Thank you for purchasing an Oriental Motor product. This Operating Manual describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

- **Items supplied with all actuator and driver package models**
  - Actuator........................................1 unit
  - Driver ........................................ 1 unit
  - CN1 connector (3 pins)....................1 pc.
  - CN2 connector (5 pins)....................1 pc.
  - CN3 connector (10 pins)............... 1 pc.
  - OPERATING MANUAL (Driver: this document)........1 copy
  - OPERATING MANUAL (Actuator)...........1 copy

- **Item supplied with the electromagnetic brake type actuator and driver package models**
  - Varistor....................................1 pc.

- **Item supplied with the connector-coupled actuator and driver package models**
  - Actuator connector leads [0.6 m (2 ft.), 5 pins].........1 pc.

(Applicable product: All models for the DRL20/DRL28 and models of high-resolution motor for the DRL42/DRL60)

The actuator (short name) and driver combinations are shown in the table below.

<table>
<thead>
<tr>
<th>Model (short name)</th>
<th>Actuator model (short name)</th>
<th>Driver model</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRL20</td>
<td>DRLM20</td>
<td>LRD503-K</td>
</tr>
<tr>
<td>DRL28</td>
<td>DRLM28</td>
<td>LRD507-K</td>
</tr>
<tr>
<td>DRL42</td>
<td>DRLM42</td>
<td>LRD514-K</td>
</tr>
<tr>
<td>DRL60</td>
<td>DRLM60</td>
<td>LRD514-K</td>
</tr>
</tbody>
</table>

- **How to identify the model for the DRL II Series actuator and driver package and the actuator model**

![Image showing how to identify the model for the DRL II Series actuator and driver package and the actuator model]

1. The actuator models begin with a description of “DRLM.”
2. The code that describes the driver is not included for the actuator models.

---

**Introduction**

- **Before use**
  Only qualified personnel should work with the product. Use the product correctly after thoroughly reading the section "Safety precautions."

The product described in this manual has been designed and manufactured for use in general industrial equipment. Do not use for any other purpose. For the driver power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

- **Overview of the product**
  The compact linear actuator DRL II Series is an actuator and driver package product consisting of a case type microstep driver offering the smooth drive function and a linear motion type actuator adopting a 5-phase stepping motor integrated with a ball screw.

- **Operating manuals for the DRL II series**
  Operating manuals for this product are listed below. After reading the following manuals, keep them in a convenient place so that you can reference them at any time.
  - **DRL II Series Actuator OPERATING MANUAL**
  - **DRL II Series Pulse input type Driver OPERATING MANUAL (this document)**
  - **CRK Series Pulse input type OPERATING MANUAL**

The OPERATING MANUAL for this product is common with the CRK Series. This manual does not come with the product. For details, contact your nearest Oriental Motor sales office.

- **Hazardous substances**
  The products do not contain the substances exceeding the restriction values of RoHS Directive (2011/65/EU).

- **Republic of Korea, Radio Waves Act**
  Seller and user shall be noticed that this equipment is suitable for electromagnetic equipments for office work (Class A) and it can be used outside home.

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

- **Checking the product**
  Verify that the items listed below are included. Report any missing or damaged items to the branch or sales office from which you purchased the product.

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Guide type</th>
<th>Table type</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 : 220 mm (D0.79 in.)</td>
<td>G : Guide type</td>
<td>V : Table type</td>
</tr>
<tr>
<td>28 : 208 mm (D1.10 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42 : 242 mm (D1.65 in.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 : 260 mm (D2.36 in.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Series name: DRL20 G - 02 B 1 P N - K B

Power supply: 24 V DC

Additional functions:
- Blank : Without additional functions
- N : With adjustable knob
- M : With electromagnetic brake

Motor type:
- P : Standard motor
- M : High-resolution motor

Lead:
- 1 : 1 mm (0.039 in.)
- 2 : 2 mm (0.079 in.)
- 4 : 4 mm (0.157 in.)
- 8 : 8 mm (0.315 in.)

Lead screw type:
- A : Rolled ball screw type
- B : Ground ball screw type

Acuator type:
- None : Standard type
- G : Guide type

Stroke:
- 02 to 10 : 25 to 100 mm (0.98 to 3.94 in.)

Driver type:
- +2 : Pulse input type driver
- K : DC 24 V

Blank : Without additional functions

With adjusting knob

With electromagnetic brake

DRL II Series is an actuator and driver package consisting of a case type microstep driver offering the smooth drive function and a linear motion type actuator adopting a 5-phase stepping motor integrated with a ball screw.
### Names and functions of parts

#### Front side of the driver

- **POWER LED (green)**
  - This LED is lit while the power is input.
- **Power supply connector (CN1)**
  - Connects the main power supply (+24 VDC).
- **Motor connector (CN2)**
  - Connects the motor.
- **I/O signals connector (CN3)**
  - Connects the I/O signals of the controller.

#### Upper side of the driver

- **Step angle setting switch (SW1)**
  - Sets the step angle.
- **Pulse input mode select switch (SW2-1)**
  - Selects the pulse input mode.
- **Not used (SW2-2)**

### Installation

**Location for installation**

The driver has been designed and manufactured for use as components to be installed inside equipment. Install them in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature 0 to +40 °C (+32 to +104 °F) (non-freezing)
- Operating ambient humidity 85% or less (non-condensing)
- Area that is free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- 1000 m (3300 ft.) or lower above sea level

**Installing the driver**

#### Installation direction

Mount the driver to a 35 mm (1.38 in.) width DIN rail. When installing two or more drivers in parallel, it is possible to install them closely in the horizontal direction. Provide a minimum clearance of 50 mm (1.97 in.) in the vertical direction.

When installing three or more drivers closely, the heat generation of the inside drivers become high. Install the less frequently used drivers toward the inside.

**Note**

- Install the driver in an enclosure whose pollution degree is 2 or better environment, or whose degree of protection is IP54 minimum.
- Be sure to install the driver vertically (vertical position). If the driver is installed in the direction other than vertical position, its heat radiation effect will deteriorate.

#### Installation method

- Pull down the driver DIN lever and lock it. Hang the hook at the rear to the DIN rail, and push in the driver. After installation, secure the both sides of the driver with the end plate.

**Removing from DIN rail**

Pull the DIN lever down until it locks using a flat tip screwdriver, and lift the bottom of the driver to remove it from the rail. Use force of about 10 to 20 N (2.2 to 4.5 lb.) to pull the DIN lever to lock it. Excessive force may damage the DIN lever.
Connection

Connection example

![Connection diagram]

Power supply current capacity

<table>
<thead>
<tr>
<th>Driver model</th>
<th>LRD503-K</th>
<th>LRD507-K</th>
<th>LRD514-K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply input voltage</td>
<td>24 VDC±10%</td>
<td>24 VDC±10%</td>
<td>24 VDC±10%</td>
</tr>
<tr>
<td>Power supply current capacity</td>
<td>0.7 A or more</td>
<td>1.4 A or more</td>
<td>2.5 A or more</td>
</tr>
</tbody>
</table>

Connecting method

- **Common to CN1 and CN2**
  1. Strip the insulation cover of the lead wire by 7 mm (0.28 in.)

![Strip wire diagram]

2. Insert each lead wire into the connector and tighten the screw.

![Insert and tighten diagram]

3. Insert the connector and tighten the screws.

![Connect and tighten diagram]

### Note
- Have the connector plugged in securely. Insecure connections may cause malfunction or damage to the motor or driver.
- When cycling the power or plugging/unplugging the connector, turn off the power and wait for 5 seconds before doing so.

- **CN3**
  1. Strip the insulation cover of the lead wire by 8 mm (0.31 in.)
  2. Insert the lead wire while pushing the button of the orange color with a screwdriver.

![Insert with orange button diagram]

3. After having inserted, release the button to secure the lead wire.

### Note
- When connecting, pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver.
- Do not wire the power supply cable in the same cable duct with other power line or motor cable.

Connecting the electromagnetic brake

- **Connecting the power supply for electromagnetic brake**

The electromagnetic brake operates via the ON/OFF status of the DC power supply. Provide a DC power supply of 24 VDC±5% 0.08 A or more for the DRL42, or 24 VDC±5% 0.25 A or more for the DRL60, for use exclusively for the electromagnetic brake. Use a shielded cable of AWG24 (0.2 mm²) or thicker to connect the electromagnetic brake to the DC power supply, keeping the length as short as possible.

### Note
- When connecting, pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver.
- Do not wire the power supply cable in the same cable duct with other power line or motor cable.

- **Connecting method**

Connect two lead wires [600 mm (23.6 in.))] from the actuator to the DC power supply.

1. Connect the red/white lead wire to the +24 VDC terminal of the DC power supply.
2. Connect the black/white lead wire to the ground terminal.
3. Connect the surge suppressor (Varistor: supplied) in parallel between the +24 VDC terminal and ground terminal of the DC power supply.

The surge suppressor does not have polarity.
Do not apply the voltage beyond its specifications. Doing so may increase the temperature rise in the electromagnetic brake, resulting in damage to the actuator. Conversely, insufficient voltage may prevent the brake from releasing.

Be sure to connect the surge suppressor to protect the contact of the switch or to prevent electrical noise.

Connect the lead wires of the electromagnetic brake in the correct polarities since they have polarities. Connecting the lead wires in reverse polarity will not properly operate the electromagnetic brake.

Provide separate power supplies for the I/O signals and the electromagnetic brake.

Note

Pin assignments list

**CN1: Power supply connector**
Connect using the supplied CN1 connector (3 pins).

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Name Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24 VDC +24 VDC power supply input</td>
</tr>
<tr>
<td>2</td>
<td>GND Power supply GND</td>
</tr>
<tr>
<td>3</td>
<td>FG Frame Ground</td>
</tr>
</tbody>
</table>

**CN2: Motor connector**
Connect using the supplied CN2 connector (5 pins).

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blue motor lead wire</td>
</tr>
<tr>
<td>2</td>
<td>Red motor lead wire</td>
</tr>
<tr>
<td>3</td>
<td>Orange motor lead wire</td>
</tr>
<tr>
<td>4</td>
<td>Green motor lead wire</td>
</tr>
<tr>
<td>5</td>
<td>Black motor lead wire</td>
</tr>
</tbody>
</table>

**CN3: I/O signal connector**
Connect using the supplied CN3 connector (10 pins).

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Type</th>
<th>Signal name Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input</td>
<td>CW(PLS)+ CW pulse signal (Pulse signal)</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>CW(PLS)- CW pulse signal (Pulse signal)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>CCW(DIR)+ CCW pulse signal (Rotation direction signal)</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>CCW(DIR)- CCW pulse signal (Rotation direction signal)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>AWO All winding off signal</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>CS Step angle select signal</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>ACOFF Automatic current cutback release signal</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>IN-COM Input common</td>
</tr>
<tr>
<td>9</td>
<td>Output</td>
<td>TIM+ Timing signal</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>TIM- Timing signal</td>
</tr>
</tbody>
</table>

* The descriptions in parentheses apply to the 1-pulse input mode.

Note

**Setting the switches**

Be sure to turn off the driver power before setting the switches. If the switches are set while the power is still on, the new switch settings will not become effective until the driver power is cycled.

**Pulse input mode**

Either the 1-pulse input mode or 2-pulse input mode can be selected in accordance with the controller used. The factory setting of the pulse-input mode depends on the destination country.

**Step angle (Resolution)**

Set a desired step angle using the step angle setting switch (SW1). See the following table for the step angles that can be set. The following table is an example for 1 mm lead of the actuator.

<table>
<thead>
<tr>
<th>SW1 Dial setting</th>
<th>Number of divisions</th>
<th>Resolution (mm)</th>
<th>Step angle (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0.002</td>
<td>0.72</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0.001</td>
<td>0.36</td>
</tr>
<tr>
<td>2</td>
<td>2.5</td>
<td>0.0008</td>
<td>0.288</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>0.0005</td>
<td>0.18</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>0.0004</td>
<td>0.144</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>0.00025</td>
<td>0.09</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>0.0002</td>
<td>0.072</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>0.0001</td>
<td>0.036</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>0.00008</td>
<td>0.0288</td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>0.00005</td>
<td>0.018</td>
</tr>
<tr>
<td>A</td>
<td>50</td>
<td>0.00004</td>
<td>0.0144</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
<td>0.000025</td>
<td>0.009</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td>0.00002</td>
<td>0.0072</td>
</tr>
<tr>
<td>D</td>
<td>125</td>
<td>0.000016</td>
<td>0.00576</td>
</tr>
<tr>
<td>E</td>
<td>200</td>
<td>0.00001</td>
<td>0.0036</td>
</tr>
<tr>
<td>F</td>
<td>250</td>
<td>0.000008</td>
<td>0.00288</td>
</tr>
</tbody>
</table>

* The resolutions are given as theoretical values.
* For the high-resolution motor, the resolution is half of the amount on the table.
* Do not change the resolution select switch while the actuator is operating. Doing so may cause the actuator to malfunction.

Conversion formula for number of divisions

\[
\text{Number of divisions} = \frac{\text{Basic resolution [mm (in.)]}}{\text{Resolution [mm (in.)]}}
\]

**Basic resolution list**

<table>
<thead>
<tr>
<th>Model</th>
<th>Basic resolution [mm (in.)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRL20</td>
<td>0.002 (0.000079)</td>
</tr>
<tr>
<td>DRL28</td>
<td>0.002 (0.000079)</td>
</tr>
<tr>
<td>DRL42</td>
<td>0.004 (0.00016)</td>
</tr>
<tr>
<td>DRL42</td>
<td>0.016 (0.00063)</td>
</tr>
<tr>
<td>DRL60</td>
<td>0.008 (0.00031)</td>
</tr>
</tbody>
</table>

* The resolutions are given as theoretical values.
Safety precautions

Handling the product without observing the instructions that accompany a “Warning” symbol may result in serious injury or death.

General
- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- Assign qualified personnel to the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire or injury.
- When the actuator is used for vertical drive such as elevating equipment etc., provide a safety brake mechanism in addition to using an electromagnetic brake type actuator to hold the load position. The actuator loses its holding torque if the power is shut off, allowing the moving part to fall and possibly cause injury or damage to equipment.
- Do not use the brake mechanism of the electromagnetic brake type actuator to reduce speed or as a safety brake. Use the electromagnetic brake to hold the moving part or actuator in position. Failure to do so may result in injury or damage to equipment.
- Do not use the brake mechanism of the electromagnetic brake type actuator to reduce speed or as a safety brake. Use the electromagnetic brake to hold the moving part or actuator in position. Failure to do so may result in injury or damage to equipment.
- Do not touch the moving part (screw shaft) of the actuator while operating. Doing so may cause injury.
- Set the operating speed and travel amount so that the moving part (screw shaft) of the actuator does not stop by hitting the stroke end or load. Failure to do so may result in injury or damage to equipment.
- Do not operate the driver beyond its specifications. Doing so may result in injury or damage to equipment.
- Do not touch the drive while operating or immediately after stopping. The drive surface is hot and may cause a skin burn(s).
- Do not forcibly bend or pull the power supply cable or motor lead wire that is connected to the drive. Doing so may cause stress to the drive, which may result in damage.

Installation
- Keep the area around the driver free of combustible materials. Failure to do so may result in fire or skin burn(s).
- Do not leave anything around the driver that would obstruct ventilation. Doing so may result in damage to equipment.
- Always use the driver with a power supply of the rated voltage. Failure to do so may result in fire.
- For the driver power supply, use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- Connect the lead wires and cables securely according to the wiring diagram. Failure to do so may result in fire.
- Do not forcibly bend, pull or pinch the power supply cable or motor lead wire. Doing so may result in fire.
- Use the actuator and driver in the specified combination. Failure to do so may result in fire.
- Provide an emergency-stop device or emergency-stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Turn on the power to the drive after making sure all input signals of the driver are turned OFF. Failure to do so may cause the actuator to start accidentally, resulting in injury or damage to equipment.
- Do not touch the moving part (screw shaft) of the actuator while operating. Doing so may cause injury.
- Before moving the moving part (screw shaft) directly by hands (manual alignment, etc.), confirm that the AWO input of the drive is turned ON. Failure to do so may result in injury.
- Immediately when trouble has occurred, stop running and turn off the drive power. Failure to do so may result in fire or injury.

Disposal
- To dispose of the driver, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

Precautions for use

- Conduct the insulation resistance test or dielectric strength test separately on the actuator and the drive. Conducting the insulation resistance measurement or withstand voltage test with the actuator and drive connected may result in injury or damage to equipment.
- Acceleration (acceleration/deceleration rate)
  The acceleration (acceleration/deceleration rate) when starting or stopping the actuator must be within the specified range, irrespective of the loaded mass. Operating at the acceleration (acceleration/deceleration rate) beyond the specified range may result in a loss of position.
• Operating speed
The operating speed of the actuator must be within the specified range, including during acceleration.

• Do not stop the moving part (screw shaft) by hitting the stroke end or load
Do not stop the moving part (screw shaft) by hitting the stroke end or equipment when operating. The mechanical impact may cause damage to the actuator. If the moving part (screw shaft) hits the stroke end or equipment, remove the load and return the moving part (screw shaft) at the recommended starting speed.

• Use an electromagnetic brake type actuator in vertical drive such as an elevating equipment
For vertical drive such as an elevating equipment etc., provide a safety brake mechanism in addition to using an electromagnetic brake type actuator to hold the load position. To use the electromagnetic brake to hold the load in position, do so after the actuator operation has stopped. If decelerating and stopping of the actuator is repeated using the electromagnetic brake, the brake hub of the electromagnetic brake will wear significantly and the braking force will drop.

• Regeneration
When a large inertial load is operated at high speed, regeneration energy will generate and increase the power supply voltage, which may damage the driver. Check the operating condition so that regeneration voltage will not generate.
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