OMRON®

# Safety-door Lock Switch

# D4BL

## Protective Doors Are Locked Until Machine Completely Stops Operation

- Select mechanical lock/solenoid release or solenoid lock/mechanical release models
- Dedicated release lock ensures both easy maintenance and door-unlock at power failure
- Tough aluminum die-cast unit incorporating a switch box with IP67 enclosure rating (EN60529, IEC529)
- Equipped with horizontal and vertical conduit openings
- Models available with LED indicators
- Head can be rotated in 4 directions
- Approved Standards

| Agency | Standard | File No. |
|---|---|---|
| TÜV | EN60947-5-1 ⊖ | R9451050 |
| Rheinland | (IEC947-5-1, ⊖ VDE0660 Part 200, 206 Ⓟ) | |
| UL | UL508 | E76675 |
| CSA | CSA C22.2, No.14 | LR45746 |
| BIA | GS-ET-19 | 9402293 |
| SUVA | SUVA | 5643 |

## Ordering Information

| Conduit type | Lock type | Voltage for Solenoid | Without Indicator 1NC ⊖ /+1NO+1NC (Slow action) | With Indicator 1NC ⊖ /+1NO+1NC (Slow action) | Without Indicator 2NC ⊖ +1NC (Slow action) | With Indicator 2NC ⊖ +1NC (Slow action) |
|---|---|---|---|---|---|---|
| 1/2-14NPT (2 conduits) | Mechanical lock | 24 VDC | D4BL-3CRA | D4BL-3CRA-A | D4BL-3DRA | D4BL-3DRA-A |
| | | 110 VAC | D4BL-3CRB | D4BL-3CRB-A | D4BL-3DRB | D4BL-3DRB-A |
| | | 230 VAC | D4BL-3CRC | D4BL-3CRC-A | D4BL-3DRC | D4BL-3DRC-A |
| | Solenoid lock | 230 VAC | D4BL-3CRG | D4BL-3CRG-A | D4BL-3DRG | D4BL-3DRG-A |

Note: ⊖ marking indicates the contacts which have positive opening mechanism approved by TÜV Rheinland.

## ■ ACCESSORIES (ORDER SEPARATELY)

**Operation Key**

| Mounting type | Part number |
|---|---|
| Horizontal | **D4BL-K1** |
| Vertical | **D4BL-K2** |
| Adjustable | **D4BL-K3** |

## ■ NOMENCLATURE

### Lock Switch

**D4BL - □ □ □ □ - □**
**1 2 3 4 5**

**1. Conduit**
- 1: PG13.5
- 2: G1/2
- 3: 1/2-14NPT

**2. Built-in Switch**
- C: 1NC/1NO (Slow-action) + 1NC (Slow-action)
- D: 2NC (Slow-action) + 1NC (Slow-action)

**3. Head Mounting Direction**
- R: Right

**4. Door Lock/Release Methods (Dedicated Release Key is Incorporated by All Models)**
- A: Mechanical lock/24-VDC solenoid release
- B: Mechanical lock/110-VAC solenoid release
- C: Mechanical lock/230-VAC solenoid release
- G: 24-VDC solenoid lock/mechanical release

**5. Indicator**
- Blank: Without indicator
- A: 1 mA at 10 to 115 VAC or VDC driving (with red and green indicator unit)

### Operation Key

**D4BL - K □**
**1**

**1. Operation Key Type**
- 1: Horizontal mounting
- 2: Vertical mounting
- 3: Adjustable mounting

# Specifications

## ■ RATINGS

1. IEC 947-5-1 and EN60947-5-1
   AC-15 3A/250 V (6A/115 V for Display Models)
2. NEMA A300 (UL/CSA Pilot Duty)

| Rated voltage | Current | | | Switching power | |
|---|---|---|---|---|---|
| | Continuous | Make | Break | Make | Break |
| 120 VAC | 10 A | 60 A | 6 A | 7,200 VA | 720 VA |
| 250 VAC | | 30 A | 3 A | | |

3. General Ratings

| Rated voltage | Non-inductive load | | | | Inductive load | | | |
|---|---|---|---|---|---|---|---|---|
| | Resistive load | | Lamp load | | Inductive load | | Motor load | |
| | NC | NO | NC | NO | NC | NO | NC | NO |
| 125 VAC | 10 A | | 3 A | 1.5 A | 10 A | | 5 A | 2.5 A |
| 250 VAC | 10 A | | 2 A | 1 A | 10 A | | 3 A | 1.5 A |
| 8 VDC | 10 A | | 6 A | 3 A | 10 A | | 6 A | |
| 14 VDC | 10 A | | 6 A | 3 A | 10 A | | 6 A | |
| 30 VDC | 6 A | | 4 A | 3 A | 6 A | | 4 A | |
| 125 VDC | 0.8 A | | 0.2 A | 0.2 A | 0.8 A | | 0.2 A | |
| 250 VDC | 0.4 A | | 0.1 A | 0.1 A | 0.4 A | | 0.1 A | |

Note: 1. Resistive loads have a power factor (cos = $\phi$) of 1.
2. Inductive loads have a power factor of 0.4 min. (AC) and a time constant of 7 ms max. (DC).
3. Lamp loads have an inrush current of 10 times the steady-state current, while motor loads have an inrush current of 6 times the steady-state current.
4. Inrush current: NC: 30 A max.; NO: 30 A max.

## ■ CHARACTERISTICS

| | | |
|---|---|---|
| Operating speed | | 0.05 to 0.5 m/s |
| Operating frequency | | 30 operations/min max. |
| Operating characteristics | Positive opening force | 19.61 N (4.41 lbf) min. |
| | Positive opening stroke | 20 mm (0.79 inch) min. |
| | All stroke | 23 mm (0.91 inch) min. |
| Locked resistive pulling force | | 700 N (157 lbf) min. |
| Insulation resistance | | 100 MΩ min. (at 500 VDC) |
| Rated insulation voltage ($U_i$) | | 300 VAC |
| Conventional enclosed thermal current ($I_{the}$) (rated continuous current) | | 10 A |
| Dielectric strength ($U_{imp}$) | | Impulse dielectric strength ($U_{imp}$) 4 kV (IEC 947-5-1) between terminals of different polarity, between each terminal and ground, and between each terminal and non-current-carrying metal part; 2.5 kV between solenoid and ground |
| Short-circuit protective device | | 10 A fuse (type gl) (IEC269) |
| Contact resistance | | 50 mΩ max. (initial value) |
| Vibration resistance | Malfunction | 10 to 55 Hz, 0.35-mm single amplitude with an imposed acceleration of 50 $m/s^2$ (5G) max. (IEC68-2-6) |
| Shock resistance | Destruction | 1,000 $m/s^2$ (100G) min. (IEC68-2-27) |
| | Malfunction | 300 $m/s^2$ (30G) min. (IEC68-2-27) |
| Life expectancy | Mechanical | 1,000,000 operations min. |
| | Electrical | 500,000 operations min. (with a load rate of 0.5) |
| Ambient temperature | Operating | –10 to 55°C (14 to 131°F) with no icing |
| Ambient humidity | Operating | 95% max. |
| Operating environmental pollution level | | Pollution degree 3 (IEC947-5-1) |
| Insulation class | | Insulation class I (IEC536) |
| Enclosure rating (See Note.) | UL | 6P and 13 |
| | NEMA | 6P and 13 |
| | IEC529 | IP67 (60947-5-1) |

Note: Although the switch box does not allow the penetration of dust, oil or water, keep the operation key insertion slot free of dust, oil, and water.

## ■ SOLENOID COIL CHARACTERISTICS

| Item | 24 VDC models | 110 VAC models | 230 VAC models |
|---|---|---|---|
| Rated operating voltage | 24 VDC $^{+10\%}/_{-15\%}$ (100% ED) | 110 VAC ±10% (50/60 Hz) | 230 VAC ±10% (50/60 Hz) |
| Current consumption | Approx. 300 mA | Approx. 98 mA | Approx. 45 mA |
| Insulation class | Class F 130°C (266°F) or less | | |

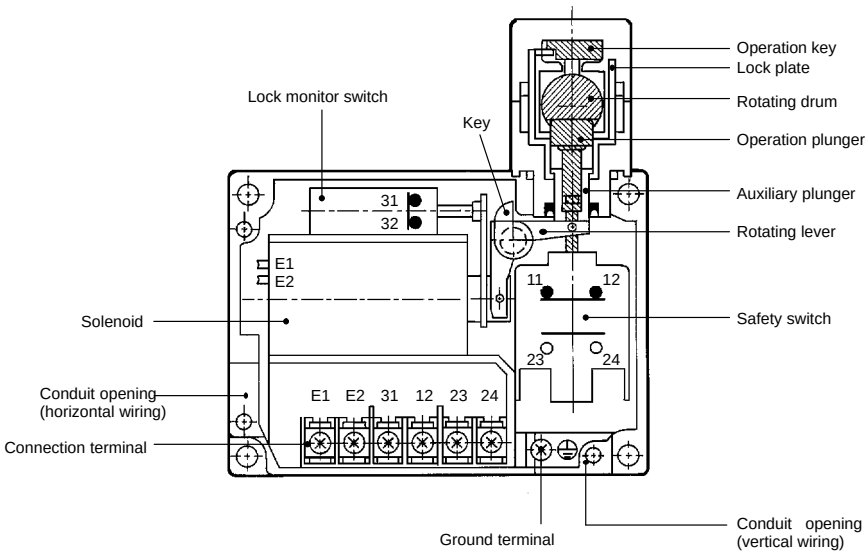
## ■ INDICATOR CHARACTERISTICS

| | |
|---|---|
| Rated voltage | 10 to 115 VAC/VDC |
| Current consumption | Approx. 1 mA |
| Indicator color | Orange, green LED |

## ■ OPERATING CHARACTERISTICS

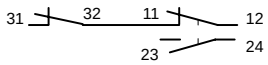
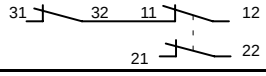
| | |
|---|---|
| Model | D4BL-□□□□ |
| Operating force (extraction) | 19.61 N (4.41 lbf) min. |
| Release force (insertion) | 19.61 N (4.41 lbf) min. |
| Pretravel | 15 mm (0.59 inch) max. |

# Construction

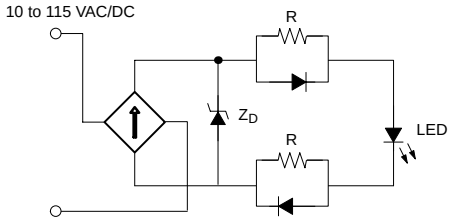


# Operation

## ■ CONTACT FORM

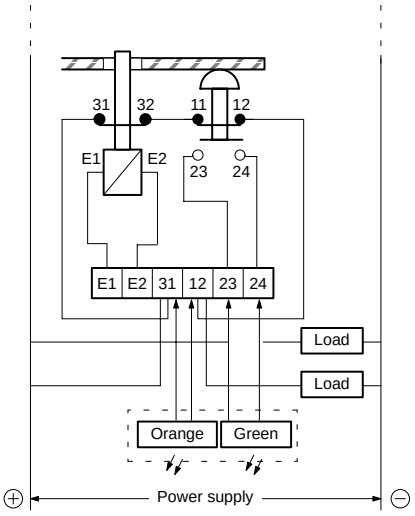
| Model | Contact | Contact form |
|---|---|---|
| D4BL-□C□□-□ | DPDB-1NC/1NO+ DPDB-1NC |   |
| D4BL-□D□□-□ | DPDB-2NC+DPDB-1NC |   |

**Internal Circuit**



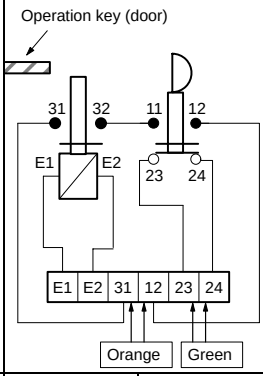
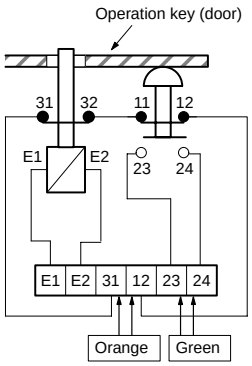
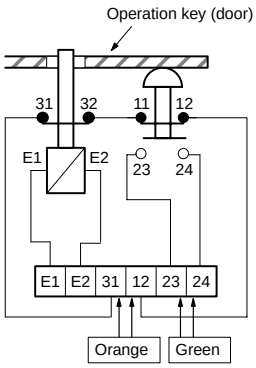
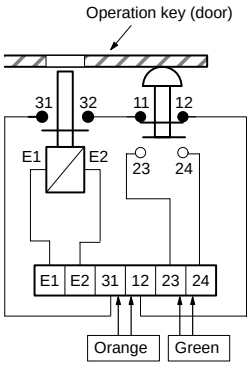
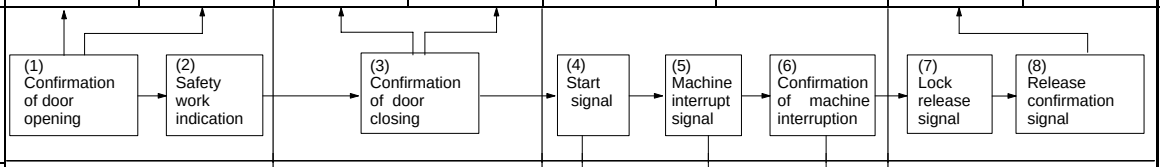
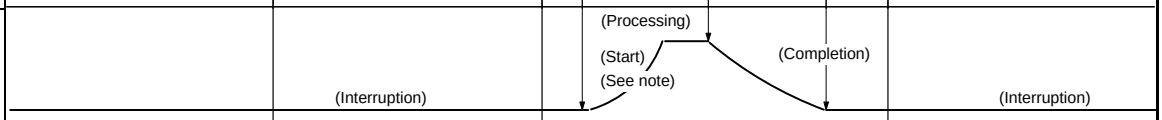

**Recommended Circuit Connection Example**

1. Connect the crimp-style terminals of each indicator unit to the internal terminals (terminals 31 and 12, 23 and 24, and 21 and 22) of the D4BL.
2. Each indicator unit must be connected in parallel with the contacts. When the contacts are open, the indicators will be lit.



## ■ OPERATING MODE

(Example of Electromagnetic Interlock System Operating Mode of D4BL-□C□□)

| Operating mode | I | II | III | IV |
|---|---|---|---|---|
| Door | The protective door is open. | The protective door is closed. | The protective door is closed and the machine is operating. | The protective door is closed and the solenoid is operating. |
| Door switch | Operation Key: The mechanical lock is released (contacts 31 and 32 are OFF).<br>Main Switch: The normally closed contact is forcibly opened (contacts 11 and 12 are OFF).<br>  | Operation Key: Mechanically locked (contacts 31 and 32 are ON).<br>Main Switch: The normally closed contact is closed (contacts 11 and 12 are ON).<br>  | The protective door is closed and the machine is operating.<br>  | Operation Key: The mechanical lock is released (contacts 31 and 32 are OFF).<br>  |
| Contact | 31 and 12: OFF<br>23 and 24: ON | 31 and 12: ON<br>23 and 24: OFF | 31 and 12: ON<br>23 and 24: OFF | 31 and 12: OFF<br>23 and 24: OFF |
| Control device |  | | | |
| Machine |  | | | |
| Indicator | Orange: ON<br>Green: OFF | Orange: OFF<br>Green: ON | Orange: OFF<br>Green: ON | Orange: ON<br>Green: ON |

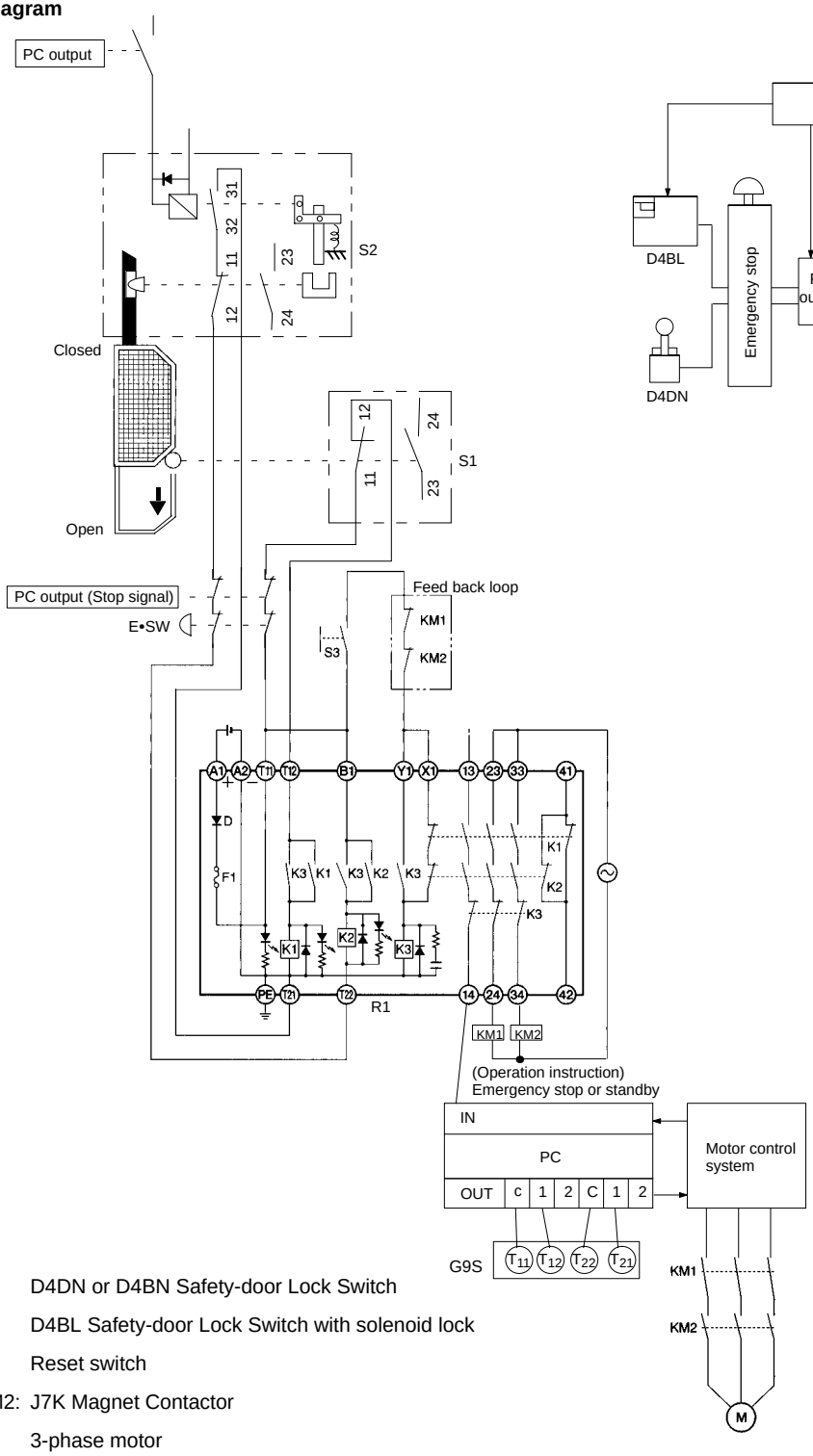
Note: Be sure to use the dedicated push button to start or stop the machine or release the door lock.

# Application Examples

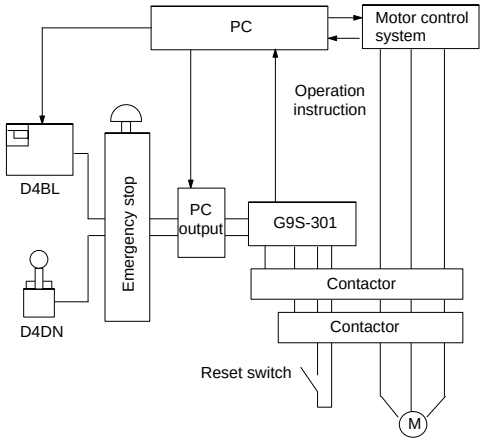
## ■ CONNECTION EXAMPLE WITH OMRON'S G9S SAFETY RELAY UNIT

**G9S-301 (24 VDC)+D4BL-□CRG-□ (Solenoid lock type)+D4D-□520 N**

**Circuit Diagram**




**Product Configuration**




S1: D4DN or D4BN Safety-door Lock Switch

S2: D4BL Safety-door Lock Switch with solenoid lock

S3: Reset switch

KM1, KM2: J7K Magnet Contactor

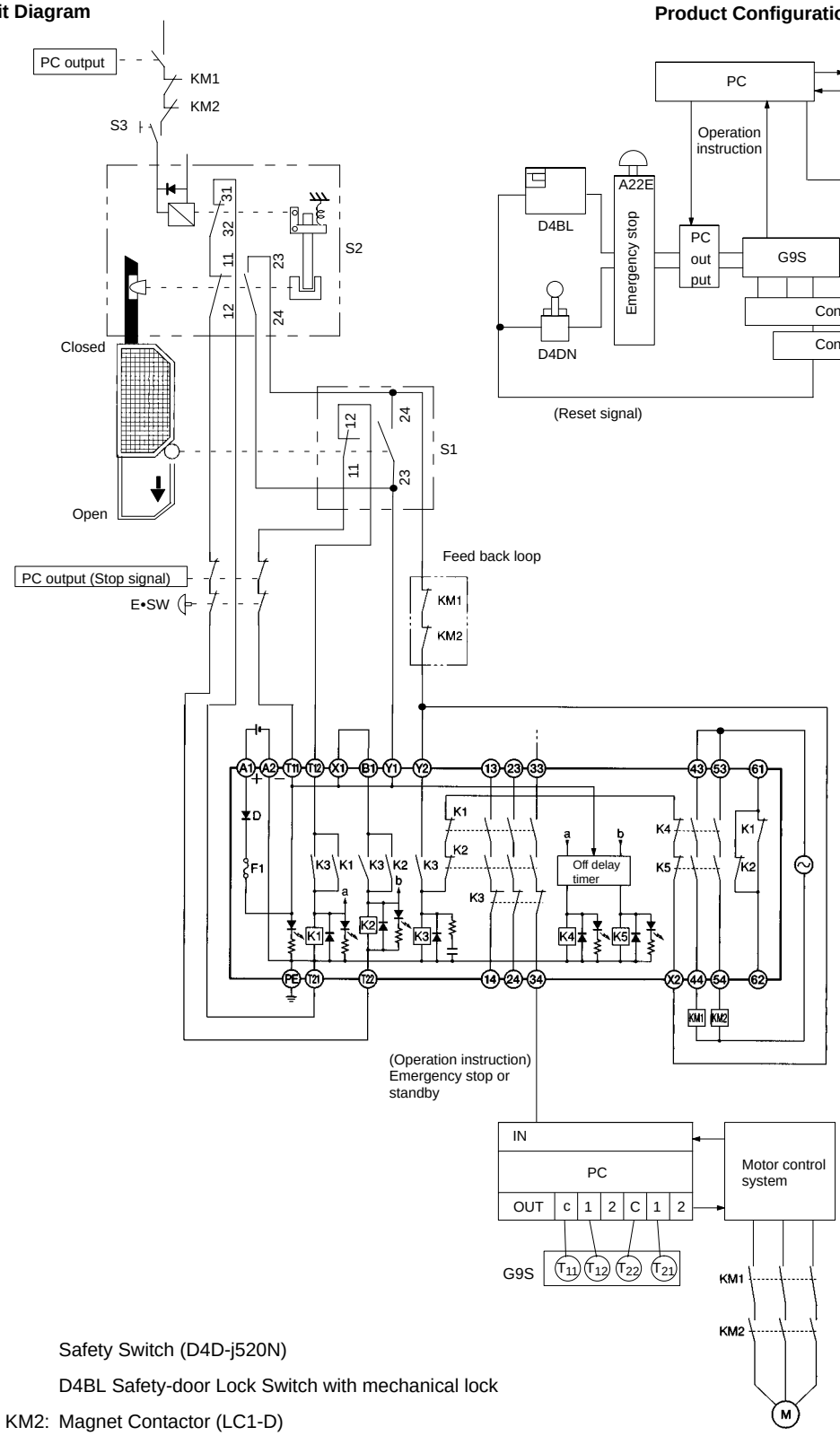
M: 3-phase motor

E-SW: Emergency stop switch

## ■ CONNECTION EXAMPLE WITH OMRON G9S SAFETY RELAY UNIT

**G9S-321-T□ (24 VDC)+D4BL-□CRA-□/-□CRB-□ (Mechanical lock type)+D4D-□520N**

**Circuit Diagram**




**Product Configuration**




S1: Safety Switch (D4D-j520N)

S2: D4BL Safety-door Lock Switch with mechanical lock

KM1, KM2: Magnet Contactor (LC1-D)

M: 3-phase motor

ESSW: Emergency-stop switch (A22E)

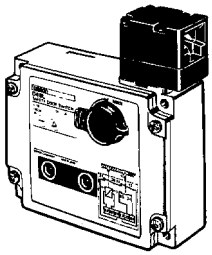
# Dimensions

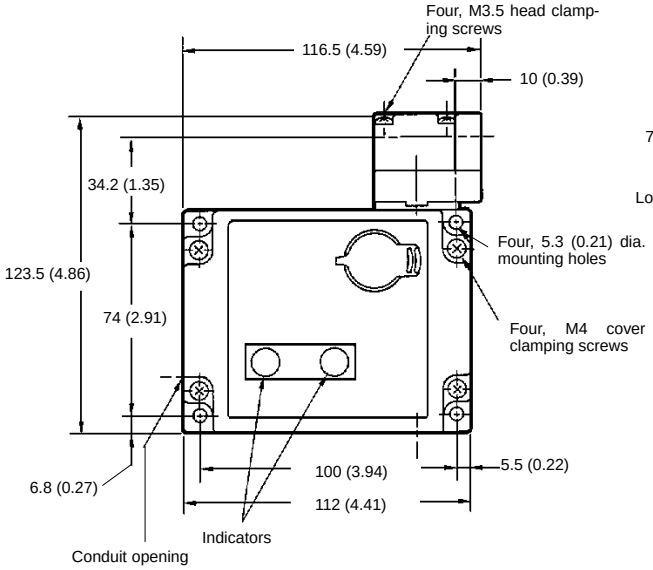
Unit: mm (inch)

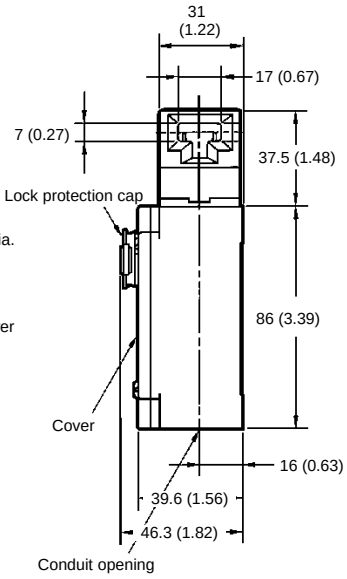
Note: Unless otherwise specified, a tolerance of ±0.4 mm applies to all dimensions.

## ■ SAFETY DOOR SWITCH

**D4BL-□□□□-□**

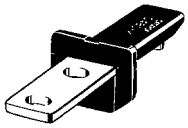


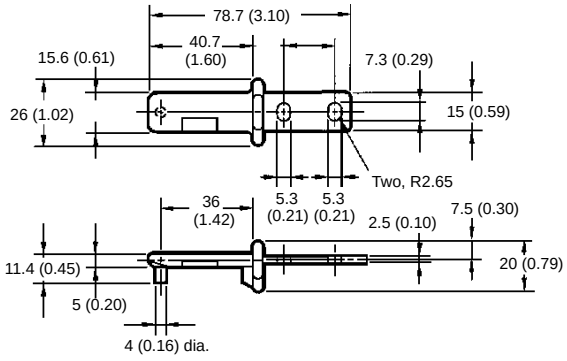


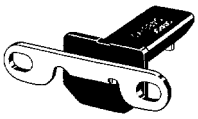

## ■ OPERATION KEYS

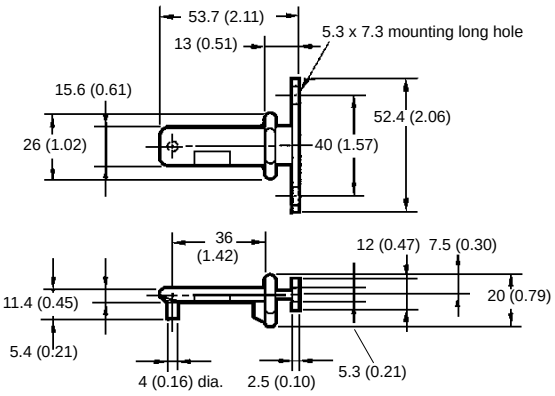
**D4BL-K1**



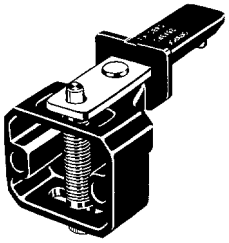


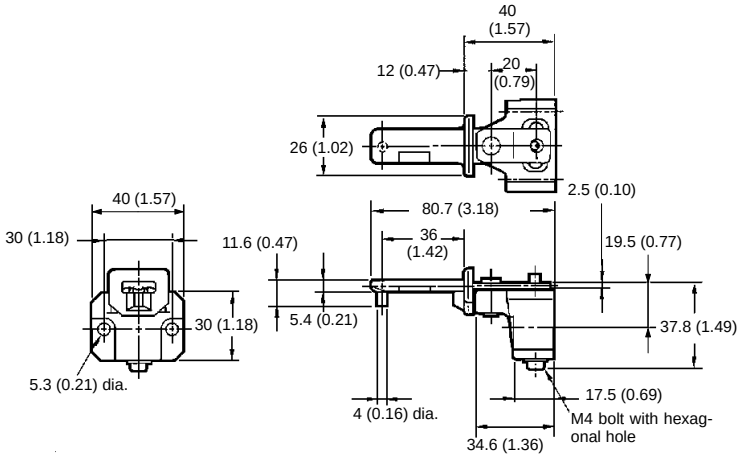

**D4BL-K2**





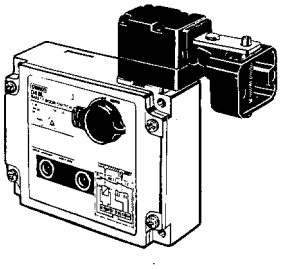
**D4BL-K3**

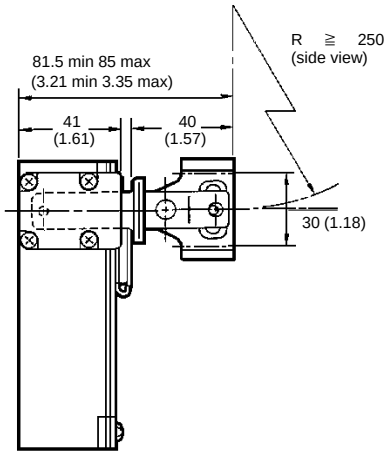




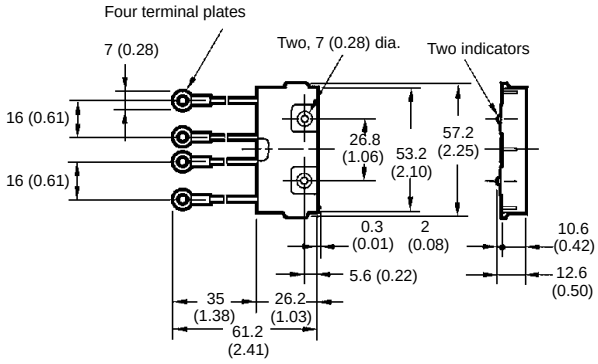

## ■ WITH OPERATION KEY INSERTED

**D4BL + D4BL-K3**






## ■ INDICATOR UNIT



# Installation

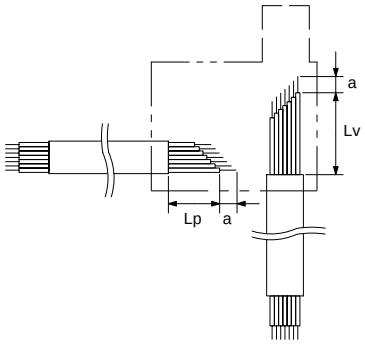
## ■ PROCEDURE FOR CONNECTING CABLE

The following procedure is recommended so that the D4BL can be wired or connected to the Indicator Units with ease.

Recommended connecting cable:
AWB20 to AWG18 with seven conductors
A UL2464-style cable is recommended.

Apply sealing tape to the cable and conduit opening so that the D4BL can conform to IP67. Tighten the connector to a torque of 1.8 to 2.2 N•m (15.93 to 19.47 in lbs).

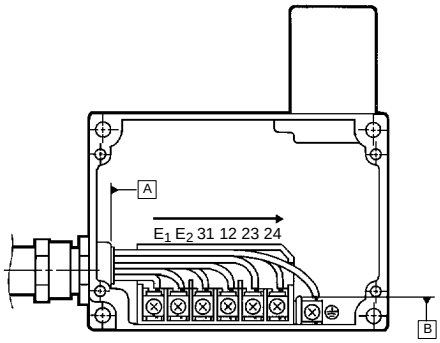
Connect the Indicator Units to the D4BL after connecting the 7-conductor cable to the D4BL.



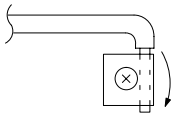

| Terminal no. | Lp mm (inch) | Lv mm (inch) | a mm (inch) |
|---|---|---|---|
| $E_1$ | 30±2 (1.18±0.08) | 80±2 (3.15±0.08) | 8±1 (0.31±0.08) |
| $E_2$ | 35±2 (1.38±0.08) | 75±2 (2.95±0.08) | |
| 31 | 45±2 (1.77±0.08) | 60±2 (2.36±0.08) | |
| 12 | 55±2 (2.17±0.08) | 50±2 (1.97±0.08) | |
| 23 (21) | 65±2 (2.56±0.08) | 45±2 (1.77±0.08) | |
| 24 (22) | 70±2 (2.76±0.08) | 35±2 (1.38±0.08) | |
| Ground | 90±2 (3.54±0.08) | 50±2 (1.9±0.087) | |

**Cable Connecting Example**

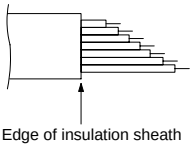
1. As shown in the following illustration, the wires must be connected in sequence beginning with the terminal nearest to the conduit opening.




The wire leads must be wrapped around the screws clockwise. Tighten each screw to a torque of 0.5 to 0.7 N•m (4.43 to 6.20 in lbs).



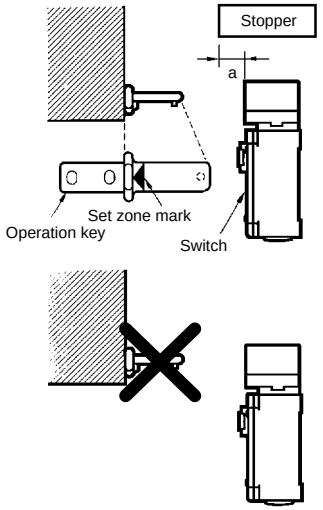
2. The external insulation sheath of the 7-conductor cable must contact with side A or B as shown in the above D4BL illustration.



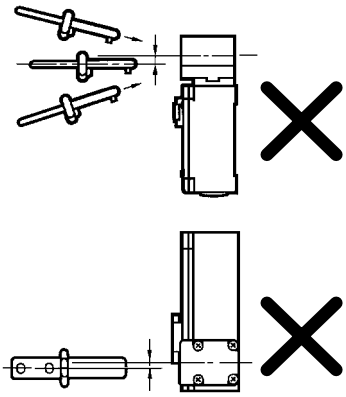
# Precautions

## ■ MOUNTING

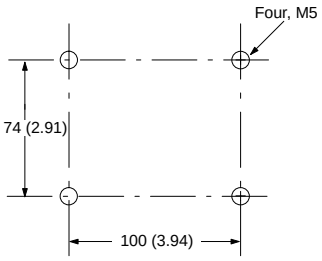
Be sure to install a stopper as shown in the following illustration when mounting the Safety-door Lock Switch. The range of space “a” must be determined according to the available set zone 4 mm (0.16 inch) max. of the Operation Key.




Refer to *Dimensions* for the mounting dimensions of the Operation Key to mount the Operation Key correctly. The Operation Key will quickly become damaged or worn away if it is not mounted correctly.

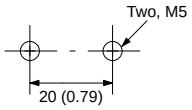


**Switch Mounting Holes**

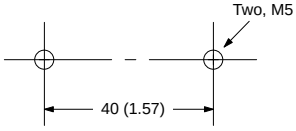



**Operation Key Mounting Holes**

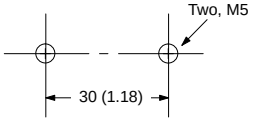
**D4BL-K1**



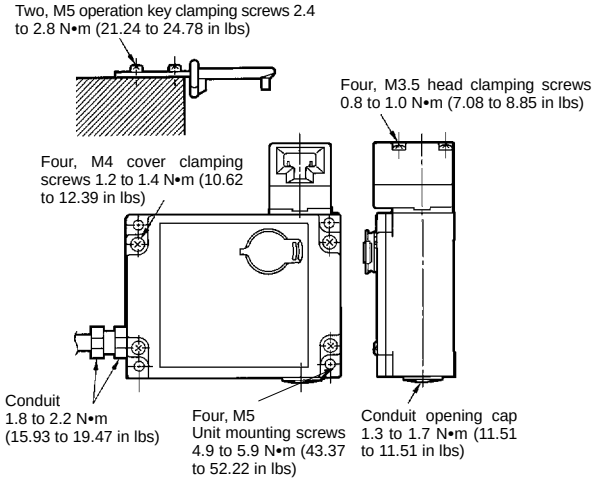

**D4BL-K2**




**D4BL-K3**




**Proper Mounting Screw Tightening Torque**

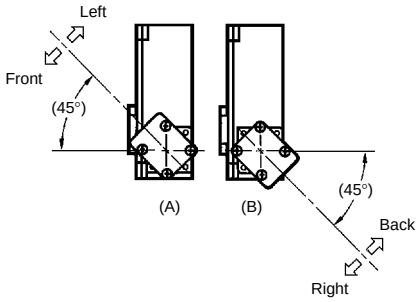


## ■ HEAD DIRECTIONS

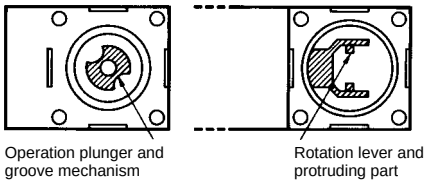
The head can be mounted in four directions. To remove the head, turn the head by 45° as shown in figures A and B below.

To change the direction of the head, make sure that the protruding part of the rotating lever engages with the groove of the plunger. Then turn the head clockwise or counterclockwise to the desired direction. At that time, make sure that the groove of the plunger is located under the rotating lever. If the direction of the head is not set when the plunger is rotated by 45°, the groove of the plunger presses the rotating lever. The head, plunger, or the built-in switch may be damaged as a result.

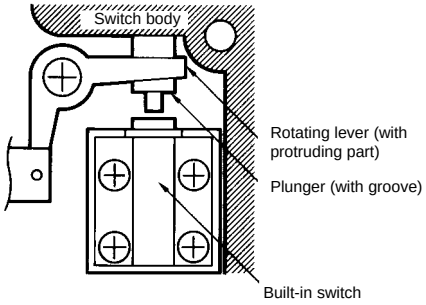
## ■ HEAD DIRECTION CHANGES




**Head Bottom View** **Switch Top View**




**Normal Positions of Rotating Lever and Plunger**

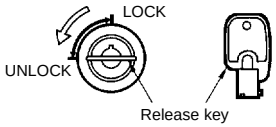



Be sure to check the mechanical lock and solenoid release functions when mounting the D4BL.

If the head direction is changed, recheck the tightening torque of each of screw. Make sure that no foreign materials will penetrate through the key hole on the head.

## ■ DEDICATED RELEASE KEY

The dedicated release key, which is provided with the D4BL, is used to unlock the protective door in case of emergency or power failure. To open the protective door, insert the dedicated release key and set the key lock to UNLOCK.




If the key lock is set to UNLOCK, when the protective door is closed and people are doing preparation work on the machine inside, the protective door will not be locked and the machine will not start operating.

Use the release key to set the key lock to LOCK.

Do not use the release key to start or stop the machine.

This key lock must be normally set to LOCK and sealed with a rubber cap in order to conform to IP67 requirements.

The dedicated release key should be kept only by the person in charge.

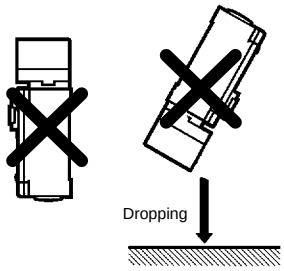
If necessary, to prevent easy access to the dedicated release key, seal the key lock using a suitable sealing wax. Be careful not to damage the key lock when breaking the seal between the rubber cap and the key lock.

A cover can be attached to the D4BL. Before attaching the cover, make sure that the key lock is set to LOCK.

## ■ OPERATION KEY

The D4BL is provided with a shock absorptive damper when shipped attached to the D4BL in order to prevent the D4BL from being damaged if it is dropped accidentally. Be sure to remove the shock absorptive damper after the D4BL is mounted.

Do not impose excessive force to the Operation Key in the switch or drop the Operation Key, or the Operation Key may be deformed or damaged.

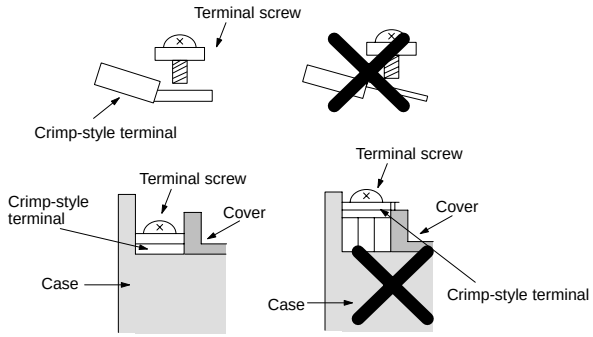



Do not operate the Safety-door Lock Switch with a tool other than OMRON's special Operation Key for the Safety-door Lock Switch, otherwise the Safety-door Lock Switch may be damaged or the safety of the system will not be assured.

## ■ OTHERS

When connecting lead wires with crimp-style terminals to the built-in switch terminals, do not impose excessive force on the crimp-style terminals.

Each crimp-style terminal must be connected in the direction as shown in the following illustrations and the crimp-style terminal must not be on the case or cover.




**NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.**

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