POWER MOLLER®'24!

Brushless DC Motor Driver
【CBM-103〔FN〕〔FP〕】User Manual

Thank you for purchasing a Itoh Denki CBM-103 series motor driver. Please read this manual before operating the product, and keep this manual readily accessible for reference.

**Applicable Power Moller models: PM570KE PM605KE PM635KE**

─ What's MDR ? ─
MDR is DC brushless motorized roller for conveyor.
MDR is defined by Conveyor Equipment Manufacturers Association (CEMA) and conveyor built by MDR is well established technology in Material Handling Industry.

ITOH DENKI CO.,LTD.
No.363

● Power connector (CN 1) ──────── 1pce
● Control connector (CN 2) ──────── 1pce
● Mounting screws and nuts
　　Spring washer & Screw M4 x 15 ──2pcs
　　Nut M4 ──────────────── 2pcs
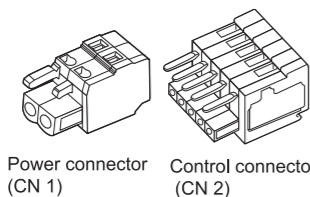
Power connector (CN 1)　　Control connector (CN 2)

Index

1 Safety Instructions

● Switch off the power, when removing from conveyor, wiring or maintenance is done, otherwise you have a risk of electrical shock or injury.
● Respect the electrical regulations of the site or the equipment, where the product in installed. (Labour safety and sanitary regulations, electrical equipment technical standard, etc)
● For accident avoidence the only person designated by employed with training on the operation and the maintenance method is allowed to operate.
● Operate the motor driver within its intended design and specifications to avoid electrical shock, injury, fire, or damage to the equipment.
● Do not use any MDR other than applicalbe models.
● Do not disassemble, repair nor modify the product (for which we do not warrant) It might cause electrical shock, injury or fire.
● Separately set the circuitry to monitor the important input and/or output signal status, which might cause accident, because the signal may stay ON or OFF in case of the CBM-103 driver card failure.
● Be sure to shut off the power before inserting or removing any connector. Do not wire connector left in the CBM-103 driver card.
● Do not operate the CBM-103 driver card with your wet hands.
● Do not drop, give external impact nor pressure to the CBM-103 driver card. If that happens, do not reuse it.
● Make sure all the connecters are properly engaged with wiring cables.
● Make sure the conveyor frame and control box where the CBM-103 driver card is mounted are grounded.
● Do not switch on or off the relay or contactor in close proximity to power or signal lines, or the CBM103 driver card as the generated noise could cause malfunction.
● When the power was turn off, dynamick brake function will not work.
● Do not pull by force during operation. It causes the CBM-103 driver card to malfanction.
● Do not force the Power Moller to turn. It may cause of damage to the driver card or shorten its life cycle.
● Make sure the external controller is powered when CBM-103 is controlled by it. If the external controller is not powered, unexpected behavior may occur on the CBM-103, Power Moller or the external controller.

2 Power

24VDC battery or switching power (24VDC 15A) or [※1] [※2] smoothed and rectified power (≦10% ripple) [※2]
　※1 Use stable power supply with 15A or over.
　※2 The power supply should not be affected by peak current 30A for 1msec.

3 Functions

②VR1　②VR2　①SW1　⑥SW4　③LED1　③LED2
⑦SW3
④CN2
⑤CN1
CBM-103FN
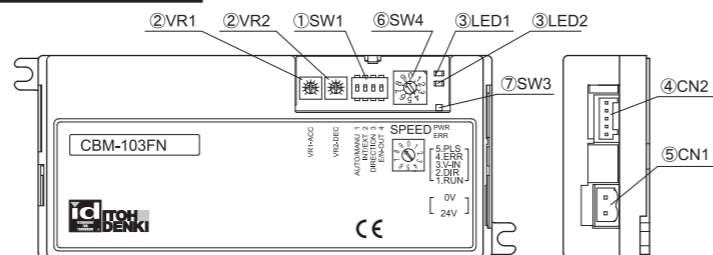
① Dip Switch (SW1)

NO	Function	ON	OFF	Default	Remarks
1	Thermister/ Low voltage/ Back EMF reset	Manual	Automatic	ON	See section 8
2	Speed variation	External	Internal	OFF	See section 5-1
3	Turning direction	See 5-2		OFF	See section 5-2
4	Error signal	Discharges in normal status	Discharges when error arises	OFF	See section 6

② Potentiometer (VR)

		Min (To the CCW end.)	Max (To the CW end.)	Default	Remarks
1	Acceleration from RUN signal	0 sec	2.5 sec	Min	See section 5-3
2	Deceleration from STOP signal	0 sec	2.5 sec	Min	

③ LEDs

	Color	Status	Remarks
1	Green	Powered and functions normally	See section 8
2	Red	Indicates type of error	

④ Control Connector (CN2)

	Function	Remarks
5	Motor pulse signal output	See section 7
4	Error signal output	See section 6
3	External speed variation	See section 5-1
2	Motor turning direction	See section 5-2
1	Motor Run/Stop	See section 5

⑤ Power Connector (CN1)
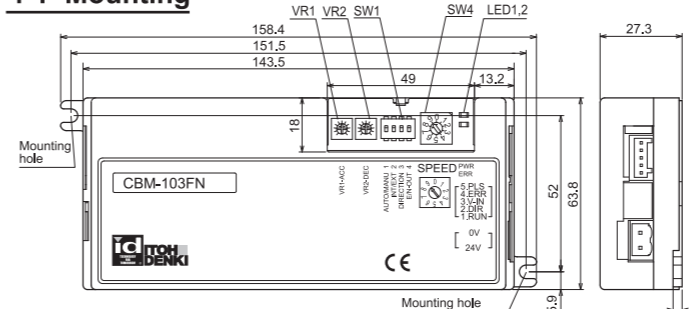
2	0VDC
1	24VDC

⑥ Rotary Switch (SW4)
10 index speed setting　(Remarks： See section 5-1)

⑦ NPN/PNP changing switch of output signal (SW3)

4 Before Operating the Product

4-1 Mounting

VR1 VR2 SW1　SW4　LED1,2
158.4
151.5
143.5
49　13.2
CBM-103FN
SPEED
Mounting hole
Mounting hole
0V 24V
27.3
18
52
63.8
5.9
3

① Drill mounting holes in the conveyor frame to fit the fixing holes in the product.
　※The product's back place should be affixed to metallic plate to ensure the heat dissipation. Care must be paid to prevent the metallic dust entry to the product.
　※Make sure the conveyor is adequately grounded.
② Fix the product tightly to the conveyor frame with the supplied mounting screws and nuts with the recommended fastening torque between 1.5Nm and 1.9Nm.

4-2 Wiring

・Wiring should be made while the product is not powered.
・Switch for Run/Stop or CW/CCW is an option and is not supplied.
・Relay contact or PLC output can be used instead of the above switch.
・Wiring to the supplied connectors should be made before inserting into the driver card.
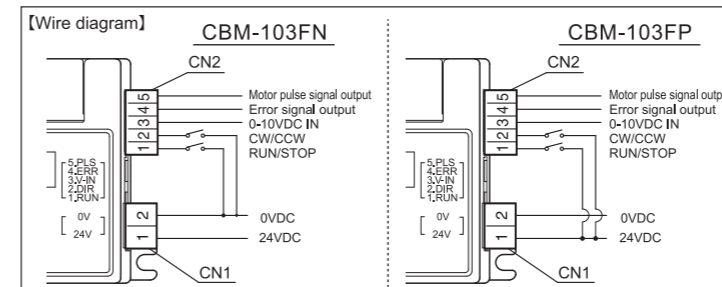
① Wire 24VDC and 0VDC to the Power Connector CN 1(2P)

0VDC
24VDC
8～9mm　1.25～2.5mm² (AWG:16～12)
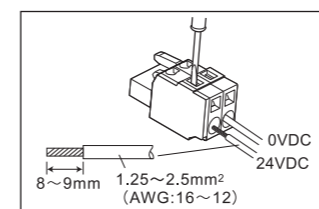
★ Connector current capacity is 16A. Avoid wiring causing excessive current.
★ Make sure the +/- wiring is correct.
★ Wiring should be made before inserting into the driver card.

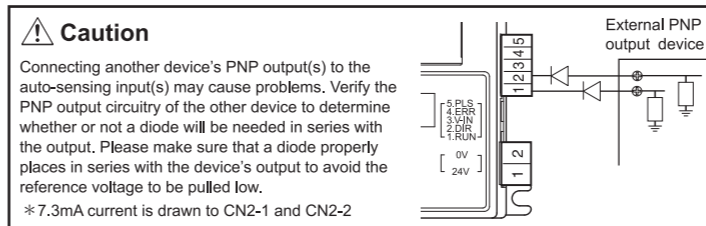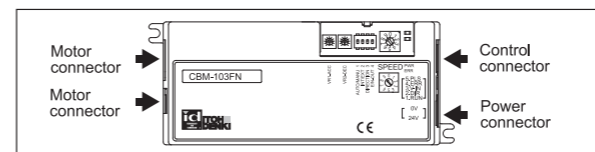② Wire to the Control Connector CN 2 (5P) per the diagram in section 3

7mm　0.08～0.5mm² (AWG:28～20)
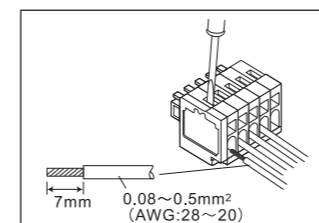
★ 0VDC to CN2-1 and CN2-2 should be common to the power voltage. (connector current capacity is 4A)
★ Analog voltage input to CN2-3 should not exceed 10VDC. 0VDC should be common to the power voltage.
★ Error signal from CN2-4 is NPN [FN], PNP [FP] open collector.
★ Motor pulse signal from CN2-5 is NPN open collector.

【Wire diagram】

CBM-103FN

CN2
Motor pulse signal output
Error signal output
0-10VDC IN
CW/CCW
RUN/STOP
5-PLS
4-ERR
3-V-IN
2-DIR
1-RUN
0V 24V
CN1
0VDC
24VDC

CBM-103FP

CN2
Motor pulse signal output
Error signal output
0-10VDC IN
CW/CCW
RUN/STOP
5-PLS
4-ERR
3-V-IN
2-DIR
1-RUN
0V 24V
CN1
0VDC
24VDC

CN2　#1 Motor run and stop (mandatory)　See section 5 in the page 3
　　　#2 Motor direction (CW/CCW)　　See section 5-2
　　　　* Motor turning direction setting and speed variation can also be done by dip switch on the PCB.
　　　#3 External speed variation by analog voltage change　See section 5-1
　　　　* Speed variation can also be done by rotaly switch on the PCB.
　　　#4 Discharge of error signal　　See section 6
　　　#5 Discharge of motor pulse　　See section 7

③ Insert the pre-wired Power Connector CN 1 and Control Connector CN 2 into the counter connector in the drive card, and insert Motor Connector into CN 3 and CN4 while the power is shut off.

Motor connector
Motor connector
CBM-103FN
Control connector
Power connector

⚠ **Caution**

Connecting another device's PNP output(s) to the auto-sensing input(s) may cause problems. Verify the PNP output circuitry of the other device to determine whether or not a diode will be needed in series with the output. Please make sure that a diode properly places in series with the device's output to avoid the reference voltage to be pulled low.
※7.3mA current is drawn to CN2-1 and CN2-2.

External PNP output device
5-PLS
4-ERR
3-V-IN
2-DIR
1-RUN

4-3 Direction setting

Dip switch 1-3 and CN-2 is to select the motor turning direction viewed from the Power Moller's power cable side. See section 5-2

5 Operation Instructions

─ Ensure the following before operating the product ─
・Power Moller is adequately installed in compliance with the manual.
・Power Moller shafts are adequately secured with the supplied brackets or accessories.
・Each connector on the driver card is adequately wired and inserted.
・Operating and environmental conditions are respected.
・Power supply has sufficient capacity (stable 24VDC, 15A or over) so as not to be affected by varying load. The protector for the power supply should not react with peak current 30A 1 milli-second or less.

① Supply 24VDC to the driver card, and the LED 1 (green) illuminates.
② Close the contact of CN2-1, and Power Moller starts running.
　※0VDC should be common to the power voltage.
　※2.2mA～7.3mA is required for RUN signal.
　※Wait 1 second after the driver card is powered before running Power Moller.
　※Signal input should be over 15ms to prevent malfunction.

RUN
V-IN DIR RUN 1 2 3
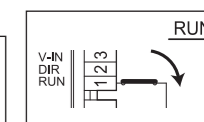
③ Open the contact of CN2-1, and the Power Moller stops.
　※Power Moller run/stop should be manipulated only by CN2-1 and 0VDC, not by the 24VDC power to the driver card.

STOP
V-IN DIR RUN 1 2 3
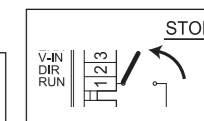
④ To vary the motor speed, follow the section 5-1.
⑤ To reverse the motor, follow the section 5-2.
⑥ To accelerate or decelerate the motor, follow the section 5-3.

5-1 Speed Variation

Speed of the Power Moller can be varied either internally by integral dip switch or externally by analog voltage input.

・Range of speed variation differs according to the Power Moller model. Check the nominal speed of the model from the circular label put on its end housing.

Example
PM605KE-15-1000-D-024
Model　　Nominal Speed
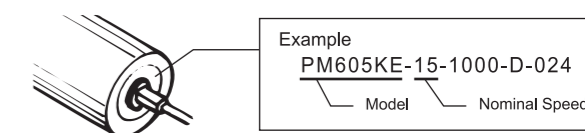
【 5-1-1　Internal Speed variation 】
①Set the SW1-2 OFF to effect the internal speed variation.
②With the combination of SW4, speed can be varied in 10 steps.

【 5-1-2　External Speed Variation 】
① Set the SW1-2 ON to effect the external speed variation.
② Inject and vary the analog voltage between 0 and 10VDC to CN2-3 to vary the motor speed in 16 steps.
　※ Max 7.3mA current is consumed at CN2-3.
　※ The analog voltage input should not exceed 10VDC.
　　Its 0VDC should be common to the Power voltage.

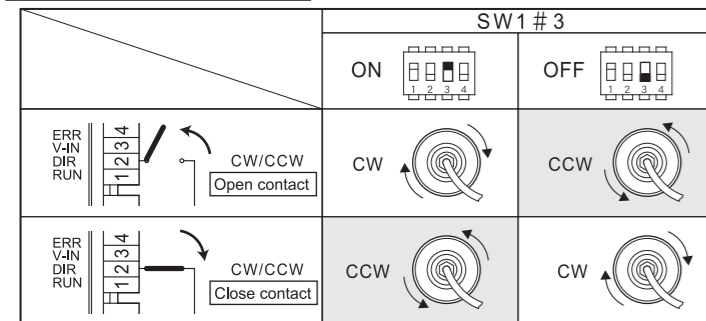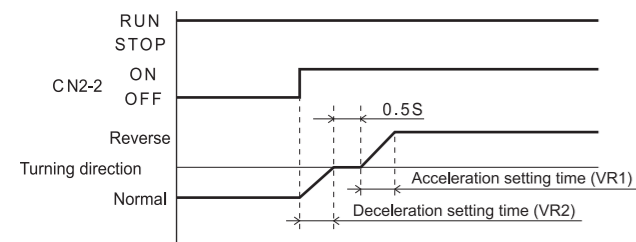| **PM570KE**	Speed deviation +/-3%				**PM605KE**	Speed deviation +/-3%		
SW1#2 OFF	Peripheral velocity (m/min)		SW1#2 ON		SW1#2 OFF	Peripheral velocity (m/min)		SW1#2 ON
DIP-SW4 (Rotary Switch)	Nominal Speed 55	Nominal Speed 15	CN2#3 External voltage (V)		DIP-SW4 (Rotary Switch)	Nominal Speed 55	Nominal Speed 15	CN2#3 External voltage (V)
9	54.3	14.3	9.5～10.0		9	57.6	15.2	9.5～10.0
8	50.9	13.4	8.9～9.3		8	54.0	14.2	8.9～9.3
7	47.5	12.5	8.2～8.6		7	50.4	13.3	8.2～8.6
–	44.3	11.7	7.6～8.0		–	47.1	12.4	7.6～8.0
6	40.8	10.7	7.0～7.4		6	43.3	11.4	7.0～7.4
–	37.5	9.9	6.4～6.8		–	39.8	10.5	6.4～6.8
5	34.1	9.0	5.7～6.1		5	36.2	9.6	5.7～6.1
–	30.7	8.1	5.1～5.5		–	32.6	8.6	5.1～5.5
4	27.3	7.2	4.5～4.9		4	29.0	7.6	4.5～4.9
–	23.9	6.3	3.9～4.3		–	25.3	6.7	3.9～4.3
3	20.5	5.4	3.2～3.6		3	21.8	5.7	3.2～3.6
–	17.1	4.5	2.6～3.0		–	18.1	4.8	2.6～3.0
2	13.6	3.6	2.0～2.4		2	14.4	3.8	2.0～2.4
1	10.1	2.7	1.4～1.8		1	10.8	2.8	1.4～1.8
0	6.8	1.8	0.7～1.1		0	7.2	1.9	0.7～1.1
–	3.4	0.9	0～0.5		–	3.6	1.0	0～0.5

5-2 Direction Setting

Reverse direction by external DIR signal can be permitted even while motor is running. Power Moller turning direction can be set or changed either internally by integral dip switch or externally by optional switch.

Setting for Turning Direction

	SW1 # 3
	ON / OFF
ERR V-IN DIR RUN (Open contact)	CW/CCW → CW (CW) / CCW (CCW)
ERR V-IN DIR RUN (Close contact)	CW/CCW → CCW (CCW) / CW (CW)

＊Turning direction viewed from the Power Moller's power cable side.
＊0VDC should be common to power voltage.
＊2.2 mA～7.3mA current is required for DIR signal.

Reverse motor direction by external DIR signal

RUN STOP
CN2-2 ON OFF
Reverse
Turning direction
Normal
0.5S
Acceleration setting time (VR1)
Deceleration setting time (VR2)

＊Reverse direction by DIP switch is prohibited while motor is running. Motor must be stopped first, and then reverse a direction by DIP switch.

5-3 Acceleration and Deceleration

① Integral potentiometer VR 1 allows the acceleration adjustment from 0 to 2.5 seconds.
② Integral potentiometer VR 2 allows the deceleration adjustment from 0 to 2.5 seconds.

・The adjustable range of time is on the control basis, thus may differs on actual transfer speed.

Set speed
VR1   VR2
RUN signal Input   Stop signal Input
VR1・VR2
0 sec (min)   2.5 sec (max)
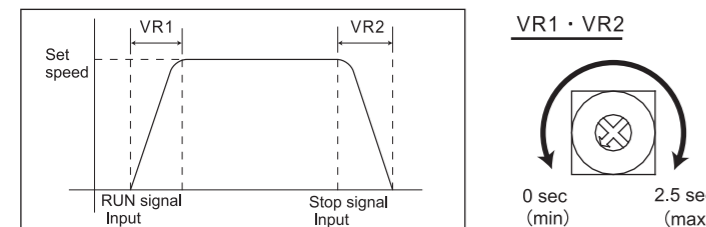
6 Error Signal Output

Error signal is discharged from CN2-4

・Disregard the error signal discharged when power is injected to the driver card (for 0.5 sec) and when power to the driver card is shut off (for 2 seconds).
・To monitor the error signal, a protective resistor should be mounted to suppress 24VDC to 25mA or less.

SW1-4 allows the selection of the error signal discharge timing: discharge on normal status or discharge when error arises.
　＊See section 8 for error status, reset and history.

〔FN〕	〔FP〕
NPN open collector output	NPN open collector output

SW1#4 OFF	SW1#4 ON
Error signal discharges when error arises	Error signal discharges in normal status
Open on normal	Open on error

＊Output voltage at error signal output current, 25mA 〔FN〕…3VDC, 〔FP〕…20.7VDC
＊When signal output is OFF, leak current of 20μA is drawn.
＊The driver card has 100Ω protective resistor.

7 Motor Pulse Signal Output

・Power Moller's motor pulse signal is discharged from CN2-5.
・2 pulses/motor rotation, NPN open collector output.

・To monitor the signal, a protective resistor should be mounted to suppress 24VDC to 25mA or less.

Speed deviation +/-3%

DIP-SW4 (Rotary switch)	Frequency (Hz)	Motor speed (rpm)	Analog voltage input	DIP-SW4 (Rotary switch)	Frequency (Hz)	Motor speed (rpm)	Analog voltage input
9	146	4378	9.5～10.0	4	74	2208	4.5～4.9
8	137	4103	8.9～9.3	n.a	64	1925	3.9～4.3
7	128	3833	8.2～8.6	3	55	1653	3.2～3.6
n.a	119	3576	7.6～8.0	n.a	46	1375	2.6～3.0
6	110	3293	7.0～7.4	2	37	1098	2.0～2.4
n.a	101	3026	6.4～6.8	1	27	818	1.4～1.8
5	92	2760	5.7～6.1	0	19	555	0.7～1.1
n.a	83	2475	5.1～5.5	n.a	9	275	0～0.5

＊100Ω resistor is built-in the driver card's output section for motor pulse signal.

8 Error Status, Reset and History

・When error arises, the error can be identified either by LED 1 (green) and LED 2 (red), or by the error signal discharged from CN2-4.

・To reset the error status, first remove the cause of error, and then switch the direction signal at CN2-2.
・To restart the Power Moller, first remove the cause of error, and then re-inject run signal at CN2-1.
・Error can also be reset by shutting off the power 2 seconds or over.

LED indication

Illuminates	blinks at 1Hz	blinks at 6Hz	off	three blinks off (1.5 sec.)	two blinks off (1.5 sec.)

LED 1 (green) LED 2 (red)	CN2-4 (Error signal) SW1#4 OFF / SW1#4 ON	Power Moller	Symptom/ Causes	Reset the error signal	Restart Power Moller
	Open / Discharge	n.a.	Normal operation	n.a.	
	Open / Open	Stop	No power	Supply 24VDC power	See Operating instructions in page3
	Discharge / Open	Stop	PCB damaged	Shut off the power then replace the driver card	See Operating instructions in page3
	Discharge / Open	Stop	Thermister reacted (Thermister error)	**Automatic recovery setting (SW1-1 OFF)** Power Moller restarts immediately 1 minute after thermister recovery from cooling off	
				Power Moller restarts by injecting RUN signal followed by STOP signal to CN2-1 to reset the error signal then inject RUN signal to CN2-1 to restart, 1 minute after thermister recovery	
				After thermister recovery, inject signal ON-OFF-ON or OFF-OFF-ON order to CN2-2	Inject signal RUN-STOP -RUN order to CN2-1
					Restarts automatically in a minute
				Manual recovery setting (SW1-1 ON) Power Moller restarts by injecting RUN signal followed by STOP signal to CN2-1 to reset the error signal then inject RUN signal to CN2-1 to restart, 1 minute after thermister recovery	
				After thermister recovery, inject signal ON-OFF-ON or OFF-ON-OFF order to CN2-2	Inject signal RUN-STOP-RUN order to CN2-1
	Discharge / Open	Stop	Connector, CN3 unplugged	Shut off the power, turn off CN2-2 and replug in the connector properly.	See Operating instructions in page3
	Discharge / Open	Stop	Motor stall for 1 second ※1 (Stall error)	Inject signal RUN-STOP-RUN order to CN2-1 to reset the error and to restart	
				Inject signal ON-OFF-ON or OFF-OFF-ON order to CN2-2	Inject signal RUN-STOP-RUN order to CN2-1 to restart
				Connector, CN4 unplugged: Shut off the power, turn off CN2-1 and replug in the connector properly.	See Operation instructions in page3
	Open / Discharge	n.a.	(Operating in overload)	(No signal)	

(continued right column)

LED 1 (green) LED 2 (red)	CN2-4 (Error signal) SW1#4 OFF / SW1#4 ON	Power Moller	Symptom/ Causes	Reset the error signal	Restart Power Moller
	Discharge / Open	Stop	Supply voltage less than 15VDC for 1 second. Supply voltage less than 15VDC 5 times for 500ms. (Under voltage error)	**Automatic recovery setting (SW1-1 OFF)** Secure the stable supply voltage 18VDC or over.	Restarts immediately
				Manual recovery setting (SW1-1 ON) First secure the stable supply voltage 18VDC or over, then inject signal RUN-STOP-RUN order to CN2-1 for error reset and restart	
				First secure the stable supply voltage 18VDC or over, then inject signal ON-OFF-ON or OFF-ON-OFF order to CN2-2	Inject signal RUN-STOP-RUN order to CN2-1 to restart
	Discharge / Open	Stop	※2 Supply voltage 40 VDC or over to Power Moller for 0.15 second. (Back EMF error)	**Automatic recovery setting (SW1-1 OFF)** Supply voltage less than 30VDC	Restarts immediately
				Manual recovery setting (SW1-1 ON) When voltage less than 30VDC is supplied to Power Moller, inject signal RUN-STOP-RUN order to CN2-1 for error reset and restart.	
				When voltage less than 30VDC is supplied, inject signal ON-OFF-ON or OFF-ON-OFF order to CN2-2	Inject signal RUN-STOP-RUN order to CN2-1 to restart

※1 When lock error occurs, the error signal can't be reset for 4 seconds.
※2 The error signal may occur when Power Moller rotates over the setting speed.

9 Troubleshooting

＊Follow the procedures below without removing plastic cover or modifying the driver card, in case any problem happens.

Symptom 1: Power Moller does not run

Power	・Check if only LED 1 (green) illuminates. ・Check if 24VDC stable voltage is adequately supplied from the power supply. ・Check if the wiring to CN1 connector is made correctly. ・Check if 24VDC cable is adequately wired to the CN 1 connector.
RUN signal	・Check if 0VDC is injected to CN2-1. ・Check if the 0VDC injected to CN2-1 is common to 0VDC injected to CN1-2. ・Check if the wiring is adequately made to CN2-1 connector.
Error	・Check if LED 2 is illuminating or blinking. If this is the case, see section 8 and remove the cause of error.
Power Moller	・Check if the Power Moller is adequately installed and its shafts are adequately fixed with the supplied mounting brackets or accessories. ・Check if the Power Moller end housing is NOT contacting conveyor frame. ・Check if the Power Moller's connector is properly inserted to the driver card. ・Check if the o-ring or belt tension is not too strong for two grooved tube or V belt pulley endcap. ・Check if the number of slaved idler rollers is adequate.

Symptom 2 : Speed variation is not achieved, or speed is slower than expected

Power Moller	・Check if the nominal speed of the Power Moller to see if the right model is used to achieve the speed variation or to reach expected speed.
SW1-2 setting	・Check if the SW1-2 is set properly: ON for external speed variation and OFF for internal speed variation.
Power	・In case of external speed variation, check if the 0VDC is common to the 0VDC input to CN1-2. ・Check if the stable 24VDC is supplied.
CN2-3 (In case of external speed variation)	・Check if the wiring is adequately made to CN2-3 connector. ・Check if the analog voltage input is made between 0 and 10VDC.

Symptom 3 : Reversing is not achieved

CW/CCW	・Check if 0VDC is injected to CN2-2, and it is common to the 0VDC input to CN1-2. ・Check if the wiring is adequately made to CN2-1.
Operating SW 1 #3	・Check if SW1#3 is not operated while Power Moller is rotating. Stop Power Moller rotating and operate SW1#3 or CN2-2.

Symptom 4 : Error Signal Not Discharged

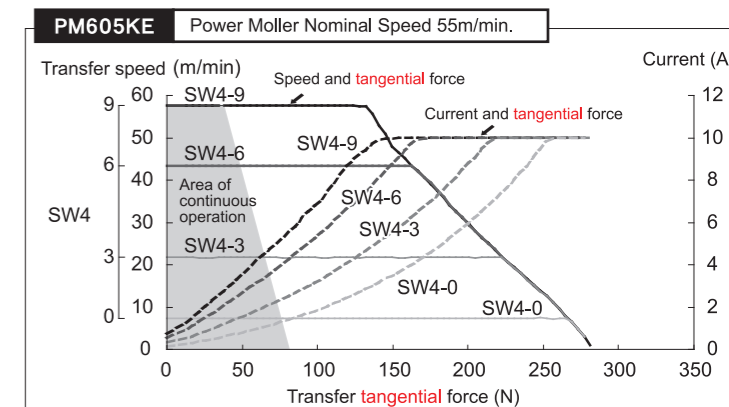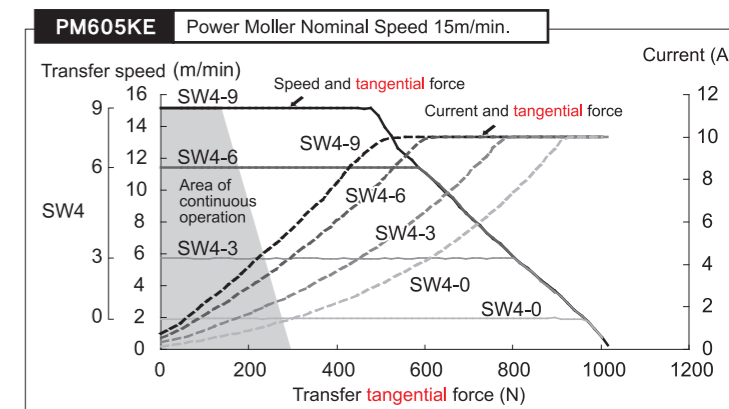| SW1-4	・Check if the setting is made properly for discharge on normal or discharge when error arises.
Voltage	・Check if the external voltage is 24VDC or less and its 0VDC is common to the 0VDC input to CN1-2. ・Check if the resistor larger than 1kΩ is mounted.
CN2-4	・Check if the wiring is adequately done to CN2-4.

Symptom 5 : Error Signal is often Discharged

LED 2 (red)	・Check if the LED 2 is blinking. If this is the case, see section 8 in page 5 and remove the cause of error.
Environment	・Check if the product is used in the ambient temperature range between 0 and 40℃. ・Check if the driver card back plate is affixed to the metallic plate face for better heat dissipation. ・Check if the Power Moller is stalled in the conveyor line.
Power Moller	・Check if the Power Moller end housing is contacting the conveyor frame. ・Check if the Power Moller's connector is properly inserted to the driver card. ・Check if the Power Moller's connector is disconnected, or about to disconnect.

10 Specifications

Power voltage	24VDC±10%		Type of brake	※1 Dynamic brake
Rated voltage	24VDC		Pin header for driver	Power: 231-432/001-000 (WAGO)
Static current	0.06A			Control: 733-365 (WAGO)
Peak current	30A ※1msec		Connector (wiring side)	Power: 231-102/026-000 (WAGO)
Starting current	10A±0.4A			Control: 733-105 (WAGO)
Motor starts running from RUN signal	≦15msec		Power Moller connector	CN3: JST S7B-XH-A
Error signal discharge	〔FN〕:NPN / 〔FP〕:PNP Open collector output (should be set to 25mA to less max output current)			CN4: JST S3P-VH
Motor pulse output	NPN Open collector output (should be set to 25mA to less max output current)	Environment	Ambient temperature	0 to +40℃
			Relative humidity	≦90%RH (no condensation)
LED	Power (green) Error (red)		Atmosphere	No corrosive gas
			Vibration	≦0.5G
Protections	Integral 18A fuse (+ side) Diode against miss-wiring Fuse against burnout of PCB		Applicable standard	RoHS EMC 〔EN61000-6-2 / EN61000-6-4〕
Thermister	95℃ on PCB or 105℃ in motor			※1 No holding effect.

11 Power Moller characteristics diagram

PM605KE Power Moller Nominal Speed 15m/min.

PM605KE Power Moller Nominal Speed 55m/min.

Contacts:

Specifications are subject to change without prior notice.

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