, perform wiring based on your operation needs.。



6. Control/Operation

6. Control/Operation

Device configuration image



Label description	RUN MDR	Driver card
M1 ＊1	Carrier wheel transfer MDR	CBK-109F□-M1-□
M2 ＊1	Roller transfer MDR	CB-016B□6-M2-□
M3 ＊1	Transfer surface switch MDR	CBK-109F□-M3-MR

＊1 Refer to the labels for cables coming from the M-RAT main unit.

Terminology

Zone sensor
A sensor to detect the existence of trays within the zone

Area sensor
A sensor to detect load and discharge of trays

6. Control/Operation

6-1. Basic operation

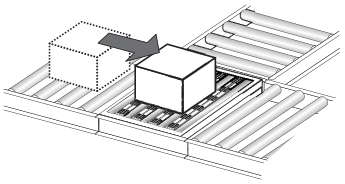
Operation image

(Roller transfer → Carrier wheel transfer)

About control

■ M-RAT uses MDR for each of carrier wheel transfer, roller transfer, and transfer surface switch (3 axes in total). Make sure to control to allow each axis to run independently.

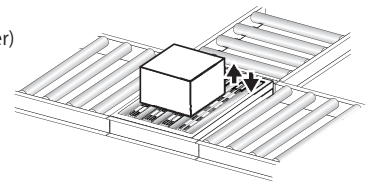
Load



Roller surface standby (SN·R ON)
↓
M2: Roller transfer MDR RUN ◄·····
↓
Load area sensor ON→ OFF ····· NO
↓ YES
Stop running M2: Roller transfer MDR
(loading complete)

↓

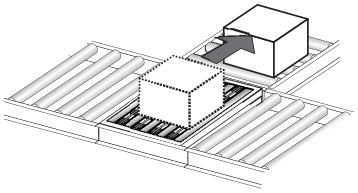
Switch the transfer surface to the diverting direction
(Roller transfer → Carrier wheel transfer)



Signal input to M3: CBK-109 CN2#1 ◄·····
↓
Start switching to the carrier wheel surface
↓
SN・S ON
SN・R OFF ····· NO
↓ YES
Stop signal input to M3: CBK-109 CN2#1
↓
Switching to the carrier wheel surface complete

↓

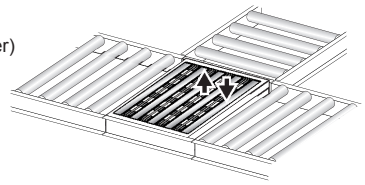
Discharge



Run M1: Carrier wheel transfer MDR ◄·····
↓
Discharge area sensor ON→ OFF ····· NO
↓ YES
Stop running M1: Carrier wheel transfer MDR
(loading complete)

↓

Prepare reception
(Transfer surface switch)
(Carrier wheel transfer → Roller transfer)



Signal input to M3: CBK-109 CN2# 1 and #2 ◄·····
↓
Start switching to the roller surface
↓
SN・S OFF
SN・R ON ····· NO
↓ YES
Stop signal input to M3: CBK-109 CN2# 1 and #2
↓
Switching to the roller surface complete

6. Control/Operation

6-2. Program example

Operation by loading through carrier wheel transfer and discharging through roller transfer

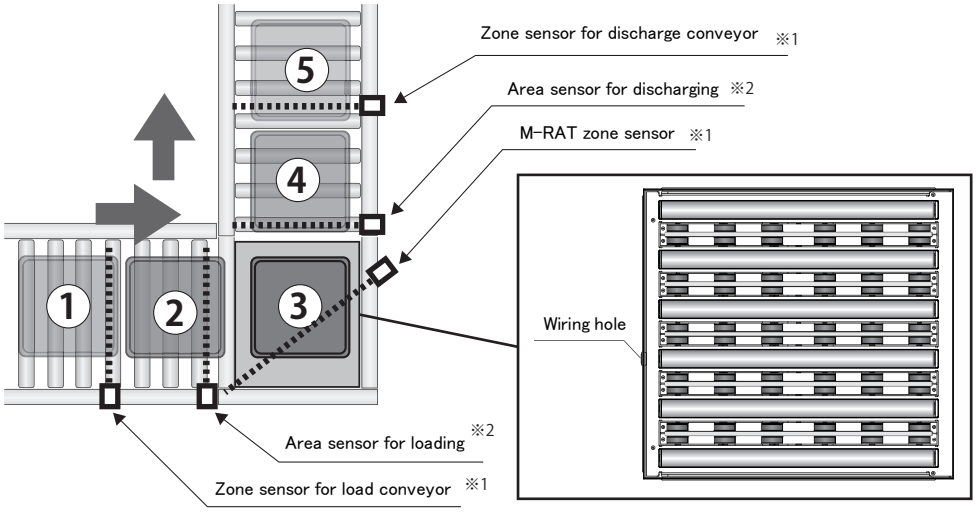
Program example (Operation by loading through carrier wheel transfer and discharging through roller transfer)

■ Do not load trays from the roller transfer direction while the standby status on the carrier wheel surface is output (signal output from SN·S).
Failure to follow this could result in damage to trays, and malfunction.

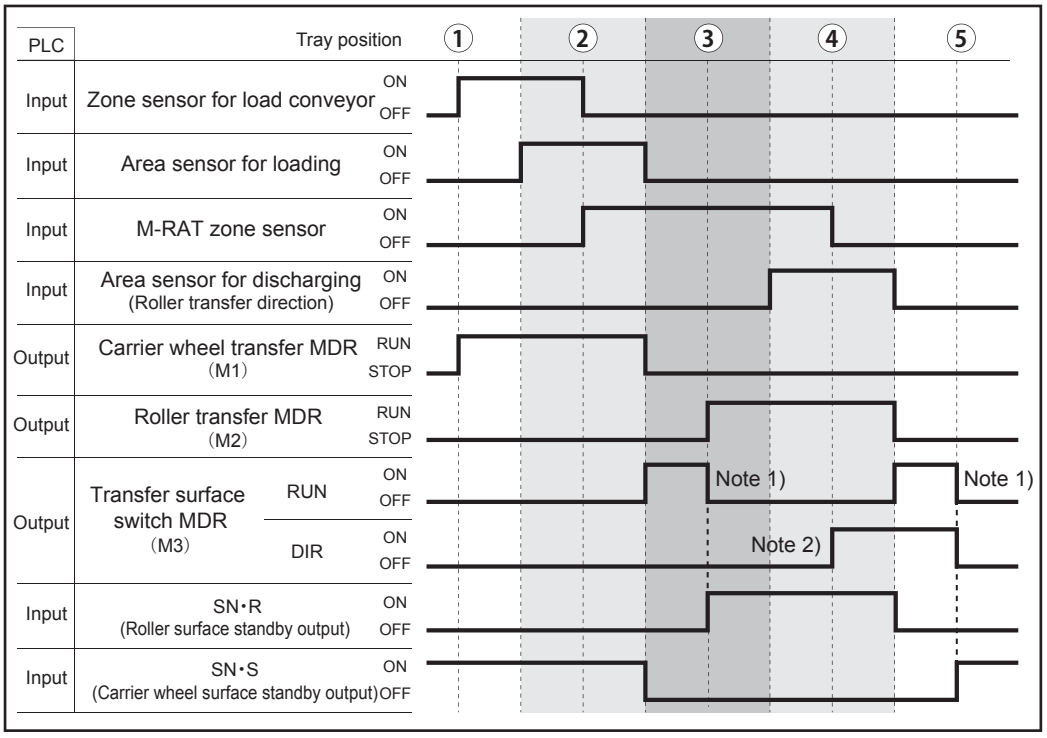
The following time chart is an example.
For actual control, determine the number of sensors and/or how to place/control them based on your operation needs.

Basic operation (example)

Load through carrier wheel transfer ⇒ Discharge through roller transfer
⇒ Standby on the carrier wheel surface after discharge ends



Time chart example



It is assumed that driver switches are used based on the initial settings.

Note 1) When controlling the transfer surface switch MDR (M3), keep the time from detection of SN·S or SN·R until the transfer surface switching MDR stops at less than 20 ms.

Note 2) Make sure to input the MDR rotation direction switch (DIR) signal before inputting the MDR RUN signal.

Terminology

※1 Zone sensor
A sensor to detect the existence of trays within the zone

※2 Area sensor
A sensor to detect load and discharge of trays

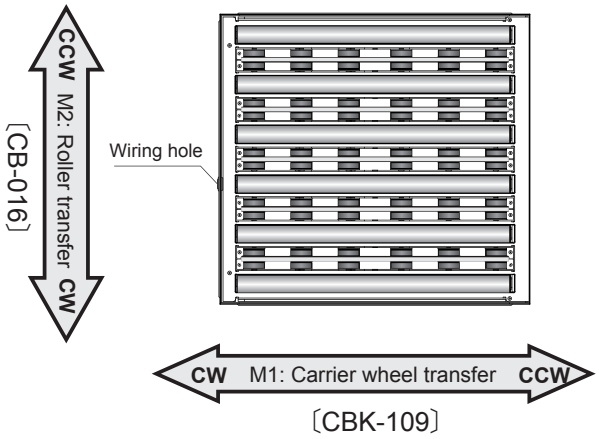
6. Control/Operation

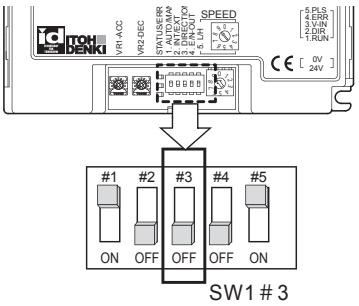
6-3. Switching the transfer direction

〔CBK-109F□-M1-□〕
〔CB-016B□6-M2-□〕
Carrier wheel transfer/
Roller transfer

Switching the transfer direction

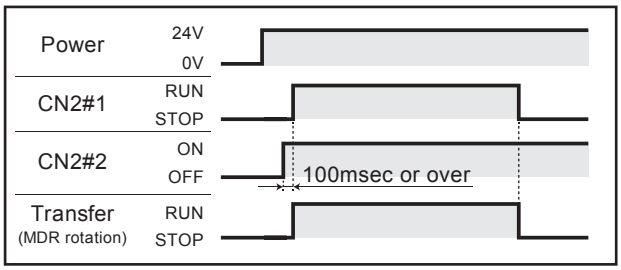
Switching the transfer direction can be set using the DIP-SW on the driver card and signal input from the control connector.





	SW1 # 3	
	ON	OFF (Factory setting)
CN2# 1 2 3 4 5 ← IN	CW	CCW
CN2# 1 2 3 4 5 ⇄ IN	CCW	CW

Signal input to CN2#2



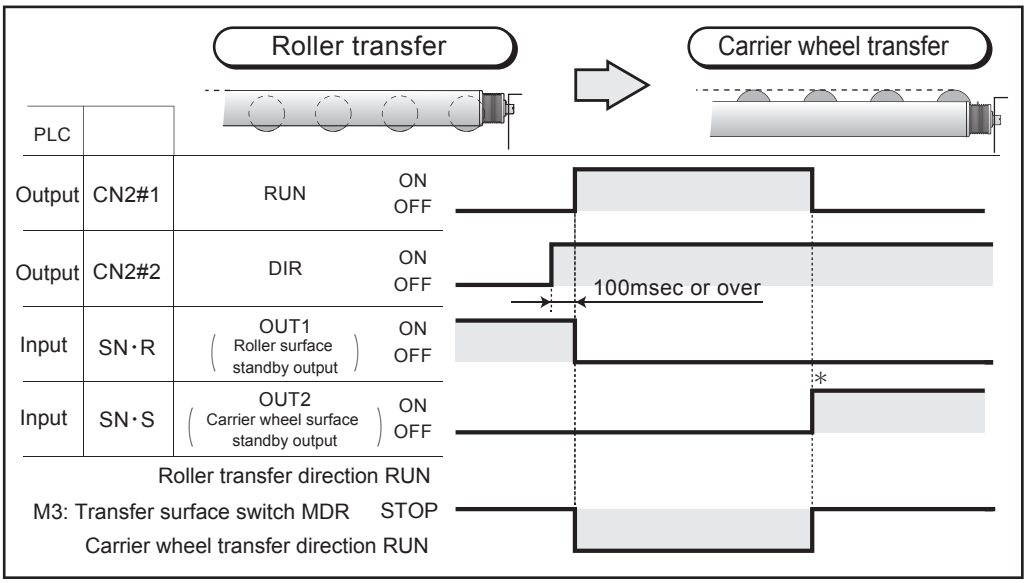
6. Control/Operation

6-4. Switching the transfer surface

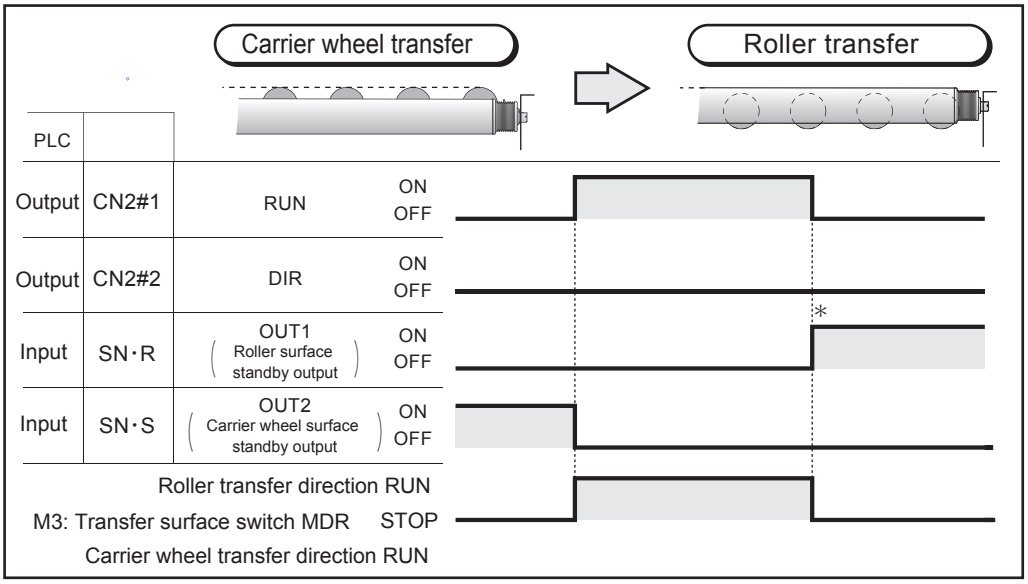
Switching the transfer surface

The transfer surface can be switched by inputting the signal to CN2#1 and CN2#2.

Roller transfer → Carrier wheel transfer



Carrier wheel transfer → Roller transfer



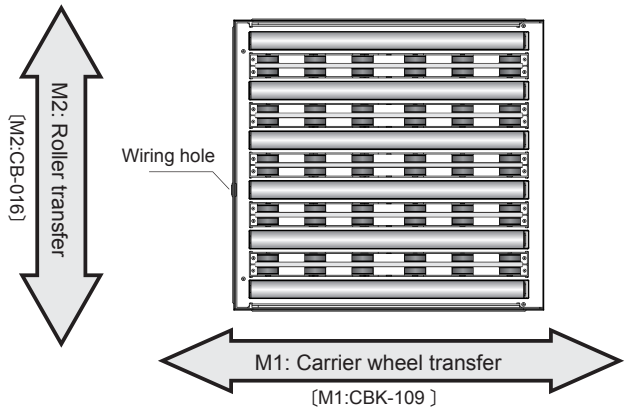
＊ Control the Transfer surface switch MDR（M3） to stop in less than 20msec after detecting SN・S and SN・R.

6-5. Changing the speed

〔CBK-109F□-M1-□〕
〔CB-016B□6-M2-□〕

Changing the speed

There are two speed change settings: the internal speed change setting, where the speed can be changed using the switch on the driver card, and the external speed change setting, where the speed can be changed by inputting the analog voltage to CN2#3.

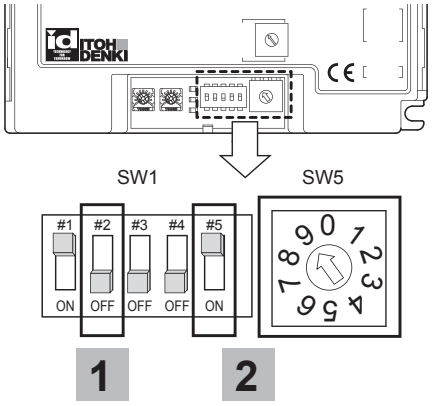


6. Control/Operation

Internal speed setting

1 Set SW1#2 to OFF.

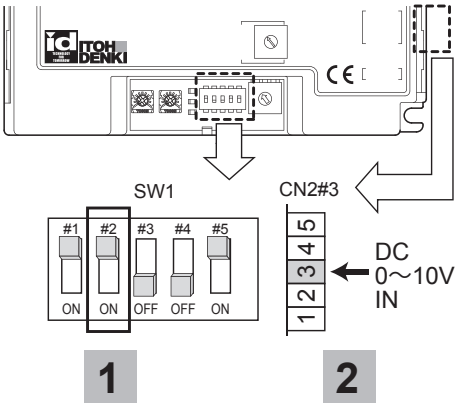
2 Set SW1#5 and SW5.



External speed setting

1 Turn SW1#2 ON.

2 Input the voltage to CN2#3.



Speed chart

■Nominal speed of 15 m/min type

m/min (Speed accuracy: ±3%)

	SW1#5：ON										SW1#5：OFF									
SW5	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2	1	θ
M1 Carrier wheel speed	—	—	—	—	—	—	—	—	—	—	—	—	14.8	13.3	11.8	10.4	8.9	7.4	5.9	4.5
M2 Roller speed	—	—	—	—	—	14.8	13.2	12.4	11.5	10.7	9.9	9.1	8.2	7.4	6.5	5.8	4.9	4.1	3.3	2.5
External voltage Input (V)	9.6 ∫ 9.9	9.1 ∫ 9.4	8.6 ∫ 8.9	8.1 ∫ 8.4	7.6 ∫ 7.9	7.1 ∫ 7.4	6.6 ∫ 6.9	6.1 ∫ 6.4	5.6 ∫ 5.9	5.1 ∫ 5.4	4.6 ∫ 4.9	4.1 ∫ 4.4	3.6 ∫ 3.9	3.1 ∫ 3.4	2.6 ∫ 2.9	2.1 ∫ 2.4	1.6 ∫ 1.9	1.1 ∫ 1.4	0.6 ∫ 0.9	0.1 ∫ 0.4

・□ : factory setting

・Change the speed up to the values described above.

■Nominal speed of 30 m/min type

m/min (Speed accuracy: ±3%)

	SW1#5：ON										SW1#5：OFF									
SW5	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2	1	0
M1 Carrier wheel speed	—	—	—	29.7	28.2	26.7	23.7	22.3	20.8	19.3	17.8	16.3	14.8	13.3	11.8	10.4	8.9	7.4	5.9	4.5
M2 Roller speed	—	—	—	—	—	—	—	—	—	—	—	—	29.3	26.4	23.5	20.5	17.6	14.7	11.7	8.8
External voltage Input (V)	9.6 ∫ 9.9	9.1 ∫ 9.4	8.6 ∫ 8.9	8.1 ∫ 8.4	7.6 ∫ 7.9	7.1 ∫ 7.4	6.6 ∫ 6.9	6.1 ∫ 6.4	5.6 ∫ 5.9	5.1 ∫ 5.4	4.6 ∫ 4.9	4.1 ∫ 4.4	3.6 ∫ 3.9	3.1 ∫ 3.4	2.6 ∫ 2.9	2.1 ∫ 2.4	1.6 ∫ 1.9	1.1 ∫ 1.4	0.6 ∫ 0.9	0.1 ∫ 0.4

・□ : factory setting

・Change the speed up to the values described above.

■ The speed can be changed even during transfer (while the RUN signal is being input).

■ Values in “Setting” indicate the speed when trays are not placed on the M-RAT.

■ The speed values described above are referenced to approximately 30 minutes after startup. During operation, the rising time to the setting speed may vary depending on ambient temperature. Perform running operation thoroughly.

■ Values described above may differ from the actual transfer speed depending on the weight, material, bottom surface, and/or shape of trays, as well as ambient temperature.

6. Control/Operation

6-6. What to do before operation・・・

Start-up inspection

To prevent accidents and/or damage to devices during operation, refer in advance and before operation to the below, and check the safety.

Items to check before turning on the power

Turn off the power of all connected devices, and perform the following inspection, taking necessary measures.

■ Turn off the power, wait a sufficient amount of time, and discharge electricity inside the DC power supply equipment.
■ Post warning labels so as to prevent unauthorized persons from turning on the power.

Parts to be inspected	Items to be checked	Description of measures
Secured positions of the M-RAT main unit	Screw looseness	Re-tighten screws
Driver card	Damage, deformation	Contact the supplier
	Screw looseness on secured positions	Re-tighten screws
	Mounting failure for driver cards and connectors	Correctly mount connectors
	Damage to cables/Wiring failure	Perform wiring correctly
Idler for roller transfer	External abnormalities, such as scratches or breakage	Refer to P.44 7-2. Before replacement work・・・
MDR for roller transfer	External abnormalities, such as scratches, dents, or breakage	
Carrier wheel	Cracks, wear on the surface	
Others	Parts deformation, damage	Contact the supplier
	Cable damage	

Items to check after turning on the power

Manually input the signal to driver cards according to inspection contents.

■ After completing measures to prevent fingers from getting stuck and/or caught in rollers during transfer switching, and/or transfer operation, perform inspection.
■ Take safety measures, such as getting ready to shut off the power in the event that something should happen.

Driver card

Parts to be inspected	Items to be checked	Description of measures
Driver card	Error check with LED indication Normal LED indication after the power is turned on If LED is indicated in a status different from those shown below, it is judged as error. CBK-109: PWR (Green) ON / ERR (Red) OFF / STATUS (Orange) OFF CB-016: PWR (Green) ON / ERR (Red) OFF / STATUS (Orange) OFF	Check error contents, and eliminate the causes. ※For driver card LED indication and error countermeasures, refer to 6-1. Driver card LED indication and error countermeasures (P.42).

6. Control/Operation

Idler/MDR

Parts to be inspected	Items to be checked	Description of measures
Idler roller for roller transfer	Abnormal sound	Refer to P.44 7-2. Before replacement work・・・
	Rotation failure	
MDR for roller transfer	Abnormal sound	
	Decrease from the specified speed	
	Abnormal temperature rise (Check the LED status of driver cards)	
MDR for carrier wheel transfer	Abnormal sound	Contact the supplier
	Decrease from the specified speed	
	Abnormal temperature rise (Check the LED status of driver cards)	
Transfer surface switch MDR	Abnormal sound	
	Abnormal temperature rise (Check the LED status of driver cards)	
Others	Leakage from equipment	Check grounding on equipment, perform grounding

Commissioning

Performing the commissioning

When the start-up inspection has finished, perform the commissioning with careful attention to the following points, and check that operation is correctly performed.

- Prevent other devices around the product from operating.
  Other devices incorporated in the system, such as conveyor lines, could create dangerous situations, since trays may start to flow from upstream when the commissioning is driven. Check carefully that other elements in the system will not operate when the product starts running.
- Make sure to check that wiring, driver card settings, and PLC settings have been carried out correctly before the commissioning.
- During operation, the transfer speed may not reach the specified value depending on ambient temperature. Perform running operation thoroughly.。

7. Maintenance and inspection

7. Maintenance and inspection

7-1. Driver card LED indication and error countermeasures

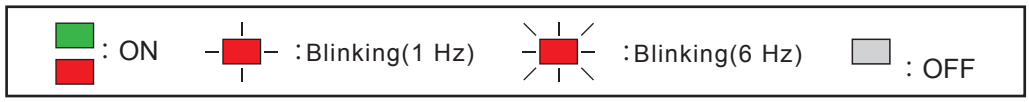
If errors occur with this product, identify the cause of errors, and perform recovery work.

Checking the driver card status

Identify the cause of errors by checking LEDs and error signal output on driver cards, and restore the product.

〔CBK-109〕
For carrier wheel transfer

LED indication explanation

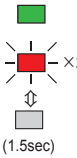


Errors can be checked by PWR (green), ERR (red), and signals from CN2#4.

- When error signals have been released using CN2#1 (RUN / STOP), the M-RAT instantly starts up when RUN is input.
- When the power supply voltage has experienced an extreme decrease, an unexpected operation may occur.
- To restart the M-RAT, switch the ON → OFF → ON / OFF → ON → OFF / RUN → STOP → RUN signals at intervals of 100msec or over.

Error details

[M]: Manual recovery setting (SW1#1 ON) / [A]: Automatic recovery setting (SW1#1 OFF : factory setting)

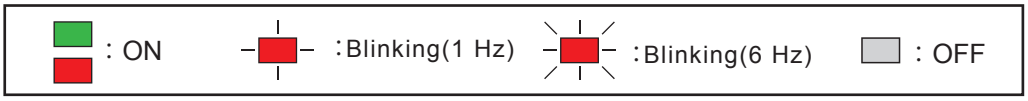
PWR (Green) / ERR (Red)	CN2#4 (Error signal) SW1#4 OFF	CN2#4 (Error signal) SW1#4 ON	Causes	How to release error signals		Recovery operation
	Output	OPEN	(Normal operation)	—		
	OPEN	Output	Damage to driver cards	Turn off the power, and replace the driver card (Refer to 5-2 Installation)		
	OPEN	Output	Thermal error Thermal protection has worked due to a temperature rise of driver cards or MDR	[A]	When one minute has elapsed after decreasing to the recovery temperature, the error signal is released, and the unit starts up instantly	
					After decreasing to the recovery temperature, the error signal is released and the unit starts up instantly by RUN → STOP → RUN on CN2#1.	
					After decreasing to the recovery temperature, the error signal is released and the unit starts up instantly by RUN → STOP → RUN on CN2#1.	Start up the unit by RUN → STOP → RUN on CN2#1
						Start up within one minute
				[M]	After decreasing to the recovery temperature, the error signal is released and the unit starts up by RUN → STOP → RUN on CN2#1	
					After decreasing to the recovery temperature, switch ON → OFF → ON or OFF → ON→ OFF on CN2#2	Start up the unit by RUN → STOP →RUN on CN2#1
	OPEN	Output	Connector disconnected	Turn off the power, and connect the connector (Refer to 5-3 Wiring)		
	OPEN	Output	MDR disconnection	Turn off the power, and replace the MDR (Refer to 7-2. Before replacement work)		
	OPEN	Output	Lock error MDR has been locked, and 0.5sec have elapsed	When 4 sec or over have elapsed after an error occurs, the error signal is released and the unit starts up by RUN → STOP → RUN on CN2#1		
				When 4 sec or over have elapsed after an error occurs, switch ON → OFF → ON or OFF → ON→ OFF on CN2#2		Start up the unit by RUN → STOP → RUN on CN2#1
	OPEN	Output	Low voltage error Power supply voltage has been 15 V or less for 1 sec, or decreases to 15 V or less 5 times within 500ms	[A]	Secure the power supply voltage of 24V DC±10%	The unit starts up instantly
				[M]	After securing the power supply voltage of 24V DC±10%, release the error signal, and start up the unit by RUN → STOP → RUN on CN2#1	
					After securing the power supply voltage of 24V DC±10%, switch ON → OFF → ON or OFF → ON → OFF on CN2#2	Start up the unit by RUN → STOP → RUN on CN2#1
	OPEN	Output	Back EMF error Voltage applied to the MDR has been 40V or higher continuously, or 50V or over momentarily. ※This error may occur when the MDR has rotated at speeds faster than the setting speed.	[A]	Voltage applied to the MDR has been 24V DC±10%	The unit starts up instantly
				[M]	After voltage applied to MDR has been 24V DC±10%, release the error signal and start up the unit by RUN → STOP → RUN on CN2#1	
					After voltage applied to MDR has been 30 V or less for 1 sec, switch ON → OFF → ON or OFF → ON → OFF on CN2#2	Start up the unit by RUN → STOP → RUN on CN2#1
	OPEN	Output	A current of 7A or more flows in the MDR	No error signal		—

Errors will be also released when the power is OFF (for two seconds or more).

7. Maintenance and inspection

〔CB-016〕
For roller transfer

LED indication explanation



Errors can be checked by PWR (green), ERR (red), and signals from CN2#4.

- When error signals have been released using CN2#1 (RUN / STOP), the M-RAT instantly starts up when RUN is input.
- When the power supply voltage has experienced an extreme decrease, an unexpected operation may occur.
- To restart the M-RAT, switch the ON → OFF → ON / OFF→ON→OFF / RUN → STOP → RUN signals at intervals of 100msec or over.

Error details

[M]: Manual recovery setting (SW1#1 ON) / [A]: Automatic recovery setting (SW1#1 OFF : factory setting)

PWR (Green) / ERR (Red)	CN2#4 (Error signal) SW1#4 OFF	CN2#4 (Error signal) SW1#4 ON	Causes	How to release error signals		Recovery operation
🟢 / ⬜	Output	OPEN	(Normal operation)	—		
⬜ / ⬜	OPEN	OPEN	No power supply	Supply 24V DC (Refer to 5-3 Wiring)		
⬜ / 🔴 blinking	OPEN	Output	Damage to driver cards	Turn off the power, and replace the driver card (Refer to 5-2 Installation)		
🟢 / 🔴	OPEN	Output	Thermal error Thermal protection has worked due to a temperature rise of driver cards or MDR	[A]	When one minute has elapsed after decreasing to the recovery temperature, the error signal is released, and the unit starts up instantly	
					After decreasing to the recovery temperature, the error signal is released and the unit starts up instantly by RUN → STOP → RUN on CN2#1.	
					After decreasing to the recovery temperature, the error signal is released and the unit starts up instantly by RUN → STOP → RUN on CN2#1.	Start up the unit by RUN → STOP → RUN on CN2#1
						Start up within one minute
				[M]	After decreasing to the recovery temperature, the error signal is released and the unit starts up by RUN → STOP → RUN on CN2#1	
					After decreasing to the recovery temperature, switch ON → OFF → ON or OFF → ON → OFF on CN2#2	Start up the unit by RUN → STOP → RUN on CN2#1
🟢 / 🔴	OPEN	Output	Connector disconnected	Turn off the power, and connect the connector (Refer to 5-3 Wiring)		
🟢 / 🔴	OPEN	Output	MDR disconnection	Turn off the power, and replace the MDR (Refer to 7-2. Before replacement work)		
🟢 / 🔴 blinking	OPEN	Output	Lock error MDR has been locked, and 4 sec have elapsed	The error signal is released and the unit starts up by RUN → STOP → RUN on CN2#1.		
				Switch ON → OFF → ON or OFF → ON → OFF on CN2#2		Start up the unit by RUN → STOP → RUN on CN2#1
🟢 / 🔴 blinking	OPEN	Output	Low voltage error Power supply voltage is 15 V or less	[A]	Secure the power supply voltage of 24V DC±10%	The unit starts up instantly
				[M]	After voltage applied to MDR has 24V DC±10%, release the error signal and start up the unit by RUN → STOP → RUN on CN2#1	
					After voltage applied to MDR has been 24V DC±10%, switch ON → OFF → ON or OFF → ON → OFF on CN2#2	Start up the unit by RUN → STOP → RUN on CN2#1

Errors will be also released when the power is OFF (for two seconds or over).

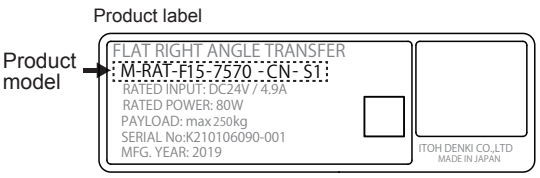
7. Maintenance and inspection

7-2. Before replacement work・・・

If any abnormalities are found, such as damaged parts, immediately take actions, including replacement with new parts.

・Check the model of this product, and prepare parts to be replaced with in advance.
・Contact us for repair/replacement of parts other than those mentioned below.

Product label



Replacement parts

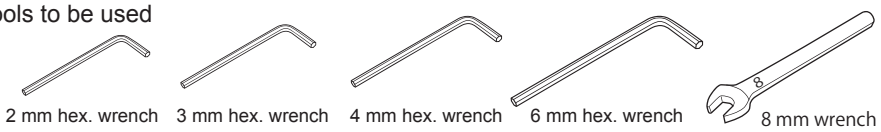
	Size	Model	Piece	Remarks
Carrier wheel cassette	**6060**	**MRAT-CC60A**	**1**	・Hex. bolt with spring lock and plain washers M6×15, 7 pieces included ・With the resin slider
	7560 / 7570 / 7580	**MRAT-CC75A**		
Resin slider	**6060**	**MRAT-SLD60A**	**1**	Use one piece for each carrier wheel cassette
	7560 / 7570 / 7580	**MRAT-SLD75A**		
Drive belt	**6060 / 7560 / 7570 / 7580**	**4PJ336**	**1**	—
MDR for roller transfer	**6060**	**PM570FE-＊-506-D-024-Z017-VM**	**1**	＊ ・For nominal speed 15m/min ・・・17
	7560 / 7570 / 7580	**PM570FE-＊-656-D-024-Z017-VM**	**1**	・For nominal speed 30m/min ・・・60
Idler	**6060**	**ARI-57-506-VM**	**1**	—
	7560 / 7570 / 7580	**ARI-57-656-VM**	**1**	

Driver	Piece	Nominal spped 15m/min type		Nominal spped 30m/min type	
		NPN input and output signals	PNP input and output signals	NPN input and output signals	PNP input and output signals
For carrier wheel transfer	1	**CBK-109FN-M1-15**	**CBK-109FP-M1-15**	**CBK-109FN-M1-30**	**CBK-109FP-M1-30**
For roller transfer	1	**CB-016BN6-M2-15**	**CB-016BP6-M2-15**	**CB-016BN6-M2-30**	**CB-016BP6-M2-30**
For transfer surface switch	1	**CBK-109FN-M3-MR**	**CBK-109FP-M3-MR**	**CBK-109FN-M3-MR**	**CBK-109FP-M3-MR**

Before replacement

1 Prepare necessary tools before replacement.

● Tools to be used



● Jig… Belt tensioning jig (Refer to Appendix 3)

＊Cable ties are also necessary when replacing the MDR for roller transfer.

2 Turn off the power of all connecting devices.

7-3. Replacement of resin sliders

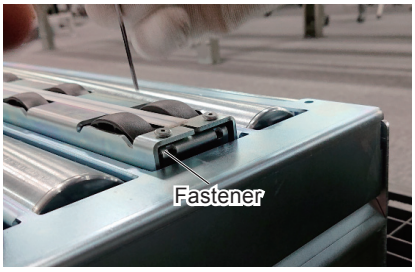
Replacement of resin sliders

■ Before replacement, perform maintenance with the carrier roller transfer surface facing up.

1 Loosen the fastener on the carrier cassette with the resin slider to be replaced.

■ Do not loosen the screw so much that it comes off.

■ Loosen the screw until clearance to pull out the resin slider can be secured.
(Reference: five to six rotations of the fixing screw)



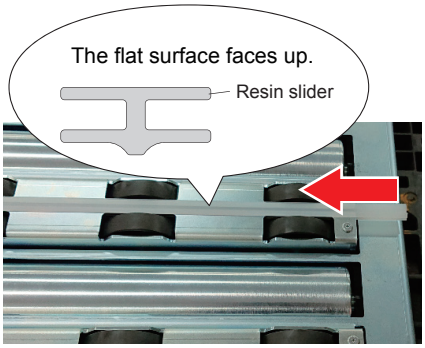
Tool: 2 mm hex. wrench

2 Remove the resin slider, and replace it with a new one.
Put in the resin slider until it comes into contact with the end.

3 Fasten the screw

■ Be careful not to get the resin slider caught in the fastener.

■ Tightening torque:
1.6～1.9Nm

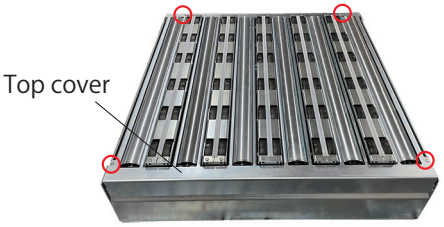


7. Maintenance and inspection

7-4. Replacement of idlers/ drive belts

Replacement of idlers/drive belts

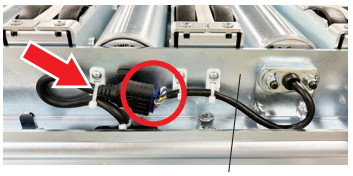
1 Remove the top cover.



Tool: 3 mm hex. wrench

2 Cut the cable tie at the position of the red arrow mark and remove the MDR connector on the roller unit.

■ Be careful not to damage the connectors and/or cables.



Roller unit

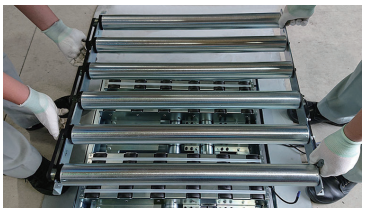
3 Remove the screws used to secure the roller unit.

Number of fixing screws per size：
6060 / 7560…6 pieces
7570…6 pieces
7580…8 pieces

Tool: 6 mm hex. wrench

4 Remove the roller unit.

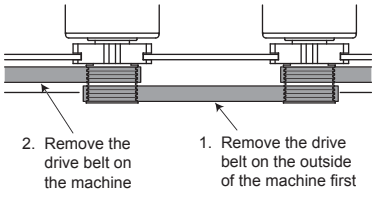
■ Have more than one person remove the unit.
■ When holding the side of the drive belt, first, pull up the roller unit slightly while holding the drive belt. Then hold the bottom of the roller unit and remove it.
■ Be careful not to damage the connectors and/or cables.



5 Remove the idlers and belts.

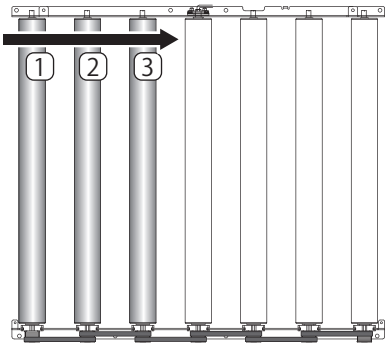
Remove them in the order from the side closest to the idler and drive belt to be replaced.

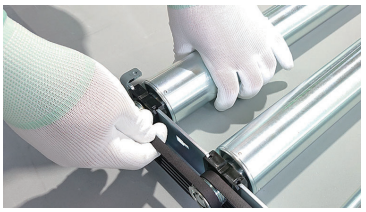
■ While turning the idler, slide and remove the drive belt.
■ When removing the drive belt on the machine, remove the outer drive belt first.



Repeat the above steps until the drive belt is removed from the idler to be replaced.

Example: When removing the idler Fig.3 remove in the order of Fig1, Fig2, and Fig3 .



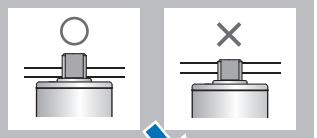


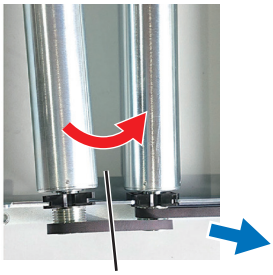
7. Maintenance and inspection

6 Fig.1 Pull up the pulley part of the idler along with the bearing holder, Fig.2 Remove the idler and drive belt. Replace with a new idler or drive belt.

7 When mounting, Fig.1 put the shaft on the opposite side of the idler pulley into the plate, and Fig.2 stagger the drive belt around the pulley.

■ When mounting, check that the idler shaft protrudes sufficiently from the plate.

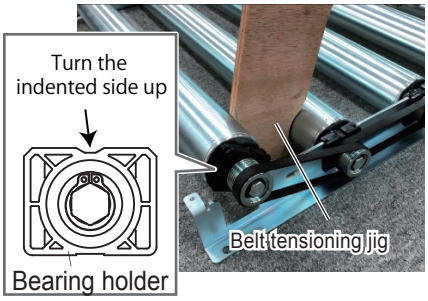




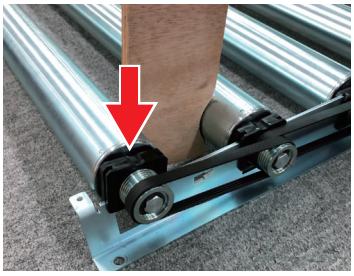
To stagger easily, tilt the idler slightly and mount

8 Align the top and bottom directions of the bearing holder, and tighten the drive belt using the belt tensioning jig.

■ To mount the drive belt, a jig is necessary.



9 Align the plate with the groove of the bearing holder, and push it straight down from above to mount the idler.



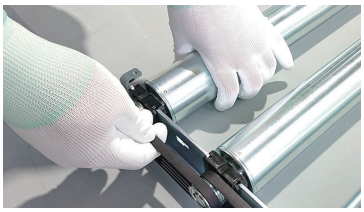
10 Remove the jig.

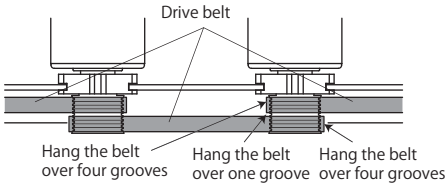
11 Repeat the above steps, and mount the drive belts and idlers.

7. Maintenance and inspection

12 Align the groove positions of the drive belt.

■ They can be easily aligned by moving the belt while turning the roller.





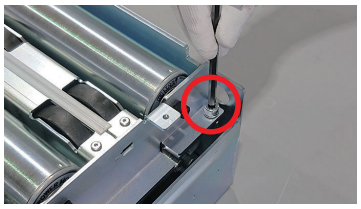
13 Mount the roller unit.

■ Have more than one person mount the unit.
■ When holding the side of the drive belt, hold the bottom of the roller unit and carry. When putting the roller unit on, change to hold the drive belt, and mount the roller unit.
■ Check the MDR cable direction and mount.
■ Be careful not to damage the connectors and/or cables.

14 Secure the roller unit using screws.

Number of fixing screws per size：
6060 / 7560…6 pieces
7570…6 pieces
7580…8 pieces

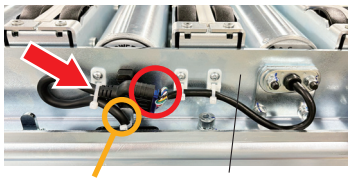
■ Tightening torque:
25～29Nm



Tool: 6 mm hex. wrench

15 Connect the MDR connector, and secure the cable using the cable tie as shown in the figure on the right.

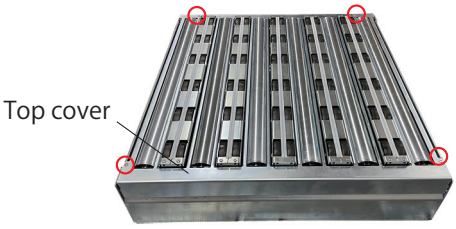
■ Hang the cable connector on the protrusion part to prevent it from getting caught during operation.



Protrusion part Roller unit

16 Mount the top cover.

■ Tightening torque:
2.9～3.5Nm



Tool: 3 mm hex. wrench

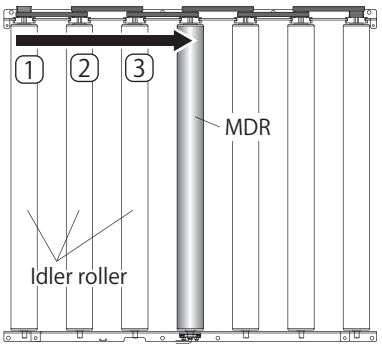
7. Maintenance and inspection

7-5.
Replacement of MDR

Replacement of MDR

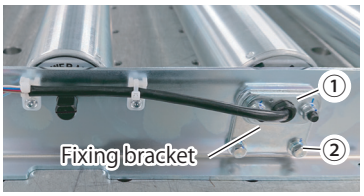
1 Perform steps 1 to 6 for Replacement of idlers/drive belts, and remove the idlers and drive belts until the drive belt hanging on the MDR comes off.

Remove in the order of Fig1, Fig2, and Fig3



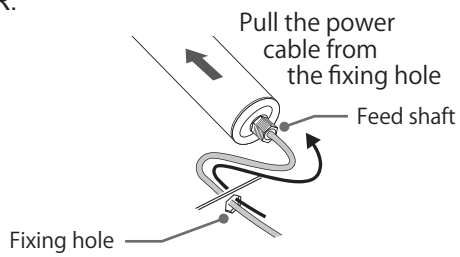
2 Remove the fixing bracket screws used to secure the MDR and cut the cable tie.

Remove the screws in the order of: Fig.1 rotation stopper part and Fig.2 bracket fixing part

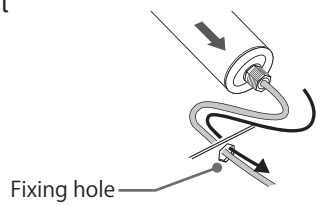


Tool: 8 mm wrench

3 After pulling up the pulley part along with the bearing holder, pull the feed shaft, and remove the MDR.



4 Pass the feed cable through the product plate, and mount a new MDR.



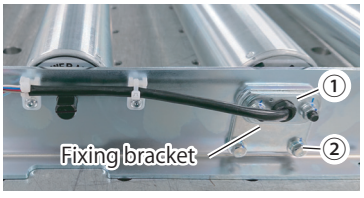
5 Perform steps 7 to 11 for Replacement of idlers/drive belts, and mount a new MDR, idlers, and drive belts.

6 Secure the MDR.

Secure the fixing braket in the order of: Fig.2 rotation stopper part and Fig.1 bracket fixing part.

■ Tightening torque：
2.9～3.4Nm

Connect the MDR connector, and secure the cable using the cable tie as shown in the figure on the right.



Tool: 8 mm wrench

7 Perform steps 12 to 16 for Replacement of idlers/drive belts.

7. Maintenance and inspection

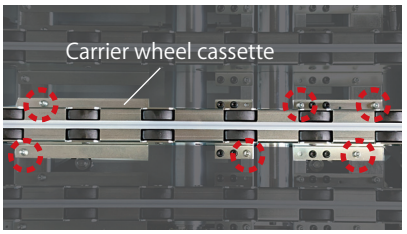
7-6. Replacement of the carrier wheel cassette

Replacement of the carrier wheel cassette

1 Perform steps 1 to 4 for Replacement of idlers/drive belts, and remove the top cover and roller unit.

2 Remove the screws used to secure the carrier wheel cassette to be replaced.

■ Remove the silver screws. Do not remove the black screws.

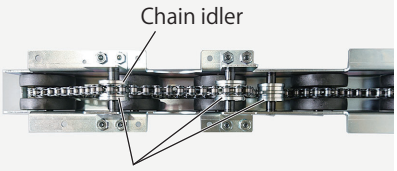


Tool: 8 mm wrench

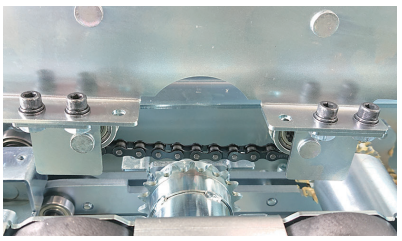
3 Replace and mount the carrier wheel cassette.

■ Mount the chain along the groove of the chain idler.

■ Mount so that the sprocket on the machine side and the chain on the carrier wheel cassette are engaged.



Mount the chain along the idler



■ It becomes easier to mount the chain by tightening.

Pull the chain slightly

4 Secure the carrier wheel cassette.

■ Tightening torque:
10～12Nm

5 Perform steps 13 to 16 for Replacement of idlers/drive belts.

8. Troubleshooting

8. Troubleshooting

If you believe the product may be malfunctioning, check the contents described in this section before contacting us and/or asking for repair.

Symptoms

M-RAT does not operate

Items to be checked	Countermeasures	References
Is PWR LED (Green) for each driver card ON? Or, has 24V DC been supplied in the power connector part of driver cards?	Supply 24V DC.	7. Installation / Wiring (⇒P.20)
Is ERR LED (Red) for each driver card blinking, or is it ON and is there an error output?	Remove the cause of error, and release the error.	9. Maintenance and inspection (⇒P.41)
Has each connector been connected correctly? Has wiring been performed properly?	Check wiring, and perform wiring properly if it has not already been done so.	7. Installation / Wiring (⇒P.20)
Has the product type (NPN input/ output / PNP input/output) matched the input and output signals (NPN input/output / PNP input/output) on PLCs? ※Check the product model.	Match the product type (NPN input/ output / PNP input/output) with the input and output signals on PLCs (NPN input/output / PNP i nput/output).	7. Installation / Wiring (⇒P.20)
Is 0 V input to the control signals common to 0 V to the power supply?	Set it to be common to 0 V to the power supply.	7. Installation / Wiring (⇒P.20)

The transfer surface cannot be switched, or transfer surface switching operation is incorrect

Items to be checked	Countermeasures	References
Is ERR LED (Red) on the driver card for M3: Transfer surface switch blinking, or is it ON and is there an error output?	Remove the cause of error, and release the error.	9. Maintenance and inspection (⇒P.41)
Has the RUN signal input to the driver card for M3: Transfer surface switch corresponded to the transfer surface? Also, is the input timing correct?	Check the signal input and input timing when the transfer surface is switched.	8. Control / Operation (⇒P.32)
Has the setting of the driver card for M3: Transfer surface been changed?	Check the setting of the driver card for M3: Transfer surface switch.	8. Control / Operation (⇒P.32)

8. Troubleshooting

Symptoms

Trays get stuck/Trays cannot be transferred

Items to be checked	Countermeasures	References
Is the load conveyor level the same as the level of the M-RAT?	Align levels of the load conveyor and the M-RAT.	7. Installation / Wiring (⇒P.20)
When loading by carrier wheels, have they been set on the top of the surface? When loading by rollers, have they been set on the top of the surface?	Set either carrier wheels or rollers on the top of the surface according to the loading direction.	8. Control / Operation (⇒P.32)
When loading by carrier wheels, have you run the carrier wheel MDR (M1)? When loading by rollers, have you run the roller MDR (M2)? Also, have you run the MDR until loading ends?	Run either carrier wheel MDR (M1) or roller MDR (M2) according to the loading direction until loading ends.	8. Control / Operation (⇒P.32)
When loading by carrier wheels, are there any carrier wheels rotating slower than others?	Replace the carrier wheel cassette including the slow rotating wheels.	9. Maintenance and inspection (⇒P.41)
Has the transfer surface switch MDR (M3) run at the time of loading?	Do not run the transfer surface switch MDR (M3) until loading ends.	9. Maintenance and inspection (⇒P.32)

When discharging, trays get stuck, or cannot be transferred

Items to be checked	Countermeasures	References
Is the discharge conveyor level the same as the level of the M-RAT?	Align levels of the discharge conveyor and the M-RAT.	7. Installation / Wiring (⇒P.20)
When discharging by carrier wheels, have they been set on the top of the surface? When discharging by rollers, have they been set on the top of the surface?	Set either carrier wheels or rollers on the top of the surface according to the discharging direction.	8. Control / Operation (⇒P.32)
When discharging by carrier wheels, have you run the carrier wheel MDR (M1)? When discharging by rollers, have you run the roller MDR (M2)? Also, have you run the MDR until discharging ends?	Run either carrier wheel MDR (M1) or roller MDR (M2) according to the discharging direction until discharging ends.	8. Control / Operation (⇒P.32)
When discharging by carrier wheels, are there any carrier wheels rotating slower than others?	Replace the carrier wheel cassette including the slow rotating wheels.	9. Maintenance and inspection (⇒P.41)
Has the transfer surface switch MDR (M3) run at the time discharging?	Do not run the transfer surface switch MDR (M3) until discharging ends.	8. Control / Operation (⇒P.32)

8. Troubleshooting

Symptoms

- The speed cannot be changed
- The speed setting is incorrect

Items to be checked	Countermeasures	References
To change the carrier wheel speed, have you operated the switch on the driver card for M1: Carrier wheels (CBK-109)? To change the roller speed, have you operated the switch on the driver card for M2: Rollers (CB-016)?	To change the carrier wheel speed, operate the switch on the driver card for M1: Carrier wheels (CBK-109). To change the roller speed, operate the switch on the driver card for M2: Rollers (CB-016).	Changing the speed (⇒P.38)
Have you changed the external speed by the voltage input to CN2#3 on CBK-109/CB-016?	Check the external speed settings, and input the voltage according to the settings.	Changing the speed (⇒P.38)
When changing the speed by the external voltage, is the power supply 0 V of the external voltage common to 0 V on the driver card?	Use the common power supply 0 V.	7. Installation / Wiring (⇒P.20)

The transfer direction (rotating direction of carrier wheels/rollers) is incorrect

Items to be checked	Countermeasures	References
Is the transfer/diverting direction based on the rotating direction settings for the driver card for M1: Carrier wheels/M2: Rollers?	Set the correct transfer/diverting direction, and the correct the rotating direction for the driver card for M1: Carrier wheels/M2: Rollers.	8. Control / Operation (⇒P.32)

Appendix

Appendix

Appendix 1.
Product specifications

M-RAT main unit specifications

Size		6060	7560	7570	7580
L	Values in ( ) show the base outer dimension including bead processing	598(601.2) (mm)	748(751.2) (mm)		
W		580(586.4) (mm)	580(586.4) (mm)	700(706.4) (mm)	820(826.4) (mm)
H		175 (mm) (excluding the protrusion part)			
Weight		80 (kg)	94 (kg)	109 (kg)	124 (kg)
Maximum load weight ※1	Nominal speed of 15m/min type	250 (kg)			
	Nominal speed of 30m/min type	150 (kg)			
Maximum load size ※2	Minimum	L:450×W:450 (mm)			
	Maximum	L:500×W:500 (mm)	L:650×W:500 (mm)	L:650×W:600 (mm)	L:650×W:700 (mm)
Speed ※3	Nominal speed of 15m/min type	15m/min			
	Nominal speed of 30m/min type	30m/min			
Lifting time ※4		0.6 (s)			
Material	Frame / Top cover / Roller	Steel, Electro - galvanizing			
	Carrier wheel roller	Glass fiber reinforced plastic Black Conductive grade			
	Resin slider	High density polyethylene			
Standby surface sensor (proximity)	NPN output	GX-H12A			
	PNP output	GX-H12A-P			
Operating environment	Ambient temperature	0 to 40ºC (no freezing)			
	Ambient humidity	90%RH or less (no condensation)			
	Altitude	1,000m or less			
	Atmosphere	No corrosive gas			
	Vibration	0.5 G or less			
	Location	Indoor			
	Mounting surface tilt (inclination)	0.5% or less			
	Pollution degree	2 (according to the definition of IEC60664-1)			

※1 Values of the maximum load weight are reference only, since they may change depending on tray conditions.
Depending on the bottom shape or unbalanced load of trays, they may not be transferred normally, even if they are within the above size range.

※2 The size that can be transferred depends on the speed, load weight, material, bottom surface, shape of trays, ambient temperature, and/or transfer conditions.

※3 Values indicate the speed that can be specified when trays are not placed.
The transfer conditions depend on the speed, load weight, material, bottom surface, shape of trays, and/or ambient temperature.

※4 Indicates the time when trays are not placed.

■ During operation, the rising time to the setting speed may vary depending on ambient temperature. Perform running operation thoroughly.

Appendix

Driver card specifications

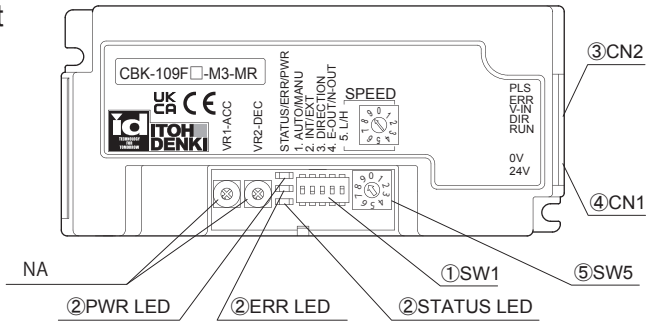
		For carrier wheel transfer For transfer surface switch	For roller transfer
Model		**CBK-109F□-M1-15** **CBK-109F□-M1-30** **CBK-109F□-M3-MR** (□=N：NPN, P：PNP)	**CB-016B□6-M2-15** **CB-016B□6-M2-30** (□=N：NPN, P：PNP)
Power supply voltage		DC24V±10%	
Rated voltage		DC24V	
Static current		0.06A	0.03A
Starting current		7.0A	4.0A
Peak current		30A (1 ms or less)	20A (1ms or less)
Wire diameter (Applicable wires to connectors included as standard)	Power connector (CN1)	0.80 ～ 1.5mm^2 (AWG：18 ～ 14)	0.50 ～ 1.5mm^2 (AWG：20 ～ 14)
	Control connector (CN2)	0.08 ～ 0.5mm^2 (AWG：28 ～ 20)	
Thermal protection		Driver card unit: 95ºC Motor: 105ºC	Driver card unit: 95ºC Motor: 105ºC
Operating environment	Ambient temperature	0 ～ 40℃ (no freezing)	
	Ambient humidity	90%RH or less (no condensation)	
	Atmosphere	No corrosive gas	
	Vibration	0.5G or less	
	Location	Indoor	
Time from RUN signal input to motor starting		15msec or less	15msec or less

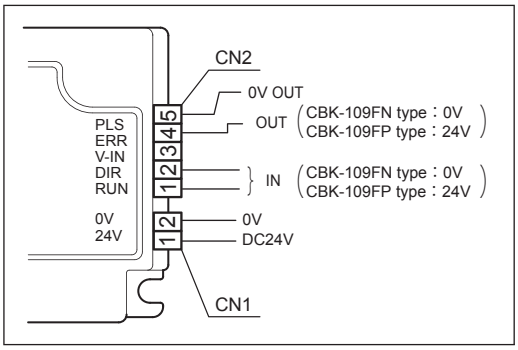
Replacement parts/Options ※Refer to P.44.

Appendix

Appendix 2. About CBK-109-F□-M3-MR

Functions List





	No.	Description	Setting when turned ON	Setting when turned OFF	Factory setting	References
① SW1 (DIP switch)	#1	Switch between auto/manual recovery if a thermal error/ low voltage error/ back EMF error occurs	Manual recovery	Auto recovery	ON	☞ 7-1 Driver card LED indication and error countermeasures
	#2	Stop holding time	0.5sec	1sec	OFF	—
	#3	Selection of the direction of rotation	☞ 7-1 Transfer derection settings		OFF	(Normally, turn it OFF.)
	#4	Selection of the alarm (error) signal output	Output under the normal condition	Output when an error occurs	OFF	☞ 7-1 Driver card LED indication and error countermeasures
	#5	Selection of the speed range	High speed range	Low speed range	ON	⚠ Caution: Do not change the initial setting from "6". Failure to comply this could result in malfunction and/or unexpected accidents.

		Color	Indication	Remarks
②	PWR LED	Green	Indicates powered condition	☞ 7-1 Driver card LED indication and error countermeasures
	ERR LED	Red	Indicates error type	
	STATUS LED	Orange	Indicates number of error occurrence form thermister reaction, motor stall or under voltage	☞ Refer to CBK-109FN User Manual

		Function		Detailed descripti0n
③ CN2 (Control)	#5	Output	Motor pulse output	・Outputs 2 pulse signals for each rotation of the internal motor. ・NPN open collector output. (NPN output only) ・Attach protection resistance so that the output is 25mA or less. ・Protection resistance of 100 Ω is included inside driver cards.
	#4	Output	Error signal output	・Outputs when MDR abnormalities have detected. ・Signal output settings under the normal condition/when an error occurs can be specified using DIP-SW1#4 ON/OFF. ・Open collector output. (CBK-109FN : 0V / CBK-109FP : 24V) ・Attach protection resistance so that the output is 25mA or less. ・ Protection resistance of 100 Ω is included inside driver cards.
	#3	—	NA	
	#2	Input	MDR rotation direction switching	The transfer direction can be switched
	#1	Input	MDR RUN/STOP	RUN/STOP signal

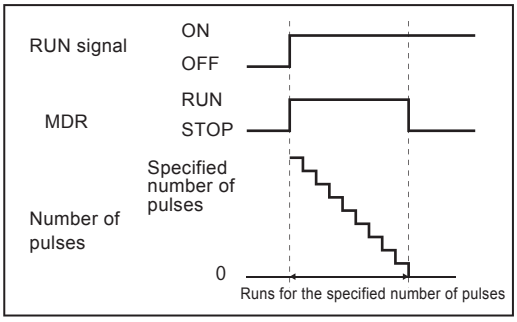
④ CN1 (Power)	2	0V
	1	24V DC

	Factory setting		
⑤ SW5	6	⚠ Caution	Do not change the initial setting from "6". Failure to follow this could result in malfunction and/or unexpected accidents.

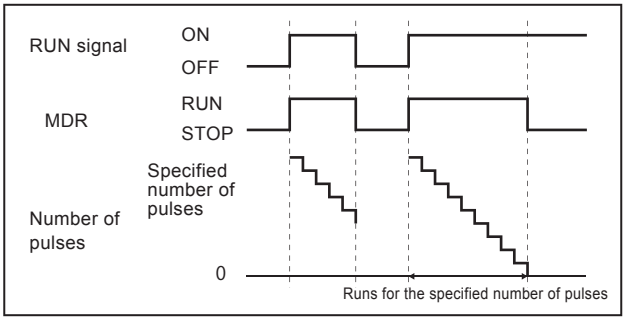
Appendix

Description of operation

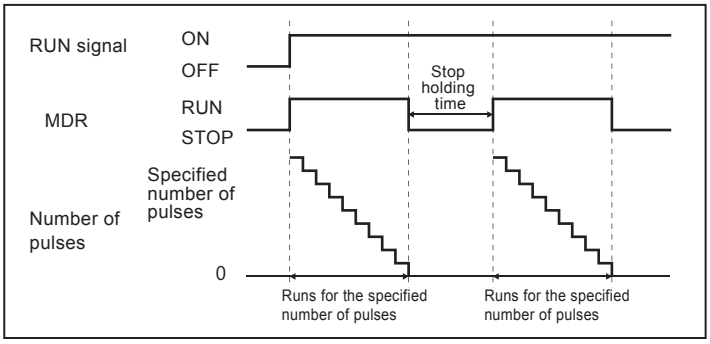
- The specified number of motor pulses is counted from RUN signal ON, and the MDR stops.



- If the RUN signal is turned OFF before reaching the specified number of motor pulses, the MDR will stop. When the RUN signal is turned ON again, the MDR will run for the specified number of pulses.



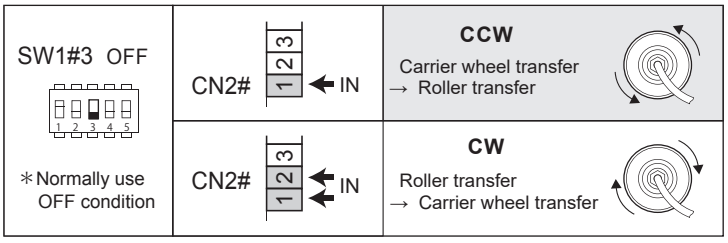
- While the MDR stops by reaching the specified number of pulses, if the RUN signal is kept ON, the MDR will run again after the elapsion of stop retention time from the MDR stop.



- If the RUN signal is ON and the DIR signal is switched before reaching the specified number of pulses, the MDR will stop for 500 ms and the rotation will be reversed.
  The MDR will run by continuously counting the number of pulses before the DIR signal is switched.

Switching the transfersurface

- Change the MDR rotation using the external switch and select the transfer surface.
  - ＊MDR rotation in the right turn direction is defined as CW when viewed from the cable side, and left turn as CCW.
  - ＊0V must be common to the power supply.
  - ＊CN2#2 carries approx. 3mA current.



Error Signal Output

- SW1#4 can change setting of normal-time signal output or error-time signal output.
- CN2#4 delivers error signal output.
  - ＊Power ON/OFF operation generates error signal. Make the control to ignore error signal from the driver card for 0.5sec at power ON, and 2sec at power OFF.
  - ＊Use a protection resistor to suppress current to 25mA or below. Use of higher current damages the transistor in the driver card.
  - ＊Protection resistor 100Ω is furnished in the driver card.

SW1#4	
OFF	ON
Error-time signal output	Normal-time signal output
Normal time open (Transistor in the driver card is ON during error)	Error time open (Transistor in the driver card is OFF during error.)

Error Detail, Cancellation Method

Refer to 7-1. Driver card LED indication and error countermeasures(P.42)

Appendix

Appendix 3. Residual risk list/MAP

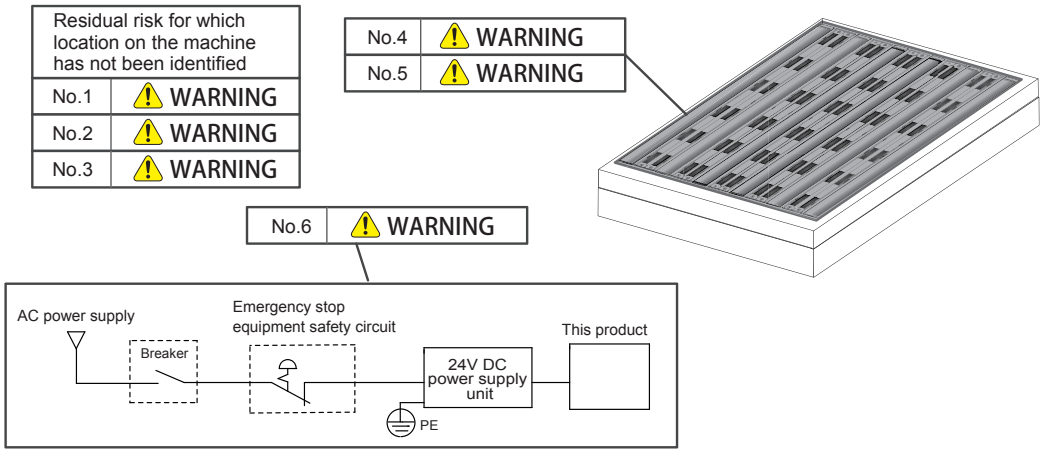
Residual risk list

No.	Operation stage	Work	Qualifications/ education required for work	Locations on machine	Seriousness of harm	Remaining risk factors	Examples of assumed measures	Measures that have been taken independently	Reference page
1	Installation	Transport	Having carefully read the user manual, and having full knowledge of all the contents	No particular location	WARNING	Dropping the machine due to a disconnected load lifting hook when carrying may result in damage to the machine, and/or bodily injury	• Use the hook with the lock function set • Do not get under the machine	Described in the instruction manual	7
2	Installation	Transport		No particular location	WARNING	Dropping the machine due to obstacle collision when carrying may result in damage to the machine, and/or bodily injury	• Before transporting, ensure the safety of the transportation route • Do not get under the machine	Described in the instruction manual	7
3	Installation	Transport/ Installation		No particular location	WARNING	Letting the machine fall due to poor footing may result in damage to the machine, and/or bodily injury	• Before transporting, ensure the safety of the surrounding area • Do not get under the machine	Described in the instruction manual	7
4	Operation	Operation		Top panel of the product	WARNING	If workers accidentally lean over the machine at the time of transferring the work, they may get injured by getting some body parts caught in the machine	Post warning labels, and pay attention to the surrounding situation during operation	Described in the instruction manual	6
5	Operation	Operation		Top panel of the product	WARNING	Workers may step on the main unit and lose their footing, or may fall when the main unit moves	• Do not step on the machine • If you step on the machine out of need, wear protective equipment	Described in the instruction manual Affix the WARNING labels	6
6	Maintenance/ Inspection	Maintenance/ Inspection		Power supply part to the product	WARNING	Persons turning on the power without notice may result in unexpected operation of the product, and/or injury of workers	Post warning labels so as to prevent unauthorized persons from turning on the power	Described in the instruction manual	9

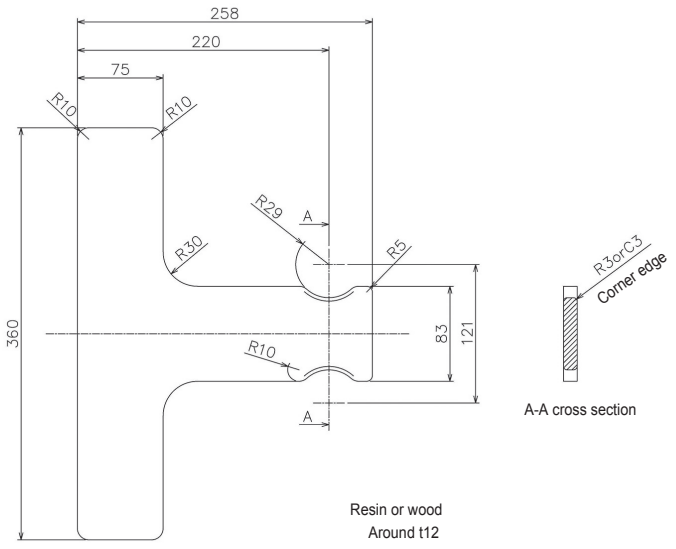
Seriousness of harm

WARNING: Indicates that there is a possibility that severe injury or even death may result if protective measures have not been taken

Residual risk MAP



Appendix 4. Belt tensioning jig



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